Kentucky Wastewater Treatment Plant Optimization

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April 2025

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BACKGROUND

- Kentucky joined the Hypoxia Task Force in 2012
- Found out about the Tennessee optimization program in 2014 during a R4 Water Directors meeting
- Tennessee invited us to participate in their program and we started a pilot in 2015
- 3 years of pilot with 3 facilities each year.
- Audit performed by EPA R4 and Dr. Larry Moore, under an EPA contract

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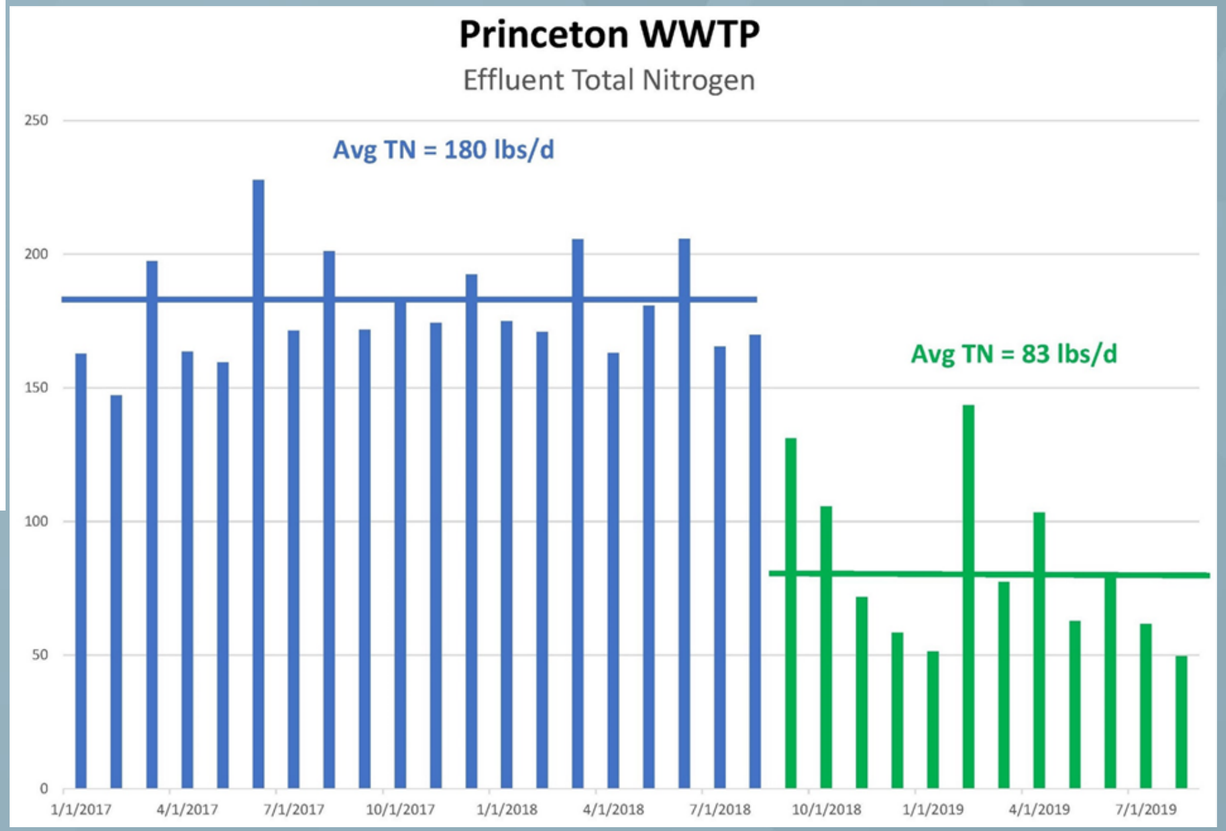
SUCCESS STORIES

Case Study: Princeton, KY

2015, the Kentucky Energy and Environment Cabinet (EEC) and EPA Region IV assembled a team of universities, sociations, and government agencies to conduct nutrient and energy efficiency assessments for wastewater eatment plants (WWTP). EPA Region IV program funding provided these assessments at no cost to participating cilities. Each year from 2016 to 2018, three new facilities participat- l in the Program, receiving free nutrient and energy assessments ong with recommendations on optimizing nutrient treatment. In 17, the Princeton WWTP took part in the pilot program, using an cel-based tool called Bio-Tiger to identify optimization opportuni- s.

Princeton Wastewater Treatment Plant

Princeton's 1.57 MGD facility, the Bio-Tiger model showed there as potential to improve denitrification. Instead of continual erations, the facility shut off all rotors in the three oxidation tches for 8 hours/night and ran one of two 40-HP rotors in each tch during the remainder of the day. Effluent total nitrogen creased ~56%, while effluent total phosphorus decreased by ~9% thout using additional chemicals. Electricity usage also decreased



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SUCCESS STORIES

KENTUCKY OPERATORS TAKE THE LEAD IN REDUCING NUTRIENTS

Model results provide a framework for better performance

When the Kentucky Division of Compliance Assistance said the EPA wanted to help the Lawrenceburg Sewage Treatment Plant (STP) reduce nutrient pollution while saving energy, Superintendent Mitch Hudson was a little skeptical. "We had already had two energy audits, mainly looking at equipment upgrades. Most of those recommendations were either impossible from an operational standpoint or came with a 20-year payback. We maybe had low expectations, but we decided to give it a fair shake."

In 2017, Hudson and the chief operator, Jason Ransdell, participated in a pilot partnership targeting low- or no-cost operational changes to improve nutrient removal and save energy.

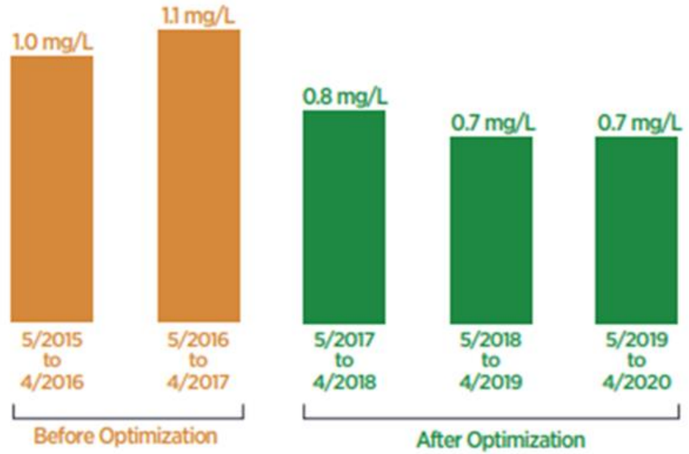
Hudson and Ransdell worked with the project team to model Lawrenceburg's 3.3 MGD Orbal ditch process with a free tool called Bio-Tiger, developed by Dr. Larry Moore at the University of Memphis. The Bio-Tiger model uses readily available treatment parameters and equipment information to develop a steady-state model and estimate potential energy savings. The model showed that aerators in the ditch supplied about 20% excess oxygen and inhibited denitrification. Hudson and Ransdell experimented with idling one 75-horsepower and two 25-horsepower aerators up to

aerators remain mostly turned off, even with a 25% increase in BOD loading. This saved about $25,000/year. Lawrenceburg also discharges 39% less phosphorus and alum demand dropped with the new protocol, saving Lawrenceburg $4,500/year.

Lawrenceburg STP

Parameter	Before Optimization	August 2018–July 2019
Effluent TN (mg/L)	11	4
Effluent NH_3 (mg/L)	0.2	0.4
Effluent TP (mg/L)	1.1	0.67

Changes in average effluent total phosphorus at the Lawrenceburg POTW after optimizations



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SUCCESS STORIES

The Improvements Just Keep Coming at the Glasgow Wastewater Treatment Plant

Equipment, process and efficiency improvements are a way of life at the award-winning Glasgow (Kentucky) Wastewater Treatment Plant.

Appeared in print as *"It Just Keeps Getting Better"*

By **Jim Force**

February 2019

Cover Story

Adam Headrick (left) and Tyler Bragg, Class IV operators, look with pride upon the final product.

The improvements just keep coming at the Glasgow (Kentucky) Wastewater Treatment Plant.

Built in 1962 as a trickling filter plant with upflow sand filters and anaerobic digesters, the plant was upgraded four times, most recently in 2014. Today, it operates as a 4.0 mgd SCADA-controlled extended aeration facility with new headworks, circular clarifiers, biosolids press and peracetic acid instead of chlorine for disinfection.

The improvements haven't gone unnoticed. For outstanding performance, Glasgow won the 2017 Kentucky Water & Wastewater Operators Association Plant of the Year award. Last year, the Glasgow Water Co. received the Kentucky Excellence in Energy Leadership Award sponsored by the Kentucky

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PERMITTING

- Kentucky has a narrative nutrient criteria (401 KAR 10:031 Section 1)
- Most major POTWs (designed flows >1 MGD) have had monitoring requirements, but not nutrient limits
- All majors will have nutrient optimization language if they don’t already have limits
- A reasonable potential analysis may impose nutrient requirements
- Permits for new or expanded discharges may impose phosphorous limits

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OPTIMIZATION IN NEW PERMITS

- 5-year permit cycle
- When applying for next permit, must complete Nutrient Reduction Evaluation Form
- Nutrient Optimization Audit provides info for the Evaluation Form
- Can be done by DOW staff or by facility engineers, but they must review their processes
- Encouraging facility to get audit done early because recommendations can save money
- DOW staff available to do nutrient optimization visits on any major facility, not just permit required

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NUTRIENT REDUCTION EVALUATION FORM

NUTRIENT REDUCTION EVALUATION FORM

Kentucky Pollutant Discharge Elimination System

Division of Water

Facility Name:		Permit Number:	

(Read accompanying instructions carefully before completing this form)
This form was created to assist facilities in performing a nutrient reduction evaluation.

REQUIRED FORM INPUT: (Sections I, II, and III)

Section I. Treatment Information

Type of Treatment:	Activated Sludge-Oxidation Ditch ☐ Activated Sludge-Sequential Batch Reactor ☐ Activated Sludge-Other ☐	Lagoon System ☐ Other ☐_____

Section II. Average Monthly Concentration of Total Phosphorus and Total Nitrogen

Include monthly data for the most recent five calendar years.

Month	Year	Average Monthly Effluent Flow (MGD)	Average Monthly Concentration of Total Phosphorus		Average Monthly Concentration of Total Nitrogen	
			Influent (mg/l)	Final Effluent (mg/l)	Influent (mg/l)	Final Effluent (mg/l)

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NUTRIENT REDUCTION EVALUATION FORM

REQUIRED FORM OUTPUT: (Sections IV and V)			
Section IV. Identification of potential measures to reduce nutrient effluent discharge. Identify potential measures (separated into: Source Reduction Measures, Operational Improvement Measures, Unit Process Configuration Improvement Measures and Additional Treatment Measures) to achieve the target effluent discharge values for TP and TN. The target TP value is ≤ 1.0 mg/l avg. monthly concentration. The target TN value is ≤ 10 mg/l avg. monthly concentration. In addition, identify the associated estimated capital and annual operating and maintenance costs and reasoning for the annual cost (electric cost, time, chemical cost, etc.)			
Source Reduction Measures:			
Identify Measure:	**Capital Cost:**	**Annual O&M Cost:**	**Reasoning:**
Operational Improvement Measures:			
Identify Measure:	**Capital Cost:**	**Annual O&M C**	

Section V. Identification of selected measures to reduce nutrient effluent discharge.

From the potential measures identified in Section IV, identify the measure(s) selected by the permittee to achieve the target nutrient effluent discharge values.

If the targets cannot be met:

- Identify any difficulties or problems believed to interfere with the facility's ability to achieve the target nutrient effluent discharge values, and
- Identify the measures that can be taken and the target nutrient effluent discharge value for these measures.

For each measure selected identify the estimated timeframe necessary to fully implement the measure.

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ENERGY OPTIMIZATION

- Contract with Kentucky Rural Water to conduct energy audits for major facilities
  - Under 10k population served in their regular NRWF grant
  - Over 10k population served with the DOW contract
- Outreach to facilities about reading their utility bill

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Cape Girardeau
Clarksville
Kingsport
Bristol
Portsmouth
Chillicothe
Athens
Hoosier National Forest
Patoka River National Wildlife Refuge
Shawnee National Forest
Hollow Lake

BY THE NUMBERS

- About 100 major facilities
- Have talked directly to 22 facilities
  - 16 have permit requirement
- 7 audits completed
- 9 audits scheduled
- 6 declined or deferred

ABOUT

17 %

Participating in the first 6 months!

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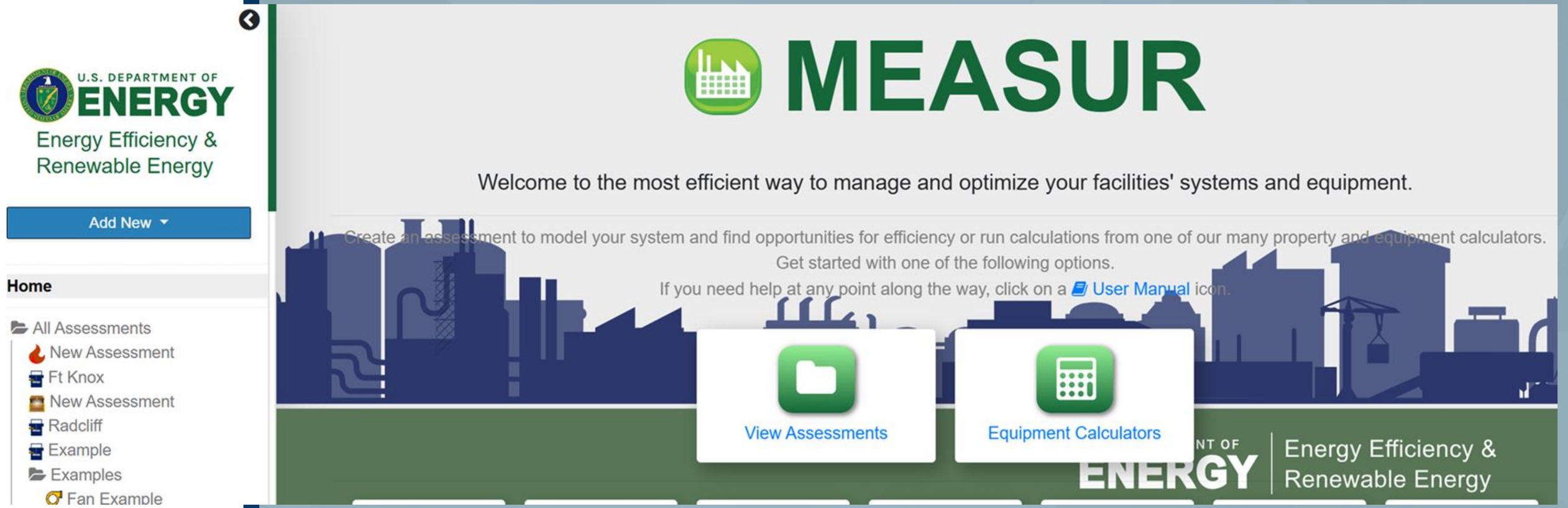
TOOLS



https://measur.ornl.gov/landing-screen

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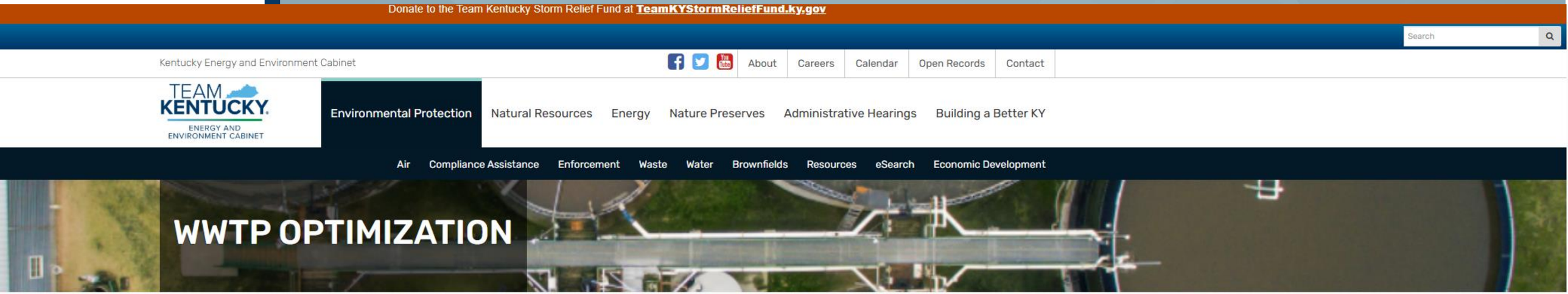
DIVISION OF WATER WEBPAGE



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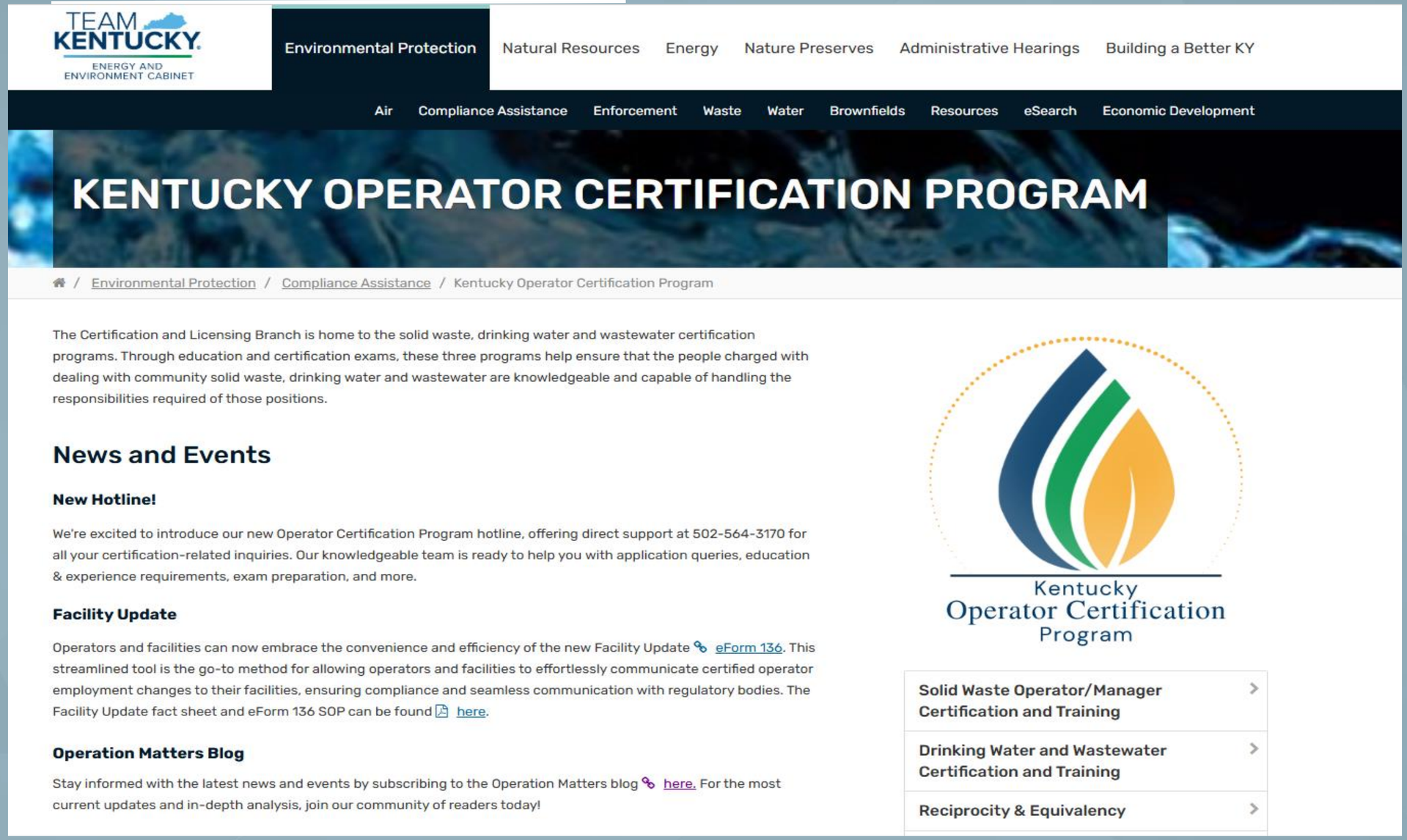
https://eec.ky.gov/Environmental-Protection/Water/Protection/Pages/WWTPOptimization.aspx#:~:text=Optimization%20is%20one%20way%20that,of%20Mexico%20Hypoxia%20Task%20Force.

OPERATOR CERTIFICATION PROGRAM



https://eec.ky.gov/Environmental-Protection/Compliance-Assistance/operator-certification-program/Pages/default.aspx

UPCOMING TRAININGS

Nutrient Reduction and Optimization Training

ON MARCH 20, 2025 / BY KYDEP / IN NEWS & EVENTS

Date: April 3, 2025
Location: Lake Cumberland State Resort Park

Date: April 30, 2025
Location: DEP Training Center, Frankfort

Date: May 29, 2025
Location: KY Dam Village State Resort Park

The Kentucky Operator Certification Program and Division of Water invites you to participate in a one-day Nutrient Reduction and Optimization Training, an essential course for wastewater operators of major facilities. This training will provide valuable insights into Kentucky's Nutrient Reduction Strategy, which outlines ongoing and future efforts to reduce nitrogen and phosphorus levels in Kentucky waters that contribute to the production of Gulf hypoxia.

Course Fee: $30

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KY OPERATOR CERTIFICATION PROGRAM

Kentucky Operator Certification Program
eec.ky.gov/ocp

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QUESTIONS

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