Nutrient Management And Water Quality

Jason Fischbach
Agriculture Agent
UW-Extension, Ashland/Bayfield

Agriculture Is A Partnership

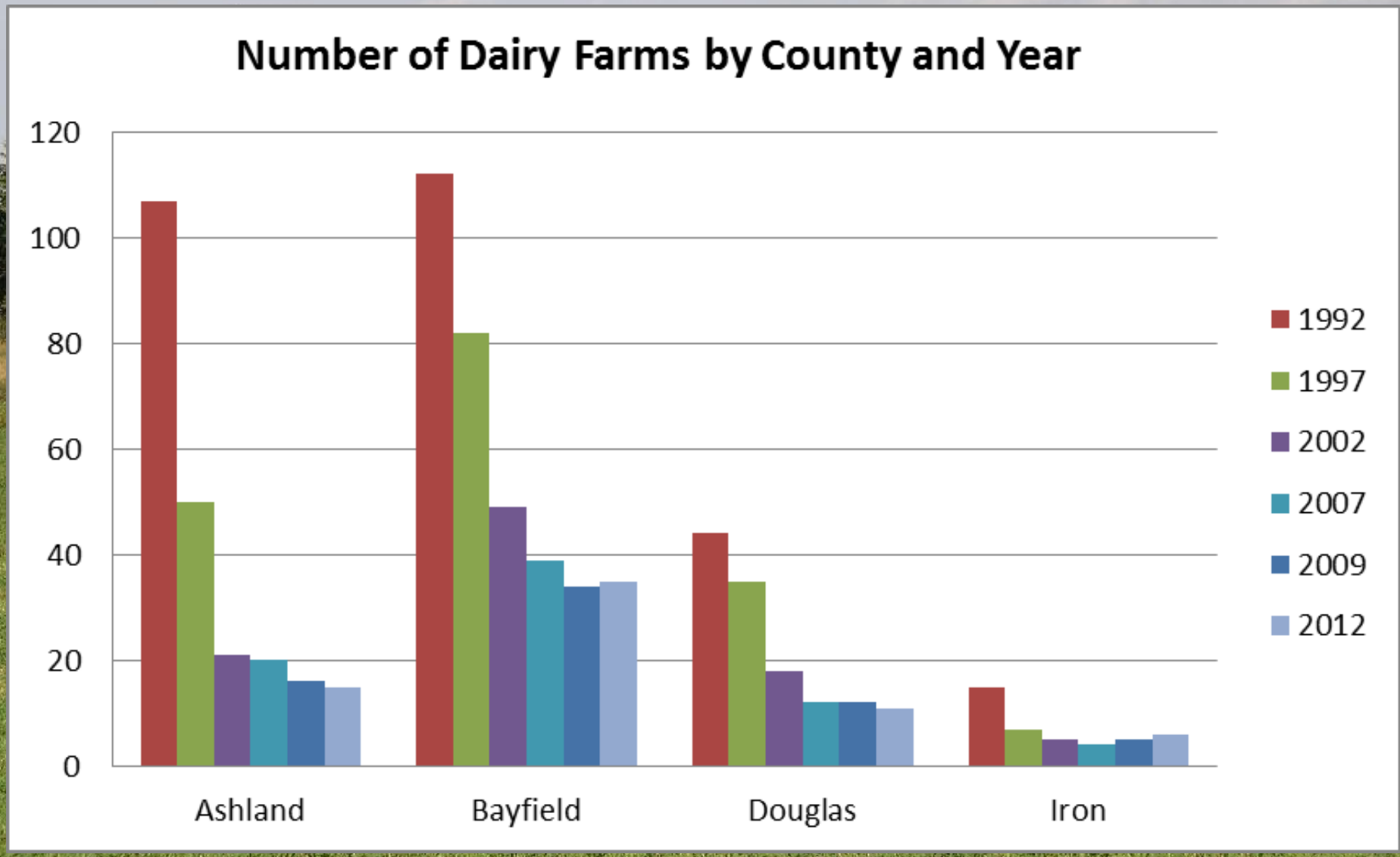
Between the
The Farmer and The Eater

- As land stewards, farmers have an obligation to protect soil and water quality

- Eating habits and policy decisions have consequences on farm economics and water quality

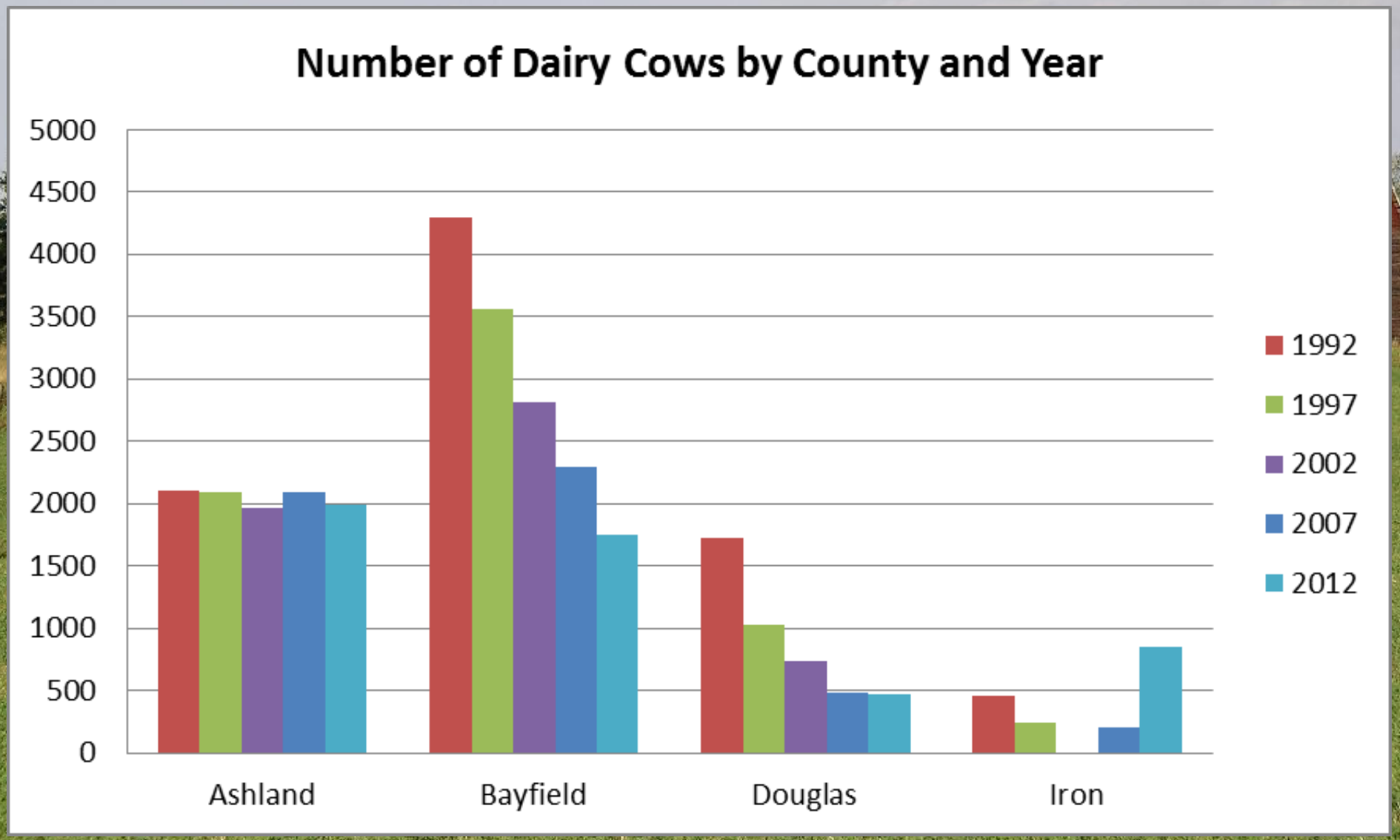

We Need Food AND
We Need Clean Water
There is no either/or

Agriculture in Transition



*US 2012 Census of Agriculture

Agriculture in Transition



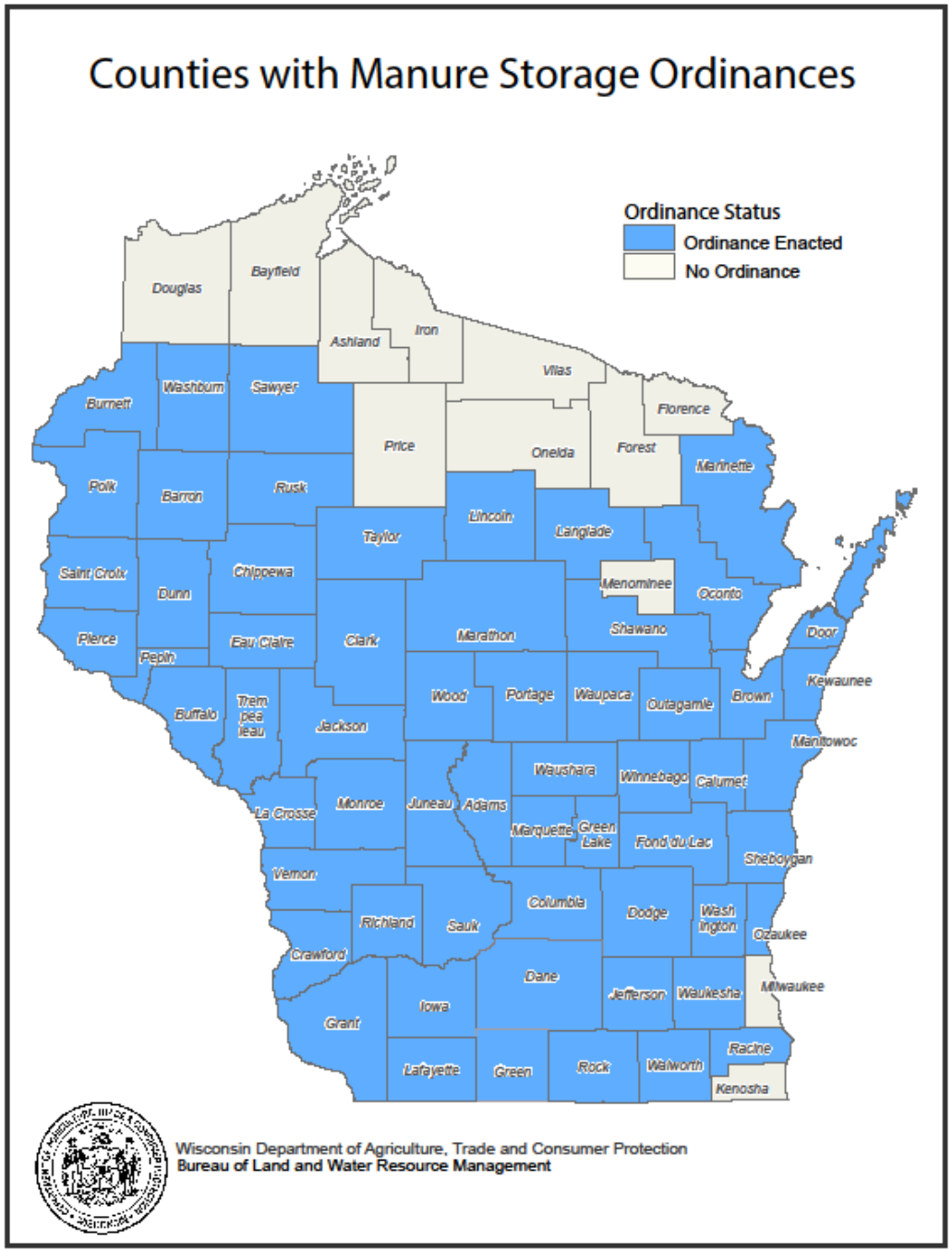
*US 2012 Census of Agriculture

For Perspective

	Ashland Bayfield Douglas Iron	Door Brown Kewaunee
# of Dairy Cows*:	5065	99,715
Harvested Acres*:	81,420	366,229
Acres/Cow:	16.1	3.7
Watershed Acres:	1.9 million	865,280
Acres/Cow:	379	8.7

*US 2012 Census of Agriculture

Current Local Regulations (lack of) Reflect the Low Agricultural Intensity



The Future of Ag in Our Region

- Big farms (commodities)
  - Expansions of existing farms to accommodate multiple generations
  - New commodity farms requiring large scale and big capital due to low margins
- Small farms (retail-ready foods)
  - Existing farms transitioning from commods.
  - New farmers with limited capital

Regulations and Standards to Protect Water Quality

- NR 151 (Standards and prohibitions)
- ATCP 51 (Livestock facility siting law)
- NR 243 (CAFO water quality permits)
- NRCS 590 Standard (Nutrient management)
- Local manure storage ordinance
- Local operational ordinances

Nutrient Management Planning

Nutrient Management Planning and Water Quality

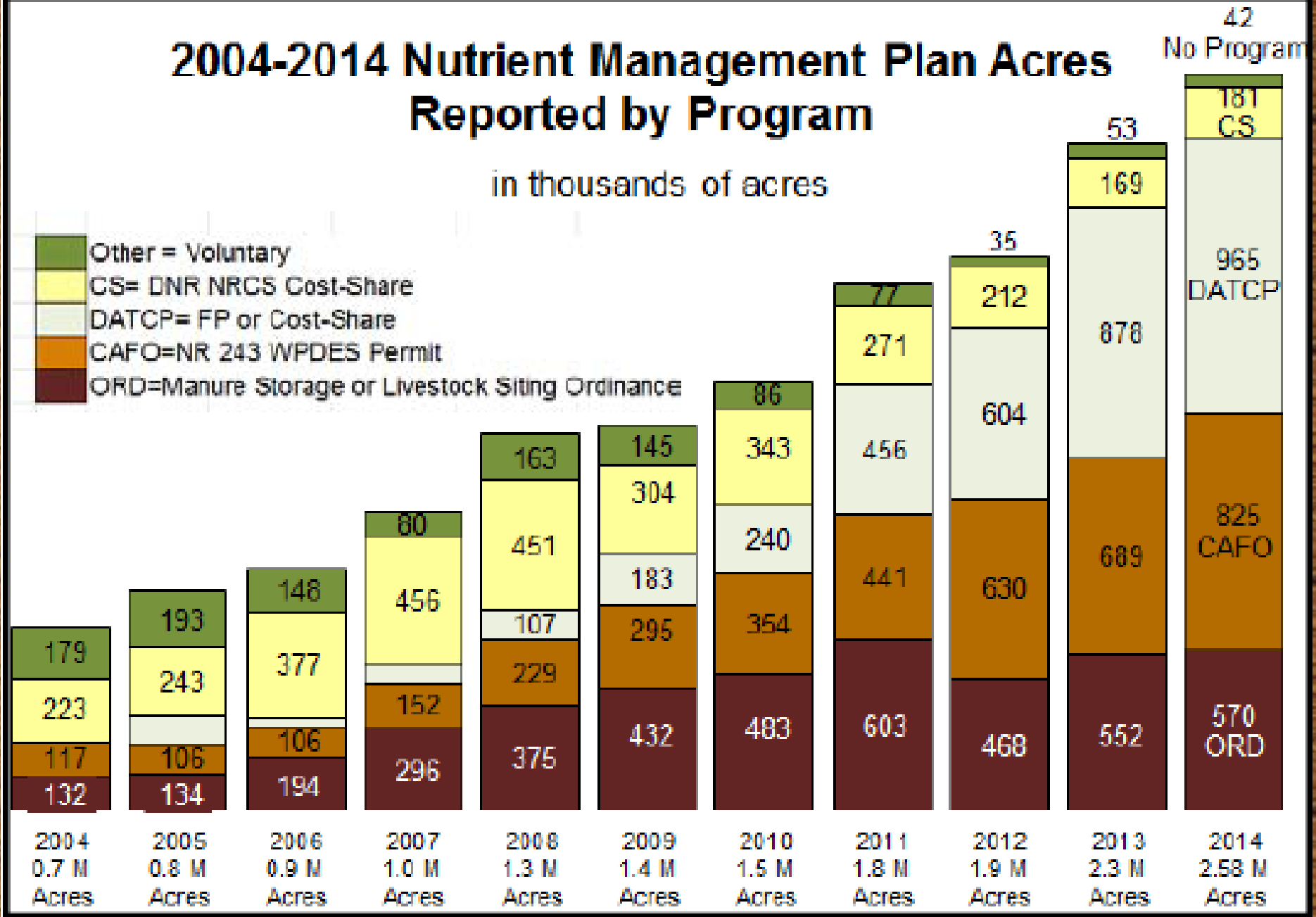
- Limit soil erosion (Tolerable Soil Loss)
- Meet but not exceed crop nutrient needs
  - Soil testing
  - Crediting existing nutrients
- Minimize nutrient/manure loss
  - Manure storage requirements
  - Spreading restrictions
  - Phosphorus restrictions
  - Nitrogen restrictions

Who Is Required to Have A Plan?

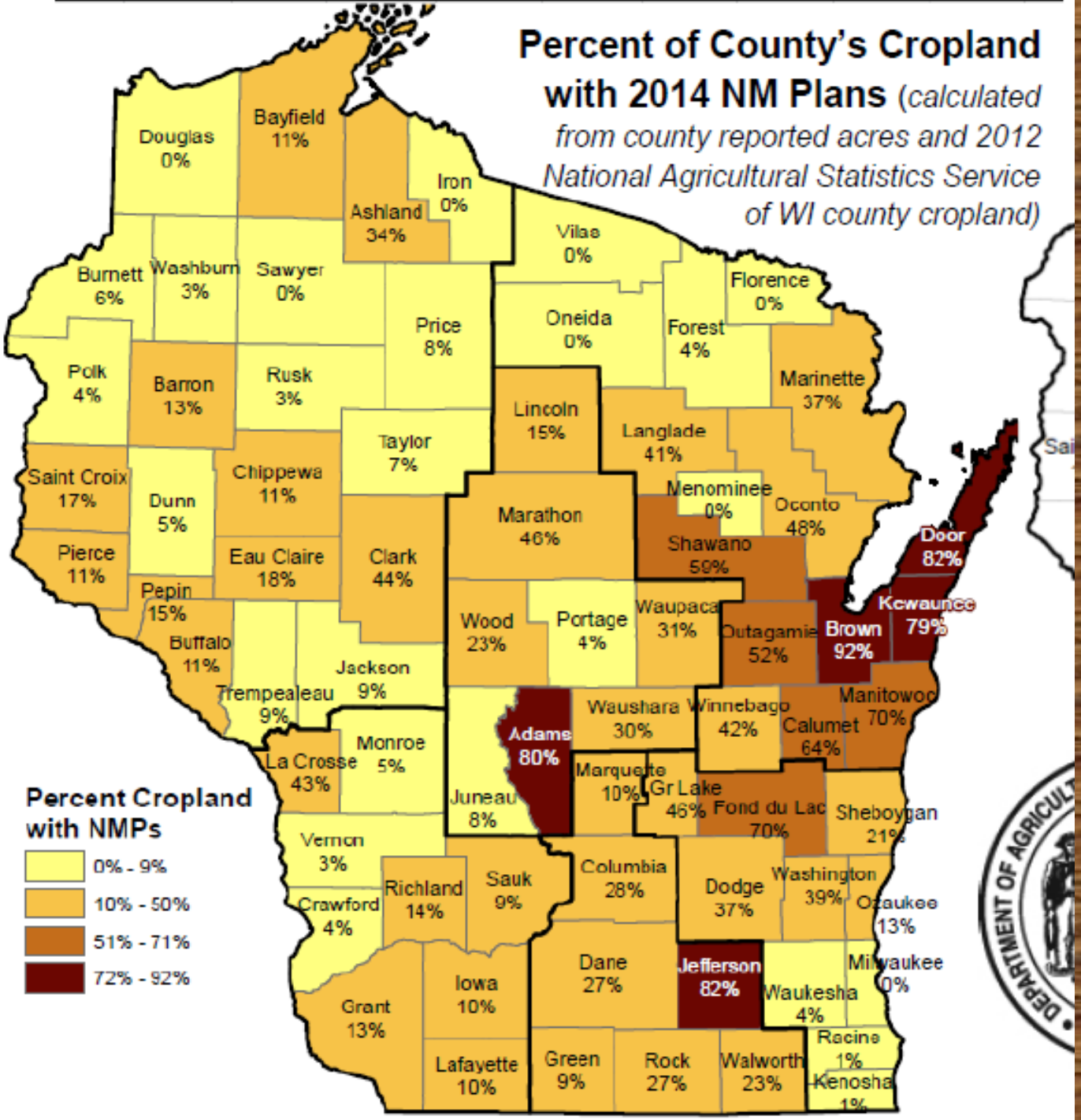
- More than 1000 au (CAFOs)
- More than 500 au (Siting ordinance)
- Local manure storage ordinance
- Receive cost-sharing for manure storage via NRCS or County
- Enroll in Farmland Preservation

2004-2014 Nutrient Management Plan Acres Reported by Program

in thousands of acres



Percent of County's Cropland with 2014 NM Plans (*calculated from county reported acres and 2012 National Agricultural Statistics Service of WI county cropland)*



Nutrient Management in Ashland/Bayfield Counties

Nutrient Management Planning Efforts To Date

- Focused on farms with livestock
- 31 plans written to date
- 12,696 acres covered under nutrient management plans
- 12/16 Ashland County dairy farms
- 9/29 Bayfield County dairy farms

22 farms in Ashland/Bayfield Counties 637 fields, 11,675 acres

Most Common Soil Types

Soil Name	Soil Type	Acres	%
Sanborg/Badriver	580B	6190	53.0%
Amnicon/Cuttre	262B	1046	9.0%
Portwing/Herbster	480B	857	7.3%
Allendale	226A	270	2.3%
Odanah/Cornucopia	3454B	206	1.8%

Predominant Soil Types

Sanborg

0-9in	Silt loam
9-17in	Silty clay loam
17-35in	Clay
35-80in	Silty Clay

Badriver

0-9in	Clay loam
10-53in	Clay
53-60in	Clay loam

Amnicon

0-10in	Silty clay loam
10-67in	Clay

Cuttre

0-3in	Clay
3-6in	Clay loam
6-80in	Clay

The Nutrient Management Plan

1. Map and Test The Soils

- 1 sample per 5 acres
- Test for P, K, OM, pH

The Nutrient Management Plan

2. Set Crop Rotations

- Year 1 – Alfalfa
- Year 2 –Corn
- Year 3 – Alfalfa seeding
- Year 4 - Alfalfa

3. Calculate Crop Nutrient Needs

- Nitrogen depends on the crop
- P and K depend on the crop, yield goals, and soil tests

Fast Facts

Year	Soil Test	pH	OM	P	K
2013	2013-11-21	6.7	3.3	26	120

[<]

Rotation Wizard

Crop Year (Fall to Fall):	2013	
Crop:	Corn silage	Corn
Yield Goal:	20.1-25	20.1-
Tillage:	Spring Chisel, disked	Sprin
Soil Test Date:	2013-11-21	2013-
Lime Rec:	NA	
Irrigation / MRTN info:	Irrigated 0.05/MRTN	Ir
Season notes:		

(lbs/acre)	N	P2O5	K2O	N
UW Recommendation:	145	40	185	145
Prior years' extra:	-	0	0	-
Adjusted UW recommendation:	145	40	185	145
1st & 2nd year legume credit:	0	-	-	0
2nd & 3rd year manure credit:	0	-	-	6
This year's manure:	16	24	40	16
This year's fertilizer:	46	0	0	0
Total credits & applications:	**62**	**24**	**40**	**22**
Over(+)/Under(-) adj UW rec:	**-83**	**-16**	**-145**	**-123**
Annual Total PI:		**3**		
Particulate PI:		**1.0**		
Soluble PI:		**1.6**		

The Nutrient Management Plan

4. Account for On-Farm Nutrients

- Nitrogen from legumes
- N, P, K from manure

Must Have Enough Acres to Spread the Manure

Manure Nutrient Content - Liquid

First-year *available* nutrient content averages.[1]

SPECIES	N	P_2O_5	K_2O
	lbs/1,000 gal		
Dairy	7 (10)	6	17
Beef	5 (6)	6	12
Swine (indoor pit)	22 (28)	14	22
Swine (outdoor pit)	9 (12)	6	8
Swine (nursery indoor pit)	10 (14)	6	10
Chicken	27 (29)	35	26

[1] *Source: Wisconsin soil test labs.*

[2] *Use values in parenthesis for incorporated manure.*

Manure As Fertilizer Example

- **Corn** Crop Nutrient Need: 145 – 40 – 185
- Manure Nutrients: 14 – 6 – 10 (lbs/1000 gal)
- No phosphorus restrictions, can apply based on nitrogen
- **10,000 gallons/acre** = 140 – 60 – 100

Manure As Fertilizer Example (the manure test matters)

- **Corn** Crop Nutrient Need: 145 – 40 – 185
- Manure Nutrients: 28 – 14 – 22 (lbs/1000 gal)
- No phosphorus restrictions, can apply based on nitrogen
- **5,000 gallons/acre** = 140 – 70 – 110

Manure As Fertilizer Example
(the crop nutrient need matters)

- **Wheat** Crop Nutrient Need: 65 – 20 – 75
- Manure Nutrients: 28 – 14 – 22 (lbs/1000 gal)
- No phosphorus restrictions, can apply based on nitrogen
- **2300 gallons/acre** = 64 – 32 - 51

Manure As Fertilizer Example (Acres Needed To Spread 1M gallons)

- Continuous Corn w/Low Test Manure:
  - 100 acres
- Continuous Corn w/High Test Manure:
  - 200 acres
- Corn/Wheat Rotation w/High Test Manure:
  - 100 acres year 1, 435 acres year 2

Example SNAP-PLUS Spreading Report

s			Crop Removal			Soil Test ppm		Adjusted Recs lb/ac			Planned Applications and Credits lb/ac			Over(+) Under(-) Adj. UW Recs lb/ac			Applications			
Prior Crop	2014 Crop	Yield Goal	P2O5	K2O	Tillage	Avg P	Avg K	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	Product Name and Analysis	Appln Rate and Method	N-P2O5-K2O credit	Total Amt
Corn grain	Corn grain	131-150	55	40	SCD	57	232	145	0	0	124	74	168	-21	74	168	Corn Starter 20-10-20	200 lb Spring Incorp	40-20-40	2,200 lb
																	Dairy Liquid 10-6-17	4000 gal Spring Incorp	28-24-68	44,000 gal
																	Dairy Solid 3-3-6	10 ton Spring Incorp	20-30-60	110 ton
Corn grain	Corn grain	131-150	55	40	SCD	96	326	145	0	0	124	74	168	-21	74	168	Corn Starter 20-10-20	200 lb Spring Incorp	40-20-40	2,200 lb
																	Dairy Liquid 10-6-17	4000 gal Spring Incorp	28-24-68	44,000 gal
																	Dairy Solid 3-3-6	10 ton Spring Incorp	20-30-60	110 ton
Corn grain	Corn grain	131-150	55	40	SCD	10	99	145	65	70	152	30	60	7	-55	-10	Corn Starter 20-10-20	300 lb Spring Incorp	60-30-60	9,900 lb

Manure As Fertilizer Example (Acres Needed To Spread 1M gallons)

- The more acres needed the longer the travel distances from the storage to the fields
  - More expensive
  - More tanker miles
  - Longer spreading times
- Are the travel distances economically feasible? Can the roads handle it?

Spreading Windows on Clay In the Far North

- Top-dressed on forages after each harvest (volume limitations)
- In the spring, before planting
- In the fall, after corn harvest
- In the late-summer, after small grain harvest
- In the winter

Wet Fall On Clay

- Compaction
- Rutting
- No chance for injected manure

Wet Fall On Clay

- No Compaction
- No Rutting
- Harvested in January
- No chance for fall injected manure

Spreading Windows on Clay In the Far North

- The key is flexibility and storage capacity
- If a window is missed, then what?
- The answer is more storage capacity, more acres, or emergency allowances
- Ideal is to have at least six months capacity as of November 1 of every year
- Option to draw down storage in the Sept 1 to freeze-up window

Spreading Restrictions and Prohibitions

- Primary means to limit nutrient/manure loss to surface and groundwater
- Some are basic, some are complicated
- Often requires ground-truthing
- Restrictions in 590 Standard and NR 243 are not always the same
- Winter
- SWQMAs

The Simple Restrictions

Nutrients shall not be applied to: (any time of year)

- Water, wetlands, gravel pits, concentrated flow channels
- Areas within 200 feet upslope of wells, sinkholes, tile inlets, gravel pits
- Fields exceeding tolerable soil loss “T”
- Non-cropland (forests, brushland)
- Manure within 50’ of a well (100’ if CAFO)

The Winter Restrictions (590 Standard/NR 141)

- Winter-spreading plan
- No applications within SWQMA (frozen or snow-covered)
- Liquid manure limited to 7000 gallons/ac
- No nutrients on slopes greater than 9%
- Manure ok up to 12% slopes when contoured

The Winter Restrictions (NR 243)

- Winter-spreading plan required
- Surface liquid manure prohibited on frozen ground or snow-covered (over 4”)
- Surface liquid on snow (up to 4”) ok if incorporated
- Injected liquid ok on snow-covered
- Surface solid and liquid manure prohibited Feb 1-Mar 31
- Solid ok (outside SWQMA) in other months with additional restrictions
- Emergency allowances are possible if storage is over-flowing

The SWQMA Restrictions
(Surface Water Quality Management Area)

What Is A SWQMA?

- 590 Standard
  - 1000’ buffer along ponds, lakes, flowages
  - 300’ buffer along a perennial stream (USGS 1:24,000 topo maps)
- NR 243 (CAFO)
  - 1000’ buffer along ponds, lakes, flowages
  - 300’ buffer along non-lake navigable waters
  - 300’ buffer along conduits to navigable waters

SWQMA – 590 Standard

- No application of manure or fertilizer on frozen or snow-covered ground
- Up to 5000 gallons unincorporated liquid manure per acre on non-frozen, non-saturated soils
- For any application of nutrients must have one of the following in place
  - Permanent vegetative buffers in place
  - A minimum of 30% crop residue in place
  - Incorporate within 3 days
  - Cover crops established after application

SWQMA – NR 243

- Winter restrictions apply
- Must follow one of five options when applying manure:
  1. 25’ buffer on all navigable waters and conduits to navigable waters; inject or incorporate everywhere else in SWQMA
  2. 25’ buffer; surface apply up to 5000 gallons/ac (clay) on no-till ground with 30% crop residue

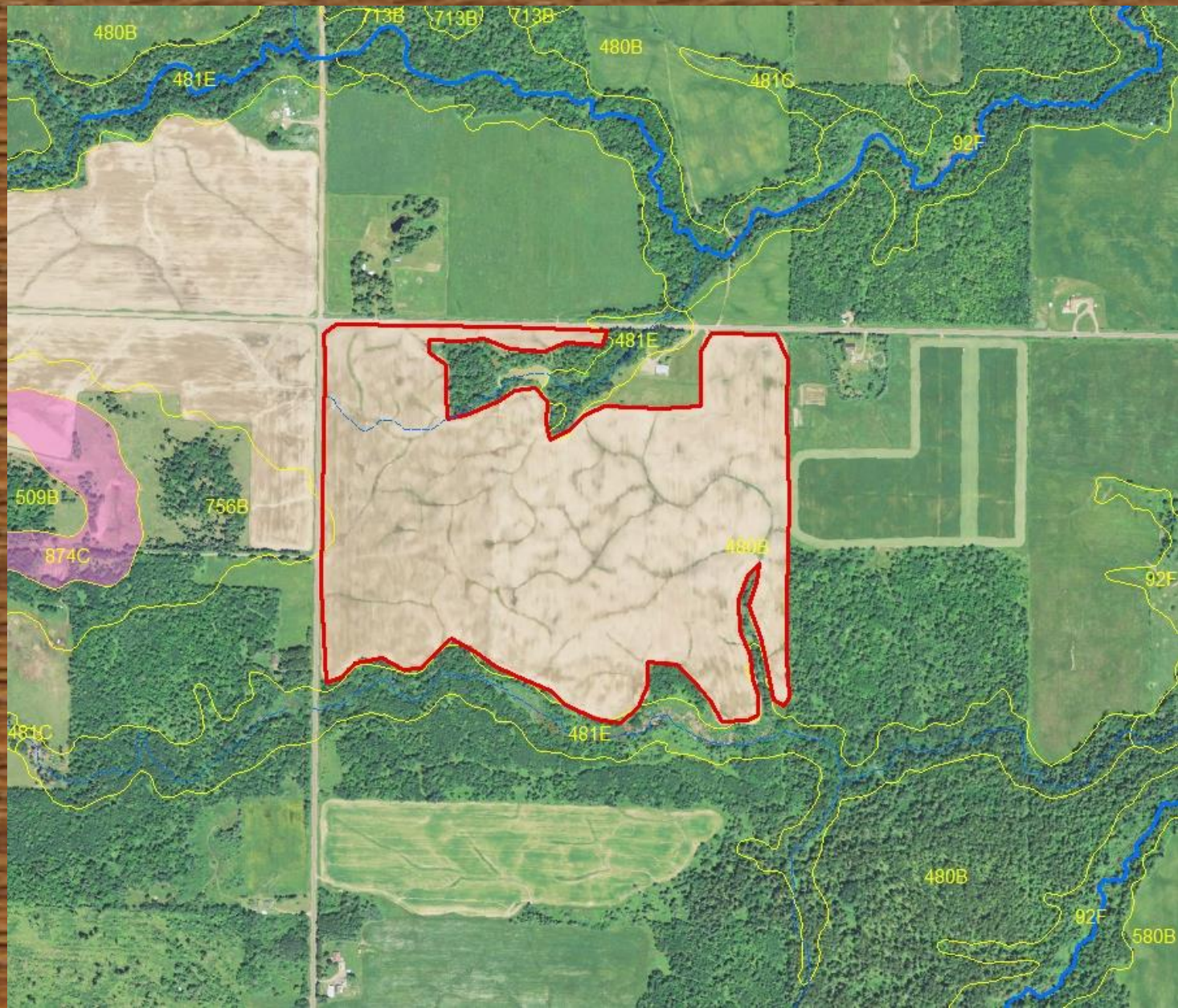
SWQMA – NR 243

3. 35’ no-spread vegetated buffer; inject or incorporate everywhere else in SWQMA or surface apply up to 5000 gallons/ac with 30% crop residue
4. 21’ no-spread filter strip; inject or incorporate everywhere else or surface apply up to 5000 gallons/ac with 30% crop residue
5. 100’ no-spread buffer

SWQMAs In Practice

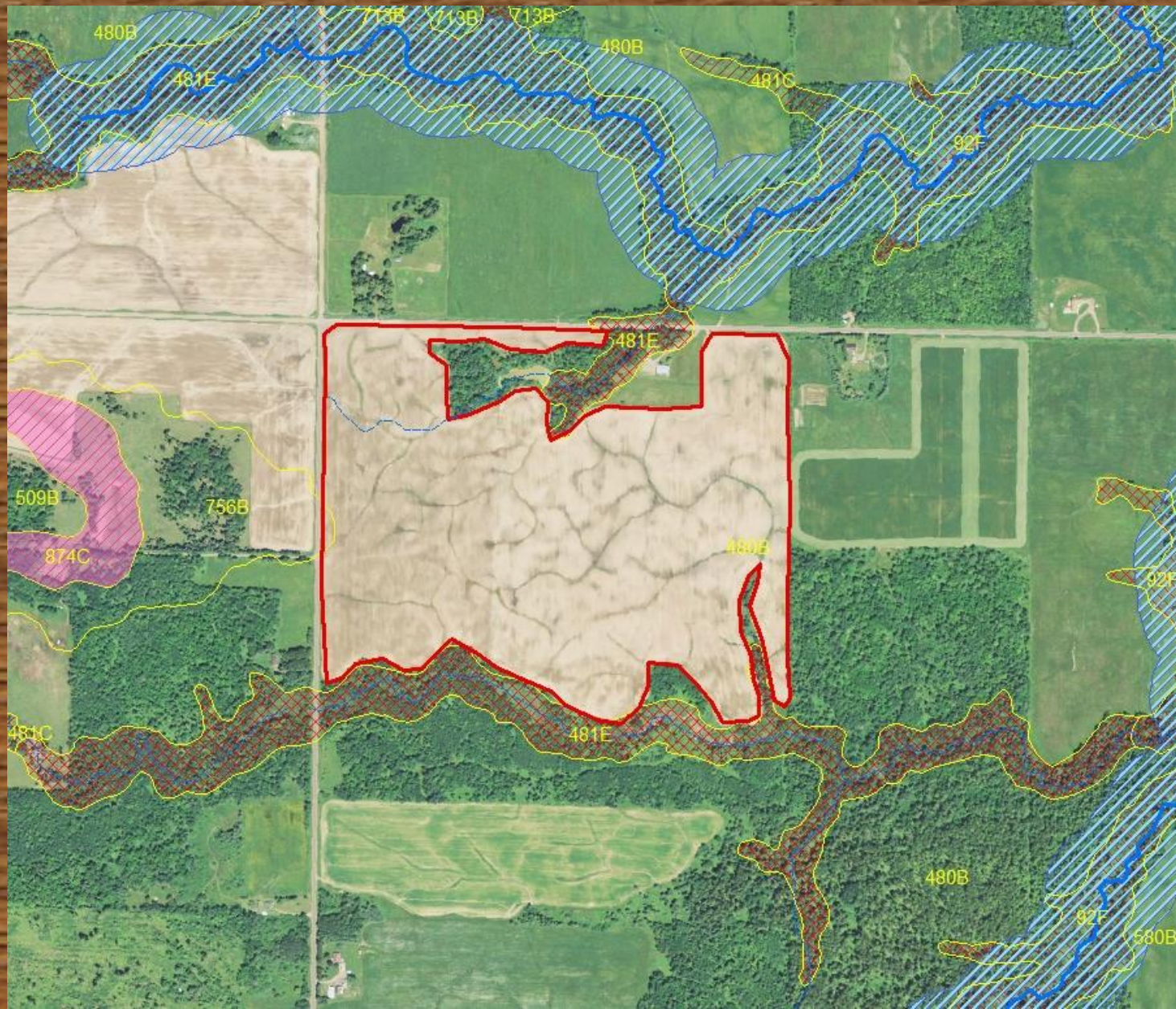
Example Field

101.7 acres



590 Slope and SWQMA Restrictions

- 300’ SWQMA (blue)
- Winter slope restrictions (red)
- Fall N restrictions (pink)

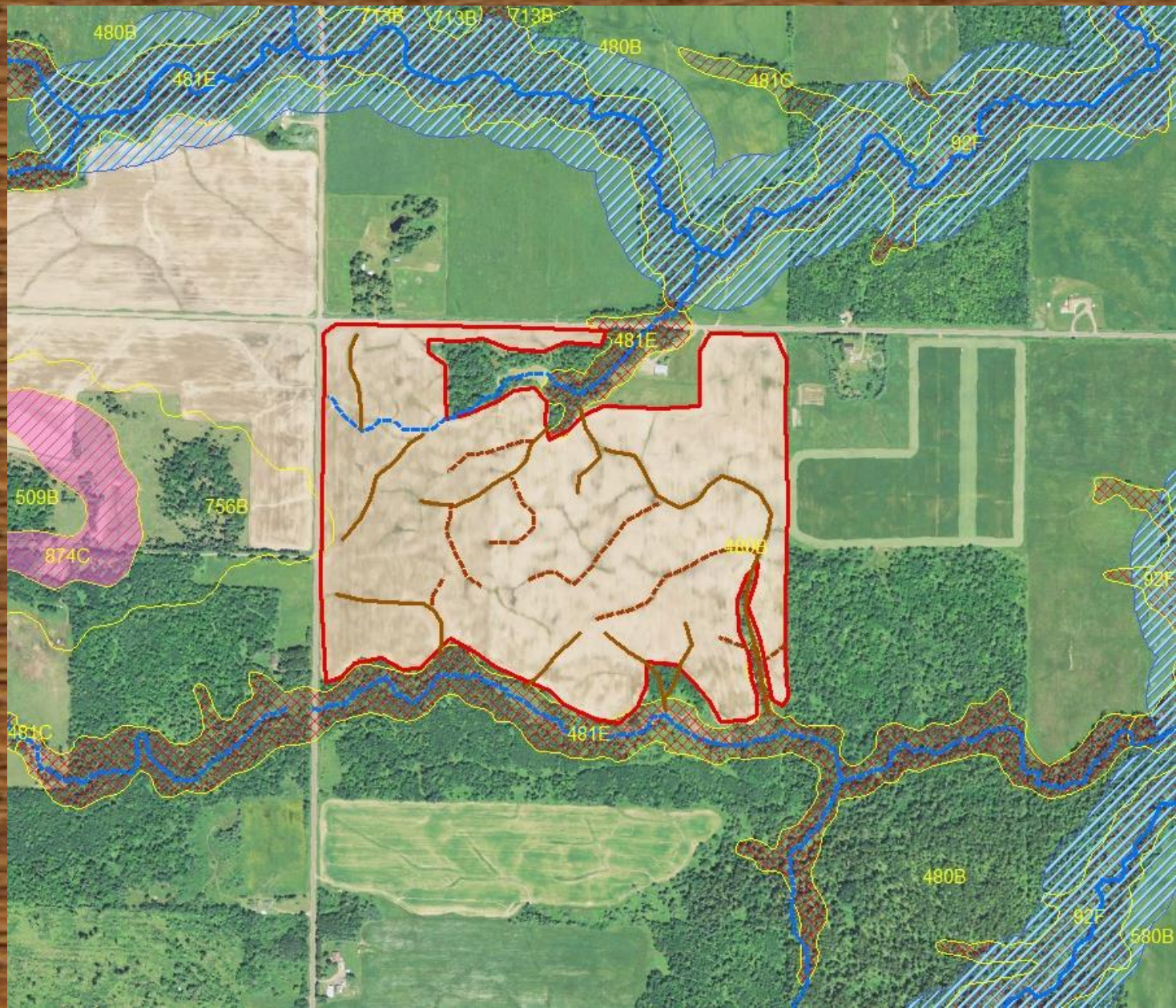


CONCENTRATED FLOW AREAS

A natural channel or constructed channel that has been shaped or graded to required dimensions and established in perennial vegetation for the stable conveyance of runoff. This definition may include non-vegetated channels caused by ephemeral erosion. These channels include perennial and intermittent streams, drainage ditches, and drainage ends identified on the NRCS soil survey and not already classified as SWQMAs. Concentrated flow channels are also identifiable as contiguous up-gradient deflections of contour lines on the USGS 1:24,000 scale topographic map. The path of flow to surface water or direct conduits to groundwater must be documented.

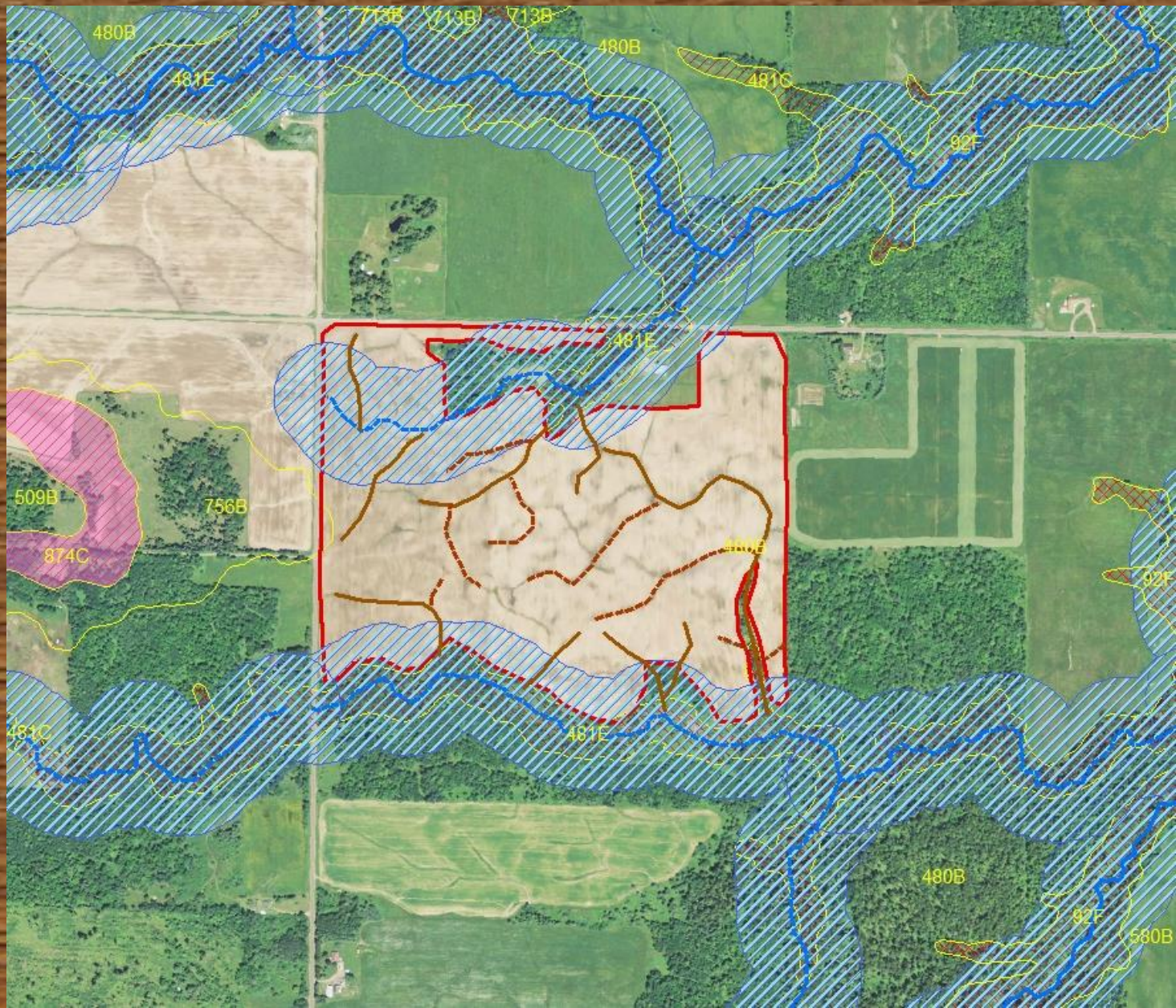
590/243 Concentrated Flow Areas (No manure)

99 Acres
(10ft flows)



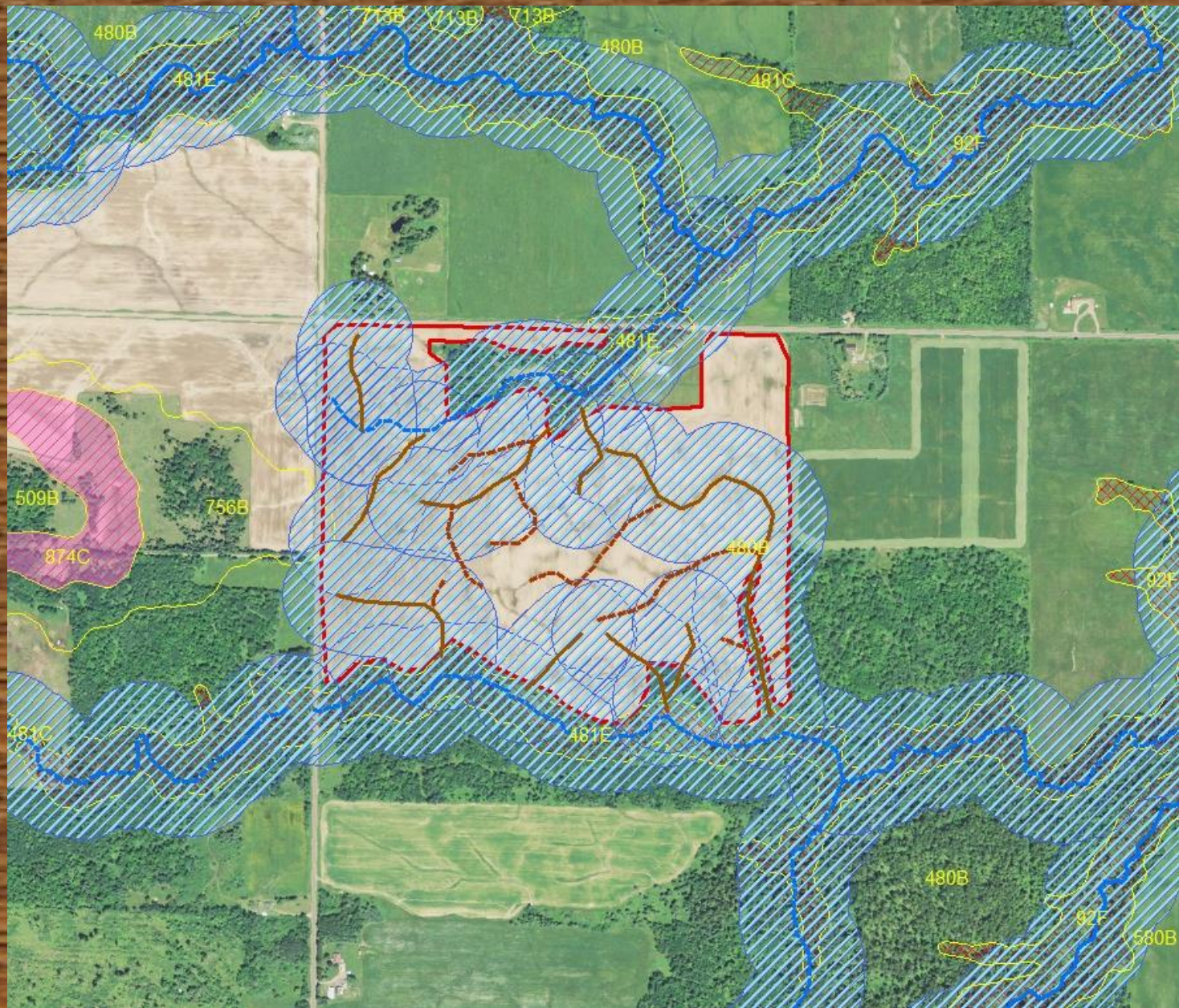
Additional 243 SWQMA Restrictions

- 300’ along navigable waters (intermittent streams)



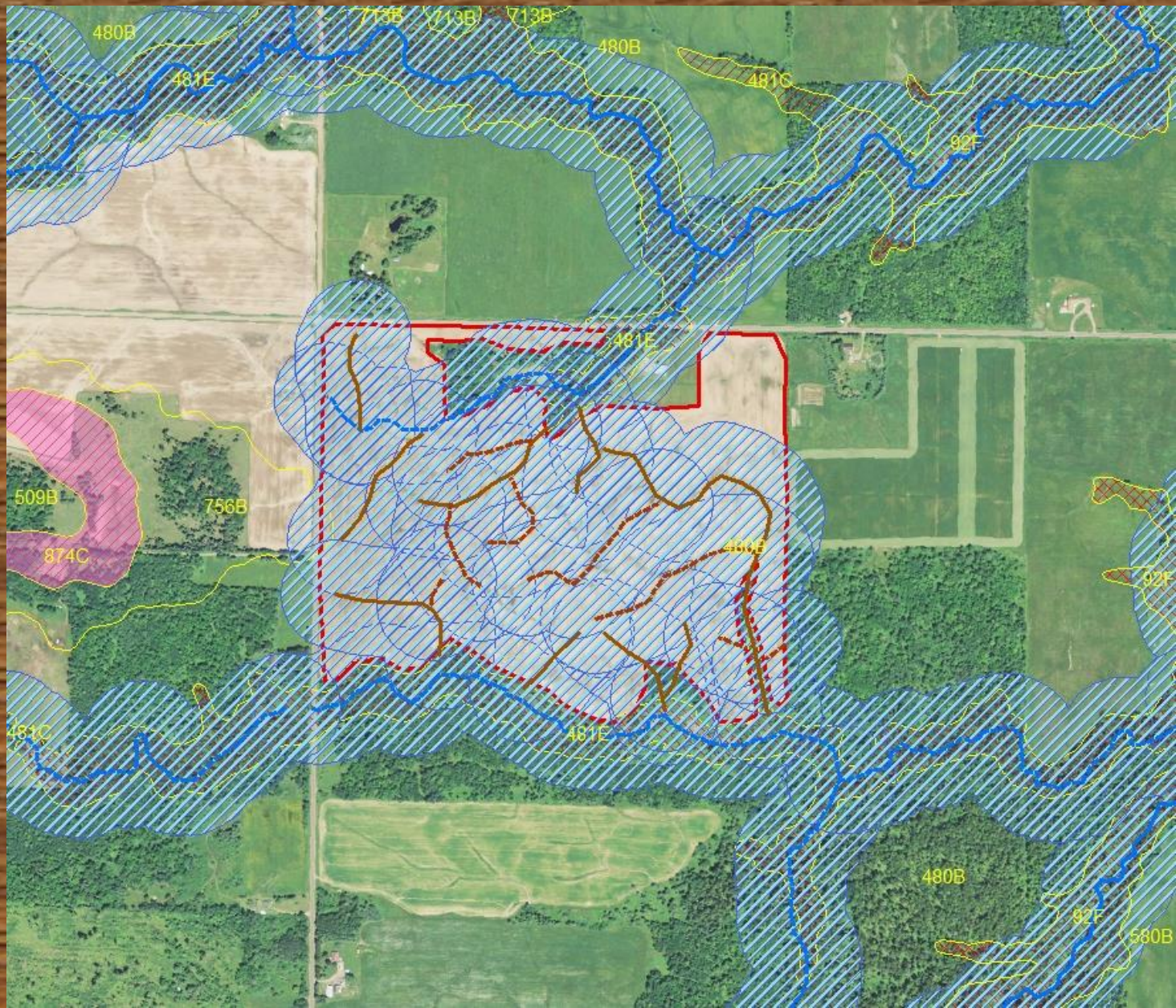
Additional 243 SWQMA Restrictions

- 300’ along direct conduits to navigable waters



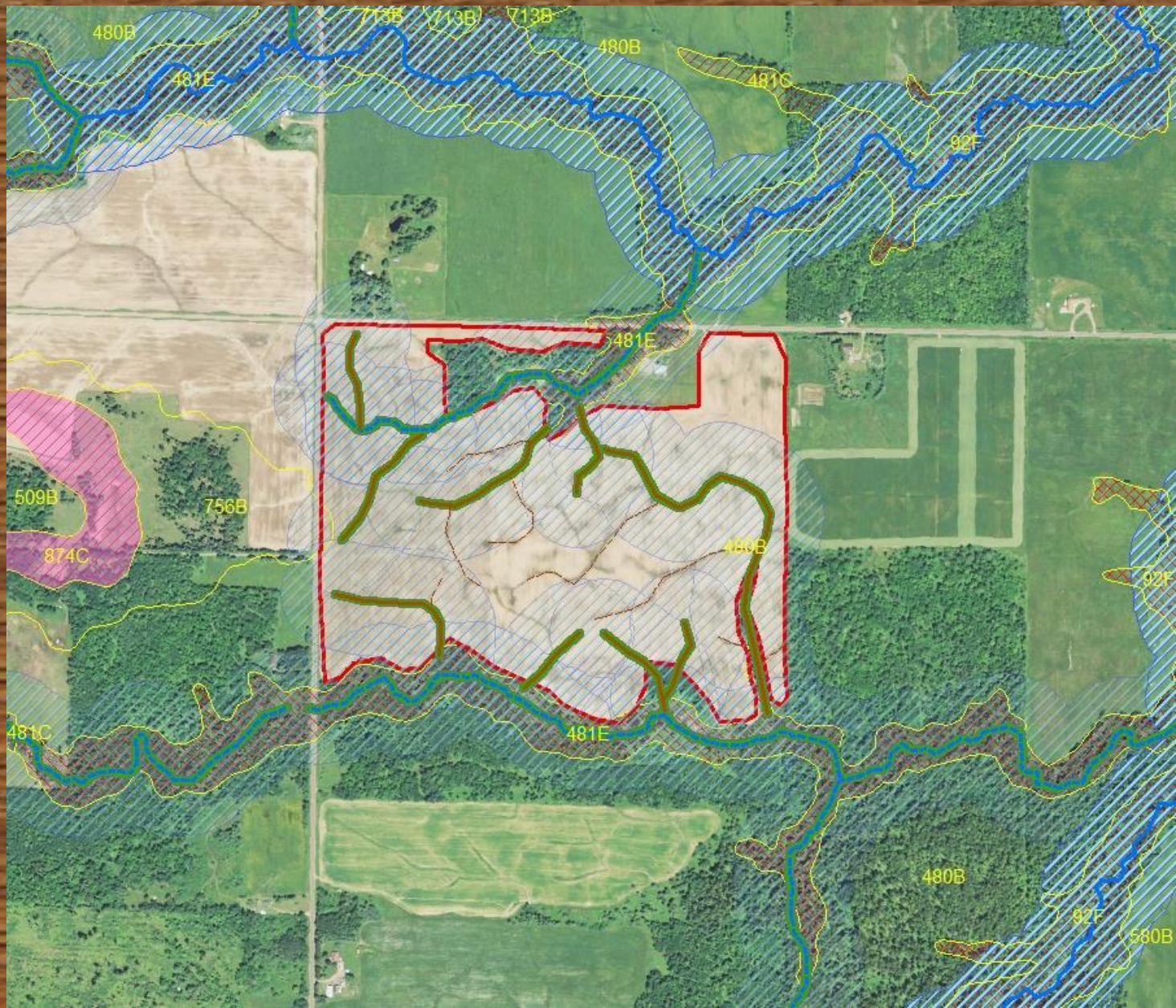
Additional 243 SWQMA Restrictions

- Do feeders to direct conduits also have a 300’ SWQMA buffer?
- Should they?



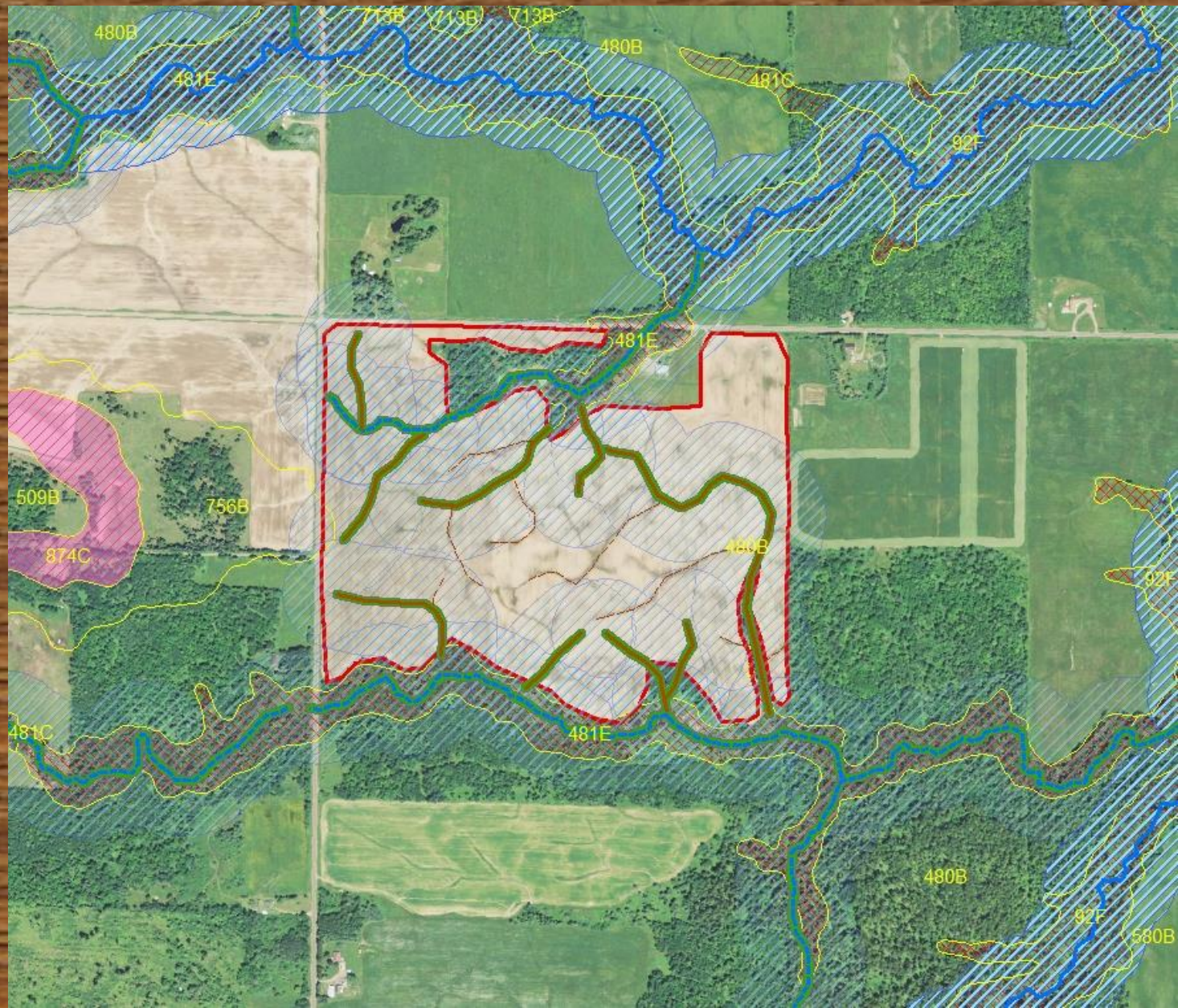
Option 1 – SWQMA Manure Applications

- 25’ buffers
- 96 acres
- inject or incorporate in all other areas in SWQMA



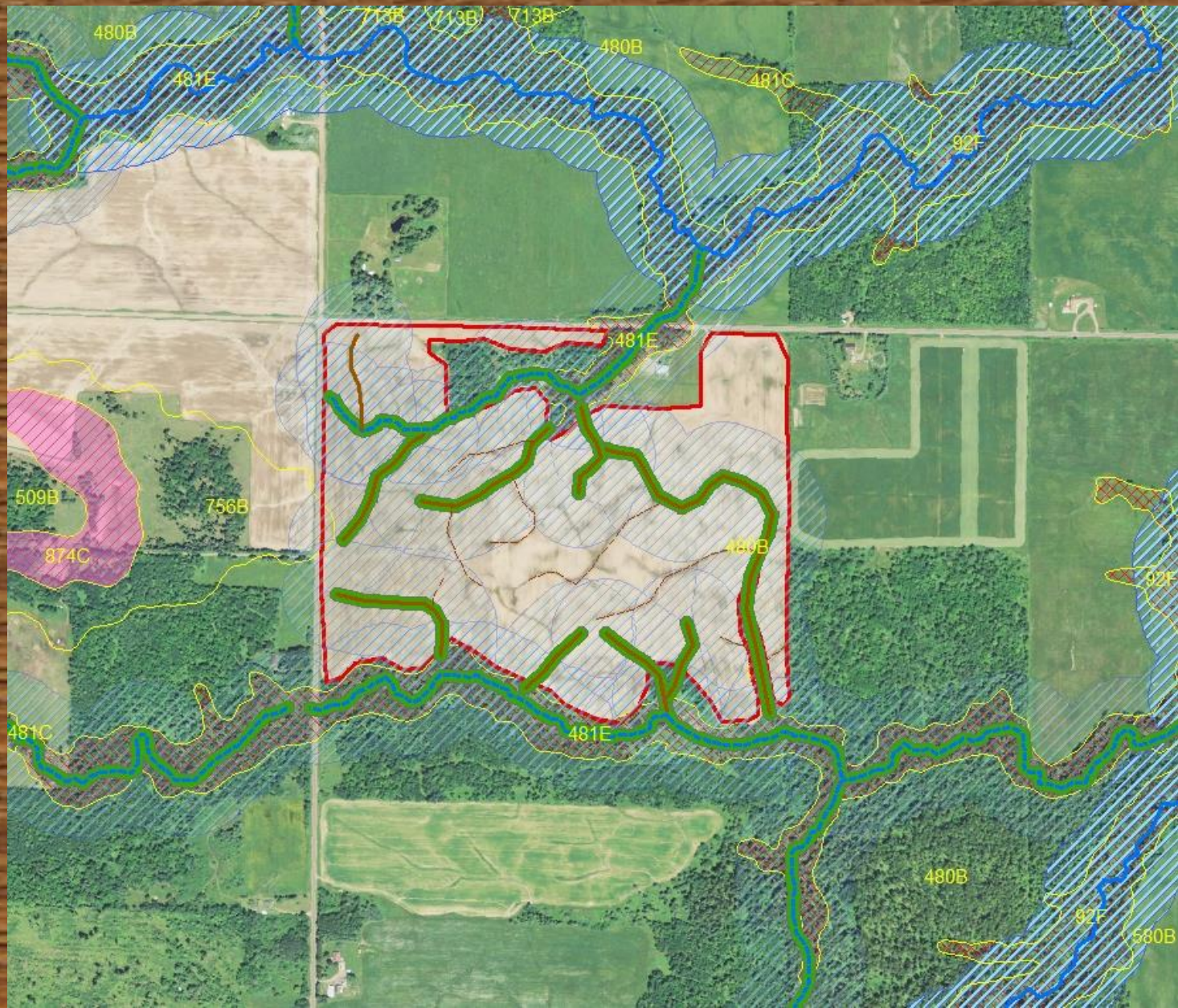
Option 2 – SWQMA Manure Applications

- 25’ buffers
- 96 acres
- Surface apply <5000 gallons/acre on no-till ground with 30% residue



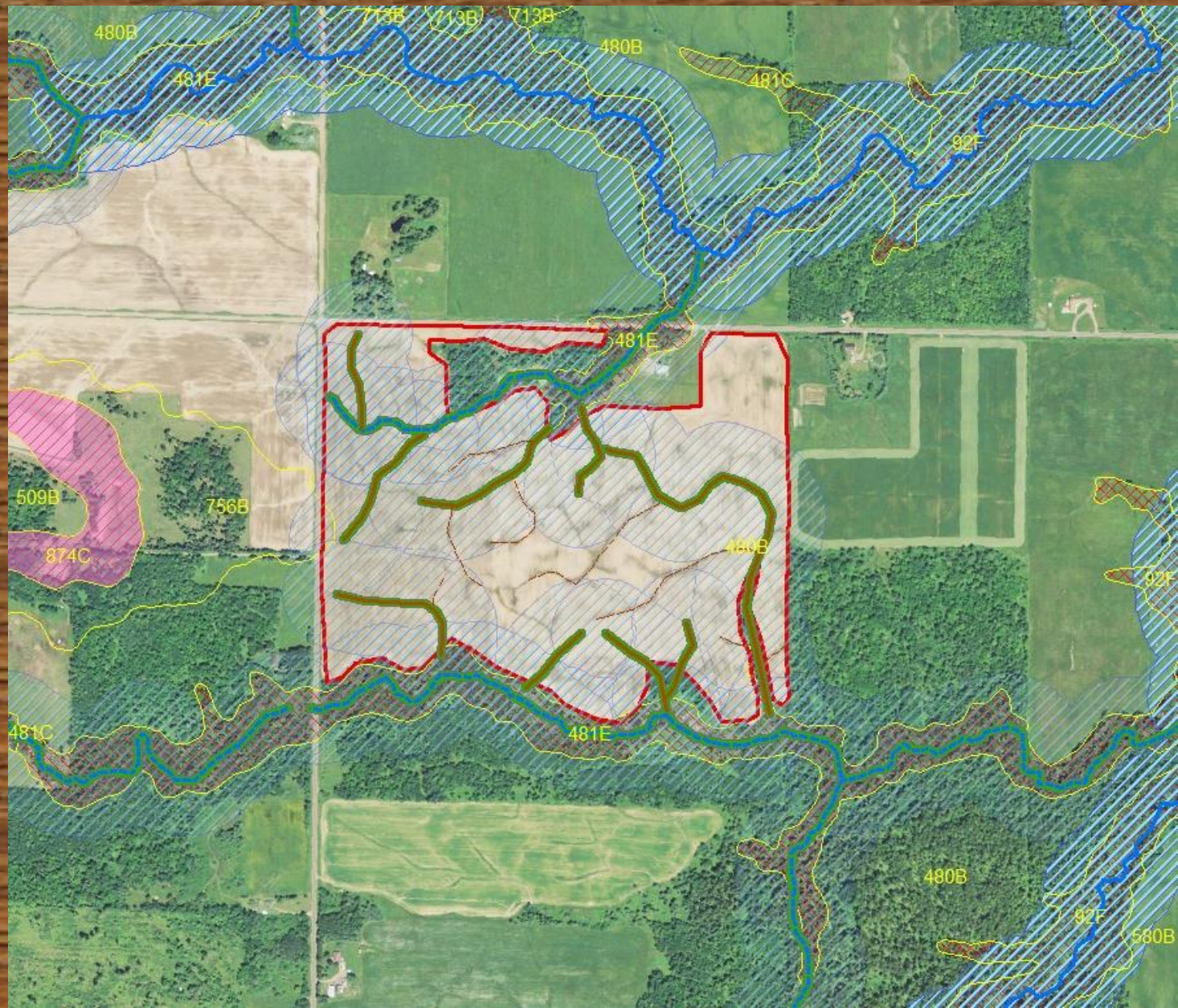
Option 3 – SWQMA Manure Applications

- 35’ vegetated buffers
- 94 acres
- inject or incorporate elsewhere
- or
- <5000 gallons/acre with 30% residue



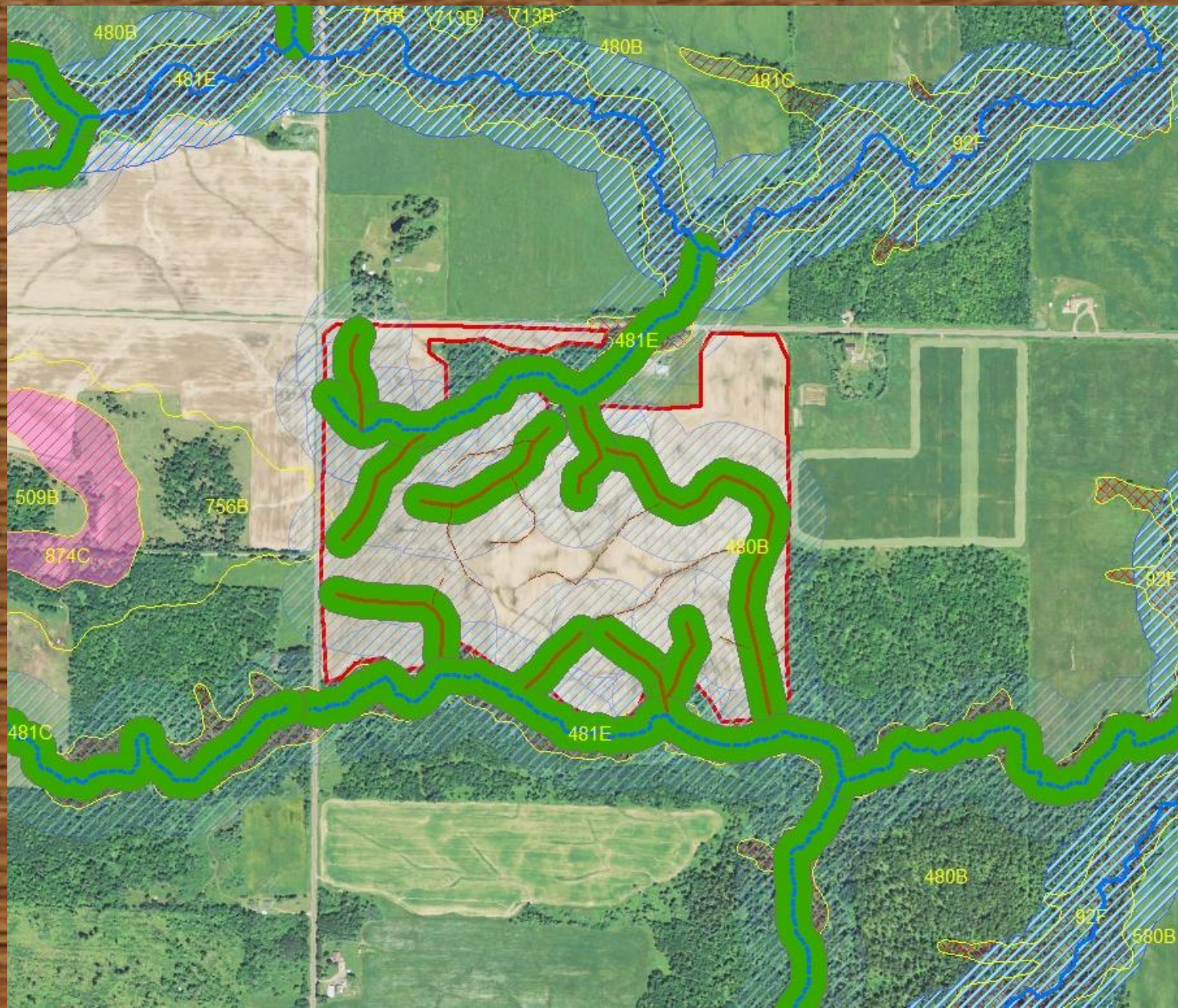
Option 4 – SWQMA Manure Applications

- 21’ filter strip
- 97 acres
- inject or incorporate elsewhere
- or
- <5000 gallons/acre with 30% residue



Option 5 – SWQMA Manure Applications

- 100’ no-spread buffer
- 82 acres



Phosphorus Restrictions

Soil Test Phosphorus
- Critical Values -

- < 50 ppm P:

  N-based manure spreading plan.

- 50 – 100 ppm P:

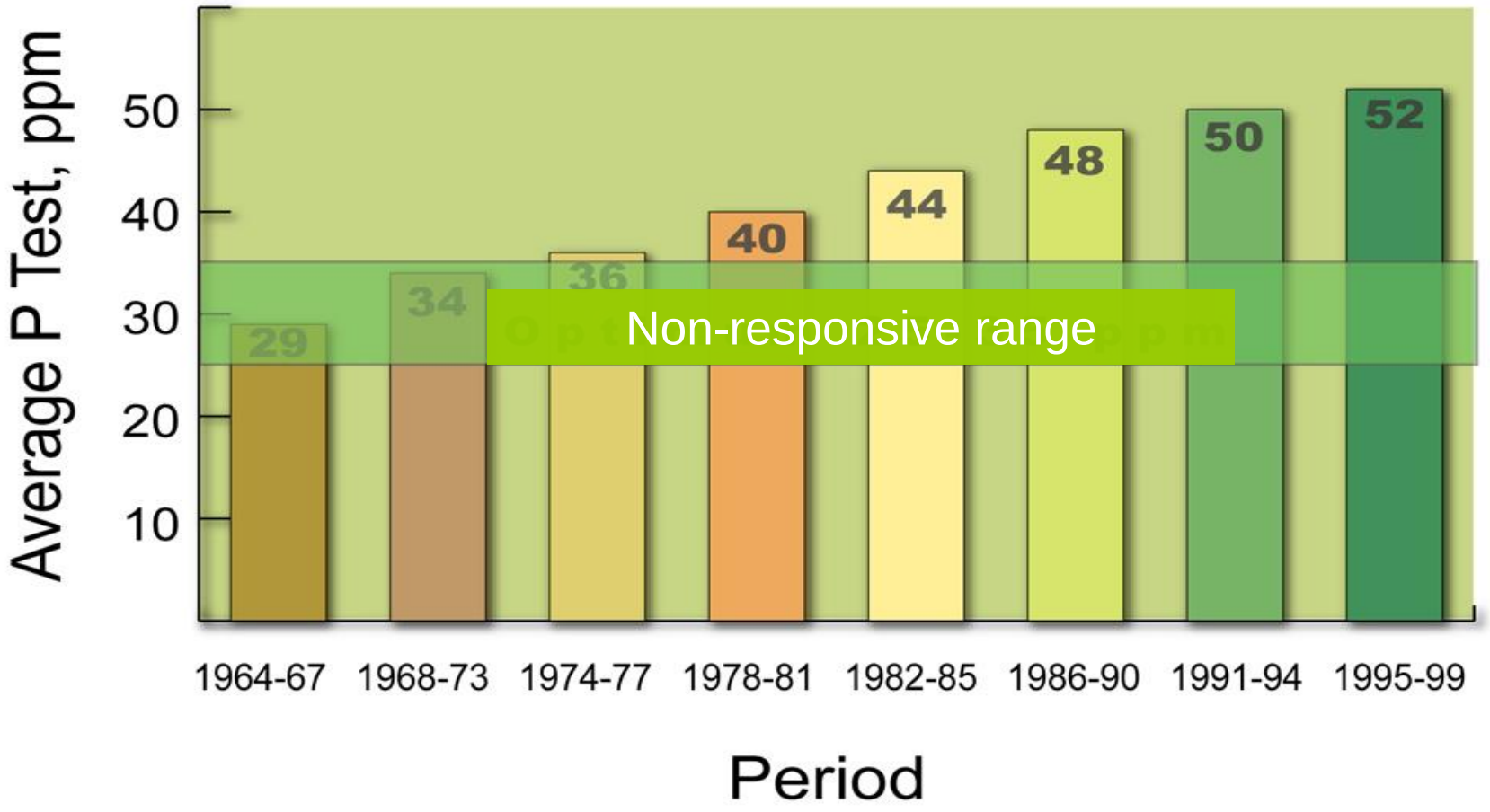
  P application not to exceed total crop P removal over the rotation.

- > 100 ppm P:

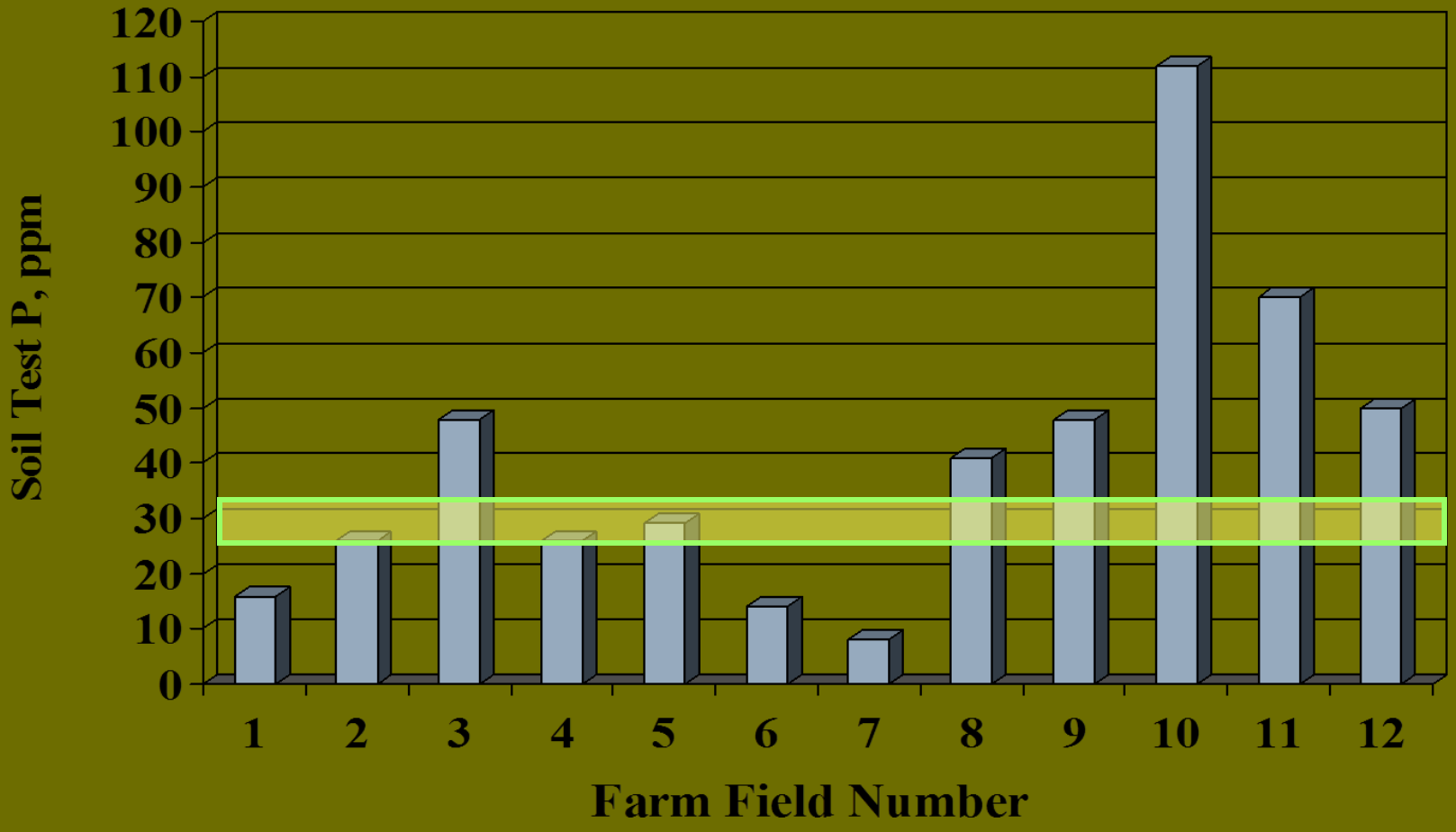
  Eliminate P applications

  - Unless required for high-demanding crop in rotation.
  - Unless no other option, then apply at less than crop removal of P with soil conservation practices in place.
  - Use P Index.

Average soil test P levels of Wisconsin cropland fields over time.



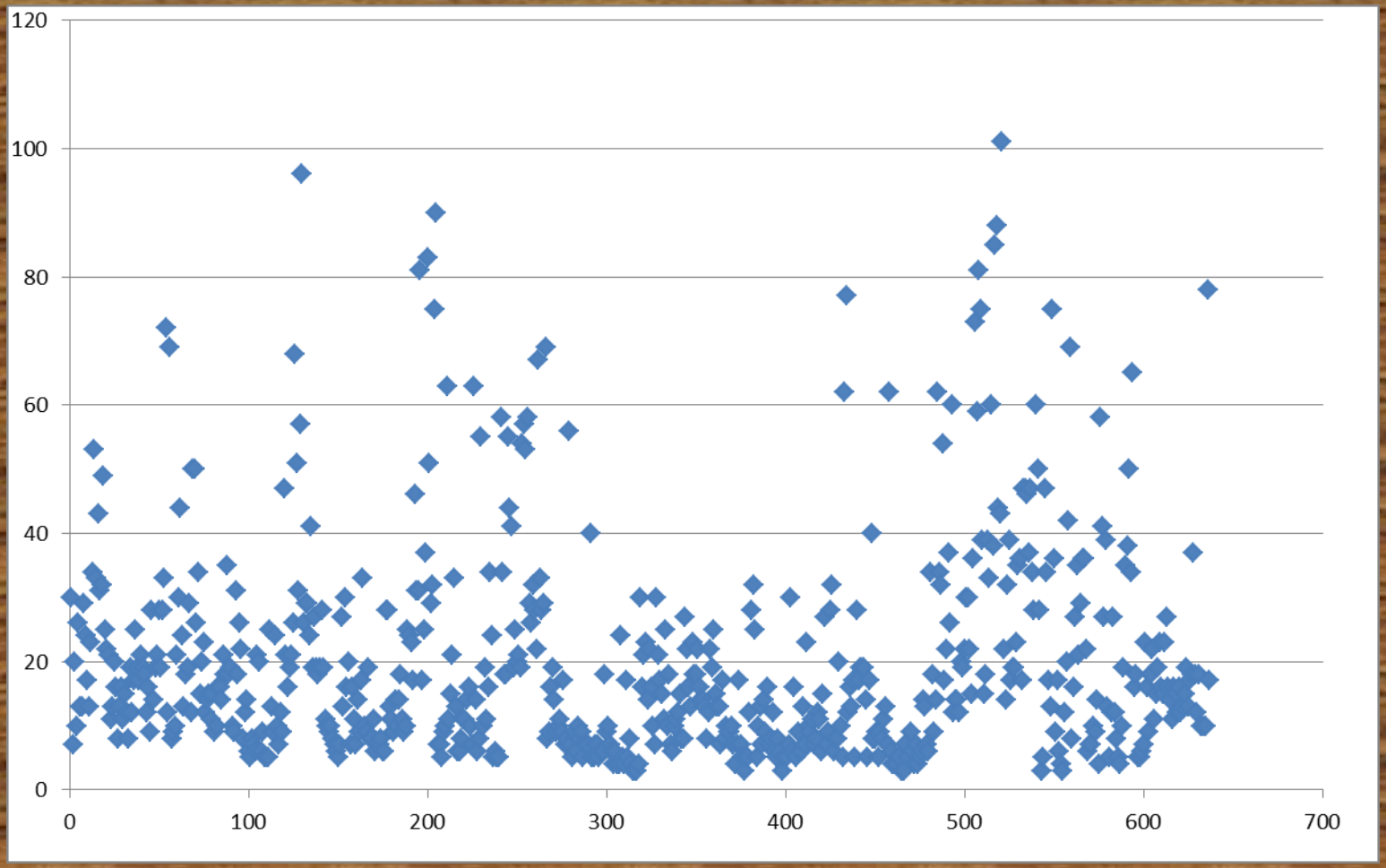
Soil Test Phosphorus Variability from a Wisconsin Dairy Farm



Local Soil Test P

22 farms in Ashland/Bayfield, 637 fields, 11,675 acres

Average = 19.9 PPM



11,675 Acres Tested

Soil Test P	Acres	%
<10 PPM	3419	29%
10-20 PPM	5077	43%
21-30 PPM	1830	16%
31-50 PPM	950	8%
51-100 PPM	395	3%
>100	5	0.04%

Phosphorus Index

- Measures the relative potential for a field to deliver P to surface waters.
- Evaluates site loading (quantity of P) and transport potential (erosion and runoff) from individual fields.
- Agricultural management practice recommendations based on PI value.

Interpretation of the Wisconsin PI

0 - 2: Minimal risk, N-based management

2 - 6: PI should not increase over 4 years or length of average rotation

6 -10: Implement plans to decrease PI to <6 over two rotations (max. 6 years)

> 10: Lower PI to <10 over one rotation or 4 years, and decrease PI to <6 over two additional rotations or 6 years

Manure As Fertilizer Example (The Phosphorus Clock)

- **Corn** Crop Nutrient Need: 145 – 40 – 185
- Manure Nutrients: 28 – 14 – 22 (lbs/1000 gal)
- No phosphorus restrictions, can apply based on nitrogen
- **5,000 gallons/acre** = 140 – 70 – 110

Manure As Fertilizer Example (The Phosphorus Clock)

- **Corn @ 120 bushels/acre removes 46 lbs P/acre**
- **70 lbs – 46 lbs = 24 lbs**
- 18 lbs P to move soil test 1 ppm
- **Each year soil test P up 1.3 ppm**
- **In 23 years, volume limitations are possible (starting soil test P – 20 ppm)**
- **P-Index may provide more flexibility**

Summary

- Nutrient management planning is designed to minimize loss of nutrients/manure to water
- Does it work?
  - If plans are followed
  - If accidents don’t happen
  - If soils don’t erode
  - If there is enough storage to avoid spreading when runoff is likely to occur
  - If there are enough acres to allow for flexibility