

**HARDNESS OF WATER FROM THE UPPER PART
OF THE FLORIDAN AQUIFER IN FLORIDA**by
William J. Shampine

The Floridan aquifer, which underlies all of Florida, yields water with a hardness of less than 180 parts per million (ppm) in the northwestern part and throughout much of the center of the State. In most of the rest of the State, the aquifer yields water having a hardness greater than 180 ppm and as much as 1,900 ppm.

Hardness of ground water is caused by dissolved salts from the geologic formations through which the water passes or by direct pollution. Sometimes pollution may indirectly increase the hardness of ground water by increasing the acid content and thus increasing the solution of calcium and magnesium salts.

Water from deep zones of the aquifer tend to be harder than water from more shallow zones. Only the hardness of water from the upper part of the aquifer is shown.

The term "hardness" is applied to the soap neutralizing power of water. Soap will neither cleanse, nor lather, until all of the hardness of the water is precipitated. Any substance, such as calcium, magnesium, iron, manganese, copper, barium, lead, and zinc, that will form an insoluble curd with soap causes hardness. Hardness is usually attributed to calcium and magnesium because other elements are seldom present in significant concentration.

Hardness is usually reported in terms of an equivalent concentration of calcium carbonate which is the amount of calcium carbonate required to cause a hardness equal to that caused by all the substances producing hardness in the water.

The terms "temporary hardness" or "carbonate hardness" and "permanent hardness" or "non-carbonate hardness" have been used extensively. When carbonates or bicarbonates are present in the water in concentrations equivalent to, or greater than, the calcium and magnesium, the scale that forms upon evaporation will consist primarily of calcium carbonate and magnesium hydroxide. Such hardness is termed "carbonate" or, because the scale can be removed with acid, "temporary." When the alkalinity is low, sulfates and chlorides may form scales that cannot readily be dissolved by acid, and such hardness is called "non-carbonate" or "permanent" (McKee and Wolf, 1963, p. 196).

In Florida the hardness is mostly carbonate hardness. In general, the non-carbonate hardness will be less than half of the carbonate hardness; however, in local areas the non-carbonate hardness may exceed the carbonate hardness. The small inset map shows the non-carbonate hardness in the Floridan aquifer in Florida. The carbonate hardness may be approximated by subtracting the value on the non-carbonate hardness map from the value on the total hardness map. In general, only the highly mineralized water in the southern part of Florida contains much non-carbonate hardness.

Detrimental effects of hardness include excessive soap consumption in homes and laundries, formation of scums and curds in homes, laundries, and textile mills, yellowing of fabrics, toughening of vegetables cooked in hard water, and the formation of scale in boilers, hot water heaters, pipes, and cooking utensils.

There have been many attempts to classify water as soft, moderately hard, or hard. Such adjectives are subject to almost as many interpretations as there are readers. The classification described below is that used by the U. S. Geological Survey. Water with a hardness of less than 60 ppm is generally rated as soft, and its treatment for the removal of hardness is rarely justified. Hardness between 60 and 120 ppm is called moderately hard and does not seriously interfere with the use of water for most purposes, but it does slightly increase the consumption of soap, and its removal by a softening process is profitable for laundries and allied industries. Hardness between 120 and 180 ppm is called hard and is unsuitable for many industrial processes and requires treatment for the prevention of scale in boilers. Hardness greater than 180 ppm is called very hard and is objectionable for most industrial and domestic uses.

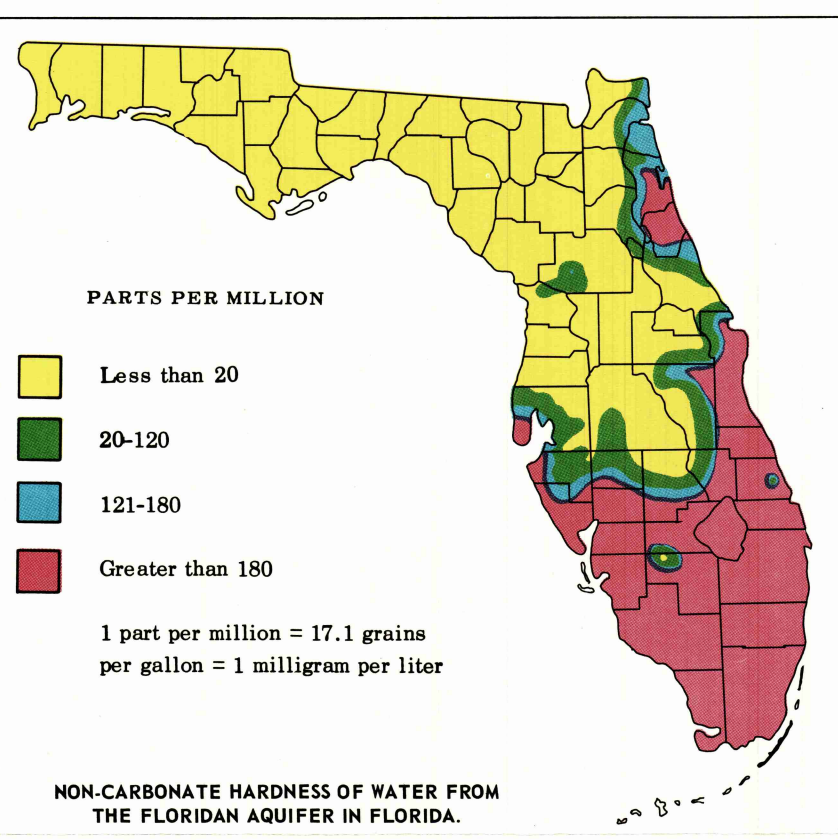
Hard waters have no harmful effects upon the health of consumers (McKee and Wolf, 1963) and are commonly used. Many people in Florida use water having a hardness of from 200 to 400 ppm. Some municipal supplies in Florida are softened and the hardness generally reduced to about 85 ppm.

Concentrations that have been recommended for various industrial water uses are shown in the following tabulation (McKee and Wolf, 1963, p. 196).

Industry and Process	Limiting or Recommended Values in ppm
Boiler feed water:	
at 0-500 psi	80
at 150-250 psi	40
at 250-400 psi	10
over 400 psi	2
Brewing	200-300
Carbonated beverages	200-250
Cooling	50
Food canning and freezing	
general	50-85
legumes	25-75
fruits and vegetables	100-200
peas	200-400
Food equipment washing	10
Food processing, general	10-250
Ice manufacturing	70-72
Laundering	0-50
Pulp and paper making	
groundwood pulp	200
soda pulp	100
Kraft pulp, bleached	100
Kraft pulp, unbleached	200
Fine paper pulp	100
Rayon	
pulp production	8
cloth manufacture	55
Steel manufacturing	50
Synthetic rubber	50
Tanning:	
beam house	513
tan house	50-135
Textile manufacture	0-50

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**DATA AVAILABILITY**

- EXCELLENT**
(Information taken from detailed studies)
- GOOD**
(More than two samples per 250 square miles)
- POOR**
(Less than two samples per 250 square miles)

EXPLANATION**PARTS PER MILLION**

- Less than 60
- 60-120
- 121-180
- Greater than 180

1 part per million = 17.1 grains per gallon = 1 milligram per liter

0 10 20 30 40 50 MILES

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William J. ShampinePrepared by
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in cooperation with the
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FLORIDA DEPARTMENT OF NATURAL RESOURCES
TALLAHASSEE, FLORIDA1965
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peas	200-400
Food equipment washing	10
Food processing, general	10-250
Ice manufacturing	70-72
Laundering	0-50
Pulp and paper making	
groundwood pulp	200
soda pulp	100
Kraft pulp, bleached	100
Kraft pulp, unbleached	200
Fine paper pulp	100
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BUREAU OF GEOLOGYThis public document was promulgated at a total
cost of \$325.00 or a per copy cost of \$1.13 for the
purpose of disseminating hydrologic data.

0 10 20 30 40 50 MILES