For Pea

By Correspondent Tonia Jurbin

It is challenging enough to run new utility infrastructure through an already aging and congested underground corridor with many abandoned services in a high traffic use area, but when you also have to worry about whether your 4.2 m by 2.4 m by 2.25 m concrete manholes are going to settle because of the soft compressible organic silts, or float out of the ground because of the peat and high water table, that makes things a little harder.

If that's not enough, add the threat of an earthquake and a nearby fish bearing creek and it becomes clear that building in the peatbogs of BC's lower mainland is tough.

BC Hydro is currently building a 12kV distribution feeder system from the Newell Substation in Burnaby (one of the largest substations in the system) to the rapidly growing industrial park in the 'Big Bend' area of Burnaby.

The 4.5 km feeder system is made up of 16 – 127 mm PVC ducts with manholes averaging every 200 m. That's about 40 km of single core cable. The final 2 km of the job, phases III and IV are being constructed in the soft soils.

Heavy section of feeder system is lowered into place. Photo at left shows peat conditions.

Part of the problem with installing these ducts is that for most of their length the combined weight of the ducts and the backfill is heavier than the same volume of material that is being removed. Distribution ducts are generally concrete encased, or have steel plates or concrete trench covers placed over them, an expensive procedure that is being reevaluated.

In good soil it's not really necessary except for protection from digging, and in poor soil the concrete can break and shear the ducts. Using steel is expensive so BC Hydro decided to take the risk and design the system without the protection.

Adding additional trench protection in this case would have made the system even heavier causing greater long-term settlement, which presents other risks to the system.

"We want the ducts to move with the ground, we know the ground is going to move. Our engineers have designed this system to accommodate some settlement, and, the possibility of the manholes floating during high water," says Carl Badenhorst, BC Hydro's project manager for the final phases of this project.

A number of interesting innovations were worked out between the BC Hydro designers and inspectors, and the contractor.

The ducts, while they are not encased in concrete, are encased in a geotextile which serves a number of purposes; it prevents the fill from washing away into the soft surrounding soils which would allow the ducts to separate, and it adds strength to the system. Flex joints

t's Sake

were designed for connecting the main duct run to the manholes using stainless steel couplings and a tough abrasion resistant vacuum hosing. A one-foot extension lip was also cast to make expanded base precast manholes. The lip allows for additional backfill on the manhole to resist the buoyant forces during high water.

Styrofoam blocks are being placed under most of the manholes; the thickness of the block varies from 102 mm to 1 m with the thickness and the depth of the peat being removed.

Styrofoam blocks that are too big could cause the 13 000 kg manhole to float, even if it is partially filled with water.

Styrofoam blocks were also used to replace the lightweight concrete that made up about .3 m of the road fill, and, it will also be placed over the duct runs to decrease the overall weight of the backfill.

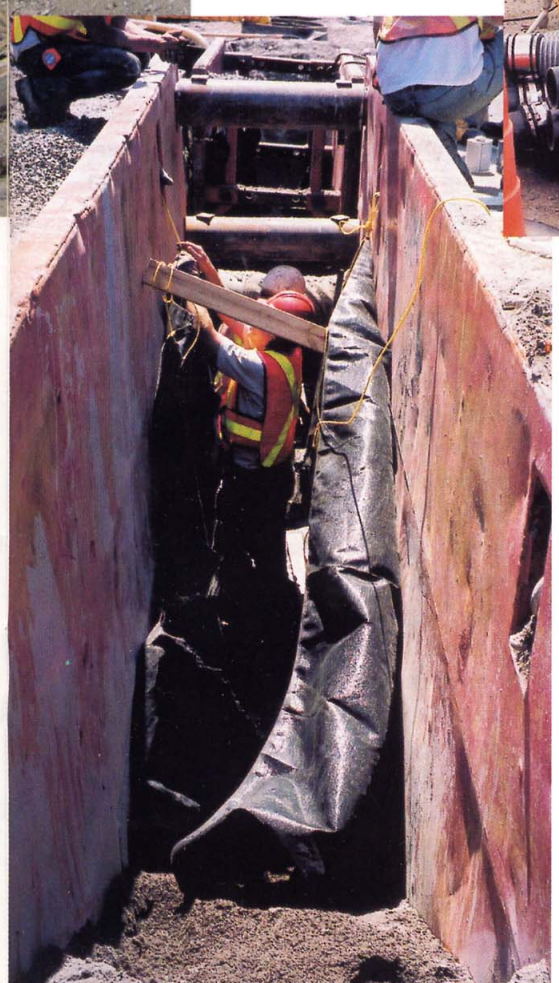
Finally, as a last precaution, a tough biaxial geogrid will be placed .3 m under the pavement that is about 3 m longer and 1 m wider than the manhole vault. The idea is to spread some of the upward forces over a larger area.

Soft soils are only one of the challenges at this site.

"Taking a large structure (the duct is roughly a metre in cross section), through a heavily serviced corridor was my biggest challenge," says Scott Lytle, the project manager for Hexcel Construction Ltd. of Delta, BC.

"We crossed a 150 mm jet fuel line three times and had to give three days notice each time. We also had three locations where we crossed or worked beside a 300 mm BC Gas distribution main, we had to give three days notice for each location. We had to get permits and a GVRD (Greater Vancouver Regional District) inspector, and provide engineered drawings for temporary support of the 450 mm gravity sanitary sewer when we crossed it. We ran into at least six abandoned services from five different utilities that we had to stop work for every time to get clearance before

Crews prepare trench with geofabric prior to working in the area.



Photos above show PVC ducts and installation using flex connectors.

removing them. We had to tunnel under telephone duct banks that had been extended over the years (without as-builts) which was very difficult. We lost most of a day because an abandoned water service we were finally cleared to remove had an opened gate valve and was draining a large area. We were pumping about 1,400 gallons/minute and we couldn't keep up."

The valve was eventually located under asphalt and about 2.5 m of fill. A sucker truck was used to locate and suck out the valve box, which finally gave the crew access to the gate valve to turn it off.

The vertical alignment of the duct bank also had to be adjusted many times to accommodate the other services that are being added or upgraded. All underground services require minimum cover, so at times the duct configuration was changed from four rows of four to two rows of eight. This allowed the duct to stay shallow and still have adequate cover when crossing over another utility, and to keep the excavation depths to a minimum when going under.

A thin layer of styrofoam covers the duct run prior to filling.

Both Badenhorst and Lytle elaborated on the importance of co-operation on this job. The civil contract for Phase III did not originally include crossing the very busy Marine Way arterial, nor did the spec include any of the geotechnical innovations that were used.

"The contractor was very careful with his work and his feedback so we were able to incorporate what we learned into the specifications for Phase IV of the project where we have the most peat and expect the water table to be at or near the surface," says Badenhorst.

Lytle adds, "There was good cooperation with our client, they were flexible and used our feedback and suggestions. They talked over all of the problems that they anticipated with us which gave us a chance to help solve them." ◆