PHASE IA ARCHAEOLOGICAL SURVEY REPORT

LaGuardia Airport Central Terminal Building Redevelopment

Queens Borough

New York City

Prepared for
Port Authority of New York & New Jersey
Port Authority of NY & NJ
225 Park Avenue South
New York, NY 10003

Prepared by
Frank G. Mikolic, Principal Investigator
John W. Lawrence, Principal Investigator
Brian M. Albright, GIS Specialist/Field Director

AECOM
516 East State St.
Trenton, New Jersey 08609

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Management Summary

SHPO PROJECT REVIEW NUMBER:
12PR05127

INVOLVED STATE AND FEDERAL AGENCIES:
FAA
Port Authority of New York and New Jersey

PHASE OF SURVEY:
IA, Literature Search and Sensitivity Assessment

LOCATION INFORMATION:
Location: New York City
Minor Civil Division: Queens Borough
County: Queens County

SURVEY AREA:
Length: 1.2 mi (2 km)
Width: width varies depending on location
Number of Acres Surveyed: 159 ac (64 ha)

USGS 7.5 MINUTE QUADRANGLE MAP:
Central Park, Flushing

SENSITIVITY ASSESSMENT:
Prehistoric (high, medium, low): Sensitivity Area 1 (Moderate to High), 2 (High), 3 (Low) and 4 (Moderate).

Historic (high, medium, low): Sensitivity Area 1 (Moderate to High), 2 (Low), 3 (Moderate to High) And 4 (Moderate to High).

ARCHAEOLOGICAL SURVEY METHODOLOGY:
Background research
Surface survey: visual inspection by walkover

RESULTS OF ARCHITECTURAL SURVEY:
Number of structures in project area: 6 (Hangars 1, 2, 3, 4, 5 and CTB in APE)
Number of known NR listed/eligible structures: 0
Number of recommended eligible structures/districts: 5 (Hangars 1, 2, 3, 4, 5)
Number of listed/eligible or potentially eligible structures that may be impacted: 3 (Hangars 1, 2, 4)

RESULTS OF ARCHAEOLOGICAL SURVEY:
Number and Name of Prehistoric Sites Identified: 1, ACP QUNS 10 (NYSM# 4533)
Number and Name of Historic Sites Identified: 0
Number and Name of Sites Recommended for Phase IB/Avoidance: 1, ACP QUNS 10 (NYSM# 4533)

REPORT AUTHOR:
Frank G. Mikolic, John Lawrence and Brian M. Albright

DATE OF REPORT:
June 2013

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1.0 INTRODUCTION

This report presents the results of a Phase IA Archaeological Survey undertaken for the proposed LaGuardia Airport Central Terminal Building Redevelopment located within Queens Borough, New York City (Figure 1). The proposed work involves the redevelopment of the existing Central Terminal Building (CTB) at LaGuardia Airport in Queens, New York. The proposed redevelopment includes the complete replacement of the existing CTB, as well as significant airside and landside improvements (see Project Limits in Figure 1 and Project Plans in Appendix A). The project was completed for the Port Authority of New York and New Jersey (PANYNJ).

AECOM of Trenton, New Jersey, conducted the Phase IA archaeological fieldwork in September of 2012 for the Port Authority of New York & New Jersey (PANYNJ). The Phase IA project team included Frank Mikolic (Principal Investigator), John Lawrence (Principal Investigator), Brian Albright (GIS specialist/Field Director), and Robert Wiencek (Archaeologist).

This survey was performed in accordance with federal and state laws for the protection of significant cultural resources. These mandates include: Section 106 of the National Historic Preservation Act of 1966, as amended, 49 U.S.C. § 470f: Protection of Historic and Cultural Resources, 36 CFR 800; Federal-Aid Highway Act of 1966, as amended in 1968 and 510; the National Environmental Policy Act of 1969, 42 U.S.C. §§ 4331(b)(4) and 4332; and the Archaeological and Historic Preservation Act of 1974, 16 U.S.C. § 469 et seq. In addition, Section 4(f) of the Department of Transportation Act, as amended, 49 U.S.C. § 303 protects historic sites of national, state, or local significance, and requires planning to minimize project impacts on such properties. This work was conducted in accordance with the New York State Historic Preservation Office's (NYSHPO) *Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State* (1994), the New York Archaeological Council's *Cultural Standards Resource Handbook* (2000); and the report format follows the guidelines set forth by the NYSHPO in their *State Historic Preservation Office Phase I Archaeological Report Format Requirements* (2005).

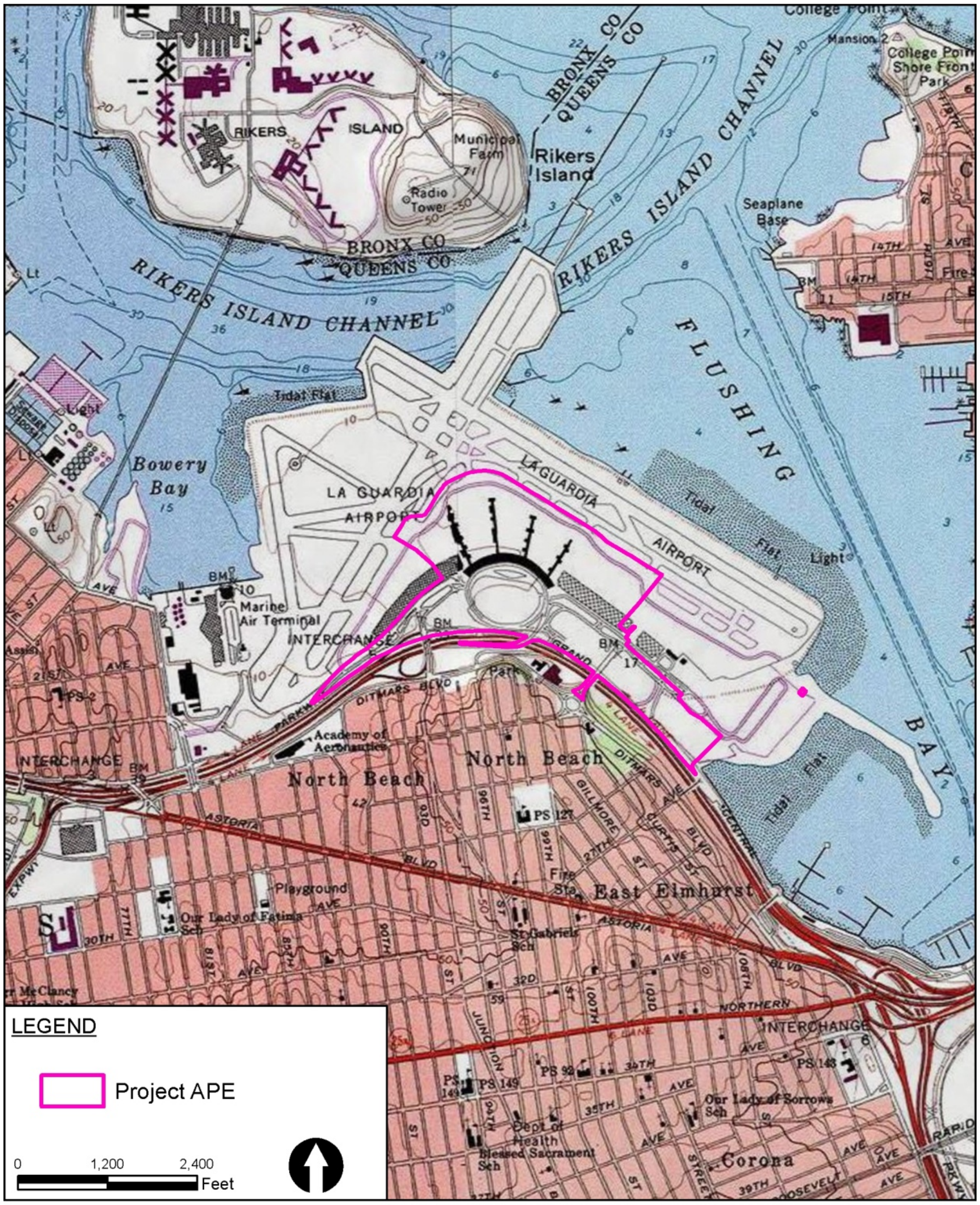
2.0 PROJECT DESCRIPTION

The proposed new CTB design includes a head house and three piers – two primary, parallel, double-loaded piers and one smaller single-loaded pier on the east side providing a connection to Terminal C. A primary component of the new project is a compact, bar-shaped head house with three levels for departures, arrivals, and ground/high occupancy vehicles (HOV). The piers provide 35 contact gates and the associated apron construction reaches the edge of existing Taxiways A and B.

Landside projects include a new parking garage west of the proposed head house and significant roadway improvements. The roadways will provide free flowing traffic movements to accommodate the total anticipated traffic for all terminals. The construction design incorporates connecting roadways to the Marine Air Terminal and Grand Central Parkway (east and west) and reconstruction of portions of the 94th Street and 102nd Street bridges. Additionally, the design provides a provision for future light rail or heavy rail access to the CTB and east end terminals, although no construction would occur as part of this Proposed Action.

2.1 AREA OF POTENTIAL EFFECTS (APE)

The recommended APE for the project has been developed to account for potential direct and indirect effects of the proposed action on archaeological resources, in accordance with Section 106. The archaeological APE (Figure 2) includes only direct effects and is confined to the footprint of temporary and permanent disturbances that will be created by the undertaking which measures approximately 159 ac (64 ha) in size.



Source: ESRI 2012a
Prepared by: AECOM 2012

Figure 1

LaGuardia Airport
CTB Redevelopment Program

Project Location

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Source: ESRI 2012b
Prepared by: AECOM 2012

Figure 2

LaGuardia Airport
CTB Redevelopment Program

Project APE

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3.0 BACKGROUND RESEARCH

3.1 Environmental Setting

The project is located within northwestern Queens County, New York. Surface geology consists of glacial tills deposited over 15,000 years ago by the retreating Wisconsin ice sheet (Sirkin 1996). Topography in the APE has been significantly altered by cutting, grading, filling and other activities associated with airport, roadway, building, parking lot and utility construction. Elevation within the APE varies between 3 m (10 ft) above sea level in the western portion of the APE to 5 m (17 ft) above sea level in the eastern part of the APE.

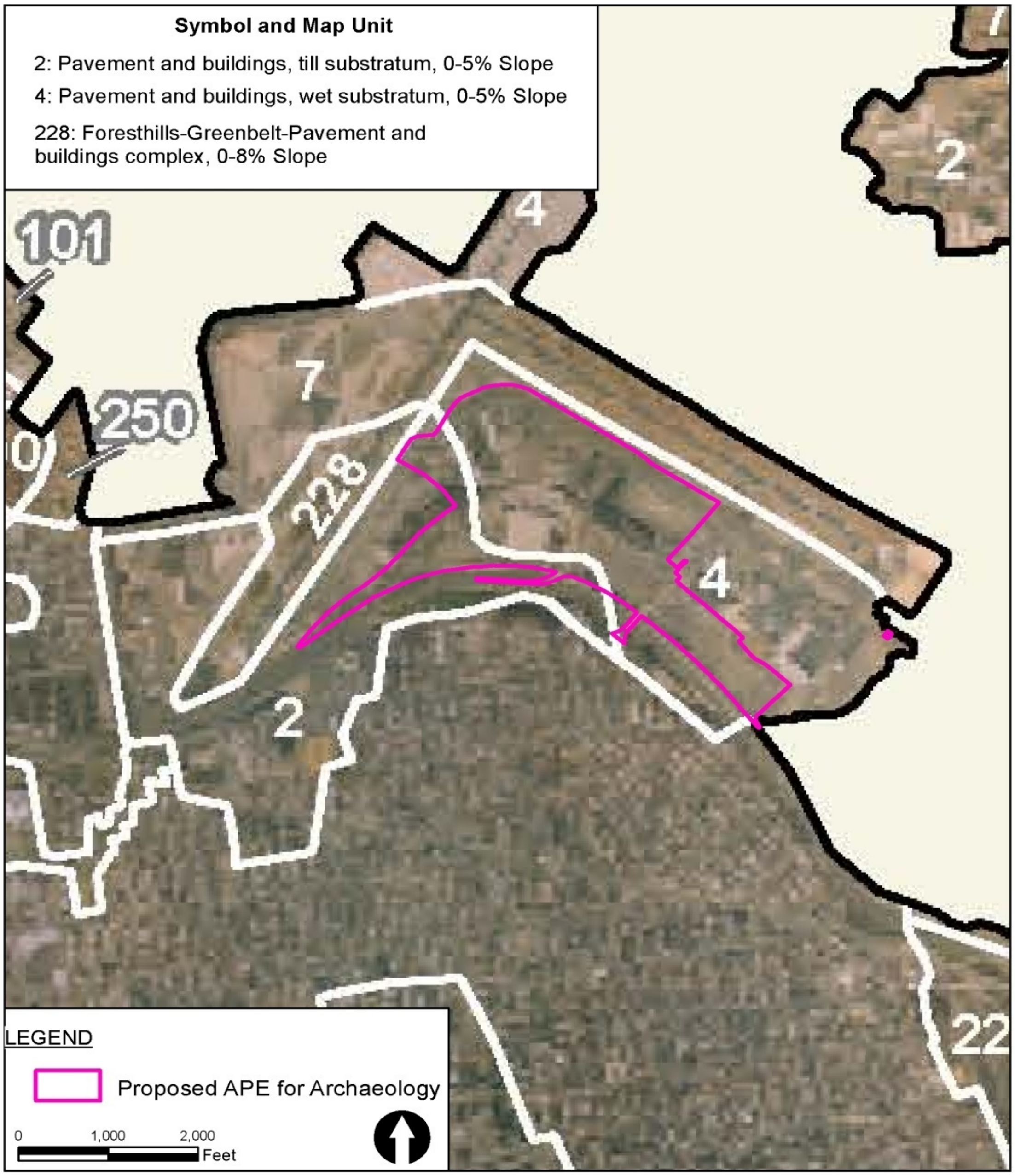
Reflecting the heavy disturbances located throughout the APE, the three soil types located within the APE (Figure 3) are classified as urban soils that have been heavily modified through construction activities. These soils include Pavement and buildings, till substratum, 0 to 5 percent slopes (map key 2) within the western portion of the APE; Foresthills-Greenbelt-Pavement and buildings complex, 0 to 8 percent slopes (map key 228) along the western edge of the APE; and Pavement and buildings, wet substratum, 0 to 5 percent slopes (map key 4) within the central and eastern portions of the APE (NYCSSS 2005). Below is a description of each of the soils types present within the APE (*ibid*):

- Pavement and buildings, till substratum, 0 to 5 percent slopes, are located on nearly level to gently sloping, highly urbanized areas where more than 80 percent of the surface is covered by impervious pavement and buildings over glacial till. Typically located in urban centers.

- Pavement and buildings, wet substratum, 0 to 5 percent slopes, are located on nearly level to gently sloping, highly urbanized areas where more than 80 percent of the surface is covered by impervious pavement and buildings over filled swamp, tidal marsh or water. Typically located in urban centers.

- Foresthills-Greenbelt-Pavement and buildings complex, 0 to 8 percent slopes, are located on level to gently sloping areas that have been filled with natural soil materials and are a mixture of anthropogenic soils that vary in depth of fill. The soils are typically located in areas with more than 15 percent impervious pavement and buildings covering the surface.

Most of the airport is constructed on land that has been reclaimed from the adjacent Flushing and Bowery bays by the placing of up to 30 feet of incinerated refuse and miscellaneous fill over the tidal mud flats of a deep deposit of soft organic clay and silt deposit (Appendix B). Figure 4 displays modeling of cut and fill areas based on differences in elevation between the 1891 USGS map and current elevations. Geotechnical studies conducted for the project have modeled approximate depths of this fill based on completed geotechnical borings (Figure 5; Appendix C). Both models, one based on differences in historic elevations and the other on geotechnical boring data, confirm that significant cutting and filling has occurred within the APE.



Source: USDA 1996
Prepared by: AECOM

Figure 3

LaGuardia Airport
CTB Redevelopment Program

Soils Within Project APE

Source: ESRI 2012b
Prepared by: AECOM 2012

Figure 4

LaGuardia Airport
CTB Redevelopment Program

Modeled Areas of Cut and Fill within LaGuardia Airport

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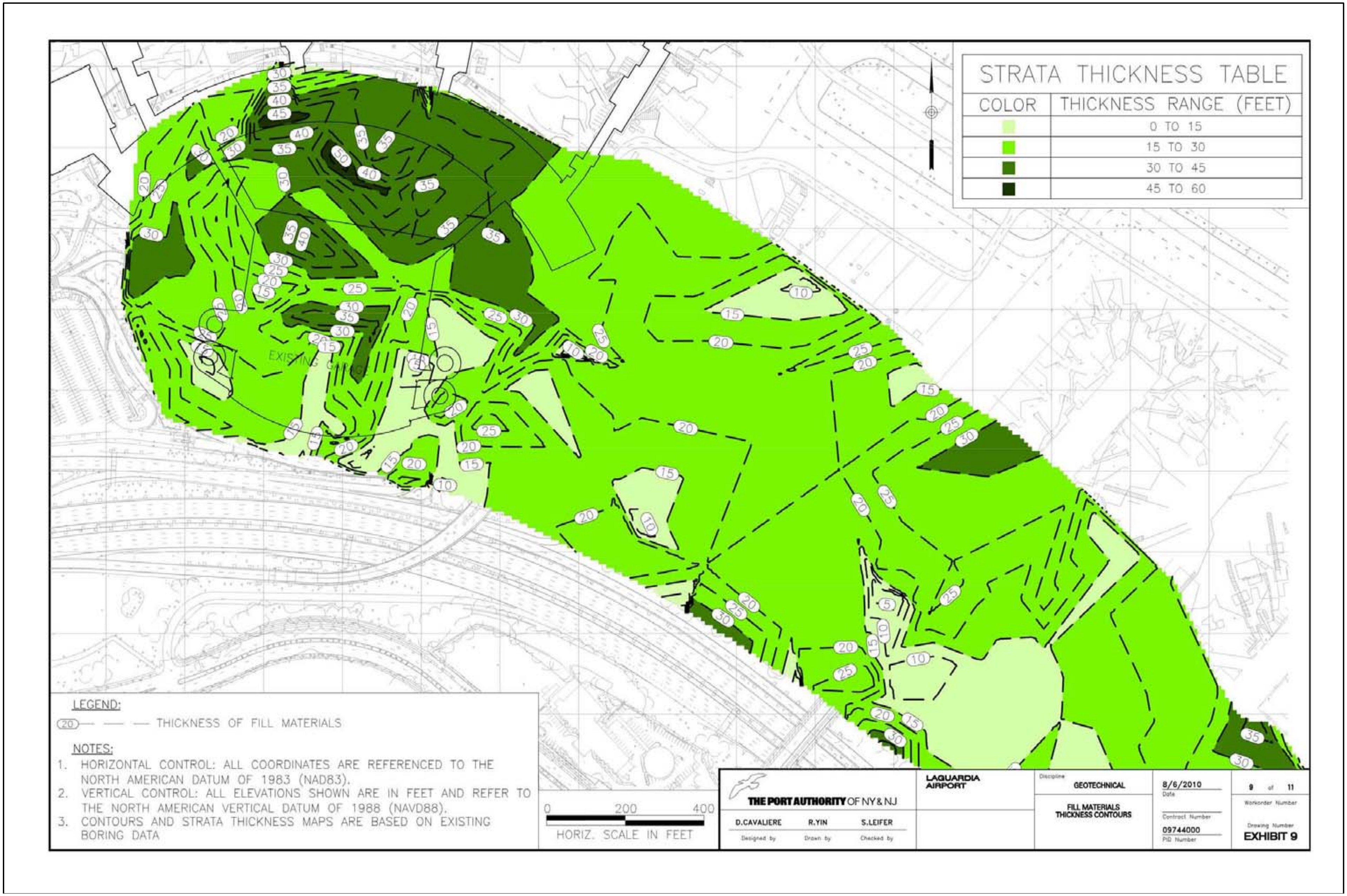

Figure 5. Mapped Thickness of Fill Materials within LaGuardia Airport Based on Geotechnical Boring Data (Figure from Appendix B).

3.2 File Review

The site assessment began with a literature review. This included an examination of site files and archaeological reports files at the NYSHPO office in Waterford, New York. A total of six known archaeological sites are located within a 1 mi (1.6 km) radius of the APE (Table 1). Analysis of site data indicates that all of the sites contained prehistoric components and were identified by Arthur C. Parker in the early 1920's. Site ACP QUNS 10 (NYSM# 4533) is identified as a prehistoric shell midden and is located within the western half of the APE. Site NYSM# 4533 is identified as a "shell heap on Jackson property on Poor Bowery at North Beach" (NYSM Site File) and is located on either side of the Grand Central Parkway between the 94th Street interchange and 49th Street. The NRHP eligibility of the ACP QUNS-10 Site remains undetermined. No other previously identified archaeological resources have been identified within the APE, however, the New York State SPHINX system mapping tool indicates that the western portion of the APE falls within an area of archaeological sensitivity (Figure 6).

One previously completed cultural resource study was conducted within the eastern edge of the APE along the shoreline of Flushing Bay (Figure 6). This survey was part of the *Cultural Resources Baseline Study for the Flushing Bay Ecosystem Restoration Project* completed by Panamerican Consultants, Inc. in 2003. The portion of the survey located within the current project APE was identified as the Inner Flushing Bay Survey Area and was noted to contain a low sensitivity for prehistoric and historic resources (Pickman et al. 2003).

Table 1. Archaeological Sites within 1 Mile (1.6 km) of the APE.

NYSOPRHP Site Number	Additional Site Number	Distance from APE mi (km)	Time Period	Site Type
ACP QUNS 4A and 4B	NYSM 4527	1 mi (1.6 km) Northeast	Prehistoric without cultural or chronological attribution	Village Burial site
ACP QUNS 9	NYSM 4532	0.3 mi (0.5 km) West	Prehistoric without cultural or chronological attribution	Burial site
ACP QUNS 10	NYSM 4533	Within western portion of APE	Prehistoric without cultural or chronological attribution	Shell midden
-	NYSM 4539	1 mi (1.6 km) Northwest	Prehistoric without cultural or chronological attribution	Shell midden
-	NYSM 4540	0.7 mi (1.1 km) Northeast	Prehistoric without cultural or chronological attribution	Burial site
-	NYSM 4542	0.8 mi (1.3 km) Northeast	Prehistoric without cultural or chronological attribution	Camp site

**Source: NYSHPO office in Waterford, New York*

Source: ESRI 2012b; NYSHPO Survey Files; NYSHPO SPHINX
Prepared by: AECOM

Figure 6

LaGuardia Airport
CTB Redevelopment Program

Previous Cultural Resource Surveys within APE

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3.3 Historic Map and Document Review

Historic maps from 1868, 1891, and 1947 indicate that the original shoreline along Flushing Bay has changed significantly over the last 140 years (Figure 7). Historic maps from 1891 and 1924 indicate that the original shoreline along Flushing Bay was once located within the western and southern portions of the APE (Figure 7). The airport site originally contained the Gala Amusement Park (Photograph 1), which was demolished in 1929 with the construction of a private airfield named the Glenn H. Curtiss Airport, later named the North Beach Airport (Photograph 2) (EPI 2007).

Source: ESRI 2012b, Beers 1868, USGS 1891 and 1947
Prepared by: AECOM 2012

Figure 7

LaGuardia Airport
CTB Redevelopment Program

Evolution of LaGuardia Shoreline

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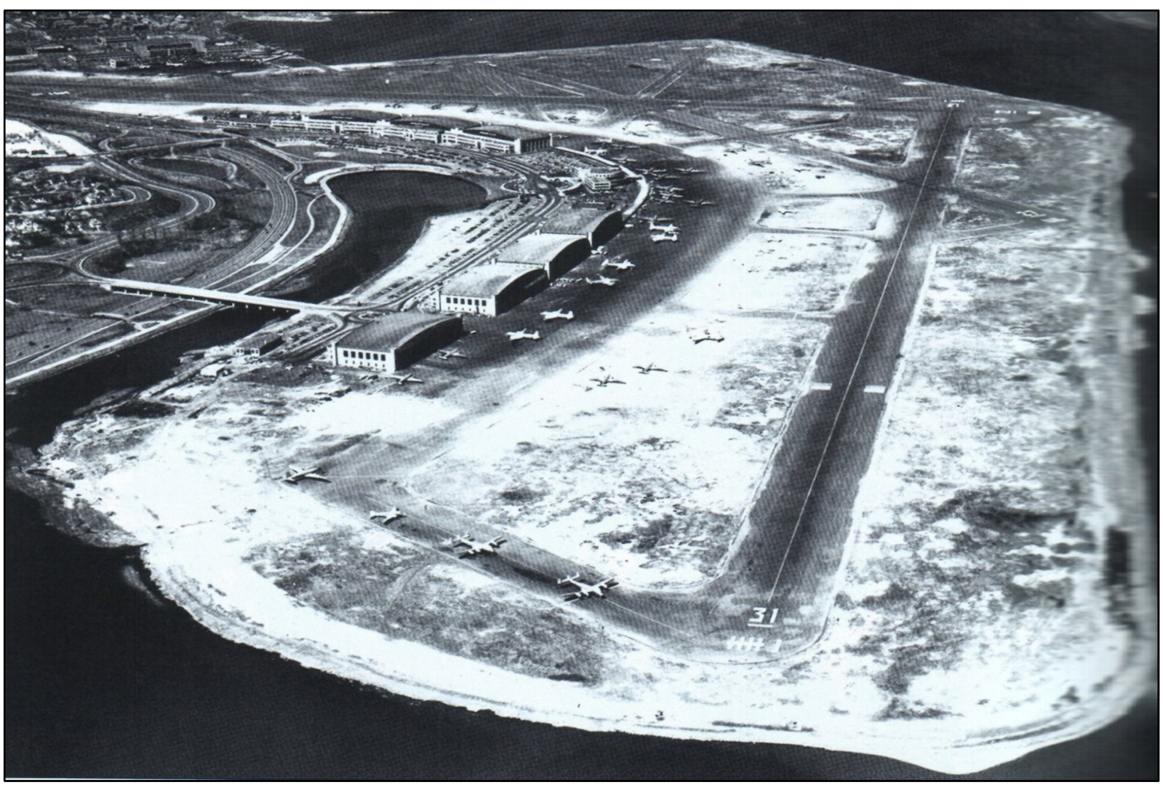
Extensive land forming began within the APE in 1929 with the construction of the Glenn H. Curtiss Airport/North Beach Airport. As the 1935 aerial (Photograph 2) shows, northern and eastern expansion into Flushing Bay began with the construction of the private airfield in 1929. Additional land forming occurred in 1937 to expand the North Beach Airport into a much larger 550 ac (222.6 ha) facility which would initially be called the New York Municipal Airport, until 1947, when the name was officially changed to LaGuardia Airport (Photographs 3; Photograph 4). Sporadic development and construction continued at the airport through the latter half of the twentieth century and into the twenty-first century. This included the expansion of LaGuardia's Northern Runway in the early 1980s (Photograph 4).

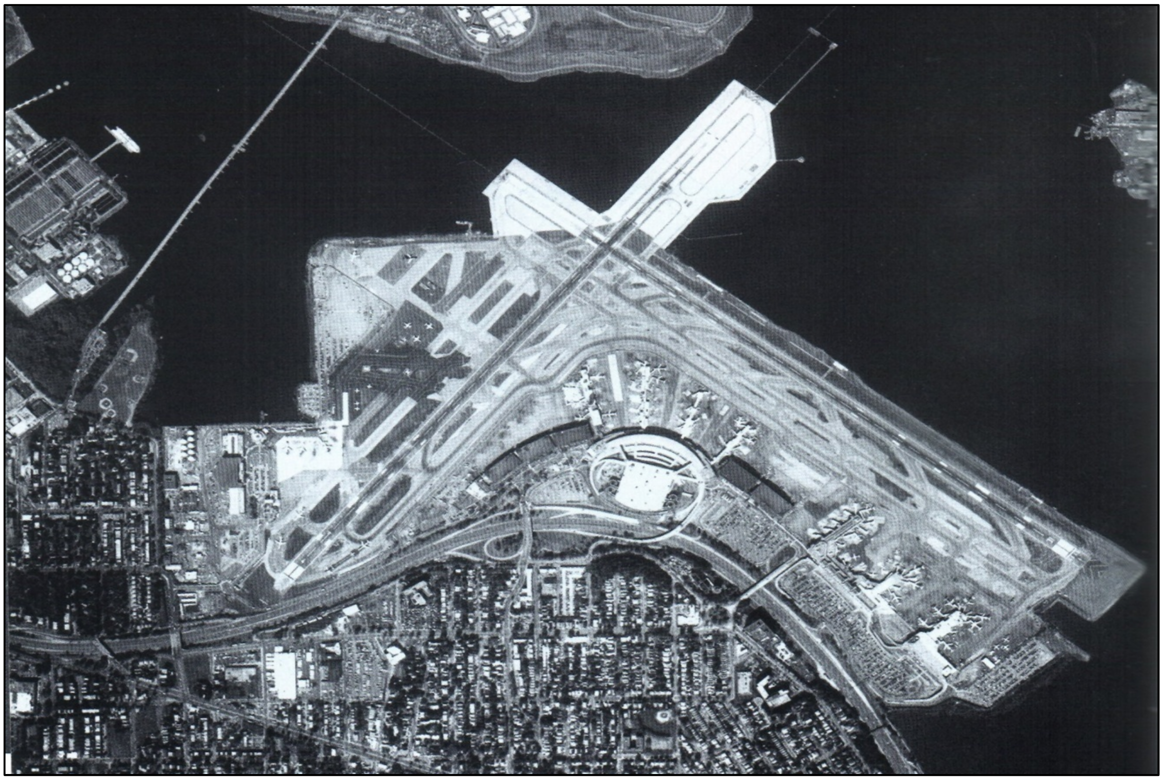
Structures once existed along the original shoreline during the nineteenth and early twentieth century. Remnants of any of these structures within the southern portion of the APE would now be located, if they still exist, under the Grand Central Parkway. Construction of the Grand Central Parkway along the southern edge of the APE was completed in 1933 and would have severely disturbed that portion of the proposed APE. The western portion of the project APE has likely been disturbed by past construction activities at the airport, however, the extent of these disturbances is not currently known.

Photograph 1. Former Gala Amusement Park, 1929 (AOM 2011).

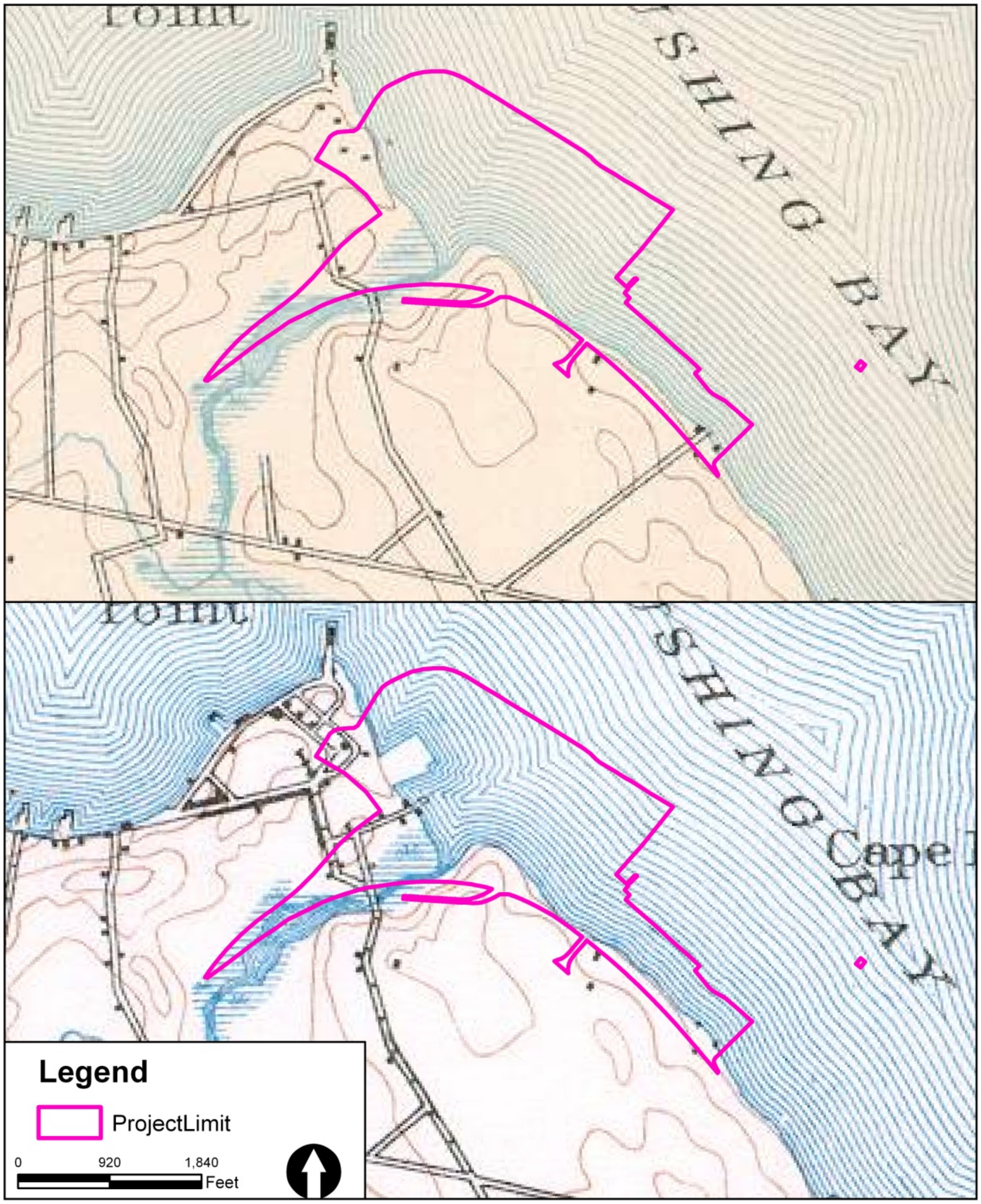
Photograph 2. 1935 Aerial Photograph of the North Beach Airport (AOM 2011).



Photograph 3. 1946 Aerial Photograph of LaGuardia Airport (Holden 2007).



Photograph 4. Early 1980's Aerial Photograph of LaGuardia Airport Showing Recently Constructed Northern Runway Expansion (Holden 2007).



Source: USGS 1891, 1924
Prepared by: AECOM

Figure 8

LaGuardia Airport
CTB Redevelopment Program

Project Location c.1891 (top) and c.1924 (bottom)

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3.4 Local Prehistoric Context

As stated in Section 3.2, site files contained information on six prehistoric sites within 1 mi (1.6 km) of the APE. All of these sites were identified by Arthur C. Parker in his 1920 statewide survey and only general information and scant details are known about these sites. Site ACP QUNS 10 (NYSM# 4533), identified by Parker in 1922 as a shell midden, is located within the western edge of the APE. The general project area would have likely been attractive to Native Americans due to the proximity of nearby resources such as freshwater streams and saltwater marshes prior to extensive land filling in the area. Expected site types would include resource procurement stations, where short-term and likely specialized activities took place. Further information on prehistoric land use and potential is presented in Section 4.0.

3.5 Local Historic Context

Beginning in 1928, passengers travelling to New York City via airplane arrived at Newark Airport in New Jersey, which afforded easy access to Manhattan. In 1931, Floyd Bennett Field, situated on Jamaica Bay in Brooklyn, opened as New York City's first municipal airport. However, it was never a commercial success, due to its inconvenient location, which lacked direct rail transportation or highways to Manhattan. As a result, Newark Airport continued to dominate air travel in the metropolitan area throughout the 1930s (Gordon 2008).

This changed with the opening of LaGuardia Airport (initially known simply as New York Municipal Airport, shortly thereafter re-named New York Municipal Airport, LaGuardia Field, and presently as LaGuardia Airport) in 1939. Mayor Fiorello LaGuardia, who took office in 1934, was a strong advocate for the establishment of a new municipal airport in New York City. He recognized the deficiencies of Floyd Bennett Field, and opted to establish an airport that would be easily accessible to Manhattan and rival Newark Airport. The site selected was the privately-owned Glenn Curtiss Airport in an area known as North Beach, the present-day location of LaGuardia Airport. Prior to its development as an airport, North Beach was occupied by the Gala Amusement Park.

The location chosen for LaGuardia Airport was readily accessible to Manhattan, via the Grand Central Parkway, completed in 1933, and the Triborough Bridge (now the Robert F. Kennedy Bridge), completed in 1936. In addition, subway lines in Jackson Heights, Flushing, and Astoria were relatively nearby offering additional transportation options. Furthermore, the waterfront location was ideal for seaplane landings, which were widely in use during this time period (Gordon 2008; Stoff 2008).

By 1937, construction of the new airport, funded jointly by the city and the Works Progress Administration (WPA), commenced. The majority of the airport was completed in 1939 and it was dedicated on October 15 of that year. It cost over $40,000 to build, making it the largest WPA-funded project at that time (Stoff 2008). The airport was designed by architectural firm Delano & Aldrich, and featured two Art Deco-style terminals, the Marine Air Terminal (National Register-listed and New York City Landmark) and the Central Terminal. Seven hangars were also constructed at the airport. A five-sided seaplane hangar (Administration Building/ Hangar 7) was constructed west of the Marine Air Terminal. Three hangars with lean-tos and shops (Hangars 1, 3, and 5) were constructed west of the Central Terminal and, according to *The New York Times* (October 8, 1939), were occupied by American Airlines. Three hangars (Hangars 2, 4, and 6) were constructed east of the Central Terminal, and were completed in 1940 (Stoff 2008).

Upon the two-year anniversary of the airport's opening in 1941, *The New York Times* (November 30, 1941) reported on the success of the airport. By that time, more than two million passengers flew to or from the airport annually on more than 100,000 flights. In addition, the article also documented the impact that the airport had on the surrounding area, estimating that the population of northern Queens and Long Island rose by roughly 10,000.

In the late 1950s, the airport commenced a redevelopment program, which included expansion of the runways, and construction of a new terminal and control tower. As a result, the original Delano & Aldrich-designed Central Terminal was demolished. The new 650,000 ft^2 (60387 m^2) Central Terminal and control tower were designed by architect Wallace K. Harrison, and opened in 1964. As built, the Central Terminal was six blocks long, four stories tall, and featured four concourses. A landscaped park, known as Fiorello Park, was constructed south of the terminal. By 1976, construction of the present-day parking garage and road network resulted in demolition of the park (Stoff 2008).

The airport has undergone multiple improvements from the 1980s to the present. In 1983, Delta Air Lines constructed a terminal at the eastern end of the airport. US Airways, in 1994, constructed a terminal west of the Delta Air Lines Terminal. In 2010, a new control tower was constructed, and the Harrison-designed control tower was partially demolished (Stoff 2008).

4.0 ASSESSMENT OF ARCHAEOLOGICAL POTENTIAL

Two qualities are considered when assessing the overall archaeological potential of a given location: 1.) sensitivity, or the relative likelihood that a given location was utilized by human beings during the historic or prehistoric periods; and 2.) integrity, or the probability that subsequent natural and cultural processes (e.g. erosion, quarrying, grading, etc.) have not erased or substantially disturbed historic or prehistoric archaeological deposits at that same location.

In order to assess the potential for intact historic and/or prehistoric archaeological sites to be present in and around LaGuardia airport, three inductive GIS-based (ESRI 2010a, 2010b) models were created and included models for historic sensitivity, prehistoric sensitivity and archaeological integrity. GIS models of prehistoric and historic sensitivity indicated areas that would have been ideal settings within the APE for prehistoric and/or historic activities before historic disturbances occurred. These sensitivity models were compared with a GIS model created for archaeological integrity. The archaeological integrity model took into account the difference in elevation between late nineteenth century maps (USGS 1891, 1897, 1900) and modern digital models (DEMs) (NCGC n.d.) to determine areas of cutting, grading and filling. Areas that were determined to have contained prehistoric or historic sensitivity and were filled or not disturbed were identified as areas of high archaeological integrity. Areas that were determined to lack archaeological integrity were those areas that were determined to have suffered significant cutting and grading disturbances.

4.1 Historic Archaeological Sensitivity

Evaluating archaeological sensitivity for historic-period archaeological resources typically relies on documentary sources such as historic maps and local histories that are sometimes supplemented with available aerial photography. In and around LaGuardia airport, historic topographic maps (USGS 1891, 1897, 1900) were used to identify and plot the locations of residential and commercial structures dating from the late nineteenth and early twentieth century (Figure 9). Each point location was then assigned a value between 1 and 3 based on the number of historic topographic maps on which it could be confidently identified. These number values served as a proxy measurement for duration of occupation. The length of occupation at a particular location is significant from a modeling standpoint because relatively longer occupations are likely to result in relatively greater archaeological sensitivity.

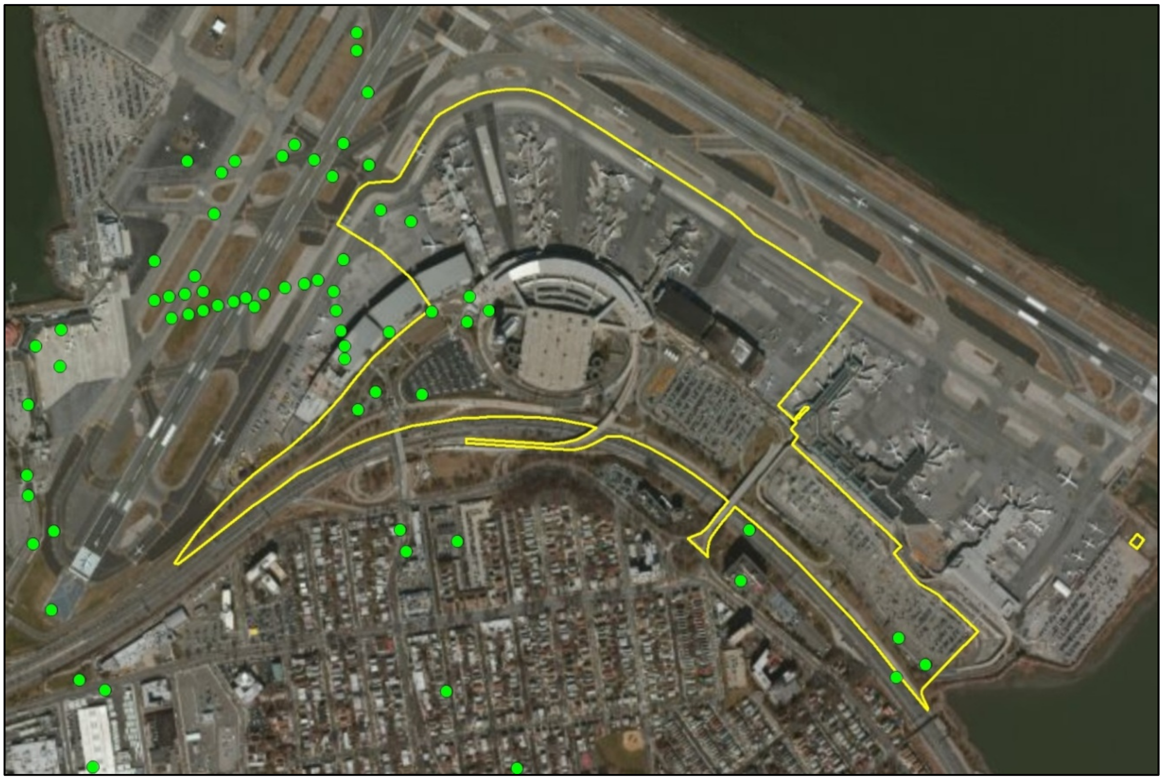


Figure 9. Mapped Historic Commercial and Residential Structures (green) in and around the Project Limits (Yellow) (ESRI 2012) 1:15000.

Using ESRI's (2010b) Kernel Density tool, a raster surface representing the spatial-temporal density of occupation was generalized from the plotted locations of the historic structures and each structure's assigned number value (Figure 10). The surface was then evaluated to identify those areas of the APE with moderate or high sensitivity for historic archaeological resources based on their proximity to relatively dense, long duration historic occupation sites. In contrast, areas of the APE beyond the 1891 waterline or in tidal wetlands were assessed to have low sensitivity for historic archaeological resources (Figure 11).

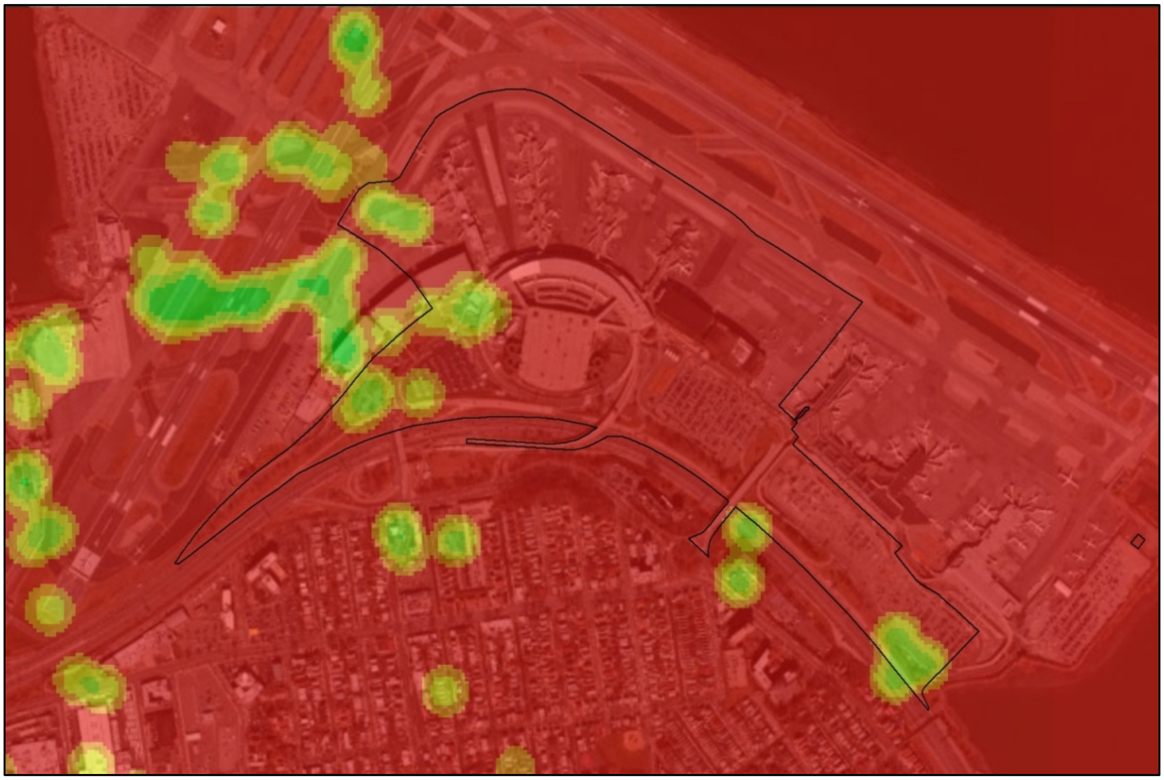


Figure 10. Spatial-Temporal Density of Historic Commercial and Residential Structures from Green (Dense-Long Duration Occupation) to Red (Absent-Zero Duration Occupation) (ESRI 2012) 1:15000.

Figure 11. Historic Archaeological Sensitivity in the Project Limits: High (Green); Moderate (Yellow); Low/No (Red) (ESRI 2012) 1:15000.

4.2 Prehistoric Archaeological Sensitivity

While evaluations of archaeological sensitivity for historic-period resources relies primarily on historic documents, initial sensitivity evaluations for prehistoric resources are typically based on a subjective analysis of the local topography, potential prehistoric resource availability, and knowledge of very general site selection criteria. Although exceptions always occur, many prehistoric occupations are associated with a limited number of physical features:

- moderately well to well drained soils
- relatively shallow slopes
- access to surface water sources
- access to valued plant and animal resources or lithic raw material sources

Because pre-development soil survey data are unavailable for much of the greater New York metropolitan area including Queens County (NRCS 2012; NYCSWCD n.d.), the prehistoric archaeological sensitivity model for the area in and around La Guardia Airport was based primarily on pre-twentieth-century topology and general ideas about potential local resource availability.

At the end of the nineteenth century, the project area consisted of a relatively broad rolling bluff overlooking Flushing Bay and the East River to the north and northeast and interior wetlands to the southwest. A meandering perennial creek drained the interior wetlands into a broad salt marsh bisecting the uplands. The shoreline of Flushing Bay at this location was narrow, rising steeply to meet the adjacent headlands (USGS 1891) (Figure 12).

The project area is located in the EPA's Long Island Sound Coastal Lowland (59g) Level IV Ecoregion (EPA 2011). Historically the natural vegetation of coastal bluffs and coastal uplands in this ecoregion featured oak-hickory or oak-tulip tree forests with red (*Quercus rubra*), white (*Q. alba*), scarlet (*Q. coccinea*), black (*Q. velutina*) and chestnut oak (*Q. prinus*); white pine (*Pinus strobus*), red maple (*Acer rubrum*) and hickory (*Carya* sp.); American beech (*Fagus grandifolia*), tulip tree (*Liriodendron tulipifera*) and flowering dogwood (*Cornus florida*); as well as sweetgum (*Liquidambar styraciflua*) and pin oak (*Q. palustris*) in wetter areas. Coastal bluffs featured pitch pine (*P. rigida*), eastern red cedar (*Juniperus virginiana*), post oak (*Q. stellata*) and northern bayberry (*Myrica pensylvanica*). Coastal dunes featured beach plum (*Prunus maritima*), beach pea (*Lathyrus maritimus*) and halophytic grasses while marshes and creeks hosted smooth cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*) and spikegrass (*Distichlis spicata*) (EPA 2010).

Figure 12. The Local Topography c. 1891 (USGS 1891) 1:15000.

The bluffs overlooking Flushing Bay would have provided access to a diverse range of subsistence resources for prehistoric peoples. The saltwater and brackish tidal environments of the East River, Flushing Bay and associated tidal wetlands likely hosted non-migratory fish like weakfish (*Cynoscion regalis*), bluefish (*Pomatomus saltatrix*), summer flounder (*Paralichthys dentatus*) and winter flounder (*Pseudopleuronectes americanus*) (NYSDEC n.d.) as well as seasonally abundant anadromous and catadromous fish like American shad (*Alosa sapidissima*), Atlantic salmon (*Salmo salar*), striped bass (*Morone saxatilis*) and American eel (*Anguilla rostrata*) (Long Island Sound Study 2012). Shellfish such as the blue crab (*Callinectes sapidus*), American lobster (*Homarus americanus*), the hard clam or quahog (*Mercenaria mercenaria*), the eastern oyster (*Crassotrea virginica*) and the blue mussel (*Mytilis edulis*) were probably also locally abundant (LISS 2012).

Supplementing the rich aquatic resources, economically valued tree species (e.g. oak and hickory) were likely present in nearby uplands and prehistoric occupants of the project area may have had some access to tuberous freshwater wetland plants like soft-stem bulrush (*Schoenoplectus tiburnaemontani*), cattail (*Typha latifolia*) and cow lily (*Nuphar lutea*) at interior locations as well as freshwater fish and shellfish. In addition to common terrestrial species like white-tailed deer (*Odocoileus virginiana*) and the North American beaver (*Castor canadensis*) a variety of waterfowl were also likely abundant. The only potential limiting factors to prehistoric occupation of this location may have been an unreliable fresh water supply and poor local availability of lithic raw materials.

Located in proximity to a variety of microenvironments (e.g. upland forest, riparian, saltwater palustrine, etc.) relatively flat (< 5% slope) upland areas in and around LaGuardia airport were assessed to have high sensitivity for prehistoric archaeological resources. More steeply sloped uplands (5-15% slope) and wetland areas were assessed to have moderate sensitivity for prehistoric archaeological resources, while areas of excessive slope (>15%) and open water were assessed to have low/no sensitivity for prehistoric archaeological resources (Figure 13).

Figure 13. Prehistoric Archaeological Sensitivity in the Project Limits: High (Green); Moderate (Yellow); Low/No (Red) (ESRI 2012) 1:15000.

4.3 Archaeological Integrity

Assessing the archaeological integrity of the area in and around La Guardia involved a direct comparison of the late-nineteenth-century topography (USGS 1891) to that recorded in modern DEMs of the project area (NCGS n.d.), along with identifying areas of large-scale cutting and filling. Using ESRI's (2010b) Topo to Raster tool the 20 ft (6.096 m) contour lines on USGS' 1891 topographic map were interpolated to a raster surface creating an 1891-era DEM. After converting the 1891-era DEM's units of elevation from feet to meters, ESRI's (2010b) Raster Calculator tool was use to subtract the interpolated 1891-era elevations from the modern elevations (NGCS n.d.).

Where the difference between the two DEMs resulted in a positive number, it is proposed that large-scale filling occurred after 1891. Where the difference between the two DEMs resulted in a negative value, large scale cutting and grading likely occurred after 1891. Because of concerns regarding the horizontal and vertical accuracy of the 1891-era contours and the subsequently derived 1891-era DEM, all areas where the modern DEM elevations and the 1891-era elevation values were within 1.0 m (3.28 ft) of each other it is assumed that no large scale cutting or filling has occurred since 1891 (Figure 14).

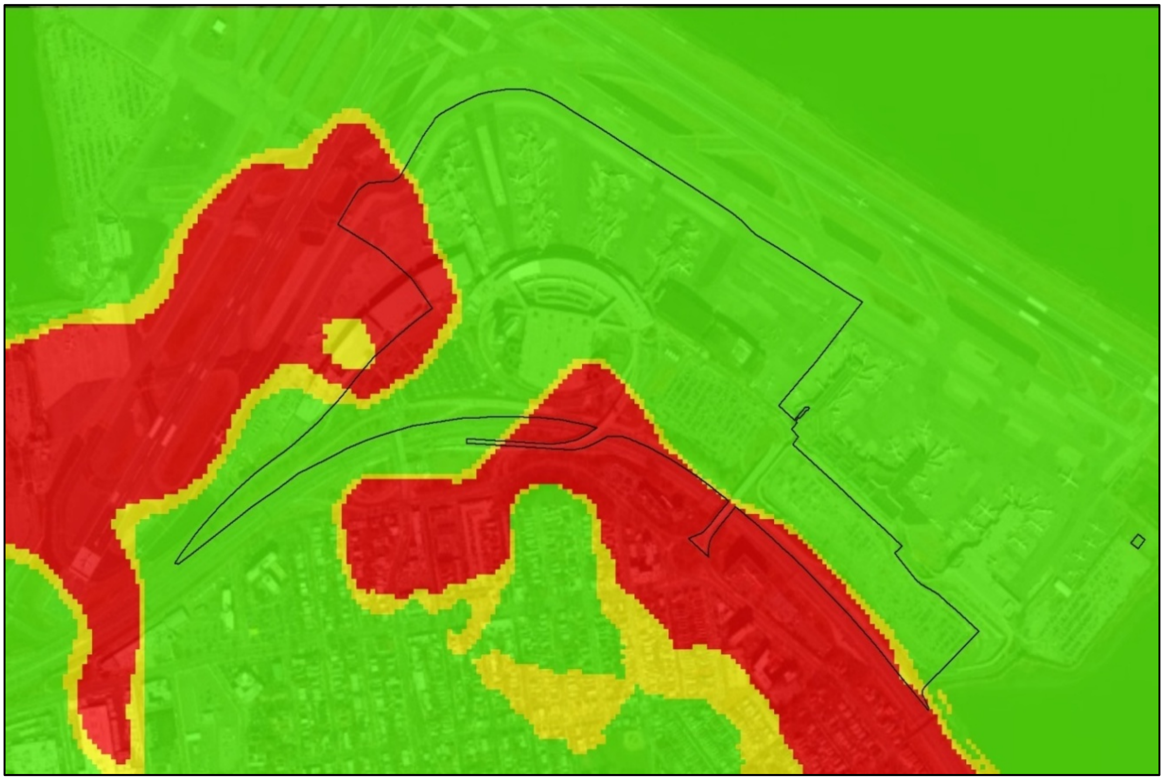


Figure 14. Modeled Historic Disturbance: Filling (Green); None (Yellow); Cutting/Grading (Red) (ESRI 2012) 1:15000.

4.4 Archaeological Potential

For historic archaeological resources, areas of moderate to high historic archaeological sensitivity not impacted by large-scale cutting/grading activities are assessed to have moderate to high archaeological potential respectively. All areas of low/no historic archaeological sensitivity and all areas impacted by historic cutting/grading are assessed to have low/no historic archaeological potential (Figure 15).

For prehistoric archaeological resources, areas of moderate to high archaeological sensitivity not impacted by cutting/grading activities are assessed to have moderate to high archaeological potential respectively. All areas of low/no prehistoric sensitivity and all areas impacted by historic cutting/grading activities are assessed to have low/no prehistoric archaeological potential (Figure 16).

Figure 15. Historic Archaeological Potential: High (Green); Moderate (Yellow); Low/No (Red) (ESRI 2012) 1:15000.

Figure 16. Prehistoric Archaeological Potential: High (Green); Moderate (Yellow); Low/No (Red) (ESRI 2012) 1:15000.

5.0 PEDESTRIAN RECONNAISSANCE METHODOLOGY

A pedestrian review of the project was conducted subsequent to the literature review and archaeological potential assessment to assess existing surface conditions. The value of the pedestrian reconnaissance was limited because the landscape in the APE has been significantly altered over the course of many years of airport property development. Large areas of the APE have been filled leaving little visual evidence above ground to determine a level of disturbance for the APE. The issue of determining archaeological potential in areas having suffered large filling episodes was resolved by creating GIS archaeological sensitivity models and comparing historic and current land elevations to determine which areas have been cut and/or filled. The GIS archaeological sensitivity models identified four moderate to high probability areas within the APE, designated Areas 1 through 4 (Figure 17). In general, the APE for this project was determined to suffer from significant disturbance with much of the area consisting of filled shoreline and saltwater marshes.

6.0 PEDESTRIAN RECONNASSIANCE RESULTS

Information gathered from the pedestrian reconnaissance, historic maps, and the GIS archaeological sensitivity models was used to identify and evaluate four areas of prehistoric and historic archaeological sensitivity within the APE (Figure 17; Table 2). The areas of archaeological potential measure a total of 10.5 ac (4.2 ha) or 7 percent of the entire proposed APE.

Table 2. Areas of Archaeological Potential within the APE.

Area of Archaeological Potential	Location within APE	Approximate Size	Disturbances Observed	Prehistoric Potential	Historic Potential	Expected Impact
1	Median grass areas and Lot 1 along LaGuardia Road	6 ac (2.4 ha)	Roadway and parking lot	Moderate to High	Moderate to High	Construction of the West Garage and Roadway
2	Median grass/tree area between Runway Drive and the Grand Central Parkway	0.7 ac (0.3 ha)	Roadway and safety railing	High	Low	Resurfacing of Existing Roadway
3	Runway apron area between Hangar 1 and Concourse D of the CTB	3.2 ac (1.3 ha)	Pavement	Low	Moderate to High	Resurfacing of Existing Aircraft Apron
4	Median grass area located between LaGuardia Road and LaGuardia Access Road and the southeastern portion of Lot 4	0.6 ac (0.2 ha)	Roadway and parking lot	Moderate	Moderate to High	Resurfacing of Existing Roadway

Source: ESRI 2012b
Prepared by: AECOM 2013

Figure 17

LaGuardia Airport
CTB Redevelopment Program

Areas of Archaeological Potential

THE PORT AUTHORITY OF NY & NJ

6.1 Area 1

Area 1 is located to the south of Hangars 1, 3 and 5 and includes grass median areas and a paved parking lot identified as Lot 1 that is utilized for short term/daily public parking at the airport (Photograph 5; Figure 18). Proposed impacts to Area 1 include the construction of a new garage facility and new roadway construction. Disturbances noted during pedestrian reconnaissance included the 94th Street overpass, LaGuardia Access Road and smaller unnamed paved parking lots. Historic mapping indicates that this area was once part of the original shoreline before large scale development of the area began in the early twentieth century. The majority of the area has been filled with smaller portions closer to Hangars 1, 3, and 5 cut and graded (Figure 4). The sensitivity model also indicates that portions of Area 1 may not have been significantly filled or disturbed during development of the airport. Historic maps indicate that at least two structures of unknown function were once located within Area 1 during the late nineteenth century (Figure 8). The potential for buried prehistoric and historic resources is considered to be moderate to high within the majority of Area 1.

Soil borings completed for groundwater monitor wells in Lot 1 indicate that there may be as much as 16 ft (5 m) of fill present within Area 1 (Appendix C). These data match relatively well with the modeled areas of cut and fill presented in Figures 4 and 5, which show a depth for fill of approximately 15 ft (4.5 m) within Area 1. Given that large pilings will be driven deep into the ground within Area 1 for the proposed garage, possibly into bedrock, there is potential that construction activities will impact deeply buried cultural resources. The IEC Report also noted that groundwater levels within Area 1 averaged approximately 10 ft (3 m) below ground surface. This would mean that an anaerobic environment exists below 10 ft (3 m) which could contribute to the preservation of organic cultural remains (i.e. wooden structural remains, historic and prehistoric midden deposits, etc.).

Photograph 5. Area 1 Overview, Parking Lot 1, View West (September 2012).

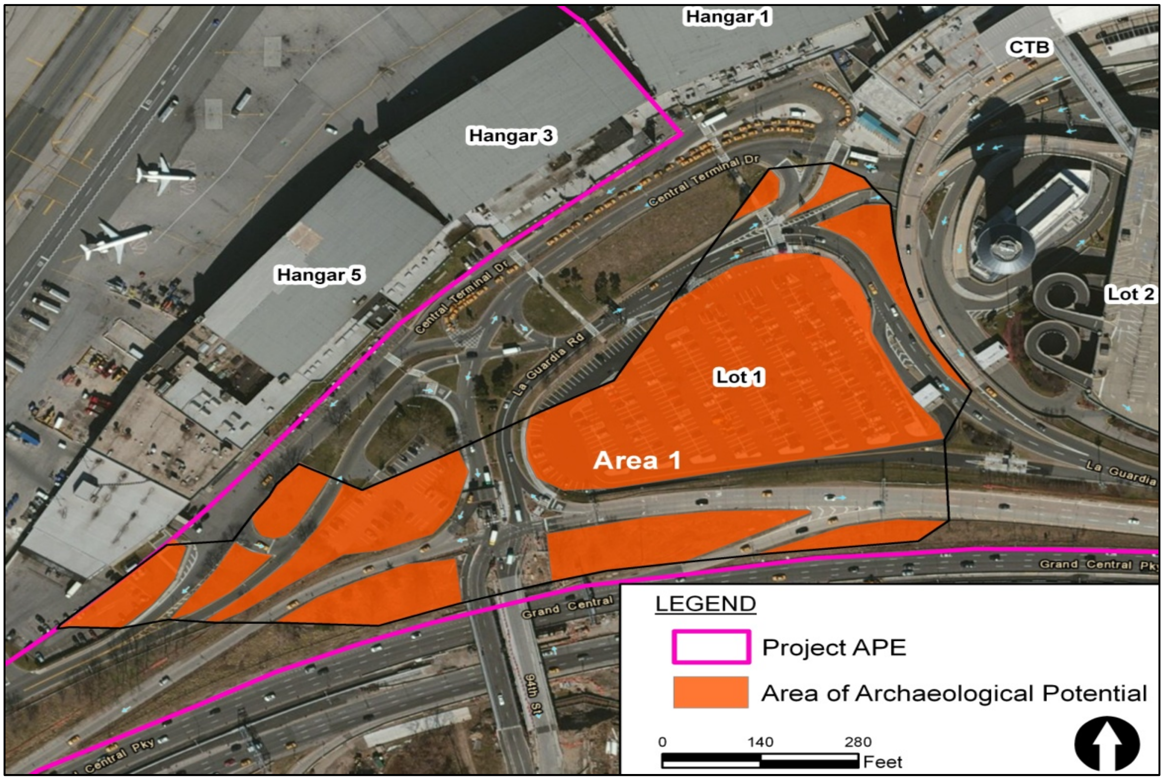


Figure 18. Archaeological Area of Potential 1.

6.2 Area 2

Area 2 is a median area located along the southwestern edge of the APE between Runway Drive and the Grand Central Parkway (Photograph 6; Figure 19). Proposed impacts to Area 2 include the resurfacing of the existing roadway surface. The area is relatively flat with a safety guide rail installed along Runway Drive. The area consists of a mix of manicured lawn outside of the safety guard rail (facing Runway Drive) and long grasses and small trees south of the safety rail (facing the Grand Central Parkway). Figure 4 shows Area 2 as having been filled with a minimum of 15 ft (4.5 m) of fill materials during airport development activities. This is also the general location of Site ACP QUNS 10 (NYSM# 4533), a large shell midden identified by Arthur C. Parker during his state-wide survey of New York in 1922. Little is known about the ACP QUNS 10 Site and the NRHP eligibility of the site has not been determined. Historic map research identified no former structures within Area 2 and there is a low potential for historic archaeological resources. Due to the presence of a previously identified prehistoric site and the filling that has occurred at the location, it is possible that portions of the site still exist under fill materials, however, since project impacts in the area are limited to the resurfacing of the existing roadway, there is little potential to impact the site.

Photograph 6. Area 2 Overview, Showing General Area of ACP QUNS-10 Site, View Southwest (September 2012).

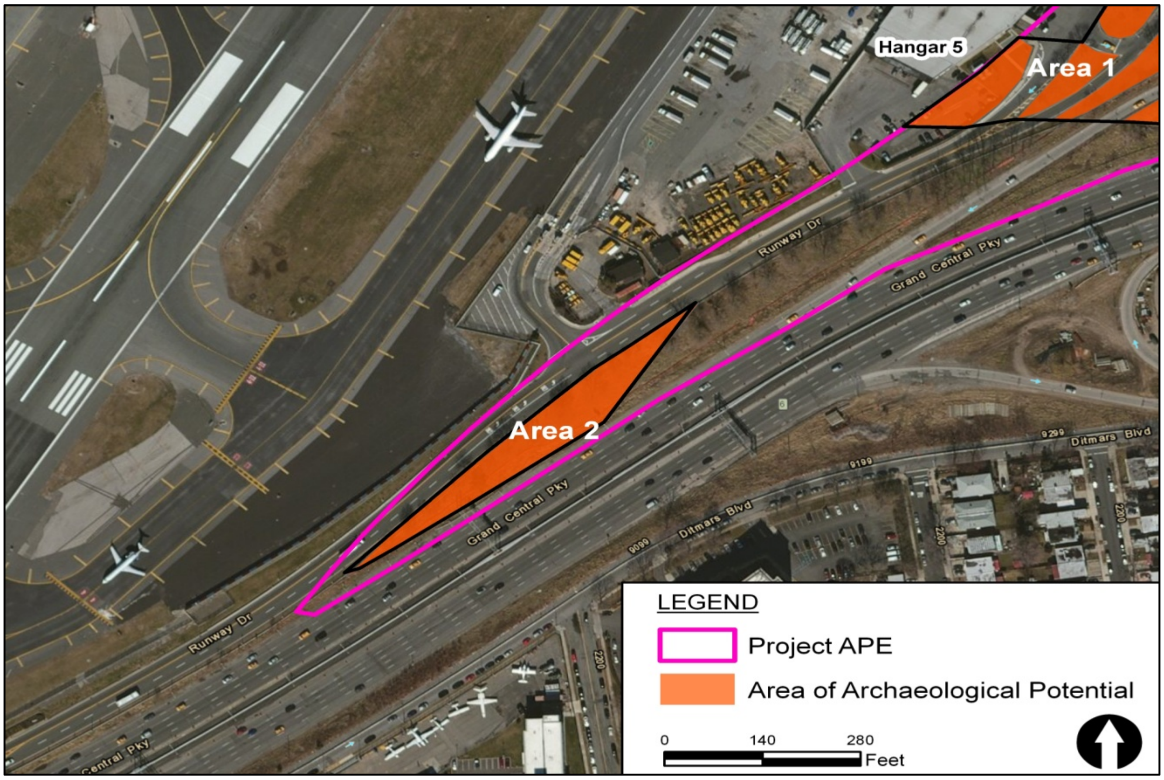


Figure 19. Archaeological Area of Potential 2.

6.3 Area 3

Area 3 is located in the area between Concourse D of the CTB and Hangar 1(Photograph 7; Figure 20). Proposed impacts to Area 3 include the resurfacing of the existing aircraft apron. Pedestrian reconnaissance identified disturbances related to grading and paving for the runway apron, the construction of the former air traffic control tower and construction of Concourse D which cuts the sensitivity area in half. The construction in 1962 of the former air traffic control tower caused significant disturbances within the central portion of Area 3. A portion of the tower, demolished in 2010, is still present adjacent to Concourse D. Modeling of cut and fill areas within the airport indicate that the area was deposited with at least 15 ft (4.5 m) of fill during previous airport development activity in the early twentieth century (Figures 4 and 5). Soil borings completed for soil and groundwater monitoring wells in Area 3 identified a minimum of 14 ft (4 m) of fill material (Appendix C).

Historic map research has identified former structures within Area 3 during the late nineteenth and early twentieth century and the area contains a moderate to high potential for historic archaeological resources. According to the sensitivity model Area 3 contained areas that were not preferred by Native Americans and prehistoric potential is considered to be low (Figure 16). Since proposed construction within Area 3 is limited to the resurfacing of the existing aircraft apron, and a minimum of 14 ft (4 m) of fill is present within the area, it is unlikely that any significant historic archaeological resources would be impacted during construction activities.

Photograph 7. Area 3 Overview, Area between the Concourse D of the CTB and Hangar 1, View North (September 2012).

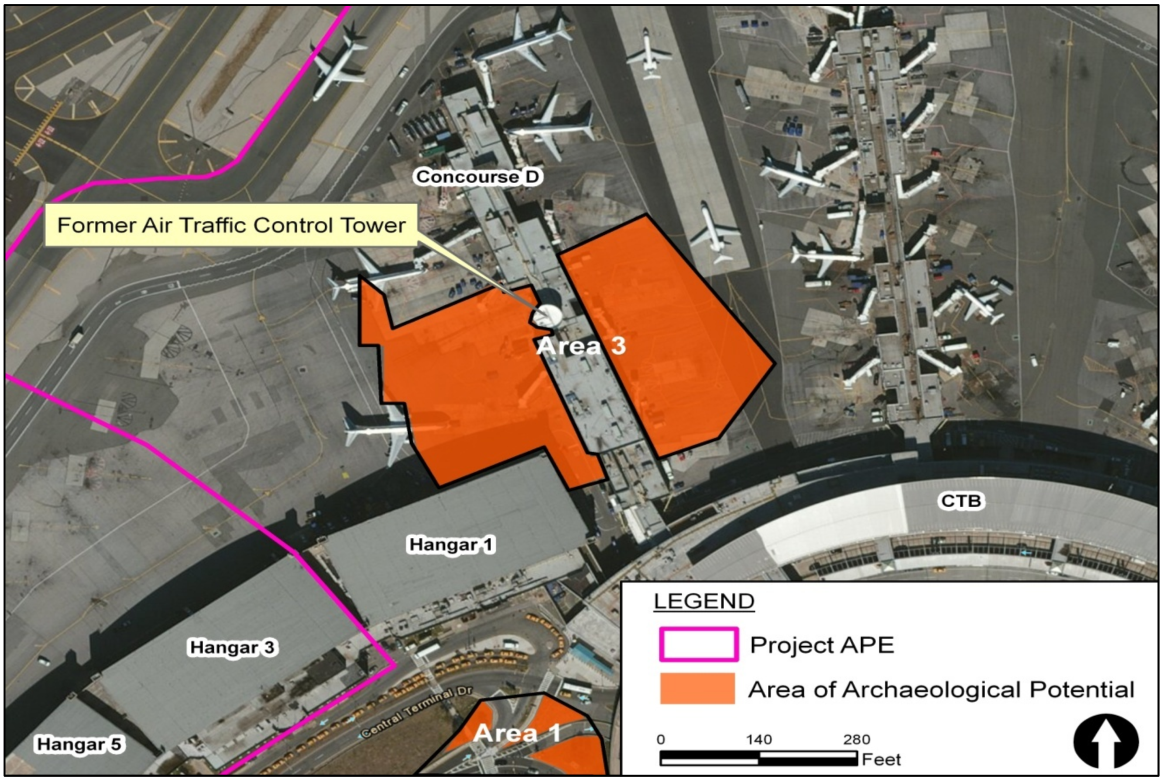
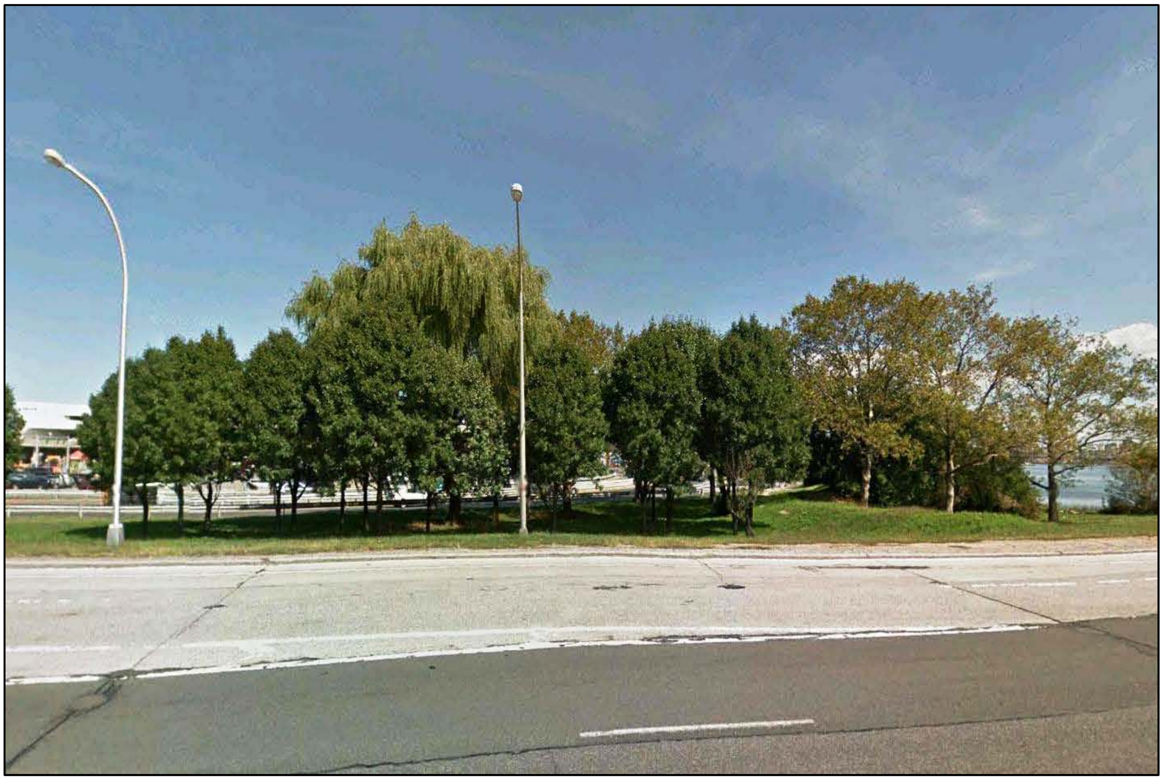


Figure 20. Archaeological Area of Potential 3.

6.4 Area 4

Area 4 is a large grass median area with small trees located along the southeastern edge of the APE between LaGuardia Access Road and LaGuardia Road (Photograph 8; Figure 21). Proposed construction impacts within Area 4 include the resurfacing of the existing roadway. Disturbances noted within the area during pedestrian reconnaissance included those caused by roadway and parking lot construction. Lot 4, designated as a short-term/daily public parking lot, is located within the northern portion of Area 4. Modeling of cut and fill areas within the airport indicates that 10 ft to 16 ft (3 m to 5 m) of fill material is present within Area 4 (Figure 4).

Historic maps indicate that this area was once part of the original shoreline where filling has occurred. At least two structures of unknown function once stood along the shoreline in the late nineteenth and early twentieth century (Figure 8). Area 4 contains a moderate to high potential for historic archaeological resources due to the presence of these former structures (Figure 15). The sensitivity model also indicates that the area has a moderate potential for prehistoric resources due to the areas proximity to the former shoreline. However, as the only expected project impact within Area 4 is the resurfacing of the existing roadway and the depth of fill appears to be a minimum of 10 ft (3 m) thick, it is unlikely that any potential historic or prehistoric site will be impacted during construction activities.



Photograph 8. Area 4 Overview, Lot 4, View Northwest (September 2012).

Figure 21. Archaeological Area of Potential 4.

7.0 RECOMMENDATIONS

Large portions of the APE, including most of the north and central portions, consist of made-land created by the infilling of Flushing and Bowery bays during the early twentieth century and they contain no potential for prehistoric or historic archaeological resources. GIS sensitivity models of the APE identified four areas of archaeological potential. These areas identified as Areas 1 through 4, contained areas of filled land where intact prehistoric or historic surfaces may lay beneath fill materials (Table 3).

Table 3. Testing Recommendations for Areas of Archaeological Sensitivity in APE.

Area of Archaeological Potential	Prehistoric Potential	Historic Potential	Expected Impact	Approximate Level of Fill Present	Testing Recommendation
1	Moderate to High	Moderate to High	Construction of the West Garage and Roadway	15 to 16 ft (4.5 to 5 m)	Archaeological monitoring of excavation if impacts exceed 15 ft (4.5 m)
2	High	Low	Resurfacing of Existing Roadway	15 ft (4.5 m)	None
3	Low	Moderate to High	Resurfacing of Existing Aircraft Apron	14 ft (4 m)	None
4	Moderate	Moderate to High	Resurfacing of Existing Roadway	10 to 16 ft (3 to 5 m)	None

Proposed construction impacts at Areas 2, 3 and 4 involve surficial disturbances consisting of resurfacing existing roadways and aircraft apron areas and it is likely that no additional investigations will be required for these areas. The previously identified ACP QUNS 10 Site (Site #4533) is located within Area 2, however due to the amount of fill present and the surficial disturbances proposed, it is not likely the site will be impacted by the project. If the project design changes and impacts to Areas 2, 3 and 4 extend to depths below fill materials, additional archaeological survey would be required. Consultation with the NYSHPO will continue as the project progresses beyond the preliminary design phase.

The construction of a new parking garage facility is proposed in close proximity and partially within Area 1 and will involve the driving of deep foundation piles. Geotechnical borings have indicated that at least 15 ft (4.5 m) of fill is present within Area 1. If excavation efforts exceed 15 ft (4.5 m), PANYNJ will consult with the NYSHPO to determine if monitoring of excavation during construction by a qualified archaeologist will need to be performed.

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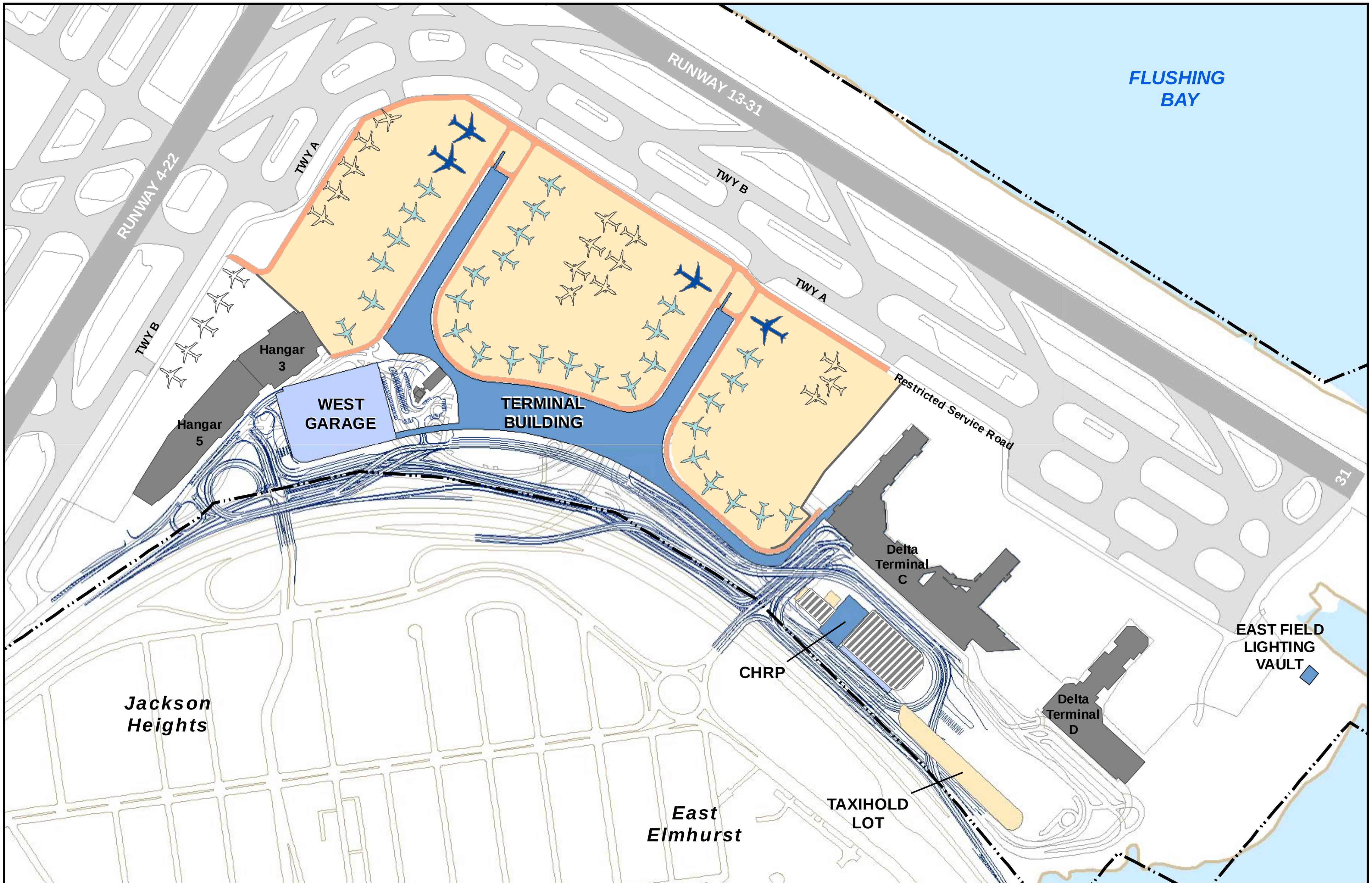
1897 *Harlem Quadrangle, New York – New Jersey* [topographic quadrangle]. 15-minute series. 1:62500. Partial revision of shoreline in 1924.
1900 *Harlem Quadrangle, New York – New Jersey* [topographic quadrangle]. 15-minute series. 1:62500.

Appendix A: General Construction Plan



Legend

- Proposed Building
- Proposed Apron/Parking Area
- Proposed Service Road
- Proposed Roadway
- Existing Building
- Building Under Construction
- Airport Property Line

Source: NYS Dept. of State, NYC DCP, NYC DoITT, ESRI
Prepared by: AECOM

0 325 650 Feet

LAGUARDIA AIRPORT CENTRAL TERMINAL BUILDING REDEVELOPMENT PROGRAM THE PORT AUTHORITY OF NY & NJ

Proposed Action

Appendix B: LaGuardia Airport CTB Modernization Geotechnical Subsurface Review and Preliminary Foundation Design Alternatives

LAGUARDIA AIRPORT

CENTRAL TERMINAL BUILDING MODERNIZATION

GEOTECHNICAL SUBSURFACE DATA REVIEW

& PRELIMINARY FOUNDATION DESIGN ALTERNATIVES

August 6, 2010

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Appendix A – GEOTECHNICAL SUBSURFACE EXHIBITS

Appendix B – SUBSURFACE INVESTIGATIONS

<u>LIST OF APPENDICES</u> (Continued):

1. Introduction

The Port Authority of New York and New Jersey is planning for the modernization of the Central Terminal Building (CTB) and other facilities at LaGuardia Airport. The construction cost of the overall program is expected to be between 3 and 4 billion dollars and is scheduled for project completion by the end of 2020. There are presently several modernization schemes under consideration. The approximate limit of the area within which the various schemes are located is shown by the outline in Exhibit 1 of Appendix A.

LaGuardia Airport has historically been one of the most difficult Port Authority facility sites in terms of foundation design and construction. The most significant reason for these difficulties is the presence of a deep deposit of soft organic clay and silt, which pervades the site. Most of the airport is constructed on land that has been reclaimed from the adjacent bay by placing up to 30 feet of incinerated refuse and miscellaneous fill over the tidal mud flats of the soft clay deposit. The result of this has been post-construction and continuing settlements of up to 8 feet in some areas. These settlements have caused significant structural and operational challenges over the years. These include some pile foundation issues due to “downdrag” loading (discussed in the Foundation Design section), flooding of portions of the airfield, buried utility ruptures due to differential settlements at building interfaces, and sidewalk and apron subsidence issues.

2. Scope of Geotechnical Effort and Report

The scope of this Pre-stage I Geotechnical effort was to compile and evaluate the existing subsurface information throughout the potential project areas of the facility, identify areas where additional Geotechnical data will be required, and provide some preliminary design criteria and foundation concepts consistent with the pre-Stage I planning state of the project design. A limited subsurface investigation was also conducted as described in a later section.

Also included in this Pre-stage I Geotechnical effort was an initiative for the development of a 2D cross-section generating tool and a 3D visualization instrument for presentation and analysis of selected subsurface geotechnical information residing in the EQUIS database.

3. Available Geotechnical Data

A review of all existing Geotechnical data was conducted, including the CAD database, the Soil Log (SL) Drawings, and the existing EQUIS database. The EQUIS database includes: a) test boring information, such as boring locations and subsurface stratigraphy and b) the results of field and laboratory tests. The SL drawings reviewed for this effort are listed in Table B, of Appendix B.

However, given the general similarity of soil strata across the entire airport, laboratory test data from borings from other areas of the airport was used to develop the general soil properties characterization of the subsurface strata presented herein. The results of laboratory tests available in the EQUIS database are also presented in the Consolidation Summary Report, Strength Summary Report and Index Property Summary Report included in Appendix B.

As a result of our review, we realized that many of the existing historic borings for the LaGuardia facility were not imported with full detail into the EQUIS data base. Some of the similar subsurface layers described on the actual field logs were combined into composite strata, losing continuity with the more recent boring entries. At the times of import this was done because of budgetary constraints. Therefore, the characterization of subsurface conditions based on the EQUIS data base must be supplemented with data from the original soil logs.

4. CAD 3D Visualization Effort

The effort undertaken in this initial phase of our pilot program was to develop the capability of connecting the AutoCAD Civil3D resource to the information contained in the existing EQUIS database and interrogating that database to drive the creation of Civil3D entities, such as points and surfaces. These products will be used to visualize the subsurface information from EQUIS in both a 2D cross-sectional and 3D visualization format.

As a result of this task completion, the ability now exists to select specific site boundaries, outlines, alignments, or series of borings and generate sets of "stick log" diagrams which are then used to produce the subsurface 2D cross-sectional profiles. From this subsurface profile base, the 3D visualizations and cutaway views can also be generated including the ability to rotate the subsurface model and also superimpose the proposed foundation outlines. The ability to generate contours of the top, bottom, or even the thickness values of any subsurface strata, within our selected site boundaries, is perhaps the most useful of the tools that have been developed as a result of this effort.

Some examples of the types of exhibits and design graphs or drawings that can be produced are included in Appendix A, entitled "Geotechnical Subsurface Exhibits". Exhibit 1 outlines the limits of the area within which the still active schemes are located, shows the locations of all previous borings drilled within the study area, and illustrates where our study cross-sections were taken in plan. Exhibits 2, 3, and 4, show the "stick log" diagrams of Cross Sections A, B, and C. Exhibits 5, 6, and 7, depict the subsurface soils profiles based on these same Cross Sections A, B, and C. Exhibit 8 is 3D visualization of the subsurface materials, based on Cross Sections B and C, and represents the CAD end product from the illustration point of view. Exhibits 9, 10, and 11, are contour maps which represent the Fill Materials Stratum thickness, the Organic Clay and Silt Stratum thickness, and the top of rock depth, respectively. These last three exhibits represent the most powerful of the AutoCAD development tools from a foundation design perspective. Additional, more specific profiles can easily be generated as required by the planning consultant.

These exhibits illustrate the general subsurface conditions within the limits of the project area and beyond. For example, review of Exhibit 10, Organic Clay and Silt Thickness Contours, indicates that the thickness of the organic stratum generally decreases from about 40 to 45 feet at the CTB to about 5 to 10 feet at the southern edge of the parking garage structure. Similarly, Exhibit 11, Top of Bedrock contours, indicates that the depth to the top of rock appears to vary vary from about 150 ft. at the western most extremity of the project outline, to about 190 ft. as we travel in a south-westerly direction.

An illustrative Presentation DVD has been provided, in Appendix F to this report to more completely demonstrate some of the capabilities of the 3D visualization tool that has been developed, to date.

5. Overview of Subsurface Conditions

LaGuardia Airport lies in a glaciated region north of the Harbor Hill Terminal Moraine. Pleistocene deposits consisting of glacial till, ground moraine, and glacial lake deposits directly overlie Precambrian crystalline rock (gneiss classification). The glacial soils were subsequently covered with a deposit of marine clay when the rise in sea level flooded the area and created the present bay environment. As previously stated, much of the airport resides on land which was reclaimed from the adjacent bays by filling with a partially incinerated refuse and miscellaneous fill.

The general idealized sequence of soil stratification at the LaGuardia site is as follows,

<u>Stratum A – Fill Materials</u>: This upper heterogeneous fill layer consists of coarse to fine sand, crushed rock and gravel, cinders, concrete, brick, glass, wood, and other forms of debris. This stratum extends essentially from existing grade to 10 to 30 feet below the surface. The compactness of this fill ranges from relatively dense within the top fifteen feet to loose, below that top zone.

<u>Stratum B – Organic Clays and Silts</u>: This layer immediately underlying the upper fill strata, consists of soft organic clay and silt materials with a thickness that varies mostly from 20 to 30 feet, with some isolated areas with as much as 50 feet. These strata component materials are still suspected to have significant consolidation potential in certain locations.

<u>Stratum C – Sand Materials</u>: This next layer consists of coarse to fine sand of medium density, ranging in thickness from about 10 to 20 feet.

<u>Stratum D – Varved Silt and Clays</u>: This approximately 50 to 60 feet thick deposit is composed primarily of varved silt and clay material, tending to be overconsolidated and stiff towards the upper portion of the strata and becoming softer with depth in some locations.

<u>Stratum E – Sand / Glacial Till Materials</u>: Below the varved silt and clay is a dense layer of glacial till, consisting primarily of sand, traces of inorganic silt, gravel, boulders and cobbles with thickness varying from 5 to 15 feet.

<u>Stratum F – Decomposed Rock</u>: There is a layer of decomposed or weathered rock, which generally consists of a very dense mixture of sand, silt and gravel. Its thickness can vary from 10 feet up to as much as 45 feet.

<u>Stratum G – Bedrock</u>: The bedrock is a sound quality gneiss, varying in depth from 150 to 190 feet below the ground surface within the project outline. This is as illustrated in the rock contour exhibit in Appendix A.

These layers occur typically in this order and these thicknesses, but with local gaps or intrusions occurring, depending on which geological area of the overall airport site is being considered. Note that there is a subtle delineation between the materials of Stratum E (Sand / Glacial Till Materials) and the decomposed rock classification of Stratum F.

As can be seen in the Subsurface Soils Profiles A and B in Appendix A, there are also significant intrusions of boulders at random depths, particularly in the upper sand strata just below the organic clays and silts, and in the sand / glacial till strata just above the decomposed rock. Red zones shown on the soil profiles indicate the presence of boulders. The presence of boulders in the upper strata would be considered more of a foundation issue from a standpoint of the installation of a pile foundation option.

The following table represents a summary of suggested average design parameters for the soil materials strata, based on the existing sample and testing information that resides in the Geotechnical database:

Stratum	Total Unit Weight (pcf)	Angle of Internal Friction (deg.)	Blow Counts (N)	CR	RR	p_c (psf)
Fill Materials	105	30	18	___		___
Organic Clays & Silts	100	___	4	.25	.03	*
Sand Materials	120	35	56	___		___
Varved Silt & Clays	125	___	35	.16	.04	*
Sand / Glacial Till Materials	135	38	70	___	___	___
Decomposed Rock	___	___	85	___	___	___

***** p_c or Pre-consolidation Pressure (see Consolidation Summary Report of Appendix B for test values)
Notes: CR or Compression Ratio $= C_c / (1 + e_0)$
RR or Recompression Ratio $= C_r / (1 + e_0)$

6. Subsurface Investigation

At this time, because of the early stage of the project, it was decided to perform only three borings along the existing Concourse A. That is where some of the thickest layers of the soft organic clay and silt deposits are found. The borings are numbered 3-177 through 3-179, and the drilling operations included obtaining some undisturbed Shelby tube samples of the compressible stratum. These undisturbed samples are currently undergoing consolidation testing in the Port Authority Materials Engineering Geotechnical Laboratory. The boring locations and soil logs are shown in Appendix B.

The laboratory test results will be used to begin an evaluation of the consolidation potential and resulting downdrag phenomena that will occur with the deep foundation alternatives (discussed in the Foundation Design section). Of particular interest, and most pronounced in the areas where these new borings were taken, is the possibility that the fill beneath the existing gate fingers is hanging up on the piles and that the underlying clays have not felt the full weight of the fill causing underconsolidation. Underconsolidated soils are those that have not yet been fully consolidated under the existing overburden pressures and, consequently, are susceptible to significant additional settlement.

7. Seismic Design Discussion

To develop the required parameters for determination of seismic loads imparted to the anticipated structures, a first step evaluation of the subsurface conditions was undertaken to establish the project site class. A copy of Table 1615.1.1 of the 2008 New York City Building Code (NYCBC) giving the definitions of the various site classes is presented in Figure 1, Appendix C. For site classes up to and including Class E, a site specific analysis is not required. Parameters given in the NYCBC for the base rock acceleration and the code procedures given for development of the response spectra, considering soil amplification, may be used for each of those classes. If the site is characterized as Class F, however, a site-specific dynamic response analysis must be performed.

7.1 Site characterization:

As described in the Subsurface Conditions section of this report, the project site is covered with a layer of fill that varies in thickness from 10 to 30 feet. Beneath the fill, alternating layers of medium dense silty sand and silty clay are encountered down to the top of bedrock. In many areas, the fill layer is underlain by a 20 to 30 feet thick layer of soft organic clays and silts. Bedrock is encountered at a depth of 150 to 190 feet below grade.

The code gives ranges of several parameters that may be used to determine the appropriate site classification (see Table 1615.1.1). At our site, the most readily available parameter is the Standard Penetration Test or N value (representing hammer blows per foot) from the borings. In order to characterize the site class, it is necessary to calculate the average N value for a depth of 100 feet. Based on the existing borings at the site, the calculated average N value is in the range of 11 to 13 blows per foot (bpf). Since the average N value is less than 15 bpf, the site should be categorized as Class E.

Layers of sandy materials, however, with N values in a range of 4 to 7 bpf were found in some borings in both the fill layers and the sand layers underneath the organic clay and silt stratum. Sandy materials with this range of blow count near the surface and below the water table are susceptible to liquefy during earthquakes. In Figure 2 of Appendix C, entitled “Liquefaction Potential Assessment”, the N values for boring 2-081 are plotted together with a liquefaction assessment diagram from the NYCBC (Figure

1813.1), indicating that the N values for the layers of sand above and below the organic clay will have the potential to be liquefied. Additionally, in most of the borings in which organic soils were encountered, the thickness of the organics was greater than 10 feet. The presence of liquefiable soils or organic soils having a thickness greater than ten feet, automatically defines the site as Class F and, consequently, a site specific analysis is required.

In order to perform a site-specific analysis, rock outcrop ground motions are required as input to a computer program, such as PROSHAKE. This program does a one dimensional wave propagation analysis to determine how the shears, accelerations, and ground motions are amplified in the selected soil profile. From this analysis, a site-specific response spectrum is developed.

7.2 Input ground motion:

The 2008 NYCBC only provides ground accelerations for Class B rock at 0.2 sec and 1 sec and the procedures to develop a response spectrum for soil Classes A to E. Since the site for the terminal is classified as Class F and is underlain by Class A rock, rock motions for Class A rock are required in order to develop the soil response spectrum needed by the Structural Engineering Discipline to calculate the seismic forces. Since the codes do not provide the ground motions for the rock, synthetic ground motions that match the Class A rock spectrum (Figure 3) which is obtained from the code, need to be developed. These synthetic motions were generated by our consultant, URS Corporation, and are shown in Figures 2 through 4 of their report. The procedures used to match the target spectrum are presented in the URS letter report and included as an Appendix D.

7.3 Selected soil profile:

Four generic soil profiles were used to represent the site, as shown in Figure 4 of Appendix C. Soil Profile A represents the area with all sands. Profile B and C represent the areas with a thick organic layer underlain by a layer of sand for B and silty clay for C. Profile D represents an area where the organic clay is underlain by a layer of sand over the clay and silt. The top layer of sand for both soil Profiles B and D and the layer below the organic clay for soil Profile D were changed to liquefiable sand for the ground softening analyses.

The PROSHAKE program requires input of shear wave velocity data for each of the soil strata. The shear wave velocity for each soil stratum was determined using empirical equations that relate the shear wave velocity to the N value, as shown below:

$G = \gamma/g\ Vs^2$ and $G = 120N^{0.8}$ Then $Vs = 2780(N^{0.8}/\gamma)^{0.5}$ ft/sec

The input soil parameters used to generate the site-specific spectrum for 5% damping are shown in Table 1 (Figure 5 of Appendix C). The site-specific response spectra for the selected profiles are shown on Figure 6, Appendix C.

The long period of the response spectra were modified to account for possible soil softening due to cyclic loading during the earthquake due to liquefaction. The approximate method for considering the effects of liquefaction on the response spectrum was provided to us by Dr. Ricardo Dobry of Rensselaer Polytechnic Institute for work on another project. The method involves reducing the shear wave velocity used in the PROSHAKE analysis for the liquefiable soils. To develop the response spectrum shown in Figure 7, Appendix C, we reduced the shear wave velocity for the liquefiable soils to 150 fps. The effect of the liquefaction is to reduce the spectral accelerations in the short period range and increase them in the long period range.

7.4 Conclusion:

The maximum points, i.e. the envelope that encompasses the spectral accelerations for all the analyses are shown in Figure 8, Appendix C, together with the NYCBC Soil Class D and E response spectra.. Figure 8 indicates that for a structural fundamental period between 0 to 1 second, the spectral accelerations are close to the NYCBC Soil Class E and for long period structures (T >1.0 second), the spectral accelerations were impacted by soil softening due to liquefaction and the values are close to those of Soil Class D. Therefore, for this preliminary design stage, we recommend using the Soil Class E spectrum of the NYCBC for the fundamental period of the structure at T <1.0 second and the Soil Class D spectrum for T >1.0 seconds.

7.5 Recommendations for Further Study:

As the project phases advance and design efforts continue, there is a need for additional subsurface investigation not only to support the foundation design alternatives which are described in the following sections, but also for better definition of this seismic design issue. While carrying out the prescribed boring and sampling program, cross-hole measurements would be recommended to determine actual site-specific shear wave velocities for the various soil strata.

8. Considerations for Foundation Design

The existing CTB is a six-block long structure consisting of a four-story central section, two three-story wings, and four radiating concourses with a total of 40 aircraft gates. The building was expanded in both the 1990’s and early 2000’s. For this primary airport structure, the foundation design was based on end-bearing steel pipe piles founded on either the glacial till or decomposed rock as the bearing layer. The Parking Garage, the other major structure at the terminal proper, utilizes the same foundation design.

The top Fill and upper organic Clay and Silt layers are considered either too loose or relatively too soft to ultimately support the column loads for either a new terminal or parking garage. These planned structures would most likely need to be founded on a deep seated foundation system, below the soft organics at about a probable minimum depth of about 50 feet. The 10 to 20 foot medium dense sand layer encountered at that point might be considered a capable bearing stratum, but is sometimes to thin and erratic in nature, particularly in the area near Parking Lot #3. Below the sand layer is a stiff varved silt and clay, which might have been an adequate bearing stratum but is inconsistent with interbeds and some softer zones with depth.

Ultimately, either the glacial till or decomposed rock layer or the bedrock surface at probable depths of from 150 to 190 feet, will be the founding strata for a steel pipe pile or deep caisson design. The medium dense sand stratum below the soft organics could be suitable bearing layer for a tapered type pile foundation. These foundation types are among those discussed in the following Section 9, entitled "Foundation Alternatives".

The deep pile foundation alternatives will be subject to a negative skin friction or "Downdrag" effect caused by the continued consolidation of the soft organic clay and silt stratum. While the soils move downward around the pile shaft, a downward force is transferred from the soil, through the shaft, and into the pile tip at the bearing elevation. Based on past experience at the LaGuardia site in this project area, as much as 50 to 250 tons of downdrag force per pile might be anticipated depending on the type, diameter, and length of the piles as well as the thickness of fill and organic soils at any particular location. There are some techniques such as bitumen coatings which can be explored to reduce this downdrag effect. However, there is relatively little data to support the long term effectiveness of these techniques. The ultimate solution is to design the foundation system to withstand and accommodate the anticipated dragdown forces.

9. Foundation Alternatives

Due to the presence of the compressible clay layer of significant thickness, deep foundation alternatives will be the primary foundation types considered for support of major structures. Based on our Pre-Stage I level of design considerations, the suitable foundation types and anticipated capacities that can be considered are:

Steel Pipe Piles (with straight shaft):
Driven concrete filled steel pipe piles of 10 to 14 inch diameter with a length of about 120 feet at a tip elevation of approximately -100. These can provide an anticipated load capacity of 80 to 120 tons which would then have to be reduced by the amount of downdrag quantified at specific locations.

Steel Tapered Tube / Monotube Piles:
Driven concrete filled steel tapered tube piles or monotube piles with 14 to 18 inch diameter tapering to a 8 to 12 inch diameter, for a length of about 60 to 120 feet. These may provide a greater anticipated load capacity of 120 to 150 tons due to additional resistance provided by the taper in the bearing stratum, and a higher potential set-up value that might develop. This set-up additional load capacity, if any, tends to be site specific and would have to be investigated before use in the final foundation design. In areas where the sand layer underlying the organic clays is sufficiently thick, it may be feasible to achieve capacities 60 to 100 tons at significantly shallower depths. However, an assessment of the potential settlement due to compression of the clays below the sand layer would be required.

Drilled Caissons (bearing on or socketed into bedrock):
Auger installed 18 to 36 inch diameter caissons resting on the top of bedrock at a depth of from 150 to 180 feet below grade, providing a large end bearing capacity. Each caisson might provide a load capacity of 180 to 400 tons depending on the caisson diameter, also then subject to a reduction due to downdrag.

Auger installed 18 to 36 inch diameter caissons socketed into the bedrock at the same depths of 150 to 180 feet below grade with an additional 5 to 10 feet for socketing. The same large end bearing capacity is provided along with an additional substantial value of side friction between the caisson shaft and the rock. Each of these socketed caissons might provide a load capacity of 400 to 750 tons or greater, depending on the caisson diameter, the length of the socket and the structural capacity of the caisson, also then subject to a reduction due to downdrag.

All pile and caisson capacities would need to be verified with pile load testing. The table presented in Appendix E, represents the results of a preliminary comparison between the foundation types considered to be most appropriate, at this stage of the project design, for the existing subsurface conditions at LaGuardia.

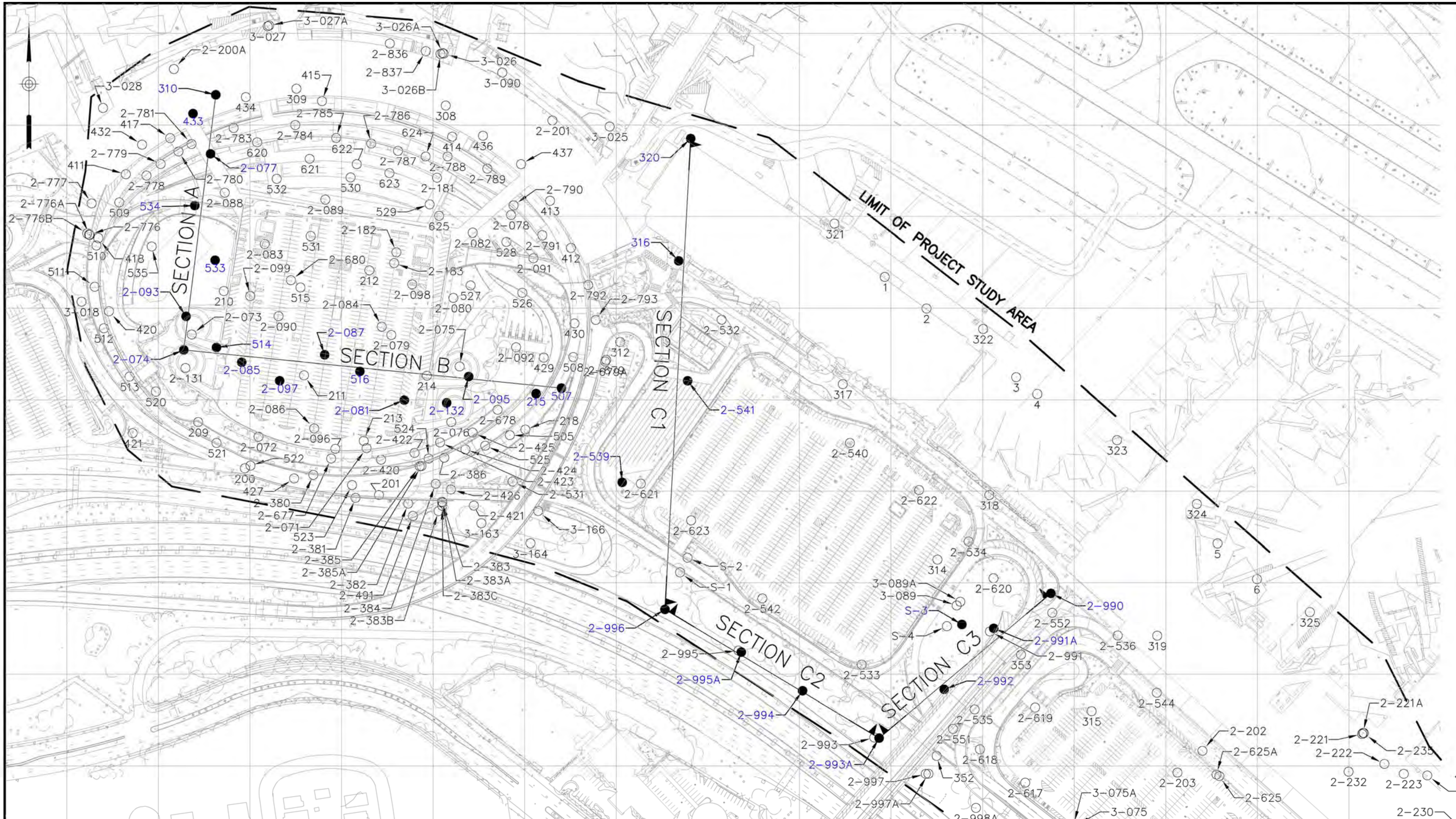
10. Conclusion

At this very preliminary stage in the LaGuardia Modernization Project, it is our recommendation, based on the existing subsurface data and our knowledge of past site foundation behaviors, to utilize the dense till/decomposed rock as the bearing stratum for a deep foundation system, thereby minimizing any potential settlement issues. Advancing the foundations deeper to the top and possibly even into the bedrock might be a preferred version of the deep foundation design, dependent on an analysis of the cost trade off between additional length and installation difficulty vs. increased capacity.

When a given design depth for optimum bearing has been more or less established, a further cost-benefit analysis will then need to be performed for the most effective diameter of the foundation elements (pile size vs. caisson). Ease of construction, amount of site disturbance, and relative reliability of the installations also need to be considered, along with the price. In view of the potentially large downdrag forces that are anticipated, it is likely that smaller diameter foundation elements may prove to be more economical.

ADDENDIX A

GEOTECHNICAL SUBSURFACE EXHIBITS



NOTE:
SOLID FILLED BOREHOLES ARE THOSE THAT HAVE BEEN INCLUDED IN THE STICK LOG CROSS SECTIONS.

0 200 400
HORIZ. SCALE IN FEET

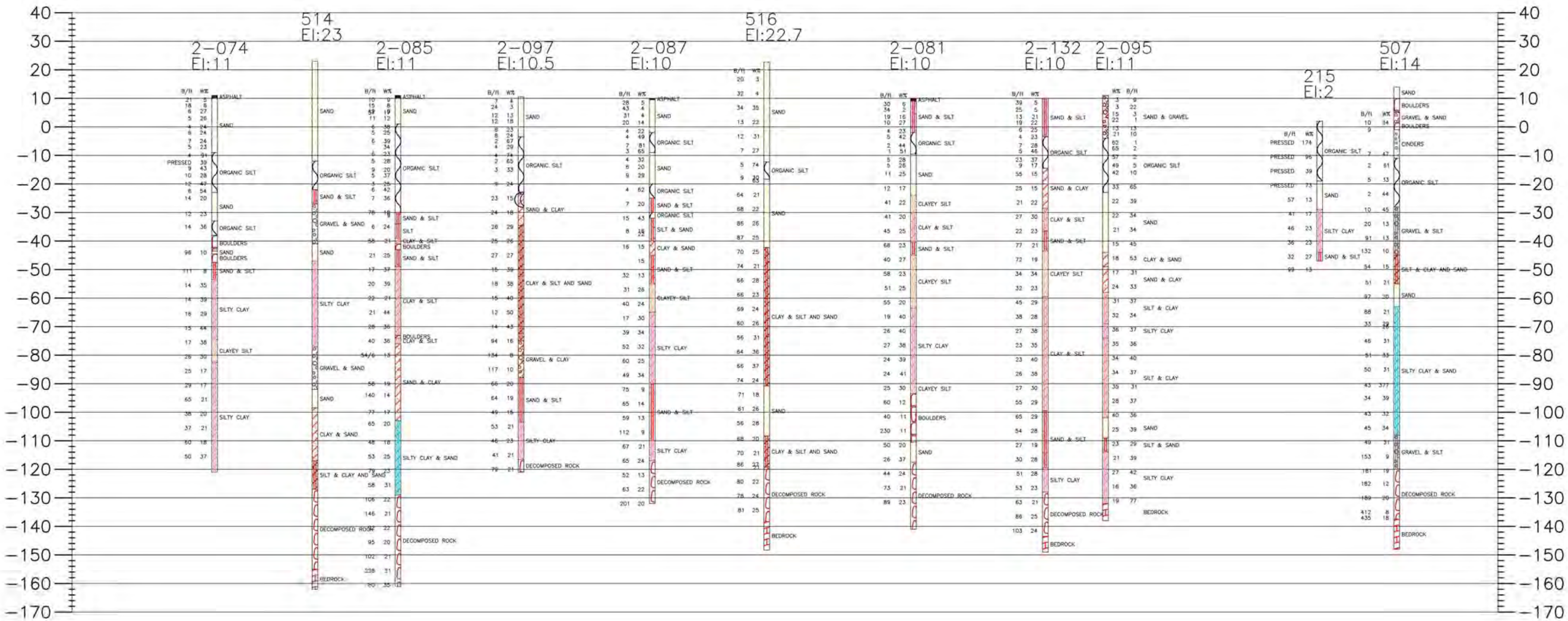
THE PORT AUTHORITY OF NY & NJ	LAGUARDIA AIRPORT	Discipline: GEOTECHNICAL	8/6/2010 Date	1 of 11	Workorder Number
D.CAVALIERE Designed by / R.YIN Drawn by / S.LEIFER Checked by		PROJECT SITE EXISTING BOREINGS AND SUBSURFACE SECTIONS	Contract Number / 09744000 PID Number	Drawing Number: EXHIBIT 1	

LEGEND:

310 BOREHOLE NUMBER
EL:16 BOREHOLE TOP ELEVAT
B/ft SPT N VALUE
W% WATER CONTENT (%)
HA HAND AUGER

0 50 100
HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ	LAGUARDIA AIRPORT	Discipline GEOTECHNICAL	8/6/2010 Date	2 of 11 Workorder Number
D.CAVALIERE Designed by / R.YIN Drawn by / S.LEIFER Checked by		BORING STICK LOG CROSS SECTION A	Contract Number 09744000 PID Number	Drawing Number EXHIBIT 2



LEGEND:

310	BOREHOLE NUMBER
EL:16	BOREHOLE TOP ELEVAT
B/ft	SPT N VALUE
W%	WATER CONTENT (%)
HA	HAND AUGER

0 80 160
HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ

LAGUARDIA AIRPORT

Discipline GEOTECHNICAL

BORING STICK LOG CROSS SECTION B

D.CAVALIERE	R.YIN	S.LEIFER
Designed by	Drawn by	Checked by

8/6/2010
Date

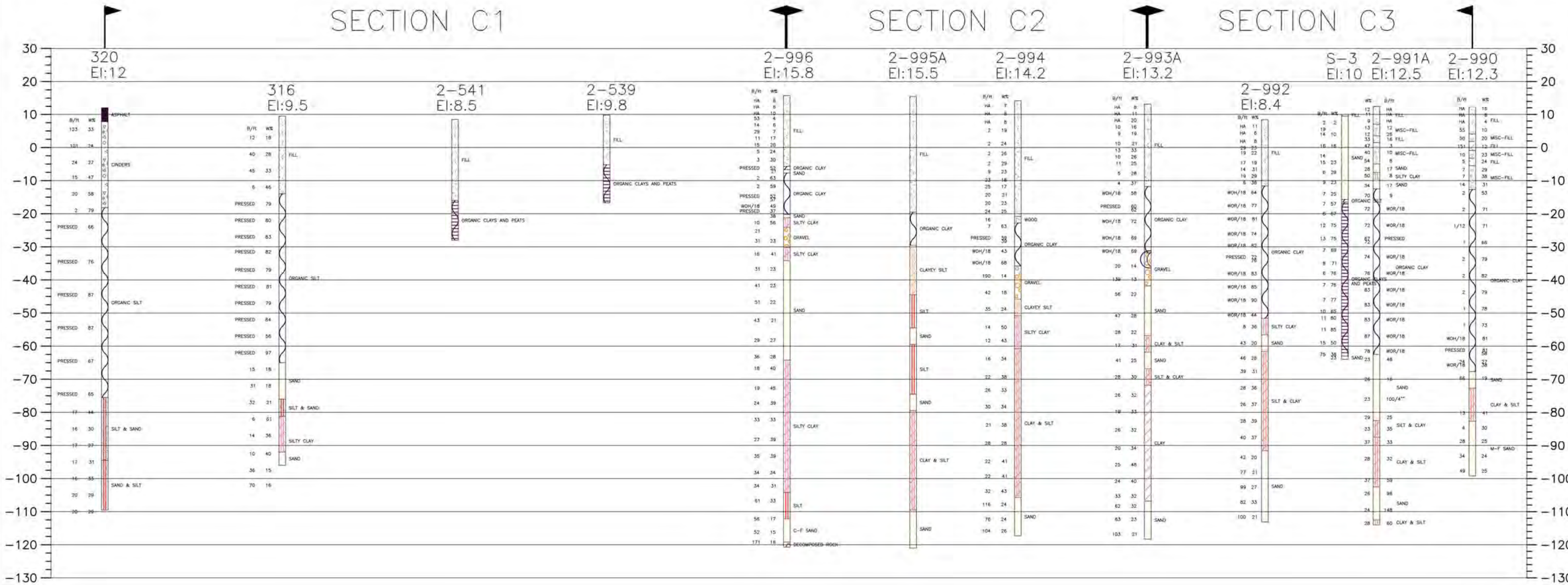
Contract Number

09744000
PID Number

3 of 11

Workorder Number

Drawing Number
EXHIBIT 3



LEGEND:

310	BOREHOLE NUMBER
EL:16	BOREHOLE TOP ELEVAT
B/ft	SPT N VALUE
W%	WATER CONTENT (%)
HA	HAND AUGER

0 150 300
HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ

LAGUARDIA AIRPORT

Discipline: GEOTECHNICAL

BORING STICK LOG CROSS SECTION C

D.CAVALIERE	R.YIN	S.LEIFER
Designed by	Drawn by	Checked by

Date: 8/6/2010

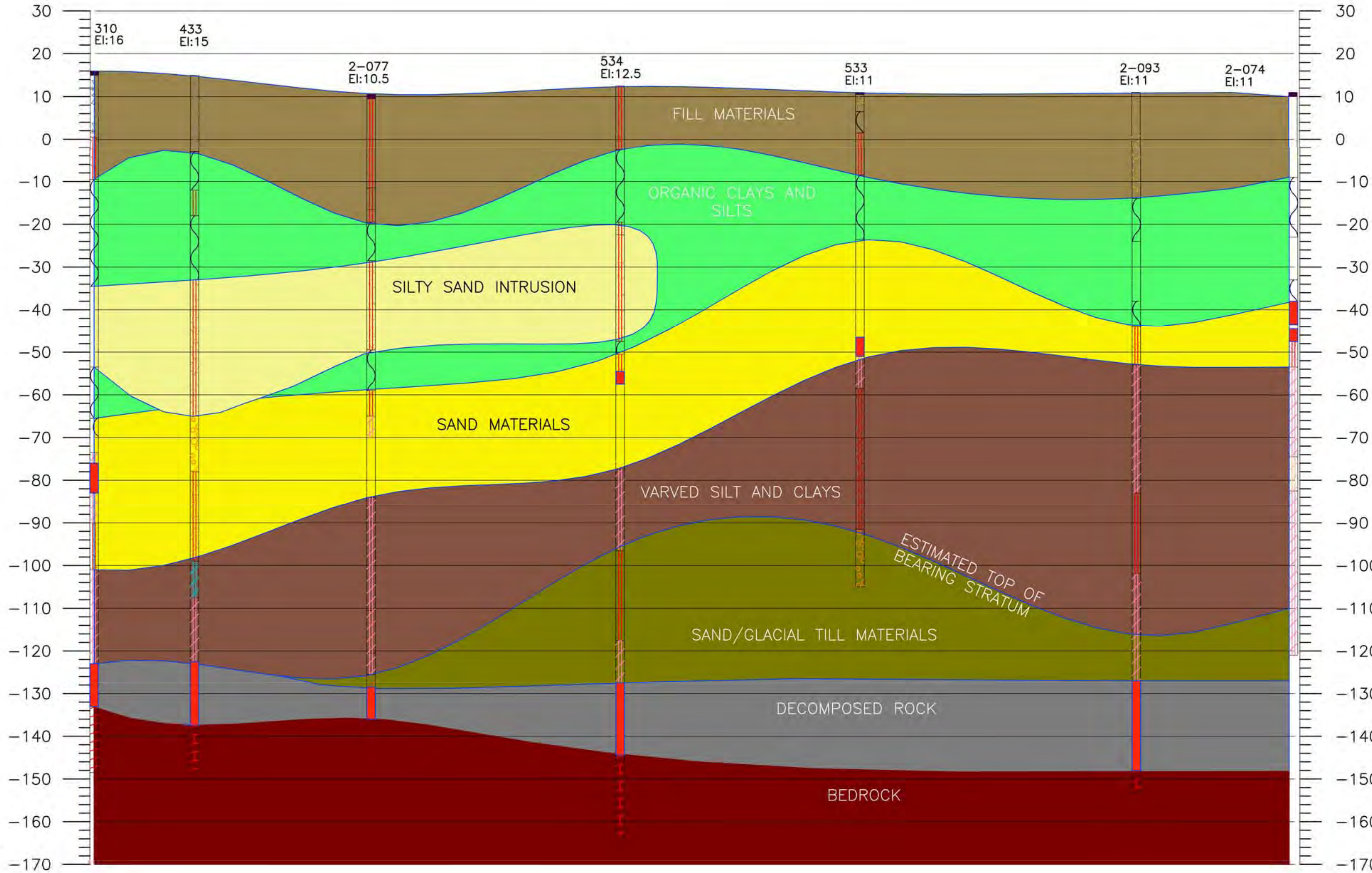
Contract Number

PID Number: 09744000

4 of 11

Workorder Number

Drawing Number: EXHIBIT 4



LEGEND:

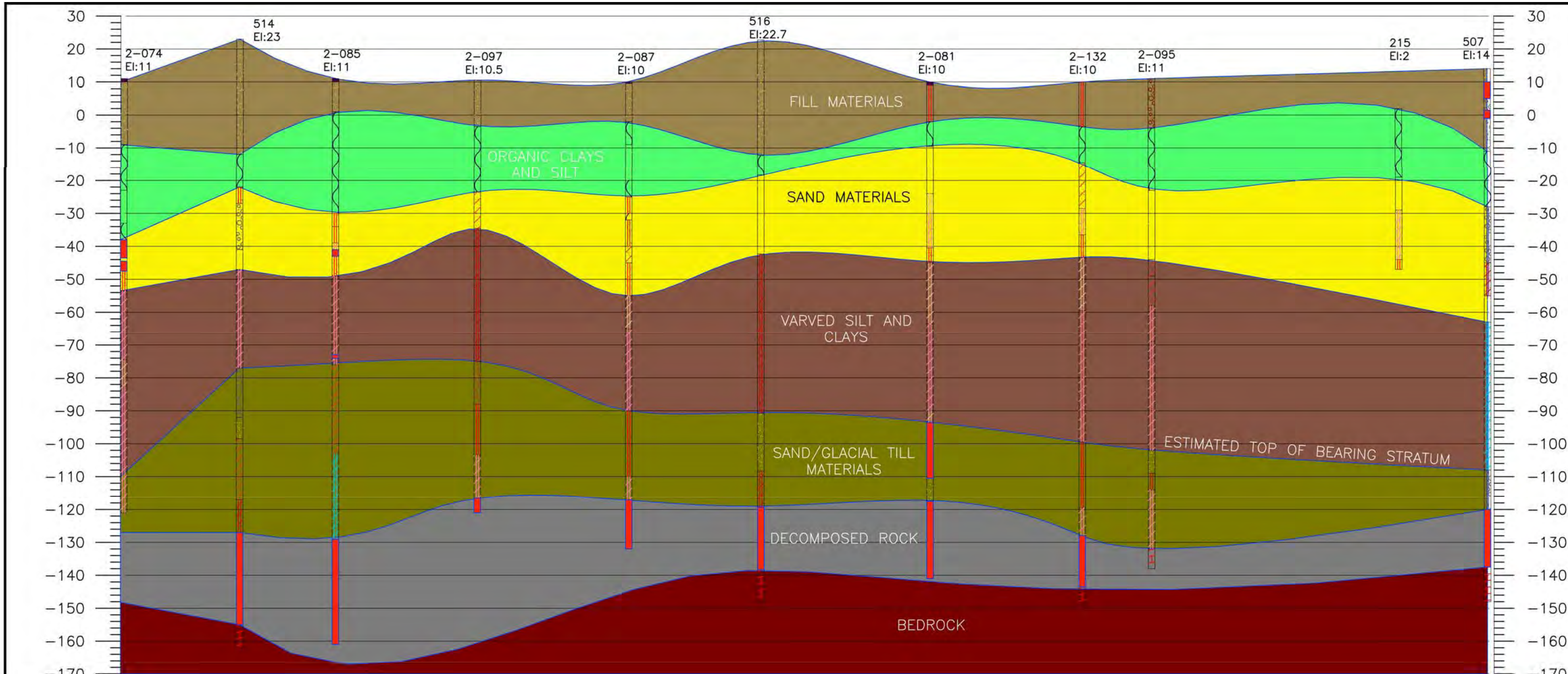
- FILL MATERIALS
- CLAYS AND SILTS
- SAND MATERIALS
- VARVED SILT AND CLAYS
- SAND/GLACIAL TILL MATERIALS
- DECOMPOSED ROCK
- BEDROCK
- SILTY SAND INTRUSION
- BOULDERS

310 BOREHOLE NUMBER
EL:16 BOREHOLE TOP ELEVATION

0 50 100
HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ

D.CAVALIERE Designed by	R.YIN Drawn by	S.LEIFER Checked by	LAGUARDIA AIRPORT	Discipline GEOTECHNICAL SUBSURFACE SOILS PROFILE A
8/6/2010 Date	Contract Number	09744000 PID Number	5 of 11 Workorder Number	Drawing Number EXHIBIT 5



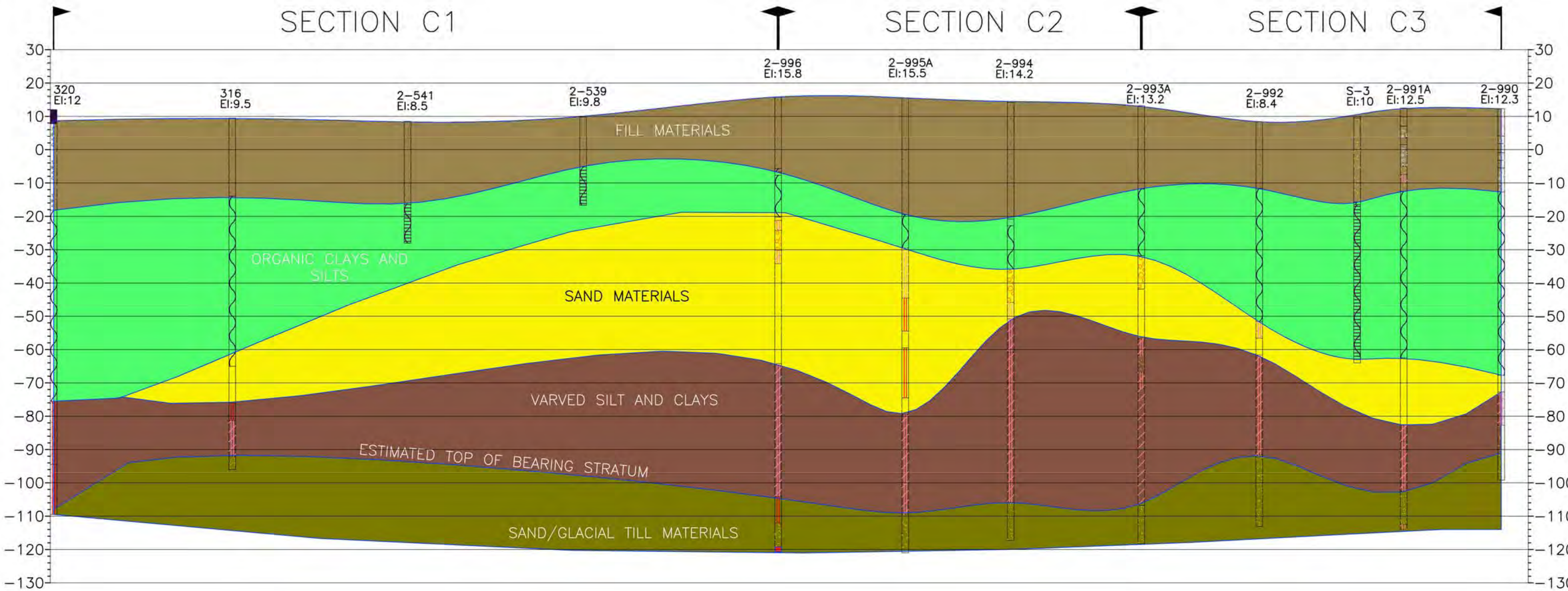
LEGEND:

- FILL MATERIALS
- CLAYS AND SILTS
- SAND MATERIALS
- VARVED SILT AND CLAYS
- SAND/GLACIAL TILL MATERIALS
- DECOMPOSED ROCK
- BEDROCK
- SILTY SAND INTRUSION
- BOULDERS

310 BOREHOLE NUMBER
EL:16 BOREHOLE TOP ELEVATION

0 60 100
HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ	LAGUARDIA AIRPORT	Discipline GEOTECHNICAL	8/6/2010 Date	6 of 11 Workorder Number	
D.CAVALIERE Designed by	R.YIN Drawn by	S.LEIFER Checked by	SUBSURFACE SOILS PROFILE B	Contract Number 09744000 PID Number	Drawing Number EXHIBIT 6



LEGEND:

- FILL MATERIALS
- CLAYS AND SILTS
- SAND MATERIALS
- VARVED SILT AND CLAYS
- SAND/GLACIAL TILL MATERIALS
- DECOMPOSED ROCK
- BEDROCK
- SILTY SAND INTRUSION
- BOULDERS

310 BOREHOLE NUMBER
EL:16 BOREHOLE TOP ELEVATION

0 150 300
HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ

D.CAVALIERE	R.YIN	S.LEIFER
Designed by	Drawn by	Checked by

LAGUARDIA AIRPORT

Discipline GEOTECHNICAL

SUBSURFACE SOILS PROFILE C

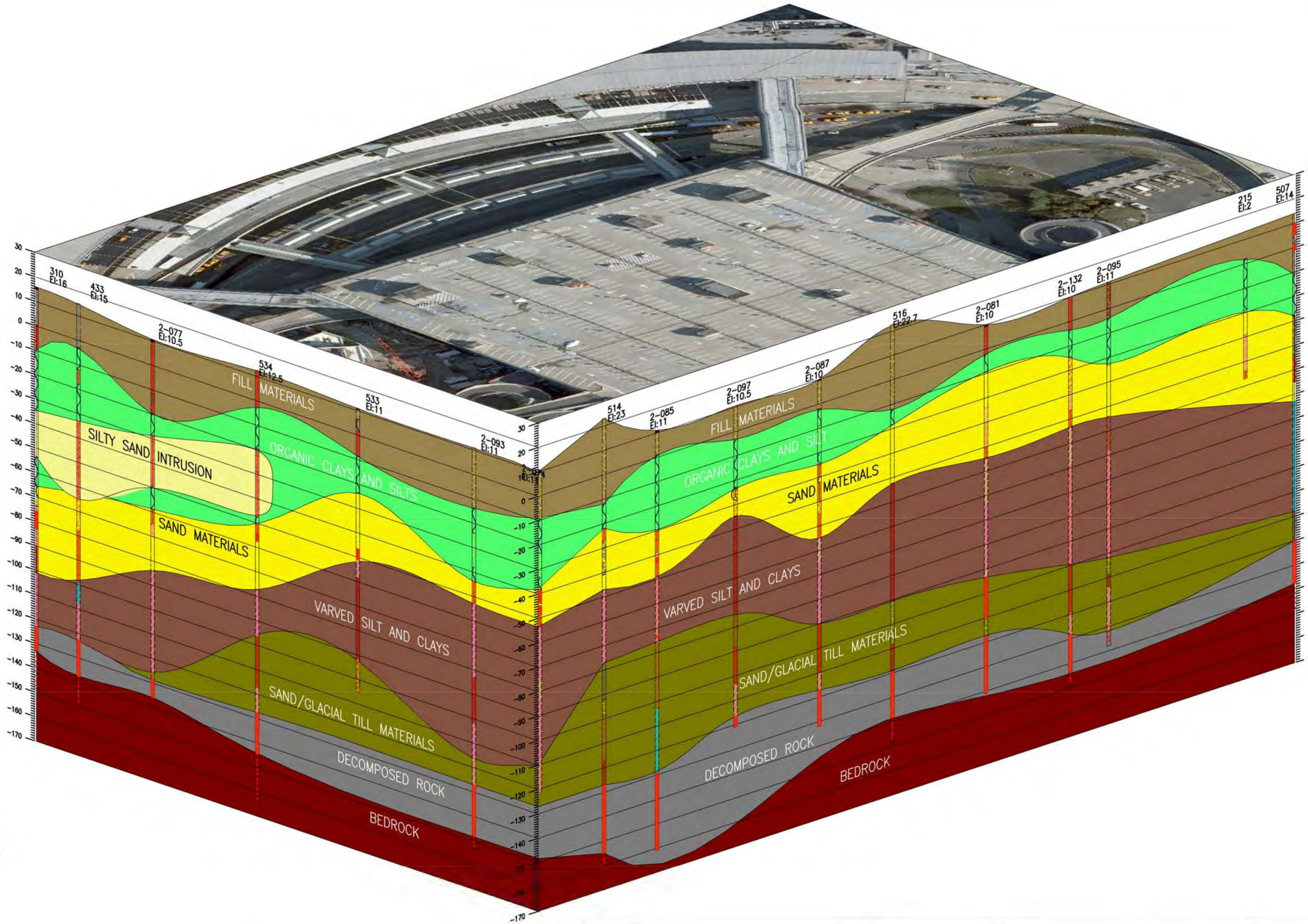
8/6/2010
Date

Contract Number

09744000
PID Number

7 of 11
Workorder Number

Drawing Number
EXHIBIT 7



LEGEND:

- FILL MATERIALS
- CLAYS AND SILTS
- SAND MATERIALS
- VARVED SILT AND CLAYS
- SAND/GLACIAL TILL MATERIALS
- DECOMPOSED ROCK
- BEDROCK
- SILTY SAND INTRUSION
- BOULDERS

310 BOREHOLE NUMBER
EL:16 BOREHOLE TOP ELEVATION

0 80 160
HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ D.CAVALIERE Designed by · R.YIN Drawn by · S.LEIFER Checked by	LAGUARDIA AIRPORT	Discipline GEOTECHNICAL THREE-DIMENSIONAL SUBSURFACE SOILS PROFILE A + B	8/6/2010 Date Contract Number 09744000 PID Number	8 of 11 Workorder Number Drawing Number EXHIBIT 8

STRATA THICKNESS TABLE

COLOR	THICKNESS RANGE (FEET)
(light green)	0 TO 15
(bright green)	15 TO 30
(dark green)	30 TO 45
(darkest green)	45 TO 60

LEGEND:

(20)— — — THICKNESS OF FILL MATERIALS

NOTES:

1. HORIZONTAL CONTROL: ALL COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD83).
2. VERTICAL CONTROL: ALL ELEVATIONS SHOWN ARE IN FEET AND REFER TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
3. CONTOURS AND STRATA THICKNESS MAPS ARE BASED ON EXISTING BORING DATA

0 200 400

HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ

D.CAVALIERE	R.YIN	S.LEIFER
Designed by	Drawn by	Checked by

LAGUARDIA AIRPORT

Discipline GEOTECHNICAL

FILL MATERIALS THICKNESS CONTOURS

8/6/2010 Date

Contract Number

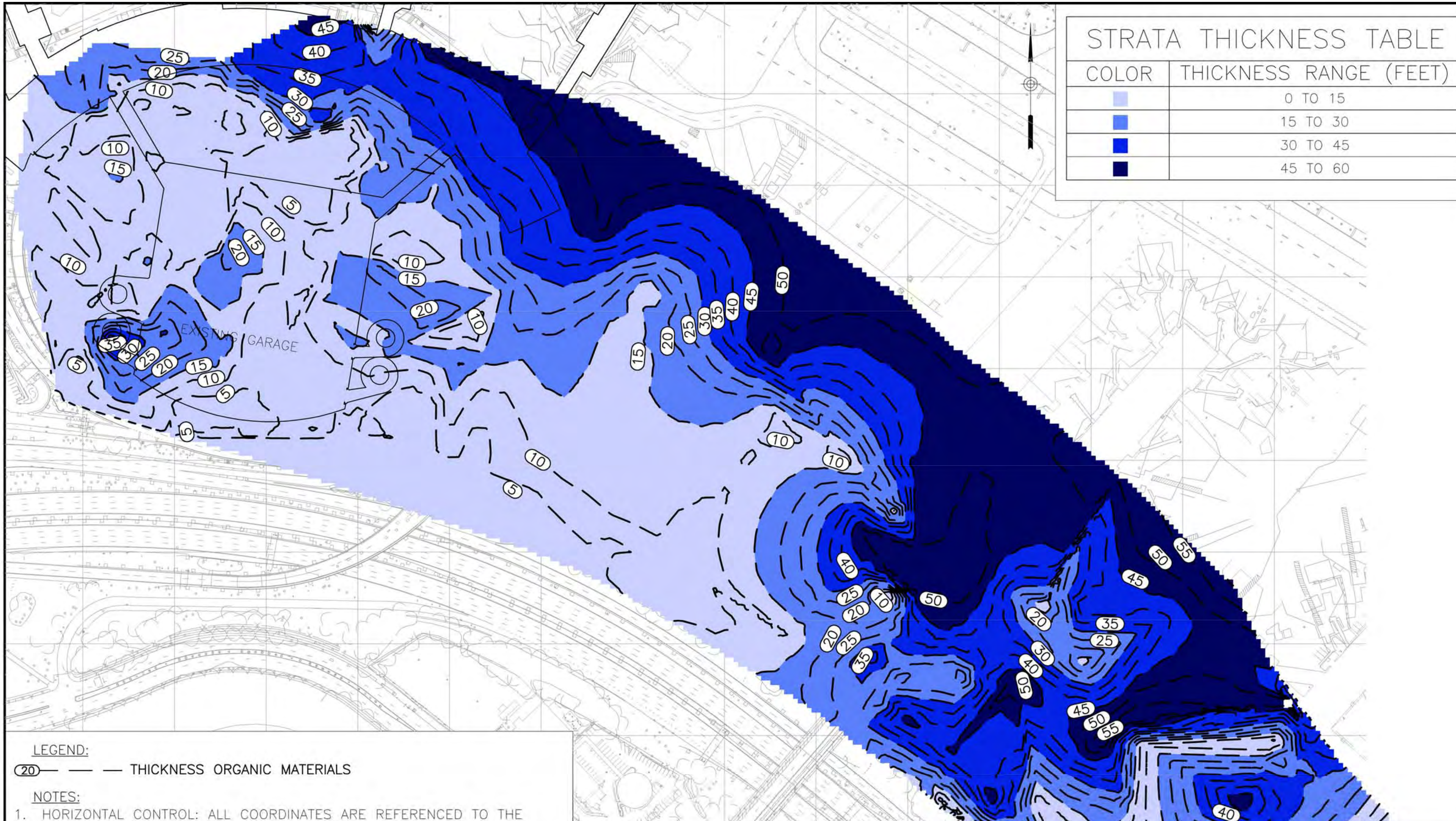
09744000 PID Number

9 of 11

Workorder Number

Drawing Number

EXHIBIT 9



STRATA THICKNESS TABLE

COLOR	THICKNESS RANGE (FEET)
(lightest blue)	0 TO 15
(light blue)	15 TO 30
(blue)	30 TO 45
(dark blue)	45 TO 60

LEGEND:

(20) — — — THICKNESS ORGANIC MATERIALS

NOTES:

1. HORIZONTAL CONTROL: ALL COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD83).
2. VERTICAL CONTROL: ALL ELEVATIONS SHOWN ARE IN FEET AND REFER TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
3. CONTOURS AND STRATA THICKNESS MAPS ARE BASED ON EXISTING BORING DATA.

0 200 400

HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ

LAGUARDIA AIRPORT

Discipline GEOTECHNICAL

ORGANIC CLAYS AND SILT THICKNESS CONTOURS

D.CAVALIERE Designed by

R.YIN Drawn by

S.LEIFER Checked by

8/6/2010 Date

Contract Number

09744000 PID Number

10 of 11

Workorder Number

Drawing Number EXHIBIT 10

LEGEND:

+5 — — — — EXISTING SURFACE ELEVATION

-5 ———— TOP OF BEDROCK ELEVATION

NOTES:

1. HORIZONTAL CONTROL: ALL COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD83).
2. VERTICAL CONTROL: ALL ELEVATIONS SHOWN ARE IN FEET AND REFER TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
3. CONTOURS AND STRATA THICKNESS MAPS ARE BASED ON EXISTING BORING DATA.

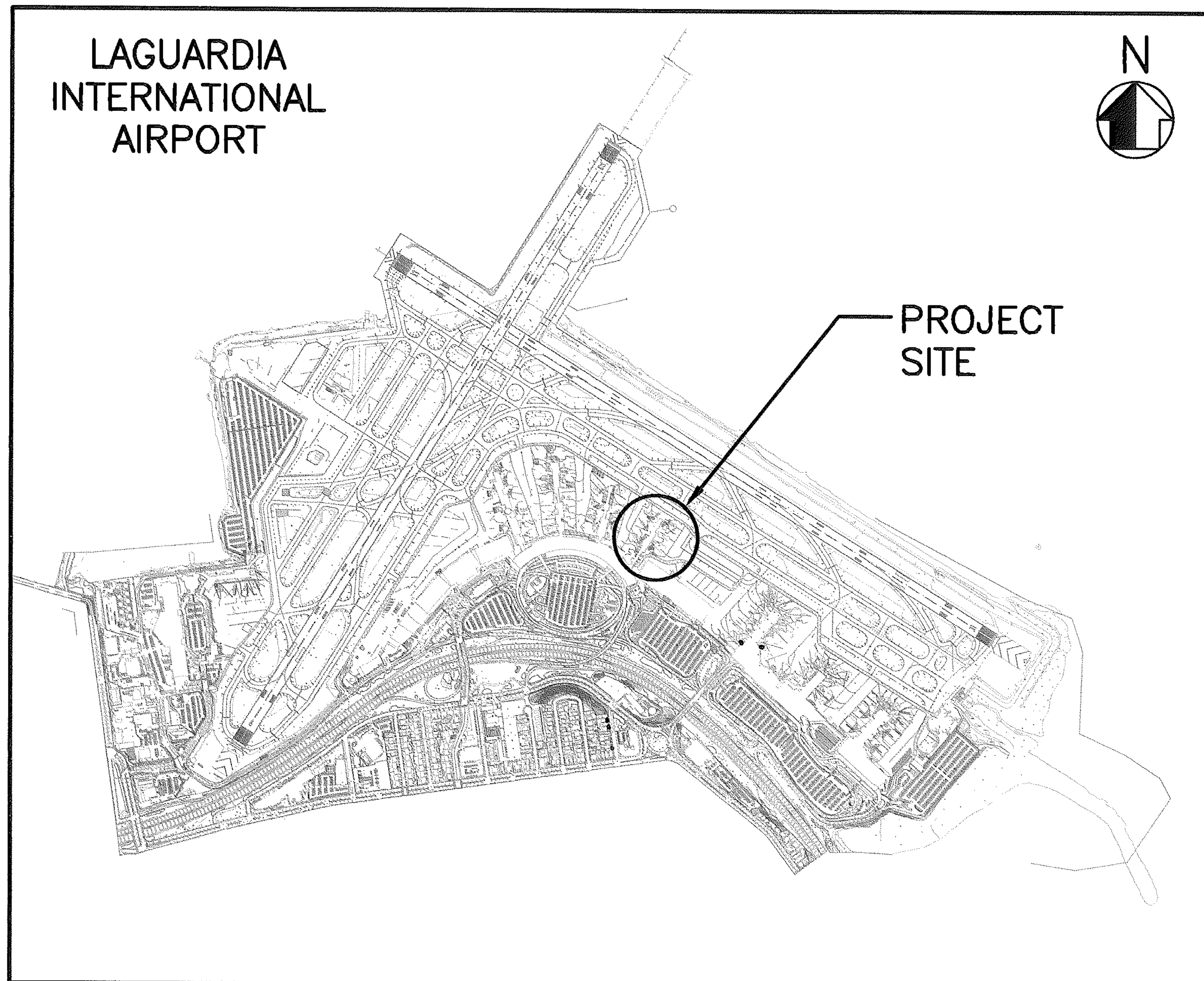
0 200 400

HORIZ. SCALE IN FEET

THE PORT AUTHORITY OF NY & NJ	LAGUARDIA AIRPORT	Discipline GEOTECHNICAL	8/6/2010 Date	11 of 11
D.CAVALIERE Designed by / R.YIN Drawn by / S.LEIFER Checked by		TOP OF BEDROCK CONTOURS	Contract Number / 09744000 PID Number	Workorder Number / Drawing Number EXHIBIT 11

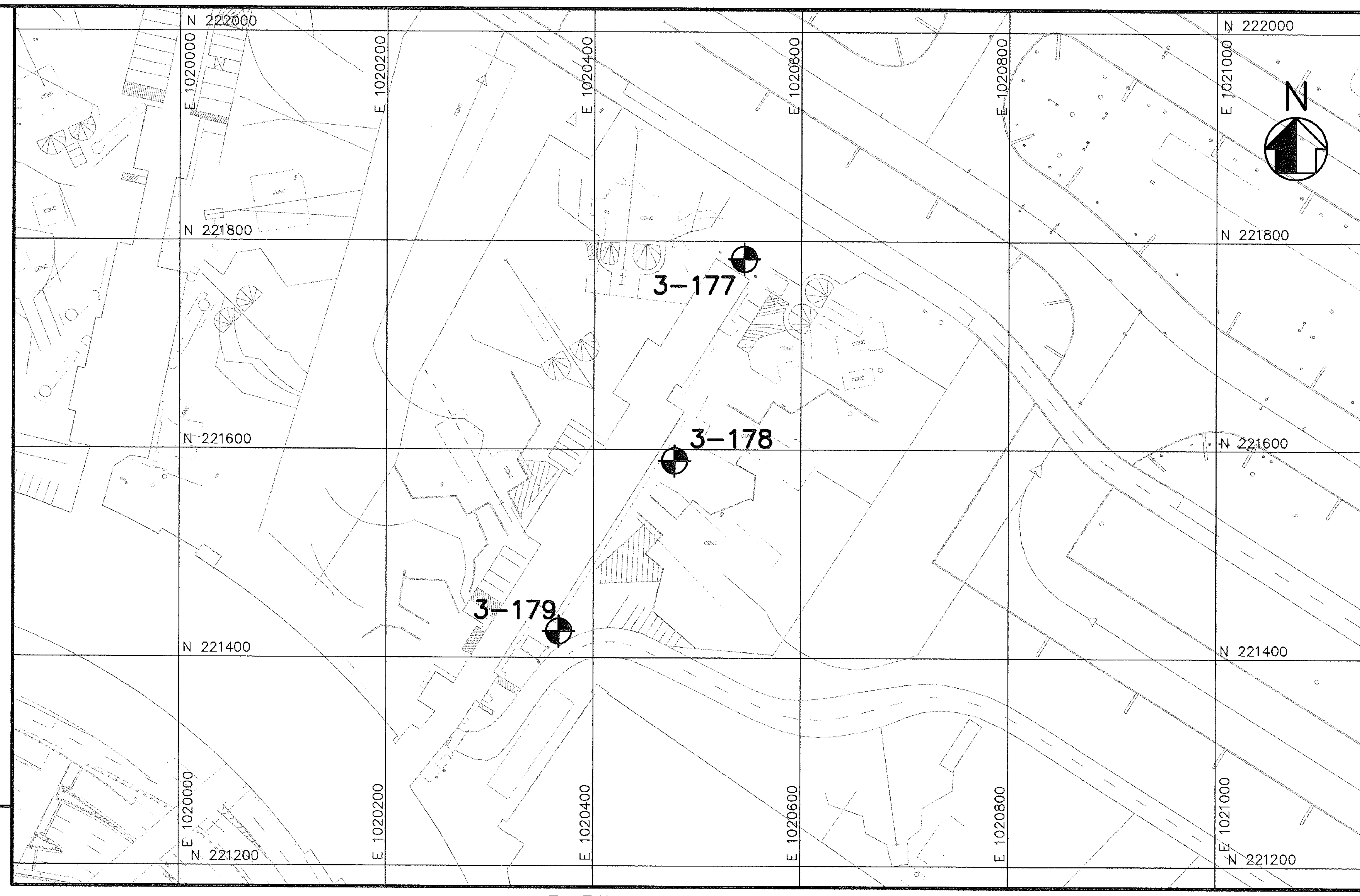
APPENDIX B

SUBSURFACE INVESTIGATIONS



PROJECT SITE MAP

0 1000 2000
SCALE IN FEET



BORING LOCATION PLAN

0 80 160
SCALE IN FEET

SOILS CLASSIFICATION TERMINOLOGY

COMPONENT PROPORTIONS	
AND	35% TO 50%
SOME	20% TO 35%
LITTLE	10% TO 20%
TRACE	1% TO 10%

FINE GRAINED SOILS

TERM	PLASTICITY INDEX
SILT	NON PLASTIC
CLAYEY SILT	1 TO 5
SILT & CLAY	5 TO 10
CLAY & SILT	10 TO 20
SILTY CLAY	20 TO 40
CLAY	40 PLUS

ABBREVIATIONS AND SYMBOLS

A	AUGER
AL	ATTERBERG LIMITS
BLK	BLACK
BR	BROWN
C	COARSE
CBR	CBR TEST
CD	CONSOLIDATED DRAINED TRIAXIAL SHEAR TEST
CM	LABORATORY COMPACTION TEST
CO	CONSOLIDATION TEST
CU	CONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
DK	DARK
DS	DIRECT SHEAR TEST
F	FINE
GR	GRAY
GS	GRAIN SIZE TEST
GVL	GRAVEL
LL	LIQUID LIMIT
LT	LIGHT, LITTLE
LV	LABORATORY VANE TEST
M	MEDIUM
NE	NOT ENCOUNTERED/RECORDED
OER	OPEN END ROD
PI	PLASTICITY INDEX
PL	PLASTIC LIMIT
REC	RECOVERY
RQD	ROCK QUALITY DESIGNATION
T	TRAP USED
TR	TRACE
U	UNDISTURBED SAMPLE
UC	UNCONFINED COMPRESSION TEST
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
V	FIELD VANE TEST
WOH	WEIGHT OF HAMMER
WOR	WEIGHT OF ROD

LA GUARDIA INTERNATIONAL AIRPORT

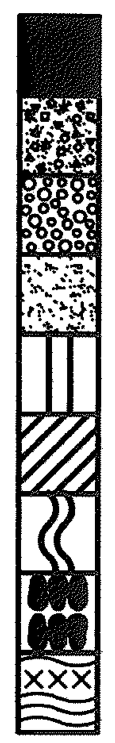
HORIZONTAL CONTROL

COORDINATES ARE BASED ON THE STATE PLANE NAD 83 NEW YORK LONG ISLAND

VERTICAL CONTROL

ELEVATION 0.00' IS 2.10 FEET BELOW NATIONAL GEODETIC VERTICAL DATUM OF 1929.

LEGEND
(FOR PRESENTATION OF BORINGS ONLY)



ASPHALT
MISCELLANEOUS AND MANMADE FILL
GRAVEL OR CRUSHED STONE
SAND
SILT
CLAY
ORGANIC SILTS AND CLAYS
DECOMPOSED ROCK
GNEISS

AS–DRILLED BORING LOCATIONS

BORING NO.	NORTHERLY	EASTERLY	SURFACE ELEV.
3-177	221783.0	1020545.0	8.1
3-178	221589.1	1020478.0	9.5
3-179	221425.3	1020366.5	11.1

LEGEND:

3–177 BORING NUMBER
AS–DRILLED BORING LOCATION

GENERAL NOTES

1. OVERBURDEN MATERIALS ARE CLASSIFIED IN ACCORDANCE WITH P.A. SOILS CLASSIFICATION SYSTEM (SF–92). SYMBOLS INDICATE MAJOR MATERIAL COMPONENTS ONLY (I.E., GENERALLY MORE THAN 35%).

2. THE DESCRIPTIVE TERM "SAME" REFERS TO THE SAMPLE DESCRIPTION LISTED IMMEDIATELY ABOVE (I.E., THE NUMERICALLY PRECEDING SAMPLE NUMBER). EXCEPTIONS TO THIS DESCRIPTION, IF ANY, ARE NOTED FOLLOWING A COMMA.

3. W.L. – INDICATES THE LEVEL OF FREE WATER SURFACE IN THE GROUND AT THE TIME BORING WAS MADE AND WAS DETERMINED BY OBSERVATION IN THE BORING HOLE OR IN A WELLPOINT. SEE BORING REPORT FOR METHOD OF OBSERVATION AND ADDITIONAL INFORMATION. THE INDICATED WATER LEVELS MAY OR MAY NOT HAVE STABILIZED AT THE TIME OF THE REPORTED OBSERVATIONS AND ALSO MAY NOT REFLECT SEASONAL CHANGES, TIDAL INFLUENCES OR THE EFFECTS OF INTENSE RAINFALL OR RUNOFF. THE OBSERVED DATA MAY NOT REFLECT PERCHED OR ARTESIAN WATER LEVELS THAT MAY BE PRESENT IN THE VARIOUS STRATA ENCOUNTERED.

4. THE BORINGS SHOWN ON THE PRESENTATION OF BORINGS DRAWINGS WERE MADE BY A DRILLING CONTRACTOR AND WERE INSPECTED BY PERSONNEL (INSPECTORS) OF THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY. CERTAIN INFORMATION ON THESE DRAWINGS WAS OBTAINED FROM OBSERVATIONS BY THE INSPECTOR THAT ARE RECORDED ON FORMS ENTITLED BORING REPORT, DRILLING REPORT AND UNDISTURBED SAMPLES. SAMPLES HAVE ALSO BEEN EXAMINED AND CLASSIFIED IN THE LABORATORY. THE DESCRIPTIONS SHOWN ON THE PRESENTATION OF BORINGS DRAWINGS MAY NOT AGREE WITH THE DESCRIPTIONS SHOWN ON THE FORMS PREPARED BY THE INSPECTOR. THESE FORMS SHOULD BE CONSULTED FOR ADDITIONAL DETAILS REGARDING BORING OPERATIONS AND THE NATURE OF THE MATERIALS ENCOUNTERED. THESE FORMS AND A DESCRIPTION OF THE P.A. SOILS CLASSIFICATION SYSTEM (SF–92) ARE AVAILABLE FOR REFERENCE AND EXAMINATION IN THE DESIGN DIVISION OFFICES OF THE ENGINEERING DEPARTMENT.

5. THE SURFACE DATA REPORTED ON THE PRESENTATION OF BORINGS DRAWINGS AND THE FORMS ENTITLED BORING REPORT, DRILLING REPORT AND UNDISTURBED SAMPLES SHOW CONDITIONS ENCOUNTERED AND OBSERVED ONLY AT THE PARTICULAR POINTS FROM WHICH SOIL SAMPLES, ROCK CORE AND SUBSURFACE DATA WERE OBTAINED AT THE TIME THE TEST BORING WAS MADE.

6. SAMPLE NUMBERS DESIGNATED AS 'UA' AND 'UB' REPRESENT SHELBY TUBE TOP (UTOP) AND SHELBY TUBE BOTTOM (UBOT) RESPECTIVELY.

7. BORINGS NUMBERED 3–177 THROUGH 3–179 WERE COMPLETED IN CONJUNCTION WITH CONTRACT NUMBER CA2–121.054, "CTB MODERNIZATION PROJECT".

NOTE: FOR PRESENTATION OF BORINGS, SEE DRAWINGS LGA–SL–291 THRU LGA–SL–292.

Sheet 1 of 3

THE PORT AUTHORITY OF NY & NJ

Dennis Cavalieri
CHIEF GEOTECHNICAL ENGINEER

No.	Date	Revision	Approved

ENGINEERING DEPARTMENT

LAGUARDIA INTERNATIONAL AIRPORT

GEOTECHNICAL

Title
CTB MODERNIZATION PROJECT

PROJECT SITE MAP, BORING LOCATION PLAN, GENERAL NOTES, LEGEND, ABBREVIATIONS & SYMBOLS, SOIL CLASSIFICATIONS

D. CAVALIERE	A. COFRANCESCO	D. CAVALIERE
Designed by	Drawn by	Checked by

Date AUGUST 5, 2010

Contract Number

Drawing Number LGA-SL-290

PID# NUMBER

PREPARED BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

THE PORT AUTHORITY OF NY & NJ

CHIEF GEOTECHNICAL ENGINEER

BORING NO. 3-177 — DATE 07-01-10 — PROJECT: CTB MODERNIZATION PROJECT

LOCATION: N 707981.8 E 666887.5
SURFACE ELEVATION: 8.1 | WL ELEVATION: 4.3 | BY: T.S. CHECKED BY: D.C.
BLOWS PER 6 IN. 1 3/8"ID SPOON 140 LB. HAMMER 30" FALL / ROCK CORE REPORT

DEPTH (FEET)	DEPTH (METERS)	ELEVATION (FEET)	WATER CONTENT (%)	BLOWS / ROCK CORE REPORT	SAMPLE NUMBER	SAMPLE CLASSIFICATION	LABORATORY TESTING
0	0	8.1 / 7.4				0.0'-0.7' ASPHALT	
			4	HAND AUGER	01	FILL-BROWN C-F SAND AND GRAVEL, TRACE SILT	
	1		2	WL HAND AUGER	02	SAME	
			14	HAND AUGER	03	MISC FILL-GRAY BROWN C-F SAND & GRAVEL, TRACE CINDERS, ASPHALT, BRICK, WOOD, SILT	
	2		37	7-9-9-6	04	SAME	
10	3		25	10-7-10-10	05	MISC FILL- GRAY C-F SAND, SOME CINDERS, LITTLE SILT, WOOD, TRACE GLASS, BRICK, CONCRETE	
			43	2-2-3	06	SAME	
	4		67	3-5-12	07	SAME	
	5		40	3-3-3	08	SAME	
			31	3-3-2	09	SAME	
20	6		50	2-2-2	10	SAME	
	7	-16.9	65	2-1-2	11	SAME	
	8		74	1-2-1	12	GRAY ORGANIC SILTY CLAY, TRACE SHELLS, FINE SAND	
			69	PRESSED 24"	13U	SAME	
30	9		73	WOH-WOH-WOH	14	SAME	
			67	PRESSED 24"	15UA	SAME	
	10		71		15UB	SAME	
			67	WOH-WOH-WOH	16	SAME	
	11		91	WOH-WOH-WOH	17	SAME	
40	12		85	WOH-WOH-WOH	18	SAME	
	13		68	PRESSED 24"	19UA	SAME	
			80		19UB	SAME	
	14		87	WOH-WOH-WOH	20	SAME	
50	15		86	WOH-WOH-WOH	21	SAME	
	16, 17		89	WOH-WOH-WOH	22	SAME	
60	18, 19		89	WOH-WOH-WOH	23	SAME	
	20		88	WOH-WOH-WOH	24	SAME	
70	21, 22		88	WOR-WOR-WOR	25	SAME	
	23	-68.9	75	WOR-WOR-WOR	26	SAME	
80	24, 25	-76.9	19	3-5-8	27	GRAY CLAYEY SILT AND FINE SAND, TRACE SHELLS	
	26	-79.9	21	12-14-21	28	BROWN C-F SAND AND GRAVEL, TRACE SILT	
90	27, 28	-86.9	20	5-7-9	29	BROWN CLAYEY SILT, LITTLE FINE SAND	
	29, 30		39	WOR-8-8	30	GRAY BROWN SILTY CLAY, TRACE FINE SAND	
100	31		49	WOH-4-4	31	SAME	
	32, 33	-101.9	53	WOR-WOR-WOR	32	SAME	
110	34	-104.9	36	5-9-13	33	GRAY BROWN SILT AND FINE SAND	
	35, 36		28	11-16-16	34	GRAY BROWN FINE SAND, LITTLE SILT	
120	37, 38	-116.9	26	8-17-15	35	SAME	
	39		45	WOR-WOR-WOR	36	GRAY BROWN SILTY CLAY, TRACE FINE SAND	
130	40		30	3-3-3	37	GRAY BROWN SILT, LITTLE FINE SAND	
	41, 42		44	WOR-WOR-WOR	38	GRAY BROWN SILTY CLAY, TRACE FINE SAND	
140	43		47	WOR-WOR-WOH	39	SAME	
150	44, 45	-141.9	30	2-2-3	40	GRAY BROWN SILT, LITTLE FINE SAND	

CONTINUED ...

CONTINUING ...

BORING NO. 3-177 — DATE 07-01-10 — PROJECT: CTB MODERNIZATION PROJECT

LOCATION: N 707981.8 E 666887.5
SURFACE ELEVATION: 8.1 | WL ELEVATION: 4.3 | BY: T.S. CHECKED BY: D.C.
BLOWS PER 6 IN. 1 3/8"ID SPOON 140 LB. HAMMER 30" FALL / ROCK CORE REPORT

DEPTH (FEET)	DEPTH (METERS)	ELEVATION (FEET)	WATER CONTENT (%)	BLOWS / ROCK CORE REPORT	SAMPLE NUMBER	SAMPLE CLASSIFICATION	LABORATORY TESTING
150	46	-144.9	46	2-2-3	41	GRAY BROWN SILTY CLAY, TRACE FINE SAND	
	47, 48		30	4-7-12	42	GRAY BROWN M-F SAND, LITTLE CLAYEY SILT SEAMS	
160	49		13	28-36-29	43	BROWN C-F SAND, SOME GRAVEL, TRACE SILT	
	50	-156.1	10	100/2"-50/0"*	44	SAME	
	51	-161.1		REC=100% RQD=76%	R1	GNEISS	

*300 LB HAMMER USED

BORING NO. 3-178 — DATE 07-08-10 — PROJECT: CTB MODERNIZATION PROJECT

LOCATION: N 707787.6 E 666821.6
SURFACE ELEVATION: 9.5 | WL ELEVATION: 0.6 | BY: T.S. CHECKED BY: D.C.
BLOWS PER 6 IN. 1 3/8"ID SPOON 140 LB. HAMMER 30" FALL / ROCK CORE REPORT

DEPTH (FEET)	DEPTH (METERS)	ELEVATION (FEET)	WATER CONTENT (%)	BLOWS / ROCK CORE REPORT	SAMPLE NUMBER	SAMPLE CLASSIFICATION	LABORATORY TESTING
0	0	9.5 / 8.6				0.0'-0.9' ASPHALT	
			5	HAND AUGER	01	FILL-BROWN C-F SAND AND GRAVEL, TRACE SILT	
	1		16	HAND AUGER	02	FILL-BROWN C-F SAND, TRACE SILT, GRAVEL	
			14	HAND AUGER	03	SAME	
	2		21	37-29-31-14	04	MISC FILL-GRAY C-F SAND & GRAVEL, LITTLE SILT, TRACE ASPHALT, CONCRETE, GLASS, CINDERS, BRICK	
			17	WL 9-4-3-1	05	MISC FILL-GRAY C-F SAND, LITTLE GRAVEL, TRACE SILT, ASPHALT, CONCRETE, GLASS, CINDERS, BRICK	
10	3		32	2-1-1	06	MISC FILL-GRAY C-F SAND & GRAVEL, LITTLE SILT, TRACE ASPHALT, CONCRETE, GLASS, CINDERS, BRICK	
	4		19	3-3-3	07	SAME	
	5		36	5-5-3	08	SAME	
			46	2-2-3	09	SAME	
20	6		35	2-2-1	10	SAME	
	7		23	2-3-3	11	SAME	
	8		47	3-2-2	12	SAME	
30	9	-20.5	69	WOH-WOH-WOH	13	GRAY ORGANIC SILTY CLAY, TRACE SHELLS, FINE SAND	
	10		92	PRESSED 24"	14UA	SAME	
			80		14UB	SAME	
	11		75	WOH-WOH-WOH	15	SAME	
40	12		69	WOH-WOH-WOH	16	SAME	
	13		49	PRESSED 24"	17UA	SAME	
			84		17UB	SAME	
	14		83	WOH-WOH-WOH	18	SAME	
50	15, 16		78	WOH-WOH-WOH	19	SAME	
	17		87	WOH-WOH-WOH	20	SAME	
60	18, 19		85	WOH-WOH-WOH	21	SAME	
	20		76	WOH-WOH-WOH	22	SAME	
70	21, 22		78	WOR-WOR-WOR	23	SAME	
	23		77	WOR-WOR-WOR	24	SAME	
80	24, 25	-75.5	58	WOR-WOR-WOR	25	GRAY ORGANIC SILTY CLAY, LITTLE BROWN PEAT, TRACE SHELLS, FINE SAND	
	26		21	3-6-8	26	BROWN C-F SAND, LITTLE SILT, TRACE GRAVEL	
90	27, 28	-83.5	23	4-6-9	27	BROWN C-F SAND, TRACE SILT	
	29, 30	-90.5	34	6-10-17	28	BROWN AND GRAY SILTY CLAY, LENSES OF M-F SAND	
100	31, 32	-95.5	43	2-2-3	29	VARVED GRAY CLAYEY SILT, LENSES OF FINE SAND	
110	33	-100.5	48	WOR-WOR-WOR	30	VARVED SILTY CLAY, LENSES OF FINE SAND	

CONTINUED ...

CONTINUING ...

BORING NO. 3-178 — DATE 07-08-10 — PROJECT: CTB MODERNIZATION PROJECT

LOCATION: N 707787.6 E 666821.6
SURFACE ELEVATION: 9.5 | WL ELEVATION: 0.6 | BY: T.S. CHECKED BY: D.C.
BLOWS PER 6 IN. 1 3/8"ID SPOON 140 LB. HAMMER 30" FALL / ROCK CORE REPORT

DEPTH (FEET)	DEPTH (METERS)	ELEVATION (FEET)	WATER CONTENT (%)	BLOWS / ROCK CORE REPORT	SAMPLE NUMBER	SAMPLE CLASSIFICATION	LABORATORY TESTING
110	34	-103.5	37	WOR-WOR-WOR	31	GRAY BROWN SILT, LITTLE FINE SAND	
	35, 36		25	5-7-12	32	GRAY BROWN M-F SAND, SOME SILT	
120	37	-113.5	24	7-12-15	33	GRAY BROWN M-F SAND, LITTLE SILT	
	38, 39		45	WOH-1-1	34	VARVED GRAY BROWN CLAY SILT, LENSES OF FINE SAND	
130	40		36	2-2-1	35	GRAY BROWN CLAYEY SILT, TRACE FINE SAND	
	41, 42		38	WOR-WOR-WOR	36	VARVED GRAY BROWN CLAY SILT, LENSES OF FINE SAND	
140	43		44	WOR-WOR-WOR	37	GRAY BROWN CLAYEY SILT, TRACE FINE SAND	
	44, 45	-140.5	44	WOR-WOR-WOR	38	VARVED GRAY BROWN CLAY SILT, LENSES OF FINE SAND	
150	46		42	WOR-WOR-5	39	VARVED GRAY BROWN SILTY CLAY, LENSES OF FINE SAND	
	47	-147.5	24	5-7-9	40	BROWN SILTY CLAY, LITTLE C-F SAND	
160	48, 49	-153.5	10	25-33-36	41	BROWN C-F SAND AND GRAVEL, TRACE SILT, GLACIAL TILL	
	50	-155.6	15	100/1"-50/0"*	42	DECOMPOSED ROCK, GNEISS	
170	51	-160.6		REC=78% RQD=29%	R1	GNEISS, HIGHLY DECOMPOSED LAYERS	

*300 LB HAMMER USED

NOTE: FOR PROJECT SITE MAP, BORING LOCATION PLAN, LEGEND, GENERAL NOTES, ABBREVIATIONS, AND SOIL CLASSIFICATIONS, SEE DRAWING LGA-SL-290.

No.	Date	Revision	Approved

ENGINEERING DEPARTMENT

LAGUARDIA INTERNATIONAL AIRPORT

GEOTECHNICAL

Title
CTB MODERNIZATION PROJECT

PRESENTATION OF BORINGS

D. CAVALIERE	A. COFRANCESCO	D. CAVALIERE
Designed by	Drawn by	Checked by

Date: AUGUST 5, 2010

Contract Number:

Drawing Number: **LGA-SL-291**

PID# NUMBER

PREPARED BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

BORING NO. 3-179	DATE 07-15-10	PROJECT CTB MODERNIZATION PROJECT					
DEPTH (FEET)	DEPTH (METERS)	ELEVATION (FEET)	WATER CONTENT (%)	BLOWS PER 6 IN. 1 3/8"ID SPOON 140 LB. HAMMER 30" FALL / ROCK CORE REPORT	SAMPLE NUMBER	LOCATION N 221425.3 E 1020366.5 / SURFACE ELEVATION 11.1 / WL ELEVATION 4.3 / BY: T.S. CHECKED BY: D.C. / SAMPLE CLASSIFICATION	LABORATORY TESTING
0	0	11.1 / 10.2				0.0'–0.9' ASPHALT	
			3	HAND AUGER	01	FILL–BROWN C–F SAND AND GRAVEL, TRACE SILT	
	1		1	HAND AUGER	02	MISC FILL–GRAY ASPHALT, SOME C–F SAND, TRACE SILT	
			1	HAND AUGER	03	SAME	
	2		17	WL 10–12–15–16	04	FILL–GRAY BROWN C–F SAND AND GRAVEL, TRACE SILT	
			8	16–19–23–27	05	FILL–BROWN C–F SAND AND GRAVEL, TRACE SILT	
10	3		27	4–6–7	06	MISC FILL–BROWN GRAY SOME GRAVEL, TRACE SILT, WOOD, CINDERS, GLASS, BRICK	
	4		56	2–2–3	07	MISC FILL–BROWN GRAY SOME GRAVEL, LITTLE WOOD, TRACE SILT, CINDERS, GLASS, BRICK	
	5		37	7–6–7	08	MISC FILL–BROWN GRAY SOME GRAVEL, TRACE SILT, WOOD, CINDERS, GLASS, BRICK	
			44	6–7–9	09	SAME	
20	6		32	2–2–2	10	SAME	
	7	−13.4		2–1–1	11	NO RECOVERY	
	8		60	2–2–1	12	GRAY ORGANIC SILTY CLAY, LITTLE WOOD, TRACE GRAVEL, SHELLS, C–F SAND	
30	9		72	WOH–WOH–WOH	13	GRAY ORGANIC SILTY CLAY, TRACE SHELLS, FINE SAND	
	10		69	PRESSED 24"	14UA	SAME	
			102		14UB	SAME	
	11		73	WOH–WOH–WOH	15	SAME	
40	12		69	WOH–WOH–WOH	16	SAME	
	13		71	PRESSED 24"	17U	SAME	
	14		75	PRESSED 24"	18UA	SAME	
			79		18UB	SAME	
			75	WOH–WOH–WOH	19	SAME	
50	15		80	WOH–WOH–WOH	20	SAME	
	16		84	PRESSED 24"	21UA	SAME	
			83		21UB	SAME	
	17		90	WOH–WOH–WOH	22	SAME	
60	18		79	WOH–WOH–WOH	23	SAME	
	19		54	PRESSED 24"	24UA	SAME	
			84		24UB	SAME	
	20		79	WOH–WOH–WOH	25	SAME	
70	21		72	WOH–WOH–WOH	26	SAME	
	22		57	PRESSED 24"	27UA	SAME	
			73		27UB	SAME	
	23		87	WOR–WOR–WOR	28	SAME	
80	24	−72.9	70	WOR–WOR–WOR	29	SAME	
	25	−73.9	60	PRESSED 24"	30UA	SAME	
			29		30UB	GRAY M–F SAND, TRACE SILT	
	26	−76.9	27	6–7–9	31	GRAY C–F SAND, SOME GRAVEL, LITTLE SILT	
90	27 / 28		22	5–10–13	32	GRAY BROWN SILTY CLAY, SOME GRAVEL	
	29		41	1–WOH–WOH	33	VARVED GRAY BROWN SILTY CLAY, LENSES OF FINE SAND	
100	30 / 31		40	4–3–3	34	GRAY BROWN CLAY, TRACE FINE SAND	
	32 / 33	−98.9	48	WOH–WOH–WOH	35	VARVED GRAY BROWN SILTY CLAY, LENSES OF FINE SAND	
110	34		38	5–6–9	36	GRAY BROWN SILT, TRACE FINE SAND	
	35		32	7–8–14	37	GRAY BROWN CLAYEY SILT, TRACE FINE SAND	
120	36 / 37		32	7–7–10	38	SAME	
	38	−113.9	50	2–2–4	39	GRAY BROWN CLAY, TRACE FINE SAND	
130	39 / 40		45	WOH–WOH–8	40	SAME	
	41 / 42	−128.9		WOH–1–1	41	SAME	
140	43		28	11–29–15	42	GRAY BROWN C–F SAND, SOME GRAVEL, LITTLE SILT	
	44 / 45	−136.9	13	13–15–14	43	GRAY BROWN C–F SAND AND GRAVEL, TRACE SILT	
150		−138.9				GRAVEL & SAND	

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BORING NO. 3-179	DATE 07-15-10	PROJECT CTB MODERNIZATION PROJECT					
DEPTH (FEET)	DEPTH (METERS)	ELEVATION (FEET)	WATER CONTENT (%)	BLOWS PER 6 IN. 1 3/8"ID SPOON 140 LB. HAMMER 30" FALL / ROCK CORE REPORT	SAMPLE NUMBER	LOCATION N 221425.3 E 1020366.5 / SURFACE ELEVATION 11.1 / WL ELEVATION 4.3 / BY: T.S. CHECKED BY: D.C. / SAMPLE CLASSIFICATION	LABORATORY TESTING
150	46		16	15–13–11	44	GRAY GRAVEL AND C–F SAND, TRACE SILT	
	47 / 48		17	13–10–8	45	SAME	
160	49		10	6–7–13	46	SAME	
	50	−153.9					
	51		27	14–17–29	47	DECOMPOSED ROCK, GNEISS	
170	52	−159.7	21	46–100/3"–50/0"*	48	SAME	
	53	−164.7		REC=82% ROD=47%	R1	GNEISS, WEATHERED SEAMS	

*300 LB HAMMER USED

NOTE: FOR PROJECT SITE MAP, BORING LOCATION PLAN, LEGEND, GENERAL NOTES, ABBREVIATIONS, AND SOIL CLASSIFICATIONS, SEE DRAWING LGA–SL–290.

THE PORT AUTHORITY OF NY & NJ

CHIEF GEOTECHNICAL ENGINEER

No.	Date	Revision	Approved

ENGINEERING DEPARTMENT

LAGUARDIA INTERNATIONAL AIRPORT

GEOTECHNICAL

Title

CTB MODERNIZATION PROJECT

PRESENTATION OF BORINGS

D. CAVALIERE	A. COFRANCESCO	D. CAVALIERE
Designed by	Drawn by	Checked by

Date AUGUST 5, 2010

Contract Number

Drawing Number LGA-SL-292

PID# NUMBER

Appendix C: Interim Environmental Conditions Report LaGuardia Airport CTB Replacement Project. Soil and Groundwater Data

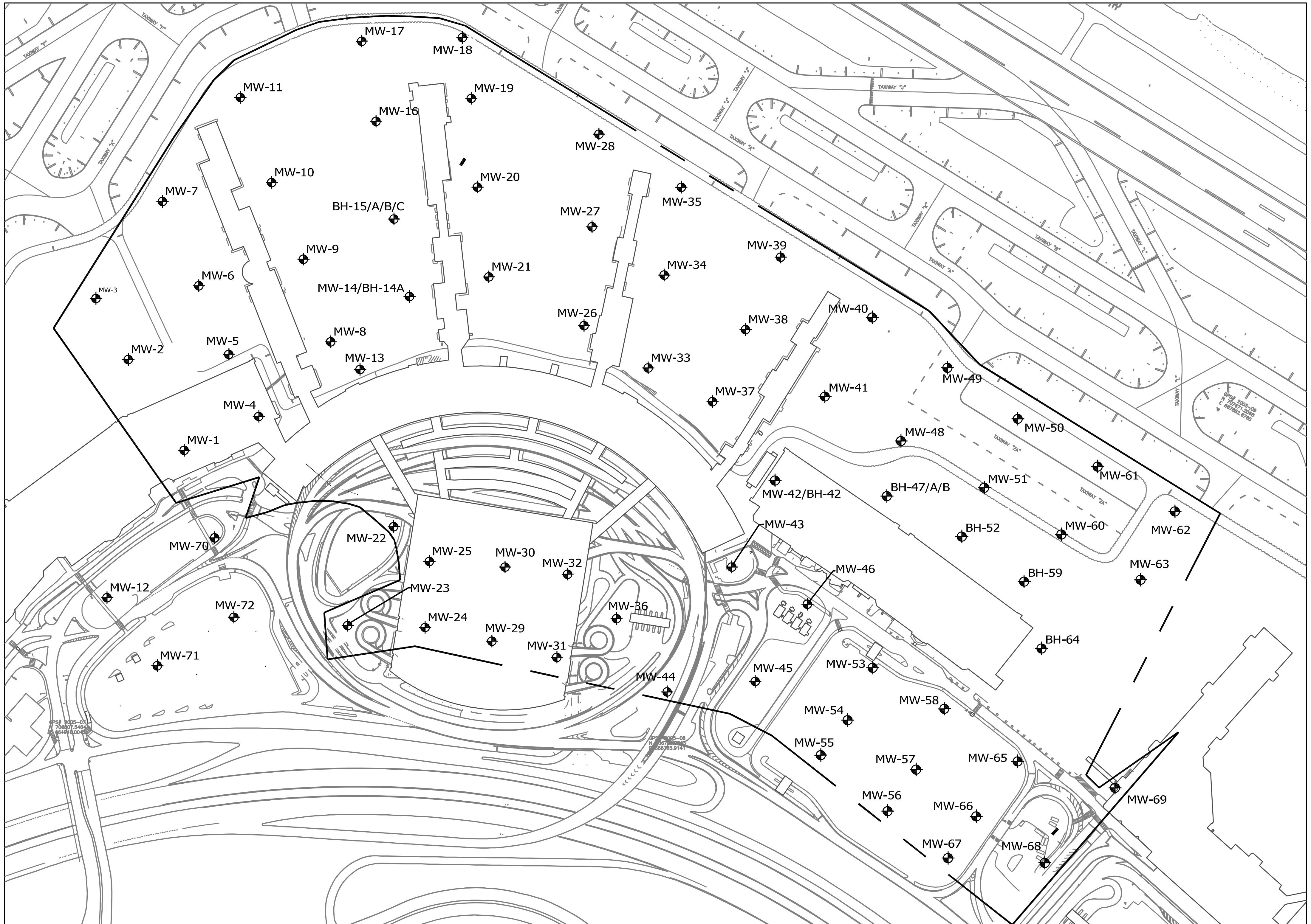
INTERIM ENVIRONMENTAL CONDITIONS REPORT

LaGUARDIA AIRPORT

CENTRAL TERMINAL REPLACEMENT PROJECT

SOIL AND GROUNDWATER DATA

March 4, 2013



0 300 600

SCALE IN FEET

LEGEND:

PROJECT AREA

BH-15/A/B/C SOIL BORING LOCATION

MW-63 MONITORING WELL

NOTES:

1.) Monitoring well locations are approximate.
2.) Monitoring wells MW–3, MW–15, MW–47, MW–52, MW–59, MW–64 were not installed due to an obstruction in the subsurface.

Sheet of

THE PORT AUTHORITY OF NY & NJ

No.	Date	Revision	Approved

ENGINEERING DEPARTMENT

LAGUARDIA AIRPORT

Title

MONITORING WELL LOCATION MAP

E. ALDRICH Designed by
R. ANDREJKOVICS Drawn by
K. KOCH Checked by

Date 2/26/2013

Contract Number

Drawing Number

PID#

Project: CTRP-BLINE-2012	**X Coordinate:** 999999.00	**Borehole ID:** CTB-MW-05
Contract No.: CA02-121.161	**Y Coordinate:** 999999.00	**Date Start/Finish:** 1/17/2013 / 1/17/2013
Subfacility: Central Terminal Replacement Project	**Borehole Diameter:** 12 in	**Drilling Company:** CRAIG DRILLING
Location: laid out as per drawing	**Total Depth:** 16 ft	**Driller's Name:** Craig Cohen
Hole Type: MONITOR WELL	**Spoon:** Split Spoon	**Drilling Method:** Hollow Stem Auger
Hammer Type: Auto	**Hammer Wt (lbs):** 140	**Contractor:** Tectonic
Surface Completion: Flush Mount	**Hammer Fall (in):** 30	**Inspector:** AW

Depth (feet)	Sample ID	Recovery Length (in)	Open Borehole WL	Blow Counts / 6"	PID Readings/6" (ppm)	Well Construction	Sample Description and Remarks
0				DRILL	0		(0.00- 0.70') ASPHALT
1	CTB-MW-05-201301170050			HA	0		(0.70- 2.00') Fill, Bwn C-F SAND, trace GRAVEL, little SILT
2				HA	0		(2.00- 4.00') Fill, Bwn C-F SAND, trace GRAVEL, little SILT
4				HA	0		(4.00- 6.00') Fill, Bwn M-F SAND, trace GRAVEL, trace SILT
6	CTB-MW-05-201301170120		∇	5,4,5,5	0		(6.00- 8.00') Fill, Bwn M-F SAND, trace GRAVEL, trace SILT
8				4,5,4,4	0		(8.00- 10.00') Fill, Bwn M-F SAND, trace GRAVEL, trace SILT
10				3,2,3,3	0		(10.00- 12.00') Fill, Bwn M-F SAND, trace GRAVEL, trace SILT
12				5,4,4,4	0		(12.00- 14.00') Fill, Bwn M-F SAND, trace GRAVEL, trace SILT
14				4,4,5,6	0		(14.00- 16.00') Fill, Bwn M-F SAND, trace GRAVEL, trace SILT
16							

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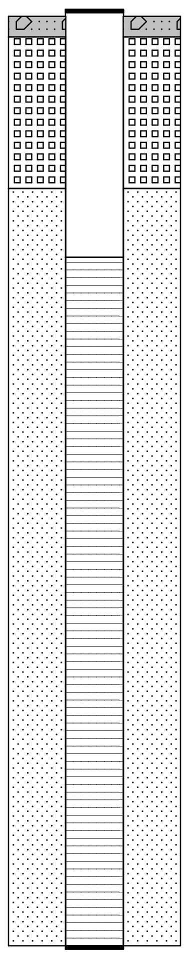
Remarks:

Coordinates provided in State Plane NAD83.

Project: CTRP-BLINE-2012	**X Coordinate:** 999999.00	**Borehole ID:** CTB-MW-06
Contract No.: CA02-121.161	**Y Coordinate:** 999999.00	**Date Start/Finish:** 1/18/2013 / 1/18/2013
Subfacility: Central Terminal Replacement Project	**Borehole Diameter:** 12 in	**Drilling Company:** CRAIG DRILLING
Location: Laid out as per drawing	**Total Depth:** 16 ft	**Driller's Name:** C Cohen
Hole Type: MONITOR WELL	**Spoon:** CRAIG DRILLING	**Drilling Method:** Hollow stem auger
Hammer Type: Auto	**Hammer Wt (lbs):** 140	**Contractor:** Tectonic
Surface Completion: Flush Mount	**Hammer Fall (in):** 30	**Inspector:** AW

Depth (feet)	Sample ID	Recovery Length (in)	Open Borehole WL	Blow Counts / 6"	PID Readings/6" (ppm)	Well Construction	Sample Description and Remarks
0		Full		HA	0		(0.00- 1.25') CONCRETE
1	CTB-MW-06-201301180218	Full		HA	0		(1.25- 2.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
2		Full		HA	0		(2.00- 4.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
4		Full		HA	0		(4.00- 6.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
6	CTB-MW-06-201301180322	12	∇	18,13,11,13	0		(6.00- 8.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
8		18		5,5,5,6	0		(8.00- 10.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
10		16		4,4,4,4	0		(10.00- 12.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
12		19		5,4,5,6	0		(12.00- 14.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
14		14		4,3,2,2	0		(14.00- 16.00') FILL, Brown C-F SAND some GRAVEL, trace SILT, Silt in tip of spoon
16							



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Remarks:

Coordinates provided in State Plane NAD83.

Project:	**X Coordinate:** 999999.00	**Borehole ID:** **CTB-MW-08**
Contract No.:	**Y Coordinate:** 999999.00	**Date Start/Finish:** /
Subfacility: **Central Terminal Replacement Project**	**Borehole Diameter:**	**Drilling Company:** CRAIG DRILLING
Location: Laid out per drawing	**Total Depth:** 16 ft	**Driller's Name:** C. Cohen
Hole Type: MONITOR WELL	**Spoon:**	**Drilling Method:** Hollow stem auger
Hammer Type:	**Hammer Wt (lbs):**	**Contractor:** TECTONIC
Surface Completion: Flush mount	**Hammer Fall (in):**	**Inspector:** DB

Depth (feet)	Sample ID	Recovery Length (in)	Open Borehole WL	Blow Counts / 6"	PID Readings/6" (ppm)	Well Construction	Sample Description and Remarks
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

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Remarks:

Coordinates provided in State Plane NAD83.

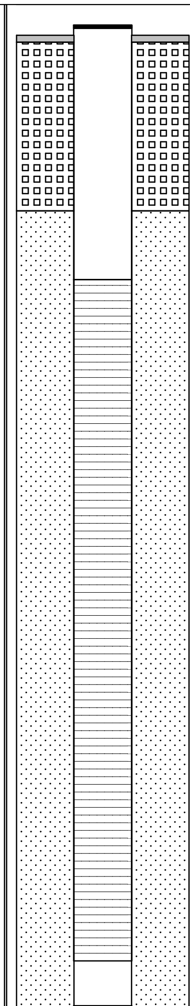
Project: CTRP-BLINE-2012
Contract No.: CA02-121.161
Subfacility: Central Terminal Replacement Project
Location: Laid out per drawing
Hole Type: MONITOR WELL
Hammer Type: AUTO
Surface Completion: Flush mount

X Coordinate: 999999.00
Y Coordinate: 999999.00
Borehole Diameter: 12 in
Total Depth: 16 ft
Spoon: CRAIG DRILLING
Hammer Wt (lbs): 140
Hammer Fall (in): 30

Borehole ID: CTB-MW-09
Date Start/Finish: 1/11/2013 / 1/11/2013
Drilling Company: CRAIG DRILLING
Driller's Name: C. Cohen
Drilling Method: Hollow stem auger
Contractor: TECTONIC
Inspector: DB

Depth (feet)	Sample ID	Recovery Length (in)	Open Borehole WL	Blow Counts / 6"	PID Readings/6" (ppm)	Sample Description and Remarks
0.00-0.80		10		Auger	0	(0.00- 0.80') ASPHALT
0.80-1.30		6		Auger	0	(0.80- 1.30') CONCRETE
1.30-2.00	CTB-MW-09-201301110225	8		HA	1.75	(1.30- 2.00') FILL, Grey C-F SAND, little GRAVEL, trace SILT
2.00-4.00		24		HA	0.80	(2.00- 4.00') FILL, Dark Brown C-F SAND, little GRAVEL, trace SILT
4.00-6.00		24		HA	5.6	(4.00- 6.00') FILL, Dark Brown C-F SAND, little GRAVEL, little SILT, trace BRICK, trace GLASS
6.00-8.00	CTB-MW-09-201301110325	18	⊻	25,12,11,11	0	(6.00- 8.00') FILL, Brown C-F SAND, little GRAVEL, little SILT, trace BRICK
8.00-10.00		18		7,7,6,7	0	(8.00- 10.00') FILL, Grey Brown C-F SAND, little SILT, trace GRAVEL
10.00-12.00		10		4,2,2,5	0	(10.00- 12.00') FILL, Grey Brown C-F SAND, little SILT, trace GRAVEL, trace BRICK
12.00-14.00		14		3,3,5,8	0	(12.00- 14.00') FILL, Grey Brown M-F SAND, trace SILT, trace BRICK
14.00-16.00		10		9,9,7,6	0	(14.00- 16.00') FILL, Grey Brown M-F SAND, trace SILT, trace BRICK, trace CINDER

Well Construction



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Remarks:

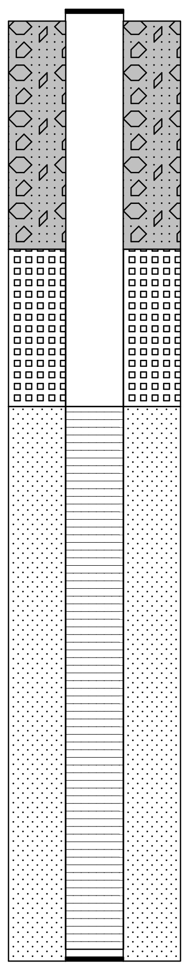
Coordinates provided in State Plane NAD83.

Project: CTRP-BLINE-2012
Contract No.: CA02-121.161
Subfacility: Central Terminal Replacement Project
Location: Deviated 4' west of BH-71
Hole Type: MONITOR WELL
Hammer Type:
Surface Completion: Flush mount

X Coordinate: 9999999.00
Y Coordinate: 9999999.00
Borehole Diameter: 12 in
Total Depth: 14 ft
Spoon:
Hammer Wt (lbs): 140
Hammer Fall (in): 30

Borehole ID: CTB-MW-71
Date Start/Finish: 2/1/2013 / 2/1/2013
Drilling Company: CRAIG DRILLING
Driller's Name: C. Cohen
Drilling Method: Hollow Stem Auger
Contractor: TECTONIC
Inspector: KL

Depth (feet)	Sample ID	Recovery Length (in)	Open Borehole WL	Blow Counts / 6"	PID Readings/6" (ppm)	Well Construction	Sample Description and Remarks
0					0		(0.00- 0.80') ASPHALT
1	CTB-MW-71-201302010910			HA	0		(0.80- 2.00') FILL, Grey Brown C-F SAND some GRAVEL, trace SILT
2				HA	0		(2.00- 4.00') FILL, Grey C-F SAND some GRAVEL, trace SILT
4				HA	0		(4.00- 6.00') FILL, Grey C-F SAND some GRAVEL, trace SILT
6				8,16,20,19	0		(6.00- 8.00') FILL, Grey C-F SAND trace GRAVEL, SILT
8	CTB-MW-71-201302011145		⊻	7,9,6,3	0		(8.00- 10.00') FILL, Grey C-F SAND trace GRAVEL, SILT
10				2,2,4,4	0		(10.00- 12.00') FILL, Grey Brown C-F SAND trace GRAVEL, SILT
12				7,6,5,4	0		(12.00- 14.00') Grey Brown organic CLAY, trace SHELLS
14							



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Remarks:

Coordinates provided in State Plane NAD83.

Project: **CTRP-BLINE-2012**	**X Coordinate:** 9999999.00	**Borehole ID:** **CTB-MW-72**
Contract No.: **CA02-121.161**	**Y Coordinate:** 9999999.00	**Date Start/Finish:** 2/1/2013 / 2/1/2013
Subfacility: **Central Terminal Replacement Project**	**Borehole Diameter:** 12 in	**Drilling Company:** CRAIG DRILLING
Location: Laid out as per drawing	**Total Depth:** 16 ft	**Driller's Name:** C. Cohen
Hole Type: MONITOR WELL	**Spoon:**	**Drilling Method:** Hollow Stem Auger
Hammer Type:	**Hammer Wt (lbs):** 140	**Contractor:** TECTONIC
Surface Completion: Flush mount	**Hammer Fall (in):** 30	**Inspector:** KL

Depth (feet)	Sample ID	Recovery Length (in)	Open Borehole WL	Blow Counts / 6"	PID Readings/6" (ppm)	Well Construction	Sample Description and Remarks
0					0		(0.00- 0.80') ASPHALT
1	CTB-MW-72-201302011320			HA	0		(0.80- 2.00') FILL, Brown C-F SAND some GRAVEL, trace SILT
2				HA	0		(2.00- 4.00') FILL, Tan C-F SAND some GRAVEL, trace SILT
4				HA	0		(4.00- 6.00') FILL, Tan C-F SAND some GRAVEL, trace SILT
6				18,7,8,12	0		(6.00- 8.00') FILL, Grey Brown SILT little M-F SAND, trace GRAVEL
8	CTB-MW-72-201302011340		▽	18,12,7,5	0		(8.00- 10.00') FILL, Tan C-F SAND little GRAVEL
10				6,3,3,3	0		(10.00- 12.00') FILL, Tan C-F SAND little GRAVEL, trace SHELLS
12				6,3,4,6	0		(12.00- 14.00') FILL, Grey C-F SAND little GRAVEL, trace SHELLS
14				1,2,2,2	0		(14.00- 16.00') Grey C-F SAND, little GRAVEL, trace SHELLS
16							

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Remarks:

Coordinates provided in State Plane NAD83.