Low Cost Surface Irrigation Improvements

Improvements through Management

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Introduction to Surface Irrigation

- Sloped
- Modified Slope - Level End
- Dead Level

Irrigation in Arizona

- Cortaro Marana Irrigation District – Pima County

- Maricopa Stanfield Irrigation District
- Central Arizona Irrigation District

Concerns About Future Impacts to CAP Water Supplies for the Districts

- Yuma and Welton Mohawk Irrigation Districts

No New Irrigated Land in Arizona

- No funding or water for farmers to develop new land
  - Except Native Americans
- Need to make existing farmland more water efficient
  - Land leveling
  - Sprinkler and Drip irrigation
  - Management strategies

Goal of Irrigation

Apply the right amount of water as uniformly as possible to meet the crop water needs: fill the root zone; minimize runoff and deep percolation

Some Considerations

- Crop Water Use
- Soil class – water holding capacity, infiltration rate (sand, loam, clay)
- Depth of soil also relates to drainage of soil
- Soil salinity
  - Identifies limiting factors for infiltration
  - Result in increased water requirement for leaching

What Can I do as an Extension Agent

- Help Farmer review what he has:
  - Head of water (gpm)
  - Reliability of water
    - yes, everyday, OK for Drip and Sprinkler
    - No, must do surface
  - Field layout
    - Even rectangle fields
    - Uneven fields with multiple soils
  - Tools
    - NRCS Soil Survey
    - Goggle Earth – size, shape, location (wash, water source)

NRCS Web Soil Survey

Soil Survey | NRCS - NRCS Soils
soils.usda.gov/**survey** ▾ United States Department of Agriculture ▾
Lists **soil surveys**, survey programs, **soil survey** technology, standards, data and references.
Soil Surveys by State - Soil Classification - Soil Geography - Soil Taxonomy

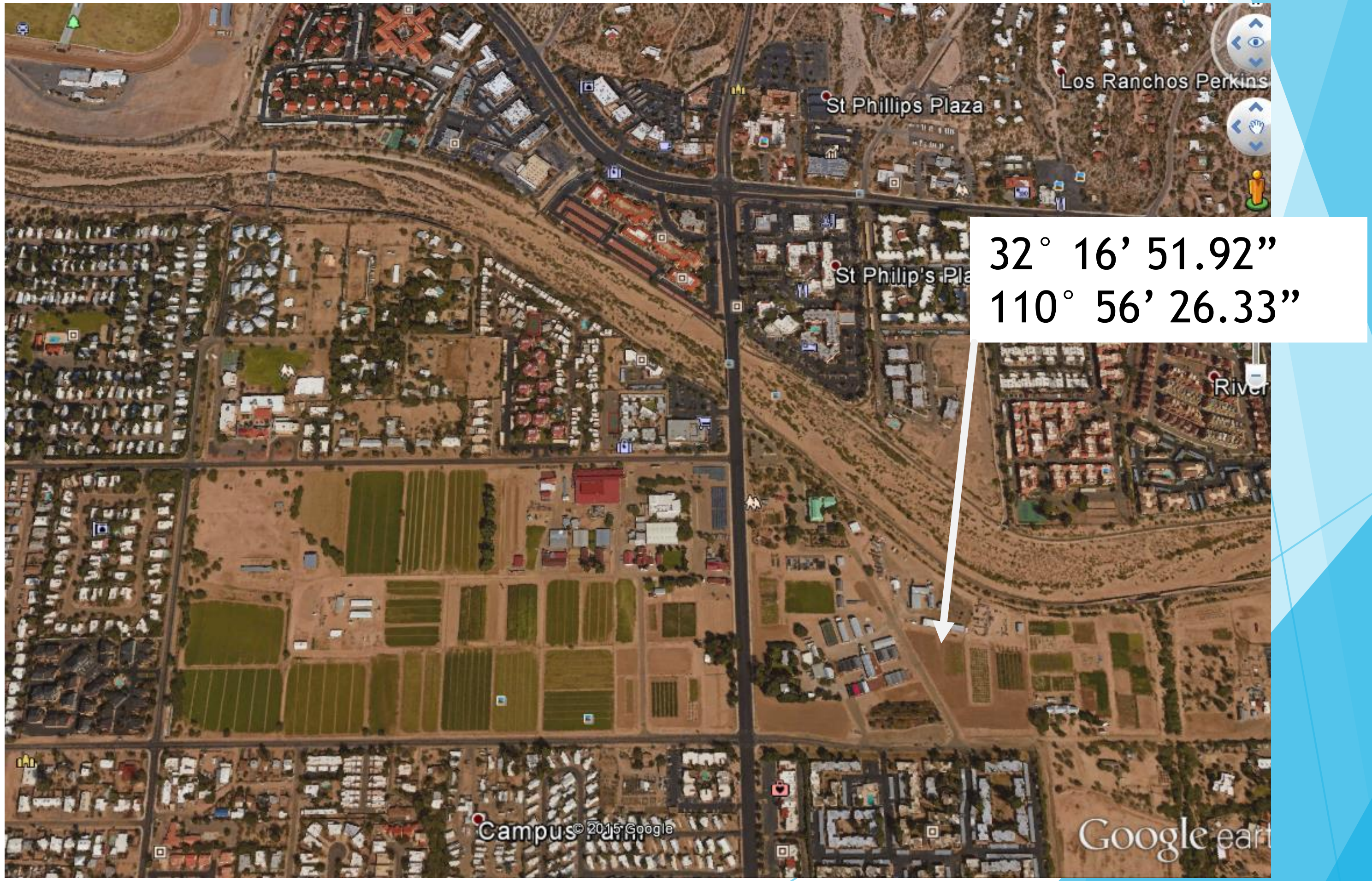
- NRCS Soils Reports
- By state – then region

Google Earth

Pull up area and measure row lengths and use elevation data to calculate slope
NOTE – this is not very accurate, but is a good starting point

Google Earth

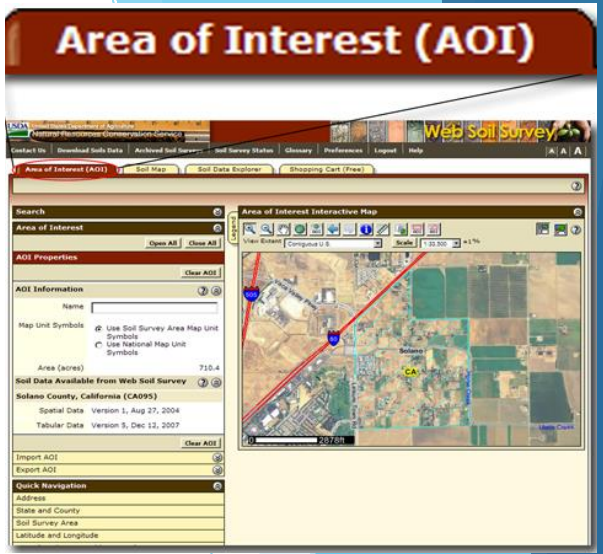
- Great Tool
- Latitude/Longitude
- Elevations
- Distances
- Site conditions
- Historic overview



NRCS Soil Survey

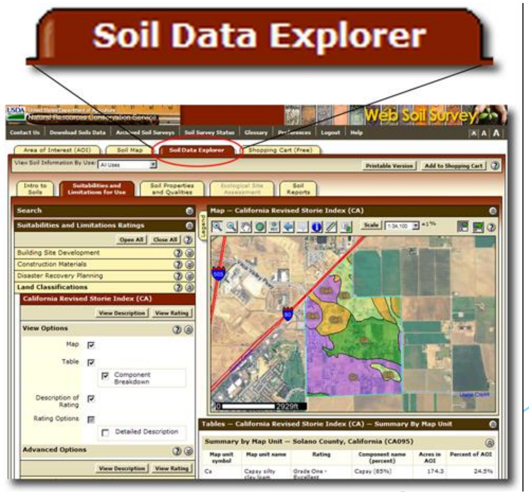
- 4 steps
  1. Area of interest (map driven by region)
  2. Soil Map – Click on the soil map tab to view a soil map
  3. Click the Soil Data Explorer tab to access soil data
  4. Use Shopping Cart tab to customize and print any reports
  - Plenty of training videos just search for NRCS soil survey in YouTube

Step 1



Step 2

Step 3



Step 4

Surface Irrigation – Dead Level

- 0.2% slope along furrow to keep water moving
- 0.0% side slope
- Very efficient because no runoff
- Short fields, typically 660 ft to 880 ft long
- High flow rate per furrow to get water out to end of field quickly
- Loose productivity for multiple seasons
- Expensive $3,000 to $8,000/ac

Surface Irrigation Design

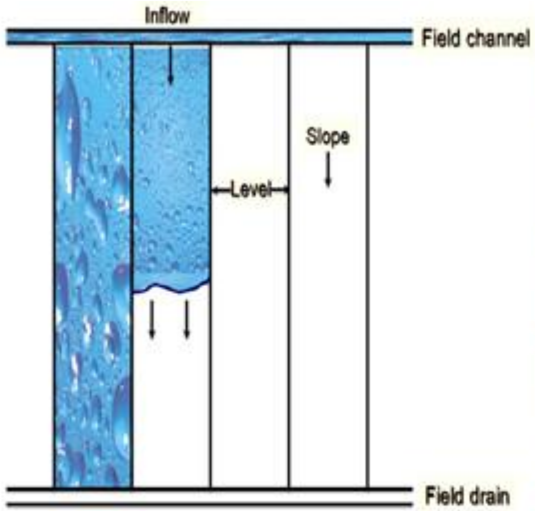
- Irrigation efficiency
  - $Eff = 100 * \frac{F_n}{F_g} = \frac{Crop\ requirement}{Total\ amount\ applied}$
  - Total Amount Applied = crop requirement (fill root zone to desired depth) + Deep Percolated Water + Runoff
  - Deep Percolated = $(F_{o-l} - F_n)$
  - $F_{o-l} = \left[T_1 - \frac{0.0929}{f * \left(\frac{0.305 * \beta}{X}\right)}\right] * \left[(\beta - 1)e^{\beta} + 1\right]$

Dang Engineer’s and their equations, Just tell me what it means

- The faster you can move water down a furrow the more efficient the irrigation will be.
- But
  - Soil erosion
  - Runoff
  - Furrow roughness

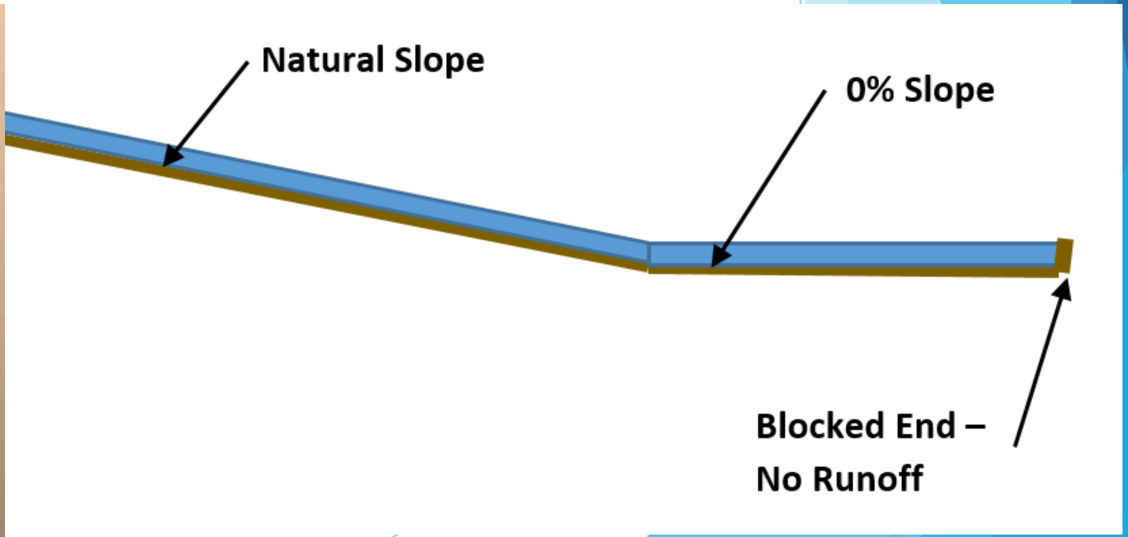
Surface Irrigation

- Most common system in Arizona
- Furrow or notched ditches for individual rows
- Some gated pipe for individual rows
- Boarder irrigation for alfalfa and wheat



Modified Slope

- Natural slope for 66% of field, then level
- Lower land leveling cost
- Do not loose top soil during land leveling process
- Lower flow rate per furrow
- Still high irrigation efficiency



Want to do Leveling

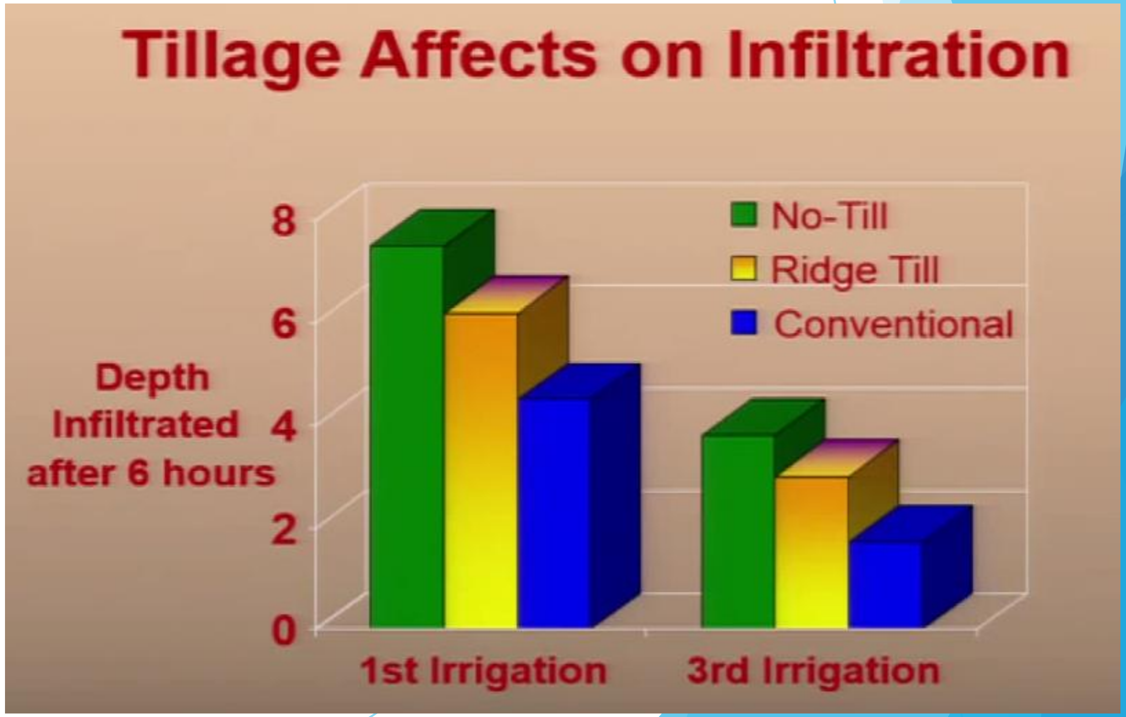
- Contact NRCS
  - EQIP $
  - Survey field
  - Do irrigation design
  - Many no cost services, time to accomplish task depends on how busy they are
- Contact a design firm for faster service
  - Cairo Engineering, Stantec Engineering (Phoenix Office)

Factors That Influence Irrigation

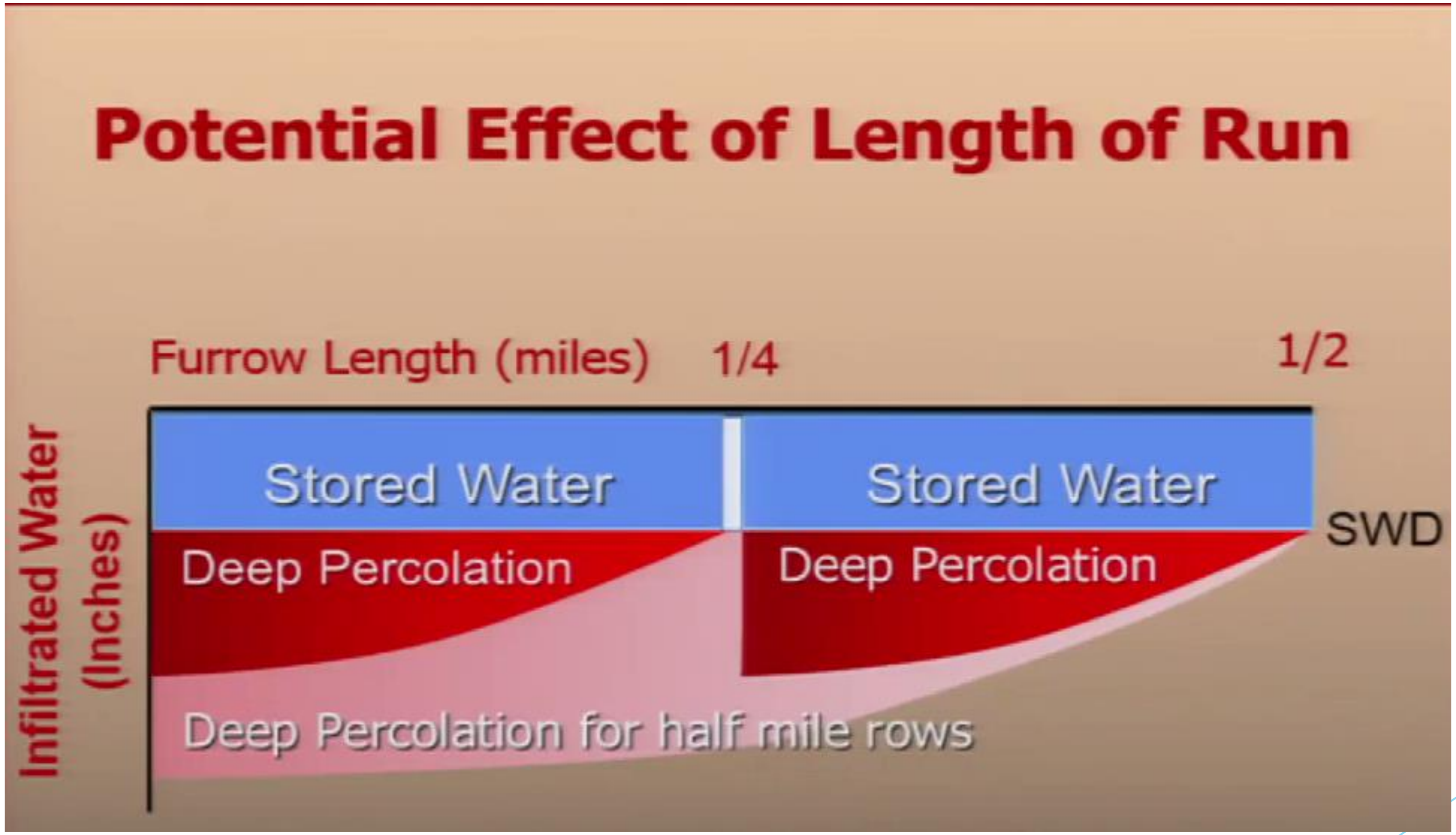
- Advance time – how fast the water runs down the furrow
- Soil texture and roughness
- Furrow slope
    - Consistency, dead level, modified sloped with level end
- Length of furrow
- Tillage

Furrow Roughness

- First irrigation is typically your pre-irrigation. High roughness will cause uneven flow of water down the furrow.
  - Decrease roughness by pulling a “bullet” down furrow
- Even with clean furrow water movement is not exactly even.



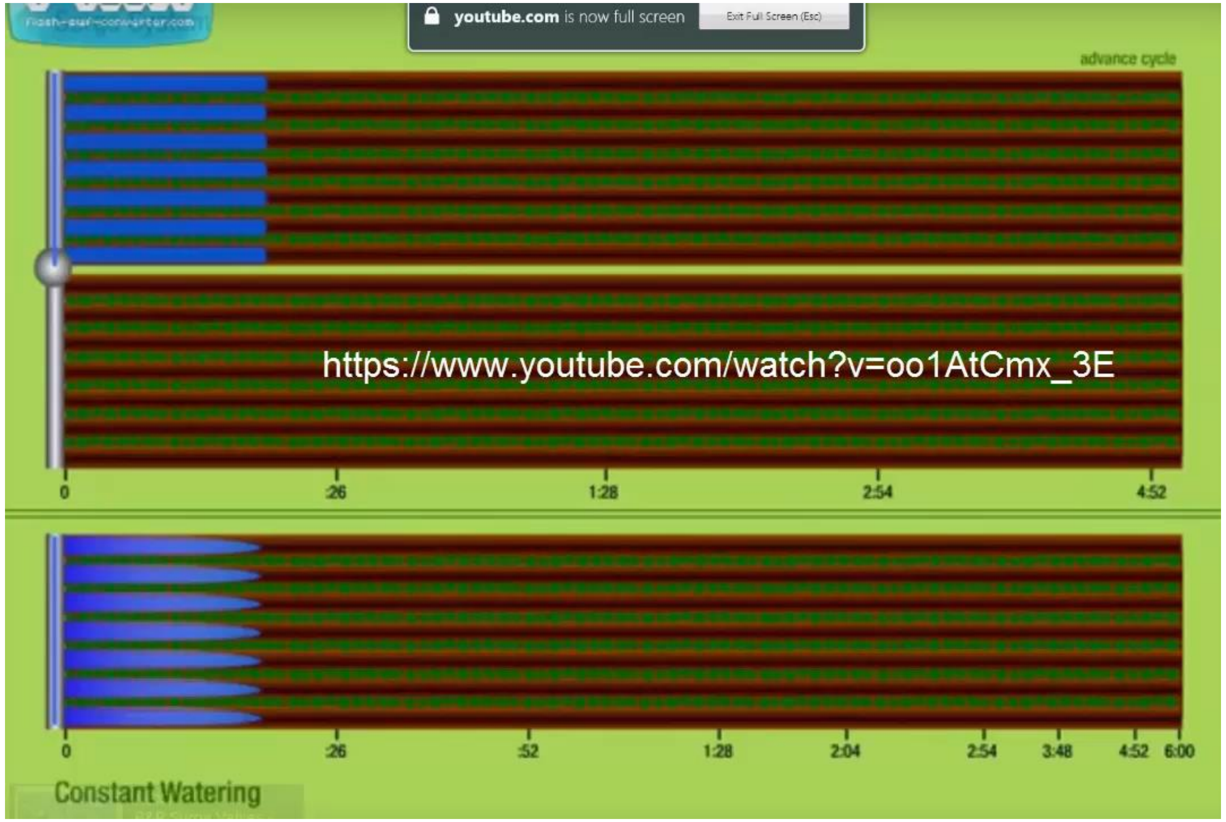
Effect of Length of Run



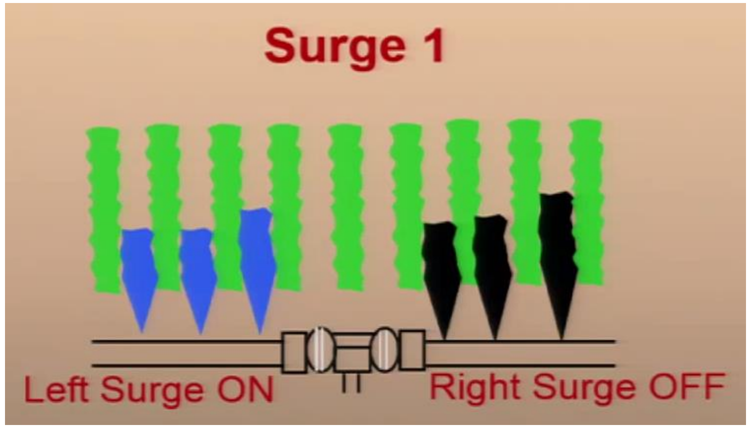
Management Techniques

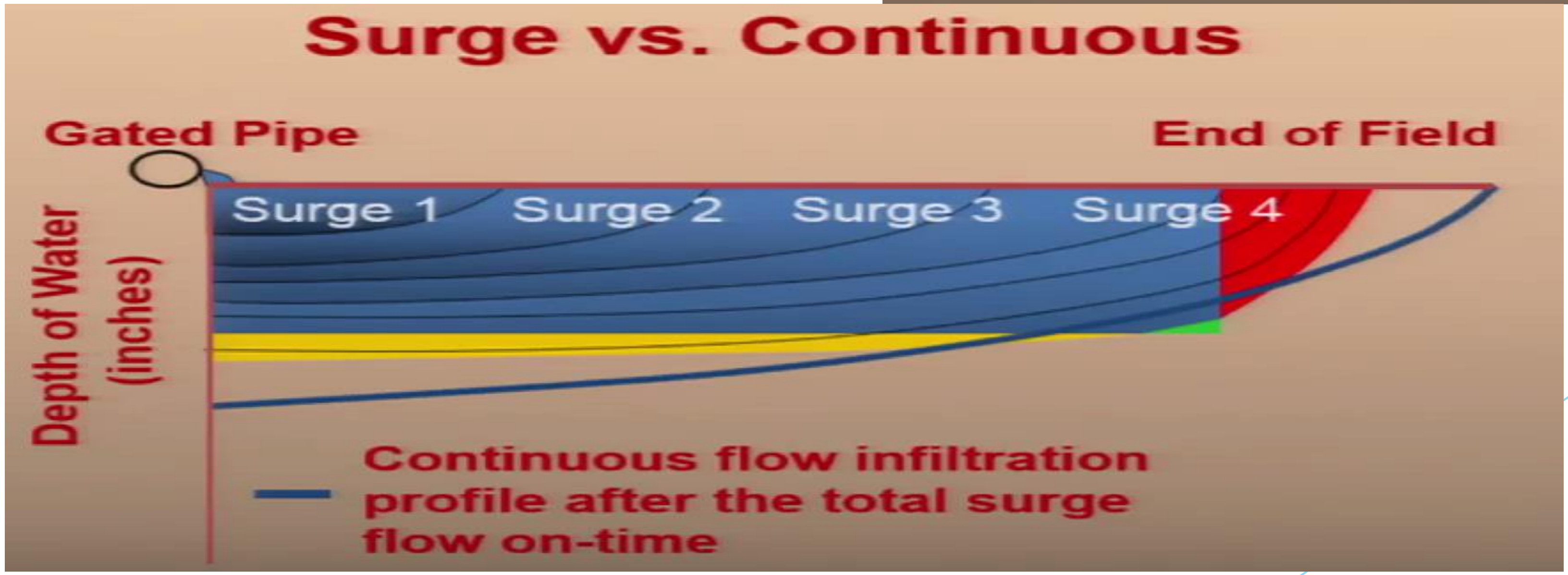
- Surge Irrigation
  - What is surge
    - Wet soil with double the head of water
    - Left/right/left/right…
    - Cycle until wetted front is 66% of way down field
  - Minimize advance time because water moves faster over wetted soil
  - Minimize deep percolation and runoff
    - Cut back to match infiltration rate

Surge Irrigation



Surge Irrigation





Irrigation Efficiency through Time Management

- WATCH YOUR IRRIGATION SET TIMES
  - Work with NRCS, Extension, or ABE Department to calculate the optimal time of irrigation
  - Have irrigator accurately keep track of time
  - Don’t move water when convenient
    - 60 minutes per irrigation at a rate of 5 cfs over 7 irrigations wastes about 3 ac-ft of water per irrigation set.

Summary

- Goal is to minimize runoff and deep percolation
- Field Length
  - Shorter the field the higher the irrigation efficiency
  - Loose cropped land due to roads and turn rows
- Correct Stream Size
  - Match flow in furrow to
    - irrigation system
    - Soils – lighter soil ⟶ higher q (gpm per furrow)
  - Set Time
    - Don’t waste water because you are “busy”

Saving Water In Agriculture

Irrigation training video in English and Spanish

Sponsored by ADWR, USBR, and USDA-NRCS

Available on line at:
https://youtu.be/aFO4h8i-h6g (English)

https://youtu.be/3F97YRy4q4U (Spanish)

Thank you to Bill Kranz, University of Nebraska Extension Irrigation Specialist, for exhibits used in this presentation

Irrigation Management Video

Thank You!

Questions?