Irrigation Water Runoff And Potential Soil Erosion

Jerry Grigar
USDA NRCS MI

United States Department of Agriculture
NRCS Natural Resources Conservation Service

Management for Irrigation Induced Erosion Reduction

Goal for sprinkler irrigation: 100% Erosion Control and Runoff Prevention

Center Pivot Design 442

LEPA - Low Energy Pivot Application

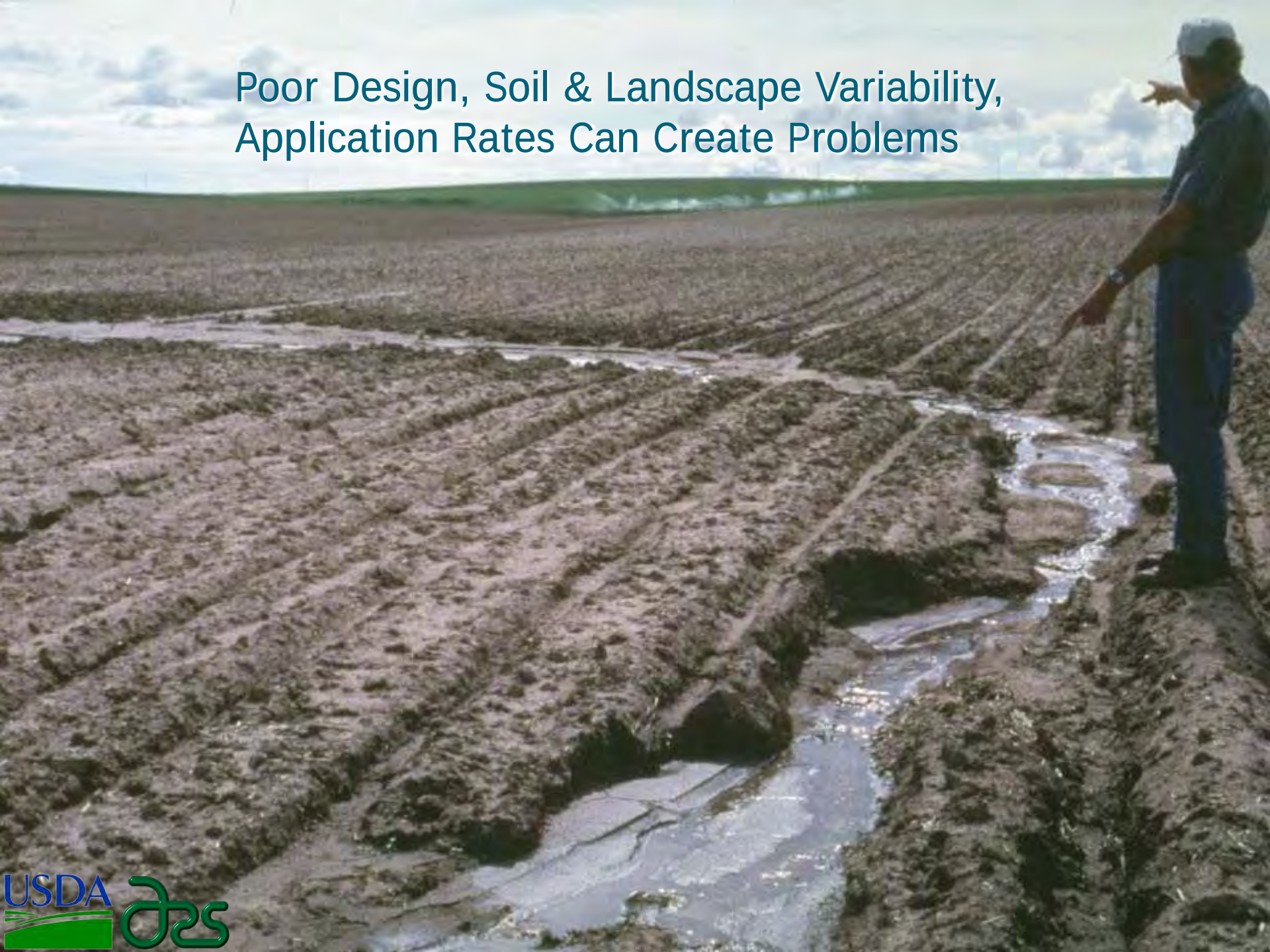
LESA – Low Elevation Spray Application or Lateral Move

MESA- Mid-Elevation Spray Application or Linear Move

LPIC- Low Pressure in Canopy or Linear Move

- Goal: Increased Efficiency reduce runoff

Poor Design, Soil & Landscape Variability, Application Rates Can Create Problems

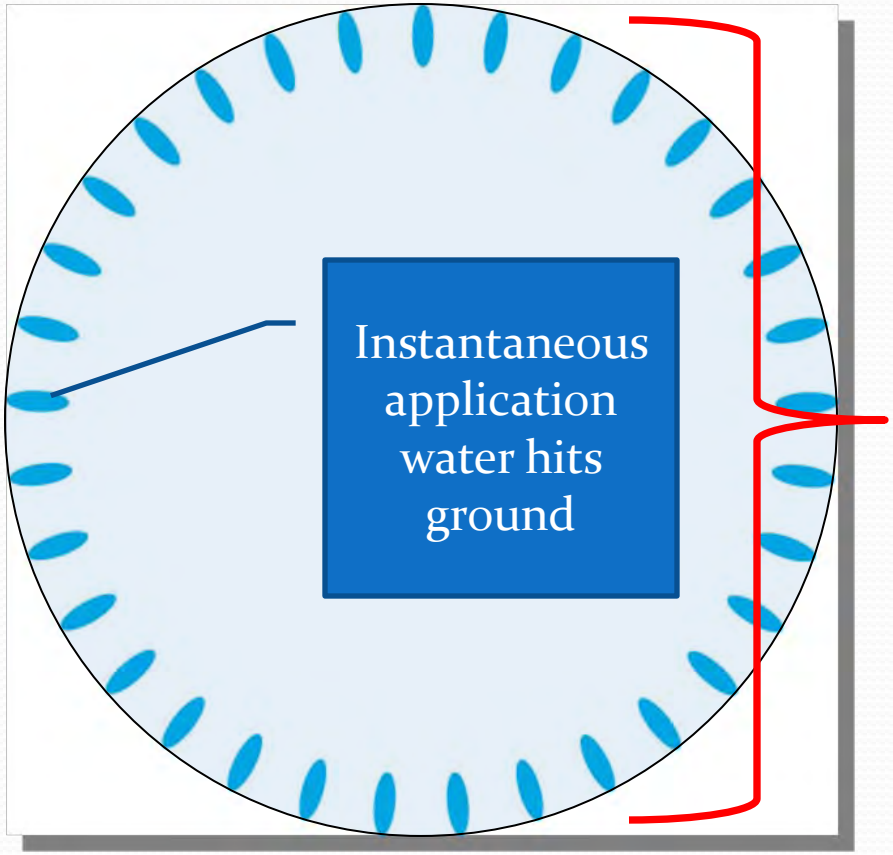


Application vs. Infiltration = Runoff ?

- There is *potential* for runoff when Application Rate exceeds the Soil Infiltration Rate.
- Runoff will occur if "surface storage" cannot temporarily hold the water not being infiltrated.
- Instantaneous Application Rates differ from Average Application Rates

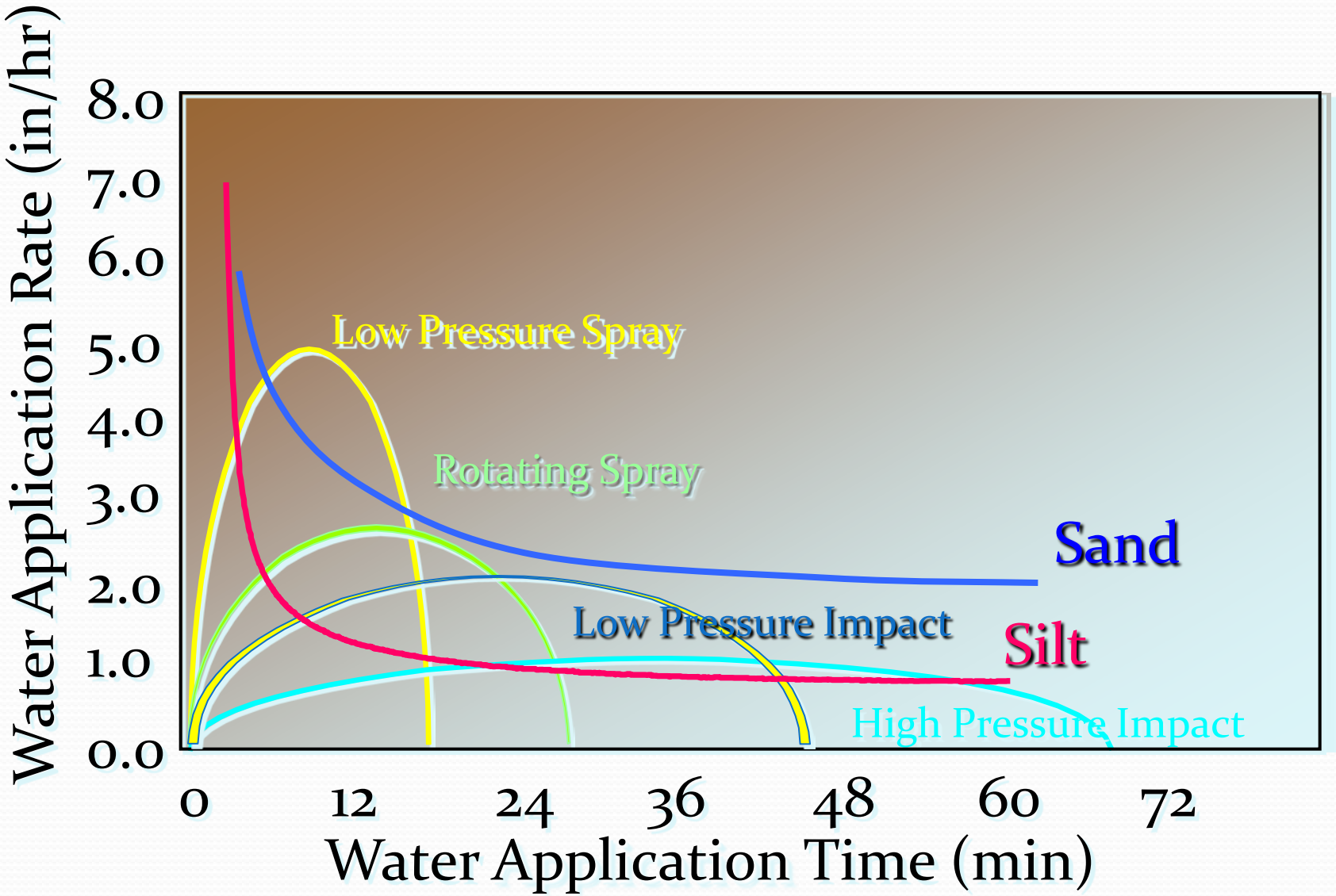
442 Std	LEPA	LESA	LESA -LM	MESA LPIC< 7 ft.	MESA >7 ft.
CU	>94%	>94%	>94%	>90%	85%
Nozzle Spacing	Not greater	than 2x	row width or 80 in.	2 foot in canopy	10 foot + or-
Discharge Height Alternate rows	Drop hose or bubbler @ 18 inches	Drop hose or bubbler @ 18 inches	Drop hose or bubbler @ 18 inches	< 7 ft do not use in 4 ft corn	> 7 ft
Row planting	Furrow /bed	All types	All types	Best to use Above corn canopy	All types
Row Orientation	Circle	Up & down	Up & down	Up & down	Up & down
Maximum slope / area	1% or less on 50%	3% or less on 50%	3% or less on 50%	3% or less on 50% Fine texture	5% or less on 50% Coarse
Runoff Control	FD or DD	FD or CRM	DD or CRM		

Instantaneous Application Serrated Plate Example

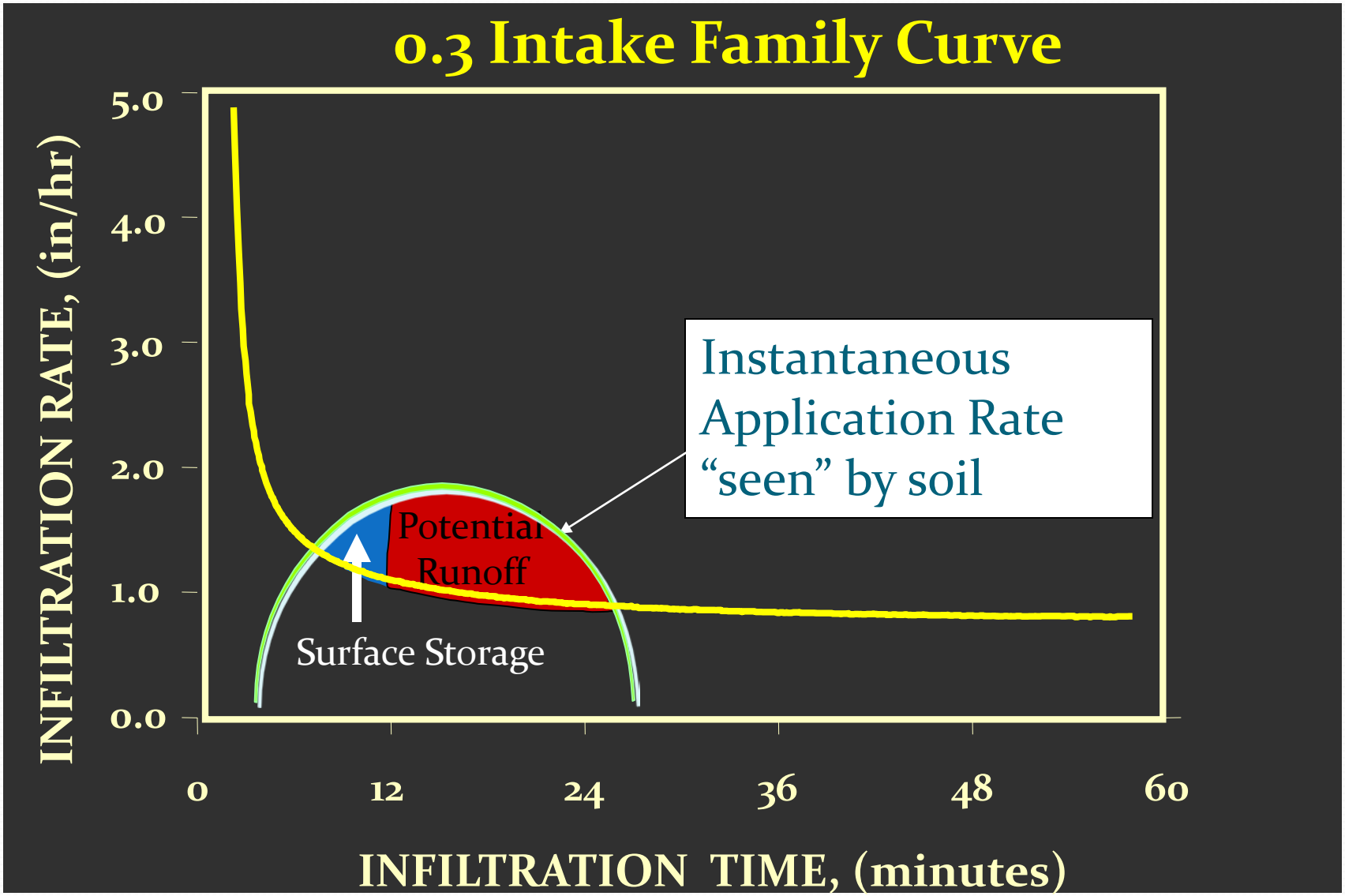


- Average application rate

Infiltration vs. Application Rates



Runoff Potential



Reducing Irrigation Runoff

NEBRASKA CENTER PIVOT- CASE STUDY

Baseline Data – High Pressure Impact Sprinkler

- 3-5% slope
- 800 GPM
- ¼ mile length
- 40 foot WD
- 1 ac in application /ac
- 26% runoff

Reducing Irrigation Runoff

- Soil Intake Family (soil texture)

Soil Intake Family	.1	.5	1.0	Baseline 0.3
Runoff	44%	11%	0%	26%

Reducing Irrigation Runoff

- Slope

Percent Slope	0-1%	1-3%	>5%	3-5% Baseline
Runoff	none	8%	35%	26%

Reducing Irrigation Runoff

- System Capacity

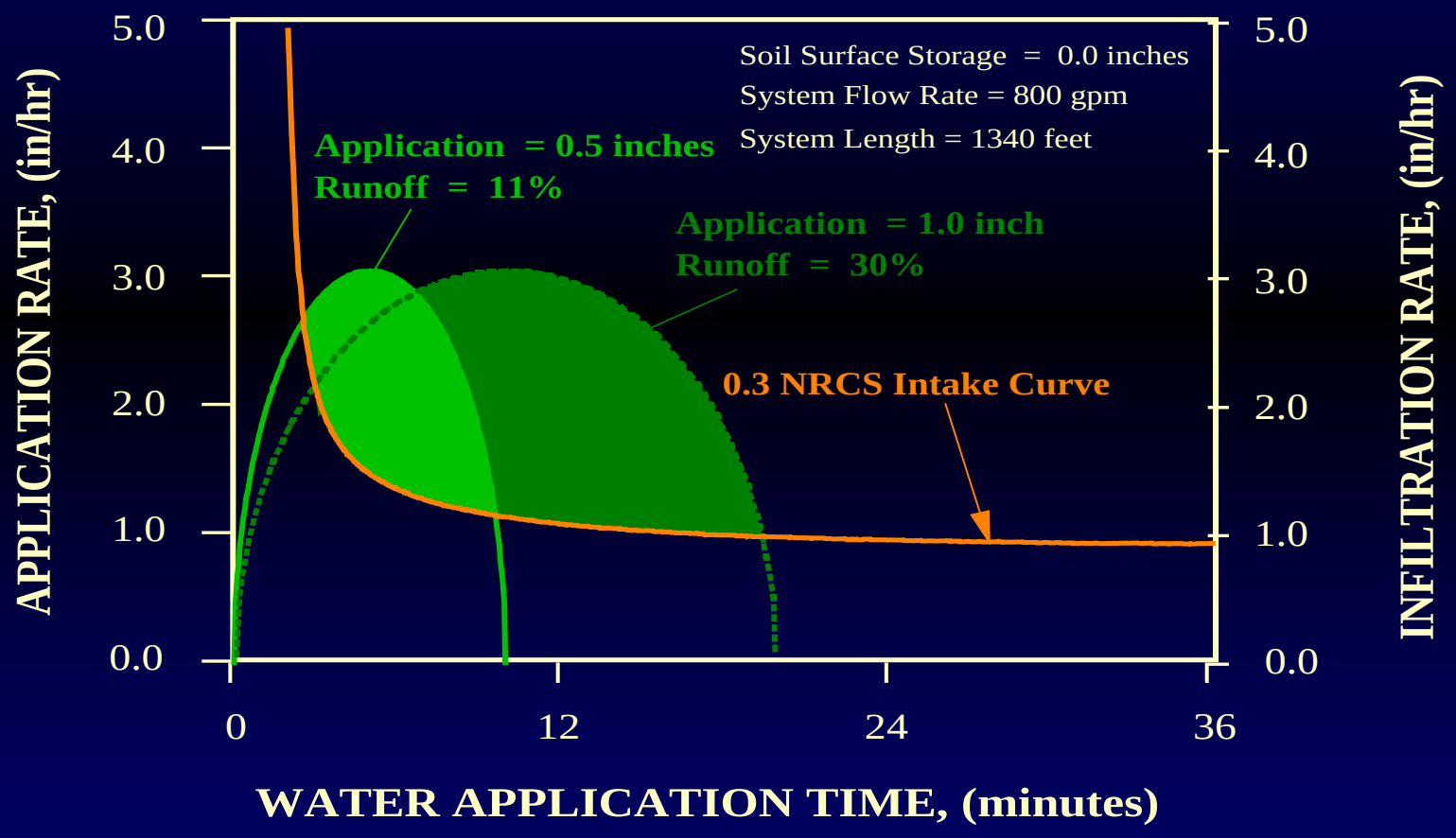
GPM	500	700	900
runoff	14%	22%	29%

Reducing Irrigation Runoff

- Application Amount (depth)

Ac-In	0.5	0.75	1.25
Runoff	3%	16%	33%

Water Application Depth Increases Runo



United States Department of Agriculture

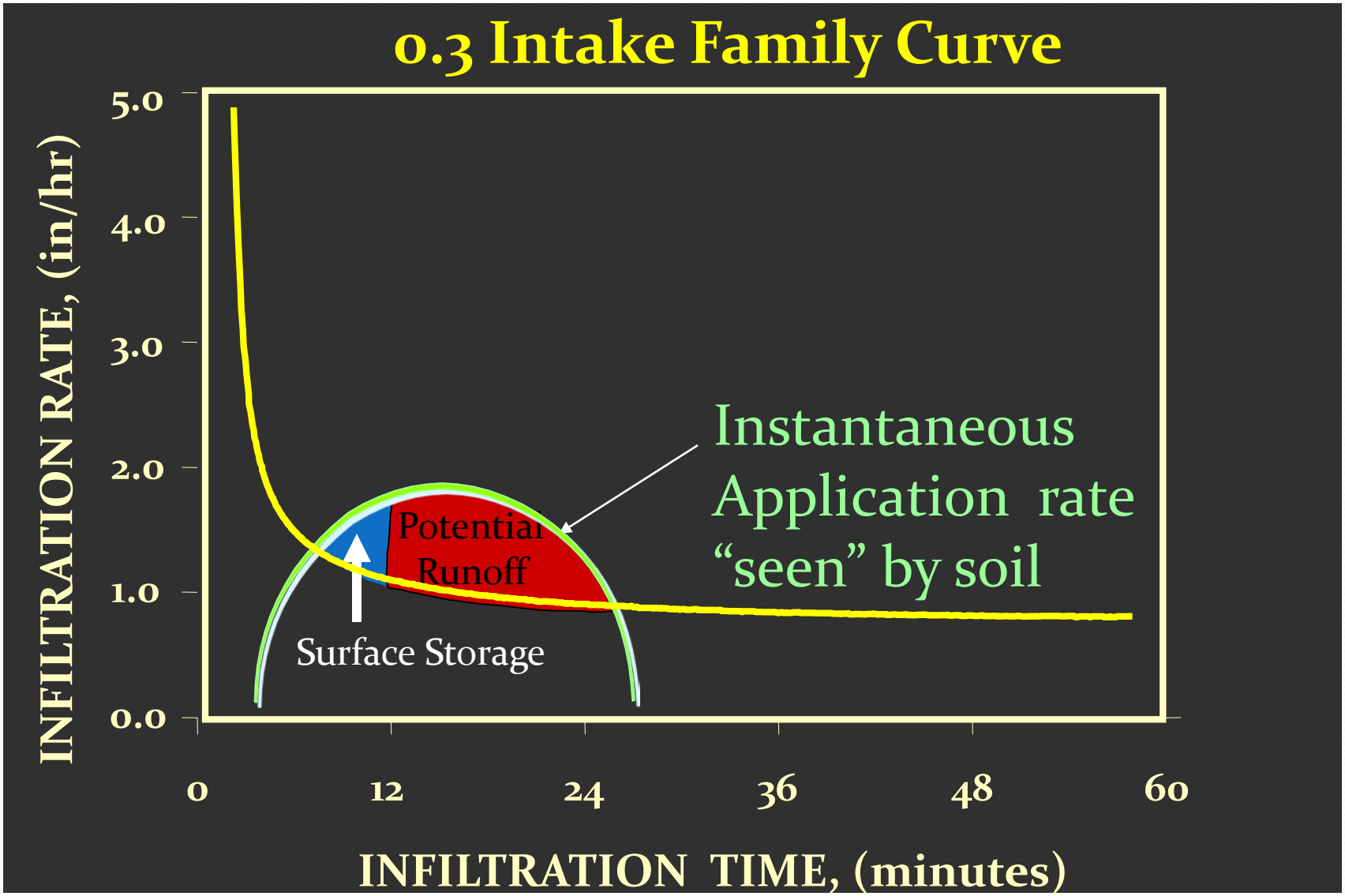
NRCS Natural Resources Conservation Service

What can we do to minimize/eliminate runoff?

Reduce Total Application per Irrigation

- Less Total Application takes advantage of initially high, then decreasing, infiltration rates
- Be careful!

Runoff Potential



Reducing Irrigation Runoff

- Wetted Diameter

Wetter Diameter (ft)	30	60	90
Runoff	48%	15%	8%

Reducing Irrigation Runoff

- Application Depth 0.75 in &
- Increased Wetted Diameter

Wetted Diameter (ft.)	60	80
Runoff	7%	2%

What can we do to eliminate/minimize runoff?

Reduce Application Rates

Choose application devices with lower average application rate

- Droplet size and effect
- Pressure & energy cost

Utilize Booms

- Zig-zag offsets
- Splitters
- Mega-booms (structural issues to consider)

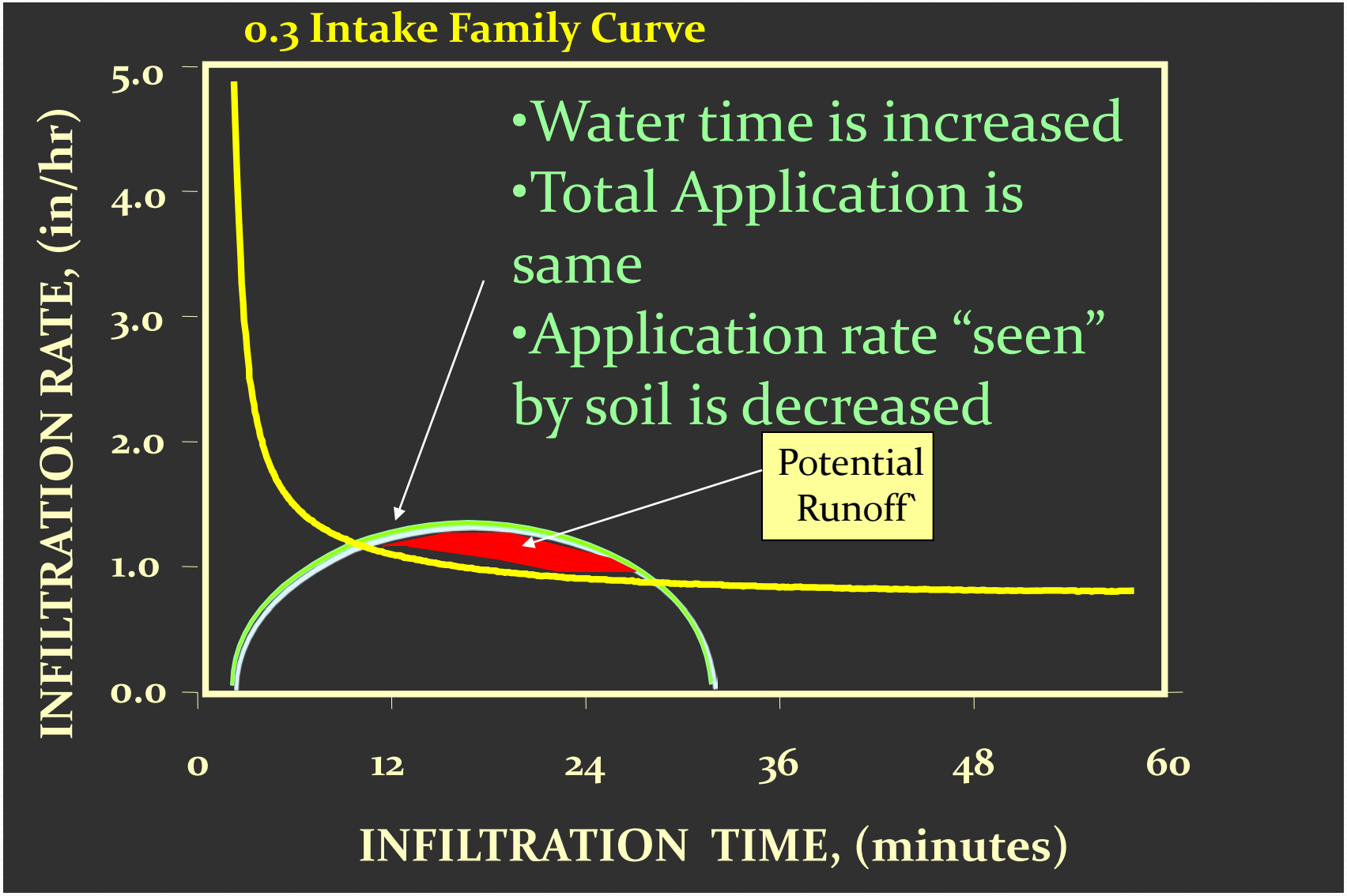
United States Department of Agriculture

NRCS Natural Resources Conservation Service

Reduce Application Rates: Booms

NELSON IRRIGATION CORPORATION

Reducing Application Rate



United States Department of Agriculture

NRCS Natural Resources Conservation Service

How to eliminate/ minimize irrigation induced erosion & runoff?

Increase & Maintain Infiltration Rates

- Apply small droplets at reduced rates
- Use crop residue management
- Deep till
- Furrow Dike
- Adopt low pressure technology

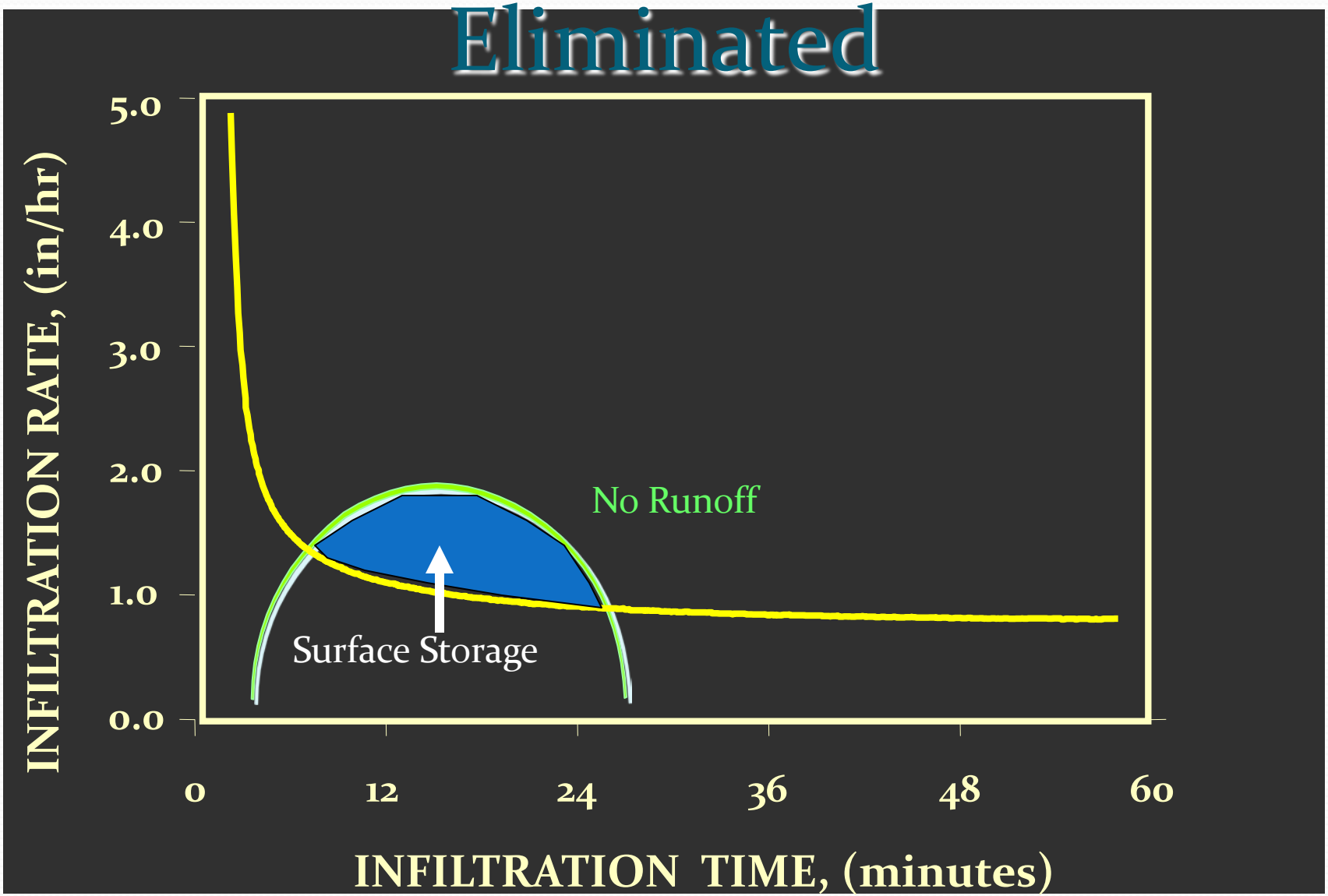
United States Department of Agriculture
NRCS Natural Resources Conservation Service

What can we do to minimize/eliminate runoff?

Increase Surface Storage

- Increase crop residue - dam it up
- Furrow Dikes
  - most effective on flat fields
    (0-2%, ¾; 2-5%, ½"; >5%,1/4")
  - Erode over time
- Use sprinkler packages that minimize surface sealing

GOAL: Runoff Potential Eliminated



Avoid a Wreck! Choose & Manage Wisely