Reducing Nonpoint Source Pollution through Effective Ditch Management

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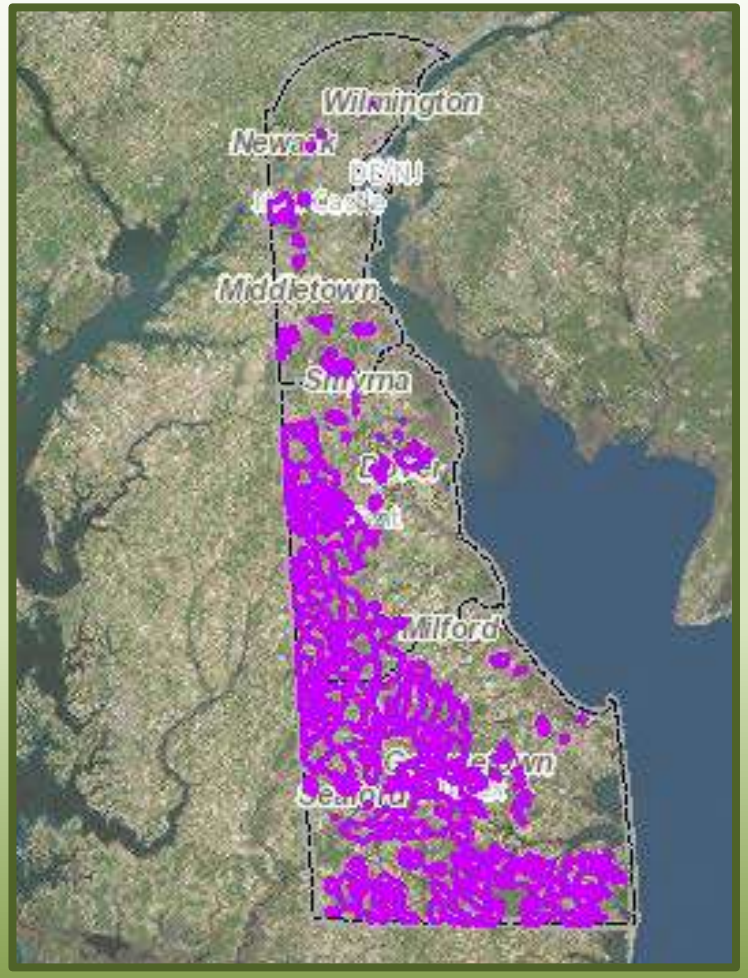
Artificial Drainage in Delaware

- Engineered system to remove excess water
  - Ditches
  - Channelized streams
  - Tile drains
- Required for land use in many areas
  - Poorly drained soils
  - High water tables

Tax Ditch 101

- 1951 Drainage Law
- Governmental subdivision of the state
- Formed through Superior Court
- Powers related to maintenance of drainage
- Managed by elected landowners



234 Tax Ditch Organizations responsible for maintaining 2,000 miles of channel providing benefit to >100,000 people.

Concerns with Artificial Drainage

- Conduits for nutrient and sediment pollution
  - Eutrophication of Chesapeake and Delaware Inland Bays
- Accumulation of vegetation and sediment requires maintenance
- Impacts from current maintenance practices on water quality are unknown

Minor Maintenance Activities

- Deteriorated pipe replacements and clearing
- Beaver dam removal
- Annual mowing
- Weed wiper bar
  - Control woody vegetation
  - Maintain clear Rights-of-Way

Major Maintenance
Tax Ditch Dip Out

- Dredging of ditch
  - Performed as needed (15-20 years)
- Spoils placed on adjacent field and spread
- Variable timing between steps
  - Difficult to know nutrient loss from spoil and amended soils



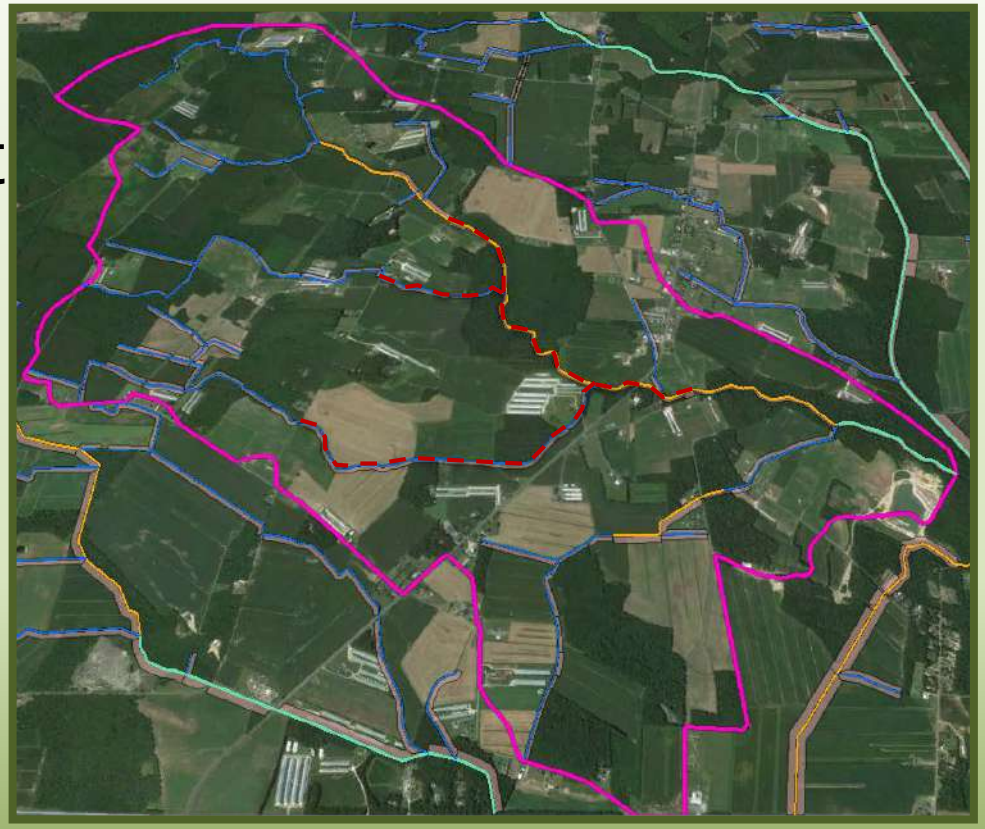

Research Objectives

- Characterize adjacent field and spoils for potential loss prior to incorporation
- Determine potential P loss from spoil amended areas

Goal: Determine method to predict P loss from amended areas

Study Site Selection

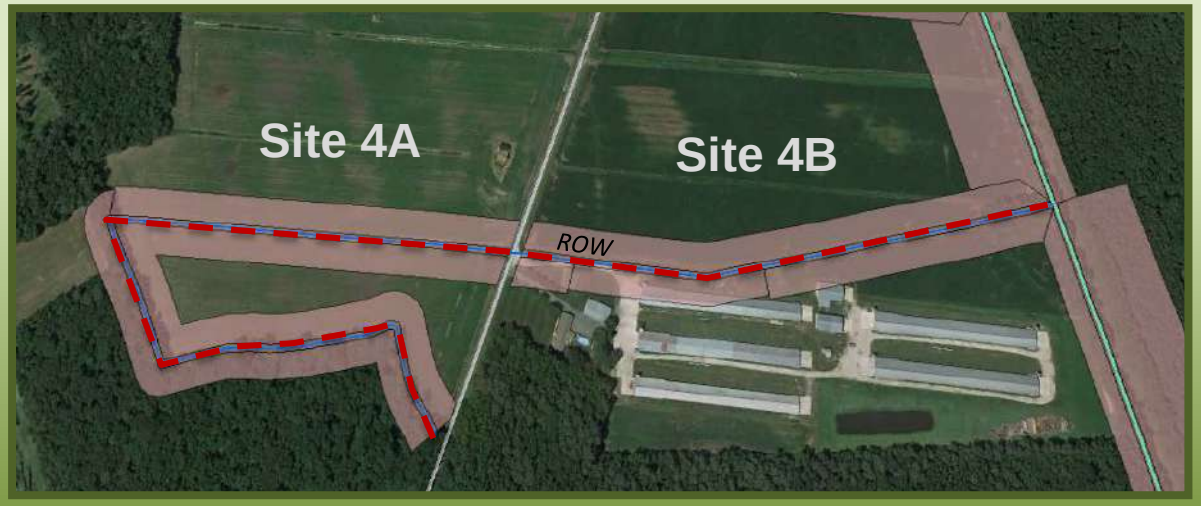
- 7 of 15 tax-ditches scheduled for dip-out in 2013-2014 were selected
- Only portion of ditch maintained at a time
  - Segments ranged from 1.25-3.6 km (≈ 0.75-2.25 mile)



- Land use in proximity to dip-out was mainly agricultural or forested

Soil Sampling

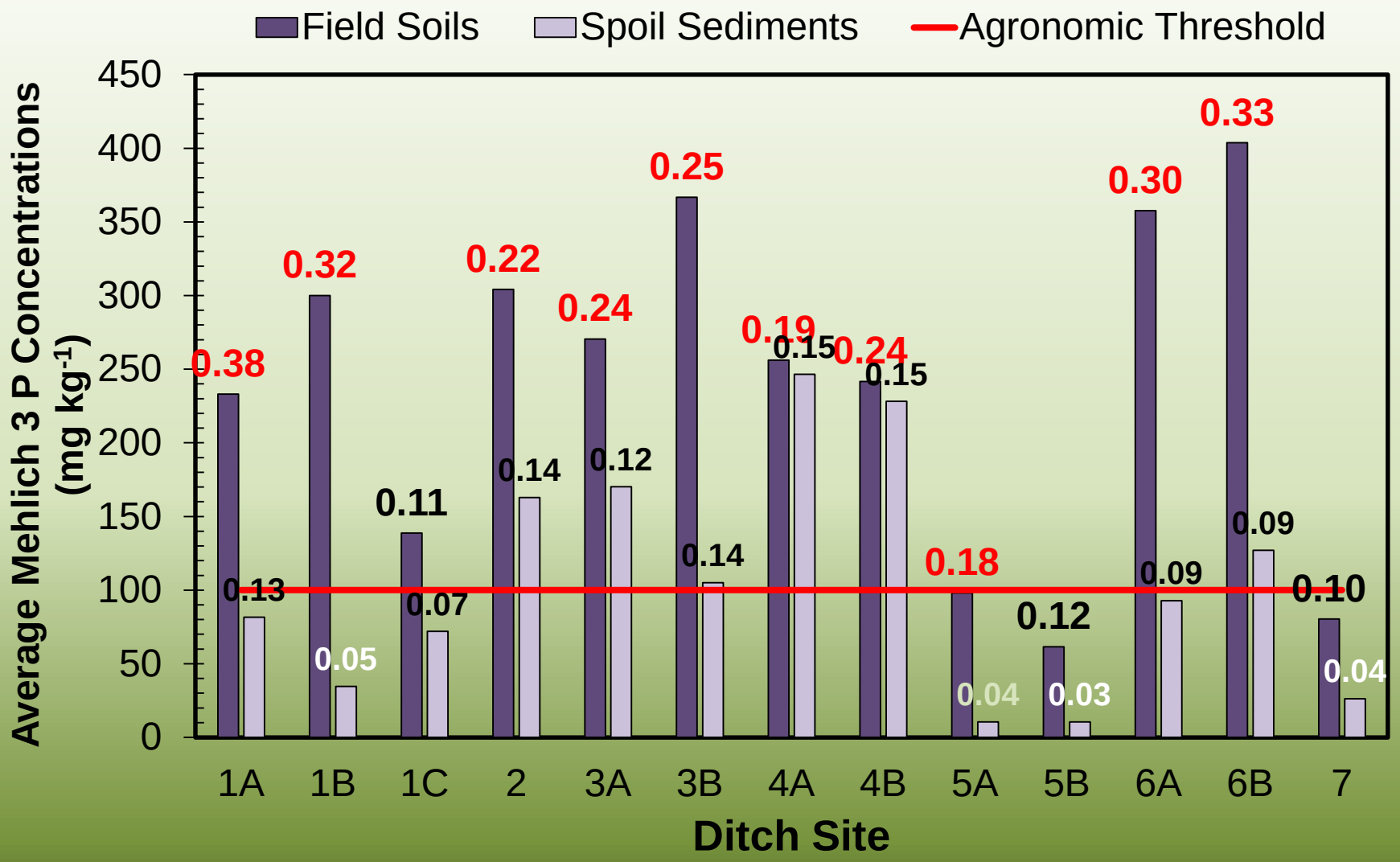
- Collected soils from adjacent fields prior to dip
- Collected representative spoil samples from piles placed on sampled fields



Laboratory Analysis

- Characterize field and spoil for potential loss prior to incorporation
- Simulate chisel plowing of field and corresponding spoil
  - Mix at 3 different ratios
    - (1S:7F, 3S:5F, and 7S:1F)
  - Determine and maintain field capacity of field-spoil mixtures
  - Collect and characterize subsamples at 2 time intervals (2 and 30 days)

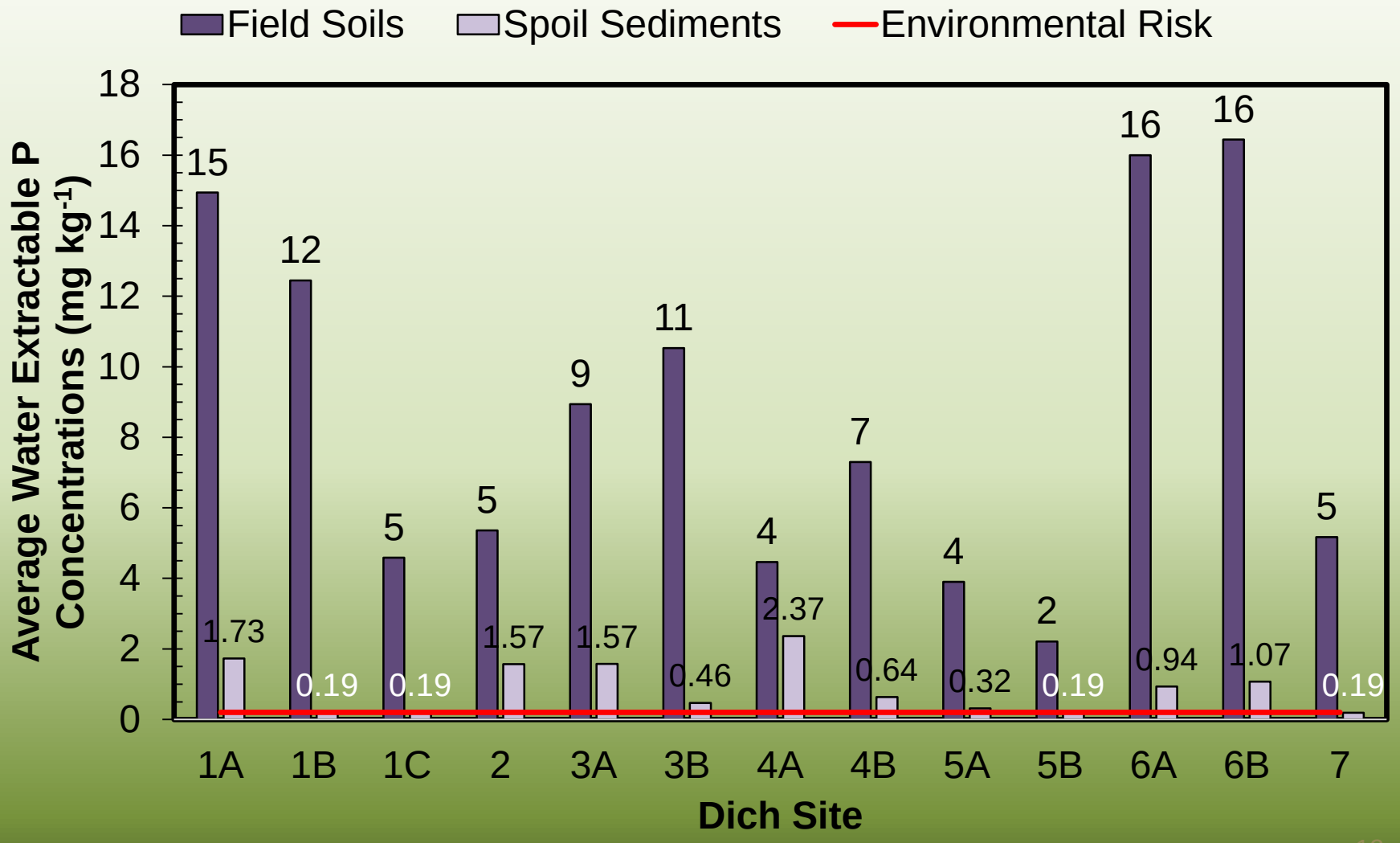
Characterization of Field and Spoil



*Numbers above are M3-PSR values

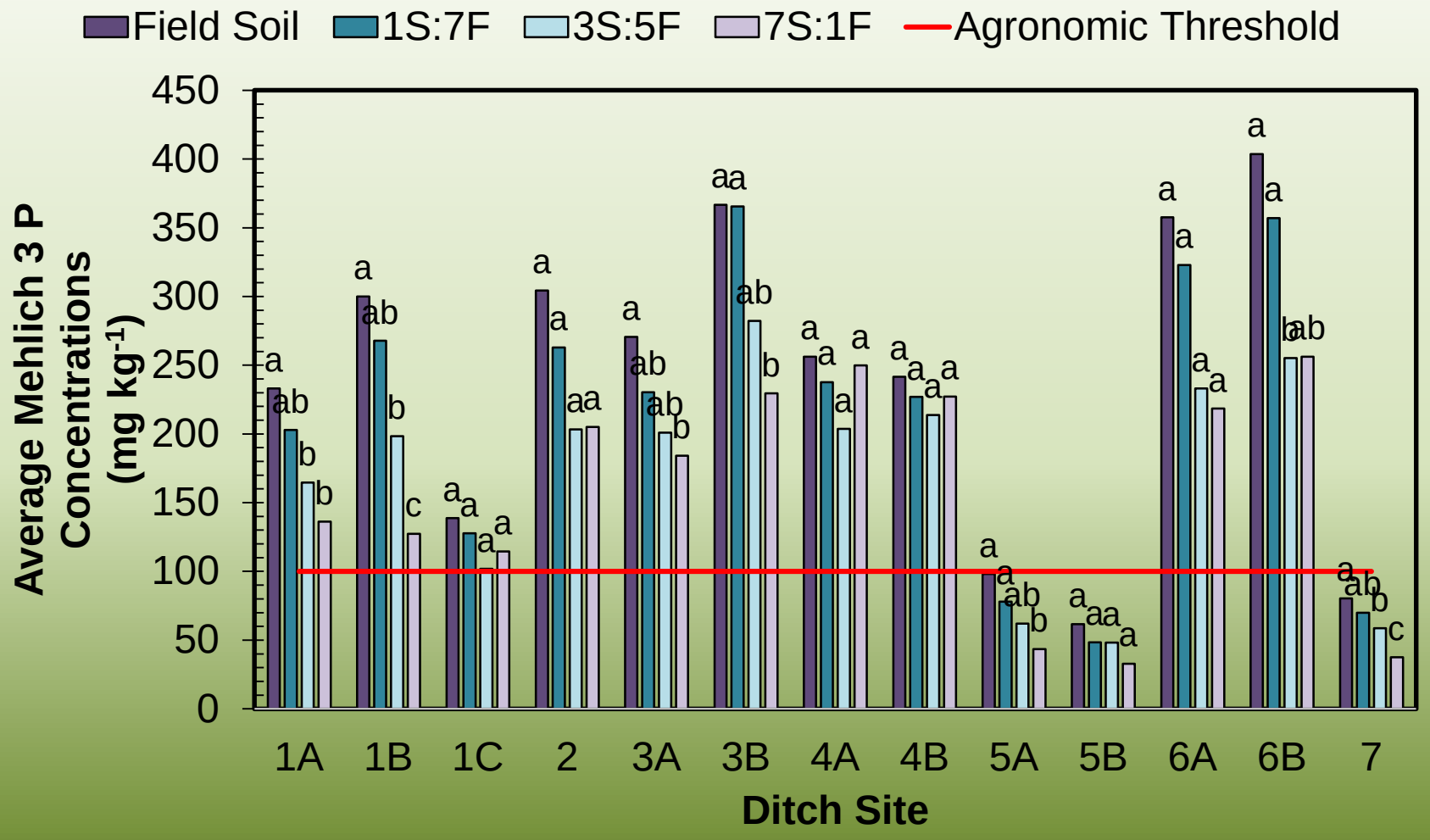
Environmental Risk > 0.15

Characterization of Field and Spoil

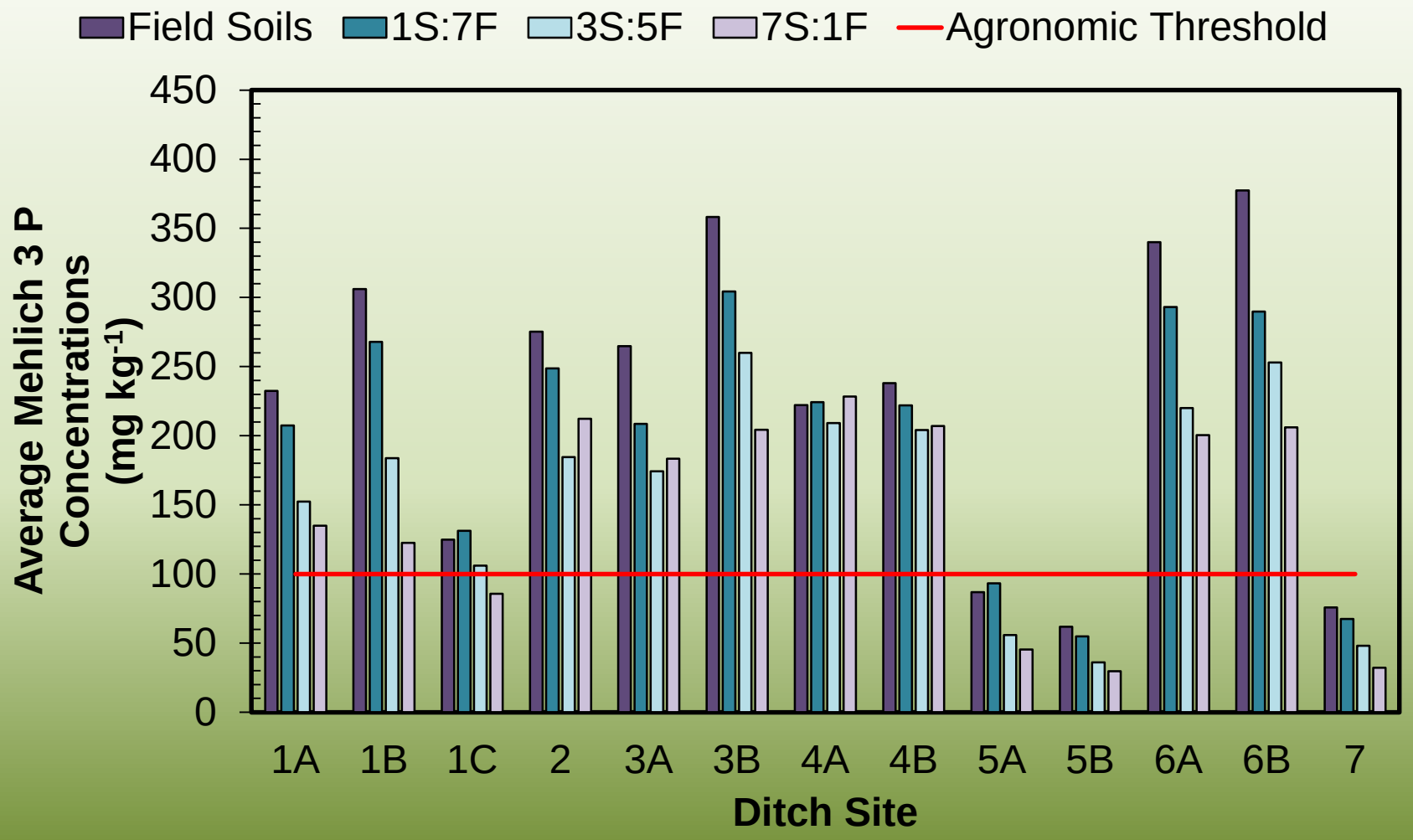


Amended Field Soils- 2 Day Results

Incorporation decreases Mehlich 3 P

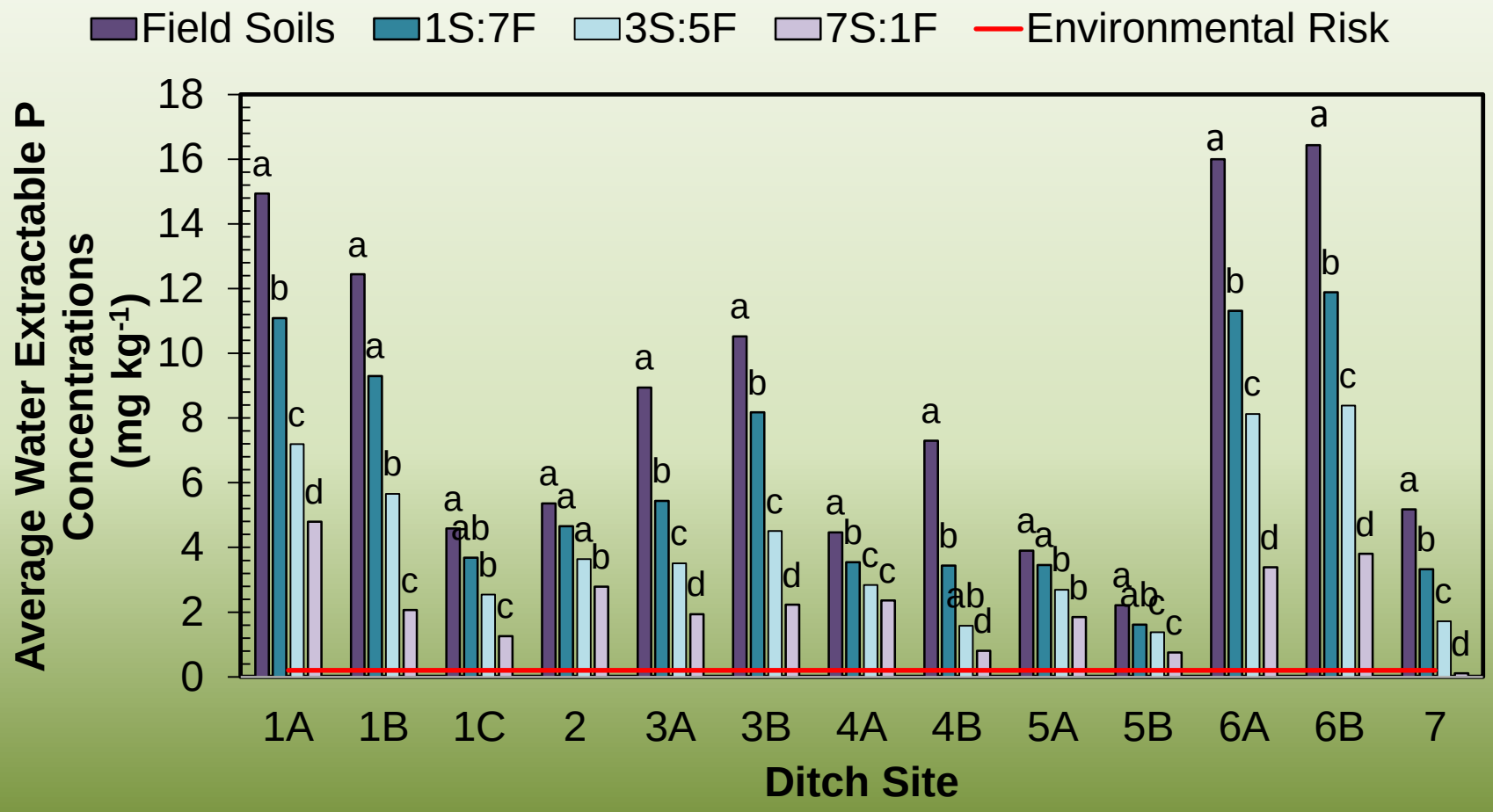


Amended Field Soils- 30 Day Results

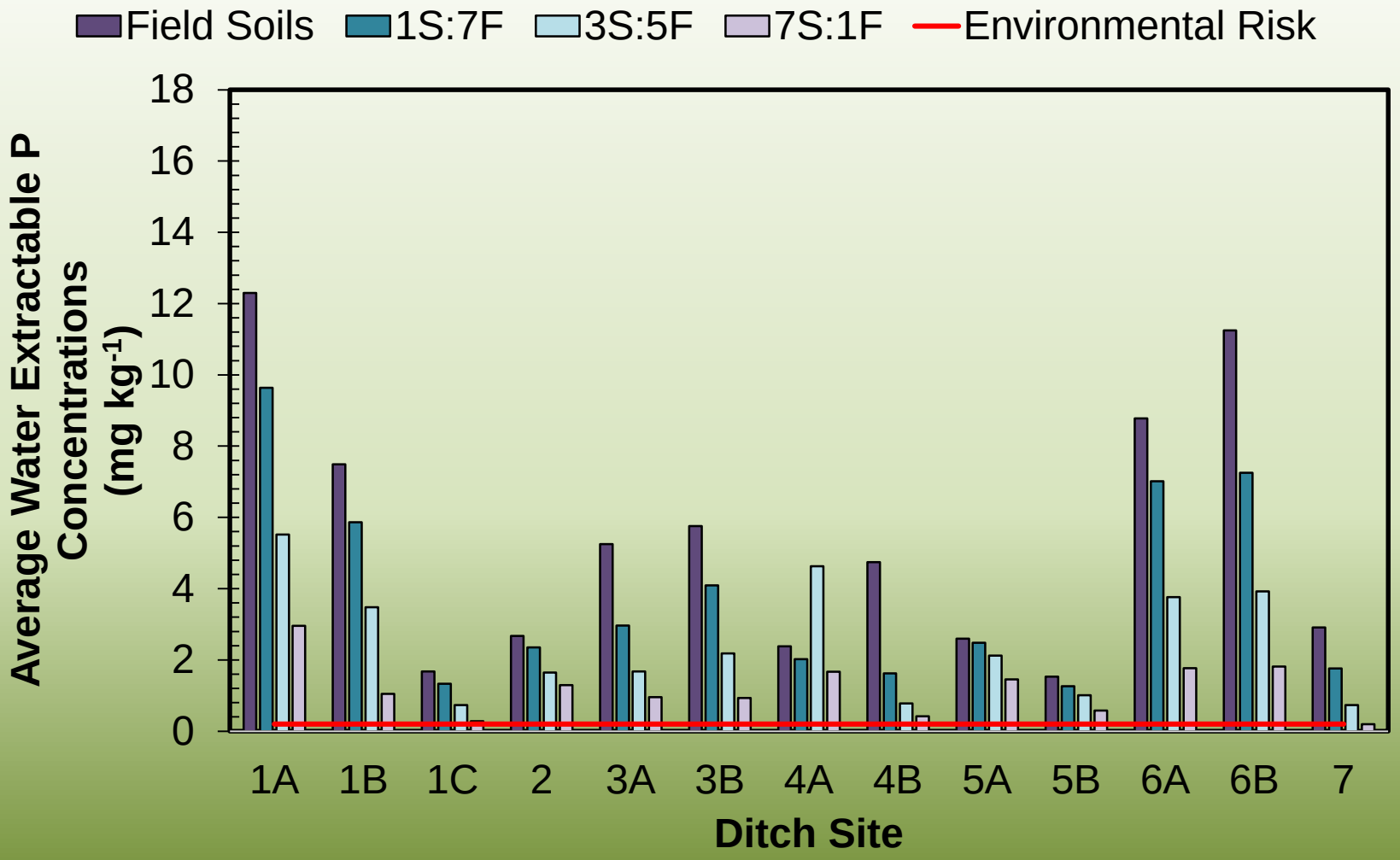


Amended Field Soils- 2 Day Results

Incorporation decreases Water Extractable P



Amended Field Soils- 30 Day Results



Incubation Conclusions

- Incorporation reduces potential risk of P loss from amended areas
  - More effective at reducing WEP than M3-P
  - Difference not always significant so need to determine optimum spreading depth
- Next steps:
  - Investigate properties of field and spoil samples to determine effective spreading depth for ditch sites
    - Regression analysis
  - Provide recommendation

Research Objectives and Goal

- Characterize ditch bottom sediments to determine potential release of P to overlying waters
- Quantify P removal from maintenance

Overall Goal: To provide a recommendation that improves current management

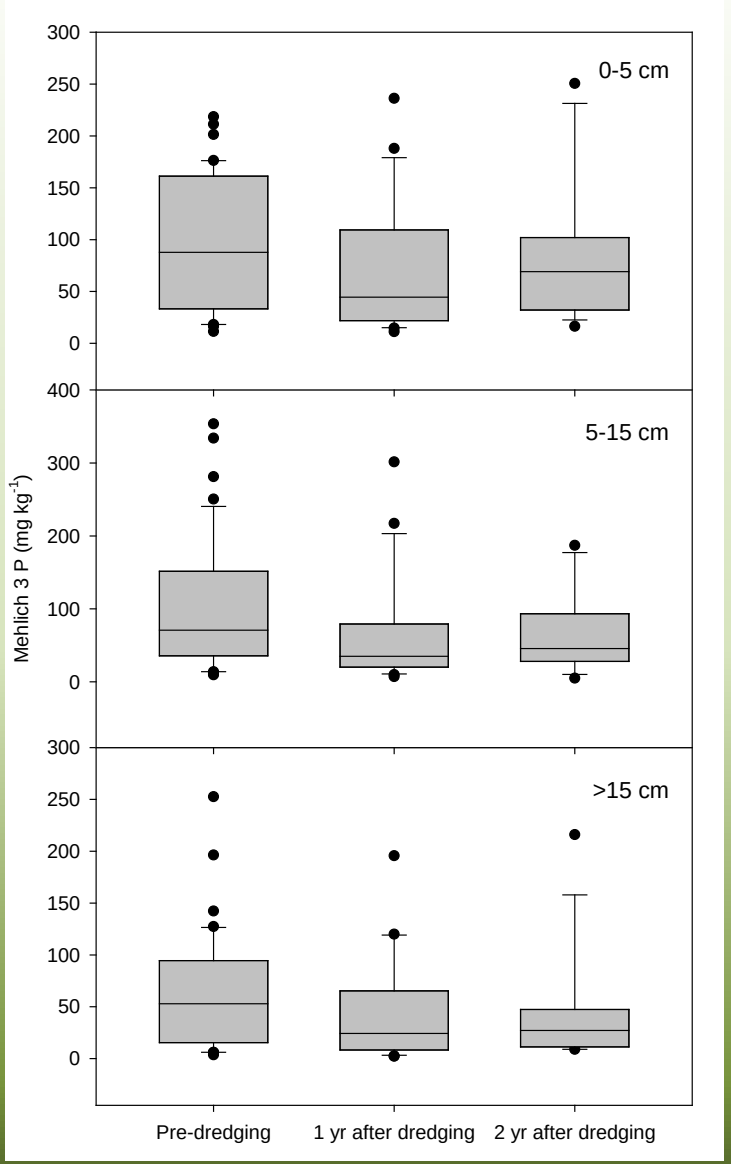
Ditch Core Sediment Sampling

Collect intact sediment core samples within each ditch
0-5, 5-15, 15+ cm

Characterization of Core Samples

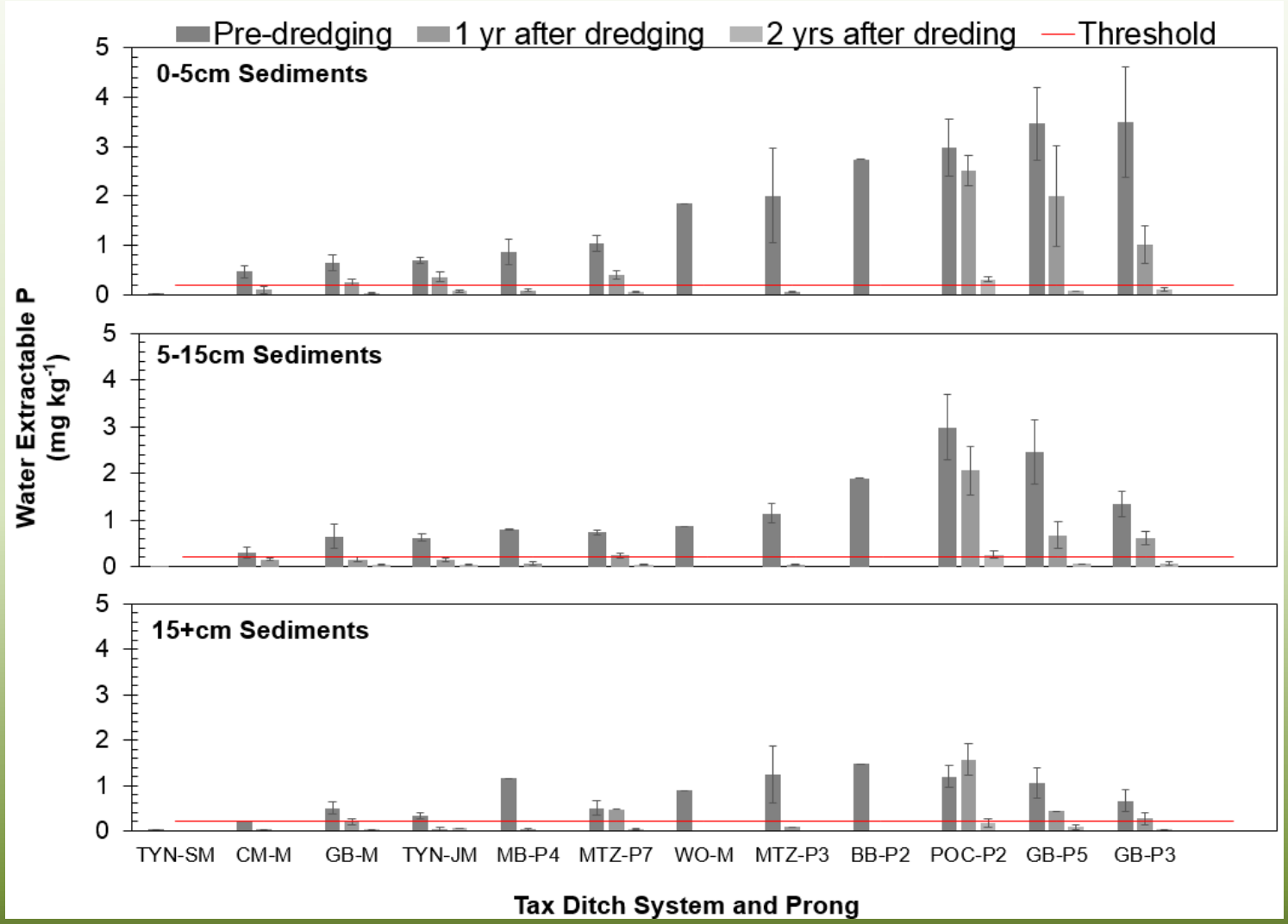
- Characterize P in sediments
  - Water soluble P (WSP), Mehlich 3 P (M3-P), EPA_{3050}-P
  - Soil texture *and sequential P fractionation*
- Quantify P removal during maintenance

Ditch Core Sediments: Mehlich 3 P

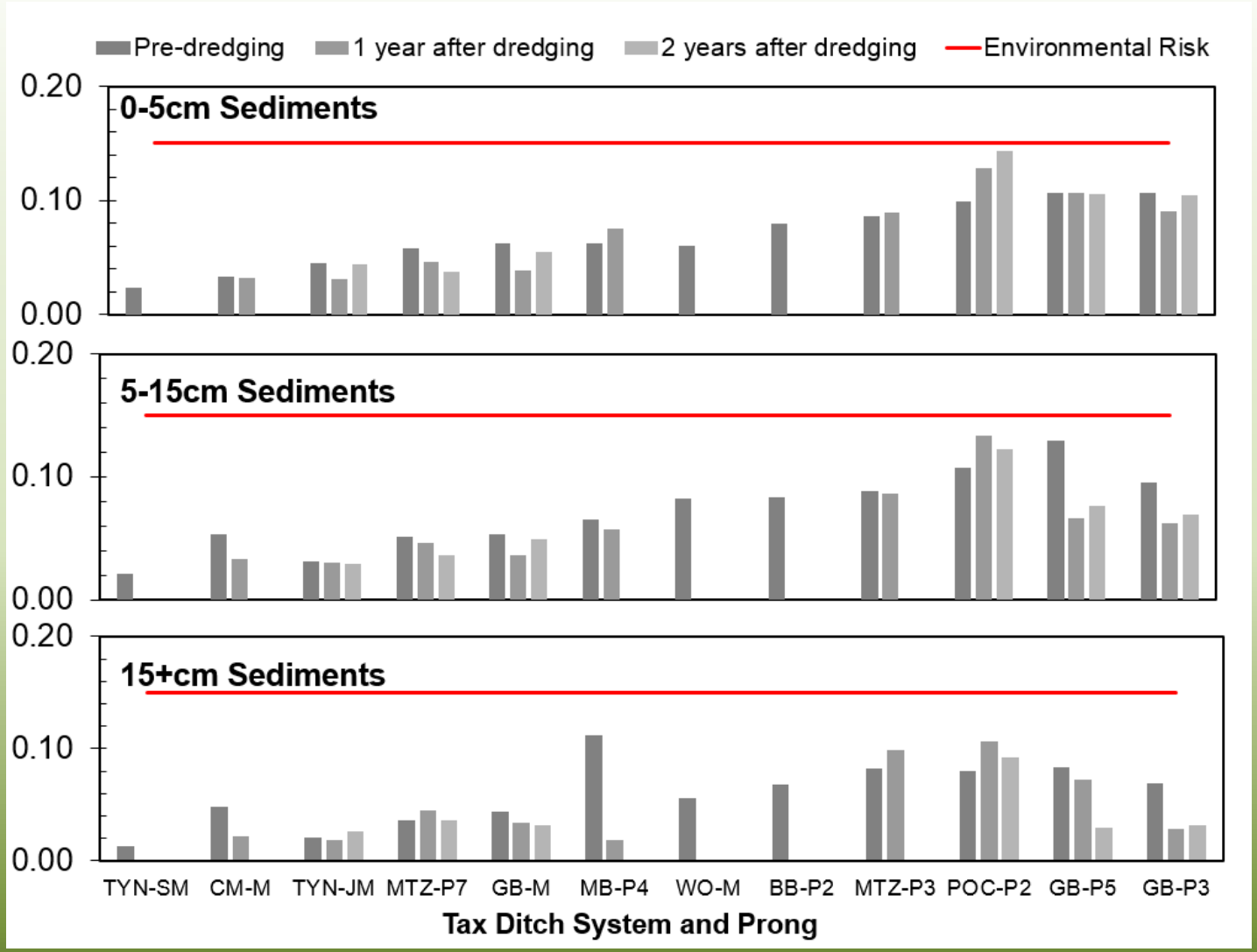


- Generally Mehlich 3-P decreased with core sediment depth and following maintenance
- 5-15cm sediments at times possessed greatest concentrations
  - Those sediments possessed 0-5cm sediments in excess of agronomic needs

Ditch Core Sediments: Water Extractable P (WEP)



Ditch Core Sediments: Mehlich 3 Phosphorus Saturation Ratio



Ditch Core Conclusions

- Enrichment of P in top 0-5cm sediments
  - Excessive levels observed
  - M3 PSR below environmental risk threshold but it is important to note that channel conditions are different than field
- Next steps:
  - Calculate total P removed from maintenance activity
  - Provide recommendation

Thank you for your time and attention.

Questions or Comments?