Welcome

A Lunchtime Webinar Series
Serving Pennsylvania’s Best Practices on Animal Ag, Water-, and Air Quality

TODAY’S FOCUS: Protecting Watershed Quality – Manure Storage & Treatment (dry)

- Ann Swinker, Associate Professor of Dairy and Animal Sciences, Penn State
- Pete Vanderstappen, Professional Engineer, Natural Resources Conservation Service

Hosting Robb Meinen
Penn State Dairy and Animal Science
Dry Manure Storage for Small Acreages -- Water Quality

Dr Ann Swinker,
Department of Dairy and Animal Science
Penn State University
Confined Animal Housing

- An attractive safe area

Generates manure and bedding
Requires more management
More Work??

- Cleaning stalls
- Picking up manure in paddocks / pens
Planning Manure Storage Sites

- Lanes & Gates
- Hard Surface
- Composting
- Land Capability
- Neighboring Property
- Water Drainage

PLAN??
Must also consider...

• Zoning Regulations, Guidelines

• Nutrient Management Regulations

• Building Codes

• New PA zoning guidelines and nutrient management regulations
Staying On Top Of the Pile

• Actively compost all stall waste
• Stockpile manure & stall waste for crop fields needs and spread when possible.
• Haul manure & stall waste off property
  - Reduce the amount of bedding used
  - Give away
Manure Handling Site

• Consider topography and flood patterns when developing manure facilities.
  - Not near streams
  - Not in Flood-prone areas
  - Not on steep hillsides
  - Flat, impermeable, deep water table
Dry - Manure Storage

Stock piled for future use

Composting on site
Both Require a Storage Site

- Select a high dry spot
- Keep away from bodies of water - do not store where water can run through the pile
- Easily accessible
- Confine the pile
- Treat any runoff
Constructing - A Hard Surface

- Concrete/macadam pad
- Create a hard surface with layers of stone aggregate topped with finer stone.
- Surround your storage pad with vegetation to filter out run off.
How Much ?? Waste Space

One 1,000 lbs. horse or steer produces ~45 lbs. manure daily
+ Bedding
= 730 cubic feet/year of waste to manage per 1,000s of animal.
Traditional Use of Manure
Commercial fertilizer vs. Manure

- Manure contains organic matter
- Organic matter is good for soil health & structure
Applying Manure/Bedding Fresh

- Improve the health of grass
- Apply according to soil test
- Good idea to keep animals off pasture for a few days
Haul Off the Property

- Haul manure & stall waste off property
- PA Mushroom Growers contact with horse farms to remove manure and straw.
- Compost all stall waste
# Absorption of Bedding Types

<table>
<thead>
<tr>
<th>Material</th>
<th>(lbs water absorbed/lbs bedding)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wood Products</strong></td>
<td></td>
</tr>
<tr>
<td>• Pine</td>
<td></td>
</tr>
<tr>
<td>- Chips</td>
<td>3.0</td>
</tr>
<tr>
<td>- Sawdust</td>
<td>2.5</td>
</tr>
<tr>
<td>- Shavings</td>
<td>2.0</td>
</tr>
<tr>
<td>• Hardwood Chips</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Shredded newspaper</strong></td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Straw</strong></td>
<td></td>
</tr>
<tr>
<td>• Oats</td>
<td>2.5</td>
</tr>
<tr>
<td>• Wheat</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Hay (mature)</strong></td>
<td>3.0</td>
</tr>
</tbody>
</table>
Composting

Natural aerobic process for stabilizing organic matter

Well composted manure has humus smell, 25-50% volume reduction, and destruction of pathogens and weed seeds due to heat of composting.
Composting Principles

FRESH ORGANIC MATERIAL

Water vapor, CO₂

Microbial Metabolism (Heat + Water + CO₂)

Oxygen

STABILIZED ORGANIC RESIDUE

=>
Solid Manure Storage

- Covered facilities
- Tarp may provide cover with less cost and more labor
- Stack or stockpile in a well-drained area for later hauling
- Regulations may require runoff control
Sample Manure Storage
Manure Stacking Facility

- Allows for the accumulation of solids
- Inexpensive method of separating liquids from solids (Not in Horses)
- Leaching should be controlled
- Works only with solid manure waste
- Good to have a vegetative filter area
Choosing a Manure Storage Facility

- Land application methods,
- Type of bedding
- Hauling, distances, volume
- Space and size requirements
- Treatment
- Common Since!!
Manure Compost Bin

Two Bin Composter

Figure 2.—Two-bin composter.

- Slat
- Chicken wire
- Posts
- Concrete pad
Manure Management

Building a Manure Composting System for a Small Horse Operation

Two bins are adequate for 2-5 horses. One bin can be composting while the other is being filled.
Economy Model
Size Matters
Actively Compost

Requires turning, moisture, oxygen, C:N
Properly composting manure - Heats up to 145 degrees F can kill parasite eggs and weed seeds
Storm Water Runoff

• Divert all clean water away from manure piles.  
  Roof gutters should flow away from buildings and manure sites.  
  Add drains, ditches

• Divert polluted waters into vegetative buffer areas.

• Manure storage areas should be separated from “clean water” areas with vegetative buffer strips.

• Keep away from the well head - water source.
Vegetative Buffer Strips

- Inexpensive to install?
- Removes some solids from liquids
- Maintenance is not easy
- Needs to be long and flat
- Channel flow reduces effectiveness
Other Uses of Composted Manure
Landscaping - Gardening
Riding Arena Footing
Compost - Use on Sustainable Trails as Footing
• Remember downwind neighbors
• You might like the smell of manure but your neighbors will not
Factors Affecting Odor Release and Dispersion

1. Wind speed
2. Area
3. Source concentration

1. Temperature
2. Wind speed
3. Topography
Summary - Manure Management

• Each farm should have a plan for managing manure spreading and disposal.
• Store manure in a dry, level, impermeable location free from storm-water runoff.
• Manage storm-water to prevent manure contamination of water and eliminate runoff.
• Control animal access to disposal site.
Questions????

[Image of a foal]
Manure Du Jour

February 12, 2009

Peter Vanderstappen, *Natural Resources Conservation Service*
Planning, Designing, and Handling Semi-Solid/Solid Manure

By: Pete Vanderstappen, PE
Area Engineer
USDA, Lebanon, Pa
February 12, 2009
Objectives

- Define stackable manure
- Discuss pros and cons
- Review regulatory considerations
- Planning considerations
- Sizing
- Typical installations
- Associated BMPs
What is Stackable Manure?

- Typically has at least 20-25% solids
  - Usually has organic material added
    - sawdust, woodchip, straw, hay, etc
  - Exception would be layer house poultry manure that stacks if pit area is ventilated and no moisture is added
- Easily stacks up and remains in a pile
- The stack itself generates very little leachate
Typical Field Stack

- In drainage way
- No filter area
Pen-pack Manure Stack
Stack Adjacent to Concrete lot

- Lacks improved base
- Lacks control and treatment of runoff
Poultry Stack
Random Stacking Area

- No controls
- Unimproved surface
Horse Facilities Stacking Pile

- No controls
- Runoff issues
Stack Pad Advantages

- Typically smaller systems with lower construction costs
- Shorter storage period requirements
- Less equipment
  - Loader
  - Spreader
  - No pump
- Roofed systems avoid treating or hauling liquids
Stack Pad Disadvantages

- Shorter storage periods
  - More frequent spreading during potentially less than ideal conditions
- Greater Nutrient Loss
- Typically requires a significant amount of bedding to maintain stack
- Does not handle other waste streams like milkhouse waste, lot runoff, etc
Planning a Stacking Facility

- Must be part of an overall Ag Waste Management System
- Typically short term
  - 30 to 120 days
- Shall not pollute water resources
- Must have a suitable site
General Rules

- Construct outside of the floodplain or protect from inundation up to the 25 yr – 24 hr storm
- Keep 100’ away from streams or sinkholes unless additional measures installed
- Refer to appropriate design references
- Keep clean water out of area
- Properly treat runoff
State Rules and Regulations

- Act 38, effective Oct 1, 2006 relates to infield stacking
- Must be part of a NMP
- Siting of pads
  - On appropriate soils
  - Flat to moderate slopes
  - Shaping to minimize rainfall absorption
State Rules and Regulations

- Follow setback requirements
- Rotate stack location
- Maximum storage period of 120 days unless covered
- Stockpile amount based on crop needs for field
Design Sources and References

- NRCS Pennsylvania Technical Guide
  Conservation Practice Standard
  - Waste Storage Facility
  - Code 313
- Available at NRCS web site under efotg
- NRCS National Engineering Handbook - Ag Waste Management Field Handbook
Inputs for Sizing a Storage

- Number and type of animals
- Percent of time confined in collection area
- Volume of bedding
  - Use 50% of volume for storage needs
- Storage Period
- Maximum stacking height
Typical Calculation

- **WSV** = **AEU** \((0.5BV + MV) \times D\)
  - **WSV**: Waste storage volume in cubic feet
  - **AEU**: No. of 1,000 lb animal units
  - **BV**: Vol. of Bedding/day/Au in cubic feet
  - **MV**: Vol. of manure/day/Au in cubic feet
  - **D**: Days of required storage

Refer to animal waste tables.
Example Sizing Calculation

- Given: 40 beef cows, avg. weight 1,000 lb; Bedding/day/cow=0.2 cubic feet; storage period required 90 days
- AEU's = 40(1,000)/1000 = 40
- From table, beef manure/day = 1.0 cubic foot/AEU
- Substitute into formula
  - WSV = AEU(0.5BV+MV)xD  thus
  - WSV = 40(0.5(0.2)+1.0) x 90
  - WSV = 3,960 cubic feet of storage required
Sizing Determination

- Required volume 3,960 cubic feet
- Typically assume beef manure with some bedding can stack up 4’ high
- Therefore Storage area = $\sqrt{(WSV/4')}$
- Substitute $SA = \sqrt{(3,960/4')} = 31.5'$
- Use an area 32’x32’ to stack manure
BMP’s Above the Site

- Keep clean water out by installing
  - Diversions to divert off-site runoff
  - Roof gutters on adjacent buildings
  - Drop inlet to divert water around site
  - Roofing entire facility
  - Temporary cover – for example, a tarp
Diversion

- Directs water around stacking area
- Sized to handle 25yr-24hr event
Roof and Gutters

- Reduce clean water access to stacking area
- Less water to treat
Drop Inlet Above Access

- Carry water under or around stacking area
- Size to handle 25yr-24hr storm event
Completed Stacking facilities

- Most are concrete pads with concrete walls
- Some facilities with conventional roof
- Hooped roofs
- Properly located field stacks on un-improved sites
Corner Lot Concrete Stack Pad

SEP 24 2004
Walled Open Stack Pad
Corner Stack Pad
Heifer Manure Roofed Facility
Poultry Manure Roofed Facility
Hoop Roof Stacking Facility

- Greater pile height
- Reduced cost per cubic foot of storage

(Photo courtesy of Mike Snyder)
Field Stack with Filter Area

- Un-improved site
BMP’s Below the Stacking Facility

- Collect or treat runoff
  - Perforated curbs
  - Vegetated filter areas below field stacks
  - Screened Collection box
  - Holding tank with pump/siphon
  - Waste treatment strip
  - Liquid storage
Perforated Curb

- Use on small drainage areas
- Filter area directly below site
Inlets to Treatment or Storage

- Screened runoff goes to distribution system or long term storage
Tank with Flout or Pump
Manure Storage Facilities

- Concrete tank
- HDPE lined storage
Waste Treatment Strip
Conclusions

- Reviewed typical stacking facilities issues
- Their pro’s and con’s
- Typical sizing
- Associated BMP’s
- Completed facilities in SE Pa
Planning, Designing, and Handling Semi-Solid/Solid Manure

☐ Thank you!
Question and Answers

- Questions received in writing will be directed to the speakers by the host.
- If your question is not answered during the time remaining, responses to the questions will be posted at www.aec.cas.psu.edu
- Recordings of this session can also be viewed at the URL listed above.
Next Week on Manure Du Jour

Focus on Water Quality & Land Application

Featuring

- **Peter Kleinman**, USDA Agricultural Research Service
- **Robb Meinen**, Penn State Department of Dairy & Animal Sciences
- **Mark Goodson**, Natural Resources Conservation Service

For more information [www.aec.cas.psu.edu](http://www.aec.cas.psu.edu)