

Bicarbonate levels alone are sometimes provided without regard of calcium and magnesium ions. Values in Table 22 reflect potential hazard of an irrigation water source in relation to bicarbonate levels.

**Table 22.** Relative hazard of an irrigation water source as related to bicarbonate levels.

HCO <sub>3</sub> <sup>-</sup> (ppm)	Potential Hazard
0-120	None to slight
120-180	Moderate
180-600	Severe
>600	Very severe

### pH

In addition to affecting soil permeability of clay soils, a high bicarbonate content in water can increase soil pH to unacceptable levels. Alkaline water has a high pH, relative high level of sodium and bicarbonate, and relatively low calcium and magnesium levels.

Use of acidifying materials may be necessary to reduce impact of bicarbonates on pH. Usually, irrigating with water sources containing low bicarbonate concentrations can be managed by use of acidifying fertilizers (e.g., ammonium sulfate) or application of granular elemental sulfur. High bicarbonate containing water may require acidification (via injection into the irrigation system) with sulfuric or phosphoric acids to correct the problem. This process requires specialized equipment and constant monitoring to ensure successful acidification of water without phytotoxic effects occurring to turf. Normally, a desirable pH range for turfgrasses is 5.5 to 7.0. Levels above and below these may have detrimental effects and is discussed in further detail in this and the soil chemical property chapters of this book.

### TOXIC IONS

Irrigation water quality is also influenced by other specific ions. Most irrigation water sources contain low levels of a variety of elements. Normally these pose no problems but can increase under conditions of inadequate leaching with quality water, poor soil permeability and during periods of high evaporation. Amount of sodium is of prime concern because it is often found in the largest amount. Sodium is also an

**Table 23.** Potential trace element tolerances for irrigation water.

Element	Continuous use (ppm)	Short-term use on fine-textured soils (ppm)
Aluminum (Al)	1.0 - 5.0	20
Arsenic (As)	1.0	10
Beryllium (Be)	0.5	1.0
Boron (B)	0.75	2.0
Cadmium (Cd)	0.005 - 0.0005	0.05
Chlorine (Cl)	10	--
Chromium (Cr) (hexavalent)	5.0	20
Cobalt (Co)	0.2	10
Copper (Cu)	0.2	5
Fluorine (F)	?	?
Fluoride	1.0	?
Iron (Fe)	?	?
Lead (Pb)	5.0	20
Lithium (Li)	5.0	5.0
Manganese (Mn)	2.0	20
Molybdenum (Mo)	0.005	0.05
Nickel (Ni)	0.5	2
Selenium (Se)	0.05	0.05
Tin (Sn)	?	?
Tungsten (W)	?	?
Vanadium (V)	10	10
Zinc (Zn)	5	10