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Sent: Wed 5/7/2014 7:03:42 PM
Subject: Fw: Here's the short article on the technical challenge of doing this project
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Subject: Here's the short article on the technical challenge of doing this project

Water tunnels would be huge project -- if they clear huge obstacles
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On a clear day, it's plain to see why many of California's leading water officials want to get their hands on Peter Stone's property.
From his driveway along the Sacramento River south of Freeport, the view to the east offers a peek at the snow-capped Sierra Nevada. When that snow melts, it flows relentlessly by, just across the levee road from Stone's front windows.
From the state and federal governments' point of view, his 20-acre property in the Sacramento-San Joaquin Delta is an ideal spot for one of the five large pumping stations they're proposing to feed what may be the largest water tunnel ever contemplated in North America.
Even in a state known for building some of the world's largest waterworks, the plan is audacious. Twin 33-foot-diameter tunnels would carry a portion of the Sacramento River's flow deep under the Delta on a 37-mile path underground to the present head of the California Aqueduct, near Tracy.
Pumps that now serve that aqueduct and its nearby federal counterpart kill millions of fish every year and are blamed for altering the habitat of the estuary itself, once among the world's most productive fisheries.
The tunnel project is intended to move the intakes upstream, to locations presumed to be less harmful to

fish and their habitat. It would also secure the freshwater diversions from threats such as earthquakes, floods and sea level rise, ensuring that the 25 million Californians who depend upon that water do not go without.
Those risks are considered inevitable, so the DWR and its partner water agencies view the project as vital to the state's economy and well- being.
To make it happen, all of those water ratepayers, from the Silicon Valley to San Diego, likely will have to pay higher bills. The project must also survive a maze of potential construction troubles.
Digging a couple of tunnels sounds simple on its face. In reality, the project would turn much of the Delta into a vast construction zone for at least a decade, and permanently industrialize numerous scenic locations that have always been quietly rural.
"This is certainly what we consider a megaproject," said Richard Sanchez, chief of engineering at the California Department of Water Resources, the project's primary sponsor. "And it's something that is certainly several orders of magnitude above what we normally do here in California as far as water projects. It would be a huge undertaking if we move forward."
The tunnel is the centerpiece of the Bay Delta Conservation Plan, an effort to balance water demand and wildlife protection. After three years of often-contentious meetings and innumerable studies, a draft environmental impact report is anticipated later this year.
The DWR is expected to make a formal decision in 2013 on whether to proceed. It would be subject to approval by state and federal wildlife agencies.
A similar project known as the Peripheral Canal was in the original plan for the State Water Project, dating back to the 1950s. But it was rejected by California voters in 1982.
This time, the DWR maintains that existing state water law gives it the power to approve the project without a public vote. This assertion will surely be tested by the project's foes, among them Delta residents such as Stone and a variety of environmental groups.
Project would be complex
A water tunnel is favored over a surface canal because it minimizes the amount of land that must be acquired. But the physical scope of the proposed tunneling work has received little attention.
A paper presented at a global tunneling conference in San Francisco last year shed some light on the project's size and complexity. Sanchez was lead author of the paper, which received little notice outside the conference.
It reveals that the project is "pushing the state of the art for tunneling projects in North America," and poses numerous "constructability challenges" due to its enormous size and cost.
Sanchez told The Bee that the cost is now estimated at around $14 billion, an increase of more than $1 billion since the last formal estimate in 2010.
The increase is due partly to the need to tunnel deeper – 150 feet down – to avoid the bulk of the Delta's loose peat and sedimentary soils, and to find a depth that will equalize groundwater and soil pressures, which will forever work against the concrete tunnels.
The cost could go higher still. Sanchez said portions of the tunnel – at least the northern stretch – may require an additional steel liner as an extra bolster against the strains imposed by the water itself.
The project could be too large for the tunneling industry to absorb in one go, according to the paper. The state will require insurance bonds to cover the project in case a contractor defaults, and no bonding agency will issue a single note to cover a $14 billion project. So Sanchez and his team are looking at breaking the tunneling into numerous segments that would be awarded to different contractors. He expects that the team will have to bid the project worldwide.
The goal is to start digging in 2015 and finish in 2025, assuming that the tunnels are dug simultaneously and approval occurs as currently scheduled.
In addition to tunnels and pumping plants, other project features include:
• Dozens of miles of levees. All tunnel access points, and many other construction features, will be protected by new levees to guard against a 200-year flood during the decade-long construction period. Permanent features, such as the pumping plants, will get similar levees.
• Fish screens for each of the five pumping stations, consisting of stainless-steel grating with sixteenth-inch openings. The screens could stretch more than a quarter-mile along the riverfront in some cases.
• At least eight large vertical construction shafts to move people and materials between the surface and the tunnels.
• Concrete production plants. These would produce a tunnel lining 2 feet thick, consisting of thousands of

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interlocking arched segments pieced together underground, with gaskets and dowels joining them.
Factoring in barge landings, access roads, construction staging areas, power lines and transformers, the completed project will have a surface footprint of 5,700 acres. It will require 210 megawatts of electricity, or more than enough to power every household in the city of Sacramento.
Challenges and unknowns
Christian Frenzel, an associate professor at the Colorado School of Mines in Golden, Colo., and an expert on large tunneling projects, reviewed the DWR paper at The Bee's request.
Frenzel agreed that it would be among the largest water tunnels of its kind in North America. He said it may also pose unique challenges because of the loose soils likely to be encountered.
One challenge arises from the simple fact that, over the long digging period, the tunneling machines must have regular maintenance. The cutting teeth on the machines – which are like giant mechanical earthworms – wear out periodically and must be replaced.
The machines generally are not removed from the tunnel during a dig, so they have to be maintained in place. In hard-rock tunnels, the newly bored tunnel itself provides an adequate place for workers to leave the safety of the machine to do maintenance.
But in the soft, sedimentary ground beneath the Delta, contractors will probably have to build "safe havens" underground to do maintenance. This may require drilling a shaft from above and injecting concrete into a space freshly dug by the machine.
"What you're basically creating is a cement room," Frenzel said. "That will be a major delay for the tunneling operation. Basically you need to wait until the cement has set to start whatever you want to do in terms of maintenance. That can easily take a couple of months."
If safe havens are not placed at the correct intervals, or the cutting teeth wear faster than expected, Frenzel said, additional costs and delays occur.
This reinforces the importance of knowing as much as possible about soil conditions along the route.
The DWR has, so far, collected about 84 soil borings along the route – where it has been able to get access. It needs hundreds more.
"Having good geotechnical data is really important," said Roger Patterson, assistant general manager of the Metropolitan Water District of Southern California, one of the primary water agencies that would fund the project. "You're trying to eliminate the uncertainties," he said. "We will want to have as much confidence as we can in the timeline and cost and do-ability."
Some property owners have granted access for drilling. Many, including Peter Stone, are resisting and preparing to wage court battles. The concerns range from simple opposition to the project to fears that the holes may compromise drinking water wells or the integrity of levees.
The state has begun eminent domain actions against many property owners, including Stone. His property has been staked by the DWR in four locations where it wants to drill for soil samples. The stakes are strung out in a wheat field on his land, which is farmed by a neighbor.
One of the five intakes would be located on Stone's property. Each intake will have six massive electric pumps and cover 20 acres, the size of Stone's entire parcel.
It would become the diversion point located farthest upstream, offering the freshest water and possibly the least threat to endangered native fish, such as Delta smelt.
If built, the intake would wipe out the 120-year-old farmhouse Stone spent years renovating, where he and his wife raised four children.
"I built it with the idea that we could pass it along to our children," said Stone, 55, who served as his own general contractor on the remodeling. "So everything we did, we did so it would last."
The state originally wanted to drill seven holes on Stone's property. It removed three, including one near the levee. He remains concerned about his water well, which sits about 50 yards from the nearest drill stake.
Asked his opinion of the diversion project itself, Stone lets his eyes wander over the wheat fields, and turns philosophical.
"I wouldn't like to see it happen. I just love it out here," he said. "On the other hand, my joy isn't in owning this house. They can't take away my joy unless I let them."
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