Manure on Frozen or Snow-Covered Ground – EPC Update #1

Preliminary planning, discussion, and information gathering has begun with respect to rule making regarding manure application on frozen or snow-covered ground. This effort will be coordinated by Claire Hruby, a geologist that has been working with the DNR's Animal Feeding Operation program for 5 years. An internal workgroup has been identified including Field Office, Communications, and Legal staff. Several other stakeholders and interested parties have been contacted to-date including representatives of the agricultural and producer groups, environmental organizations, university researchers and extension experts, nutrient applicators, drinking water agencies, and Iowa Geological and Water Survey staff. Depending on the complexity of the rule, a draft could be filed as early as September. The earliest such a rule could be enforced would be winter of 2009. The initial findings are summarized in this document, and the questions that must be addressed as part of this rule-making process will also be presented.

The Practice

As stated in the motion, this rule is intended to restrict surface application of manure on ground made impermeable by freezing soil moisture, snow pack or surface ice. If manure is injected or incorporated this rule would not apply. Proper injection is thought to be impossible with more than 4 inches of snow. Application during overnight freezes in the spring should be allowed (when the first ½ inch or less of soils is frozen or when there is less than 1 inch of snow). Research by Discovery Farms in Wisconsin, shows that a single application of liquid manure on frozen ground that is not snow-covered can infiltrate soil through macropores, such as worm burrows. Solid cattle manure, especially that which contains bedding materials, has been shown to reduce soil erosion (Young and Holt, 1977), and should be considered separately. Further consideration of manure types, facility types, and soil and weather conditions will be necessary.

Winter application and water quality in early 2008

It is important to first understand more about the practice as it has occurred in Iowa and what the measured impacts on water quality have been. Several producers confirmed that a wet fall followed by an early freeze contributed to the decision to apply on frozen ground during the winter of 2007-2008. No surveys are available documenting the frequency of this practice, so we must rely on field observations. Multiple incidences of manure application on frozen and snow-covered ground were observed by Field Office specialists resulting in documented elevated ammonia levels and other water quality impacts.

During the period of high ammonia values reported by Des Moines Water Works and others this past spring, staff from Field Office #4 visited the Brushy Creek watershed (Carroll County) and observed fields where liquid swine manure had been applied to snow-covered ground. Several photos were taken documenting impact of runoff from these fields on surface water. Puddles in these fields, tile outlets, and stream water samples were field-tested using Hach kits. Ammonia measured by these kits showed that manure application did impact ammonia levels in Halbur Creek, a tributary of Brushy Creek. On a positive note, staff observed significant improvements in manure storage on

open feedlots that had been cited with violations as a result of the 2005 fish-kill in the watershed.

In response to a complaint, staff from Field Office #2 visited a site in Hardin County where poultry manure had been land applied on frozen snow-covered ground. Staff estimated that approximately 40% of the application field had slopes over 4%. The Hach test-kit indicated that water ponded in the field had an ammonia concentration greater than 3.0 mg/L. A sample was taken and sent to University Hygienic Laboratories. The lab reported 20 mg/L ammonia nitrogen, 120 mg/L TKN, and 1.1 mg/L nitrate + nitrite. A few weeks later the site was revisited and water quality violations were documented. After further investigation, a Notice of Violation was issued and a $6000 penalty was paid.

Ammonia levels are often elevated in spring melt-waters especially after long cold snowy winters when opportunities for volatilization are limited. There are multiple sources of ammonia and it is difficult to determine relative contributions of these sources statewide, however, we can conclude that application of manure on frozen ground contributed to the elevated ammonia levels in the Brushy Creek watershed (Carroll County) this past spring. Elevated ammonia concentrations are a concern for drinking-water facilities that depend on surface water as their source water due to the increase in chlorine necessary for treatment, the formation of dichoramine which lead to taste and odor problems, and the potential for the formation of disinfection byproducts which are regulated contaminants. Loss of nutrients should also be a concern to crop producers given the high value of manure as fertilizer. Toxic conditions resulting from high ammonia levels were not documented in large streams (see attached "Ammonia08" report). Although pH and temperature data is limited, it is likely that ammonia standards set for aquatic life were violated in the Brushy Creek watershed. Fortunately low water temperatures favor the ionized form of ammonia (NH_4^+) as opposed to the un-ionized form (NH_3), which is toxic to fish.

Impacts of Rule Making

It is generally understood that only a small fraction (perhaps between 1-5%) of producers find it necessary to apply manure to frozen or snow covered ground in any given year. These tend to be older and smaller facilities with insufficient storage capacity and/or poorly managed storage. To some it may seem like a waste of effort to attempt to change the behavior of a small percentage of producers, however, given the recent rise in animal numbers (especially swine), the concentration of animals in certain areas, and the documented water quality challenges, a small change could make a big difference. It is also important to consider that a statewide ban on manure application on frozen or snow-covered ground could force producers to apply in the spring when the ground is saturated or in early fall when the potential for leaching nitrogen is high. A thorough review of current research and expertise will be necessary to ensure that any change in state policy results in improved water quality. The best outcome of this process will be to inform producers of best management practices and to give them the tools to continuously evaluate and improve their management techniques. While regulations are necessary to discourage the worst practices, empowering producers to make better management decisions will benefit both the economy and improve the quality of our water resources. Finally, it is also important to consider that Iowa's soils have a finite capacity to hold nutrients and water. While it appears that market forces may slow the growth of animal

agriculture, effort should be made to evaluate the capacity of Iowa's soils to sustain additional animals. The technology is now available to help us make more meaningful (science-based) decisions about permitting and manure management, and to communicate that information to producers and the public.

Options

We are currently faced with three choices. We can choose to ban manure application on frozen or snow-covered ground statewide as proposed by Iowa Citizens for Community Improvement (ICCI) as presented in a petition to the EPC on May 13, 2008. While this petition states the groups' intention to impact only facilities that require manure management plans, the text of their proposed rule change appears to apply to all confinement operations. For the time being they have agreed to extend their petition for at least another 30 days (until the August EPC meeting) while they evaluate the DNR's attempt at rule writing. The second choice is to develop rules as the EPC motion suggests that would further regulate the practice and could prohibit surface application of manure on frozen or snow-covered ground under certain conditions, during certain times, or in certain areas. Finally, the third option is to continue to enforce the existing rules without modification. Regardless of the outcome of the rule-making, DNR is committed to working with its partners to educate producers and the public about best management practices.

Iowa's Current Regulations and Enforcement

Rules relating to animal feeding operations are found in 567 Iowa Administrative Code – Chapter 65. 65.3(5) describes restrictions on the application of manure including 65.3(3)*g*., which prohibits application of manure that is not injected or incorporated on the same date as applied, within 200 feet from a designated area or 800 feet from a high quality resource water, unless a 50-foot area with permanent vegetation cover exists. 65.3(4) includes recommended practices for manure application including 65/3(4)*c*., which states that *"Manure application on frozen or snow-covered cropland should be avoided where possible. If manure is spread on frozen or snow-covered cropland, application should be limited to areas on which: 1) land slopes are 4% or less, or 2) adequate erosion control practices exist."* Additional recommendations regarding application on areas subject to flooding, areas adjacent to water-bodies, and steeply sloping cropland are also included. Also, by law anyone applying or transporting manure must be a certified manure applicator. Chapters 67, 68, and 121 regulate the application of sewage, septage and solid waste, but these do not apply to manure application. In general, these rules restrict application away from waterways and to land with slopes less than 5% if applied to frozen or snow-covered ground. Chapter 61 describes water quality standards. Any water quality impacts that result from land application of manure are subject to these rules.

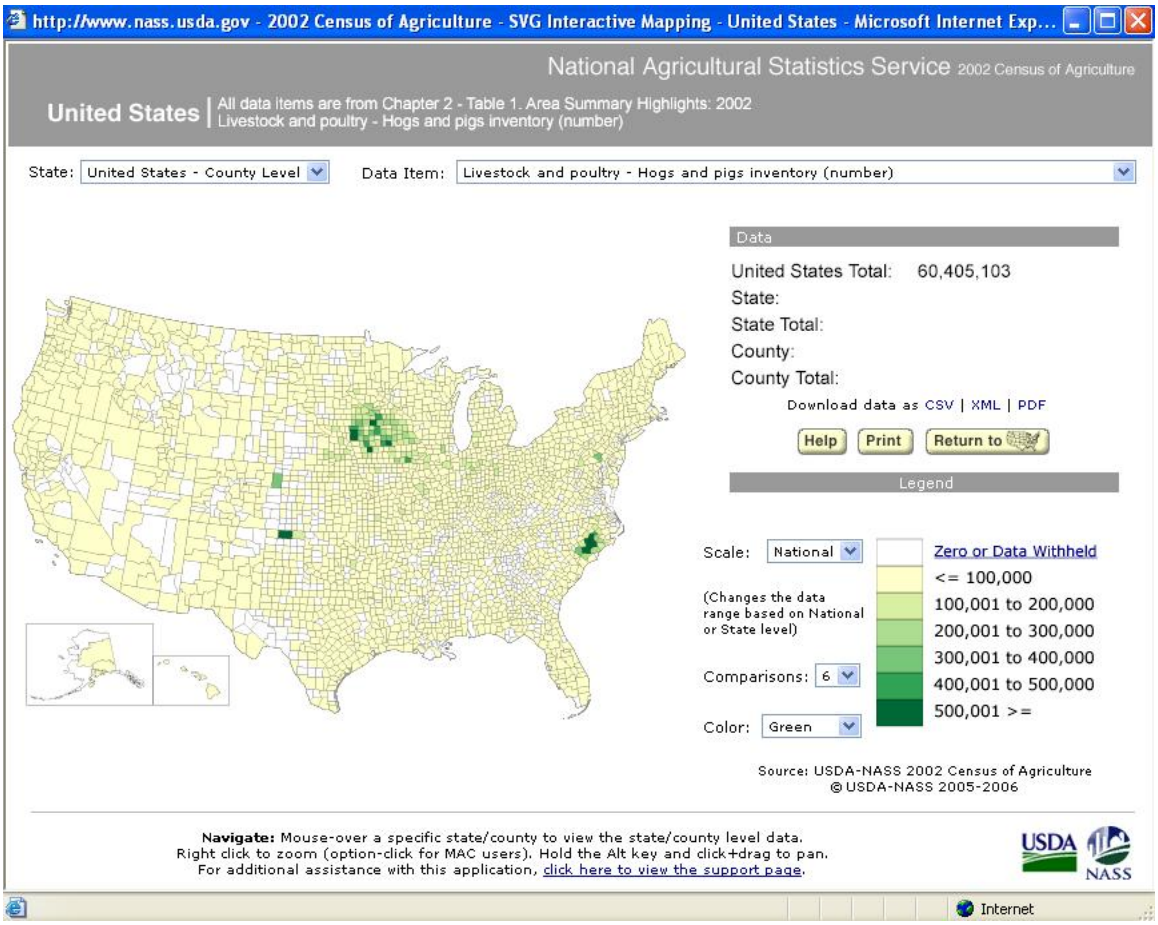
NPDES permits issued to some open feedlots include a prohibition on surface application of manure on frozen or snow-covered ground.

Currently, if Field Office staff observe manure applied to frozen or snow-covered ground that is not in violation a separation distance requirement or causing water quality violation, they are likely to have to return to that site during a subsequent melt event in order to document a violation. This is often difficult when staff are busy responding to other issues, often many counties away. When they are able to return, significant effort

and some expense is required to thoroughly document cause-and-effect including photography, field testing, and sampling water to be sent to a lab for analysis.

Surrounding States

According to the National Agricultural Census Data, Iowa has considerably more animals in higher concentrations than any of the surrounding states, and numbers of some animal types have increased significantly in the past few years.



Wisconsin, which has mostly large dairies and turkey operations, has gone through the most recent rule-making related to manure application on frozen and snow-covered ground. Surface application of manure is prohibited in Wisconsin in February and March and on fields with 5 feet or less of soil above fractured bedrock. Liquid manure application is prohibited in winter except in emergencies. Solid manure is not allowed in winter on land with slopes greater than 9%. In addition, Wisconsin's new rules restrict application on saturated ground. These rules apply to facilities that are required to have WPDES permit, which are generally animal feeding operations with more than 1000 animal units. Some facilities were given until 2010 to install 6 months of storage. Conditions where emergency application is allowed are carefully defined. A summary of Wisconsin's rules can be found at: http://dnr.wi.gov/runoff/pdf/rules/nr243/WinterSpreading.pdf .

There is a lot of variation between other nearby states, but all identify surface application of manure on frozen or snow-covered ground as a high risk practice. Minnesota general permit prohibits surface application in winter within 300 feet of protected areas, where slopes are greater than 2% for liquid manure, where slopes are greater than 6% for dry manure, or where the upper 6 inches are saturated. Illinois refers to an NRCS best management practice (BMP) document for guidance. Missouri's CAFO permit references a BMP document which prohibits surface application when soils are frozen or saturated. Kansas prohibits liquid application on frozen or snow-covered ground except in emergencies when application is approved by the secretary; solid manure is allowed if applied waste can be retained onsite. Most of these state rules refer to CAFO's. A publication summarizing regulations in the Canadian provinces shows that most recommend avoiding application of manure on frozen or snow-covered ground (Fleming and Fraser, 2000). This publication is also useful because it has a good scientific literature review.

Literature Review

A complete review of the scientific literature has not yet been completed, but a summary of the materials reviewed to-date is included below.

- Greatest nutrient losses occur when manure is applied in late winter shortly before snowmelt (Lorimer and Melvin, 1996; Komiskey, 2006)
- Nitrogen lost in runoff following winter dairy and openlot manure spreading varied from negligible levels to 20% of the manure-N applied (Komiskey, 2006)
- Not all frozen soils are impermeable. Where open pores exist loss of N to runoff can be minimal. (Steenhuis at al., 1981; Converse at al., 1976; Frame, personal communication)
- Higher amounts of N from liquid dairy manure were lost due to early fall application through leaching than due to winter application (Gupta et. al, 2004)
- A six-year study of application of liquid dairy manure showed that higher concentrations of N, P, and K occurred in runoff when manure was applied in winter as compared to spring and fall applications (Philips et. al., 1981)
- Over a 2-year field study where dairy manure was applied to frozen ground, average losses of N, P, and K were 10%, 6%, and 8% respectively (Hensler et al., 1970)
- Application rates and weather conditions played a large role in determining the amount of nutrients list in runoff from dairy manure applied in winter. Excessive nutrient losses occurred when manure spreading occurred during active thaw periods. Minimal losses were seen when manure was applied and then covered with snow that melted at a much later date. (Klausner et al., 1976)
- Losses from manure applied to corn stubble were higher than for manure applied to bean stubble due to the difference in snow accumulation (Lorimer and Melvin, 1996)
- Spreading manure in winter does not guarantee pathogen die off. E. coli survival is greater under cooler water temperatures. Freezing conditions can be lethal to fecal bacteria. (Tamasi, 1981; Stoddard et. al, 1998; Kibbey et al., 1978)

Discussions with Stakeholders

Similar issued were brought up by DNR staff and stakeholder groups. Here is a list of those issues.

- Will a rule prohibiting manure on frozen ground improve Iowa's water quality? How can we measure the impact of changes in policy?
- How do we define frozen or snow-covered ground?
- Who and what should this rule apply to? *Confinements? Open feedlots? Liquid manure? Solid manure?*
- What geographical criteria should be used to prohibit surface application of manure on frozen or snow-covered ground? *Slopes? Floodplains? Tile intakes? Streams? Impaired watersheds?*
- Should there be exceptions for small dairies that currently scrape and haul daily?
- Should facilities with insufficient storage be phased-in?
- Should there be any additional documentation in MMP's or onsite plans for winter application?
- How should we handle emergency situations?
- How will the rule be implemented?

Implementation

The final question is 'How would the rule be implemented?' Some of the potential criteria are mappable such as streams, lakes, slopes, ag drainage wells, sinkholes, and other land features. Statewide floodplain maps are not currently available. Locations of tile intakes are also too numerous and subtle to be accurately mapped even using recent technology (LIDAR). Maps of prohibited or restricted zones could be shared with the public using the AFO Siting Atlas (http://www.iowadnr.gov/mapping/maps/afo_siting_atlas.html), an online interactive map that allows people to view DNR maps at the scale of their choosing. These maps have already proved useful for communication with producers about karst regions, major water sources, alluvial soils, designated wetlands and other issues relating to siting restrictions. This website can also be used by the public to view mapped locations of confinements and open feedlots. Multiple forums currently exist for communication of rules and best management practices, such as the Iowa Manure Management Action Group (IMMAG) and the Heartland Regional Animal Manure Management Newsletter.

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Violation summary by IDNR, Watershed Monitoring & Assessment Section, May 7, 2008

Des Moines River @Des Moines

	Ammonia-N	pH	Temp		Acute NH3-N WQC	chronic WQC (ELS present feb-sept)	acute violation?	chronic violation?	chronic WQC (ELS absent)	chronic viol?
2/11/2008	0.18		8.25	1.1	5.20	1.65	FALSE	FALSE	2.69	FALSE
2/12/2008	0.16		8.13	1.1	6.56	2.00	FALSE	FALSE	3.25	FALSE
2/13/2008	0.14		8.13	1.1	6.56	2.00	FALSE	FALSE	3.25	FALSE
2/14/2008	0.15		8.11	1.4	6.82	2.07	FALSE	FALSE	3.35	FALSE
2/15/2008	0.2		8.13	1.1	6.56	2.00	FALSE	FALSE	3.25	FALSE
2/18/2008	0.2		8.08	1.1	7.22	2.16	FALSE	FALSE	3.51	FALSE
2/21/2008	0.12		8.09	1.1	7.08	2.13	FALSE	FALSE	3.46	FALSE
2/25/2008	0.21		7.98	2.2	8.73	2.50	FALSE	FALSE	4.07	FALSE
2/26/2008	0.31		8.05	0.6	7.65	2.26	FALSE	FALSE	3.67	FALSE
2/27/2008	0.49		8.05	0.6	7.65	2.26	FALSE	FALSE	3.67	FALSE
2/28/2008	0.57		8.05	0.6	7.65	2.26	FALSE	FALSE	3.67	FALSE
2/29/2008	0.5		8.01	1.1	8.25	2.40	FALSE	FALSE	3.89	FALSE
3/3/2008	0.62		8.07	0.6	7.36	2.19	FALSE	FALSE	3.56	FALSE
3/7/2008	0.85		7.99	0.6	8.57	2.47	FALSE	FALSE	4.01	FALSE
3/10/2008	0.77		8.05	0.6	7.65	2.26	FALSE	FALSE	3.67	FALSE
3/12/2008	0.8		7.92	1.2	9.76	2.72	FALSE	FALSE	4.42	FALSE
3/14/2008	1.18		7.85	1.1	11.10	2.99	FALSE	FALSE	4.85	FALSE
3/18/2008	1.81		7.71	1.1	14.20	3.54	FALSE	FALSE	5.75	FALSE
3/20/2008	1.91		7.72	4.4	13.96	3.50	FALSE	FALSE	5.68	FALSE
3/21/2008	1.47		7.96	6.7	9.06	2.58	FALSE	FALSE	4.18	FALSE
3/24/2008	0.9		8.09	6.7	7.08	2.13	FALSE	FALSE	3.46	FALSE
	average		8.02							
	median		8.05							
	max		8.25							

From: Olson, John [DNR]
Sent: Wednesday, May 07, 2008 4:58 PM
To: Skopec, Mary [DNR]
Cc: Wilton, Tom [DNR]; Krier, Kenneth [DNR]
Subject: RE: Raccoon River data

Mary,

Ken, Tom, and I have given the ISA/DMWW ammonia data a review. Our conclusions, which are based on information in the attached Excel file, are as follows:

1. The data provided do not suggest an ammonia toxicity problem in the Des Moines or Raccoon rivers. The data for February and March show only one violation: the level of ammonia in the sample from the Raccoon River collected on March 7, 2008 (2.72 mg/l) exceeded the Class B(WW1) chronic criterion of 2.33 mg/l. None of the 24 samples from the Raccoon or the 21 samples from the Des Moines River contained a level of ammonia that exceeded an acute criterion for ammonia.

2. Due to the lack of supporting data for pH and temperature, conclusions regarding the tributary streams are more tentative. We assumed water temperatures in the vicinity of 2 C and used default pH values of 8.0 (the average pH in the Des Moines & Raccoon samples) and 8.3 (the maximum pH in the Des Moines and Raccoon samples). At a pH of 8.0, none of the samples from the February 29th, March 13, 18, 19, or 27 sampling events exceeded an acute criterion for ammonia. A number of samples from the Raccoon tributaries and the Boone River did, however, exceed chronic criteria. At an assumed pH of 8.3 (a worst-case scenario, of sorts), the number of acute criteria violations increased in Brushy Creek for the February 29th sampling: assuming a pH of 8.3, all six samples collected from Brushy Creek that day violated the acute criteria. An assumed pH of 8.3 also suggested single acute violations for the Boone River and South Raccoon rivers.

3. We also ran the violation summary for chronic criteria with "early life stages" absent. The ELS period for most Iowa rivers runs from March through September, and we used ELS-present to ensure that we didn't miss any violations due to this distinction. Using ELS-absent chronic criteria does reduce the number of chronic violations slightly.

4. The ISA should be encouraged to collect supporting data for water temperature and pH when collecting samples to be analyzed for ammonia.

The data provided do suggest some potential ammonia problems in the tributaries of the Raccoon River basin, especially in Brushy Creek (and maybe also in Halbur Creek and the South Raccoon River). According to Tom and Ken, any attempt to follow-up these data with biological sampling now (i.e., spring) would likely generate inconclusive results due to sampling outside of the biocriteria index period (July 15 to October 15).

Please let us know of any follow-up questions on this.

John.

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