

# Preparation of Operations and Maintenance Manuals for Domestic Wastewater Treatment Facilities

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State of Oregon  
Department of  
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Quality



# Preparation of Sewage Treatment Plant O&M Manuals

This document prepared by:

Oregon Department of Environmental Quality  
811 SW 6<sup>th</sup> Avenue  
Portland, OR 97204  
1-800-452-4011  
[www.oregon.gov/deq](http://www.oregon.gov/deq)

# Preparation of Sewage Treatment Plant O&M Manuals

This document provides general instructions for completion of **operations and maintenance (O&M) manuals for domestic wastewater facilities**. This information is intended as guidance for wastewater treatment plant owners and should be interpreted and used in a manner fully consistent with the state's environmental cleanup laws and implementing rules. This document does not constitute rulemaking by the Oregon Environmental Quality Commission and may not be relied on to create a right or benefit, substantive or procedural, enforceable at law or in equity, by any person, including Oregon Department of Environmental Quality (ODEQ ) employees.

**Do You Have Comments or Suggestions for Improving this Guidance?** Please let us know! Please contact an ODEQ plan review engineer at one of the offices listed below:

| Northwest Region Offices   | Western Region Offices   | Eastern Region Offices  |
|--|--|---|
| <p><b>Mike Pinney, MS, PE</b><br/>2020 SW 4th Ave., Suite 400<br/>Portland, OR 97201<br/>Phone: 503-229-5310<br/>Fax: 503-229-6945<br/>TTY: 503-229-5471</p> | <p><b>Tim McFetridge, PE</b><br/>750 Front St NE, #120<br/>Salem, OR 97301-1039<br/>Phone: 503- 378-4995<br/>Toll free in Oregon: 800-349-7677<br/>Fax: 503-373-7944<br/>TTY: 503-378-3684</p> | <p><b>Heidi Williams, PE</b><br/>700 SE Emigrant, #330<br/>Pendleton, OR 97801<br/>Phone: 541-276-4063<br/>1-800-304-3513<br/>Fax: 541-278-0168</p> |
|  | <p><b>Jon Gasik, MS, PE</b><br/>221 Stewart Ave., Suite 201<br/>Medford, OR 97501<br/>Phone: 541-776-6242<br/>Fax: 541-776-6262<br/>Toll free in OR: 877-823-3216</p>                          |   |

# Table of Contents

|  |   |
|--|---|
| Introduction.....  | 1 |
| Purpose.....   | 1 |
| Applicability .....                                      | 1 |
| Regulatory Basis .....                                   | 1 |
| General.....   | 2 |
| Format.....  | 3 |
| Contents .....   | 4 |
| Table of Contents/Homepage:.....                         | 4 |
| Emergency Operations: .....                              | 4 |
| General:.....  | 4 |
| Operation and Control of Unit Processes:.....            | 5 |
| Operation and Control of Other Mechanical Systems:.....  | 7 |
| Regulatory: Include the following (as applicable): ..... | 7 |
| Appendices and Attachments.....                          | 7 |
| Submittals .....   | 9 |

# Introduction

## Purpose

This document is intended to help domestic wastewater treatment plant owners in writing operations and maintenance (O&M) manuals required by their permit. The use and reference of this information may improve the quality and usefulness of O&M manuals and reduce review time. Please note, however, that if any conflicts arise between this document and Oregon rules, regulations or the permit, then the applicable rules, regulations, and/or permit take priority over this document.

## Applicability

The information in this document primarily applies to mechanical wastewater systems that either discharge to surface waters under a National Pollutant Discharge Elimination System (NPDES) permit, or irrigate recycled water under a Water Pollution Control Facilities (WPCF) permit. This document does not apply to satellite sewage pumping stations, lagoon systems, on-site (subsurface disposal) systems, or industrial wastewater treatment systems. For information regarding operations and maintenance of these other systems, please see:

- **Sewage Pumping Stations:** *Guidelines for Writing Pump Station O&M Manuals*, ODEQ, August, 1994
- **Lagoon Systems:** *Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers, and Managers*, (EPA/600/R-11/088) August 2011
- **On-Site Systems:** *Guidelines for Writing Large On-site System Operation & Maintenance (O&M) Manuals for WPCF permitted facilities*, ODEQ, April 2000
- **Industrial Systems:** *Internal Management Directive, Operations, Monitoring and Management (OM&M) Plans for Land Application of Non-Sanitary Wastewater*, ODEQ, November 2002

## Regulatory Basis

ODEQ regulates domestic wastewater systems under two types of permits. NPDES permits are for systems that may discharge to surface waters, and WPCF permits are issued to systems that do not discharge to surface waters. A permit is a legally enforceable agreement between the permit holder (permittee) and the ODEQ, as the permit issuer. Schedule F (General Conditions) of these permits requires proper operation and maintenance.

Oregon Administrative Rules Chapter 340 Division 52 requires domestic wastewater treatment facility owners prepare and received ODEQ approval of an O&M manual prior to operating.

# General

An O&M manual should be targeted to operating the plant, especially in situations where time may be critical. It should be complete and thorough, but easy to use. It should not contain narrative copied from the Facilities Plan or Predesign Reports.

To present information in the most accessible manner, include less narrative and more drawings, schematics, tables, schedules, and checklists. An operator looking for a specific piece of information should not have to read an essay to find it. Avoid boilerplate language in favor of information that is specific to the treatment plant.

The manual should identify the author of the manual and any updates. The manual should also include the date prepared, finalized, and dates of any updates.

# Format

Paper O&M manuals should be bound in 3-ring binders to accommodate future revisions. All manufacturers' literature should be bound separately. Sections should be tabbed and labeled as appropriate. Provide both cover and spine labels.

Electronic manuals (e-manuals) use a menu-driven or intuitive “drill down” navigation system that allows for quick retrieval of information. The user should be able to quickly and intuitively find the desired information without having to navigate an excessive number of sub-menus or links. Once at the desired information, the drill-down pathway should be easily identifiable.

For facilities that are committed to the electronic O&M manual format, a printed version is unnecessarily redundant and not required. However, all e-manuals must include:

1. Backup capabilities in case of computer failure; and
2. A printable user-guide on how to navigate and update the manual is required. The user-guide must describe log-in security features.
3. Manufacturers' literature in a print-friendly format (for example, pdf).

E-manuals should also:

1. Include an ever-present navigation menu with logically labeled tabs, buttons, or menu headings and drop downs. The user should be able to easily identify and return to the homepage with a single click.
2. Identify unit processes either graphically or via the menu system.
3. Be formatted and protected to easily allow necessary modifications and updates, but only by appropriate personnel. The e-manual should reflect when it was last updated.

NOTE: For satellite pump stations, ODEQ recommends a separate standalone O&M manual for each pump station in paper format. A satellite pump station is one that is not located at the wastewater treatment plant site. A printed copy of the O&M Manual should be maintained at each pump station.

# Contents

The following is a recommended O&M manual outline.

## Table of Contents/Homepage

The table of contents should correspond to the tabs. For e-manuals, the electronic menu system should act as a Table of Contents with tabs on the homepage.

## Emergency Operations

This section should be separate and readily available in case of emergencies. Emergency phone numbers listed should include the Oregon Emergency Response System (OERS), local utility emergency contacts (gas, electric, and water), and the local ODEQ Regional Office. This section should include copy of, and/or link to, the emergency and SSO response plans. Describe or reference procedures for chlorine leaks, fires, gas leaks, power outages, etc.

## General

- a) **Historical Background:** Provide a narrative on the background and history on the facility. The level of description in ODEQ's approval letter for the project is a minimum. The engineer should be able to do better.
- b) **Overall Process Description:** Briefly describe the type of treatment process employed and the various units or processes incorporated in the facility.
- c) **Plant Layout:** Include plan-view diagrams of the plant and outfall, along with influent sewer manholes, pump stations, force mains, and any piped diversions, overflow dams, or bypass weirs. Show locations of power drops, main breakers, gas meters, backflow preventers, fuel tanks, chemical storage, and other such auxiliary equipment as may concern firemen responding to an alarm.
- d) **Design Data Table:** Include design population and flows, design efficiency and effluent quality goals (BOD, TSS, ammonia, nutrients, etc), and design capacity for each process unit. The design data may normally be copied directly from the approved plans, which should include a complete listing as a reference.
- e) **Flow diagrams:** Include simple schematics showing the individual units and flow sequence. Generally, separate diagrams for solids and liquids should be included.
- f) **Hydraulic Profile**
- g) **Utilities:** Include or reference a plan that shows how the plant is served with water, gas, electricity, phone, etc. The map should show the location of isolation valves, access points and other pertinent features. Describe the standby power system in detail. Provide explicit procedures to be followed on loss of utility power and conversion to standby power, and vice-versa. Develop a complete list of all non-maintained contacts that will have to be manually re-set on each occurrence. Describe the phasing of any start-ups controlled by time-delay relays. Provide instructions on which equipment to re-set and start up first. Tabulate whether various equipment items may be considered non-critical, describe which start-ups must be staggered, and provide instructions accordingly.
- h) **Preventative Maintenance & Asset Management Systems:** ODEQ expects wastewater treatment plant owners to use an asset management system to schedule and track maintenance activities electronically. While commercial software packages can be expensive, EPA now offers a free, easy-to-use, asset management tool for small wastewater utilities known as Check Up Program for Small Systems (CUPSS). CUPSS includes preventative maintenance scheduling and is available at: <http://water.epa.gov/infrastructure/drinkingwater/pws/cupss/index.cfm>.

- i) **Operator and Management Responsibilities:** Include operator certification requirements, plant staffing requirements, and a breakdown of workhours estimated to operate and maintain the facility. Include workhour allowances for continuing education for operators. Include delegation of authority. For instance, a discharge monitoring report (DMR) must be properly signed by a ranking elected official or their designated representative(s). Accordingly, the plant supervisor and/or operators must receive written delegation to sign DMRs.
- j) **Budget:** Provide estimated budget costs for operating and maintaining the plant. The estimate should contain a breakdown by major category such as staffing and benefits, training, power, laboratory, parts, supplies, repairs, chemicals, sludge hauling and disposal costs, grit and screenings disposal, and so on.

## Operation and Control of Unit Processes

Each unit process should be under a separate tab. The recommended unit process categories include: Influent Pump Station, Headworks, Primary, Secondary, Tertiary, Disinfection, Recycled Water, Solids Treatment/Storage, and Miscellaneous Equipment. Each unit process should contain the following information:

- a) **Description of Unit Processes:**
  - i) Describe each unit mechanically, including each unit component and its function.
  - ii) Describe the feed. Prescribe normal operating positions of all gates and valves (normally open or closed). Provide a flow schematic showing valve, gate and pump locations, and employ and index system for identification.
  - iii) Describe thoroughly the treatment process employed in each unit; chemical, biological, physical or combination.
  - iv) Describe the relationship of each unit to adjacent units in the facility.
  - v) Describe where and/or how additions or expansions to the plant are intended by the designer.
- b) **Control of Unit Processes:**
  - i) Describe thoroughly and in detail how each unit process is to be operated and how to control the unit process. Thoroughly discuss all applicable process control parameters. equipment item in detail. For example, a conventional activated sludge facility may employ any or all of the following parameters for process control: dissolved oxygen, settleable solids, suspended solids, volatile solids, total solids, total volatile solids, pH sludge volume index, sludge age, food to microorganism ratio, return sludge rate, and sludge wasting rate. These parameters should be defined and their significance to plant operation or process control thoroughly discussed. This discussion should include normal operational levels or ranges and how these levels are maintained. Include a discussion of solutions to common problems anticipated when operational ranges are not maintained. For parameters such as food to microorganism ratio, sludge volume index, sludge age, return sludge rates, give formulas and examples for calculating respective values. Often manufacturers have developed general guides, which can be adapted to a particular process.
  - ii) Either in this section or an appendix should include forms for recording startup conditions. Forms for pump curves showing actual impeller trim and motor HP installed. Provide a tabulation of all control and alarm set-points and elevations. Normally, this can be copied from schedules in the plans or specifications. Either in the appropriate unit process section or in a "Forms" section, include forms for recording startup conditions. Forms may be developed by the engineer or adapted from the manufacturer's standard forms. The shutoff head, discharge head, and suction head of pumping equipment should be measured and recorded to create a basis for maintenance and also to estimate the actual pumping rate. Include the engineer's theoretical system-head design curve, with actual measured operating points entered at the time of start-up. Initial vibration levels should also be measured, diagrammed, and recorded for all major items of rotary equipment such as blowers,

pumps, and mixers. Power draws for each one at startup should be measured and recorded, including normal and shutoff, for future reference.

- c) Common Operating and Control Problems:
  - i) Discuss common operating problems such as: foaming, frothing, sludge bulking, rising sludge, ashing, shock loads, hydraulic washouts, short circuiting, and insufficient oxygen. Include the probably causes and possible remedies. Where appropriate, describe means by which the operator may visually identify certain problems.
- d) Alternate Operational Modes
  - i) Describe, if applicable, alternative operational modes. Include flow diagrams and valve settings. Discuss any changes in unit process control that may be necessitated by the alternative mode. Discuss any change in treatment efficiency.
- e) Emergency Operations and Failsafe Modes
  - i) Discuss all applicable failsafe features or features incorporated into design, such as: warning devices, standby power, high water, and overload alarms.
- f) Start Up Procedures
  - i) Discuss preparation for start-up. Include a discussion of pre start-up inspection, checklist, staffing duties and responsibilities, dry run, wet run, etc.
  - ii) Devise and discuss a start-up procedure for each individual unit in regard to mechanical operation and unit process. Discussion should include relationship to overall plant operation. Discuss process monitoring and objectives desired during various stages of start-up phase. Describe any special technique that may be applicable, such as sludge seeding.
- g) Equipment Maintenance Summary
  - i) As discussed above, ODEQ expects wastewater treatment plant owners to schedule and track maintenance activities electronically. Accordingly, this section should include a completed spreadsheet from the electronic maintenance scheduling system to be used. The engineer must normally extract these items from the manufacturer's O&M information provided with each item of equipment. Plant maintenance staff should carefully review any engineer's draft of this section before it is finalized.
  - ii) List all equipment suppliers and service reps telephone numbers and contact information.
  - iii) Include a list of critical replacement parts that may have long delivery times associated with them. Normally the equipment manufacturers can make helpful recommendations. Indicate where the spares are to be stored.
- h) Safety
  - i) Keep Material Data Safety Sheets, (MSDS) available and up to date. Reference their location.
  - ii) Discuss safety precautions: Prescribe means of preventing and/or procedures for testing for hazardous conditions, specifically toxic or explosive gases. Discuss and define Confined Space entry requirements.
  - iii) Prescribe first aid procedures for dealing with accidents involving personal injury or provide a first aid handbook and training.

## Operation and Control of Other Mechanical Systems

Such systems may include alarms, telemetry, emergency power and fuel transfer systems, landscaping irrigation, chemical feeders, HVAC, seal water, level controls, flowmeters, samplers, and so on. Provide information on how these systems work, and their operation and maintenance requirements. Supplement with appropriate diagrams as necessary. Any of these may be sufficiently complex to warrant a separate section in the manual.

## Regulatory: Include the following (as applicable)

- a) Copy of the permit
- b) Draft Discharge Monitoring Report (DMR) form: See *Completing Discharge Monitoring Reports (DMRs)*, ODEQ, February 2012: <http://www.deq.state.or.us/wq/wqpermit/docs/domdmrinstr.pdf>
- c) SSO response plan: See *Internal Management Directive, Sanitary Sewer Overflows (SSOs)*, ODEQ, November 2010: <http://www.deq.state.or.us/wq/pubs/imds/SSOEnforcement.pdf>
- d) Laboratory QA/QA plan: See *QA GUIDANCE FOR SELF MONITORING LABORATORIES (NPDES and WPCF)*, ODEQ, October 2010: <http://www.deq.state.or.us/lab/techrpts/docs/NPDESWPCF.pdf>
- e) Recycled Water Use Plan: See *INTERNAL MANAGEMENT DIRECTIVE, IMPLEMENTING OREGON'S RECYCLED WATER USE RULES*, ODEQ, June 2009: <http://www.deq.state.or.us/wq/pubs/imds/RecycledWater.pdf>
- f) Biosolids/Sludge Management Plan: See *Internal Management Directive, Implementing Oregon's Biosolids Program*, ODEQ, December 2005: <http://www.deq.state.or.us/wq/pubs/imds/biosolids.pdf>
- g) Hauled Waste Acceptance Plan: See *Guidance Manual for the Control of Wastes Hauled to Publicly Owned Treatment Works*, USEPA, EPA-833-B-98-003, September 1999: <http://www.epa.gov/npdes/pubs/hwfinal.pdf>
- h) Sewer Use and/or Pretreatment Ordinance

## Appendices and Attachments

- a) **As-Built Drawings.** One set of reproducible drawings should be obtained from the design engineer and stored in a permanent archive. Alternatively, electronic versions of the as-built drawings should be linked or stored as part of the e-manual. One complete set of paper as-built record drawings should also be kept on file at the treatment plant.
- b) **Manufacturer's O&M Literature.** Provide a list of manufacturers/suppliers and phone contacts for ordering equipment and spare parts. Cut-sheets and other manufacturer's literature should be contained in paper binders. General brochures and literature, if provided, should have irrelevant information marked out and/or relevant information highlighted. Information on equipment not provided or not applicable should not be included. (Reference, but do not submit to the State)
- c) **WWTP Operating References.** Relevant publications on treatment plant O&M should be referenced or linked where appropriate. Links to relevant websites or e-publications are also encouraged.
- d) **Post Startup Addendum.** This section should be provided to the operator to address any issues or alterations to the manual as a result of changes in intended operations during startup.

## Preparation of Sewage Treatment Plant O&M Models

NOTE: At the writer's discretion, any applicable charts, graphs, guidelines, or documents that may be significant and useful to plant operation and maintenance should be included in the appendix. It is not necessary to submit these items for review.

# Submittals

Submit complete draft O&M manuals for review by ODEQ and the plant operations staff well in advance of scheduled start-up (at least 90 days). Sewage treatment utilities are not authorized to accept or use treatment works without an approved manual, per OAR 340-52. For that reason, late submittal of the draft manual may delay plant start-up.

Manuals are expected to be maintained current through updating a master copy of the manual kept at the plantsite. This expectation also applies to ODEQ's file copy of the manual. Utilities should submit copies of insert pages reflecting all physical and procedural changes to ODEQ. For e-manuals, utilities may submit updated complete copies with the changes highlighted.