The Iowa Wastewater Project
(Small Community Wastewater Research Project)

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WRCC meeting

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Small Community Wastewater Issues Prevail Across Iowa

My team proposes to apply over 20 years of research, program expertise, and practical experience to rapidly bring less expensive and more effective wastewater treatment to Iowa communities with populations of less than 5,000.

The multi-year effort has the potential to positively impact 867 communities, 648,821 Iowans, and reach each of Iowa's 99 counties.

Within two years of implementation, data from the Small Community Wastewater Research Project could save over $250,000 in capital expenditures for ***just one*** community of approximately 1,500 people facing a wastewater treatment upgrade.

In the longer-term, much smaller Iowa communities, and even individual households, could also benefit financially from the Small Communities Wastewater Research Project.

The project will also reduce point-source nitrogen discharges


Iowa State Map
MILES
0 10 20 30 40 50 60
Albers equal area projection
MINNESOTA
WISCONSIN
ILLINOIS
MISSOURI
NEBRASKA
SD
Eagle Grove
Sac City &
Lake View
Spirit Lake
Estherville
Decorah
Sheldon
Spencer
Emmetsburg
Mason City
Charles City
Le Mars
Cherokee
Storm Lake
Waverly
Sioux City
Fort Dodge
Webster City
Iowa Falls
Cedar Falls
Waterloo
Dubuque
Denison
Carroll
Boone
Ames
Marshalltown
Marion
Cedar Rapids
Maquoketa
Clinton
Ankeny
Newton
Grinnell
Urbandale
West Des Moines
Des Moines
Iowa City
Davenport
Bettendorf
Muscatine
Atlantic
Council Bluffs
Indianola
Knoxville
Oskaloosa
Washington
Red Oak
Creston
Osceola
Chariton
Ottumwa
Fairfield
Mount Pleasant
Shenandoah
Clarinda
Centerville
Burlington
Fort Madison
Keokuk
Missouri River
Mississippi River
Des Moines River
Iowa River
Cedar River
Turkey River
Raccoon River
Little Sioux River
Lake Red Rock
Rathbun Lake
PHYSICAL FEATURES
Streams
Lakes
Highest elevation in state (feet) +1670
The lowest elevation in Iowa is 480 feet above sea level (Mississippi River).
POPULATED PLACES
100,000 – 499,999 • Cedar Rapids
25,000 – 99,999 • Sioux City
24,999 and less • Fairfield
State capital ★ Des Moines
TRANSPORTATION
Interstate; limited access highway 80
Other principal highway
Railroad
washingtonstatesearch.com

Research Can Address Current Performance Gaps

We propose to explore and evaluate multiple cost-effective wastewater treatment options that may be suitable for small Iowa communities.

A recent success story is in Walker, IA, where *Submerged Attached Growth Reactors (SAGR)* have been shown to successfully meet ammonia discharge requirements year-round.

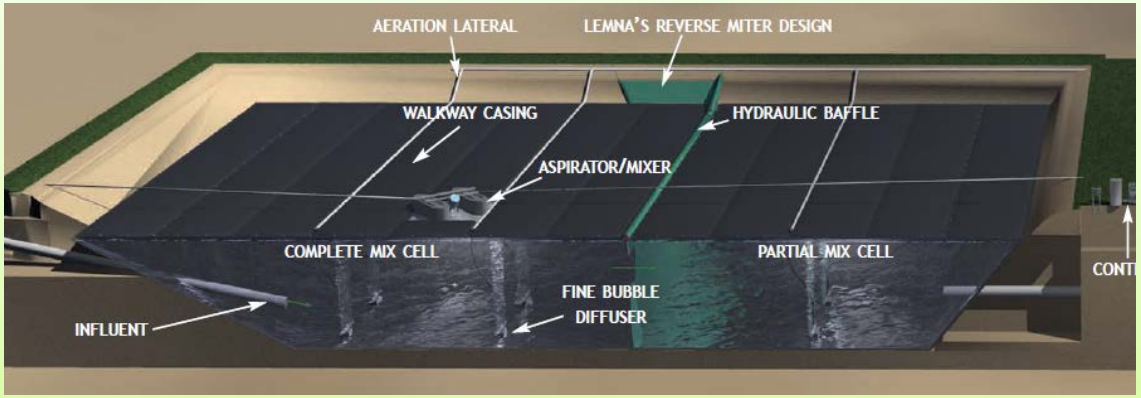
SAGR-based systems are now being proposed that are 30% smaller (and less expensive) for similar communities in Iowa based on performance data from Walker. The Walker project cost $2,535,515 ($3200/person). We estimate that ***over $150,000 could have been saved*** with a more appropriately-sized system.

The Iowa Department of Natural Resources (IDNR) must review and approve all technologies for use in small communities to treat wastewater. The folks at IDNR are talented, but limited staff time is a ***barrier to innovation***.

The SAGR System at Walker, IA, is Likely 2X Larger Than Needed

There are IDNR Approved Technology Assessments as Alternatives to SAGR

LemTec™ is a lagoon system that can be followed by a polishing reactor to remove ammonia



AdvanTex uses engineered textile media with a design similar to long-used sand filters

There are commercially available technologies that are not permitted due to a lack of winter-time performance data in Iowa

- *NitrOx™* is a cold weather, lagoon-based ammonia removal approach.
- *Aire-O_2 Bio-ffilm®* is a fixed film media system that claims to provide year-round ammonia treatment.
- *Bio-Domes* can be placed into an existing lagoon to potentially improve ammonia treatment.
- *Algaewheel®* uses algae, grown on rotating paddle wheels, to treat ammonia.
- *IDEAL™* uses existing lagoons and a “fill and draw” technique to treat ammonia.

How can we get the winter-time performance data needed?

Nitrogen Removal from Wastewater by an Aerated Subsurface-Flow Constructed Wetland in Cold Climates

Eric D. Redmond, Craig L. Just, Gene F. Parkin*

ABSTRACT: The objective of this study was to assess the role of cyclic aeration, vegetation, and temperature on nitrogen removal by subsurface-flow engineered wetlands. Aeration was shown to enhance total nitrogen and ammonia removal and to enhance removal of carbonaceous biochemical oxygen demand, chemical oxygen demand, and phosphorus. Effluent ammonia and total nitrogen concentrations were significantly lower in aerated wetland cells when compared with unaerated cells. There was no significant difference in nitrogen removal between planted and unplanted cells. Effluent total nitrogen concentrations ranged from 9 to 12 mg N/L in the aerated cells and from 23 to 24 mg N/L in unaerated cells. Effluent ammonia concentrations ranged from 3 to 7 mg N/L in aerated wetland cells and from 22 to 23 mg N/L in unaerated cells. For the conditions tested, temperature had only a minimal effect on effluent ammonia or total nitrogen concentrations. The tanks-in-series and the PkC* models predicted the general trends in effluent ammonia and total nitrogen concentrations, but did not do well predicting short-term variability. Rate coefficients for aerated systems were 2 to 10 times greater than those for unaerated systems. *Water Environ. Res.*, 85 (2013).

KEYWORDS: subsurface-flow wetland, aeration, ammonia, nitrogen removal, vegetation, cold climate.

(Wallace, 2001) and has been shown to perform better than unaerated wetland systems (Kinsley et al., 2002; Nivala et al., 2007; Wallace et al., 2008). Treatment efficiencies for biochemical oxygen demand, suspended solids, and total Kjeldahl nitrogen were higher in aerated wetland systems (Wallace et al., 2008). Nitrification of a municipal wastewater using an aerated subsurface-flow wetland required approximately half the energy of a traditional mechanical activated-sludge treatment system (Austin and Nivala, 2009). Therefore, subsurface-flow wetlands offer potentially significant advantages of lower energy costs, small ecological footprint, and aesthetic appeal similar to that of natural wetlands.

The role of vegetation in nitrogen removal is reported to be highly variable, sometimes enhancing performance and sometimes showing no significant effect (Karathanasis et al., 2003; Thomas, 1995). The effect of cold temperature on nitrogen removal in aerated subsurface-flow wetlands has not been reported despite the presence of several operational systems that

The Iowa City Wastewater Treatment Plant Staff Have Been Long-time Research Partners

Our goal is to build a wastewater research facility to ***certify existing technologies*** targeted for use in small Iowa communities and to ***develop new technologies*** that will remove nitrogen rather than simply convert it from ammonia to nitrate prior to discharge.

A Newly Formed Committee of the Iowa Water Environment Association (IAWEA) Focuses on Small Communities

The IAWEA Executive Board approved the formation of a Small Community Committee and appointed Matt Wildman (HR Green Consultants, Cedar Rapids) as the chair. The Board was very supportive and felt the committee will provide great value to small communities around the State.

The committee has representatives from IDNR, Iowa League of Cities, University of Iowa, State Legislature, Consultants, and plans to reach out to small communities in different regions of the State.

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Thank You

The University of Iowa College of Engineering

IIHR Hydroscience & Engineering