

Dairy Facility Siting and Technologies for Mitigating Emissions on Midwest Dairies

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Siting of Dairy Facilities

Question: Is odor is the main practical air quality concern for a dairy farm?

Response: If yes, then address that concern.

- Odor is:
 - Challenging to control
 - A local/neighbor issue
 - Especially problematic for new facilities
- A big part of the solution:
 - Manage what is local and who are neighbors

Siting for Reduced Odor Risk: Planning Tools

- Advance planning may be required
 - State rule
 - County or township ordinance
- Advance planning is beneficial
 - Identify concerns
 - Identify siting options
 - Assess potential of mitigation strategies
 - Possible plus for getting approval

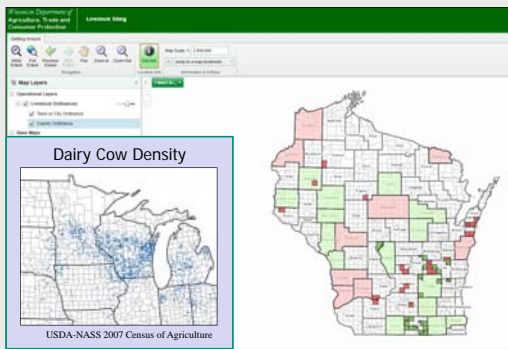
Wisconsin Department of Agriculture, Trade & Consumer Protection
Livestock Facility Siting

Siting Standards Protect the Public

- The standards were developed using sound science to protect water quality and manage odor
- The siting standards only apply to new and expanding livestock facilities in areas that require local approval
- Local governments may adopt more stringent standards to address unique local conditions, but should first try implementing the state standards. Implementation of standards such as nutrient management may provide adequate protection to deal with local concerns

Standard	Applies to	Requirements
Animal Units (AU)	All applicants	<ul style="list-style-type: none"> • Calculate number of animal units
Odor Management	Required only of applicants* within 2500 feet of their nearest neighbor that are <ul style="list-style-type: none"> • New farms over 500 AU • Expanding farms over 1000 AU 	<ul style="list-style-type: none"> • Predict odor from facility structures based on structure types, odor control practices used and distance to neighbors • Achieve required odor score • Local discretion to award extra points
	<small>* Planned farms may voluntarily complete acid compost.</small>	

Dairy Siting Dilemma: Contradictory Rural Community Acceptance



State vs. Local Rule

- In WI, state rules rule for air & water quality

Wisconsin Dairy Family Wins Siting Case

Posted on July 16, 2012

On July 11th, a Wisconsin dairy farm family... won a major victory for concentrated animal feeding operations (CAFO) producers. The Wisconsin Supreme Court sided with the family against the town of... concluding that the town cannot set pollution control measures for siting or expanding a CAFO that are more strict than those measures laid out by the Wisconsin Legislature.

<http://famfutures.com/blogs-wisconsin-dairy-family-wins-siting-case-3426>

- In other states (e.g. MN, NE and SD), local zoning may govern odor

Dairy Siting Dilemmas

- Contradictory rural community acceptance
 - Livestock expansion is often accepted where capacity is pressed and opposed where it may be most beneficial
- Response to odor varies
 - Sensitivity
 - Offensiveness



USDA-NASS 2007 Census of Agriculture

While 'minimum separation' may be prescribed, 'acceptable' separation is relative to the recipient.

Use Available Planning Tools

- Actively address local environment
- Good way to mitigate 'odor problem'
- Options:
 - OFFSET <http://www.extension.umn.edu/distribution/livestocksystems/DI7680.html>
 - WI Odor Standard (derived from OFFSET) http://datcp.wi.gov/uploads/Environment/pdf/Worksheet_2.pdf
 - Odor Footprint Tools (offspring of OFFSET)
 - NOFT <http://water.unl.edu/web/manure/odor-footprint-tool>
 - SDOFT www.sdstate.edu/abe/research/structures/upload/SDOFT.pdf
 - Multi-Source Odor Setback Model <https://engineering.purdue.edu/~odor/setback.htm>

Air Pollution Control Points

- Prevent generation
- Capture or destroy before releasing to the atmosphere
- Disperse or disguise to mitigate impact



Reducing Generation: Dietary Manipulation

- Balance ration (a BMP)
 - Limit excess protein → Limit NH₃ emissions
- Monensin → Improved feed efficiency
 - Anticipate that less manure → less methane and possibly less odor
- Variety of products and claims
 - Evidence for odor reduction?
 - Primary effects and cost?



Reducing Generation: Solids Separation and Reduction

Objective: Remove volatile organics and nutrients

- Mechanical separation alone → ~30% Max. reduction
 - Challenge is removing dissolved solids
 - Study by Harrison and Whitefield, 2012
- Polymer addition (e.g. ferric chloride) can substantially improve solids reduction
 - Coagulant usage can become extensive and expensive



Reducing Generation: Anaerobic Digester

Objective: Break down organic matter → biogas

- Digester effluent has:
 - + Less odor-generating potential (60 to 80% reduction)
 - + Greenhouse gas reduction CH₄ → CO₂
 - Higher NH₄ content → higher potential ammonia loss
- Digester biogas contains hydrogen sulfide
 - Odor from leaks in cover or S-removal process?



Reducing Generation: Wastewater treatment

Objective: Break down solids w/o odor emissions

- **Low-tech: Treatment lagoons**
 - + Less odorous than storage basin
 - Larger facility and management required
 - Less effective in cold climates
 - Seasonal odor bursts (spring turnover)
 - High NH_3 and N losses
- **High-tech: Municipal treatment systems**
 - + Can clean-up wastewater w/little odor
 - Manure requires pre-treatment for solids reduction
 - Large capital and operating cost



Reducing Generation: Aeration

Objective: Break-down organics aerobically

- **Aerobic emissions**
 - + Very little odor
 - + Less undesired gas emissions (e.g. CH_4 , NH_3)
- **Conventional systems have high cost and power demand**
 - Typical installation
 - Under capacity (size & # units)
 - More a show of effort
- **Liquid-circulation systems show more promise**
 - Treatment must be continual



Reducing Generation: Manure Additives

Objective: Alter bioactivity for reduced emissions

- **Have often underachieved**
 - Limited effectiveness
 - Costly to implement over time
 - Side effects (e.g. pH swings)
- **May enhance solids breakdown**
 - + Easier manure handling
 - + Longer-term emission benefits
- **May be effective for certain circumstances**
 - + Producer testimonials
 - + May have limited initial/trial investment cost



Reducing Generation: Composting

Objective: Aerobically break down organic matter

- **Emissions [compared to stock-piling]**
 - + Less odor and less-offensive odor
 - May lose more NH_3 and N
- **Management concerns [vs. stock-piling]**
 - Additional equipment and labor needs
 - + Significant volume reduction
 - + Greater acceptance / market potential



Capturing & Destroying Gases: Permeable Covers

Objective: Reduce emission rate of odor

- Slow air exchange at manure surface
- Break down gases within cover media
- **Can provide >50% odor reduction**
- **Biocovers (thick straw layer)**
 - + Low capital cost
 - Maintenance issues and cost
- **Geotextile covers**
 - Higher up-front cost
 - + Durability has improved



Capturing & Destroying Gases: Impermeable Covers

Objective: Seal off surface to eliminate emissions

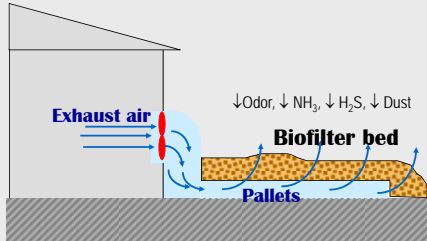
- **Can provide 90% odor reduction**
- **Gas buildup**
 - Typically flared
 - May be combusted for heat or power supply [covered-lagoon digester]
- **High initial cost**
- **Maintenance needs**
 - Pumping out
 - Repairs



Capturing & Destroying Gases: Biofilters

Objective: Microbes consume odorous gases

- Can provide 90% odor reduction of treated air
 - Most farm systems don't treat all of the airflow



Capturing & Destroying Gases: Biofilters

- Horizontal biofilter
 - Less expensive to build
- Vertical biofilter
 - Smaller footprint
- Management issues
 - Fan costs & use w/large fans
 - Moisture management
 - Rodent and weed control
- Limited applications on dairy farms
 - Pit fans in deep-pit (slatted-floor) barns
 - Treat air in mortality or food waste receiving sheds



Mitigating Impact of Emissions: Vegetative Environmental Buffers

Objective: Divert and dilute odorous air

- Vertical barriers deflect and help disperse odors
 - Not suited to dairy barns
 - Height & fan limitations
 - Negligible emission effect
- VEB use trees for windbreak and filtering
 - Natural windbreak
 - Shelterbelt



Mitigating Impact of Emissions: Vegetative Environmental Buffers

- Environmental benefits
 - Many people like them (natural, scenic)
 - Visual barrier
 - Modest emissions effect (10-20% reductions)
- Management issues
 - Windbreak effects on ventilation
 - Take time to establish
 - Require some care and management
 - Greatest benefit within wind shadow
 - Place downwind of source or upwind of recipients?

Summary

- Good siting of facilities can alleviate many potential odor challenges
 - Understand your locale
 - Use available planning tools
- Technologies exist for mitigating emissions
 - What is needed: emission reduction or addressing concerns of a few residents?
 - All have costs and management concerns
 - Consider expected benefits and costs

Air Quality in Animal Agriculture

<http://www.extension.org/pages/15538/air-quality-in-animal-agriculture>

- Webcasts
- Videos
- Fact sheets
- Photos
- Web links
- Other environmental resources