



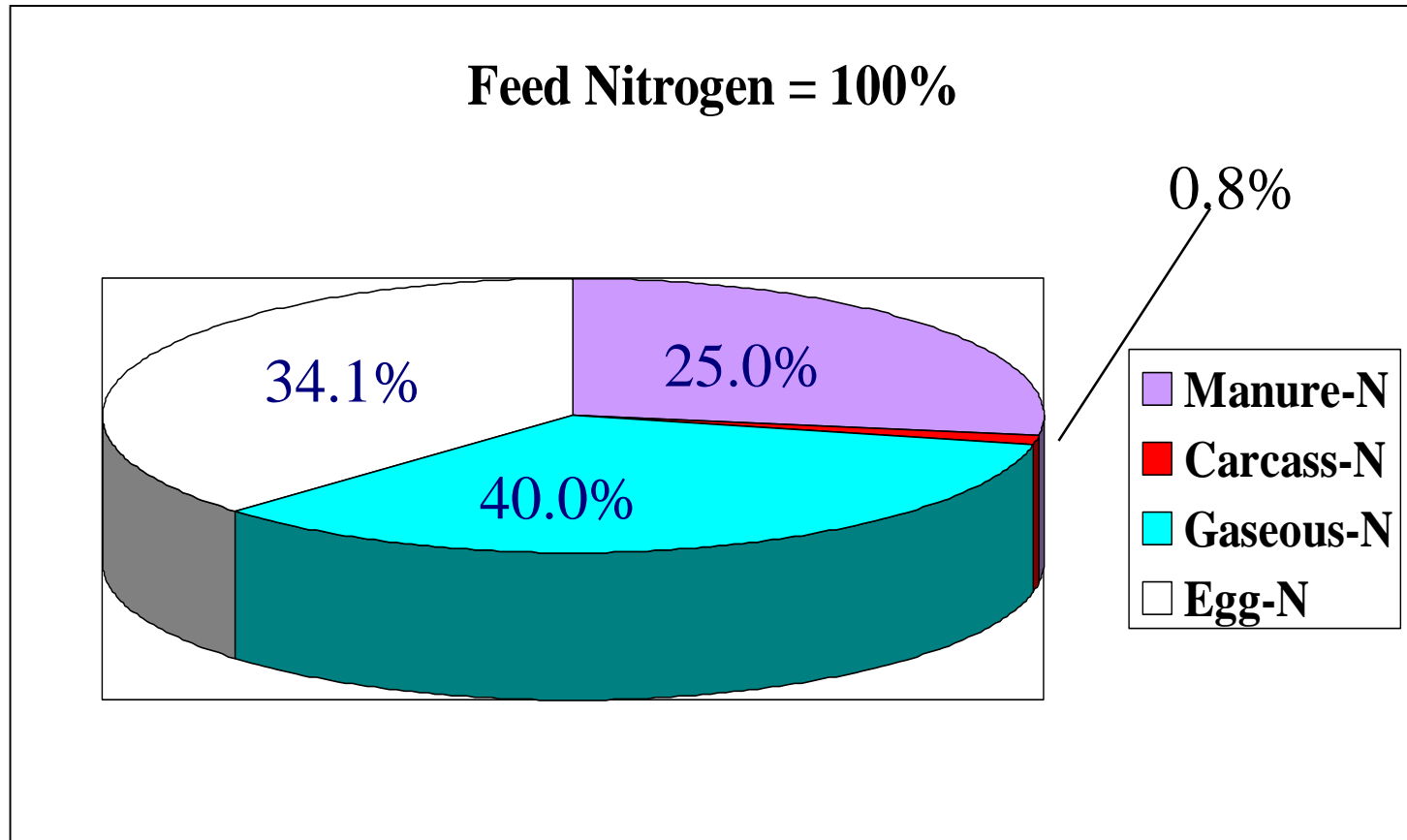
Vegetative and Riparian Buffers for Environmental Stewardship & Renewable Fuels on Poultry Farms

Paul Patterson,
Penn State University

50 yr - American Tree Farmer

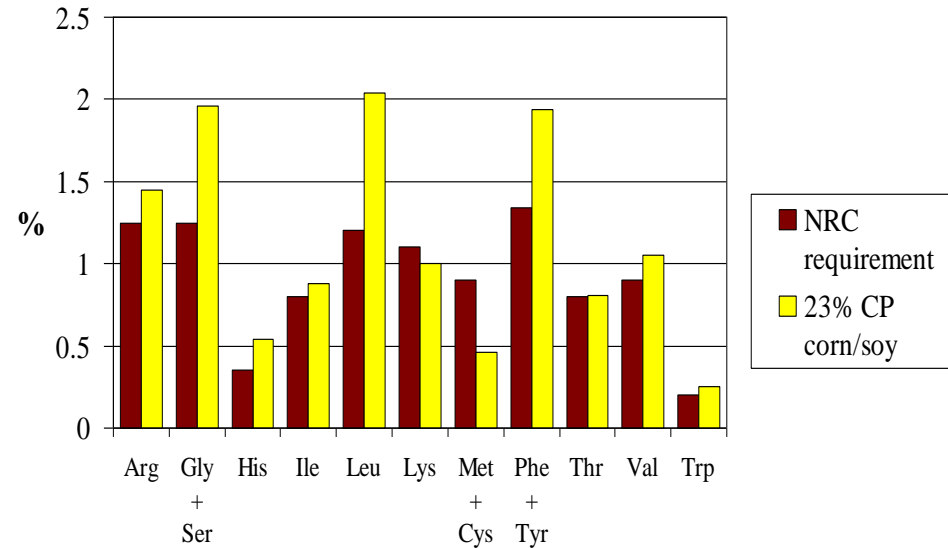


Hen Nitrogen Partitioning



Dietary Strategies for N

1. Formulate on amino acids (AA) not CP
2. Optimize dietary AA with requirement
3. Phase-feed for current weight/production
4. Use ingredients “True AA Digestibility”



Management Strategies for N

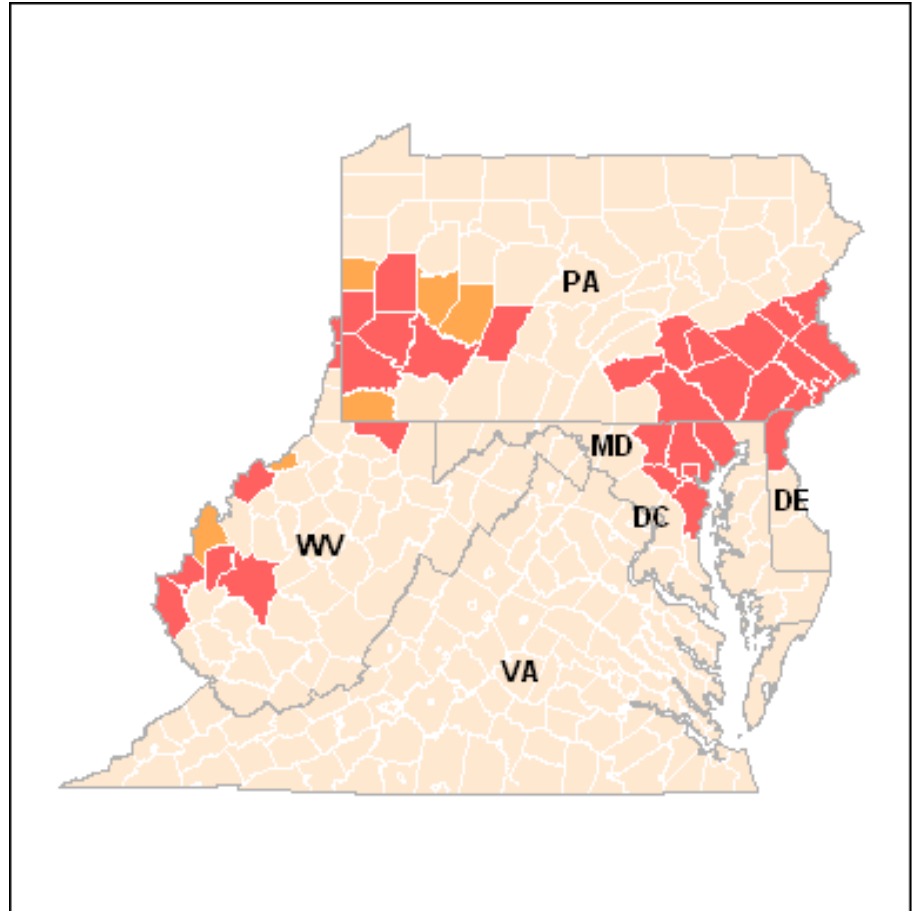
1. Min manure moisture contamination
2. Compost manure to a stable end point
3. Implement rapid drying technologies
4. Utilize sex-separate rearing



Introduction

- Ammonia
- Particulate Matter
- Odor
- Viruses/Bacteria

EPA PM Non-Attainment Zones



EPA Designation

- Attainment/Unclassifiable
- Nonattainment - Whole County
- Nonattainment - Partial County

Issues vs. Answers (Veg Buffers?)

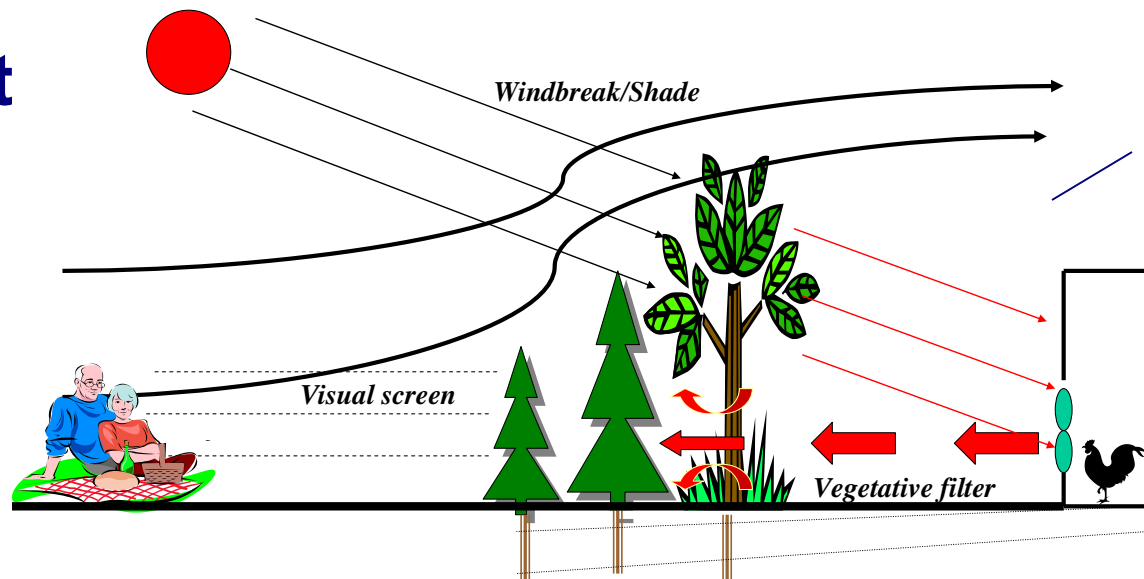
- Visual screen for neighbors
- Farm beautification
- Energy conservation
- Snow load

■ Emissions:

1. ammonia & dust
2. odor & viruses

■ Biomass:

- Litter
- Fuel

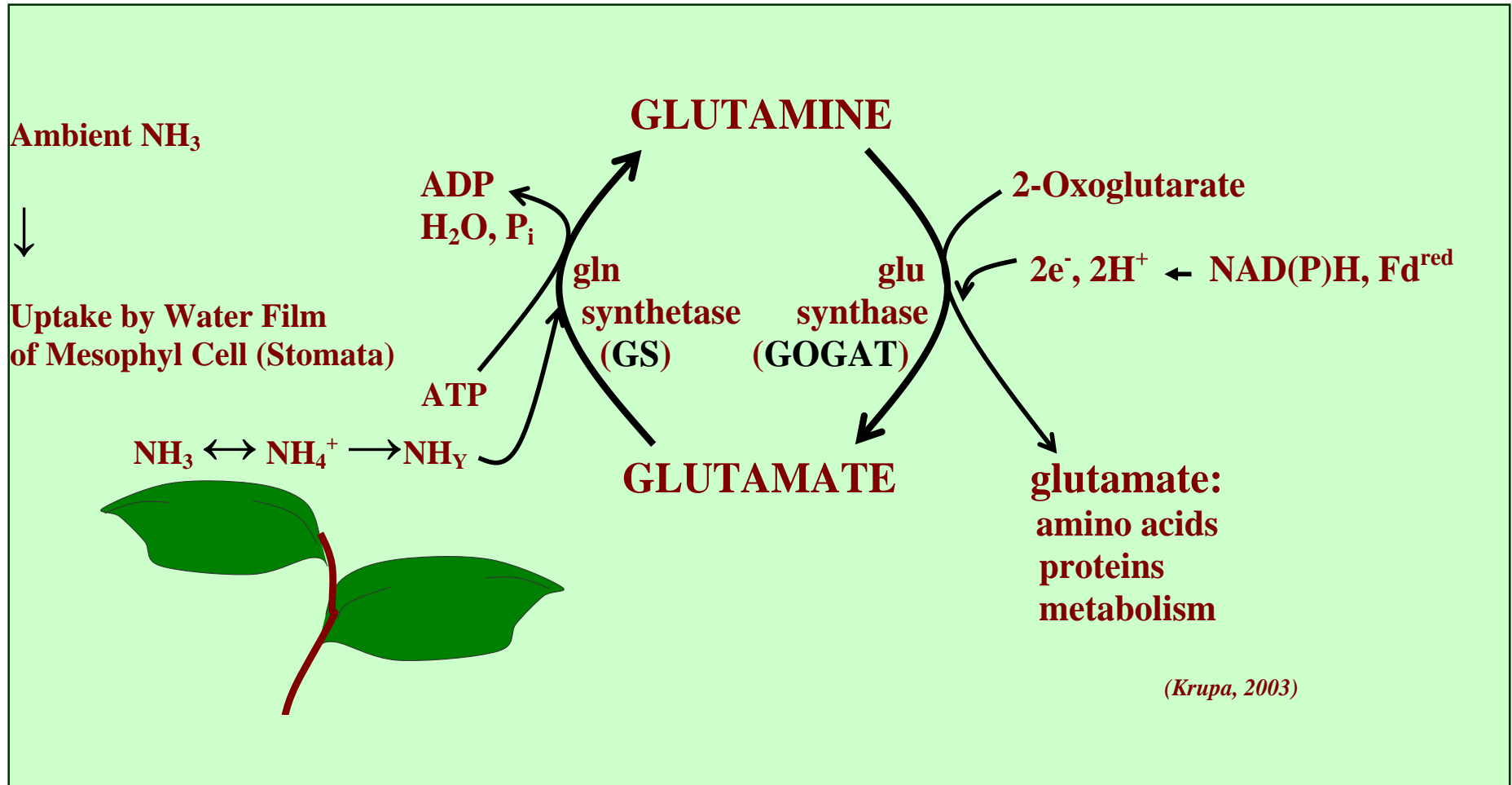


Research in PSU Chambers

- Honey locust, poplar, red cedar, reed canary grass
- Some plants can tolerate NH_3 some can not
- Plants deposited N in leaves
 - Poplar: 4.04 to 10.20%
 - Locust: 5.32 to 8.99%
 - Grass: 2.86 to 6.36%
- Plants dry matter increased



Research in PSU Chambers



Research at PSU Pot in Pot

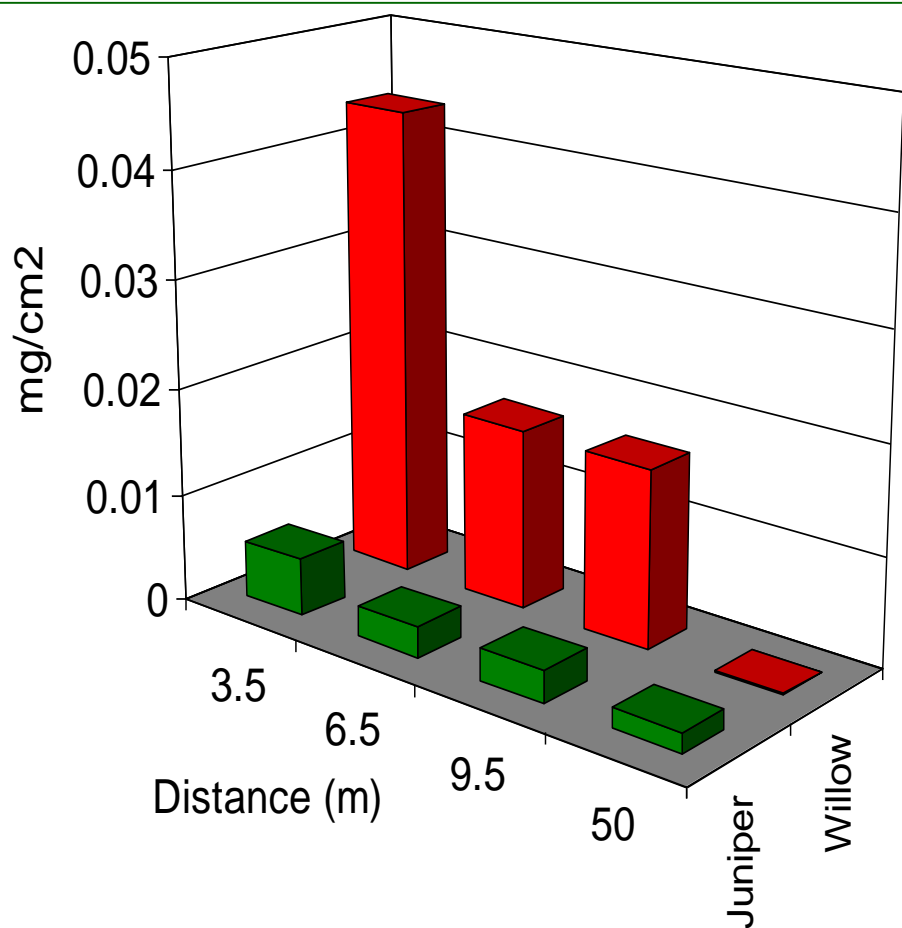


Research at PSU Pot in Pot

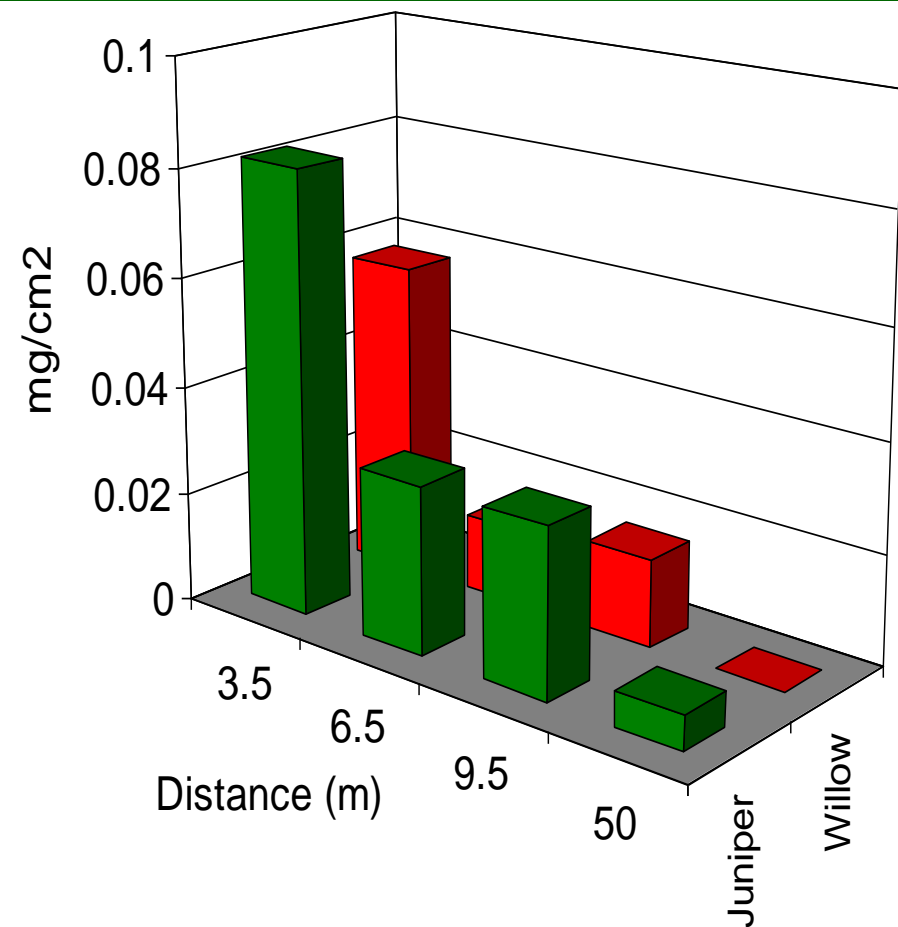
- NH_3 was reduced with greater distance from fans
- NH_3 was absorbed by the trees, and plant DM increased
- NH_3 was reduced among the trees
- Dust (PM) was reduced downwind of the fans
- Plant species differed in NH_3 and PM capture



Foliar-PM_{2.5}



Foliar-PM₁₀



Research on PA Poultry Farms

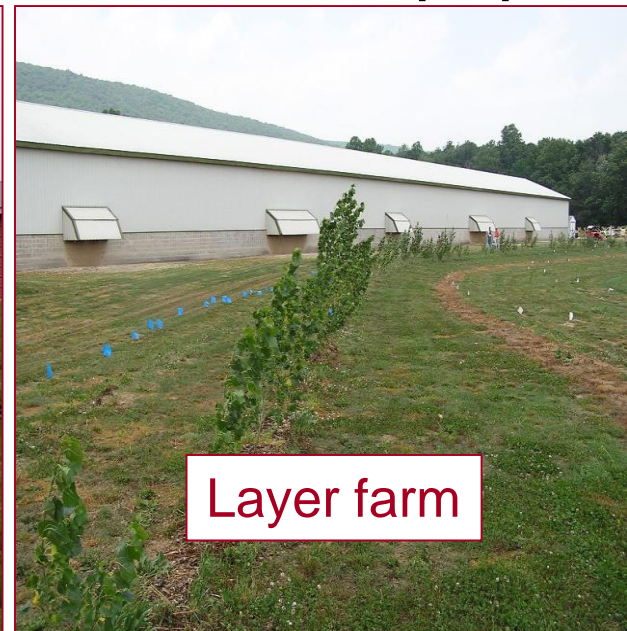
- Plants near the fans had greater N (3.75% vs. 2.32%) and dry matter than those downwind
- PM_{2.5}: Hybrid & Streamco willow, and N. spruce > poplar;
PM₁₀ N. spruce > willows or poplar;
Total PM: N. spruce and H. willow > S. willow or poplar



Turkey farm



Broiler farm



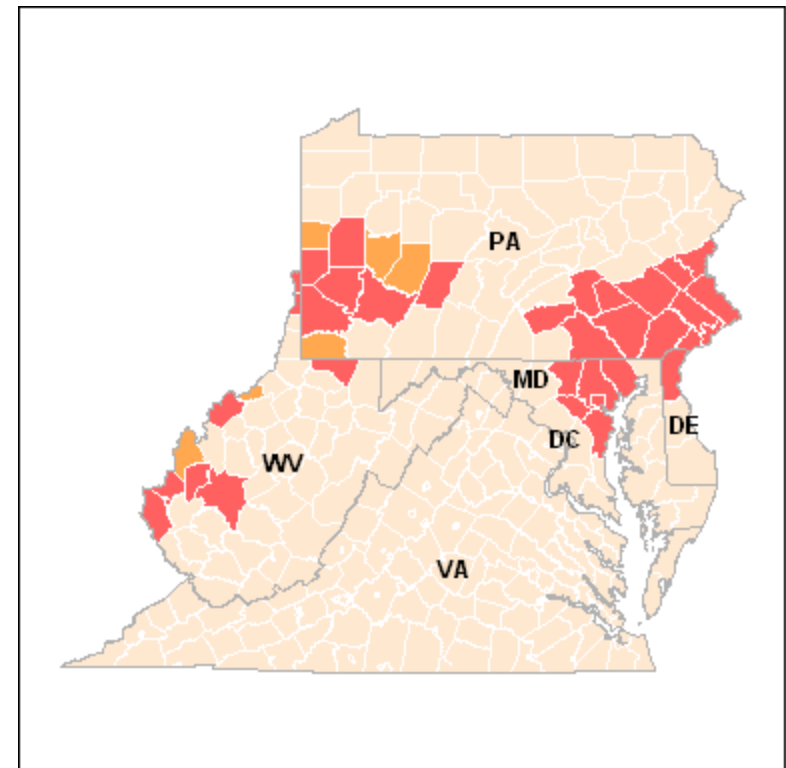
Layer farm



Introduction

- Ammonia
- Particulate Matter
- **Odor** *Filtering exhaust air dust can reduce odors up to 65% (Hartung, 1989)*
- **Viruses** *Bacteria and other microorganisms travel with dust and PM emitted from exhaust fans (Simmons, III et al., 2006)*

EPA PM Non-Attainment Zones



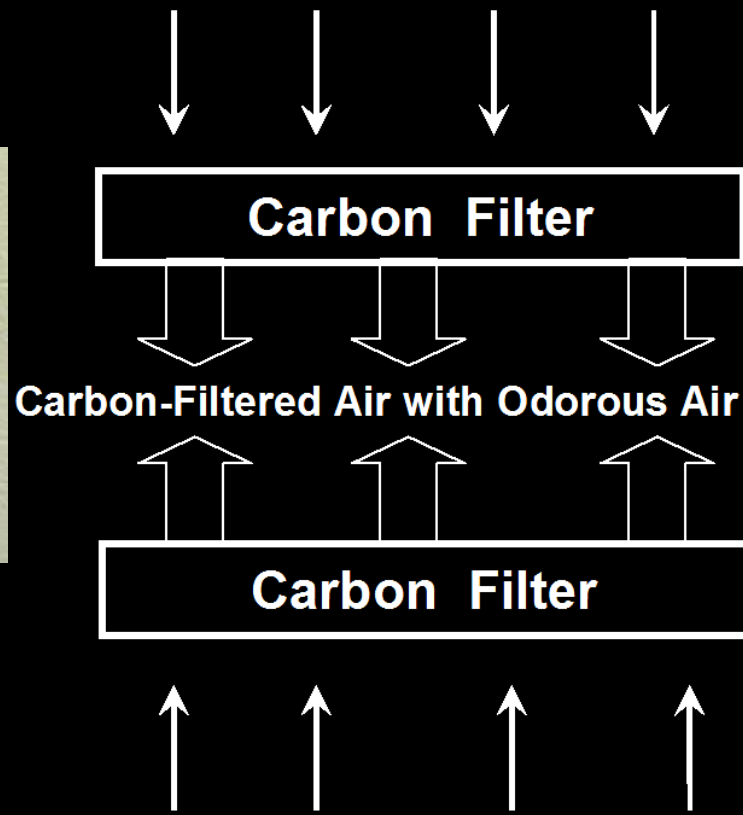
EPA Designation

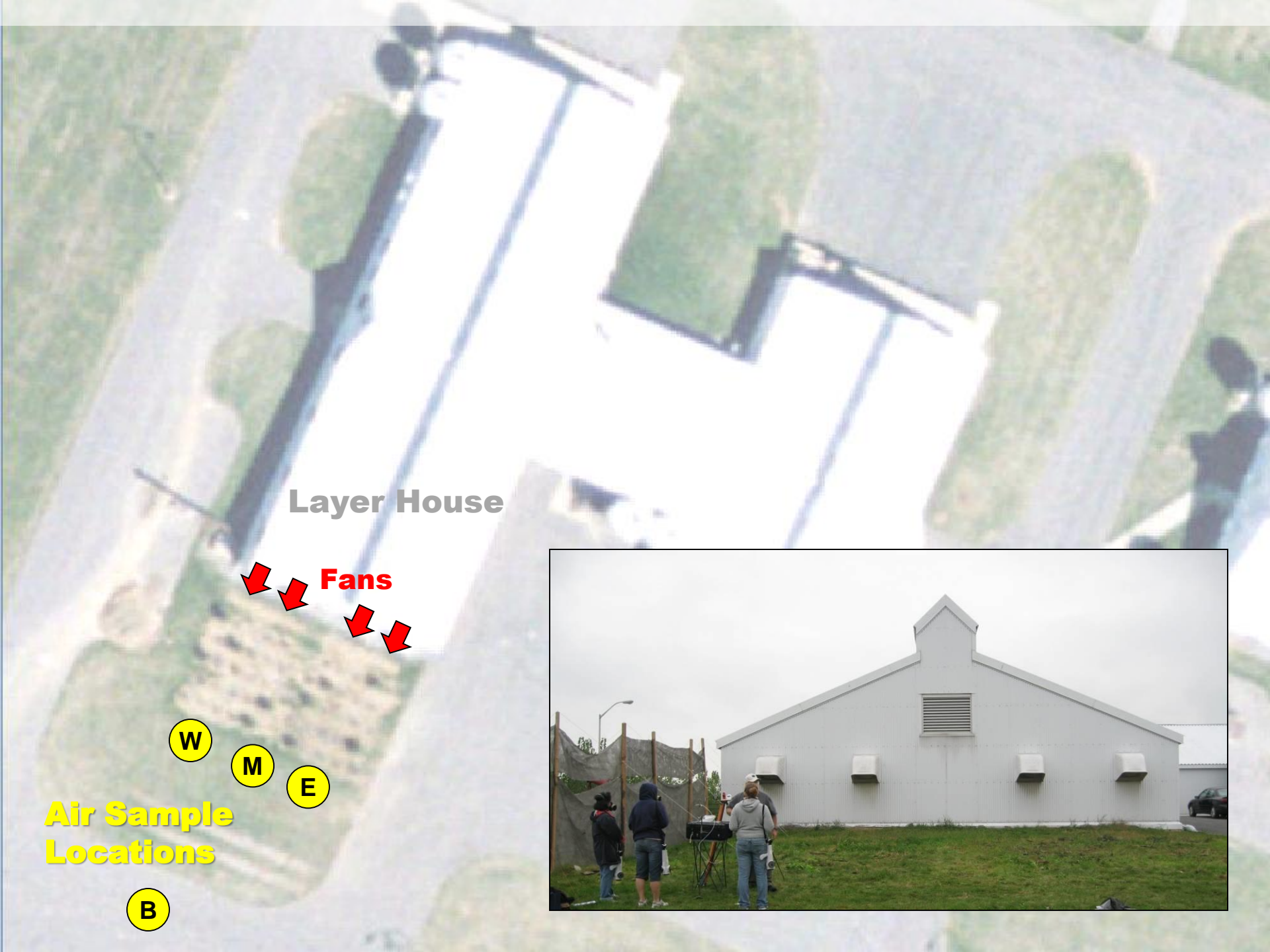
- Attainment/Unclassifiable
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Odor Threshold Concentration (Dynamic Olfactometer)



Odor Threshold Concentration (Field Olfactometer)





Layer House

Fans

W

M

E

**Air Sample
Locations**

B



Materials and Methods

- PSU Hen House
- Pot in Pot system (76 liter)
- Trees 5 rows of 10:
 - Canaan fir
 - Ornametal pear
 - Juniper
 - Whitespice clump birch
 - Streamco willow



Odor (detectable threshold) from PSU Hen House

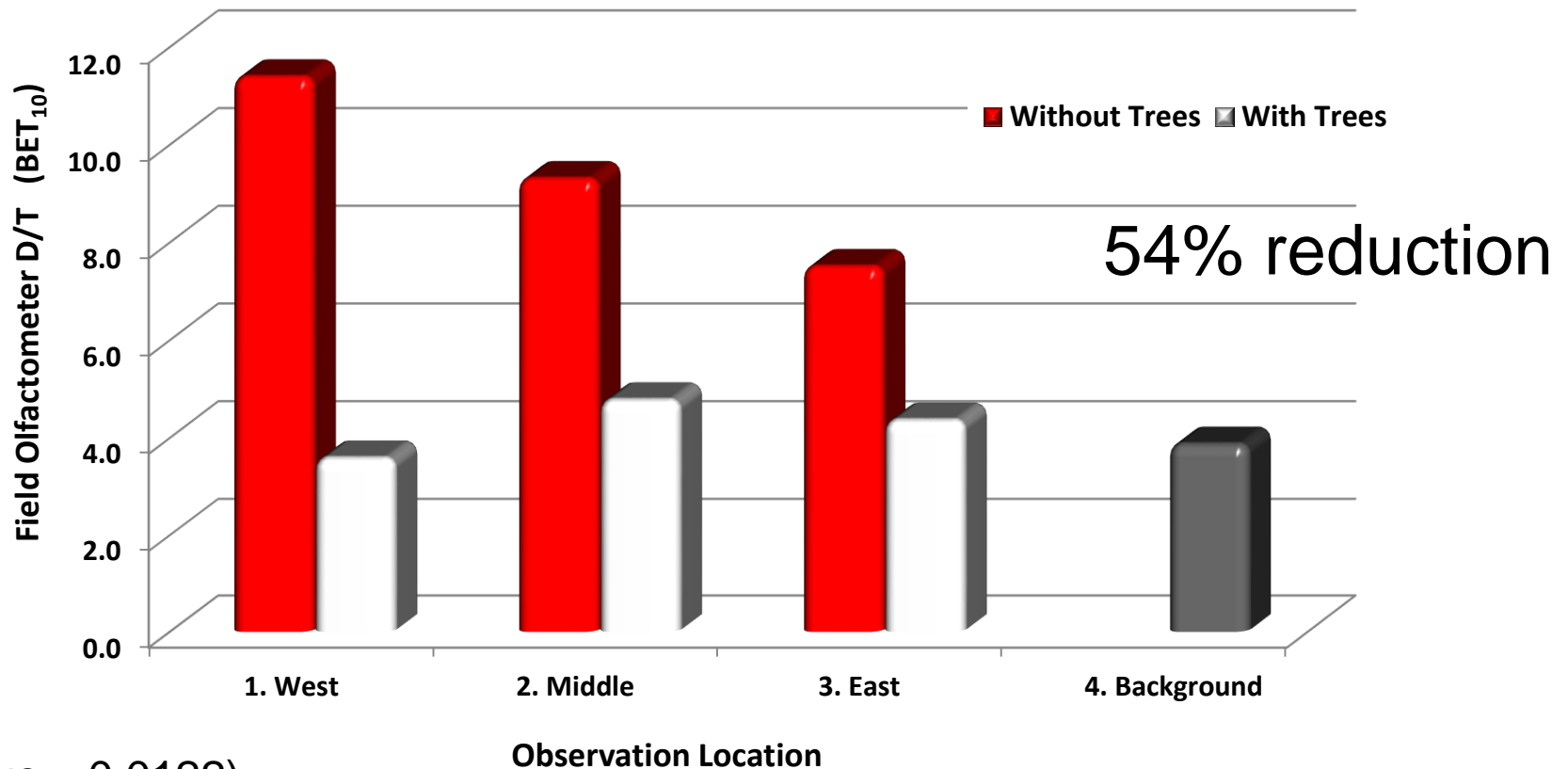
Treatment	9/15/08	9/22/08
No Trees	33.7	44.7
Trees	21.7	20.7
P-value	0.3999	0.3431

Dynamic olfactometer and AC'SENT data sense olfactometry software.

46% reduction

Odor (Nasal Ranger, detectable threshold) from PSU Hen House

Poultry Housing Shelterbelt Odor Emissions



(*P*-value = 0.0122)

Vegetative Buffers Can

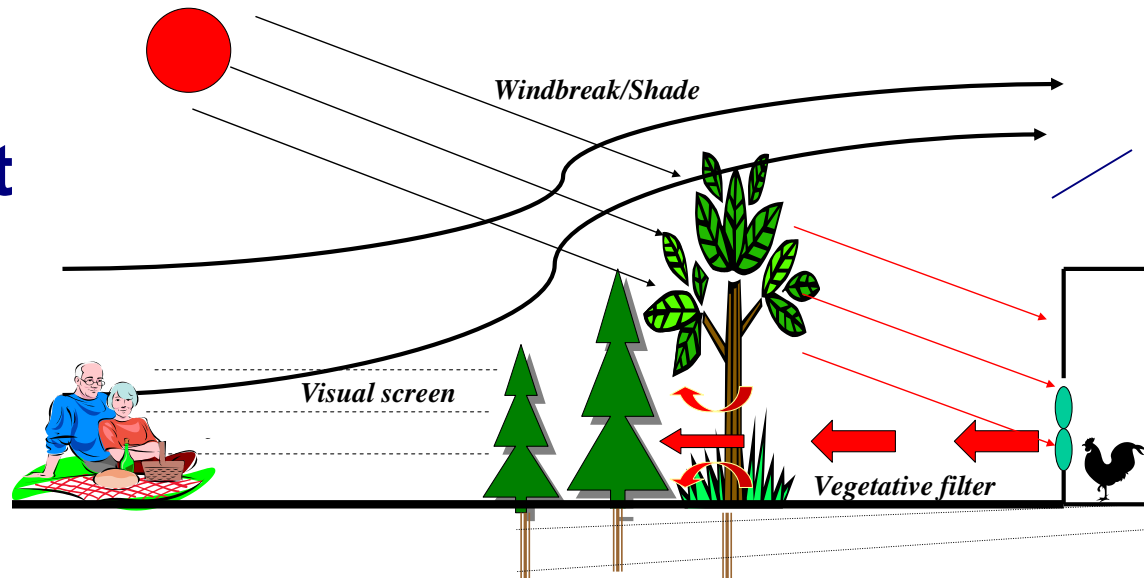
- Visual screen for neighbors
- Farm beautification
- Energy conservation
- Snow load
- Flies

- **Emissions:**

1. ammonia & dust
2. odor & viruses

- **Biomass:**

- Litter
- Fuel



Biomass Crops

- Poplar: 1/7yr →
- Willow: 1/3yr ↓



- Miscanthus: 1/yr →



Broiler Litter Study



Miscanthus Grass



Pine Shavings



Poplar Shavings



Chopped Willow

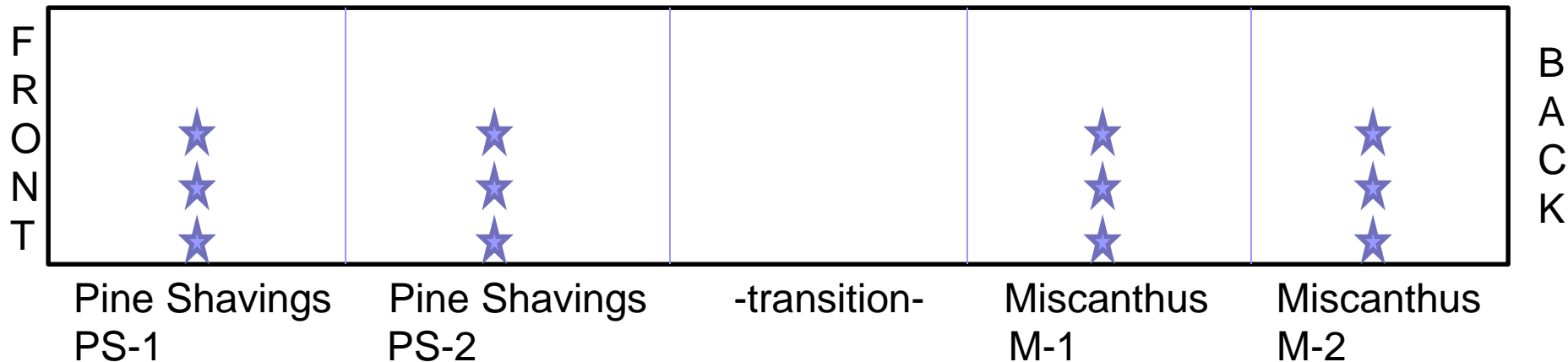


Biomass Willows



Commercial Broiler House

- The litter samples and ammonia measures were at three locations per treatment cell designated with stars for A, B, and C below. A is central in the house between left and right water lines, B is between the right feed and wall water line, and C is between the wall and right water line. All are marked with green tape on the water and feedlines. So there are 6 sampling locations in Pine and 6 for Miscanthus, total 12.



Poultry Litter as a Fuel Source

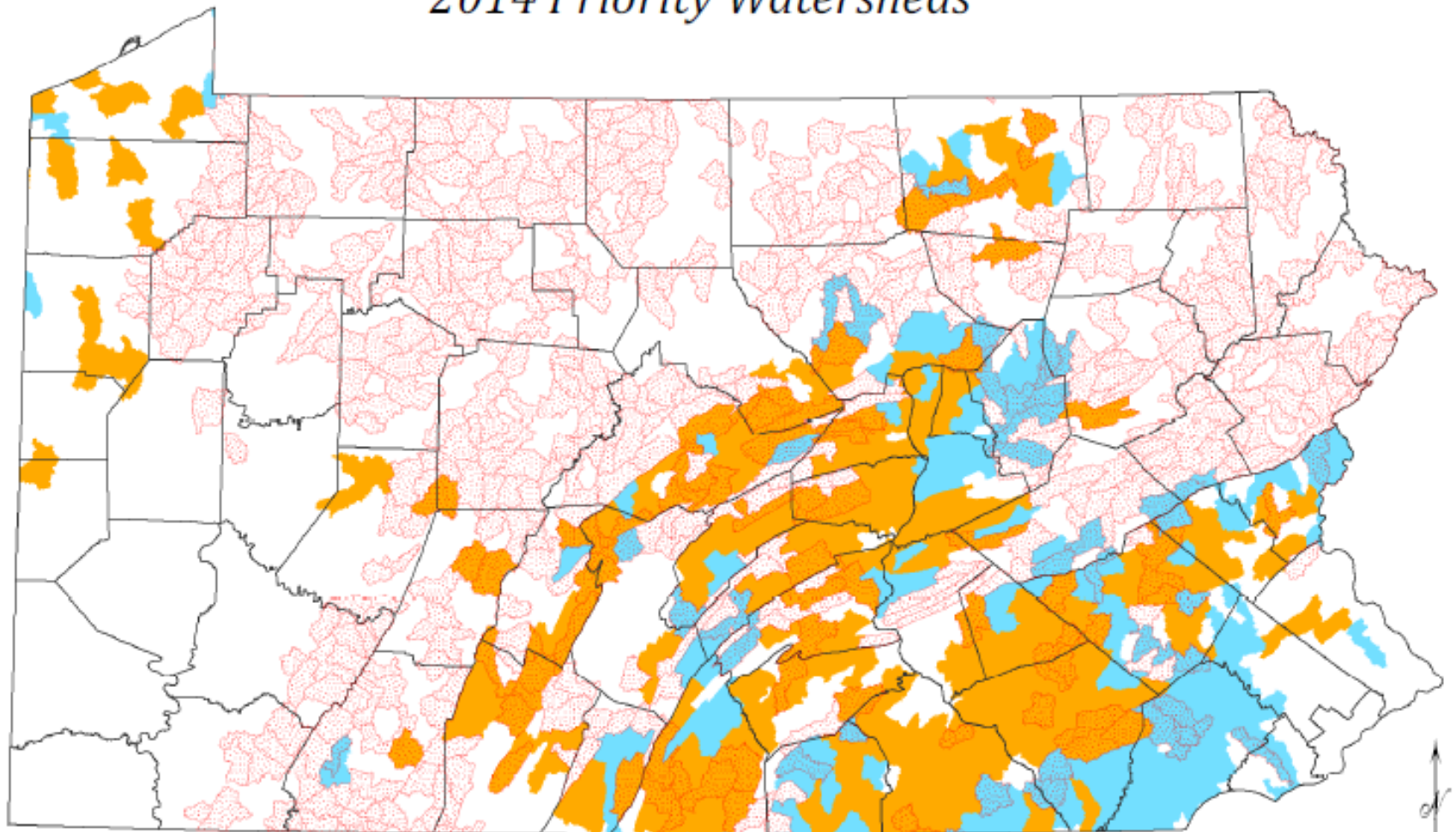




Vegetative and Riparian Buffers for Environmental Stewardship and Renewable Fuels on Poultry Farms

- Veg Buffers: Odor, NH₃, PM
- Screening/Landscaping
- Riparian Buffers
- Energy Conservation
- Biomass/Energy

2014 Priority Watersheds



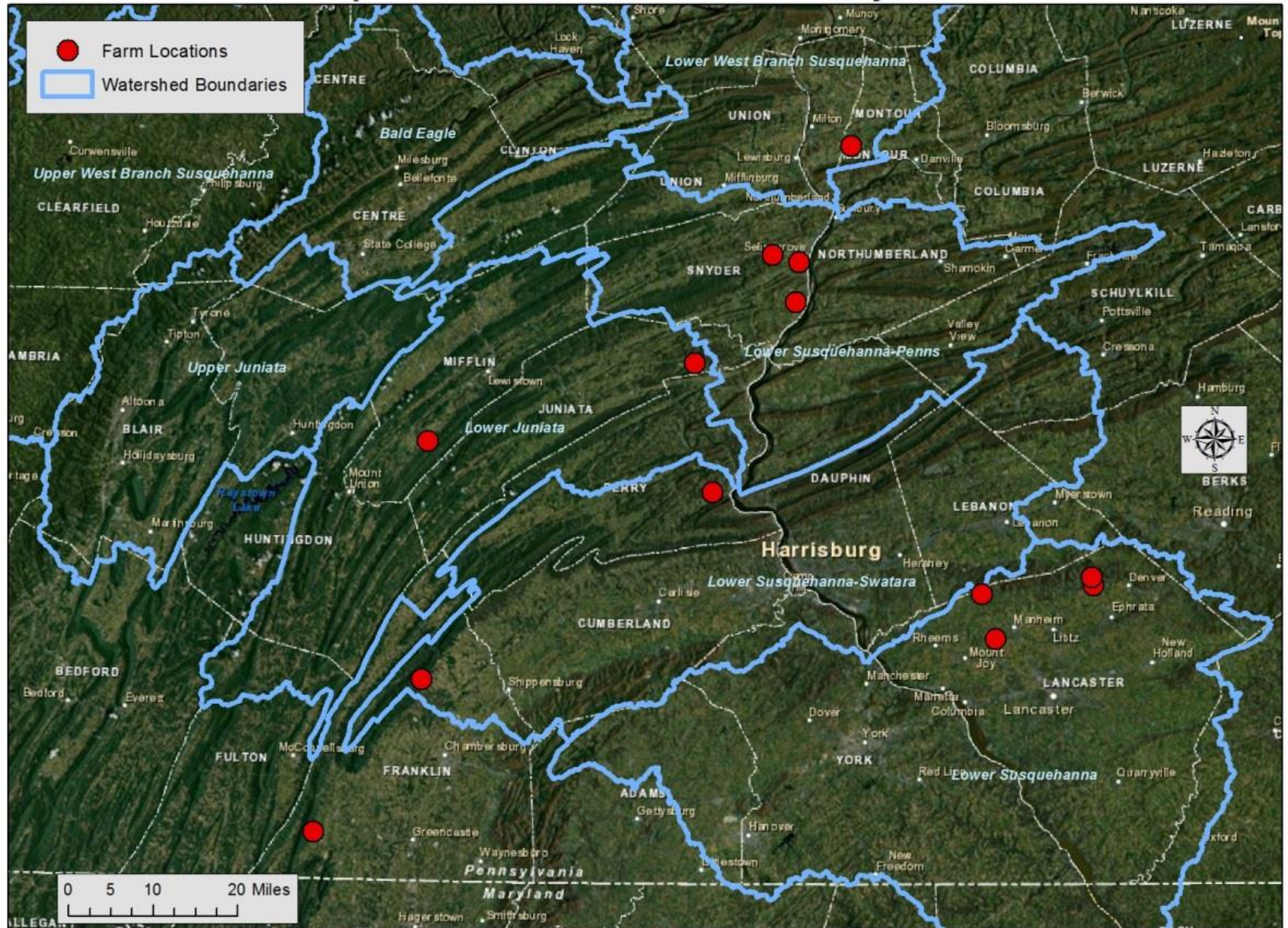
- High Priority Watershed
- Medium Priority Watersheds
- Brook Trout Greatly Reduced
- County Boundary



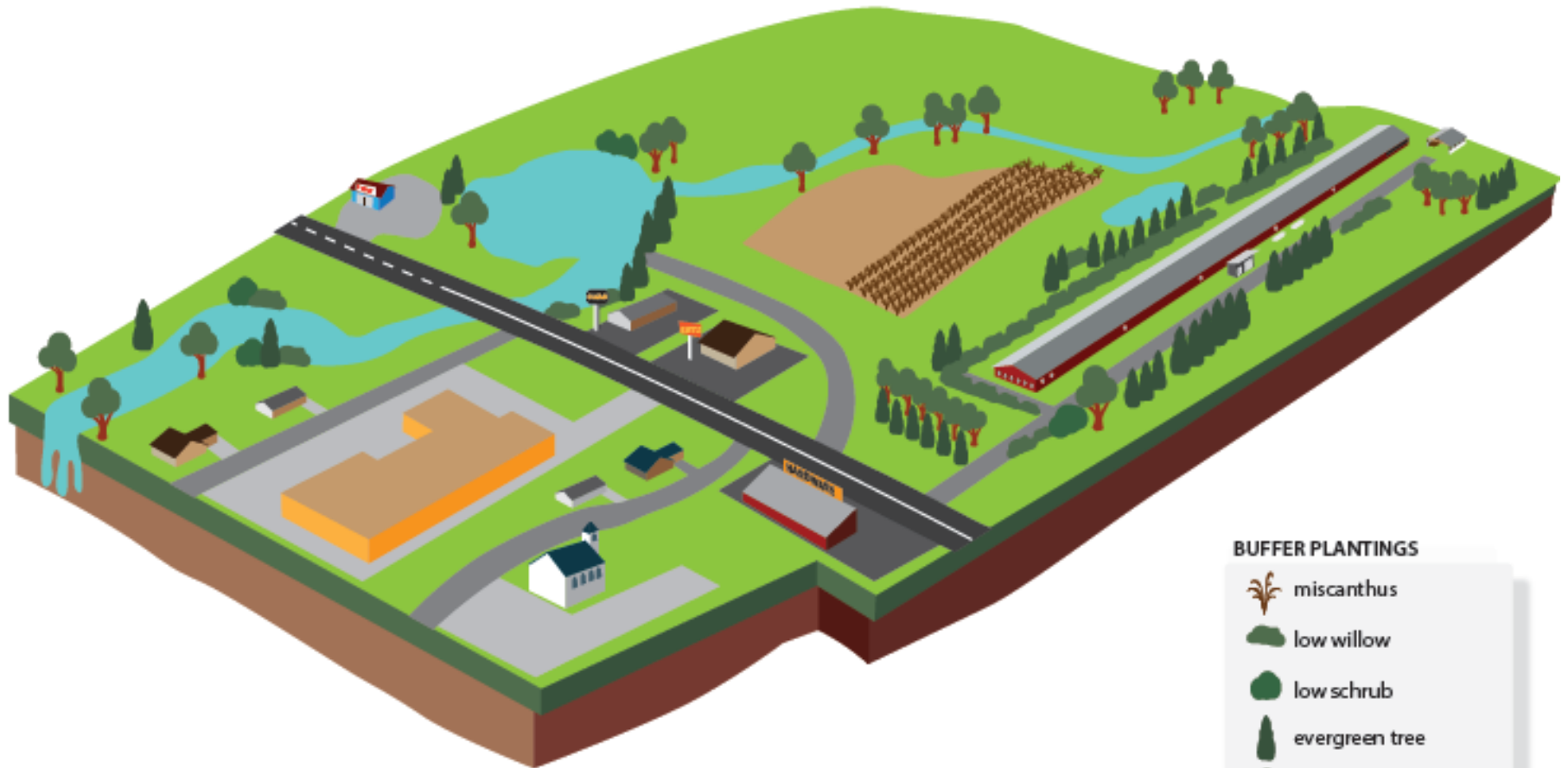
Grant Partners

- Farmers (13)
- County Conservation Districts (7)
- PA State Conservation Commission
- PA DCNR
- Dble A Willow, Ernst Seed Total Energy Soln.
- TNC
- NRCS (PA, Big Flats, Norman Berg)

Cooperator Farm Locations in Pennsylvania



Landscaping, Screening

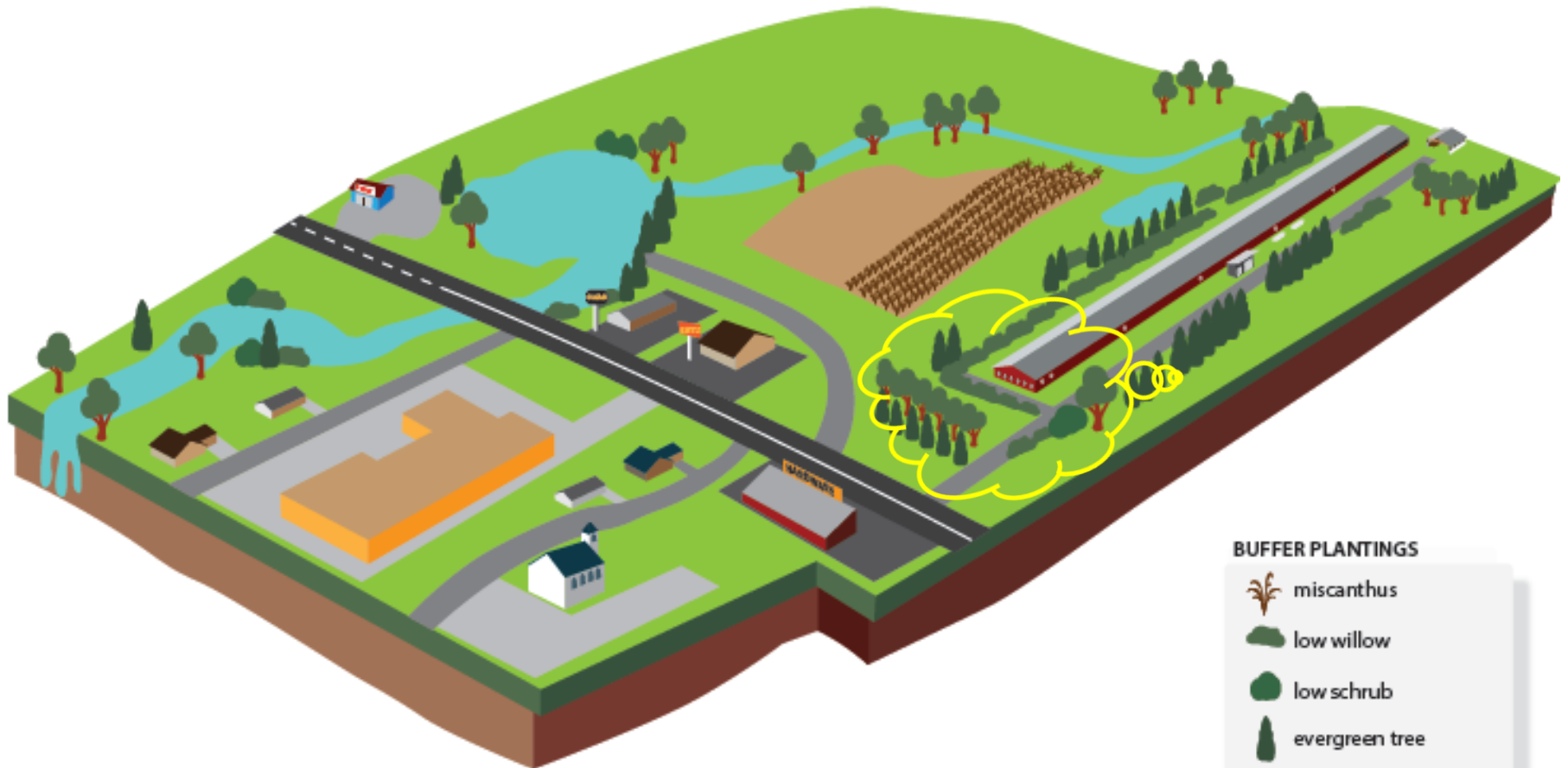


BUFFER PLANTINGS

-  miscanthus
-  low willow
-  low shrub
-  evergreen tree
-  deciduous tree (large)

Graphics not to scale. For illustrative purposes only.

Vegetative Buffers: NH₃, PM, Odor

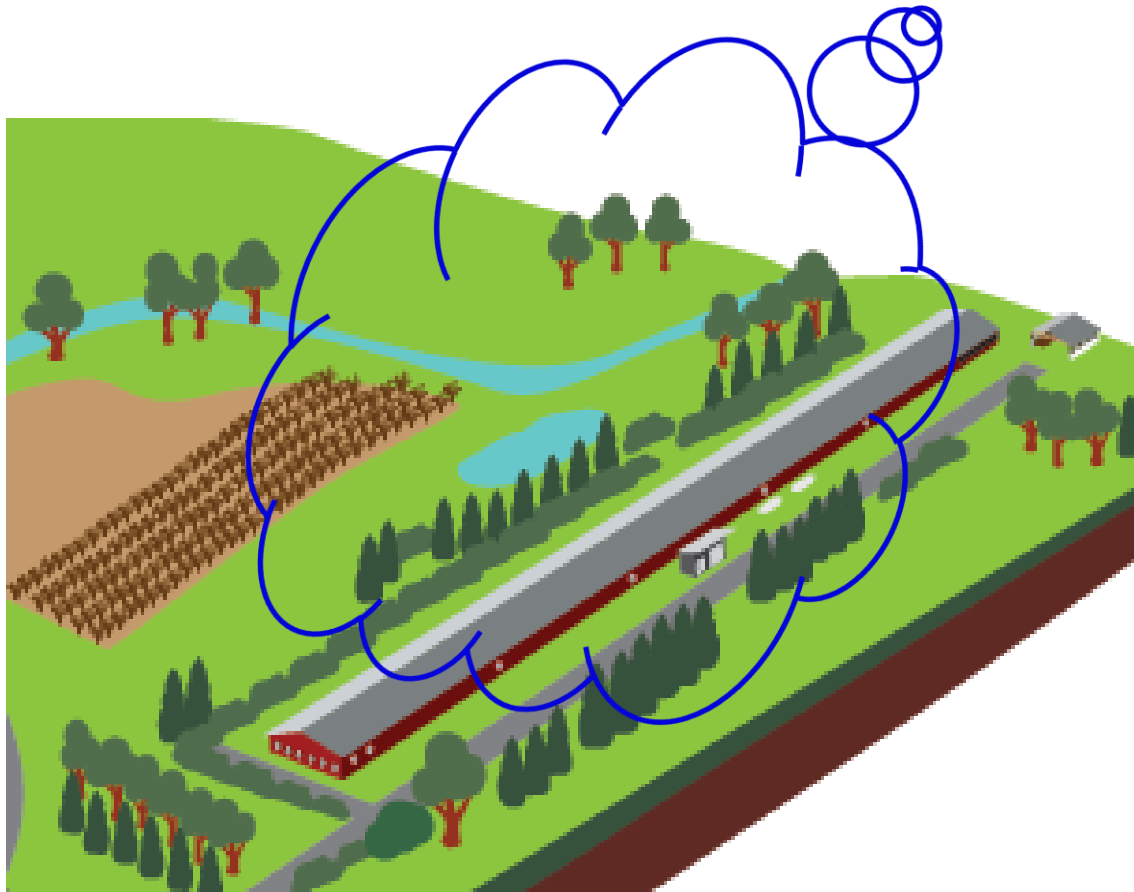


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Riparian Buffer: Nutrients, Sediment, Hormones, Microorganisms



Biomass: for bedding & fuel

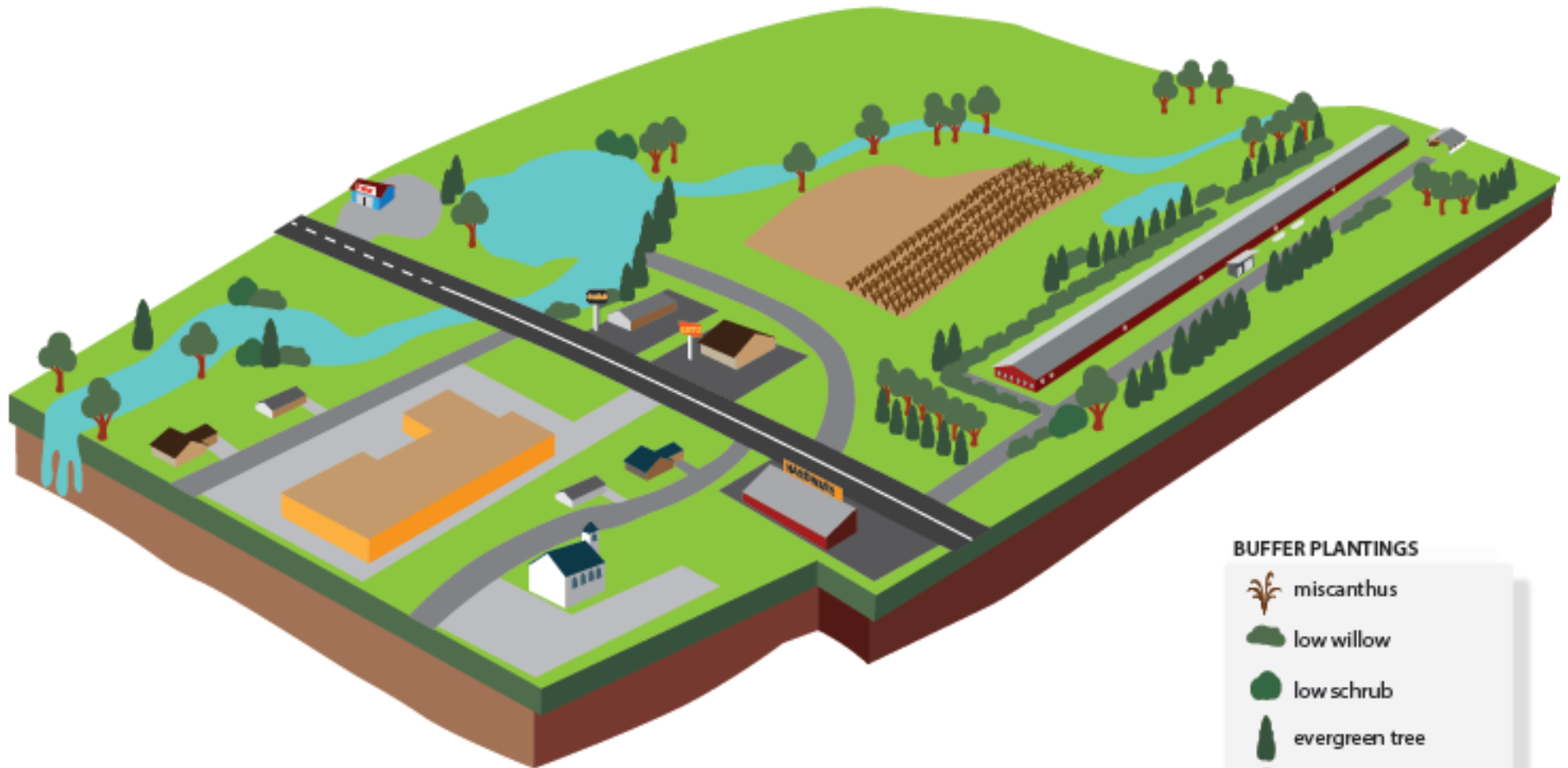


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Energy Conservation: Shade and Windbreaks



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Commercial Hen Complex



- Buffer Vegetation:
 - streamco willow
 - Arborvitae
 - hybrid poplar, hackberry, maple, alder, oak
 - *Miscanthus giganteus*, (Giant silver grass)



Recommendations: Preparation

- **Weed Control**
 - A. Pre- & postemergence herbicides
 - B. Mulch & fabrics
 - C. Equipment
- **Fertility**
 - A. Soil test
 - B. Develop a fertilizer program
 - C. Fertilizer types
- **Irrigation**
 - A. Importance at planting
 - B. Low-volume systems
 - C. Other options



Recommendations: Plant Species

Ausstree or Hybrid Willow?
Evergreen or Deciduous?
Shrubs vs. Grasses?





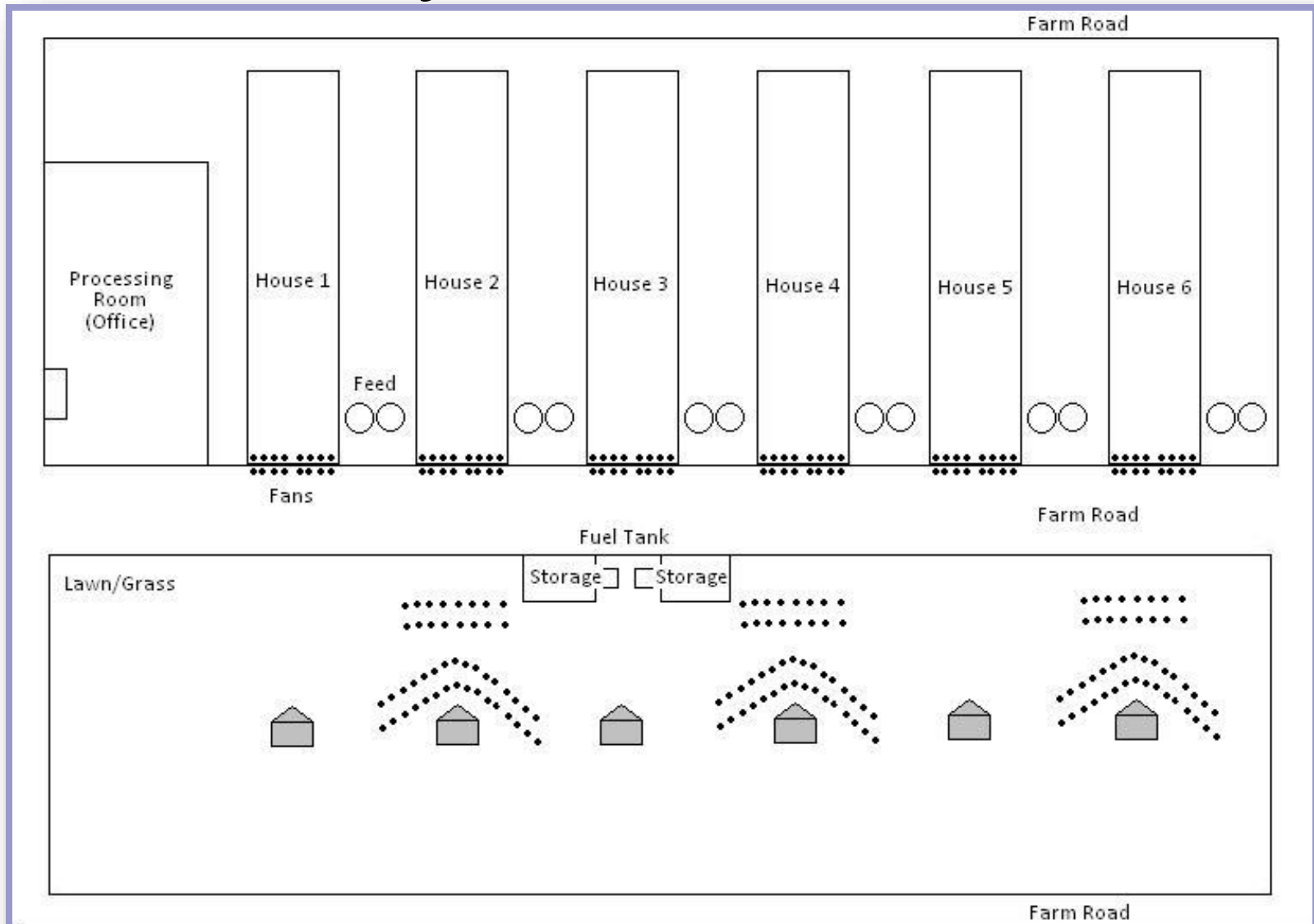


Commercial Hen Complex



- Buffer Vegetation:
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Overall Layout



Corn Field

Foliage Biomass to Trap Ammonia-N

Assuming:

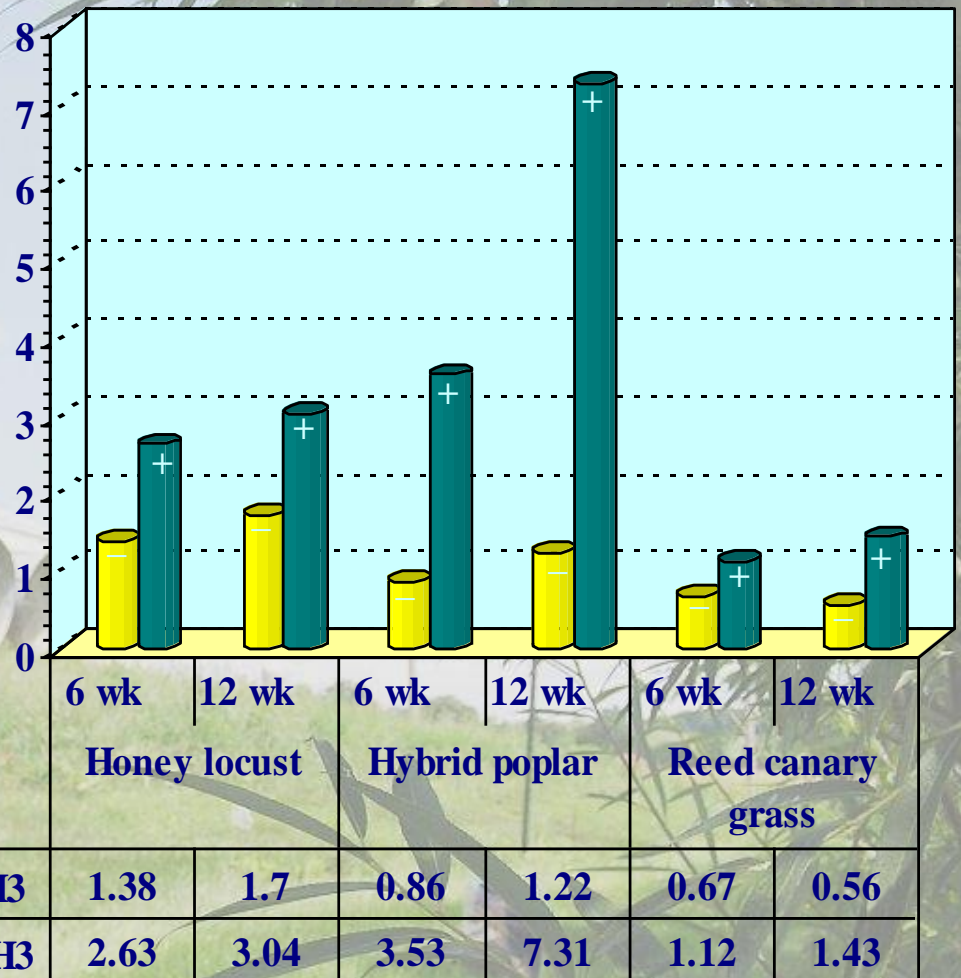
~A small hen house (4,000 birds)
with four 24 in (61cm) fans

~[NH₃]: 30 ppm=0.020833 g m⁻³

~Each fan discharges
140,213 m³ of air d⁻¹

~30% of NH₃-N is trapped

g/100 g of foliage



Then the foliar biomass required to trap this amount of NH₃-N will be:

104 to 238 lbs of poplar, or
474 to 509 lbs of locust, or
730 to 1466 lbs of grass

Contact Information

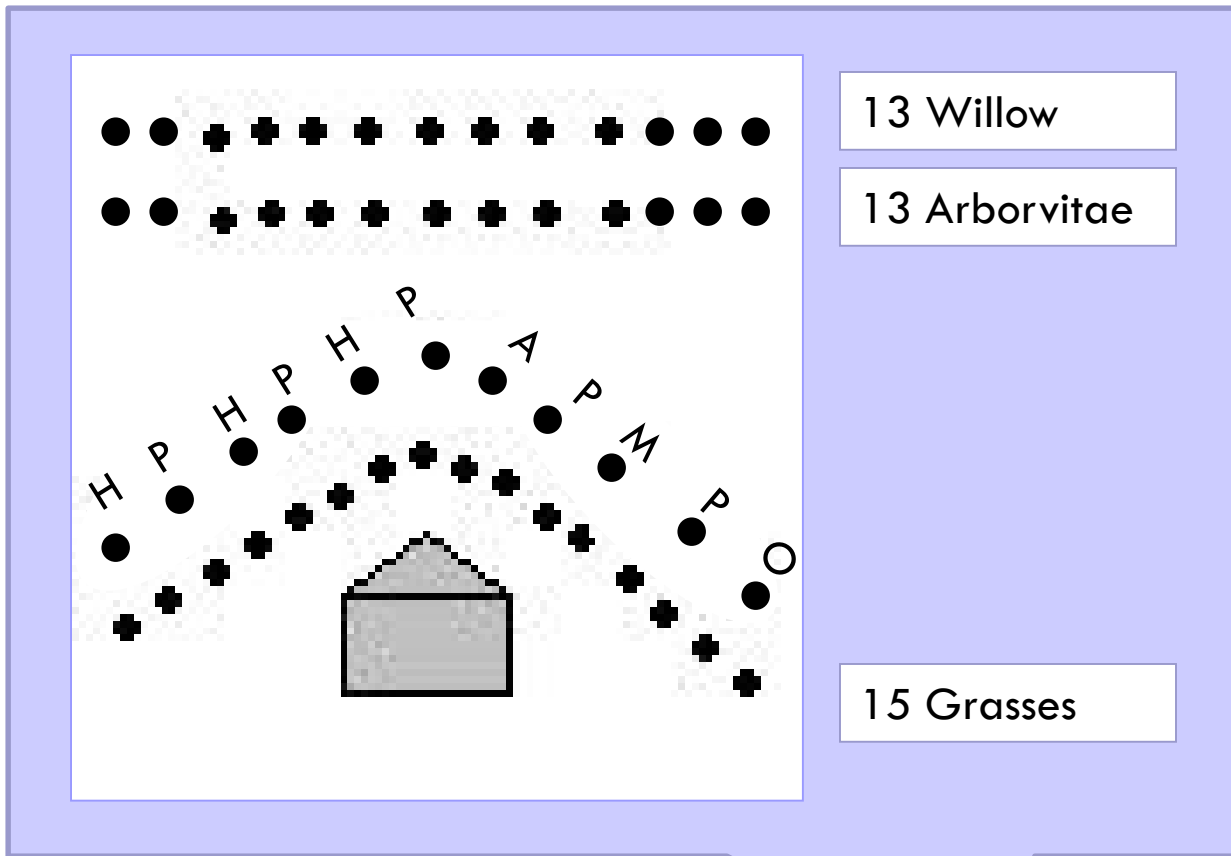
- Paul Patterson, Department of Animal Sci.
php1@psu.edu, (814) 865-3414



Additional Resource Persons

- Shawn Belt, Horticulturist, USDA-NRCS Norman A. Berg National Plant Materials Center, Beltsville, MD 20705, (301) 504-8516, shawn.belt@md.usda.gov
- Rickey Bates, Horticulturist, Penn State, University Park, PA 16802, (814) 863-2198, rmb30@psu.edu
- Martin van der Grinten, USDA-NRCS Big Flats Plant Materials Center, NY, Van Der Grinten, Martin - NRCS, Corning, NY Martin.Vandergrinten@ny.usda.gov

Vegetative Buffer Layout



13 Willow

13 Arborvitae

15 Grasses

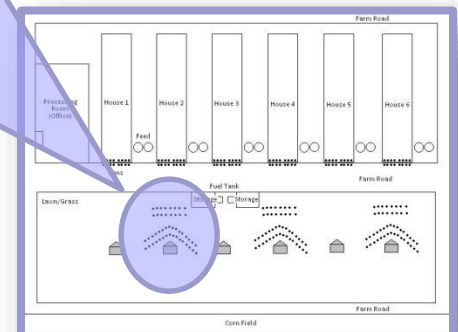
H=Hackberry

P=Poplar

A=Alder

M=Maple

O=Oak



Summary of Findings

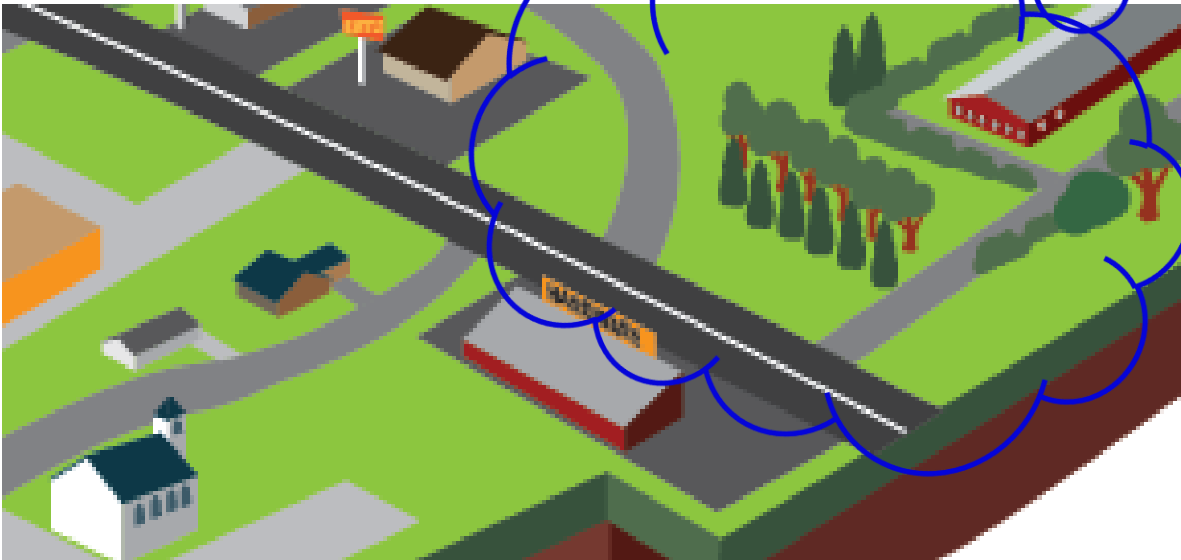
- Vaccine strain NDV and IBV was transmitted between house and coop birds **Bird positivity increased with more time, and downwind transmission of NDV detected**
- VEB did not reduce NDV swabs **But reduced serum NDV (trial 1), and reduced serum and cloaca IBV in (trial 3).**

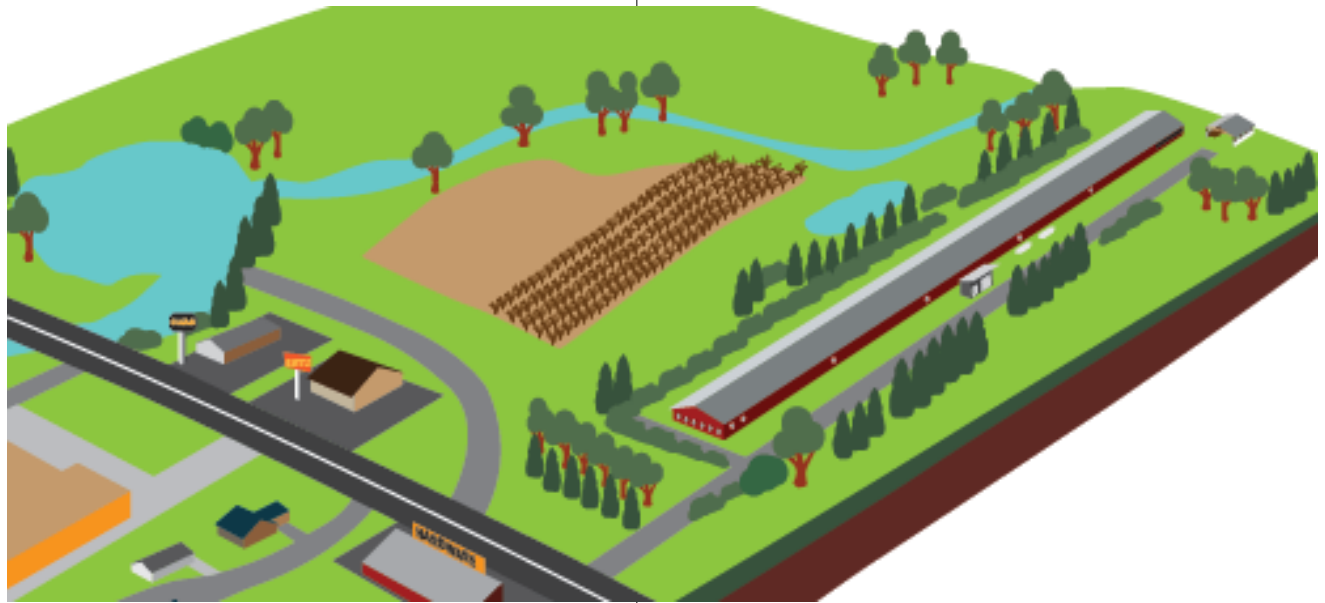
Vegetative Buffers

NH₃

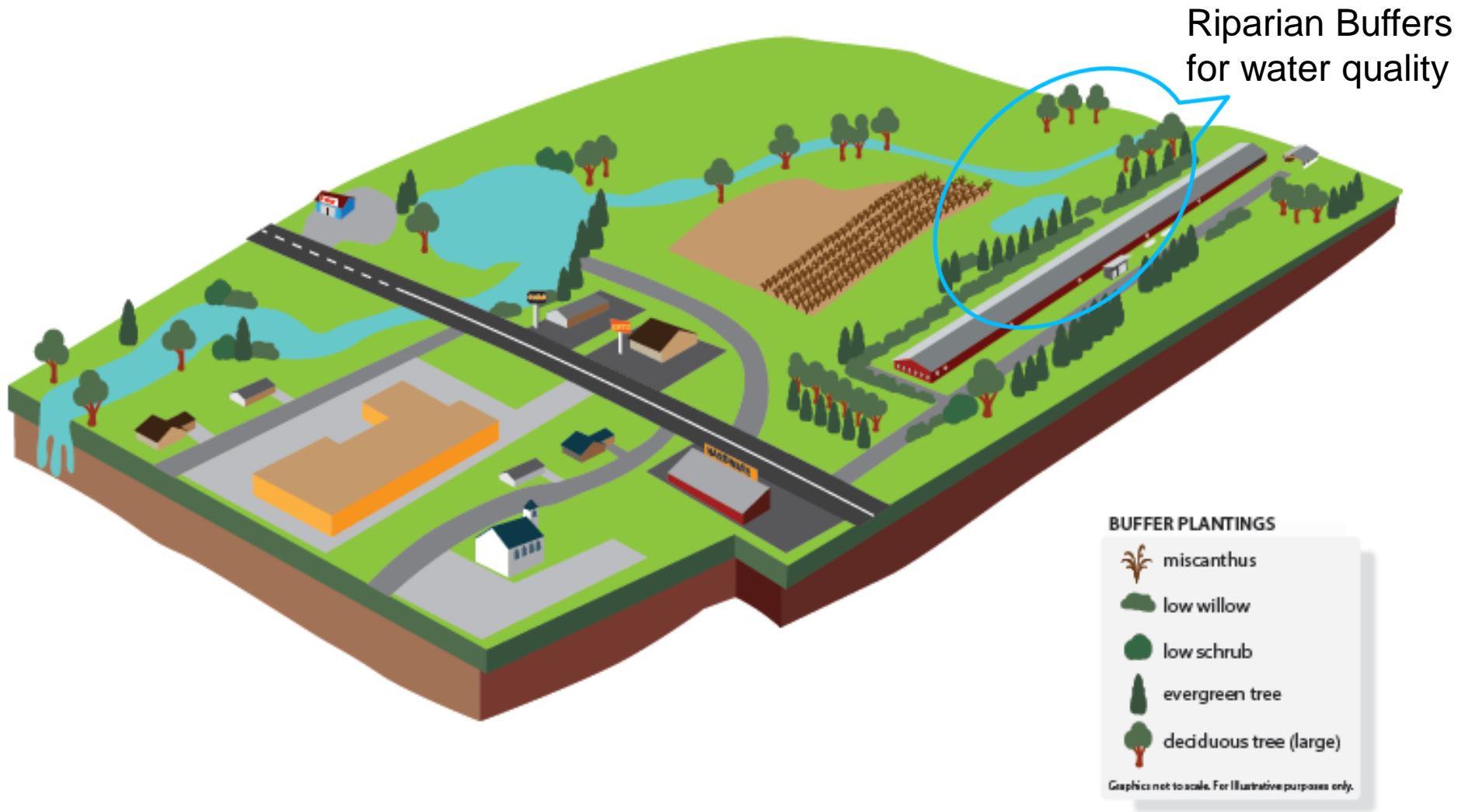
PM

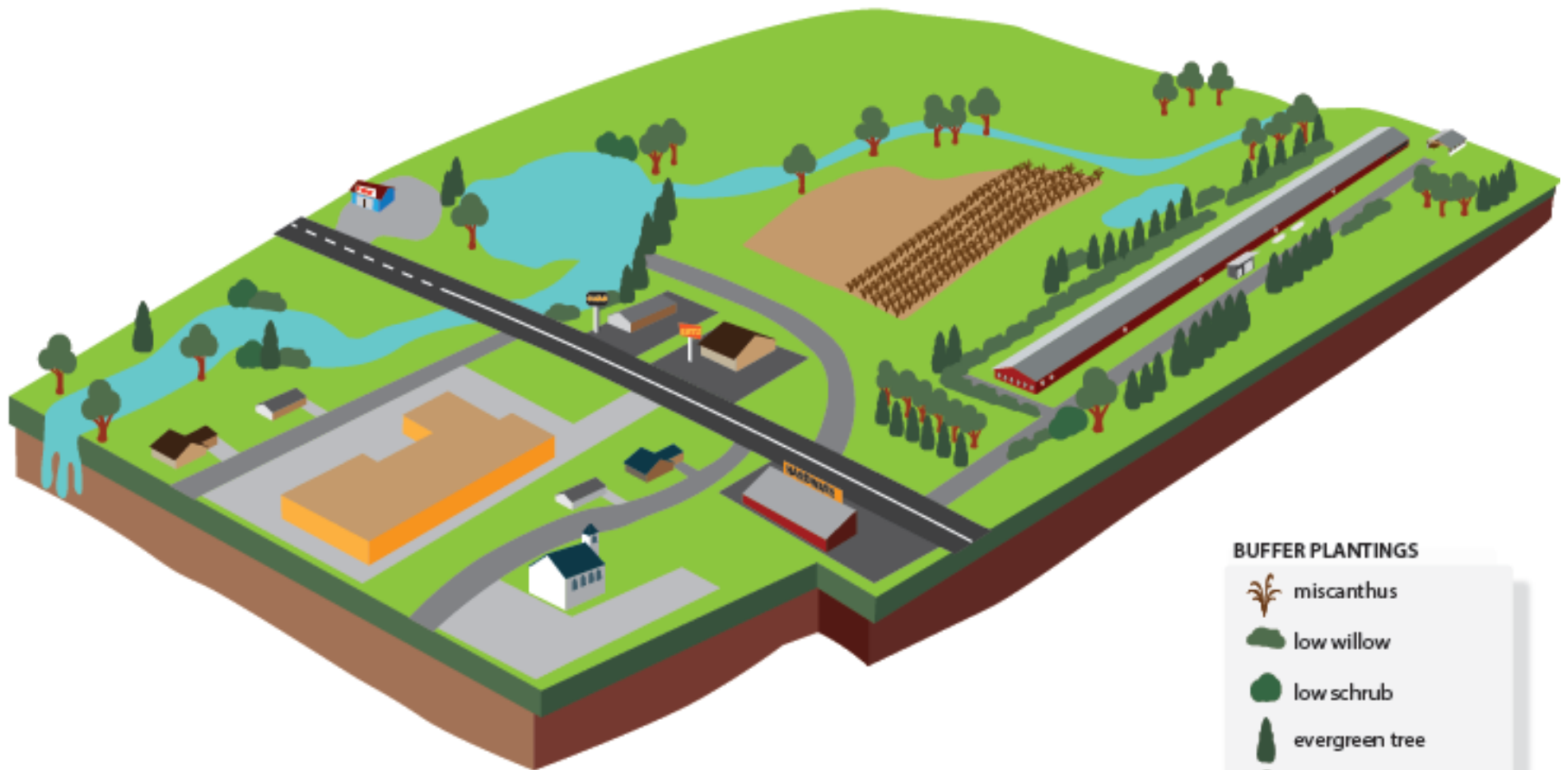
Odor





Riparian Buffer: Nutrients, Sediment, Hormones, Microorganisms

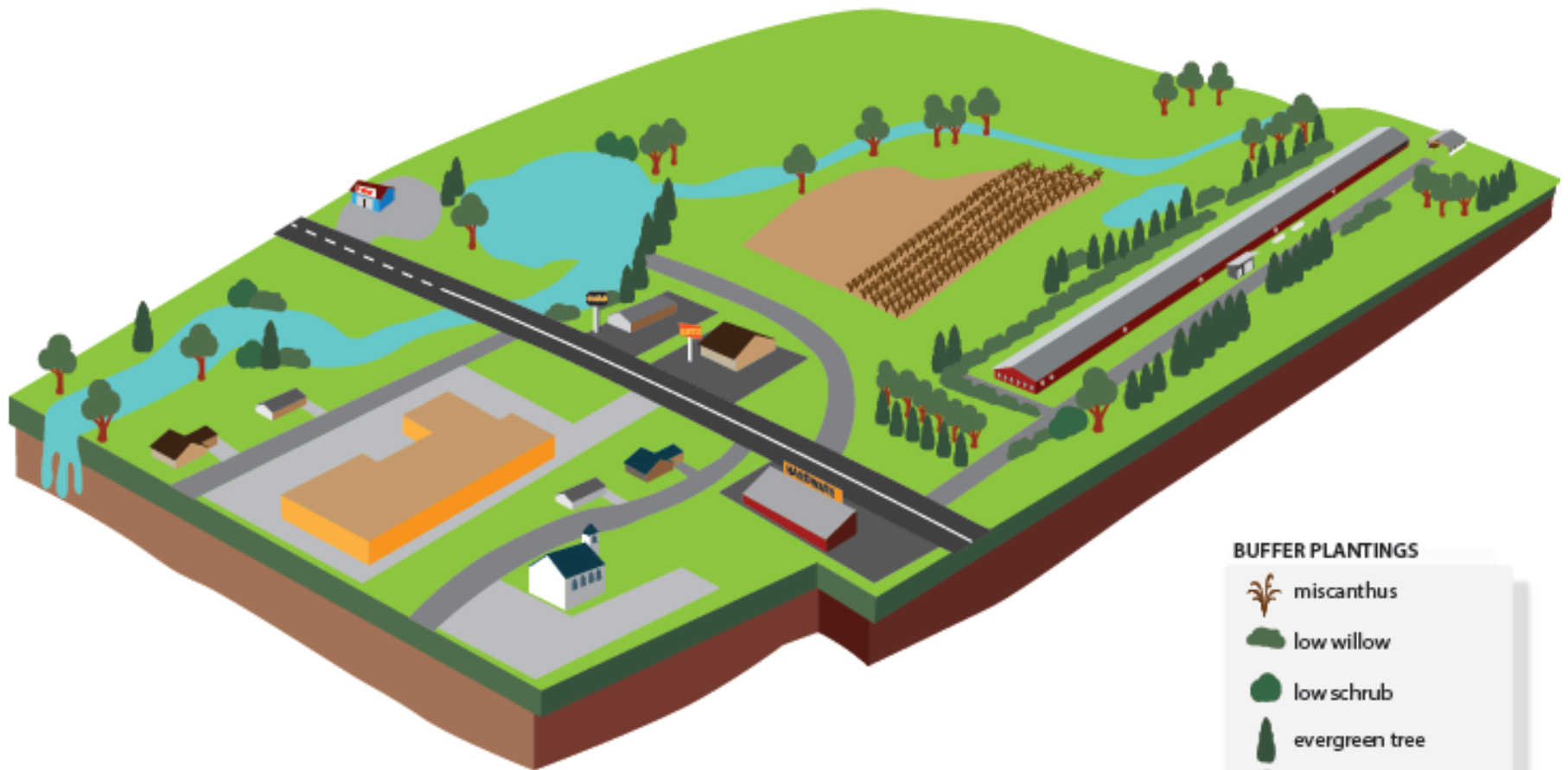




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