$000 Current Seawater Desalting Costs?

By Mark Bird

Photo and map courtesy of Colorado River Commission

Introduction

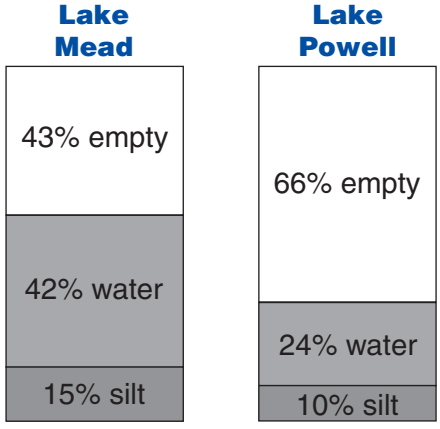
Can nations now desalinate a million—or a billion—gallons of seawater at no real cost? Could $000 be the real cost to purify an acre/foot of desalted ocean water? This article answers these questions in the affirmative if the indirect desalting benefits are considered.

The United States Colorado River system will be used as an example of 19 benefits that are derived from desalination. Similar results would apply to multiple water shortage locations around the world. Most of these 19 benefits would be applicable to nations adjacent to an ocean. For example, clean water benefits would apply to a far greater extent to nations other than the U.S.

An example

Lakes Mead and Powell on the Colorado River are the two largest reservoirs in the U.S. As the only large river system in the southwest, the Colorado is a lifeline for over 25 million people. Almost every year for the past 25 years, no river water has entered the ocean.

It took from 1963 to 1980 (17 years) for Lake Powell to fill completely. The water now remaining in Lake Powell could all fit into Lake Mead and Lake Mead would still be far from being full. Insofar as the Colorado River system now provides water to around 10 million more people than when Lake Powell was filling, it appears likely that it will take more than 17 years for both lakes to fill under normal river flow conditions.



Population growth, possible plans by the state of Colorado to pipe water to the east side of the Continental Divide, Native American water claims, increased reservoir evaporation from global warming and other factors will intensify water shortages in the southwest. Exacerbating the problem will be rising temperatures: the five warmest years in over a century, in order, have been 1998, 2002, 2003, 2004 and 2001.

Global warming may be the cause of less annual snowfall, vegetation needing more water, more evaporation from all Colorado River reservoirs and more evaporation from over 1,000 miles of river canals. That evaporation is no trivial matter as it is estimated as much as 20 percent of river flow evaporates under normal conditions. If global warming is the primary or a leading contributor to low river flows for the past five years, there is the distinct likelihood that these reservoirs will never fill from river flow.

If the U.S. government had pursued desalination research and development more vigorously during the past 30 years, the following 19 factors would now be less severe. If the U.S. pursues desalination R&D and other remedies to restore these lakes now, these factors will become less severe. As over 200 cities including the largest cities in Arizona, Nevada and California are highly dependent on the Colorado River, if the U.S. ignores desalination R&D and other remedies, the worst case scenario is the economic collapse of these three states.

19 Factors

Inland Areas

California desalting potentially allows more river water for reservoirs and the other six Colorado River states.

According to the U.N., about half of the world's rivers are depleted and polluted. Major rivers, including the Ganges, Yellow and Rio Grande, now regularly run dry. Coastal desalting at these or other river deltas would provide water for inland areas.

Pollutants

In 2004, the non-profit organization American Rivers designated the Colorado as the "Number One Most Endangered River in the U.S.," a rank earned more because of pollutants than because of water scarcity.

As an example of one pollutant, American Rivers noted that 400 pounds of rocket fuel flow toward Lake Mead each day. Among the over 100 pollutants and chemical compounds found in the two lakes are arsenic, chlorine compounds, cow manure, *Cryptosporidium*, lead, mercury, medical waste, paint derivatives, parasites, pesticides, phosphates, plane exhaust derivatives from the nearby Las Vegas airport (that now hosts 40 million passengers per year), plastics, septic tank discharge, sewage sludge, ski boat gasoline and urban storm runoff. Last but not least is residue from the years of atmospheric nuclear testing at Nevada test sites. This water flows untreated to farms in Arizona and California. Fruits and vegetables from these farms are shipped to all 50 states.

California desalting plants would mean people would be ingesting higher quality water. If the U.S. had vigorously pursued desalination over the past few decades, both lakes would likely be at a higher water level today. These pollutants are concentrated in the lower levels of the lakes. Now that both lakes have declined considerably, there is a very real chance that higher concentrations of these pollutants are entering our food supply and will continue to do so.

Groundwater deterioration

Subsurface water is far more subject to contamination from mining, agriculture and industry than desalted water. Higher concentrations of metals, pesticides, toxins and human and nonhuman fecal matter are contained in groundwater than desalted water. Sub-surface water is likely to experience declining water quality in the decades to come. Desalting can help prevent further groundwater deterioration by giving cites and nations less justification for groundwater withdrawal.

Diseases

Cancer, birth defects, internal organ malfunctions and over a dozen other diseases are partly attributable to low quality water. Seventy percent of the human body and 90 percent of blood is water. The thousands of waterborne disease deaths from the December Asian tsunami catastrophe is a global reminder of the necessity of clean water.

Electricity

Glen Canyon Dam at Lake Powell has lost 25 percent of its power generation capacity. Hoover Dam at Lake Mead has lost 17 percent of its power generation capacity. Increased power costs have already been passed on to some consumers. Glen Canyon Dam may lose 100 percent of its power capacity in another three years.

Recreation

According to National Park Service records, in 2004 Lake Mead had roughly one million less visitors than in the year prior to the last five low flow years. Some people incorrectly think Lake Mead is closed to recreation as they have seen the low water levels on major news networks. In the past five years, tens of millions of recreation dollars have been lost to the region. Millions have been spent just from marinas having to repeatedly relocate due to the declining water levels.

Food prices

A significant portion of the food consumed in the United States is grown in Southern California. Coastal desalination would increasingly assist farms, allowing Colorado River water to be used for prudent inland agriculture.

Water shortage preparation

Desalination far better prepares arid regions for probable future periods of water shortages. It gives water agencies and states more flexibility. The National Weather Service is forecasting that the inflow to Lake Powell from April to July will be 114 percent of average. It would probably take ten consecutive years of inflow to fill Lakes Powell and Mead.

Global warming

Climatologists are nearly unanimous in their belief that global warming is occurring and that it will intensify in the future. A few years ago, an iceberg the size of Delaware chipped off of Antarctica. In the past 30 years, an area of ice larger than Texas has been lost in the Arctic. Alaskan villages have already been relocated due to rising water levels. Desalting plants currently in operation—over 10,000 of them—have already reduced damages caused by global warming by taking water out of the oceans.

The dollar value of inundated an Florida or Southern California coastal land could be considered an asset for desalination. Relative to the Colorado River states, desalination further reduces global warming damages as millions of people in the southwest are being urged to undergo turf conversion, eliminate lawns and generally water less with the partial consequence that less cooling and less oxygen enter the warming atmosphere.

Environmental damages

Substantially less adverse ecological destruction to wildlife, endangered species, national parks, flora, public land, roads and utilities would occur with desalination than with comparable groundwater development.

Litigation

Since there is a relatively infinite amount of ocean water and less impact with desalination as compared to land-based water development, the cost of litigation (calibrated in both time and money) would be substantially reduced. A previous legal dispute between Arizona and California lasted for over a decade before being decided by the U.S. Supreme Court. Recent news stories have indicated most river states, many Native American tribes, environmentalists representing the parched river delta and others all thought their water interests were shortchanged before the last five low flow years.

Currently, given the water scarcity in the Colorado River system, there is talk of the potential for litigation between the lower basin Colorado River states, and possible disputes between the lower and upper basin states. If states do not reach agreement on how future water reductions will be managed, it is probable that such litigation will be in the courts for years.

Mexico

Mexico has an annual legal entitlement to 1.5 million acre-feet of water from the Colorado River. In 1974, Congress authorized the construction of a desalting plant at Yuma Arizona to ensure water quality going to Mexico. As the U.S. recognizes these obligations, ocean desalination thereby reduces probable costs, salinity damages and international embarrassment by helping to maintain Mexico's water supply. Colorado River salinity damages are not trivial; they typically range from $500 to $750 million dollars per year. Besides being lethal to crops, river salt is harmful to machinery, fish and wildlife. In this context, desalination is not only an interstate solution but also fosters positive international relations.

Incentives

The federal government can develop conservation contingent desalting funding agreements with cities and states, and this can work on an international scale in the same fashion. Desalting can be legislatively contingent upon EPA-type monitoring of farm wastewater and per capita water consumption rates. This would promote conservation as well as reduce the time and quantity of desalination.

Coastal aquifers

Cities in Southern California and around the world are subject to seawater intrusion into municipal aquifers. Desalting reduces seawater intrusion and groundwater withdrawal-induced subsidence because if a coastal aquifer is near normal capacity, the substantial water pressure prevents seawater intrusion.

Mineral development

Desalting is likely to lead to cheaper development of the abundance of gold and dozens of other minerals in the oceans. Salt has hundreds of uses besides the small percentage used as table salt. In the virtually impossible event that desalting costs do not continue to rapidly decline, new chemical separation techniques applied to saline residue could make desalting a literal goldmine.

Trade imbalance

If the U.S. does not pursue desalting, Japan or other countries will assume leadership. Such neglect is likely to cost the U.S. tens of billions of trade dollars in the 21st century. By the middle of the century, the U.S.-Japan desalting trade imbalance could be as large as the highest U.S.-Japan auto trade imbalance. Unlike just three decades ago when the U.S. was on the cutting-edge in desalination development, Japan now produces and sells about three times as much desalination technology as the United States, according to former U.S. Senator Paul Simon (deceased).

War prospects reduced

Israel has engaged in several armed disputes over water. Prior to Iraq's invasion of Kuwait, Turkey and Syria were making vigorous plans to build upstream dams on the Tigris and Euphrates rivers. Both rivers flow through the center of Iraq for hundreds of miles. As Kuwait has some of the best desalting facilities, this was suggested as a crucial motive for the invasion. Similarly, strife in Somalia was attributed both to drought and to Ethiopia preventing water from flowing into Somalia. Egypt has threatened to go to war if several downstream nations try to divert water from Nile River tributaries. Desalting reduces future prospects for conflict in these and other locations with scarce water. What if U.S. and Israeli scientists assisted Middle East countries in building desalting plants as a means of promoting political stability?

One billion people

Over a billion people now have inadequate drinking water, according to the United Nations. This includes millions of children whose lives are measurably shortened or ended by poor quality water. Given auspicious desalting cost trends and global ocean-land distribution, desalting helps to bequeath to posterity an infinite clean water source.

Future costs

People buy homes, stocks and land because of an anticipated higher future value of these commodities. Governments regularly make decisions based on a future economic value. Hence, governments should also consider not only the present price of desalination but also the future price.

The following table depicts historic and future costs of desalting ocean water. Costs increased in the 1980s due to escalating energy costs. It appears certain to this writer that future less-energy-intensive desalting technology will accelerate a decrease in costs. The following table was adapted and updated from former Senator Simon's book, *Tapped Out*, page 123.

Decade	Cost per 1,000 gallons
1950s	$ 15- 20
1960s	$ 6- 9
1970s	$ 2- 7
1980s	$ 4- 7
1990s	$ 4- 6
2000s	$ 2- 5
2010s	$ 1- 2 ?
2020s	$??

Future desalting costs are also likely to decline given anticipated advances in pre-treatment, membranes and computer monitoring of desalination functions. Some scholars anticipate major theoretical desalting discoveries in the near future. Four types of potential innovations are tidal-solar desalting, vertical desalting, microbial desalting and environmentally benign fusion desalting. Conventional plants may also be modified to serve a vastly less expensive innovation. While desalting costs are certain to decline, the price of land-based water development is certain to increase.

Conclusion

According to the U.N. Commission on Sustainable Development, between three and four million people annually die from waterborne diseases. According to Water Partners International, "Water-related diseases are the leading causes of death in the world. This killer takes the lives of more than 14,000 people each day and is responsible for 80 percent of all sickness in the world."

Many water experts would contend that desalting is an impossibility for poor countries. But millions of people subsist on 10 gallons or less per day. At a current desalting rate of $3 per 1,000 gallons, the lives of millions would improve at a cost of three cents per day.

The world's current desalting plants save thousands of lives per year. By the end of the 21st century, with vastly improved desalting technology in use all over the planet, desalting is likely to save over a million lives per year. By governments not explicitly recognizing the current life-enhancing properties of desalting, are they not implicitly placing a low value on life?

A proper scientific analysis of desalting entails estimating the dollar and human value of the above 19 factors, and then using this value when evaluating the costs of ocean desalting. If all or even half of the above cost factors were considered, ocean desalting becomes an increasingly attractive option. Given these 19 factors, could the current real cost of ocean desalting be less than $000 per billion gallons for the U.S. Southwest?

About the author

♦ *Mark Bird is a faculty member at the Community College of Southern Nevada. He is a former federal water planner and author of over 30 water-related articles. Bird can be reached via email at mark_bird@ccsn.edu*