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New York State Department of Environmental Conservation
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Attn: Randall J. Passmann, P.E.

Re: Soil Boring & Sampling Services
Belleayre UMP
Town of Shandaken, New York
SJB Project No: AD-08-051

Dear Mr. Passmann:

Empire Geo-Services, Inc. is pleased to present this soils investigation report summarizing our findings from field work and laboratory analyses performed in support of the referenced project. The work was completed as outlined in the request for proposal and scope of work prepared by the New York State Department of Environmental Conservation (NYSDEC), and authorized by NYSDEC purchase order no. 011165.

PROJECT DESCRIPTION

As we understand it, a water storage pond is to be constructed at a site along Ulster and Delaware Turnpike for use by the Belleayre Mountain ski area. Plans call for an impoundment facility about 1400 feet long and 200 feet or more wide, created through cuts and embankment fills of native soils. The proposed top of embankment elevation is 1929.0 feet, and the pond invert elevation is between 1905.0 and 1910.0 feet. Planned embankment side slopes are between 1V:2.5H and 1V:3H. Water will be sourced from an adjacent stream, whereby a portion of its flow will be diverted into the pond for storage, and via a transmission line from an existing nearby pond (Cathedral Glen). Plans also include pond outlet works and pumping facilities to transmit water to upper and lower mountain areas for use as needed.

METHOD OF INVESTIGATION

Field Testing:

Subsurface conditions at the site were investigated by our affiliated drilling and materials testing firm, SJB Services, Inc. (SJB). Five test borings (B-4, B-5, B-6, B-7 and B-8) and three test pits (TP-1, TP-2 and TP-3) were performed, as shown on the subsurface investigation plan (Attachment 1). A CME 550x all terrain vehicle mounted drill rig equipped with hollow stem augers, flush-joint casing and rock core tooling was used to complete the test borings. The test pits were excavated with a John Deere 410E rubber-tire backhoe furnished by others.

At locations B-4, B-5 and B-6, soils were sampled on a continuous basis to a depth of 12 feet and at standard five foot intervals thereafter in accordance with ASTM D1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils. At location B-7, soil characterization is based on a single split spoon sample at the 10 to 12 foot interval and the driller's observations, and at B-8, soils were characterized by the driller based on auger cuttings and other noted aspects of the drilling operation, along with a single split spoon sample taken at the boring termination depth.

Borings B-4 and B-8 were each augered to a target depth of 40 feet. At locations B-5, B-6 and B-7, auger refusal was encountered at depths of 33.5 feet, 23.8 feet and 25.0 feet respectively. Refusal material encountered in each hole was cored for a length of 5 feet in general accordance with ASTM D2113 - Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation, using an NQ size core barrel. Representative portions of the recovered split-spoon soil samples, and the recovered rock core in its entirety, were transported to Empire's office for visual classification by a geotechnical engineer and/or geologist.

The test pits were excavated to depths of 10.5 to 12.5 feet, with each excavation observed and logged by a geologist. In order to obtain a representative sample of native materials for laboratory testing, two bulk samples were taken from each test pit, at discrete depth intervals of 6 to 7 feet and 9.5 to 12 feet. Oversize materials (approximately four inches or larger) were excluded. A single composite sample was prepared from those collected for use in the laboratory testing program described below.

An individual subsurface log was prepared for each of the test borings and test pits based upon the visual classifications and field records. The existing ground surface elevation at each boring and test pit location were furnished by the NYSDEC and are included on the logs. The logs are included in Attachment 2 together with a sheet which explains the terms and symbols used in their preparation. A photograph of the recovered rock core samples is presented in Attachment 3.

A total of three falling head permeability tests were performed, two at boring B-4 at depths of 19.0 and 34.0 feet, and one at B-7 at a depth of 12.5 feet. Prior to each test, three inch diameter flush-joint casing was installed and seated in the bottom of the borehole to facilitate its completion, and upon filling the casing with water, the drop in water level was recorded at intervals of one to five minutes over a 30 minute period. Results of the permeability testing are presented in Attachment 4.

Laboratory Testing:

Laboratory testing was conducted by SJB on the composite bulk sample collected from the test pits, as follows:

- ASTM D-422, Particle Size Analysis of Soils
- ASTM D-698-02, Laboratory Compaction Characteristics of Soil Using Method C Standard Effort
- ASTM D-5084, Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter
- ASTM D-3080, Direct Shear Test of Soils Under Consolidated Drained Conditions
- ASTM D-2216, Natural Water Content

Results of the field and laboratory testing program are presented in Attachment 4.

RESULTS OF INVESTIGATION

Subsurface Profile:

The site was generally found to be mantled with sands and gravels with trace to some amounts of silt to depths of 19 to 24 feet, this sequence being of a firm to compact relative density. Below this, very compact basal glacial till was encountered, as exhibited by coarser sands and gravels embedded in a matrix of silt and fine sand (in the test pits, the transition to till was interpreted as being shallower than that indicated by the test borings, generally at the depth at which color changed from orange-brown to brown or where digging became more difficult; for the purposes of this report, these upper soils are considered silty sands and gravels). Coarse augering, boulders and cobbles were commonly noted throughout the overburden soils, likely resulting in elevated blow counts in some instances. Underlying the till, sandstone bedrock was encountered at B-5, B-6 and B-7 at depths of 33.5 feet, 23.8 feet and 25.0 feet respectively, as evidenced by auger refusal and confirmatory rock coring at each location.

These findings are in general agreement with published information reviewed for this investigative summary. The Soil Survey of Ulster County, New York (U.S. Department of Agriculture, 1979) maps surficial soils (generally representative of the upper six feet) in the area as either Wellsboro and Wurtsboro very bouldery soils, gently sloping, or Lackawanna and Swartswood very bouldery soils, moderately steep. The survey describes these map units in terms of their sandy and gravelly loam (and bouldery) compositions, and as being moderately well to well drained. The soil survey also identifies certain limitations associated with each soil unit for selected uses, for consideration in site selection and design. In this regard, "large stones" are listed as a limitation with respect to the suitability of site soils for the construction of embankments, dikes and levees, while "slope" limits the use of the moderately steep Lackawanna and Swartswood unit in the construction of pond reservoir areas. The shrink-swell potential of these soils is listed as low, while soil erodibilty "K" factors range from 0.20 to 0.28, indicating low to moderate erosion potential.