Salinity in Livestock Ponds Summary Report

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Introduction

Much of Central Montana is underlain by salt-laden, Cretaceous marine shales. Saline conditions in Petroleum County are concentrated in the Colorado Group bedrock formation, as shown in Figure 4. The formation is characterized by shallow soils with highly soluble salt loads in the groundwater. In 2011, catastrophic floods flushed salts out of the groundwater and into the surface water. This geological condition can be compounded by certain land-use practices. Cropping systems, especially the prominent crop-fallow patterns, can also create a local perched water table to enhance surface evaporation, leaving salt to concentrate on the soil surface. The saline groundwater and saline surface run-off contribute soluble salts to the local watersheds and ponded water. When land-use management creates local saline conditions, the condition is known as saline seep.

Dryland saline seeps, which can impair soil and water quality, were recognized as an issue in the latter half of the 20th century. Impacted areas are dependent upon local stratigraphy and geomorphology, but fallow periods in cultivated fields during wet years can be a major factor for their presence. After 2011, saline seeps became noticeably more prevalent and many livestock ponds have become unusable. This has been a major burden for producers who rely on potable water for their cattle. Seeps and ponds can sometimes be reclaimed through techniques like planting perennial forage in groundwater recharge areas to reduce salt leaching. However, climatic factors may enable the underlying problem to persist well into the 21st century, so collecting and understanding data is critical.

Animals need salt in their diet to survive, but when they consume excess salt, it upsets their electrolyte balance and can cause symptoms such as dehydration, weight loss, and diarrhea. With many drinking water sources becoming highly saline in recent years, this can be a concern for producers. Poor water quality will discourage livestock water consumption, reduce livestock feed intake, and decrease livestock weight gain. Cattle are generally reluctant to drink water with high salt content, but they will then drink a large amount at once which can cause them to get very sick and potentially die. Salinity is estimated using a measurement called specific conductance (SC), which indicates the amount of dissolved salts in the water. Knowing the salt levels in drinking water is critical for maintaining healthy and productive livestock. Table 1 shows approximated salinity tolerances for livestock.

Table 1: A General Guide to the Use of Saline Water for Livestock: Interpretation of Water Analysis for Livestock Suitability (Source: SDSU)

Water salinity (EC)[2] µS/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.
7000-9999	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.

Historical Data

Surface water measurements of specific conductance were taken by both the USGS and MT DEQ from 1962-present (Figure 1). Of the 1071 samples taken during that period, only 20 were greater than 10,000 µS/cm. Although many of these samples were taken in moving water, which can be less susceptible to evaporation concentrating salts than stock ponds, these data were considerably lower than samples taken for this project in 2020. There was a slight overall increase in specific conductance from 1962-present. The group of samples taken after the 2011 flood was significantly greater than the samples taken from 1974-2011. Samples taken during the 1960s were slightly higher than those taken from 1974-2011, and had two readings greater than 10,000 µS/cm (there was not another over 10,000 µS/cm until 2004). This may have been a result of the wetter period during the 1960s.

The main takeaway from the historical SC data is that there were significantly more readings over 8000 µS/cm after the flood in 2011, as shown below. This is consistent with the notion that salts in the groundwater are flushed out to the surface when the water table rises.

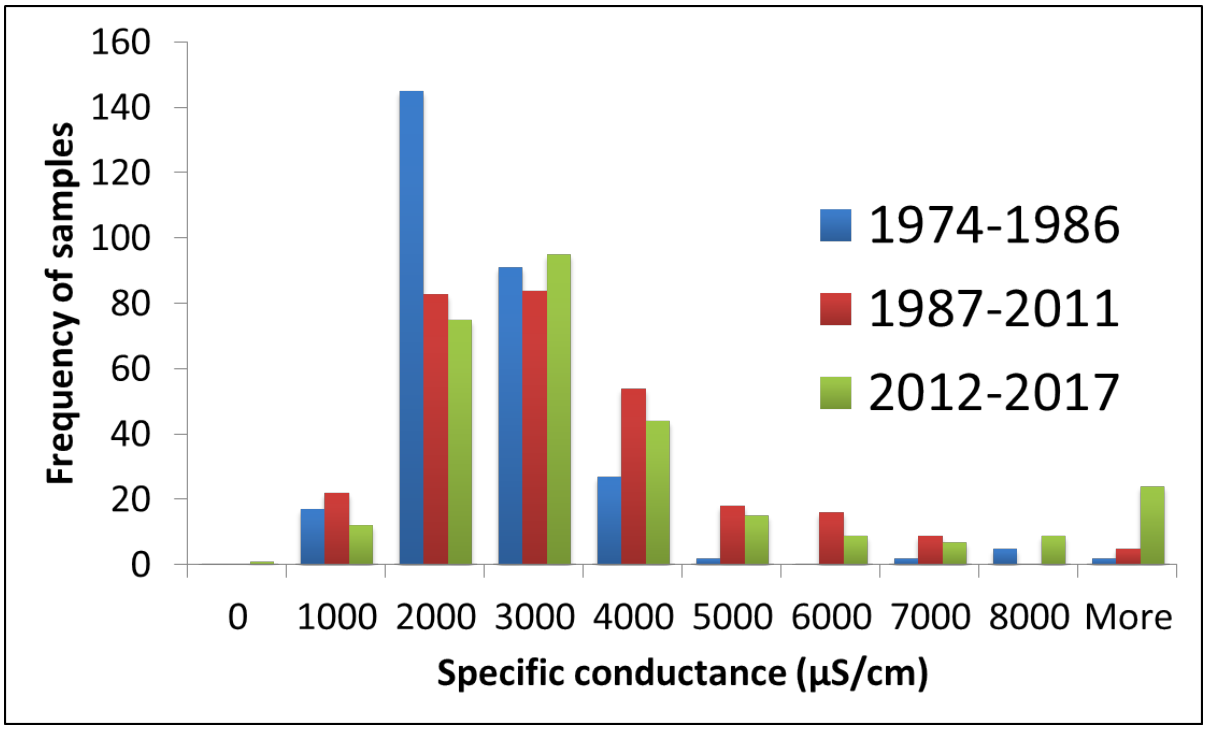

Figure 1: Histogram showing frequency of specific conductance measurements for streams and wetlands in Petroleum County (1974-2017)

2020 Sampling Results

Throughout the summer months of 2020, I made 72 SC measurements in livestock ponds around Petroleum County. Many samples were taken at the request of producers who were concerned about high salinity, so they cannot be directly compared with historical data. However, there were many samples that exceeded the maximum threshold for livestock suitability. Fifteen of the 62 unique measurements were above 10,000 µS/cm, which is not acceptable for livestock drinking water under any conditions (Figure 2). Eighteen samples ranged from 5,000 µS/cm to 9,999 µS/cm. For these stock ponds, there is considerable risk when used for livestock drinking water. Only 29 livestock ponds (46.7%) were considered satisfactory for drinking water by SC standards. See the chart below for a detailed look at the unique measurements taken during the project.

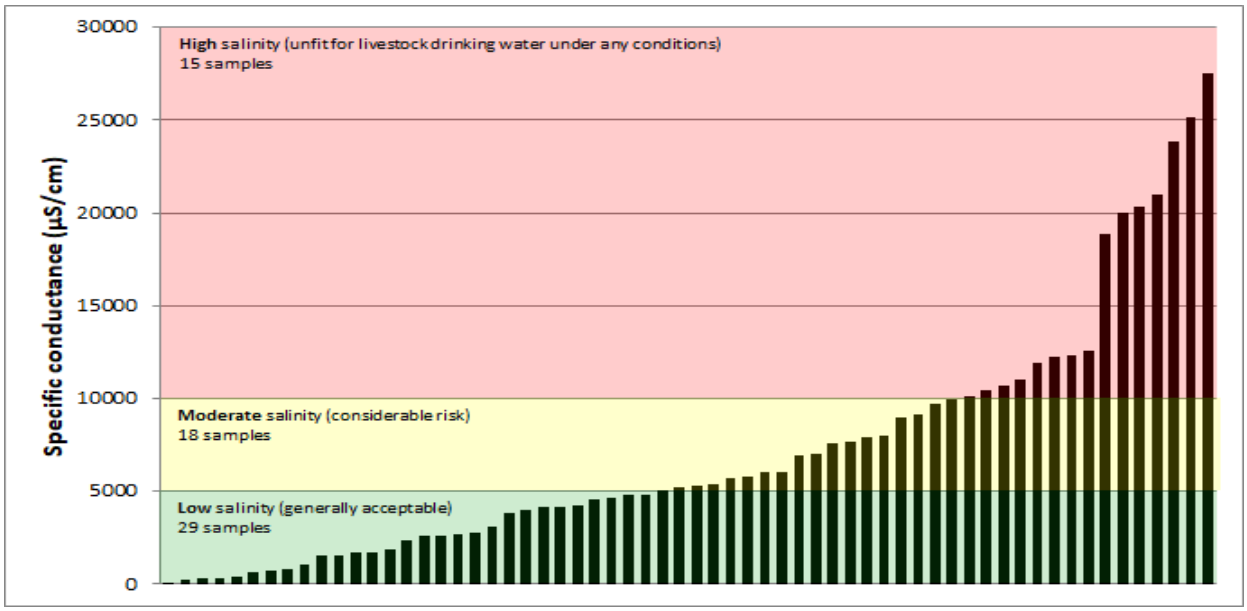

Figure 2: Sorted specific conductance measurements of livestock ponds in Petroleum County

During the dry summer months, water in livestock ponds evaporates and elevates the concentration of salts. Livestock are particularly vulnerable in the summer, as their water intake increases by 30% when effective temperatures rise from 65°F to 86°F. With a greater demand for water, which is generally more saline in these months, cattle are at increased risk for sickness. Ten ponds were sampled early in the summer and again late in the summer (Figure 3). Each SC level increased across this timespan. The average increase was 27%.

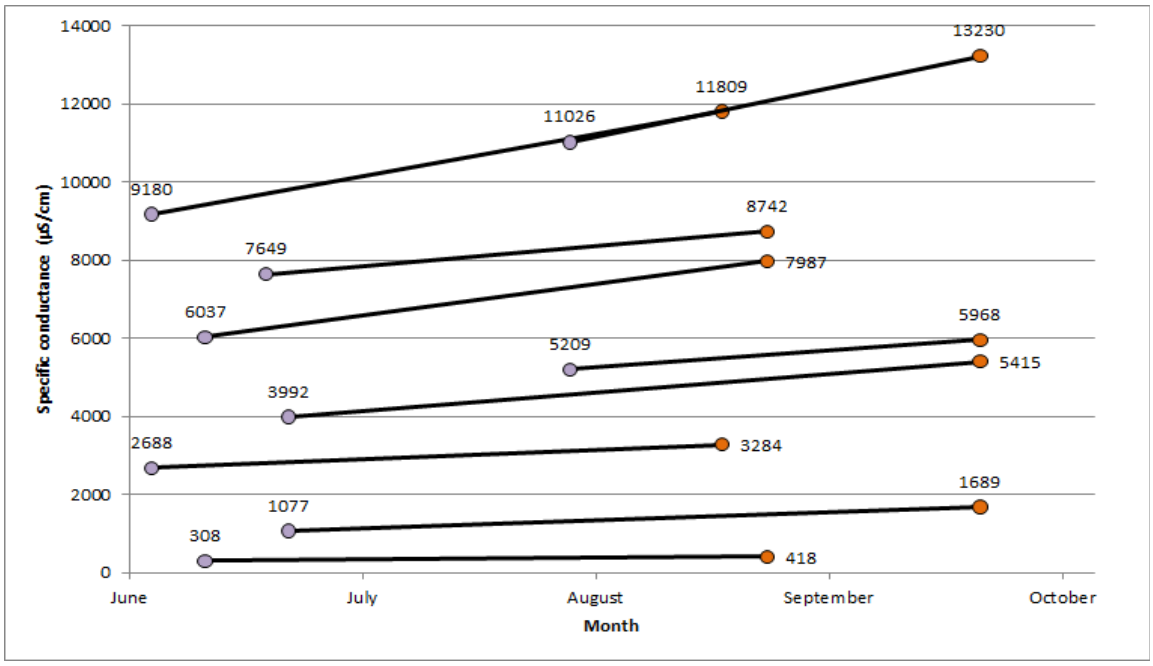

Figure 3: Seasonal change in ten livestock ponds in Petroleum County

There were no spatial trends in the collected data (Figure 4). There were also no direct correlations between specific conductance and the underlying soil electrical conductivity, sodium absorption ratio, or pH. However, several extremely high measurements were located on soils classified as Ustic Torriorthents or Neldore Series.

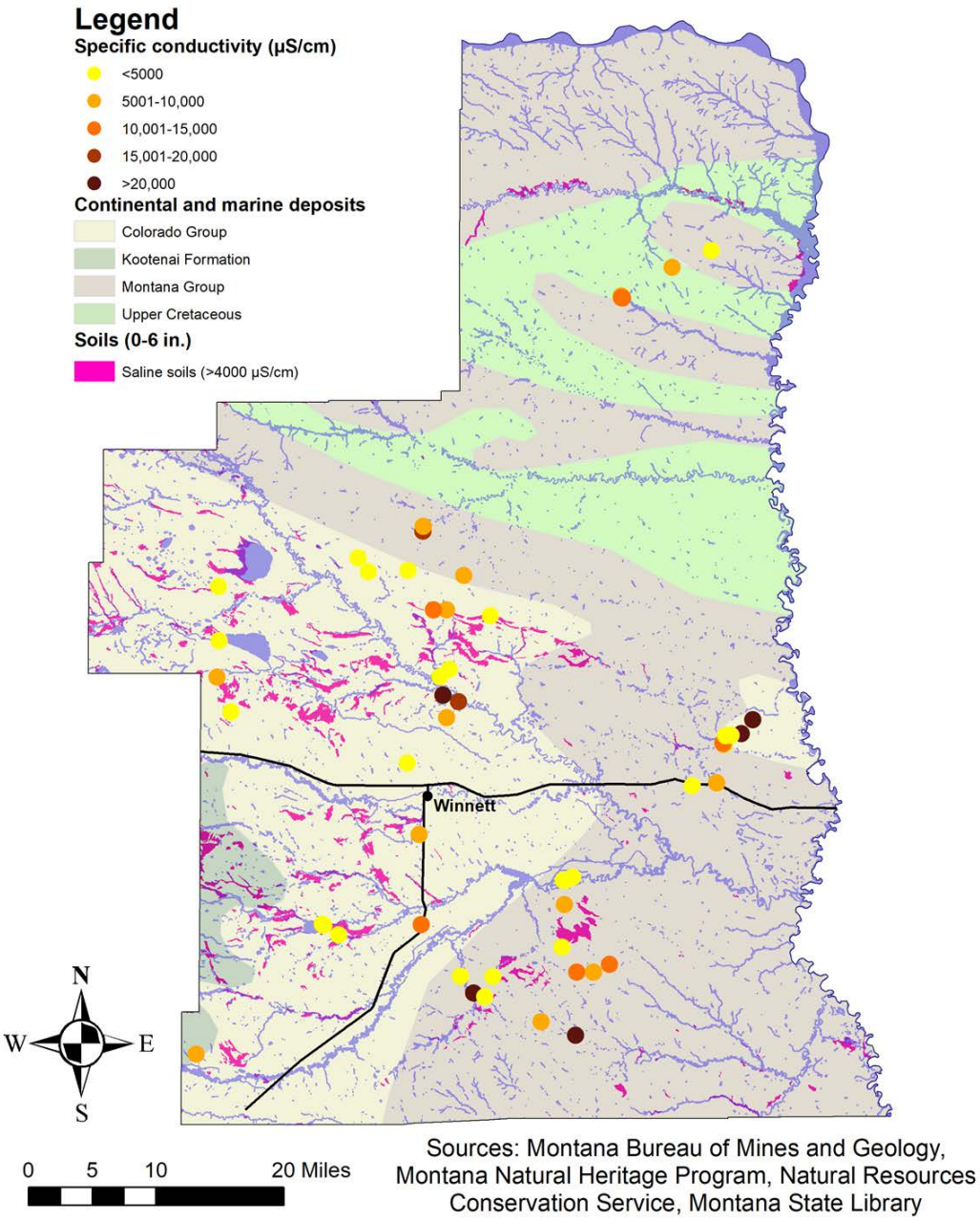

Figure 4: Map of specific conductance measurements taken in Petroleum County (2020)

Conclusions

The geology of Central Montana makes Petroleum County particularly susceptible to highly saline soil and water. It is widely known that this problem has been exacerbated by a rising groundwater table as a result of recent flooding. Salinity monitoring in livestock ponds is helpful for producers to get a general sense of the salt intake of their cattle. Specific conductance is a blanket measurement that indicates the concentration of ions in the water, so it should not be used as a definitive representation of water quality. High specific conductance measurements often indicate high sulfate concentrations. Sulfate toxicity is one of the primary drivers of a neurological disease called polioencephalomalacia (PEM), which can cause blindness and brain damage in ruminants. When specific conductance is high, a more comprehensive water quality analysis should be conducted to make informed management decisions.

Specific conductance is an important parameter for producers to know about the quality of their livestock drinking water. Continued monitoring of salinity in livestock ponds would help show trends over time. Evaluating temporal and spatial patterns may provide insights into better grazing plans. Tracking potentially correlative attributes such as soil type or groundwater flow patterns could help inform decisions about pond or saline seep reclamations. By optimizing water resources, producers can mitigate the adverse effects of high salinity intake. This can significantly improve the health and productivity of cattle.

Organizations such as Montana Salinity Control Association (MSCA) and Natural Resource Conservation Service (NRCS) offer assistance combatting saline seeps. Just south of Winnett in Petroleum County lies a region of salt-laden bedrock close to the surface. The naturally saline spot was exacerbated by a crop-fallow system, which created a perched saline groundwater table. A joint project from MSCA, NRCS, and Petroleum County Conservation District has restored the area back to perennial forage. Gradually, the water table has been dropping and the conspicuous white crust is disappearing as the salts are leached deeper into the soil profile. Through dynamic and collaborative management efforts, the salinity issue in Central Montana can be mitigated. Monitoring livestock ponds can play a role in helping to understand the current situation and make decisions in the future.

Works Cited

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