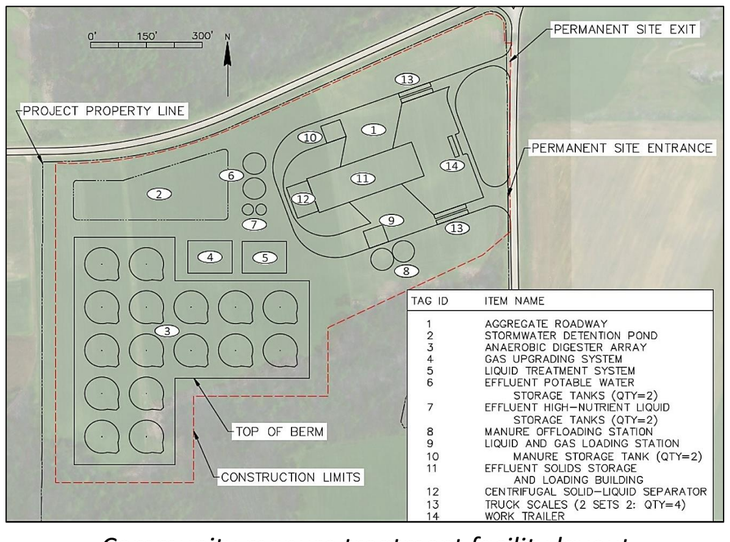
Community Manure Treatment Facility

Project Description & Goals

At least 50% of the annual total phosphorus load into local lakes comes in late winter and early spring from manure application during frozen conditions. Community manure treatment is a watershed priority identified by a coalition of 19 partners including local non-profits, agencies, and community organizations.

The core project goals guiding this project include:

- Site and design of a manure treatment facility and manure transport system with the capacity to treat waste from 40,000 cows.
- Providing an alternative to manure spreading on frozen soil, thereby reducing phosphorus runoff.
- Determine profitable and environmentally beneficial digester byproducts, like renewable natural gas, high-value liquid fertilizer, and solids used for animal bedding.

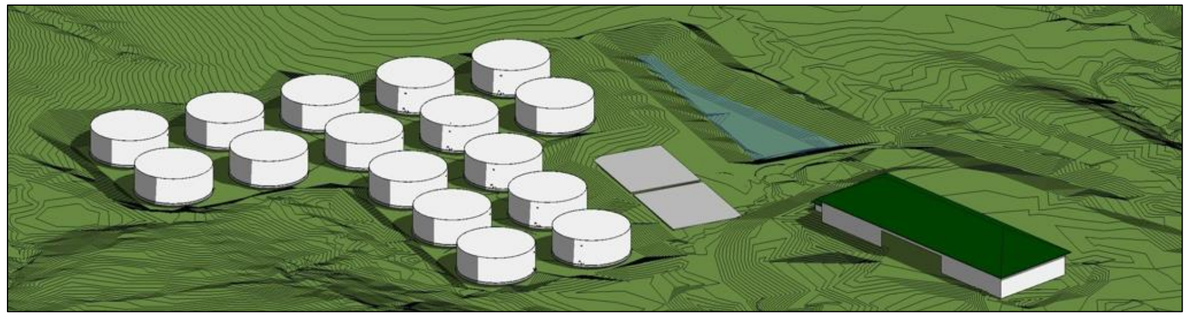


Community manure treatment facility layout

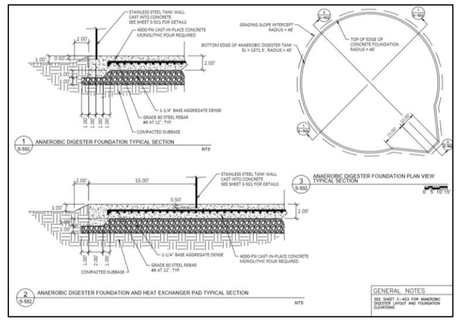
Multidisciplinary Collaboration

This project was led by a team of five students and made possible with the support and collaboration of:

- 7 instructors, including 6 P.E.s, one of whom holds a mechanical engineering degree
- 1 teacher's assistant, who is an EIT
- 2 mentors, both registered P.E.s
- 4 industry professionals, including 1 P.E.
- The Client and its staff
- 7 judges, including 5 P.E.s



Conceptual view of the facility facing NW



Digester foundation

Design Alternatives

All alternatives include:

- 16 stainless steel anaerobic digesters (1.25M gallons each)
- 9 deliveries per hour (10 hours/day, 7 days/week)
- Capacity to treat waste from 30k to 45k cows
- Centrifugal solids-liquids separation
- Renewable natural gas generation

	Alternative 1 Renewable Natural Gas (RNG)	**Alternative 2** RNG & Liquid Byproducts	**Alternative 3** RNG & Solid Byproducts
Biogas Upgrading System	Membrane gas upgrade	Liquid scrubbing	Membrane gas upgrade
Byproduct System	N/A	Reverse osmosis	Drum dryer
Life Cycle Cost (30 years)	$404M	$407M	$484M
Score	30%	37%	32%

Protection of Public Health, Safety, & Welfare

- Treats manure from 30k to 45k cows at a centralized facility
- Decreases eutrophication and algal blooms in the watershed
- Complies with regulations, reducing environmental and health impacts
- Collaborates with agricultural and residential communities to determine beneficial byproducts
- Reduces the facility's impacts to local traffic by limiting trucking hours
- Generates renewable natural gas
- Employs modern technology to increase efficacy of biogas conversion

Knowledge & Skills Gained

The five-member student team developed three design alternatives to meet the Client's objectives by:

- Collaborating with mentors and subject matter experts
- Considering how the project would affect the community and environment
- Visiting a small-scale digester facility
- Preparing a proposal, engineering report, geotechnical report, technical drawings, and calculations
- Presenting the preliminary and final designs to a panel of judges

This hands-on, real-world project experience allowed the team to gain knowledge and skills in:

- Anaerobic digestion of manure
- Renewable natural gas production and economy
- Methods for separating phosphorus into different states
- Economic opportunities of digestate byproducts
- Transportation and logistics for manure trucking
- Stormwater pond sizing
- Geotechnical and structural design considerations
- Secondary containment
- Teamwork and project management
- Communication with client and industry professionals

Technical Areas Involved

- Construction engineering
- Environmental engineering
- Geotechnical engineering
- Hydraulic engineering
- Hydrologic engineering
- Structural engineering
- Transportation engineering