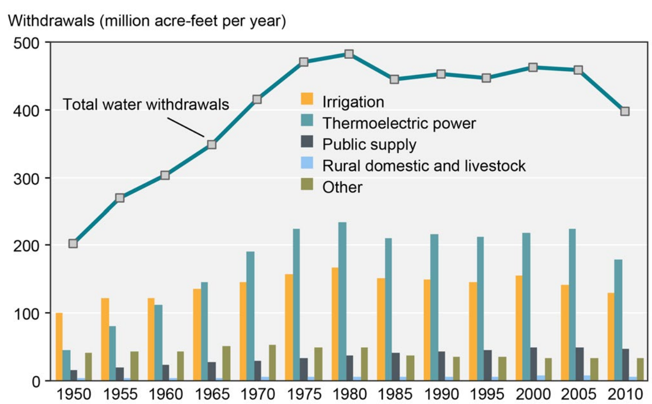
The Case for Trans-Basin Water Pipelines

by Maury D. Gaston

Water issues are increasingly in the news. Texas and California, two of our most populous and economically vibrant states, have been experiencing drought not seen in the careers of today's water and municipal professionals. Recent floods in Texas may be the end of the drought there, or may not be. El Nino may return to California this winter. Like the recent drought, we simply won't know until we are past it.

Progress thus Far

Water industry leaders have significantly reduced per capita water consumption from its peak. In 1980, our population was 230 million and our daily water withdrawals were 430 billion gallons, or 1,869 gallons per person per day. This includes water for energy production, agriculture, and household use, the water-energy-food nexus. In 2010, our population had increased to 309 million and our total water withdrawals fell to 355 billion gallons per day. This is a 38% reduction in per capita water use. [1]



Water use by sector since 1950.

There may be additional per capita savings to be had, but now is a great opportunity to make additional progress by augmenting our nation's water supply. This paper presents a plan for that including benefits of flood control, drought relief, economic security, jobs, and much more.

Parallels in Infrastructure

Let's briefly review the history and development of our transportation, electrical, and energy infrastructure. Today's interstate highway system has its origin in local trails that became county roads, which became a state road network, which grew into the U. S. highway system. Short-line and local railroads grew to the trans-continental railroad, a public-private partnership that spurred unprecedented economic growth. [2]

The United States rail network is a public-private partnership success.

Early on, local steam plants produced electricity for cities and small towns that were soon connected to one another and have since grown to various investor-owned, connected power grids using numerous fuel sources. Most of these were built and are operated through the private sector. The power to burn a bulb or heat a home in Minnesota may well have been generated by a hydroelectric facility in Alabama. All of these utilities are generally investor-owned private entities serving the public with essential services.

Our vast petroleum network is privately owned and operated and makes possible the free trade and movement of valuable energy resources from their source to the refineries, and then to consumers.

Water, on the other hand, has largely remained a local and sometimes regional service usually provided at a service rate far below its value. Given the current imbalances in water supply and demand, and the lack of public capital, it's time to rethink both policy and funding, and consider an integrated water network financed through public-private partnerships. When the cost of water more closely reflects its value, investment in water supply will be attractive.

Water and Economics

We all know water is essential for life, but the economic value of water is often not as well understood by the general public. The residents in Texas and California, and the farmers and ranchers in the Great Plains however, have more recently developed a keen understanding of these issues at this defining time.

Even in the midst of these record-setting droughts, our nation is blessed with an abundance of water, and that abundance has been necessary for our prosperity and growth. Our coastlines and waterways have contributed to our nation's strength and growth and fostered our expansion from sea to shining sea. Simply put, economic growth has always followed water supply.

Economic growth has always followed water supply.

While today's droughts draw our attention and we speak of a water shortage, we actually have all the water we have ever had, and we also have all the water we will ever have. After all, it's called a hydrological cycle for a reason.

As recently as 2010, following a year of above-average rainfall, the Tennessee River had an excess flow of 45 billion gallons each day. All reservoirs were full, and 29 hydroelectric dams were generating at full capacity, yet excess flow still escaped downstream. [3]

A hydroelectric dam producing power from river flows.

Roman aqueducts were necessary for the growth and security of the Empire.

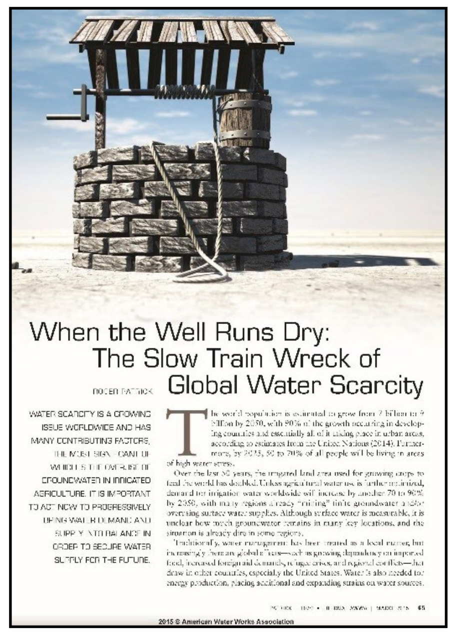
The story of mankind is the story of water. The Tigris and Euphrates rivers are the cradle of civilization. The Nile River made the rise of Egypt possible. Roman aqueducts secured the empire's water supply and together with the Roman roads ensured her power. Moving water from areas of abundance to areas of need is as old as civilization itself.

In 1982, studies were being done related to collecting flood waters from the Missouri and Mississippi rivers and using them to slake the thirst of the Colorado River basin. [4] More recently, the seven Colorado River Basin states commissioned a study concerning augmentation of their water supply. [5] Leaders of this project have indicated there is private investor interest. A $3.4-billion water supply project in Texas is being privately funded. [6] More than 30 years later, the 2015 floods in Texas quickly filled low reservoirs and then billions of gallons more freely flowed into rivers, over many miles of riverbanks into our communities and homes causing unmeasured damage, and was eventually lost to the sea. If volume and elevation gauges had been in place, the rising rivers could have been drawn from and those precious gallons transferred away from the immediate area to a system of reservoirs or into a network whereby water can be directed to where it is needed. Pervasive flood damage can be avoided and water supply needs can be met. We can regulate rail, air traffic, and electrical demand in real time throughout the day and all year long. Why not do the same with water?

A plan is on the table which would move Missouri River water across Kansas and Colorado.

The Water Dichotomy

Our problem is that our water supply and our water demand are separated. This water supply vs. water demand problem is bad enough when only population centers are considered, but it is further exacerbated when our agricultural water supply and water demand are out of balance. Conservation in all areas of water use has helped and has pushed the drop-dead date into the future to varying degrees. However, given the current circumstances and future projections, augmented water supply is increasingly seen as necessary.


When the Well Runs Dry:
The Slow Train Wreck of
Global Water Scarcity

ROGER PATRICK

WATER SCARCITY IS A GROWING ISSUE WORLDWIDE AND HAS MANY CONTRIBUTING FACTORS, THE MOST SIGNIFICANT OF WHICH IS THE OVERUSE OF GROUNDWATER IN IRRIGATED AGRICULTURE. IT IS IMPORTANT TO ACT NOW TO PROGRESSIVELY BRING WATER DEMAND AND SUPPLY INTO BALANCE IN ORDER TO SECURE WATER SUPPLY FOR THE FUTURE.

The world population is estimated to grow from 7 billion to 9 billion by 2050, with 90% of the growth occurring in developing countries and essentially all of it taking place in urban areas, according to estimates from the United Nations (2014). Furthermore, by 2025, 50 to 70% of all people will be living in areas of high water stress.

Over the last 50 years, the irrigated land area used for growing crops to feed the world has doubled. Unless agricultural water use is further [illegible], demand for irrigation water worldwide will increase by another 70 to 90% by 2050, with many regions already "mining" finite groundwater and/or overusing surface water supplies. Although surface water is measurable, it is unclear how much groundwater remains in many key locations, and the situation is already dire in some regions.

Traditionally, water management has been treated as a local matter, but increasingly there are global effects—such as growing dependency on imported food, increased foreign aid demands, refugee crises, and regional conflicts—that draw in other countries, especially the United States. Water is also needed for energy production, placing additional and expanding strains on water sources.

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Water scarcity around the world and here in the United States was recently chronicled in the March 2015 edition of Journal AWWA by Roger Patrick. [7]

Given the geographical dichotomy of our water supply and our water demand; our current, multiple droughts; the cost of damaging floods; and our public funding environment today; the discussion of an expanded and integrated water network funded through public-private partnerships is an idea whose time has come.

In December of 2015, the White House announced a program to investigate just that. [8] One of the plan's three main points is to increase water exchanges and transfers. The program also calls to promote innovative financing to fund new water infrastructure. All of that is complementary to the concepts promoted in this paper, originally published on World Water Day in March 2015, and expanded since then to include recent developments.

A Future Vision

An expanded and integrated water supply system, as suggested here, provides a vision for building a water augmentation network to move our water from where we have it abundantly – and maybe even suddenly – to where we need it badly.

Eight of the American Public Works Association's top ten projects of the 20th century involve water. [9] Let's have another innovative, forward-thinking public works project, address flood control on one hand and water shortages on the other, put hundreds of thousands of Americans to work, strengthen our economy, and ensure our future economic vitality with respect to water supply, and do it with public-private partnerships.

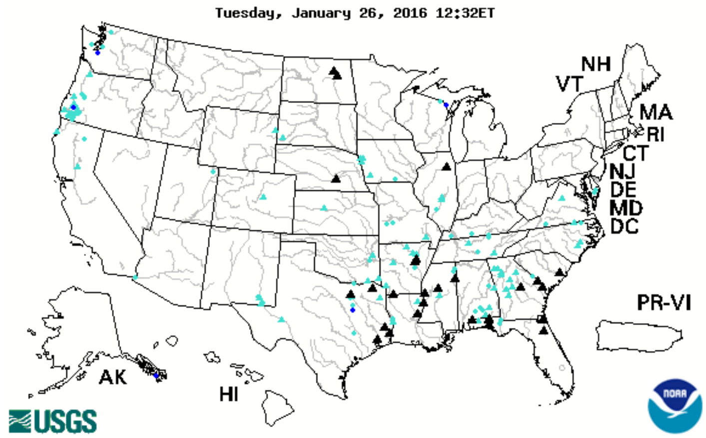
Eight of the 20th century's top ten public works projects involve water.

Let's look at some of the benefits of such an insightful undertaking.

Private investment in infrastructure has increased 50 percent in the 12 months prior to September 2014 and the trend is continuing. [10] Many organizations, including the Brookings Institution, have documented the impact of infrastructure investment on the American economy in general and job creation in particular. Infrastructure jobs are not limited to short-term construction. In fact, there are more jobs in long-term infrastructure finance, design, operation, and governance than in hands-on construction. [11]

In the manufacturing and construction sectors, the building of trans-basin pipelines would be a tremendous boost to iron and steel, aggregates, concrete, transportation, welding, heavy equipment, valves, pumps, and power suppliers, among other industrial and economic sectors.

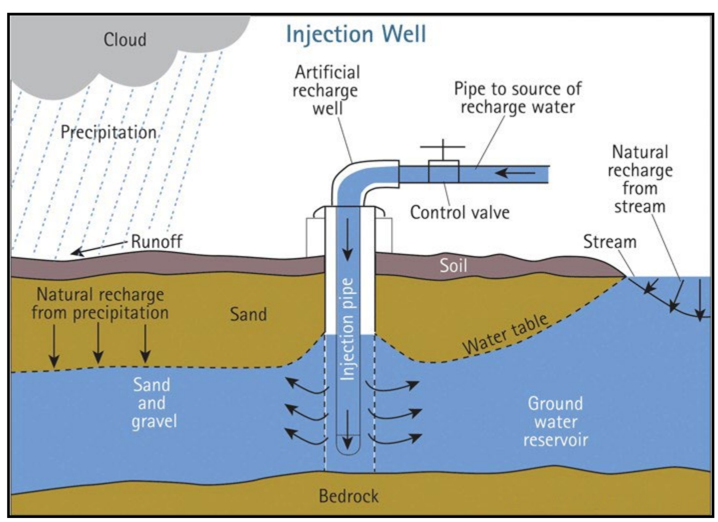
The United States Geological Survey has a network of more than 7,500 stream gauges to monitor stream and river flow and provide flood-prediction data. [12]



The USGS stream gauge network.

This information can be used to activate pumps to move valuable water before it becomes destructive floodwater, transfer it to areas of drought, fill depleted reservoirs, and recharge falling aquifers. This may strike some as far-fetched, but the nation's electrical grid works that way, moving electrons in real time from where they are to where they are needed. [13]

Groundwater replenishment, pumping surface water into the aquifer, is more economical than construction of new reservoirs and more economical than desalination. [14] Projected costs vary widely depending on many variables, but the average of the 25th and 75th percentiles for aquifer recharge is $595 per acre-foot compared to $2,200 for reservoir construction and more than $2,450 for desalination. Groundwater recharge would face significantly less opposition, if any, as compared to additional reservoirs; and while very expensive, desalination's benefits are mostly along the coasts.



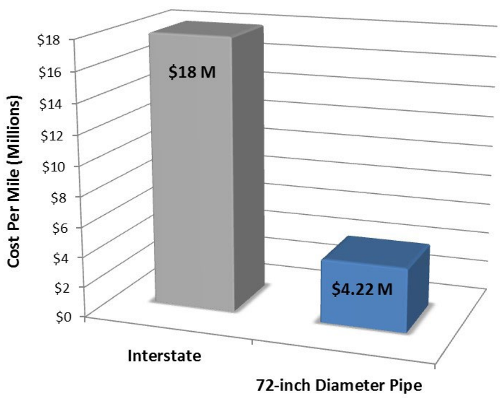
Artificial groundwater re-charge with injection wells.

Laurent Auguste, President and CEO of Veolia Water Americas, recently wrote about the crucial role water plays in economic development and security. [15]

Challenges

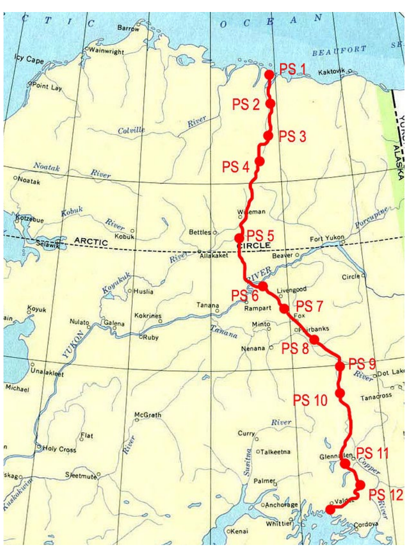
The needs and benefits are obvious, but what are the obstacles to super-regional or even a nationwide water supply network?

Cost is always an issue. Perhaps surprisingly, the cost per mile of a 72-inch diameter pipeline is one-quarter the cost of a mile of interstate highway. [16]



Relative costs of a mile of interstate highway and a mile of 72-inch diameter pipe.

A 72-inch diameter pipeline flowing at 4 feet per second, can deliver 50,000 gallons per minute, 73 million gallons per day, 26 billion gallons or 80,000 acre-feet each year. [17] This would move significant volumes of water from where we have it abundantly – strong river flows, good rainfall, and springtime floods – to where we need it badly. Maintenance costs of an underground pipeline are less than those of a surface highway, but operational costs such as pump station construction and electricity for pumping will be substantial.



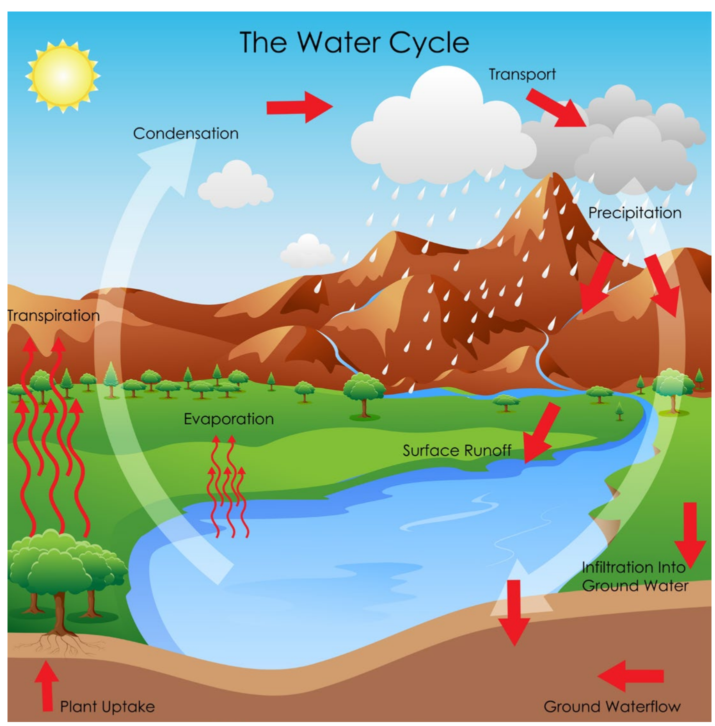
The Alaskan pipeline is 800 miles long, the same distance as Atlanta, Georgia, to Dallas, Texas; and from Seattle, Washington, to the San Joaquin Valley.

The economic value of the interstate highway system is well accepted. We also build long and expensive pipelines for oil and gas because we understand the economic benefits of such projects.

The value of an expanded and integrated water network will be no less beneficial, because the real value and necessity of water far exceeds its cost. As the cost of water approaches the value of water, such projects become more economically viable to public-private partnerships. The previously noted $3.4-billion project in Texas is an example. It is projected to deliver 50,000 acre-feet per year. Revenue to pay 4 percent interest is only $85 per 10,000 gallons delivered, a typical household volume of both use and cost of water.

Another obstacle to an expanded and integrated water supply is inter-basin transfers. Why not combine contiguous basins into a super-basin? One may extrapolate this line of thought to our having two basins in North America – one on each side of the continental divide. Interestingly, transfers across the divide are being made now because they have to be. A recent Denver Post article cited six different trans-mountain diversions across the Rockies. A Bureau of Reclamation-sponsored project in 2011 resulted in numerous trans-basin suggestions, many across the continental divide, the largest basin boundary. [18] Inter-basin transfers are currently being constructed in Texas because of the recent severity of the problem.

At the end of the day, the hydrological cycle transfers water across river basins, and with reasonable planning and safeguards, we can do the same through an integrated water network with no negative ecological impact.



The water cycle moves water all around the earth through the atmosphere, rivers, lakes, and the ground.

Another issue to be dealt with is that of ecological balance, organism transfer, and related topics. A sufficient level of treatment can ensure that unacceptable microbial contamination will not occur between basins. Treatment to potable standards is not necessary, but some level of treatment to prevent unwanted transfers is readily available and easily enough accomplished.

The purpose of the integrated water network is to fill drying reservoirs and charge falling aquifers using in-place infrastructure downstream to collect, treat, and deliver water to the tap and the fields.

The purpose of the expanded and integrated water network is to fill reservoirs and replenish diminishing groundwater. Downstream infrastructure to collect, treat, and deliver drinking water to the tap and irrigation supplies to agriculture is already in place. The purpose will be to simply move water from where it is abundantly to where it is needed badly. Providing some level of treatment to ensure no ecological problems from these transfers would actually improve the quality of surface water and ground water supplies, much like wastewater treatment standards have improved the quality of many previously polluted waterways.

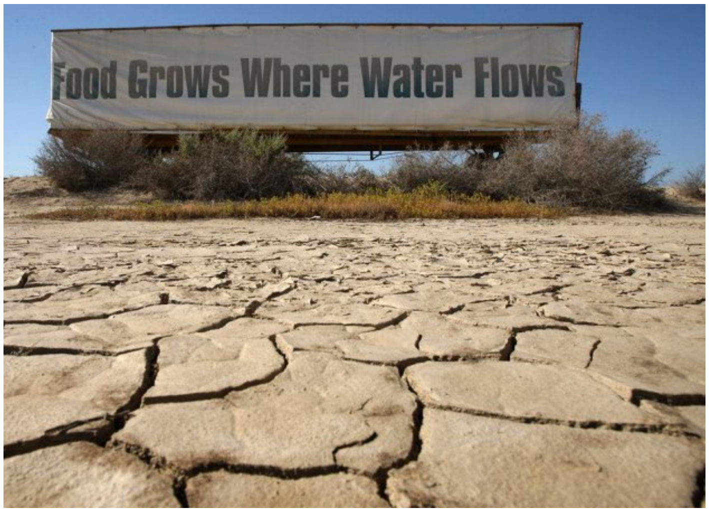
A major obstacle to a super-regional or national integrated water network is the concept of states' rights and water law. Generally speaking, the more arid areas in the western United States use prior appropriation water law and the more water-rich states in the east use riparian law. [19]

Right-of-way acquisition is an easy obstacle.

Another challenge is the acquisition of rights-of-way necessary for construction. This is a common requirement and easily enough addressed. In fact, existing road and railroad rights-of-way may very well be used. For example, the Colorado River Basin augmentation project, proposes use of the I-70 right-of-way. [20] More than one electric generating company has suggested using transmission line rights-of-way to move water. [21]

Broad Problems Require Broad Solutions

Recognizing our drought, our threat of flooding, and our water supply and demand issues as a single national problem and opportunity rather than multiple local and regional disparate problems will help us arrive at various super-regional or even a national solution. Struggling agriculture above the Ogallala aquifer is not an isolated Midwestern problem. It's a national problem because stress on our nation's breadbasket will raise prices across the country for all types of food and can even develop into a security issue as it ultimately did for Rome. [22] The economic health and vitality of California and Texas, and the entire nation for that matter, depend on water, and that makes water a national problem calling for a national solution. If an electrical power plant goes down, or a fleet of aircraft are stranded in a storm, we move our supply to meet our demand. Why not do the same with water?



Our nation's food supply is threatened by drought in agricultural areas.

Conclusion

Our electrical grid is privately funded and provides a public service. Our nation's air transportation system is a partnership between publicly funded airports and privately owned airlines. [23] The railroads have been previously referenced as an example of how a nation-wide infrastructure network can be built and operated. [24] Private funds are increasingly being viewed as part of the highway infrastructure solution. [25]

Water is no less important than electricity, airports, railroads, and highways, and we have the precedence and means to share our water resources for the economic benefit of everyone.

A public-private partnership approach ensures local control, local authority, and local decision making – all consistent with the culture and tradition of the water industry. Such a partnership is also more politically acceptable in today's environment of deficit spending and revenue shortfall. Public-private partnerships are gaining popularity and being employed more frequently for more infrastructure needs and solutions. [26]

Call to Action

Let's take a big leadership step forward in the water industry to address our demand and supply imbalance, prevent future floods, solve our persistent water woes, and do it with innovative public-private partnership financing.

In summary, establishment of agriculture in arid regions, migration of people and industries into those areas, multiple and persistent droughts, and devastating floods have placed tremendous local and regional strain on America's water agencies. Meanwhile, many parts of our rich nation have vast and abundant water supplies that are not being used and oftentimes experience seasonal flooding that can be tapped. We can bring these water resources and water needs together with an expanded and integrated water network, provide flood protection, create economic growth and opportunity, and ensure the future supply of dependable water resources.

Certainly there are obstacles and challenges as noted and addressed above, and there are also tremendous benefits. With courage, innovation, and focus, water professionals and the American people can solve this problem, rebalance our water supply and water demand, lessen the impact of flooding, and grow the American economy.

An expanded, integrated water supply network is a thought-provoking and stimulating concept that often results in thoughtful and open-minded professionals saying, "Let's do this!"

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