Wastewater Treatment For Schools

What Do I Need to Know?

Why You Need A Basic Understanding Of Wastewater

WLOS

A News 13 investigation uncovered four local schools with thousands in fines, dumping more treated wastewater into the creek than they should.

More than a dozen mountain schools are in the wastewater treatment business.

Source: lohttps://wlos.com/news/local/news-13-investigates-schools-in-the-waste-water-treatment-businesss.com

Good Wastewater Decisions Are Critical Because…

1. Wastewater may be one of the largest capital costs when developing a new school
2. Wastewater service is critical for public health
3. Wastewater could become the biggest liability for a school if not managed properly
   - Operation and maintenance cost
   - Regulatory cost
   - Replacement cost
4. Wastewater is critically important when evaluating school sites
   - Land area
   - Disposal
   - Connection to existing sewer
5. The School Board may end up owning and operating an onsite wastewater system

Options for Managing Wastewater

1. Public sewer available
   - Connect by gravity
   - Connect with a lift station
   - Possibly pay for offsite improvements
   - Pay connection or impact fees
2. Public sewer not available
   - Provide an onsite wastewater collection and treatment system
   - Operate and maintain a wastewater system

Estimating Wastewater Flow

- Water usage (existing or historical use from other similar schools)
  - Subtract consumptive uses like irrigation
- Theoretical
  - With a cafeteria and gym showers – 15 to 30 gpd per student
  - With a cafeteria only – 10 to 20 gpd per student
- Local requirements
  - Local health departments or utilities may have their own design guidelines

Connecting to Existing Gravity Sewer

- Easiest option
- Confirm depth of existing sewer and make sure that there is adequate grade to accommodate farthest reach of school plumbing
- Pay applicable connection fees to the utility (if required)
- School may be responsible for O&M of pipes on school property
- School billed monthly based on water usage so you may want to consider separate meters for non-potable water use

Tip #1 – Connect to existing gravity sewer whenever you can.

Connecting With a Lift Station

- Lift station can be private or could be conveyed to the utility for ownership and maintenance
    - A lift station can cost $100,000 to $300,000 to construct and can be $5,000 to $15,000 annually to maintain
- Must be secured
- Odor control is important, especially during periods of low flow

Tip #2 – If you need to build a lift station, try to get the Utility to take ownership. This may require meeting their standards and oversizing the station for the use of non-school connections

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Planning For A Connection Fee

- A connection fee is the cost for your capacity in the existing wastewater collection system and treatment plant.
- Typical Calculation
  1. Determine your wastewater volume
  2. Determine the utilities definition of an EDU or ERC. This is typically in the range of 200 gpd.
  3. Divide the wastewater volume for the school by the flow rate for an EDU to determine the number of EDU's the school will represent

     Example: 250 students x 30 gpd per student = 7500 gpd

     7500 gpd ÷ 200 gpd/EDU = 37.5 EDU's
  4. Determine the connection fee per EDU. Connection fees can range from $500 to $20,000.

Tip #3 – If connection fee is < $5,000/EDU you are probably way ahead paying a connection fee versus an onsite solution

I Need an Onsite Wastewater Solution.

Now What?

1. Hire a soil scientist and an engineer to evaluate the property. You need to know:
   a) Options for disposal/reuse
   b) Treatment requirements (may be determined by disposal options)
   c) Area requirements (typically wastewater treatment and disposal are in secured areas)
   d) Permitting agency. Could be health department or it could require an NPDES permit from the State.
2. Planning surface discharge or reuse? Make sure you understand the additional treatment requirements and associated cost.

Tip #4 – Hire soil scientists that know the area and hire engineers with a successful track history doing schools

Wastewater Basics

- Flow is typically measured in average gallons per day (gpd)
- Treatment plants need to be able to handle…
  - the maximum gpd
  - the peak hydraulic flow in gallons per minute (gpm)
- Organic strength of wastewater is typically measured by Biological Oxygen Demand (BOD5)
  - Measurement of the oxygen required to remove the organics
- The amount of particle matter in wastewater is measured as total dissolved solids (TSS)
- Nutrients of concern are typically phosphorous (TP) and nitrogen (Measured as TKN or ammonia before treatment and measured as TN, nitrate, TIN or ammonia after treatment)

Wastewater Treatment 101

1. Screening and/or pre-treatment
   - Large settling tanks (4xdaily flow)
   - Screens for inorganic material (good to avoid if possible)
2. Aeration
   - Reduce organics (BOD5 Limits)
   - Converts ammonia to nitrate (ammonia limits)
   - Puts solids in suspension
3. Settling tanks/clarifiers
   - Settles out solids & collects them for disposal (TSS Limits)
4. Denitrification tanks – Converts nitrate to nitrogen gas (TN, TIN or Nitrate Limits
5. Disinfection – Chlorine or UV light
6. Odor Control

Why Is School Wastewater Challenging?

- Schools are generally 5 days per week, 8 hours per day
- Schools shut down for long periods of time (summer and Christmas)
  – Almost no flow
- Special events can cause high peak hourly flow or max day flows (think football game)
- Wastewater generated by a school is typically highly variable BOD and is high in TKN
- School boards are not in the wastewater business
- Large capital cost ($500 to $1500 per student)
- Plants out of compliance cost school $$$

Why Is School Wastewater Challenging?

- Low wastewater flow can equate to high odor
- Large capital cost, especially for higher treatment limits
- Ongoing maintenance cost > sewer bill
- Security
- Esthetics
- Odor
- Space
- Cleaning Chemicals will kill wastewater treatment plants and/or contribute nutrients

Why is BOD5 Variable?

- Highly influenced by type of food preparation
  - Full food preparation will elevate BOD_5
  - No food preparation will lower BOD_5
- Less solids & more water
- Low to no flow on weekends and holidays

Why is This Important?

- BOD5 is food for the micro-organisms in wastewater treatment. No food and the process struggles.
- Too much food and the plant can be overloaded
- Variable BOD_5 requires constant adjustments and operator oversight
- May be necessary to add supplemented BOD_5 at times of low flow (expensive)

Ammonia

- The predominant portion of TKN
- Typical residential wastewater 50mg/L to 70mg/L typical
- School wastewater 150 mg/L to 170 mg/L typical

Why is This Important?

- Ammonia, TIN, nitrate and TN permit limits are becoming more common as effluent limits
- Ammonia can be difficult to manage when BOD5 is very low and/or variable
- Ammonia limits are generally the most common permit violation for a school
- Ammonia removal can require chemical addition for carbon and alkalinity (can be a large added cost)

Tip #4 – If the system is likely to have an ammonia limit, be very careful regarding technology selections

Key Considerations

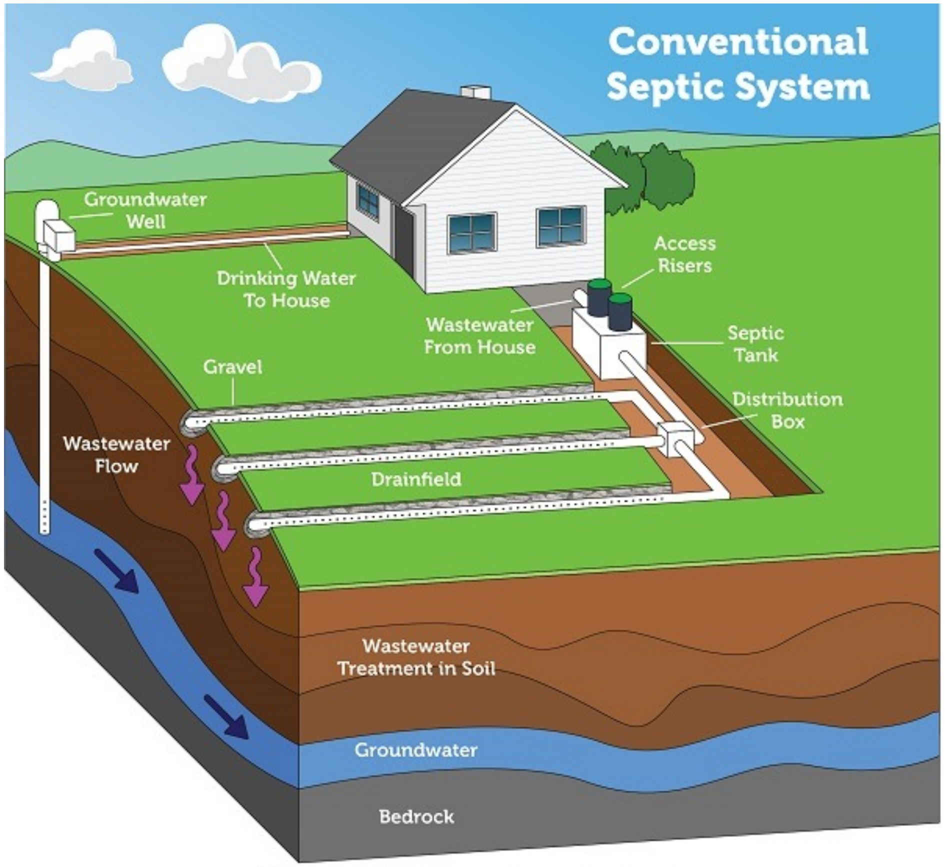
- Treatment reliability
    - Specifically with schools
- Energy consumption
    - Blowers to produce air require a lot of energy
- Sludge production
    - How much and how often does sludge need to be deposed of
- Land area requirement

Key Considerations

- Expected useful life
- Cold weather performance
  - Cold temperature inhibits wastewater treatment, especially for ammonia removal. Low flow results in colder liquid temperature.
- Maintenance requirements
- Operator requirements

The Simplest of Treatment – Conventional Septic

- Septic tank provides
  - 30% to 50% BOD_5 removal
  - 60% to 80% TSS removal
- Very low soil loading rate, depending on the soil
  - Can result in a very large drainfield
- Relatively low O&M cost
- Does not meet standards for many current regulations



Please note: Septic systems vary. Diagram is not to scale.

Other Options

- Lagoons
- Recirculating Trickling Filters
- Aerobic Treatment Units ATU's
- Activated Sludge Treatment Plants
- Natural Vegetative Systems and Constructed Wetlands
- Recirculating Peat Filters

Other Options

- Recirculating Textile Filters
- Trickling Filters
- Sequencing Batch Reactors SPR)
- Membrane Biological Reactor (MBR)
- Moving Bed Biological Reactor (MBBR)
- And Others

Treatment Type	Treatment Performance Reliability	Energy Consumption	Sludge Production	Land Area Needed	Expected Useful Life	Cold Weather Performance	Maintenance Requirements
Intermittent Sand Filter	Excellent	Good	Excellent	Poor	Good	Good	Excellent
Peat Filter	Excellent	Good	Excellent	Marginal	Poor	Excellent	Good
Recirculating Sand Filter	Good	Satisfactory	Excellent	Satisfactory	Good	Marginal	Excellent
Recirculating Textile Filter	Good	Satisfactory	Good	Good	Excellent	Satisfactory	Excellent
Trickling Filter	Satisfactory	Satisfactory	Good	Excellent	Excellent	Satisfactory	Good
Rotating Biological Filter	Satisfactory	Good	Good	Excellent	Satisfactory	Satisfactory	Marginal
Wetland – Rock Reed Filter)	Excellent	Excellent	Excellent	Poor	Marginal	Poor	Satisfactory
Activated Sludge/Submerged fixed film	Marginal	Poor	Poor	Excellent	Marginal	Satisfactory	Poor
Aerated tank	Poor	Poor	Poor	Excellent	Marginal	Satisfactory	Marginal
SBR	Satisfactory	Good	Poor	Excellent	Marginal	Satisfactory	Poor

Most Common: Activated Sludge/Submerged fixed film, Aerated tank, SBR

Poor | Marginal | Satisfactory | Good | Excellent

Source: Planning & Installing Sustainable Onsite Systems

Disposal/Reuse

1. Subsurface drainfields
2. Subsurface drip irrigation
3. Surface discharge
4. Reuse

Tip #5 – The level of treatment will generally be higher for a surface discharge than a subsurface discharge. Reuse will require the highest level of treatment.

Selecting a Wastewater Treatment Process

- O&M Requirements
  - Blowers and liquid aeration typically require more energy, more operator oversite, more adjustments, and produce more sludge
- Capital Cost
  - Aerated systems are typically lower capital cost than systems that use some type of media
- Recirculating media systems tend to be more stable and require the lowest O&M
- Footprint is largely defined by disposal
- Visit existing systems, make sure they have been around for more then 5 years

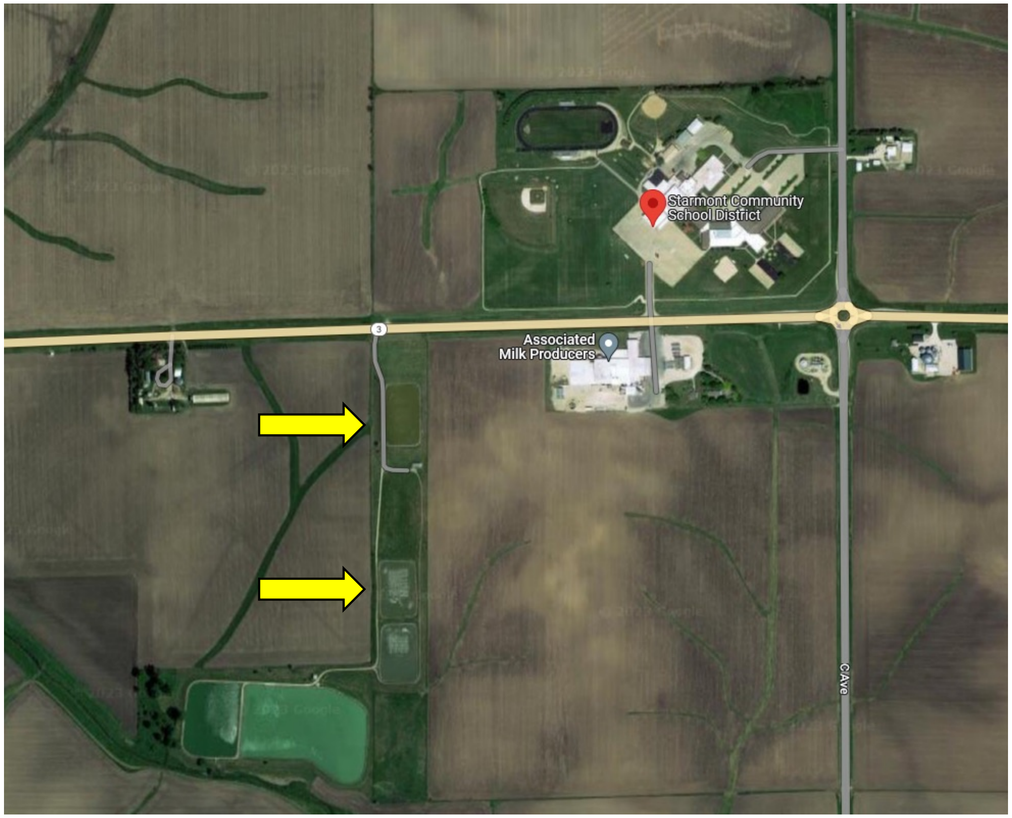
Starmont Community School District
Arlington, IA

604 students

Source: https://www.snyder-associates.com/projects/starmont-high-schools-wastewater-dilemma-requires-speedy-solution

Starmont Community School District
Arlington, IA

- Lagoons require a lot of space
- Low O&M cost
- Aesthetics aren't great
- Not real conducive to an onsite solution unless you have a lot of land



Cane Creek Middle School
Fletcher, NC

12,000 gpd

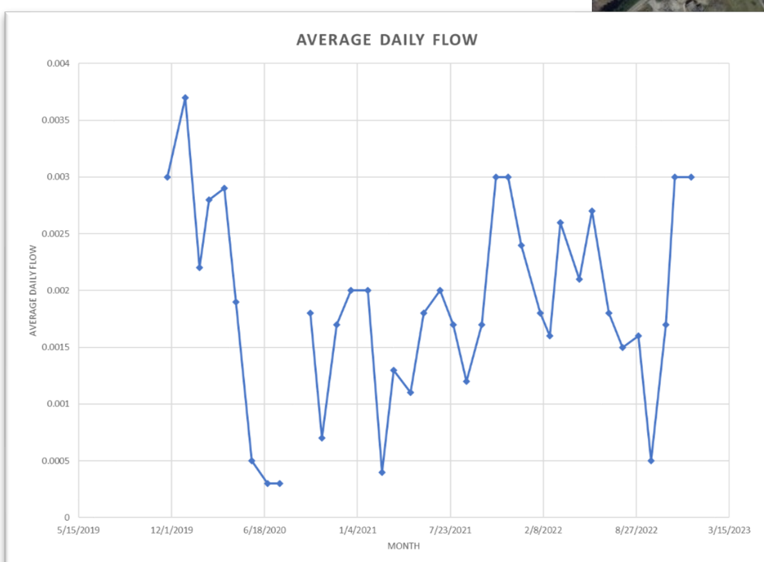
277 students

- Headworks
- Open aerated tank
- Clarifier

Cane Creek Middle School

Fletcher, NC

- Open tanks are esthetically challenging and will be an odor concern
- Hard to manage with variable flow



Orenco Systems

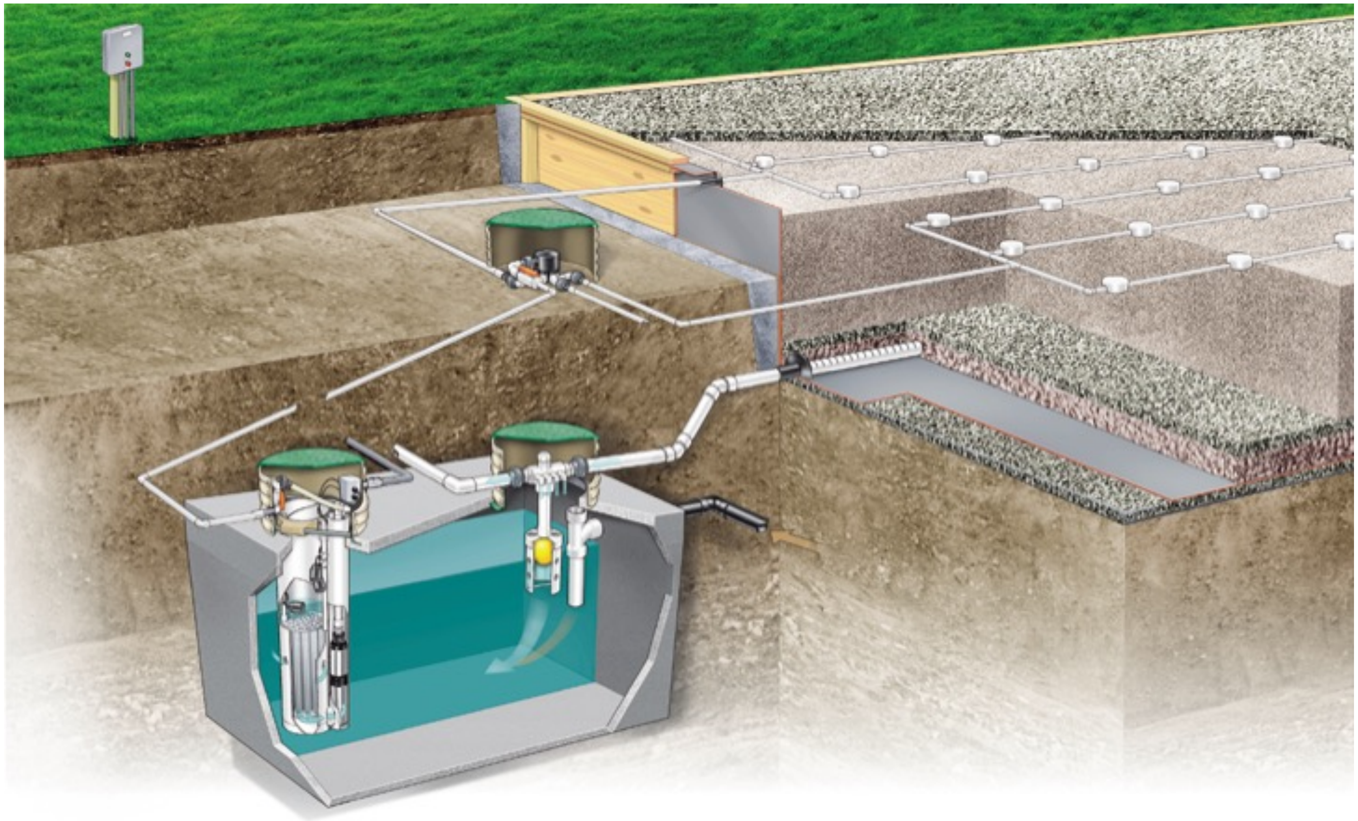
Aerated Systems & Low Flow

- System starves and loses biology during low flow
  - Plant can go out for compliance
  - Can take weeks to recover
  - Can require expensive supplemental BOD (methanol or MicroC)
  - Cheap BOD (dog food) can cause other problems due to oil, grease and fillers

Bandy's High School

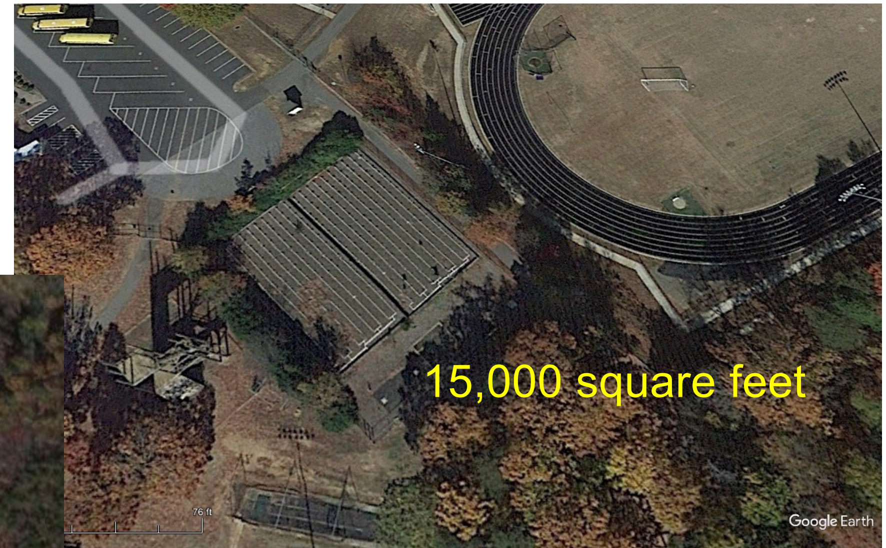
Catawba, NC

797 Students



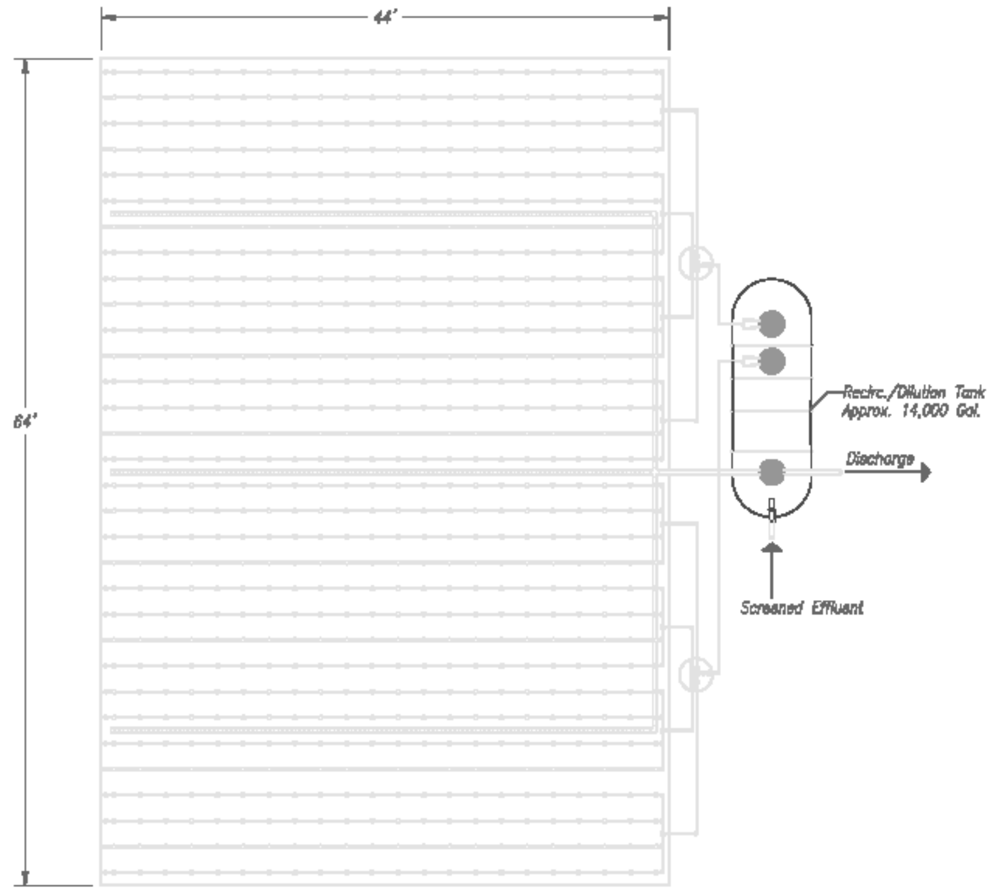
Bandy's High School

Catawba, NC



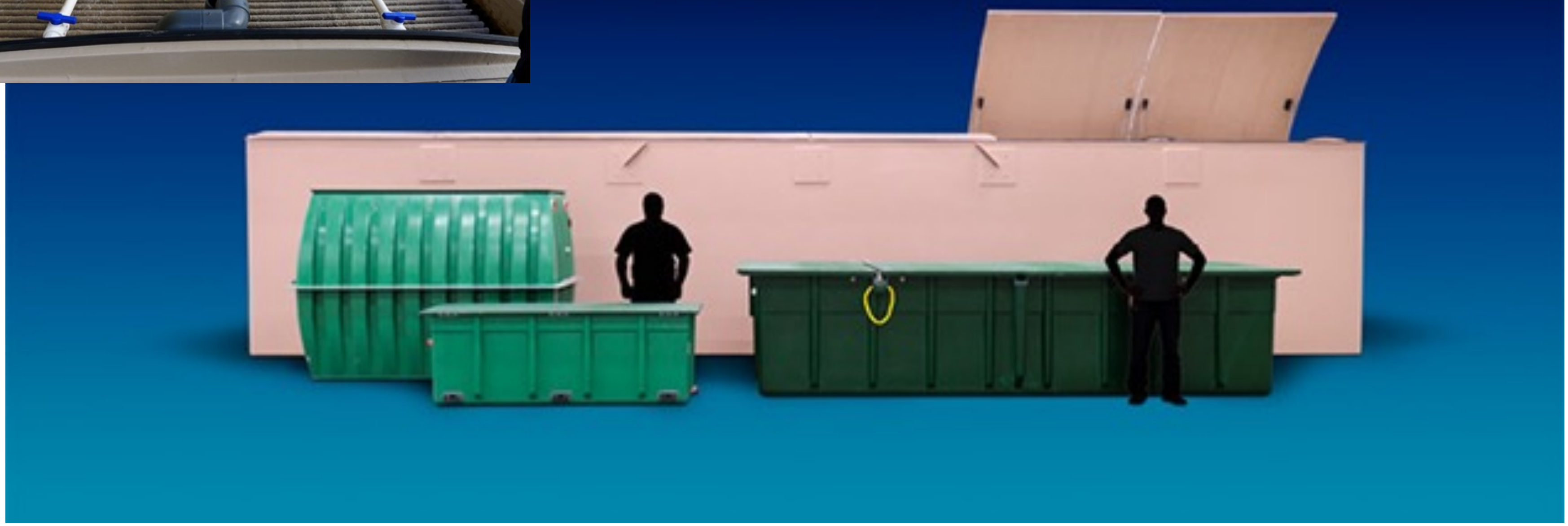
Recirculating Sand Filters

- Simple to operate
- Low energy use
- Outstanding performance
- Large surface area (2.5 gallons per square foot typical)
- Sands may not be available
- Expertise to design & build may not be available



Textile Packed Bed Filters

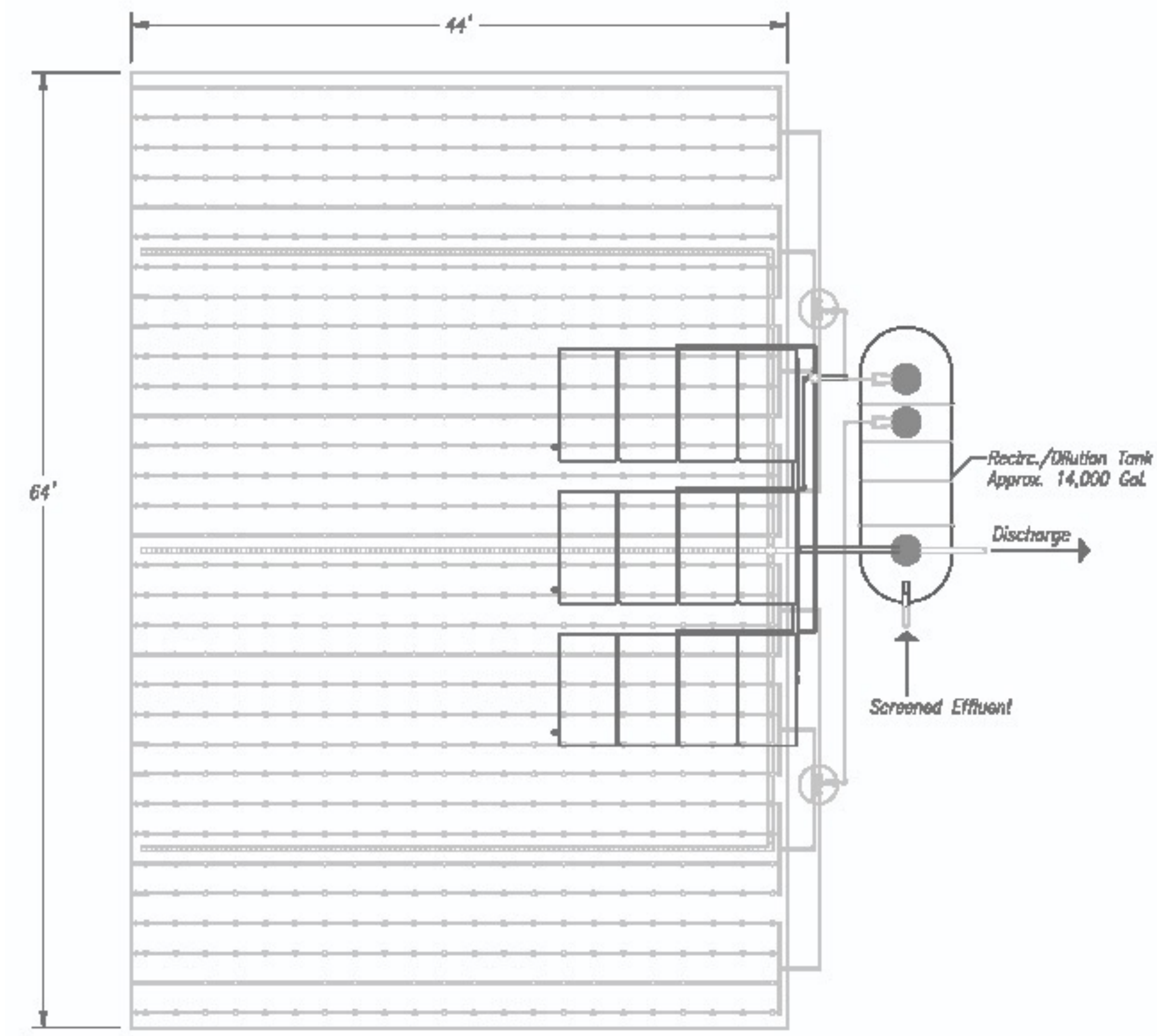
Essentially a commercialized sand filter with 10 times the loading rate



AX100 “POD”

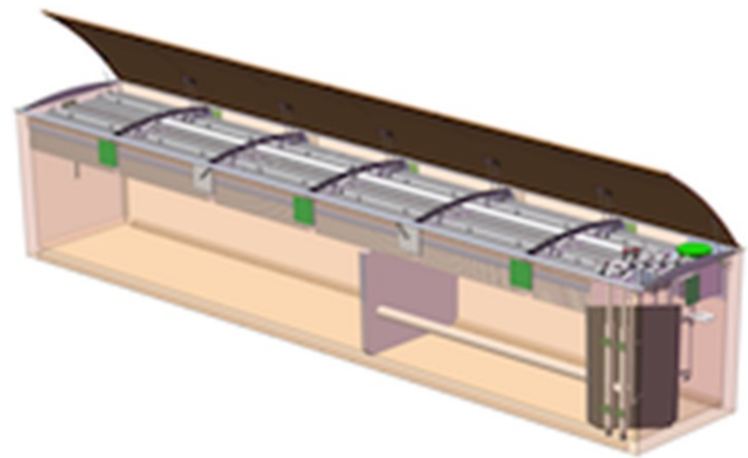
- Physical specifications
  - 16' x 8' x 3.5'
  - Footprint: ~128 sq ft
  - Dry weight: ~1650 lbs
- Hydraulic loading capabilities up to ...
  - Actual: 2500 gpd
  - Peak: 5000 gpd
- Approx. 165 students of capacity per pod

Advanced Treatment Systems



AX-MAX Textile Treatment “POD”

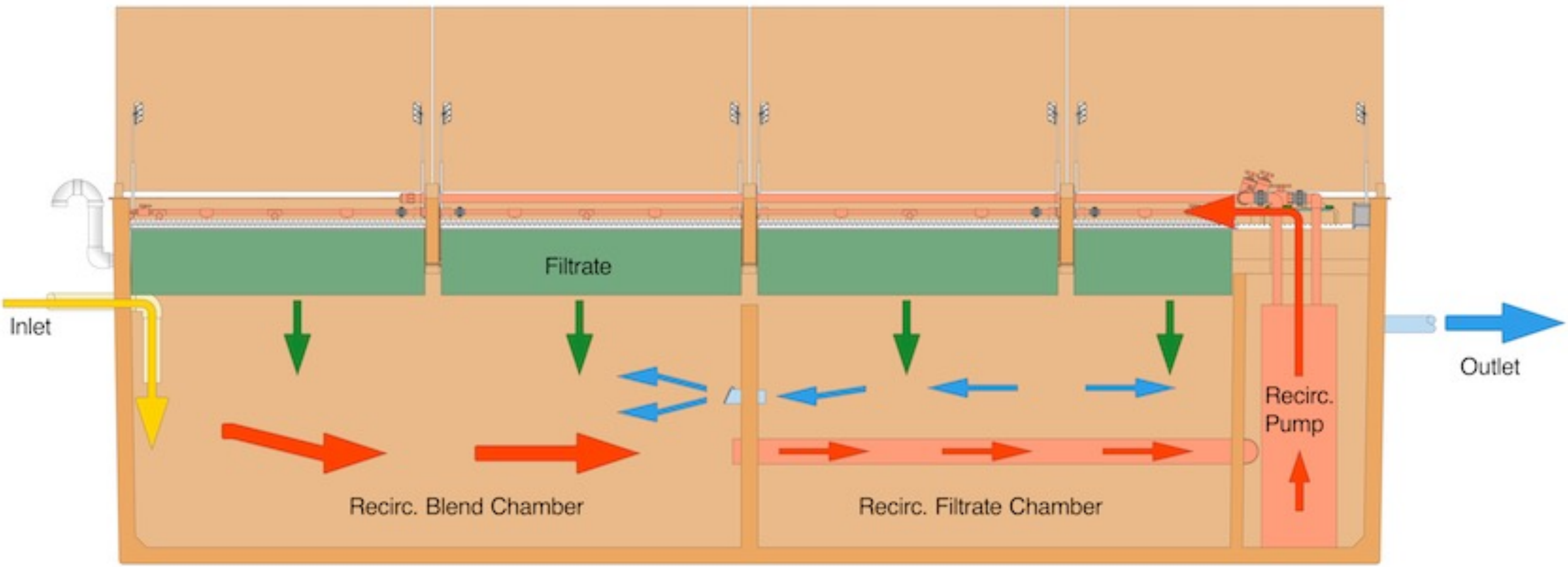
- AX-MAX300-42
  - 300 square feet of textile media
  - 42-ft in length, 7.5-ft standard width
  - Anti-buoyancy frame
  - Integrated recirculation tankage and media filter
  - 7500 gpd adf typical
  - Approx. 500 students of capacity per pod



Modular Construction

- 7,500-gallon pods
- Phasing can easily be incorporated
- Easy construction

Textile Filter Process Description



Umpqua Valley Christian School

Dixonville, OR

750 gpd
275 students
3 AX100's

Umpqua Valley Christian School

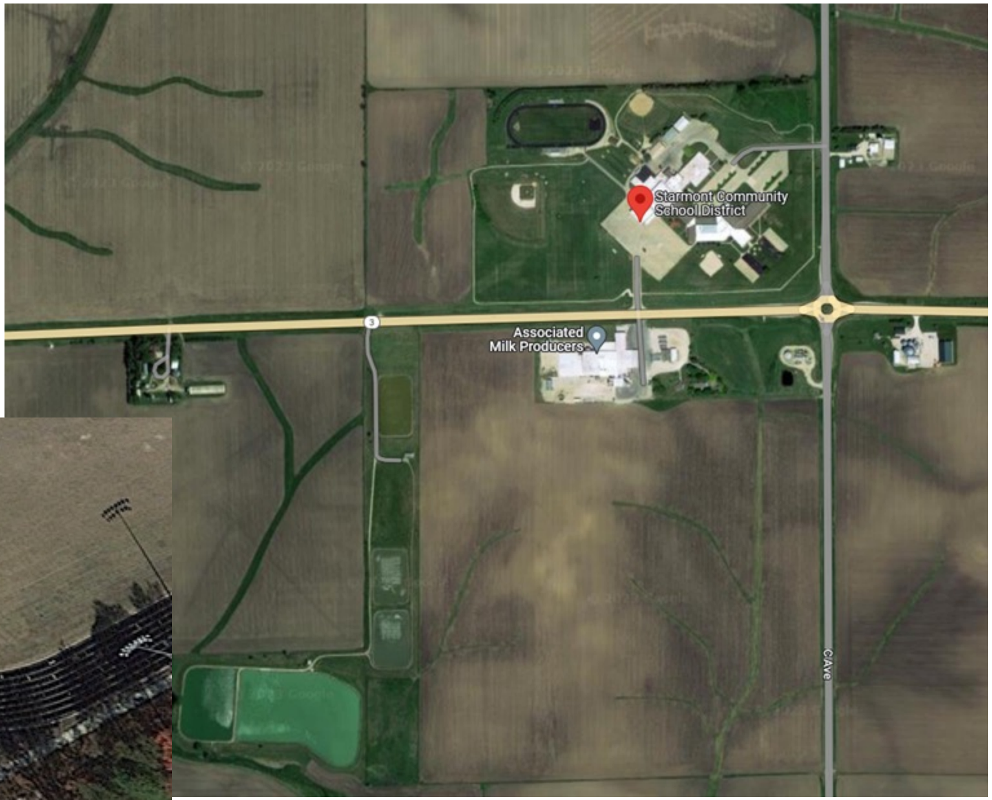
Dixonville, OR

Bethany Community School
North Carolina

6,000 gpd
571 students
1 AX-Max

Bethany Community School
North Carolina

Remember the Lagoon & Sand Filter

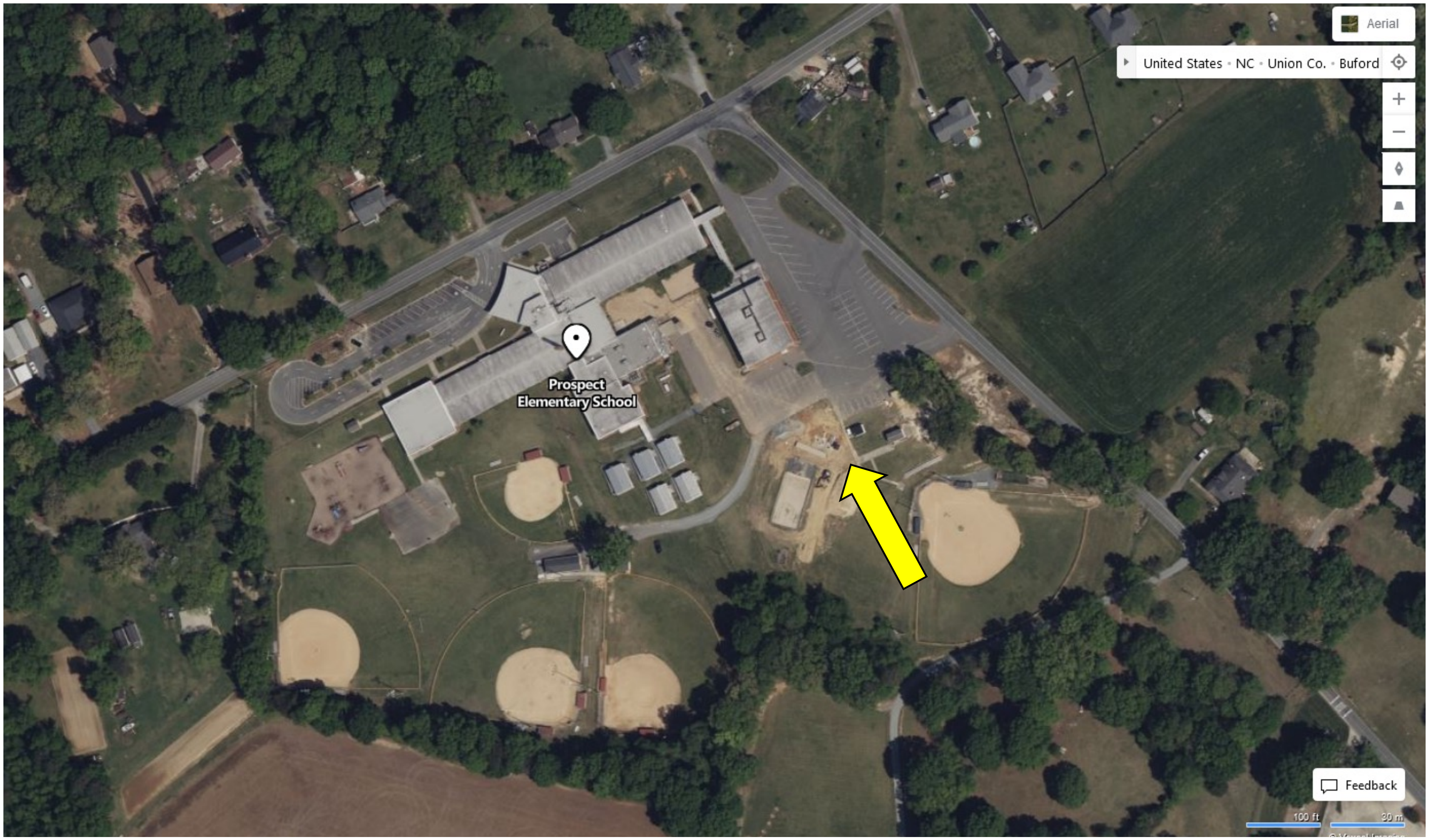


Prospect Elementary

Monroe, NC

469 Students
3500 gpd
1 AX-Max Unit

Prospect Elementary
Monroe, NC



Pueblo County High School
Pueblo, CO

15,000 gpd (TN limit of 10 mg/L)
1167 Students
2 AX-Max, MBBR, 1 AX-Max

Old System

Pueblo County High School

Pueblo, CO

New System

Effluent Polishing in Existing Systems

Gilboa-Conesville Central School, NY

294 Students, 4500 gpd
1 AX-Max unit after existing sand filter
to achieve ammonia limit

Existing Wastewater Treatment Systems
Effluent Polishing

Textile filter added to sand filter to comply with new ammonia requirement – 1 mg/L summer, 2 mg/L winter

Decentralized Wastewater Management

Creating a Community Solution

Creating a Community Solution
Dawes Intermediate School

544 Students
22,500 gpd capacity
8,166 gpd for school
9 AX100’s with room for expansion

Creating a Community Solution Dawes Intermediate School

- System built for school but had capacity for new development
- Ownership assumed by South Alabama Utilities
- Expandable for new development
- Utility contributed to cost

Why Make the School Wastewater Part of a Regional Solution?

- Provides treatment capacity for offsite septic-to-sewer of new development
  - Provides flow during summer and holidays
  - Makes system conducive to a regional Utility for ownership and maintenance
    - School builds system and conveys the system to the utility
    - School plays sewer bill
    - School, in some cases, can negotiate a payback agreement to receive money from connection fees that home pay

O&M is a Critical Consideration

- It optimizes the treatment process
- It ensures system longevity
- It establishes accountability
- It protects the owner’s investment

Tip #6 – Assure that the system is being maintained by a licensed operator that is trained on the technology and is following the recommended maintenance procedures (especially preventative maintenance)

Routine Maintenance Frequency

Textile Filters

- Monthly visit for first year
- Then, once every 3-6 months afterwards

Scheduled Maintenance Reference Chart	Recommended Activity Period				
Activity	Monthly	Quarterly	Semi-annually	Annually	Biennially
Visually Inspect Tank Liquid Levels	●[1]	●			
Check Biotube® Effluent Filters; Clean as Required	●[1]	●		●	
Check Biotube® Pump Vault Filters; Clean as Required	●[1]	●		●	
Record Elapsed Time Meters and Event Counters for All Pumps	●				
Inspect Spin Nozzles, Clean as Required	●[2]		●		
Confirm Proper Operation of Automatic Distributing Valve (if applicable)	●				
Sample Influent and Effluent Quality Parameters[3]		●[1]	●		
Confirm and Record Pump Voltages and Amperages		●[1]		●	
Inspect Distribution of Effluent in AX-Max Units; Clean as Required			●		
Record Scum and Sludge Accumulation in Tanks				●	
Flush Distribution Laterals in AX-Max Units				●	
Inspect Pumping System Components; Clean as Required				●	
Replace Lithium Battery in TCOM Control Panel (if applicable)					●

[1] This maintenance schedule is only required during the first year of system operation.
[2] This maintenance schedule is only required during the first quarter of system operation.
[3] Recommended guidelines only. Sampling should be scheduled according to regulatory requirements.

Trends To Be Aware Of

- Water conservation impacts wastewater
  - Increases organic strength in wastewater
  - Increases ammonia % in wastewater
  - Decreased hydraulic flow of wastewater
- Permit limits are becoming more stringent
  - TN, TIN, nitrate, ammonia and TP limits are becoming more common
    - Significantly increases capital cost
    - Significantly increases operations cost
    - Significantly makes compliance more difficult
- Many engineers do what they know and are not up to speed on alternative wastewater treatment systems

Questions?

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