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Virgin Valley HDD Cased Crossing

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1. ABSTRACT

The Virgin River is a tributary of the Colorado River flowing through some of the most scenic and arid environments in the United States. Approximately 162 miles long, the river's headwaters begin at the Navajo Reservoir in the Dixie National Forest north of Zion National Park in Utah. The river flows through Utah, northwest Arizona and southwest Nevada with the last of the river forming the north arm of Lake Mead. Flow in the river can range from a trickle in the hot summer months to intense flash flooding in the monsoonal season. Its normal steady flow is vital to this very delicate desert ecosystem.

The Virgin Valley Water District required a replacement water supply line to transport potable water from water supply diversion points south of the Virgin River to storage facilities and users north of the river. Installation would necessitate crossing the Virgin River east of the Riverside Road Bridge. The pipeline river crossing would traverse sensitive riparian land controlled by private owners. Environmental permits and challenging construction conditions resulted in a design incorporating trenchless technology for installation of 950 lineal feet of 24-inch diameter fusible polyvinyl chloride (FPVCP) casing pipe and 1,360 lineal feet of 16-inch diameter FPVCP carrier pipe. Trenchless technology was critical to the success of the project due to seasonal river flows, timing for permitting and construction.

Further details of the design, evaluation, and installation process for this important project under one of the Southwest desert's most iconic rivers will be provided in this paper.

2. INTRODUCTION AND BACKGROUND

Clark County, Nevada's most heavily populated county, is located at the southern tip of the state. It accounts for more than two-thirds of Nevada's residents, mainly because it is home to one of the world's most well-known resort cities, Las Vegas. Mesquite is a city located at the northeast corner of Clark County, less than two miles west of the Arizona state line (see Figure 1). It was originally settled as a farming community, but today it includes a mix of residential and non-residential development, and has become a popular retirement city.

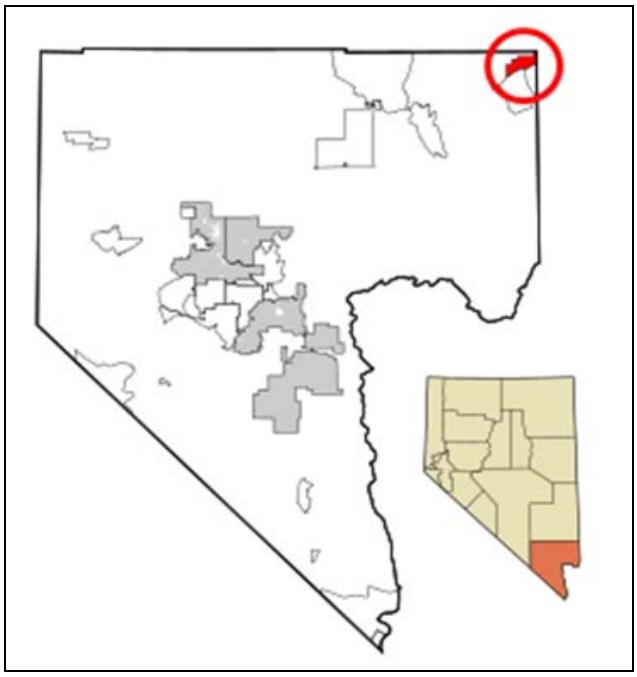

Figure 1. Location of Mesquite in Clark County, Nevada.

The Virgin Valley Water District (VVWD) was created in 1993 by Nevada's State Legislature. It was initially formed from the Mesquite Farmstead Water Association and Bunkerville Water User's Association, each organization was responsible for the infrastructure and associated water rights of their respective regions (see Figure 2). The best water quality in VVWD comes from the Bunkerville area on the south side of the river. Approximately 37% of VVWD's water supply comes from the south side of river, which means water must be transported across the river to VVWD's storage facilities to feed the 98% of users located on the north side of river.

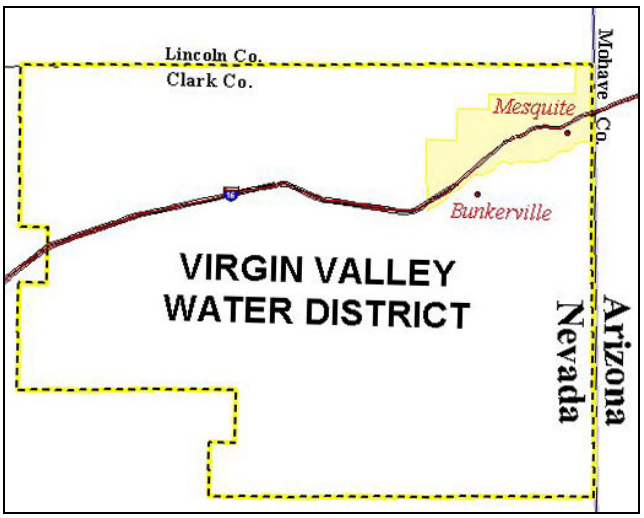

Figure 2. Virgin Valley Water District's service area.

In the 1970s, a steel water pipe was installed along West Riverside Road to handle the transport of water from the southern to the northern side of the Virgin River, and was suspended on the bridge that crossed the river. This pipe was active until 2009 when the Nevada Department of Transportation (NDOT) decided to demolish the existing road (which included the bridge) and replace it with a wider road. VVWD requested that NDOT allow them to reinstall a suspended water line along the new bridge, but NDOT declined the request, as the design of the bridge and its structural components would not allow for a pipe installation underneath the bridge. As a result, VVWD had

to explore other alternatives for installing the transmission main to transport potable water from water supply diversion points south of the Virgin River to storage facilities and users north of river.

After discussions with NDOT, VVWD determined that the only option would be to install a new water line before destruction of the existing bridge and its attached water line. Due to the limited timeline, VVWD decided to quickly install a 16-inch polyvinyl chloride (PVC) water line by horizontal directional drilling (HDD) under the Virgin River. The project was accelerated and pipe was installed underneath the river without a casing. VVWD was not comfortable having the line installed on its own because the pipe was installed unprotected, through a cobble formation, and there was little confidence in a long lifetime for the pipeline. As the water line is vital to the conveyance between the north and south sides of the river, especially during peak production months, possible failure of the line would result in an inconvenience to many residents on both sides of the river, and an emergency replacement would cause months of service disruption.

In 2016, VVWD proposed the addition of a second water line adjacent to the existing line. The new line would be installed with a casing and would reconnect back to the 16-inch pipe on the north and south sides of the river. This new water line would be used as the primary line while the existing 16-inch water line would be used as a backup.

3. PROJECT DESIGN

The VVWD hired Forsgren Associates, Inc. (Engineer) of Mesquite, Nevada to provide the design and environmental analysis for the proposed water line across the Virgin River. The scope of work included the construction of a water line that would run parallel to the existing line and cross the Virgin River, connecting the VVWD infrastructure on both the south and north sides of the river to convey potable water to the City of Mesquite (see Figure 3). The installation would include temporary dewatering and excavation of a trench for installation of a water supply line approximately 10 to 20 feet below the existing ground level across the Virgin River. Trenchless methodologies were not considered in the initial scope.

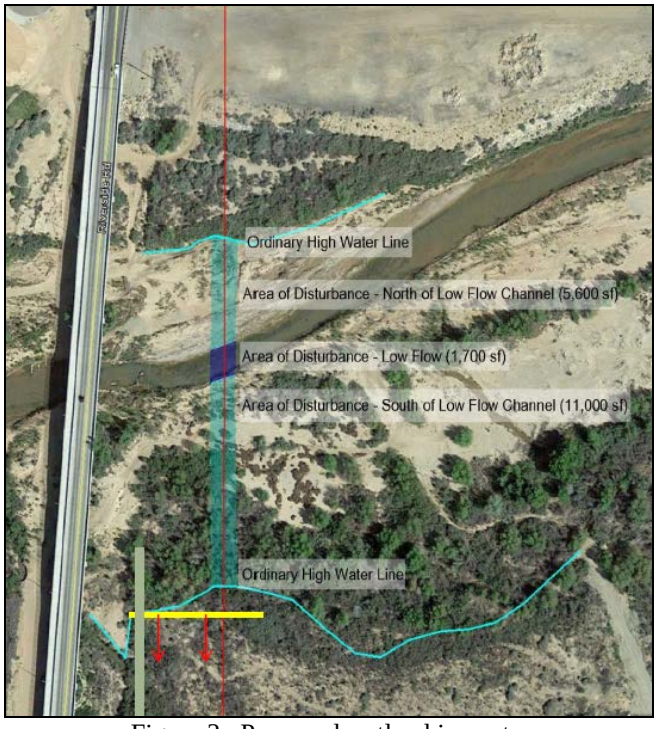

Figure 3. Proposed wetland impacts.

VVWD wanted to have the project design completed and ready for bid by October of 2016. They were anticipating construction to begin in December during the Virgin River's low flow season. This would minimize environmental

impact as well as protect aquatic life. The original scope of work included approximately 1,360 lineal feet of 16-inch PVC potable water carrier pipe with approximately 600 lineal feet of 30-inch PVC casing pipe. The selected installation method was open trenching with dewatering, for which the District had already obtained a permit. Since the entire length of the project passed through properties owned by various entities - including the Bureau of Land Management (BLM), the City of Mesquite, and private owners - the District had to obtain the appropriate permits before construction began (see Figure 4).

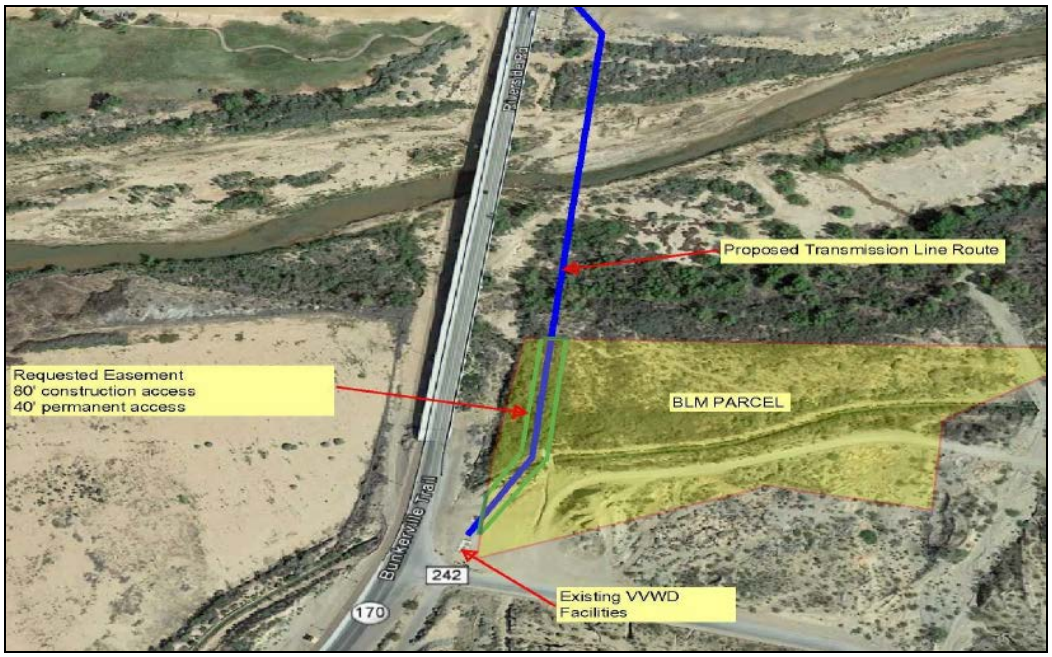

Figure 4. BLM easement location.

The Army Corps of Engineers played an important role in helping to obtain all federal permits required for the project. They consulted with the BLM and the Fish and Wildlife Service to help VVWD and the Engineer take the necessary steps to proceed with permitting. The permits from the City and the Fish and Wildlife Service were not difficult to attain, however the BLM permit was a different story. The proposed pipeline crossed through approximately 485 feet of BLM property in the uplands portion of the project, as well as a small portion of the project in the wetlands area, just outside the typical Virgin River high water mark. The process of acquiring the BLM permit was difficult and would take weeks to complete. As a result, the project was postponed for a few months.

VVWD was eventually issued the BLM easement permit in January of 2017. However, low flow season had passed, and flows were gradually rising, so the option to open trench and dewater to install the proposed pipe was no longer feasible as VVWD and local contractors were not comfortable diverting the river. Forsgren decided to explore alternate installation methods rather than delaying the project until low flow season of the following year. After careful review, Forsgren and VVWD decided that utilizing a trenchless installation method would be the best option for completing this project quickly. In the end, HDD was selected as the trenchless method of installation.

The existing pipe under the Virgin River is a 16-inch PVC pipe and it connects back to PVC pipe on both the north and south sides of the river. To maintain material consistency, VVWD required the use of plastic pipe for the newly proposed line. For trenchless installations, a fully-restrained joint pipe system would be required.

Steel was initially considered for the casing pipe, but after consulting with local experienced HDD drillers, VVWD concluded that installing steel via HDD under the river would be more complex due to the total length of the pipe to be installed. The steel pipe would have been heavy, and would not be flexible enough to meet the minimum bend radius for the proposed HDD path. High-density polyethylene (HDPE) pipe was considered as another option for casing pipe, but was eliminated due to VVWD's lack of familiarity with the product in relation to trenchless installation. Both VVWD and Forsgren were familiar with fusible polyvinyl chloride pipe (FPVCP) pipe and have

had previous experience with the material, so VVWD decided that this was the best material option for the casing pipe.

HDPE pipe was briefly considered as an option for the carrier pipe inside the casing; however, HDPE material incompatibility with chlorinated water pushed VVWD towards another material alternative. Because of FPVCP's superior resistance to oxidation from chlorine-based disinfectants, VVWD ultimately accepted FPVCP for the proposed 16-inch carrier water line.

4. BIDDING

The plans and specifications for the project were reissued in January 2017 and the project bid on February 2, 2017. The Base Bid advertised 1,360 linear feet of 16-inch DR-21 FPVCP with 897 linear feet of 24-inch DR-21 FPVCP casing pipe to be installed via horizontal directional drilling. The 24-inch casing starts just before the irrigation ditch and ends just after the Virgin River crossing.

The project was awarded to Mesquite General Contracting, Inc of Mesquite, Nevada. The VVWD Board members concluded that the additional cost to install dual lines for this project, and the protection provided by the 24" casing line to the 16" carrier line would not justify the perceived benefit for having the redundant line, therefore two lines were not required. The additive alternate was not awarded, and the contractor would only install the designed base bid. Mesquite General Cross Country Horizontal Drilling, Inc of Rio Vista, CA, to perform the HDD pipe installation, as they were familiar with both the project area and the specified FPVCP.

5. CONSTRUCTION

Construction began in March of 2017 on the south side of the project (see Figure 5). While drilling the pilot hole, the contractor encountered a minor loss of returns, and an inadvertent return was found approximately 10 feet north of the Virgin River active flow channel. Quick action was taken to mitigate the release, with both the contractor and engineer following the emergency response procedure that was put in place before construction began. VVWD was notified that a minimal amount of fluid was released on the north side of the river. Both the contractor and engineer explained to VVWD and the Nevada Department of Environmental protection that the amount of bentonite released into the river was non-toxic and non-invasive. The release was logged and photographed for record purposes and no violations were issued (see Figure 6). Since this minor incident was quickly resolved, it did not cause any delays in the installation. Once the release was contained, construction continued with no additional events.

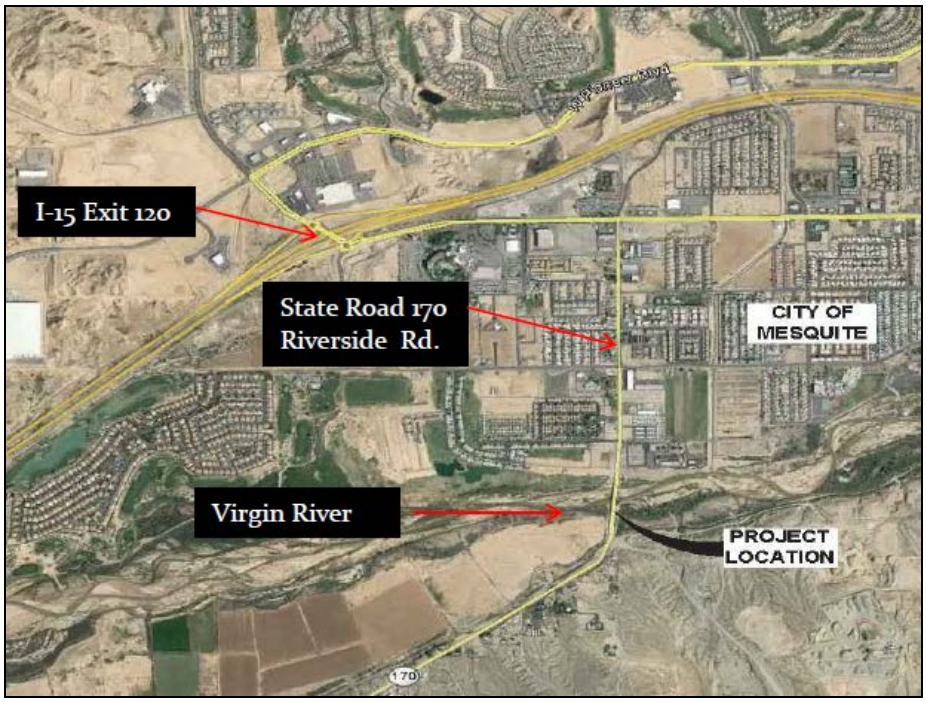

Figure 5. General map of project construction


Figure 6. Release of bentonite as a result of minor frac out event.

The majority of the project was located in open space, far from residences. This caused minimal issues with pipe staging and equipment layout. The carrier pipe was staged and laid out on the north side of the project, adjacent to the casing pipe, before installation (see Figure 7). VVWD received permission from the City of Mesquite who owned an acre of open unused land approximately 0.2 miles north of the project site. For the duration of construction, this land was used to store miscellaneous equipment for the project. Also, since there were plenty of areas available for staging, storage, and layout, traffic was not affected during the pipe installation. There was, however, a wastewater treatment plant on the north side of the project near the pipe staging area. Using fork lifts,

excavators, pipe roller “cradles”, and personnel to direct the pipe around the tree during pull back, the pipe was maneuvered around a tree that stood next to the treatment plant (see Figure 8). All pipe staging was strategically planned to ensure that the pipe was properly supported and that it did not exceed the minimum bend radius recommended by the pipe supplier.

Figure 7. Carrier and casing pipe fused and ready to pull in.

Figure 8. Pipe staging around the city wastewater treatment plant.

The pilot hole was drilled and it measured approximately 12 to 14 inches in diameter. The hole was enlarged by reaming steps until sufficiently sized for the 24-inch casing pipe. The 24-inch casing pipe was installed without disruption after preparation of the bore hole was complete (see Figure 9).

Figure 9. Casing pipe installation with casing pipe at exit pit (left) and casing pipe on north (entry) side of project (right).

After the casing pipe was successfully pulled into place, the 16-inch carrier pipe was placed on rollers in preparation for insertion into the casing pipe (see Figure 10).

Figure 10. Carrier pipe being pulled into the casing pipe. Initial insertion (left) and alignment around the tree to the insertion point (right).

As soon as the carrier and casing pipe were installed, the contractor connected back to the existing line at each end of the drill. Since the new line was installed adjacent to the existing line, and served the same purpose, the contractor connected the new pipe in the same location that the existing pipe, using a mechanical joint wye fitting. After these connections were successfully made, new meter vaults were installed on the new pipe to measure the water flow through the line on both the north and south ends of the river. Once this was finalized, the new water line was pressure tested. Upon successful completion of the pressure test, the pipe was ready for operation.

6. CONCLUSION

The total length of construction was approximately three weeks and the project was completed at the end of March 2017. Because a trenchless installation was performed, the time of the year was not a concern since the low flow season did not need to be considered. Forsgren, VVWD, and the Contractor worked well together to ensure that the frac out incident was quickly addressed and resolved in order to continue on with the project without any delays. They communicated very well with each other in order to assure that the remainder of the project was completed without any major setbacks. VVWD now has a new casing-protected water line across Virgin River in addition to the backup uncased water line to guarantee continuous potable water supply to its residents.

7. REFERENCES

Forsgren Associates Inc. (2017) Contract Documents and Specifications for the Virgin River Transmission Line Crossing Project, Clark County, NV

Virgin Valley Water District Official Website. Retrieved from https://vvh2o.com

Mesquite, Nevada Official Website. Retrieved from http://www.mesquitenv.gov/