by Jeff Griffin ■ Senior Editor

Tough Outfall Installation

Made Possible Pit-Launched HDD

Horizontal directional drilling (HDD) is playing an important role in the project at a world-renowned oceanography center in California. HDD is helping to construct a new seawater return piping system that is essential for the center to conduct its research and teaching programs.

The Scripps Institution of Oceanography is one of the oldest, largest and most important centers for marine science research in the world.

Established in 1903, the institution became a part of the University of California in 1912. Located on the Pacific Coast north of La Jolla, and just over 15 miles from the San Diego International Airport, research at Scripps encompasses physical, chemical, biological, geological and geophysical oceanic studies.

Ongoing investigations include the topography and composition of the ocean bottom, waves and currents, and the flow and interchange of matter between seawater and the ocean bottom or the atmosphere.

The institution uses approximately one million gallons per day of high quality seawater for ocean research and teaching activities. Fresh seawater is drawn from the ocean through an intake at the foot of the institution's pier. After use, it is returned to the beach through a discharge pipe that also carries urban runoff, a practice that was initiated in 1910.

To continue returning seawater to the beach, Scripps discharge system must be modified to comply with the most recent environmental discharge regulations, and HDD played an important role in construction of new out-fall piping.

The first discharge requirements affecting the Scripps facilities were enacted in 1969. Scripps obtained a discharge permit that year and permits were periodically reissued in the years that followed.

Ultimately, the State Water Board designated the beach and waters directly in front of the institution an Area of Special Biological Significance (ASBS). Although the California Ocean Plan prohibits waste discharge into an ASBS, the water board issued a conditional exception allowing continued discharge of Scripps seawater and municipal stormwater. It also established requirements and conditions that must be met by March 2008 for discharges to continue.

Project begins

After the first two lines were installed, additional return lines were added to the system with all work projected to be completed in March of this year. "Currently the seawater return discharges are co-mingled with the storm water in a combined piping system throughout Scripps Institution of Oceanography, and both are discharged out of two outfalls," explains Anka Fabian, University of San Diego principal engineer for the project.

"In order to meet the new permit requirements for eliminating dry weather flows," she continues, "the selected seawater system has to be separated from the storm water systems discharging to the same outfalls. This is to completely separate the storm water and seawater return systems inside and outside the buildings."

In the initial plan for separating the outflow lines, pipes were aligned and placed near the existing storm drain lines. But after survey and review of existing drawings, it was found that there were many utilities in the existing easements of the narrow Biological Grade Road.

Because of the presence of these utilities and other factors, trenchless construction offered several benefits, and bid documents reflected trenchless design with conventional trenching as an alternative.

"The bids came in close," says Fabian. "Although the cost for trenchless was slightly higher, it was decided that there was no doubt that this was the better way to go because of site constraints and to reduce impact on the SIO community. The project was given a CEQA (California Environmental Quality Analysis) negative declaration and approved by the Coastal Commission which was very supportive of this methodology."

The general contractor is NEWest Construction, San Diego.

Surface and subsurface soil conditions complicated the project. "There are brushy hillsides with steep slopes crossing asphalt roads," says Brian Aanestad, vice president, Inland Valley Engineering Inc., Temecula, CA., the HDD subcontractor. The soils consist of sandstone, hard, cement-like sandstone and cemented cobble up to eight inches in diameter.

"Due to the heavy congestion of many existing utilities, including existing seawater lines, the bores were designed to clear all existing lines and limit excavation requirements. There were not many windows to move between existing lines," Aanestad explained.

Surface to pit

Surface conditions made it impossible to use conventional surface-launched HDD equipment. "Surface-launch drills did not have sufficient space to move back to allow the drill to hit the tie-in depths for the new seawater lines or to maintain proper grade alignment," said Aanestad.

'Microtunneling had been considered, but we offered the alternative method of pit-launched HDD that provided a substantial savings versus microtunneling."

The original contract called for the installation of 2,300 linear feet of fusible 8-inch C-900 PVC pipe which was completed in seven bores.

However, Aanestad says once project owner representatives saw the capabilities of directional drilling, more such installations were added to the project.

"By the end of December," says Aanestad, "we had completed the seven bores for the C-900 PVC and three additional bores to place approximately 1,150 linear feet of 3-inch HDPE for fiber optic cable to the control valves. The shortest was 80 linear feet and the longest 550 linear feet which was to install 8-inch pipe at a 24-percent incline. Most bores are at between a 4 and 17 percent, incline up brushy hillsides and across roads."

HDD installations were added for approximately 450 feet of 12-inch HDPE pipe; 750 feet of 8-inch C-900 PVC pipe; 325 feet of 6-inch HDPE pipe, all for additional seawater return lines; and 3-inch HDPE pipe for the control valves.

For the project, Inland Valley used a custom-built, pit-launch Model 50x55 directional drilling unit with rack-and-pinion carriage drive. The unit produces 50,000 pounds of thrust and pullback force with a maximum rotary torque of 500 foot pounds. The power unit, set up adjacent to the launch pit, was powered by a 230-horsepower diesel engine.

A DigiTrak Mark III tracking system was used to guide the path of the pilot bores. The machine uses 10-foot lengths of drill pipe.

"Tough and varying soil conditions caused us to develop custom downhole tools and make modifications and improvements to vendor-manufactured products," says Aanestad. "For most of the work we were able to maintain one style of bit for drilling 4-inch diameter pilot holes and one backreaming design to enlarge the hole for product pull in. For the 8-inch pipe, we generally made two backreaming passes before pipe was pulled in. A third pass was added on a couple of bores where a lot of hard cobble was encountered."

The drill frame has a 4-foot wide and 18-foot long foot print. To start a bore, the drill frame was placed in a 8 by 20 foot starting pit. Initial plans were to use a smaller pit, but once on the job it was enlarged in order to make multiple bores from the same pit and to accommodate trail ditch on exit pits. Pits were from 15 to 26 feet deep.

New direction

"This was the first time we had employed HDD at the university," says Fabian. "Once on the job, we could better grasp what was needed, we could accommodate the proper pit sizes and areas necessary to lay out the pipe."

Segments of PVC were fused into lengths of 150 to 550 feet prior to pull-in and 15- to 30-foot trenches or slots were dug to facilitate pulling pipe back into the pilot hole.

A 300 gallon StraightLine SL300 drilling fluid mixing system was used with a 35 gpm pump to provide fluids to the drill unit. Viscosity of the bentonite fluid was adjusted to varying soil conditions, but did not exceed a viscosity of 80.

Fluids escaping from the bore hole were contained in entry and exit pits and collected by a vacuum truck and pumped to an enclosed steel storage tank. Fluids were removed from the tank at 4,500-gallon intervals and transported by truck to a disposal site.

The use of directional drilling avoided environmental issues that would have occurred with open-cut construction. Pits were constructed in roads or in parking lots to avoid potential environmental concerns for damaging steep slopes with native plants such as sage scrub.

"We employed an archeologist who monitored the soils and a biologist who ensured that the pits and staging areas did not grow beyond set boundaries," Fabian says.

With return lines in place and work on additional drilling installations progressing on schedule, Aanestad reflects on the project and the role directional drilling played.

"HDD," he said, "achieved large cost savings through the reduction of excavation, the speed with which pipe installations were made, the ability of one machine to install any size of pipe, and the greater push angles that could be achieved. In addition, a reduction in the amount of support equipment needed reduced mobilization costs and contributed to costs savings."

The ability of the project owner, general contractor and HDD contractor to work together and to make adjustments as necessary contributed to the project's success.

All parties involved remained flexible while dealing with restricted work space, varying soil conditions and protecting the environment," says Aanestad. "The commitment by all three parties to provide a seawater return pipeline system to meet the needs of the institution, while maintaining consideration to the regular daily activities of the research environment, aquarium and college made for a successful job."

The university and Scripps are pleased with the results of their first experience with directional drilling.

Concludes Fabian: "The overall performance of the technology and contractors exceeded expectations – particularly the HDD portion. Directional drilling has enabled us to add in lines for telecommunications for a small additional cost, which would have been much more costly if trenched.

"I think this has been an interesting project and I underestimated what a great construction tool HDD really is. I hope to use this much more in the future."

FOR MORE INFORMATION:

HDD contractor:
Inland Valley Engineering, (951) 719-8414,
inlandvalleyengineering.com

Tracking system:
DigiTrak from Digital Control Inc.,
(800) 288-3610, digital-control.com

Fluid mixing system:
StraightLine,
(800) 654-3484, straightlinehdd.com