Department of Agriculture, Trade and Consumer Protection

A G E N D A

Livestock Siting Technical Expert Committee

Friday, December 19, 2014
9:00 a.m. to 3:00 p.m.

DATCP
Board Room 106
2811 Agriculture Drive
Madison WI 53718

9:00 a.m.	Call to Order
9:05	Review of November 18th meeting notes – Jeff Lyon
9:15	Completion of Third Committee Assignment • State standards and local groundwater protection ordinances - Sara Walling • Discussion of Nutrient Management Question 4 – Members
10:30	Break – Coffee provided
10:45	Overview of Odor Model – Steve Struss and Richard Castelnuovo
12:00 p.m.	Lunch – Provided
12:45	Discussion of Fourth Committee Assignment – Members
1:50	Break
2:00	Continue Discussion of Fourth Committee Assignment – Members
2:45	Wrap Up and Future Meetings – Jeff Lyon • Summary of progress on assignment and decision on need for additional discussion • Discussion of future meetings-January and beyond
3:00	Adjourn

MEETING NOTES

Livestock Siting Technical Expert Committee

September 18, October 15, and November 18, 2014

Third Meeting Attendees
Members: Kevin Beckard, Mark Borchardt, Tonya Gratz, Jerry Halverson, Brian Holmes, Bob Pofahl, and Mark Ruark. Advisors: Joe Baeten, Richard Castelnuovo, David Panofsky, Pat Murphy, Sue Porter, John Ramsden, Steve Struss, Robert Thibodeaux, and Gretchen Wheat. Additional attendees: Lisa Trumble, Matt Woodrow, Sara Walling.

Notes for the committee are intended to capture the committee's consensus regarding responses to assignment questions, and will be maintained on a cumulative basis. The notes covering the most recent activity of the committee are highlighted in gray. Notes will be presented to the committee for further review at future meetings. The following are the cumulative notes for the first two meetings.

Consistency of Rules (CR)

CR Question # 1
To be consistent with the state standards in NR 151 and ATCP 50, ATCP 51 should include a requirement for livestock operators to manage their operations to avoid significant discharges of process wastewater. The "zero discharge" standard in NR 243 should not be incorporated into ATCP 51. In applying this new standard, ATCP 51 should use the definition of process wastewater and significant discharge in NR 151. Complying with this standard will depend on a number of factors including a farm's location to waters of the state. The siting application should be modified to better document current and future compliance with this requirement.

CR Question # 2 (as modified at second meeting)
ATCP 51 should require that new and substantially altered bunkers, paved or other lined feed storage facilities be designed, constructed and operated in accordance with NRCS standard 629 (January, 2014) and NRCS standard 635 (September, 2012) except that facilities proposed in low risk locations may not need to install collection systems or vegetative treatment areas if certain conditions are met. This exception is only available to proposed livestock facilities under 1,000 AU. As a first step, a permit applicant must have an evaluation of their site and existing facilities conducted using the procedures discussed in the response to Engineering Question #5.

Applying the evaluation criteria in NR 151.055(3), it must be determined that any existing facility subject to alteration ("expanded facility") is not causing a substantial discharge. The evaluation also must document that the proposed new or expanded facility has adequate separation distances to protect against surface water and groundwater contamination. In addition, the evaluation must show that the soils near the new or expanded facility do not have a

high potential for leaching contaminates to groundwater. The committee discussed further limiting the exception to exclude new or expanded facilities that exceed 0.5-1.0 acres in size.

If these required conditions are met, applicants can receive approval of the proposed facility if they (1) design and construct the new facility, or new portion of the expanded facility, in accordance with Tables 1, 2, or 3 in the current NRCS standard 629, and (2) divert clean water away from the new or expanded facility.

These design and construction requirements apply to new or substantially altered storage areas that hold commonly stored feeds, not just feed over 70 percent moisture (cannery, brewers and distillers byproduct feeds). The committee considered applying these requirements to facilities that store feed with as low as 40 percent moisture, but also considered using a percentage somewhere between 40 and 70 percent. The design and construction requirements do not apply to feed stored in bags or tower silos.

CR Question # 3

For all volumes generated, milking center wastewater should be discharged to manure storage or another structure that meets the design criteria of NRCS standard 313 except if the livestock facility produces less than 500 gallons of wastewater daily and does not store the wastewater for an extended period, then the livestock operation must use the treatment practices described in NRCS standard 629 (January 2014).

CR Question # 4

To be consistent with the state standards in NR 151 and ATCP 50, ATCP 51 should require that cropland covered by a permitted facility's nutrient management plan have an average Phosphorus Index (PI) of 6 over a rotation and annual PI not to exceed 12, consistent with the requirements of NR 151.04. A facility's required nutrient management plan, if it includes an appropriate phosphorus index (PI) calculation value, may be used to demonstrate compliance with these PI requirements. A livestock operator may meet the phosphorus management requirements in NRCS standard 590 (September, 2005) by using a soil test management approach as an alternative to a PI calculation. A local government may request NM plan updates and other documentation to monitor a permitted facility's compliance with the PI requirement.

CR Question # 5

ATCP 51 should incorporate the following standards adopted in NR 151 and ATCP 50:

a. A requirement that pastures be managed to control erosion and be covered by a nutrient management plan if they have certain stocking rates.
b. A requirement that tillage not be conducted within a 5-20 foot setback between cropped fields and surface water.

As a condition of their permits, livestock facilities would be responsible for maintaining compliance with these requirements on all land, including rented acres.

CR Question # 6

DNR does not currently enforce the tillage setback through its CAFO permits, but it may revise its rule requirements to incorporate this and other NR 151 requirements. While DNR does not

currently enforce the annual maximum PI of 12, it has other CAFO requirements that function in a similar manner and may include this particular requirement in a future rule update. DNR may also require CAFOs to prepare a pasture management plan. After considering how NR 151 standards are applied to CAFOs, the committee did not recommend any adjustments to its recommendations for questions 1 through 5 above.

CR Question # 7

To be consistent with ATCP 50, references in ATCP 51 should be updated to reflect the following NRCS technical standards:

a. NRCS technical guide waste storage facility standard 313 (January, 2014).
b. NRCS technical guide, closure of waste impoundments standard 360 (March, 2013).
c. NRCS technical guide waste treatment standard 629 (January, 2014)
d. NRCS technical guide waste transfer standard 634 (January, 2014).
e. NRCS technical guide vegetated treatment area standard 635 (September, 2012).

The committee recognized that references to the NRCS standards listed, and possibly additional NRCS standards, will need to be updated in ATCP 51.

Engineering

E Question # 1 (as modified at the third meeting)

For the purposes of the siting rule, BARNY is a more appropriate tool than BERT for evaluating animal lot runoff and design practices to meet targets for annual phosphorus runoff. BERT does not account for local rainfall conditions, does not generate a result expressed in terms of annual phosphorous runoff, and does not provide design practices to reduce runoff. Despite its limitations, BARNY has a long history and wide acceptance as a tool to assess barnyard runoff. NRCS currently maintains BARNY as a worksheet in Spreadsheet on Vegetated Treatment Areas. NRCS will be updating BARNY to include the most recent NOAA rainfall data. ~~Before making a final recommendation, the committee will evaluate the Annual Phosphorus Loss Estimator (APLE) for barnyards, developed by UW-Madison research soil scientist Peter Vadas, to determine whether it is a better tool than BARNY.~~ Based on a comparison between BARNY and the Annual Phosphorus Loss Estimator (APLE) for barnyards, developed by UW-Madison research soil scientist Peter Vadas, BARNY remains a more appropriate evaluation and design tool, although APLE may have a better supported model for predicting runoff and future enhancements, it may be a better choice over BARNY in the future.

Whichever model is used, a local government should be allowed to require a livestock applicant to submit documentation (e.g. a printout of the model inputs and outputs) to demonstrate compliance with the runoff limits for barnyards. Most agreed that this documentation is easily provided, is often voluntarily submitted, and should be available to local governments if it is not voluntarily provided.

E Question # 2

ATCP 51 should better define when an operator can modify an existing animal lot to meet the ATCP 51.20(2) runoff threshold without implementing the full set of requirements in NRCS 635 related to wastewater treatment. In defining what is allowed as a "minor alteration," ATCP 51

should retain the requirement that an operator must comply with the NRCS 635 standard if the animal lot is "substantially altered," which means "an increase of more than 20% in the area or capacity of a livestock structure used to house, feed or confine livestock."

ATCP 51 should identify the management or practice changes that can be implemented as "minor alterations" to achieve compliance with the runoff thresholds. The following should be considered: lot cleaning, changes to provide laminar flow (e.g., shaping, seeding), roof gutters, diversions, underground outlets, and sediment basins. To document compliance with ATCP 51, an applicant must submit a copy of the BARNY model completed to reflect the proposed changes. To the extent that the changes involve an engineered practice, the applicant must submit a design for the practice that meets the applicable NRCS or other technical standard.

These submissions represent the applicant's commitment to perform the work promised, and may be enforced in the same manner as other permit requirements. ATCP 51 should be modified to enable a local government to set a one year limit regarding the installation of these "minor alterations," with the authority to reduce the time if the local government determines that the unmanaged runoff presents an unacceptable risk of contamination to surface or groundwater.

E Question # 3

The evaluation standards and procedures for existing storage structures, as reflected in Worksheet 4 (Appendix A, 390-33) and Existing Manure Storage Evaluation Flowchart, are reasonable and consistent with sound technical principles. Minor adjustments in the evaluation standards might be appropriate, such as extending the allowable window from 3 to 10 years for properly designed storage facilities that are not steel or concrete. Additional guidance should be provided to engineering professionals who conduct evaluations of storage facilities. For example, it is usually necessary to empty a facility, particularly earthen-lined structures, to conduct a valid inspection, however this may be difficult. A number of factors may determine whether there is reasonable cause to fully empty a facility, including its age, the results of visual inspection of its exposed area, and the likelihood that agitation may have compromised its liner. If no documentation is available regarding a facility's separation distances to groundwater or bedrock, test pits or borings may be required to complete a facility evaluation. This approach is consistent the procedures used by DNR in its evaluation of storage facilities under NR 243.

By definition, a manure storage facility includes the waste transfer portion of the facility. It is feasible to evaluate exposed portions of an existing waste transfer system. If the waste transfer system was installed according to technical standards, a professional engineer could review the design and "as-built" documentation. Reception tanks may be visually inspected, or assessed for leakage using soil borings. Likewise open channels and equipment such as pumps and valves can be visually inspected. The evaluation of conveyances, such as underground pipes, is more challenging; it may not be realistic to require pressure testing of pipes or digging test wells at various intervals along its length. The committee will review a flowchart for the assessment of waste transfer systems, to be prepared by staff.

E Question # 4

ATCP 51 and related worksheets should be updated to reflect the latest technical requirements for engineered and related practices used in connection with the odor and other siting standards.

Specifically, the following practices in the siting rule should be associated with the listed NRCS or other standards:

- For composting facilities, reference NRCS Standard 317.
- For anaerobic digesters, NRCS Standard 366.
- For digester substrate storage, NRCS Standard 313 or DNR Industrial waste rules, such as NR 213, Wis. Admin. Code, based on types and amounts stored.
- For manure residual storage, NRCS Standard 313.
- For solid separation, NRCS Standard 632.
- For treatment of liquid waste, NRCS Standard 629 (except for vegetated treatment areas covered under NRCS 635).
- For sand settling lanes, NRCS Standard 632.
- For impermeable manure storage covers, NRCS Standard 367
  For natural crust and bio-covers, DNR recommendations related to control practices for air emissions.
- For treatment membranes, NRCS Standards 629.

E Question # 5(as modified at the third meeting)

Existing permanent feed storage facilities should be evaluated to determine whether they (1) are in good condition, and (2) do not present risks of discharging leachate or contaminated runoff to waters of the state. The evaluation should determine if the facility is causing a substantial discharge using the criteria in NR 151.055(3). For facilities constructed within the last 10 years, the evaluation should determine if the facility was designed according to then-existing standards. To establish that a facility is in good working condition a visual inspection should be performed looking for signs of failure (e.g. cracks) or discharge of leachate. The evaluation also should determine the separation distances of a facility from streams, lakes, areas of concentrated flow, wetlands, floodplains and other surface waters susceptible to pollution risks. In terms of groundwater risks, the evaluation should determine the separation distances of a facility to bedrock and saturated soils, and any soils with a high potential for groundwater contamination. Tables 1 through 3 in the NRCS standard 629 should be used as a starting point to determine adequate separation distances.

The evaluation process for feed storage should be consistent with the other evaluation processes for manure storage and animal lots. DATCP should develop a flowchart to outline the evaluation processes. In the case of existing feed storage, the evaluation should be limited to paved facilities and be triggered only when the aggregate of paved storage exceeds ½ to ¾ acre (based on typical feed storage areas for a 500 AU dairy operation). The draft flowchart should account for the risk of infiltration and runoff of leachate and contaminated runoff. Specifically, the flowchart should have one or more steps that take into consideration: (1) separation from groundwater, (2) permeability of soil, and (3) the likelihood of runoff reaching surface water. Based on evaluation of these factors, the operator may or may not need to perform repairs, install a perimeter drain, or make improvements to the treatment area. The committee will review another draft flowchart.

ATCP 51 should include management requirements for existing storage facilities including those that are operated without modification. The requirements for clean water diversion and leachate collection in ATCP 51.20(3) should be retained for existing paved facilities that store feed with 70% or more moisture content (cannery, brewers and distillers byproduct feeds). In addition, livestock operators should be required to divert clean water, and follow basic management practices such waste feed cleanup and proper snow plowing, for all feed storage facilities.

E Question # 6
ATCP 51 should provide more clarity regarding local government monitoring of a permitted facility's compliance with siting standards, including local review of whether engineered practices are properly operated and maintained. DATCP should strongly encourage local governments to monitor compliance, and support these local efforts by developing effective tools and providing training and guidance.

Checklists are effective tools to ensure accuracy and consistency in monitoring livestock facilities for compliance. Checklists need to be specific to either the producer to support self-certification, or the local government to enable consistent review of compliance. Checklists should be practice specific and incorporate the operation and maintenance (O&M) requirements in NRCS technical standards. For example, animal lots should follow the O&M requirements in NRCS standard 635.

While local governments are generally responsible for determining the nature and extent of monitoring activities performed on permitted farms within their jurisdiction, DATCP may consider the option of requiring that all permitted facilities complete and submit a self-certification checklist to local governments every two years. Monitoring of permitted facilities should be coordinated with DNR activities to avoid unnecessary duplication in the submissions required of CAFOs. DATCP should work with local authorities to collect accurate information concerning the implementation of the siting law and the performance of permitted farms, including responding to changes in farming operations and documentation of monitoring results. An additional fee to cover the monitoring costs of local governments to might be considered and could help encourage local implementation.

Nutrient Management

NM Question # 1
As part of their review of a permit application under ATCP 51, local governments should have access to Waste and Nutrient Management Worksheet # 3 (390-30 to 32) documentation supporting a nutrient management plan regardless of the size of the livestock facility applying for livestock siting permit. The CAFO exemption ATCP 51.16(4) should be removed. Local governments should be able to request documentation to substantiate that the applicant, who may also hold a WPDES Permit is meeting the requirements for a nutrient management plan under the siting law. The applicant, not the DNR, should be responsible for providing this documentation.

The local government would use this documentation to establish that the land application of nutrients from the livestock facility complies with the NRCS 590 Standard and covers the maximum number of animal units requested in the permit application. Local governments may

request additional information to substantiate the planner's answer to one or more questions on the NM checklist (390-32) and may deny approval if the documentation does not reasonably substantiate the answer. In a typical case, applicants or their consultants can easily satisfy a local request for documentation by providing the applicant's SnapPlus database and NRCS 590 nutrient management restriction maps from the annual planning process.

NM Question # 2

As part of the Waste and Nutrient Management Worksheet # 3 (390-30 to 32), the applicant must document through their nutrient management plan developed to NRCS 590 Standard that the owned or rented land is adequate to spread the manure generated by the maximum number of animal units authorized under the permit. The annual NM plan updates would include the current animal units at the facility and the acreage necessary to apply the nutrients.

A permit modification process may be further described in the rule to accommodate the needs of operators while maintaining the "maximum animal unit" concept fundamental to the permitting process under the livestock siting rule.

NM Question # 3

Waste and Nutrient Management Worksheet # 3 (390-31 and/or 390-32) should be modified to require that an applicant identifies land spreading acres that are rented, in addition to those that are owned. Maps depicting the rented and owned acres are able to be requested to support Worksheet #3. The committee also discussed that requesting additional information regarding rented acres for spreading manure could be requested.

NM Question #4:

The committee viewed a presentation by Sara Walling regarding the proposed changes to the NRCS 590 Nutrient Management Standard. Changes to the NRCS 590 NM standard may include adjustments to winter spreading prohibitions, winter spreading plan requirements, and nitrogen restriction based on sensitive soil types. The committee began discussing whether those changes should be more stringent for Livestock Siting facilities. The committee will continue to discuss Nutrient Management questions #4 on December 19th.

Additional Information for:

NM Question #4 – NRCS 590 Nutrient Management Standard Exclusions and Local Restrictions

It is valuable to understand the interworking relationship that many of our performance standards have related to livestock operations. A set of state regulations exist that establish statewide standards for livestock operations, nutrient management requirements, and related practices. The following are state administrative rules that specifically impact the practices livestock farms (and in some cases, all farms) must implement to limit impacts to surface and groundwater resources.

NR 151 – Runoff Management: Sets the agricultural performance standards and manure management prohibitions and also establishes performance standards for urban and transportation sources of polluted runoff as well. The agricultural standards and prohibitions were developed to control polluted runoff from all cropland and livestock operations while protecting Wisconsin's water resources.

ATCP 50 – Soil and Water Resource Management Program: The conservation practices used to meet the NR 151 performance standards are identified in this rule. When NR151 states that farms must comply with a nutrient management plan "that is designed to limit or reduce the discharge of nutrients to waters of the state", ATCP 50 establishes the specific details such as "the plan shall include every field in which nutrients are applied, be prepared by a qualified NM planner and comply with the NRCS 590 NM standard.

NR 243 – Animal Feeding Operations: Establishes design standards, acceptable management practices, permit requirements, and the basis for issuing permits to CAFO farms (1,000 AU or greater; less than 1,000 AU in some cases). NR 243 incorporates requirements by reference to ATCP 50 and to some extent NR 151.

ATCP 51 – Livestock Facility Siting: Establishes how local governments regulate the siting of new and expanded livestock operations. It establishes procedures local governments must follow if they decide to issue conditional use or other local permits for siting livestock facilities. The statute limits the exclusion of livestock facilities from agricultural zoning districts. It also created the Livestock Facility Siting Review Board to hear appeals concerning local permit decisions. ATCP 51 incorporates requirements of ATCP 50 and NR 151. Given that nearly half of the farms permitted to date under ATCP 51 are also CAFO size, the more restrictive requirements of NR 243 apply to those facilities.

At the November 2014 meeting of the Livestock Siting Technical Expert Committee, DATCP presented information regarding the proposed changes to the NRCS 590 NM Standard. Those changes largely fall into the following three areas:

- Increased winter spreading prohibitions
- Winter Spreading Risk Assessment and winter spreading plan requirements
- N application restrictions

Also at the November 2014 meeting of the Livestock Siting Technical Expert Committee, it was pointed out that ATCP 51 limits local control of livestock facility requirements, especially for locally identified areas or resources concern. Through ordinance development, a framework currently exists to enable counties to enact more stringent standards than state requirements.

- **Ch. 92.11 - Regulation of local soil and water resource management practices.**

  (1) PROPOSED ORDINANCES. To promote soil and water conservation or nonpoint source water pollution abatement, a county, city, village or town may enact ordinances for the regulation of land use, land management and pollutant management practices.

  (2) APPLICABILITY; CONTENTS.

  (3) PRESENTATION; NOTICE; HEARING; COUNTY BOARD ADOPTION.

  (4) REFERENDUM; LOCAL APPROVAL REQUIRED.

- **Ch. 92.15 - Local regulation of livestock operations**

  (3)(a) Notwithstanding ss. 92.11 and 92.17, a local governmental unit may enact regulations of livestock operations that exceed the performance standards, prohibitions, conservation practices and technical standards under s. 281.16 (3) only if the local governmental unit demonstrates to the satisfaction of the department of agriculture, trade and consumer protection or the department of natural resources that the regulations are necessary to achieve water quality standards under s. 281.15.

  - Manitowoc County successfully utilized the process in 92.11 to enact more stringent standards. Manitowoc's ordinance includes provisions including prohibitions on manure application within 50 feet of all water bodies, 100 feet of exposed bedrock, wells or sinkholes, winter spreading prohibitions on slopes >6%, and many other items related to incorporation requires, etc.
  - Dane County used existing authority of their Lakes and Watershed Commission to require a winter application permit to apply liquid manure. Their ordinance regulates the winter application of stored, pumpable liquid manure in order to protect the health and welfare of Dane County's residents and the economic and environmental value of the County's natural resources.
  - This option allows counties to provide additional protections to water quality from all sources of manure in the county, not just those few that fall under the Livestock Facility Siting Law.

ATCP 51.10 (3) provides a provision for local governments to enact more stringent local standards via authority in ch. 93.60.

(3) More Stringent Local Standards. A political subdivision may not apply local standards that are more stringent than the standards in this subchapter unless all of the following apply:

(a) The political subdivision is authorized to adopt the local standards under other applicable law.

(b) The political subdivision enacted the standards by local ordinance, before the livestock facility operator filed the application for local approval.

(c) The political subdivision enacted the standards based on reasonable and scientifically defensible findings of fact adopted by the political subdivision's governing authority.

(d) The findings of fact under par. (c) clearly show that the standards are needed to protect public health or safety.

- Example:
  - **Fond Du Lac- Town of Oakfield**
    - Prohibition on spreading of liquid manure in areas of known Karst formations
    - Prohibition on spreading of liquid manure within one-half mile of known municipal wells operated by the Village of Oakfield.

- Case-by-case restriction on the spreading of liquid manure within 75 feet of a shallow water table (many depths range from 0 to 11.4 inches), or locations within proximity of a number of wetlands or DNR and U.S. Fish and Wildlife lands that need to be protected from erosion and surface

Questions for the Expert Committee:

- Wisconsin has statewide standards, regulations in place, and a formal process and timeline for updating those rules and standards. A formal process exists that allows local governments to enact more stringent standards than those developed by the state to ensure that unique conditions and landscapes are provided further protections.
    - Should the revised NRCS 590 NM standard be incorporated into ATCP 51?
    - If water quality is a concern for a local government, should only farms that fall under ATCP 51 or all farms in the jurisdiction be responsible for following practices to ensure that water quality is being protected?
    - Should local governments utilize the existing process?
    - Should changes be made to the process for enacting more stringent standards to enable local governments to adopt them?

Assignment
Livestock Facility Siting Technical Expert Committee
December 2014

Scope of Fourth Assignment

The committee's fourth assignment covers the topic of odor generation and odor control practices as well as setbacks. All three are utilized in determining an odor score.

The questions in this assignment will likely take more than one meeting to complete. The first meeting will include a review of the odor model and standard and a discussion of odor generation and odor control practices, the numbers associated with them and the scoring system. The committee will determine whether or not changes need to be made to either odor generation numbers or the odor control practice credits. There will also be a discussion on property line and road right of way setback distances for structures (manure storage, animal lots, feed storage and housing.)

Notes will be prepared by DATCP staff reflecting the committee discussions and recommendations. As previously discussed, the committee will wait to address issues related to the odor from land applied manure, pending the completion of the work of Manure Irrigation Workgroup.

Odor

1. Worksheet 2 (Appendix A, Chart 2, 390-25) (a copy of which is also attached to this assignment) calculates the odor generated by livestock structures using odor generation numbers developed in accordance with the best available science.

   Background: ATCP 51.14 requires that certain livestock facilities have a passing odor score calculated according to Worksheet 2. The odor score is the product of a model that predicts odor from livestock structures in the proposed facility. Chart 2 assigns an odor generation factor, expressed as a number, for different types of housing, waste storage and animal lots commonly used in Wisconsin livestock facilities. Applicants multiply the odor generation factor for each livestock structure by its area (measured in square feet) to predict the untreated odor that will be generated. The odor generation factors were established in 2004 based on the best available science. Subsequent research and program implementation has shed new light on the method and numbers used to calculate odor. The current Chart 2 does not include odor from certain sources such as housing for sheep and goats or sand separation channels, or sources of odor not well documented at the time the chart was developed.

What is your recommendation with respect to odor generation numbers? Should the numbers stay the same or should they be raised or lowered?

With respect to dairy housing types, should it be clarified whether this housing include natural and power ventilated barns? With respect to poultry, there is currently only one category. Should two categories be created for layers with different odor generation

numbers? For example, currently layers and litter in the same building have an odor generation number of 20. There is no category for layers in housing equipped with a belt system where litter is stored separately from the birds. Currently, broilers in housing with litter have an odor generation number of 1.

With respect to waste storage facilities, should the method for predicting odors be switched from storage duration to storage surface area? Currently short term storage has an odor generation number of 28 and long term storage (6 months or longer) has a generation number of 13. If so, the current odor generation number of 28 could be used for structures less than one acre in size and the current odor generation of 13 for structures larger than 1 acre, when measured at the maximum operating level. Are the generation numbers correct? Is there a need to combine storage duration and surface area to properly predict odor?

Currently there is no category for sand and solid separation systems. First, should a category be established? If so, is it appropriate to distinguish between parts of the system used for separation and those used for storage of separated materials? It has been suggested that an odor generation number of 40 could be assigned to treatment areas (e.g. a lane where sand is separated or a building housing mechanical separation equipment) and a generation number of 2 for the sand/solids storage area. For systems enclosed by buildings, the use of appropriate odor control practices, e.g. bio-filters could be used.

Do you have additional recommendations regarding any source listed in Chart 2 or sources that should be listed in Chart 2?

Odor Source	*Chart 2 Number*	*Recommendation*
Dairy free stall (slatted floor including floor and pit below)	6	
Dairy free stall (scrape)	4	
Dairy free stall (Bedded pack)	2	
Dairy free stall (Alley flush to storage)	10	
Poultry Housing, layers	20	
Waste Storage Facilities (Short term-less than 6 months)	28	
Waste Storage Facilities (Long term-6 months or more)	13	
Sand and solids separation systems - sand separation lanes (a.k.a. sand channels) and mechanical separation systems (e.g. screen, friction dryers, and screw presses)	Not listed	

2. Worksheet 2 (Appendix A, Chart 3, 390-26) (a copy is attached) identifies odor control practices that reduce odor from livestock structures, and assigns an odor control percentage to each of the practices consistent with the best available science.

   Background: In calculating their odor score, livestock operators can take credit for practices that reduce odor. The practices listed in Chart 3 apply to specific sources, and may not be combined with other practices in the same category. For example, bottom fill and aeration cannot be combined to reduce the odor score for manure storage. In order to claim a credit for a practice, the practice must meet the specifications described in Worksheet 3. To reflect the odor reduction from a practice, the applicant multiples the credit, expressed as a percentage, by the amount of odor generated by the related source. The odor control numbers were established in 2004 based on the best available science. Subsequent research and program implementation has provided new information on control methods and the factors assigned to odor control practices. The current rule includes a process for DATCP to approve innovative control practices not listed in Chart 3. DATCP has used this authority on one occasion to recognize a new odor control innovation for layer operations.

   In 2010, DNR developed a list of control practices for air emissions including a rating of the effectiveness of the practice in controlling odor.

In the area of housing there are several odor control practices that livestock operators can implement. Do any of the reduction factors/multipliers need to be adjusted for diet manipulation, biofilters, fresh water flush, treated water flush, immediate return flush, air dams, or windbreaks. Also, should a new category for wet scrubber be added?

With respect to waste storage should the reduction factor/multiplier be adjusted for anaerobic digestion, chemical or biological additives, compost, solid separation and reduction, aeration, geotextile covering or natural crust? Should a category for poultry layer housing utilizing a dryer belt system be added?

Do you have additional recommendations regarding any source listed in Chart 3, or sources that should be listed in Chart 3?

Odor Source and Control Practice	*Chart 3 Reduction Factor*	*Cannot combine with*	*Recommendation*
Housing: Diet manipulation (A1)	20% (0.8 multiplier)	None	
Housing: Bio-filter (B1)	90% (0.1 multiplier)	B2, B3, B4, B5	
Housing: Wet scrubber	Not included		
Housing: Fresh Water Flush (B3)	60% (0.6 multiplier)	B1, B2, B4, B5	
Housing: Treated Water Flush (B4)	30% (0.7 multiplier)	B1, B2, B3, B5	
Housing - Immediate return flush	Not included		
Housing: Air Dam (B5)	20% (0.8 multiplier)	B2, B3, B4, B5	
Housing: Windbreak (C1)	10% (0.9 multiplier)	None	
Waste Storage: Anaerobic digestion (E1)	80% (0.2 multiplier)	E2, E3, E4, E5	
Waste Storage: Chemical or biological additives (E2)	20% (0.8 multiplier)	E1, E3, E4, E5	
Waste Storage: Compost (E3)	80% (0.2 multiplier)	E1, E2, E4, E5	
Waste Storage: Solids separation and reduction (E4)	40% (0.6 multiplier)	E1, E2, E3, E5	
Waste Storage: Aeration (F1)	70% (0.3 multiplier)	F2, F3, F4, F5, F6	
Waste Storage: Geotextile cover (F3)	50% (0.5 multiplier)	F1, F2, F4, F5, F6	
Waste Storage: Natural crust (F5)	70% (0.3 multiplier)	F1, F2, F3, F4, F6	

3. ATCP 51.14(2)(c) and Worksheet 2 (Appendix A, 90-22) exempts operators from the odor standard if their proposed livestock facilities are 1) a new facility with fewer than 500 animal units; 2) expansions less than 1,000 animal units, or 3) have livestock structures at least 2,500 feet from the nearest affected neighbor. "Affected neighbors" (ATCP 51.01 (2)) are residences or "high-use buildings" (ATCP 51.01 (16)) other than those owned by the livestock operator or by persons who agree to a shorter setback.

   Background: The exemption for new facilities with fewer than 500 animal units and expansions with less than 1,000 animal units is based on the assumption that these facilities are not large generators of odors. Further, these operations oftentimes have less flexibility and financial resources to move livestock structures to increase setback distances or implement other odor control practices than those which are more readily available to larger livestock operations. The 2,500 foot exemption is based on earlier decisions that odors beyond 2,500 feet are minimal, and the protection of nearest affected neighbors is not necessary.

   Some have indicated that the exemptions may discourage expanding operations from planning for their future and making investments to address regulatory requirements that come with expansions.

   Currently 39 of the 121 permitted facilities are exempt from the odor standard; 35 of which are expansions under 1,000 AUs and one of which is more than 2,500 feet from the nearest neighbor.

Is it appropriate from a technical standpoint to continue these exemptions from the odor standard?

4. Livestock operators who complete required plans related to incident response and employee training and an optional odor management plan (Appendix A, Application for Local Approval, Nos. 12 and 13, p. 390-18) may claim additional points toward a passing odor score.

   Background: All applicants for a siting permit are required to submit an environmental incident response plan that outlines procedures to respond to incidents including overflows and spills from waste storage facilities, catastrophic system failures, manure spills during transport and application, movement of manure during or after application, catastrophic mortality disposal emergency, and odor complaints. The plan must include contact information for the person at the operation responsible for handling concerns and mobilizing first responders. A model plan is available from DATCP.

   Permit applicants must also submit an employee training plan covering training on nutrient management, odor management, runoff management, manure and waste handling, employee safety, and environmental incident response. The plan must provide details about training related to the employees to be trained, the form and frequency of training, and training presenters. Operators must hold at

least one training per year, and have a system for recording employee attendance. A model plan is available from DATCP.

A permit applicant may prepare and submit an optional odor management plan, which must address activities to reduce community conflict; practices used to reduce dust; practices used to reduce odor from feed storage leachate; practices used to conserve water; and practices used to reduce odor from dead animals. There is no model for preparation of these plans.

In completing Step 3 of Worksheet 2 (Appendix A, 390-22), all applicants may take an 80 point credit for completing required incident response and employee training plans. Applicants may take an additional 20 point credit if they complete an optional odor management plan. All applicants who were required to complete the odor worksheet claimed the 80 points, while 18 of 121 applicants also claimed the 20 points for the optional odor management plan.

Is it appropriate from a technical standpoint to award 80 points for the mandatory plans and 20 points for the optional plan? Can the plans be improved or strengthened to better control odor? If not, should the odor scoring system be adjusted and still include a requirement to have a mandatory plan to address odor practices?

5. ATCP 51 provides no guidance to local governments for monitoring livestock operations to determine whether odor control practices are properly implemented and maintained.

   Background: As noted in an engineering question about monitoring practices, the rule does not provide guidance regarding responsible and appropriate monitoring procedures.

Should a checklist be developed similar to the one used for nutrient management that producers and local governments can use to verify that a facility has installed, and continues to properly operate, odor control practices and management activities required under a siting permit?

In addition to a checklist, is it appropriate to allow for self-reporting by farm operators, requests by local governments for documentation, and on-site inspections of permitted facilities? Should DATCP provide guidance and training to local authorities on compliance monitoring?

Do you have other recommendations?

Setbacks

1. ATCP 51.12 establishes the maximum setback distance that local governments may impose on permitted livestock facilities through a local siting ordinance. They in are:

- No more than 350 feet for manure storage structures from the property line and road right of ways for all sized livestock facilities.
- No more than 100 feet to 200 feet, depending on the size of the livestock facility, for other structures including animal housing, animal lots, milking parlors and feed storage from property line and road right of ways,

  Background: Separation distance is generally regarded as the best method to reduce the impacts on neighboring property owners and land uses. Distance dilutes odors through mixing with atmospheric air. Wind speed, direction, atmospheric conditions, surrounding land use and topography all affect odor impacts.

  The maximum setbacks were established as a compromise to protect the interests of bordering property owners and neighboring land uses while allowing for the expansion of livestock operations.

  The odor standard, which accounts for separation distance between structures and the nearest neighbor (as well as odor control practices), generally determines whether or not and where manure storage, housing, feed storage or animal lots can be sited on a livestock operation. Since the odor standard relies on several variables to predict odor, in some instances it has not proven to be as reliable as distance.

Do current road and property line setbacks provide adequate protection to residences, high use buildings, parks, seasonal residences for hunting, and public spaces while still allowing for new and expanded livestock operations?

Could structure-to-structure setbacks more effectively protect certain land uses from the impacts of livestock facilities, or does the odor standard adequately address potential odor impacts while still providing options for producers?

Worksheet 2 (continued)

Chart 2: Odor Generation Numbers

Animal Housing Area Type	Housing/ Management Type Code	Manure Management Method	Odor Generation Number	Exempt Buildings Maximum Size (ft^2) *(May exclude up to 4)*
Dairy Stanchion	DSDC	Daily to weekly cleaning	2	7500
Dairy Free Stall and Beef & Dairy Heifers (Forage Ration)	DBSS	Slatted floor (includes floor and pit below)	6	2500
	DBSC	Scrape	4	3500
	DBAF	Alley flush to storage	10	1500
	DBBP	Bedded pack	2	7500
Beef Finishing (High Energy Ration)	BFSF	Slatted floor (includes floor and pit below)	12	1000
	BFSC	Scrape	8	2000
	BFBP	Bedded pack	4	3500
Pork Gestation/ Farrow/Nursery	PGSF	Slatted floor (includes floor and pit below)	46	N/A
	PGPP	Pull plug to storage	22	N/A
Pork Finishing	PFSF	Slatted floor (includes floor and pit below)	34	N/A
	PFPP	Pull plug to storage	20	N/A
	PFSS	Scrape systems to storage	11	1500
	PFDB	Deep bedded	4	3500
Poultry	PBLT	Broiler (litter)	1	15000
	PDLQ	Ducks (liquid)	20	N/A
	PLAY	Layers	20	N/A
	PTDL	Turkey and Ducks (litter)	2	7500

Type Codes	*Waste Storage Facility* Types *Note: Storage under slatted floor is addressed under animal housing.*	Odor Generation Number
WSSS	Solid (stack)	2
WSLT	Long term (6 months or longer as determined in Column E of worksheet 3)	13
WSST	Short term (less than 6 months as determined in Column E of worksheet 3)	28

Animal Lot Codes	*Animal Lot* Types		Odor Generation Number
ALPV	**Paved**		4
UPDB	**Unpaved**	Dairy/Beef/Sheep/Goats	6
UPSW		Swine/Poultry	11

Worksheet 2 (continued)

Chart 3: Odor Control Practices

Category	Practice Code	Practice Name (Practices must meet specifications on pages A−11 to A−13)	Multiplier*
		Animal Housing Area	
A	A1	Diet manipulation	0.8
B (Choose only 1)	B1	Bio−filter	0.1
	B2	Vegetable oil sprinkling (for swine only)	0.4
	B3	Fresh water flush	0.4
	B4	Treated water flush	0.7
	B5	Air Dam (for swine only)	0.9
C	C1	Windbreak (includes man−made berms)	0.9
D	D1	Frequent cleaning of animal housing area	0.9
		Waste Storage Facilities	
E (Choose only 1)	E1	Anaerobic digestion	0.2
	E2	Chemical or biological additives	0.8
	E3	Compost	0.2
	E4	Solids Separation and Reduction	0.6
	E5	Water Treatment	0.1
F (Choose only 1)	F1	Aeration	0.3
	F2	Bio−cover	0.4
	F3	Geotextile cover	0.5
	F4	Impermeable cover	0.1
	F5	Natural crust	0.3
	F6	Bottom fill	0.9
G	G1	Windbreak (includes man−made berms)	0.9
		Animal Lots	
H (Choose only 1)	H1	Frequent cleaning of *animal lot*	0.4
	H2	Drag *animal lot*	0.5
I	I1	*Animal lot* moisture control	0.8
J	J1	Windbreak (includes man−made berms)	0.9

*Smaller multiplier = more odor controlled (e.g. a multiplier of 0.4 represents a 60% control).

Innovative Odor Control Practices (all odor sources):
You may take credit for odor control practices not listed in Chart 3 if *DATCP* pre−approves a multiplier for each of those practices. Follow the procedure in *ATCP 51.14(5)(c)* to obtain *DATCP* approval. If you obtain *DATCP* approval, you may include the approved practice and multiplier in odor worksheet calculations in the same manner as for odor control practices listed in Chart 3 (attach *DATCP* approval to your application).

Odor Table

Table 1	Existing ATCP 51.12 Setbacks (shaded)		With respect to each of the neighboring land uses, do existing setbacks adequately mitigate the impacts of odor? If "no," insert a suggested separation distance that would be more effective.			
Structure, or practice	Property line (feet)	Road (feet)	Single residential structure	High-use building (e.g. school) or cluster of 6 residences	Public areas (e.g. park)	Municipal boundary or non-ag zoned area
1.Animal housing*	100 ft for <1000 AU 200 ft for >1000AU	100 ft for <1000 AU 150 ft for >1000AU				
a. <1,000 AU						
b. 1000 – 5000 AU						
c. >5,000 AU						
2. Animal Lot*	100 ft for <1000 AU 200 ft for >1000AU	100 ft for <1000 AU 150 ft for >1000AU				
a. < 1/2 acre						
b. > 1/2 acre						
3. Milking parlor**	100 ft for <1000 AU 200 ft for >1000AU	100 ft for <1000 AU 150 ft for >1000AU				
4. Feed storage**	100 ft for <1000 AU 200 ft for >1000AU	100 ft for <1000 AU 150 ft for >1000AU				
a. < 2 acres						
b. > 2 acres						
5. Manure Storage*	350 ft	350 ft				
a. < 4 acres						
b. > 4 acres						
c. Composting pad						
* rule has provisions for odor control practices for these structures						

Odor Research Summary
December 10, 2014

Odor Generation

DATCP and DNR (2009) *WI Dairy and Livestock Air Emission/Odor Project Report*, NRCS Conservation Innovation Grant # 68-3A75-5-157

- The odor model used by Livestock Facility Siting rule (ATCP 51) accurately predicts the odors from averaged sized manure storage lagoons (around 4 acres), however it under predicts odors from small lagoons (0.4 acre).

Housing

The 2010 Livestock Facility Siting Technical Expert Committee reviewed a number of studies related to housing and manure storage. Below is a summary.

- The generation number for dairy alley flush systems is too low in consideration of ongoing research, documented instances of odor events and other observable evidence involving more than one Wisconsin facility. Producers can use existing control practices to mitigate odors, and should be aided by the addition of a control practice involving the immediate return of wastewater before it becomes anaerobic.

- For alley flush to storage (DBAF), the odor generation number should be increased from 10 to 20. In addition, fresh water flush should be eliminated as an odor control practice and treated water flush should be retained with modifications. There should be an odor control credit of 50% for immediate return flush, which should be defined to accurately capture the practice of re-circulating flush liquids taken from a reception pit rather than a manure storage facility.

- For poultry housing, layers (PLAY), there is a need to differentiate odor generation numbers for high rise housing (birds and litter in same building) and dryer belt system housing (litter stored separately from birds). Based on the best available science, the number for a belt system should be 1, not 20.

Manure Storage

- Research suggests that odor generation is more accurately predicted based on the surface area of a manure storage structure, not on whether the storage duration is shorter or longer than six months. More odors are generated per square foot of surface area by structures having less than one acre of total exposed surface area than by structures having more than one acre of total surface area. In determining that odor generation is more accurately predicted based on the surface area of a manure storage structure, it is valuable to consider measurements used in other odor models such as OFFSET and their underlying dispersion models. Size-based

criteria will be easier for local governments to verify. The method for predicting odors should be switched from storage duration to storage surface area, and the worksheet should assign the current odor generation number of 28 to structures less than one acre and assign the current odor generation of 13 to structures larger than 1 acre, when measured at the maximum operating level (MOL).

- Sand and solids separation may take the form of sand separation lanes (a.k.a. sand channels) or mechanical separation systems (e.g. screens, friction dryers, and screw presses). A separation system also includes areas used for storage of separated materials. In light of research on comparable odor sources and unpublished field studies, it appears that sand channels may be major odor sources, and that sand stacking areas generate far less odor. In addition, based on field studies and comparisons with similar odor sources, sand separation buildings and manure solids separation buildings share key characteristics with sand settling lanes and should be treated as major odor sources. The structures are very distinct odor sources, performing like a point source rather than an area source, the generation number should be appropriately high for the treatment area, with the recognition that control practices can control odors from buildings where these activities are carried out. Accordingly, it would be appropriate to assign an odor generation number of 40 to the treatment area (e.g. lane where sand is separated, or building housing mechanical separation equipment) and a generation number of 2 for the sand/solids storage area. For systems enclosed by buildings, there should be recognition of appropriate practices, e.g. bio-filters, that can be applied to control odor.

Odor Control Practices

Garcia, A., Tjardes, K., Stein, H., Ullery, C., Pohl, S. and C. Schmit (2003) *Recommended strategies for odor control in dairy operations.* Publ. #ESS803-D, Cooperative extension service, South Dakota State University.

- Ranks the effectiveness of odor control practices using categories of high, medium and low. Setbacks and manure storage covers are among the few practices that rank as high.

Lorimor, J., Hoff, S., & O'Shaughnessy, P. (2002) *Iowa Concentrated Animal Feeding Operation Air Quality Study, Chapter 10 Emission Control Systems***,** Iowa State University and The University of Iowa Study Group (Entire study is here http://www.ehsrc.uiowa.edu/cafo_air_quality_study.html).

- Table 1 assigns a percentage reduction to the listed emission reducing strategies (see sections below for details on certain practices).

Confined Animal Manure Managers Program (2003) *Poultry Training Manual: Odor Control from Poultry Production Facilities*

- Lists recognized BMPs and supporting documentation.

Pennsylvania Department of Agriculture Odor Management Program (2011). *Approved Odor BMPs*

- Lists recognized BMPs and supporting documentation.

Aeration-Manure Storage

Andersen, D., Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Manure Storage & Handling - Aeration Overview*, part of the Air Management Practices Assessment Tool (AMPAT) developed at Iowa State University and funded by the National Pork Board.

- Aeration is the process of mixing air into the manure to promote the growth of aerobic bacteria. Oxygen must be supplied either naturally, mechanically through mixing, or using oxygen diffusion systems. This technology can provide dramatic odor reduction from livestock waste management facilities, but has not found frequent application in agriculture due to intensive energy use and resulting added utility costs. Odor reductions may range from 50 to 90%, with the level of performance dependent on the degree of aeration.

DATCP and DNR (2009)

- Installing a proprietary system involving both solid separation and aeration resulted in about a 20% reduction in odors in the first year and about a 25% reduction in the second year.

Zhu, J., Zhang, Z. & Miller C. (2008) *Odor and Aeration Efficiency Affected by Solids in Swine Manure During Post-aeration Storage*, ASABE 51 (1): 293-300 Jan.-Feb.

- The results showed that continuous aeration for 5, 15, and 30 days at 35 mV ORP, 1 and 3 mg l DO levels was sufficient to keep the treated liquid odor-free for a storage period of up to 180 days if the manure solids levels were below 0.79%, 0.87%, and 0.96%; 0.82%, 1.0%, and 1.23%; and 1.02%, 1.11%, 1.52%, respectively. It turns out that in order to reduce aeration time and rates, the manure total solids content should not exceed 1%.

ZhiJian Zhang, Z. (2005) *Effectiveness of short-term aeration in treating swine finishing manure to reduce odour generation potential*, Agriculture, Ecosystems and Environment 105: 115–125.

- Four-day aeration scheme is recommended for manure with total solids content less than 2.0% to achieve the removal efficiency of over 70% for reducing odour generation potential.

2010 Siting Committee Review

- Based on real life experience, there was a general concern that aeration does not perform at the level required to achieve the high degree of reduction required to receive a 70% credit. In most cases, aeration is not adequate to achieve the required 2 mg/l of dissolved oxygen. In evaluating the appropriate credit, it is valuable to consider research and experience in related areas of waste treatment, the necessity for separating solids before aeration, and field observations that suggested that a 30% credit might be more appropriate.

Anaerobic Digestion-Manure Storage

Ubeda, Yolanda; Nicolas, Jacques Calvet, S et al (2010) *Preliminary study of effects of anaerobic digestion of manure on VFA content and Odor concentration* Unpublished Conference Proceedings International Symposium on Air Quality and Manure Management for Agriculture (ASABE2010).

- In this study, the potential reduction of odor by anaerobic digestion has been evaluated in three commercial facilities located in Belgium, Luxembourg and Germany. Odor concentrations were measured by olfactometric analyses in two different situations: at normal conditions and after stirring the odor source. Parallel to these measures, representative samples were taken for digested and untreated manure and other co-substrates present in the facilities. Volatile solids, total solids, total suspended solids, volatile suspended solids, soluble chemical oxygen demand, ammonia nitrogen, total kjeldhal nitrogen, volatile fatty acids, and pH were determined in a laboratory. The performance of anaerobic digestion in terms of VFA concentration reduction achieved values of 77-96%. Odor concentration was reduced by anaerobic digestion in the two studied scenarios: at normal conditions and after stirring the odor source. No significant effect of anaerobic digestion on chemical analyses was observed, except for an increase in the ammonia nitrogen content. Significant correlations were found between the logarithm of odor concentration and different odor-producing acids (VFA, acetic, butyric, isobutyric, isovaleric). Correlations between odor concentration, VFA and other parameters (VS, VSS and pH) were also obtained. These results confirm that anaerobic digestion may reduce odor annoyance potential and VFA concentrations. In addition, odor concentration seems to be related with other chemical parameters, therefore more research is needed to obtain further conclusions.

DATCP and DNR (2009)

- The storage lagoon receiving wastes from the low temperature digester produced about 15% less ambient odors than a similar lagoon storing undigested wastes. On the other hand, the storage lagoon receiving wastes from the high temperature digester produced about 15% more ambient odors than did the lagoon storing undigested wastes. Because of the inherently subjective nature of this type of testing, plus or minus 15% should not be considered statistically significant. Factors such as retention time, operational reliability, and addition of substrate material can all influence the performance of an anaerobic digester, and therefore its effectiveness at controlling odors.

Lingying Z, Rausch, J, & Combs, T. (2008) *Overview of Odor Control for Manure Storage Facilities*, **Ohio** State University Extension Fact Sheet Agricultural and Natural Resources AEX-738-08.

- If an anaerobic digester is designed, operated, and maintained properly, a relatively complete anaerobic decomposition process is expected and very little odor is produced. Anaerobic digesters can reduce manure odors by 70%-80% compared to untreated manure. However, the cost of an anaerobic digester, the energy input to the digesters in a cold climate, and high failure rates are currently

limiting wide adoption of this technology. Proper design, construction, and management of the anaerobic digester are critical to the success of this system.

Zhang, R.; McGarvey, J.; Ma, Y.; Mitloehner, F. (2008) *Effects of anaerobic digestion and aerobic treatment on the reduction of gaseous emissions from dairy manure storages*. International Journal of Agricultural and Biological Engineering, North America, 119.

- Previous research results have indicated that anaerobically treated manure had lower odor intensity than untreated manure. Zhang et al. evaluated the odor characteristics of untreated and anaerobically treated swine and dairy manure over a three-month anaerobic storage period and found that untreated manure had strong odors with high concentrations of volatile fatty acids (VFAs), hydrogen sulfide (H2S) and methyl mercaptan (CH3SH) in the emitted gases, while anaerobically digested manure had lower odors, VFAs and low or no detectable sulfur gases.

Hansen, M.N., Kai, P., Moller, H.B. (2006) *Effects of anaerobic digestion and separation of pig slurry on odor emission*, Applied engineering in agriculture Jan., v. 22, no. 1 p. 135-139.

- Anaerobic digestion and separation of slurry change composition and physical properties of slurry and may therefore lessen the odor pollution during storage and land application. An experiment was set up to study the effects of anaerobic digestion and separation of slurry on the emission of odor. Odor concentration above treated and untreated slurry was compared during storage and following land application. Concentrations of odorous gasses were measured using GC/MS analysis and odor concentrations were determined using dynamic dilution olfactometry. Slurry concentrations of malodorous volatile fatty acids were reduced by between 79% and 97% by anaerobic digestion, while concentrations of malodorous phenolic and indolic odor components above the slurry were reduced by both anaerobic digestion and subsequent separation. Odor concentration in air sampled above slurry stores was slightly reduced by anaerobic digestion; however, odor concentration was found to be higher above stores of anaerobically digested slurry following mixing of the slurry prior to land application. Odor concentration in air sampled above land applied slurry was reduced by 17% by anaerobic digestion and by 50% by combined anaerobic digestion and separation.

Goodrich, P. (2005) *Anaerobic Digester Systems for Mid-Sized Dairy Farms*, The Minnesota Project

- Odor reduction from the use of digesters is translated into monetary values for the different examples, e.g. $15,000 annual odor control benefit for having a digester.

Wright, P. et al (2004) *Preliminary Comparison of Five Anaerobic Digestion Systems on Dairy Farms in New York State*, Presented at 2004 ASAE/CSAE Ann. Int. Meeting.

- In a study of 5 different digester systems using distinct feed stocks. It was found that effluent volatile fatty acid levels in 3 farms are above the recommended 500-ppm for odor control. One of the three farms had a high dilution rate in their raw

manure. This increased volume of water has reduced the retention time below the designed value.

Lorimor, J. (2002)

- Storage, Anaerobic digestion of manure, odor reduction, 80 - 85%.

Powers, W., Van Horn, H., Wilkie, A., Wilcox C. and Nordstedt, R. (1999) *Effects of anaerobic digestion and additives to effluent or cattle feed on odor and odorant concentration*, J Anim Sci 1999. 77:1412-1421.

- Anaerobic digestion reduced odor intensity significantly.

ManureNet, Ontario Canada – national information resource and coordination centre for Manure / Nutrient Management and Bioenergy Issues. The digester webpage contains an extensive list of research papers.

2010 Siting Committee Review

- A review of anaerobic digestion odor control research, including the unpublished findings of field studies conducted by the University of Minnesota, indicates that actual odor control from digesters varies based on a number of operational factors, and is generally less than 80% for most installations. Performance can be influenced by the types and amounts of substrates used, and substrates should be reviewed on a case-by-case basis. The credit should be reduced from 80% to 40%, but operators should be allowed to combine digestion with solid separation from Worksheet 2 Category E to increase the combined credit to 60%. The credit might be increased in cases where there is documentation demonstrating that operating conditions or enhancements provide additional odor reductions. The innovative practice provision can be used to account for improvements in odor control technology, such as two-stage systems, and the proper use of substrates. It was recognized that operating conditions and enhancements can improve performance in controlling odor, and some digesters might be able to achieve the current 80% odor control credit under certain specific conditions.

Chemical or Biological Additives-Manure Storage

Andersen, D., Harmon, J. Hoff, S. & Rieck-Hinz, A. (2014) *Manure Storage & Handling – Manure Additives (coming soon), part* of the AMPAT developed at Iowa State University and funded by the National Pork Board.

Shah, S., Grabow, G. & Westerman, P. (2011) *Additives for Improving Hog Farm Air Quality*, Air Quality Education in Animal Agriculture project was supported by National Research Initiative Competitive Grant 2007-55112-17856.

- Additives for improving air quality by reducing emissions of ammonia, hydrogen sulfide, and VOCs from hog house shallow pits and lagoons fall into eight categories: pH modifiers and acidifiers, (2) digestive additives, (3) oxidizing agents, (4) disinfectants, (5) adsorbents, (6) enzyme inhibitors, (7) saponins from yucca, and (8) masking agents and counteractants. A single additive is unlikely to

provide benefits for multiple gases, and, in fact, while reducing the emission of one gas, it may increase the emission of another. Table 1 lists additives that have shown potential in the laboratory or field in improving air quality in hog production.

Lingying Z, Rausch, J, & Combs, T. (2008)

- Manure additives are typically chemicals, microorganisms, enzymes, disinfectants, and adsorbents or absorbents added directly to the manure to control odor. Manure additives have various odor control effectiveness. A National Pork Producer Council study conducted by Purdue University under laboratory conditions showed that only four manure pit additives reduced odor and the majority did not. The performance of many of these additives needs to be scientifically tested under field conditions before they are widely applied.

Q. Zhang, J. Feddes, I. Edeogu, M. Nyachoti, J. House, D. Small, C. Liu, D. Mann, G. Clark (2002) Odour Production, Evaluation and Control, Manitoba Livestock Manure Management Initiative, Winnipeg.

- Different studies have resulted in conflicting results for the effectiveness of using manure additives. This is partially due to the lack of universally accepted protocols for evaluating manure additives. Although some existing manure additive products have been shown to be effective in odour reduction under laboratory conditions, they may not perform well in actual production facilities.

Zhang, Q. (1999) *In-Barn Evaluations of Manure Pit Additives for Odour Reduction* ARDI Project #98-087, Department of Biosystems Engineering University of Manitoba.

- Six pit additives (odour counteractants) that were evaluated appeared to be ineffective in reducing odour intensity of barn air that could be detected by a human odour panel using cloth swatches, at least in a commercial setting. It should be mentioned that this does not necessarily mean that these additives are without benefit. Other manure characteristics that do not directly impinge on the perceived odour intensity may be favourably affected.

Heber, A. et al (2001) *Laboratory Testing of Commercial Manure Additives for Swine Odor Control*, Purdue University.

- Thirty-five manure storage pit additive products were evaluated by the Purdue University Agricultural Air Quality Laboratory in an experiment supported by the National Pork Board. Five products reduced odor with a 75% Certainty of Decrease.

2010 Siting Committee Review

- There are a wide variety of chemical and biological additives currently on the market; and their relative effectiveness in controlling odors varies. For example, a Purdue University study concluded that only 5 out of 35 additives tested provided any measureable reduction in odor. Enzymes are an emerging technology that seems to hold some promise. Acidifiers have been shown to effectively limit the release of ammonia from manure storage structures. When taking a credit for chemical or biological additives (E2), applicants should be allowed the 20% credit

only if they identify specific additives used and provide science-based documentation that the products are effective in controlling odors. Livestock operators should be able to combine this odor control practice with other complementary odor control practices listed in Worksheet 2 Category E, such as solid separation.

Composting-Manure Storage

2010 Siting Committee Findings

- Composting can have a positive effect on odors if properly managed; however, the 80% credit in the current siting rule is too high, given that there are emissions from compost piles, and effective composting depends on variables such as stack height that are needed to achieve good aeration of the windrows and avoid odors. The credit should be reduced from 80% to 50%, but an additional credit could be provided for indoor composting if the building's exhaust air is treated with an odor control practice such as a bio-filter.

Impermeable Covers-Manure Storage

Andersen, D., Harmon, J. Hoff, S. & Rieck-Hinz, A. (2014) *Manure Storage & Handling - Impermeable Covers*, *part* of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- Impermeable covers can be used to reduce odors and emissions from manure storage or to capture biogas for heat or power generation. Odors may be reduced by 85 to 99% dependent on edge sealing.

Stenglein, R., Clanton, C. Schmidt, D., Jacobson, L. & Janni, K. (2011) *Covers for Mitigating Odor and Gas Emissions in Animal Agriculture: An Overview*, *Air* Quality Education in Animal Agriculture project was supported by National Research Initiative Competitive Grant.

- The following impermeable covers may reduce odor by the percentages indicated: concrete by 95 – 100%; wood lid, 75 – 95%; Positive Air Pressure, 95%; Negative Air Pressure, 95 – 99%; Floating, 39 – 95%.

Nicolai, R., Pohl, S. and Schmidt, D. (2004) Covers for manure storage units. Livestock Development in South Dakota: Environment and Health. FS 925-D. South Dakota State Univ.

- The following impermeable covers may reduce odor by the percentages indicated: Concrete Lid, 95%; Wood lid, 95%; Inflatable plastic, 95% ; Floating plastic (HDPE), 60-78%.

Permeable Covers-Manure Storage

Andersen, D., Harmon, J. Hoff & Rieck-Hinz, A. (2014) *Manure Storage & Handling - Permeable Covers*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- Permeable covers are used to reduce odors and emissions from manure storage structures. Permeable covers are materials such as a natural crust, straw, ground corn stalks, as well as expanded clays, ceramics and ground rubber that lie directly on the surface of the stored manure and provide a physical barrier between the manure and the surrounding air. Odor reductions vary from 40 to 90% depending on type and thickness of the cover.

Stenglein, R., Clanton, C. Schmidt, D., Jacobson, L. & Janni, K. (2011)

- The following permeable covers may reduce odor by the percentages indicated: Natural Crust by 56 – 78%; Straw, 45 – 83%; Straw (8 in) + Geotextile, 76 – 83%; Geotextile (2.4 mm), 51 – 63%; %; Leca®, 69 – 89%; Macrolite®, 56 – 62%.

Nicolai, R., Pohl, S. and Schmidt, D. (2004)

- The following covers provide the odor reductions as indicated: Permeable Straw, 40-90%; Geotextile, 40-65%; Geotextile + straw; 50-80%; Leca®, 90%, Macrolite®, 60%.

Lingying Z, Rausch, J, & Combs, T. (2008)

- Impermeable and permeable covers range in their control of odor from 46% to 95%.

Lorimor, J. (2002)

- Storage, Natural crusting of manure surface, odors reduced by 75 %.
- Storage, Floating permeable man-made covers, odors reduced by 60 - 75 %.

2010 Siting Committee Review

- The WI Dairy and Livestock Air Emission/Odor Project indicated that geotextile covers are upwards of 70% effective at controlling odors from manure storage. University of Minnesota research findings about an early generation of covers indicated control effectiveness between 30% and 70%, but there have been improvements in this technology. Geotextile cover credit should be increased from 50% to 60%.
- For natural crust (F5), the rule should retain the current 70% credit, but strengthen the definition with more measurable criteria, e.g. “80% of the surface, 80% of the time.”

Solids Separation and Reduction-Manure Storage

Lingying Z, Rausch, J, & Combs, T. (2008)

- Liquid and solid separation is usually used to reduce solid content of manure storages and thus reduce odor. The liquid-solid separation is therefore an

important step in manure treatment but the odor control effectiveness of the different steps has not been clearly quantified.

Ndegwa, P.M., J. Zhu and A. Luo. 2000. Solids-Liquid Separation of Swine Manure for Odor Control. ASAE Meeting July Milwaukee.

- In this work, a bench-scale study was conducted to evaluate how the screen size of a swine-slurry separation process affects the odor potential from the resulting liquid. Results suggest that particles smaller than 0.075 mm (0.003 in) must be removed to have a positive impact on odor generation. Because this is extremely small, the practical value of this approach appears limited. A side conclusion of this work is that solids concentrations can predict odor strength in deep pits.

Sheffield, R., Barker, J. & Rashash, D. (?) Solids Separation of Animal Manure North Carolina University.

- The separation effectiveness is described by system type.

2010 Siting Committee Review

- Experience and existing research, including experience in related industries, does not support the 40% odor control credit provided for solids separation and reduction, nor does it support distinguishing credits for different separation processes. From a performance standpoint, there is a significant concern that separation systems may not achieve required levels of separation. The rule should recognize the cumulative benefits of using solid separation with other practices such as digesters and chemical additives to provide more effective odor control. The credit should be reduced from 40% to 20%, and livestock operators should be required to make periodic checks (e.g. after agitation) to document compliance with the two or less percent solids requirement. However, operators should be allowed to combine this practice other practices in Worksheet 2 Category E to qualify for a combined reduction.

Building Barriers-Housing

Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Animal Housing - Barriers Overview*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- Barriers, often called "windbreak walls", are used downwind of fans to reduce the forward momentum of airflow. Odor reductions of 25 to 90% can be anticipated depending on design.

2010 Siting Committee Review

- The credit for air dams is appropriate and this practice should be available for all positively ventilated housing, not just swine. The definition of a windbreak should be expanded to include air dams because air dams function in the same manner as windbreaks and are given the same odor control credit.

Chimney-Housing

Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Animal Housing - Chimney Overview*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- The use of chimneys in animal housing systems can elevate odors and increase dispersion with increased wind speed and air turbulence at higher elevations. Odor can be reduced by as much as 75% but the effect is localized.

Biofilters-Housing

Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Animal Housing – Biofilters Overview*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- Biofilters, which are used on mechanically-ventilated livestock buildings to treat the ventilation air, may reduce odor by 70 to 95%.

Janni, K, Nicolai, R., Hoff, S. & Stenglein, R. (2012) *Biofilters for Odor and Air Pollution Mitigation in Animal Agriculture*, Air Quality Education in Animal Agriculture project was supported by National Research Initiative Competitive Grant 2007-55112-17856.

- Well-designed and managed biofilters can reduce odors and hydrogen sulfide (H2S) by as much as 95 percent and ammonia (NH3) by 80 percent. Biofilters have been used by nonagricultural industries for many years and on animal facilities for over 12 years in North America.

2010 Siting Committee Review

- The bio-filter odor control credit of 90% reduction assumes that all of the exhaust air from a confinement building is filtered. However it is common to only vent the most odorous exhaust air from the manure pit beneath the animal housing through a bio-filter. A credit as low as 50% might be more appropriate. A separate credit should not be provided for bio-filters placed on reception pits in animal housing, since pit odors are not counted separately in the odor model, but are included within the housing generation number.

Landscaping-Housing

Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Animal Housing – Landscaping Overview*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- Landscaping or the use of Vegetative Environmental Buffers (VEBs) can be used to manage odors and dust coming from animal housing and manure storage structures. Odor reduction is limited to about 6% to 15%.

Vegetable Oil Sprinkling-Housing

Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Animal Housing – Vegetable Oil Sprinkling Overview*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board,

- The principal behind vegetable oil sprinkling is that oil is sprayed into the air causing the dust particles to stick to oil droplets and other dust particles, thereby settling to the floor. Odor may be reduced by an estimated 25 to 60%.

Diet Manipulation-Housing

Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Animal Housing – Dietary Manipulation Overview*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- Reducing nutrients in manure can lead to reductions in emissions. Reducing nutrients in manure is broken into two main areas, nutrient input reduction and nutrient form modification. Depending on the method, odor reduction ranges from 11 to 40 percent: Here are two examples:

  Lowering Crude Protein: Traditionally corn/soybean diets were formulated to meet all the amino acid requirements, resulting in protein being provided at a level higher than required. Crude protein can generally be reduced by 3.5 to 4.5 percent and the amino acids supplied using supplemental amino acids without impacting pig performance. This resulted in reductions of odors of between 30 to 40 percent.

  Adding Fermentable Carbohydrates: Adding soybean hulls, wheat bran or midds, or sugar beet pulp to diets reduces nitrogen excretion in urine as urea which shifts more nitrogen to feces and lowers the pH. This makes the excreted nitrogen more stable and less likely to volatilize. Soybean hulls have been added to diets at a rate of 10 percent with 3.4 percent fat and found to reduce odor by 11 percent.

Carter, S., Sutton, A. & Stenglein, R. (2012) *Diet and Feed Management to Mitigate Airborne Emissions*, Air Quality Education in Animal Agriculture project was supported by National Research Initiative Competitive Grant 2007-55112-17856

- Using a combination of several feed related techniques can reduce ammonia and hydrogen sulfide emissions by 30-50 percent and odors by 30 percent with little extra cost for the producer.

2010 Siting Committee Review

- There is a need to improve the definition to include odor control as a feed management goal and require documentation. Current research and data do not support a 20% credit for diet manipulation. From a performance standpoint, feed management is driven primarily by cost and animal performance considerations, not odor control. Properly balanced rations will limit the use of distillers grains and other byproducts as a protein source. There was a concern that producers may

not have adequate documentation to demonstrate that diets are selected and managed with odor control as a goal. A credit of 10% is more appropriate.

Wet Scrubbers -Housing

Harmon, J., Hoff, S. & Rieck-Hinz, A. (2014) *Animal Housing – Wet Scrubber Overview*, part of the AMPAT developed at Iowa State University and funded by the National Pork Board.

- Wet scrubbers are used on ventilation air as it exits livestock housing. They use liquid to collect dust or particulate matter (PM) and absorb gases from air by using a wet surface, spray system, or wet material bed. They may achieve odor reductions of 30 to 60%.

Manuzon, R., Zhao, L. & Jonjak, A. (2011) *Wet scrubber for mechanically ventilated animal facilities*, Air Quality Education in Animal Agriculture project was supported by National Research Initiative Competitive Grant 2007-55112-17856

- Lists research literature on subject.

Odor Management Plans

Minnesota Pollution Control Agency (2010) *Air Emissions and Odor Management Plan*, Feedlot General NPDES/SDS Permit Application Form.

- MN CAFOs are required to develop an air emission and odor management plan.

University of Minnesota Extension (2001) *Preparing an Odor Management Plan* Extension Publication FO-07637.

Pennsylvania State Conservation Commission (2014) *Odor Management Program Guidance & Technical Manual*.

- Provides guidance for developing a plan that meets state requirements.

Alberta Agriculture and Rural Development (2011) Odour Management Plan for Alberta Livestock Producers.

2010 Siting Committee Review

- Management plans are important in promoting positive outcomes on permitted farms. To be recognized, they must contain the baseline components to ensure that permitted farms responsibly address odor and related management issues, and they must be specific and enforceable. The plans must be strengthened to ensure they achieve their intended purposes, including odor control. Because plans are an important tool in promoting responsible behavior, including efforts to manage odor, the odor plan requirements should be required of all applicants, although the specific requirements for odor plans should vary depending on whether the applicant is required to complete Worksheet 2. Even with improvements to the plans and elimination of the optional plan, there is insufficient technical basis to award 100 points toward a passing odor score and recommended that a maximum of 50 points be credited in the odor model.

- To justify awarding points the plan requirements must be strengthened, which includes consolidation of plan requirements into one mandatory plan. Planning standards should include better defined requirements with a greater focus on odor management, and stronger compliance responsibilities. To ensure uniformity and consistency, the state should develop a state approved form with options for tailoring it to meet individual needs that facilities must use to complete their management plans. Specific plan requirements include expanded training requirements to ensure that affected employees understand general odor principals and specific information on using the odor control practices authorized in the local siting permit. Plans should have detailed odor complaint response protocols that cover internal complaint investigation processes, documentation, recordkeeping, and actions taken to investigate and respond to complaints. The management plan must clearly define the acceptable management practices to control odor from animal housing, animal lots, manure storage, feed storage, mortalities, reducing dust, managing community conflict and water conservation. The plan should include documentation to illustrate that required practices are properly maintained, including schedules for inspection.