Government of Canada Gouvernement du Canada

Canada.ca > Agriculture and Agri-Food Canada > Agriculture and the environment > Agricultural practices > Agriculture and water > Livestock watering

Water quality impacts on livestock

Water quality can affect both total water consumption and the general health of livestock. Livestock can tolerate poor water quality better than humans, but if concentrations of specific compounds found in water are high enough, livestock can be affected. Most factors affecting water quality are not fatal to livestock. Livestock may not show clinical signs of illness, but growth, lactation and reproduction may be affected, causing an economic loss to the producer.

Research indicates that livestock, when provided with high quality water, will drink more, eat more and ultimately gain weight more quickly. Research also shows that improved water quality can lead to a decrease in disease and other health problems in animals.

On this page:

Factors affecting water quality

Some of the most common factors that reduce water quality are described below.

- Blue-green algae (cyanobacteria)
- Bacteria viruses and parasites
- Sulphates

- Total dissolved solids
- Nitrates
- Alkalinity
- Taste and odour
- Water temperature

Blue-green algae (cyanobacteria)

Blue-green algal blooms are common problems in farm dugouts and ponds. Warm water conditions combined with a nutrient rich body of surface water provide ideal conditions for algae blooms. The primary sources of nutrients that contribute to aquatic plant growth are animal excrement, fertilizers and organic matter like grass, hay, leaves and topsoil.

Blue-green algae is actually a bacteria called cyanobacteria and has a shimmering, blue-green colour which looks like spilled paint floating on top of the water. Heavy blooms appear thicker and have an appearance and consistency similar to pea soup.

Unlike green algae, blue-green algae are composed of tiny cells which clump together and will usually slip through your fingers when trying to pick it from the water.

Blue-green algae produce two types of toxins: Neurotoxins (nerve toxins, which can cause sudden death) and hepatotoxins (liver toxins, which can cause death within hours or days). Clinical signs of exposure to hepatotoxins in cows may become apparent within minutes. Although these toxins are released during growth, a more rapid release of toxins occurs when the algae dies.

The best way to avoid blue-green algae problems is to prevent blooms. Algae blooms can be reduced by limiting nutrients entering the water source and aerating the water.

By placing an intake one metre below the water surface and pumping the water to a trough for livestock to drink from you will help avoid the ingestion of concentrated toxins.

Registered chemicals containing copper can be used to treat blue-green algae blooms. One of the most common chemicals used is copper sulphate. Copper sulphate can be applied to dugouts at a rate of one gram per square metre of surface area (a 20 metres × 50 metres dugout would require 1000 grams or one kilogram (kg)).

Careful consideration should be used when calculating the amount of copper sulphate to be used to treat the water body. Overdosing can result in serious consequences to the water quality. Caution is required because a high rate of application will also kill the zooplankton. Zooplankton naturally feed on the algae present in the water body

There are two common application methods for copper sulphate:

- the copper compound can be dissolved in warm water and then sprayed over the water's surface (note that copper sulphate is corrosive to the metal components of a sprayer or;
- the copper sulphate can be placed into a weighted cloth bag and two people can drag the bag back and forth across the water's surface using a rope.

Copper sulphate is is toxic to fish. Doses must be reduced by 50 per cent when dugouts are stocked with fish.

Water from another source should be used for watering livestock for two weeks following a chemical treatment or a natural, blue-green algae bloom, and die-off.

Bacteria viruses and parasites

Bacteria, viruses and parasites are common in dugouts and reservoirs that collect runoff from a manure source to which livestock have direct access. There is a large variety of these organisms that can cause a number of different symptoms and production losses.

Calves are provided some immunity through their mother's milk, but are still susceptible to high concentrations of pathogens. Mature cattle often have built-in resistance to many of these contaminants, but the introduction of an uncommon pathogen can rapidly spread through the herd causing very serious diseases.

Water contaminated by feces can transmit many disease-causing organisms such as *E. coli*, *cryptosporidia*, *salmonella*, and *leptospirosis*. For the most part these organisms mainly affect young animals, but some can have negative impacts on mature animals.

Leptospirosis, for example, can be spread though contaminated water and cause increased rates of miscarriage, usually occurring between two to five weeks after the initial infection.

The easiest way to minimize pathogens in water is to prevent inflow from manure sources and prevent direct entry of animals. The sun's ultraviolet rays are effective in killing pathogens in water that is relatively clear. Allowing animals direct entry can stir up particles and prevent ultraviolet rays from destroying harmful pathogens.

Guideline recommendations for maximum levels of coliforms vary from 10 to 5,000 counts per 100 milligrams/litre (mg/L), with the lower range for calves and higher range for cows. Direct entry dugouts can reach coliform concentrations exceeding 15,000 counts per millilitre (mL).

Sulphates

High concentrations of sulphates can be found in surface sources that are fed from saline areas and groundwater-fed dugouts. The dietary sulphur requirement for beef cattle is 0.08 to 0.15 per cent of dietary dry matter intake. Intakes above 0.4 per cent may be toxic.

In the rumen, sulphate is converted to sulphide which can kill the rumen bacteria that produce thiamine or be directly toxic to the brain.

Sulphate has varying effects on cattle depending on the levels they are exposed to. The following table outlines the effects.

Effects of sulphate on cattle

Sulphate Concentration (milligrams/litre)	Effects
500	May affect calves; over time they adapt with few health problems.
> 800	Can affect trace mineral metabolism causing deficiencies of copper, zinc, iron and manganese leading to depressed growth rates, infertility and depressed immune response.
> 1,000	May cause thiamin (vitamin B1) deficiency, which can lead to Polioencephalomalasia (PEM).
7,000 or higher	Can result in death

Canadian Water Quality Guidelines recommend a maximum sulphate concentration of 1,000 milligrams/litre (mg/L).

Reducing sulphates is costly. Present treatment technologies include ion exchange and membranes, such as nanofiltration, but treatment is expensive. Due to the high cost, the best option is likely to find another source with a lower sulphate concentration.

Total dissolved solids

Total dissolved solids (TDS), or salinity, refers to the mineral quantities in water. TDS includes common salts such as sodium chloride, calcium, magnesium, sulphates and bicarbonates. While all have slightly different effects on animal metabolism, none are particularly worse than any other. Also, the effects of various salts seem to be additive, meaning that a mixture seems to cause the same degree of harm as an equivalent concentration of a single salt.

Livestock have an ability to adapt to saline water to some extent, but abrupt changes may cause harm. The main symptom from ingesting saline water is diarrhea. If TDS is high enough, cattle may avoid drinking the water for several days, followed by a period of high consumption, which causes illness or even death.

Water with TDS higher than 5,000 milligrams/litre (mg/L) should not be used for lactating or pregnant cows. Most animals will reduce intake at this level. Water with TDS greater than 7,000 mg/L is unsuitable for cattle. As with most contaminants, calves are more sensitive to salts in water than grown animals.

Treatment of high TDS water requires a membrane system such as reverse osmosis. As with sulphates, treatment is expensive and the best option is to find another water source.

Nitrates

Nitrates are occasionally found in groundwater that has been contaminated by manure or fertilizer. In dugouts and reservoirs, high nitrate concentrations are rarely found, except following direct runoff from manure or a chemical fertilizer source. Nitrates themselves are not very toxic, but bacteria in ruminant animals convert the nitrates to nitrite which reduces the blood's ability to metabolize oxygen and effectively causes shortness of breath and eventual suffocation.

Nitrate toxicity resulting exclusively from water is rare, but is primarily of concern when combined with forages having high nitrate levels. A combination of nitrates in feed and water can reach toxic levels and result in death as quickly as three to five hours after consumption.

Chronic nitrate toxicity can also occur even if clinical signs are not observed. This can result in depressed weight gain and appetite, and a greater susceptibility to infection and miscarriage. Contaminated water will more often cause chronic nitrate toxicity than acute poisoning.

Water analyses generally report nitrates and nitrites together. Recommended limits of total nitrates plus nitrites in water for cattle is 100 milligrams/litre (mg/L) as nitrogen (N) or 450 mg/L as nitrates (NO_3). These levels are rarely seen in surface water except in extremely contaminated water bodies, but are found more often in groundwater.

These levels should not harm livestock by themselves, but may cause problems when combined with feeds containing nitrates. Cause for concern increases at higher levels, especially during periods of drought.

Alkalinity and pH

Water pH ranging from 6.0 to 8.5 is considered acceptable for most livestock. Water with a pH less than 5.5 may cause acidosis in cattle, leading to reduced feed intake and performance.

Excessive alkalinity (pH approx. 10) can cause physiological and digestive upset in livestock. Alkalinity can also increase the laxative effects of water with high sulfate levels.

Waters with alkalinity levels lower than 1,000 parts per million (ppm) are considered satisfactory. Greater concentrations would probably be considered unsatisfactory. However, for mature livestock, they may do little harm at concentrations less than 2,500 ppm - unless the carbonate levels exceed bicarbonate levels.

Most waters are alkaline in nature, but fortunately, most waters have alkalinities below 800 ppm (measured as calcium carbonate ($CaCO_3$)), and are not harmful to cattle.

There have only been a few instances where a water source has been found to be too alkaline for livestock.

Taste and odour

Some researchers speculate that cattle are sensitive to certain taste and odours.

Manure in the water will impact its taste and odour. Cattle have shown a preference to drink at clean water sources over contaminated ones. Cattle will not reduce consumption of contaminated water until manure exceeds 0.25 per cent in the water.

Iron and manganese can also affect the odour and taste of water. It is unknown at this time what levels will result in reduced water intake.

Good management practices of water bodies, such as keeping source waterways grassed, preventing direct livestock access and aerating dugouts are inexpensive ways to minimize unwanted tastes and odours and ensure a good quality water source. Treatment to remove taste and odour is expensive but prevention is affordable.

Water temperature

Water temperature may affect water intake by livestock. Research has shown that cool water helps livestock maintain a proper body temperature and can increase water intake, in turn increasing weight gains. If it is possible to maintain cool drinking water, there is a performance advantage to producers.

Deep dugouts and groundwater are naturally cool. Use of a water pump which draws this cool water out only when desired by livestock is beneficial. Shallow sloughs and dugouts as well as small water troughs may heat up to a point where livestock water intake is affected.

Effect of water quality on weight gain

Studies have been conducted to examine the effect of water quality on cattle weight gains. These studies have shown that the more water an animal drinks, the more feed it consumes, which leads to greater weight gain.

During a study conducted in Alberta, researchers documented a nine per cent greater weight gain in calves drinking water from a trough compared to those drinking directly from a pond. Steers showed a 16-19 per cent increase in weight under the same environment.

Another study conducted at the Western Beef Development Centre in Saskatchewan examined four different water treatments processes and the effect they had on cattle intake and weight gain. This study found that enhanced water quality by aeration and coagulation treatments increased water intake an average of 9 per cent over untreated.

On average, yearlings drinking aerated water pumped to a trough gained 90.7 grams/day (0.2 pounds/day) more than those drinking directly from a dugout. Cattle consuming high quality coagulated and chlorinated water also gained 77.1 grams/day (0.17 pounds/day) more than those directly accessing the dugout for water.

The tables below shows the weight gain in the first 60 days of grazing (Period 1), and from the 61st day until the end of the study (Period 2). The units of the first table are kilograms/day. Units of the second table are pounds/day. The periods were separated to compare the differences in forage quality and cattle growth stage.

In Period 1, the cattle gain more weight because are not fully grown and the grass is of higher quality. Consequently, in Period 2, the cattle are close to being fully grown; the grass is of poorer quality. Lower weight gain is expected between 30 and 60 days.

Average daily weight gain (kilograms/day) over five years with different water treatments

Treatment	1999	2000	2001	2002	2003	Period 1 [1]	Period 2 [1]	Average over 5 years

Note: [1] Period 1: day 0 – 60 averaged over 5 years; Period 2: day 61 to end averaged over 5 years n/a = not available

Treatment	1999	2000	2001	2002	2003	Period 1 [1]	Period 2 [1]	Average over 5 years
Direct	0.88	1.17	0.94	0.8	1.05	1.18	0.5	0.97
Pumped	0.94	1.14	0.88	0.92	1.15	1.21	0.54	1
Coagulated	1.06	1.15	0.95	0.92	1.17	1.33	0.54	1.05
Aerated	1.05	1.08	0.99	1.02	1.12	1.3	0.53	1.06
Well Water	n/a	n/a	n/a	n/a	2.67	n/a	n/a	n/a
Note: [1] Period 1: day 0 – 60 averaged over 5 years; Period 2: day 61 to end averaged over 5 years n/a = not available								

Average daily weight gain (pounds/day) over five years with different water treatments

Treatment	1999	2000	2001	2002	2003	Period 1 [1]	Period 2 [1]	Average
Direct	1.94	2.58	2.07	1.76	2.31	2.6	1.1	2.14
Pumped	2.07	2.51	1.94	2.03	2.54	2.67	1.19	2.2
Coagulated	2.34	2.54	2.09	2.03	2.58	2.93	1.19	2.31
Aerated	2.31	2.38	2.18	2.25	2.47	2.87	1.17	2.34
Well	n/a	n/a	n/a	n/a	2.67	n/a	n/a	n/a
Note: [1] Period 1: day 0 – 60 averaged over 5 years; Period 2: day 61 to end averaged over 5 years n/a = not available								

Date modified:

2020-01-24