

**WATER SUPPLY STUDY
MULBERRY POINT, TUTTLES POINT
AND INDIAN COVE**

FEASIBILITY STUDY

Appendix B – Water Main Geologic Investigation

LEGGETTE, BRASHEARS & GRAHAM, INC.

PROFESSIONAL GROUNDWATER AND ENVIRONMENTAL ENGINEERING SERVICES

4 RESEARCH DRIVE, SUITE 301
SHELTON, CT 06484
(203) 929-8555
FAX (203) 926-9140
www.lbgweb.com

January 14, 2011

Mr. Ronald J. Nault, P.E.
Luchs Consulting Engineers, LLC
DeCarlo & Doll Architects/Engineers
89 Colony Street
Meriden, CT 06451

RE: Water Main Geologic Investigation
Mulberry Point, Tuttle Point and Indian Cove
Guilford, Connecticut

Dear Mr. Nault:

Leggette, Brashears & Graham, Inc. (LBG) conducted a geologic investigation of the Mulberry Point, Tuttle Point and Indian Cove shoreline communities located in Guilford, Connecticut. This investigation was conducted as part of a study authorized by the Town of Guilford (Town) to evaluate the feasibility of extending the nearby municipal water supply to the shoreline communities. The three shoreline communities are densely developed with approximately 350 summer and year round homes in a 126 acre area. All of the homes are served by private potable supply wells and individual septic systems, many which have been compromised by elevated nitrate, sodium and chloride concentrations. In response to these conditions, the Town is evaluating the feasibility of extending public water to these communities.

As part of the geologic investigation, soil borings were advanced throughout the area to determine bedrock depths along the proposed water main routes. This information will aid in refining initial costs associated with extending a water main to the communities. In addition, one boring located in each community was drilled into bedrock to get a preliminary determination of the rippability of the underlying bedrock. This information is also important in the cost evaluation associated with clearing the bedrock to install the water mains and associated service lines.

FIELD INVESTIGATION AND RESULTS

Soil Boring

As part of the geologic investigation, 60 soil borings (LBG-1 through LBG-60) were advanced throughout the shoreline communities on November 18, November 30 and December 3, 2010 (Plate 1). All drilling was performed by Connecticut Test Borings (CTB) of Seymour, Connecticut, under the direct supervision of a LBG hydrogeologist. All borings were advanced along the edges of the roadway by the direct-push method using a Geoprobe® rig. Soil samples were collected continuously from grade to 6 ft bg (feet below grade), or to refusal, whichever was encountered first. Refusal that was encountered was potentially either bedrock or a large boulder. Soil samples were collected at all of the soil boring locations using a 4-foot long Macro-core fitted with a 2-inch diameter acetate liner. Soil samples from each interval were logged by the onsite LBG hydrogeologist.

Prior to the drilling activities, LBG conducted a site walk of the three proposed service areas to locate visible bedrock outcrops. Based on the field reconnaissance, soil borings were located along the proposed water main route in areas where bedrock was not observed or where supplemental information was needed at specific areas requiring confirmation of depth of refusal. The geologic logs of the soil borings is included in Attachment I. The approximate locations of the borings are shown on Plate 1. Properties shaded in yellow are properties where bedrock outcrops were observed during the site walk.

Based on the drilling results for the entire area, refusal was encountered at depths ranging from 0.5 ft bg to 5.5 ft bg. At several locations, bedrock was not encountered down to the drilling termination depth of 6 ft bg (Plate 1). Soil below the asphalt, and road sub base along the western portion of the study area (including Vineyard Point Road, West Lane and the Indian Cove community) as well as the northern trunk of Mulberry Point Road consisted primarily of red-orange silt, fine sand and clay. Borings along Daniel Avenue, towards Mulberry Point contained primarily silt and clay. Soil below the asphalt and road sub base in the Mulberry Point and Tuttle Point communities generally were coarser, consisting of fine to coarse sand. Fine gravel was observed with the sand in several borings located along Mulberry Point Road, Tuttle Point Road and Marshall Avenue.

Along the furthest western reaches of the study area (proposed Vineyard Point Road Supply Route) refusal was not encountered at the boring termination depth (6 ft bg) at the northern drilling area (LBG-1 located near the intersection of Sachem Head Road). However, refusal was encountered between 5 and 5.5 ft bg in the two southern borings along Vineyard Point Road (approaching West Lane). On West Lane, which is included in the Vineyard Point Supply Route, refusal was encountered at 0.5 ft bg (LBG-4) and 1.25 ft bg (LBG-5).

In the proposed Indian Cove community service area (including the intersection of West Lane and Indian Cove Road), refusal was generally shallow, ranging from 0.5 ft bg (LBG-52 on Spencer Avenue) and 0.75 ft bg (LBG-6 at the intersection of West Lane and Indian Cove Road) to 4.5 ft bg (LBG-47 near the intersection of Indian Cove Road and Daniel Avenue). On average, refusal was encountered approximately 2.5 ft bg in this community. However, refusal was not encountered down to 6 ft bg at several locations along the northern extent of Indian Cove including LBG-44 and LBG 45 along Daniel Road at the Indian Cove inlet, LBG-58 on Lower Road and LBG-56 on North Reeves Avenue.

Along the furthest eastern reaches of the study area (Mulberry Point Road Supply Route) depth to refusal ranged from 0.75 ft bg (LBG-11) to greater than 6 ft bg (LBG-21 and LBG-18) with an average of 3.5 ft bg along the Mulberry Point Road Supply Route.

In the Mulberry Point and Tuttle Point Service Area, along the proposed 12-inch diameter water main route, depth of refusal ranged from 0.75 ft bg (LBG-60 at the intersection of Tuttle Point Road and Faulkner Drive) to greater than 6 ft bg at two locations (LBG-25 on Mulberry Point Road and LBG 6 on Tuttle Point Road). On average, refusal was encountered approximately 3.5 ft bg along the proposed 12-inch main route of these communities.

In the Mulberry Point and Tuttle Point Service Area, along the proposed 8-inch diameter water main route, depth of refusal ranged from 1 ft bg (LBG-29 on Marshall Avenue) to greater than 6 ft bg at multiple locations within the Mulberry Point community. These locations are concentrated in the central portion of the Mulberry Point community, on High Ridge Road (LBG-40 and LBG-41), Highland Avenue (LBG-35), Marshall Avenue (LBG-43) and Spring Street (LBG-33). On average, refusal was encountered approximately 4 ft bg along the proposed 8-inch main route of these communities.

Rock Coring

In addition to the soil boring investigation, rock cores were advanced at three locations (BRX-1 through BRX-3) on December 6, 2010. One rock core was located in each of the communities. All rock cores were collected using a truck-mounted CME-75 hollow stem auger rig equipped with an NWD4 (commonly referred to as an "NX" size), double tube core barrel with a diamond bit. The inner diameter of the core barrel was 2 1/8 inches. All cores were advanced approximately 2 feet into rock. A photograph of the cores and relevant information are shown on figures 1 through 4 and the geologic logs of the rock cores are included in Attachment II. The approximate locations of the rock cores are shown on Plate 1.

The first core (BRX-1) was advanced at the LBG-29 location on Marshall Avenue, near Tuttle Point Road. The core was advanced through approximately 1 foot of overburden material before rock was encountered. A competent, moderately hard to weak gneiss, with fine to coarse grains, was observed at this location. Jointing was observed from 2.6 to 3.3 ft bg where the rock was more friable. Photographs of the core from this location are shown on figure 2.

The second core (BRX-2) was advanced at the LBG-57 location on Lower Road (Plate 1). The core was advanced through approximately 1.5 feet of overburden material before rock was encountered. A moderately hard, fine grained gneiss was observed from 1.5 to 2.5 ft bg. Underlying the gneiss was a pocket of brown sandy loam containing sub-angular fine to coarse gravel. Immediately under the soil pocket was a hard, competent, coarse grained pegmatite. Based on the pocket of soil observed between the gneiss and pegmatite, it is likely that the overlying gneiss represents a boulder that was overlying a layer of soil above the actual bedrock (pegmatite). Photographs of the core from this location are shown on figure 3.

The third core (BRX-3) was advanced at the LBG-6 location on West Lane, at the intersection of Indian Cove Road. The core was advanced through approximately 0.75 feet of overburden material before rock was encountered. A competent, moderately hard, fine-grained gneiss was observed at this location. Unlike the gneiss observed at the first core location (BRX-1), the core on West Lane (BRX-3) was a finer grained rock with less weathered jointing that was observed at BRX-1. Photographs of the core from this location are shown on figure 4.

CONCLUSIONS AND RECOMMENDATIONS

The drilling that was conducted throughout the Guilford Mulberry Point, Tuttle Point and Indian Cove shoreline communities has provided an overview of the rock type and depth that can be anticipated along the proposed water main routes. Soil boring information indicates that refusal was encountered as shallow as 0.5 ft bg to greater than 6 ft bg. In general, shallow refusal was encountered throughout most of the Indian Cove community, with exceptions on North Reeves Avenue, Lower Road and Daniel Road (at the Indian Cove inlet) where refusal was not encountered above 6 ft bg. Depth to refusal was generally deeper along Vineyard Point Road and the northern extent of Mulberry Point Road and in the central portion of the Mulberry Point community (including High Ridge Road, Spring Street, the northern section of Faulkner Drive, Marshall Avenue and Mulberry Point/Tuttle Point Road).

The three rock core samples indicate that the underlying bedrock consists of a fine to coarse grained gneiss that is moderately to very competent with some jointing. The rock sample collected on Marshall Avenue in the Mulberry Point community consisted of a coarser-grained gneiss with more weathered fractures compared to the finer grained gneiss collected on Indian Cove Road. In addition, a very competent pegmatite was observed at the Lower Road drilling location.

The soil and bedrock core borings have provided information of depth to refusal along the proposed water main routes. Additional soil borings are recommended in several areas where there were some discrepancies in depth to refusal. The areas where we recommend additional soil borings include Mulberry Point Road (in the vicinity of LBG-20, LBG-17, LBG-13, LBG-11, LBG-23 and LBG-27); Faulkner Drive (in the vicinity of LBG-38), Marshall Avenue (in the vicinity of LBG-59 and LBG-29); Lower Road (in the vicinity of LBG-57); and Spencer Avenue (in the vicinity of LBG-52). These locations were targeted because the depth to refusal was encountered significantly higher (approximately 2 feet or more) than the nearby soil borings. The purpose of the additional borings in these areas would be to determine if the shallow refusal encountered in each area is reflective of the top of bedrock or is indicative of a large boulder. Based on the drilling conditions encountered during the investigation, approximately 18 to 20 borings can be advanced per day using the Geoprobe® rig.

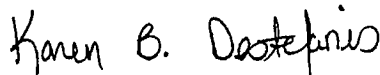
In addition to the supplemental soil borings, we recommend additional soil cores, particularly in the vicinity where the pegmatite was observed (BRX-2 located on Lower Road). This pegmatite is extremely dense with only one joint fracture, compared to the gneiss cores obtained at the other two locations. Additional cores at shallow refusal locations in the Indian Cove and Mulberry Point Road region would provide more information regarding jointing features, with respect to rock competency. Based on the drilling conditions encountered during the initial investigation, approximately 5 to 7 soil borings can be advanced per day using the truck-mounted CME-75 hollow stem auger rig (equipped with an NWD4 core barrel). Because of the size of the hollow stem auger rig, traffic control is necessary when collecting the rock core samples.

Communications with the Guilford Health Department indicate that there are a considerable amount of files associated with septic repairs, particularly in the Indian Cove community, that are available for review. These files were not reviewed as part of this investigation, but may provide useful information related to refusal depths at specific properties.

If you have any questions regarding the testing program or results, please do not hesitate to contact me at your convenience.

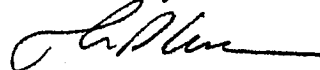
Very truly yours,

LEGGETTE, BRASHEARS & GRAHAM, INC.



Karen B. Destefanis, CPG
Associate

Reviewed By



Thomas P. Cusack, CPG
Senior Vice Principal

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Enclosures

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