City of Hayward, California

Bert Weiss, Hayward's Utilities Operation and Maintenance Manager, provided the following answers to questions about the Winton Road 1-880 Overpass Project.

1. Can you please provide a project description?

From a piping project perspective, the City of Hayward had an existing 30 inch AC transmission main that lead up to an overpass where the pipe transitioned down to a 20 inch welded steel line located in a prestressed concrete overpass structure after which it transitioned back up to the 30 inch AC line on the other side of the overpass. The 20 inch steel line needed to be replaced with a 30 inch fully restrained 30 inch Class 53 ductile iron pipe and tied in on either side.

From a broader perspective, my underlying foundation level organizational improvement "project" is to demonstrate that government can and does work from a literal and figurative perspective. This translates to building a highly trained and extremely proficient first responder workforce that is completely involved in the: "design, build, own, operate, maintain, and repair" of the distribution and collection systems that we have the honor of being the stewards of. We owe at least that much to owners of the systems, the residents and business of the City of Hayward, that we are employed to serve. I genuinely feel that we should be at least as good as any highly skilled, properly equipped, and well-practiced contractor workforce. If we are that, we'll also be able deliver more value than a contractor can because the profit margin is taken entirely out of the equation. However, if we can't achieve this most of the time in most instances, we owe the owners of the system that we work for our collective resignation letters. That is not to say that we don't have a need for contractors. Contractors should be used as a resource that allows us to temporarily supplement our workforce or to bring such specialized skill sets to the table that it makes no economic sense for us acquire those skills because they are used so infrequently.

2. Why was the project being done?

Once again, from a piping project perspective, because we had a leak in the 20 inch welded steel line that was a result of a differential settling in the earthen approaches of the overpass. This caused our 20 inch welded steel pipe to get kinked, which in turn caused the mortar lining to fall away, which ultimately caused the steel to corroded through. The other obvious project goal was to eliminate the bottleneck created by stepping the pipe diameter down from 30 inches to 20 inches for approximately 300 feet, and then back up to 30 inches.

From the aforementioned foundation level organizational improvement project one need look no further than this last presidential election. An alarming number of people feel government is broken, that it doesn't work – and this is true for democrats, republicans, independets, liberals and/or conservatives. We are all very familiar with the negative public works stereotype. People justifiably wonder what they are getting for their money. You would obviously be less than thrilled to find that you have a government workforce of professionals and trades people that do nothing more than hire private contracted professionals and trades people to do the design, build, maintain, and repair work of a water distribution or wastewater collection system.

Would you find it acceptable to employ a police force and pay for the salary and benefits associated with such an endeavor if you came to find that the police department in turn subcontracted out the actual police work to a private security contractor? Of course not. Then why would it ever be acceptable to have a Utilities Department that employs engineers whose job it is to hire private consulting engineering firms to "design" your system and then contract out the actual repair or construction work to private contractors because your in-house trades people don't have the knowledge, skills, abilities, and equipment to do the construction and repair work that needs to be done on the system they are employed to operate and maintain. The short answer is that it isn't acceptable – end of conversation and period.

Why would you not cut out the parasitic middleman, so to speak. The people and business that we serve frankly deserve much better than that. This is made even more relevant when you consider that the systems that we are the stewards of are located on top of and crossing over a very active earthquake fault named after our very city, the Hayward Fault. We are the first responders. We are the people that will be turned to by the people that we serve after a seismic event. This is when our well-practiced, highly trained, thoroughly dedicated, and properly equipped workforce will need to step up to the plate and start picking up the pieces around us. We will need to be able to get the water flowing to as many people and hydrants as quickly as possible. We will definitely need help from other agencies and contractors, but what we definitely can't be, or even be perceived to be, is helpless – or even worse, worthless.

3. What were the biggest design challenges?

Regarding the piping project, I don't know that there was a "biggest" design challenge from a mechanical perspective. After the pipe started leaking I heard opportunity for a great in-house project knocking. Because the overpass structure belongs to the State, the California Department of Transportation, aka. Caltrans, my Department had to try to sell them on the idea of allowing us to replace the pipe and in the process to upsize it from a 20-inch line to a 30-inch line. Because I had just come from an agency that was involved in the construction of a major tunnel project and the associated water line that supplied water to the fire suppression

system and operations and maintenance building, my former Caltrans acquaintances were able to figure out who needed to get the approval from to proceed with the project. By good fortune, the approval process was vastly simplified once I conveyed to the approving party that the City was going to do the work in-house. With no construction contractors involved, Caltrans knew that there was no potential for "fly by night" work to be done that would result in them holding the bag when things started to fall apart. Given that the City of Hayward was doing the work, if anything went wrong at anytime in the future, Caltrans would know where they could find us. This was truly going to be a hallmark "design, build, own, operate, maintain and repair" project.

Beyond that, the project actually consisted of an endless series of revelations that required modifications in the many design components of the job, but those challenges were approached in a similar manner to the challenge of eating an elephant – we would do it one bite at a time.

From an organizational change project perspective, the hands down biggest challenge, was to get my Director to agree to allow us to do the work in-house. His initial reluctance and skepticism was perfectly understandable. For an agency of our size to take on work like this is practically unheard of. But persistence in providing deliberate and detailed answers to his many technical questions over the course of many months finally resulted in our having a sobering exceedingly brief heart to heart conversation. My Director asked me if I understood the consequences of anything going wrong with the project. Without hesitation, I answered: "My career will end, and I understand that," to which he added: "…as will mine." With that understanding in place, we finally sealed the deal, and my team and I were given the okay to proceed.

4. What kind of creative, or atypical design solutions were discussed as potential options?

My team and I went through months of planning the details around how we were going to get the pipe pulled through the overpass. On a macro level, it was ridiculously simple. We would dig a loading pit on one side of the overpass, a receiving pit on the other side of the overpass, pull out the old pipe, and pull in the new one. Then we tie in both sides, backfill the holes and call it day. Easy peasy, right?

Of course the devil is always in the details and this project had countless revelations and details that needed to be worked out. Traffic control, shoring, how were we going to clean the overpass interior because the overpass structure was actually two separate structures with a gap between the two that allowed you to look directly down on the traffic below of the busiest freeway in the SF Bay Area, and we needed to take out yards of debris that had accumulated over the decades inside the structure, how were we going to pull the old pipe out safely, how

were we going to transport the pipe, what size excavators and other heavy equipment were we going to need, where were we going to stage materials, how were we going to pull the new pipe in, how were we going to open the 3 foot thick reinforced concrete ends of the over pass, and on, and on, and on. I personally spent months' worth of time starring at the ceiling when I woke up at 2:00 in the morning running through scenario after scenario and then "going back to the drawing board" when a fatal flaw in the plan suddenly appeared in my mind's eye. Our project photo journal and the accompanying captions help illustrates the many design solutions that where contemplated and eventually employed.

5. What was the thought process behind selecting ductile iron, and more specifically TR Flex as the pipeline material for the project?

This was the absolute one no brainer decision for me. I knew Caltrans would only allow two pipeline materials to even be considered. Welded steel pipe and ductile iron. Plastic was by good fortune simply not even an option available. Beyond that, my choice came down to HREW (hot rolled electric weld pipe) that is indisputably an excellent pipe choice, if you have the specialized skill sets that are required to do full penetration butt welds – which I didn't have in my team members…

…or we could use a TR Flex, DIP, that I could teach the skills sets to basically anyone in about 15 minutes or less and be assured a fully restrained pipe that could easily follow the arch contour of the overpass and withstand any seismic induced motion that the overpass could take in stride. Add to that that DIP is tough, it can take a licking and keep on ticking; is a domestic product; is insanely readily available; required no specialized skill sets, equipment or tooling to assemble; could be easily cut to length, had fittings that could be added anywhere we saw fit that also required no specialized skill sets for a full strength fully restrained pipe system; was a smoking hot bargain price-wise; would easily last for a century in this application; was fully approved by Caltrans, was in service in many bridges and other structures throughout the US and the world, did I mention that is required no specialized skill sets to assemble?

It is important to point out that I: have a degree in welding technology, worked for a materials testing and failure analysis lab and have written weld procedures for the aerospace, nuclear, bridge building, maritime, and refinery/process piping industry. I LOVE welding and the welding industry. The number of things in our world made possible and held together by welds can fill countless books. I was a certified welding inspector for years. I taught non-destructive testing and was offered a tenured track teaching position at a local junior college's welding department. Welding has been very good to me over the years.

For me, the choice was a no brainer – we were going to use the TR Flex DIP! Why?!??! Because it required no specialized skill sets to assemble the pipe. I simply had no time or desire to train the guys on my team to weld, let alone become proficient pipe welders. I cannot emphasize just how significant that fact is.

6. What other materials had been considered and why were they not selected?

As mentioned, the alternative material was welded steel pipe and, all together now, why didn't I select that option? "Because TR Flex DIP does not REQUIRE SPECIALIZED SKILL SETS to assemble!"

7. How much did pumping cost savings using Ductile Iron Pipe factor into the decision to select it? (Feel free to rank on a scale of 1-5 if you'd like with 1 being low impact and 5 being high impact)

This wasn't even a consideration. The water pressure in my system in this location, as is the case with about 90% of my service area, is provided by gravity from the world-famous San Francisco Public Utilities Commission Hetch Hetchy water system. Both the City of Hayward, and especially the SFPUC have incredible water systems but that is a huge subject that we don't have the time to talk about for now.

8. How much did the life expectancy of DIP being 100+ years factor into the decision to select ductile iron? (Feel free to rank on a scale of 1-5 if you'd like with 1 being low impact and 5 being high impact)

I'd have to rank that at right around 13 on a 1 to 5 scale.

9. How much did the fact that domestic Ductile Iron Pipe is over 95% recycled material factor into the decision to select it? (Feel free to rank on a scale of 1-5 if you'd like with 1 being low impact and 5 being high impact)

I'd have to rank that right around 13 on a 1 to 5 scale again. The City of Hayward drives itself and takes great pride in its efforts to be "safe, clean, green and sustainable." The latest City logo is in fact a big green "H." The City doesn't allow single use plastic water bottles at any of its function because of the negative environmental impact that these single use bottles have. You can't even get a plastic single use grocery bag in Hayward, or for that matter, in the majority of the SF Bay Area. Could you imagine how hypocritical it would be for us to use a plastic water line that at best is made of 6% recycled material if not simply outright 100% virgin material, even if Caltrans would allow plastic pipe to be used in any of their bridge, overpass or tunnel structures? The importance of the use of sustainable, renewable materials and practices cannot be emphasized strongly enough in our fair City.

10. How much did the pressure rating, safety factor, and surge allowance factor into the decision to select ductile iron? (Feel free to rank on a scale of 1-5 if you'd like with 1 being low impact and 5 being high impact)

I'd have to give that a 13 again.

11. How much did ease of installation factor into the decision to select ductile iron? (Feel free to rank on a scale of 1-5 if you'd like with 1 being low impact and 5 being high impact)

You must know by now that this will again be another 13 on the 1 to 5 scale.

12. How much did low maintenance, and the availability of parts factor into the decision to select ductile iron? (Feel free to rank on a scale of 1-5 if you'd like with 1 being low impact and 5 being high impact)

At the risk of sounding like a broken record: "Thirteen!"

13. How much did seismic resistance and material strength factor into the decision to select ductile iron? (Feel free to rank on a scale of 1-5 if you'd like with 1 being low impact and 5 being high impact)

Easily another 13. As mentioned previously, we have an earthquake fault named after our City. Following any news of any significant earthquake somewhere in the world, we have a whole series of subject matter experts from places like the USGS, that show up on the local news reminding us that we have something like a 70% likelihood of having an earthquake with magnitude of 7 or greater on the Richter Scale within the next 30 years. We are endlessly reminded that it isn't a question of if, but rather when our world is going to get seriously rocked. We therefore have a very real need for pipes that are going to hold together if we have any hope of having a somewhat functional distribution system – especially if one of those pipes happens to be suspended over the busiest freeway in the SF Bay Area.

14. How was the appearance of the pipe when it arrived? How would you rank it on a scale of 1-10?

The pipe looked great, it looked like DIP fresh from the factory.

15. Can you please describe the method utilized to install the and home the pipe?

When we originally approached Caltrans about this project, we of course asked if we could saw open the center divide of the overpass so that we could easily clean the decades worth of debris from the interior of the structure with a vac truck, easily remove the existing pipe by simply lifting it out, and easily place the new 30 inch TR Flex in the open channel that would have existed. We were of course shut down before we could finish the sentence. Presenting

that option was worth a shot, but in our hearts we knew that the "easy plan" obviously wasn't going to happen. We quickly shifted gears to the only other option which was to open the ends of the over pass "and just" pull the new pipe through. As we were having this preliminary conversation with the Caltrans folks in Sacramento, we had no real details in mind about how exactly we would accomplish this, but this had to be "the plan."

Over the course of the next 8 months while I was periodically trying to convince my Director to allow us to proceed with the project my team and I were brainstorming options and running through the informal cost benefit and shortcoming analysis. We contemplated using a winch, an excavator, a winch on a dozer or a front loader as the means of pulling the pipe into the over pass with. We considered wire rope(s) or chains. We considered adding new pipe rollers, conveyor belt rollers, rollers mounted to the pipe, rollers that road in channels that would act like rails, using pipe casing insulators with rollers, pipe casing insulators with UHMW or Nylon blocks, pipe casing insulators with UHMW or Nylon blocks sliding on channels, banding lumber around the pipe, laying UHMW sheets on the floor of the structure in lieu of steel channels, using aluminum channels, using street car or light rail vehicle rails pipe…

We ultimately utilized an in-house designed set of sleds, a pulling head, a spreader bar, and lifting chains all pulled by an excavator, but I would say the sleds that ultimately proved to be one of the bigger design challenges of the project.

16. What were the biggest installation challenges?

We had an entire series of challenges that had to be overcome before we ever got to the installation challenges. However, once the overpass ends were opened up by means of a wire saw (thank you Cal West Concrete Cutting for bringing that very specialized equipment and skill sets to the table), the old pipe and pipe roller supports were removed and the overpass hand cleaned for the 10th time with fox tail broom, dust pans and shop vacs, we finally faced the installation challenges. The two biggest problems were the longitudinal gap between the two separate structures that made up the overpass and the unfinished and therefore rough/bumpy and very abrasive unfinished floor of the overpass structures.

While the installation plan evolution had settled on using an excavator as a means of pulling the pipe through the overpass fairly early in the game, one issue that remained was the fact that the pulling head of the TR Flex pipe had a central pad eye as an attachment point. We couldn't use a single wire rope or chain. Because of the arch of the overpass structure, the wire rope or chain would effectively want to saw its way into the gap in the floor and almost certainly cause pieces of concrete to rain down on the traffic below. On a minor side note, we

had resigned ourselves to having to work with an open gap throughout the duration of the project meaning that we had to be exceedingly careful because of the freeway traffic that was blatantly visible through the gap rather than try to shut down lanes/divert traffic. Caltrans had made it very clear that if lanes were to be closed it would take a very long and onerous lane closure/traffic control plan approval process, which would also dictate when the work could be done. When we inquired about the cost of traffic control it was clear that it would cost tens of thousands per event. Most every uniformed observer that opined on the matter insisted that we should consider hanging a net under the gap, or put up falsework to support a solid barrier under the gap, but that would only add to the project cost because we would then have to do the aforementioned lane closures and then install or erect the costly "safety net" and then do more of the same to disassemble everything, not to mention the time prohibitive approval process associated with the design of such a system, and in no time flat, those measures would end up costing more than the whole piping project.

As we had done a number of times before, we turned to the expertise of certain vendors to overcome design challenges throughout the project: United Trench Safety for shoring ideas and equipment; Greoniger/Ferguson for piping materials and technical support and advice; Pape and Hertz for heavy equipment rental…). Our go to folks for all rigging equipment was Carpenter Rigging. They instantly settled the debate about do we use wire rope or high alloy lifting chains to pull the pipe with. It was going to be lifting chains because: they were way more abrasion resistant, could allow for a tapering up or down in chain capacity to accommodate our needs (the first stick of pipe needed the 300 plus feet of chain, but was also pulling the lightest load, approximately 3,200 lbs. which was the weight of the first stick of pipe vs. the capacity that we needed to pull the final pipe length of pipe in with when we had approximately 45,000 lbs. of pipe that we were pulling), and would provide the City with the greatest "post-project surplus equipment" benefit. The final consideration was the fact that we would be pulling the chain or wire rope through the structure by hand while on hands and knees because of the vertical space available in the overpass – so having the option of using 20 foot lengths of chain that we could hook together had way more appeal that one continuous length of wire rope or chain.

The next issue was the spreader bar that we needed to keep the chains away from the gap between the overpass structures over the 880 freeway. Typically, spreader bars are engineered meaning that a consultant would get involved, calculate the loads, factor in the material geometry of the spreader bar rectangular tube steel or wide flange beams, generate a drawing, stamp the drawing, send that out to get fabricated that required certified welders, non-destructive testing, and money and time, and more money and more time… In lieu of that, Carpenter furnished us with a modular manufactured spreader bar system that had all the design, quality control and engineering already incorporated into it from the factory. So, we

ended up with something that we could actually use again in the future because of its modular design, at a fraction of the cost of designing and fabricating a custom spreader.

We then focused on what was going to support the pipe during the pull and after the pipe went into service. Early on in the ideation and design phase of the project, we decided that pipe casing insulators would make the most sense. We would not use ones with little wheels/roller because they would be fragile and wouldn't likely hold up to the bumps of the unfinished concrete floor during the pull, but even more importantly they would be endless point loading the concrete floor once the pipe was in service inside the two very dynamic, and moving independent of each other, pretensioned concrete structures that made up the overpass. That left us with pipe casing insulators that utilized UHMW or nylon blocks as skids/supports. The manufacturers assured us their product would work great for this application but we were very skeptical because we had crawled across the rough floor on our hands and knees countless times. The acceptance criteria for the system that we would use was that the pipe had to be able to be pulled through the 300 foot length of the overpass, and then back out again. I wanted to be sure that in the unlikely event that we had to pull the pipe back out again that it wouldn't be dragging on the floor of the structure and raining concrete chucks onto the traffic below because the insulator pads/blocks had worn to nothing. We elected to apply a little science to the process and ordered some sample sets of insulators with a variety of block materials that we would drag one length of pipe affixed with the heavy pulling head on asphalt by our rental 644 Deere loader with to determine approximate wear rates. We also again turned to Carpenter rigging and added a dynomometer to the pulling chain so that we could figure out if the 300 series Deere excavator that we had planned on renting to pull the pipe with, did indeed have the strength to pull the full train of pipe through the structure.

One insulator block material after another failed dramatically. The nylon wore out in about 80 feet on the asphalt which was even less abrasive than the rough concrete floor. The HDPE made it to about the 100 foot mark before the bell of the pipe was dragging on the asphalt. The UHMW got a little further yet, but well short of the 300 foot mark for a single pull, let alone the 600 feet of travel that would be incurred if the pipe had to be pulled in and out of the over pass even only once. Nobody was expecting these dismal results - it was a very good thing that we had elected to apply "the science" to the selection process. This back to the drawing board revelation led to a series of nights starring at the bedroom ceiling running through design options. There was no doubt that the plastic blocks would last if we used structural channels as rails, but that added a new layer of complexity buy having to weld the structural shapes end to end, pull them into the overpass, grind down the humps and shim up the depressions in the unfinished concrete floor, and then securing the rails in place to prevent them from pulling as we pulled pipe across them. I needed a relatively simple solution, not a

whole new layer of complexity. Rube Goldberg complex stuff is exceedingly easy to dream up but costly to execute and tends to have a very high rate of failure or never work as imagined or advertised.

The golden rule of industrial design, KISS (Keep It Simple, Stupid), had to be incorporated to overcome our challenge. Rollers couldn't be used because of the previously mentioned point loading or the requisite channels that I had already decided against wanting to use. We were really only left with one option – an in-house designed skid system. I immediately resolved myself to use as much "off the shelf" componentry as possible. As a result, the bands of the insulators would be incorporated and be turned into a "sled system." The sled system could also be used to address another concern, namely how to keep the pipe more or less centered in the overpass as we pulled the train through, which we accomplished by adding "out riggers to the sled assemblies that would use blocks of UHMW plastic to slide along the much more finished concrete walls. I then napkin sketched a sled assembly with the fewest cuts, welds, and break/bends made of the simplest and most readily available HR flat bar and shapes. My folks and I took some dimensions of the pipe and the interior dimensions of the overpass and laid out a sectional view of the pipe with some sidewalk chalk on the ground. That gave us the dimensions that we needed to make sure that we would keep the pipe more or less centered and drove the height of the pipe cradle of the sled. After doing one more quick napkin sketch, we took a trip to see Russ and Rich, the gifted fabricators, at RA Metal Fab in South San Francisco, a resource made available to us through Groeniger. After a brief explanation of what we were trying to accomplish and a few more design modifications to the napkin sketch we settled on a prototype design. We also agreed to send them a length of the TR Flex DIP to ensure the cradles would fit the OD of the pipe. After a couple of days, we got a call that the prototype sleds were ready to be picked up and put through the paces of the drag test.

We bolted the lead and tail sleds to the pipe, chained the pipe to the front loader with the dynamometer in place, and pulled. And pulled right past the 80 foot mark. And pulled past the 120 foot mark. And kept going to the end of our private road 1000 plus feet later, and then dragged it all the way back, and then kept dragging the pipe through a turn and only then did we finally park the loader. If there was any reduction in the flat bar sled runner thickness from the wear, you would have needed a micrometer to measure the difference. In fact, the flat bar skids were quite warm but could be touched with a bare hand! The prototype sleds performance exceeded our wildest expectations. On the following day we loaded the same pipe and affixed the lead and tail sled onto our equipment trailer and delivered it to the overpass jobsite. After dragging the lifting chains into place and attaching the spreader bar to the pulling head, we pulled our prototype pipe and sled assembly into the overpass. Holy Cow!!! We had just pulled in the first stick of 30 inch diameter, ductile iron pipe, into the

overpass and the clearances were GREAT! We pulled it further and then assessed the wear on the concrete floor. We were relieved to see that the skids barely even left a telltale mark on the 50 year old concrete. As we keep pulling we watched as the skids simply road over the lumps of the unfinished floor. After numerous stops to verify that nothing was amiss, the pipe was pulled through the whole overpass without incident and out of the far side. What a monumental day, the latest in series of milestones that this project ultimately consisted of.

On the following day, we made the most minor design improvements and ordered 47 final design sled assemblies from RA Metal. One of the design improvements included coating the carbon steel components of the sleds with fusion bonded epoxy. Another involved substituting a hot roll flat bar (solid bar) for the thin walled rectangular tube steel that mounted the sled cradle assemblies to the flat bar runners, but by that was really about it.

Once the epoxied sleds started to arrive, my Director requested one final "test." Since we had successfully pulled the one stick of pipe through, he just wanted to make sure that nothing would go array when we started pulling the multiple pipe train through. It should also be noted that we took the added precaution of adding a third sled assembly to each stick of pipe to ensure a very broad weight distribution and a greater structural redundancy to our pipe support system.

This final "test run" also provided us with the first opportunity to join our 30 inch TR Flex pipe. Because of the limited number of sticks involved, we elected to simply use two 2-1/2 ton Herrington ratchet come-alongs and some polyester straps to pull the pipe together, especially since we didn't have anything really convenient to push against, if we were to push the pipes together with the excavator. This was a first for all of us. I had never used the come-along method, but it worked like a charm. If I would do anything different I would bump up a size or two in the come-alongs' capacities, but what we had proved to be more than effective. This was also my crews first opportunity to assemble TR-Flex pipe **of any size** and lock the lengths together, with the retainer dogs. They had participated in and/or witnessed the metric equivalent of 24 inch Kubota pipe being assembled in a previous project, and to say the TR-Flex assembly process is much simpler is a gross understatement. After having assembled the first two sticks the next one went together like we had been doing this for years. That is one of the many things that I appreciate about TR-Flex pipe. The learning curve is virtually nonexistent. Assembly proficiency is gained virtually instantly.

The first pipe was dropped into the loading trench and pulled forward to make room for the second stick. We ratcheted those together, slipped in the retainer dogs, and pulled the two-pipe train forward to make room in the loading pit for the third pipe. It was all finally happening! My guys were no longer thinking about how this was going to work in the abstract, we were living the dream. With the third stick of pipe added to our final test train,

we started to pull the train through. There were absolutely zero surprises, and the train was pulling through in a beautiful linear self-centering manner. Once the pipe train made it all the way across we celebrated the latest in a series of sequential successes and called it a day. In fact we decided there was little point in pulling out the pipe train and reassembling everything, so on the following day we laid out all of the lifting chains in reverse and pulled the train back to the starting point. Once again there was no visible wear on the runners or the concrete floor of the overpass, so we laid out the two 300 foot series of lifting chains for a final time and started the permanent install of our new 30 inch TR-Flex DIP in the Winton Street 880 overpass.

17. How much experience did the installing crew have with ductile iron pipe? How did this impact the project?

The crew consisted of individuals with varying levels of experience. I had one tenured player that has made many C900 and DIP repairs, but only with a maximum pipe diameter size of 12 inches. The majority of the crew consisted of people that had been in the industry for less than three years. This was hands down the largest pipe, largest piping project, and most complex project that they have been involved in. What impact did any of this lack of experience have on the project? I would have to put that number squarely on zero.

18. What did you like, or dislike about the assembly of the pipe? Did you feel like it went together smoothly, or was it a struggle to get it together? Why?

We all loved the relative ease of assembly of the pipe. Again, the skill sets that were required we immediately acquired, and the tooling involved had a minimal cost in the scheme of the project. There was one instance when a gasket started to roll but we pulled the pipe apart, reseated the rubber, and then pulled the pipe together. Some of the many things to love about the TR-Flex pipe is the guaranteed outcome, the fact that you end up with a fully restrained pipe, that in turn can also easily be disassemebled if there is a need or desire to do so, makes this pipe type an excellent choice for above, or underground, permanent, or temporary pressure piping, and an excellent pipe choice for seismic areas. That combined with its: standard OD's, excellent price, ready availability, the fact that is made of nearly 100% recycled material in the United States… what is there not to love?!

19. What did you learn about installation through the progression of the job?

Nothing that doesn't endlessly apply in all underground construction. More room (aka a wider trench) makes things much easier but isn't always possible. Other than that, not much – but that is actually a very good thing.

20. Were there any obstacles that were unaccounted for during design? What were they and how did you overcome them?

As had been mentioned previously, we had any number of revelations that ultimately simply required a step back, a rethink of the plan that was based on a mistaken assumption and then we pushed forward against any, and all, challenges. It started with how we were going to clean the interior of the overpass at the very outset of the project, the means by which we opened the ends, the fact that we had veins of pea gravel that made the initial trenching a little more challenging than we had assumed but that just required a change in shoring plans, the means used to open the ends of the overpass, the concrete that was encountered in the 20 to 30 inch transitions on the pipe were a pain on the first side but where made child's play by renting a 5,000 lbs breaker for the excavator on the other side that blew through the reinforced concrete, so on, and so forth. We overcame each and every obstacle by shifting to Plan B or C or D. With that said, we employed a very systematic approach to each challenge and were very deliberate with a plan to overcome the challenge in a safe, cost effective, and innovative way. The attached pictures really tell the story better than I ever can. At the end of the day I think we learned more than we can list but enjoyed almost every minute of the project, and ended up with all kinds of additions to our bag of tricks that we'll use in the future on different underground construction challenges.

21. How much pipe did you install per day? What was the most and least pipe installed in a day dedicated to laying pipe? What factors contributed to the differences?

We laid/pulled as much as 5 sticks and as little as two, but that had absolutely <u>everything</u> to do with the manpower available at any given time. Don't forget, while I have started developing a special projects crew as a result of this project, we still have the same number of utility field workers as before. We still had to do all of the things that are involved in the operation, maintenance, and repair of an impressive municipal water distribution system. When we had leaks or main breaks elsewhere, project manpower had to be rerouted to deal with those issues. My Division, and for the matter the entire Department, runs very lean staffing levels. There are no "extra" people. The bottom line was that at any given time I typically had between 3 and five people to work with, and I'm included in those numbers. We set up the traffic control every day, we had to move the machines, we had to load, secure and transport the pipe to the overpass jobsite, we did the assembly and pulling, and then buttoned up the jobsite. Because of the huge volumes of traffic on Winton, we were only allowed to work between the hours of 9 and 3. At 9 AM the cones and signage went up and by 3 PM, everything was buttoned up. As a result, we could only get so much done on any given day, but that was okay. Had I had more people we could have pulled more pipe into the overpass

on any given day, but as strange as that sounds, the sticks per day number was not as applicable as you might think in this instance. The biggest focus was to make sure that countess motorists that passed under us for the duration of our project were oblivious to our existence. Safety was the highest priority, which was, by the way, a much appreciated demand of my Director, but let's be very clear, that the emphasis on safety didn't impede us one bit.

22. What were the tie in points like? How did that process go? What did you learn?

We had to tie into the existing 30 inch AC pipe on either side of the overpass. What was interesting was the original line must not have been laid at the same time the overpass was being built, because the alignment was not what it could have been. The original pipe layers had to use 3-1/4 foot sections of AC to get the deflection they needed to achieve the alignment needed to go into the overpass. Because we were required to add EBAA Flex-Tends on either side of the overpass per Caltrans' seismic requirements, a minor amount of misalignment could easily be accommodated. The first thing that we did was pull the pipe through the overpass. Then we added the casing pipes to the locations where the pipe was penetrating the ends of the overpass by slipping the casing over the installed ductile. This was followed by a 200 psi hydro test which the TR Flex pipe passed with flying colors, in fact the pipe only dropped 5 psi over four days before we finally relieved the pressure to start on the tie-ins. From there we assembled a spool piece and a valve that got tied to the Romac AC/DIP transition coupling, which fit perfectly by the way, and then the last component that completed the tie-in was the EBAA Flex-Tend. After that, everything was wrapped in the V-Bio wrap. We then repeated the same sequence of steps on the other side of the overpass. The process went quite smooth. The only noteworthy thing that I/we learned yet again, is that while the Flex-Tend in theory should be ridiculously easy to install because of the gimbled ball ends and telescoping center section being able to move in any way that you need it to – it always seems that things are moving in every way except the way that you want them to. At the end of the day, you simply need to start at one flanged connection and then come-along the EBAA into compliance until things line up on the opposite side, in an application like this. Don't make my repeated mistake of treating the Flex-Tend like a fixed flange by flange spool. For some reason, I forget that lesson and then relearn it, every time. Of course, that would explain why I'm a ditch digger and why the tool of my trade is a shovel, and not a pen or a scalpel… As with everything else on this project, we ultimately had to be systematic and deliberate with our planning of the many moves, and things slipped into place.

23. What was the time frame available to complete the project? Was it completed on time?

Here again, there wasn't really a time frame. My Director kept emphasizing that making sure everything was done safely was by far the highest priority, which my folks and I, and I would imagine the motoring public on the freeway that was oblivious to the work that was going on over them, appreciated to no end. The other thing that caused the project to take longer was the aforementioned fact that we had an entire municipal water system to operate, maintain, and repair too, so scarce resources get routed to where they were needed most at any given time. This project was in effect a major, but very legitimate, side job/project being slipped in as the opportunity presented itself. When all was said and done, yes, it was completed "on time" by virtue of the fact that nobody in the City was asking when is this going to wrap up. I think most people that were even aware of the work we were doing marveled over the fact that we would even undertake such a project and likely were equally stunned that it appeared to move forward at the pace it did.

24. Were there things about the job that surprised you? What? Why?

I generally hate surprises and would gladly forgo pleasant ones in exchange for no bad ones. I really don't know that there were any surprises. Endless revelations that resulted in our having to switch to a Plan B or C or D but once again, once we were handed a revelation, we bolted on the thinking caps and came up with a very deliberate and well executed plan to address the latest challenge.

25. How did the testing process go? Any issues? If so, what were they and how were they overcome?

If you mean the pressure testing, as mentioned previously, that went absolutely great. The pipe held the hydro test pressure like a champ!

26. How do you feel about the project now compared to when it was in the conceptual stage? Did it go as planned? Are you pleased? Disappointed?

In hindsight, I can't believe how many incremental phases we went through from the ideation stage through completion. Did it goes as planned? Absolutely. It might not have been as linear a process as I might have wished for but the pipe is in service and my guys and are thrilled about their monumental achievement. What more could I ask for?

27. If faced with the situation again, what would you do differently?

Nothing at all. I'm assuming that I would not have the benefit of hindsight on certain field conditions, so there really isn't anything that I would do differently.

28. What are the biggest benefits this project provides to the City of Hayward?

Oh my gosh, were do I start.

1. It proves to the people that we serve that government can work – literally and figuratively. Some of our community partners like the folks at Groeniger/Ferguson, Western States Tools, United Trench Safety, and Air & Tool Engineering Company have told us how great it is to know that City forces would and could undertake a project like this. I can't tell you how significant this is. These people deal with, and have working relationships with almost all of our water and collection system utility peers in the San Francisco Bay Area. For them to take note of, and compliment us on our accomplishment, is truly noteworthy.
2. My folks that participated in this project are so incredibly proud of their accomplishment. This adds a major capstone project to their resume. It has given them the confidence that I need in them to take a deep breath and start problem solving when faced with an overwhelming task. Given that our City has a famous earthquake fault named after it, that coincidentally happens to run through the middle of our City, I know this latter attribute will be critical in days following a long overdue major seismic event.
3. We saved the rate payers, the people that we serve, an enormous amount of money.
4. Projects like this serve to solidify our relationships with essential community and regional partners like: Groeniger, RA Metal, Pape Machinery, United Trench Safety, Hertz Equipment Rental, Carpenter Rigging & Supply, Pac States Pipe, Western States Tools, San Francisco Public Utilities Commission to name a few. These solid working/professional relationships will in turn become worth their weight in gold when that long past due seismic event finally occurs.
5. With every additional success story, and especially ones of this magnitude, the probability that I'll be able to get a special projects team approved becomes exponentially greater, which in turn would just add to every one of the points above.

29. How was the level of interaction/ involvement/ support from the manufacturer? How could it have been better?

Pac States Pipe's support was excellent. Before we pulled the trigger on the project, we ran the tentative plan past their engineers and they gave us the thumbs up and told us that the project seems to be well planned. That was incredibly helpful given all that they have seen done with their pipe, both good and bad. Honestly, the interaction, involvement and support could not have been any better.

30. How was the level of interaction/ involvement/ support from your distributor? How could it have been better?

Scott Silverthorn of Ferguson/Greongier is worth thirteen times his weight in platinum. He has been my technical go to person for years now. Whenever I am faced with a challenge I enlist his services and his opinion. He, like the Pac States Pipe folks, work with countless contractors and utilities and have seen just about everything, once again both to the good and the bad. I can credit him with being a key player in the success of a staggering number of my most challenging projects. He was as interested and engaged, as he is in all our projects, and has provided me with technical support that engineering consultants couldn't dream of, and he doesn't cost us one penny. The industry will be dealt a serious blow the day he finally retires, that is for damn sure.

31. What are the biggest takeaways from this project?

That there is no upper limit to what we can achieve. One of my greatest passions is organizational change, and what this project did to transform my Division, and my Director's Department, is truly priceless. This project has served to usher in a very bright future for the organization that I'm a part of, the City of Hayward, aka the Heart of the Bay!

32. What about the job are you most proud of?

My associates/coworkers. My Director, Alex Ameri, for supporting this effort. The folks on my team, Sean, Bud, Daryl, Peter, Gil, Art, Mo, Mark, Joe B and Joe E, Barry, Nano, Steve, Barbara, Hui, JoAnne, Hui, Jeremy, Gardner, Juan, Alvin, Larry, Abraham, Paul, Jack, Donald, Alex M, and for that matter the many other folks from other divisions and departments in the City, that poured their heart and soul into this effort and/or that ran interference on the rest of our obligations to the people that we serve that allowed us to accomplish what we did. The contributions of the many key players with the aforementioned community and regional partners including, but not limited to: Scott, Mary and the rest of the folks at Groeniger, Russ and Richard at RA Metal, Lisa and Ben at Pape Machinery, Russ and JoAnne at United Trench Safety, Nadine at Hertz Equipment Rental, and all of the great folks at Carpenter Rigging & Supply, Pac States Pipe, Western States Tools, Caltrans… all players that all ultimately contributed to our success. I could not have asked for, or worked with, a better group of people. I am honestly very proud of everyone's' collective contributions and accomplishments.

33. How happy are you overall with the outcome of the project?

I am thrilled, I couldn't be happier.

34. What does the crew of installers think about how the project went?

They are pumped and are dying to participate in the next major challenge/undertaking.

35. Please provide any supplementary pertinent information.

Please refer to the photo journal.