Use-dependent/Dynamic Soil Properties—Algorithms & New NASIS Calculations and Validations

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Use-dependant Properties

Soil properties that change with land use and management

Use-dependant Properties

- Projects
  - measuring use-dependant properties under different land use and management
- Soil Survey report
  - added value
- No consistency
  - Properties
  - Methods

SSSA Symposium
Indianapolis, 2002

- Title: Dynamic Soil Properties, Pedology and Soil Function.
- Purpose: Foster education, communication and research on dynamic soil properties.
- Sponsored by S-5, S-3 and S-7
  - 8 invited speakers, 6 volunteer speakers and 12 posters

Soil Science Society of America

Aspects of Incorporating Use-dependant data into Soil Survey

- **Objectives**
  - Give an example of differences in near-surface properties between two contrasting land uses within the same map unit component, using on-site methods.
  - Provide possible frameworks for incorporating use-dependant property information into Soil Survey.

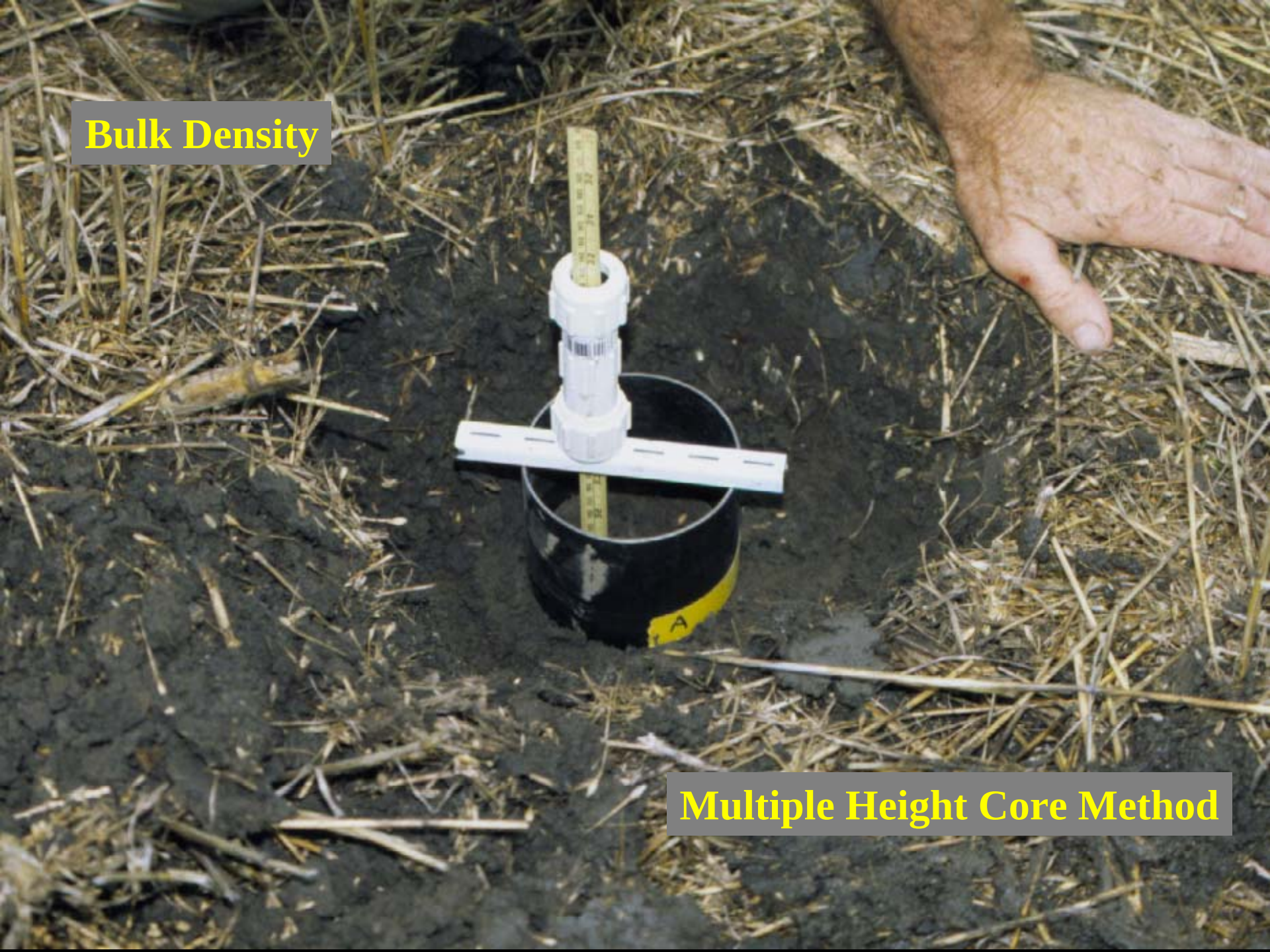
Land uses:

Woodland

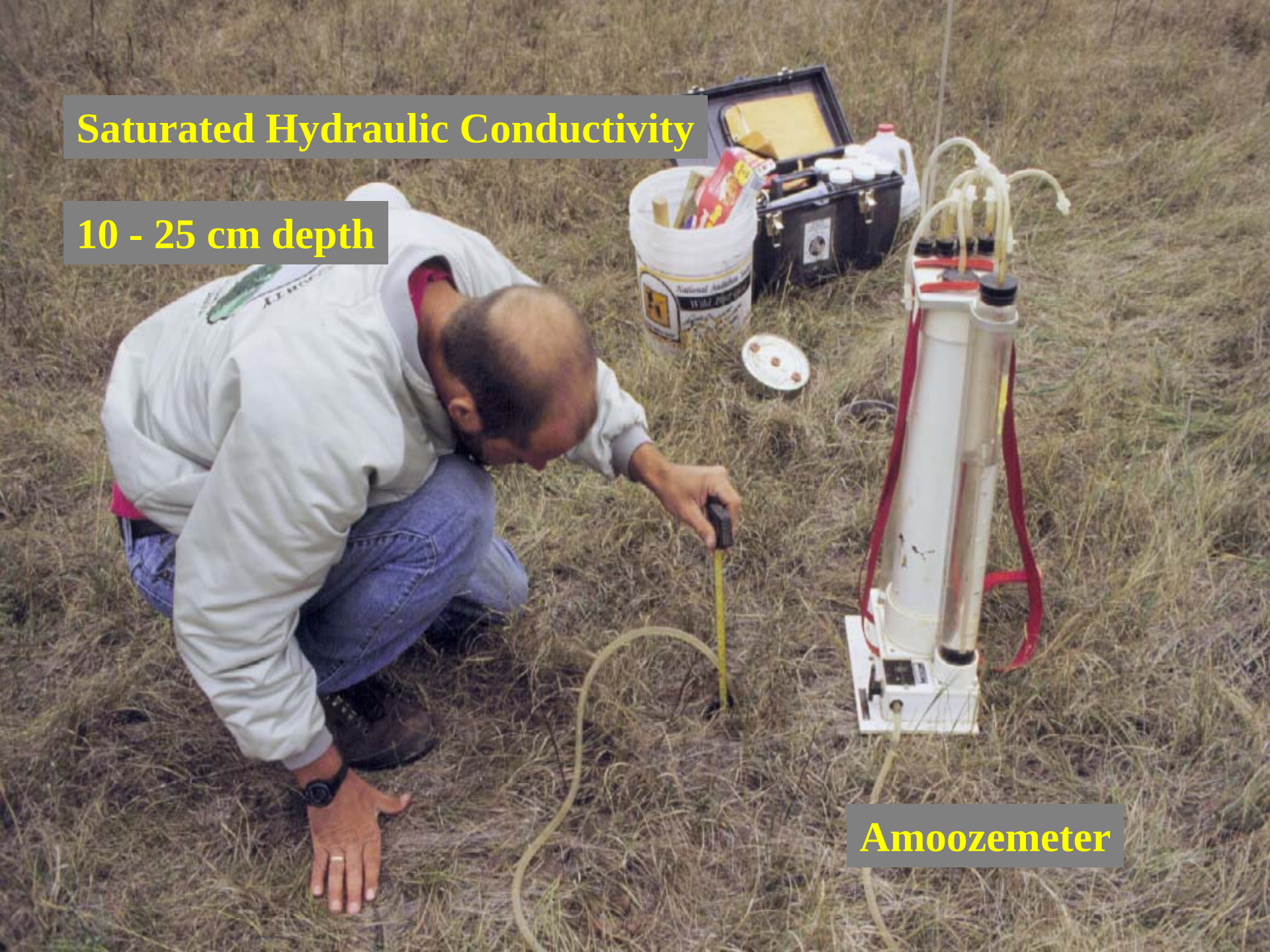
Cropland: Conventional tillage, corn-soybean rotation

Capac loam

Infiltration


Bulk Density
Multiple Height Core Method

Penetration Resistance
Pocket Penetrameter
0 - 20 cm depth


Saturated Hydraulic Conductivity
10 - 25 cm depth
Amoozemeter

Soil Strength
Modified Singleton Blade

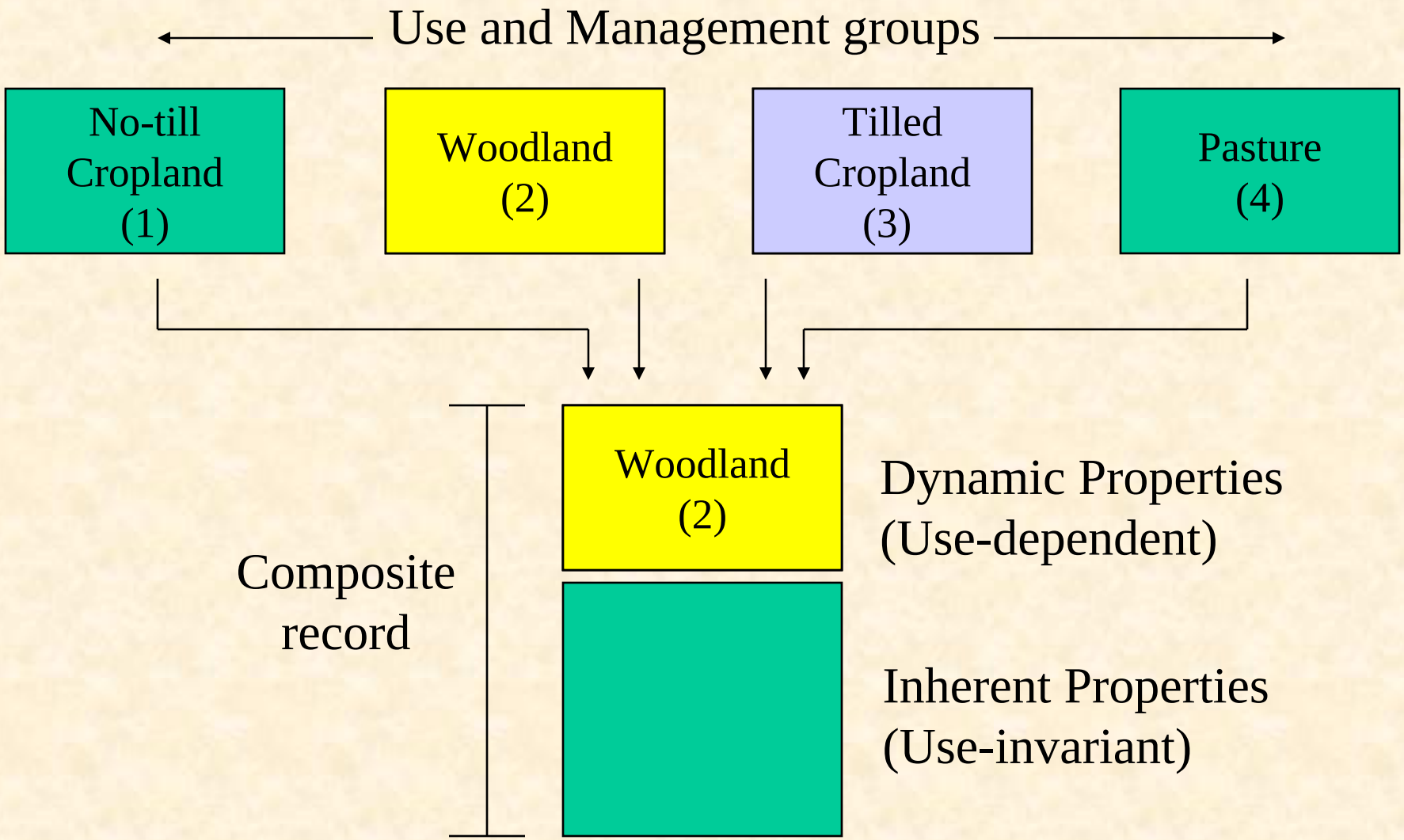
Morphological Index

Soil Respiration

Aggregate Stability

Soil pH and Nitrates

Property	Conv. tillage corn-soybean rotation	Forest site
Bulk density (g cm^{-3})		
0 - 3 cm depth	1.40	1.01
11 - 13 cm	1.45	
Penetration resistance (kPa)	1300	900
Soil strength (kg dm^{-2})		
0 - 2 cm depth	3.5	4.5
4 - 6 cm	3.2	3.2
Infiltration (in hr^{-1})	0.5	50
K-sat (in hr^{-1})	0.46	2.29
Aggregate stability (% > 0.25 mm)	37	65
Morphological index	2.47	3.55
Soil respiration (g CO_2-C m^{-1} d^{-1})	1.9	7.1
Soil pH	5.7	4.9
Soil nitrate (kg ha^{-1})	17	2.1



(Grossman et al., 2001)

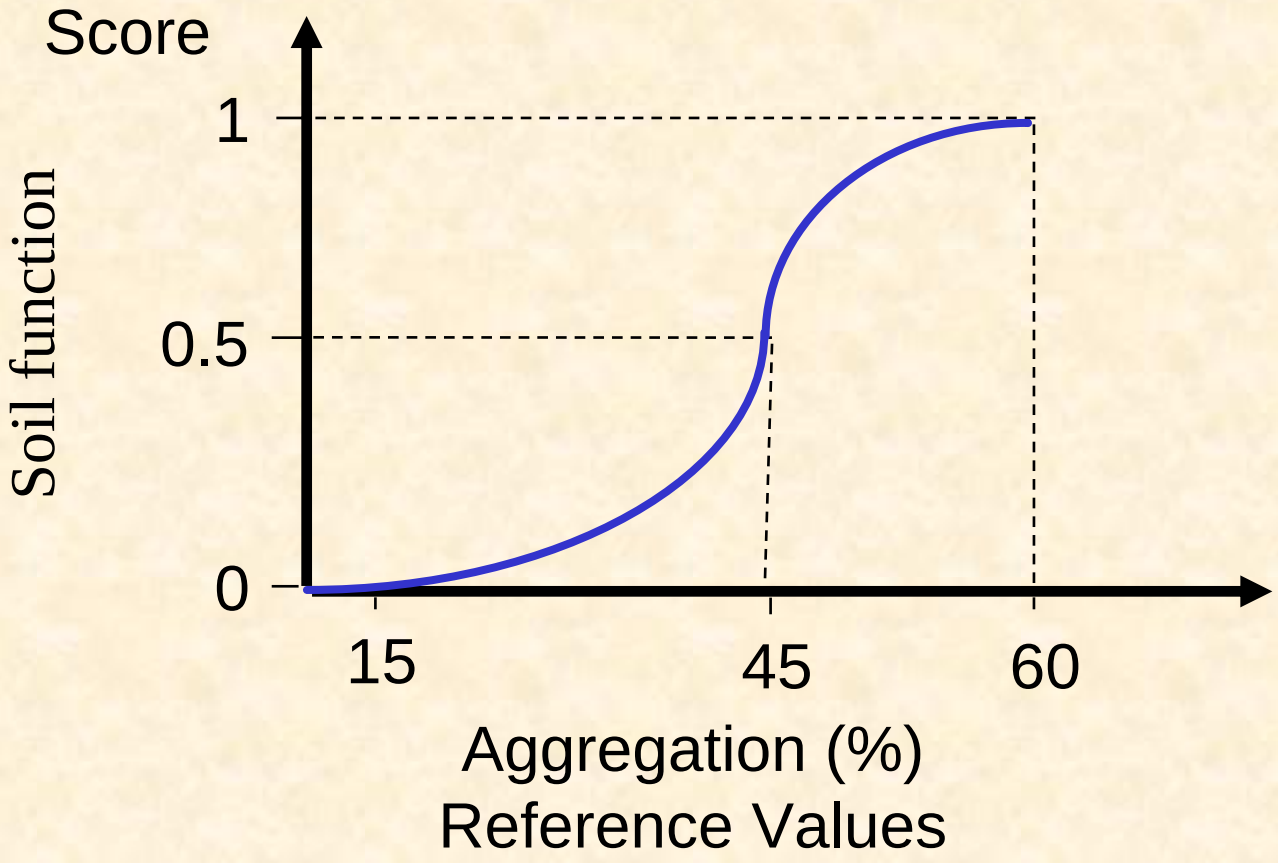
Use and Management Groups

- degree & intensity of soil disturbance
- crop rotation and vegetation diversity
- biomass production
- fertilization, amendments
- time
- soil resilience
- climate

Database Options

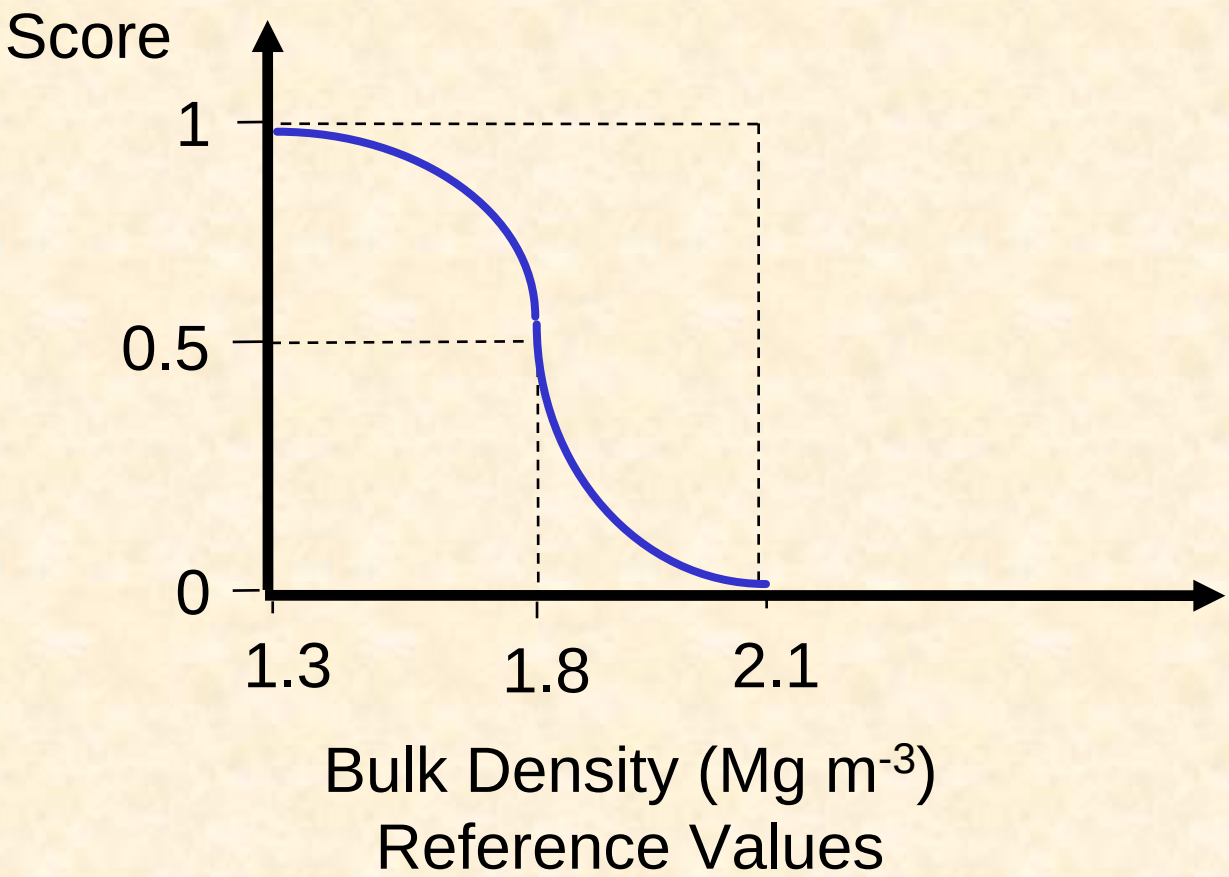
- Use-dependant database, separate from NASIS
  - linked through the map unit component
- Incorporate use-dependant data into NASIS
  - measured or estimated
- Incorporate use-dependant information into NASIS
  - no data is entered
  - scoring functions (equations) are entered

Scoring Function



(Karlen et al., 1994)

Scoring Function



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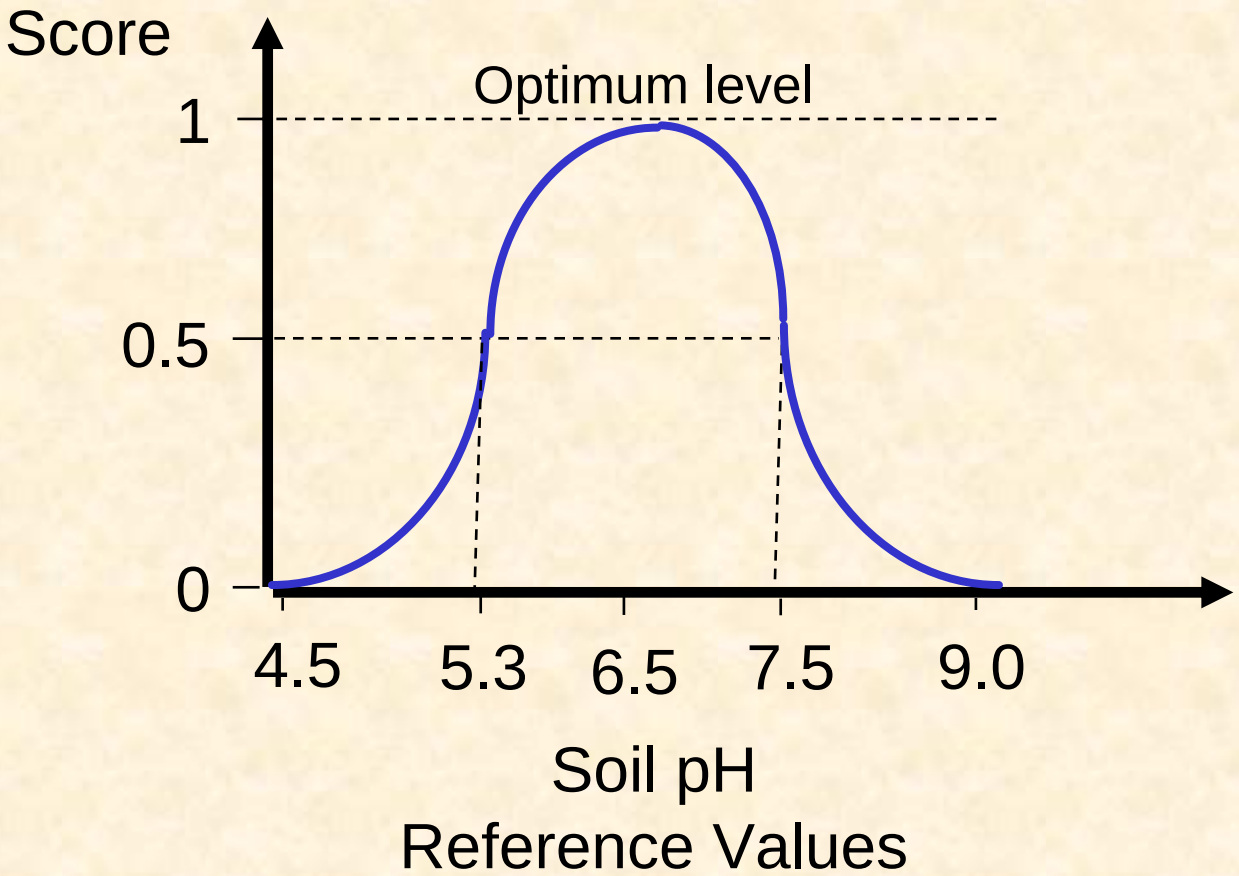
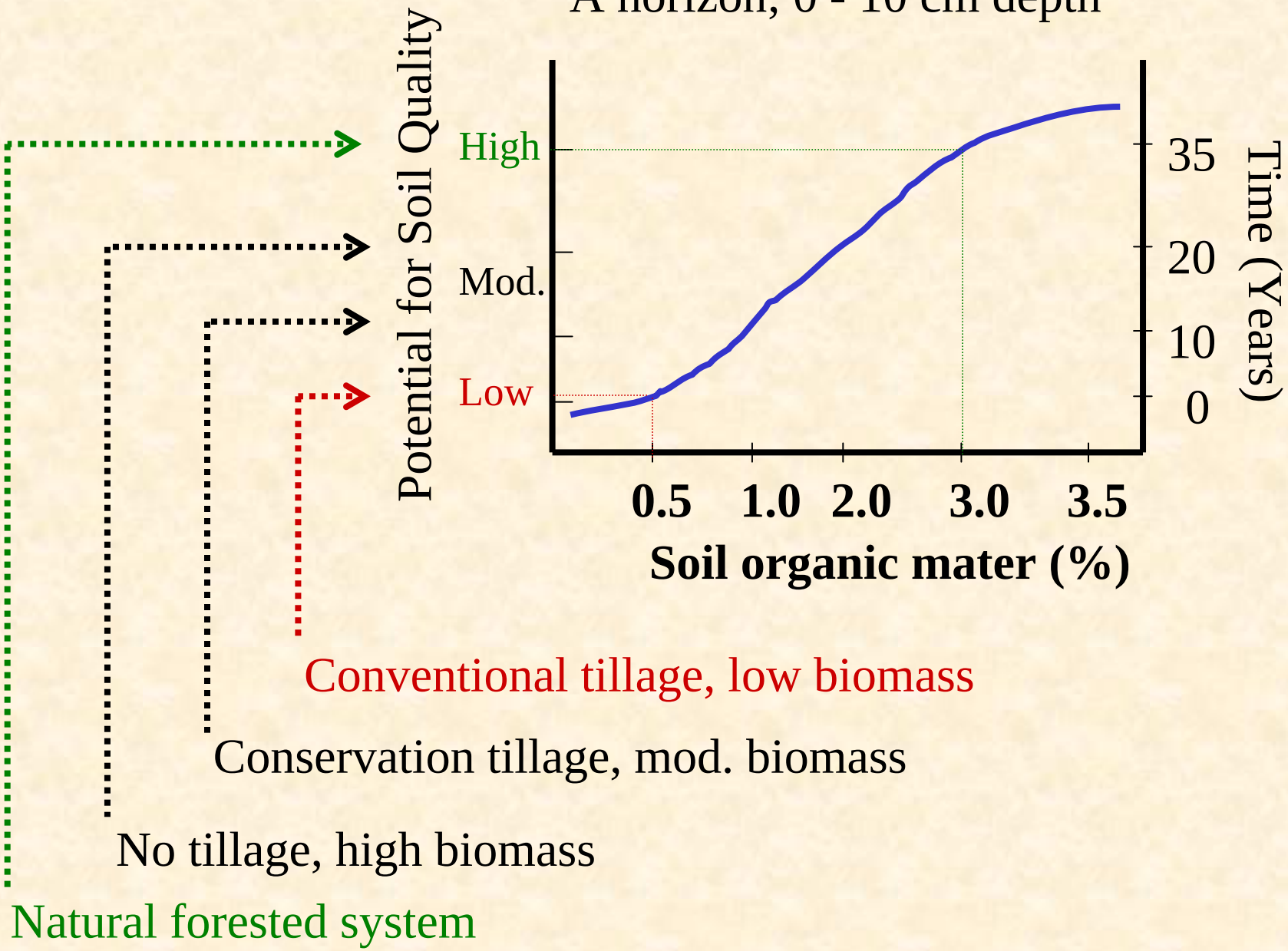
Scoring Function



(Karlen et al., 1994)

Scoring Function for
A horizon; 0 - 10 cm depth



Validations and Calculations

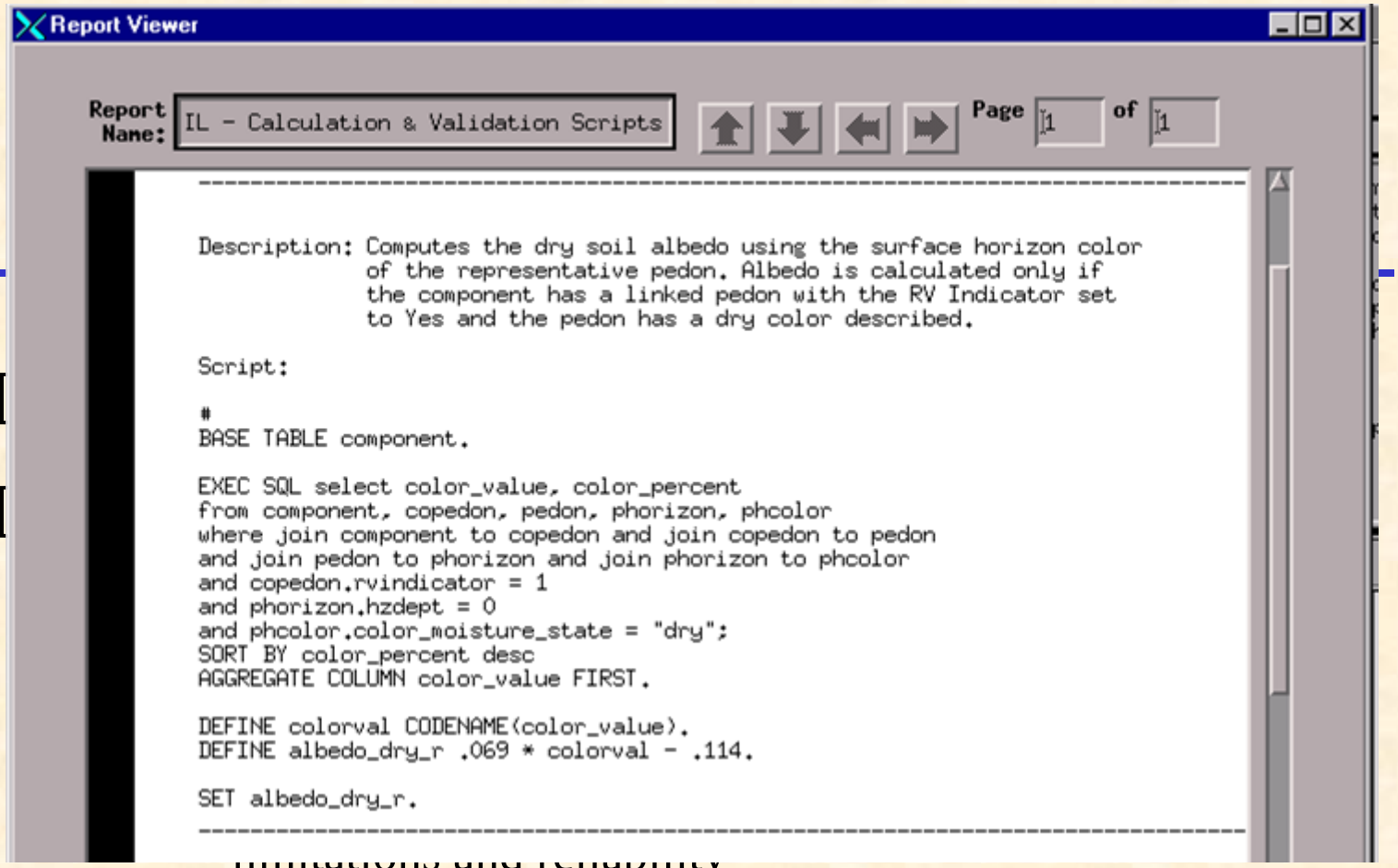
For NASIS

Validation/Calculation Committee

- Purpose:
  - Evaluate and recommend validations and calculations for NASIS
- Members:
  - Cathy Seybold (Chair), Ricky Bigler, Bob Grossman, Joyce Scheyer, Tom Reinsch, Curtis Talbot, Jim Fortner, Karl Hipple

Calculations & Validations

- 41 calculations and validations
  - Algorithms (pedotransfer functions)
- Recent releases
  - Atterberg limits
  - Particle size estimator - version 2
  - Correct case for component name and map unit name



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limitations and reliability

- Program script in NASIS
- Contact NSSC

Calculations - In Progress

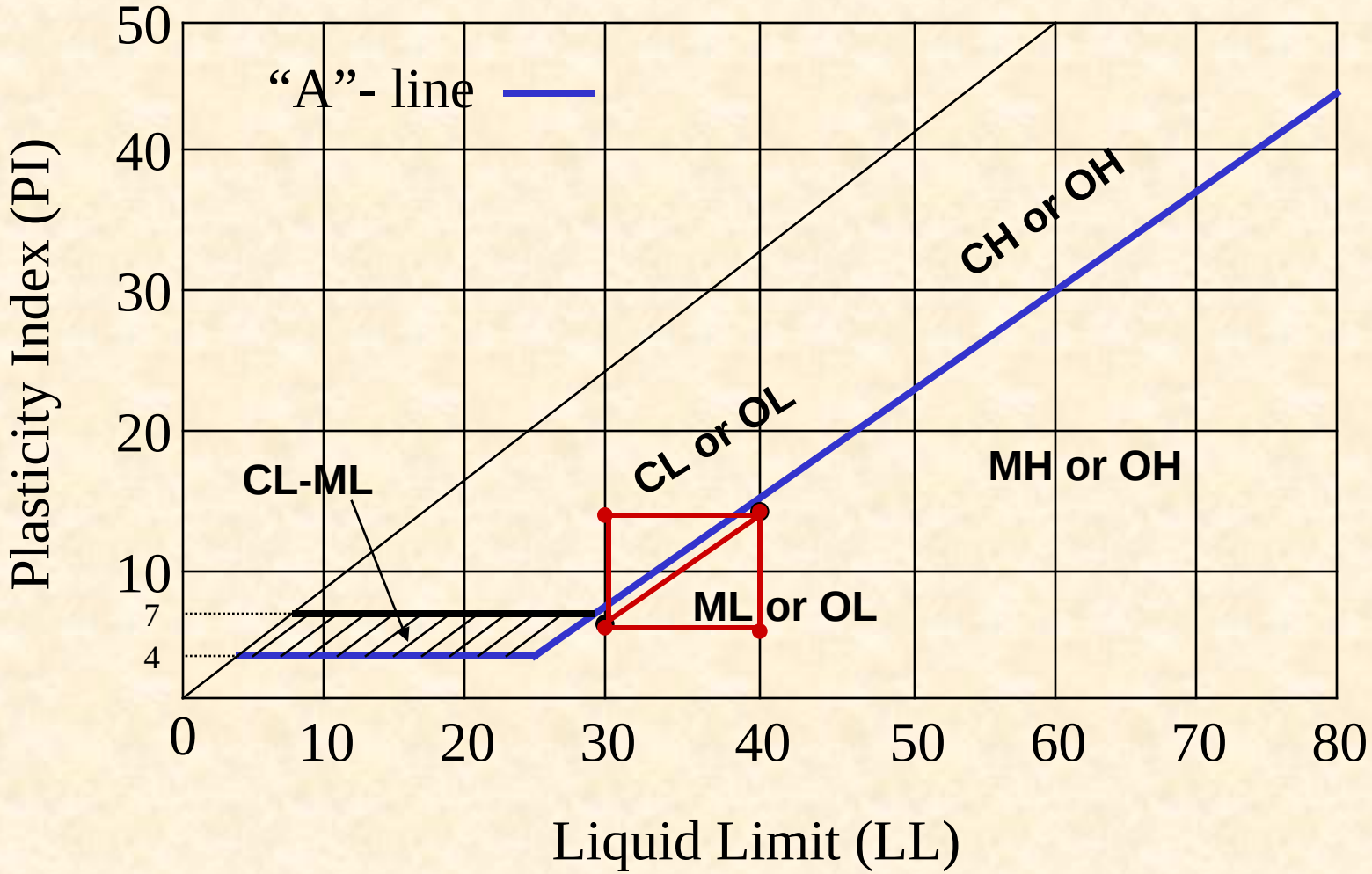
- Unified and Aashto
- Percent Passing Sieves
- Atterberg Limits - Enhancements
  - Spodisols and Andisols
- CEC
- ECEC
- Bulk density

Validations

- In Progress
  - Bulk density
  - CEC and ECEC
- Current validations
  - Particle size class vs. particle size separates
    - enhancements
  - Unified

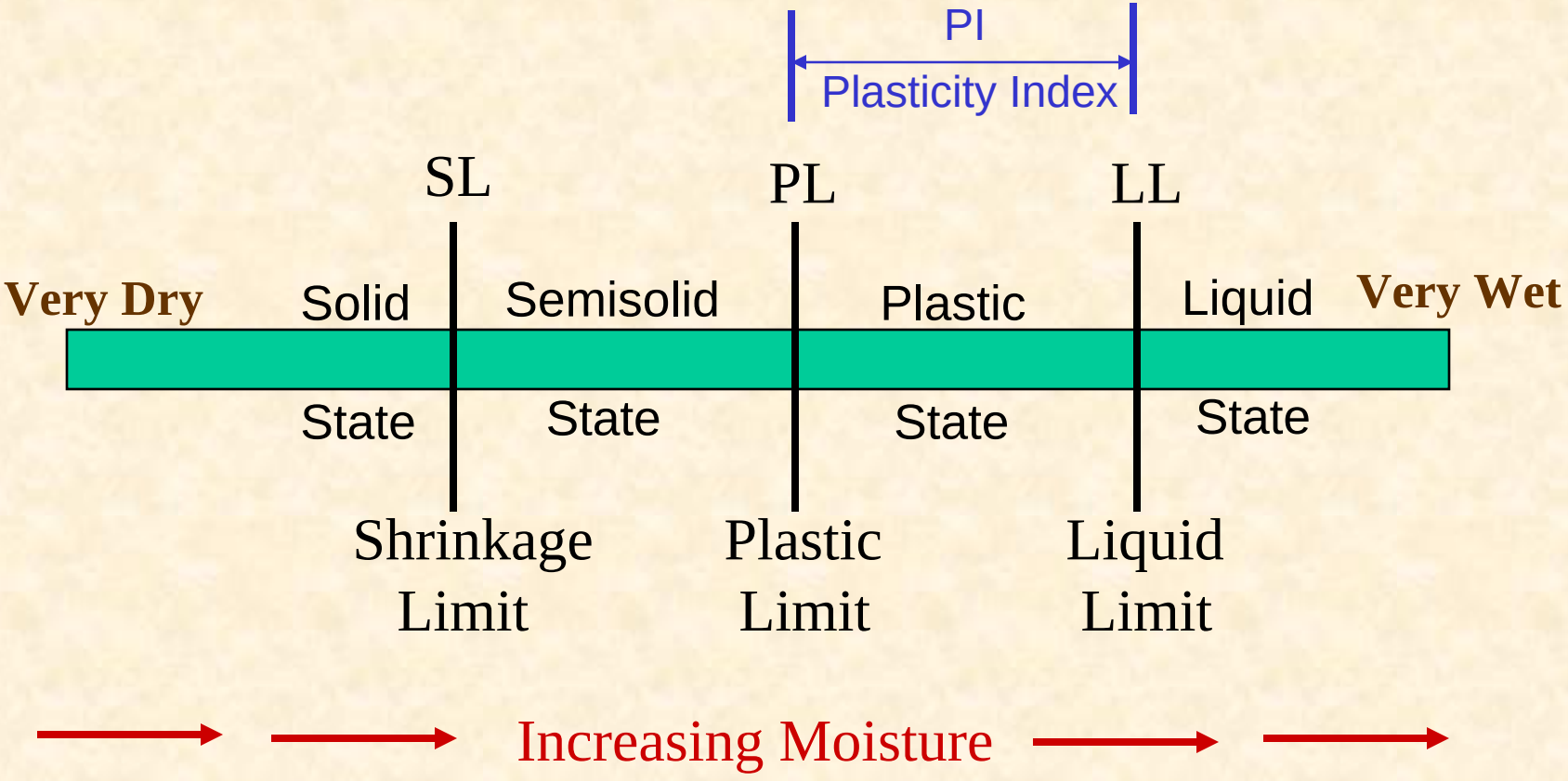
LL low: 30 high: 40
PI low: 6 high: 14

Plasticity Chart



(ASTM D 2487 - 92)

Atterberg Limits



(PCA, 1992)

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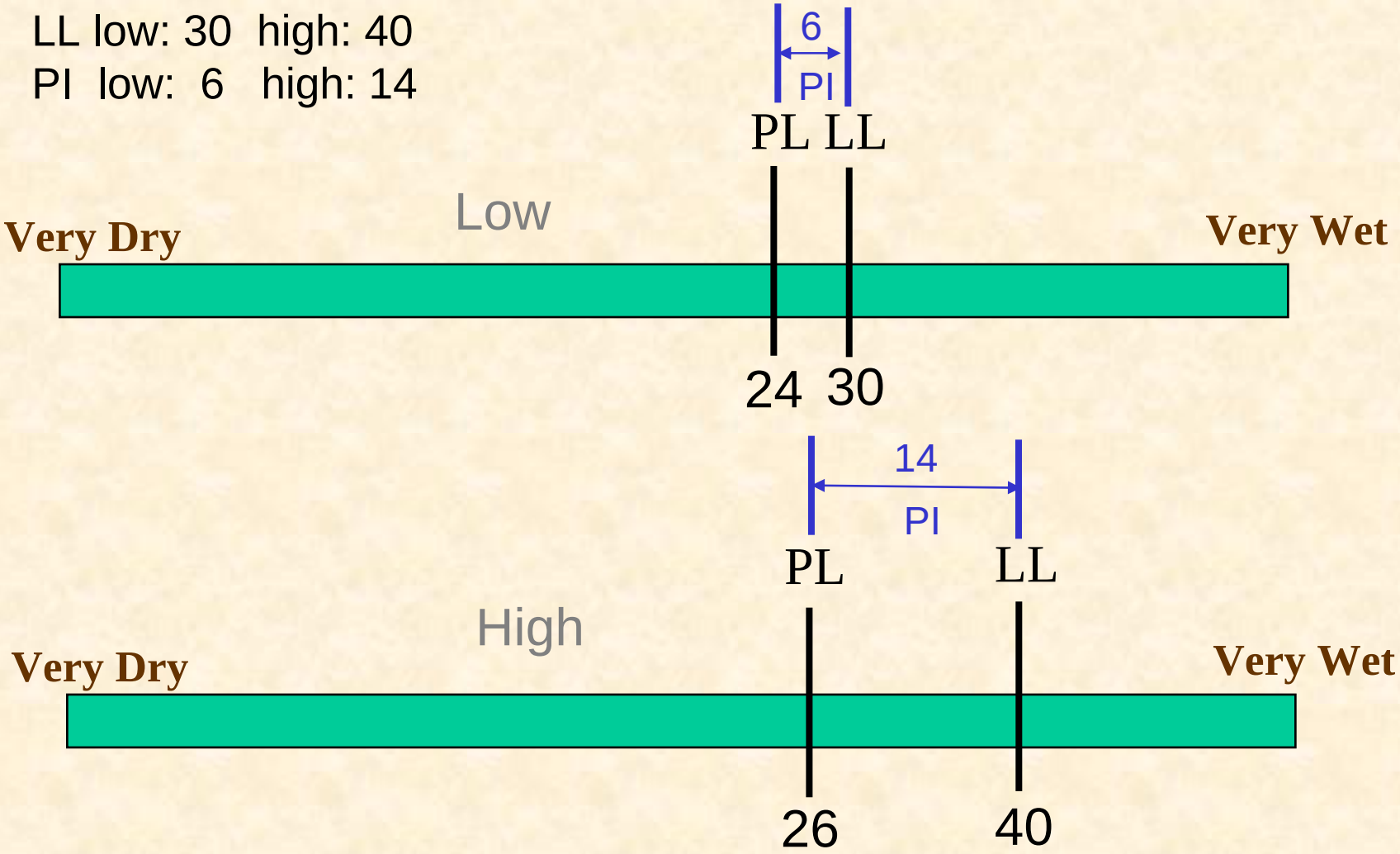

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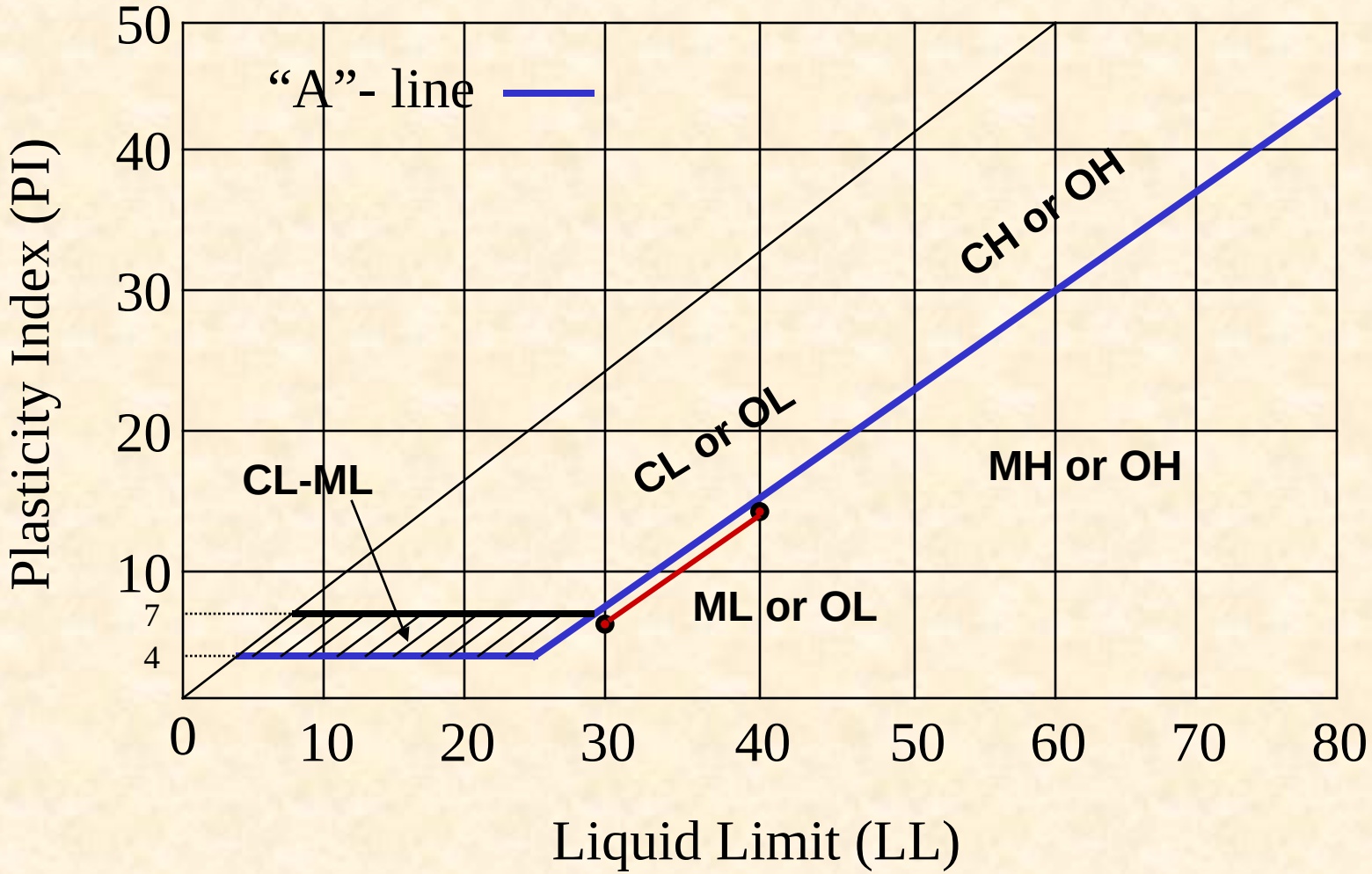
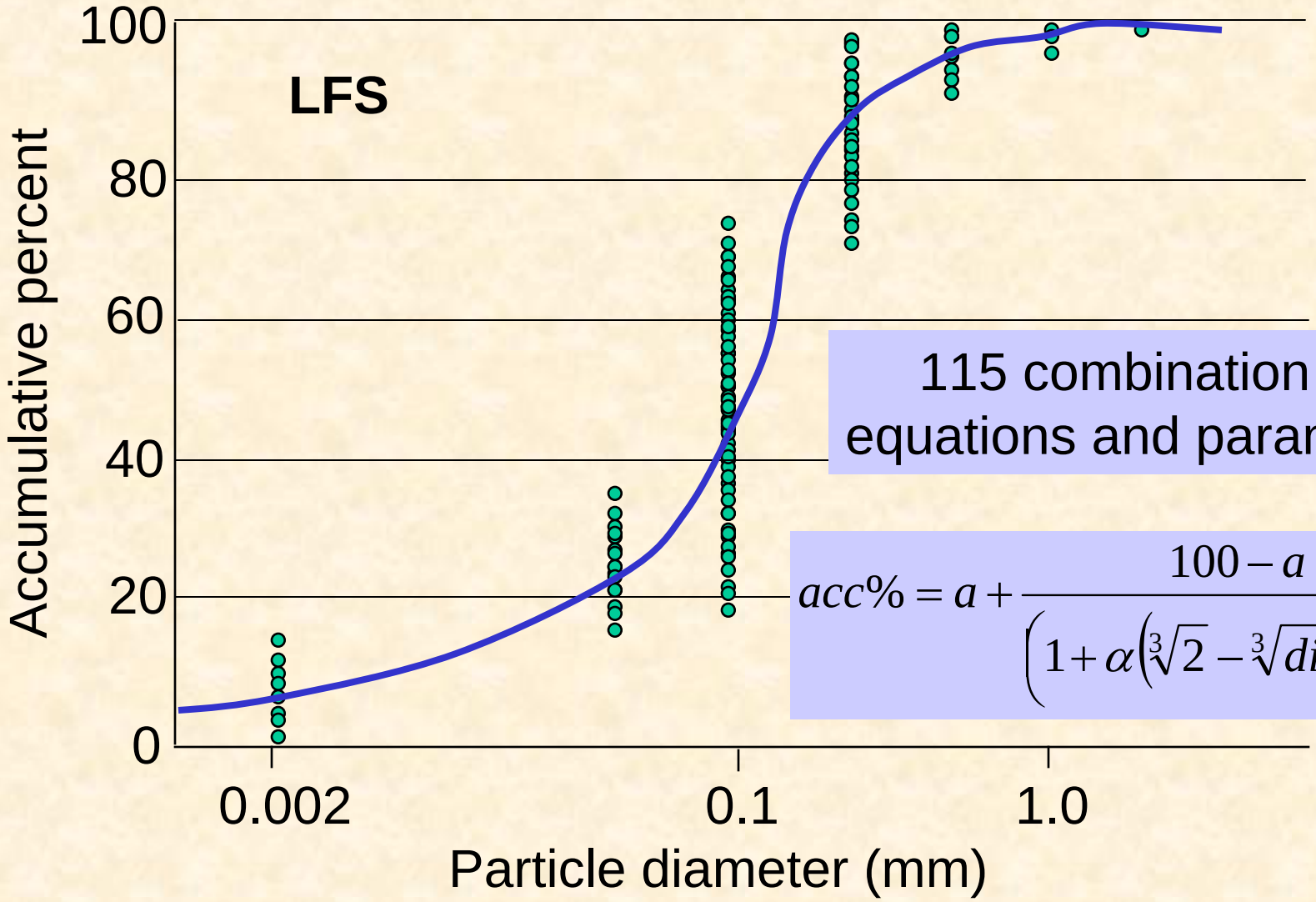


(ASTM D 2487 - 92)

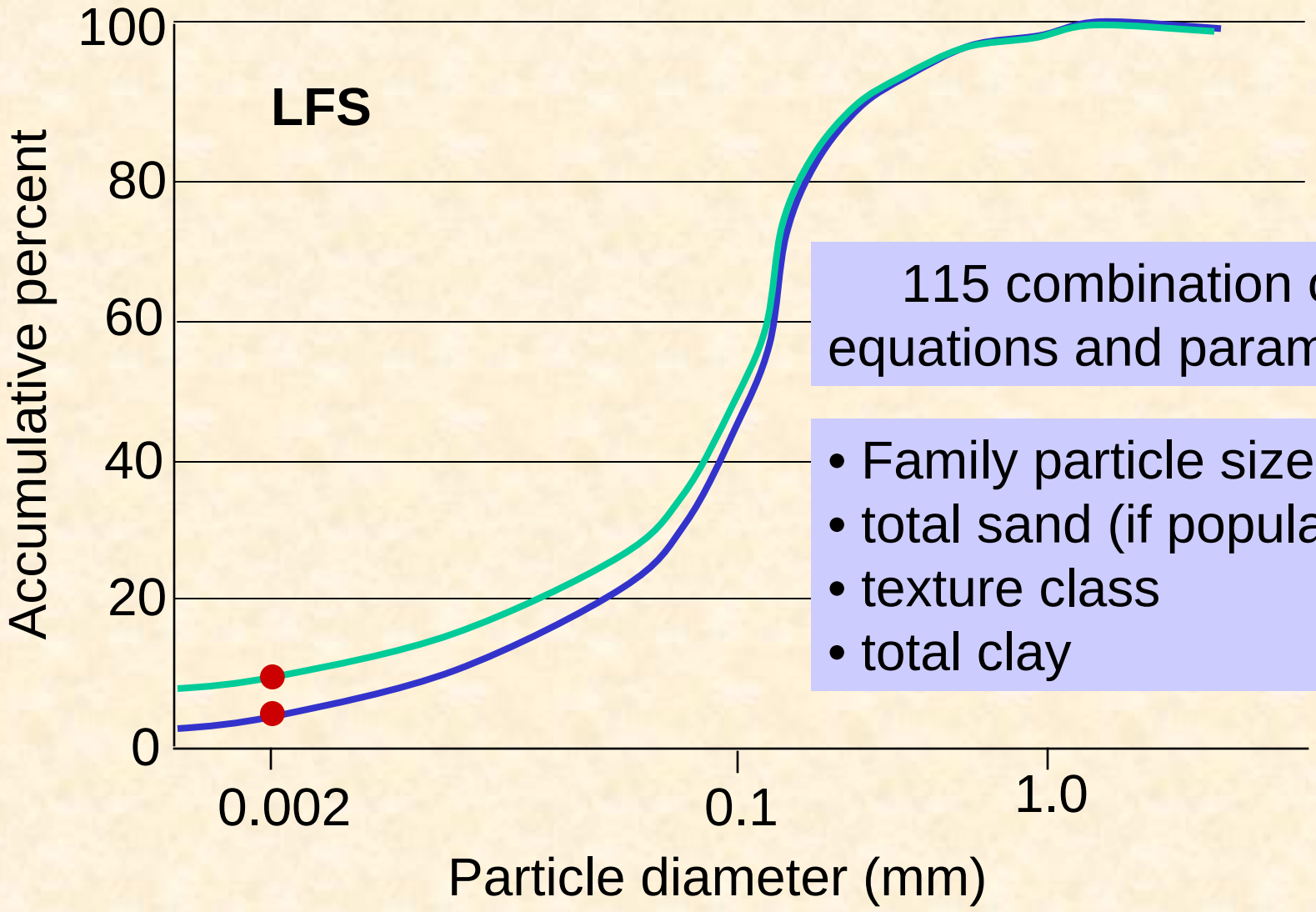
Particle Size Estimator

- Input parameters
  - % clay
  - texture class
  - Family particle size
  - % sand (if available)
- Estimates
  - vcos, cos, ms, fs, vfs, total sand, total silt



115 combination of equations and parameters

$$acc\% = a + \frac{100 - a}{\left(1 + \alpha\left(\sqrt[3]{2} - \sqrt[3]{diam}\right)^{n}\right)^{l}}$$



115 combination of equations and parameters

- Family particle size class
- total sand (if populated)
- texture class
- total clay

Particle Size Estimator

- Tested on 145,435 particle-size distributions
  - less than 0.001% failure rate
- Estimated values do not represent the range of values possible for a particle size class.
- Provides an estimate around a central tendency for a particle size class.
- Is not reliable to estimate the particle separates for a given sample.