Nutrient Management

in

Watershed Model version 5.3

and

Scenario Builder

Water Quality Goal Implementation Team

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Presentation H1

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Background to this presentation

- \> 1 million NM acres in the 2011 milestones

- On March 15th WQGIT members expressed concern that early model runs did not show a nutrient benefit for nutrient management plans

- Hansen and Dubin had meetings with modeling team to determine how NM is used

- Ag Workgroup met on 3/29 to discuss the processes for NM in Scenario Builder and the watershed model (5.3)

We will cover:

- Description of how crop yields and N application rates are calculated in Model 5.3 and Scenario Builder

- Description of how nutrient management is treated in Scenario Builder and Model 5.3

- Comments from the Ag Workgroup

Preview: Where we are going

- Using <u>corn</u> as an example, the nitrogen (N) application rate on acres under nutrient management (NM) is 78% of the N rate on acres not under nutrient management (non-NM)

- Except in counties where manure-N is in excess of plant needs, N application rates are the same for nutrient management and non-nutrient management acres

  - This rate is the NM (78%) rate

Definitions

- Maximum yield: 95th percentile of the highest county-level yield in the Chesapeake Bay Watershed for each crop (based on the Census of Agriculture: 1982-2007)

- Theoretical plant uptake: Based on total plant uptake of N, not just what ends up in the grain. For corn it is grain N content (0.83 lb N/bu) x 1.17 = 0.98 lb N/bu

- Yield ratio: State level yield goal calculated per state nutrient management regulations (e.g. highest 3 of last 5 years) divided by maximum yield

- Application rate: This is theoretical plant uptake x maximum yield for non-NM acres, and non-NM application rate x yield ratio for NM acres

There are two "land application rates"

- Non-nutrient management (non-NM)
  - Max yield x Theoretical plant uptake
  - Ex: Max yield = 175 bu/ac, T.P.U. = 0.98 lb N/bu

    Non-NM = 175 x 0.98 = **172 lb N/ac**

- Nutrient management (NM)
  - Non-NM rate x yield ratio
  - EX: non-NM rate = 172 lbs N/ac, yield ratio = 78%

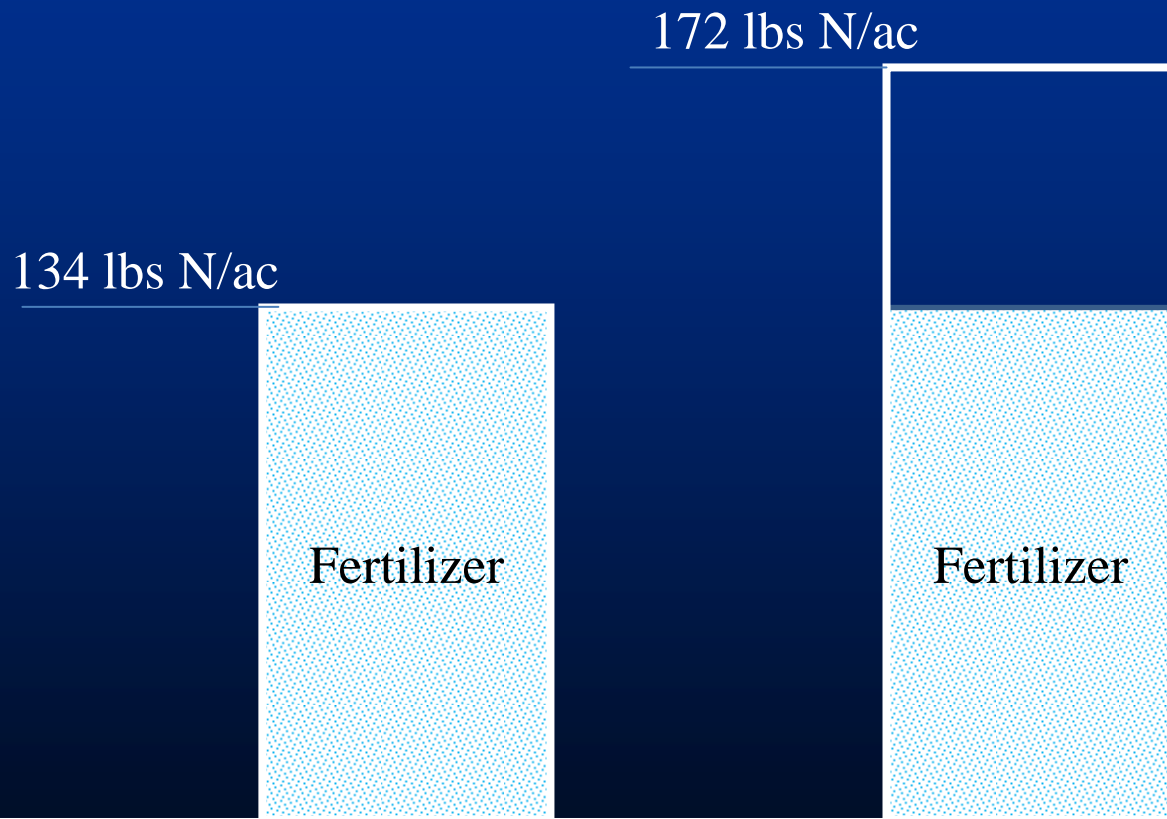   **NM** = 172 lb N/ac x 0.78 = **134 lbs N/ac**

On "Inorganic" acres

- The same N rate is applied to both non-NM and NM acres

- This rate is equivalent to the NM rate (in the way that it is calculated)

Diagram of Manure Applied to NM and non-NM acres

Scenario 1: Only inorganic nutrients are used

172 lbs N/ac

134 lbs N/ac

Fertilizer

Fertilizer

On "<u>Organic</u>" (manured) acres

- Manure is initially applied equally to all acres (NM and non-NM) based on plant needs

- If there is insufficient manure to meet plant needs, inorganic fertilizer is supplemented <u>*up to the NM rate*</u> on both NM and non-NM acres

- If there is excess manure (above plant needs on NM acres), it is applied at the non-NM rate on non-NM acres, and, if necessary, ***transported*** to adjacent counties (allocated based on crop needs)

Definition of "transport of manure"

1. State-reported transport as a BMP: The reported quantity of manure is removed from the county in excess and added to the receiving county *before* land applications are calculated.

2. "Model" transport: This occurs when a county has more manure than needed for crops after deductions (e.g. transport BMP) have been calculated. Manure is transported to adjacent counties to meet their *NM* application rates. If the adjacent counties cannot use it all, the remaining manure stays in the original county

Diagram of Manure Applied to NM and non-NM acres
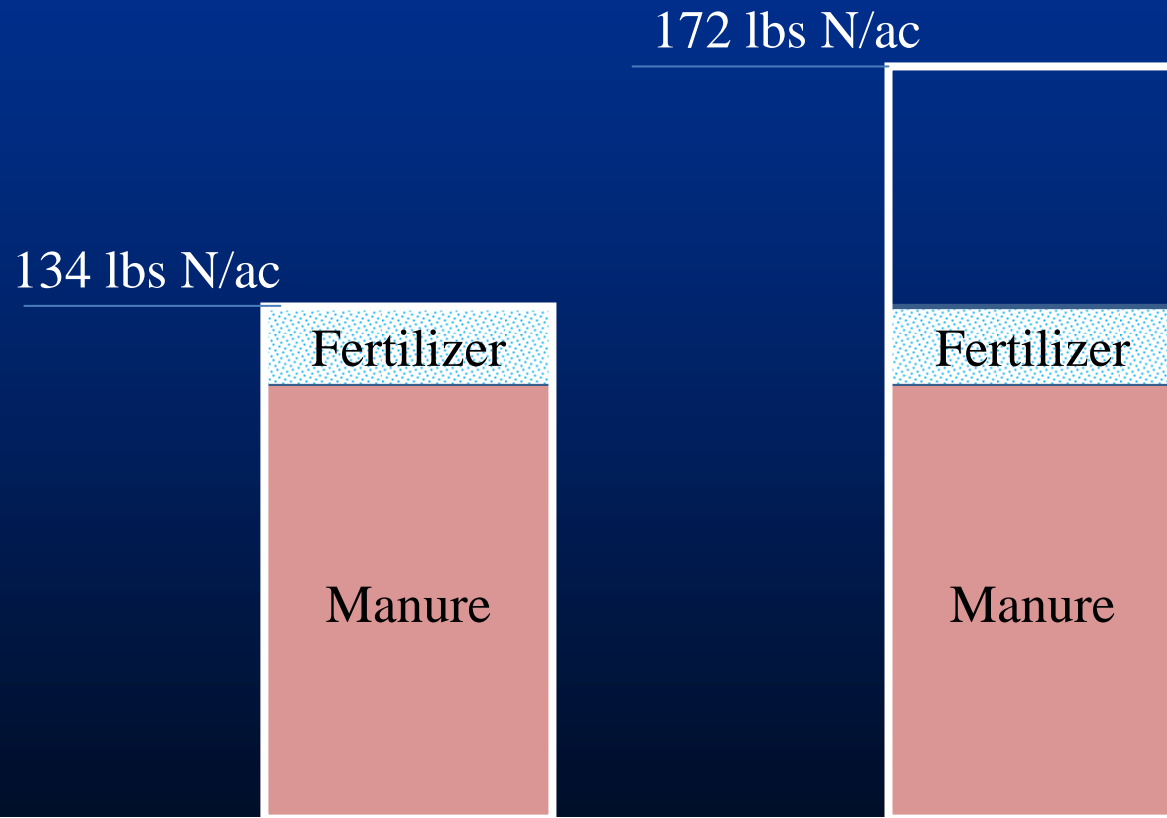
Scenario 2: Not enough manure to supply plant N needs

172 lbs N/ac

134 lbs N/ac

Fertilizer

Manure

Fertilizer

Manure

Diagram of Manure Applied to NM and non-NM acres

Scenario 3: Manure supplies exceed NM rate but no manure excess
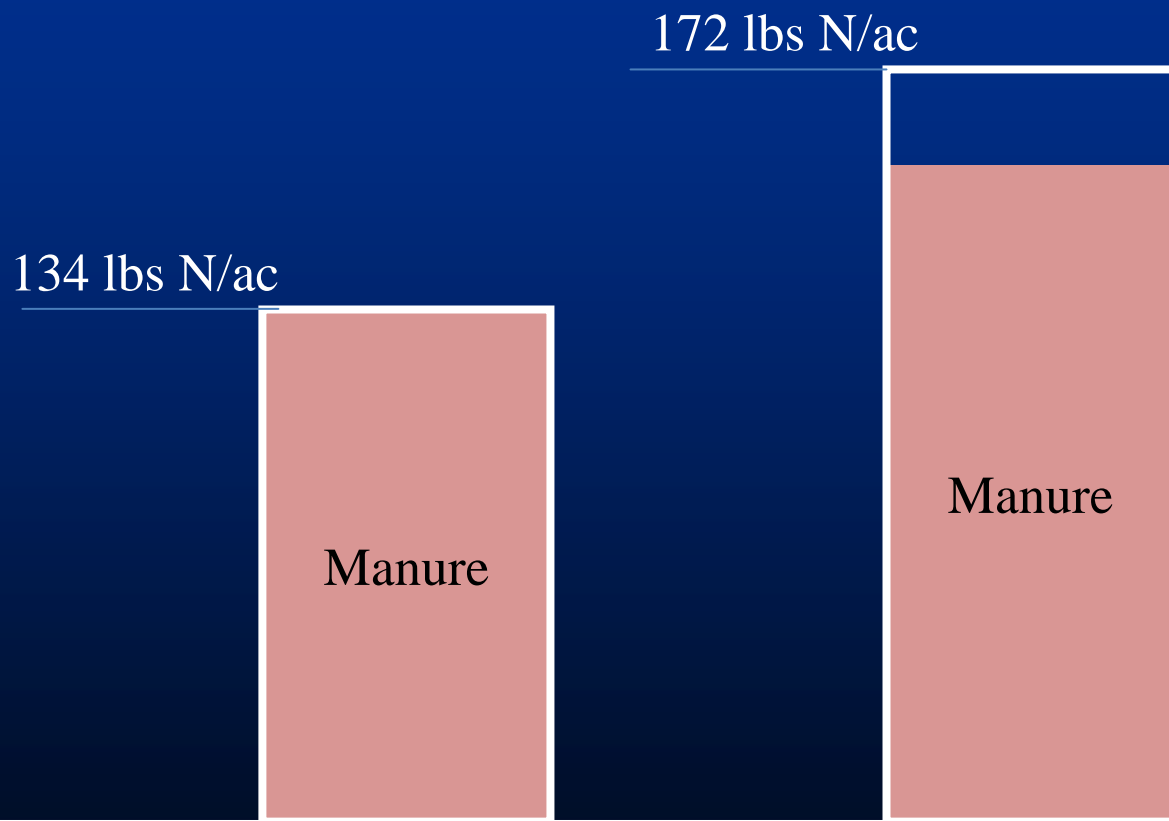
172 lbs N/ac

134 lbs N/ac

Manure

Manure

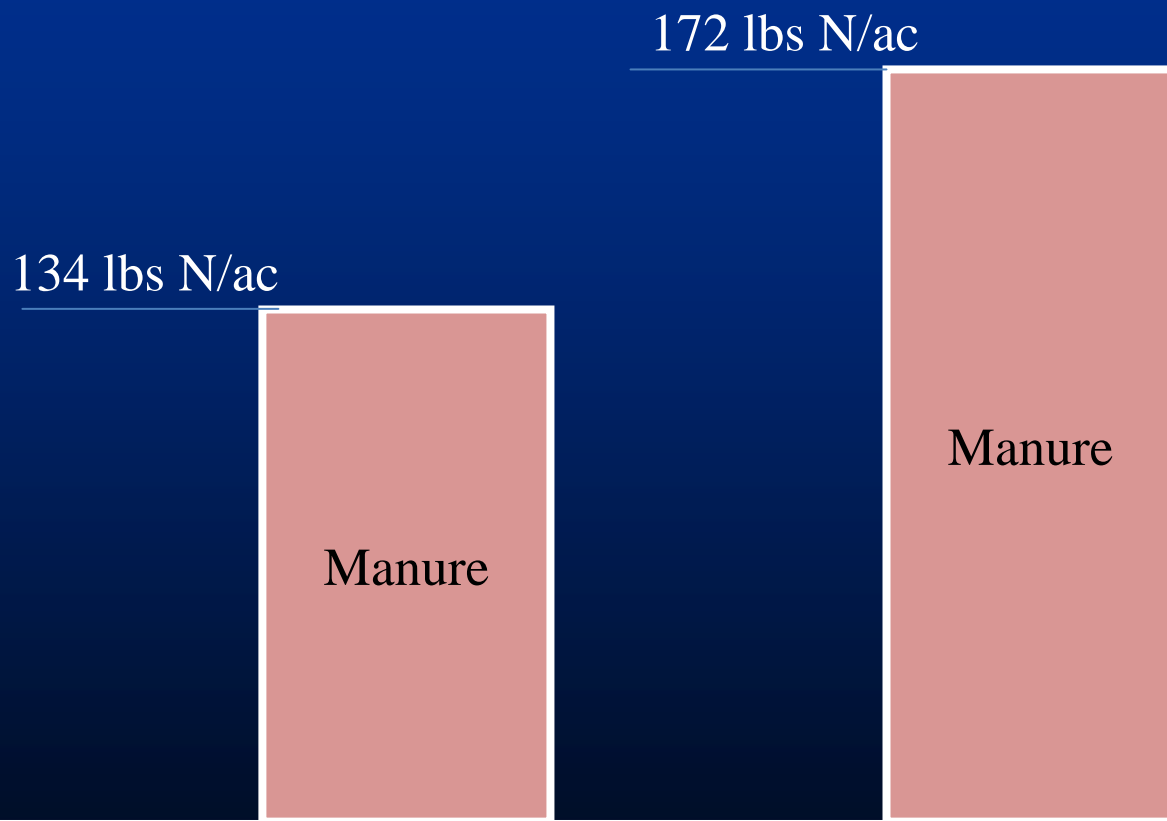# Diagram of Manure Applied to NM and non-NM acres

Scenario 4: Manure in excess of plant needs-transported to adjacent county

172 lbs N/ac

Manure to transport

134 lbs N/ac

Manure
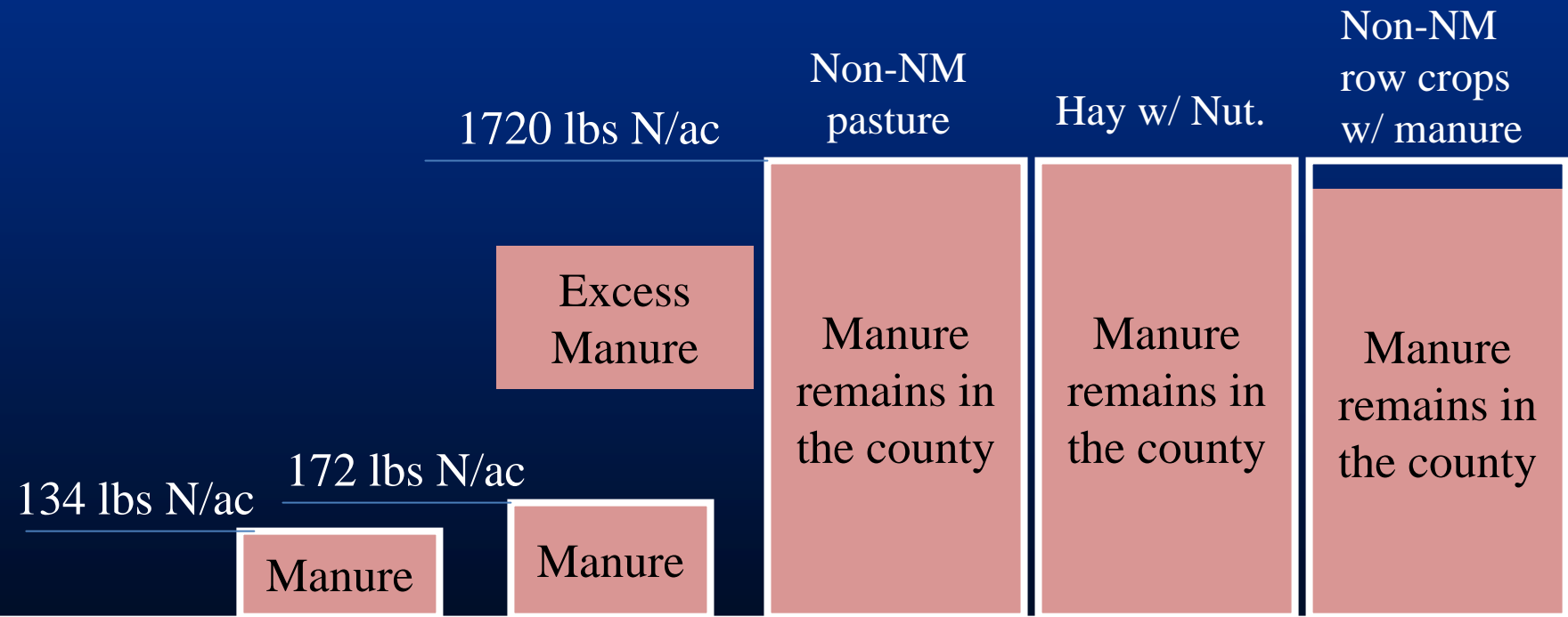
Manure

Manure transport to adjacent counties

- If the counties can accept, manure is applied as though it were inorganic (only up to the NM rate); not at a "disposal" rate

- If the counties cannot accept, the manure remains in the original county

- This manure is then applied in excess of the non-NM rate on non-NM land to a maximum of 10 times the non-NM rate to specific land uses (in the following order- see slide 15)

Land use hierarchy for excess manure in the originating county

- Applied in excess of the non-NM rate to:
  1. Non-NM pasture
  2. Hay with nutrients
  3. Non-NM row crops with manure
- If more manure remains it generates a model error

Diagram of Manure Applied to NM and non-NM acres

Scenario 5: Manure in excess and applied at disposal rate

1720 lbs N/ac

Non-NM pasture

Hay w/ Nut.

Non-NM row crops w/ manure

Excess Manure

Manure remains in the county

Manure remains in the county

Manure remains in the county

134 lbs N/ac

172 lbs N/ac

Manure

Manure

Major Points

- Nutrient application rates are based on N

- All manures are treated the same; as quantities of N and P

- Except in counties where manure N is in excess of plant N needs, the rate of N applied to acres under nutrient management (NM) is the same as the rate of N applied to acres not under nutrient management (non-NM)

Ag Workgroup Comments

Definitions

- Maximum yield: 95th percentile of the highest county-level yield in the Chesapeake Bay Watershed for each crop (based on the Census of Agriculture: 1982-2007)

- Theoretical plant uptake: Based on total plant uptake of N, not just what ends up in the grain. For corn it is grain N content (0.83 lb N/bu) x 1.17 = 0.98 lb N/bu

- Yield ratio: State level yield goal calculated per state nutrient management regulations (e.g. highest 3 of last 5 years) divided by maximum yield

- Application rate: This is theoretical plant uptake x maximum yield for non-NM acres, and non-NM application rate x yield ratio for NM acres

Ag Workgroup Comments

- **Maximum yield**
  - Use yearly NASS numbers (where available) rather than 5-year Census of Ag
  - Should be calculated by state rather than basin-wide

- **Yield ratio**
  - Use annual NASS numbers
  - Calculate by county rather than by state

There are two "land application rates"

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    - Max. yield x Theoretical plant uptake
    - Ex: Max yield = 175 bu/ac, T.P.U. = 0.98 lb N/bu

        Non-NM = 175 x 0.98 = **172 lb N/ac**

- Nutrient management (NM)
    - Non-NM rate x yield ratio
    - EX: non-NM rate = 172 lbs N/ac, yield ratio = 78%

        NM = 172 lb N/ac x 0.78 = **134 lbs N/ac**

Ag Workgroup Comments

- Non-NM and NM rates
    - The N rate on non-NM organic acres should be higher than the inorganic rate (manure is generally applied at a higher rate than fertilizer)
        - Inorganic rate is 0.98 lbs N/ac (for corn)
        - Organic rate should be higher
            - This requires more discussion

On "Inorganic" acres

- The same N rate is applied to both non-NM and NM acres

- This rate is equivalent to the NM rate (in the way that it is calculated)

Ag Workgroup Comments

- Inorganic acres should have a benefit for nutrient management

- This benefit should be calculated following the same logic as for organic acres (currently the NM rate of N for corn on organic acres is 78% of the rate on non-NM acres)

On "<u>Organic</u>" (manured) acres

- Manure is initially applied equally to all acres (NM and non-NM) based on plant needs

- If there is insufficient manure to meet plant needs, inorganic fertilizer is supplemented <u>*up to the NM rate*</u> on both NM and non-NM acres

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Ag Workgroup Comments

- Under non-NM the rate of manure N would generally be higher than the rate of fertilizer N

- "Model" transport
  - There should not be "model" (automatic) transport of manure to adjacent counties
  - Manure should stay in the originating county *unless* transport is reported by the state
  - If there is "model" transport it should consider transportation-related differences between wet (e.g. liquid dairy) and dry (e.g. poultry litter)
  - More information on Slide 30

Manure transport to adjacent counties

- If the counties can accept, manure is applied as though it were inorganic (only up to the NM rate); not at a "disposal" rate

- If the counties cannot accept, the manure remains in the original county

- This manure is then applied in excess of the non-NM rate on non-NM land to a maximum of 10 times the non-NM rate to specific land uses (in the following order- see next slide)

Land use hierarchy for excess manure in the originating county

- Applied in excess of the non-NM rate to:

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  2. Hay with nutrients

  3. Non-NM row crops with manure

- If more manure remains it generates a model error

Ag Workgroup Comments

- Excess manure within a county should be applied (allocated) by growth regions as indicated by the states.

- The default (if not defined by the state) could be:

  - Non-NM row crop w/manure (at 1X the non-NM N rate)

  - Non-NM hayland (at 1X the non-NM N rate)

  - Non-NM pasture (at 1X the non-NM N rate)

  - Repeat until non-NM row crops have received up to 10X

  - NM row crop (at 0.5X the NM N rate)

  - - then an error is generated

Additional issues

- Biosolids: All states should report biosolids applications as these impact nutrient applications for organic and inorganic sources on agricultural land

- Timing and method of application should be examined- model time steps that approximate "spoon feeding" of nutrients

- Available AFO acres per state should be examined to insure adequate representation

- Determine how P-based management can be credited

Conclusion

- The Ag Workgroup requests that the WQGIT consider their comments and implement appropriate changes in Scenario Builder and the Watershed Model as soon as practical.