Solving the Nitrate Problem

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Tailwater Systems
John Skardon
CEO

The Nitrate Problem

- It is a global problem affecting <u>every major agricultural area</u> around the planet
- Excess nutrients leaving our agricultural operations create real costs and safety issues for others
- Existing ecosystems don't have the capacity to control the problem
- Its cumulative….

source: pubs.usgs.gov

Tailwater systems

The Regulatory Environment for Nitrate (CA)

- Nitrate is a criteria 1 pollutant for drinking water
- Growers have already been compelled to provide drinking water to adjacent communities through clean up and abatement orders
- The regulatory risk to your company from increased enforcement is real

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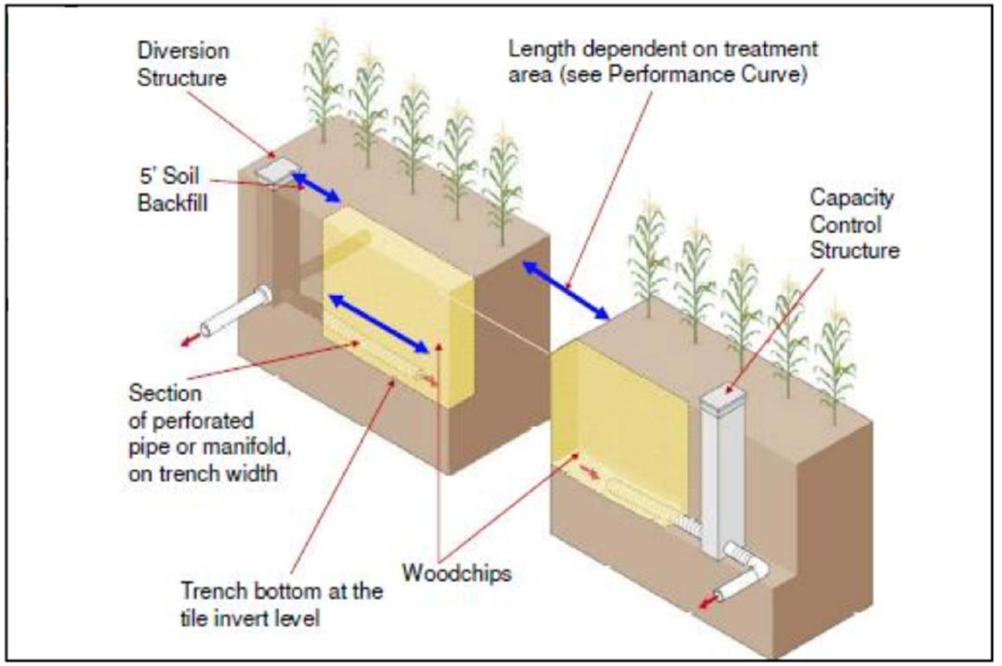
Existing Solutions

Woodchip Bioreactors

- Biological
  - Nitrate converted to CO_2 and N_2 gas
  - Nearly 100% water recovery
- Very large area
- Extremely inefficient removal/unit volume
- Very expensive to construct
- Not suitable for high NO_3 concentrations (<20 or 30 mg/L)
- Performance declines over time (consumption of the wood chips by bacteria)
- Prone to clogging
- Not possible to maintain (buried)
- Very susceptible to sulfur bacteria due to uneven flow and conditions inside



source: nrcs.usda.gov

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Existing Solutions

Reverse Osmosis

- Physical
  - Filtration only
  - 50-70% recovery
- The most expensive solution
- Very high electric power requirements
- Extensive pretreatment required
  - TDS, turbidity, organics
- Creates NO_3 rich brine (major liability)
- Membrane cleaning can take system off line for days

Source: Wikipedia Commons

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Tailwater Bioreactor

- Biological
  - Converts NO_3 to CO_2 and N_2
  - Near 100% recovery
- No pretreatment*
- Very low power consumption
- Tolerates very high NO_3 levels
- Some phosphorus removal
- Very high performance
- Small footprint
- Simple construction
- Lowest operating cost of any solution commercially available
- Self cleaning, limited maintenance
- Software controlled (flow rates, NO_3)

US Patents Pending

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Bioreactor Sizing (50 GPM)*

- Low to moderate NO3 (< 100mg/L)
  - 50 Gallons/minute x 90 minutes(HRT) = 4500 Gallon Volume
- High NO_3 levels (> 100 mg/L) increase HRT by 25% to achieve < 10mg/L NO_3 on outlet
  - 50 Gallons/minute x 120 minutes(HRT) = 6000 Gallon Volume
- For flows > 100 GPM, use multiple reactors in parallel.

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Operating Cost*

- Setup Charge
  - Pays for setup and installation
- Monthly Subscription
  - Pays for use of equipment
- Variable carbon/nutrient charge
  - Dependent upon NO3 concentration and target NO3 removal
- Tailwater does all maintenance, data collection and carbon/nutrient refill.
- Typical values range from $0.25 to $1.5 per 1000 gallons treated assuming 7x24 operation*

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Site Selection and Installation

- Requirements
  - At least a 20’ wide strip, flat, with packed gravel base
  - Source of AC power (230V 3 phase required for 50 GPM and higher)
  - Pressurized waste water source*
  - Gravity drain of effluent
- Installation
  - 1 to 4 days on site
- Inoculation (growing bacteria inside the reactor)
  - 1 to 3 weeks

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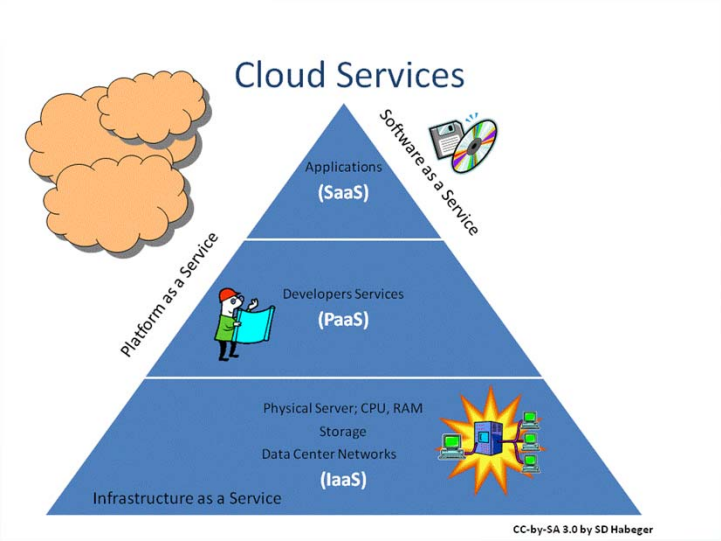
Day to Day Operation

- Customer has no responsibilities
- Cloud storage of all data
- Can access and control system via smartphone, tablet, PC
- System adjusts carbon flow
- System turns on if wastewater available
- Sample ports for collecting inlet and outlet(treated) water
- Containerized carbon supply (generally via IBC Tote)



source: wikimedia commons

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Options

- Continuous online nitrate monitoring
  - $20,000 setup charge
- Pre-treatment
  - High sediment loading removal
- Post Treatment
  - Remove dissolved organics
  - Particulate removal
  - Kill step for bacteria (UV)

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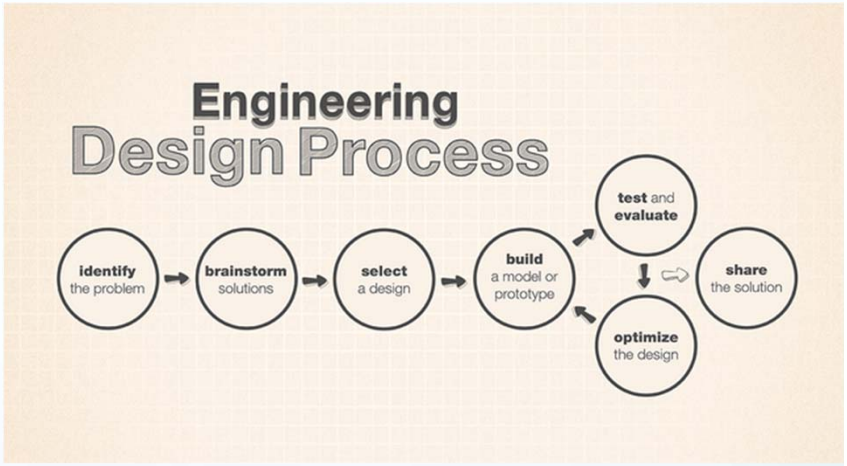
Bioreactor Design

- Site Visit by Tailwater Staff
- Customer provides
  - Flat area (3-6 inches of crusher rock foundation)
  - AC power
  - Pressurized source of waste water
  - Gravity drain (must be at grade or below)
  - Current wastewater sample data
  - Flow rate by month (weekly is better)



Source: jpl.nasa.gov

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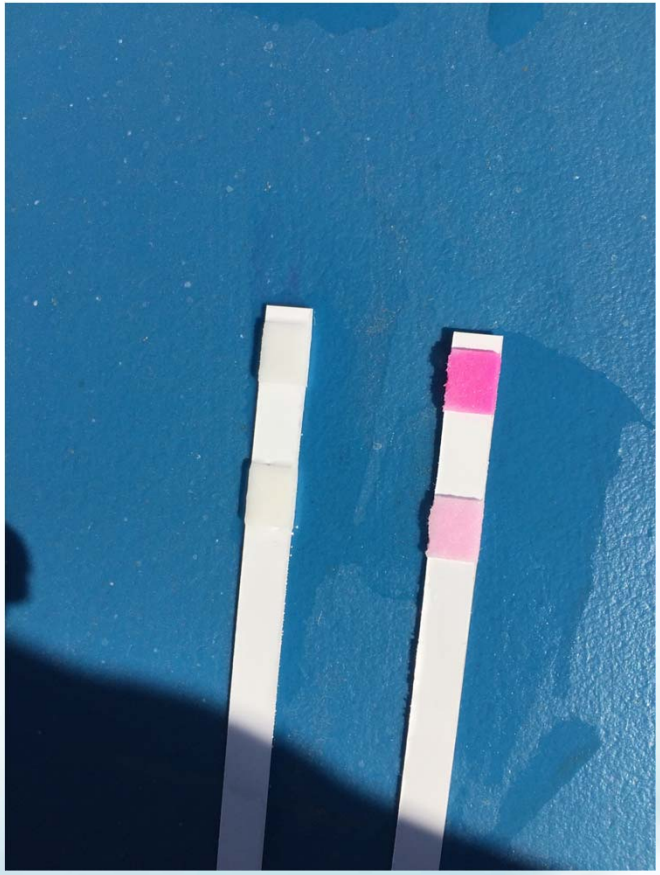
Typical Bioreactor Performance
10-100 mg/L NO3-N

- Retention time- 90 minutes
- Test strips
  - Inlet concentration (right) 50+ ppm nitrate as N
  - Outlet Concentration (left) near 0 for nitrate as N and nitrite
- Lab Results
  - 62.5 mg/L input,
  - 0.1 mg/L output,
  - 99% Reduction



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Example Small System

- 10 GPM Tile Drain System
  - 99% NO_3 removal
  - 10x20’ footprint
  - < 500W power consumption
  - Fully automated
  - Cloud data collection

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Example Medium System

- 50 GPM System
  - 95 to 99% NO3 removal
  - 1000 ft2 footprint
  - Gravel foundation
  - Fully automated

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Got Nitrate Problems? Call Us

- The most affordable solution
- Highest performance
- Simple site requirements
- Adaptable to nearly any nitrate problem

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