Intended Outcomes

After this session, the participants will:

- Recognize sources of contaminated runoff.
- Be aware of feedlot site selection factors.
- Understand the features and benefits of common feedlot runoff control practices.

“Runoff control undoubtedly constitutes the single most important technology available to the feedlot industry for preventing discharge to navigable waters of the United States.” (EPA, 1974)
Runoff will occur when the depth of snowmelt or rainfall exceeds about 0.5 inches.
Ft. Collins Rainfall Data

Period of Record 1898-2002

• 38,106 Days of Data

• 8,521 measurable precipitation events (22%)

• 821 events > 0.5 inches

• 90 events > 1.54” or 2yr design storm

• 4 events > 3.54” or 25yr design storm
Frequency of Feedlot Runoff Events at Ft. Collins, CO.
Period of Record 1898-2001

Median = 7 events per year
Average = 7.9 events per year

During no year on record has Ft. Collins received zero feedlot runoff events.
### Runoff Characteristics

<table>
<thead>
<tr>
<th>Source</th>
<th>Total Solids, (%)</th>
<th>Total N, (mg/l)</th>
<th>Total P, (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical</td>
<td>Range</td>
<td>Typical</td>
</tr>
<tr>
<td>Beef Feedlot Runoff (rainfall)</td>
<td>1.5</td>
<td>0.5–5.0</td>
<td>350</td>
</tr>
<tr>
<td>Beef Feedlot Runoff (snowmelt)</td>
<td>2</td>
<td>0.8–22.0</td>
<td>1200</td>
</tr>
<tr>
<td>Beef Lot Runoff Pond</td>
<td>0.3</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Municipal/Residential</td>
<td>0.05</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>
Runoff Management Principles

I. Minimize Runoff Volume

II. Collect Runoff (so it can be managed)

III. Separate Solids (decrease management challenges)

IV. Store Liquids (until needed)

V. Land Apply Liquids at Agronomic Rate
Runoff Management Principles

I. Minimize Runoff Volume

- Good site location.
- Keep “clean” water clean (divert run-on).
- Clean lots regularly.
- Grade flat lots to drain.
- Reduce manure movement off steep lots.
Runoff Management Principles

Minimize Runoff Volume

• Good Site Location
  * Locate lots to minimize “runon”
  * Lots slope at 2% to 5%
  * On soils w/ > 25% clay content
Click on box to the right to play video clip
Runoff Management Principles

• Other Location Requirements
  * Room for runoff collection & storage
    (about 1 acre for 100 to 200 AUs)
  * Setback >150’ from water courses & wells
  * Adequate distance from neighbors
Runoff Management Principles

Minimize Runoff Volume

• Keep clean water clean
  * Divert “clean” runoff away from feedlot
  * Exclude roof water
    - > 5% of total drainage area
      - Collection channels along foundation
      - Roof gutters & outlet piping
  * Fix leaking water tanks
  * Minimize use of “flow through” tanks

Feedlot Runoff Management
## Runoff Management Principles

- **Minimize Runoff Volume w/ Appropriate lot size**

<table>
<thead>
<tr>
<th>Type of Animal</th>
<th>Earth Lot Area (square feet per head)</th>
<th>Concrete Lot Area (square feet per head)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beef</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cow &amp; Calf</td>
<td>300</td>
<td>50</td>
</tr>
<tr>
<td>Calf (&lt; 600 lbs)</td>
<td>150</td>
<td>35</td>
</tr>
<tr>
<td>Calf (600-1400 lbs)</td>
<td>225</td>
<td>40</td>
</tr>
<tr>
<td><strong>Dairy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calf (&lt; 250 lbs)</td>
<td>125</td>
<td>20</td>
</tr>
<tr>
<td>Calf (250-600 lbs)</td>
<td>250</td>
<td>30</td>
</tr>
<tr>
<td>Calf (600-1000 lbs)</td>
<td>400</td>
<td>40</td>
</tr>
<tr>
<td><strong>Sheep</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rams &amp; Ewes</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Ewes with lambs</td>
<td>40</td>
<td>16</td>
</tr>
<tr>
<td>Feeder Lambs</td>
<td>20</td>
<td>8</td>
</tr>
</tbody>
</table>

*Feedlot Runoff Management (from Murphy & Harner, 2002)*
Runoff Management Principles

- Clean Lots Regularly
  - Each time a pen is turned
  - Monthly is better
    * Leave 1” to 2” packed manure seal
    * Clean under fences
    * Pulling better than pushing
      (e.g. use a box scraper or rear mounted blade)
Runoff Management Principles

- Flat Lots Need Drainage
  - Build mounds
  - Install collection channels
  - Fill low spots that pond runoff
Click on box to the right to play video clip
Runoff Management Principles

Mounds ...

* Add slope to a flat lot
* Provide windbreak & warming area
* Serve as a low tech compost pile
Cross Section of a Feedlot Mound

Typical Cross-Section of a Mound

Provide about 30 sq.ft. per AU per side

Feedlot Runoff Management

(from Murphy & Harner, 2002)
Single Row Feedlot Design

Click on box to the right to play video clip

(From Murphy & Harner, 2002)
Runoff Management Principles

Steep Lots Need ...

* Roads & channels aligned on the contour
* More frequent cleaning
* Consider terraces or other erosion control practices
* Buffers between lot & area below it
Click on box to the right to play video clip
Runoff Management Principles

Managed runoff from these areas too:

- Manure Stockpiles
- Composting Areas
- Snow Piles
- Silage Pit
Runoff Management Questions

- Can you divert runoff away from the pens?
- What is the slope of your feedlot?
  - Is the lot too flat to drain rainfall runoff?
  - Are there low areas that pond water on the lot?
  - Is the lot so steep that gullies form, or manure piles at bottom?
- Are your pens bigger than they need to be?
- How frequently do you collect manure?
- Do you leave a thin manure layer to seal the surface?
- How do you handle snow?
- How will you collect and manage feedlot runoff?
Typical Feedlot Components

Feedlot Runoff Management
Two Basic Types of Runoff Control Options

• Containment

• Discharge
## Feedlot Runoff Control Alternatives Based on Pounds of N in the Runoff

<table>
<thead>
<tr>
<th>Total Annual N in Runoff, lbs</th>
<th>Containment Systems</th>
<th>Vegetative Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lagoon</td>
<td>Holding Pond</td>
</tr>
<tr>
<td>&lt;100 (&lt;2 Acres)*</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>100-500 (2 - 10 Acres)*</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>500-1,000 (10 - 20 Acres)*</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1,000 – 4,000 (20 - 70 Acres)*</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>&gt;4,000 (&gt; 70 Acres)*</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

* ~ 50 lbs. per acre of feedlot in Colorado  

*(from Murphy & Harner, 2002)*
Feedlot Runoff Control Alternatives Based on Water Surface Evaporation.

<table>
<thead>
<tr>
<th>Free Water Surface Evaporation inches</th>
<th>Containment Systems</th>
<th>Vegetative Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lagoon</td>
<td>Holding pond</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>45 – 60</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>30 – 45</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>&lt; 30</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

(from Murphy & Harner, 2002)
Controlling runoff from **AFOs** with a sediment basin discharging into vegetative system using filter strips or wetland cells.
Controlling runoff from AFOs or CAFOs using a conventional total containment structure such as a holding pond or evaporative pond.
The size of a vegetative system is based on hydraulic characteristics, crop nutrient use, and the water holding capacity of the soil.
In some watersheds, phosphorus (P) may be the limiting nutrient rather than N, and thus the crop uptake of P becomes the design-limiting nutrient.
Holding ponds or lagoons are commonly used for operations greater than 300 AUs or where space is limited.
Renovation vs. New Construction

The costs of controlling the runoff from existing facilities must be weighed against new lot construction on an alternative location.

Producers constructing new facilities need to address current regulations and also design for compliance with future regulations.
References


