# Asset Inventory Report Plan

# Wastewater Treatment Plant (WWTP) & Sewer System


Olive Hill

Carter County, Kentucky

2025

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**Disclaimer:**
This assessment and risk analysis were conducted to support operational planning and capital improvement efforts. While every effort was made to evaluate assets using available data and practical field knowledge, this document is not a substitute for a professional engineering evaluation. It is strongly recommended that a licensed engineer be consulted before initiating any major design, construction, or capital replacement activities.

## A. Non-Technical Summary:

The City of Olive Hill's Wastewater Treatment Plant (WWTP) and sewer system provide essential services to keep the community safe and clean by treating wastewater before it is released into Tygarts Creek. This report evaluates the condition of critical equipment, like pumps and treatment systems, to ensure they work reliably. Many parts of the system are old or deteriorating, which could lead to breakdowns or environmental issues if not addressed. Key findings include the need to repair or replace equipment like clarifiers and pumps, reducing excess water entering the sewer system during rain events, and planning for future upgrades. The City of Olive Hill (city) is committed to prioritizing these improvements to maintain quality service and comply with environmental regulations. Community support, including potential rate adjustments, may be needed to fund these efforts and sustain the wastewater system.

The City of Olive Hill owns and operates the WWTP and associated collection systems. The city's governing board is comprised of a mayor, Jerry Callihan, and six city council members. The Wastewater Supervisor, Josh Shutte, is responsible for the wastewater treatment plant and the collection system operation and maintenance. The wastewater supervisor reports to the mayor and city council. The Olive Hill wastewater personnel have historically managed the operations and maintenance responsibilities. Currently, the city has one full-time certified wastewater operator. The City's utility office bills for both water and wastewater. The city council and mayor must approve all financial decisions.

## B. Existing Wastewater Facilities

The city's WWTP, located at 230 Cross Street, in Olive Hill, Carter County, Kentucky, operates under the Kentucky Pollutant Discharge Elimination (KPDES) Permit # KY0025925, which became effective on November 1, 2023, and expires on October 31, 2028. The WWTP was last upgraded in 1994. The WWTP operates as a domestic wastewater plant from a publicly owned treatment works with a design capacity of 0.350 million gallons per day (MGD), consisting of; headworks (manual bar screen, grinder pump, and grit removal system) and treatment (Oxidation Ditch & Clarifiers). Peracetic Acid (PAA) is used as a disinfectant in the contact chamber before discharging to Tygarts Creek. Biosolids are digested, pressed, and dried before being disposed of in a landfill

| KPDES Permit Limits<br>Olive Hill WWTP<br>**KPDES # KY0025925** | | |
|---|---|---|
| Parameter | | Monthly Average Limits |
| Carbonaceous Biochemical Oxygen Demand ($CBOD^2$) | | 10 mg/l |
| *Total Suspended Solids (TSS)* | | 30 mg/l |
| Nitrogen, ammonia total (as N) | May 1- October 31 | 2.0 mg/l |
| | November 1- April 30 | 5.0 mg/l |
| Dissolved Oxygen (DO) | | 7.0 mg/l [1] |
| Escherichia Coli (E. Coli) | | 130 Col./100 ml |
| Total Residual Chlorine | | 0.011 mg/l |
| Total Nitrogen | | Report |
| *Total Phosphorous* | | Report |

[1] Daily Minimum

*Source:* KPDES Permit for Olive Hill

*Note on Violations: From 2020 to 2025, the WWTP received multiple Notices of Violation (NOVs), mainly due to exceedances in CBOD and E. Coli limits, often related to high flows during wet weather. These issues emphasize the need to address inflow and infiltration (I&I) and upgrade essential equipment.*

A review of census data revealed a decrease in Carter County's population by approximately 4.5% from 2013-2023, and a decrease in population for the City of Olive Hill by approximately 4.7% from 2013-2023. The Kentucky Data Center, University of Louisville, projects a significant decrease, approximately 14.7%, in the population of the county through 2040. Olive Hill WWTP serves the city, which includes a population of approximately 1,775. That equals around 771 service connections. Based on the projected population, and the generally accepted standard rate of 100 gallons per capita per day (gpcd), the hydraulic design capacity of 0.350 MGD of the plant is sufficient for the future population.

## C. Collection System Inventory and Assessment

According to the Kentucky Infrastructure Agency's Water Resource Information System (WRIS), Olive Hill has an approximately 20-mile sanitary sewer system. This system consists of roughly 18 miles (90%) of gravity sewers and 2 miles (10%) of force mains. About 8.8 miles of the sewer lines are made of clay pipes, which may lead to excessive inflow & infiltration (I&I). Additionally, the age of the sewer lines is a concern, with 70% of the collection system being over 50 years old, raising critical questions about its reliability and efficiency.

The WWTP is designed for a flow of 0.350 MGD and typically averages 0.275 MGD under normal conditions. However, during wet weather, flows can exceed 1.0 MGD, which suggests the potential for increased I&I issues. This situation underscores the importance of proactive measures to ensure the long-term sustainability and effectiveness of Olive Hill's sewage infrastructure.

## D. Critical Assets

Critical assets in a WWTP are essential for maintaining efficient operations and complying with regulatory standards. These typically include pumps, aeration systems, clarifiers, blowers, sludge handling equipment, and control systems. Failure of any critical asset can disrupt treatment processes, compromise effluent quality, and pose risks to public health and the environment.

Understanding which assets are most critical to the operation of the city's wastewater system is essential for prioritizing limited resources. Criticality in this context reflects the likelihood and consequence of asset failure, which helps the city focus maintenance, repair, and replacement efforts where they are most needed.

The following assessment was conducted by the Kentucky Rural Water Association (KRWA) in collaboration with the city as part of the initial development of their asset management plan. The goal is to provide a starting point for the city to identify and manage its most at-risk assets.

### *Raw Sewage Pumps*

One of the most critical components of the WWTP is the set of three influent pumps, located at the beginning of the treatment process. These pumps are vital to moving incoming wastewater into the system. Failure of these pumps would result in a significant sanitary system failure.

- Pump #1 and Pump #2: These pumps were installed simultaneously (installation date unknown) and have reached an advanced stage of deterioration. The pumps experience frequent breakdowns, and their performance has significantly diminished, impacting the plant's ability to process wastewater during peak flow conditions effectively.
    - Condition: Significant deterioration with frequent breakdowns.

    - Redundancy: The system is designed with 200% redundancy, meaning that if one pump fails, the others can maintain service. This redundancy helps mitigate the risk of a complete system failure.
    - Renewal Strategy: The city plans to replace both pumps with similar models and incorporate condition-based maintenance to extend their lifespan. Additionally, one pump will be rebuilt to serve as a backup.
- Pump #3: Installed in 2025, this pump is new and in excellent condition, meeting all performance targets.
    - Condition: Excellent and meeting all the performance targets.
    - Redundancy: This pump, when paired with the other two, ensures system redundancy and reliability.
    - Renewal Strategy: Continue regular maintenance to ensure optimal performance.

### *Headworks*

The headworks of the WWTP are responsible for the initial processing of raw wastewater, including screening out debris and removing grit before it enters the treatment system.

- Manual Barscreen: The manual barscreen is responsible for removing large debris from wastewater.
    - Condition: Excellent with no major issues and performs as expected.
    - Redundancy: There is no redundancy for this unit, which could pose a risk in the event of a failure. However, Redundancy for this asset is uncommon.
    - Renewal Strategy: Continue with current maintenance and ensure that it operates efficiently.
- Grinder Pump (Muffin Monster): This pump grinds large solids to facilitate easier handling during treatment.
    - Condition: Moderate deterioration, occasional performance deficiencies but functional.
    - Redundancy: There is no redundancy for this unit.
    - Renewal Strategy: The grinder pump will be repaired as needed and maintained through corrective maintenance to ensure it continues to meet operational needs.
- Grit Removal System: This system removes heavy solids and grit from the influent.
    - Condition: Beyond useful life, with broken components and no longer meets performance targets.
    - Redundancy: There is no redundancy for this unit.
    - Renewal Strategy: The grit removal system will continue to operate until it fails, after which it will be replaced.

### *Treatment System*

The treatment system at the WWTP plays a key role in removing pollutants from the wastewater before discharge. It includes the oxidation ditch, aerators, and clarifiers.

- Oxidation Ditch: This is a critical part of the biological treatment process, where aerobic microorganisms break down organic material in the wastewater.
    - Condition: Minor defects but no significant issues that compromise its function.
    - Redundancy: The oxidation ditch itself has no redundancy, but it is designed to handle typical flow rates.
    - Renewal Strategy: Continue with routine maintenance, as failure of this component could severely impact plant performance. A moderate failure risk is anticipated but not immediate.
- Aerators: Aerators are responsible for supplying oxygen to the microorganisms in the oxidation ditch, essential for biological treatment. The aerator plays a crucial role in the treatment process, and failure would severely affect wastewater treatment efficiency.
    - Aerator #1:
        - Condition: Beyond useful life, significant performance deficiencies.
        - Redundancy: 200% redundancy is in place with other aerators.
        - Renewal Strategy: Replace Aerator #1 with a new or upgraded model. Preventive maintenance will continue for the other aerators.
    - Aerator #2: Recently upgraded from a traditional to a floating aerator; however, the new unit has failed. The utility is currently reviewing warranty options for replacement.
        - Condition: beyond its useful life and failing to meet any performance targets
        - Redundancy: 200% redundancy is in place with other aerators.
        - Renewal Strategy: Fix or replace the Asset, then maintain through preventive maintenance and repair as needed.
    - Aerators #3 and #4: These aerators are showing moderate deterioration but still meet performance targets. Aerators #3 and #4 share a single motor.
        - Condition: Moderate deterioration but functional.
        - Redundancy: 200% redundancy if other aerators are in working order. However, the system is very vulnerable currently because 2 of the 4 aerators are down.
        - Renewal Strategy: Continue with preventive maintenance and repair, as necessary.
- Clarifiers: The clarifiers are designed to remove suspended solids from the treated water. Clarifier #1 is in relatively good condition, while Clarifier #2 is severely deteriorated.
    - Clarifier #1:
        - Condition: Good condition, occasional breakdowns.
        - Redundancy: This Unit has no redundancy at this time. However, when both clarifiers are working correctly, the system has 100% redundancy.
        - Renewal Strategy: Continue regular maintenance and corrective repairs, as necessary.
    - Clarifier #2: This clarifier has been out of service for some time. It poses a significant risk to operations.
        - Condition: Significant deterioration and having major performance deficiencies, out of service.

        - Redundancy: This unit has 100% redundancy when working correctly. However, because this Asset is out of service, the system is vulnerable to a sanitary system failure.
        - Renewal Strategy: A priority for rehabilitation and corrective maintenance to restore functionality.

### *Disinfection System*

The disinfection system is responsible for ensuring that effluent meets regulatory standards for pathogens before being discharged into Tygarts Creek.

- Peracetic Acid (PAA) System: PAA is used as a disinfectant, replacing chlorine. It is critical to ensure that the effluent is free from harmful bacteria and pathogens.
    - Condition: This asset is in excellent condition and meets all the performance targets, but regular inspections are required to ensure proper chemical dosing and flow-through.
    - Redundancy: No redundancy in place for the disinfection system.
    - Renewal Strategy: Regular inspections and maintenance to ensure the system meets treatment goals.

### *Biosolid Handling System*

Biosolid handling equipment is essential for processing and disposing of the solid waste that results from wastewater treatment. The system includes digesters, a belt press, and drying beds.

- Digesters #1 and #2: These digesters are responsible for breaking down the sludge produced during treatment.
    - Digester #1: Significant deterioration and breakdowns are common. It is still functional but has only 40% of its effective life remaining.
        - Condition: Significant deterioration, frequent breakdowns.
        - Redundancy: 100%
        - Renewal Strategy: Replace with similar assets, continuing with usage-based maintenance.
    - Digester #2: While still meeting performance targets, it shows moderate deterioration.
        - Condition: Moderate deterioration, frequent breakdowns.
        - Redundancy: 100%
        - Renewal Strategy: Similar replacement strategy to Digester #1.
- Belt Press: This helps dewater the biosolids.
        - Condition:
        - Redundancy:
        - Renewal Strategy:
    - Polymer Pump: A component of the belt press.

        - Condition: Significant deterioration and performance deficiencies, with frequent breakdowns
        - Redundancy: There is no redundancy for the component.
        - Renewal Strategy: Repair as needed, but replacement may become necessary soon.
    - Booster Pump: This is a component of the belt press. Used to increase water pressure for cleaning the belts.
        - Condition: The component is in excellent condition and meets all the performance targets. Only 20% of its useful life has been consumed.
        - Redundancy: None
        - Renewal Strategy: Replace the asset with a similar asset and conduct preventive maintenance.
    - Exit Conveyor: This is another component of the Belt Press. Responsible for transporting dewatered solids to the dumpster.
        - Condition: shows moderate deterioration and major performance deficiencies. It experiences frequent breakdowns throughout the year, with 80% of its effective life consumed.
        - Redundancy: none.
        - Renewal Strategy: Replace with a new or improved asset and perform preventive maintenance.
- Drying Beds:
        - Condition: moderate deterioration, minor performance deficiencies, but seldom breakdown.
        - Redundancy: 200% redundancy
        - Renewal Strategy: refurbish or rehabilitate the asset and perform preventative maintenance.

### *Outfall*

The outfall is the final point where treated effluent is discharged into Tygarts Creek, and it is essential to ensure it does not cause environmental harm.

- Condition: The outfall is in excellent condition with no significant performance issues.
- Redundancy: None, which is common.
- Renewal Strategy: Regular inspections are needed, especially due to flooding risks.

### *Lift Stations*

The city operates five lift stations that play a vital role in the wastewater collection system by pumping sewage from lower to higher elevations, especially where gravity flow is not feasible. These lift stations are essential for ensuring the efficient transport and treatment of wastewater and should be checked daily. However, not all lift stations carry the same level of criticality. In

this system, each lift station is equipped with two pumps, providing 100% redundancy to help ensure continuous operation.

- Eastwood Lift Station
    - Service area:
    - Consequence of Failure: Medium (manageable sanitary risk).
    - Condition: Minor defects and performance deficiencies; approximately 20% of effective life consumed. Experiences frequent breakdowns.
    - Redundancy: 100%
    - Backup Power: None
    - Renewal Strategy: Repair-focused due to low probability of failure.

- Fields Bridge Lift Station
    - Service Area:
    - Condition: Minor defects and performance deficiencies. Experiences frequent breakdowns.
    - Redundancy: 100%
    - Backup Power: None
    - Renewal Strategy: Repair-focused due to low probability of failure.

- Green Hill Lift Station (US60)
    - Service Area:
    - Condition: Minor defects and meets all performance targets. Experiences frequent breakdowns.
    - Redundancy: 100%
    - Backup Power: None
    - Renewal Strategy: Repair-focused due to low probability of failure.

- Cold Spring Lift Station
    - Service area:
    - Condition: Major performance deficiencies; 80% of effective life consumed and has Frequent breakdowns.
    - Redundancy: 100%
    - Backup Power: None
    - Renewal Strategy: Replacement is recommended due to the high probability of failure.
    - Operator Notes: It was mentioned that the pumps are too small, and this lift station has a hard time keeping up with the flow.

- Waterside Lift Station
    - Service Area:
    - Condition: Excellent physical condition and meets performance targets. This lift station periodically experiences breakdowns, but less than 20% of its effective life has been consumed.

- Redundancy: 100%.
- Backout Power: None
- Renewal Strategy: Repair-focused due to low probability of failure.

## E. Risk Summary

This asset inventory and condition assessment uses a risk-based approach to help the City prioritize maintenance, rehabilitation, and capital improvements. Each major asset in the wastewater treatment plant and collection system is assigned a risk score based on the Probability of Failure (POF), Consequence of Failure (COF), and the presence or absence of redundancy. This structured framework supports data-driven decisions by identifying which assets pose the greatest threats to service reliability, regulatory compliance, and environmental protection.

## F. Risk Classification

Assets are grouped into three priority categories based on their calculated Final Risk Score:

- **High Risk (Score ≥ 32):**
  Immediate attention recommended. These assets have a high likelihood of failure and/or would cause significant operational or environmental harm if they failed. Typically these are assets without redundancy or already showing signs of breakdown.
- **Medium Risk (Score 16–31):**
  Moderate priority. These assets are functional but may have moderate deterioration, increasing failure risk, or limited backup. Proactive monitoring, routine maintenance, and near-term planning for repair or replacement are advised.
- **Low Risk (Score < 16):**
  Low priority. These assets are in good condition, with low failure probability and minimal system impact. Continue preventive maintenance and regular inspections.

This prioritization allows the City to:

- Focus resources where failure risks are highest.
- Plan asset replacement before catastrophic breakdowns occur.
- Extend asset life through targeted maintenance.
- Minimize regulatory violations, emergency repairs, and service disruptions.

**Important Note:** Some non-functional or offline assets may show deceptively low risk scores due to their current inoperable status (i.e., no likelihood of failure because failure has already occurred). These cases must be adjusted using operational judgment and engineering expertise to avoid underestimating system vulnerabilities.

## G. Methodology

To calculate risk scores, each asset is evaluated using the following formula:

**Risk Score = (Probability of Failure × Consequence of Failure) × Redundancy Modifier**

Components of the Risk Score:

- Probability of Failure (POF):
  Represents the likelihood that the asset will fail in the near term. Factors include:
  - Age and expected useful life
  - Physical condition (deterioration, corrosion, etc.)
  - Performance issues (e.g., frequent breakdowns)
  - Historical maintenance or failure data
- Consequence of Failure (COF):
  Measures the potential impact of failure on:
  - Wastewater treatment operations
  - Regulatory compliance (e.g., KPDES permit limits)
  - Environmental impact (e.g., risk to Tygarts Creek)
  - Public health and safety
  - Financial or reputational consequences
- Redundancy Modifier:
  Adjusts the risk score based on available backups or system resilience:
  - Full redundancy (e.g., backup pump in service): reduces overall risk
  - No redundancy: increases risk significantly

Score Scale:

- Risk scores range from 1 (very low risk) to 90 (extremely high risk).
- This flexible scoring system allows side-by-side comparison of equipment condition and strategic value, guiding capital planning and grant applications.

Highest Risk Assets (Final Risk = 32 or higher)

Listed are the units that pose the most significant operational risks and should be prioritized for rehabilitation or replacement:

| High Risk Assets<br>Olive Hill WWTP | | | | |
|---|---|---|---|---|
| Asset | Risk Score | Primary Issue | Recommended Action | Notes |
| **Aerators #3 & 4** | 80 | High Consequence, High Probability of Failure. No redundancy. | Monitor Closely, Plan for Component replacement. | • Manages critical oxygenation; failure could disrupt treatment performance.<br>• Extremely high risk because the other aerators are out of service. |
| **Clarifier #1** | 45 | Aging, minor defects, no redundancy | Monitor closely; plan replacement | • Essential for solids separation<br>• Very High Risk because the other Clarifier is out of Service |
| **Grit Removal System** | 40 | Non-functional components, no redundancy | Replace or overhaul | • Grit bypasses can damage downstream pumps and processes. |
| **Aerator #1** | 40 | Beyond useful life, deficiencies | Replace | • The asset has been removed and is not in service, leaving the system vulnerable. |
| **Aerator #2 (Floating Aerator)** | 40 | Recently replaced but broken | Replace | • The floating aerator is already out of service, leaving the system vulnerable.<br>• Looking into Warranty options. |
| **Grinder Pump (Muffin Monster)** | 32 | Moderate deterioration, no redundancy | Overhaul and add redundancy | • Protects downstream equipment<br>• Clogs and jams could increase. |
| **Exit Conveyor** | 32 | Major deficiencies, frequent breakdowns, No Redundancy | Repair or replace | • Downtime causes a backlog in solids management and increases operator burden. |
| **Cold Springs Lift Station** | 32 | Frequent Breakdowns, undersize pumps, near end of life | Expand? Replace | • Undersized pumps cannot keep up with the flow, Risk of Sanitary Sewer Overflow (SSO) |

Medium Risk Assets (Final Risk = 20–39)

These are functioning but show signs of wear or increased failure risk:

| Medium Risk Assets<br>Olive Hill WWTP |
|---|

| Asset | Risk Score | Primary Issue | Notes |
|---|---|---|---|
| **Clarifier (2)** | *25* | Out of Service, Major deterioration | • Already failed but counted as medium due to risk model; critical for restoring redundancy to Clarifier #1. |
| **Oxidation Ditch** | *24* | Minor defects, Aging infrastructure | • Key biological process component<br>• Still functional but aging |
| **Booster Pump** | 20 | Component failure, No redundancy | • Part of belt press system<br>• Failure affects biosolid handling and cleaning capacity. |
| **Belt Press** | 20 | performance issues, No redundancy | • Vital for solids dewatering<br>• Downtime causes sludge buildup and increased operator effort. |
| **Raw Sewage Pump 1** | 20 | Moderate deterioration | • Performance diminished |
| **Raw Sewage Pump 2** | 20 | Moderate deterioration | • Performance diminished |
| **Digester #1** | 18 | Moderate deterioration, meeting all performance targets | • Functional, but shares load with degraded Digester #2<br>• Signs of wear are increasing. |
| **Digester #2** | 18 | Moderate deterioration, meeting all performance targets | • Functional, but shares load with degraded Digester #1<br>• Signs of wear are increasing. |
| **Polymer Pump (Belt Press)** | 18 | | • Essential for sludge thickening<br>• Failure adds risk to the belt press process. |
| **Fields Bridge Lift Station** | 18 | Frequent breakdowns, still functional | • No backup power.<br>• Moderate sanitary impact if failure occurs |

Low Risk Assets (Final Risk < 16)

- These assets are performing well with minimal issues.
- *Action:* Maintain preventive maintenance schedules; no urgent action required.

| Low Risk Assets<br>Olive Hill WWTP | | |
|---|---|---|
| Asset | Risk Score | Notes |
| PAA Contact Tank | *16* | Excellent condition with low failure probability; critical function but low risk overall. |
| RAS Valve Pit | 12 | Performs reliably with low risk; minimal consequence of failure. |
| Outfall (Stairs) | 14 | Structural asset with low failure probability and low system impact. |
| Drying Beds | 8 | Good condition, low consequence of failure, and adequate performance |
| Flow Meter | 4 | Reliable with a low likelihood of failure and low consequence. |
| Raw Sewage Pump #3 | 4 | Newly installed with full redundancy and excellent performance. |
| East Wood Lift Station | 10 | Frequent breakdowns and minor defects; 20% of the life used. While consequences are manageable and redundancy exists, the lack of backup power and recurring issues increase risk. |
| Waterside Lift Station | 14 | Good condition, low age consumption, and full redundancy. However, occasional breakdowns and no backup power elevate its risk slightly above “low.” |
| US 60/Green Hill Lift Station | 12 | Very few service connections and low consequences of failure. Even with breakdowns, it performs well with full redundancy. |

## H. Observations

The city’s WWTP and collection system face challenges from aging infrastructure, limited redundancies, and high flows during wet weather due to I/I. Key issues include:

- Critical Asset Vulnerabilities: Non-operational assets (e.g., Clarifier #2, Aerators #1 and #2) reduce system reliability, particularly for aeration and solids separation.

- Headworks Issues: The non-functional grit removal system risks damage to downstream equipment.
- Biosolids Handling: Deteriorating digesters and belt press require ongoing maintenance to avoid disruptions.
- Collection System: Aging clay pipes (70% over 50 years old) contribute to I&I, causing flows to significantly exceed the WWTP's 0.350 MGD design capacity during wet weather.

## I. Recommended Actions

- Rehabilitate Clarifier #2 to restore redundancy and reduce risk to Clarifier #1.
- Replace aerator #1, rehabilitate or refurbish aerators #3 and #4 to ensure adequate oxygenation. Pursue warranty replacement for aerator #2.
- Overhaul the grit removal system to protect downstream equipment.
- Conduct an I&I study to identify and repair leaking sewer lines, targeting a 20% flow reduction during wet weather.
- Complete a rate study to ensure revenues cover operational costs and capital upgrades, exploring grants or low interest loans.
- Replace Cold Springs Lift Station pumps with higher-capacity models following a flow study.
- Install backup generators at critical lift stations (e.g., Waterside, Cold Springs) to mitigate power outage risks.

## J. Current Finances

The City can set rates and fees needed to fund the operation of the wastewater system. According to the City, the last rate increase occurred on January 1, 2025.

## K. Future Updates

The asset inventory should be updated annually to reflect completed repairs, new condition assessments, and emerging priorities.