METROPOLITAN SPECIAL COMMITTEE ON THE BAY–DELTA: Project implementation considerations for California Water Fix; Dr. Jacob Katz on managing floodplain productivity for multiple benefits

February 8, 2017    Maven    Meetings

At the January meeting of Metropolitan's Special Committee on the Bay Delta, committee members were given an overview of the California Water Fix facilities and a review of other large tunnel projects similar to the California Water Fix; and a presentation on how floodplains can be managed to benefit native species, salmon in particular. But first, a brief update on the status of the Cal Water Fix proceedings.

UPDATE ON CAL WATER FIX

Metropolitan Program Manager Randall Neudeck kicked off the meeting with a brief update of the California Water Fix project. He noted that the project began in 2006; three drafts of the environmental document were released in 2011, 2012, and 2013. The final environment document was released in 2016. The state and federal agencies have completed a draft biological assessment that is currently being used to develop the biological opinion.

In the next year or two will be the accumulation of many milestones coming to fruition, he said. "We expect that in 2017, they’ll finalize that..."
biological opinion and the 2081 permit, that the Army Corps will hopefully will have a permit of their 404 process, and that the state and federal agencies will have a record of decision. The goal is to bring these documents to your board with a cost sharing agreement for discussion.”

The floor was then opened up for questions.

Director Keith Lewinger asked, “These various milestones … We’re all – at least I am – expecting that somebody is going to sue the state over these plans. Which of these milestones are potentially the subject of litigation?”

Representative from Metropolitan’s legal office answers, “Potentially all of them. The truth of the matter is, anytime you have issuance of a permit, once you get to the final decision, they can challenge any aspect of that approval process.”

Roger asks about the timeline for completing litigation; the answer is a long time. “No, it’s not going to be short,” responds the legal rep. “The shorter ones would probably be the NEPA lawsuits; those tend to move more quickly because it’s based generally on the admin record and the admin record is usually a little bit more manageable but, in this case it’s a very large project so I don’t even know if that would be true. It’s not going to be a short process.”

Director Lewinger asks if the lawsuits will delay construction of the project. “We don’t actually know that it will,” answers Jeffrey Kightlinger, Metropolitan’s General Manager. “You don’t necessarily finish lawsuits before you start construction. There are many examples of that – the Hyperion Treatment plan, the Century Freeway – all these projects were built while litigation was going in one form and construction took place on a parallel track.”

Director Lorraine Paskett asks about the final documents. “Is there anything different than what you expected or is it what you expected? Are there any high points that you would want us to know about?”

“The endangered species permits are based on the biological assessment, which we briefed the committee on what was included in that,” answered Mr. Neudeck. “Normally, the permits reflect what was in the analysis. I don’t think we’ll see any surprises there. We haven’t really seen a full copy of those draft permits yet. We’ve seen pieces that have gone out for independent science review that has to be taken into account in the final, so there could be some changes there.”

Mr. Neudeck also reminded of the change in federal administration. “They’re going to be finished under the watch of the new administration which, we don’t have any confirmed folks in place yet. So I think it’s fair to say we really need to keep an eye on this and see what we can learn by reading the various pieces that we do see, because we just don’t know yet.”
Director Paskett asks if Mr. Neudeck has a rough estimate for when the board will be making the decision.

“The schedule that the agencies gave us, setting the transition aside, was the first of April,” Mr. Neudeck replied. “It will take at least a couple of months probably to have new folks take a look at that. So, it’s in that kind of a time frame, could be longer, or maybe not, maybe they’ll just say ‘go ahead.’”

As to when the Board will be asked to make a decision, Mr. Neudeck said, "We always wanted to bring the cost allocation at the same that we have the permits and it looks like its on track to do that, particularly on the State Water Project side. The federal side seems to be sliding just a little bit but, that’s our plan, to bring it in its entirety because you have to see the whole of the package.”

**PROJECT IMPLEMENTATION CONSIDERATIONS FOR CALIFORNIA WATER FIX**

The bulk of the meeting was taken up by the presentation by John Bednarksi, manager of the Infrastructure Reliability Section of Metropolitan’s Engineering Services Group. This was the first of a two-part presentation on the implementation aspects of the California Water Fix that will be given this month and in February. The presentation today will cover an overview of the California Water Fix facilities and a review of other large tunnel projects similar to the California Water Fix that either have been completed or are in the latter stages of completion. February’s presentation will cover risk management – both construction risk management but also design risk management, as well as the cost estimates that have been prepared for the California Water Fix.

**Overview of the facilities**

The infrastructure for the California Water Fix stretches about 38 miles from the intakes on the Sacramento River to Clifton Court. There are three intakes on the Sacramento River, each at 3,000 cfs. The water from those intakes is collected into the north tunnels and then flows to the intermediate forebay where the water is commingled together. The hydraulic grade for the twin tunnels is set and the water
flows then through the main tunnels down to the Clifton Court pumping plant where the water is lifted into Clifton Court and then can be distributed to either the Jones Pumping Plant or the Banks pumping plant, which are south of Clifton Court.

The three north tunnels are approximately 9 miles. The tunnels are fairly large because they are part of a gravity fed system. Those tunnels range from 28 feet to 40 feet in diameter. They convey the water from the intakes to the intermediate forebay; at that point, the water is split into the 40-foot diameter twin tunnels, which then carry the water 30 miles to the south to the Clifton Court pumping facilities.

There is a total of 69 miles of tunnel. The main tunnels will be designed with a 100-year lifespan; primarily this means that the tunnel segment design will be very robust. The gasket liner will be the primary liner for the system; there will be no steel liner inside.

"We’ll be relying entirely on the segmental liner design and the gaskets to prevent either infiltration into the tunnels or exfiltration leakage out of the tunnels during operation," Mr. Bednarski said. "We’ve conducted a number of studies based on a revised hydraulic profile, and we’re very confident that these tunnels will operate very well with minimal leakage either in or out of the tunnels."

The tunnels will be about 150 feet below grade. Mr. Bednarski explained that because the tunnels will be going through soft, fully saturated ground rather than rock, the project calls for a pressurized-face tunnel boring machine; either an earth-pressure balance machine or a slurry machine will be used for the construction.

The excavated diameter of the tunnels is 45 feet. The tunnel segments themselves are about a little over two feet thick; the inside diameter is about 40 feet. In terms of the relative size of the tunnels, the California Water Fix is in the middle of large tunnel boring machines.

Mr. Bednarski noted that the Sparvo tunnel, a road transportation tunnel, was the largest tunnel at 51.2 feet, until it was surpassed by the Seattle tunnel about 5 years ago. Since that time, the Seattle tunnel has even been outstripped by a larger tunnel in Hong Kong that is 58 feet in diameter. "As you can see, larger and larger tunnels are being built, so
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over 700,000 tunnel segments, which is about 80,000 segmental rings. Excavation of the tunnels will remove 23 million cubic yards of material, all of which has been accounted for in the EIR/EIS. The material will be stock piled near the tunneling sites on the islands as construction moves through the Delta.

Ten to twelve tunnel boring machines will be in operation simultaneously during the program. To power the machines, almost 200 megawatts of power will be needed to be brought to each of the launching shafts for these machines. Although there are large, high voltage transmission lines already in the Delta, those are not available as they are used to transport power up and down the state. So they are working with a number of different power providers in the Delta to ensure they can bring in the requisite amount of power needed to run the machines. Since there is a long lead time needed for acquiring the power, DWR has already started this work, Mr. Bednarski noted.

There will be three intakes, ranging in length from 1250 to 1600 feet long, depending on the morphology of the river at the different locations. "The configuration of these intakes mimic two very successful intake projects that are located about two hours north of Sacramento that are very similar in size – 2,500 to 3,000 cfs," he said. "We've used that same concept of a screened intake along the river levees. The water..."
will be conveyed through box conduits into the earthen sedimentation basins in the back. It’s about 1,300 feet from the face of the screens to the back of sedimentation basins.”

The outlet shaft is at the back of the sedimentation basins. At that point, the water will drop into the tunnel system and then carried south to Clifton Court.

At the terminus of the tunnels at Clifton Court, there will be two large pumping stations at 4500 cfs each; they will lift the water about 15 to 20 feet out of the bottom of the tunnels and deposit it into Clifton court where it will then flow by gravity to both the Jones and the Banks pumping facilities.

Cost of the tunnels

There have been two cost estimates that have been prepared in 2014 and 2015; they are within 7% of each other. “For this estimate, we’re using the $14.94 billion, which is the higher of the two cost estimates at this point and time. Tunneling costs are projected to be about $6.8 billion dollars. Contingency on the tunnels and the remaining construction is at 36%, or about $3.4 billion dollars. That totals up with the land acquisition and the labor for project management, construction management, and design to $14.94 billion at this point in time, in 2014 dollars.”

Organization of the Construction Enterprise

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Program Estimate developed in September 2015
Program Estimate in 2015 Dollars

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He presented an organizational chart that will be used once the DCE agreement and other documents are in place and funding has been secured. "We also have developed an organizational chart that will be put into motion once the DCE agreement and all the other documents are put in place and funding is secured for the program," Mr. Bednarski said.

The program will be led by the program director; direct reports to the program director include finance, accounting, and legal counsel. "I'd like to point out, just to illustrate how seriously we take risk management on this project, that the risk management of the project will be a direct report to the program director," he said.

Below the program director is the program manager, an inward facing position that will be responsible for managing the entire program. Directly below that, the Chief Engineer and then below that, the Engineering Design Manager, who will be leading the design for all of the activities to be constructed.

Schedule

Once the program is authorized, they anticipate 16 years to implement the project. In the first 12 to 15 months, they will be hiring staff to fill key positions and hiring the consultants that will be performing key work activities.

Mr. Bednarski said that there's about 4 years of land acquisition work that will take place early on. "We’ve learned from other projects that it’s really important to make sure that you have all of you property acquired before you begin construction and start awarding construction contracts," he said.

About four years after the commencement of the project, they will begin working on awarding the tunnel construction contracts. "Tunneling will not start right away; I just want to make sure everybody understands that," he said. "Once the contracts are awarded, the tunneling will still not start right away because we anticipate that the contractors will be responsible for sinking those large shafts that will serve as the launching points for the tunneling activity. Again, it’s a 16 year overall implementation schedule."
Construction of the tunnels is anticipated to last for about 11 years; they are anticipating that 10 to 12 tunnel boring machines (TBMs) will be operating simultaneously during periods of construction, especially in years 7, 8, and 9. He acknowledged that 10 to 12 machines working at one time is a large number, but it’s not unprecedented. "In Mumbai, India, they have up to 17 TBMs working on their metro system simultaneously. In Doha, Qatar, 21 TBMs, and in Mexico City, they have up to eight TBMs working on a sewage collection system there too, so we feel strongly that the management of the tunneling activities is within the state of the industry practice these days."

Other mega-tunneling projects around the world

Mr. Bednarksi then turned to other mega-tunneling projects around the world, noting that they would be presenting selected projects that are ‘soft-ground’ or ‘mixed-ground’ tunnels that have been completed.

**Eurasia Tunnel – Turkey:** This tunnel won recently the International Tunnel Association Project of the Year in 2015. It has a 40 foot inside diameter (he noted typo on the slide) and is very similar in size to the California Water Fix tunnel. It was a design-build-operate-transfer project, a unique delivery mechanism where the contractor designed it, built it, and is operating the tunnel and then in the future will transfer that tunnel back to the owner, he said. The project was completed ahead of schedule and within budget. Some of the key challenges for the project was the tunnel was 300 feet under the water, and the pressure was about 165 PSI, which is more than the Cal Water Fix, he noted. The tunnel also crosses an earthquake fault, so a seismic joint was installed inside the tunnel. The tunnel went into operation last year.
The Lee Tunnel – London: The Lee Tunnel is part of the Thames Tideway project in London. This is a project to link several tunnels together to capture surface runoff before it goes into the Thames river. The tunnels act as a collection and storage system, whereby as the rains subside, the water can be pumped out into a wastewater treatment plan and then deposit it back into Thames river as clean water. The Lee Tunnel was recently completed; it is about 24 feet in diameter. This project was done with a design build approach. It was completed in December 2015, on schedule and slightly under budget.

"Some of the complexities of this project were that it was constructed in urban London so there were issues with work site availability; they dealt with contaminated soils, as well as offloading the material that came out of the tunnels, but that project was completed successfully," he said.

Port of Miami Tunnel, Florida: This tunnel was recently completed. This was another unique delivery method called a ‘Triple P’, where the tunnel designer and owner work out a relationship whereby the designer, builder and concessionaire of the tunnel are the same entity. The tunnel is similar in size to the California Water Fix tunnels. The tunnel, running 120 feet underground, was completed under budget and opened to traffic in 2014.

"Some of the main challenges were that the ground was very challenging as they were going through very soft limestone material as well as coral," Mr. Bednarski said. "There was a lot of grouting required on this project. There was a lot of investigation by the owner prior to issuing these contract documents as to how to best share the risk on this project because they knew the ground would be very challenging, but, the risk transfer and risk sharing worked out very successfully. The grouting operation was a complete success and so was the tunneling operation."
**East Side Access – New York:** This is a large, $10 billion project that was built to enhance the connectivity of the Long Island Railway to Penn Station. The part of the project that they focused on was the Queens Bored Tunnel, which was a complicated $800 million project. It was built with a design-big-build-delivery approach.

The challenges included shallow ground cover, crossing underneath active railway lines, and lots of cobbles and boulders in the ground. “It was very tricky tunneling, but, the tunneling project went through very smoothly and successfully,” he said.

**Blue Plains Tunnel Project, District of Columbia:** This is part of Washington DC’s overall CSO program. It is a five tunnel program and the Blue Plains project is one of those tunnels. The delivery approach was design-build. It was completed in 2005, ahead of schedule, and under budget. One of the challenges was that this was the first time that this agency had used design-build, so there was a lot of institutional resistance to that approach initially. Now, they’re implementing the rest of the tunneling project with the same approach and the program is going very smoothly.
**Bay Tunnel, San Francisco:** This was part of the San Francisco Public Utilities Commission’s Water Supply Improvement Program. It’s a $5 billion program to go throughout the entire SFPUC system and upgrade their systems for seismic reliability and other reliability issues. The tunnel is the second largest project within that program. The Calaveras Dam Rebuild is the largest at about $800 million; the tunnel project was $300 million.

“The reason it’s applicable to us is that was a five mile tunnel drive; our tunnel drive is about eight miles,” he said. “There are no intermediate shafts on this, so it’s similar to our project.”

The Bay Tunnel is the first bored tunnel underneath the San Francisco Bay. “Those of you that have been on the Bart system, those are what we call immersable tube tunnels, so this is the first time that a tunnel had actually been bored underneath the bay,” said Mr. Bednarski. “It was a very successful project. There were some issues with contaminated ground but the project finished on time and within budget.”

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**Willamette River Combined Sewer Outfall Program, Portland, OR:** This project involves constructing two tunnel, one on the East side and one of the West side of the Willamette river. Because of their prior challenging experiences with design-bid-build, they went with a cost-reimbursable fixed-fee procurement method. Under this approach, the contractor is hired early on for a fixed fee to work directly with the design engineers and the owner to plan out the project; then they negotiate an actual reimbursement schedule for tunneling the actual tunnel works and building the shafts and the pump stations. The challenges with this project included a lot of rocks, cobbles, and boulders as well as the need to do a lot of soil modification deep down in the tunnel shaft. The project was completed eight months ahead of schedule and slightly under budget.
Gotthard Base Tunnel, Swiss Alps: This is the longest tunnel in the world. Two tunnels, each one 35 miles long, about 6,500 feet underneath the Swiss Alps. A $12.5 billion project through hard rock. It was over budget by about 7% over a 17-year construction period. Because of the rock and squeezing ground conditions, the tunnel boring machines did get stuck several times. There are 95 miles of tunnel all together. The project is completed and it was put into operation last year.

Alaskan Way replacement project, Seattle, WA: This is a $2 billion project to replace the elevated viaduct that goes along the waterfront in Seattle. At the time this project was conceived, it was the largest tunnel boring machine in the world; there is a 53 foot inside diameter and 57 feet outside diameter. The project was procured with design build. The project has been challenged with the tunnel boring equipment, some of the site supervision, the way that the project was set up and the project specifications, and is currently experiencing a two-year delay.

The tunnel is about 75% complete with the mining, which started in 2013. The tunnel boring machine broke down just a few thousand feet into the job, and it took them a couple years to figure out how to fix the machine. They eventually mined a large access pit where they fixed the machine, and are now making excellent progress.

The problems they experienced with the tunnel boring machine were related to the fact that the tunnel boring machine manufacturer had never made a machine this large, so the machine was likely under designed from the beginning. There is also better supervision in the tunnel now so they’ve been able to optimize their production.

Finally, the project was delivered on a design, build, contract but the owner put in an upset price whereby if a contractor submitted a bid...
above that upset price, that bid would not be accepted. "The feeling now of the project team in Seattle is that it artificially suppressed the bids," Mr. Bednarksi said. "They feel very strongly that in tunnel projects, the work is the work and it's going to be what the price is. When you get multiple bidders on that, the owner should really stay away from putting upset bid prices in."

Lessons learned

In their talks with various entities, the first and foremost recommendation they heard is to have a proactive risk identification and management program. Mr. Bednarski noted that risk management is very high in their organizational chart. Good geotechnical information is key.

He noted that there are a number of different methods for delivering the project that have been used, such as design-bid-build; they still need to ascertain what the best approach for California Water Fix is.

It's important to have a knowledgeable owner embedded throughout the project team; and to resolve right-of-way issues early on. "We have planned out a very aggressive right of way acquisition program that will be implemented in the very early stages of staffing the office," he said. "We anticipate to have all of the access to the key project sites acquired before we begin any construction work."

Mr. Bednarski closed with noting that at the upcoming February meeting, they will be discussing design and construction risk management process, as well as the cost estimates that have been generated for the program.

During the discussion period, Director Blois asks Mr. Bednarski what his gut feeling is on the risk level of this project after studying all the other projects. "Is this a slam dunk or is this one really tough?"

Mr. Bednarski responds, "I think it's somewhere in the middle. I think that there are areas that are going to be challenging. A lot of it has to do with the location of the project being in the Delta. We are identifying the logistics to the site as being key challenges for the tunnel contractors. Getting material, equipment and supplies into and out of these job sites everyday is really going to become a logistical issue because there are only two major highways that go through the Delta, Highway 4 and Highway 12; then we're relying on levee roads and anything else that we can construct along the way. We have the opportunity for barge landings; those have been cleared in the EIR, EIS so the contractors will have the opportunity to bring materials in on barges."
He continued: “It’s my personal opinion that we’re in the sweet spot of these large machines. While we have to do more investigations, the initial indications are that the ground will be somewhat abrasive but it’s going to be uniform material. We’re not expecting to hit areas where it’s just, “Oh gosh, we missed something” or we hit a big boulder. We’re just not expecting that kind of ground.”

Director McKenney asked if the project is going to build roads that will continue to be a benefit of the project after construction.

“*We’re anticipating that we’ll be making improvements to some of the levee roads, especially the areas that we directly traverse across,*” said Mr. Bednarski. “*We’ve made that commitment in the EIR/EIS, and we’ve made that commitment to the state board in our testimony to them. We anticipate that many of the facilities will be temporary, though. Certainly as you drop down off the levee roads and then start crossing the islands, these will be less permanent facilities, as will be the electrical infrastructure that we bring in. The anticipation is that it would be just brought in for construction. That’s not to say that there may be improvements to some of the local county and state road systems that are in the vicinity of our project that our contractors will be traveling across. We have to work through all of these issues with the local building officials, city engineers, county engineers and things like that, in order to get the permits to haul across their roads. There could be some improvements to those kinds of roads as part of this project.*”

Director McKenney noted that it could be an interesting point to bring up, when talking to the public about the benefits of the project.

**DR. JACOB KATZ: MANAGING FLOODPLAIN PRODUCTIVITY FOR MULTIPLE BENEFITS**

The last item on the agenda was a presentation by Dr. Jacob Katz on efforts underway in Northern California to study the benefits of inundating the floodplains to benefit native species, particularly juvenile salmon.

Dr. Katz began by noting that his presentation is much like the previous presentation on the tunnels, except that in this case, it is