The Stratigraphy of the Stony Brook University Campus

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Stony Brook University is located in central Suffolk County on the north shore of Long Island (*Figure 1*), and overlies some 900 feet of Pleistocene and Cretaceous unconsolidated sediments, which overlie early Paleozoic and Precambrian bedrock. Well logs available at the New York State Department of Conservation for water wells and borings for engineering purposes as well as logs from Suffolk County Water Authority were used to evaluate the underlying strata. Ten boreholes penetrate the Magothy Formation as well as the Pleistocene sediments; in addition five shallow boreholes and a cliff face exposed during construction give a more detailed description of the Pleistocene sediments.

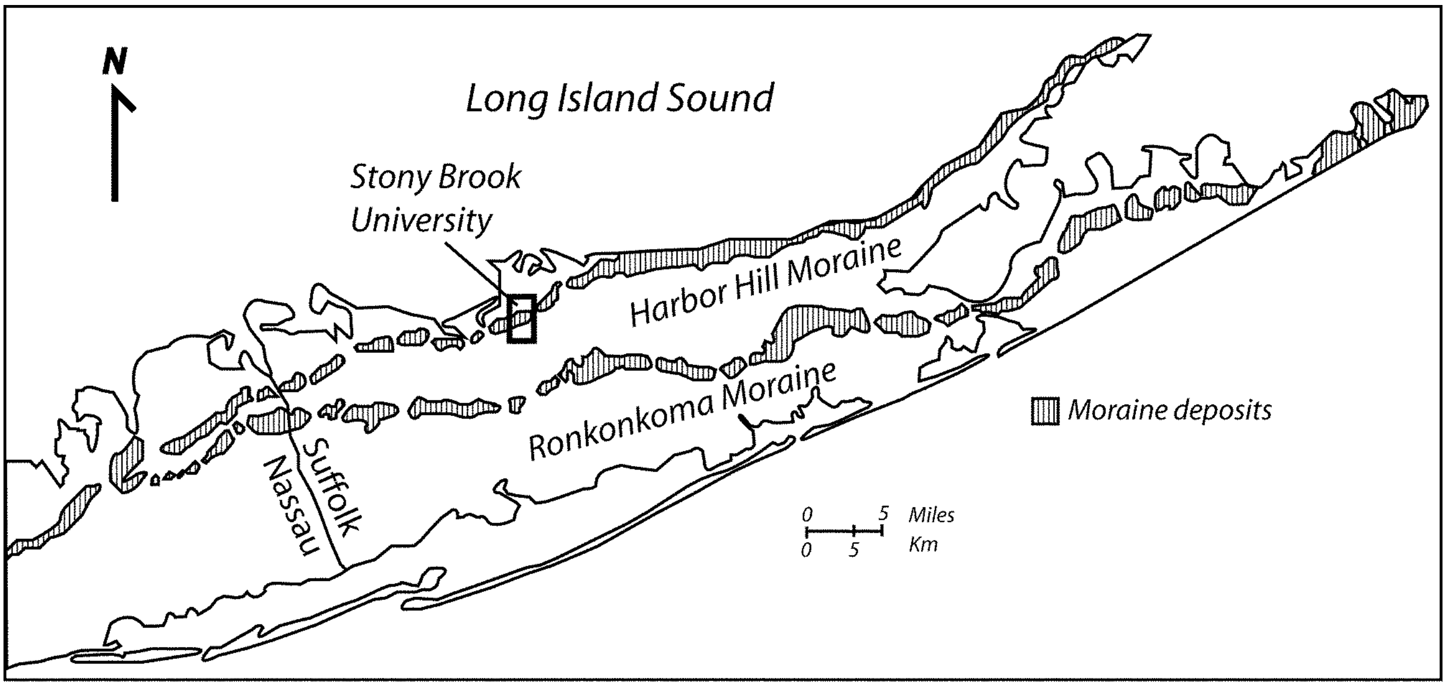

Fig. 1 Map of Long Island.

Jenson and Soren (1974) mapped the hydrological units beneath Suffolk County, Long Island based on well logs from municipal water well borings. Smolensky, Buxton and Shernoff (1989) remapped the hydrologic units. Fig. 2 is a north-south cross-section from Long Island Sound to the Atlantic Ocean that goes through Stony Brook University modified from Jensen and Soren (1974). According to Jensen and Soren (1974) and Smolensky, Buxton and Shernoff (1989), the basement is early Paleozoic and Precambrian bedrock which is overlain by the Lloyd Sand and Raritan Clay Members of the Raritan Formation, these are overlain by Magothy Formation and the Pleistocene sediments. The type of sediment found in each geologic unit and their thickness are shown in *Table* 1. The Cretaceous sediments and the top of the basement dip about 1^{o} to the south (Jensen and Soren, 1974).

Krulikas and Koszalka (1983) describe a lacustrine clay known informally as the Smithtown clay, found within the Pleistocene sediments. The clay is mainly found between the Ronkonkoma and Harbor Hill Moraines in north-central Suffolk County. They suggested that the lake resulted from the damming of water by the Ronkonkoma Moraine upon the retreat of the glacier that formed the Ronkonkoma Moraine. The clay was then buried by sediments associated with the next glacial advance that created the Harbor Hill Moraine.

Most of the Stony Brook University campus is on the Harbor Hill Moraine. The Stony Brook portion of the Harbor Hill Moraine was formed by glacial tectonics. Tzakas and others (2002) describe how pushing of unconsolidated sediments in front of the glacier formed the moraine. Tingue and others (2004) have use ground penetrating radar to show that underlying sediments in the Ashley Schiff Preserve have features typical of a fold and thrust terrane.

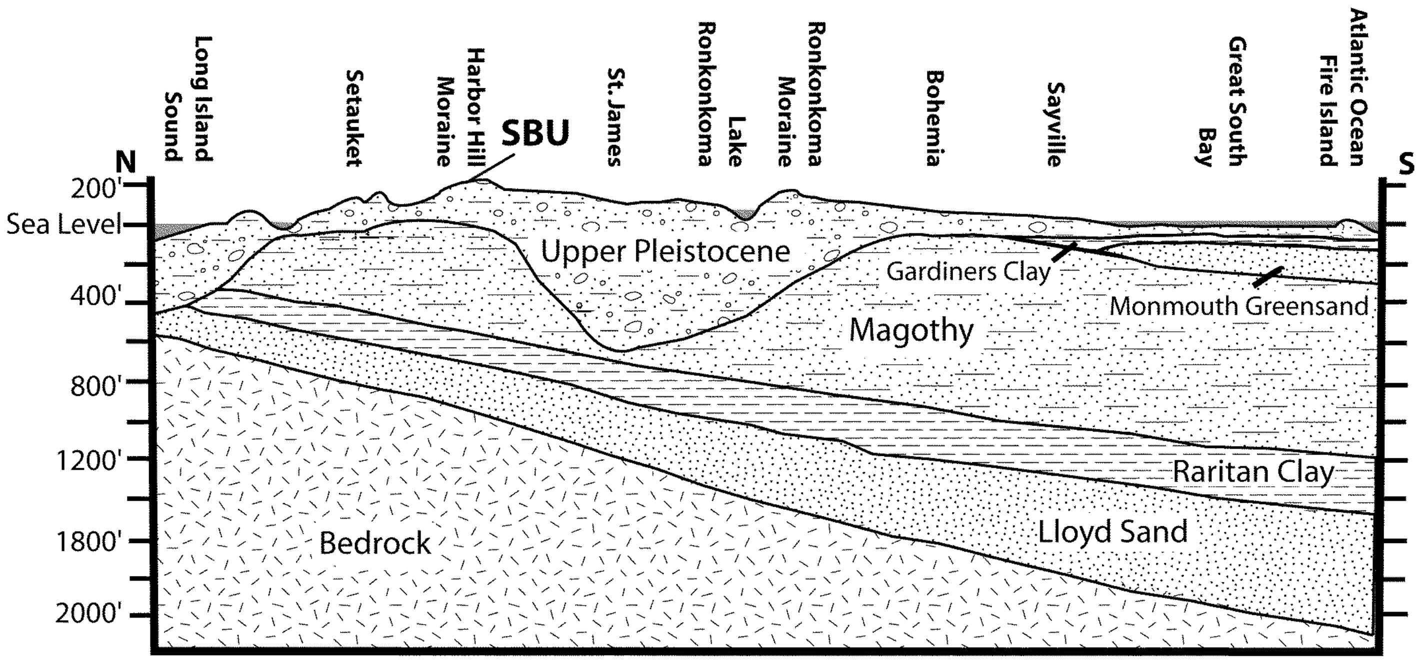

Fig. 2. North-south cross section from Long Island Sound to the Atlantic Ocean showing the underlying strata. Modified from Jenson and Soren (1974).

Table 1. Description of Sediments Beneath Stony Brook Campus based on Jensen and Soren (1974).

Geological Age	Geological Unit		Thickness (ft)	Description of Sediment Deposit
Quaternary-Pleistocene	Upper Pleistocene Deposits	Till	0-150	Unsorted and unstratified clay, silt, sand, gravel and boulders; tan brown, and brownish-gray
		Outwash	0-350	Stratified fine to coarse sands and gravel, light to dark brown, tan, and yellowish-brown.
		Smithtown Clay	0-150	Lacustrine deposits consist of clay and silt, brown, brownish gray and gray.
Cretaceous	Magothy Formation		0-1000	Gray to white fine to coarse sand with clay, silt and lignite interbedded.
	Raritan Formation	Raritan Clay Member	0-250	Clay, silty clay, and clayey and silty fine sand, light to dark-gray, brownish-red, red, pink, and grayish-white. Beds and lenses of lignite, pyrite and sand.
		Lloyd Sand Member	0-550	Fine to coarse sand and gravel, grayish-whit, light to medium-gray and yellowish-gray, with intercalated beds and lenses of light to dark gray clay, silt, clayey and silty sand and some lignite and pyrite.
Precambrian-Early Paleozoic	Bedrock		Unknown	Crystalline rocks mainly granite, gneiss and schist

While no bore holes penetrate the bedrock on campus, it is most likely that the basement is part of the Avalon Terrane exposed in eastern Connecticut and thought to underlie Long Island Sound immediately to the north (Pacholik and Hanson, 2001). The Avalon Terrane consists of 600 to 700 Ma old dominantly leucocratic gneisses and 300 Ma granitic intrusions. In many places the top of the basement rocks consists of a regolith of residual clay. The Magothy Formation, which is part of the Matawan Group, is separated from the Raritan Formation by an unconformity. Near the base of the Magothy Formation is a coarse basal zone which is overlain by a fining upward sequence consisting mainly of fine sands and clay, typical of a delta environment (Smolensky, Buxton and Shernoff, 1989). The Magothy Formation is overlain by Pleistocene sediments. During the Pleistocene, continental glacial advance and retreat occurred many times. It is not clear how many times this area was glaciated. Glacier scour and melt water valleys have created an irregular surface between the glacial sediments and the Magothy Formation.

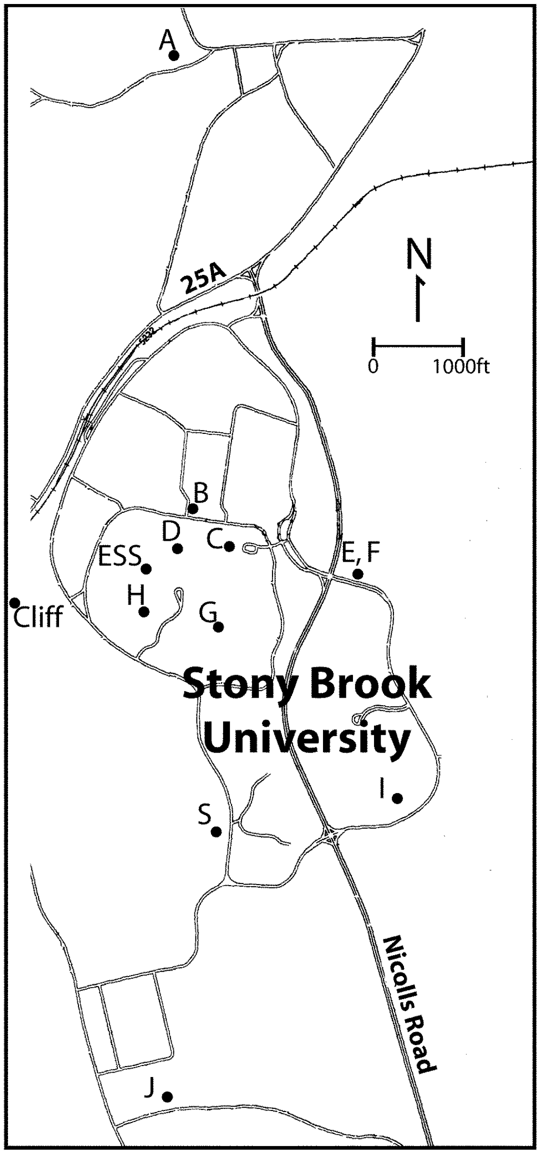

Fig. 3 Map showing locations of the boreholes. See text for descriptions.

Ten deep wells (hundreds of feet) and five shallow wells (less than 100 feet) were chosen for analysis based on quality of the logs and their location. A stratigraphic column was also constructed based on a section on campus that was exposed during construction of a recharge basin (see Appendix). Figure 3 locates the wells, with letters A through J for the deep wells, ESS gives the location of a shallow borehole near the Earth and Space Sciences Building, S shows the location of a shallow borehole on South Campus and Cliff marks the location of the sedimentary section exposed during construction of a recharge basin. Suffolk County Water Authority (SCWA) well A is the northern most well which is on Mud Road, followed by wells at the Student Union (B), Arts and Science Center (C), Old Chemistry (D), Daniel Webster Drive SCWA Well 1 (E), Daniel Webster Drive SCWA Well 2 (F), Javits Lecture Hall (G), Heavy Engineering (H), Henry Clay Drive SCWA (I) and the southern most well, Oxhead Road SCWA (J). The driller's information is presented in *Table* 2; this includes well location, contractor, date, drill type, depth, elevation and reason for drilling. The shallow borehole information is provided in *Table* 3 and the stratigraphic columns are found in the appendix)

Table 2. Information on the Deep Well Location and Drilling Information.							
Well Letter	**Location**	**UTM Zone 18 NAD83**	**Owner**	**Driller**	**Date**	**Type of Drill**	**Well Use**
A	Mud Road	657969E 4533215N	SCWA	Strata Well Co.	September 2, 1981	Reverse Rotary	Municipal Water Supply
B	Student Union Building	658147 E 4531137N	NY State	Lauman Co.	April 4, 1973	Rotary	Cooling
C	Arts and Science Center	657793E 4531137N	NY State	Lauman Co.	July 27, 1960	*NS*	Construction Test Well
D	Old Chemistry Building	658047 E 4531200N	NY State	Lauman Co.	October 23, 1967	*NS*	Cooling
E	Daniel Webster Drive 1	658735 E 4530930N	SCWA	Lauman Co.	November 14, 1968	*NS*	Municipal Water Supply
F	Daniel Webster Drive 2	658937 E 453093N	SCWA	Strata Well Co.	December 3, 1970	*NS*	Municipal Water Supply
G	Javis Lecture Hall	658928 E 457393N	NY State	Lauman Co.	August 21, 1968	*NS*	Cooling
H	Heavy Engineering	658928 E 457393N	NY State	Lauman Co.	December 16, 1968	*NS*	Cooling
I	Henry Clay Drive	658928 E 4529949N	SCWA	Lauman Co.	March 4, 1971	*NS*	Municipal Water Supply
J	Oxhead Road	657858 E 4528642N	SCWA	Mathies Well & Pump Co., Inc.	April 4, 1973	*NS*	Municipal Water Supply

NS – Not Specified

Table 3. Drilling Information for Shallow Boreholes drilled by Land Air and Water Environmental Services					
Locations	**Date**	**Drill Type**	**Depth (ft)**	**Elevation (ft)**	**Reason for Drilling**
ESS 1	October 2000	Hollow Stem Auger	20	120	Educational
ESS 2	October 4, 2001	Hollow Stem Auger	12	120	Educational
ESS 3	October 31, 2002	Hollow Stem Auger	15	120	Educational
ESS 4	October 2003	Hollow Stem Auger	9	120	Education
South Campus 1	October 23, 1997	Hollow Stem Auger	82	190	Educational
South Campus 2	October 15, 1998	Hollow Stem Auger	52	120	Educational

Results

For each deep borehole, the driller provided the depth of the well relative to land surface, however, the surface elevation was not always provided. Elevation for these wells was determined based on located the site on a topographic map and interpolating the elevation. The depth to the water table relative to the land surface was provided in all logs, except the one at Henry Clay Drive. The depth of the well and elevation of water table are provided in *Table 4*. In some logs the driller or geologist noted the upper surface of Magothy Formation. When this information was not provided, or its placement was not consistent with the description of the sediments, the upper surface of the Magothy Formation was determined by comparing the sediment descriptions in the logs to descriptions in the literature. Generally the Pleistocene sediments are tan, whereas the Cretaceous sediments are a variety of brighter or more distinct colors, such as red, black, white, gray etc.

Based on the stratigraphic columns of the deeper borehole, the depth of specific units relative to mean sea level were determined and displayed in *Table 5*. The logs of the Student Union Building (B) and Daniel Webster Road 1 (E) include a gravelly unit that the loggers call the "basal unit"; *Table 5* gives the elevation of the "basal unit" described by the drillers of logs B and E, but in the *Table 5* it is identified as gravelly which was also identified in boreholes A, C, D, F, I, and J. The surface of the gravelly units in boreholes B and E differs by 85 ft. The position of the gravelly unit within the other boreholes does not show a trend, suggesting that this describes channel fill in multiple channels and not a well-defined stratigraphic unit.

Lignite was identified in the Magothy Formation in boreholes B, C, D, F and J. The elevation of these units, displayed in *Table 5*, range from –155 to –377 ft relative to mean sea level. In addition to the elevation of the lignite layers, the thickness of each layer is provided in *Table 5*. In borehole B, Student Union building, the lignite is found in two units. The deeper unit is 12 ft thick with lignite located in fine to medium gray sand, with pieces of clay. The 8 ft thick unit directly above consists of sandy gray clay, pyrite and lignite. To summarize, the sediments found with the lignite are gray, fine to coarse sands and clays, and occasionally pyrite probably representing overbank deposits formed in a swampy environment. Lignite is deposited in an environment that is humid and wet, allowing the preservation of organic material.

Table 4.The Elevation of the land surface, the elevation of the bottom of the bore hole and the elevation of the groundwater table relative to mean sea level.

Borehole ID	Location	Elevation of Location (ft)	Elevation of bottom of hole (ft)	Elevation of water table (ft)
A	Mud Road	116	-464	26.5
B	Student Union Building	120	-377	57
C	Arts and Science Center	135	-500	37
D	Old Chemistry Building	135	-521	27
E	Daniel Webster Drive 1	125	-428	46
F	Daniel Webster Drive 2	107	-380	31
G	Javits Lecture Hall	140	-210	*30*
H	Heavy Engineering	130	-217	15
I	Henry Clay Road	226	-449	*NA*
J	Oxhead Road	145	-420	35

Table 5. The elevation and thickness of geological layers and features according to the boreholes

Borehole	Location	Elevation of Upper surface of Gravelly Magothy * (ft)	Elevation of Upper Surface of Layers containing Lignite (ft)*	Thickness of Magothy Lignite (ft)	Elevation of the Base of Glacial Sediments* (ft)	Elevation of upper surface of Pleistocene Clays (ft)*	Thickness of Pleistocene Clay (ft)
A	Mud Road	-374	NA	NA	-29	NA	NA
B	Student Union Building	-307●	-272	20	-49	22	10
C	Arts and Science Center	-371	-240	5	-54±15	*NA*	NA
D	Old Chemistry Building	-421	-270/-296	11/9	-50	-39	5
E	Daniel Webster Drive 1	-370●	NA	NA	-8±19	29	12
F	Daniel Webster Drive 2	-355	-156	16	-27±18	36	14
G	Javits Lecture Hall	NA	*NA*	NA	-38	*4*	12
H	Heavy Engineering	NA	NA	NA	-50±11	NA	NA
I	Henry Clay Road	NA	NA	NA	41	NA	NA
J	Oxhead Road	NA	-369	8	-100	17	11

**Elevation Relative to Mean Sea Level* *NA – Not applicable*

● *The basal unit in the Magothy Formation identified by in the borehole logs.*

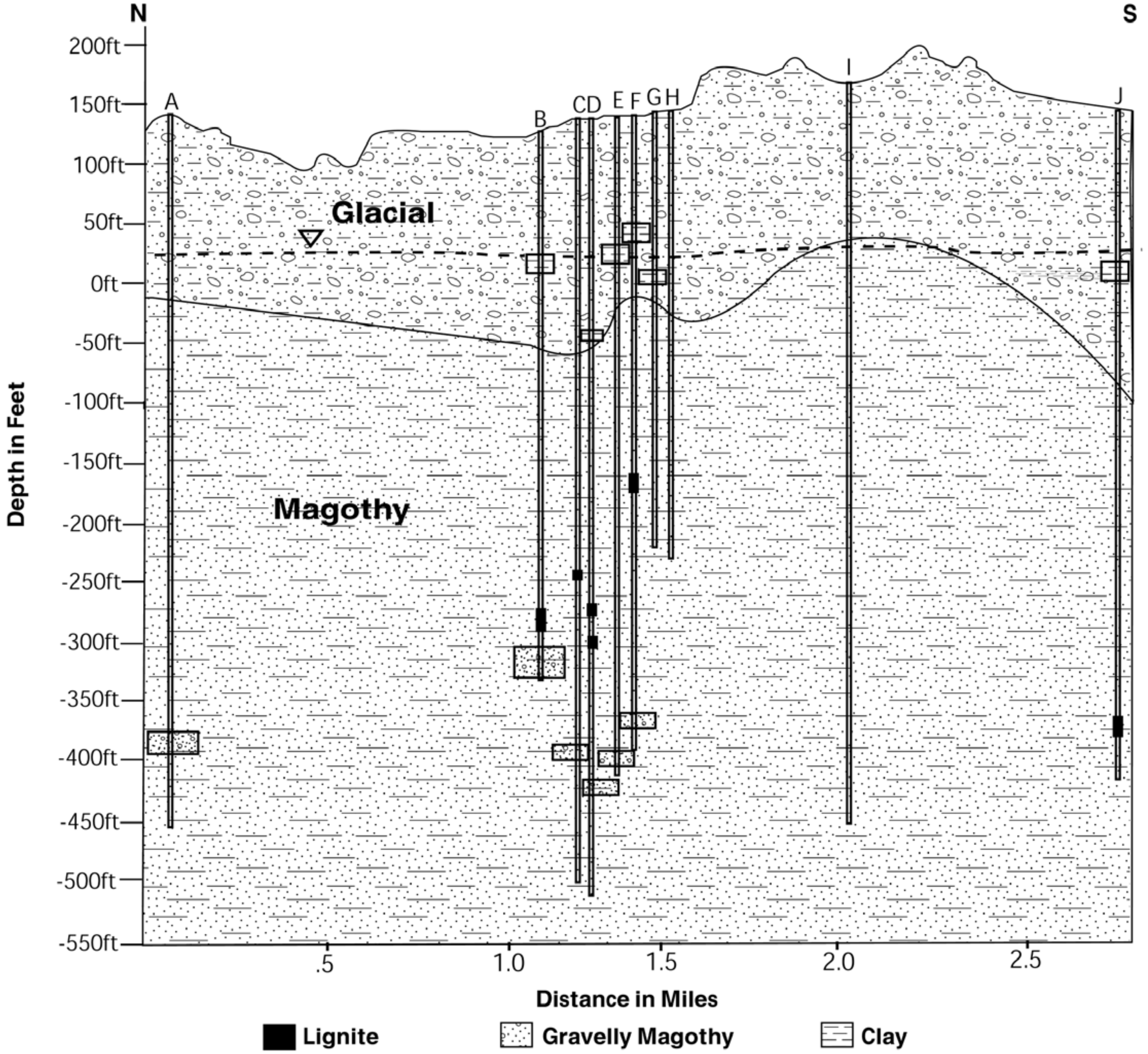

Figure 4. North-south stratigraphic cross section across the Stony Brook Campus.

The data in *Table 5* were used to construct a cross-section of the strata below the Stony Brook University campus. The cross-section, *Figure 4*, extends from borehole A, at Mud Road, located north of campus, to borehole J, located south of the campus. Moving south from borehole A the elevation of the upper surface of the Magothy Formation decreases from -29 to –61 ft at location H. However, Henry Clay Drive (I) borehole, located on the Moraine, the upper surface of the Magothy is at an elevation of 41 ft above sea level. South of the Moraine at location J, the upper Magothy surface is lower at –100 ft. Thus, the upper surface of the Magothy Formation is higher under the Harbor Hill Moraine which may be a result of differential erosion by the glaciers or perhaps the Cretaceous sediments were pushed up by the advancing glacier that formed the Stony Brook portion of the Harbor Hill Moraine.

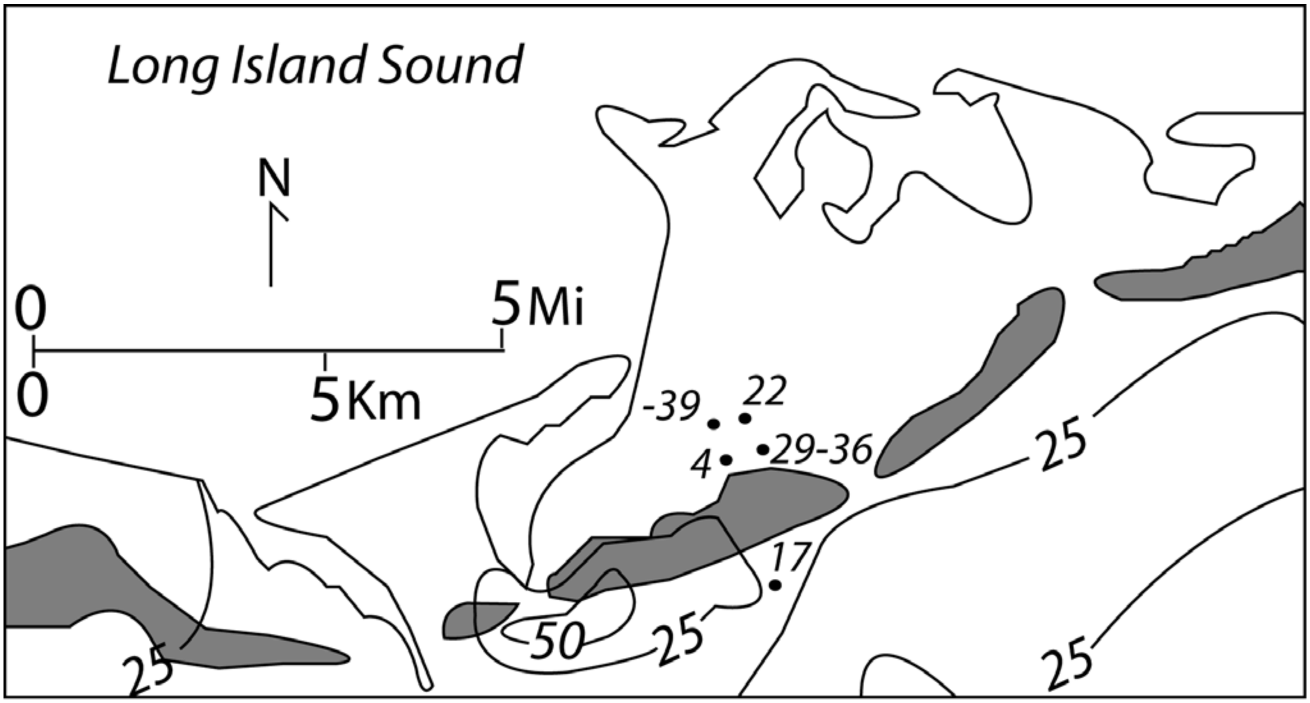

Figure5. Contour map showing the elevation of the top of the Smithtown clay from Krulikas and Koszalka (1983) and the elevation of the top of the clay in boreholes on or near the Stony Brook University campus.

Within boreholes D, E, F and J is a layer of lacustrine clay similar to the Smithtown clay found by Krulikas and Koszalka (1983) in northwestern Suffolk County. Figure 5 is a contour map showing the elevation of the top of the Smithtown clay south of Stony Brook University. The Smithtown clay is up to 170 feet thick, but more typically on the order of 20 to 50 feet thick. The elevation of the top of the five- to fourteen-foot thick lacustrine clay found underlying the Stony Brook University campus is fairly consistent with the elevation of the clay found by Krulikas and Koszalka (1983). The clay on campus is found both north and south of the moraine, but not under the highest part of the moraine. If the rise in the Magothy Formation under the moraine were present during the deposition of the Smithtown clay in a proglacial lake, this area may have been above the level of the lake. Or, if the bulge is due to glacial tectonics, the clay may have been removed by the pushing of the glacier. A lacustrine clay was noted near the surface on campus at an elevation of about 140 feet during the construction of the Student Activity Center. If this clay were the Smithtown Clay, this would suggest that the clay had been transported by glacial tectonics to a much higher elevation.

The reported depth to the water table ranges from 15 to 57 ft above mean sea level. Since the logs were completed at different times of the year and in different years, some of the differences in the elevations may result from seasonal or annual variations in precipitation as well as variations in the elevation of the water table with distance from Long Island Sound. In Figure 4, the elevation of the water table is approximated based on the borehole logs.

The sediments found in the shallow borehole and the cliff face are similar to each other (see Appendix for details). Located near the land surface is silty sand and sandy silt probably loess (Zhong et al, 2002) which generally overlies till. In the shallow bore holes and exposed cliff, the till consisted of a 3ft thick layer near the top of the sections. Six feet of till was identified in the boreholes at Student Union, and about eight feet of till was found in the Old Chemistry bore hole. Below the till are usually alluvial sands and gravels showing plane or cross bedding.

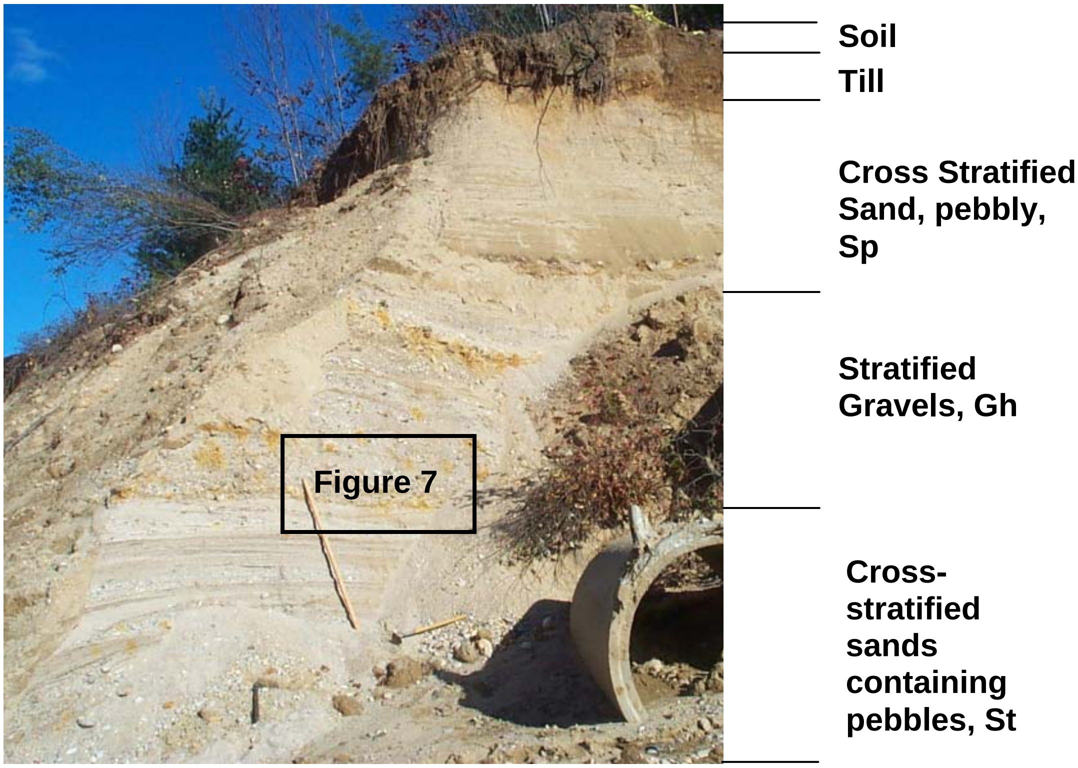

Figure 6. Photograph of the exposed cliff located near the west campus recharge basins. The cliff composes mainly of alluvial sands and gravels, with 3 ft of till near the top. The black box illustrates the section photographed in *Figure* 7.

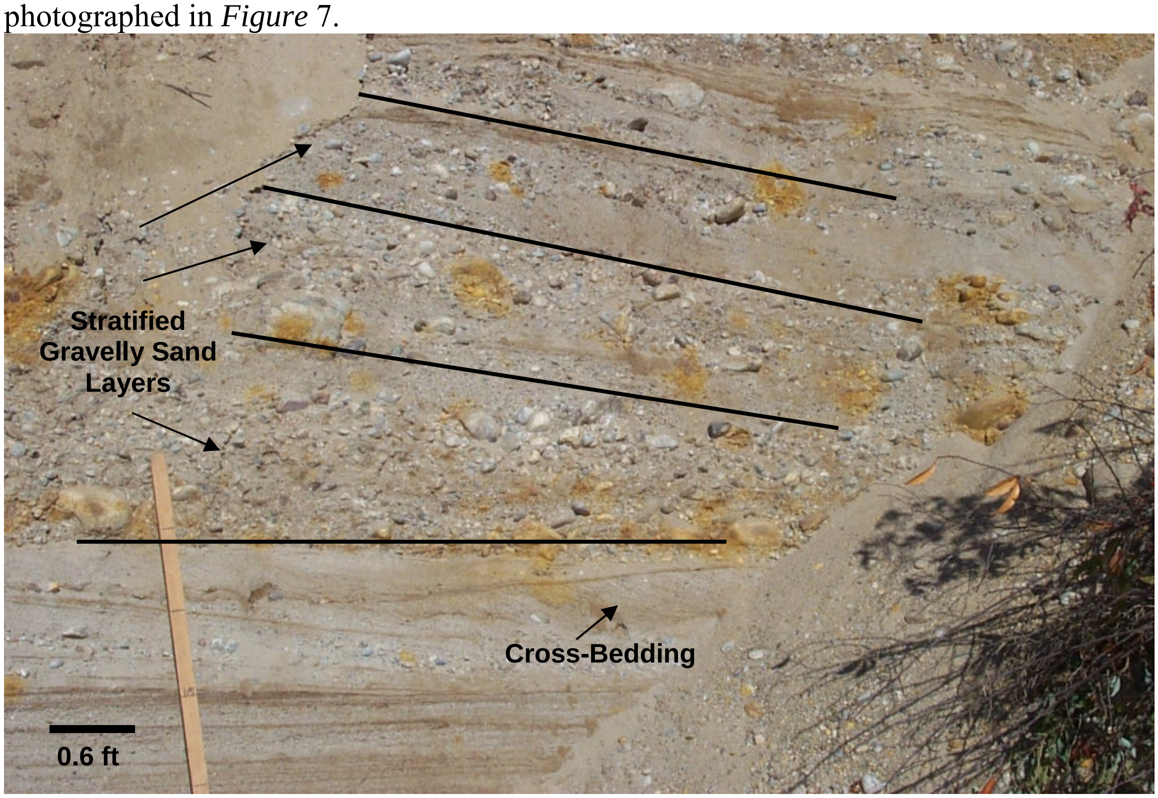

Figure 7. Close up of the exposed cliff strata in Fig. 6. The sections in the photograph are the stratified layers of gravel, deposited a layer of finer sand with cross stratification. The cross-bedding and finer sediments deposited indicate a low energy, unidirectional flow of the outwash material. The environment changed to a high energy, unidirectional flow of melt water indicated by the gravelly sandy layers.

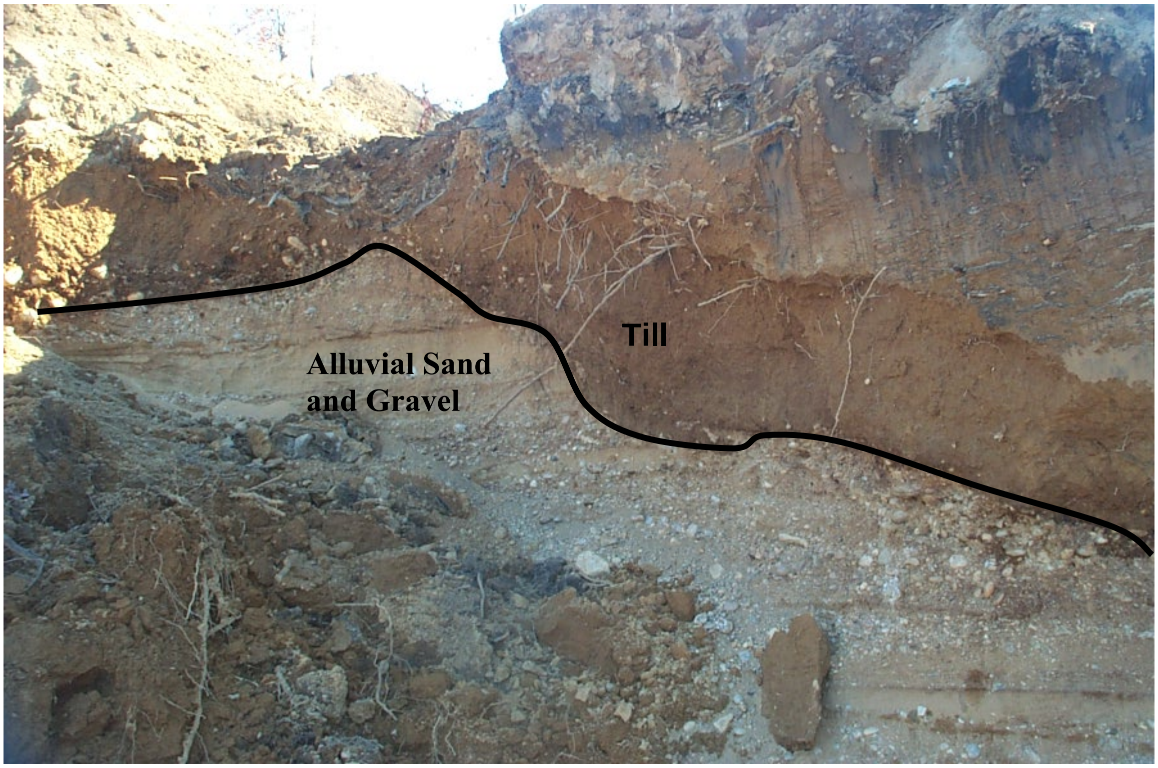

Figure 8. Till overlying alluvial sand and gravel.

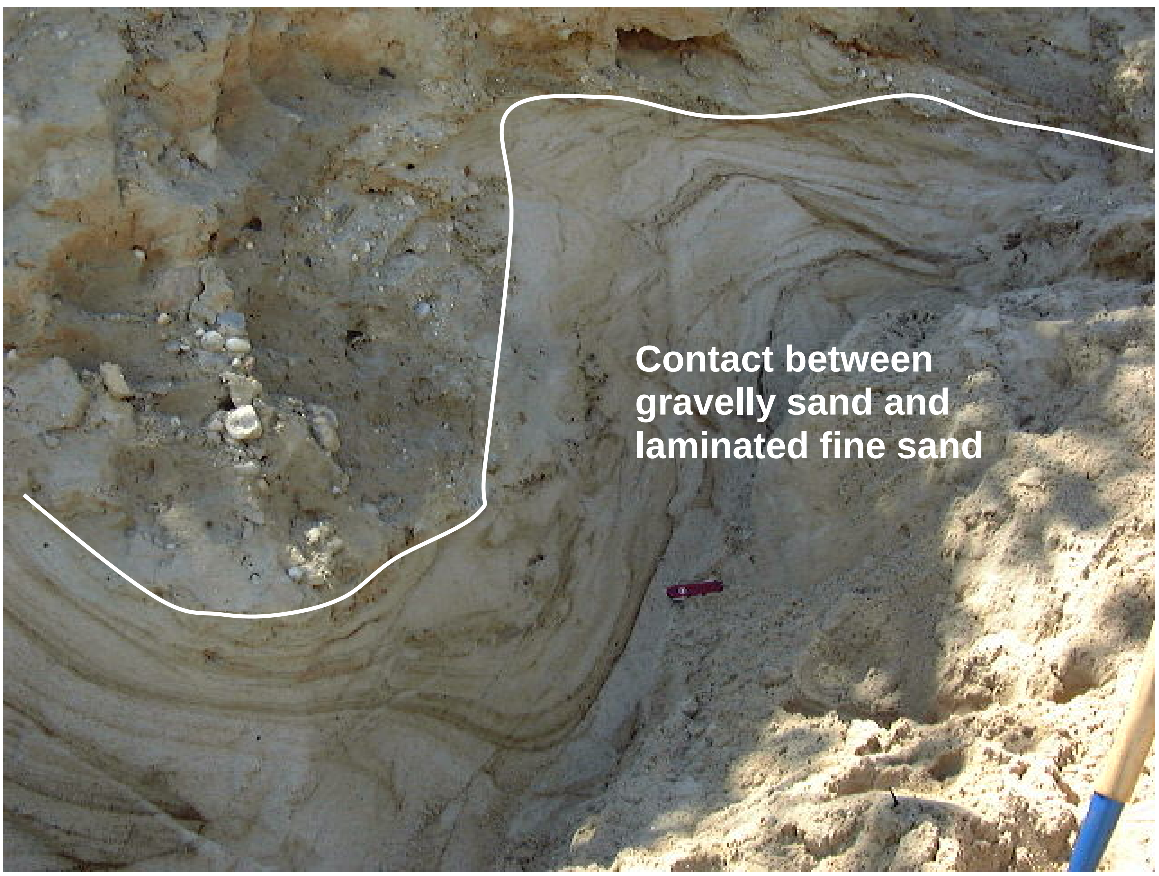

Figure 9. Fold found during construction of the Student Activity Center (SAC). The gravelly sands and finer, laminated sands and clay are folded. Swiss Army Knife is used for scale.

Discussion

The deepest geological formation penetrated by the boreholes in this study is the Magothy Formation. Found near the base of the boreholes is a layer of gravelly sands with some clay which was identified as the "Basal Magothy" in two locations. However, a comparison of sediments found in the other boreholes indicates that the Magothy Formation is found at deeper elevations and the Raritan clay was never penetrated. Based on these boreholes the "Basal Magothy" described by the loggers is actually a gravelly unit indicating channel deposits found within the Magothy Formation. The upper surface of the gravelly unit is irregular, which is typical of a delta environment. The presence of gravel at the lower sections of the formation suggests that the deposition of the Magothy Formation began in a high-energy delta environment, which decreased in energy over time.

Deposited in the lower energy environment are mainly clays and fine sands. The lignite recognized in the finer layers of the Magothy Formation is found at a variety of depths, suggesting there is no continuous layer of lignite within the Magothy Formation. However, in boreholes located at the Student Union, the Art and Science building and the Old Chemistry building the lignite is found in similar sediments and depths. The elevation of the lignite layers are –240 ft, -270 ft and –277 ft, and the thickness of the layer varies from 5 ft thick at the Art and Science Center to 12 ft thick at the Student Union. Since these boreholes are in close proximity to one another, the lignite layer may extend beneath this entire area.

The cross-section of the entire Stony Brook University, *Figure 4*, shows the upper surface of the Magothy Formation is extremely irregular. The elevation of the Magothy Formation rises considerably beneath the Harbor Hill Moraine. This rise may have glacial tectonic implications based on the location. As the glacier moved into the Long Island region and made contact with the unconsolidated sediments, the glacier could have pushed the Magothy Formation. However, the clay unit found, also plotted in the *Figure 5*, poses an issue for this theory. If the Magothy Formation was tectonically altered, the deposition of the clay could not be related to the clay found south of the moraine; the clay would also be tectonically altered. The clay found beneath Stony Brook University could possibly relate to the clay unit discussed by Krulikas and Koszalka (1983) according to the map. The clay north of the moraine may have been pushed into its location by the glacier. To further investigate the rise of the Magothy formation beneath the moraine, well boreholes logged from different locations on the moraine need to be obtained to see if this is trend within the moraine.

The shallow boreholes provided the majority of the detailed information on the glacial sediments. The sediments described in the borehole logs were mainly sandy silt, silt sand, sand and gravelly sands. The exposed cliff provided a more detailed analysis of the sediment associated with the glacier (*Figure 6*). Soil is found at the top of the cliff and is commonly formed on loess. The exposed cliff had about 3 ft of glacial till. The sediments found within the till layer are similar to the outwash sediments, however the till is unsorted and unstratified, while the outwash beneath is stratified. The loggers of the shallow or deeper boreholes rarely identify a layer of till. The method of sediment extraction makes distinguishing till and outwash difficult; the layers were not preserved or not identified. Only two of the deep boreholes recognized a layer that has the distinct features of till, these units were 6 to 8 ft thick. *Figure 8* shows a more distinct boundary between till and outwash found near the location of the cliff. Beneath the till in the exposed cliff is outwash containing cross-stratified sands and stratified gravel. Layers of sand and gravel are similar to the sediments described by the loggers of the shallow boreholes. The cliff also exposed sedimentary structures (*Figure 7*). The structures reveal details about the depositional environment. The alternating of stratified sands and stratified gravels indicate deposition was rapid and inconsistent. The melt water deposited the sediments quickly in a stream, and then as sediments pile melt water creates or deposits sediments to a new stream. This may explain why the sediment sizes were not consistent in the ESS boreholes, which were drilled within feet of each other. In addition to the melt water inconsistence, glacial tectonics may have altered the sediments layers. *Figure 9* is a photograph of the sediments found beneath the SAC. The fine sediments and the coarse gravel are folded, most likely due to the glaciotectonic forces as the glacier advanced forward.

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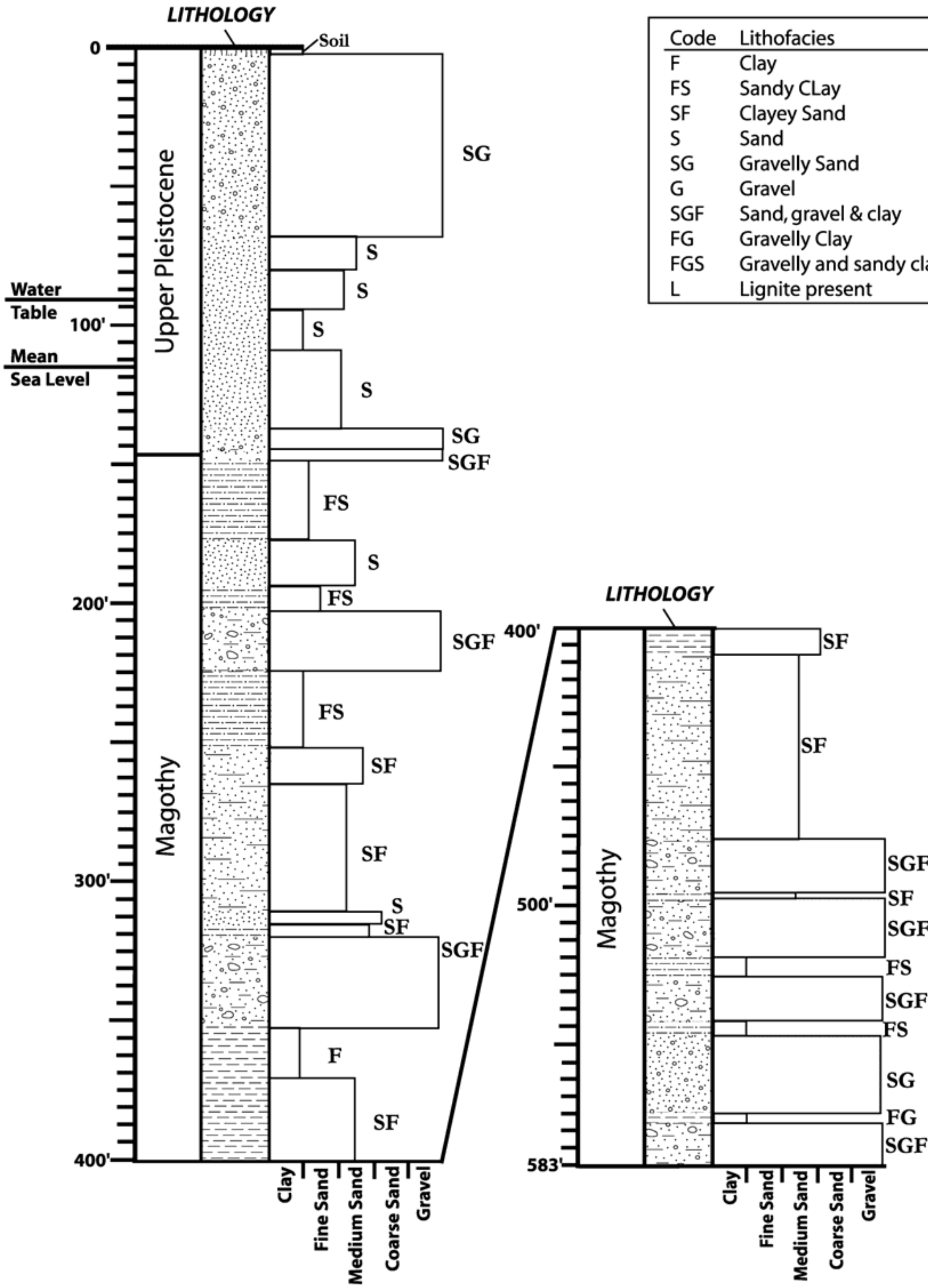
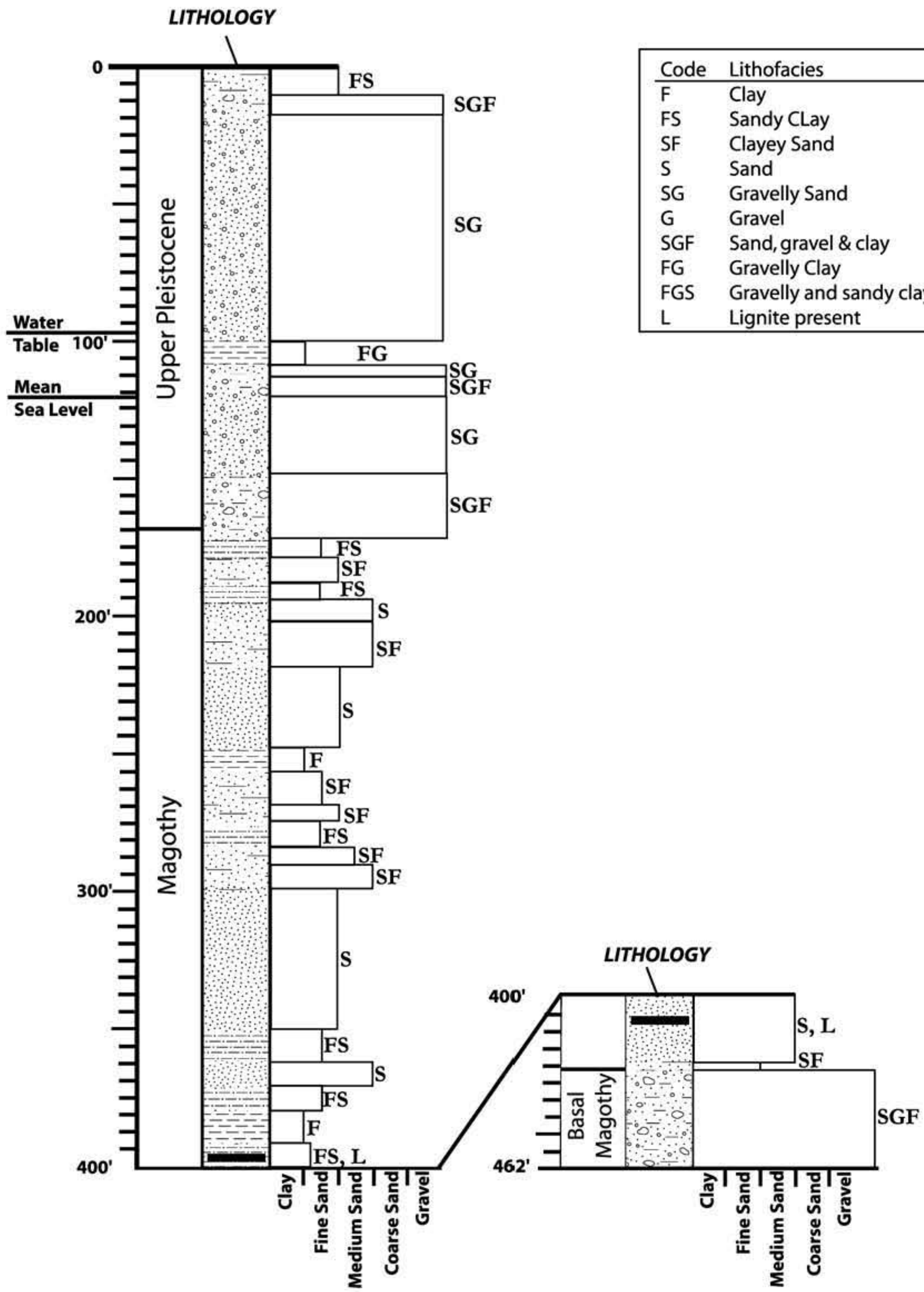
Lithologic Log of Borehole at Mud Road (A)

Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

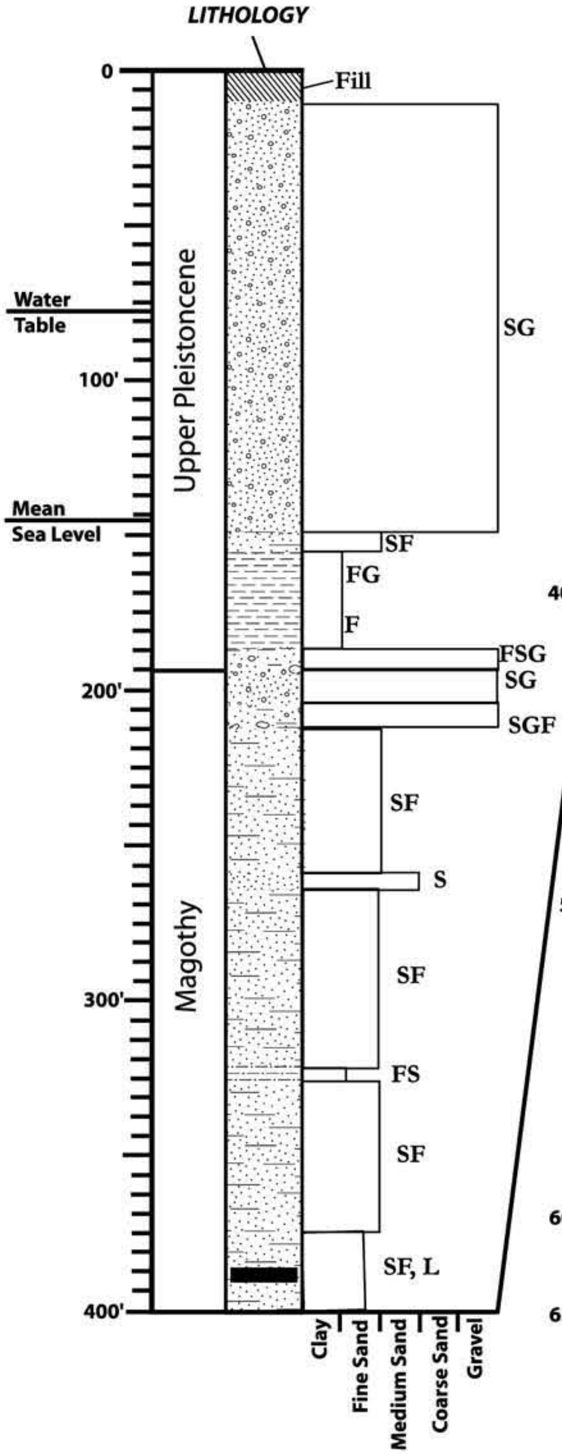


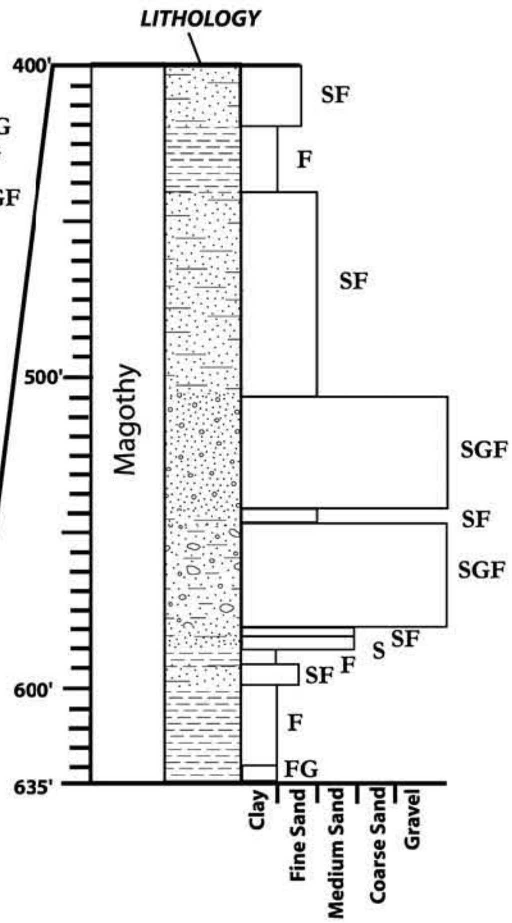
Lithologic Log of Borehole at Student Union Building (B)



Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

Lithologic Log of Borehole at Art and Science Center (Staller Center) (C)

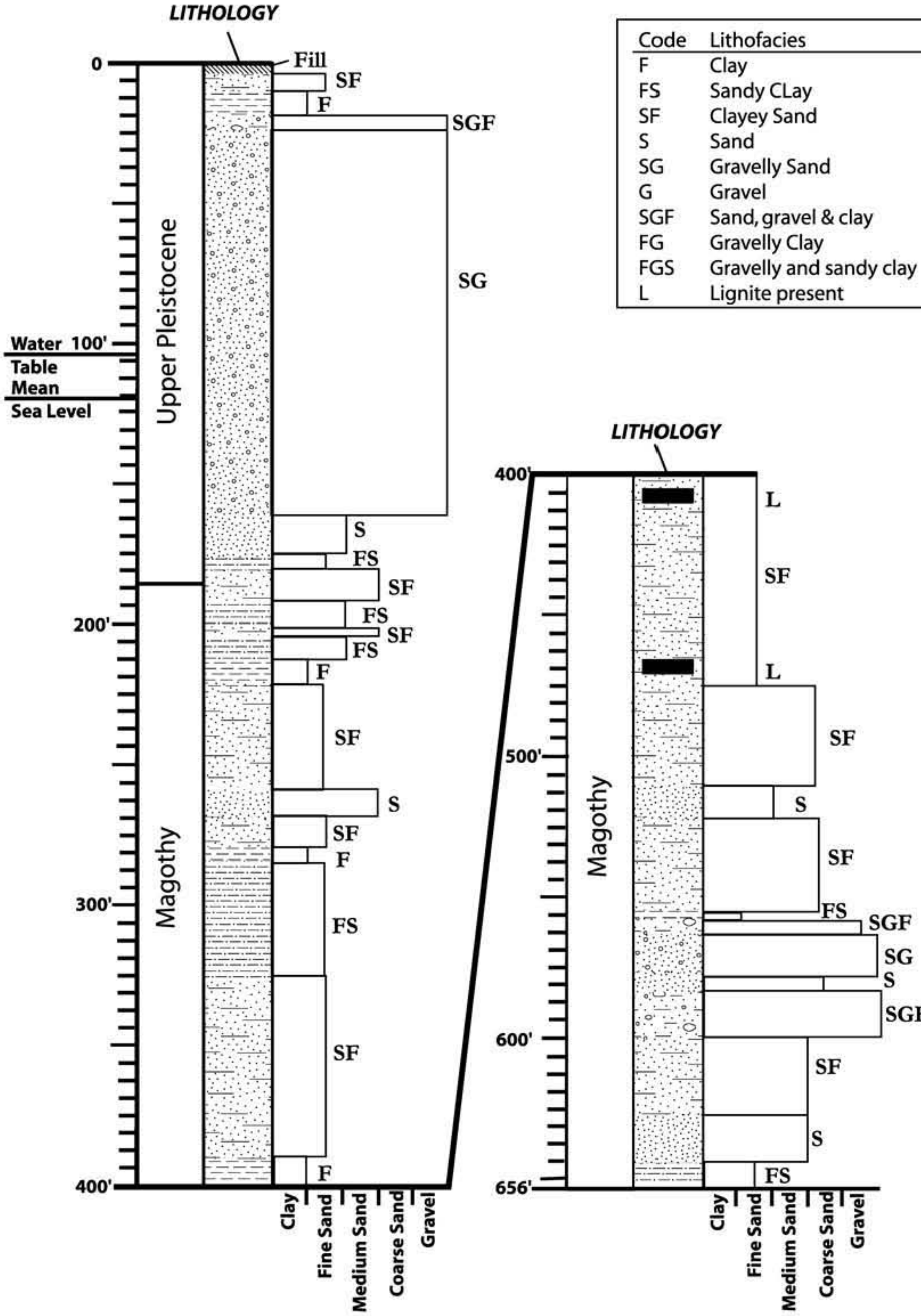




Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

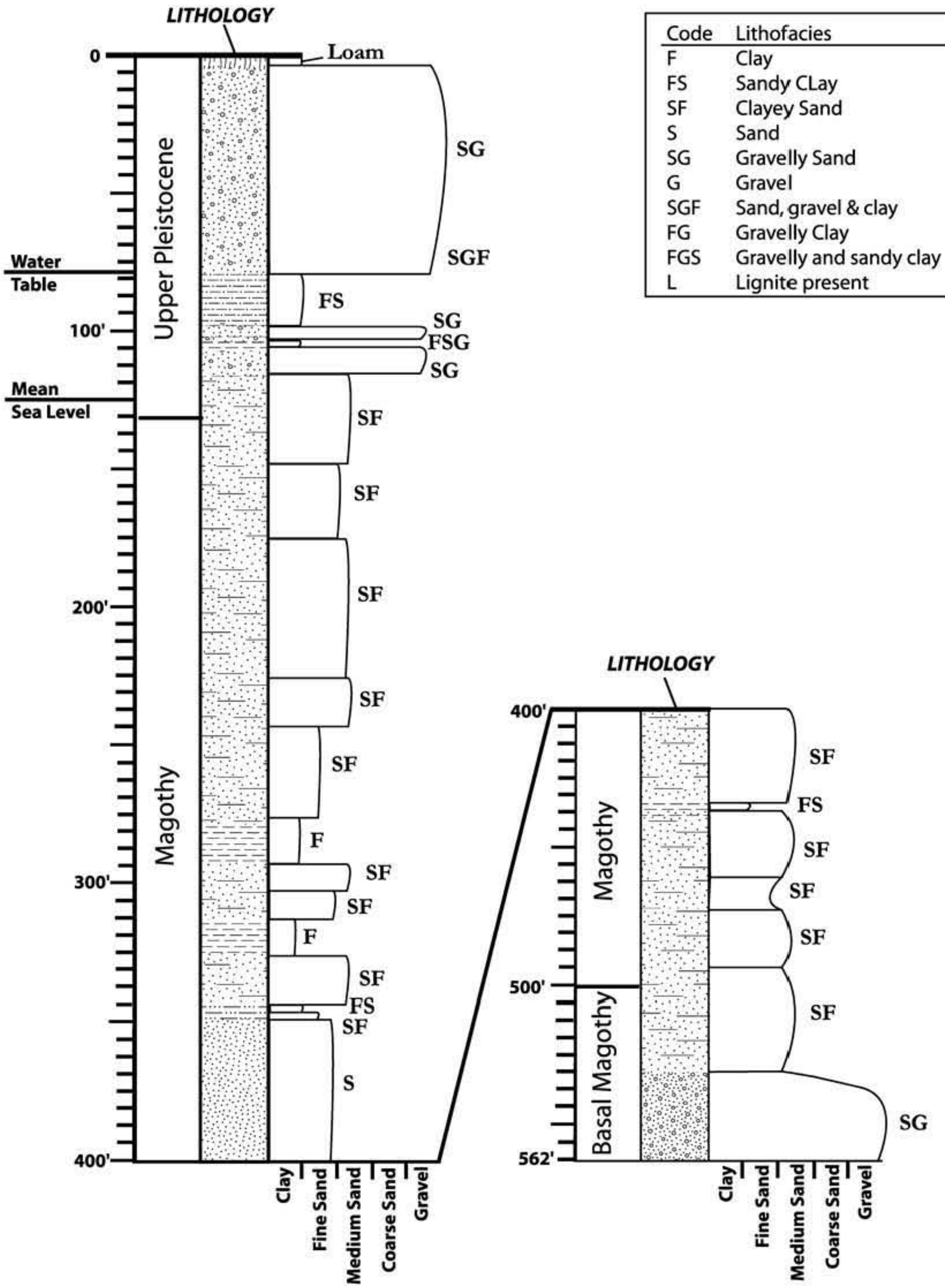
Lithologic Log of Borehole at Old Chemistry (D)

Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present



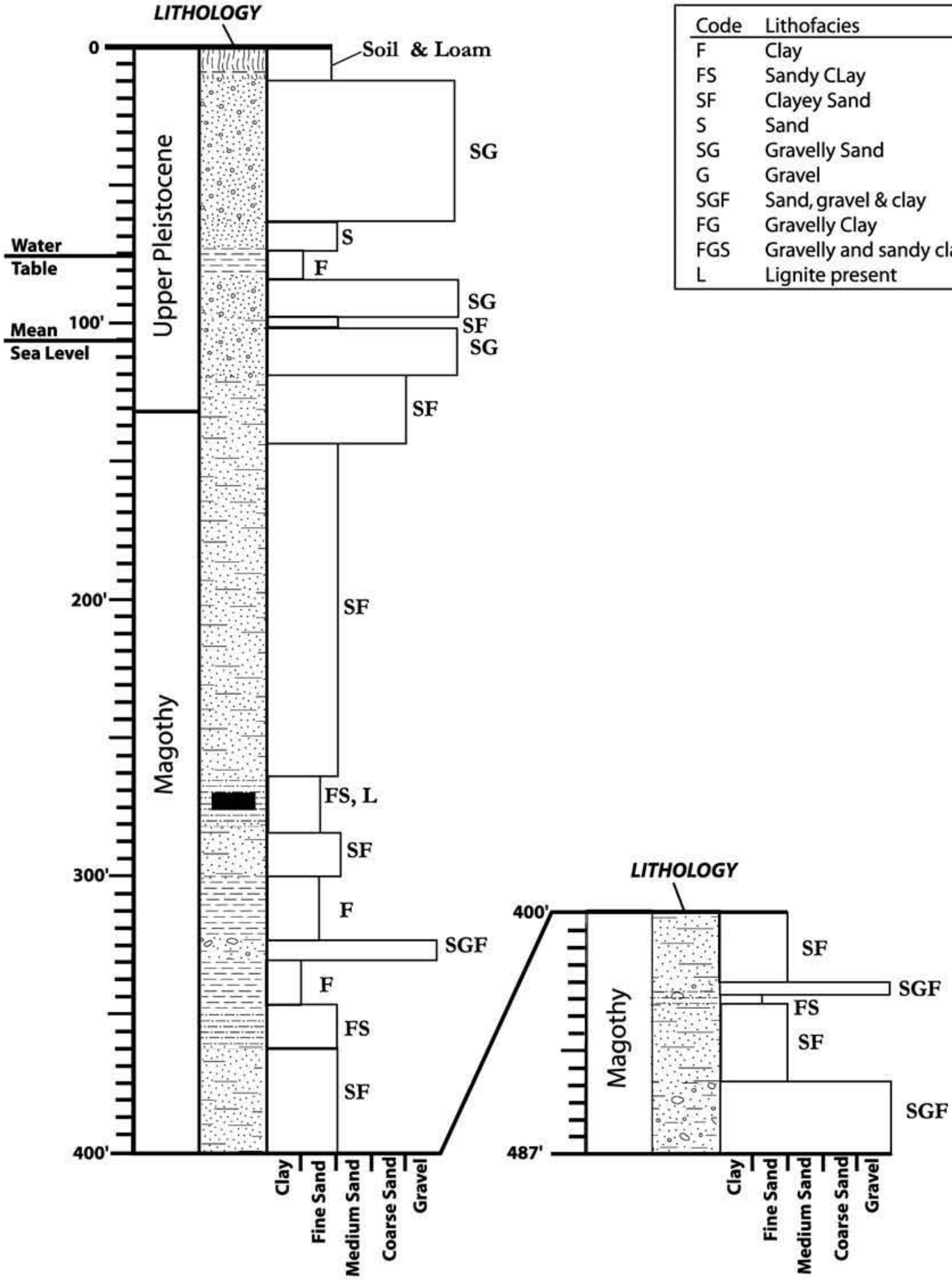
Lithologic Log of Borehole at Daniel Webster Drive 1(E)

Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

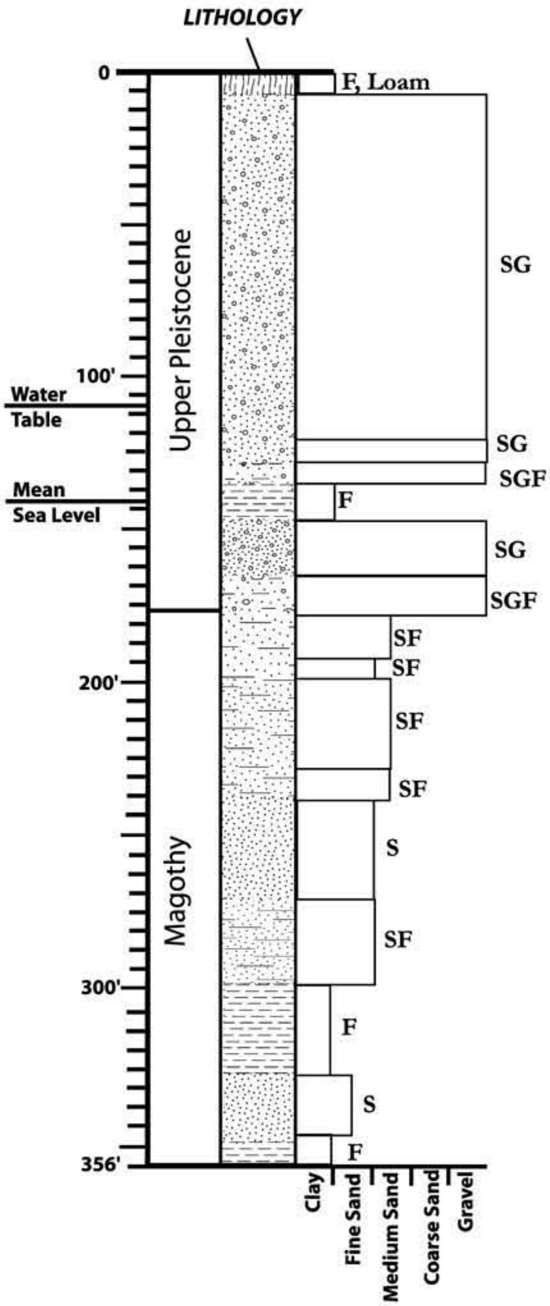


Lithologic Log of Borehole at Daniel Webster Drive 2 (F)

Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

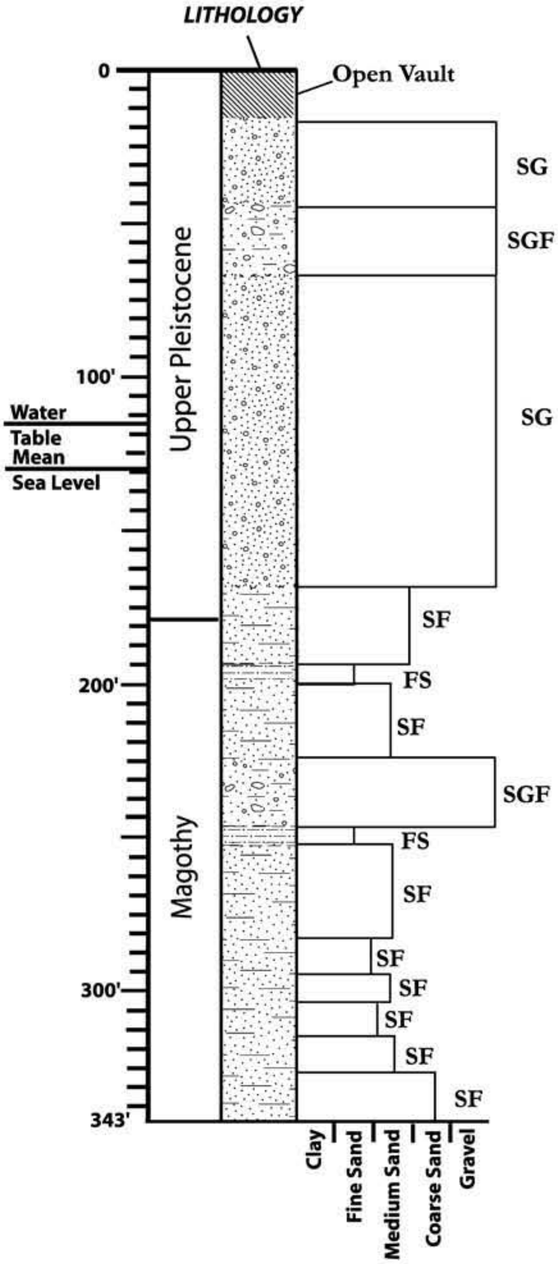


Lithologic Log of Borehole at Javis Lecture Hall (G)



Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

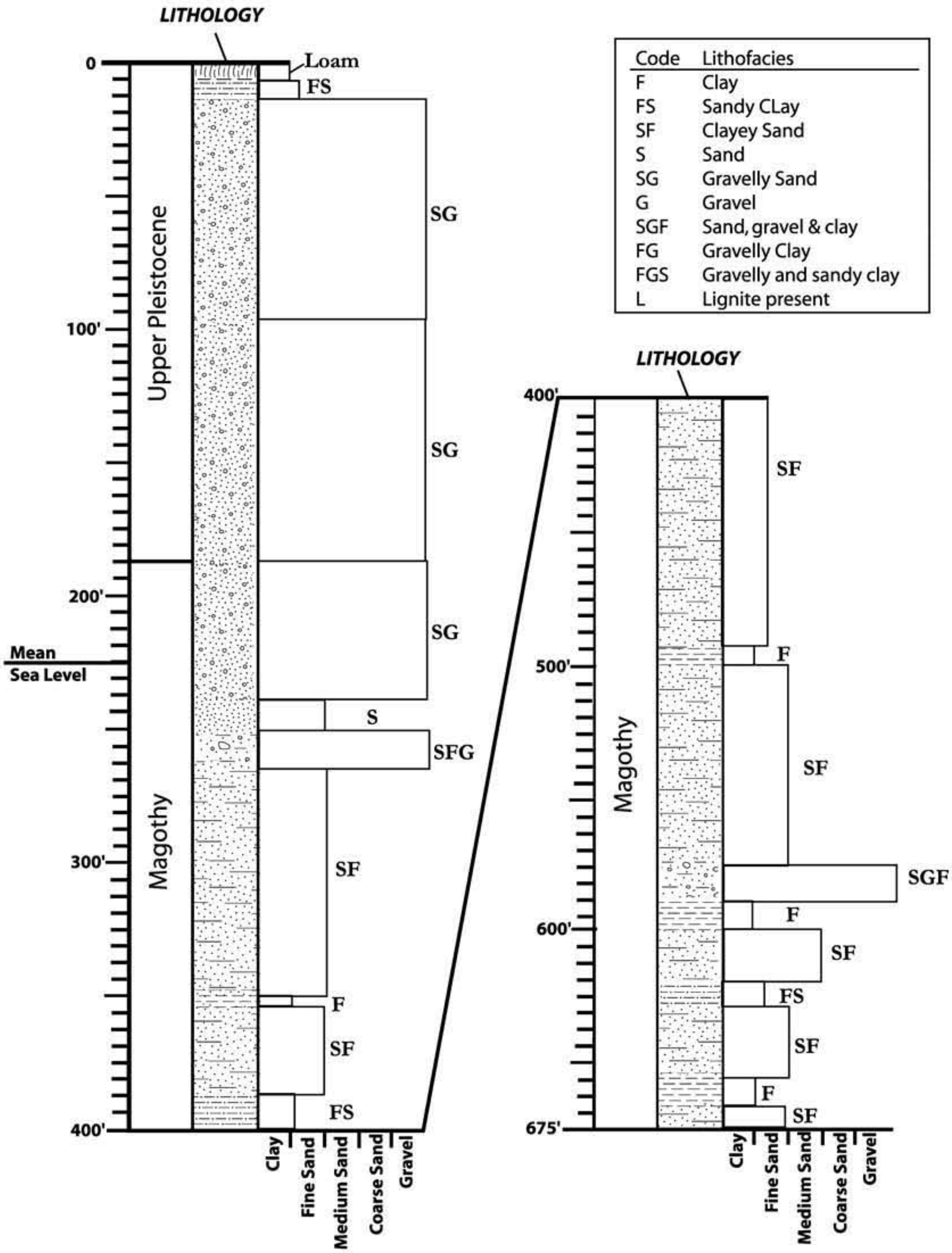
Lithologic Log of Borehole at Heavy Engineering Lab (H)



Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

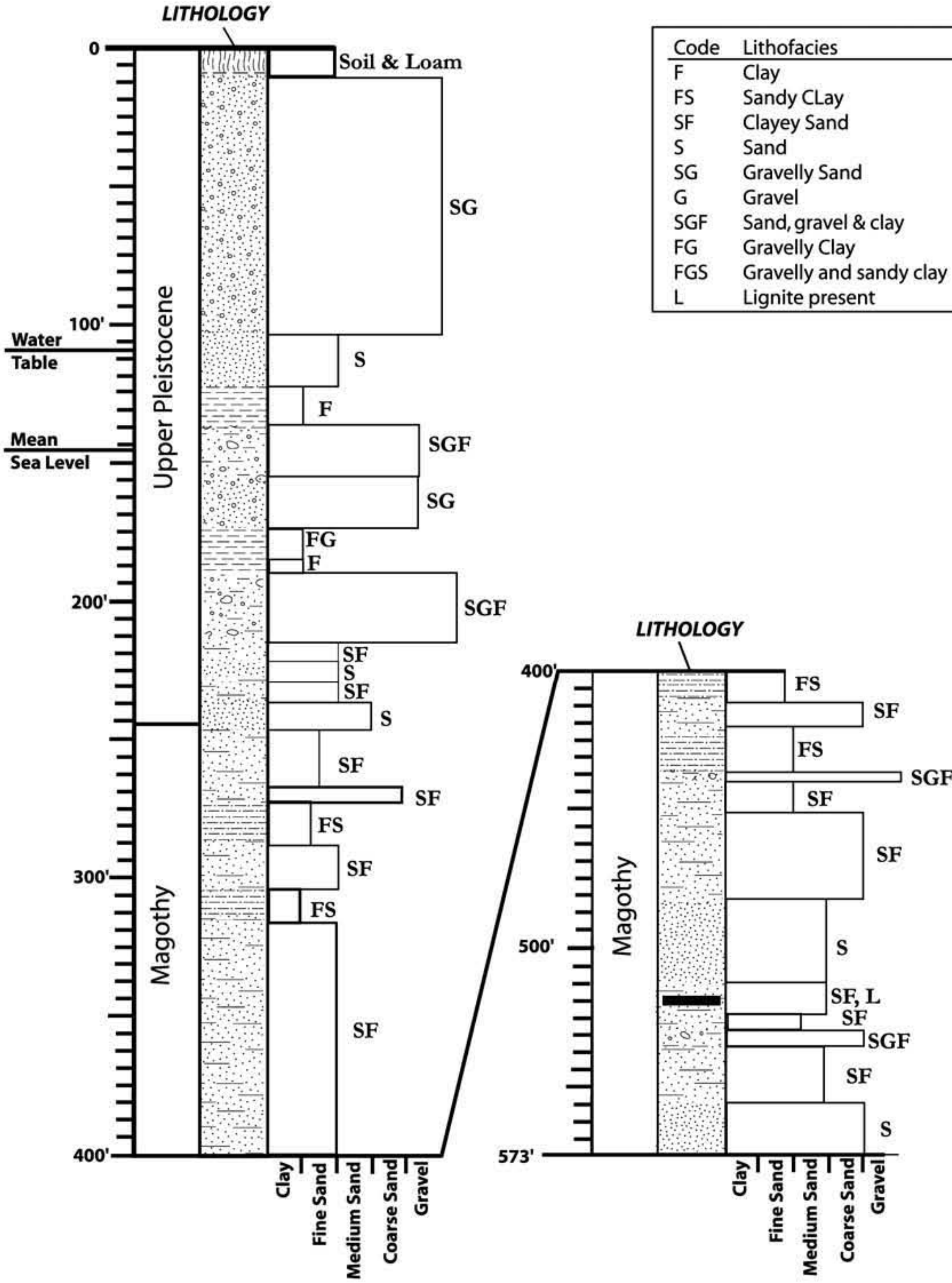
Lithologic Log of Borehole at Henry Clay Drive (I)

South Entrance to Stony Brook Hospital



Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

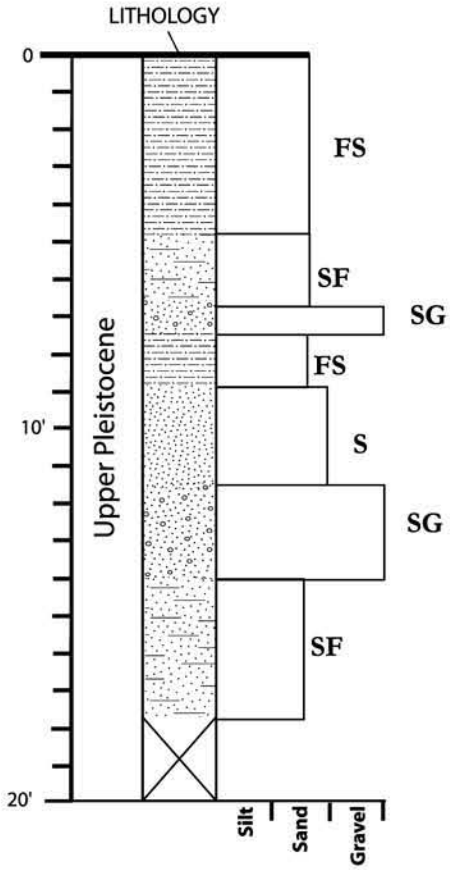
Lithologic Log of Borehole at Oxhead Road (J)



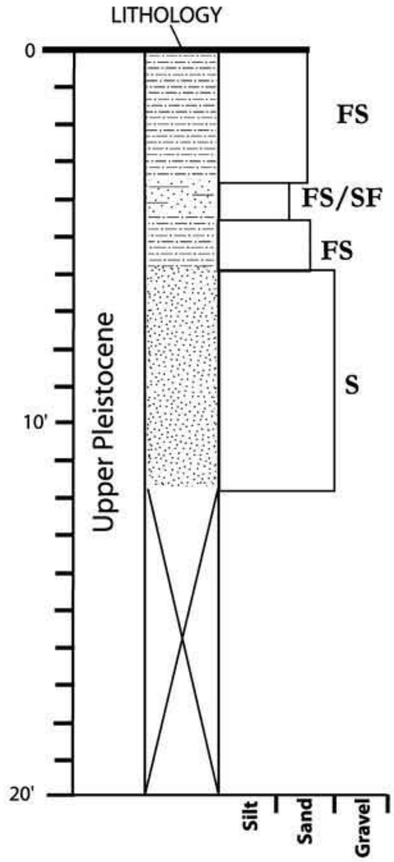
Code	Lithofacies
F	Clay
FS	Sandy CLay
SF	Clayey Sand
S	Sand
SG	Gravelly Sand
G	Gravel
SGF	Sand, gravel & clay
FG	Gravelly Clay
FGS	Gravelly and sandy clay
L	Lignite present

Lithologic Log of Boreholes at Earth and Space Sciences (ESS)

Borehole 1 - October 2000



Borehole 2 - October 4, 2001

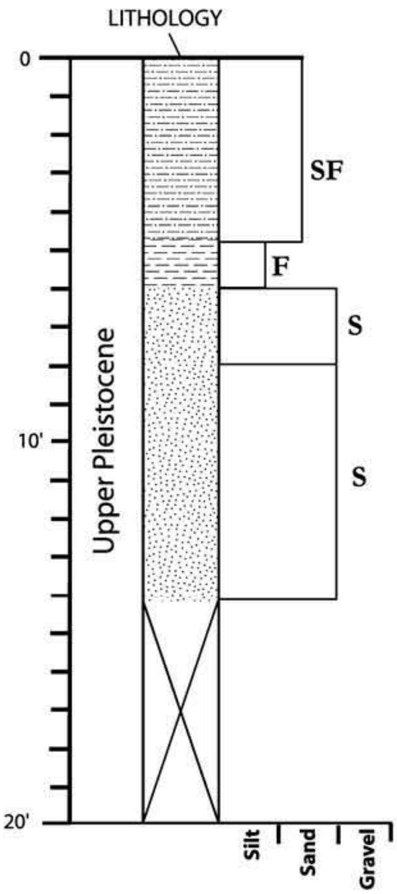


Code	Lithofacies
F	Silt
FS	Sandy Silt
SF	Silty Sand
S	Sand
SG	Gravelly Sand
G	Gravel

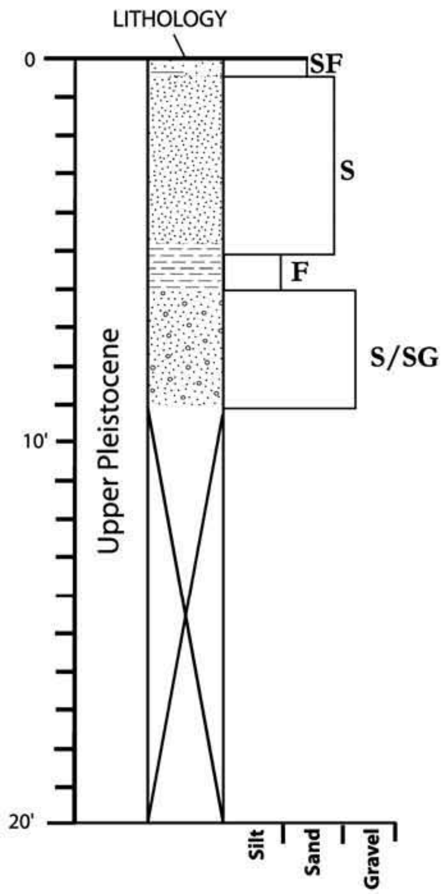
The borehole did not extend to these depths

Lithologic Log of Boreholes at Earth and Space Sciences (ESS)

Borehole 3- October 31, 2002



Borehole 4 - October 2003

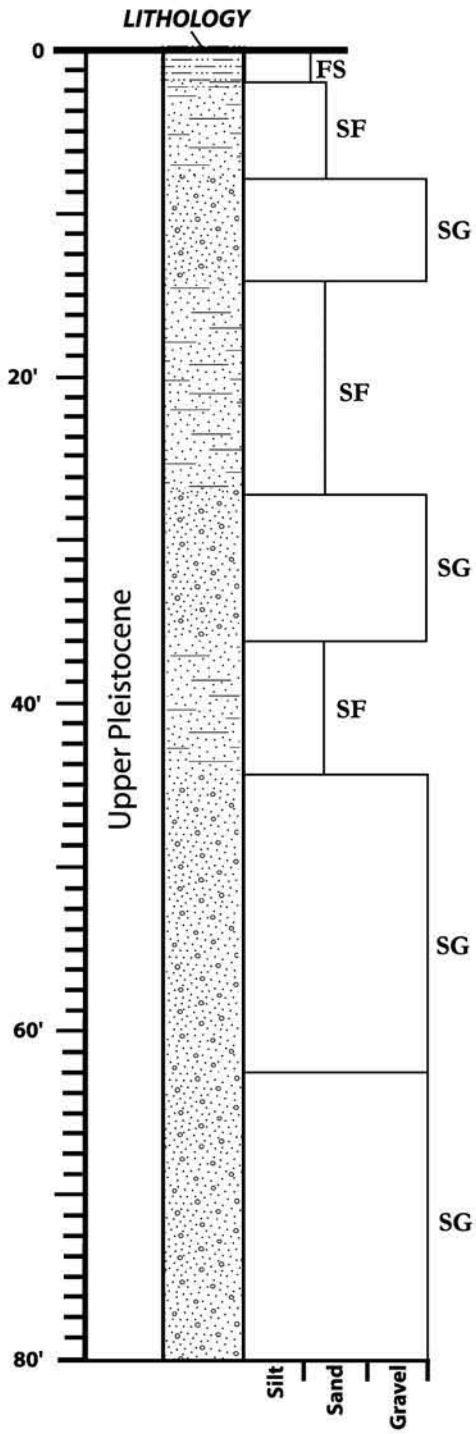


Code	Lithofacies
F	Silt
FS	Sandy Silt
SF	Silty Sand
S	Sand
SG	Gravelly Sand
G	Gravel

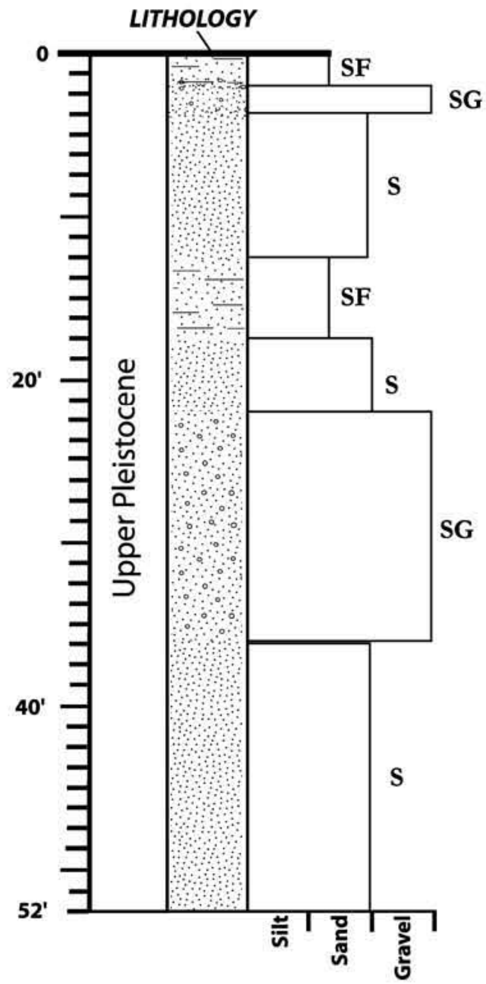
☒ The borehole did not extend to these depths

Lithologic Logs of South Campus Boreholes (S)

Borehole 1 - October 23, 1997

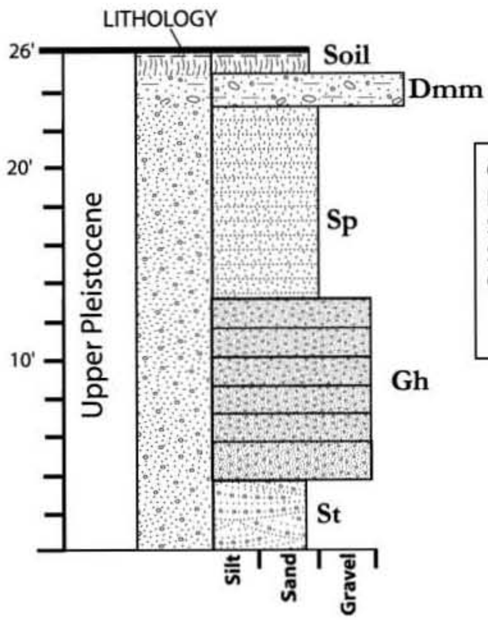


Borehole 2 - October 15, 1998



Code	Lithofacies
F	Silt
FS	Sandy Silt
SF	Silty Sand
S	Sand
SG	Gravelly Sand
G	Gravel

Composite Strat Section of Cliff



Code	Lithofacies
Dmm	Diamict (Till)
Sp	Planar Cross Stratified Sands with gravel
St	Trough Cross Stratified Sands with gravel
Gh	Stratified gravel, Distinct horitantal bedding