CHAPTER 4

SUBSURFACE CONDITIONS AT THE FIELD LOAD TEST SITE

4.1 SITE DESCRIPTION

As shown in Figure 4.1, the test site is located at Virginia Tech's Kentland Farms facility, approximately ten miles west of Blacksburg, VA. The site where the load test facility is located lies within the flood plain of the New River, in an area of the farm that has not been cultivated in recent years. The surface topography is relatively flat, and the New River is approximately ¼ mile south of the site.

Prior to construction of the test facility, the topsoil layer and herbaceous vegetation were removed with a bulldozer. The subgrade was free of tree roots.

4.2 GEOLOGY

The site is underlain by alluvial soils deposited by the New River. The alluvial soils range in composition from silt to sand, and are about 20 to 30 ft thick at the site. The alluvial soils are underlain by the Elbrook Formation, which consists of dark gray fine-grained limestone and dolomite, with red shale interbeds, and is of Cambrian age. The Elbrook Formation has been associated with karst features such as sinkhole development, subsurface cavities, solution features, and pinnacled bedrock in the region (Stose, 1913; Johnson, 1993). No karst features have been found at the test site.

4.3 SUBSURFACE CONDITIONS

The soil stratigraphy at the test site is shown in Figure 4.2. The near surface soils consist of hard, partially saturated lean sandy clay and sandy silt, which is overconsolidated due to desiccation. Thin gravel and cobble seams within the fine-

grained soils at depths of 4.5 feet, 5 feet, and 17 feet below original ground surface. Standard penetration test blow counts (SPT N-values) ranged from 30 in the dessicated crust to about 10 at a depth of 15 feet. Blow counts in the gravel and cobble seams were greater than 50. Drilling to depths deeper than 20 feet was difficult. At these depths, auger cuttings and gravel fragments in split spoon samples indicated the presence of gray to white fine-grained weathered limestone or brecciated limestone and shale.

From August 1997 to October 1998, the water table depth varied from a high of about 10 feet in March, to a low of about 18 feet in December, based on periodic readings of a ground water monitoring well.

4.4 SUBSURFACE INVESTIGATION

Various in situ techniques were used to determine soil stratification, shear strength, soil modulus, state of stress in the ground, and groundwater levels, and to obtain samples for laboratory testing. The subsurface investigation included:

- Solid-stem auger borings with Standard Penetration Tests (SPTs),
- Dilatometer soundings (DMTs), and
- Large block samples to obtain high-quality samples for laboratory tests.

The locations of the borings, DMT soundings, and block sample excavations are shown in Figure 4.3.

4.4.1 Soil Borings

Six solid-stem auger borings were drilled at the site using a Mobile B80 drill rig. The subsurface materials encountered were identified, described, and classified in general accordance with ASTM D2488. Copies of the soil boring logs are included in Appendix

C. Standard penetration tests were performed during the drilling operation in general accordance with ASTM D1586. N-values obtained during the SPT tests are shown in Figure 4.4. Relatively undisturbed tube samples were obtained by pushing 3-inch-diameter Shelby tubes in general accordance with ASTM D1587. The split spoon and Shelby tube samples were transported to Virginia Tech's soil mechanics laboratory for subsequent testing.

4.4.2 Observation Well

A 2-inch-diameter slotted pvc standpipe piezometer (MW-1) was installed at the site using the drill rig and 4-inch-diameter solid stem augers. The bottom 10-foot-long slotted section of the pipe was set at a depth interval from 11 to 21 feet below ground surface. The annulus was backfilled with sand from the bottom of the drill hole to about 4 feet above the top of the slotted section of pipe. The remainder of the annulus was filled with bentonite hole plug. The water level in the piezometer has been measured and recorded periodically during construction of the site, and is measured each time a load test is performed.

4.4.3 Dilatometer Tests

Seven DMT soundings were performed at the site in August 1997. DMT measurements were taken at 8-inch intervals to a maximum depth of about 16 feet. This depth was limited by the durability of the membrane on the DMT blade as well as by the penetration ability of the blade, which was advanced using the hydraulic system on a Mobile B80 drill rig.

To the extent possible, the DMT tests were performed in accordance with the information and recommendations given in Schertmann (1988). Other soundings were attempted in addition to the seven successful soundings, but these were only advanced to shallow depths before difficulties in obtaining pressure readings necessitated abortion of the tests. Most of these problems can be attributed to membrane damage inflicted by advancing the DMT blade through the upper two gravel and cobble seams. The deepest

soundings were limited by the depth at which the lower gravel and cobble seam was encountered. The DMT test is best-suited to more easily-penetrated, homogenous soil layers (Schmertmann, 1988). As the experience at this site confirms, obstructions such as gravels, cobbles, boulders, and cemented layers have the potential to thwart advancement of the blade, or to damage the membrane of the blade during advancement. The DMT soundings were primarily used qualitatively as a means of identifying changes in the soil stratigraphy.

4.4.4 Block Samples

Three block samples were excavated at the location shown in Figure 4.3 for the purpose of obtaining high quality undisturbed samples for triaxial testing. On the average, the soil blocks were 9 x 10 x 11 inches, and were excavated at depths ranging from 1 to 2.5 feet below the ground surface. Photographs taken at various stages of the block sampling operation are shown in Figure 4.5. The blocks of soil were excavated over a four-hour period on June 23, 1998, using small hand tools and razor wire. The work was performed from two parallel trenches that were excavated the previous evening with a small backhoe. The soil blocks were obtained by carefully carving a block from the undisturbed soil between the trenches. The blocks were set on plywood sheets, wrapped numerous times with plastic wrap, and sealed in plastic bags immediately after removing them from the ground. They were then transported to the laboratory on the plywood sheets, with great care to minimize shock and vibration.

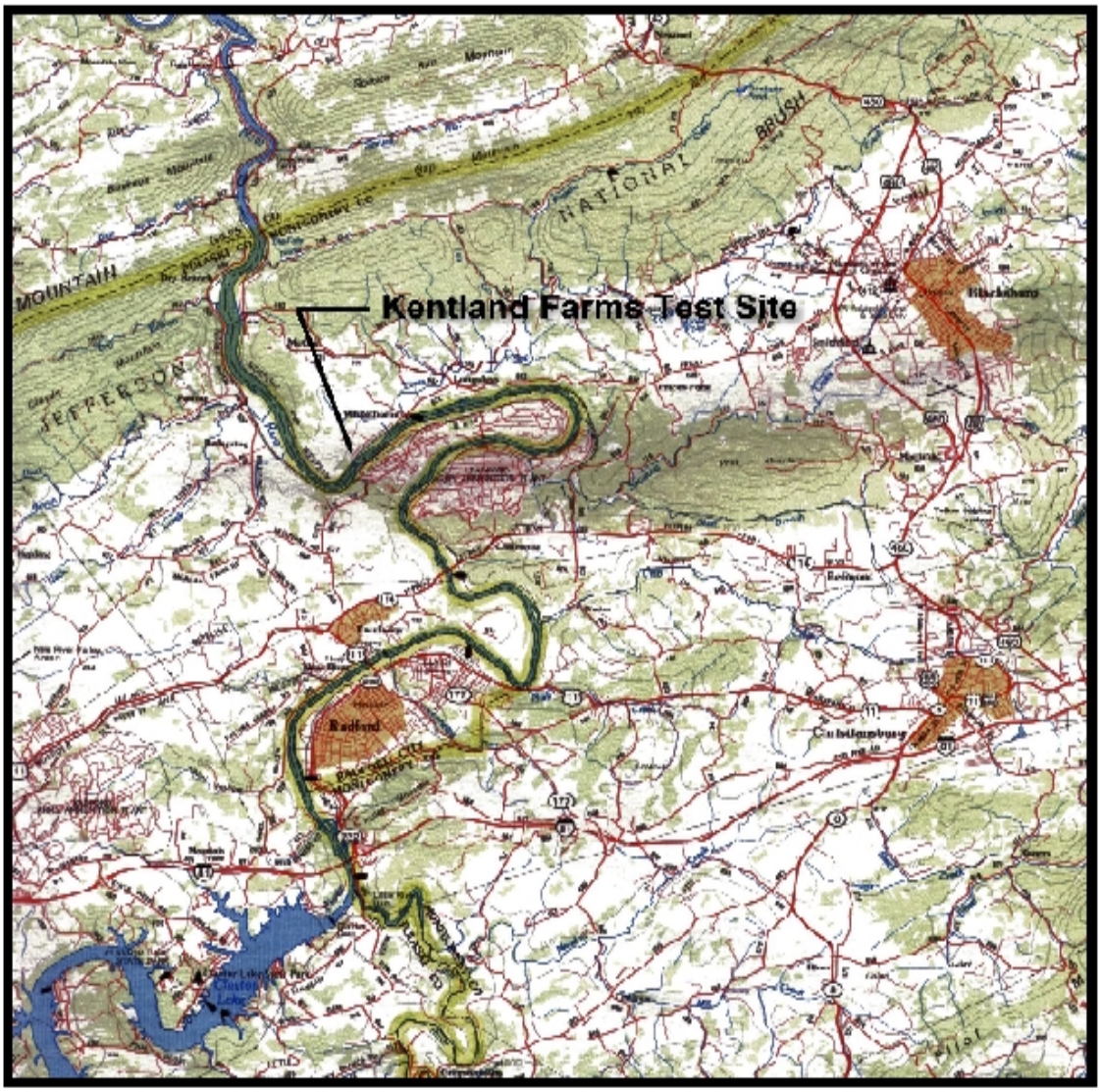

Figure 4.1. Site location map.

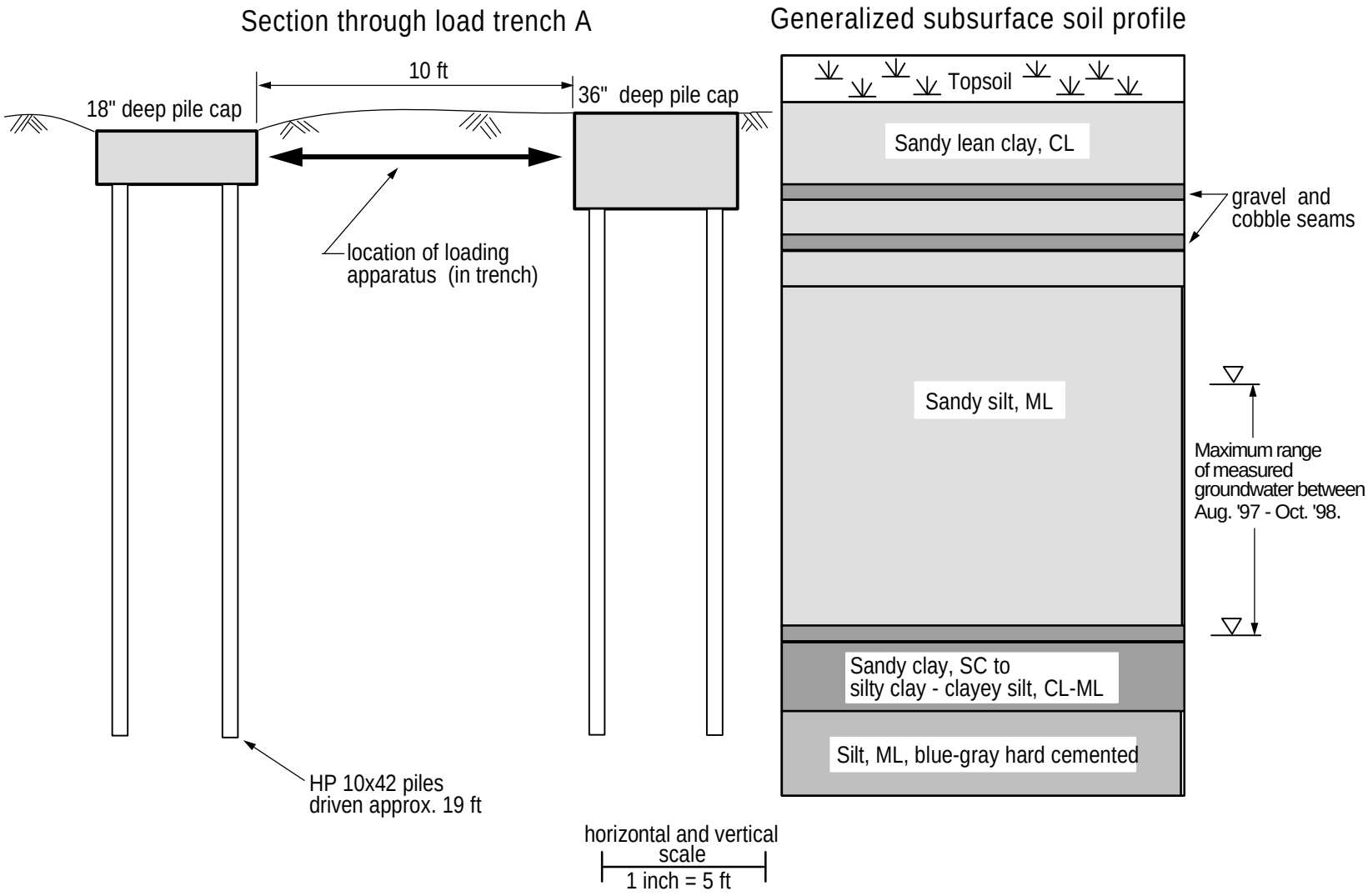

Figure 4.2. Subsurface profile at Kentland Farms field test facility.

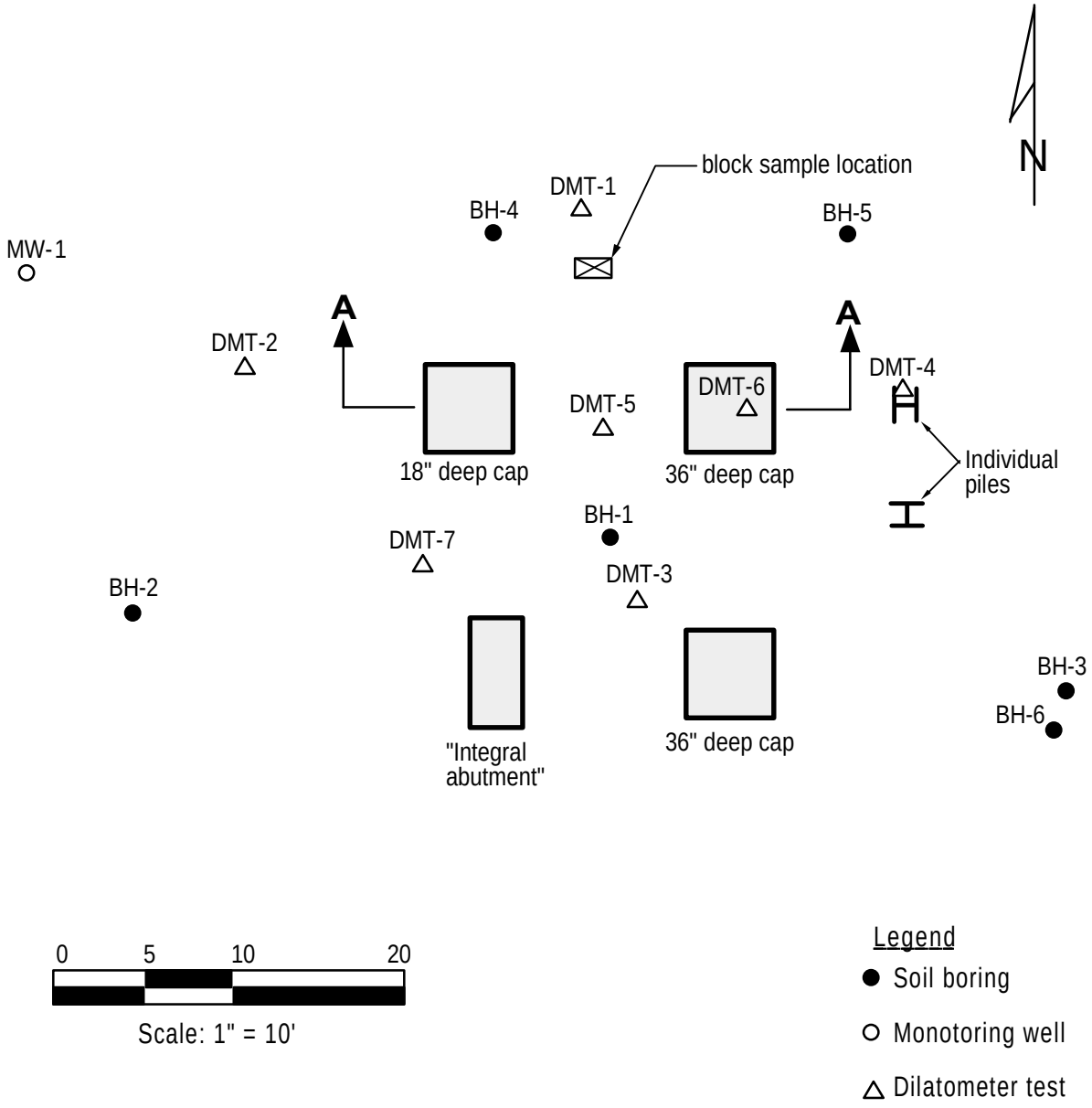

Figure 4.3. Site plan and subsurface investigation drawing.

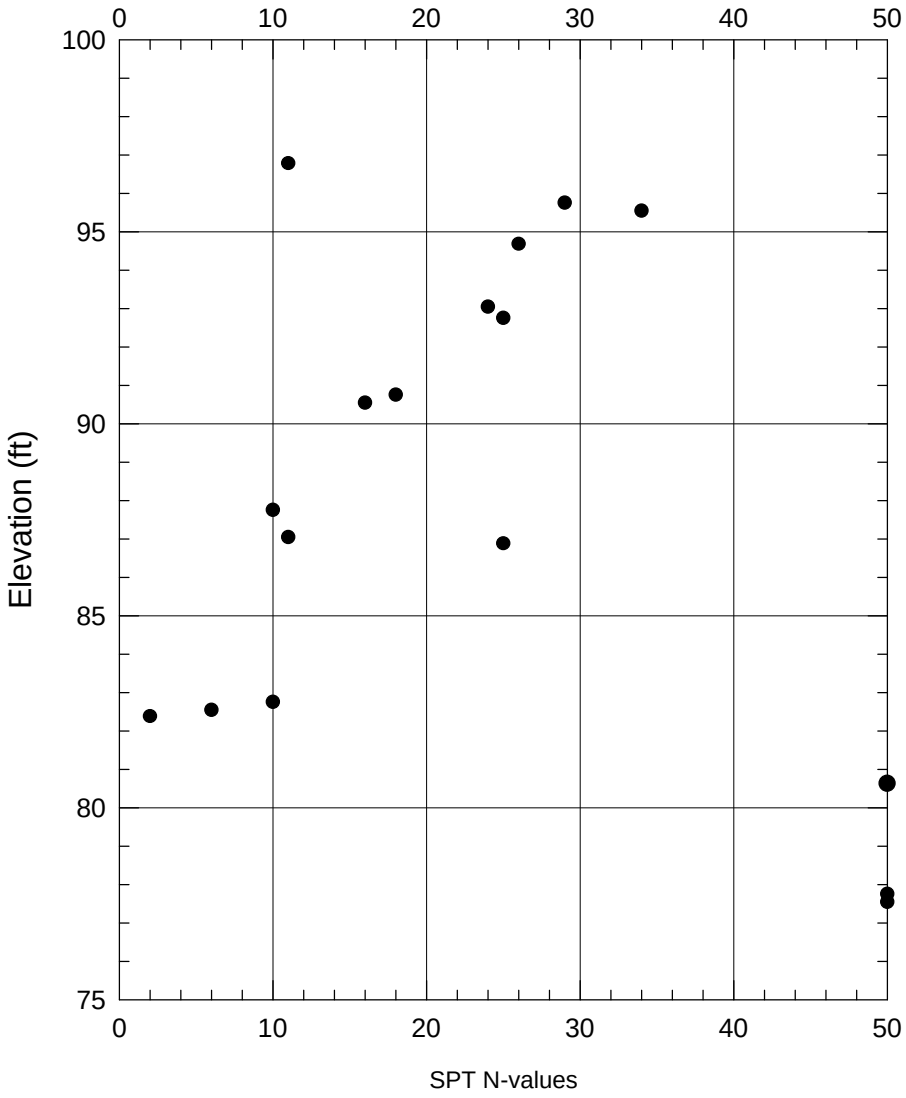

Figure 4.4. Standard penetration test results.

(a) Parallel trenches for digging block samples.

(b) Carving block samples.

(c) Block sample excavation almost complete.

(d) Block sample wrapped in cellophane.

Figure 4.5. Excavating soil block samples.