EPA Document # 305F22002 March 2022

Compliance Tips for Small Wastewater Treatment Lagoons with Clean Water Act Discharge Permits

Background on this Compliance Advisory

This advisory is written to assist owners and operators of small publicly and privately owned lagoon wastewater treatment plants (WWTPs) to comply with the law. Of the facilities in recent "significant noncompliance" (SNC) with their Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit, approximately 60 percent are WWTPs. WWTP owners and operators are reminded of their responsibility to comply with the requirements in their NPDES permit, and that compliance and financial assistance resources are available to help them comply. Also note that EPA and states currently are undertaking an initiative to reduce NPDES SNC. As a result, NPDES permittees, regardless of industry sector, facility size or type, will see an increased presence by EPA and its state and tribal partners in an effort to identify and address SNC violations using enforcement and other compliance assurance tools.

This advisory provides extensive information on the causes of, and potential solutions to, lagoon WWTP noncompliance. Because there are various types of lagoon WWTPs in operation, not all the information provided in this advisory will apply to any one lagoon system. Also note, EPA has issued a separate, similar advisory to assist owners and operators of small mechanical WWTPs.

While this advisory focuses on operational issues affecting small lagoon WWTPs, another frequently identified noncompliance concern at small lagoon WWTPs is the failure of owners and operators to submit required discharge monitoring reports (DMRs) or the submittal of incomplete or inaccurate DMRs. These failures can mask serious violations. If you are having trouble completing or timely submitting your DMRs, contact your permitting authority and request assistance.

Increased WWTP compliance will improve surface water quality and reduce potential impacts on drinking water supplies. For more information about EPA's current efforts to reduce SNC, refer to: **Clean Water Agencies Increasing Attention to Significant Non-Compliance Dischargers**.

Lagoon WWTP Compliance: Quick Reference Guide

Attached to this Compliance Advisory is a **Guide** to assist lagoon owners and operators in troubleshooting operational and compliance problems. The information in the **Guide** is presented in three parts:

1. Wastewater Lagoon Overview

Waste stabilization ponds, also known as wastewater lagoons, are frequently used to treat municipal and industrial wastewater in the United States. Although wastewater lagoons can be used to treat a variety of wastes, their low energy and maintenance requirements often make them suitable for treating wastewater from small and rural communities. **Table 1** in the **Guide** provides an overview of lagoon types. Facultative and aerated lagoons are the primary focus of this document.

In considering the suggestions presented in this document, facilities should ensure that they are not in conflict with any state requirements or provisions in their NPDES permit.

2. Background on Troubleshooting Topics

To familiarize yourself with the common causes of lagoon malfunctioning, review **Table 2** in the **Guide**. These topics correspond with the troubleshooting steps and possible solutions found in **Table 3** in the **Guide**.

3. Solutions to Underlying Causes of Wastewater Lagoon Effluent Violations

Small lagoon systems often have difficulty recruiting and retaining trained operators and obtaining adequate funding for operations, maintenance, and system upgrades – each essential for achieving and maintaining compliance. **Table 3** in the **Guide** serves as a valuable starting point for identifying solutions to common causes of effluent violations. Before making any major process or operation and maintenance changes, operators are advised to confer with their permitting authority.

Compliance and Financing Assistance Resources

The following assistance resources can help you correct violations and achieve/maintain compliance.

Compliance Assistance Resources

- **Reducing Significant Non-Compliance (SNC) with NPDES Permits - Resources for NPDES Permittees and Other Organizations**
- **EPA Small and Rural Wastewater Systems Website and Tools**
- **WaterOperator.org** is a free training resource portal for operators of small systems
- **Rural Community Assistance Partnership Website**
- **National Rural Water Association Website**
- **Water Environment Federation (WEF)** provides technical education training for water quality professionals.
- **EPA National Pollutant Discharge Elimination System Website**
- **NetDMR Support Portal**
- **EPA Biosolids (Wastewater Sewage Sludge) Website**

Potential Funding and Financing Sources

- **Funding Sources for Small and Rural Wastewater Systems**
- **EPA Water Infrastructure and Resiliency Finance Center's Environmental Finance Centers**
- **Clean Water State Revolving Funds**

General References and Webinars

- U.S. EPA, 2011, Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers, and Managers (EPA/600/R-11/088). Office of Research and Development, Washington, DC (https://www.epa.gov/sites/default/files/2014-09/documents/lagoon-pond-treatment-2011.pdf)
- Lagoon Systems in Maine, Troubleshooting Wastewater Lagoons. (http://www.lagoonsonline.com/trouble-shooting-wastewater-lagoons.htm)
- Optimizing Performance of Facultative Wastewater Lagoon Systems Webinars Part 1 and 2, February and March 2020. Hosted by U.S. EPA Office of Compliance. Presentation by Steve Harris, President, H&S Environmental, LLC. (https://www.epa.gov/compliance/technical-assistance-webinar-series-improving-cwa-npdes-permit-compliance)

- U.S. EPA, 2002, Wastewater Technology Factsheet: Facultative Lagoons (EPA/832/F-02/014). Office of Water, Washington, DC. (https://www3.epa.gov/npdes/pubs/faclagon.pdf)

- U.S. EPA, 2016, Overview of Lagoon System Management Webinar. (https://www.youtube.com/watch?v=zu6ZIKav22c)

Disclaimer

This Compliance Advisory addresses select provisions of EPA regulatory requirements using plain language. Nothing in this Compliance Advisory is meant to replace or revise any NPDES permit, any EPA regulatory provision, or any other part of the Code of Federal Regulations, the Federal Register, or the Clean Water Act. EPA recommends that operators consult with their permitting agency prior to making major changes to their systems.

Lagoon Wastewater Treatment Plant (WWTP) Compliance: Quick Reference Guide

Table 1. Lagoon Types and Characteristics

Lagoon Type	Characteristics
Facultative	➢ Oxygen is supplied through algal photosynthesis. ➢ Facultative lagoons have an anaerobic bottom layer, a facultative middle layer, and an aerobic top layer. ➢ Many facultative lagoons have secondary treatment processes to meet new, more stringent requirements.
Partially-Mixed Aerated Lagoons	➢ Oxygen is supplied through mixing or aerating components that help circulate and distribute air throughout the pond. ➢ Partial mix lagoons have an anaerobic bottom layer, a facultative middle layer, and an aerobic top layer.
Anaerobic	➢ Anaerobic lagoons have essentially no dissolved oxygen and are often used as preliminary treatment systems.
Aerobic	➢ Dissolved oxygen is maintained throughout the depth (1-6 ft). ➢ Aerobic lagoons are appropriate for treatment in warm, sunny climates.

Table 2. Common Causes of Lagoon Malfunction

Topic	Causes
High BOD	Many conventional lagoons systems utilize multiple cells, often with each cell having a different function. The primary treatment cell in a lagoon system is typically designed to remove up to 80% of a system's influent biochemical oxygen demand (BOD).
Short circuiting (reduced retention time)	Retention or detention time is a key design parameter for both facultative and aerated lagoons. If the designed retention time is reduced, treatment effectiveness is reduced. One cause of lost retention time is short circuiting. Short circuiting occurs when wastewater passes through a lagoon system too quickly without adequate treatment. Dead spots in the flow pattern of material through a lagoon system, improper placement of influent and effluent points, and lack of mixing can cause short circuiting. Water layer stratification due to differences in temperature, particularly in cold weather, can cause influent short circuiting. The reduced retention time of wastewater in the system can result in high BOD and effluent violations.
Excess sludge accumulation	Sludge at the bottom of lagoons contains anaerobic bacteria and other organisms that treat wastewater anaerobically and digest organic solids. However, excess accumulated sludge requires periodic removal to maintain full functioning capacity of the wastewater treatment process. When there is excess sludge and solids in the lagoon, there is less volume for wastewater, which reduces retention time and the effectiveness of treatment. Excessive sludge buildup can also result in channels through the lagoon causing short circuiting.

Exceeding ammonia limits	Ammonia can be toxic to aquatic life in receiving waters, even at low levels. Ammonia in lagoons is removed in three processes: stripping of gaseous ammonia, uptake of ammonia into algae as a nutrient, and biological nitrification (microbes converting ammonia into nitrate). High effluent ammonia can also be caused by organic or hydraulic overloading, low oxygen concentration, short circuiting, and excess sludge accumulation.
Low dissolved oxygen	Aerated lagoons depend on aeration so that microorganisms have dissolved oxygen (DO) to counter high BOD and/or for ammonia removal by nitrification. The main types of aeration in aerated lagoons are mechanical and diffused aeration. Mechanical failure of this aeration equipment can result in low dissolved oxygen levels and poor mixing. Adequate mixing is needed to disperse the organic or ammonia load into the system and facilitate contact between microorganisms and organic matter or ammonia (their food). Facultative lagoons have a top aerobic layer that develops DO from atmospheric reaeration and algal photosynthesis. At night when the sun is gone and surface algae cannot photosynthesize, they respire and consume oxygen. Conversely, in very sunny and warm weather when algae are actively photosynthesizing, they can substantially increase DO in the upper lagoon layers.
Algae overgrowth	Algae, aquatic photosynthetic organisms, are a naturally occurring and necessary part of facultative wastewater lagoons. Algae grow near the surface of lagoons where they have ample access to sunlight, water, and carbon dioxide. Their growth is further encouraged by abundant nitrogen and phosphorus introduced to the influent or added by the sludge blanket. During the day, they consume carbon dioxide and produce oxygen that contributes to dissolved oxygen content near the surface of a lagoon. At night, they respire and consume oxygen. Conventional green algae are a sign of a healthy lagoon. The oxygen they produce is necessary for bacteria to stabilize waste (and thus remove BOD) in the pond. However, some types of algae can be harmful, such as blue-green algae. Too much algae in the effluent can lead to total suspended solids (TSS), BOD, and pH violations. Blue-green algae are filamentous and block sunlight, and some blue-green algae produce toxic and odorous byproducts. When algae in the effluent die, settle out, and decay, they exert some oxygen demand on the receiving stream.
Odors	In general, most properly designed and operated lagoons should not produce objectionable odors. However, anaerobic lagoons have the potential to generate significant odors such as from those associated with hydrogen sulfide (rotten egg smell) and ammonia. Also, some facultative lagoons can generate odors for short periods in the early spring after ice melts off the surface or in late fall when surface water temperatures are dropping. Duckweed and other weeds can create habitat for insects or burrowing animals. Odors can come from animals or decaying plant material. Odors can occur in conditions of low dissolved oxygen. If lagoon layers become stratified (and ice-covered in the winter), they may experience the natural mixing that would occur in a pond or lake during the change in seasons. When there is low DO or seasonal mixing, trapped gases from the anaerobic bottom layer may rise to the surface and release into the air before bacteria in the lagoon neutralize them, causing odors.
Organic overloading	Organic overloading occurs when the lagoon is receiving more organic material than it was designed to take in and treat. This can either be a result of “shock loads,” or sudden overloading often caused by industrial waste, or of an overall increase in organic loading.
Pass-through and interference	Pretreatment programs are designed to prevent pass-through of specific pollutants and interference at publicly owned treatment works. Pass-through means untreated waste, generally coming from an industrial or commercial user, that is not treated by the lagoon and simply passes through to the discharge in quantities or concentrations that cause violations of the WWTP’s NPDES permit. Interference is when components of the influent interfere with plant operations and it’s ability to effectively treat the wastewater (for example, they could contain toxic compounds that kill the microorganisms in the pond). The National Pretreatment Program is a Clean Water Act regulatory program designed to control pollution emitted from indirect dischargers, often commercial or industrial users that send their waste to a direct discharger (NPDES permit-holder) like a wastewater treatment plant. If a lagoon is consistently experiencing pass-through and interference, the operator may

	need industrial users in their community to pretreat their waste to reduce the organic content and to develop a slug loading plan before sending it to the lagoon. Learn more about the National Pretreatment Program and slug loading plans.
Hydraulic overloading	Hydraulic overloading occurs when the flow into the lagoon exceeds the lagoon's hydraulic design capacity. Causes include increased flow due to population growth within the collection system or from external sources such as inflow and infiltration (I&I), and decreased capacity due to increased sewage sludge solids generation in the system. Infiltration is groundwater that can seep into the collection system through broken sewage pipes and manholes. Inflow is water that enters a sewer system from sources such as storm drains, and roof and cellar drains. Increases of flow above the design capacity shortens water retention time within the treatment system and degrades performance.
Overgrown vegetation (lagoon surface and banks)	Aquatic vegetation and plants like duckweed can grow in and around a lagoon and take up surface space from algae, block sunlight and oxygen from entering the pond, and provide habitat for insects and animals. In addition, they can contribute to odors and scum formation, and their roots can potentially penetrate a lagoon lining and cause leaks. Trees and shrubs should never be allowed to grow on lagoon dikes. The roots can destabilize the dikes and allow leakage.
Erosion and burrowing animals	It is important to protect lagoon dike walls from destruction by waves, weather, and burrowing animals (such as muskrats). Rodents will dig partially submerged tunnels and can cause damage to dikes.
Low water levels (leakage)	Some states have design requirements for lagoons that include maximum seepage, leakage tolerance, and/or leak detection. Lagoons can leak due to excessive vegetation, burrowing animals, or leaks in the lagoon lining, seals, or control structures. Leakage can cause low water levels, increased vegetation, and potential groundwater or permit violations.
Scum, trash and grit accumulation	Lagoons commonly have an influent grate or screen structure that is designed to collect large pieces of trash and prevent it from entering the system. Trash can interfere with normal functioning of the lagoon, and trash incorporated into sludge makes it less appealing for farmers to use for land application. Damage or removal of the grate or screen structure can allow trash to enter the lagoons. A scum layer may form at the surface of a lagoon cell from fats, oils, grease, and other floating material. Scum layers inhibit oxygen and sunlight from entering at the lagoon surface, which can lead to anoxic conditions and odors. Scum can also invite unwanted insects. For information on controlling fats, oils and grease refer to "Controlling Fats, Oils, and Grease Discharges from Food Service Establishments."
Disinfection and dechlorination issues	The last steps in treating wastewater in a lagoon are often disinfection (to kill pathogenic organisms) and dechlorination (to remove chlorine residual). The most common methods of disinfection are chlorination (with gas or liquid), exposure to ultraviolet light, and ozone. Chlorine is toxic even at low levels, so chlorination must be followed by dechlorination before discharge (with a recommended minimum of 30 seconds detention time) to protect fish and other aquatic life in receiving waters.

Table 3. Effluent Violations at Small Lagoons: Troubleshooting and Potential Solutions

Topic	Troubleshooting	Recommended Potential Solutions
High BOD **High BOD**	➢ Measure BOD from the effluent of the primary cell to determine if it is removing 80% of the influent BOD.	Refer to these topic areas below to determine the likely root cause and identify potential solutions: ➢ **Short circuiting** ➢ **Excess sludge accumulation** ➢ **Organic overloading** ➢ **Hydraulic overloading** ➢ **Algae overgrowth** ➢ **Improper headworks**
Short circuiting (reduced retention time)	➢ Add small floating objects (e.g., oranges or tennis balls) at the influent discharge pipe, observe the path they take, and how long it takes the objects to move from influent to effluent. If they are floating along the dike wall and taking a shortcut through the cell, that is evidence of short circuiting. ➢ Observe sewage sludge solids in the effluent (as detected through a microscope). ➢ Identify sharp disparity between dissolved oxygen, pH, and/or temperature on opposite ends of the primary lagoon cell.	➢ Design lagoon so that the bottom is as flat as possible, and any corners are rounded to improve flow. ➢ Install baffles, curtains, or other engineered barrier devices to redirect flow, enhance turbulence and mixing, and avoid short circuiting between inlet and outlet. ➢ Adjust location of inlets and outlets to opposite corners of cell and/or introduce influent through a manifold to distribute flow more evenly. Note that completely relocating inlet and outlet structures for maximum retention time is usually not cost-effective when compared to adding baffles, curtains, or other devices to eliminate short circuiting ➢ See **Low dissolved oxygen**. For lagoons equipped with mechanical mixing or aeration, minimize stratification and sludge buildup that can lead to short-circuiting by increasing mixing or aeration. ➢ See **Excess sludge accumulation**. Remove excess sludge that can cause channeling through the lagoon resulting in short circuiting.

Topic	Troubleshooting	Recommended Potential Solutions

Excess sludge accumulation
 	
Excess sludge accumulation
	➢ Measure sludge blanket depth in the lagoon system cells. Measurements should be taken from multiple points in a lagoon cell (suggested minimum of 12-24 sample points) and averaged to determine overall depth.
	➢ Measure BOD, TSS, and ammonia at the conveyance points between each cell in a lagoon system. If BOD, TSS, and ammonia are reduced after the primary cell, but rise again at the effluent, this can indicate settled sludge coming back into the water column and can cause spikes in BOD, TSS, ammonia, and phosphorus.
	➢ Determine if the TSS in the effluent is increasing every year.
	➢ Track the difference between the effluent BOD and TSS levels over time. Typically, BOD and TSS track closely. An increasing effluent TSS and a constant BOD can indicate sludge buildup.
	➢ Detect sludge solids in the effluent through a microscope.
	➢ Check for sludge accumulation in wastewater conveyances at the effluent and chlorine contact chamber.
		
		➢ Remove sludge accumulation from conveyances, chlorine contact chambers, and influent/effluent structures.
		➢ Remove excess sludge from the bottom of a lagoon in compliance with the requirements in 40 CFR Part 503. The use or disposal of sewage sludge (including land application) is subject to Part 503 of the Clean Water Act (CWA), which has limits for heavy metals, pathogen reduction, vector attraction and nitrogen when land applying, and maximum moisture requirements for landfills. As a rule of thumb, a sludge depth should not exeed 25% of the lagoon operating depth. For example, in a standard 5-foot operating depth facultative lagoon, 18 inches of sludge would be considered excessive.
		➢ Contact the state/federal regulatory agency to find out if there are special requirements for sludge disposal. In many cases, de-sludging of facultative lagoons will need to take place once every 20 years.
		➢ Typically, sludge is removed from lagoons with sludge-pumping equipment. The sludge is then often thickened and dewatered (a drying process) to make it lighter, as well as easier and less expensive to transport. Several dredging systems designed for use in wastewater treatment lagoons are commercially available.
		➢ Methods of sludge disposal, except landfilling, are subject to Part 503 of the CWA:
		  o Re-use by applying directly to land as a fertilizer or soil conditioner. This may require an additional permit, depending on the use, but can be cost-effective.
		  o Incineration

Topic	Troubleshooting	Recommended Potential Solutions
		○ Landfill ○ Surface disposal ○ Re-use by forming heat-dried pellets for fertilizer (can be expensive due to processing) ○ Compost
Exceeding ammonia limits **Exceeding ammonia limits**	➢ Use a single parameter colorimeter to measure ammonia. ➢ For process control screening only (see 40 CFR 136 for approved test procedures): An inexpensive way to test ammonia is to use an ammonia test kit, also called an aquarium kit or fish kit. The test kit will not provide an exact measurement, but it can be a helpful indicator for detecting the presence of ammonia. ➢ Submit effluent samples for ammonia analysis to the certified laboratory that analyzes lagoon effluent samples for discharge monitoring reports (DMRs).	➢ For most lagoon WWTPs, make sure that the primary treatment cell is effectively removing about 80% of the influent BOD. If BOD is being passed on to subsequent cells, the oxygen demand will lower the system's capacity to break down ammonia. This is especially true for multi-cell lagoon WWTPs with an aerated primary cell designed principally for BOD load reduction followed by another aerated cell designed for nitrification. ➢ Prevent short circuiting, which reduces retention time and limits the lagoon's ability to remove ammonia. See **Short circuiting**. ➢ Remove excess sludge. Excess sludge can feed ammonia back into a lagoon system. See **Excess sludge accumulation**. ➢ For aerated lagoons, relying on biological nitrification for ammonia removal. Troubleshoot aeration equipment and air delivery system to ensure that enough dissolved oxygen is maintained to satisfy nitrification oxygen demand (as well as carbonaceous biological oxygen demand where needed). See **Low dissolved oxygen**. ➢ Use a controlled discharge, if possible. Some facultative lagoons can be operated as controlled discharge if there is adequate volume. Since ammonia limits are generally less stringent in the winter months, holding the water and discharging at that time may make ammonia compliance possible. ➢ If necessary, consider initiating an engineering study of feasible options for upgrading the lagoon WWTP for consistent ammonia removal.
	Measure dissolved oxygen through an entire 24-hour day. When measuring DO, it is important to sample at different times of day and at night, if possible.	**<u>For aerated lagoons only:</u>**

Topic	Troubleshooting	Recommended Potential Solutions

Low dissolved oxygen	➢ If possible, take dissolved oxygen measurements at locations throughout the lagoon system using a DO probe. If this is not possible, take DO measurements at the exit locations for each lagoon cell.	➢ Add more aeration capacity (mechanical or diffused aeration) to the lagoon cell(s) or increase their run time with a goal of $\geq$ 2 mg/L dissolved oxygen in each treatment cell.
		➢ Clean clogged air diffusers.
		  ○ If clogging is minor, try increasing the airflow output, or try turning off the affected section and increasing diffusion in the section that is not blocked.
		  ○ Draw down the pond to clean or repair the diffusers.
		➢ Add more mixing to the final cell in the lagoon system to discourage algae growth and improve effluent TSS.
		➢ Recirculate effluent to the headworks using portable pumps to provide more oxygen.
		
		<u>For facultative lagoons and aerated lagoons:</u>
		
		➢ See **Excess sludge accumulation**. Remove excess sludge from the bottom of the lagoon and at conveyances, chlorine contact chambers, and influent/effluent structures.
		➢ See **Algae overgrowth**. Stifle excess algae growth if you suspect it is causing low DO.
		➢ See **Scum and trash accumulation**. If you see excess surface scum or floating trash, inspect and repair screens and grates or install pretreatment.
		➢ See **Overgrown vegetation**. Remove duckweed, trees, and brush around the treatment cell.
		➢ See **Organic overloading** if other topics do not address problem.

Algae overgrowth	➢ Examine effluent microscopically and observe elevated algae content. Operators may be able to get assistance from a local high school or college biology instructor.
	➢ Run a filtered BOD test, also known as soluble BOD (SBOD). When algae are present in a BOD bottle, they respire and consume oxygen, causing inflated BOD numbers. A soluble BOD test can reveal algae's true influence on BOD.
	➢ Detect high effluent BOD and high effluent TSS, with an effluent TSS/BOD5 ratio > 2.
		<u>Conventional green algae:</u>
		
		➢ Add cover to create shade. Shading the lagoon reduces the sunlight penetrating the surface of the water, which algae need to survive. Types of shade can include:
		  ○ Certain water-soluble pond dyes can block out specific solar wavelengths (light rays) that algae need to grow.
		  ○ Floating covers such as a swimming pool cover (should not cover the entire lagoon). Note for

Topic	Troubleshooting	Recommended Potential Solutions
Algae overgrowth	➢ Measure high effluent pH (>9.0), a clear sign of algae overgrowth because algae consume inorganic carbon for growth, raising the pH. 	aerated lagoons, there are some covers that are compatible with aerators. ○ Floating ballast balls. ○ Duckweed can be a good natural shade provider; however, duckweed can also cause problems and must be kept out of effluent. See **Overgrown vegetation**. ➢ For aerated lagoons, increase mixing/aeration to inhibit overgrowth of algae. Another option is to increase aerator running time at night and decrease it during the day. ➢ Draw effluent from variable depths below the surface to reduce amount of surface algae that enters the effluent. Conversely, take care not to draw effluent from too low or it may inadvertently draw in sludge. ➢ Where necessary and feasible, add a rock filter or a constructed wetland to help polish the effluent and remove excess algae. ➢ Remove excess sludge. See **Excess sludge accumulation.** **<u>Blue-green algae:</u>** ➢ Can be a sign of incomplete treatment or organic overloading. See **Organic overloading**. ➢ Isolate the cell if possible and break up mat of algae physically with a motorboat.
Odors	➢ **<u>Seasonal turnover may cause temporary odors that will resolve on their own.</u>** ➢ Note that cells other than the primary cell may be causing odors. Use a DO probe to identify the cell causing the odor. ➢ Observe excess duckweed or other weed growth on banks. ➢ Detect excess algae growth. ➢ Measure organic overloading. ➢ Perform a water balance if you suspect hydraulic overloading. ➢ Observe excess sludge accumulation.	➢ If possible, recirculate effluent from the cell experiencing an odor to the head of the plant. ➢ Floating ballast balls or other floating or modular covers can aid in odor control. ➢ For aerated lagoons, increase aeration capacity or aerator run time to increase oxygen. ➢ Remove vegetation. See **Overgrown vegetation**. ➢ For algae, see **Algae overgrowth**. ➢ If due to excessive loading, see **Organic overloading.** In a multi-cell lagoon operated in series, consider converting to operating in parallel whereby influent flow is split between

Topic	Troubleshooting	Recommended Potential Solutions
Odors		the first two cells, reducing the loading rate on the first cell. If operating a two-cell lagoon, and depending on the lagoon design and actual loading, this may not be possible as treatment through a single cell is in many cases not sufficient. ➢ See **Hydraulic overloading** if a water balance reveals unknown sources to the lagoon. ➢ See **Excess sludge accumulation** if you identify build-up at conveyances, influent/effluent structures, or at the bottom of a cell. ➢ If the odor problem is severe, applying a chemical such as sodium nitrate may be useful. Proceed with caution when adding any chemicals to a lagoon.
Organic overloading	➢ Observe high BOD and low pH in the effluent, low dissolved oxygen levels throughout the lagoon system and sometimes, odors. ➢ Color changes can also be an indicator of overloading. The color of the lagoon may change from its usual color (often, but not always, an emerald green), to gray, brown, black, pink or red. 	➢ Increase aeration capacity. ➢ Check for and address any toxic pollutants that may be stressing biological community in the lagoon WWTP. ➢ Operating lagoons in parallel is recommended when organic overloads or shock loads are expected. ➢ Recirculate effluent to the headworks using portable pumps to provide more oxygen and increase hydraulic residence time. ➢ If possible, bypass an overloaded cell and let it rest.
Pass-through and interference	➢ Detection of influent BOD at a flow rate or concentration that will cause interference. ➢ Solid or viscous pollutants in amounts that will cause obstruction to the flow in the WWTP resulting in interference. ➢ Observations of other violations of prohibitions at 40 CFR 403.5(b).	➢ If applicable, slowly feed industrial or commercial waste into the lagoon WWTP to prevent overload. ➢ Require industries to institute pollution prevention practices in their facilities to minimize impact on the lagoon WWTP. ➢ If necessary, require industrial users to pretreat their waste before sending it to the lagoon WWTP.

Topic	Troubleshooting	Recommended Potential Solutions
Hydraulic overloading **Hydraulic overloading**	➢ Observe that water levels in the lagoon are exceeding the design depth (i.e., reduced freeboard) for an extended time, and/or the lagoon is commonly overloaded during rainfall events. ○ Contact your local technical service provider or a professional engineer to perform an I&I study that may consist of smoke or dye testing for the collection system. ➢ Observe turbidity and low DO in the final cell.	➢ If inflow is discovered, cap or seal the open access points. ➢ If you identify sources of infiltration, consider repairing the broken pipes through trenchless rehabilitation or an open cut replacement, as appropriate. ➢ Familiarize yourself with the local sewer use ordinance (40 CFR 35.2130) that gives municipalities legal standing to prohibit excessive flows from industrial or commercial sources. ➢ If correcting inflow and infiltration does not correct the loading, consider constructing an additional cell. ➢ If you suspect the overloading is due to sludge accumulation, see **Excess sludge accumulation**.
Overgrown vegetation (lagoon surface and banks)	➢ Observe weed growth in the lagoon and vegetation on dikes and edges of lagoon cells. Duckweed may be used as a sun cover, but it should never comprise more than 40 percent of the lagoon. 	➢ Unless duckweed is specifically introduced to create shade and control algal growth, skim the surface regularly and do not allow it or other vegetation to accumulate. ○ Use a boat or take advantage of a windy day to push and collect duckweed in the corner of a lagoon cell, then remove it with a rake or a vacuum truck. ➢ Mow grass periodically and control weed growth along the edges of lagoon cells, including pulling new growth of cattails and bulrushes. ➢ Cut and remove trees, shrubs, and dead vegetation on dikes and edges of lagoon cells. ➢ As a last resort, if there is excessive vegetation in the lagoon or on the dikes that can be remedied only by herbicides, identify a licensed pesticide applicator to apply according to label restrictions. Failure to do so may result in harm to the beneficial biological activity in the lagoon and result in a failure to meet permit limits.

Topic	Troubleshooting	Recommended Potential Solutions
Erosion and burrowing animals	➢ Inspect earthen structures for signs of rodent damage and erosion. 	➢ Repair by filling, compacting, leveling, and re-seeding vegetation. ➢ Install riprap or concrete liner along banks to prevent erosion (see photo). If riprap is not available, gunite (also known as shotcrete or sprayed concrete) may be an option. Be sure to extend the liner down to 3 feet below the surface of water, which will help deter muskrats and protect against erosion from strong wave action. Operators should always contact the appropriate regulatory authority prior to lining dikes to discuss any regulatory requirements. ➢ Maintain fencing around the lagoon to discourage rodents. ➢ Remove rodent food supply such as cattails and burr reed. ➢ Discourage muskrats by raising and lowering the water level 6 to 8 inches over several weeks. ➢ If the problem persists, check with the local game commission officer for approved methods of removal. ➢ Control vegetation. See **Overgrown vegetation**.
Low water levels (leakage)	➢ Conduct a water balance to determine the difference between recorded inflows and outflows. ➢ Inspect control structures and lagoon lining for breaches.	➢ See **Erosion and burrowing animals** and **Overgrown vegetation** if you identify these problems. ➢ Repair control structures and lagoon lining if you identify breaches. For additional information, refer to the Oregon Department of Environmental Quality's *Guidelines for Estimating Leakage from Existing Sewage Lagoons*, or contact a technical service provider to assist with testing, if possible.

Topic	Troubleshooting	Recommended Potential Solutions
Scum, trash, and grit accumulation	➢ Observe scum and trash accumulation in the primary cell. 	➢ Use a rake, portable pump, or motorboat to break up scum. ➢ Clean inlet and outlet structures regularly to remove any floating debris, caked scum, or other trash. ➢ Consider installing or modifying the influent structure to screen out trash so that it does not add to sludge removal costs. ➢ Consider also installing a slow channel in the headworks that could settle sand and grit particles before they enter the lagoon and contribute to build-up of sludge. ➢ Consider installing a custom-made screen to use around pond surface outlets to keep windblown weed and surface trash from entering a pipe. In other cases, provisions are made for selection of depth for lagoon draw-off and keeping surface scum and trash from entering. ➢ Scum formation may be a result of poor aeration (see **Low dissolved oxygen**) or sludge build-up (see **Excess sludge accumulation**). ➢ Excessive fats, oils, and greases in the influent may indicate a need for pretreatment (see **Organic overloading**). Skimming, floating booms, and sorbent pads can be used to control excessive oil and grease.
Disinfection and dechlorination issues	**<u>To diagnose coliform violations:</u>** ➢ Perform fecal coliform or total coliform tests. ➢ Assess possible contamination from waterfowl. **<u>To diagnose chlorine residual:</u>** ➢ A chlorine (Cl-) residual test determines the amount of chlorine present after disinfection. Generally, there should be 0.5 mg/L Cl- remaining after 1 hour of detention time. Grab samples must be tested immediately (they cannot be preserved). ➢ Make sure there are no additional factors interacting with the residual chlorine test. For example, exposure to sunlight, sample agitation, and a dirty sample collection bottle can cause an inaccurate (generally lower) reading than what is present in the pond.	**<u>Coliform violations:</u>** ➢ Increase chlorine feed rate and chlorine contact detention time at peak flow. ➢ Remove any solids from the chlorine contact chamber. **<u>Chlorine residual:</u>** ➢ Allow chlorine to dissipate naturally over time in a secondary pond. Chlorine residual samples must be taken to determine when the residual is low enough to discharge per the facility's NPDES permit. ➢ If the chlorine residual is above the facility's NPDES permit, add a dechlorination chemical such as sulfur dioxide (gas), sodium metabisulfite (solution) or sodium bisulfate (solution) to the secondary pond effluent.