SALINE SEEPS

CCA & Retailer Training, Huntley, Aug 8 2019

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Photo courtesy USDA NRCS

Objectives

- Explain saline vs sodic soils
- Describe how saline seeps are formed
- Illustrate the prevention and restoration process

Photo courtesy USDA NRCS

Why am I covering this ‘old’ topic?

- With wet year(s), we’re seeing more salts at surface likely due to groundwater rise.
- Saline seeps and saline soil can dramatically decrease yield
- Clark asked me to ☺

Saline vs Sodic Soils

	EC (mmhos/cm)	Sodium adsorption ratio (SAR)	Exchangeable sodium % (ESP; meq/100g)	pH
Saline	> 4.0	< 13	< 15	< 8.5
Sodic	< 4.0	> 13	> 15	> 8.5
Saline-sodic	> 4.0	> 13	> 15	< 8.5

- Electrical conductivity (EC)
  - Range from 0.5 to over 25 (white salt crust)
  - Cropland is generally under 2.0
  - Strongly saline has EC value > 16
- Saline sometimes mistakenly called ‘alkali’, most common are ‘seeps’
- Sodic soil has high sodium, appears bare, & black under surface, fairly rare in MT

Impacts

Crop production (plants wilt)

Photo courtesy USDA NRCS

Photo courtesy Jane Holzer

Water quality
Wildlife habitat and health

Sodic soils

- Have poor drainage and crusting
- More involved and costly to ‘fix’ than saline soils
- Excess sodium (Na^{+}) needs to be replaced from soil with calcium or magnesium (Ca^{2+}, Mg^{2+}) **before** leaching sodium out of soil.
- Gypsum or lime are common amendments for this. Elemental sulfur is cheaper IF soil is already calcareous.
- Tillage may temporarily help with permeability

Image by Dorivar Ruiz Diaz, Kansas State Univ

MSU Extension Water Quality has more information
http://waterquality.montana.edu/energy/cbm/faq-watersoil.html

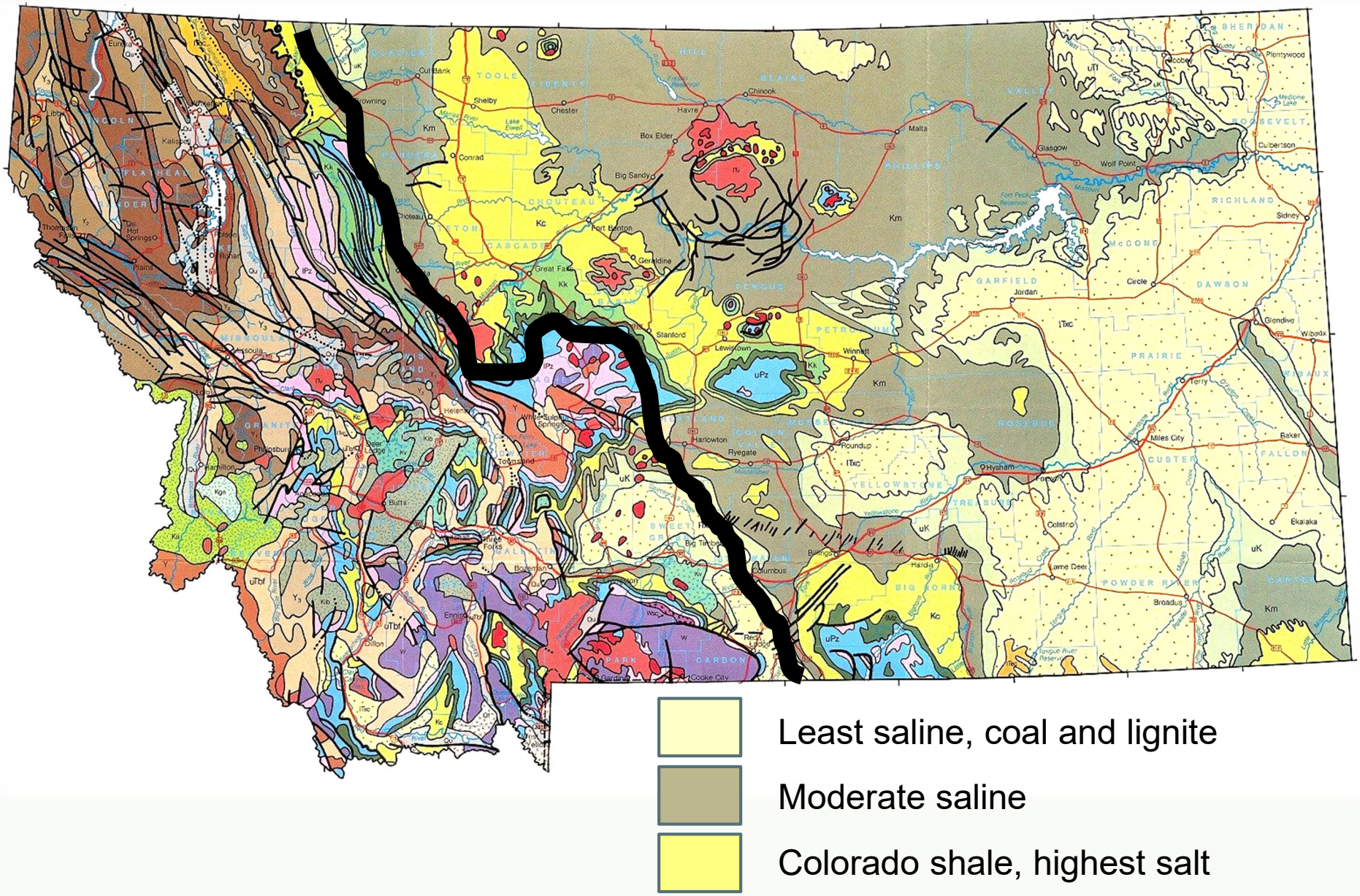
How does this happen?

Saline seep = shallow saline spring

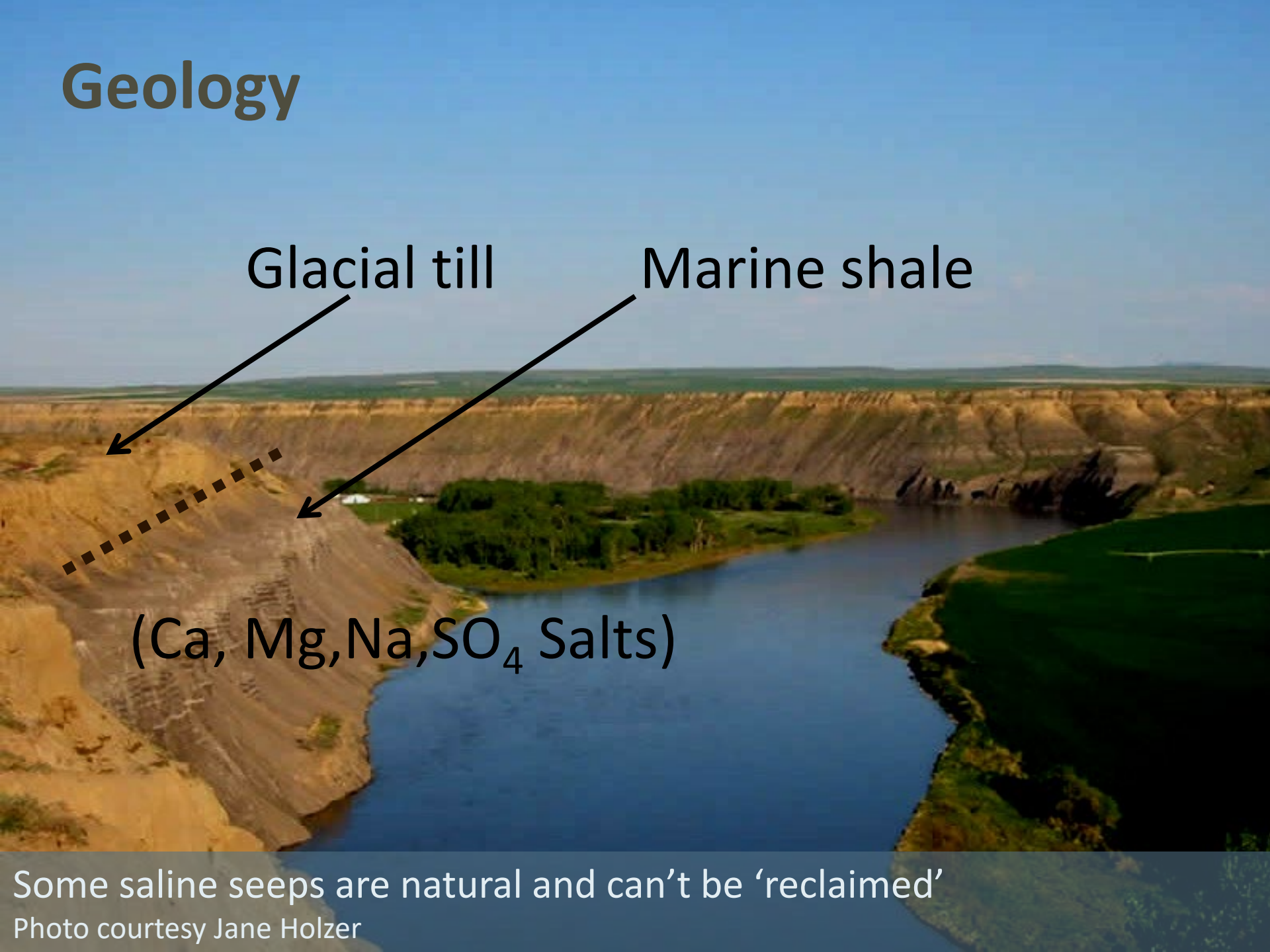
1. Geology
2. Climate
3. Cropping system

Geology

East of line – covered by inland sea, marine sediment



Geology



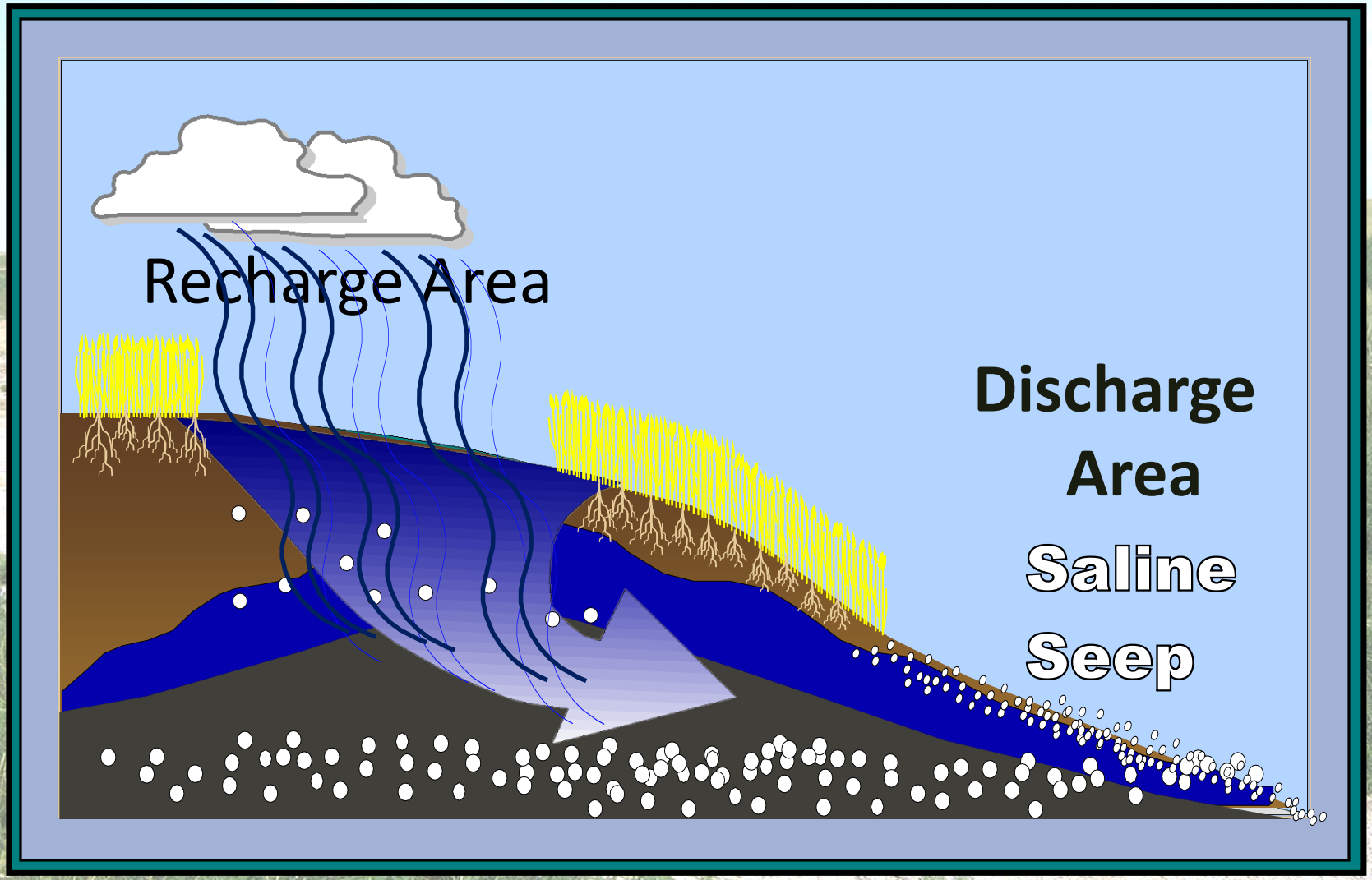
Some saline seeps are natural and can't be 'reclaimed'

Photo courtesy Jane Holzer

Cropping system causes

- Converting perennial grasslands to annual cropping
- Crop-fallow systems. Fallow allows excess water (carrying salts) to evaporate or move downward creating a saline seep
- Irrigation and water ditches/canals elevate water table over broad area, bringing soluble salts closer to surface

Saline Seeps - How They Form



Animation by Tera Ryan, MSCA

upslope

Salt Leaching

Creates saline seep down slope

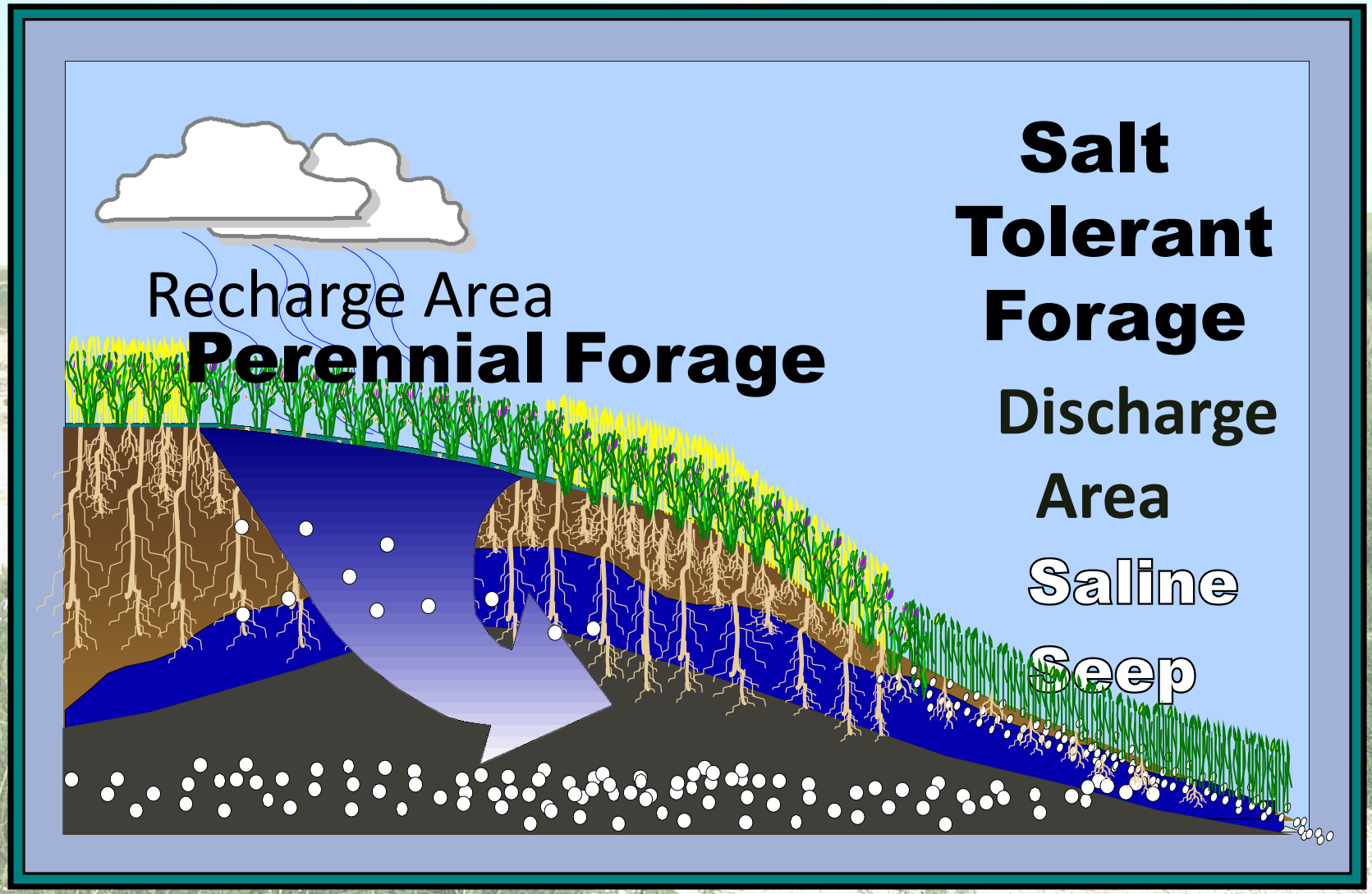
Cropping system change can prevent and reclaim problem

Photo courtesy USDA NRCS

Questions?

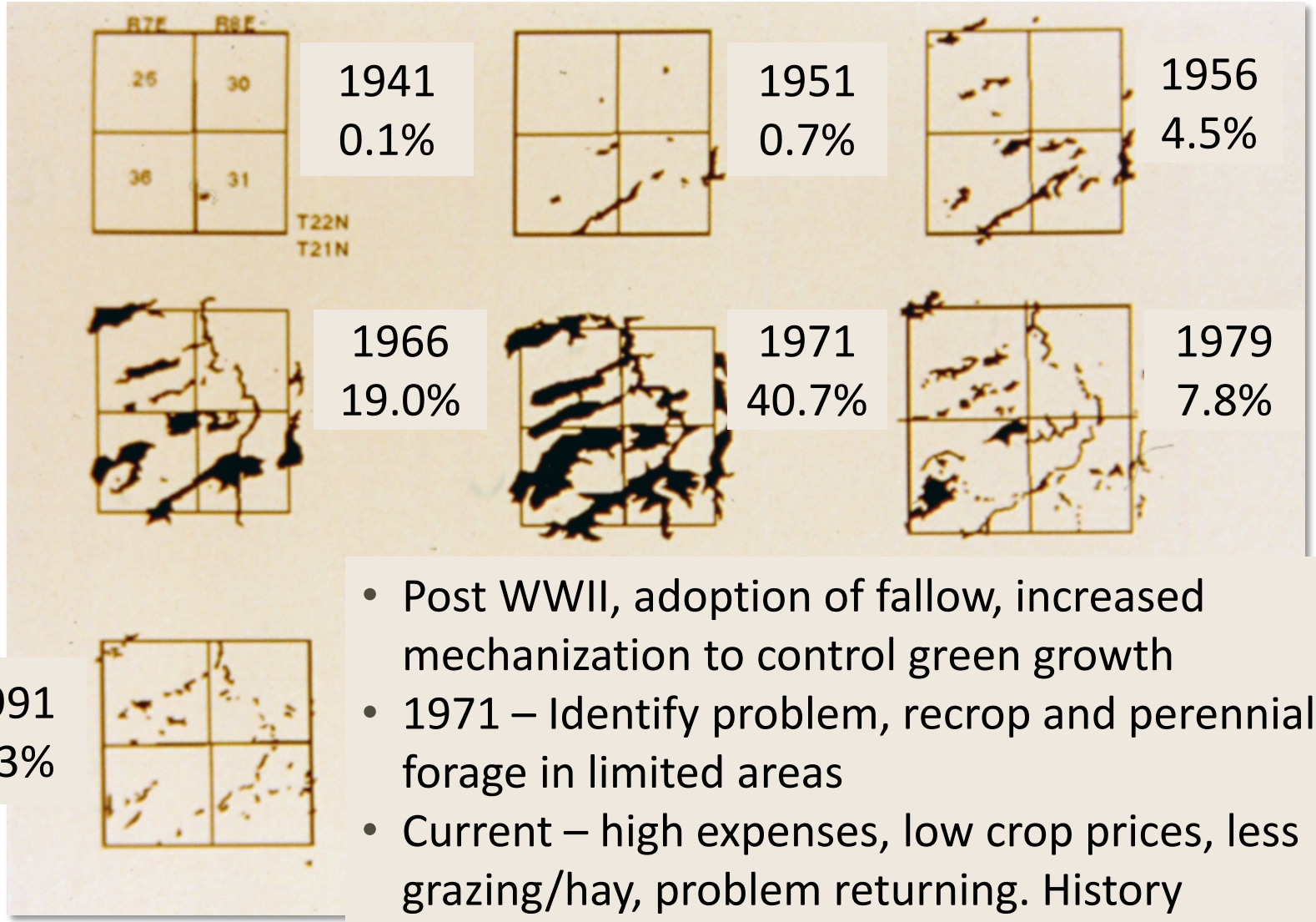
On to saline seep reclamation

Saline Seeps - How They Are Reclaimed



Animation by Tera Ryan, MSCA

Progression of salinity – 1941- 1991



- Post WWII, adoption of fallow, increased mechanization to control green growth
- 1971 – Identify problem, recrop and perennial forage in limited areas
- Current – high expenses, low crop prices, less grazing/hay, problem returning. History forgotten?

saline seep % in 4 square mile area of Highwood Bench

Progression of reclamation

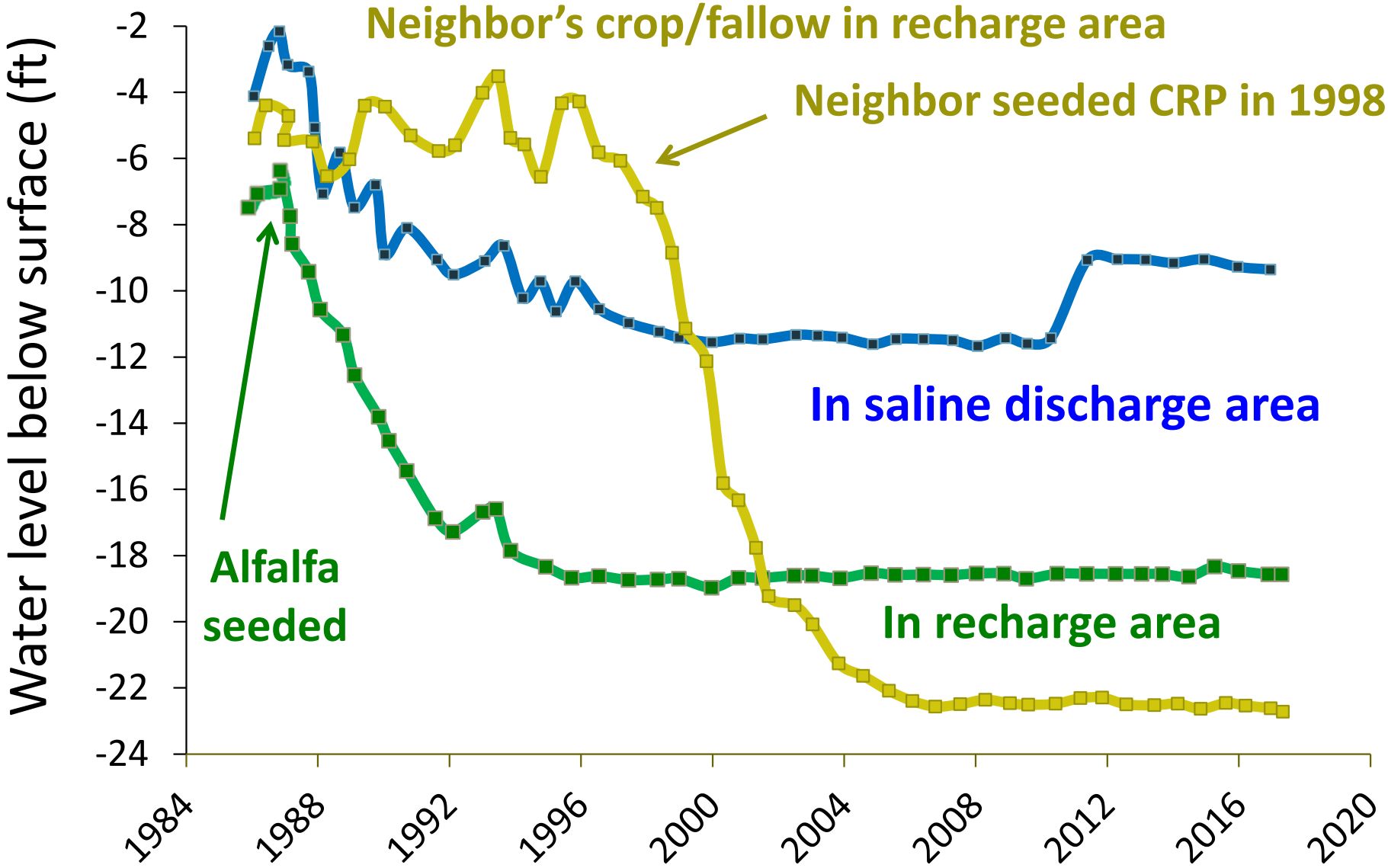
- Once a saline seep is reclaimed – always potential for return when the water table rises near surface
- Perennial forage in recharge areas for 5 to 10 years
- Forage can be left as long as producing economical yield
- Track the water table trend with monitoring wells (MSCA ground water investigation) in spring and fall.
- Once water table is no longer dropping, generally safe to rotate to annual crops
- Re-cropping with annuals delays water table rise (compared to fallow), but over time the water table will gradually build back up (after 15-20 years), again need perennial forage
- Saline seep formation accelerates if return to crop-fallow

124 acres alfalfa planted in 1981 in recharge area to use all annual precipitation, and 14 acres salt-tolerant forage in saline seep…

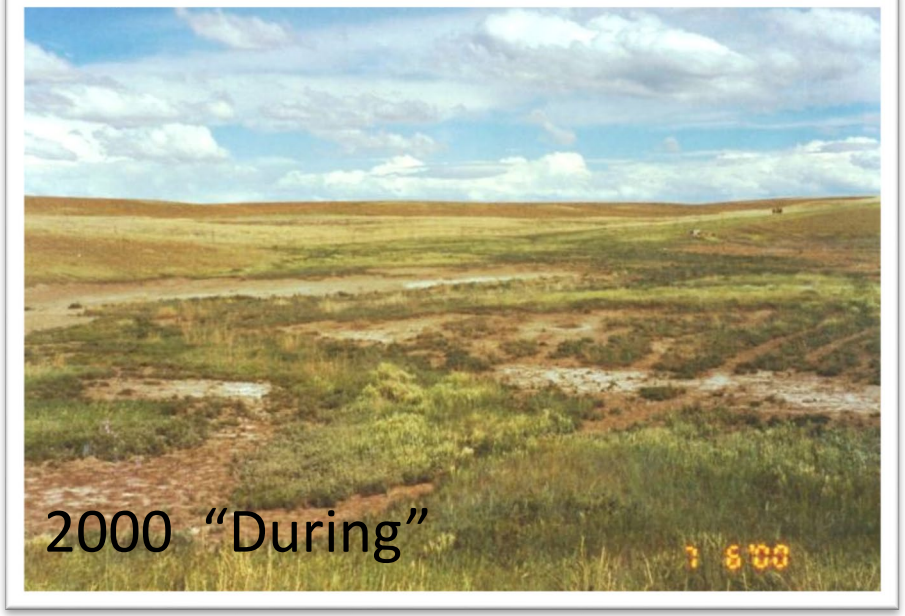
→ a reclaimed and healthy ecosystem

Depth to groundwater in monitoring wells

Hydrograph: land use effects on water levels



Pondera County



Soil Sample

- Need to know how saline
- Sample 0-6 inch depth where seeds will germinate
- Separate sampling for areas with salt crystals on surface versus poor vegetative growth
- Decide which is majority of area and plan seed mix around area most likely to grow forage
- Saline EC value varies by age of seep, depth to groundwater and time of year

Soil amendments or **NOT**

- Saline salts in MT are sulfate (SO_4^{2-}) based in combination with sodium, calcium, and magnesium (Na^+, Ca^{2+}, Mg^{2+})
- **Gypsum** ($CaSO_4*2H_2O$) will make saltier, so reserve its use for sodic-only soil.

Image from Creative Commons, by mrbanjo1138

Saline forage tolerance

- Varies by ability to withstand saline high water table and/or periodic flooding VERSUS tolerance to droughty saline conditions
- Tolerance can be lower as seedling but more tolerant as plant matures
- Rhizomatous species can spread into saline conditions that a seedling could not tolerate
- The USDA NRCS has lists of salt tolerant species

Summary

- Reduce salt leaching from recharge area by planting perennial crops
- Then plant in the saline area when the recharge area forage is robust
- Often there is no need to plant a very salt tolerant forage, wait for salts to begin leaching and then plant for the long-term goal

Thank you!

Questions?

For more information contact the Montana Salinity Control Association http://www.montanasalinity.com/

And Soil and Water Management Module No. 2 *Salinity and Sodicity Management*

http://landresources.montana.edu/swm/index.html

Photo courtesy MSCA