

Livestock Water Quality

A clean, plentiful supply of livestock water important to achieve optimum animal performance and health. Water quality is difficult to visualize and requires laboratory analysis. There are several measures of water quality which could result in poor animal health or decreased animal production performance. These parameters are: total dissolved solids (TDS), electric conductivity (EC), hardness, sodium, pH, nitrates, sulfates, toxic nutrients or contaminants, and coliform bacteria.

Total Dissolved Solids (TDS) is the measure of all inorganic constituents or minerals which are dissolved in the water. The most common soluble salts found in water are combinations of sodium, calcium, and magnesium ions with sulfate, chloride and bicarbonate ions. High salinity waters can affect animal health resulting in diarrhea, excessive water intake, mineral intake imbalances, and decreased production performance.

Electrical Conductivity (EC) estimates TDS, the EC of water is related to the cations and anions dissolved in the water source. Common cations in water include: calcium, magnesium, and sodium. Anions include: chloride, sulfate and bicarbonate. Higher salinity water has higher EC. Animals tend to consume more high salinity water because it creates an electrolyte imbalance which is displayed through symptoms including dehydration, diarrhea, fever, decreased production such as decreased weight gains and lower pregnancy rates.

Table 8-4: Use of Water Containing Salt

Total Dissolved Solids (EC) Comments	
<1000 ppm (<1.68 mmho/cm)	Safe for all livestock classes.
1000 – 2999 ppm (1.68 – 5.0 mmho/cm)	Satisfactory for most livestock. Swine and cattle unacclimated to higher TDS water may exhibit temporary diarrhea. May cause decreased gain or death with poultry.
3000 – 4999 ppm (5.0 – 8.33 mmho/cm)	Satisfactory for some livestock. Swine and cattle may refuse water and exhibit diarrhea temporarily. May cause decreased gain or death with poultry.
5000 – 6000 ppm (5.0 – 10.0 mmho/cm)	Reasonable for some livestock. Do not use for pregnant or lactating livestock. Do not expect optimum performance Unacceptable for poultry.
>6000 ppm (>10.0 mmho/cm)	Reasonable for some livestock Diarrhea and increased water intake in swine Do not use for pregnant or lactating livestock Do not expect optimum performance Unacceptable for poultry.
>7000 ppm (>11.7 mmho/cm)	Unacceptable for all livestock use.

(NRC 1974, 2001)

Hardness is expressed as the total calcium and magnesium ions in water reported as the calcium carbonate (CaCO_3). While hardness itself is not a contributing factor in animal performance and health issues, hard water can result in excessive intake of calcium and/or magnesium which results in issues with mineral imbalances when combined with a balanced diet or ration.

Table 8-5: Water Hardness Guidelines

Category	Hardness ppm
Soft	0 – 60
Moderately Hard	61 – 120
Hard	121 – 180
Very Hard	> 180

(Beef Cattle NRC 2016)

Sodium, in high concentrations in an animal's water source, can have a diuretic effect. This leaves the animal thirsty, drinking more of the toxic water, and becoming dehydrated. Sodium also interacts with sulfates posing a greater risk if water is high in sodium sulfate. When adjusting a ration or diet to accommodate for high sodium water, a chloride deficiency may be an unintended result. Water with sodium levels greater than 50 ppm with an equivalent sulfate level should not be used for poultry. Salt in swine diets should be reduced if the sodium level in the water is greater than 400 ppm. In beef and dairy cattle, salt intake should be reduced if the water sodium concentration is greater than 800 ppm.

pH has not been well defined in livestock species, however the current NRC recommendations for beef cattle and swine is to keep pH between 6.5 – 8.5.

Nitrates are found in most all forages and occasionally in water. Nitrate itself is not toxic, but during digestion, gut bacteria reduce nitrate to nitrite, which then enters the blood stream. There, the nitrite converts the red pigment hemoglobin, which carries oxygen from lungs to tissue, to methemoglobin, a dark brown pigment which cannot carry oxygen. Nitrate poisoning is usually more of a problem in pregnant and young, especially newborn animals. Older animals seem able to tolerate higher nitrate levels. For more on animal health and nitrates refer to the [Feed Testing](#) section of the Ward Guide. High nitrate water levels are often caused by shallow water tables, leaching of nitrate from sandy soils, or under heavy N fertilization.

Table 8-6: Use of Water Containing Nitrates

NO ₃ -N ppm	Comments
0 – 10	Safe for consumption by all livestock species.
11 – 20	Safe in all livestock species. Ensure diet low in nitrates for ruminant animals.
21 – 40	Safe for most livestock species. Can be harmful to ruminant species over long periods of time.
41 – 100	Safe for most livestock species. Ruminants at risk; feed with very low nitrate diet. Death possible.
> 100	Safe for non-ruminant livestock species. Unsafe for ruminant livestock (cattle, goats, sheep). Death possible. Do not use as water source for affected species.
> 300	Unsafe for all livestock species. Do not use as water source.

(NRC Beef 2016, Swine 2012)

Sulfates include sodium sulfate, magnesium sulfate and calcium sulfate. These compounds have a laxative effect on animals. Waters high in sulfates pose animal health issues including diarrhea, poor average daily gains, and potential to develop a neurological disorder known as Polioencephalomalacia (PEM).

Table 8-7: Use of Water Containing Sulfate

SO ₄ -S ppm	Comments
< 50	Safe for all livestock species
< 500	Safe for most livestock species Not recommended for poultry
500 – 1000	Safe for most livestock species Not recommended for poultry Not recommended for young ruminants such as baby calves
1000 – 6999	Unsafe for ruminants and poultry Acceptable for swine
> 7000	Toxic to all livestock species

(NRC Beef 2016, Swine 2012, Interpretation of Water Analysis for Livestock Suitability, SDSU 2008)

Contaminants or other nutrients present in water at toxic levels may include: Aluminum, Arsenic, Beryllium, Boron, Cadmium, Cobalt, Copper, Fluorine, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Vanadium, and Zinc.

Coliform Bacteria are indicator organisms that illness causing microorganisms may be present in water. The Bureau of National Affairs (1973) recommends that livestock water contain less than 5,000 coliform forming units/100ml. Coliforms such as *E.coli* are more commonly found in surface water.