JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

SUPPLEMENTAL DOCUMENTS

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
April 2, 2009

TABLE OF CONTENTS

A

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

FINAL PREDESIGN DOCUMENTS

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
March 6, 2008

TABLE OF CONTENTS

List of Figures

I. PROJECT PROGRAM

The Project Program consists of a Site Program and a Site Analysis. The Site Program discusses each of the structural elements for the project, including the Ashlar Seawall, the North Plaza, Northwest Stairs, and the West Terrace Walk. It provides a description of the various relationships between the structures, their historical significance, and previous and current investigations. This section includes discussions on how the movement of the existing structures affects their functionality. This section also addresses the impact from construction activities related to rehabilitation of these historical structures.

The Site Analysis is a graphic representation of the historically significant areas covered in this study. The site plans highlight various regions that require repair, the influence of the repairs to the site, and historically significant areas. Another site plan shows the various foundation types and points out key elements of the memorial.

A. SITE PROGRAM

1. INTRODUCTION

The Jefferson Memorial is located in the West Potomac Park Historic District and is part of the National Mall & Memorial Parks (NAMA). The structure sits on the southeast shore of the Tidal Basin, at the southern terminus of the Sixteenth Street cross-axis of the Washington Monument Grounds on axis with the White House. The Memorial consists of a dome-like structure reminiscent of the Roman Pantheon and is surrounded by concentric walls and pathways. It was constructed from 1939-1943 and has undergone several changes since then, both cosmetic and structural. The structural changes were necessitated by continual settlement and consolidation of the soft soils present on site. This Project Program identifies the elements around the Memorial that are impacted by soil movements, and addresses their need for stabilization and repair. Figure 1 illustrates the foundation types for the Memorial and its appurtenant structures.

2. AREAS OF STUDY

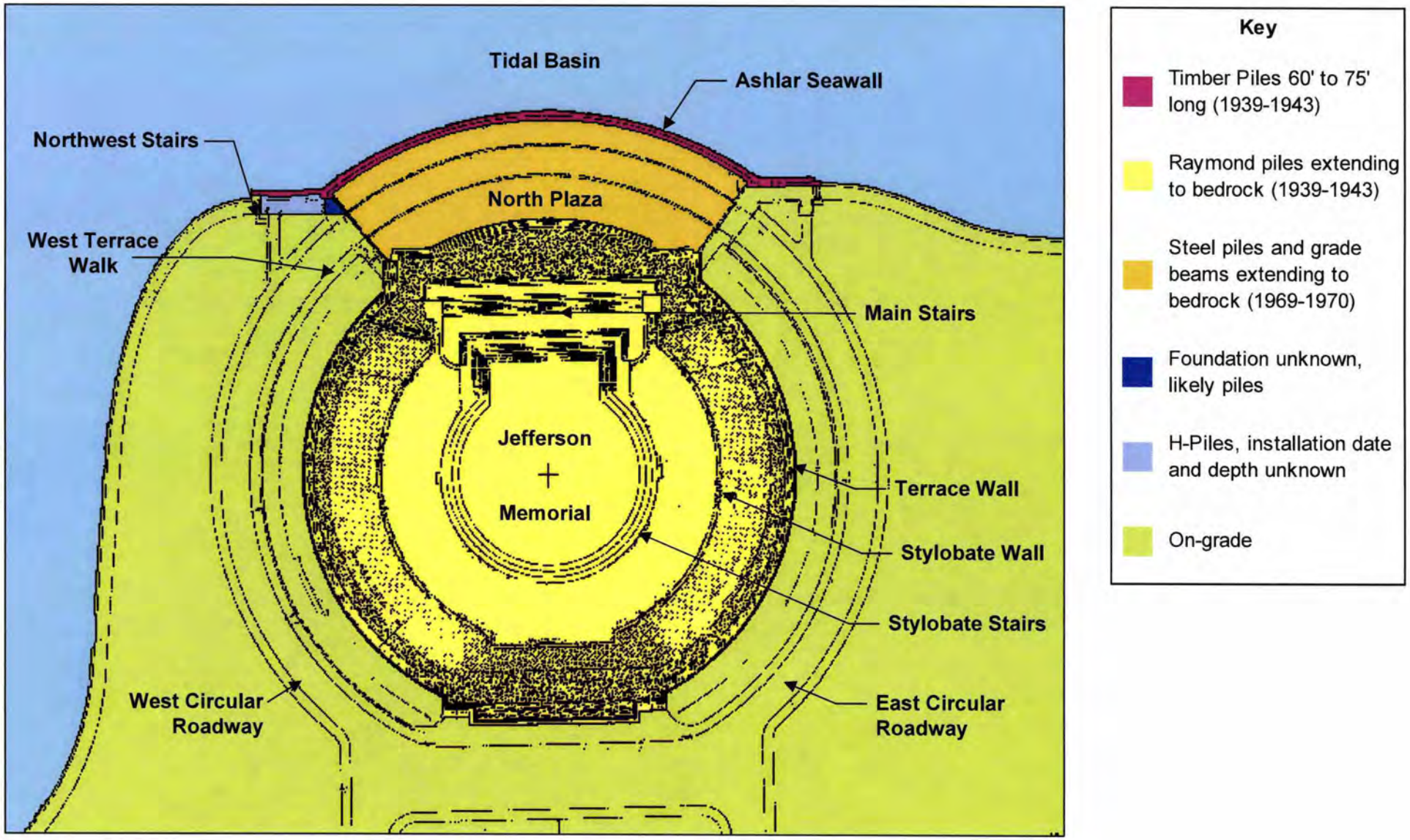
a) Ashlar Seawall

The Ashlar Seawall is the original seawall, which was built in 1941. The granite capstones and the ashlar facing are original materials, and are part of the historic fabric of the Memorial.

The Ashlar Seawall forms the southern boundary of the Tidal Basin and runs along the North Plaza of the Jefferson Memorial. It is a cast-in-place concrete stub wall supported on timber piles and faced with stone, and is approximately 490 feet in length. The arced portion is 378 feet long, and the two horizontal extensions to the east and west of the arc are approximately 56 feet each.

In February 2006, differential movement between the capstone of the Ashlar Seawall and the exposed aggregate concrete paving of the western portion of the North Plaza was observed. Data from "Investigation of Settlement and Upheaval at Jefferson Memorial," prepared by HNTB in 2008 indicates that movement in the seawall has been observed since its construction. This report also indicates that the movement seems to have accelerated since 2005. The magnitude of differential settlement between the Ashlar Seawall and the North Plaza, as indicated in the 2008 HNTB report, suggests that immediate rehabilitation of the Ashlar Seawall is necessary.

The wall is comprised of 10 wall segments separated by joints. At the joints between wall segments, the capstones of the Ashlar Seawall are displaced with respect to each other, indicating relative movement and/or rotation between the seawall segments. Figures 2 and 3 are photos of the Ashlar Seawall and North Plaza interface.



Reference: Base plan provided by Storch Engineers, 1969

Figure 1. Jefferson Memorial Foundation Types

Figure 2. View Standing on the Ashlar Seawall Looking West (3-29-07)

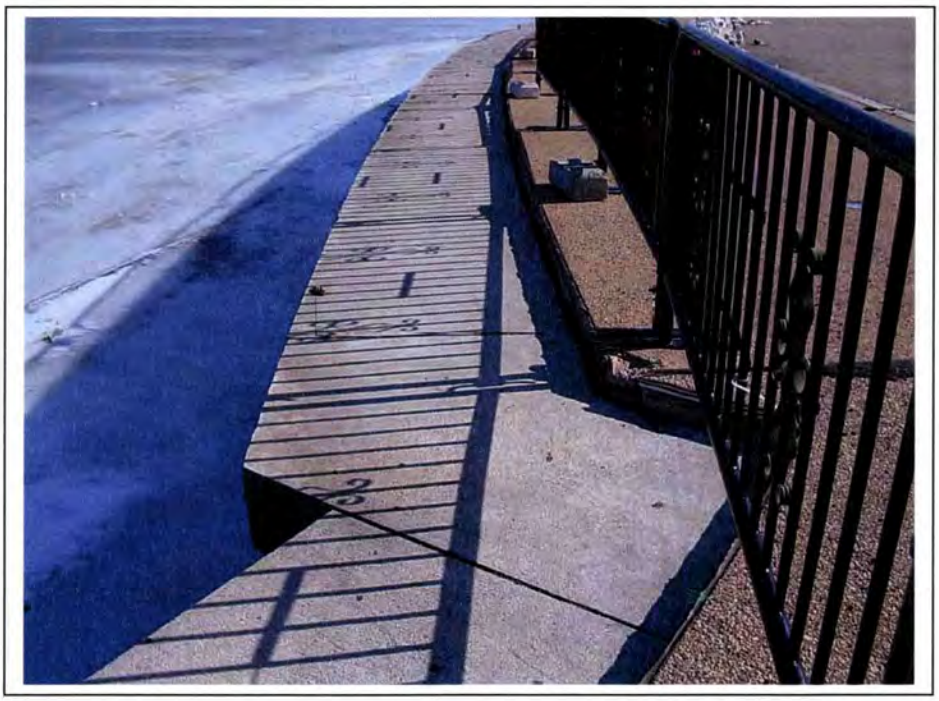


Figure 3. Standing on the North Plaza Looking East at Ashlar Seawall (2-28-07)

b) North Plaza

The North Plaza of the Jefferson Memorial was originally constructed as a slab on grade in 1939-1943, and consisted of an asphalt road bordered by concrete sidewalks. The plaza settled and showed considerable damage in the years immediately following the Memorial's construction. According to "Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial" by Storch Engineers in 1965, portions of the North Plaza were removed when it began cracking in 1951 and were not repaired until 1969-1970 when the North Plaza was entirely demolished and replaced with a structural slab on a system of piles and grade beams. The intent of this repair was to buttress the North Stairs with steel pipe piles reinforced with H-piles, and reconstruct the North Plaza on H-piles driven to bedrock to prevent additional settlement of the North Plaza slab.

When the plaza was reconstructed in 1969-1970, it was paved with exposed aggregate concrete and regular concrete colored red-brown. Thereafter, vehicles were prohibited from driving around the Memorial (Prothero 2001). In 1999-2000, the entire North Plaza and surrounding roads were restored. The North Plaza was milled to the structural slab, paved with a new exposed aggregate concrete, and the road was made flush with the sidewalks.

Due to settlement that the Circular Roadway had experienced, and according to the Storch documents (1965-1969), a 150-foot long portion of the Circular Roadway adjacent to the west end of the Plaza was filled to meet the Plaza grade. To the east of the Plaza, the backfill wedge over the Circular Roadway was about 20-feet long.

Although the North Plaza has been demolished and rebuilt since its original construction and therefore is not historical itself, the historical lines of the roadway have been preserved. When the North Plaza was last repaved in 1999-2000, the historic character of the original circulation pattern was respected. Granite pavers mark the location of the original concrete curb, and different colors of exposed aggregate concrete are used to distinguish areas that were originally asphalt roadway from those that were originally concrete sidewalk.

Historically, there was no railing or barrier between the North Plaza and the Ashlar Seawall. A barrier is presently in place between the North Plaza and the Ashlar Seawall to prevent the public from accessing the Ashlar Seawall which is displaying settlement with respect to the North Plaza. The barrier can be seen in Figure 4. When the North Plaza was last repaved in 1999-2000, in-slab lighting was used to provide a visual cue or warning as park visitors approached the edge of the North Plaza and the Ashlar Seawall.

Presently, there is differential settlement between the Circular Roadway on grade and the North Plaza structure on piles. This differential settlement is pronounced on the west side, and has necessitated frequent asphalt patching to mitigate tripping hazards. Park maintenance personnel have indicated that these locations require additional patching at the rate of approximately 0.5 inches every three months, and this frequent patching is only a recent necessity (2006-2008). Figures 4 and 5 show the asphalt patches on the western side of the North Plaza.

Figure 4. Asphalt Patches on North Plaza and Circular Roadway Interface (9-12-06)

Figure 5. Asphalt Patches on North Plaza and Circular Roadway Interface (10-12-06). Note "bulge" in grassy area suggesting the presence of a grade beam on piles.

The North Plaza has numerous expansion joints running both north-south and east-west. According to the HNTB report from 2008, joint openings between the North Plaza and the Main Stairs appear to be widening in the direction of the Tidal Basin. The opening of the joints represents a tripping hazard for visitors and personnel working at the Jefferson Memorial. The

opening of the joints as well as inclinometer data included in the HNTB 2008 report suggests that the North Plaza structure is moving laterally. Inclinometer data shows that the soil layer approximately ten feet below the western end of the North Plaza is moving laterally in a north-northwest direction at an average rate of about 0.33 inches per year. These vectors of movement are shown in Figure 43 on page 64 of the HNTB 2008 report. Rehabilitation of the North Plaza is needed to control this joint opening at the interface between the plaza and the North Stairs. Failure to address the lateral movement of the North Plaza will eventually result in structural damage to the North Plaza and the Ashlar Seawall. The proposed underpinning of the Ashlar Seawall alone will not prevent further lateral movement of the North Plaza.

c) Northwest Stairs and Walkway

The Northwest Stairs have been repaired since their construction in 1939, and remain part of the Memorial and its appurtenant structures. It is important to repair them to ensure visitor safety and aesthetic appearance. Although the Northwest Stairs and walkway have been demolished and rebuilt at least one time since their original construction, the same general layouts and locations were used. The repairs were necessitated by differential settlement and, at the time of their completion, restored the stairs and walkway to elevations matching the adjacent Memorial features.

The Northwest Stairs are located at the western end of the Ashlar Seawall and to the west of the North Plaza. A concrete walkway connects the Northwest Stairs to the North Plaza. The stairs have a history of settlement and have been jacked and repaired several times. During the Storch (1969-1970) repairs, the stairs were jacked back up to grade using a steel "needle" beam. In 1998, the stairs and sidewalk were demolished and rebuilt with a reinforced slab that appears to bear on the seawall and on five H piles along their south side, parallel with the seawall. The steel piles are shown as existing in the plans for the restoration of the entrance steps and plaza in 1998, but it is not known when they were installed. Today, the stairs and adjacent walkway visibly lean toward the Tidal Basin, possibly due to settlement of the seawall.

A slab-on-grade sidewalk intersects the stairs perpendicularly from the south. At this interface, there are differential elevations resulting in a tripping hazard, which has been mitigated through asphalt patching. Figure 6 shows a photograph of the vicinity.

The concrete walkway extends east from the Northwest Stairs to the North Plaza. This walkway is also supported on the seawall and on a grade beam on piles along its southern edge. The northwest walkway also leans toward the Tidal Basin likely due to settlement of the seawall.

The walkway joins the North Plaza through a roughly triangular-shaped segment of exposed aggregate concrete. The foundation for this triangular wedge is unknown. The HNTB report from 2008 indicates the existence of a significant void underneath this area. It is possible that this triangular wedge is supported on piles or that it is partially bearing on the walkway grade beam and on the North Plaza foundation. The triangular wedge is experiencing settlement, but at a lesser rate than the slab-on-grade Circular Roadway. Figure 7 shows the triangular wedge bounded by asphalt patches.

Figure 6. Asphalt Patch at Northwest Stairs (10-12-06)

Figure 7. Standing on West Approach Walk and Looking at Triangular Wedge (10-12-06)

d) West Terrace Walk

The West Terrace Walk has been repaved since the Memorial's construction, but should retain the same historical location and grading.

Settlement is also occurring on the exposed aggregate concrete sidewalk that leads to the exhibit area on the west side of the Terrace Walk. As shown in Figure 8, there is an asphalt patch in this area to mitigate tripping hazards. The foundation plans for the Jefferson Memorial indicate that the structure is pile-supported from the center of the Memorial to the extent of the Terrace Wall. (Refer to Figure 1, Jefferson Memorial Foundation Types.) Therefore, the West Terrace Walk can be presumed to be pile-supported.

Figure 8. West Terrace Walkway Looking Toward Main Stairs (10-12-06)

3. FUNCTIONAL REQUIREMENTS AND RELATIONSHIPS

a) Ashlar Seawall

The Ashlar Seawall serves as the northern border for the North Plaza of the Jefferson Memorial. It retains the soil underneath the North Plaza and protects it from erosion from the Tidal Basin waters. The reinforced concrete seawall is approximately ten feet in height and it is supported by a timber pile foundation. It is faced with panels of ashlar stone and capped with a one-foot thick granite capstone. The top of the capstone was intended to be flush with the top of the exposed aggregate paving of the North Plaza. Recent settlement of the seawall has caused the elevation of the capstone to drop with respect to the North Plaza, approximately 6.5 inches on the western end of the arced portion as of December 2007.

The differential elevation between the Ashlar Seawall and the North Plaza has necessitated blocking the area from public access. A temporary fence prevents the public from sitting or standing on the seawall. The barrier affects the aesthetic appearance of the seawall and prevents the visitors from experiencing the Memorial as it was designed.

b) North Plaza

The North Plaza connects the Ashlar Seawall to the north and the Main Stairs to the south, and is bounded by the Circular Roadway on the east and west. Differential settlement is evidenced at the interface between the Circular Roadway and the North Plaza. Park maintenance staff have treated this interface with temporary asphalt patching. In addition, the joint between the North Plaza and the Main Stairs has opened, indicating lateral movement of the North Plaza toward the Tidal Basin.

The North Plaza allows visitors to experience a frontal view of the Memorial and to access the Main Stairs which lead to the interior of the monument. The plaza also affords a view of the Tidal Basin and Washington Monument, as well as other historical vistas. The North Plaza is utilized during the Cherry Blossom festival and other events that take place around the Tidal Basin. Visitors and school groups gather here, and joggers and bikers traverse the plaza regularly. The difference in elevation between the North Plaza and the Circular Roadway has created a serious tripping hazard and access issue for visitors to the Memorial.

c) Northwest Stairs and Walkway

The Northwest Stairs and walkway connect the pathway around the Tidal Basin to the Jefferson Memorial. This area is used by visitors to the Memorial as well as bikers and joggers on the pathway around the Tidal Basin. Settlement between the Northwest Stairs on piles and the walkway on grade has caused a difference in elevation and requires periodic asphalt patching.

d) West Terrace Walk

The West Terrace Walk connects the Main Stairs with the entrance to the exhibit level of the Memorial. This area is regularly used by visitors as a circulation route around the Memorial, and into the bookstore and gift shop areas, and receives a high volume of pedestrian traffic. Settlement has created the need for a temporary asphalt patch on the walkway, and this area should be repaired to allow ease of public access.

4. UNIQUE DESIGN PARAMETERS

This project presents unique design challenges due to the different mechanisms that may be contributing to the movement of the structures. It is also unique because of the interaction between the different structures and how behavior of one structure might affect the behavior of an adjacent structure. Movement of the Ashlar Seawall, the North Plaza and the areas surrounding the Memorial has been recorded since construction, more than 65 years ago. It is important that the design considers the current state of stress of both the structures and the soil.

Information obtained during the "Investigation of Settlement and Upheaval at the Jefferson Memorial" shows that the Ashlar Seawall is experiencing settlement and probable failure of the timber piles supporting it. It is imperative that the seawall be underpinned in order to prevent collapse of the wall. The underpinning of the seawall will not provide for lateral resistance against the movement of the plaza.

This investigation also shows that the North Plaza has experienced significant lateral movement. The condition of the existing pile foundation system is not known; however, based on the current rate of lateral movement observed in the plaza, the pile foundation system is likely under significant stress.

The design is also unique in the sense of the historical value of the structures. The Ashlar Seawall, North Plaza and the walkways are structural elements in the Memorial's cultural

landscape. The seawall is historic. The plaza, walks and Northwest Stairs are not original (historic), but when they were last rehabilitated, the historic character of the original circulation patterns was respected. The design must take into account the preservation of these features.

Data from inclinometers, tiltmeters, piezometers and survey data has been collected for approximately the last 14 months and is included in the HNTB 2008 report. The predesign effort for this project includes quarterly survey monitoring of 22 points on the Ashlar Seawall and North Plaza, and quarterly data collection from the inclinometers, piezometers, tiltmeters, and ground water monitoring wells. This information will be used to verify the mechanisms of soil and structure movement considered in the design.

5. PAST AND CURRENT STUDIES

The Jefferson Memorial is located in West Potomac Park which was a river flat and marsh prior to 1792 (Storch 1965). In accordance with the McMillan plan, when the East and West Potomac parks were created, an area of 327 acres was reclaimed through the dredging of the Washington Channel to establish East Potomac Park. The work was completed in 1927, and by 1932 East Potomac Park was developed as a tourist camp and golf course (Storch 1965). West Potomac Park was created from hydraulic dredging of the swampy regions southwest of the Washington Monument (Heine 1953). It was completely reclaimed and graded by 1908, and by 1922 it was developed and the Lincoln Memorial-Reflecting Pool complex was completed (Storch 1965).

The Jefferson Memorial is founded on a network of deep foundations and grade beams that are arranged radially. The main structure, the Stylobate Wall, and the Terrace Wall are supported by 443 cast-in-place Raymond piles, 88 twenty-four-inch concrete caissons, and 103 sixteen-inch concrete caissons. The surrounding roads and grass areas are on grade. The Ashlar Seawall to the north of the Memorial is supported by vertical and battered timber piles. The North Plaza was initially constructed on grade, but in 1969-1970 it was demolished and reconstructed as a structural slab on grade beams, and steel piles driven to rock.

Throughout the years, several different studies have been undertaken to assess and monitor the settlements taking place on site. They are listed below:

1) Settlement Data, Jefferson Memorial 1941-1968

    a) This data is included in the Storch Report listed below:
        i) Survey data with vertical and horizontal movements since the construction of the Memorial

2) Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial, Storch Engineers, 1965 and 1968

    a) These reports include the following:
        i) Subsurface investigations, geology, and stratigraphy of the site
        ii) Survey data with vertical and horizontal movements since the construction of the Memorial
        iii) Laboratory testing and analysis
        iv) Physical conditions of the structure and adjacent areas
        v) Proposed solutions for repair of the North Plaza, Main Stairs, Stylobate and Terrace Walls, and surrounding areas
        vi) Adjustment of corners of Stylobate Wall at entrances to the lower level of Memorial
        vii) Pile-supported buttress for Stylobate Wall and Terrace Wall to provide lateral support

viii) Demolition of North Plaza and replacement with structural slab on piles
ix) Construction of new tie beams and buttresses beneath Main Stairs
x) Removal and resetting of 12 capstones on the west end of the Ashlar Seawall

3) Preservation and Restoration of the Jefferson Memorial - Einhorn Yaffee Prescott (EYP) and Hartman-Cox Architects, 1990 and 1992

a) Contains detailed chronology of the Memorial since June 1934
b) Geotechnical inspection as part of this report in 1988 did not reveal signs of settlement of the walls or superstructure
c) Report included the following information:
i) Review of landscape design and existing conditions of plants
ii) Irrigation study
iii) Geotechnical study including history of problems and alternative solutions
iv) Stylobate Mall drainage and recommendations for sheet piling
v) Cost estimate and impact analysis

4) Investigation of Settlement and Upheaval at Jefferson Memorial – HNTB, 2008

a) Contains the following information:
i) Review and summary of historical information
ii) Site investigation and soil borings
iii) Data collected from inclinometers, tiltmeters, piezometers, and ground water observation wells
iv) Survey monitoring of the site
v) Interpretation of data and three alternative recommendations for repair of the Ashlar Seawall
vi) Repair solutions addressing the differential settlements between the North Plaza and the Circular Roadway, and the Northwest Stairs and the adjacent walkway
vii) Recommendations for continued collection of instrumentation data and quarterly survey monitoring, and further investigation of the lateral movement of the North Plaza

5) Pre-Design and Schematic Design Services for the Jefferson Memorial – HNTB, current

a) Design alternatives to address the settlement of the Ashlar Seawall and lateral movement of the North Plaza
b) Quarterly survey monitoring of 22 points on the Ashlar Seawall and North Plaza
c) Quarterly collection of data from inclinometers, piezometers, tiltmeters, and ground water monitoring wells
d) Core sampling of the reinforced concrete Ashlar Seawall to assess condition of the concrete and rebar
e) Condition assessment of the ashlar stone facing of the seawall
f) Prepare Pre-Design and Schematic Design documents

6. REFERENCES

Christie, Douglas W., and Hugh S. Lacy. "Deep Foundations in Washington, DC." Deep Foundations Institute 31st Annual Conference on Deep Foundations (2006): 3-18.

Einhorn Yaffee Prescott, McMullan & Associates, Inc., Stephenson & Good, A. Morton Thomas and Associates, Inc., and Schnabel Engineering. Jefferson Memorial Specific Tests and Evaluations of Stylobate Mall. 1992.

Fugate, Jeffrey N. "City Study: Washington D.C." (2005) 23 May 2007 <http://ocw.mit.edu/NR/rdonlyres/Architecture/4-175Fall-2005/1915607E-48BF-40E8-89FB-0D931E5AA5C9/0/washingtondc.pdf>.

Heine, Cornelius W. A History of National Capital Parks 1953 24 May 2007 <http://www.cr.nps.gov/history/online_books/nace/adhi.htm>.

Historic American Buildings Survey, Jack Boucher. 20. Aerial view from the northeast. Jack Boucher, photographer; February 1992. HABS DC, WASH, 453-20.

HNTB, "Investigation of Settlement and Upheaval at Jefferson Memorial." 23 January 2008.

National Park Service, "Environmental Assessment." Thomas Jefferson Memorial Security Improvement Project (2002). 11 May 2007 <http://www.nps.gov/archive/thje/ea>.

Prothero, Sally, Audrey Tepper, Stephen Lorenzetti, Maureen Joseph, Nancy J. Brown, and Jennifer Hanna. "Thomas Jefferson Memorial: National Park Service Cultural Landscapes Inventory." 1998, Revised 2001. 12 Feb 2007 <http://www.nps.gov/archive/thje/cli/cli_general_information.pdf>.

Storch Engineers, Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures. 1965.

B. SITE ANALYSIS

The Site Analysis is presented graphically in the following schematics:

1. Areas of Study, Figure 9.
2. Previous and Current Settlement Studies, Figure 10.
3. Impact of Construction Operations, Figure 11.

KEY:

AREAS OF STUDY UNDER SCOPE OF SERVICES

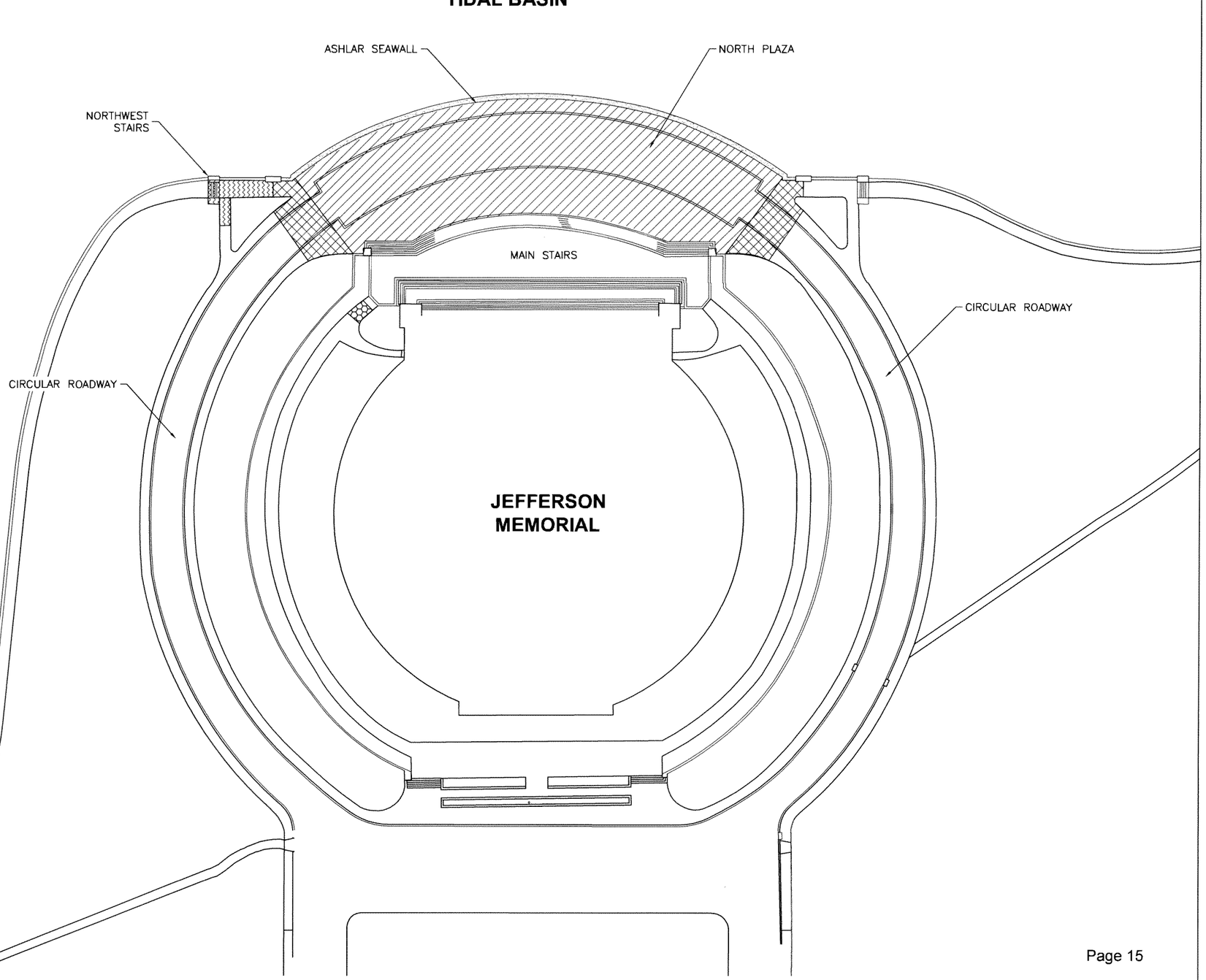
DIFFERENTIAL SETTLEMENT AT INTERFACE BETWEEN CIRCULAR ROADWAY ON GRADE AND NORTH PLAZA STRUCTURAL SLAB ON PILES

SETTLEMENT OF ASHLAR SEAWALL

DIFFERENTIAL SETTLEMENT BETWEEN NORTHWEST STAIRS ON PILES AND WALKWAY ON GRADE

DIFFERENTIAL SETTLEMENT AT WEST END OF TERRACE WALL

LATERAL MOVEMENT AS EVIDENCED BY PLAZA JOINT OPENING BETWEEN NORTH PLAZA AND MAIN STAIRS



40 0 40 80

SCALE OF FEET

FIGURE 9

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

AREAS OF STUDY
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED: DW/CJR/HR
DRAWN: NSF
CHECKED: JG
PWIS/PMS NO.: 128232
DATE: 3/6/08
DWG. NO.: 808/80284

KEY:

PREVIOUS AND CURRENT STUDIES RELATED TO MOVEMENTS OF THE SEAWALL AND NORTH PLAZA

NORTH PLAZA:

- 1965 & 1968 STORCH REPORTS AND PLANS FOR RECONSTRUCTING PLAZA
- 1998 NPS PLANS FOR RESTORATION OF ENTRANCE STEPS AND PLAZA
- 1999–2000 REPAVING WITH EXPOSED AGGREGATE CONCRETE
- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

MEMORIAL & STYLOBATE MALL:

- MONITORING DATA FROM 1941–1968
- 1965 & 1968 STORCH REPORTS WITH PROPOSED REPAIR SOLUTIONS
- 1990 & 1992 EINHORN YAFFEE PRESCOTT REPORTS

ASHLAR SEAWALL:

- MONITORING DATA FROM 1941–1968
- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

NORTHWEST STAIRS:

- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

WEST TERRACE WALK:

- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

CIRCULAR ROADWAY AT INTERFACE WITH NORTH PLAZA:

- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

40 0 40 80

SCALE OF FEET

TIDAL BASIN

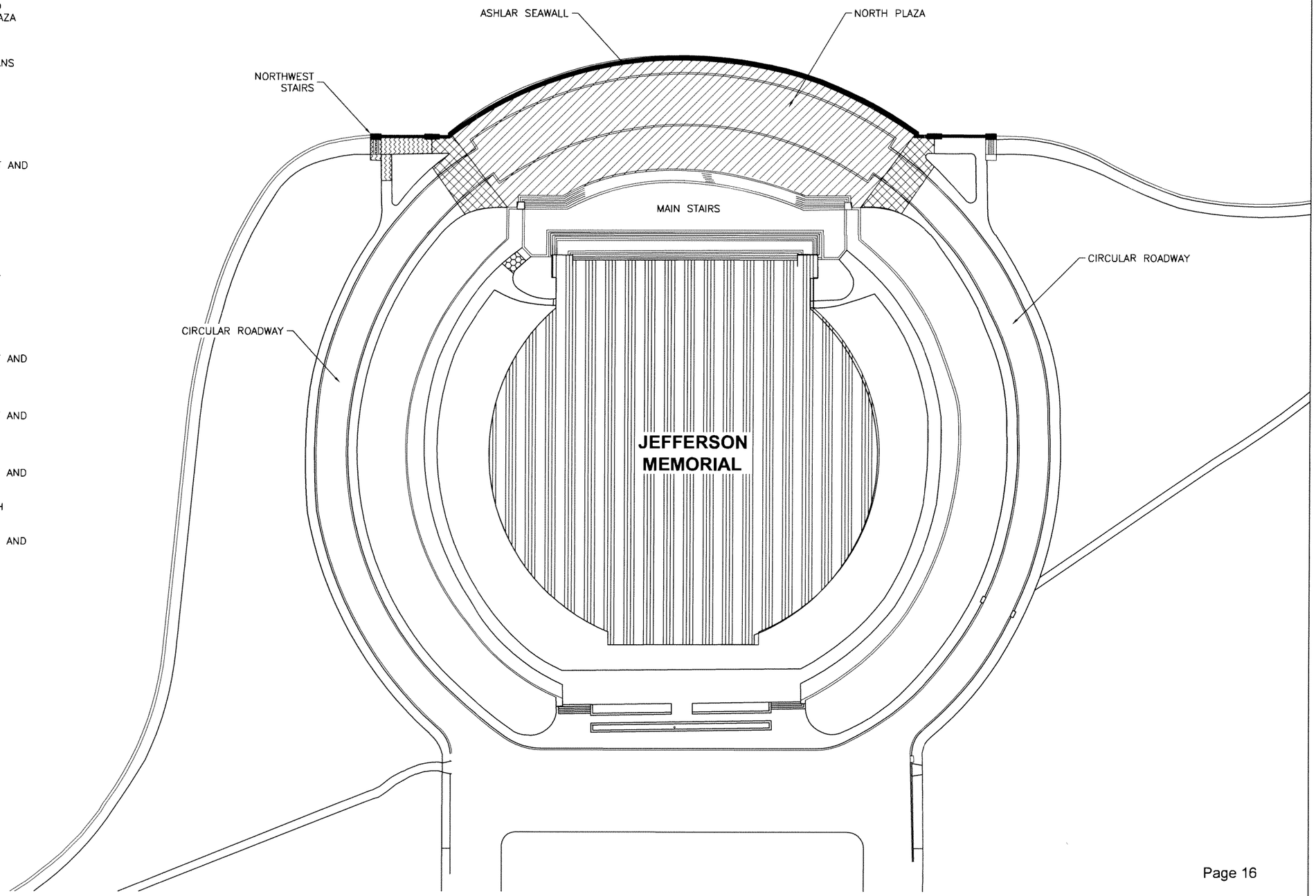


FIGURE 10

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

PREVIOUS AND CURRENT SETTLEMENT STUDIES
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED DW/CJR/HR
DRAWN NSF
CHECKED JG
PMIS/PMS NO. 128232
DATE 3/6/08
DWG. NO. 808/80284

KEY:

AREAS THAT MAY POTENTIALLY BE AFFECTED BY CONSTRUCTION OPERATIONS

- REHABILITATION OF THE ASHLAR SEAWALL. THIS IS A HISTORIC STRUCTURE
- REHABILITATION OF THE NORTH PLAZA.
- REPLACEMENT OF EXISTING SLAB ON GRADE WITH STRUCTURAL SLAB AND INSTALLATION OF FLEXIBLE JOINTS
- INSTALLATION OF TEMPORARY COFFERDAM AND DEWATERING
- POSSIBLE CONSTRUCTION STAGING AREA
- POSSIBLE SITE ACCESS
- REPLACEMENT OF EXISTING SLAB ON GRADE WITH STRUCTURAL SLAB AND INSTALLATION OF FLEXIBLE JOINTS

40 0 40 80
SCALE OF FEET

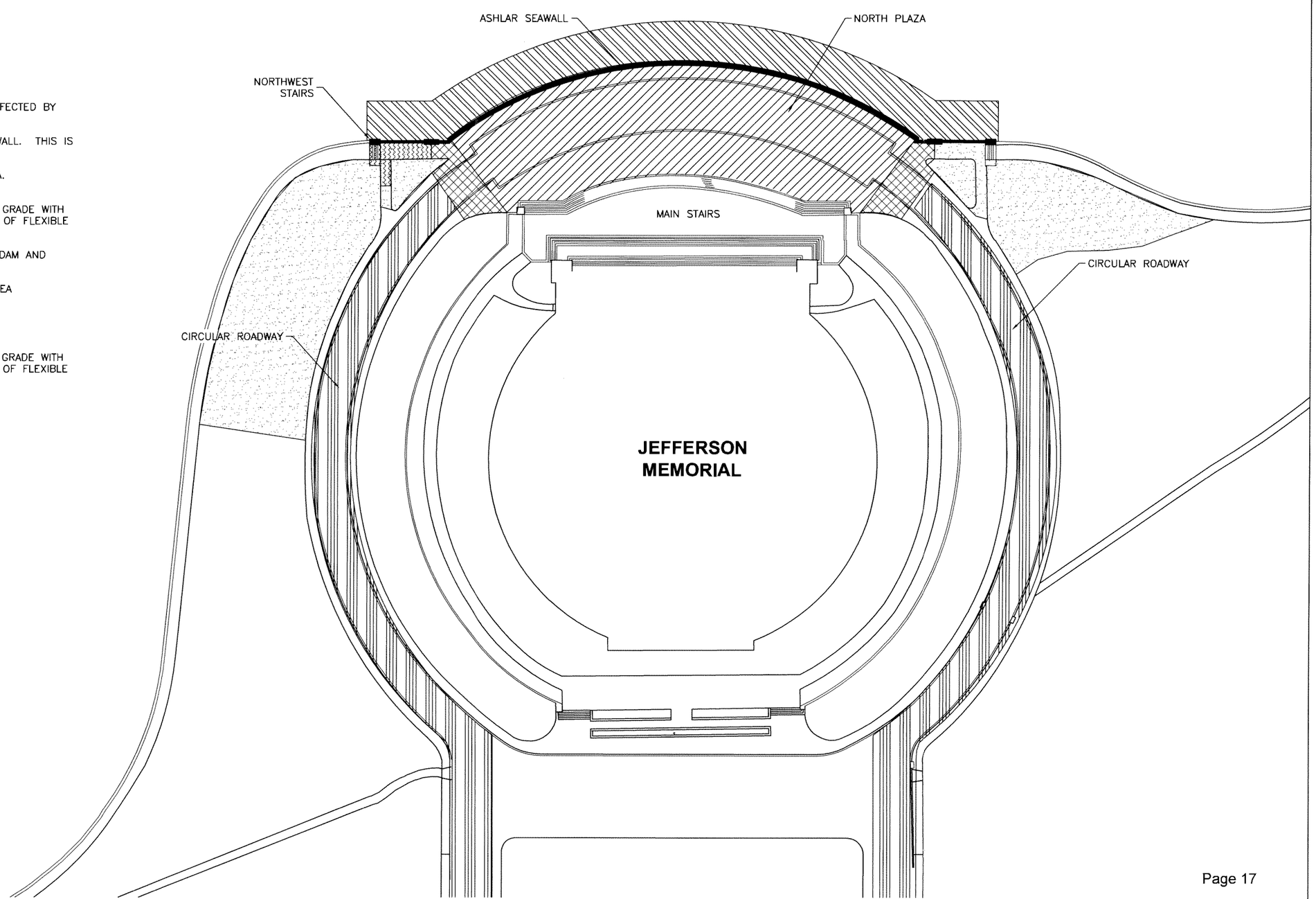


FIGURE 11

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	DW/CJR/HR DESIGNED: NSF DRAWN: JG CHECKED:
						REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	PMIS/PMS NO.: 128232 DATE: 3/6/08 DWG NO.: 808/80284
	IMPACT OF CONSTRUCTION OPERATIONS TITLE OF DRAWING					SUB SHEET NUMBER	

II. CLASS C COST ESTIMATE

The purpose of the Class C Cost Estimate is to determine the probable cost of the proposed design at Jefferson Memorial. For this cost estimate, the Ashlar Seawall and the North Plaza have been evaluated separately. This estimate considers the probable cost of materials and services in the Washington, DC, area. The Class C estimate is based on a Predesign effort.

A. COST ESTIMATE: SEAWALL

This remediation solution for the Ashlar Seawall consists of installing micropiles to the north and south of the footing of the existing concrete wall. Segments of the North Plaza slab must be removed to excavate behind the seawall. We anticipate removing the plaza slab at the expansion joint located approximately 10 feet behind the seawall. The existing grade beams would remain in place. Battered micropiles could be installed from inside the excavation to the south of the wall footing, and pile cap extensions would be constructed. The micropiles to the north of the footing could be installed from the north plaza elevation; however, a temporary cofferdam would be needed to construct the pile cap extension.

This solution would consist of 53 vertical micropiles in front of the wall, and 53 micropiles battered at five degrees behind the wall. The piles would have an unbonded length of approximately 80 feet, and a bonded length of 10 feet into bedrock. At least one load test on a sacrificial, instrumented micropile should be performed.

Following micropile installation, the wall would be backfilled and the plaza slab replaced. This solution will require removal of the riprap and backfilling after installation of micropiles.

Figure 12 and Figure 13 show schematics for this remediation for the Ashlar Seawall.

The Class C Cost Estimate is included in the pages that follow. A description of the assumptions used in preparation of these cost estimates is also presented.

Class C Construction Cost Estimate

Project: Jefferson Memorial Seawall and Plaza Repair
Park: Thomas Jefferson Memorial
PMIS: 128232

Basis of Estimate

Date of Estimate:	03/05/08
Estimated By:	Kirk Associates 1177 Berkshire, Suite 100 Grosse Pointe Park, MI (248) 240-9605
Supporting Material:	Pre-Design Documents / Reports, 01/08
Cost Data:	Square Foot Cost Data. Unit Prices based on 2008 Cost data Conversations with Consulting Engineers
Mark-ups and Add-ons:	**Published Location Factor:** RS Means (Washington, D.C.). **Project Remoteness:** Site is in downtown Washington D.C. (dense urban) **Federal Wage Rate Factor:** 6 Percent Guidance from NPS. **Design Contingency:** Limited Detail on Pre-Design Report, however this is a small project. 25 percent seems appropriate. **Taxes:** 4.75 Percent Sales Tax included in Unit Costs **Standard General Conditions:** Above Normal Range of 18 Percent due to special equipment needs. **Government General Conditions:** 10 Percent within NPS Guidance Recommendations. **Bonds and Permits:** 1.5 percent bond included in General Conditions. No permit costs. **Historic Preservation Factor:** Memorial cost include 5% Historic Factor. **Overhead:** Small Job, Limited sub-contractors due to work in region. **Profit:** 10 Percent **Contracting Method Adjustment:** No indication of what the construction contract will be, assume it require 25% premium (may be lower). **Inflation Escalation:** Assume midpoint of construction to begin July, 2009 with 18 month construction period. Inflation predictions indicate 6% per year.
Comments:	Most Work assumed to be completed by land based equipment Installation of water side cofferdam would be completed by water based equipment Park operations will be open in this area during the repair work Removed materials will be kept on site before re-installation
Seawall Alternative 3:	This alternative consists of installing micropiles battered at 0 degrees in front of the wall, and 5 degrees behind the wall. This would required using a temporary cofferdam to allow for the construction of the pile cap extension. The piles would have an unbonded length of approximately 80 feet and a bonded length of 10 feet.

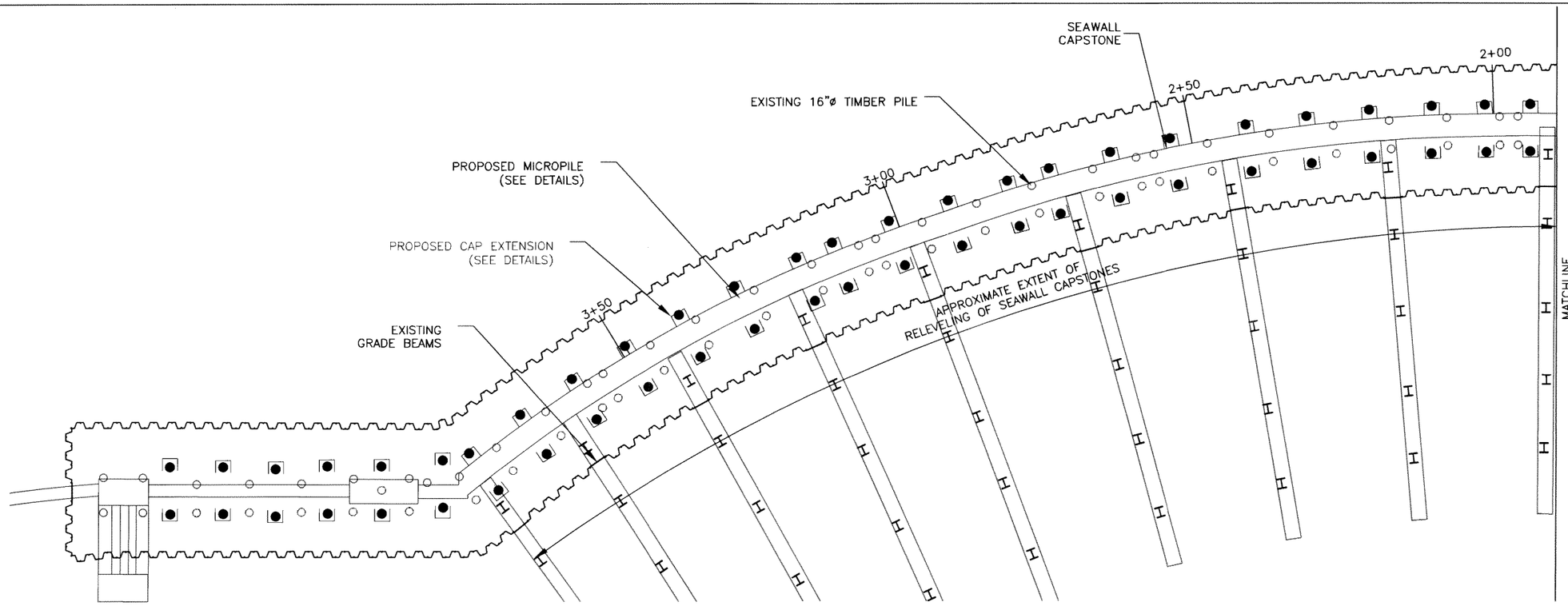
Class C Construction Cost Estimate

Project: Jefferson Memorial Seawall and Plaza Repair
Park: Thomas Jefferson Memorial
PMIS: 128232
Seawall Alternative 3:

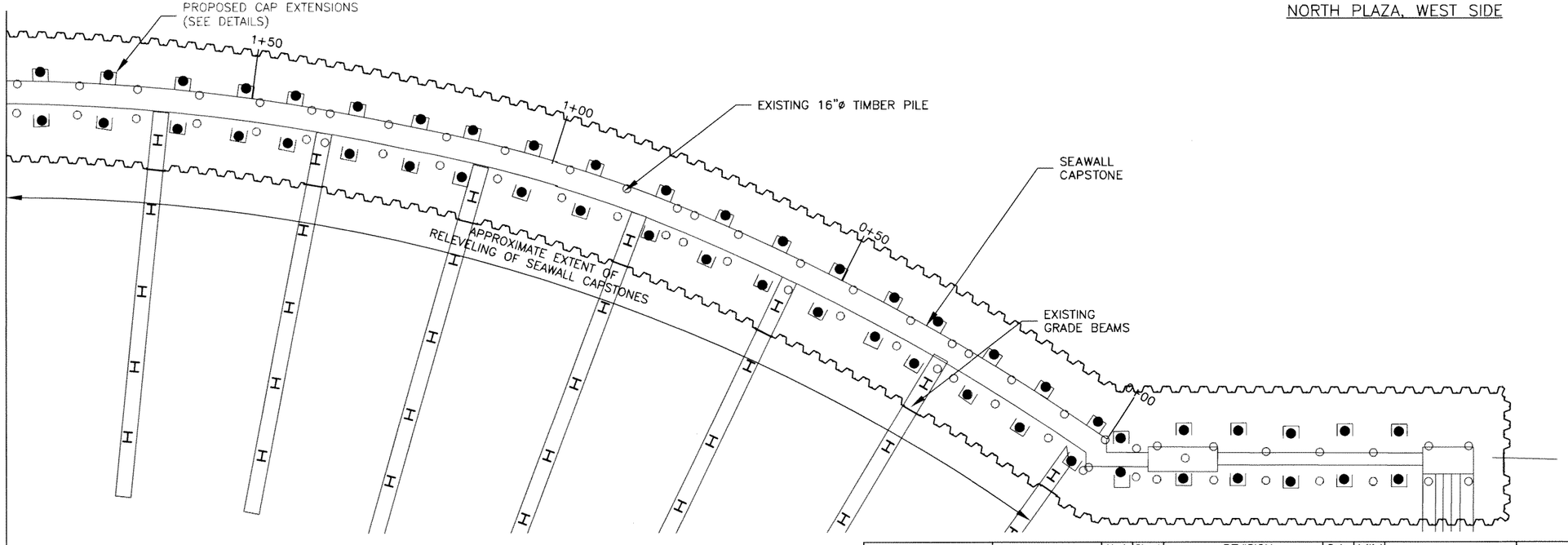
Estimate By: S. Garrett
Date: 03/05/08
Reviewed By: R. Merrick
Date: 02/26/08

Estimate is based on 2008 costs

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	Complete pre-work condition survey	1	LS	$10,000.00	$10,000
2	Install vibration monitoring equipment	1	LS	$3,500.00	$3,500
3	Remove North Plaza Slab (to expansion joint at 10'-0")	5,000	SF	$10.00	$50,000
4	Remove Capstone (store on site)	500	LF	$150.00	$75,000
5	Install temporary cofferdam-land side (sheet pile)	4,000	Wall SF	$24.00	$96,000
6	Install temporary cofferdam-water side (sheet pile)	6,000	Wall SF	$38.00	$228,000
7	Excavate to rip rap	2,222	CY	$20.00	$44,444
8	Excavate of 5' of rip rap	926	CY	$30.00	$27,778
9	Install temporary grade beam supports	1	LS	$12,500.00	$12,500
10	Core mircopiles	107	EA	$825.00	$88,275
11	Install sacrificial micropile	1	EA	$12,500.00	$12,500
12	Conduct load test	1	LS	$7,500.00	$7,500
13	Install battered mircopiles (90' length)	106	EA	$12,500.00	$1,325,000
14	Install cap extensions	106	EA	$1,280.00	$135,680
15	Install new engineered fill	2,222	CY	$35.00	$77,778
16	Install rip-rap	926	CY	$55.00	$50,926
17	Install New North Plaza structural slab	5,000	SF	$35.00	$175,000
18	Install 3" exposed aggregrate concrete topping slab	5,000	SF	$13.50	$67,500
19	Reinstall / Minor Repair Capstone	500	LF	$300.00	$150,000
20	Repair site damage from construction	1	Allowance	$5,000.00	$5,000
21	Complete post-work condition survey	1	LS	$12,000.00	$12,000
	Subtotal Direct Construction Costs				**2,654,381**
	Published Location Factor	3.0%			79,631
	Remoteness Factor (urban)	0.0%			0
	Federal Wage Rate Factor	6.0%			79,631
	Design Contingency	25.0%			663,595
	Total Direct Construction Costs				**3,477,239**
	Standard General Conditions	30.0%			1,043,172
	Government General Conditions	10.0%			347,724
	Historic Preservation Factor (Memorial)	5.0%			173,862
	Subtotal NET Construction Cost				**5,041,997**
	Overhead	12.5%			630,250
	Profit	10.0%			504,200
	Estimated NET Construction Cost				**6,176,446**
	Contracting Method Adjustment (Full Open)	5.0%			308,822
	Inflation Escalation (6.0% / Yr; 27 Months)	13.5%			833,820
	Total Estimated NET Cost of Construction				**7,319,100**



NORTH PLAZA, WEST SIDE



NORTH PLAZA, EAST SIDE

10 0 10 20
SCALE OF FEET

FIGURE 12

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD.

LEGEND

○ EXISTING 16" ø TIMBER PILE
● PROPOSED MICROPILE

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

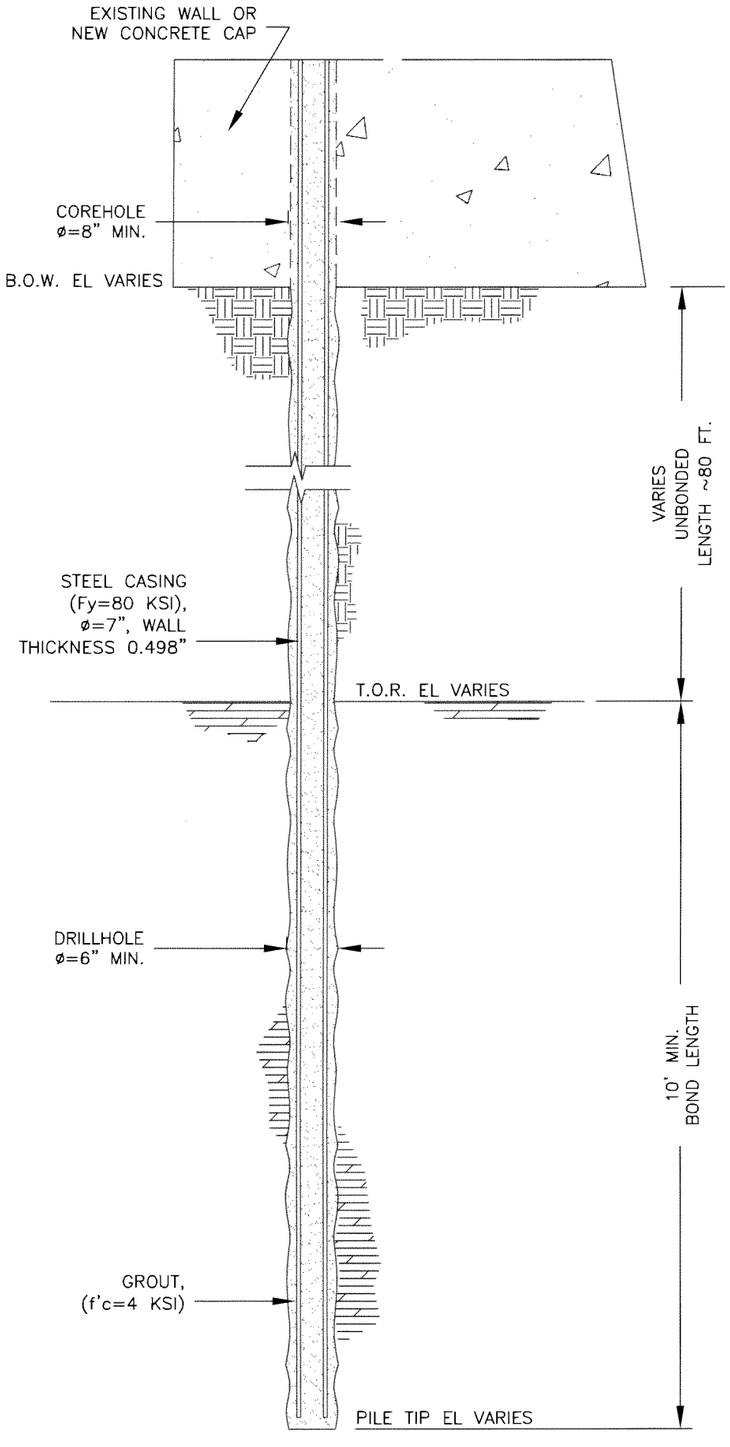
REMEDIATION OF ASHLAR SEAWALL
TITLE OF DRAWING

SUB SHEET NUMBER

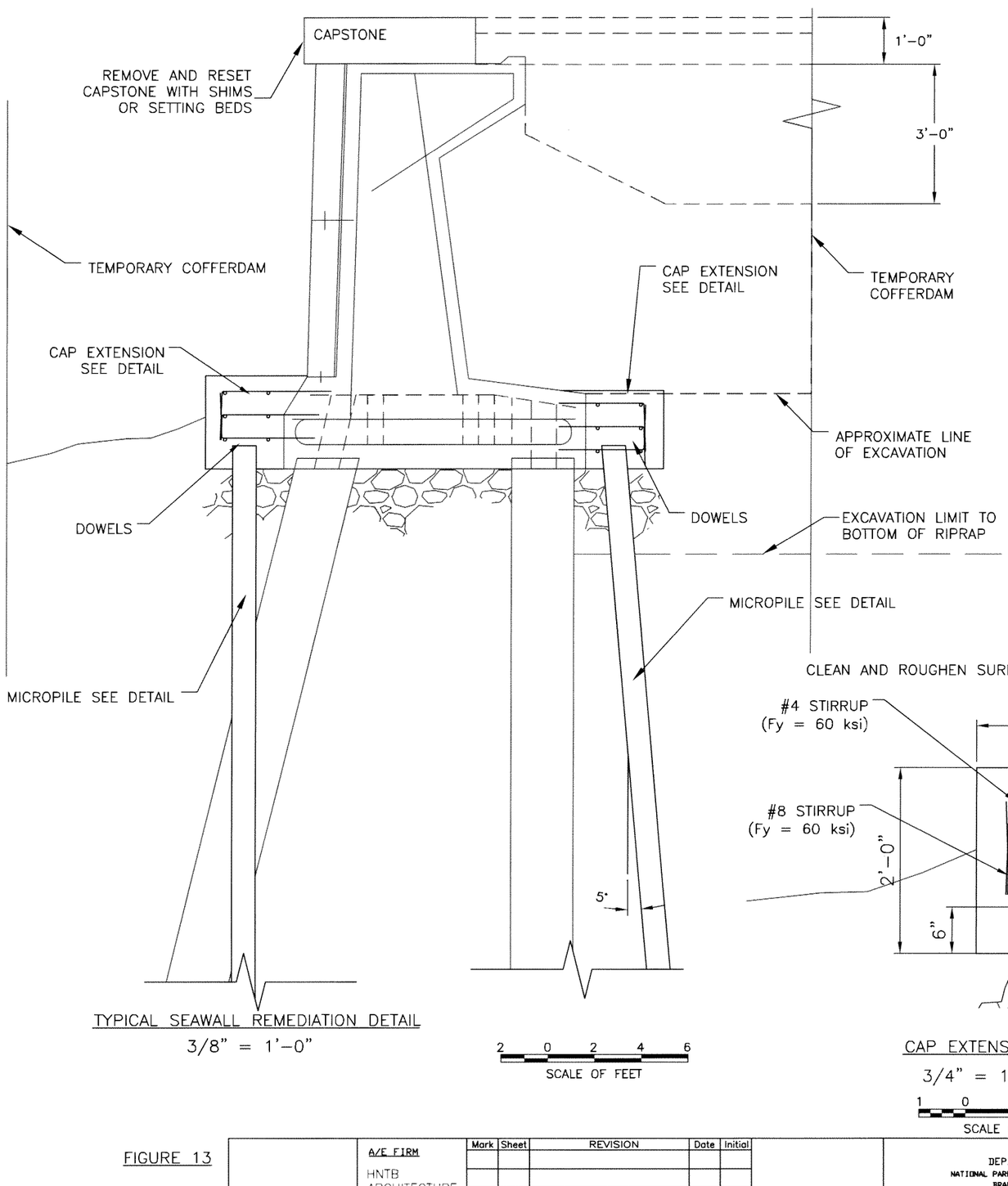
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED: DW/CJR/HR
DRAWN: NSF/SCB
CHECKED: JG
PMIS/PMS NO.: 128232
DATE: 3/6/08
DWG. NO.: 808/80284

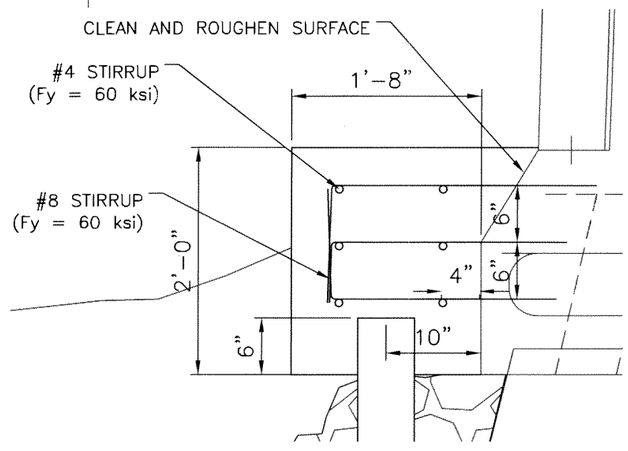


TYPICAL MICROPILE TYPE I DETAIL
NO SCALE



TYPICAL SEAWALL REMEDIATION DETAIL
3/8" = 1'-0"

2 0 2 4 6
SCALE OF FEET



CAP EXTENSION DETAIL
3/4" = 1'-0"

1 0 1 2 3
SCALE OF FEET

FIGURE 13

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	DESIGNED DW/CJR/HR DRAWN NSF/SCB CHECKED JC
						REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	PROJ/PKG NO. 128232 DATE 3/6/08 DWG. NO. 808/80284
REMEDIATION OF ASHLAR SEAWALL – SECTIONS TITLE OF DRAWING						SUB SHEET NUMBER	

B. COST ESTIMATE: NORTH PLAZA

1. NORTH PLAZA STRUCTURE

This rehabilitation solution consists of retrofitting the North Plaza structure with new piles and a new structural slab to resist lateral movements. It requires removing the existing structural slab at the North Plaza, and installing pipe piles to bedrock. The existing piles and pile caps would remain in place. This solution addresses the condition of the existing piles, and supplements their load capacity with additional piles.

This would consist of approximately forty-five 18"-diameter steel pipe piles battered at 30° toward the Ashlar Seawall, and ninety 18"-diameter steel pipe piles installed vertically. The vertical piles would have a length of approximately 90 feet, and the battered piles would have a length of approximately 105 feet. All piles are to be driven to top of bedrock, which is approximately located at EL -86.6 feet. At least three load tests on sacrificial, instrumented pipe piles should be performed. The layout of the pipe piles would consist of 15 radial sections containing three battered piles, and six vertical piles in each section. Six continuous arced grade beams would span across all of the sections, and dowel into the existing grade beams where they intersect.

All sections of the north plaza structural slab will be removed and demolished. The pipe piles will be driven into bedrock and the arced grade beams will be formed and poured. Stay-in-place formwork will be used to span the gaps between the radial and arced grade beams, and a new structural slab of approximately 20,800 feet^2 will be constructed.

Figures 14 through 17 show schematics of this remediation for the North Plaza.

2. DIFFERENTIAL SETTLEMENT AT EAST AND WEST ENDS

At the North Plaza, there is noticeable relative movement at the interface between the structural slab-on-piles and the adjacent Circular Road slab-on-grade. The elevation difference, resulting from settlement of the slab-on-grade, is a tripping hazard and requires frequent asphalt patching. Our proposed remediation method consists of cutting at the edge of the structural slab, removing 10 feet of the Circular Roadway slab at both ends of the North Plaza, and replacing with a 10-foot wide structural transition slab. Micropiles would be installed at five feet on center adjacent to the eastern and western-most grade beams on the North Plaza, and would be capped with a grade beam. This beam would support the one edge of a new structural slab. A new footing would support the other edge of the slabs, and at either end a flexible joint would be used to allow the slab to undergo anticipated settlements without causing tripping hazards.

Figure 18 and Figure 19 show schematics for this remediation.

3. DIFFERENTIAL SETTLEMENT ALONG NORTHWEST STAIRS

The Northwest Stairs that approach the North Plaza along the Ashlar Seawall are supported on their north side by the seawall, and on their south side by H piles and a grade beam. To the south of the stairs, a slab-on-grade sidewalk intersects perpendicularly. At this interface between the sidewalks on piles and on grade, there are differential elevations resulting in a tripping hazard and the need for an asphalt patch. Our proposed remediation method consists of removing 10 feet of the sidewalk slab, and creating a joint at the base of the existing grade beam. A new structural slab would be constructed and supported on the existing beam to the north, and a new footing at the south edge. The interface would be sealed with a flexible joint to allow the sidewalk to undergo anticipated settlements.

Figure 20 shows schematics for this remediation.

NORTH PLAZA STRUCTURE

Class C Construction Cost Estimate

Project: Jefferson Memorial Seawall and Plaza Repair
Park: Thomas Jefferson Memorial
PMIS: 128232

Basis of Estimate

Date of Estimate:	03/05/08
Estimated By:	Kirk Associates 1177 Berkshire, Suite 100 Grosse Pointe Park, MI (248) 240-9605
Supporting Material:	Pre-Design Documents / Reports, 01/08
Cost Data:	Square Foot Cost Data. Unit Prices based on 2008 Cost data Conversations with Consulting Engineers
Mark-ups and Add-ons:	**Published Location Factor:** RS Means (Washington, D.C.). **Project Remoteness:** Site is in downtown Washington D.C. (dense urban) **Federal Wage Rate Factor:** 6 Percent Guidance from NPS. **Design Contingency:** Limited Detail on Pre-Design Report, however this is a small project. 25 percent seems appropriate. **Taxes:** 4.75 Percent Sales Tax included in Unit Costs **Standard General Conditions:** Above Normal Range of 18 Percent due to special equipment needs. **Government General Conditions:** 10 Percent within NPS Guidance Recommendations. **Bonds and Permits:** 1.5 percent bond included in General Conditions. No permit costs. **Historic Preservation Factor:** Memorial cost include 5% Historic Factor. **Overhead:** Small Job, Limited sub-contractors due to work in region. **Profit:** 10 Percent **Contracting Method Adjustment:** No indication of what the construction contract will be, assume it require 25% premium (may be lower). **Inflation Escalation:** Assume midpoint of construction to begin July, 2009 with 18 month construction period. Inflation predictions indicate 6% per year.
Comments:	Work assumed to be completed by land based equipment Park operations will be open in this area during the repair work Removed materials will be kept on site before re-installation
North Plaza Alternative 1:	This alternative consists of retrofitting the North Plaza structure with new piles and a new structural slab to resist lateral movements. It requires removing the existing structural slab at the North Plaza, and installing vertical and battered HP piles to bedrock. The existing piles and pile caps would remain in place. A series of 6 arched grade beams will be installed to reinforce the new structural slab.

Class C Construction Cost Estimate

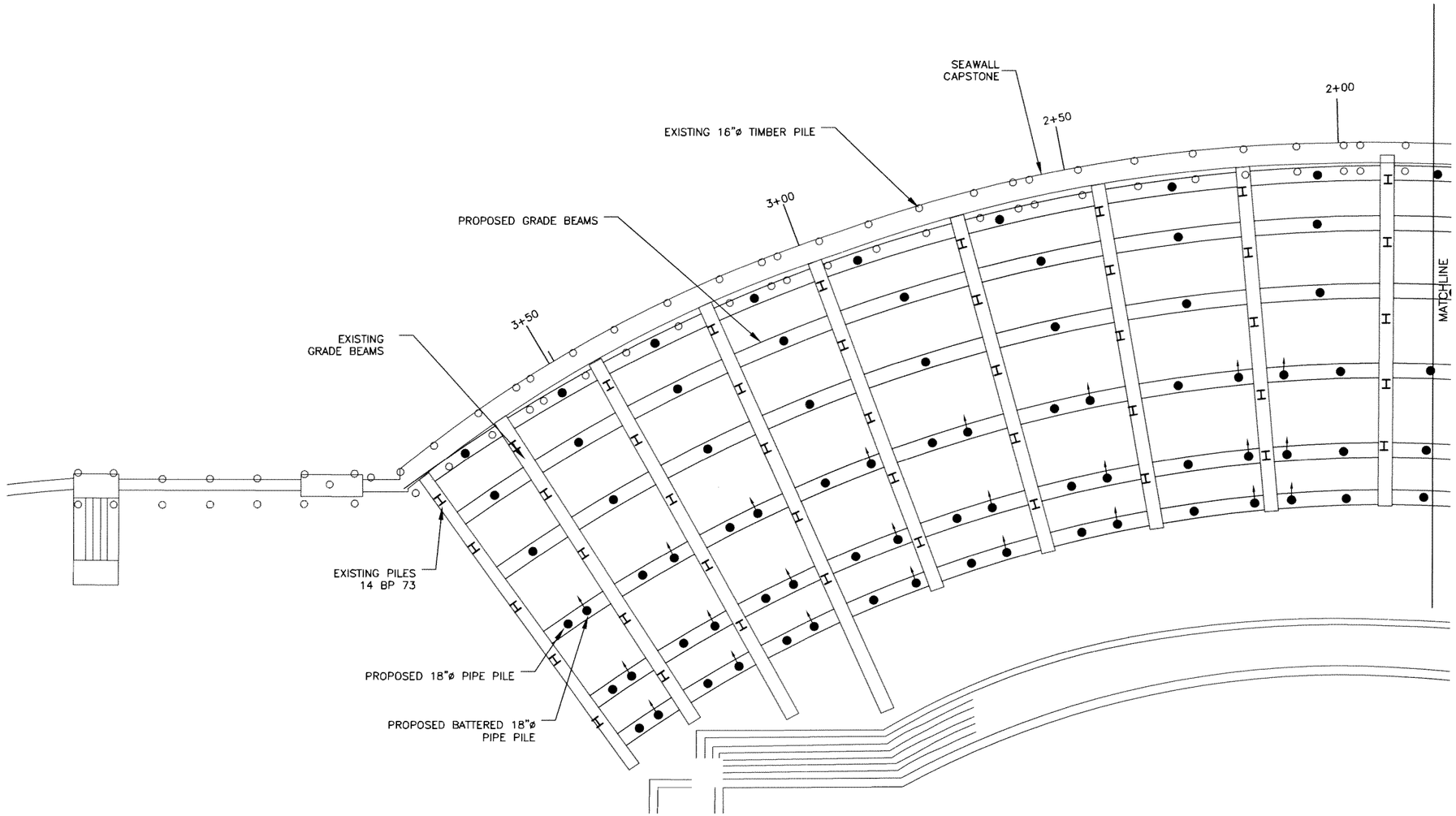
Project: Jefferson Memorial Seawall and Plaza Repair
Park: Thomas Jefferson Memorial
PMIS: 128232
North Plaza Alternative 1:

Estimate By: S. Garrett
Date: 03/05/08

Reviewed By: R. Merrick
Date: 02/26/08

Estimate is based on 2008 costs

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	Complete pre-work condition survey	1	LS	$10,000.00	$10,000
2	Install vibration monitoring equipment	1	LS	$3,500.00	$3,500
3	Remove North Plaza Slab (in sections)	20,800	SF	$7.50	$156,000
4	Remove and store North Plaza Granite features	2,091	SF	$3.00	$6,272
5	Excavate under slab for grade beam placement	1,156	CY	$15.00	$17,333
6	Install leave in place forms for 6 grade beams / section	15	Sections	$1,800.00	$27,000
7	Install temporary bracing	15	Sections	$700.00	$10,500
8	Install sacrificial HP pile	2	EA	$17,500.00	$35,000
9	Conduct load test	2	LS	$7,500.00	$15,000
10	Install battered HP piles (105' length)	45	EA	$17,500.00	$787,500
11	Install vertical HP piles (90' length)	90	EA	$16,500.00	$1,485,000
12	Install arched 6 continuous grade beams	587	CY	$425.00	$249,333
13	Install New North Plaza structural slab	20,800	SF	$35.00	$728,000
14	Install 3" exposed aggregrate concrete topping slab	20,800	SF	$13.50	$280,800
15	Reinstall North Plaza Granite Features	2,091	SF	$8.00	$16,725
16	Repair site damage from construction	1	Allowance	$2,500.00	$2,500
17	Complete post-work condition survey	1	LS	$12,000.00	$12,000
	Subtotal Direct Construction Costs				**3,842,464**
	Published Location Factor	3.0%			115,274
	Remoteness Factor (urban)	0.0%			0
	Federal Wage Rate Factor	6.0%			115,274
	Design Contingency	25.0%			960,616
	Total Direct Construction Costs				**5,033,628**
	Standard General Conditions	30.0%			1,510,088
	Government General Conditions	10.0%			503,363
	Historic Preservation Factor (Memorial)	5.0%			251,681
	Subtotal NET Construction Cost				**7,298,760**
	Overhead	12.5%			912,345
	Profit	10.0%			729,876
	Estimated NET Construction Cost				**8,940,981**
	Contracting Method Adjustment (Full Open)	5.0%			447,049
	Inflation Escalation (6.0% / Yr; 27 Months)	13.5%			1,207,032
	Total Estimated NET Cost of Construction				**10,595,100**



REMEDIATION OF NORTH PLAZA – WEST SIDE
SCALE 1" = 10'–0"

LEGEND

- ● PROPOSED 18"ø PIPE PILE
- PROPOSED BATTERED 18"ø PIPE PILE
- I EXISTING PILES 14 BP 73
- ○ EXISTING 16"ø TIMBER PILE

FIGURE 14

10 0 10 20
SCALE OF FEET

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

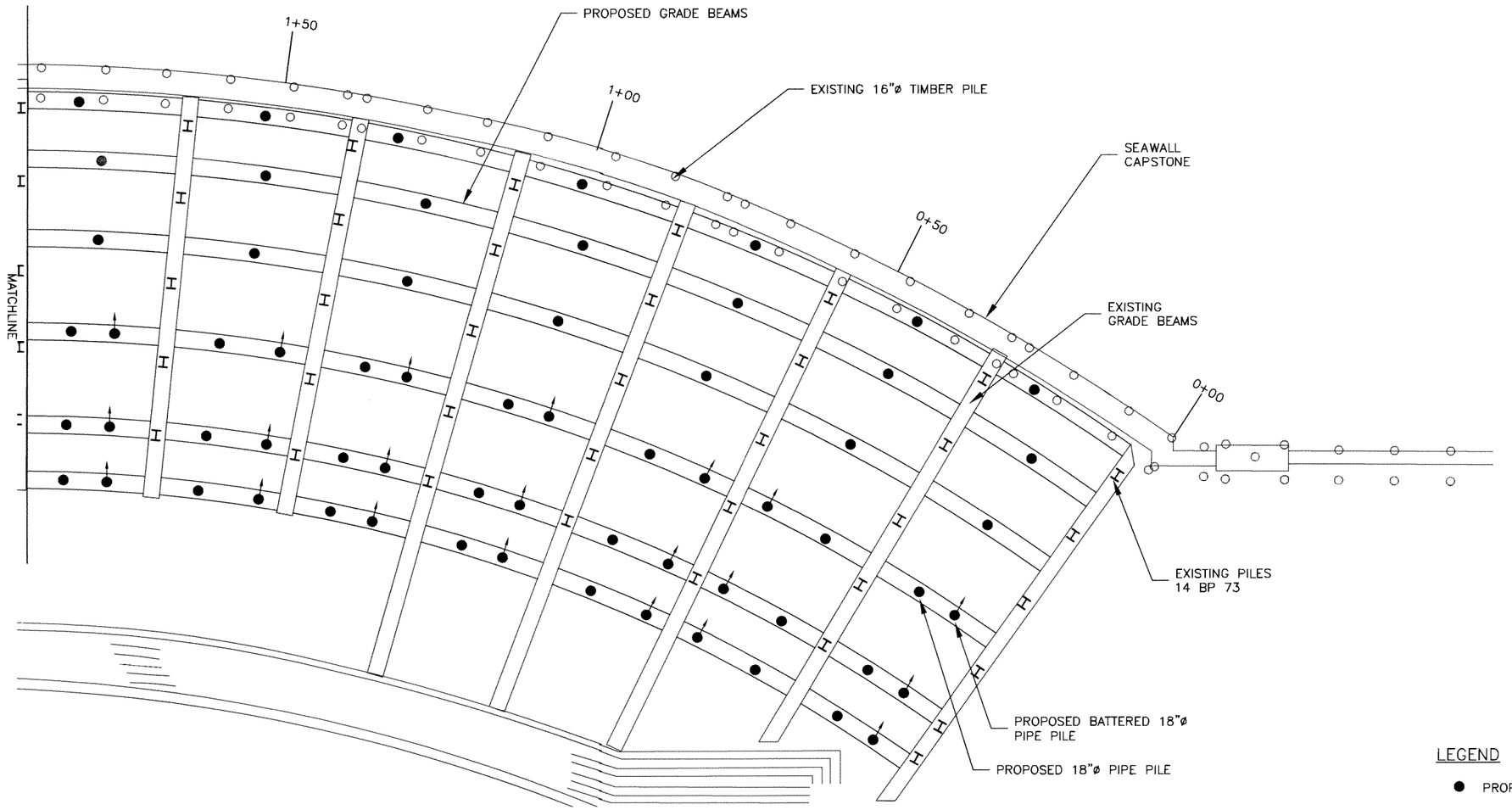
REMEDIATION OF NORTH PLAZA – WEST SIDE
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED DW/CJR/HR
DRAWN NSF/SCB
CHECKED JG
PMIS/PMS NO. 128232
DATE 3/6/08
DWG. NO. 808/80284



REMEDIATION OF NORTH PLAZA – EAST SIDE
SCALE 1" = 10'–0"

LEGEND

- ● PROPOSED 18"ø PIPE PILE
- ● PROPOSED BATTERED 18"ø PIPE PILE
- I EXISTING PILES 14 BP 73
- ○ EXISTING 16"ø TIMBER PILE

FIGURE 15

10 0 10 20
SCALE OF FEET

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD.

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

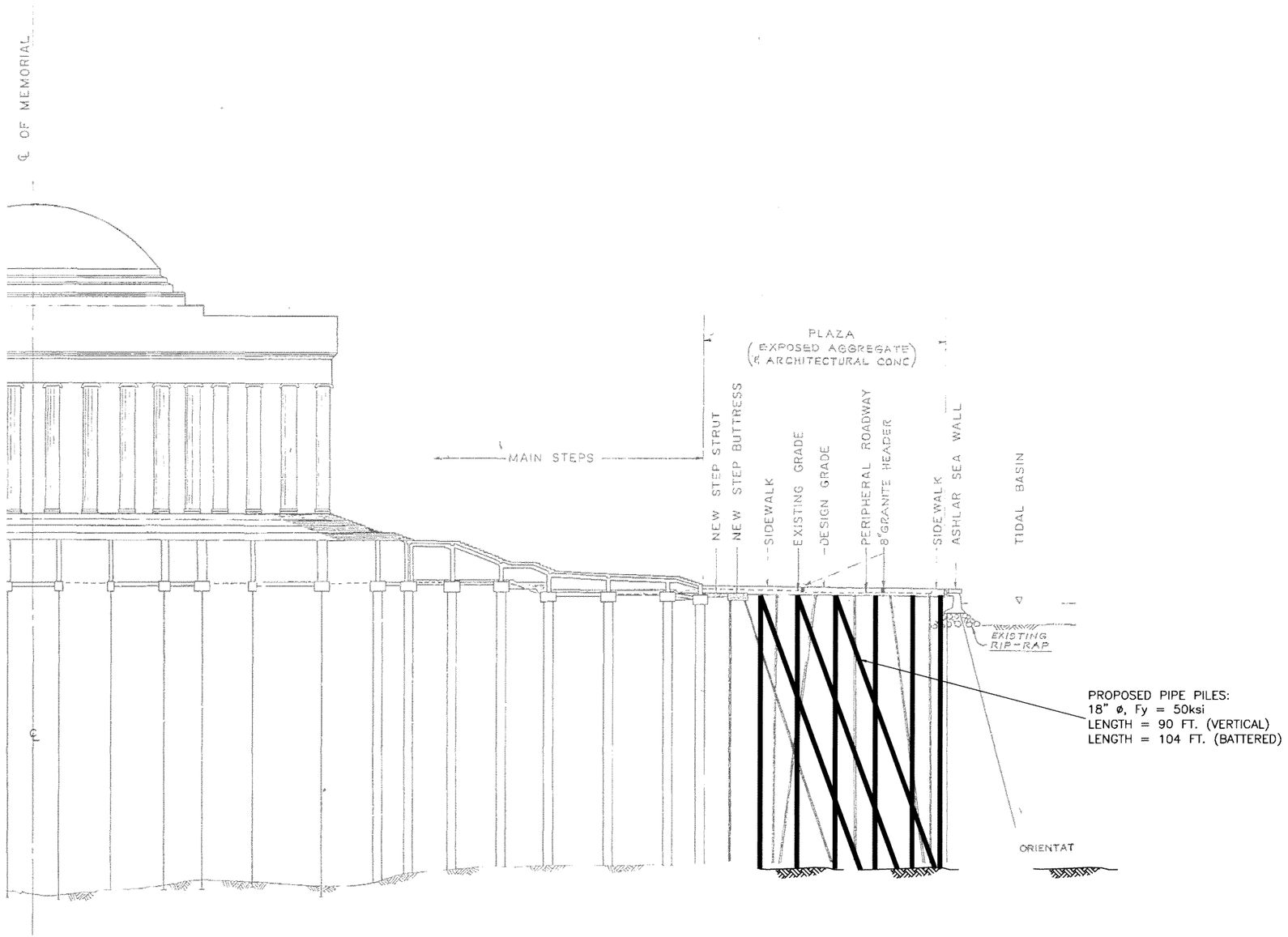
REMEDIATION OF NORTH PLAZA – EAST SIDE
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED	DW/CJR/HR
DRAWN	NSF/SCB
CHECKED	JG
PHIS/PKG NO.	128232
DATE	3/6/08
DWG. NO.	808/80284



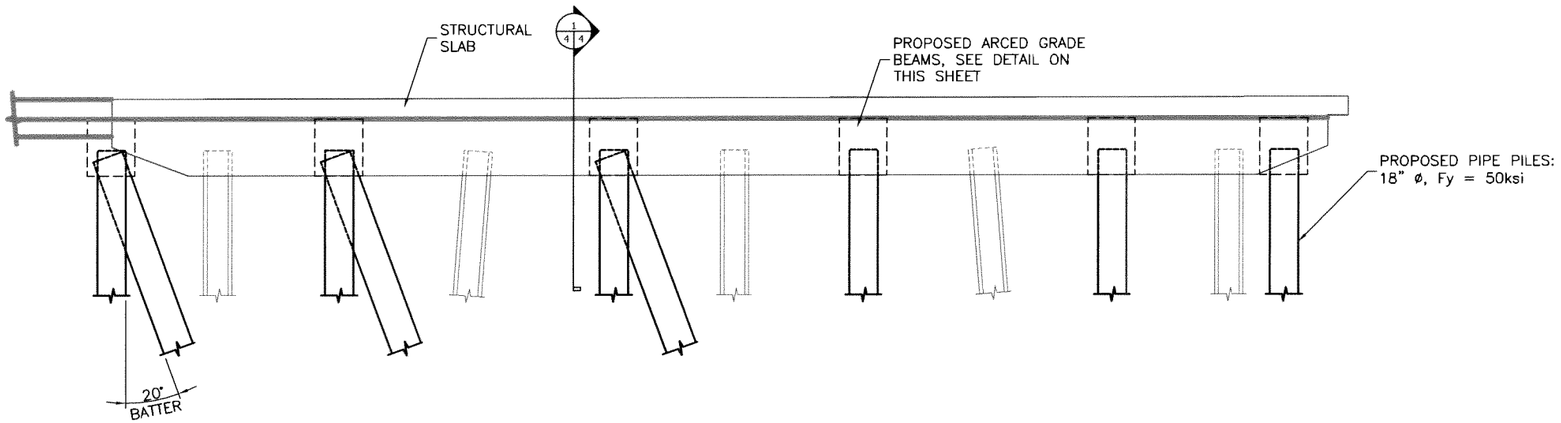
NOTE:
GEOMETRY BASED ON
HISTORICAL DOCUMENTS AND
MUST BE VERIFIED IN FIELD

REMEDIATION OF NORTH PLAZA – ELEVATION
SCALE 1" = 20'–0"

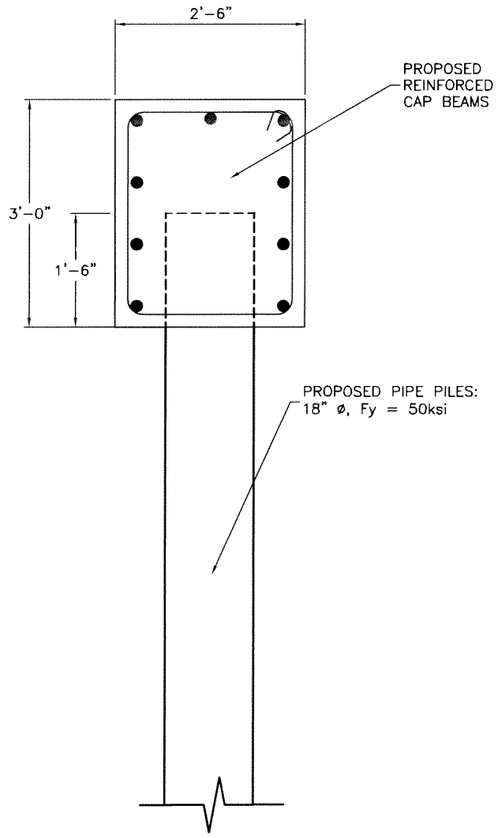
FIGURE 16

20 0 20 40
SCALE OF FEET

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	DW/CJR/HR DESIGNED NSF/SCB DRAWN JG CHECKED
							REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	PMIS/PRS NO. 128232 DATE 3/6/08 DWG NO. 808/80284
				REMEDIATION OF NORTH PLAZA – ELEVATION TITLE OF DRAWING			SUB SHEET NUMBER	



REMEDIATION OF NORTH PLAZA – SECTIONS
SCALE 3" = 1'–0"



1/4 ARCED BEAM DETAIL
SCALE 1" = 1'–0"

FIGURE 17

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD

6 3 0 6
SCALE OF INCHES

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR; NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION; BRANCH OF DESIGN AND CONSTRUCTION	DESIGNED: HR/MD; DRAWN: NSF/SCB; CHECKED: JG
						REPAIR & CONTROL SETTLEMENT (TITLE OF PROJECT); THOMAS JEFFERSON MEMORIAL (LOCATION WITHIN PARK); NATIONAL MALL & MEMORIAL PARKS (NAME OF PARK)	PMIS/PMS NO.: 128232; DATE: 3/6/08; DWG. NO.: 808/80284
						REMEDIATION OF NORTH PLAZA – SECTIONS (TITLE OF DRAWING)	SUB SHEET NUMBER

DIFFERENTIAL SETTLEMENT AT EAST AND WEST ENDS

DIFFERENTIAL SETTLEMENT ALONG NORTHWEST STAIRS

Class C Construction Cost Estimate

Project: Jefferson Memorial Seawall and Plaza Repair
Park: Thomas Jefferson Memorial
PMIS: 128232

Basis of Estimate

Date of Estimate:	03/05/08
Estimated By:	Kirk Associates 1177 Berkshire, Suite 100 Grosse Pointe Park, MI (248) 240-9605
Supporting Material:	Pre-Design Documents / Reports, 01/08
Cost Data:	Square Foot Cost Data. Unit Prices based on 2008 Cost data Conversations with Consulting Engineers
Mark-ups and Add-ons:	**Published Location Factor:** RS Means (Washington, D.C.). **Project Remoteness:** Site is in downtown Washington D.C. (dense urban) **Federal Wage Rate Factor:** 6 Percent Guidance from NPS. **Design Contingency:** Limited Detail on Pre-Design Report, however this is a small project. 25 percent seems appropriate. **Taxes:** 4.75 Percent Sales Tax included in Unit Costs **Standard General Conditions:** Above Normal Range of 18 Percent due to equipment needs. **Government General Conditions:** 10 Percent within NPS Guidance Recommendations. **Bonds and Permits:** 1.5 percent bond included in General Conditions. No permit costs. **Historic Preservation Factor:** Memorial cost include 5% Historic Factor. **Overhead:** Small Job, Limited sub-contractors due to work in region. **Profit:** 10 Percent **Contracting Method Adjustment:** No indication of what the construction contract will be, assume it require 25% premium (may be lower). **Inflation Escalation:** Assume midpoint of construction to begin July, 2009 with 18 month construction period. Inflation predictions indicate 6% per year.
Comments:	Work assumed to be completed by land based equipment Park operations will be open in this area during the repair work Removed materials will be kept on site before re-installation
Remediation Method for North Plaza and NW & NE Stairs:	This alternative is for the remediation for the North Plaza and Northwest Stairs.

Class C Construction Cost Estimate

Project: Jefferson Memorial Seawall and Plaza Repair
Park: Thomas Jefferson Memorial
PMIS: 128232
Remediation Method for North Plaza and NW & NE Stairs:

Estimate By: S. Garrett
Date: 03/05/08
Reviewed By: R. Merrick
Date: 02/26/08

Estimate is based on 2008 costs

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	Complete pre-work condition survey	1	LS	$7,000.00	$7,000
2	Install vibration monitoring equipment	1	LS	$5,500.00	$5,500
3	Remove stair slab	230	SF	$12.00	$2,760
4	Remove North Plaza Slab	900	SF	$10.00	$9,000
5	Remove and store North Plaza Granite features	2,091	SF	$3.00	$6,272
6	Excavate under slab	209	CY	$30.00	$6,278
7	Install new grade beams	29	CY	$550.00	$15,889
8	Install new concrete footing	22	CY	$450.00	$10,000
9	Install sacrificial micropile	2	EA	$13,500.00	$27,000
10	Conduct load test	2	LS	$7,500.00	$15,000
11	Install battered mircopiles (90' length)	24	EA	$13,500.00	$324,000
12	Install new engineered fill	209	CY	$35.00	$7,324
13	Install new structural slab	1,130	SF	$30.00	$33,900
14	Install 3" exposed aggregrate concrete topping slab	1,130	SF	$13.50	$15,255
15	Reinstall North Plaza Granite Features	2,091	SF	$8.00	$16,725
16	Install flexible joint	266	LF	$32.00	$8,512
17	Repair site damage from construction	1	Allowance	$2,500.00	$2,500
18	Complete post-work condition survey	1	LS	$9,000.00	$9,000
	Subtotal Direct Construction Costs				**521,915**
	Published Location Factor	3.0%			15,657
	Remoteness Factor (urban)	0.0%			0
	Federal Wage Rate Factor	6.0%			15,657
	Design Contingency	25.0%			130,479
	Total Direct Construction Costs				**683,709**
	Standard General Conditions	30.0%			205,113
	Government General Conditions	10.0%			68,371
	Historic Preservation Factor (Memorial)	5.0%			34,185
	Subtotal NET Construction Cost				**991,378**
	Overhead	12.5%			123,922
	Profit	10.0%			99,138
	Estimated NET Construction Cost				**1,214,438**
	Contracting Method Adjustment (Full Open)	5.0%			60,722
	Inflation Escalation (6.0% / Yr; 27 Months)	13.5%			163,949
	Total Estimated NET Cost of Construction				**1,439,100**

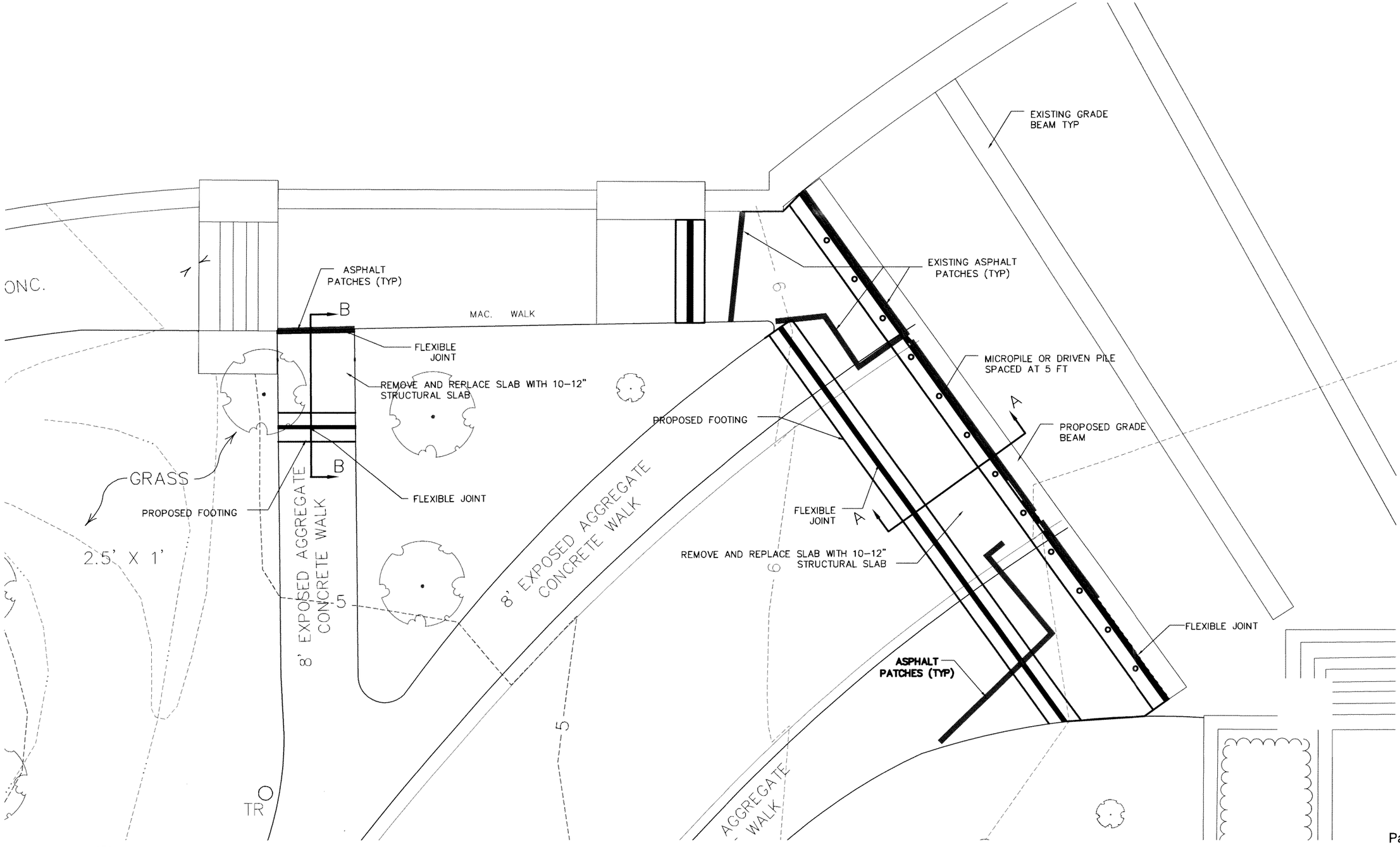
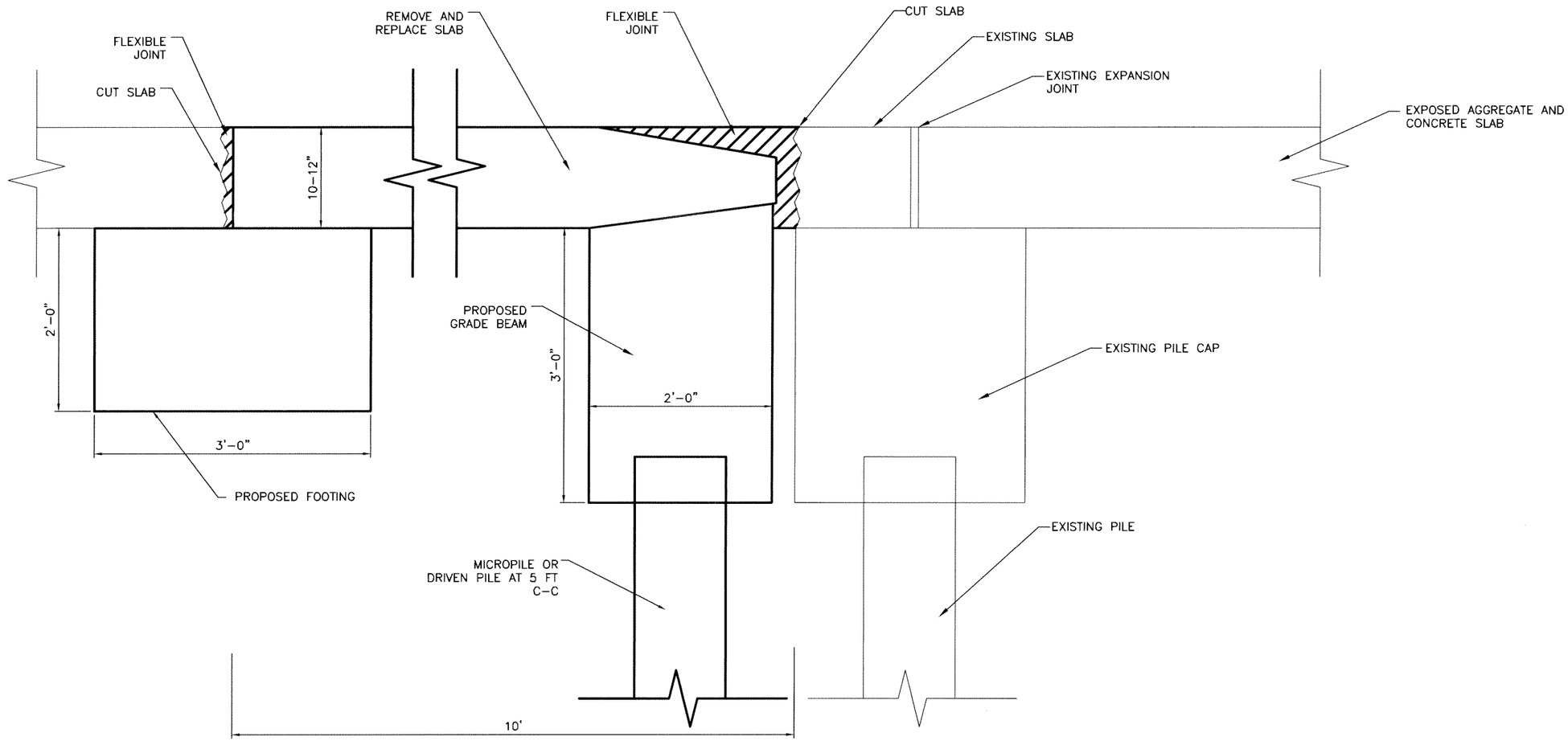


FIGURE 18

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	DW/CJR/HR DESIGNED NSF/SCB DRAWN JC CHECKED
							REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	PHIS/PRS NO. 128232 DATE 3/6/08 DWG. NO. 808/80284
				NORTH PLAZA REPAIRS TITLE OF DRAWING			SUB SHEET NUMBER	

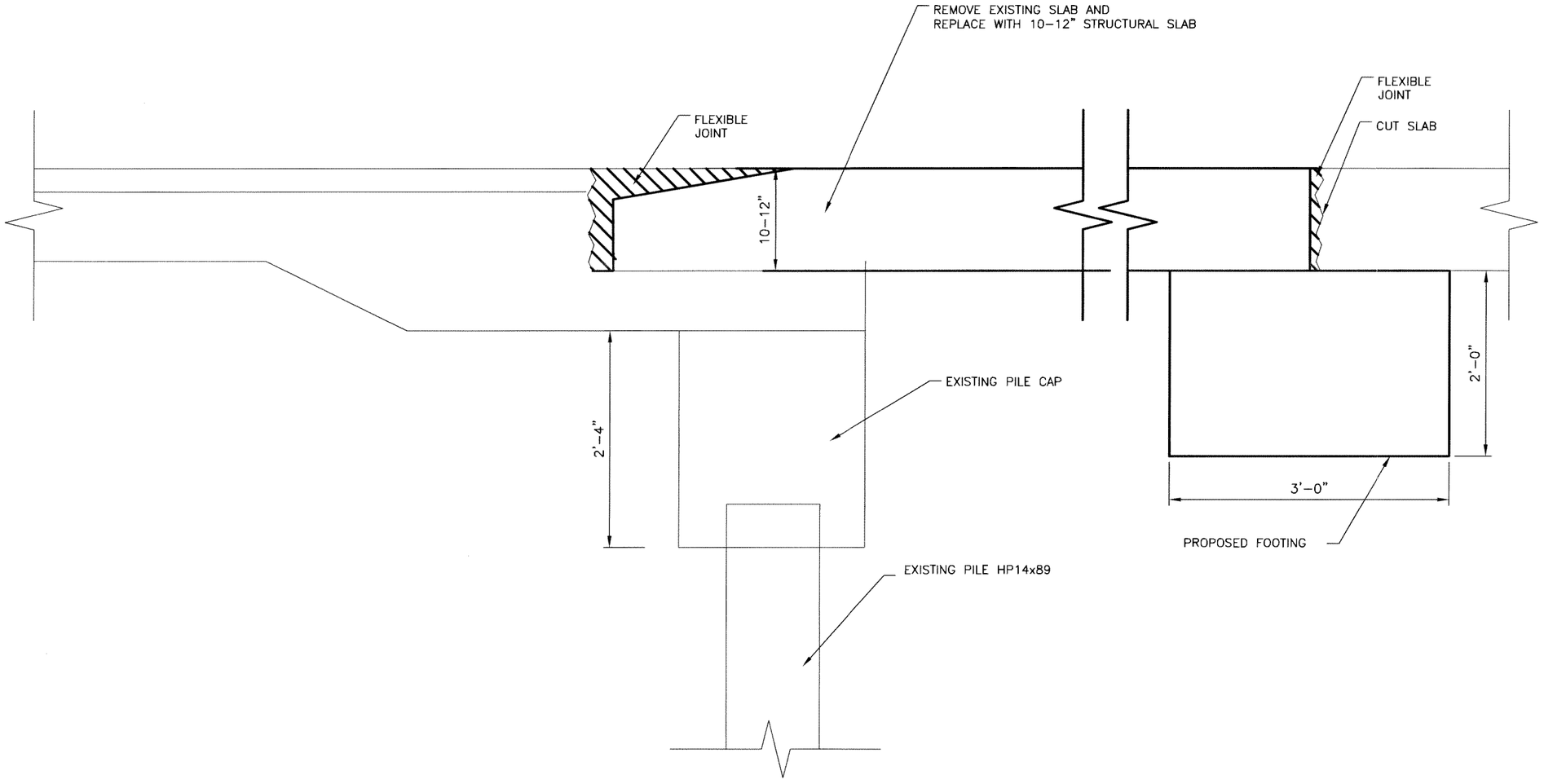


SECTION A–A
ASPHALT PATCH REPAIRS – NORTH PLAZA
3/4" = 1'–0"

FIGURE 19

1 0 1 2 3
SCALE OF FEET

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	DW/CJR/HR DESIGNED NSF DRAWN JG CHECKED
							REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	PMIS/PKG NO. 128232 DATE 3/6/08 DWG. NO. 808/80284
		PROPOSED REMEDIATION FOR NORTH PLAZA TITLE OF DRAWING					SUB SHEET NUMBER	



SECTION B–B
ASPHALT PATCH REPAIRS – NORTHWEST STAIRS
3/4" = 1'–0"

FIGURE 20

1 0 1 2 3
SCALE OF FEET

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial		UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	DW/CJR/HR DESIGNED NSF DRAWN JG CHECKED
								REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	PMIS/PMIS NO. 128232 DATE 3/6/08 DWG. NO. 808/80284
				PROPOSED REMEDIATION NORTHWEST STAIRS TITLE OF DRAWING			SUB SHEET NUMBER		

III. COST COMPARABILITY ANALYSIS

The Cost Comparability Analysis evaluates the anticipated cost of the Jefferson Memorial project based on the costs associated with three comparable projects. Jefferson Memorial is compared to projects at Ellis Island, the New Jersey Turnpike, and the Children's Hospital in Washington, DC. The projects are analyzed according to four assets, which are characteristic to the projects listed above. These assets include: underpinning with deep foundation elements, reinforced concrete, temporary cofferdams, and mobilization.

Ellis Island underwent a seawall repair that utilized micropiles and reinforced concrete to stabilize the wall. Sheet piling was used to contain the concrete at the base of the wall. Although the sheet piling in this project was permanent, the cost is comparable to the temporary cofferdam.

The project at the New Jersey Turnpike was a rehabilitation of existing bridges where micropiles were installed to transfer part of the load from the existing piles. Reinforced concrete was used to connect the micropiles to the pile cap. This project overcame difficulties associated with limited headroom and construction along a waterway. A temporary cofferdam was utilized to allow for construction in a waterway.

The Children's Hospital project retrofitted existing foundations to allow additional load to be placed on the structure. This project also utilized micropiles as an underpinning solution. Although a temporary cofferdam was not necessary in this project, dewatering of excavations required for the installation of the pilecaps was necessary. The dewatering was achieved by installing shoring on the excavation walls and pumping water from the bottom of the excavation.

The analysis examines the quantities of each asset and their associated cost. The costs are projected to 2010, which is the anticipated start of construction.

Considering the unit cost of the primary asset, the anticipated cost of the Jefferson Memorial project is in the lower portion of the cost range of the other projects in this comparison. It is 34% less than the unit cost at Ellis Island, 28% more than the unit cost at the New Jersey Turnpike, and 22% less than the unit cost at the Children's Hospital. The average unit cost of the three comparisons is $219.61; therefore, the unit cost of Jefferson Memorial is 19% below the average.

Cost Comparability Analysis (Comp 1)

NPS

National Park Service

Project Title: *Ellis Island Seawall Repair*

Location: *Jersey City, New Jersey*

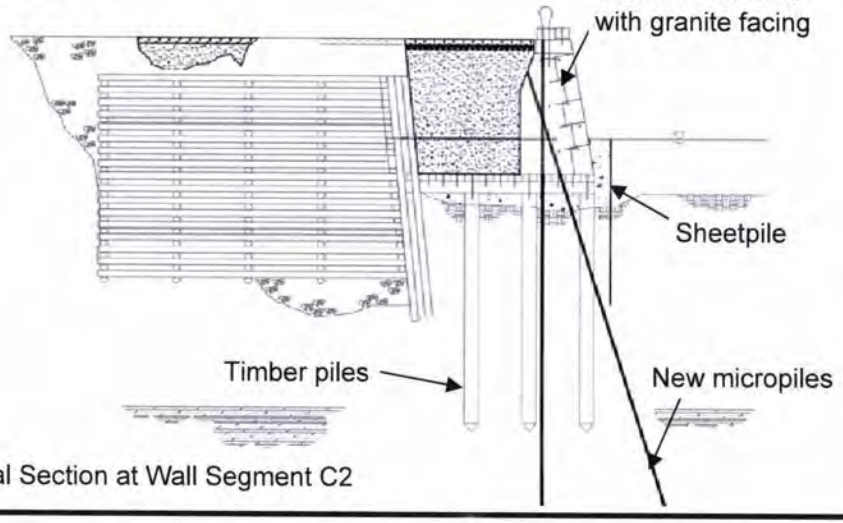
Year Completed: *2007 (walls completed to date)*

Program Summary: *Located in the Upper New York Bay, the historic Ellis Island attracts almost 4 million visitors each year. The seawalls that surround the Island were constructed in the early 1900s and now show varying degrees of deterioration. This is evidenced by erosion of mortar joints, dislodged granite blocks along the wall face, decay of wood cribbing, washout from behind the seawall, and local wall displacements compromising its stability at some locations.*

An innovative approach to the repair of the seawalls was developed, which consisted of the use of micropiles for stabilization of vertical and horizontal seawall movements. The micropiles were installed through the existing seawalls and penetrated through a thick overburden, consisting of soft alluvial deposits and relatively hard glacial till, and were bonded into Manhattan Schist. Drilling of the micropiles often encountered timber and other obstructions.

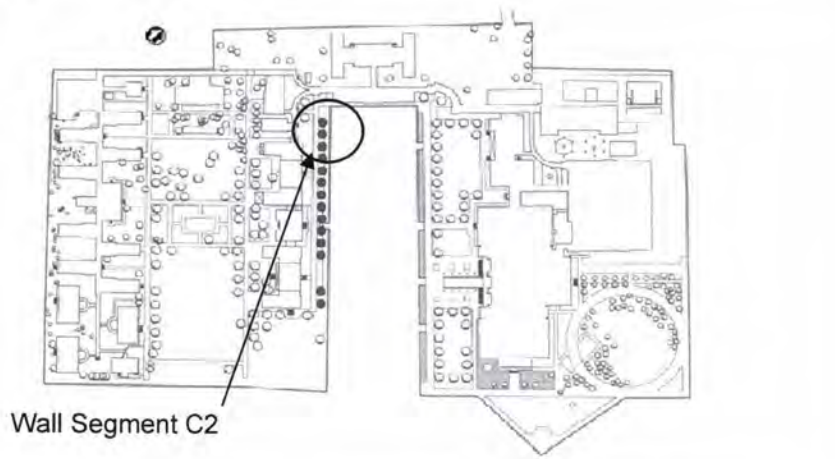
This project is uniquely challenging due to the balance of historical preservation, aesthetics, economics, and feasibility that is required for all design aspects.

Elevation Image



Typical Section at Wall Segment C2

Plan Image



Cost Comparability Analysis (Comp 2)

NPS

National Park Service

Project Title: *NJTA Pile Rehabilitation Maintenance*

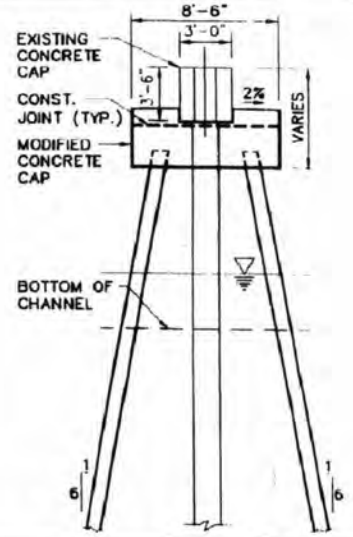
Location: *Gloucester, New Jersey*

Year Completed: *2006*

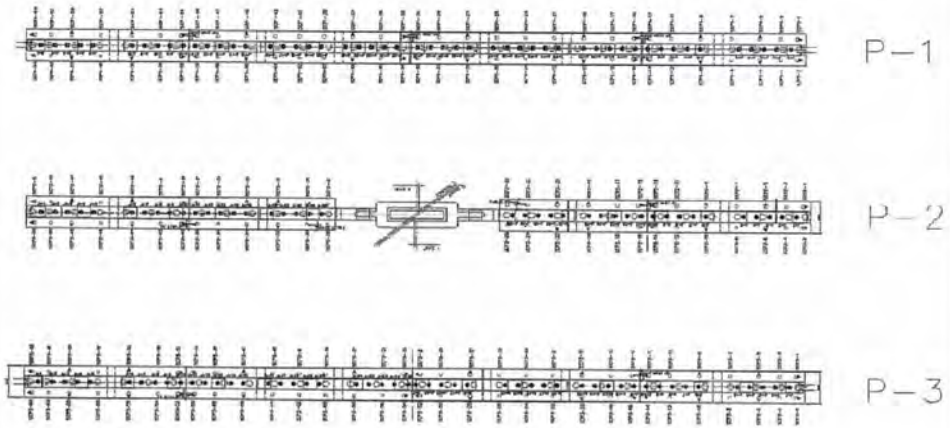
Program Summary: *Pile rehabilitation maintenance was performed on several bridges along the New Jersey Turnpike. As part of this maintenance, micropiles were added to pier and abutment caps for each structure to replace existing piles. A total of 260 micropiles were installed as part of this retrofit effort. This project required 180 micropiles to be installed through granular soils, while the other 80 micropiles were installed in predominantly fine soils.*

The micropiles consisted of hollow core bars installed under limited headroom conditions. The upper portion of the micropiles included permanent steel casing to provide buckling and bending capacity along the exposed portion of the micropiles and the potential scour zone. The hollow core bars were bonded to the soil with varying bond lengths, depending on the location of the micropile. The micropiles were connected through new cap beams.

Elevation Image



Plan Image



Cost Comparability Analysis (Comp 3)

NPS

National Park Service

Project Title: *Children's Hospital Addition - CPS*

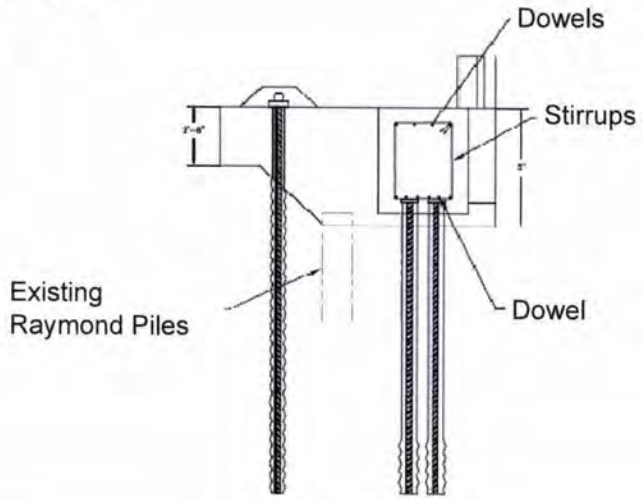
Location: *Washington, DC*

Year Completed: *2007*

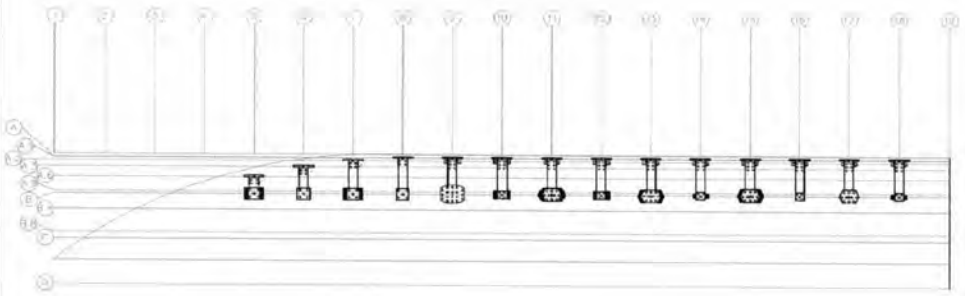
Program Summary: *Opening its doors over 130 years ago, the Washington D.C. Children's National Medical Center (CNMC), currently ranks as the 9th best pediatric institution in America. As the reputation of the hospital grows, there is an increasing demand on the available space. To meet the growing demand of floor space, the hospital is currently expanding the surgical wing up to five stories. The proposed construction consists of an addition on the northern side of the existing building. This area currently consists of only three levels of below grade parking with no levels above grade.*

This analysis focuses on the retrofitting of the existing foundation to support the additional load, which results from the new floors added above the existing structure. The original foundations include Raymond Step-Tapered piles with an 80-ton capacity. New loading on the foundation requires each Raymond pile to have a capacity of 150 tons. The design and construction of the foundation upgrading work was particularly challenging due to various project constraints related to high ground water table, installation of micropiles under limited head room, and keeping the parking garage fully operational for the whole duration of the construction.

Elevation Image



Plan Image



Pile Cap Locations

Cost Comparability Analysis

NPS

National Park Service

	Current NPS Project PMIS #:	Comp 1	Comp 2	Comp 3
Project Title	**Jefferson Memorial**	**Ellis Island Seawall Repair**	**NJTA Pile Rehabilitation Maintenance**	**Children's Hospital Addition - CPS**
Location	Washington, DC	Jersey City, NJ	Gloucester, NJ	Washington, DC
Year Completed	2010	2007	2006	2007
Construction Type[1]	Repair / Rehabilitation	Repair / Rehabilitation	Repair / Rehabilitation	Repair / Rehabilitation
Primary Asset Category[2, 3]	9999 Underpinning with Deep Foundation Elements	9999 Underpinning with Deep Foundation Elements	9999 Underpinning with Deep Foundation Elements	9999 Underpinning with Deep Foundation Elements
Primary Asset Size (Quantity)	24525	4319	18500	2960
Unit of Measure	Linear Feet	Linear Feet	Linear Feet	Linear Feet
Cost of Primary Asset	$4,342,455.00	$960,227.00	$2,035,000.00	$561,000.00
Unit Cost of Primary Asset	$177.06	$222.33	$110.00	$189.53
Second Asset Category	9999 Reinforced Concrete	9999 Reinforced Concrete	9999 Reinforced Concrete	9999 Reinforced Concrete[5]
Second Asset Size (Quantity)	1731	70	880	77
Unit of Measure	Cubic Yards	Cubic Yards	Cubic Yards	Cubic Yards
Cost of Secondary Asset	$1,637,829.00	$69,339.30	$959,200.00	$685,000.00
Unit Cost of Secondary Asset	$946.18	$990.56	$1,090.00	$8,896.10
Third Asset Category	9999 Temporary Cofferdam	9999 Temporary Cofferdam	9999 Temporary Cofferdam	9999 Temporary Cofferdam[6]
Third Asset Size (Quantity)	182	75	950	1
Unit of Measure	Linear Feet	Linear Feet	Linear Feet	Lump Sum
Cost of Third Asset	$524,926.00	$61,125.00	$807,500.00	$60,000.00
Unit Cost of Third Asset	$2,884.21	$815.00	$850.00	$60,000.00
Fourth Asset Category	9999 Mobilization	9999 Mobilization	9999 Mobilization	9999 Mobilization[7]
Fourth Asset Size (Quantity)	1	1	1	1
Unit of Measure	Lump Sum	Lump Sum	Lump Sum	Lump Sum
Cost of Fourth Asset	$14,399,390.00	$143,510.73	$500,000.00	$30,000.00
Unit Cost of Fourth Asset	$14,399,390.00	$143,510.73	$500,000.00	$30,000.00
Total Project Cost	$20,904,600.00	$1,234,202.03	$4,301,700.00	$1,336,000.00
Year of Comparability Analysis	2010	2010	2010	2010
Comparable Primary Asset Unit Cost (Year of Comparison)[4]	$177.06	$264.79	$138.87	$225.73

[1] Designate "New Construction" or "Repair/Rehab."

[2] Primary asset type should only be the comparable project components that correspond to current NPS project.

[3] See "Assets Code" tab for assets code and categories.

[4] For each comparable, primary unit assets' costs shall be escalated to the proposed date of construction for the NPS project.

[5] Includes removal of existing concrete slab, excavation for pilecaps and lagging and dewatering of excavation.

[6] Temporary lagging and dewatering was used for the installation of pilecaps. This cost covers for additional chemical grout installed at the bottom of excavation for pilecaps to control ground water.

[7] Includes mobilization of equipment for the installation of the micropiles. The mobilization of equipment to perform dewatering and install pilecaps is included in the prices presented for second assest category (Reinforced concrete).

Notes: For the Jefferson Memorial quantities and costs, consider the following:

1 Ashlar Seawall:
Asset 1 includes items 1, 2, 9, 10, 11, 12, 13, 14, and 20.
Asset 2 includes items 3, 4, 17, 18, and 19.
Asset 3 includes items 5, 6, 7, 8, 15, and 16.
Asset 4 includes additional construction costs.

2 North Plaza:
Asset 1 includes items 1, 2, 7, 8, 9, 10, and 14.
Asset 2 includes items 3, 4, 5, 6, 11, 12, and 13.
Asset 3 is not applicable to this section.
Asset 4 includes additional construction costs.

3 Remediation Method for North Plaza and NW & NE Stairs:
Asset 1 includes items 1, 2, 8, 9, 10, and 15.
Asset 2 includes items 3, 4, 5, 6, 7, 11, 12, 13 and 14.
Asset 3 is not applicable to this section.
Asset 4 includes additional construction costs.

IV. SCOPE AND COST VALIDATION

The Scope and Cost Validation confirms whether the scope of work is sufficient to complete the project, and comments on the accuracy of the cost estimate. This attempts to identify and correct any potential problems prior to continuing with the Schematic Design. The Project Program, Class C Cost Estimate, and Cost Comparability Analysis were used to create the Scope and Cost Validation.

The PMIS Project Statement does not fully describe the differences in the movements of the Ashlar Seawall and the North Plaza. The lateral movement of the North Plaza should be addressed with greater detail as indicated in the following responses.

The PMIS Class C Cost Estimate is not sufficient to address the remediation of both the Seawall and North Plaza. Of these two, only the remediation of the Seawall meets this requirement.

Preparation Date: 3/06/08
Park: National Mall and Memorial Parks
PMIS #: 128232 **Construction Year:** 2009
Project Title: Emergency Repairs for Settlement at the Jefferson Memorial Seawall

Financial Data

PMIS Class C Construction Cost Estimate: $8,050,000 (net)
Project Program Class C Construction Cost Estimate: $19,353,300.00 (net)

See "Scope and Cost Validation Documentation" definition for additional information.

Answers to the following questions shall not exceed two pages per numbered question.

1. EXISTING CONDITIONS - Does the PMIS Project Statement adequately describe the current level of performance and/or functionality being provided (i.e. describe current conditions)? If not, provide additional description(s) of the existing performance and/or functionality, as necessary, to complete current conditions.

   Schnabel Response: The Project Statement does not fully describe the current conditions at the site. Movement of two elements of the Memorial has been observed. These two elements are defined as the Seawall and the North Plaza. The Seawall and North Plaza are supported by separate foundation elements. Movement in the Seawall has been observed horizontally and vertically, while the North Plaza movement has only been observed horizontally. Although the direction of movement is similar in the two elements, the rates of movements are not consistent between the Seawall and the North Plaza.

   We recommend replacing the Justifications section of the Project Statement with the following:

   "The Jefferson Memorial is a National Historic Landmark and is listed as a contributing structure within the East and West Potomac Parks Historic District. The structure and the site are open daily to the public and are also the location of numerous public functions and major events. In late March of 2006, it was brought to the attention of the park maintenance staff that the Seawall and North Plaza had separated several inches at the northwest and radiated out to the northeast to a lesser degree. The separation was both vertical and horizontal in nature and was several inches and formed a tripping hazard to the public. A temporary fence was placed along the northern perimeter to prevent public access to the worst section of the hazard and cold patches were applied to various public areas to prevent tripping. Historical evidence indicates that similar settlement was an issue commencing from initial construction and corrections were made over 30 years ago to correct the settlement that appeared to be successful until the present conditions appeared. After several months of survey monitoring, the Seawall appears to be moving

both horizontally and vertically, while the North Plaza movement has only been observed horizontally. Although the direction of movement is similar in the two elements, the rates of movements are not consistent between the Seawall and the North Plaza. The movements appear to be still active and may result in catastrophic failures and endangerment to the visiting public if not resolved quickly. Further movement is expected and a solution addressing the cause(s) of the movement must be implemented to prevent further degradation and impairment to the site."

2. IDENTIFIED PROJECT GOALS - Does the PMIS Project Statement adequately describe the proposed level of performance and/or functionality required? If not, provide additional description(s) of any proposed level of performance and/or functionally required that is not described in the PMIS Project Statement.

   Schnabel Response: The Project Statement adequately describes the level of performance and functionality of the Seawall and Plaza structures, and adequately describes the impact on the functionality and structural integrity of the structures, if remediation does not occur.

3. REQUESTED SCOPE - Does the PMIS Project Statement adequately describe the capital investments needed to optimally close the performance gap between existing performance and required performance levels? Provide description(s) and Class C Construction Cost Estimates for each capital improvement required to optimally close the performance gap and which were not shown in the PMIS Project Statement. For each capital improvement, clearly identify the benefits accrued to the project by adding the capital improvement(s) to the existing PMIS Project Statement SOW. Provide a side by side comparison of existing PMIS Project Statement scope and cost estimate and new proposed scope and cost estimate required to close the functional needs.

   Schnabel Response: The Project Statement does not adequately describe the capital investments needed to optimally close the performance gap between existing performance and required performance levels. Although the PMIS Project Statement does adequately describe the level of performance required for remediation, the PMIS Class C Cost Estimate does not sufficiently cover the level of performance required. The PMIS Class C Cost Estimate is based on remediation of the Seawall and Northwest Stairs and Walkway and West Terrace Walk, but does not include the cost for remediation of the North Plaza. Class C cost estimates have been provided as part of the Predesign documentation. In addition to the alternatives provided in the Predesign, additional alternatives are under development, with cost estimates, that will be discussed in the Value Analysis Meeting. Below is a side by side comparison.

Existing PMIS Project Statement	PMIS Class C Cost Estimate	Predesign Elements	Class C Cost Estimates
Remediation of Seawall and Transition Areas to include Northwest Stairs and Walkway and West Terrace Walk	$8.05M	Seawall Remediation – Remediation of the Seawall addresses the imminent failure of the Seawall but does not eliminate the life safety hazards in and around the plaza, nor does it provide lateral restraint against lateral movement of the North Plaza.	$7.3M
		Northwest Stairs and Walkway and West Terrace Walk Remediation – If this remediation does not take place, then the life safety hazards in and around the plaza will still exist.	$1.4M
		North Plaza Remediation - If the North Plaza is not addressed, then it will likely continue to move laterally. The plaza slab joints would continue to open and the plaza will eventually begin to "push" on the seawall. In addition, if this remediation does not take place, then the life safety hazards in and around the plaza will still exist.	$10.6M

4. FUNDING ANALYSIS - Does the existing budget (PMIS Class C Cost Estimate) provide a viable solution sufficient to solve the PMIS stated problem (SOW)? If the PMIS Project Statement SOW and budget do not fully close the required performance gap, provide an analysis of what performance and/or functional improvements can be provided within the existing budget (PMIS Class C Cost Estimate), and what performance and/or functional improvements would be deleted. Analysis should include a description of the impacts related to deleted work.

Schnabel Response: The existing budget (PMIS Class C Cost Estimate, $8.05M) does not provide a viable solution sufficient to solve the PMIS stated problem (SOW). Remediation of the Seawall (~$7.3M) meets the PMIS Class C Construction Cost

Estimate. Remediation of the Seawall addresses the imminent failure of the Seawall but does not eliminate the life safety hazards in and around the plaza, nor does it provide lateral restraint against lateral movement of the North Plaza. Remediation of the North Plaza ($10.6M) is not sufficiently covered by the PMIS Class C Construction Cost Estimate. If the North Plaza is not addressed, then it will likely continue to move laterally. In addition, if this remediation does not take place, then the life safety hazards in and around the plaza will still exist. Finally, remediation of the Northwest Stairs and Walkway and West Terrace Walk ($1.4M) also is not sufficiently covered by the PMIS Class C Construction Cost Estimate; however, when combined with the Seawall remediation, it is within 10% of the existing PMIS Cost Estimate. If this remediation does not take place, then the life safety hazards in and around the plaza will continue to exist.

V. WRITTEN RESPONSES TO REVIEW COMMENTS

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232		Project Title: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza, and Transition Areas
DBB (X) or DB ( )	Milestone: ( ) HSR (X) PD ( ) SD ( ) DD ( ) CD-100% Draft ( ) CD-100% Complete Other: ( )	
Construction FY:	Proposed Award Date: ( ) Proposed Midpoint of Construction Date: ( )	
Contracting Method:	( ) Non-Competitive (Sole Source - 8A, Service Disable, Hub Zone) (X) Full & Open (Competitive Negotiation) ( ) Limited Competition (Comp. Neg. - Hub Zone, Comp. 8A, Small Bus. Set Aside) ( ) Full & Open (Seal Bid - Low Price)	
A/E Prime: HNTB	NPS Project Manager: Pat Mac Donald	Phone No.: 6621
QA Due Date: 2/25/08	NPS Project Specialist: Doug Denk	Phone No.: 2236
	NPS Contracting Officer: Margaret Lemke	Phone No.: 2039
QA Completed & Posted Date: 2/25/08 w/o Estimating Comments; 2/27/08 Complete	NPS Contract Specialist: Eric Weisman	Phone No.: 2055

Remarks/Special Instructions: 52.236-23 Responsibility of the Architect-Engineer Contractor.

RESPONSIBILITY OF THE ARCHITECT-ENGINEER CONTRACTOR (APR 1984)

(a)The Contractor shall be responsible for the professional quality, technical accuracy, and the coordination of all designs, drawings, specifications, and other services furnished by the Contractor under this contract. The Contractor shall, without additional compensation, correct or revise any errors or deficiencies in its designs, drawings, specifications, and other services.

(b) Neither the Government's review, approval or acceptance of, nor payment for, the services required under this contract shall be construed to operate as a waiver of any rights under this contract or of any cause of action arising out of the performance of this contract, and the Contractor shall be and remain liable to the Government in accordance with applicable law for all damages to the Government caused by the Contractor's negligent performance of any of the services furnished under this contract.

SEE THE TABS AT THE BOTTOM OF THIS FORM FOR INDIVIDUAL REVIEW COMMENTS

Quality Assurance review comments shall apply to all issues throughout the review set that have either identical or similar concerns. No attempt is made to identify all occurrences. The contractor's own Quality Control shall ensure that these review comments are thoroughly resolved prior to any subsequent submittals.

Discipline (route only to marked boxes):	Summary Comments:	
√ Civil Engineering (CE)	LRT 2/21/08 Refer to comments.	
√ Landscape Architecture (LA)	JHC 2/25/08 see comments	
√ Architecture (AR) / Lighting (LT)	2/25/08 Refer to comments	
√ Preservation Architecture (PA)	CRJ 2/20/08 No Comments	
√ Structural Engineering (SE)	LLR 2/19/08 Refer to comments.	
Mechanical Engineering (ME)		
Electrical Engineering (EE)		
√ Safety Engineer (SF)	bo 2/19/08 No Comments	
Constructability (CN)		
√ Estimating (EST)	RAM 2/26/08 Refer to Comments	
NPS-10 (ET)		
Natural Resource Specialist (NRS)		
Cultural Resource Specialist (CRS)		
√ Project Specialist (PS)	2/25/08 Refer to comments	
√ Project Manager (PM)	2/25/08 Refer to comments	
√ Park	Refer to comments	
√ Region	n/a	
√ Others	n/a	

Construction Cost Estimating Review

Park Name: Jefferson Memorial Park Alpha Code: NAMA

Project Title: Repair & Control Settlement at Jefferson Memorial Seawall, North Plaza, & Transition Areas PMIS #: 128232

Region: National Capital

Project Manager: MacDonald

Proposed Date of Mid-point of Construction: July, 2009

Net Available Construction Funds :

Date Of Estimate: 11-Feb-08 Estimate Escalated to: July, 2009 (Date)

Level of Estimate:

Circle One: (Class C) Class B Class A

Associated Design Submittal:

Circle One: (PD Submittal) SD/DAB Submittal DD Submittal Draft 100% CD Submittal Final 100% CD Submittal

Estimated By: Kirk Associates

Primary Estimator, Firm and Contact Information

Estimated Total NET Construction (Base): $20,904,600

Estimated Total NET Construction (Highest Price Option): $0

Estimated TOTAL NET Construction (Base with Options): $20,904,600

Estimate Reviewed By: Robert A. Merrick, PE Review Date:

Review Comments:

Estimate appears to be complete and professionally prepared. There is an overall difference in the NPS recommended cost and the submitted cost of about 10%. For a pre-design package of this size and type, this is not a significant difference. Major differences are in application of some of the mark-ups.

Approval Status:

☐	Not Accepted	Signature of disapproving official	Date
■	Accepted with Comments	Robert A. Merrick (Signature of approving official)	2/26/2008 (Date)
☐	Accepted	Signature of approving official	Date

Comments:

Initial & Date your comments!

NAMA 128232

CIVIL ENGINEERING
REVIEWER: Lawrence R. Torrez (303) 969-2697
DATE REVIEWED: 2/21/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Task Order	Part 1.2.1, Perform Surveying and Monitoring and Data Collection: This part of the Task Order should be emphasized in the Pre-Design Report (Project Program) as the results of this year-long data collection (with quarterly monitoring) could quite possibly affect the recommended alternatives for settlement corrections.	The Predesign effort for this project includes quarterly survey monitoring of 22 points on the Ashlar Seawall and North Plaza, and quarterly data collection from the inclinometers, piezometers, tiltmeters, and ground water monitoring wells. This information will be used to verify the mechanisms of soil and structure movement considered in the design. This information was added to the Predesign document. - SEI
2	Class C Cost Estimates	The "Seawall Alternative" is listed as "Seawall Alternative 3". Provide information documenting the other alternatives examined for the Seawall.	[Development of other alternatives is in progress and will be fully documented in the Schematic Design report. - NPS DSC D&C]
3	Class C Cost Estimates	The "North Plaza" is listed as "North Plaza Alternative 1". Provide information documenting the other alternatives examined for the North Plaza.	[Development of other alternatives is in progress and will be fully documented in the Schematic Design report. - NPS DSC D&C]

End of Review Comments

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

LANDSCAPE ARCHITECTURE
REVIEWER: Joanne Cody (303) 969-2278
DATE REVIEWED: 2/25/08

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	pg.5-8	North plaza and west terrace walks - The site program does not identify requirements for rehab work. Needs to address accessibility and ability to maintain accessible grades and transitions at the completion of this project and for anticipated life of project.	Areas indicated to undergo work will be rehabiliated to comply with accessibility requirements. - HNTB
2	Sea wall	How will edge of seawall/north plaza interface be made safe for visitors? Need to provide tactile warning strips at the very least.	[Per Park, record documents do not indicate that the historic design of the seawall (no railing, use of differing surfaces to define edge of grounds) is a safety issue. Assuming Seawall & North Plaza repairs that will result in the Seawall capstones being once again flush with the top of the North Plaza, A-E shall evaluate options to announce the edge of the plaza adjacent to the Seawall through some sort of architectural element(s) as described in Scope of Work, Mod #01, Description of Work. - NPS DSC D&C]
3	pg. 34,35	Are these proposed fixes adequate to meet accessibility standards?	Areas indicated to undergo work will be rehabiliated to comply with accessibility requirements. - HNTB
4	current accessibility standards	http://www.access-board.gov/ada-aba/final.htm	Noted. - HNTB
5	Contextual analysis	Analysis needs to be included to identify acceptable surface materials and finishes.	The material selection will be completed at a future time. Materials chosen will respect historic character. - SEI
6		end of comments	

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

ARCHITECTURE-LIGHTING
REVIEWER: Ed Nieto (303) 969-2577
DATE REVIEWED: 2/25/08

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1		Will landscape lighting for safety/security be incorporated in this project?	The only lighting affected by the Predesign will be the in-slab lighting of the North Plaza. The intention is replacement in kind. - SEI
2			
3		(End of Comments).	

STRUCTURAL ENGINEERING
REVIEWER: Larry L. Reynolds, P.E. (303) 987-6630
DATE REVIEWED: 2/19/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Summary Comment	There does not seem to be the same level of investigation and analysis for the North Plaza repairs as there is for the Seawall repairs. Refer to comments below.	
2	General	The Site Investigation Report , 1/30/08, page 119 states "Lateral movement of the north Plaza requires additional investigation." The Predesign report includes a Class C estimate for the North Plaza of just over $11 million. How were the repair recommendations for the north Plaza developed? Was the additional investigation undertaken? Please clarify.	The "Investigation of Settlememt and Upheaval at the Jefferson Memorial" dated 1/30/08 included the following site investigation and instrumentation: 7 soil borings, 3 ground water observation wells, 3 inclinometer casing locations, 2 vibrating wire piezometers, 2 tiltmeters, 142 survey monitoring points, and numerous locations where joints and differential settlements were measured. This report also recommended that additional piezometers be installed at varying depths and that continued monitoring be performed for the survey monitoring points, ground water wells, inclinometers, piezometers, and tiltmeters. Also, it recommends additional investigation in the form of joint measurements on the North Plaza. The Predesign task for this project includes quarterly monitoring of 22 survey monitoring points, and quarterly readings of the ground water wells, inclinometers, piezometers, tiltmeters, and measurements at joint locations. No further investigation has been authorized. - SEI
3	General	If the additional North Plaza investigation has not been completed, what kinds of further investigation are required to produce the necessary data so more specific recommendations can be developed? Please clarify.	Please refer to response above for recommendations from "Investigation of Settlement and Upheaval at the Jefferson Memorial" dated 1/30/08. - SEI

STRUCTURAL ENGINEERING

REVIEWER: Larry L. Reynolds, P.E. (303) 987-6630

4	Page 26	Estimate shows removal of approximately 21,000 ft^2 of North Plaza slab removal and replacement. Can this area be reduced by removing/replacing only those portions of the slab where new work is required? Please clarify.	For the Predesign documents, Schnabel was directed to provide the worst case scenario for remediation of the North Plaza, which was determined to be a full structural retrofit. Two additional remediation alternatives for the North Plaza are being developed and include varying amounts of slab removal and replacement. - SEI
5		End of review comments.	

Jeff[redacted] Memorial [redacted]AMA 128232
Repair & Control Settlement at Jefferson Memorial Seawall, North Plaza, & Transition Areas
Robert A. Merrick, PE
26-Feb-08
Review: Draft Schematic Design Documents Submittal

Net construction
A/E:
A/E Estimator: Kirk Associates
PM: MacDonald

Estimate Date: 11-Feb-08

	Estimated NET Construction (Base)	$20,904,600
	Estimated NET Construction (Option)	$0
Estimated NET Construction (Total)		**$20,904,600**

Seawall

NPS Suggested Rates Mark-ups:		NPS Computed Amounts	A/E Used Rates	A/E Computed Amounts
	Shown for Base less mark ups	**$2,586,881**		**$2,586,881**
-0.9%	Location Factor	-$23,282	3%	$77,606
0%	Remoteness Factor	$0		$0
8%	Federal Wage Rate Factor	$103,475	6.00%	$77,606
5.75%	State & Local Taxes	$74,373	included	$0
30%	Design Contingency	$776,064	25%	$646,720
	Total Direct Construction Costs	**$3,517,511**		**$3,388,814**
25%	Standard General Conditions	$879,378	30%	$1,016,644
10%	Government General Conditions	$351,751	10%	$338,881
5%	Historic Preservation Factor	$175,876	10%	$338,881
	Sub-Total Net Construction Cost	**$4,924,516**		**$5,083,221**
15%	Overhead	$738,677	12.5%	$635,403
10%	Profit	$492,452	10%	$508,322
	Estimate Net Construction	**$6,155,645**		**$6,226,946**
5%	Contracting Method Adjustment	$307,782	20%	$1,245,389
14%	Inflation Escalation FY10 (Annual Rate 6%)	$861,790	13.5%	$840,638
1.5%	Bond	$111,552		$0
	Total Estimate Net Cost of Base Construction	**$7,436,769**		**$8,312,973**

-$876,204 89.5%

North Plaza

NPS Suggested Rates Mark-ups:		NPS Computed Amounts	A/E Used Rates	A/E Computed Amounts
	Shown for Base less mark ups	**$3,434,667**		**$3,434,667**
-0.9%	Location Factor	-$30,912	3%	$103,040
0%	Remoteness Factor	$0		$0
8%	Federal Wage Rate Factor	$137,387	6.00%	$103,040
5.75%	State & Local Taxes	$98,747	included	$0
30%	Design Contingency	$1,030,400	25%	$858,667
	Total Direct Construction Costs	**$4,670,288**		**$4,499,414**
25%	Standard General Conditions	$1,167,572	30%	$1,349,824
10%	Government General Conditions	$467,029	10%	$449,941
5%	Historic Preservation Factor	$233,514	10%	$449,941

	Sub-Total Net Construction Cost	$6,538,[illegible]		$6,749,121	
15%	Overhead	$980,761	12.5%	$843,640	
10%	Profit	$653,840	10%	$674,912	
	Estimate Net Construction	$8,173,055		$8,267,673	
5%	Contracting Method Adjustment	$408,650	20%	$1,653,535	
14%	Inflation Escalation FY10 (Annual Rate 6%)	$1,142,221	13.5%	$1,116,136	
1.5%	Bond	$148,110		$0	
	Total Estimate Net Cost of Base Construction	$9,873,985		$11,037,343	

$65381

-$1163358 89.5%

Remediation Method for North Plaza & NW/NE Stairs

NPS Suggested Rates Mark-ups:		NPS Computed Amounts	A/E Used Rates	A/E Computed Amounts		
	Shown for Base less mark ups	**$483,663**		**$483,663**		
-0.9%	Location Factor	-$4,353	3%	$14,510		
0%	Remoteness Factor	$0		$0		
8%	Federal Wage Rate Factor	$19,347	6.00%	$14,510		
5.75%	State & Local Taxes	$13,905	included	$0		
30%	Design Contingency	$145,099	25%	$120,916		
	Total Direct Construction Costs	**$657,661**		**$633,599**		
25%	Standard General Conditions	$164,415	30%	$190,080		
10%	Government General Conditions	$65,766	10%	$63,360		
5%	Historic Preservation Factor	$32,883	10%	$63,360		
	Sub-Total Net Construction Cost	**$920,725**		**$950,398**		
15%	Overhead	$138,109	12.5%	$118,800		
10%	Profit	$92,073	10%	$95,040		
	Estimate Net Construction	**$1,150,906**		**$1,164,237**		
5%	Contracting Method Adjustment	$57,545	20%	$232,847		
14%	Inflation Escalation FY10 (Annual Rate 6%)	$161,127	13.5%	$157,172		
1.5%	Bond	$20,857		$0		
	Total Estimate Net Cost of Base Construction	**$1,390,435**		**$1,554,257**	-$163,822	89.5%
	Summary					
	Seawall	$7,436,769		$8,312,973		
	North Plaza	$9,873,985		$11,037,343		
	Remediation Method for North Plaza & NW/NE Stairs	$1,390,435		$1,554,257		
	Total	**$18,701,190**		**$20,904,573**	-$2,203,383	89.5%

DENVER SERVICE CENTER

ESTIMATING REVIEWER: Robert A. Merrick, PE
DATE REVIEWED: 2/26/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Overall	Estimate appears to be complete and professionally prepared. There is an overall difference in the NPS recommended cost and the submitted cost of about 10%. For a pre-design package of this size and type, this is not a significant difference. Major dif	Noted - KA
2	Unit Costs	For a pre-design package, unit costs and quantities appear to be a reasonable assessment of the work defined. No response necessary.	Noted - KA
3	Mark-ups	Location Factors: RS Means Published factor indicates the DC area is 99.1% of the National Average costs. Submitted estimate uses 3%. Difference is insignificant. No response necessary.	Noted - KA
4	Mark-ups	Standard General Conditions: Submitted Estimate uses 30%. This might be a little high, even for complexity of this project.	With the current construction complexity we feel 30% should be used. We will continue to monitor and adjust if necessary in later estimates based on the refined design. - KA
5	Mark-ups	Historic Preservation Factor: Submitted Estimate uses 10%. This might be slightly high.	Will revise to 5% - KA
6	Mark-ups	Contracting Method Adjustment: This project will most likely be procured with full/open competitive negotiation. 5% premium is probable.	Noted. Good discussion item at the value analysis workshop. - KA
7	Mark-ups	Inflation Escalation: NPS recommends 4% per year.	Noted, will monitor inflation. - KA
8		End of Comments	

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

PROJECT SPECIALIST
REVIEWER: D.Denk
DATE REVIEWED: 22-Feb-08

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Page 6, 1st paragraph	State in what direction the North Plaza appears to be moving laterally, if this can be determined from existing data.	Please refer to "Investigation of Settlement and Upheaval at the Jefferson Memorial" dated 1/30/08, page 64, Figure 43. This figure shows the vector of lateral movement measured by inclinometer readings from Decemeber 2006 to January 2008. The data indicate that the soil 10 ft beneath the North Plaza is undergoing signficant lateral displacement at an average rate of about 0.33 inches per year in the North-Northwest direction. This information was added to the PreDesign document. - SEI
2	Page 6, 1st paragraph	Does the opening of the joints on the North Plaza represent more than an aesthetic issue and tripping hazard? Could this movement create structural problems? Could this movement create continued problems with the Seawall if not addressed (even after proposed Seawall repairs are implemented)?	The opening of joints on the North Plaza indicate that the structure is experiencing lateral movement. Failure to address the lateral movement will result in damage to the North Plaza and the Ashlar Seawall, even after the proposed underpinning of the seawall is completed. This information was added to the PreDesign document. - SEI
3	Page 9, Part 4	Expand this discussion to include a brief description of why separate solutions are necessary to address the movement of the Seawall and North Plaza, respectively. Explain briefly why addressing only one of these elements may not address the other, or why addressing only one of these elements may not be prudent.	Information obtained during the "Investigation of Settlement and Upheaval at the Jefferson Memorial", shows that the Ashlar Seawall is experiencing settlement and probable failure of the timber piles supporting it. It is imperative that the seawall be underpinned in order to prevent collapse of the wall. Please see comment above for additional information. - SEI

PROJECT SPECIALIST
REVIEWER: D.Denk

4	Page 9, Part 4	The last sentence in this part states that additional monitoring data is required. Will this requirement be met through the additional monitoring to be performed under this PD-SD task order (see Part 5, 5, b & c), or is a need for additional monitoring or a different type of monitoring being stated here? Please clarify and address.	Please see Response to Comment #2, Structural Engineering. The Predesign task for this project includes quarterly monitoring of 22 survey monitoring points, and quarterly readings of the ground water wells, inclinometers, piezometers, tiltmeters, and measurements at joint locations. However, it does not include additional piezometer installation at varying depths as recommended in the "Investigation of Settlement and Upheaval at the Jefferson Memorial" dated 1/30/08. - SEI
5	Pages 5-6	Describe the cracking of the exposed aggregate concrete topping course (believed by the Park to be due to the fact that this course is very thin on the north side of the North Plaza) evident in several locations on the north side of the North Plaza.	Cracking of the exposed aggregate concrete topping course appears to be the result of insufficient thickness of the topping slab over the top fo the grade beams. This deficiency will be taken into consideration and all efforts will be made to mitigate future cracking to the greatest extent possible in the design of the new topping slab for the North Plaza. - HNTB
6	Pages 18 & 23	Indicate if this work would necessitate removal and replacement of existing in-slab light fixtures in the north side of the North Plaza.	The North Plaza remediation method provided in the Predesign documents requires demolition of the entire North Plaza slab, including the removal of the in-slab light fixtures. Two additional remediation alternatives are being developed and include varying amounts of slab removal and replacement, and therefore may or may not affect the in-slab light fixtures. - SEI
7	Page 20 & 26	Do these estimates include replacement of the North Plaza exposed aggregate topping/finish course? If not, please add this item to these estimates.	The estimates have been revised to include the exposed aggregate topping/finish course. - SEI
8	Page 20 & 26	Do these estimates include removal, storage, and reinstallation of the granite features of the North Plaza that will be disturbed? If not, please add this item to these estimates.	The estimates have been revised to include removal, storage, and reinstallation of the granite features of the North Plaza that will be disturbed. - SEI
9		[End of Comments]	

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

PROJECT MANAGER
REVIEWER: Patrick Macdonald
DATE REVIEWED: 2/22/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Page 2	Describe extent of rip rap fronting seawall and confirm if this is considered an historic feature.	NPS File No. 808_20013, provided as one of the documents for the "Investigation of Settlement and Upheaval at the Jefferson Memorial", shows the Ashlar Seawall on a pile foundation with rip rap directly beneath it. This plan is dated July 9, 1940. Per phone conversation with Perry Wheelock, the riprap itself is not historic, but the design should work around it and the final solution should result in the overall wall retaining its historic appearance. - SEI
2	Page 3	Please indicate location of West Terrace walk on this plan.	This information was added to the Predesign document. - SEI
3	Page 5	Discuss in more detail the scope (and intent) of the 1969-70 project. Describe intent of this project to represent the original site design for this area by introducing flush granite "curb / edging" and two different color exposed agregate concrete mixes to represent original roadway and pedestrian site features.	This information was added to the Predesign document. - SEI
4	Pages 5 - 6	Please indicate that plaza historically lacked a railing along seawall.	This information was added to the Predesign document. - SEI
5	Pages 5 - 6	Describe non-historic light fixtures set into plaza pavement and document that (per NPS recollection) the purpose of this lighting is to serve as a warning / announcement of the nearby edge of seawall.	This information was added to the Predesign document. - SEI
6	Page 6, Paragraph 2	Elaborate on difference between existing NW stair and walkway layout and original layout.	Although the Northwest Stairs and walkway have been demolished and rebuilt at least one time since their original construction, the layout and location closely match. The repairs were necessitated by differential settlement and at the time of their completion, restored the stairs and walkway to elevations matching the adjacent Memorial features. This information was added to the Predesign document. - SEI

PROJECT MANAGER REVIEWER: Patrick Macdonald

7	Page 8	Please clarify - Does differential settlement at West Terrace walk occur at interface between pile supported pavement and a slab on grade?	The foundation plans for the Jefferson Memorial indicate that the structure is pile-supported from the center of the Memorial to the extents of the Terrace Wall. (Refer to Figure 1, Jefferson Memorial Foundation Types.) Therefore, the West Terrace Walk can be presumed to be pile-supported. This information was added to the Predesign document. - SEI
8	Pages 8 - 9	Paragraph 2 - Elaborate on how differential settlement impacts compliance with ADA requirements.	Differential settlement can dramatically impact ADA accessibility compliance. The ADA guidelines state: 4.5.2 Changes in Level. Changes in level up to 1/4 in (6 mm) may be vertical and without edge treatment (see Fig. 7(c)). Changes in level between 1/4 in and 1/2 in (6 mm and 13 mm) shall be beveled with a slope no greater than 1:2 (see Fig. 7(d)). Changes in level greater than 1/2 in (13 mm) shall be accomplished by means of a ramp that complies with 4.7 or 4.8. 4.8.2* Slope and Rise. The least possible slope shall be used for any ramp. The maximum slope of a ramp in new construction shall be 1:12. The maximum rise for any run shall be 30 in (760 mm) (see Fig. 16). Curb ramps and ramps to be constructed on existing sites or in existing buildings or facilities may have slopes and rises as allowed in 4.1.6(3)(a) if space limitations prohibit the use of a 1:12 slope or less. - HNTB
9	Page 8 - 9	Please indicate that the differential settlement of pavement areas, if not addressed by methods similar to those presently employed by the park's maintenance staff, will result in tripping hazards and represent a significant risk to the NPS due to the likelihood that they will result in tort claims.	The differential settlement which has been observed at the Jefferson Memorial site are very likely to continue if not addressed with a permanent solution. The current solutions implemented by the NPS are generally sufficient to mitigate ADA accessibility concerns, but without constant observation of the conditions and continual repair and replacement of the temporary asphalt ramps, it is highly likely that ADA accessibility would not be maintained and significant tripping hazards would result. - HNTB

PROJECT MANAGER
REVIEWER: Patrick Macdonald

10	Page 8 - 9	Describe the risks to the plaza and seawall structural features assuming continued vertical and lateral movement.	Information obtained during the "Investigation of Settlement and Upheaval at the Jefferson Memorial", shows that the Ashlar Seawall is experiencing settlement and probable failure of the timber piles supporting it. It is imperative that the seawall be underpinned in order to prevent collapse of the wall. Opening of joints on the North Plaza indicate that the structure is experiencing lateral movement. Failure to address the lateral movement will result in potential damage to the North Plaza and the Ashlar Seawall, even after the proposed underpinning of the seawall is completed. This information was added to the PreDesign document. - SEI
11	Page 16	Please confirm with NAMA (Wheelock) that North Plaza is an historic structure as indicated on Key index.	From P. Wheelock's comment # 16: "The seawall, plaza and walks are structural elements in the Memorial's cultural landscape. The seawall is historic, the plaza, walks and northwest stair are not original (historic), but when they were last rehabilitated the historic character of the ori - SEIginal circulation patterns were respected." This information was added to the Predesign document.
12	Pages 20, 26, 33	Historic Factor should only be applied to the work in this project affecting the seawall capstone and ashlar facing stone.	Historic Factors have been revised based on comments in EST review. - SEI
13	Pages 20, 26, 33	Contracting Method Adjustment should reflect a "Full and Open" solicitation.	See response to Comment 6 on EST tab. - SEI
14	Page 23	Do the proposed new grade beams need to be arced? Would chorded grade beams suffice and result in a cost savings?	More than one configuration is possible for the proposed grade beams, but it is not likely to result in a major cost savings. - SEI
15	Page 38	Ellis Island Seawall project still on-going. Please revise the "year completed" date to 2008.	The data shown for Ellis Island in the Cost Comparability Analysis was taken from seawall segments that were completed in 2007. - SEI
16	Page 45	Response to Question 3 incomplete. The Scope and Cost Validation Form will be a stand alone document submitted to WASO so please provide the "description(s) and Class C Construction Cost" information requested under this question.	The Scope and Cost Validation Form has been revised. See Form. - SEI

PROJECT MANAGER REVIEWER: Patrick Macdonald

17	Page 46	Response to Question 4 should be revised following adjustments to Construction Cost Estimates per other comments above. Following these adjustments, please indicate extent of NW and NE Stair and Terrace Walk repairs that can fit into the project budget.	The Scope and Cost Validation Form has been revised. See Form. - SEI
18		[end of comments]	

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

PARK
REVIEWER: Steve Sims (SS), Jorge Alvarez (JA), Perry Wheelock (PW), Steve Lorenzetti (SL), Tony Ashdown (TA)
DATE REVIEWED:

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Page 15	Correct the scale of the legend hatching to the scale of the hatching on the drawing so they are the same.	This has been corrected. - SEI
2	Page 17	What is the basis for deciding which alternative to estimate? How does the NPS 'validate' the cost validation without a decision on which alternative to use?	[NPS DSC will address this comment. - NPS DSC D&C]
3	Page 18	Does the option chosen resist lateral movement?	The lateral movement is addressed through the alternative for the North Plaza remediation. - SEI
4	Page 20	How can we adjust the contracting method adjustment to reflect the NPS's plan? Is this project suitable for Design-Build?	Per NPS DSC, this is to be a "Full and Open" solicitation. - SEI
5	Page 23	Does the North Plaza option completely abandon the existing pile system? Is it necessary to install all new piles, caps and plaza? Aren't there soil anchoring methods that we could use with the existing foundation system to resist lateral movement?	The North Plaza option is a structural retrofit and supplements the existing pile system. For this option, new piles and grade beams are necessary, and their installation requires the removal and replacement of the North Plaza slab. Two additional remediation alternatives are being developed and include varying amounts of slab removal and replacement. - SEI
6	Pages 27-28	Why does this alternative rely soley on H-piles, whereas the seawall depends soley on micropiles. I still do not understand how the use of one pile over the other is being decided. Don't both structures need to resist vertical and lateral movement?	For the Predesign documents, Schnabel was directed to provide the worst case scenario for remediation of the North Plaza, which was determined to be a full structural retrofit. Two additional remediation alternatives are being developed. We are also developing four additional remediation schemes for the Ashlar Seawall. - SEI
7	Page 33	This estimate is nearly double the cost provided with the Investigate report. Why?	The new cost estimate considers pre condition survey, vibration monitoring instrumentation, test pile installation and load testing and an increased footage of micropiles, which are an increase to the previous estimate in the Investigative Report. Also, these estimates where prepared by different firms.

PARK

REVIEWER: Steve Sims (SS), Jorge Alvarez (JA), Perry Wheelock (PW), Steve Lorenzetti (SL), Tony Ashdown (TA)

8	Page 34	How was the 10 foot dimension of the transition slab derived? Consider lengthening the transition slab to 20-30 feet with a few transition joints to allow more movement over a longer span.	This 10 foot dimension is a conceptual design and may be modified when the selected alternative is further developed. - SEI
9	Page 35	Can we re-use the existing pile cap instead of installing the micropiles and new pile cap?	The North Plaza alternative presented in the Predesign documents requires a new pile configuration and new pile caps. Other North Plaza alternatives consider the existing cap. - SEI
10	Page 37	Are the costs being used for the projects 'final' as-constructed costs? If not, shouldn't we compare the estimated cost of the Jefferson Memorial project with as-built cost data for an accurate comparison?	The information for "NJTA Pile Rehabilitation Maintenance" and "Children's Hospital Addition" shown in the Cost Comparability Analysis are as-built costs. The costs for "Ellis Island Seawall Repair" are as-bid. - SEI
11	Page 37	What is the basis for deciding which alternative to estimate? How does the NPS 'validate' the cost validation without a decision on which alternative to use?	The project's tight schedule did not permit the A/E to prepare a Class C Cost Estimate for all alternatives to be evaluated at the Value Analysis meeting by the due date of this report. These estimates are currently being developed and will be available for the VA exercise. A revised (Final) Scope and Cost Validation form will be prepared following the VA study that reflects the Preferred Alternatives selected during the VA study. - NPS DSC D&C
12	Page 43	Paragraph 2, 2nd sentence. How should the North Plaza be addressed in greater detail?	This sentence is a general comment with more detail provided on pages 44 and 45 of the Predesign document. - SEI
13	Page 46	Is it a true statement that the North Plaza movement cannot be arrested by repairs on the seawall alone and that both the plaza and the seawall must be stabilized/repaired? Should the plaza be stabilized laterally to protect the new work at the seawall? Can the existing north plaza resist lateral movement?	Yes, the opening of joints on the North Plaza indicate that the structure is experiencing lateral movement. Failure to address the lateral movement will result in damage to the North Plaza and the Ashlar Seawall, even after the proposed underpinning of the seawall is completed. This information was added to the Predesign document. - SEI
14		[Note: All above Comments #1 - #13 from S. Sims.]	
15	Page 2	First Paragraph, 2nd to last sentence: "This Project Program identifies the elements *around* the Memorial..."	This has been corrected. - SEI

PARK

REVIEWER: Steve Sims (SS), Jorge Alvarez (JA), Perry Wheelock (PW), Steve Lorenzetti (SL), Tony Ashdown (TA)

16	Page 9	Section 4 - last third of first PP - not clear if you are referring to a yet to be proposed rehabilitation design or to the original design of the Memorial and its surrounding landscape. The seawall, plaza and walks are structural elements in the Memorial's cultural landscape. The seawall is historic, the plaza, walks and northwest stair are not original (historic), but when they were last rehabilitated the historic character of the original circulation patterns were respected.	This information was added to the Predesign document. - SEI
17		[Note: Above two comments #15 & #16 from P. Wheelock.]	

If comments go beyond this row, the sheet must be reformatted in order to print the additional lines.

B

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

FULLY DEVELOPED SCHEMATIC DESIGN
PREFERRED ALTERNATIVES

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
August 1, 2008

TABLE OF CONTENTS

I. INTRODUCTION

The Jefferson Memorial is located in the West Potomac Park Historic District and is part of the National Mall & Memorial Parks (NAMA). The structure sits on the southeast shore of the Tidal Basin, at the southern terminus of the Sixteenth Street cross-axis of the Washington Monument Grounds on axis with the White House. The Memorial consists of a dome-like structure reminiscent of the Roman Pantheon, and is surrounded by concentric walls and pathways. It was constructed from 1939-1943 and has undergone several changes since then, both cosmetic and structural. The structural changes were necessitated by continual settlement and consolidation of the soft soils present on site.

This document was developed following the Value Analysis which took place on March 12-14, 2008, and presents the Fully Developed Schematic Design Alternatives that resulted from the meeting.

Appendix A contains sheets showing the site layout and various Fully Developed Schematic Design Alternatives. Sheet 1 is a Vicinity Map for orientation to the site.

Appendix B contains Class B Cost Estimates for the four Schematic Design Preferred Alternatives. The estimates consider the probable cost of materials and services in the Washington, DC, area. The Class B estimates are based on a Schematic Design effort.

II. AREAS OF STUDY

1. Ashlar Seawall

The Areas of Study for the Jefferson Memorial project are presented graphically in Appendix A, Sheet 2. The Ashlar Seawall is the original seawall, which was built in 1941. The granite capstones and the ashlar facing are original materials, and are part of the historic fabric of the Memorial.

The Ashlar Seawall forms the southern boundary of the Tidal Basin and runs along the North Plaza of the Jefferson Memorial. It is a cast-in-place concrete stub wall supported on timber piles and faced with stone, and is approximately 490 feet in length. The arced portion is 378 feet long, and the two horizontal extensions to the east and west of the arc are approximately 56 feet each.

In February 2006, differential movement between the capstone of the Ashlar Seawall and the exposed aggregate concrete paving of the western portion of the North Plaza was observed. Data from "Investigation of Settlement and Upheaval at Jefferson Memorial," prepared by HNTB in 2008 indicates that movement in the seawall has been observed since its construction. This report also indicates that the movement seems to have accelerated since 2005. The magnitude of differential settlement between the Ashlar Seawall and the North Plaza, as indicated in the 2008 HNTB report, suggests that immediate rehabilitation of the Ashlar Seawall is necessary.

The wall is comprised of 10 wall segments separated by joints. At the joints between wall segments, the capstones of the Ashlar Seawall are displaced with respect to each other, indicating relative movement and/or rotation between the seawall segments. Figures 1 and 2 are photos of the Ashlar Seawall and North Plaza interface.

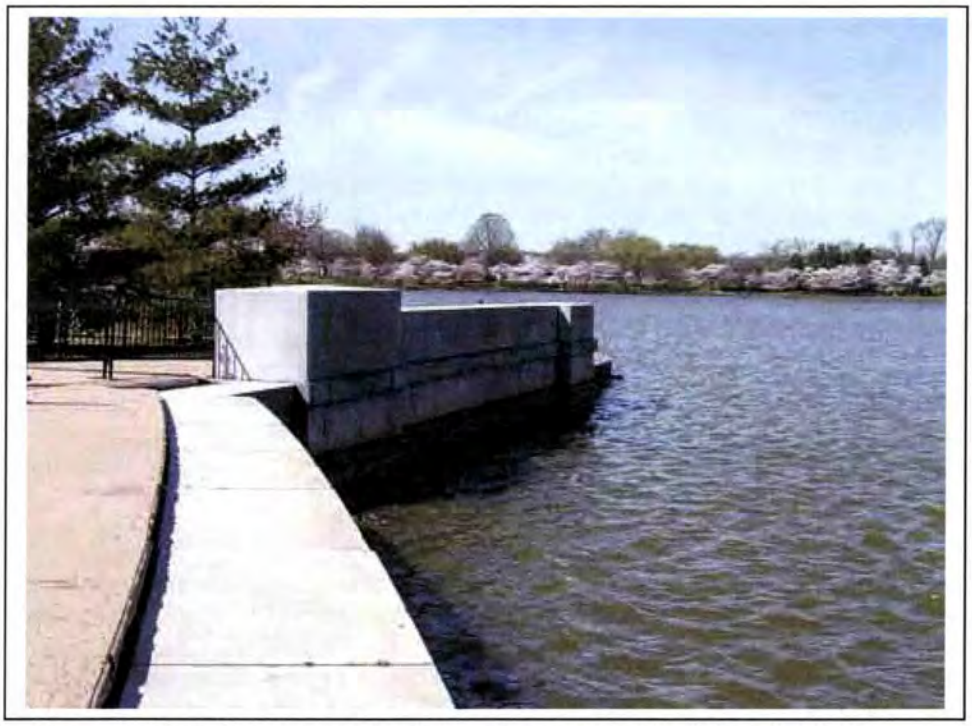


Figure 1. View Standing on the Ashlar Seawall Looking West (3-29-07)

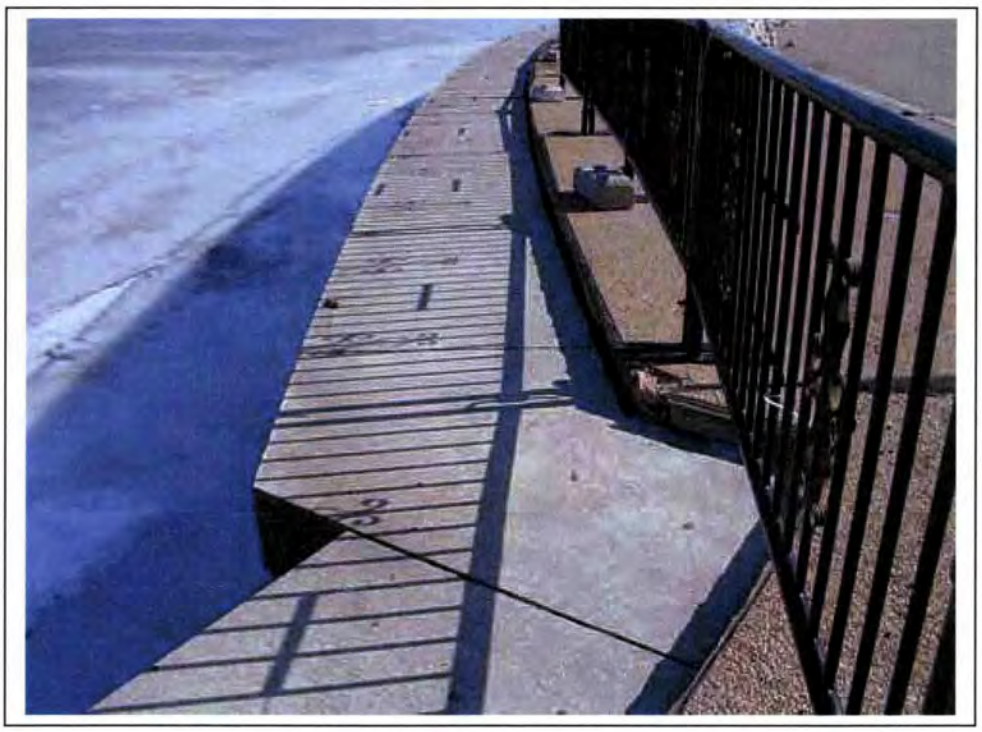


Figure 2. Standing on the North Plaza Looking East at Ashlar Seawall (2-28-07)

2. North Plaza

The North Plaza of the Jefferson Memorial was originally constructed as a slab on grade in 1939-1943, and consisted of an asphalt road bordered by concrete sidewalks. The plaza settled and showed considerable damage in the years immediately following the Memorial's construction. According to "Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial" by Storch Engineers in 1965, portions of the North Plaza were removed when it began cracking in 1951, and were not repaired until 1969-1970 when the North Plaza was entirely demolished and replaced with a structural slab on a system of piles and grade beams. The intent of this repair was to buttress the North Stairs with steel pipe piles reinforced with H-piles, and reconstruct the North Plaza on H-piles driven to bedrock to prevent additional settlement of the North Plaza slab.

When the plaza was reconstructed in 1969-1970, it was paved with exposed aggregate concrete and regular concrete colored red-brown. Thereafter, vehicles were prohibited from driving around the Memorial (Prothero 2001). In 1999-2000, the entire North Plaza and surrounding roads were restored. The North Plaza was milled to the structural slab, paved with a new exposed aggregate concrete, and the road was made flush with the sidewalks.

Due to settlement that the Circular Roadway had experienced, and according to the Storch documents (1965-1969), a 150-foot long portion of the Circular Roadway adjacent to the west end of the Plaza was filled to meet the Plaza grade. To the east of the Plaza, the backfill wedge over the Circular Roadway was about 20-feet long.

Although the North Plaza has been demolished and rebuilt since its original construction and therefore is not historical itself, the historical lines of the roadway have been preserved. When the North Plaza was last repaved in 1999-2000, the historic character of the original circulation pattern was respected. Granite pavers mark the location of the original concrete curb, and different colors of exposed aggregate concrete are used to distinguish areas that were originally asphalt roadway from those that were originally concrete sidewalk.

Historically, there was no railing or barrier between the North Plaza and the Ashlar Seawall. A barrier is presently in place between the North Plaza and the Ashlar Seawall to prevent the public from accessing the Ashlar Seawall which is displaying settlement with respect to the North Plaza. The barrier can be seen in Figure 3. When the North Plaza was last repaved in 1999-2000, in-slab lighting was used to provide a visual cue or warning as park visitors approached the edge of the North Plaza and the Ashlar Seawall.

Presently, there is differential settlement between the Circular Roadway on grade and the North Plaza structure on piles. This differential settlement is pronounced on the west side, and has necessitated frequent asphalt patching to mitigate tripping hazards. Park maintenance personnel have indicated that these locations require additional patching at the rate of approximately 0.5 inches every three months, and this frequent patching is only a recent necessity (2006-2008). Figures 3 and 4 show the asphalt patches on the western side of the North Plaza. Sheet 3 in Appendix A shows the Previous and Current Settlement Studies.

Figure 3. Asphalt Patches on North Plaza and Circular Roadway Interface (9-12-06)

Figure 4. Asphalt Patches on North Plaza and Circular Roadway Interface (10-12-06). Note "bulge" in grassy area suggesting the presence of a grade beam on piles.

The North Plaza has numerous expansion joints running both north-south and east-west. According to the HNTB report from 2008, joint openings between the North Plaza and the Main Stairs appear to be widening in the direction of the Tidal Basin. The opening of the joints represents a tripping hazard for visitors and personnel working at the Jefferson Memorial. The

opening of the joints as well as inclinometer data included in the HNTB 2008 report suggests that the North Plaza structure is moving laterally. Inclinometer data collected for the report showed that the soil layer approximately ten feet below the western end of the North Plaza was moving laterally in a north-northwest direction at an average rate of about 0.33 in/year. These vectors of movement are shown in Figure 43 on page 64 of the HNTB 2008 report. Based on inclinometer readings obtained in March 2008, the west end of the North Plaza appears to be moving at a rate of 0.5 in/year and the east end shows apparent movement of 0.15 in/year in the upper 10 feet of soil. The vectors of movement are similar to those shown in the HNTB 2008 report. Rehabilitation of the North Plaza is needed to control this joint opening at the interface between the plaza and the North Stairs. Failure to address the lateral movement of the North Plaza will eventually result in structural damage to the North Plaza and the Ashlar Seawall. The proposed underpinning of the Ashlar Seawall alone will not prevent further lateral movement of the North Plaza.

3. Northwest Stairs and Walkway

The Northwest Stairs have been repaired since their construction in 1939, and remain part of the Memorial and its appurtenant structures. It is important to repair them to ensure visitor safety and aesthetic appearance. Although the Northwest Stairs and walkway have been demolished and rebuilt at least one time since their original construction, the same general layouts and locations were used. The repairs were necessitated by differential settlement and, at the time of their completion, restored the stairs and walkway to elevations matching the adjacent Memorial features.

The Northwest Stairs are located at the western end of the Ashlar Seawall and to the west of the North Plaza. A concrete walkway connects the Northwest Stairs to the North Plaza. The stairs have a history of settlement and have been jacked and repaired several times. During the Storch (1969-1970) repairs, the stairs were jacked back up to grade using a steel "needle" beam. In 1998, the stairs and sidewalk were demolished and rebuilt with a reinforced slab that appears to bear on the seawall and on five H piles along their south side, parallel with the seawall. The steel piles are shown as existing in the plans for the restoration of the entrance steps and plaza in 1998, but it is not known when they were installed. Today, the stairs and adjacent walkway visibly lean toward the Tidal Basin, possibly due to settlement of the seawall.

A slab-on-grade sidewalk intersects the stairs perpendicularly from the south. At this interface, there are differential elevations resulting in a tripping hazard, which has been mitigated through asphalt patching. Figure 5 shows a photograph of the vicinity.

The concrete walkway extends east from the Northwest Stairs to the North Plaza. This walkway is also supported on the seawall and on a grade beam on piles along its southern edge. The northwest walkway also leans toward the Tidal Basin likely due to settlement of the seawall.

The walkway joins the North Plaza through a roughly triangular-shaped segment of exposed aggregate concrete. The foundation for this triangular wedge is unknown. The HNTB report from 2008 indicates the existence of a significant void underneath this area. It is possible that this triangular wedge is supported on piles or that it is partially bearing on the walkway grade beam and on the North Plaza foundation. The triangular wedge is experiencing settlement, but at a lesser rate than the slab-on-grade Circular Roadway. Figure 6 shows the triangular wedge bounded by asphalt patches.

Figure 5. Asphalt Patch at Northwest Stairs (10-12-06)

Figure 6. Standing on West Approach Walk and Looking at Triangular Wedge (10-12-06)

4. West Terrace Walk

The West Terrace Walk has been repaved since the Memorial's construction, but should retain the same historical location and grading.

Settlement is also occurring on the exposed aggregate concrete sidewalk that leads to the exhibit area on the west side of the Terrace Walk. As shown in Figure 7, there is an asphalt patch in this area to mitigate tripping hazards. The foundation plans for the Jefferson Memorial indicate that the structure is pile-supported from the center of the Memorial to the extent of the Terrace Wall. Therefore, the West Terrace Walk can be presumed to be pile-supported.

Figure 7. West Terrace Walkway Looking Toward Main Stairs (10-12-06)

III. FUNCTIONAL REQUIREMENTS AND RELATIONSHIPS

1. Ashlar Seawall

The Ashlar Seawall serves as the northern border for the North Plaza of the Jefferson Memorial. It retains the soil underneath the North Plaza and protects it from erosion from the Tidal Basin waters. The reinforced concrete seawall is approximately ten feet in height, and is supported by a timber pile foundation. It is faced with panels of ashlar stone and capped with a one-foot thick granite capstone. The top of the capstone was intended to be flush with the top of the exposed aggregate paving of the North Plaza. Recent settlement of the seawall has caused the elevation of the capstone to drop with respect to the North Plaza, approximately 6.5 inches on the western end of the arced portion as of December 2007.

The differential settlement between the Ashlar Seawall and the North Plaza has necessitated blocking the area from public access. A temporary fence prevents the public from sitting or standing on the seawall. The barrier affects the aesthetic appearance of the seawall and prevents the visitors from experiencing the Memorial as it was designed.

2. North Plaza

The North Plaza connects the Ashlar Seawall to the north and the Main Stairs to the south, and is bounded by the Circular Roadway on the east and west. Differential settlement is evidenced at the interface between the Circular Roadway and the North Plaza. Park maintenance staff have treated this interface with temporary asphalt patching. In addition, the joint between the North Plaza and the Main Stairs has opened, indicating lateral movement of the North Plaza toward the Tidal Basin.

The North Plaza allows visitors to experience a frontal view of the Memorial and to access the Main Stairs which lead to the interior of the monument. The plaza also affords a view of the Tidal Basin and Washington Monument, as well as other historical vistas. The North Plaza is utilized during the Cherry Blossom festival and other events that take place around the Tidal Basin. Visitors and school groups gather here, and joggers and bikers traverse the plaza regularly. The difference in elevation between the North Plaza and the Circular Roadway has created a serious tripping hazard and access issue for visitors to the Memorial.

3. Northwest Stairs and Walkway

The Northwest Stairs and walkway connect the pathway around the Tidal Basin to the Jefferson Memorial. This area is used by visitors to the Memorial as well as bikers and joggers on the pathway around the Tidal Basin. Settlement between the Northwest Stairs on piles and the walkway on grade has caused a difference in elevation and requires periodic asphalt patching.

4. West Terrace Walk

The West Terrace Walk connects the Main Stairs with the entrance to the exhibit level of the Memorial. This area is regularly used by visitors as a circulation route around the Memorial, and into the bookstore and gift shop areas, and receives a high volume of pedestrian traffic. Settlement has created the need for a temporary asphalt patch on the walkway, and this area should be repaired to allow ease of public access.

IV. PAST AND CURRENT STUDIES

The Jefferson Memorial is located in West Potomac Park which was a river flat and marsh prior to 1792 (Storch 1965). In accordance with the McMillan plan, when the East and West Potomac parks were created, an area of 327 acres was reclaimed through the dredging of the Washington Channel to establish East Potomac Park. The work was completed in 1927, and by 1932 East Potomac Park was developed as a tourist camp and golf course (Storch 1965). West Potomac Park was created from hydraulic dredging of the swampy regions southwest of the Washington Monument (Heine 1953). It was completely reclaimed and graded by 1908, and by 1922 it was developed and the Lincoln Memorial-Reflecting Pool complex was completed (Storch 1965).

The Jefferson Memorial is founded on a network of deep foundations and grade beams that are arranged radially. The main structure, the Stylobate Wall, and the Terrace Wall are supported by 443 cast-in-place Raymond piles, 88 twenty-four-inch concrete caissons, and 103 sixteen-inch concrete caissons. The surrounding roads and grass areas are on grade. The Ashlar Seawall to the north of the Memorial is supported by vertical and battered timber piles. The North Plaza was initially constructed on grade, but in 1969-1970 it was demolished and reconstructed as a structural slab on grade beams, and steel piles driven to rock.

Throughout the years, several different studies have been undertaken to assess and monitor the settlements taking place on site. They are listed below:

1) Settlement Data, Jefferson Memorial 1941-1968

    a) This data is included in the Storch Report listed below:
        i) Survey data with vertical and horizontal movements since the construction of the Memorial

2) Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial, Storch Engineers, 1965 and 1968

    a) These reports include the following:
        i) Subsurface investigations, geology, and stratigraphy of the site
        ii) Survey data with vertical and horizontal movements since the construction of the Memorial
        iii) Laboratory testing and analysis
        iv) Physical conditions of the structure and adjacent areas
        v) Proposed solutions for repair of the North Plaza, Main Stairs, Stylobate and Terrace Walls, and surrounding areas
        vi) Adjustment of corners of Stylobate Wall at entrances to the lower level of Memorial
        vii) Pile-supported buttress for Stylobate Wall and Terrace Wall to provide lateral support
        viii) Demolition of North Plaza and replacement with structural slab on piles
        ix) Construction of new tie beams and buttresses beneath Main Stairs
        x) Removal and resetting of 12 capstones on the west end of the Ashlar Seawall

3) Preservation and Restoration of the Jefferson Memorial - Einhorn Yaffee Prescott (EYP) and Hartman-Cox Architects, 1990 and 1992

    a) Contains detailed chronology of the Memorial since June 1934
    b) Geotechnical inspection as part of this report in 1988 did not reveal signs of settlement of the walls or superstructure

c) Report included the following information:
   i) Review of landscape design and existing conditions of plants
   ii) Irrigation study
   iii) Geotechnical study including history of problems and alternative solutions
   iv) Stylobate Mall drainage and recommendations for sheet piling
   v) Cost estimate and impact analysis

4) Investigation of Settlement and Upheaval at Jefferson Memorial – HNTB, 2008

   a) Contains the following information:
      i) Review and summary of historical information
      ii) Site investigation and soil borings
      iii) Data collected from inclinometers, tiltmeters, piezometers, and ground water observation wells
      iv) Survey monitoring of the site
      v) Interpretation of data and three alternative recommendations for repair of the Ashlar Seawall
      vi) Repair solutions addressing the differential settlements between the North Plaza and the Circular Roadway, and the Northwest Stairs and the adjacent walkway
      vii) Recommendations for continued collection of instrumentation data and quarterly survey monitoring, and further investigation of the lateral movement of the North Plaza

5) Pre-Design and Schematic Design Services for the Jefferson Memorial – HNTB, current

   a) Design alternatives to address the settlement of the Ashlar Seawall and lateral movement of the North Plaza
   b) Quarterly survey monitoring of 22 points on the Ashlar Seawall and North Plaza
   c) Quarterly collection of data from inclinometers, piezometers, tiltmeters, and ground water monitoring wells
   d) Core sampling of the reinforced concrete Ashlar Seawall to assess condition of the concrete and rebar
   e) Condition assessment of the ashlar stone facing of the seawall
   f) Prepare Pre-Design and Schematic Design documents

V. DESIGN PARAMETERS

This project presents unique design challenges due to the different mechanisms that may be contributing to the movement of the structures. It is also unique because of the interaction between the different structures and how behavior of one structure might affect the behavior of an adjacent structure. Movement of the Ashlar Seawall, the North Plaza and the areas surrounding the Memorial has been recorded since construction, more than 65 years ago. It is important that the design considers the current state of stress of both the structures and the soil.

Information obtained during the "Investigation of Settlement and Upheaval at the Jefferson Memorial" shows that the Ashlar Seawall is experiencing settlement and lateral movement, with probable failure of the timber piles supporting it. It is imperative that the seawall be underpinned in order to prevent collapse of the wall. The underpinning of the seawall alone will not provide for lateral resistance against the movement of the plaza.

This investigation also shows that the North Plaza has experienced significant lateral movement. The condition of the existing pile foundation system is not known.

The design is also unique in the sense of the historical value of the structures. The Ashlar Seawall, North Plaza and the walkways are structural elements in the Memorial's cultural landscape. The seawall, ashlar facing and capstones are historic. The plaza, walks and Northwest Stairs are not original (historic), but when they were last rehabilitated, the historic character of the original circulation patterns was respected. The design must take into account the preservation of these features.

The design concepts have been developed based on the information included in the report by HNTB, "Investigation of Settlement and Upheaval at the Jefferson Memorial National Mall and Memorial Parks, dated January 30, 2008. The information used for the development of design concepts included monitoring data from inclinometers, piezometers, tiltmeters, boring logs, survey data and historical documents.

The monitoring data collected in the HNTB 2008 report suggests that the soil is moving both in a vertical and horizontal direction. The conceptual approach followed in this design is based on the fact that the soil is moving relative to the structures and is explained as follows:

1- Lateral movement of the soil relative to the structures will exert additional pressure on the foundation systems (timber piles for the Ashlar Seawall and steel H-piles for the North Plaza).

2- Measurement of the magnitude and rate of lateral movement of the soil would allow estimating the magnitude and direction of additional pressure exerted on the foundation systems. Because the movement of the soil is time dependent, and because the time elapsed since the start of monitoring is relatively short (16 months), it is necessary to make some assumptions regarding the movement rate until additional monitoring data is collected over time. Lateral movement of the soil is being monitored and must continue to be monitored in order to gather additional information that would help to understand the behavior of the soil mass over time.

3- Vertical movement of the soil is also reported on the HNTB 2008 report. Vertical movement of the soil is being measured by survey points located on the ground surface and structures. Vertical movement of the soil will create down drag forces on the foundation systems that may lead to settlement of the structures, as well as additional stresses on the structural elements of the foundation systems.

4- There are several possible mechanisms that may contribute to soil movement, which are described in more detail in the HNTB 2008 report. The solutions (alternatives) proposed

in this report have been based on the limited measurements available of deformations of the soil. Additional monitoring data with time is necessary to verify design assumptions considered for time-dependent behavior of the soil.

The preferred alternatives have been selected partially based on their ability to reinforce the existing structures and/or limit soil movement.

Sheet 4 of Appendix A contains a plan view of the Impact of Construction Activities, and Sheets 5 and 6 contain an Existing Utility Plan and an Existing Lighting Plan, respectively. Sheets 5 and 6 contain information from historical plans which must be confirmed prior to further design development.

VI. FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

1. Ashlar Seawall and North Plaza

Prior to the Value Analysis, Draft Schematic Designs were developed which consisted of five alternative designs for remediation of the Ashlar Seawall, and three alternative designs for remediation of the North Plaza. At the VA Meeting, the various Ashlar Seawall and North Plaza alternatives were paired into feasible combinations and evaluated. Also, two funding scenarios were outlined. For each funding scenario, two Preferred Alternatives were selected. They are shown below. Please refer to the Value Analysis Report dated April 9, 2008, for additional details.

a) Alternative 2

Alternative 2 is comprised of driving HP piles to support the Ashlar Seawall, and using driven pipe piles to address the lateral movement of the North Plaza.

This alternative considers driving HP piles as foundation elements for the Ashlar Seawall. We anticipate that the piles would be installed from a crane on the North Plaza to disintegrated rock at a total depth of approximately 95 feet below the North Plaza surface elevation. For this alternative, segments of the North Plaza slab must be removed to excavate behind the seawall. We anticipate removing the plaza slab at the expansion joint located approximately 10 feet behind the seawall. The existing grade beams would remain in place.

This alternative would consist of 53 HP14X89 vertical HP piles in front of the wall, and 53 HP piles battered at 5° behind the wall. Following pile installation, pile cap extensions would be constructed, the wall would be backfilled, and the plaza slab replaced. This alternative will require removal of the riprap and backfilling after installation of piles.

The North Plaza structure would be supplemented with new piles to resist the lateral movements along with replacement of the structural slab and topping course. This effort requires removing part of the existing structural slab at the North Plaza, and installing pipe piles driven to bedrock. The existing piles and pile caps of the North Plaza would remain in place.

The North Plaza remediation approach focuses on the west portion of the North Plaza to counter the magnitude and direction of the movement that has been recorded. This alternative would consist of approximately seventy (70) 24-in-O.D. pipe piles battered at 30° toward the Main Stairs and forty-seven (47) 24-in-O.D. pipe piles installed vertically. The vertical piles would have a length of approximately 90 feet and the battered piles would have a length of approximately 105 feet. The top of bedrock is located approximately at EL -87. In order to drive these piles, the use of a barge to stage the crane will likely be necessary. At least two load tests on a sacrificial, instrumented pipe pile should be performed. Portions of the North Plaza structural slab will be removed and demolished as necessary. The pipe piles will be driven to bedrock, and the pile caps will be formed and poured.

Schematic drawings are presented on Sheets 7 and 8 of Appendix A.

b) Alternative 6

Alternative 6 is comprised of drilling micropiles through the existing Ashlar Seawall to control settlement of the seawall, and using caissons to address the soil movement and the lateral movement of the North Plaza.

This alternative would consist of 51 micropiles battered at 7°, and 51 micropiles battered at 13° through the wall stem. The piles would have a bonded length of 10 feet into bedrock and a total length of 90 feet. At least one load test on a sacrificial, instrumented micropile should be performed. The advantage of this alternative is that it limits the amount of demolition and excavation. However, the micropiles must be installed through holes cored through the full wall height.

To address the soil movement, large diameter piers would be installed in front of the Ashlar Seawall and embedded into the bedrock a minimum of 20 ft. The piers will work as structural elements that would serve as a curtain to restrain lateral movement of the soil in the surrounding areas around the Ashlar Seawall and the North Plaza. In the Tidal Basin in front of the western portion of the North Plaza, nineteen 7-foot diameter concrete caissons would be installed and connected by a 15-foot wide concrete cap. North of the eastern portion of the North Plaza, one group of seven 6-foot diameter caissons, and one group of fifteen 6-foot diameter caissons will be connected with 12-foot wide concrete caps. The caissons and caps would be positioned to counteract the plaza and soil movement.

This alternative is oriented to reduce the additional stresses induced on the foundation systems by the lateral movement of the soil. This solution has the advantage that it is installed outside the footprint of the North Plaza, and therefore does not require the removal and reconstruction of the plaza structural slab.

At this point in the schematic design, we have considered that the caissons will be drilled and constructed from the water. It is anticipated that the drilling, removal of spoils, and placement of rebar cages and concrete will be performed from a temporary bridge structure or by barge. Access to the bridge or barges is anticipated to be from the west lawn area. A temporary access road may be required in this area for removal and delivery of materials. It is also anticipated that the plaza would be used as a temporary staging area for the caisson cans and rebar cages. Further development of the construction techniques will be addressed during the development of the Construction Documents.

Schematic drawings are presented on Sheets 9 and 10 of Appendix A.

c) Alternative 3

Alternative 3 consists of demolishing the existing seawall and constructing a new seawall supported on driven pipe piles. Driven pipe piles would be used to address the lateral movement of the North Plaza in a similar fashion to Alternative 2, as well as support the new seawall. The new seawall would have similar dimensions and appearance as the original seawall. The original granite capstones and ashlar stone facing would be preserved and reused.

This alternative would consist of approximately one hundred and seventeen (117) 24-in-O.D. pipe piles battered at 30° toward the Main Stairs and sixty-seven (67) 24-in-O.D. pipe piles installed vertically. The vertical piles would have a length of approximately 90 feet and the battered piles would have a length of approximately 105 feet. The top of bedrock is located approximately at EL -87. In order to drive these piles, the use of a barge to stage the crane will likely be necessary. At least two load tests on a sacrificial, instrumented pipe pile should be performed. Portions of the North Plaza structural slab will be removed and demolished as necessary. The pipe piles will be driven to bedrock, and the pile caps will be formed and poured.

Schematic drawings are presented on Sheets 11 and 12 of Appendix A.

d) Alternative 7

Alternative 7 consists of demolishing the existing seawall and constructing a new seawall supported on 6-foot and 7-foot diameter caissons. The caissons would address the soil movement and the lateral movement of the North Plaza, as well as support the new seawall. Beneath the western portion of the Ashlar Seawall, twenty-two 7-foot diameter caissons would be installed and embedded into the bedrock a minimum of 20 feet. On the eastern side of the Ashlar Seawall, twenty-six 6-foot diameter caissons would be installed. The new seawall would have similar dimensions and appearance as the original seawall. The original granite capstones and ashlar stone facing would be preserved and reused.

Schematic drawings are presented on Sheets 13 and 14 of Appendix A.

2. Circular Roadway at Interface with North Plaza

At the North Plaza, there is noticeable relative movement at the interface between the structural slab-on-piles and the adjacent Circular Roadway slab-on-grade. The elevation difference, resulting from settlement of the slab-on-grade, is a tripping hazard and requires frequent asphalt patching. Our proposed remediation method consists of cutting at the edge of the structural slab, removing 10 feet of the ring road in the west direction, and replacing with a 10-foot wide structural transition slab. Micropiles would be installed at five feet on center adjacent to the western-most and eastern-most grade beams on the North Plaza, and would be capped with a grade beam. This beam would support the east and west edges of a new structural slab. A new footing would support the east and west edges of the slab, and at either end a flexible joint would be used to allow the slab to undergo anticipated settlements without causing tripping hazards. Schematic drawings are presented on Sheets 15 and 16 in Appendix A.

3. Northwest Stairs

The Northwest Stairs that approach the North Plaza along the Ashlar Seawall are supported on their north side by the seawall, and on their south side by H piles and a grade beam. To the south of the stairs, a slab-on-grade sidewalk intersects perpendicularly. At this interface between the sidewalks on piles and on grade, there are differential elevations resulting in a tripping hazard and the need for an asphalt patch. Our proposed remediation method consists of removing 10 feet of the sidewalk slab, and creating a joint at the base of the existing grade beam. A new structural slab would be constructed and supported on the existing beam to the north, and a new footing at the south edge. The interface would be sealed with a flexible joint to allow the sidewalk to undergo anticipated settlements. Schematic drawings are presented on Sheets 15 and 16 in Appendix A.

4. West Terrace Walkway

At the West Terrace Walkway, there is noticeable relative movement next to the interface with the main stairs. Based on historical structural documents, the structural slab-on-piles is above a pile supported structure. The elevation difference evidenced at this location results in a tripping hazard and requires frequent asphalt patching. Our proposed remediation method is similar to the method indicated for the Circular Roadway Interface. However, the foundation support of this slab must be verified in situ by test pits to verify whether it is supported on piles on both ends or only on one end.

VII. REFERENCES

Christie, Douglas W., and Hugh S. Lacy. "Deep Foundations in Washington, DC." Deep Foundations Institute 31st Annual Conference on Deep Foundations (2006): 3-18.

Einhorn Yaffee Prescott, McMullan & Associates, Inc., Stephenson & Good, A. Morton Thomas and Associates, Inc., and Schnabel Engineering. Jefferson Memorial Specific Tests and Evaluations of Stylobate Mall. 1992.

Fugate, Jeffrey N. "City Study: Washington D.C." (2005) 23 May 2007 <http://ocw.mit.edu/NR/rdonlyres/Architecture/4-175Fall-2005/1915607E-48BF-40E8-89FB-0D931E5AA5C9/0/washingtondc.pdf>.

Heine, Cornelius W. A History of National Capital Parks 1953 24 May 2007 <http://www.cr.nps.gov/history/online_books/nace/adhi.htm>.

Historic American Buildings Survey, Jack Boucher. 20. Aerial view from the northeast. Jack Boucher, photographer; February 1992. HABS DC, WASH, 453-20.

HNTB, "Investigation of Settlement and Upheaval at Jefferson Memorial." 23 January 2008.

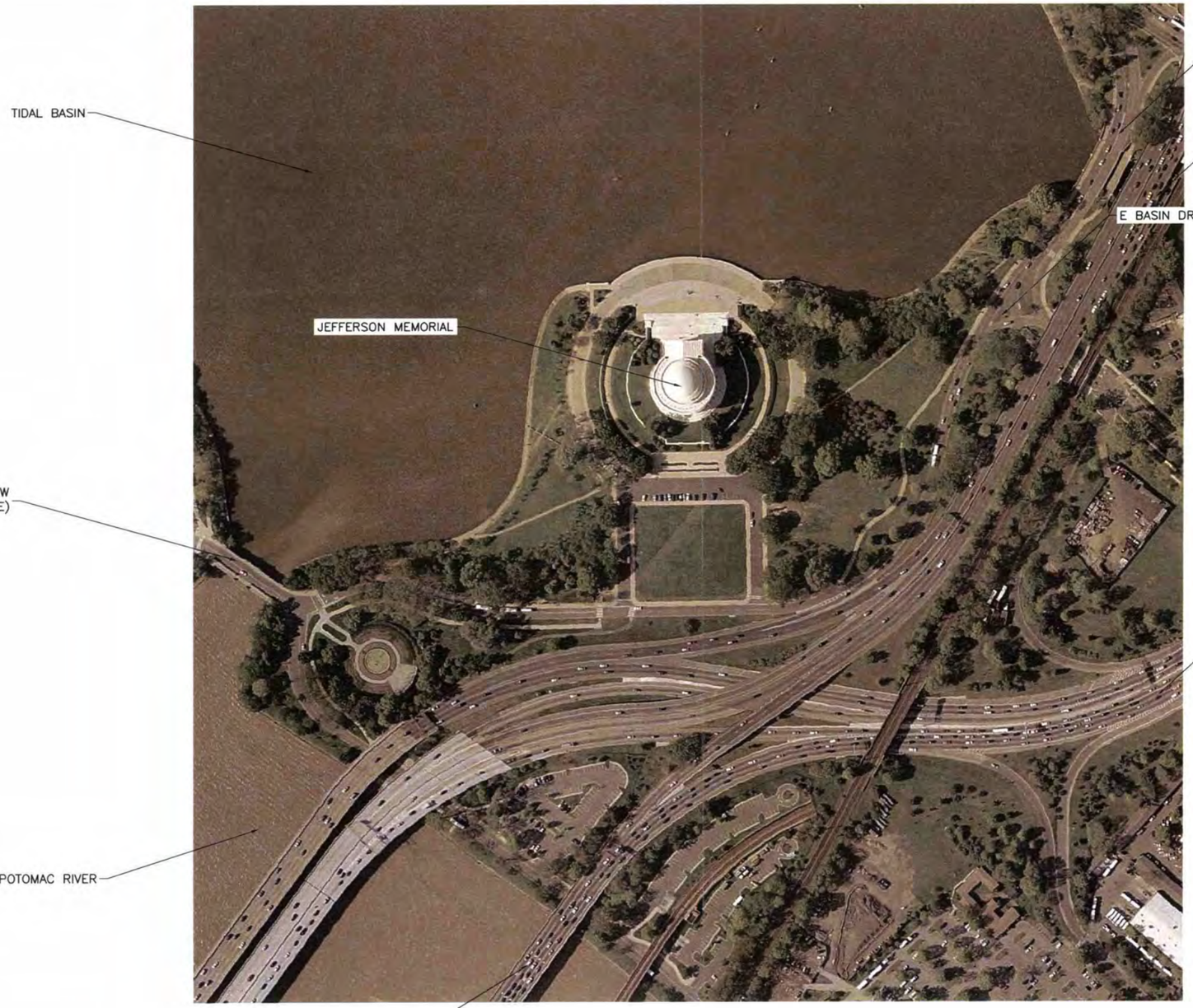
National Park Service, "Environmental Assessment." Thomas Jefferson Memorial Security Improvement Project (2002). 11 May 2007 <http://www.nps.gov/archive/thje/ea>.

Prothero, Sally, Audrey Tepper, Stephen Lorenzetti, Maureen Joseph, Nancy J. Brown, and Jennifer Hanna. "Thomas Jefferson Memorial: National Park Service Cultural Landscapes Inventory." 1998, Revised 2001. 12 Feb 2007 <http://www.nps.gov/archive/thje/cli/cli_general_information.pdf>.

Storch Engineers, Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures. 1965.

APPENDIX A

Schematic Design Drawing Sheets



FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

REFERENCE: TERRAIN NAVIGATOR PRO 2007, JEFFERSON MEMORIAL, WASHINGTON, DC.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							DESIGNED NSF/SCB DRAWN JG CHECKED
				VICINITY MAP TITLE OF DRAWING			1 SUB SHEET NUMBER
							REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
							PHILE/PROJ NO. 128232 DATE 5/1/08 DWG. NO. 808/80284

KEY:

AREAS OF STUDY UNDER SCOPE OF SERVICES

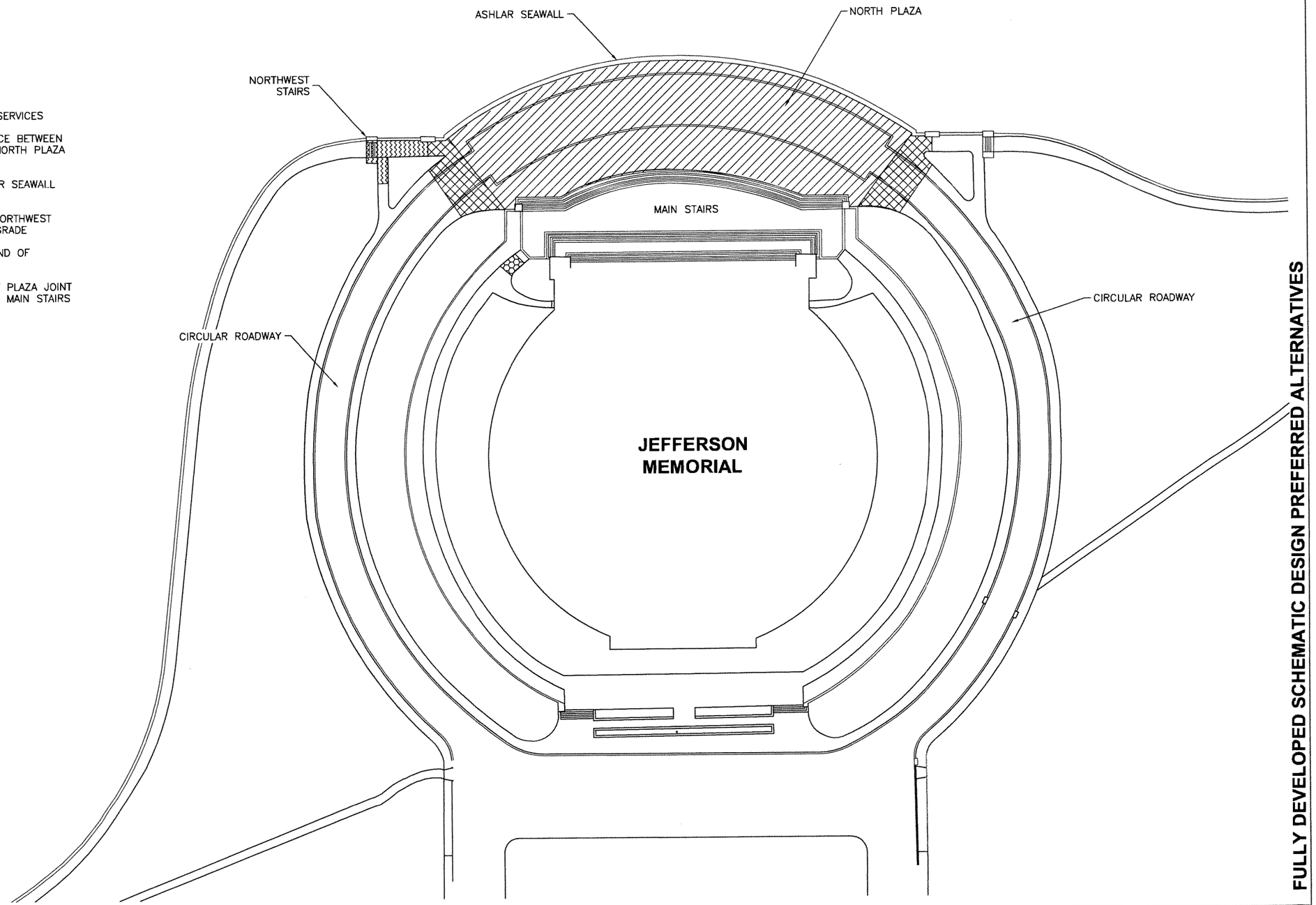
DIFFERENTIAL SETTLEMENT AT INTERFACE BETWEEN CIRCULAR ROADWAY ON GRADE AND NORTH PLAZA STRUCTURAL SLAB ON PILES

SETTLEMENT AND ROTATION OF ASHLAR SEAWALL

DIFFERENTIAL SETTLEMENT BETWEEN NORTHWEST STAIRS ON PILES AND WALKWAY ON GRADE

DIFFERENTIAL SETTLEMENT AT WEST END OF TERRACE WALL

LATERAL MOVEMENT AS EVIDENCED BY PLAZA JOINT OPENING BETWEEN NORTH PLAZA AND MAIN STAIRS



40 0 40 80

SCALE OF FEET

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

AREAS OF STUDY
TITLE OF DRAWING

2
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED DW/CJR/HR
DRAWN NSF/SCB
CHECKED JG
PMIS/PKG NO. 128232
DATE 5/1/08
DWG. NO. 808/80284

5/1/08 11:05 SBUCUREL 006JOBS\061500078.8 JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN FOR DAB'S\ANALYS

KEY:

PREVIOUS AND CURRENT STUDIES RELATED TO MOVEMENTS OF THE SEAWALL AND NORTH PLAZA

NORTH PLAZA:

- 1965 & 1968 STORCH REPORTS AND PLANS FOR RECONSTRUCTING PLAZA
- 1998 NPS PLANS FOR RESTORATION OF ENTRANCE STEPS AND PLAZA
- 1999–2000 REPAVING WITH EXPOSED AGGREGATE CONCRETE
- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

MEMORIAL & STYLOBATE MALL:

- MONITORING DATA FROM 1941–1968
- 1965 & 1968 STORCH REPORTS WITH PROPOSED REPAIR SOLUTIONS
- 1990 & 1992 EINHORN YAFFEE PRESCOTT REPORTS

ASHLAR SEAWALL:

- MONITORING DATA FROM 1941–1968
- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

NORTHWEST STAIRS:

- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

WEST TERRACE WALK:

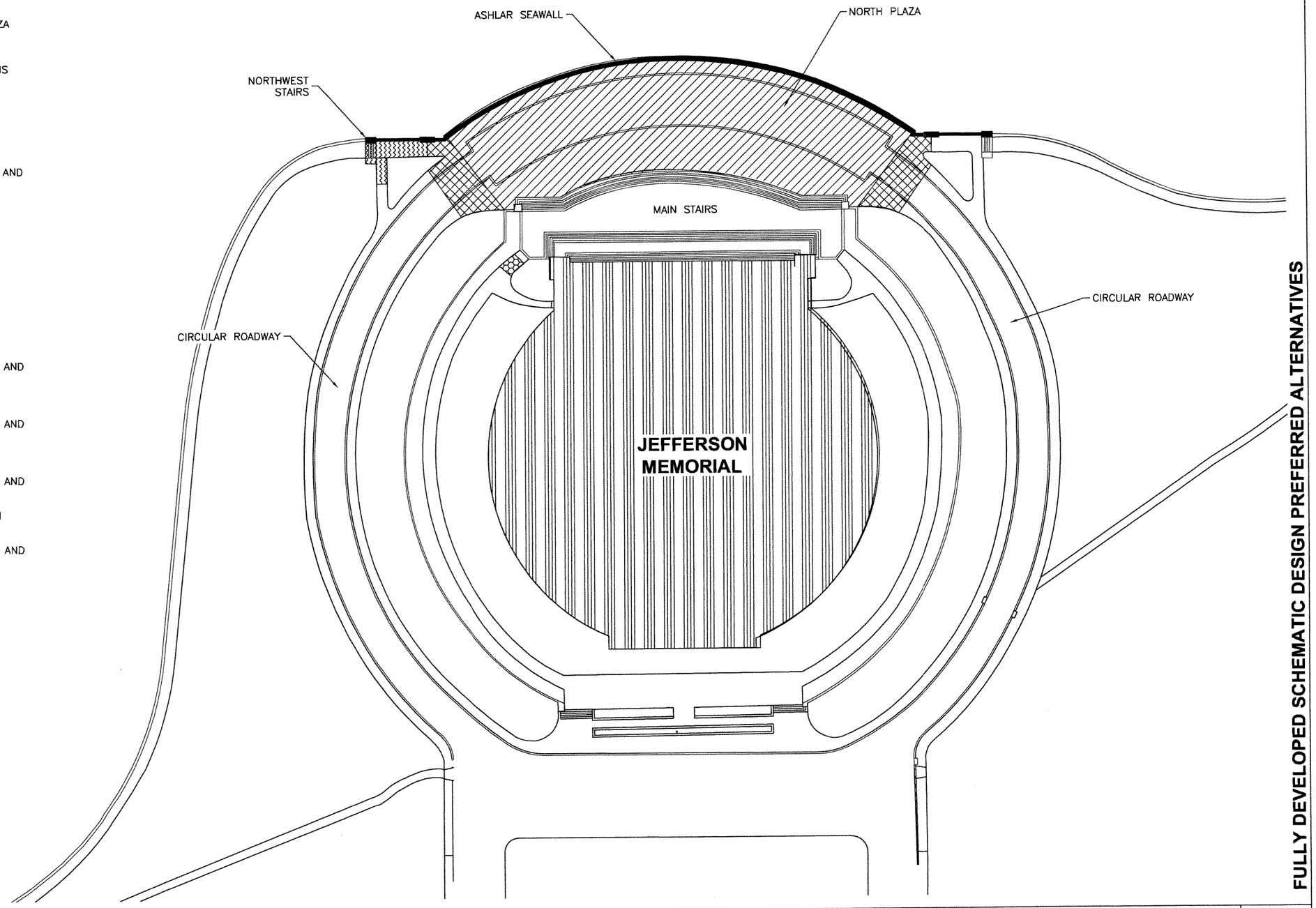
- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

CIRCULAR ROADWAY AT INTERFACE WITH NORTH PLAZA:

- 2008 HNTB INVESTIGATION OF SETTLEMENT AND UPHEAVAL

40 0 40 80
SCALE OF FEET

TIDAL BASIN



FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

PREVIOUS AND CURRENT SETTLEMENT STUDIES
TITLE OF DRAWING

3
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED	DW/CJR/HR
DRAWN	NSF/SCB
CHECKED	JG
DWIS/PMIS NO.	128232
DATE	5/1/08
DWG. NO.	808/80284

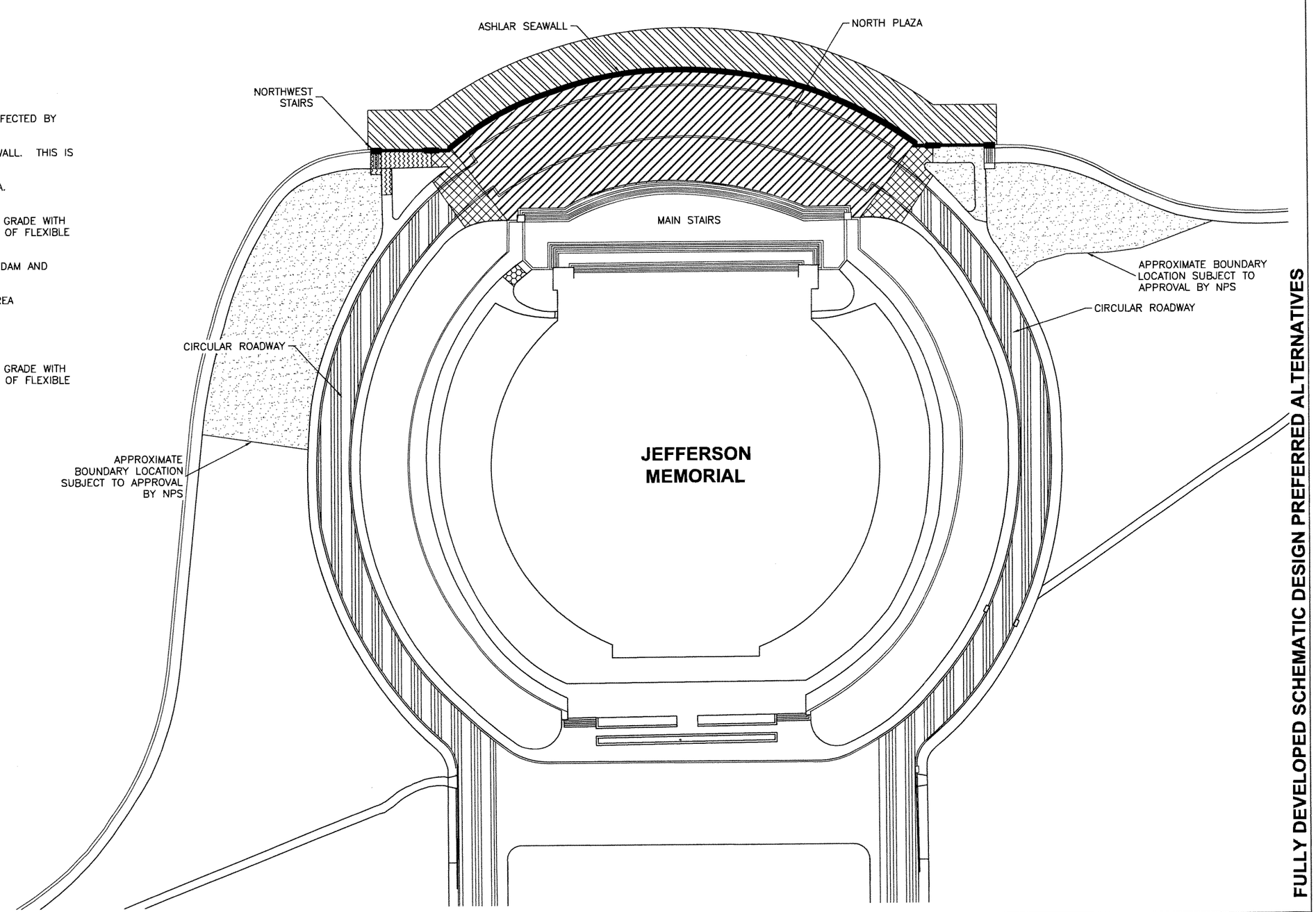
5/1/08 11:05 SBUCUREL 2008JOBS\06150078.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN FOR DAB\51ANALYS

TIDAL BASIN

KEY:

AREAS THAT MAY POTENTIALLY BE AFFECTED BY CONSTRUCTION OPERATIONS

- REHABILITATION OF THE ASHLAR SEAWALL. THIS IS A HISTORIC STRUCTURE
- REHABILITATION OF THE NORTH PLAZA.
- REPLACEMENT OF EXISTING SLAB ON GRADE WITH STRUCTURAL SLAB AND INSTALLATION OF FLEXIBLE JOINTS
- INSTALLATION OF TEMPORARY COFFERDAM AND DEWATERING
- POSSIBLE CONSTRUCTION STAGING AREA
- POSSIBLE SITE ACCESS
- REPLACEMENT OF EXISTING SLAB ON GRADE WITH STRUCTURAL SLAB AND INSTALLATION OF FLEXIBLE JOINTS
- REPAIRS TO EXISTING SIDEWALK



40 0 40 80
SCALE OF FEET

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

IMPACT OF CONSTRUCTION OPERATIONS
TITLE OF DRAWING

4
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

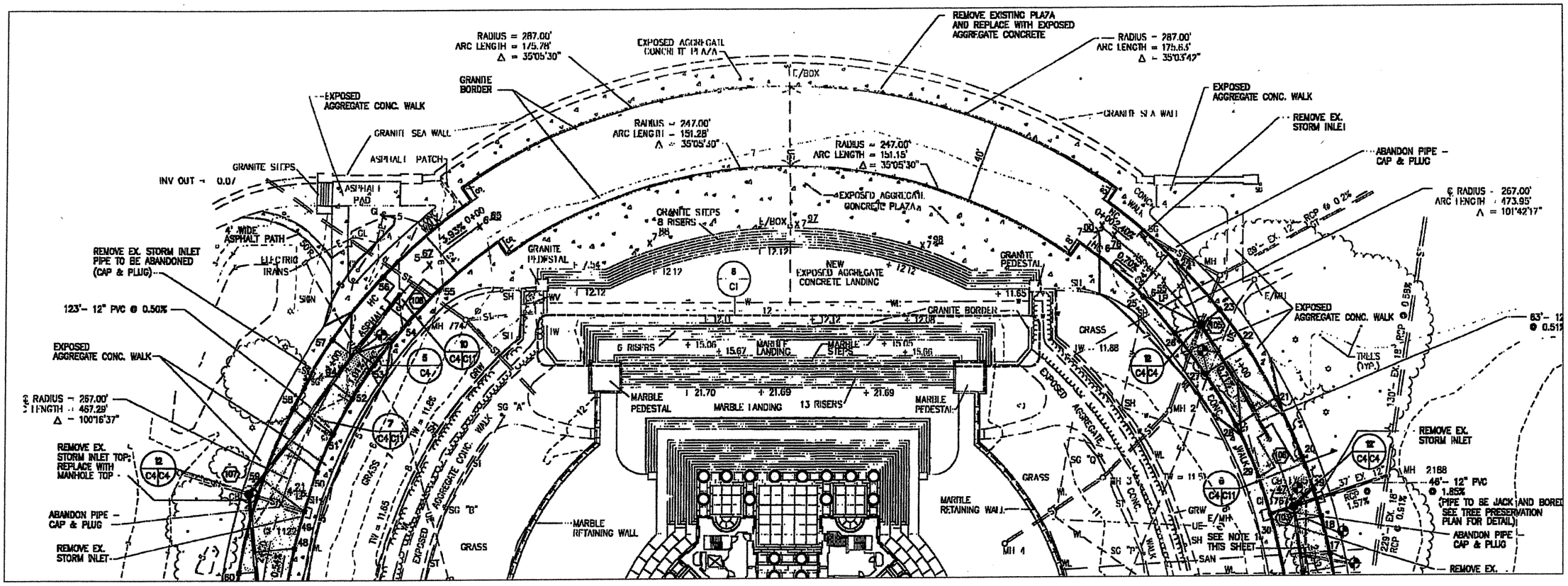
REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED	DW/CJR/HR
DRAWN	NSF/SCB
CHECKED	JC
APPD/PROJ NO.	128232
DATE	5/1/08
DWG NO.	808/80284

C:\2006Jobs\06150078.B Jefferson Memorial Predesign & Schematic Design\CADD\Schematic Design for DAB\51ANALYSIS.dwg, 7/28/2008 3:05:46 PM, nfahey

O:\JOBS\06150078.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN FOR DAB\51ANALYSIS

7/28/08 14:24 NFAHEY



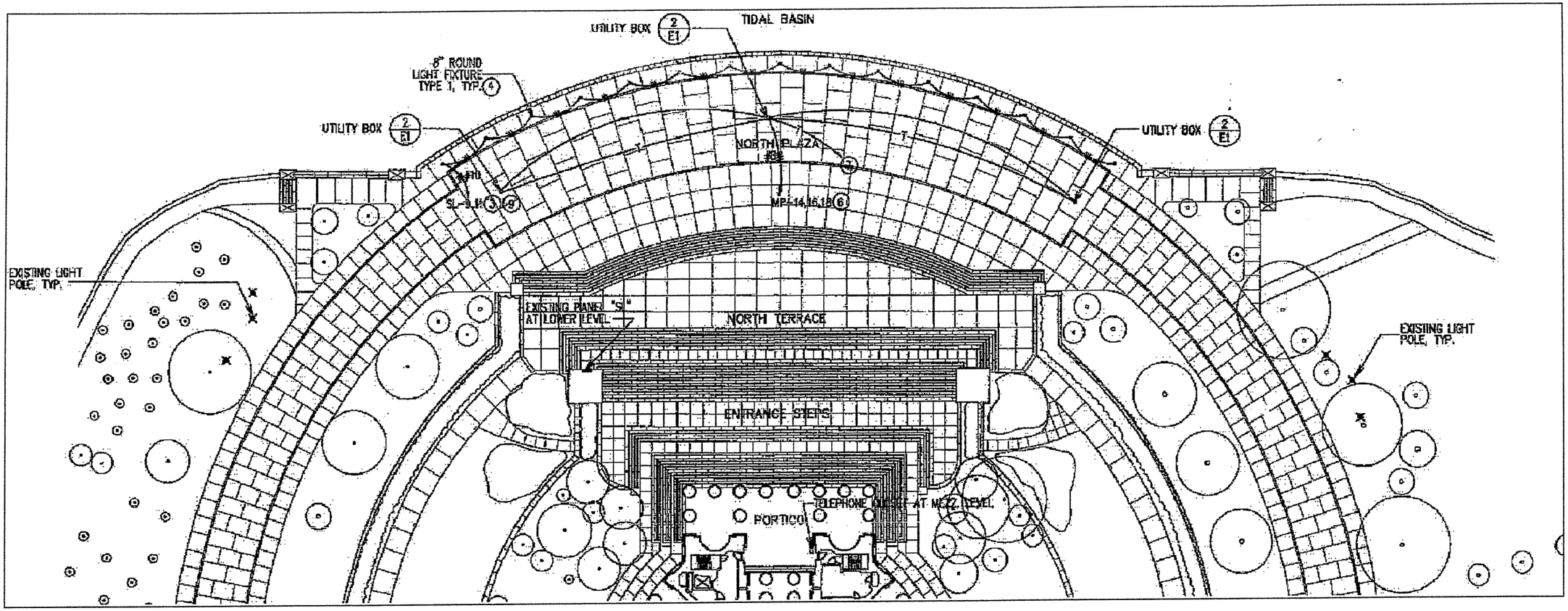
40 0 40 80
SCALE OF FEET

NOTE:
THIS INFORMATION WAS OBTAINED FROM CONSTRUCTION DRAWINGS 808_41011 PROVIDED BY THE NATIONAL PARK SERVICE AND DATED 1/98.

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	5 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR; NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION; BRANCH OF DESIGN AND CONSTRUCTION	DESIGNED DW/CJR/HR; DRAWN NSF/SCB; CHECKED JG; FILE/PKG NO. 128232; DATE 5/1/08; DWG. NO. 808/80284
							REPAIR & CONTROL SETTLEMENT (TITLE OF PROJECT); THOMAS JEFFERSON MEMORIAL (LOCATION WITHIN PARK); NATIONAL MALL & MEMORIAL PARKS (NAME OF PARK)	
			UTILITY PLAN (TITLE OF DRAWING)					



40 0 40 80
SCALE OF FEET

NOTE:
THIS INFORMATION WAS OBTAINED FROM CONSTRUCTION DRAWINGS 808_41011 PROVIDED BY THE NATIONAL PARK SERVICE AND DATED 1/98.

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

LIGHTING PLAN
TITLE OF DRAWING

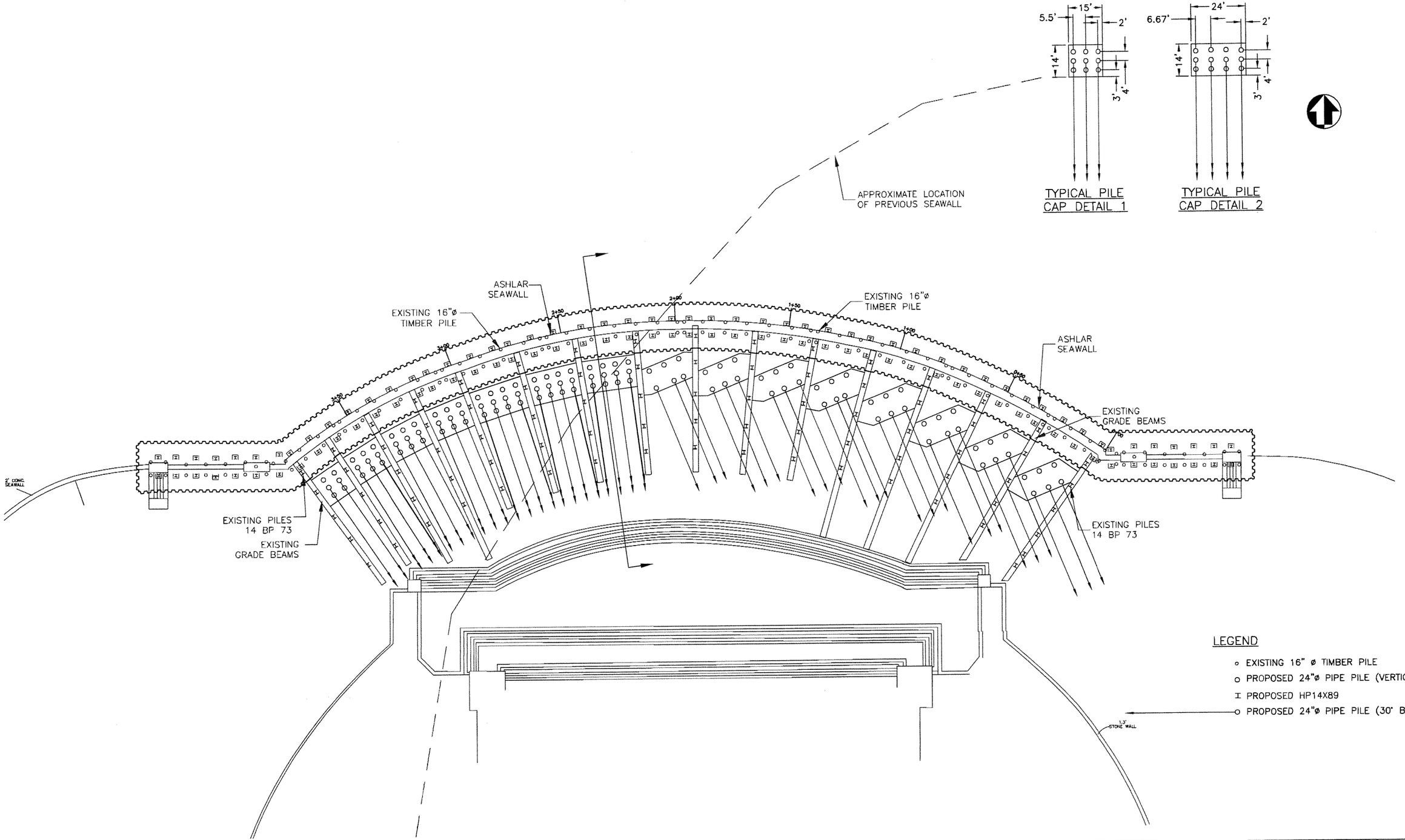
6
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED	DW/CJR/HR
DRAWN	NSF/SCB
CHECKED	JG
PROJECT NO.	128232
DATE	5/1/08
DWG NO.	808/80284

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES



FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

NORTH PLAZA

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD.

20 0 20 40
SCALE OF FEET

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

ALTERNATIVE 2 – PLAN VIEW
TITLE OF DRAWING

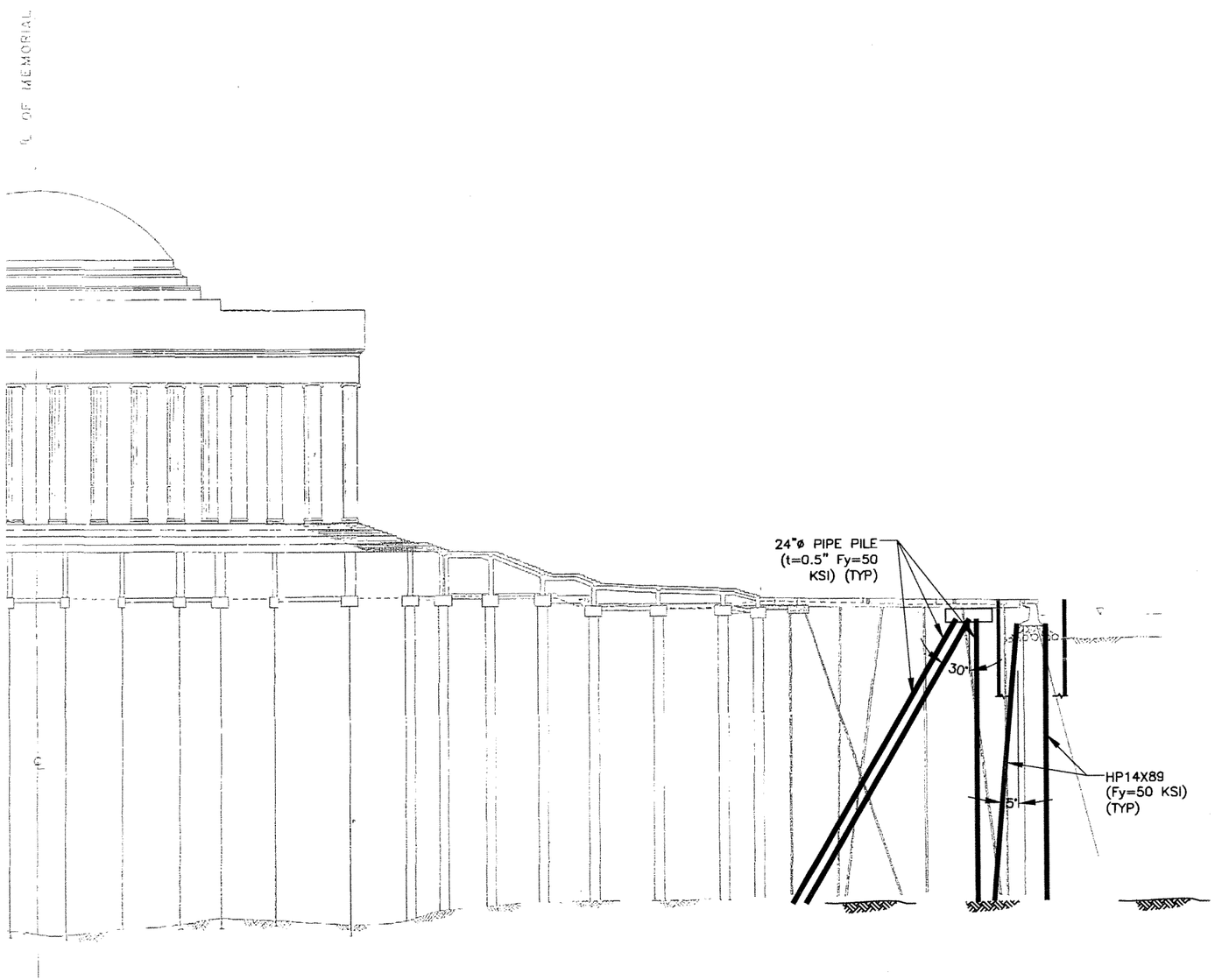
7
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

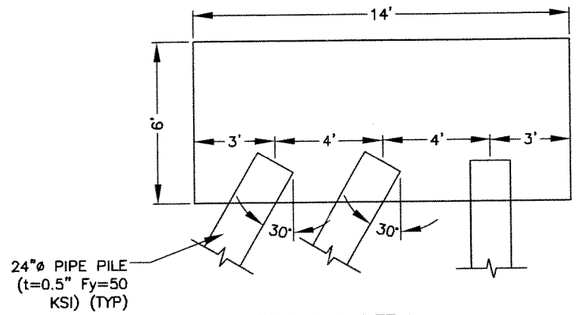
DESIGNED DW/CJR/HR
DRAWN NSF/SCB
CHECKED JG
PROJ./PKG NO. 128232
DATE 5/1/08
DWG. NO. 808/80284

5/2/08 17:43 MFAHEY
XREFS: G:\2006\JOBS\0615 JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN\NORTH PLAZA\TBASE_PLAN.DWG; G:\2006\JOBS\0615 JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\COST ALTERNATIVES\ALT A\S1\JEFF_ALT4.DWG;
G:\JOBS\0615007B.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN FOR DWR\ALT-2_OPTI
78.8 JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\COST ALTERNATIVES\ALT A\S1\JEFF_ALT4.DWG;

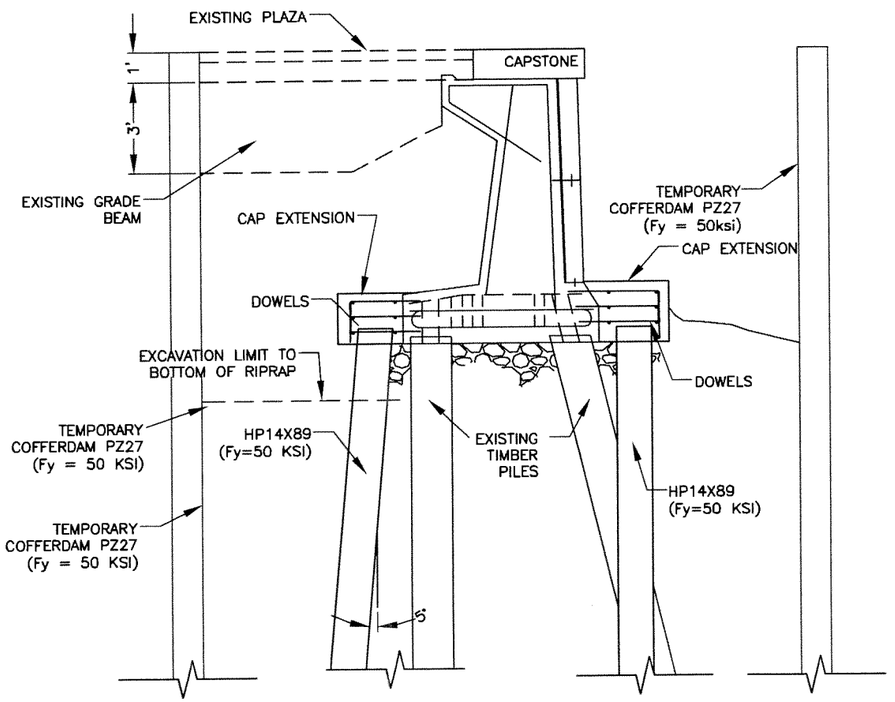


NOTE:
GEOMETRY BASED ON
HISTORICAL DOCUMENTS AND
MUST BE VERIFIED IN FIELD

REMEDIATION OF NORTH PLAZA – ELEVATION
SCALE 1" = 20'-0"



PILE CAP DETAIL
SCALE: NOT TO SCALE



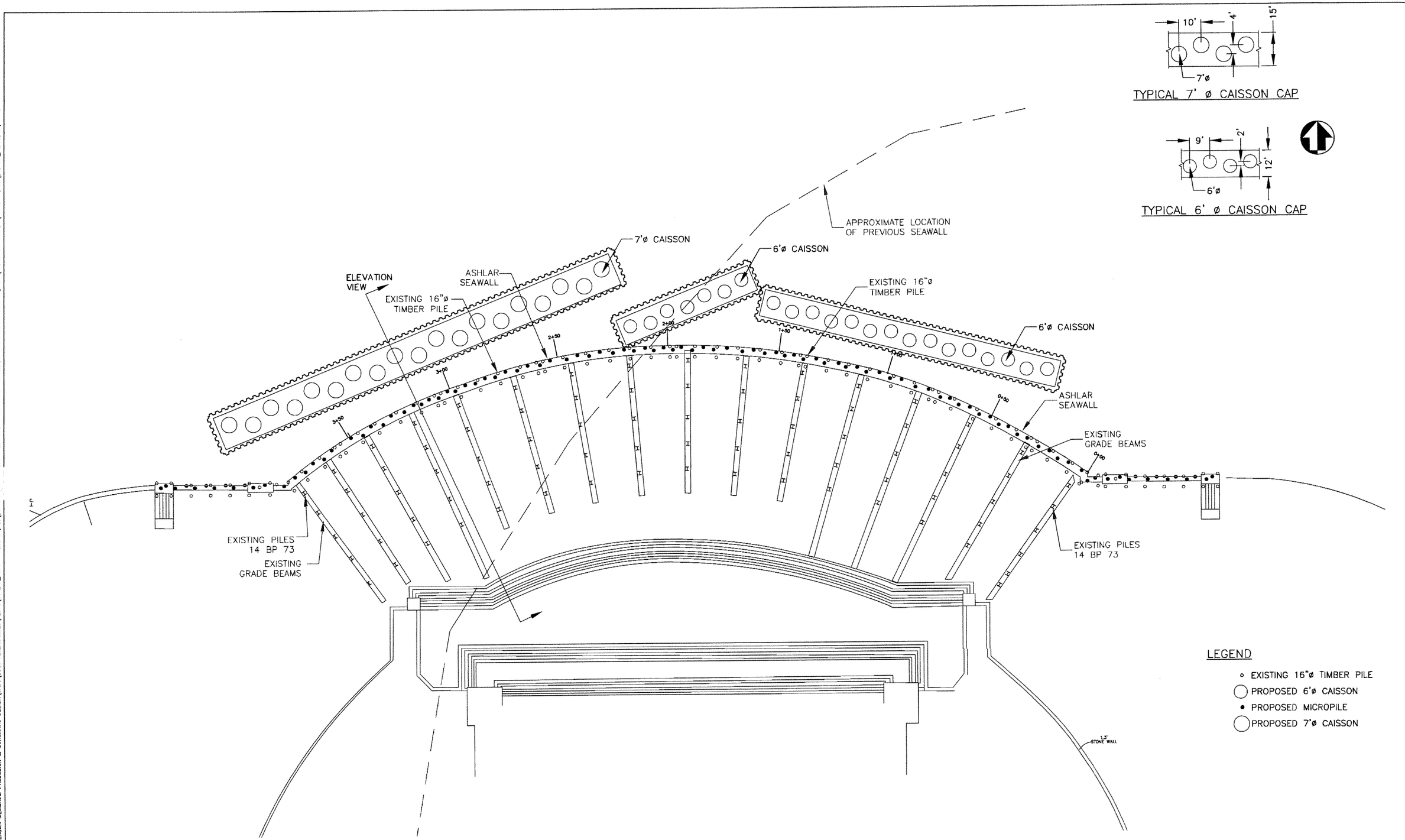
TYPICAL ALTERNATIVE DETAIL
SCALE: NOT TO SCALE

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

20 0 20 40
SCALE OF FEET

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
						DW/CJR/HR DESIGNED; NSF/SCB DRAWN; JG CHECKED
ALTERNATIVE 2 – ELEVATION VIEW TITLE OF DRAWING						REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
8 SUB SHEET NUMBER						PROJECT NO. 128232; DATE 5/1/08; DWG. NO. 808/80284

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES



20 0 20 40
SCALE OF FEET

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD.

NORTH PLAZA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

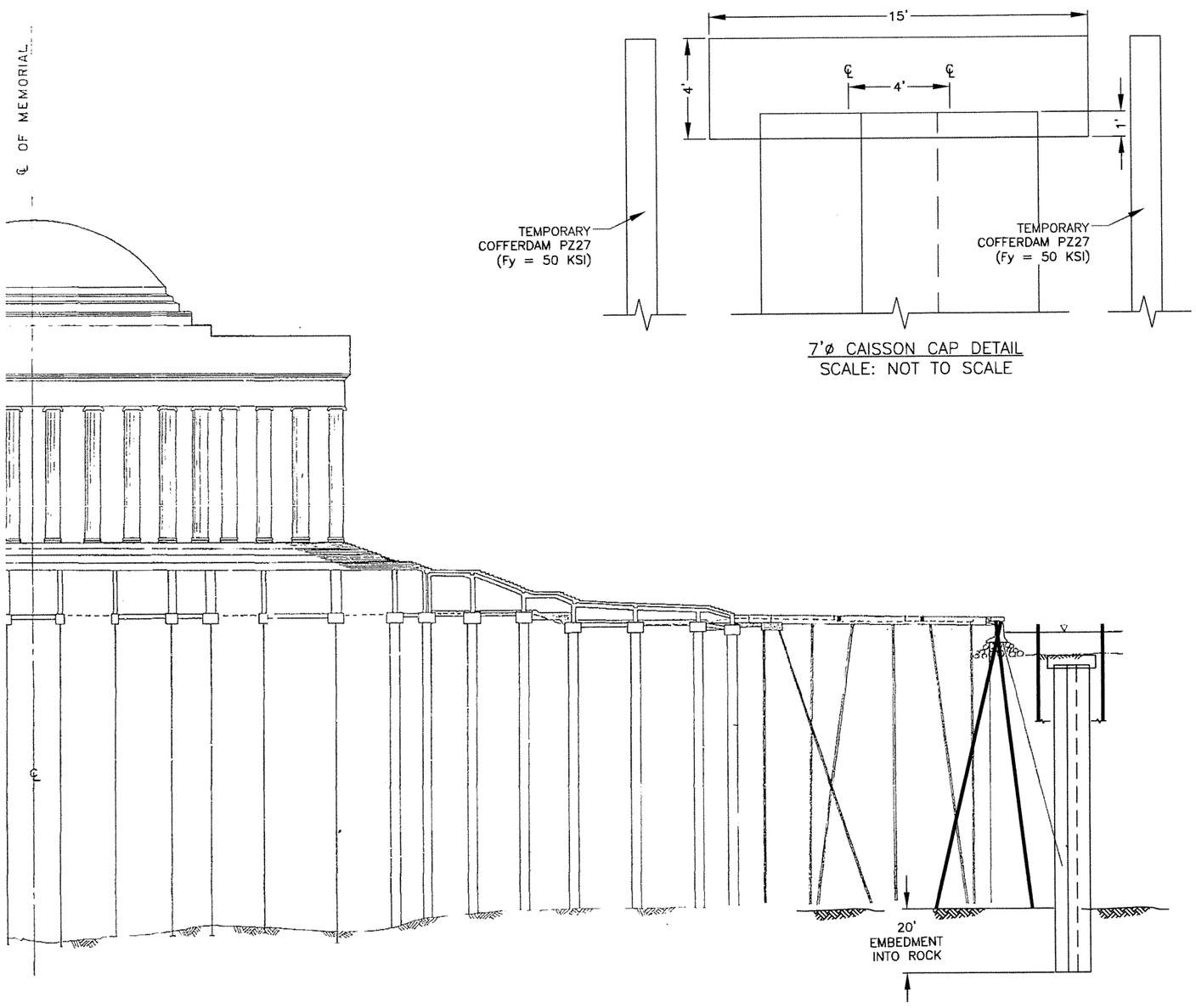
ALTERNATIVE – 6 PLAN VIEW
TITLE OF DRAWING

9
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

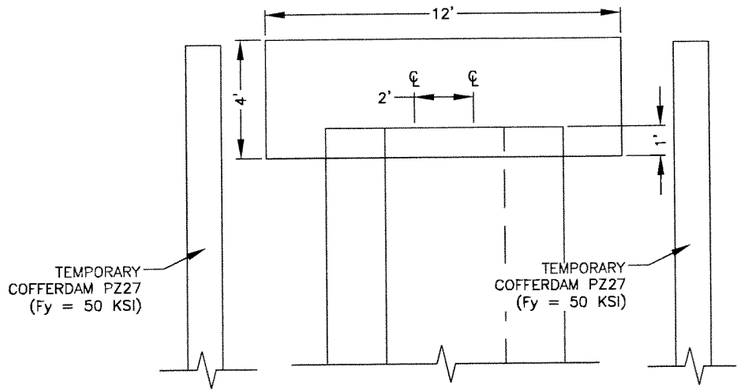
DESIGNED DW/CJR/HR
DRAWN NSF/SCB
CHECKED JG
PREPARED NO. 128232
DATE 5/1/08
DWG. NO. 808/80284



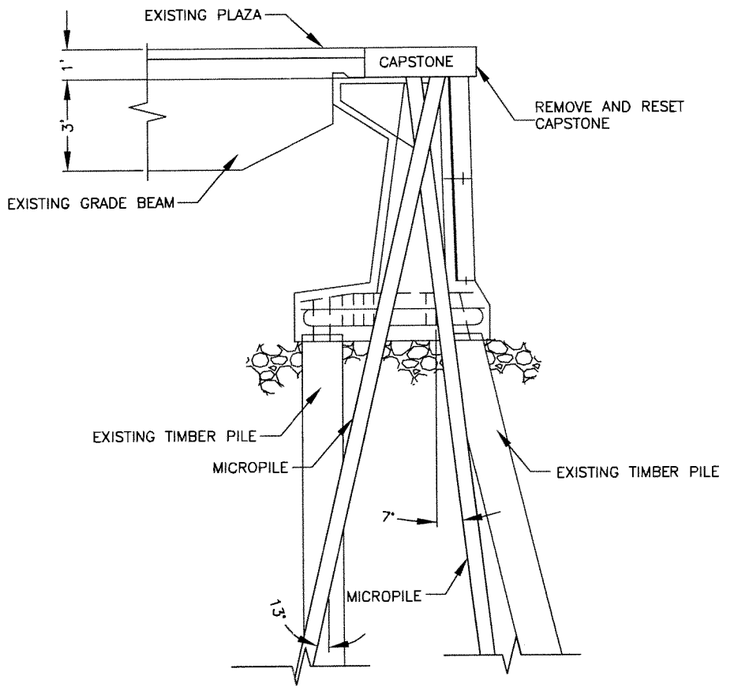
NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD

REMEDIATION OF NORTH PLAZA – ELEVATION
SCALE 1" = 20'–0"

7'ø CAISSON CAP DETAIL
SCALE: NOT TO SCALE



6'ø CAISSON CAP DETAIL
SCALE: NOT TO SCALE



TYPICAL ALTERNATIVE DETAIL
SCALE: NOT TO SCALE

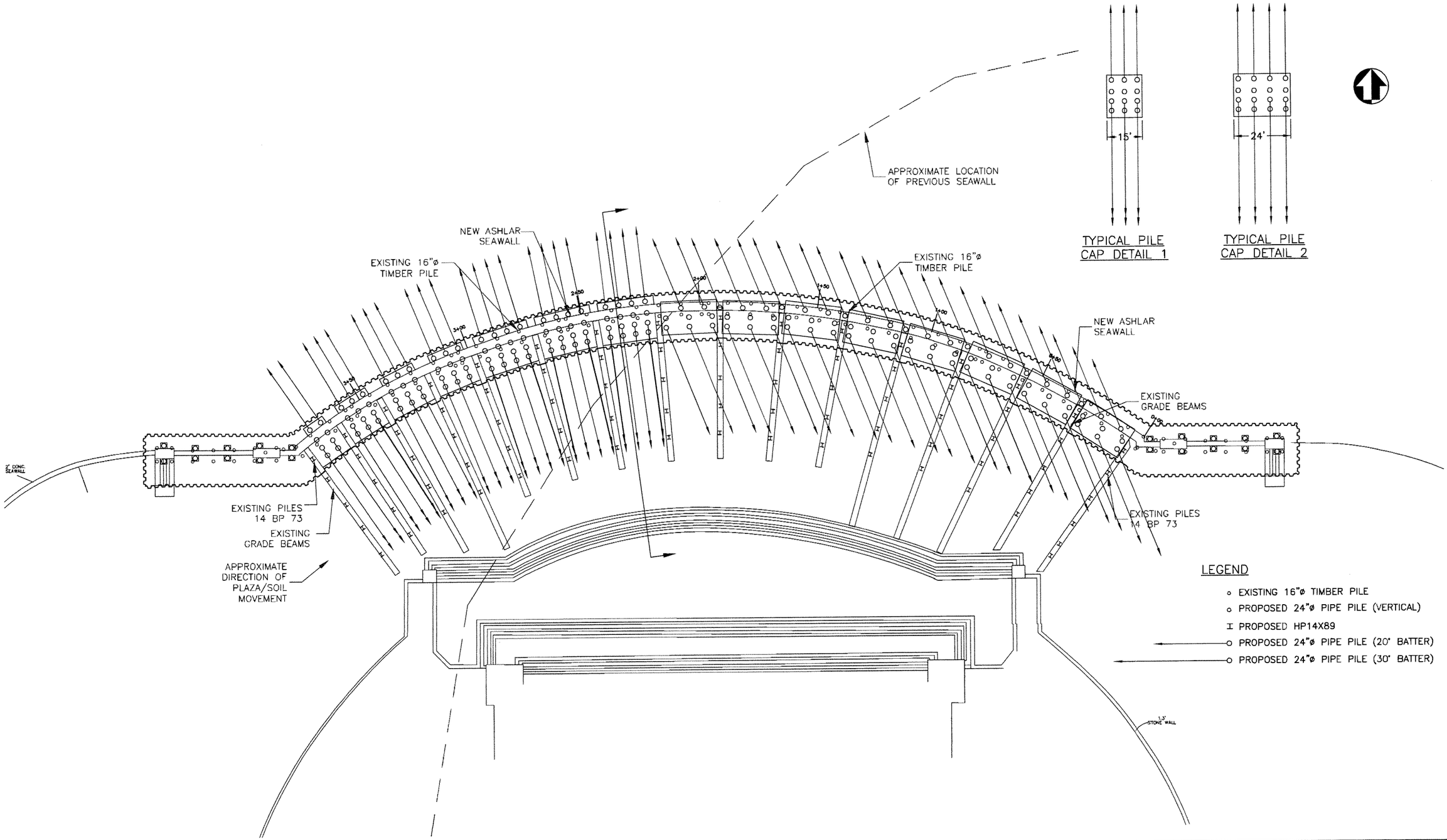
20 0 20 40
SCALE OF FEET

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	10 SUB SHEET NUMBER
							UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
							ALTERNATIVE 6 – ELEVATION VIEW TITLE OF DRAWING

DESIGNED: DW/CJR/HR
DRAWN: NSF/SCB
CHECKED: JG
PMIS/PRS NO.: 128232
DATE: 5/1/08
DWG. NO.: 808/80284

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES



NORTH PLAZA

20 0 20 40
SCALE OF FEET

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

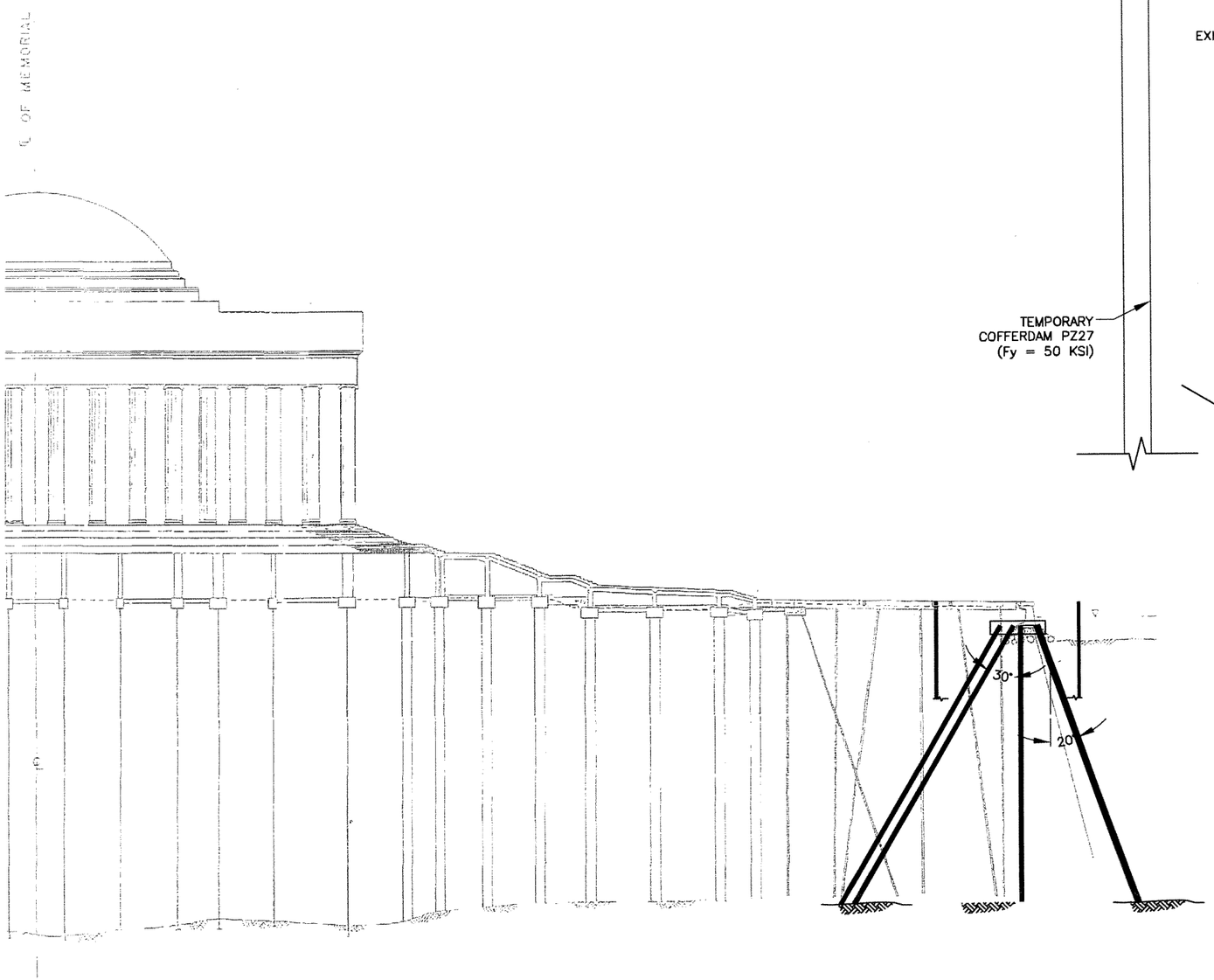
ALTERNATIVE 3 – PLAN VIEW
TITLE OF DRAWING

11
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

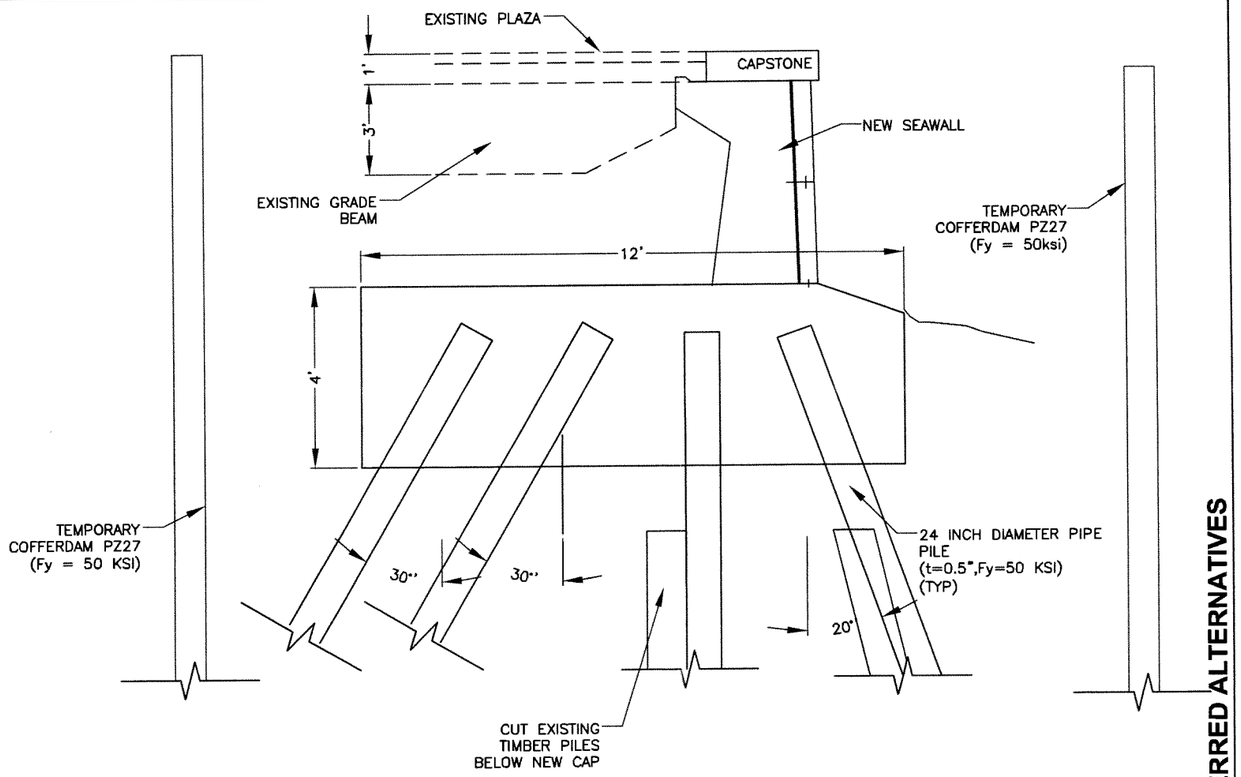
REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED	DW/CJR/HR
DRAWN	NSF/SCB
CHECKED	JG
PROJ./FMS NO.	128232
DATE	5/1/08
DRAWING NO.	808/80284



NOTE:
GEOMETRY BASED ON
HISTORICAL DOCUMENTS AND
MUST BE VERIFIED IN FIELD

REMEDIATION OF NORTH PLAZA – ELEVATION
SCALE 1" = 20'-0"

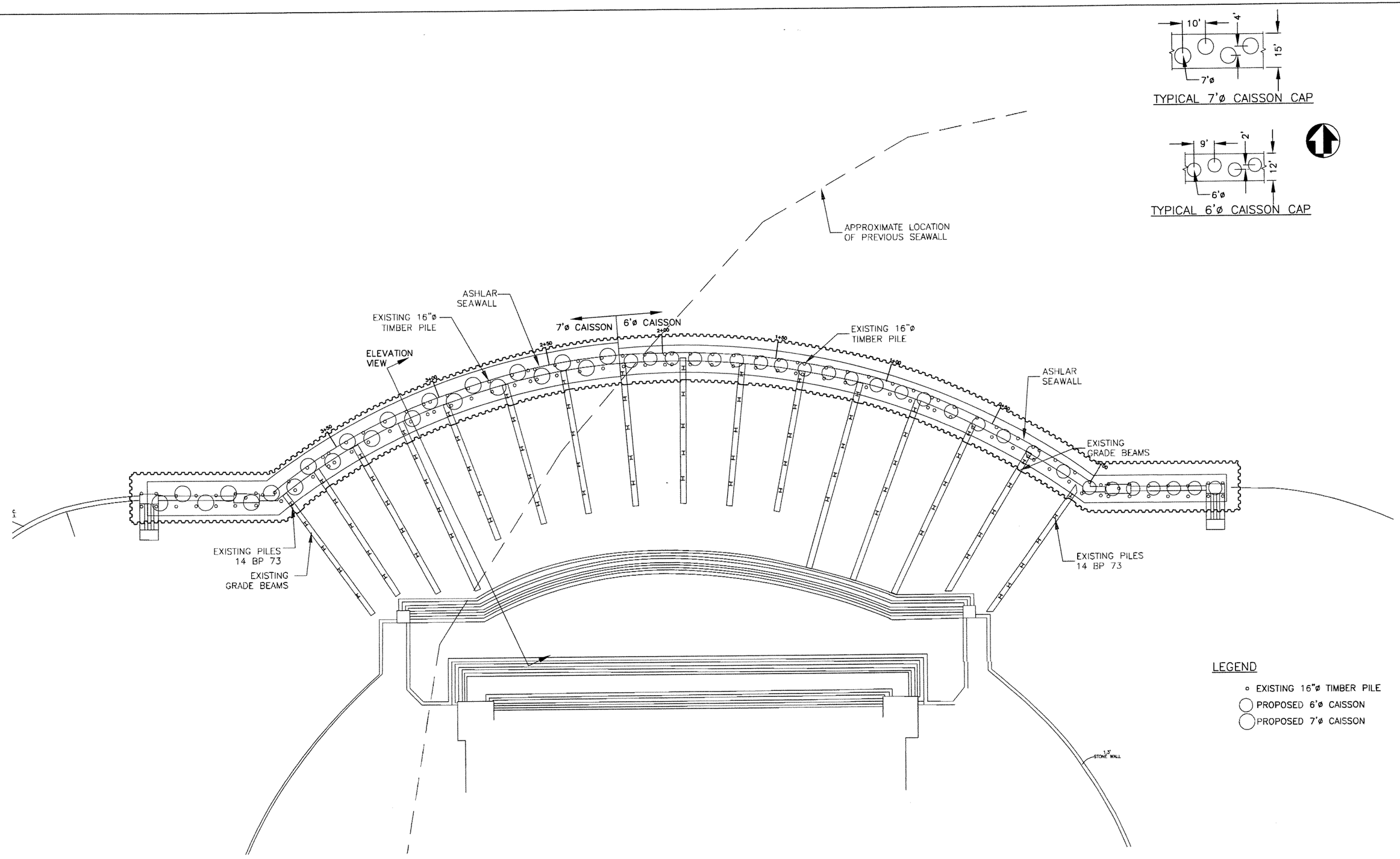


TYPICAL ALTERNATIVE DETAIL
SCALE: NOT TO SCALE

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

20 0 20 40
SCALE OF FEET

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	12 (SUB SHEET NUMBER)	UNITED STATES DEPARTMENT OF THE INTERIOR; NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION; BRANCH OF DESIGN AND CONSTRUCTION	DESIGNED DW/CJR/HR; DRAWN NSF/SCB; CHECKED JG
							REPAIR & CONTROL SETTLEMENT (TITLE OF PROJECT); THOMAS JEFFERSON MEMORIAL (LOCATION WITHIN PARK); NATIONAL MALL & MEMORIAL PARKS (NAME OF PARK)	PWIS/PMIS NO. 128232; DATE 5/1/08; DWG. NO. 808/80284
							ALTERNATIVE 3 – ELEVATION VIEW (TITLE OF DRAWING)	



FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

NORTH PLAZA

20 0 20 40
SCALE OF FEET

NOTE:
GEOMETRY BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN FIELD.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

ALTERNATIVE 7 – PLAN VIEW
TITLE OF DRAWING

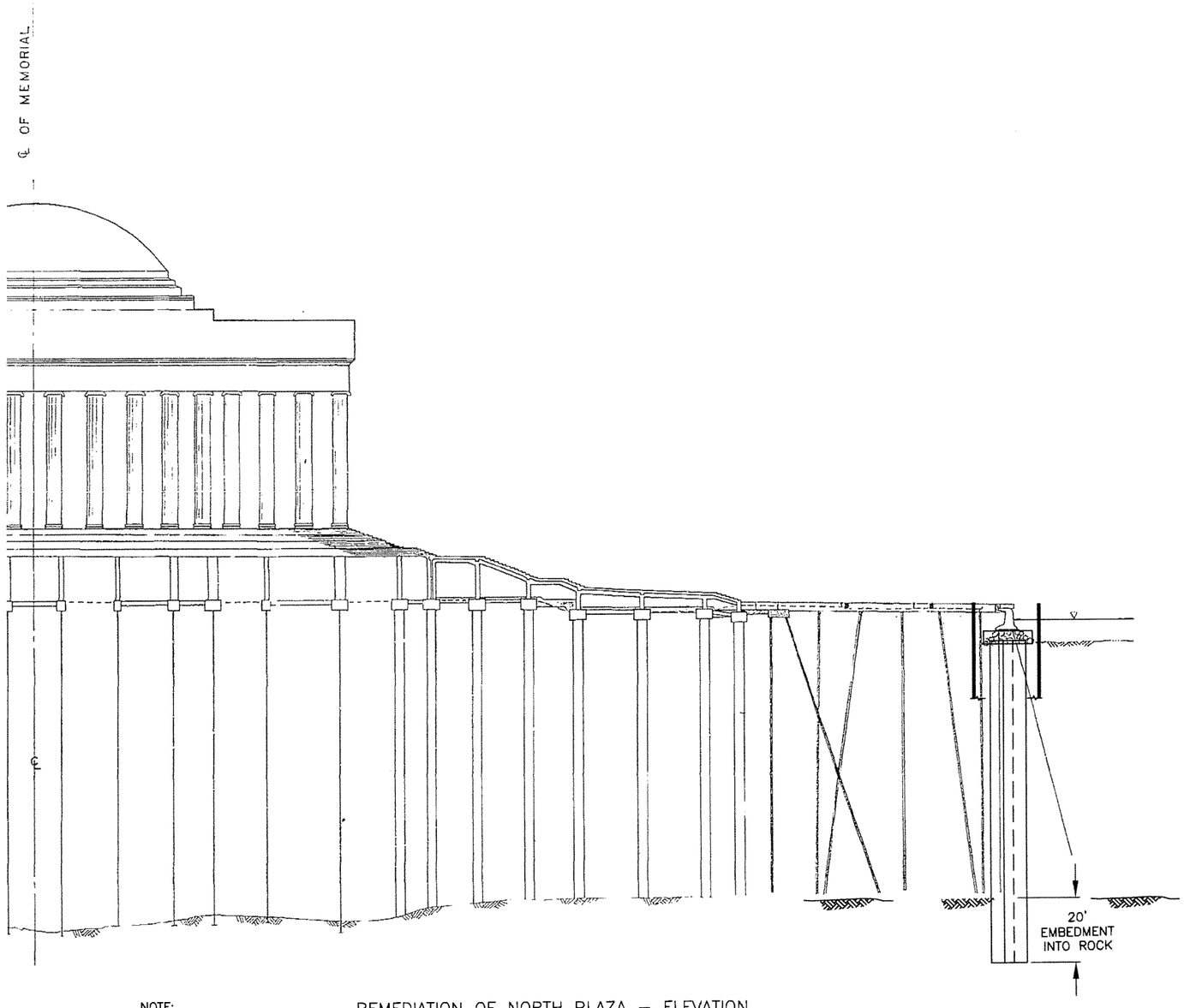
13
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

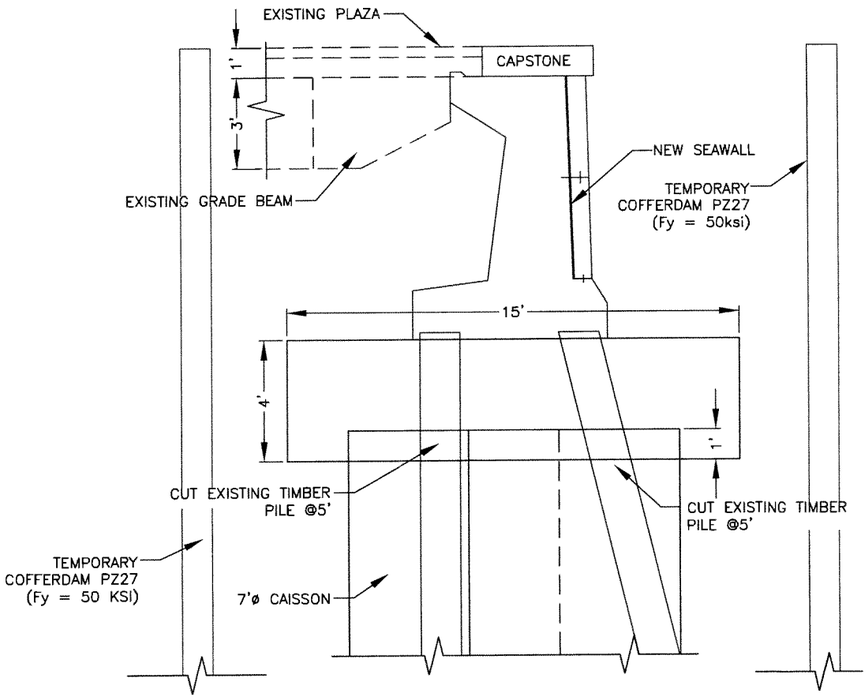
DESIGNED DW/CJR/HR
DRAWN NSF/SCB
CHECKED JG
PROJ/PKG NO. 128232
DATE 5/1/08
DWG NO. 808/80284

5/1/08 11:24 SBUCUREL
XREFS: G:\2006JOBS\0615...
2006JOBS\06150078.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN FOR DWG\ALT-7_O
JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN\NORTH PLAZA\2 BASE_PLAN.DWG;
AISSON.DWG



NOTE:
GEOMETRY BASED ON
HISTORICAL DOCUMENTS AND
MUST BE VERIFIED IN FIELD

REMEDIATION OF NORTH PLAZA – ELEVATION
SCALE 1" = 20'–0"



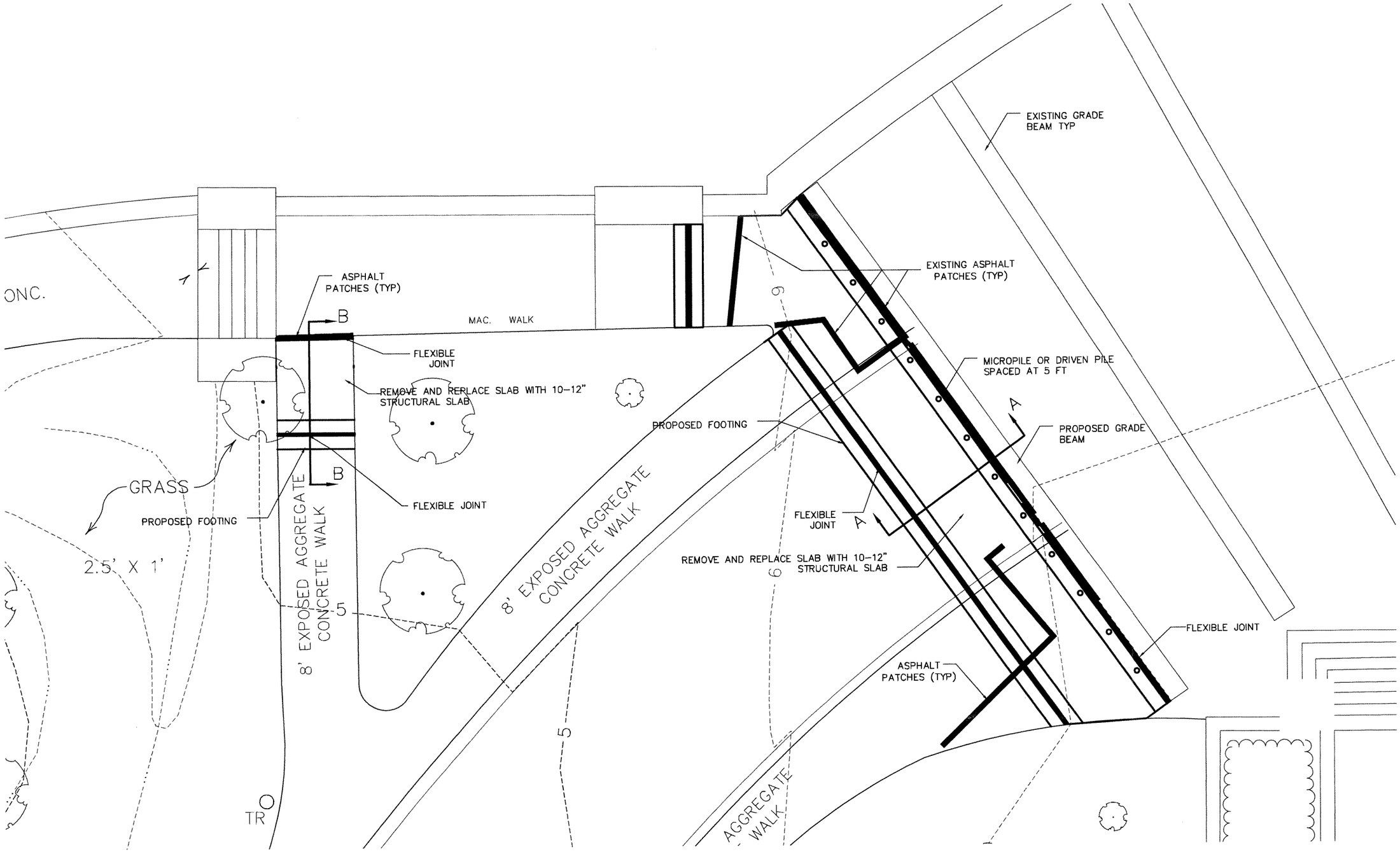
TYPICAL ALTERNATIVE DETAIL
SCALE: NOT TO SCALE

20 0 20 40
SCALE OF FEET

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							REPAIR & CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
				ALTERNATIVE 7 – ELEVATION VIEW TITLE OF DRAWING			14 SUB SHEET NUMBER

DESIGNER DW/CJR/HR
DRAWN NSF/SCB
CHECKED JG
PMIS/PRS NO. 128232
DATE 5/1/08
DWG. NO. 808/80284



FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

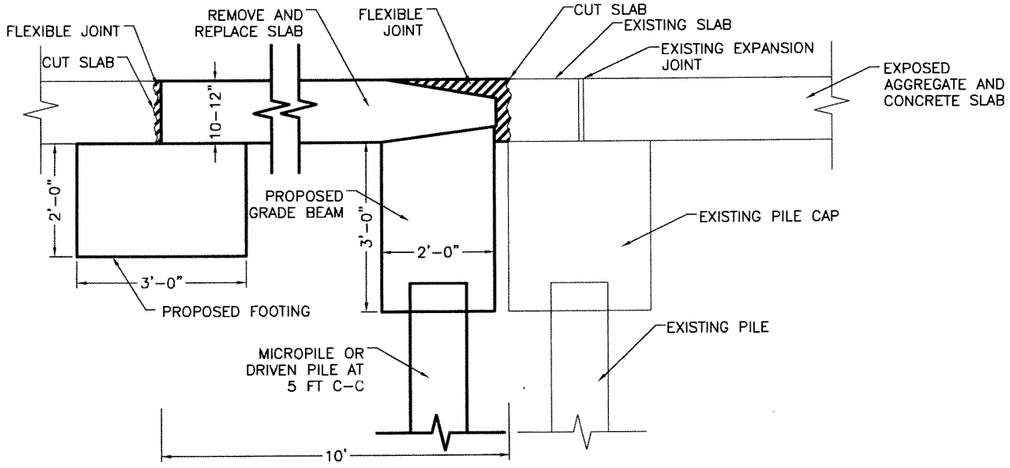
	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	15 SUB SHEET NUMBER
							NORTH PLAZA & NORTHWEST STAIRS TITLE OF DRAWING

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

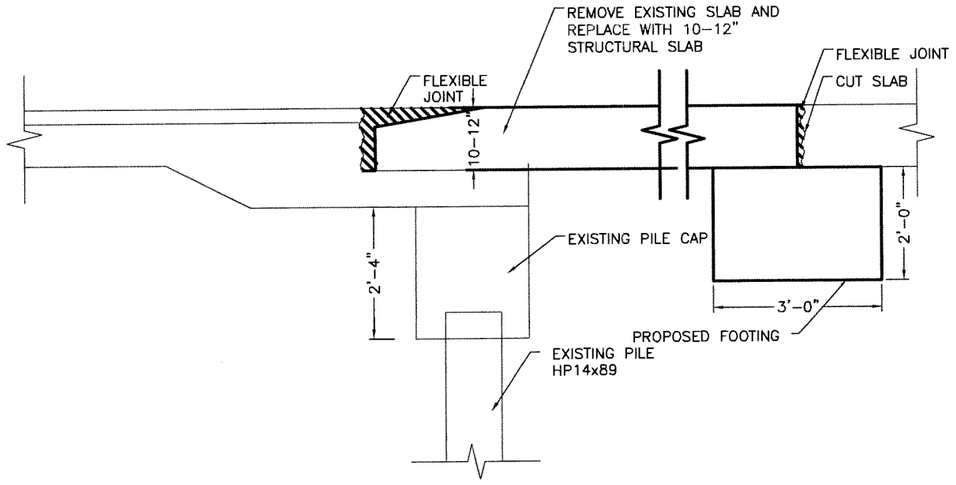
REPAIR & CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DW/CJR/HR
DESIGNED
NSF/SCB
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
5/1/08
DWG. NO.
808/80284

4/17/08 11:09 SBUCURE
X:\2006JOBS\06150078.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\SCHEMATIC DESIGN FOR DAB\STWALK



SECTION A–A
ASPHALT PATCH REPAIRS – NORTH PLAZA
3/4" = 1'–0"



SECTION B–B
ASPHALT PATCH REPAIRS – NORTHWEST STAIRS
3/4" = 1'–0"

1 0 1 2 3
SCALE OF FEET

FULLY DEVELOPED SCHEMATIC DESIGN PREFERRED ALTERNATIVES

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	16 (SUB SHEET NUMBER)	UNITED STATES DEPARTMENT OF THE INTERIOR; NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION; BRANCH OF DESIGN AND CONSTRUCTION	DESIGNED DW/CJR/HR; DRAWN NSF/SCB; CHECKED JG
							REPAIR & CONTROL SETTLEMENT (TITLE OF PROJECT); THOMAS JEFFERSON MEMORIAL (LOCATION WITHIN PARK); NATIONAL MALL & MEMORIAL PARKS (NAME OF PARK)	PMIS/PKG NO. 128232; DATE 5/1/08; DWG. NO. 808/80284
							NORTH PLAZA REPAIRS (TITLE OF DRAWING)	

APPENDIX B

Class B Cost Estimates

Class B Construction Cost Estimate

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Basis of Estimate

DRAFT

Date of Estimate: 05/05/08

Estimated By: Kirk Associates
1177 Berkshire, Suite 100
Grosse Pointe Park, MI
(248) 240-9605

Supporting Material: Pre-Design Documents / Reports, 01/08
Revised Information from Engineers, 04/08

Cost Data: Square Foot Cost Data.
Unit Prices based on 2008 Cost data
Conversations with Consulting Engineers
Conversations with Installation Contractors

Mark-ups and Add-ons: **Published Location Factor:** NPS DSC for Washington, D.C. -0.9 %
Project Remoteness: Site is in downtown Washington D.C. (dense urban)
Federal Wage Rate Factor: 8 Percent Guidance from NPS.
Design Contingency: Limited Detail on Design Report, however this is a small project. 15 percent seems appropriate.
Taxes: 5.75 Percent Sales Tax (State and Local)
Standard General Conditions: Above Normal Range of 18 Percent due to special equipment needs.
Government General Conditions: 10 Percent within NPS Guidance Recommendations.
Bonds and Permits: 1.5 percent bond included in General Conditions. No permit costs.
Historic Preservation Factor: Memorial cost include 5% Historic Factor.
Overhead: Small Job, Limited sub-contractors due to work in region.
Profit: 10 Percent
Contracting Method Adjustment: The contract will be full open bid with a 5% premium.
Inflation Escalation: Assume midpoint of construction to begin July, 2009 with 18 month construction period. Inflation predictions indicate 6% per year.
Bond: 1.5% on the Entire Project

Comments: Work assumed to be completed by land based equipment
Park operations will be open in this area during the repair work
Removed materials will be kept on site before re-installation

Alternative 2: This alternative is comprised of driving HP piles to support the Ashlar Seawall, and using driven pipe piles to address the lateral movement of the North Plaza.

Seawall: This alternative would consist of 53 HP14X89 vertical HP piles in front of the wall, and 53 HP piles battered at 5° behind the wall. Following pile installation, pile cap extensions would be constructed, the wall would be backfilled, and the plaza slab replaced. This alternative will require removal of the riprap and backfilling after installation of piles.

Plaza: This alternative would consist of approximately seventy (70) 24-in-O.D. pipe piles battered at 30° toward the Main Stairs and forty-seven (47) 24-in-O.D. pipe piles installed vertically. The vertical piles would have a length of approximately 90 feet and the battered piles would have a length of approxirnately 105 feet. The top of bedrock is located approximately at EL -87. At least two load tests on a sacrificial, instrumented pipe pile should be performed. Portions of the North Plaza structural slab will be removed and demolished as necessary. The pipe piles will be driven to bedrock, and the pile caps will be formed and poured.

Transition Area: The remediation method consists of cutting at the edge of the structural slab, removing 10 feet of the Circular Roadway in the east and west directions, and replacing with a 10-foot wide structural transition slab. Micropiles would be installed at five feet on center adjacent to the western-most and eastern-most grade beams on the North Plaza, and would be capped with a grade beam. This beam would support the North Plaza edge of a new structural slab. A new footing would support the Circular Roadway edge of the slab, and at either end a flexible joint would be used to allow the slab to undergo anticipated settlements without causing tripping hazards.

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Alternative 2: **DRAFT**

Estimate is Based on 2008 Costs

Bid Item	Material Costs	Installation Costs	**Total Costs**	**Total NET**
A10 Foundations	$0	$0	**$0**	$0
A20 Basement Construction	$0	$0	**$0**	$0
B10 Superstructure	$0	$0	**$0**	$0
B20 Exterior Enclosure	$0	$0	**$0**	$0
B30 Roofing	$0	$0	**$0**	$0
C10 Interior Construction	$0	$0	**$0**	$0
C20 Stairs	$0	$0	**$0**	$0
C30 Interior Finishes	$0	$0	**$0**	$0
D10 Conveying	$0	$0	**$0**	$0
D20 Plumbing	$0	$0	**$0**	$0
D30 HVAC	$0	$0	**$0**	$0
D40 Fire Protection	$0	$0	**$0**	$0
D50 Electrical	$0	$0	**$0**	$0
E10 Equipment	$0	$0	**$0**	$0
E20 Furnishings	$0	$0	**$0**	$0
F10 Special Construction	$0	$0	**$0**	$0
F20 Selective Building Demolition	$0	$0	**$0**	$0
G10 Site Preparation	$682,777	$1,731,836	**$2,414,613**	$5,964,730
G20 Site Improvements	$2,882,395	$2,277,069	**$5,159,464**	$12,745,235
G30 Site Mechanical Utilities	$0	$0	**$0**	$0
G40 Site Electrical Utilities	$0	$0	**$0**	$0
G90 Other Site Construction	$0	$0	**$0**	$0
Subtotal Direct Construction Cost	$3,565,172	$4,008,905	**$7,574,077**	**$18,709,965**
Published Location Factor	-0.9%		($68,167)	
Remoteness Factor (urban)	0.0%		$0	
Federal Wage Rate Factor	8.0%		$320,712	
State and Local Taxes (material)	5.75%		$204,997	
Design Contingency	15.0%		$1,136,112	
Total Direct Construction Costs			**$9,167,732**	
Standard General Conditions	25.0%		$2,291,933	
Government General Conditions	10.0%		$916,773	
Historic Preservation Factor	5.0%		$458,387	
Subtotal NET Construction Cost			**$12,834,824**	
Overhead	12.5%		$1,604,353	
Profit	10.0%		$1,283,482	
Estimated NET Construction Cost			**$15,722,660**	
Contracting Method Adjustment (Full Open)	5.0%		$786,133	
Inflation Escalation (6.0% / Yr; 25 Months)	12.5%		$1,965,332	
Bond	1.5%		$235,840	
TOTAL Estimated NET Cost of Construction			**$18,709,965**	

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 2: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1010 Site Clearing									
Plaza	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
Transition	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
	Totals G1010 Site Clearing	**20,800**	**SF**		**$0**		**$5,000**	$0.24	**$5,000**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1020 Site Demolition & Relocations									
Both	Complete pre-condition survey	1	LS	$0.00	$0	$10,000.00	$10,000	$10,000.00	$10,000
Plaza	Install vibration monitoring equipment	1	LS	$0.00	$0	$3,500.00	$3,500	$3,500.00	$3,500
Plaza	Remove North Plaza Structural Slab	6,864	SF	$0.48	$3,295	$6.88	$47,224	$7.36	$50,519
Plaza	Remove North Plaza topping Slab	20,800	SF	$0.48	$9,984	$1.18	$24,544	$1.66	$34,528
Plaza	Remove North Plaza Granite Feature	2,091	SF	$0.22	$460	$4.65	$9,723	$4.87	$10,183
Plaza	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Seawall	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Transition	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Seawall	Remove capstone (store on site)	500	LF	$0.00	$0	$152.00	$76,000	$152.00	$76,000
Both	Complete post-construction survey	1	LS	$0.00	$0	$15,000.00	$15,000	$15,000.00	$15,000
Transition	Remove Transition Area slab	1,300	SF	$0.48	$624	$10.22	$13,286	$10.70	$13,910
Transition	Remove granite features (store on site)	256	LF	$0.22	$56	$4.65	$1,190	$4.87	$1,247
Transition	Remove Block granite (store on site)	4	Ea	$0.00	$0	$12,500.00	$50,000	$12,500.00	$50,000
Transition	Remove granite stairs (store on site)	120	LF	$0.65	$78	$16.14	$1,937	$16.79	$2,015
	Totals G1020 Site Demolition & Relocations	**20,800**	**SF**		**$14,497**		**$274,905**	$13.91	**$289,402**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 2:

Estimate By:
Date:

DRAFT

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost
G1030 Site Earthwork							
Plaza	Excavate under slab for grade beam placement	636	CY	$0.00	$0	$15.08	$9,584
Seawall	Excavate to rip rap	2,222	CY	$0.00	$0	$21.16	$47,022
Seawall	Excavate rip rap	926	CY	$0.00	$0	$26.12	$24,185
Seawall	Install 10' exposed; 40' total temporary cofferdam-water side installation (sheet pile)	48,600	Wall SF	$12.22	$593,892	$24.16	$1,174,176
Seawall	Install engineered fill	2,858	CY	$15.50	$44,296	$22.16	$63,328
Seawall	Install rip rap	926	CY	$32.50	$30,093	$26.18	$24,241
Transition	Excavate under slab for grade beam placement	169	CY	$0.00	$0	$26.12	$4,402
	Totals G1030 Site Earthwork	**20,800**	**SF**		**$668,280**		**$1,346,938**

				Material		Installation	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost
G1040 Hazardous Waste Remediation							
Plaza	Haul away spoils (less than 20 miles)	3,013	CY	$0.00	$0	$25.56	$77,019
Seawall	Haul away rip rap (less than 20 miles)	926	CY	$0.00	$0	$25.56	$23,667
Transition	Haul away spoils (less than 20 miles)	169	CY	$0.00	$0	$25.56	$4,307
	Totals G1040 Hazardous Waste Remediation	**20,800**	**SF**		**$0**		**$104,993**
G10	**Site Preparation**				**$682,777**		**$1,731,836**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 2:

DRAFT

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2030 Pedestrian Paving									
Plaza	Install North Plaza structural slab	6,864	SF	$21.50	$147,576	$16.25	$111,540	$37.75	$259,116
Plaza	Install 3" exposed aggregrate topping slab	20,800	SF	$8.33	$173,264	$6.28	$130,624	$14.61	$303,888
Plaza	Re-install North Plaza Granite Features	2,091	SF	$0.25	$523	$8.25	$17,251	$8.50	$17,774
Seawall	Re-install capstone	500	LF	$65.00	$32,500	$235.00	$117,500	$300.00	$150,000
Seawall	Repair capstone	50	LF	$122.50	$6,125	$168.00	$8,400	$290.50	$14,525
Seawall	Install new engineered fill	926	CY	$12.00	$11,111	$22.18	$20,537	$34.18	$31,648
Transition	Re-install granite features	256	LF	$0.25	$64	$8.25	$2,112	$8.50	$2,176
Transition	Re-install granite blocks	4	EA	$5.00	$20	$12,500.00	$50,000	$12,505.00	$50,020
Transition	Re-install stairs	120	LF	$5.00	$600	$16.25	$1,950	$21.25	$2,550
Transition	Install new engineered fill	169	CY	$12.00	$2,022	$22.18	$3,738	$34.18	$5,760
Transition	Install structural slab	1,300	SF	$21.50	$27,950	$16.25	$21,125	$37.75	$49,075
Transition	Install 3" exposed aggregrate topping slab	1,300	SF	$8.33	$10,829	$6.28	$8,164	$14.61	$18,993
	Totals G2030 Pedestrian Paving	**20,800**	**SF**		**$412,584**		**$492,941**	$43.53	**$905,525**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 2: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2040 Site Development									
Plaza	Install pile cap forms (stay in place)	15	Section	$1,080.00	$16,200	$720.00	$10,800	$1,800.00	$27,000
Plaza	Install temporary bracing (wood)	15	Section	$420.00	$6,300	$280.00	$4,200	$700.00	$10,500
vertical	Install 2 sacrificial 24" dia pipe pile (90')	90	Vert LF	$95.62	$8,606	$64.18	$5,776	$159.80	$14,382
diagonal	Install 70 battered 24" dia pipe pile (105')	7,350	Vert LF	$95.62	$702,807	$64.18	$471,723	$159.80	$1,174,530
vertical	Install 47 battered 24" dia pipe pile (90')	4,230	Vert LF	$95.62	$404,473	$64.18	$271,481	$159.80	$675,954
Plaza	Install reinforced pile cap	907	CY	$228.00	$206,889	$212.00	$192,370	$440.00	$399,259
Seawall	Install temporary grade beam support (wd)	1	LS	$0.00	$0	$15,000.00	$15,000	$15,000.00	$15,000
vertical	Install 1 sacrificial HP pile (90')	90	Vert LF	$90.78	$8,170	$64.18	$5,776	$154.96	$13,946
vertical	Install 53 HP pile (90')	4,770	Vert LF	$90.78	$433,021	$64.18	$306,139	$154.96	$739,159
diagonal	Install 53 battered HP pile (90')	4,770	Vert LF	$90.78	$433,021	$64.18	$306,139	$154.96	$739,159
Seawall	Install concrete cap extensions	47	CY	$228.00	$10,741	$258.00	$12,155	$486.00	$22,896
Seawall	Install safety lighting (at edge, match system)	25	Ea	$375.00	$9,375	$294.00	$7,350	$669.00	$16,725
Soil	Core micropile	90	Vert LF	$0.00	$0	$12.08	$1,087	$12.08	$1,087
Transition	Install sacrificial mircopile	36	CY	$233.12	$8,472	$136.00	$4,943	$369.12	$13,415
Transition	Install concrete grade beams	29	CY	$228.00	$6,587	$212.00	$6,124	$440.00	$12,711
Transition	Install concrete footing	22	CY	$228.00	$5,067	$212.00	$4,711	$440.00	$9,778
Transition	Install flexible joint	266	LF	$10.58	$2,814	$16.00	$4,256	$26.58	$7,070
Transition	Core 24 micropile	2,448	Vert LF	$0.00	$0	$12.08	$29,572	$12.08	$29,572
Transition	Install 24 battered mircopiles	872	CY	$233.12	$203,332	$136.00	$118,622	$369.12	$321,955
	Totals G2040 Site Development	**20,800**	**SF**		**$2,465,874**		**$1,778,224**	$204.04	**$4,244,099**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2050 Landscaping									
Plaza	Replace damaged landscaped area-soil	98	CY	$32.00	$3,129	$10.50	$1,027	$42.50	$4,156
Plaza	Replace damaged landscaped area-seed	2,400	SF	$0.01	$24	$1.25	$3,000	$1.26	$3,024
Transition	Replace damaged landscaped area-soil	24	CY	$32.00	$770	$10.50	$253	$42.50	$1,023
Transition	Replace damaged landscaped area-seed	1,300	SF	$0.01	$13	$1.25	$1,625	$1.26	$1,638
	Totals G2050 Landscaping	**20,800**	**SF**		**$3,936**		**$5,904**	$0.47	**$9,841**
G20	**Site Improvements**				**$2,882,395**		**$2,277,069**		**$5,159,464**

TOTAL ESTIMATED DIRECT PROJECT CONSTRUCTION COST **$7,574,077**

Class B Construction Cost Estimate

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Basis of Estimate

DRAFT

Date of Estimate: 05/05/08

Estimated By: Kirk Associates
1177 Berkshire, Suite 100
Grosse Pointe Park, MI
(248) 240-9605

Supporting Material: Pre-Design Documents / Reports, 01/08
Revised Information from Engineers, 04/08

Cost Data: Square Foot Cost Data.
Unit Prices based on 2008 Cost data
Conversations with Consulting Engineers
Conversations with Installation Contractors

Mark-ups and Add-ons: **Published Location Factor:** NPS DSC for Washington, D.C. -0.9 %
Project Remoteness: Site is in downtown Washington D.C. (dense urban)
Federal Wage Rate Factor: 8 Percent Guidance from NPS.
Design Contingency: Limited Detail on Design Report, however this is a small project. 15 percent seems appropriate.
Taxes: 5.75 Percent Sales Tax (State and Local)
Standard General Conditions: Above Normal Range of 18 Percent due to special equipment needs.
Government General Conditions: 10 Percent within NPS Guidance Recommendations.
Bonds and Permits: 1.5 percent bond included in General Conditions. No permit costs.
Historic Preservation Factor: Memorial cost include 5% Historic Factor.
Overhead: Small Job, Limited sub-contractors due to work in region.
Profit: 10 Percent
Contracting Method Adjustment: The contract will be full open bid with a 5% premium.
Inflation Escalation: Assume midpoint of construction to begin July, 2009 with 18 month construction period. Inflation predictions indicate 6% per year.
Bond: 1.5% on the Entire Project

Comments: Work assumed to be completed by land based equipment
Park operations will be open in this area during the repair work
Removed materials will be kept on site before re-installation

Alternative 3: This alternative consists of demolishing the existing seawall and constructing a new seawall supported on driven pipe piles.

Plaza and Seawall: This alternative would consist of approximately one hundred and seventeen (117) 24-in-O.D. pipe piles battered at 30° toward the Main Stairs and sixty-seven (67) 24-in-O.D. pipe piles installed vertically. The vertical piles would have a length of approximately 90 feet and the battered piles would have a length of approximately 105 feet. The top of bedrock is located approximately at EL -87. At least two load tests on a sacrificial, instrumented pipe pile should be performed. Portions of the North Plaza structural slab will be removed and demolished as necessary. The pipe piles will be driven to bedrock, and the pile caps will be formed and poured.

Transition Area: The remediation method consists of cutting at the edge of the structural slab, removing 10 feet of the Circular Roadway in the east and west directions, and replacing with a 10-foot wide structural transition slab. Micropiles would be installed at five feet on center adjacent to the western-most and eastern-most grade beams on the North Plaza, and would be capped with a grade beam. This beam would support the North Plaza edge of a new structural slab. A new footing would support the Circular Roadway edge of the slab, and at either end a flexible joint would be used to allow the slab to undergo anticipated settlements without causing tripping hazards.

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Alternative 3: **DRAFT**

Estimate is Based on 2008 Costs

Bid Item	Material Costs	Installation Costs	Total Costs	Total NET
A10 Foundations	$0	$0	**$0**	$0
A20 Basement Construction	$0	$0	**$0**	$0
B10 Superstructure	$0	$0	**$0**	$0
B20 Exterior Enclosure	$0	$0	**$0**	$0
B30 Roofing	$0	$0	**$0**	$0
C10 Interior Construction	$0	$0	**$0**	$0
C20 Stairs	$0	$0	**$0**	$0
C30 Interior Finishes	$0	$0	**$0**	$0
D10 Conveying	$0	$0	**$0**	$0
D20 Plumbing	$0	$0	**$0**	$0
D30 HVAC	$0	$0	**$0**	$0
D40 Fire Protection	$0	$0	**$0**	$0
D50 Electrical	$0	$0	**$0**	$0
E10 Equipment	$0	$0	**$0**	$0
E20 Furnishings	$0	$0	**$0**	$0
F10 Special Construction	$0	$0	**$0**	$0
F20 Selective Building Demolition	$0	$0	**$0**	$0
G10 Site Preparation	$682,777	$1,970,336	**$2,653,113**	$6,556,635
G20 Site Improvements	$3,090,518	$2,675,991	**$5,766,509**	$14,250,767
G30 Site Mechanical Utilities	$0	$0	**$0**	$0
G40 Site Electrical Utilities	$0	$0	**$0**	$0
G90 Other Site Construction	$0	$0	**$0**	$0
Subtotal Direct Construction Cost	$3,773,295	$4,646,326	**$8,419,621**	**$20,807,402**
Published Location Factor	-0.9%		($75,777)	
Remoteness Factor (urban)	0.0%		$0	
Federal Wage Rate Factor	8.0%		$371,706	
State and Local Taxes (material)	5.75%		$216,964	
Design Contingency	15.0%		$1,262,943	
Total Direct Construction Costs			**$10,195,459**	
Standard General Conditions	25.0%		$2,548,865	
Government General Conditions	10.0%		$1,019,546	
Historic Preservation Factor	5.0%		$509,773	
Subtotal NET Construction Cost			**$14,273,642**	
Overhead	12.5%		$1,784,205	
Profit	10.0%		$1,427,364	
Estimated NET Construction Cost			**$17,485,212**	
Contracting Method Adjustment (Full Open)	5.0%		$874,261	
Inflation Escalation (6.0% / Yr; 25 Months)	12.5%		$2,185,651	
Bond	1.5%		$262,278	
TOTAL Estimated NET Cost of Construction			**$20,807,402**	

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 3: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1010 Site Clearing									
Plaza	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
Transition	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
	Totals G1010 Site Clearing	**20,800**	**SF**		**$0**		**$5,000**	$0.24	**$5,000**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1020 Site Demolition & Relocations									
Both	Complete pre-condition survey	1	LS	$0.00	$0	$10,000.00	$10,000	$10,000.00	$10,000
Plaza	Install vibration monitoring equipment	1	LS	$0.00	$0	$3,500.00	$3,500	$3,500.00	$3,500
Plaza	Remove North Plaza Structural Slab	6,864	SF	$0.48	$3,295	$6.88	$47,224	$7.36	$50,519
Plaza	Remove North Plaza topping Slab	20,800	SF	$0.48	$9,984	$1.18	$24,544	$1.66	$34,528
Plaza	Remove North Plaza Granite Feature	2,091	SF	$0.22	$460	$4.65	$9,723	$4.87	$10,183
Plaza	Conduct Load Test	2	EA	$0.00	$0	$7,500.00	$15,000	$7,500.00	$15,000
Seawall	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Seawall	Remove capstone (store on site)	500	LF	$0.00	$0	$152.00	$76,000	$152.00	$76,000
Seawall	Remove facestone (store on site)	500	LF	$0.00	$0	$227.00	$113,500	$227.00	$113,500
Seawall	Remove existing seawall	500	LF	$0.00	$0	$274.00	$137,000	$274.00	$137,000
Transition	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Both	Complete post-construction survey	1	LS	$0.00	$0	$15,000.00	$15,000	$15,000.00	$15,000
Transition	Remove Transition Area slab	1,300	SF	$0.48	$624	$10.22	$13,286	$10.70	$13,910
Transition	Remove granite features (store on site)	256	LF	$0.22	$56	$4.65	$1,190	$4.87	$1,247
Transition	Remove Block granite (store on site)	4	Ea	$0.00	$0	$12,500.00	$50,000	$12,500.00	$50,000
Transition	Remove granite stairs (store on site)	120	LF	$0.65	$78	$16.14	$1,937	$16.79	$2,015
	Totals G1020 Site Demolition & Relocations	**20,800**	**SF**		**$14,497**		**$532,905**	$26.32	**$547,402**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 3: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1030 Site Earthwork									
Plaza	Excavate under slab for grade beam placement	636	CY	$0.00	$0	$15.08	$9,584	$15.08	$9,584
Seawall	Excavate to rip rap	2,222	CY	$0.00	$0	$21.16	$47,022	$21.16	$47,022
Seawall	Excavate rip rap	926	CY	$0.00	$0	$26.12	$24,185	$26.12	$24,185
Seawall	Install 10' exposed; 40' total temporary cofferdam-water side installation (sheet pile)	48,600	Wall SF	$12.22	$593,892	$24.16	$1,174,176	$36.38	$1,768,068
Seawall	Install engineered fill	2,858	CY	$15.50	$44,296	$22.16	$63,328	$37.66	$107,624
Seawall	Install rip rap	926	CY	$32.50	$30,093	$26.18	$24,241	$58.68	$54,333
Transition	Excavate under slab for grade beam placement	169	CY	$0.00	$0	$26.12	$4,402	$26.12	$4,402
	Totals G1030 Site Earthwork	**20,800**	**SF**		**$668,280**		**$1,346,938**	$96.89	**$2,015,219**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1040 Hazardous Waste Remediation									
Plaza	Haul away spoils (less than 20 miles)	2,250	CY	$0.00	$0	$25.56	$57,519	$25.56	$57,519
Seawall	Haul away rip rap (less than 20 miles)	926	CY	$0.00	$0	$25.56	$23,667	$25.56	$23,667
Transition	Haul away spoils (less than 20 miles)	169	CY	$0.00	$0	$25.56	$4,307	$25.56	$4,307
	Totals G1040 Hazardous Waste Remediation	**20,800**	**SF**		**$0**		**$85,493**	$4.11	**$85,493**
G10	**Site Preparation**				**$682,777**		**$1,970,336**		**$2,653,113**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 3: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2030 Pedestrian Paving									
Plaza	Install North Plaza structural slab	6,864	SF	$21.50	$147,576	$16.25	$111,540	$37.75	$259,116
Plaza	Install 3" exposed aggregrate topping slab	20,800	SF	$8.33	$173,264	$6.28	$130,624	$14.61	$303,888
Plaza	Re-install North Plaza Granite Features	2,091	SF	$0.25	$523	$8.25	$17,251	$8.50	$17,774
Seawall	Install new seawall	444	CY	$228.00	$101,333	$212.00	$94,222	$440.00	$195,556
Seawall	Install new seawall foundation	889	CY	$228.00	$202,667	$212.00	$188,444	$440.00	$391,111
Seawall	Re-install capstone	500	LF	$65.00	$32,500	$235.00	$117,500	$300.00	$150,000
Seawall	Repair capstone	50	LF	$122.50	$6,125	$168.00	$8,400	$290.50	$14,525
Seawall	Re-install facestone	500	LF	$65.00	$32,500	$435.00	$217,500	$500.00	$250,000
Seawall	Repair facestone	75	LF	$122.50	$9,188	$168.00	$12,600	$290.50	$21,788
Transition	Re-install granite features	256	LF	$0.25	$64	$8.25	$2,112	$8.50	$2,176
Transition	Re-install granite blocks	4	EA	$5.00	$20	$12,500.00	$50,000	$12,505.00	$50,020
Transition	Re-install stairs	120	LF	$5.00	$600	$16.25	$1,950	$21.25	$2,550
Transition	Install new engineered fill	169	CY	$12.00	$2,022	$22.18	$3,738	$34.18	$5,760
Transition	Install structural slab	1,300	SF	$21.50	$27,950	$16.25	$21,125	$37.75	$49,075
Transition	Install 3" exposed aggregrate topping slab	1,300	SF	$8.33	$10,829	$6.28	$8,164	$14.61	$18,993
	Totals G2030 Pedestrian Paving	**20,800**	**SF**		**$747,160**		**$985,170**	$83.29	**$1,732,331**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 3: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2040 Site Development									
Plaza	Install pile cap forms (stay in place)	15	Section	$1,080.00	$16,200	$720.00	$10,800	$1,800.00	$27,000
Plaza	Install temporary bracing (wood)	15	Section	$420.00	$6,300	$280.00	$4,200	$700.00	$10,500
Seawall	Install temporary grade beam support (wd)	1	LS	$0.00	$0	$15,000.00	$15,000	$15,000.00	$15,000
vertical	Install 2 sacrificial 24" dia pipe pile (90')	180	Vert LF	$95.62	$17,212	$64.18	$11,552	$159.80	$28,764
diagonal	Install 117 battered 24" dia pipe pile (105')	12,285	Vert LF	$95.62	$1,174,692	$64.18	$788,451	$159.80	$1,963,143
vertical	Install 67 battered 24" dia pipe pile (90')	6,030	Vert LF	$95.62	$576,589	$64.18	$387,005	$159.80	$963,594
Plaza/SW	Install reinforced pile cap	1,363	CY	$228.00	$310,756	$212.00	$288,948	$440.00	$599,704
Seawall	Install concrete cap extensions	9	CY	$228.00	$2,027	$258.00	$2,293	$486.00	$4,320
Seawall	Install safety lighting (at edge, match system)	25	Ea	$375.00	$9,375	$294.00	$7,350	$669.00	$16,725
Soil	Core micropile	90	Vert LF	$0.00	$0	$12.08	$1,087	$12.08	$1,087
Transition	Install sacrificial mircopile	36	CY	$233.12	$8,472	$136.00	$4,943	$369.12	$13,415
Transition	Install concrete grade beams	29	CY	$228.00	$6,587	$212.00	$6,124	$440.00	$12,711
Transition	Install concrete footing	22	CY	$228.00	$5,067	$212.00	$4,711	$440.00	$9,778
Transition	Install flexible joint	266	LF	$10.58	$2,814	$16.00	$4,256	$26.58	$7,070
Transition	Core 24 micropile	2,448	Vert LF	$0.00	$0	$12.08	$29,572	$12.08	$29,572
Transition	Install 24 battered mircopiles	872	CY	$233.12	$203,332	$136.00	$118,622	$369.12	$321,955
	Totals G2040 Site Development	**20,800**	**SF**		**$2,339,421**		**$1,684,916**	$193.48	**$4,024,337**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2050 Landscaping									
Plaza	Replace damaged landscaped area-soil	98	CY	$32.00	$3,129	$10.50	$1,027	$42.50	$4,156
Plaza	Replace damaged landscaped area-seed	2,400	SF	$0.01	$24	$1.25	$3,000	$1.26	$3,024
Transition	Replace damaged landscaped area-soil	24	CY	$32.00	$770	$10.50	$253	$42.50	$1,023
Transition	Replace damaged landscaped area-seed	1,300	SF	$0.01	$13	$1.25	$1,625	$1.26	$1,638
	Totals G2050 Landscaping	**20,800**	**SF**		**$3,936**		**$5,904**	$0.47	**$9,841**
G20	**Site Improvements**				**$3,090,518**		**$2,675,991**		**$5,766,509**

TOTAL ESTIMATED DIRECT PROJECT CONSTRUCTION COST **$8,419,621**

Class B Construction Cost Estimate

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Basis of Estimate

DRAFT

Date of Estimate: 05/02/08

Estimated By: Kirk Associates
1177 Berkshire, Suite 100
Grosse Pointe Park, MI
(248) 240-9605

Supporting Material: Pre-Design Documents / Reports, 01/08
Revised Information from Engineers, 03/08

Cost Data: Square Foot Cost Data.
Unit Prices based on 2008 Cost data
Conversations with Consulting Engineers
Conversations with Installation Contractors

Mark-ups and Add-ons:
Published Location Factor: NPS DSC for Washington, D.C. -0.9 %
Project Remoteness: Site is in downtown Washington D.C. (dense urban)
Federal Wage Rate Factor: 8 Percent Guidance from NPS.
Design Contingency: Limited Detail on Design Report, however this is a small project. 15 percent seems appropriate.
Taxes: 5.75 Percent Sales Tax (State and Local)
Standard General Conditions: Above Normal Range of 18 Percent due to special equipment needs.
Government General Conditions: 10 Percent within NPS Guidance Recommendations.
Bonds and Permits: 1.5 percent bond included in General Conditions. No permit costs.
Historic Preservation Factor: Memorial cost include 5% Historic Factor.
Overhead: Small Job, Limited sub-contractors due to work in region.
Profit: 10 Percent
Contracting Method Adjustment: The contract will be full open bid with a 5% premium.
Inflation Escalation: Assume midpoint of construction to begin July, 2009 with 18 month construction period. Inflation predictions indicate 6% per year.
Bond: 1.5% on the Entire Project

Comments: Work assumed to be completed by land based equipment
Park operations will be open in this area during the repair work
Removed materials will be kept on site before re-installation

Alternative 6: This alternative is comprised of drilling micropiles through the existing Ashlar Seawall to control settlement of the seawall, and using caissons to address the soil movement and the lateral movement of the North Plaza.

Seawall: This alternative would consist of 51 micropiles battered at 7°, and 51 micropiles battered at 13° through the wall stem. The piles would have a bonded length of 10 feet into bedrock and a total length of 90 feet. At least one load test on a sacrificial, instrumented micropile should be performed.

Plaza: To address the soil movement, large diameter piers would be installed in front of the Ashlar Seawall and embedded into the bedrock a minimum of 20 ft. The piers will work as structural elements that would serve as a curtain to restrain lateral movement of the soil in the surrounding areas around the Ashlar Seawall and the North Plaza. In the Tidal Basin in front of the western portion of the North Plaza, nineteen 7-foot diameter concrete caissons would be installed and connected by a 15-foot wide concrete cap. North of the eastern portion of the North Plaza, one group of seven 6-foot diameter caissons, and one group of fifteen 6-foot diameter caissons will be connected with 12-foot wide concrete caps. The caissons and caps would be positioned to counteract the plaza and soil movement.

Transition Area: The remediation method consists of cutting at the edge of the structural slab, removing 10 feet of the Circular Roadway in the east and west directions, and replacing with a 10-foot wide structural transition slab. Micropiles would be installed at five feet on center adjacent to the western-most and eastern-most grade beams on the North Plaza, and would be capped with a grade beam. This beam would support the North Plaza edge of a new structural slab. A new footing would support the Circular Roadway edge of the slab, and at either end a flexible joint would be used to allow the slab to undergo anticipated settlements without causing tripping hazards.

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Estimate By: S. Garrett
Date: 05/02/08

Reviewed By:
Date:

Alternative 6: **DRAFT**

Estimate is Based on 2008 Costs

Bid Item	Material Costs	Installation Costs	Total Costs	Total NET
A10 Foundations	$0	$0	**$0**	$0
A20 Basement Construction	$0	$0	**$0**	$0
B10 Superstructure	$0	$0	**$0**	$0
B20 Exterior Enclosure	$0	$0	**$0**	$0
B30 Roofing	$0	$0	**$0**	$0
C10 Interior Construction	$0	$0	**$0**	$0
C20 Stairs	$0	$0	**$0**	$0
C30 Interior Finishes	$0	$0	**$0**	$0
D10 Conveying	$0	$0	**$0**	$0
D20 Plumbing	$0	$0	**$0**	$0
D30 HVAC	$0	$0	**$0**	$0
D40 Fire Protection	$0	$0	**$0**	$0
D50 Electrical	$0	$0	**$0**	$0
E10 Equipment	$0	$0	**$0**	$0
E20 Furnishings	$0	$0	**$0**	$0
F10 Special Construction	$0	$0	**$0**	$0
F20 Selective Building Demolition	$0	$0	**$0**	$0
G10 Site Preparation	$460,438	$1,304,717	**$1,765,156**	$4,364,384
G20 Site Improvements	$3,349,006	$3,922,568	**$7,271,574**	$17,979,117
G30 Site Mechanical Utilities	$0	$0	**$0**	$0
G40 Site Electrical Utilities	$0	$0	**$0**	$0
G90 Other Site Construction	$0	$0	**$0**	$0
Subtotal Direct Construction Cost	$3,809,444	$5,227,286	**$9,036,730**	**$22,343,501**
Published Location Factor	-0.9%		($81,331)	
Remoteness Factor (urban)	0.0%		$0	
Federal Wage Rate Factor	8.0%		$418,183	
State and Local Taxes (material)	5.75%		$219,043	
Design Contingency	15.0%		$1,355,510	
Total Direct Construction Costs			**$10,948,135**	
Standard General Conditions	25.0%		$2,737,034	
Government General Conditions	10.0%		$1,094,813	
Historic Preservation Factor	5.0%		$547,407	
Subtotal NET Construction Cost			**$15,327,389**	
Overhead	12.5%		$1,915,924	
Profit	10.0%		$1,532,739	
Estimated NET Construction Cost			**$18,776,051**	
Contracting Method Adjustment (Full Open)	5.0%		$938,803	
Inflation Escalation (6.0% / Yr; 25 Months)	12.5%		$2,347,006	
Bond	1.5%		$281,641	
TOTAL Estimated NET Cost of Construction			**$22,343,501**	

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 6: DRAFT

Estimate By: S. Garrett
Date: 05/02/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1010 Site Clearing									
Plaza	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
Transition	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
	Totals G1010 Site Clearing	**20,800**	**SF**		**$0**		**$5,000**	$0.24	**$5,000**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1020 Site Demolition & Relocations									
Both	Complete pre-condition survey	1	LS	$0.00	$0	$10,000.00	$10,000	$10,000.00	$10,000
Plaza	Install vibration monitoring equipment	1	LS	$0.00	$0	$3,500.00	$3,500	$3,500.00	$3,500
Plaza	Remove North Plaza topping Slab	20,800	SF	$0.48	$9,984	$1.18	$24,544	$1.66	$34,528
Plaza	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Seawall	Remove capstone (store on site)	500	LF	$0.00	$0	$152.00	$76,000	$152.00	$76,000
Seawall / Transition	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Both	Complete post-construction survey	1	LS	$0.00	$0	$15,000.00	$15,000	$15,000.00	$15,000
Transition	Remove Transition Area slab	1,300	SF	$0.48	$624	$10.22	$13,286	$10.70	$13,910
Transition	Remove granite features (store on site)	256	LF	$0.22	$56	$4.65	$1,190	$4.87	$1,247
Transition	Remove Block granite (store on site)	4	Ea	$0.00	$0	$12,500.00	$50,000	$12,500.00	$50,000
Transition	Remove granite stairs (store on site)	120	LF	$0.65	$78	$16.14	$1,937	$16.79	$2,015
	Totals G1020 Site Demolition & Relocations	**20,800**	**SF**		**$10,742**		**$210,457**	$10.63	**$221,200**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1030 Site Earthwork									
Seawall	Install 10' exposed, 40' total temporary cofferdam-water side (sheet pile)	36,800	Wall SF	$12.22	$449,696	$24.16	$889,088	$36.38	$1,338,784
Transition	Excavate under slab for grade beam placement	169	CY	$0.00	$0	$26.12	$4,402	$26.12	$4,402
	Totals G1030 Site Earthwork	**20,800**	**SF**		**$449,696**		**$893,490**	$64.58	**$1,343,186**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 6: **DRAFT**

Estimate By: S. Garrett
Date: 05/02/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1040 Hazardous Waste Remediation									
Plaza	Haul away spoils (less than 20 miles)	4,951	CY	$0.00	$0	$25.56	$126,541	$25.56	$126,541
Seawall	Haul away spoils (less than 20 miles)	2,060	CY	$0.00	$0	$25.56	$52,654	$25.56	$52,654
Transition	Haul away spoils (less than 20 miles)	649	CY	$0.00	$0	$25.56	$16,576	$25.56	$16,576
	Totals G1040 Hazardous Waste Remediation	**20,800**	**SF**		**$0**		**$195,770**	$9.41	**$195,770**
G10	**Site Preparation**				**$460,438**		**$1,304,717**		**$1,765,156**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2030 Pedestrian Paving									
Plaza	Install 3" exposed aggregrate topping slab	20,800	SF	$8.33	$173,264	$6.28	$130,624	$14.61	$303,888
Seawall	Re-install capstone	500	LF	$65.00	$32,500	$235.00	$117,500	$300.00	$150,000
Seawall	Repair capstone	50	LF	$122.50	$6,125	$168.00	$8,400	$290.50	$14,525
Transition	Re-install granite features	256	LF	$0.25	$64	$8.25	$2,112	$8.50	$2,176
Transition	Re-install granite blocks	4	EA	$5.00	$20	$12,500.00	$50,000	$12,505.00	$50,020
Transition	Re-install stairs	120	LF	$5.00	$600	$16.25	$1,950	$21.25	$2,550
Transition	Install new engineered fill	169	CY	$12.00	$2,022	$22.18	$3,738	$34.18	$5,760
Transition	Install structural slab	1,300	SF	$21.50	$27,950	$16.25	$21,125	$37.75	$49,075
Transition	Install 3" exposed aggregrate topping slab	1,300	SF	$8.33	$10,829	$6.28	$8,164	$14.61	$18,993
	Totals G2030 Pedestrian Paving	**20,800**	**SF**		**$253,374**		**$343,613**	$28.70	**$596,987**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 6: **DRAFT**

Estimate By: S. Garrett
Date: 05/02/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2040 Site Development									
Plaza	Install temporary bracing (at wall)	22	Section	$540.00	$11,880	$420.00	$9,240	$960.00	$21,120
soil	Drill 2 sacrificial 7' diameter drilled caisson	184	Vert LF	$0.00	$0	$168.44	$30,993	$168.44	$30,993
rock	Drill 2 sacrificial 7' diameter drilled caisson	40	Vert LF	$0.00	$0	$768.82	$30,753	$768.82	$30,753
Plaza	*note: all caissons to depth of 90' in soil and an additional 20' in rock*								
Plaza	Install 1" thick steel casing	184	Vert LF	$160.22	$29,480	$116.44	$21,425	$276.66	$50,905
Plaza	Install concrete fill into caisson	230	CY	$188.00	$43,290	$84.00	$19,342	$272.00	$62,633
Plaza	Install re-bar into caisson	230	CY	$18.50	$4,260	$41.50	$9,556	$60.00	$13,816
Soil	Drill 19 - 7' diameter drilled caisson	1,710	Vert LF	$0.00	$0	$198.76	$339,878	$198.76	$339,878
rock	Drill 19 - 7' diameter drilled caisson	380	Vert LF	$0.00	$0	$907.21	$344,739	$907.21	$344,739
Soil	Drill 22 - 6' diameter drilled caisson	2,024	Vert LF	$0.00	$0	$168.44	$340,923	$168.44	$340,923
rock	Drill 22 - 6' diameter drilled caisson	440	Vert LF	$0.00	$0	$768.82	$338,281	$768.82	$338,281
Plaza	Install 1" thick steel casing	3,734	Vert LF	$160.22	$598,261	$116.44	$434,787	$276.66	$1,033,048
Plaza	Install concrete fill into caisson	5,513	CY	$188.00	$1,036,521	$84.00	$463,126	$272.00	$1,499,647
Plaza	Install re-bar into caisson	5,513	CY	$18.50	$101,998	$41.50	$228,806	$60.00	$330,805
Plaza	Install concrete caps	740	CY	$228.00	$168,624	$212.00	$156,791	$440.00	$325,415
Seawall	Install temporary grade beam support (wood)	1	LS	$0.00	$0	$15,000.00	$15,000	$15,000.00	$15,000
Soil	Core micropile	90	Vert LF	$0.00	$0	$12.08	$1,087	$12.08	$1,087
Seawall	Install sacrificial mircopile	36	CY	$233.12	$8,472	$136.00	$4,943	$369.12	$13,415
Soil	Core 102 micropile	9,180	Vert LF	$0.00	$0	$12.08	$110,894	$12.08	$110,894
Seawall	Install 102 battered mircopiles	3,707	CY	$233.12	$864,163	$136.00	$504,144	$369.12	$1,368,307
Seawall	Install safety lighting (at edge, match system)	25	Ea	$375.00	$9,375	$294.00	$7,350	$669.00	$16,725
Transition	Install concrete grade beams	29	CY	$228.00	$6,587	$212.00	$6,124	$440.00	$12,711
Transition	Install concrete footing	22	CY	$228.00	$5,067	$212.00	$4,711	$440.00	$9,778
Transition	Install flexible joint	266	LF	$10.58	$2,814	$16.00	$4,256	$26.58	$7,070
Transition	Core 24 micropile	2,448	Vert LF	$0.00	$0	$12.08	$29,572	$12.08	$29,572
Transition	Install 24 battered mircopiles	872	CY	$233.12	$203,332	$136.00	$118,622	$369.12	$321,955
	Totals G2040 Site Development	**20,800**	**SF**		**$3,094,125**		**$3,575,345**	$320.65	**$6,669,470**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 6: **DRAFT**

Estimate By: S. Garrett
Date: 05/02/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2050 Landscaping									
Plaza	Replace damaged landscaped area-soil	22	CY	$32.00	$711	$10.50	$233	$42.50	$944
Plaza	Replace damaged landscaped area-seed	1,200	SF	$0.01	$12	$1.25	$1,500	$1.26	$1,512
Transition	Replace damaged landscaped area-soil	24	CY	$32.00	$770	$10.50	$253	$42.50	$1,023
Transition	Replace damaged landscaped area-seed	1,300	SF	$0.01	$13	$1.25	$1,625	$1.26	$1,638
	Totals G2050 Landscaping	**20,800**	**SF**		**$1,506**		**$3,611**	$0.25	**$5,118**
G20	**Site Improvements**				**$3,349,006**		**$3,922,568**		**$7,271,574**

TOTAL ESTIMATED DIRECT PROJECT CONSTRUCTION COST **$9,036,730**

Class B Construction Cost Estimate

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Basis of Estimate

DRAFT

Date of Estimate: 05/05/08

Estimated By: Kirk Associates
1177 Berkshire, Suite 100
Grosse Pointe Park, MI
(248) 240-9605

Supporting Material: Pre-Design Documents / Reports, 01/08
Revised Information from Engineers, 03/08

Cost Data: Square Foot Cost Data.
Unit Prices based on 2008 Cost data
Conversations with Consulting Engineers
Conversations with Installation Contractors

Mark-ups and Add-ons: **Published Location Factor:** NPS DSC for Washington, D.C. -0.9 %
Project Remoteness: Site is in downtown Washington D.C. (dense urban)
Federal Wage Rate Factor: 8 Percent Guidance from NPS.
Design Contingency: Limited Detail on Design Report, however this is a small project. 15 percent seems appropriate.
Taxes: 5.75 Percent Sales Tax (State and Local)
Standard General Conditions: Above Normal Range of 18 Percent due to special equipment needs.
Government General Conditions: 10 Percent within NPS Guidance Recommendations.
Bonds and Permits: 1.5 percent bond included in General Conditions. No permit costs.
Historic Preservation Factor: Memorial cost include 5% Historic Factor.
Overhead: Small Job, Limited sub-contractors due to work in region.
Profit: 10 Percent
Contracting Method Adjustment: The contract will be full open bid with a 5% premium.
Inflation Escalation: Assume midpoint of construction to begin July, 2009 with 18 month construction period. Inflation predictions indicate 6% per year.
Bond: 1.5% on the Entire Project

Comments: Work assumed to be completed by land based equipment
Park operations will be open in this area during the repair work
Removed materials will be kept on site before re-installation

Alternative 7: This alternative consists of demolishing the existing seawall and constructing a new seawall supported on 6-foot and 7-foot diameter caissons.

Seawall & Plaza: The caissons would address the soil movement and the lateral movement of the North Plaza, as well as support the new seawall. Beneath the western portion of the Ashlar Seawall, twenty-two 7-foot diameter caissons would be installed and embedded into the bedrock a minimum of 20 feet. On the eastern side of the Ashlar Seawall, twenty-six 6-foot diameter caissons would be installed. The new seawall would have similar dimensions and appearance as the original seawall. The original granite capstones and ashlar stone facing would be preserved and reused.

Transition Area: The remediation method consists of cutting at the edge of the structural slab, removing 10 feet of the Circular Roadway in the east and west directions, and replacing with a 10-foot wide structural transition slab. Micropiles would be installed at five feet on center adjacent to the western-most and eastern-most grade beams on the North Plaza, and would be capped with a grade beam. This beam would support the North Plaza edge of a new structural slab. A new footing would support the Circular Roadway edge of the slab, and at either end a flexible joint would be used to allow the slab to undergo anticipated settlements without causing tripping hazards.

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Alternative 7: **DRAFT**

Estimate is Based on 2008 Costs

Bid Item	Material Costs	Installation Costs	Total Costs	Total NET
A10 Foundations	$0	$0	**$0**	$0
A20 Basement Construction	$0	$0	**$0**	$0
B10 Superstructure	$0	$0	**$0**	$0
B20 Exterior Enclosure	$0	$0	**$0**	$0
B30 Roofing	$0	$0	**$0**	$0
C10 Interior Construction	$0	$0	**$0**	$0
C20 Stairs	$0	$0	**$0**	$0
C30 Interior Finishes	$0	$0	**$0**	$0
D10 Conveying	$0	$0	**$0**	$0
D20 Plumbing	$0	$0	**$0**	$0
D30 HVAC	$0	$0	**$0**	$0
D40 Fire Protection	$0	$0	**$0**	$0
D50 Electrical	$0	$0	**$0**	$0
E10 Equipment	$0	$0	**$0**	$0
E20 Furnishings	$0	$0	**$0**	$0
F10 Special Construction	$0	$0	**$0**	$0
F20 Selective Building Demolition	$0	$0	**$0**	$0
G10 Site Preparation	$677,139	$1,995,909	**$2,673,048**	$6,614,267
G20 Site Improvements	$3,153,722	$4,254,741	**$7,408,463**	$18,331,716
G30 Site Mechanical Utilities	$0	$0	**$0**	$0
G40 Site Electrical Utilities	$0	$0	**$0**	$0
G90 Other Site Construction	$0	$0	**$0**	$0
Subtotal Direct Construction Cost	$3,830,860	$6,250,650	**$10,081,511**	**$24,945,983**
Published Location Factor	-0.9%		($90,734)	
Remoteness Factor (urban)	0.0%		$0	
Federal Wage Rate Factor	8.0%		$500,052	
State and Local Taxes (material)	5.75%		$220,274	
Design Contingency	15.0%		$1,512,227	
Total Direct Construction Costs			**$12,223,330**	
Standard General Conditions	25.0%		$3,055,833	
Government General Conditions	10.0%		$1,222,333	
Historic Preservation Factor	5.0%		$611,167	
Subtotal NET Construction Cost			**$17,112,662**	
Overhead	12.5%		$2,139,083	
Profit	10.0%		$1,711,266	
Estimated NET Construction Cost			**$20,963,011**	
Contracting Method Adjustment (Full Open)	5.0%		$1,048,151	
Inflation Escalation (6.0% / Yr; 25 Months)	12.5%		$2,620,376	
Bond	1.5%		$314,445	
TOTAL Estimated NET Cost of Construction			**$24,945,983**	

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 7: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1010 Site Clearing									
Plaza	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
Transition	Prepare site for construction	1	LS	$0.00	$0	$2,500.00	$2,500	$2,500.00	$2,500
	Totals G1010 Site Clearing	**20,800**	**SF**		**$0**		**$5,000**	$0.24	**$5,000**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1020 Site Demolition & Relocations									
Both	Complete pre-condition survey	1	LS	$0.00	$0	$10,000.00	$10,000	$10,000.00	$10,000
Plaza	Install vibration monitoring equipment	1	LS	$0.00	$0	$3,500.00	$3,500	$3,500.00	$3,500
Plaza	Remove North Plaza Structural Slab	4,160	SF	$0.48	$1,997	$6.88	$28,621	$7.36	$30,618
Plaza	Remove North Plaza topping Slab	20,800	SF	$0.48	$9,984	$1.18	$24,544	$1.66	$34,528
Plaza / Seawall	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Seawall	Remove capstone (store on site)	500	LF	$0.00	$0	$152.00	$76,000	$152.00	$76,000
Seawall	Remove facestone (store on site)	500	LF	$0.00	$0	$227.00	$113,500	$227.00	$113,500
Seawall	Remove existing seawall	500	LF	$0.00	$0	$274.00	$137,000	$274.00	$137,000
Transition	Conduct Load Test	1	EA	$0.00	$0	$7,500.00	$7,500	$7,500.00	$7,500
Both	Complete post-construction survey	1	LS	$0.00	$0	$15,000.00	$15,000	$15,000.00	$15,000
Transition	Remove Transition Area slab	1,300	SF	$0.48	$624	$10.22	$13,286	$10.70	$13,910
Transition	Remove granite features (store on site)	256	LF	$0.22	$56	$4.65	$1,190	$4.87	$1,247
Transition	Remove Block granite (store on site)	4	Ea	$0.00	$0	$12,500.00	$50,000	$12,500.00	$50,000
Transition	Remove granite stairs (store on site)	120	LF	$0.65	$78	$16.14	$1,937	$16.79	$2,015
	Totals G1020 Site Demolition & Relocations	**20,800**	**SF**		**$12,739**		**$489,578**	$24.15	**$502,317**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 7: DRAFT

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1030 Site Earthwork									
Plaza	Excavate under slab for pile cap placement	385	CY	$0.00	$0	$15.08	$5,809	$15.08	$5,809
Seawall	Excavate to rip rap	2,222	CY	$0.00	$0	$21.16	$47,022	$21.16	$47,022
Seawall	Excavate rip rap	926	CY	$0.00	$0	$26.12	$24,185	$26.12	$24,185
Seawall	Install 10' exposed, 40' total temporary cofferdam-water side (sheet pile)	48,600	Wall SF	$12.22	$593,892	$24.16	$1,174,176	$36.38	$1,768,068
Transition	Excavate under slab for grade beam placement	169	CY	$0.00	$0	$26.12	$4,402	$26.12	$4,402
Seawall	Install engineered fill	2,607	CY	$15.50	$40,415	$22.16	$57,780	$37.66	$98,195
Seawall	Install rip rap	926	CY	$32.50	$30,093	$26.18	$24,241	$58.68	$54,333
	Totals G1030 Site Earthwork	**20,800**	**SF**		**$664,399**		**$1,337,615**	$96.25	**$2,002,014**

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G1040 Hazardous Waste Remediation									
Plaza / SW	Haul away spoils (less than 20 miles)	5,757	CY	$0.00	$0	$25.56	$147,140	$25.56	$147,140
Transition	Haul away spoils (less than 20 miles)	649	CY	$0.00	$0	$25.56	$16,576	$25.56	$16,576
	Totals G1040 Hazardous Waste Remediation	**20,800**	**SF**		**$0**		**$163,717**	$7.87	**$163,717**

G10	**Site Preparation**				**$677,139**		**$1,995,909**		**$2,673,048**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 7: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2030 Pedestrian Paving									
Plaza	Install 3" exposed aggregrate topping slab	20,800	SF	$8.33	$173,264	$6.28	$130,624	$14.61	$303,888
Seawall	Install new seawall	444	CY	$228.00	$101,333	$212.00	$94,222	$440.00	$195,556
Seawall	Install new seawall foundation	889	CY	$228.00	$202,667	$212.00	$188,444	$440.00	$391,111
Seawall	Re-install capstone	500	LF	$65.00	$32,500	$235.00	$117,500	$300.00	$150,000
Seawall	Repair capstone	50	LF	$122.50	$6,125	$168.00	$8,400	$290.50	$14,525
Seawall	Re-install facestone	500	LF	$65.00	$32,500	$435.00	$217,500	$500.00	$250,000
Seawall	Repair facestone	75	LF	$122.50	$9,188	$168.00	$12,600	$290.50	$21,788
Transition	Re-install granite features	256	LF	$0.25	$64	$8.25	$2,112	$8.50	$2,176
Transition	Re-install granite blocks	4	EA	$5.00	$20	$12,500.00	$50,000	$12,505.00	$50,020
Transition	Re-install stairs	120	LF	$5.00	$600	$16.25	$1,950	$21.25	$2,550
Transition	Install new engineered fill	169	CY	$12.00	$2,022	$22.18	$3,738	$34.18	$5,760
Transition	Install structural slab	1,300	SF	$21.50	$27,950	$16.25	$21,125	$37.75	$49,075
Transition	Install 3" exposed aggregrate topping slab	1,300	SF	$8.33	$10,829	$6.28	$8,164	$14.61	$18,993
	Totals G2030 Pedestrian Paving	**20,800**	**SF**		**$599,062**		**$856,379**	$69.97	**$1,455,441**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 7: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By:
Date:

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2040 Site Development									
Plaza / SW	Install temporary bracing (at wall)	22	Section	$540.00	$11,880	$420.00	$9,240	$960.00	$21,120
soil	Drill 2 sacrificial 7' diameter drilled caisson	184	Vert LF	$0.00	$0	$168.44	$30,993	$168.44	$30,993
rock	Drill 2 sacrificial 7' diameter drilled caisson	40	Vert LF	$0.00	$0	$768.82	$30,753	$768.82	$30,753
Plaza / SW	*note: all caissons to depth of 90' in soil and an additional 20' in rock*								
Plaza / SW	Install 1" thick steel casing	184	Vert LF	$160.22	$29,480	$116.44	$21,425	$276.66	$50,905
Plaza / SW	Install concrete fill into caisson	230	CY	$188.00	$43,290	$84.00	$19,342	$272.00	$62,633
Plaza / SW	Install re-bar into caisson	230	CY	$18.50	$4,260	$41.50	$9,556	$60.00	$13,816
Soil	Drill 22 - 7' diameter drilled caisson	1,980	Vert LF	$0.00	$0	$198.76	$393,543	$198.76	$393,543
rock	Drill 22 - 7' diameter drilled caisson	440	Vert LF	$0.00	$0	$907.21	$399,171	$907.21	$399,171
Soil	Drill 26 - 6' diameter drilled caisson	2,392	Vert LF	$0.00	$0	$168.44	$402,908	$168.44	$402,908
rock	Drill 26 - 6' diameter drilled caisson	520	Vert LF	$0.00	$0	$768.82	$399,786	$768.82	$399,786
Plaza / SW	Install 1" thick steel casing	4,372	Vert LF	$160.22	$700,482	$116.44	$509,076	$276.66	$1,209,558
Plaza / SW	Install concrete fill into caisson	6,444	CY	$188.00	$1,211,485	$84.00	$541,302	$272.00	$1,752,787
Plaza / SW	Install re-bar into caisson	6,444	CY	$18.50	$119,215	$41.50	$267,429	$60.00	$386,644
Plaza / SW	Install concrete caps	866	CY	$228.00	$197,414	$212.00	$183,560	$440.00	$380,974
Seawall	Install safety lighting (at edge, match system)	25	Ea	$375.00	$9,375	$294.00	$7,350	$669.00	$16,725
Soil	Core micropile	90	Vert LF	$0.00	$0	$12.08	$1,087	$12.08	$1,087
Transition	Install sacrificial mircopile	36	CY	$233.12	$8,472	$136.00	$4,943	$369.12	$13,415
Transition	Install concrete grade beams	29	CY	$228.00	$6,587	$212.00	$6,124	$440.00	$12,711
Transition	Install concrete footing	22	CY	$228.00	$5,067	$212.00	$4,711	$440.00	$9,778
Transition	Install flexible joint	266	LF	$10.58	$2,814	$16.00	$4,256	$26.58	$7,070
Transition	Core 24 micropile	2,448	Vert LF	$0.00	$0	$12.08	$29,572	$12.08	$29,572
Transition	Install 24 battered mircopiles	872	CY	$233.12	$203,332	$136.00	$118,622	$369.12	$321,955
	Totals G2040 Site Development	**20,800**	**SF**		**$2,553,154**		**$3,394,751**	$285.96	**$5,947,904**

Project: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza and Transition Areas
Park: Thomas Jefferson Memorial
PMIS: 128232
Alternative 7: **DRAFT**

Estimate By: S. Garrett
Date: 05/05/08

Reviewed By: _____
Date: _____

Estimate is Based on 2008 Costs

				Material		Installation		Total	
Item No.	Description	Qty.	Unit	Cost/Unit	Mat'l Cost	Cost/Unit	Install Cost	Cost/Unit	TOTAL
G2050 Landscaping									
Plaza	Replace damaged landscaped area-soil	22	CY	$32.00	$711	$10.50	$233	$42.50	$944
Plaza	Replace damaged landscaped area-seed	1,200	SF	$0.01	$12	$1.25	$1,500	$1.26	$1,512
Transition	Replace damaged landscaped area-soil	24	CY	$32.00	$770	$10.50	$253	$42.50	$1,023
Transition	Replace damaged landscaped area-seed	1,300	SF	$0.01	$13	$1.25	$1,625	$1.26	$1,638
	Totals G2050 Landscaping	**20,800**	**SF**		**$1,506**		**$3,611**	$0.25	**$5,118**
G20	**Site Improvements**				**$3,153,722**		**$4,254,741**		**$7,408,463**

TOTAL ESTIMATED DIRECT PROJECT CONSTRUCTION COST **$10,081,511**

APPENDIX C

Written Responses to Review Comments

DENVER S ICE CENTER
Quali surance

NAMA 128232			Project Title: Repair and Control Settlement at Jefferson Memorial Seawall, North Plaza, and Transition Areas
DBB (X) or DB ( )	Milestone: ( ) HSR ( ) PD (X) SD ( ) DD ( ) CD-100% Draft ( ) CD-100% Complete Other: ( )		
Construction FY: (09	Proposed Award Date: (04/17/09)	Proposed Midpoint of Construction Date: (03/01/10	
Contracting Method: ( ) Non-Competitive (Sole Source - 8A, Service Disable, Hub Zone) (X) Full & Open (Competitive Negotiation) ( ) Limited Competition (Comp. Neg. - Hub Zone, Comp. 8A, Small Bus. Set Aside) ( ) Full & Open (Seal Bid - Low Price)			
A/E Prime: HNTB		NPS Project Manager: Macdonald	Phone No.: 6621
QA Due Date: 05/02/08		NPS Project Specialist: Denk	Phone No.: 2336
		NPS Contracting Officer: Lemke	Phone No.: 2039
QA Completed & Posted Date: 5/9/08 Complete		NPS Contract Specialist: Weisman	Phone No.: 2344

Remarks/Special Instructions: 52.236-23 Responsibility of the Architect-Engineer Contractor.

RESPONSIBILITY OF THE ARCHITECT-ENGINEER CONTRACTOR (APR 1984)

(a)The Contractor shall be responsible for the professional quality, technical accuracy, and the coordination of all designs, drawings, specifications, and other services furnished by the Contractor under this contract. The Contractor shall, without additional compensation, correct or revise any errors or deficiencies in its designs, drawings, specifications, and other services.

(b) Neither the Government's review, approval or acceptance of, nor payment for, the services required under this contract shall be construed to operate as a waiver of any rights under this contract or of any cause of action arising out of the performance of this contract, and the Contractor shall be and remain liable to the Government in accordance with applicable law for all damages to the Government caused by the Contractor's negligent performance of any of the services furnished under this contract.

SEE THE TABS AT THE BOTTOM OF THIS FORM FOR INDIVIDUAL REVIEW COMMENTS

Quality Assurance review comments shall apply to all issues throughout the review set that have either identical or similar concerns. No attempt is made to identify all occurrences. The contractor's own Quality Control shall ensure that these review comments are thoroughly resolved prior to any subsequent submittals.

Discipline (route only to marked boxes):	Summary Comments:	
√ Civil Engineering (CE)	LRT 4/25/08 No comments. Very good SD submittal.	
√ Landscape Architecture (LA)	JHC 5/5/08 no comments	
√ Architecture (AR) / Lighting (LT)	5/2/08 No comments	
√ Preservation Architecture (PA)	CRJ 5/8/05 No Comments	
√ Structural Engineering (SE)	LLR 4/24/08 Refer to comments.	
Mechanical Engineering (ME)		
Electrical Engineering (EE)		
√ Safety Engineer (SF)	bo 4/23/08 No Comments	
Constructability (CN)		
√ Estimating (EST)	RAM 05/09/08 Refer to Analysis and comments	
NPS-10 (ET)		
√ Natural Resource Specialist (NRS)		
√ Cultural Resource Specialist (CRS)		
√ Project Specialist (PS)	DMD 05/02/08 Refer to Comments	
√ Project Manager (PM)	PM 05/02/08 Refer to Comment	
√ Park	No comments rec'd	
√ Region		
√ Others	Steve Brokken, Refer to Comments, Refer to Memo	

Construction Cost Estimating Review

Park Name: Jefferson Memorial Park Alpha Code: NAMA

Project Title: Repair & Control Settlement at Jefferson Memorial Seawall, North Plaza, & Transition Areas PMIS #: 128232

Region: National Capital

Project Manager: MacDonald

Proposed Date of Mid-point of Construction: July, 2009

Net Available Construction Funds : $8,474,576

Date Of Estimate: 2-May-08 Estimate Escalated to: July, 2009 (Date)

Level of Estimate: (Circle One) Class C | (Class B) | Class A

Associated Design Submittal: (Circle One) PD Submittal | (SD/DAB Submittal) | DD Submittal | Draft 100% CD Submittal | Final 100% CD Submittal

Estimated By: Kirk Associates
Primary Estimator, Firm and Contact Information

Estimated Total NET Construction (Base): $22,343,501

Estimated Total NET Construction (Highest Price Option): $0

Estimated TOTAL NET Construction (Base with Options): $22,343,501

Estimate Reviewed By: Robert A. Merrick, PE Review Date: 5/9/2008

Review Comments:

Estimate appears to be complete and professionally prepared and appears to be a reasonable representation of the probable cost of construction for this project.. There is an overall difference in the NPS recommended cost and the submitted cost of less than 3%. There are some differences in mark-ups - see attached analysis and comments. There is a large difference in the estimated cost and available funds.

Approval Status:

☐	Not Accepted	Signature of disapproving official	Date
■	Accepted with Comments	Robert A. Merrick (Signature of approving official)	5/9/2008 (Date)
☐	Accepted	Signature of approving official	Date

Comments:
Initial & Date your comments!

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

STRUCTURAL ENGINEERING
REVIEWER: Larry L. Reynolds, P.E. (303) 987-6630
DATE REVIEWED: 4/24/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Summary Comment	Well executed schematic design. Refer to comments below.	
2	SD Alternatives	Page 4: First paragraph for Alternative 1 refers to "bedrock" at approximately 95 feet. First paragraph for Alternative 2 refers to "disintegrated rock" at approximately 95 feet. Are these the same strata? Please clarify.	The "bedrock" and "disintegrated rock" refer to the same strata. To clarify these should be refer to as "rock".
3	SD Alternatives	Page 7, Paragraph B: Refers to "...a new footing at the south edge." Will this footing be prone to settlement? Should it be pile supported? Please clarify.	The concept of this section is to act as a transition between the sidewalks supported on piles and the sidewalks supported on grade. The flexible joints at each end will provide a transition between the pile supported plaza and the unpile supported walkways, which will likely continue to settle.
4	SD Alternatives	Subsheet 6: Detail shows new pile cap extension. Have calculations been performed to see if this is feasible? The concern is whether adequate strength can be developed in the interface with the existing pile cap.	Preliminary calculations have been performed. If this alternative is chosen, final calculations will be further developed to include steel sizes and dimensioning.
5	SD Alternatives	Subsheet 10: Reconstructed seawall is not identified. Please revise.	For the Schematic Design, we have considered that the dimensions of the reconstructed seawall would mimick the existing seawall.
6	VA Report	Page 12: Potential impacts to the monument from construction activities, especially pile driving, appear to be a significant risk. Was this considered? Please clarify.	Pile driving was considered and labeled as a high priority during the VA process.
7	VA Report	Page 22, Factor 2: Can the plaza safely support the weight of the construction equipment? Please clarify.	Types, size, etc of construction equipment and their impact to the plaza will be considered during the Design Development process.
8		End of review comments.	

Jeffe emorial A 128232
Repair & Control Settlement at Jefferson Memorial Seawall, North Plaza, & Transition Areas
Robert A. Merrick, PE Net construction
9-May-08 A/E:
Review: Draft Schematic Design Documents Submittal A/E Estimator: Kirk Associates
PM: MacDonald

Estimate Date: 2-May-08

	Estimated NET Construction (Base)	$22,343,501
	Estimated NET Construction (Option)	$0
Estimated NET Construction (Total)		**$22,343,501**

Preferred Alternative: Alternative 6

NPS Suggested Rates Mark-ups:		NPS Computed Amounts	A/E Used Rates	A/E Computed Amounts
	Shown for Base less mark ups	**$9,036,730**		**$9,036,730**
-0.9%	Location Factor	-$81,331	-0.9%	-$81,331
0%	Remoteness Factor	$0	0%	$0
8%	Federal Wage Rate Factor	$418,183	8%	$418,183
5.75%	State & Local Taxes	$219,043	5.75%	$219,043
25%	Design Contingency	$2,259,183	15%	$1,355,510
	Total Direct Construction Costs	**$11,851,808**		**$10,948,135**
25%	Standard General Conditions	$2,962,952	25%	$2,737,034
10%	Government General Conditions	$1,185,181	10%	$1,094,813
5%	Historic Preservation Factor	$592,590	5%	$547,407
	Sub-Total Net Construction Cost	**$16,592,531**		**$15,327,389**
12.5%	Overhead	$2,074,066	12.5%	$1,915,924
10%	Profit	$1,659,253	10%	$1,532,739
	Estimate Net Construction	**$20,325,850**		**$18,776,051**
5%	Contracting Method Adjustment	$1,016,293	5%	$938,803
7.5%	Inflation Escalation FY10 (Annual Rate 4%)	$1,524,439	12.5%	$2,347,006
1.5%	Bond	$348,222	1.5%	$281,641
	Total Estimate Net Cost of Base Construction	**$23,214,804**		**$22,343,501**

[redacted]

DENVER SERV ENTER

ESTIMATING REVIEWER: Robert A. Merrick, PE
DATE REVIEWED: 5/9/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	**Overall**	Estimate appears to be complete and professionally prepared. There is less than 4% difference between submitted estimate and NPS recommended.	
2	**Unit Costs**	For a schematic design package, unit costs and quantities appear to be a reasonable assessment of the work defined. No response necessary.	
3	**Mark-ups**	Inflation Escalation: NPS recommends 4% per year. Confusion - Submitted Basis of Estimate Statement states that assumed mid-point of construction to be July, 2009. with an 18 month construction period. I do not see this contract even being awarded until April-June of 2009. Project Manager has given an assumed award date of April, 4009, and a midpoint of March, 2010. At 4%/year	Comment noted, will address in future cost estimates.
4	**Mark-ups**	Design Contingency: I recommend keeping a 25% contingency in this project at this phase of design. Because of the unknowns involved in this project. I would even recommend a 5% contingency at final Construction documents.	Comment noted, will address in future cost estimates.
5		**End of Comments**	

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

NATURAL RESOURCE SPECIALIST
REVIEWER:
DATE REVIEWED:

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1		[no comments]	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

CULTURAL RESOURCE SPECIALIST
REVIEWER:
DATE REVIEWED:

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1		[no comments]	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

PROJECT SPECIALIST
REVIEWER: D.Denk
DATE REVIEWED: 5/2/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Class C Cost Estimates	Class C Estimate for North Plaza Alt 3, Basis of Estimate, Comments: states that 'work is assumed to be completed by land based equipment' but this alternative must use water based equip for the caissons - correct note and estimate if needed	This has been considered during development of later estimates.
2	Report, SD Preferred Alts, page 16, #2	Discussion of preferred alternative for Circular Roadway at Interface with North Plaza discusses only the west interface, but this work must also address the interface on the east side of the plaza. Revise discussion to add east side.	Please see revised report.
3	Report, SD Preferred Alts, Dwg Sheet 4	Work at West Terrace Walk is not indicated on this sheet but should be shown	Please see revised Sheet 4.
4	Report, SD Preferred Alts, Dwg Sheet 15	Sheet does not show the West Terrace Walkway work, or Circular Roadway work on east side of Plaza.	West Terrace Walkway work will be addressed in the Design Documents development. Circular Roadway work on the east side of the Plaza will be a similar concept to the work on the west side and will be addressed in the Design Documents development.
5		[end of comments]	
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

If comments go beyond this row, the sheet must be reformatted in order to print the additional lines.

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

PROJECT MANAGER
REVIEWER: Patrick Macdonald
DATE REVIEWED: 5/2/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	General	Please provide a narrative description of how execution of the caisson work will take place, describing in detail the work that is anticipated to take place from Plaza, the work that is anticipated to take place from the water (and whether this will be on barges, structures, etc.), how will spoils be handled/removed from site, etc. Describe the work in a way that makes clear what sorts of operations will be utilized and the impacts to the site.	Caissons will be drilled and constructed from the water. At this time, it is anticipated that the drilling, removal of spoils, and placement of rebar cages and concrete will be performed on a temporary bridge structure. It is also anticipated that the plaza would be used as a temporary staging area for the caisson cans and rebar cages.
2		[end of comments]	
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			

If comments go beyond this row, the sheet must be reformatted in order to print the additional lines.

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

PARK
REVIEWER:
DATE REVIEWED:

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1		[no comments]	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

If comments go beyond this row, the sheet must be reformatted in order to print the additional lines.

DENVER SERVICE CENTER
Quality Assurance

NAMA 128232

REGION
REVIEWER:
DATE REVIEWED:

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1		[no comments]	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

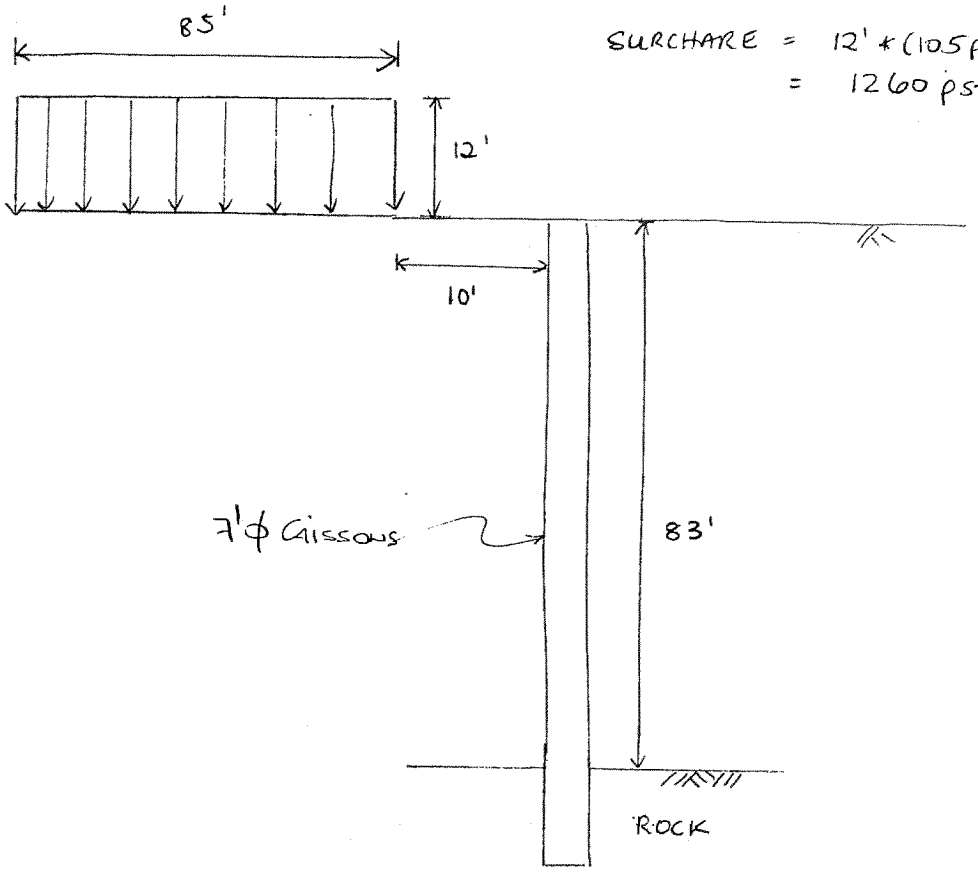
REVIEWER: Steve Brokken, PE, URS Group
DATE REVIEWED: 6/9/2008

NO.	DWG or SPEC SECTION	QUALITY ASSURANCE COMMENT	RESPONSE
1	Design, General	Per June 9 Memo from S.Brokken, address the potential for flow of soil between caissons - provide a narrative response with analysis as necessary to explain and justify Schnabel's differing view of this concern and/or how this concern will be addressed	The vertical soil movement observed is likely due to the compression or consolidation of soft soils due to the observed piezometric gradient. The lateral soil movement is likely the result of the fill beneath the plaza acting as a "surcharge" or "embankment". As consolidation of the tidal basin continues the "surcharge" or "embankment" influences the subsurface both vertically and laterally. The caissons are to be designed to resist only the lateral pressure imparted by the "surcharge" or "embankment". At this point, based on the instrumentation data collected, we do not view this issue as a mud flow or slope stability issue where the caissons need to be designed to resist a large migration of soil mass.
2	Design, General	Per June 9 Memo from S.Brokken, address concern regarding the stiffness of the caissons - provide a narrative response with analysis as necessary to explain and justify Schnabel's differing conclusion relating to this concern and/or how this concern will be addressed	As stated in No. 1, the lateral soil movement observed is likely due to the effective surcharge load of the plaza fill due to compression or consolidation of soft soils likely as a result of the observed differential head. The pressures described by URS may or may not develop; however, similar (but slightly lower) pressure will occur due the the surcharge of the north plaza backfill. The intent of the design is for the caissons to address the difference in these lateral pressures.
3	Design, General	As related to #2 above, please quantify (within a range) the expected amount of displacement of the caisson wall system under full loading	Please see the response to Comment 5.
4	Design, General	As related to #2 above, please comment on the recommendation that batter elements be installed to provide lateral support to the top of the wall - comment on the reasonableness of this recommendation, pros and cons of this recommendation, and whether further detailed design analysis of this recommendation is warranted in the next phase of design	Please see the response to Comment 6.

REVIEWER: Steve Brokken, PE, URS Group

5	Design, General	Per June 9 Memo from S.Brokken, address concern regarding the design approach to determination of loads on the caisson/"wall" system - provide a narrative response with analysis as necessary to explain and justify Schnabel's differing approach and loading conclusions relating to this concern and/or how this concern will be addressed	Based on an analysis of lateral pressures induced by the north plaza backfill on teh caissons, Schnabel has considered a maximum lateral force of about 5 k/ft acting on the caisson. At this stage, prior to fine tuning the design, we estimate the lateral deflection of the caissons to be in a range of 2 to 3.5 inches after 50 years.
6	Design, General	Per June 9 Memo from S.Brokken, address the suggestion regarding geometric arrangement of the caisson wall elements - provide a narrative response with analysis as necessary to explain and justify Schnabel's design and/or why this suggestion is/is not valid or how this suggestion could be addressed	Schnabel acknowledges URS's comments regarding the geometric arrangement of the caissons. We intend to "fine tune" the spacing, size, orientation, etc. of the caissons and also consider the use of tieback during the development of the DD. Although using tiebacks as part of the caisson solution is a reasonable option, we must note that the layout of the existing piles beneath the plaza and seawall will make it logistically difficult to fit tiebacks from the top of the caissons and extend them beneath the plaza. This will be addressed during the Design Development stage.
7	Design, General	Per June 9 Memo from S.Brokken, address the suggestion regarding extending the limits of the caisson wall elements - provide a narrative response with analysis as necessary to explain and justify Schnabel's design and/or why this suggestion is/is not valid or how this suggestion could be addressed	Schnabel acknowledges URS's comments regarding the potential for movement at the boundaries of the caisson walls. The limits shown on the Schematic Drawings were based on the projection of the soil movement beneath the plaza. The scope of this effort is to address movement of soil beneath the plaza and not the areas lateral of the plaza. These comments will be considered during the development of the DD.
8	Cost Estimate	Address S.Brokken comment that costs for the coffer dam appear to be light, and the potential for use of a barge does not appear to be included	Schnabel acknowledges URS's comments regarding the costs for the cofferdam and barge. These comments will be considered during the development of the DD.
9		[end of comments]	
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

CALCULATE LATERAL FORCE ON 7 FT DIAMETER CAISSONS
MODEL USING FILL AS SURCHARGE



SURCHARGE = 12' * (105 pcf)
= 1260 psf

USE RIGID WALL CONDITION IN CT SHORING PROGRAM

FROM CT SHORING OUTPUT, CALCULATE PRESSURE PER FOOT OF WALL

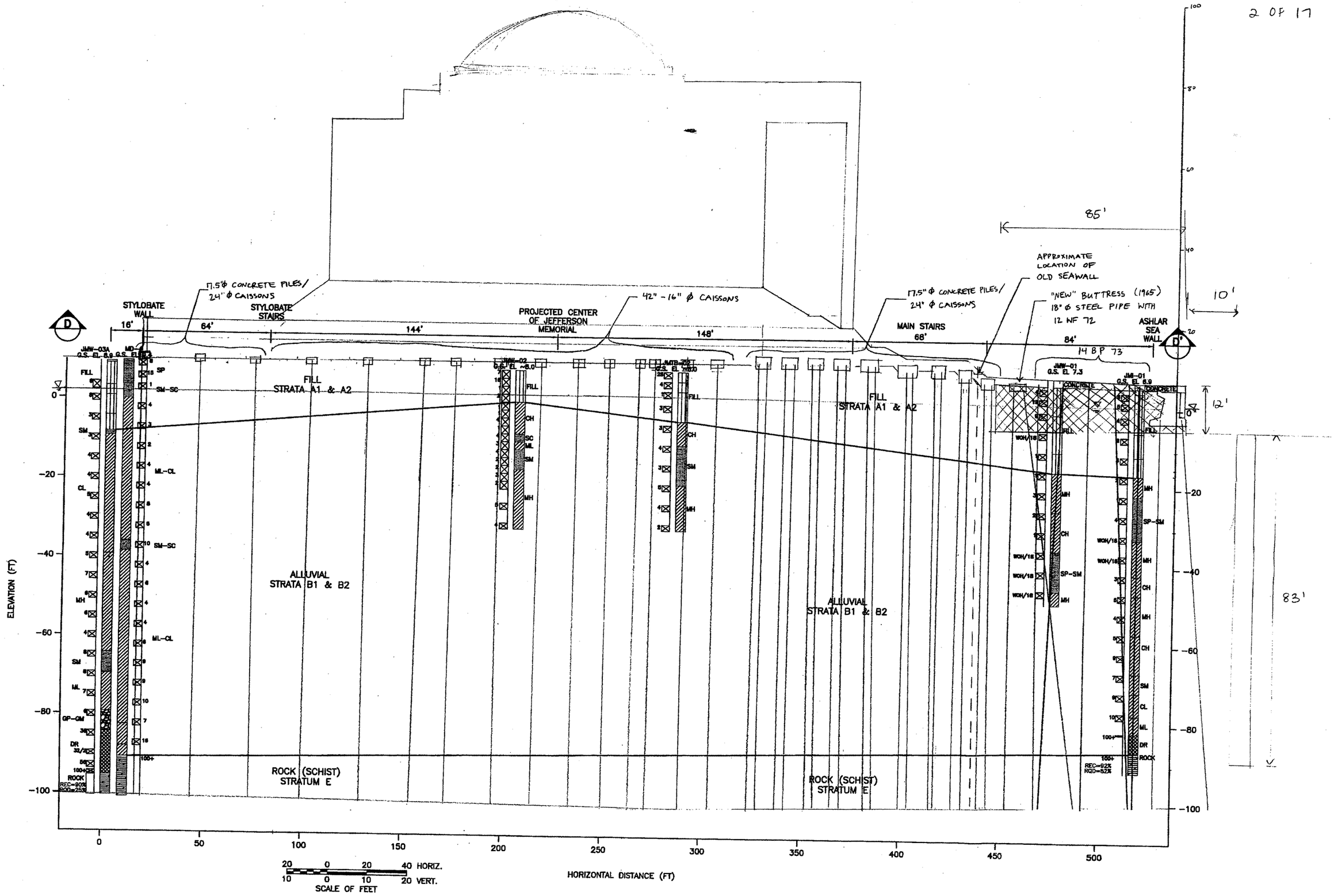
CAISSONS ARE 7' ϕ AND SPACED AT 10' C-C

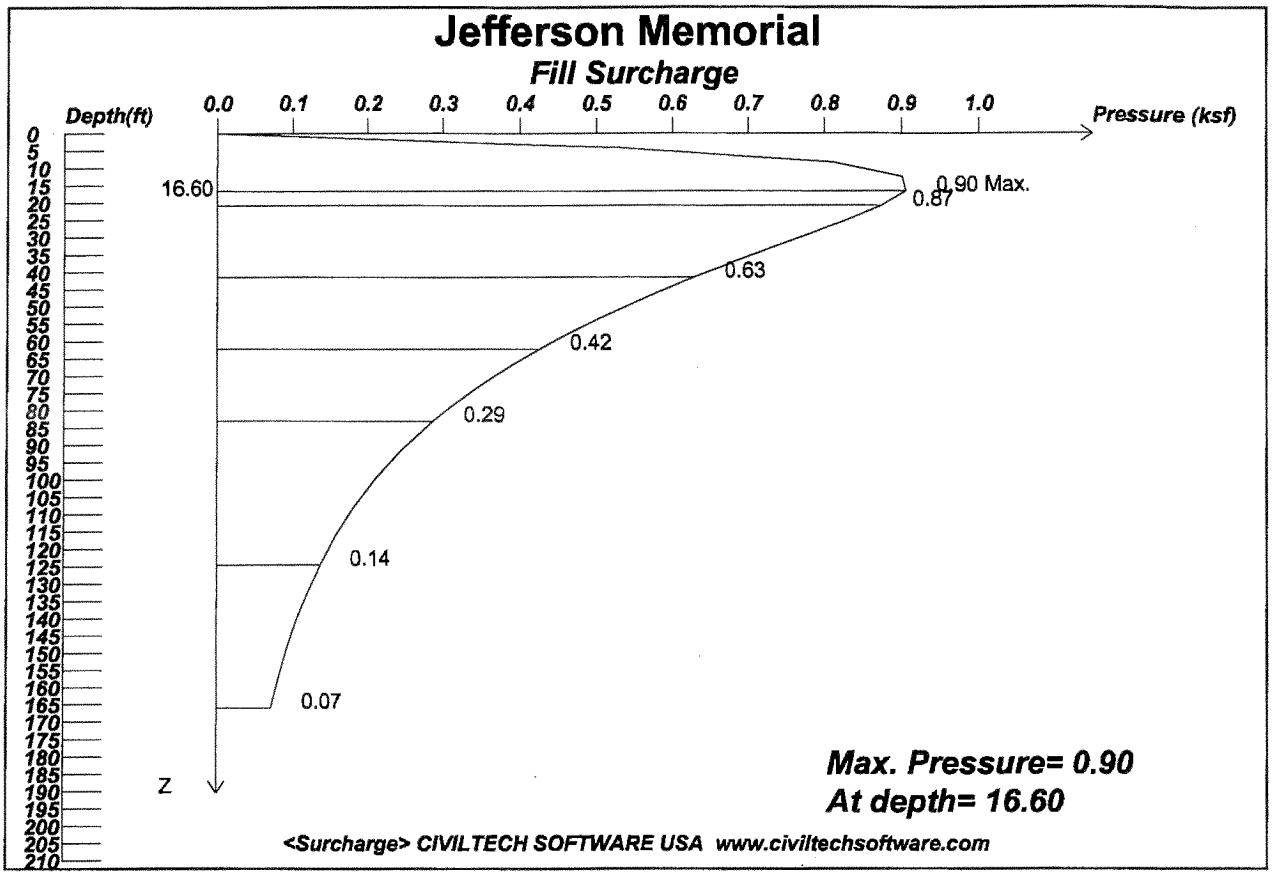
CT SHORING OUTPUT PROVIDES SURCHARGE PRESSURE IN KSF

USE OUTPUT TO FIND PRESSURE PER LENGTH OF WALL,
THEN PER FOOT OF CAISSON (10 FT SPACING, 7FT ϕ CAISSON)

AT A DEPTH OF 22', THE FORCE IS 5.1 KIPS PER LINEAR FT.

THE MAXIMUM FORCE IS 5.4 KIPS PER LINEAR FT.


17.5"ϕ CONCRETE PILES/ 24" ϕ CAISSONS
STYLOBATE WALL
STYLOBATE STAIRS
PROJECTED CENTER OF JEFFERSON MEMORIAL
42" - 16" ϕ CAISSONS
17.5" ϕ CONCRETE PILES/ 24" ϕ CAISSONS
APPROXIMATE LOCATION OF OLD SEAWALL
"NEW" BUTTRESS (1965) 18" ϕ STEEL PIPE WITH 12 WF 72
MAIN STAIRS
ASHLAR SEA WALL
85'
10'
12'
83'
16'
64'
144'
148'
68'
84'
14 BP 73
D
D'
JMW-03A G.S. EL 8.9
JMW-02 G.S. EL ~8.0
JMB-02 G.S. EL 9.0
JMW-01 G.S. EL 7.3
JMI-01 G.S. EL 8.9
FILL
STRATA A1 & A2
ALLUVIAL STRATA B1 & B2
ROCK (SCHIST) STRATUM E
CONCRETE
SP
SM-SC
ML-CL
SM
CL
MH
CH
SC
ML
GP-GM
DR
SP-SM
WOH/18
ROCK
REC=90%
RQD=25%
REC=92%
RQD=82%
ELEVATION (FT)
HORIZONTAL DISTANCE (FT)
0
50
100
150
200
250
300
350
400
450
500
0
-20
-40
-60
-80
-100
20 0 20 40 HORIZ.
10 0 10 20 VERT.
SCALE OF FEET



Licensed to D. Wilder Schnabel Engineering, LLC

Date: 7/10/2008 File: G:\2006Jobs\06150078.B Jefferson Memorial Predesign & Schematic Design\Calcs\Jefferson I

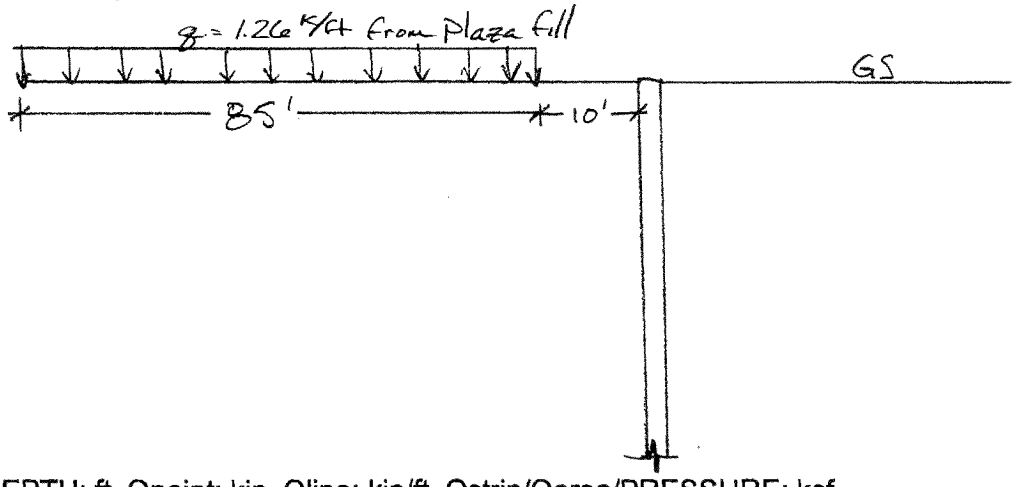
Wall Height, H= 83 Load Depth at Surface, D= 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

Max. Pressure = 0.905 at depth = 16.60

X	Width	Strip Load
10.0	85.0	1.26



UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

report.out

****

SURCHARGE LOADS CALCULATION SUMMARY
<Surcharge>
Software Copyright by CivilTech Software
www.civiltechsoftware.com

****

Licensed to D. Wilder Schnabel Engineering, LLC
Date: 7/10/2008 File: G:\2006Jobs\06150078.B Jefferson Memorial Predesign & Schematic Design\Calcs\Jefferson Fill Surcharge.lp8

Jefferson Memorial
Fill Surcharge

Height of Wall = 83
Depth of Wall = 0
Load Factor of Surcharge Loading = 1

Wall Condition:
Rigid Wall Condition -- No movement or deflection of the wall are allowed.

**********Loading**********

STRIP LOADING:

Xstrip	Width	Qstrip
10.0	85.0	1.3

**********Total Pressure Distribution**********

Max. Pressure =0.905 at depth =16.60

Depth	Pressure
0.00	0.000
4.15	0.530
8.30	0.810
12.45	0.901
16.60	0.905
20.75	0.874
24.90	0.829
29.05	0.779
33.20	0.727
37.35	0.677
41.50	0.628
45.65	0.582
49.80	0.539
53.95	0.498
58.10	0.460
62.25	0.425
66.40	0.392
70.55	0.362
74.70	0.334
78.85	0.309
83.00	0.286
91.30	0.244
99.60	0.210
107.90	0.181
116.20	0.156
124.50	0.136

132.80	0.118
141.10	0.104
149.40	0.091
157.70	0.080
166.00	0.071
182.60	0.056
199.20	0.045
215.80	0.037
232.40	0.030
249.00	0.025
265.60	0.021
282.20	0.018
298.80	0.015
315.40	0.013
332.00	0.000

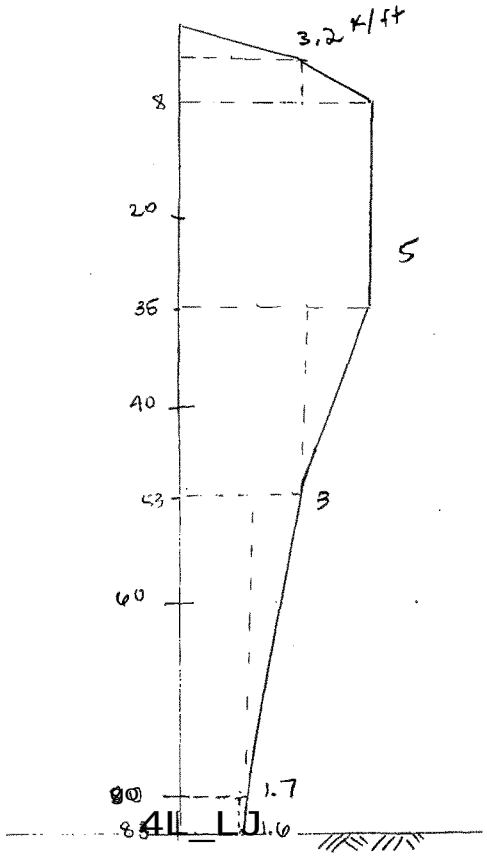
Depth Is Measured From Top of the Wall
LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Considers:
10ft spacing
7ft caisson

Depth (ft)	Surcharge Pressure (ksf)	Pressure Per Foot of Wall (k/ft)	Pressure Per Foot of Caisson (k/ft)
0	0		
4.15	0.53	2.20	3.14
8.3	0.81	3.36	4.80
12.45	0.901	3.74	5.34
16.6	0.905	3.76	5.37
20.75	0.874	3.63	5.18
24.9	0.829	3.44	4.91
29.05	0.779	3.23	4.62
33.2	0.727	3.02	4.31
37.35	0.677	2.81	4.01
41.5	0.628	2.61	3.72
45.65	0.582	2.42	3.45
49.8	0.539	2.24	3.20
53.95	0.498	2.07	2.95
58.1	0.46	1.91	2.73
62.25	0.425	1.76	2.52
66.4	0.392	1.63	2.32
70.55	0.362	1.50	2.15
74.7	0.334	1.39	1.98
78.85	0.309	1.28	1.83
83	0.286	1.19	1.70

} INTERPOLATE TO OBTAIN VALUE AT 22': 5.1 K/ft

PRESSURE PER FOOT OF CAISSON:



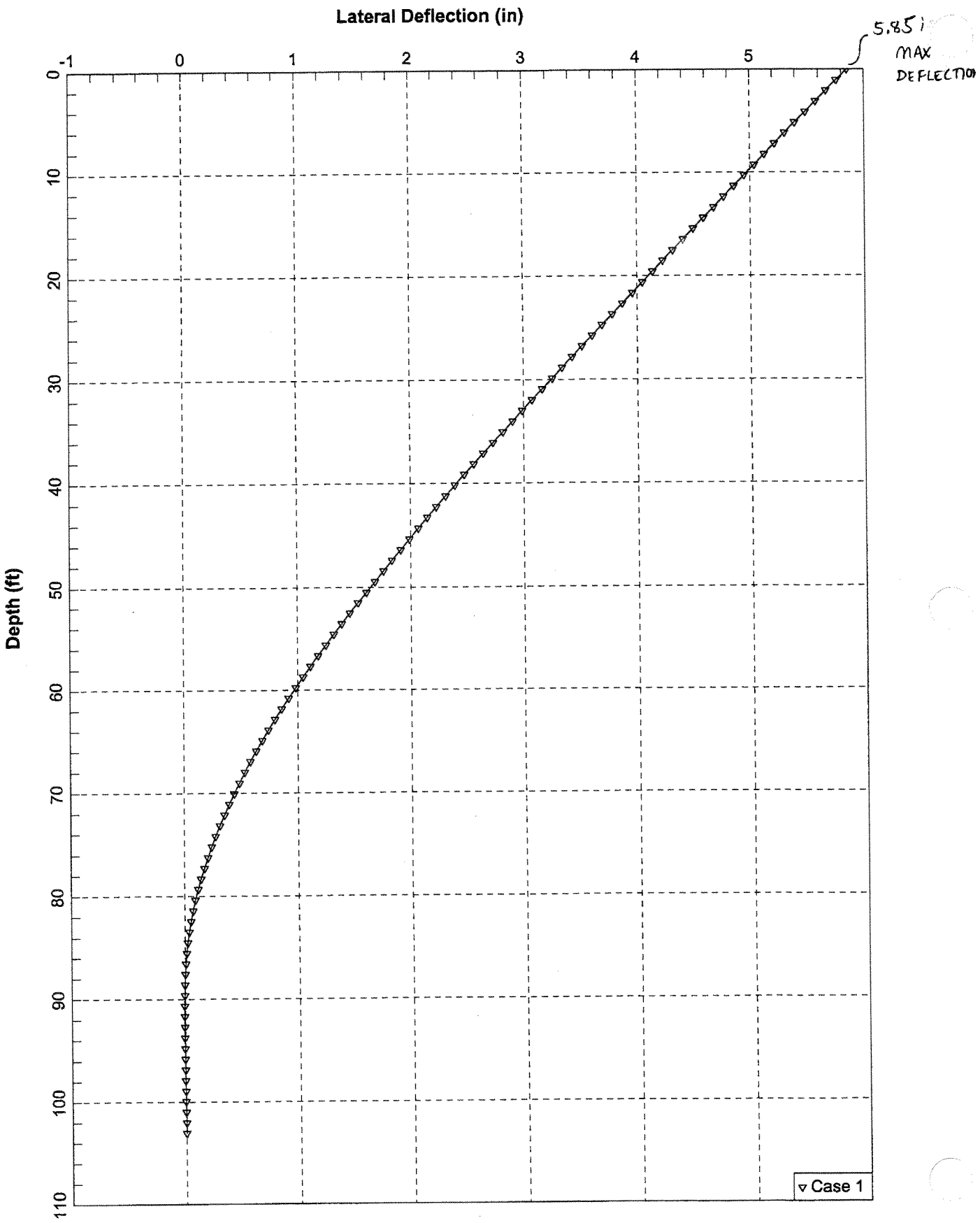
ΣArea = $\frac{1}{2}(4')(3.2\ k/f) + (4')(3.2\ k/f) + \frac{1}{2}(4)(1.8\ k/f) + (20')(1.8\ k/f) + (18')(3\ k/f) +$

$\frac{1}{2}(18')(2\ k/f) + (27')(1.7\ k/f) + \frac{1}{2}(27')(1.3\ k/f) + (3')(1.6\ k/f) + \frac{1}{2}(3')(.1\ k/f)$

$= 298.2\ k = 298{,}200\ lb$

PUT PRESSURE DISTRIBUTION INTO LPILE TO OBTAIN APPLIED DEFLECTION. MAX DEFLECTION = 5.85 in.

SEE LPILE OUTPUT AND FOLLOWING PAGES


Lateral Deflection (in)
-1
0
1
2
3
4
5
5.851
MAX
DEFLECTION
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
Case 1

Surcharge Loading.lpo

LPILE Plus for Windows, Version 5.0 (5.0.39)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This program is licensed to:

Helen Robinson
SEI

Path to file locations: G:\2006Jobs\06150078.B Jefferson Memorial Predesign & Schematic Design\Calcs\Schematic Design for DAB\LPILE\
Name of input data file: Surcharge Loading.lpd
Name of output file: Surcharge Loading.lpo
Name of plot output file: Surcharge Loading.lpp
Name of runtime file: Surcharge Loading.lpr

Time and Date of Analysis

Date: July 15, 2008 Time: 17:51:36

Problem Title

Jefferson Memorial - Surcharge Loading

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100

- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 10.000E-07 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 1236.00 in

Depth of ground surface below top of pile = 996.00 in

Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	84.00000000	2442681.	5539.0000	3684476.
2	1236.0000	84.00000000	2442681.	5539.0000	3684476.

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is strong rock (vuggy limestone)
Distance from top of pile to top of layer = 996.000 in
Distance from top of pile to bottom of layer = 1300.000 in

(Depth of lowest layer extends 64.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 2 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	996.00	.04000
2	1300.00	.04000

Shear Strength of Soils

Shear strength parameters with depth defined using 2 points

Surcharge Loading.lpo

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	996.000	2000.00000	.00	------	------
2	1300.000	2000.00000	.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Distributed Lateral Loading

Distributed lateral load intensity defined using 6 points

Point No.	Depth X in	Dist. Load lbs/in
1	48.000	267.00000
2	96.000	416.67000
3	420.000	416.67000
4	636.000	250.00000
5	960.000	141.67000
6	996.000	133.33000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = .000 lbs
Bending moment at pile head = .000 in-lbs
Axial load at pile head = .000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = .000 lbs
Specified moment at pile head = .000 in-lbs
Specified axial load at pile head = .000 lbs

(Zero moment for this load indicates free-head conditions)

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. Es*h p F/L lbs/in
0.000	5.849	.0015697	0.0000	-.0072964	2.6990E-08	0.0000
0.0000						
12.360	5.759	.0015174	0.0000	-.0072964	2.6091E-08	0.0000
0.0000						
24.720	5.669	.0015697	4.2334E-06	-.0072964	2.6990E-08	0.0000
0.0000						
37.080	5.579	.0016221	-2.1167E-06	-.0072964	2.7890E-08	0.0000
0.0000						
49.440	5.488	.0015174	1062.5330	-.0072964	2.6091E-08	0.0000
0.0000						
61.800	5.398	26265.8174	4041.0522	-.0072964	.4516203	0.0000
0.0000						
74.160	5.308	99894.8113	8111.2019	-.0072963	1.7176	0.0000
0.0000						
86.520	5.218	226775.	12657.7063	-.0072961	3.8992	0.0000
0.0000						
98.880	5.128	412793.	17616.5787	-.0072957	7.0977	0.0000
0.0000						
111.240	5.038	662257.	22758.1308	-.0072949	11.3870	0.0000
0.0000						
123.600	4.947	975374.	27908.1720	-.0072938	16.7708	0.0000
0.0000						
135.960	4.857	1352147.	33058.2132	-.0072922	23.2491	0.0000
0.0000						
148.320	4.767	1792573.	38208.2544	-.0072901	30.8219	0.0000
0.0000						
160.680	4.677	2296655.	43358.2956	-.0072872	39.4892	0.0000
0.0000						
173.040	4.587	2864390.	48508.3368	-.0072837	49.2510	0.0000
0.0000						
185.400	4.497	3495781.	53658.3780	-.0072793	60.1072	0.0000
0.0000						
197.760	4.407	4190826.	58808.4192	-.0072741	72.0580	0.0000
0.0000						
210.120	4.317	4949525.	63958.4604	-.0072678	85.1032	0.0000
0.0000						
222.480	4.227	5771879.	69108.5016	-.0072604	99.2430	0.0000
0.0000						
234.840	4.138	6657887.	74258.5428	-.0072519	114.4772	0.0000
0.0000						
247.200	4.048	7607550.	79408.5840	-.0072421	130.8059	0.0000
0.0000						
259.560	3.959	8620867.	84558.6252	-.0072309	148.2291	0.0000
0.0000						
271.920	3.869	9697839.	89708.6664	-.0072184	166.7468	0.0000
0.0000						

284.280	3.780	1.0838E+07	94858.7076	-.0072043	186.3590	0.0000
0.0000						
296.640	3.691	1.2043E+07	100009.	-.0071886	207.0657	0.0000
0.0000						
309.000	3.603	1.3311E+07	105159.	-.0071711	228.8668	0.0000
0.0000						
321.360	3.514	1.4642E+07	110309.	-.0071520	251.7625	0.0000
0.0000						
333.720	3.426	1.6038E+07	115459.	-.0071309	275.7526	0.0000
0.0000						
346.080	3.338	1.7496E+07	120609.	-.0071079	300.8372	0.0000
0.0000						
358.440	3.250	1.9019E+07	125759.	-.0070828	327.0164	0.0000
0.0000						
370.800	3.163	2.0605E+07	130909.	-.0070556	354.2900	0.0000
0.0000						
383.160	3.076	2.2255E+07	136059.	-.0070261	382.6581	0.0000
0.0000						
395.520	2.989	2.3969E+07	141209.	-.0069944	412.1207	0.0000
0.0000						
407.880	2.903	2.5746E+07	146359.	-.0069603	442.6778	0.0000
0.0000						
420.240	2.817	2.7587E+07	151501.	-.0069236	474.3293	0.0000
0.0000						
432.600	2.732	2.9491E+07	156583.	-.0068845	507.0720	0.0000
0.0000						
444.960	2.647	3.1457E+07	161554.	-.0068426	540.8836	0.0000
0.0000						
457.320	2.562	3.3484E+07	166407.	-.0067980	575.7392	0.0000
0.0000						
469.680	2.479	3.5571E+07	171142.	-.0067506	611.6136	0.0000
0.0000						
482.040	2.396	3.7715E+07	175760.	-.0067003	648.4817	0.0000
0.0000						
494.400	2.313	3.9916E+07	180259.	-.0066470	686.3186	0.0000
0.0000						
506.760	2.231	4.2171E+07	184641.	-.0065906	725.0993	0.0000
0.0000						
519.120	2.150	4.4480E+07	188904.	-.0065311	764.7985	0.0000
0.0000						
531.480	2.070	4.6841E+07	193050.	-.0064684	805.3913	0.0000
0.0000						
543.840	1.990	4.9252E+07	197078.	-.0064024	846.8527	0.0000
0.0000						
556.200	1.912	5.1713E+07	200988.	-.0063331	889.1576	0.0000
0.0000						
568.560	1.834	5.4221E+07	204780.	-.0062603	932.2809	0.0000
0.0000						
580.920	1.757	5.6775E+07	208454.	-.0061841	976.1975	0.0000
0.0000						
593.280	1.681	5.9374E+07	212011.	-.0061044	1020.8825	0.0000
0.0000						
605.640	1.606	6.2016E+07	215449.	-.0060210	1066.3108	0.0000
0.0000						
618.000	1.532	6.4699E+07	218770.	-.0059340	1112.4573	0.0000
0.0000						
630.360	1.459	6.7424E+07	221973.	-.0058433	1159.2970	0.0000
0.0000						
642.720	1.388	7.0187E+07	225076.	-.0057488	1206.8048	0.0000
0.0000						
655.080	1.317	7.2988E+07	228112.	-.0056505	1254.9634	0.0000
0.0000						
667.440	1.248	7.5826E+07	231098.	-.0055483	1303.7619	0.0000

0.0000						
679.800	1.180	7.8700E+07	234032.	-.0054422	1353.1895	0.0000
0.0000						
692.160	1.113	8.1611E+07	236916.	-.0053321	1403.2353	0.0000
0.0000						
704.520	1.048	8.4557E+07	239748.	-.0052180	1453.8885	0.0000
0.0000						
716.880	.984312	8.7537E+07	242530.	-.0050998	1505.1382	0.0000
0.0000						
729.240	.922021	9.0552E+07	245260.	-.0049775	1556.9735	0.0000
0.0000						
741.600	.861267	9.3600E+07	247939.	-.0048511	1609.3837	0.0000
0.0000						
753.960	.802102	9.6681E+07	250567.	-.0047204	1662.3578	0.0000
0.0000						
766.320	.744578	9.9794E+07	253144.	-.0045855	1715.8849	0.0000
0.0000						
778.680	.688748	1.0294E+08	255670.	-.0044463	1769.9543	0.0000
0.0000						
791.040	.634666	1.0611E+08	258145.	-.0043027	1824.5551	0.0000
0.0000						
803.400	.582384	1.0932E+08	260568.	-.0041548	1879.6765	0.0000
0.0000						
815.760	.531959	1.1256E+08	262941.	-.0040025	1935.3074	0.0000
0.0000						
828.120	.483444	1.1582E+08	265263.	-.0038456	1991.4372	0.0000
0.0000						
840.480	.436894	1.1911E+08	267533.	-.0036843	2048.0550	0.0000
0.0000						
852.840	.392367	1.2243E+08	269753.	-.0035185	2105.1498	0.0000
0.0000						
865.200	.349918	1.2578E+08	271921.	-.0033480	2162.7110	0.0000
0.0000						
877.560	.309604	1.2916E+08	274038.	-.0031730	2220.7274	0.0000
0.0000						
889.920	.271483	1.3256E+08	276104.	-.0029933	2279.1885	0.0000
0.0000						
902.280	.235611	1.3598E+08	278120.	-.0028089	2338.0832	0.0000
0.0000						
914.640	.202048	1.3943E+08	280084.	-.0026197	2397.4007	0.0000
0.0000						
927.000	.170851	1.4290E+08	281997.	-.0024259	2457.1302	0.0000
0.0000						
939.360	.142080	1.4640E+08	283858.	-.0022272	2517.2609	0.0000
0.0000						
951.720	.115794	1.4992E+08	285669.	-.0020237	2577.7817	0.0000
0.0000						
964.080	.092053	1.5346E+08	287432.	-.0018154	2638.6820	0.0000
0.0000						
976.440	.070917	1.5703E+08	289153.	-.0016022	2699.9520	0.0000
0.0000						
988.800	.052446	1.6061E+08	290840.	-.0013841	2761.5841	0.0000
0.0000						
1001.	.036702	1.6422E+08	-125471.	-.0011611	2823.5708	-67510.1957
2.2735E+07						
1014.	.023745	1.5751E+08	-836105.	-.0009401	2708.2538	-47490.1934
2.4720E+07						
1026.	.013462	1.4355E+08	-1295983.	-.0007334	2468.1916	-26923.6659
2.4720E+07						
1038.	.005615	1.2547E+08	-1531775.	-.0005487	2157.4076	-11230.4119
2.4720E+07						
1051.	-.000102	1.0568E+08	-1599923.	-.0003900	1817.1241	203.1900
2.4720E+07						

1063.	-.004025	8.5923E+07	-1548925.	-.0002584	1477.3743	8049.0062
2.4720E+07						
1075.	-.006489	6.7393E+07	-1418979.	-.0001531	1158.7673	12977.8491
2.4720E+07						
1088.	-.007809	5.0846E+07	-1242252.	-7.1920E-05	874.2498	15618.7862
2.4720E+07						
1100.	-.008267	3.6684E+07	-1043550.	-1.1816E-05	630.7591	16533.5776
2.4720E+07						
1112.	-.008101	2.5049E+07	-841238.	3.0574E-05	430.6981	16202.9787
2.4720E+07						
1125.	-.007511	1.5889E+07	-648268.	5.8685E-05	273.1983	15021.9962
2.4720E+07						
1137.	-.006651	9023820.	-473228.	7.5792E-05	155.1576	13301.6026
2.4720E+07						
1149.	-.005637	4190763.	-321345.	8.4866E-05	72.0569	11274.8612
2.4720E+07						
1162.	-.004553	1080161.	-195393.	8.8485E-05	18.5725	9105.8484
2.4720E+07						
1174.	-.003450	-639344.	-96475.4829	8.8788E-05	10.9930	6900.1654
2.4720E+07						
1187.	-.002358	-1304713.	-24686.4227	8.7453E-05	22.4335	4716.1874
2.4720E+07						
1199.	-.001288	-1249592.	20382.4025	8.5699E-05	21.4858	2576.5028
2.4720E+07						
1211.	-.000240	-800860.	39266.8952	8.4291E-05	13.7702	479.2404
2.4720E+07						
1224.	.000795	-278914.	32397.2475	8.3549E-05	4.7957	-1590.8338
2.4720E+07						
1236.	.001826	0.0000	0.0000	8.3358E-05	0.0000	-3651.4392
1.2360E+07						

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	5.84918452 in
Computed slope at pile head	=	-.00729644
Maximum bending moment	=	1.642163E+08 lbs-in
Maximum shear force	=	-1599923. lbs
Depth of maximum bending moment	=	1001.16000 in
Depth of maximum shear force	=	1050.60000 in
Number of iterations	=	18
Number of zero deflection points	=	2

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,	y = pile-head displacment in
Type 2 = Shear and Slope,	M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,	V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,	S = Pile-head Slope, radians
Type 5 = Deflection and Slope,	R = Rot. Stiffness of Pile-head in-lbs/rad

Surcharge Loading.lpo

Load Type	Pile-Head Condition 1		Pile-Head Condition 2		Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V=	0.000	M=	0.000	0.0000	5.8492	1.6422E+08	-1599923.

The analysis ended normally.

CALCULATE THE ULTIMATE LATERAL RESISTANCE OF A SINGLE PILE INSTALLED IN A COHESIVE SOIL (CONTE & TRONCONE, 2004)

$$P_y = \left(\sqrt{2} + \frac{\gamma z}{c_u}\right) c_u d$$

$$P_y = \left(\sqrt{2} + \frac{(105\,pcf)(22\,ft)}{(250\,psf)}\right)(250\,psf)(7\,ft)$$

$$P_y = 18645\ lb/ft = 18.6\ k/ft$$

LIMITING LATERAL FORCE PER UNIT LENGTH

$$P_y = (5.14 + 2\alpha) c_u d$$

FOR $\alpha = 0.5$

$$P_y = (5.14 + 2(0.5))(250\,psf)(7\,ft)$$

$$P_y = 10{,}745\ lb/ft = 10.7\ k/ft$$

FOR $\alpha = 1.0$

$$P_y = (5.14 + 2(1.0))(250\,psf)(7\,ft)$$

$$P_y = 12{,}495\ lb/ft = \boxed{12.5\ k/ft}$$

Max force that soil would exert on caisson at a limit equilibrium state.

Max anticipated lateral force is ~ 5.4 k/ft

Therefore soil flow is not anticipated

C

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

CONDITION ASSESSMENT OF THE ASHLAR SEAWALL MEMO
Prepared by Schnabel Engineering

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
May 16, 2008

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

Memo

To: **Patrick MacDonald, Doug Denk (National Park Service)**
cc: **Nathan James (HNTB Architecture, Inc.)**

From: **Darrell Wilder, P.E.**
Jesús E. Gómez, Ph.D., P.E.

Date: **May 16, 2008**

Subject: **06150078.B, Jefferson Memorial**
Condition Assessment of the Ashlar Seawall

This memo presents our survey of the Ashlar Seawall at the Jefferson Memorial. We have completed these services under our agreement dated December 26, 2007, and modified on February 12, 2008.

PURPOSE OF SURVEY

The granite capstones and Ashlar facing stones are original seawall elements, and therefore hold significant historical value. They will be preserved during construction and reused for repair or reconstruction of the wall. The purpose of the Ashlar Seawall condition assessment was to determine the general condition of the capstones and Ashlar facing stones so that methods of safely preserving the stones during construction may be developed. Schnabel examined all capstones and Ashlar facing stones of the seawall to identify areas of deterioration and cracking. This was accomplished through a visual inspection and documentation of the wall, and a limited physical evaluation using a Schmidt hammer.

DESCRIPTION OF SURVEY

The survey was completed on March 17-19, 2008, for the Ashlar facing stones, and on March 31, 2008, for the capstones. The capstones were inspected from the North Plaza, and the Ashlar facing stones were inspected from a small boat in the Tidal Basin. The Ashlar facing consists of two rows of stone blocks. The lower blocks are located within the tidal zone. We attempted to conduct the survey of the lower blocks during low tide; however, portions of the lower blocks were not visible and the entire lower block could not be inspected. From the boat, Schnabel personnel photographed each block of the Ashlar Seawall as part of the visual survey. The boat was positioned closer to the seawall to record measurements of the blocks, visual observations, and obtain Schmidt hammer readings.

The Schmidt hammer is a non-destructive device that was used to perform the physical evaluation. It contains a spring-loaded hammer that rebounds off the stone surface and records a rebound value. The rebound value correlates to the strength of the stone and shows consistency of the stone properties. Five rebounds were recorded for each block, one in each corner and one in the middle of the block.

SUMMARY OF OBSERVATIONS / FINDINGS

The Ashlar Seawall capstones and Ashlar facing stones appeared to be in generally good condition. The facing stones in the top row were on average 65 in. long and 40 in. high, and 70 in. long and 40 in. high in the bottom row. Light colored deposits (stains) were observed along the entire seawall that seem to be caused by leaching of the seawall concrete through the joint between the capstones and the upper facing blocks. These deposits are more significant at Section 8. As discussed in previous design documents, this section has rotated toward the Tidal Basin. It is not clear whether the staining and rotation are related or not. Deposits and/or discoloration were also observed on Blocks 4A, 5A, 6A, 7A, 38A, 39A, 50A, 52A, 24B, 55B, and 69B.

Minor cracks consisting of a maximum width of ½ inch and a varying length of 6 to 18 inches were observed on Blocks 19A, 20A, 33A, and 91A. Spalling was observed on Blocks 13A, 14A, 29A, 55A, 85A, 27B, 29B, and 81B. A significant crack with spalling exists at Block 33B, where the spalling width is 2 inches and the height is 13 inches. This block will require special measures for handling during removal and replacement. Photos of the deposits, cracks, and spalls are included in Appendix A. Sketches, notes, and Schmidt hammer values are included in Appendix B.

Schmidt hammer testing on the Ashlar facing shows consistent results on all stone blocks. The rebound values obtained using the Schmidt hammer in a horizontal position against the Ashlar facing blocks typically range from 42 to 66. This approximately correlates to a compressive strength greater than 9,000 psi. The results show little scatter within each block and throughout the full length of the seawall.

The capstones were nominally 69 in. long and 45 in. wide and were in generally good condition. Spalling was observed in Capstones 9, 47, 63, 65, and 66. At Capstones 47 and 63 the spalling occurs at the corner of the capstone. Capstone 65 has a crack along the entire width of the capstone. This capstone will require special measures for handling during removal and replacement.

We have endeavored to conduct and prepare the condition assessment of the Ashlar Seawall identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this agreement, or any report, opinion, document, or other instrument of service.

MLD:HR:DW:JEG:hcf

Appendix A: Photo Survey
Appendix B: Condition Assessment Data

Distribution:

National Park Service (2)
Attn: Mr. Patrick MacDonald,
Attn: Mr. Doug Denk

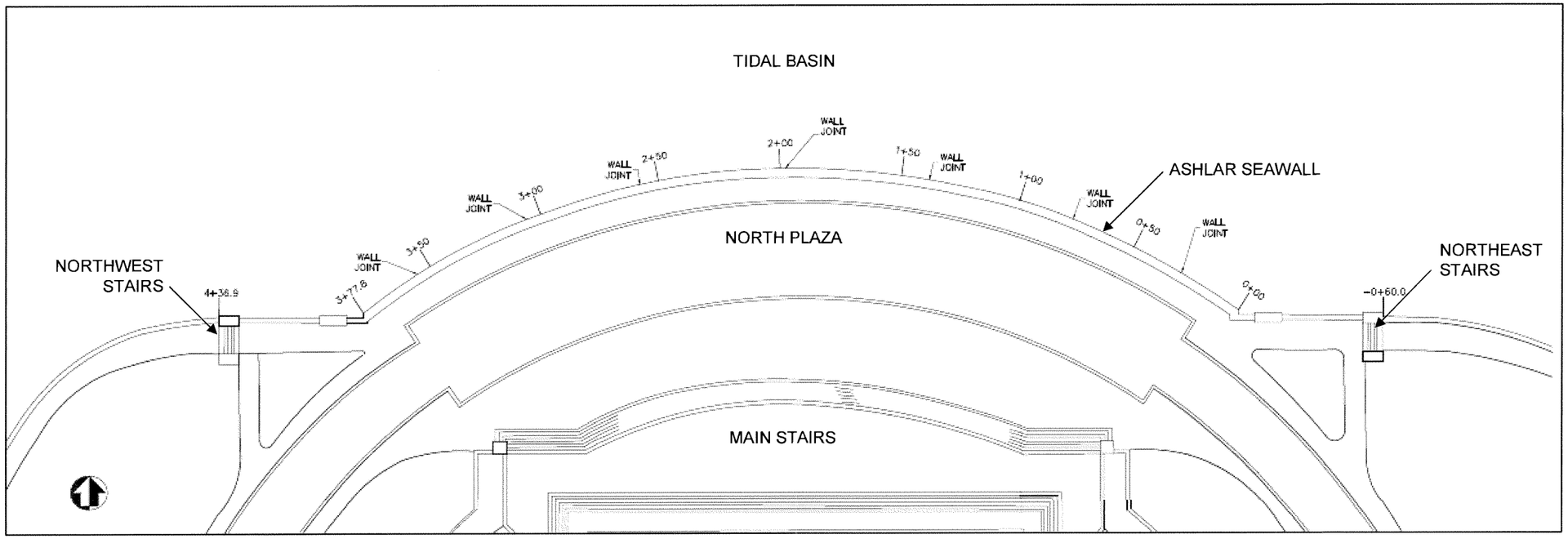
HNTB (1)
Attn: Mr. Nathan James

APPENDIX A

Photo Survey

Ashlar Facing
Capstones

Ashlar Facing



Section	Station			Facestone Block Numbers		
1	-0+60.0	to	0+00	1A to 11A	and	1B to 13B
2	0+00	to	0+27.9	12A to 16A	and	14B to 18B
3	0+27.9	to	0+77.4	17A to 25A	and	19B to 26B
4	0+77.4	to	1+37.0	26A to 36A	and	27B to 36B
5	1+37.0	to	1+96.5	37A to 47A	and	37B to 46B
6	1+96.5	to	2+56.1	48A to 58A	and	47B to 56B
7	2+56.1	to	3+05.6	59A to 67A	and	57B to 64B
8	3+05.6	to	3+55.1	68A to 76A	and	65B to 72B
9	3+55.1	to	3+77.8	77A to 81A	and	73B to 77B
10	3+77.8	to	4+36.9	82A to 92A	and	78B to 90B

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

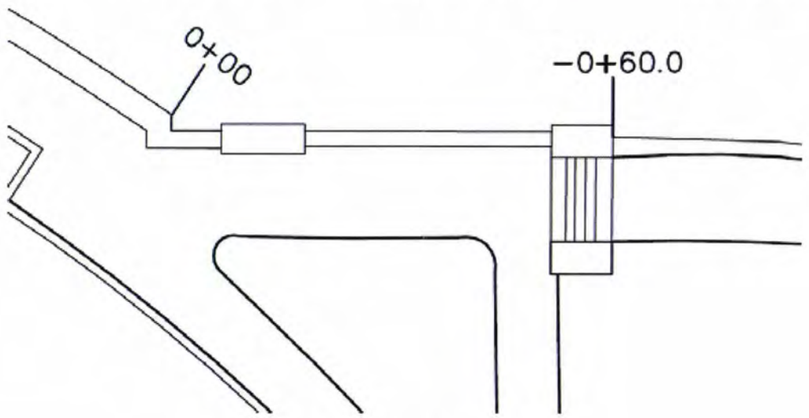
ASHLAR SEAWALL SURVEY
TITLE OF DRAWING

1
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR AND CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

MLD/HR
DESIGNED
MLD
DRAWN
CJR
CHECKED
PROJECT NO.
128232
DATE
05/16/2008
DWG. NO.
808/80284



SECTION 1

BLOCK 4A

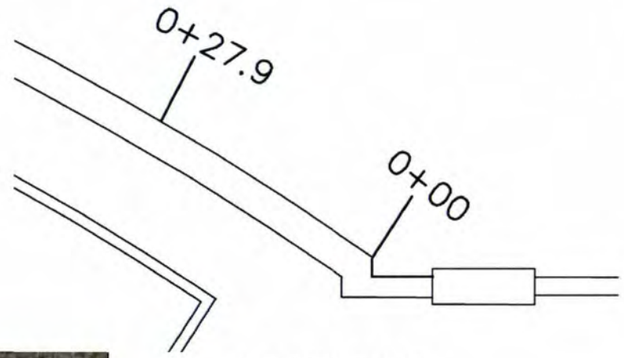
BLOCK 5A

BLOCK 6A

BLOCK 7A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	2 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR DESIGNED MLD DRAWN CJR CHECKED 128232 DATE 05/16/2008 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				



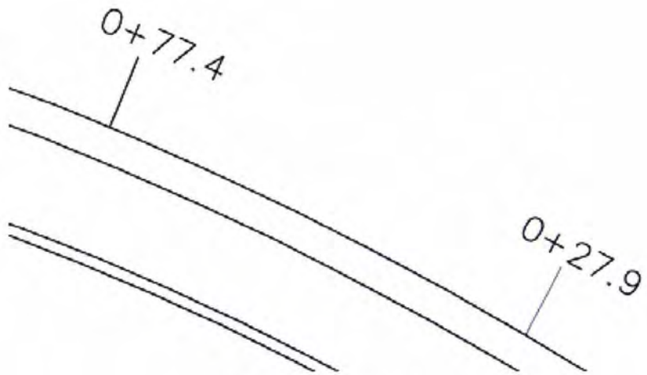
SECTION 2

BLOCKS 13A
& 14A

BLOCK 14A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	3 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	MLD/HR MLD CJB
								REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	128232 05/16/2008 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING					



SECTION 3

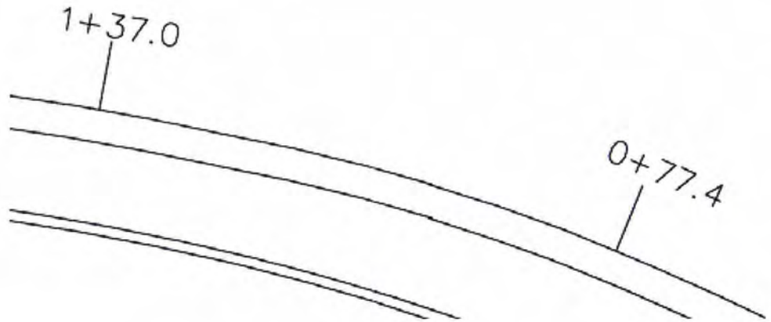
BLOCK 19A

BLOCK 20A

BLOCK 24B

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	4 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK ASHLAR SEAWALL SURVEY TITLE OF DRAWING	MLD/HR DESIGNED MLD DRAWN DJB CHECKED 128232 DATE 05/16/2008 808/80284



SECTION 4

BLOCK 27B

BLOCK 29B

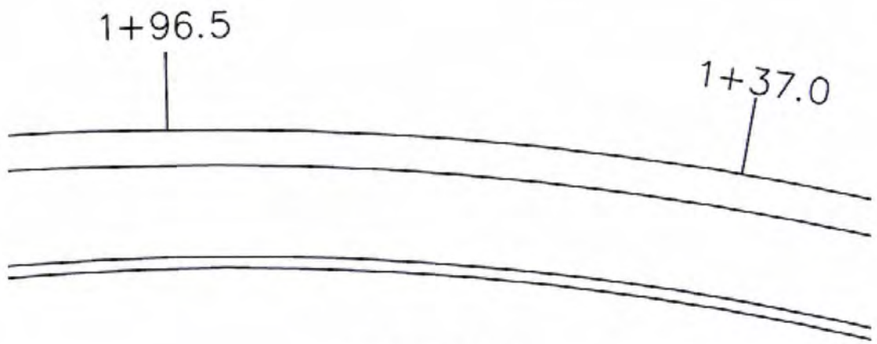
BLOCK 29A

BLOCK 33B

BLOCK 33A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
	ASHLAR SEAWALL SURVEY TITLE OF DRAWING						5 SUB SHEET NUMBER
							MLD/HR MLD CJR 128232 05/16/2008 808/80284



SECTION 5

BLOCK 38A

BLOCK 39A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	6 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	DESIGNED MLD/HR DRAWN MLD CHECKED CJB PROJECT NO. 128232 DATE 05/16/2008 DWG. NO. 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				

STA 1+96.5

BLOCK 50A

BLOCK 52A

BLOCK 55A

BLOCK 55B

STA 2+56.1

SECTION 6

BLOCK 50A

BLOCK 52A

BLOCK 55A

BLOCK 55B

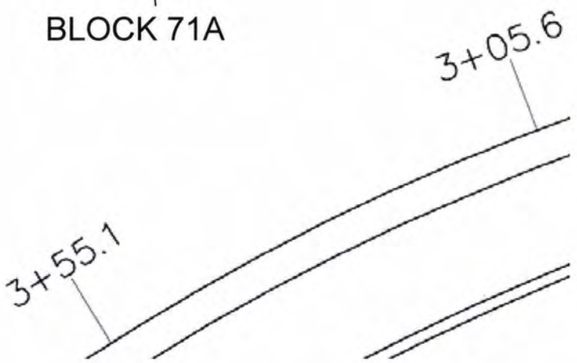
NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	7 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR MLD CJR 128232 05/16/2008 808/80284
								ASHLAR SEAWALL SURVEY TITLE OF DRAWING

SECTION 7

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	8 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR MLD CJR 128232 05/16/2008 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				

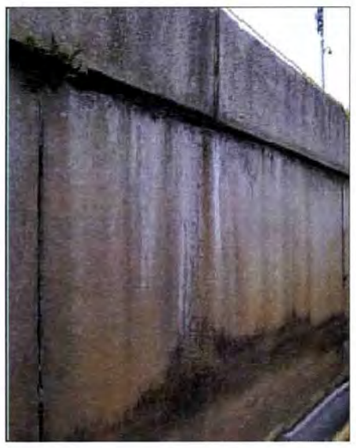


SECTION 8
(EAST PORTION)

BLOCK 68A

BLOCK 68A

BLOCK 69A



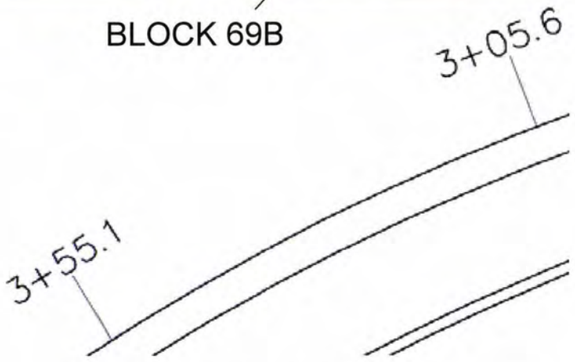
BLOCK 70A

BLOCK 71A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING			9 SUB SHEET NUMBER

DESIGNED MLD/HR
DRAWN MLD
CHECKED CJR
DRAWING NO. 128232
DATE 05/16/2008
ENG. NO. 808/80284



SECTION 8
(WEST PORTION)

BLOCK 72A

BLOCK 69B

BLOCK 73A

BLOCK 74A

BLOCK 76A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					
ASHLAR SEAWALL SURVEY (TITLE OF DRAWING)					

10 (SUB SHEET NUMBER)

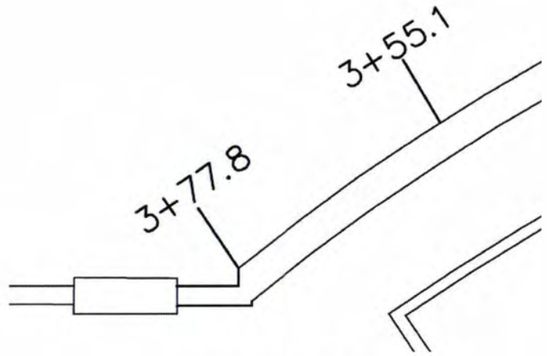
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR AND CONTROL SETTLEMENT (TITLE OF PROJECT)
THOMAS JEFFERSON MEMORIAL (LOCATION WITHIN PARK)
NATIONAL MALL & MEMORIAL PARKS (NAME OF PARK)

MLD/HR (REFERENCE)
MLD (DRAWN)
CJB (CHECKED)
128232 (PROJECT NO.)
05/16/2008 (DATE)
808/80284 (DWG. NO.)

STA 3+55.1

STA 3+77.8

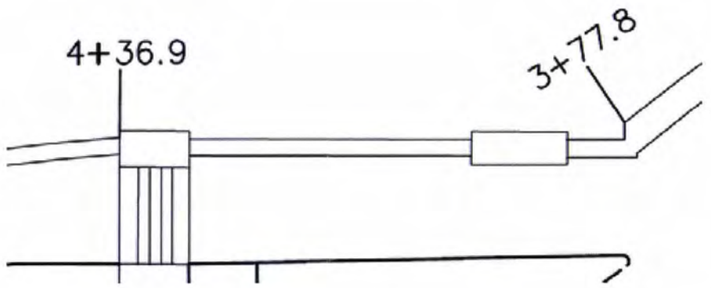


SECTION 9

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	11 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				

MLD/HR	
MLD	
CJR	
PROJECT NO.	128232
DATE	05/16/2008
DWG. NO.	808/80284



SECTION 10

BLOCK 85A

BLOCK 85A

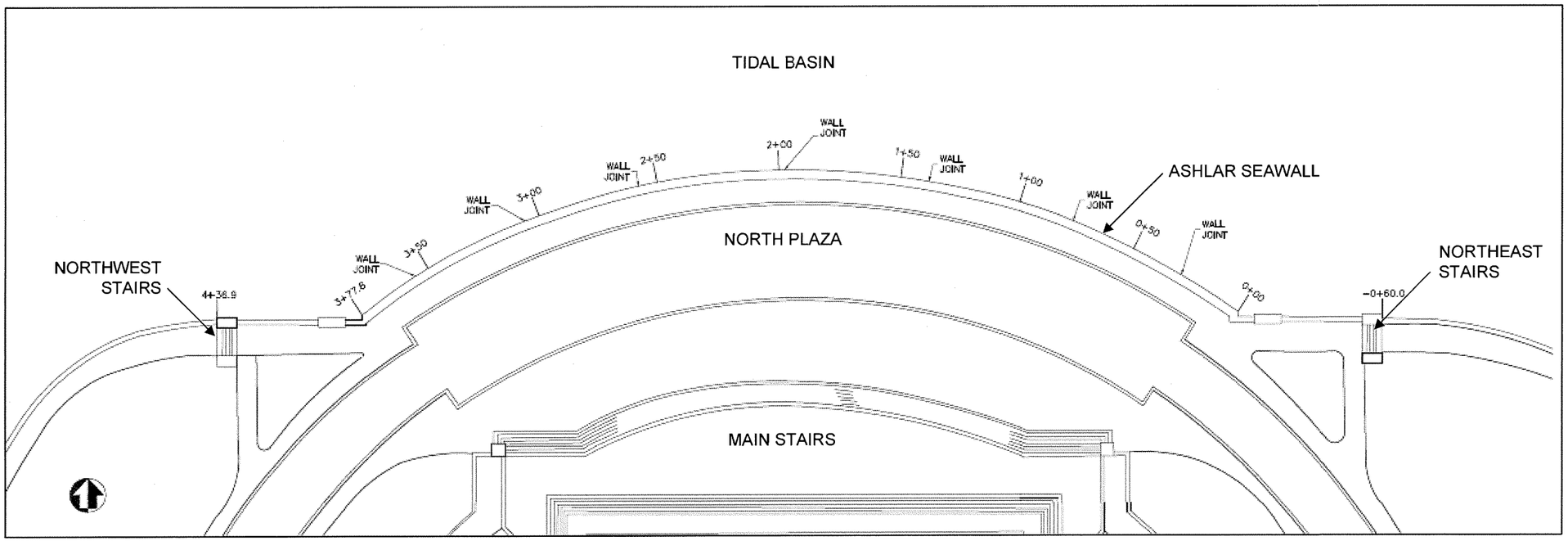
BLOCK 81B

BLOCK 91A

BLOCK 91A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	12 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR MLD CJR 128232 05/16/2008 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				



Section	Station			Facestone Block Numbers		
1	-0+60.0	to	0+00	1A to 11A	and	1B to 13B
2	0+00	to	0+27.9	12A to 16A	and	14B to 18B
3	0+27.9	to	0+77.4	17A to 25A	and	19B to 26B
4	0+77.4	to	1+37.0	26A to 36A	and	27B to 36B
5	1+37.0	to	1+96.5	37A to 47A	and	37B to 46B
6	1+96.5	to	2+56.1	48A to 58A	and	47B to 56B
7	2+56.1	to	3+05.6	59A to 67A	and	57B to 64B
8	3+05.6	to	3+55.1	68A to 76A	and	65B to 72B
9	3+55.1	to	3+77.8	77A to 81A	and	73B to 77B
10	3+77.8	to	4+36.9	82A to 92A	and	78B to 90B

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

ASHLAR SEAWALL SURVEY
TITLE OF DRAWING

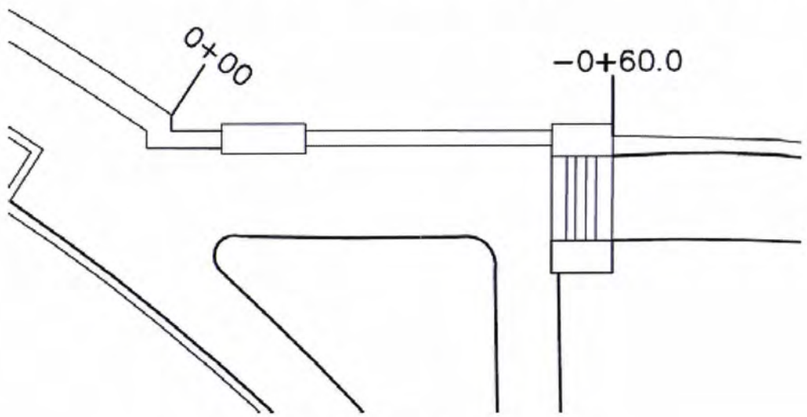
1
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR AND CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

MLD/HR
MLD
CJR

128232
05/16/2008
808/80284



SECTION 1

BLOCK 4A

BLOCK 5A

BLOCK 6A

BLOCK 7A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

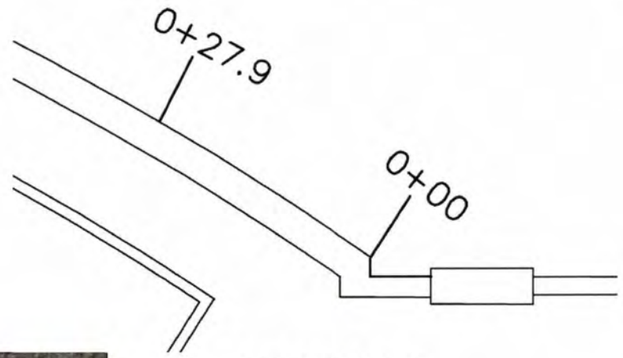
ASHLAR SEAWALL SURVEY
TITLE OF DRAWING

2
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR AND CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED	MLD/HR
DRAWN	MLD
CHECKED	CJR
PROJECT NO.	128232
DATE	05/16/2008
DWG. NO.	808/80284



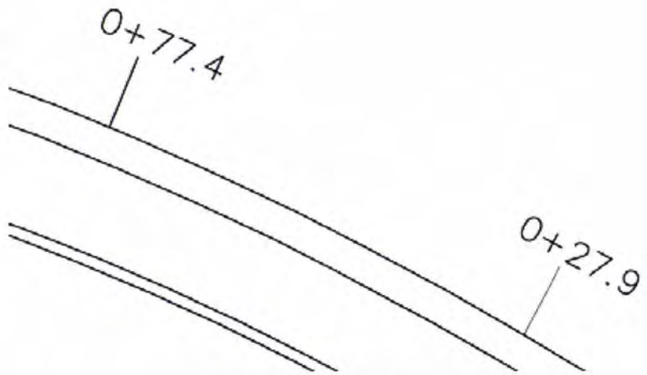
SECTION 2

BLOCKS 13A
& 14A

BLOCK 14A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	3 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR RECEIVED MLD DRAWN CJB CHECKED 128232 DATE 05/16/2008 DWG. NO. 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				



SECTION 3

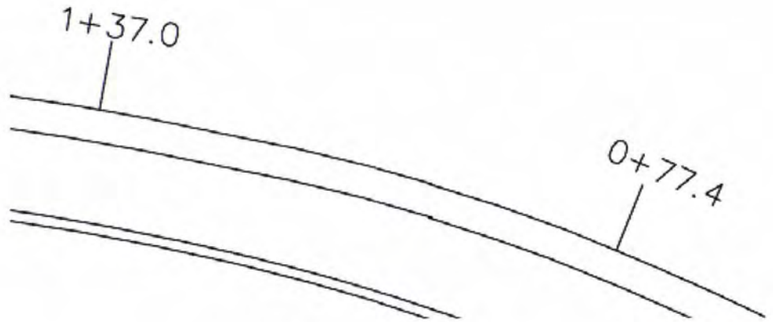
BLOCK 19A

BLOCK 20A

BLOCK 24B

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	4 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR MLD CJB 128232 05/16/2008 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				



SECTION 4

BLOCK 27B

BLOCK 29B

BLOCK 29A

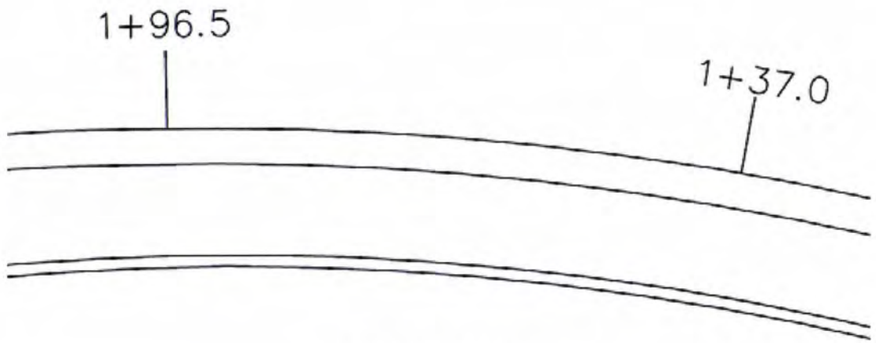
BLOCK 33B

BLOCK 33A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	5 SUB SHEET NUMBER
							UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
							ASHLAR SEAWALL SURVEY TITLE OF DRAWING

MLD/HR
RECEIVED
MLD
DRAWN
CJR
CHECKED
PROJECT NO.
128232
DATE
05/16/2008
DWG. NO.
808/80284



SECTION 5

BLOCK 38A

BLOCK 39A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	6 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
								MLD/HR DESIGNED MLD DRAWN CJB CHECKED 128232 DATE 05/16/2008 DWG. NO. 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				

SECTION 6

BLOCK 50A

BLOCK 52A

BLOCK 55A

BLOCK 55B

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

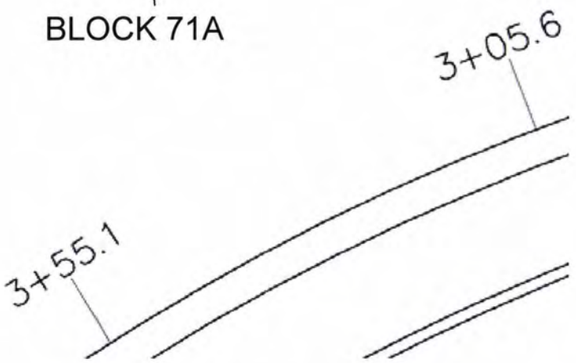
	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	7 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
	ASHLAR SEAWALL SURVEY TITLE OF DRAWING							

MLD/HR RECOMMEND
MLD DRAWN
CJB CHECKED
PROJECT NO. 128232
DATE 05/16/2008
DWG. NO. 808/80284

SECTION 7

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	8 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR MLD CJR 128232 05/16/2008 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				



SECTION 8
(EAST PORTION)

BLOCK 68A

BLOCK 68A

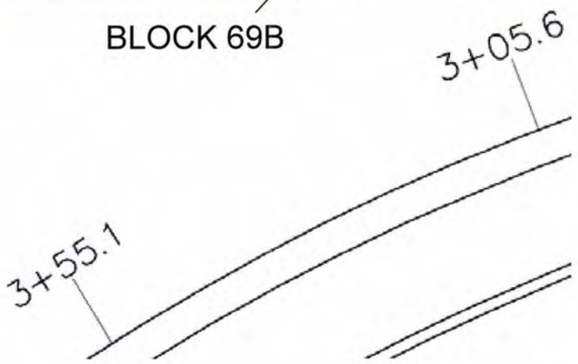
BLOCK 69A

BLOCK 70A

BLOCK 71A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	9 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK ASHLAR SEAWALL SURVEY TITLE OF DRAWING	MLD/HR MLD CJR 128232 05/16/2008 808/80284



SECTION 8
(WEST PORTION)

BLOCK 72A

BLOCK 69B

BLOCK 73A

BLOCK 74A

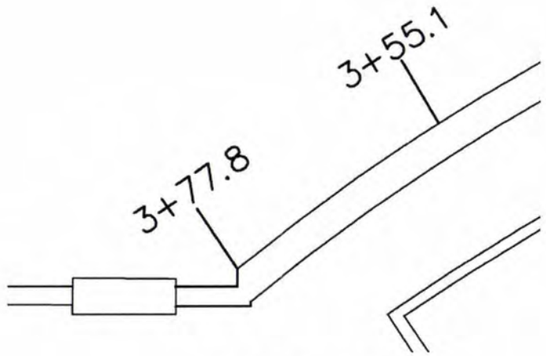
BLOCK 76A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	10 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK ASHLAR SEAWALL SURVEY TITLE OF DRAWING	MLD/HR MLD CJR 128232 05/16/2008 808/80284

STA 3+55.1

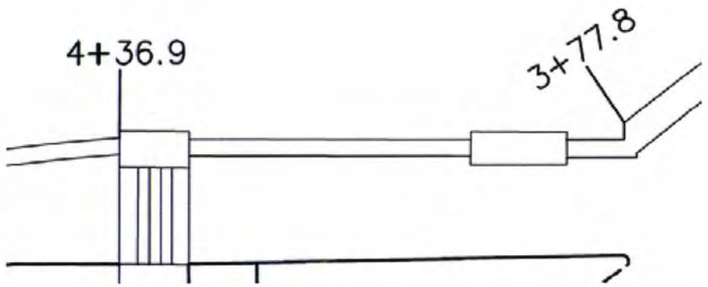
STA 3+77.8



SECTION 9

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	11 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR MLD CJR 128232 05/16/2008 808/80284
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				



SECTION 10

BLOCK 85A

BLOCK 85A

BLOCK 81B

BLOCK 91A

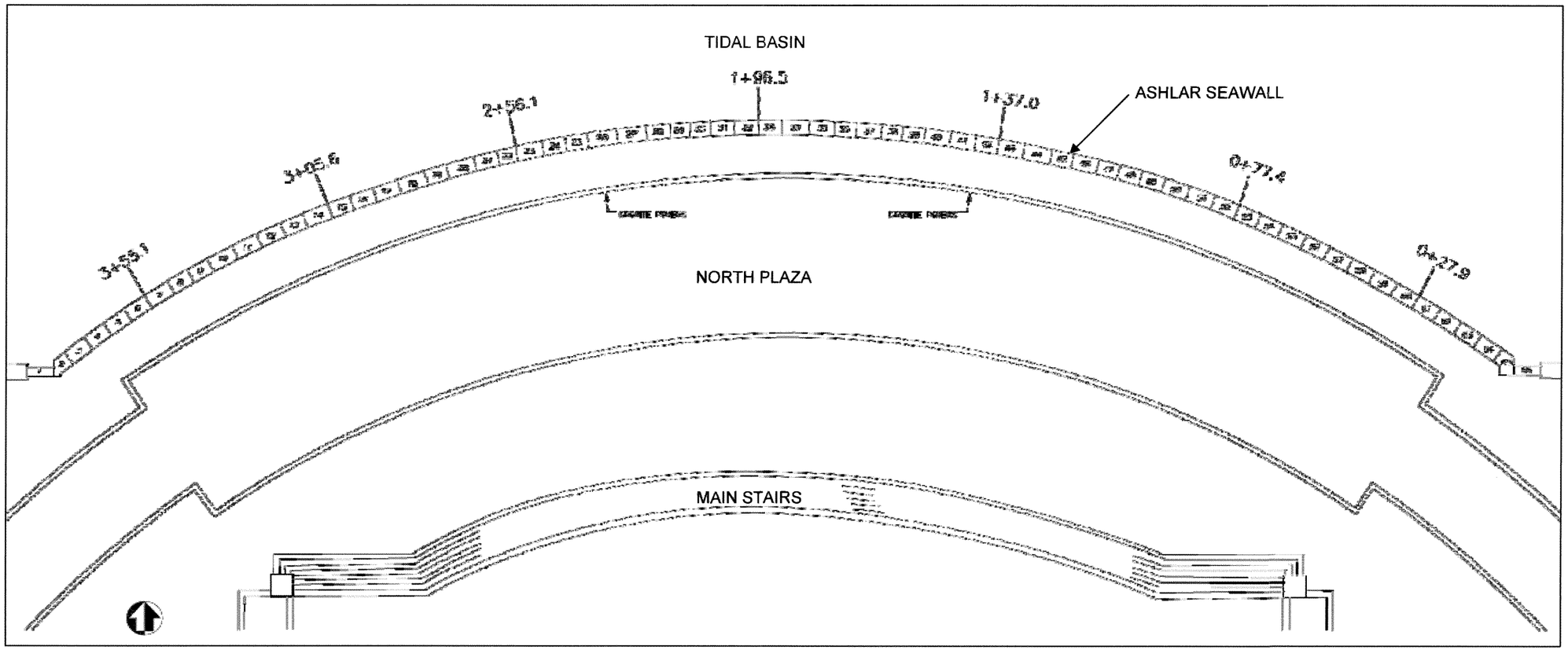
BLOCK 91A

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	12 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
				ASHLAR SEAWALL SURVEY TITLE OF DRAWING				REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK

DESIGNED	MLD/HR
DRAWN	MLD
CHECKED	CJR
PROJECT NO.	128232
DATE	05/16/2008
DWG. NO.	808/80284

Capstones



Section	Station			Capstone Block Numbers		
1	-0+60.0	to	0+00	Parapet Wall (capstones not accessible)		
2	0+00	to	0+27.9	61	to	66
3	0+27.9	to	0+77.4	53	to	60
4	0+77.4	to	1+37.0	43	to	52
5	1+37.0	to	1+96.5	33	to	42
6	1+96.5	to	2+56.1	23	to	32
7	2+56.1	to	3+05.6	15	to	22
8	3+05.6	to	3+55.1	7	to	14
9	3+55.1	to	3+77.8	1	to	7
10	3+77.8	to	4+36.9	Parapet Wall (capstones not accessible)		

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

CAPSTONE SURVEY
TITLE OF DRAWING

13
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

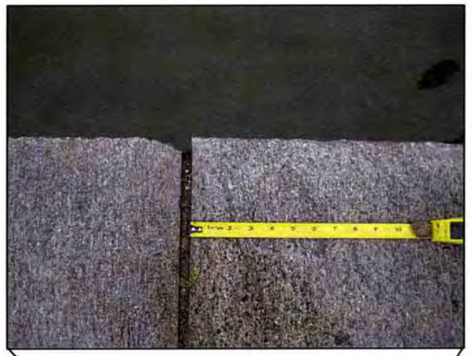
REPAIR AND CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

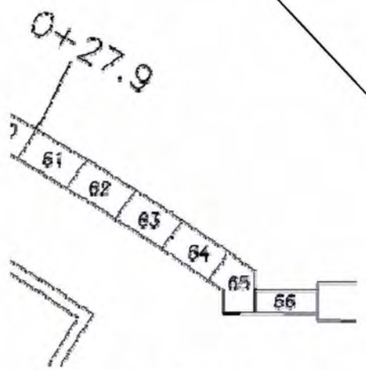
DESIGNED	MLD/HR
DRAWN	MLD
CHECKED	DJB
PROJECT NO.	128232
DATE	05/16/2008
DWG. NO.	808/80284

CAPSTONE 66

CAPSTONE 65

CAPSTONE 64





SECTION 2

CAPSTONE 63

CAPSTONE 62

CAPSTONE 61

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

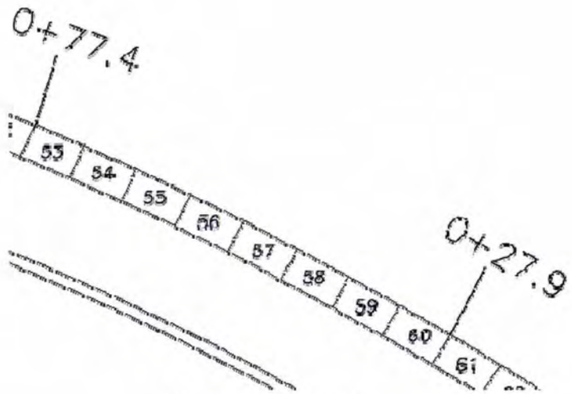
	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	14 SUB SHEET NUMBER
							UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
				CAPSTONE SURVEY TITLE OF DRAWING			MLD/HR REVIEWED MLD DRAWN CJB CHECKED AREA/PROJ NO. 128232 DATE 05/16/2008 DWG. NO. 808/80284

CAPSTONE 60

CAPSTONE 59

CAPSTONE 58

CAPSTONE 57



SECTION 3

CAPSTONE 56

CAPSTONE 55

CAPSTONE 54

CAPSTONE 53

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	15 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	MLD/HR DESIGNED MLD DRAWN CJB CHECKED PROJECT NO. 128232 DATE 05/16/2008 DWG. NO. 808/80284
				CAPSTONE SURVEY TITLE OF DRAWING				

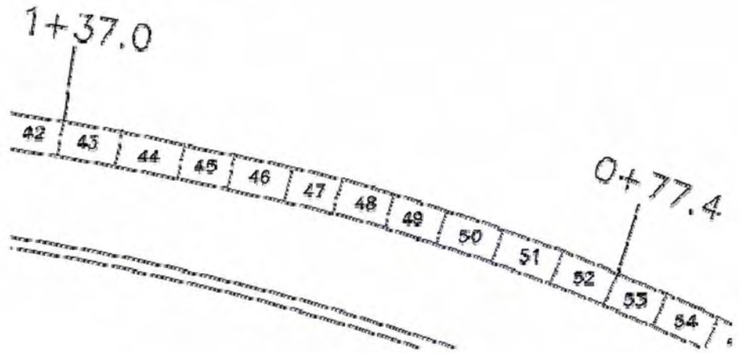
CAPSTONE 52

CAPSTONE 51

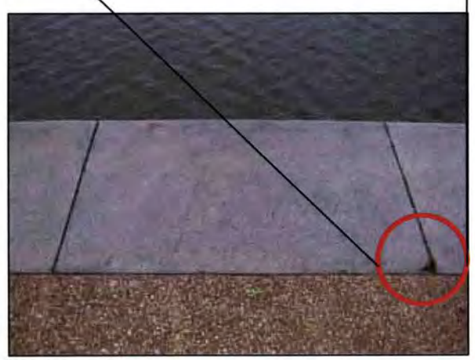
CAPSTONE 50

CAPSTONE 49

CAPSTONE 48



SECTION 4



CAPSTONE 47

CAPSTONE 46

CAPSTONE 45

CAPSTONE 44

CAPSTONE 43

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	16 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	DESIGNED MLD/HR DRAWN MLD CHECKED CJB PROJECT NO. 128232 DATE 05/16/2008 DWG. NO. 808/80284
				CAPSTONE SURVEY TITLE OF DRAWING				

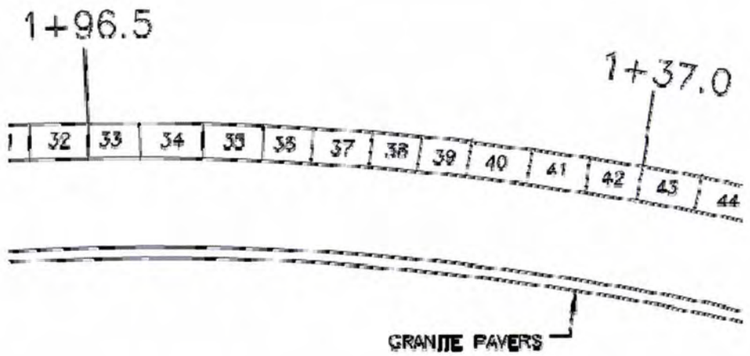
CAPSTONE 42

CAPSTONE 41

CAPSTONE 40

CAPSTONE 39

CAPSTONE 38



SECTION 5

CAPSTONE 37

CAPSTONE 36

CAPSTONE 35

CAPSTONE 34

CAPSTONE 33

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

CAPSTONE SURVEY
TITLE OF DRAWING

17
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

REPAIR AND CONTROL SETTLEMENT
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

MLD/HR
DESIGNED
MLD
DRAWN
CJR
CHECKED
FIELD/WO NO.
128232
DATE
05/16/2008
DWG. NO.
808/80284

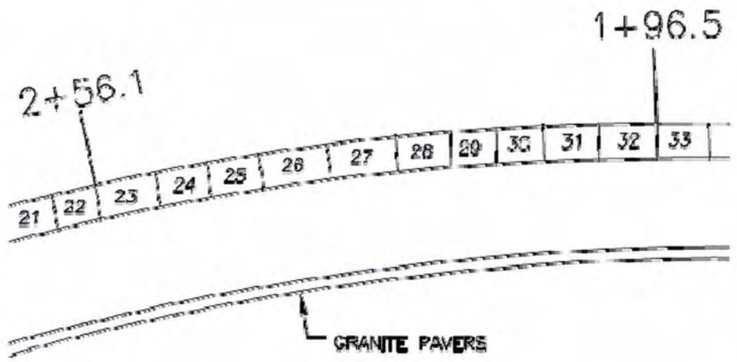
CAPSTONE 32

CAPSTONE 31

CAPSTONE 30

CAPSTONE 29

CAPSTONE 28



SECTION 6

CAPSTONE 27

CAPSTONE 26

CAPSTONE 25

CAPSTONE 24

CAPSTONE 23

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

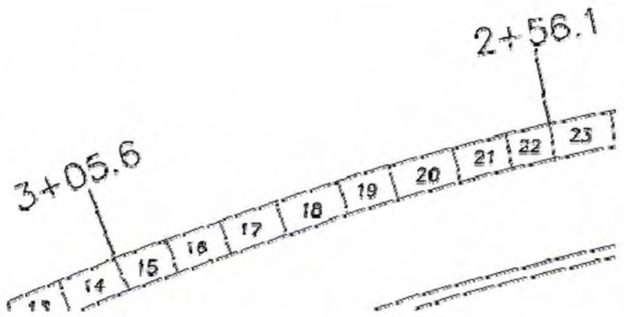
	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	18 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK CAPSTONE SURVEY TITLE OF DRAWING	DESIGNED MLD/HR DRAWN MLD CHECKED CJB PROJECT NO. 128232 DATE 05/16/2008 DWG. NO. 808/80284

CAPSTONE 22

CAPSTONE 21

CAPSTONE 20

CAPSTONE 19



SECTION 7

CAPSTONE 18

CAPSTONE 17

CAPSTONE 16

CAPSTONE 15

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	19 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
								CAPSTONE SURVEY TITLE OF DRAWING

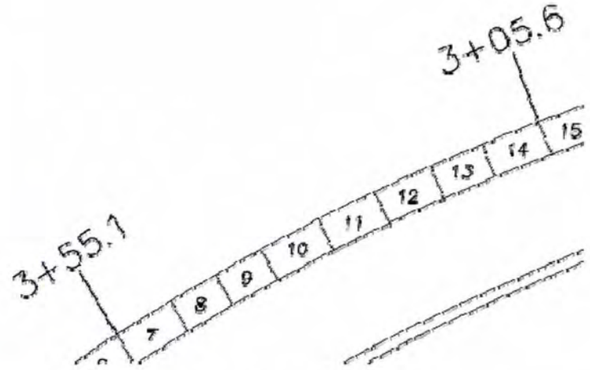
DESIGNED	MLD/HR
DRAWN	MLD
CHECKED	CJR
PROJECT NO.	128232
DATE	05/16/2008
DWG. NO.	808/80284

CAPSTONE 14

CAPSTONE 13

CAPSTONE 12

CAPSTONE 11



SECTION 8

CAPSTONE 10

CAPSTONE 9

CAPSTONE 8

CAPSTONE 7

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

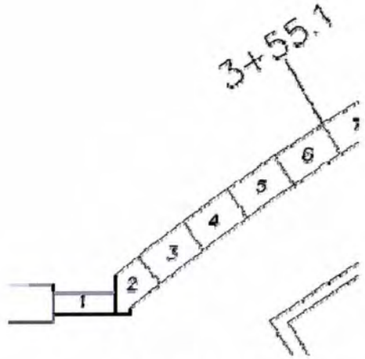
	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	20 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
								CAPSTONE SURVEY TITLE OF DRAWING

MLD/HR
REVIEWED
MLD
DRAWN
CJB
CHECKED
PROJECT NO.
128232
DATE
05/16/2008
DWG. NO.
808/80284

CAPSTONE 6

CAPSTONE 5

CAPSTONE 4



SECTION 9

CAPSTONE 3

CAPSTONE 2

CAPSTONE 1

NOTE: GEOMETRY IS BASED ON HISTORICAL DOCUMENTS AND MUST BE VERIFIED IN THE FIELD.

	A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
							REPAIR AND CONTROL SETTLEMENT TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK
				CAPSTONE SURVEY TITLE OF DRAWING			21 SUB SHEET NUMBER

MLD/HR	
DESIGNED	MLD
DRAWN	CJB
CHECKED	
PROJECT NO.	128232
DATE	05/16/2008
DWG. NO.	808/80284

APPENDIX B

Condition Assessment Data

Ashlar Facing
Capstones

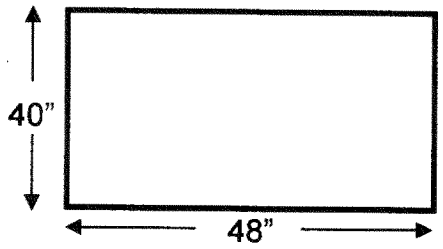
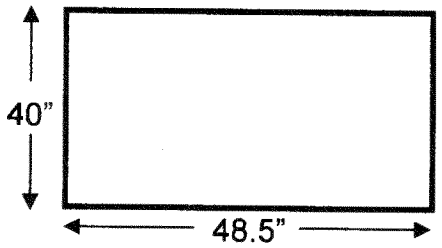
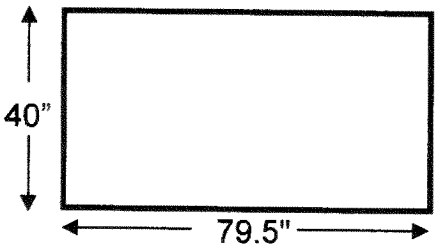
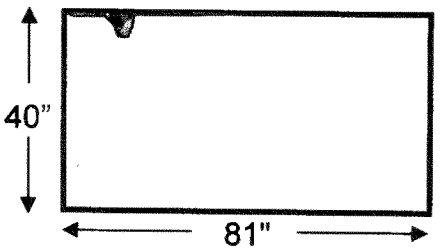
Ashlar Facing

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

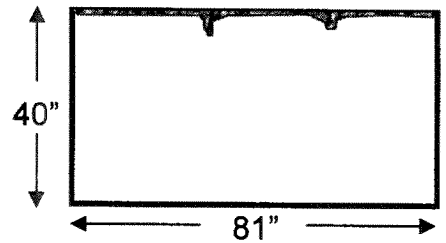
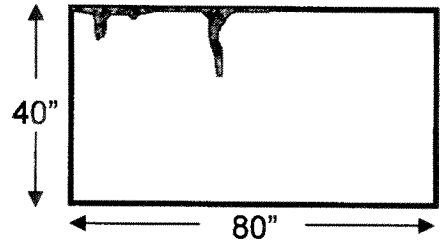
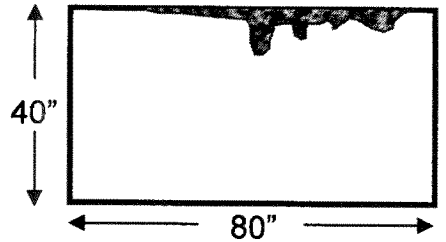
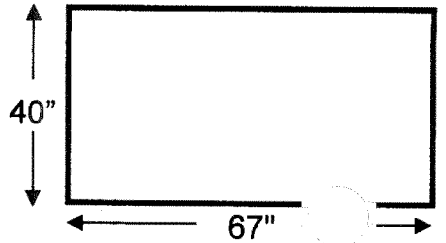
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 1A	1	58	Parapet block extends 20-1/2" north at transition to rubble seawall	
	2	62		
	3	58		
	4	61		
	5	58		
	Avg.	59.4		
Block 2A	1	54	Parapet block extends 13" north beyond adjacent Ashlar Seawall.	
	2	62		
	3	62		
	4	55		
	5	64		
	Avg.	59.4		
Block 3A	1	50		
	2	54		
	3	58		
	4	56		
	5	62		
	Avg.	56		
Block 4A	1	54	Upper portion of block contains deposits and discoloration.	
	2	60	(See photo)	
	3	62		
	4	57		
	5	50		
	Avg.	56.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

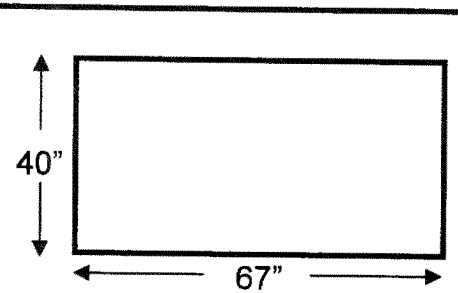
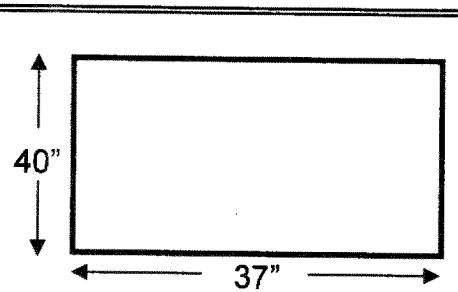
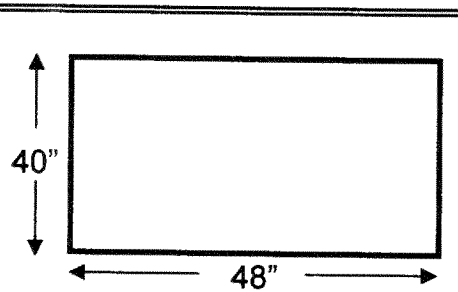
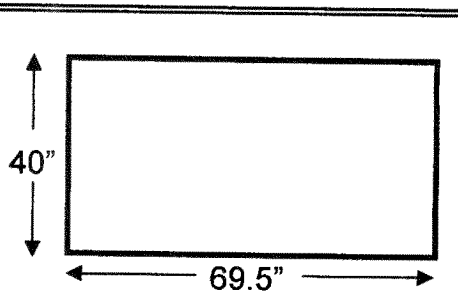
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 5A	1	54	Upper portion of block contains deposits and discoloration.	
	2	60		
	3	60		
	4	50		
	5	50		
	Avg.	54.8		
Block 6A	1	60	Upper portion of block contains deposits and discoloration.	
	2	56		
	3	55		
	4	60		
	5	52		
	Avg.	56.6		
Block 7A	1	52	Upper portion of block contains deposits and discoloration.	
	2	48		
	3	48		
	4	58		
	5	57		
	Avg.	52.6		
Block 8A	1	58	Parapet block extends 9" north beyond adjacent Ashlar Seawall.	
	2	49		
	3	54		
	4	60		
	5	60		
	Avg.	56.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

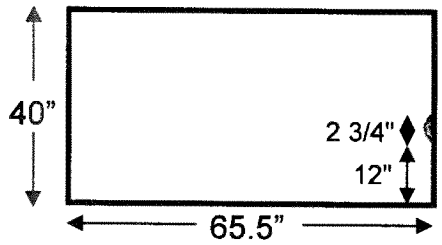
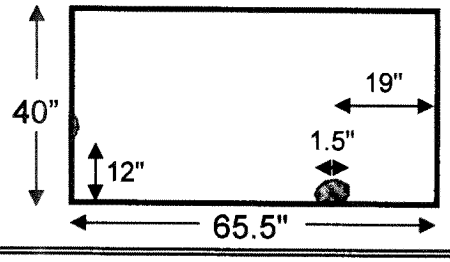
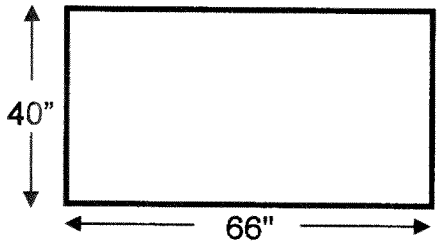
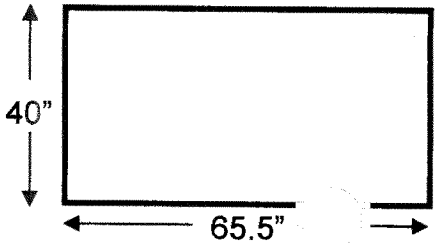
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 9A	1	55	Parapet block extends 9" north beyond adjacent Ashlar Seawall.	
	2	53		
	3	59		
	4	60		
	5	48		
	Avg.	55		
Block 10A	1	56		
	2	55		
	3	56		
	4	60		
	5	58		
	Avg.	57		
Block 11A	1	58	End Section 1	
	2	50		
	3	60		
	4	60		
	5	61		
	Avg.	57.8		
Block 12A	1	55	Begin Section 2	
	2	52		
	3	56		
	4	59		
	5	58		
	Avg.	56		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

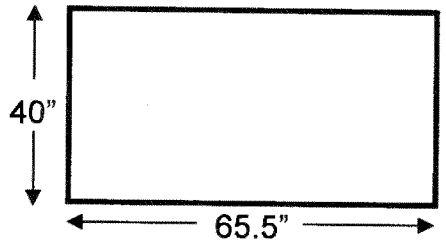
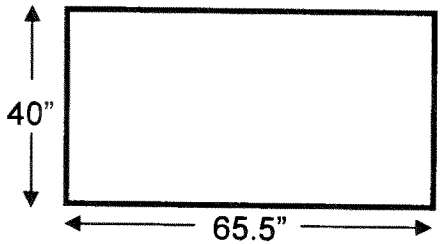
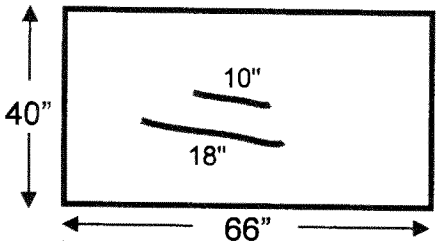
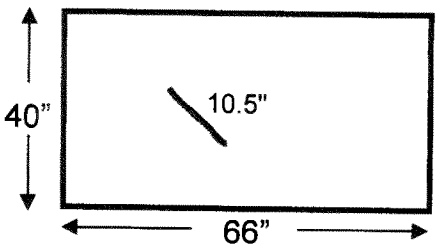
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 13A	1	54	Spalling of granite stone	
	2	53	(See photo and sktech)	
	3	57		
	4	64		
	5	52		
	Avg.	56		
Block 14A	1	60	Spalling of granite stone	
	2	56	(See photo and sktech)	
	3	56		
	4	52		
	5	62		
	Avg.	57.2		
Block 15A	1	52		
	2	48		
	3	54		
	4	55		
	5	60		
	Avg.	53.8		
Block 16A	1	57	End Section 2	
	2	54	Measurements were taken of the joint between Blocks 14A and 15A.	
	3	56	The blocks were separated by 1/2" at the top, 3/4" at 20" below the top	
	4	62	of block, and 3/4" at the bottom of block.	
	5	58	Block 16A protrudes north with respect to Block 17A.	
	Avg.	57.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

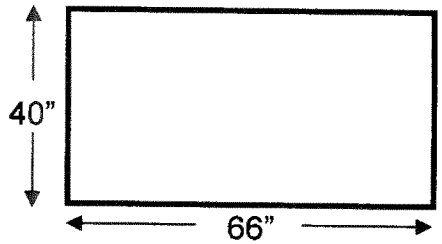
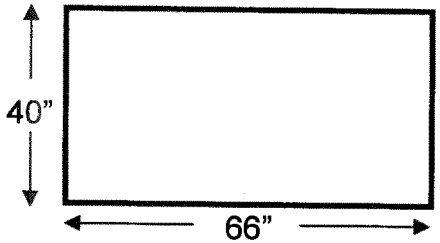
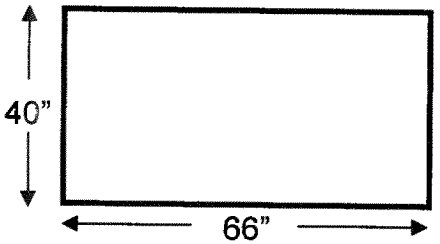
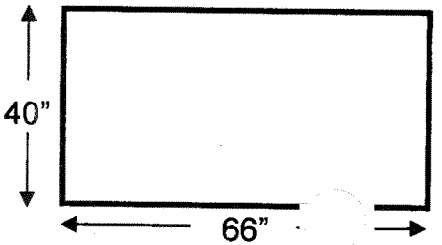
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 17A	1	54	Begin Section 3	
	2	56		
	3	61		
	4	56		
	5	52		
	Avg.	55.8		
Block 18A	1	50		
	2	57		
	3	56		
	4	58		
	5	58		
	Avg.	55.8		
Block 19A	1	58	Slight blemish noted. (See photo & sketch)	
	2	61		
	3	60		
	4	62		
	5	62		
	Avg.	60.6		
Block 20A	1	56	Very slight blemish noted. (See photo & sketch)	
	2	58		
	3	48		
	4	60		
	5	56		
	Avg.	55.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

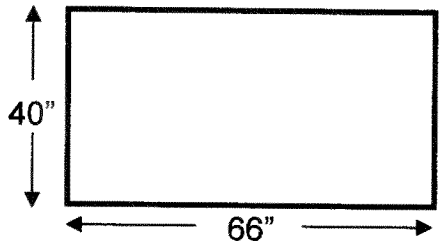
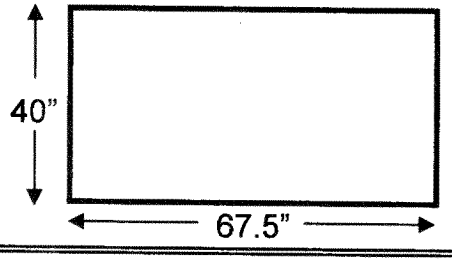
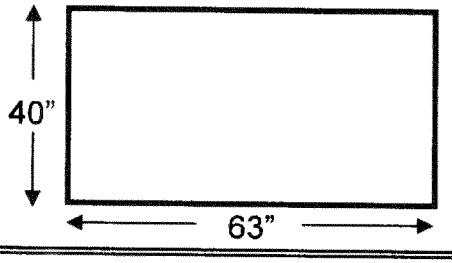
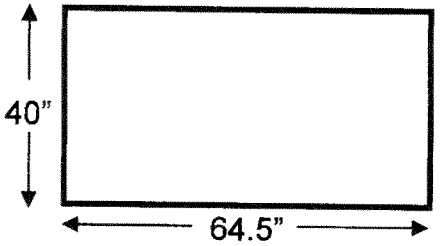
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 21A	1	54		
	2	57		
	3	57		
	4	58		
	5	56		
	Avg.	56.4		
Block 22A	1	54		
	2	48		
	3	56		
	4	56		
	5	60		
	Avg.	54.8		
Block 23A	1	57		
	2	50		
	3	58		
	4	61		
	5	60		
	Avg.	57.2		
Block 24A	1	52		
	2	51		
	3	54		
	4	60		
	5	56		
	Avg.	54.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

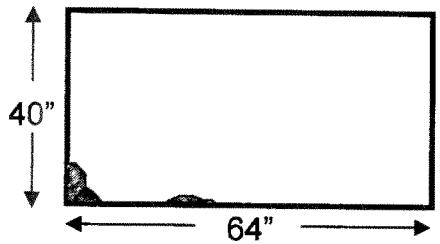
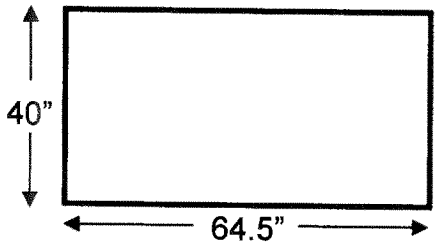
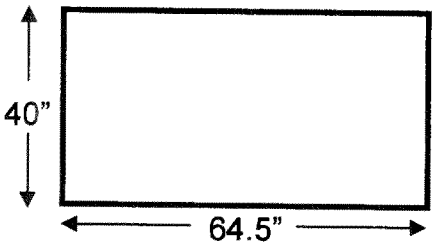
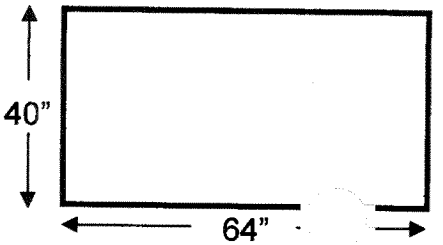
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 25A	1	60	End Section 3	
	2	48	Measurements were taken of the joint between Blocks 25A and 26A.	
	3	50	The blocks were separated by 1-1/8" at the top, 1-1/4" at 20" below the	
	4	59	top of block, and 1-1/4" at the bottom of block.	
	5	52	Block 25A is flush with Block 26A.	
	Avg.	53.8		
Block 26A	1	50	Begin Section 4	
	2	56		
	3	62		
	4	46		
	5	52		
	Avg.	53.2		
Block 27A	1	51		
	2	52		
	3	60		
	4	62		
	5	56		
	Avg.	56.2		
Block 28A	1	48		
	2	53		
	3	52		
	4	60		
	5	56		
	Avg.	53.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

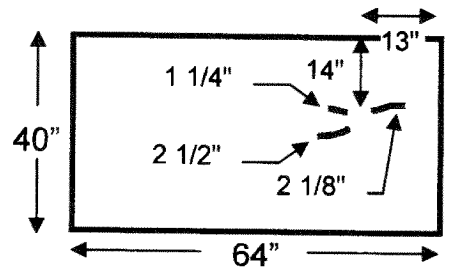
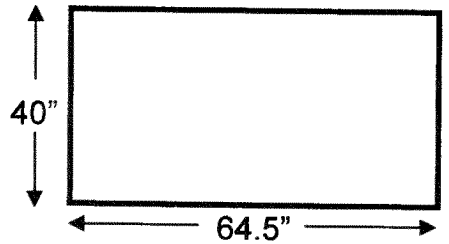
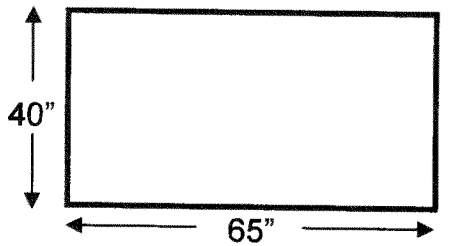
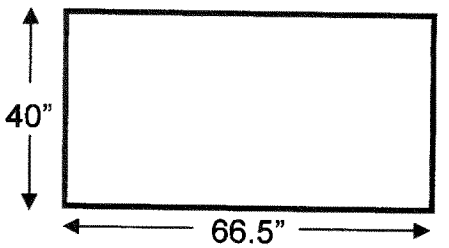
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 29A	1	54	Spalling of granite stone	
	2	54	(See photo and sktech)	
	3	56		
	4	59		
	5	52		
	Avg.	55		
Block 30A	1	57		
	2	50		
	3	62		
	4	58		
	5	52		
	Avg.	55.8		
Block 31A	1	56		
	2	52		
	3	56		
	4	60		
	5	62		
	Avg.	57.2		
Block 32A	1	50		
	2	52		
	3	60		
	4	54		
	5	53		
	Avg.	53.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

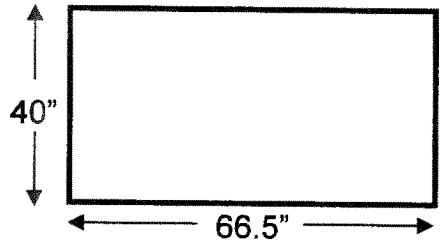
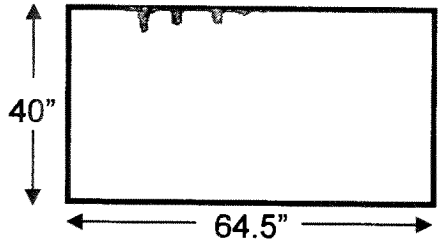
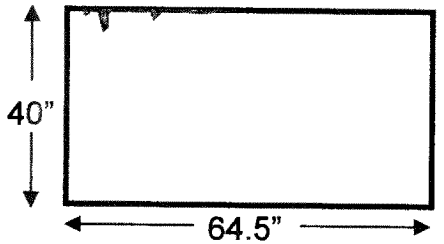
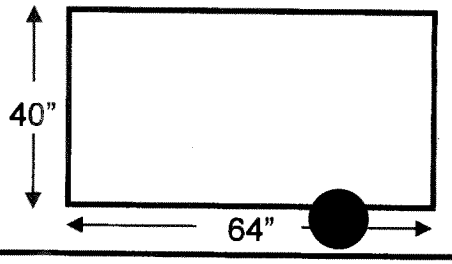
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 33A	1	54	Blemishes noted. (See photo & sketch)	
	2	48		
	3	56		
	4	53		
	5	52		
	Avg.	52.6		
Block 34A	1	48		
	2	54		
	3	52		
	4	51		
	5	62		
	Avg.	53.4		
Block 35A	1	59		
	2	52		
	3	61		
	4	63		
	5	56		
	Avg.	58.2		
Block 36A	1	52	End Section 4	
	2	48	Measurements were taken of the joint between blocks 36A and 37A. The	
	3	50	blocks were separated by 1-1/4" at the top, 1-1/4" at 20" below the top of	
	4	60	block, and 1-1/4" at the bottom of block.	
	5	54	Block 37A protrudes north with respect to Block 36A.	
	Avg.	52.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

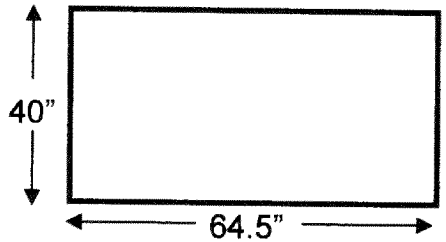
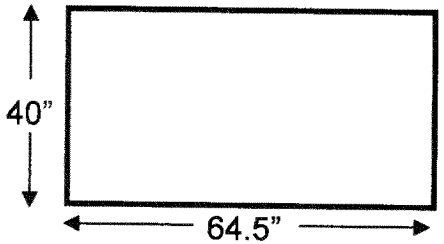
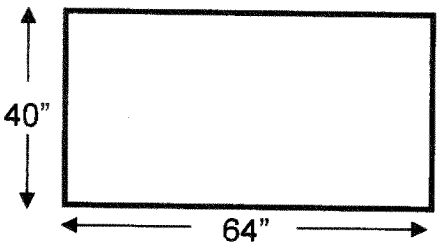
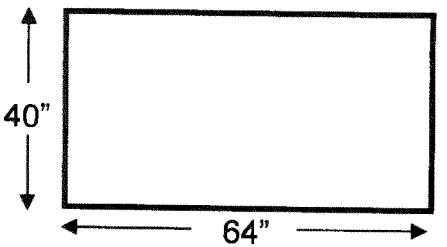
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 37A	1	54	Begin Section 5	
	2	52		
	3	58		
	4	46		
	5	52		
	Avg.	52.4		
Block 38A	1	54	Upper portion of block contains deposits and discoloration.	
	2	58		
	3	55		
	4	53		
	5	62		
	Avg.	56.4		
Block 39A	1	54	Upper portion of block contains deposits and discoloration.	
	2	52		
	3	60		
	4	50		
	5	50		
	Avg.	53.2		
Block 40A	1	48		
	2	48		
	3	60		
	4	59		
	5	64		
	Avg.	55.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

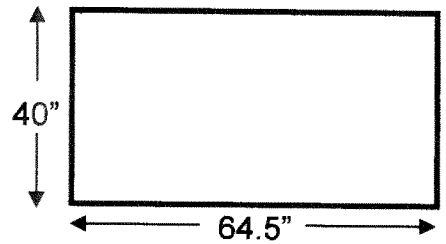
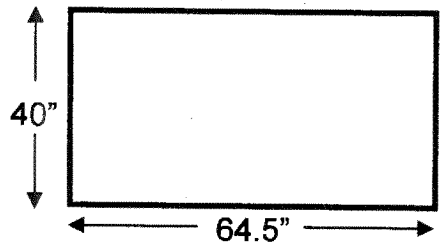
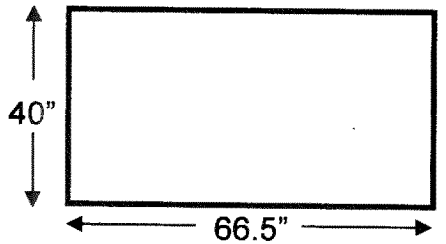
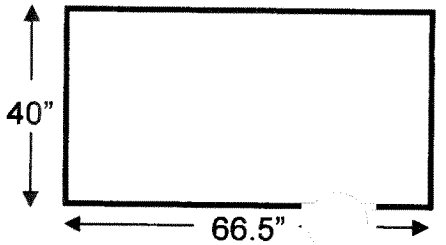
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 41A	1	49		
	2	56		
	3	54		
	4	54		
	5	54		
	Avg.	53.4		
Block 42A	1	54		
	2	58		
	3	48		
	4	56		
	5	56		
	Avg.	54.4		
Block 43A	1	57		
	2	57		
	3	52		
	4	56		
	5	56		
	Avg.	55.6		
Block 44A	1	55		
	2	56		
	3	52		
	4	52		
	5	54		
	Avg.	53.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

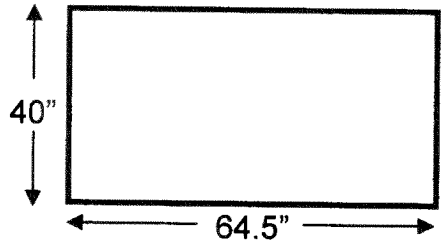
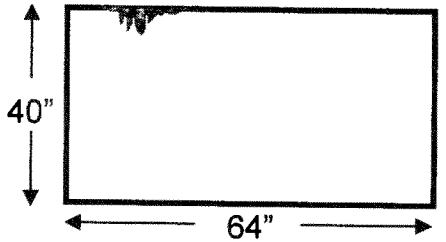
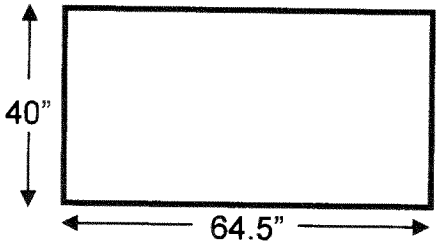
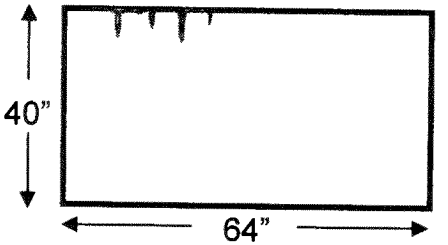
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 45A	1	50		
	2	50		
	3	57		
	4	54		
	5	50		
	Avg.	52.2		
Block 46A	1	55		
	2	52		
	3	48		
	4	55		
	5	54		
	Avg.	52.8		
Block 47A	1	49	End Section 5	
	2	55	Measurements were taken of the joint between Blocks 47A and 48A. The	
	3	54	blocks were separated by 7/8" at the top, 1" at 20" below the top of block,	
	4	58	and 1-1/4" at the bottom of block.	
	5	58	Block 37A protrudes north with respect to Block 36A.	
	Avg.	54.8		
Block 48A	1	48	Begin Section 6	
	2	50		
	3	53		
	4	58		
	5	52		
	Avg.	52.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

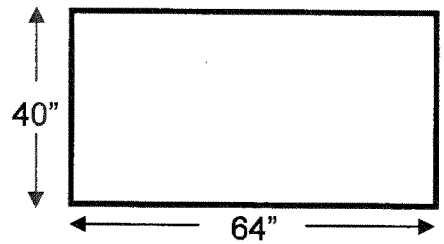
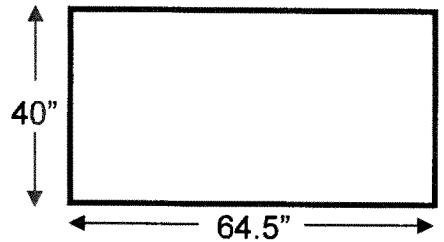
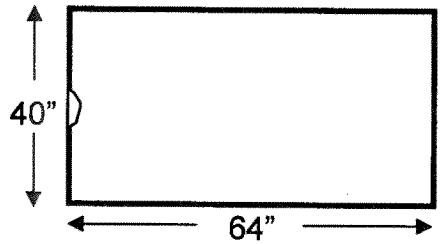
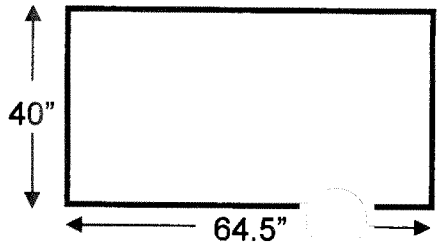
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 49A	1	58		
	2	58		
	3	51		
	4	58		
	5	60		
	Avg.	57		
Block 50A	1	50	Upper portion of block contains deposits and discoloration.	
	2	48		
	3	58		
	4	48		
	5	62		
	Avg.	53.2		
Block 51A	1	50		
	2	51		
	3	55		
	4	48		
	5	62		
	Avg.	53.2		
Block 52A	1	56	Upper portion of block contains deposits and discoloration.	
	2	58		
	3	54		
	4	50		
	5	59		
	Avg.	55.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

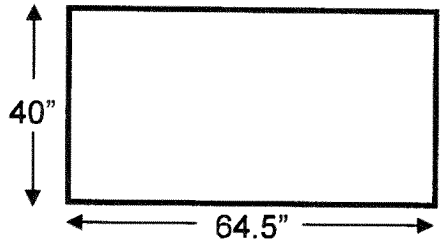
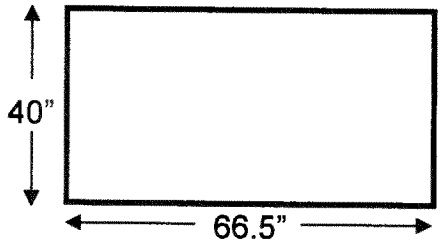
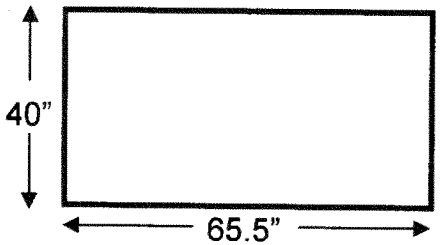
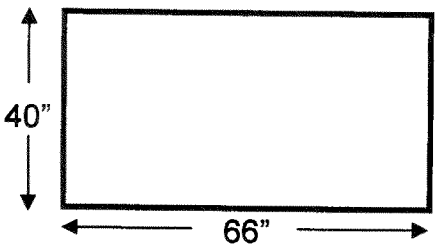
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 53A	1	54		
	2	50		
	3	59		
	4	57		
	5	56		
	Avg.	55.2		
Block 54A	1	57		
	2	56		
	3	54		
	4	52		
	5	50		
	Avg.	53.8		
Block 55A	1	46	5-1/2" long, 1-3/4" wide spall noted at left edge of block.	
	2	53		
	3	52		
	4	55		
	5	54		
	Avg.	52		
Block 56A	1	60		
	2	55		
	3	64		
	4	54		
	5	54		
	Avg.	57.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

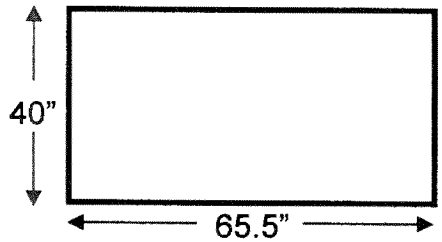
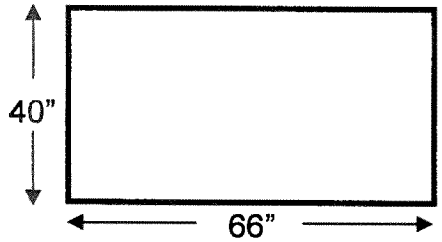
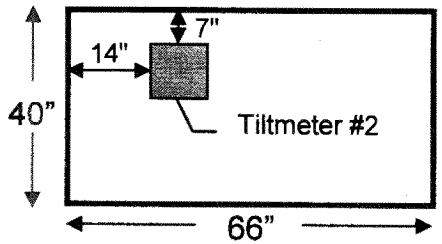
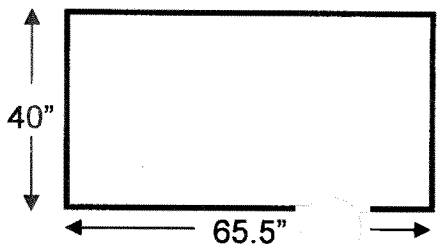
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 57A	1	54		
	2	57		
	3	64		
	4	54		
	5	49		
	Avg.	55.6		
Block 58A	1	53	End Section 6	
	2	54	Measurements were taken of the joint between Blocks 58A and 59A. The	
	3	57	blocks were separated by 5/8" at the top, 1" at 20" below the top of block,	
	4	55	and 1-5/8" at the bottom of block.	
	5	51	Block 58A is rotated northward.	
	Avg.	54		
Block 59A	1	52	Begin Section 7	
	2	58		
	3	60		
	4	52		
	5	62		
	Avg.	56.8		
Block 60A	1	48		
	2	61		
	3	56		
	4	50		
	5	58		
	Avg.	54.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

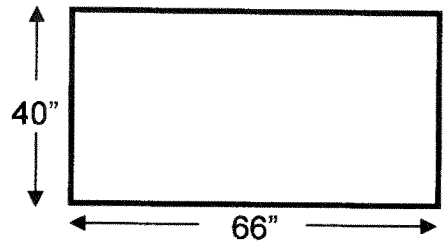
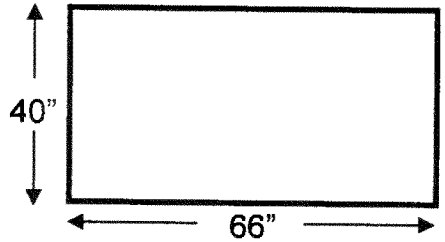
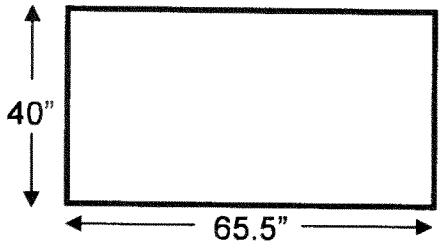
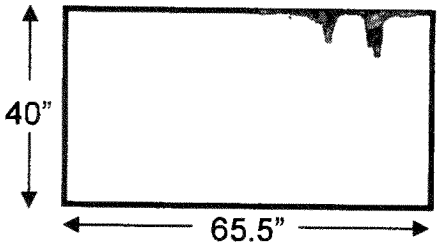
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 61A	1	56		
	2	56		
	3	56		
	4	59		
	5	54		
	Avg.	56.2		
Block 62A	1	58		
	2	55		
	3	54		
	4	60		
	5	58		
	Avg.	57		
Block 63A	1	50	Tiltmeter #2 attached to block.	
	2	60		
	3	62		
	4	53		
	5	56		
	Avg.	56.2		
Block 64A	1	54		
	2	57		
	3	53		
	4	50		
	5	50		
	Avg.	52.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

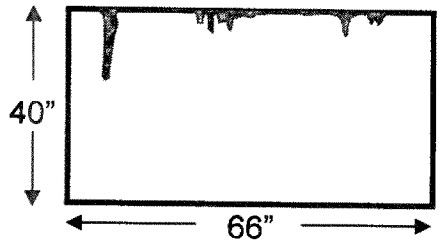
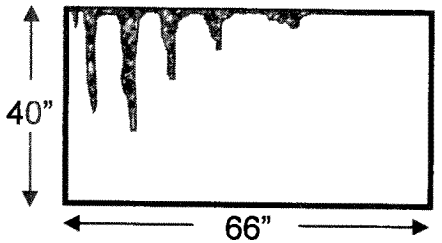
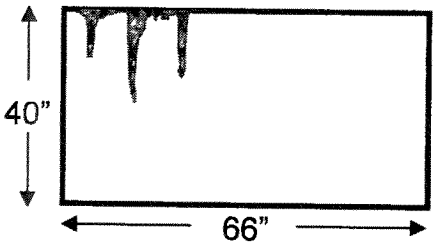
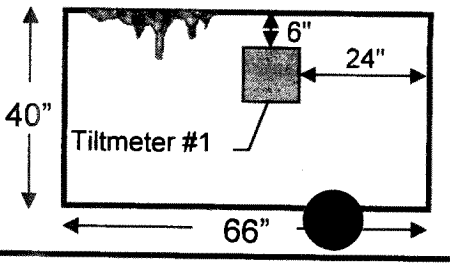
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 65A	1	56		
	2	47		
	3	57		
	4	58		
	5	46		
	Avg.	52.8		
Block 66A	1	58		
	2	56		
	3	54		
	4	52		
	5	54		
	Avg.	54.8		
Block 67A	1	56	End Section 7	
	2	52	Measurements were taken of the joint between Blocks 67A and 68A. The	
	3	62	blocks were separated by 2-1/2" at the top, 1-1/2" at 20" below the top of	
	4	59	block, and 7/8" at the bottom of block.	
	5	56	Block 67A is rotated northward.	
	Avg.	57		
Block 68A	1	59	Begin Section 8	
	2	57	Top of Block 68A is 5/8" lower than top of Block 67A.	
	3	46		
	4	49		
	5	51		
	Avg.	52.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

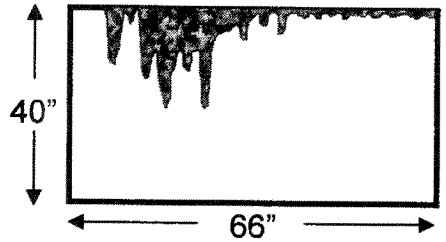
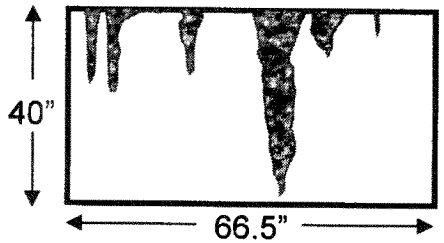
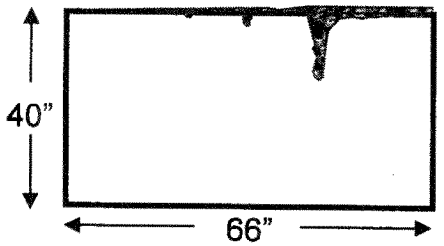
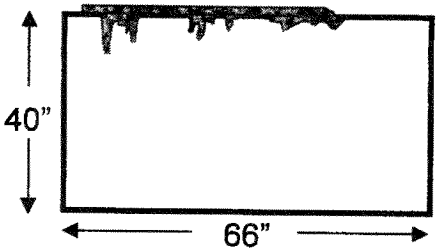
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 69A	1	46	Upper portion of block contains deposits and discoloration.	
	2	56		
	3	60		
	4	62		
	5	56		
	Avg.	56		
Block 70A	1	53	Upper portion of block contains deposits and discoloration.	
	2	60		
	3	61		
	4	59		
	5	64		
	Avg.	59.4		
Block 71A	1	52	Upper portion of block contains deposits and discoloration.	
	2	59		
	3	64		
	4	54		
	5	60		
	Avg.	57.8		
Block 72A	1	54	Upper portion of block contains deposits and discoloration.	
	2	57	Tiltmeter #1 attached to block.	
	3	48		
	4	61		
	5	51		
	Avg.	54.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

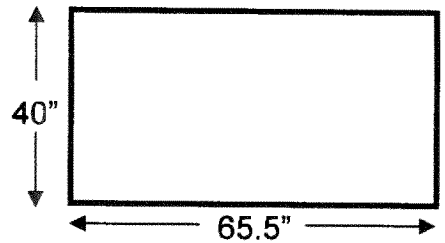
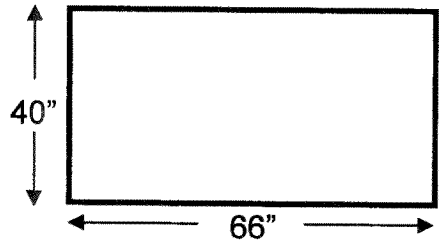
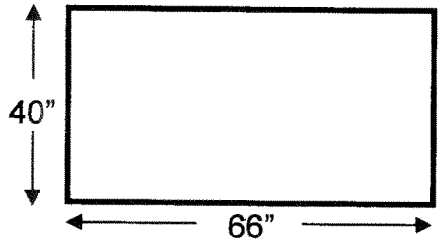
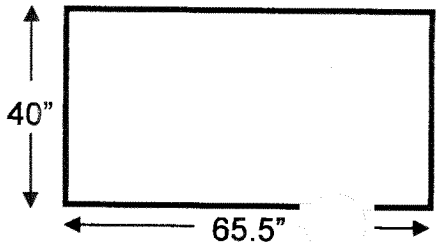
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 73A	1	58	Upper portion of block contains deposits and discoloration.	
	2	58	Sample of joint material taken.	
	3	58		
	4	58		
	5	52		
	Avg.	56.8		
Block 74A	1	54	Upper portion of block contains deposits and discoloration.	
	2	51		
	3	58		
	4	54		
	5	52		
	Avg.	53.8		
Block 75A	1	55	Upper portion of block contains deposits and discoloration.	
	2	54		
	3	56		
	4	56		
	5	60		
	Avg.	56.2		
Block 76A	1	58	End Section 8	
	2	52	Upper portion of block contains deposits and discoloration.	
	3	64	Measurements were taken of the joint between Blocks 76A and 77A. The	
	4	52	blocks were separated by 2-1/4" at the top, 1-5/8" at 20" below the top of	
	5	48	block, and 1" at the bottom of block. The top of Block 76A is 7/8" lower	
	Avg.	54.8	than the top of Block 77A. Block 76A is rotated northward.	

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

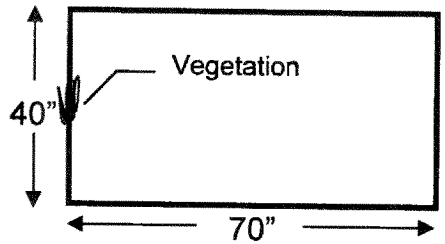
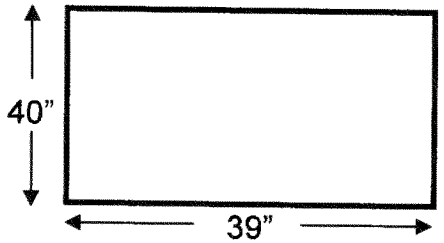
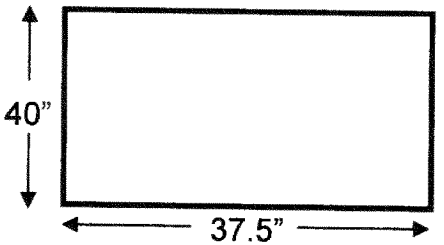
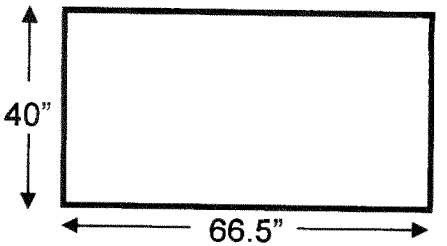
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 77A	1	53	Begin Section 9	
	2	56		
	3	59		
	4	50		
	5	64		
	Avg.	56.4		
Block 78A	1	55		
	2	62		
	3	55		
	4	48		
	5	55		
	Avg.	55		
Block 79A	1	60		
	2	50		
	3	60		
	4	50		
	5	58		
	Avg.	55.6		
Block 80A	1	55		
	2	47		
	3	60		
	4	54		
	5	54		
	Avg.	54		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

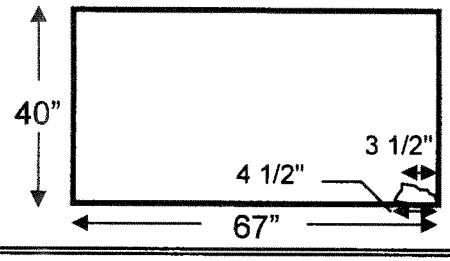
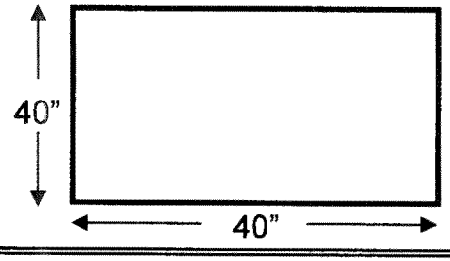
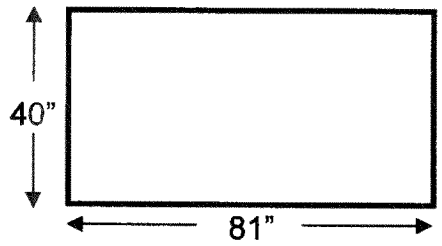
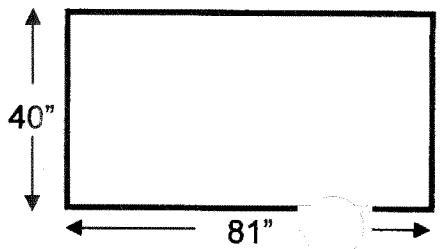
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 81A	1	58	End Section 9	
	2	56	Vegetation growing from joint.	
	3	63	Block 81A extends 16" beyond the face of Block 82A.	
	4	46		
	5	60		
	Avg.	56.6		
Block 82A	1	55	Begin Section 10	
	2	60		
	3	52		
	4	56		
	5	59		
	Avg.	56.4		
Block 83A	1	56		
	2	64		
	3	62		
	4	54		
	5	56		
	Avg.	58.4		
Block 84A	1	64	Block 84A extends 9" beyond the face of Block 83A.	
	2	61		
	3	52		
	4	50		
	5	50		
	Avg.	55.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

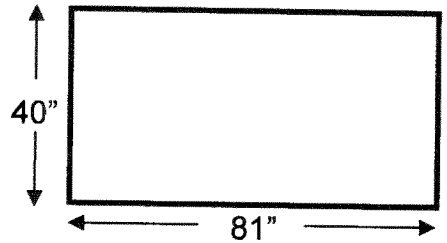
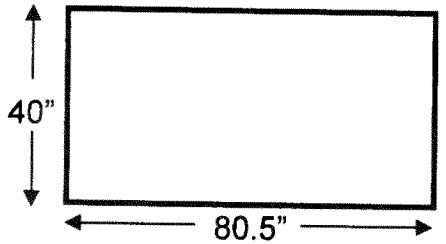
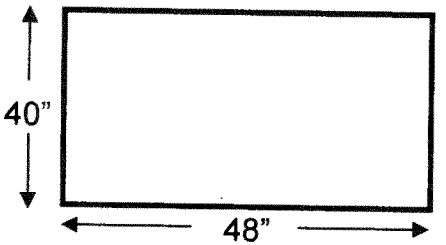
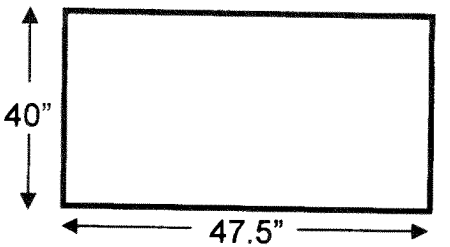
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 85A	1	63	Spall noted at corner of block. (See sketch & photos)	
	2	63	Block 85A extends 9" beyond the face of Block 86A.	
	3	60		
	4	65		
	5	58		
	Avg.	61.8		
Block 86A	1	54		
	2	48		
	3	65		
	4	58		
	5	60		
	Avg.	57		
Block 87A	1	52		
	2	52		
	3	54		
	4	59		
	5	58		
	Avg.	55		
Block 88A	1	55		
	2	54		
	3	55		
	4	50		
	5	56		
	Avg.	54		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

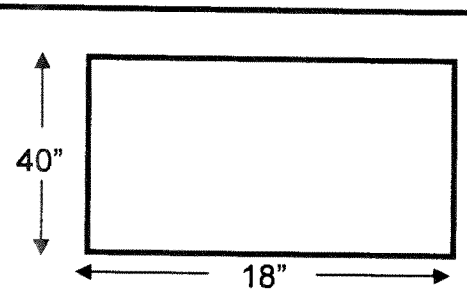
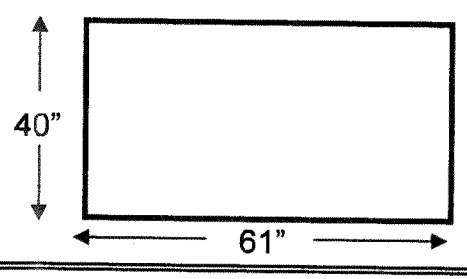
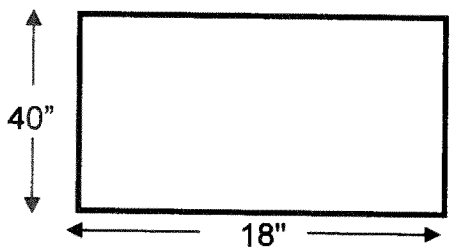
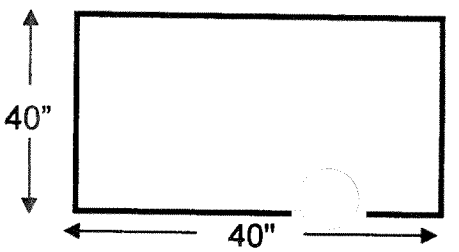
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 89A	1	54		
	2	54		
	3	56		
	4	54		
	5	58		
	Avg.	55.2		
Block 90A	1	60		
	2	61		
	3	54		
	4	57		
	5	57		
	Avg.	57.8		
Block 91A	1	59	Block 91A extends 12-1/2" beyond the face of Block 90A.	
	2	59	See Photos of crack at corner of Block 91A on Sheet 12.	
	3	60		
	4	64		
	5	60		
	Avg.	60.4		
Block 92A	1	55		
	2	58		
	3	52		
	4	64		
	5	59		
	Avg.	57.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

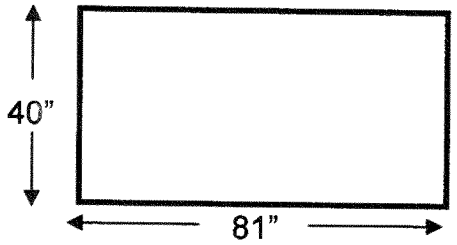
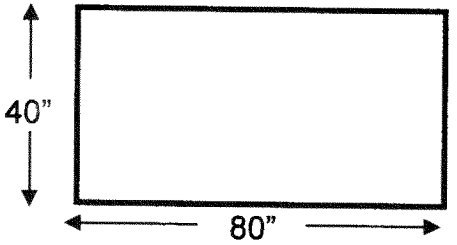
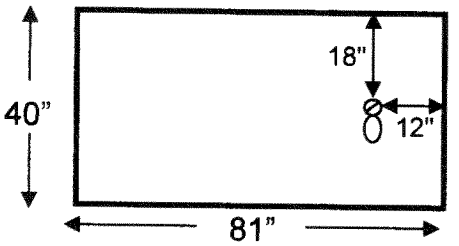
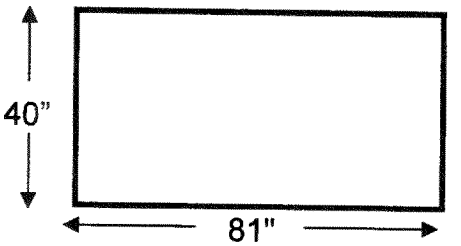
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 1B	1	56		
	2	52		
	3	42		
	4	56		
	5	52		
	Avg.	51.6		
Block 2B	1	54		
	2	48		
	3	56		
	4	55		
	5	54		
	Avg.	53.4		
Block 3B	1	48	End Parapet	
	2	52		
	3	46		
	4	46		
	5	48		
	Avg.	48		
Block 4B	1	55		
	2	54		
	3	48		
	4	54		
	5	54		
	vg.	53		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

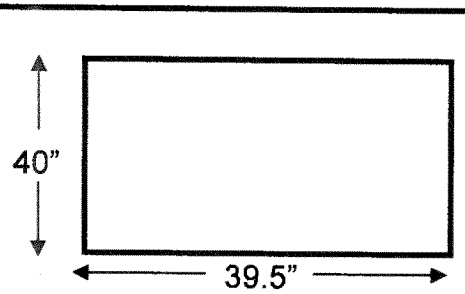
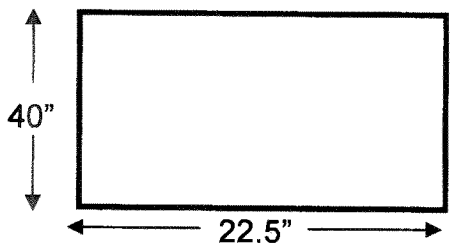
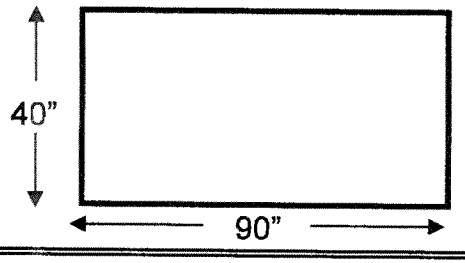
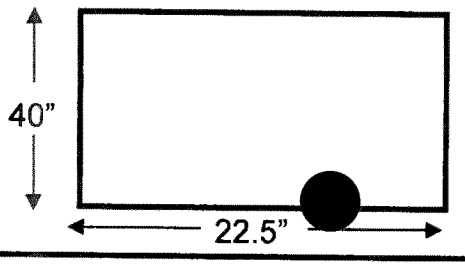
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 5B	1	55		
	2	58		
	3	58		
	4	50		
	5	54		
	Avg.	55		
Block 6B	1	49		
	2	52		
	3	56		
	4	50		
	5	56		
	Avg.	52.6		
Block 7B	1	54	Ring bolted into wall.	
	2	59		
	3	58		
	4	58		
	5	52		
	Avg.	56.2		
Block 8B	1	56		
	2	60		
	3	52		
	4	42		
	5	56		
	Avg.	53.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

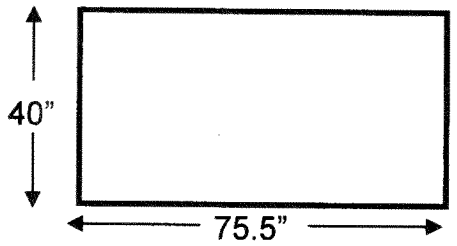
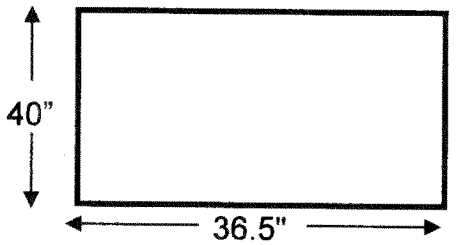
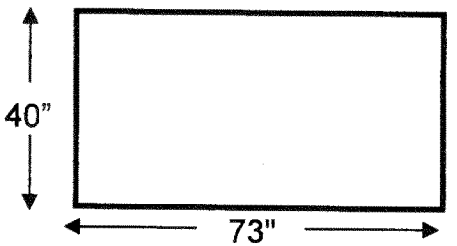
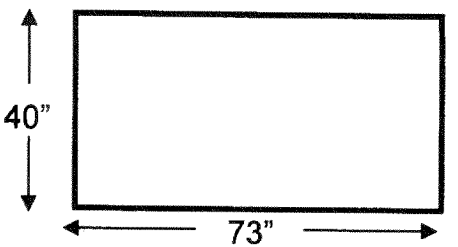
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 9B	1	48		
	2	55		
	3	54		
	4	56		
	5	52		
	Avg.	53		
Block 10B	1	60		
	2	55		
	3	50		
	4	54		
	5	56		
	Avg.	55		
Block 11B	1	60		
	2	58		
	3	60		
	4	56		
	5	60		
	Avg.	58.8		
Block 12B	1	50		
	2	52		
	3	58		
	4	56		
	5	55		
	Avg.	54.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

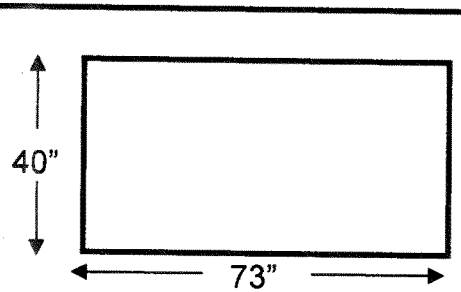
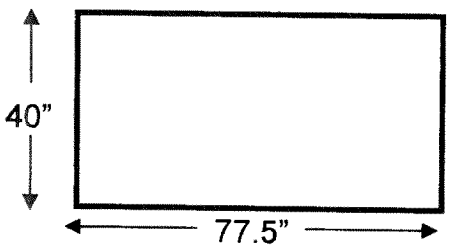
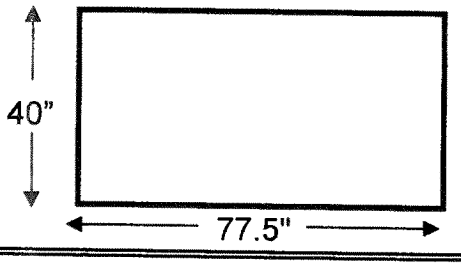
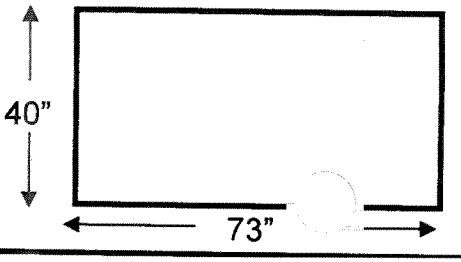
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 13B	1	58	End Section 1	
	2	60		
	3	54		
	4	52		
	5	56		
	Avg.	56		
Block 14B	1	56	Begin Section 2	
	2	54		
	3	58		
	4	60		
	5	54		
	Avg.	56.4		
Block 15B	1	52		
	2	56		
	3	60		
	4	60		
	5	58		
	Avg.	57.2		
Block 16B	1	62		
	2	58		
	3	58		
	4	56		
	5	60		
	Avg.	58.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

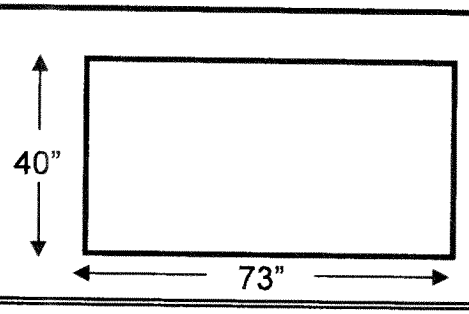
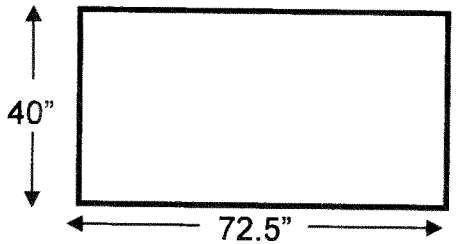
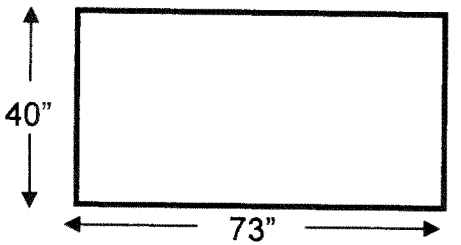
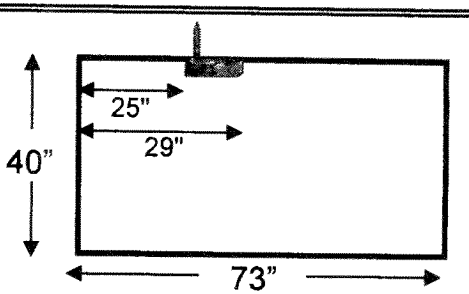
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 17B	1	60		
	2	60		
	3	62		
	4	56		
	5	52		
	Avg.	58		
Block 18B	1	60	End Section 2	
	2	62		
	3	50		
	4	56		
	5	62		
	Avg.	58		
Block 19B	1	56	Begin Section 3	
	2	58		
	3	54		
	4	56		
	5	50		
	Avg.	54.8		
Block 20B	1	60		
	2	60		
	3	58		
	4	52		
	5	54		
	Avg.	56.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

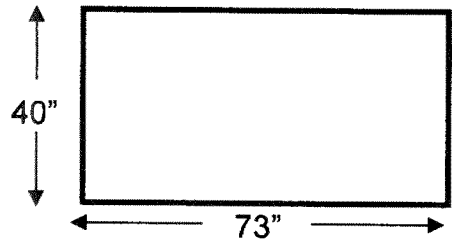
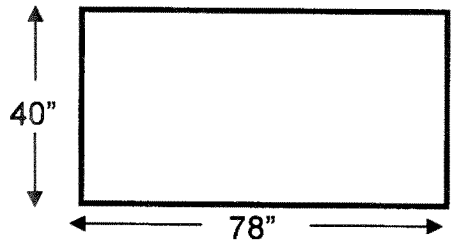
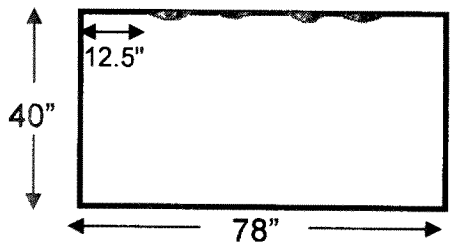
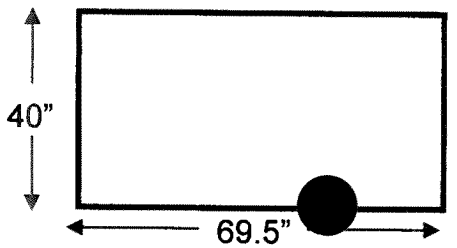
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 21B	1	60		
	2	62		
	3	61		
	4	54		
	5	58		
	Avg.	59		
Block 22B	1	56		
	2	58		
	3	62		
	4	52		
	5	54		
	Avg.	56.4		
Block 23B	1	55		
	2	57		
	3	56		
	4	64		
	5	58		
	Avg.	58		
Block 24B	1	54	Joint discoloration and deposit noted at top of block.	
	2	54		
	3	52		
	4	60		
	5	57		
	Avg.	55.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

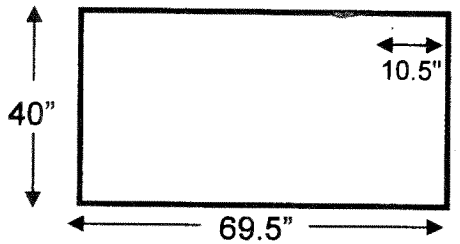
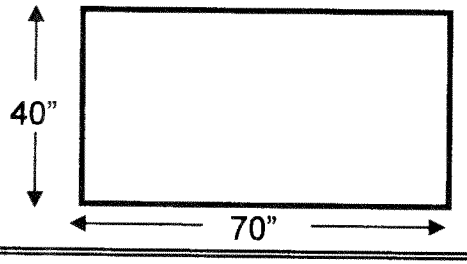
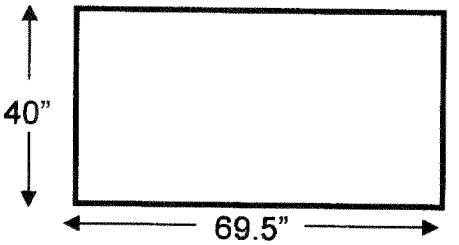
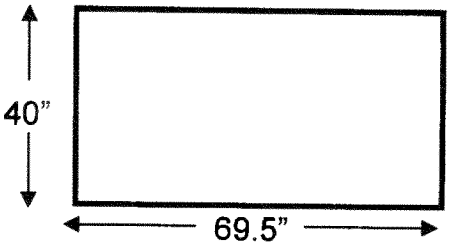
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 25B	1	56		
	2	56		
	3	56		
	4	60		
	5	52		
	Avg.	56		
Block 26B	1	53	End Section 3	
	2	52	Joint between Blocks 26B and 27B flush in the north/south direction.	
	3	57	Measurements were taken of the joint between Blocks 26B and 27B. The	
	4	46	blocks were separated by 1-9/16" at the top, 1-5/8" at 18" below the top of	
	5	60	block, and 1-3/4" at 29" below the top of the block.	
	Avg.	53.6		
Block 27B	1	58	Begin Section 4	
	2	48	Spalling noted at top of block.	
	3	52		
	4	57		
	5	58		
	Avg.	54.6		
Block 28B	1	58		
	2	63		
	3	44		
	4	52		
	5	54		
	Avg.	54.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

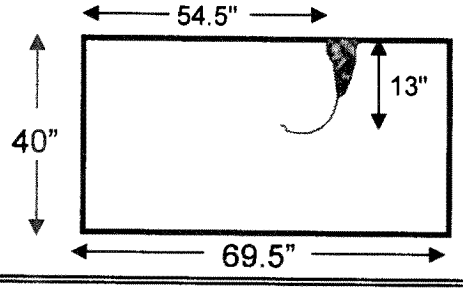
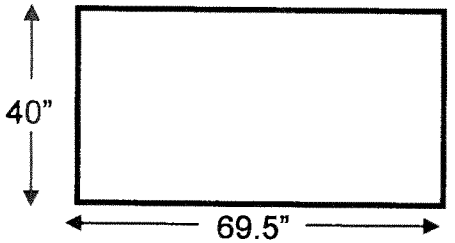
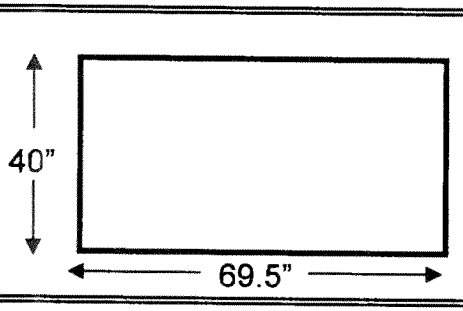
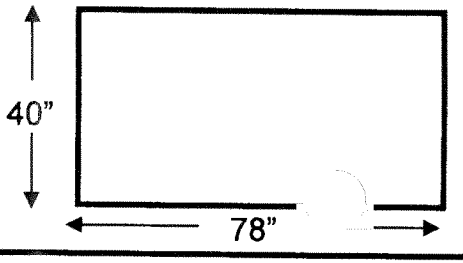
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 29B	1	54	Spalling noted at top of block.	
	2	60		
	3	60		
	4	56		
	5	60		
	Avg.	58		
Block 30B	1	55		
	2	58		
	3	54		
	4	52		
	5	60		
	Avg.	55.8		
Block 31B	1	60		
	2	65		
	3	52		
	4	61		
	5	58		
	Avg.	59.2		
Block 32B	1	55		
	2	52		
	3	60		
	4	51		
	5	58		
	Avg.	55.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

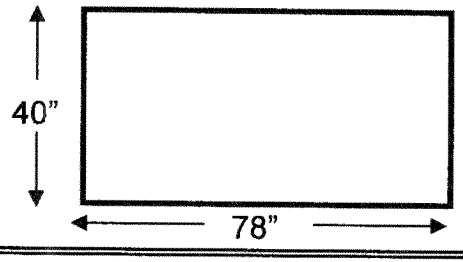
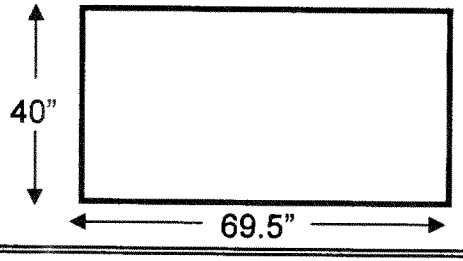
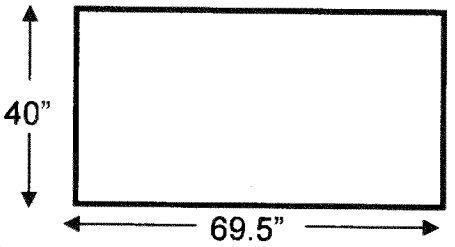
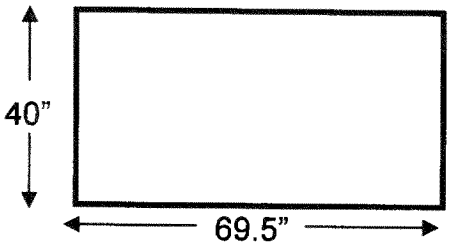
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 33B	1	58	Large crack noted.	
	2	58		
	3	54		
	4	50		
	5	55		
	Avg.	55		
Block 34B	1	57		
	2	60		
	3	54		
	4	55		
	5	56		
	Avg.	56.4		
Block 35B	1	56		
	2	58		
	3	60		
	4	60		
	5	56		
	Avg.	58		
Block 36B	1	56	End Section 4	
	2	56	Measurements were taken of the joint between Blocks 36B and 37B. The	
	3	57	blocks were separated by 1-10/16" at the top, 1-3/4" at 18" below the top of	
	4	54	block, and 1-15/16" at 27" below the top of block.	
	5	50		
	vg.	54.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

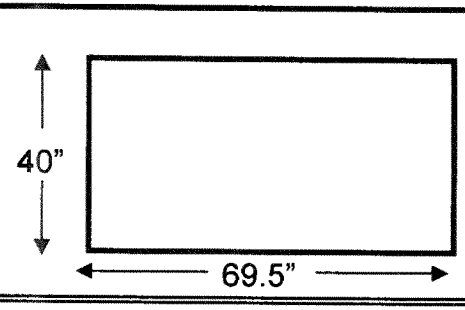
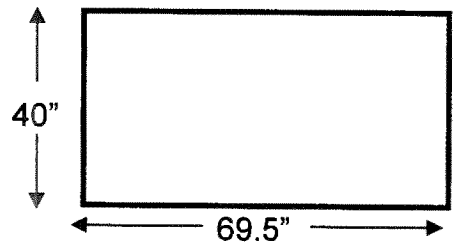
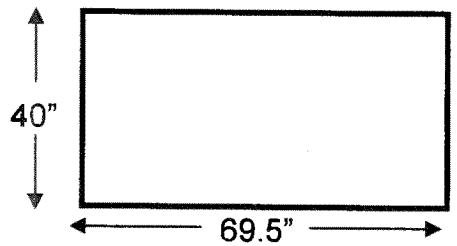
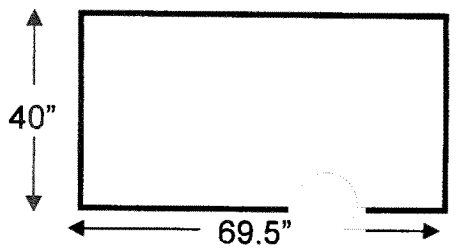
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 37B	1	50	Begin Section 5	
	2	55		
	3	55		
	4	55		
	5	60		
	Avg.	55		
Block 38B	1	58		
	2	52		
	3	56		
	4	52		
	5	60		
	Avg.	55.6		
Block 39B	1	50		
	2	52		
	3	56		
	4	62		
	5	57		
	Avg.	55.4		
Block 40B	1	60		
	2	56		
	3	55		
	4	55		
	5	52		
	Avg.	55.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

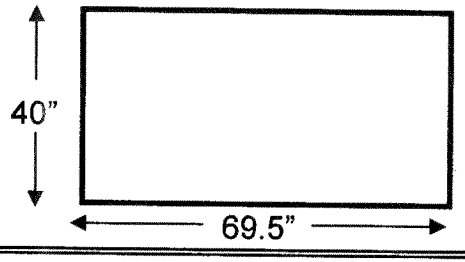
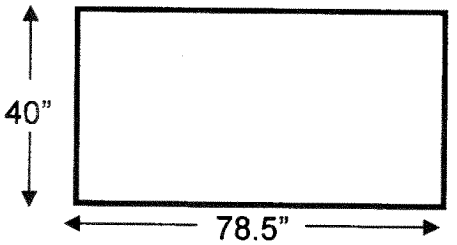
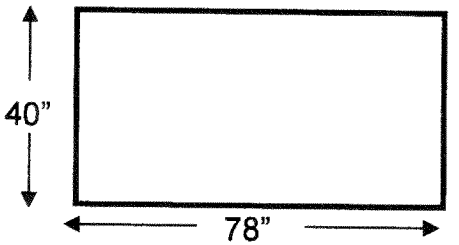
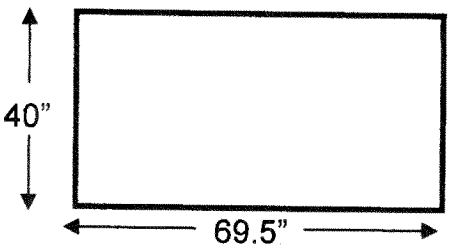
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 41B	1	52		
	2	61		
	3	56		
	4	50		
	5	60		
	Avg.	55.8		
Block 42B	1	57		
	2	44		
	3	46		
	4	58		
	5	48		
	Avg.	50.6		
Block 43B	1	52		
	2	53		
	3	58		
	4	58		
	5	57		
	Avg.	55.6		
Block 44B	1	56	Due to riprap obstruction, values could not be obtained for #2 and #5.	
	2			
	3	57		
	4	56		
	5			
	Avg.	56.3		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

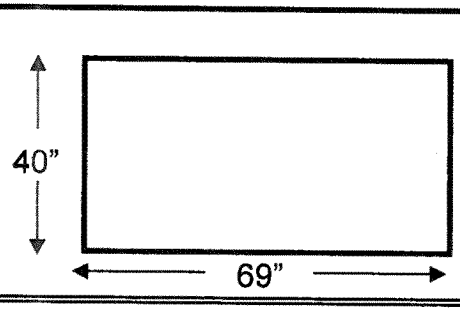
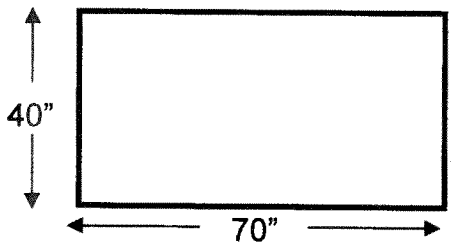
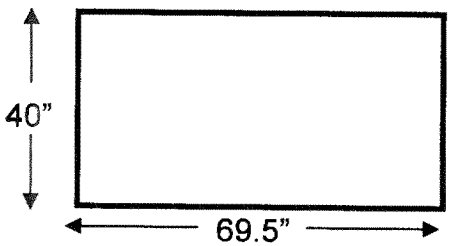
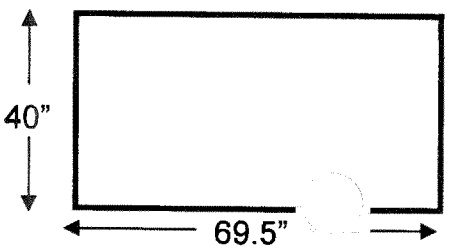
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 45B	1		Due to riprap obstruction, values could not be obtained for #1 and #4.	
	2	54		
	3	64		
	4			
	5	55		
	Avg.	57.7		
Block 46B	1	48	End Section 5	
	2	56	Measurements were taken of the joint between Blocks 46B and 47B. The	
	3	50	blocks were separated by 1-1/2" at the top of joint.	
	4	53		
	5	53		
	Avg.	52.0		
Block 47B	1	51	Begin Section 6	
	2	52		
	3	64		
	4	57		
	5	51		
	Avg.	55.0		
Block 48B	1	51		
	2	47		
	3	54		
	4	56		
	5	59		
	Avg.	53.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

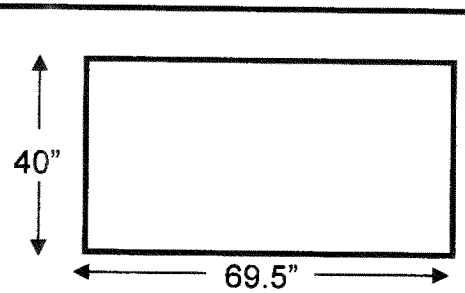
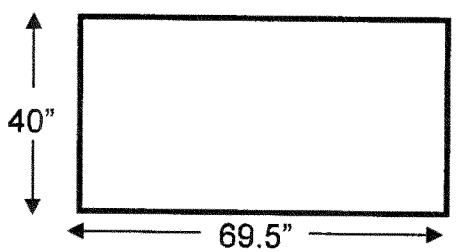
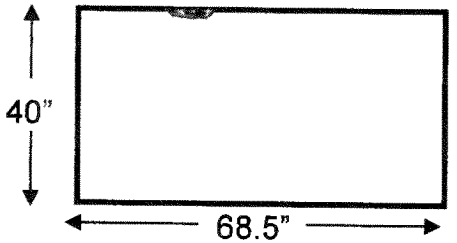
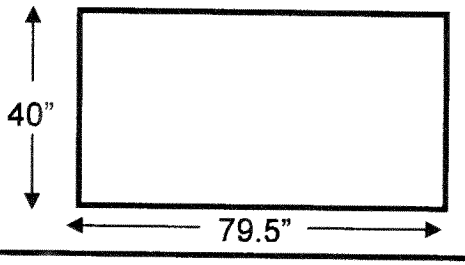
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 49B	1	50		
	2	56		
	3	51		
	4	51		
	5	60		
	Avg.	53.6		
Block 50B	1	56		
	2	58		
	3	52		
	4	59		
	5	58		
	Avg.	56.6		
Block 51B	1	55		
	2	54		
	3	58		
	4	54		
	5	60		
	Avg.	56.2		
Block 52B	1	50		
	2	58		
	3	52		
	4	52		
	5	48		
	vg.	52		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

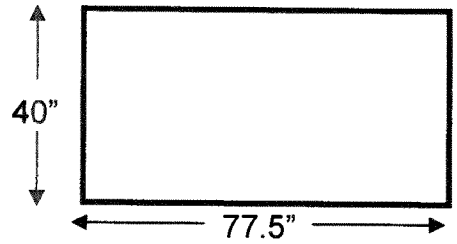
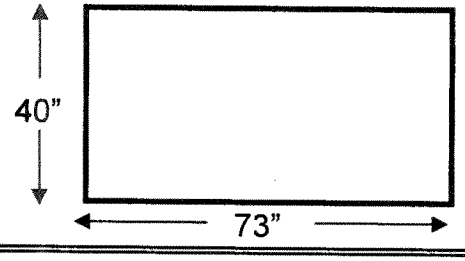
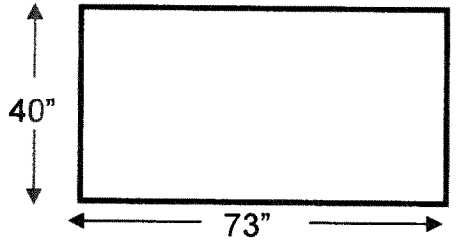
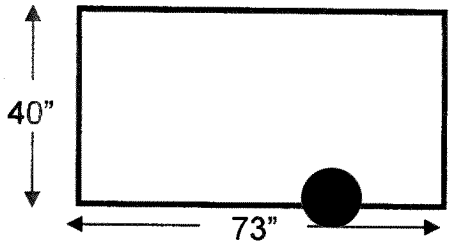
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 53B	1	48		
	2	56		
	3	58		
	4	52		
	5	48		
	Avg.	52.4		
Block 54B	1	59		
	2	44		
	3	50		
	4	48		
	5	48		
	Avg.	49.8		
Block 55B	1	55	Upper portion of block contains deposits and discoloration.	
	2	58		
	3	62		
	4	49		
	5	48		
	Avg.	54.4		
Block 56B	1	58	End Section 6	
	2	56	Measurements were taken of the joint between Blocks 56B and 57B. The	
	3	54	blocks were separated by 1-1/4" at the top of joint.	
	4	48		
	5	62		
	Avg.	55.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

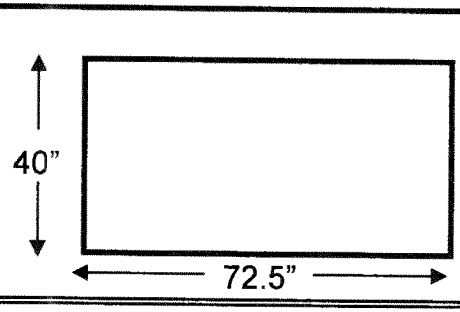
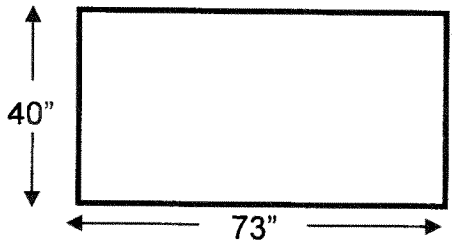
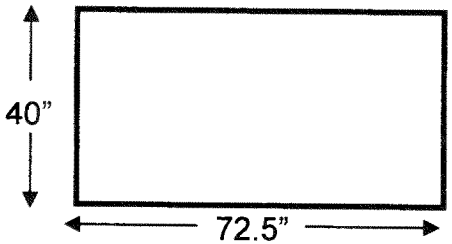
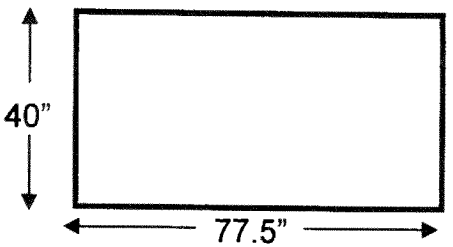
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 57B	1	54	Begin Section 7	
	2	54		
	3	56		
	4	54		
	5	58		
	Avg.	55.2		
Block 58B	1	60		
	2	60		
	3	52		
	4	53		
	5	48		
	Avg.	54.6		
Block 59B	1	53		
	2	54		
	3	60		
	4	52		
	5	49		
	Avg.	53.6		
Block 60B	1	58		
	2	60		
	3	61		
	4	56		
	5	49		
	vg.	56.8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

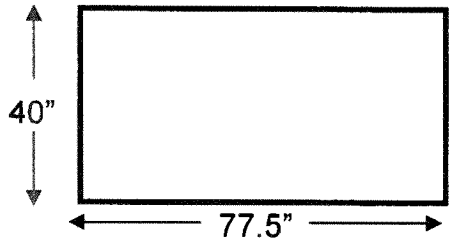
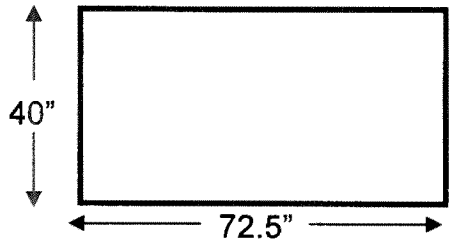
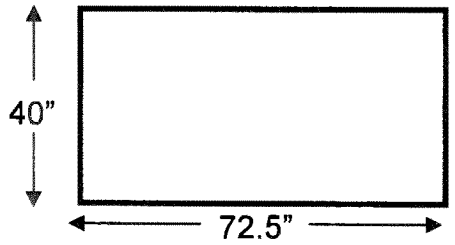
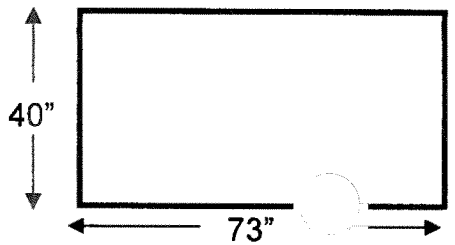
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 61B	1	52		
	2	52		
	3	56		
	4	52		
	5	50		
	Avg.	52.4		
Block 62B	1	54		
	2	53		
	3	60		
	4	54		
	5	50		
	Avg.	54.2		
Block 63B	1	56		
	2	56		
	3	56		
	4	54		
	5	62		
	Avg.	56.8		
Block 64B	1	58	End Section 7	
	2	54	Measurements were taken of the joint between Blocks 64B and 65B. The	
	3	58	blocks were separated by 1-1/4" at the top of joint.	
	4	52		
	5	50		
	Avg.	54.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

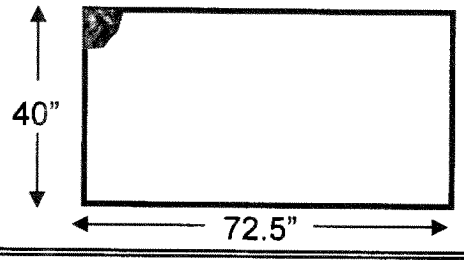
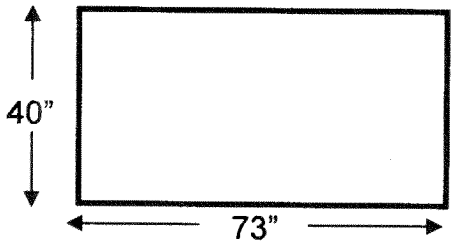
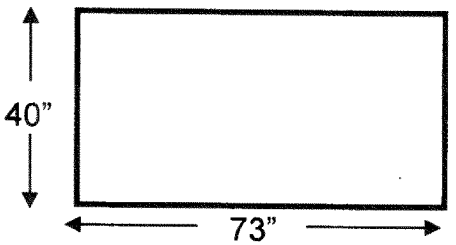
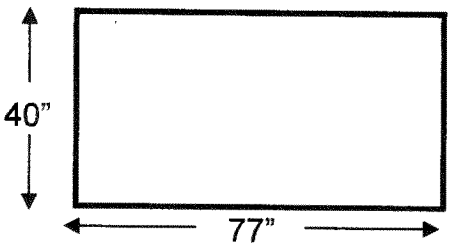
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 65B	1	50	Begin Section 8	
	2	56		
	3	59		
	4	52		
	5	60		
	Avg.	55.4		
Block 66B	1	56		
	2	60		
	3	60		
	4	61		
	5	60		
	Avg.	59.4		
Block 67B	1	64		
	2	50		
	3	62		
	4	58		
	5	57		
	Avg.	58.2		
Block 68B	1	62		
	2	58		
	3	62		
	4	60		
	5	54		
	Avg.	59.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

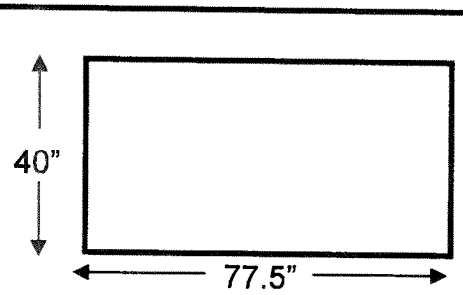
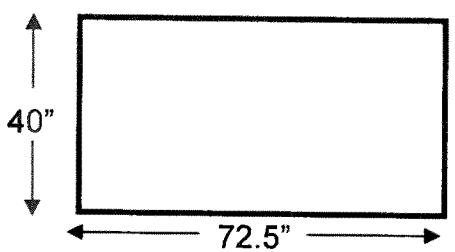
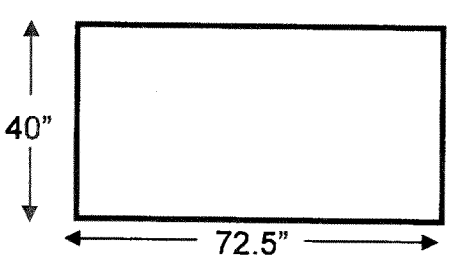
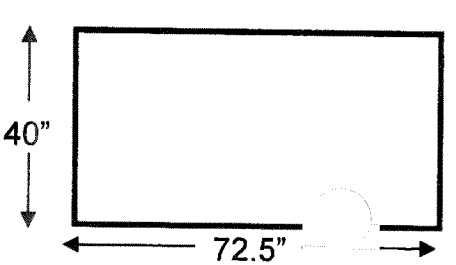
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 69B	1	54	Discoloration noted in top left corner of block. (See sketch & photo)	
	2	62		
	3	56		
	4	56		
	5	62		
	Avg.	58		
Block 70B	1	58		
	2	60		
	3	62		
	4	62		
	5	56		
	Avg.	59.6		
Block 71B	1	62		
	2	59		
	3	52		
	4	56		
	5	57		
	Avg.	57.2		
Block 72B	1	48	End Section 8	
	2	56	Measurements were taken of the joint between Blocks 72B and 73B. The	
	3	58	blocks were separated by 1" at the top of joint.	
	4	58		
	5	56		
	Avg.	55.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

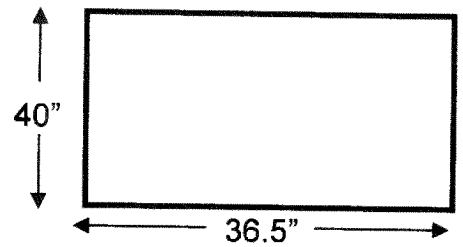
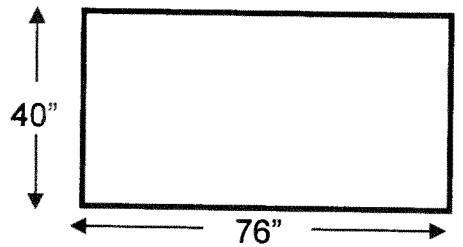
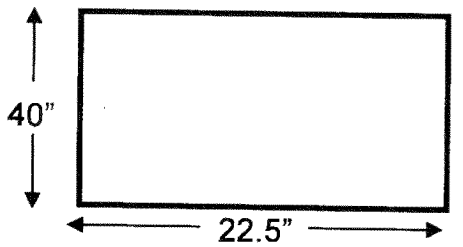
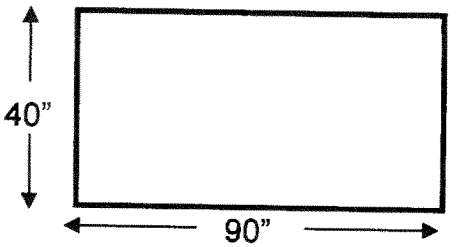
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 73B	1	54	Begin Section 9	
	2	58		
	3	52		
	4	52		
	5	58		
	Avg.	54.8		
Block 74B	1	60		
	2	56		
	3	56		
	4	60		
	5	58		
	Avg.	58		
Block 75B	1	56		
	2	48		
	3	59		
	4	51		
	5	56		
	Avg.	54		
Block 76B	1	61		
	2	54		
	3	61		
	4	54		
	5	48		
	g.	55.6		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

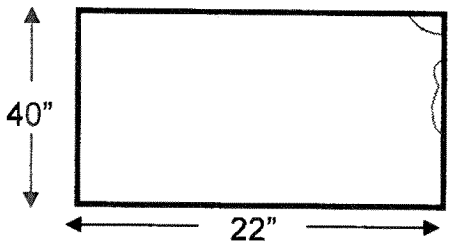
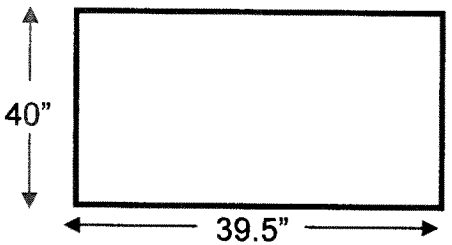
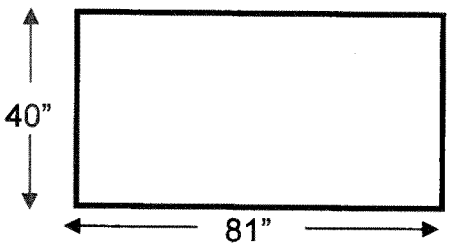
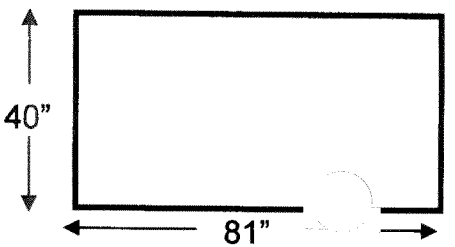
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 77B	1	59	End Section 9	
	2	64		
	3	60		
	4	51		
	5	56		
	Avg.	58		
Block 78B	1	58	Begin Section 10	
	2	60		
	3	60		
	4	56		
	5	54		
	Avg.	57.6		
Block 79B	1	57		
	2	56		
	3	55		
	4	51		
	5	52		
	Avg.	54.2		
Block 80B	1	60		
	2	58		
	3	52		
	4	62		
	5	60		
	Avg.	58.4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

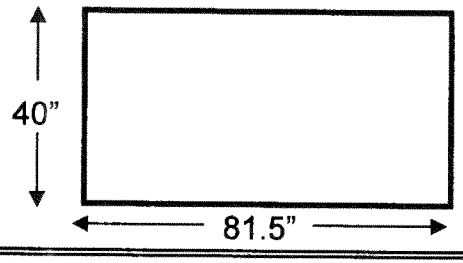
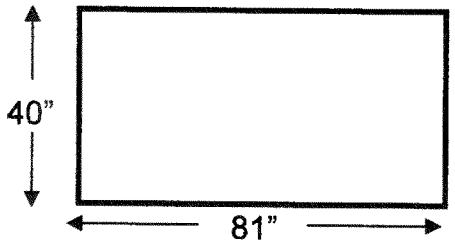
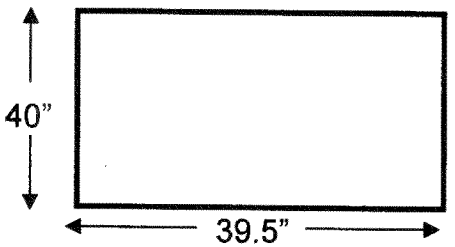
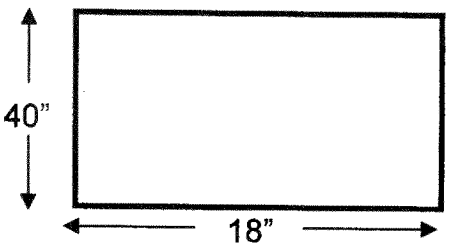
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 81B	1	59	Spalling noted at top right corner and along right side of block.	
	2	58		
	3	58		
	4	58		
	5	48		
	Avg.	56.2		
Block 82B	1	56		
	2	60		
	3	61		
	4	62		
	5	61		
	Avg.	60		
Block 83B	1	61		
	2	48		
	3	59		
	4	51		
	5	58		
	Avg.	55.4		
Block 84B	1	59		
	2	58		
	3	59		
	4	56		
	5	54		
	g.	57.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

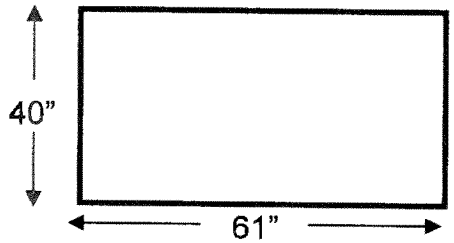
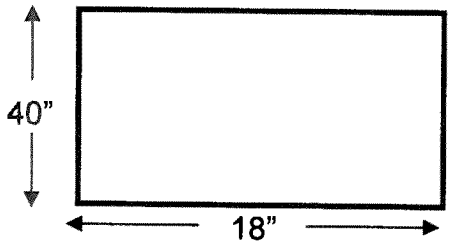
	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 85B	1	63		
	2	58		
	3	48		
	4	59		
	5	48		
	Avg.	55.2		
Block 86B	1	54		
	2	56		
	3	53		
	4	54		
	5	57		
	Avg.	54.8		
Block 87B	1	58		
	2	62		
	3	62		
	4	54		
	5	63		
	Avg.	59.8		
Block 88B	1	54		
	2	58		
	3	58		
	4	54		
	5	62		
	Avg.	57.2		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/17/08-3/19/08

	Point	Schmidt Hammer Rebound Value (R)	Comments	Sketch
Block 89B	1	54		
	2	58		
	3	58		
	4	51		
	5	56		
	Avg.	55.4		
Block 90B	1	56		
	2	60		
	3	62		
	4	48		
	5	54		
	Avg.	56		

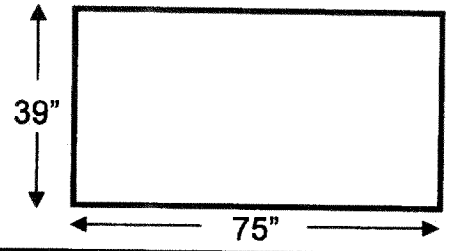
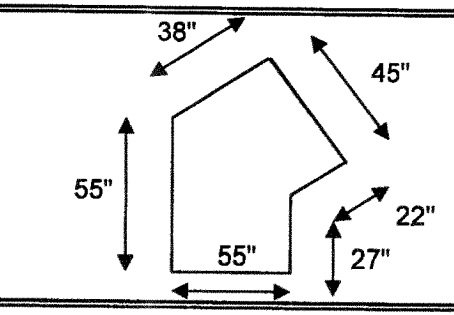
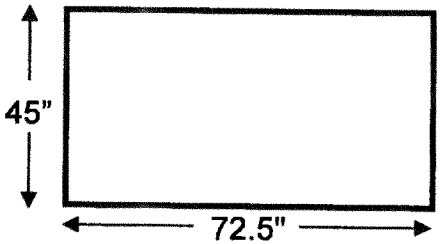
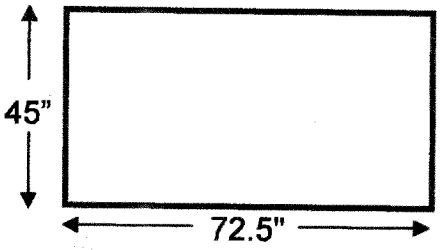
Capstones

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

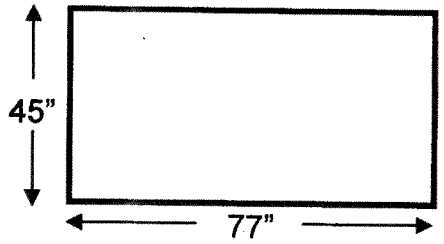
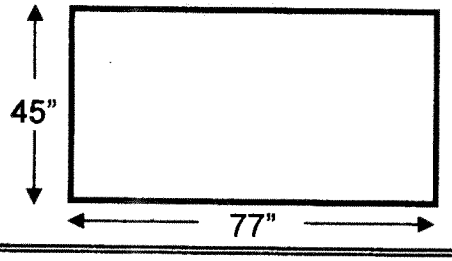
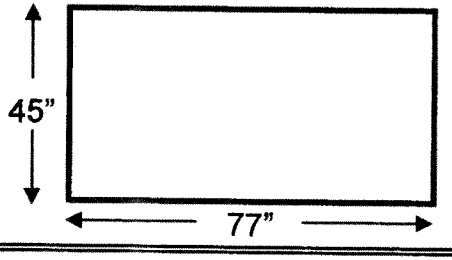
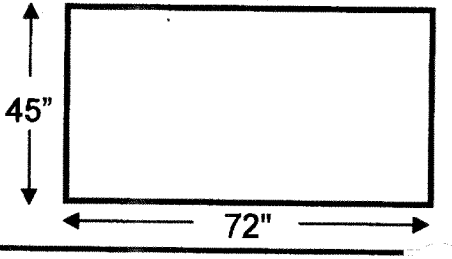
	Comments	Sketch
Capstone 1		
Capstone 2		
Capstone 3		
Capstone 4		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

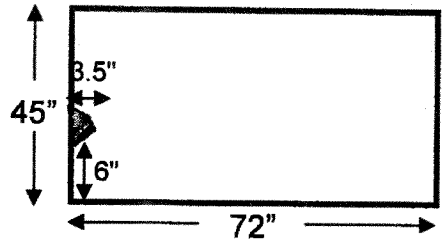
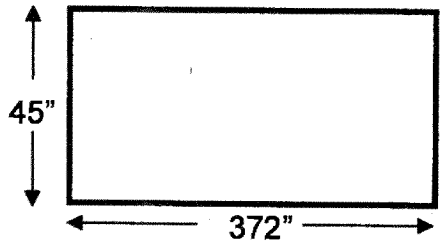
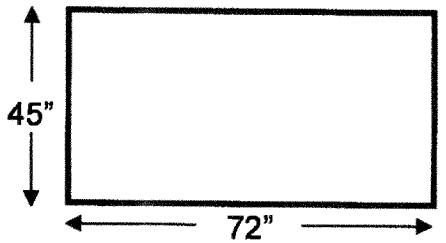
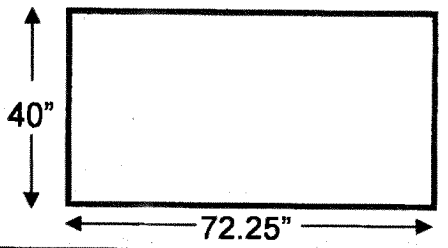
	Comments	Sketch
Capstone 5		
Capstone 6		
Capstone 7		
Capstone 8		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

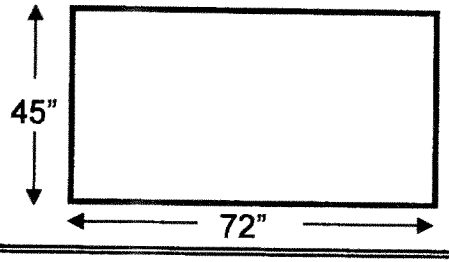
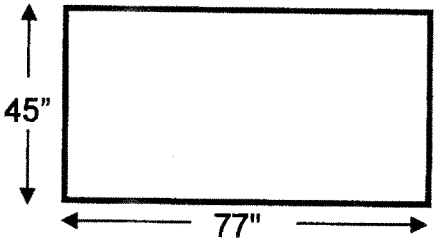
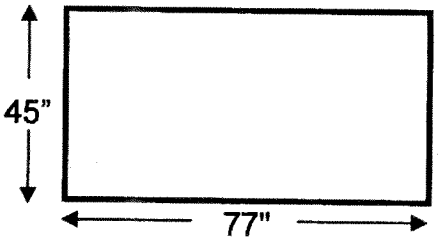
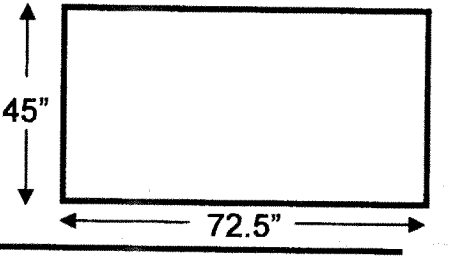
	Comments	Sketch
Capstone 9	Block cracked (See photo and sketch)	
Capstone 10		
Capstone 11		
Capstone 12		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

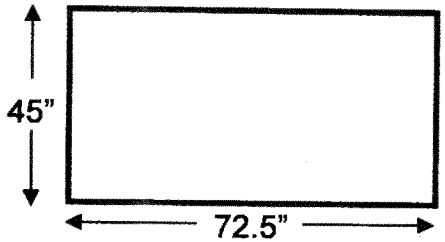
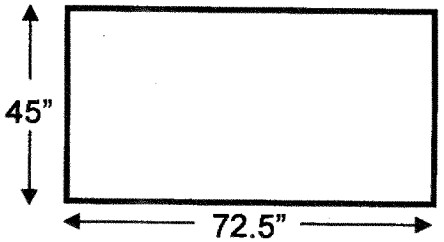
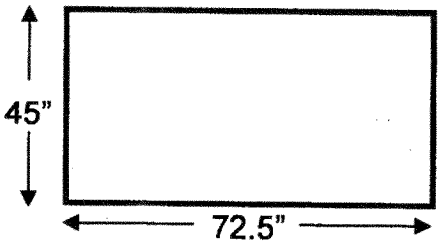
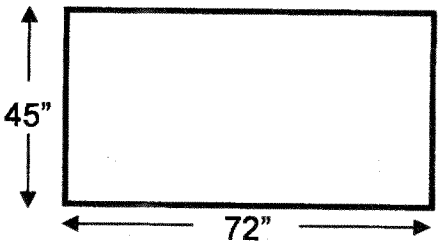
	Comments	Sketch
Capstone 13		
Capstone 14		
Capstone 15		
Capstone 16		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

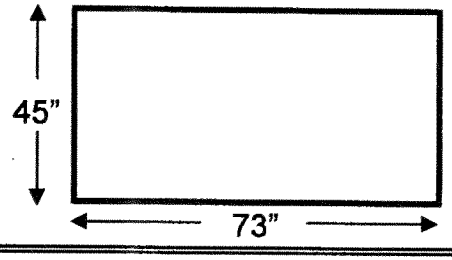
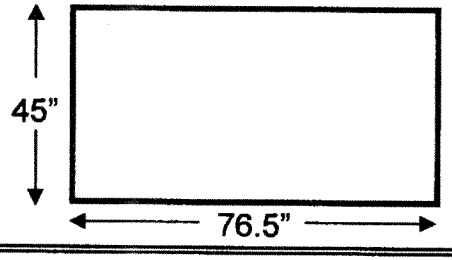
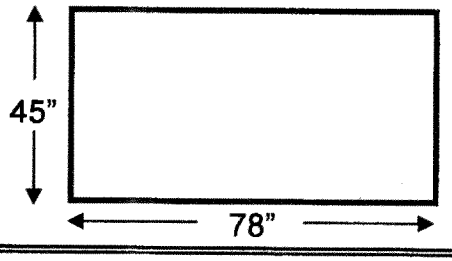
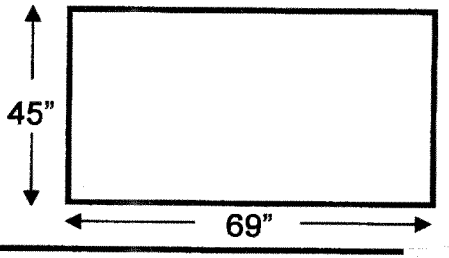
	Comments	Sketch
Capstone 17		
Capstone 18		
Capstone 19		
Capstone 20		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

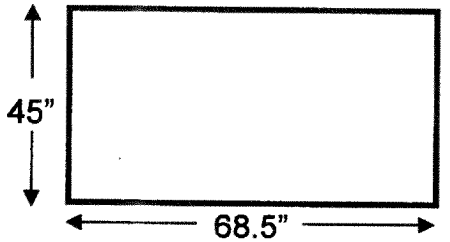
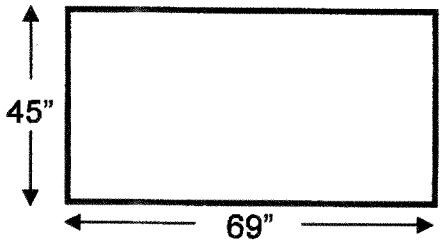
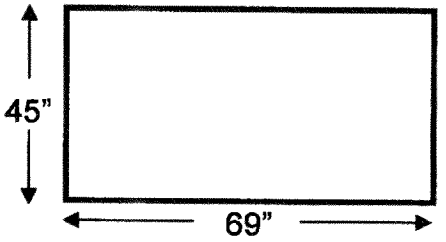
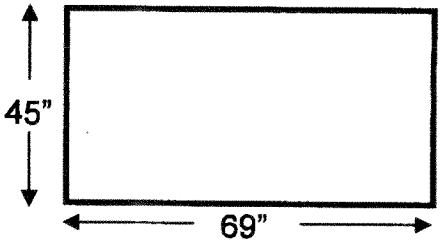
	Comments	Sketch
Capstone 21		
Capstone 22		
Capstone 23		
Capstone 24		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

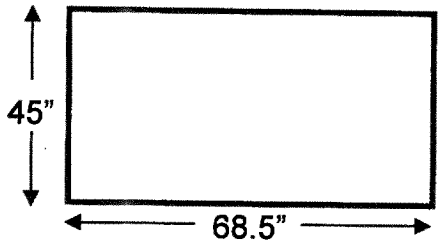
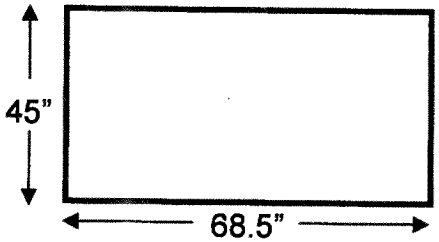
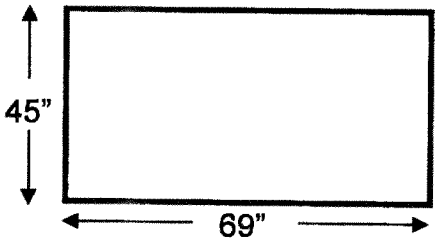
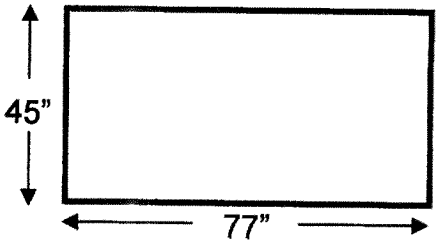
	Comments	Sketch
Capstone 25		
Capstone 26		
Capstone 27		
Capstone 28		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

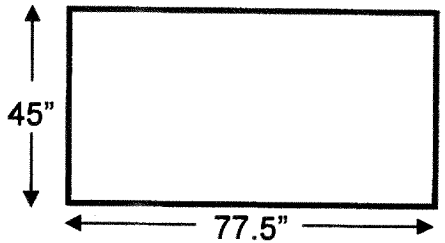
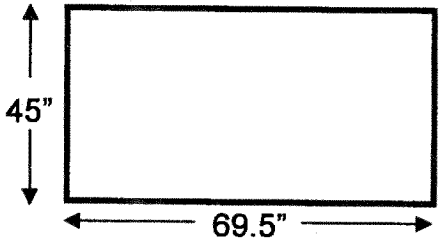
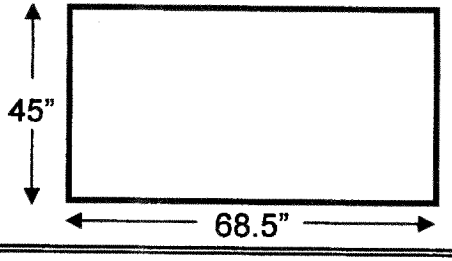
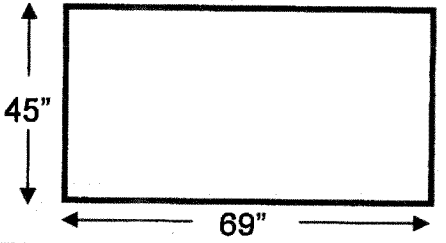
	Comments	Sketch
Capstone 29		
Capstone 30		
Capstone 31		
Capstone 32		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

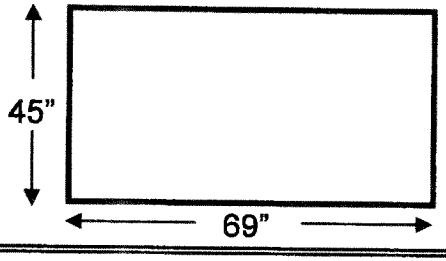
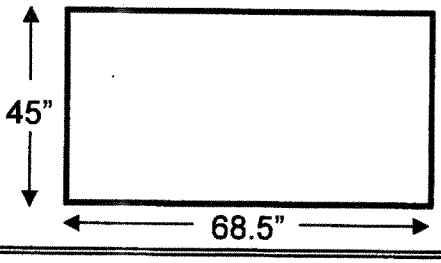
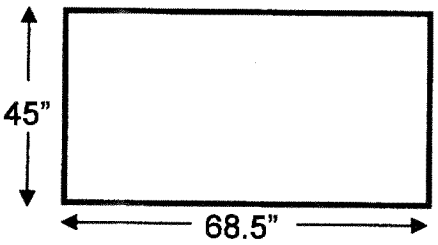
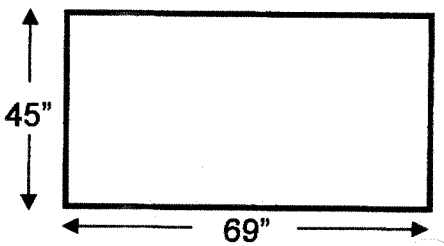
	Comments	Sketch
Capstone 33		
Capstone 34		
Capstone 35		
Capstone 36		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

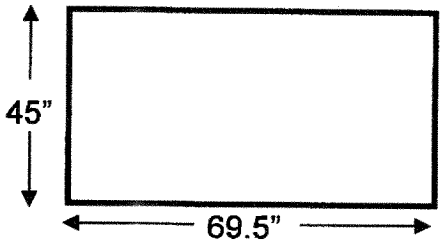
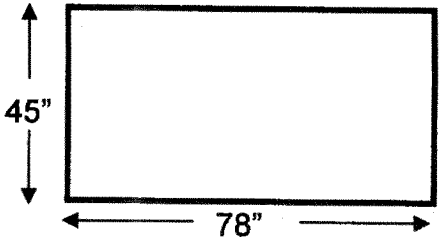
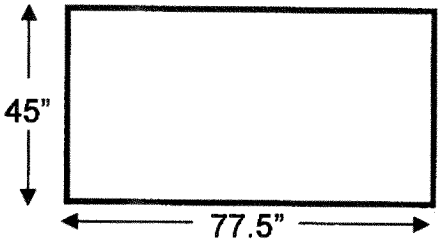
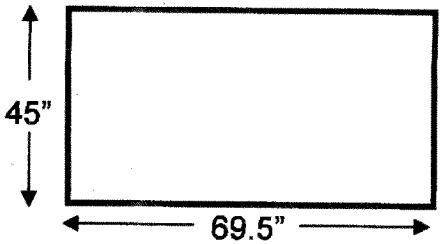
	Comments	Sketch
Capstone 37		
Capstone 38		
Capstone 39		
Capstone 40		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

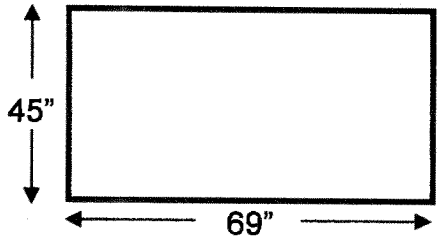
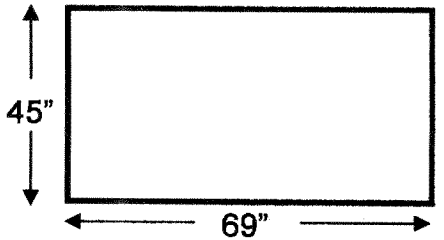
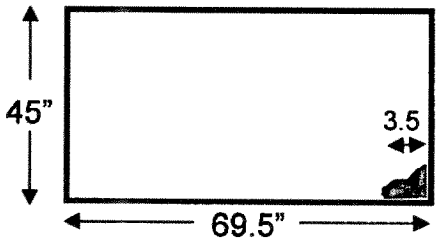
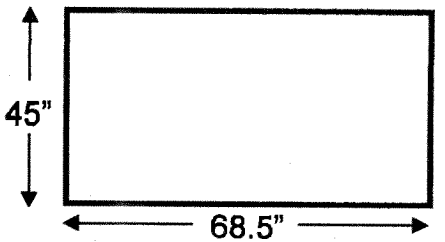
	Comments	Sketch
Capstone 41		
Capstone 42		
Capstone 43		
Capstone 44		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

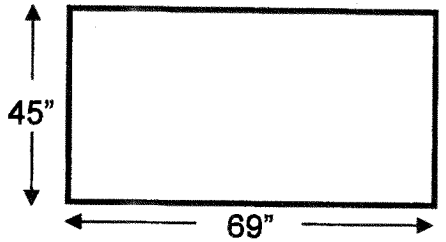
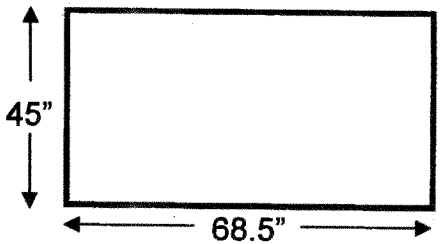
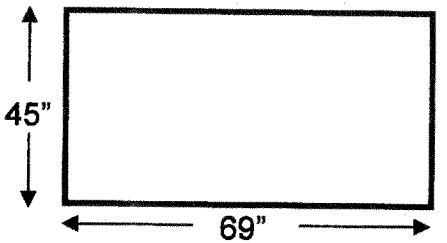
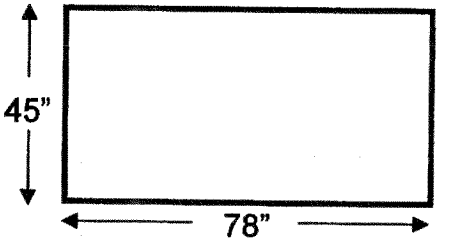
	Comments	Sketch
Capstone 45		
Capstone 46		
Capstone 47	Damage at corner of block (See photo and sketch)	
Capstone 48		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

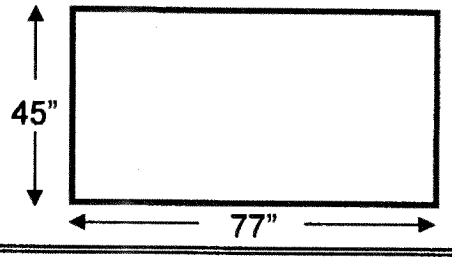
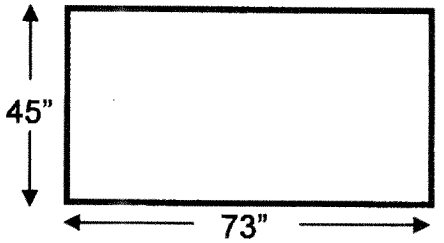
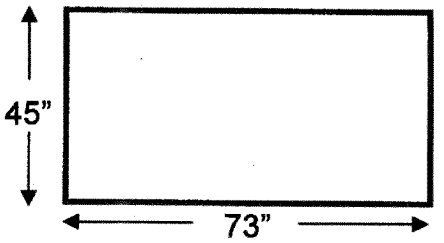
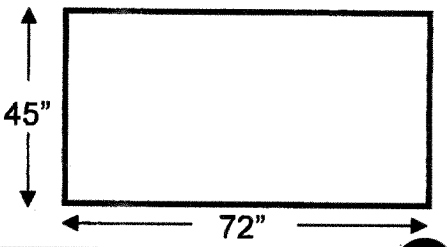
	Comments	Sketch
Capstone 49		
Capstone 50		
Capstone 51		
Capstone 52		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

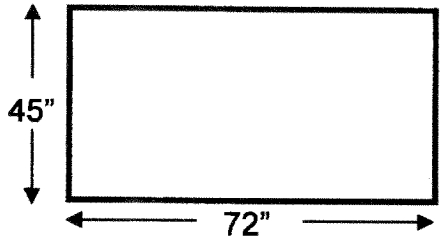
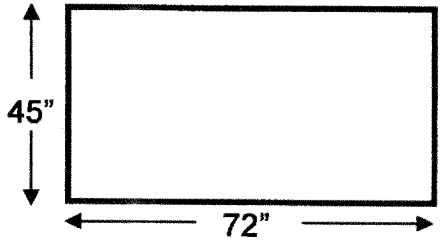
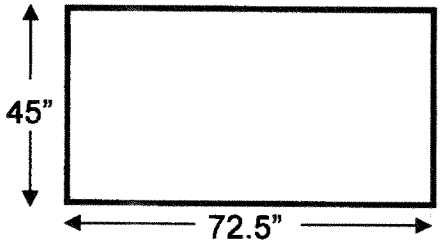
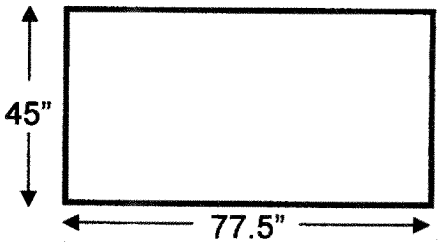
	Comments	Sketch
Capstone 53		
Capstone 54		
Capstone 55		
Capstone 56		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

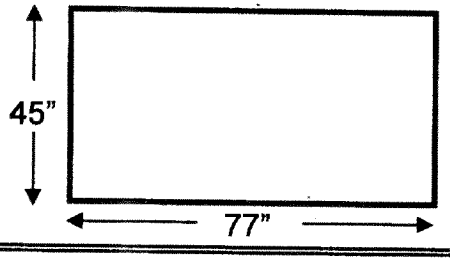
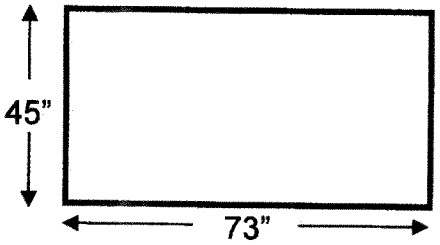
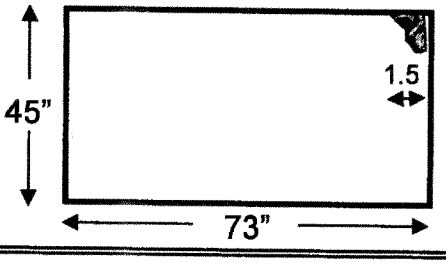
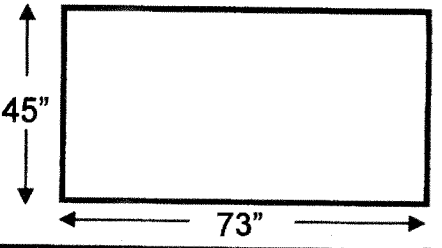
	Comments	Sketch
Capstone 57		
Capstone 58		
Capstone 59		
Capstone 60		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

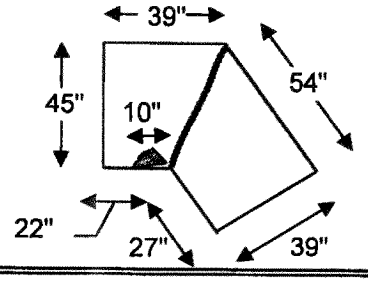
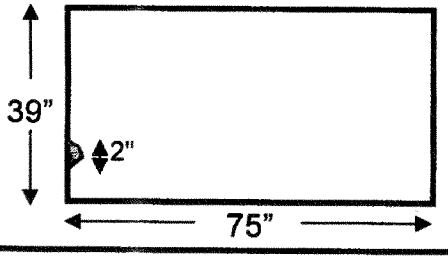
	Comments	Sketch
Capstone 61		
Capstone 62		
Capstone 63	Damage at corner of block (See photo and sketch)	
Capstone 64		

Survey of Ashlar Seawall

Schnabel Engineering

Project: Jefferson Memorial
Location: Washington, D.C.
Client: National Park Service, Denver Service Center

Performed: Schnabel Engineering
Date: 3/21/2008

	Comments	Sketch
Capstone 65	Large crack and spall on block (See photo and sketch)	
Capstone 66	Spalling on block (See photo and sketch)	

D

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

CORE REPORT FOR THE ASHLAR SEAWALL
Prepared by Schnabel Engineering

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
July 22, 2008

CORE REPORT FOR THE ASHLAR SEAWALL

Jefferson Memorial, Washington, DC
Schnabel Reference 06150078.B

FOR

HNTB

1615 M Street, NW, 7th Floor, Washington, DC 20036

July 22, 2008

PREPARED BY

Schnabel Engineering

510 East Gay Street, West Chester, Pennsylvania 19380
Phone (610) 696-6066 Fax (610) 696-7771

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

July 22, 2008

Mr. Nathan James
Project Manager
HNTB
1615 M Street, NW, 7th Floor
Washington, DC 20036

Subject: **Core Report for the Ashlar Seawall, Jefferson Memorial, National Park Service, Washington, DC (Schnabel Reference 06150078.B)**

Dear Mr. James:

Schnabel Engineering, LLC (Schnabel), is pleased to present our concrete core report for the North Plaza Seawall at the Jefferson Memorial. We have completed these services under Modification #2 to Task Order No. 097, dated April 25, 2008.

PURPOSE OF REPORT

The North Plaza Seawall at the Jefferson Memorial has been undergoing settlement. It was first noticed in February 2006, and has continued since that time. Schnabel understands that the National Park Service (NPS) desires that the existing concrete seawall remain in service for an additional 30 to 40 years and is to be incorporated as part of the remediation effort. The purpose of the concrete coring is to observe the integrity of the seawall at various locations. Schnabel observed the work that was performed from April 28 through May 8, 2008.

DESCRIPTION OF OBSERVATIONS

Schnabel personnel observed drilling and core recovery from 4-inch holes cored vertically through the concrete seawall at five locations along the wall. A location plan is attached in Appendix A. The cores ranged in length from 8.5 to 9.5 ft. Lorton Contracting Company, Inc. (Lorton) removed and stored Capstones 3, 14, 34, 52, and 64. Cameron Drilling Company, Inc. (Cameron) drilled the cores in the locations where capstones were removed. Following the coring, Lorton plugged the bottom of the core holes with gravel and grouted the holes. They also set the capstones back into place on a bed of mortar and sealed the joints. Mr. Steve Sims of NPS supervised the sealing of joints.

Appendix B displays photos that exhibit some of the conditions observed. Our observations are summarized in the core logs attached in Appendix C. Compressive strength testing and petrographic analyses of the cores are also attached in Appendices D and E.

SUMMARY OF OBSERVATIONS

In general, the top 2 to 3 ft of the concrete in the cores include smaller segments with more cracking than the lower sections. The lower core segments varied in length from 2.5 to 35.75 inches. In Cores #2 through #5, the foundation material beneath the wall appeared to be washed out, leaving a void of approximately 2 to 8 inches. The last segment in Core #3 slipped beneath the wall and into a void, and it could not be recovered. A horizontal joint was noted at approximately 3.5 to 4 ft in Cores #2, through #5. It appears that this joint may be due to the placement of concrete lifts during construction and it has experienced wear along the interface, possibly the result of flexure of the wall and translation of the joint.

Horizontal reinforcing steel was encountered in Cores #1 through #3, and #5 at a depth of approximately 3 to 3.5 inches. Horizontal reinforcing steel was also encountered in Cores #1, #2, #4, and #5 at a depth of approximately 7 to 8 ft.

Core #1 included broken concrete and soil at a depth of about 2 ft. A seam was located in Core #2 at a depth of 4 ft. During drilling, the return appeared to be leaking through the seam and into the Tidal Basin. Broken concrete was encountered in Core #3 at a depth of approximately 9 inches. Core #4 appeared to be softer than the other cores based on the penetration rate. It was drilled in 85 minutes, while other cores generally took between 180 and 240 minutes to drill.

Efflorescence was observed in several joints and breaks in the concrete cores, and was also observed on the ashlar facing of the seawall. Evidence of efflorescence and other chemical reactions was observed in several cores and is shown in Photos 1, 8, 10, and 13.

After the completion of coring, core holes were wet grouted. Gravel was used to plug the bottom of Core Holes #1, and #3 through #5. Non-shrink, non-metallic grout was used to fill each core hole. A total of 9.5 bags of grout were used in this operation.

Capstone #14 contained a survey point. Following capstone replacement, Schnabel measured the difference in elevation and lateral distance from the survey points on Capstone #15. This information will be used for adjusting subsequent rounds of site survey readings. The southwest corner of Capstone #52 chipped off during capstone removal. Lorton retained the chip and repaired the capstone following concrete coring and capstone replacement.

LAB TESTING

Five compressive strength tests were completed by Schnabel on May 20, 2008. The results are attached to this report. The compressive strength values measured ranged from about 5,000 to 7,500 psi and are included in Appendix D.

Petrographic analyses were performed on Core Lengths 1-10, 3-3 and 5-1, by Construction Petrographics, Inc. (CPI) in a report dated June 4, 2008. The results are included in Appendix E. The petrographic analyses indicate that the coarse and fine aggregates are composed of a wide variety of rock and mineral types that are predominantly silica rich rocks and particles. The air content is estimated to be less than 1 percent. The amount of unhydrated cement grains within the cement pastes indicates water/cement ratios lower than 0.45.

Freeze-thaw deterioration was evident in Cores 1-10 (bottom of wall) and 5-1 (top of wall). There was no evidence of freeze-thaw deterioration observed in Core 3-3 (middle of wall).

Alkali-silica reaction (ASR) has occurred in each of the three cores tested, to some degree. Microcracks in and around the coarse and fine aggregate were observed, but cracking of the concrete due to the ASR was not observed. Several deposits of alkali-silica gel are present.

CONCLUSIONS

In general, the top two to three feet of each core showed significant cracking and breaking. Close visual inspection shows the appearance of several lift lines that have deteriorated as a result of efflorescence. If the concrete wall is to remain in use, it is recommended that as part of the underpinning effort, the broken and cracked portion of the top of the wall be removed, and a new cap be formed at the top of the wall.

In addition, several horizontal cracks and joints were observed in the cores. These cracks and joints appear to be the result of lift lines that have opened due to the flexure of the wall. It is anticipated that the micropile layout, as shown in the current Schematic Documents, will provide additional reinforcement to the concrete wall. This reinforcement will likely provide stabilization to the further development of cracks and joints of the concrete wall.

The visual analysis showed that there is a possibility of ASR, which is apparent in dark rings around the aggregate (see Photos 4, 14, and 25). The petrographic analyses confirmed evidence of ASR occurring in the concrete. Silica gel also appears to be forming in the concrete, as noted in Photos 5, 9, 18, and 27. The high compressive strength results of the concrete core breaks and the microscopic magnification of the petrographic analyses indicate that ASR does not currently appear to be a widespread issue in the concrete wall. Low air content and water/cement ratio have likely contributed to limiting the presence of moisture in the concrete. When the ASR gel is exposed to moisture, swelling of the gel occurs, which causes the concrete to develop tension and compressive stresses which in turn cause the concrete to crack. While, at the time of this report, presence of ASR gel in the concrete does not appear to be widespread, the process of installing micropiles (five feet on center) may increase the amount of moisture in the concrete, which may increase the formation of ASR gel in the concrete wall. We recommend that NPS establish a program of periodic concrete coring and petrographic analyses in order to monitor the presence of ASR in the wall if the existing wall is to remain in service.

We have endeavored to prepare this report of the seawall concrete identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other

representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this agreement, or any report, opinion, document, or other instrument of service.

We appreciate the opportunity to be of service for this project. Please contact either of the undersigned at (610) 696-6066 if clarification is needed for any aspect of this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

Melinda Dirdal

Melinda Dirdal, E.I.T.
Staff

Darrell Wilder

Darrell Wilder, P.E.
Associate

MLD:HR:DW:JEG:GMH:jlm

Appendix A: Core Location Plan
Appendix B: Photos
Appendix C: Core Logs
Appendix D: Compressive Strength Test of Rock/Concrete Cores
Appendix E: Petrographic Report

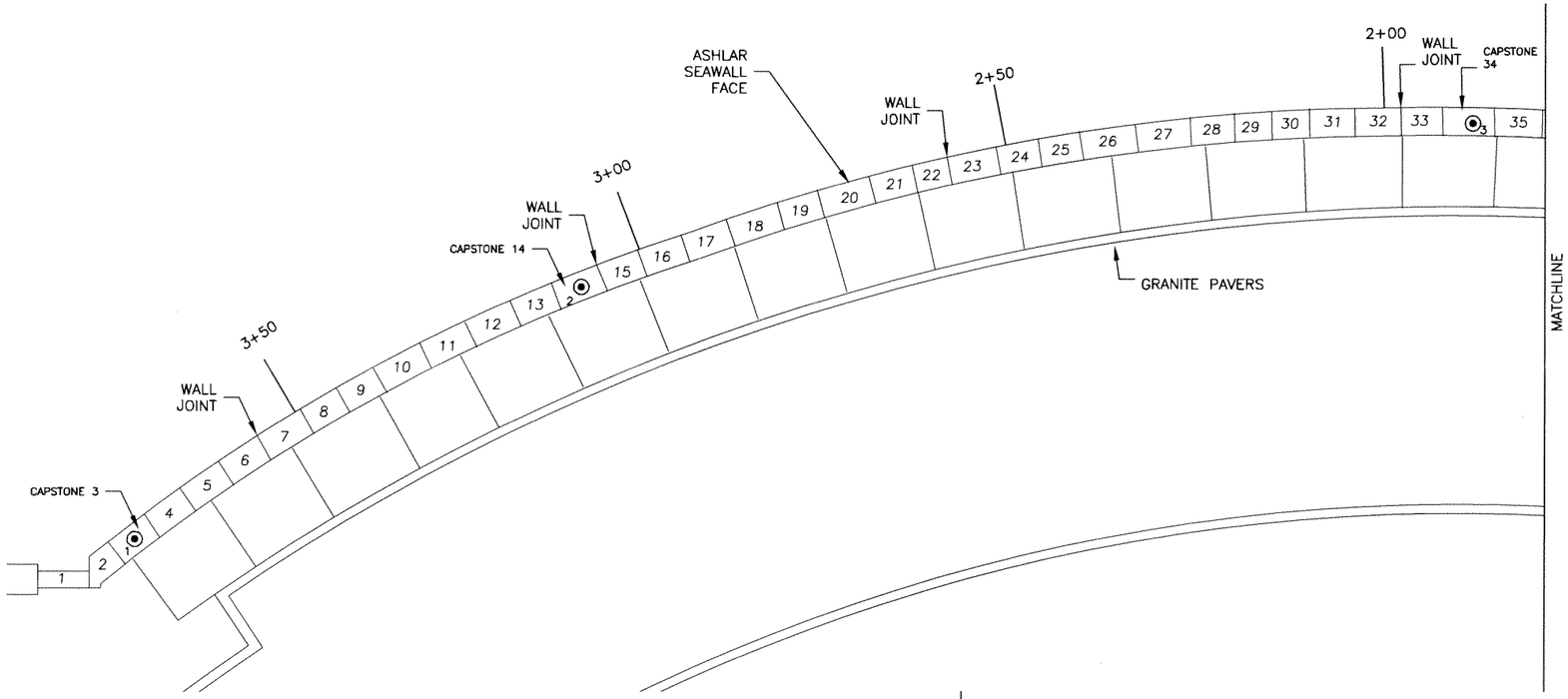
Distribution:

HNTB (1)
Attn: Mr. Nathan James

National Park Service (2)
Attn: Mr. Patrick MacDonald
Attn: Mr. Doug Denk

APPENDIX A

Core Location Plan



CORE NUMBER	STATIONING
1	3+71.8
2	3+08.6
3	1+87.7
4	0+80.1
5	0+05.9

LEGEND

1 CAPSTONE BLOCK AND NUMBERING

4" DIA. CORE HOLE AND NUMBERING

10 0 10 20
SCALE OF FEET

2006\JOBS\06150078.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\CADD\CONCRETE CORING\30BLOCKS_NUMBER
5/14/08 17:00 NFAHEY

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

CORE LOCATION PLAN
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

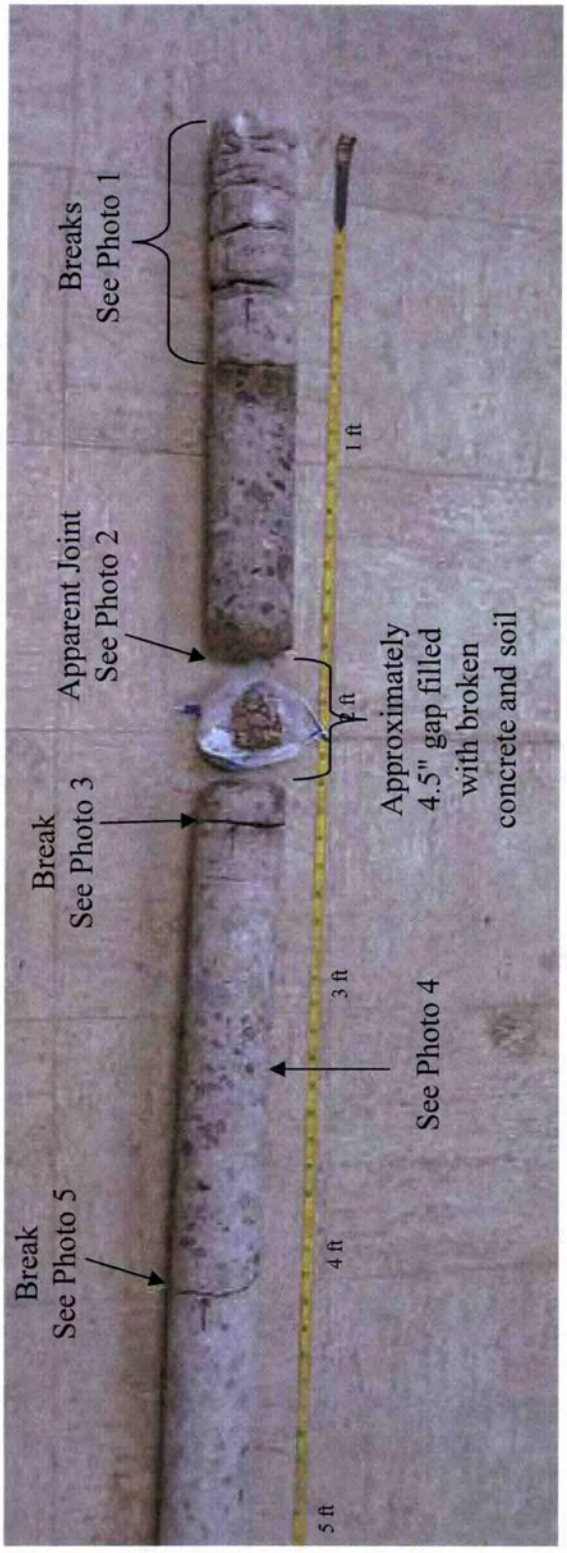
JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

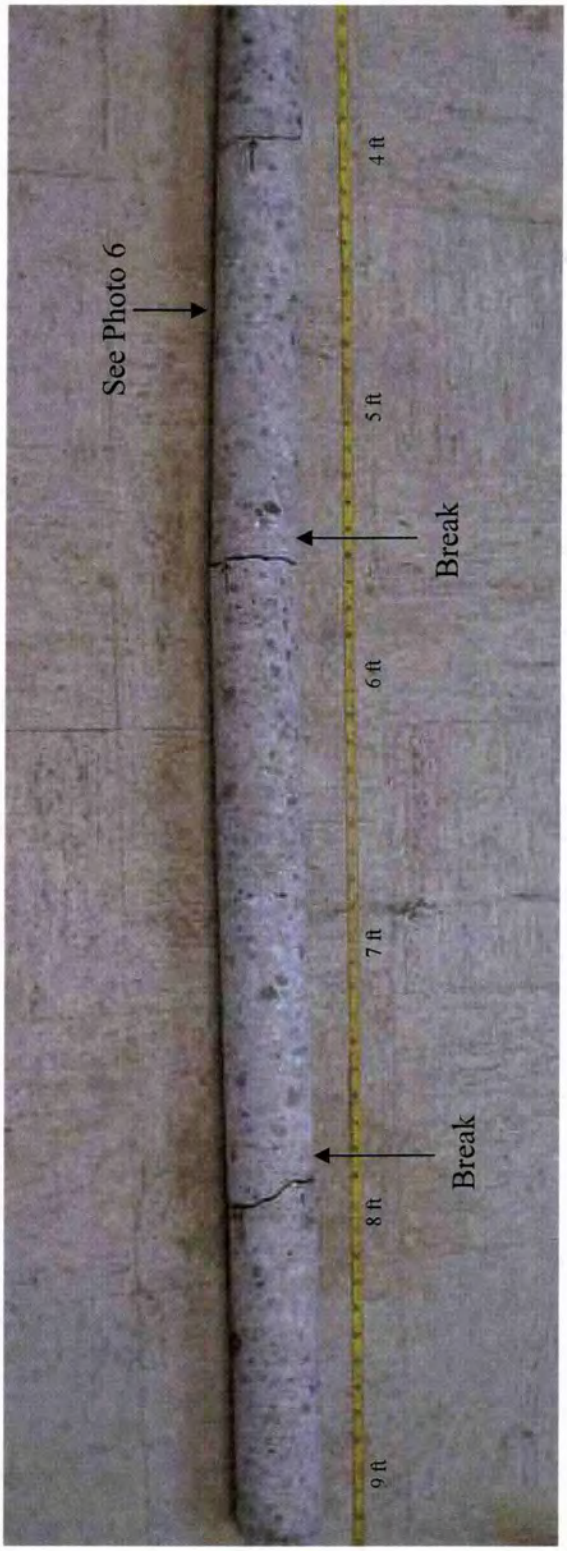
MD
DESIGNED
NSF
DRAWN
DW
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

APPENDIX B

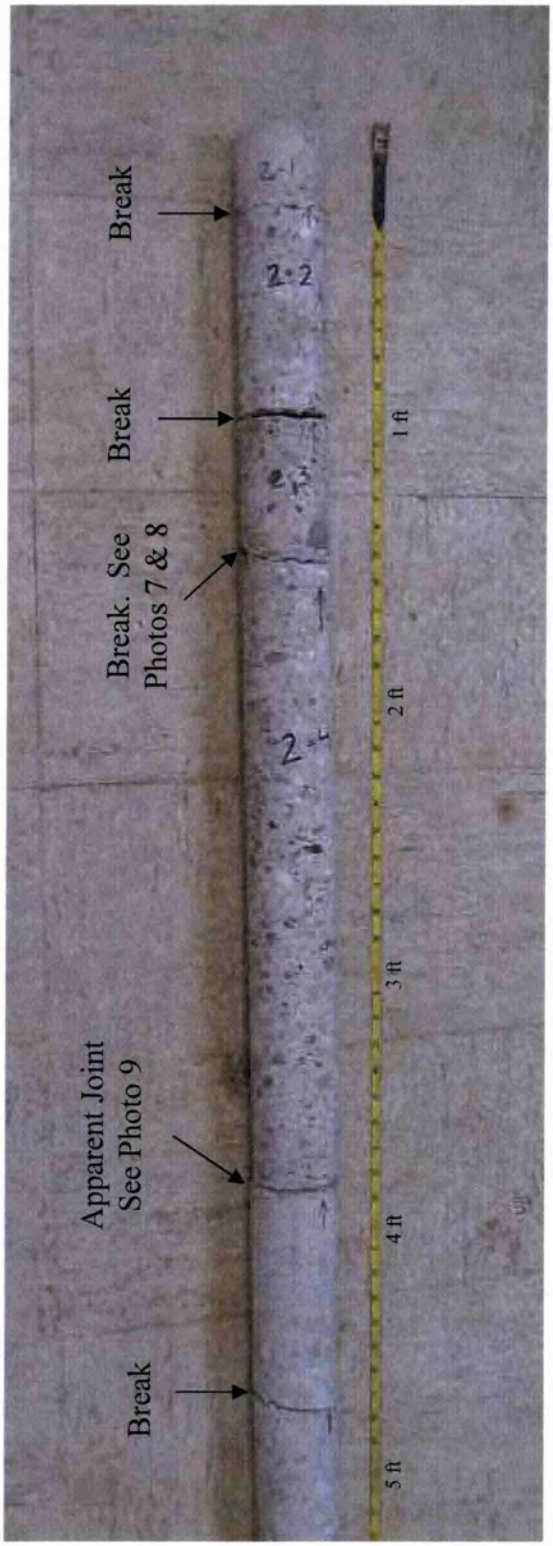
Photos

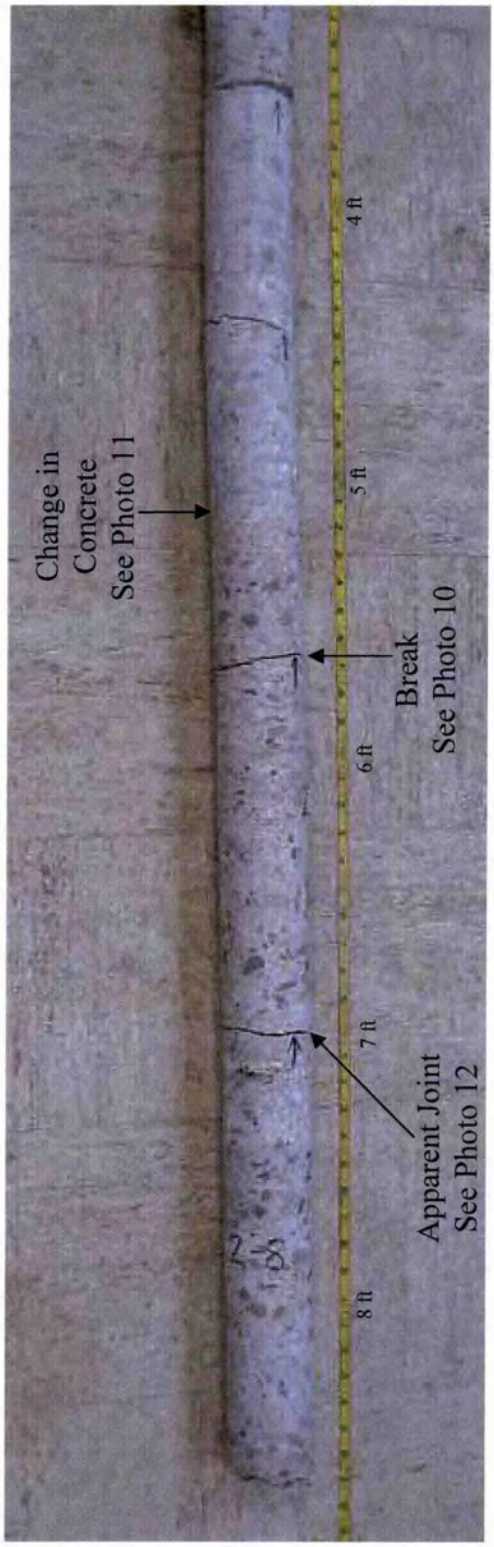
Core #1


Breaks
See Photo 1
Apparent Joint
See Photo 2
Break
See Photo 3
See Photo 4
Approximately
4.5" gap filled
with broken
concrete and soil
Break
See Photo 5
1 ft
3 ft
4 ft
5 ft

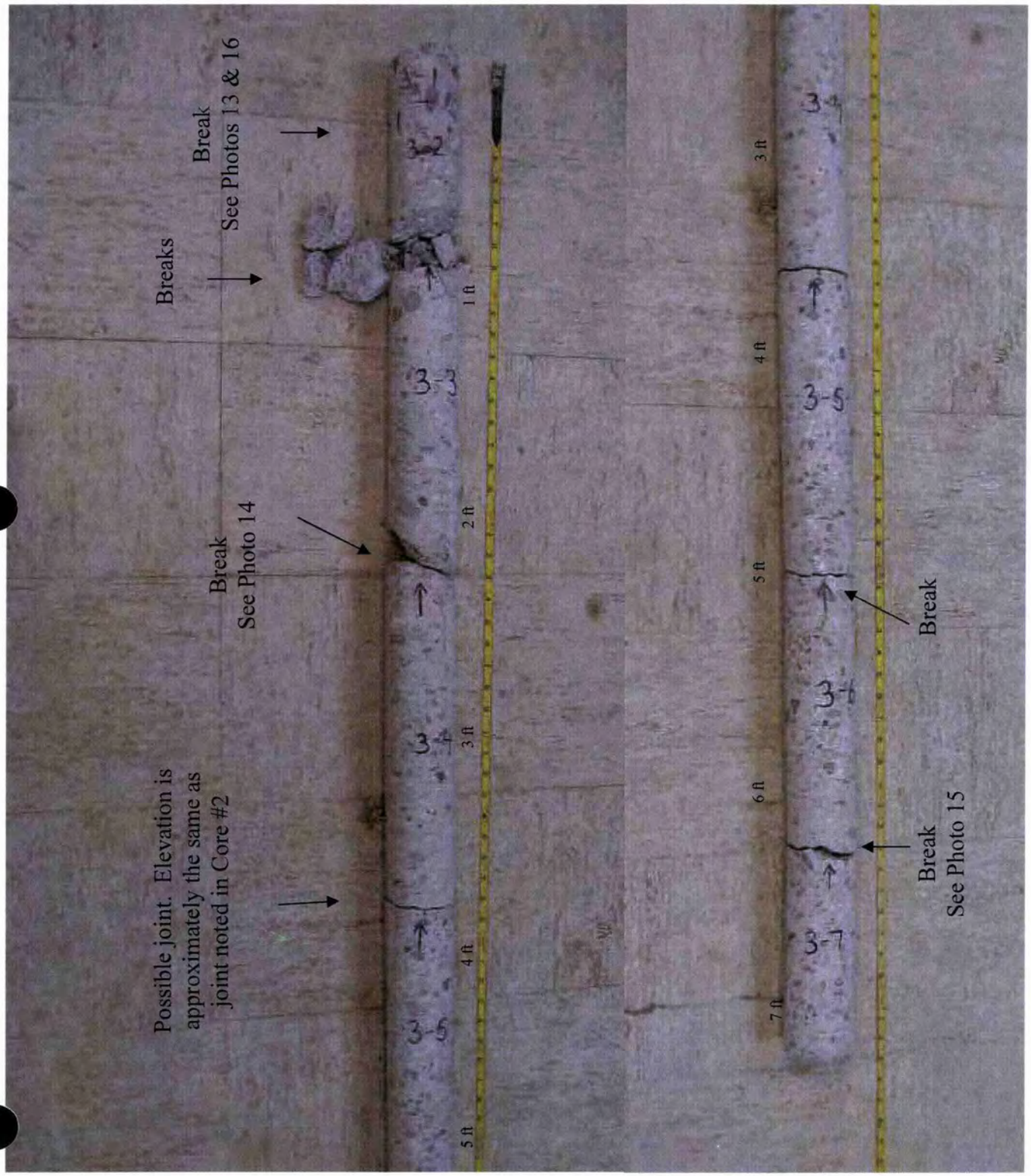

See Photo 6
Break
Break
4 ft
5 ft
6 ft
7 ft
8 ft
9 ft

Core #2

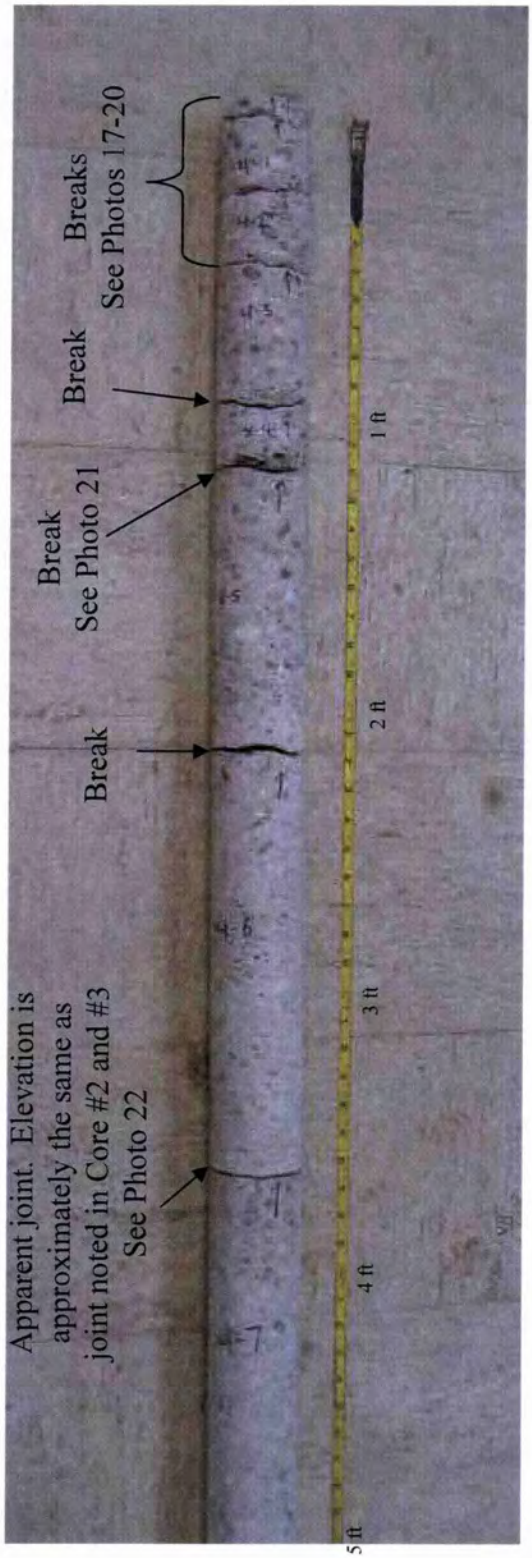

Break
Apparent Joint
See Photo 9
Break. See
Photos 7 & 8
Break
Break
5 ft
4 ft
3 ft
2 ft
1 ft

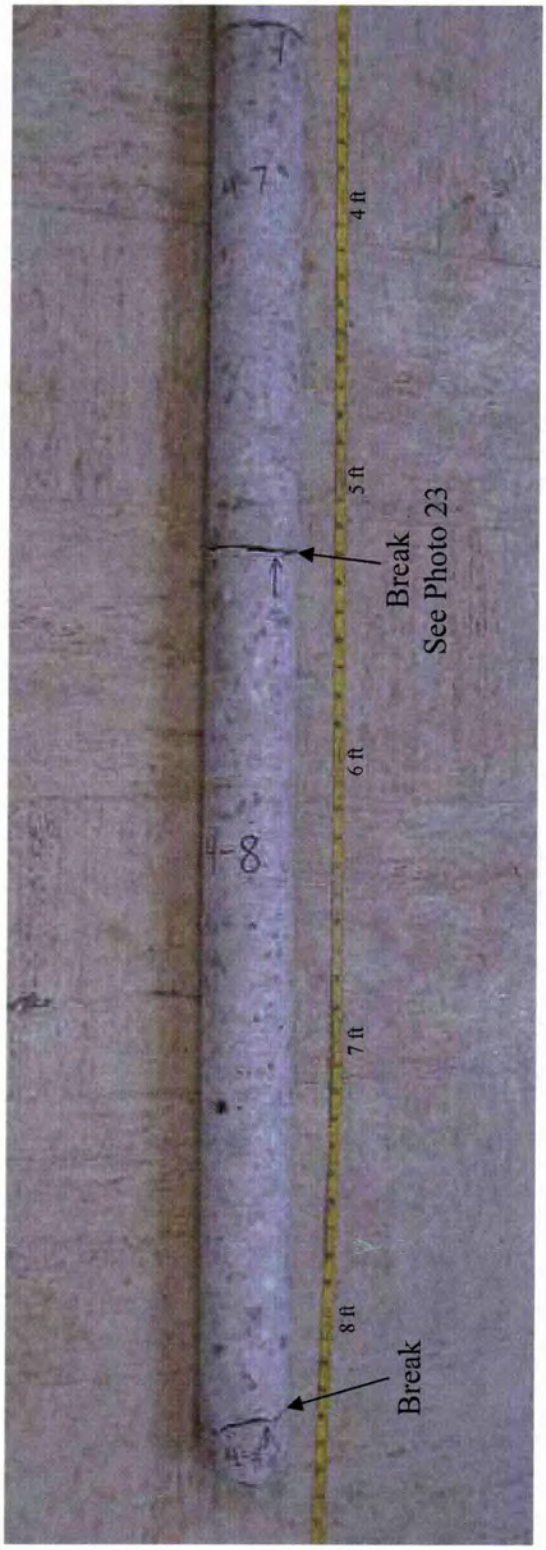

Change in
Concrete
See Photo 11
Break
See Photo 10
Apparent Joint
See Photo 12
8 ft
7 ft
6 ft
5 ft
4 ft

Core #3

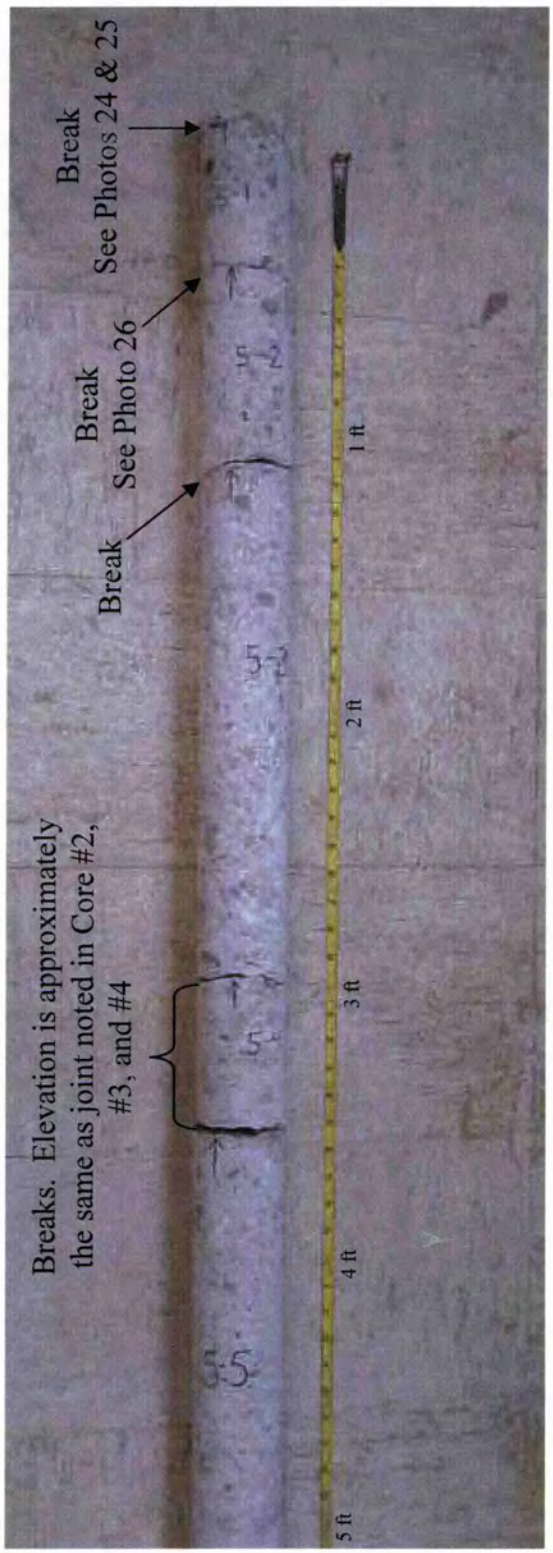

Breaks
Break
See Photos 13 & 16
Break
See Photo 14
Possible joint. Elevation is approximately the same as joint noted in Core #2
Break
Break
See Photo 15

Core #4


Apparent joint. Elevation is approximately the same as joint noted in Core #2 and #3
See Photo 22
Break
Break
See Photo 21
Break
Breaks
See Photos 17-20
1 ft
2 ft
3 ft
4 ft
5 ft


Break
See Photo 23
4 ft
5 ft
6 ft
7 ft
8 ft
Break

Core #5


Breaks. Elevation is approximately the same as joint noted in Core #2, #3, and #4
Break
See Photos 24 & 25
Break
See Photo 26
Break
1 ft
2 ft
3 ft
4 ft
5 ft

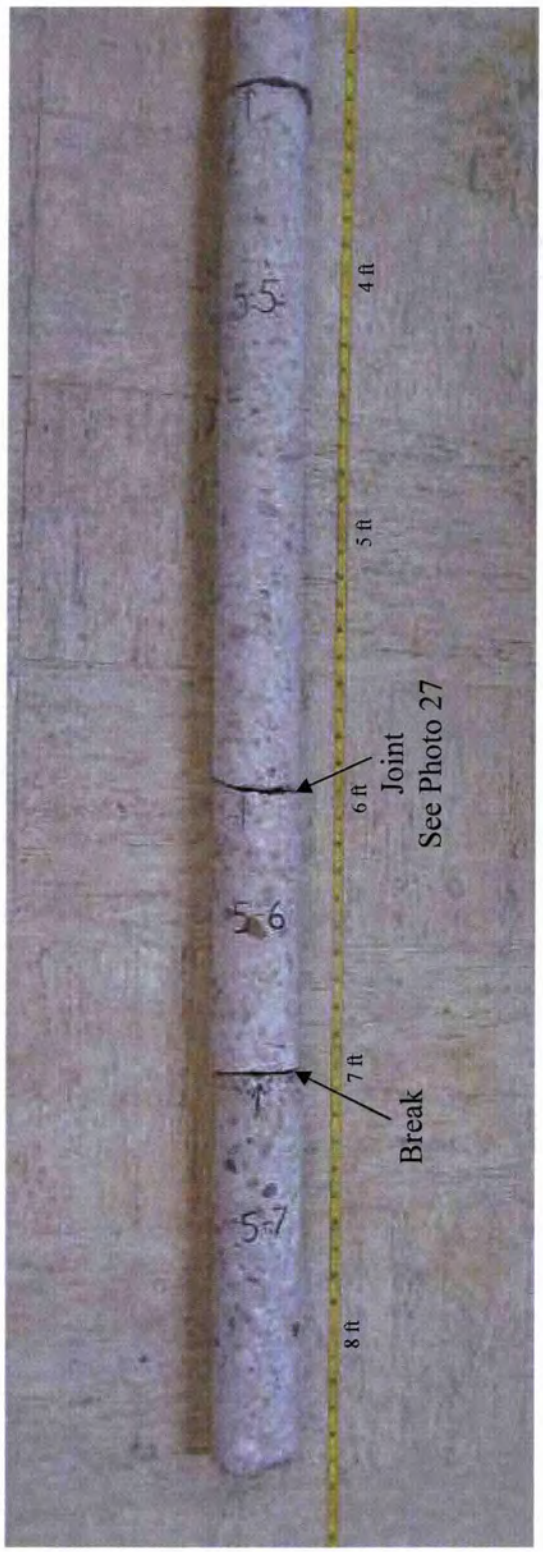

4 ft
5 ft
6 ft
Joint
See Photo 27
7 ft
Break
8 ft

Photo 1: Core 1, Segments 3 and 4 - Cross section of break, showing reinforcing steel (not intact) and evidence of efflorescence (white staining).

Photo 2: Core 1, Segments 8 and 9 - Cross section of joint.

Photo 3: Core 1, Segments 9 and 10 - Cross section of break.

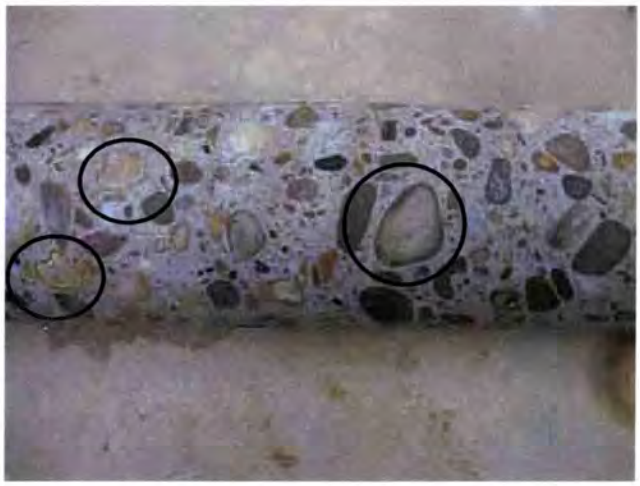


Photo 4: Core 1, Segment 10 - Dark rings around aggregate show a potential for ASR.

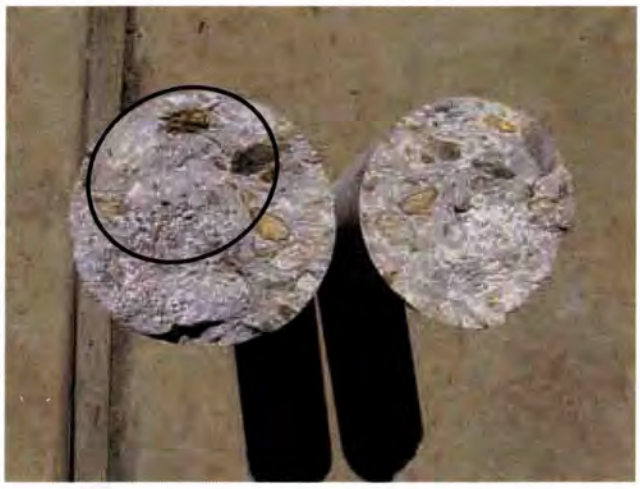


Photo 5: Core 1, Segments 10 and 11 – Silica gel forming in concrete.

Photo 6: Core 1, Segment 11 - Entrapped air in concrete.

Photo 7: Core 2, Segments 3 and 4 - Chip in Segment 4.

Photo 8: Core 2, Segments 3 and 4 - Evidence of efflorescence (white staining).

Photo 9: Core 2, Segments 4 and 5 - Smooth finish shows evidence of a joint. Silica gel forming in concrete.

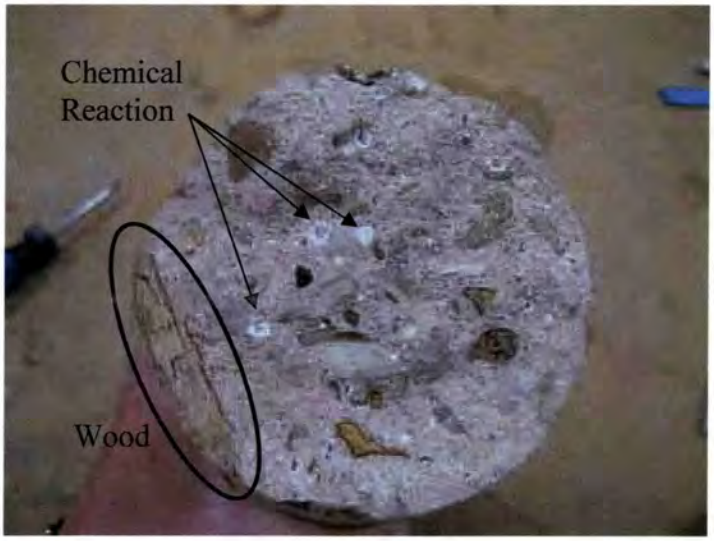


Photo 10: Core 2, Segment 6 - Cross section showing wood and chemical reaction in concrete (efflorescence).

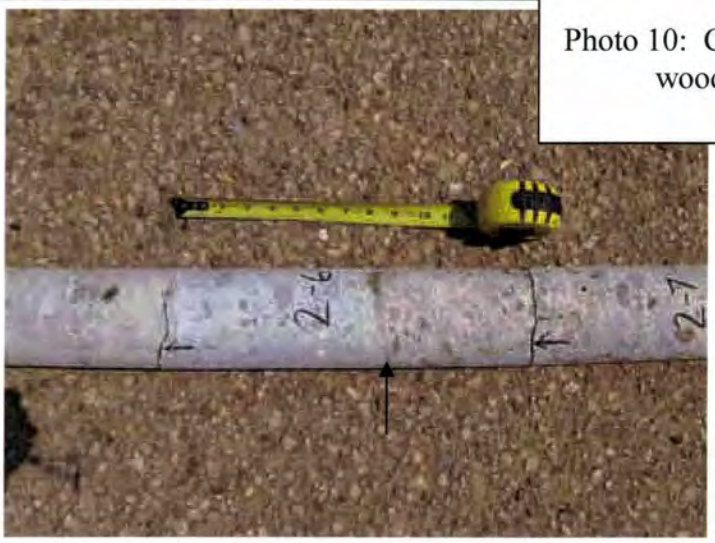


Photo 11: Core 2, Segment 6 - Core shows a change in concrete.

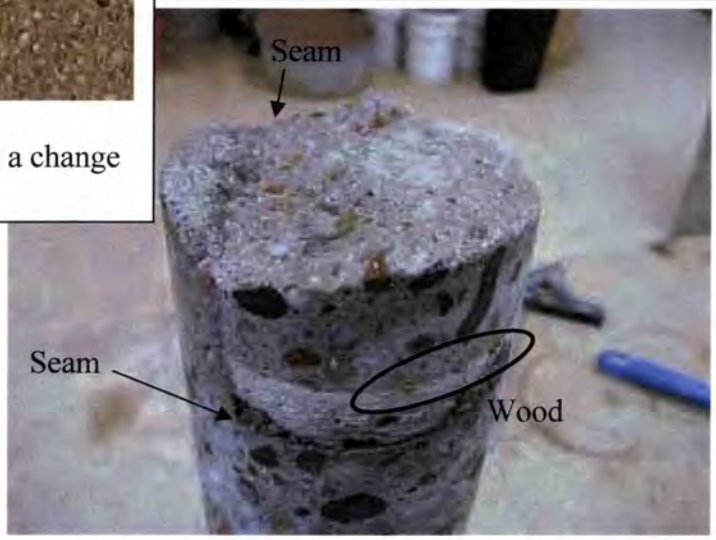


Photo 12: Core 2, Segment 8 - Core shows a seam and pieces of wood.

Photo 13: Core 3, Segments 1 and 2 - Cross section of break showing evidence of efflorescence (white staining).

Photo 14: Core 3, Segment 3 - Dark rings around the aggregate show a potential for ASR.

Photo 15: Core 3, Segment 7 - Evidence of wearing across joint.

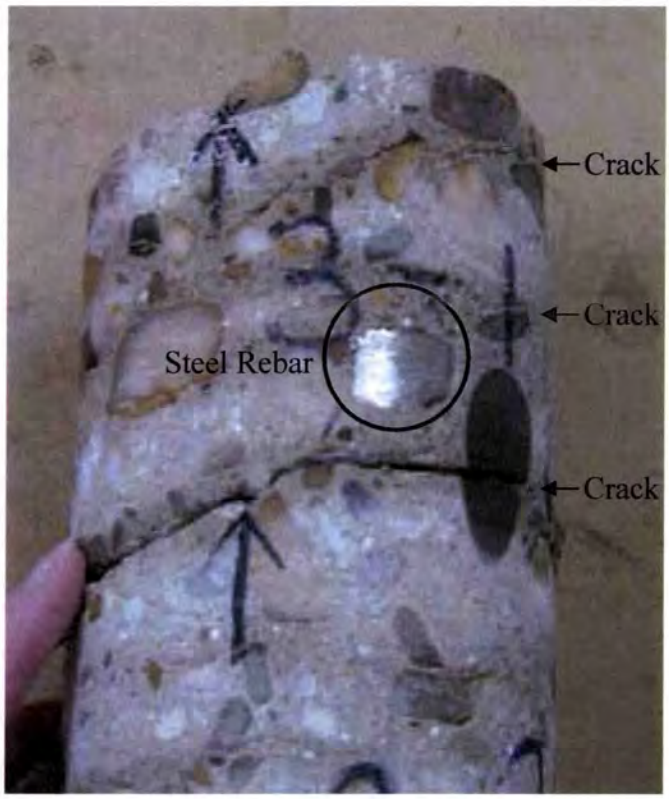


Photo 16: Core 3, Segments 1 and 2 - Cracking shows that concrete was likely placed in lifts. Steel rebar is also shown here.

Photo 17: Core 4, Segment 1 - Top of core shows significant cracking.

Photo 18: Core 4, Segment 1 - Cracking within Segment 1 shows evidence of efflorescence (white staining).

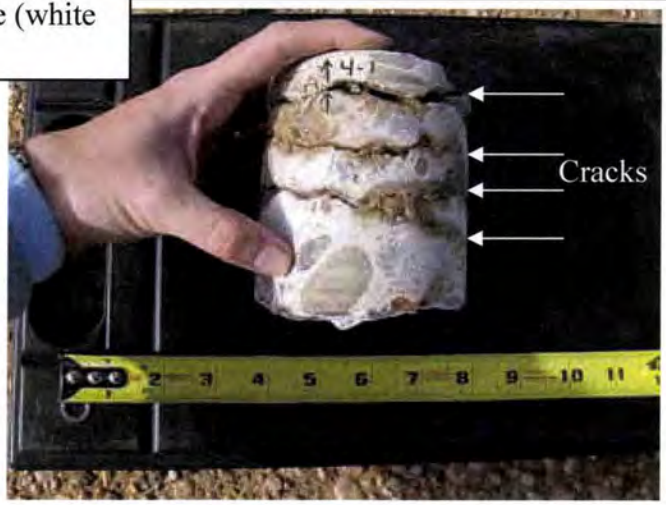


Photo 19: Core 4, Segment 1 - Cracking shows that concrete was likely placed in same lifts at top of wall.

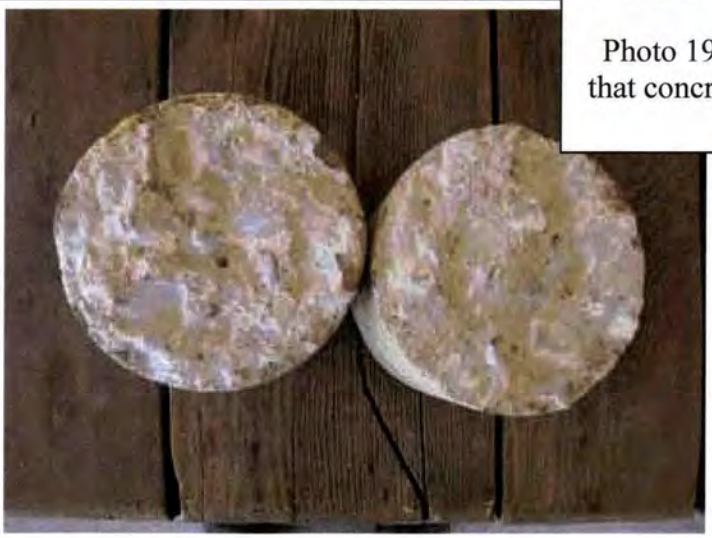


Photo 20: Core 4, Segments 1 and 2 - Cross section shows signs of wearing.

Photo 21: Core 4, Segments 4 and 5 - Cross section of break shows evidence of wearing.

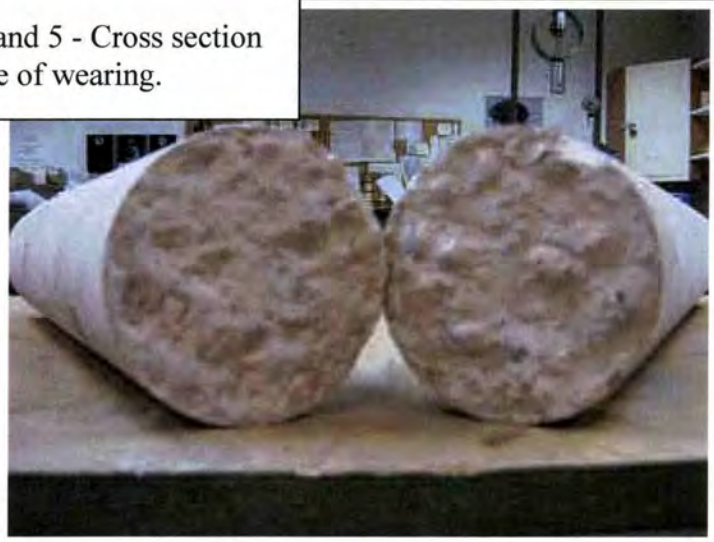


Photo 22: Core 4, Segments 6 and 7 - Cross section of break shows evidence of wearing.

Photo 23: Core 4, Segments 7 and 8 - Cross section of break shows evidence of wearing.

Photo 24: Core 5, Segment 1 - Top of core.

Photo 25: Core 5, Segment 1 - Cross section of joint showing evidence of efflorescence (white staining) and possible signs of ASR.

Photo 26: Core 5, Segments 1 and 2 - Cross section of break. Note that the aggregate fractured and that a ring appears around aggregate indicating potential ASR.

Photo 27: Core 5, Segments 6 and 7 - Cross section of joint shows evidence of efflorescence.

APPENDIX C

Core Logs

Schnabel Engineering

CORE LOGS

Project: Jefferson Memorial
Date prepared: 5/9/2008
By : MD
Reviewed: JG

Project #: 06150078.B

Core # 1 - Section 9 - 4" core diameter
Date: 5/1/2008
Observed by: Melinda Dirdal

Stationing
3+71.8

Segment	Length of core recovered	Depth	Comments
1	.75"	0' to 1'	1 intact piece
2	1"	0' to 1'	1 intact piece
3	1.5"	0' to 1'	Metal rebar at the bottom of this segment
4	1.75"	0' to 1'	1 intact piece
5	2"	0' to 1'	1 intact piece
6	.5"	0' to 1'	Partial core
7	2.75"	0' to 1'	1 intact piece
8	12"	1' to 2.5'	Fine material between core segments 8 and 9
9	1.5"	1' to 2.5'	1 intact piece
10	9.25"	2.5' to 5.5'	1 intact piece
11	18"	2.5' to 5.5'	Concrete contains entrapped air
12	26.75"	5.5' to 8'	1 intact piece
13	15"	8' to 9.5'	Metal rebar towards the top of this segment

Schnabel Engineering

CORE LOGS

Project: Jefferson Memorial
Date prepared: 5/9/2008
By : MD
Reviewed: JG

Project #: 06150078.B

Core # 2 - Section 8 - 4" core diameter
Date: 5/2/2008
Observed by: Melinda Dirdal

Stationing
3+08.6

Segment	Length of core recovered	Depth	Comments
1	3.5"	0' to 1'	Metal rebar between core segments 1 and 2
2	8"	0' to 1'	1 intact piece
3	5.75"	1' to 4'	1 intact piece
4	26.5"	1' to 4'	1.5" x 3" chip out of top of core segment. Seam at bottom of core segment.
5	13.5"	4' to 6.9'	Color of return changed from tan to white. Change in concrete
6	10"	4' to 6.9'	Change in concrete. Bottom portion appears to be the same mix as upper segments in this core.
7	15.25"	4' to 6.9'	1 intact piece
8	19"	6.9' to 8.5'	Seam in concrete. Metal rebar in concrete.
9	0"	8.5' to 9.2'	Void

Core # 3 - Section 5 - 4" core diameter
Date: 5/2/2008
Observed by: Melinda Dirdal

Stationing
1+87.7

Segment	Length of core recovered	Depth	Comments
1	3.5"	0' to 2.2'	Metal rebar through core
2	6"	0' to 2.2'	Broken concrete between core segments 2 and 3
3	15"	0' to 2.2'	1 intact piece
4	17.5"	2.2' to 4.9'	1 intact piece
5	16"	2.2' to 4.9'	1 intact piece
6	14.5"	4.9' to 7.1'	2" chip out of top of core
7	11"	4.9' to 7.1'	1 intact piece
8	unknown	7.1' to 8.4'	Core was lost through the bottom of hole
9	0"	8.4' to 8.8'	Void

Schnabel Engineering

CORE LOGS

Project: Jefferson Memorial
Date prepared: 5/9/2008
By : MD
Reviewed: JG

Project #: 06150078.B

Core # 4 - Section 4 - 4" core diameter
Date: 5/5/2008
Observed by: Melinda Dirdal

Stationing
0+80.1

Segment	Length of core recovered	Depth	Comments
1	4"	0' to 1.2'	Edge of rebar observed in hole, but not observed in core. 5 intact pieces
2	2.75"	0' to 1.2'	Some cracks
3	5.5"	0' to 1.2'	Some cracks
4	2.5"	0' to 1.2'	Some cracks
5	10.75"	1.2' to 2'	Some cracks
6	16.5"	2' to 5.3'	Few cracks. Air observed in concrete
7	21.25"	2' to 5.3'	Air observed in concrete
8	35.75"	5.3' to 8.2'	2 pieces of metal rebar towards middle and bottom of core
9	2.5"	8.2' to 8.3'	1 intact piece
10	0"	8.3' to 8.5'	Void

Core # 5 - Section 2 - 4" core diameter
Date: 5/5/2008
Observed by: Melinda Dirdal

Stationing
0+05.9

Segment	Length of core recovered	Depth	Comments
1	6.75"	0' to 3'	Metal rebar through core. 3 intact pieces
2	8"	0' to 3'	1 intact piece
3	21"	0' to 3'	1 intact piece
4	6"	3' to 6.1'	1 intact piece
5	29.5"	3' to 6.1'	1 intact piece
6	12"	6.1' to 8.3'	1 intact piece
7	16.75"	6.1' to 8.3'	Metal rebar through core
8	0"	8.3' to 8.6'	Void

APPENDIX D

Compressive Strength Test of Rock/Concrete Cores

Schnabel Engineering

COMPRESSIVE STRENGTH
TEST OF ROCK/CONCRETE CORES

510 E. Gay Street
West Chester, PA 19380
(610) 696-6066

CLIENT: HNTB Architecture Inc.

PROJECT: Jefferson Memorial
LOCATION: Washington, DC
PROJECT NO.: 06150078.B

LOCATION:

IDENTIFICATION NO.	1-12	2-4	3-4	4-6	5-5	
LENGTH OF CORE SUBMITTED	27.0	26.5	18.0	16.5	30.5	
LENGTH OF CORE PREPARED	8.44	8.31	8.19	8.44	8.44	
DIAMETER (INCHES)	3.737	3.707	3.726	3.731	3.732	
CROSS SECTIONAL AREA (SQ IN)	10.97	10.79	10.90	10.93	10.94	
⟨IMUM LOAD (FORCE LBS)	81,790	65,570	55,500	62,760	69,670	
'IO H TO D (L/D)	2.26	2.2	2.20	2.26	2.3	
CORRECTION FACTOR RATIO	1	1	1	1	1	
CORRECTED CRUSHING LOAD	81,790	65,570	55,500	62,760	69,670	
COMPRESSIVE STRENGTH (PSI)	7,450	6,070	5,080	5,740	6,360	
TYPE OF FAILURE	2	2	2	2	2	
DATE CORED	5/1/2008	5/2/2008	5/2/2008	5/5/2008	5/5/2008	
DATE TESTED	5/20/2008	5/20/2008	5/20/2008	5/20/2008	5/20/2008	
UNIT WEIGHT	143.4	144.3	142.7	139.8	144.8	
MOISTURE CONDITION	DRY	DRY	DRY	DRY	DRY	
NOM. MAXIMUM SIZE OF AGG.	n/a	n/a	n/a	n/a	n/a	

Remarks:

Notes:

Type of failure 1 = Cone, 2 = Cone and Split, 3 = Columnar, 4 = Shear
Cores obtained in accordance with ASTM C42 when obtained by Schnabel personnel
⟩s tested in accordance with ASTM C174 and C39

APPENDIX E

Petrographic Report

CONSTRUCTION PETROGRAPHICS, INC.
Petrographic Laboratory Services
36642 Quakertown, Farmington Hills, MI 48331 · (248) 880-8601

REPORT ON PETROGRAPHIC EXAMINATION OF CONCRETE CORES FROM JEFFERSON MEMORIAL SEA WALL

Schnabel Project No. 06150078.C0
CPI Project No. 08-962
June 4, 2008

INTRODUCTION

Three concrete cores, identified as 1-10, 3-3, and 5-1 (Photos 1, 2, and 3), were received May 15, 2008, from Schnabel Engineering LLC, West Chester, Pennsylvania.

The following information was reported to CPI: The cores were obtained from the Jefferson Memorial sea wall in Washington, D.C. Because they are long cores, Cores 1-10 and 3-3 were each saw-cut into two segments, A and B. Core 5-1 consists of one core segment.

Petrographic examination, by ASTM C 856, of the three cores was requested, to evaluate the concrete properties and any deterioration to the concrete.

This report presents the details and results of the petrographic examination of Cores 1-10, 3-3, and 5-1.

FINDINGS AND CONCLUSIONS

1. The three cores are 3-3/4-inch-diameter concrete cores. Core lengths are as follows:

   Core 1-10 - 19-1/2 inches.
   Core 3-3 - 13-1/4 to 16-1/8 inches.
   Core 5-1 - 5-3/4 to 7 inches.

2. The concrete mixtures in the three cores are very similar to each other, or are essentially the same mixture. The concrete components are described as follows:

   a. Coarse aggregate. In all three cores the coarse aggregate is a natural gravel composed of a wide variety of rock types, predominantly silica-rich rocks. These include quartzite (metaquartz), other various silica-rich metamorphic rocks, silica-rich sandstones (metasandstones), chert, and chalcedony. The aggregate is generally very hard.

      The aggregate has a top size of 1-1/4 inches in Cores 1-10 and 3-3 and 3/4-inch in Core 5-1. The particles are rounded to subrounded in shape, with a few flat and elongated particles. The aggregate has an apparent fairly uniform size gradation and distribution in the concrete.

   b. Fine aggregate. In all three cores the fine aggregate is a natural sand composed of a wide variety of rock and mineral types, predominantly silica-rich particles. These include mainly metaquartz grains; with much lesser amounts of chert, chalcedony, and quartz-rich sandstones and siltstones. Some of the sandstones and siltstones are iron-rich and/or clay-rich.

      The particles are angular to rounded in shape and have an apparent uniform size gradation and distribution in the concrete.

   c. Air-void system. In all three cores the concrete is not air-entrained. The air content is estimated to be less than 1 percent.

d. Cement paste properties. Petrographically, the cement pastes in all three cores are very similar to each other. The cement paste properties are described as follows:

Paste property	Core 1-10	Core 3-3	Core 5-1
Color	Light tan.	Light tan.	Light tan.
Luster	Dull.	Dull.	Dull.
Hardness	In core's top 9 inches, paste is moderately hard, to possibly moderate. Paste in bottom 10-1/2 inches is moderately hard.	In core's top 9 inches, paste is moderately hard. Paste in remaining 7 inches is moderately hard to hard.	Moderately hard to hard throughout.
Bond to aggregate	In core's top 9 inches, bond is moderately weak. Bond in bottom 10-1/2 inches is moderate to moderately tight.	In core's top 9 inches, bond is moderately tight. Bond in bottom 7 inches is moderate.	Moderately weak throughout.
Unhydrated cement grain estimate	9 to 12 %; relic grains; coarsely ground.	9 to 12 %; relic grains; coarsely ground.	8 to 12 %; relic grains; coarsely ground.

The relic and coarsely ground nature of the unhydrated cement grains within the cement pastes indicates "old" concrete. Therefore, the water/cement ratios of the concretes were not estimated. Still, the amount of unhydrated cement grains within the cement pastes indicates water/cement ratios of lower than 0.45.

3. Freeze-thaw deterioration is present in Cores 1-10 and 5-1.

   In Core 1-10, freeze-thaw microcracks are present in the top 4 inches of the core. The microcracks are widely space, commonly 1/2- to 3/4-inch spacing, and pass mainly around aggregate particles.

   In Core 5-1, freeze-thaw deterioration is present in the top 5-3/4 inches of the core. Several cracks (up to 0.01-inch-wide) are present in the core's top 2-3/4 inches, parallel to the core top surface, commonly passing purposefully through aggregate particles. Several parallel microcracks are present in the core's top 5-3/4 inches, passing around and through aggregate particles.

   No evidence of freeze-thaw deterioration was observed in Core 3-3.

4. Alkali-silica reaction has occurred in each of the three concrete cores, to some degree. The aggregate involved are the chalcedony particles, from both the coarse and fine aggregate fractions. Many chalcedony particles are internally fractured (microcracked), and some of the microcracks extend out into the concrete. These microcracks are short, random, hairline microcracks that generally pass around aggregate particles. No cracks from the reaction were observed. Several alkali-silica gel deposits are present.

   Based upon the amount of microcracks, the degree of alkali-silica reaction in Cores 1-10 and 3-3 appears somewhat small. In Core 1-10 some of the short, random microcracks from the reaction are present. In Core 3-3, a very few of these microcracks are present. In both cores several deposits of alkali-silica gel are present.

   In Core 5-1 the degree of alkali-silica reaction appears very small. The internally fractured chalcedony particles are present. However, none of the characteristic random microcracks were observed. Also, no deposits of alkali-silica gel were observed.

Additional information about the concrete is presented in the attached Petrographic Data Forms.

LABORATORY TESTING

Cores 1-10, 3-3, and 5-1 were examined petrographically, in accordance with ASTM C 856, "Standard Practice for Petrographic Examination of Hardened Concrete." The cores were saw-cut in half longitudinally, and one resultant saw-cut surface from each core was lapped. The lapped surfaces, as well as existing and freshly fractured surfaces of the concrete, were examined macroscopically and using a stereomicroscope at magnifications up to 40X. Thin sections of the concrete, approximately 20 to 25 microns thick and mounted on a 1- by 1-1/2-inch glass microscope slide, were prepared from the midportion of each core. The thin sections were examined using a polarizing-light microscope at magnifications up to 200X. Information obtained from the examination is presented in the attached Petrographic Data Forms.

Respectfully submitted,

Jean L. Randolph
Petrographer
President of Construction Petrographics, Inc.

Attachments

Your samples will be retained in our laboratory storage facility for a period of three months. At that time they will be automatically discarded, unless we hear otherwise from you.

PETROGRAPHIC DATA FORM

Project No.: 08-962 **Date:** 06/04/08

Project: Jefferson Memorial Seawall; Schnabel Project No. 06150078.C0. **Examined by:** J. L. Randolph JLR

Test: Petrographic examination of hardened concrete (by ASTM C 856).

Sample Identification: **CORE 1-10** -- consists of two core segments, labeled as 1-10A and 1-10B.
Total core length - 19-1/2 inches.
[Length of 1-10A: 9 inches.]
[Length of 1-10B: 10-1/2 inches.]
Core diameter - 3-3/4 inches.

Surface Descriptions:
Core top surface (top of 1-10A) - Irregular concrete surface, with relief to 3/8 inch. Most of surface is coated with a thin, white deposit.
Bottom of 1-10A and top of 1-10B - Saw-cut concrete surfaces.
Core bottom surface (bottom of 1-10B) - Broken concrete surface, passing through and around aggregates.

Coarse Aggregate:
Type - Natural gravel composed of a wide variety of rock types, predominantly silica-rich rocks, including quartzite (metaquartz), other various silica-rich metamorphic rocks, silica-rich sandstones (metasandstones), chert, and chalcedony.
Condition - Very hard. Many of the chalcedony particles are internally fractured.
Top size - 1-1/4 inches.
Shape - Rounded to subrounded; a few flat and elongated particles.
Gradation - Fairly uniform.
Distribution - Uniform.

Fine Aggregate:
Type - Natural sand composed of a wide variety of rock and mineral types, predominantly silica-rich particles, mainly including metaquartz grains; with much lesser amounts of chert, chalcedony, and quartz-rich sandstones and siltstones (some are iron-rich and/or clay-rich); and a few other igneous and metamorphic minerals.
Condition - Some of the chalcedony particles are internally fractured.
Shape - Angular to rounded.
Gradation - Uniform.
Distribution - Uniform.

Air-Void System: Not air-entrained.
Estimated air content - < 1 %.

Cracks/Microcracks: Several microcracks are present, parallel to core top surface, in the top 4 inches of the core. The microcracks are widely spaced-- commonly 1/2- to 3/4-inch spacing between microcracks, passing mainly around aggregate particles.

Short, random, hairline microcracks are present in the core, passing around aggregate particles; some microcracks extend out from internally fractured chalcedony particles. In 1-10A and in the top 5 inches of 1-10B, some of these microcracks are present. In the bottom 4 inches of 1-10B, a few of these microcracks are present.

Reinforcement: None observed.

Cement Paste Properties:

Color - Light tan.
Luster - Dull.
Hardness - In 1-10A, paste is moderately hard to possibly moderate. In 1-10B, paste is moderately hard.
Bond to aggregate - In 1-10A, bond is moderately weak. In 1-10B, bond is moderate to moderately tight.
Depth of carbonation - Not evaluated.
Thin section analysis (Performed on midportion of core)
Estimated unhydrated cement grains - 9 to 12 %, by volume of paste; relic grains; coarsely ground.
Estimated calcium hydroxide - 10 to 18 %, by volume of paste; coarsely crystalline.
Estimated water/cement ratio - Not estimated, due to age of concrete.

Other: 1) The bottom 1 inch of the core is a different concrete pour; not evaluated.
2) Ettringite is very common, coating and filling air voids.
3) Several alkali-silica gel deposits present throughout core.

PETROGRAPHIC DATA FORM

Project No.: 08-962 **Date:** 06/04/08

Project: Jefferson Memorial Seawall; Schnabel Project No. 06150078.C0. **Examined by:** J. L. Randolph

Test: Petrographic examination of hardened concrete (by ASTM C 856).

Sample Identification: **CORE 3-3** -- consists of two core segments, labeled as 3-3A and 3-3B.
Total core length - 13-1/4 to 16-1/8 inches.
[Length of 3-3A: 8-3/4 to 9-1/4 inches.]
[Length of 3-3B: 4-1/4 to 6-7/8 inches.]
Core diameter - 3-3/4 inches.

Surface Descriptions:
Core top surface (top of 3-3A) - Broken concrete surface, passing around aggregate particles.
Bottom of 3-3A and top of 3-3B - Saw-cut concrete surfaces.
Core bottom surface (bottom of 3-3B) - Broken concrete surface, passing through aggregates.

Coarse Aggregate:
Type - Natural gravel composed of a wide variety of rock types, predominantly silica-rich rocks, including quartzite (metaquartz), other various silica-rich metamorphic rocks, silica-rich sandstones (metasandstones), chert, and chalcedony.
Condition - Very hard. Some of the chalcedony particles are internally fractured.
Top size - 1-1/4 inches.
Shape - Rounded to subrounded; a few flat and elongated particles.
Gradation - Fairly uniform. Distribution - Uniform.

Fine Aggregate:
Type - Natural sand composed of a wide variety of rock and mineral types, predominantly silica-rich particles, mainly including metaquartz grains; with much lesser amounts of chert, chalcedony, and quartz-rich sandstones and siltstones (some are iron-rich and/or clay-rich); and a few other igneous and metamorphic minerals.
Condition - Some of the chalcedony particles are internally fractured.
Shape - Angular to rounded.
Gradation - Uniform. Distribution - Uniform.

Air-Void System: Not air-entrained.
Estimated air content - < 1 %.

Cracks/Microcracks: A very few short, random, hairline microcracks are present in the core, passing around aggregate particles; a few microcracks extend out from internally fractured chalcedony particles.

Reinforcement: None observed.

Cement Paste Properties:
Color - Light tan. Luster - Dull.
Hardness - In 3-3A, paste is moderately hard. In 3-3B, paste is moderately hard to hard.
Bond to aggregate - In 3-3A, bond is moderately tight. In 3-3B, bond is moderate.
Depth of carbonation - Not evaluated.
Thin section analysis (Performed on midportion of core)
Estimated unhydrated cement grains - 9 to 12 %, by volume of paste; relic grains; coarsely ground.
Estimated calcium hydroxide - 10 to 18 %, by volume of paste; coarsely crystalline.
Estimated water/cement ratio - Not estimated, due to age of concrete.

Other: 1) Ettringite is very common, coating and filling air voids.
2) Several alkali-silica gel deposits present throughout core.

PETROGRAPHIC DATA FORM

Project No.: 08-962 **Date:** 06/04/08

Project: Jefferson Memorial Seawall; Schnabel Project No. 06150078.C0. **Examined by:** J. L. Randolph JLR

Test: Petrographic examination of hardened concrete (by ASTM C 856).

Sample Identification: **CORE 5-1** -- consists of one core segment.
Core length - 5-3/4 to 7 inches. Core diameter - 3-3/4 inches.

Surface Descriptions:
Core top surface - Broken concrete surface, passing around aggregate particles.
Core bottom surface - Broken concrete surface, passing around aggregate particles.

Coarse Aggregate:
Type - Natural gravel composed of a wide variety of rock types, predominantly silica-rich rocks, including quartzite (metaquartz), other various silica-rich metamorphic rocks, silica-rich sandstones (metasandstones), chert, and chalcedony.
Condition - Very hard. Some of the chalcedony particles are internally fractured.
Top size - 3/4 inch.
Shape - Rounded to subrounded; a few flat and elongated particles.
Gradation - Fairly uniform. Distribution - Uniform.

Fine Aggregate:
Type - Natural sand composed of a wide variety of rock and mineral types, predominantly silica-rich particles, mainly including metaquartz grains; with much lesser amounts of chert, chalcedony, and quartz-rich sandstones and siltstones (some are iron-rich and/or clay-rich); and a few other igneous and metamorphic minerals.
Condition - Some of the chalcedony particles are internally fractured.
Shape - Angular to rounded.
Gradation - Uniform. Distribution - Uniform.

Air-Void System: Not air-entrained.
Estimated air content - < 1 %.

Cracks/Microcracks: Several cracks (up to 0.01-inch-wide) are present in core's top 2-3/4 inches, parallel to core top surface, commonly passing purposefully through aggregate particles.

Several microcracks are present, parallel to core top surface, in the top 5-3/4 inches of the core, passing around and through aggregate particles.

Reinforcement: Two very lightly corroded, 1/2-inch-diameter rebars are present at a core depth of 2 to 2-1/2 inches, perpendicular to each other.

Cement Paste Properties:
Color - Light tan.
Luster - Dull.
Hardness - Moderately hard to hard.
Bond to aggregate - Moderately weak.
Depth of carbonation - Not evaluated.
Thin section analysis (Performed on midportion of core)
Estimated unhydrated cement grains - 8 to 12 %, by volume of paste; relic grains; coarsely ground.
Estimated calcium hydroxide - 10 to 18 %, by volume of paste; coarsely crystalline.
Estimated water/cement ratio - Not estimated, due to age of concrete.

Other: 1) Ettringite is abundant along cracks; it is very common, coating and filling air voids.
2) No alkali-silica gel deposits observed.

Photo 1. Side view of Core 1-10, received in two segments, identified as 1-10A and 1-10B, as received for testing.

Photo 2. Side view of Core 3-3, received in two segments, identified as 3-3A and 3-3B, as received for testing.

Photo 3. Side view of Core 5-1, as received for testing.

E

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

REPAIR AND CONTROL SETTLEMENT MEMO – QUARTERLY MONITORING OF INSTRUMENTATION AND SURVEY POINTS

Prepared by Schnabel Engineering

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
July 10, 2008 (Revised July, 24, 2008)

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

Memo

To: **Patrick MacDonald, Doug Denk (National Park Service)**
cc: **Nate James (HNTB Federal Services Corporation)**

From: **Helen Robinson, P.E.**
Darrell Wilder, P.E.

Date: **July 10, 2008 (Revised July 24, 2008)**

Subject: **06150078.B0, Jefferson Memorial**
Repair and Control Settlement
Quarterly Monitoring of Instrumentation and Survey Points

This memo presents updated instrumentation and survey data for the Jefferson Memorial project. It includes data collected during June 2008 from inclinometers, tiltmeters, piezometers, ground water monitoring wells, and elevation surveys. Please refer to the "Investigation of Settlement and Upheaval at the Jefferson Memorial" report by HNTB 2008 for further information about the instruments and past data collected.

Survey Monitoring Data

On June 10 and 11, 2008, Greenhorne & O'Mara performed survey monitoring consisting of a survey loop from HV83001 to the Jefferson Memorial, and through several benchmarks as established during the "Investigation of Settlement and Upheaval" project. The original control loop was run again using benchmarks 808_HV86002 and 808_HV89003, and points 700 through 704. Twenty-two points on the North Plaza and Ashlar Seawall were surveyed. For this verification control loop and subsequent survey of monitoring points, Greenhorne & O'Mara used a Trimble DiNi Electronic Level System. This level provides an accuracy consistent with 0.01 ft.

Appendix A contains a plan with survey point locations, and graphs and tables with the updated survey readings. The present rate of settlement of the seawall increases progressively toward the west. At the western end of the seawall, the rate of settlement is about 1.05 inches/year. At the midpoint of the wall, the rate of settlement is about 0.52 inches/year. At the eastern end of the seawall, the rate of settlement is about 0.38 inches/year. The North Plaza is supported on piles to bedrock that were installed during repairs in 1969-1970. The plaza does not show movement beyond the accuracy of the survey.

Inclinometer Data

The readings obtained from December 2006 to June 2008 show movement in the northwest direction. Plots are included in Appendix B. Inclinometer JMI-01 shows a total of about 0.92 inches of cumulative movement 41 degrees west of north. Inclinometer JMI-02 shows a total of about 0.50 inches of cumulative movement 51 degrees west of north. Inclinometer JMI-03 shows a total of about 0.17 inches of cumulative movement 13 degrees west of north. The data shows that lateral movement occurs to a depth of about 60 ft (EL -53.3) in

JMI-01 and JMI-02. These data indicate the ground under the Memorial is undergoing significant lateral displacement at an average rate of about 0.27 inches per year within the top 10 ft of the surface of the North Plaza.

Tiltmeter Data

Tiltmeter 1 is located at approximately Station 3+30 of the Ashlar Seawall. From June 6 to September 15, 2007, data from Tiltmeter 1 suggest a rate of tilt of 0.0033 degrees/month as shown in Appendix C. After September 15, 2007, the tiltmeter data show fluctuating readings. During a site visit on January 15, 2008, Schnabel Engineering (Schnabel) personnel noted that the protective case enclosing Tiltmeter 1 had become separated from the seawall where it had been anchored. Schnabel personnel re-anchored the protective case on February 11, 2008. However, the data still appears to be fluctuating following that adjustment. From May 15 to June 17, 2008, the readings appear to have stabilized. On June 25, 2008, Schnabel personnel visited the site to further secure the tiltmeter boxes and instruments.

Tiltmeter 2 is located at approximately Station 2+75 of the Ashlar Seawall. From May 23, 2007, to January 15, 2008, Tiltmeter 2 obtained the data shown in Appendix C. The average rate of tilt measured was about 0.008 degrees/month from May 23 to September 3, 2007. Following a sudden decrease of the instrument readings from September 3 and 4, 2007, the average rate of tilt was 0.022 degrees/month from September 4, 2007, to February 14, 2008. From February 15 to May 12, 2008, the average rate of tilt was 0.009 degrees/month. Following this date, the data appears to fluctuate. On June 25, 2008, Schnabel personnel visited the site to further secure the tiltmeter boxes and instruments.

Ground Water Monitoring Data

The boring logs completed for this study note ground water level readings measured during drilling and after completion of the borings. Ground water monitoring wells were installed in Borings JMW-01, JMW-02 and JMW-03A. Water level elevation readings for the wells are shown below. An average ground water elevation is also listed for each monitoring well.

Ground Water Monitoring Well Readings Between November 2006 and June 2008 (NAVD 29)

	Water Elevation (ft)		
Date	**JMW-01**	**JMW-02**	**JMW-03A**
11/21/2006	1.30	3.39	4.66
12/19/2006	1.27	3.90	3.72
1/5/2007	1.75	-	3.71
2/28/2007	1.76	3.75	3.52
5/7/2007	1.15	3.36	3.80
6/26/2007	-0.24	3.92	2.90
1/15/2008	1.75	3.50	5.19
3/11/2008	1.65	3.38	3.75
6/17/2008	2.99	3.18	4.16
Average Elevation	**1.49**	**3.55**	**3.93**

The data in the table suggest a ground water gradient of approximately 0.6 percent toward the Tidal Basin. The average water elevation in the Tidal Basin during this period was approximately EL 1.2 according to the data from the National Oceanic and Atmospheric Administration (NOAA) for Station #8594900 located approximately one mile downstream on the Washington Channel, adjusted to the Jefferson Memorial site. This adjustment was developed by comparing the Tidal Basin water elevation measured manually during a site visit by Schnabel, to the NOAA data for that station on the same day and at approximately the same time. Our estimated adjustment was approximately +2.1 ft to the NOAA data. We conclude that the ground water elevation is consistent with the Tidal Basin water elevation.

Piezometer Data

Piezometer JMI-01 is at a depth of 54 ft from the top of the North Plaza (EL -47.5), and JMI-03 is located at a depth of 39 ft from the top of the North Plaza (EL -32.2). Appendix D shows the pore pressure data collected by each piezometer. The plot shows a progressive drop in the pore pressure of about 0.8 psi in piezometer JMI-01, and about 0.6 psi in JMI-03 from November 2006 until June 2008 (1.6 years). This apparent drop in pore water pressure corresponds to a drop in piezometric head of about 1.8 and 1.4 ft, respectively. From November 2006 to mid February 2007, the piezometers show a downward trend in pore water pressure. Between February 2007 and October 2007, the piezometric readings seem relatively constant. From October 2007 to February 2008, the pore water pressure again shows a downward trend. Finally, from February to June 2008, an upward trend is apparent.

It is important to note that the measured pore pressures are lower than the theoretical pore pressures corresponding to a hydrostatic condition. At JMI-01, the piezometric head at EL -47.5 is about 2.8 ft less than hydrostatic. At JMI-03, the piezometric head at EL -32.2 is about 0.6 ft lower than hydrostatic. The hydrostatic head was estimated based on the average tidal pool elevation.

Please review the data that we have presented and let us know if you have any questions or comments about the information provided here.

Appendix A: Survey Monitoring Data
Appendix B: Inclinometer Data
Appendix C: Tiltmeter Data
Appendix D: Piezometer Data

Distribution:

National Park Service (2)
Attn: Mr. Patrick MacDonald
Attn: Mr. Doug Denk

HNTB Federal Services Corporation (1)
Attn: Mr. Nate James

APPENDIX A

Survey Monitoring Data

N

W E

S

60 30 0 60 120

SCALE: 1"=60'

TIDAL BASIN

STA 703

STA 702

STA 701

STA 704

STA 700

JMI-01

JMI-02

JMI-03

JMW-01

JMTB-01

JMTB-02

JMW-02

JMW-03

JMW-03A

SECTION I

SECTION II

SECTION III

SECTION IV

SECTION V

SECTION VI

SECTION VII

SECTION VIII

SECTION IX

SECTION X

SECTION XI

SECTION XII

SECTION XIII

JEFFERSON MEMORIAL

LEGEND:

BORING

33 SURFACE SHOT

SECTION

CHECKED BY: _____ JOB # 094108

GREENHORNE & O'MARA, INC.
6110 FROST PLACE
LAUREL, MARYLAND 20707
(301) 982-2800

JEFFERSON MEMORIAL MONITORING REPORT SHEET 5A

Jefferson Memorial Plaza Monitoring

		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08		
DESCRIPTION	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	DIFFERENCE FROM 11/06 to 6/08 (inches)	Rate of Movement (in/year)
Section I	1	38.124							
	2	32.308	32.318	32.304					
	3	30.476	30.481	30.471					
	4	26.466	26.468	26.460					
	5	22.056	22.063	22.058					
	6	11.395		11.365					
Section II	7	38.356	38.371	38.353					
	8	32.309	32.317	32.306					
	9	30.460	30.464	30.454					
	10	26.459	26.460						
	11	22.093	22.094						
	12	11.819							
Section III	15	6.404	6.383	6.403					
	16	6.456	6.433	6.439					
	17	6.540	6.549	6.573					
	18	6.601	6.610	6.628	6.619	6.610	6.610	0.108	0.068
	19	6.517	6.508	6.526	6.509	6.498	6.490	-0.324	-0.203
	20	7.008	6.988	7.009					
	21	7.120	7.118	7.143					
	22	7.561	7.560	7.579					
	23	7.492	7.488	7.510					
Section IV	24	6.455	6.432	6.439	6.426	6.416	6.405	-0.600	-0.376
	25	6.458	6.443	6.453					
	26	6.515	6.518	6.541	6.540	6.532	6.521	0.072	0.045
	27	7.309	7.303	7.325					
	28	7.788	7.799	7.805					
	29	11.570	11.591	11.592					
	30	12.513	12.519	12.512					
	31	21.605	21.629	21.614					
	32	22.823	22.849	22.836					
	33	30.468	30.496	30.481					

Jefferson Memorial Plaza Monitoring

		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08		
DESCRIPTION	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	DIFFERENCE FROM 11/06 to 6/08 (Inches)	Rate of Movement (in/year)
Section V	34	7.768	7.773						
	35	7.209	7.193						
	36	6.457	6.449	6.470	6.464	6.460	6.451	-0.072	-0.045
	37	6.467	6.443	6.453					
	38	6.448	6.423	6.433	6.426	6.417	6.404	-0.528	-0.331
Section VI	39	6.407	6.383	6.392	6.381	6.373	6.363	-0.528	-0.331
	40	6.428	6.404	6.414					
	41	6.506	6.495	6.520	6.517	6.508	6.499	-0.084	-0.053
	42	7.229	7.217	7.242					
	43	7.796	7.793	7.804					
	44	11.576	11.582	11.589					
	45	12.528	12.539	12.534					
	46	21.630	21.649	21.633					
	47	22.821	22.839	22.824					
	48	30.464	30.483	30.468					
Section VII	49	7.816	7.813						
	50	7.221	7.216						
	51	6.500	6.495	6.514	6.514	6.504	6.492	-0.096	-0.060
	52	6.353	6.331	6.333					
	53	6.309	6.288	6.294	6.280	6.271	6.259	-0.600	-0.376
Section VIII	54	6.073	6.041	6.043	6.029	6.016	6.004	-0.828	-0.518
	55	6.131	6.093	6.094					
	56	6.376	6.373	6.389	6.388	6.379	6.368	-0.096	-0.060
	57	7.151	7.151	7.160					
	58	7.771	7.778	7.781					
	59	11.576	11.582	11.590	11.587	11.577	11.568	-0.096	-0.060
	60	12.526	12.529	12.530					
	61	21.638	21.653	21.638	21.645	21.633	21.623	-0.180	-0.113
	62	22.886	22.899	22.886					
	63	30.451	30.470	30.458					

Jefferson Memorial Plaza Monitoring

DESCRIPTION	POINT NUMBER	11/06/06 INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	06/12/07 MONTHLY READING ELEV. LOOP ONLY	07/11/07 MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	12/28/07 MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP	03/11/08 QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	06/11/08 QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	DIFFERENCE FROM 11/06 to 6/08 (Inches)	Rate of Movement (in/year)
Section IX	72	7.826	7.824						
	73	7.082	7.074						
	74	6.347	6.344	6.352	6.352	6.344	6.331	-0.192	-0.120 ⚠
	75	6.001	5.953	5.950					
	76	5.955	5.906	5.906	5.885	5.871	5.858	-1.164	-0.729
Section X	79	5.760	5.703	5.702	5.677	5.660	5.642	-1.416	-0.887
	80	5.836	5.783	5.785					
	81	6.181	6.183	6.190	6.189	6.180	6.168	-0.156	-0.098
	82	7.005	7.001	7.010					
	83	7.809	7.814	7.812					
	84	11.571	11.588	11.593					
	85	12.528	12.530	12.525					
	86	21.632	21.640	21.625					
	87	30.479	30.496	30.479					
	112			22.892					
Section XI	88	7.814	7.819						
	89	7.018	7.019						
	90	6.174	6.175	6.185	6.182	6.171	6.161	-0.156	-0.098
	91	5.821	5.762	5.760					
	92	5.842	5.782	5.780					
	93	5.743	5.683	5.678	5.658	5.638	5.603	-1.680	-1.052
	94	5.753	5.688	5.685					

Jefferson Memorial Plaza Monitoring

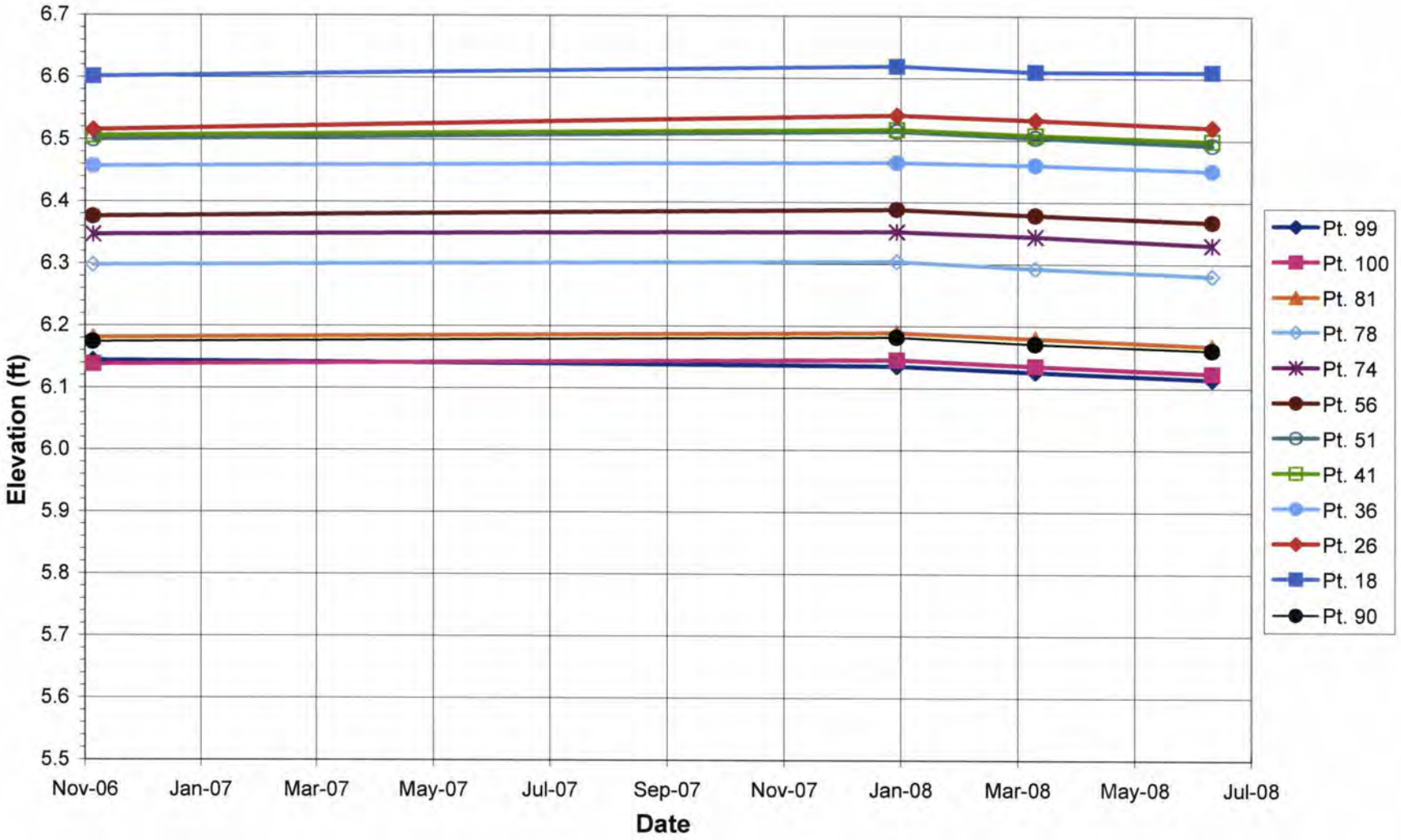
DESCRIPTION	POINT NUMBER	11/06/06 INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	06/12/07 MONTHLY READING ELEV. LOOP ONLY	07/11/07 MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	12/28/07 MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP	03/11/08 QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	06/11/08 QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	DIFFERENCE FROM 11/06 to 6/08 (Inches)	Rate of Movement (in/year)
Section XII	95	5.673	5.603	5.600	5.573	5.554	5.533	-1.680	-1.052 ⚠
	96	5.680	5.611	5.608					
	97	5.735	5.670	5.668					
	98	5.779	5.713	5.710					
	99	6.144	6.138	6.147	6.135	6.126	6.114	-0.360	-0.225
	100	6.138	6.133	6.138	6.145	6.135	6.124	-0.168	-0.105
	101		7.024	7.035					
	102	7.821	7.824	7.829					
	103	11.602	11.616	11.620					
	104	12.538	12.540	12.538					
	105	21.660	21.671	21.659					
	106	22.904	22.917	22.905					
	107	30.475	30.496	30.479					
Section XIII	134	38.333	38.367	38.344					
	135	32.296	32.323	32.304					
	136	30.479	30.498	30.479					
	137	26.456	26.481						
	138		22.113						
	139		11.884						

Jefferson Memorial Plaza Monitoring

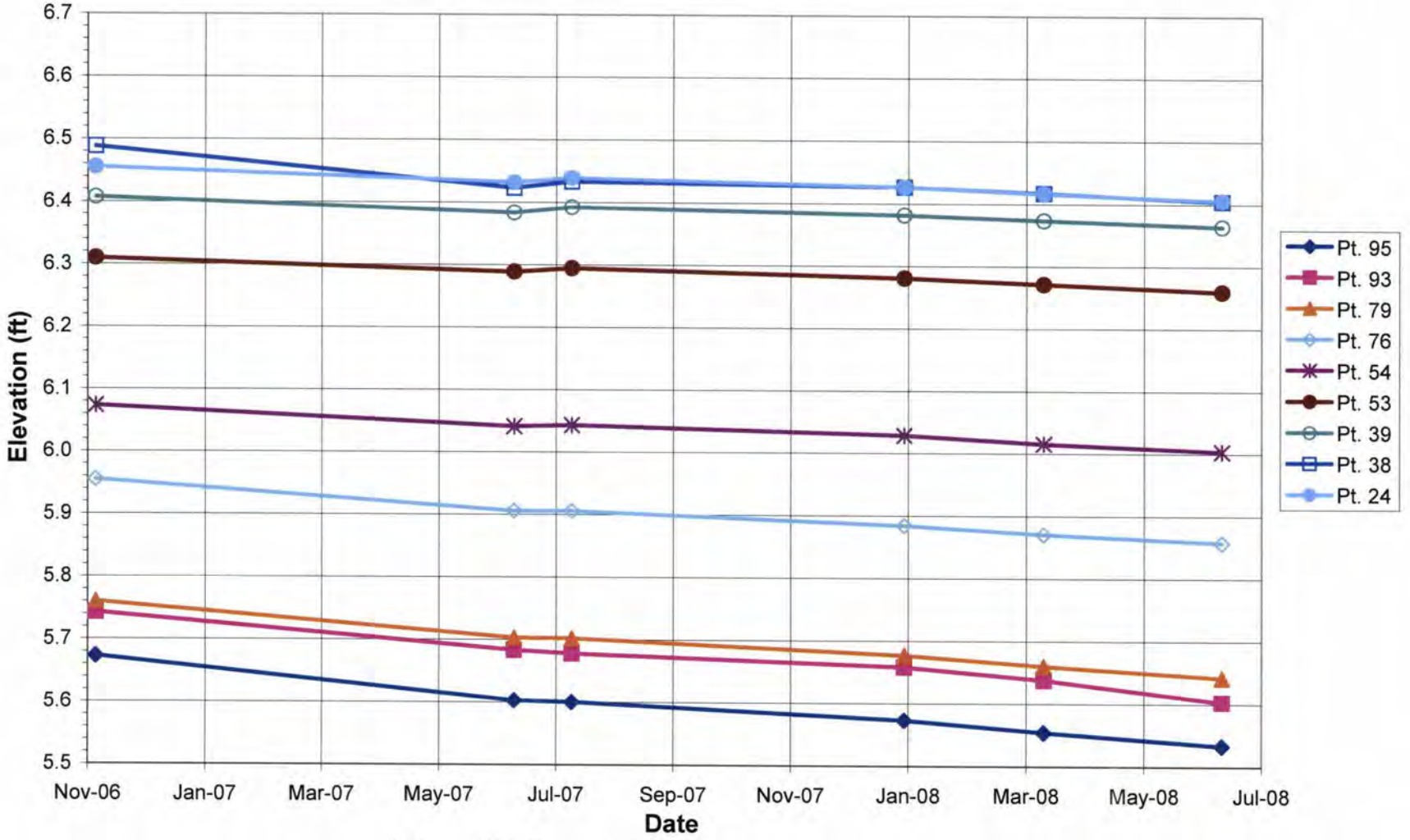
		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08		
DESCRIPTION	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	DIFFERENCE FROM 11/06 to 6/08 (inches)	Rate of Movement (in/year)
Ground Shots	13	4.413	4.396						
	14	9.448	9.426						
	64	22.073	22.090						
	65	22.086	22.102						
	66	22.173	22.100						
	67	22.176	22.105						
	68	22.044	22.066						
	69		22.087						
	70	22.000	22.020						
	71	21.997	22.020						
	77	5.920	5.868	5.868					
	78	6.298	6.295	6.302	6.304	6.293	6.281	-0.204	-0.128 ⚠1
	108	12.442	12.450						
	109	7.807	7.812						
	110	11.783	11.785						
	111	11.535	11.510						
	112		22.907	22.892					
	113	7.108	7.089						
	114	6.798							
	115	6.694							

Jefferson Memorial Plaza Monitoring

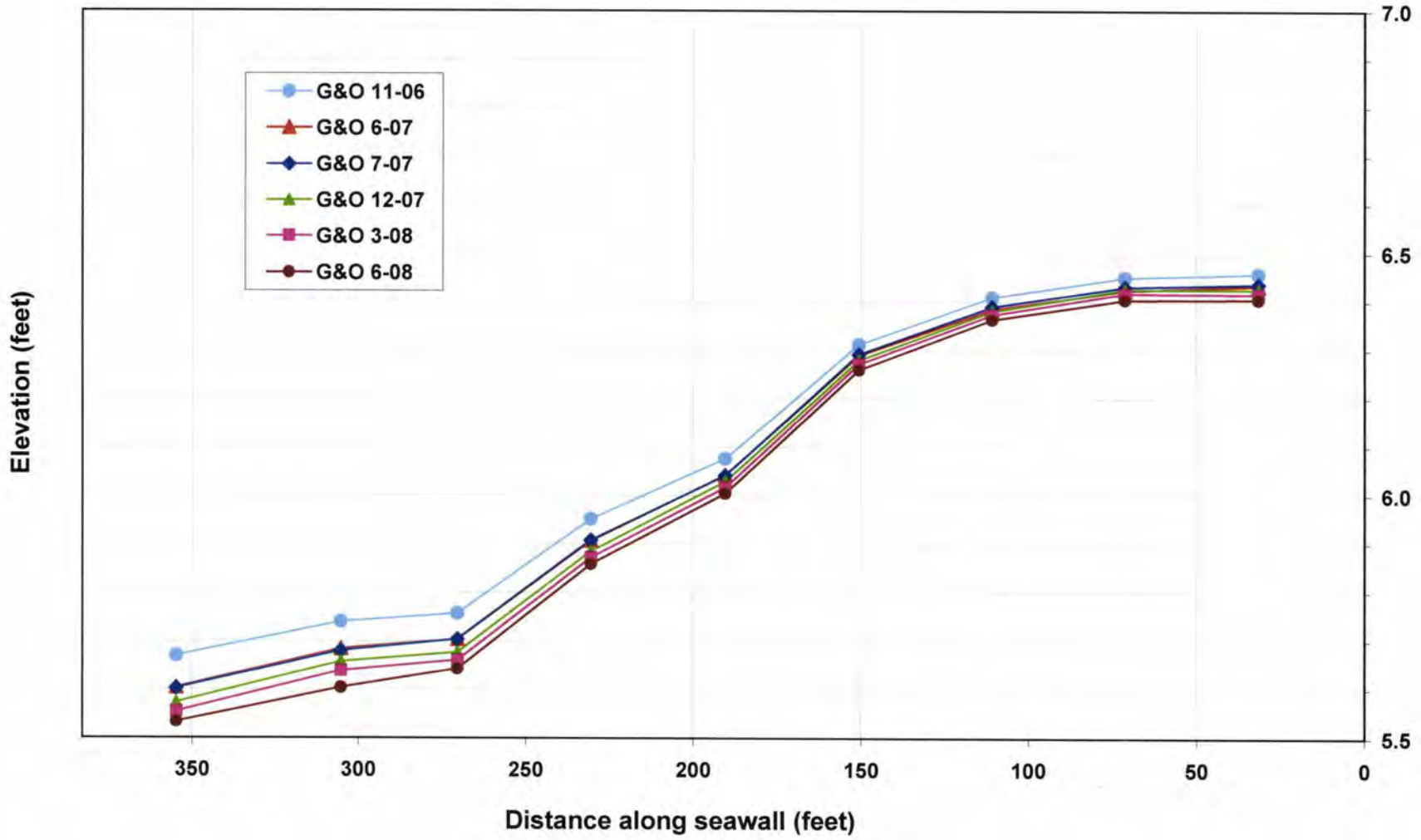
		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08		
DESCRIPTION	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	QUARTERLY READING ELEV. FOLLOWING VERIFICATION LOOP	DIFFERENCE FROM 11/06 to 6/08 (inches)	Rate of Movement (in/year)
Ground Shots	116	6.842	6.842						
	117	6.301	6.294						
	118	5.951							
	119	5.990	5.994	6.001					
	120	5.892							
	121	5.697	5.647	5.650					
	122	5.992	5.999	6.000					
	123	5.689	5.637	5.631					
	124	8.462	8.429						
	125	5.370	5.375	5.370					
	126	5.400							
	127	5.637							
	128	4.998	4.959						
	129		5.119	5.112					
	130	11.788	11.801						
	131	11.685	11.679						
	132	11.657	11.633						
	133	11.953	11.963						
	140		22.085						
	141	22.099	22.095						
	142	22.079	22.079						
	143	22.079	22.075						
	150		6.559			6.488	6.478		
	151		1.897			1.862	1.837		
	152		3.999				3.936		



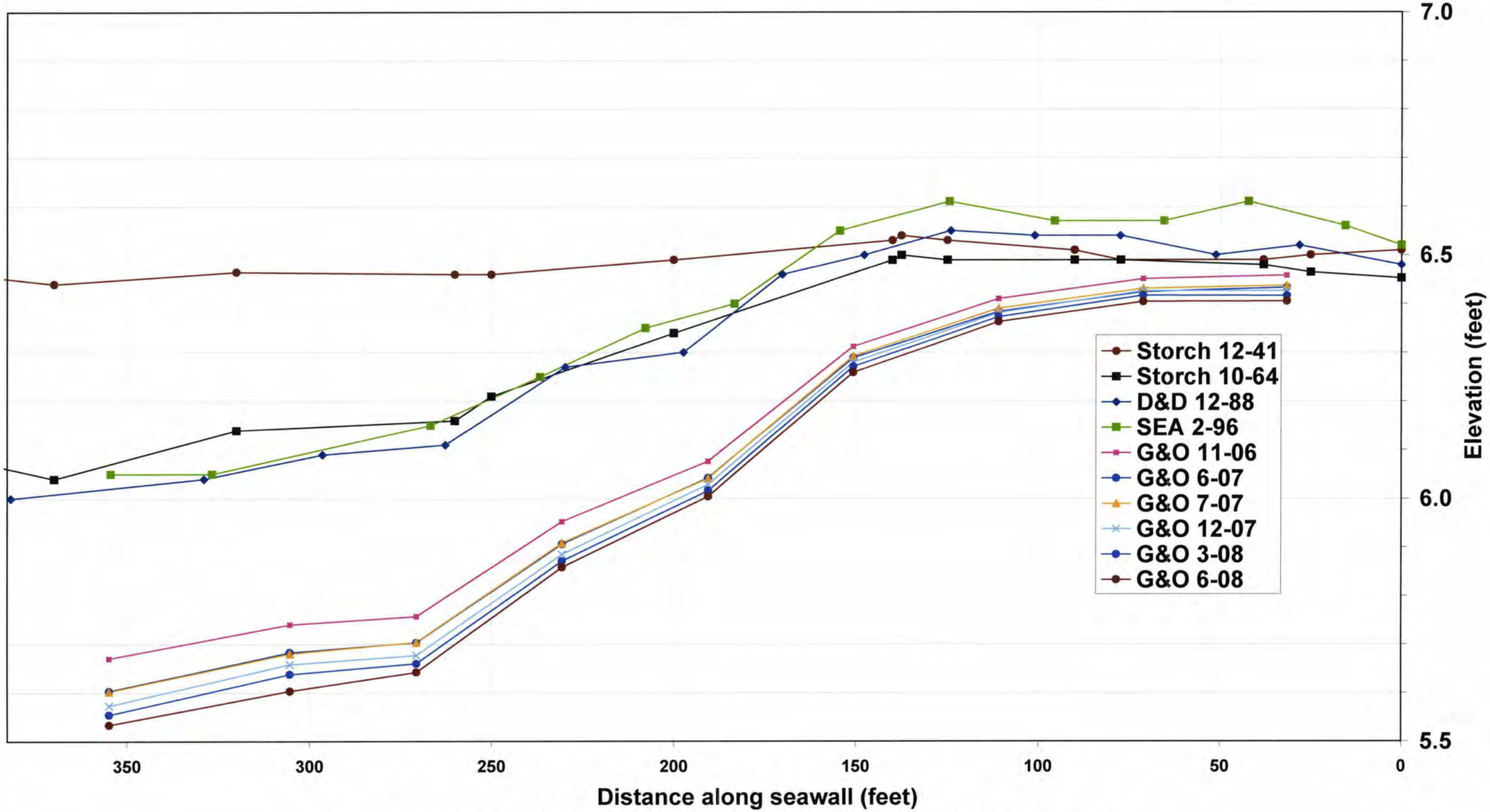
Plot of Selected Points Along the North Plaza



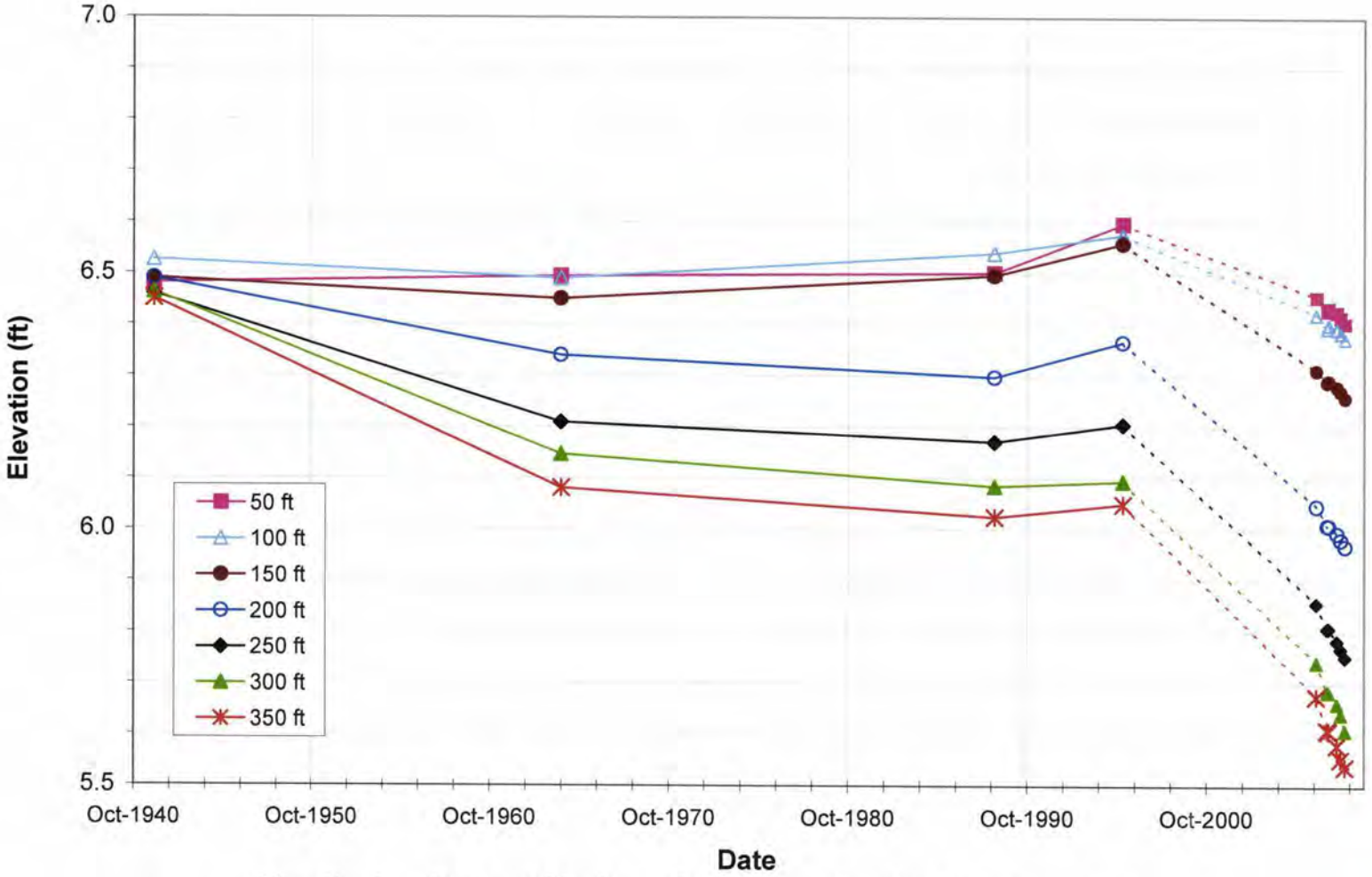
Plot of Selected Points Along the Ashlar Seawall



Nov 2006- June 2008 Survey Along Capstone of Ashlar Seawall



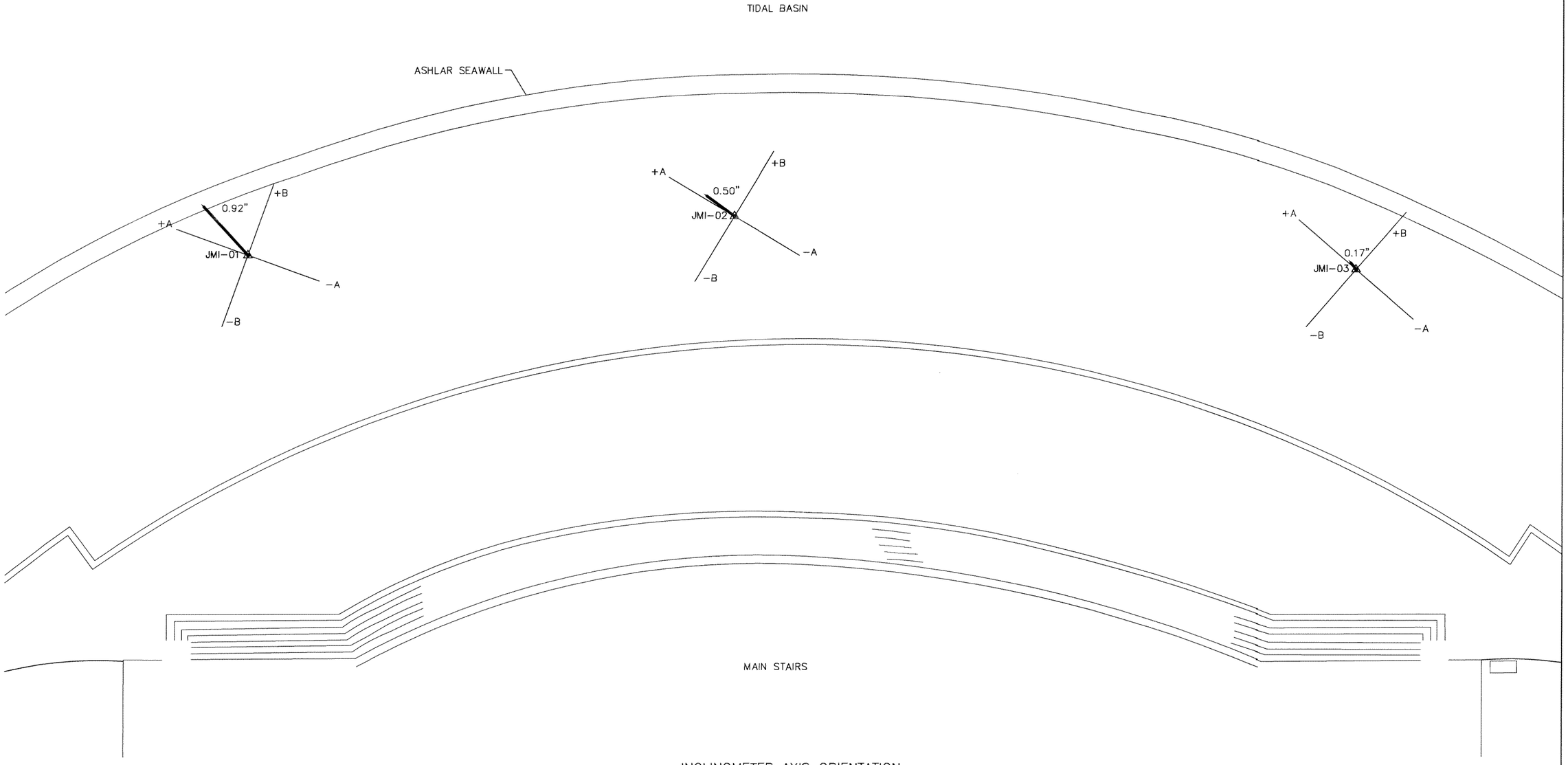
Historical Surveys Along Capstone of Ashlar Seawall



Monitoring Data at Various Points on the Ashlar Seawall Capstone

APPENDIX B

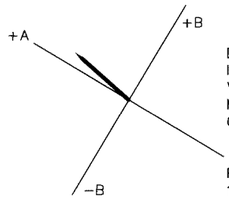
Inclinometer Data



INCLINOMETER AXIS ORIENTATION

10 0 10 20
SCALE OF FEET

LEGEND



DENOTES ORIENTATION OF INCLINOMETER AXES AND VECTOR OF LATERAL MOVEMENT WITHIN 10 FT. OF THE GROUND SURFACE

READINGS SHOWN FROM 11/06 TO 6/08

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

TITLE OF DRAWING

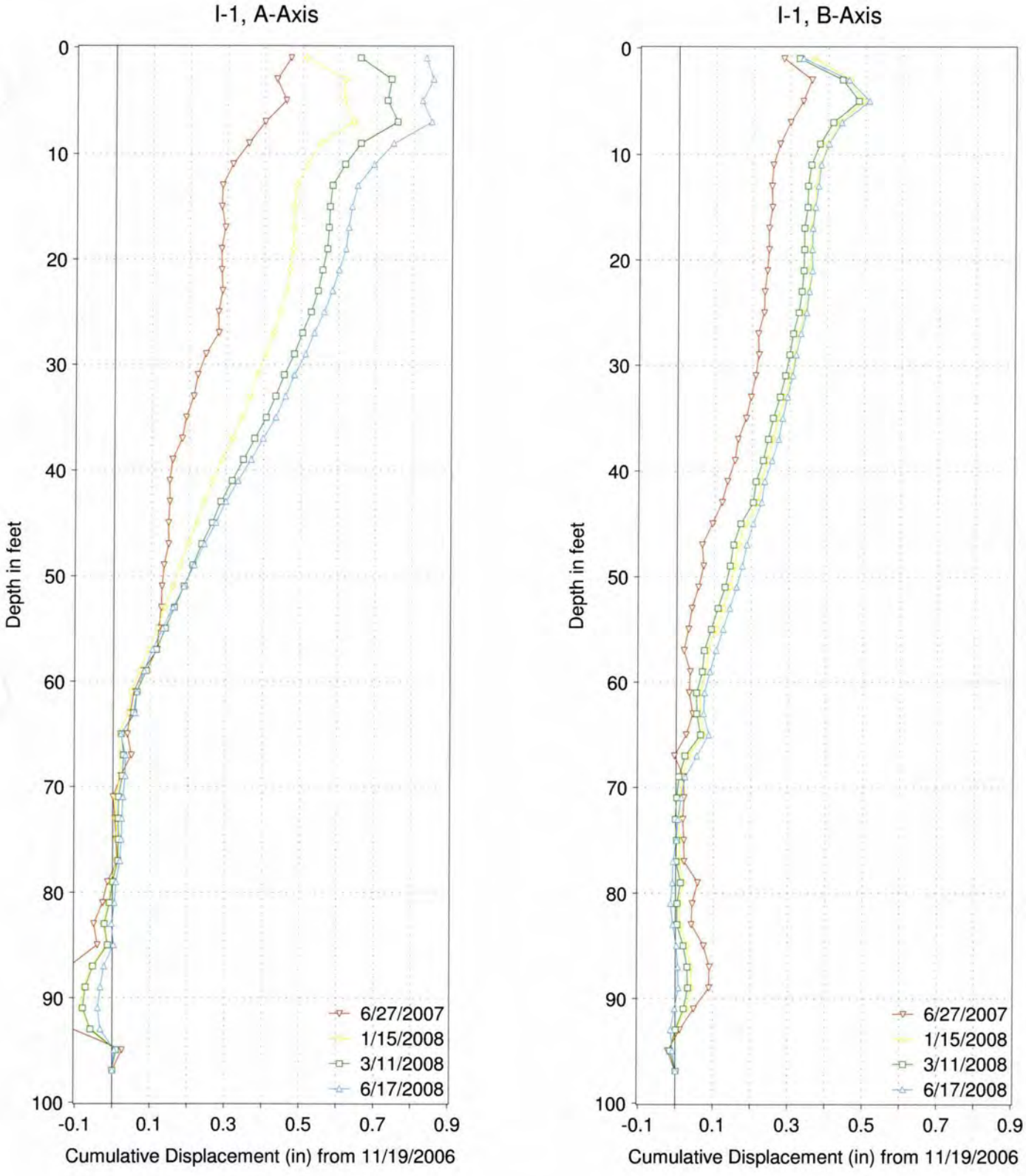
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

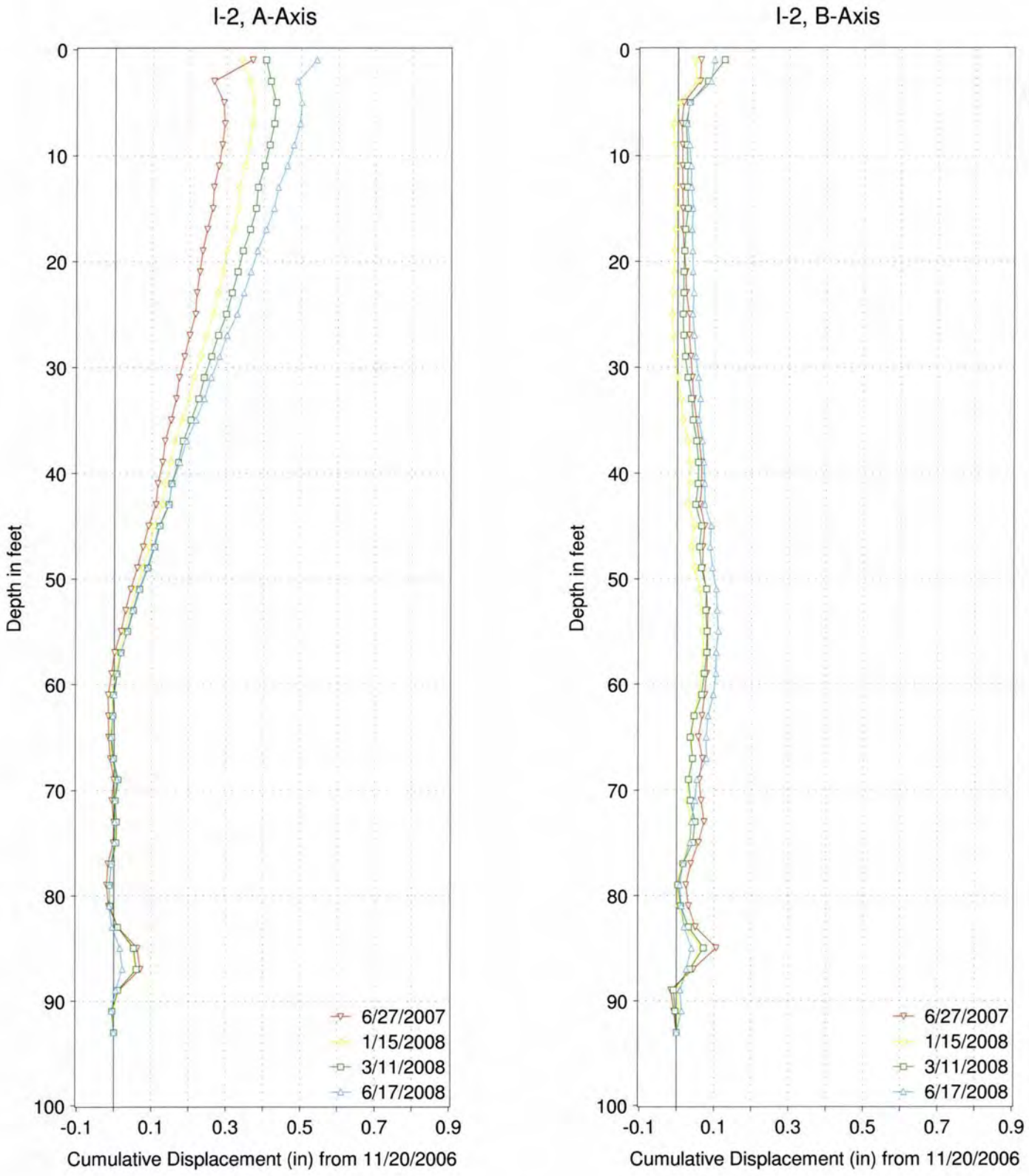
HR
DESIGNED
JM
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
7/10/08
DWG. NO.
808/80284

7/10/08 10:16 NFAHEY R17 G:\2006JOBS\06150078.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\DATA\INSTRUMENTATION\INCLINOMETERS\511INCLINOMETER_AXES_6-23-08.DWG



06150078 Jefferson Memorial
Baseline @ 11/19/06
Orientation Adjusted to Match I-2
Figure 44

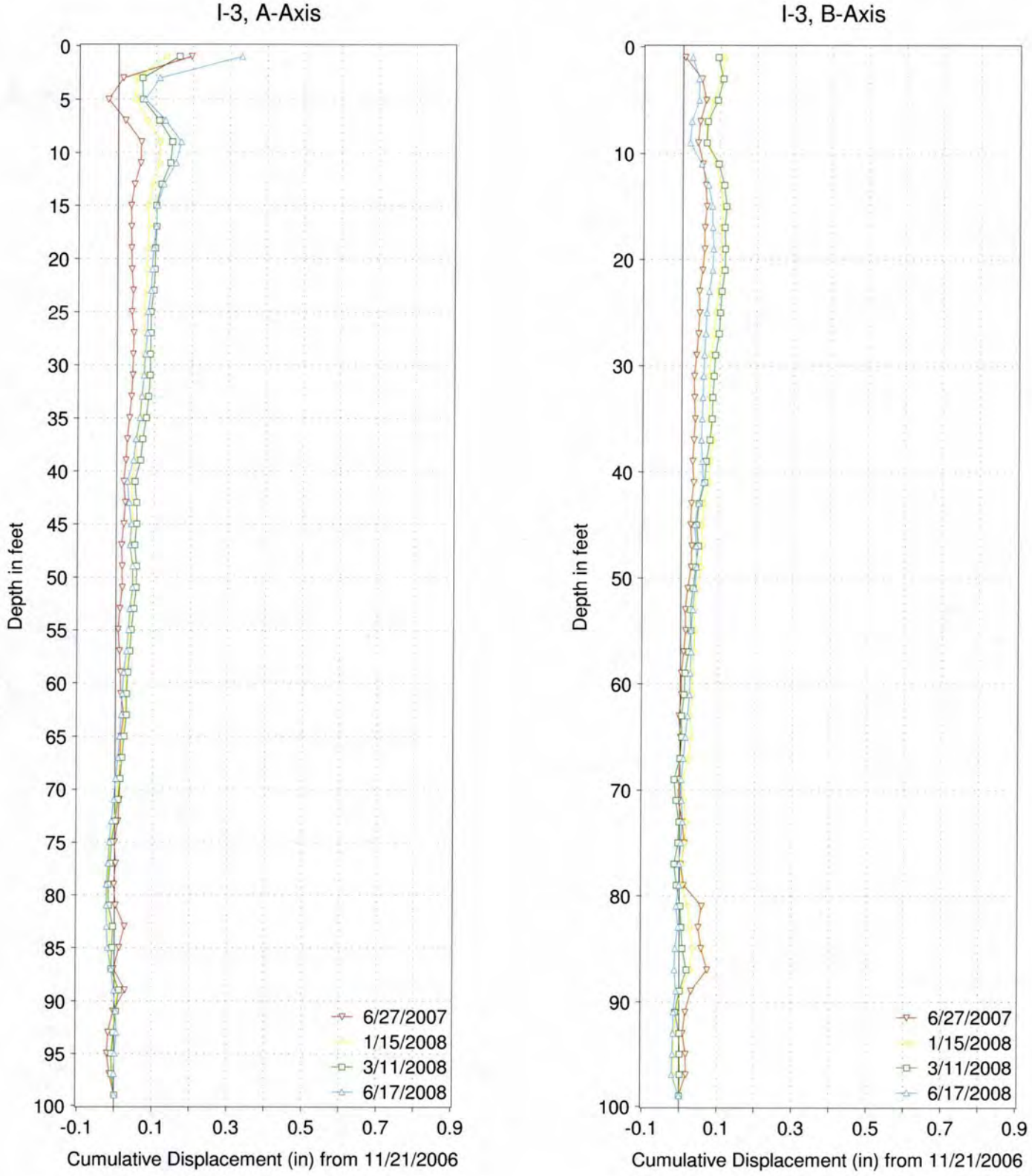
Schnabel Engineering



06150078 Jefferson Memorial
Baseline @ 11/20/06

Figure 45

Schnabel Engineering

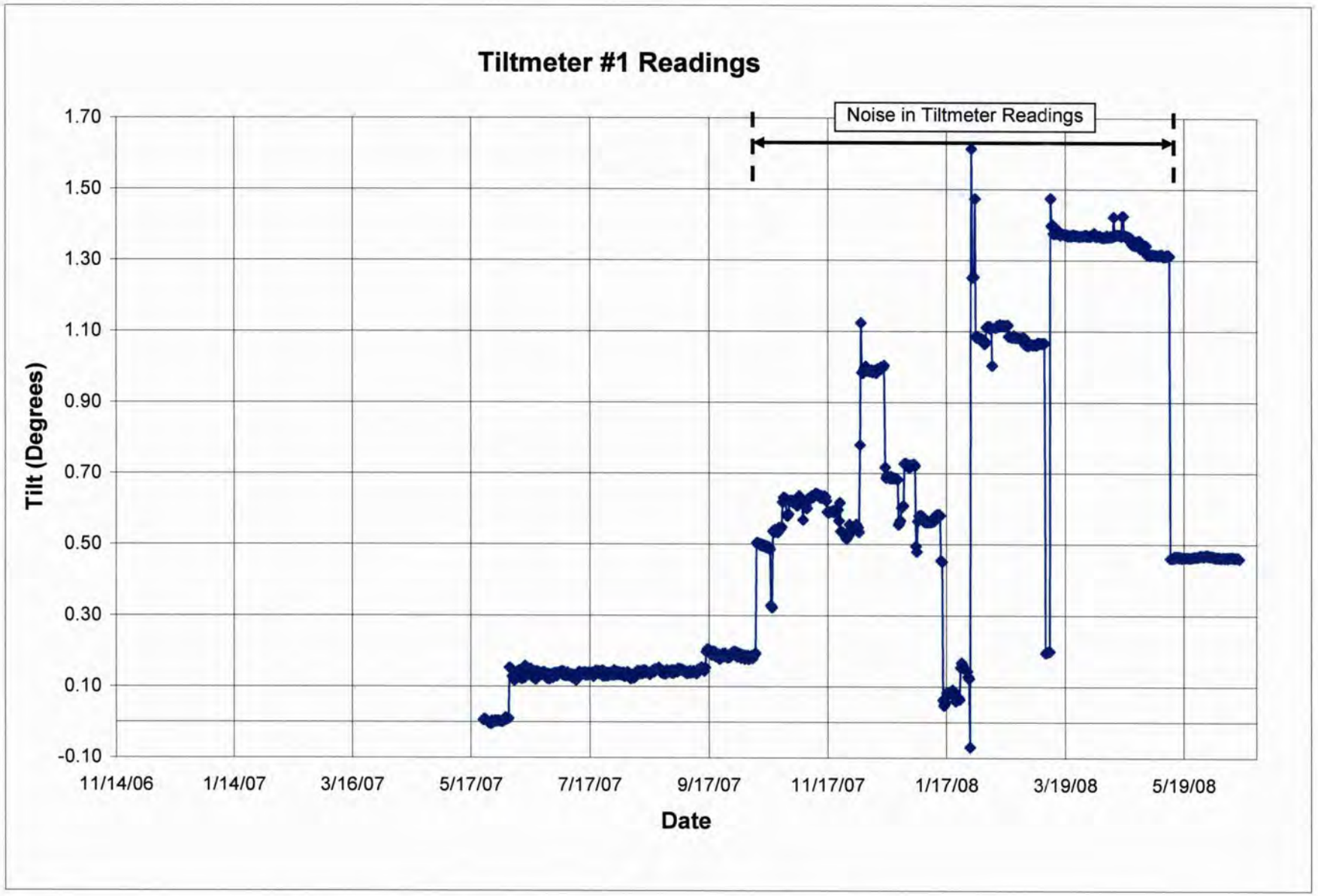


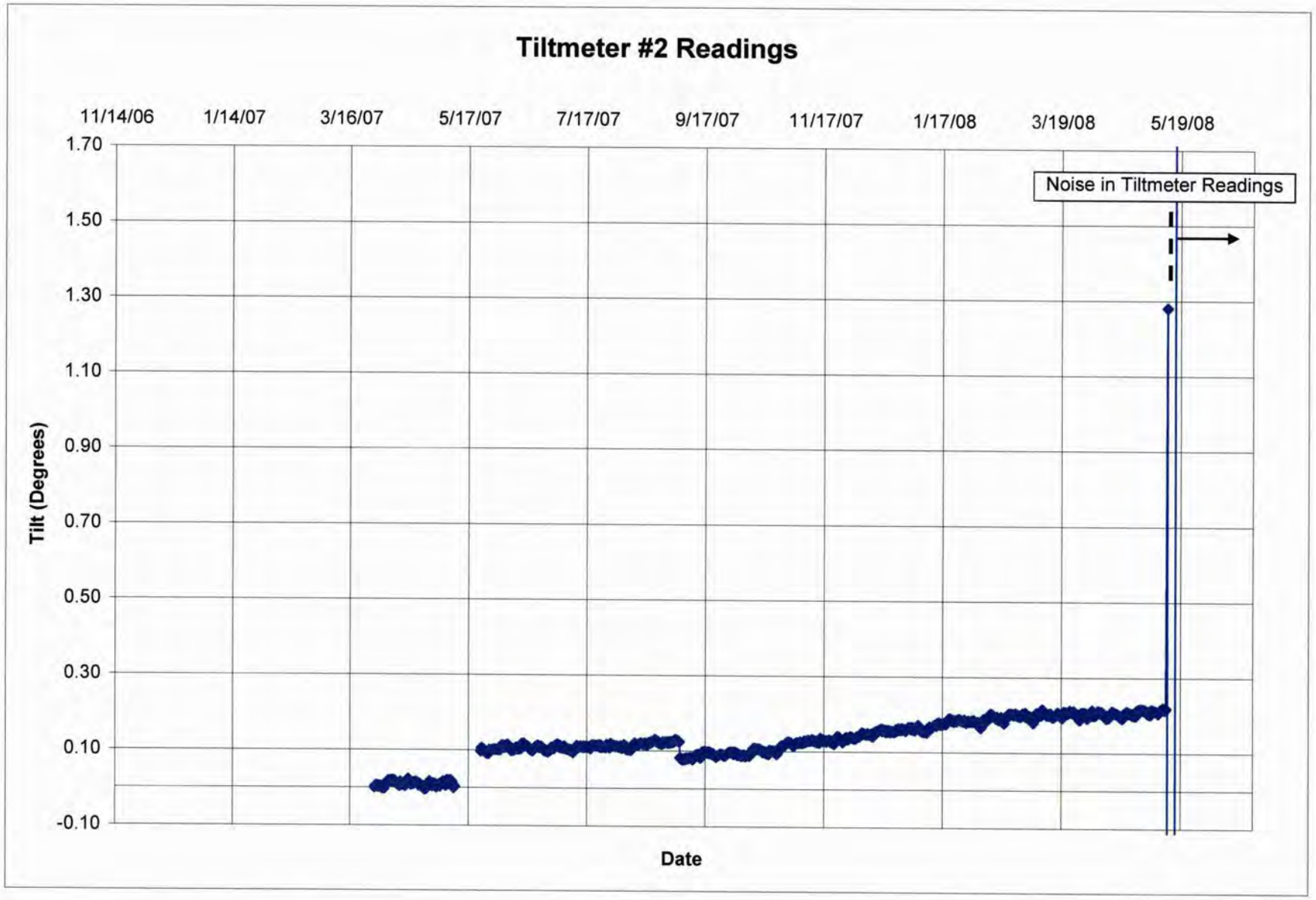
06150078 Jefferson Memorial
Baseline @ 11/21/06
Orientation Adjusted to Match I-2
Figure 46

Schnabel Engineering

APPENDIX C

Tiltmeter Data

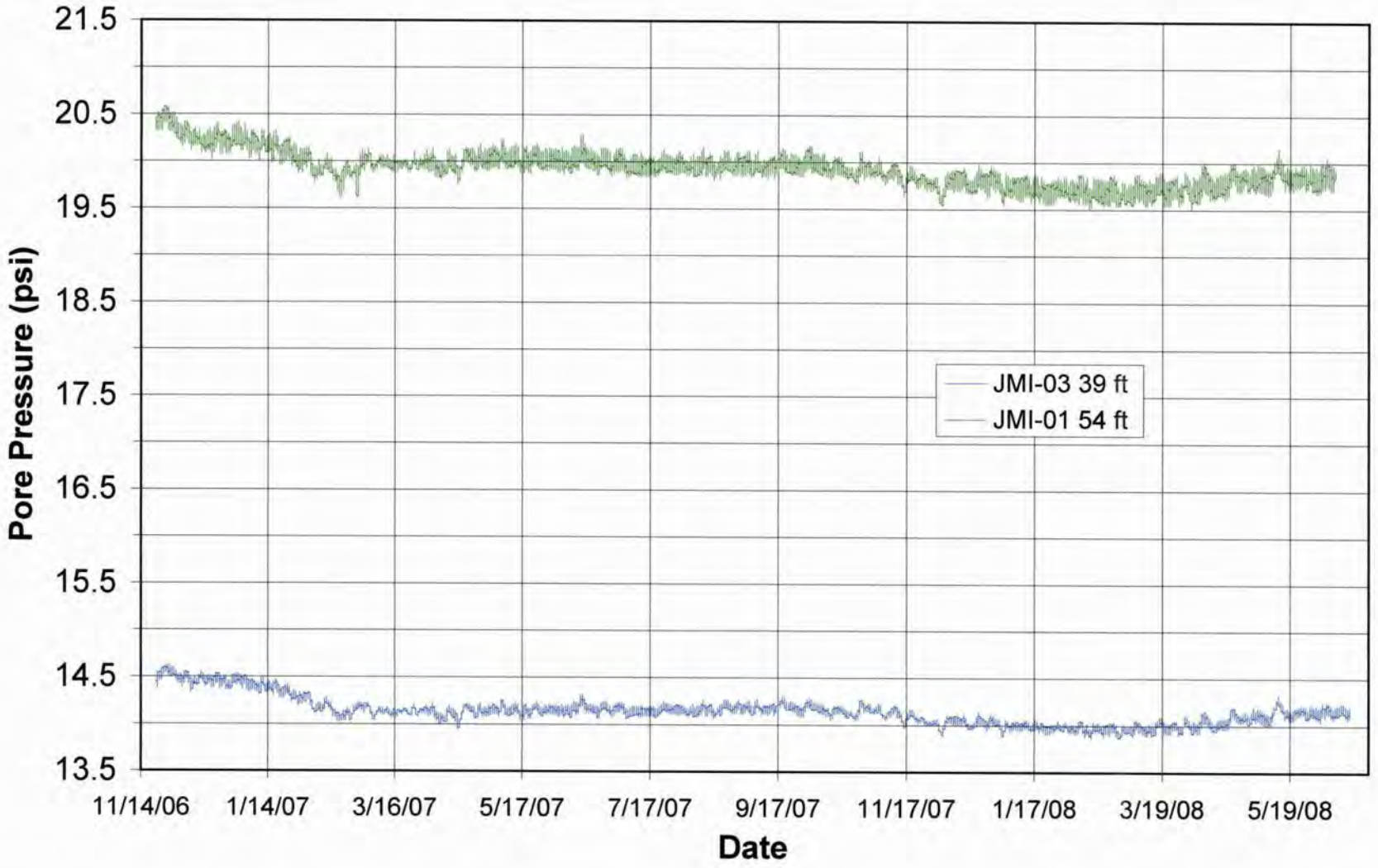

Tiltmeter #1 Readings
Noise in Tiltmeter Readings
Tilt (Degrees)
1.70
1.50
1.30
1.10
0.90
0.70
0.50
0.30
0.10
-0.10
11/14/06
1/14/07
3/16/07
5/17/07
7/17/07
9/17/07
11/17/07
1/17/08
3/19/08
5/19/08
Date


Tiltmeter #2 Readings
11/14/06
1/14/07
3/16/07
5/17/07
7/17/07
9/17/07
11/17/07
1/17/08
3/19/08
5/19/08
1.70
1.50
1.30
1.10
0.90
0.70
0.50
0.30
0.10
-0.10
Tilt (Degrees)
Date
Noise in Tiltmeter Readings

APPENDIX D

Piezometer Data

Vibrating Wire Piezometer Data



F

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

NORTH PLAZA CONE PENETRATION TEST AND SOUNDING REPORT
Prepared by Schnabel Engineering

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
October 6, 2008

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

October 6, 2008

Mr. Nathan James
Project Manager
HNTB Federal Services Corporation
1615 M Street NW, 7th Floor
Washington, DC 20036

Subject: **North Plaza Cone Penetration Test Sounding Report for the Jefferson Memorial, National Park Service, Washington, DC (Schnabel Reference 06150078.I)**

Dear Mr. James:

Schnabel Engineering, LLC (Schnabel), is pleased to present our report on cone penetrometer test sounding (CPT) for the North Plaza at the Jefferson Memorial. We have completed these services under Task Order No. T2011080513 dated August 13, 2008.

PURPOSE OF REPORT

The purpose of these soundings was to develop a continuous soil and pore pressure profile below grade at the North Plaza. The CPTs measure fine changes in soil properties and record tip resistance (q_c), sleeve friction (f_s), and dynamic pore water pressure (u) at five-centimeter intervals. Pore pressure dissipation tests were performed at selected depths. Schnabel observed the work performed on September 17 and 18, 2008.

DESCRIPTION OF OBSERVATIONS

Schnabel personnel observed four CPTs (JMC-01 through JMC-04) at locations on the North Plaza and in grassy areas to the east and west of the plaza. A location plan is included in Appendix A. ConeTec, Inc. (ConeTec) advanced the CPT to practical refusal at depths of approximately 84 to 91 ft below existing grade. Following testing, ConeTec backfilled the probe holes with bentonite chips. Appendix B contains ConeTec's CPT Testing report.

Please note that the ground water table position indicated in the logs is not accurate, and reflects the anomalous pore pressure values measured with depth that suggest a downward piezometric gradient.

We have endeavored to prepare this report of the CPTs identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in

the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this agreement, or any report, opinion, document, or other instrument of service.

We appreciate the opportunity to be of service for this project. Please contact either of the undersigned at (610) 696-6066 if clarification is needed for any aspect of this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

Lauren L. Fagerholm, EIT

Lauren L. Fagerholm, E.I.T.
Staff

Darrell Wilder, P.E.
Associate

LLF:DW:JEG:jlm

Appendix A: Location Plan
Appendix B: ConeTec, Inc. Report

Distribution:

HNTB Federal Services Corporation (1)
Attn: Mr. Nathan James

National Park Service (2)
Attn: Mr. Patrick MacDonald
Attn: Mr. Doug Denk

APPENDIX A

Location Plan

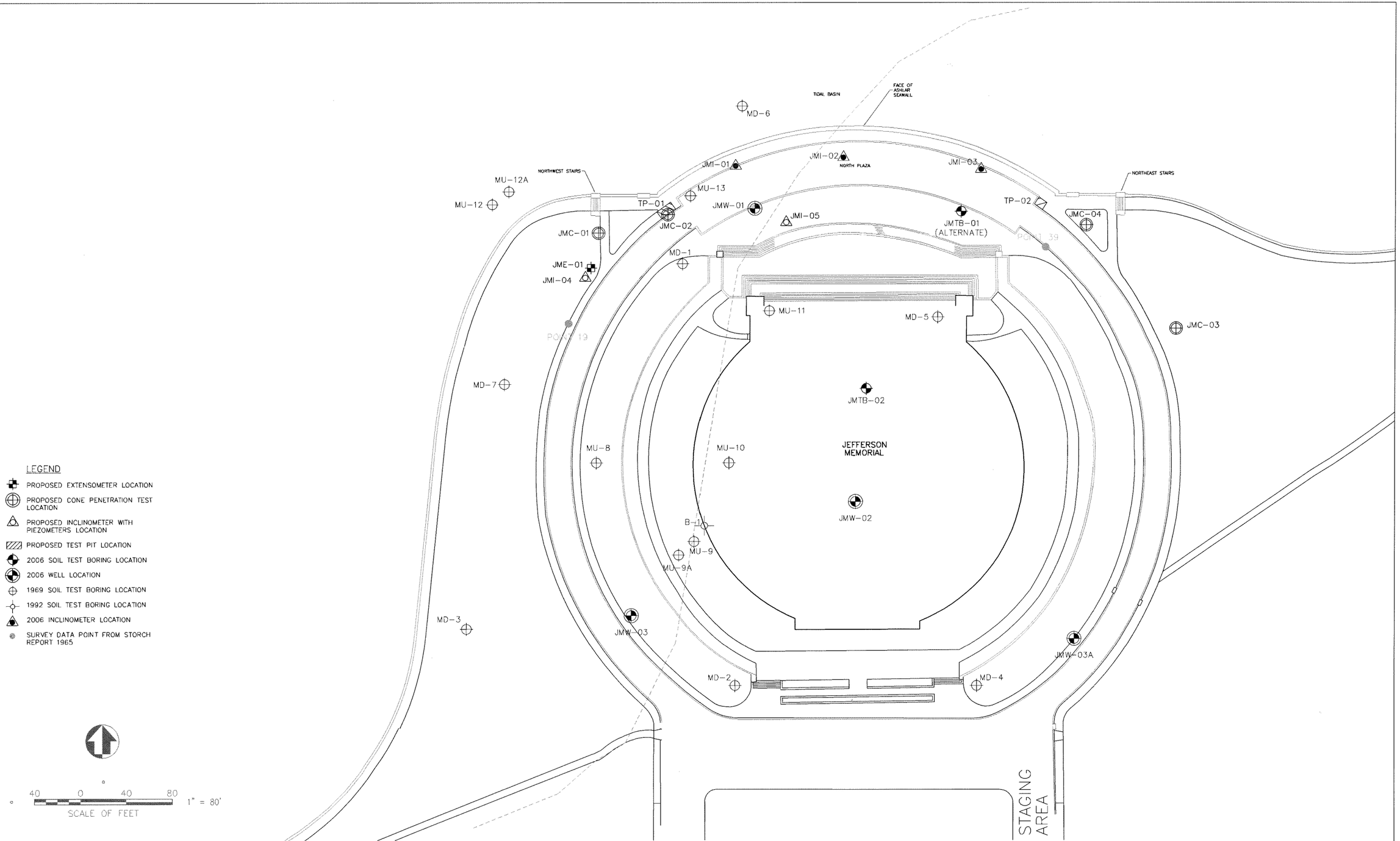


FIGURE 1 – LOCATION PLAN

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

SHEET
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DW
DESIGNED
LLF
DRAWN
JG
CHECKED
CONTRACT NO.
C20000408000
DATE
9/24/08
DWG. NO.
1

APPENDIX B

ConeTec, Inc. Report

ConeTec Inc.

Geotechnical and Environmental Site Investigation Contractors

606-H Roxbury Industrial Center, Charles City, VA 23030 • Tel: (804) 966-5696 • Fax: (804) 966-5697
• E-mail: ecargill@conetec.com • Website: www.conetec.com

September 23, 2008

Mr. Darrell Wilder
Schnabel Engineering
510 East Gay Street
West Chester, PA 19380

Dear Mr. Wilder,

Re: CPT Testing
Jefferson Memorial; Washington, D.C.

We are pleased to enclose our data submission for the CPT testing that ConeTec performed for you at the above referenced site on September 17 and 18, 2008.

Four cone penetration tests (CPT) soundings were performed to a depth of approximately 1 to 47 feet below existing grade. The soundings were halted when refusal conditions were met. A compression model electronic piezo cone penetrometer, with a 15 cm^2 tip and a 225 cm^2 friction sleeve, was used. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. At the beginning of the sounding, the cone was outfitted with a vacuum-saturated, six millimeter-thick, porous plastic pore pressure element that is located immediately behind the tip (the U_2 location).

The cone was advanced using a 25-ton, truck-mounted cone penetration rig. As the cone was advanced into the ground, tip resistance (qc), sleeve friction (fs) and dynamic pore water pressure (U) were recorded approximately every five centimeters and the data is included on the attached disk. Additionally, several pore pressure dissipation tests were performed at select depths. A summary of the field testing can be found in the attached table. A tabular output of this data and summary of engineering parameters, is included in the .xls file.

Thank you very much for using ConeTec. It was a pleasure working with you and your staff and we look forward to working with you again in the future. If you have any questions or require additional information, please do not hesitate to contact us.

Best regards,

Ethan Cargill
Regional Manager

CONETEC

Table 1: Sounding Information Table

Jefferson Memorial
September 17 and 18, 2008
08-970

Sounding Number	Depth (ft)	Estimated GWT (ft)	Comments
CPT-1	84.64	37	
CPT-2	86.94	38	
CPT-3	90.39	24	
CPT-4	87.27	24	

Pore Water Dissapation Data

Sounding Number	Depth (ft)	Duration (sec)	c_{h^*} (cm^2/min)
CPT-2	10.01	3595	0.213
CPT-2	25.59	2815	0.270
CPT-2	40.03	490	1.667
CPT-2	50.03	4315	0.241
CPT-2	65.45	5455	0.246
CPT-2	81.86	265	31.9
CPT-3	45.93	3835	0.354

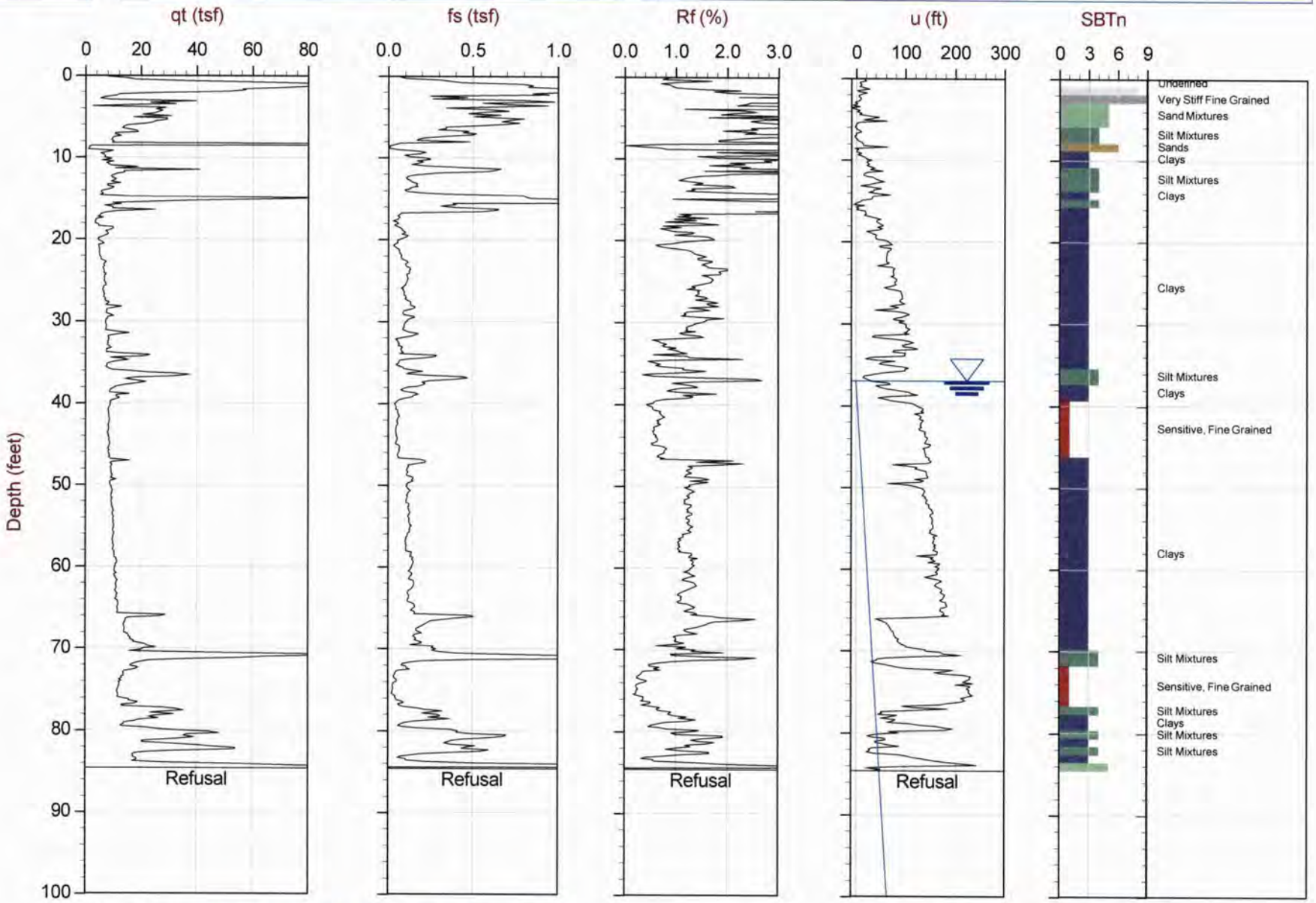
*Using I_R=100

CONETEC

Schnabel Engineering

Job No: 07-970
Date: 09:18:08 07:28
Site: Jefferson Mem.

Sounding: CPT-1
Cone: STD 20T AD167



Max Depth: 25.800 m / 84.64 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.300 m

File: 970CP03.COR
Unit Wt: SBT Chart Soil Zones

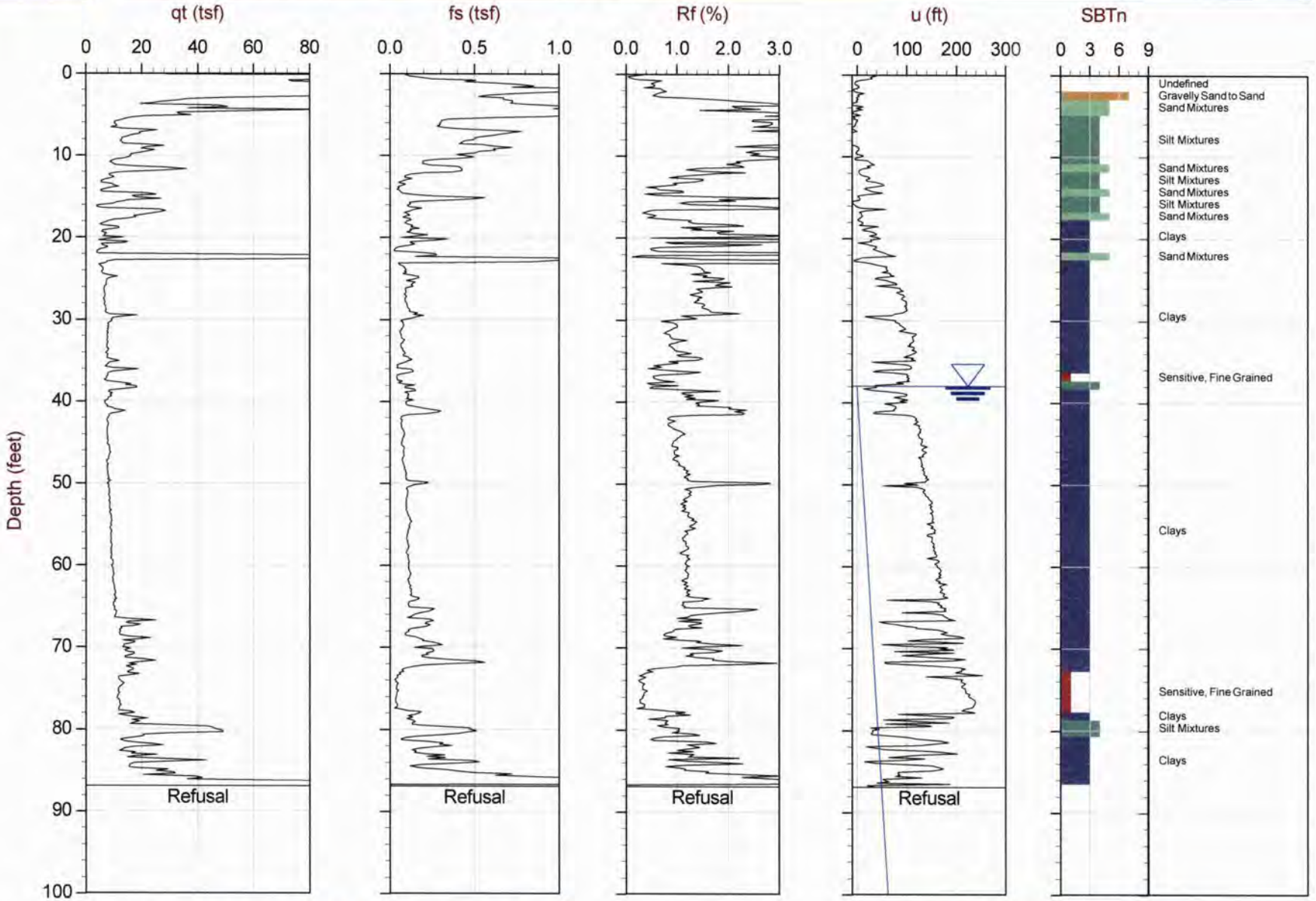
SBT: Lunne, Robertson and Powell, 1997

CONETEC

Schnabel Engineering

Job No: 07-970
Date: 09:18:08 08:33
Site: Jefferson Mem.

Sounding: CPT-2
Cone: STD 20T AD167



Max Depth: 26.500 m / 86.94 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.300 m

File: 970CP04.COR
Unit Wt: SBT Chart Soil Zones

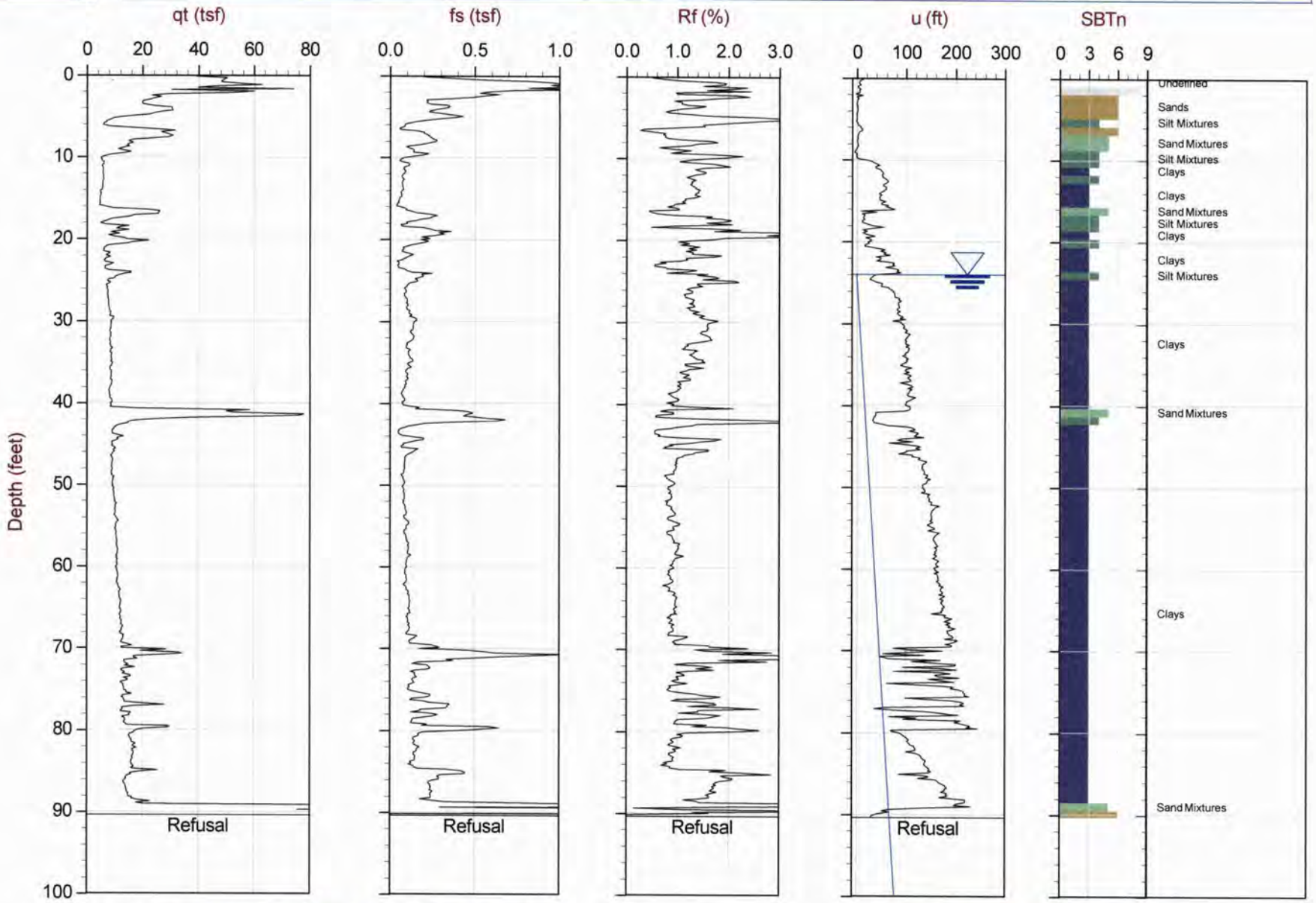
SBT: Lunne, Robertson and Powell, 1997

CONETEC

Schnabel Engineering

Job No: 07-970
Date: 09:17:08 10:58
Site: Jefferson Mem.

Sounding: CPT-3
Cone: STD 20T AD167



Max Depth: 27.550 m / 90.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.300 m

File: 970CP01.COR
Unit Wt: SBT Chart Soil Zones

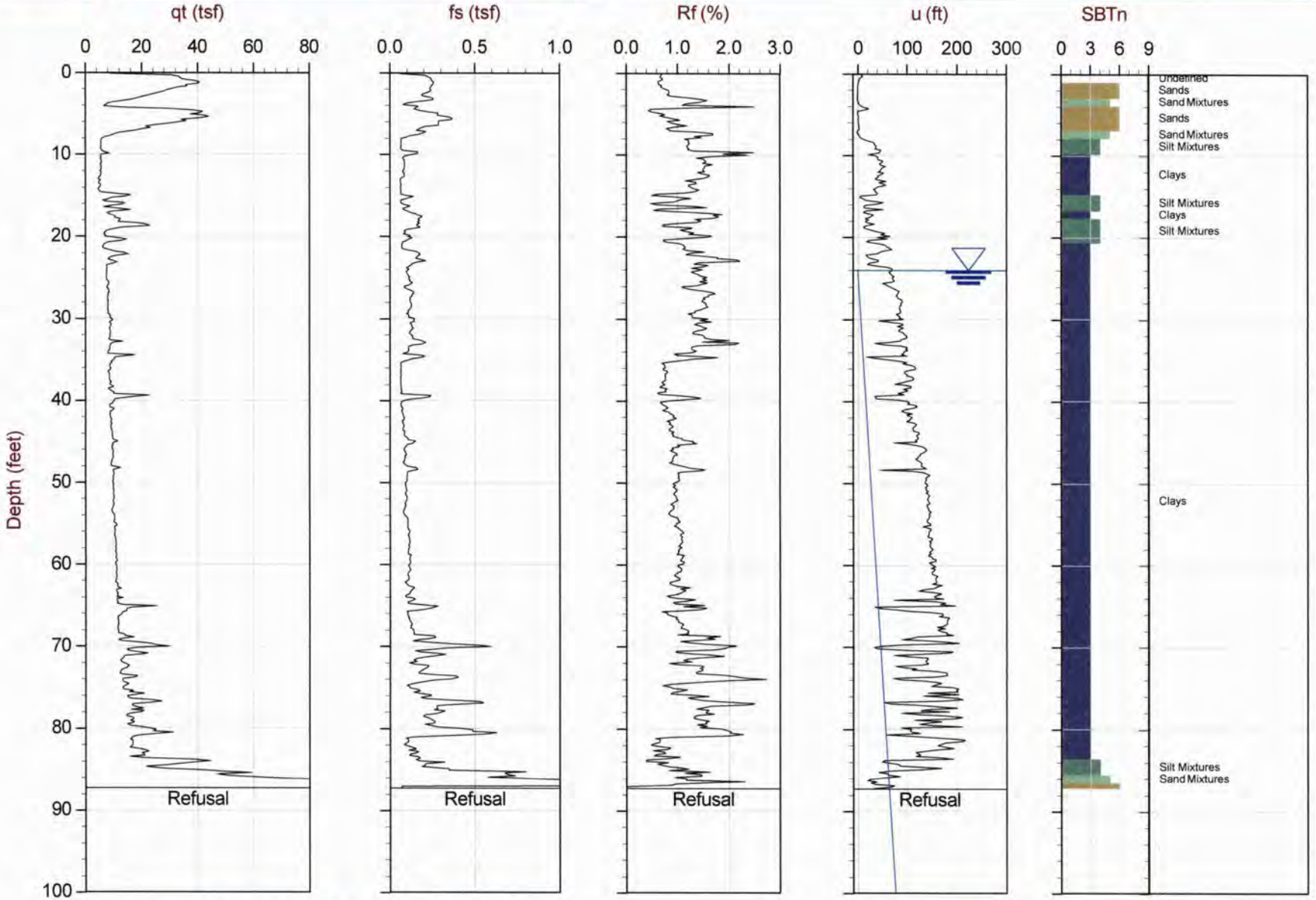
SBT: Lunne, Robertson and Powell, 1997

CONETEC

Schnabel Engineering

Job No: 07-970
Date: 09:17:08 13:16
Site: Jefferson Mem.

Sounding: CPT-4
Cone: STD 20T AD167



Max Depth: 26.600 m / 87.27 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.300 m

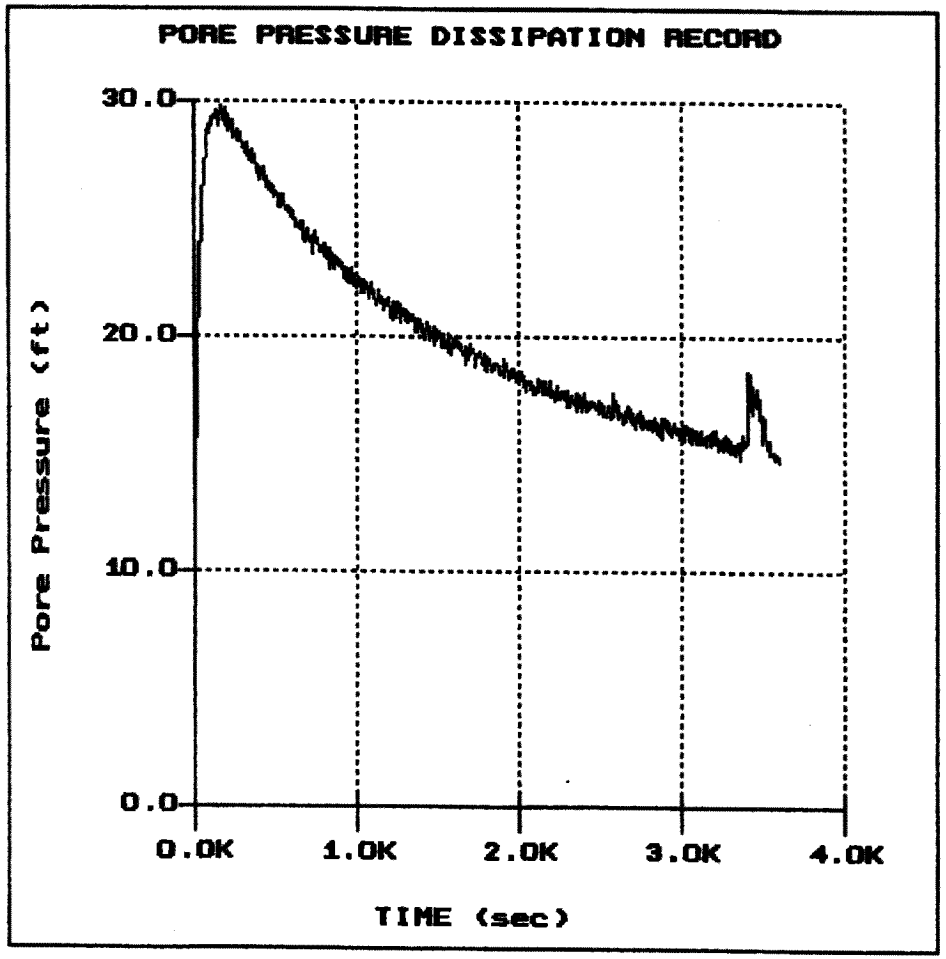
File: 970CP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997

Schnabel

Hole: CPT-2
Location:Jefferson Mem.

Cone:STD 20T AD167
Date:09:18:08 08:33

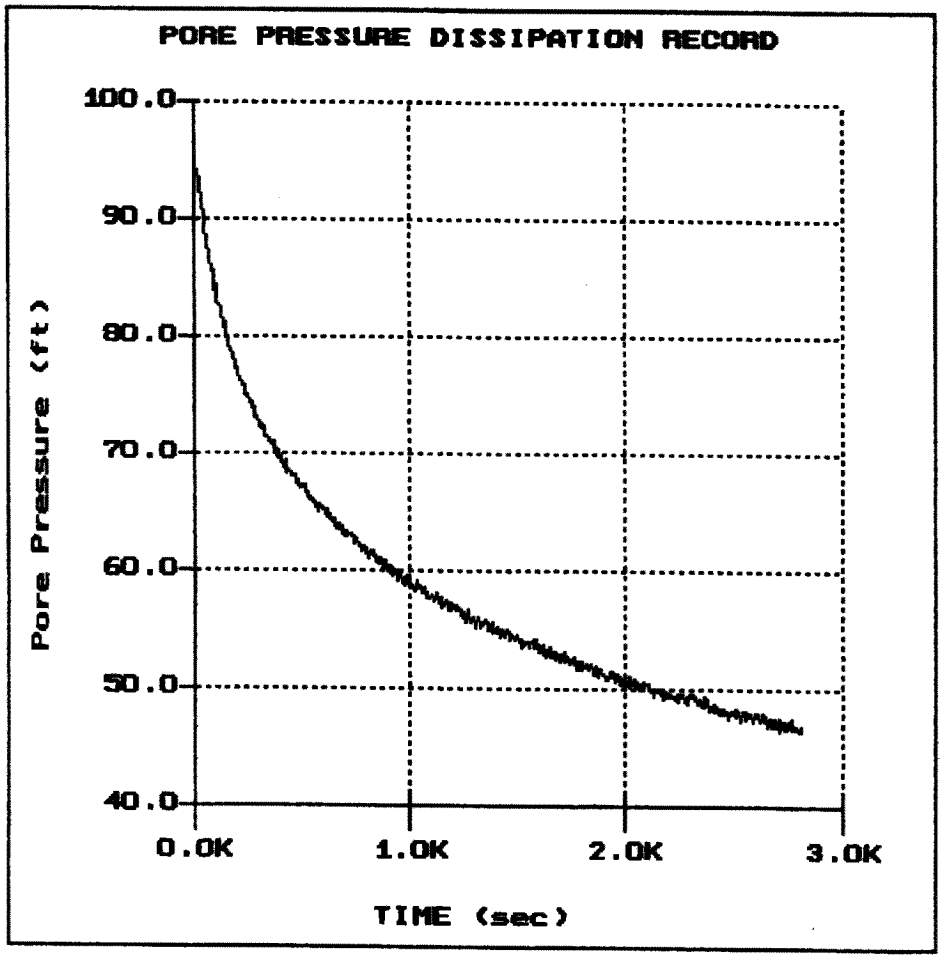


File: 97DCP04.PPD
Depth (m): 3.05
(ft): 10.01
Duration : 3595.0s
U-min: 7.78 0.0s
U-max: 29.74 165.0s

Schnabel

Hole: CPT-2
Location:Jefferson Man.

Cone:STD 20T AD167
Date:09:18:08 08:33

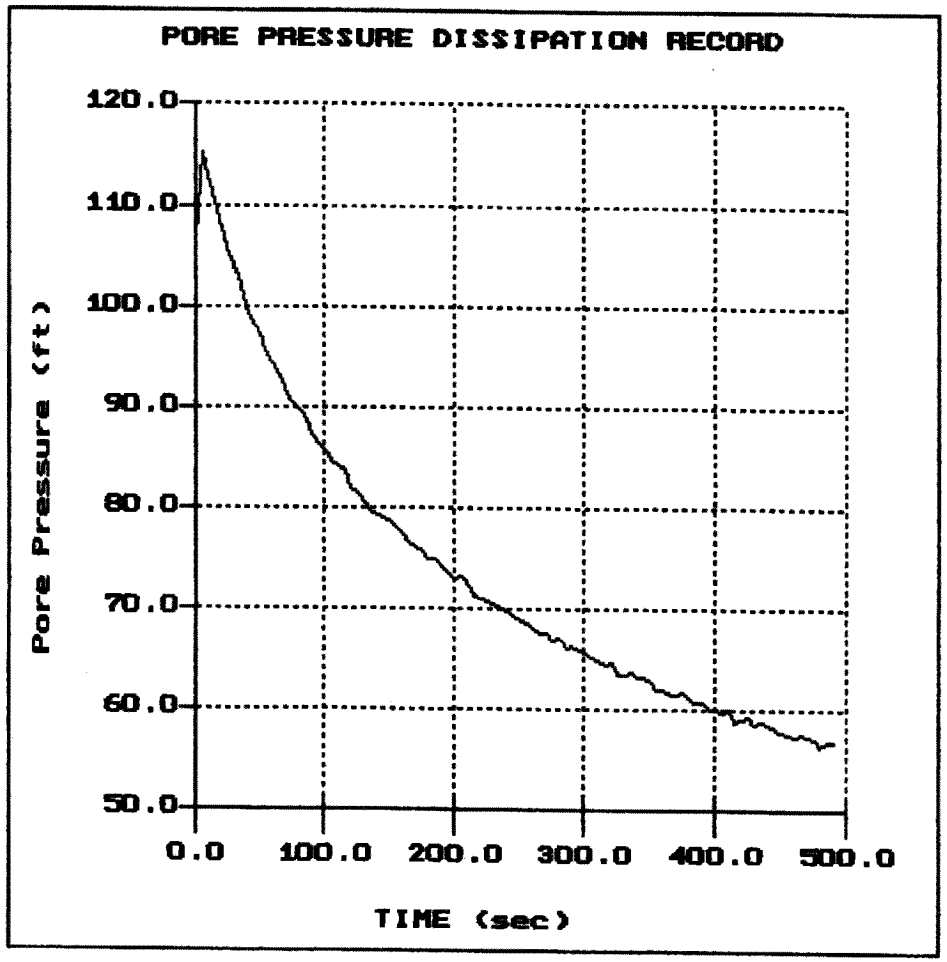


File: 970CP04.PPD
Depth (m): 7.80
(ft): 25.59
Duration : 2815.0s
U-min: 46.42 2815.0s
U-max: 94.11 15.0s

Schnabel

Hole: CPT-2
Location:Jefferson Mem.

Cone:STD 20T AD167
Date:09:18:08 08:33

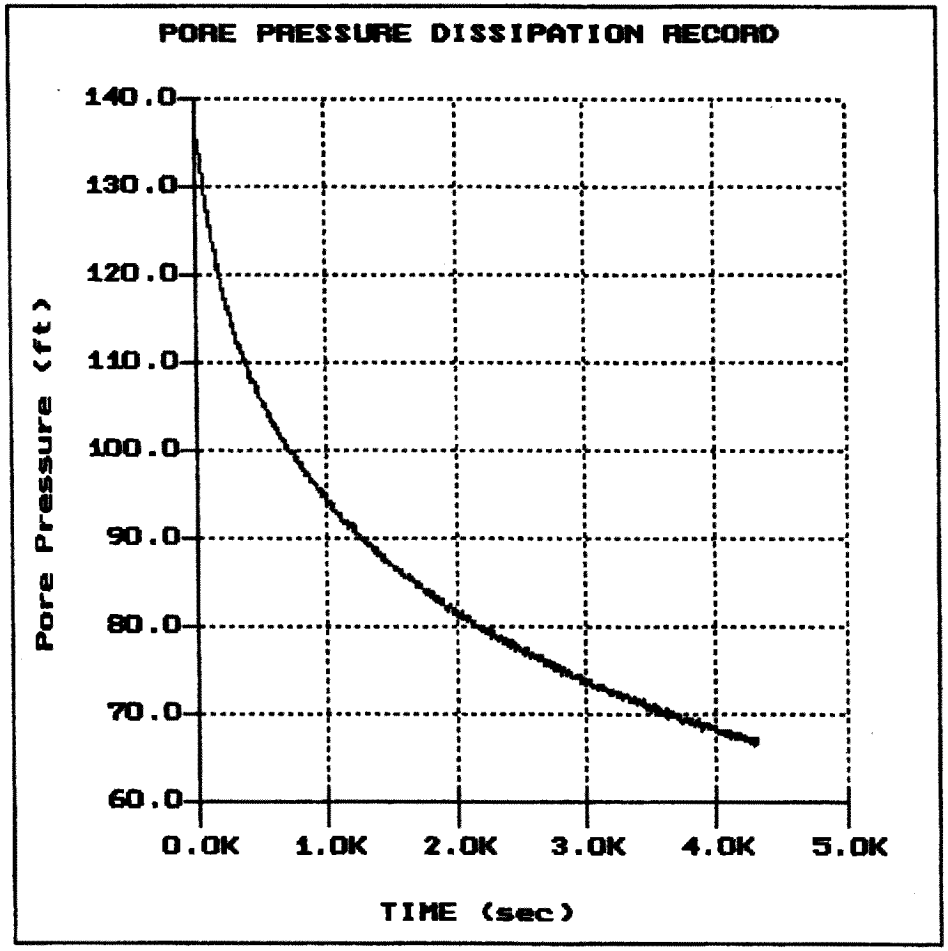


File: 970CP04.PPD
Depth (m): 12.20
(ft): 40.03
Duration : 490.0s
U-min: 56.22 480.0s
U-max: 115.16 5.0s

Schnabel

Hole: CPT-2
Location:Jefferson Mem.

Cone:STD 20T AD167
Data:09:18:08 08:33

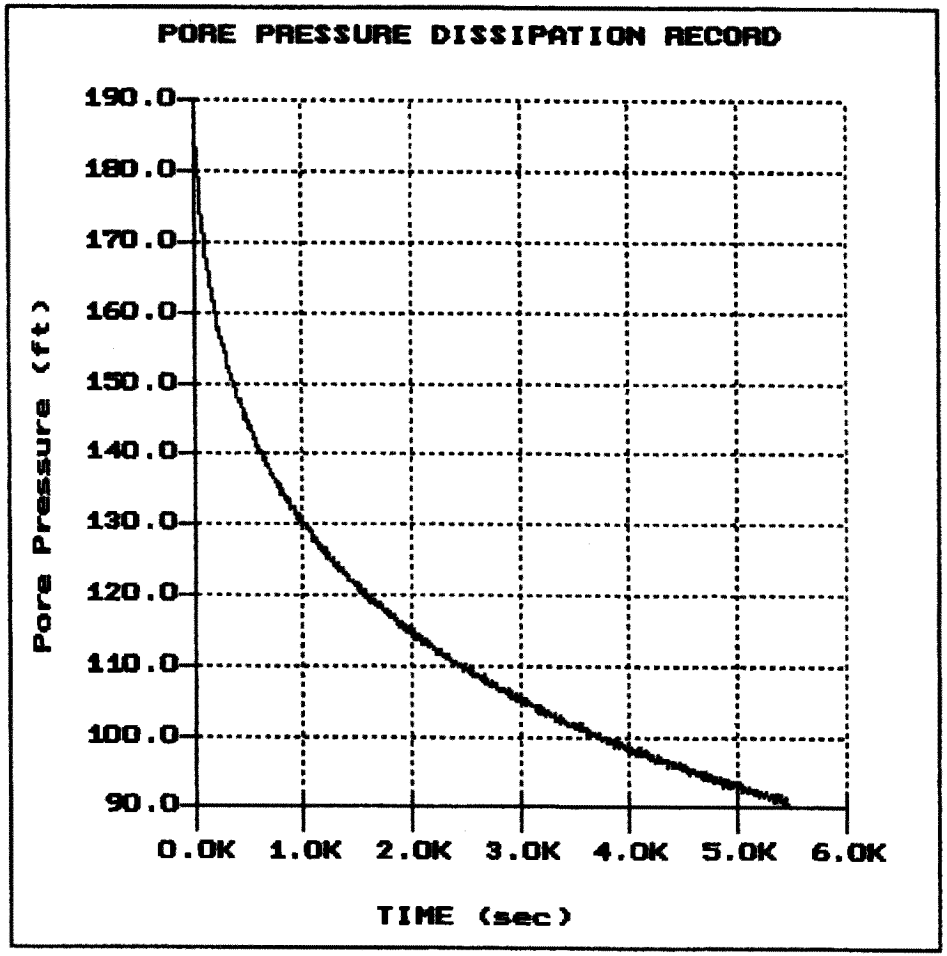


File: 970CP04.PPD
Depth (m): 15.25
(ft): 50.03
Duration : 4315.0s
U-min: 66.48 4290.0s
U-max: 135.14 20.0s

Schnabel

Hole: CPT-2
Location:Jefferson Man.

Cone:STD 20T AD167
Date:09:18:08 08:33

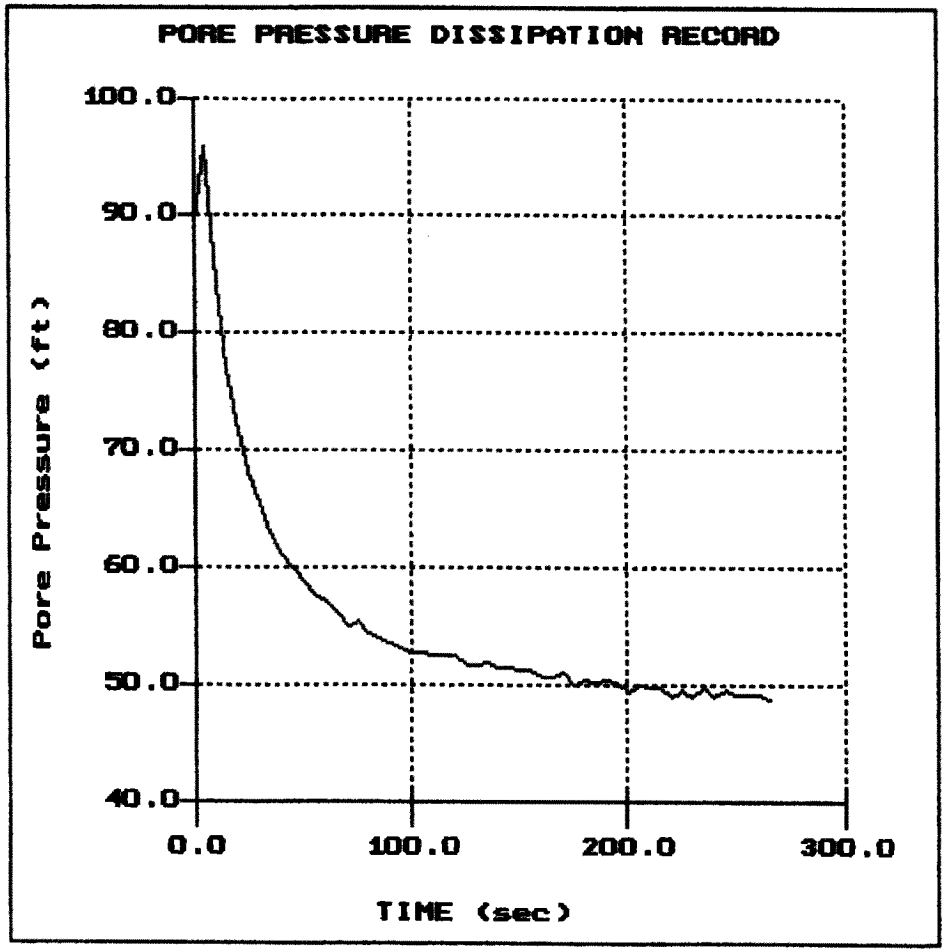


File: 970CP04.PPD
Depth (m): 19.95
(ft): 65.45
Duration : 5455.0s
U-min: 90.38 5430.0s
U-max: 183.18 15.0s

Schnabel

Hole: CPT-2
Location:Jefferson Mem.

Cone:STD 20T AD167
Date:09:18:08 08:33

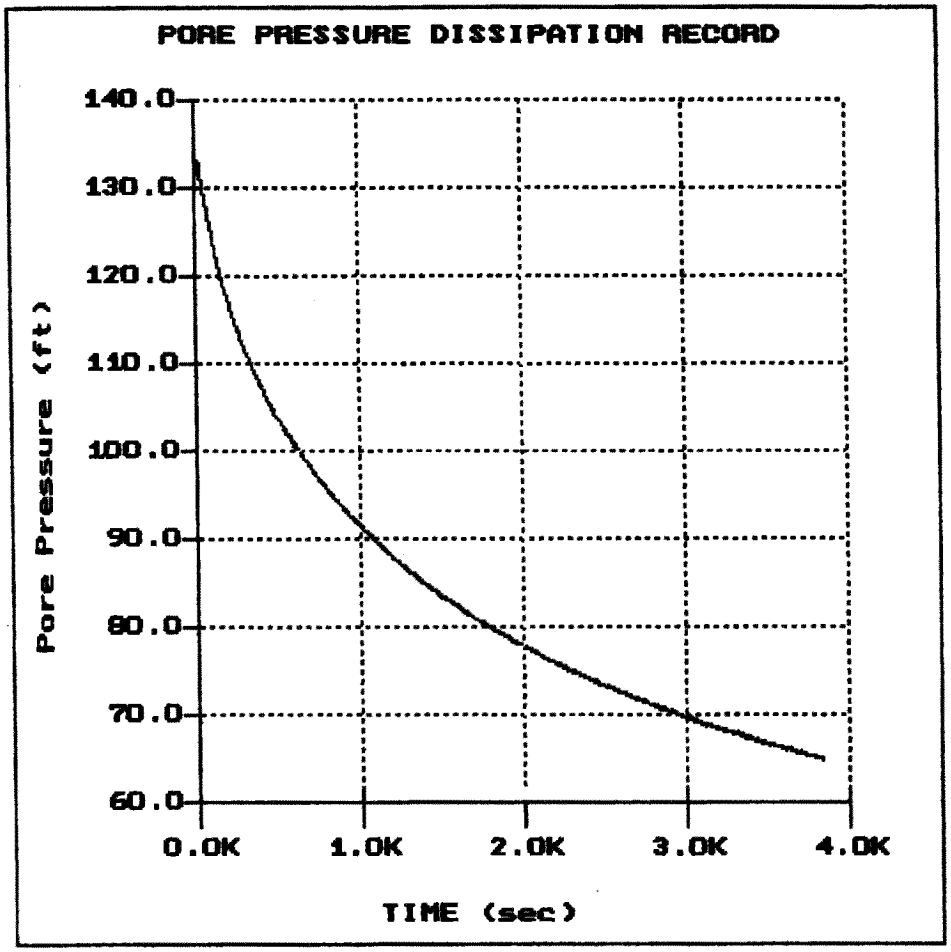


File: 970CP04.PPD
Depth (m): 24.95
(ft): 81.86
Duration : 265.0s
U-min: 48.84 265.0s
U-max: 95.75 5.0s

Schnabel

Hole: CPT-3
Location:Jefferson Mem.

Cone:STD 20T AD167
Date:09:17:08 10:58



Time: 2000.00 U(t): 100.000

File: 970CP01.PPD
Depth (m): 14.00
(ft): 45.93
Duration : 3835.0s
U-min: 64.82 3835.0s
U-max: 133.09 15.0s

G

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

JEFFERSON MEMORIAL PLAZA INVESTIGATION REPORT

Prepared by Schnabel Engineering

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
October 6, 2008

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

October 6, 2008

Mr. Nathan James
Project Manager
HNTB Federal Services Corporation
1615 M Street NW, 7th Floor
Washington, DC 20036

Subject: **Jefferson Memorial Plaza Investigation, National Park Service, Washington, DC (Schnabel Reference 06150078.H)**

Dear Mr. James:

Schnabel Engineering, LLC (Schnabel), is pleased to present the results of the plaza investigation at the Jefferson Memorial. We have completed these services under Task Order No. T2011080513, dated August 13, 2008.

PURPOSE OF REPORT

The purpose of this investigation was to observe the conditions below grade at the west and east transition zones of the North Plaza. Schnabel observed the work performed from September 15 through 17, 2008.

DESCRIPTION OF OBSERVATIONS

Schnabel personnel observed excavations of test pits at two locations adjacent to the North Plaza. A location plan is included in Appendix A. Ground-Works, LLC (Ground-Works) excavated the test pits to the bottom of the grade beams, approximately four feet. Following the excavations, Ground-Works backfilled the areas with the excavated material in four lifts and used a jumping jack to compact the material after each lift. Approximately four inches of #57 stone were then placed and compacted with a vibrating plate compactor. Finally, asphalt was placed on top and compacted with a vibrating plate compactor.

Appendix B displays photos that exhibit some of the conditions observed.

SUMMARY OF OBSERVATIONS

Test Pit #1

Test Pit #1 was excavated to a depth of about four feet exposing two approximately 3'-2" deep grade beams (See Photo 1 for the grade beam layout). The existing six inches of cold patch asphalt were removed exposing a concrete slab. The six-inch slab contained reinforcing bar on the west side running from the western slab towards the east, but terminating before the slab over the eastern grade beam. Reinforcing bar was also observed in the northeast corner running from the northern slab towards the south, but terminating before the granite pavers (See Photo 2). Soils encountered below the slab were brown silty sand with cobbles, green-gray clay with cobbles and brick fragments, and a six-inch layer of rounded cobbles as shown in Photo 4.

A two to three inch void and loose soils were observed below the grade beam adjacent to the north plaza (See Photos 3 and 5). Ground-Works personnel were able to easily push the handle of a shovel about 14 inches into the loose, moist soil below the grade beam. The concrete plaza slab above the grade beam was about 13-inches thick. The grade beam stuck out 5.5 inches beyond the slab joint as shown in Photos 6 and 7. No bond breaker was observed between the slab and the beam.

The slab to the north of the excavation had a three to five-inch void observed below it. Daylight was observed through the void from the opening at the seawall (See Photos 8 and 9). The western grade beam ran south from the seawall to the corner of the slab and then ran west along the sidewalk (See Photos 10, 11, and 12).

As shown in Photos 13, 14, and 15, Ground-Works backfilled the excavated area with the excavated material in four lifts, and used a jumping jack to compact the material after each lift. Approximately four inches of #57 stone were then placed and compacted with a vibrating plate compactor. Finally, asphalt was placed on top and compacted with a vibrating plate compactor.

Test Pit #2

Test Pit #2 was excavated to a depth of about four feet exposing an approximate 3'-2" grade beam as shown in Photo 16. The six-inch concrete slab was removed. The slab contained reinforcing bar running from the northern slab towards the south, but terminating before the granite pavers and running from the eastern slab towards the west, also terminating before the granite pavers (See Photo 17). Soils encountered were brown silty sand with cobbles and green-gray clay with cobbles and brick fragments. The concrete slab above the grade beam was about eight-inches thick, and the beam stuck out about six inches beyond the slab joint as shown in Photos 18 and 19. No bond breaker between the slab and the beam was observed.

The contractor then backfilled the area with the excavated material in four lifts and used a jumping jack to compact the material after each lift. Approximately four inches of #57 stone were then placed and compacted with a vibrating plate compactor. Finally, asphalt was placed on top and compacted with a vibrating plate compactor, as shown in Photos 20, 21, and 22.

We have endeavored to prepare this report of the North Plaza test pits identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this agreement, or any report, opinion, document, or other instrument of service.

We appreciate the opportunity to be of service for this project. Please contact either of the undersigned at (610) 696-6066 if clarification is needed for any aspect of this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

B. Philip Shull, Jr., E.I.T.
Staff

Darrell Wilder, P.E.
Associate

BPS:DW:JEG:jlm

Appendix A: Location Plan
Appendix B: Photos

Distribution:

HNTB Federal Services Corporation (1)
Attn: Mr. Nathan James

National Park Service (2)
Attn: Mr. Patrick MacDonald
Attn: Mr. Doug Denk

APPENDIX A

Location Plan

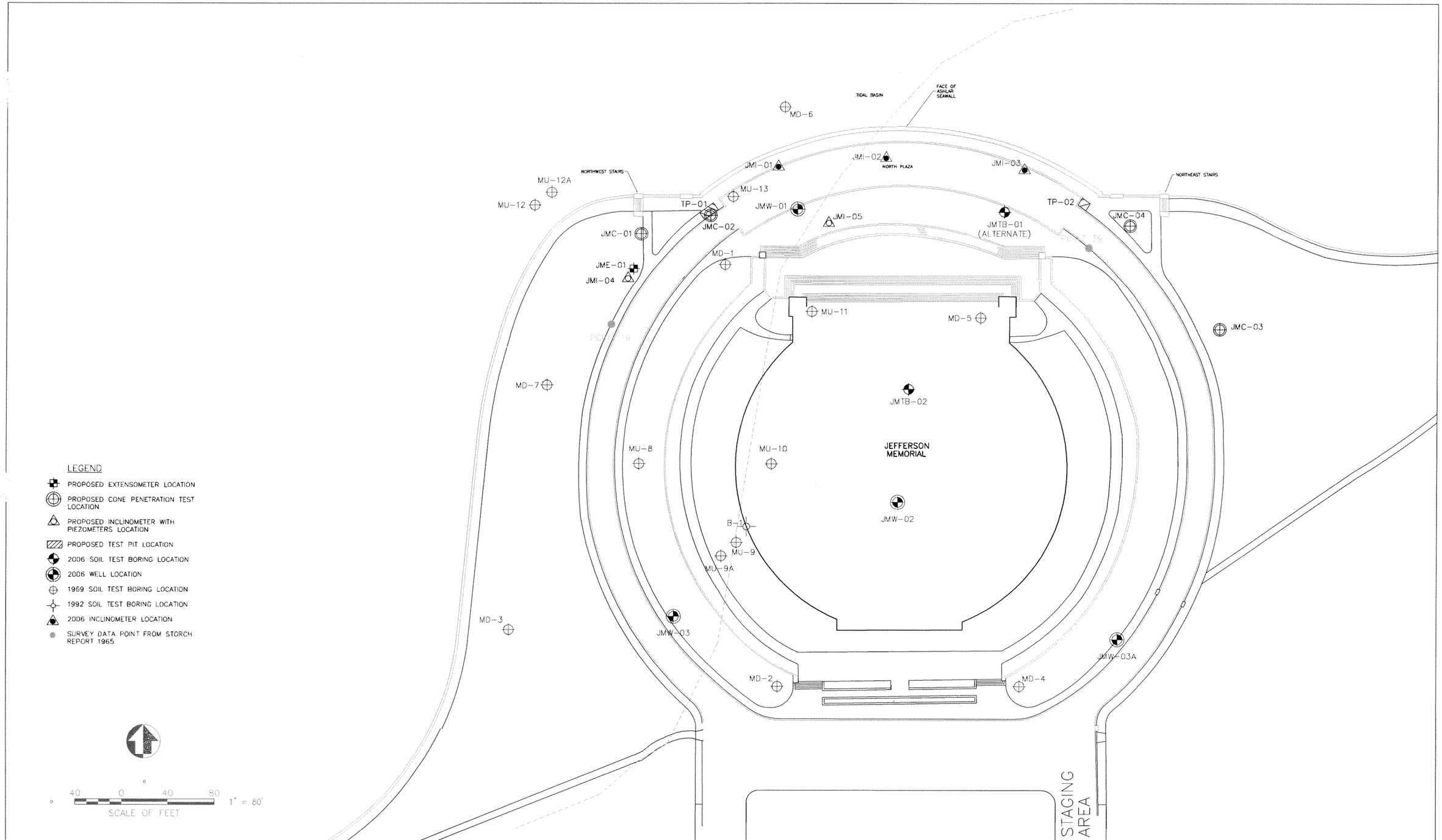


FIGURE 1 – LOCATION PLAN

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

SHEET

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED	DW
DRAWN	LLF
CHECKED	JG
CONTRACT NO	C20000408000
DATE	9/24/08
DWG. NO.	1

APPENDIX B

Photos

PHOTO 1 – Approximate locations of grade beams

Schnabel Engineering	Jefferson Memorial Plaza Investigation	Project Number 06150078.H Test Pit #1

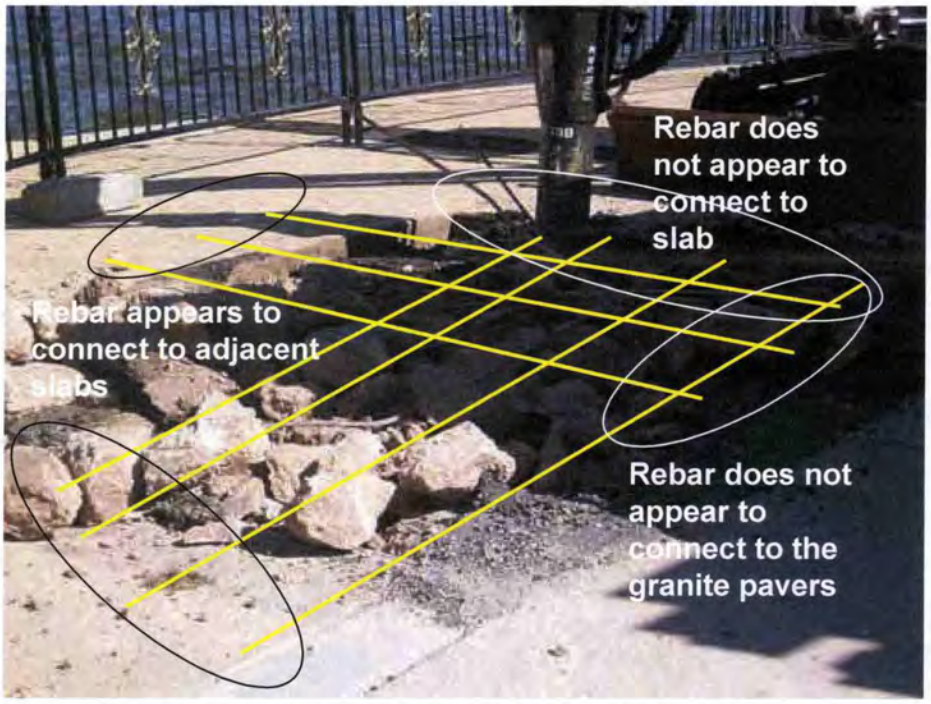


PHOTO 2 – Approximate location of slab reinforcing bar

PHOTO 3 – Void below eastern grade beam

Schnabel Engineering	Jefferson Memorial Plaza Investigation	Project Number 06150078.H Test Pit #1

PHOTO 4 – Subgrade material. Note the 6" layer of rounded cobbles

PHOTO 5 – Void below eastern grade beam

Schnabel Engineering	Jefferson Memorial Plaza Investigation	Project Number 06150078.H Test Pit #1

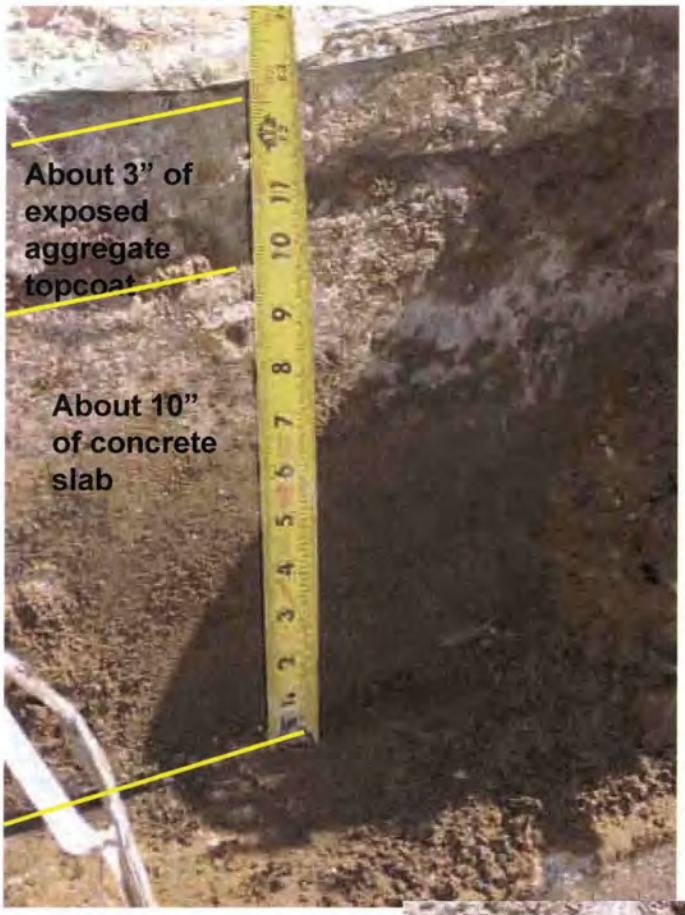


PHOTO 6 – Concrete slab above eastern grade beam

PHOTO 7 – Eastern grade beam beyond slab joint

Schnabel Engineering	Jefferson Memorial Plaza Investigation	Project Number 06150078.H Test Pit #1

PHOTO 8 – 3 to 5" void below northern slab

PHOTO 9 – 3 to 5" void below northern slab

Schnabel Engineering	Jefferson Memorial Plaza Investigation	Project Number 06150078.H Test Pit #1

PHOTO 10 – Location of western grade beam

PHOTO 11 – Location of western grade bean

PHOTO 12 – Corner of western grade beam

PHOTO 13 – Backfilling and compaction

PHOTO 14 – Backfilling and compaction of #57 stone

PHOTO 15 – Final asphalt layer

PHOTO 16 – Test Pit #2 grade beam

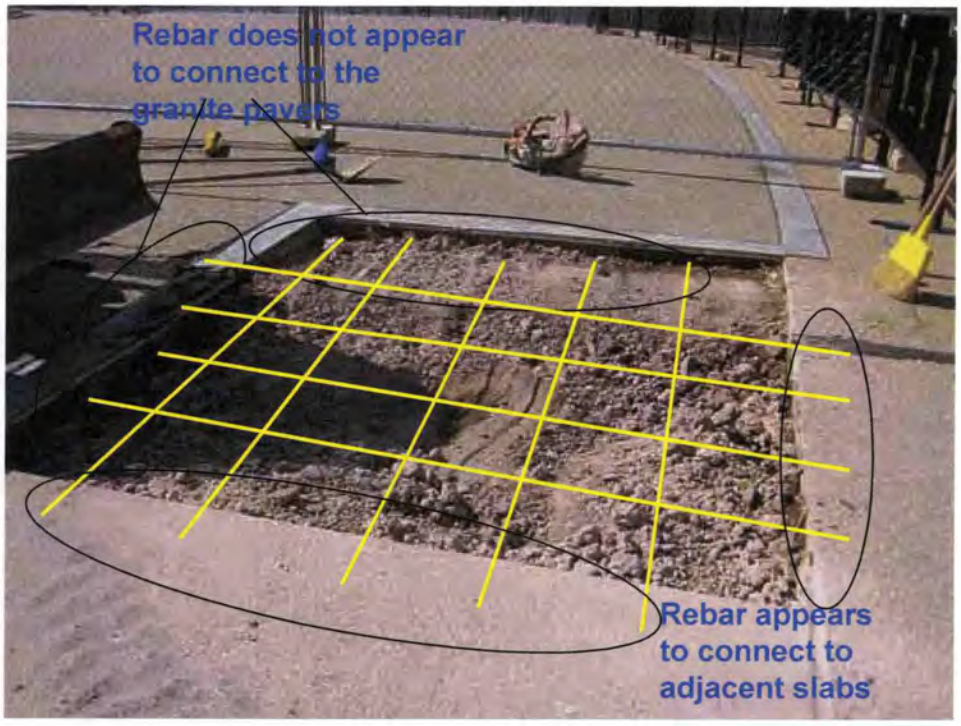


PHOTO 17 – Approximate location of slab reinforcing bar

PHOTO 18 – Concrete slab above grade beam

PHOTO 19 – Grade beam beyond slab joint

Schnabel Engineering	Jefferson Memorial Plaza Investigation	Project Number 06150078.H Test Pit #2

PHOTO 20 – Backfilling and compaction

PHOTO 21 – Backfilling and compaction of #57 stone

Schnabel Engineering	Jefferson Memorial Plaza Investigation	Project Number 06150078.H Test Pit #2

PHOTO 22 – Final asphalt layer

H

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

NORTH PLAZA INSTRUMENTATION INSTALLATION REPORT FOR THE JEFFERSON MEMORIAL

Prepared by Schnabel Engineering

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
October 6, 2008

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

October 6, 2008

Mr. Nathan James
Project Manager
HNTB Federal Services Corporation
1615 M Street NW, 7th Floor
Washington, DC 20036

Subject: **North Plaza Instrumentation Installation Report for the Jefferson Memorial, National Park Service, Washington, DC (Schnabel Reference 06150078.F)**

Dear Mr. James:

Schnabel Engineering, LLC (Schnabel), is pleased to present our instrumentation installation report for the North Plaza at the Jefferson Memorial. We have completed these services under Task Order No. T2011080513 dated August 13, 2008.

PURPOSE OF REPORT

One extensometer, five piezometers, and two inclinometers were installed in three borings to measure the ground movement and pore pressures in the soils beneath the North Plaza and transition areas. Schnabel observed the work performed from September 16 through 23, 2008.

DESCRIPTION OF OBSERVATIONS

Connelly and Associates, Frederick, Maryland, drilled three borings at this site under the observation of Schnabel. Appendix A includes specific observations, remarks, and logs for the borings. Figure 1 in Appendix A shows the location of these borings as well as the Storch borings from 1965 and the Schnabel Engineering Associates borings from 1992 and 2006.

For this investigation, one boring was drilled through the North Plaza and two were advanced in the lawn area to the west of the plaza. They were drilled with a 4¼-inch I.D. hollow stem auger and sampled with a 1⅜-inch I.D. split spoon sampler using a 140-pound hammer falling 30 inches.

Schnabel personnel cored the concrete slab of the North Plaza in order to advance Boring JMI-05; the core was about 18-inches thick. During observation of the core hole, a void of about one inch was observed beneath the bottom of the North Plaza slab. The void is documented in Boring JMI-05, located in Appendix A.

The stratigraphy observed during our exploratory borings is generally consistent with historical information. Mica schist bedrock was encountered between EL -80 and -90 (NAVD 29), and fill soils were recorded to a minimum EL -2.5 (NAVD 29). Soft alluvial materials with alternating layers of fine-grained and granular soils underlie the fill. The alluvium contains organics. The boring logs completed for this study note ground water level readings measured during drilling. Ground water was generally encountered between EL +4 and -9.5.

Inclinometers

Inclinometer casing was installed by Connelly in Boring JMI-04 to a depth of 93.7 ft (EL -89.2), and in Boring JMI-05 to a depth of 103 ft (EL 95.5). Flush-mounted well caps, that are removed to obtain inclinometer readings, protect these inclinometers.

Vibrating Wire Piezometers

Three vibrating wire piezometers were installed in Boring JMI-04 and two were installed in JMI-05. The instrument was taped to a ¾-inch PVC pipe adjacent to the inclinometer casing, and grouted in the borehole. Table 1 below indicates the approximate location of each piezometer installed. The elevations of these instruments were selected to correspond with sampling of alluvial strata materials. Each instrument is connected to a datalogger, which records the signal from the piezometers every hour. Dataloggers are located inside the well caps of JMI-04 and JMI-05.

Table 1 – Piezometer Setup

Piezometer Label	Serial Number	Depth (ft)	Elevation (ft)
JMI-04A	08-15665	14	-9.5
JMI-04B	08-15666	34	-29.5
JMI-04C	08-15667	64	-59.5
JMI-05A	08-15668	79	-71.5
JMI-05B	08-15669	49	-41.5

Extensometers

One extensometer was installed to the west of the North Plaza in Boring JME-01. Figure 1 shows the location of JME-01 containing ten measurement rings and one datum magnet. The extensometers are anchored in the ground with a continuous access tube passing through their center. The benchmark datum magnet is anchored at the bottom of the access tube. The annular space between the casing and the borehole wall is filled with grout. A reed switch probe travels inside the casing. The reed switch probe is inserted to the bottom of the casing on the end of a graduated measurement tape, and hoisted until it passes each anchor. The probe will sound a buzzer at each anchor and the depth is measured by reading the graduated tape. Table 2 below lists the initial depth readings of the benchmark datum magnet and ten extensometers.

Table 2 – Initial Extensometer Readings
October 1, 2008 (NAVD 29)

Location	Depth (ft)
Datum	80.69 – 80.46
Extensometer A	75.94 – 75.72
Extensometer B	67.85 – 67.63
Extensometer C	59.76 – 59.53
Extensometer D	50.36 – 50.15
Extensometer E	43.72 – 43.54
Extensometer F	35.90 – 35.69
Extensometer G	27.83 – 27.61
Extensometer H	22.64 – 22.43
Extensometer I	12.00 – 11.77
Extensometer J	2.50 – 2.27

We have endeavored to prepare this report of the instrument installation identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this agreement, or any report, opinion, document, or other instrument of service.

We appreciate the opportunity to be of service for this project. Please contact either of the undersigned at (610) 696-6066 if clarification is needed for any aspect of this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

Lauren L. Fagerholm, EIT

Lauren L. Fagerholm, E.I.T.
Staff

Darrell Wilder, P.E.
Associate

LLF:DW:JEG:jlm

Appendix A: Subsurface Exploration Data
Appendix B: Photos

Distribution:

HNTB Federal Services Corporation (1)
Attn: Mr. Nathan James

National Park Service (2)
Attn: Mr. Patrick MacDonald
Attn: Mr. Doug Denk

APPENDIX A

Subsurface Exploration Data

Subsurface Exploration Procedures
General Notes for Subsurface Exploration Logs
Descriptive Criteria for Rock Core Logging
Identification of Soils
Boring Logs, JME-01, JMI-04, and JMI-05
Location Plan, Figure 1

SUBSURFACE EXPLORATION PROCEDURES

Boring Procedures

Drillers advanced the borings using hollow-stem augers. A plug device blocked off the center opening in the hollow-stem auger to prevent cuttings from entering the augers during drilling. At the designated depth, drillers removed the plug and performed the Standard Penetration Test. Water or drilling fluid was not introduced into the boring using this procedure, unless indicated on individual logs. The logs indicate water level data.

Standard Penetration Test Results

The numbers in the Sampling Data column of the boring logs represent Standard Penetration Test (SPT) results. Each number represents the blows needed to drive a two-inch O.D., 1⅜ inch I.D. split-spoon sampler six inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first six inch interval usually represents a seating interval. The total of the number of blows for the second and third six-inch intervals is the SPT "N value." When the blow count reaches 100 before the full driving distance, we determine the SPT N value based on extrapolation of the blows recorded. The SPT is conducted according to ASTM D1586.

Rock Coring

Rock was cored with NQ2 size core barrels. Recovery (REC) and Rock Quality Designation (RQD) are noted on the test boring logs, as applicable.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation may be expected between samples visually classified and samples classified in the laboratory.

Disintegrated rock is residual material with SPT N values between 60 blows per foot and refusal. Refusal is a penetration rate of 100 blows per two inches or less penetration.

Boring Locations and Elevations

Our personnel staked the borings by taping from known locations. Figure 1 shows the approximate exploratory locations. We scaled ground surface elevations at the exploratory locations from the Figure 58 Jefferson Memorial Monitoring Points by Greenhorne & O'Mara, Inc. dated December 28, 2007. Project planning should consider these locations and elevations no more accurate than the methods and plans used to obtain them.

SCHNABEL ENGINEERING
GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate blows required to drive a 2-inch O.D., 1⅜-inch I.D. sampling spoon 6 inches using a 140 pound hammer falling 30 inches. The Standard Penetration Test (SPT) N value is the number of blows required to drive the sampler 12 inches, after a 6 inch seating interval. The Standard Penetration Test is performed in general accordance with ASTM D1586.

2. Visual classification of soil is in accordance with terminology set forth in "Identification of Soil." The ASTM D2487 group symbols (e.g., CL) shown in the classification column are based on visual observations.

3. Estimated ground water levels indicated on the logs are only estimates from available data and may vary with precipitation, porosity of the soil, site topography, and other factors.

4. Refusal at the surface of rock, boulder, or other obstruction is defined as an SPT resistance of 100 blows for 2 inches or less of penetration.

5. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at the subsurface exploration location.

6. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, water level observations and penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

7. Key to symbols and abbreviations:

S-1, SPT - Sample No., Standard Penetration Test
5+10+1 - Number of blows in each 6-in increment

UD-1, UNDIST - Sample No., 2" or 3" Undisturbed Tube Sample
REC=24", 100% - Recovery in inches, Percent Recovery

C-1, CORE - Core No., Rock Core
Run = 5.0 ft - Run Length in feet
REC = 60" 100% - Recovery in inches, Percent Recovery
RQD = 60" 100% - RQD in inches, Percent RQD

MC - Moisture Content

PP - Pocket Penetrometer Reading (tsf)

FID - Flame Ionization Detector Reading (ppm)

PID - Photoionization Detector Reading (ppm)

GP - Geostick Penetration Reading (inches)

LL - Liquid Limit

PL - Plastic Limit

TPH - Total Petroleum Hydrocarbons

Descriptive Criteria for Rock Core Logging

Rock is defined as natural subsurface material yielding SPT blow counts of N ≥ 100/2 inches (Martin, 1977). Rock descriptions may include the following descriptive elements, as applicable, generally in the order indicated. Supplemental descriptors may also be used, depending on project performance objectives and available information.

ROCK TYPE, strength, weathering, fracturing, color, recovery, RQD

Rock Type General terms are used following the NRCS (2001) rock type classification chart based on visual identification. Some of the NRCS rock types common to our geographic area of practice are listed below. Mineralogical modifiers may be added where they help define distinct units (e.g., Garnet-Muscovite Schist).

Sedimentary:	Conglomerate, Sandstone, Mudstone, Siltstone, Claystone, Shale, Limestone, Dolomite, Coal, Chert
Igneous:	Pegmatite, Granite, Diorite, Gabbro, Diabase, Rhyolite, Monzonite, Andesite, Basalt
Metamorphic:	Gneiss, Schist, Phyllite, Slate, Quartzite, Marble, Amphibolite, Hornfels

Strength (modified from Hoek, 2001) The estimated Uniaxial Compressive Strength associated with each rock strength term is based on the field strength index test for intact rock samples as follows.

Extremely Strong	>36,000 psi	Specimen can only be chipped with a geological hammer.
Very Strong	15,000 - 36,000 psi	Specimen requires many blows of a geological hammer to fracture it.
Strong	7,500 - 15,000 psi	Specimen requires more than one blow of a geological hammer to fracture it.
Medium Strong	3,500 - 7,500 psi	Specimen cannot be peeled with a pocketknife, can be fractured with one blow from a geological hammer.
Weak	700 - 3,500 psi	Specimen can be peeled with a pocketknife with difficulty, shallow indentation made by firm blow with point of a geological hammer.
Very Weak	150 - 700 psi	Material crumbles under firm blows with point of a geological hammer, can be peeled with a pocket knife.

Weathering (modified from ACOE, 1994; and USBR, 2001)

Fresh	Mineral crystals appear bright and show no discoloration. Fractures show little or no staining on their surfaces. Discoloration does not extend into intact rock.
Slightly Weathered	Rock is generally fresh except along fractures. Some fractures are stained and discoloration may extend up to 0.5 inches into rock.
Moderately Weathered	Significant portions of rock appear dull and discolored. Rock may be significantly weaker than in its fresh state near fractures. Soil zones of limited extent may occur along some fractures.
Highly Weathered	Rock appears dull and discolored throughout. Majority of rock mass is significantly weaker than in its fresh state. Isolated zones of stronger rock and/or soil may occur throughout.
Severely Weathered	Significant portions of rock mass essentially weathered to soil. Rock fabric may still be discernable (i.e., saprolite). Isolated zones of stronger rock may occur locally. Quartz may be present as hard, fractured dikes or veins.

Fracturing (from ACOE, 1994)

Very Slightly Fractured	> 6.5 ft
Slightly Fractured	2 ft - 6.5 ft
Moderately Fractured	8 in - 2 ft
Highly Fractured	2.5 in - 8 in
Intensely Fractured	< 2.5 in

Color (from Munsell Color System; and GSA, 1995) Color descriptions include a primary color and up to two shade or secondary color modifiers, and may also include a color pattern term to define the relationship between multiple colors.

Shade:	Light, Dark
Secondary:	Blackish, Brownish, Grayish, Greenish, Reddish, Yellowish, Orangeish
Primary:	Black, Brown, Gray, Green, Red, Yellow, Orange, White
Pattern:	and, to, with mottles of, with speckles of, with streaks of, with bands of

Recovery is defined as the total length of recovered core in a core run divided by the total length of the core run, times 100 percent. A core run may be any depth interval of concern. Only natural fractures are considered for determining the length of core pieces. Mechanical breaks formed during or after coring do not count against the length determination. The length of recovered core pieces is measured along the core axis, between fracture midpoints.

RQD (ASTM D-6032, Deere & Deere, 1988, 1989) is defined as the total length of core pieces at least four inches long recovered from a core run divided by the total length of the core run, times 100 percent. A core run may be any depth interval of concern. Only natural fractures are considered for determining the length of core pieces. Mechanical breaks formed during or after coring do not count against the length determination. The length of recovered core pieces should be measured along the core axis, between fracture midpoints. Core pieces that are highly to severely weathered, very weak, or contain numerous pores should not count toward RQD.

Rev January 25, 2006

Schnabel

SCHNABEL ENGINEERING
IDENTIFICATION OF SOILS

I. DEFINITION OF SOIL GROUP NAMES (ASTM D-2487)

			SYMBOL	GROUP NAME
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾" to 3" Fine, No. 4 to ¾"	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	SM	SILTY SAND
			SC	CLAYEY SAND
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
		Organic	OH	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color and organic odor		PT	PEAT

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D-2487)

			Examples
Adjective Form	GRAVELLY SANDY	>30% to <50% coarse grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
"With"	WITH GRAVEL WITH SAND	>15% to <30% coarse grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS ..... Unified Soil Classification Symbols are shown above as group symbols. A dual symbol "-" indicates the soil belongs to two groups. A borderline symbol "/" indicates the soil belongs to two possible groups.

FILL ..... Man-made deposit containing soil, rock and often foreign matter.

PROBABLE FILL ..... Soils which contain no visually detected foreign matter but which are suspect with regard to origin.

DISINTEGRATED ROCK (DR) ..... Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2" or less penetration.

PARTIALLY WEATHERED ROCK (PWR) ..... Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2" or less penetration.

BOULDERS & COBBLES ..... Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inch size.

LENSES ..... 0 to ½ inch seam within a material in a test pit.

LAYERS ..... ½ to 12 inch seam within a material in a test pit.

POCKET ..... Discontinuous body within a material in a test pit.

MOISTURE CONDITIONS .... Wet, moist or dry to indicate visual appearance of specimen.

COLOR ..... Overall color, with modifiers such as light to dark or variation in coloration.

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JME-01
Contract Number: 06150078.F0
Sheet: 1 of 3

Contractor: Connelly and Associates, Inc.
Frederick, Maryland
Contractor Foreman: T. Connelly
Schnabel Representative: L. Fagerholm
Equipment: CME-550 (ATV)
Method: 4-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 9/18/08 **Finished:** 9/18/08
Location: See Location Plan

Ground Surface Elevation: 5± (ft) **Total Depth:** 89.6 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	9/18	10:00 AM	14.0'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Rootmat and topsoil		4.3					SAND FILL
	FILL, sampled as clayey sand with silt, fine to medium grained sand, moist, brown, contains fine to coarse gravel, contains roots	FILL		A1	5	SPT 2+6+6 REC=3.6", 20%		
						SPT 24+9+10 REC=3.6", 20%		
						SPT 18+22+16 REC=3.6", 20%		
						SPT 65+35/2" REC=5.4", 67%		
					10	SPT 3+3+8		Augers Scraping
14.0 ▽	LEAN CLAY WITH SILT, wet, dark gray, contains roots, contains mica, contains organics, probable ALLUVIAL material	CL	-9.5	B2	15	SPT 5+5+4		ALLUVIAL (CLAY OR SILT)
					20	SPT WOH/12"+3		
					25	SPT 3+3+3		
29.0	SANDY SILT, moist, dark gray, contains rock fragments, contains mica, probable ALLUVIAL material	ML	-24.5		30	SPT WOH/18"		

(continued)

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JME-01
Contract Number: 06150078.F0
Sheet: 2 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SANDY SILT, moist, dark gray, contains rock fragments, contains mica, probable ALLUVIAL material *(continued)*				35	SPT 5+3+2		ALLUVIAL (CLAY OR SILT) *(continued)*
	Changes to WITH SAND							
	Changes to CLAYEY SILT, slight organic odor	ML		B2	40	SPT WOH/12"+3		
					45	SPT 3+3+4		
49.0	CLAYEY SAND, fine to coarse grained sand, moist, dark gray, contains mica, probable ALLUVIAL material	SP	-44.5	B1	50	SPT 7+7+7		ALLUVIAL (SAND)
54.0	SILTY LEAN CLAY, moist, dark gray, estimated <5% sand, contains mica, probable ALLUVIAL material		-49.5		55	SPT 6+6+5		ALLUVIAL (CLAY OR SILT)
					60	SPT WOH+6+5		
	Changes to moist, gray and white, Contains seams of sand	CL		B2	65	SPT 5+5+7		
					70	SPT 4+8+9		
74.0	SILTY SAND, fine to medium grained sand, moist, gray, contains mica, probable ALLUVIAL material	SP	-69.5	B1	75	SPT WOH+6+12		ALLUVIAL (SAND)

(continued)

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JME-01
Contract Number: 06150078.F0
Sheet: 3 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SILTY SAND, fine to medium grained sand, moist, gray, contains mica, probable ALLUVIAL material *(continued)* Changes to CLAYEY	SP		B1	80	SPT 12+11+7		ALLUVIAL (SAND) *(continued)*
84.0			-79.5	D				RESIDUAL
85.1	DISINTEGRATED ROCK, sampled as dry, gray, contains mica	DR	-80.6		85	SPT 100/5"		Auger and Sampler Refusal
	SCHIST, weak to strong, moderately weathered, moderately fractured (8 in - 2 ft), green and black, coarse grained			E		SPT 100/2" CORE Run = 4.5 ft REC=54", 100% RQD=38.9", 72%		ROCK
89.6			-85.1					

Bottom of Boring at 89.6 ft.
Auger refusal at 85.1 ft.
10 Extensometers grouted in place.

TEST BORING LOG 06150078.F0.GPJ SCHNABEL DATA TEMPLATE 2008_04_01.GDT 10/3/08

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JMI-04
Contract Number: 06150078.F0
Sheet: 1 of 3

Contractor: Connelly and Associates, Inc.
Frederick, Maryland
Contractor Foreman: T. Connelly
Schnabel Representative: L. Fagerholm
Equipment: CME-550 (ATV)
Method: 4-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 9/16/08 **Finished:** 9/17/08
Location: See Location Plan

Ground Surface Elevation: 5± (ft) **Total Depth:** 93.7 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	9/16	9:30 AM	9.0'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Rootmat and topsoil		4.3					
	FILL, sampled as sandy silt, fine to coarse grained sand, moist, dark brown, contains rock and root fragments	FILL		A2		SPT 5+10+10 REC=3.6", 20%		FILL (CLAY OR SILT)
						SPT 3+5+2 REC=9", 50%		
4.0	Changes to orangish brown		0.5					
	FILL, sampled as clayey sand with silt, moist, dark gray				5	SPT 7+18+35 REC=7.2", 40%		
						SPT 4+5+3 REC=1.8", 10%		
	Changes to wet, contains rock fragments ▽	FILL		A1	10	SPT WOH/18" REC=16.2", 90%		
14.0	SANDY LEAN CLAY WITH SILT, moist, dark gray, light organic odor, probable ALLUVIAL material		-9.5		15	SPT 4+3+1		ALLUVIAL (CLAY OR SILT)
					20	SPT 1+2+1		
		CL		B2	25	SPT 2+2+4		
	Changes to contains rounded gravel				30	SPT 3+6+7		

(continued)

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JMI-04
Contract Number: 06150078.F0
Sheet: 2 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
34.0	SILT WITH SAND, moist, dark gray, contains mica, probable ALLUVIAL material	CL	-29.5		35	SPT WOH+1+1		ALLUVIAL (CLAY OR SILT) *(continued)*
	Changes to CLAYEY				40	SPT WOH/12"+2		
		ML			45	SPT 2+1+1		
	Changes to contains wood				50	SPT 1+3+2		
				B2				
54.0	SILTY LEAN CLAY, moist, dark gray, probable ALLUVIAL material, Contains sand seams		-49.5		55	SPT 2+6+6		
		CL			60	SPT 1+3+3		
					65	SPT 5+10+9		
69.0	SILTY SAND, fine to medium grained sand, moist, dark gray, contains mica, probable ALLUVIAL material		-64.5		70	SPT 4+9+8		ALLUVIAL (SAND)
		SP		B1				
	Changes to wet				75	SPT 12+40+27		

(continued)

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JMI-04
Contract Number: 06150078.F0
Sheet: 3 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
		SP		B1				ALLUVIAL (SAND) *(continued)*
79.0	DISINTEGRATED ROCK, sampled as wet, blackish gray white, contains mica	DR	-74.5	D	80	SPT 100/6"		RESIDUAL
					85	SPT 100/2"		Sampler Refusal
88.7	SCHIST, weak to strong, moderately weathered, moderately fractured (8 in - 2 ft), green and black, coarse grained		-84.2	E	90	SPT 100/2" CORE Run = 5.0 ft REC=57", 95% RQD=39.5", 66%		Auger and Sampler Refusal ROCK
93.7			-89.2					

Bottom of Boring at 93.7 ft.
Auger refusal at 88.7 ft.
Inclinometer and Piezometer grouted in place.
Zero reading of Piezometer #08-15665=8754.04; Piezometer #08-15666=8471.463; Piezometer #08-15667=8721.791
Piezometers are attached to a 3/4" PVC pipe at depths of 14 ft (EL -9.5), 34 ft (EL -29.5), and 64 ft (EL-59.5) respectively.

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JMI-05
Contract Number: 06150078.F0
Sheet: 1 of 3

Contractor: Connelly and Associates, Inc.
Frederick, Maryland
Contractor Foreman: T. Connelly
Schnabel Representative: L. Fagerholm
Equipment: CME-550 (ATV)
Method: 4-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 9/22/08 **Finished:** 9/23/08
Location: See Location Plan

Ground Surface Elevation: 8± (ft) **Total Depth:** 103.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	9/22	10:23 AM	4.0'	---	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	Concrete		6.4			SPT		
1.4								
1.5	VOID BELOW SLAB		6.3			SPT 1+2+4		Void space between concrete slab and fill.
	FILL, sampled as sandy silt, moist, brown, contains gravel, and rock fragments ▽	FILL			5	SPT 7+2+1		FILL (CLAY OR SILT)
	Changes to wet							
7.0	FILL, sampled as lean clay, moist, dark brown, estimated <5% sand, contains mica		0.8			SPT 1+1+3		Auger scraping
	Changes to WITH SAND, fine to medium grained sand, contains rock fragments			A2	10	SPT 1+WOH/12"		
		FILL						
	Changes to contains gravel				15	SPT 3+2+11		Possible RIP RAP layer, augers crunching
19.0	CLAYEY SAND, wet, dark brown, contains mica, contains rock fragments, probable ALLUVIAL material	SP	-11.2	B1	20	SPT 4+25+7		ALLUVIAL (SAND)
24.0	SANDY SILT, wet, brown, contains gravel, contains wood, probable ALLUVIAL material	ML	-16.2	B2	25	SPT 4+5+7		ALLUVIAL (CLAY OR SILT)
29.0	SILTY SAND, moist, dark brown, probable ALLUVIAL material	SP	-21.2	B1	30	SPT 2+3+3		ALLUVIAL (SAND)

(continued)

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JMI-05
Contract Number: 06150078.F0
Sheet: 2 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
		SP		B1				
34.0	SANDY LEAN CLAY, moist, dark brown, contains mica, contains rock fragments, probable ALLUVIAL material	CL	-26.2	B2	35	SPT WOH+3+3		ALLUVIAL (CLAY OR SILT)
39.0	SILT WITH SAND, moist, dark brown, contains organics, contains mica, probable ALLUVIAL material	ML	-31.2	B1	40	SPT WOH+2+2		
	Changes to CLAYEY				45	SPT WOH/12"+1		
49.0	LEAN CLAY, moist, dark brown, contains mica, probable ALLUVIAL material	CL	-41.2	B2	50	SPT WOH/18"		
					55	SPT WOH/18"		
	Changes to Contains fine sand seams				60	SPT WOH/12"+3		
					65	SPT WOH/12"+4		
	Changes to Contains fine sand seams				70	SPT WOH+4+5		
74.0	SILTY SAND, moist, dark brown, contains mica, probable ALLUVIAL material	SP	-66.2	B1	75	SPT 11+13+15		ALLUVIAL (SAND)

(continued)

Schnabel Engineering

TEST BORING LOG

Project: Jefferson Memorial Installation-Subsurface (2008)
West Potomac Park
Washington, Washington, D.C.

Boring Number: JMI-05
Contract Number: 06150078.F0
Sheet: 3 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
		SP		B1				ALLUVIAL (SAND) *(continued)*
79.0	SANDY LEAN CLAY, moist, dark brown, contains mica, contains rock fragments, probable ALLUVIAL material		-71.2		80	SPT 2+1+2		ALLUVIAL (CLAY OR SILT)
		CL		B2	85	SPT 4+4+4		
89.0	DISINTEGRATED ROCK, sampled as dry, gray		-81.2		90	SPT 100/3"		RESIDUAL
		DR		D	95	SPT 100/5"		
97.0	SCHIST, weak to strong, moderately weathered, moderately fractured (8 in - 2 ft), green and black, coarse grained		-89.2					Auger and Sampler Refusal
				E	100	SPT 100/1.5" CORE Run = 6.0 ft REC=67.5", 94% RQD=60", 83%		ROCK
103.0			-95.2					

Bottom of Boring at 103.0 ft.
Auger refusal at 97.0 ft.
Inclinometer and Piezometers grouted in place.
Zero reading of Piezometer #08-15668=8830.639 and Piezometer #08-15669=8740.244
Piezometers are attached to a 3/4" PVC pipe at depths of 79 ft (EL -71.5) and 49 ft (EL -41.5) respectively.

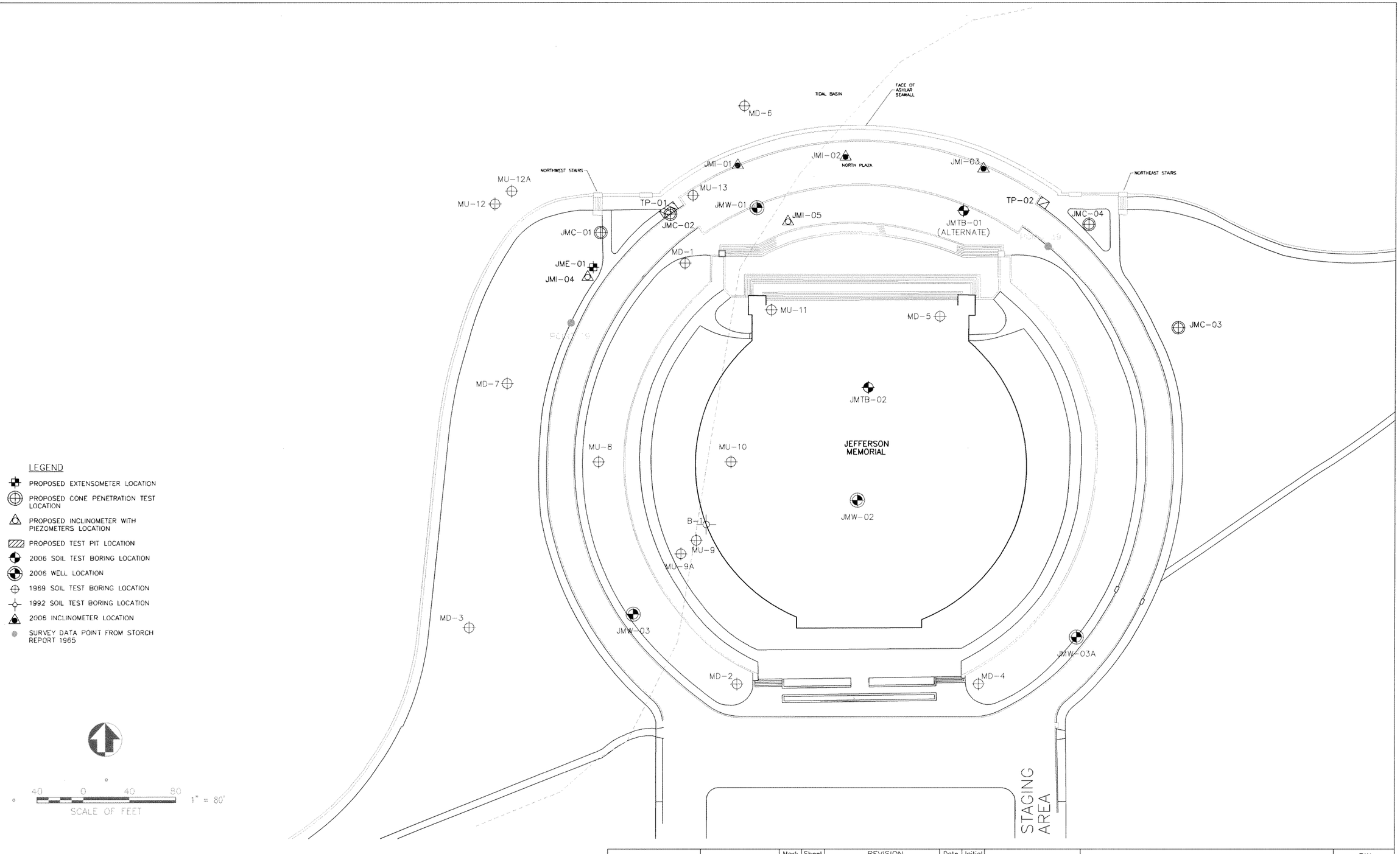


FIGURE 1 – LOCATION PLAN

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM

HNTB ARCHITECTURE

SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

SHEET

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED: DW
DRAWN: LLF
CHECKED: JG
CONTRACT NO: C20000408000
DATE: 9/24/08
DWG. NO.: 1

APPENDIX B

Photos

Photos 1 through 6: Instrumentation Installation Pictures

PHOTO 1: JMI-05 18-inch core

PHOTO 2: One-inch gap below plaza slab

Schnabel Engineering	Jefferson Memorial North Plaza Instrumentation Installation	Project Number 06150078.F

PHOTO 3: Connelly drill rig set up

PHOTO 4: Dataloggers for JMI-04

PHOTO 5: Installation of inclinometer casing

PHOTO 6: Extensometer measurement rings with pull cable, before installation

JEFFERSON MEMORIAL
NATIONAL MALL & MEMORIAL PARKS
WASHINGTON, DC

CONTRACT # 1443C2000040800
REPAIR AND CONTROL SETTLEMENT AT JEFFERSON MEMORIAL SEAWALL, NORTH PLAZA, AND TRANSITION AREAS
PMIS NO. 128232

REPAIR AND CONTROL SETTLEMENT MEMO – QUARTERLY MONITORING OF INSTRUMENTATION AND SURVEY POINTS

Prepared by Schnabel Engineering

NATIONAL PARK SERVICE
DENVER SERVICE CENTER
November 11, 2008

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

Memo

To: **Patrick MacDonald, Doug Denk (National Park Service)**
cc: **Roark Redwood (HNTB Federal Services Corporation)**

From: **Helen Robinson, P.E.**
Darrell Wilder, P.E.

Date: **November 11, 2008**

Subject: **06150078.B0, Jefferson Memorial**
Repair and Control Settlement
Quarterly Monitoring of Instrumentation and Survey Points

This memo presents updated instrumentation and survey data for the Jefferson Memorial project. It includes data collected during September 2008 from inclinometers, tiltmeters, piezometers, ground water monitoring wells, and elevation surveys. Please refer to the "Investigation of Settlement and Upheaval at the Jefferson Memorial" report by HNTB 2008 for further information about the instruments and past data collected.

Survey Monitoring Data

On September 8 and 9, 2008, Greenhorne & O'Mara performed survey monitoring consisting of a level loop from HV83001 to the Jefferson Memorial, and through several benchmarks as established during the "Investigation of Settlement and Upheaval" project. The level loop consists of 11 benchmarks, and is shown in a plan view in Appendix A. When the readings were taken, a positive change in elevation was measured in 10 of the 11 benchmarks compared to the level loop from June 2008. The trend showed an average increase in elevation of 0.125 inches. According to the surveyor, the Trimble DiNi Electronic Level System survey equipment provides an accuracy of 0.01 ft (0.12 inches) for this loop of points; therefore, the positive elevation change is within the accuracy of the equipment. Prior to this set of readings, the quarterly benchmark readings had slightly decreased in elevation with each reading. Greenhorne & O'Mara completed two additional Level Loops on September 30 and October 3, 2008, to verify the trend. The readings are consistent with those taken on September 8 and 9, 2008. Using the level run from September 8 and 9, 22 points on the North Plaza and Ashlar Seawall were surveyed.

Appendix A contains a plan with survey point locations, and graphs and tables with the updated survey readings. Based on the apparent present trend of the benchmarks, the survey points on the North Plaza and Ashlar Seawall show a positive change in elevation. However, this may be a result of seasonal variation or the accuracy of the instrument. We recommend continuing to perform the quarterly monitoring and data reduction following the same procedures used thus far, and to assess the magnitude of seasonal variation, if any. If this trend continues, it will be necessary to develop an action plan, which may include discarding some of the benchmarks as reference points or using alternate reference points.

Inclinometer Data

The readings obtained from December 2006 to September 2008 show movement in the northwest direction. Plots are included in Appendix B. Inclinometer JMI-01 shows a total of about 0.87 inches of cumulative movement 44 degrees west of north. Inclinometer JMI-02 shows a total of about 0.49 inches of cumulative movement 55.5 degrees west of north. Inclinometer JMI-03 shows a total of about 0.17 inches of cumulative movement 8.8 degrees west of north. The data shows that lateral movement occurs to a depth of about 60 ft

(EL -53.3) in JMI-01 and JMI-02. These data indicate the ground under the Memorial had undergone significant lateral displacement at an average rate of about 0.22 inches per year between November 2006 and July 2008, within the top 10 ft of the surface of the North Plaza. During the past 3 months, about 0.02 inch of movement was measured.

Tiltmeter Data

Tiltmeter 1 is located at approximately Station 3+30 of the Ashlar Seawall. From June 6 to September 15, 2007, data from Tiltmeter 1 suggest a rate of tilt of 0.0033 degrees/month as shown in Appendix C. After September 15, 2007, the tiltmeter data showed fluctuating readings. During a site visit on January 15, 2008, Schnabel Engineering (Schnabel) personnel noted that the protective case enclosing Tiltmeter 1 had become separated from the seawall where it had been anchored. Schnabel personnel re-anchored the protective case on February 11, 2008. However, the data still appears to be fluctuating following that adjustment. From May 15 to June 17, 2008, the readings appear to have stabilized. On June 25, 2008, Schnabel personnel visited the site to further secure the tiltmeter boxes and instruments. Most recently, readings were collected on September 16, 2008, which indicated a relatively steady tilt averaging -0.0041 degrees/month over a period of 3 months.

Tiltmeter 2 is located at approximately Station 2+75 of the Ashlar Seawall. From May 23, 2007, to January 15, 2008, Tiltmeter 2 obtained the data shown in Appendix C. The average rate of tilt measured was about 0.008 degrees/month from May 23 to September 3, 2007. Following a sudden decrease of the instrument readings from September 3 and 4, 2007, the average rate of tilt was 0.022 degrees/month from September 4, 2007, to February 14, 2008. From February 15 to May 12, 2008, the average rate of tilt was 0.009 degrees/month. Following this date, the data appears to fluctuate. On June 25, 2008, Schnabel personnel visited the site to further secure the tiltmeter boxes and instruments. The average rate of tilt between July 25 and September 16, 2008, was roughly 0.0096 degrees/month.

Ground Water Monitoring Data

The boring logs completed for this study note ground water level readings measured during drilling and after completion of the borings. Ground water monitoring wells were installed in Borings JMW-01, JMW-02, and JMW-03A. Water level elevation readings for the wells are shown below. An average ground water elevation is also listed for each monitoring well.

Ground Water Monitoring Well Readings Between November 2006 and September 2008 (NAVD 29)

Water Elevation (ft)			
Date	**JMW-01**	**JMW-02**	**JMW-03A**
11/21/2006	1.30	3.39	4.66
12/19/2006	1.27	3.90	3.72
1/5/2007	1.75	-	3.71
2/28/2007	1.76	3.75	3.52
5/7/2007	1.15	3.36	3.80
6/26/2007	-0.24	3.92	2.90
1/15/2008	1.75	3.50	5.19
3/11/2008	1.65	3.38	3.75
6/17/2008	2.99	3.18	4.16
9/16/2008	2.66	3.95	3.76
Average Elevation	**1.49**	**3.55**	**3.93**

The data in the table suggest a ground water gradient of approximately 0.5 percent toward the Tidal Basin. The average water elevation in the Tidal Basin during this period was approximately EL 1.2 according to the data from the National Oceanic and Atmospheric Administration (NOAA) for Station #8594900 located approximately one mile downstream on the Washington Channel. Based on this, the ground water elevation is relatively consistent with the Tidal Basin water elevation.

Piezometer Data

Piezometer JMI-01 is at a depth of 54 ft from the top of the North Plaza (EL -47.5), and JMI-03 is located at a depth of 39 ft from the top of the North Plaza (EL -32.2). Appendix D shows the pore pressure data collected by each piezometer. The plot shows a progressive drop in the pore pressure of about 0.8 psi in piezometer JMI-01, and about 0.6 psi in JMI-03 from November 2006 until June 2008 (1.6 years). This apparent drop in pore water pressure corresponds to a drop in piezometric head of about 1.8 and 1.4 ft, respectively. From November 2006 to mid February 2007, the piezometers show a downward trend in pore water pressure. Between February and October 2007, the piezometric readings seem relatively constant. From about November 2007 to about February 2008, the piezometers show a downward trend in pore water pressure. Between February 2008 and the most current readings, the piezometric readings seem relatively consistent.

It is important to note that the measured pore pressures are lower than the theoretical pore pressures corresponding to a hydrostatic condition. At JMI-01, the piezometric head at EL -47.5 is about 2.8 ft less than hydrostatic. At JMI-03, the piezometric head at EL -32.2 is about 0.6 ft lower than hydrostatic. The hydrostatic head was estimated based on the average tidal pool elevation.

Please review the data that we have presented and let us know if you have any questions or comments about the information provided here.

Appendix A: Survey Monitoring Data
Appendix B: Inclinometer Data
Appendix C: Tiltmeter Data
Appendix D: Piezometer Data

Distribution:

National Park Service (2)
Attn: Mr. Patrick MacDonald
Attn: Mr. Doug Denk

HNTB Federal Services Corporation (1)
Attn: Mr. Roark Redwood

APPENDIX A

Survey Monitoring Data

Jefferson Memorial Plaza Monitoring

		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08	09/08/08		
DESCRIP.	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	DIFFERENCE FROM 11/06 to 9/08 (inches)	Rate of Movement (in/year)
Section I	1	38.124								
	2	32.308	32.318	32.304						
	3	30.476	30.481	30.471						
	4	26.466	26.468	26.460						
	5	22.056	22.063	22.058						
	6	11.395		11.365						
Section II	7	38.356	38.371	38.353						
	8	32.309	32.317	32.306						
	9	30.460	30.464	30.454						
	10	26.459	26.460							
	11	22.093	22.094							
	12	11.819								
Section III	15	6.404	6.383	6.403						
	16	6.456	6.433	6.439						
	17	6.540	6.549	6.573						
	18	6.601	6.610	6.628	6.619	6.610	6.610	6.630	0.348	0.189
	19	6.517	6.508	6.526	6.509	6.498	6.490	6.510	-0.084	-0.046
	20	7.008	6.988	7.009						
	21	7.120	7.118	7.143						
	22	7.561	7.560	7.579						
	23	7.492	7.488	7.510						
Section IV	24	6.455	6.432	6.439	6.426	6.416	6.405	6.427	-0.336	-0.183
	25	6.458	6.443	6.453						
	26	6.515	6.518	6.541	6.540	6.532	6.521	6.545	0.360	0.196
	27	7.309	7.303	7.325						
	28	7.788	7.799	7.805						
	29	11.570	11.591	11.592						
	30	12.513	12.519	12.512						
	31	21.605	21.629	21.614						
	32	22.823	22.849	22.836						
	33	30.468	30.496	30.481						

Jefferson Memorial Plaza Monitoring

		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08	09/08/08		
DESCRIP.	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	DIFFERENCE FROM 11/06 to 9/08 (inches)	Rate of Movement (in/year)
Section V	34	7.768	7.773							
	35	7.209	7.193							
	36	6.457	6.449	6.470	6.464	6.460	6.451	6.472	0.180	0.098
	37	6.467	6.443	6.453						
	38	6.448	6.423	6.433	6.426	6.417	6.404	6.427	-0.252	-0.137
Section VI	39	6.407	6.383	6.392	6.381	6.373	6.363	6.383	-0.288	-0.156
	40	6.428	6.404	6.414						
	41	6.506	6.495	6.520	6.517	6.508	6.499	6.522	0.192	0.104
	42	7.229	7.217	7.242						
	43	7.796	7.793	7.804						
	44	11.576	11.582	11.589						
	45	12.528	12.539	12.534						
	46	21.630	21.649	21.633						
	47	22.821	22.839	22.824						
	48	30.464	30.483	30.468						
Section VII	49	7.816	7.813							
	50	7.221	7.216							
	51	6.500	6.495	6.514	6.514	6.504	6.492	6.517	0.204	0.111
	52	6.353	6.331	6.333						
	53	6.309	6.288	6.294	6.280	6.271	6.259	6.278	-0.372	-0.202
Section VIII	54	6.073	6.041	6.043	6.029	6.016	6.004	6.022	-0.612	-0.332
	55	6.131	6.093	6.094						
	56	6.376	6.373	6.389	6.388	6.379	6.368	6.391	0.180	0.098
	57	7.151	7.151	7.160						
	58	7.771	7.778	7.781						
	59	11.576	11.582	11.590	11.587	11.577	11.568	11.589	0.156	0.085
	60	12.526	12.529	12.530						
	61	21.638	21.653	21.638	21.645	21.633	21.623	21.640	0.024	0.013
	62	22.886	22.899	22.886						
	63	30.451	30.470	30.458						

Jefferson Memorial Plaza Monitoring

		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08	09/08/08		
DESCRIP.	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	DIFFERENCE FROM 11/06 to 9/08 (inches)	Rate of Movement (in/year)
Section IX	72	7.826	7.824							
	73	7.082	7.074							
	74	6.347	6.344	6.352	6.352	6.344	6.331	6.354	0.084	0.046
	75	6.001	5.953	5.950						
	76	5.955	5.906	5.906	5.885	5.871	5.858	5.871	-1.008	-0.547
Section X	79	5.760	5.703	5.702	5.677	5.660	5.642	5.655	-1.260	-0.684
	80	5.836	5.783	5.785						
	81	6.181	6.183	6.190	6.189	6.180	6.168	6.192	0.132	0.072
	82	7.005	7.001	7.010						
	83	7.809	7.814	7.812						
	84	11.571	11.588	11.593						
	85	12.528	12.530	12.525						
	86	21.632	21.640	21.625						
	87	30.479	30.496	30.479						
	112			22.892						
Section XI	88	7.814	7.819							
	89	7.018	7.019							
	90	6.174	6.175	6.185	6.182	6.171	6.161	6.184	0.120	0.065
	91	5.821	5.762	5.760						
	92	5.842	5.782	5.780						
	93	5.743	5.683	5.678	5.658	5.638	5.603	5.617	-1.512	-0.821
	94	5.753	5.688	5.685						

Jefferson Memorial Plaza Monitoring

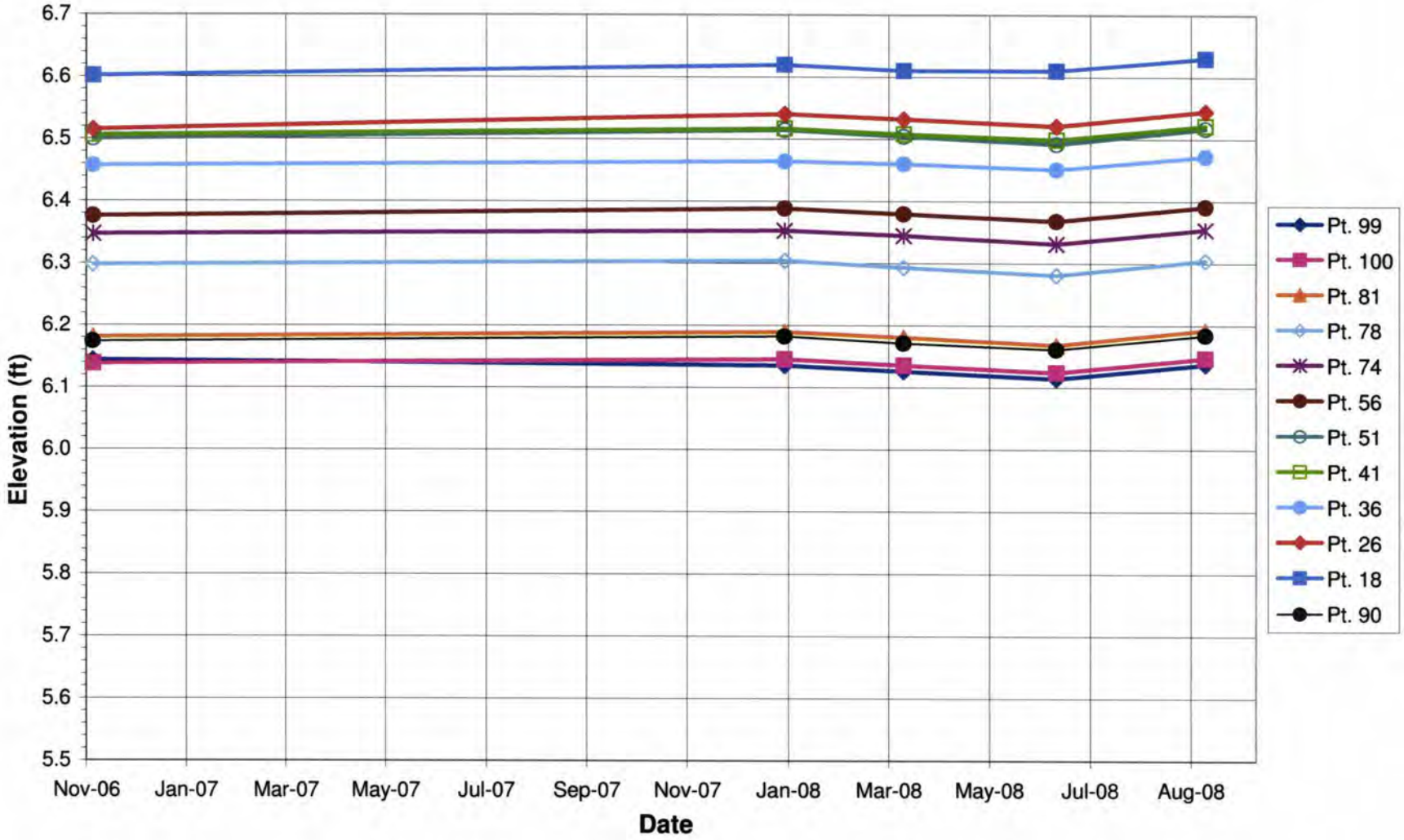
		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08	09/08/08		
DESCRIP.	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	DIFFERENCE FROM 11/06 to 9/08 (inches)	Rate of Movement (in/year)
Section XII	95	5.673	5.603	5.600	5.573	5.554	5.533	5.545	-1.536	-0.834
	96	5.680	5.611	5.608						
	97	5.735	5.670	5.668						
	98	5.779	5.713	5.710						
	99	6.144	6.138	6.147	6.135	6.126	6.114	6.137	-0.084	-0.046
	100	6.138	6.133	6.138	6.145	6.135	6.124	6.147	0.108	0.059
	101		7.024	7.035						
	102	7.821	7.824	7.829						
	103	11.602	11.616	11.620						
	104	12.538	12.540	12.538						
	105	21.660	21.671	21.659						
	106	22.904	22.917	22.905						
	107	30.475	30.496	30.479						
Section XIII	134	38.333	38.367	38.344						
	135	32.296	32.323	32.304						
	136	30.479	30.498	30.479						
	137	26.456	26.481							
	138		22.113							
	139		11.884							

Jefferson Memorial Plaza Monitoring

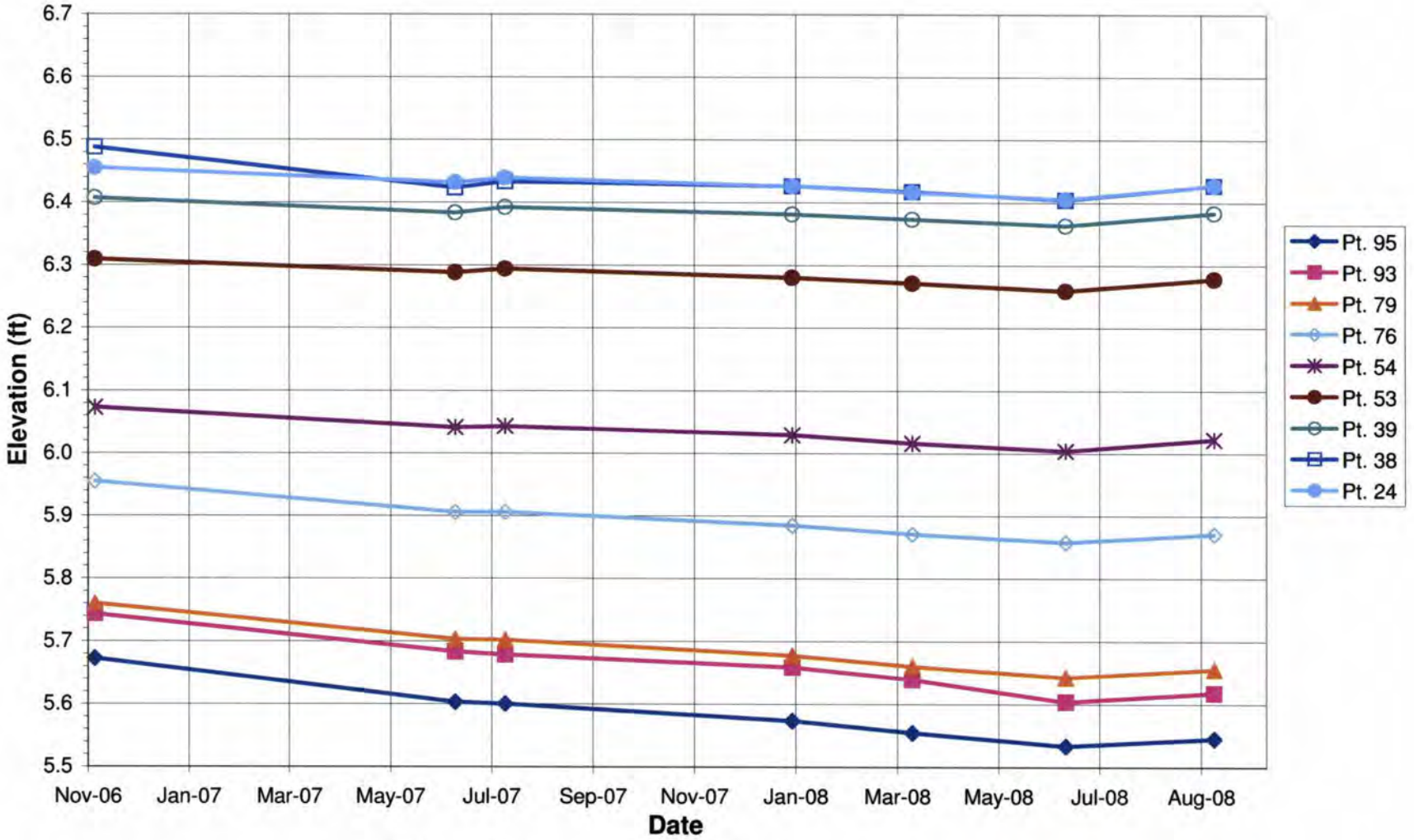
		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08	09/08/08		
DESCRIP.	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	DIFFERENCE FROM 11/06 to 9/08 (inches)	Rate of Movement (in/year)
Ground Shots	13	4.413	4.396							
	14	9.448	9.426							
	64	22.073	22.090							
	65	22.086	22.102							
	66	22.173	22.100							
	67	22.176	22.105							
	68	22.044	22.066							
	69		22.087							
	70	22.000	22.020							
	71	21.997	22.020							
	77	5.920	5.868	5.868						
	78	6.298	6.295	6.302	6.304	6.293	6.281	6.305	0.084	0.046
	108	12.442	12.450							
	109	7.807	7.812							
	110	11.783	11.785							
	111	11.535	11.510							
	112		22.907	22.892						
	113	7.108	7.089							
	114	6.798								
	115	6.694								

Jefferson Memorial Plaza Monitoring

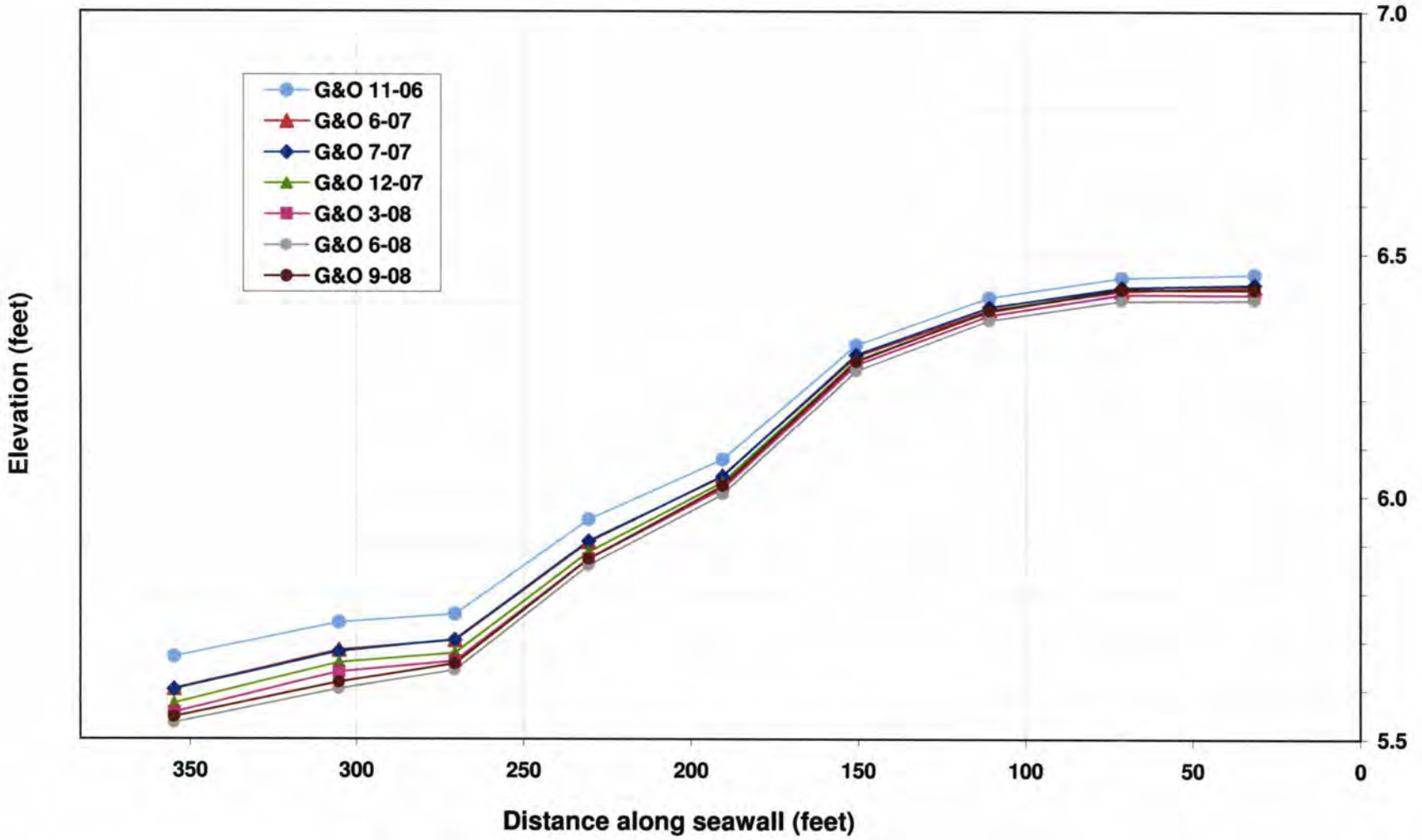
		11/06/06	06/12/07	07/11/07	12/28/07	03/11/08	06/11/08	09/08/08		
DESCRIP.	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	QUARTERLY READING ELEV. AFTER VERIF. LOOP	DIFFERENCE FROM 11/06 to 9/08 (inches)	Rate of Movement (in/year)
Ground Shots	116	6.842	6.842							
	117	6.301	6.294							
	118	5.951								
	119	5.990	5.994	6.001						
	120	5.892								
	121	5.697	5.647	5.650						
	122	5.992	5.999	6.000						
	123	5.689	5.637	5.631						
	124	8.462	8.429							
	125	5.370	5.375	5.370						
	126	5.400								
	127	5.637								
	128	4.998	4.959							
	129		5.119	5.112						
	130	11.788	11.801							
	131	11.685	11.679							
	132	11.657	11.633							
	133	11.953	11.963							
	140		22.085							
	141	22.099	22.095							
	142	22.079	22.079							
	143	22.079	22.075							
	150		6.559			6.488	6.478	6.499		
	151		1.897			1.862	1.837	1.845		
	152		3.999				3.936	3.950		



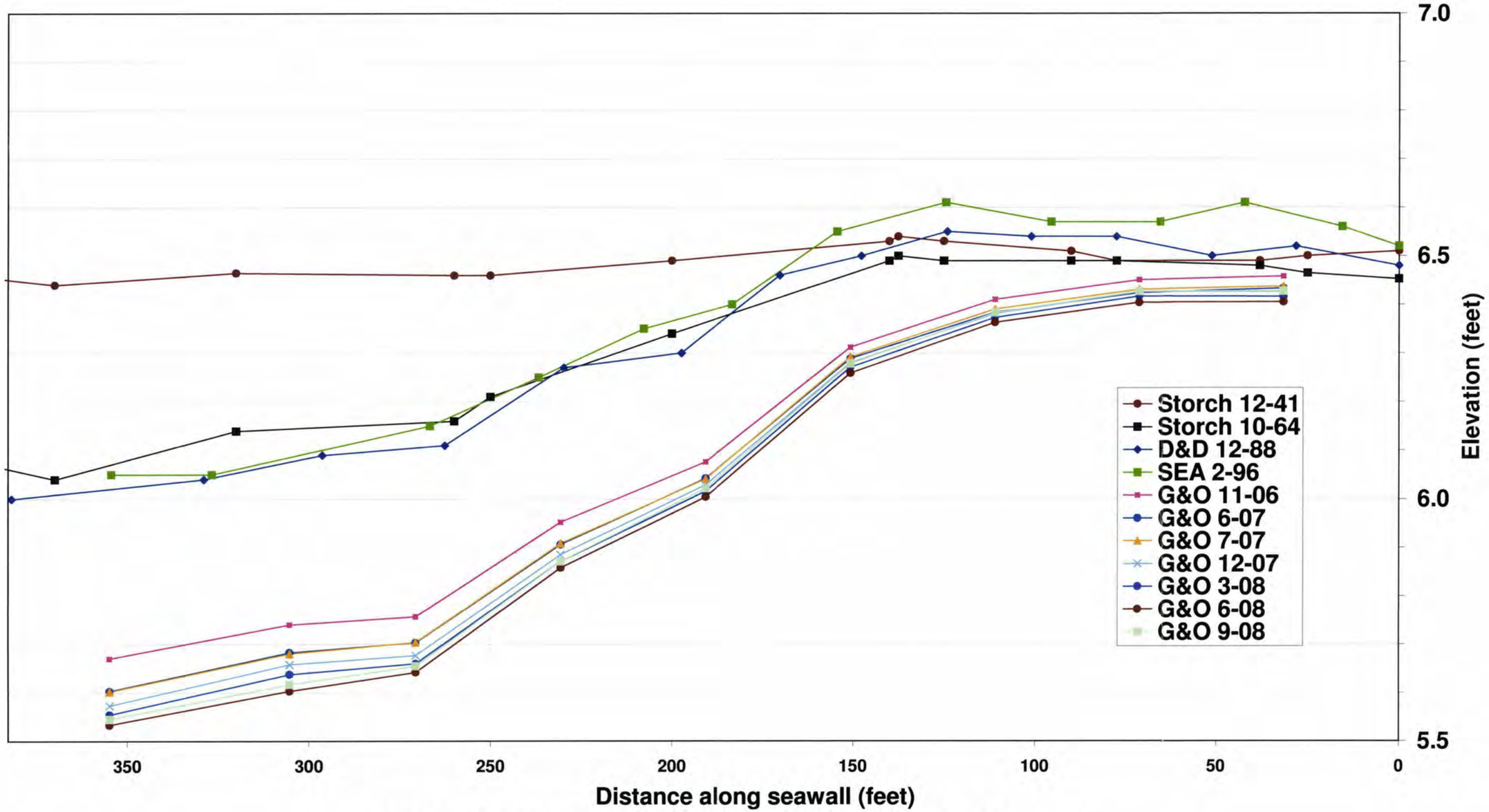
Plot of Selected Points Along the North Plaza



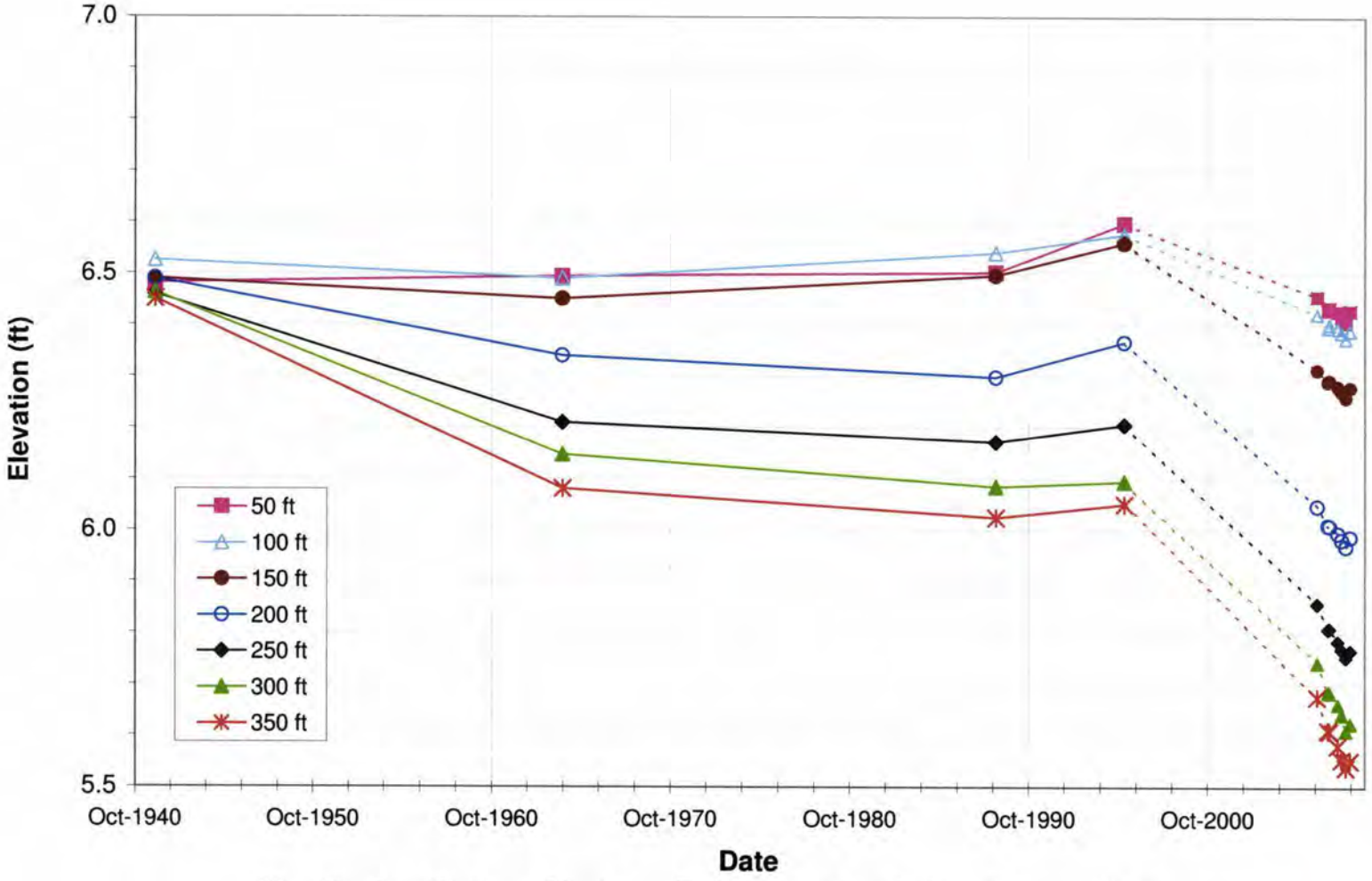
Plot of Selected Points Along the Ashlar Seawall



Nov 2006- Sept 2008 Survey Along Capstone of Ashlar Seawall



Historical Surveys Along Capstone of Ashlar Seawall



Monitoring Data at Various Points on the Ashlar Seawall Capstone

N
W E
S

60 30 0 60 120
SCALE: 1"=60'

TIDAL BASIN

JMI-01
JMI-02
JMI-03
STA 703
STA 702
JMW-01
JMTB-01
JMTB-02
JMW-02
JMW-03
JMW-03A
STA 704
STA 701
STA 700
JEFFERSON MEMORIAL
SECTION I
SECTION II
SECTION III
SECTION IV
SECTION V
SECTION VI
SECTION VII
SECTION VIII
SECTION IX
SECTION X
SECTION XI
SECTION XII
SECTION XIII

LEGEND:
BORING
33 SURFACE SHOT
SECTION

CHECKED BY: _____ JOB # 094108

GREENHORNE & O'MARA, INC.
6110 FROST PLACE
LAUREL, MARYLAND 20707
(301) 982-2800

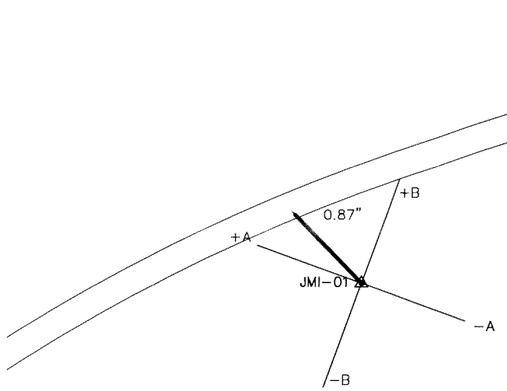
JEFFERSON MEMORIAL MONITORING REPORT SHEET 5A

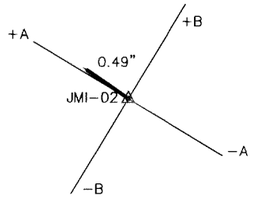
APPENDIX B

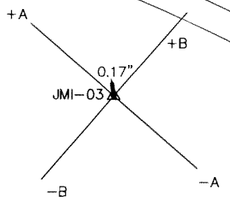
Inclinometer Data

TIDAL BASIN

ASHLAR SEAWALL



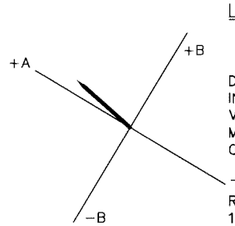




MAIN STAIRS

INCLINOMETER AXIS ORIENTATION

LEGEND



DENOTES ORIENTATION OF INCLINOMETER AXES AND VECTOR OF LATERAL MOVEMENT WITHIN 10 FT. OF THE GROUND SURFACE

READINGS SHOWN FROM 11/06 TO 9/08

10 0 10 20
SCALE OF FEET

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

TITLE OF DRAWING

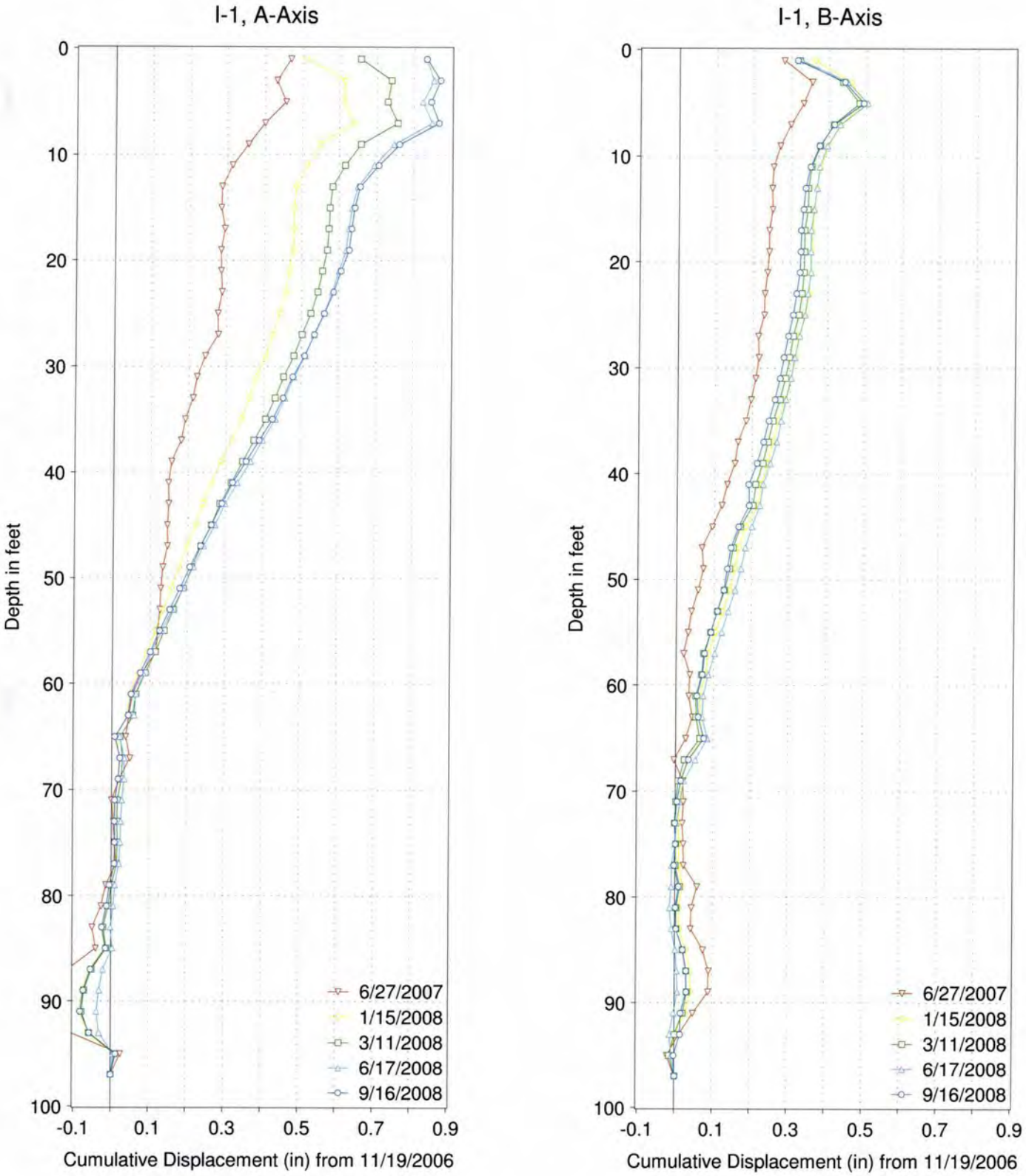
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

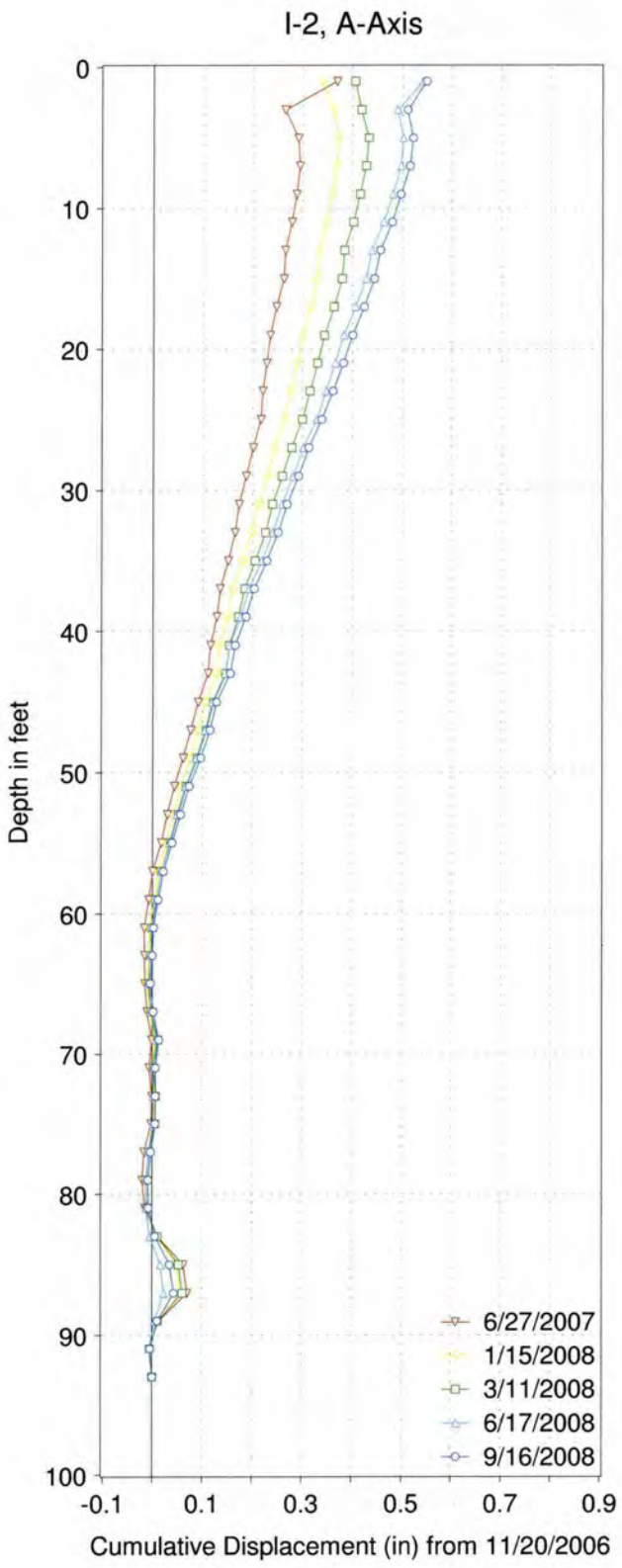
DESIGNED	HR
DRAWN	JM
CHECKED	JG
PMIS/PMS NO.	128232
DATE	9/19/08
DWG. NO.	808/80284

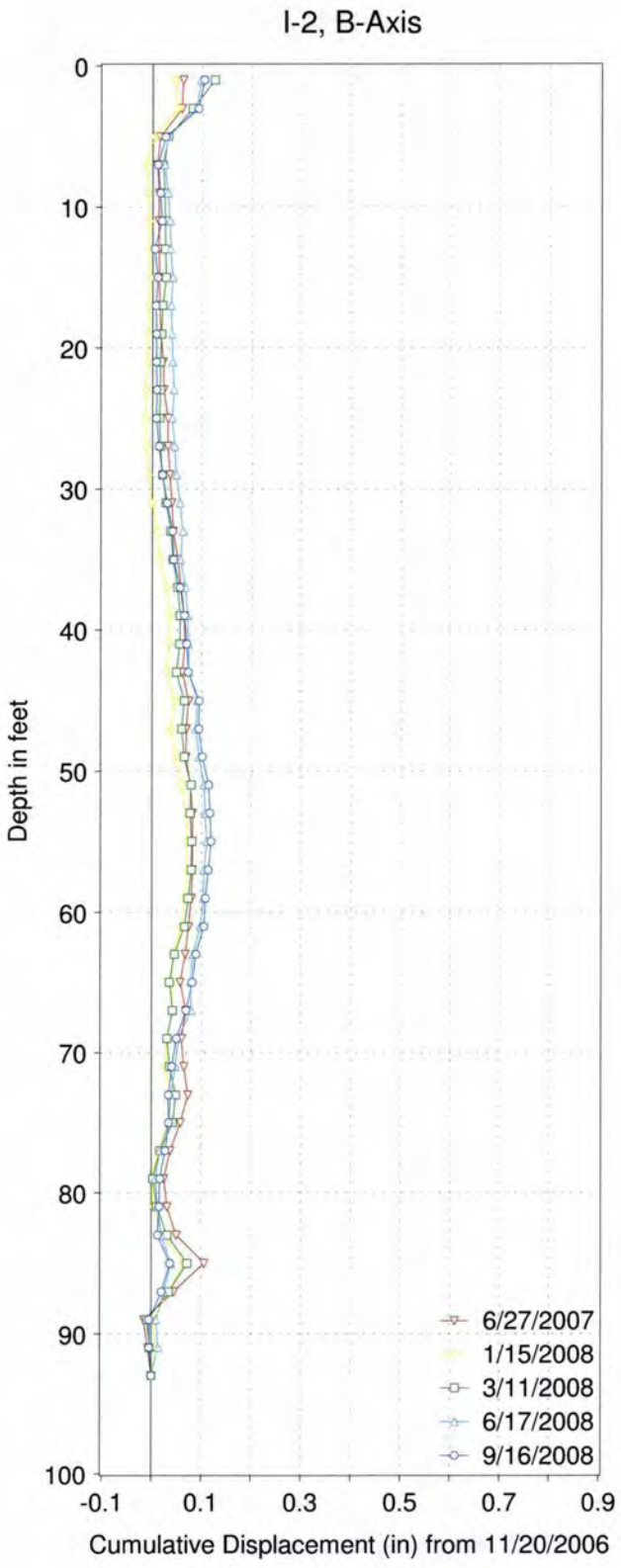
9/19/08 15:30 NFAHEY R17 G:\2006\0805\06150078.B JEFFERSON MEMORIAL PREDESIGN & SCHEMATIC DESIGN\DATA\INSTRUMENTATION\INCLINOMETERS\51INCLINOMETER_AXES_9-18-08.DWG



06150078 Jefferson Memorial
Baseline @ 11/19/06
Orientation Adjusted to Match I-2
Figure 44

Schnabel Engineering

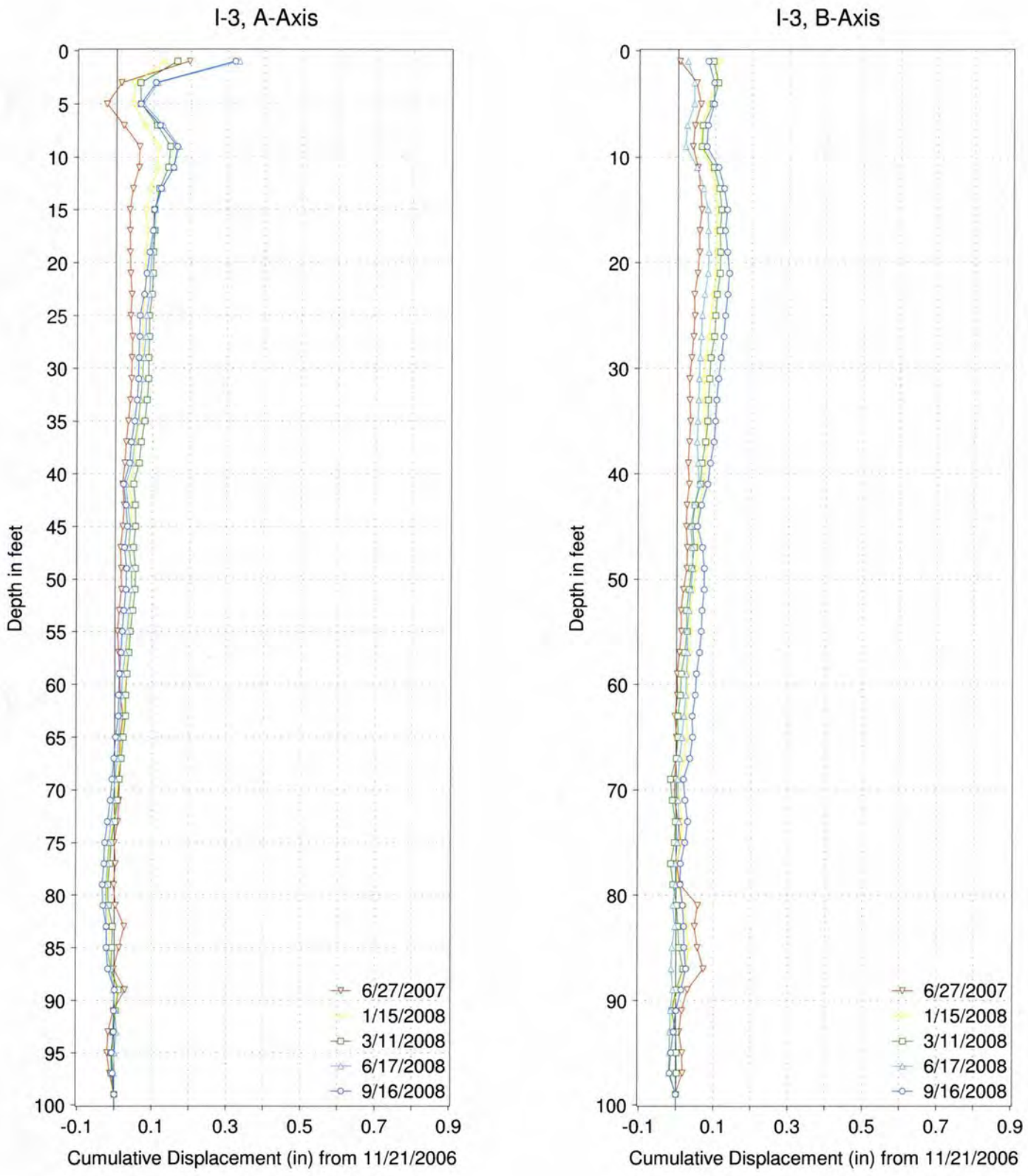




06150078 Jefferson Memorial
Baseline @ 11/20/06

Figure 45

Schnabel Engineering

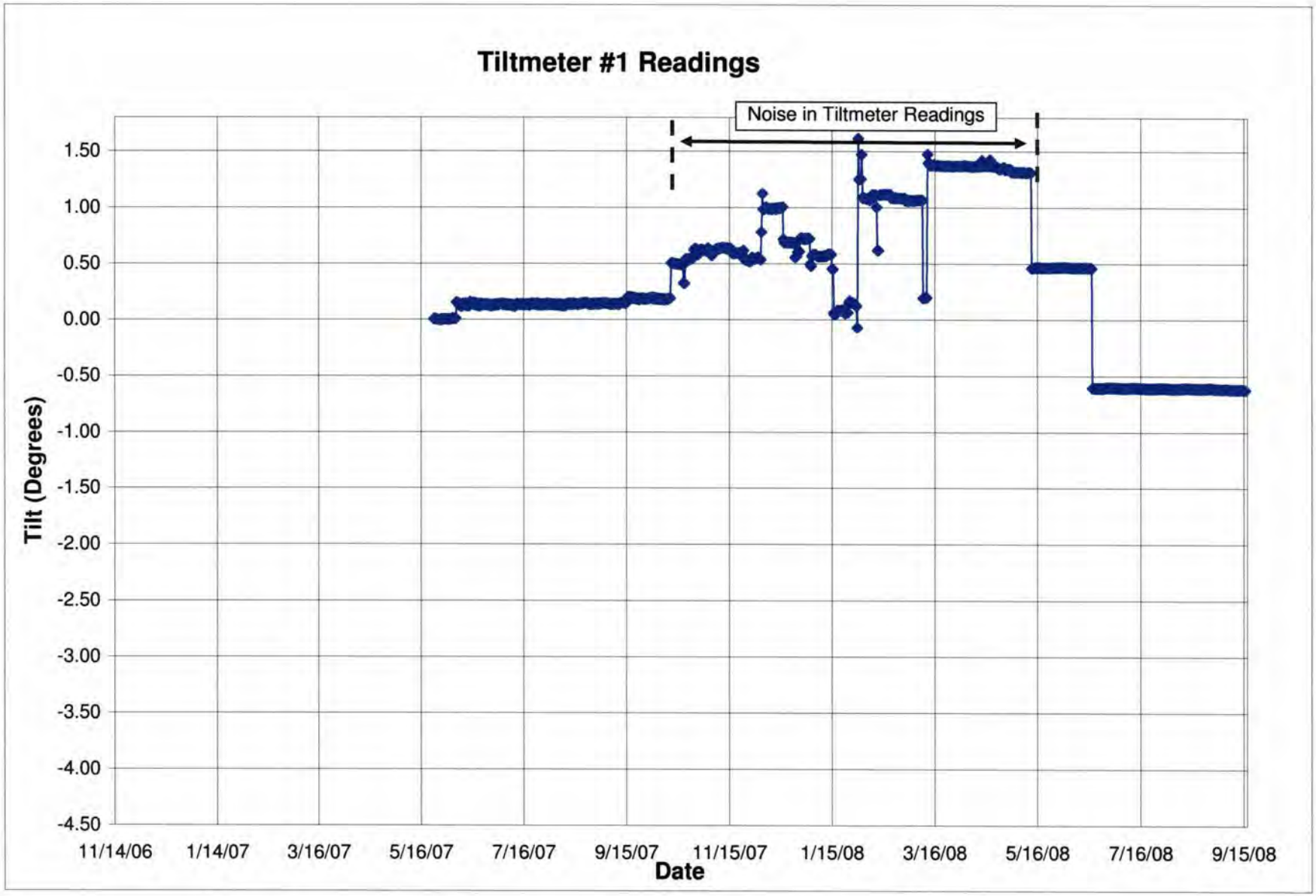


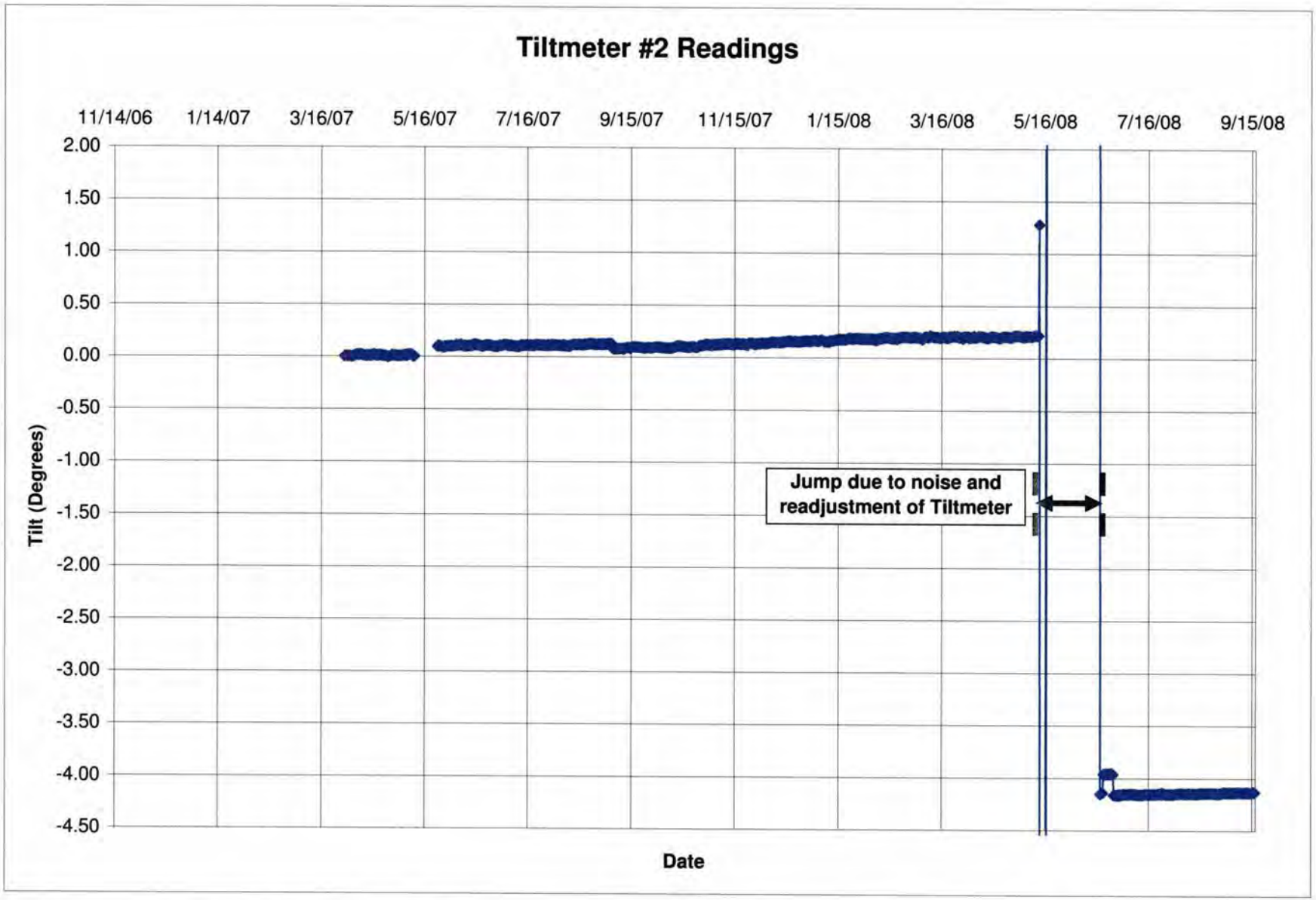
06150078 Jefferson Memorial
Baseline @ 11/21/06
Orientation Adjusted to Match I-2
Figure 46

Schnabel Engineering

APPENDIX C

Tiltmeter Data


Tiltmeter #1 Readings
Noise in Tiltmeter Readings
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
Tilt (Degrees)
11/14/06
1/14/07
3/16/07
5/16/07
7/16/07
9/15/07
11/15/07
1/15/08
3/16/08
5/16/08
7/16/08
9/15/08
Date


Tiltmeter #2 Readings
11/14/06
1/14/07
3/16/07
5/16/07
7/16/07
9/15/07
11/15/07
1/15/08
3/16/08
5/16/08
7/16/08
9/15/08
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
Tilt (Degrees)
Jump due to noise and readjustment of Tiltmeter
Date

APPENDIX D

Piezometer Data

Vibrating Wire Piezometer Data