

## Introduction

- Western Interior Seaway ~100mya left marine sediment in Central and Eastern Montana
- Colorado Shale contains particularly high salt concentrations (shown as Colorado Group on map)
- Fallows allow water to percolate through salt-laden strata
- Rising groundwater table flushes salts out to surface
- Producers have seen livestock ponds become highly saline and unusable after catastrophic floods in 2011



Akins Coulee in 2009 (left) and 2019 (right)



Salt deposits in dry coulee after being flushed out of the groundwater

A General Guide to the Use of Saline Water for Livestock Interpretation of Water Analysis for Livestock Suitability (Source: SDSU)

Water salinity (EC) <sup>2</sup> $\mu\text{S/cm}$	Comments
Less than 1000	Relatively low level of salinity. Excellent for all classes of livestock and poultry.
1000-2999	Very satisfactory for all classes of livestock and poultry. May cause temporary and mild diarrhea in livestock not accustomed to the water. May cause watery droppings in poultry.
3000-4999	Satisfactory for livestock, but may cause temporary diarrhea or be refused at first by animals not accustomed to the water. Poor water for poultry, often causing watery feces, increased mortality, and decreased growth, especially in turkeys.
5000-6999	Can be used with reasonable safety for dairy and beef cattle, sheep, swine, and horses. Avoid use for pregnant or lactating animals. Not acceptable for poultry.
7000-10,000	Unfit for poultry and probably for swine. Considerable risk in using for pregnant or lactating cows in confinement, horses, sheep, or for the young of any these three species. In general, use should be avoided, although older ruminants, horses, poultry, and swine may subsist on them under certain conditions.
Over 10,000	Risks with these highly saline waters are so great that they cannot be recommended for use under any conditions.

## Legend

### Specific conductivity ( $\mu\text{S/cm}$ )

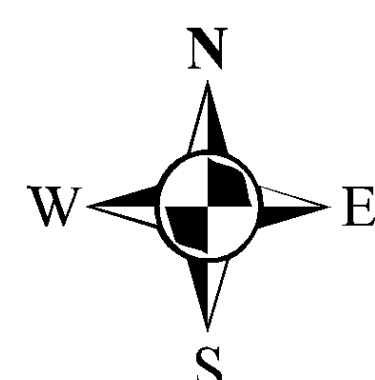
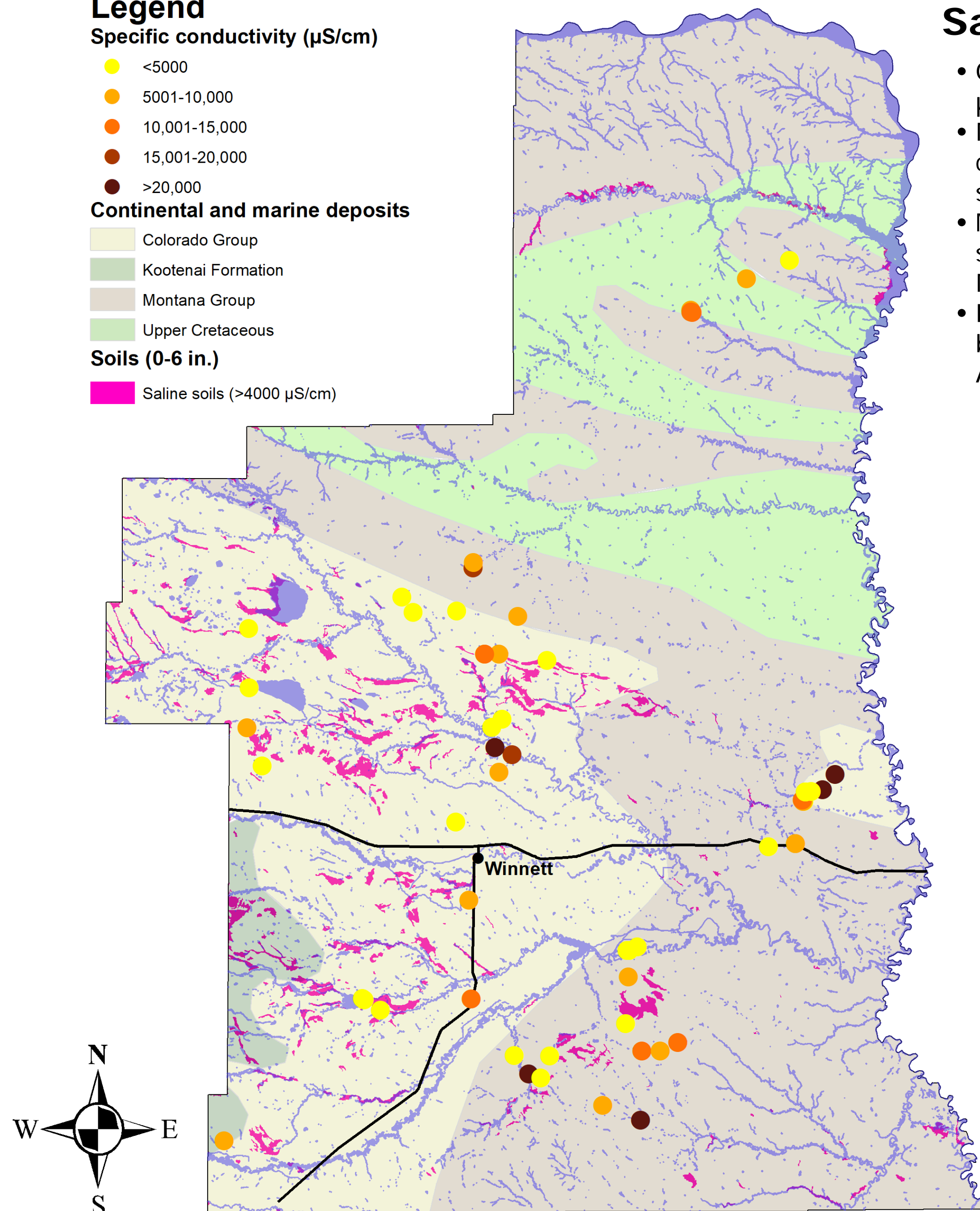
- <5000
- 5001-10,000
- 10,001-15,000
- 15,001-20,000
- >20,000

### Continental and marine deposits

- Colorado Group
- Kootenai Formation
- Montana Group
- Upper Cretaceous

### Soils (0-6 in.)

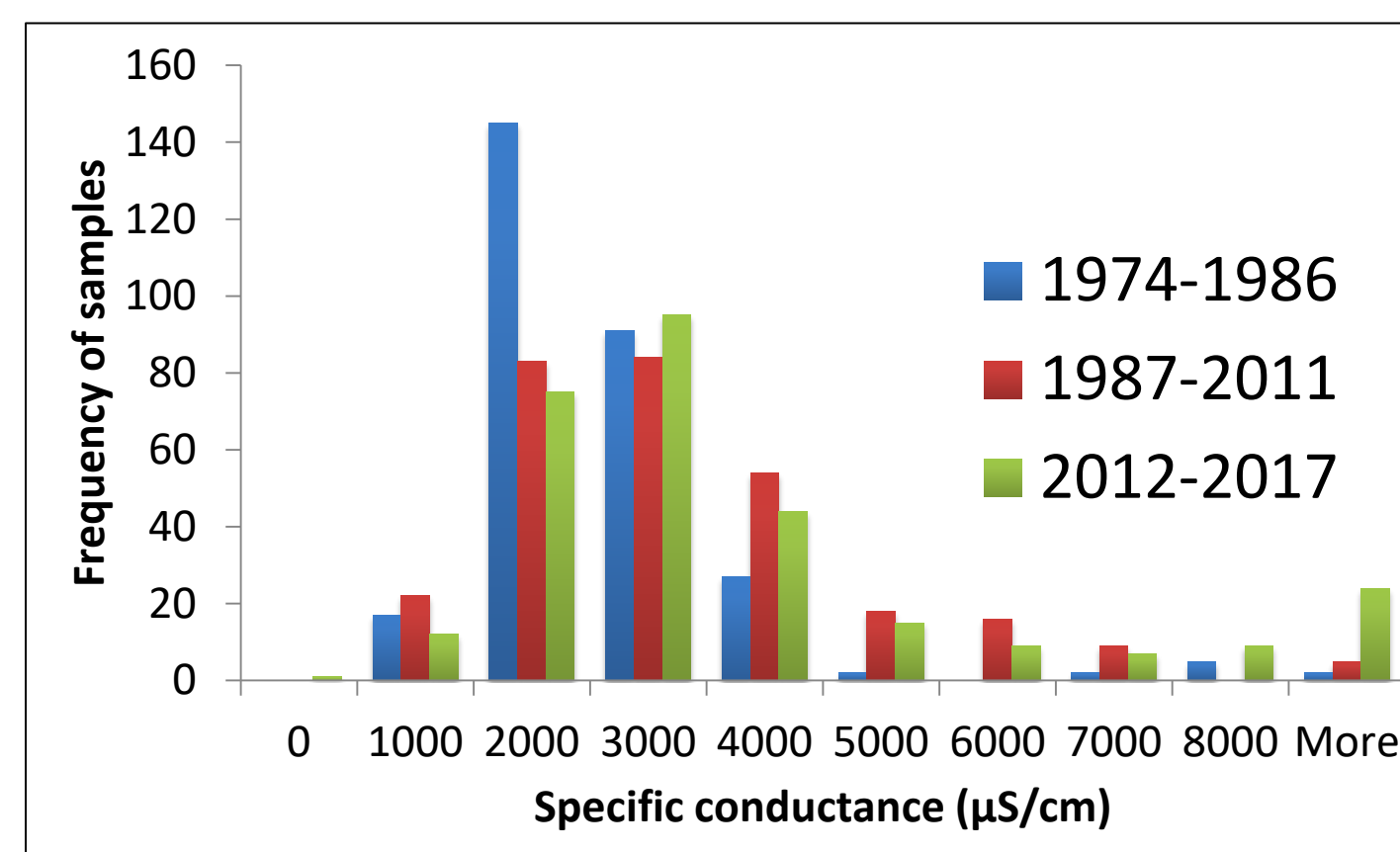
- Saline soils (>4000  $\mu\text{S/cm}$ )



Sources: Montana Bureau of Mines and Geology, Montana Natural Heritage Program, Natural Resources Conservation Service, Montana State Library

## Historical data

- SC data taken in streams and wetlands by USGS and MT DEQ
- Only 2% of samples taken from 1974-2011 were above 8000  $\mu\text{S/cm}$
- 11% of samples taken from 2011-2017 were over 8000  $\mu\text{S/cm}$
- Indicates overall increase in surface water salinity levels after 2011 floods



Histogram of specific conductance samples in Petroleum County (1974-2017)

## Sampling results

- Over 24% of samples were over 10,000  $\mu\text{S/cm}$
- No clear spatial trends or direct correlation with soil electric conductivity, sodium absorption ratio, or pH
- Many high measurements were located on soils classified as Ustic Torriorthents or Neldore Series
- Replicate samples of ten ponds increased by an average of 27% from June/July to August/September



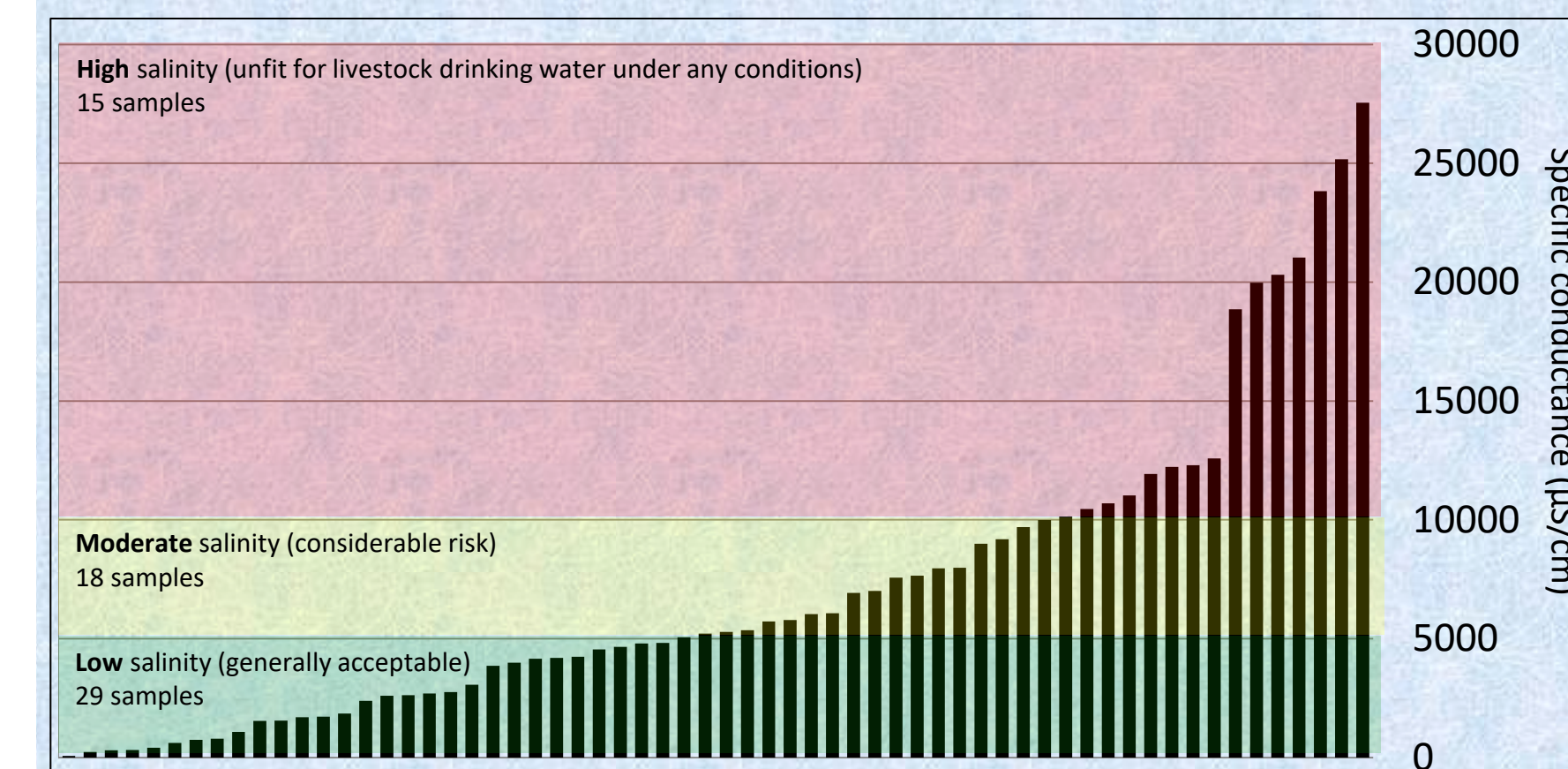
Active livestock pond with very low salinity (613  $\mu\text{S/cm}$ )



Sampling Akins Coulee (drone photo)



A YSI Pro30 handheld meter was used to measure specific conductance



Sorted specific conductance measurements of stock ponds in Petroleum County

## Impact of salinity on livestock, wildlife, producers, and watersheds

- High salt in drinking water upsets livestock electrolyte balance and causes dehydration, weight loss, and diarrhea
- High levels of salinity often indicate high sulfates, which can cause a neurological disease called polioencephalomalacia (PEM)
- Salinity tolerance of wildlife varies by species, but consistently saline drinking water is likely to cause sickness and physiological issues
- Excess salt content in livestock ponds are often the result of adjacent saline seeps
- Saline seeps are nonpoint sources of pollution that contaminate soil and make land unproductive
- Poor livestock drinking water quality and unusable ponds are financial burdens for producers



Salt deposits on the banks of wetlands are prevalent in Central Montana

## Conclusions

- Continued monitoring would help to understand trends in livestock pond salinity
- Investigation of specific salts (e.g. sulfate) would provide insight into implications of drinking water
- Cooperation with Montana Salinity Control Association and Montana Bureau of Mines and Geology would support background knowledge and potential solutions to the problem
- Best management practices could help reduce salinity despite naturally occurring salts
- Important for improving livestock and watershed health