TECHNOLOGY FOR A CLEANER, SAFER PLANET

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INSIDE

Quarterly PVC Pipe News

We are pleased to announce that the *PVC Pipe News* will be published on a quarterly basis. So look for the *News* quarterly and enjoy reading it twice as often as before.

The Mojave River Pipeline Project

Figure 1. Luckily for me, this visitor came to the jobsite three weeks before I did.

by Craig Fisher, P.E.
Technical Director

When I think of my trip to the Mojave Water Agency, hot and dusty are the first thoughts that come to mind. Then I think about that excellent Mexican restaurant we stopped at for lunch. Eventually my thoughts roll around to the reason for the visit, which was to see the installation of 24-inch PVC pipe for Reach 4A of the Mojave River Pipeline Project (MRPP).

At its core, the MRPP is much like the story of Southern California itself. The story has a simple beginning. Irrigation provided from water wells made agriculture a viable option for farmers. Then along came California's second "gold rush" after the end of WWII. People flocked to Southern California - attracted by its climate and job market. Soon the demand for water outstripped its natural supply, and the water table began to drop at an alarming rate. Moreover, population trends showed that the situation would only get worse if something wasn't done.

STATE WATER PROJECT / CALIFORNIA AQUEDUCT

At the macro level, the State Water Project (SWP) was the solution for Southern California's ever growing thirst for more water. The SWP transports, on average, between 2.0 and 2.5 million acre-feet

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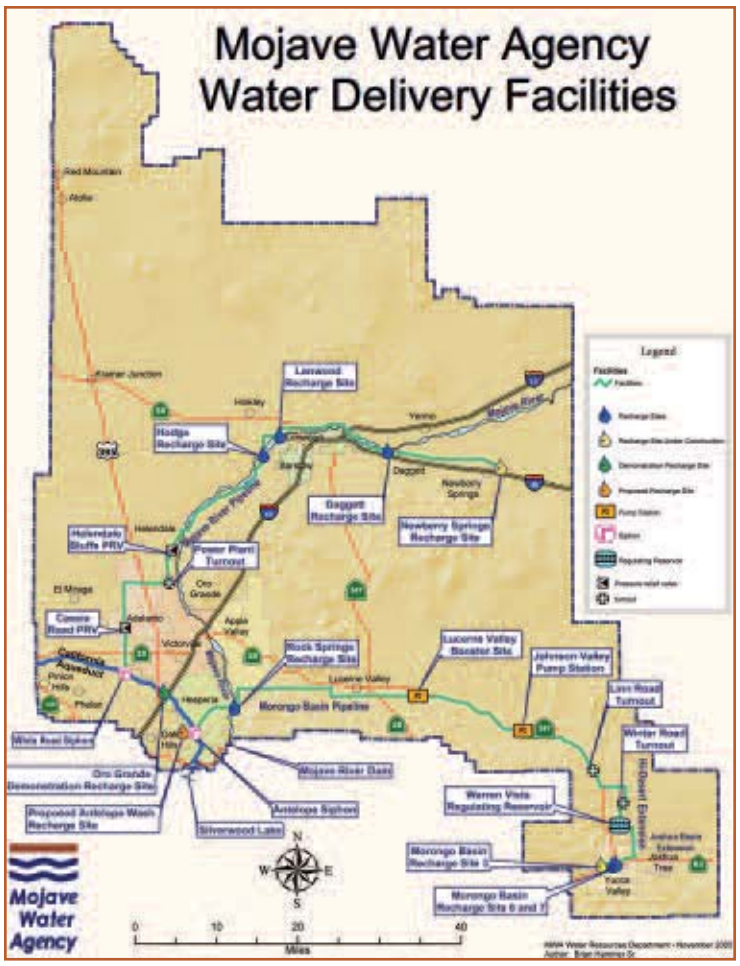

Figure 2. The California Aqueduct is shown in light blue. The Mojave River Pipeline, shown in green, starts at the White Road Siphon.

of water a year. That equates to 650 to 815 billion gallons a year. The SWP officially begins at Lake Oroville in water rich Northern California. Water releases from that lake travel south until they reach the California Aqueduct. The 660 miles of aqueduct bring the water to Southern California. The aqueduct conveys the water through a system of canals, pipelines, and tunnels. As shown in Figure 2, the California Aqueduct nicks the Southwest corner of the Mojave Water Agency's service area.

M W A

Background on the Mojave Water Agency (MWA) provides the proper context for introducing the MRPP. In land area, the MWA is a giant. Its boundaries encompass approximately 4,900 square miles. The entire state of Connecticut could fit within its boundaries and there would still be room to spare. The map in Figure 3 shows the location of MWA within the State of California. The MWA's key stakeholders include thirty water agencies and six municipalities.

The seed that would grow into the MWA was planted at the turn of the 20th century. With irrigation, this corner of California proved to be well suited for growing fruit. Apples, apricots, plums, and grapes were produced in abundance from the area's farms. By the beginning of the 1950's, the agricultural demand for water exceeded the amount in which it was naturally replenished. The overdraft situation was further aggravated by additional demands from industry and a growing population in the 1960's. The falling water table was brought to the courts for resolution through various lawsuits.

Where there is adversity, opportunity can be found nearby. The Chinese acknowledge this by the way they write the word "crisis." In Chinese, the word is a combination of two characters - the first one represents danger and the other represents opportunity.

The dangers of over pumping were many. In addition to the area's farmers, industry, and inhabitants, there is an entire ecosystem that depends on the Mojave River for its existence. Over pumping will eventually deny water to those further downstream on the Mojave River and turn it into a wasteland. Moreover, such over pumping can compromise the quality of the water for everyone and everything. In light of these concerns, another real consequence could be a building moratorium. In fact, the California Real Estate Commissioner ordered a halt to growth and development in Victor Valley in 1960. It was later struck down, but it shows just how real the danger is.

The opportunity spawned from the overdraft was singular. A water agency could be formed that would find a way to balance the supply of water with its demand. This, in turn, could eliminate the area's overdraft situation and its associated problems. Thus, in the midst of adversity, the MWA was born. The bill that made the MWA possible was

Figure 3. The Mojave Water Agency has more square miles of land area within its boundaries than the entire State of Connecticut.

Figure 4. Cement lined and coated steel pipe had been the MWA's pipe material preference. This type of pipe was used for the first three reaches of the MRPP. This photo demonstrates the skill of the backhoe operator, who is threading the steel pipe through the braces of the trench box. Bumping the pipe against the trench box could be disastrous for the internal and external coating. As indicated by the casing skids, the pipe is to be pushed into place inside a casing.

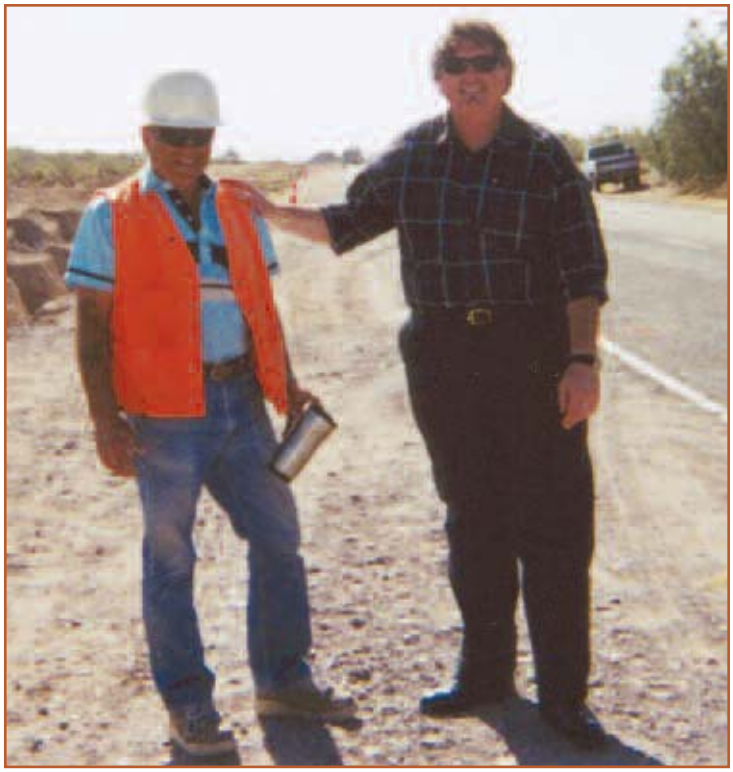

Figure 5. Senior Constructor Inspector, Bobbie Copple (left), discussed the project with Gary Desrocher, Manufacturer Representative (right), and Craig Fisher (taking picture).

signed on July 18, 1959. Residents approved the measure in June of 1960, and the MWA was founded on July 21, 1960.

BALANCING SUPPLY AND DEMAND

The MWA is one of 29 state water contractors. As such, the MWA is entitled to receive an annual allotment of 50,800 acre-feet of water (16.6 billion gallons) through the SWP. In addition to that, MWA purchased another 25,000 acre-feet (8.1 billion gallons) of entitlement from the Berrenda Mesa Water District. Thus, the MWA has secured the necessary water resources to bring its basins into balance.

Next, the SWP water needs to be delivered to the MWA's customers as well as the aquifers. Two large transmission pipelines and a half dozen recharge sites were constructed in an effort to accomplish this. The pipelines strike through the MWA service area like the two fangs of an MRPP visitor - the diamondback rattlesnake. (See Figure 1.) The Mojave River Pipeline follows the river it was named after. It drives Northeast and then East. The Morongo Basin Pipeline goes East and then arcs Southeast. It skirts the southern edge of the MWA service area. (See Figure 2.)

MRPP

Work on the MRPP began in 1995. Reaches 1, 2 and 3 of the pipeline brought water from the California Aqueduct (at the White Road Siphon) to recharge sites at Lenwood, Hodge and Daggett/Yermo. The MWA's product of choice for the first three reaches was cement mortar lined and coated welded steel pipe. (See Figure 4.) However, the MWA was open to discussing alternative materials for the MRPP, and they carefully examined every aspect of PVC before deciding to allow it as an option for Reach 4A of the MRPP.

The MWA was primarily concerned with the strength, durability, ease (or difficulty) of installation and the compatibility of PVC pipe with the use of native material for bedding and backfill. Additional research and consultations with industry representatives, including a visit to a PVC manufacturing facility, provided the MWA with the necessary assurance that PVC pipe, manufactured in accordance with AWWA C905, would be a viable alternative for the project.

THE USE OF PVC PIPE IN THIS SECTION RESULTED IN A SAVINGS OF APPROXIMATELY $800,000 COMPARED TO STEEL PIPE.

On December 18, 2003, the MWA Board of Directors approved a $1,575,000 contract with Utah Pacific Construction to begin construction of Reach 4A. The contract called for 40,450 feet of 24-inch, SDR 32.5, Pressure Rated 125 psi, PVC pressure pipe manufactured in accordance with AWWA standard C905. The use of PVC pipe in this section resulted in a savings of approximately $800,000 compared to steel pipe.

Figure 6. The embedment was screened (top) to remove cobbles and boulders from the embedment material. The embedment was placed in loose lifts of 24-inches (bottom).

Figure 7. Portions of Reach 4A paralleled active railroad tracks (top). The huge forces generated at changes of direction in a 24-inch pipeline required enormous thrust blocks (bottom).

MWA STAFF

We discussed the MRPP with several MWA staff. First, we visited with MWA's Director of Engineering, and the project's design engineer, Gary Martin, P.E., S.E. We also met with Mike Limbaugh, Engineering Controller, and Bobbie Copple, Senior Construction Inspector. (See Figure 5.) The MWA has performed all MRPP design work and construction management in-house. The project team was part of the consultant group that had program management responsibilities on the earlier Morongo Basin Pipeline Project, the predecessor to the MRPP. By doing the design and construction management in-house, the MWA believes it has maintained a high level of quality while reducing the project cost by approximately 40%, as measured against earlier cost estimates for the project.

THIS [1,500 FEET PER DAY] EXCEEDED MWA'S EXPECTIONS. THEY THOUGHT THE INSTALLATION RATE FOR PVC WOULD BE LOWER THAN THAT OF STEEL PIPE (ABOUT 1,000 FEET PER DAY).

REACH 4A

Mr. Copple informed us that the contractor laid an average of 1,500 feet of pipe per day. This exceeded MWA's expections. They thought the installation rate for PVC would be lower than that of steel pipe (about 1,000 feet per day). 40 days after dirt started flying, the installation of the pipe was complete. Figure 6 shows some of the jobsite action. The pipe's embedment material was screened to remove cobbles and boulders, and it was placed in loose lifts of 24-inches.

Figure 7 shows some of the design challenges for this project. Portions of the alignment paralleled railroad tracks, and there were several road crossings. At the maximum test pressure of 140 psi, the resulting unbalanced forces on the 25.8" OD pipe at a 45-degree elbow, as shown in Figure 7, would be almost 20,000 pounds.

Acceptance testing for the project included examination of the pipe for visible and measurable damage, and hydrostatically testing the installed pipe. Damage inspection included visible surface damage and excessive deflection. Each 2-mile segment of the installed pipeline was hydrostatically tested at a prescribed pressure for a period of 24 hours with acceptable make-up water as defined in the specifications. All segments passed the required acceptance tests and the project was officially accepted in mid-August, 2004. It should be noted that electrical continuity testing, which is normally required for mortar-lined and coated steel pipe, was not required for Reach 4A.

CONCLUSION

Reach 4A has been in operation for over one year and with no operational problems noted. The MWA has now adopted the practice of bidding PVC pipe as an accepted alternative pipe material for future projects.