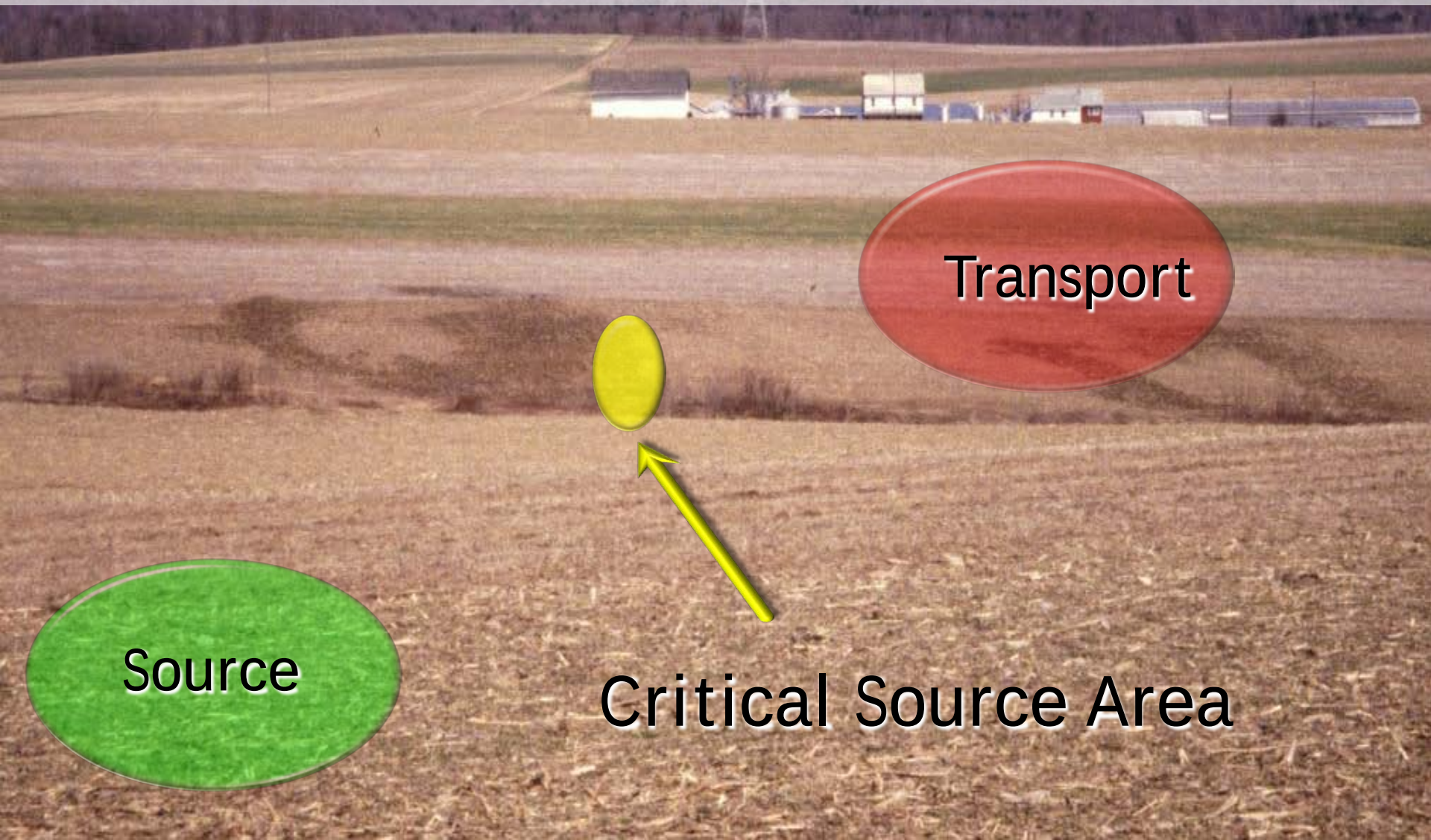
Influence of fragipan soils on runoff and phosphorus management

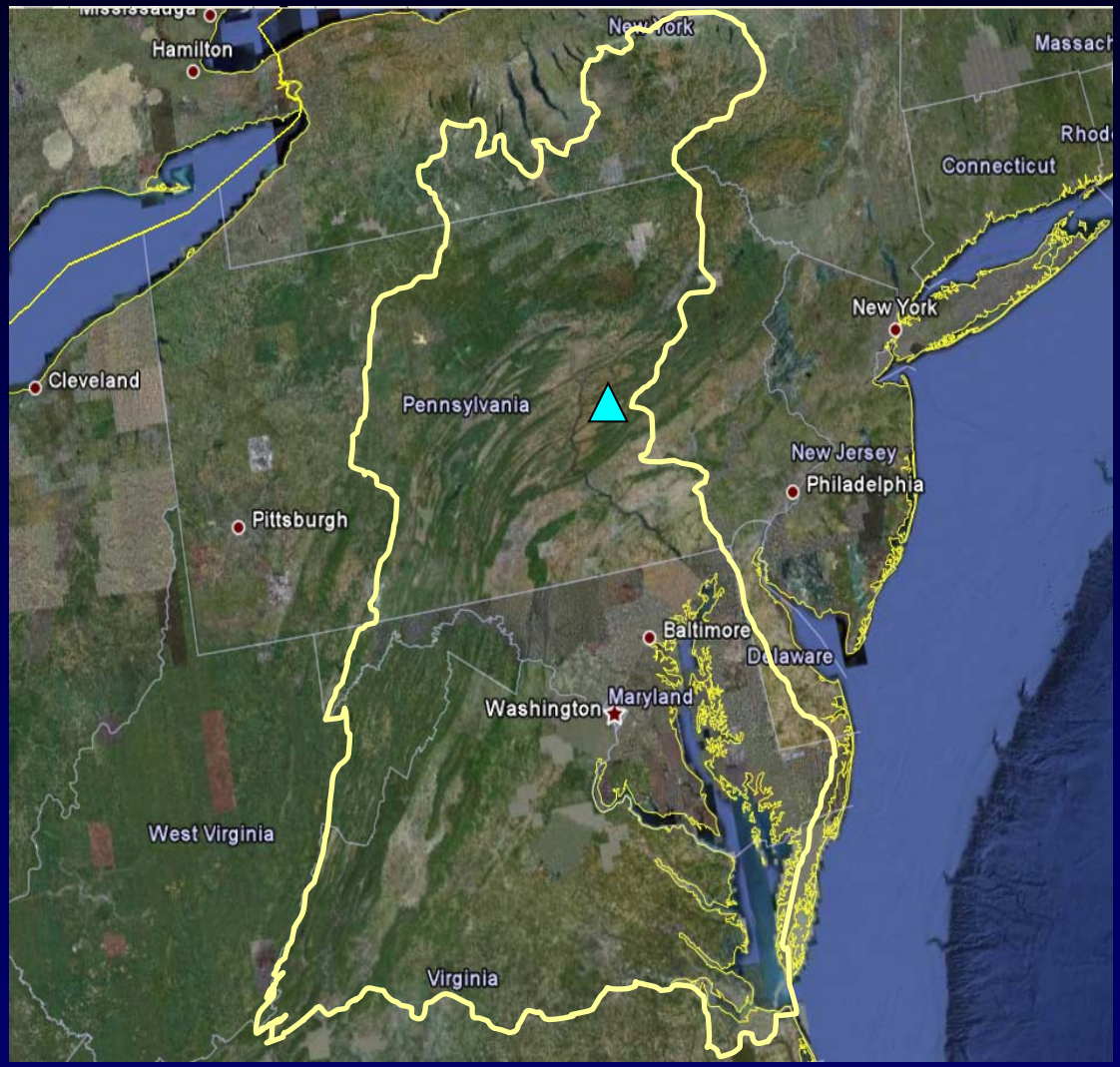
Anthony Buda

USDA-ARS
Pasture Systems and Watershed Management Research Unit
University Park, PA

Critical source areas and P management – the traditional model



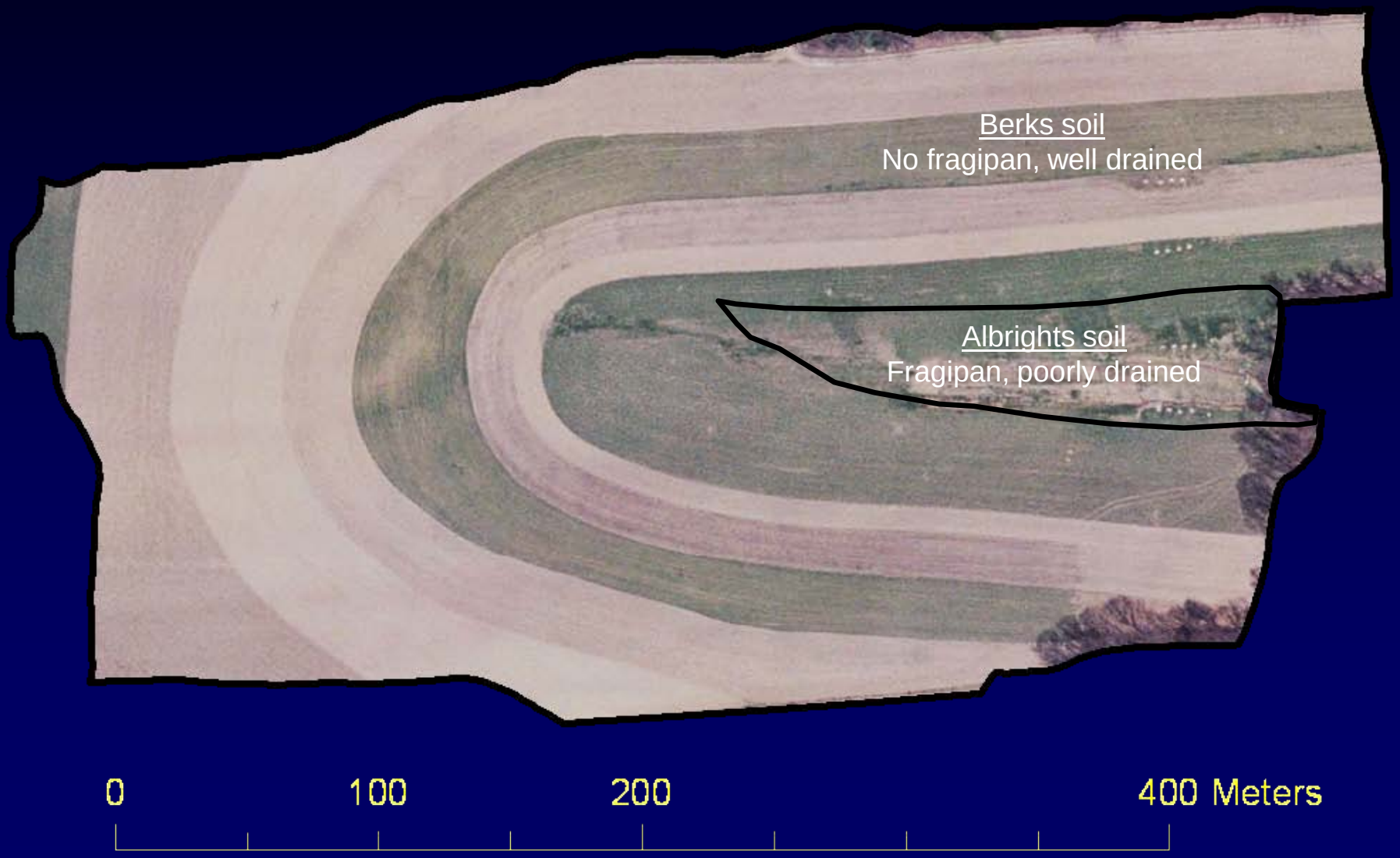
How do fragipan soils affect CSA identification? Results from the Mattern hillslope study



Mahantango Creek
Experimental Watershed
Klingerstown, PA
Area = 7.2 km^2

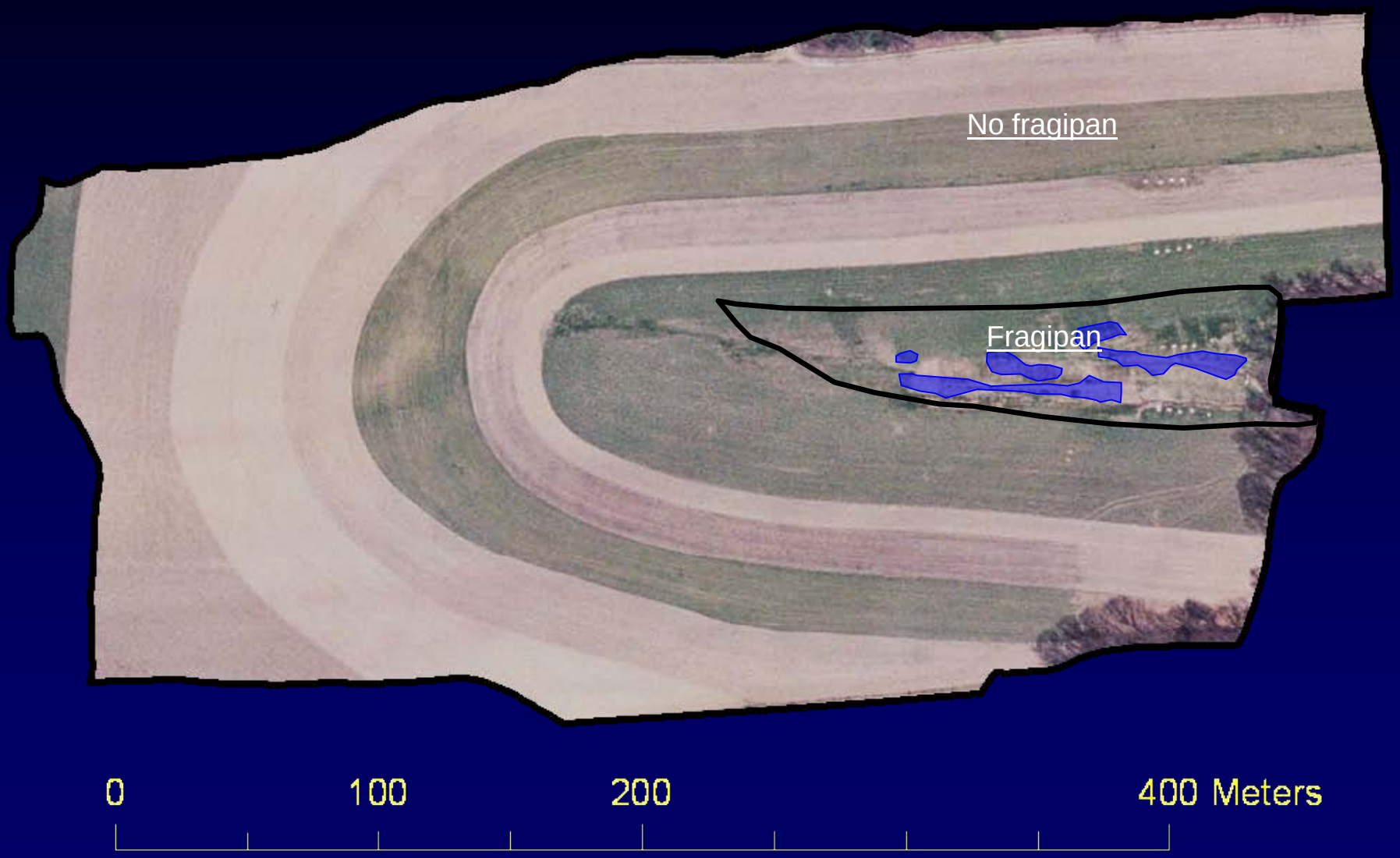
Mattern watershed
Area = 11 ha

The Mattern watershed



Fragipan soils and zones of saturation

Late August 2003



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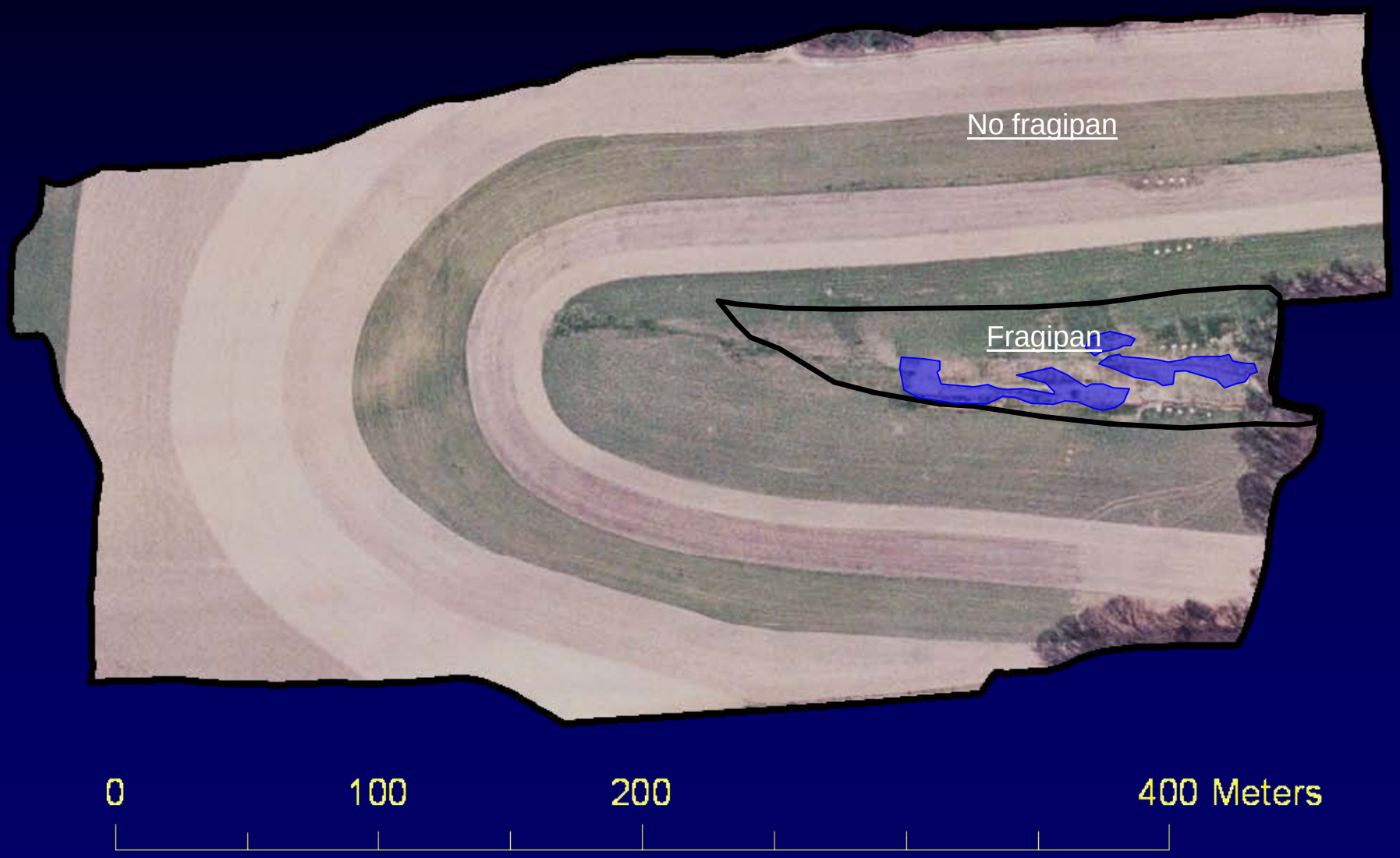

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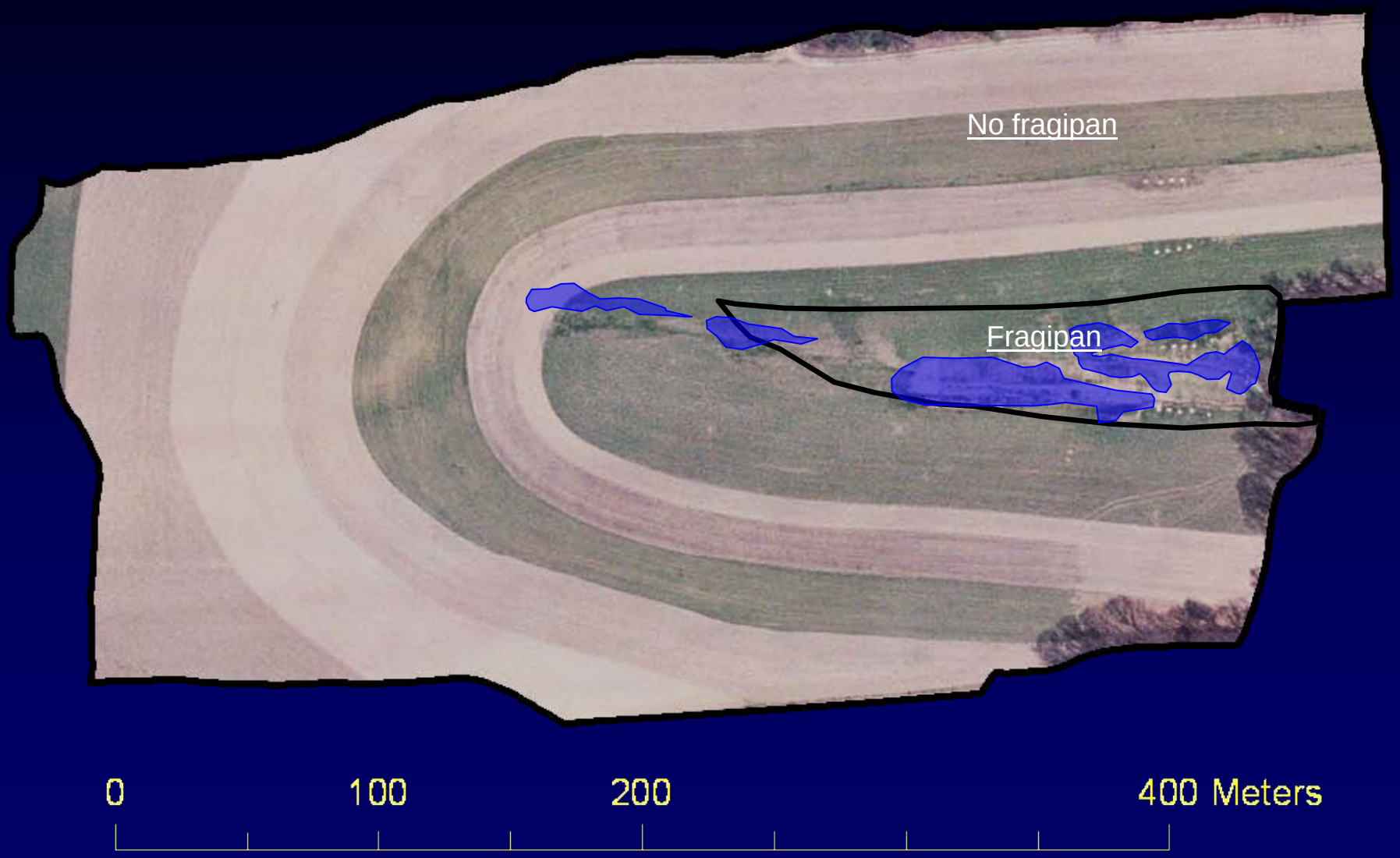

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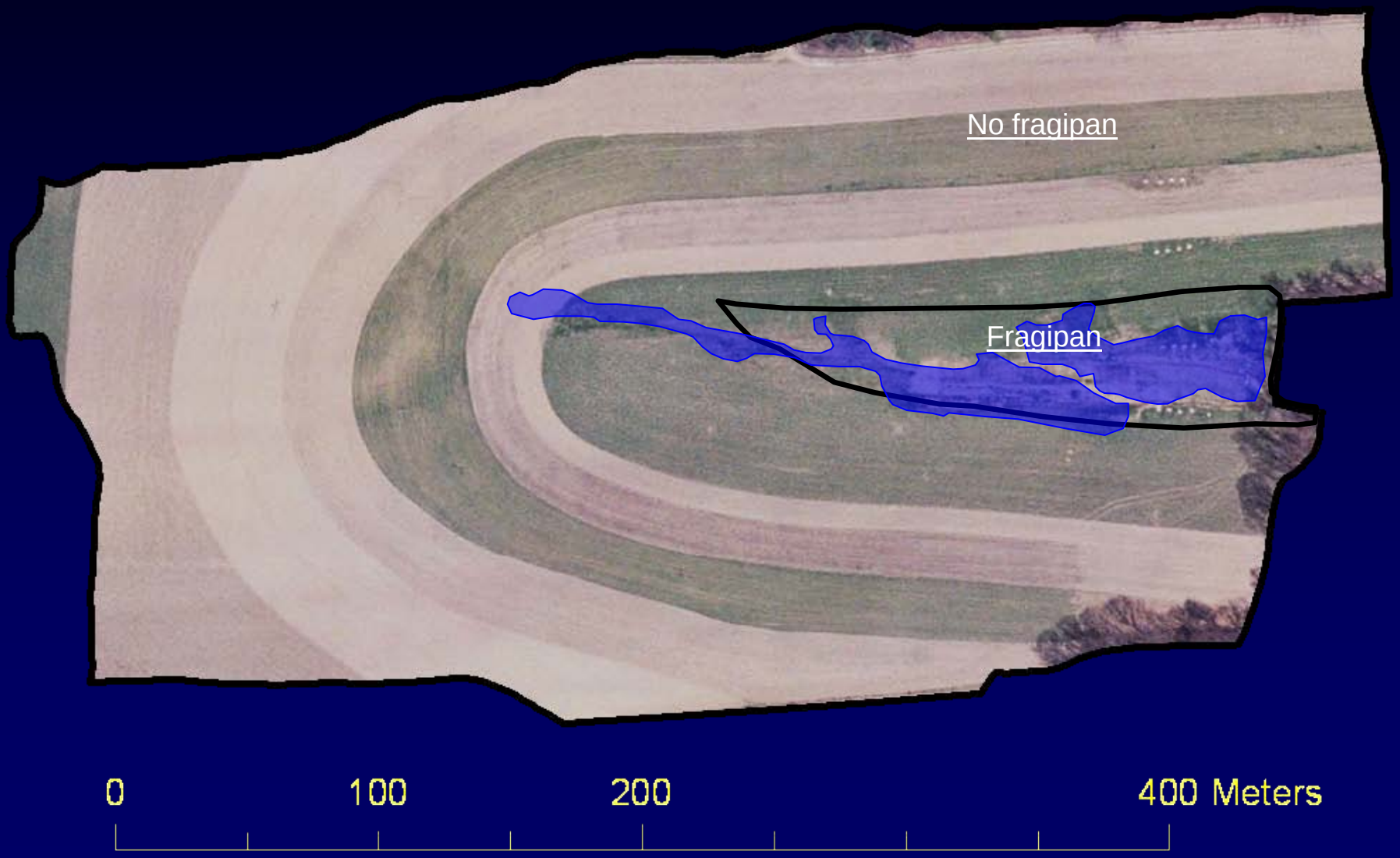

Fragipan soils and zones of saturation

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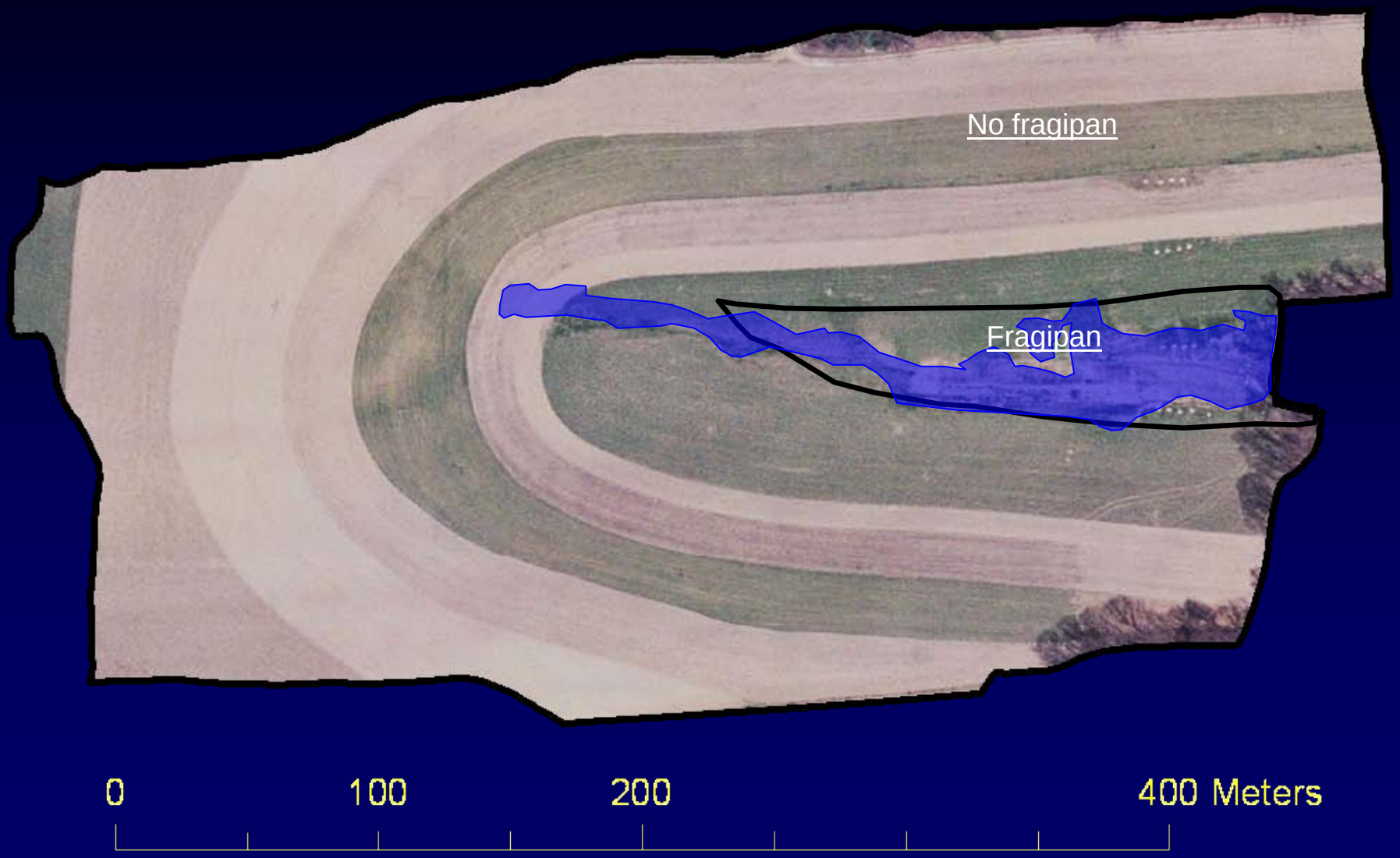
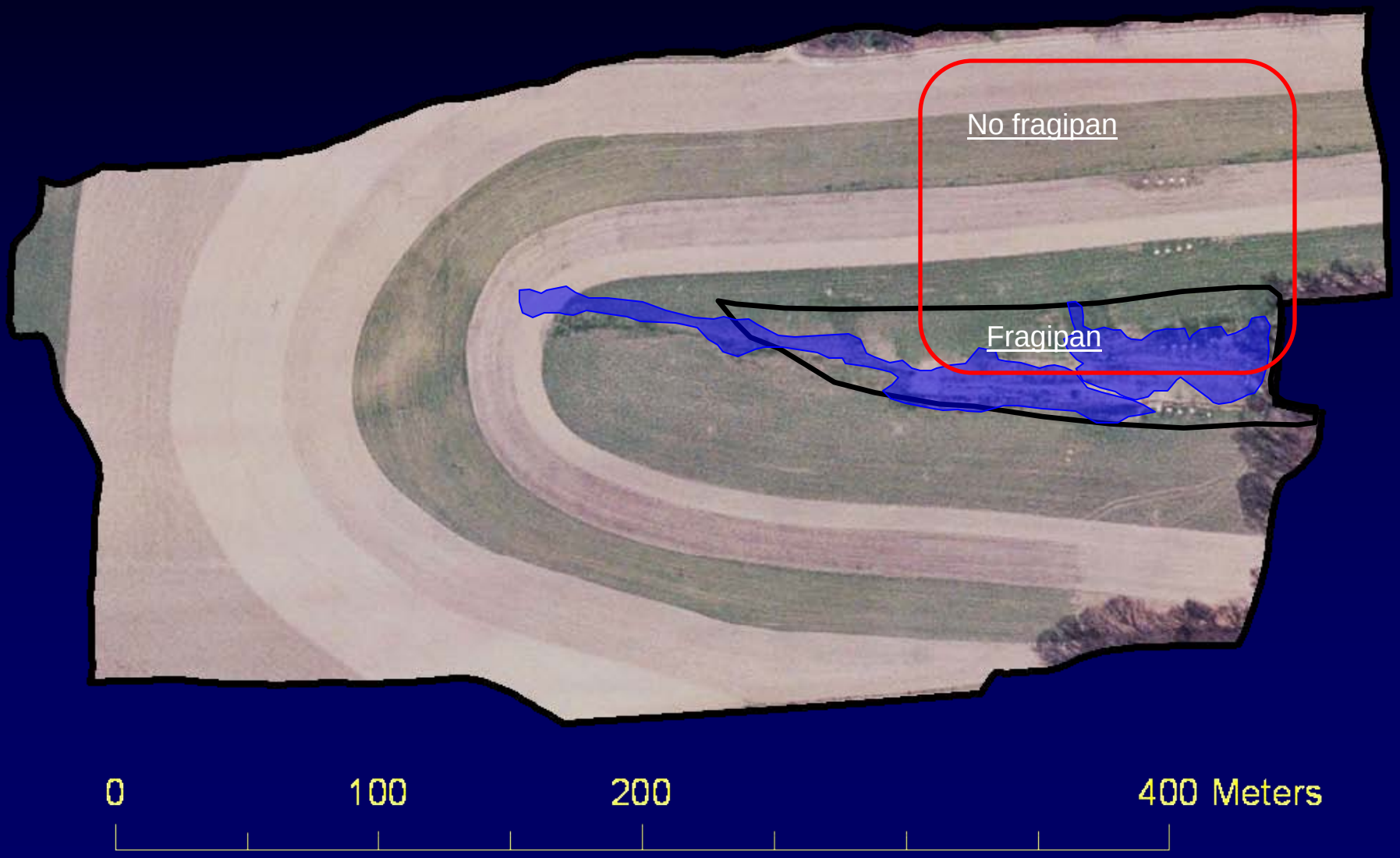
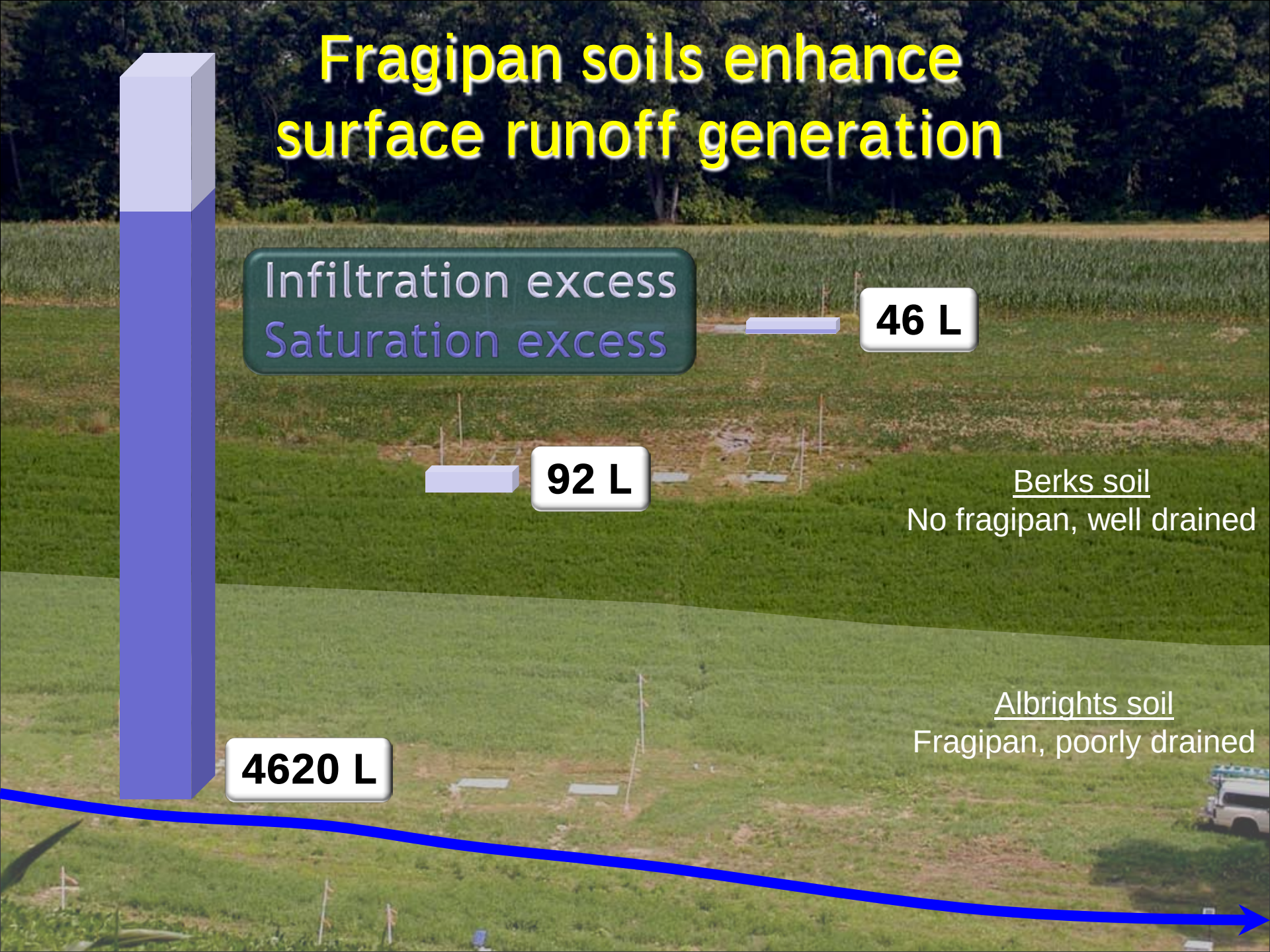


Fragipan soils and zones of saturation

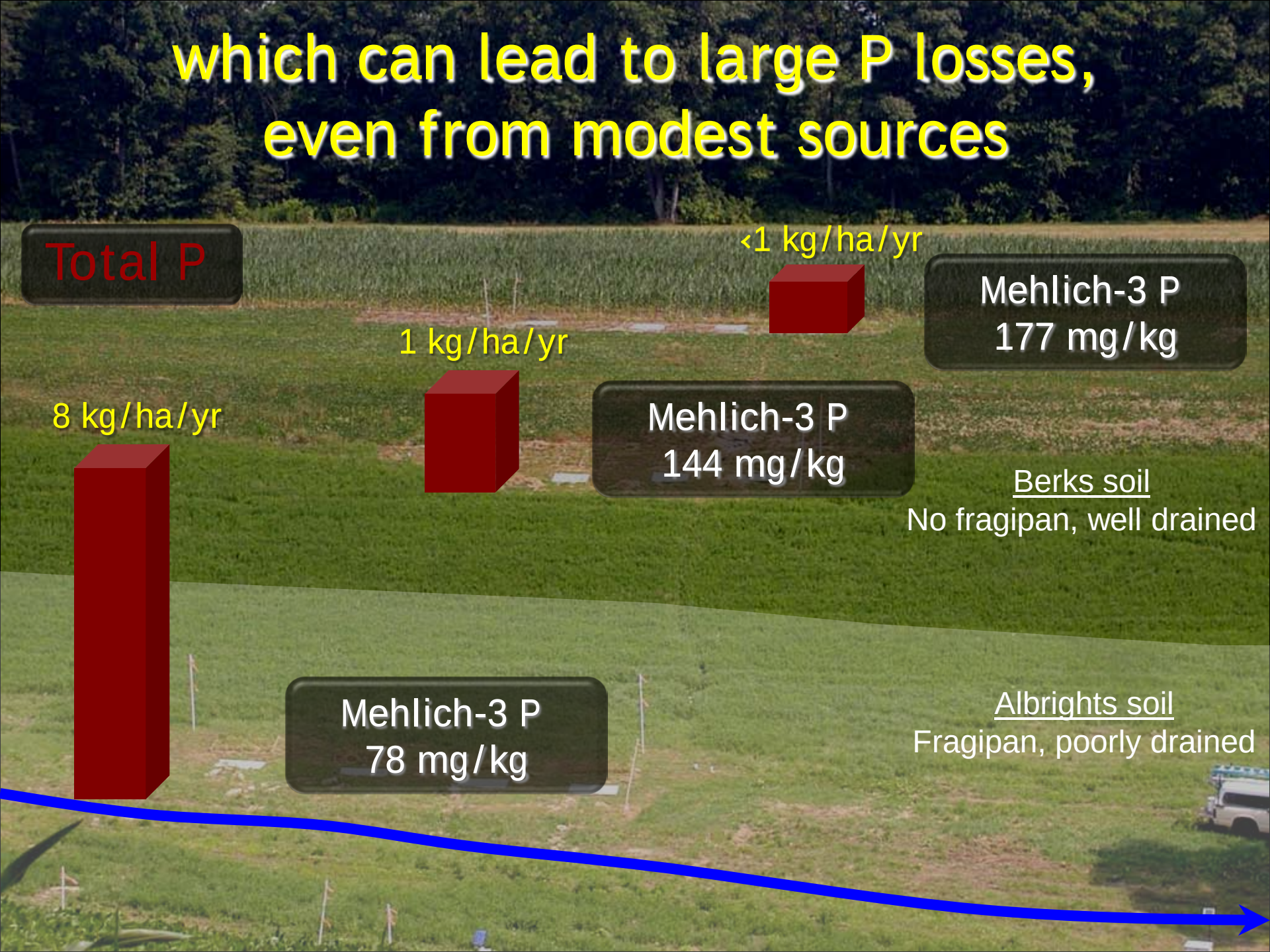
Late November 2003



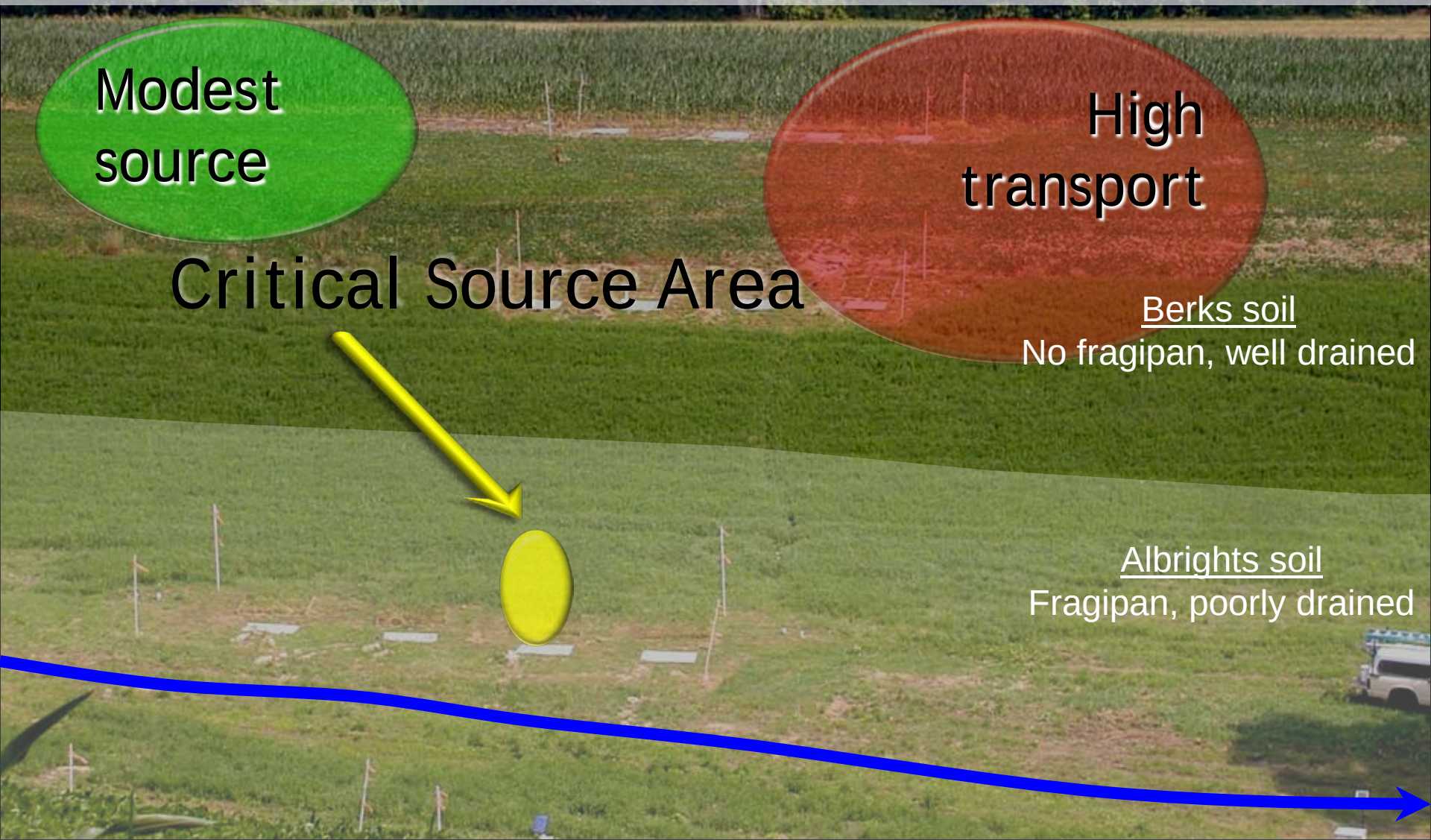
Fragipan soils enhance surface runoff generation



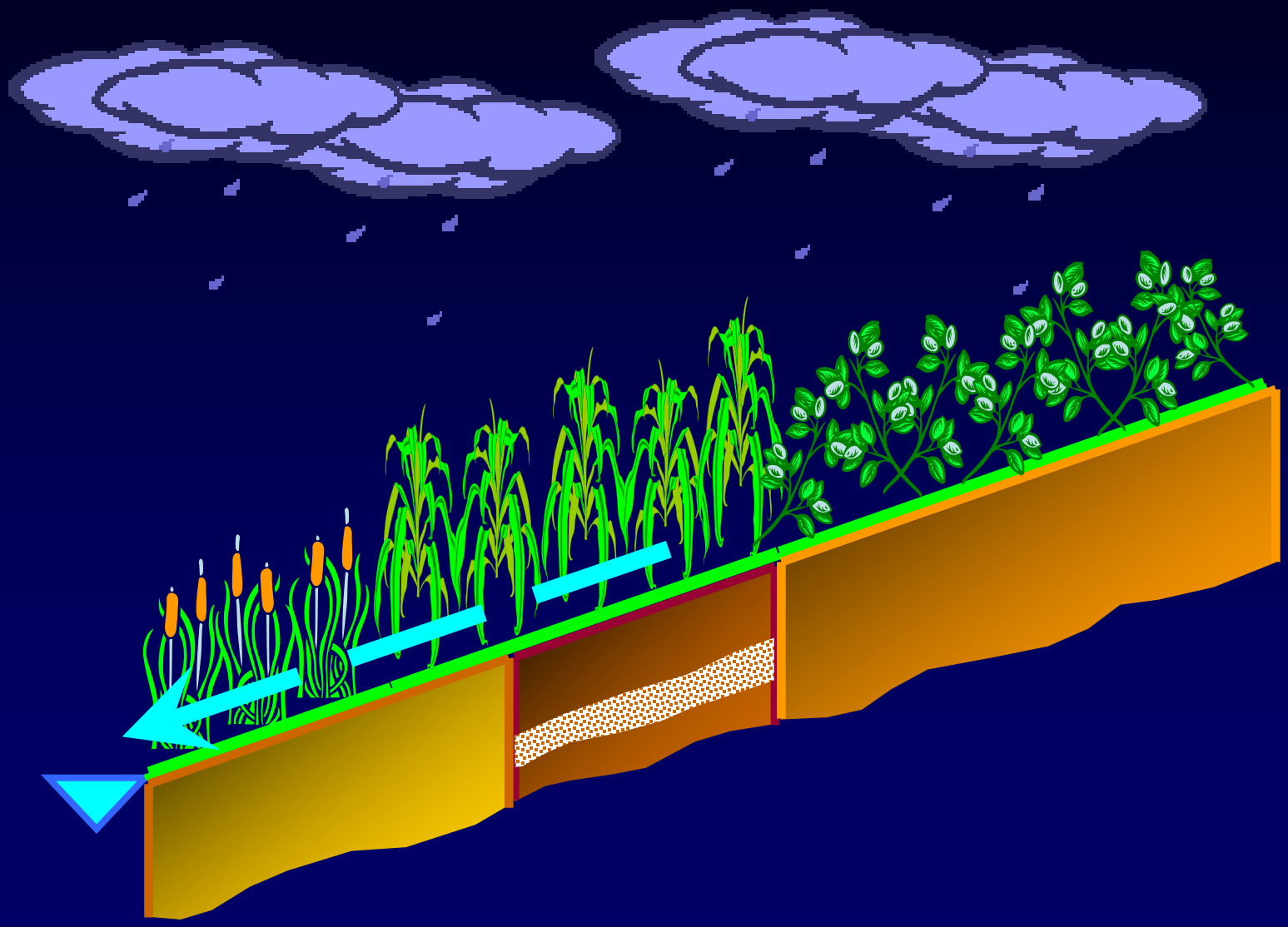
which can lead to large P losses, even from modest sources



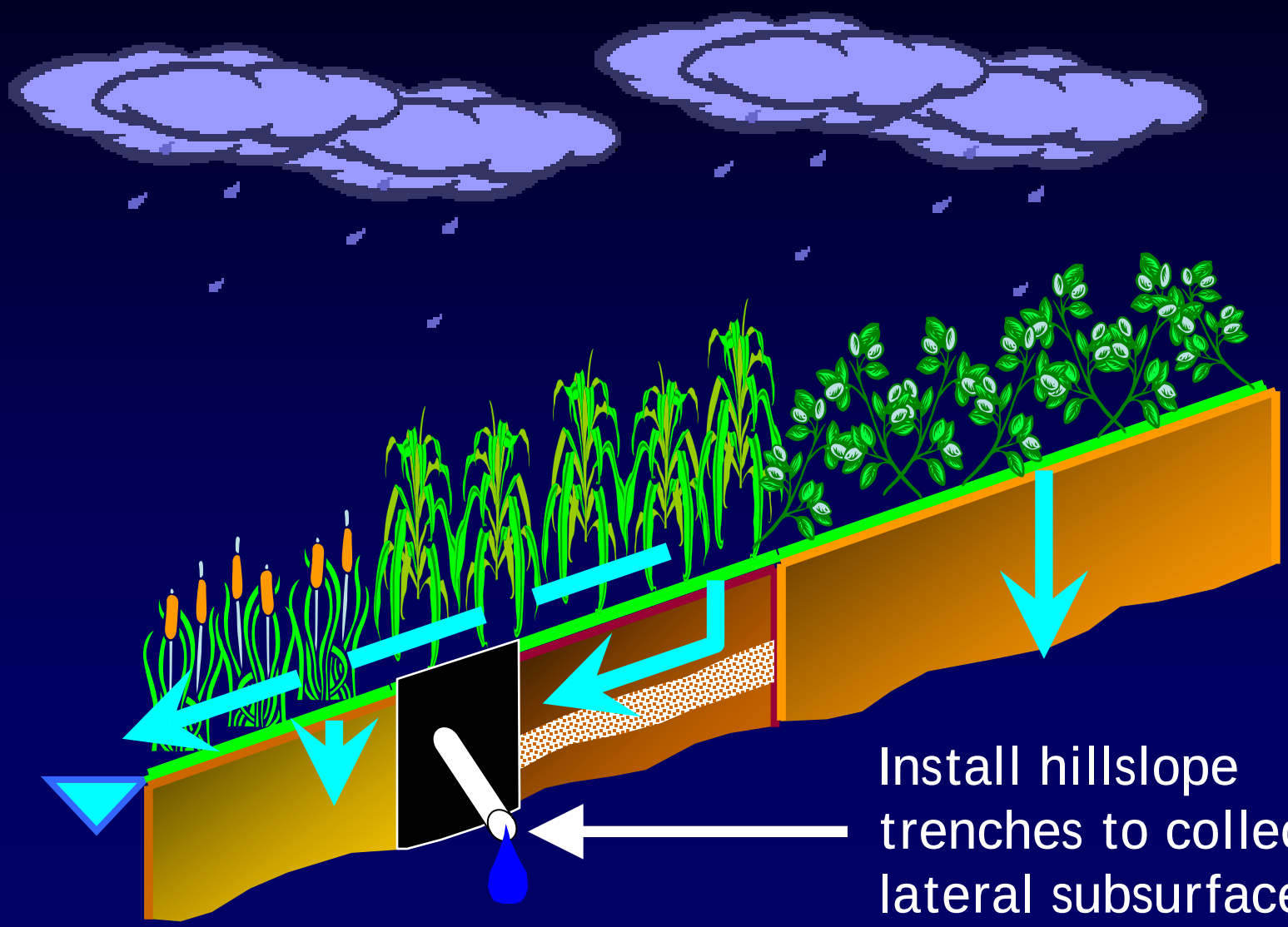
Critical source areas and P management – revised model



Overland flow is not the only pathway for phosphorus transport

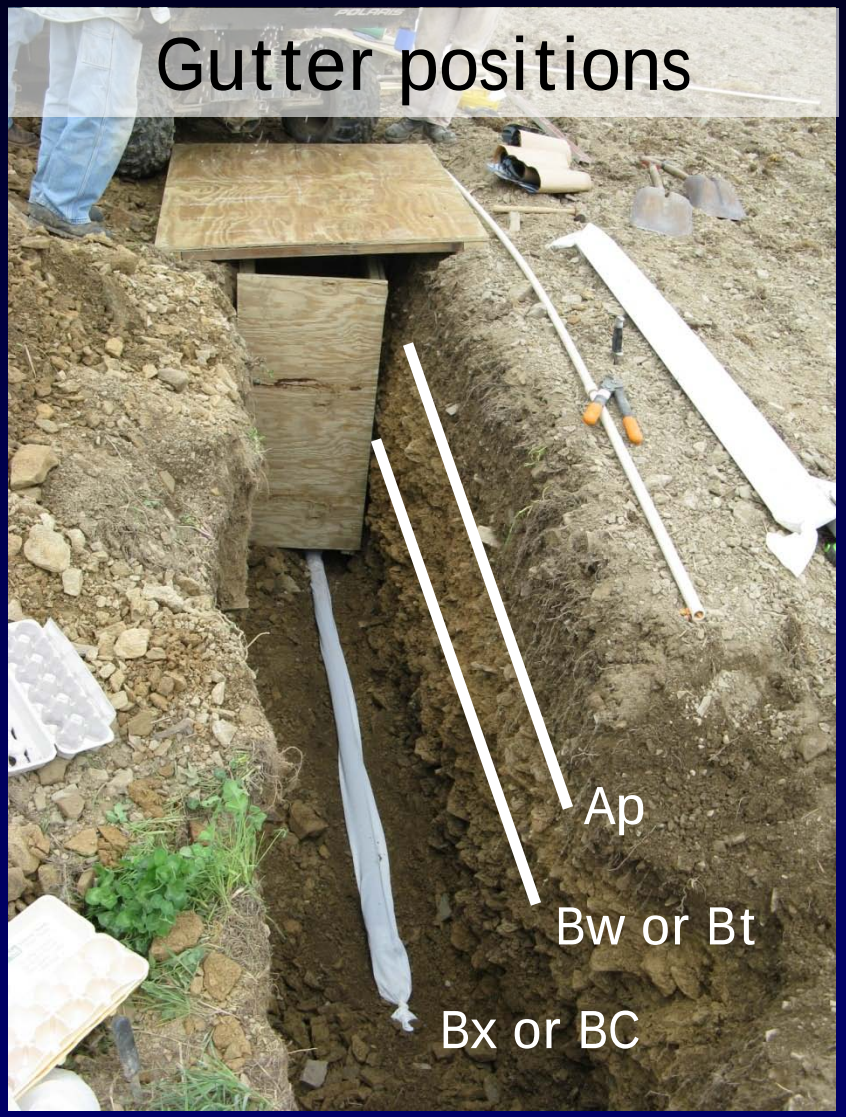


Subsurface flow is also important

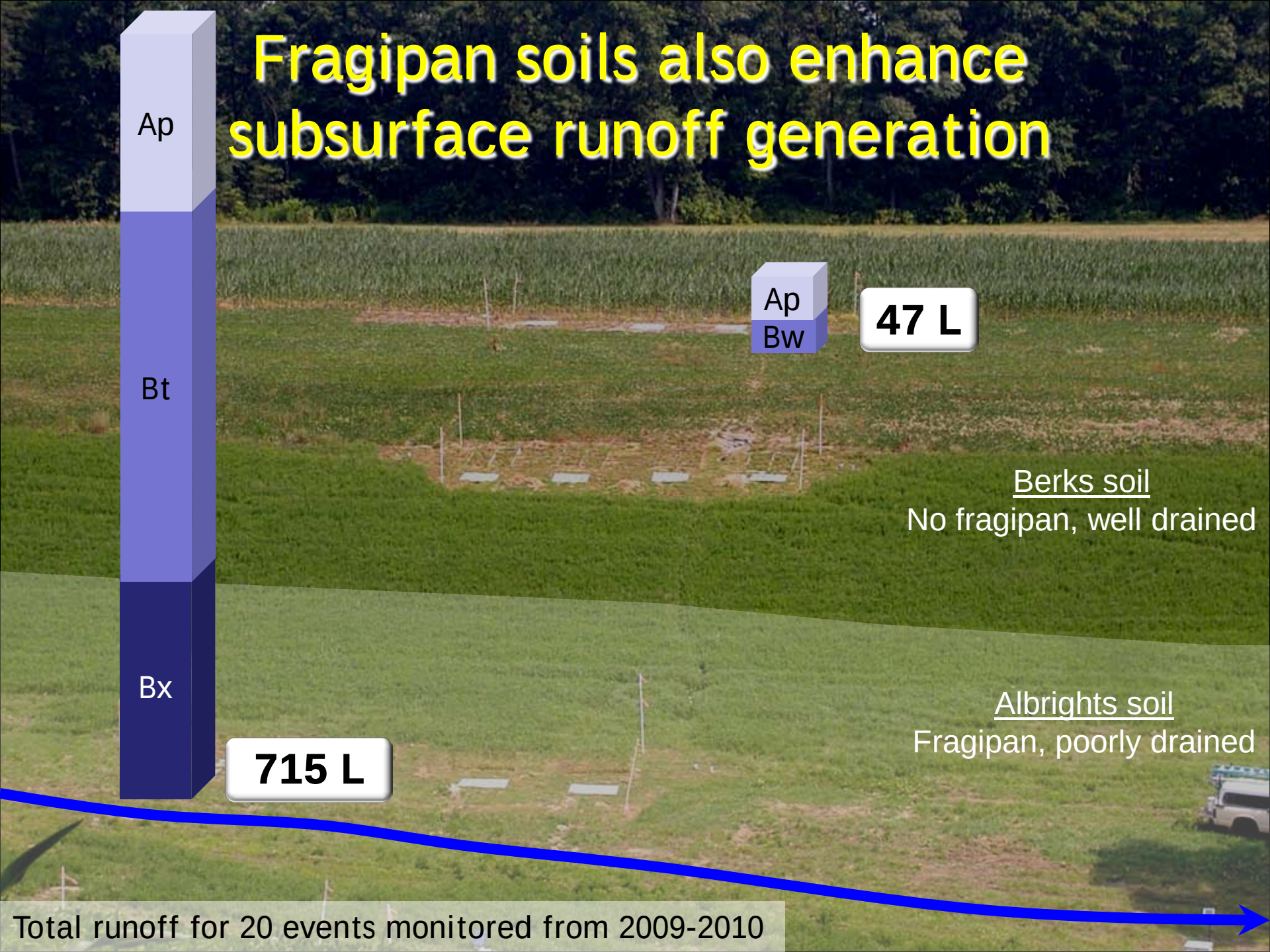


Install hillslope trenches to collect lateral subsurface flow

Hillslope trench design

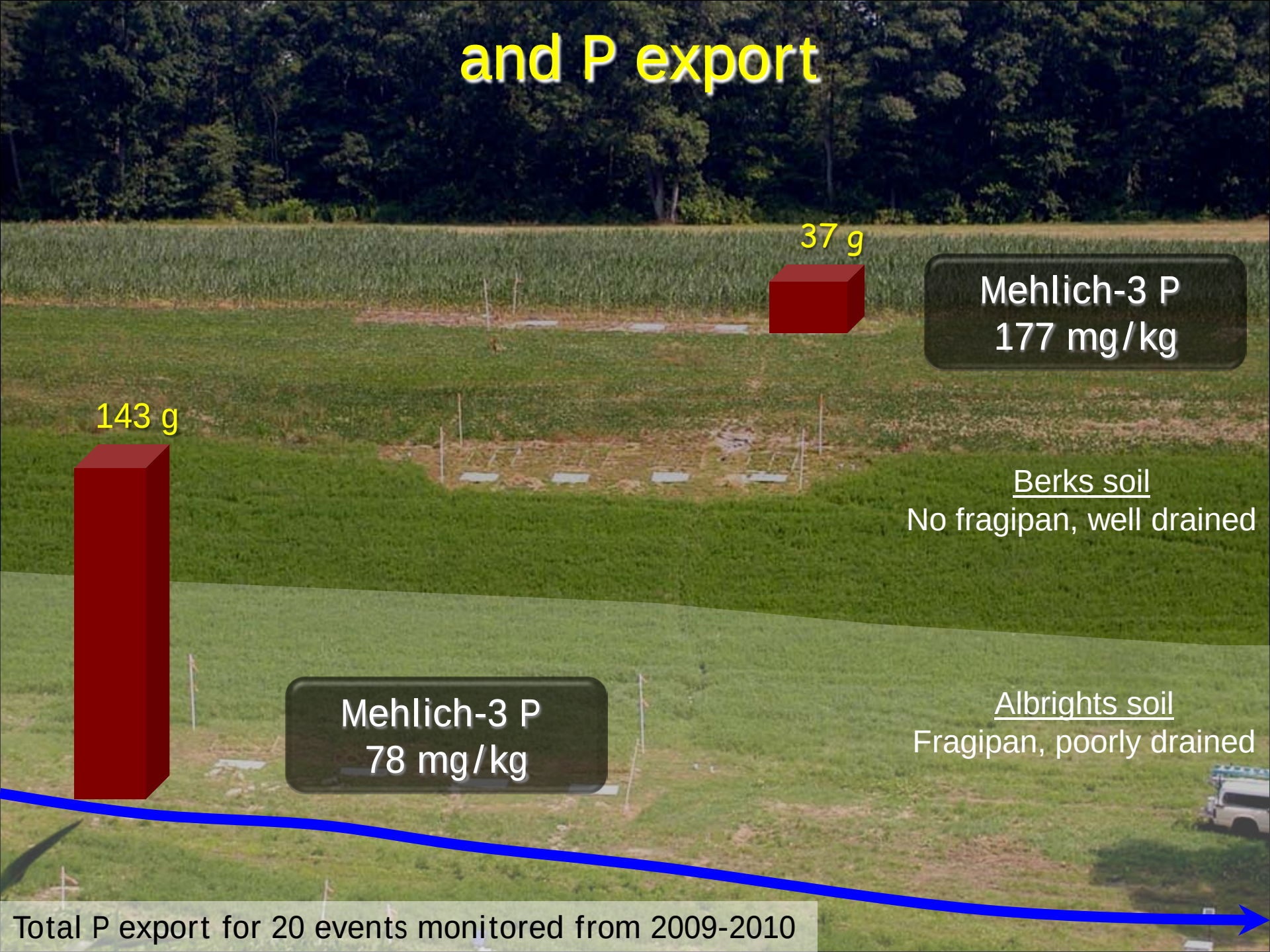


Fragipan soils also enhance subsurface runoff generation



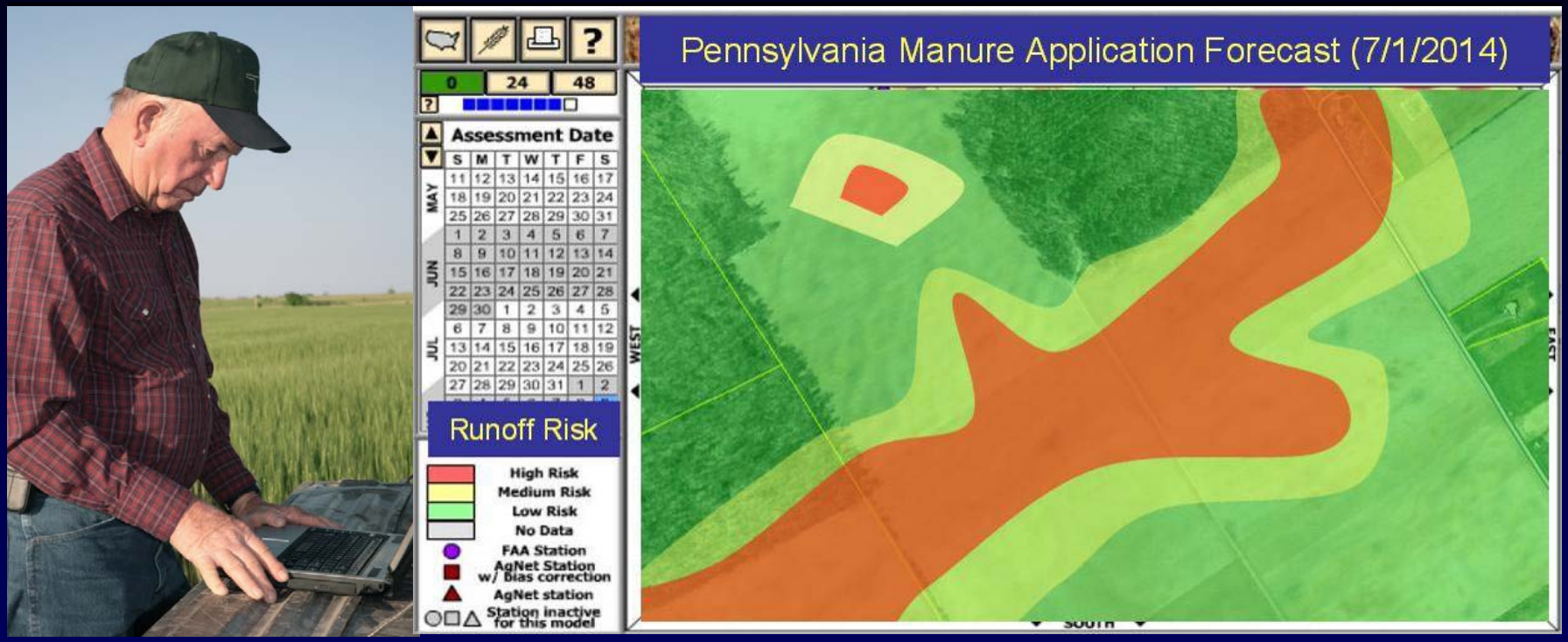
Total runoff for 20 events monitored from 2009-2010

and P export



Total P export for 20 events monitored from 2009-2010

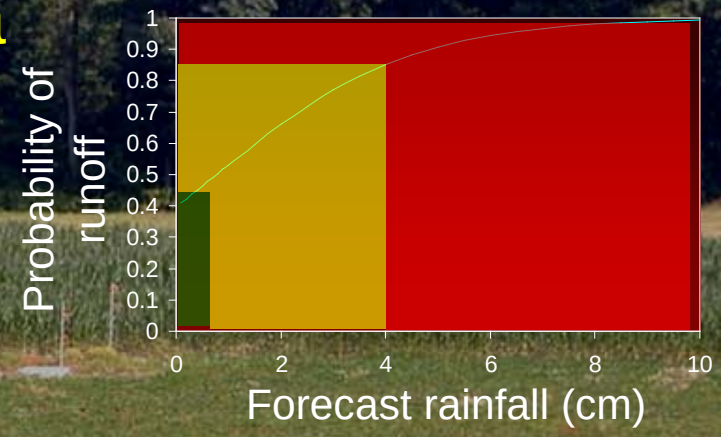
Develop new tools that can assist farmers with short-term field management decisions

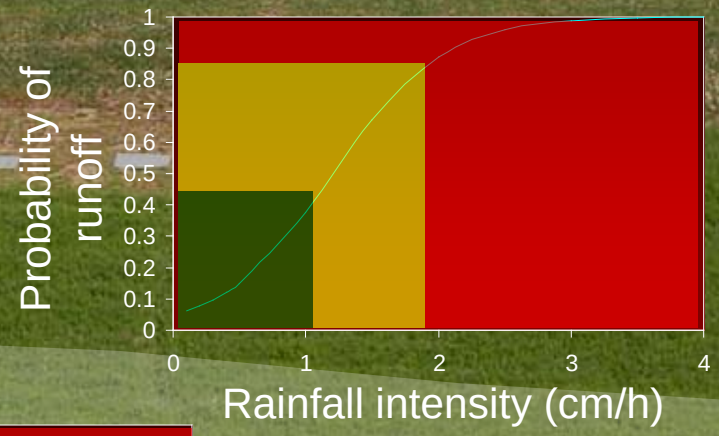


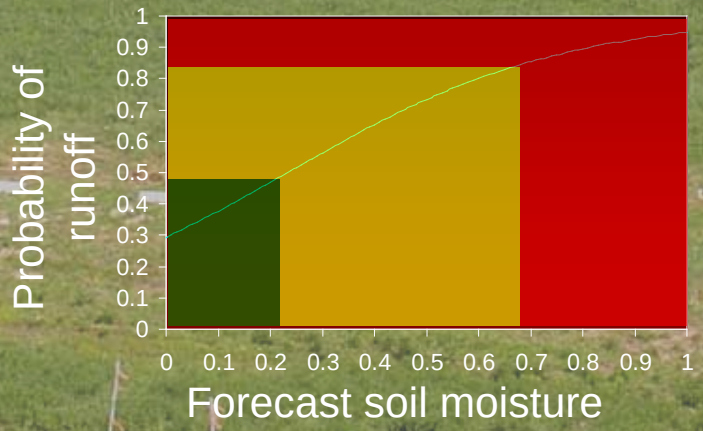
Decision support system that uses available forecast data from Penn. State Climatologist

- Rainfall
- Soil moisture
- Solar radiation
- Rainfall intensity

Probability of runoff using weather forecast data







Develop 1 and 5 day runoff forecasts

Mapping fragipans would help identify hydrologically active areas and improve runoff forecasts

Percent of soil map unit mapped as fragipan

1-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80-90 | 90-100

Data courtesy of Sharon Waltman, USDA NRCS

Lessons for future management

- Fragipan soils are focal points for soil saturation and runoff generation via surface and subsurface flow pathways.
- Major P loads can be generated from modest P sources in fragipan soils.
- Developing a map of fragipan soils would improve our ability to forecast runoff probability and guide P application.

Questions / Discussion