

Exposed Pipeline is Once Again Protected Thanks to ARMORFORM

A once buried pipeline that is now exposed can be of serious concern. When Colonial Pipeline found out that a 16" diameter pipeline that had once been buried well beneath Raccoon Creek in North Georgia was now exposed they required immediate action.



Exposed 16" diameter pipeline caused by the natural relocation of Raccoon Creek.

In December of 1995, shortly after the exposed pipeline was discovered, Colonial Pipeline had a crucial decision to make. The pipeline obviously needed to be re buried. The options were to close the pipe, refit it and re bury it below the now relocated creek bottom or to simply move the creek back to its original position. The first option appeared to be the easiest thing to do, however, shutting down the pipeline would cause serious down time and there was no guarantee that the creek would not relocate itself again and cause the pipeline to be re exposed. Upon further inspection of the site it was discovered that the outer bank of the creek was now less than 20 feet away from a 500,000 volt electrical tower! It was obvious that the creek would have to be moved.



A 500,000 volt electrical tower is dangerously close to the edge of the creek's outer embankment.

It was decided to relocate a 250 feet long curved section of the creek in order to re bury the exposed pipeline and to protect the electrical tower. The creek would have to be moved over 40 feet thus creating a much sharper bend than that which was formed naturally, and there was evidence in the surrounding terrain that the creek frequently overtopped its banks. It was obvious that there was the potential for a serious erosion problem. Hard armoring of the creek's embankments would be necessary.

Once it was decided what needed to be done Colonial Pipeline was faced with another problem. The application of the hard armor system would have to be done without dewatering the site. Since it was an active creek, flow conditions of 2 feet deep at velocities of 5 fps were expected during the construction. Any type of poured concrete or shotcrete was immediately ruled out. Rip rap seemed to be the obvious solution, but very large stones would be needed and it was feared that the sized of the stone would lower the capacity of the creek and cause more water to spill out of its banks. It was decided that an articulated concrete block mat, or ACB, would be the best possible solution. **ARMORFORM® Articulating Block Mat (ABM)**

A preconstruction meeting was held at the project site with Colonial Pipeline and ARMORFORM representatives present. It was determined that the creek should retain its current sectional area. The creek would be relocated by cutting from the inside embankment and filling the outside embankment. Final geometry would be trapezoidal with a bottom width of 20 feet, a depth of 12 feet, 1.5:1 side slopes and a bed slope of approximately 1%. It was also estimated that a discharge of 7,000 cfs would be experienced frequently. This volume of water equates to a unit discharge of over 180 cfs/ft at a velocity of over 16 fps. Since the application area is in a sharp curve, additional shear stresses can also be expected. The size of ARMORFORM ABM that was chosen is a 6" thick mat.

CONTINUED

Pipeline case study (continued)

Since time was a critical issue the custom fabricated ABM panels were assembled immediately and the dirt work was commenced. Just a few days after the preconstruction meeting the custom fabricated ABM panels were delivered to the job site, and the now relocated creek was ready for armoring.



After grading was completed the creek was effectively "moved" to re bury the exposed pipeline. Also note that the electrical tower is now far away enough from the outer embankment to be out of the photograph.

Once the side slopes were graded to the desired angle, an "anchor" trench was cut at the top of each slope. This trench is located approximately 1 foot back from the top of the slope and its purpose is to provide an anchor or "toe-in" for the ARMORFORM mats. This anchor will help reduce the possibility of the mat from sliding down the slope, however, its primary function is to prevent scour at the top of the slope caused by water flowing outside of the creek's banks when a flood occurs. A geotextile filter fabric supplied by *Mirafit* was installed directly over the subgrade to prevent the loss of fines when water passes through the open areas of the concrete mat. The ARMORFORM panels were then placed on top of the geotextile and temporarily held in place by placing sandbags around the edges. During the inflation process the sandbags are simply pushed off of the ABM as the injected grout thickens the mat.

The ARMORFORM panels were installed starting at the downstream end first. By working downstream to upstream, panels could be overlapped onto one another in the flow direction so that water could not infiltrate the system. Access to the project site was limited to 1 side of the creek, however, the armoring was required on both embankments. The work crews simply carried the light weight ABM panels across the creek and unrolled them into place. The grout was then pumped through a hose and into the ABM from the opposite side of the creek where the pump and the trucks delivering the concrete were located.



ABM panels being inflated on the inside embankment. Note the geotextile filter fabric on the slopes of the outer embankment in the foreground.

The installation of the ARMORFORM panels continued into its second day with just under half of the project completed. While the inflation of the panels continued, a dozier backfilled the anchor trenches of the mats that were installed the previous day. The second day of installation proved to be much more productive, and the project was completed in the early hours of the evening. The installation of the ARMORFORM panels went without a single glitch. Over 400 cubic yards of fine aggregate concrete was injected into the ABM panels in just 2 days, and the project was completed substantially under the amount budgeted by Colonial Pipeline.



As the inflation of the ARMORFORM mats continues into the second day a dozier can be seen in the background filling in the anchor trench of the mats installed the previous day. Note the change in the color of the concrete. The freshly pumped concrete in the foreground is dark gray, while the concrete that was installed the previous day has turned to a whitish color.

CONTINUED

Pipeline case study (continued)



Completed ARMORFORM 6" ABM installation (looking downstream)

Nearly four years after the installation of the 6" Articulating Block Mat the creek still flows between the ARMORFORM protected embankments with no apparent damage to the system. The mats are completely intact and are providing the necessary protection to the creek's embankments to insure that the pipeline will not be re exposed.



Other Installations

ARMORFORM has been utilized to protect a pipeline or fiber optic cable in several projects. If the pipeline or fiber optic cable crosses a creek the potential for erosion of the creek bed to expose the pipeline or cable is imminent. Shown here are photographs of just a couple of projects in which ARMORFORM was utilized to protect these crossings.



ARMORFORM ABM being installed over a fiber optic cable crossing in a shallow creek.

ABM mat before concrete injection (looking upstream)



ARMORFORM ABM mat being installed over a restored pipeline crossing

ABM Mat after concrete injection (looking downstream)

