

How Water Works

ILLUSTRATED PROCESSES, EQUIPMENT, AND TECHNOLOGY

Lime Softening Removes Hardness-Causing Minerals

Natural water contains dissolved minerals, some of which impart a quality known as “hardness.” Hard water is caused by the presence of calcium and magnesium, and lime softening removes these hardness-causing minerals. Because of the special facilities required and the complexity of the process, it’s applicable mainly to medium-sized or large water systems where all treatment can be accomplished at a central location to minimize cost.

1a and 1b. Lime softening is used to treat either surface water (1a) or groundwater (1b) sources.

2. Large quantities of chemicals are used in the water softening process. Lime can be purchased in two forms: calcium hydroxide, $\text{Ca}(\text{OH})_2$, which is called hydrated lime or slaked lime, and calcium oxide, CaO , which is called quicklime or unslaked lime. Lime and sodium carbonate, Na_2CO_3 , also known as soda ash, are necessary when there is a nominal amount of magnesium hardness in the water. Sodium hydroxide, also known as caustic soda, NaOH , can be used in place of lime or soda ash for softening, but it’s generally more expensive.

3. Conventional dry feeders and solution feeders are used to dispense coagulants, such as alum, and coagulant and settling aids, such as organic polymers, if necessary. Dust control equipment should always be used while working with dry powdered chemicals.

4. A rapid-mix basin is used to thoroughly mix lime, soda ash, and other chemicals with water and to maintain mixing long enough for the chemicals to dissolve—especially critical for lime, because it dissolves slowly.

5. Solids-contact clarifiers are often used to perform coagulation–flocculation, sedimentation, sludge

collection, and sludge recirculation. A solids-contact basin saves on construction costs by handling many softening processes in one component.

6. Filters used in a lime–soda ash softening plant are identical to those used in a conventional rapid sand or multimedia filter plant.

7. A recarbonation basin adds carbon dioxide, CO_2 , to softened water to stabilize the water before it enters the distribution system and to adjust the pH when two-stage softening is practiced.

8. Sludge-dewatering devices such as vacuum filters reduce the amount of water in the sludge, thereby making it easier to handle. Most plants dispose of sludge by trucking it to a land disposal site.

9. Chlorine is added for disinfection.

10. Finished water contact basins ensure contact time is allotted for adequate disinfection.

11. A covered clearwell stores water before it enters the distribution system.

12. Pumps send safe, softened water throughout the community.

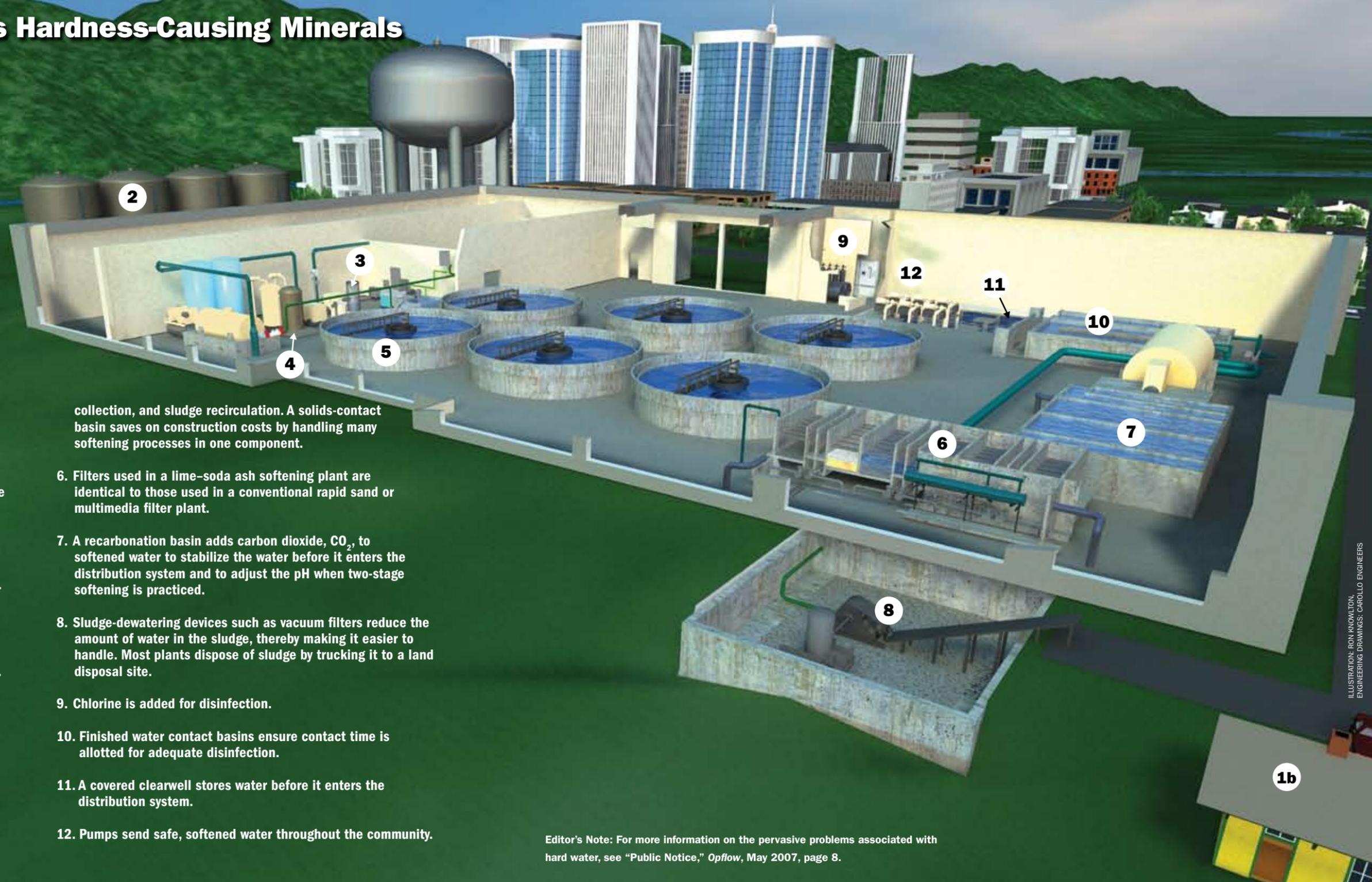


ILLUSTRATION: RON KNOWLTON
ENGINEERING DRAWINGS: CAROLO ENGINEERS

Editor’s Note: For more information on the pervasive problems associated with hard water, see “Public Notice,” *Opflow*, May 2007, page 8.

Some illustration elements exaggerated for emphasis.