Abstract

Since its formation in 1951, the North Texas Municipal Water District has been charged with developing a reliable water supply source for its 13 member cities and 57 other customers (some direct and some indirect), serving more than 1.6 million people in portions of north Texas. The District’s service area covers portions of Collin, Dallas, Denton, Fannin, Hunt, Kaufman, Rains, and Rockwall Counties. Long-range water supply planning efforts identified significant increases in water demands that must be met through a corresponding increase in available raw water supply. Compounding the need for raw water is the fact that the north Texas region experienced serious drought conditions within the last few years with the District’s primary water supply reservoir, Lake Lavon, falling some 17 feet in water surface elevation from May 2005 to October 2006. Additional raw water supply was needed to prevent extensive water restrictions during this drought and provide for continued growth of the service area.

In an effort to supplement available supplies, the District contracted for 50,000 acre-feet of water per year from the Sabine River Authority in Lake Tawakoni, located approximately 45 miles east of Dallas in October 2005. The infrastructure needed to transfer this water from Lake Tawakoni was designed and constructed within an accelerated schedule from January 2006 to July 2008. The infrastructure includes approximately 30 miles of 54 and 60-inch-diameter transmission pipeline and two pump stations, each with a raw water pumping capacity of 75 MGD at a total project cost of nearly $100 million.

Construction management and coordination of the multiple project components was critical. The focus of this paper will be a discussion of the major project components, construction management, and lessons learned during construction of the multi-million dollar project on an accelerated schedule. Unique project issues included coordination of 5 construction contracts, equipment pre-selection and delivery, implementing pipeline corrosion control, technology based management and paperless submittal process, conflict resolution, and specific items of interest related to engineers as resident representatives. Some of the construction issues to be discussed include addressing failures of pipeline joint bonds and construction of a 14-foot diameter shaft on the shore of Lake Tawakoni.
Introduction

The North Texas Municipal Water District (NTMWD) is a water supply and reclamation district created by an act of the Texas Legislature in 1951. The District generally serves a 1,975 square-mile area encompassing portions of Collin, Dallas, Denton, Fannin, Hunt, Kaufman, Rains, and Rockwall Counties. The District provides treated water to 13 member cities and 57 other customers (some direct and some indirect), which have a combined population of more than 1.6 million people. The District supplies wholesale treated water to one of the fastest growing areas in the United States. Some cities in the District’s service area have experienced nearly 10% compounded growth rates in the last 10 years.

The District currently has permitted water rights from Lake Lavon, Lake Texoma, Lake Chapman, Lake Tawakoni and reuse of treated wastewater effluent from the Wilson Creek Regional Wastewater Treatment Plant. Long-range water supply planning efforts have identified significant increases in water demands that must be met through a corresponding increase in available raw water supply. Compounding the need for raw water is the fact that the north Texas region experienced serious drought conditions within the last few years with the District’s primary water supply reservoir, Lake Lavon, falling some 17 feet in water surface elevation from mid-2005 to mid-2006. Additional raw water supply was needed to prevent extensive water restrictions during this drought and provide for continued growth of the service area.

In an effort to supplement available supplies, the District contracted for 50,000 acre-feet of water per year from the Sabine River Authority in Lake Tawakoni, located approximately 45 miles east of Dallas in October 2005. The infrastructure needed to transfer this water from Lake Tawakoni was designed and constructed within an accelerated schedule from January 2006 to July 2008. The infrastructure includes approximately 30 miles of 54 and 60-inch-diameter transmission pipeline and two pump stations, each with a pumping capacity of 75 MGD at a total project cost of nearly $100 million. As shown in Figure 1, these facilities will connect to the District’s East Fork Raw Water Conveyance Pipeline to convey raw water from a constructed wetland near Combine, Texas, to Lake Lavon.

![Figure 1. Overall Project Area](image-url)
Project Components, Contracts, and Phasing

Each of the major project components are listed below. Each is discussed in more detail in the following sections.

- **Lake Tawakoni Pump Station and Intake:** The Lake Pump Station includes an electrical substation, four 25 MGD (1750 hp) vertical turbine pumps installed in a circular wet well with a firm capacity of 75 MGD, two variable frequency drives and a connection to an existing raw water intake pipeline.

- **Intermediate Pump Station:** The Intermediate Pump Station includes an electrical substation with provisions for temporary power, three 25 MGD (1500 hp) horizontal split-case pumps, and a 6 MG ground storage tank.

- **Tawakoni Raw Water Pipeline:** The Raw Water Pipeline includes approximately 12 miles of 60-inch pipeline between the Lake Pump Station and the Intermediate Pump Station Ground Storage Tank and about 18 miles of 54-inch pipeline between the Intermediate Pump Station and the East Fork Conveyance Pipeline connection.

To meet a design and construction schedule for a project of this scope, the project was divided into multiple bid packages. Given long lead times for equipment and limited time for construction the project was ultimately designed and bid in seven different contracts. Each of these is listed below with a brief discussion of the impacts to project design and construction time.

- **Contract 1 – Substation Electrical Equipment:** This contract was originally included for pre-selection of large substation transformers, but was removed from the project as the District was able to coordinate temporary power until permanent power could be provided by the utility at the Intermediate Pump Station. At the Lake Pump Station the utility was able to construct a new power line and substation within the time constraints needed by the project.

- **Contract 2 – Pumps, Control Valves, and Variable Frequency Drives:** Manufacturing lead times on this equipment was at least 12 months. After completion of system hydraulics and preliminary design of the facilities, pumps, valves, and control equipment were selected and bid with a 15-month lead time to avoid late equipment delivery.

- **Contract 3 – Lake Pump Station Sump and Intake:** This contract included the below-grade facilities at the Lake Tawakoni Pump Station, including the pump station intake, connection to the existing intake pipeline, and construction of the pump station wet well. By separating this work from the overall pump station construction, bidding and construction could occur as soon as below-grade facilities design was complete instead of waiting until the complete pump station facility was designed.

- **Contract 4 – Lake and Intermediate Pump Station:** This contract included the above-ground pump station facilities at the lake and the entire Intermediate
Pump Station and ground storage tank construction. Combining the two pump stations into one contract provided several advantages. A single point of responsibility allowed for more effective management. Construction of operational features of the system was simplified since all electronics and programming would be completed by the same entity, and problems during construction were reduced since only established contractors had bonding capacity to bid the combined project.

- **Contract 5 – West Pipeline:** The West Pipeline included about 10 miles of the 54-inch-diameter pipeline. Pipeline contracts of not more than 10 miles were selected to keep construction schedules to about 9 months.

- **Contract 6 – Central Pipeline:** The Central Pipeline included about 8 miles of 54-inch-diameter pipe and 2 miles of 60-inch-diameter pipe.

- **Contract 7 – East Pipeline:** The East Pipeline included about 10 miles of 60-inch-diameter pipeline.

An interesting feature of the project is the phasing plan, which included construction of the pipeline and pump stations all to be used for the transfer of raw water initially. By 2010, the Lake Tawakoni Water Treatment Plant will be constructed and a new potable water transmission line built to tie the new plant to the District’s South Water Transmission System. At this point, the Intermediate Pump Station will be expanded such that the additional capacity (30 MGD) will be treated water pumped to the South System and the remaining capacity will be raw water pumped to Lake Lavon. By 2020, the 54” section of the pipeline will be converted for transmission of treated water to the District’s South and East Systems and the remaining Intermediate Pump Station capacity converted to treated water.

**Construction Management**

The final component of the project was to provide construction phase services, including field representation for the project. Construction management and coordination of the multiple project components was critical. In order to provide continuity between the design and construction phases of the project, it was determined that several of the design engineers would proceed to work as on-site construction representatives for the District. These engineers were assigned to the two pump station facilities and to portions of the pipeline and were under the guidance of experienced construction managers. This aided construction management by reducing response time to contractors on submittals and questions in the field.

Day to day management of the construction phase was handled through use of “FNManager”, a web-based construction management program. FNManager allowed all construction documentation, submittals, and correspondence to be handled online. All construction resident representatives were given web access to FNManager through on-site offices or laptop to check current submittals and post daily reports and construction photos. The contractor was able to post Requests for Information (RFI) and receive timely responses from the engineer within the same day in many
cases. The “paperless” submittal process helped speed up RFI and submittal review process with an improved response time. Following approval, hard copies were made.

Additional construction management tools including monthly meetings and equipment startup checklists were used to coordinate construction activities. For each construction contract, monthly progress meetings were held with the contractor, District, design engineers, and resident representatives to coordinate ongoing activities. Detailed checklists for major equipment installation and startup were prepared by resident representatives and design engineers. The checklists were provided to the contractor as a guide to how systems needed to be started up and tested for proper operation. The checklists required the contractor to coordinate with equipment representatives for timely site visits during startup activities.

Lake Pump Station and Intake Construction

The Lake Pump Station is located adjacent to two older and smaller pump stations on a narrow peninsula on the shoreline of Lake Tawakoni. Fitting a third pump station near the shoreline was challenging. However, the existing intake tower and 48-inch intake pipe shared by the two older pump stations were adequately sized for the new 75 MGD Lake Pump Station to access water at different lake levels. A connection was made to the existing intake piping on shore by constructing a vertical shaft (known as the Tie-In Vault) over the intake pipe and “tapping” the pipe to connect it to the Lake Tawakoni Pump Station wet well. This eliminated the need for Corps of Engineers notification and individual 404 permitting, since no construction occurred within the lake. Not only did on-shore construction eliminate lengthy environmental permitting, but it also allowed for quicker and simpler construction since no work was required in the lake.

One of the major construction difficulties was the Tie-In Vault. The Tie-In Vault was designed as a 14-foot diameter, 57-foot deep shaft with an 84-inch diameter tunnel that connects to a 36-foot diameter sump for the vertical turbine pumps. The shaft was originally designed to be excavated and supported using tunnel liner plates. The vault would be a cast-in-place concrete structure constructed from the bottom up. During the excavation of the shaft, the liner plate failed on two separate occasions. During the first failure, ground water began entering the shaft and deterioration of the surrounding soils caused the shaft to shift significantly. The original shaft was removed and a more robust support system was implemented for the second attempt. The second failure was similar to the first failure, however at a depth of approximately 36-feet the liner plate failed and a surge of water began entering the shaft. Within a matter of hours, the shaft filled with water to a hydrostatic level equal to the current lake elevation at the time. Over the next several months the contractor attempted several methods to dewater the shaft and continue the excavation including soil stabilization injection, grout injection, and well points. Each attempt to dewater caused more subsidence of the surrounding soils and voids outside of the excavated shaft. In an effort to avoid a catastrophic failure and additional soil subsidence, the contractor proposed a new design using pre-cast concrete liner segments in lieu of a cast-in-place structure. Well points were drilled just outside of the shaft to dewater the structure while the foundation base and bottom
10-feet around the existing intake pipe were cast-in place. Reduced 13.5-foot diameter, 5-foot tall pre-cast concrete liner segments were placed vertically for the top 45-feet of the shaft. Grout was pumped between the liner plate and pre-cast segment liners to lock the shaft in place. The Tie-In Vault was completed successfully but construction was delayed nearly four months due to the difficulties. The actual cause of the water intrusion was never determined. Throughout this process the resident engineer closely monitored activities and communicated the contractor’s ideas to the design engineer and District for approval. Detailed documentation of daily construction activities aided the District in a favorable resolution of change order negotiations with the contractor.

Several other construction difficulties with the Lake Pump Station were related to the limitations of a small site on a narrow peninsula with two existing pump stations. The pump station layout was designed to use the smallest footprint while allowing adequate access for operation and maintenance. During design, a circular sump with four 25 MGD vertical turbine pumps and a single discharge header was determined to provide the smallest building footprint of 60-feet by 90-feet. The new pumps, valves, discharge piping, and fittings were laid out in a very tight space within the pump station building. As a result there were several conflicts fitting all of the required equipment and controls into the facility. The most significant conflict was with a pump control valve bypass pipe configuration that could not be constructed as originally designed. The resolution of this issue was to combine piping for pump air release valve and pump control valve bypass pipe. Resolution of this and other minor conflicts was aided by having an engineer who had been involved in design on-site as the District’s resident representative.

Other issues with the small structure arose from the complicated structural foundation that connected the circular sump to the rectangular building foundation and slab. The contractor had to add many additional construction joints and build-up the foundation in small sections. The resident engineer played a significant role in facilitating communication of the contractor’s ideas for joint locations with the structural engineer to make sure that joint locations did not adversely affect the structure.

The delivery of pre-purchased pumps and variable frequency drives (VFD) was another major issue during construction. The pumps began arriving on site a month after the original targeted delivery date. Once on site, a visual inspection of the pump revealed defects in the epoxy coating. Several segments of the pump columns were sent back for coating repairs. Upon delivery of the VFD’s, a visual inspection revealed damage to the cabinet panels along with dirt and grime contamination inside of the cabinets. The VFD’s were sent back to the manufacturer for repair and replacement of several damaged parts and delivered back to the site nearly 4 months later. Prompt identification of these issues by the resident engineer reduced the overall length of delays.

Intermediate Pump Station and Ground Storage Tank Construction

The Intermediate Pump Station is located on a site with no existing facilities. In the future, a water treatment plant will be constructed on the same site. The design
of the treatment plant was underway during construction of the pump station. The resident engineer and contractor kept this in mind for infrastructure that would be impacted by the future treatment plant. During design of the pump station, a concept design of the plant and high service pumps was completed in order to identify piping and electrical connections that would be needed in the future.

The only major conflict encountered during construction was for several butterfly valves located near tees. The design used for the project was for butterfly valves oriented with horizontal shafts and worm gear actuators. There were two locations where a valve was supposed to be placed near a 54-inch tee. Design plans showed these locations in a schematic manner only. The tees were fabricated with crotch plates as required by steel pipe design standards. The contractor’s original plan was to install the valve on the flanged outlet of the tee. When this was attempted, it was found that the actuator gear box conflicted with the crotch plate. The resident engineer and contractor were able to work out a solution to install the valve with a vertical shaft and a bevel gear. The District decided that for an installation with two sets of gears it was required that these be accessible within a manhole.

The pump station was designed with slots for six horizontal split case pumps. Three were installed with the initial raw water project. The next three would be installed with the water treatment plant to be used as the high service pumps. In the future, the raw water pumps will be converted to treated water service when the final phase of the plant is completed. In order to accommodate this configuration, the suction and discharge headers were constructed with an air gap for the intermediate period with provisions for connecting the two sides in the future. It was desired that this air gap be inside a vault so the connection could be made easily. The air gap vault was designed with a blind flange on each side so that a spool piece could be installed in the future. The vault wall was cast around a wall flange on the pipe to provide a seal for the wall. The pipe outside of the wall included a restrained split-sleeve coupling to provide a small amount of flexibility. A large crack had developed inside the vault wall following completion of hydrostatic testing at about 200 psi of one side of the discharge header. It was eventually determined that the coupling had “stretched” about ¼-inch to the full amount of separation between pipe ends inside the coupling. This caused the vault wall to crack as the rest of the pipe was restrained and bedded with flowable fill. Prior to testing the other side of the header, the resident engineer and contractor were able to come up with a solution to prevent the same problem occurring again. The joint across the coupling was welded with an internal butt-strap. This was acceptable as the need for flexibility was not as critical as thought during initial design. That was primarily because the vault and the header pipe were both founded on a stiff shale layer such that less differential settlement is expected than the original design anticipated.

Part of the design that became essential during construction to keep the entire project moving forward was a bypass pipe installed between the suction and discharge header. The original intent of this bypass was to help direct fouled water to the future water treatment plant lagoons when the pipeline is pigged in the future. There were several pipeline segments downstream of the pump station with no access to large volumes of water for filling of the pipeline for hydrostatic testing. The only
water available to these contractors would have been from the District’s or their customers treated water systems. Due to the timing of this testing during the high demand summer months, this was not a preferred option. The Intermediate Pump Station was not completed in time to fill these pipelines; however the yard pipe, storage tank and bypass pipe were completed at this time. The existing pumps at the lake were sufficient to fill the tank, which was then used to fill the pipelines by gravity flow. This bypass pipe then became essential in helping to provide water to the four pipeline segments that were part of the Lake Tawakoni and East Fork raw water supply projects.

**Pipeline Construction**

The pipeline route is located through a region with soils considered to be very to extremely corrosive, therefore the corrosion protection system is a key part of maintaining the infrastructure over the entire design life. To improve competition and pricing, the pipeline contracts were written such that the contractors bid multiple pipe materials, including bar-wrapped concrete cylinder pipe (AWWA C-303) and polyurethane coated steel pipe (AWWA C-200) each with a different associated corrosion protection system.

Bar-wrapped concrete cylinder pipe was the low bid submitted for all three pipeline contracts. An impressed current system had been designed for this pipe material with deep anode groundbeds. The pipe was specified to have Carnegie joints with rubber gaskets and only was welded in locations where it was required for thrust restraint. As a result, joint bonding clips were specified for the gasketed joints in order to provide an electrically continuous pipeline. Three steel clips were specified to be arc welded to the pipe cylinder at each joint. The joints were wrapped with a diaper filled with mortar to protect the exposed joint ring and bonding clips.

Following completion of the work, the pipeline was tested to determine that it was electrically continuous prior to energizing the impressed current. Serious defects were uncovered with the pipeline continuity in two of the three pipeline contracts. The continuity was measured using the four-wire lineal pipe resistance method. This method allows testing to be made at low voltage and current and thus is a good model of the way the CP system will actually operate. The use of this method required some education of the pipeline contractors as they were not familiar with it.

Test stations generally are located at intervals of about 1,000 feet along the entire pipeline. These were used to break the line into small sections that could each be tested individually for continuity. The continuity test method requires an accurate measurement of length to determine resistance of the pipe cylinder and an accurate count of bonded joints to determine resistance of the joint clips in order to determine a calculated total resistance value for the section of pipe. The test is used to determine an actual resistance value between the test stations. Resistance of the steel cylinder (2.3 to 2.9 μΩ/foot, varies with pipe size) and the bonding clips (55 μΩ) are known values that are assumed for the purposes of the calculation, although once a given section is determined to be continuous these can be verified with the field measurements. These values are compared and where the measured value is greater than the calculated value, a discontinuity is indicated.
All three pipeline sections had some discontinuities that were discovered during the testing stage. The East Pipeline had one section that was discontinuous; the Central Pipeline had twenty sections that were discontinuous; the West Pipeline had nine sections that were discontinuous. The test was accurate enough to determine if a single joint in the test section was improperly bonded, as in the case of the East Pipeline discontinuity. The causes for the discontinuities were determined to be primarily due to poor workmanship when welding the clips to the pipe cylinder. Only one joint was found to have been installed with no bonding clips. Previous experience has also found that the thermal contraction of the pipe after installation can cause weak joint clip welds to fail. As the majority of the pipe was laid during the spring and summer of 2007, this likely exacerbated the problem. When the pipe is moved from the warm conditions strung out along the route and buried in a cool trench, the pipe is subjected to thermal contraction. The stresses are relieved when the mortar at the joints cracks. If the weld of the bonding clip is insufficient, the stress can cause these welds to be broken.

The contractors came up with essentially the same method of locating the discontinuities. They would physically uncover a pipe joint near the midpoint between the two test stations. The resistance between the uncovered joint and the test station on the upstream and downstream side was then measured to determine which side was discontinuous. This process continued until locating the discontinuity to within about three joints. At this point, the contractor would uncover each joint, remove part of the mortar coating on the joint and weld additional bonding clips between the bell and spigot. The majority of this repair work was completed while the pipeline was in service and so did not impact the operation of the transmission system. During the CP system testing, there were locations where active corrosion was found to have already started. The discontinuities in the pipeline prevented the impressed current system from being energized in order to protect those parts of the pipeline.

The other major issue encountered during construction of the pipeline was the failure of the mortar coating on a significant number of pipe joints. The bar-wrapped concrete cylinder pipe was selected for each contract and was produced by only one manufacturer. The manufacturer used two plants to fabricate the pipe. The East Pipeline was the first pipe to be fabricated. This line is 60-inch diameter pipe manufactured in 32 to 35-foot lengths with about 1,500 pieces. The pipe was delivered and strung along the pipeline route several weeks prior to beginning pipe laying operations. After the pipe laying operations began serious flaws with the mortar coating of the pipe were noticed. Sections of the coating were falling off up to several square feet in areas leaving the spirally-wound reinforcement wires and pipe cylinder exposed. Upon discovery of this, additional pieces were inspected and the issue was found to be widespread with pieces from one of the plants. The manufacturer was notified immediately and responded promptly.

The solution that was settled on between the District, engineer, contractor and manufacturer was for the manufacturer to inspect every piece of pipe and repair any disbonded coatings in the field. The manufacturer ended up repairing over 500 pieces of pipe. About three weeks elapsed between the start of pipe laying and the discovery of the coating problems. The coating flaw was not seen on these pieces during
installation, but since the condition was unknown an extended warranty was required for these pieces and eventually for the entire East Pipeline. The warranty is intended to allow the District to put the pipeline CP system into operation and monitor the pipe to determine if there are corrosion problems due to disbanding of the pipe coating. As the manufacturer has a long-standing relationship with the District and engineer this was felt to be acceptable resolution. During the initial CP system testing, active corrosion in this section of the pipeline was no higher than the other sections. By using an impressed current CP system any flaws with the coating that were not caught during detailed inspections will be able to be detected and mitigated.

**Contractor/Resident Rep Issues & Lessons Learned**

A project of this magnitude with an accelerated schedule resulted in many lessons learned that can be applied toward future projects. Specific lessons learned during the construction phase that can be put into practice by a resident representative include:

- **Document everything** with detailed daily reports, notes, and photos. Several potential claims were avoided or reduced due to accurate and detailed daily reports and photos. (e.g. Tie-In Vault ground water issue; restoration of pipeline right-of-way)

- **Require contractor to follow RFI process.** Contractors typically do not want to wait for RFI answers from the engineer. With time sensitive activities, the resident representative should attempt to get answers from the engineer verbally and document immediately afterward. At both pump stations, structural steel fabrication issues were resolved quickly by the resident representatives through direct contact with the structural engineer, followed by RFI’s for the files.

- **Concrete formwork, rebar, and pours need to be inspected and watched closely.** On a fast paced project, quality control on rebar and formwork often declines. Resident representatives need to be present for all concrete pours to monitor work and inspect delivery tickets for correct mix design. At both pump stations, concrete deliveries were occasionally discovered to be of the wrong mix design or beyond the time limits allowed by the specifications.

- **Pay close attention to plans, submittals, and record data for potential conflicts between disciplines (civil, structural, architectural, electrical, mechanical).** Be sure the contractor follows through with required changes from “Approved as Noted” submittal comments. Several issues with yard piping and valves were caught with the submittal drawings but not changed for fabrication. Wall fan sizes were changed in the submittal, but adjustments were not made for the precast wall panels.

- **Cross-check the construction plans with shop drawings and record data carefully.** The contractor often constructs the facilities directly off of the
submittal drawings, not the plans (e.g. rebar drawings for complicated foundation beams at both pump stations).

- Remind the general contractor to monitor quality control of all sub-contractor work.
- Carefully check major equipment upon delivery for compliance with submittal drawings and for potential damage during delivery (e.g. pipe coatings, Lake Pump Station - pumps, yard piping, and VFDs).
- Keep a running punch-list of small issues that need to be addressed by the contractor prior to final completion.
- Hold pre-activity meetings prior to the start of major phases of construction.
- Be aware of the fine line between the contractor’s responsibility for means, methods and safety and the resident representative’s responsibility of monitoring that the District is getting a project in general conformance with the design intent as specified by the engineer, without directing the contractor’s activities.

**Project Cost and Schedule Summary**

Construction for all phases of the Lake Tawakoni Water Supply Project is complete. During construction heavy rains in the region ended the two year drought; therefore the District’s water supply needs were not as urgent. As a result, the tight construction schedule was relaxed by the District and the contractors were allowed several additional months to complete construction. Bid totals, key dates, and estimated costs for the construction contracts and all incidentals are listed in the Table 1 below:

**Table 1. Bid Totals and Key Dates**

<table>
<thead>
<tr>
<th>Contract</th>
<th>Bid Date</th>
<th>Substantial Completion</th>
<th>Bid Amount</th>
</tr>
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<tbody>
<tr>
<td>Contract No. 2, Equipment Pre-Selection</td>
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<td>10/01/07</td>
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<td>Contract No. 3, Lake Sump &amp; Intake</td>
<td>08/01/06</td>
<td>06/15/07</td>
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<td>07/15/08</td>
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<td>Contract No. 5, West Pipeline</td>
<td>10/26/06</td>
<td>10/15/07</td>
<td>$ 17,330,000</td>
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<td>Contract No. 6, Central Pipeline</td>
<td>11/15/06</td>
<td>12/15/07</td>
<td>$ 15,200,000</td>
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<tr>
<td>Contract No. 7, East Pipeline</td>
<td>11/02/06</td>
<td>09/15/07</td>
<td>$ 17,320,000</td>
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| Subtotal Construction              | $ 73,560,000 |
| Total Power Supply                | $ 12,110,000 |
| Miscellaneous, Right-of-Way, and Professional Services | $ 11,680,000 |
| Total Project Cost                | $ 97,350,000 |