Water is the most abundant compound in the world. It is also taken for granted—until its quantity or quality becomes scarce. Recently, drought conditions in parts of the country have severely limited maintenance of turfgrass quality. These experiences have made turfgrass managers more aware of the critical need to effectively manage water supplies. The following article is the first in a series which will cover information presented at the 25th Nebraska Turfgrass Conference.

The authors have considerable experience and expertise relating to turfgrass water quality and quantity, water use and drought resistance.

Some of this information is technical by the very nature of drought resistance in plants. Drought stress is complex and involves a number of interactive factors. However, turfgrass managers should not despair, as you will read this month and in following months.

PART I OF IV

WATER: AN ENDANGERED HERITAGE

H_2O: How can we use it wisely, share it fairly, and still maintain its quality?

by A. E. Dudek, Ph.D., University of Florida

Water is something everyone seems to take for granted. It is cause for concern only during times of scarcity. Yet it is the most abundant chemical compound in the world. It is a major constituent of all living organisms. Without water, life would cease to exist.

It is used in most agricultural and industrial processes. But most importantly, there is no substitute for water, even in this age of high technology. A person can survive one week without food, but only three days without water.

Conversion of water into plant dry

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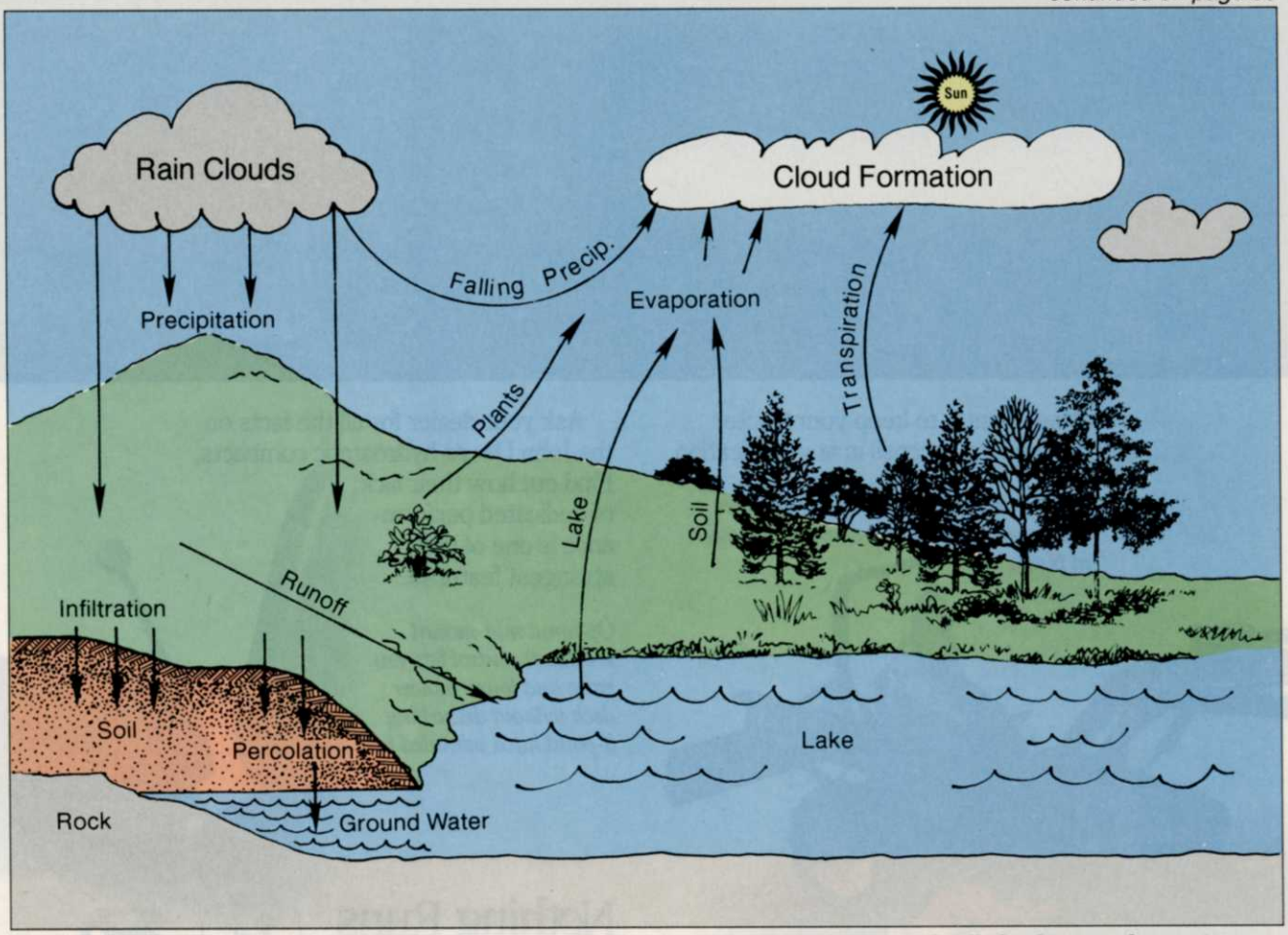

Figure 1. Hydrologic Cycle - Moisture is recycled through evaporation, condenses and falls back to earth as rain, sleet, hail, snow, dew and fog.

matter is very inefficient. Botanists say that 1000 pounds of water (approximately 120 gallons) is needed to produce one pound of plant dry matter. Industrial needs also have great demands for water, requiring 200 gallons to produce a pound of rubber, 30 gallons to produce a pound of paper, and 18 gallons to produce a pound of steel.

Furthermore, agricultural and industrial demands on water are heavily impacted by human needs, which in many cases are very wasteful. On the average, we use 25 gallons of water for a shower, 16 gallons to run the dishwasher, three gallons to flush the toilet, but only five to six pints for body functions.

Water crisis

Today, most people are unaware of a water crisis which involves quality and quantity. This crisis is a result of increased demand on a constant supply. Worse yet, we have contaminated and continue to pollute our present resources.

Average annual precipitation in the United States is 30-60 inches per year in the humid East to 10-30 inches in the dry West.

It has been estimated that, if we continue to increase use of fossil fuels at the present rate of four percent per year, the mean global temperature will increase by two degrees Celsius by the year 2000 and seven degrees by the year 2050. This temperature increase may not seem much, but it would make North America significantly drier than it is today. The drying trend would magnify our future water needs.

One researcher says that, "for the next generation of Americans, water—its competing uses and conflicts that arise out of those uses—may be *the* most critical national problem."

Since the amount of available water is fixed, and water needs multiply with population and industrial growth, how can we use it wisely, share it fairly, and still maintain water quality?

Most people are unaware of a water crisis which involves quality and quantity.

The U.S. Water Resource Council predicts that our 1980 water requirements for municipal, industrial and agricultural uses of 443 billion gallons of water per day (bgd) will nearly double to 805 bgd by the year 2000 and triple to 1,386 bgd by the year 2020. A gloomy outlook for water has been projected. So areas that should be emphasized to meet future water needs are:

1) New technologies for using limited water resources.

2) Expanded capital to cover increased operating costs for recycling waste water.

3) Awareness of a quantitative water shortage in the Southwest, and that other states will share similar fates.

4) Maintenance of water *quality* being equally or more important than *quantity*.

Water quality has changed significantly over the past years. Fossil fuels have influenced the distribution of acid rain throughout the U.S. and Canada. Overpumping has decreased underground water supplies in the U.S., leading to increased salinity of irrigation water. Surface waters have been polluted by heavy municipal, industrial and agricultural uses. This ultimately has increased pollution of our underground water resources.

Water resouces

Oceans cover 70 percent of the Earth's surface and contain 97 percent of its water.

This is a result of the hydrological cycle (Fig. 1). Water evaporates from soil and water surfaces into the atmosphere as a vapor, where it condenses

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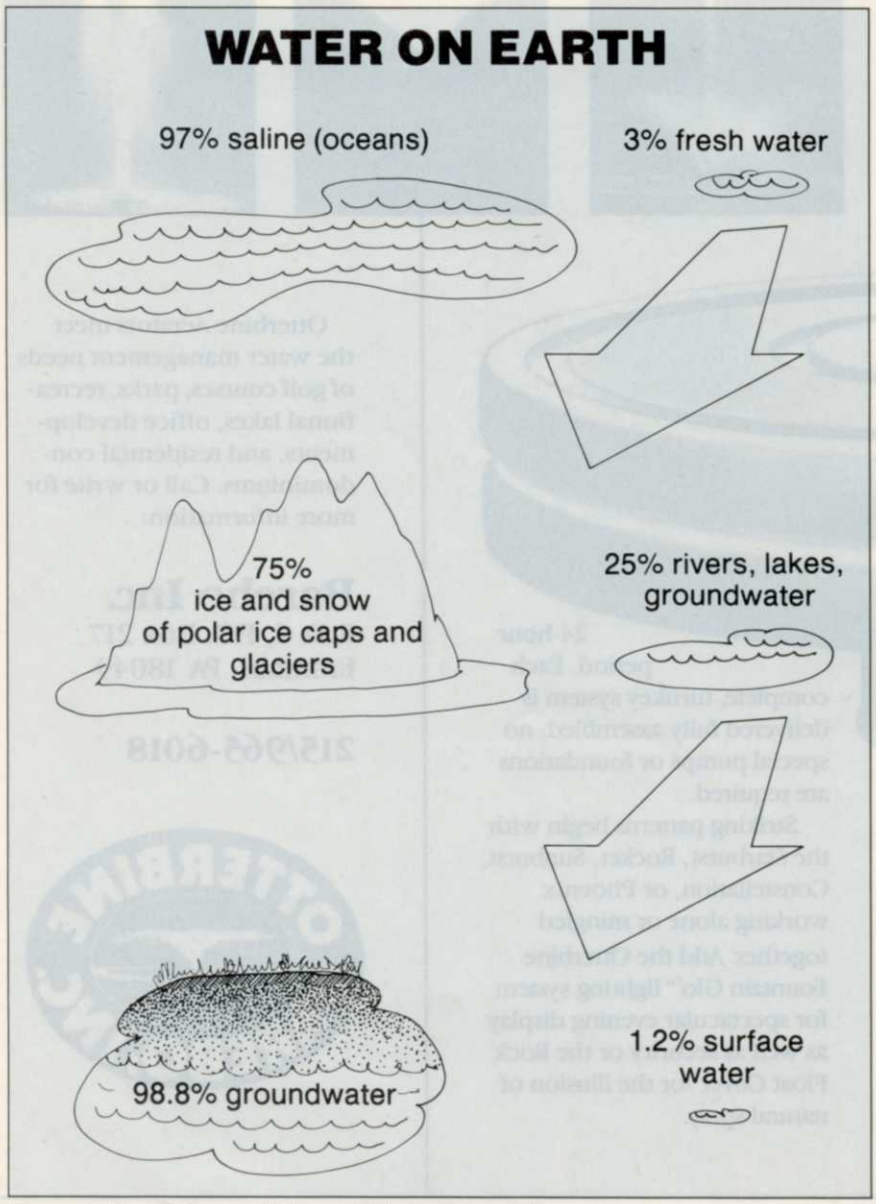

Figure 2. Breakdown of the earth's water supply.

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as rain or snow which falls back to the ground as precipitation. Free water then percolates through the soil, picks up dissolved minerals, and carries them back to the ocean by means of streams and rivers. This cycle is continuous, and is why the oceans of the world are as salty (saline).

Only three percent of the Earth's water supply is fresh (non-saline). Of this three percent freshwater, 75 percent is trapped as ice and snow in polar ice caps and glaciers. Only 25 percent is found in rivers, lakes and groundwater. The 25 percent is further broken down to only 1.2 percent surface water with the remaining 98.8 percent as groundwater. Oceans are being used as a water source by desalination, but this process is costly.

Present-day water resources involve wells, rivers and streams, and effluent. Well water was once a relatively constant source of stable, good quality water, free of toxic materials and pest problems. But overpumping and groundwater contamination have caused serious environmental concerns with this water source. Rivers and streams are also polluted because of surface runoff.

Effluent may be the turfgrass industry's salvation.

Recycled effluent

Increased population goes hand-in-hand with increased waste. On the average, each person produces 70-100 gallons of waste water and .25 pounds of sewage sludge daily. Thus, 400 gallons of polluted water are produced with every pound of organic matter transported to the nearest sewage treatment plant.

Water recycling will become the rule rather than the exception, and turf would be a *natural* for recycling effluent water.

Turf is a perennial ground cover that grows most of the year, in contrast to annual agronomic or horticultural crops. Turf has a high water requirement. Most importantly, turf is an urban commodity that is used close to the source of effluent supply. Wastewater is used on a turf ground cover for plant uptake, evapotranspiration into the atmosphere, and percolation into the ground where it is filtered and then purified by soil microbes. Thus, benefits of wastewater irrigation are several:

1) Inexpensive source of water.

2) Save potable water for other purposes.

3) Urban greenbelt areas for recreation.

4) Economic returns on crop sales.

5) Positive alternative to advanced wastewater treatment and surface water discharge.

Depending on the degree of wastewater treatment and availability, some states require the use of recycled water for turf irrigation instead of potable water.

Gray water

Gray water is a relatively new idea being used in new housing developments.

Forty percent of the average household's wastewater comes from the toilet, 30 percent from the bath and shower, 15 percent from the laundry, 10 percent from the kitchen and 5 percent from other sources.

The gray water concept isolates the toilet water from other household water. Only toilet water with its organic matter is connected to sewage lines for transportation to a sewage treatment plant where it undergoes normal processing. Thus, processing at the treatment plant is reduced 60 percent because the remaining sources of water are collected, treated and recycled at the home. Gray water is used for washing automobiles, watering landscapes, etc. Also, this water may be recycled back to the bathroom where it can be used in the toilet to further reduce our demands on potable water.

For the next generation of Americans, water may be the most critical national problem.

The future

The 1972 Federal Water Pollution Control Act amendments set a national goal of eliminating discharge of pollutants into navigable waters by 1985. We've made a lot of progress to date, but we still have a long way to go. Unfortunately, the Clean Water Bill has not yet been resolved in Congress.

Obviously, a master plan involving federal, state and local water planning groups is needed to analyze our existing and future needs. All water-related industries must be protected. During times of water shortages, turf facilities are the first to be restricted. Water priorities must be set based on essential, critical needs which are fair to all concerned.

Water is our most precious resource. Be careful how you use it. **LM**