Wastewater Lagoons 101

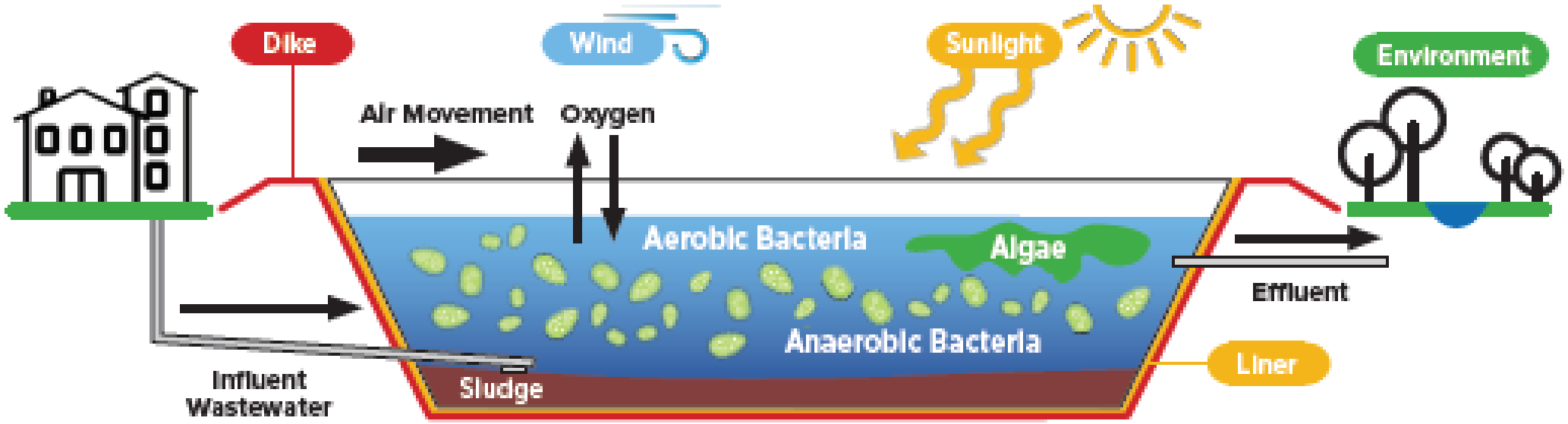
Mike Beck

Senior Wastewater Specialist

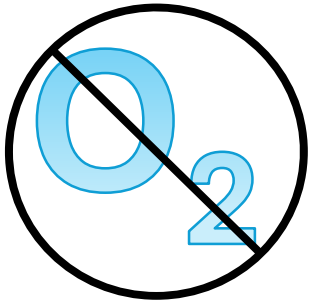
ERG

How do wastewater lagoons work?

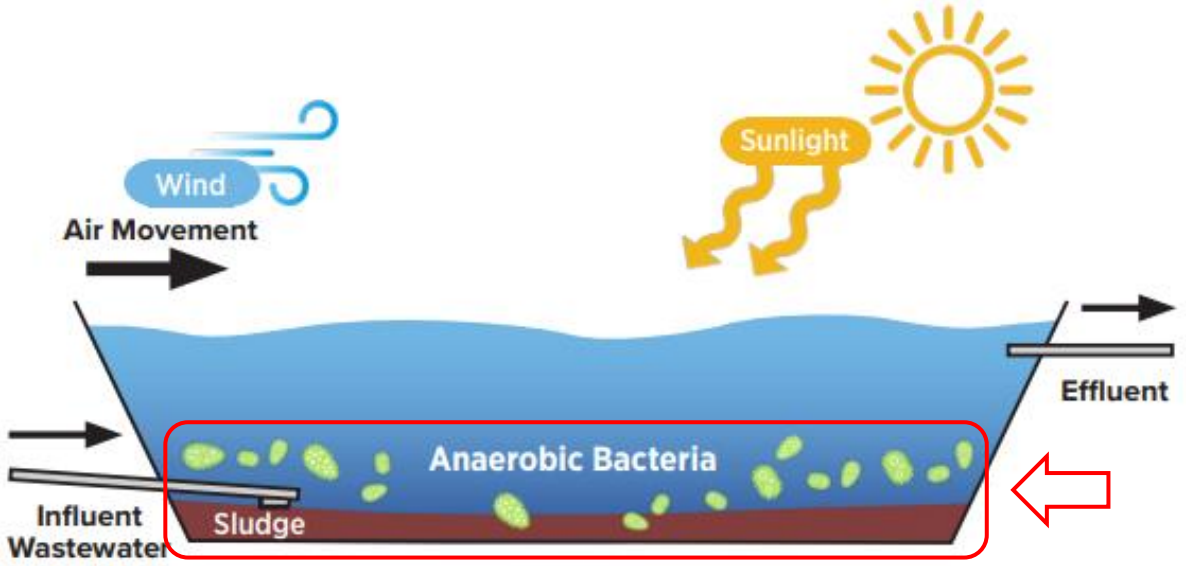
- Lagoons are designed to store and treat wastewater through natural and passive biological processes.
- The sun creates warm, bright conditions for photosynthesis for algae and the wind provides oxygen needed to support the growth of beneficial bacteria.
- Sludge settles to the bottom and the bacteria then breakdown and consume the material in the wastewater before being discharged into the environment/receiving water.



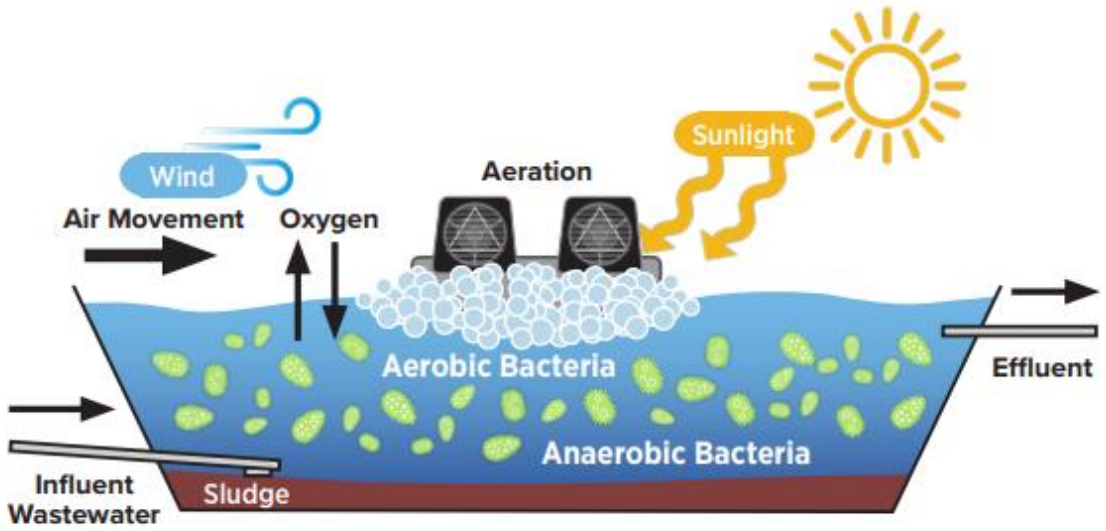
Types of Wastewater Lagoons: **Anaerobic “absence of oxygen”**



- Typically identified as the first stage in more complex wastewater treatment systems.
  - Also called “waste stabilization ponds”
- Often used in industrial wastewater for high strength waste.
- Not aerated, heated, or mixed.
- Biological treatment wastewater take place deep in the lagoon without any oxygen.



Types of Wastewater Lagoons: **Aerated "air (O_2) added"**

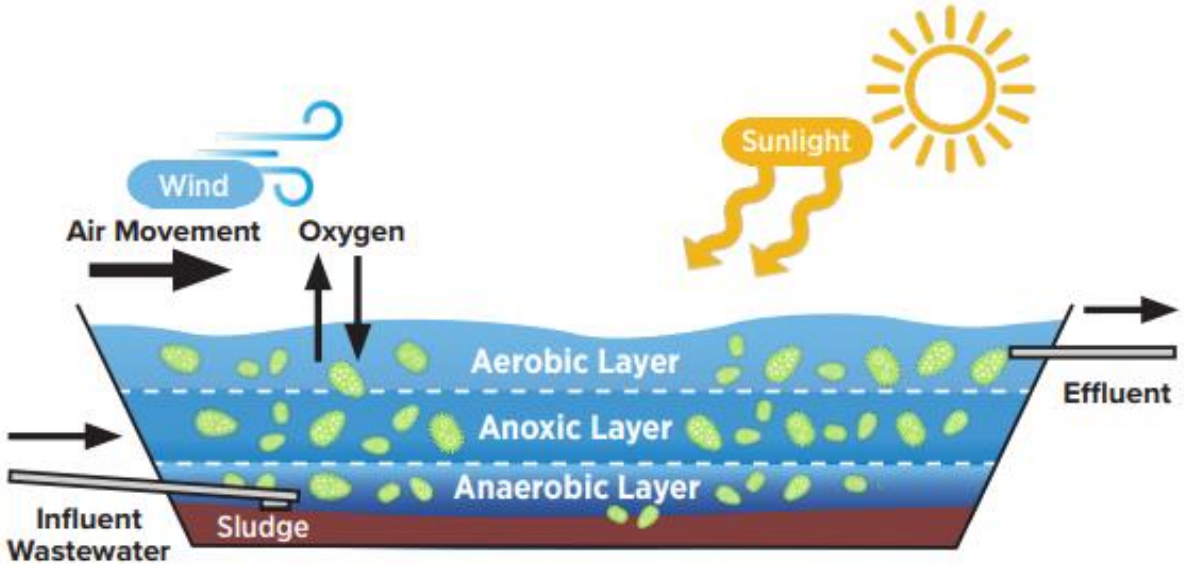


$+O_2$

- Also called **aerobic lagoons**, oxygen is supplemented to the system through mechanical or diffused aeration, instead of by photosynthesis/wind only.
- Usually classified by the amount of mixing that is provided to the system (e.g., partial-mixed or complete-mixed).
- These systems are well-suited to treat both municipal and industrial wastewater.

Types of Wastewater Lagoons: **Facultative**

- Essentially facultative is a combination of the other two types
- Consist of three layers
  - Bottom: anaerobic
  - Middle: anoxic “low oxygen/oxygen deprived”
  - Top: aerobic
- This is historically the most common configuration for small communities to treat municipal wastewater



Benefits vs. mechanical plants

Cost effective- lower capital cost due to simpler design

Lower Maintenance- less mechanical systems to wear out

Energy efficient- flow through the system is often passive and doesn’t require active pumping, sunlight provides energy and wind some aeration

Operationally simple- doesn’t require advanced operator certifications and most daily tasks are simple to perform like vegetation management, clearing debris.

Common Challenges

- No built-in solids dewatering and removal
  - solids accumulate over time and then need to be removed in bulk which is costly.
- Short circuiting is common leading to lower detention times and less treatment.
- Requires substantial land/large footprint
  - A typical treatment cell can be multiple acres
- Restricted to more rural locations, not able to be placed near housing due to odors
- Treatment efficiency/performance is sensitive to seasonal changes
- Limited ability to remove nutrients
  - Ammonia/Phosphorus

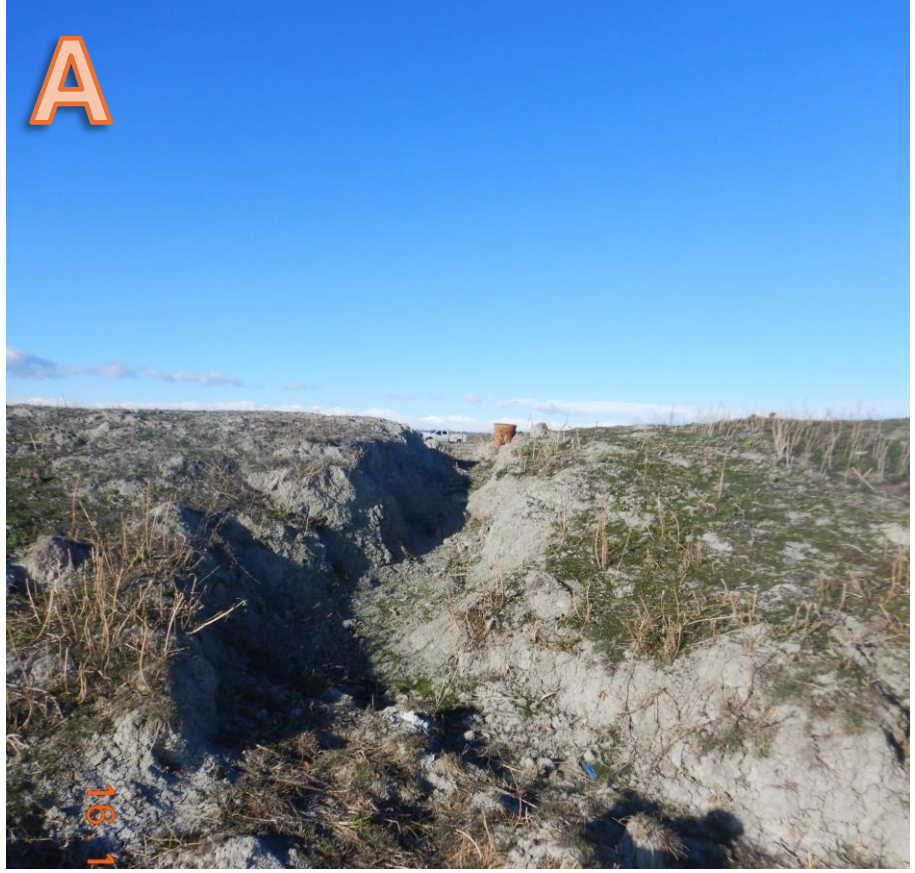
*Match the issue with the picture:

Damaged Liner

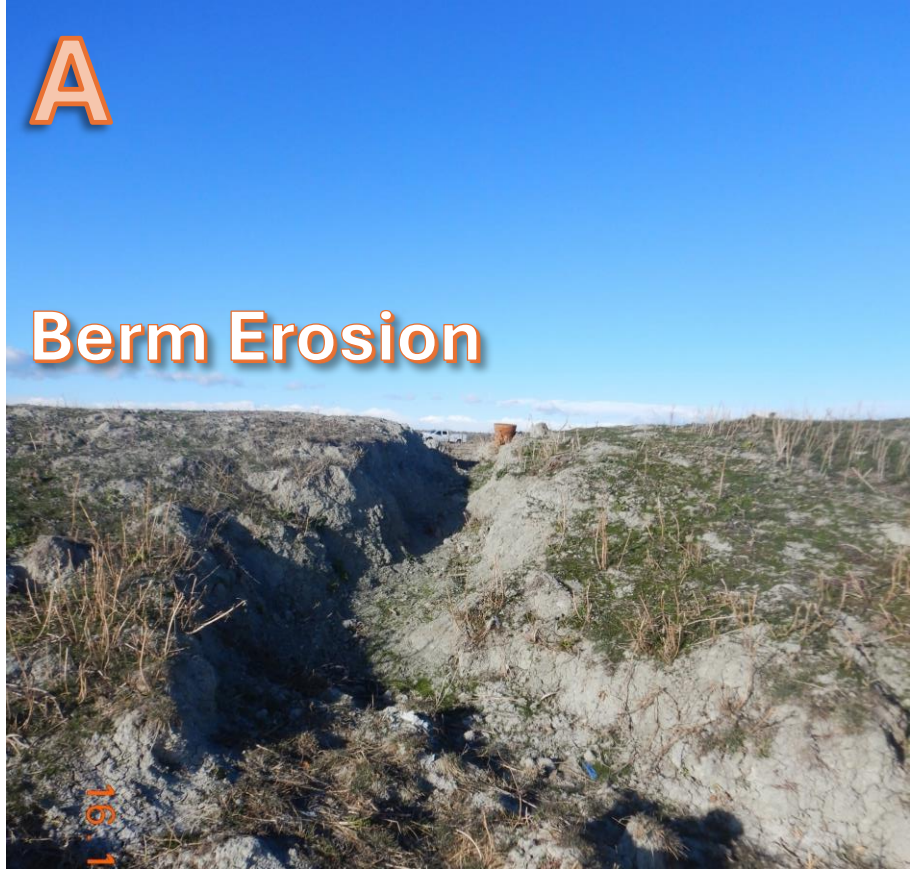
Berm Erosion

Waterfowl

Algae in Effluent



What are the impacts of these issues?



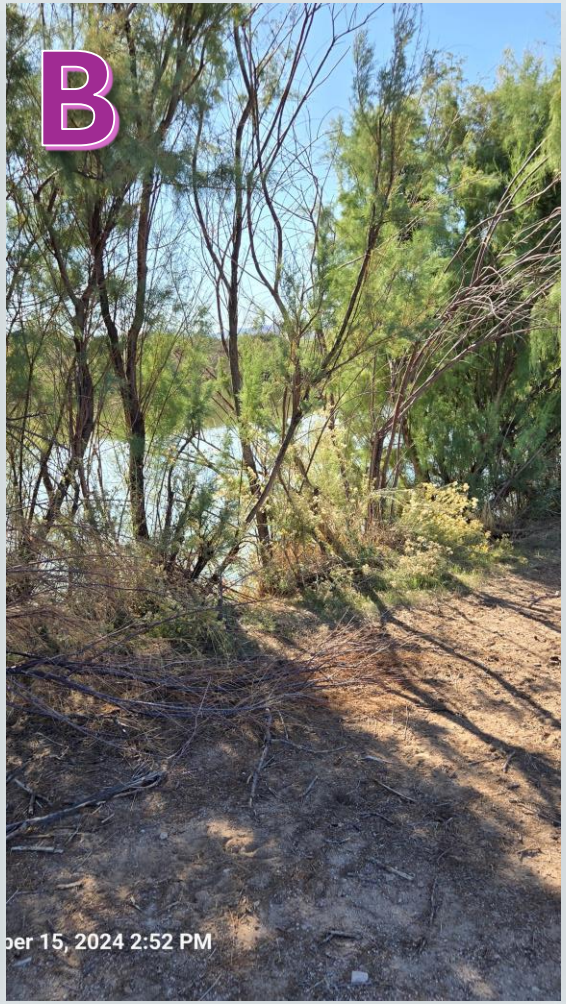
Match the issue with the picture (part 2):

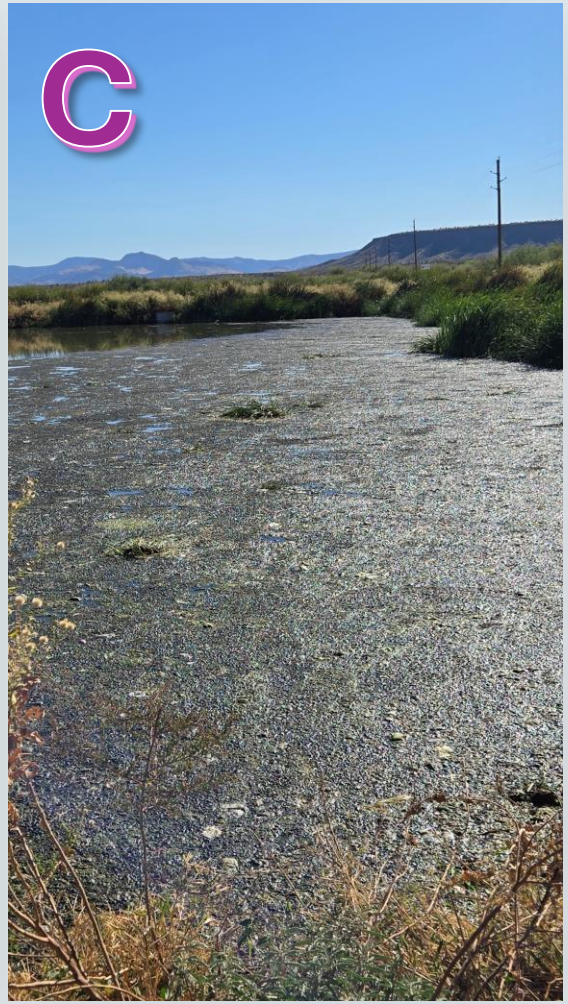
Aquatic Vegetation

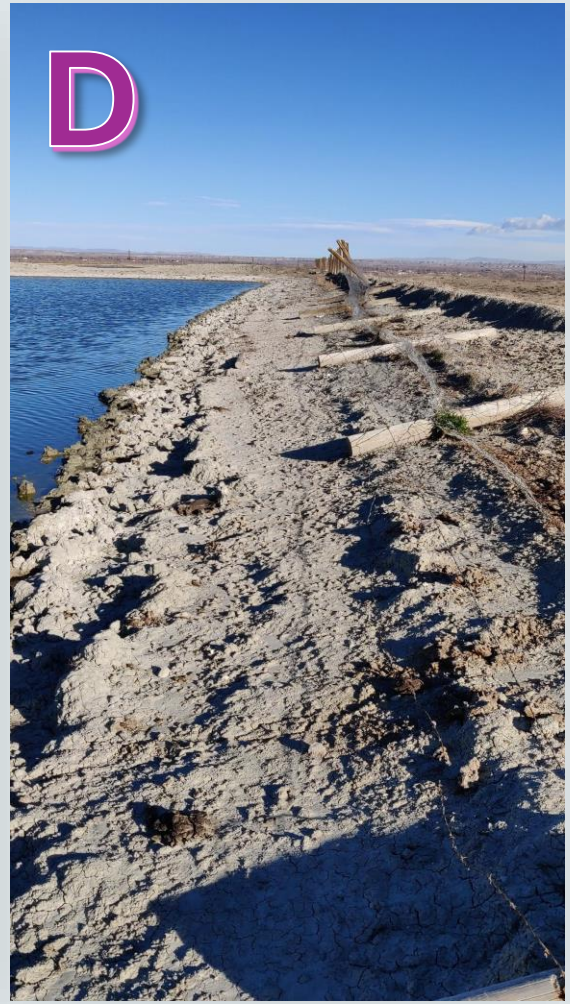
Perimeter Fencing

Sludge Beaching

Rooted Vegetation







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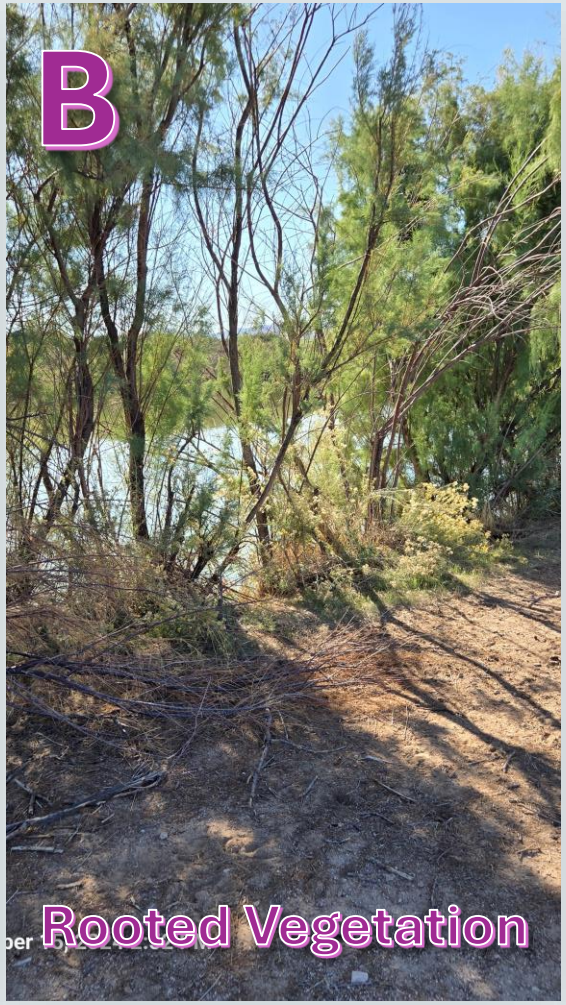

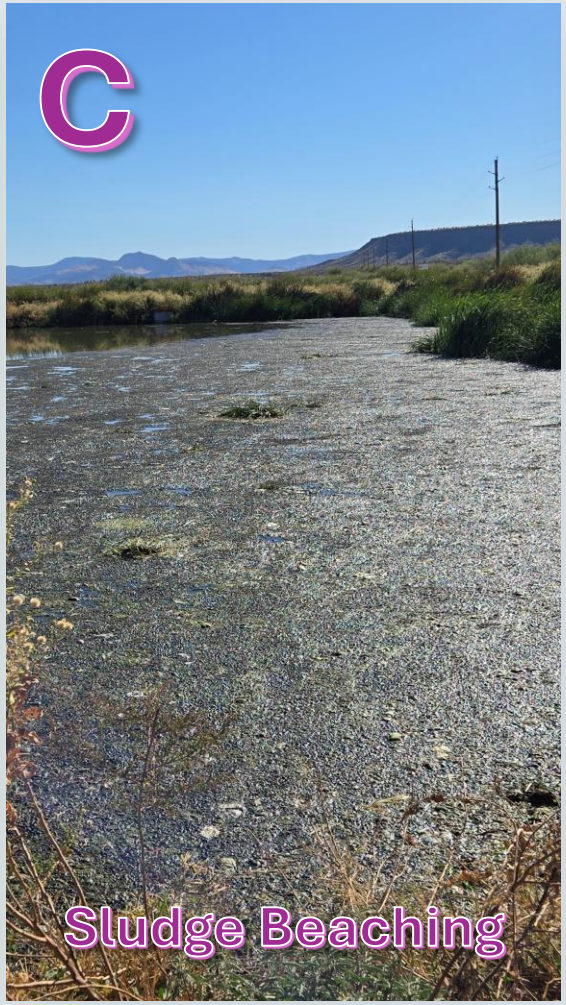

Conclusion

- While lagoons are lower maintenance and often cost less to install then mechanical plants they still require:
  - maintenance of pumps, valves, aerators, disinfection systems
  - vegetation control both around and in lagoon,
  - periodic management of sludge
  - perimeter security
  - sample collection and flow monitoring

Resources

- https://www.epa.gov/compliance/resources-wastewater-operators

- First Stop Lagoon Toolbox
- Troubleshooting Manual for Small Lagoon Systems
- Lagoon Tipsheet
- The Universe of Lagoons
- Lagoon Action Plan

MARCH 26, 2025

FIRST STOP TOOLBOX FOR LAGOON WASTEWATER TREATMENT SYSTEMS:

An Overview of How Users Can Utilize the First Stop Toolbox To Address Technical and/ Or Compliance Challenges Facing a Particular Lagoon

PRESENTER

ALMA HIDALGO

OFFICE OF WASTEWATER MANAGEMENT

EPA

Priorities of EPA's Lagoon Wastewater Treatment Program

Improve public health and clean waterway protections for small, rural, and tribal communities that rely on lagoon wastewater treatment systems through coordinated technical and financial assistance.

Why Focus on Lagoons?

- Lagoons are commonly used by small, rural, and tribal communities because they provide a low-tech and cost-effective option for wastewater treatment.
- These communities usually have populations of fewer than 3,000 residents.
- The EPA estimates that lagoons account for about 25% of all the wastewater treatment systems in the country.
- Many lagoon facilities have O&M and/or compliance concerns.
  - Protective water quality-based ammonia and nutrient limits can be challenging to meet.
  - Significant percentage of discharging lagoons discharge to impaired waters.
- EPA is working to provide local and state/Tribal decision-makers with **technical, financial, and regulatory resources** to support lagoon systems experiencing compliance challenges.
- The effort will help lagoon communities access Infrastructure funding and helpful resources while also identifying communities that are in need of technical assistance.

EPA's Lagoon Wastewater Treatment Program
Goals & Priority Focus Areas

1. Identifying the Universe of Lagoons Nationally
2. Providing Financial and Technical Assistance Tools, Including Tools that Assist Communities with Accessing Funding
3. Developing Cost and Performance Data for Alternative and Retrofit Technologies that Treat or Remove Ammonia or Nutrients
4. Developing Cost and Performance Regulatory Support Tools Including Streamline Economic Impact Evaluation
5. Developing Plans for Community Engagement, Communication and Partnerships to Support the Lagoon Action Plan

EPA Lagoon Action Plan - Deliverables & Activities

Q1 & Q2 2022

- Release of Innovative Water Technologies for Lagoon Wastewater Systems in Small Communities **Request for Applications** (ORD)
- EPA released the Lagoon Inventory Dataset and Universe of Lagoons Report (OST)

Q1 2024

- Release of Understanding Lagoon Requirements Under 40 C.F.R. Part 503: **Best Management Practices for Use or Disposal of Sewage Sludge**, Part 1 – Land Application of Sewage Sludge Removed from Lagoons (OST)

Q1 2024

- Release of **Troubleshooting Manual** for Small, Facultative, Partial-Mix Aerated, and Complete-Mix Aerated Wastewater Lagoons (OECA)

Field Season 2024

- EPA Lagoon Team **pilot of direct TA** for lagoon systems and partnerships with Providers like RCAP and NRWA (OWM)
- Released Small Lagoon Community Economic Streamlining Tool, Individual Lagoon Tool, and First Stop Toolbox (OST and OWM)

Q4 2025 & Q4 2026

- Obtain **cost and performance data** for alternative and add-on technologies for ammonia and nutrients via research grants; add data to Searchable Clearinghouse of Wastewater Technologies (ORD and OWM)

EPA Lagoon Action Plan - Deliverables & Activities

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Introduction: The First Stop Toolbox for Lagoons

A user-friendly **diagnostic tool** that provides **situationally-relevant resources** depending on the factors contributing to a lagoon's issues:

- Walks users through Compliance/Technical Assistance, Technology Solutions, Financial Assistance, and Regulatory resources sequentially.
- Provides curated resources to inform users' next steps.
- Can be used by someone with strong or limited knowledge of a specific lagoon's technical status.
- Lagoon operators, technical assistance providers, and local decisionmakers may find this toolbox particularly useful when looking for technical resources related to lagoon operations and/or management.

Summary

- The First Stop Toolbox is a user-friendly diagnostic tool that provides situationally-relevant resources depending on the factors affecting a lagoon.
- Users can return to the FST periodically and change their question responses based on the type of support and/or resources that are needed at a given time.
- Toolbox will be updated as new materials are produced, or as older materials are revised or retired.
- There is an available recording from our October 2024 First Stop Toolbox webinar that provides a more detailed walkthrough of each Toolbox section: www.epa.gov/lagoons
- Contact EPA's Lagoon Team: https://www.epa.gov/small-and-rural-wastewater-systems/forms/contact-us-about-small-and-rural-wastewater-systems

Questions?

First Stop Toolbox – Homepage

Environmental Topics | Laws & Regulations | Report a Violation | About EPA

CONTACT US

First Stop Toolbox for Lagoons

The first stop toolbox is designed to provide permit compliance assistance to small community lagoon wastewater facility operators (or their managers such as mayors or local decision makers). It is designed for those experiencing compliance challenges for ammonia, nitrogen and/or phosphorus or those who otherwise wish to improve their facility operations. The toolbox will not collect and store user information and is not used for regulatory purposes.

This toolbox is intended to guide the user through a sequence of questions aimed at identifying the best resources for the user to return to compliance and/or address identified challenges.

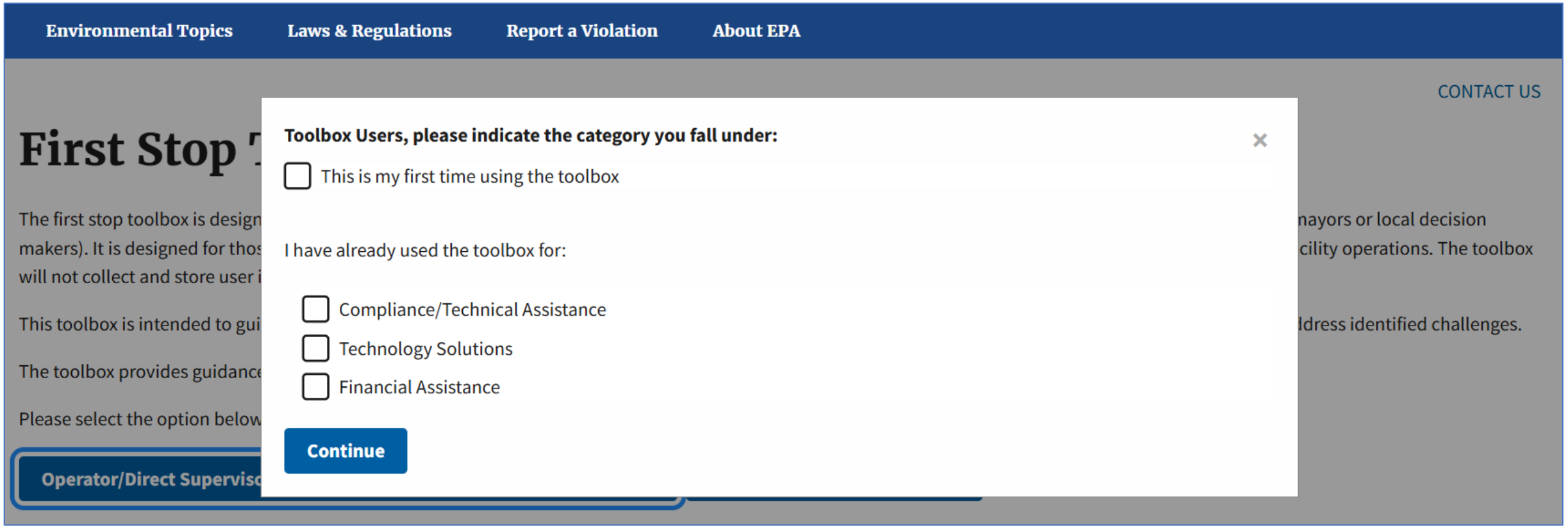
The toolbox provides guidance and resources on Compliance/Technical Assistance, Technology Solutions, Financial Assistance, and Regulatory Options.

Please select the option below that best describes your role.

Operator/Direct Supervisor or Local Decision Maker (Mayor/City Council) **Technical Assistance Provider**

EPA

First Stop Toolbox – Homepage



First Stop Toolbox – Sections

First Stop Toolbox – Questions

First Stop Toolbox for Lagoons

Compliance/Technical Assistance | Technology Solutions | Financial Assistance | Regulatory Options

The following questions can be used to identify if these contributors are affecting your system leading to non-compliance. (NOTE: sludge volume is discussed in Technology Solutions section.)

Process Control and Operations & Maintenance

Question	Yes	No	Unknown
Is all critical equipment associated with the lagoon system functional? For example, pumps, valves, aerators, baffle curtains, flow meters, etc.	○	◉	○
Was there an operational error of misunderstanding that led to non-compliance?	◉	○	○
Is there significant bank vegetation growth, algae, floating solids, waterfowl, leaking dikes, or excessive odors observed in and around the lagoon?	◉	○	○
Is there significant aquatic vegetation growth? For example, duckweed, cattails, etc.	○	◉	○

Inflow, Infiltration, and Short-Circuiting

Question	Yes	No	Unknown
Is there an increase in flow entering the lagoon during and directly after a rainstorm or spring snow melt?	○	◉	○
When observing the lagoon surface are there areas of stagnant water and accumulated solids or vegetation while other areas are clear?	○	◉	○

EPA

First Stop Toolbox – Jump Links

First Stop Toolbox for Lagoons

Compliance/Technical Assistance | Technology Solutions | Financial Assistance | Regulatory Options

Jump to:

Process Control and Operations & Maintenance | Inflow and Infiltration | Climate Change Resiliency | Hydraulic Short-Circuiting | Design Limitations | Ammonia Removal Optimization | Total Nitrogen Removal Optimization | Phosphorus Removal Optimization | Technical Assistance Provider List

Process Control and Operations & Maintenance

Question	Your answer
Is all critical equipment associated with the lagoon system functional? For example, pumps, valves, aerators, baffle curtains, etc.	*No*
Was there an operational error of misunderstanding that led to non-compliance?	*Yes*
Is there significant bank vegetation growth, algae, floating solids, waterfowl, leaking dikes, or excessive odors observed in and around the lagoon?	*Yes*
Is there significant aquatic vegetation growth? For example, duckweed, cattails, etc.	*No*

EPA

First Stop Toolbox – Generated Resources

Process Control and Operations & Maintenance

Question	Your answer
Is all critical equipment associated with the lagoon system functional? For example, pumps, valves, aerators, baffle curtains, etc.	*No*
Was there an operational error of misunderstanding that led to non-compliance?	*Yes*
Is there significant bank vegetation growth, algae, floating solids, waterfowl, leaking dikes, or excessive odors observed in and around the lagoon?	*Yes*
Is there significant aquatic vegetation growth? For example, duckweed, cattails, etc.	*No*

Reference Title	URL	Description
Top Resources		
Troubleshooting Manual for Small, Facultative, Partial-Mix Aerated, and Complete-Mix Aerated Wastewater Lagoons	https://www.epa.gov/system/files/documents/2024-02/lagoon-troubleshooting-manual.pdf	**EPA manual** assisting operators of small wastewater lagoon systems diagnose and troubleshoot the causes of a system's noncompliance, optimize system performance, and attain compliance with their National Pollutant Discharge Elimination System (NPDES) permit.
Wastewater Technology Fact Sheet: Facultative Lagoons	https://www3.epa.gov/npdes/pubs/faclagon.pdf	**EPA fact sheet** describing **facultative lagoons** and their performance, applications, advantages, and disadvantages.
Wastewater Technology Fact Sheet: Aerated, Partial Mix Lagoons	https://www3.epa.gov/npdes/pubs/apartlag.pdf	**EPA fact sheet** describing **aerated, partial mix lagoons** and their performance, applications, advantages, and disadvantages.
Wastewater Technology Fact Sheet: Anerobic Lagoons	https://www3.epa.gov/npdes/pubs/alagoons.pdf	**EPA fact sheet** describing **anaerobic lagoons** and their performance, applications, advantages, and disadvantages.

First Stop Toolbox – Next Steps

Question	Your answer
Are you aware of technical assistance providers available to help small community system owners and operators?	*Yes*

Reference Title	URL	Description
Troubleshooting Manual for Small, Facultative, Partial-Mix Aerated, and Complete-Mix Aerated Wastewater Lagoons	https://www.epa.gov/system/files/documents/2024-02/lagoon-troubleshooting-manual.pdf	**EPA manual** assisting operators of small wastewater lagoon systems diagnose and troubleshoot the causes of a system's noncompliance, optimize system performance, and attain compliance with their National Pollutant Discharge Elimination System (NPDES) permit.
Water Technical Assistance Request Form	https://www.epa.gov/water-infrastructure/forms/water-technical-assistance-request-form	Online EPA form to request **Water Technical Assistance (WaterTA)**.
Water Technical Assistance Fact Sheet: Ensuring Equitable Access to Water Infrastructure Funding	https://www.epa.gov/system/files/documents/2023-02/Water%20TA%20Fact%20Sheet_FINAL.pdf	**EPA fact sheet** summarizing several EPA water TA programs and resources available to local municipalities, tribes, communities, and entities eligible for **EPA water infrastructure funding programs**.

Back to top

Back to Questions | Print/Save to PDF | Go to Technology Solutions

If after reviewing the Compliance and Technical Assistance resources provided and adjusting your system based on recommendations from the references, you are still unable to meet permit limits, proceed to the Technology Solutions section.

Lagoon Troubleshooting Resources

Cornell D. Gayle, PE

Manual for Simple Lagoons

Troubleshooting Manual for Small, Facultative, Partial-Mix Aerated, and Complete-Mix Aerated Wastewater Lagoons

Source: Jessica Duggan, EPA Region 8.

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
EPA Document # 305B23001

EPA Troubleshooting Manual for Small, Facultative, Partial-Mix Aerated, and Complete-Mix Aerated Wastewater Lagoons

Manual Break Down

General

Manual / Change /Money

How to Troubleshoot

General Tips

Specific

Facultative

Partially Mixed Aerated

Complete Mix Aerated

- Facultative Lagoon – no mechanical parts
- Partially Mixed Aerated – a couple aerators to keep the smell down
- Compete Mix Aerated – strategically placed mixers and aerators

How it works

1. Describe the problem
2. Provide a simple solution

Table 2. Manual navigation.

Section 3: General Lagoon Troubleshooting Tips	Section 4: Facultative Lagoon Troubleshooting Tips	Section 5: Partial-Mix Aerated Lagoon Troubleshooting Tips	Section 6: Complete-Mix Aerated Lagoon Troubleshooting Tips
Short-Circuiting	Short-Circuiting	Short-Circuiting	Foaming
Sewage Sludge Accumulation	Organic Overload	Organic Overload	Algal Overgrowth
Hydraulic Overloading	Odors	Odors	Inadequate Nitrification for Facilities with Ammonia Permit Limits

Example

Table 2. Manual navigation.

	Section 3: General Lagoon Troubleshooting Tips	Section 4: Facultative Lagoon Troubleshooting Tips	Section 5: Partial-Mix Aerated Lagoon Troubleshooting Tips	Section 6: Complete-Mix Aerated Lagoon Troubleshooting Tips
A	Short-Circuiting	Short-Circuiting	Short-Circuiting	Foaming
B	Sewage Sludge Accumulation	Organic Overload	Organic Overload	Algal Overgrowth
C	Hydraulic Overloading	Odors	Odors	Inadequate Nitrification for Facilities with Ammonia Permit Limits

Hydraulic Overloading is in Section 3 General on row C.
So we go to section 3C.

Describe the Problem

3C. Hydraulic Overloading

Hydraulic overloading occurs when increased flow (e.g., from population growth) or I&I exceed lagoon design flow capacity. Hydraulic overloading shortens water retention time and degrades performance.

As depicted in Figure 2 below, inflow is water that enters a sewer system through a specific path, such as manhole covers, roof leaders, cellar drains, yard drains, area drains, drains from wet areas, cross-connections between storm sewers and sanitary sewers, catch basins, or cooling towers. Infiltration is water that can seep into the collection system through broken sewage pipes or faulty joints.

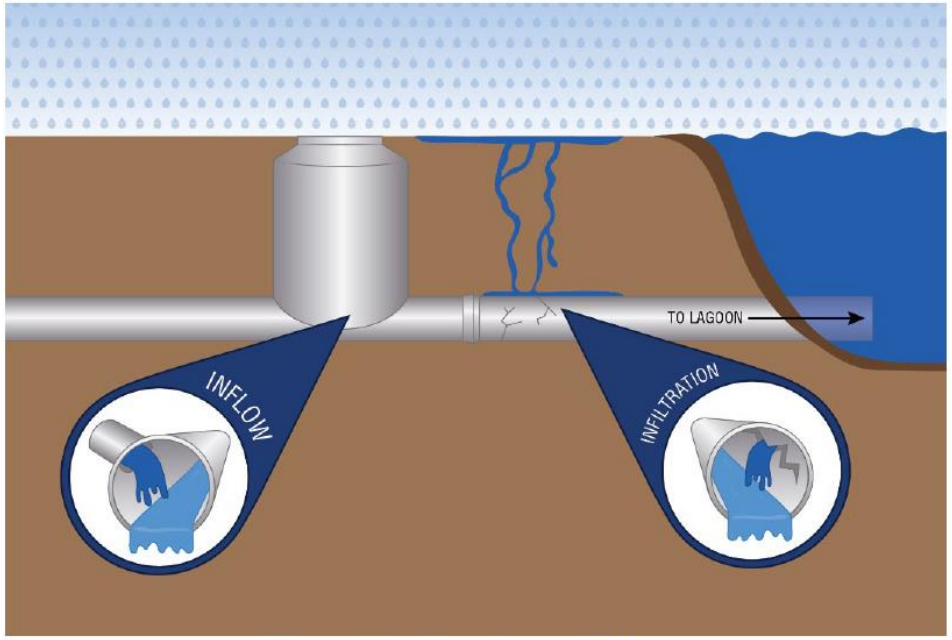


Figure 2. Infiltration and inflow.

Provide a Simple Solution

Potential Solutions

If resources allow, consider contacting a technical assistance provider or a professional engineer to perform an I&I study.

If I&I studies are not accessible, facilities may monitor for common indicators of an I&I problem such as significant spikes in inflow during a wet weather event, high groundwater conditions, or lift stations that run for a longer period after a rain event. Additionally, systems may consider utilizing a 2014 EPA Guide for Estimating Infiltration and Inflow for additional means of identifying I&I.

If inflow is discovered, cap or seal the open access points contributing to inflow. Repair manholes by grouting and/or repairing the frames and covers.

If sources of infiltration are discovered, consider repairing damaged pipes that are contributing to infiltration through trenchless rehabilitation or an open-cut replacement, as appropriate.

Note: Become familiar with the sewer use ordinance that gives municipalities legal standing to prohibit illegal sources of I&I.

If correcting I&I does not resolve the hydraulic overloading, consider constructing an additional lagoon cell. Resolving hydraulic overloading via construction may be necessary to meet effluent limits.

Compliance Tip Sheet

...cument # 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**.

...agoon WWTP Compliance: Quick Reference Guide

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

...Wastewater Lagoon Overview

Resources on Page 2

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)

Causes on Page 4

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

Trouble Shooting on Page 7

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**.
		➢ Unless duckweed is specifically introduced to create shade