Bella Machines presents:

The Los Angeles Desalination Project Proposal

Author: Brian Nissen

Company: Bella Machines

www.bellamachines.com

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CALIFORNIA WATER

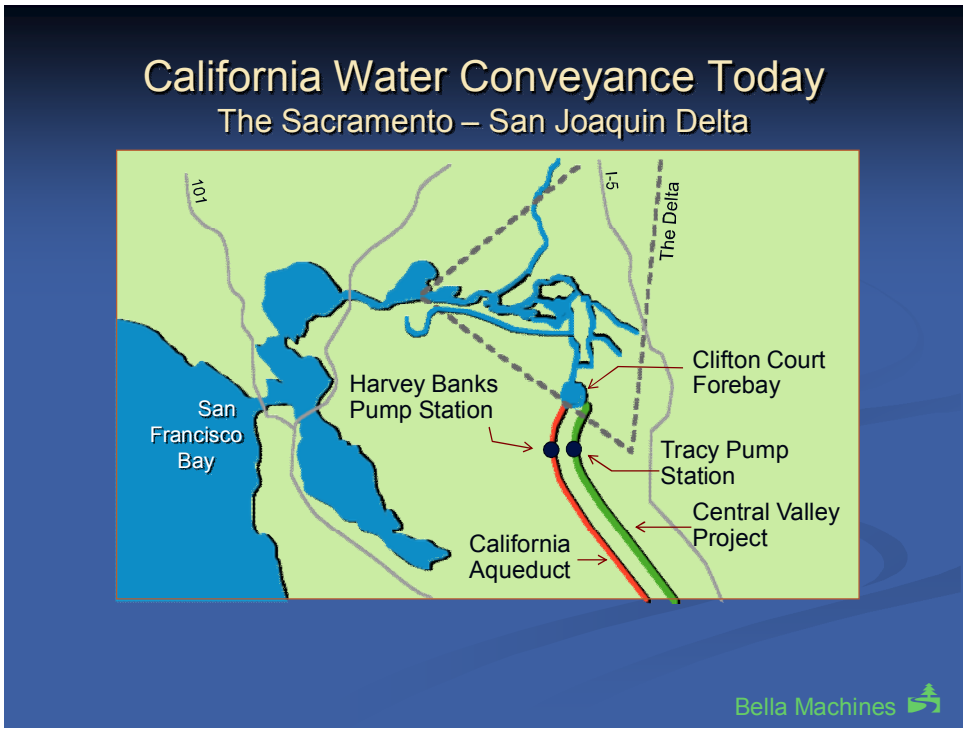
The California water crisis has been a problem that has been percolating for decades. With two-thirds of California's population living in Southern California, but two-thirds of California's annual precipitation falling in Northern California, finding reliable water sources is a constant struggle. As troublesome as things have been for California in the past, conditions are only expected to worsen. Water exports from the Sacramento-San Joaquin Delta to Southern California have been limited to protect fish, and the population of Southern California is projected to increase dramatically. California's protracted water wars have pitted farmers against municipalities.

Here at Bella Machines, we have developed and patented a special water system to harness the power of falling water and convert it directly into power for pumping. This new system is called Transformed Hydraulic Power. Transformed Hydraulic Power is a different way of thinking about hydraulic power because its end purpose is to pump water, not to generate electricity.

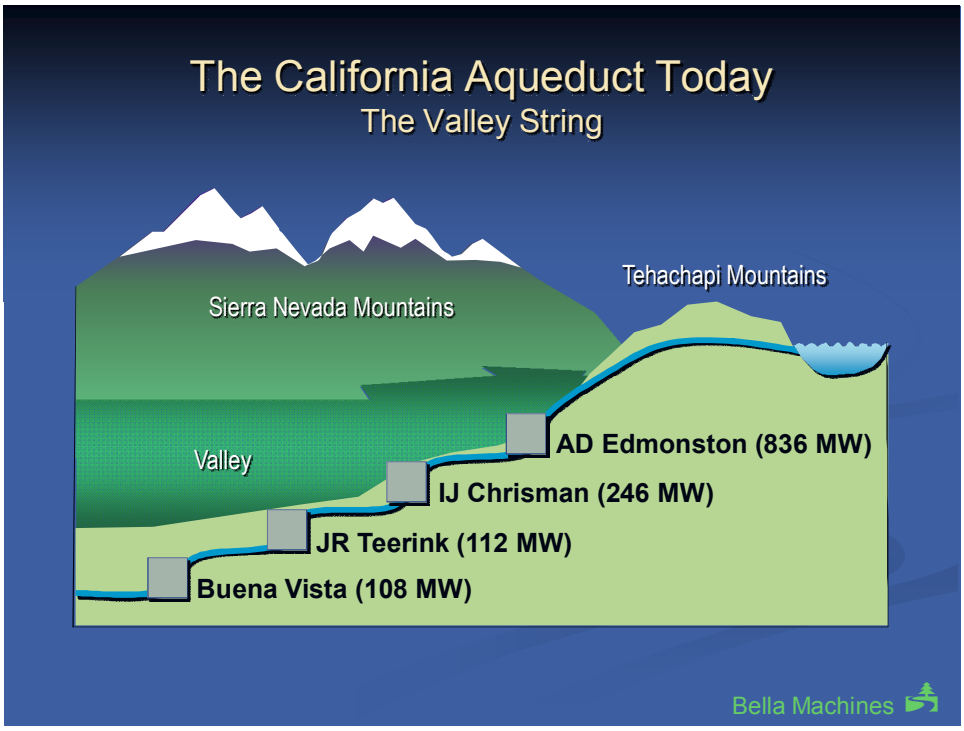
Water has an extremely high density. This fact enables it to have the capacity to generate great amounts of power. Likewise, pumping water consumes great amounts of power. Transformed Hydraulic Power takes the power from falling water and uses it directly to pump water from a second source, like the sea. By eliminating electricity as a conversion step, a greater Overall System Efficiency can be achieved.

The ideal location for implementing a massive desalination project would be Los Angeles. This would create a local, large water supply which would ease tensions over water in California and will benefit future generations. Despite the escalation of the California water crisis, there is a solution. Most importantly, it is a renewable energy solution.

CONVEYANCE VS. DESALINATION



In order to understand the necessity for the Los Angeles Desalination Project, it's helpful to understand how the current water conveyance system works. The Sacramento-San Joaquin Delta is the hub of the California water system. On the southern end of the Delta is the Clifton Court Forebay where two large pumping stations, the Tracy Pumps and the Harvey O. Banks Pumps, export Delta water south. The Tracy Pumps are part of the Federal Central Valley Project and serve mostly agricultural consumers in the Central Valley. The Harvey O. Banks Pumps are part of the State Water Project (SWP) and serve mostly urban consumers within the Central Valley as well as Southern California. The California Aqueduct is the longest conveyor of the SWP and has a string of pumping stations that convey water as far south as San Diego. The California Aqueduct is owned and operated by the California Department of Water Resources.



Before California Aqueduct water can reach the Metropolitan Water District (MWD), which serves the Los Angeles and San Diego areas, it must be lifted 2,000 ft up and over the Tehachapi Mountains. This is made possible by the AD Edmonston Pumping Station. With a capacity of 836 MW, the Edmonston Pumping Station is by far the largest user of electricity among the energy hungry pumps around the State. The current high cost of conveyance and the lack of protection for the Delta Ecosystem begs for a better solution. New water generation in Los Angeles will not only reduce water demand on the Delta, but will be a wiser use of our energy resources. Reducing flow through the California Aqueduct Pumps, and specifically the Edmonston Pumps, will save substantial amounts of energy. This energy would be better utilized for new water generation.

Pumping water from the Delta to LA starting from the Clifton Court Forebay, through the California Aqueduct, has an energy requirement of 3.81 MW*Hr/Acre*ft. [1] Pumping

[1] Department of Water Resources, Division of Operations and Maintenance. State Water Project Annual Report of Operations 2001, California: April, 2005. Retrieved from: http://www.water.ca.gov/pubs/operations/state_water_project_annual_report_of_operations_2001/annual01.pdf2001, plus pumping energy ratio calculations. Available by request

that same volume of water to LA starting from the Sacramento River, through the proposed Delta Tunnels, and then through the California Aqueduct would increase that energy requirement to 4.11 MW*Hr/Acre*ft. [2] An appropriate comparison would be to contrast those conveyance costs to local new water generation. Running a 100% electric desalination plant in LA would consume 4.21 MW*Hr/Acre*ft. [3] However, the LA Desalination Project, with 23% of its' power coming from built-in renewable energy, would consume only 3.42 MW*Hr/Acre*ft. [4] Often the most compelling argument against desalination is the high cost of energy. Ironically, in California, water conveyance is even more expensive. Why pump water 500 miles south, and over mountain tops, when it is cheaper to produce locally?

Delta water exports to the MWD are important because it is 25% of the overall water taken from the Clifton Court Forebay, and 56% of the California Aqueduct's annual volume.[5] The MWD's water demand is only expected to grow due to population growth and continued reductions from the Colorado River Aqueduct. Population growth in Southern California is relentless. The California Business Roundtable predicts that 20 million more people will live in Southern California in the next 20 years.

The reductions from the Colorado River Aqueduct are a result of the seven-state Quantification Settlement Agreement (QSA) which allowed the MWD to take Colorado River Basin surplus water that was previously unclaimed. As Nevada and Arizona grow and claim more water, California's share is reduced.[6] The MWD (which owns and operates the Colorado River Aqueduct) has turned to the California Aqueduct to make-up for these reductions, almost gallon for gallon. In 1998, the MWD received 500,000 Acre*ft from the California Aqueduct, and by 2010 it had risen to 1,500,000 Acre*ft. [7]

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[2] Ibid
[3] Bella Machines, 2018 LA Desalination energy balance calculations without THP. Available at bellamachines.com
[4] Bella Machines, 2018 LA Desalination energy balance calculations with THP at 1 BGD. Available at bellamachines.com
[5] Department of Water Resources, Division of Operations and Maintenance. State Water Project Annual Report of Operations 2001, California: April, 2005. Retrieved from: http://www.water.ca.gov/pubs/operations/state_water_project_annual_report_of_operations_2001/annual01.pdf2001
[6] Metropolitan Water District of Southern California. Annual Progress Report to the California State Legislature February 2004, California: February, 2004. Retrieved from: http://www.mwdh2o.com/mwdh2o/pages/yourwater/sb60/archive/SB60_04.pdf
[7] Metropolitan Water District, "MWD Water Sources" Retreived from: http://www.inkstain.net/fleck/wp-content/uploads/MWD.png

Continuing down the path of taking more water from the Delta year after year to feed a rapidly growing demand is unsustainable. Desalination is inevitable for Southern California; it is just a matter of time.

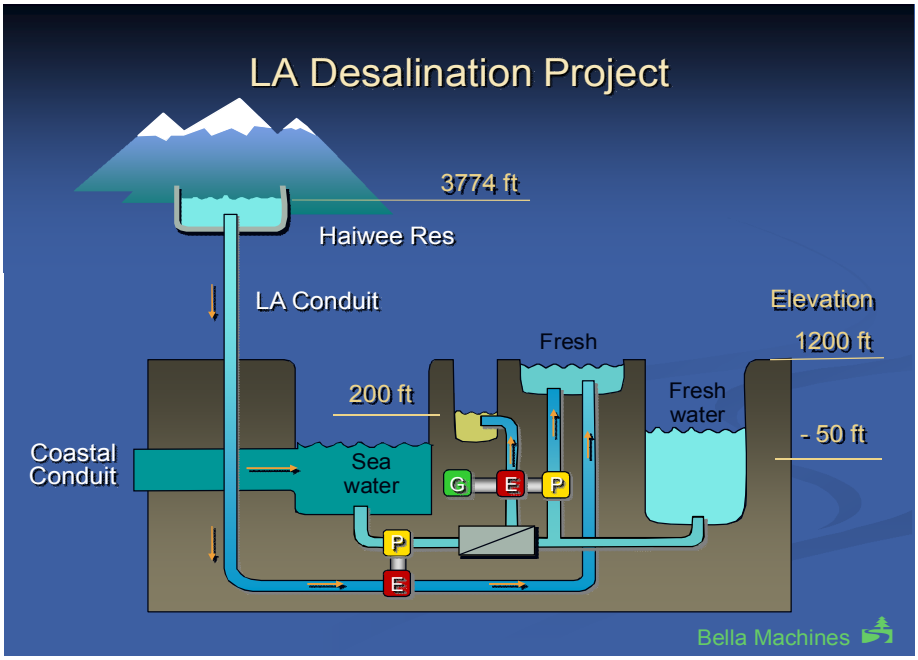
The LA Desalination Project is a proposal to build a 1,000 MGD plant in Sylmar, California. Sylmar was chosen because it has extensive water infrastructure, and since it is 20 miles from the coast, would be better prepared for 100 years of anticipated sea level rise. Only large projects producing new water will have the capacity to significantly reduce water taken from the Delta, and maximize energy savings from the California Aqueduct.

Desalination plants such as the Carlsbad Facility near San Diego are small in capacity, only 50 MGD, and are permanent industrial eyesores on the coastline. This invokes NIMBY ("Not In My Backyard") opposition. In contrast, The LA Desalination Project will be located completely underground. Although putting infrastructure such as Beach Wells, and Pumping Facilities underground is more expensive than building surface facilities, once the construction is complete, the California Coastline will be just as beautiful as it was before. In addition to minimizing opposition, locating all utilities underground will also avoid risks from terrorist threats and avoid right-of-way issues.

WHAT IS TRANSFORMED HYDRAULIC POWER?

The diagram on the next page is a rendering of what the LA system might look like. However, the elevations, flows and locations are subject to change pending a survey being completed of the LA Aqueduct. This diagram is designed to give an overview of how the system could work.

Beach wells will be dug and covered, then connected to the Coastal Conduit. The Coastal Conduit will convey seawater by gravity to the underground seawater reservoir at Sylmar. The seawater reservoir has a proposed dynamic elevation of 50 ft below sea level. All of the pumping equipment as well as the Membrane Bank will be located in the new Sylmar Underground Facility.



Transformed Hydraulic Power is based on the scientific principle of water-to-water energy conversion. At the top of the diagram is the Haiwee Reservoir. This water is transferred to the LA Super Conduit. The LA Super Conduit is a continuous and unbroken pipeline that delivers water to the Sylmar Underground Facility at a very high pressure. At the bottom of the diagram is the Freshwater Engine, which is the lowest red box. This extracts energy from the LA Super Conduit water and transfers it to the Seawater Pump, which is the connected yellow box. Pressurized seawater is sent to the Membrane Bank, which is the grey box. Two liquids exit the Membrane Bank; the brine and the freshwater. Since the brine is still at high pressure it must be sent through an energy recovery process. This is accomplished with the Brine Engine, which is the upper red box. This energy is transferred to the Freshwater Pump, which is the connected yellow box. This pump lifts the newly generated freshwater to the surface at Sylmar where large treatment plants already exist.

THE POWER BENEFITS

Few know that only about 50% of a power plant's starting energy value, before it is converted into electricity and put on the grid, will be used by the end consumer. This is what we call Overall System Efficiency. By using water-to-water energy conversion we are consolidating the conversion steps of: 1) generating electricity (water-to-wire), 2) transmission (wire-to-wire), and 3) pumping water (wire-to-water). This allows our system to do about twice the useful work of any equivalent hydropower plant putting electricity on the grid. Since the demand for pumping water at Sylmar will never end, generating electricity would be considered extremely wasteful.

The Power that can be derived from falling water is equal to the Flow times the Fall. The total Fall from the Haiwee Reservoir to Sylmar is over 2,500 ft. There is tremendous potential to expand on this energy resource. By replacing the LA Aqueduct with the LA Super Conduit, the power of falling water can be fully utilized to pump seawater through membranes. The LA Aqueduct is 233 miles long and 100 years old. In 1970 a second aqueduct was completed between Haiwee Reservoir and Sylmar, which is 137 miles. Only 2 hydropower plants are connected to the second aqueduct. Between the aging infrastructure on the first aqueduct, and the lack of hydropower on the second aqueduct, the time has come to upgrade the system to increase power production, and overall system efficiency. Even though the LA Aqueduct hydropower plants between the Haiwee Reservoir and Sylmar will be shut down, these power losses will be outweighed by substantial power gains. The power gains include:

- Power savings by reducing demand on the California Aqueduct Pumps that convey water from the Delta to Southern California. The A.D. Edmonston Pumping Plant is the largest Lift in the world and is tasked with pumping water over the Tehachapi Mountains. Every gallon of water that is generated in LA is one less gallon that must be pumped out of the Central Valley.

- Greater generating capacity from the new LA Super Conduit compared to the loss of generating capacity from the LA Aqueduct. The LA Super Conduit will have a

continuous and unbroken Fall, unlike the LA Aqueduct, with much of its water falling without generating power.

- Greater Overall System Efficiency, by cutting electricity out of the loop and utilizing direct water-to-water energy conversion. Reducing conversion steps is the easiest way to maximize power output and minimize losses.

THE WATER BENEFITS

Another benefit of Transformed Hydraulic Power is that it multiplies the usable water leaving the system. Even after filtering seawater at a sizable pressure drop and after rejecting brine water from the new LA Desalination Plant, it is still conceivable that the filtered seawater flow may be equal to the LA Super Conduit flow. The LA Aqueduct historically serves about 50% of LA's water needs. Assuming this water is transferred to the LA Super Conduit, this new system could supply the other 50% of LA's water by using the sea! This would be a major achievement. There are other water benefits:

- Only new water will reduce water demand on the Delta and be a positive impact on the health of the Delta Ecosystem. The LA Desalination Project does this.

- By combining the "free water" from Transformed Hydraulic Power and the "electric water" made from energy savings, this project will generate 2000 MGD (2,240,000 Acre*ft/yr) of new water at net zero grid impact (3.81 MW*Hr/Acre*ft).

- Blending unsalted water from Stormwater Capture (or recycled water) with seawater produces brackish water. Brackish water is known to require substantially less energy to generate fresh water. This technique could double the new water generated at net zero grid impact.

- With a proposed startup capacity of 1,000 MGD (1,120,000 Acre*ft/yr), with plans for future expansion, this project has the most promise of being a long term solution to California's water problems.

LA DESALINATION PROJECT BENEFITS

Jobs

More living wage jobs are needed in the United States. Many Americans would like to see infrastructure improvements. This project would provide living wage jobs, and invest in our infrastructure.

Water

Water is not a luxury. It is a necessity. It is needed for agriculture and for personal use. Southern California population growth over the next decade will only further the conflict between agriculture and municipal water demand. If Southern California can become less dependent on the Delta, then more water can stay in the Central Valley for farming. California is the nation's number one farm state. The economic impact of farming affects the whole state, and surrounding states as well. Food security and food inflation are important issues that impact every American. In the future, water needs will compete with energy needs for our attention. The LA Desalination Project will address both needs.

Environment

The uniqueness of this project is that it provides water while being kind to the environment. Transformed Hydraulic Power has a positive environmental impact.

- It is fish friendly. There is no way for fish to enter system and be harmed. The use of Beach Wells on the coastline, fish screens at Haiwee Reservoir, as well as innovative brine disposal methods are all designed to minimize impact to marine life and the environment.

- It protects the Sacramento-San Joaquin Delta Ecosystem by reducing water demand. Further, it provides a back-up plan for the Southern California water supply, in case the Delta experiences any problems.

- It is a renewable energy power supply that produces no Green House Gas emissions and has no ongoing fuel costs.

- The power supply requires a high elevation reservoir. This will also provide a counter measure to loss of snowpack in the mountains caused by Global Warming. Snow is nature's water storage system. It regulates water flow throughout the year. Without it, other measures must be taken to make up for this lost storage.

NEXT STEP

Transformed Hydraulic Power is intended for large scale public utility and can play an integral role in solving California's water crisis and creating jobs in America. The next step in the process is to have a Feasibility Study completed by an independent party. This study would examine the geographical issues and any construction issues for the region selected. The Feasibility Study would also analyze the capacity and cost of this proposed project. The Feasibility Study is estimated to cost $2 million. Tax payers have spent over $200 million studying the Delta Tunnels Project. Shouldn't we study alternatives when so much is at stake? Please see the Feasibility Study Plan for a more detailed look into the engineering, construction and environmental reviews that are needed in order for The Los Angeles Desalination Project to move forward.

Bella Machines
21457 SW 95th Court
Tualatin, Oregon 97062
503-486-5757
brian@bellamachines.com