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GEOARCHEOLOGICAL EVALUATION

SHORE PARKWAY BRIDGE OVER FRESH CREEK BASIN

97 DOT 006 K

TAMS

Prepared by TAMS Consultants, Inc. and
Geoarcheological Research Associates for

NEW YORK CITY DOT

New York City Department of Transportation

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EXECUTIVE SUMMARY

The New York City Department of Transportation (NYCDOT) is planning to replace the Shore Parkway Bridge over Fresh Creek Basin with a new bridge that will be located in essentially the same location. The Shore Parkway Bridge over Fresh Creek Basin is located on the Shore Parkway in the southeastern part of the Borough of Brooklyn, New York. The bridge carries the Shore Parkway over Fresh Creek Basin, an estuary of Jamaica Bay, and was constructed in 1941 as part of the Belt Parkway System. The bridge is east of the Rockaway Parkway interchange and west of the Pennsylvania Avenue interchange. In this area the northbound lanes of the Shore Parkway are bounded by parkland and Jamaica Bay to the south of the bridge and by the closed Pennsylvania Avenue Landfill and Jamaica Bay to the north of the bridge. Undeveloped marshland and the residential neighborhood of Canarsie bound the southbound lanes of the Shore Parkway to the north and south of the bridge.

In 1997 a cultural resources assessment of the nine Shore Parkway Bridges was performed leading to the determination that Fresh Creek Basin has the potential to contain deeply-buried archaeologically-sensitive prehistoric resources (HPI, 1997). Per recommendations included in that assessment, the NYCDOT contracted TAMS Consultants, Inc. (TAMS) and their subconsultant Geoarcheology Research Associates (GRA) to perform a geoarcheological analysis.

The objective of this work effort was to assess the possibility for preservation of archeological deposits and buried cultural surfaces adjacent to the existing bridge (the proposed reconstruction will only be disturbing a narrow strip of land adjacent to the present bridge). In coastal or estuarine situations similar to the one in the bridge vicinity, such deposits are typically associated with peat or organic sediments indicative of prehistoric coastal or bay margin environments. The age of these deposits can be determined through radiocarbon dating.

The geoarcheological analysis consisted of the monitoring of several geotechnical and environmental borings performed as part of the design phase of bridge construction. In addition, the field team performed specialized soil analyses and submitted a small number of soil samples for radiocarbon dating.

Analysis demonstrated that most of the upper soil layers have been extensively disturbed by historic landscaping. However, along isolated portions of the project corridor at depths of approximately six meters (m) (20 feet [ft]) below mean sea level, Holocene and Pleistocene deposits were identified. Although a comprehensive interpretation of the shoreline geomorphology was impossible, analysis of intact sequences of these deposits indicated that a late-Holocene rise in sea level promoted active estuarine sedimentation coupled with stream sedimentation, migration, and incision.

While the compromised contexts of the upper deposits preclude the possibility of preservation of archeological materials for most of the impact area, isolated portions of the late-Holocene sequences probably represented an environment considered attractive for natural resource procurement during prehistory. However, these isolated upper stratigraphies have only limited archaeological potential, appear to predate previously documented prehistoric activity in this area, and yielded no direct evidence of prehistoric activity. Therefore, no further study of the archaeological resources of the Shore Parkway Bridge over Fresh Creek Basin project area is recommended.

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1 INTRODUCTION

1.1 Location and Description of Project Area

The Shore Parkway Bridge over Fresh Creek Basin is located on the Shore Parkway in the southeastern part of the Borough of Brooklyn, New York (see Figure 1). The bridge carries the Shore Parkway over Fresh Creek Basin, an estuary of Jamaica Bay (see Figure 2 and Photos 1, 2, and 3). The bridge is east of the Rockaway Parkway interchange and west of the Pennsylvania Avenue interchange and is oriented in a northeast direction over Fresh Creek. In this area the northbound lanes of the Shore Parkway are bounded by parkland and Jamaica Bay to the south of the bridge and by the closed Pennsylvania Avenue Landfill and Jamaica Bay to the north of the bridge. Undeveloped marshland and the residential neighborhood of Canarsie bound the southbound lanes of the Shore Parkway to the north and south of the bridge.

The bridge was constructed in 1941 and is part of the Belt Parkway System. This system is a six lane high-volume highway carrying two-way traffic. The general direction of traffic in the vicinity of the bridge is east-west along the Jamaica Bay shoreline of Brooklyn and Queens. The Belt Parkway System begins in Bay Ridge, to the west where Interstate 278 branches off toward the Verrazano Narrows Bridge and ends to the northeast at the Whitestone Bridge.

The New York City Department of Transportation (NYCDOT) is planning to demolish and replace the existing Shore Parkway Bridge over Fresh Creek Basin. The proposed new bridge will have three spans and will be aligned to maintain the existing centerline of the parkway.

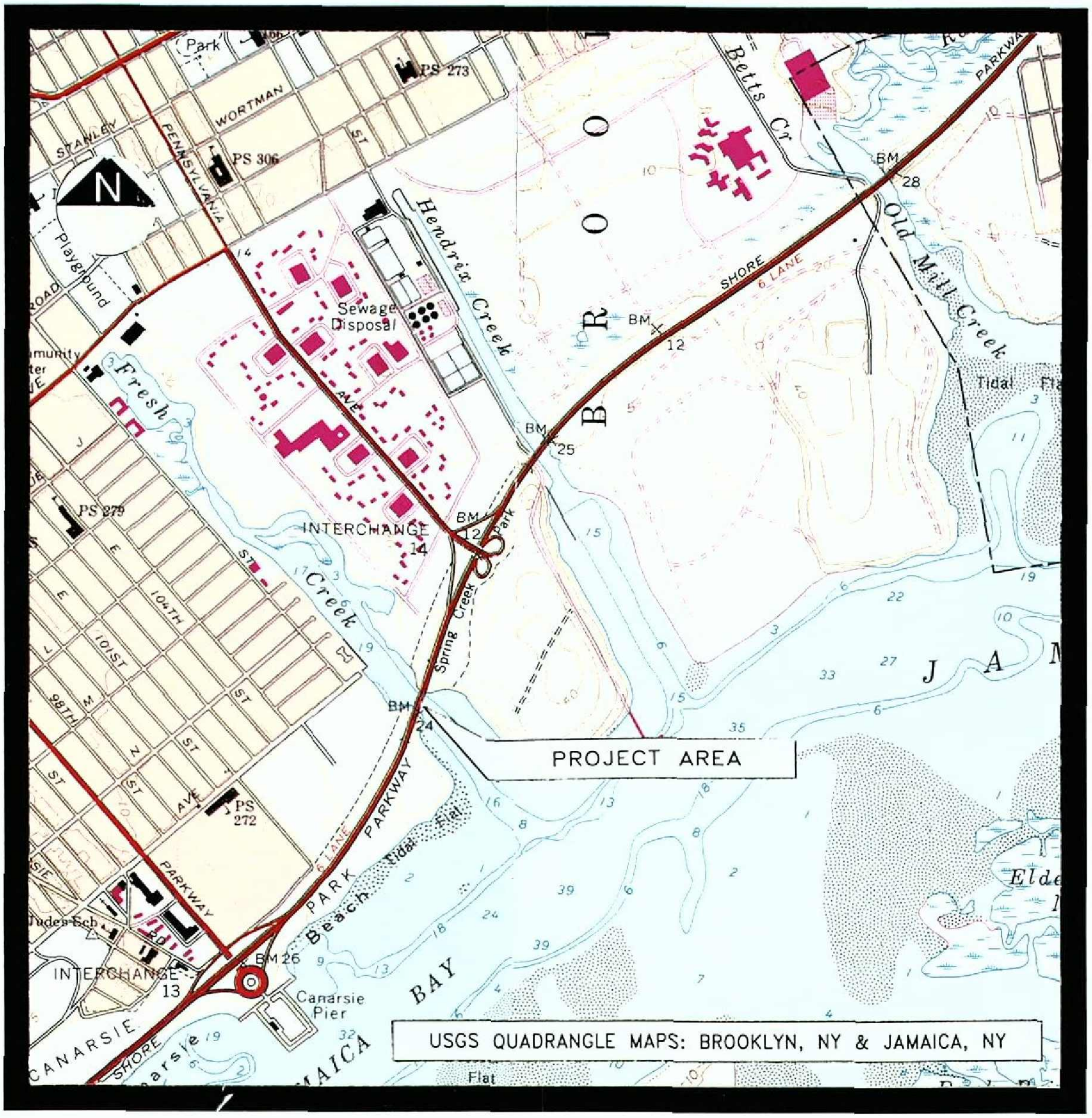
1.2 Project History

A cultural resource assessment of the nine Shore Parkway bridges proposed for rehabilitation or replacement was conducted in 1996 and 1997 as part of the NYCDOT City Environmental Quality Review (CEQR) compliance process (HPI, 1997). That assessment involved extensive documentary and cartographic analysis and identified the Shore Parkway Bridge over Fresh Creek Basin (among other bridges along the parkway) as possessing the potential to contain prehistoric archaeological resources. It considered the impacts of alternatives developed as part of the Generic Environmental Impact Statement (GEIS) upon cultural resources (HNTB/Ebasco et al, August 1998). The GEIS proposed the monitoring of the soil boring program to test for "evidence [that] includes the presence/absence of a thick peat lens, a shell midden, or other prehistoric cultural remains" as a mitigative strategy. The subsurface data would be used to eliminate, narrow, or more clearly define any areas of archaeological sensitivity (HNTB/Ebasco et al, August 1998).

FED. RD. REG. NO.	STATE	FEDERAL AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
	NEW YORK		1	1

RECONSTRUCTION OF
THE SHORE PARKWAY BRIDGE
OVER FRESH CREEK BASIN

P.I.N. 84193BK025BR	BOROUGH OF BROOKLYN	B.I.N. 2-23150-9



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CITY OF NEW YORK
DEPARTMENT OF TRANSPORTATION
BUREAU OF BRIDGES

CONTRACT NO. HBK1072

RECONSTRUCTION OF
THE SHORE PARKWAY BRIDGE
OVER FRESH CREEK BASIN
BOROUGH OF BROOKLYN B.I.N. 2-23150-9

TAMS Consultants, Inc.
655 THIRD AVENUE, NEW YORK N.Y. 10017

IN CHARGE OF: KFS DESIGNED BY: GRM DRAFTED BY: GRM
CHECKED BY: JHP CHECKED BY: JHP

SUBSURFACE EXPLORATION SITE LOCATION PLAN

N.Y.C.D.O.T. MICROFILM IDENTIFICATION NUMBER

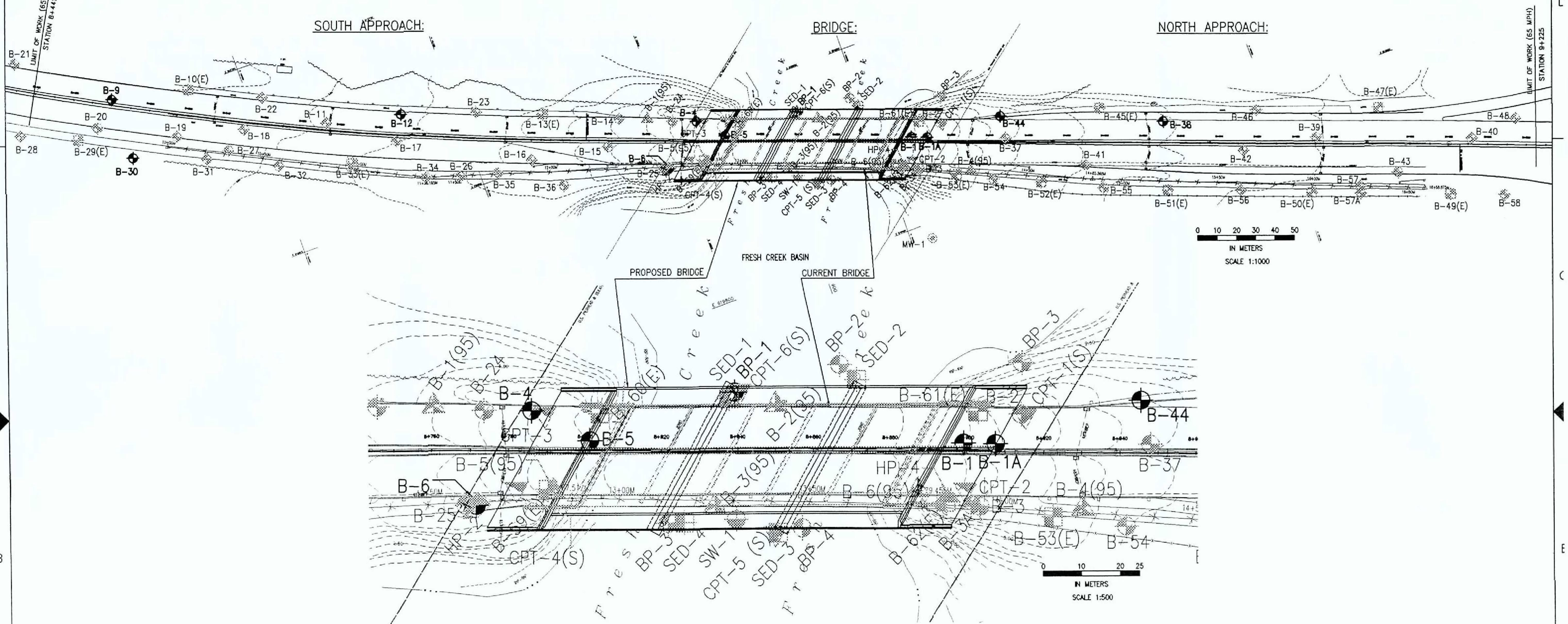
BIN 2-23150-9 ROLL FRAME

DWG. NO.	SCALE	DATE	SHEET
6253-SO-1	AS NOTED	JUNE 1999	--

FED. RD. REG. NO.	STATE	FEDERAL AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
	NEW YORK		1	1

RECONSTRUCTION OF
THE SHORE PARKWAY BRIDGE
OVER FRESH CREEK BASIN

P.I.N. 84193BK025BR | BOROUGH OF BROOKLYN | B.I.N. 2-23150-9



NOTES:

1. THE 1999 SUBSURFACE EXPLORATION PROGRAM WAS COMPRISED OF BORINGS, CONE PENETROMETER, SEDIMENT SAMPLE AND HYDROPUNCH SAMPLES WAS COMPRISED BY WARREN GEORGE, INC..
2. THE SUBSURFACE EXPLORATION PROGRAM WAS SUPERVISED BY TAMS CONSULTANTS, INC. BETWEEN SEPTEMBER 20, 1999 AND OCTOBER 27, 1999
3. HORIZONTAL CONTROL:
THE COORDINATE SYSTEM USED IN THIS BORING LOCATION PLAN IS THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE.
4. VERTICAL CONTROL:
ALL ELEVATIONS REFER TO THE BOROUGH OF BROOKLYN DATUM WHICH IS 0.78 METERS (2.56 FEET) ABOVE THE NATIONAL GEODETIC VERTICAL DATUM (N.G.V.D.) AT SANDY HOOK, NJ ESTABLISHED BY THE U.S.C.&G. SURVEY.
5. BORING LOCATIONS FROM PREVIOUS INVESTIGATIONS ARE APPROXIMATE.
6. LOGS OF BORINGS ARE IN APPENDIX A OF THIS REPORT.

LEGEND:

- B-1, BP-3 GEOTECHNICAL BORINGS
- B-9, BP-1 GEOARCHEOLOGICALLY-MONITORED BORINGS
- B-45(E) ENVIRONMENTAL BORINGS
- CPT-2, CPT-1(S) GEOTECHNICAL CONE PENETRATING TESTING, (S) REFERS TO CPT AND SEISMIC TESTING
- MW-1 GROUNDWATER MONITORING WELL (ENV.)
- SW-1 SURFACE WATER SAMPLE (ENV.)
- SED-1 SEDIMENT SAMPLE (ENV.)
- HP-1 HYDROPUNCH SAMPLES (ENV.)
- B-4(95) BORINGS FROM 1995 SUBSURFACE INVESTIGATION

(E) REFERS TO BORINGS WHERE ENVIRONMENTAL SAMPLES WERE TAKEN

CITY OF NEW YORK
DEPARTMENT OF TRANSPORTATION
BUREAU OF BRIDGES

CONTRACT NO. HBK1072

RECONSTRUCTION OF
THE SHORE PARKWAY BRIDGE
OVER FRESH CREEK BASIN
BOROUGH OF BROOKLYN B.I.N. 2-23150-9

GEOARCHEOLOGICALLY – MONITORED BORINGS, BORING LOCATION PLAN

TAMS Consultants, Inc.
655 THIRD AVENUE, NEW YORK N.Y. 10017

IN CHARGE OF: KFS | DESIGNED BY: JP/MP | DRAFTED BY: MGP | CHECKED BY: JHP | CHECKED BY: JJE

N.Y.C.D.O.T. MICROFILM IDENTIFICATION NUMBER
BIN 2-23150-9 ROLL FRAME

DWG. NO.	SCALE	DATE	SHEET
FIGURE 2	AS NOTED	JUNE 2000	--

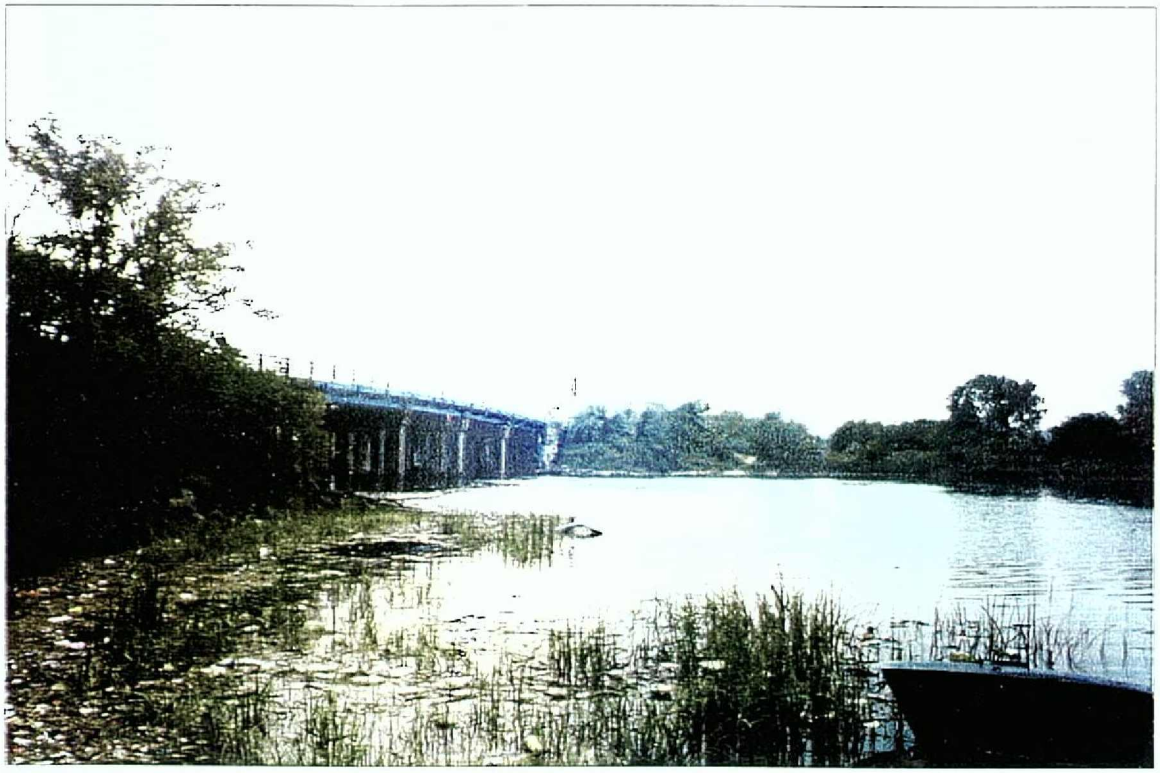


Photo 1 Facing south showing Shore Parkway Bridge over Fresh Creek Basin.

Photo 2 Facing south from west side of bridge showing southern embankment on left.

Photo 3 Facing southeast from bridge showing tidal marsh and Jamaica Bay.

1.3 Objective and General Methodology

The objective of this geoarcheological evaluation is to assess the probability for preservation of archeological deposits and buried surfaces of habitable age beneath the thick fill layers upon which the Shore Parkway Bridge over Fresh Creek Basin lies. Geoarcheological work was performed in conjunction with a geotechnical boring program and consisted of inspections of sediments and identifications of stratigraphies preserved in a series of eleven subsurface corings spanning the project corridor. In addition, the field team performed specialized soil analyses and submitted a small number of soil samples for radiocarbon dating.

2 GEOLOGICAL SETTING

The subsurface geology of the project site consists of basement rock of Precambrian age overlain by sedimentary deposits of Cretaceous, Pleistocene, and recent age. The sedimentary formations from the bedrock upward are the Raritan Clay and Magothy Sand of the Cretaceous age, the Jameco Sand and Gardiners Clay of the Pleistocene age, and upper Pleistocene sands and gravels. The recent deposits are comprised of Holocene sediments deposited through marine sources and the modern fills deposited in this area during this century.

The Precambrian bedrock consists of folded and faulted gneisses and schists. The surface of the bedrock dips to the southeast and may be at least 91 m (300 ft) below the existing ground surface. The Raritan Clay Member is a formation of continental origin and consists of deposits of clay, silty clay, clayey silt, and fine silty sand. The top of this formation may lie approximately 76 m (250 ft) below the ground surface. The Magothy Formation consists of strata similar to those in the Raritan Clay.

Jameco deposits are the oldest Pleistocene sediments on Long Island and are taken to have been deposited by streams, which originated as melt water from glaciers located to the north. Jameco deposits are composed mostly of coarse sand and gravel and with some cobbles and boulders. The Gardiners Clay is an interglacial deposit of marine origin. The formation unconformably overlies the Jameco and older deposits and is unconformably overlain by upper Pleistocene deposits. The top of this formation may lie approximately 46 m (150 ft) below the ground surface. The upper Pleistocene deposits are of Wisconsin age and are composed primarily of glacial drift material such as lacustrine deposits, and outwash sand and gravel.

The project site is located over a tidal marsh region which was originally a part of Jamaica Bay (Photos 1 through 3). Marshes of this type begin to form wherever the water is shallow enough for a type of marine vegetation called "eel grass" to obtain a foothold, usually 30 to 60 centimeters (cm) (one to two ft) below the low-water mark and where no strong currents are flowing. Dead grass and fine silt entangled with the eel grass gradually accumulate until the ground level is built up well above the low-water mark and marsh grass takes root upon it. The build-up continues until the marsh reaches a level covered by only occasional high tides. This marsh material, which is frequently termed "meadow mat", is very compressible. In reclaiming land along the side of the bay, fill materials have been placed over the marsh deposits.

Several paleo-geographic factors played a dramatic role in the prehistoric settlement of the Atlantic Coast (including the project area) and upon post depositional processes and site preservation. These factors include the following:

- Regional sea level has risen on the order of 20-30 m (65-100 ft) since the close of the Pleistocene and six m (20 ft) over the past 5,000 years (Newman et al, 1969; Stright, 1990);

- The current shoreline would have extended up to several kilometers (miles) to the southeast during most of the Holocene;

- The present project landscape would have been an estuarine location during much of prehistory with somewhat different (i.e. slightly steeper) gradients than those of the present;

- Over the course of the Holocene estuarine meso-environments migrated progressively landward; and

- The Euroamerican period (past 400 years) probably resulted in more terrain (and by extension, subsurface) modifications than those for all preceding periods taken together.

3 PREHISTORIC AND HISTORIC OVERVIEW

The prehistoric and historic context of the south shore of western Long Island and the Shore Parkway was established in the 1997 cultural resources assessment (HPI, 1997) and is only briefly summarized here. The prehistoric era in this region is traditionally divided into four time periods reflective of cultural adaptations to a gradually changing environment. These major culture periods are:

- Paleo-Indian Period (circa 12,000 to 9,500 years before present [BP]);
- Archaic Period (circa 9,500 to 3,000 BP);
- Woodland Period (circa 3,000 to 500 BP); and
- Contact Period (circa 500 to 300 BP).

The Archaic and Woodland prehistoric periods have been further broken down into shorter time periods describing specific adaptations and more subtle technological changes.

The cultural resources assessment describes a number of previously-recorded Late Woodland (circa 1,550 to 500 BP) to Contact Period resources located in and nearby the project area. These resources, listed in the files of the New York State Museum (NYSM) and the New York Office of Parks, Recreation, and Historic Preservation (OPRHP), consist of the following:

- Canarsee Village, located approximately 610 m (2000 ft) north of the Shore Parkway Bridge over Fresh Creek Basin, at the head of Fresh Creek;

- A campsite located somewhere in the vicinity of the bridge, along the shore of Fresh Creek; and

- At least two very large shell middens adjacent to, and in one case overlapping, the present location of the bridge over Fresh Creek Basin.

Several researchers describe these Late-Woodland resources as associated with and contemporaneous to each other (HPI, 1997).

Although Brooklyn has numerous historic cultural resources, none have been identified nearby the Fresh Creek project area. The cultural resources assessment determined that the Shore Parkway Bridge over Fresh Creek Basin has no historical archaeological potential.

4 RESEARCH DESIGN/SURVEY METHODS

4.1 Research Design

The New York State Historic Preservation Act of 1980 (SHPA) and the New York State Environmental Quality Review Act (SEQRA) require all state, county, and local government agencies to identify historic resources (buildings, structures, sites, objects, and districts that are more than 50 years old) listed or eligible for inclusion on the State or National Register of Historic Places within an established project area. National Register eligibility recommendations are based on National Register Criteria for Historic Significance (Table 1) and seven aspects or qualities of historic integrity (Table 2).

The New York City Environmental Quality Review (CEQR) process provides a framework for evaluating the City's cultural resources. Chapter 3, Section F of the *CEQR Technical Manual* requires all New York City agencies to identify designated or eligible New York City landmarks and districts (more than 30 years old) and State or National Register-listed or eligible cultural resources (including archaeological sites) within the project area. The *CEQR Technical Manual* defines a site as follows:

> *the location or place where a significant event or sequence of events took place, or the location of an important building or structure, whether now standing, ruined, or vanished, where the location itself possesses historic, cultural or archaeological value. A site can be important because of its association with significant historic (or prehistoric) events or activities, buildings, structures, objects, or people, or because of its potential to yield information important in prehistory or history. Examples of sites include a Native American habitation site or a battlefield* (New York City, 1991).

The objective of this survey is to provide the physical evidence necessary to identify the presence or absence of archaeological resources. Such evidence could include direct indications of prehistoric activity such as the presence of a shell midden or other prehistoric remains, or indirect evidence such as the presence of intact stratigraphic deposits, indicative of prehistoric coastal or bay margin environments, dating to the period of likely prehistoric occupation that would be likely to contain cultural resources.

Table 1

Criteria for Historic Significance

36 CFR 60.4, Part I
The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:
A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
B. that are associated with the lives of persons significant in our past; or
C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. that have yielded, or may be likely to yield, information important in prehistory or history.

36 CFR 60.4, Part II
Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:
A. a religious property deriving primary significance from architectural or artistic distinction or historical importance; or
B. a building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or
C. a birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life; or
D. a cemetery which derives its primary significance from graves or persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or
E. a reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or
F. a property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or
G. a property achieving significance within the past 50 years if it is of exceptional importance.

Table 2

Aspects or Qualities of Integrity

Aspects/Quality	Definition
Location	The place where the historic property was constructed or the place where the historic event occurred.
Design	The combination of elements that create the form, plan, space, structure, and style of a property.
Setting	The physical environment of a historic property.
Materials	The physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property.
Workmanship	The physical evidence of the crafts of a particular culture or people during any given period in history or prehistory.
Feeling	A property's expression of the aesthetic or historic sense of a particular period of time.
Association	The direct link between an important historic event or person and a historic property.
Source: US Department of the Interior, 1991.	

4.2 Field Methods

Field work consisted of the monitoring of eleven of the geotechnical and environmental borings performed as part of geotechnical engineering analyses and foundation design analysis of the piers and abutments (Figure 2). Continuous sampling and retrieval was performed by a Mobile B61 gas engine hydraulic pull-down drill rig (2.4 m [8 ft] wide/152.4 m [500 ft] long) (Photo 4). A modification of that rig was used on a barge for extracting samples within Fresh Creek (Photo 5). Samples were retrieved using a 5.1-cm (two-in) diameter split-spoon sampling device (Photo 6).

Monitored boring locations spanned the entire 780-m (2,560-ft) right of way in order to sample the buried sediments in a representative manner (Figure 2). Monitored borings were located along the southern approach, within the existing Fresh Creek channel, and along the northern approach.

The research team prepared stratigraphic descriptions and profiles in accordance with prevalent lithostratigraphic nomenclature (ISG, 1994). Pedostratigraphic (i.e. soil-based) descriptions were not necessary for this project because no apparent soils were recognized in the borings. Particular attention was paid to isolating organic sediments (i.e. peats and vegetation mats) for radiocarbon dating and to isolating transitions in depositional environments. Beach and till facies were isolated and stratigraphic breaks in overall sequences were noted.

4.3 Radiocarbon Dating

Specimens for radiocarbon dating were extracted from deposits that were deemed intact in the field and which contained a sediment stratigraphy indicative of discrete depositional environments. The type as well as the context of radiocarbon material dated is critical for making chronostratigraphic interpretations. Following sample description, ten samples were initially selected for radiocarbon dating. This number was eventually pared to three and the balance of the samples were bottled and sealed by TAMS' geotechnical staff and stored at the Warren George facility. Samples were submitted to Beta-Analytic Laboratories (Coral Gables, FL) for dating.

The conventional radiocarbon age (Taylor, 1987:4-6) is reported in years BP or "before present" as of the year 1950. Calibration to correct for changes through time in the radiocarbon content of the atmosphere is performed by Beta Analytic using Stuiver et al. (1993). These results take the form of ranges for two standard deviations (2-sigma) in either years BP or in calendar years (either BC or AD). The jagged shape of the calibration curve makes it possible to obtain more than one such range which do not overlap.

Photo 4 Packaging sediments for storage following geoarcheological inspections. View from in front of B61 gas engine coring rig (with extensions), south shore of Fresh Creek Basin.

Photo 5 Facing southwest showing boring operation within Fresh Creek.

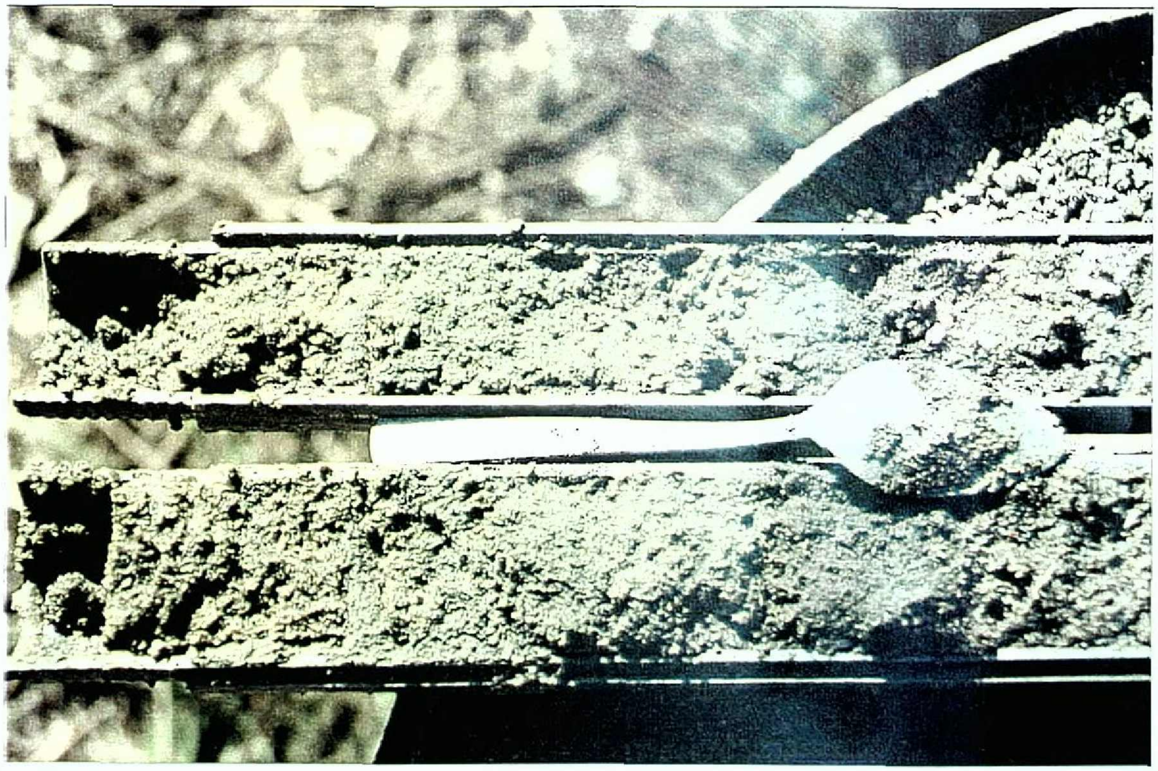


Photo 6 Examination of near shore sediments (beach facies) below fluvial sands in boring B-1A (depth 12-13 m [40-42 ft]).

5 RESULTS

5.1 Geoarcheologically-Monitored Borings

A total of eleven borings were geoarcheologically-monitored at the Shore Parkway Bridge over Fresh Creek Basin. Field work began on September 28 and proceeded intermittently for ten days, concluding on October 7, 1999. In order to gain a broad a picture of the basin's stratigraphy, the monitored boring locations spanned the entire 780-m (2,560-ft) right-of-way (ROW). Six borings were located along the southern approach (B-9, B-30, B-12, B-6, B-4, and B-5), one within the existing Fresh Creek channel (BP-1, Photo 5), and four along the northern approach (B-1, B-1A, B-44, and B-38). Additional observations were made of selected soil samples at the Warren George storage facility in Jersey City, NJ, where the geotechnical boring samples were stored after completion of the boring program.

Sampling commenced beneath the asphalt pavement (on roadway borings) or within surface sediments. Most cores penetrated variable depths of fill, and then extended variously through layers of sand and/or peat, softer organic sediment, and coarser sand and sandy glacial till. Core depths ranged from 1.8 to 38.7 m (6 to 127 ft) and were contingent upon geotechnical concerns and/or identifications of geoarcheologically-diagnostic sediment types. The set of eleven borings were supervised by an archeologist and a geoarcheologist. Geotechnical personnel provided detailed logs of the sample retrievals.

The magnitude of landscaping was evident in both landform relations and erosional features exposed within and flanking the channel of Fresh Creek and all tracts beachward. The present configuration of the Fresh Creek inlet itself is a product of considerable channel straightening over the past century. The majority of the ROW was situated on the built up roadway of the Belt Parkway. The raised highway berm verified that most of the project terrain had already been significantly resculpted during the initial interval of highway construction (circa 50 years ago) (Photos 1 and 2). Most of the fill for berm construction was clearly obtained from the beach and inlet. The only potential for recovering prehistoric remains was in preserved "pockets" of the substrate underlying a semi-continuous mantle of earth fill, that often extended to depths in excess of 6 m (20 ft).

Table 3 presents soil descriptions, surface elevations, and the closing depths of each geoarcheologically-monitored boring. Ground surface elevations ranged from -6.4 m (-20.8 ft) within the creek (BP-1) to 6.8 m (22.3 ft), with most borings extracted from surfaces between 2.7 and 6.1 m (9 and 20 ft) (Table 3). Depths of excavation generally extended to at least 2.4 m (8 ft) and occasionally beneath 36.5 m (120 ft) (B-6, BP-1, and B-4); the latter were excavated in an attempt to reach Pleistocene sediments. In one case (B-1/B-1A) two adjacent locations were examined because of refusal of the core to extend beneath required depths.

Table 3

Boring Records

Core	Surface Elevation*		Closing Depth**		Stratigraphy Notes
	m	ft	m	ft	
B-9	2.1	6.9	1.8	6	0-1.2 m (0-4 ft) - sandy fill; 1.2-1.8 m (4-6 ft) fine sand with interbedded organic clay.
B-30	2.3	7.4	2.4	8	0-2.4 m (0-8 ft) - black organic clay.
B-12	2.9	9.5	2.4	8	0-1.2 m (0-4 ft) - sandy fill; 1.2-2.4 m (4-8 ft) - sandy fill with charcoal, clinkers.
B-5	6.8	22.3	8.8	29	0-0.2 m (0-0.5 ft) - asphalt fill; 0.2-6.4 m (0.5-21 ft) - sandy fill with coal, shells; 6.4-8.8 m (21-29 ft) - oxidized sands.
B-6	5.8	19	38.7	127	24.4-26.5 m (80-87) - gray shelly sand; 26.5-29.6 m (87-97 ft) gray fine sand; 29.6-33.5 m (97-110 ft) - olive brown loamy sand with silt lumps; 33.5-35.1 m (110-115 ft) - dense loamy sand bedded in thin layers with igneous rock and fossil shell fragments (possibly a glacial river deposit); 35.1-38.1 m (115-125 ft) - olive coarse sand, no shells; 38.1-38.7 m (125-127 ft) - olive fine sand.
BP-1	-6.4	-20.8	37.2	122	0-4.8 m (0-16 ft) - organic sand and silt; 4.8-7.9 m (16-26) - brown sands; 7.9-28.0 m (26-92 ft) - fine grayish brown sand; 28.0-35.7 m (92-117 ft) - gray coarse sands; 35.7-37.2 m (117-122 ft) - gravels.
B-1/ B-1A	6.7/ 6	21.2/ 19.7	15.8	52	0-0.5 m (0-1.5 ft) - asphalt fill; 0.5-6.7 m (1.5-22 ft) - sandy fill; 6.7-7.9 m (22-26 ft) - shore face sands; 7.9-11.0 (26-36 ft) fluvial loamy sand; 11.0-13.7 m (36-45 ft) - loamy sand with small shell fragments and possible foraminifera tests (shells of single celled creatures); 13.7-15.85 m (45-52 ft) - gray sands.
B-4	6.0	19.7	38.7	127	0-6.1 m (0-20 ft) - slag and fill; 6.1-36.6 m (20-120 ft) - gray or brown sand with shells; 36.6-38.7 m (120-127 ft) - gray estuarine silt and fine sand.
B-44	4.8	15.9	2.4	8	0-1.8 m (0-6 ft) - yellowish brown fine sand with sparse shell hash; 1.8-2.4 m (6-8 ft) - pale brown fine sand with larger shell fragments.
B-38	3.4	11.2	2.4	8	0-1.2 m (0-4 ft) - brownish gray fine sand, shell fragments, oxidation streaks; 1.2-2.4 m (4-8 ft) - pale brown oxidized medium sand.
Notes: *Elevation below MSL. **Depth below ground surface.					

Shallower borings - those 2.4 m (8 ft) or less - were often difficult to interpret because they encountered ostensibly intact sediments of sands and organic clays (i.e. B-9 and B-30 on the south end and B-44 and B-38 on the north end); in some cases the sands were well sorted. Excavation of the deeper cores as well as B-12 revealed, however, that the upper sediments were probably disturbed and that the absence of visible disturbance was largely a function of sediment composition and the magnitude of sediment reworking. Thus, beach sands removed from one part of the landscape or another remained reasonably well-sorted when moved "en mass". Along similar lines, organically enriched lower energy deposits (i.e. of brackish and estuarine origin) may have been moved and/or simply naturally reworked by low energy deposition of the Fresh Creek waters at the inlet, even subsequent to the period of historic channel straightening.

Typical profiles of "in channel" and "on roadway" borings respectively are provided by cores BP-1 and B-1A (Figures 3 and 4). These were selected because they extend well into undisturbed sediment and provide a composite sequence indicative of the range of pre- and post-disturbance processes that resulted in the sediment sequences preserved in the project area.

Boring BP-1 was taken from with the channel floor at an elevation of -6.3 m (–20.8 ft) and on the order of 9 m (30 ft) below the road grade and the general surface elevation of "on roadway" borings (Photo 4 and Figure 3). Figure 3 shows that the channel inlet stratigraphy features a capping black to brown organic silty clay underlain by a series of sand deposits. Dominantly brown to grayish brown sands extend from circa 4.5 to 18.3 m (15 to 60 ft). These sands entrain variable quantities of clam shell fragments, some fossilized, which could not be identified as to species. Beneath 18.3 m (60 ft) the medium sands are replaced by a heavily gleyed (N5/0) lower energy fine sandy silt that coarsens with depth to the base of the sequence at 36.6 m (120 ft). A single sample for radiocarbon dating was obtained from BP-1 at a depth of 2.4 to 3.0 m (8 to 10 ft) (see Section 5.2).

Boring B-1A was situated on the roadway on the north bank of Fresh Creek inlet. It was at an elevation of 6.0 m (19.7 ft). The upper 5.2 m (17 ft) of the core consists of a well-sorted brown sand (10YR5/3) with relatively well-preserved clam shell fragments (pieces >.078 in [2mm]) and variable frequencies of chert, red quartz, and coal clasts. This matrix was identified as Fill I. A second fill deposit occurs at 5.2-7.0 m (17-23 ft) and consists of subangular to subrounded coarse sands with mud (circa 40 percent) and chert gravels.

Intact beach sands were reached below this depth and extended to 7.9 m (26 ft). These unconformably overlay a well-sorted loamy sand (with circa 20 percent silt) (9 to 11.3 m [26 to 37 ft]) with isolated forams but largely recognized as a fluvial facies. An accelerator mass spectrometry (AMS, as opposed to the standard radiometric process) date from this deposit was obtained from within this sediment and produced a determination of 4780±40 BP (Beta-137977). Beneath the fluvial facies an apparent beach sand was encountered consisting of a loamy quartzose sand with small shell fragments and forams (11.3 to 13.7 m [37 to 45 ft]); silty organic interbeds were preserved within the matrix. The organics yielded a determination of 2440±80 BP (Beta-137978).

Core BP-1, Stratigraphic Log

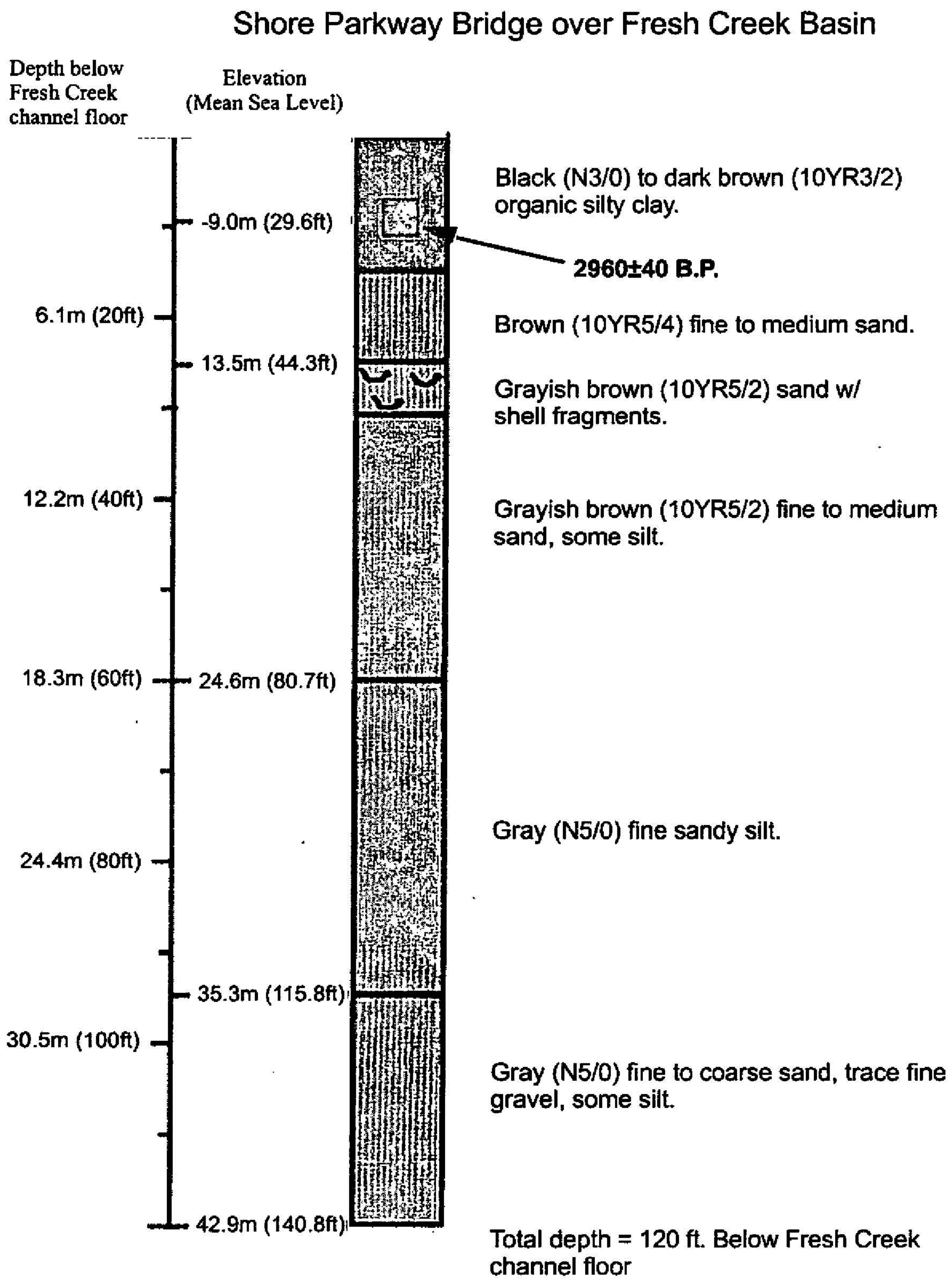


Figure 3

Core BP-1A, Stratigraphic Log

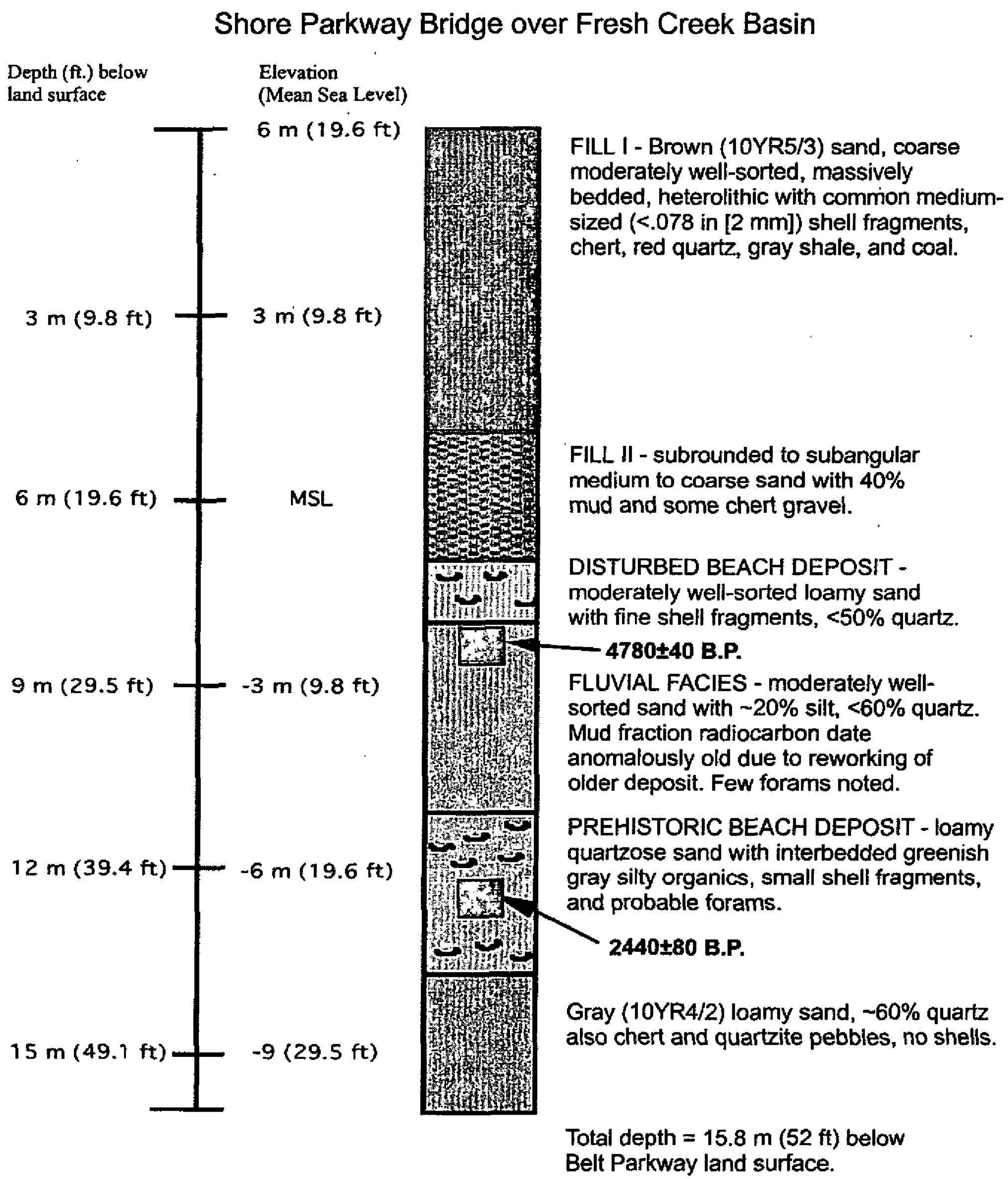


Figure 4

The beach sands unconformably overlay a gray (10YR4/2) loamy sand with gravels that extended to the base of the studied section (13.7 to 16.1 m [45 to 53 ft]).

Boring B-1A provided a reference section for establishing the pattern of 20th-century disturbance that apparently characterized the upper ca. 6.1 m (20 ft) of sediment. To the north of B-1A, borings B-4 and B-44 featured analogous sequences (Table 3). At the upper end of the ROW boring B-38 varied slightly sedimentologically, containing an anomalous brownish gray fine sand, but would appear to also have derived from a disturbed context.

Across the inlet to the south, boring B-6 contained a sequence very similar to that of B-1A, especially the lower intact deposits that apparently also featured fluvial sands overlying a beach or littoral facies. The shallower borings - B-5, B-12, B-30, and B-9 - were excavated through fills.

5.2 Radiocarbon Determinations

Table 4 presents the results of the three radiocarbon determinations performed by Beta Analytic Laboratories. The conventional radiocarbon age (Taylor, 1987: 4-6) is reported in years BP or "before present" as of the year 1950. Calibration to correct for changes through time in the radiocarbon content of the atmosphere is performed by Beta Analytic using Stuiver et al. (1993). These results take the form of ranges for two standard deviations (2-sigma) in either years BP or in calendar years (either BC or AD). The jagged shape of the calibration curve makes it possible to obtain more than one such range which do not overlap. This is in fact the case for the sample from 105.0 to 115.5 m (32-34 ft.) in Boring B-1A.

Specimens for radiocarbon dating were extracted from deposits that were deemed intact in the field and which contained a sediment stratigraphy indicative of discrete depositional environments. The type as well as the context of radiocarbon material dated is critical for making chronostratigraphic interpretations. Several caveats must therefore be considered when utilizing the radiometric results for comprehensive landscape chronologies. These are discussed for the individual dates below.

Table 4

Radiocarbon Dates

Core	Depth[1]		Elevation[2]		Radiocarbon Date[3]	Calendar Years (BP)	Calendar Years	Material/Method	Lab No
	m	ft	m	ft					
BP-1	2.4-3.0	8-10	-9.4	-30.8	2960±40	3250 to 2980	BC 1300 to 1030	Organic sediment by AMS	Beta-137976
B-1A	9.7-10.4	32-34	-4.1	-13.45	4780±40	5600 to 5460 and 5370 to 5340[4]	BC 3650 to 3510 and BC 3420 to 3390[4]	Organic sediment by AMS	Beta-137977
B-1A	12.2-12.8	40-42	-6.8	-22.3	2440±80	2720 to 2350	BC 770 to 400	Organic sediment by standard radiometric	Beta-137978

Notes: [1]Depth below ground surface.
[2]Elevation below MSL.
[3]Radiocarbon years BP (Taylor, 1987).
[4]Jagged shape of the calibration curve makes it possible to obtain more than one, non-overlapping date range.

For boring BP-1 the material submitted for the determination was a fine-grained organic sediment, at a depth of about 2.8 m (9 ft). Such deposits are generally the product of organic decomposition within an anaerobic setting as would be expected in a ponded or low-energy estuarine or backwater environment. The context is one that would be expected at a stream mouth or graded subtidal river at an estuary. It is also an expected paleogeographic micro-environment for the ancient Fresh Creek channel. The determination of 2960±40 BP (Beta-137976) is consistent with the low energy environment that would have formed at the stream mouth as sea level rise stabilized 2000-3000 BP.

Boring B-1A produced two radiocarbon dates, one within the fluvial facies (9.1 to 9.8 m [30 to 32 ft])(4780±40 BP; Beta-137977) and a second within the lower beach sediments (12.2 to 12.8 m [40 to 42 ft])(2440±80 BP; Beta-137978) (Table 4). These determinations are an example of classic "inverted stratigraphy", since the uppermost is nearly twice as old as the lower. The explanation for this inversion is a function of both the materials dated and the processes of deposition associated with each sampling provenience. Accordingly, the AMS method was used for dating the older fluvial facies (4780±40 BP; Beta-137977) since the entraining matrix was a medium sand and only a fraction of organic material was recovered. The lower sediment (2440±80 BP; Beta-137978) was a silty organic deposit, analogous to that BP-1, and typical of a low energy estuarine setting; the dated material was relatively high in carbon. Since the fluvial sediment was identified as a high energy channel or near channel deposit, it is probable that a major flooding event of late-Holocene Fresh Creek accounted for the discharge of sands along the drainage (i.e. following an axis parallel to the beach). The dated materials may be considered allogenic (i.e. externally derived) and probably originally decomposed several thousand years prior to the flooding event and at a location considerably upstream of the project area. That older material was mobilized and incorporated in the bedload of the stream that eventually laid down the "older carbon" material at the stream mouth.

Since the organic matrix of the lower sediment is largely low energy sediment, it is likely that these materials decomposed in the general vicinity of the present project area. The estuarine contexts of both the lower sediment at B-1A and the dated deposit at BP-1 are similar.

6 INTERPRETATIONS AND RECOMMENDATIONS

Examination of soil borings and radiocarbon results indicates that portions of an ancient estuarine micro-environment are preserved within the project area. As discussed in Section 5, estuarine deposits were identified in two project area contexts: the 2.7-m (9-ft) level at BP-1 and the 12.5-m (41-ft) level at B-1A (Figure 2). Table 3 shows that the differences in surface elevation between these two locations is 12.3 m (40.5 ft). Thus, in terms of absolute elevations, the identification of the organic estuarine muds occurs as follows (Table 4):

BP-1: -9.4 m (-30.8 ft); deposits dated to 2960±40 BP (Beta-13796); and
B-1A: -6.8 m (-22.3 ft); deposits dated to 2440±40 BP (Beta-13798).

This relationship is stratigraphically consistent and suggests the presence of slowing sea level rise and meta-stable shorelines between 3,000 and 2,000 years BP. Similar observations have been made elsewhere in the lower Hudson Estuary (GRA, 1997; Newman et al, 1969). In general it is thought that regional shorelines during this interval were depressed about 4 m (13.1 ft) below present levels. However, longshore currents and near shore sedimentation can account for significant net sedimentation along coastal reaches on a local level (Bloom, 1983).

Due to extensive near surface disturbance in the project area it is not possible to comprehensively reconstruct the area's prehistoric shoreline nor to fully assess archaeological preservation systematics. However, the geoarcheological evaluation of borings along the Shore Parkway Bridge over Fresh Creek Basin facilitates the following observations:

- Extensive landscape remodeling has resulted in large-scale removal of the upper package of sediment ranging from 1.5 to 7.6 m (5 to 25 ft) across the project impact area;

- Two packages of fill are recognized in deeper deposits and overlie late-Holocene beach deposits;

- The later Holocene (less than 3000 BP) is characterized by fluvial deposits that have aggreaded over a meta-stable estuarine landscape;

- The estuarine landscape persists between circa 3,000 and 2,500 BP and would have probably been attractive to prehistoric groups exploiting the terrestrial and estuarine resources;

- The presence of high energy fluvial deposits overlain by extensive fill suggests that after 2,000 BP intact prehistoric deposits are unlikely to be preserved; and

- There is no direct evidence for prehistoric occupation in the project area, other than the presence of a landscape that would have been an ideal micro environment for later Archaic occupants (see fourth bullet above).

In conclusion, the absence of a continuous upper stratigraphic profile suggests minimal likelihood for impacting cultural resources within the footprint of the present project design. Furthermore, radiocarbon dating of the identified intact late-Holocene deposits predate the Late Woodland resources previously identified in the vicinity (see Section 3) by between 1,000 and 1,500 years. The fact that no evidence of the previously documented shell middens was observed may indicate that those earlier soil layers have not been preserved in the project area. Therefore, no further study of the archaeological resources of the Shore Parkway Bridge over Fresh Creek Basin project area is recommended.

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