LONG BRIDGE PROJECT
Connecting North and South Through our Nation's Capital

Appendix B3:

Geotechnical Engineering Report

LONG BRIDGE PROJECT

Long Bridge Project

Environmental Impact Statement (EIS)

Geotechnical Engineering Report

April 15, 2019

District Department of Transportation

U.S. Department of Transportation
Federal Railroad Administration

Long Bridge Project EIS

Geotechnical Engineering Report

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1.0 Introduction

The objective of the geotechnical report is to compile and review available geotechnical information along the Long Bridge Corridor and provide concept-level geotechnical recommendations for the planning study to inform the NEPA, the decision-making process and future geotechnical engineering needs. No subsurface exploration or laboratory testing was performed. The scope of services includes:

Task 1: Site Reconnaissance and Gather Existing Data

- Perform a one-day site reconnaissance to review existing conditions in the field;
- Request available geotechnical reports, boring logs and foundation design and construction records from owners of major facilities near the alignment;
- Obtain published geologic mapping data across the project;
- Compile and catalog available geotechnical data for project use; and
- Prepare plan showing locations of geotechnical data along the alignment.

Task 2: Geotechnical Investigation and Report

- Review existing geologic and geotechnical reports and data;
- Prepare a longitudinal profile of subsurface conditions from existing subsurface data;
- Develop concept-level recommendations for foundations, retaining walls and embankments;
- Consider the potential impacts of the project on existing structures;
- Assess application of existing foundations at nearby sites for the project; and
- Prepare and submit a geotechnical report with estimated subsurface conditions, concept-level geotechnical recommendations, and recommendations for future studies.

2.0 Description of Site and Proposed Construction

2.1. Site Description

The Long Bridge Project consists of potential improvements to the approximately 2.2-mile Corridor and related railroad infrastructure improvements located between the RO Interlocking in Arlington, Virginia, and the L'Enfant (LE) Interlocking near 10th Street SW in the District of Columbia (the District) (collectively, the Long Bridge Corridor). The Project proposes to provide additional long-term railroad capacity and to improve the reliability of railroad service through the Corridor.

The Study Area (see **Figure 2-1**) is surrounded by diverse land uses between the District and Arlington County, Virginia, including local and national parks, residential mixed use, and commercial development. These land uses constrain the operational considerations for the railroad. In general, the Project intent is to increase the number of tracks recommended by the capacity modeling for the Long Bridge corridor from two-tracks to four-tracks. Operational speeds will be maintained within the narrow railroad corridor. The Project Study Limits include multiple transportation structures. The proposed railroad alignment will impact the configuration of six (6) existing undergrade bridges and one existing overgrade viaduct within the corridor:

- CSXT bridge over George Washington Memorial Parkway (Unknown Bridge #)
- Long Bridge over Potomac River, Mount Vernon Trail, and Ohio Drive SW (DDOT Br #510)
- CSXT bridge over Ohio Drive SW (DDOT Br #512)
- CSXT bridge over Interstate 395/695 (DDOT Br #1135)
- CSXT bridge over Washington Channel (DDOT Br #513)
- CSXT bridge over Maine Avenue SW (DDOT Br #514)
- Maryland Avenue SW decking (viaduct) over CSXT (Unknown Bridge #)

In addition, there will be a new CSXT bridge over the WMATA Yellow Line Tunnel; the pedestrian bridge over Maine Avenue SW that connects the Mandarin Oriental Hotel and the SW Riverfront will need to be replaced or reconfigured; new signal bridges will be incorporated along the Corridor; and retaining walls will be used throughout the corridor.

Figure 2-1 | Site Vicinity Map

The conceptual engineering plans[1] show a proposed track alignment which begins at the south end in Virginia and continues north into the District. In Virginia, the proposed track alignment passes through several parks including the Long Bridge Park, which is upstream of the proposed alignment. In the District between the Potomac River and Washington Channel, the proposed track alignment passes through East Potomac Park Island.

Three waterways are found along the railroad alignment. Roaches Run Pond in Virginia is located immediately southeast of the alignment, while the alignment crosses the Potomac River and the Washington Channel.

The track alignment passes over the George Washington Memorial Parkway (GWMP) in Virginia. In the District, the track alignment passes over I-395; the WMATA Metrorail Yellow line Tunnel Portal; Ohio Drive SW; Maine Avenue SW; Maryland Avenue SW bridge deck; the 12th Street bridge; the 12th Street Expressway; and the L'Enfant Plaza bridge.

2.2. Proposed Construction

The Corridor is owned and operated by CSXT Transportation (CSXT), a Class I freight railroad. In addition to CSXT, the Corridor is used by Amtrak and Virginia Railway Express (VRE) and is currently a two-track railway with potential improvements to expand to a four-track railway. The interlockings will consist of switches and crossovers that will permit the trains to switch between any of the four tracks.

The Project is evaluating two build alternatives for the project. The two alternatives are identical except:

- Action Alternative A: Construct new two-track bridges over the GWMP and over the Potomac River upstream of the existing Long Bridge, while maintaining the existing bridges to create a four-track crossing.

- Action Alternative B: Replace the existing bridges and construct two new two-track bridges over the GWMP and the Potomac River to create a four-track crossing.

If Alternative B is selected, the new two-track bridges are expected to be constructed first and tied into the existing track before the existing bridges are removed from service to allow for replacement.

The improvements will involve staged construction to maintain traffic during construction, widening and raising existing embankments to support the four-track alignment, construction of new embankments and retaining walls, and installation of new foundations for the proposed new bridges. Major structures of interest located along the conceptual track alternatives alignment are included indicated on **Figure 2-2**.

[1] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.

Figure 2-2 | Structures of Interest

Structures of Interest:

1) CSXT Bridge over GWMP
2) CSXT Long Bridge over the Potomac River
3) CSXT over WMATA Metro Yellow Line Tunnel and Tunnel Portal
4) CSXT Bridge over I-395
5) CSXT Bridge over Ohio Drive SW
6) CSXT Bridge over Washington Channel
7) CSXT Bridge over Maine Avenue SW
8) Maryland Avenue Deck over CSXT
9) 12th Street SW Bridge over CSXT
10) 12th Street Expressway Bridge over CSXT
11) L'Enfant Plaza SW Bridge over CSXT

2.3. Vertical Datum

The plans and reports referenced herein are based on several different vertical elevation datums. The conceptual engineering plans are based on NAVD88. Some of the historic plans and reports reference the U.S. Coast and Geodetic Survey Mean Sea Level of 1929, which is based on NGVD29. Other historical plans and reports are based on the datum established by the District of Columbia Engineering Department, named the D.C. Engineer's Plane of Reference, or D.C. Engineer's datum.

In the vicinity of the project alignment, NGVD29 is approximately 0.78 feet below the NAVD88 datum, based National Weather Service Records, while the D.C. Engineer's Plane of Reference (DCE) is 0.08 feet below NAVD88 and 0.70 feet above NGVD29. Elevation data included in this report indicates which vertical datum is referenced, either NAVD88, NGVD29, or DCE, consistent with the respective plans and reports.

3.0 Geology and Subsurface Conditions

3.1. Regional Geology

The site is located within the Atlantic Coastal Plain Physiographic Province with the Piedmont Physiographic Province to the north and west and the Continental Shelf to the south and east. Coastal

Plain sedimentary deposits generally consist of sand, gravels, clays, and silts that dip gently to the southeast. Sand and gravel terraces formed at higher elevations along the sides of major rivers in the region. The fall line, approximately two miles north of the site, marks the limit of where relatively young Coastal Plain sedimentary deposits overlie crystalline rock of Piedmont.

The oldest Coastal Plain deposits in the region are the Potomac Formation soils from the Cretaceous period. This formation typically consists of stiff to hard silts and clays, interbedded with dense sands and gravels that were deposited in channels, bars, and floodplains by rivers that flowed eastward. The Potomac Formation is unconformably overlain by deposits from the Tertiary and Quaternary periods. The Tertiary deposits are typically encountered at higher elevations along with upper-level Quaternary deposits, and they generally consist of sands and gravels with varying amounts of silt and clay. Low-level Quaternary fluvial and estuarine deposits underlie much of the broad floodplain adjacent to the Potomac River and typically consist of sand, silt, gravel, and varying amounts of clay and peat.

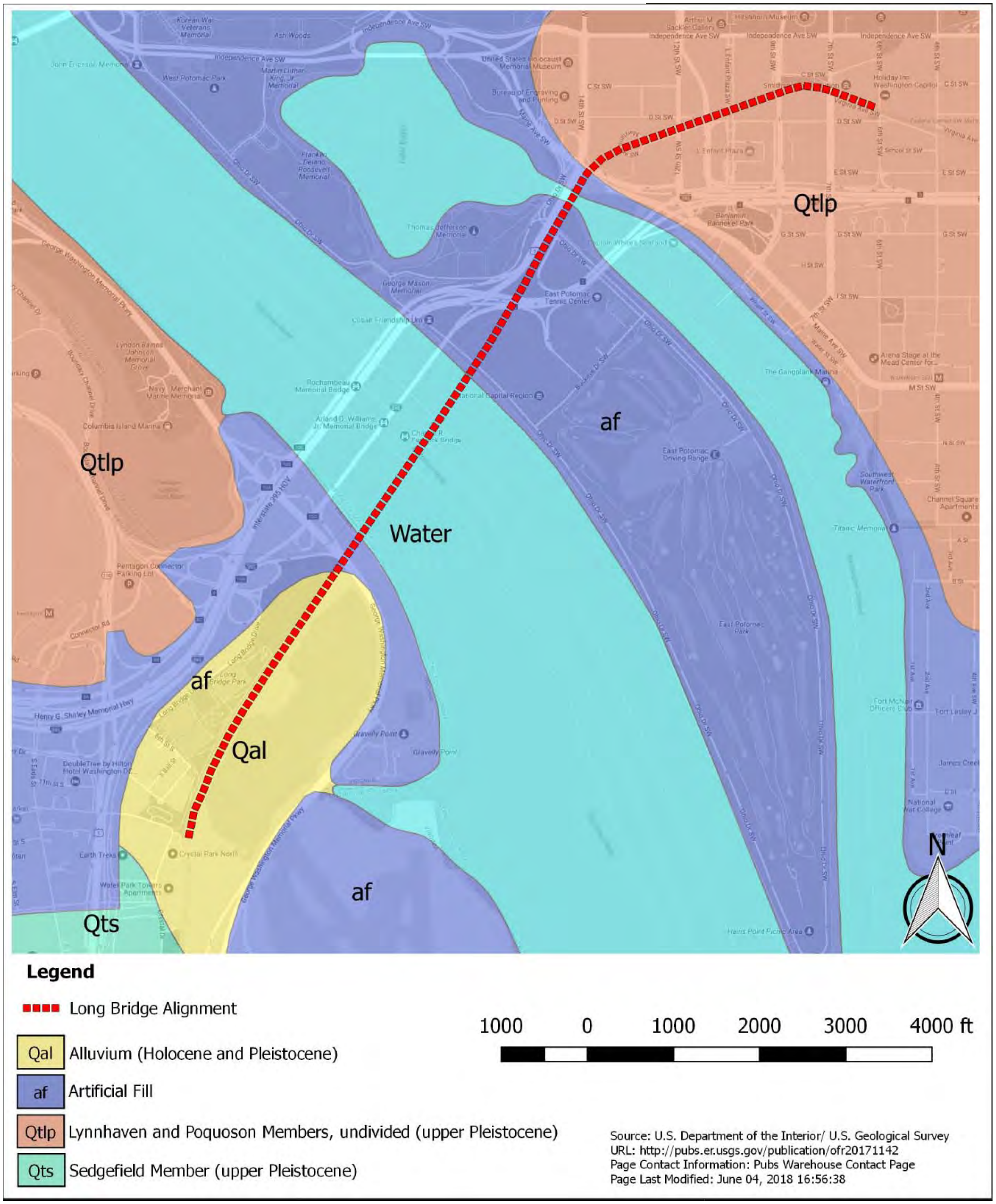
3.2. Site Geology

According to the Geologic Map of the Washington West Quadrangle[2] and the review of the available geotechnical data along the project alignment, the site is underlain by surficial deposits of low-level Quaternary deposits, which are underlain by older Potomac Formation soils and crystalline bedrock. The Tertiary deposits and upper-level Quaternary deposits typically observed at higher elevations have been eroded away and replaced with low-level Quaternary deposits of the Tabb Formation. In the vicinity of the project site, the Tabb formation is subdivided into two units, the undifferentiated Lynnhaven and Poquoson Members (Q_{tlp}) and the Sedgefield Member (Q_{ts}). In the immediate vicinity of the Potomac River, younger alluvial deposits are present in low-lying areas and the river channel.

The alluvial deposits generally consist of eroded Coastal Plain soils that have been redeposited as sediment in the Potomac River channel and adjacent floodplain. The East Potomac Park Island separates the main Potomac River channel from the smaller Washington Channel and consists of fill soil historically constructed over tidal flats consisting of alluvial deposits. Variable depths of existing fill soils are present across the project alignment. The most land surface in urban areas of the District have been cut or filled artificially. Crystalline bedrock consisting of weathered granite or schist occurs below the Potomac Formation deposits. A map showing the surficial geology of the site is provided as **Figure 3-1**.

[2] U.S. Department of the Interior/ U.S. Geological Survey, URL: http://pubs.er.usgs.gov/publication/ofr20171142 Page Contact Information: Pubs Warehouse Contact Page Page Last Modified: June 04, 2018 16:56:38

Figure 3-1 | Surficial Geology Map



3.3. Generalized Subsurface Stratigraphy

The following generalized subsurface stratigraphy has been categorized based on the subsurface exploration data and soil descriptions available from the available construction drawings and geotechnical data. The strata designations do not imply continuity of materials described but reflect the general description and characteristics of the subsurface materials at the site. Soil descriptions included in the available historic boring logs and summarized below are generally not in accordance with the United Soil Classification System. A generalized subsurface profile, indicating the various strata encountered along the project alignment and described below, is included as **Appendix 1, Figure 1**.

3.3.1. Existing Fill (Stratum F)

Existing artificial fill soils extend across the alignment from the ground surface to depths of up to 28.5 feet. The existing fill soils typically consist of sands, gravelly sands, clayey and silty sands, and sandy clays with varying amounts of organics and debris. Within East Potomac Park, the existing fill extends to depths of up to 26 feet between EL +4 and EL -13 (NGVD29) and typically consists of clayey sands, clays, and sandy loam containing varying amounts of gravel and cinders. The existing fill soils are of variable consistencies and densities.

3.3.2. Alluvial Deposits (Stratum A)

Alluvial deposits are present below the Potomac River and Washington Channel and below the artificial fill creating East Potomac Park. The alluvial deposits are thickest below East Potomac Park Island, where they extend as deep as EL -94.1 (NGVD29). Typical properties of the alluvial deposits are summarized in **Table 3-1**.

Table 3-1 | Generalized Soil Properties of Alluvial Deposits[3]

Description	Undrained Shear Strength (ksf)	Preconsolidation Pressure (tsf)	Effective Friction Angle (deg.)	Total Unit Weight (pcf)
Organic Clay below Water	0.2 to 0.3	0 to 0.2	23	110
Organic Clay below East Potomac Park Island Fill	0.5 to 0.7	0.2 to 0.3	23	120
Silty Sand	--	--	30	130

The alluvial deposits generally consist of very soft to firm, highly plastic organic clays (OH, OL, and CH) with discontinuous layers of loose to dense, slightly organic silty sands (SM). The deposits are generally black to dark gray and contain varying amounts of gravel, silt, and sand. Below the artificial fill of East Potomac Park Island, the alluvial deposits are slightly more consolidated than the deposits below the

[3] WMATA Metrorail Section (L001 to L002), Final Report Subsurface Investigation for L'Enfant – Pentagon Route, dated December 1970, prepared by Mueser, Rutledge, Wentworin & Johnston General Soil Consultant for WMATA.

Potomac River or the Washington Channel. Laboratory test results included in Appendix 2 indicate the alluvial deposits of Stratum A are generally considered corrosive to buried steel and concrete.

3.3.3. Quaternary Deposits (Stratum Q)

Low-level Quaternary deposits were encountered north and south of East Potomac Park Island. The Quaternary deposits extend from below the ground surface, existing fill, and/or alluvial deposits to between EL -35 and EL -60 (NGVD29). The Quaternary deposits are eroded away and replaced with alluvial deposits below East Potomac Park Island. Typical properties of the Quaternary deposits are summarized in **Table 3-2**.

The Quaternary deposits typically consist of fine to coarse, crossbedded sand, sandy gravel, silt, and clay. Layers of silt and silty clay with varying amounts of sand are common, as are layers of gravel, pebbles, and occasional cobbles. Generally light to dark gray, tan, pale orange, to medium orange in color. This stratum has SPT N Values of 5 to greater than 100 but is generally medium dense and stiff consistency. This Stratum is designated as T1 through TX in the WMATA documents[4]. This stratum was also interpreted from descriptions included in several other plans and logs available from the historical data. However, the identification of this stratum was difficult due to the variety of descriptions and soil classifications used in the various documents.

Table 3-2 | Generalized Soil Properties of Quaternary Deposits[4]

Description	Undrained Shear Strength (ksf)	Preconsolidation Pressure (tsf)	Effective Friction Angle (deg.)	Total Unit Weight (pcf)
Silty Clay to Plastic Clay	0.7 to 3.5	0.5 to 3	25	130
Silty Sand	--	--	30 to 34	130
Gravelly Sand	--	--	34 to 38	130

3.3.4. Potomac Formation (Stratum P)

Potomac Formation soils were encountered below the Quaternary or Alluvial deposits to between EL -95 and EL -110 (NGVD29). The Potomac soils are completely eroded away replaced with alluvial soils below East Potomac Park Island. Typical properties of the Potomac soils are summarized in **Table 3-3**. This stratum is designated as P1 through PX in the WMATA documents[4].

Potomac Formation soils at the site generally consist of sands with some variable amounts of gravel, interbedded with occasional layers clays. The Potomac sands typically consist of dense to very dense gray and gray-brown fine to coarse sand (SC, SM, and SC) with varying amounts of gravel and silt. The

[4] WMATA Metrorail Section (L001 to L002), Final Report Subsurface Investigation for L'Enfant – Pentagon Route, dated December 1970, prepared by Mueser, Rutledge, Wentworin & Johnston General Soil Consultant for WMATA.

Potomac clay typically consists of dark gray to blue, stiff to very hard plastic clay (CH, CL) with very fine sand and scattered lignite fragments.

Table 3-3 | Generalized Soil Properties of Potomac Formation Soils[5]

Description	Undrained Shear Strength (ksf)	Preconsolidation Pressure (tsf)	Effective Friction Angle (deg.)	Total Unit Weight (pcf)
Plastic Clay	2 to 5	12 to 20	25	130
Sandy Clay	4 to 6	15 to 20	34	130
Sands and Gravels	--	--	33 to 38	130

3.3.5. Rock (Stratum R)

Crystalline bedrock was encountered below the Alluvial deposits or Potomac Formation soils at depths of 100 feet to 120 feet below existing grades, or EL -90 to EL -110 (NGVD29). Rock consisted of weathered and jointed schistose gneiss with zones of gneissic schist and granite gneiss. The bedrock is generally covered by an irregular thickness of decomposed rock. Unconfined compressive strengths of the rock ranged from approximately 5 to 15 ksi.[5]

3.4. Groundwater

Groundwater levels across the alignment, particularly on East Potomac Park Island, will be influenced by the water levels in the Potomac River. A water level gauge installed in the Washington Channel, just south of the project site and maintained by the National Weather Service (*Washington Channel Gauge at SW Waterfront*) indicates the water level in the channel (and presumably the adjacent Potomac River) typically varies between EL +1 and EL +4 (NAVD88). The record flood was recorded on October 17, 1942, at EL +9.65 (NAVD88).

In Washington, DC and Arlington, VA, groundwater was generally observed in the available test borings between EL +12 and EL -5.5 (NAVD88). Observed groundwater levels are indicated on the generalized subsurface profile, included as **Appendix 1, Figure 1**.

Some of the higher water levels indicated on the plans may represent zones where groundwater is perched above a low permeability layer. The presence and elevation of perched groundwater may vary significantly with variations in weather conditions. The final design should anticipate the fluctuation of the water table depending upon variations in tides, precipitation, surface runoff, pumping, evaporation, river levels, and similar factors.

[5] WMATA Metrorail Section (L001 to L002), Final Report Subsurface Investigation for L'Enfant – Pentagon Route, dated December 1970, prepared by Mueser, Rutledge, Wentworin & Johnston General Soil Consultant for WMATA.

4.0 Conceptual Geotechnical Recommendations

Concept level geotechnical recommendations are provided below for each major structure identified in **Figure 2-2**. Each major structure impacted by the proposed construction is addressed in its own subsection with the following format:

- Description of structure and summary of proposed construction
- Summary of site stratigraphy
- Summary of existing structure foundation
- Summary of geotechnical issues facing proposed construction
- Conceptual geotechnical recommendations

The structures are discussed in order from south to north, as indicated in Figure 2-2. Based on the conceptual engineering plans, neither proposed build alternatives are expected to impact the Maryland Avenue SW viaduct, the 12th Street SW Bridge, the 12th Street Expressway Bridge, or the L'Enfant Plaza SW Bridge. As discussed in Section 2.2, the proposed concept engineering plans[6] indicate the CSXT railroad alignment across the project study limits will be expanded to four tracks. Action Alternatives A and B are the same except for the replacement of the CSXT bridge over the GWMP and Long Bridge over the Potomac River.

4.1. CSXT Bridge over George Washington Memorial Parkway

In Arlington, Virginia, the existing two-track CSXT railroad alignment passes over the GWMP and is supported by a two-span through-girder bridge. The GWMP is owned and maintained by the National Park Service (NPS). The conceptual engineering plans[6] indicate the railroad alignment in this section will be expanded from two tracks to four. Action Alternative A includes retaining the existing bridge and constructing a new two-track bridge adjacent to the west side of the existing bridge. Action Alternative B includes constructing a new two-track bridge adjacent to the west side of the existing bridge and replacing the existing two-track bridge. Retaining walls are planned at the approaches to limit encroachment on the right-of-way. The conceptual plans indicate the railroad elevations in this section will be raised up approximately two feet, to between approximately EL +27 and EL +28 (NAVD88).

4.1.1. Site Subsurface Stratigraphy

Information about the subsurface stratigraphy below the CSXT Bridge over the GWMP is available from a subsurface exploration performed in 1970 by the Washington Metro Area Transit Authority (WMATA) for the Metrorail Yellow Line between L'Enfant Plaza and the Pentagon[7] and included in this report as Appendix 2. Test borings I-24 and L-27 were performed approximately 25 feet and 150 feet from the bridge, respectively, and show the bridge is founded on existing fill which extends from the ground surface to between EL -10 and EL -13 (NGVD29). The existing fill is underlain by very dense sand and

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[6] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.
[7] WMATA Metrorail Section (L001 to L002), Final Report Subsurface Investigation for L'Enfant – Pentagon Route, dated December 1970, prepared by Mueser, Rutledge, Wentworin & Johnston General Soil Consultant for WMATA.

gravel Quaternary deposits and Potomac Formation soils. The subsurface stratigraphy and available data are summarized in **Table 4-1**.

Notes on the boring logs included in Appendix 2 indicate that groundwater levels observed during drilling were at approximately EL 0 (NGVD29). Groundwater levels will be influenced by the level of the adjacent Potomac River.

Table 4-1 | Generalized Subsurface Stratigraphy – CSXT Bridge over GWMP

Stratum	Top of Strata Elevation[1]	Soil Description[2]	Available Data
Artificial Fill (F)	Ground Surface	variable **Gravel, Sand, Silt, Clay,** with varying amounts of organics (GP, SP, SM, ML, CL, OL)	N Value: 3 to 44
Quaternary Deposits (Q)	EL -10 to EL -13	very dense **Poorly Graded Sand** and **Silty Sand**, gray-brown to brown, with varying amounts of gravel and silt (SP, SP-SM, SM, GP)	N Value: 29 to 50/5"
Potomac Formation (P)	EL -30 to EL -35	Very dense fine to medium **Clayey Sand** and very stiff to hard **Sandy Clay**, light brown to gray-green. Some highly plastic clay observed on north side. (SC, CL, CH)	N Value: 65 to 100+
Bedrock (R)	Not Encountered[3]	Bedrock not encountered. Nearby borings and historic rock contour map indicate bedrock is between approximately EL -100 to EL -120	--
Notes:	1. Elevations reference U.S. Coast and Geodetic Survey Datum (NGVD29) 2. USCS soil descriptions provided in parentheses 3. Bedrock not encountered above the boring termination elevations of EL -68 and EL -95		

4.1.2. Existing Bridge Foundation

The existing bridge carrying the CSXT tracks over the GWP is a 117-foot long, two span through-girder bridge originally constructed around 1929. The piers and abutments with integral wing walls are founded on 20-ton timber piles. The abutments, wing walls, and piers are supported by a combination of plump and battered piles, with pile batter indicated as 3H:12V. The plans indicate the perimeter piles are battered outwards from the substructures. The pile cap subgrade elevations are indicated as EL -2.0 (DCE) for the abutments and pier. Notes on the plans indicate estimated pile lengths of 50 feet, resulting in an estimated tip elevation of EL -52 (DCE).

4.1.3. Geotechnical Issues

Up to 19 feet of new embankment fill will be required to widen and raise the existing approach embankments to support the proposed alignment. The new embankment section must be keyed into the existing embankment section while maintaining site drainage. Over the existing embankment footprint, less than two feet of new fill will be required to raise the track subgrade. The difference in fill height across the widened embankment could result in a differential settlement between the new and existing embankment sections.

4.1.4. Geotechnical Recommendations

The new bridge could be supported by driven steel H pile foundations extending below the existing fill soils underlying the site with 12-inch steel H-piles driven to tip elevations between EL -30 and EL -35 (NAVD88) into the dense Quaternary deposits could provide factored geotechnical resistances of 200 to 260 kips. The embankment settlement could result in down-drag loading on the new foundations, though any down-drag is expected to be limited to the existing artificial fill soils and is not expected to be significant.

The stratigraphy below the bridge generally consists of dense granular soils, suggesting that any settlement due to embankment construction will occur relatively quickly. Ground improvement is not expected not be necessary.

4.2. Long Bridge over the Potomac River, Mount Vernon Trail, and Ohio Drive SW

The Long Bridge over the Potomac River (Long Bridge) is a historic steel girder bridge carrying two tracks of the CSXT railroad over the Potomac River between Virginia and East Potomac Park Island in the District. The existing bridge extends 2,522 feet, spanning the Mount Vernon Trail on the Virginia side of the river and the Rock Creek Park Trail and Ohio Drive SW on East Potomac Park Island.

Construction was completed on the original iron and steel truss bridge in 1904 and it included eleven truss spans and one swing draw span, supported on two abutments and twelve piers founded in the Potomac River. Available plans [8, 9] indicate the bridge was modified in 1942 by constructing eleven supplemental piers between the original truss spans and replacing the iron and steel truss spans with steel girders. The bridge currently includes twenty-two spans and one swing draw span supported by two abutments and twenty-three piers. The span lengths vary between 80.3 feet and 108.3 feet at the typical spans and 140.3 feet at the swing draw spans.

The conceptual engineering plan for the bridge replacement[10] includes constructing a new two-track bridge west (upstream) of the existing bridge, while the existing two-track bridge may remain in service

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[8] General Plan, Sheet 1/5, dated January 1942, prepared for the Pennsylvania Railroad Reconstruction Bridge No. 138.45 over the Potomac River Washington DC.
[9] Masonry Plan, revised date November 1901, for the Long Bridge over the Potomac River for the Baltimore & Potomac Railroad.
[10] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation

(Action Alternative A) or may be removed and replaced with a new two-track bridge over the same alignment (Action Alternative B). The conceptual plans indicate the railroad grades at the south approach to the bridge will be raised approximately 6 feet from EL +27 up to EL +33 (NAVD88), while the railroad grades at the north side of the bridge and approach will be raised approximately 5 feet from EL +25 to EL +30 (NAVD88). Up to 25 feet of new fill will be placed to widen the approach embankments and raise the grades.

4.2.1. Site Subsurface Stratigraphy

Information about the subsurface stratigraphy along the Long Bridge alignment is available from a subsurface exploration performed in 1970 by WMATA for the Metrorail Yellow Line between L'Enfant Plaza and the Pentagon[11] and included in this report as Appendix 2. Twelve of the test borings were performed in the Potomac River, directly adjacent to the south side of the Long Bridge. The subsurface stratigraphy and available data are summarized in **Table 4-2**.

Table 4-2 | Subsurface Stratigraphy – Long Bridge over the Potomac River

	Top of Strata Elevation[1]			
Stratum	**South Approach (South Abutment)**	**South River Channel (Piers 12A to 3A)**	**North River Channel (Piers 3 to 0)**	**North Approach (North Abutment)**
Artificial Fill (F)	Ground Surface	N/E[2]	N/E	Ground Surface
Alluvial Deposits (A)	EL 0 to EL -10	EL -5 to EL -30	EL -4 to EL -5	EL -5 to EL -10
Quaternary Deposits (Q)[3]	EL -6 to EL -22	EL -23 to EL -30	N/E	EL -54 to EL -55
Potomac Formation (P)	EL -50 to EL -57	EL -50 to EL -58	EL -58 to EL -60	EL -58 to EL -60
Disintegrated Rock (D)[4]	Below EL -102	EL -101 to EL -115	N/E	N/E
Bedrock (R)[5]	Below EL -104	N/E, or EL -104 to below EL -120	N/E	N/E
Notes:	1. Elevations reference U.S. Coast and Geodetic Survey Datum (NGVD29) 2. N/E = Not Encountered 3. Quaternary Deposits are referred to as Strata T1 to T5 in the WMATA exploration (App. 1) 4. Disintegrated Rock is referred to as Decomposed Rock in the WMATA exploration (App. 1) 5. Bedrock is referred to as Weathered and Jointed Gneiss in the WMATA exploration (App. 1)			

[11] WMATA Metrorail Section (L001 to L002), Final Report Subsurface Investigation for L'Enfant – Pentagon Route, dated December 1970, prepared by Mueser, Rutledge, Wentworin & Johnston General Soil Consultant for WMATA.

The complete report of the subsurface exploration, included in Appendix 2, includes detailed descriptions of the site geology, subsurface strata, groundwater conditions, as well as boring location plans and boring logs. Soil laboratory test results, including index, strength, and consolidation are included and summarized for the various strata. Soil corrosion characteristics are provided for the Alluvial deposits. Sheets F-L-8 through F-L-10 in Appendix 2 include a detailed subsurface profile of the Potomac River adjacent to the Long Bridge.

The test boring logs and subsurface profiles included in Appendix 2 show that the Alluvial deposits below the Long Bridge generally consist of soft to medium stiff organic clays, with occasional interbedded layers of loose to medium dense silty sands. The Quaternary deposits generally consist dense to very dense silty sand with varying amounts of gravel. The Potomac Formation soils observed below the Long Bridge generally consist of clayey sand and sandy clay, with highly plastic clay observed north of existing Pier 7.

The surface of the mudline below the river may have changed significantly due to erosion and redeposition since the test borings were performed in 1970.

4.2.2. Existing Bridge Foundation

Limited information is available regarding the existing Long Bridge substructure. Available foundation information includes several plan sheets from the original construction dated November 1901[12], several plan sheets from the reconstruction dated October 1942[13], as well as a description provided in Section 9.4 of the WMATA[14] exploration, included as Appendix 2. The abutments and piers consist of granite masonry backed with concrete. The north and south abutments are approximately 27 feet and 18 feet tall, respectively. The north abutment is founded on 136 timber piles with cut-off elevations of EL -4 (NGVD29). The south abutment is founded on 206 timber piles with cut-off elevations of EL -8 (NGVD29). Pile tip elevations at the north and south abutments are indicated as EL -50 and EL -30, respectively (NGVD29). Borings included in Appendix 2 suggest the abutment piles are founded in dense Quaternary deposits or Potomac Formation soils.

The original bridge piers are supported on between 109 and 114 timber piles per pier. Timber pile tip elevations vary between EL -24 and EL -42 (NGVD29), bearing in dense Quaternary deposits or Potomac Formation soils. The plans do not indicate the diameter or taper of the piles. The supplemental piers added in 1942 are supported on steel 14BP73 H Piles, driven to 55-ton at tip elevations between EL -62 to EL -70 (NGVD29) in Potomac Formation soils. The number of piles per pier is not available. Pier 8, supporting the swing draw span, is founded on a 44-ft diameter timber and concrete caissons tipped at approximately EL -55 (NGVD29). WMATA plans state that caissons are tipped between EL -34 and EL -42

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[12] Masonry Plan, revised date November 1901, for the Long Bridge over the Potomac River for the Baltimore & Potomac Railroad.

[13] General Plan, Sheet 1/5, dated January 1942, prepared for the Pennsylvania Railroad Reconstruction Bridge No. 138.45 over the Potomac River Washington DC.

[14] WMATA Metrorail Section (L001 to L002), Final Report Subsurface Investigation for L'Enfant – Pentagon Route, dated December 1970, prepared by Mueser, Rutledge, Wentworin & Johnston General Soil Consultant for WMATA.

(NGVD29) in Quaternary deposits. The pier piles are all cut-off below the water line, at elevations between EL -2 and EL -20 (NGVD29).

Note the reconstruction plans from 1942 indicate submarine cables are present in dredged trenches adjacent to the existing piers.

4.2.3. Geotechnical Issues

Bedrock grades below the Long Bridge vary from EL -104 at the south side of the bridge to deeper than EL -120 (NGVD29) at the north side of the bridge. Due to the depth to rock, it is likely more economical to support the foundations in the dense Quaternary deposits and Potomac Formations soils overlying the rock. The alluvial deposits of Stratum A may be corrosive to buried steel and concrete elements; therefore, the foundation design will need to consider corrosion effects.

The new bridge piers constructed through the Potomac River are expected to be necessary with either build alternative. New piers in the river will likely require temporary cofferdams to construct below the waterline and must be designed to withstand extreme event limit states that include vessel collisions and scour. The new foundations, particularly those founded in the river, must consider potential scour effects. If the existing Long Bridge is replaced, the existing pile foundations could conflict with the new foundations unless the new piers are installed between the existing piers or the existing pile foundations are removed. The existing submarine cables will need to be avoided or relocated. The existing navigation channel must be maintained, further limiting potential pier locations. The impact of pile driving on the existing bridge should be evaluated during future design phases. Abandoned piers from older bridges may be present in the riverbed.

Up to 25 feet of new embankment fill will be required to widen and raise the existing approach embankments to support the proposed four-track alignment. The new embankment section must be keyed into the existing embankment section while maintaining site drainage. Due to the organic alluvial deposits below the approach embankments, the significant post-construction settlement could occur below the widened embankment. Over the existing embankment footprint, less than 5 feet of new fill will be required to raise the track subgrade. The difference in fill height could result in a differential settlement between the new and existing embankment. The embankment settlement could result in down-drag loading on the new foundations.

4.2.4. Geotechnical Recommendations

The new bridge abutments and piers could be supported by piles driven through the soft alluvial deposits of Stratum A to bear in the underlying dense sands and gravels of Strata Q and P. The new abutments could be supported by steel H pile foundations driven approximately 20 feet into the Potomac Formation soils of Stratum P, to tip elevations between EL -70 and EL -80 (NAVD88). Driving shoes may be necessary to penetrate some of the harder or denser layers overlying the bearing strata. The expected embankment settlement could cause down-drag on the abutment piles and should be considered in future geotechnical studies. 14-inch steel H-piles could provide factored geotechnical resistances of 200 to 300 kips, depending on the down-drag and corrosion considerations.

New piers in the river could be supported by pre-stressed concrete piles. Full-length pre-stressed concrete piles could be barged to the site. Pre-stressed concrete piles are also generally more resistant to weather and corrosion than steel piles. 36-inch square pre-stressed concrete piles could achieve factored geotechnical resistances of 1,000 to 1,200 kips when driven approximately 40 feet into the dense soils of Strata Q or P, to tip elevations between approximately EL -70 to EL -80 (NAVD88).

Alternatively, larger spun-cast pre-stressed concrete cylinder piles could be driven to even higher factored resistances, requiring fewer piles per pier. Cylinder piles can also extend directly into the superstructure support, avoiding the need for a pile cap. Cylinder piles are typically available at diameters of 36, 42, 54, or 66 inches, depending on the manufacturer. It is expected that 66-inch diameter spun-cast cylinder piles could achieve 1,500 to 1,700 kips of factored geotechnical resistance when driven approximately 40 feet into the dense soils of Strata Q or P, to tip elevations between approximately EL -70 to EL -80 (NAVD88). Large diameter spun cast piles will likely need to be driven unplugged, so the piles can reach the desired elevations. If the pile plugs during driving, the pile interior may need to be cleaned.

The estimated factored pile resistances described above use a geotechnical resistance factor of 0.65 and consider that the nominal resistance of the piles during driving will be measured using dynamic pile testing equipment with signal matching techniques. Static load tests, performed on at least one pile per site condition and dynamic testing of at least two piles per site condition, but no less than 2 percent of the production piles, could allow the use of a higher geotechnical resistance factor (0.80 vs. 0.65) and result in increased factored pile capacities than if only dynamic pile testing was used. Based on the subsurface stratigraphy described above, the north and south sides of the river channel below the Long Bridge alignment consist of two distinct site conditions and would require separate static load tests.

A drivability analysis of the piles should be performed on the selected pile type and size during final design to demonstrate that available pile hammers can install the piles to the necessary nominal capacities and desired depths without exceeding the permissible driving stresses. Specialty heavy hammers such as a Vulcan V060 or V5100 may be necessary to install the large diameter spun-cast cylinder piles.

The final pile design must consider the pile spacing. If the piles are spaced closer than 2.5B, where B is the center-to-center distance between the piles, the factored geotechnical resistance must be reduced to account for group effects.

4.3. CSXT over WMATA Yellow Line Tunnel and Tunnel Portal

On East Potomac Park Island, the existing two-track CSXT alignment passes over the existing pile-supported cut-and-cover tunnel carrying the Washington Metro Area Transit Authority (WMATA) Metrorail Yellow Line. The proposed concept engineering plans[15] indicate the CSXT railroad alignment in this area will be expanded from two tracks to four tracks. The existing tracks will be realigned while two new tracks are planned west of the existing tracks and pass over the WMATA Metrorail Yellow Line

[15] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.

tunnel portal The existing tracks will remain at-grade over the tunnel structure while the two new tracks will be supported by a new bridge spanning the tunnel portal. The conceptual plans indicate the railroad grades in this area will be raised approximately 5 feet from EL +25 to EL +30 (NAVD88). Up to 20 feet of new fill will be placed to raise the grade and widen the embankment for the new approaches. New retaining walls are proposed to support the embankments and accommodate the right-of-way. Two existing sanitary sewer lines cross below the railroad alignment on either side of the tunnel portal.

4.3.1. Site Stratigraphy

The WMATA tunnel portal is located on an artificial island historically constructed over tidal flats. Geotechnical data at the tunnel portal is available from test borings L-38 and L-39U, which were drilled in 1970 approximately 25 feet and 80 feet from the tunnel portal, respectively, and are provided on the as-built plans from WMATA Metrorail Section L-1 L'Enfant – Pentagon Route[16] included as Appendix 3. The subsurface stratigraphy and available data are summarized in **Table 4-3**. Notes on the boring logs indicate that average groundwater levels observed during drilling varied between EL +1.5 and EL -6.8 (NGVD29). Groundwater levels are likely influenced by the level of the adjacent Potomac River.

Table 4-3 | Generalized Subsurface Stratigraphy – CSXT over WMATA Yellow Line

Stratum	Top of Strata Elevation[1]	Soil Description[2]	Available Data
Artificial Fill (F)	Ground Surface	**Clayey Sand**, brown, containing gravel and cinders (SC)	N Value: 18 to 21
Alluvial Deposits (A)	EL +3.7 to EL +3.9	Soft to stiff **Organic Clay** and loose to very-compact fine to medium **Sand** and **Silty Sand**, brown to dark gray, containing organic matter, shells, fine gravel, and silt lenses (OH, OL, MH, SP, SM, SP-SM)	N value[3]: 4 to 8
	EL -84.3 to EL -87.1	Very-compact **Silty Sand**, gray to dark gray, contains trace gravel (SM, SP-SM)	N Value: 30 to 61
Potomac Formation (P)	EL -90.1 to EL -94.3	Very dense fine to medium **Clayey Sand** and very stiff to hard **Sandy Clay**, gray-green (SC, CL)	N Value: 94 to 100+

[16] As-built WMATA Metrorail Section L-1, for L'Enfant Plaza – Pentagon Route, dated November 1975, prepared by Harry Weese & Associates General Architectural Consultant and De Leuw Cather & Company General Engineering Consultant for WMATA.

Bedrock (R)[4]	N/E	Bedrock not encountered, nearby borings and historic rock contour map shows bedrock is between approximately EL -100 to EL -110	--
Notes:	1. Elevations reference U.S. Coast and Geodetic Survey Datum (NGVD29). Elevations are at boring locations. 2. USCS soil descriptions provided in parentheses 3. Three SPT samples performed in this stratum had N values of 100+ where gravel or layers of very compact sand were encountered, as shown in the boring logs. 4. Bedrock not encountered above the boring termination elevations of EL -97.3 and EL -97.6 (NGVD29)		

4.3.2. Existing Tunnel and Portal Foundation

Where the WMATA tunnel passes below the CSXT alignment, the as-built plans[17] indicate the tunnel is supported by pile-supported reinforced-concrete tunnel segments constructed using cut-and-cover construction techniques. Tunnel Segment L1008 supports the CSXT embankment and railroad alignment, while on either side Tunnel Segments L1000 and L1015 (tunnel portal) support portions of the CSXT embankment. The new track alignment is proposed to span over Tunnel Segments L1008 and L1015.

The existing WMATA railroad grades are near EL +5.4 (NGVD29) at the tunnel portal and descend at approximately a 4% grade to EL -2.6 (NGVD29) at the end of Tunnel Segment L1000. The tunnel segments vary from 35-feet to 38-feet wide and are founded on a 4.25-feet thick concrete slab, supported by 80-ton plump HP14X73 steel piles. Pile lengths are not included on the original plans, though notes indicate the minimum pile tip elevation is EL -92 (NGVD29).

A sheet pile cofferdam was used east of the CSXT alignment to support the cut-and-cover construction of the WMATA tunnel. Notes on the as-built plans indicate that the sheet piling was removed after construction and that the space between the tunnel boxes and the cofferdam backfilled with sand up to the top elevation of the tunnel box and with structural backfill from the top of the tunnel box elevation up to the final grade. No anchors were indicated to support the earth pressures applied to the tunnel segments.

4.3.3. Geotechnical Issues

The concept plans show a new bridge will carry two new CSXT railroad alignments over the WMATA portal structure, while the existing track embankment extending over the tunnel structure may be raised by up to 5 feet. The new bridge foundations, retaining walls, and expanded embankments could surcharge the WMATA tunnel and portal structures.

According to the WMATA Adjacent Construction Project Manual, existing WMATA facilities - including deep foundations, retaining walls, and underground utility lines - are considered to be affected by the adjacent construction when the proposed excavation and construction falls within the WMATA Zone of Influence (ZOI). The WMATA ZOI is generally considered to be within 25 feet (horizontal) of WMATA

[17] As-built WMATA Metrorail Section L-1, for L'Enfant Plaza – Pentagon Route, dated November 1975, prepared by Harry Weese & Associates General Architectural Consultant and De Leuw Cather & Company General Engineering Consultant for WMATA.

facilities, or within an envelope starting two feet below the lowest point of the WMATA structure continuing upwards at 45 degrees until it intersects the existing ground line.

Where the proposed construction falls within the ZOI, WMATA Design Criteria and Standard Specifications are typically required to be used for that portion of the project. CSXT may be exempt from some or all of the WMATA adjacent construction requirements if they own the right-of-way and have granted an easement to WMATA for the Metroline. Adjacent construction is typically not permitted to increase stress or deformation in the existing WMATA tunnels or other underground structures, and any additional loading typically must be transferred outside and below the tunnel structures.

WMATA prohibits excavation or tunneling below their structures, unsupported excavation within 10 feet of their facilities, or pile driving within 25 feet (horizontal) of WMATA structures or tracks. Piles located within 25 feet of WMATA facilities must be installed in pre-augered holes extending at least 10 feet into the bearing strata below the ZOI or approved bearing subgrade and backfilled with concrete.

Up to 20 feet of new embankment fill is planned to widen the existing approach embankments to support the four-track alignment. Due to the soft, organic sediments below the embankments, the significant post-construction settlement could occur. The difference in fill height across the widened embankment could result in a differential settlement between the new and existing embankment. The embankment settlement could result in down-drag loading on the new foundations.

4.3.4. Geotechnical Recommendations

The new bridge abutments, embankments, and retaining walls should be set back horizontally from the tunnel and portal structure at least the height of the proposed wall or embankment, or a minimum of 25 feet, to avoid the WMATA ZOI. Express permission from WMATA will be needed to raise the existing embankment over the tunnel structure. Any new fill placed over the tunnel structure or possibly within or near the ZOI is expected to surcharge the tunnel and its effect must be evaluated in the future design.

A deep foundation will be necessary to transfer the new bridge foundation loads below the tunnel and portal structure's ZOI. The new bridge could be supported on 14-inch steel H-piles driven through pre-augered holes to refusal on rock, estimated between EL -90 and EL -100 (NAVD88). The piles should be pre-augered to at least 10 feet below the subgrade of the WMATA tunnel. HP14x73 grade 50 steel piles driven to refusal on rock could provide factored geotechnical resistances of 250 to 350 kips. The expected settlement from the new approach embankments could cause down-drag on the piles and should be considered in future geotechnical studies.

Soft organic sediments underlie the proposed bridge and approach embankments. Organic soils are problematic due to their potential for long-term settlement regardless of the surcharge. Undercutting and replacement are not expected to be feasible due to the thickness of the organic soils and the shallow water table. Construction of the track structure should not begin until settlement of the new embankment has occurred. If excessive settlements or durations are expected, ground improvements measures may be necessary. Embankment subgrade settlement and the need for ground improvement must be evaluated during future geotechnical studies.

Two abandoned below-grade sanitary sewer lines shown on the conceptual engineering track alignment plans pass below the railroad alignment on either side of the tunnel portal. These abandoned sewer lines may require plugging or removal prior to constructing the proposed embankment if the weight of the embankment has the potential to over-stress them.

Depending on the required set-back of the abutments from the tunnel, it may be cost effective to combine the proposed CSXT Bridge over the WMATA tunnel with the proposed CSXT Bridge over I-395, which is approximately 100 feet east of the tunnel portal and described in the next section of this report.

4.4. CSXT Bridge Over I-395

On East Potomac Park Island, the existing two-track CSXT alignment passes over I-395 and is supported by a two-span steel-girder bridge originally constructed in 1959. The District Department of Transportation (DDOT) owns and maintains I-395. The conceptual engineering plans[18] indicate the railroad alignment in this section will be expanded from two tracks to four tracks and the existing two-track bridge will be replaced with two separate two-track bridges. The conceptual plans indicate the railroad grades in this section will be raised approximately 5 feet from EL +25 to EL +30 (NAVD88). Up to 25 feet of new fill will be placed to widen the embankment and raise the grade.

4.4.1. Site Subsurface Stratigraphy

The CSXT Bridge over I-395 is located on an artificial island historically constructed over tidal flats. Two test borings, B-1 and B-2, were performed adjacent to the bridge to support the construction of the bridge and their logs are included on the original bridge. The logs contain a description of the subsurface stratigraphy but do not include Standard Penetration Tests (SPT) or laboratory test results. Groundwater is indicated on one boring log at EL +4.5 (DCE) and is likely controlled by the level of the adjacent Potomac River. Additional geotechnical data including SPT results are available from test boring L-38, which was drilled in 1970 approximately 50-feet southeast of the existing CSXT Bridge to support the original design and construction of the WMATA Metrorail Yellow Line[19]. The boring log for L-38 is provided on the plans included in Appendix 3. Selected sheets from the original bridge construction plans showing boring logs for B-1 and B-2 are included in Appendix 4. The subsurface stratigraphy and available data are summarized in **Table 4-4**.

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[18] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.
[19] As-built WMATA Metrorail Section L-1, for L'Enfant Plaza – Pentagon Route, dated November 1975, prepared by Harry Weese & Associates General Architectural Consultant and De Leuw Cather & Company General Engineering Consultant for WMATA.

Table 4-4 | Generalized Subsurface Stratigraphy – CSXT Bridge Over I-395

Stratum	Top of Strata Elevation[1]	Soil Description[2]	Available Data[3]
Artificial Fill (F)	Ground Surface	stiff **Clay**, red and tan, containing gravel, cinders, and bricks (CL, GP, SC)	N Value: 18 to 21
Alluvial Deposits (A)	EL -0.3 to EL -2.7	soft **Clay** and lose fine to coarse **Sand**, brown to dark gray, containing organic matter and fine gravel (OH, OH, CH, SM)	N Value: 6 to 25
	EL -29.8 to EL -44.7	firm **Clay** with seams of sand and fine gravel, dark gray, containing organic matter (OH)	N Value: 12 to 24
Bedrock (R)	EL -89.7 to EL -90.3	soft weathered **Granite**	--

Notes:
1. Elevations reference D.C. Engineer's Plane of Reference (DCE), from borings B-1 and B-2
2. Soil descriptions from B-1 and B-2, USCS soil descriptions provided in parentheses from boring L-38
3. Available SPT data from boring L-38

4.4.2. Existing Bridge Foundation

The existing bridge carrying the CSXT tracks over I-395 is a 163-foot long, two span steel-girder bridge originally constructed in 1959. The original plans indicate the abutment walls vary from 15 feet to 16 feet tall, while the adjacent wing walls vary from 19 feet to 21 feet tall. The piers, abutments and wing walls are founded on 64-ton 14BP73 steel piles. The abutments, wing walls, and piers are supported by a combination of plump and battered piles, with pile batter varying between 1H:6V and 5H:12V. The plans indicate the abutment piles are battered towards the piers and the piles should not extend beyond the back of the existing pile caps unless they were driven out of tolerance. The pile cap subgrade elevations are indicated as EL -1.9, EL -1.1, and EL -3.6 (DCE) for the south abutment, piers and north abutment, respectively. Pile lengths or tip elevations are not indicated but notes on the plans require the piles to be driven until a firm bearing on the rock is secured, assumed to be at EL -97 (DCE) for estimating purposes.

4.4.3. Geotechnical Issues

Up to 25 feet of new embankment fill will be required to widen and raise the existing approach embankments to support the four-track alignment. The new embankment section must be keyed into the existing embankment section while maintaining site drainage. Due to soft, organic sediments below the embankments, the significant post-construction settlement could occur below the widened embankment. Over the existing embankment footprint, only approximately 5 feet of new fill will be required to raise the track subgrade. The difference in fill height across the widened embankment could result in a differential settlement between the new and existing embankment. The embankment settlement could result in down-drag loading on the new foundations.

The original plans indicate a temporary runaround was used to offset the track northwest during the original bridge construction. The runaround plan shows approximately 85-feet of sheet pile was installed about 70 feet away from the centerline of the existing tracks. The plans indicate the sheet piles were installed to tip elevations of approximately EL -10 and the top elevations varied from approximately EL +5 to EL +12 (DCE). The plans do not indicate if the sheet piling was removed after completing construction. If present, the sheet piles could obstruct new pile installation.

4.4.4. Geotechnical Recommendations

The new bridge could be supported on 14-inch steel H-piles driven to refusal on rock, estimated between EL -90 and EL -100 (NAVD88). HP14x73 grade 50 steel piles could provide factored geotechnical resistances of 250 to 350 kips. The expected embankment settlement could cause down-drag on the abutment piles and should be considered in future geotechnical studies. It is expected that down-drag effects can be accommodated where piles are driven to refusal on rock.

Vibrations from driving adjacent H-piles are expected to have minimal effect on the adjacent existing CSXT Bridge. However, the existing bridge piles could present obstructions if the new bridge foundations are not offset a sufficient distance. Alternatively, it may be possible to incorporate portions of the existing bridge foundation to support part of the new bridge. A condition assessment of the existing foundation elements would be necessary.

Drilled shaft foundations were considered; however, drilled shafts could encounter installation difficulties due to the shallow groundwater table and the presence of sand layers in the clay soils. Full depth temporary casing and/or drilling slurry combined with wet drilling techniques may be necessary to successfully install drilled shafts.

Up to 45 feet of soft organic sediments underlie the proposed bridge and approach embankments. Organic soils are problematic due to their potential for long-term settlement regardless of the surcharge. Undercutting and replacement are not expected to be feasible due to the thickness of the organic soils and the shallow water table. Construction of the track structure should not begin until settlement of the new embankment has occurred. If excessive settlements or durations are expected, ground improvements measures may be necessary. Embankment subgrade settlement and the need for ground improvement must be evaluated during future geotechnical studies.

4.5. CSXT Bridge over Ohio Drive SW

On East Potomac Park Island, the existing two-track railroad alignment passes over Ohio Drive Southwest and is supported by a two-span steel-girder bridge originally constructed in 1905. The conceptual engineering plans[20] indicate the railroad alignment in this section may be expanded from two tracks to four tracks and the existing two-track bridge will be replaced with a new four-track bridge. Staged construction will be necessary to maintain railroad traffic during construction. The conceptual

[20] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.

plans indicate the railroad elevations in this section will be raised approximately 4 feet from EL +24 to EL +28 9 (NAVD88). Up to 24 feet of new fill will be placed to widen the embankment and raise the grade.

4.5.1. Site Subsurface Stratigraphy

Boring information is not available at the existing CSXT Bridge over Ohio Drive SW. The closest boring information comes from two boring logs shown on plans dated September 10, 1941[21], for the adjacent Tidal Basin Bridge carrying Ohio Drive SW over the Washington Channel, located approximately 450 feet north of the CSXT Bridge. One test boring was performed in the channel while the other was performed behind the south abutment on East Potomac Park Island. The logs contain a description of the subsurface stratigraphy but do not include Standard Penetration Tests (SPT) or laboratory test results. The subsurface stratigraphy is summarized in **Table 4-5**. Test boring logs from the original construction of the adjacent Tidal Basin Bridge are included in Appendix 5.

Table 4-5 | Subsurface Stratigraphy – CSXT Bridge over Ohio Drive SW

Stratum[1]	Top of Strata[2]	Soil Description
Fill (F)	Ground Surface	Sandy Loam and fine brown Sand, some concrete and gravel
Alluvial Deposits (A)	EL -4.4 to EL -13.1	Silt, black, with varying amounts of sand and gravel. Likely contains organic matter
Potomac Formation (P)	EL -79.3 to N/E[3]	Sand and Gravel, slight blue clay binder
Disintegrated Rock (D)	EL -95 to EL -96	Disintegrating Rock, decaying Rock
Bedrock (R)	N/E[3,4]	Bedrock not encountered, historic rock contour map and nearby borings indicate bedrock between approximately EL -100 to EL -110

Notes:
1. Stratigraphy estimated from soil descriptions provided on the above referenced boring logs
2. Elevations reference D.C. Engineer's Plane of Reference (DCE)
3. N/E = Not Encountered
4. Bedrock not encountered above the boring termination elevations of EL -97.4 and EL -105.4

4.5.2. Existing Bridge Foundation

The existing bridge carrying the CSXT tracks over Ohio Drive SW is a 108-feet long, two span, and steel-girder bridge originally constructed around 1905. The bridge is supported by a pier in the median of Ohio Drive SW. The abutments, wing walls, and piers are supported by plump timber piles extending through the soft alluvial soils to tip elevations between EL -71.5 to EL -74.5 (DCE). The existing plans do not indicate a pile size or capacity. The pile cap subgrade elevations are indicated as EL -6.0 (DCE) for the north abutment and pier, and EL -8.0 (DCE) for the south abutment.

[21] Tidal Basin Bridge, Plan and elevation, dated September 1941, prepared for the Office of the Engineer Commissioner, DC

4.5.3. Geotechnical Issues

Up to 24 feet of new embankment fill will be required to widen and raise the existing approach embankments to support the four-track alignment. The new embankment section must be keyed into the existing embankment section while maintaining site drainage. The new fill will cause settlement of the embankment subgrade, resulting in down-drag on the new foundations. Over the existing embankment footprint, only approximately 4 feet of new fill will be required to raise the track subgrade. The difference in fill height across the widened embankment could result in a differential settlement between the new and existing embankment.

4.5.4. Geotechnical Recommendations

The new bridge could be supported on 14-inch steel H-piles driven to refusal on rock, estimated between EL -100 and EL -110 (NAVD88). HP14x73 grade 50 steel piles could provide factored geotechnical resistances of 250 to 350 kips. The expected approach embankment settlement could cause down-drag on the abutment piles and should be considered in future geotechnical studies. It is expected that down-drag effects can be accommodated where piles are driven to refusal on rock.

The existing bridge foundations could present obstructions of the new bridge piles. Because details about the existing foundation are unknown, future investigations should identify the existing foundation type, layout, and configuration (i.e. pile batter and direction) so the new foundations can be offset a sufficient distance to avoid conflict.

Drilled shaft foundations were considered; however, drilled shafts could encounter installation difficulties due to the shallow groundwater table and the presence of sand layers in the clay soils. Full depth temporary casing and/or drilling slurry combined with wet drilling techniques may be necessary to successfully install drilled shafts.

Up to 45 feet of soft organic sediments underlie the proposed bridge abutments that will settle under the weight of the new embankment. Organic soils are problematic due to their potential for long-term settlement regardless of the surcharge. Undercutting and replacement are not expected to be feasible due to the thickness of the organic soils and the shallow water table. Construction of the track structure should not begin until settlement of the new embankment has occurred. If excessive settlements or durations are expected, ground improvements measures may be necessary. Embankment subgrade settlement and the need for ground improvement must be evaluated during future geotechnical studies.

4.6. CSXT Bridge over Washington Channel

The CSXT Bridge over the Washington Channel is a historic, 150-ft long two-span steel girder bridge carrying two tracks of the CSXT railroad over the Washington Channel between the East Potomac Park Island and the southwest DC region. The bridge pier is founded in the Washington Channel. The conceptual plans indicate the railroad alignment in this section may be expanded from two tracks to four tracks and the existing two-track bridge will be removed and replaced with a new four-track bridge. Staged construction will be necessary to maintain railroad traffic during construction. The conceptual engineering plans[22] indicate the railroad elevations in this section will be raised approximately four feet from EL +24 to EL +28 (NAVD88). Up to 28 feet of new fill will be placed to raise the grade and widen the embankment for the new approaches.

4.6.1. Site Subsurface Stratigraphy

Boring information is not available at the existing CSXT Bridge over the Washington Channel, however two borings logs are found on the original plans dated September 10, 1941[23], from the adjacent Tidal Basin Bridge carrying Ohio Drive SW over the Washington Channel, located approximately 150 ft west of the CSXT Bridge over the Washington Channel. One test boring was performed in the channel while the other was performed behind the south abutment on East Potomac Park Island. The logs contain a description of the subsurface stratigraphy but do not include Standard Penetration Tests (SPT) or laboratory test results. The subsurface stratigraphy is summarized in **Table 4-6**. Test boring logs from the original construction of the adjacent Tidal Basin Bridge are included in Appendix 5.

Table 4-6 | Subsurface Stratigraphy – CSXT Bridge over Washington Channel

Stratum[1]	Top of Strata[2]	Soil Description
Fill (F)	Ground Surface	Sandy Loam and fine brown Sand, some concrete and gravel
Alluvial Deposits (A)	EL -4.4 to EL -13.1	Silt, black, with varying amounts of sand and gravel. Likely contains organic matter
Potomac Formation (P)	EL -79.3 to N/E[3]	Sand and Gravel, slight blue clay binder
Disintegrated Rock (D)	EL -95 to EL -96	Disintegrating Rock, decaying Rock
Bedrock (R)	N/E[3,4]	Bedrock not encountered, historic rock contour map and nearby borings indicate bedrock between approximately EL -100 to EL -110

Notes:
1. Stratigraphy estimated from soil descriptions provided on the above referenced boring logs
2. Elevations reference D.C. Engineer's Plane of Reference (DCE)
3. N/E = Not Encountered
4. Bedrock not encountered above the boring termination elevations of EL -97.4 and EL -105.4

4.6.2. Existing Bridge Foundation

The existing CSXT Bridge over the Washington Channel was originally constructed in 1891 and replaced in 1904 with the existing 150-ft long two span steel-girder bridge. The bridge was rehabilitated in 1931. The available plans[24] indicate the existing bridge is supported on deep foundations. However, the foundation types, lengths or tip elevations are not indicated. The original abutment foundations were abandoned behind the new abutments. It is not clear from the plans if the original pier foundations

[22] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.
[23] Tidal Basin Bridge, Plan and elevation, dated September 1941, prepared for the Office of the Engineer Commissioner, DC
[24] Washington Channel of the Long Bridge, dated 1891-1905, prepared for the US Engineer Office.

were reused or abandoned in-place. A concrete strut is shown to extend along the bottom of the channel between the abutments and piers, between EL -10.0 and EL -4.0 (DCE). The available plans indicate the abutment walls vary from 27 ft to 28 ft tall and the pile cap subgrade elevations are indicated at EL -10 (DCE) for the abutments and pier.

The available plans do not indicate the presence of any buried submarine cables below the Washington Channel. However; the submarine cables which are expected to extend below the Potomac River may continue below the Washington Channel.

4.6.3. Geotechnical Issues

Abandoned foundations from the original bridge may be present behind the existing abutments and around the existing pier. The new bridge foundations will need to avoid the existing and abandoned bridge foundations to prevent obstructions while installing the new bridge foundations. Alternatively, the existing and/or abandoned foundations will need to be removed. Submarine cables, if present, will need to be avoided or relocated.

Up to 28 feet of new embankment fill is planned to widen the existing approach embankments to support the four-track alignment. The new embankment section must be keyed into the existing embankment section while maintaining site drainage. Due to the soft, organic sediments below the embankments, the significant post-construction settlement could occur. The difference in fill height across the widened embankment could result in a differential settlement between the new and existing embankment. The embankment settlement could result in down-drag loading on the new foundations.

4.6.4. Geotechnical Recommendations

The new bridge could be supported on 14-inch steel H-piles driven to refusal on rock, estimated between EL -100 and EL -110 (NAVD88). HP14x73 grade 50 steel piles could provide factored geotechnical resistances of 250 to 350 kips. The expected approach embankment settlement could cause down-drag on the abutment piles and should be considered in future geotechnical studies. It is expected that down-drag effects can be accommodated where piles are driven to refusal on rock. Potential scour needs to be evaluated in future design.

Soft organic sediments underlie the proposed bridge and approach embankments. Organic soils are problematic due to their potential for long-term settlement regardless of the surcharge. Undercutting and replacement are not expected to be feasible due to the thickness of the organic soils and the shallow water table. Construction of the track structure should not begin until settlement of the new embankment has occurred. If excessive settlements or durations are expected, ground improvements measures may be necessary. Embankment subgrade settlement and the need for ground improvement must be evaluated during future geotechnical studies.

New piers in the channel could be supported by 36-inch square pre-stressed concrete piles. Full-length pre-stressed concrete piles could be barged to the site. Pre-stressed concrete piles are also generally more resistant to weather and corrosion than steel piles. 36-inch square pre-stressed piles could achieve factored geotechnical resistances of 1,000 to 1,200 kips when driven approximately 40 feet into the dense soils of Strata Q or P, to tip elevations between approximately EL -70 to EL -80 (NAVD88).

Alternatively, larger spun-cast pre-stressed concrete cylinder piles could be driven to even higher factored resistances, requiring fewer piles per pier. Cylinder piles can also extend directly into the superstructure support, avoiding the need for a pile cap. Cylinder piles are typically available at diameters of 36, 42, 54, or 66 inches, depending on the manufacturer. 66-inch diameter spun-cast cylinder piles could achieve 1,500 to 1,700 kips of factored geotechnical resistance when driven approximately 40 feet into the dense soils of Strata Q or P, to tip elevations between approximately EL -70 to EL -80 (NAVD88). Large diameter spun cast piles will likely need to be driven unplugged, so the piles can reach the desired elevations. If the pile plugs during driving, the pile interior may need to be cleaned.

The estimated factored pile resistances described above use a geotechnical resistance factor of 0.65 and consider that the nominal resistance of the piles during driving will be measured using dynamic pile testing equipment with signal matching techniques. Static load tests, performed on at least one pile per site condition and dynamic testing of at least two piles per site condition but no less than 2 percent of the production piles could allow the use of a higher geotechnical resistance factor (0.80 vs. 0.65) and result in increased factored pile capacities than if only dynamic pile testing was used.

A drivability analysis of the piles should be performed on the selected pile type and size during final design to demonstrate that available pile hammers can install the piles to the necessary nominal capacities and desired depths without exceeding the permissible driving stresses. Specialty heavy hammers such as a Vulcan V060 or V5100 may be necessary to install the large diameter spun-cast cylinder piles. The final pile design must consider the pile spacing. If the piles are spaced closer than 2.5B, where B is the center-to-center distance between the piles, the factored geotechnical resistance must be reduced to account for group effects.

4.7. CSXT Bridge over Maine Avenue SW

In southwest DC, the existing two-track railroad alignment passes over Maine Avenue SW and Maiden Lane and is supported by a five-span steel-girder bridge. The bridge is approximately 160 feet long and is supported on two abutments, two piers, and six columns. The bridge abutments also support an existing pedestrian bridge with its own piers on the east side of the existing two-track bridge. The south abutment wall includes a retaining wall along the west side of the south approach ramp to provide grade separation between the railroad embankment and the adjacent ramp for Maine Avenue. The east side of the south approach is supported by an embankment slope. The north abutment consists of a concrete retaining wall north of Maiden Lane. The pedestrian bridge is a four-span steel-girder bridge supported on two abutments, one pier, and four columns.

The conceptual plans[25] indicate the railroad alignment in this section will be expanded from two tracks to four tracks and the existing two-track bridge will be removed and replaced with a new four-track bridge. The addition of two new tracks will require relocation or replacement of the existing pedestrian bridge. Staged construction will be necessary to maintain railroad traffic during construction. The conceptual plans indicate the railroad grades in this section will be raised approximately 3 feet from

[25] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.

approximately EL +25 to EL +28 (NAVD88). Up to 25 feet of new fill will be placed to widen the embankment and raise the grade.

4.7.1. Site Subsurface Stratigraphy

Four test borings, 1 through 4, were performed near the existing bridge to support the 1943 renovation and their logs are included on the original bridge construction plans[26]. The logs show the bridge is founded on existing fill extending from the ground surface to between EL 0 and EL -14 (DCE). The existing fill is underlain by interbedded deposits of sand, gravel, silt, and clay extending to the bottom of the borings. The logs contain soil descriptions but do not include Standard Penetration Tests (SPT) or laboratory test results. Groundwater levels are not indicated on the boring logs but are likely controlled by the level of the adjacent Potomac River.

Selected sheets from the original bridge construction plans[26] showing the boring logs are included in Appendix 6. The subsurface stratigraphy and available data are summarized in **Table 4-7**. The boring logs do not include enough information to identify the soil stratum; however, differentiate the stratigraphy is generally differentiated based on the available soil descriptions and a comparison to nearby boring data.

Table 4-7 | Subsurface Stratigraphy – CSXT Bridge over Maine Avenue SW

Stratum	Top of Strata Elevation[1]	Soil Description[2]
Artificial Fill (F)	Ground Surface	**Gravel, Sand, Clay,** with varying amounts of cinders, coal, shells, bricks, tile, and ash
Undifferentiated Deposits	EL 0 to EL -14	**Sand, Gravel, Silt**, gray, brown, and yellow, with varying amounts of **organics**, clay, gravel, and silt (possible Alluvial Deposits)
Undifferentiated Deposits	EL -15 to EL -40	**Sand, Gravel, Silt, Silty Clay, Clay**, gray, brown, reddish brown (possible Quaternary Deposits)
Undifferentiated Deposits	EL -50 to EL -60	**Sand, Clay, Silty Clay**, gray, greenish-gray, white, blue (possible Potomac Formation)
Bedrock (R)	N/E[3]	Bedrock not encountered, historic rock contour map shows bedrock is between approximately EL -100 to EL -110
Notes:	1. Elevations reference D.C. Engineer's Plane of Reference (DCE) 2. Soil description from original plans, not in accordance with USCS 3. Bedrock not encountered above the boring termination elevations of EL -85.3 and EL -97	

4.7.2. Existing Bridge Foundation

The existing CSXT Bridge over Maine Avenue SW was originally constructed in 1905 and was renovated in 1943 to lengthen the bridge by moving the abutment to the south and adding new piers. The available

[26] Plan of Proposed Extension Maine Avenue Underpass East of 14th St. SW, under Penn RR, dated May 1943, approved by the Corps of Engineer USA Engineer Commissioner for the Office of the Engineer Commissioner DC., and
Plans of Water Street Bridge North of Washington Channel, Washington, D.C., dated January 1905

plans indicate the existing bridge is supported on deep foundations. The original piers and abutments from the 1905 construction are supported by round, plumb piles that could be timber or concrete. The plans do not indicate the piles type, size, or length for the original piles.

The plans from the 1943 renovation indicate the new piers, retaining wall, and abutment are supported by round, concrete piles. The south abutment and associated retaining walls vary from 10 ft to 19 ft tall and are supported on a combination of plumb and battered piles. Pile batter is indicated as 3H:12V. Piers 1 through 3 appears to be founded on plumb piles. The plans indicate the piles are tipped between elevations EL -13.8 to EL -64.5 (DCE), typically deeper near the Washington Channel. The plans do not indicate the pile size.

The plans do not indicate if the original foundations were removed or abandoned in-place. The available plans indicate the abutment walls vary from 27 ft to 28 ft tall and the pile cap subgrade elevations are found between EL 1.5 and EL 1.6 (DCE).

The available plans do not indicate the presence of any buried submarine cables below the Washington Channel. However; the submarine cables which are expected to extend below the Potomac River may continue below the Washington Channel.

4.7.3. Geotechnical Issues

The conceptual engineering plans[27] show a proposed four-track bridge and the pedestrian bridge to be relocated in order to accommodate the additional track alignments. Accommodating additional tracks may require the realignment of the existing piers and columns. New tracks cannot be installed without relocating the pedestrian bridge.

The limited vertical clearance and the requirement to maintain traffic on the rails and on Maine Avenue during construction will present challenges and may be prohibitive to the use of conventional piles or drilled shafts. The limited clearance and the maintenance of traffic could prevent driving piles and excavating drilled shafts and thus micropiles may be the preferred alternative. New foundations constructed near the previous temporary trestle may encounter buried substructures from this structure and consideration should be given to offsetting new foundations away from these potential obstructions.

4.7.4. Geotechnical Recommendations

Micropile foundations are recommended to support the relocated piers. The drill rig used for micropile installation is smaller than typical drilled shaft rigs and can more easily operate in low-clearance environments. A significant advantage of using micropiles is that the installation often uses continuous casing with rotary percussion drilling methods, and can be installed through gravels and below the water table while maintaining borehole stability and without causing excessive vibrations.

Micropiles typically develop their capacity in side friction. Often, due to their small size and construction methods, end-bearing is neglected. Micropiles are typically 6 inches to 12 inches in

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[27] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.

diameter. For preliminary estimating, 7 to 9-5/8 inch diameter micropiles are expected to support an allowable capacity between approximately 60 kips to 80 kips. The micropiles would extend approximately 20-ft into coarse-grained Quaternary Deposits or Potomac Formation soils. Post grouting of the micropiles may be necessary to fully develop the bond capacity of the micropile.

4.8. Maryland Avenue SW Viaduct Over CSXT

In southwest DC, the existing CSXT railroad alignment passes below a steel-girder viaduct structure supporting Maryland Avenue SW east of 12th Street SW, including the Maryland Avenue SW traffic circle and Linear Park. The viaduct was constructed in several phases. Phase I was originally constructed in 1989 and subsequently expanded to the north during Phase II. The viaduct extends approximately 668 feet long and divided into 10 'bays' and is supported by one abutment and five rows of reinforced-concrete multi-column piers with integrated crash walls.

Two existing main tracks extend below the Maryland Avenue SW viaduct between Piers 2 and 3, while a third spur track extends between Piers 1 and 2 and ties into the main tracks east of the deck-over structure. The original plans[28] indicate the existing spur track may be as much as 2 feet higher in elevation than the existing main tracks, with the grade difference retained by the crash wall integrated with Pier 2. The existing main tracks are identified as Tracks A (south track) and B (north track) in the original plans and as Tracks 2 and 3 in the conceptual plans.

The conceptual engineering plans[29] show that the existing track alignment in this area will be expanded to four through-tracks with no spur track. Tracks 1 through 3 will share one bay, while Track 4 will be in a second bay. The crash walls will be widened, but no impacts to the existing viaduct structure or foundations are expected.

4.8.1. Site Subsurface Stratigraphy

Four test boring logs, B-9, B-10, B-13, and B-17, are included on the original plans[30] of the deck-over bridge. The plans indicate that the test borings were performed near 14th & D Street SW, however, a boring location plan is not available. The logs contain a description of the subsurface stratigraphy, Standard Penetration Test (SPT) results, and unconfined compressive strengths from selected samples using a penetrometer. Groundwater is not indicated on the logs. Excerpts of the original plans showing the boring logs are included as Appendix 7. The available subsurface stratigraphy is summarized below in **Table 4-8**.

The Geotechnical Engineering Report dated August 12, 1999, prepared by Schnabel Engineering Associates[31] to support the original design and construction of the adjacent Mandarin Oriental Hotel,

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[28] Construction Plans for Maryland Avenue Over Conrail, dated July 1989, prepared by Dewberry and Davis for The Portals Development Associates.
[29] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.
[30] Construction Plans for Maryland Avenue Over Conrail, dated July 1989, prepared by Dewberry and Davis for The Portals Development Associates.
[31] Geotechnical Engineering Report, dated August 1999, prepared by Schnabel Engineering for the Mandarin Oriental Hotel at the Portals, Maryland Avenue, SW Washington DC.

was also reviewed. The Geotechnical Engineering Report for the Mandarin Oriental Hotel is included in Appendix 8. Seven test borings were performed to support the design of the hotel and water observation wells were installed in two of the borings. Groundwater was observed in the wells at approximately EL -2 (DCE) during 1989. Water levels at the site are expected to closely follow the adjacent Potomac River due to the relatively permeable sands observed in the test borings. The subsurface stratigraphy is summarized in **Table 4-8**.

Table 4-8 | Subsurface Stratigraphy – Maryland Avenue

Stratum	Top of Strata Elevation[1]	Soil Description[2]	Available Data
Artificial Fill (F)	Ground Surface	Medium dense **Clayey Sand** and **Silty Sand**, brown and black, fine to coarse sand, trace gravel and clay. Observed in two borings.	N Value: 12 to 17
Coarse-grained Quaternary Deposits (Q)	EL +16.5 to EL +19.6	Medium dense to very dense **Sand** and **Gravel**, brown, orange-brown, and reddish-brown, fine to coarse sand, varying amounts of gravel, silt, and clay.	N Value: 19 to 64
Fine-grained Quaternary Deposits (Q)[3]	EL +2 to EL -2.4	Soft to medium stiff **Silt**, blackish gray, with varying amounts of fine sand and traces of gravel and cobbles. Observed between 4.4 and 15.5 ft thick.	N Value: 3 to 7
Coarse-grained Quaternary Deposits (Q)	EL -2.4 to EL -10.9	Medium dense to very dense **Sand** and **Gravel**, brown, orange-brown, and reddish-brown, fine to coarse sand, varying amounts of cobbles, gravel, silt, and clay.	N Value: 15 to 100+
Potomac Formation (P)[4]	EL -37 to EL -47.6	hard **Silty Clay** and dense to very dense **Clayey Sand**, blue-gray, greenish gray, and brown, varying amounts of fine sand, traces of silt and fine	N Value: 40 to 100+ Pen.: 4.5 tsf +
Bedrock (R)	Not Encountered[5]	Bedrock not encountered, historic rock contour map shows bedrock is between approximately EL -100 to EL -110	--
Notes:	1. Elevations reference D.C. Engineer's Plane of Reference (DCE) 2. Soil description from original plans, not in accordance with USCS 3. Typical N Values, one SPT N value was 31 and may have been affected by gravel 4. Typical N Values, one SPT N value was 18 5. Bedrock not encountered above the boring termination elevations of EL -97.3 and EL -97.6		

4.8.2. Existing Foundation

The original plans[32] prepared by Dewberry & Davis in 1989 for the Maryland Avenue over Conrail indicate that the Phase I Maryland Avenue SW viaduct consists of a steel-girder deck-over bridge

[32] Construction Plans for Maryland Avenue Over Conrail, dated July 1989, prepared by Dewberry and Davis for The Portals Development Associates.

supported by one abutment and five rows of reinforced-concrete multi-column piers with integrated crash walls. Plans for Phase II are not available.

Bays 1 and 2, on the west side of the viaduct, are supported by Piers 1 through 4 and abut the Mandarin Oriental Hotel to the south. Bays 3 and 4 are supported by Piers 1 through 5, while Bays 5 through 10 are supported by Piers 1 through 3 and a stub abutment along the south side that is generally in-line with Pier 4. The abutment is founded at the top of a 1.5H:1V slope that extends from between EL +41.6 and EL +33.5 (DCE) at the abutment to between EL +23.4 and EL +14.6 (DCE) where the toe of the slope is retained by the crash wall integrated with Pier 3.

The piers and abutment are supported on a combination of plumb and battered 70 ton to 90 ton HP12X53 driven steel piles. The plans indicate some piles are in tension. Design batter angles vary between 3H: 12V and 4H:12V. Pile cap subgrades at the piers vary from EL +5.8 to EL +15.7 (DCE). Pile cap subgrades at the abutments vary from EL +30.1 to EL +41.2 (DCE). The piles are indicated to be driven up to the specified bearing capacity at an estimated pipe tip elevation of EL -60 (DCE).

The original plans indicate the minimum vertical clearance above the existing main tracks between Piers 2 and 3 varies from a minimum of 21.0 feet to 25.1 feet. Through vertical clearance is not indicated above the spur track.

4.8.3. Geotechnical Issues

Minor impacts to the existing structures are expected to accommodate the proposed track alignment with no impacts to geotechnical considerations.

4.9. 12th Street SW Bridge over CSXT

In southwest DC, the existing CSXT tracks pass below a steel-girder two-span bridge carrying 12th Street SW that was completely reconstructed around 1985. The conceptual engineering plans[33] show that the existing track alignment in this area will be expanded to four through-tracks with no spur track. No impacts to the existing structures are expected to accommodate the proposed track alignments.

4.10. 12th Street Expressway Bridge over CSXT

In southwest DC, the existing railroad alignment and D Street Southwest pass below a steel-girder bridge structure supporting the 12th Street Expressway and the ramp from the 12th Street Express to D Street Southwest. The conceptual engineering plans[33] show that the existing track alignment in this area will be expanded from three tracks to four through-tracks with no spur. No impacts to the existing structures are expected to accommodate the proposed track alignments.

4.11. L'Enfant Plaza SW Bridge over CSXT

In southwest DC , the existing railroad passes below a steel-girder two-span bridge structure supporting the L'Enfant Plaza Southwest. The conceptual engineering plans[33] show that the existing track alignment

[33] Plans of Proposed Conceptual Engineering of Long Bridge Corridor Track Alignments and Bike-Pedestrian Connection, Draft For CSXT Review, dated Oct. 19, 2018, prepared by VHB and HNTB for the District of Columbia Department of Transportation.

in this area will be expanded from three tracks to four tracks and will include part of the L'Enfant North track interlocking. No impacts to the existing structures are expected to accommodate the proposed track alignments.

4.12. General Recommendations

4.12.1. Embankments and Slopes

Widening and raising of existing embankments are planned. Existing fill slopes vary from approximately 1.5H:1V to 4.5H:1V. Most of the slopes are covered with vegetation or stone. Evidence of sloughing or severe erosion was not observed and slopes appear to be performing satisfactory. Fill slopes of 2H:1V to 3H:1V are expected to be feasible depending on the fill materials proposed to construct the slopes and soils below the planned embankments. The new embankment section must be keyed into the existing embankment section while maintaining site drainage.

Where steeper slopes are required to stay within the right of way, reinforced slopes may be constructed. These slopes utilize geogrids placed in layers within the fill soils to provide lateral support.

Cut slopes in existing fills or quaternary deposits materials are expected to be feasible at 2H:1V to 3H:1V. Future subsurface explorations should verify the presence of Potomac Group clays. Although not expected based on the current subsurface data, cuts in this formation would need to be shallower at 3H:1V or 3.5H:1V, if encountered. In these areas, retaining walls may be more practical.

As discussed in the bridge sections, soft alluvial soils are present throughout the alignment, particularly below East Potomac Park Island. The weight from the new embankments will cause settlement of the underlying soft soils. Waiting periods may be required to allow the settlements to dissipate prior to track construction. Where excessive waiting times are not practical, the subgrade soils are organic, or where slope stability issues occur due to these soft soils, ground improvement may be necessary to reduce the settlement time or magnitudes.

4.12.2. Retaining Walls

Retaining walls may be constructed where the embankment widening will not fit within the right of way. In fill sections, MSE walls may be a feasible option where the subgrade consists of Quaternary deposits soils or thin deposits of nonorganic soils with short wall heights. Retaining walls planned over alluvial soils, may need to be built in stages or with ground improvement. Cast in place walls may need to be supported on piles when located in areas of alluvial deposits. Locations of alluvial soils are shown on **Appendix 1, Figure 1** and should be expected near the Potomac River, Washington Channel, and East Potomac Park Island.

Shifting of the track alignment may impact existing retaining walls. These walls must be evaluated for condition and stability.

4.12.3. Underground Utilities

Construction of new tracks and placement of new fill will create additional stress and possible settlement of utilities. An inventory of these utilities should be made during future design phases and assessments made to determine what protection measures may be required. Protection measures may include relocation, replacement, protection slabs, lining, ground improvement and/or use of lightweight fill.

5.0 Recommended Future Studies

The conclusions and recommendations provided are based on historical subsurface data and construction records. It is assumed that the data was accurate at the time it was made. However, the data is very old and the passage of time (grading, climate change, etc.) likely altered the subsurface conditions, especially the near surface soils. Furthermore, the subsurface data was limited in nature and lacks geologic data, standard penetration test data, hammer type, and laboratory testing data. In some instances, there are no borings at the locations of interest. Uncertainty remains in some of the existing structures regarding the foundation sizes, lengths, capacities, condition and taper, and the soil corrosively potential is unknown across the site. The conclusions and recommendations herein are based on this data and were prepared to guide preliminary planning, cost estimating and identify potential geotechnical challenges that should be addressed in future studies.

A supplemental phased subsurface exploration and testing program should be performed during the next phase of the project to verify the assumptions, conclusions, and recommendations for final design. Particular attention should be made to the items discussed in the following sections.

5.1. Soil and Groundwater Properties

Test borings for final design should be performed along the proposed track alignment at 500-foot intervals with closer spacing at larger embankment heights and bridge approaches. Undisturbed samples should be obtained for consolidation, strength, and organic content testing. In-situ testing should be considered where obtaining quality undisturbed samples is difficult. This will be critical to understanding long-term embankment performance and identifying the need and extent of waiting periods, surcharging and/or ground improvement.

Test borings should be performed for all new structures to provide foundation recommendations. The program should satisfy AASHTO, AREMA, DDOT and WMATA requirements where appropriate.

Sampling and testing of the corrosion potential of the subsurface soils with regard to buried steel and concrete should be performed across the site. The sample locations should consider the subsurface stratigraphy because the corrosion potential is affected by the type of soil and groundwater conditions. Samples should be obtained from the ground surface to below the water table to capture potential corrosive zones. A project corrosion consultant is recommended to provide input to the subsurface sampling and testing plan.

The groundwater table could affect the location of any potential corrosion zone or impact temporary excavations during construction. Monitoring wells or piezometers could be installed in completed boreholes to evaluate the current stabilized groundwater levels and where excavations are expected.

5.2. Foundation Properties and Condition

If the foundations of the existing railroad track bridges are planned to be reused, a targeted exploration should be performed at selected substructures. Excavations to reveal all or portions of the foundations is the most direct method of determining information about the existing foundation. Test pit excavations should be performed at selected foundation locations to verify the dimensions, grades, and conditions of pile caps, to verify the type, diameter, and taper of the underlying piles. Nondestructive testing should be performed to estimate the foundation lengths.

Additional test pits should be performed around foundation elements in areas identified as having a high potential for soil corrosion to look for damage or deterioration of either the pile cap concrete or steel. Probing with a small diameter rod may be effective at quickly identifying the depth of the top of pile caps or footings where test pits are not performed.

6.0 Limitations

Analyses and recommendations submitted in this report are based on the information revealed by the available surface data. The data available is not considered sufficient for the final design of this project. It is attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

This report was prepared to assist with the conceptual level design, planning, and preliminary budgets for this project. Future geotechnical investigations, testing, recommendations, and designs will be required during the preliminary and perhaps final design of this project. The scope of the future preliminary geotechnical investigation should be developed based on the preliminary designs for the project. The investigation should address the geotechnical issues identified in this report as well as geotechnical issues and considerations identified as the preliminary design progresses. Final geotechnical investigations, site tests, analyses, and reports may also be required to refine the preliminary study to satisfy the needs for the final design.

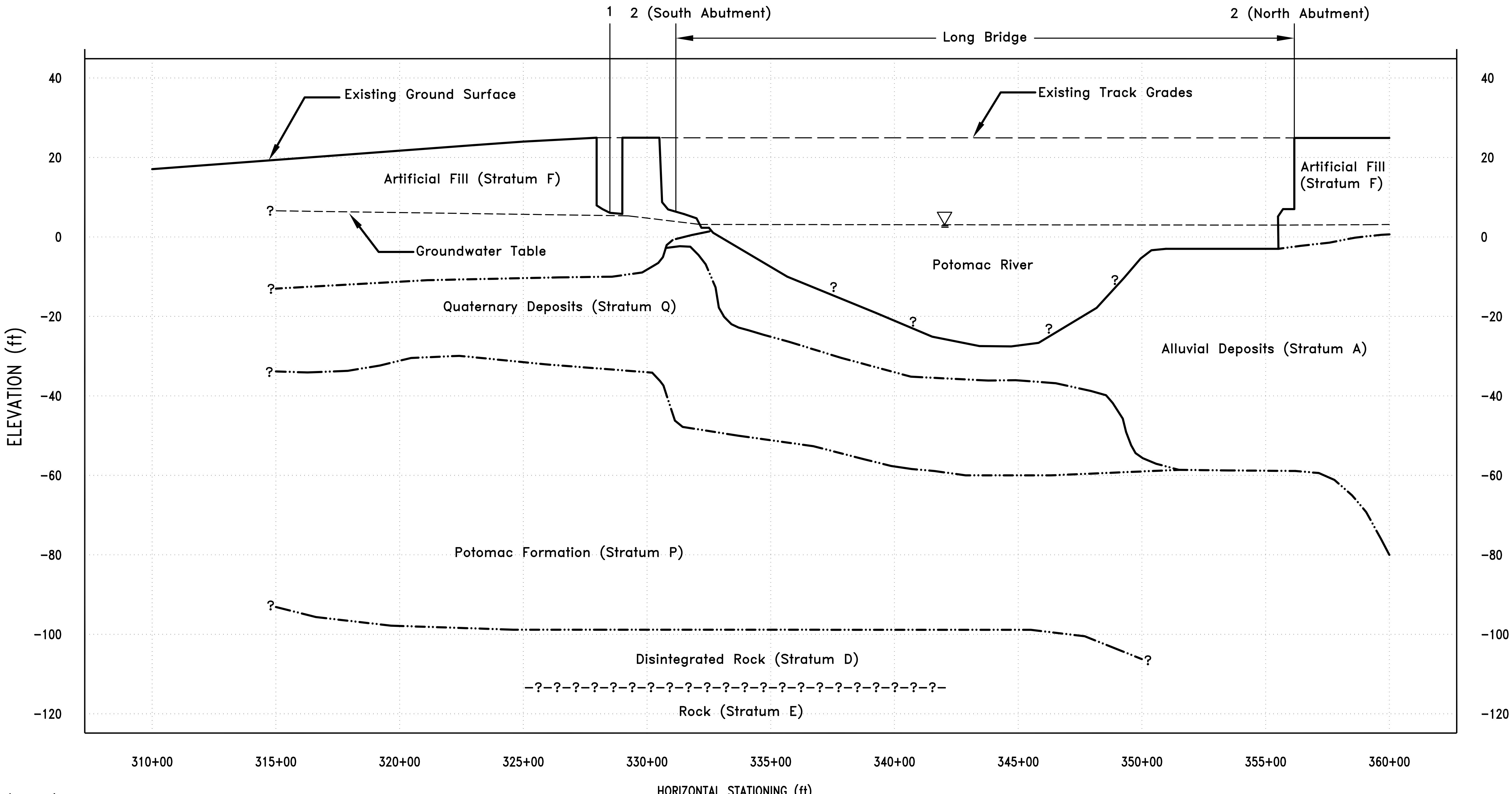
This report has been prepared to aid in the evaluation of this site and to assist in the design of the project. It is intended for use concerning this specific project. The conclusions are based on information on the site and construction as described in this report. The conclusions, recommendations, and designs are expected to be refined as additional data, investigations, and designs are completed.

The services identified were completed 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 report, or other instrument of service.

APPENDIX 1

Figure 1: Subsurface Profile

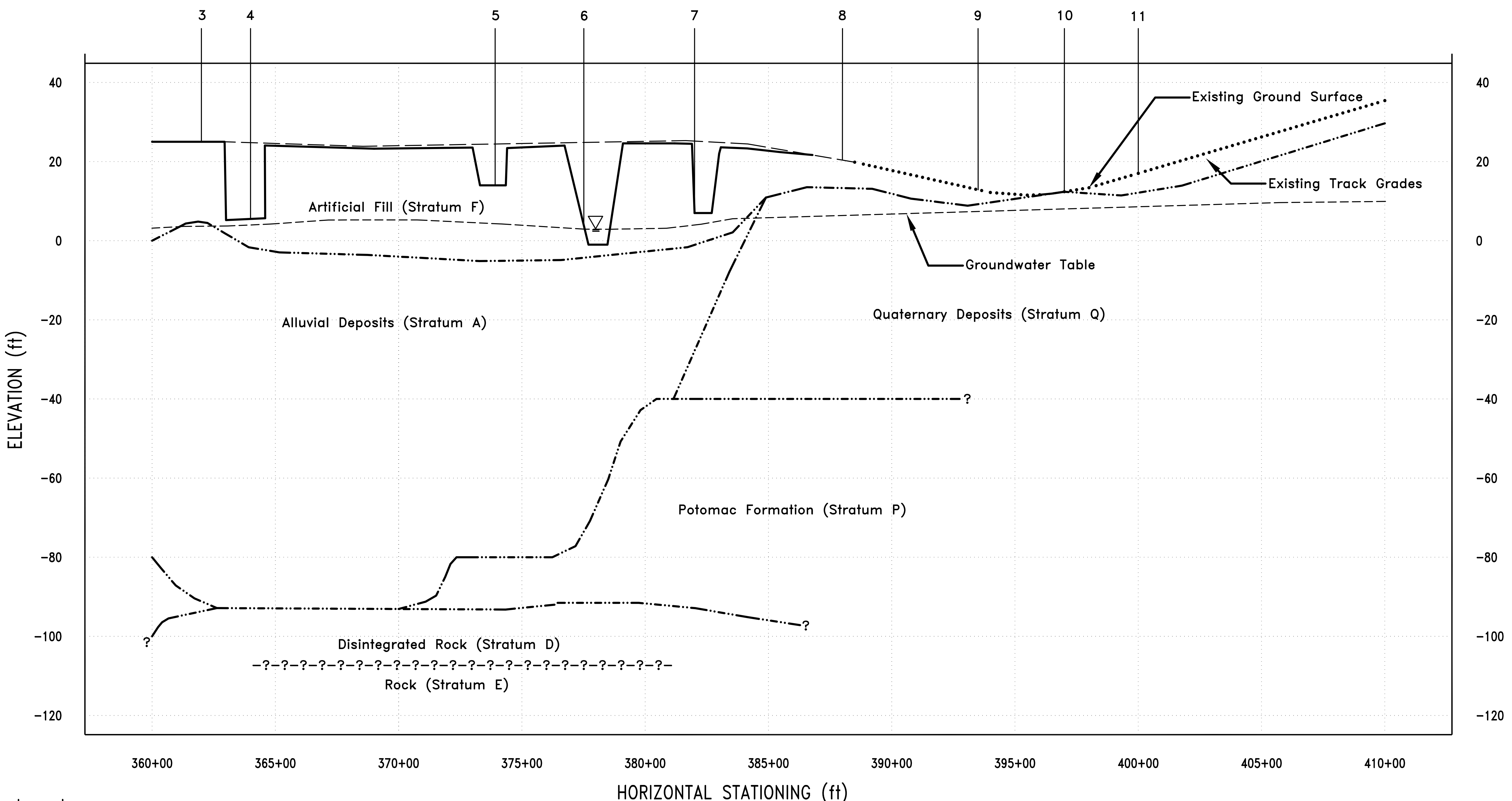
2 Sheets



Legend:
1 CSXT Bridge over GWMP
2 CSXT Long Bridge over the Potomac River
3 CSXT Bridge over WMATA Metro Yellow Line Tunnel and Tunnel Portal
4 CSXT Bridge over I−395
5 CSXT Bridge over Ohio Drive SW
6 CSXT Bridge over Washington Channel
7 CSXT Bridge over Maine Avenue SW
8 Maryland Avenue Deck over CSXT
9 12th Street SW Bridge over CSXT
10 12th Street Expressway Bridge over CSXT
11 L'Enfant Plaza SW Bridge over CSXT

? No Information Available

Schnabel ENGINEERING	LONG BRIDGE PROJECT EIS WASHINGTON, DC	SUBSURFACE PROFILE PROJECT NO. 17C12021.00 APPENDIX 1, FIGURE 1A



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LONG BRIDGE PROJECT EIS
WASHINGTON, DC

SUBSURFACE PROFILE

PROJECT NO. 17C12021.00
APPENDIX 1, FIGURE 1B

APPENDIX 2

SUBSURFACE EXPLORATION FOR WMATA METRORAIL SECTION L-1 L'ENFANT PLAZA – PENTAGON ROUTE

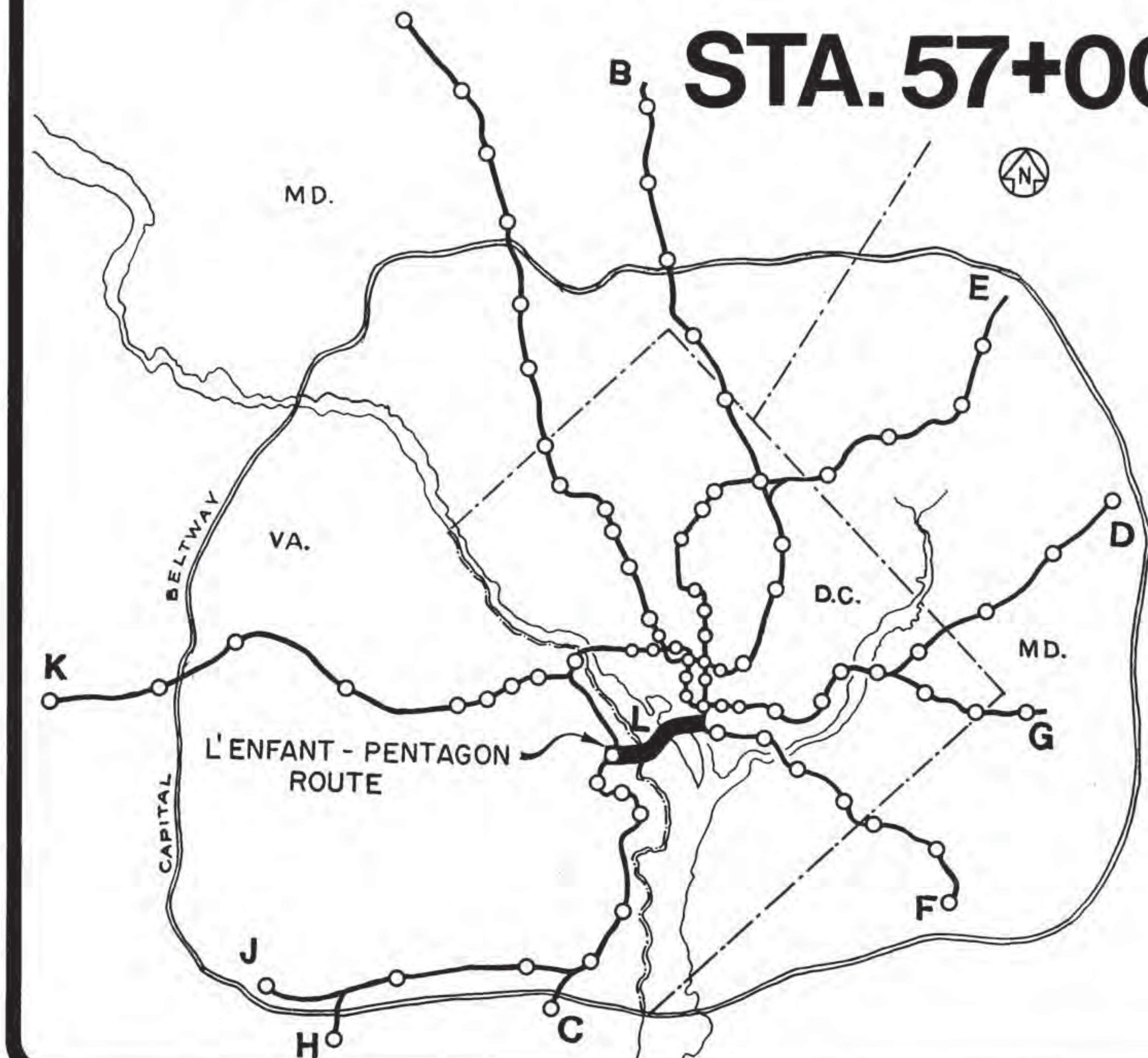
Final Report - Subsurface Investigation, L'Enfant – Pentagon Route,Sta. 57+00(L001) to 175+00(L002) dated December 1970, prepared for WMATA by Mueser, Rutledge, Wentworin & Johnston, General Soils Consultant

91 Sheets

FINAL REPORT - SUBSURFACE INVESTIGATION

L'ENFANT - PENTAGON ROUTE

STA. 57+00(LOOI) TO 175+00(LOO2)



metro
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

Mueser, Rutledge, Wentworln & Johnston
General Soils Consultant

New York, N.Y. December, 1970

FOREWORD

The subsurface investigation and foundation engineering studies for L'Enfant-Pentagon River Crossing Route of the Washington Metropolitan Area Rapid Transit System in Washington, D.C. were conducted by Mueser, Rutledge, Wentworth & Johnston. Mr. William H. Mueser and Dr. Philip C. Rutledge were the partners in charge of the project. Dr. James P. Gould, associate, was responsible for overall project supervision and Mr. Charles R. Heidengren, project engineer, directed a staff of engineers and geologists engaged in field investigations. This report is No. 46 of the series submitted by our office since the start of the exploration work and No. 10 in the series under the current engineering services contract. For ease of identification, the covers of the reports dealing with different routes of the Rapid Transit System have been color-coded, the color for L'Enfant-Pentagon Route being gray.

The work was carried out in coordination with DeLeuw, Cather and Company, the General Engineering Consultants for the project. Harry Weese and Associates are the General Architectural Consultants. During the course of this investigation, boring information, historical data, reference drawings, maps, surveys, technical reports and test data were made available to us by numerous organizations, both public and private. Acknowledgements and references to sources of information will be summarized in a separate submittal at the completion of this contract.

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LABORATORY TEST PLATES NOS. A1 THROUGH A57

1. INTRODUCTION

1.1 Authorization

This final report of the subsurface investigation of Sections L001 and L002 of L'Enfant-Pentagon River Crossing Route is submitted pursuant to the requirements of Contract No. 3Z7021, dated March 16, 1970, between the Washington Metropolitan Area Transit Authority (WMATA) and Mueser, Rutledge, Wentworth & Johnston, Consultant. The contract requires that the Consultant plan and supervise test boring investigations, perform laboratory tests, review proposed construction and design requirements and summarize the data developed with conclusions and recommendations in a series of final reports, each one covering certain design sections of the Rapid Transit System. Earlier subsurface investigations relating to the Sections L001 and L002 were summarized in the report, "Preliminary Subsurface Investigation, Adopted Regional System, 1968" submitted in February 1969.

1.2 Scope of Work

Borings for L'Enfant-Pentagon Route under this contract have been performed in two programs, including 15 borings by Warren George, Inc. in April and May 1970, and 22 borings by Sprague and Henwood, Inc. in September to November 1970. The total amounts of various categories of boring work are summarized in Table No. 1. Eight standpipe observation wells were installed in the borings for the purpose of continuing measurements of ground water levels through the period of the study and during design and construction and to facilitate the making of field permeability tests. Ordinary split-spoon samples and undisturbed soil samples recovered from the borings were transported to our New York laboratory for examination and performance of laboratory tests. Testing of soil and water samples relating to corrosion characteristics was performed by Value Engineering Laboratory of Alexandria, Virginia. The numbers of tests performed in each category are listed in Table No. 2. Based on the field and laboratory data, analytical studies were performed leading to recommendations for design which are presented in Chapter 8. A summary of the general criteria for design of foundations and underground structures is contained in Chapter 7.

1.3 Presentation of Data

The section of L'Enfant-Pentagon Route explored under this contract commences at the east at Station 57+00 at the intersection of Frontage Road and 7th Street S.W., turning to the west to cross Washington Channel, East Potomac Park, the Potomac River and continuing to join Huntington Route at Station 175+00 just east of Pentagon Station. The interpreted results of the field investigation are presented on a series of ten sheets which comprise a continuous geological section extending from the east to the west limits of this portion of the route. Engineering laboratory test results are summarized in Table No. 5 and detailed laboratory data are presented on series of plates bound at the end of this report. Corrosion test results are summarized on Table No. 6. Permeability and water pressure tests carried out in the exploration program are summarized in Table No. 7.

2. SUBCONTRACT BORING OPERATIONS

2.1 Boring Information

The locations of Borings Nos. L-1 through L-37U made for this study are shown in synoptic form on the General Location Plan, Drawing No. F-L-2. Boring ground surface elevations and coordinate locations are listed in Table No. 4. Surface elevations are referenced to U.S. Coast and Geodetic Survey mean sea level of 1929, which is designated as project datum. Horizontal control is based on the Maryland State Plan Coordinate System, adjusted for scale and elevation to the project grid. Information obtained from the exploration program is presented in summary on the geological sections in Drawings Nos. F-L-4 through F-L-13. Pursuant to the contract requirements, samples have been described and classified according to the Unified Soil Classification system. The principal features of this system are summarized on Table No. 3. Borings Nos. 1-1, 1-2U and 1-22 through 1-31, made in the preliminary subsurface investigation of the Regional System, are also plotted in these sections. Boring information from six studies made for other projects were utilized on the geological sections. The sources of these data are given in Table No. 9. Abbreviated logs of these borings are plotted on the geological sections and prints of original reports will be made available for inspection in the files of WMATA.

2.2 Availability of Boring Logs and Samples

Logs of all borings made in the current investigation are shown on Drawings Nos. F-1-14 through F-L-21. Prints of the original logs recorded by our field engineers were submitted to GEC during the course of the work. Boring logs presented in this report include the essential numerical data regarding depths of materials, casing blows, sample position and sampler penetration resistance, but in certain cases the description of samples or principal strata have been modified from the field logs and the Unified Soil Classification changed as a result of laboratory examination and testing. Independent logs were made by the boring subcontractor in accordance with specification requirements and prints of the contractor's logs are to be submitted to WMATA. These three versions of the boring logs are available for the reference in the Office of Engineering of the Washington Metropolitan Area Transit Authority. Section designers and bidders should consider each set of logs in making their own evaluation of subsurface conditions. Soil samples and rock cores obtained from the test borings made for this investigation are stored at the WMATA warehouse at 1st and L Streets N.E. The inventory has been arranged and designated according to the routes involved. During the laboratory testing program the majority of 3-inch thin-tube samples were utilized completely. However, the stored samples afford the opportunity for a practically complete appraisal of subsurface materials encountered in the investigation.

3. GEOLOGICAL CONDITIONS

3.1 Geological Setting

The boundary between two major geographic provinces of significantly different characteristics passes through the District of Columbia. The southeastern portion of the District lies in the "coastal plain" which consists of a broad belt of flat-lying sediments over deep bedrock. The northwestern portion of the district lies within the "Piedmont" province which comprises a relatively thin cover of overburden on crystalline bedrock, the surface of which dips to the southeast beneath the coastal plain deposits. The "fall line", which is a boundary between these two geographic units, runs southwest from a line along the Montgomery County boundary through Farragut Square, crossing the Potomac just north of Roosevelt Island and passing to the west roughly on the line of Spout Run north of Rosslyn. Sections L001 and L002 lie entirely within the coastal plain sediments and are characterized by a very substantial thickness of recent alluvium within the river crossing. In the following paragraphs the origin and general characteristics of the major groups of deposits are discussed. The engineering properties of individual strata which have been identified in the borings are described in Chapter 4.

3.2 Bedrock

Bedrock is variously described as "metamorphosed sedimentary rock" in the literature and as "schistose gneiss" in our studies. Bedrock was cored in these sections only in a zone at the west side of the Potomac River, between Elev. -100 and -110. It is probable that bedrock reaches a low at about Elev. -150 on this line beneath Washington Channel and rises to about Elev. -50 or -60 at the juncture with Huntington Route. In all areas the bedrock is overlain by thoroughly decomposed rock or "saprolite", which is essentially a hard or compact residual soil.

3.3 Cretaceous Deposits

The Cretaceous coastal plain sediments consist of a succession of wedged-shaped layers which were deposited in relatively shallow seas on the sloping bedrock surface by streams flowing eastward out of the contineital interior. The interfaces between successive Cretaceous formations dip towards the southeast and the wedges thicken in the same direction. The Cretaceous sediments are lenticular on a large scale as a result of changing conditions of deposition but are much more regular in stratification than the younger overlying soils. The lowermost Cretaceous strata are grouped in the Potomac formation and consist primarily of the Patuxent arkosic sands and Patapsco clays. Usually the basel Cretaceous deposit overlying decomposed rock is extremely coarse grained and bouldery.

3.4 Pleistocene Terrace Deposits

The uppermost natural sediments in the downtown Washington area comprise a succession of river terrace deposits of Pleistocene times which overlie the Cretaceous formation. A time gap of many million years is represented at the discontinuity between the two major groups of materials. These Pleistocene terraces consist of a mixture of silty and sandy clays with sands, interlayed and lensed in a complex pattern. While continental ice did not reach south to the Washington area the Pleistocene terraces were formed by debris carried in streams charged by glacial melt water flowing from the north and northwest. The complicated alternation of soils in the terrace is a result of successive changes of sea level and volume of runoff during periods of glaciation and interglacial stages. At the time of ice advance the level of sea fell with respect to the land, stream gradients increased and sediment load decreased, resulting in a period of erosion or down cutting. During recession of the glaciers, inflow increased,sea level rose and comparatively coarse gained materials were deposited. As the warming trend continued, the area was inundated and the finest grained sediments were laid down. A series of these flat-top terraces at several characteristic elevations have been identified in the Washington area. Each terrace exhibits a characteristic change in gradation in a vertical profile from coarse-grained and gravelly soils at its base to sands, silts and clays at shallower depths, corresponding to the change from low sea level at the start of ice retreat to high sea level at the warmest time of the interglacial period.

3.5 River Alluvium

Washington Channel, Potomac Park and the east half of the Potomac River is underlain by a thickness as great as 90 feet of slightly to moderately organic silty clay, comprising recent river alluvium. This sediment was deposited in post-glacial times in a broad channel cut down by flow from the upland at a time when sea level was several hundred feet below its present elevation. The channel appears to have been cut during several separate drops in sea level since there are steps in the west side of the channel between Elev. -30 and -50 and between Elev. -50 and -80. The deepest portion of the old channel is beneath the east line of Potomac Park and, surprisingly, very little of the recent alluvium is present beneath the west half of the Potomac River. All of these sediments, except the uppermost materials beneath open water, have been overconsolidated either by a drop of sea level at a later stage of deposition or by the presence of a greater height of sediment since removed by erosion.

3.6 Manmade Fill

Shallow fills from nearby natural soils cover the southwest Washington area and thicken toward the bulkhead structures lining Washington Channel. Approximately 10 feet of fill has been placed to form Potomac Park. The greater portion of the area west of the Potomac River to the Pentagon was under water or consisted of shoaling sand bars and fill up to about 30 feet in thickness has been placed throughout this area.

4. PRINCIPAL SUBSURFACE STRATA

4.1 Geological Section Drawings

The essential data needed for a continuous picture of subsurface conditions along the route are presented on a series of 10 geological section drawings, Nos. F-L-4 throught F-L-13, bound at the end of the text. The information noted thereon includes the following:

1. Location and depth of borings;
2. Position of soil samples and the value of standard sampler penetration resistance;
3. Position of rock cores, percentage core recovery and RQD values;
4. Unified Soil Classification of individual soil samples;
5. Natural water content and Atterberg limits of soil samples where available;
6. Shear strength values of soil samples tested;
7. Ground water levels observed in the borings; the position of pervious intake points surrounding observation wells; and the estimated equilibrium ground water table for the dates of the boring program;
8. Stratification lines separating the principal subsurface materials.

Each geological section is bounded by a vertical match line which is at the same position as the match line on the adjoining drawing. Centerline of outbound track, which is taken as the base line for the route is plotted on the strip map above each geological section. Stationing along that centerline is indicated on the strip map and on the geological section. The position of centerline, top of rail and stationing on the line were obtained from DeLeuw, Cather and Co. Drawings Nos. PP-R-113 to -115 which are dated November 1968.

4.2 Distribution of Principal Strata

An overall view of the distribution of the major groups of strata can be obtained from the generalized geological sections on Drawing No. F-L-3. This drawing reproduces in simplied form the information on the detailed geological sections, grouping the materials in the major categories of fill, river alluvium, Pleistocene terrace, Cretaceous Potomac, decomposed rock and bedrock. Each one of the major formations is divided into a series of strata whose engineering properties are generally consistent. The generalized strata descriptions are summarized on Drawing No. F-L-1. Properties of the soil samples tested are illustrated on the laboratory plates bound at the end of the report. Each of these plates identifies the principal strata from which the sample was obtained. Plasticity characteristics of clayey soils are plotted on four plasticity charts, Plates Nos. A1 to A4. Gradation characteristics of both fine grained and coarse grained strata are summarized on Plates Nos. A5 to A12. Each plate assembles grain size curves for samples from a particular stratum and the plates are arranged in order of increasing age starting with the most recent materials.

4.3 Description of Principal Strata

The subsoil strata are designed on geological sections and in the summaries of data by a letter-number combination which conforms to the usage followed in the previous investigations of other routes. These strata are described in the following subsections.

4.301 Stratum F, fill, generally inorganic soils obtained from nearby natural materials. The fill in southwest Washington is derived principally from the uppermost terrace deposits. It varies from silty clay to gravelly sand and a friction angle of 30^{o} can be assumed for this material. Fill covering East Potomac Park is highly variable, consisting chiefly of sand and gravel, frequently mixed with organic materials at its base. Friction angles can be assumed in the range of 25^{o} to 30^{o}. The fill on the west side of the Potomac River is of sandy and clayey soils but the lower portion contains a mixture of rubbish, waste materials and some organic soils. Its consistency is highly variable and to compute earth loads on structures a friction angle should be estimated from the boring information.

4.302 Stratum A1, very soft to medium stiff dark gray and black organic clay with lenses of highly organic vegetal material. This is the dominant soil of the river crossing, comprising recent sediment laid down in the deep erosion channel of the ancestor of the Potomac River. This old channel was centered at its deepest point near the east limit of East Potomac Park and Stratum A1 filled the cross section between the east shore of Washington Channel and the middle of the Potomac River. West of this point the old river channel cut several steps within river gravels and the underlying Cretaceous. Here the Stratum A1 clays are encountered only as thin and discontinuous lenses at shallow depths near the west shore and on land where slow-flowing stream channels drained into the Potomac.

Typical Atterberg limit values of the organic clay are plotted in Plate No. A1 for sediment beneath Washington Channel and East Potomac Park, and in Plate No. A2 for clays beneath the Potomac River. The median value of Atterberg limits is similar for each of these locations: liquid limit equal to 77 and plasticity index of 37. However, water content, strength, and preconsolidation condition are significantly different at the three locations. Grain size curves are shown in Plate No. A5. Stratum A1 clays are characterized by thin layers of rotten vegetal matter scattered throughout but concentrated in certain horizons where water contents are highest, and by sand lenses and seams which become more numerous with depth. Results of engineering properties tests on Stratum A1 are summarized in three soil properties profile, Plates Nos. 9 through 11. Water contents and Atterberg limit values are plotted in the right panel of each plate. Estimated profiles of compressive strength and preconsolidation stress with depth are shown in the left panels. Shear strength is taken equal to one-half of the compressive strength, that is, shear strength in kips per sq. ft. is the same number as the compressive strength plotted in these profiles in tons per sq. ft. The "overconsolidation" referred to in this section is the increment of stress exceeding the present effective overburden pressure to which the clay has been loaded at some time in the past. It is indicated on the soil properties profiles by the increment between the "effective overburden pressure" and the "estimated preconsolidation profile". In each one of these sections of the river alluvium some degree of overconsolidation is evident. This probably results from the existence in former times of a greater height of sediment, laid down when sea level was higher than present. This depositional stage may have been followed by a period in which sea level fell, exposing the upper sediments to drying and consolidating the lower clay. Since the time of deposition it is likely that some of the uppermost materials were removed by stream action, although mud flats occupied the location of East Potomac Park in historic times.

For Stratum A1 beneath Washington Channel, Plate No. 9, recent dredging appears to have been carried to between Elev. -26 and -30. Very soft clays subsequently deposited above this level have a shear strength of about 100 to 200 pounds per square foot. Below the former dredge line the strengths increase with depth from values of approximately 400 pounds per square foot at Elev. -30 to 900 psf at Elev. -90. There is an indication of a zone of drying between Elev. -55 and -60 which might have resulted from exposure at some stage of deposition. Overconsolidation amounts to approximately 0.6 to 0.7 tons per square foot at Elev. -30 and 0.3 tsf at Elev. -90. Shear strength in-situ at any depth equals about 25 to 30 per cent of the preconsolidation stress. A similar relationship obtains in Stratum A1 clays at each location.

The organic clay beneath Potomac Park, Plate No. 10, appears to be overconsolidated to about 0.3 tons per square foot at the top of the layer at Elev. 0 and 1.0 tsf at its base near Elev. -80. This probably results from the presence of a greater height of sediment combined with lowering of sea level at some time after deposition. Shear strengths increase from 500 to 600 pounds per square foot at the top of the layer directly beneath fill to about 1800 or 2000 psf at Elev. -80.

Properties of Stratum A1 beneath the Potomac River are summarized on Plate No. 11. An upper and lower portion of the stratum are separated by river sands between Elev. -33 and -43. From the river bottom, Elev. -5. to Elev. -16 to -18 the sediment consists of very soft material with shear strength about 100 to 200 psf which has been deposited since dredging or natural erosion of the bottom. Below about Elev. -18 the shear strength in the upper Stratum A1 is fairly uniform at about 500 psf and it is overconsolidated by about 0.4 tsf. In the lower portion of the stratum between about Elev. -43 and -59, shear strength averages about 1600 psf, which is similar to the clay at this level beneath Potomac Park.

4.303 Stratum A2, loose to medium compact dark gray silty fine to medium sand with occasional lenses of small gravel. Stratum A2 sands are found in thin lenses scattered throughout Stratum A1, tending to become more numerous with depth. West of Station 98 there are several definite layers between Elevs. -10 and -40, and it forms a thin cover of river bottom materials on the west half of the Potomac. Gradation curves, plotted in Plate No. A6, show its characteristic single-size distribution. Sampler penetration resistance is less than 10 blows per foot in the shallower sands, but increases to more than 50 blows per foot in the layer below Elev. -30 which contains some gravel. The effective angle of shearing resistance would range from 28^{o} to 32^{o}.

4.304 Stratum T1, stiff to medium light brown or gray or mottled brown-gray silty clay or clayey silt with lenses of brown silty fine sand. Several different phases of the Pleistocene clays have been identified and typical Atterberg limit values of these materials are shown in Plate No. A3. In southwest Washington limited thicknesses of the usual stiff and dried silty clay of Stratum T1 appear above Elev. -10. Shear strengths range from about 1.5 to 2.5 kips per square foot. Below Elev. -10 north of G Street S.W., near the northeastern limit of the route, Stratum T1(E) appears in a layer about 15 feet thick. This material is overconsolidationed to about 3 tons per square foot in excess of existing overburden and shear strength ranges between 2 and 3 kips per square foot. The coarse-grained deposits of Stratum T5, encountered west of Station 117 beneath the Potomac River, contain lenses and thin layers of Stratum T1 clay and the organic phase of the Pleistocene, designated Stratum TO. These materials are stiff with shear strength of approximately 2.5 to 3 kips per square foot. West of the Potomac River between Stations 139 and 153 a shallow layer of T1 clay was found immediately beneath fill which appears to have formed shoals in the river flood plain. This material has been exposed to drying and shear strength is estimated to range between 1 and 1.5 kips per square foot.

4.305 Stratum T2, medium compact to compact brown and orange-brown silty or clayey fine to medium sand with trace of small gravel. This is the sandy member of the upper Pleistocene terrace and is found directly beneath fill in southwest Washington. Standard penetration resistance is in the range of 15 to 40 blows per foot and effective friction angle is estimated to equal about 34^{o}.

4.306 Stratum T3, compact to very compact brown and red-brown fine to coarse sand with some silt and gravel, or sand and gravel with a trace of silt and numerous boulders. Stratum T3 was encountered only in the upper terrace deposits in southwest Washington, generally between Elev. +10 and -10. Several typical grain-size curves are plotted in Plate No. A7. Standard penetration resistance ranges from about 40 to more than 100 blows per foot where highly gravelly lenses are encountered. The layer doubtless contains scattered cobbles and boulders and the coarse-grained lenses are expected to be relatively pervious. An effective friction angle of 38^{o} may be taken for this material in computing earth loads on structures.

4.307 Stratum T4, medium compact to compact gray and gray-brown fine to medium sand with some silt and small gravel, containing lenses of dark gray clay. Stratum T4 is the lowermost sand member of the Pleistocene terrace and was encountered in rather thin lenses in southwest Washington where it interfingers with lower Stratum T1 clays. It is also interlayed with Stratum T5 sand and gravel west of the Potomac River. Penetration resistance is typically in the range of about 20 to 40 blows per foot and friction angle is typically 32° to 34°.

4.308 Stratum T5, compact to very compact gray and gray-brown fine to coarse to coarse sand with some gravel and trace silt, or sand and gravel with numerous boulders. This is the most important Pleistocene material on this route. It comprises a layer ranging up to about 20 feet in thickness at the base of the terrace in southwest Washington. From Station 117 beneath the Potomac River west to the west end of the route it was found in a thick and continuous layer beneath fill and above Cretaceous and probably represents a late Pleistocene deposit in the former flood plain of the Potomac River. Because of its importance to the planned structures, a large number of gradation curves were obtained which are plotted in Plates Nos. A7 through A10. Standard penetration resistance ranges from about 30 to well over 100 blows per foot, depending on the proportion of gravel or boulders in the formation.

4.309 Stratum P1, hard mottled red-brown and gray or light gray and tan plastic clay with occasional pockets of fine sand. This is the familiar Cretaceous Patapsco clay which has been encountered in several separate layers at various points on the route. The clay appears in southwest Washington north of G Street S.W. as the uppermost Cretaceous soil. It occurs again in a fairly continuous band between Station 102 at East Potomac Park and Station 125 near the center of the Potomac River. It was encountered in isolated bands within the Cretaceous west of the River. The few Atterberg limit values which were determined are summarized in Plate No. A4. Consolidation tests performed for investigation of other routes indicate that it has been overconsolidated to between 15 and 20 tsf in excess of existing overburden pressures and the typical shear strength is between about 3 and 4 kips per square foot.

4.310 Stratum P2, compact to very compact light gray or tan silty or clayey fine to medium sand with pockets of silty clay and trace of small gravel, occasional lignite fragments. These are Patuxent arkosic sands of the Potomac formation and comprise one of the principal Cretaceous materials encountered in this route. They are found interlayered and mixed with typical "greensand" of Stratum P3 from Station 101 to the the west limit of the study. Gradation curves in Plate No. A11 show the distinction between the clayey sands of Stratum P3 and the silty or slightly clayey sand of Stratum P2. Standard penetration resistance is high to very high, between about 50 and 100 blows per foot. The effective friction angle would be expected average about 36°.

4.311 Stratum P3, hard gray-green or gray-blue silty or sandy clay and silty or clayey fine sand with occasional small gravel. Stratum P3 is the principal Cretaceous material, encountered in almost every boring throughout the route. It is distinguished by its characteristic "greensand" color and sticky clay binder. Gradation is illustrated by curves in Plates Nos. A11 and A12. Standard penetration resistance is high to very high ranging from about 60 to 120 blows per foot and effective friction angle averages about 34°, slightly less than that of Stratum P2 because of the presence of interlensed clayey materials.

4.312 Stratum P4, very compact mottled light gray, tan, buff or white silty or clayey fine to medium sand with some gravel, boulders and scattered lignite fragments. This is the densest and coarsest Cretaceous material and was identified only west of Station 125 where it lies at the bottom of the Cretaceous column immediately above decomposed rock. Sampler penetration resistance typically exceeds 100 blows per foot. It is likely that the most pervious Cretaceous materials are present near the base of this layer at the contact with decomposed rock which represents the position of a long erorion interval.

4.313 Stratum D, hard orange-brown or yellow-brown micaceous fine sandy silt or very compact light gray and green micaceous silty fine to medium sand, decomposed rock. This material represents the end product of weathering and decomposition of bedrock in-situ and is found in a relatively thin band from Station 116 to Station 134, beneath the Potomac River. It is an extremely compact and essentially impervious material at this location. Beyond this point to the west limit of the route no borings were deep enough to reach decomposed rock but the approximate position of the top of layer is shown based on an interpolation between borings at the west side of the Potomac River and borings made previously near Pentagon Station.

4.314 Stratum WR, weathered and jointed schistose gneiss bedrock. This comprises the typical bedrock of the area which is reached at the bottom of a group of borings in the west half of the Potomac River. The uppermost rock is heavily jointed and weathered and coring was not deep enough to reach sound material. General information from deep borings in the area indicate that the lowest point in the rock surface on the line is at about Elev. -150 at the east side of East Potomac Park at the point where the river sediments are the deepest.

5. GROUND WATER CONDITIONS

5.1 Ground Water Observations

Observations of ground water levels were made in borings of this study generally by bailing water at the end of the day and observing the rise of water level to an equilibrium position which was measured on the following morning. In addition, a total of 8 observation wells were installed in borings for continuing measurements. These consisted of 1-1/2-inch diameter steel standpipes, perforated at the bottom, installed in the following manner. The bottom of the bore hole was filled with sand-cement grout to the elevation intended for the base of standpipe. A sand cushion was placed, the standpipe lowered into the hole, and the annular space filled with grits or pea gravel to an elevation several feet above top of perforated standpipe. Then an upper seal consisting of about 4-feet of sand-cement grout was placed and the remainder of the hole backfilled with soil or grout depending on its position with respect to the subway. The perforated intake point of the standpipe was isolated in this manner for three reasons:

1. To confine measurement of water levels to a specific interval in the subsoil profile;
2. To prevent rain water, leakage from utilities or shallow seepage from flowing into the open hole and influencing the reading;
3. To permit measurement of permeability of falling-head tests within a specific material at a particular elevation.

Information on the type and depth of observation wells is included with notes on the boring log drawings. The present status of observation wells is listed in Table No. 4. The condition of several of the wells is questionable, possibly having been penetrated in the grouting. All other wells appear to be in proper operation.

Ground water levels obtained from measurements in bore holes or observation wells are noted by symbol on the geologic sections. The estimated average position of the water table during the exploration period is plotted as a short-dash line on the geologic sections. The position of pervious backfill surrounding observation wells is shown by a cross-hatched symbol in these sections.

5.2 General Ground Water Conditions

Ground water levels are influenced by a variety of factors, such as long-term variations in rainfall and river levels, intense individual rain storms, the presence of sewers and underground utilities, and temporary or permanent pumping associated with foundation construction. A study by the U.S. Geological Survey of long-term observations for a number of wells in the Washington Metropolitan Area indicates that ground water in Spring of 1970 was several feet below the seasonal level averaged since 1932, but in July and August 1970, observed water levels returned to normal or slightly above the long-term average position. In upland areas away from the low levels in downtown Washington, the ground water variation within a year is typically 5 or 6 feet from a minimum in September to a maximum in April. However, in the L'Enfant-Pentagon River Crossing Route it is probable that both high and low levels will be controlled by fluctuation of open water in the Potomac and Anacostia Rivers.

5.3 Special Ground Water Conditions

Ground water conditions observed along the line of the route in borings of 1970 will be discussed in this section, commencing at the northeast and proceeding south and west towards Pentagon Station. The estimated average ground water level for the period of observations is shown by a dash line on the geologic sections. In the portion of the route within southwest Washington the ground water levels are typically a few feet below mean sea level, Elev. 0. The water table lies within the upper Pleistocene sand and gravel of Stratum T3 and has been influenced by drainage to deep basements and possibly to low-lying sewers whose flow is pumped to reach sea level. No evidence has been obtained in the borings of either depressed or elevated ground water levels, but in the highly lenticular Pleistocene terraces perched water is frequently encountered above the general water table supplied by infiltration from nearby open areas. Beneath Washington Channel, piezometric levels in the subsoil seem to be hydrostatic with open water. In East Potomac Park ground water is several feet above mean sea level and there is no evidence of elevated or depressed water levels in the underlying soil. Piezometric levels in subsoils beneath the Potomac River appear to correspond to the mean river level. From the west shore of the Potomac to Pentagon Station the ground water is generally one to two feet above mean sea level. The natural runoff in much of this area is intercepted by railroad and highway fills and much of the area has been landscaped and grass-covered. It is probable that in many areas infiltration from the surface forms perched water levels at elevations above the general water table.

The range of variation between mean high and mean low water in the Potomac River a short distance upstream of this proposed crossing is between 3 and 4 feet. Extreme high water in the Potomac occurs at times of very heavy rainfall or tidal surge caused by hurricanes and in the past has reached elevations in the range of +5 to +7 once in ten years with an elevation of about +9 or +10 once in 25 years. The Corps of Engineers predicted extreme high water under maximum probable hurricane is about Elev. +16 near the confluence of the Potomac and Anacostia.

5.4 Ground Water Levels for Design

Design criteria discussed in Chapter 7 require that loading on buried subway structures include pressures from long-term high ground water levels. For computations of pressures and uplift forces the following general rules are recommended in selecting high water levels:

1. In southwest Washington north and east of Maine Avenue there is little likelihood of surface flooding by high river levels or the blocking of run-off from the land areas. A long-term high water level at Elev. +5 would be appropriate.

2. Outboard of the west line of Maine Avenue, through Washington Channel, East Potomac Park and Potomac River, the maximum water levels acting upon the subway structures undoubtedly are a function of flood levels in the river. For design of the structure utilizing normal structural stresses a high water level at +10, the 25 year storm, is probably reasonably conservative. However, the structure should be tested for a water level at Elev. +16, allowing some stress increase above normal values and providing at least a small safety factor against overall uplift pressures hydrostatic with Elev. +16.

3. Section Designers should study river flood records to determine the lowest level for parapets, door sills or openings in vent shafts or for the walls of retained cuts. These controlling levels should be high enough to provide protection against probable river floods.

4. On the line of the route west of the Potomac to Pentagon Station the ground surface averages about Elev. +20 except that certain ramp and road locations are cut down to Elev. +10. Design high water levels should not be lower than Elev. +5. Depending on the possibility of flooding over the low ground, water levels to Elev. +10 may have to be considered at some locations.

5.5 Permeability Testing in L-Series Borings

A series of permeability tests were performed in the field during the boring operations as falling-head tests in cased bore holes and in the standpipes of the observation wells. Permeability coefficients computed from these tests are listed in Table No. 7. Tests were performed by raising the water level and observing the time rate of return to an equilibrium position. The differential head thus observed plotted on a logarithmic scale against elapsed time on an arithmetic scale should form a straight line. Coefficient of permeability is computed by dividing the slope of the straight line by a shape factor whose value depends on the flow pattern of the bore hole. The principal stratum opposite the opening in the bore hole which is assumed to control inflow to the boring during the test is listed in Table No. 7.

For the most part these tests indicate the low to very low permeability that is typical of the majority of soils of the Washington area. However, it is probable that distinctly high permeability values will be evidenced locally in certain materials. Within southwest Washington in the lower portion of Stratum T5 and in gravelly lenses of Stratum T3 permeability may be in the order of 2×10^{-2} feet per minute. The observation wells in Borings Nos. L-3 and L-4 within the underlying Cretaceous clayey sands indicate that they are of distinctly low permeability, roughly 1×10^{-6} feet per minute. However, scattered samples in this formation which are designated as SP or SP-SM suggest that some lenses may be much more pervious and that the permeability tends to increase with depth in the formation. Inflow to the subway tunnels would be expected to average 1 to 2 gallons per minute per running foot of length of excavation in southwest Washington.

The recent river alluvium Stratum A1, as might be expected, exhibits low permeability values in the tests. However, a test in the observation well in Boring No. L-17 contacted the single-size sands of Stratum A2 and yielded a permeability of 2×10^{-2} feet per minute. Seepage to the planned excavations within the river sediments may be comparatively low values, averaging less than 1 gpm per running foot.

A number of tests are available for Cretaceous sands west of the Potomac River, which gave typical values of 1×10^{-3} to 5×10^{-3} feet per minute. These permeability coefficients are associated with the Stratum P2 materials on the geologic sections. In many of these holes in the land area west of Potomac River drilling mud was used to advance the boring through the lower Pleistocene Stratum T5 and reliable permeability measurements were generally not obtained. However, the boring records show loss of wash water or loss of drilling mud in the gravelly streaks of Stratum T5 and it should be anticipated that the average permeability of the material would be about at least $1x10^{-3}$ feet per minute and in certain areas could be between $1x10^{-2}$ and $5x10^{-2}$ feet per minute. Inflow to the dewatering system during excavation might average as much as 3 to 4 gallons per minute per running foot of length of excavation in this area. The seepage quantity may be largely controlled by the communication of Stratum T5 to open water levels.

6. LABORATORY TESTING PROGRAM

6.1 Scope of the Program

All of the 2 and 3-inch undisturbed soil samples recovered in acceptable condition from the borings were transported to our New York laboratory for tests of engineering properties. Tests generally included determination of water content, gradation, and Atterberg limits and measurement of physical properties by unconfined compression, unconsolidated-undrained triaxial shear, direct shear, permeability and one-dimensional consolidation tests. All split-spoon samples were examined in our New York laboratory, field classifications were checked and water contents determined on the majority of fine grained samples. Certain samples believed to be representative of a significant amount of material were selected for Atterberg limit tests and grain size analysis. Selected samples of all types were subjected to tests of their potential corrosion characteristics.

6.2 Presentation of Laboratory Test Information

Basic results of all tests on 3-inch thin tube samples are listed in Table No. 5, Summary of Laboratory Test Data. Detailed laboratory test data are presented on Plates Nos. A1 to A57. These plates are assembled in the following order: plasticity charts, gradation curves, triaxial strength tests, direct shear tests, and consolidation tests. To aid in visualizing the distribution of soil properties, the test values of natural water content, Atterberg limits and shear strength are noted by symbol on the geological sections at the location of the particular soil sample.

6.3 Identification Test Data

Natural water contents, Atterberg limits and grain size curves are useful in confirming or calibrating visual classifications made in accordance with the Unified Soil System. In addition, the relation between natural water content and Atterberg limits gives a qualitative indication of the degree of preconsolidation of clayey soils. All Atterberg limit values are plotted on a series of three plasticity charts, Plates Nos. A1 to A4, grouped according to the stratum from which the samples were obtained.

Gradations of coarse-grained samples relate to their permeability characteristics, but where such gradations include silt and clay sizes as for the Washington soils, there is no direct quantitative relationship. Gradation curves for samples selected as representative of the principal strata are plotted on eight plates, Nos. A5 to A12. Many grain-size curves have been determined for the gravelly Pleistocene Stratum T5 samples obtained with the standard 1-1/2-inch inside-diameter split spoon. It should be noted that cobbles and boulders which were encountered in this material in many borings cannot be recovered by the sampler and are not included in the laboratory grain-size curves.

6.4 Consolidation Testing

One-dimensional consolidation tests have been performed on a total of 24 samples of the river alluvium of Stratum A1. Results are detailed on consolidation plates, one for each test, Nos. A34 to A57. These plates present the conventional curve of void ratio versus log of pressure in the right panel and selected time curves for pressure increments liable to be encountered in the field in the left panel. Properties of the sample tested are listed at the bottom of the plate.

Settlement of subway structures placed in excavation in the organic clay will involve recompression rather than virgin compression of clayey subsoils. Potential settlements are controlled to a large extent by the degree of preconsolidation of the material, this is, the magnitude of the maximum stress to which the samples have been subjected at some past time. The maximum probable preconsolidation stress was estimated for each sample by the conventional Casagrande construction, as indicated on the right panel of the test plate. The minimum possible preconsolidation is determined by the backward projection of the virgin compression slope to an intersection with the in-situ void ratio. These test values are utilized to determine the profile of preconsolidation stress shown on the soil properties profiles in Plates Nos. 9 to 11. All of the test samples of Stratum A1 are overconsolidated to some extent.

6.5 Recompression Index

The compressibility property of greatest interest for stress changes below the preconsolidation value is the "recompression index", C_r, which is the slope of the semi-log straight line in the unloading-reloading cycle of a void ratio-log pressure curve. This index is a dimensionless number which is numerically equal to the difference in void ratio between two pressures on the straight line differing by a factor of 10. The recompression index is ordinarily taken equal to the comparable perimeter for swelling, the "swelling index". To determine the relationship of the recompression index to the void ratio at rebound, many multiple-cycle unloading-reloading tests have been performed in the previous investigations of other routes. For any particular test sample the successive values of recompression index thus obtained plot roughly as a straight line versus the void ratio at rebound, the value of the index increasing as the void ratio at rebound decreases. A family of such straight lines reflects the difference in the plasticity characteristics of different clays. Based on the rebound testing of previous investigations and this study, a family of curves giving this relationship for the principal clay strata was derived and is plotted in Plate No. 1. The estimated recompression index for the clay at its in-situ condition is the point on one of these lines at the intersection with the average in-situ void ratio.

Values of C_r estimated in this manner for the principal clay strata of this investigation are presented in a table at the upper right of Plate No. 1. Also listed are the value of the virgin compression index C_c, obtained from the void ratio-log pressure curve in the virgin range. The values listed in the plate for Stratum A1 are not typical of the river alluvium encountered in this study, whose median properties are: liquid limit, 77; plastic limit, 40; natural water content 65 per cent. A diagram similar to that of Plate No. 1 indicates an average C_r value of 0.02. The average virgin compression index equals 0.75.

6.6 Coefficient of Consolidation

The parameter controlling the time rate of settlement is the "coefficient of consolidation", c_v, computed from the observed laboratory time curve in the recompression load increment corresponding to the pressure change expected in the field. The coefficient of consolidation in the range of recompression loading is many times higher than the ordinary value for virgin compression. Typical properties of the Stratum A1 clays are as follows: coefficient of consolidation in range of recompression loading equals 0.2 ft^2 per day; coefficient of consolidation in range of virgin compression equals 0.03 ft^2 per day. It is anticipated that recompression settlements which take place during the subway construction will occur rapidly and will be essentially complete by the time construction is finished.

6.7 Shear Strength Testing of Soil

Three types of strength tests have been utilized in this study; unconfined compression, unconsolidated-undrained triaxial shear and direct shear tests. Unconfined compression tests were performed on 2- and 3-inch thin tube samples at essentially unaltered moisture content. Unconsolidated-undrained (UU) triaxial tests are performed in the triaxial cell, the confining pressure applied without permitting drainage, followed by shear while increasing axial load also with no drainage. The confining pressure has the effect of restraining failure which might occur at too low stresses due to the presence of sand pockets, or pockets, or fractures and cracks, and it compensates in part for possible sample disturbance. Ideally undisturbed, homogeneous, saturated specimens of clay from a single sample sheared undrained under different chamber pressures would all exhibit the same deviator stress at failures, and therefore the Mohr envelope for a series of such tests would plot as a horizontal straight line. However, because of the presence of sand pockets or partings, sample disturbance or incomplete saturation, the undrained test strengths frequently increase slightly with increasing confining pressure. Where a sufficient number of specimens is not available from a single sample to define the Mohr failure envelope, test results from several samples were combined together where the sample appearance, water content and plasticity limits indicated their similarity. Unconfined compression tests are plotted with undrained triaxial tests of similar material. Each envelope of Plates Nos. A13 to A32 is intended to yield one reliable determination of the undrained shear strength of the particular material. These average values are noted by symbol on the geological section at the position of the sample in the boring and by a prominant symbol on the soil properties profiles of Plates Nos. 9 to 11. For the principal material tested for strength properties, the river alluvium of Stratum A1, shear strength is equal to about 0.25 to 0.3 times the preconsolidation stress acting on the sample.

6.8 Tests Relating to Corrosion Characteristics

Laboratory test data relating to corrosion characteristics of soil and water samples are summarized in Table No. 6. Where ordinary identification test values are available for soil samples they are noted in the same column as the corrosion properties. Soil samples were obtained from borings of the L-series and consisted of a portion of a numbered sample or were taken from a spoon sampler driven especially for this purpose. The soil samples generally were recovered at elevations near to the top and base of the planned subway structure. Water samples generally were taken at a position at the mid-height of the planned structure. For the most part the water samples were taken using the conventional driller's bailer after removing a sufficient amount of water from the hole to be reasonably sure that the sample was not mixed with wash water which had been pumped in during the boring operations.

Testing of soil samples included determination of pH, electrical resistivity in ohms per cm^2, total chlorides, total sulfates and a qualitative evaluation of the presence of sulfides. All ground water samples were subject to measurement of pH and electrical resistivity. Certain of these samples were also tested to determine chemical characteristics including carbonate alkalinity, bicarbonate alkalinity, free carbon dioxide, hardness, chloride and sulfate content.

Soil samples to be tested were thoroughly mixed with distilled water until the sample was saturated, as indicated by the appearance of free water. This saturated soil was then allowed to stand for at least 30 minutes before testing. Water samples were tested as they are received from the field. Resistivity was determined by placing the water or prepared soil sample in a Bechman Cel-M soil cup, while tapping the bottom of the cup to expel any air bubbles. The sample was then struck off level with the top of the cup. The measurement of resistivity was obtained by use of a Vibroground Resistivity Meter, Model No. 293. Determinations of pH soil and water samples were obtained with a Radiometer pH Meter, Model No. 29. Quantitative analyses were performed on soil samples for determination of total chlorides as NaCl and total sulfates as SO_4, with results expressed as parts per million. Chemical analysis of water samples was made according to methods listed in the current standard procedures of the American Water Works Association. Qualitative tests were performed on each soil sample to estimate the possible presence of sulfides. About 6 drops of 15 per cent HCl was applied to a handful of the soil sample. The odor of hydrogen sulfide gas generated was then noted. The entry in Table No. 6, "No TR", indicates that no hydrogen sulfide was detected in this determination.

7. DESIGN CRITERIA AND DESIGN PROBLEMS

7.1 Scope

Section V of the "Manual of Design Criteria" by the General Engineering Consultants sets forth criteria governing design of structures of the Rapid Transit System. Frequent reference is made therein to data and recommendations to be provided by the Soils Consultant. This chapter summarizes the general design information and recommendations which are common to all portions of the route studied in this investigation. Specific design problems anticipated at various sections of this route are discussed in Chapter 8.

7.2 Soil Properties For Design (Sections V.C.1 and V.F. of Criteria)

Table No. 8, "Soil Properties For Design", presents average unit weight, shear strength parameters and bearing capacities of strata encountered throughout the investigation. Application of these properties is governed by stratification shown on the geological sections. Refinements in soil unit weights are not justified because the overburden materials are highly lenticular and the geological sections necessarily simplify these details. The weight of drainable water in the subsoils is small and trickling flow from surface infiltration above the fluctuating water table keeps the soil at a high degree of saturation. Therefore, no distinction should be made in total unit weight of soil above and below ground water. Where select compacted backfill is to be placed around or above buried structures, in conformance with standard specifications, a total unit weight not less than 125 lbs. per cubic foot should be utilized. Where backfill will be coarse-grained and broadly graded with a small amount of fines, the total unit weight should be taken at 130 lbs. per cubic foot.

Shear strength parameters are derived from laboratory testing for most of the materials, except those containing an appreciable amount of gravel or rock fragments. Because of the wide variety of subsurface conditions encountered in the study, a range of properties is generally stated for a particular material. Section Designers should select specific values from data given on the geological sections and in the compilation of laboratory test results. For strata which are expected to perform as cohesive materials a shear strength in kips per sq. ft. is listed and the allowable bearing capacity is based on this value. Where no shear strength value is tabulated the soil is expected to perform as a cohessionless material.

The tabulated basic allowable bearing capacities apply to conventional size footings, mats, caissons or piers with minimum dimension of the bearing area of at least 3 feet. These bearing values assume that subsoils will be maintained undisturbed, that flow of water across and through the subgrade will be controlled, and that excavation equipment will be of a size and weight that will not remold bearing soils. Where a range of bearing pressures is given for a particular stratum, the appropriate value must be chosen by referring to sampler penetration resistance or laboratory test data at a specific location. The tabulated values do not consider the effects of surcharge surrounding the bearing level of the foundation. For deeply buried footings, piers or caissons in cohesionless strata, these values may be increased by conventional analyses using the listed friction angles, after determining that settlements for increased bearing are tolerable. On the other hand, bearing pressures for small footings or blocks for support of temporary bracing, placed at or near the surface of cohesionless materials, must be decreased by conventional analyses which take into account the smaller footing widths. Bearing capacity problems for specific sections of this route are discussed in Chapter 8.

7.3 Stability Problems

Stability problems, as distinguished from design of structures for applied pressures, include two general categories:

1. Stability of the base of braced vertical-sided open cuts;
2. Stability of earth embankment and open cut slopes made for surface trackage.

At the grades now planned, no locations are foreseen where a definite threat would exist to stability of the base of vertical braced cuts so long as excavations are made carefully without disturbing subgrade materials, are fully braced, and are accomplished with satisfactory ground water control. Stability should be re-evaluated for final grades utilizing strength data given in Table No. 8. The possibility of heave of a subgrade in sand is entirely dependent on the adequacy of dewatering of the subgrade rather than on the threat of overall shear failure. Sand movements due to seepage or upward directed gradients would take the form of boiling, running or piping of materials which could produce serious loss of ground and loss of support for soldier beams or cofferdam sheeting but would not cause massive shear displacement unless allowed to continue uncontrolled.

7.4 Settlement Problems

Problems of consolidation settlement resulting from volume change of the foundation soils fall into three principal categories:

1. Swell and subsequent recompression of clays below a cut-and-cover structure produced by removal of weight during excavation and its replacement on completion of the structure;
2. Settlements of surrounding areas due to drawdown of ground water levels caused by construction de-watering;
3. Consolidation settlements of fills placed to raise the grade of surface trackage.

Consolidation of the first and second categories generally will occur in the recompression range of loading of the subsoils and large settlements are not anticipated. Special conditions relating to Item 2 are discussed in Section 7.7.

Excavation for cut-and-cover sections will release as much as about 3 tons per square foot of pressure on materials below the subgrade. Where the subgrade is underlain by relatively deep terrace clays, this could produce measurable upward movements during excavation, to be followed by settlement of the subway under the weight of completed structure plus back-fill. Discussions of specific areas of concern in this route are presented in Chapter 8. The Section Designer should evaluate the possible recompression settlements and consider the influence of the resulting differential settlements on the subway structure.

Consolidation settlements of fills may be a problem in the East Potomac Park area. Conventional settlement analyses should be performed with the compression index data described in Chapter 6 and the information presented on the soil properties profiles.

7.5 Pressures on Earth Retaining Structures (Section V.C. 1&7, V.D. 1 through 3 of Criteria)

Criteria require that earth retaining structures be designed for certain combinations of horizontal and vertical pressures of soil, rock and water. This section concerns the basic assumptions and methods of pressure computation to be utilized for retaining structures other than rock tunnels. Procedures for computing pressures on retaining structures are illustrated on Plates Nos. 2 through 7. Descriptions of specific problems to be encountered in this route are given in Chapter 8. The following procedures are general recommendations only and should be modified as necessary by the Section Designer to conform to the subsurface materials and ground water conditions at the particular location, the type of structure and the probable method of construction.

The general assumptions and methods of computation to be applied are as follows:

1. The evaluation of subsurface conditions should be based on the geological sections contained in this Final Report. Subsoil strata which are catagorized as "fine grained" in the Unified Classification system are expected to perform as cohesive materials when applying pressures on retaining structures. Subsoil strata which are catagorized as "coarse grained" are expected to perform as cohesionless materials.

2. Vertical dead loads are taken equal to the total overburden weight (soil and water or saturated weights as listed in Table No. 8) plus design surcharge. Consideration should be given in certain tunnel areas to the possible effect of vertical shear stresses acting in the overburden above the structure.

3. Active horizontal earth pressures are computed for coarse grained strata utilizing the coefficient $\tan^2 (45^\circ - \phi/2)$, where ϕ equals the effective stress friction angle given in Table No. 8 . These pressures are normally considered as short-term loading.

4. Active horizontal earth pressures are computed for cohesive strata either by utilizing the expression given above with the effective stress friction angle of Table No. 8 or by the conventional formula, (effective vertical stress - 2c), in which "c" is the undrained shear strength of the soil as listed in Table No. 8. In general, where it is the intention to minimize the horizontal earth pressure, the lower of these two values should be utilized. In no case should the active earth pressure be taken greater than the at-rest value.

5. At-rest horizontal earth pressures for both cohesive and cohesionless strata are computed with the coefficient (1 - sin ϕ), where ϕ equals the effective stress friction angle as given in Table No. 8. These pressures are normally considered as long-term loads for design of permanent structures.

6. For long term loading associated with the design of permanent structures, the ground water level should be taken at the probable maximum levels discussed in Chapter 5. However, for construction or short term loading conditions an evaluation should be made of lower probable water levels based upon the anticipated drawdown during construction. The ground water level is taken at the same elevation on both sides of the structure.

7. The distribution of vertical pressures on cut-and-cover subway structures from loads of adjacent non-underpinned foundations should be computed according to procedures illustrated in Plate No. 6, "Vertical Pressure from Structural Loads".

8. The distribution of horizontal pressures on cut-and-cover subway structures from the loads of adjacent non-underpinned foundations should be determined from the diagrams in Plate No. 7, "Horizontal Pressures from Structural Loads". The distributions shown are an approximation of twice the values given by ordinary elastic solutions for the distribution of horizontal pressures in soil due to superposed loads.

9. The distribution of vertical and horizontal pressures on earth tunnels from the loads of adjacent non-underpinned foundations are not necessarily equal to the values obtained from Plates Nos. 6 and 7. The Section Designer should consider the possibility that inward movement of the ground towards the tunnel opening during excavation will tend to relieve the superposed pressure on the temporary and permanent structures.

10. Foundations of non-underpinned structures which receive their entire support beneath the line rising at a slope of one vertical on one horizontal from a point 2 feet below the edge of the base of the subway excavation are not considered to apply pressures on the subway structure. See Zone C in Plate No. 8.

11. Specific recommendations for methods of earth pressure computations for particular structures are given in the following subsections, 7.501 to 7.512.

7.501 Temporary Vertical-Wall Cofferdams (Plate No. 2). It is intended that design of temporary structures required for the work will be the sole responsibility of the contractor. Standard drawings which set forth the basic requirements for temporary supporting structures are to be included in each contract set as appropriate. The following list of items summarizes the conditions which must be considered in design of temporary vertical-wall cofferdams.

1. The basic horizontal earth pressures are computed as active values. The total active resultant is multiplied by a factor ranging between 1.1 and 1.4, depending on the stiffness of the wall, and the resulting load is redistributed on the cofferdam in a trapezoidal pressure diagram similar to that shown in Plate No. 2. The multiplying factors generally are as follows:

a. For sheet pile cofferdam in an area where some horizontal movement of retained earth is tolerable, use 1.1.

b. For soldier beam cofferdams where horizontal movement of retained earth is to be minimized or prevented, use 1.2 to 1.3.

c. For cast-in-place concrete walls where movement is to be prevented, use 1.4.

2. Passive resistance provided by soil in the interior of the cofferdam is computed using the conventional expressions for passive pressures, generally ignoring vertical friction forces on the cofferdam. A suitable safety factor, generally between 1.3 and 1.5, must be applied to the computed theoretical passive resistance.

3. Ground water pressures are estimated consistent with the required or permissible drawdown levels. Where soldier beams with wood lagging are to be utilized ground water is generally assumed to be below subgrade of the interior excavation. When the wall is intended to prevent all leakage of ground water, maximum exterior ground water pressures should be used.

4. For the design of struts, walers and steel sheet piling, the trapezoidal load diagram is applied for final excavation conditions assuming struts, walers and sheet piling are hinged at brace points, except the uppermost brace point.

5. The design of struts, walers and sheet piling must be checked for the several stages of partial excavation when the wall is assumed to be continuous over the brace immediately above the excavated level. This condition may produce the maximum loading in struts and walers.

6. The design of struts, walers and sheet piling must be checked for the condition when portions of the subway structure are completed and lower struts are removed. Consideration must be given to the possible increase in loading on the upper struts remaining in place, using some reasonable allowance for arching in the span between the completed structure and the lowest strut then in place.

7. The depth of penetration of soldier beams or steel sheet piling below subgrade must be analyzed for the resistance necessary to provide a support point below subgrade. Generally, the maximum horizontal resistance on the flange of soldier beams may be taken as three times the ordinary passive pressure computed for the width of the flange.

8. Struts and walers should be sized for the above loads at allowable normal working stresses. Allowable normal working stresses must consider the effect of combined axial and flexural loading, unsupported span lengths and lateral stability of the members.

9. The design of all members must include the effects of loads of street traffic, construction equipment, supported utilities, adjacent structures which are not underpinned, and any other loads that must be carried by the cofferdam during the construction period.

10. The sizes selected for soldier piles shall be based on the above design conditions. Horizontal earth pressures acting on soldier piles are determined by multiplying the computed active earth resultant by the factor 0.8 and applying that force in a trapezoidal pressure diagram of the form shown on Plate No. 2 . In computing maximum positive moments in the span of soldier piles between brace points, continuity over brace points may be assumed.

11. For the ordinary span of soldier piles in the range of 5 feet to 7 feet center to center, structural grade wood lagging shall generally be of the following thicknesses, unsurfaced:

From ground surface to 25 foot depth,
use 3" thick;
Below 25 foot depth,
use 4" thick.

Ordinarily, the lagging should be of a type of wood and grade that will provide an allowable working stress of not less than 1100 psi. In the case of greater soldier pile spacing or the presence of unusually heavy construction surcharge or particularly soft cohesive soils, greater thicknesses of lagging may be required.

12. In general, the vertical spacing of tiers of braces center to center should not exceed 16 feet during excavation. In those locations where underpinning of small or light adjacent structures is omitted and a tightly braced cofferdam is intended to prevent movement of the structure in lieu of underpinning, the vertical spacing generally should not exceed 12 feet, center to center, during excavation and removal of intermediate braces during the construction should be compensated for by increased stiffness of soldier piles.

13. Details on working drawings shall show appropriate means for posting of struts and walers, lacing of struts in both vertical and horizontal planes to provide lateral stability, web and connection stiffeners, brackets, and provisions for wedging and jacking of struts to prevent horizontal movement. Details are a vital element in the adequacy and safety of temporary earth retaining structures and shall be shown completely on the working drawings in conjunction with the methods and sequence of installation of all elements of the structure. Particular attention should be given to procedures for wedging or jacking to maintain tight contact for all bracing members and to provide for uniformity of distribution of load to struts and walers.

7.502 Concrete Box and Station Arch Sections, Long-Term Loading, Case I, (Plate No. 3). Criteria Case I assumes maximum total loads. Vertical pressures are taken as full weight of overburden plus surcharge. Horizontal earth pressures ordinarily are taken as at-rest values on both walls of the structure. In locations where the structure lies in alluvium of Stratum A1, relatively soft stratum T1 clays with shear strength of 1.5 ksf or less, or clayey fills, the maximum horizontal earth pressure should be increased to as much as 1.2 times the computed at-rest values. Water pressure for horizontal loading should be taken at the highest permanent ground water table recommended in Chapter 5.

7.503. Concrete Box and Station Arch Sections, Sidesway Condition, Case II, (Plate No. 3). Criteria Case II considers the possible sideway condition due to unbalanced horizontal loading. The unbalanced horizontal loading is presumed to occur as the result of a future deep excavation on one side of the subway when horizontal earth pressures on that side would be reduced to a minimum value. Vertical pressures are taken as full weight of overburden plus surcharge. Horizontal earth pressures are asymmetrical with at-rest earth pressures on one wall and active earth pressures on the other. As in Case I, the at-rest values may be increased by a factor up to 1.2 in the presence of particularly soft or loose soils. Such a modification is not intended to be applied to the active earth pressures. Even though a nearby deep excavation might produce differential ground water pressures across the subway, the water table is taken horizontal at some level which represents the typical future drawdown. The lower the selection of the ground water level, the greater will be the difference in horizontal earth pressures on the two sides of the structure and, for this reason, the lowest anticipated future ground water level shall be used.

7.504 Concrete Box and Station Arch Sections, Short-Term Loading Case III (Plate No. 3). The short-term loading, Case III of the Criteria, assumes full vertical overburden load plus surcharge and minimum horizontal earth pressures taken as active values. Since this loading is considered to act shortly after completion of backfill, the possible presence of ground water pressures acting on the sides of the structure is to be disregarded. The purpose of this assumption is to maximize positive moments in the roof slab.

7.505 Horseshoe-Shaped Earth Tunnel, Construction Condition (Plate No. 4). Construction loading is based on the assumption that the method of construction of the horseshoe-shaped tunnel in earth will tend to permit inward movement of the surrounding soil between springline and invert, and that the temporary supporting system may settle vertically to some extent. In designing the temporary supports consideration should be given to the probable decrease in vertical pressure at the tunnel top due to the development of side shears in the overburden. The magnitude of these side shears is computed assuming at-rest earth pressures above the tunnel top and a coefficient of friction ranging between approximately 0.3 in clayey soils to 0.5 in sandy soils. Horizontal earth pressures acting upon the tunnel supports are taken as active values plus water pressures consistent with the assumed construction drawdown level. If substantial earth movements inwards toward the opening are expected below the springline, it may be reasonable to reduce the vertical effective pressure applied to the active wedge at the tunnel sides by taking into account vertical shear in the overburden above the wedge. Consideration should be given to the possible settlement of tunnel supports, the mining of adjacent tunnels and the construction procedures in evaluating this reduction of vertical stresses above the active wedge.

7.506 Horseshoe-Shaped Earth Tunnel, Long Term Loading (Plate No. 4). Vertical pressures are taken as full overburden weight plus surcharge without side shear restraint. Horizontal total pressures are intended to be taken at a reasonable value which will yield the most economical permanent cross section. For the usual geometry of the single-track horseshoe tunnel this is expected to be an average horizontal total pressure value of 0.75 to 0.85 times the average total vertical pressure. For the double-track tunnel this ratio of horizontal to vertical pressures would be somewhat lower value. It is not intended to consider an average horizontal total pressure greater than the average vertical pressure on the top of tunnel where cover over the tunnel is equal to 1.5 times the tunnel height or more.

7.507 Circular Earth Tunnels with Rigid Permanent Lining, Construction Condition (Plate No. 5). It is assumed that construction of the circular tunnel will be in such a manner that the temporary supports deflect downward at the crown and outward at the springline. This condition contrasts with that for horseshoe tunnels where inward movements between springline and invert might be assumed during construction. For construction conditions, some allowance should be made for the development of side shears which reduce the vertical pressures from total overburden plus surcharge. These side shears ordinarily would be less than for the horseshoe tunnel where settlement of footer blocks is expected. Horizontal pressures should be taken as reasonable values considering the outward deflection of the supporting structure, ordinarily not less than at-rest values, and generally in the range of 2/3 to 3/4 of the effective vertical pressures acting at the springline during construction. Water pressures are taken for the probable construction drawdown condition. Pressures which are computed in vertical and horizontal diagrams may be applied as all-around radially directed pressures varying smoothly between vertical and horizontal values. In general, it is expected that the contractor's temporary tunnel supports would be stiffer than a flexible circular lining which serves both as a temporary and permanent support. It is not recommended that the temporary support system be designed on the basis of the deflection criteria given in Paragraph 7.509.

7.508 Circular Earth Tunnels with Rigid Permanent Lining, Long-Term Loading (Plate No. 5). Because the basis for design for long-term loading conditions is essentially an empirical procedure, the criteria are based on a ratio of total horizontal to total vertical pressures and make no distinction between effective earth and ground water pressures. Long-term loading does not include a reduction in vertical pressures for side shears and assumes that horizontal total pressures equal to 0.875 times the vertical total pressures are applied to the tunnel for design at normal working stresses in the permanent structure. For relatively favorable ground conditions where overburden consists predominately of compact coarse grained soils, the total vertical pressure is taken as the height of overburden above the crown of the tunnel plus surcharge. For relatively unfavorable ground conditions where the overburden consists primarily of fine grained plastic soils, the total overburden is taken as the full weight of materials above the springline of the tunnel plus surcharge. It is not intended to include consideration of the condition of larger horizontal total pressures than vertical total pressures. Structural design of the permanent section for both the horseshoe-shape and circular tunnels must be checked using ultimate strength design methods and horizontal total pressure factors of 0.45 for the poorer ground conditions and 0.65 for the most favorable ground conditions.

7.509 Circular Earth Tunnels, Flexible Lining. In certain locations designated for earth tunnels the use of prefabricated circular metal or precast concrete liner may be appropriate. The standard design of a prefabricated metal liner for a single-track earth tunnel has been prepared by the General Engineering Consultant. In general, it is anticipated that the use of a flexible liner will produce relatively large total horizontal pressures as a result of the outward deflection of the liner at the springline. For final design conditions it is anticipated that these horizontal total pressures would generally be in the range of 0.90 to 0.97 times the average vertical pressure on the crown. The Section Designer may analyze the resultant pressures by a method utilizing a modulus of horizontal subgrade reaction which allows for the increase of horizontal pressures due to outward deflection of the liner at the springline. As an alternative, the Section Designer may analyze the liner by assuming that the horizontal diameter increased under load by an amount in the range of 1/2 to 1-1/2 inches. The smaller value applies to compact coarse grained Pleistocene materials, Cretaceous strata or decomposed rock. The larger value applies to fill, T1 clays or organic soils.

7.510 Pressures from Adjacent Structures on Earth Tunnels. The horizontal and vertical pressures on tunnel structures due to adjacent non-underpinned buildings ordinarily are expected to be less than the values computed from Plates Nos. 6 and 7. The Section Designer may assume that inward movement of soil towards the tunnel opening usually will prevent the superposed loading from reaching the temporary supports. If the surrounding soil is loose or soft or consists of moderately plastic clays, some portion of the theoretical superposed loading may reach the permanent tunnel section. In the latter case, it is probable that the additional load may be applied as a fairly uniform all-around compression.

7.511 Analysis of Invert Slabs of Arch Stations in Soil. Structural design of the invert slab of station arch section is importantly influenced by the contact pressures acting upwards on the base of slab. The following general rules should be considered by the Section Designer in his analysis of the invert slab:

1. In those locations where the invert slab lies within Pleistocene terrace deposits or more recent materials, the invert slab generally will be continuous from wall to wall and may be designed with an assumed distribution of contact pressures on the base of slab or by analyzing the slab as beam on an elastic foundation. If the contact pressure diagram is to be assumed, the maximum intensity of contact pressures beneath the wall generally may be taken as equal to the nominal bearing capacity of the subsoils given in Table No. 8 plus a surcharge allowance equal to approximately one-half of the total pressure of overburden acting immediately outside of the station wall at that subgrade level. The minimum contact pressures acting upward at the center of the invert slab should be not less than the magnitude of the hydrostatic uplift for the highest permanent ground water table. In general, the ratio of contact pressures between maximum at the wall and minimum beneath the center of the slab should not be greater than about 2 to 1. The softer the subgrade material, the more nearly uniform will be the contact pressures.

2. If the continuous invert slab is to be analyzed as a beam on an elastic foundation the modulus of subgrade reaction generally should be limited by the following values:

a. 75 kips per cubic foot for fill, organic soils, lower Stratum T1 clays with shear strength of 1.5 ksf or less;

b. 150 kips per cubic foot for the stiff Stratum T1 clays and coarse-grained Pleistocene terrace materials;

c. 200 kips per cubic foot for Cretaceous strata;

d. 300 kips per cubic foot for decomposed rock or thoroughly weathered rock.

If the elastic analysis is utilized, the resulting distribution of contact pressures generally should be limited to the values stated in Item (1) above.

3. In those locations where base of the invert slab lies in or only a short distance above hard and relatively impervious material such as Cretaceous strata, decomposed rock or bedrock, consideration should be given to the use of separate footings beneath each wall of the station and an invert slab dowelled to these footings with permanent underdrainage to relieve hydrostatic uplift pressures on the slab. In such cases the wall footing should be carried to the relatively impervious hard stratum or cut-off sheeting should be installed surrounding the invert slab and driven to the hard stratum so that the permanent under-drainage does not create a general lowering of ground water levels outside of the station. Criteria require that the invert slab be able to resist the full hydrostatic uplift at stresses which do not exceed utlimate strength.

7.512 Vertical and Inclined Shafts. Theoretical horizontal radial pressures on vertical shafts excavated with ground movements sufficient to produce an active state of stress are lower than conventional active values. The difference between them increases with increasing values of the ratio Z/R, where Z equals depth and R is shaft radius. Radial earth pressures acting on vertical shafts and shafts inclined from the vertical no more than 10^{o} can be estimated by multiplying ordinary active earth pressures by the following reduction factors:

Ratio of Z/R:	0	1	2	4	6	10
Reduction Factor:	1.0	0.9	0.8	0.7	0.6	0.5

Water pressures for design high water levels must be added to the earth pressures. Radial pressures near the surface should be taken not less than 100 psf. These pressures apply to cylindrical shafts. For other shapes reduction factors must be modified by judgement, perhaps taking R as the radius of a circle that encompasses or extends beyond the extreme corners of the shaft. For shafts with inclination greater than 45^{o} from the vertical, tunnel design pressures should be utilized. For shafts with inclination between 10^{o} and 45^{o}, pressures should be interpolated between these limits.

7.513 Reinforced Concrete Retaining Walls. Standard specifications permit reuse of excavated material as backfill but require that it conform to certain quality standards and be placed within two percentage points of optimum moisture. It is anticipated that in most locations it will be difficult to meet these requirements with excavated soils and, therefore, it may be assumed that much of the backfill material behind retaining walls will be imported and will consist of fairly clean coarse-grained soil. If specification requirements for compaction are enforced, the basic earth pressures for design would be at-rest values based on effective friction angles ranging from 30 to 35 degrees. A more important design question concerns drainage within the backfill. It is assumed that in designing relatively high walls positive drainage will be provided which will guarantee that water pressures are maintained at low levels.

7.6 Support of Existing Structures (Sections V.G.1. and 2. of Criteria).

Criteria require that heavy structures which encroach on or are immediately adjacent to the subway be underpinned in advance of subway excavation unless the foundations for these structures extend as low as the excavation subgrade. Foundation loads may be carried downward by walls constructed in trenches or pits using underpinning procedures, by drilled piers, by driven piles of various types, or by open-end steel pipe piles jacked to bearing. Temporary support for light structures could be provided by jacking pits, whereby a series of jacking points are established on the structure which will compensate for settlement during subway excavation. Certain minor structures or portions of larger structures encroaching on or contiguous to the subway may more economically be removed and replaced or subsequently repaired rather than being underpinned or temporarily supported. Consideration should be given to this possibility, including necessary agreements with the owners. In some cases relatively minor changes in subway plan alignment may afford substantial economy in underpinning.

All excavation for cut-and-cover construction or for tunnels must be made carefully to minimize loss of ground. Tightly braced vertical-wall cofferdams could eliminate the need for underpinning of light and non-critical structures as hereinafter defined. Supporting cofferdam walls can be soldier beams with timber breastboards installed as the excavation proceeds, heavy Z-section steel sheet piling or concrete walls constructed in trenches. The essential requirement is that these walls be installed tight against the surrounding soil and without loss of ground. As excavation proceeds within the walls, motion must be prevented by installation of adequate horizontal struts that are preloaded by wedging or jacking as they are placed. During excavation continuous checking is required to assure that all struts maintain their preload. As subway construction proceeds there must be a positive transfer of loads between the cofferdam walls and the subway structure before struts are removed. No attempt should be made to remove or salvage any part of the cofferdam walls below the top of subway structures or below the depth affected by loads of contiguous structures.

7.601 General Underpinning Requirements. The age, type, usage and construction of adjacent structures must be given initial and primary consideration in design of underpinning. The geometry of adjacent zones within which underpinning is necessary is illustrated on Plate No. 8. Particular problems for this route are discussed in Chapter 8. Basic underpinning requirements are listed below.

1. Underpinning members must be completely independent of and free-standing from the subway structure and isolated from it in such a manner that transfer of train vibrations to the supported buildings is minimized.

2. In general, those foundations of adjacent structures which lie within the active earth Zone A surrounding the excavation must be underpinned. For vertical cuts this is defined as a zone inside of the line rising at a slope of 2 vertical on 1 horizontal from a point 2 feet below the edge of the base of the subway excavation. The limiting slope angle of Zone A within which underpinning is required ranges from 1 vertical on 1 horizontal to 2 vertical on 1 horizontal depending on the character of the soils within Zone A. Where building foundations lying immediately outside of these limits are so heavy that they would expand the active zone, underpinning should be provided by the Section Designer. In contrast, where movement of a vertical wall cofferdam is negligible at the surface, the width of the active zone decreases and avoidance of underpinning of marginal foundation elements should be considered by the Section Designer.

3. Where foundations of smaller structures lying in active Zone A adjacent to the excavation apply an equivalent line load on the front wall or on side walls perpendicular to the street totalling less than 2 kips per lineal foot, it may be possible to eliminate underpinning and control movement by careful excavation within tightly braced cofferdams. In this case the following additional requirements are recommended for cofferdam construction. If soldier beams and breastboards are to be used, excavation depth below each row of boards before the next row is placed should be no more than the height of a board plus two inches. All breastboards must be tightly backpacked and wedged as installed and loss of ground through the space between boards must be prevented. The uppermost tier of bracing should be placed at a depth no greater than 5 feet below adjacent ground surface. The vertical spacing of tiers of braces should be no greater than 12 feet, center to center. If special studies and evaluations are made, vertical spacing may be increased, particularly after excavation is complete, to meet structure requirements.

4. In all cases of excavation in soil where foundations of adjacent structures supported in Zones A and B in Plate No. 8 are not underpinned, the temporary retaining structure and the permanent subway structure must be designed to resist the horizontal and vertical pressures applied by these foundations, computed in the manner described in Section 7.5, with particular attention to deformations occurring during excavation and during the installation of the temporary supports and the permanent structures.

7.602 Requirements for Underpinning Supports. The following requirements pertain to the underpinning supports themselves:

1. For excavations in soil, all portions of the bearing area or tip of underpinning members shall extend into Zone C of Plate No. 8 below a line rising at a slope of 1 vertical on 1 horizontal from a point two feet below the edge of the base of the subway excavation. The support provided to the underpinning member below this line should accommodate the total applied load with adequate safety factor. In this case, pressures on the subway structure from the underpinning members need not be considered.

2. Underpinning walls, piers or piles which form a portion of the excavation support system shall be extended to a depth not less than 2 feet below the lowest nearby subgrade of the subway excavation. The bearing support for such underpinning members must provide an adequate safety factor during subway excavation and construction as well as after completion of construction. Where underpinning members will be exposed at the sides of the excavation they must be capable of resisting all horizontal loads applied to them by non-underpinned foundations in Zones A and B, computed in the manner described in Section 7.5.

3. Materials suitable for support of underpinning piles are the Cretaceous strata of the P group, decomposed rock of Stratum D and bedrock. In some cases the very compact sands of Pleistocene Strata T3 or T5 may prove satisfactory where they are not underlain by terrace clays. Typical ranges of pile working loads in these strata, as limited by the strength of the bearing material, are as follows:

> Pleistocene sand and gravel, Strata T3 and T5: 50 to 70 tons;
> Cretaceous Strata P1, P2, P3 or P4: 60 to 80 tons;
> Decomposed rock, Stratum D: 70 to 90 tons;
> Bedrock: 120 to 200 tons.

It should be noted that in many instances it will be difficult to jack piles or drive them by conventional impact hammer through Cretaceous strata or decomposed rock to bedrock.

4. Design bearing intensities for underpinning walls, piers or caissons should be limited to the allowable values described in Section 7.2. For cohesionless Strata T3, T5, P2 and P4 it would be appropriate to compute specific bearing capacity by conventional methods which give credit for the depth of surcharge surrounding the bearing level.

7.7 Construction Dewatering and Drawdown (Sections V.G. and V.G.3. Criteria)

To preserve the integrity of bearing materials for subway structures and to insure the safety of temporary construction, ground water levels must be drawn down or controlled by other methods, at the subgrade within open excavations and at the heading of earth tunnels. Ground water conditions and permeability of subsurface strata are described in Chapter 5. Seepage control problems expected to be encountered in specific sections of this route are discussed in Chapter 8. Median permeability values for the various materials are generally low and construction dewatering is not expected to require pumping of large average quantities of water. Nevertheless, the subsoils include layers and lenses of cohesionless single-size fine to medium sands, particularly in Strata A2, T2, T4 and P2, which could become highly unstable with uncontrolled seepage.

Piezometers shown in standard drawings should be specified by the Designer to be installed during construction to monitor the drawdown. For cut-and-cover construction, water levels within the excavation should be lowered and maintained at a depth not less than two feet below the lowest general subgrade at all times, as demonstrated by the piezometer observations. Piezometric levels surrounding earth tunnels ordinarily should be reduced so that the average gradient of total head directed towards the tunnel heading is less than one. This latter requirement will not insure stability of cohesionless sand and dewatering at the face must be complete enough to prevent piping or running of materials being excavated. On the other hand, perched water levels found at a distance above the tunnel top about equal to the tunnel height ordinarily can be disregarded.

7.701 Limitation on Drawdown. The required drawdown within the excavation ordinarily will extend outside of the immediate construction area. This increases effective pressures on subsoils beneath adjacent structures by an amount equal to the number of feet of drawdown times 62.5 pcf and could produce settlements of such structures. In general, the Pleistocene and Cretaceous clays are moderately to heavily preconsolidated and are not subject to large potential settlements.

The problem posed by drawdown depends not only on soil characteristics but also on the sensitivity and vulnerability of adjacent structures to settlements. Surveys of the character of adjacent structures and their foundations were not included in this investigation and the Section Designer must determine which structures are particularly vulnerable. The extent and amount of drawdown depend on the nature of the temporary subway structure and the dewatering or cut-off methods chosen by the contractor and cannot be predicted without knowledge of these factors. Therefore, the design studies should be directed to determining the magnitude of drawdown which is permissible in areas surrounding the construction.

Where the Section Designer concludes that a building is particularly vulnerable, the magnitude of settlements produced by drawdown should be estimated in the following manner:

1. Subsoils contributing to consolidation settlements include principally Pleistocene clays of Stratum T1, alluvial clays Stratum A1, and fill materials. Consolidation settlements due to drawdown may be ignored in Pleistocene sands of Strata T2, T3, T4 and T5, in all Cretaceous strata and in decomposed rock or bedrock.

2. Drawdown for a depth averaging about four feet below the ground water table shown on the geologic sections may be ignored in computing settlements since water levels generally have fallen to at least this low level in seasonal fluctuations.

3. The magnitude of settlement should be computed by conventional methods for an assumed drawdown utilizing a straight-line semilog recompression index as described in Chapter 6.

Settlements computed in this manner will guide the limitations on dewatering to be specified in the construction contract. In certain cases specifications may require use of a water-tight cofferdam, or recharge of ground water, or the permissible drawdown may be limited to certain elevations monitored by piezometers, without setting forth the method of control.

8. SPECIFIC SUBSURFACE PROBLEMS OF L'ENFANT-PENTAGON ROUTE

8.1 Scope

This chapter describes specific subsurface problems relating to design and construction of Sections L001 and L002 of L'Enfant-Pentagon River Crossing Route. The discussion commences at the northeastern end of the study, Station 57+00 at the intersection of Frontage Road and 7th Street, S.W., and continues west beneath Washington Channel, East Potomac Park, and Potomac River to join Huntington Route near Pentagon Station at 175+00. No subway stations are included within this study. The position of top of rail of outbound track and type of construction being considered are as shown on DeLeuw, Cather & Co. Drawings Nos. PP-R-113 to -115 and the top of rail for this location is shown as a long-dash line on the geologic sections. Information on recent construction experiences and foundations of the more important structures bordering the route is given in Chapter 9.

8.2 Stations 57 to 72+50, Single-track Earth Tunnels

The tunnels which extend southwest from L'Enfant-Pentagon Station dip from top of rail at about Elev. -30 to a low point at Elev. -55, then rise to Elev. -50 at Maine Avenue. Base of the tunnels will lie in Cretaceous materials and their top will be in gravelly Stratum T5 materials at a maximum depth of about 30 feet below ground water. Invert conditions would be favorable but it is expected that the upper part of the tunnel opening would encounter pervious gravelly lenses and scattered boulders so that the dewatering could be troublesome and the advance of a tunnel shield difficult. Distinctly improved tunnel conditions could be obtained by lowering grade 20 feet at Maine Avenue so that the tunnel would be entirely within Cretaceous except for the northernmost section nearest to L'Enfant-Pentagon Station. This position will not eliminate the need for systematic predrainage because much of the Cretaceous P2 material consists of slightly silty or clayey single-size sand, characterized by gradation curves in Plate No. A11. Dewatering problems may be accentuated by recent construction for marinas and bulkheads on the east bank of Washington Channel which could have opened a contact between open water and the lower Pleistocene Stratum T5. Construction drawdown is not expected to produce significant settlement in these heavily overconsolidated soils. The principal underpinning problem will involve construction of the inbound tunnel near to or beneath Jefferson Junior High School. This structure is supported on spread footings at about Elev. +7 near the top of gravelly sands of Stratum T3. Positioning the tunnel entirely within Cretaceous strata at this location might eliminate the need for underpinning. We understand that consideration is being given to possible alternative line and grade for both the river crossing and for Branch Route in southwest Washington. A tunnel position entirely in the Cretaceous in southwest Washington probably is feasible only with a low-level mined tunnel on the river crossing.

8.3 Stations 72+50 to 74+50, Cut-and-Cover Transition

Original plans show a transition between land tunnels and sunken tubes in Washington Channel in cofferdam construction at the east bank of Washington Channel. Base of excavation would extend a maximum of 60 feet through fill and recent river sediment. Subgrade will reach lower Pleistocene sand and gravel of Stratum T5 and very compact Cretaceous clayey sand of Stratum P3. Construction conditions could be expected to be relatively difficult. Installation of a reasonably water-tight cofferdam in an area with old or unknown former bulkhead structures can be particularly troublesome. Conditions for cut-off at subgrade should be favorable on the inboard half of this box but difficult at the outboard side where the lowest Pleistocene may communicate to open water. For a depth of 40 feet below subgrade there is no evidence of pervious lenses within the Cretaceous material, but the necessity for control of uplift pressures beneath the subgrade must be considered in construction. Lateral earth pressures on the cofferdam would be relatively high for the depth of excavation required.

8.4 Stations 74+50 to 85, Double-box Sunken Tube or Cofferdam Construction

Original plans for construction through Washington Channel contemplated double-tube boxes built in sections, floated into position and sunk in a dredged trench. Subgrade would range between Elev. -45 and -50 in organic clay of Stratum A1 having a shear strength of about 600 pounds per square foot. From the subgrade to Elev. -28 or -30 shear strength averages about 500 psf. Sediment above Elev. -30 apparently was deposited after bottom dredging or erosion and has a strength of about 100 to 200 psf. This very soft sediment should be swept from the site for a distance of 50 feet beyond the top of trench on each side in order to minimize continuous sloughing into the trench. The cut below Elev. -30 down to subgrade could be made at slopes of 1-1/2 horizontal to 1 vertical. The subgrade is in relatively highly organic materials and the base of the trench would require suitable bedding material to prepare it for the placing of boxes. If the clay at subgrade can be maintained undisturbed, pile support would not be necessary.

Open-cofferdam construction has been considered as an alternative, extending over half the width of the channel in two stages. Construction procedures might include casting the base of the boxes by tremie methods. In any case, stability of the temporary cofferdam must be carefully evaluated.

While the organic clay below subgrade is not notably sandy, open-cofferdam construction may necessitate deep pumping in the interior to relieve water pressures in Stratum T5 and in sand seams in the lower portion of Stratum A1. This is particularly important at the east side of the Channel where subgrade will be underlain at shallow depths by Stratum T5. If the quality of bearing materials is preserved, settlements of the completed boxes due to recompression of the underlying organic clay would not exceed 1-1/2 to 2 inches.

8.5 Station 85 to 97+50, Cut-and-Cover Boxes

This cut-and-cover construction in Potomac Park will involve a maximum excavation of approximately 50 feet within soft to medium organic clay of Stratum A1. Strength and preconsolidation characteristics are shown on Plate No. 10. Shear strength at subgrade equals 1 to 1.2 kips per square foot at the deepest excavation on the east and decreases upward from subgrade level to 500 or 600 pounds per square foot near Elev. 0 at the top of the layer. Overconsolidation at subgrade ranges from about 0.5 tons per square foot at the deepest excavation to 0.3 tsf at the surface of the clay. Pile support would not be necessary if the total weight of structure and backfill does not exceed the total weight of excavated soil by more than the overconsolidation values. In order to avoid pile support, bearing qualities of the subgrade material must be carefully protected. Even though the underlying clay is not particularly sandy, relief of hydrostatic pressures below subgrade may be necessary to prevent damage by piping upward to the excavation. Design of the temporary retaining structure will require a detailed evaluation of lateral pressures imposed by the soft clay and the passive resistance available below subgrade. At the deepest excavation at Station 85, the safety factor against base failure in the clay is only about 1.3 and sheeting may be required to extend to greater than usual depths below subgrade. It is inevitable that the construction dewatering will produce settlement of the surrounding ground. This might be in the range of 1 to 3 inches and its effect on existing structures must be considered by the Section Designer.

8.6 Stations 97+50 to 102+50, Retained Cut and Embankment

The base of the retaining wall, 250 feet in length, will lie in fill for the most part. If toe pressures can be restricted to less than 1 ton per square foot, spread bearing could be provided by excavating the fill to a depth equal to approximately half the width of the wall base and replacing select granular materials. If toe pressures are excessive, timber pile support of the retaining walls is indicated. The borings encountered a fairly continuous layer of loose sand, Stratum A2, between about Elev. -18 and -28 and this could be utilized for point bearing support of 12 to 14-ton timber piles.

The planned embankment reaches a maximum height of about 10 feet above grade at its junction with the aerial structure to follow. This height of fill would impose a load of approximately 0.6 tons per square foot which would exceed the preconsolidation stress in the underlying Stratum A1 by 0.3 tsf. While a 10-foot high embankment is stable post construction settlement could amount to about one-half foot. This would mean that the track would require releveling at intervals after completion.

8.7 Stations 102+50 to 139, Aerial Structure

The first 400 feet of this structure will rise over East Potomac Park. Suitable foundation support would be provided by H-piles driven for relatively high load, between 70 and 90 tons, into the very compact Cretaceous clayey sand and sandy clay of Strata P2 and P3 below Elev. -55 or -60. Use of a non-displacement pile is preferable because driving through fill and soft organic materials could produce substantial remolding with resultant downdrag on displacement piles. It is believed that 80-ton driving resistance could be developed at a depth of about 10 to 15 feet below the Cretaceous surface. Present plans contemplate that the river crossing would be made on a span parallel to and similar in general style to the existing Penn Central Long Bridge. Foundations of the existing structure were built in several stages, alternating piers on short timber piles with deeper piers on steel H-piles to Cretaceous. We understand that the spacing between the two bridges would provide at least a 30-foot distance between piers at their closest position. Under these conditions it is unlikely that the driving of new piles would have damaging effect on the existing bridge foundation. The effect of excavation for the new piers on stability of the existing piers would have to be carefully planned to avoid interference with existing foundations. The optimum pile would be a non-displacement steel H-pile of about 80-ton capacity driven to depths of about 15 to 18 feet below the Cretaceous surface. Piles battered upstream for the new structure should not pass beneath existing timber piles and new piles should be at least 10 feet distant from the tips of batter piles of the existing bridge.

The geologic sections on Drawings Nos. F-L-8 and -9 show the average pile tip and type and the base of piers of the existing bridge, plus the bearing level of the three center piers which are on spread bearing in Stratum T5. It should be noted that the current river bottom interpretated from the borings on the west half of the river is as much as 20 feet below the river bottom obtained from earlier sounding information. It appears that certain of the piers on timber piles and a substantial portion of the pile length have been exposed by scour. Any studies for the new parallel bridge should include complete soundings and an underwater survey of the condition of the existing structure in order to ensure that these are known before new construction commences.

8.8 Stations 139 to 146+50, Retained Fill and Cut

This comprises a short section of shallow fill with a maximum height of 5 or 6 feet above ground surface, followed by retained cut extending through fill and bottoming at a maximum depth of 15 feet in soft to medium Stratum T1 silty clay. Walls for the low height of retained fill could be placed on spread bearing in select granular fill which replaces the existing fill of mixed quality below bearing level. Toe pressures should be limited to about one ton per square foot. The deepest cut will be in highly variable T1 clay which seems to have formed a shallow exposed shoal or island at the side of the main river channel. As a consequence, it contains organic pockets or lenses and is mixed with fill in its upper portion. It would be necessary to provide for the removal of unsatisfactory material beneath the base of the retaining walls, replacing select granular fill. Under these conditions spread bearing should be satisfactory if toe pressures can be limited to about 1-1/2 tons per square foot.

8.9 Stations 146+50 to 175, Cut-and-Cover Boxes

Original plans show this section dropping from a portal at about Elev. 0 on the east to a maximum depth of cut of 50 or 55 feet to Elev. -20. For almost the entire length subgrade would lie in compact silty sand and gravel of Stratum T5 overlain by fill varying up to 30 feet in thickness. Near the west end of the section beyond Station 170, subgrade would reach clayey sand and sandy clay of Stratum P3. The maximum depth of excavation below ground water is 30 feet and it should be expected that a major dewatering effort would be necessary in certain sections because of the pervious nature of Stratum T5 and the likelihood that it contacts nearby open water. While the underlying Cretaceous is generally of low permeability, the need for deep wells to relieve uplift pressures originating in gravelly or bouldering lenses should not be overlooked. This might be important toward the west end of the section where the top of decomposed rock of Stratum D rises to within about 20 feet of subgrade and ground water flow would be concentrated in the overlying Cretaceous materials. With proper dewatering, subgrade quality would be expected to be good and no problems of stability of the base of excavation should be encountered. Pressures on the cofferdam structure will tend to be about average for the depth of cut involved, assuming a typical friction angle of 30° in the overlying fill and 38° in Stratum T5 materials. At many locations Stratum T5 appears to contain coarse gravelly or bouldery lenses which will interfere with driving of cofferdam sheeting or soldier piles. Consequently, interlocking steel sheeting may not be a practical choice for the cofferdam. At the west end of the line, beyond Station 172, the excavation will pass through soft organic clay of Stratum A1 which was deposited in a shallow tributrary flowing on the flood plane of the Potomac River. Shear strength of the organic clay is about 500 pounds per square foot and cofferdam pressures would be substantially higher than average beyond Station 172. In this section the subgrade of inbound track lies within Stratum A1 clays or A2 silty sand underlain by Stratum T5. The most careful procedures will be necessary to protect the subgrade from disturbance by upward seepage or operation of excavating equipment.

We understand consideration is now being given to the alternative construction of two single-track tunnels from a portal at Station 146+50 to continue to their connection with Huntington Route at Station 175. These tunnels would dip down with a top of rail at a low point of Elev. -38 at Station 165. Beyond Station 155 the base of tunnel would be in hard or compact clayey sand and sandy clay of Stratum P3 and the top in Stratum T5. It is expected that major pre-drainage by deep wells would be required throughout. It must be assumed that cobbles and boulders in Stratum T5 would interfere to some extent with the advance of tunnel shields. With effective dewatering, the surface settlement could be limited to moderate or low values, except west of Station 172 where the tunnel top is in organic soil of Stratum A1 overlain by fill.

8.10 Tunnel Construction for the River Crossing

We have put forward a suggestion that tunneling for the river crossing might be given consideration because of the complexity of the presently planned construction in this section. The practicability and economics of deep tunnel construction beneath open water hinge primarily on the need for compressed air in the construction. The most favorable alternative tunnel location would comprise two single-track tunnels with top of rail at the following positions:

Deviate from planned grade at Elev. -55 at Station 64;
Drop to Elev. -84 at Station 80;
Continue level at Elev. -84 to Station 100;
Drop to Elev. -106 at Station 115;
Rise to Elev. -94 at Station 135;
Rise to Elev. -50 at Station 170;
At this point the tunnel top passes into Stratum T5 and its position depends on conformance with Huntington Route structures.

The tunnel beneath open water encounters two distinctly different soil conditions. Between Stations 75 and 100 the tunnel would be in the lowermost Stratum A1 clay where shear strengths range from 900 pounds per square foot beneath Washington Channel to 1,800 psf beneath East Potomac Park. Layers and lenses of the gravelly Stratum T5 would be near to or just below the opening. The most promising means of avoiding compressed air would be to dewater this Stratum T5 and a portion of the underlying Cretaceous so that they serve as an underdrain to the tunnel construction and bring about a reduction of water pressures within the organic clay layer. West of Station 100 the tunnel would lie within clayey sand and sandy clay of Strata P2 and P3 and plastic clay of Stratum P1 with a cover of 20 to 30 feet of Cretaceous between the tunnel top and the base of river deposits. A portion of this section is underlain by relatively pervious Stratum P4 clayey sand with some gravel and deep pumping in this layer as an underdrain would have to be effective in lowering water pressures in order to avoid compressed air.

In the land area west of the Potomac it is likely that compressed air could be omitted if the tunnel could be kept in Cretaceous strata with a cover of about 15 feet between top of tunnel and base of the Pleistocene Stratum T5. Tunneling conditions would be fair to good west of Station 135 area but dewatering by deep wells in the Cretaceous very likely would be necessary.

To have any assurance that this scheme is practicable it will be necessary to demonstrate that deep dewatering will lower water pressures in the soils intersected by the tunnel beneath the river and Washington Channel. This would require at least two complete deep-well pumping tests, one made from land in East Potomac Park and the other made in the Potomac River, possibly with the well installed from the center pier of the existing railroad bridge. Since the lower portion of the organic clay is substantially overconsolidated, surface settlement to be expected from the dewatering process would be small but might be measurable on structures supported above the tunnel. An effort should be made in the pumping tests to obtain information on compression of the organic clay which occurs near the pump well location. This might be important in connection with Piers Nos. 1, 2 and 3 of the existing railroad bridge which are supported on timber piles which stop in or above organic clay of Stratum A1. The pumping tests would require a considerable number of observation wells, possibly 6 to 8 for each test, carefully positioned to evaluate the drawdown conditions.

9. RECENT FOUNDATION CONSTRUCTION EXPERIENCE

9.1 Scope

A number of projects near the proposed alignment of Sections L001 and L002 of L'Enfant-Pentagon Route have been under construction during 1970 or were completed prior to this study. These projects provide examples of foundation construction problems and their solutions. The case histories will be discussed in the same order as the subway design sections of Chapter 8, that is starting from the northeast end of the study area and proceeding south and west along L'Enfant-Pentagon Route. Because of the variability of Pleistocene terrace materials, these particular experiences cannot be extrapolated to predict conditions to be encountered at distant locations.

9.2 Area Northeast of Washington Channel

The HUD building on 7th Street S.W. between D Street and the Southwest Freeway is supported on shallow foundations. A mat foundation was used for the central core of the building and spread footings for the adjacent wings. The mat was 6-1/2 feet thick and was founded at Elev. -5. Spread footings bottom between Elevs. -2 and -3.5, all in sand and gravel of Stratum T3.

The Southwest Freeway Bridge of Interstate Route 95 carries Seventh Street S.W. between F and G Streets on a simple-span structure. Piers and abutments are supported on spread footings with maximum bearing intensities between 2.5 and 3 tsf. The base of footings vary between about Elev. +1 and +5 within the compact sand and gravel of Stratum T3. In general, this material provides high-quality support for shallow foundations in much of the southwest Washington area.

9.3 Structures on Washington Channel

In 1962 a sheet-pile bulkhead was constructed along the portion of the Maine Avenue waterfront between the Southwest Freeway bridge at the north and P Street near Fort McNair at the south. The bulkhead was tied back to an anchorage with 2-1/2-inch diameter tie rods. The bulkhead was constructed of ZP27 steel sheet piling with tip elevations varying between -35 and -49. The anchorage consisted of double-batter timber piles with tip elevations between -30 and -35. High-level decks are now under construction in the area behind the bulkhead. The decks are supported on 50-ton cast-in-place concrete piles with all tip elevations below -40, making them end-bearing either in the Stratum T5 sand and gravel or Stratum P3 Cretaceous clayey sand and sandy clay. Six test piles were driven and load tested during construction. North of the subway alignment is the Southwest Freeway Bridge over Washington Channel. The piers and abutments are supported on steel H-piles, 12BP74, and cast-in-place concrete piles with tip elevations ranging between -56 and -115. This bridge was constructed in 1959.

9.4 Potomac River Crossing

The proposed aerial structure is located immediately south of the Penn Central Long Bridge. A simple-span structure was reconstructed in 1942 with steel girders replacing truss spans. These had been constructed between 1892 and 1898 for a bridge at Trenton, New Jersey, were dismantled in 1903 and erected again at Washington, D.C. in 1904. All of the piers consist of granite masonry backed with concrete and are supported on piles. The original structure was supported on timber piles with tips at elevations ranging between -24 and -42. The draw span is founded on concrete caissons bearing at elevations between -34 and -42 in Stratum T5 sand and gravel. When the bridge was reconstructed with steel girders in 1942 steel H-piles, 14 BP73, were driven to 55-ton bearing. These piles have tip elevations ranging between -62 and -70 in the underlying Cretaceous Stratum P2 and P3 material.

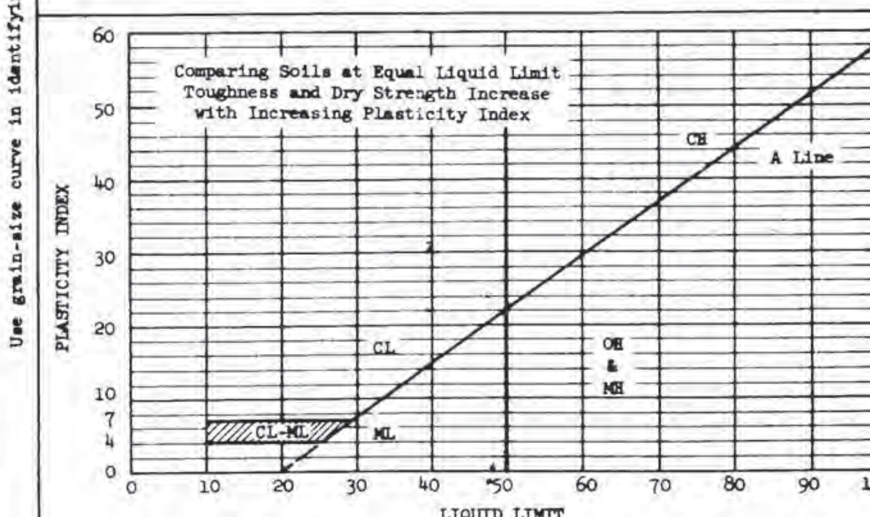
9.5 Shirley Highway Area

The Marriott Motel is supported on monotube piles averaging 40 feet in length. All of the structures carrying the Shirley Memorial Highway over other roads are pile supported. Foundations include 15-ton timber piles with estimated 60-foot length for the bridge over the George Washington Memorial Parkway; 20-ton timber piles for a structure over Boundary Channel Drive; and 30-ton cast-in-place concrete piles on the bridge over Jefferson Davis Highway.

TABLE No. 3, UNIFIED CLASSIFICATION SYSTEM

Major Divisions (1)	(2)	(2)	Group Symbols (3)	Typical Names (4)	Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights) (5)	Information Required for Describing Soils (6)	Laboratory Classification Criteria (7)
Coarse-grained Soils. More than half of material is **larger** than No. 200 sieve size.	Gravels. More than half of coarse fraction is larger than No. 4 sieve size.	Clean Gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions, and drainage characteristics.	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.		Not meeting all gradation requirements for GW
		Gravels with Fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixture.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).	Give typical name; indicate approximate percentages of sand and gravel, maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses.	Atterberg limits below "A" line or PI less than 4. Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
			GC	Clayey gravels, gravel-sand-clay mixtures.	Plastic fines (for identification procedures see CL below).		Atterberg limits above "A" line with PI greater than 7
	Sands. More than half of coarse fraction is smaller than No. 4 sieve size.	Clean Sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines.	Wide range in grain size and substantial amounts of all intermediate particle sizes.		$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands or gravelly sands, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.	Example: <u>Silty sand, gravelly</u>; about 20% hard, angular gravel particles 1/2-in. maximum size; rounded and subangular sand grains, coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).	Not meeting all gradation requirements for SW
		Sands with Fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).		Atterberg limits below "A" line or PI less than 4. Limits plotting in hatched zone with PI between 4 and 7 are borderline cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures.	Plastic fines (for identification procedures see CL below).		Atterberg limits above "A" line with PI greater than 7
The No. 200 sieve size is about the smallest particle visible to the naked eye.	(For visual classification, the 1/4-in. size may be used as equivalent to the No. 4 sieve size)						Use grain-size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse-grained soils are classified as follows: Less than 5%: GW, GP, SW, SP. More than 12%: GM, GC, SM, SC. 5% to 12%: Borderline cases requiring use of dual symbols.

Major Divisions		Group Symbols	Typical Names	Identification Procedures on Fraction Smaller than No. 40 Sieve Size: Dry Strength (Crushing characteristics)	Dilatancy (Reaction to shaking)	Toughness (Consistency near PL)	Information Required for Describing Soils
Fine-grained Soils. More than half of material is **smaller** than No. 200 sieve size.	Silts and Clays. Liquid limit is less than 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	None to slight	Quick to slow	None	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high	None to very slow	Medium	
		OL	Organic silts and organic silty clays of low plasticity.	Slight to medium	Slow	Slight	Give typical name; indicate degree and character of plasticity; amount and maximum size of coarse grains; color in wet condition; odor, if any; local or geologic name and other pertinent descriptive information; and symbol in parentheses.
	Silts and Clays. Liquid limit is greater than 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Slight to medium	Slow to none	Slight to medium	
		CH	Inorganic clays of high plasticity, fat clays.	High to very high	None	High	
		OH	Organic clays of medium to high plasticity, organic silts.	Medium to high	None to very slow	Slight to medium	Example: <u>Clayey silt</u>, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML).
Highly Organic Soils		Pt	Peat and other highly organic soils.	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			



PLASTICITY CHART

For laboratory classification of fine-grained soils

(1) **Boundary classifications:** Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well-graded gravel-sand mixture with clay binder. (2) All sieve sizes on this chart are U. S. standard.

TABLE NO. 4, SURVEY DATA FOR BORINGS

BORING NUMBER	HORIZONTAL CONTROL COORDINATES: EAST	NORTH	VERTICAL CONTROL: GROUND SURFACE ELEVATION (FT)	STATUS OF OBSERVATION WELLS: INSTALLED	TYPE	PRESENT CONDITION
L-1	E 793,660	N 382,222	+28.5			
L-2	E 793,533	N 381,649	+27.3			
L-3	E 793,378	N 381,328	+24.9	5-12-70	1.5"	F.
L-4	E 792,918	N 381,068	+11.9	5-12-70	0.5"	F.
L-5	E 792,449	N 381,018	-22.1			
L-6	E 792,304	N 380,994	-23.0			
L-7U	E 792,191	N 380,976	-23.0			
L-8	E 791,997	N 380,951	-22.3			
L-9U	E 791,721	N 380,911	-19.0			
L-10	E 791,581	N 380,889	-18.2			
L-11	E 791,356	N 380,941	+ 6.2	5-11-70	0.5"	F.
L-12	E 791,204	N 380,861	+ 7.6			
L-13	E 791,004	N 380,754	+10.0			
L-14U	E 790,663	N 380,739	+12.6	5-13-70	1.5"	F.
L-15	E 790,448	N 380,708	+ 9.1			
L-16	E 790,068	N 380,529	+11.7			
L-17U	E 789,857	N 380,336	+10.8	9-18-70	1"	Q.
L-18	E 789,672	N 380,127	+ 9.3			
L-19	E 789,441	N 379,816	- 4.0			
L-20U	E 789,328	N 379,645	- 5.5			
L-21	E 789,216	N 379,473	- 6.0			
L-22	E 789,094	N 379,293	-10.2			
L-23	E 788,849	N 378,923	-28.4			
L-24	E 788,700	N 378,694	-29.0			
L-25	E 788,520	N 378,436	-30.9			
L-26	E 788,310	N 378,128	- 7.4			
L-27	E 788,232	N 378,030	+ 7.1			
L-28	E 787,870	N 377,512	+22.2			
L-29	E 787,702	N 377,243	+19.3			
L-30	E 787,505	N 377,076	+19.5	10-15-70	1"	F.
L-31	E 787,298	N 376,979	+18.9			
L-32	E 786,991	N 376,962	+17.9			
L-33U	E 786,528	N 377,228	+36.5			
L-34	E 786,292	N 377,468	+22.3	9-25-70	1"	Q.
L-35	E 786,083	N 377,641	+20.7			
L-36	E 785,803	N 377,769	+20.4			
L-37U	E 785,202	N 377,824	+18.9	10-5-70	1"	F.

LEGEND: 10-15-70 = Date of installation;
F. = Still functioning in 1970;
Q. = Condition is questionable.

TABLE NO. 5
SUMMARY OF LABORATORY TEST DATA

SAMPLE IDENTIFICATION				CLASSIFICATION PROPERTIES								PHYSICAL PROPERTIES: STRENGTH								CONSOLIDATION					
									UNIFIED CLASSIFICATION SYSTEM			UNCONFINED COMPRESSION			TRIAXIAL COMPRESSION										
BORING NO.	SAMPLE NO.	DEPTH FT.	STRATUM DESIGNATION	NATURAL WATER CONTENT %(W) AVERAGE OF ENTIRE SAMPLE	LIQUID LIMIT (W_L)	PLASTICITY INDEX (I_p)	NATURAL WATER CONTENT OF LIMIT SAMPLE %(W)	SPECIFIC GRAVITY OF SOLIDS (G)	SOIL TYPE	% SAND (<#4, >#200 SIEVE)	% CLAY (<#200 SIEVE)	COMPRESSIVE STRENGTH TSF	WATER CONTENT AT END OF TEST %	STRAIN AT FAILURE %	TYPE OF TEST	DEVIATOR STRESS ($\sigma_1 - \sigma_3$) TSF	CONFINING PRESSURE (σ_3) TSF	NATURAL WATER CONTENT %	WATER CONTENT AT END OF TEST %	NATURAL WATER CONTENT %	EXISTING OVERBURDEN STRESS TSF	ESTIMATED PROBABLE PRECONSOLIDATION STRESS - TSF	COMPRESSION INDEX C_c	SWELLING INDEX C_s	VOID RATIO AT START OF SWELL, e_r
L-1	9S	45.5	TIE	50.0					CL			2.06 2.63	70.0 41.9	7.4 5.4											
L-2	9S	39.0	TIE	23.1					CL																
L-5	4S	14.5	A1	67.6					OH			0.34 0.53 0.44	66,0 60.9 74.0	8.1 10.9 6.2											
	5S	19.5	A1	84.7	101.3	60.7	83.6		OH			0.51 0.59	85.5 83.7	6.1 6.7											
	9S	35.0	A1	41.7					OH																
	10S	40.0	A1	69.0					OH			0.64	68.5	6.2											
	11S	45.0	A1	71.8 221.0	99.3	62.3	77.3		CH OH			0.59 0.48	69.0 220.0	8.6 9.9											
L-6	3S	11.0	A1	76.8					OH			0.43 0.43 0.42	76.9 74.2 78.1	7.4 8.5 8.7											
	5S	21.0	A1	80.8	98.5	62.4	83.8		CH			0.44 0.58	77.2 84.0	6.2 8.5											
	6S	26.0	A1	83.7					OH			0.52 0.48 0.49	85.1 78.5 84.5	6.9 4.9 6.2											
	7S	31.0	A1	68.0					OH			0.53 0.59	70.0 64.9	5.9 7.4											
	8S	36.0	A1	69.7	81.3	47.6	67.0		OH			0.63 0.69 0.71	71.1 68.0 69.7	8.6 7.4 9.9											
	9S	41.0	A1	65.1					OH			0.73 0.79	66.4 63.2	7.5 9.2											
	10S	46.0	A1	68.2					OH			0.65 0.82 0.61	68.0 70.0 68.0	8.7 9.9 6.7											
L-7U	3U	10.9	A1	69.0					OH																
	5U	21.1	A1	76.0	72.2	22.7	77.0	2.57	OH			0.51	71.4	6.2	Q	0.57	2.0	79.2	78.5	86.6	0.4	0.97	1.32	0.17	1.253
	6U	26.1	A1	86.5					OH						Q Q	0.48 0.49	0.5 1.0	92.0 82.8	91.9 82.3						
	7U	31.1	A1	77.0					OH			0.56	69.7	9.7	Q Q	0.48 0.62	0.5 1.0	75.6 81.8	75.5 81.5						

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DE LEUW CATHER & COMPANY
GENERAL ENGINEERING CONSULTANTS

DATE DECEMBER 2, 1970 FILE NO. 3291E SHEET NO. 1 OF 5 TABLE NO. 5

TABLE NO. 5

SUMMARY OF LABORATORY TEST DATA

Sample Identification: Boring No.	Sample No.	Depth Ft.	Stratum Designation	Classification Properties: Natural Water Content %(H) Average of Entire Sample	Liquid Limit (W_L)	Plasticity Index (I_p)	Natural Water Content of Limit Sample %(W)	Specific Gravity of Solids (G)	Unified Classification System: Soil Type	% Sand (<#4, >#200 Sieve)	% Clay (<#200 Sieve)	Strength – Unconfined Compression: Compressive Strength TSF	Water Content at End of Test %	Strain at Failure %	Triaxial Compression: Type of Test	Deviator Stress ($\sigma_1 - \sigma_3$) TSF	Confining Pressure (σ_3) TSF	Natural Water Content %	Water Content at End of Test %	Consolidation: Natural Water Content %	Existing Overburden Stress TSF	Estimated Probable Preconsolidation Stress – TSF	Compression Index C_c	Swelling Index C_s	Void Ratio at Start of Swell, e_r
L-7U Cont'd	8U	36.1	A1	73.3	69.6	25.4	71.4		OH			0.65	72.6	8.0	Q	0.65	2.0	73.8	73.4	76.5	0.6	1.0	0.87	0.15	1.169
	9U	41.1	A1	72.7					OH			0.45 0.46	73.1 76.5	6.2 3.5											
	11U	51.1	A1	63.4	77.4	29.3	69.5	2.64	OH			0.56	65.1	5.3	Q	0.59	1.0	66.8	66.6	63.1	0.8	1.3	0.71	0.15	0.928
	12U	56.1	A1	56.8					OH			0.82	62.6	6.4	Q Q	0.58 0.74	0.5 2.0	57.2 57.4	56.4 57.0						
	13U	61.1	A1	65.8	71.8	25.3	60.9	2.52	OH			0.33 0.81	69.6 71.9	12.1 6.3						65.7	1.0	1.5	0,82	0.16	1.089
L-9U	4U	16.0	A1	54.0					OH			0.48	51.1	8.9	Q Q	0.47 0.55	0.5 2.0	58.1 52.5	57.7 52.2						
	5U	21.0	A1	73.3	62.6	18.2	61.3		OH			0.60	70.3	7.2	Q	0.56	1.0	77.7	77.5	72.3	0.3	0.9	0.93	0.15	1.075
	6U	26.0	A1	80.7					OH			0.59	87.0	5.4	Q Q	0.60 0.58	0.5 1.0	80.6 73.4	80.1 73.0						
	7U	31.0	A1	87.4	82.3	26.2	88.3	2.55	OH			0.60	90.2	8.0	Q	0.78	2.0	83.5	83.0	84.9	0.5	0.95	1,00	0.20	1.307
	8U	36.0	A1	64.5					OH			0.77	46.7	7.1	Q Q	0.73 0.78	0.5 1.0	72.0 70.0	72.0 -						
	9U	41.0	A1	72.1	76.6	27.6	81.0		OH			0.83	66.1	7.1	Q	0.88	2.0	76.3	76.2	81.6	0.7	1.3	1.00	0.17	1.304
	10U	46.0	A1	71.0					OH			0.86	80.2	6.3	Q Q	0.78 0.86	0.5 1.0	64.5 68.5	63.7 67.6						
	11U	51.0	A1	70.7	73.0	27.5	63.7	2.55	OH			0.74	72.5	7.6	Q	0.78	2.0	71.1	70.7	64.9	0.9	1.4	0.78	0.12	1.053
	12U	56.0	A1	82.5					OH																
	14U	66.0	A1	56.7	70.7	26.5	64.8		OH						Q Q Q	0.88 0.76 0.89	0.5 1.0 2.0	42.0 54.9 72.0	42.0 54.7 71.5	63.8	1.1	1.5	0.75	0.16	0.862
L-10	3S	12.0	A1	65.3	83.4	42.0	70.1		OH			0.55 0.51	69.1 58.8	7.3 8.5											
	4S	17.0	A1	47.9					OH			0.60 0.63 0.49	53.8 47.0 46.7	9.8 8.6 8.7											
	5S	22.0	A1	62.3	81.4	40.1	65.4		OH			0.66 0.65	63.1 60.5	9.4 13.5											
	8S	37.0	A1	80.3					OH			0.79 0.98 0.88	84.1 79.7 76.4	8.6 9.6 9.7											
L-12	7S	31.0	A1	65.7					OH			0.90 1.06 0.91	65.0 73.1 58.6	7.9 7.9 7.3											

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DATE DECEMBER 2, 1970 FILE NO. 3291E SHEET NO. 2 OF 5 TABLE NO. 5

TABLE NO. 5

SUMMARY OF LABORATORY TEST DATA

Sample Identification: Boring No.	Sample No.	Depth Ft.	Stratum Designation	Classification Properties: Natural Water Content %(H) Average of Entire Sample	Liquid Limit (W_L)	Plasticity Index (I_p)	Natural Water Content of Limit Sample %(W)	Specific Gravity of Solids (G)	Unified Classification System: Soil Type	% Sand (<#4, >#200 Sieve)	% Clay (<#200 Sieve)	Strength – Unconfined Compression: Compressive Strength TSF	Water Content at End of Test %	Strain at Failure %	Triaxial Compression: Type of Test	Deviator Stress ($\sigma_1 - \sigma_3$) TSF	Confining Pressure (σ_3) TSF	Natural Water Content %	Water Content at End of Test %	Consolidation: Natural Water Content %	Existing Overburden Stress TSF	Estimated Probable Preconsolidation Stress – TSF	Compression Index C_c	Swelling Index C_s	Void Ratio at Start of Swell, e_r
L-12 Cont'd	12S	53.0	A1	61.3 101.3					OH																
L-13	13S	64.0	A1	64.6					OH&SC			0.78	62.6	7.8											
	14S	66.1	A1	62.4					OH			1.28 1.26	65.2 59.3	6.7 6.7											
	15S	68.4	A1	59.1	77.8	43.5	63.3		OH			1.20 1.22	57.9 58.0	6.7 7.9											
	16S	71.0	A1	64.5					OH			1.23 1,00	61.5 66.9	9.0 10.4											
	18S	78.1	A1	70.9					OH			1.44 1.25	71.0 70.1	7.4 8.9											
	19S	86.1	A1	75.4	96.0	55.8	70.2		OH																
	20S	88.6	A1	61.0					OH			0.94 1.41	69.4 54.9	10.1 7.5											
L-14U	4U	16.0	A1	60.8	57.7	25.2	45.9	2.64	OH			0.79	61.4	6.3						46.1	0.7	1.3	0.43	0.08	0.732
	5U	23.0	A1	60.2					CH																
	14U	73.0	A1	56.3	78.1	31.6	62.2	2.55	OH			1.64	54.9	5.4	Q	1.40	1.0	56.3	56.1	58.4	2.0	2.6	0.73	0.17	0.769
	15U	76.0	A1	57.1					OH			1.15	53.9	9.5	Q Q	1.40 1.51	0.5 2.0	64.4 52.9	64.1 52.4						
	16U	79.0	A1	65.4					OH			1.85	56.4	6.3	Q Q	1.81 1.82	0.5 2.0	69.4 70.2	68.7 69.9						
	17U	82.0	A1	58.9	57.8	27.9	52.8	2.75	OH			2.06	60.8	6.8	Q	1.88	1.0	61.2	61.2	51.5	2.2	3.5	0.71	0,15	0.855
	18U	84.0	A1	62.3					OH			1.97	66.0	7.7	Q Q	1.97 2.01	0.5 2.0	55.7 64.3	55.6 64.2						
	19U	88.0	A1	60.5	83.0	42.8	68.0		OH			1.63 1.07	71.8 59.0	6.7 7.4	Q	1.38	1.0	48.5	48.2	51.3	2.3	3.2	0.62	0.15	0.804
	20U	92.0	A1	56.3					OH			1.41 1.76	55.8 57.0	8.9 8.1											
L-15	6S	24.0	A1	45.7					OH			0.61 0.65	43.8 47.6	7.9 8.5											
L-16	6S	24.0	A1	49.0	61.0	30.8	50.3		OH			0.75 0.81 0.86	52.0 48.7 46.0	10.0 9.0 10.0											
	7S	29.0	A2	31.0					SM	92	8	0.63	37.9	6.0											
	10S	40.9	A1	45.0					OL			0.90 0.75	39.4 51.5	7.0 7.0											

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DATE DECEMBER 2, 1970 FILE NO. 3291E SHEET NO. 3 OF 5 TABLE NO. 5

TABLE NO. 5

SUMMARY OF LABORATORY TEST DATA

SAMPLE IDENTIFICATION				CLASSIFICATION PROPERTIES					UNIFIED CLASSIFICATION SYSTEM			PHYSICAL PROPERTIES – STRENGTH – UNCONFINED COMPRESSION			TRIAXIAL COMPRESSION					CONSOLIDATION					
BORING NO.	SAMPLE NO.	DEPTH FT.	STRATUM DESIGNATION	NATURAL WATER CONTENT %(W) AVERAGE OF ENTIRE SAMPLE	LIQUID LIMIT (W_L)	PLASTICITY INDEX (I_p)	NATURAL WATER CONTENT OF LIMIT SAMPLE %(W)	SPECIFIC GRAVITY OF SOLIDS (G)	SOIL TYPE	% SAND (<#4, >#200 SIEVE)	% CLAY (<#200 SIEVE)	COMPRESSIVE STRENGTH TSF	WATER CONTENT AT END OF TEST %	STRAIN AT FAILURE %	TYPE OF TEST	DEVIATOR STRESS ($\sigma_1 - \sigma_3$) TSF	CONFINING PRESSURE (σ_3) TSF	NATURAL WATER CONTENT %	WATER CONTENT AT END OF TEST %	NATURAL WATER CONTENT %	EXISTING OVERBURDEN STRESS TSF	ESTIMATED PROBABLE PRECONSOLIDATION STRESS - TSF	COMPRESSION INDEX C_c	SWELLING INDEX C_s	VOID RATIO AT START OF SWELL, e_r
L-16 Cont'd	12S	51.0	A1	42.0					OH&SM			0.19	33.2	3.0											
												0.49	49.5	6.0											
	13S	56.0	A1	59.0	59.7	18.8	56.0		OH			1.60	63.0	8.0											
												1.58	61.2	6.0											
												1.24	50.6	9.0											
	15S	63.0	A1	58.0	76.7	24.7	65.5		OH			1.20	57.1	6.0											
												1.21	54.9	7.0											
												1.30	60.2	8.0											
L-17U	4U	12.9	A1	51.0	68.6	37.0	51.9	2.71	OH			0.59	56.5	8.0	Q	0.50	0.5	44.1	43.8	53.3	0.62	1.40	0.60	0.12	0.835
															Q	0.68	1.0	50.5	49.8						
	5U	16.0	A1	46.0	58.6	27.9	47.0		OH			0.69	42.5	11.0	Q	0.67	2.0	49.5	49.0	48.4	0.72	1.2	0.43	0.07	0.849
	6U	18.7	A2	47.0					OH&SM			0.64	53.0	15.0	DIRECT SHEAR TEST $\phi = 30.5°$, C = 0.08 TSF										
	9U	28.8	A2	26.0					SM			0.23	24.9	3.0											
	11U	37.9	A1	42.0	84.7	47.3	62.7	2.59	OH			0.93	40.2	5.0	Q	0.65	0.5	-	37.9	62.6	1.1	1.6	0.76	0.16	0.909
															Q	1.25	1.0	40.4	39.8						
	15U	47.7	A1	66.0					OH																
	17U	55.0	A1	52.0	60.9	23.3	53.6		OH			1.17	53.0	7.0	Q	0.90	0.5	57.0	56.6	71.8	1.4	2.4	0.89	0.20	1.092
															Q	1.24	1.0	41.2	40.5						
	18U	58.0	A1	54.0					OH						Q	1.01	0.5	47.0	46.8						
															Q	1.26	1.0	-	57.7						
															Q	1.25	2.0	56.3	55.6						
	19U	61.0	A1	61.0	89.2	47.9	62.0	2.60	OH			1.44	61.6	6.0	Q	1.59	2.0	55.1	54.5	65.3	1.5	2.9	0.83	0.14	0.850
															Q	1.11	2.0	64.0	62.6						
L-18	7S	26.0	A2	34.0					SM			0.82	40.5	5.0											
												0.63	32.2	5.0											
												0.39	28.0	4.0											
	11S	40.9	A1	76.0					OH			1.70	82.0	7.0											
												1.91	76.0	6.0											
												1.98	70.4	6.0											
	12S	46.0	A1	61.0	80.9	30.4	61.5	2.65	OH			1.46	60.3	8.0											
												1.13	62.2	8.0											
												1.60	59.4	8.0											
	13S	51.0	A1	59.0	104.5	39.2	75.0		OH			1.38	55.5	8.0											
												1.09	50.0	4.0											
												1.42	68.8	7.0											
	14S	56.0	A1	34.0					OL			0.74	33.0	4.0											
												1.16	33.5	4.0											
												0.78	35.8	4.0											

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DATE DECEMBER 2, 1970 FILE NO. 3291E SHEET NO. 4 OF 5 TABLE NO. 5

TABLE NO. 5

SUMMARY OF LABORATORY TEST DATA

SAMPLE IDENTIFICATION				CLASSIFICATION PROPERTIES					UNIFIED CLASSIFICATION SYSTEM			PHYSICAL PROPERTIES – STRENGTH – UNCONFINED COMPRESSION			TRIAXIAL COMPRESSION					CONSOLIDATION					
BORING NO.	SAMPLE NO.	DEPTH FT.	STRATUM DESIGNATION	NATURAL WATER CONTENT %(W) AVERAGE OF ENTIRE SAMPLE	LIQUID LIMIT (W_L)	PLASTICITY INDEX (I_p)	NATURAL WATER CONTENT OF LIMIT SAMPLE %(W)	SPECIFIC GRAVITY OF SOLIDS (G)	SOIL TYPE	% SAND (<#4, >#200 SIEVE)	% CLAY (<#200 SIEVE)	COMPRESSIVE STRENGTH TSF	WATER CONTENT AT END OF TEST %	STRAIN AT FAILURE %	TYPE OF TEST	DEVIATOR STRESS ($\sigma_1 - \sigma_3$) TSF	CONFINING PRESSURE (σ_3) TSF	NATURAL WATER CONTENT %	WATER CONTENT AT END OF TEST %	NATURAL WATER CONTENT %	EXISTING OVERBURDEN STRESS TSF	ESTIMATED PROBABLE PRECONSOLIDATION STRESS - TSF	COMPRESSION INDEX C_c	SWELLING INDEX C_s	VOID RATIO AT START OF SWELL, e_r
L-20U	4U	11.6	A1	61.0	92.8	55.2	76.6	2.62	CH						Q	0.25	0.5	57.2	56.8	71.0	0.23	0.34	0.65	0.16	0.964
	5U	16.0	A1	69.0	81.2	40.1	70.2	2.57	OH			0.39	43.8	11.0	Q	0.54	1.0	88.5	88.1	71.0	0.32	0.73	0.80	0.12	0.873
															Q	0.45	2.0	74.5	74.1						
	6U	20.0	A1	85.0	85.0	48.5	60.0		CH			0.51	93.0	13.0	Q	0.32	0.5	92.5	91.2	69.7	0.38	0.50	0.60	0.14	0.987
															Q	0.51	1.0	78.0	77.4						
	7U	24.0	A1	88.0	90.8	52.6	79.0	2.58	OH			0.43	97.0	12.0	Q	0.43	0.5	93.5	92.2	84.7	0.63	0.90	1.06	0.20	1.239
															Q	0.58	2.0	76.0	74.8						
	8U	27.9	A1	68.0					OL						Q	0.49	1.0	-	85.0						
															Q	0.45	2.0	51.2	50.0						
	12U	47.0	A1	43.0	52.5	19.7	41.2		OH			1.59	48.5	7.0	Q	1.81	0.5	35.5	35.5	46.8	1.1	4.2	0.56	0.12	0.733
															Q	1.56	1.0	43.9	43.6						
	13U	50.9	A1	48.0					OH			1.43	45.5	15.0	Q	2.10	2.0	49.0	48.2						
L-26	14S	64.5	P1	28.0					CH			2.24	27.1	1.0											
L-33U	8U	32.4	T1-T2	19.0	28.0	10.4	19.4		CL			1.09	19.3	4.0											
L-37U	5U	23.8	A1	119	228	66.5	132.4	2.10	OH											106.1	1.3	1.2	1.20	0.26	0.943
	6U	27.5	A1	24.0					ML						Q	0.46	0.5	22.6	22.4		PERMEABILITY TEST $K = 1.2 \times 10^{-4}$ FT/MIN.				
															Q	0.42	1.0	24.4	23.1						
															Q	0.59	2.0	24.3	23.4						

NOTES

1. ALL TESTS SUMMARIZED ABOVE WERE PERFORMED IN THE SOILS LABORATORY OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON.
2. THE SAMPLE DEPTH LISTED ABOVE IS THE AVERAGE DEPTH OF THE SAMPLE RECOVERED.
3. FOR GROUND SURFACE ELEVATIONS AT THE BORINGS SEE TABLE NO. 4. FOR GENERALIZED STRATA DESCRIPTIONS SEE DRAWING NO. F-L-1.
4. "NATURAL WATER CONTENT OF ENTIRE SAMPLE" IS A WEIGHTED AVERAGE OF ALL MATERIAL TYPES RECOVERED.
5. THE TRIAXIAL COMPRESSION TESTS PERFORMED WERE:
   Q - QUICK TESTS (UU - UNCONSOLIDATED UNDRAINED TESTS)
   Q_c - CONSOLIDATED QUICK TESTS (CU - CONSOLIDATED UNDRAINED TESTS)
6. STRENGTH TESTS WERE PERFORMED ON PISTON TYPE SAMPLES (U) APPROXIMATELY 2.9 INCHES IN DIAMETER AND ON SHELBY TYPE SAMPLES (S) APPROXIMATELY 1.8 INCHES IN DIAMETER. THE RATIO OF HEIGHT TO DIAMETER OF ALL STRENGTH TEST SPECIMENS WAS APPROXIMATELY 2.0.
7. THE TRIAXIAL COMPRESSION TESTS WERE PERFORMED AT A RATE OF STRAIN OF APPROXIMATELY 1 PER CENT PER MINUTE.
8. THE DIRECT SHEAR TESTS WERE PERFORMED AT A CONSTANT RATE OF STRAIN EQUAL TO A HORIZONTAL DISPLACEMENT OF 0.02 INCHES PER HOUR. THE SPECIMENS WERE OF APPROXIMATELY 1/2 INCH THICKNESS.
9. COMPRESSION INDEX C_c - STRAIGHT LINE PORTION OF THE VIRGIN CURVE OF CONSOLIDATION TEST: $e = e_o - C_c \log P/P_o$
10. SWELLING INDEX C_s - STRAIGHT LINE PORTION OF THE REBOUND CURVE OF CONSOLIDATION TEST: $e = e_o - C_s \log P/P_o$

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TABLE No. 6, SUMMARY OF LABORATORY TEST DATA RELATING TO CORROSION CHARACTERISTICS

		Boring number	L-3	L-3	L-4	L-4	L-8	L-12	L-12	L-14U	L-14U	L-14U	L-17U	L-17U	L-19	L-19	L-19	L-21	L-21	L-24	L-24	L-24	L-25	L-25
		Depth below surface, feet	68	85	45	65	15	32	50	16	30	50	20	100	35	45	65	1.0	5.0	5	15	25	10	30
SOIL	Classification Properties	Stratum	P2 & P3	P2 & P3	T1	P3	A1	A1	A1	A1	A1	A1	A1	P1	A2		P2 & P3						T5	P4
		Unified Classification	SC	SC	SC-SM	SC	OH	OH	OH & SC	CH	CL	OH	OH	CL	SP-SM		SP-SC						SP	
		Sample number	15D	18D		13D	4D	8D	11D	4U	6D	10D	6U	27D	8D		14D						3D	
		Natural water content, %	20	20		20	77	67	73	46	-	19	47	29										
		Liquid limit					95	*84		58		*83	*59											
		Plastic limit					41	*47		33		*36	*31											
		% sand (#4 to #200 sieve)	83																				*53	
		% fines (-#200 sieve)	17																				*13	
	Electrical and Chemical Properties	pH	5.6	7.0	5.5	5.4	6.7	6.2	6.6	7.0	5.7	6.6	7.6	9.3	7.5		8.5						6.7	
		Resistivity, ohms/cm^2	2,306	1,740	1,827	1,305	1,697	2,741	1,784	4,263	1,305	1,610	6,525	1,566	16,965		3,132						13,050	
		Total chlorides, % as NaCl					0.0074			0.0066	0.0088	0.01154	0.0024	0.01155	0.0103		0.0083						0.0144	
		Total sulfates, % as SO_4					0.0287			0.0094	0.0004	0.01160	0.0004	0.0062	0.0004		0.0042						0.0018	
		Sulfides	No TR	No TR	No TR	No TR	Slight	Slight	Slight	Slight	No TR	No TR	Strong	No TR	No TR		No TR						No TR	
WATER	Electrical and Chemical Properties	pH					6.7						7.9			6.8		7.4	7.2	7.4	7.6	7.6		7.6
		Resistivity, ohms/cm^2					4,133						3,610			2,828		3,219	3,132	2,523	2,464	2,464		2,654
		Carbonate alkalinity as $CaCO_3$, p.p.m.					0						0			0		0	0	0	0	0		0
		Bicarbonate alkalinity as $CaCO_3$, p.p.m.					38						65			123		101	106	153	135	132		130
		Free carbon dioxide, p.p.m.					125						3			30		7.5	10	2	5	8		25
		Hardness as $CaCO_3$, p.p.m.					22						27.5			45		27.5	27.5	37.5	65	65		12
		Chloride (Cl), p.p.m.					11						18			15		16	12.5	15	17	20		3
		Sulfate (SO_4), p.p.m.					33						67			49		47	49	65	73	79		39
		Hydroxide alkalinity as $CaCO_3$, p.p.m.																						

* Identification test data derived from nearby sample which appears similar to corrosion test sample.

TABLE No. 6, SUMMARY OF LABORATORY TEST DATA RELATING TO CORROSION CHARACTERISTICS (CONT.)

		Boring number	L-25	L-30	L-30	L-30	L-32	L-32	L-33U	L-33U	L-34	L-34	L-34	L-36	L-36	L-37U	L-37U	L-37U
		Depth below surface, feet	60	10	25	35	15	30	40	55	25	35	45	25	45	20	35	50
SOIL	Classification Properties	Stratum	P4	T1	T5	T5	T1	T4	T5	T5	T5		T5	F	T5	F		T5
		Unified Classification	SP-SC	CL	SP	SP	CL	ML	SP-SM	SP-SM	SP-SM		SP-SM	SC	GP	SP		SP
		Sample number	13D	3D	6D	8D	4D	7D	10D	13D	6D		8D	6D	11D	4D		12D
		Natural water content, %		21			22	25										
		Liquid limit																
		Plastic limit																
		% sand (#4 to #200 sieve)				*51			88	49			*59	54				49
		% fines (-#200 sieve)				*11			10	7			*15	46				8
	Electrical and Chemical Properties	pH	8.9	6.5	6.7		7.2	7.2	8.0	5.8	7.6		7.8	6.8	6.7	7.0		5.9
		Resistivity, ohms/cm^2	3,088	10,440	13,920		8,265	6,525	11,131	9,135	1,523		10,875	5,220	4,350	1,827		2,654
		Total chlorides, % as NaCl	0.0062	0.0058	0.0157						0.0045		0.0037			0.0288		0.0107
		Total sulfates, % as SO_4	0.0040	0.0006	0.0006						0.0004		0.0012			0.0132		0.0008
		Sulfides	No TR	No TR	No TR		Slight	No TR	No TR	No TR	No TR		No TR	Strong	No TR	Strong		No TR
WATER	Electrical and Chemical Properties	pH				7.8						7.2					7.3	
		Resistivity, ohms/cm^2				2,740						2,697					3,176	
		Carbonate alkalinity as $CaCO_3$, p.p.m.				0						0					0	
		Bicarbonate alkalinity as $CaCO_3$, p.p.m.				160						137					91	
		Free carbon dioxide, p.p.m.				17.5						11					4	
		Hardness as $CaCO_3$, p.p.m.				40						75					2.0	
		Chloride (Cl), p.p.m.				8.6						12					10	
		Sulfate (SO_4), p.p.m.				77						86					67	
		Hydroxide alkalinity as $CaCO_3$, p.p.m.																

TABLE No. 7, SUMMARY OF FALLING HEAD PERMEABILITY TESTS IN BORE HOLES AND OBSERVATION WELLS

Boring No.	L-1	L-3 Observ. Well	L-4	L-4 Obersv. Well	L-11 Observ. Well	L-14U Observ. Well	L-17U	L-17U Observ. Well	L-27	L-30 Observ. Well	L-34	L-34 Observ. Well	L-37U Observ. Well		
Elevation of top and bottom of opening tested	-35.0 -61.5	-50.1 -62.1	-43.1 -66.1	-42.6 -55.1	-28.3 -40.8	- 6.9 -19.4	-31.2 -32.9	-21.2 -33.2	-57.9 -68.9	- 3.0 -15.5	-22.7 -26.2	-26.7 -37.7	-30.1 -43.1		
Length of opening, feet	25.0	12.0	23.0	12.5	12.5	12.5	1.7	12.0	11.0	12.5	3.5	11.0	13.0		
Computed permeability, feet/minute	$1x10^{-2}$	$< 1x10^{-6}$	$> 1x10^{-2}$	$< 1x10^{-6}$	$2.3x10^{-6}$	$9.4x10^{-4}$	$1.8x10^{-4}$	$> 1x10^{-2}$	$1.4x10^{-3}$	$1.9x10^{-3}$	$3.4x10^{-3}$	$2.3x10^{-3}$	$3.8x10^{-4}$		
Stratum tested	T5	P2 & P3	P3	P3	A1	A1	A1	A2	T5	T5	T5	T5	A2 & T5		

Boring No.															
Elevation of top and bottom of opening tested															
Length of opening, feet															
Computed permeability, feet/minute															
Stratum tested															

TABLE NO. 8, SOIL PROPERTIES FOR DESIGN

STRATUM	SHEAR STRENGTH AND CONSOLIDATION CONDITION OF COHESIVE STRATA	EFFECTIVE FRICTION ANGLE, ϕ	TOTAL UNIT WEIGHT, PCF	ALLOWABLE BEARING PRESSURE, TSF
(F) FILL				
Placed over marsh, mixed with cinders		28°	120	None ordinarily
Other locations		30°	130	1 to 1.5
(A) RECENT ALLUVIUM				
(A1) Organic clay	Beneath fill overconsolidated 0.2 to 0.3 tsf. Strength 0.5 to 0.7 ksf.	23°	120	None ordinarily
	Beneath water overconsolidated as much as 0.2 tsf. Strength 0.2 to 0.3 ksf.	23°	110	None
(A2) Silty sand		30°	130	2
(T) PLEISTOCENE				
(T1)A & (T1)G, silty clay	Overconsolidated 3 to 5 tsf. Strength 1.5 to 2.5 ksf, higher near surface.	25° to 28°	130	1.5 to 2.5
(T1)B, organic clay	Overconsolidated 1.5 to 2.5 tsf. Strength 2 to 3 ksf.	25°	130	2
(T1)C & (T1)F, silty clay	Overconsolidated 0.5 to 1 tsf. Strength 0.7 to 0.9 ksf, higher at surface.	25°	130	1 or less
(T1)D, plastic clay	Overconsolidated 2.5 to 3 tsf. Strength 2.5 to 3.5 ksf.	25°	130	2 to 3

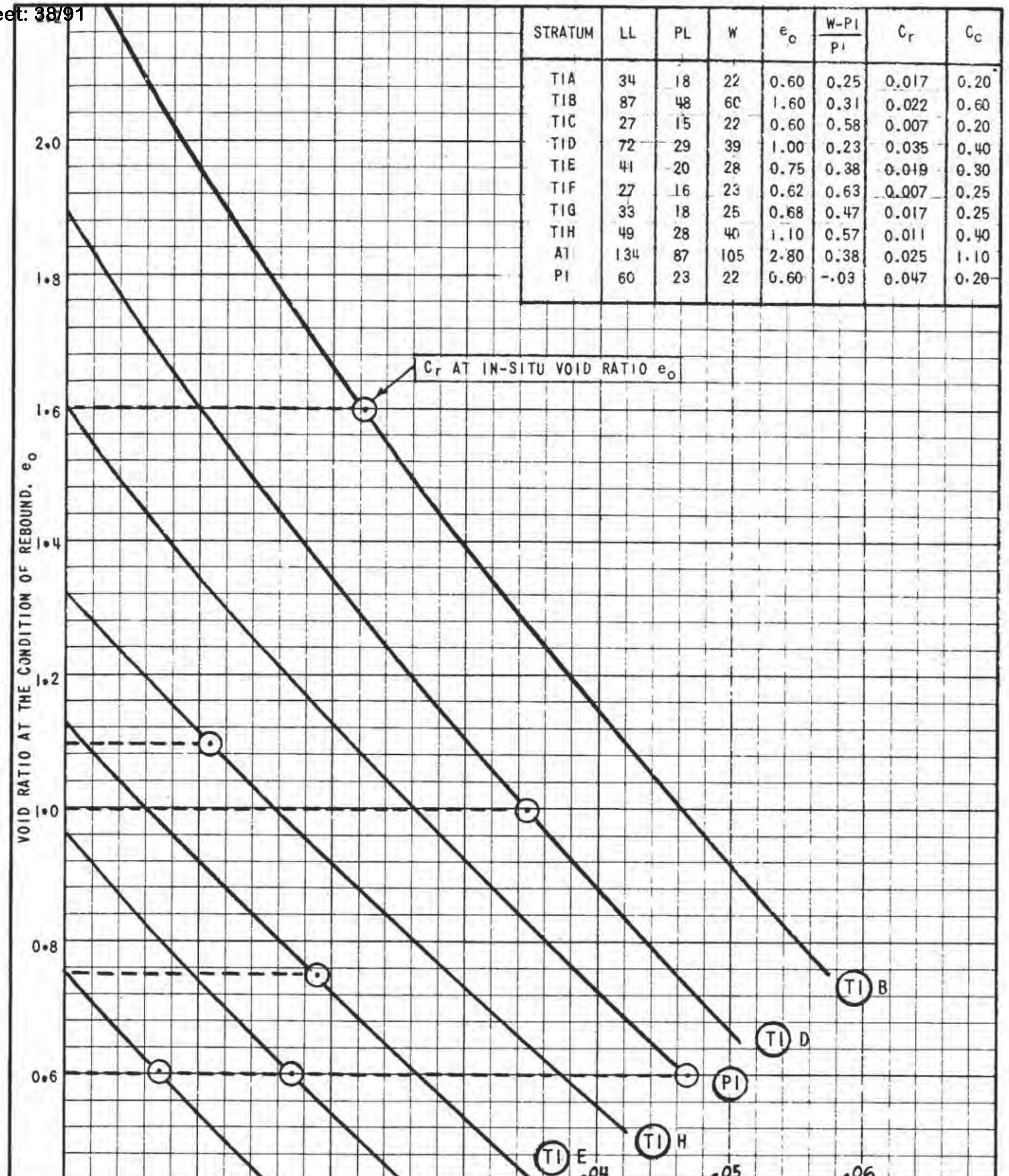
TABLE NO. 8, SOIL PROPERTIES FOR DESIGN (Continued)

STRATUM	SHEAR STRENGTH AND CONSOLIDATION CONDITION OF COHESIVE STRATA	EFFECTIVE FRICTION ANGLE, ϕ	TOTAL UNIT WEIGHT, PCF	ALLOWABLE BEARING PRESSURE, TSF
(T1)E, medium plastic clay	Overconsolidated 3 tsf. Strength 2 to 3 ksf.	25°	130	2 to 2.5
(T1)H, plastic clay	Overconsolidated 1.5 to 2.5 tsf. Strength 1.3 to 1.5 ksf.	25°	130	1.5
(T2), silty sand		34°	130	2 to 3
(T3), gravelly sand		34° to 38°	130	3 to 4
(T4), silty sand		30° to 34°	130	1.5 to 3
(T5), gravelly sand		32° to 38°	130	2.5 to 4
CRETACEOUS				
(P1) Plastic clay	North & west of New Jersey Ave.: overconsolidated 15 to 20 tsf. Strength 4 to 5 ksf but erratic.	25°	130	3.5 to 5
	East of New Jersey Ave.: over-consolidated 12 to 14 tsf. Strength 2 to 5 ksf.	25°	130	2 to 5
(P2), clayey sand		33° to 36°	130	3 to 6
(P3), sandy clay	Overconsolidated 15 to 20 tsf. Strength 4 to 6 ksf.	34°	130	4 to 7
(P4), gravelly sand		34° to 38°	135	5 to 8
DECOMPOSED ROCK, Stratum (D)		36°	140	5
BEDROCK	Moderately jointed, relatively sound and sound. Compressive strength 5 to 15 ksi.	45°	170	30 to 60

TABLE No. 9, SUMMARY OF BORINGS BY OTHERS

JOB NUMBER	PROJECT NAME	SOURCE OR OWNER	BORING CONTRACTOR	NUMBER OF BORINGS	REMARKS
f4	Southwest Freeway (I-95)	District of Columbia Department of Highways and Traffic	Giles Drilling Corp.	78	3 boring logs utilized dated 1958
1D	Southwest Project Area "C", D.C.R-1	Redevelopment Land Agency, D.C.	Raymond Concrete Pile Div.	45	4 boring logs utilized dated 1961
ℓ-1	Southwest Project Area "C", D.C.R-1	Redevelopment Land Agency, D.C.	Granger & Oliver	29	1 boring log utilized dated 1968
1B	Richmond, Fredericksburg & Potomac RR Bridge	U.S.G.S. Professional Paper No. 217	Not stated	5	4 borings in open water 1 boring on land, rock coring included - undated
ℓ-2	Marriott Hotel	Beall & Lemay	Raymond Concrete Pile Div.	13	4 borings on land utilized dated 1954
ℓ-3	Shirley Memorial Highway	Howard Needles Tammen & Bergendoff	American Testing & Engineering Co.	Various	3 boring logs utilized dated 1966 and 1968

STRATUM	LL	PL	W	e_o	$\frac{W-PI}{PI}$	C_r	C_c
TIA	34	18	22	0.60	0.25	0.017	0.20
TIB	87	48	60	1.60	0.31	0.022	0.60
TIC	27	15	22	0.60	0.58	0.007	0.20
TID	72	29	39	1.00	0.23	0.035	0.40
TIE	41	20	28	0.75	0.38	0.019	0.30
TIF	27	16	23	0.62	0.63	0.007	0.25
TIG	33	18	25	0.68	0.47	0.017	0.25
TIH	49	28	40	1.10	0.57	0.011	0.40
AI	134	87	105	2.80	0.38	0.025	1.10
PI	60	23	22	0.60	-.03	0.047	0.20



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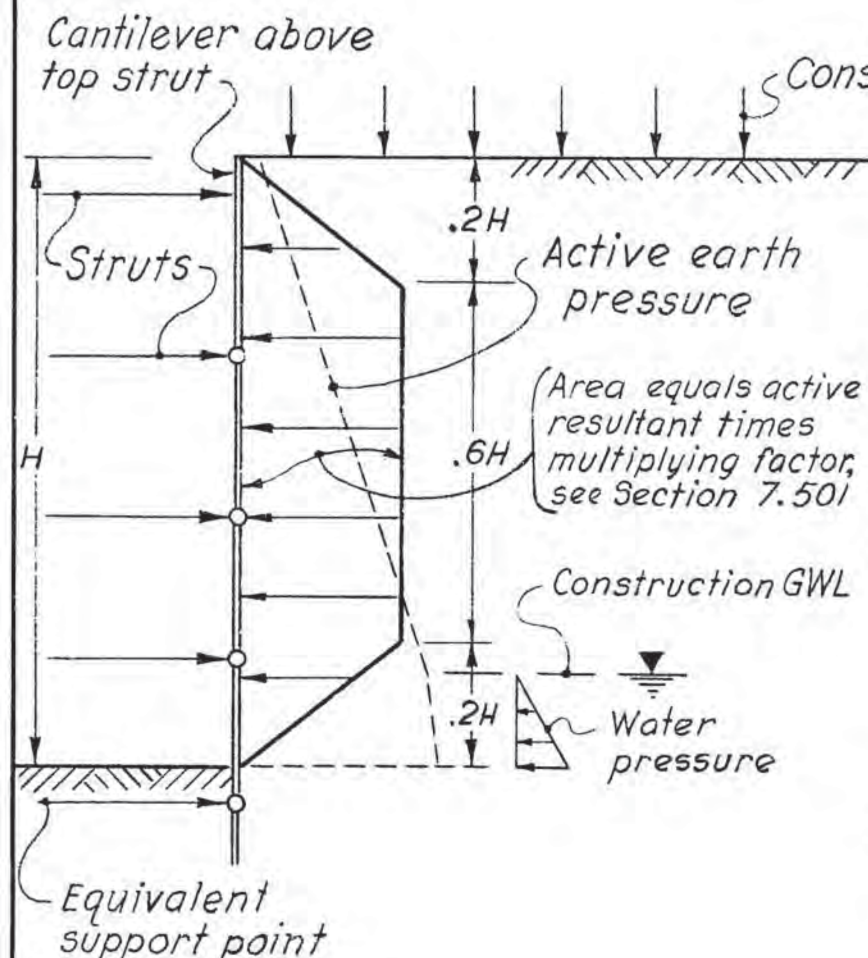
MADE BY: AR DATE: 6-69 FILE NO. 3291B
CH'KD BY: SLT DATE: 6-69 PLATE NO. 1

VALUES OF RECOMPRESSION INDEX



NOTES:

1. Pressure diagram is for design of walers and strut.
2. Assume cofferdam wall hinged at brace points.
3. Check loads for partial excavation condition.
4. For sheet pile wall, active pressure diagram may extend below subgrade to support point.
5. Water pressure generally not included for lagged soldier pile wall.

CONSTRUCTION CONDITION - COMPLETE EXCAVATION

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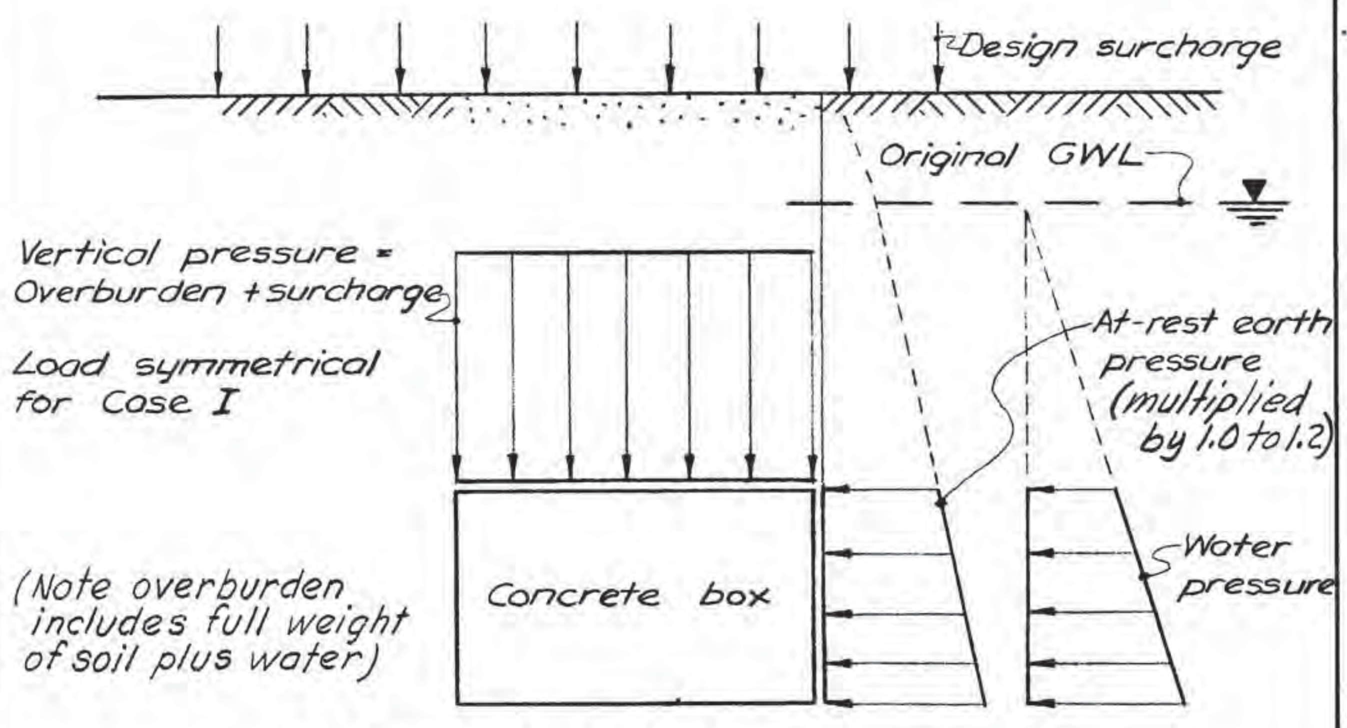
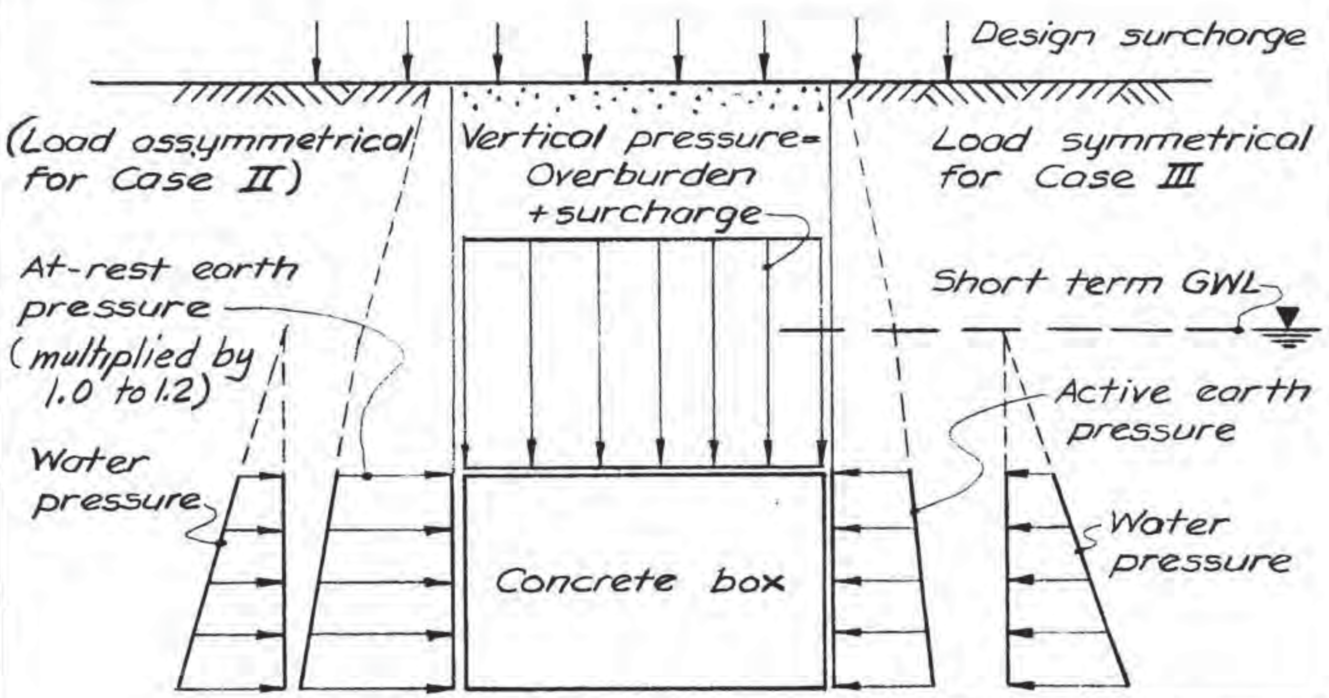
MADE BY: JPG DATE: 8-8-68 FILE NO. 3291A
CH'KD BY: DATE: PLATE NO. 2

DESIGN LOADING
TEMPORARY COFFERDAM



LONG-TERM LOADING, CASE I



SIDESWAY CONDITION
CASE II

For short term loading, Case III, use symmetrical active earth pressures on sides, assuming no water pressures.

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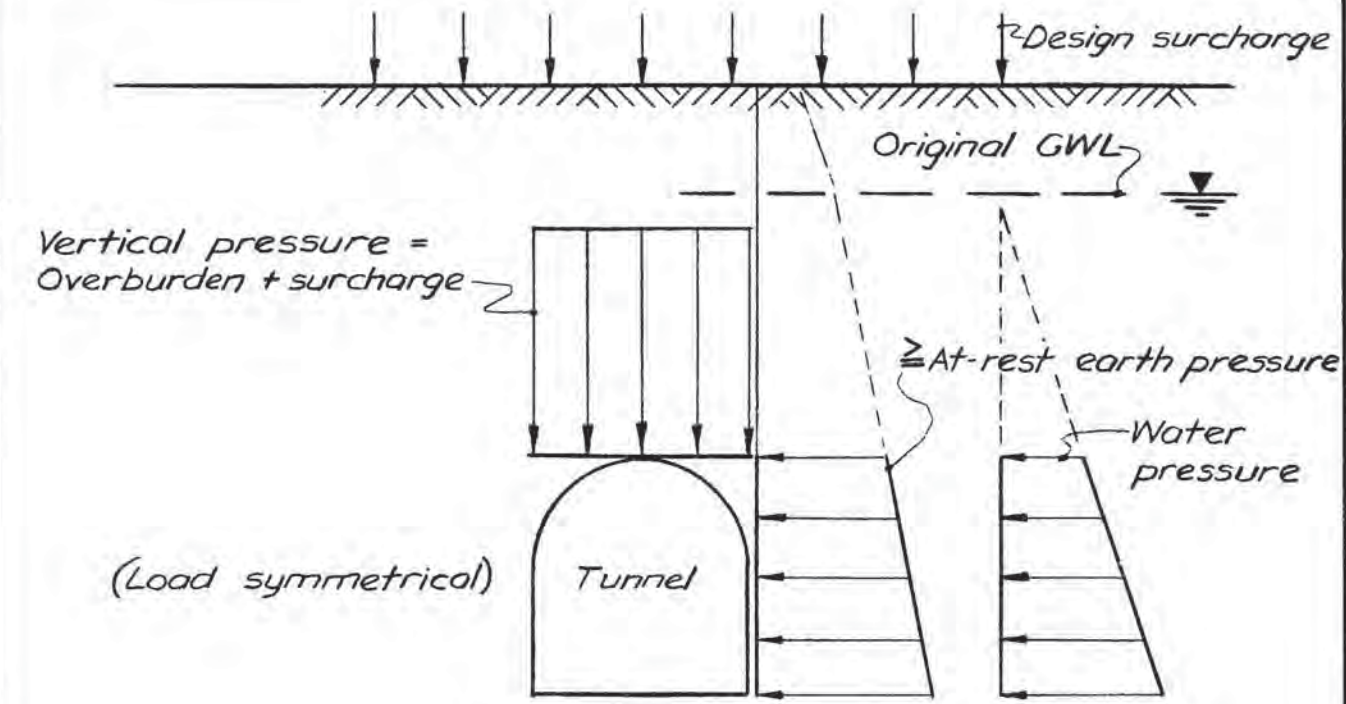
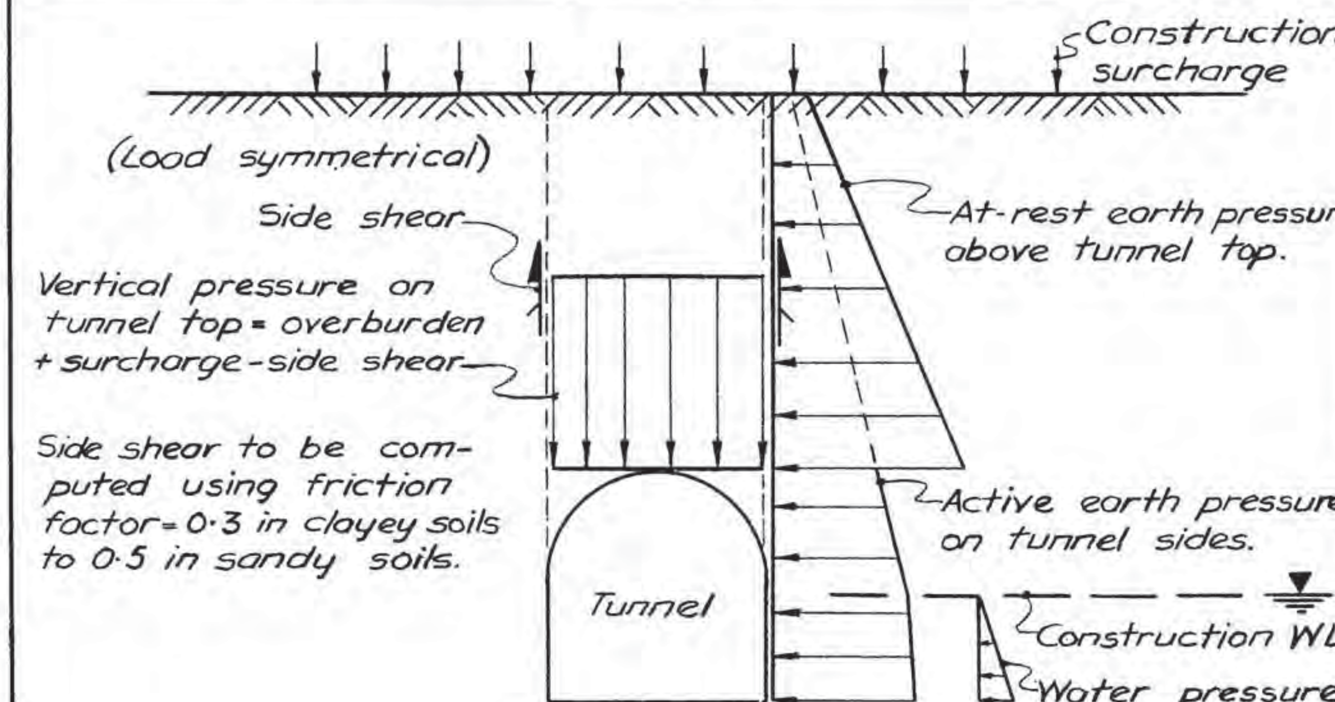
MADE BY: JPG	DATE: 8-8-68	FILE NO. 3291A
CH'KD BY:	DATE:	
DESIGN LOADING CONCRETE BOX SECTION		PLATE NO. 3



LONG-TERM LOADING



CONSTRUCTION AND
SHORT-TERM LOADING

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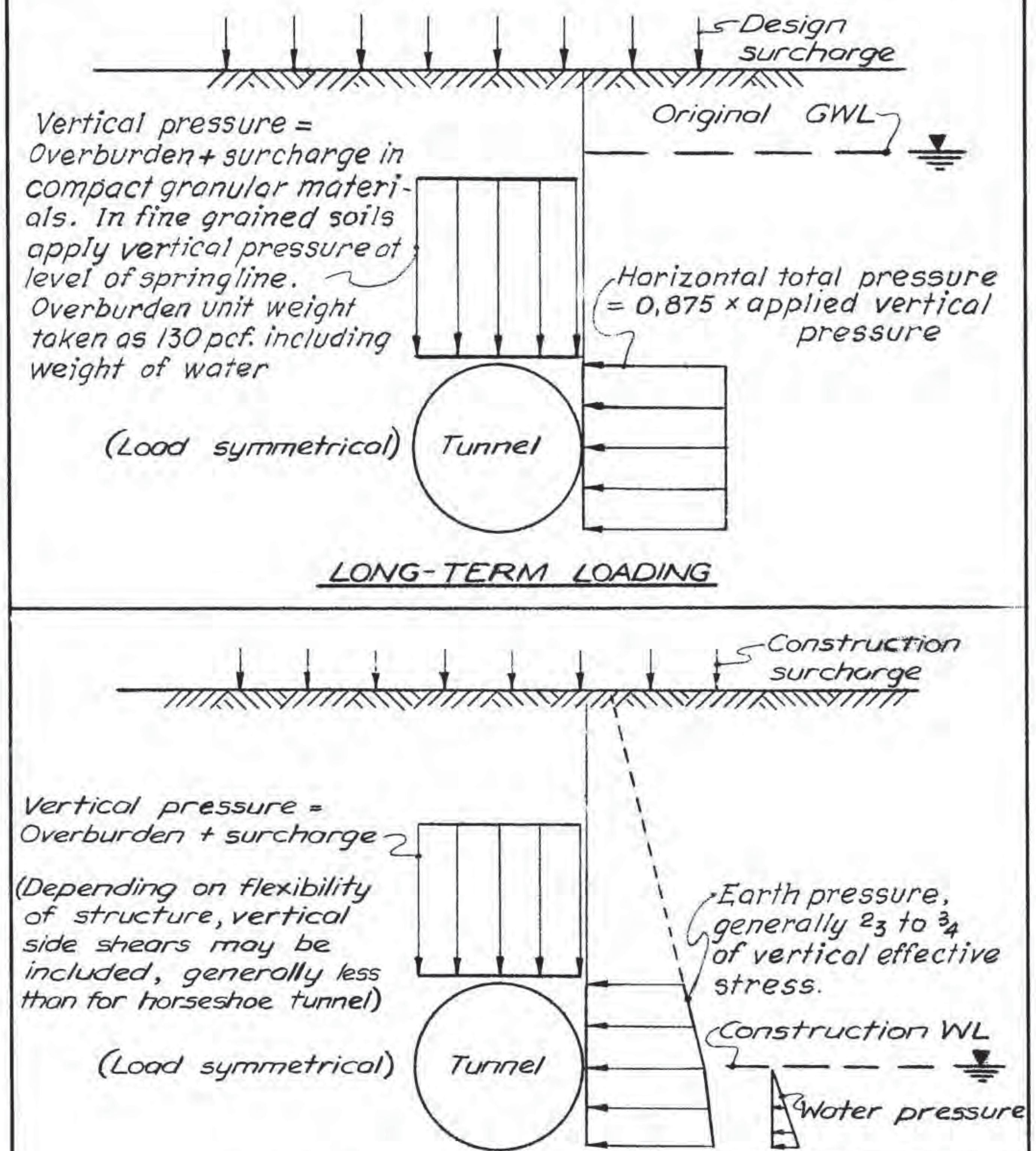
DESIGN LOADING HORSESHOE TUNNEL		PLATE NO. 4



CONSTRUCTION AND SHORT-TERM LOADING

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DESIGN LOADING CIRCULAR TUNNEL	PLATE NO. 5

Revised 3-27-70 JPG.

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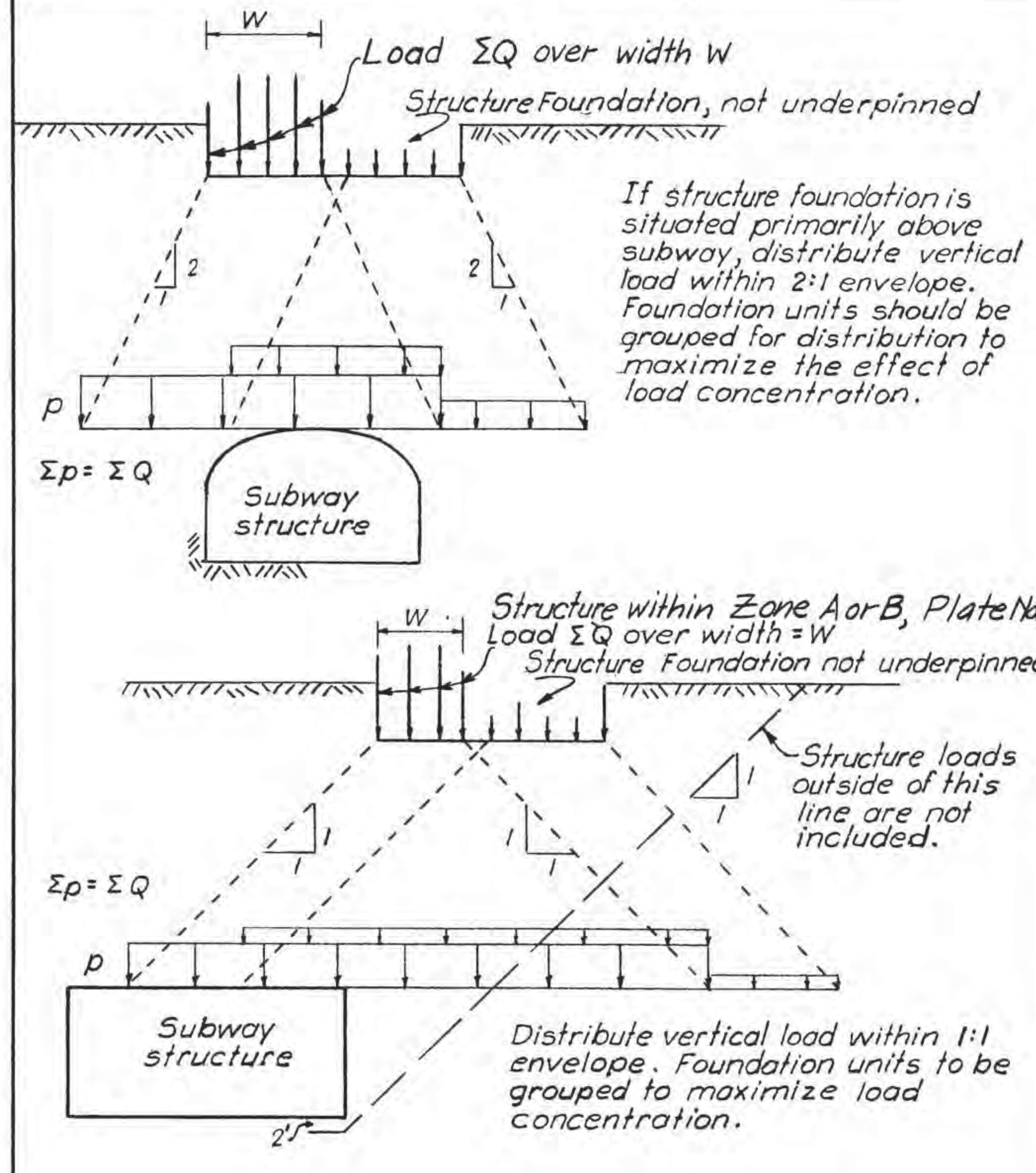

DISTRIBUTION OF VERTICAL PRESSURES IN A VERTICAL PLANE

NOTE:

If length of loaded foundation area parallel to axis of the subway is more than 3W, ignore spread of load in the direction parallel to the axis. If length is less than 3W, distribute pressure at the ends of the loaded area using the slope angles shown above.

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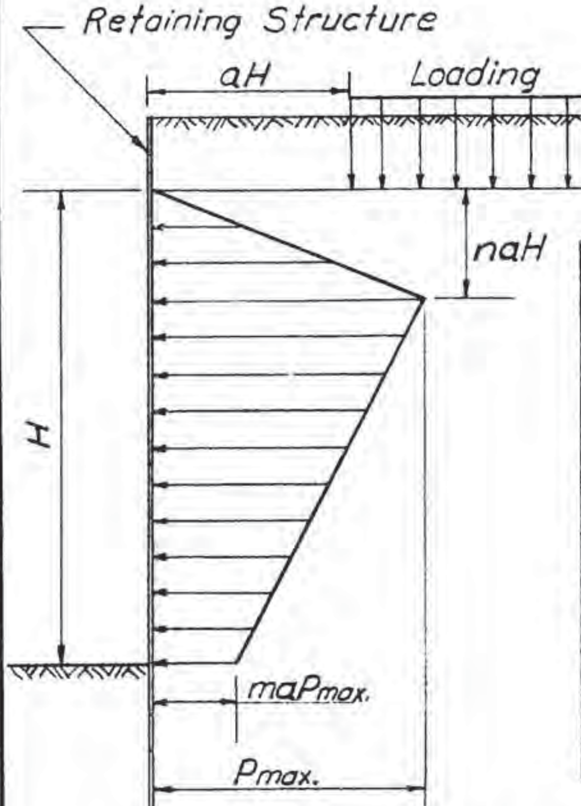
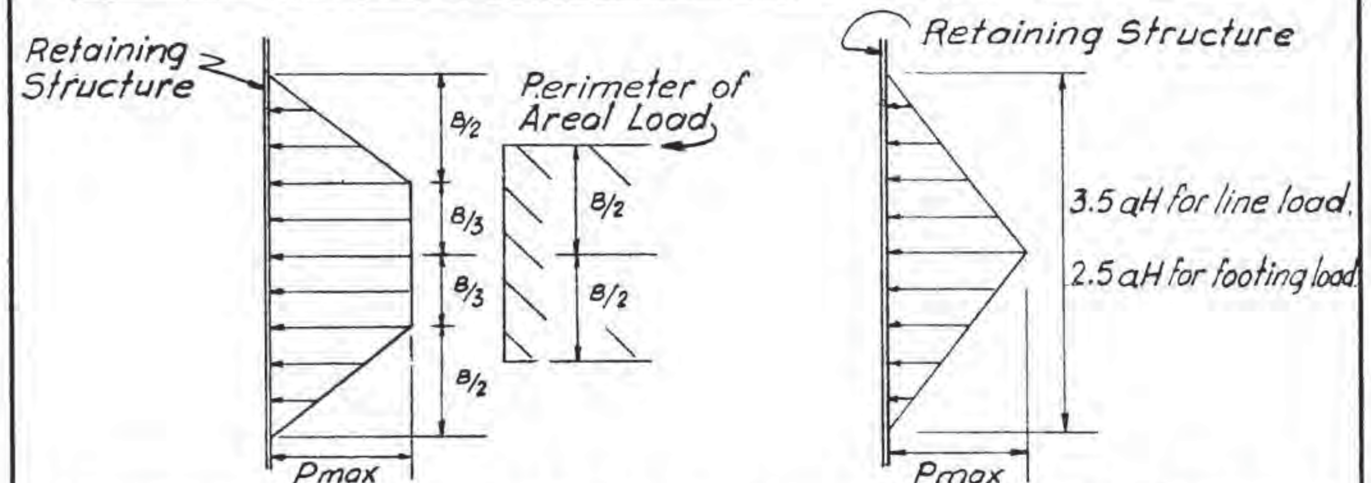
MADE BY: L.G. DATE: 12-15-67 CH'KD BY: J.P.G. DATE: 12-15-67	FILE NO. 3291
VERTICAL PRESSURES FROM STRUCTURAL LOADS	PLATE NO. 6



aH = distance from retaining structure to footing load or parallel line load or to leading edge of areal load or perpendicular line load.
Q = total load per ft. of length parallel to retaining str., or total footing load.

Parameters	n	m	Pmax.
Footing Load	0.6	0.4	$(2.1-1.8a)Q/H^2$
Line Load Perp. to Retaining Structure	0.6	0.4	$(1.4-1.2a)Q/H^2$
Areal Load	0.4	0.25	$(0.8-0.5a)Q/H$
Line Load Parallel to Retaining Structure	0.4	0.25	$(1.1-0.5a)Q/H$

DISTRIBUTION OF HORIZONTAL PRESSURES ON VERTICAL PLANE



a) Areal Loading & Finite Line Load Parallel to Excavation.

b) Footing Load & Line Load Perpendicular to Excavation

DISTRIBUTION OF HORIZONTAL PRESSURES IN PLAN

NOTE:
This approximate procedure is intended for non-underpinned foundations supported in Zones A and B (Plate No.8). For distributed foundation loads, the magnitude of Q should be computed only from loads in Zone A and B.

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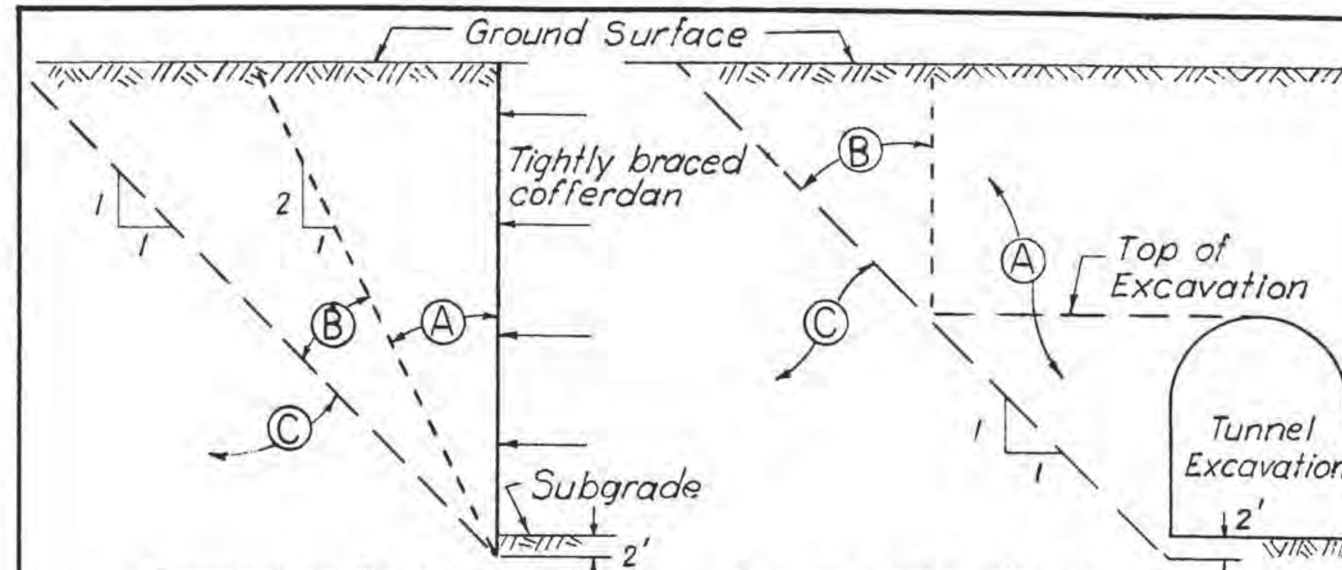
CH'KD BY: J.P.G. DATE: 12-15-67
HORIZONTAL PRESSURES FROM STRUCTURAL LOADS
PLATE NO. 7



Braced Vertical - Sided Open Excavation

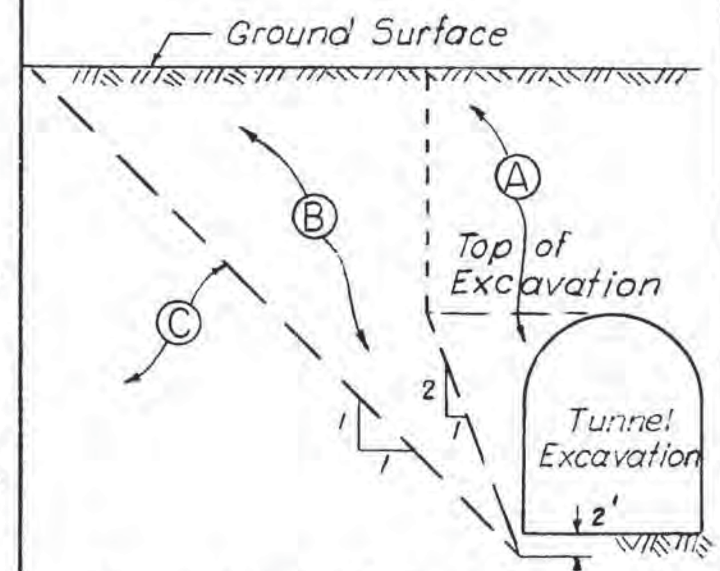
Supported Earth Tunnel Excavation, Soft or Loose Soil or Fill, Generally Strata F, A1, A2, T0 or T1 (lower portion)

REQUIREMENTS FOR UNDERPINNING, SUBWAY IN SOIL,

ZONE A:
Foundations within this zone generally require underpinning. Horizontal and vertical pressures on subway structures of non-underpinned foundations must be considered.

ZONE B:
Foundations within this zone generally do not require underpinning. Horizontal and vertical pressures on subway structures of non-underpinned foundations must be considered.

ZONE C:
Underpinning structures must receive their support within this zone. Horizontal and vertical pressures on subway structures of foundations or underpinning structures bearing in this zone generally need not be considered.



Supported Earth Tunnel Excavation, Stiff or Compact Natural Soil

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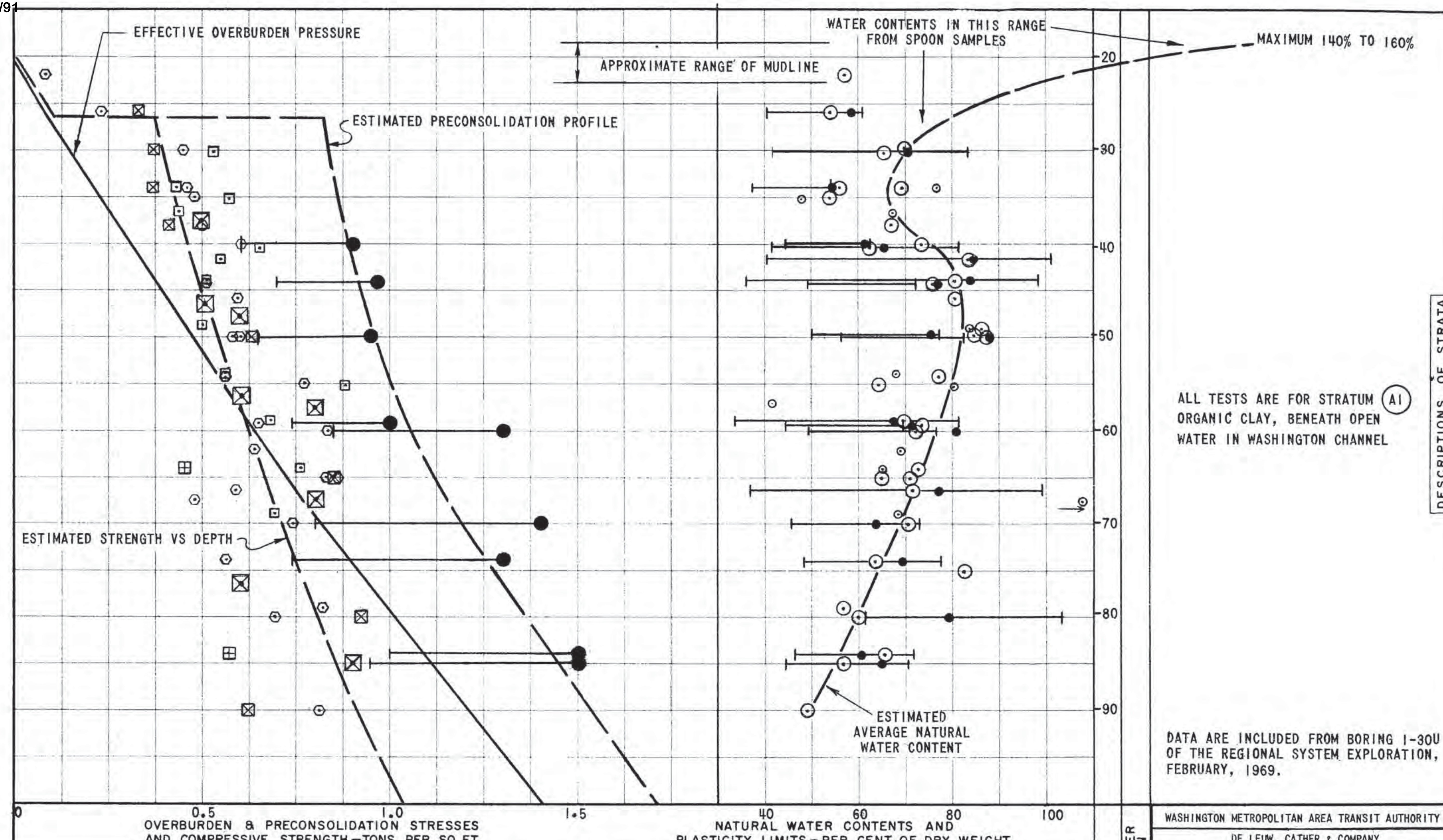
MADE BY: LG DATE: 12-15-67 FILE NO. 3291
CH'KD BY: JPG DATE: 12-15-67
UNDERPINNING REQUIREMENTS SUBWAY IN SOIL
PLATE NO. 8



- GROUND WATER LEVEL OBSERVED IN BORING

RANGE OF PRECONSOLIDATION STRESS VALUES: MINIMUM POSSIBLE — MOST PROBABLE

- UNCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR TEST - AVERAGE OF 3 TESTS
- UNCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR TEST - SINGLE TEST
- UNCONFINED COMPRESSION TEST ON 3" SAMPLE - AVERAGE OF 2 TESTS
- UNCONFINED COMPRESSION TEST ON 2" SAMPLE - AVERAGE OF 2 OR 3 TESTS
- UNCONFINED COMPRESSION TEST ON 2" OR 3" SAMPLE - SINGLE TEST

- AVERAGE NATURAL WATER CONTENT OF ENTIRE UNDISTURBED SAMPLE
- NATURAL WATER CONTENT OF DRY SAMPLE OR NATURAL WATER CONTENT OF PORTION OF UNDISTURBED SAMPLE

PLASTIC LIMIT — LIQUID LIMIT
NATURAL WATER CONTENT OF LIMIT SPECIMEN

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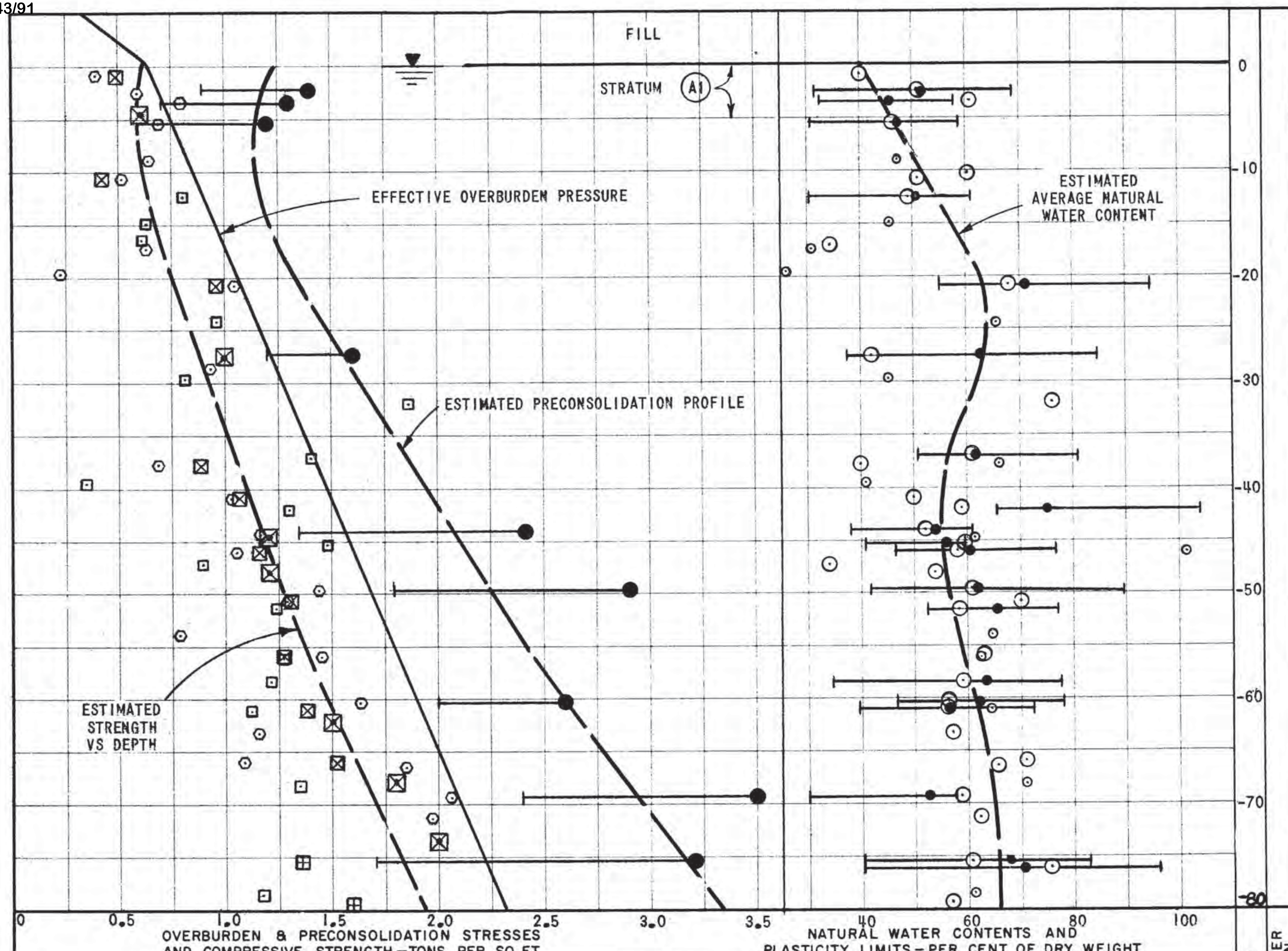
CH'KD BY:	VLT	DATE:	8-10-70	

SOIL PROPERTIES PROFILE
BORINGS NOS. L-5 TO L-10

PLATE NO. 9



AVERAGE GROUND SURFACE ELEVATION = +10

ALL TESTS ARE FOR STRATUM (A1) ORGANIC CLAY, BENEATH FILL IN EAST POTOMAC PARK

DATA ARE INCLUDED FROM BORING I-29U OF THE REGIONAL SYSTEM EXPLORATION FEBRUARY, 1969

DESCRIPTIONS OF STRATA

- GROUND WATER LEVEL OBSERVED IN BORING

RANGE OF PRECONSOLIDATION STRESS VALUES: MINIMUM POSSIBLE —— MOST PROBABLE

- UNCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR TEST - AVERAGE OF 3 TESTS
- UNCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR TEST . SINGLE TEST
- UNCONFINED COMPRESSION TEST ON 3" SAMPLE - AVERAGE OF 2 TESTS
- UNCONFINED COMPRESSION TEST ON 2" SAMPLE - AVERAGE OF 2 OR 3 TESTS
- UNCONFINED COMPRESSION TEST ON 2" OR 3" SAMPLE - SINGLE TEST

- AVERAGE NATURAL WATER CONTENT OF ENTIRE UNDISTURBED SAMPLE
- NATURAL WATER CONTENT OF DRY SAMPLE OR NATURAL WATER CONTENT OF PORTION OF UNDISTURBED SAMPLE

PLASTIC LIMIT —— LIQUID LIMIT
NATURAL WATER CONTENT OF LIMIT SPECIMEN

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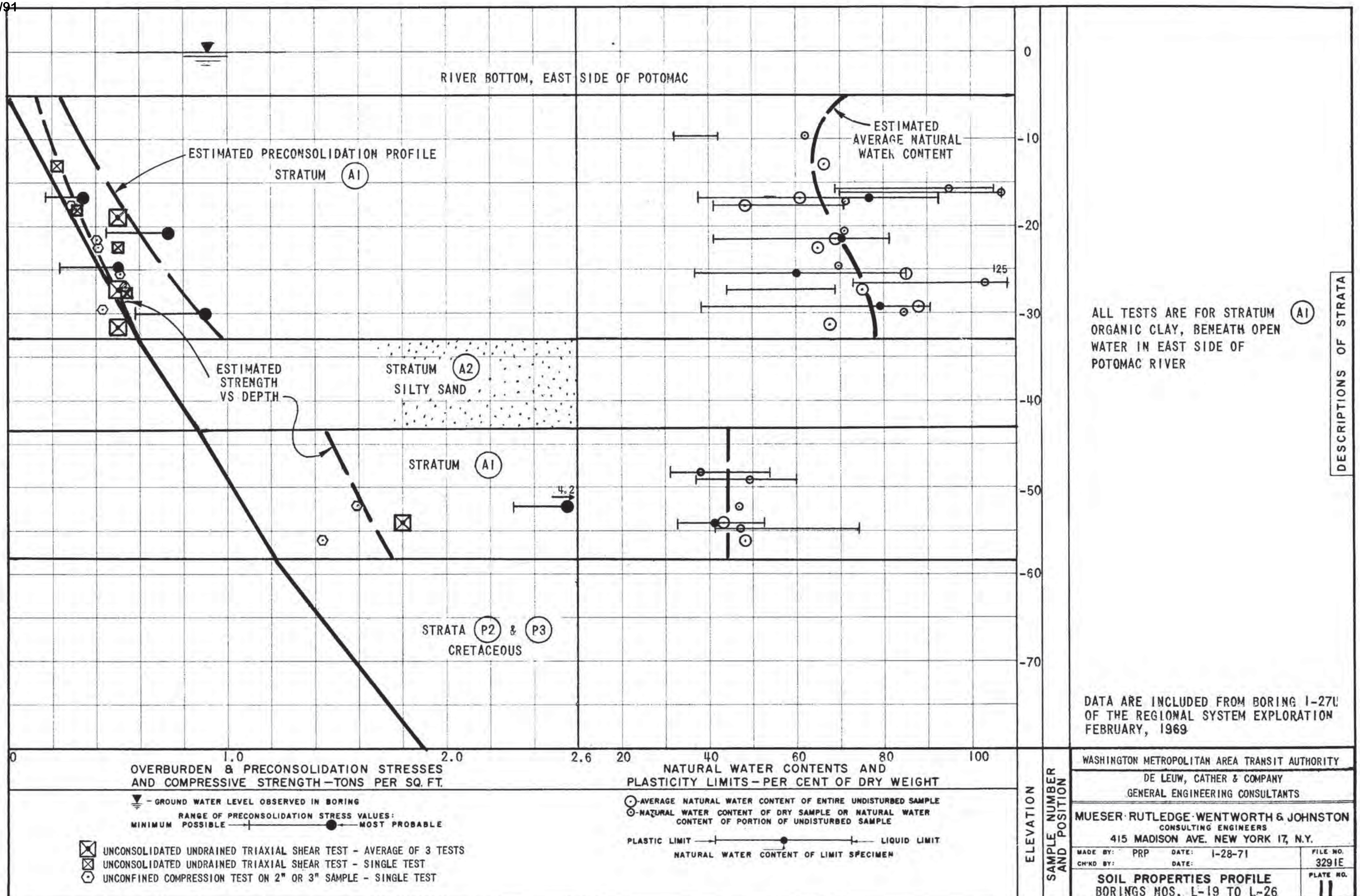
MADE BY: PRP DATE: 8-70 to 1-71 FILE NO. 3291E
CH'KD BY: DATE:

SOIL PROPERTIES PROFILE
BORINGS NOS. L-12 TO L-16

PLATE NO. 10


RIVER BOTTOM, EAST SIDE OF POTOMAC
ESTIMATED PRECONSOLIDATION PROFILE
STRATUM (A1)
ESTIMATED AVERAGE NATURAL WATER CONTENT
ESTIMATED STRENGTH VS DEPTH
STRATUM (A2) SILTY SAND
STRATUM (A1)
STRATA (P2) & (P3) CRETACEOUS
4.2
125
0
-10
-20
-30
-40
-50
-60
-70
0
1.0
2.0
2.6
20
40
60
80
100
OVERBURDEN & PRECONSOLIDATION STRESSES AND COMPRESSIVE STRENGTH—TONS PER SQ. FT.
NATURAL WATER CONTENTS AND PLASTICITY LIMITS—PER CENT OF DRY WEIGHT
ELEVATION
SAMPLE NUMBER AND POSITION
DESCRIPTIONS OF STRATA
ALL TESTS ARE FOR STRATUM (A1) ORGANIC CLAY, BENEATH OPEN WATER IN EAST SIDE OF POTOMAC RIVER
DATA ARE INCLUDED FROM BORING 1-27U OF THE REGIONAL SYSTEM EXPLORATION FEBRUARY, 1969
- GROUND WATER LEVEL OBSERVED IN BORING
RANGE OF PRECONSOLIDATION STRESS VALUES: MINIMUM POSSIBLE — MOST PROBABLE
UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST - AVERAGE OF 3 TESTS
UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST - SINGLE TEST
UNCONFINED COMPRESSION TEST ON 2" OR 3" SAMPLE - SINGLE TEST
-AVERAGE NATURAL WATER CONTENT OF ENTIRE UNDISTURBED SAMPLE
-NATURAL WATER CONTENT OF DRY SAMPLE OR NATURAL WATER CONTENT OF PORTION OF UNDISTURBED SAMPLE
PLASTIC LIMIT — LIQUID LIMIT
NATURAL WATER CONTENT OF LIMIT SPECIMEN
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MADE BY: PRP DATE: 1-28-71
CH'KD BY: DATE:
FILE NO. 3291E
SOIL PROPERTIES PROFILE
BORINGS NOS. L-19 TO L-26
PLATE NO. 11

GENERAL NOTES

1. BORINGS NOS. L-1 TO L-37 WERE MADE BETWEEN APRIL 27 TO NOVEMBER 2, 1970 UNDER THE SUPERVISION OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON. BORINGS OF THE "1" SERIES WERE MADE BETWEEN JUNE TO AUGUST, 1968 UNDER THE SUPERVISION OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON.

   SHOWN THUS ON LOCATION PLANS: ⊕

   ON GEOLOGICAL SECTIONS: ○

2. BORINGS NOT IN THE "L" SERIES WHICH WERE MADE AT VARIOUS TIMES FOR OTHER PROJECTS AND WERE ASSEMBLED FOR USE IN THIS STUDY.

   SHOWN THUS ON LOCATION PLANS: ✱

   ON GEOLOGICAL SECTIONS: □

   THESE PROJECTS ARE INDICATED ON THE GENERAL LOCATION PLANS THUS: ◇ AND ARE LISTED IN TABLE NO. 9.

3. ELEVATIONS REFER TO USC&GS MEAN SEA LEVEL DATUM OF 1929, WHICH IS DESIGNATED AS PROJECT DATUM.

4. FOR LOCATIONS OF THE GEOLOGICAL SECTIONS WITHIN THE STUDY AREA, SEE GENERAL LOCATION PLANS DRAWING NO. F-L-2.

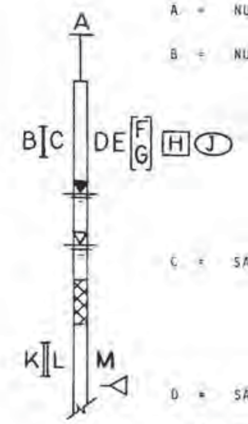
5. LOCATION PLANS SHOWN ON GEOLOGICAL SECTION DRAWINGS WERE OBTAINED FROM DE LEUW, CATHER & COMPANY MAPS.

6. CENTERLINE OF OUTBOUND TRACK, STATIONING ON THAT CENTERLINE AND POSITION OF TOP RAIL WERE OBTAINED FROM DE LEUW, CATHER & COMPANY DRAWINGS DATED NOVEMBER, 1968 AND REVISED MARCH, 1969. THESE ARE SUBJECT TO CHANGE IN FINAL PLANS.

INDEX OF DRAWINGS, L'ENFANT - PENTAGON ROUTE SECTIONS L001 AND L002

DRAWING NUMBER	DRAWING TITLE
F-L-1	L'ENFANT-PENTAGON ROUTE, INFORMATION DRAWING
F-L-2	L'ENFANT-PENTAGON ROUTE, GENERAL LOCATION PLAN
F-L-3	L'ENFANT-PENTAGON ROUTE, GENERAL GEOLOGICAL SECTION
F-L-4	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 55+00 TO 67+00
F-L-5	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 67+00 TO 79+15
F-L-6	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 79+15 TO 92+15
F-L-7	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 92+15 TO 105+10
F-L-8	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 105+00 TO 122+45
F-L-9	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 122+45 TO 135+00
F-L-10	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 135+00 TO 146+00
F-L-11	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 146+00 TO 155+00
F-L-12	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 155+00 TO 167+00
F-L-13	L'ENFANT-PENTAGON ROUTE, GEOLOGICAL SECTION, STATION 167+00 TO 177+10
F-L-14	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-1 TO L-4
F-L-15	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-5 TO L-10
F-L-16	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-11 TO L-14
F-L-17	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-15 TO L-18
F-L-18	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-19 TO L-22
F-L-19	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-23 TO L-27
F-L-20	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-28 TO L-32
F-L-21	L'ENFANT-PENTAGON ROUTE, LOGS OF L-SERIES BORINGS, NOS. L-33 TO L-37

LEGEND FOR GEOLOGICAL SECTIONS



I = LOCATION AND LENGTH OF SOIL SAMPLE.

II = LOCATION AND LENGTH OF ROCK CORE RUN.

A = NUMBER AND LOCATION OF BORING.

B = NUMBER AND TYPE OF SOIL SAMPLE:
- SUFFIX "D" = DRY SAMPLE TAKEN WITH 2" OD SPLIT SPOON;
- SUFFIX "S" = SHELBY SAMPLE TAKEN WITH 2" OD THIN TUBE;
- SUFFIX "U" = UNDISTURBED SAMPLE TAKEN WITH 3" OD THIN TUBE USING PISTON SAMPLER;
- SUFFIX "R" = SAMPLE TAKEN WITH OPEN-END DRILL ROD;
- SUFFIX "UD" OR "SD" = THIN TUBE SAMPLE DISTURBED IN SAMPLING;
- "NR" = SAMPLE ATTEMPTED BUT NOT RECOVERED;
- SUFFIX "C" = ROCK CORE RUN.

C = SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT, EXCEPT WHERE SPECIFIC DISTANCE IS NOTED.
SAMPLER DRIVEN WITH 140 LB. HAMMER FALLING 30".
P = THIN TUBE SAMPLER ADVANCED BY PUSHING;
T = THIN TUBE SAMPLER ADVANCED BY TAPPING.
(R SAMPLES DRIVEN WITH 300 LB. HAMMER FALLING 18")
* INDICATES SPOON SAMPLE DRIVEN WITH 300 LB. HAMMER

D = SAMPLE CLASSIFICATION ACCORDING TO UNIFIED SOIL CLASSIFICATION SYSTEM.

E = SAMPLE NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT.

[F] = ATTERBERG LIQUID LIMIT VALUE.

[G] = ATTERBERG PLASTIC LIMIT VALUE.

[H] = SHEAR STRENGTH IN KSF DETERMINED FROM UNCONFINED COMPRESSION TEST FOR SOIL SAMPLES OR COMPRESSIVE STRENGTH IN K.S.I. FOR ROCK CORES.

(J) = SHEAR STRENGTH IN KSF DETERMINED FROM UNCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR TEST.

K = NUMBER DESIGNATION OF NX SIZE ROCK CORE RUN.

L = LENGTH OF ROCK CORE RECOVERY EXPRESSED AS A PERCENT OF LENGTH OF CORE RUN.

M = ROCK QUALITY DESIGNATION R.Q.D. IN %

▼ = GROUND WATER LEVEL OBSERVED IN "1" SERIES BORINGS IN 1968 AND "L" SERIES BORINGS IN 1970.

▽ = GROUND WATER LEVEL OBSERVED IN BORINGS OTHER THAN "L" AND "1" SERIES BORINGS

⊠ = POSITION OF POROUS BACKFILL SURROUNDING OBSERVATION WELL IN "L" AND "1" SERIES BORINGS.

M.L. = POSITION OF MATCH LINE BETWEEN GEOLOGICAL SECTIONS.

◁S = CORROSION TEST OF SOIL SAMPLE

◁W = CORROSION TEST OF WATER SAMPLE

GENERALIZED STRATA DESCRIPTIONS

SYMBOL	DESCRIPTION	UNIFIED SOIL CLASSIFICATION		SOURCE AND AGE
		PRIMARY	SECONDARY	
(F)	FILL, GENERALLY OF INORGANIC SOIL OBTAINED FROM NEARBY NATURAL MATERIALS, MIXED WITH BRICK AND CINDERS WHERE PLACED ON MARSH AREAS.	ML, SM	SC, CL	MAN MADE IN HISTORIC TIMES
(A1)	SOFT TO MEDIUM STIFF DARK GRAY AND BROWN ORGANIC CLAY WITH LENSES OF HIGHLY ORGANIC MATERIAL.	OH, OL,	CH, Pt	RIVER ALLUVIUM OF POST-GLACIAL TIMES
(A2)	LOOSE TO MEDIUM COMPACT DARK GRAY SILTY FINE TO MEDIUM SAND WITH OCCASIONAL LENSES OF SMALL GRAVEL.	SM	SP	
(T1)	STIFF TO MEDIUM LIGHT BROWN OR GRAY OR MOTTLED BROWN-GRAY SILTY CLAY OR CLAYEY SILT WITH LENSES OF BROWN SILTY FINE SAND.	CL, CH, OL	LENSES OF SM OR SC	PORTIONS OF THE "25-FOOT" "50-FOOT" AND "90-FOOT" TERRACES, DEPOSITED BY RIVERS IN PLEISTOCENE TIMES
(T2)	MEDIUM COMPACT TO COMPACT BROWN AND ORANGE-BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACES OF SMALL GRAVEL.	SM, SP	SC, SW	
(T3)	COMPACT TO VERY COMPACT BROWN AND RED-BROWN FINE TO COARSE SAND WITH SOME SILT AND GRAVEL, OR SAND AND GRAVEL WITH A TRACE OF SILT AND NUMEROUS BOULDERS.	SM, SP	GP, GM	
(T4)	MEDIUM COMPACT TO COMPACT GRAY AND GRAY-BROWN FINE TO MEDIUM SAND WITH SOME SILT AND SMALL GRAVEL CONTAINING LENSES OF DARK GRAY CLAY.	SM, SP	SC, SW	
(T5)	COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL AND SOME TO TRACE SILT, OR SAND AND GRAVEL WITH NUMEROUS BOULDERS.	SM, SP	GP, GM	
(P1)	HARD MOTTLED RED-BROWN AND GRAY OR LIGHT GRAY AND TAN PLASTIC CLAY WITH OCCASIONAL POCKETS OF FINE SAND.	CH	CL	POTOMAC GROUP OF CRETACEOUS PERIOD
(P2)	COMPACT TO VERY COMPACT LIGHT GRAY OR TAN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH POCKETS OF SILTY CLAY AND TRACE OF SMALL GRAVEL, OCCASIONAL LIGNITE FRAGMENTS.	SC, SM	SP	
(P3)	HARD GRAY-GREEN OR GRAY-BLUE SILTY OR SANDY CLAY AND SANDY SILT AND SILTY OR CLAYEY FINE SAND WITH OCCASIONAL SMALL GRAVEL.	CL, SC	CH, SM	
(P4)	VERY COMPACT MOTTLED LIGHT GRAY, TAN, BUFF OR WHITE SILTY OR CLAYEY FINE TO MEDIUM SAND WITH SOME GRAVEL AND SCATTERED LIGNITE FRAGMENTS.	SC, SM	SP, GM	
(D)	HARD ORANGE-BROWN OR YELLOW-BROWN MICACEOUS FINE SANDY SILT OR VERY COMPACT LIGHT GRAY AND GREEN MICACEOUS SILTY FINE TO MEDIUM SAND, DECOMPOSED BEDROCK.	ML	SM	WEATHERED IN SITU FROM CRYSTALLINE BEDROCK
(WR)	WEATHERED AND JOINTED QUARTZ HORNBLENDE GNEISS			ROCKS OF PALEOZOIC OR PRECAMBRIAN AGE
(J)	JOINTED TO MODERATELY JOINTED QUARTZ HORNBLENDE GNEISS, GENERALLY R.Q.D. < 75%			
(R)	RELATIVELY SOUND TO SOUND QUARTZ HORNBLENDE GNEISS, OCCASIONALLY MODERATELY JOINTED, GENERALLY R.Q.D. > 75%			

IGNED		DATE
WN	AR	12-70 DATE
CKED	SLT	1-71 DATE
ROVED		DATE

REFERENCE DRAWINGS	
NUMBER	DESCRIPTION
F-L-2	Boring Locations

REVISIONS		
DATE	BY	DESCRIPTION

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415 MADISON AVE., NEW YORK 17, N. Y.

SUBMITTED William H. [signature]

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT ☐

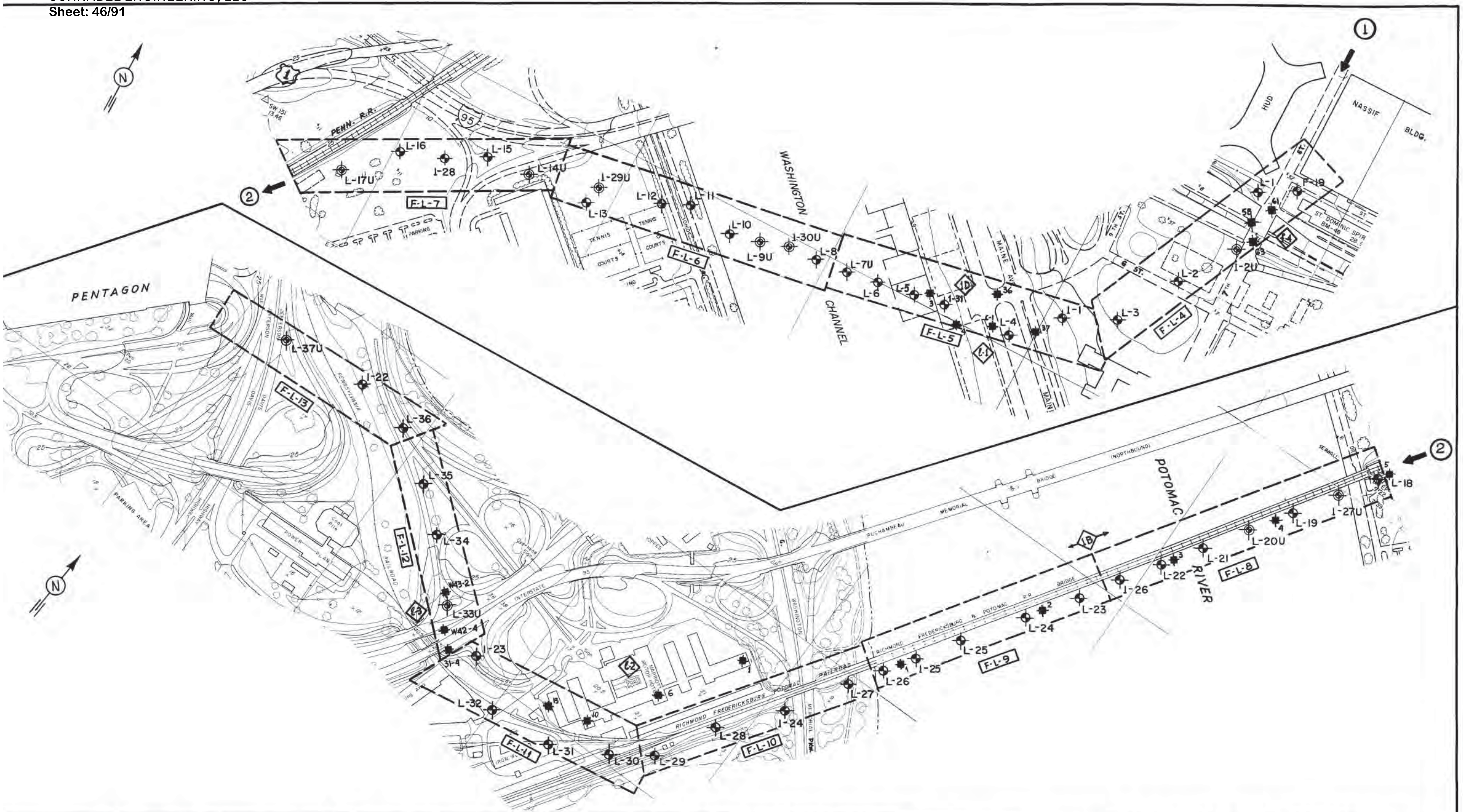
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT ☐

APPROVED

L'ENFANT - PENTAGON RIVER CROSSING ROUTE
GENERAL INFORMATION DRAWING

SCALE

DRAWING NO. F-L-1



DESIGNED		DATE
DRAWN	A.R.	1-10-71
CHECKED	SLT & JPG	1-10-71
APPROVED		DATE

REFERENCE DRAWINGS	
NUMBER	DESCRIPTION
F-L-1	General Notes and Legend

REVISIONS		
DATE	BY	DESCRIPTION

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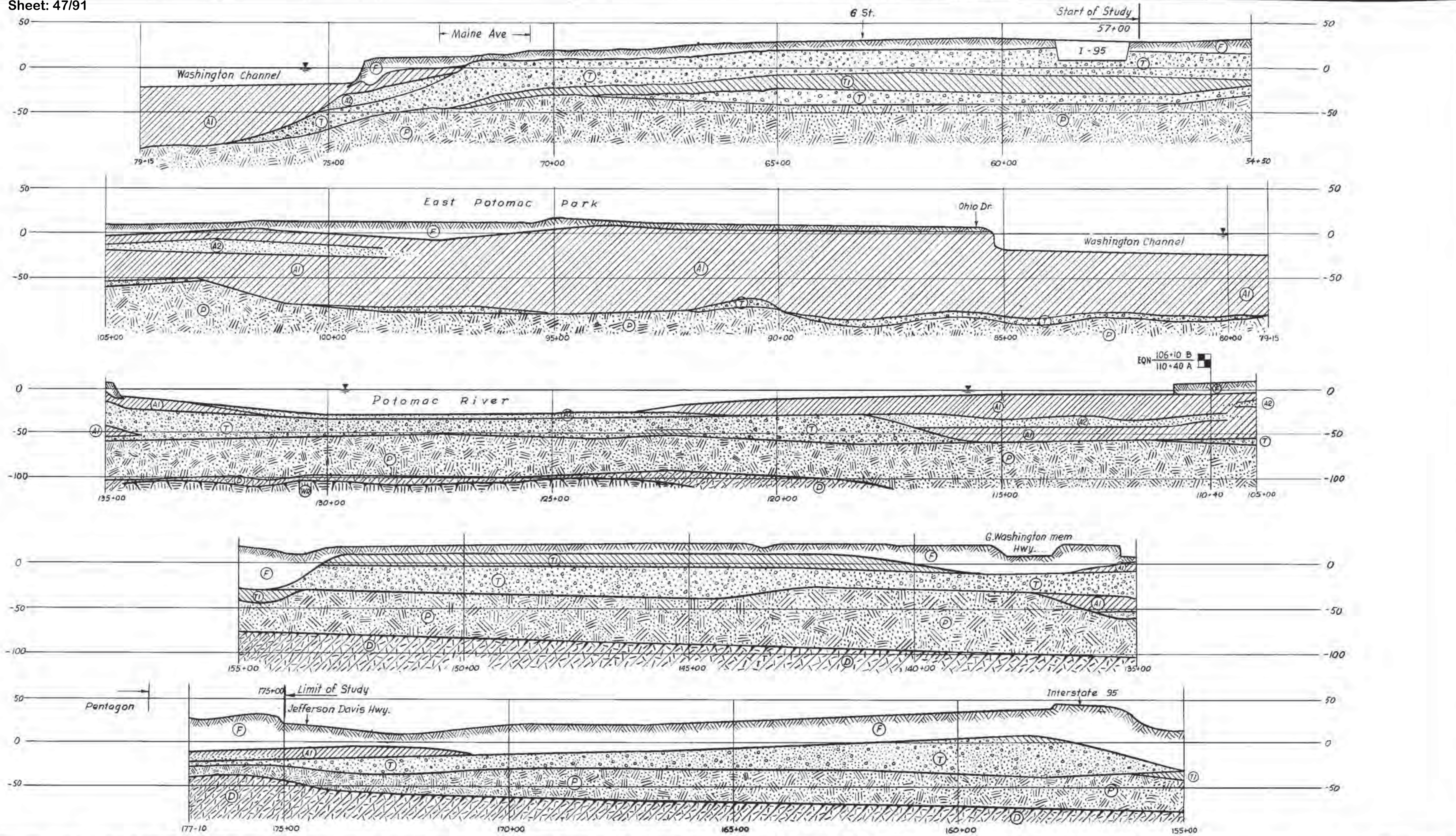
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE

GENERAL LOCATION PLAN

SCALE 200' 0 200' 400'

DRAWING NO. F-L-2



	A. R.	1-26-71
	SLT & JPG	1-27-71

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-2	General Location Plan

REVISIONS

DATE	BY	DESCRIPTION

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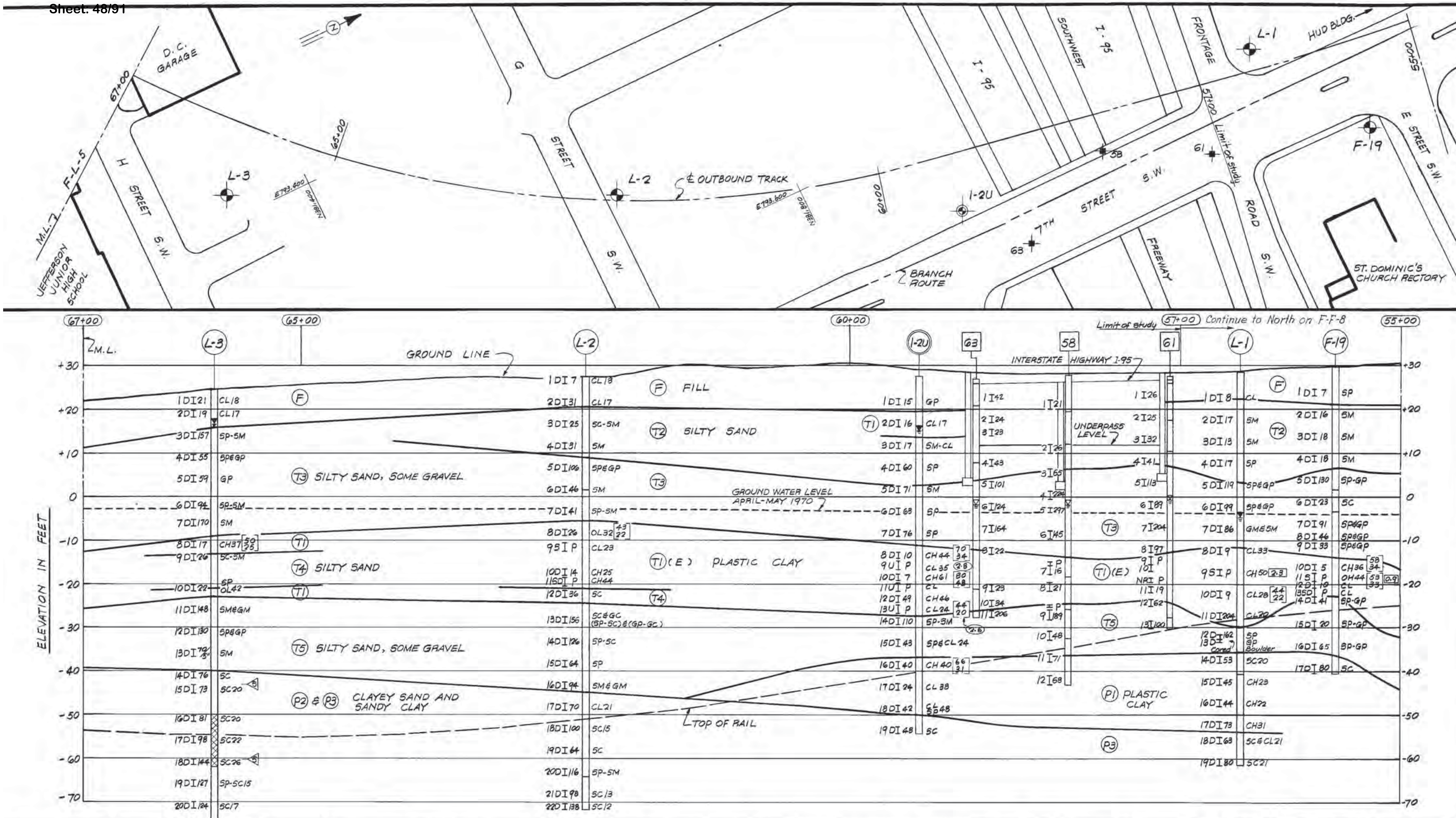
L'ENFANT - PENTAGON RIVER CROSSING ROUTE
GENERAL GEOLOGICAL SECTION

SCALE HORIZ. 0 100' 200' VERT. 0 50' 100'
DRAWING NO. F-L-3



NUMBER	REFERENCE DRAWINGS DESCRIPTION
F-L-1	General Notes & Legend. For data on "I"- series borings, See Regional System Subsurface Investigation, Feb. 1969. Position of top of rail from D.C. Co. Dwgs. of Nov. 1968. revised March 1969.

DRAWN AR & FBC 12-70
CHECKED SLT & JPG 1-71

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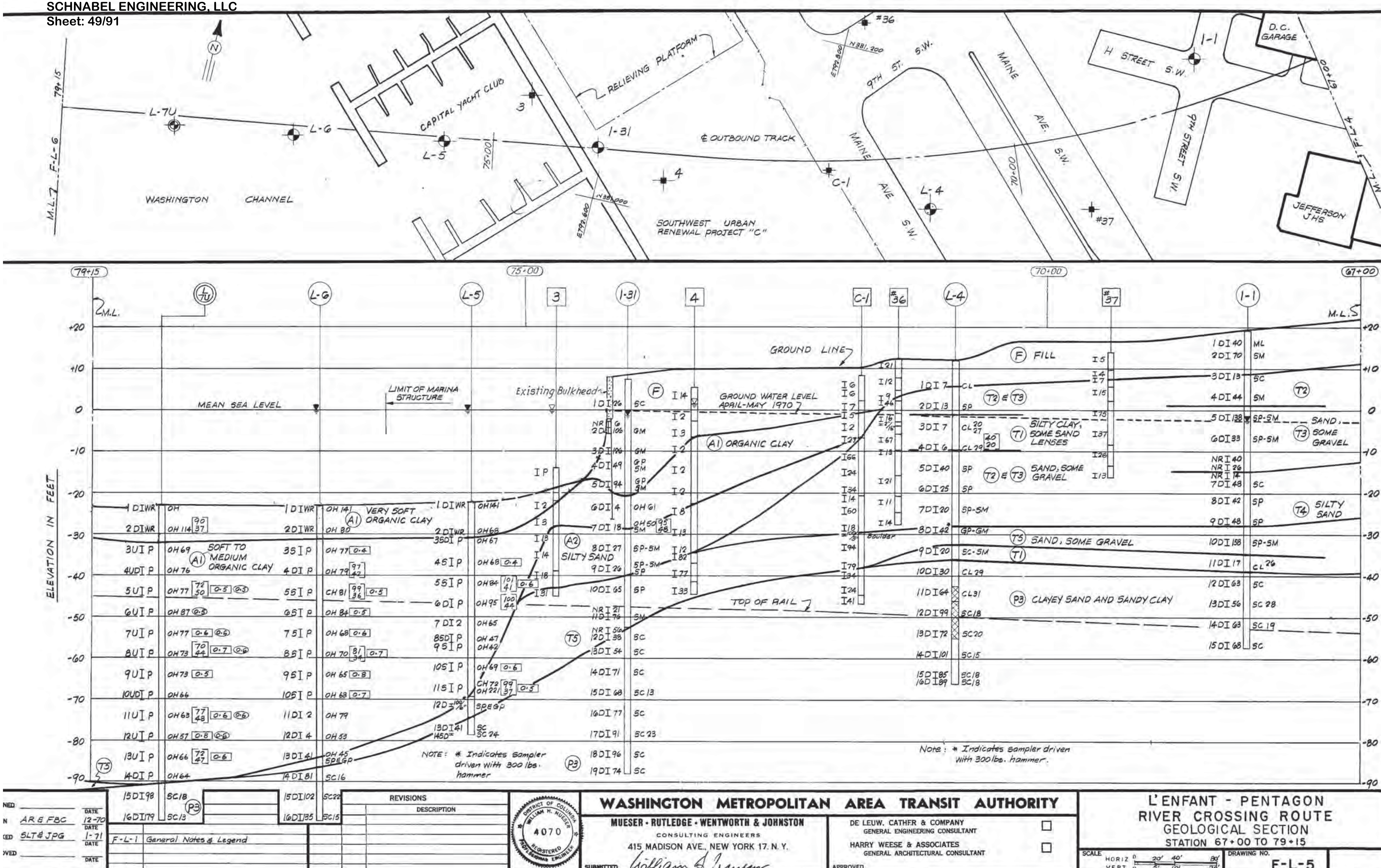
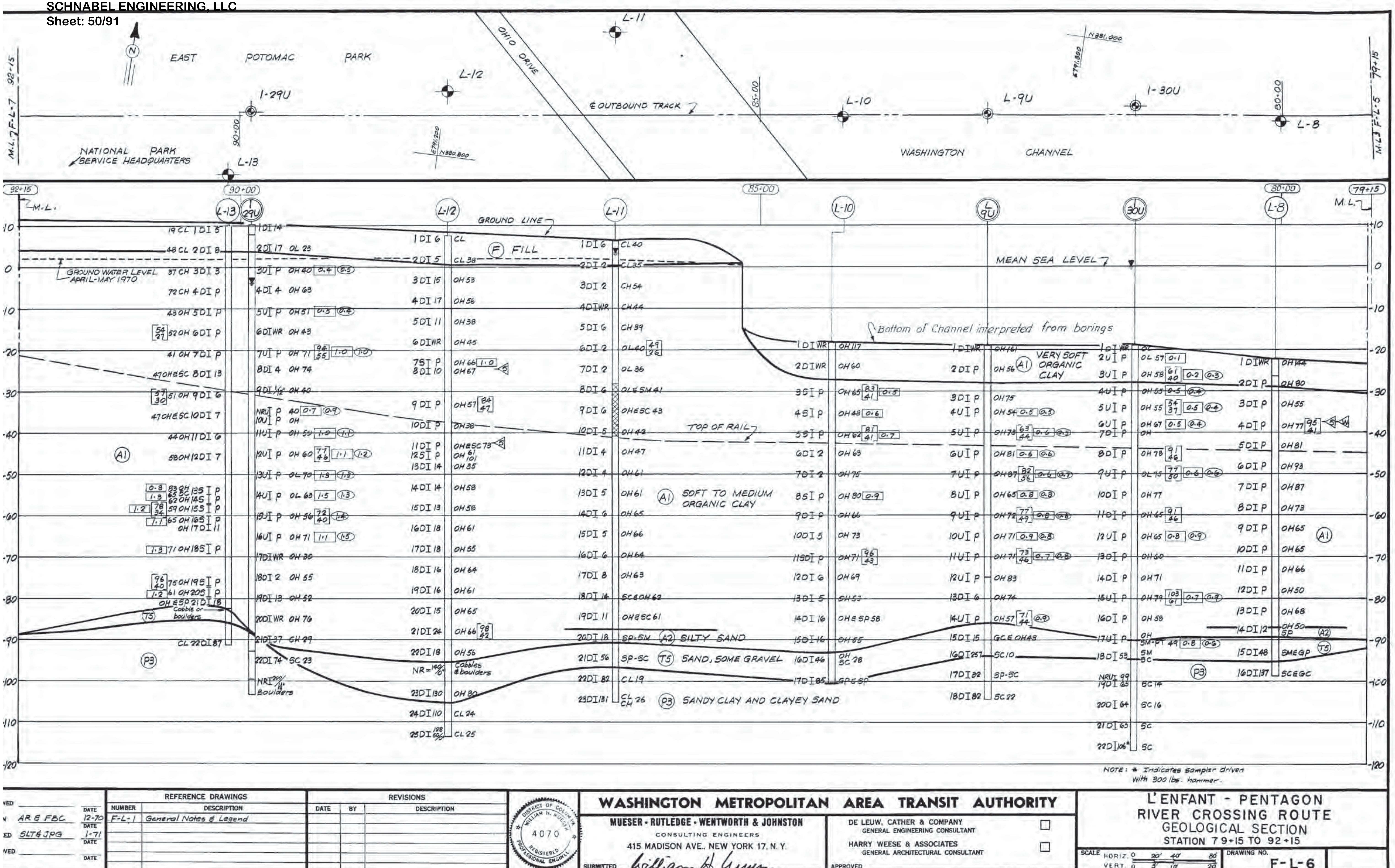
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 55+00 TO 67+00

SCALE HORIZ 0 20' 40' 80'
VERT 0 5' 10' 20'

DRAWING NO. F-L-4

APPENDIX 2
SCHNABEL ENGINEERING, LLC
Sheet: 49/91




EAST POTOMAC PARK
NATIONAL PARK SERVICE HEADQUARTERS
OHIO DRIVE
℄ OUTBOUND TRACK
WASHINGTON CHANNEL
L-13
1-29U
L-12
L-11
L-10
L-9U
1-30U
L-8
92+15
90+00
85+00
80+00
79+15
M.L.
GROUND LINE
F FILL
GROUND WATER LEVEL APRIL-MAY 1970
MEAN SEA LEVEL
Bottom of Channel interpreted from borings
VERY SOFT ORGANIC CLAY
TOP OF RAIL
A1 SOFT TO MEDIUM ORGANIC CLAY
A2 SILTY SAND
T5 SAND, SOME GRAVEL
P3 SANDY CLAY AND CLAYEY SAND
Cobble or boulders
Cobbles & boulders
Boulders
NOTE: * Indicates sampler driven with 300 lbs. hammer.
REFERENCE DRAWINGS
NUMBER
DESCRIPTION
F-L-1 General Notes & Legend
REVISIONS
DATE
BY
DESCRIPTION
AR & FBC 12-70
SLT & JPG 1-71
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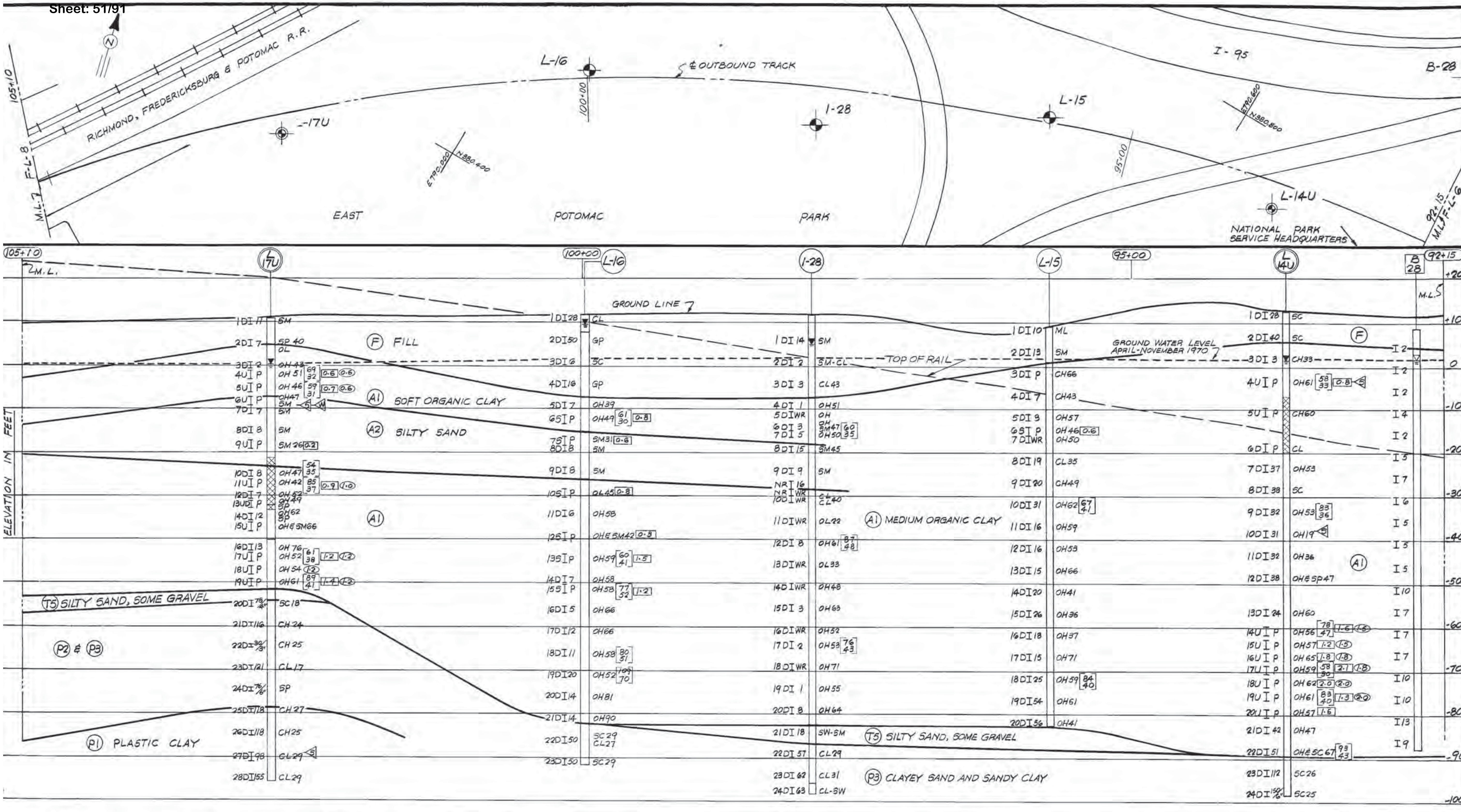
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 79+15 TO 92+15
SCALE HORIZ. 0 20' 40' 80'
VERT. 0 5' 10' 20'
DRAWING NO.
F-L-6



DESIGNED		DATE
DRAWN	AR & FBC	12-70
CHECKED	SLT & JPG	1-71
APPROVED		

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-1	General Notes & Legend

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DATE	BY	DESCRIPTION

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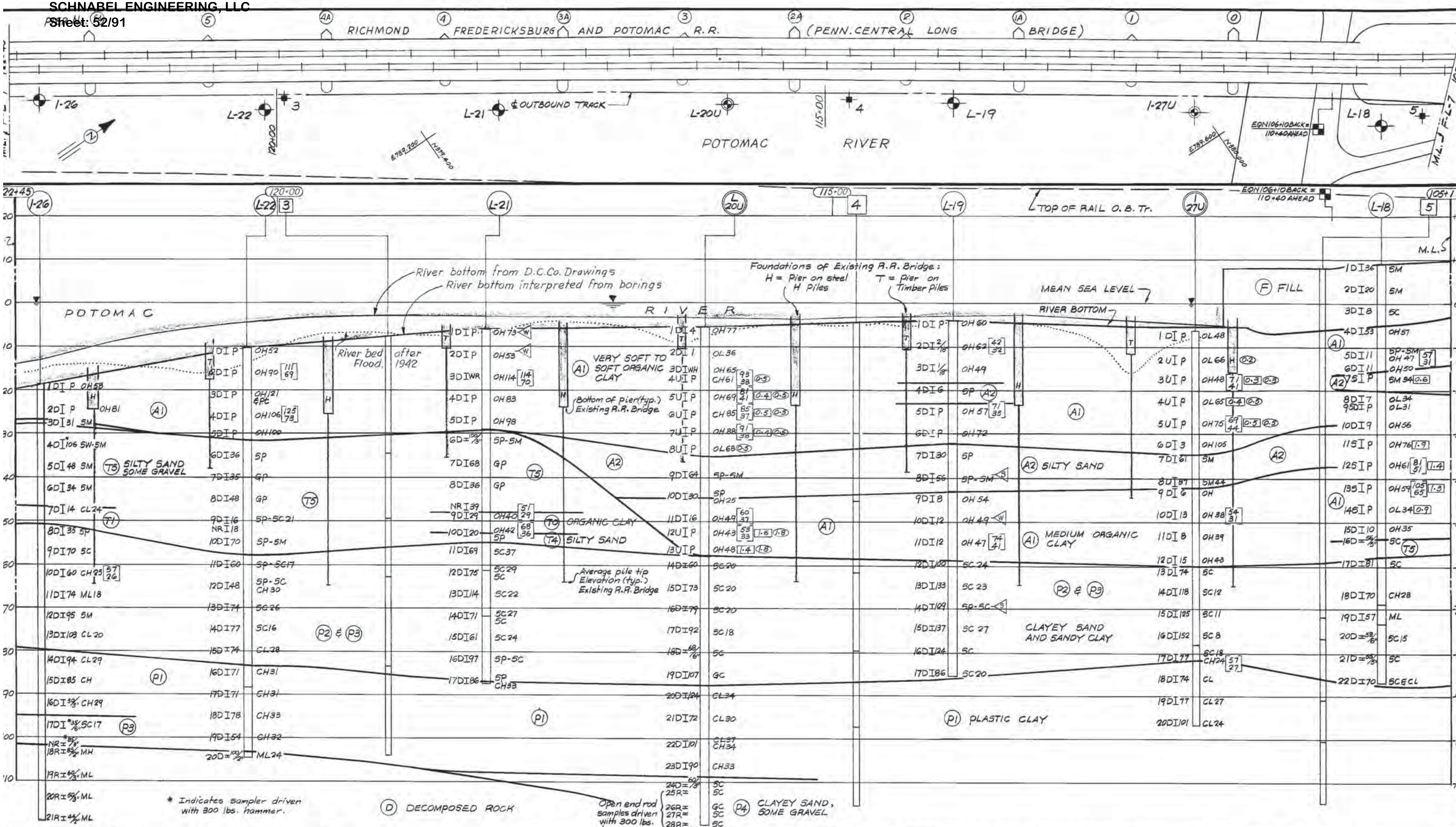
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 92+15 TO 105+10

SCALE HORIZ. 0 20' 40' 80'
VERT. 0 5' 10' 20'

DRAWING NO. F-L-7



REFERENCE DRAWINGS	
NUMBER	DESCRIPTION
F-L-1	General Notes & Legend

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CHECKED	SLT & JPG	1-71
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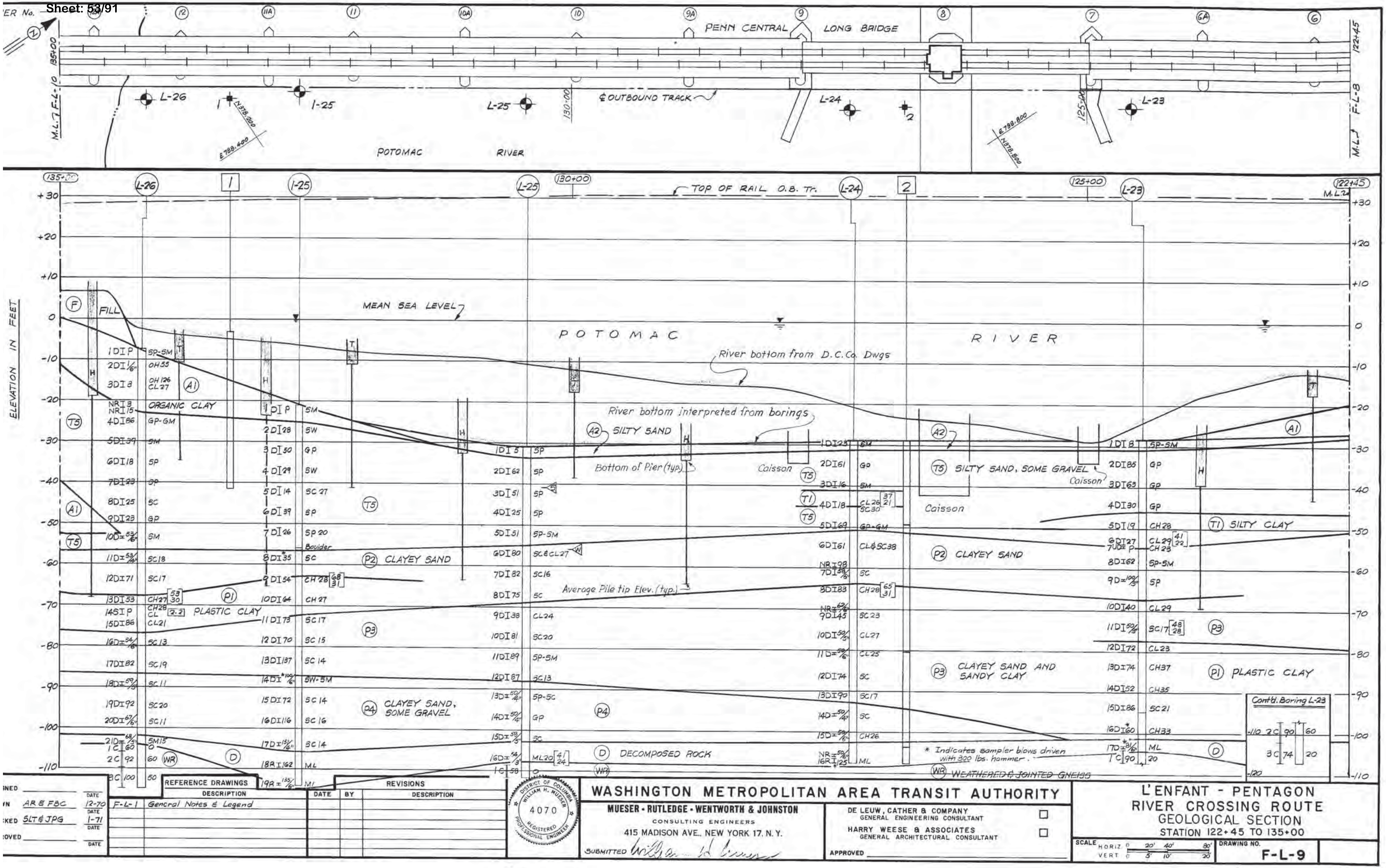
L'ENFANT - PENTAGON RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 105+10 TO 122+45

SCALE HORIZ. 0 20' 40' 80' — VERT. 0 5' 10' 20'

DRAWING NO. F-L-8


PENN CENTRAL
LONG BRIDGE
¢ OUTBOUND TRACK
POTOMAC
RIVER
TOP OF RAIL O.B. Tr.
ELEVATION IN FEET
MEAN SEA LEVEL
FILL
ORGANIC CLAY
POTOMAC
RIVER
River bottom from D.C.Co. Dwgs
River bottom interpreted from borings
SILTY SAND
Bottom of Pier (typ)
Caisson
SILTY SAND, SOME GRAVEL
SILTY CLAY
CLAYEY SAND
Average Pile tip Elev. (typ)
PLASTIC CLAY
CLAYEY SAND AND SANDY CLAY
CLAYEY SAND, SOME GRAVEL
DECOMPOSED ROCK
WEATHERED & JOINTED GNEISS
* Indicates sampler blows driven with 300 lbs. hammer.
Cont'd. Boring L-23
REFERENCE DRAWINGS
F-L-1 General Notes & Legend
REVISIONS
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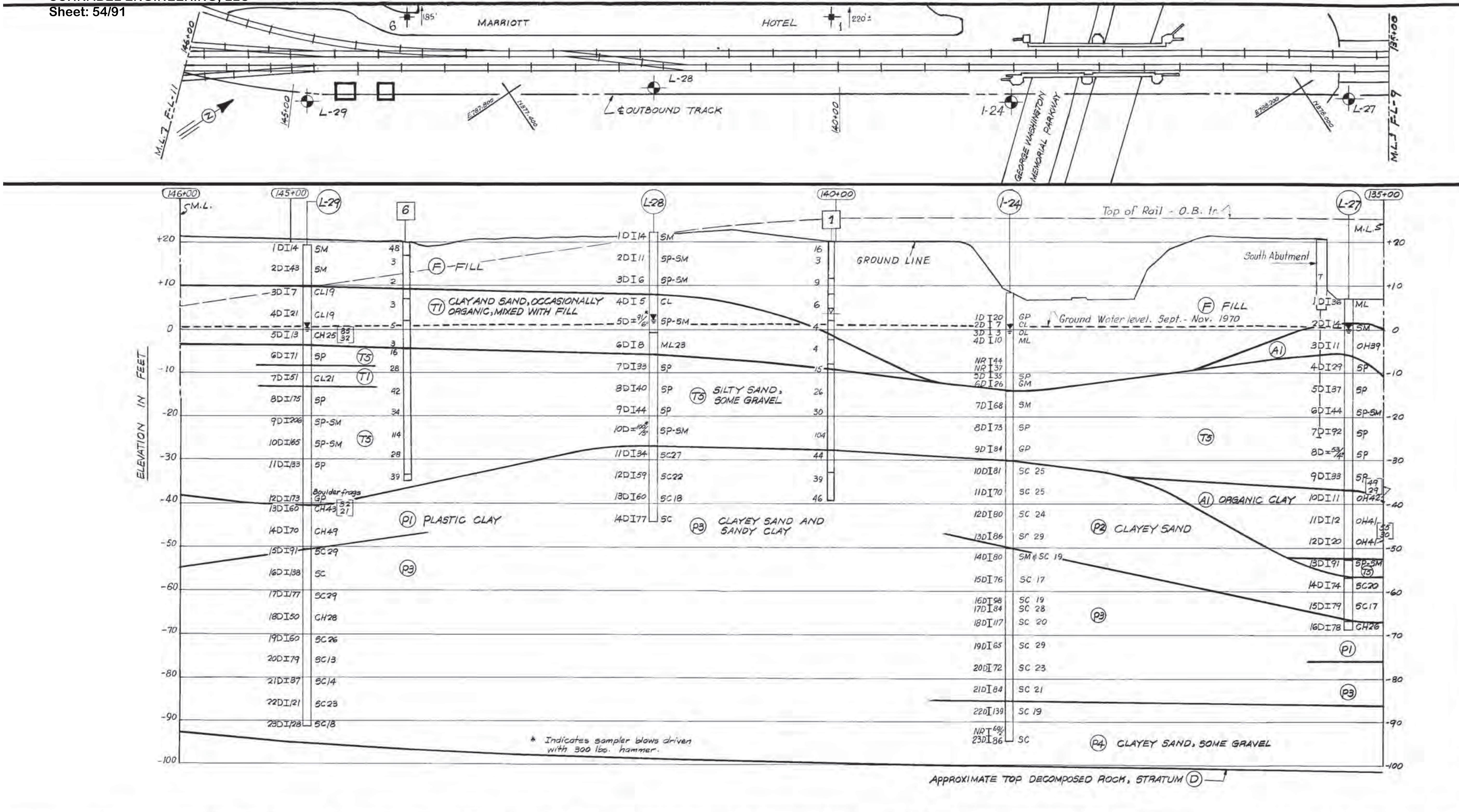
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 122+45 TO 135+00
DRAWING NO. F-L-9



REFERENCE DRAWINGS	
NUMBER	DESCRIPTION
F-L-1	General Notes & Legend

DESIGNED ______ DATE
DRAWN AR & FBC DATE 12-70
CHECKED SLT & JPG DATE 1-71
APPROVED ______ DATE

REVISIONS: DATE | BY | DESCRIPTION

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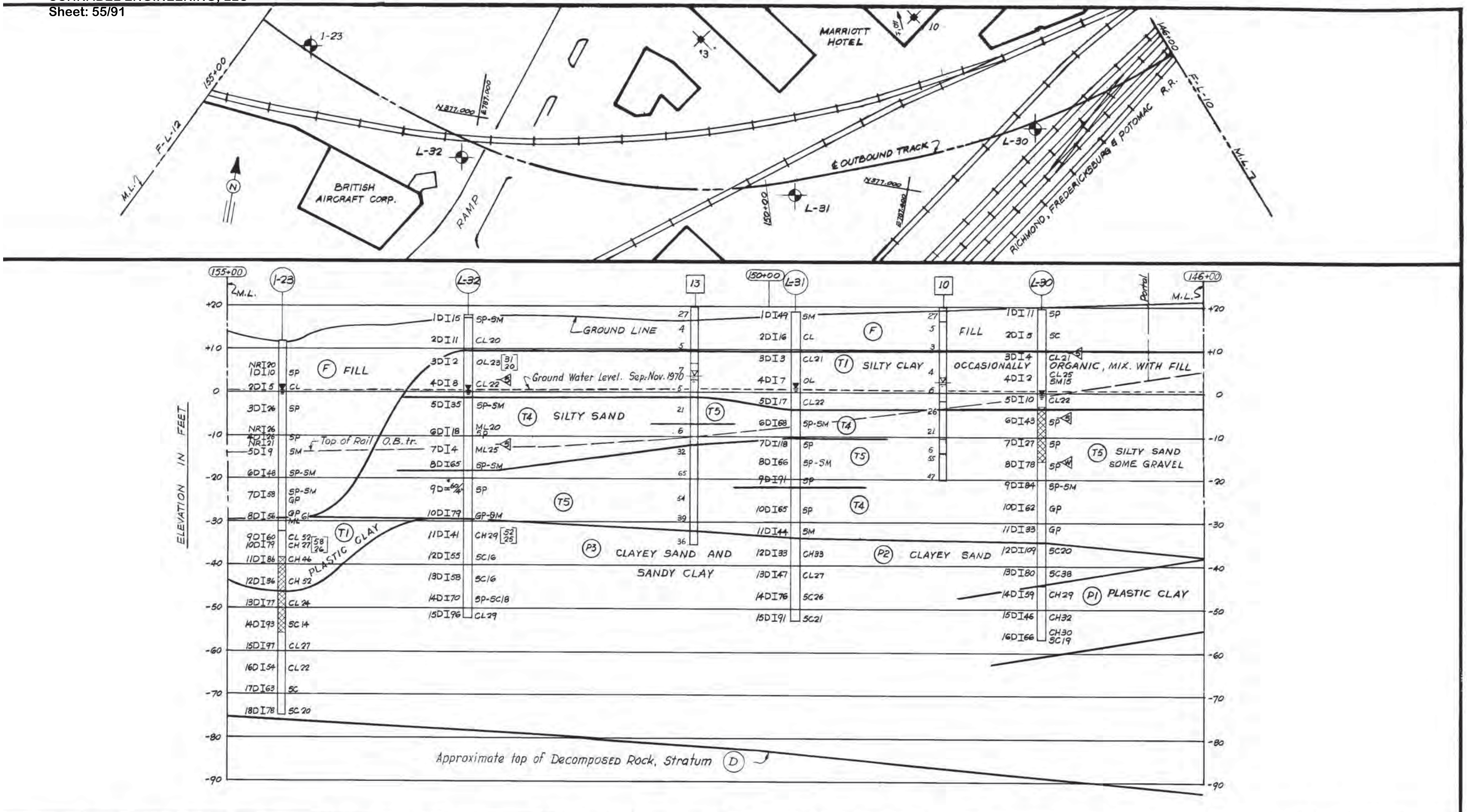
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 135+00 TO 146+00

SCALE HORIZ. 0 20' 40' 80'; VERT. 0 5' 10' 20'

DRAWING NO. F-L-10

APPENDIX 2
SCHNABEL ENGINEERING, LLC
Sheet: 55/91



DESIGNED		DATE
DRAWN	AR & FBC	12-70
CHECKED	SLT & JPG	1-71
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-1	General Notes & Legend

REVISIONS

DATE	BY	DESCRIPTION

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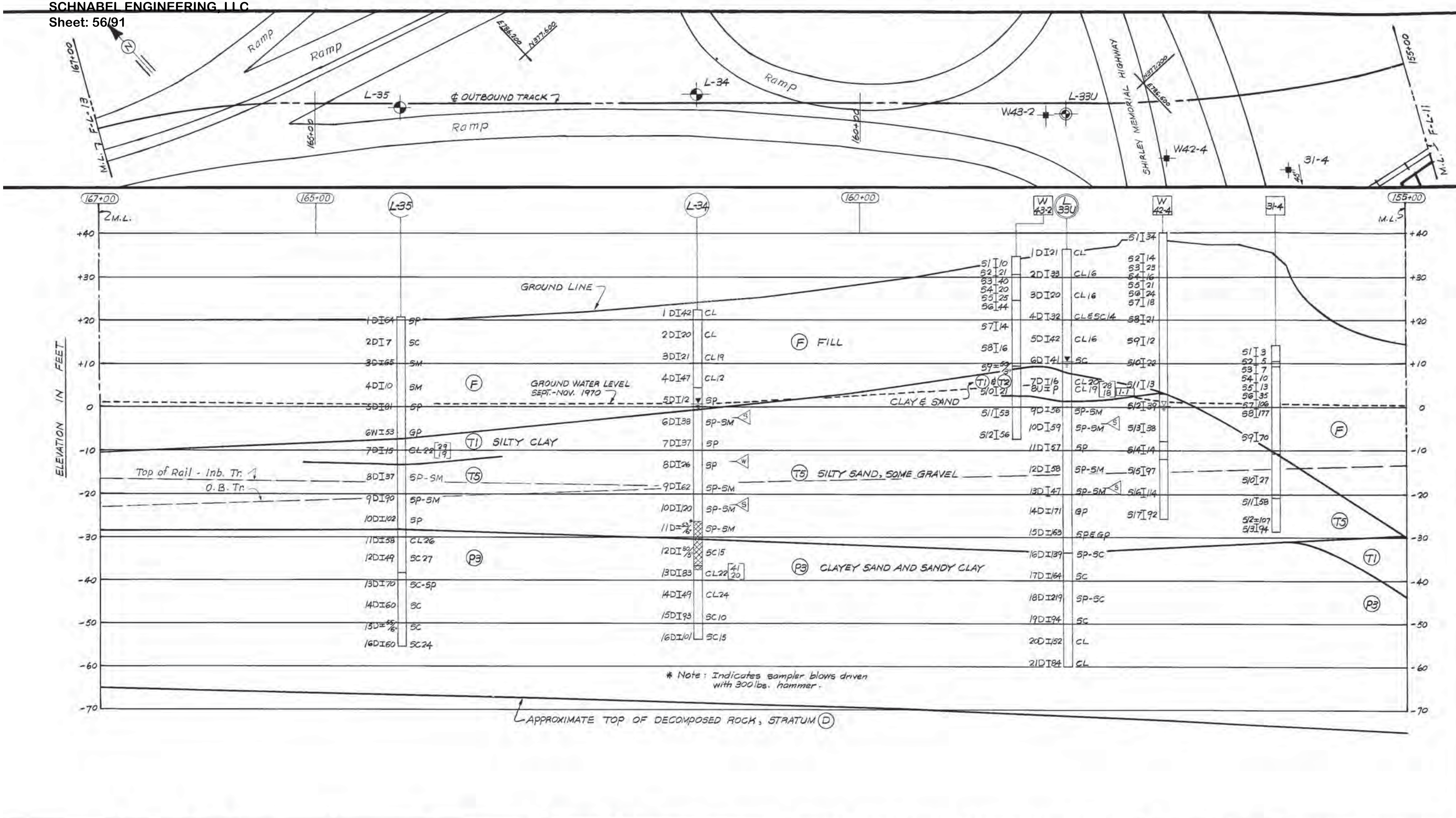
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 146+00 TO 155+00

SCALE: HORIZ. 0 20' 40' 80' VERT. 0 5' 10' 20'

DRAWING NO. F-L-11



REFERENCE DRAWINGS
NUMBER: F-L-1 — DESCRIPTION: General Notes & Legend

REVISIONS: DATE / BY / DESCRIPTION

DESIGNED — DATE
DRAWN AR & FBC — 12-70
CHECKED SLT & JPG — 1-71
APPROVED — DATE

DISTRICT OF COLUMBIA, WILLIAM H. MUESER, 4070, REGISTERED PROFESSIONAL ENGINEER

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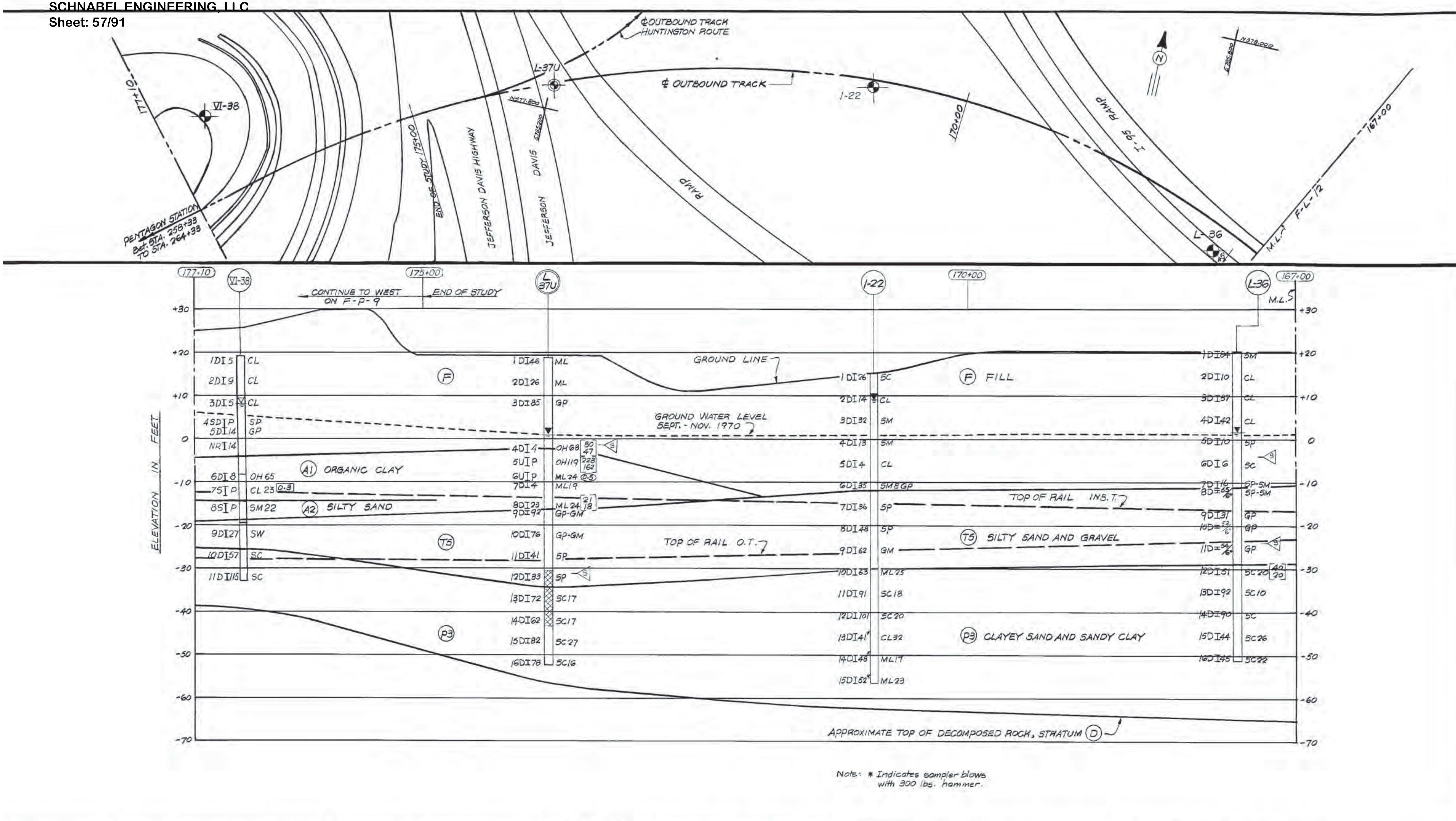
L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 155+00 TO 167+00

SCALE HORIZ. 0 20' 40' 80'
VERT. 0 5' 10' 20'

DRAWING NO. F-L-12

APPENDIX 2
SCHNABEL ENGINEERING, LLC
Sheet: 57/91



DESIGNED		DATE	
DRAWN	AR & FBC	DATE	12-70
CHECKED	SLT & JPG	DATE	1-71
APPROVED		DATE	

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-1	General Notes & Legend

REVISIONS

DATE	BY	DESCRIPTION

DISTRICT OF COLUMBIA WILLIAM H. MUESER 4070 REGISTERED PROFESSIONAL ENGINEER

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L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
GEOLOGICAL SECTION
STATION 167+00 TO 177+10

SCALE HORIZ. 0 20' 40' 80' VERT. 0 5' 10' 20'

DRAWING NO. F-L-13

BORING NUMBER L-1
Ground surface elevation +28.5

Sample	Penetration	Description
1D	3,5,3	Dark brown silty clay, some fine sand & concrete & brick fragments, (Fill) (CL)
2D	7,8,9	Brown silty fine sand (SM)
3D	7,6,7	"Do 2D" Trace gravel (SM)
4D	8,10,7	Brown medium to fine sand (SP)
5D	32,49,70	Brown coarse to medium sand, some gravel (SP) & (GP)
6D	25,39,60	"Do 5D" (SP) & (GP)
7D	35,44,42	Brown silty coarse to medium sand & gravel GM & SM)
8D	4,4,5	Gray silty clay (CL)
9S	P	Relatively stiff gray clay (CL)
10D	3,4,5	Gray medium plastic clay, trace organic matter (CL)
11D	35,169	Green-gray clay, some coarse to medium sand, trace small gravel (CL)
12D	48,114	Lt. gray c. sand
13 Cored		Some gravel (SP)
		Lt. brn. quartzite bldr. cored 9", Rec 7" (GP)
14D	22,26,27	Light gray clayey fine sand, (Cretaceous) (SC)
15D	19,21,24	Stiff light gray-green plastic clay, some medium to fine sand & silt pockets (CH)
16D	15,17,27	"Do 15D" (CH)
17D	25,32,41	"Do 15D" (CH)
18D	12,18,45	Light gray-green clayey fine to medium sand & sandy clay (SC & CL)
19D	22,32,48	Gray clayey fine to medium sand (SC)

Strata: BROWN SILTY CLAY, FINE SAND FILL — 6.0'; BROWN SILTY COARSE TO FINE SAND AND GRAVEL, TRACE SOME SILT, BE-COMMING VERY COMPACT BELOW 24' DEPTH — 40.0'; GRAY SILTY CLAY WITH SAND LENSES & ORGANIC MATTER — 58.5'; LT. BRN. BOULDER AND GRAVEL — 64.0'; LT. GRAY CLAYEY FINE SAND — 69.0'; LIGHT GRAY-GREEN PLASTIC CLAY, CLAYEY SAND AT BOTTOM — 90.0'

Boring started 5-6-70, completed 5-8-70
Final depths:
Boring = 90.0' Casing = 65.0'
Casing diameter = 2-1/2"
Average depth of ground water = 34.0' = El.-5.5

REMARKS:
Wash water loss noted at 58' depth.
Boulder encountered at 61' depth, diamond bit used to break through.

BORING NUMBER L-2
Ground surface elevation +27.3

Sample	Penetration	Description
1D	3,3,4	Top: Dk gray silty clay, sm f sand & ashes (CL) Bot: Brown silty clay (Fill) (CL)
2D	8,14,17	Brown silty clay, trace coarse sand & carbonaceous material (Possible Fill) (CL)
3D	13,10,15	Brown silty fine sand, trace carbonaceous material (SC-SM)
4D	13,15,16	Top: Brown fine sandy silt, tr small gravel (ML) Bot: Brown silty f-m sand tr small gravel (SM)
5D	38,52,54	Brown f-m sand & small to coarse gravel, trace silt (SP & GP)
6D	27,23,23	Top: Orange to gray f-m sand, trace gravel (SP) Bot: Orange f-m sand, some silt, trace coarse sand & small gravel (SM)
7D	26,15,26	Tan f-m sand, some silt, trace small gravel (SP-SM)
8D	13,13,13	Top: Mottled dark gray silty clay & tan f-m sand, some silt & trace gravel (CL & SM) Bot: Dark gray fine sandy clay, tr medium sand (CL)
9S	P	Gray silty clay (CL)
		Dark gray silty clay, numerous thin layers of decomposed vegetation & trace fine sand (CH)
10D	4,6,8	Dark gray plastic, slightly organic clay, trace very fine sand (CH)
11SD	P	
12D	13,18	Dark gray f-m sand, trace to some clay, thin layers of decomposed wood, trace coarse sand & small gvl (SC)
13D	32,69,87	Top: Light gray c-f sand & gravel, some clay (SC & GC) Bot: Light gray & orange c-f sand & gravel, trace clay (SP-SC) & (GP-GC)
14D	30,57,69	Gray f-c sand w/lenses of gray clay & decomposed wood, trace small gravel (SP-SC)
15D	17,24,40	White-tan c-f sand, trace silt & small gravel (SP)
16D	54,54,40	Top: Tan & red-brown f-c sand, sm gravel & silt (SP) Bot: Mottled medium brown & red-brn f-m sand & small to coarse gravel some silt (SM & GM)
17D	46,30,40	Orange & gray silty clay with some f-m sand & trace small gravels (CL)
18D	38,46,54	Light gray clayey f-m sand, trace coarse sand & occasional lenses of green silty clay (SC)
19D	22,29,35	Gray & tan to orange clayey coarse to fine sand with some silt (SC)
20D	20,51,65	Gray & white-tan coarse to fine sand with some silt (SP-SM)
21D	33,47,51	Light gray clayey f-c sand with gray-green silty clay layer (SC)
22D	31,51,87	Do. 21D (SC)

Strata: ASHES & BROWN SI CLAY, TR ORG MATERIAL — 7.0'; BROWN SILTY FINE SAND, TRACE SMALL GRAVEL AND ORGANIC MATERIAL — 18.5'; BROWN & OR TO GRY F-C SAND & GRAVEL, TRACE SILT — 26.0'; OR TO TAN F-M SAND W/SM SILT TRACE SMALL GVL — 33.0'; LAYERS OF GRAY SILTY CLAY AND CLAYEY FINE SAND, THIN LAYER OF DECOMPOSED VEGETATION AND WOOD FRAGMENTS — 52.0'; LIGHT GRAY COARSE TO FINE SAND, SOME GRAVEL WITH SOM TO TRACE CLAY, OCCASIONAL LAYER OF DECOMPOSED WOOD — 72.5'; LIGHT GRAY AND TAN TO ORANGE COARSE TO FINE CLAYEY SAND AND OCCASIONAL LAYER OF GRAY-GREEN SILTY CLAY, CRETACEOUS FORMATION — 99.5'

Boring started 5-1-70, completed 5-5-70
Final depths:
Boring = 99.5' Casing = 80.0'
Casing diameter = 2-1/2"
Average depth of ground water = = El.+

REMARKS:
No measurement of ground water level made in this hole.

BORING NUMBER L-3
Ground surface elevation +24.9

Sample	Penetration	Description
		*
1D	11,10,11	Brown fine sandy clay, trace roots & organic (fill) (CL)
2D	8,8,11	"Do 1D" (Probable fill) (CL)
3D	40,77,80	Brown fine to coarse sand, some gravel, trace silt (SP - SM)
4D	28,21,14	Brown & gray coarse to fine sand & gravel (SP & GP)
5D	40,29,30	Brown gravel (GP)
6D	50,58,36	Red-brown fine to medium sand, trace coarse sand, gravel & silt (SP - SM)
7D	70/100	Red-brown coarse to fine sand, some gravel & silt (SM)
8D	4,7,10	Gray slightly organic plastic clay, trace fine sand (CH)
9D	10,13,13	Gray clayey fine to medium sand, some silt, trace organic (SC - SM)
10D	10,9,13	Top: gray fine to medium sand, trace silt (SP) Bot: gray slightly organic silty clay (OL)
11D	49,99	Orange-brown coarse to fine sand & gravel, some silt (SM &GM)
12D	42,68,62	Light gray medium to fine sand & gravel (SP &GP)
13D	67,70/5"	Light gray coarse to fine sand & gravel (SM)
14D	67,47,29	Tan clayey fine to medium sand trace coarse sand (Cretaceous)(SC)
15D	27,30,43,47	"Do 14D" (SC)
16D	30,35,46	"Do 14D" (SC)
17D	29,39,59	"Do 14D" (Light gray) (SC)
18D	29,50,94	Top: "Do 14D" (SC) Bot: Light gray clayey fine to medium sand, layers of lignite fragments, & organic (SC)
19D	57,70	Light gray fine to medium sand, trace clay (SP-SC)
20D	50,74	Tan medium to fine sand, some clay, layer of red brown fine sand (SC)
21D	61,56,92	Light gray medium to fine sand, trace clay & gravel (SP & SC)

Strata: MEDIUM BROWN F SANDY CLAY TRACE ROOTS GRAVEL (FILL) — 9.0'; VERY COMPACT BROWN COARSE TO FINE SAND & GRAVEL BECOMES COARSER WITH DEPTH, FREQUENT GRAVEL BETWEEN 15' & 24' — 34.0'; VERY STIFF SLIGHTLY ORGANIC CLAY — 38.0'; MED CPT GRAY FINE TO MEDIUM SAND, TRACE TO SOME SILT — 46.0'; 48.0'; VERY COMPACT BROWN & GRAY COARSE TO FINE SAND & GRAVEL — 65.0'; VERY COMPACT LIGHT GRAY TO TAN MEDIUM TO FINE SAND, SOME CLAY, TRACE GRAVEL — 101.5'

BORING NUMBER L-4
Ground surface elevation +11.9

Sample	Penetration	Description
		Asphalt pavement
1D	6,3,4	Gray fine to medium sandy clay (Fill) (CL)
2D	9,6,7	Light gray coarse to medium sand, some gravel (SP)
3D	3,3,4	Top: Orange-brown oxidized medium to fine sandy clay, some gravel (CL) Bot: Gray silty clay (CL)
4D	3,3,3	Gray silty clay (CL)
5D	21,21,19	Light gray silty medium to fine sand, some gravel (SP)
6D	7,10,15	Orange-brown medium to fine sand, trace gravel (SP)
7D	6,9,11	Do. 6D (SP)-(SM)
8D	19*,26*,16*	Light brown coarse to medium sand & gravel (GP)-(GM)
9D	9,7,13	Light gray to gray-brown clayey fine sand (SC-SM)
10D	11,14,16	Gray-green silty clay (Weathered Cretaceous) (CL)
11D	20,31,33	Top: Gray-green f sandy clay & lignite (CL) Bot: Gray-green clayey medium to fine sand (SC)
12D	27,55,44	Green-gray clayey fine sand (SC)
13D	21,33,39	Do, 12D (SC)
14D	34,45,56	Do, 12D (SC)
15D	29,36,49	Do, 12D (SC)
16D	16,42,47	Do, 12D (SC)

Strata: 0.5'; GREEN SANDY CLAY, FILL — 6.0'; LIGHT GRAY COARSE TO MEDIUM SAND — 13.0'; ORANGE-BROWN TO GRAY SILTY CLAY — 21.5'; GRAY TO BROWN MEDIUM TO FINE SAND, TRACE SILT AND GRAVEL — 40.0'; C-M SAND & GRAVEL — 44.5'; LT GRAY F-M SAND — 48.0'; GRAY-GREEN SILTY OR SANDY CLAY — 58.0'; GREEN-GRAY CLAYEY FINE SAND — 78.0'

Boring started 5-11-70, completed 5-12-70
Final depths:
Boring = 78.0' Casing = 55.0'
Casing diameter = 2-1/2"
Average depth of ground water = 16.0' = El.-4.1

REMARKS:
6" Asphalt pavement at surface.
Sampler blows for Sample 8D are with 300 lb. hammer falling 18".
Observation well consisting of 1/2" steel pipe installed with tip at 65' depth.

(L-3) Boring started 5-11-70, completed 5-12-70
Final depths:
Boring = 101.5' Casing = none
Casing diameter = none
Average depth of ground water = 8.0' = El.+16.9

REMARKS:
Drilling mud used to maintain hole open.
Observation well consisting of 1-1/2" steel pipe installed with tip at 84.0' depth. Measured ground water level is probably inaccurate because observation well is clogged with drilling mud.
Some gravel noted between 17' to 18'; 23' to 24'; 37'; 48' to 48.5'; and 52' to 53' depth.

*INDICATES SAMPLER DRIVEN WITH 300LB. HAMMER

DEPTH BELOW GROUND SURFACE, FEET

LEGEND FOR L-SERIES BORING LOGS

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

Ⓐ = DEPTH BELOW GROUND SURFACE IN FEET.

Ⓑ = NUMBER OF BLOWS OF 300 LB. HAMMER FALLING 18" REQUIRED TO DRIVE CASING OF THE SIZE NOTED ONE FOOT.

Ⓒ = NUMBER AND TYPE OF SAMPLE:
SUFFIX "D" = DRY SAMPLE TAKEN WITH 2" OD SPLIT SPOON;
SUFFIX "S" = SHELBY SAMPLE TAKEN WITH 2" OD THIN TUBE;
SUFFIX "R" = DRY SAMPLE TAKEN IN OPEN END DRILL ROD;
SUFFIX "U" = UNDISTURBED SAMPLE TAKEN WITH 3" OD THIN TUBE USING PISTON SAMPLER;
SUFFIX "UD" = 3" OD THIN TUBE SAMPLE DISTURBED IN SAMPLING;
NR = SAMPLE ATTEMPTED BUT NOT RECOVERED;
SUFFIX "C" = ROCK CORE RUN USING NX SIZE DOUBLE TUBE DIAMOND CORE BARREL;
CORE = CORING IN OVERBURDEN OR CORING IN BEDROCK WITH SAWTOOTH BIT

Ⓓ = SAMPLER PENETRATION RESISTANCE IN BLOWS PER 6" OF DRIVING, EXCEPT WHERE SPECIFIC DISTANCE IS NOTED. SAMPLER DRIVEN WITH 140 LB. HAMMER FALLING 30".
P = THIN TUBE SAMPLER ADVANCED BY PUSHING;
T = THIN TUBE SAMPLER ADVANCED BY TAPPING;
(R SAMPLES DRIVEN WITH 300 LB. HAMMER FALLING 18")
78/25 — LENGTH OF ROCK CORE RECOVERY EXPRESSED AS A PERCENT OF LENGTH OF CORE RUN. ROCK QUALITY DESIGNATION, R.Q.D. IN PER CENT.

Ⓔ = DESCRIPTION OF INDIVIDUAL SOIL SAMPLE, INCLUDING UNIFIED SOIL CLASSIFICATION SYMBOL, OR DESCRIPTION OF INDIVIDUAL ROCK CORE RUN.

Ⓕ = DESCRIPTION OF PRINCIPAL SOIL STRATA OR PRINCIPAL DIVISIONS OF BEDROCK. STRATA DIVISION LINES ARE NOTED WITH DEPTH BELOW GROUND SURFACE.

NOTES FOR L-SERIES BORING LOGS

1. BORINGS NOS. L-1 TO L-15 WERE MADE BY WARREN GEORGE, INC. FROM APRIL 27 TO MAY 13,1970 UNDER THE SUPERVISION OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON.

   BORINGS NOS. L-16 TO L-37A WERE MADE BY SPRAGUE & HENWOOD, INC. FROM SEPTEMBER 8 TO NOVEMBER 2,1970 UNDER THE SUPERVISION OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON.
2. FOR BORING LOCATIONS SEE DRAWING NO. F-L-2.
3. FOR GENERAL NOTES SEE DRAWING NO. F-L-1.
4. THE DEGREE OF CONSISTENCY OR COMPACTNESS OF SAMPLES ARE NOT GIVEN IN THE BORING LOG DESCRIPTIONS BUT ARE INDICATED BY THE FOLLOWING VALUES OF STANDARD SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT:

FINE GRAINED SOILS, SILTS AND CLAYS:

LESS THAN 2 BPF	=	VERY SOFT
2 TO 4 BPF	=	SOFT
4 TO 8 BPF	=	MEDIUM STIFF
8 TO 15 BPF	=	STIFF
15 TO 30 BPF	=	VERY STIFF
GREATER THAN 30	=	HARD

COARSE GRAINED SOILS, SANDS AND GRAVELS:

LESS THAN 4 BPF	=	VERY LOOSE
4 TO 10 BPF	=	LOOSE
10 TO 30 BPF	=	MEDIUM COMPACT
30 TO 50 BPF	=	COMPACT
GREATER THAN 50	=	VERY COMPACT

5. ABBREVIATIONS:

COLOR		MATERIAL TYPE	
BLACK:	blk	CLAY:	cl
BROWN:	brn	GRAVEL:	gvl
DARK:	dk	SAND:	sd
GRAY:	gry	SILT:	si
GREEN:	grn	SILTY CLAY:	si cl
LIGHT:	lt	DITTO PREVIOUS SAMPLE:	Do
MOTTLED:	mtld	BOTTOM OF SAMPLE:	Bot

GRAIN SIZE		MISCELLANEOUS	
COARSE:	c	FRAGMENTS:	fgmt
COARSE TO FINE:	c-f	LAYER:	lyr
COARSE TO MEDIUM:	c-m	MATERIAL:	mtl
FINE:	f	MATTER:	mat
FINE TO COARSE:	f-c	MEDIUM (CONSISTENCY):	med
FINE TO MEDIUM:	f-m	OCCASIONAL:	occ
MEDIUM:	m	POCKET:	pkt
MEDIUM TO COARSE:	m-c	ROCK QUALITY DESIGNATION:	RQD
MEDIUM TO FINE:	m-f	SLIGHTLY:	sl
		SOME:	sm
		TRACE:	tr
		VEGETAL:	veg
		WITH:	w/

		REFERENCE DRAWINGS		REVISIONS		
		NUMBER	DESCRIPTION	DATE	BY	DESCRIPTION
SIGNED	DATE	F-L-1	General Notes			
DRAWN VW & AR	12-70	F-L-2	Boring Locations			
CHECKED SLT & JPG	1-71					
APPROVED	DATE					

DISTRICT OF COLUMBIA — WILLIAM H. MUESER — 4070 — REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER • RUTLEDGE • WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK 17, N.Y.
SUBMITTED William H. Mueser

DE LEUW, CATHER & COMPANY — GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES — GENERAL ARCHITECTURAL CONSULTANT
APPROVED

L'ENFANT - PENTAGON RIVER CROSSING ROUTE
LOGS OF L-SERIES BORINGS, Nos. L-1 TO L-4

SCALE VERT. 0 3' 6' 12'
DRAWING NO. F-L-14

APPENDIX 2
SCHNABEL ENGINEERING, LLC
Sheet: 59/91

BORING NUMBER L-5
Ground surface elevation -22.1

Sample	Blows	Description	Stratum
1D	WR	Very soft gray organic silty clay (OH)	VERY SOFT ORGANIC SILTY CLAY
2D	WR	Do, 1D (OH)	8.5'
3SD	P	Do, 1D, medium soft (OH)	MEDIUM STIFF DARK GRAY-BROWN ORGANIC SILTY CLAY, BE-COMMING STIFFER WITH DEPTH, OCCA-SIONAL SMALL POCKETS OF SAND AND LENSES OF ORGANIC MATTER
4S	P	Do, 3SD (OH)	
5S	P	Do, 3SD (OH)	
6SD	P	Medium gray-brown organic silty clay with layers of sand & lenses of organic materials (OH)	
7D	3,1,1	Do, 6SD (OH)	
8SD	P	Do 6SD, with some large gravel (OH)	
9S	P	Do, 6SD (OH)	
10S	P	Do, 6SD (OH)	
11S	P	Do, 6SD (OH)	47.0'
12D	100/6"	Gray coarse sand & gravel (SP & GP)	V COMP SAND AND GRAVEL 52.0'
13D	11,20 21	Gray-green clayey fine sand (Cretaceous) (SC)	COMPACT CLAYEY FINE SAND
14SD	P	Do, 13D, with some gravel (SC)	56.2'

Boring started 4-27-70, completed 4-28-70
Final depths:
Boring = 56.2' Casing = 56.0'
Casing diameter = 3-1/2"
Average depth of ground water = —— = El.+0 (Open water)
REMARKS:
Boring made in open water.
Casing went down under its own weight from 0 to 9' depth.

BORING NUMBER L-6
Ground surface elevation -23.0

Sample	Blows	Description	Stratum
1D	WR	Very soft dark gray organic silty clay (OH)	SOFT GRAY ORGANIC SILT SOME CLAY
2D	WR	"Do 1D" (OH)	8.0'
3S	P	Soft dark Gray Brown organic silty clay, trace sand (OH)	SOFT TO MEDIUM STIFF DARK GRAY BROWN ORGANIC SILTY CLAY - BECOMING STIFFER WITH DEPTH
4D	P	Medium "Do 2D" (OH)	
5S	P	"Do 3S" (OH) more plastic	
6S	P	"Do 3S" (OH)	
7S	P	"Do 3S" (OH)	
8S	P	"Do 3S" (OH)	
9S	P	"Do 3S" (OH)	
10S	P	"Do 3S" (OH)	
11D	1,1,1	"Do 4D (OH) Trace dec. wood	
12D	2,2,2	"Do 4D" (OH)	
13D	4,18, 23	Top "Do 4D" (OH) Bottom: Gray coarse sand & gravel (SP) & (GP)	61.0' SAND & GRAVEL 63.5
14D	24,39 42	Light gray clayey fine to medium sand with pockets of gray green clayey silt (Cretaceous) (SC)	VERY COMPACT GRAY GREEN CLAYEY SAND GRAVEL INCREAS-ING W/ DEPTH
15D	28,42 60	"Do 14D" with trace gvl (SC)	
16D	87,85 50	Gray green clayey sand Some gravel (SC)	76.5'

Boring started 4-29-70, completed 4-30-70
Final depths:
Boring = 76.5' Casing = 65.0'
Casing diameter = 3-1/2"
Average depth of ground water = —— = El.+0 (Open water)
REMARKS:
Boring made in open water.
Hole washed ahead of casing to 60' depth and driven from 60' to 65' depth.

BORING NUMBER L-7U
Ground surface elevation -23.0

Sample	Blows	Description	Stratum
1D	WR	Very soft dark gray organic silty clay (OH)	VERY SOFT DARK GRAY ORGANIC SILTY CLAY 9.0'
2D	WR	"Do 1D" (OH)	
3U	P	Gray-brown organic silty clay. Trace of fine sand (OH)	SOFT TO MEDIUM STIFF DARK GRAY-BROWN ORGANIC SILTY CLAY WITH TRACE OF FINE SAND & OCC WOOD FGMTS. CONSIS-TENCY INCR. WITH DEPTH
4UD	P	"Do 3U" (OH)	
5U	P	"Do 3U" (OH)	
6U	P	"Do 3U" (OH)	
7U	P	"Do 3U" (OH)	
8U	P	"Do 3U" (OH)	
9U	P	"Do 3U" (OH)	
10UD	P	"Do 3U" (OH)	
11U	P	"Do 3U" (OH)	
12U	P	"Do 3U" (OH)	
13U	P	Gray silty clay with trace of fine sand moderately organic (OH)	
14D	P	Medium dark gray organic silty clay, tr fine sand (OH)	67.5'
15D	30,38 60	Light gray-green clayey medium fine sand, trace to some gravel, (Cretaceous) (SC)	VERY COMPACT FINE TO MEDIUM SAND SOME CLAY, TRACE GRAVEL
16D	34,82 97	Light gray green medium - fine sand, trace-some clay trace small gravel (SP) & (SC)	76.5'

Boring started 5-11-70, completed 5-12-70
Final depths:
Boring = 76.5' Casing = 10.0'
Casing diameter = 4'
Average depth of ground water = —— = El.+
REMARKS:
Boring made in open water.
Casing went down under its own weight from 0 to 9'.
Hole washed with chopping bit and jet auger from 10' to 75' depth.

BORING NUMBER L-8
Ground surface elevation -22.3

Sample	Blows	Description	Stratum
1D	WR	Very soft dark gray organic silty clay (OH)	SOFT ORGANIC CLAY 4.0'
2D	P	Soft dark gray-brown organic silty clay (OH)	SOFT TO MEDIUM STIFF DARK GRAY-BROWN ORGANIC SILTY CLAY WITH TRACE FINE SAND, CONSIS-TENCY INCREAS-ING WITH DEPTH
3D	P	"Do 2D" (OH)	
4D	P	"Do 2D" (OH)	
5D	P	"Do 2D" (OH)	
6D	P	"Do 2D" (OH)	
7D	P	"Do 2D" (OH)	
8D	P	"Do 2D" (OH)	
9D	P	"Do 2D" (OH)	
10D	P	"Do 2D" (OH)	
11D	P	"Do 2D" (OH)	
12D	P	"Do 2D" (OH)	
13D	P	"Do 2D" (OH)	64.8'
14D	6,6,6	Top 3" "Do 2D" (OH) Bot: Gray medium sand, trace gravel (SP)	MEDIUM SAND 67.0'
15D	8,16, 32	Gray-brown gravel & coarse sand with lenses of silty clay (SM & GP)	GVL & COARSE SAND 73.0'
16D	6,9, 128	Gray-green clayey sand with some small gravel, (Cretaceous) (SC & GC)	GREEN CLAYEY SAND 76.5'

Boring started 5-7-70, completed 5-8-70
Final depths:
Boring = 76.5' Casing = 74'
Casing diameter = 4" & 3-1/2"
Average depth of ground water = —— = El.+0 (Open water)
REMARKS:
Boring made in open water.
Washed ahead of casing from 10' to 70' depth and casing driven from 70' to 74' depth.

BORING NUMBER L-9U
Ground surface elevation -19.0

Sample	Blows	Description	Stratum
1D	WR	Very soft dark gray organic silty clay (OH)	VERY SOFT ORGANIC SILTY CLAY 9.0'
2D	P	"Do 1D" (OH)	
3D	P	Soft dark gray-brown organic silty clay, trace fine sand (OH)	SOFT TO MEDIUM STIFF DARK GRAY-BROWN ORGANIC SILTY CLAY, BECOMMING STIFFER AND SANDIER WITH DEPTH
4U	P	"Do 3D" (OH)	
5U	P	"Do 3D" (OH)	
6U	P	"Do 3D" (OH)	
7U	P	"Do 3D" (OH)	
8U	P	"Do 3D" (OH)	
9U	P	"Do 3D" (OH)	
10U	P	"Do 3U" (OH)	
11U	P	"Do 3D" Gray, silty, stiffer (OH)	56.0'
12U	P	Gray-brown organic silty clay. Some sand pockets, trace gravel (OH)	GRAY-BROWN SILTY CLAY WITH POCKETS OF SAND, LENSES OF DEC. WOOD 67.0'
13D	3,3,3	Gray-Brown organic silty clay. Some sand pockets; layers of decayed wood (OH)	
14U	P	Gray-Brown organic silty clay with some sand pockets (OH)	
15D	12,8, 7	Gravel and brown silty clay (GC) & (OH)	GRAVEL, ROCK FGMTS. & SILTY CLAY 75.0'
16D	81,94 163	Light Gray fine to medium sand, trace-some clay, trace gravel (SC)	VERY COMPACT GREEN & GRAY-GREEN CLAYEY SAND
17D	8,14, 18	Light Gray-Green coarse sand & gravel, trace clay & silt (Partly washed) (SP-SC)	
18D	20, 32,50	Green clayey fine to medium sand, trace small gravel (SC)	85.5'

Boring started 5-5-70, completed 5-7-70
Final depths:
Boring = 85.5' Casing = 82.0'
Casing diameter = 4-1/2" & 3-1/2"
Average depth of ground water = —— = El.+0 (Open water)
REMARKS:
Boring made in open water.
Casing lowered in mud and pushed to 9' depth.
Washed ahead of casing from 10' to 67' depth.
Drilling mud used to maintain open hole from 67' to 74' depth. Casing lowered in hole from 74' to 84' depth.
Probable small boulders at 73' depth.

BORING NUMBER L-10
Ground surface elevation -18.2

Sample	Blows	Description	Stratum
1D	WR	Very soft, dark gray organic silty clay (OH)	VERY SOFT DARK GRAY ORGANIC SILTY CLAY
2D	WR	"Do 1D" (OH)	9.0'
3S	P	Gray-brown organic silty clay, trace sand (OH)	SOFT TO MEDIUM STIFF DARK GRAY-BROWN ORGANIC SILTY CLAY WITH OCCAS-IONAL SAND POCKETS & TRACE OF WOOD CONSIS-TENCY INCREAS-ING WITH DEPTH
4S	P	"Do 3S" (OH)	
5S	P	"Do 3S" (OH)	
6D	1,1,1	Medium dark gray organic silty clay (OH)	
7D	1,1,1	"Do 6D" (OH)	
8S	P	"Do 6D" (OH)	
9D	P	"Do 6D" (OH)	
10D	2,2,3	"Do 6D" (OH)	
11SD	P	"Do 6D" (OH)	
12D	2,2,4	"Do 6D" (OH)	
13D	2,2,3	"Do 6D" (OH)	
14D	3,7,9	Gray-brown organic silty clay with layers of sand (OH & SP)	
15D	5,6,10	Medium dark gray organic silty clay, trace fine sand layers (OH)	75.0'
16D	21,22 24	Top: "Do 15D" trace gravel (OH) Bot: Gray coarse sand & gravel with some clay lenses (SC)	VERY COM-PACT C. SAND & GVL W/ CLAY LENSES
17D	85,43 42	Coarse sand & gravel (partly wash) (GP) & (SP)	82.5'

Boring started 4-30-70, completed 5-4-70
Final depths:
Boring = 82.5' Casing = 81.0'
Casing diameter = 3-1/2"
Average depth of ground water = —— = El.+0 (Open water)
REMARKS:
Boring made in open water.
Hole washed ahead of casing from 11' to 56' depth.
Casing driven from 56' to 81' depth.

		REFERENCE DRAWINGS		REVISIONS		
DESIGNED		NUMBER	DESCRIPTION	DATE	BY	DESCRIPTION
DRAWN VW & AR	DATE 12-70	F-L-14	Notes and Legend			
CHECKED SLT & JPG	DATE 1-71					
APPROVED	DATE					

DISTRICT OF COLUMBIA WILLIAM H. MUESER 4070 REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER • RUTLEDGE • WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK 17, N. Y.
SUBMITTED William H. Mueser

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APPROVED

L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
LOGS OF L-SERIES BORINGS, Nos. L-5 TO L-10

SCALE VERT. 0 3' 6' 12'
DRAWING NO. F-L-15

BORING NUMBER L-11
Ground surface elevation +6.2

Depth (ft)	Casing blows	Sample	Blows	Description	Stratum
0–5	3, 5, 5, 7, 7	1D	3,3,3	Dark brown silty clay, trace partly decomposed wood & vegetation, ashes (Fill) (CL)	FILL 6.0'
5–10	4, 2, 2, 3, 3	2D	1,1,1	Dark brown silty clay, trace decomposed vegetation, thin layer of fine sand fill at top, oxidized at bottom (CL)	
10–15	2, 3, 3, 4, 7	3D	1,1,1	Olive-brown plastic clay, slightly organic (CH)	
15–20	2, 2, 3, 4, 4	4D	WR	Do, 3D, thin layers of clayey sand (CH)	
20–25	4, 2, 3, 4, 4	5D	2,3,3	Dark gray clay, some fine sand, trace organic material & decomposed wood (CH)	
25–30	4, 5, 5, 5, 5	6D	1,1,1	Dark gray organic silty clay with thin layers of sand (OH)	DARK BROWN TO DARK GRAY SLIGHTLY ORGANIC SILTY CLAY, BE-COMMING MORE ORGANIC WITH DEPTH WITH THIN LAYER OF FINE SAND OR THICKER LAYER OF DARK GRAY CLAYEY SAND AND LAYER OF DECOM-POSED VETETA-TION
30–35	3, 5, 5, 5, 7	7D	1,1,1	Do, 6D, some fine sand (OL)	
35–40	9, 11, 14, 14, 22	8D	2,3,3	Dark gray fine to medium sand, some silt & gray organic silty clay layers (OL & SM)	
40		9D	3,2,4	Dark gray highly organic silty clay & dark gray clayey sand (OH & SC)	
45		10D	2,2,3	Dark gray organic silty clay, trace sand & decomposed vegetation(OH)	
50		11D	2,2,2	Do, 10D (OH)	
55		12D	2,2,2	Do, 10D (OH)	
60		13D	3,2,3	Dark gray organic silty clay, trace silt & fine sand (OH)	
65		14D	3,3,3	Do, 13D (OH)	
70		15D	2,3,2	Do, 13D (OH)	
75		16D	3,3,3	Do, 13D (OH)	
80		17D	4,4,4	Dark gray organic clay with thin fine sand layers (OH)	
85		18D	8,6,8	Layers of dark gray clayey sand, organic silty clay & decomposed vegetation (SC & OH)	
90		19D	6,5,6	Organic silty clay, some clayey fine sand layers (OH & SC)	
95		20D	11,9, 9	Dark gray fine to medium sand with some clay layers, trace gravel (SP-SM)	97.0'
100		21D	20,36 20	Do, 20D, some gravel (SP-SC)	GRAY SAND SM CLAY LAYERS & GRAVEL 103.0'

CONTINUED →

BORING NUMBER L-11 Cont'd.

Depth (ft)	Sample	Blows	Description	Stratum
105	22D	35,42 40	Layers of fine sandy clay (Cretaceous) (CL)	LAYERS OF GRAY FINE SANDY CLAY AND GREEN CLAYEY SAND
110	23D	37,56 75	Top: Do, 22D (CL) Bot: Green clay, trace fine sand pockets (CH)	111.5'

Boring started 5-7-70, completed 5-8-70
Final depths:
Boring = 111.5' Casing = 103'
Casing diameter = 2-1/2'
Average depth of ground water = 3.0' = El.+3.2

REMARKS:
Hole washed ahead of casing to 95' depth.
Hole caved in at 95' depth and casing lowered in hole and driven. blows not recorded.
Observation well consisting of 1/2" steel pipe installed with tip at 45' depth.
Strong discharge of methane gas noted in this hole below 90' depth.

BORING NUMBER L-12
Ground surface elevation +7.6

Depth (ft)	Sample	Blows	Description	Stratum
0	1D	2,3,3	Dark brown to brown silty clay, partly decomposed vegetation (Fill) (CL)	FILL
5	2D	1,2,3	Dark gray silty clay with thin layers of silty fine sand, trace decomposed vegetation (Probable Fill) (CL)	7.0'
10	3D	3,6,9	Dark gray partly organic silty clay with thin layer of fine sand & trace decomposed vegetation, slightly oxidized (OH)	
15	4D	6,6, 11	Do, 3D (OH)	
20	5D	3,4,7	Do, 3D (OH)	
25	6D	WR	Dark gray organic silty clay, thin layer of fine sand (OH)	
30	7S	P	Do, 6D (OH)	
32	8D	4,5,5	Do, 6D (OH)	DARK GRAY SILTY CLAY, PARTLY ORGANIC AT TOP, INCREAS-INGLY ORGANIC WITH DEPTH, WITH THIN LAYERS OF FINE SAND OR CLAYEY SAND AND OCCA-SIONAL LAYERS OF DECOM-POSED VEGETA-TION
40	9D	P	Do, 6D (OH)	
45	10D	P	Do, 6D, some fine sand (OH)	
50	11D	P	Dark gray organic silty clay & dark gray clayey sand & layer of decomposed vegetation & wood (OH & SC)	
52	12S	P	Dark gray organic clay (OH)	
55	13D	4,6,8	Dark gray organic clay & layers of decomposed vegetation (OH)	
60	14D	5,5,9	Do, 13D (OH)	
65	15D	4,7,6	Dark gray organic clay varved with thin layer of dark brown silty clay (OH)	
70	16D	6,9,9	Dark gray organic clay, thin layer of fine sand (OH)	
75	17D	7,7, 11	Do, 16D (OH)	
80	18D	5,7,9	Dark gray organic clay, trace fine to medium sand with some clay, layers of decomposed vegetation (OH)	
85	19D	6,8,8	Dark gray organic clay & layer of decomposed vegetation (OH)	
90	20D	7,6,9	Do, 19D (OH)	
95	21D	8,11, 13	Do, 19D (OH)	
100	22D	7,9,9	Dark gray organic silty clay some fine sand, with layers of decomposed vegetation (OH)	103.0'

← CONTINUED

BORING NUMBER L-12 Cont'd.

Depth (ft)	Sample	Blows	Description	Stratum
105	NR	140/0"	Probably some cobbles & small boulders	COBBLES & SMALL BOULDERS IN A MATRIX OF ORGANIC SILTY CLAY 113.0'
110	23D	56,61 69	Dark gray organic silty clay & some gravel (OH)	
115	24D	42,53 57	Mottled gray-green fine sandy clay (Cretaceous) (CL)	GRAY-GREEN FINE SANDY CLAY
120	25D	60,68 50/0"	Do, 24D (CL)	121.0'

Boring started 5-7-70, completed 5-7-70
Final depths:
Boring = 121.0' Casing = none
Casing diameter = none
Average depth of ground water = —— = El.+

REMARKS:
Drilling mud used to maintain hole open.
No measurement of ground water level made in this hole.
Numerous small boulders and cobbles encountered between 103' and 113' depth.

BORING NUMBER L-13
Ground surface elevation +10.0

Depth (ft)	Casing blows	Sample	Blows	Description	Stratum
0–5	5, 11, 12, 10, 14	1D	3,2,3	Brown silty clay with trace of fine sand & organic material. Roots (Fill) (CL)	BROWN CLAY, TRACE OF FINE SAND FILL 6.0'
5–10	9, 14, 16, 16, 18	2D	3,4,4	"Do 1D" & dark gray slightly organic silty clay	
10–15	11, 13, 14, 12, 13	3D	2,1,2	Dark gray slightly organic silty clay with thin layer of sand (CH)	
15–20	8, 8, 10, 10, 10	4D	P	"Do 3D" (CH)	
20–25	8, 5, 8, 8, 10	5D	P	Dark brown organic silty clay, trace shells & layers of clayey sand, trace dec. vegetation(OH)	
25–30	10, 16, 10, 9, 8	6D	P	"Do 5D" (OH)	
30–35	8, 8, 8, 12, 13	7D	P	"Do 5D" (OH)	
35–40	13, 15, 15, 16, 27	8D	5,5,8	Medium dark gray organic silty clay, some clayey fine sand (OH & SC)	DARK GRAY OR DARK BROWN SLIGHTLY ORGANIC SILTY CLAY, BECOMING MORE ORGANIC WITH DEPTH WITH LAYERS OF CL FINE TO MEDIUM SAND WITH SOME CLAY & DEC. VEG.
40–45	12, 12, 10, 16, 17	9D	1,3,3	Dark gray organic silty clay, trace fine sand (OH)	
45–50	10, 10, 14, 12, 12	10D	3,3,4	Dark gray organic clay & fine to medium sand with some clay. Thin layer of decomposed vegetation (OH & SC)	
50–55	16, 12, 12, 14, 16	11D	2,2,4	Dark gray organic silty clay. Trace decomposed vegetation (OH)	
55–60	16, 18, 20, 19, 20	12D	3,3,4	"Do 11D" Layers of decayed vegetation. (OH)	
60–65	16, 19, 19, 20, 20	13S	P	Top: Dark gray organic clay (OH) Bot: Brown clayey sand (SC)	
65–70	16, 20, 20, 20, 19	14S	P	Dark gray organic clay (OH)	
		15S	P	"Do 14S" (OH)	
70–75	20, 21, 23, 22, 22	16S	P	"Do 14S" (OH)	
		17D	5,5,6	Dark gray organic clay with layers of decomposed vegetation (OH)	
75–80	19, 16, 22, 27, 30	18S	P	"Do 17D" (OH)	
80–85	20, 27, 29, 32, 35				
85–90	26, 32, 37, 42, 57	19S	P	"Do 17D" (OH)	
		20S	P	"Do 17D" (OH)	
90–95	52, 60, 60, 69, 165	21D	8,8,10	Dark gray organic clay & layers of decomposed vegetation. Thin layers of fine to medium sand (OH & SP) Cobble or boulder at 93'	92.5'
95–100	197, 210, 276, 270, 282				CRETA-CEOUS CLAY & SAND
100		22D	26,35 52	Gray silty clay (CL)	101.5'

Boring started 5-11-70, completed 5-13-70
Final depths:
Boring = 101.5' Casing = 100.0'
Casing diameter = 2-1/2"
Average depth of ground water = —— = El.+ ——

REMARKS:
Cobble or boulder encountered at 93' depth.
No measurement of ground water made in this hole.

BORING NUMBER L-14U
Ground surface elevation +12.6

Depth (ft)	Sample	Blows	Description	Stratum
0	1D	7,11, 17	Dark gray clayey fine to medium sand, trace gravel (Fill) (SC)	MISC. FILL, SILTY F-M SAND BRICK AND GRAVEL 7.0'
5	2D	9,17, 23	"Do 1D" & brick & gravel (Fill) (SC)	
10	3D	1,1,2	Dark green, slightly organic silty clay. Trace dec veg, tr sand, slightly dried (CH)	
15	4U	P	"Do 3D" (OH) more organic	
22	5U	P	Dark gray organic silty clay (CH)	
30	6D	P	Dark gray silty clay, some fine to medium sand. Trace of shells & organic matter (CL)	
35	7D	13,17, 20	Dark gray silty clay, some Gray fine to medium sand slightly organic (OH)	
40	8D	19,17, 21	Dark gray fine to medium sand with some clay. Trace coarse sand & small gravel (SC)	DARK GRAY ORGANIC SILTY CLAY; BECOMING MORE ORGANIC WITH DEPTH & TRACE LAYERS OF DECAYED VEG. LAYER OF FINE TO MEDIUM SAND WITH SOME CLAY
45	9D	10,13, 19	Dark gray organic clay. Trace fine sand (OH)	
50	10D	9,14, 17	Dark gray organic clay Trace of sand & decayed vegetation (OH)	
55	11D	13,13, 19	Dark gray organic clay. Trace of fine sand & decayed vegetation (OH)	
60	12D	11,17 21	Dark gray organic clay, sm Gray fine to medium sand layers (OH & SP)	
69	13D	7,11, 13	Dark gray organic clay with layer of decayed vegetation & trace of shells - Very thin layers of fine sand (OH)	
72	14U	P	"Do 13D"	

CONTINUED

BORING NUMBER L-14U Cont'd.

Depth (ft)	Sample	Blows	Description	Stratum
76	15U	P	"Do 13D" (OH)	
79	16U	P	"Do 13D" (OH)	
82	17U	P	"Do 13D" (OH)	
85	18U	P	"Do 13D" (OH)	
88	19U	P	Dark gray sandy clay at top. Bottom: dark gray organic clay (OH)	
92	20U	P	Dark gray organic clay (OH)	
95	21D	13,20, 22	Dark gray organic silty clay with layer of decayed vegetation & thin layer of fine sand (OH)	
100	22D	17,24 27	Layer of dark gray organic clay with layers of decayed vegetation & layers of dark gray fine to medium clayey sand. (OH & SC)	102.0'
105	23D	37,48, 64	Mottled green & orange fine to medium clayey sand (Cretaceous)(SC)	MOTTLED GREEN & ORANGE CLAYEY FINE TO MEDIUM SAND
110	24D	150/6"	Do, 23D (SC)	111.0'

Boring started 5-11-70, completed 5-12-70
Final depths:
Boring = 111.0' Casing = none
Casing diameter = none
Average depth of ground water = 11.0' = El.+1.6

REMARKS:
Drilling mud used to maintain hole open.
Observation well consisting of 1-1/2" steel pipe installed with tip at 30' depth.
Undisturbed sample pressed at 28' depth, met very hard resistance, presumably in layer of sand or shells and no penetration was obtained.

DESIGNED		DATE	
DRAWN	VW & AR	DATE	12-70
CHECKED	SLT & JPG	DATE	1-71
APPROVED		DATE	

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-14	Notes and Legend

REVISIONS

DATE	BY	DESCRIPTION

District of Columbia — William H. Mueser — 4070 — Registered Professional Engineer

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

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L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
LOGS OF L-SERIES BORINGS, Nos. L-11 TO L-14U

SCALE VERT. 0 3' 6' 12'
DRAWING NO. F-L-16

BORING NUMBER L-15

Ground surface elevation +9.1

Sample	Blows	Description
1D	4,5,5	Red-brown sandy silt - roots. (Fill) (ML)
2D	6,7,6	Red-brown silty fine sand (Fill) (SM)
3D	P	Dark gray to dark brown slightly organic silty clay with trace of fine sand, slightly dried (CH)
4D	2,3,4	"Do 3D" (CH)
5D	2,2,6	Medium gray organic silty clay (OH)
6S	P	"Do 3D" (OH)
7D	WR	"Do 5D" (OH)
8D	6,8,11	Dark gray sandy clay. Numerous fragments of decayed wood (CL)
9D	8,9,11	Layers of dark gray sandy clay & organic silty clay (CH)
10D	11,14,17	Dark gray sandy clay & decayed wood (OH)
11D	4,7,9	Dark gray organic clay (OH)
12D	4,6,10	Dark gray organic clay - layer of decayed wood and leaves (OH)
13D	4,4,11	"Do 12D" (OH)
14D	6,7,13	"Do 12D" Very thin layers of sand (OH)
15D	9,9,17	"Do 12D" (OH)
16D	5,7,11	"Do 12D" Trace of fine sand (OH)
17D	5,8,7	"DO 12D" with lenses of gray fine to medium sand (OH)
18D	7,11,14	"Do 12D" with layers of gray fine to medium sand (OH)
19D	11,21,33	Dark gray organic clay with decayed vegetation alternating with layers gray fine to medium sand (OH)
20D	13,19,37	Dark gray organic clay & decayed vegetation & thin layer of tan brown sandy clay alternating with layer of gray fine to medium sand (OH)

Strata: SAND & SILT TRACE ROOTS FILL 8.0' — LAYERS OF DARK GRAY ORGANIC CLAY, BECOMING MORE ORGANIC WITH DEPTH & LENSES OF DEC. VEG. ALTERNATED W/ LAYERS OF LENSES OF SANDY CLAY OR SAND & SOME CLAY 91.5'

Boring started 5-8-70, completed 5-11-70
Final depths:
Boring = 91.5' Casing = none
Casing diameter = none
Average depth of ground water = - = El.+ -

REMARKS:
Drilling mud used to maintain hole open.
No measurement of ground water level made in this hole.

BORING NUMBER L-16

Ground surface elevation + 11.7

Blows (casing): 21, 19, 23, 37, 46, 49, 59, 70, 38, 42, 39, 59, 70, 71, 80, 88, 70, 68, 79, 81, 58, 49, 46

Sample	Blows	Description
1D	7,12,16	Red-brown silty clay, trace brick, wood (fill) (CL)
2D	16,21,29	Red-brown fine to medium sand & gravel (probable fill) (GP)
3D	2,3,3	Brown clayey fine to coarse sand, some gravel (probable fill) (SC)
4D	7,7,9	Do 2D (probable fill) (GP)
5D	2,3,4	Dark gray organic silty clay, trace wood & vegetation matter, oxidized (OH)
6S	P	Do 5D (OH)
7S	P	Dark gray silty fine to medium sand, trace clay (SM)
8D	2,4,4	Do 7S, with pocket of clay (SM)
9D	2,4,4	Do 8D (SM)
10S	P	Dark gray organic clayey silt (OL)
11D	2,2,4	Dark gray organic silty clay, numerous wood & vegetation fragments (OH)
12S	P	Organic silty clay lensed with dark gray silty fine sand (OH) & (SM)
13S	P	Dark gray organic silty clay, trace wood fiber (OH)
14D	2,3,4	Do 13S (OH)
15S	P	Do 13 S, layers of vegetation matter, trace fine sand (OH)
16D	2,2,3	Dark gray highly organic silty clay (OH)
17D	3,5,7	Do 16D, numerous fibrous wood fragments (OH)
18D	3,5,6	Do 17D (OH)
19D	7,9,11	Do 17D, layers of vegetation matter, trace fine sand layers (OH)
20D	6,6,8	Do 19D, layer of fibrous wood (OH)
21D	7,6,8	Do 20D (OH)
22D	22,23,27	Top: Gray-green clayey fine to medium sand, trace lignite (SC) Bot: Dark green silty clay, Cretaceous (CL)
23D	17,22,28	Green clayey fine sand (SC)

Strata: CLAY FILL 4.0' — BROWN RED-BROWN CLAYEY FINE TO COARSE SAND, TRACE GRAVEL (PROBABLE FILL) 19.0' — SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE WOOD 27.0' — LOOSE GRAY SILTY FINE TO MEDIUM SAND, TRACE VEG. MATTER 38.0' — SOFT TO MEDIUM STIFF DARK GRAY ORGANIC SILTY CLAY, LAYERS AND POCKETS OF FIBROUS WOOD AND VEGETABLE MATTER, WOOD AND VEGETABLE MATTER INCREASES FROM 70' TO 89' 94.0' — VY CPT GREEN FINE SAND AND CLAY 103.5'

Boring started 9-14-70, completed 9-16-70
Final depths:
Boring = 103.5' Casing = 23.0'
Casing diameter = 4"
Average depth of ground water = 2.0' = El.+9.7
REMARKS:
Drilling mud used to maintain hole open from 23' depth; ground water level is probably inaccurate because of drilling mud.

BORING NUMBER L-17U

Ground surface elevation + 10.8

Blows (casing): 46, 39, 37, 35, 29, 34, 32, 43, 35, 47, 36, 42, 47, 51, 53, 87, 84, 73, 79, 76, 72, 75, 69, 102, 101, 98, 100, 104, 126, 124, 117, 108, 103, 96, 120, 157, 135, 124, 118, 138, 126, 63, 54, 59, 50, 47, 53

Sample	Blows
1D	5,5,6
2D	3,4,3
3D	1,1,1
4U	P
5U	P
6U	P
7D	5,4,3,4
8D	2,4,4
9U	P
10D	2,3,5
11U	P
12D	3,3,4
13UD	P
14D	2,6,6
15U	P
16D	4,6,7
17U	P
18U	P
19U	P
20D	22,43,78/4"
21D	45,71
22D	48,30/3"
23D	37,84
24D	76/6"
25D	40,78
26D	43,75
27D	23,41,57,36
28D	27,46,109

Descriptions:
- Black-brown silty fine sand, trace gravel, some cinder (fill) (SM)
- Top: dark-gray fine to medium sand, trace gravel & silt, cinder (fill) (SP) Bot: Gray slightly organic silty clay, some fine sand (OL)
- Dark gray slightly organic silty clay (OH)
- Do 3D, trace fine sand (OH)
- Do 3D (OH)
- Top: Do 3D (OH) Bot: Gray silty fine sand (SM)
- Gray organic silty fine sand, trace of wood fibers (SM)
- Do 7D (SM)
- Do 7D with pockets of organic silt (SM)
- Dark gray organic silty clay, trace of wood fragments & vegetation matter (OH)
- Dark gray organic silty clay, trace vegetation matter (OH)
- Do 11U, layer of vegetation matter (OH)
- Top: Do 12D (top 3")(OH) Bot: Gray fine to medium sand, trace gravel (SP)
- Top: Dark gray organic silty clay (OH) Bot: Gray medium to fine sand, trace silt (SP)
- Layered organic silty clay & fine sand (OH) & (SM)
- Do 14D top (OH)
- Dark gray fine sandy org. clay, trace wood fragments (OH)
- Do 17U (OH)
- Do 17 U (OH)
- Gray-green clayey fine to medium sand, Cretaceous (SC)
- Hard green-gray plastic clay (CH)
- Do 21D (CH)
- Stiff gray silty clay (CL)
- Slightly greenish-gray fine to coarse sand, trace silt (SP)
- Stiff green-gray plastic clay (CH)
- Do 25D (CH)
- Dark green fine sandy clay (CL)
- Do 27D (CL)

Strata: MED CPT SILTY FINE SAND & CINDER FILL 6.0' — SOFT TO MEDIUM STIFF DARK GRAY ORGANIC SILTY CLAY, TRACE VEG. MATTER 18.0' — LOOSE SLIGHTLY ORGANIC SILTY FINE SAND WITH FIBROUS WOOD & VEGETATION MATTER BETWEEN 30' TO 34.0' 34.0' — SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE LAYER OF VEG. FIBERS 43.0' — LOOSE GRY F - M SA WITH LYRS OF SILTY CL 51.0' — MEDIUM STIFF GRAY FINE SANDY/ SILTY ORGANIC CLAY, LYR OF WOOD 62.5' — SAND & GRAVEL 65.0' — HARD GRAY-GREEN SILTY CLAY TO PLASTIC CLAY WITH SAND POCKETS 106.5'

Boring started 9-14-70, completed 9-17-70
Final depths:
Boring = 106.5' Casing = 52.0'
Casing diameter = 4"
Average depth of ground water = 10.4' = El.+0.4
REMARKS:
Observation well consisting of 1" steel pipe installed with tip at 42' depth.
Drilling mud used to maintain hole open below 70' depth.

BORING NUMBER L-18

Ground surface elevation + 9.3

Blows (casing): 7, 92, 97, 102, 121, 149, 49, 36, 30, 29, 2, 50, 21, 23, 35, 118, 161, 217, 34, 21, 16, 17, 12

Sample	Blows	Description
1D	3,12,24	Brown silty fine sand, roots (fill) (SM)
2D	23,13,7	Do 1D, trace brick fragments (fill) (SM)
3D	45,4,4	Gray clayey fine sand, trace gravel (probable fill) (SC)
4D	13,30,23	Dark gray organic silty clay, some gravel (OH)
5D	12,7,4	Top: Gray fine to medium sand, trace silt (SP - SM) Bot: Dark gray slightly organic silty clay, trace wood fragments trace fine sand (OH)
6D	4,4,7	Do 5D (OH)
7S	P	Gray silty fine sand, trace organic (SM)
8D	6,3,4	Dark gray organic clayey fine sand (SM)&(OL)
9SD	P	Do 8D (OL)
10D	7,4,5	Dark gray organic silty clay, trace gravel (OH)
11S	P	Dark gray organic clay, wood & peat (OH)
12S	P	Do 11S (OH)
13S	P	Dark gray organic silty clay (OH)
14S	P	Gray slightly organic clayey silt, trace fine sand (OL)
15D	3,4,6	Medium dark gray organic silty clay, some fine sand & decomposed wood (OH)
16D	56/5"	Gray clayey medium to fine sand, some gravel & coarse sand (SC)
17D	27,54	Gray-green clayey fine to medium sand, Cretaceous (SC)
18D	16,28,42	Gray-green silty clay (CH)
19D	13,25,32	Dark gray fine sandy silt & Lignite (ML)
20D	53/6"	Gray clayey fine to coarse sand (SC)
21D	55/5"	Green clayey fine sand (SC)
22D	25,45	Green clayey fine to medium sand with some clay pockets (SC)&(CL)

Strata: MEDIUM COMPACT TO COMPACT BROWN SILTY FINE SAND & CLAYEY FINE SAND, SOME BRICKS & GRAVEL (FILL) 14.0' — SOFT TO MEDIUM STIFF ORGANIC SILTY CLAY, TRACE WOOD 24.5' — MED CPT GRY SILTY F SA 29.0' — SOFT TO MEDIUM STIFF DARK GRAY ORGANIC SILTY CLAY WITH LAYERS OF WOOD FIBERS 63.0' — SAND & GRAVEL 67.0' — VY CPT GRAY-GREEN CLAYEY F - M SAND, TURNING TO HARD CL AT 74.0' 79.0' — SANDY SILT 82.5' — VERY COMPACT GRAY-GREEN CLAYEY FINE SAND 96.0'

Boring started 9-8-70, completed 9-11-70
Final depths:
Boring = 96.0' Casing = 23.0'
Casing diameter = 4"
Average depth of ground water = 9.5' = El.-0.2
REMARKS:
Drilling mud used to maintain open hole from 7.5' depth; casing lowered in drilled hole.
Loss of drilling mud noted from 11.5' to 14.5' depth.
Ground water level may not be accurate due to use of drilling mud.

SIGNED		DATE
DRAWN	VW & AR	12-70
CHECKED	SLT & JPG	1-71
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-14	Notes and Legend

REVISIONS

DATE	BY	DESCRIPTION

DISTRICT OF COLUMBIA · WILLIAM H. MUESER · 4070 · REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER · RUTLEDGE · WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK 17, N.Y.
SUBMITTED William H. Mueser

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
APPROVED

L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
LOGS OF L-SERIES BORINGS, Nos. L-15 TO L-18

SCALE VERT. 0 3' 6' 12'
DRAWING NO. F-L-17

BORING NUMBER L-19
Ground surface elevation – 4.0

Sample	Blows	Description	Stratum
1D	P	Soft dark gray-brown organic silty clay, trace fine sand & vegetation (OH)	SOFT DARK GRAY & GRAY-BROWN ORGANIC SILTY CLAY WITH OCCASIONAL LAYERS OR LENSES OF SAND & SCATTERED PARTLY DECOMPOSED VEGETATION (RIVER ALLUVIUM) 28.0'
2D	2/18"	Dark gray organic silty clay with lenses of silty sand (OH)	
3D	1/18"	Gray-brown organic silty clay, some fine sand (OH)	
4D	4,3,3	Top: Gray-brown medium to fine sand (SP) Bot: Light gray medium to fine sand (SP)	
5D	P	Gray-brown organic silty clay, trace fine sand & vegetation (OH)	
6D	P	Do 5D with lenses of peat & gray fine sand (OH)	
7D	10,11 19	Gray coarse to fine sand with a trace silt & gravel (SP)	CPT TO VY CPT GRAY COARSE TO FINE SAND WITH SOME GRAVEL 39.0'
8D	13,14 42,28	Gray coarse to fine sand & gravel, trace silt (SP - SM)	
9D	2,4,4	Brown organic silty clay, trace gravel & partly decomposed vegetation (OH)	STIFF BROWN ORGANIC SILTY CLAY, LAYERED WITH FINE SAND & PARTLY DECOMPOSED VEGETATION TR GVL 55.0'
10D	7,6,6	Gray organic silty clay with some gravel (OH)	
11D	5,6,6	Brown organic silty clay, layered with fine sand & partly decomposed vegetation (OH)	
12D	17,32 68	Light gray clayey medium sand, Cretaceous (SC)	VERY COMPACT LIGHT GRAY & GRAY-GREEN CLAYEY SAND & SAND WITH TRACE TO SOME CLAY, OCCASIONAL LAYERS OF CLAYEY SILT & TRACE GRAVEL 81.5'
13D	18,47 86	Light gray medium to fine sand, some clay (SC)	
14D	30,79	Light gray-green medium to fine sand, some clay & gravel (SP - SC)	
15D	42,95	Do 14D with lenses of gray-green clayey silt (SC)	
16D	30,52 72	Do 14D (SC) Light gray-green clayey medium to fine sand, trace gravel, occasional lenses of gray-green clayey silt (SC)	
17D	30,32 54		

Boring started 9-14-70, completed 9-16-70
Final depths:
Boring = 81.5' Casing = 73.0'
Casing diameter = 3"
Average depth of ground water = - = El.+0 (open water)

REMARKS:
Boring made in open water.
Washed ahead of casing below 56' depth; casing blows not recorded. Casing pushed 0' to 7' depth.
Sand ran up into casing at 65' depth.

BORING NUMBER L-20U
Ground surface elevation – 5.5

Sample	Blows	Description	Stratum
1D	1,1,3	Soft dark gray organic silty clay, some fine to medium sand (OH)	SOFT TO MEDIUM STIFF DARK GRAY ORGANIC SILTY CLAY, NUMEROUS WOOD FIBERS 29.5'
2D	3,0,1	Soft dark gray organic fine sandy clay (OL)	
3D	WH	Do 1D, numerous wood fragments (OH)	
4U	P	Do 3D, trace coarse sand (OH)	
5U	P	Do 3D (OH)	
6U	P	Do 3D (OH)	
7U	P	Do 3D, trace white shells (OH)	
8U	P	Dark gray organic clayey silt, trace wood fragments (OL)	
9D	14,39 25	Gray fine to coarse sand, trace silt & gravel (SP)-(SM)	CPT TO VY CPT GRAY F - C SAND, TRACE SILT & GRAVEL 39.0'
10D	17,16 14	Top: Gray fine to medium sand, trace silt (SP) Bot: Dark gray organic silty clay, some fine sand layers (OH)	MEDIUM STIFF DARK GRAY ORGANIC SILTY CLAY, TRACE WOOD & LENSES OF FI SA 52.5'
11D	5,6,10	Dark grey organic silty clay, layer of wood & vegetation matter & lense of sand (OH)	
12U	P	Do 11D (OH)	
13U	P	Do 11D (OL/OH)	
14D	20,40	Gray-green clayey fine to medium sand, Cretaceous (SC)	VERY COMPACT CLAYEY MEDIUM SAND, INTER-BEDDED WITH LAYERS OF GRAY-GREEN SILTY CLAY, VERY COMPACT CLAYEY GRAVEL AT THE BOTTOM
15D	20,27 46	Do 14D (SC)	
16D	31,48	Do 14D (SC)	
17D	30,62	Light gray-green medium to fine sand, some clay (SC)	
18D	68/6"	Light gray-green clayey coarse to medium sand, some gravel (SC)	
19D	43,47 60	Light gray-green gravel, some coarse to medium sand & clay (GC)	
20D	46,78	Green silty clay, trace fine sand (CL)	
21D	21,33 39	Green silty clay, trace fine sand (CL)	
22D	37,47 54	Top: Do 21D (CL) Bot: Mottled brown & gray plastic clay (CH)	
23D	42,45 45	Gray-green plastic clay, trace fine sand (CH)	

(CONT'D)

BORING NUMBER L-20U (Cont'd)

Sample	Blows	Description	Stratum
24D	60/4" 300 lb wt	Gray-green clayey medium sand, some gravel (SC)	AS ABOVE 114.5'
25D		Gray-green clayey medium sand, some gravel (SC)	
26D	300 lb wt	Light gray-green gravel, some sand & clay (GC)	
27D	300 lb wt	Green-gray clayey medium to fine sand, some gravel (SC)	
28D	300 lb wt	Do 27D (SC)	

Boring started 9-17-70, completed 9-24-70
Final depths:
Boring = 114.5' Casing = 93.0'
Casing diameter = 3" & 4"
Average depth of ground water = - = El.+0 (open water)

REMARKS:
Boring made in open water.
Washed ahead of casing below 54' depth; casing blows not recorded.
Materials extremely compact below 106', open end hammer used to obtain samples from 106.5' to 114.5'.

BORING NUMBER L-21
Ground surface elevation – 6.0

Sample	Blows	Description	Stratum
1D	P	Soft dark gray-brown organic silty clay, trace fine sand (OH)	SOFT BROWN ORGANIC SILTY CLAY WITH SCATTERED FRAGMENTS OF DECOMPOSED VEGETATION & PEAT LENSES (RIVER ALLUVIUM) 23.0'
2D	P	Do 1D, black (OH)	
3D	WR	Do 1D, with numerous vegetal fibers (OH)	
4D	P	Do 1D (OH)	
5D	P	Soft dark gray organic silty clay with peat lenses & trace fine sand (OH)	
6D	100/3"	Light gray fine to medium sand, trace fine gravel & silt (SP - SM)	COMPACT TO VERY COMPACT GRAY GRAVEL & COARSE TO MEDIUM SAND, SOME COBBLE FRAGMENTS 42.0'
7D	17,31 37	Light gray gravel & coarse to medium sand, trace silt (GP)	
8D	12,17 19	Do 7D, with some fragments of cobbles (GP)	
NR	14,18 21	Medium dark gray organic silty clay, some gray fine sand layers, trace decomposed vegetation (OH)	STIFF TO HARD SILTY CL W/GRAY FINE SAND 49.0'
9D	10,13 16		
10D	4,6,14	Top: Do 9D (OH) Bot: Gray fine sand, trace gravel (SP)	
11D	23,33 36	Mottled brown & gray clayey medium to fine sand (SC)	VERY CPT GRAY-GREEN CLAYEY SAND 55.5'
12D	27,48	Top: Gray-green clayey fine to medium sand (SC) Bot: Mottled brown & gray clayey medium sand, trace to some clay layers, trace gravel (SC)	VY CPT MOTTLED BRN & TAN CLAYEY MEDIUM SAND 66.0'
13D	14,43 71	Light gray medium sand, some clay (SC)	
14D	21,28 43	Top: Mottled brown & tan clayey medium sand (SC) Bot: Gray-green fine to medium sand, some clay (SC)	VERY COMPACT LIGHT GRAY-GREEN MEDIUM TO COARSE SAND W/ TRACE CLAY, LYR PLASTIC CLAY AT BOTTOM 81.5'
15D	19,24 37	Gray-green medium sand, some clay lenses (SC)	
16D	21,37 60	Light gray-green coarse to medium sand, trace clay & lignite (SP - SC)	
17D	24,34 52	Top: Light gray-green medium sand, trace clay (SP) Bot: Gray-green plastic clay with sand layers (CH)	

Boring started 9-28-70, completed 10-1-70
Final depths:
Boring = 81.5' Casing = 70.0'
Casing diameter = 3" & 4"
Average depth of ground water = - = El.+0 (open water)

REMARKS:
Boring made in open water
Casing pushed from 0' to 5' depth. Washed ahead of casing from 50' to 70' depth; casing blows not recorded.

BORING NUMBER L-22
Ground surface elevation – 10.2

Sample	Blows	Description	Stratum
1D	P	Gray-brown organic silty clay, trace decomposed vegetation (OH)	SOFT GRAY BROWN ORGANIC SILTY CLAY WITH TRACE OF SAND & DECOMPOSED VEGETATION, OCCASIONAL LENSES OF PEAT (RIVER ALLUVIUM) 21.0'
2D	P	Do 1D (OH)	
3D	P	Do 1D, some peat lenses & trace fine sand (OH) & (PT)	
4D	P	Do 1D with trace sand (OH)	
5D	P	Do 1D (OH)	
6D	14,17 19	Gray coarse to medium sand, some gravel, trace silt (SP)	MEDIUM COMPACT TO VERY COMPACT GRAY GRAVEL AND COARSE TO MEDIUM SAND, TRACE OF SILT AND CLAY LENSES 47.5'
7D	21,17 18	Gray gravel, some coarse to medium sand, trace silt (GP)	
8D	13,17 31	Do 7D (GP)	
9D	4,7,9	Gray medium to fine sand some clay (SP - SC)	
NR	4,6,12		
10D	13,34 36	Gray coarse to fine sand trace silt, some gravel (SP)-(SM)	
11D	23,28 32	Light gray-green medium to coarse sand, some clay, trace gravel Cretaceous (SP - SC)	VERY COMPACT LIGHT GRAY-GREEN MEDIUM TO COARSE SAND WITH TRACE TO SOME CLAY AND TRACE GRAVEL, LAYER OF HARD GRAY-GREEN CLAY AT BOTTOM 78.0'
12D	15,24 24	Top: Light gray & brown medium sand, trace clay (SP - SC) Bot: Dark gray plastic clay (CH)	
13D	17,32 42	Gray-green clayey fine to medium sand, trace gravel (SC)	
14D	27,50	Light gray-green clayey coarse to medium sand (SC)	
15D	21,53	Gray-green silty clay, trace fine sand (CL)	
16D	21,31 40	Gray-green plastic clay, some sand pockets, trace gravel (CH)	
17D	27,33 36	Red-brown plastic clay, some pockets of gray-green silty clay (CH)	HARD RED-BROWN AND DARK GRAY PLASTIC CLAY 93.0'
18D	17,30 48	Do 17D (CH)	
19D	17,27 27	Dark gray-brown slightly Micaceous plastic clay (CH)	
20D	100/2"	Gray-green Micaceous fine sand, trace Quartz gravel (decomposed rock)	94.2'

Boring started 10-2-70, completed 10-7-70
Final depths:
Boring = 94.2' Casing = 74.0'
Casing diameter = 3" & 4"
Average depth of ground water = - = El.+0 (open water)

REMARKS:
Boring made in open water.
Washed ahead of casing from 49' to 74' depth; casing blows not recorded.

REFERENCE DRAWINGS	
NUMBER	DESCRIPTION
F-L-14	Notes and Legend

REVISIONS		
DATE	BY	DESCRIPTION

DESIGNED ____ DATE
DRAWN VW & AR 12-70
CHECKED SLT & JPG 1-71
APPROVED ____ DATE

DISTRICT OF COLUMBIA WILLIAM H. MUESER 4070 REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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SUBMITTED William H. Mueser
DE LEUW, CATHER & COMPANY GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES GENERAL ARCHITECTURAL CONSULTANT
APPROVED

L'ENFANT - PENTAGON RIVER CROSSING ROUTE
LOGS OF L-SERIES BORINGS, Nos. L-19 to L-22
SCALE VERT. 0 3' 6' 12'
DRAWING NO. F-L-18

BORING NUMBER L-23
Ground surface elevation – 28.4

Casing blows (per ft): 6, 10, 50, 41, 42, 51, 70, 120, 60, 58, 40, 41, 36, 28, 27, 26, 31, 25, 29, 28, 20, 27, 32, 45, 51, 89, 20, 211, 329, 371, 341, 297, 362, 400, 141, 70, 70, 88, 91, 140, 231, 252, 291

Sample	Blows	Description	Stratum
1D	5,5,3	Gray medium to fine sand, some silt (SP - SM)	2.5'
2D	40,42 43	Gray gravel & fine to medium sand, trace silt (GP)	VERY COMPACT TO COMPACT GRAY GRAVEL AND FINE TO MEDIUM SA TRACE SILT
3D	21,30 33	Do 2D (GP)	
4D	17,23 7	Do 2D (GP)	17.5'
5D	5,7,12	Brown plastic clay with some sand lenses (CH)	STIFF BROWN CLAY, WITH SAND LENSES
6D	8,9,18	Do 5D (CL)	26.3'
7UD	P	Gray-brown plastic clay, some gravel (CH)	VERY COMPACT LIGHT BROWN GRAVEL & COARSE TO MED. SAND, TRACE SILT
8D	30,32	Brown coarse to medium sand, some gravel, trace silt (SP - SM)	
9D	100/3"	Light brown coarse to medium sand, some gravel, trace silt (SP)	39.0'
10D	14,17 23	Gray-green fine sandy clay, some lignite lenses, trace gravel, highly weathered, Cretaceous (CL)	HARD GRAY-GREEN CLAY WITH A LAYER OF VERY COMPACT GRAY MEDIUM SAND, OCCAS-IONAL LENSES OF LIGNITE & POCKETS OF CLAYEY SAND
11D	30, 50/3"	Gray medium sand, some clay, trace gravel (SC)	
12D	17,30 42	Gray-green silty clay, trace fine sand (CL)	
13D	21,53	Gray-green plastic clay, trace fine sand (CH)	
14D	19,27 25	Top: Red-brown clay (CH) Bot: Gray-green clay, trace sand (CH)	
15D	21,65	Gray-green & gray-blue clayey medium sand, some gravel (SC)	66.5'
16D	35,25*	Dark gray clay, trace fine sand (CH)	HARD GRAY CLAY 73.0'
17D	81/6"*	Gray-green Micaceous silt, trace fine sand & gravel (decomposed rock) (ML)	DECOM-ROCK 76.0'
1C	90/20	Hornblende Mica Gneiss, jointed & weathered	HBLNDE, MICA, GNEISS, JOINTED TO MOD. JOINTED, PARTLY WEATHERED
2C	90/60	Moderately jointed, partly weathered Gneiss, angles of joints: 45°	
3C	74/20	Jointed Gneiss	89.0'

Boring started 10-8-70, completed 10-14-70
Final depths:
Boring = 89.0' Casing = 76.0'
Casing diameter = 3" & 4"
Average depth of ground water = - = El.+0 (open water)

REMARKS:
Boring made in open water
Washed ahead of casing from 43' to 76' depth; casing blows not recorded.
Cobbled requiring coring encountered between 70' and 70.5' depth.
* indicated sampler driven with 300 lb. hammer.

BORING NUMBER L-24
Ground surface elevation – 29.0

Casing blows (per ft): 12, 16, 14, 10, 15, 20, 46, 71, 53, 38, 27, 81, 27, 20, 22, 26, 31, 30, 28, 38, 44, 170, 114, 161, 138, 64, 50, 41, 46, 68, 47, 40, 38, 39, 57, 70, 91, 132, 291, 326, 178 … 90, 130, 88, 120, 107, 130, 132

Sample	Blows	Description	Stratum
1D	2,13 10	Gray silty fine sand, some gravel, trace wood (SM)	SAND 2.0'
2D	19,21 40	Gray-brown gravel, some coarse to medium sand, trace silt (GP)	VERY COMPACT GRAY-BROWN GRAVEL, SOME SAND
3D	14,8,8	Brown silty fine sand, some gravel (SM)	12.0'
4D	7,7,11	Top: Gray & brown silty clay (CL) Bot: Brown clayey coarse to medium sand, some gravel, trace silt (SC)	STIFF SI CLAY 16.0'
5D	24,34 35	Gray-brown gravel, some medium to fine sand, trace silt (GP-GM)	V COMP GRAVEL WITH SOME SAND 21.5'
6D	8,24 37	Top: Gray-green silty clay, some fine sand pockets (CL) Bot: Light brown clayey medium sand, trace fine gravel, some gray clay layers (SC)	
NR	40,58		
7D	58/6"	Light gray-green clayey medium to fine sand, some gravel (SC)	
8D	30,53	Gray-green clay, trace fine sand (CH)	VERY COMPACT LIGHT GRAY-GREEN MEDIUM FINE SAND WITH TRACE TO SOME CLAY AND GRAVEL, INTER-BEDDED LAYERS OF HARD PLASTIC CLAY
NR	62/6"		
9D	18,21 24	Light gray-green clayey fine sand (SC)	
10D	15,27 50/5"	Gray fine sandy clay, trace gravel & lignite lenses (CL)	
11D	50/6"	Gray fine sandy clay, trace lignite (CL)	
12D	28,45 29	Gray-green medium sand, some clay & gravel (SC)	
13D	35,55	Do, 12D, trace gravel (SC)	
14D	50/4"	Gray & gray-green medium sand, some gravel, trace to some clay (SC)	
15D	50/6"	Gray-green clay, some gravel, trace sand (CH)	74.0'
NR	50/6"		HARD MICA-CEOUS SILT
16R	25*, 100*	Gray-green micaceous silt, some gravel (Decomposed Bedrock)(ML)	79.0'

Boring started 10-21-70, completed 10-26-70
Final depths:
Boring = 79.0' Casing = 72.0'
Casing diameter = 3"
Average depth of ground water = - = El.+0 (open water)

REMARKS:
Boring made in open water.
Washed ahead of casing from 25' to 65' depth; casing blows not indicative of consistency. Casing driven from 66' to 72'.
* indicated sampler driven with 300 lb. hammer.

BORING NUMBER L-25
Ground surface elevation – 30.9

Casing blows (per ft): 4, 10, 50, 90, 324, 41, 20, 36, 30, 29, 14, 10, 10, 20, 32, 14, 30, 19, 17, 30, 36, 254, 14, 43, 50, 50, 42, 40, 36, 28, 28, 30, 31, 30, 29, 27, 29, 32, 36, 38, 38, 37, 29, 27, 27, 28, 27, 26, 25, 53, 61, 103, 91, 88, 72, 85, 70, 46, 47, 45, 39, 40, 39, 43, 45, 47, 51, 53, 79, 88, 126, 138

Sample	Blows	Description	Stratum
1D	2,2,3	Gray medium sand, trace gravel & silt (River Alluvium) (SP)	SA & SI 2.5'
2D	35,30 32	Brown medium to fine sand, trace gravel (SP)	VERY COMPACT BROWN FINE TO MEDIUM SAND, TRACE TO SOME GRAVEL, TRACE OF SILT
3D	17,20 31,53	Brown fine sand, trace silt (SP)	
4D	5,5,20	Brown fine to medium sand, trace gravel (SP)	
5D	22,21 30	Light brown coarse to fine sand, some gravel, trace silt (SP-SM)	24.0'
6D	15,27 53	Light gray & gray-green fine sand, some clay & lignite lenses, some silty clay layers (SC & CL)	VERY COMPACT MEDIUM TO FINE CLAYEY SAND, TRACE GRAVEL, OCCA-SIONAL LIGNITE LENSES
7D	27,32 50	Light gray medium to fine sand, some clay & gravel (SC)	
8D	22,53	Light gray medium sand, some clay (SC)	38.0'
9D	15,17 21	Gray-green fine sandy clay (CL)	
10D	12,23 58	Light gray-green medium to fine sand, some clay & gravel (SC)	VERY COMPACT LIGHT GRAY-GREEN MEDIUM TO FINE SAND WITH SOME GRAVEL AND TRACE TO SOME CLAY
11D	35,54	Gray medium to coarse sand some gravel, trace silt (SP-SM)	
12D	31,56	Green-gray clayey fine sand (SC)	
13D	18 50/4"	Light gray-green medium sand, some gravel, trace clay (SP-SC)	
14D	42, 50/4"	Gray-green gravel & medium sand, trace clay (GP)	
15D	58/5"	Light gray-green fine to coarse sand, some clay & gravel (SC)	72.0'
16D	54/3"	Gray-green micaceous silt, trace fine sand & gravel (Decomposed Bedrock)(ML)	HARD MIC SILT DEC GNEISS 77.0'
1C	58/0	Micaceous hornblende gneiss, weathered & jointed	WTHD GNEISS 80.0'

Boring started 10-15-70, completed 10-20-70
Final depths:
Boring = 80.0' Casing = 72.0'
Casing diameter = 3"
Average depth of ground water = - = El.+0 (open water)

REMARKS:
Boring made in open water.
Washed ahead of casing with chopping bit from 25' to 72' depth; casing blows not indicative of consistency.
Cored with double-barrel sawtooth bit from 77' to 80'.

BORING NUMBER L-26
Ground surface elevation – 7.4

Casing blows (per ft): 12, 13, 10, 11, 9, 10, 16, 49, 196, 171, 141, 91, 70, 59, 28, 41, 50, 51, 53, 23, 38, 50, 38, 44, 20, 23, 40, 42, 47, 38, 33, 45, 48, 39, 70, 91, 110, 131, 71, 110, 131, 158, 169

Sample	Blows	Description	Stratum
1D	P	Gray medium to fine sand trace silt & organic material (SP-SM)	LOOSE M-C SAND AND GRAVEL INTER-BEDDED WITH SOFT ORGANIC SILTY CLAY, (RIVER ALLUVIUM)
2D	1/12" 1/6"	Gray-brown organic silty clay, trace sand lenses & vegetation (OH)	
3D	1,1,2	Top: Do, 2D (OH) Bot: Gray-brown silty clay, some gravel & coarse to medium sand (CL)	
NR	1,2,1		
NR	2,3,12		15.5'
4D	41,47 39	Brown gravel & fine to coarse sand, trace silt (GP-GM)	MEDIUM COMPACT TO VERY COMPACT BROWN AND GRAY GRAVEL AND COARSE TO FINE SAND, TRACE TO SOME SILT AND OCCAS-IONAL CLAY LENSES
5D	45,16 23	Brown fine to medium sand, trace gravel, some silt (SM)	
6D	15,8 10	Brown gravel & coarse sand, trace silt (SP)	
7D	8,8,15	Do, 6D (SP)	
8D	10,11 14	Gray clayey fine to medium sand & gravel (SC)	
9D	10,8, 15	Brown gravel & coarse to medium sand, trace silt (GP)	
10D	53/6"	Orange-brown fine to medium sand, some gravel, some silt (SM)	49.0'
11D	38, 53/4"	Gray clayey medium sand, trace gravel (SC)	VERY COMPACT LIGHT GRAY AND GRAY-GREEN MEDIUM TO FINE SAND, TRACE TO SOME CLAY AND GRAVEL WITH OCCA-SIONAL FRAGMENTS OF LIGNITE, INTER-BEDDED WITH LAYERS OF HARD GRAY-GREEN MEDIUM PLASTIC CLAY
12D	16,55	Do, 11D (SC)	
13D	14,20 33	Gray-green medium plastic clay (CH)	
14S	P	Top: Do, 13D (CH) Bot: Gray fine sandy clay trace gravel & lignite (CL)	
15D	26,60	Gray fine to medium sandy clay, trace gravel & lignite (CL)	
16D	54/6"	Light gray medium to fine sand, some clay, trace gravel (SC)	
17D	30,52	Light gray-green clayey medium sand (SC)	
18D	39, 59/5"	Do, 17D, with trace gravel (SC)	
19D	32,60	Do, 17D (SC)	
20D	67/6"	Light gray-green medium to fine sand, some clay & gravel (SC)	95.0'
21D	68/5"	Gray-green micaceous silty fine sand (Decom-posed Rock)(SM)	SI SAND 97.0'
1C	60/0	Jointed & weathered micaceous hornblende gneiss	MICA-CEOUS-HORN-BLENDE GNEISS, JOINTED AND PARTLY WEATH-ERED
2C	92/60	Moderately jointed Angle of joints 50°	
3C	100/50	Jointed & partly weath-ered, Angle of joints 60°-70°	108.0'

Boring started 10-27-70, completed 11-2-70
Final depths:
Boring = 108.0' Casing 97.0'
Casing diameter = 3" & 4"
Average depth of ground water = - = El. +0 (open water)

REMARKS:
Boring made in open water.
Washed ahead of casing from 0' to 8' depth and below 51'; casing blows not recorded.
600 lb. hammer used to drive casing from 18' to 51' depth.
Cored with sawtooth bit from 97' to 99'. Cored with NX-M diamond barrel from 99' to 108'.

BORING NUMBER L-27
Ground surface elevation + 7.1

Casing blows (per ft): 39, 14, 79, 90, 36, 38, 40, 37, 39, 38, 31, 39, 42, 51, 59, 50, 60, 72, 76, 89, 68, 70, 72, 91, 110, 70, 80, 80, 96, 119, 98, 141, 196, 290, 271, 68, 51, 53, 50, 60, 38, 29, 30, 31, 29, 26, 21, 20, 22, 20, 26, 30, 32, 40, 41, 40, 43, 50, 63, 72, 139, 281, 240, 251, 101

Sample	Blows	Description	Stratum
1D	14,23 13	Brown silt, some gravel & cinders (fill) (ML)	SILT, GRAVEL, CINDERS AND FILL
2D	7,6,8	Top: Gray fine gravel & coarse to medium sand (possible fill)(SP&GP) Bot: Dark gray-brown organic silty fine to medium sand, some gravel (SM)	6.0' MEDIUM STIFF SILTY CLAY AND SAND
3D	3,5,6	Brown organic silty clay, trace sand & gravel, mixed with some fill (OH)	13.0'
4D	14,13 16	Gray-brown coarse to fine sand & gravel, trace silt (SP)	COMPACT TO VERY COMPACT BROWN AND GRAY-BROWN COARSE TO FINE SAND WITH SOME GRAVEL AND TRACE OF SILT, LAYER OF FINE SAND AT THE BOTTOM
5D	12,17 20	Do 4D (SP)	
6D	20,25 19	Gray-brown coarse to fine sand, some gravel, trace silt (SP)-(SM)	
7D	36,56	Brown coarse sand, some gravel, trace silt (SP)	
8D	53/5"	Do 7D (SP)	
9D	10,16 17	Light brown fine sand, some medium sand, trace silt (SP)	44.0'
10D	3,5,6	Dark gray organic silty clay, trace fine sand & gravel (OH)	MEDIUM STIFF TO STIFF DARK GRAY AND GRAY-BROWN SILTY CLAY W/GRAY FI SA, SM WOOD
11D	3,5,7	Top: Medium dark gray organic silty clay (OH) Bot: Brown & gray-brown silty clay, some fine sand & silt layers & partly decomposed wood & leaves (OH)	
12D	9,8,12	Medium dark gray organic silty clay, trace fine sand layers & decom-posed wood (OH)	60.0'
13D	18,40 51	Light gray-brown & brown medium to coarse sand & some gravel, trace silt (SP - SM)	SAND AND GRAVEL 64.0'
14D	16,30 44	Mottled light gray & light brown clayey fine to medium sand, Cretace-ous (SC)	VY CPT LT GRAY AND BROWN CLAYEY MEDIUM SAND
15D	27,52	Do 14D, with trace gravel (SC)	74.0'
16D	24,54	Very hard gray-green plastic clay (CH)	HARD CLAY 76.0'

Boring started 9-17-70, completed 9-21-70
Final depths:
Boring = 76.0' Casing = 65.0'
Casing diameter = 3"
Average depth of ground water = 6.5' = El.+0.6

REMARKS:
Washed ahead of casing from 45' to 65' depth; casing blows not indicative of consistency.

		REFERENCE DRAWINGS		REVISIONS		
		NUMBER	DESCRIPTION	DATE	BY	DESCRIPTION
SIGNED	DATE	F-L-14	Notes and Legend			
DRAWN VW & AR	12-70					
CHECKED SLT & JPG	1-71					
APPROVED	DATE					

DISTRICT OF COLUMBIA · WILLIAM H. MUESER · 4070 · REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

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CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK 17, N. Y.
SUBMITTED William H. Mueser

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
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GENERAL ARCHITECTURAL CONSULTANT
APPROVED

L'ENFANT - PENTAGON RIVER CROSSING ROUTE

LOGS OF L- SERIES BORINGS, Nos. L-23 to L-27

SCALE VERT. 0 3' 6' 12'

DRAWING NO. F-L-19

DEPTH BELOW GROUND SURFACE, FEET

BORING NUMBER L-28
Ground surface elevation + 22.2

Depth (ft)	Casing blows	Sample	Sampler blows	Description
0	9, 10, 13, 17, 20	1D	5,6,8	Black & brown fine sand, some silt, gravel & cinders (fill) (SM)
5	3, 9, 12, 13, 13	2D	6,5,6	Orange-brown fine sand, some silt, trace gravel (fill) (SP - SM)
10	12, 12, 13, 17, 23	3D	2,2,4	Do 2D (fill) (SP - SM)
15	21, 24, 260, 51, 60	4D	3,2,3	Orange-brown silty clay, some fine sand (CL)
20	31, 20, 19, 21, 23	5D	91/6"*	Gray fine sand, some rock fragments, trace brick & silt (fill) (SP - SM)
25	19, 23, 23, 51, 80	6D	4,3,5	Brown oxidized inorganic silt, trace clay & fine sand, old ground (ML)
30	23, 24, 42, 43, 39	7D	16,19,14	Brown fine to coarse sand, some gravel, trace silt (SP)
35	23, 45, 49, 51, 94	8D	14,20,20	Do 7D (SP)
40	37, 52, 61, 147, 250	9D	18,19,25	Do 7D (SP)
45	127, 145, 218, 87, 41	10D	100/5"*	Do 7D, some silt (SP-SM)
50	29, 33, 56, 78, 137	11D	13,15,19	Light brown-red brown clayey fine to medium sand, weathered Cretaceous (SC)
55		12D	22,24,35	Tan-brown clayey fine to medium sand (SC)
60		13D	16,26,34	Do 12D, brown-green (SC)
65		14D	19,31,46	Do 13D (SC)

Strata:
- 0 – 23.0': LOOSE TO MEDIUM COMPACT BLACK-BROWN FINE SAND, SOME SILT, CINDER, BRICK (FILL)
- 23.0' – 28.0': BROWN SILT
- 28.0' – 49.0': COMPACT BROWN FINE TO COARSE SAND, SOME GRAVEL, TRACE SILT, BECOMES GRAVELLY WITH DEPTH
- 49.0' – 66.5': COMPACT TO VERY COMPACT LIGHT BROWN-TAN AND GREEN CLAYEY FINE TO MEDIUM SAND

Boring started 10-16-70, completed 10-19-70
Final depths:
Boring = 66.5' Casing = 55.0'
Casing diameter = 2-1/2"
Average depth of ground water = 20.4' = El.+1.8

REMARKS:
Casing blows from 25' to 55' depth are with 600 lb. hammer.
* indicates sampler driven with 600 lb. hammer.

BORING NUMBER L-29
Ground surface elevation + 19.3

Depth (ft)	Casing blows	Sample	Sampler blows	Description
0	11, 28, 39, 42, 48	1D	6,7,7	Dark brown silty fine sand, trace gravel & cinder (fill) (SM)
5	26, 39, 56, 68, 50	2D	4,39	Dark brown silty fine sand, trace gravel & cinder (fill) (SM)
10	8, 11, 12, 10, 9	3D	3,4,3	Brown silty clay, some fine sand, trace gravel (possible fill) (CL)
15	10, 11, 12, 12, 16	4D	8,10,11	Do 3D (possible fill) (CL)
20	10, 12, 16, 23, 48	5D	4,6,7	Do 3D (possible fill) (CH)
25	26, 51, 73, 109, 128	6D	29,42	Brown fine to coarse sand, some gravel, trace silt (SP)
30	87, 104, 163, 189, 204	7D	8,43	Dark brown oxidized, cracked, iron stained silty clay, trace fine sand (CL)
35	116, 121, 168, 231, 296	8D	71,104	Brown fine to coarse sand, some gravel, trace silt, (SP)
37 – 39				Gravel, possibly cobbles from 37' to 39'
40	100, 116, 142, 186, 220	9D	80,126	Do 8D (SP - SM)
45	60, 73, 81, 104, 128	10D	80,85	Brown coarse to fine sand & gravel (SP - SM)
50	67, 114, 169, 204, 293	11D	60,73	Do 10D, gravel wash (SP)
55	81, 93, 104, 286, 561	12D	58,115	Gravel & boulder fragments (GP)
60	141	13D	19,29,31	Hard light green-gray plastic clay, possibly highly weathered Cretaceous (CH)
65		14D	19,34,36	Do 13D, highly plastic (CH)
70		15D	19,72	Gray fine to medium sand, some clay (SC)
75		16D	57,81	Slightly green-gray fine to coarse sand, trace silt layers & clay (SC)
80		17D	73,104	Gray clayey fine to medium sand (SC)
85		18D	13,24,26	Do 13D (CH)
90		19D	13,28,32	Gray-green clayey fine sand (SC)
95		20D	28,51	Do 17D, trace gravel (SC)
100		21D	34,53	Green-gray clayey fine to medium sand, trace coarse sand (SC)
105		22D	48,73	Do 21D, trace gravel (SC)
110		23D	48,80	Do 22D (SC)

Strata:
- 0 – 23.0': MEDIUM COMPACT TO STIFF BROWN SILTY FINE SAND AND FINE SANDY SILT, SOME CINDER IN UPPER PORTION (FILL)
- 23.0' – 60.0': VERY COMPACT DARK BROWN FINE TO COARSE SAND, SOME SILT AND GRAVEL, BECOMES GRAVELLY WITH DEPTH
- 60.0' – 70.0': HARD LIGHT GREEN-GRAY PLASTIC CLAY CRETACEOUS
- 70.0' – 111.0': VERY COMPACT GRAY-GREEN CLAYEY FINE TO MEDIUM SAND WITH LAYERS OF GRAY-GREEN PLASTIC CLAY; AS ABOVE

Boring started 10-8-70, completed 10-14-70
Final depths:
Boring = 111.0' Casing = 61.0'
Casing diameter = 4"
Average depth of ground water = 18.5' = El.+0.8

REMARKS:
Casing blows are with 600 lb. hammer falling 18"
Drilling mud used to maintain hole open from 45' to 55' and 61' to 111' depth. Casing driven from 45' to 55' depth after hole caved in.
Washed ahead of casing from 55' to 61' depth; casing blows not indicative of consistency from 45' to 61' depth.
Slight loss of wash water noted from 32' to 34' depth.
Possibly cobbles from 37' to 39' depth and boulders from 51' to 58' depth.

BORING NUMBER L-30
Ground surface elevation + 19.5

Depth (ft)	Casing blows	Sample	Sampler blows	Description
0	6, 31, 45, 56, 62	1D	5,5,6	Black fine to medium sand, trace brick & gravel, coal & cinder (fill) (SP)
5	25, 48, 78, 69, 78	2D	2,2,3	Light brown clayey fine sand (fill) (SC)
10	1, 9, 12, 12, 14	3D	2,2,2	Brown-red-brown fine sandy clay (possible fill) (CL)
15	9, 17, 19, 19, 31	4D	2,1,1	Top: Light brown silty clay (CL) Bot: Dark brown silty fine sand, trace clay, trace organic matter (possible fill) (SM)
20	29, 41, 60, 200, 37	5D	4,5,5	Light brown silty clay, trace silt & gravel (CL) (possible fill)
25	19, 21, 27, 33, 34	6D	17,18,25	Light brown fine to coarse sand, trace silt & gravel (SP)
30	18, 26, 39, 42, 41	7D	12,12,15	Dark brown fine to coarse sand, trace silt & gravel (SP)
35	36, 45, 51, 38, 60	8D	30,36,42	Light brown to dark brown fine to coarse sand, trace silt, some gravel (SP)
40	57, 70, 48, 44, 43	9D	36,48	Brown fine to medium sand, some coarse sand, gravel & silt (SP-SM)
45	47, 50, 53, 39, 31	10D	22,33,29	Brown coarse to medium sand & gravel (GP)
50	28, 32, 87, 126, 31	11D	23,17,16	Brown fine to coarse sand & gravel (GP)
55	81	12D	59,50	Gray clayey fine to medium sand, Cretaceous (SC)
60		13D	34,46	Do 12D, some Lignite fragments (SC)
65		14D	18,24,35	Hard gray-green plastic clay (CH)
70		15D	17,20,26	Do 14D (CH)
75		16D	19,23,43	Top: Do 14D (CH) Bot: Gray clayey fine to medium sand (SC)

Strata:
- 0 – 23.0': MEDIUM STIFF BROWN-RED BROWN FINE SANDY SILT & SILTY FINE SAND, COAL BRICK AND CINDER IN UPPER PORTION (FILL)
- 23.0' – 54.0': COMPACT TO VERY COMPACT BROWN-DARK BROWN FINE TO COARSE SAND, SOME SILT AND GRAVEL, BECOMES MORE COMPACT WITH DEPTH
- 54.0' – 64.0': VERY COMPACT GRAY CLAYEY FINE TO MEDIUM SAND
- 64.0' – 76.5': HARD GRAY-GREEN PLASTIC CLAY

Boring started 10-13-70, completed 10-14-70
Final depths:
Boring = 76.5' Casing = 60.0'
Casing diameter = 2-1/2" & 4"
Average depth of ground water = 17.5' = El.+2.0

REMARKS:
Casing blows below 24' depth are with 600 lb. hammer falling 18".
Washed ahead of casing from 56.5' to 60.0' depth; casing blows not indicative of consistency.

Observation well consisting of 1" steel pipe installed with tip at 33.5' depth.

BORING NUMBER L-31
Ground surface elevation + 18.9

Depth (ft)	Casing blows	Sample	Sampler blows	Description
0	12, 23, 19, 24, 27	1D	17,18,31	Brown silty fine sand, trace coarse sand, gravel & cinders (Fill) (SM)
5	29, 17, 19, 23, 24	2D	9,8,8	Brown silty clay, some fine sand, trace gravel (Fill) (CL)
10	25, 28, 30, 31, 38	3D	2,1,2	Brown fine sandy clay (Fill) (CL)
15	121, 115, 107, 92, 76	4D	8,3,4	Dark gray organic fine sandy silt, trace gravel & coal (Fill) (OL)
20	78, 125, 118, 132, 156	5D	3,7,10	Brown silty clay, trace gravel & iron fragments (Fill) (CL)
25	38, 52, 53, 57, 69	6D	21,43,25	Brown fine to medium sand, trace gravel & silt (SP-SM)
30	89, 67, 68, 75, 39	7D	37,81	Brown fine to coarse sand, trace silt & gravel (SP)
35	35, 46, 28, 32, 33	8D	33,31,35	Brown fine to coarse sand, some gravel & trace silt (SP)-(SM)
38		9D	23,31,60	Do. 6D (SP)
40	27, 35, 35, 34, 38			
45	31, 37, 42, 29, 36	10D	34,36,29	Brown medium to fine sand, trace coarse sand & gravel (SP)
50	31, 35, 39, 46, 54	11D	13,16,28	Light gray-brown silty fine sand, trace gravel (SM)
55		12D	11,12,21	Hard green plastic clay, some fine sand (Cretaceous) (CH)
60		13D	17,20,27	Hard green fine sandy clay (CL)
65		14D	21,31,45	Gray-green clayey fine to medium sand (SC)
70		15D	25,36,55	Do. 14D (SC)

Strata:
- 0 – 23.0': MEDIUM COMPACT BROWN FINE SANDY CLAY AND SILTY FINE SAND, TRACE GRAVEL, CINDERS, FILL
- 23.0' – 53.0': VERY COMPACT BROWN FINE TO MEDIUM SAND, SOME SILT AND GRAVEL BECOMES COARSER AND MORE COMPACT WITH DEPTH
- 53.0' – 71.5': HARD GREEN FINE SANDY CLAY TURNING TO CLAYEY FINE TO MEDIUM SAND AT 64'

Boring started 10-8-70, completed 10-12-70
Final depths:
Boring = 71.5' Casing = 55.0'
Casing diameter =
Average depth of ground water = 17.7' = El.+1.2

REMARKS:
Casing blows from 25' to 55' depth are with 600 lb. hammer falling 18".

BORING NUMBER L-32
Ground surface elevation + 17.9

Depth (ft)	Casing blows	Sample	Sampler blows	Description
0	0, 14, 12, 10, 16	1D	7,7,8	Asphalt pavement; Red-brown fine to medium sand, some silt & gravel (fill) (SP - SM)
5	61, 30, 20, 26, 23	2D	100, 5,6	Mottled brown-gray-green silty clay (fill) (CL)
10		3D	1,1,1	Dark gray organic sandy silty clay (OL)
15		4D	3,3,5	Dark brown oxidized silty clay, some organic matter (CL)
20	WC, WC, WC, WC, WC	5D	26,23,12	Red-brown fine to coarse sand, some gravel, trace silt (SP - SM)
25	1, 7, 21, 21, 20	6D	3,4,14,14	Top: Brown fine sandy silt, trace clay (ML) Bot: Dark brown fine to coarse sand, trace silt & gravel (SP)
30	6, 8, 12, 17, 36	7D	3,2,2	Brown fine sandy silt, trace to some clay (ML)
35	91, 153, 130, 121, 156	8D	30,35	Brown medium to fine sand, some gravel & silt (SP - SM)
40	71, 92, 120, 69, 41	9D	60/4"*	Gray-brown coarse to fine sand, some gravel (SP)
45	58, 52, 36, 49, 56	10D	29,35,44	Do 9D, trace silt, coarser (GP - GM)
50		11D	21,19,22	Gray-green fine sandy clay, Cretaceous (CH)
55		12D	14,19,36	Green clayey fine sand (SC)
60		13D	22,23,35	Do 12D (SC)
65		14D	20,50	Brown fine sand, some clay (SP - SC)
70		15D	22,44,52	Do 11D (CL)

Strata:
- 0 – 0.4': Asphalt pavement
- 0.4' – 8.0': F - M SAND AND SILTY CLAY
- 8.0' – 19.0': SOFT TO MEDIUM STIFF DARK GRAY SLIGHTLY ORGANIC SILTY CLAY
- 19.0' – 47.0': COMPACT TO VERY COMPACT RED-BROWN AND GRAY-BROWN FINE TO COARSE SAND, SOME GRAVEL, TR SILT, THIN LYRS BRN FINE SAND/CLAYEY SILT BETWEEN 25' AND 35'
- 47.0' – 70.0': HARD GRAY-GREEN FINE SANDY CLAY, TURNING TO GREENISH-GRAY CLAYEY FINE TO MEDIUM SAND AT 55'

Boring started 10-6-70, completed 10-7-70
Final depths:
Boring = 70.0' Casing = 50.0'
Casing diameter = 2-1/2"
Average depth of ground water = 17.3' = El.+0.6

REMARKS:
Casing blows from 40' to 50' depth are with 600 lb. hammer falling 18".
Washed ahead of casing from 40' to 45' depth; casing blows not indicative of consistency.
Gravel noted at 5' depth.
* indicates sampler driven by 300 lb. hammer falling 18".

DESIGNED		DATE
DRAWN	VW & AR	12-70
CHECKED	SLT & JPG	1-71
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-14	Notes and Legend

DATE	BY	DESCRIPTION

DISTRICT OF COLUMBIA WILLIAM H. MUESER 4070 REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

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APPROVED

L'ENFANT - PENTAGON
RIVER CROSSING ROUTE
LOGS OF L - SERIES BORINGS, Nos. L-28 to L-32

SCALE VERT. 0 3' 6' 12'
DRAWING NO. F-L-20

DEPTH BELOW GROUND SURFACE, FEET

BORING NUMBER L-33U
Ground surface elevation + 36.5

Sample	Blows	Description
1D	5,9,12	Mottled red-brown & gray silty clay, some fine to medium sand & gravel (fill) (CL)
2D	10,16,17	Stiff brown silty clay, trace fine sand (fill) (CL)
3D	4,8,12	Do 2D (fill) (CL)
		Stiff brown silty clay, some fine sand & clayey fine sand (CL & SC)
4D	14,16,16	
		Stiff gray silty clay, some fine sand, trace gravel & brick fragments (CL)
5D	17,21,21	
6D	6,6,35	Clayey medium to fine sand, trace wood (SC)
7D	4,6,10	Stiff brown silty clay, some fine sand (CL)
8U	P	Do 7D (CL)
9D	22,34	Brown fine to coarse sand, some gravel, trace silt (SP - SM)
10D	21,28,31,30	Brown coarse to fine sand, trace silt, trace gravel (SP - SM)
11D	27,28,29	Do 10D (SP)
12D	24,28,30	Gray-brown medium to fine sand, trace coarse sand, gravel & silt (SP - SM)
13D	10,23,24,28	Do 12D (SP - SM)
14D	48,123	Brown gravel & fine to coarse sand (GP)
15D	60,103	Brown coarse sand & gravel (SP & GP)
16D	50,89	Gray-green fine to coarse sand, some clay (SP - SC)
17D	73,91	Gray-green clayey fine to coarse sand (SC)
18D	93,126	Do 16D (SP - SC)
19D	36,58	Do 17D (SC)
20D	63,89	Green fine sandy clay (CL)
21D	10,38,46	Do 20D (CL)

Strata: MEDIUM STIFF TO STIFF MOTTLED RED-BROWN AND GRAY SILTY AND SANDY CLAY (FILL) — 29.0'; STIFF BRN SILTY CLAY — 35.0'; VERY COMPACT BROWN & GRAY FINE TO COARSE SAND, SOME SILT AND GRAVEL, BECOMES MORE COMPACT AND GRAVELLY WITH DEPTH — 70.0'; VERY COMPACT GRAY-GREEN CLAYEY FINE TO COARSE SAND, TRACE GRAVEL, CHANGING TO SANDY CLAY AT 90' — 96.5'

Boring started 9-29-70, completed 10-5-70
Final depths:
Boring = 96.5' Casing = 72.0'
Casing diameter = 4"
Average depth of ground water = 26.4' = El.+10.1

REMARKS: Drilling mud used to maintain hole open from 25' to 65' depth. Hole caved at 65' depth and casing driven to 72' depth; casing blows not recorded from 25' to 45' depth.
Gravel encountered between 20' to 21' and 27' to 28' depth.

BORING NUMBER L-34
Ground surface elevation + 22.3

Sample	Blows	Description
1D	4,18,24	Brown silty clay, some fine to medium sand, some gravel & roots (fill) (CL)
2D	19,12,8	Red-brown fine to medium sandy clay, some gravel (fill) (CL)
3D	8,9,12	Brown silty clay, trace fine sand, probable fill (CL)
4D	24,29,18	Dark brown silty clay, some fine sand, trace organic, probable fill (CL)
5D	7,7,5	Brown fine to medium sand, trace to some silt, occasional gravel, possible fill (SP)
6D	21,21,17	Brown fine to coarse sand, some silt & gravel (SP - SM)
7D	14,16,21	Brown coarse to fine sand, some gravel (SP)
8D	8,9,17	Do 7D, gray-brown (SP)
9D	16,20,42	Brown fine to medium sand, some coarse sand & gravel, trace silt (SP - SM)
10D	50,60,60	Do 9D (SP - SM)
11D	53/6"*	Do 9D (SP - SM)
12D	27,50/5"	Brown-gray clayey fine to medium sand, trace gravel, Cretaceous (SC)
13D	20,39,44	Gray-green fine sandy clay (CL)
14D	17,29,20	Do 13D (CL)
15D	26,40,53	Light green-gray clayey fine to coarse sand, some gravel (SC)
16D	45,56	Light green-gray clayey fine to coarse sand, some gravel (SC)

Strata: BROWN FINE SANDY OR SILTY CLAY & SILTY FINE SAND, TRACE ROOTS IN UPPER PORTION, FILL — 18.0'; FINE TO MEDIUM SAND — 23.0'; COMPACT TO VERY COMPACT GRAY & BROWN FINE TO COARSE SAND, SOME SILT & GRAVEL, BECOMES COARSER & MORE COMPACT WITH DEPTH — 53.0'; BRN - GRY CLAYEY F - M SAND — 59.0'; COMPACT TO VERY COMPACT GRAY GREEN FINE SANDY CLAY & CLAYEY FINE TO MEDIUM SAND, MORE CPT WITH DEPTH — 76.0'

Boring started 9-22-70, completed 9-24-70
Final depths:
Boring = 76.0' Casing = 55.0'
Casing diameter = 2-1/2"
Average depth of ground water = 21.9' = El.+0.4

REMARKS:
Casing blows from 47' to 55' depth are with 600 lb. hammer falling 18".
Loss of drilling water noted between 49' to 50' depth.
Observation well consisting of 1" steel pipe installed with tip at 58' depth.
* indicates sampler driven with 300 lb. hammer falling 18".

BORING NUMBER L-35
Ground surface elevation + 20.7

Sample	Blows	Description
1D	7,11,53	Brown fine to medium sand, some gravel & concrete fragments (fill) (SP)
2D	4,4,3	Red-brown clayey fine to medium sand, some gravel (fill) (SC)
3D	9,56	Gray silty fine to medium sand & gravel (fill) (SM)
4D	6,5,5	Brown silty fine sand, trace gravel (fill) (SM)
5D	8,32,49	Red-brown coarse to fine sand, some gravel (probable fill) (SP)
6W	11,42	Gravel (wash) (GP)
7D	9,8,7	Medium brown silty clay, trace fine sand oxidized, partially desiccated (CL)
8D	19,19,18	Gray silty medium to fine sand, some gravel, coarse sand & silt (SP - SM)
9D	6,42,48	Brown fine to coarse sand, some gravel, trace silt (SP - SM)
10D	44,58	Brown medium to coarse sand some gravel (SP)
11D	12,24,34	Hard gray-green silty clay, trace fine sand, Cretaceous (CL)
12D	23,26	Do 11D, gray-green clayey fine sand (SC)
13D	28,42	Gray-green fine to medium sand, some gravel (SC)-(SP)
14D	20,40	Do 13D (SC)
15D	55/6"	Do 13D (gray-green) (SC)
16D	13,47	Do 13D, trace gravel (SC)

Strata: MEDIUM COMPACT TO COMPACT BROWN FINE TO COARSE SAND, SOME SILT AND GRAVEL, BRICK FRAGMENTS IN UPPER PORTION, BECOMES MORE GRAVELLY AND COMPACT WITH DEPTH (FILL) — 28.0'; DRIED SILTY CLAY — 34.0'; VERY COMPACT GRAY-BROWN FINE TO COARSE SAND, SOME GRAVEL, TRACE SILT — 49.0'; HARD GRAY-GREEN SILTY CLAY AND SAND — 59.0'; VERY COMPACT SLIGHTLY GREEN-GRAY CLAYEY FINE TO MEDIUM SAND, SOME GRAVEL — 76.0'

Boring started 9-23-70, completed 9-29-70
Final depths:
Boring = 76.0' Casing = 27.0'
Casing diameter = 4"
Average depth of ground water = — = El.+ —

REMARKS:
Drilling mud used to maintain hole open.
No measurement of ground water level made in this hole.

BORING NUMBER L-36
Ground surface elevation + 20.4

Sample	Blows	Description
1D	24,40,44	Brown silty fine to medium sand, some gravel, topsoil (fill) (SM)
2D	7,5,5	Brown silty clay, some fine sand, trace gravel (fill) (CL)
3D	8,12,25	Do 2D (fill) (CL)
4D	14,17,25	Brown fine silty clay, some brick & coal fragments (fill) (CL)
5D	3,6,4	Gray fine to coarse sand, some brick fragments and glass pieces (fill) (SP)
6D	2,2,4	Dark brown clayey fine sand (fill) (SC)
7D	7,6,10	Gray medium to fine sand, some coarse sand & silt (fill) (SP - SM)
8D	55/6"	Gray medium to fine sand some gravel, coarse sand & silt (SP - SM)
9D	13,14,17	Brown sand & gravel (GP)
10D	53/6"	Gray-brown coarse to medium sand & gravel (GP)
11D	54/6"	Do 10D (GP)
12D	14,23,28	Gray-green clayey fine sand, Cretaceous (SC)
13D	40,52	Gray-green clayey fine to medium sand, some gravel (SC)
14D	34,56	Gray-green fine to coarse sand, some gravel & clay (SC)
15D	14,20,24	Green clayey fine to medium sand (SC)
16D	15,20,25	Do 15D (SC)

Strata: MEDIUM COMPACT TO COMPACT GRAY AND BROWN SILTY FINE SAND, SOME BRICK FRAGMENTS AND GLASS PIECES, BECOMES RELATIVELY LOOSE BETWEEN 20' AND 26' — 31.5'; COMPACT TO VERY COMPACT GRAY-BROWN FINE TO COARSE SAND, SOME GRAVEL, TRACE SILT, BECOMES GRAVELLY — 49.0'; VERY COMPACT GRAY-GREEN CLAYEY FINE TO MEDIUM SAND, SOME GRAVEL IN UPPER PORTION OF THE STRATUM — 71.5'

Boring started 9-28-70, completed 9-29-70
Final depths:
Boring = 71.5' Casing = 25.0'
Casing diameter = 4"
Average depth of ground water = 19.8' = El.+ 0.6

REMARKS:
Drilling mud used below 30' depth to maintain hole open.
Loss of drilling water noted from 22' to 23.5'.
Some gravel noted between 39' to 40' and 46' to 48' depth.

BORING NUMBER L-37U
Ground surface elevation + 18.9

Sample	Blows	Description
1D	20,22,24	Brown silt, trace gravel glass & roots (fill) (ML)
2D	7,12,14	Brown clayey silt, trace brick & gravel (fill) (ML)
3D	30,55	Gray gravel, some coarse sand, trace clay lenses (fill) (GP)
		Wash showed fragments of brick, cinders and wood from 14' to 20'
4D	40,2,2,3	Top: Fine gravel & coarse sand, trace cinders, brick & wood (fill); Bot: Gray organic silty clay with peat lenses (OH)
5U	P	Do 4D (OH)
6U	P	Do 6U (ML)
7D	1,2,2	Brown fine sandy silt, some clay (ML)
8D	8,9,14	Do 6U (ML)
9D	40,52	Brown-gray fine to coarse sand & gravel, trace silt (GP - GM)
10D	16,40,36	Do 9D (GP - GM)
11D	17,20,21	Gray-brown coarse to medium sand, some gravel (SP)
12D	26,14,19	Gray fine to coarse sand & gravel (SP)
13D	16,56	Dark green clayey fine to medium sand, weathered Cretaceous (SC)
14D	12,30,32	Do 13D (SC)
15D	26,56	Greenish-gray clayey fine to medium sand, trace gravel (SC)
16D	20,58	Do 15D (SC)

Strata: COMPACT FINE TO COARSE SAND, GRAVEL, CLAYEY SILT, TRACE ROOTS AND GLASS PIECES IN UPPER PORTION (FILL) — 21.0'; MEDIUM STIFF BROWN SANDY SILT, ORGANIC AT TOP OF LAYER — 35.0'; VERY COMPACT BROWN AND GRAY FINE TO COARSE SAND, SOME GRAVEL, TRACE SILT — 53.0'; VERY COMPACT DARK-GREEN & GRAY GREEN CLAYEY FINE TO MEDIUM SAND, TRACE GRAVEL IN LWR PORT. — 71.0'

Boring started 9-30-70, completed 10-2-70
Final depths:
Boring = 71.0' Casing = 64.0'
Casing diameter = 2-1/2" & 4"
Average depth of ground water = 17.8' = El.+1.1

REMARKS:
Gravel noted at 35' depth.
Observation well consisting of 1" steel pipe installed with tip at 60' depth.

DESIGNED		DATE
DRAWN	VW & AR	12-70
CHECKED	SLT & JPG	1-71
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-L-14	Notes and Legend

REVISIONS

DATE	BY	DESCRIPTION

Seal: DISTRICT OF COLUMBIA — WILLIAM H. MUESER — 4070 — REGISTERED PROFESSIONAL ENGINEER

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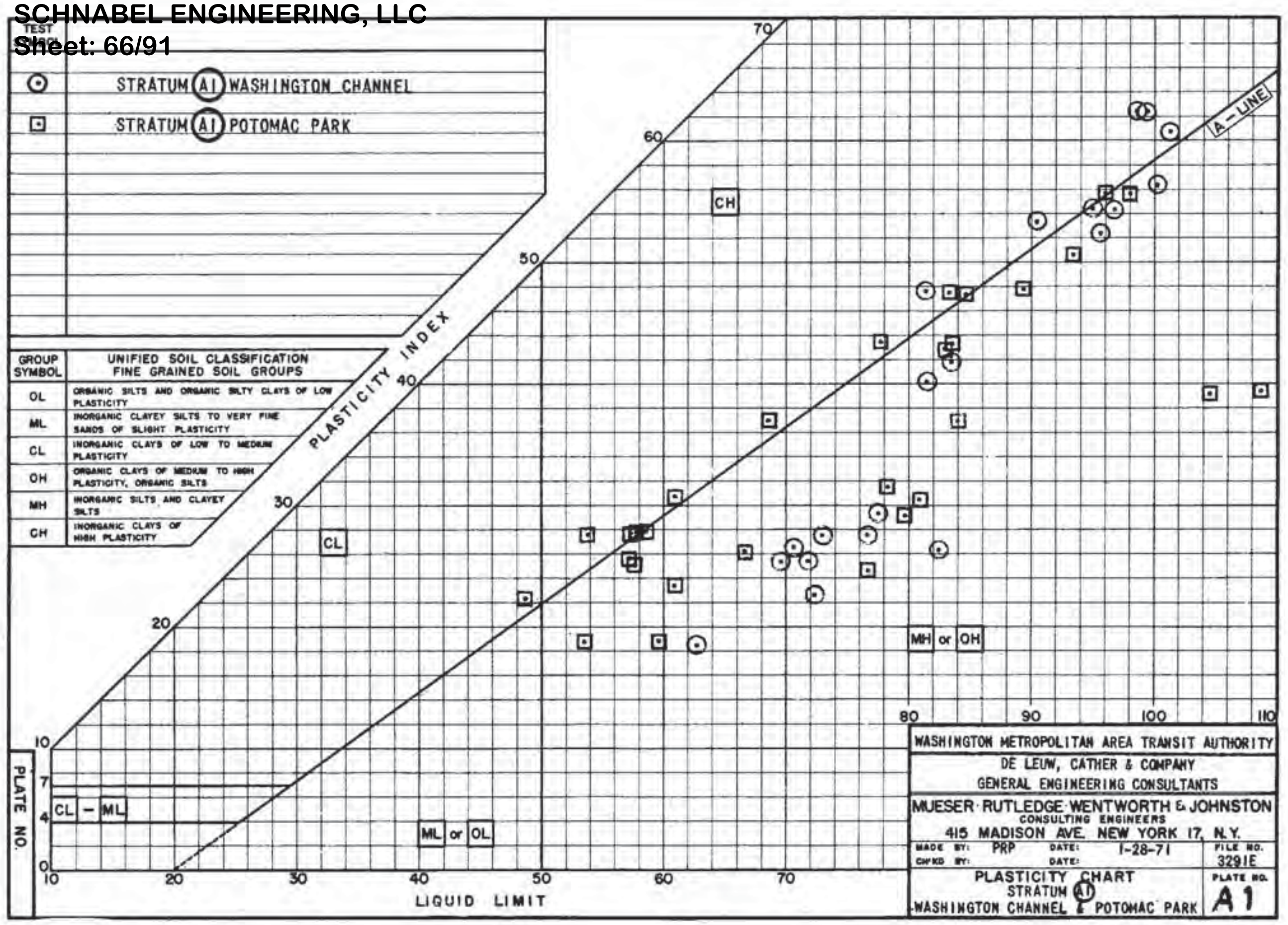
MUESER · RUTLEDGE · WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK 17, N.Y.
SUBMITTED William H. Mueser
DE LEUW, CATHER & COMPANY GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES GENERAL ARCHITECTURAL CONSULTANT
APPROVED

L'ENFANT - PENTAGON RIVER CROSSING ROUTE
LOGS OF L-SERIES BORINGS, Nos. L-33 to L-37U
SCALE VERT. 0 5' 10' 15'
DRAWING NO. F-L-21


TEST SYMBOL
STRATUM (A1) WASHINGTON CHANNEL
STRATUM (A1) POTOMAC PARK
GROUP SYMBOL
UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
OL ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
ML INORGANIC CLAYEY SILTS TO VERY FINE SANDS OF SLIGHT PLASTICITY
CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
OH ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
MH INORGANIC SILTS AND CLAYEY SILTS
CH INORGANIC CLAYS OF HIGH PLASTICITY
PLASTICITY INDEX
A-LINE
CH
CL
MH or OH
ML or OL
CL - ML
LIQUID LIMIT
PLATE NO.
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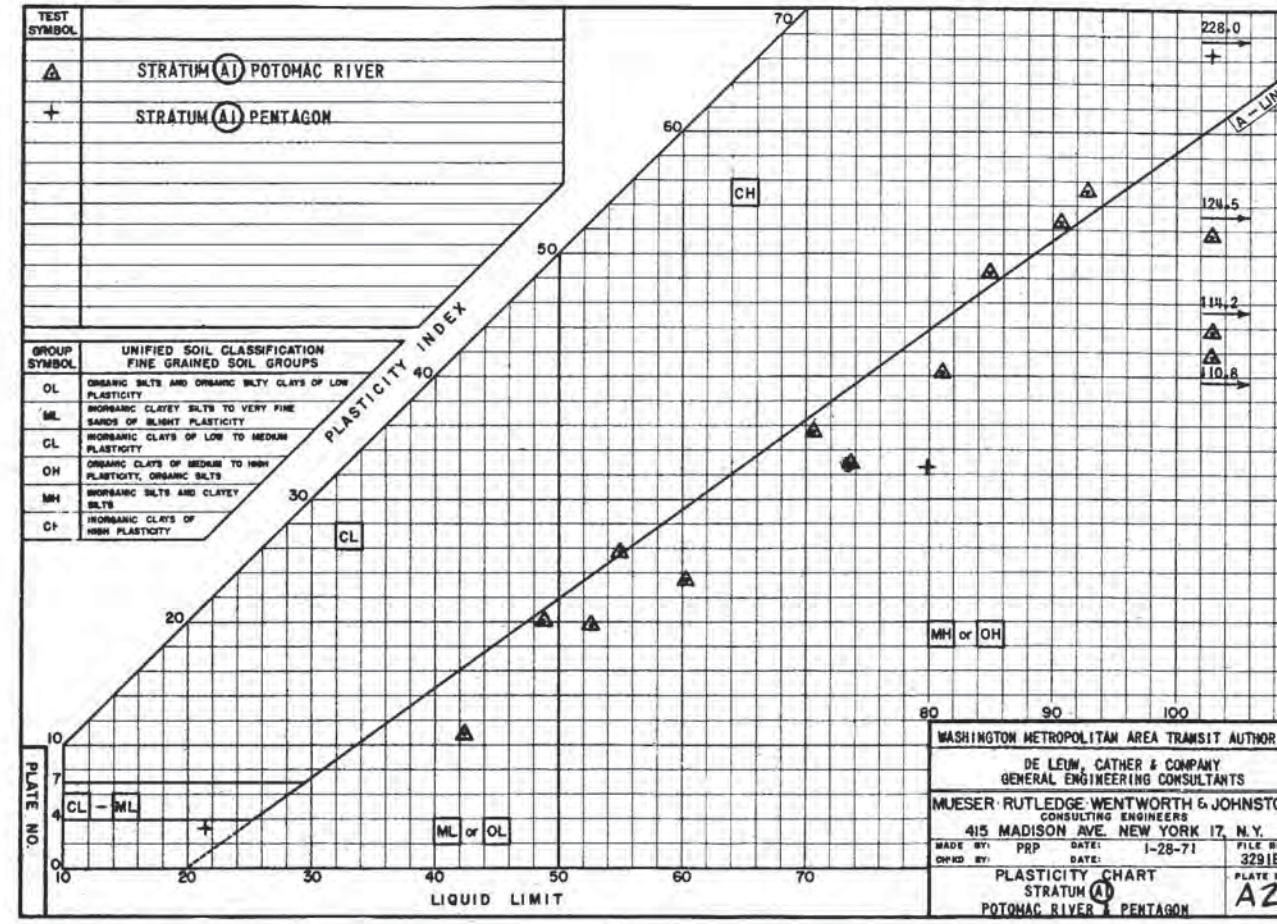
MADE BY: PRP DATE: 1-28-71
FILE NO. 3291E
PLASTICITY CHART
STRATUM (A1)
WASHINGTON CHANNEL & POTOMAC PARK
PLATE NO. A1


TEST SYMBOL
STRATUM (A1) POTOMAC RIVER
STRATUM (A1) PENTAGON
228.0
124.5
114.2
110.8
GROUP SYMBOL
UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
PLASTICITY INDEX
A-LINE
CH
CL
MH or OH
ML or OL
CL - ML
LIQUID LIMIT
PLATE NO.
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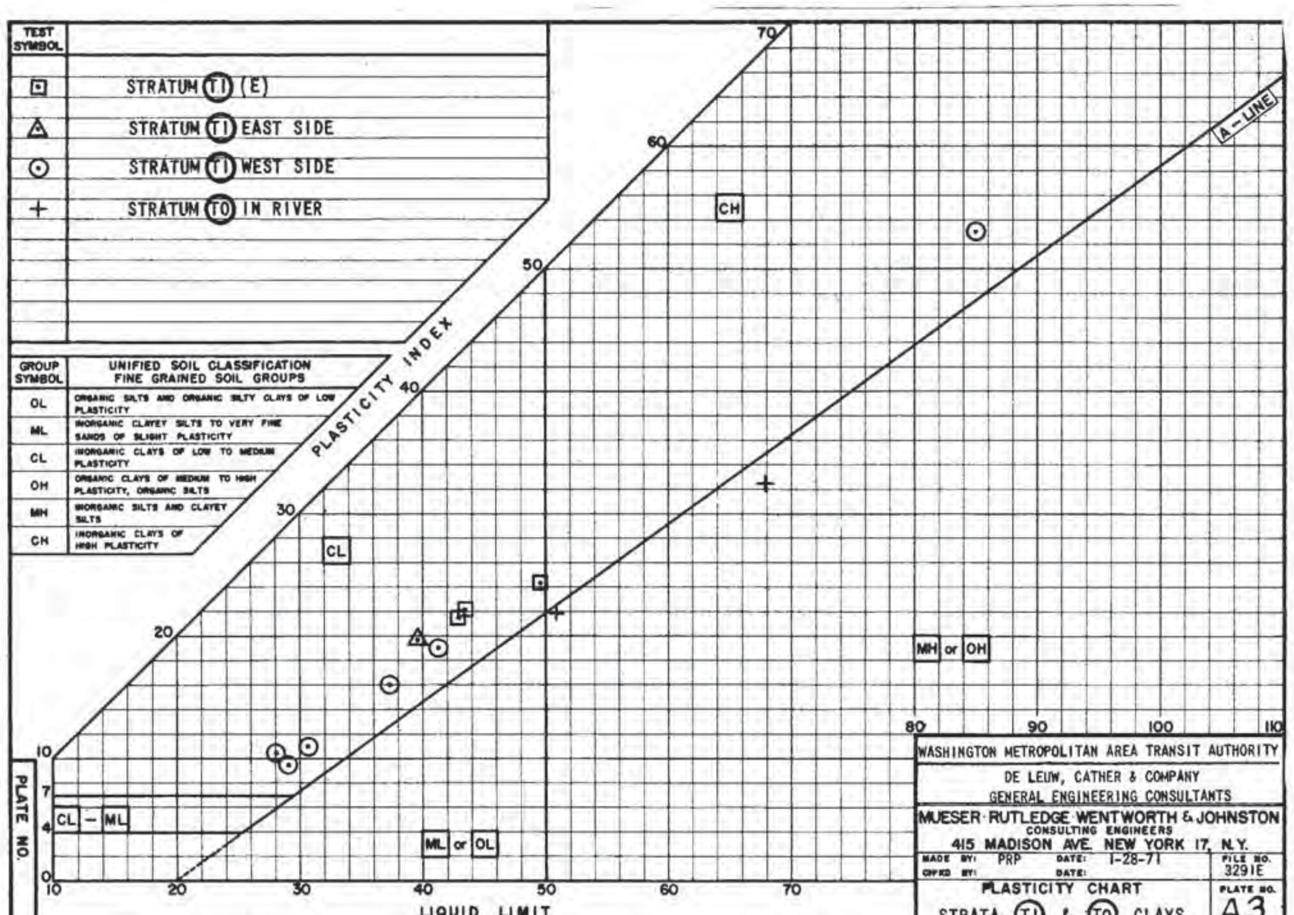
PLASTICITY CHART
STRATUM (A1)
POTOMAC RIVER & PENTAGON
PLATE NO. A2


TEST SYMBOL
STRATUM (T1) (E)
STRATUM (T1) EAST SIDE
STRATUM (T1) WEST SIDE
STRATUM (T0) IN RIVER
GROUP SYMBOL
UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
PLASTICITY INDEX
A-LINE
CH
CL
MH or OH
ML or OL
CL - ML
LIQUID LIMIT
PLATE NO.
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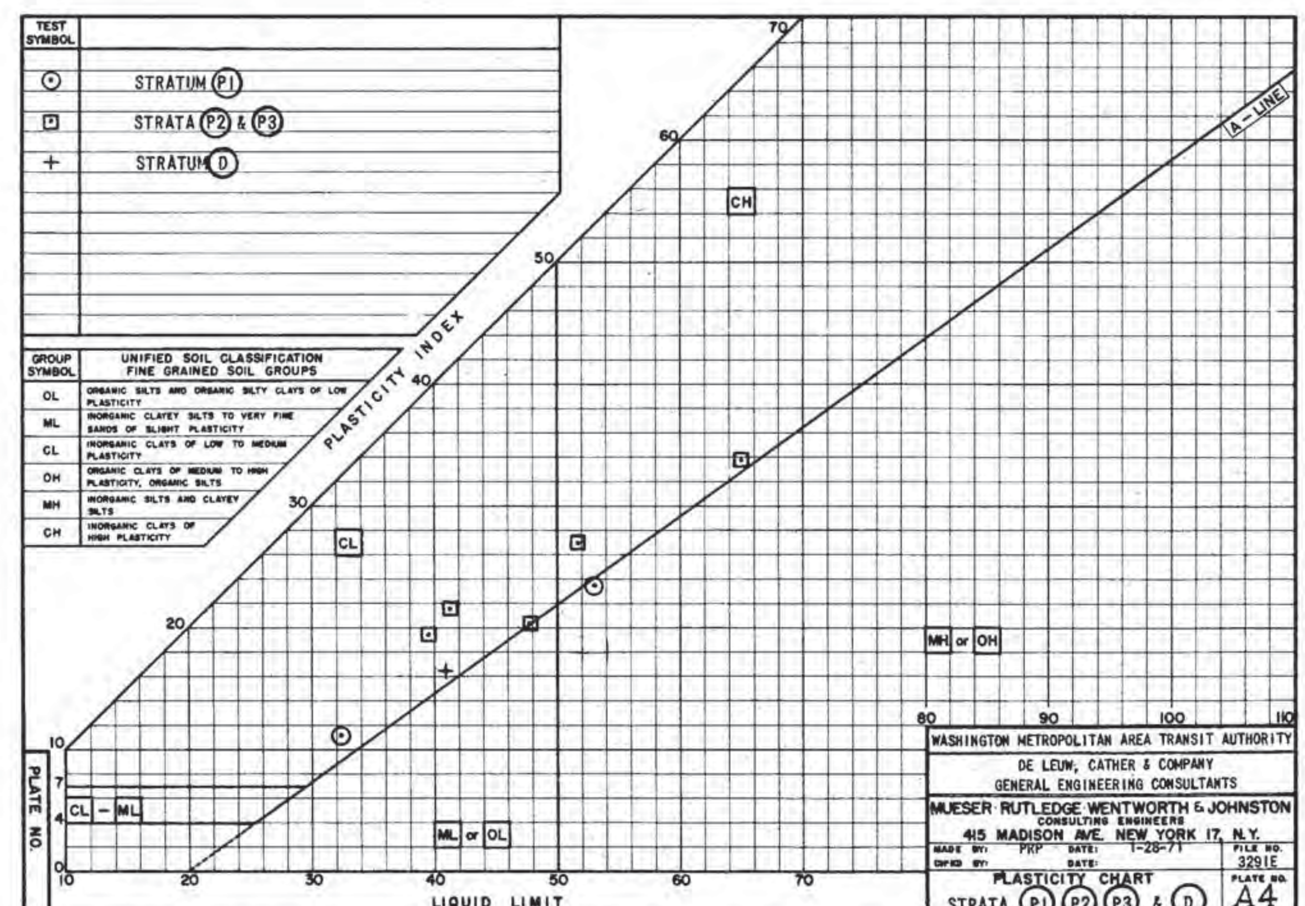
FILE NO. 3291E
PLASTICITY CHART
STRATA (T1) & (T0) CLAYS
PLATE NO. A3


TEST SYMBOL
STRATUM (P1)
STRATA (P2) & (P3)
STRATUM (D)
GROUP SYMBOL
UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
PLASTICITY INDEX
A-LINE
CH
CL
MH or OH
ML or OL
CL - ML
LIQUID LIMIT
PLATE NO.
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MADE BY: PRP DATE: 1-28-71
FILE NO. 3291E
PLASTICITY CHART
STRATA (P1) (P2) (P3) & (D)
PLATE NO. A4

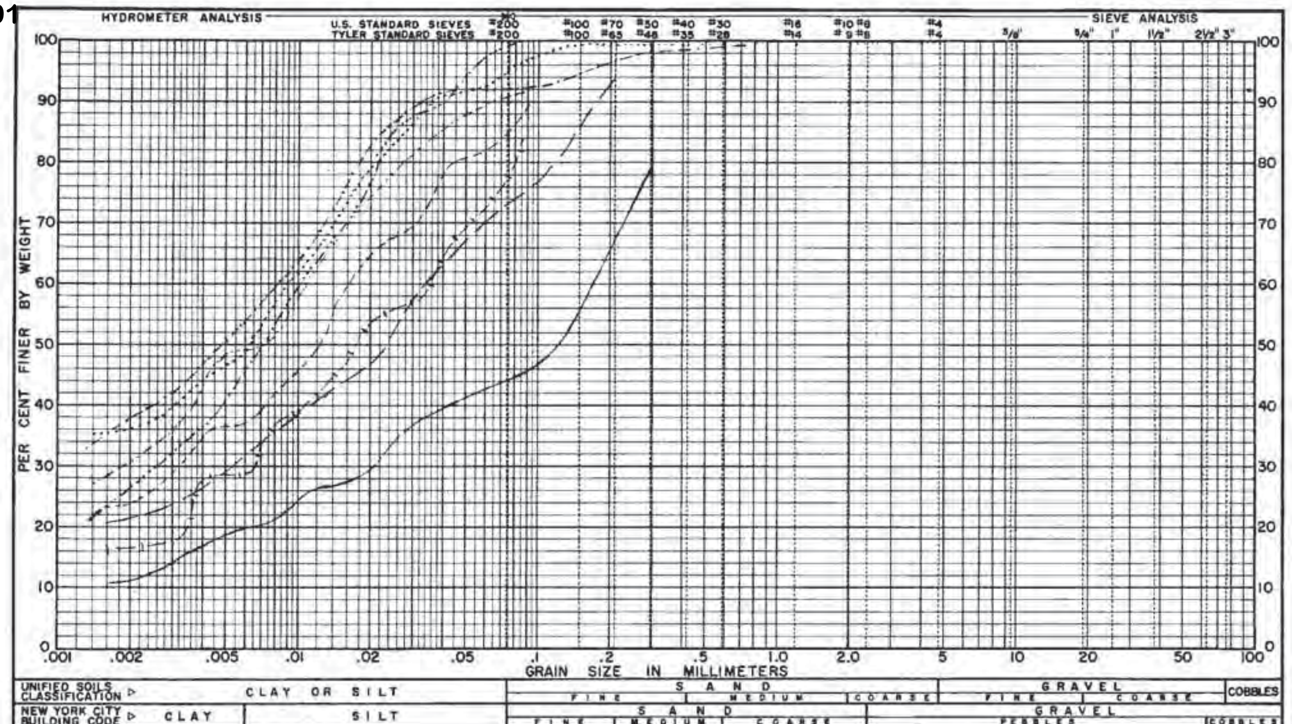

PLATE NO. A5

SYMBOL	BORING	SAMPLE
—— ——	L-5	5D
———	L-5	11 D
— — —	L-6	5 D
········	L-9U	8 U
—I—I—	L-10	3 S
--·--·--	L-13	15 D
-·—·—	L-14U	17 U
—·—·—	L-19	11 D

DESCRIPTION OF SAMPLE

STRATUM (A1)

SOFT TO MEDIUM STIFF DARK GRAY AND BROWN ORGANIC CLAY WITH LENSES OF HIGHLY ORGANIC MATERIAL

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MADE BY: AR DATE: 2-3-71 FILE NO. 3291E
CHKD BY: DATE:

GRADATION CURVES
STRATUM (A1)
PLATE NO. A5

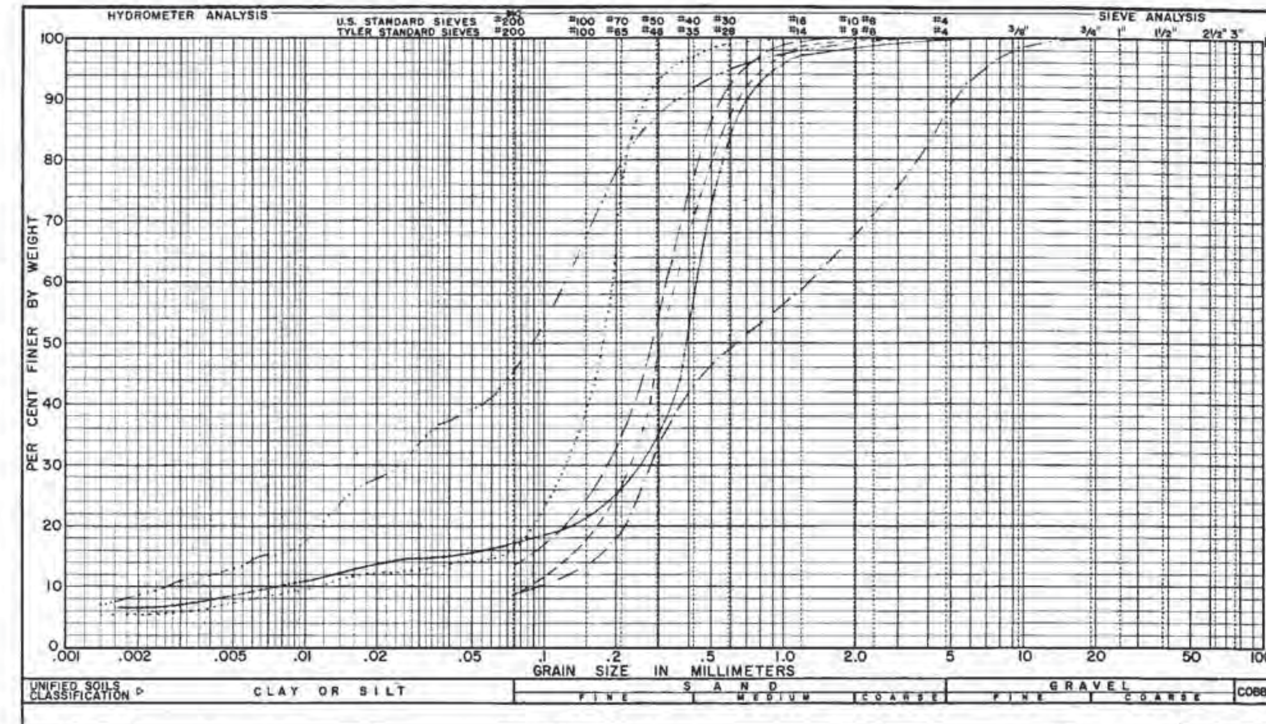

PLATE NO. A6

SYMBOL	BORING	SAMPLE
———	L11	18D
— — —	L16	7D
—— ——	L16	8D
········	L16	12D
—·—·—	L20	9D
··········	L36	6D

DESCRIPTION OF SAMPLE

STRATUM (A2)

LOOSE TO MEDIUM COMPACT DARK GRAY SILTY FINE TO MEDIUM SAND WITH OCCASIONAL SMALL GRAVEL

STRATUM (F)

STIFF MOTTLED BROWN AND TAN SILTY CLAY

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MADE BY: AR DATE: 2-3-71 FILE NO. 3291E
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GRADATION CURVES
STRATA (F) & (A2) BENEATH RIVER
PLATE NO. A6

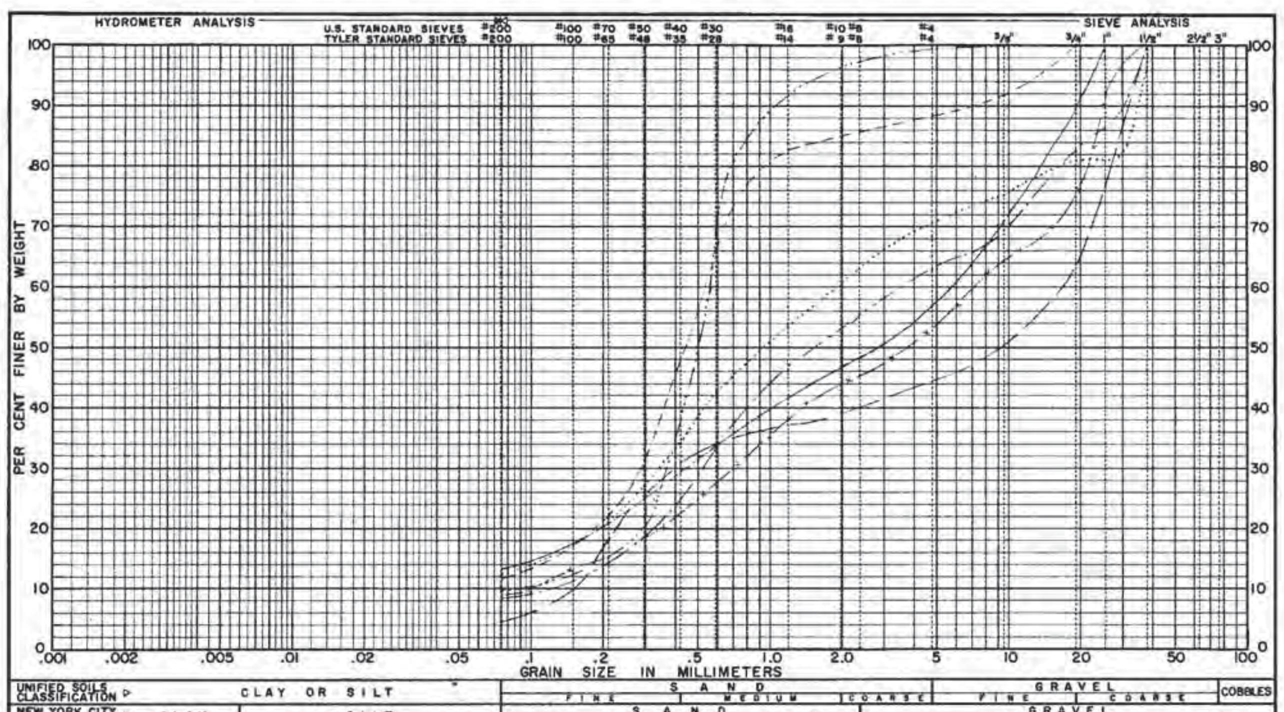

PLATE NO. A7

SYMBOL	BORING	SAMPLE
———	L1	7D
—— ——	L2	5D
— — —	L2	14D
········	L2	16D
—·—·—	L3	12D
··—·—	L4	7D (T2)
—·—·—	L4	8D

DESCRIPTION OF SAMPLE

STRATUM (T3)

COMPACT TO VERY COMPACT BROWN AND RED-BROWN FINE TO COARSE SAND WITH SOME SILT AND GRAVEL, OR SAND AND GRAVEL WITH A TRACE OF SILT AND NUMEROUS BOULDERS

STRATUM (T5)

COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL AND SOME TO TRACE SILT, OR SAND AND GRAVEL WITH NUMEROUS BOULDERS

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MADE BY: AR DATE: 2-3-71 FILE NO. 3291E
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GRADATION CURVES
STRATA (T3) & (T5) EAST SIDE
PLATE NO. A7

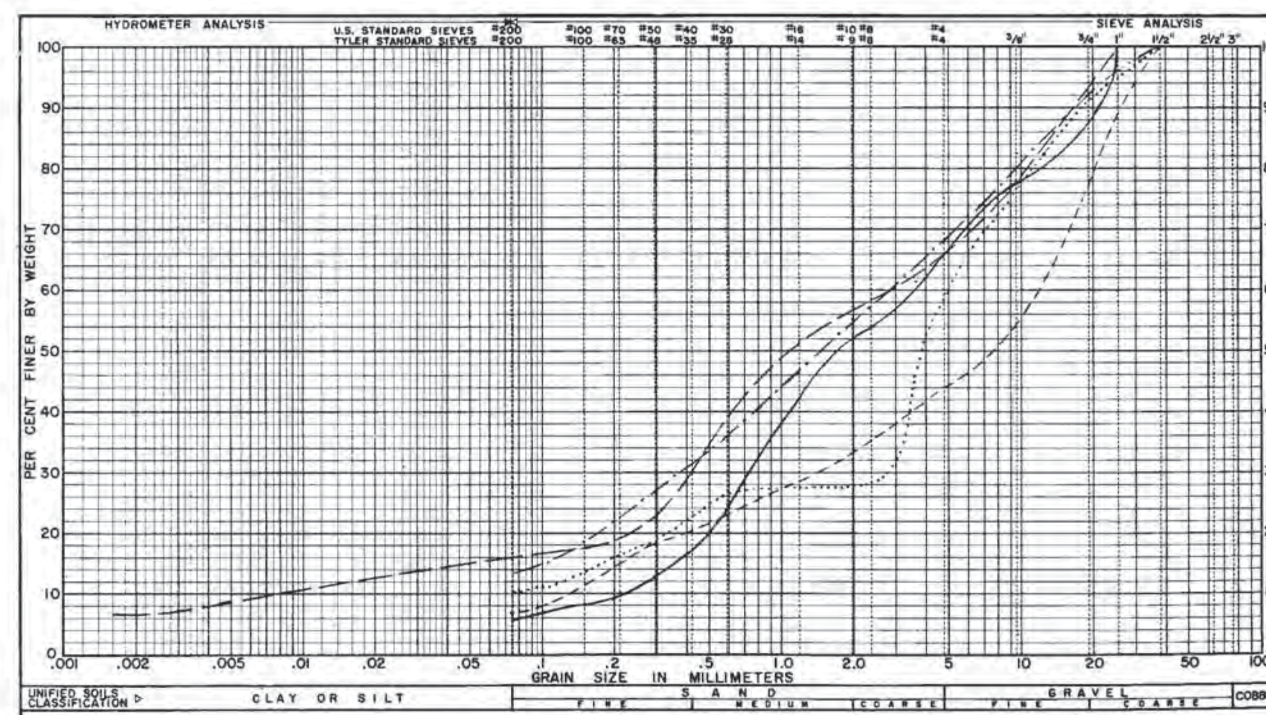

PLATE NO. A8

SYMBOL	BORING	SAMPLE
———	L5	12D
—— ——	L8	15D
— — —	L21	7D
········	L22	10D
—·—·—	L25	5D

DESCRIPTION OF SAMPLE

STRATUM (T5)

COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL AND SOME TO TRACE SILT, OR SAND AND GRAVEL WITH NUMEROUS BOULDERS

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GRADATION CURVES
STRATUM (T5) BENEATH RIVER
PLATE NO. A8

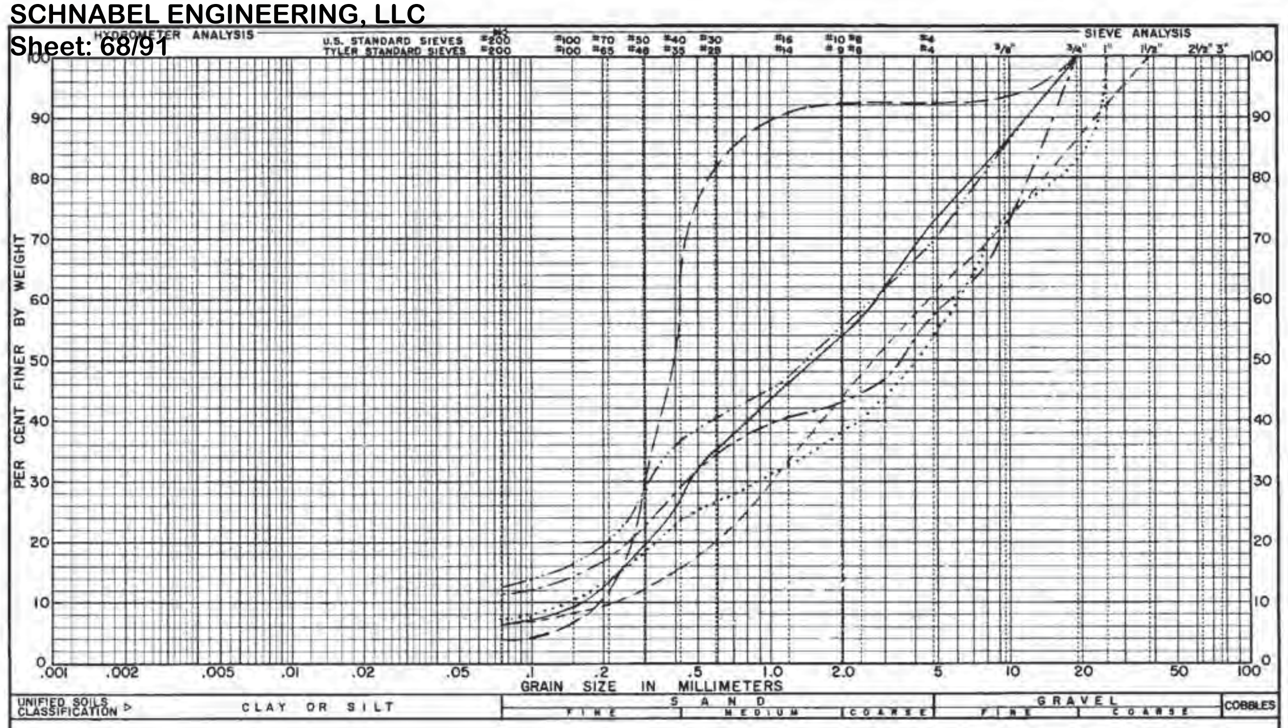

PLATE NO. A9

SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE
———	L27	60	STRATUM (T5) COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL AND SOME TO TRACE SILT, OR SAND AND GRAVEL WITH NUMEROUS BOULDERS
— —	L27	90	
- - - -	L28	90	
········	L29	90	
-·-·-	L30	90	
—··—	L31	80	

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GRADATION CURVES
STRATUM (T5) VIRGINIA
PLATE NO. A9

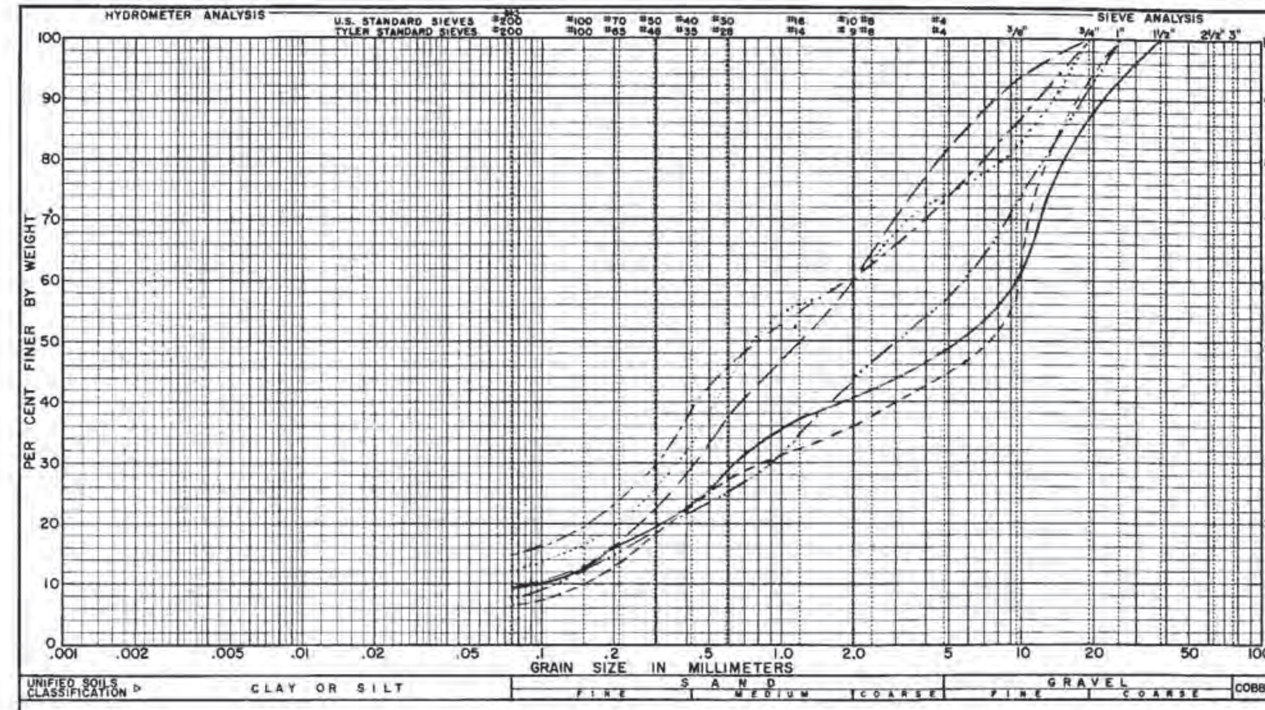

PLATE NO. A10

SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE
———	L32	100	STRATUM (T5) COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL AND SOME TO TRACE SILT, OR SAND AND GRAVEL WITH NUMEROUS BOULDERS
— —	L33U	100	
- - - -	L33U	130	
-·-·-	L34	60	
········	L35	90	
—··—	L37U	120	

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GRADATION CURVES
STRATUM (T5) VIRGINIA
PLATE NO. A10

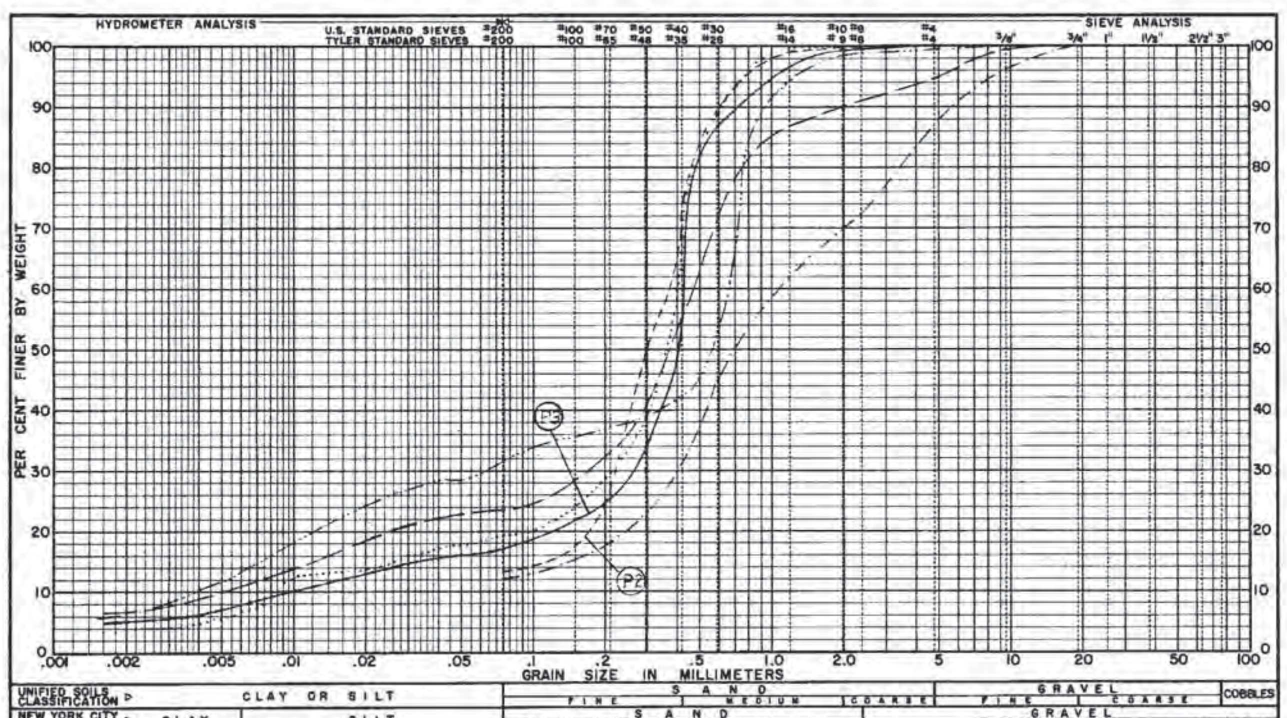

PLATE NO. A11

SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE
———	L3	150	STRATUM (P2) COMPACT TO VERY COMPACT LIGHT GRAY OR TAN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH POCKETS OF SILTY CLAY AND TRACE OF SMALL GRAVEL, OCCASIONAL LIGNITE FRAGMENTS
— —	L9U	160	
- - - -	L18	170	
-·-·-	L19	140	STRATUM (P3) HARD GRAY-GREEN OR GRAY-BLUE SILTY OR SANDY CLAY AND SANDY SILT AND SILTY OR CLAYEY FINE SAND WITH SMALL OCCASIONAL GRAVEL
········	L20	140	
—··—	L21	140	

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MADE BY: AR DATE: 2-3-71 CHKD BY: DATE: FILE NO. 3291E
GRADATION CURVES
STRATA (P2) & (P3) EAST SIDE
PLATE NO. A11

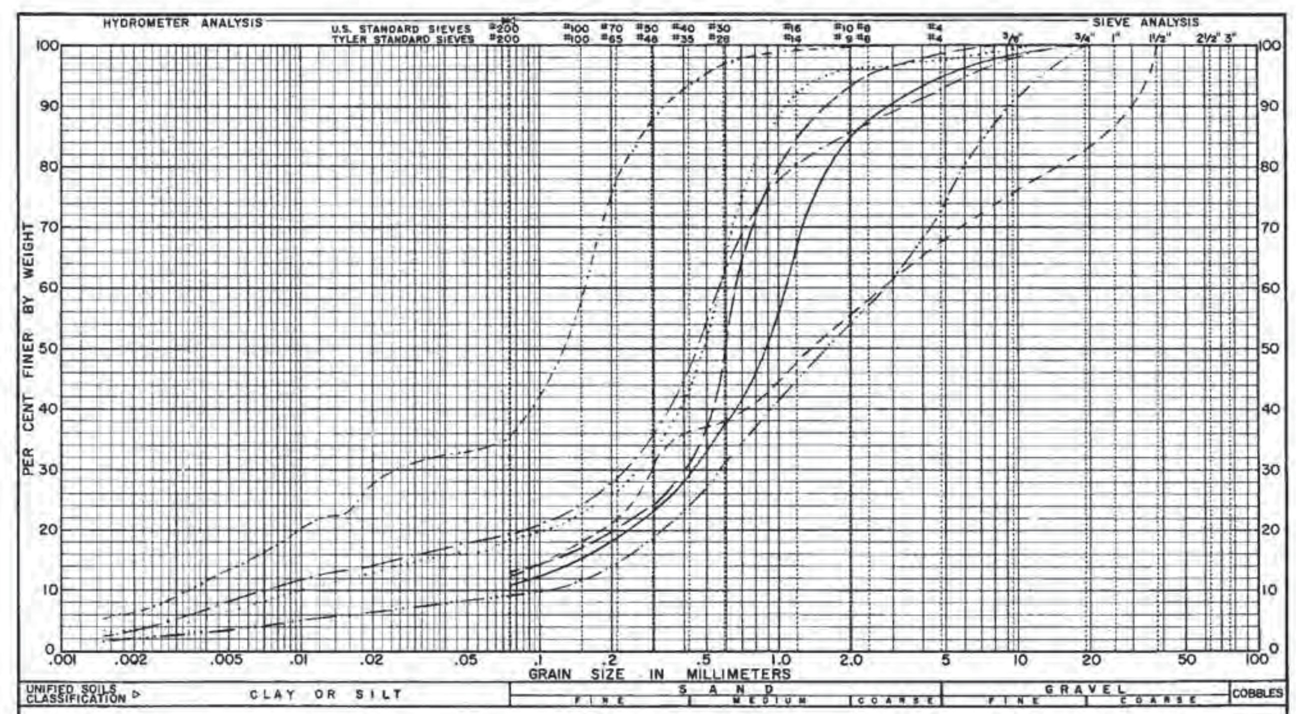

PLATE NO. A12

SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE
———	L21	160	STRATUM (P2)
— —	L22	120	STRATUM (P2)
- - - -	L24	120	STRATUM (P3)
········	L25	70	STRATUM (P4)
-·-·-	L26	180	STRATUM (P3)
—··—	L35	180	STRATUM (P4)
-··--	L36	180	STRATA P2-P3

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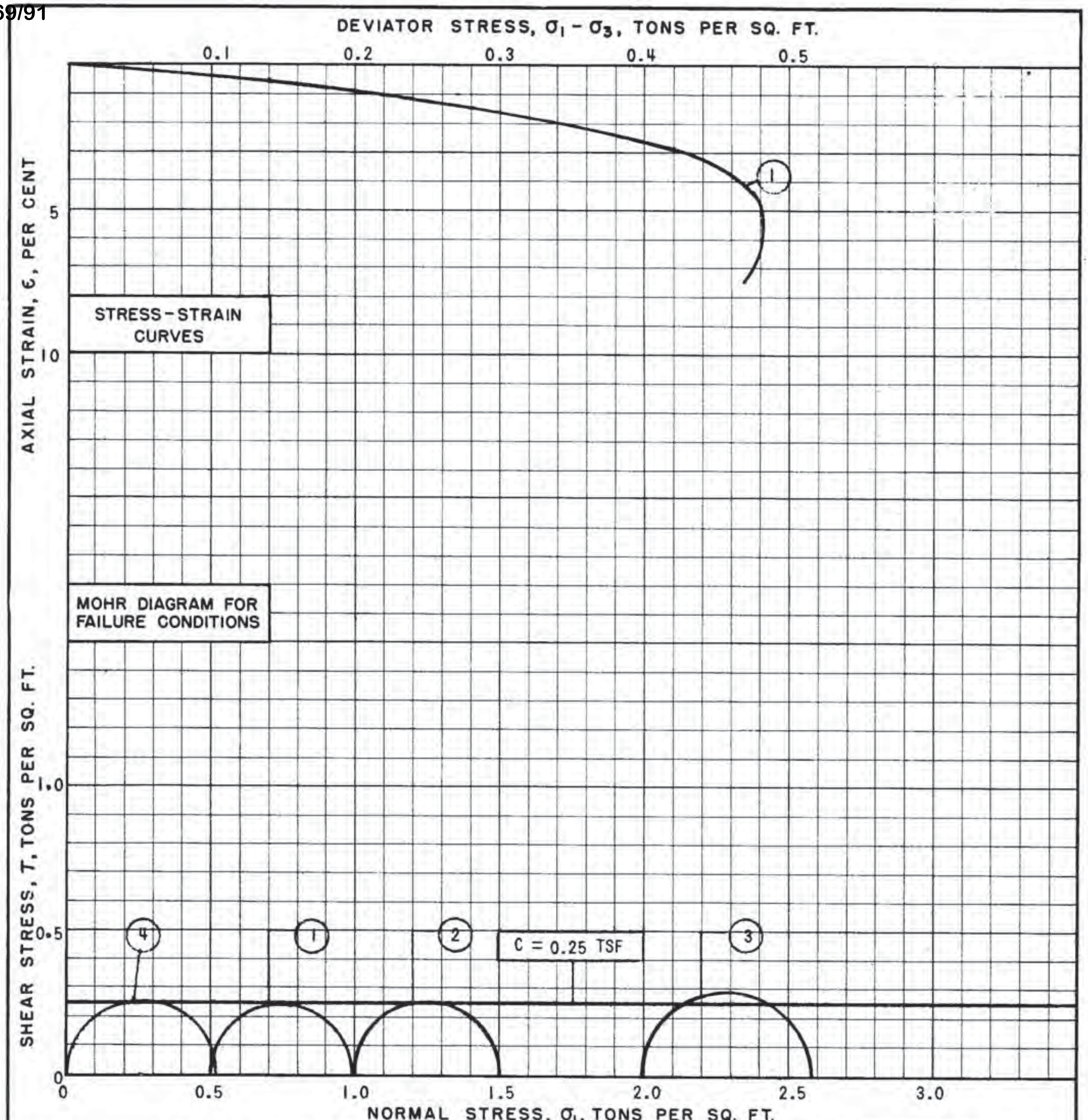
GRADATION CURVES
STRATA (P2) (P3) & (P4) WEST SIDE
PLATE NO. A12



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY
TRACE FINE SAND SEAMS & VEGETATION
STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L-7U	6U	OH	Q	0.5	92.0	91.9			0.48	5
2	L-7U	6U	OH	Q	1.0	82.8	82.3			0.49	6
3	L-7U	5U	OH	Q	2.0	79.2	78.5			0.57	7
4	L-7U	5U	OH	U	--	72.6	71.4			0.51	6

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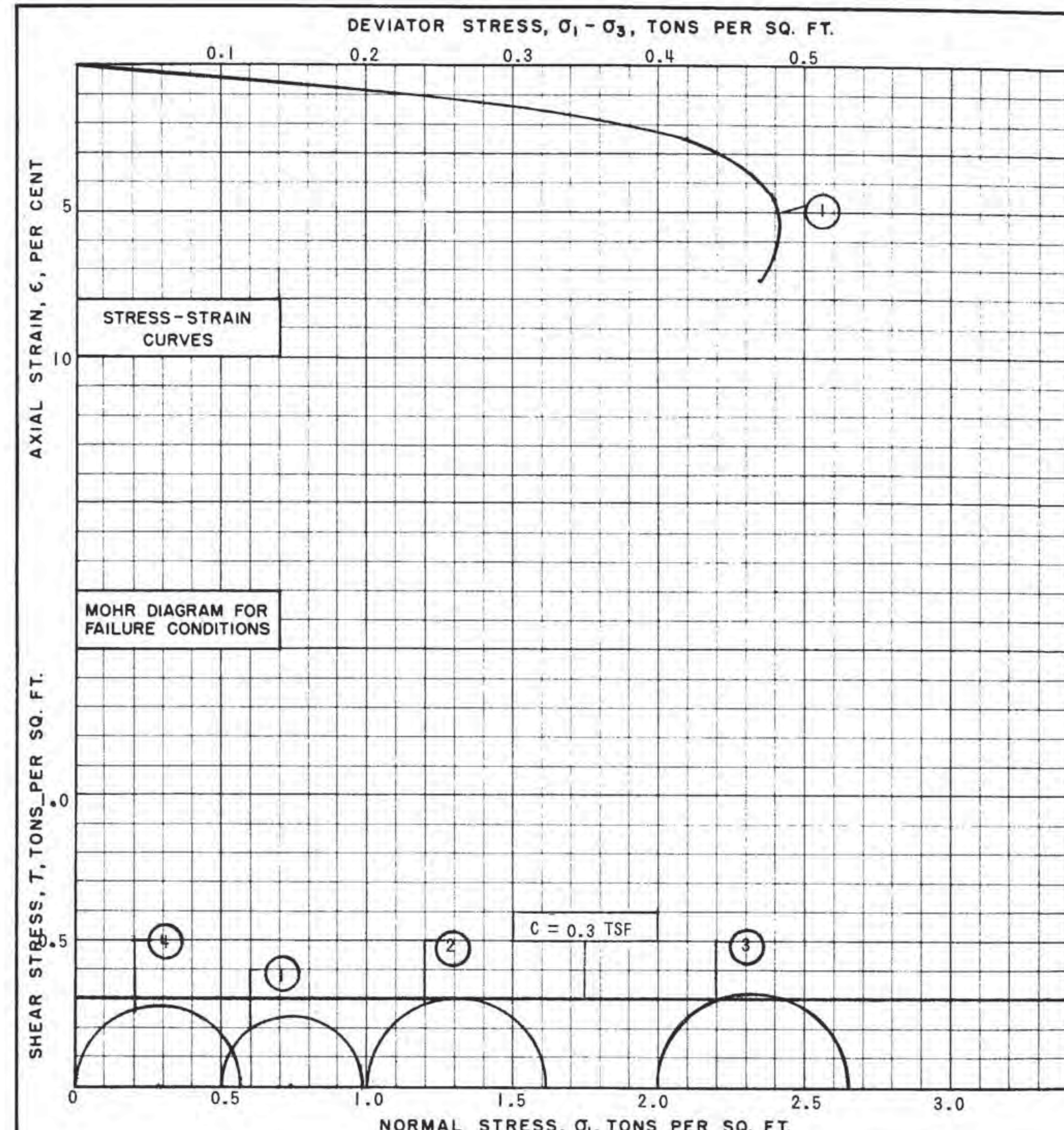
MADE BY: VLT DATE: 7-16-70 FILE NO. 3291E
CH'KD BY: JS DATE: 7-16-70

SUMMARY OF STRENGTH TESTS
BORING L7U, SAMPLES 5U & 6U

PLATE NO. A 13



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY
STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L7U	7U	OH	Q	0.5	75.6	75.5			0.48	5
2	L7U	7U	OH	Q	1.0	81.8	81.5			0.62	5
3	L7U	8U	OH	Q	2.0	73.8	73.4			0.65	5
4	L7U	7U	OH	U	---	70.0	69.7			0.56	10

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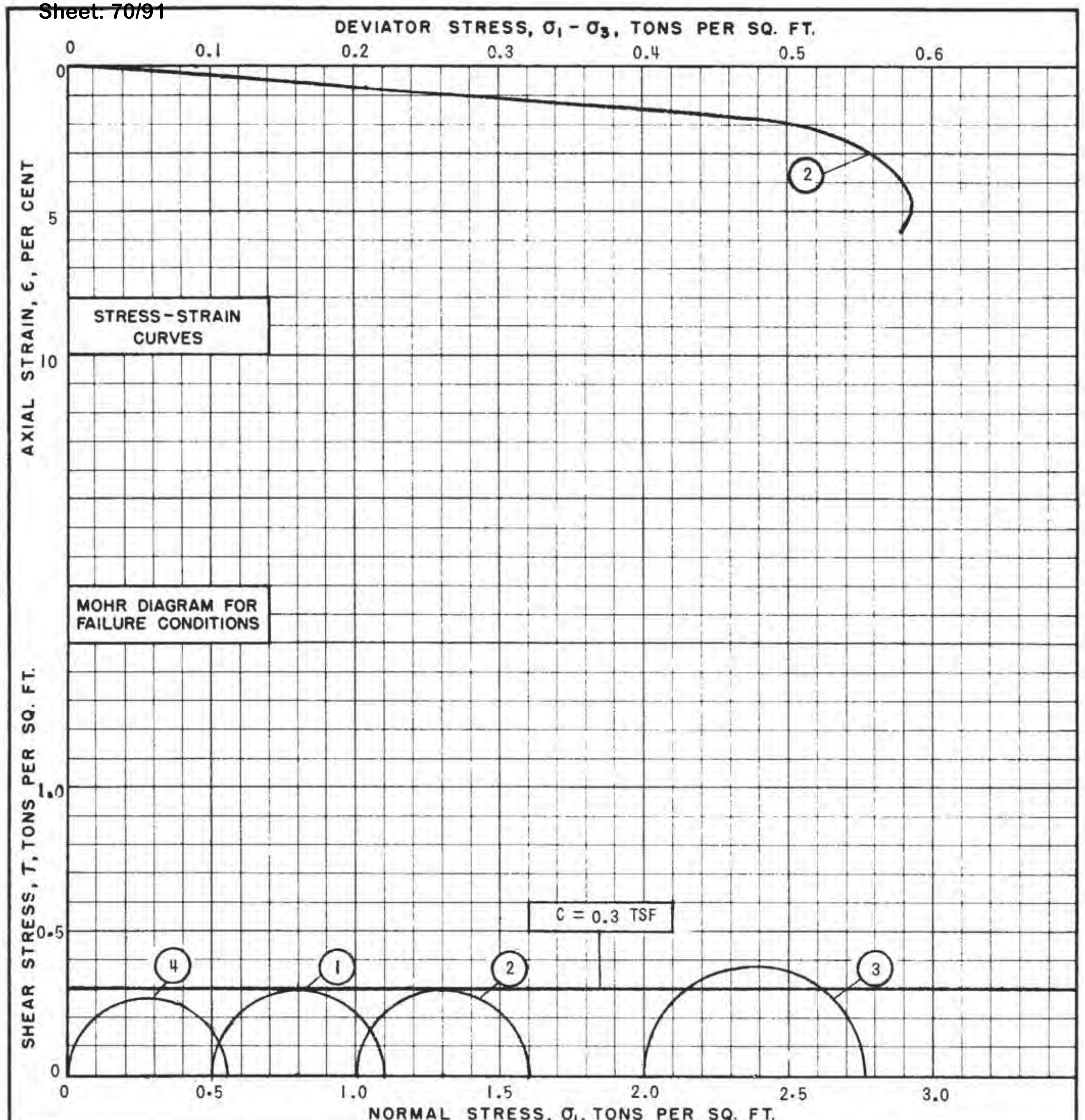
MADE BY: VLT DATE: 7-17-70 FILE NO. 3291E
CH'KD BY: JS DATE: 7-23-70

SUMMARY OF STRENGTH TESTS
BORING L7U, SAMPLES 7U & 8U

PLATE NO. A 14



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY

STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	7U	12U	OH	Q	0.5	57.2	56.4			0.58	6
2	7U	11U	OH	Q	1.0	66.8	66.6			0.59	5
3	7U	12U	OH	Q	2.0	57.4	57.0			0.74	8
4	7U	11U	OH	U	-	65.9	65.1			0.56	5

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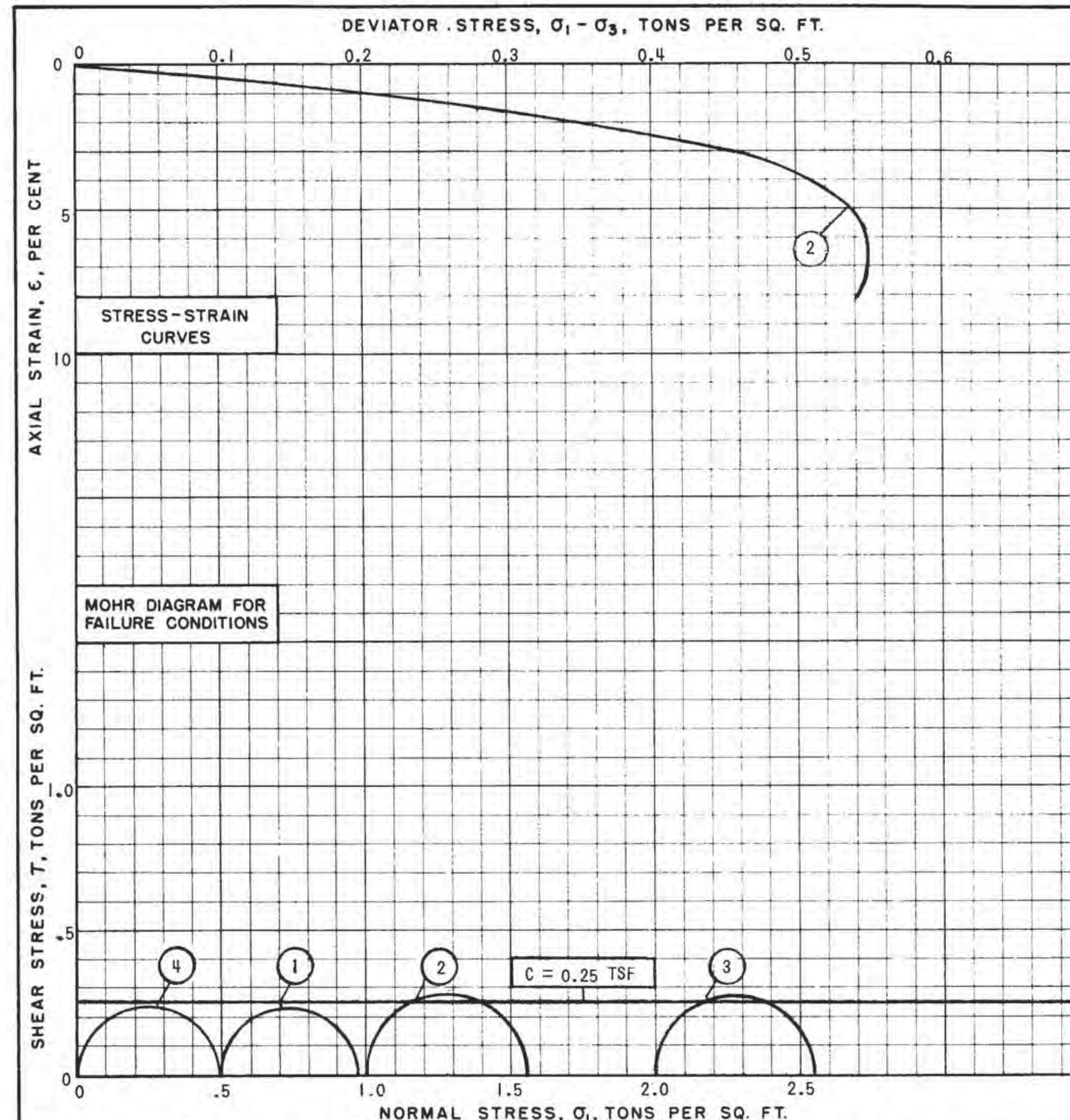
CH'KD BY: PRP DATE: 9-2-70
FILE NO. 3291E

SUMMARY OF STRENGTH TESTS
BORING L7U SAMPLES 11U & 12U
PLATE NO. A15



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY

STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L9U	4U	OH	Q	0.5	58.1	57.7			0.47	6
2	L9U	5U	OH	Q	1.0	77.7	77.5			0.56	6
3	L9U	4U	OH	Q	2.0	52.5	52.0			0.55	8
4	L9U	4U	OH	U	--	51.6	51.1			0.48	9

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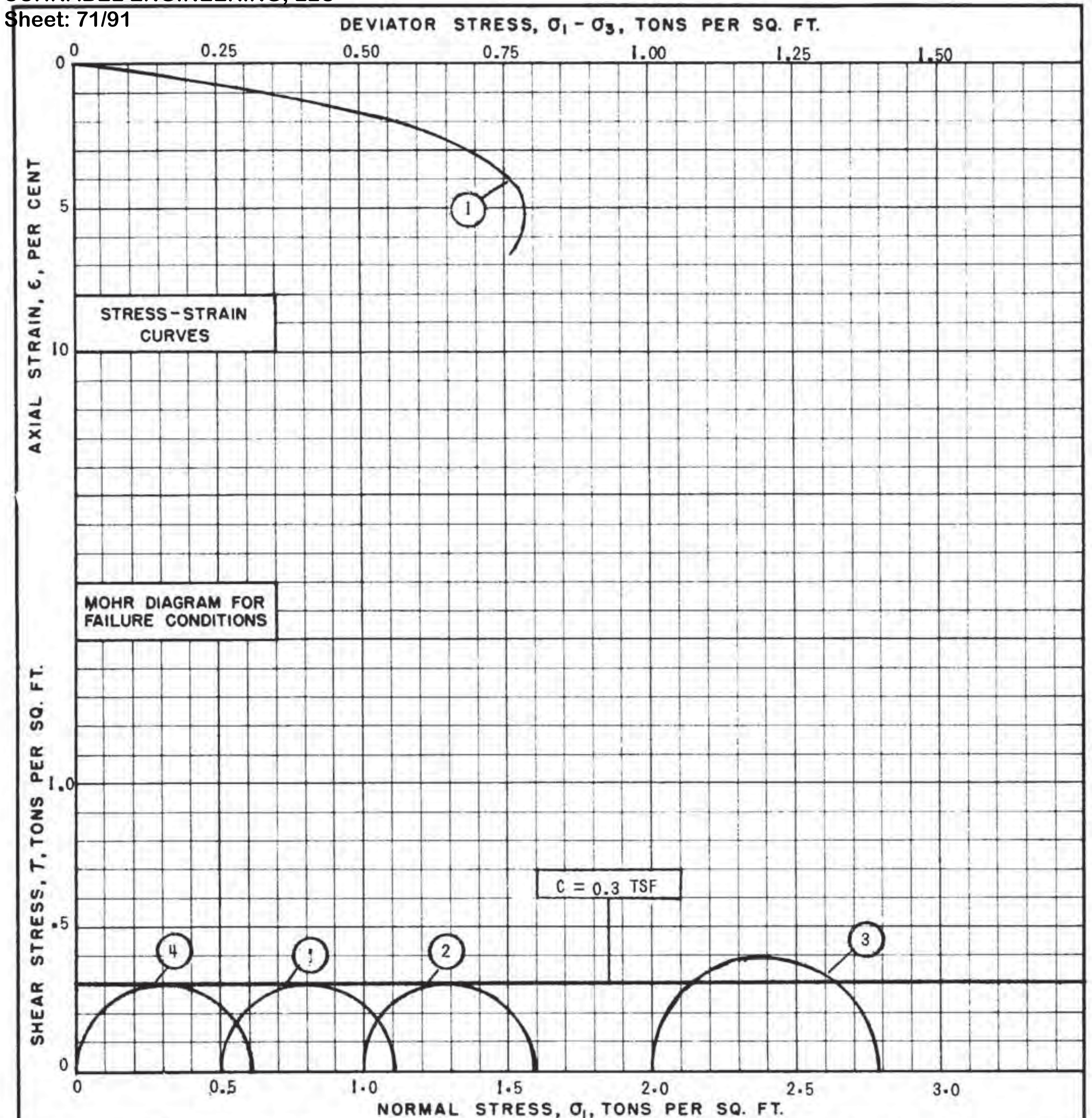
FILE NO. 3291E

SUMMARY OF STRENGTH TESTS
BORING L9U, SAMPLES 4U & 5U
PLATE NO. A16



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
MEDIUM DARK GRAY ORGANIC SILTY CLAY STRATUM (A1)	Q - UNCONDOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L9U	6U	OH	Q	0.5	80.6	80.1			0.60	6
2	L9U	6U	OH	Q	1.0	73.4	73.0			0.58	7
3	L9U	7U	OH	Q	2.0	83.5	83.0			0.78	5
4	L9U	6U	OH	U	--	87.9	87.0			0.59	5

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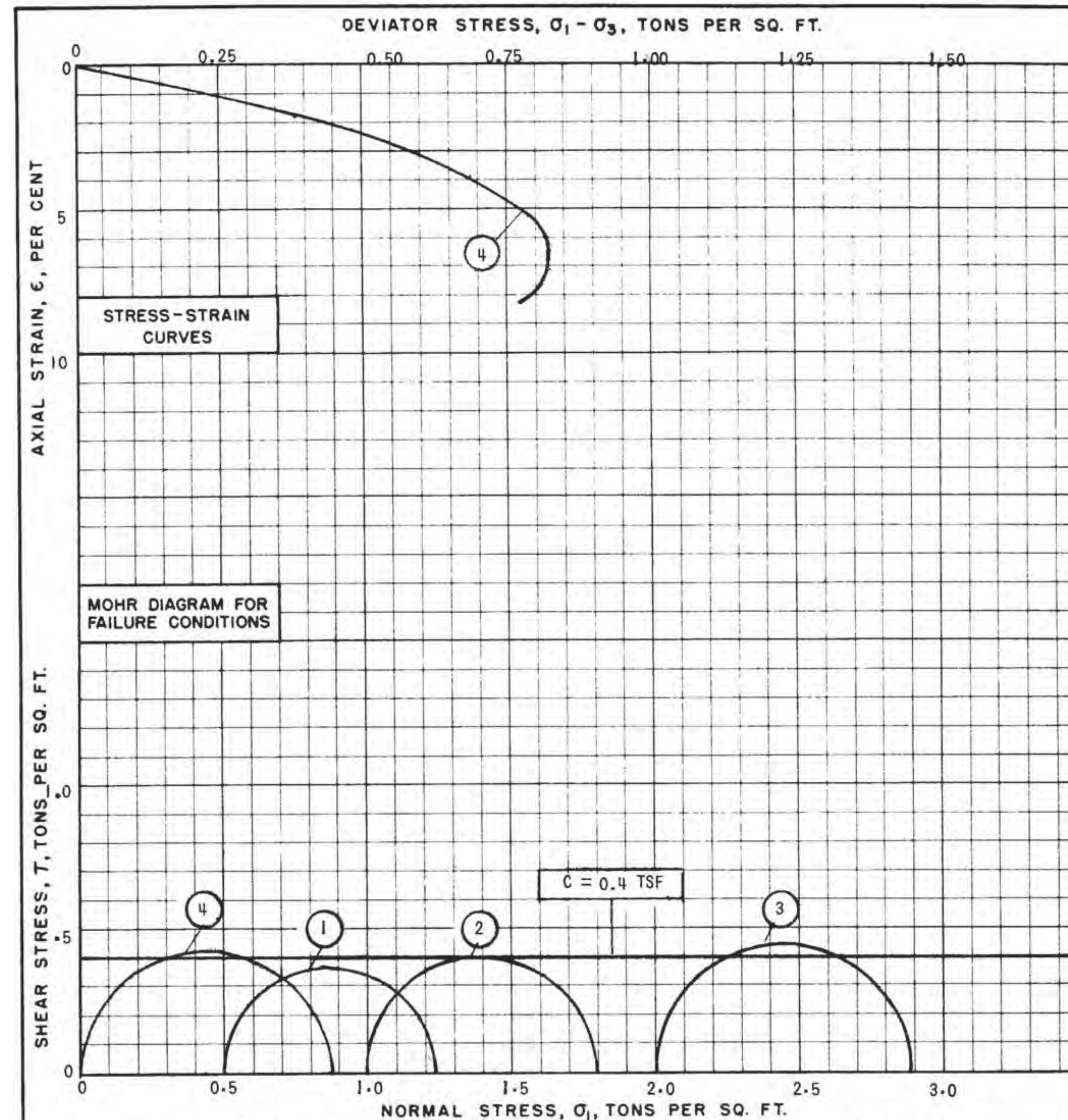
FILE NO. 3291E

SUMMARY OF STRENGTH TESTS
BORING L-9U, SAMPLES 6U & 7U
PLATE NO. A17



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
MEDIUM DARK GRAY ORGANIC SILTY CLAY TRACE FINE SAND SEAMS STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L9U	8U	OH	Q	0.5	72.0	72.0			0.73	7
2	L9U	8U	OH	Q	1.0	70.0	--			0.78	6
3	L9U	9U	OH	Q	2.0	76.3	76.2			0.88	6
4	L9U	9U	OH	U	--	66.5	66.1			0.83	7

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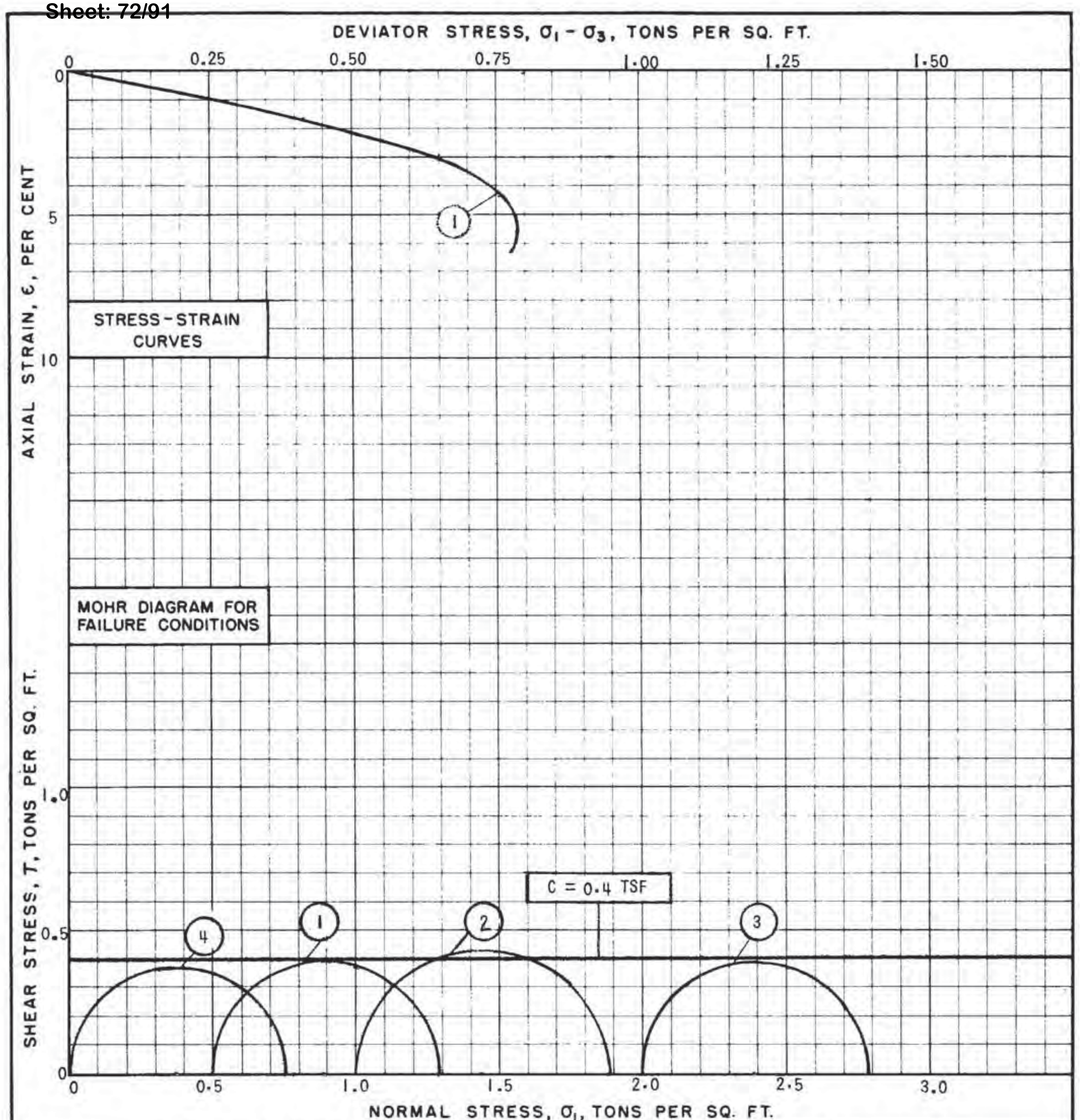
CH'KD BY: VLT DATE: 7-20-70
FILE NO. 3291E

SUMMARY OF STRENGTH TESTS
BORING L-9U, SAMPLES 8U & 9U
PLATE NO. A18



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY,
TRACE FINE SAND SEAMS AND VEGETATION
STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L-9U	10U	OH	Q	0.5	64.5	63.7			0.78	5
2	L-9U	10U	OH	Q	1.0	68.5	67.6			0.86	6
3	L-9U	11U	OH	Q	2.0	71.1	70.7			0.78	6
4	L-9U	11U	OH	U	--	72.8	72.5			0.74	8

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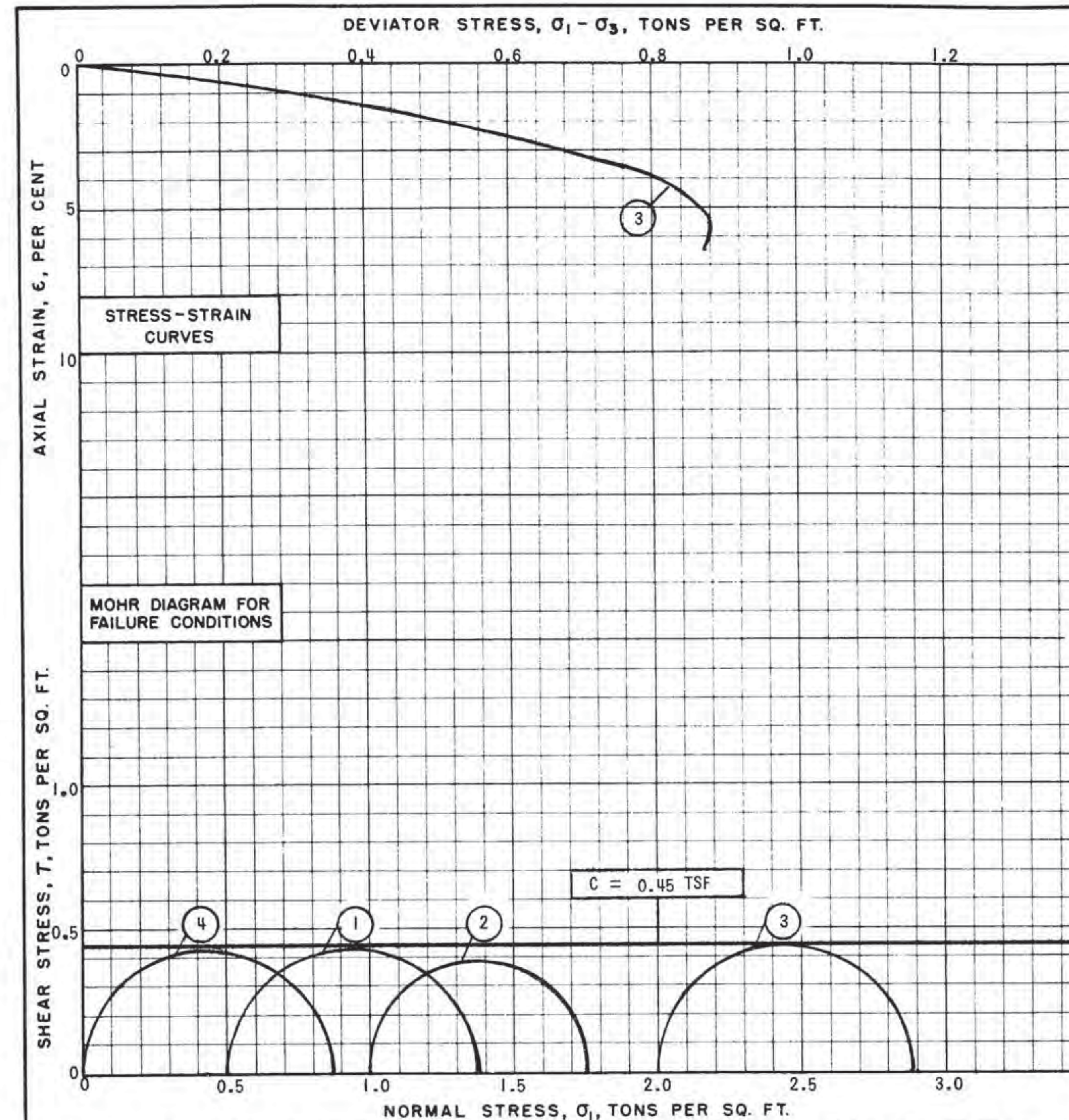
SUMMARY OF STRENGTH TESTS
BORING L9U SAMPLES 10U & 11U

PLATE NO. A 19



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY
TRACE SAND FINE SAND LAYERS AND VEGETATION
STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L9U	14U	OH	Q	0.5	42.0	42.1			0.88	10
2	L9U	14U	OH	Q	1.0	54.9	54.7			0.76	7
3	L9U	14U	OH	Q	2.0	72.0	71.5			0.89	5
4	L9U	10U	OH	U	---	80.7	80.2			0.86	6

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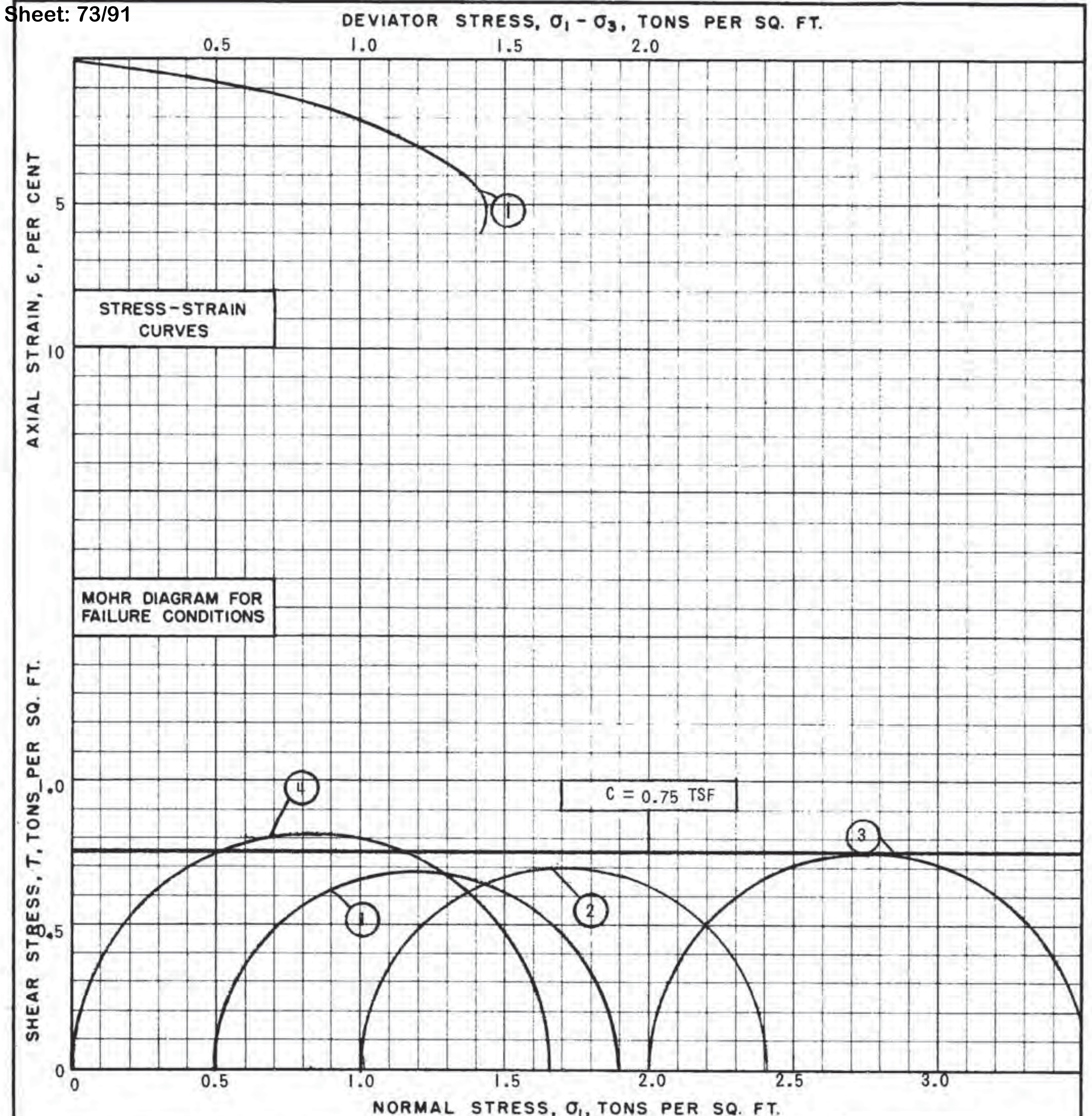
SUMMARY OF STRENGTH TESTS
BORING L9U, SAMPLES 10U & 14U

PLATE NO. A 20



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
STIFF DARK GRAY ORGANIC SILTY CLAY, TRACE FINE SAND POCKETS & VEGETATION STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L14U	15U	OH	Q	0.5	64.4	64.1			1.40	5
2	L14U	14U	OH	Q	1.0	56.3	56.1			1.40	5
3	L14U	15U	OH	Q	2.0	52.9	52.4			1.51	6
4	L14U	14U	OH	U	---	55.3	54.9			1.64	5

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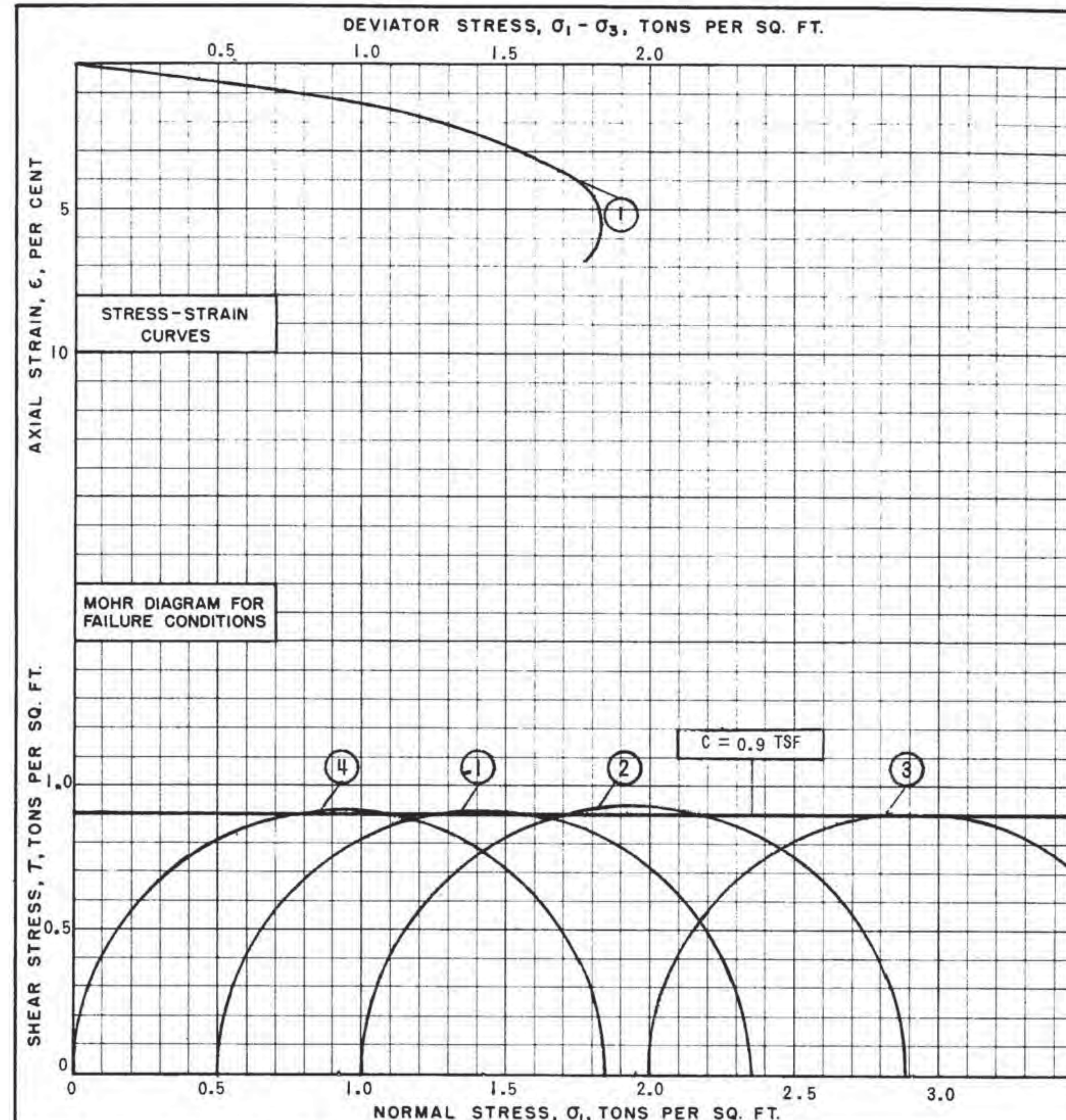
CH'KD BY: PRP DATE: 9-2-70

SUMMARY OF STRENGTH TESTS
BORING L14U, SAMPLES 14U & 15U
PLATE NO. A21



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
STIFF DARK GRAY ORGANIC SILTY CLAY, TRACE FINE SAND POCKETS & VEGETATION STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L14U	16U	OH	Q	0.5	69.4	68.7			1.81	5
2	L14U	17U	OH	Q	1.0	61.2	61.2			1.88	6
3	L14U	16U	OH	Q	2.0	70.2	69.9			1.82	5
4	L14U	16U	OH	U	---	56.7	56.4			1.85	6

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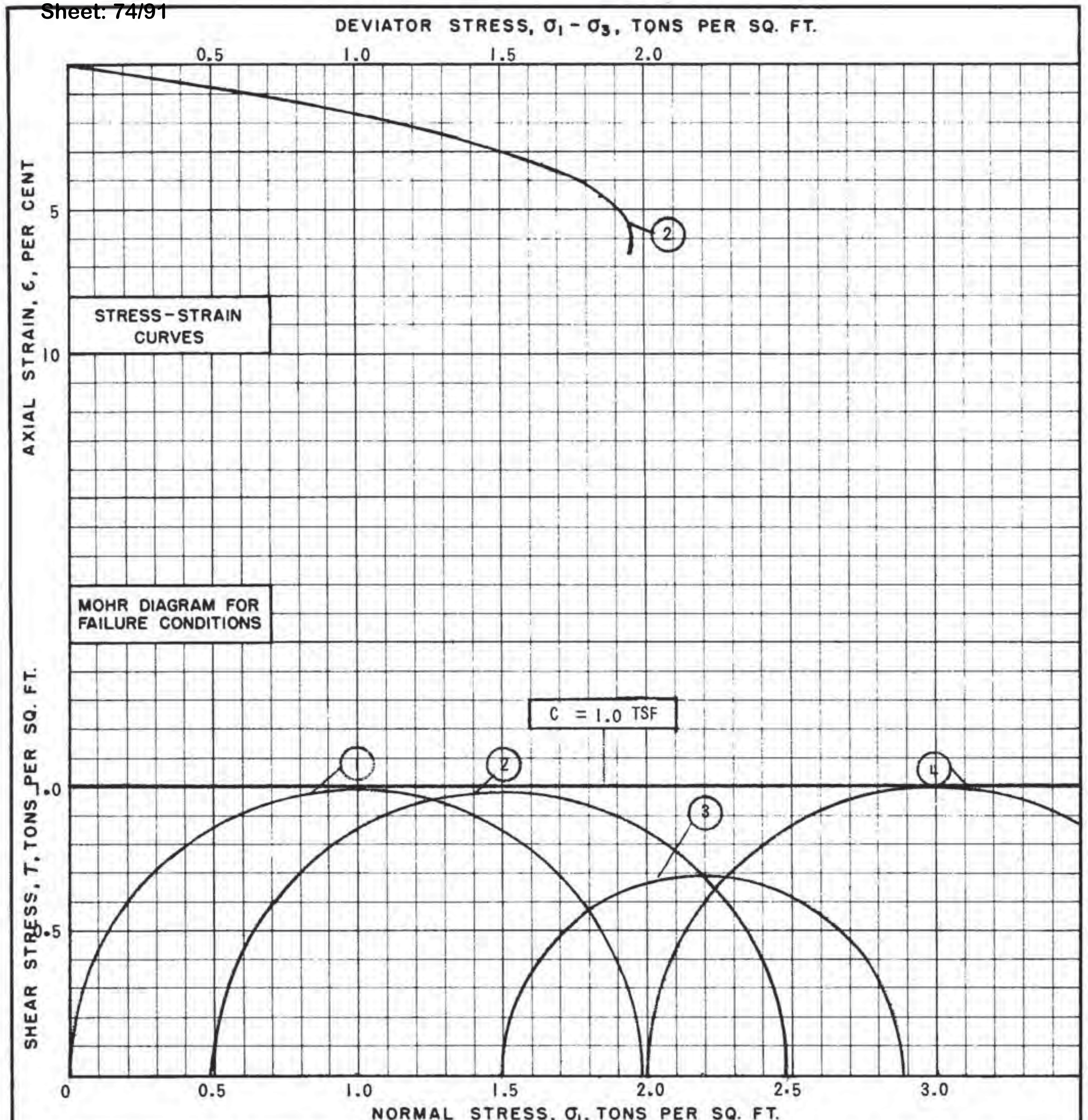
CH'KD BY: PRP DATE: 9-2-70

SUMMARY OF STRENGTH TESTS
BORING L14U, SAMPLES 16U & 17U
PLATE NO. A22



DESCRIPTION OF MATERIAL TESTED

STIFF DARK GRAY ORGANIC SILTY CLAY, TRACE FINE SAND LAYERS, VEGETATION & DECOMPOSED WOOD

STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	L14U	18U	OH	U	---	66.6	66.0			1.97	8
2	L14U	18U	OH	Q	0.5	55.7	55.6			1.97	5
3	L14U	19U	OH	Q	1.0	48.5	48.2			1.38	6
4	L14U	18U	OH	Q	2.0	64.3	64.2			2.01	6

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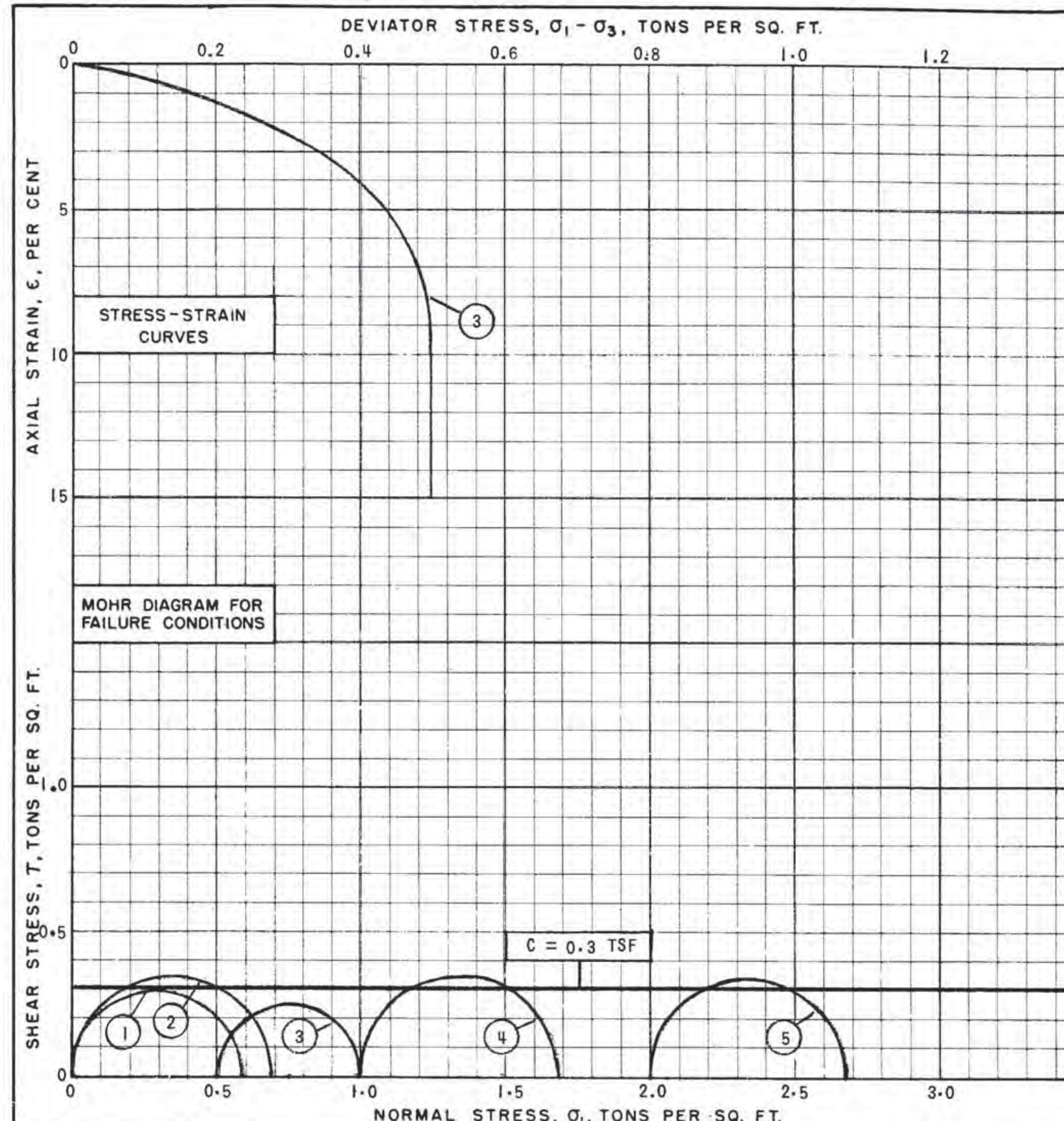
SUMMARY OF STRENGTH TESTS
BORING L14U, SAMPLES 18U & 19U

PLATE NO. A23



DESCRIPTION OF MATERIAL TESTED

MEDIUM TO SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION

STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE TSF	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS TSF	AXIAL STRAIN %
1	17U	4U	OH	U	-	56.5	56.5			0.59	8
2	17U	5U	OH	U	-	42.5	42.6			0,69	11
3	17U	4U	OH	Q	0.5	44.1	43.8			0.50	10
4	17U	4U	OH	Q	1.0	50.5	49.8			0.68	15
5	17U	5U	OH	Q	2.0	49.5	49.0			0.67	12

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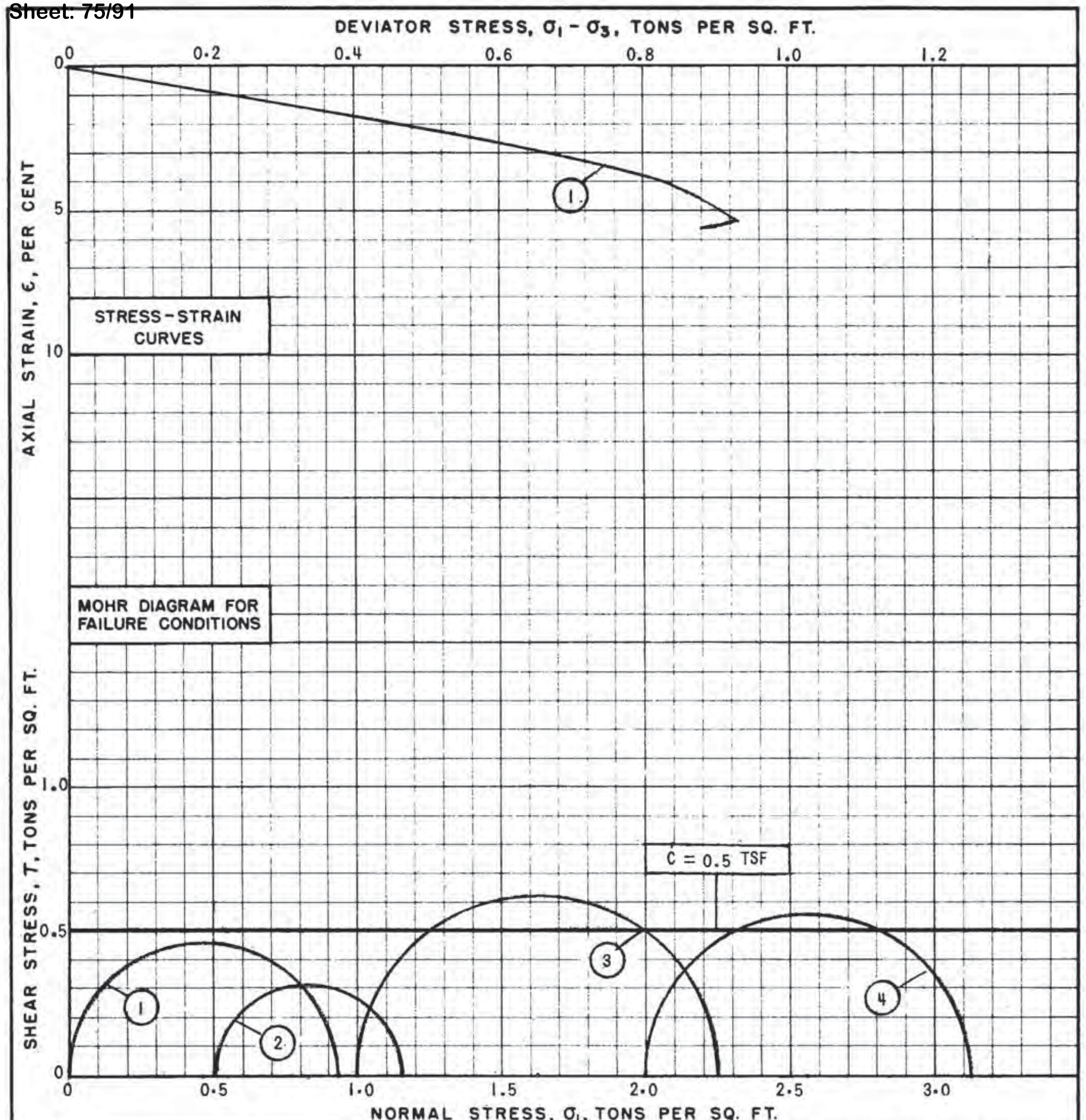
CH'KD BY: VLT DATE: 11-24-70

SUMMARY OF STRENGTH TESTS
BORING L-17U SAMPLE 4U & 5U

PLATE NO. A24



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY, SOME FINE SAND LAYERS, TRACE DECOMPOSED VEGETATION

STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	17U	11U	OH	U	-	40.6	40.2			0.93	5
2	17U	11U	OH	Q	0.5	-	37.9			0.65	16
3	17U	11U	OH	Q	1.0	40.4	39.8			1.25	6
4	17U	19U	OH	Q	2.0	64.0	62.6			1.11	12

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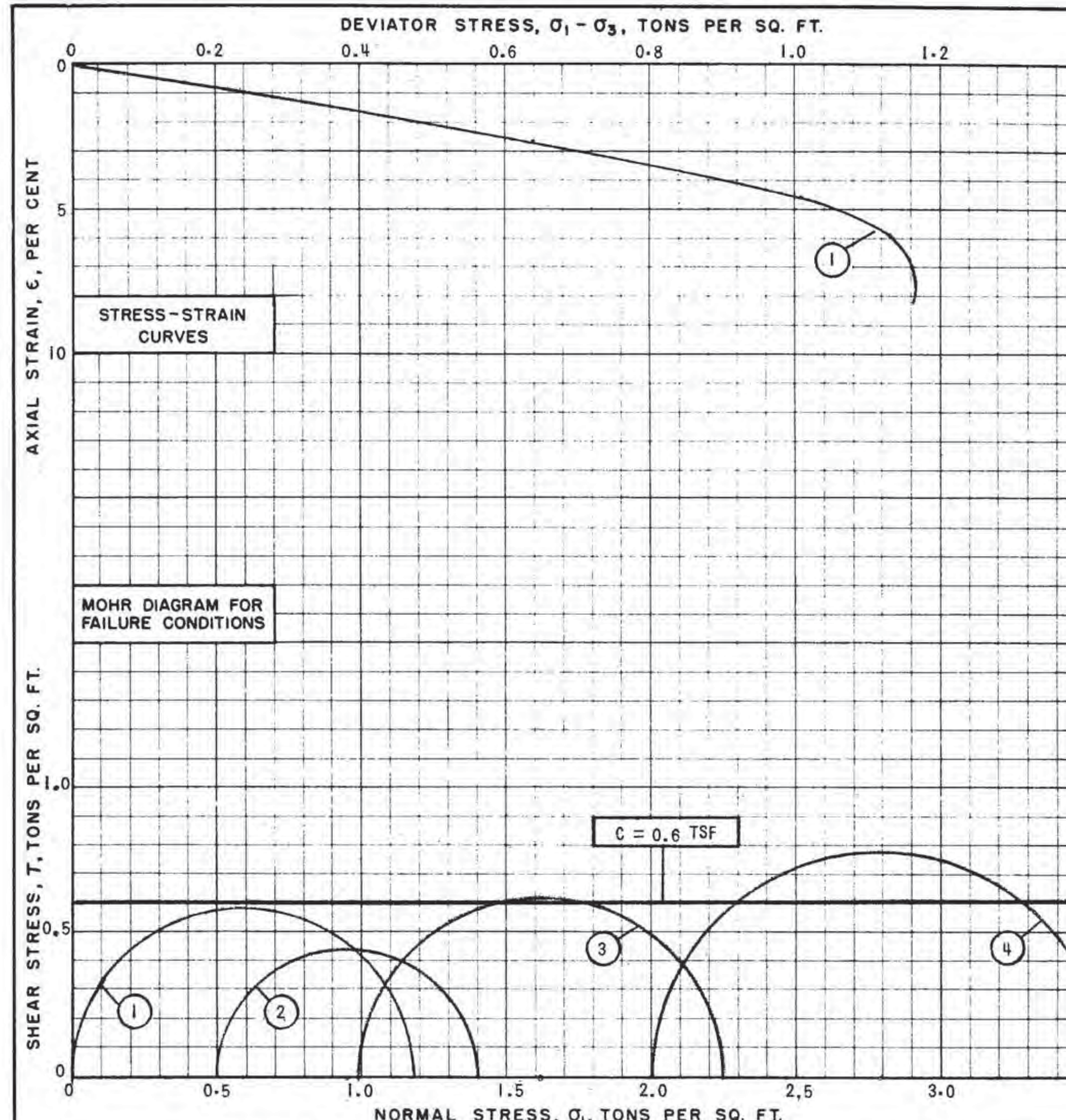
SUMMARY OF STRENGTH TESTS
BORING L-17U SAMPLE 11U & 19U

PLATE NO. A25



DESCRIPTION OF MATERIAL TESTED

MEDIUM DARK GRAY ORGANIC SILTY CLAY TRACE SHELLS AND VEGETATION

STRATUM (A1)

SYMBOLS FOR TEST TYPE

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	17U	17U	OH	U	-	53.6	53.0			1.17	7
2	17U	17U	OH	Q	0.5	57.0	56.6			0.90	11
3	17U	17U	OH	Q	1.0	41.2	40.5			1.24	12
4	17U	19U	OH	Q	2.0	55.1	54.5			1.59	7

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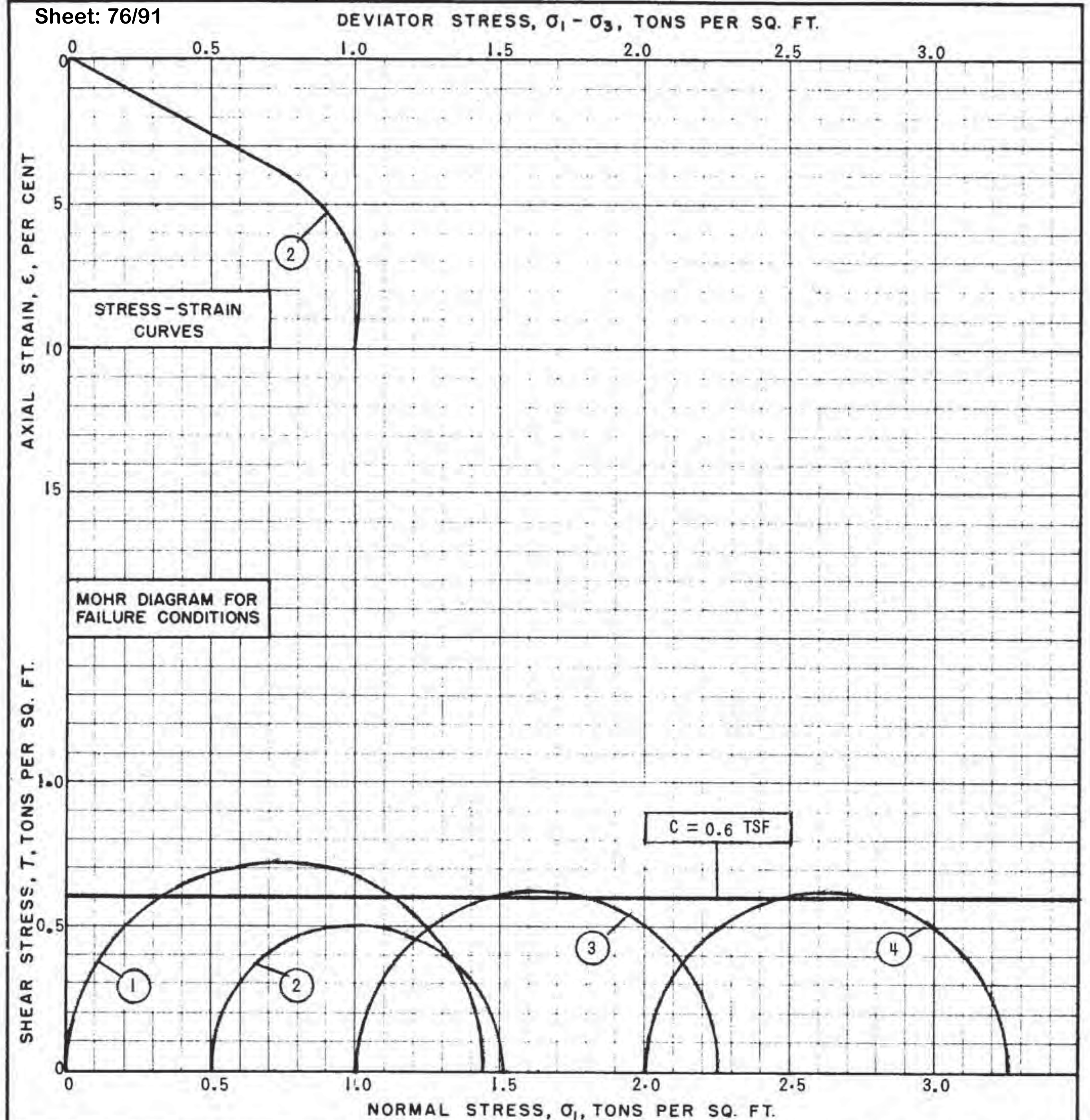
SUMMARY OF STRENGTH TESTS
BORING L-17U SAMPLE 17U & 19U

PLATE NO. A26



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
MEDIUM DARK GRAY ORGANIC SILTY CLAY, TRACE MEDIUM TO FINE SAND SEAMS, TRACE DECOMPOSED WOOD STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	17U	19U	OH	U	-	62.3	61.6			1.44	6
2	17U	18U	OH	Q	0.5	47.0	46.8			1.01	7
3	17U	18U	OH	Q	1.0	-	57.7			1.26	6
4	17U	18U	OH	Q	2.0	56.3	55.6			1.25	6

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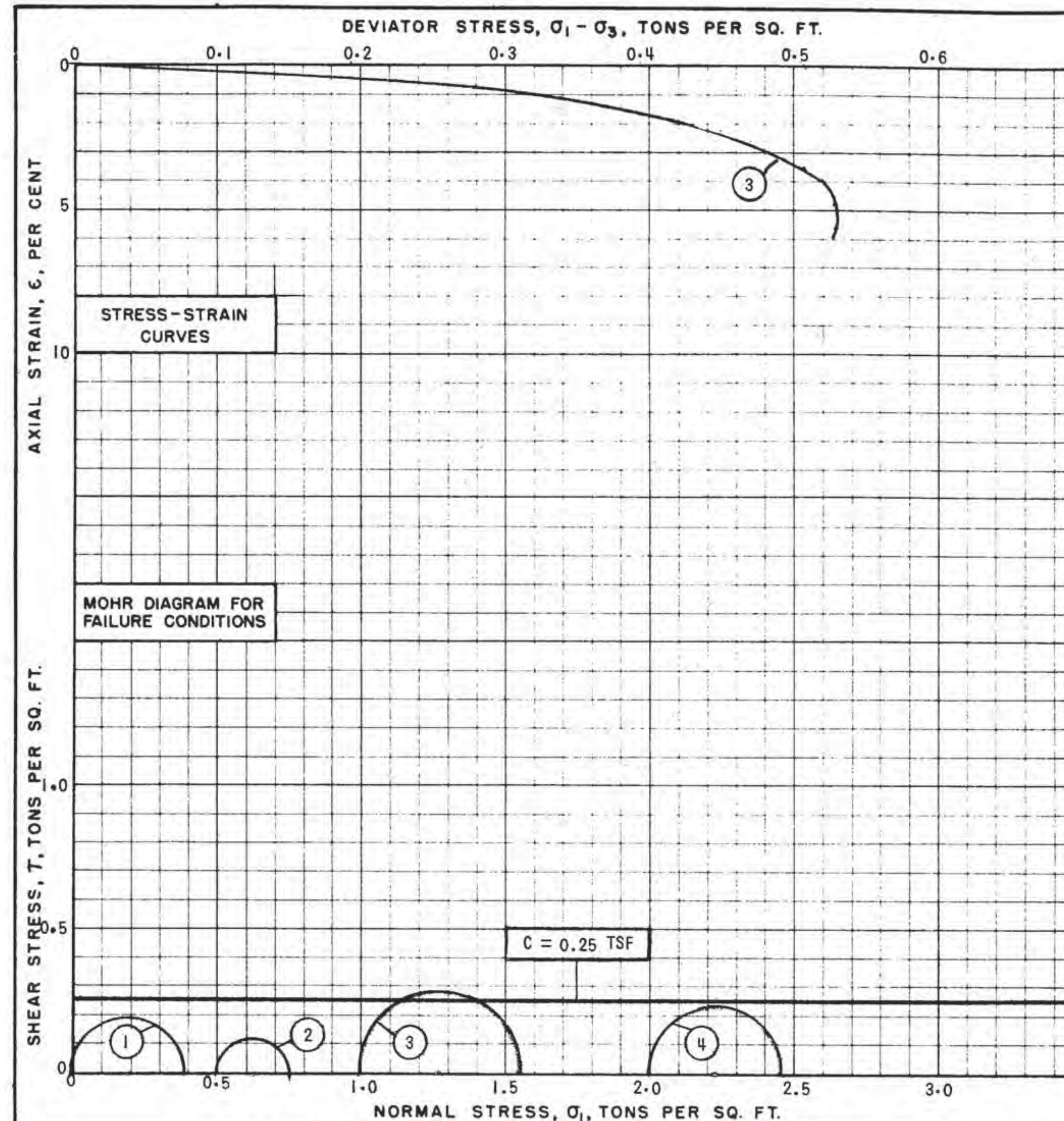
MADE BY: AAK DATE: 11-16-70 FILE NO. 3291E
CH'KD BY: VLT DATE: 11-24-70
SUMMARY OF STRENGTH TESTS
BORING L-17U SAMPLES 18U & 19U
PLATE NO. A27



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	20U	5U	OH	U	-	-	43.8			0.39	11
2	20U	4U	OH	Q	0.5	57.2	56.8			0.25	15
3	20U	5U	OH	Q	1.0	88.5	88.1			0.54	6
4	20U	5U	OH	Q	2.0	74.5	74.1			0.45	6

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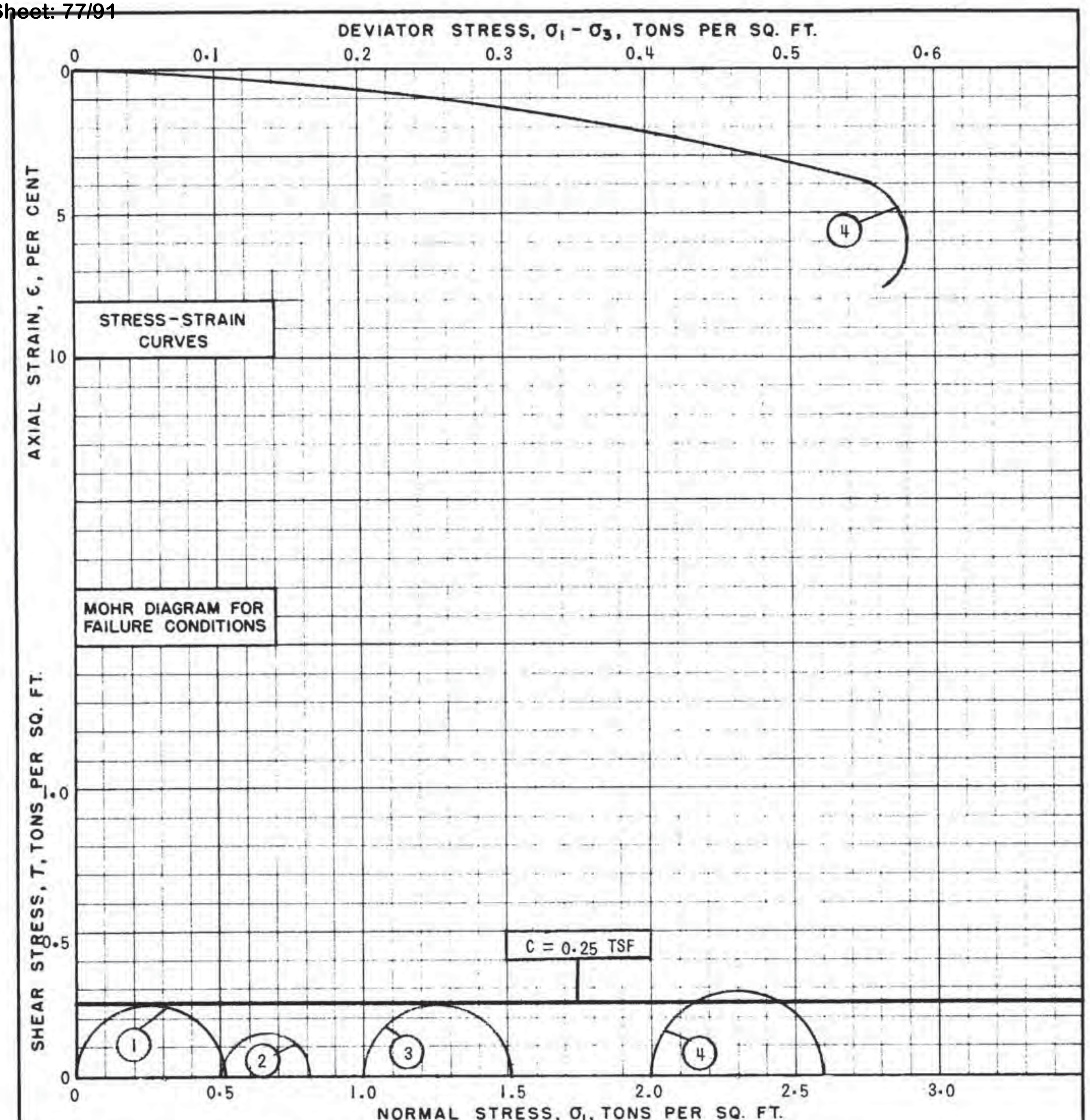
MADE BY: VLT DATE: 11-23-70 FILE NO. 3291E
CH'KD BY: AAK DATE: 11-24-70
SUMMARY OF STRENGTH TESTS
BORING L-20U SAMPLE 4U & 5U
PLATE NO. A28



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE DECOMPOSED VEGETATION STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	20U	6U	OH	U	-	93.6	93.0			0.51	13
2	20U	6U	OH	Q	0.5	92.5	91.2			0.32	14
3	20U	6U	OH	Q	1.0	78.0	77.4			0.51	7
4	20U	7U	OH	Q	2.0	76.0	74.8			0.58	6

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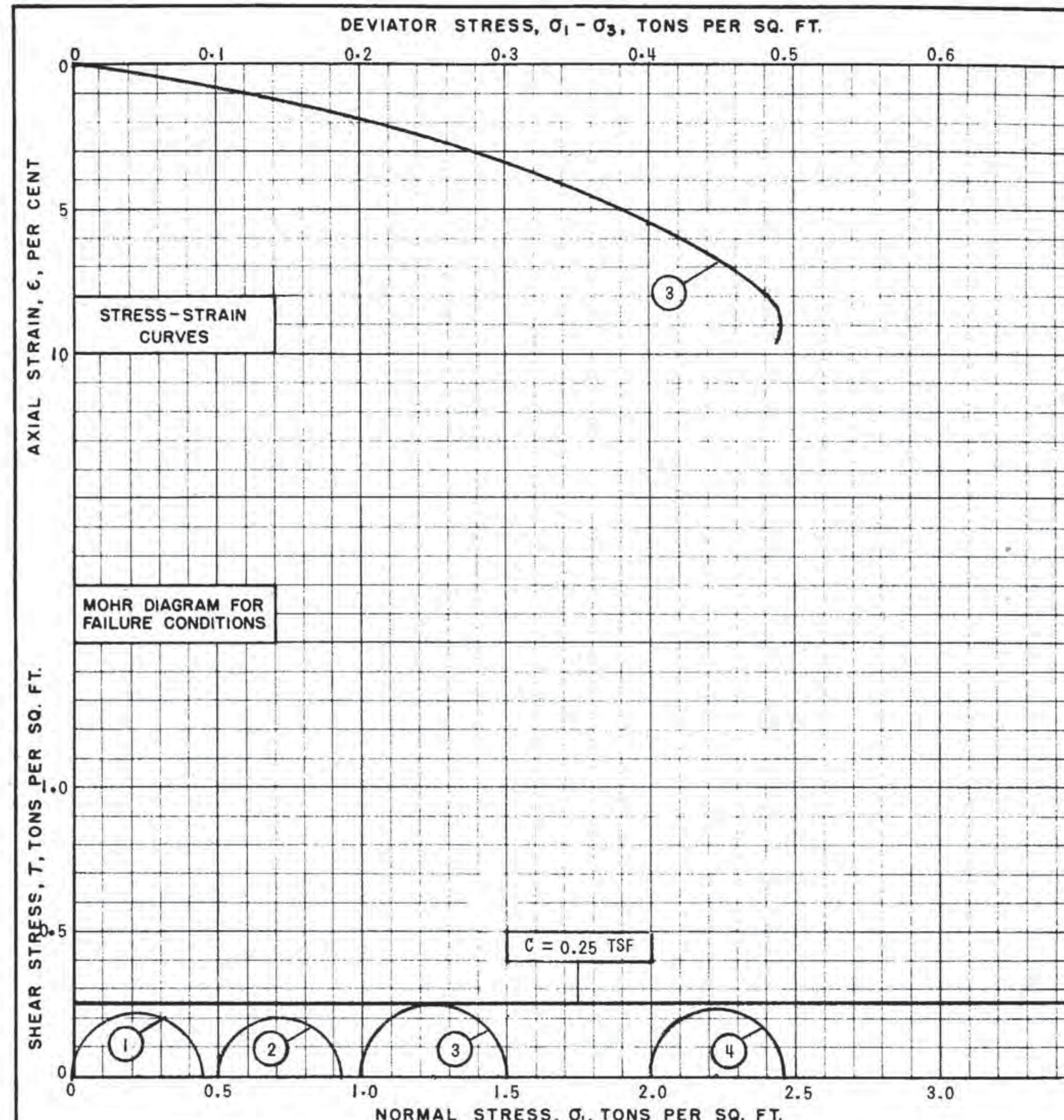
MADE BY VLT	DATE: 11-20-70	FILE NO 3291E
CH'KD BY: AAK	DATE: 11-24-70	

SUMMARY OF STRENGTH TESTS
BORING L-20U SAMPLE 6U & 7U

PLATE NO. A29



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE FINE SAND LAYERS AND VEGETATION STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE T.S.F.	WATER CONTENT - % INITIAL	WATER CONTENT - % FINAL	DEGREE OF SATURATION - % INITIAL	DEGREE OF SATURATION - % FINAL	DEVIATOR STRESS T.S.F.	AXIAL STRAIN %
1	20U	7U	OH	U	-	-	97.0			0.43	12
2	20U	7U	OH	Q	0.5	93.5	92.2			0.42	13
3	20U	8U	OH	Q	1.0	-	85.0			0.49	9
4	20U	8U	OH	Q	2.0	51.2	50.0			0.45	11

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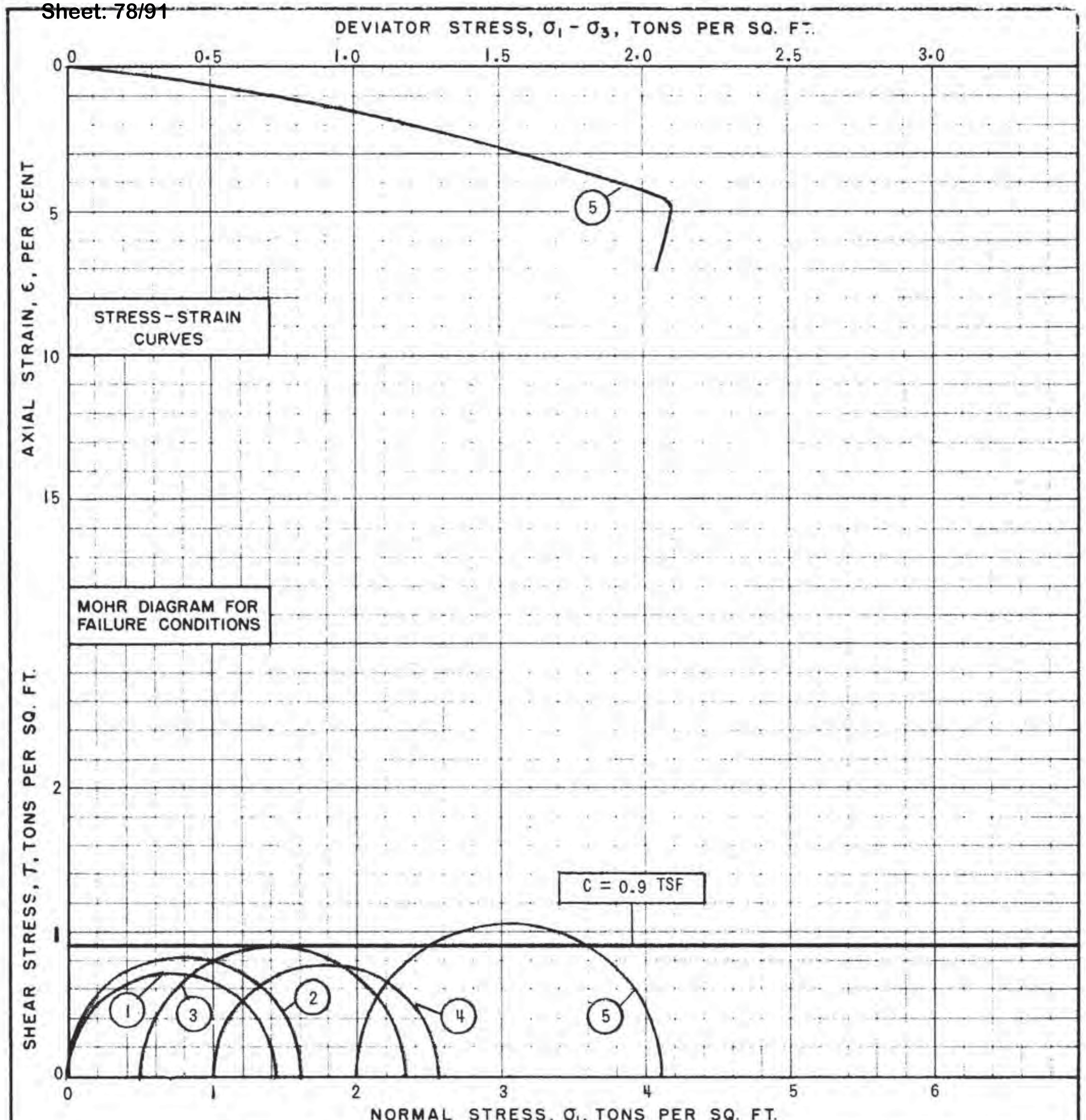
CH'KD BY: AAK	DATE: 11-24-70	

SUMMARY OF STRENGTH TESTS
BORING L-20U SAMPLE 7U & 8U

PLATE NO. A30



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
STIFF GRAY ORGANIC SILTY CLAY, TRACE DECOMPOSED VEGETATION STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST U - UNCONFINED COMPRESSION TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE TSF	WATER CONTENT - %		DEGREE OF SATURATION - %		DEVIATOR STRESS TSF	AXIAL STRAIN %
						INITIAL	FINAL	INITIAL	FINAL		
(1)	20U	13U	OH	U	-	46.0	45.5			1.43	15
(2)	20U	12U	OH	U	-	-	48.5			1.59	7
(3)	20U	12U	OH	Q	0.5	35.5	35.5			1.81	14
(4)	20U	12U	OH	Q	1.0	43.9	43.6			1.56	15
(5)	20U	13U	OH	Q	2.0	49.0	48.2			2.10	5

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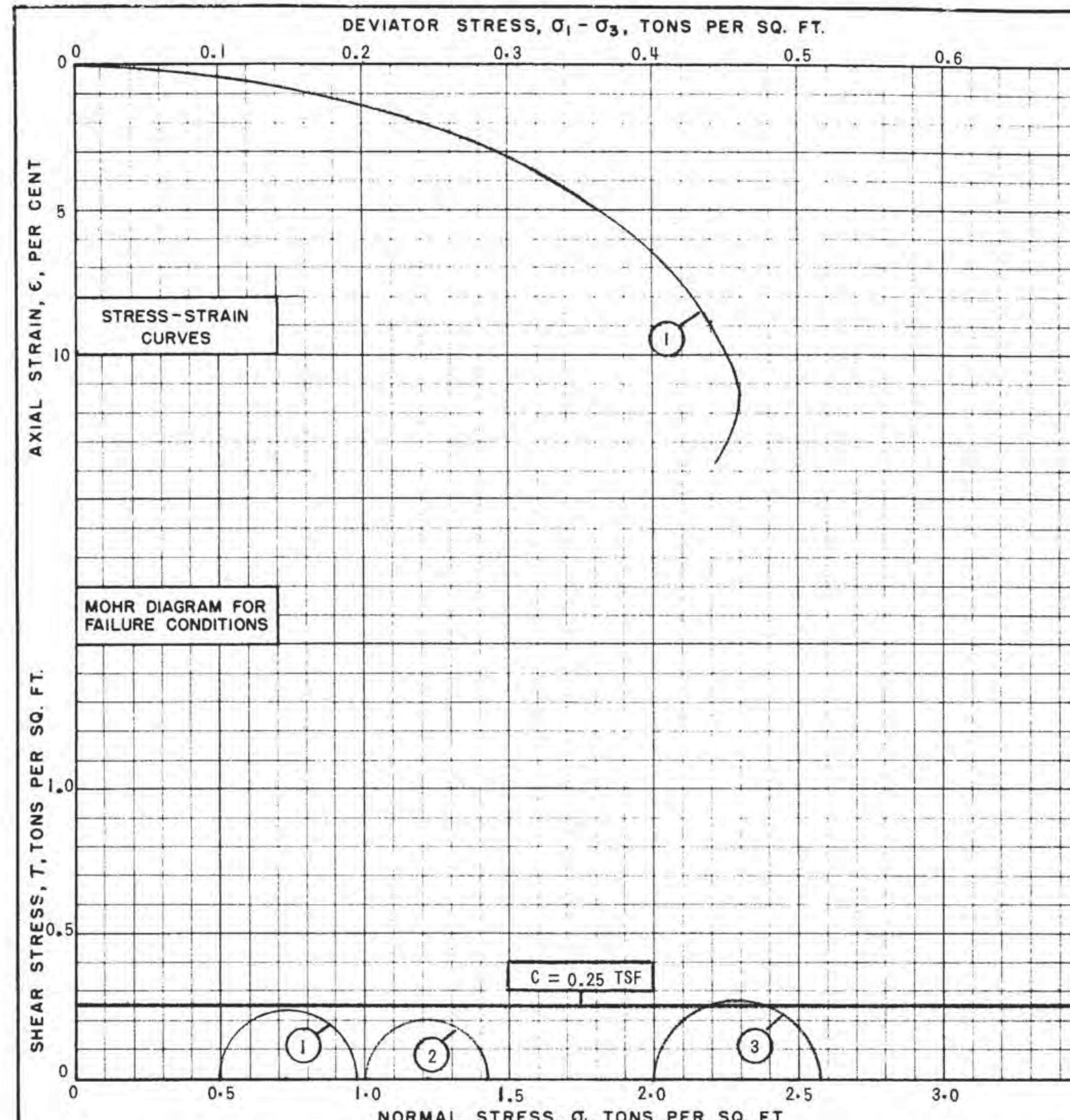
MADE BY	AAK	DATE	11-5-70	FILE NO. 3291E
CH'KD BY	VLT	DATE	11-24-70	

SUMMARY OF STRENGTH TESTS
BORING L-20U SAMPLE 12U & 13U
PLATE NO. A31



DESCRIPTION OF MATERIAL TESTED	SYMBOLS FOR TEST TYPE
BROWN SILTY CLAY, TRACE FINE SAND STRATUM (A1)	Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE TSF	WATER CONTENT - %		DEGREE OF SATURATION - %		DEVIATOR STRESS TSF	AXIAL STRAIN %
						INITIAL	FINAL	INITIAL	FINAL		
(1)	37U	6U	CL	Q	0.5	22.6	22.4			0.46	11
(2)	37U	6U	CL	Q	1.0	24.4	23.1			0.42	11
(3)	37U	6U	CL	Q	2.0	24.3	23.4			0.59	17

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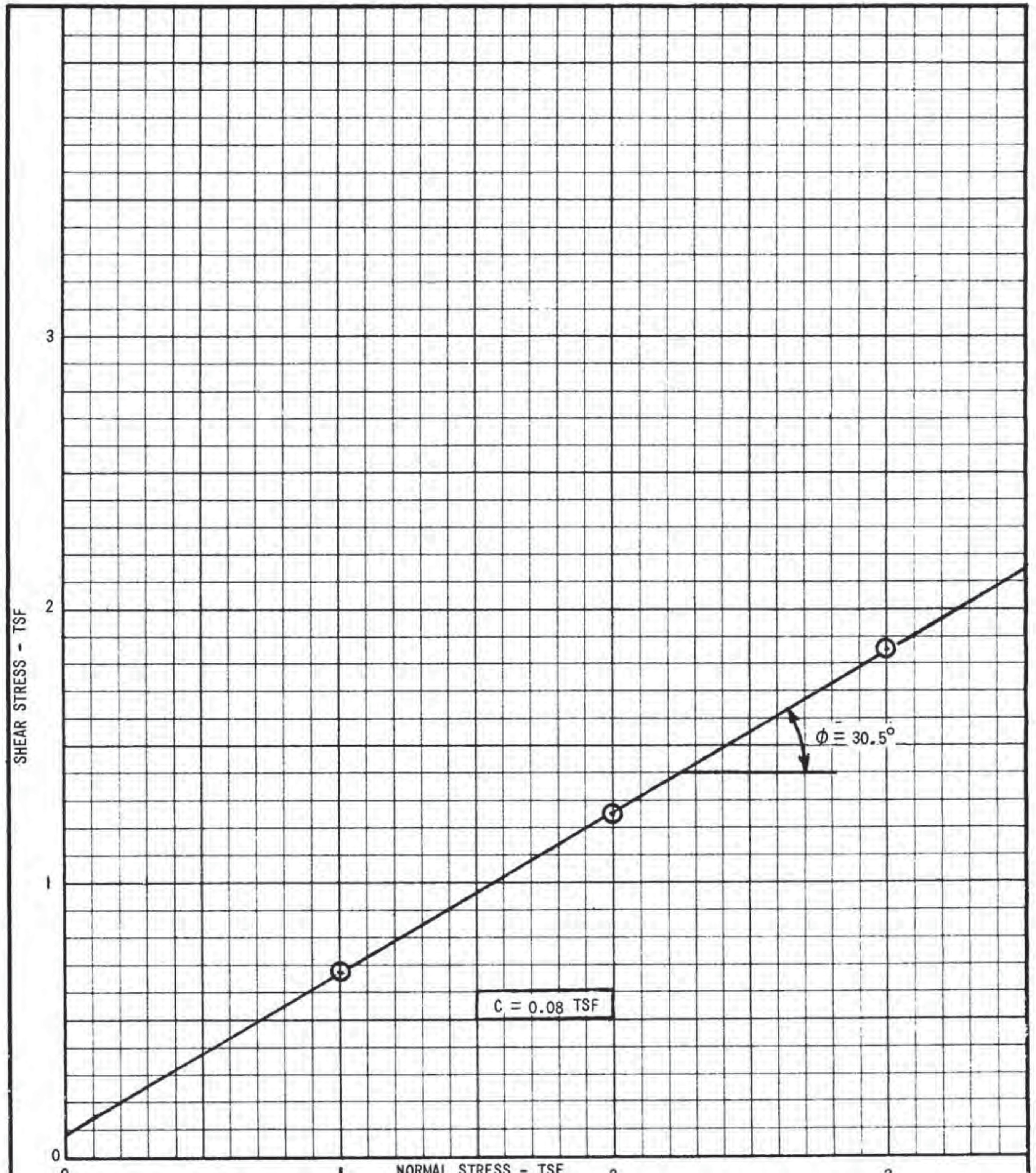
MADE BY	VLT	DATE	11-23-70	FILE NO. 3291E
CH'KD BY	AAK	DATE	11-24-70	

SUMMARY OF STRENGTH TESTS
BORING L-37U SAMPLE 6U
PLATE NO. A32



GRAY SILTY FINE SAND

STRATUM (A2)

BORING NUMBER	SAMPLE NUMBER	FINAL CONDITION			
		WATER CONTENT	PER CENT SATURATION	NORMAL STRESS TSF	SHEAR STRESS TSF
L-17U	6U	46.2		1.0	0.67
		38.0		2.0	1.25
		37.6	93.4	3.0	1.85

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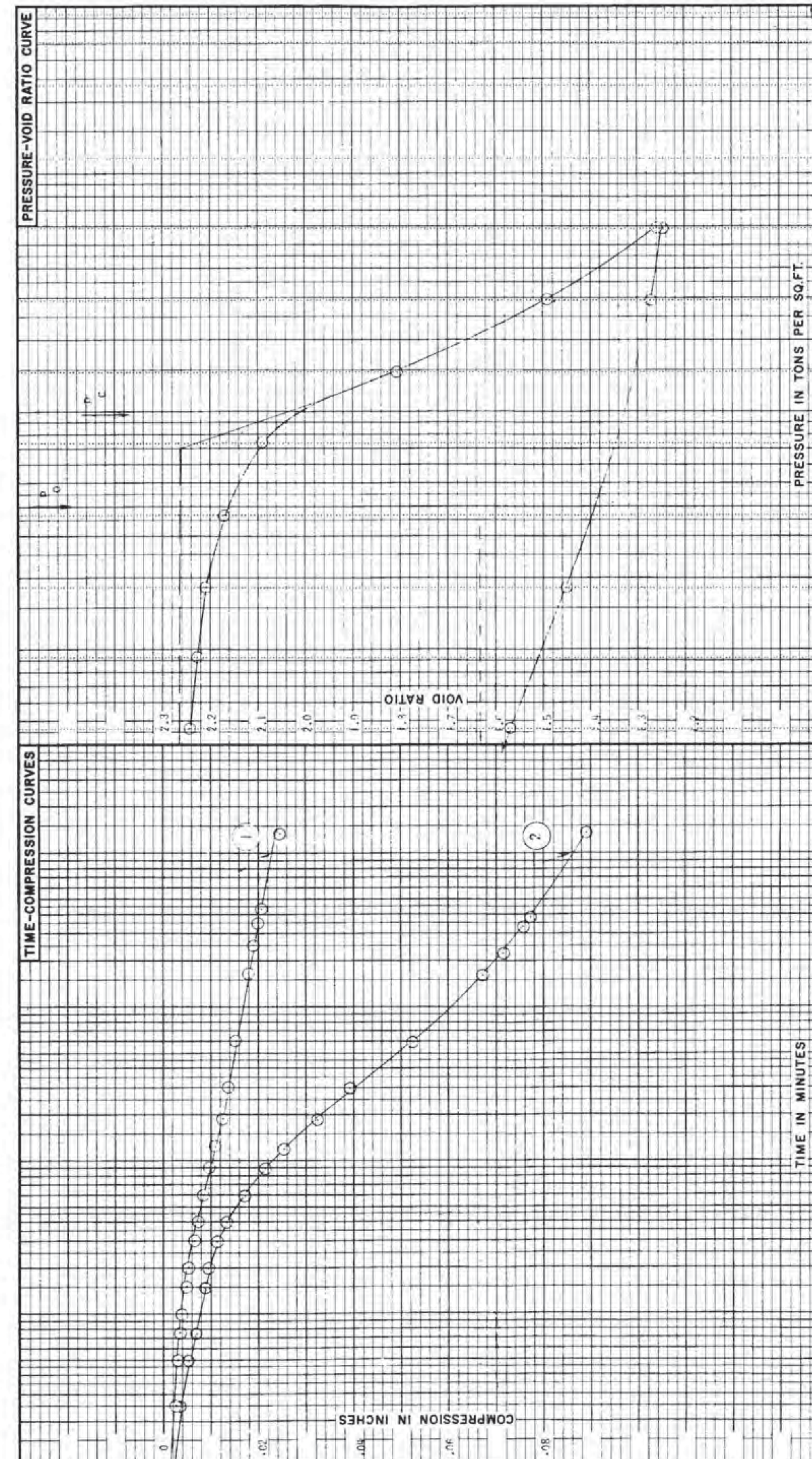
MADE BY: AAK DATE: 11-11-70
CH'KD BY: VLT DATE: 11-23-70
FILE NO. 3291E

DIRECT SHEAR TEST
BORING L-17U SAMPLE 6U
PLATE NO. A33



CURVE NUMBER	PRESSURE INCREMENT FROM (TSF)	TO (TSF)
①	0.733	1.47
②	1.47	2.93
③		
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: MEDIUM DARK GRAY ORGANIC SILTY CLAY TRACE FINE SAND SEAMS

PROPERTIES OF PLASTICITY LIMIT SPECIMEN	
STRATUM DESIGNATION	A1
LIQUID LIMIT (w_L)	72.2
PLASTIC LIMIT (w_p)	49.5
PLASTICITY INDEX (I_p)	22.7
NATURAL WATER CONT. % (w)	77.0
LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	1.21
SPECIFIC GRAVITY (G)	2.55 *

* Assumed

PROPERTIES OF CONSOLIDATION SPECIMEN	
ELEVATION OF SPECIMEN	-44.4
DEPTH OF SPECIMEN (FT.)	21.4
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	.9920
INITIAL WATER CONTENT %	96.6
FINAL WATER CONTENT %	65.0
INITIAL DEGREE SATURATION %	98.5
FINAL DEGREE SATURATION %	101.8

INITIAL VOID RATIO (e_o), SHOWN THUS: ———	2.273
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - -	1.637
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS: P_c↓	.97
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS: P_o↓	0.36
COMPRESSION INDEX (C_c)	1.32
SWELLING INDEX (C_s), REBOUND FROM e = 1.253	0.17

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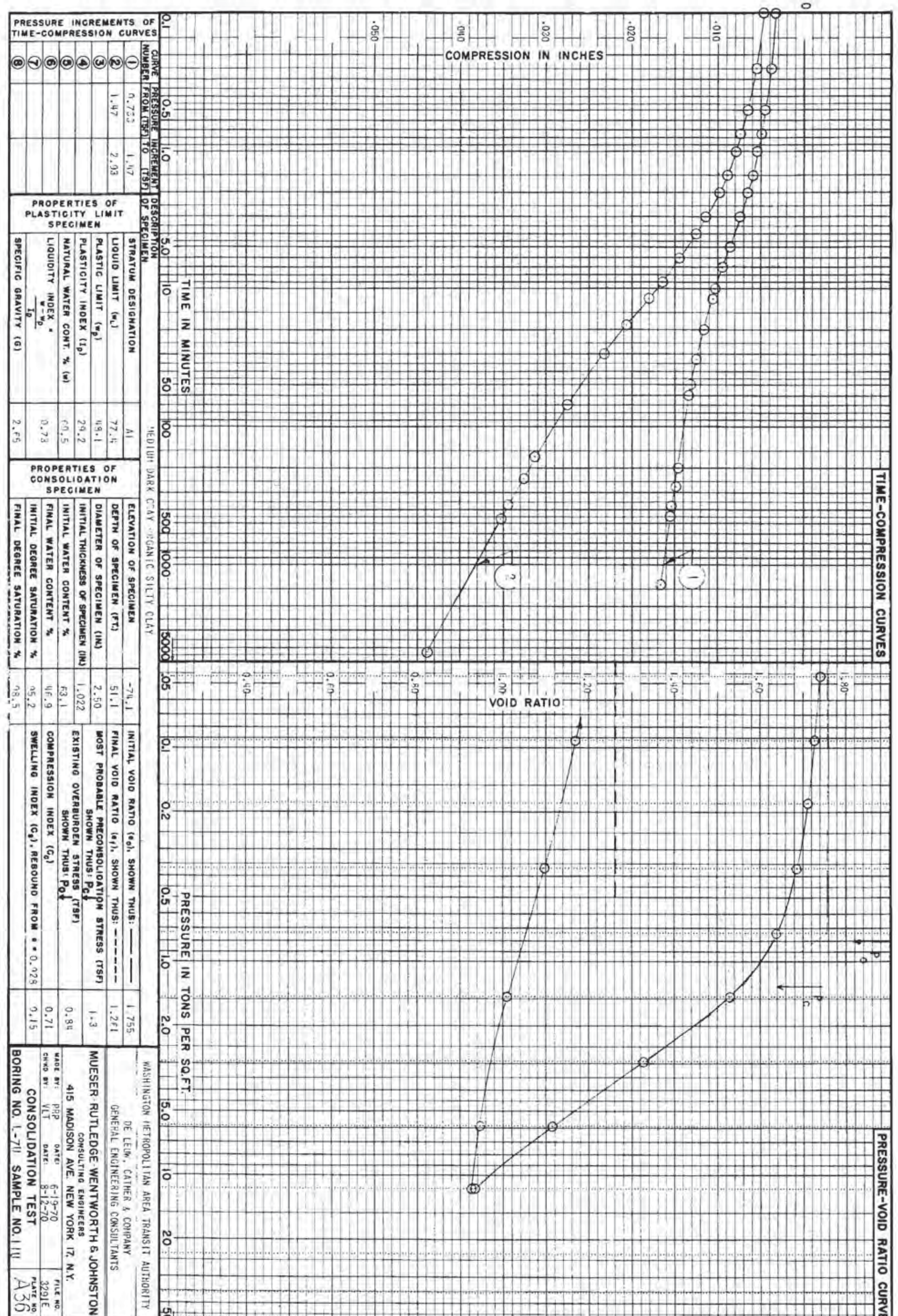
CH'KD BY: JHS DATE: 7-2-70
FILE NO. 3291E

CONSOLIDATION TEST
BORING NO. L-7U SAMPLE NO. 5U
PLATE NO. A34


TIME-COMPRESSION CURVES
COMPRESSION IN INCHES
TIME IN MINUTES
PRESSURE-VOID RATIO CURVE
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
PROPERTIES OF CONSOLIDATION SPECIMEN
MEDIUM DARK GRAY ORGANIC SILTY CLAY
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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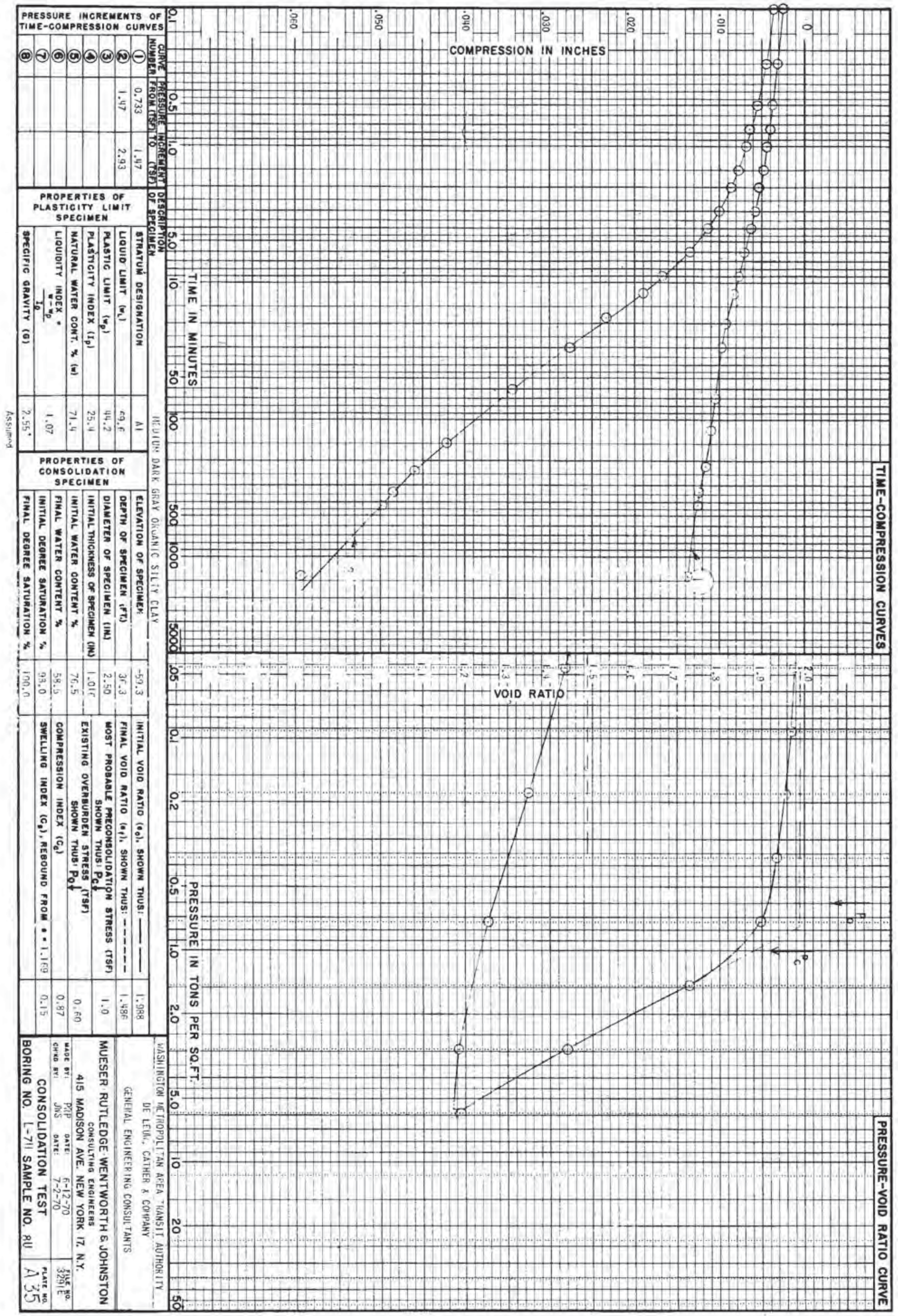
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST
BORING NO. L-711 SAMPLE NO. 1U
A36


TIME-COMPRESSION CURVES
COMPRESSION IN INCHES
TIME IN MINUTES
PRESSURE-VOID RATIO CURVE
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
PROPERTIES OF CONSOLIDATION SPECIMEN
MEDIUM DARK GRAY ORGANIC SILTY CLAY
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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CONSULTING ENGINEERS
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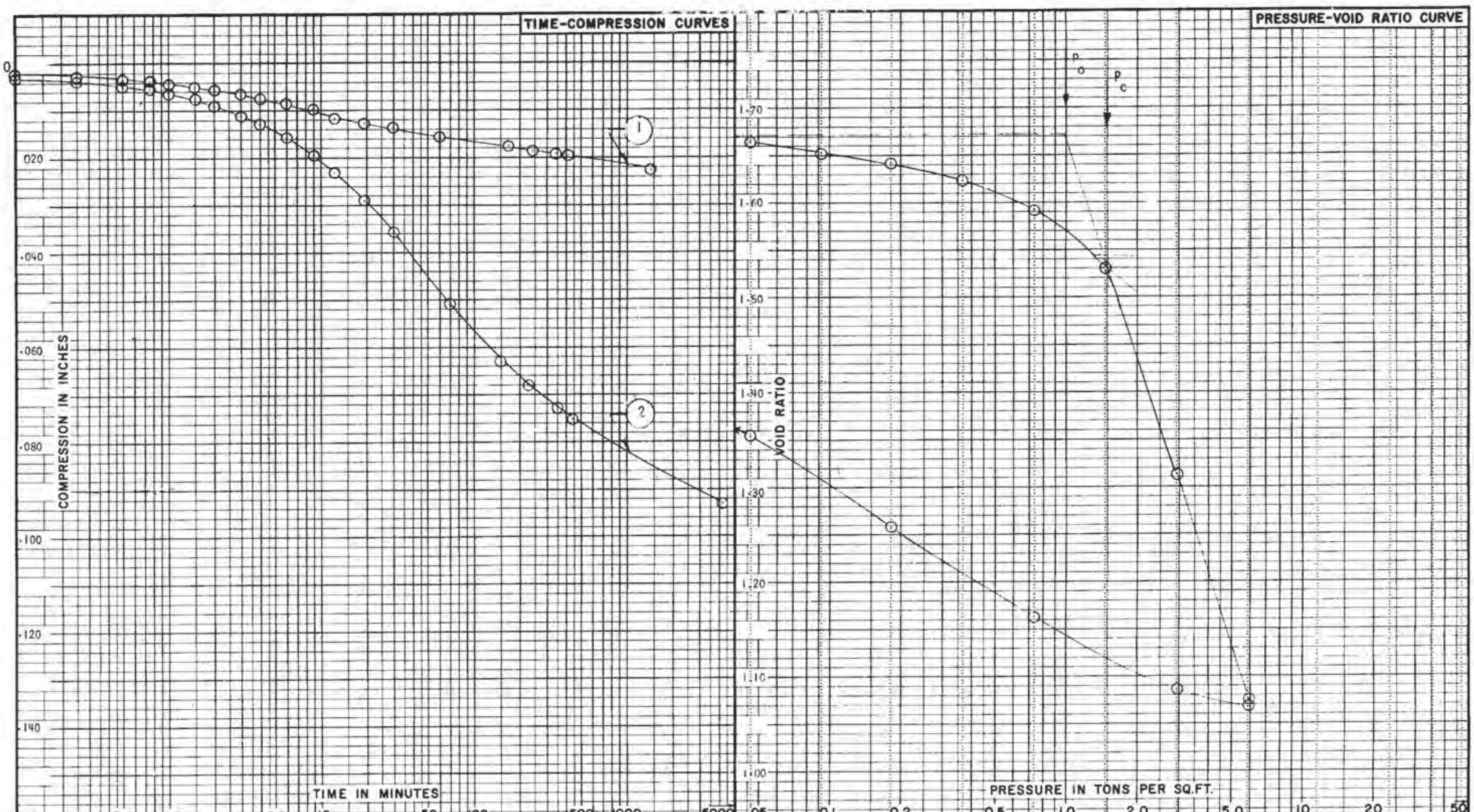
CONSOLIDATION TEST
BORING NO. L-711 SAMPLE NO. 8U
A35



Description of specimen: MEDIUM DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION

Pressure increments of time-compression curves

Curve number	Pressure increment from (TSF)	To (TSF)
1	1.47	2.93
2	2.93	5.87
3		
4		
5		
6		
7		
8		

Properties of plasticity limit specimen

Stratum designation	A1
Liquid limit (w_L)	71.8
Plastic limit (w_P)	46.5
Plasticity index (I_p)	25.3
Natural water cont. % (w)	60.9
Liquidity index = $\frac{w - w_p}{I_p}$	0.57
Specific gravity (G)	2.52

Properties of consolidation specimen

Elevation of specimen	-84.3
Depth of specimen (FT.)	61.3
Diameter of specimen (IN.)	2.50
Initial thickness of specimen (IN.)	1.012
Initial water content %	65.7
Final water content %	56.8
Initial degree saturation %	99.0
Final degree saturation %	100+

Initial void ratio (e_o), shown thus: ———	1.671
Final void ratio (e_f), shown thus: ------	1.411
Most probable preconsolidation stress (TSF) shown thus: P_c↓	1.5
Existing overburden stress (TSF) shown thus: P_o↓	1.0
Compression index (C_c)	0.82
Swelling index (C_s), rebound from e = 1.069	0.16

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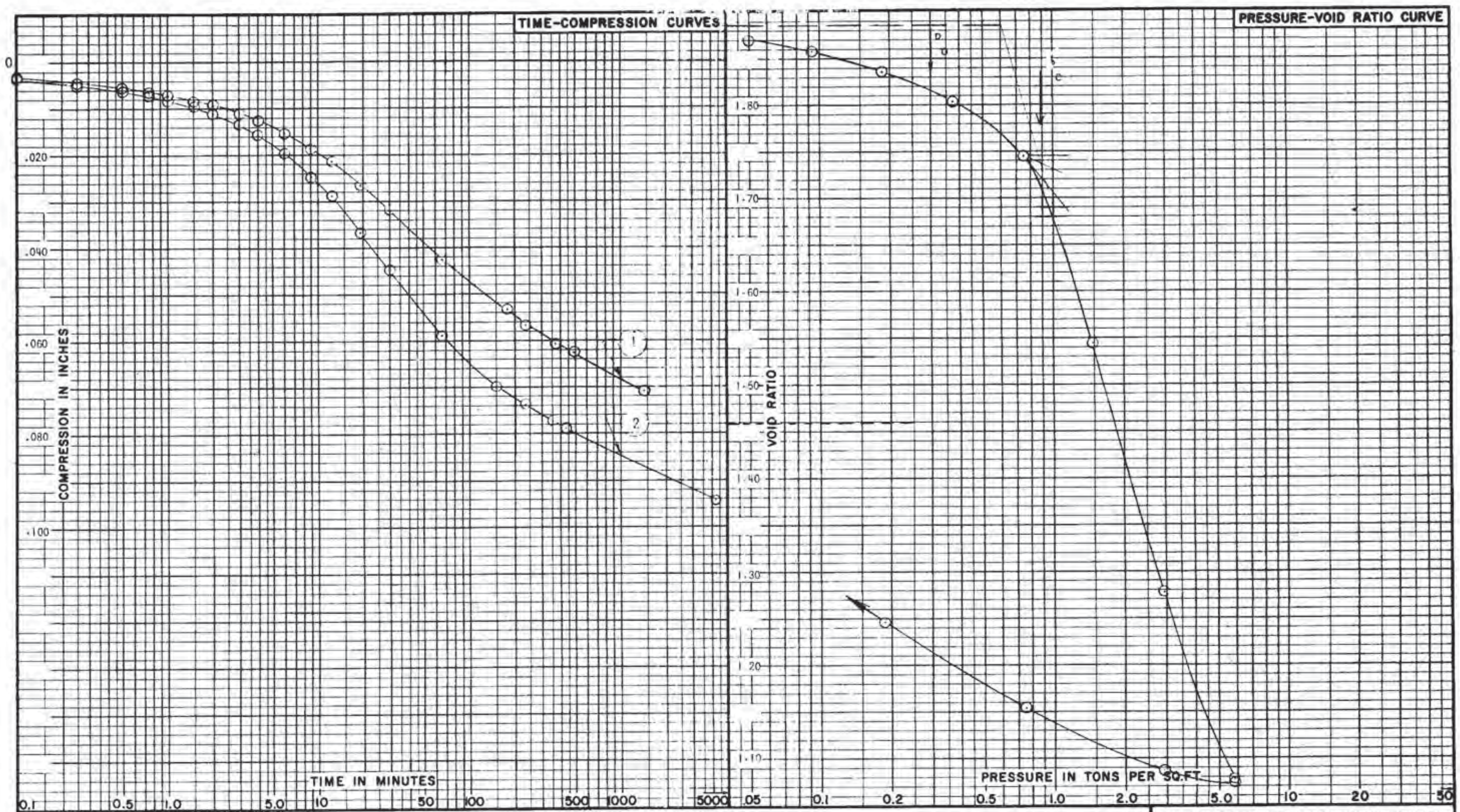
MADE BY: PRP DATE: 6-18-70 FILE NO. 3291E
CH'KD BY: VLT DATE: 8-19-70

CONSOLIDATION TEST
BORING NO. L-7U SAMPLE NO. 13U PLATE NO. A37



Description of specimen: MEDIUM DARK GRAY ORGANIC SILTY CLAY

Pressure increments of time-compression curves

Curve number	Pressure increment from (TSF)	To (TSF)
1	0.733	1.47
2	1.47	2.93
3		
4		
5		
6		
7		
8		

Properties of plasticity limit specimen

Stratum designation	A1
Liquid limit (w_L)	62.6
Plastic limit (w_P)	44.4
Plasticity index (I_p)	18.2
Natural water cont. % (w)	61.3
Liquidity index = $\frac{w - w_p}{I_p}$	0.93
Specific gravity (G)	2.55*

* Assumed

Properties of consolidation specimen

Elevation of specimen	-40.0
Depth of specimen (FT.)	21.0
Diameter of specimen (IN.)	2.50
Initial thickness of specimen (IN.)	1.010
Initial water content %	72.3
Final water content %	58.4
Initial degree saturation %	97.8
Final degree saturation %	100+

Initial void ratio (e_o), shown thus: ———	1.887
Final void ratio (e_f), shown thus: ------	1.459
Most probable preconsolidation stress (TSF) shown thus: P_c↓	0.9
Existing overburden stress (TSF) shown thus: P_o↓	0.35
Compression index (C_c)	0.93
Swelling index (C_s), rebound from e = 1.075	0.15
Coefficient of consolidation (C_v) cm^2/sec	

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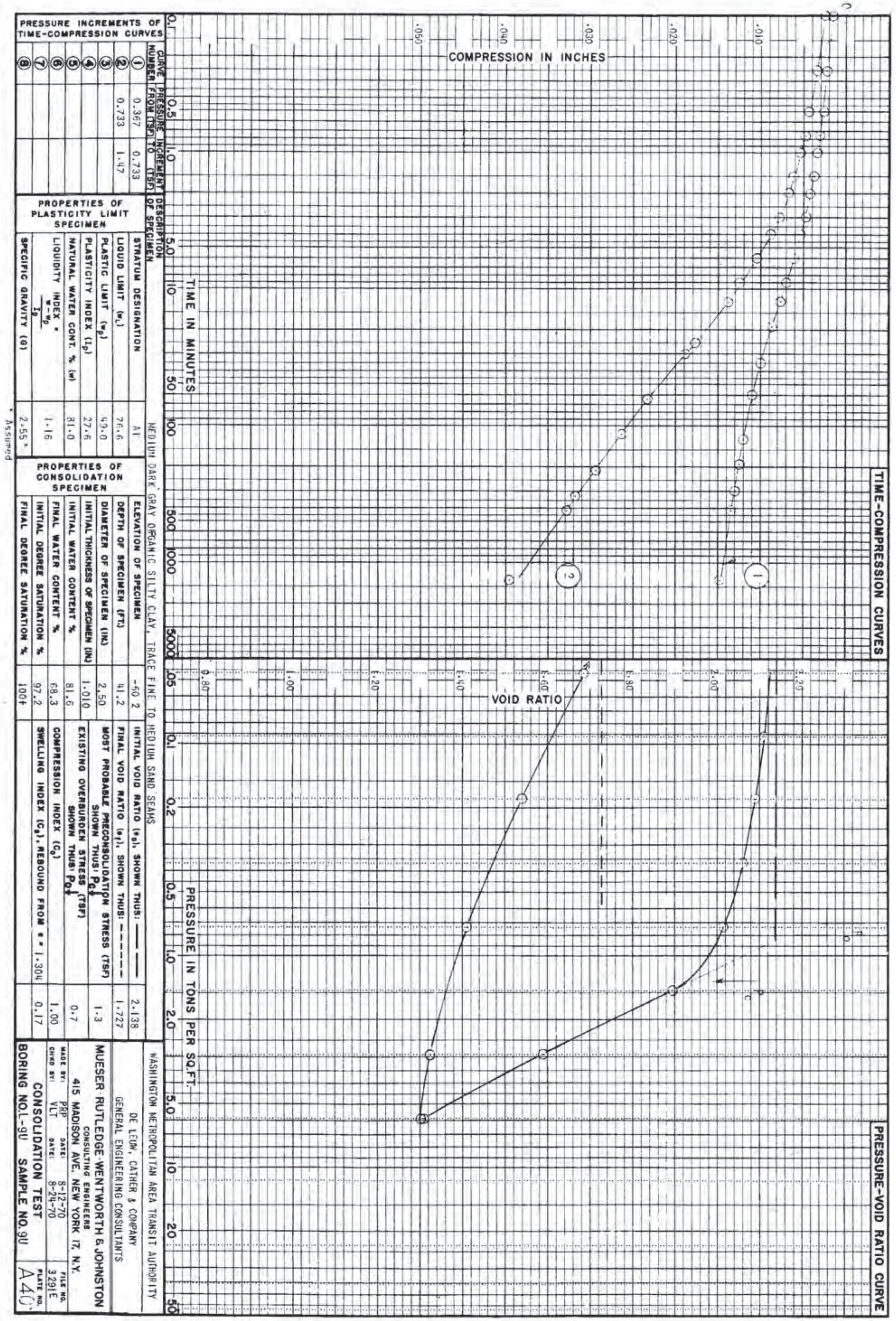
MADE BY: PRP DATE: 6-5-70 FILE NO. 3291E
CH'KD BY: JWS DATE: 7-15-70

CONSOLIDATION TEST
BORING NO. L-9U SAMPLE NO. 5U PLATE NO. A38


TIME-COMPRESSION CURVES
PRESSURE-VOID RATIO CURVE
COMPRESSION IN INCHES
TIME IN MINUTES
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
1 0.367 0.733
2 0.733 1.47
MEDIUM DARK GRAY ORGANIC SILTY CLAY, TRACE FINE TO MEDIUM SAND SEAMS
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
STRATUM DESIGNATION A1
LIQUID LIMIT 76.6
PLASTIC LIMIT 49.0
PLASTICITY INDEX 27.6
NATURAL WATER CONT. % 81.0
LIQUIDITY INDEX 1.16
SPECIFIC GRAVITY 2.55*
* Assumed
PROPERTIES OF CONSOLIDATION SPECIMEN
ELEVATION OF SPECIMEN -60.2
DEPTH OF SPECIMEN (FT) 41.2
DIAMETER OF SPECIMEN (IN) 2.50
INITIAL THICKNESS OF SPECIMEN (IN) 1.010
INITIAL WATER CONTENT % 81.6
FINAL WATER CONTENT % 68.3
INITIAL DEGREE SATURATION % 97.2
FINAL DEGREE SATURATION % 100+
INITIAL VOID RATIO 2.138
FINAL VOID RATIO 1.727
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) 1.3
EXISTING OVERBURDEN STRESS (TSF) 0.7
COMPRESSION INDEX 1.00
SWELLING INDEX, REBOUND FROM e = 1.304 0.17
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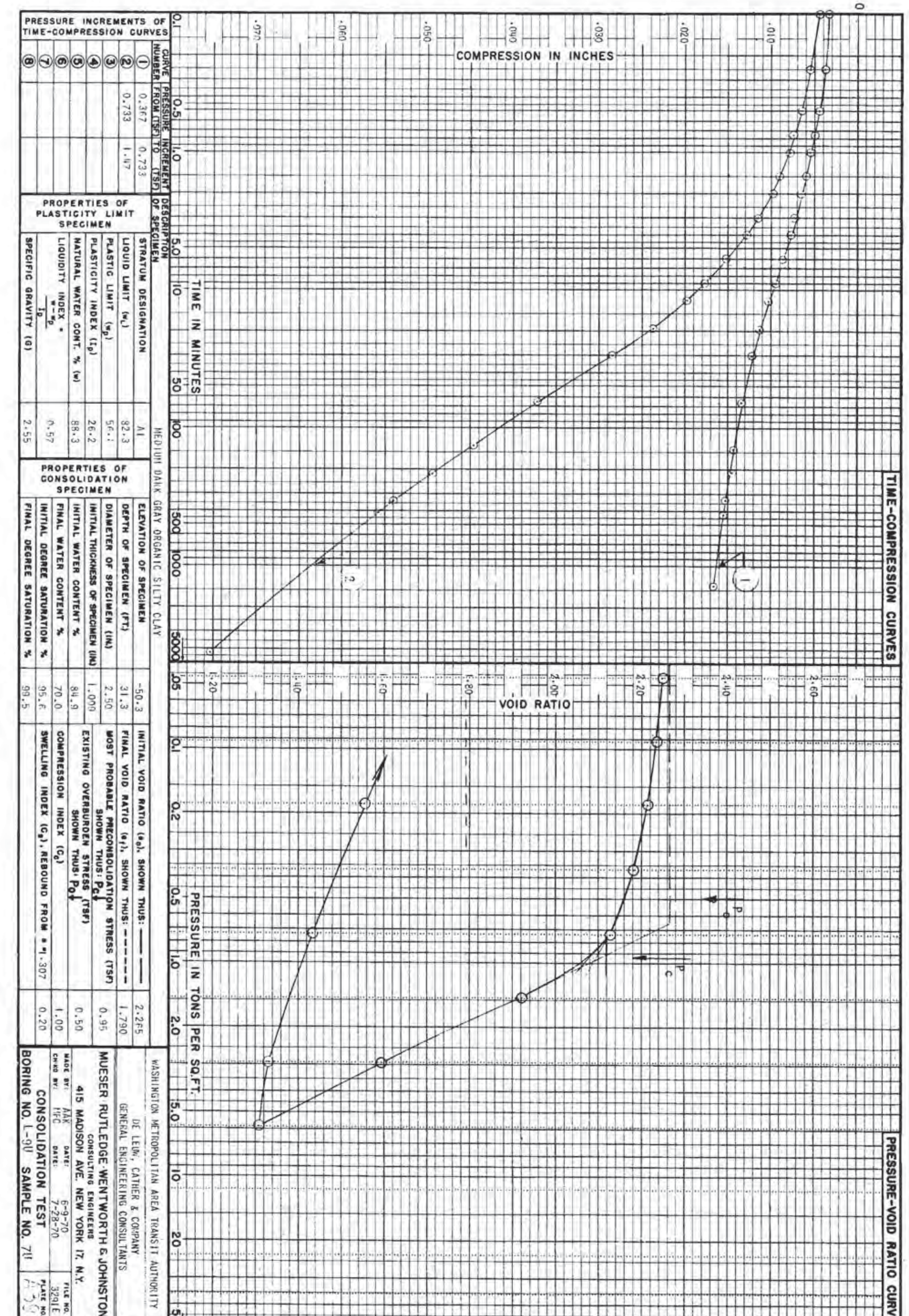
MADE BY: PRP DATE: 8-12-70
CHKD BY: VLT DATE: 8-24-70
FILE NO. 3291E
CONSOLIDATION TEST
BORING NO. L-9U SAMPLE NO. 9U
PLATE NO. A40


TIME-COMPRESSION CURVES
PRESSURE-VOID RATIO CURVE
COMPRESSION IN INCHES
TIME IN MINUTES
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
1 0.367 0.733
2 0.733 1.47
MEDIUM DARK GRAY ORGANIC SILTY CLAY
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
STRATUM DESIGNATION A1
LIQUID LIMIT 82.3
PLASTIC LIMIT 56.1
PLASTICITY INDEX 26.2
NATURAL WATER CONT. % 88.3
LIQUIDITY INDEX 0.57
SPECIFIC GRAVITY 2.55
PROPERTIES OF CONSOLIDATION SPECIMEN
ELEVATION OF SPECIMEN -50.3
DEPTH OF SPECIMEN (FT) 31.3
DIAMETER OF SPECIMEN (IN) 2.50
INITIAL THICKNESS OF SPECIMEN (IN) 1.000
INITIAL WATER CONTENT % 84.9
FINAL WATER CONTENT % 70.0
INITIAL DEGREE SATURATION % 95.6
FINAL DEGREE SATURATION % 99.5
INITIAL VOID RATIO 2.265
FINAL VOID RATIO 1.790
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) 0.95
EXISTING OVERBURDEN STRESS (TSF) 0.50
COMPRESSION INDEX 1.00
SWELLING INDEX, REBOUND FROM e = 1.307 0.20
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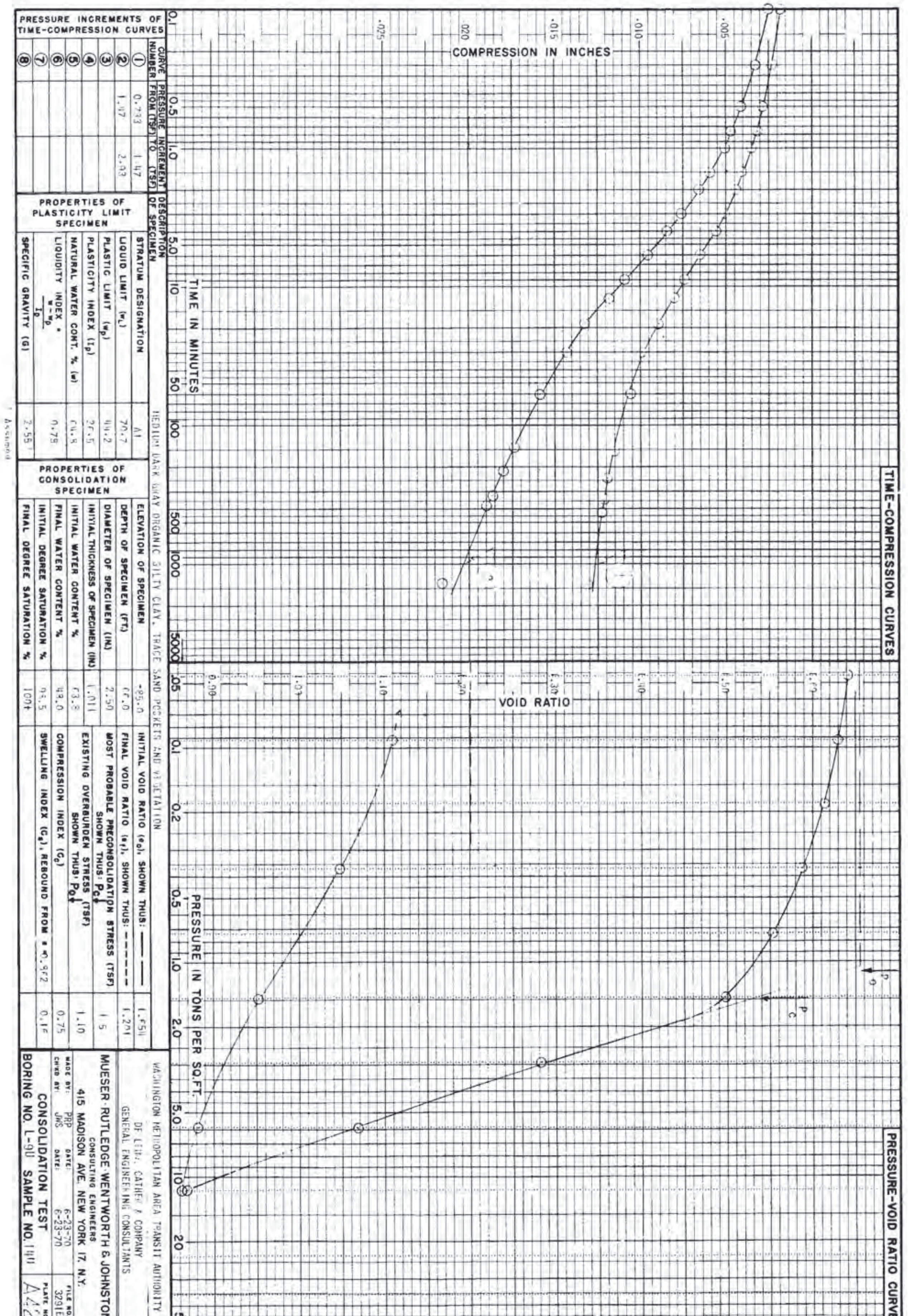
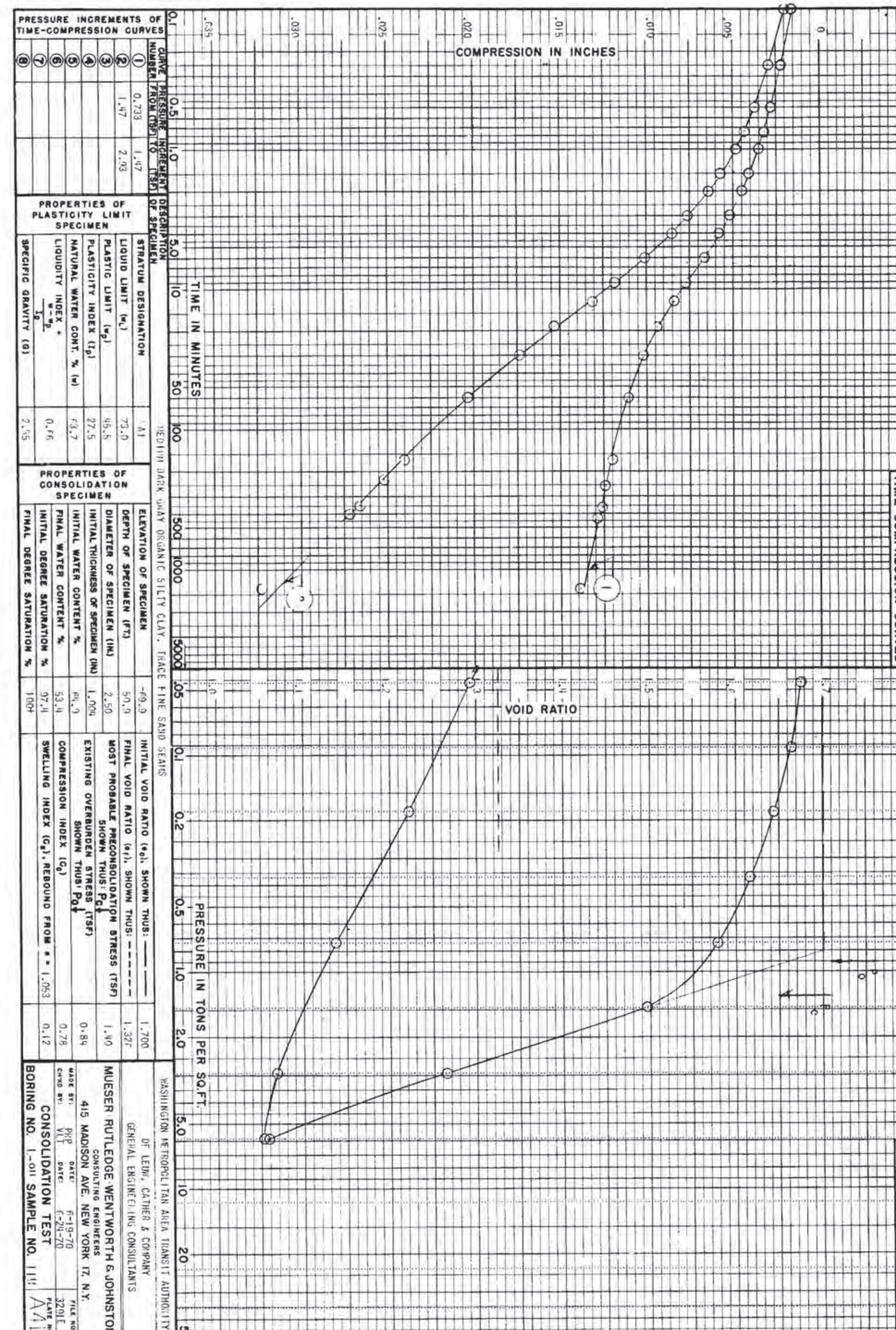
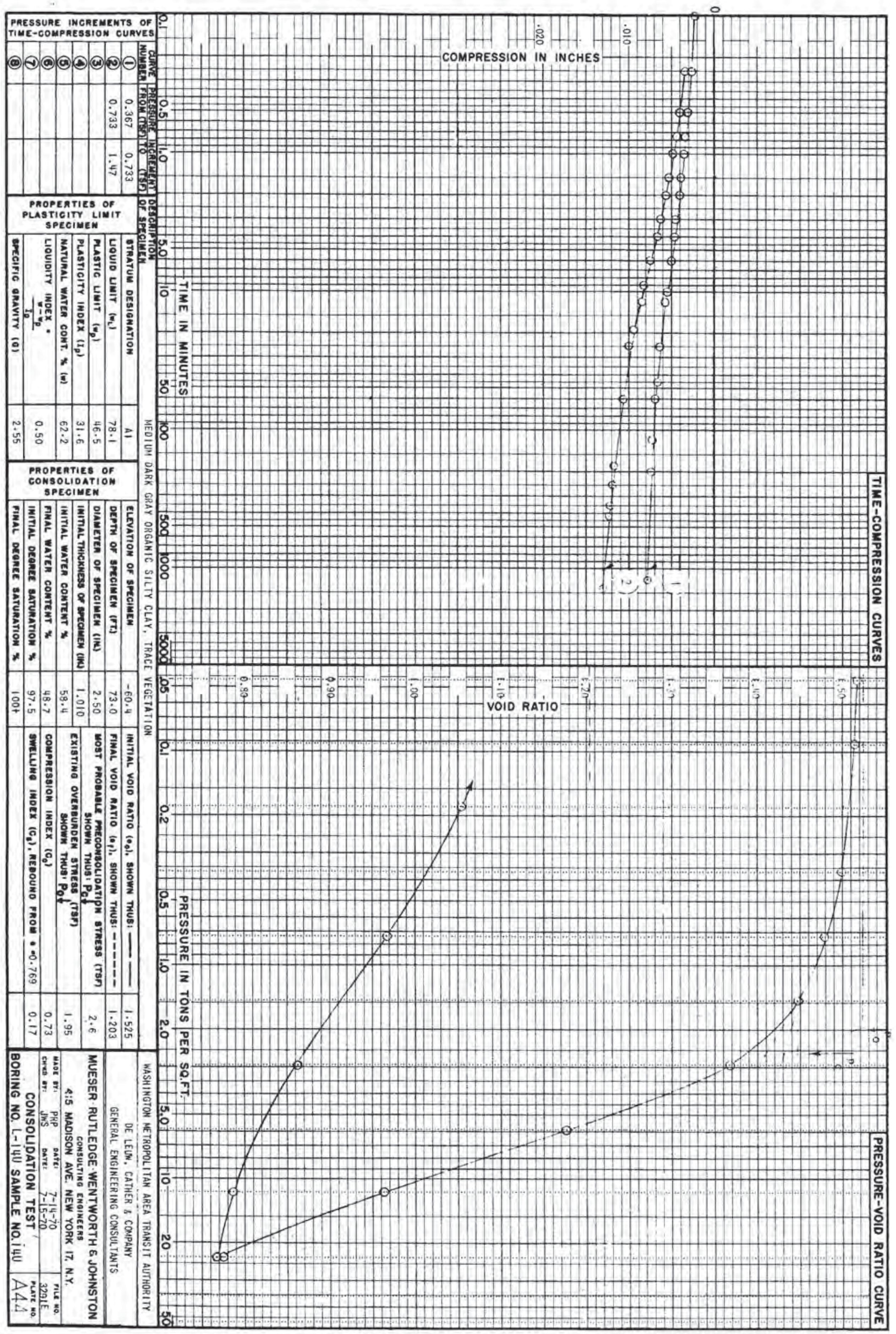
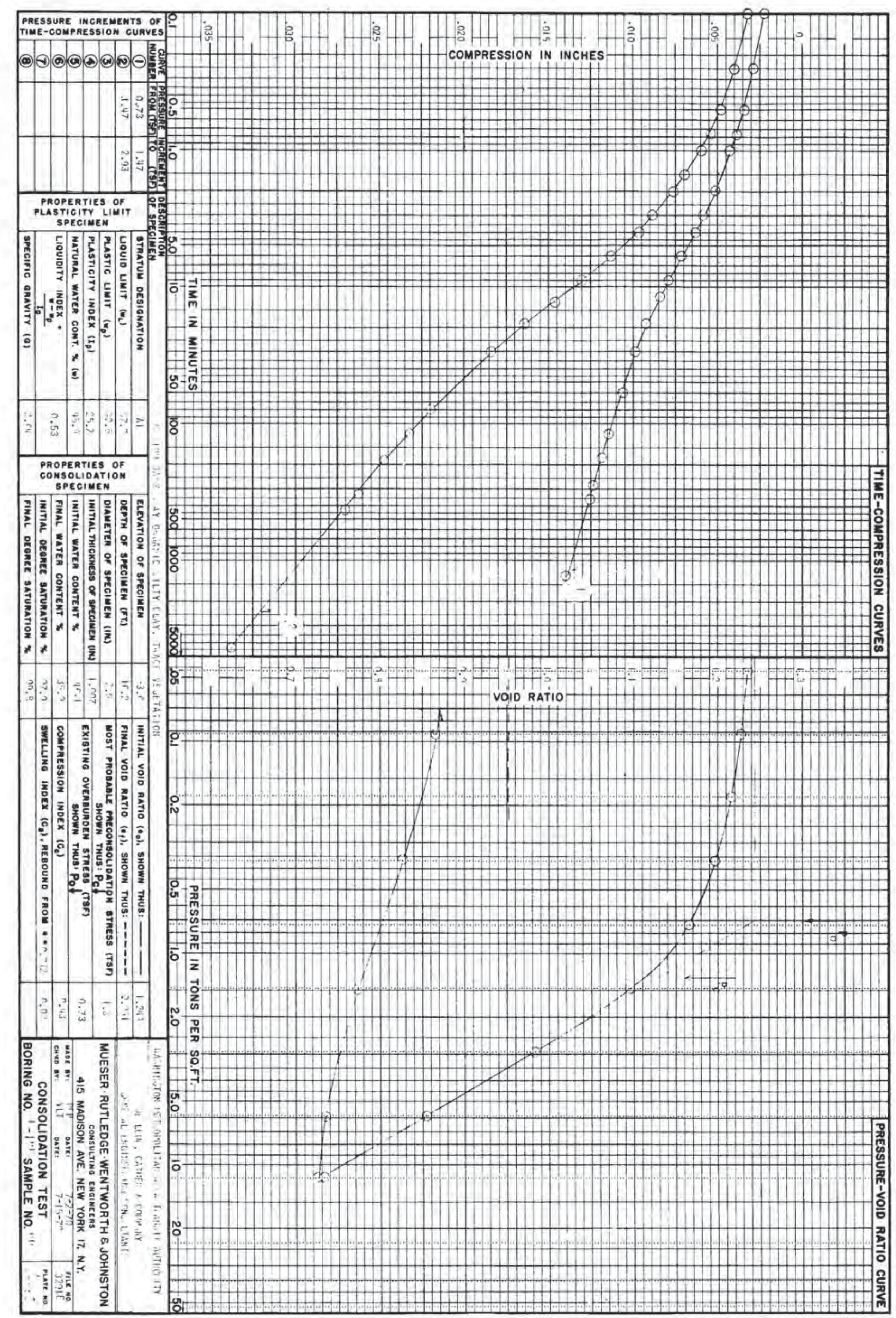
MADE BY: DAK DATE: 6-9-70
CHKD BY: 7-28-70
FILE NO. 3291E
CONSOLIDATION TEST
BORING NO. L-9U SAMPLE NO. 7U
PLATE NO. A39

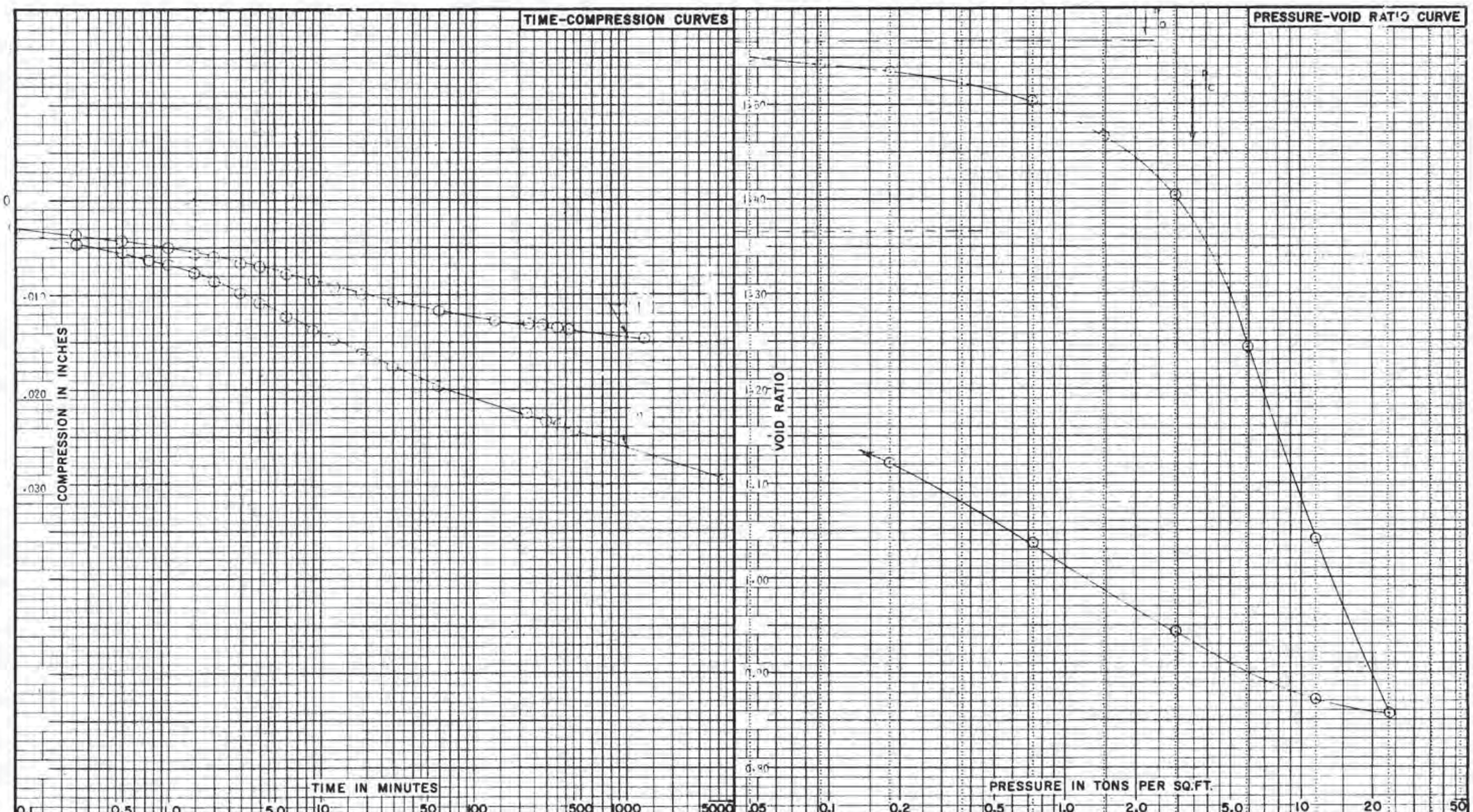
APPENDIX 2
SCHNABEL ENGINEERING, LLC
Sheet: 83/91






PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
PROPERTIES OF CONSOLIDATION SPECIMEN
MEDIUM DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION
COMPRESSION IN INCHES
TIME IN MINUTES
TIME-COMPRESSION CURVES
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE-VOID RATIO CURVE
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANTS
MUESER RUTLEDGE WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST


PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
PROPERTIES OF CONSOLIDATION SPECIMEN
COMPRESSION IN INCHES
TIME IN MINUTES
TIME-COMPRESSION CURVES
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE-VOID RATIO CURVE
MUESER RUTLEDGE WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST



PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES: CURVE NUMBER	PRESSURE INCREMENT FROM (TSF)	TO (TSF)
①	0.733	1.47
②	1.47	2.93
③		
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: STIFF DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION AND SAND POCKETS

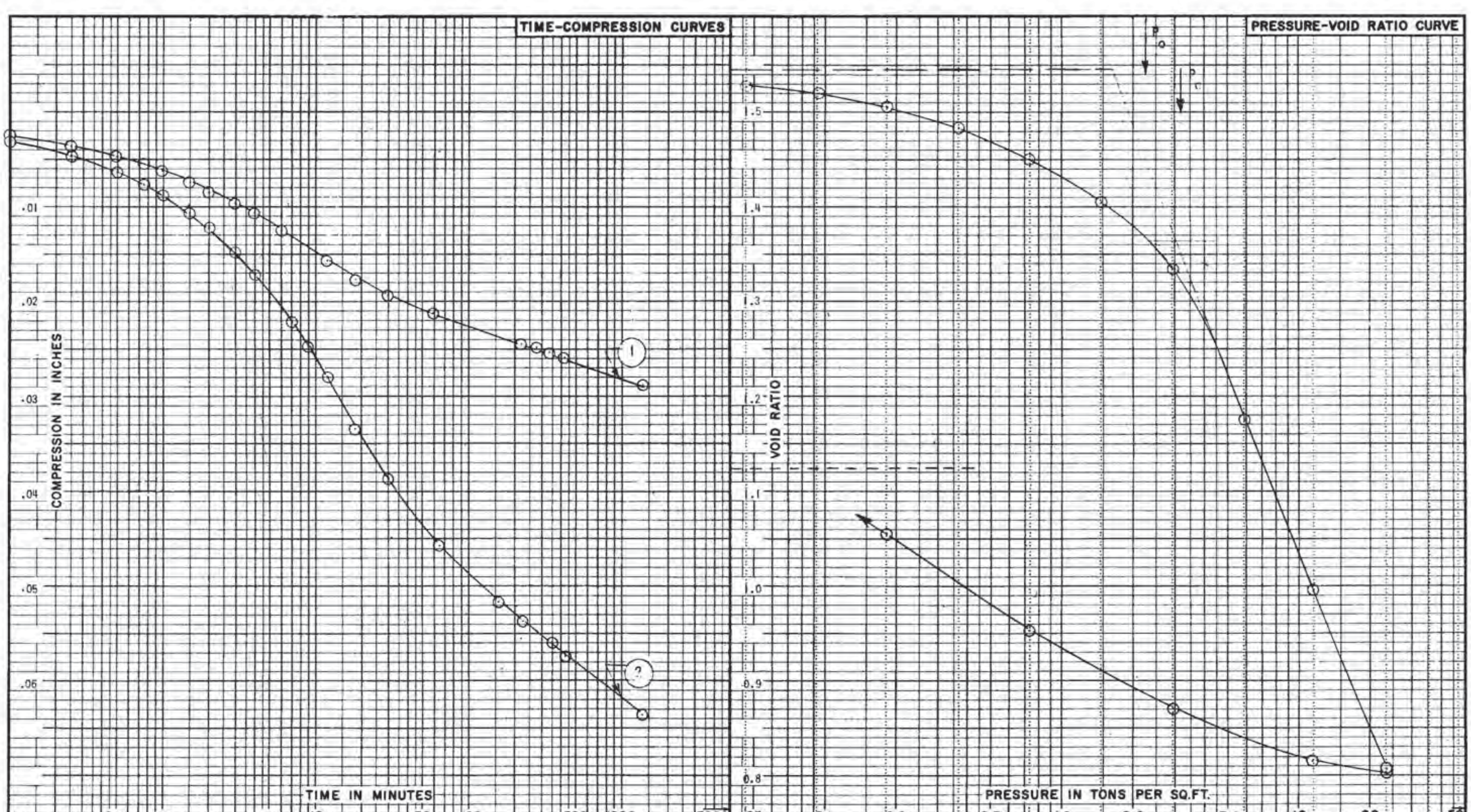
PROPERTIES OF PLASTICITY LIMIT SPECIMEN	
STRATUM DESIGNATION	A1
LIQUID LIMIT (w_L)	57.8
PLASTIC LIMIT (w_p)	29.9
PLASTICITY INDEX (I_p)	27.9
NATURAL WATER CONT. % (w)	52.3
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.77
SPECIFIC GRAVITY (G)	2.75*

* Assumed

PROPERTIES OF CONSOLIDATION SPECIMEN	
ELEVATION OF SPECIMEN	-69.4
DEPTH OF SPECIMEN (FT.)	82.0
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	1.015
INITIAL WATER CONTENT %	51.5
FINAL WATER CONTENT %	46.9
INITIAL DEGREE SATURATION %	90.7
FINAL DEGREE SATURATION %	94.7

INITIAL VOID RATIO (e_o), SHOWN THUS: ———	1.563
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - -	1.366
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS: P_c	3.5
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS: P_o	2.15
COMPRESSION INDEX (C_c)	0.71
SWELLING INDEX (C_s), REBOUND FROM e = 0.855	0.15

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANTS
MUESER·RUTLEDGE·WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
MADE BY: IM DATE: 6-16-70
CH'KD BY: JWS DATE: 7-15-70
FILE NO. 3291E
CONSOLIDATION TEST
BORING NO. L-1HU SAMPLE NO. 17U
PLATE NO. A45



PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES: CURVE NUMBER	PRESSURE INCREMENT FROM (TSF)	TO (TSF)
①	1.47	2.93
②	2.93	5.87
③		
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: STIFF DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION AND SAND SEAMS

PROPERTIES OF PLASTICITY LIMIT SPECIMEN	
STRATUM DESIGNATION	A1
LIQUID LIMIT (w_L)	83.0
PLASTIC LIMIT (w_p)	40.2
PLASTICITY INDEX (I_p)	42.8
NATURAL WATER CONT. % (w)	68.0
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.65
SPECIFIC GRAVITY (G)	2.75*

* Assumed

PROPERTIES OF CONSOLIDATION SPECIMEN	
ELEVATION OF SPECIMEN	-76.9
DEPTH OF SPECIMEN (FT.)	88.7
DIAMETER OF SPECIMEN (IN.)	2.75
INITIAL THICKNESS OF SPECIMEN (IN.)	1.0135
INITIAL WATER CONTENT %	51.3
FINAL WATER CONTENT %	39.9
INITIAL DEGREE SATURATION %	91.0
FINAL DEGREE SATURATION %	97.8

INITIAL VOID RATIO (e_o), SHOWN THUS: ———	1.545
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - -	1.124
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS: P_c	3.2
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS: P_o	2.3
COMPRESSION INDEX (C_c)	0.63
SWELLING INDEX (C_s), REBOUND FROM e = 0.804	0.15

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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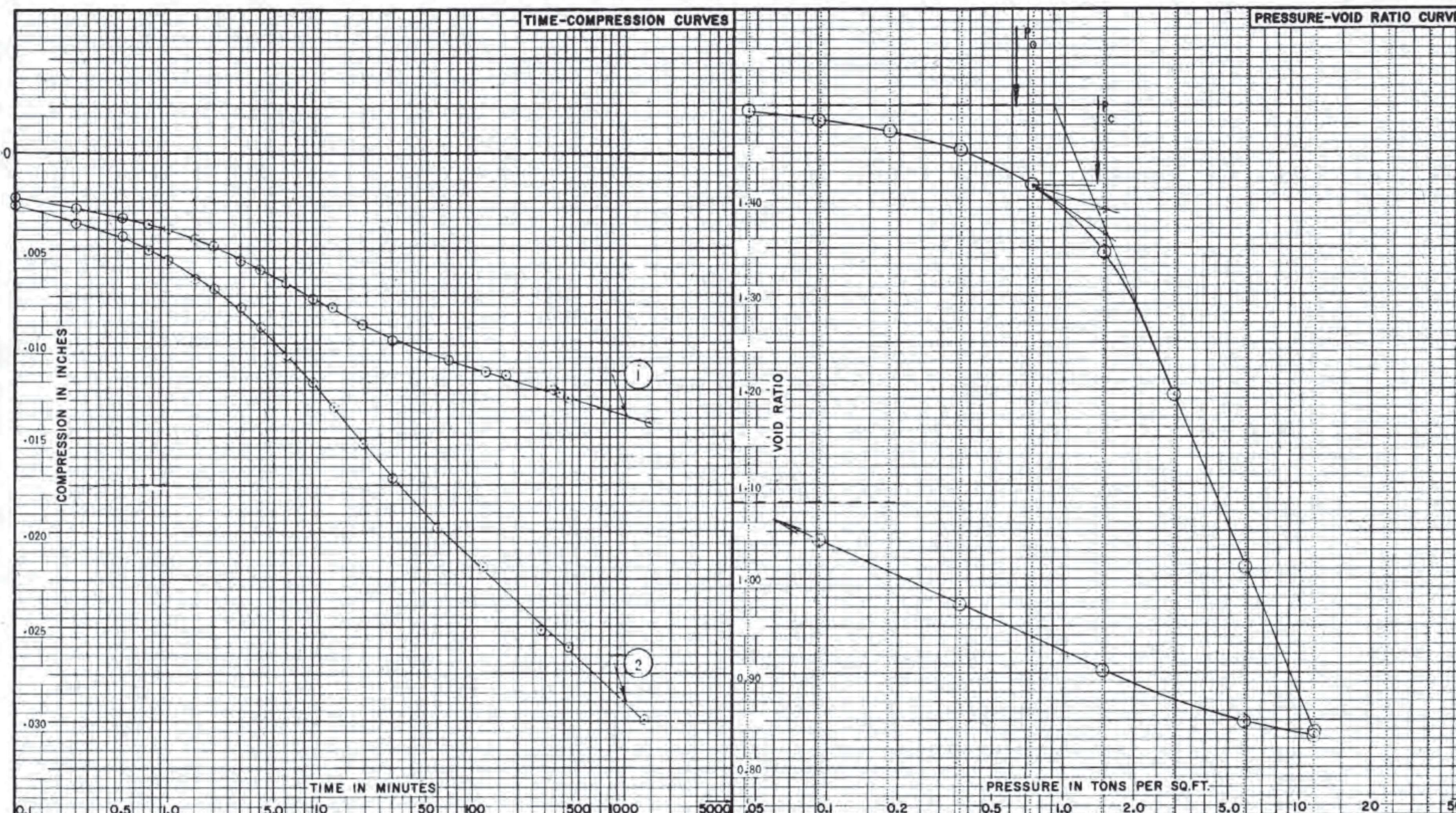
GENERAL ENGINEERING CONSULTANTS
MUESER·RUTLEDGE·WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
MADE BY: VLT DATE: 7-14-70
CH'KD BY: JWS DATE: 7-15-70
FILE NO. 3291E
CONSOLIDATION TEST
BORING NO. L-1HU SAMPLE NO. 19U
PLATE NO. A46



CURVE NUMBER	PRESSURE INCREMENT FROM (TSF)	TO (TSF)
①	0.367	0.733
②	0.733	1.47
③		
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: MEDIUM DARK GRAY ORGANIC SILTY CLAY

PROPERTIES OF PLASTICITY LIMIT SPECIMEN	
STRATUM DESIGNATION	A1
LIQUID LIMIT (w_L)	68.6
PLASTIC LIMIT (w_p)	31.6
PLASTICITY INDEX (I_p)	37.0
NATURAL WATER CONT. % (w)	51.9
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.55
SPECIFIC GRAVITY (G)	2.71

PROPERTIES OF CONSOLIDATION SPECIMEN	
ELEVATION OF SPECIMEN	-2.3
DEPTH OF SPECIMEN (FT.)	13.1
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	1.005
INITIAL WATER CONTENT %	53.3
FINAL WATER CONTENT %	39.3
INITIAL DEGREE SATURATION %	96.3
FINAL DEGREE SATURATION %	98.6

INITIAL VOID RATIO (e_o), SHOWN THUS: ———	1.500
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - -	1.081
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS: P_c	1.4
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS: P_o	0.62
COMPRESSION INDEX (C_c)	0.60
SWELLING INDEX (C_s), REBOUND FROM e = 0.835	0.12

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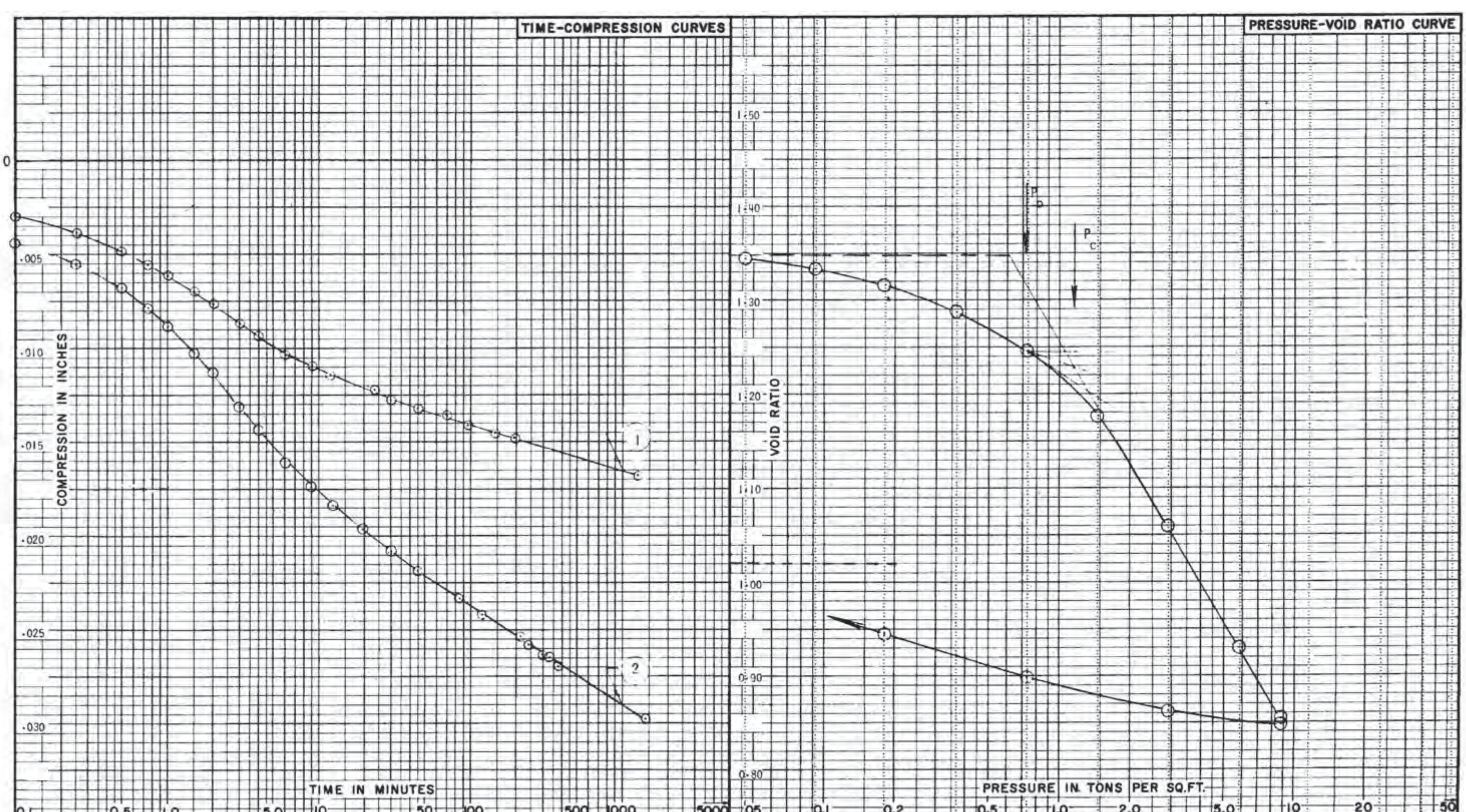
MUESER RUTLEDGE WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
MADE BY: AAK DATE: 10-27-70 FILE NO. 3291E
CHK'D BY: VLT DATE: 11-12-70
CONSOLIDATION TEST
BORING NO. L-17U SAMPLE NO. 4U
PLATE NO. A47



CURVE NUMBER	PRESSURE INCREMENT FROM (TSF)	TO (TSF)
①	0.367	0.733
②	0.733	1.47
③		
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: MEDIUM DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION

PROPERTIES OF PLASTICITY LIMIT SPECIMEN	
STRATUM DESIGNATION	A1
LIQUID LIMIT (w_L)	58.6
PLASTIC LIMIT (w_p)	30.7
PLASTICITY INDEX (I_p)	27.9
NATURAL WATER CONT. % (w)	47.0
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.58
SPECIFIC GRAVITY (G)	2.71*

PROPERTIES OF CONSOLIDATION SPECIMEN	
ELEVATION OF SPECIMEN	-4.9
DEPTH OF SPECIMEN (FT.)	15.7
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	0.991
INITIAL WATER CONTENT %	48.4
FINAL WATER CONTENT %	37.9
INITIAL DEGREE SATURATION %	98.2
FINAL DEGREE SATURATION %	100.2

INITIAL VOID RATIO (e_o), SHOWN THUS: ———	1.348
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - -	1.020
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS: P_c	1.2
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS: P_o	0.72
COMPRESSION INDEX (C_c)	0.43
SWELLING INDEX (C_s), REBOUND FROM e = 0.849	0.07

*Assumed

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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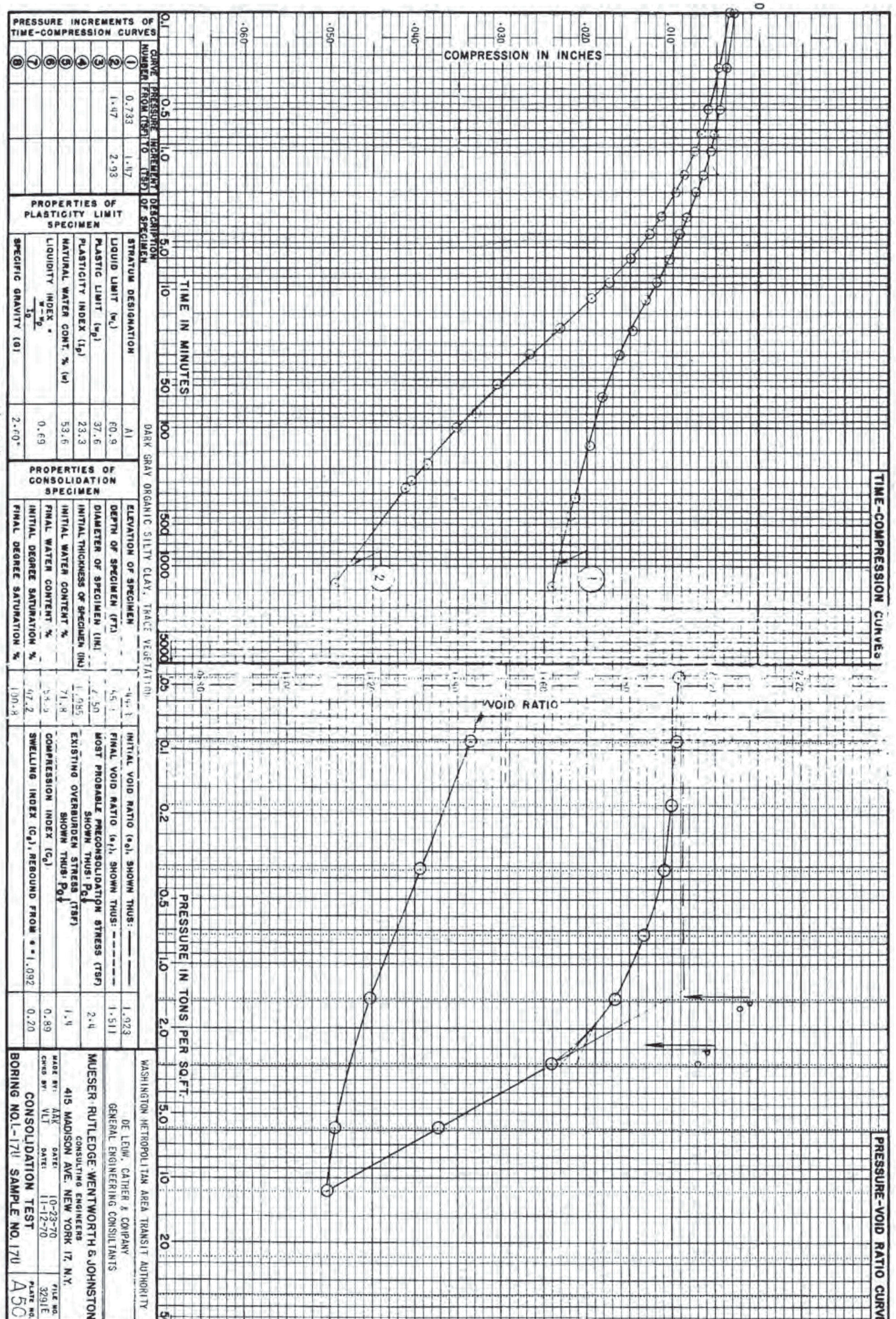
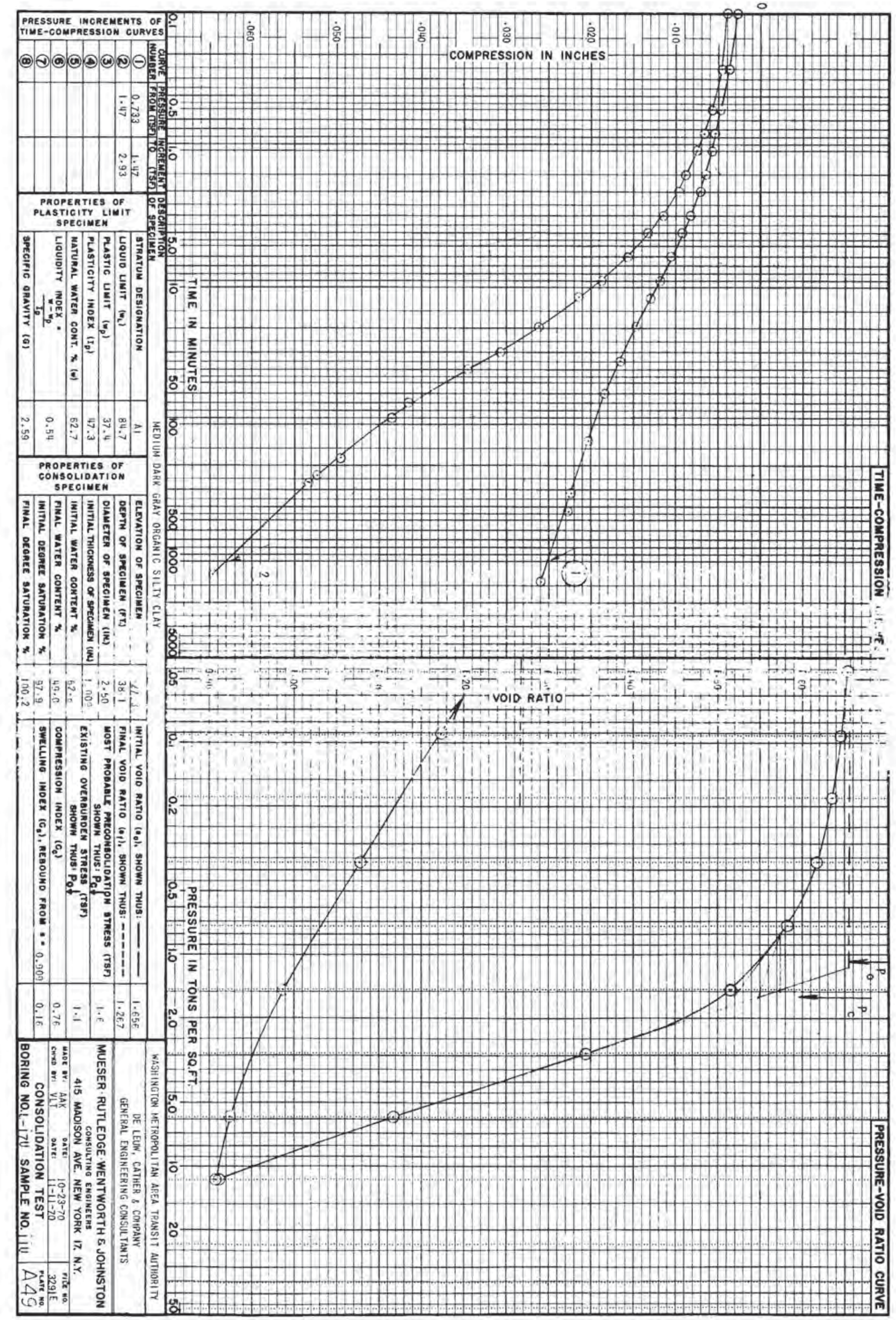
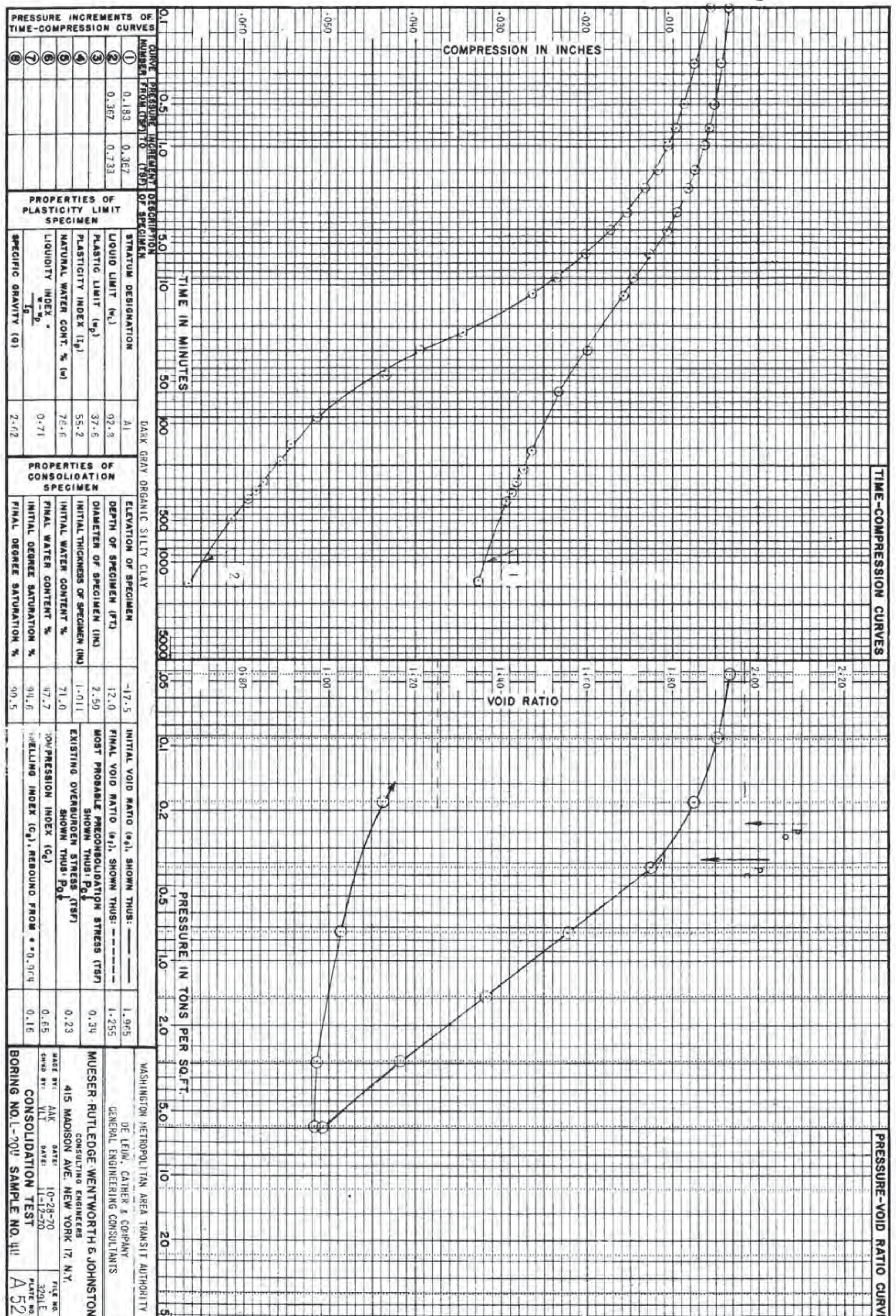
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
MADE BY: AAK DATE: 10-27-70 FILE NO. 3291E
CHK'D BY: VLT DATE: 11-11-70
CONSOLIDATION TEST
BORING NO. L-17U SAMPLE NO. 5U
PLATE NO. A48


TIME-COMPRESSION CURVES
PRESSURE-VOID RATIO CURVE
COMPRESSION IN INCHES
TIME IN MINUTES
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION
MUESER RUTLEDGE WENTWORTH & JOHNSTON
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST
BORING NO. L-17U SAMPLE NO. 17U
A50


TIME-COMPRESSION CURVES
PRESSURE-VOID RATIO CURVE
COMPRESSION IN INCHES
TIME IN MINUTES
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
MEDIUM DARK GRAY ORGANIC SILTY CLAY
MUESER RUTLEDGE WENTWORTH & JOHNSTON
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST
BORING NO. L-17U SAMPLE NO. 11U
A49


TIME-COMPRESSION CURVES
COMPRESSION IN INCHES
TIME IN MINUTES
PRESSURE-VOID RATIO CURVE
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
PROPERTIES OF CONSOLIDATION SPECIMEN
DARK GRAY ORGANIC SILTY CLAY
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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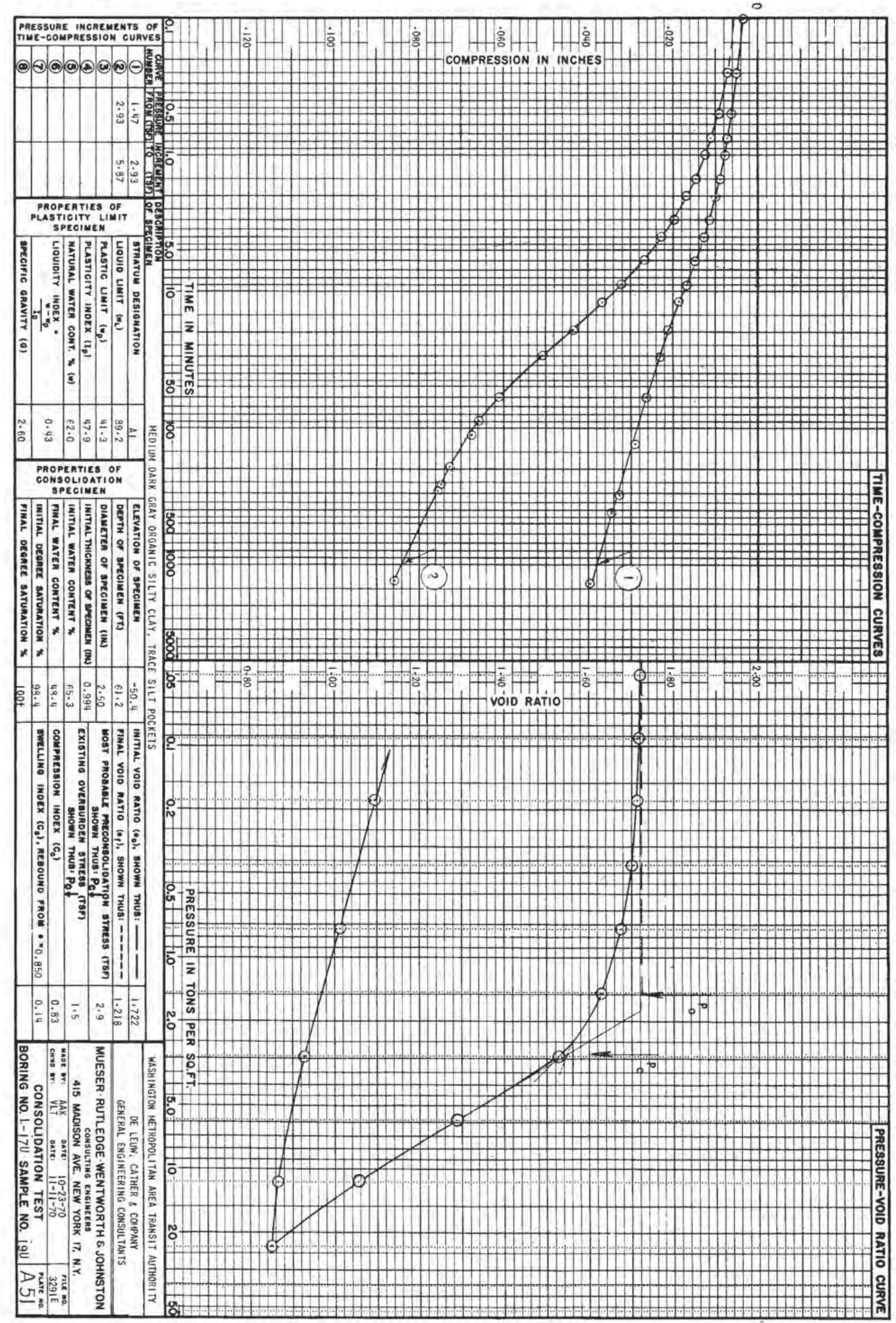
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST
BORING NO. L-20U SAMPLE NO. 4U
A 52


TIME-COMPRESSION CURVES
COMPRESSION IN INCHES
TIME IN MINUTES
PRESSURE-VOID RATIO CURVE
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES
PROPERTIES OF PLASTICITY LIMIT SPECIMEN
PROPERTIES OF CONSOLIDATION SPECIMEN
MEDIUM DARK GRAY ORGANIC SILTY CLAY, TRACE SILT POCKETS
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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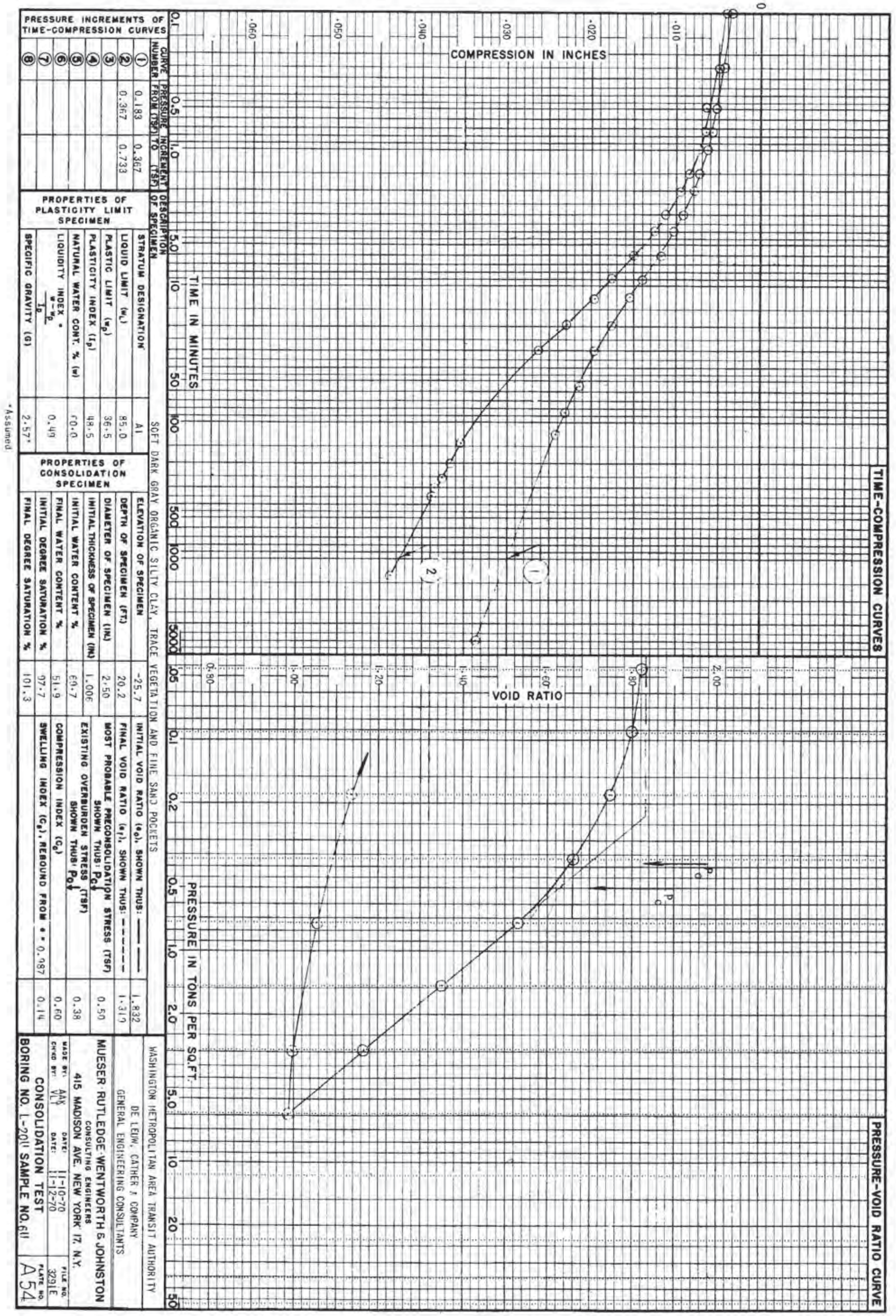
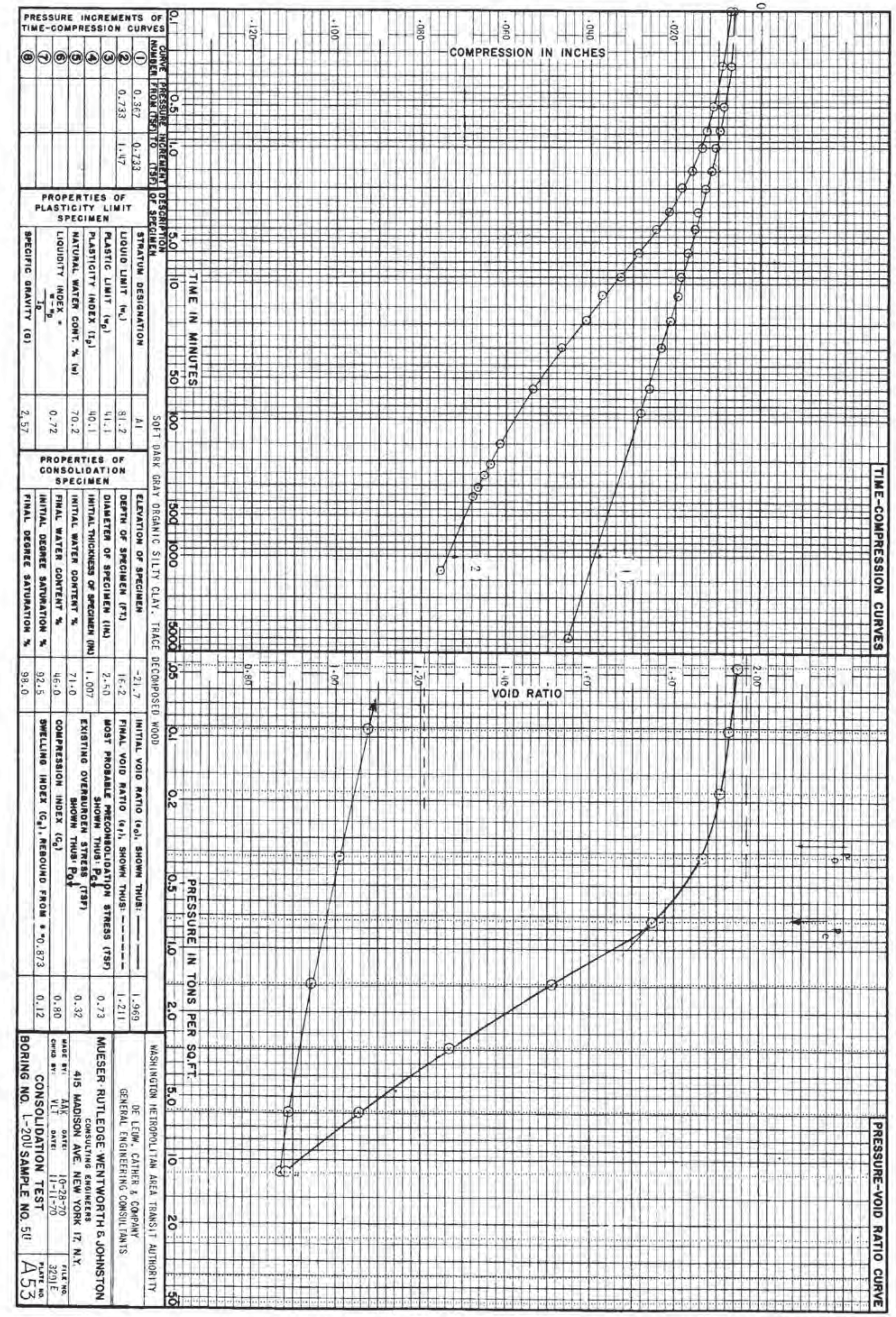
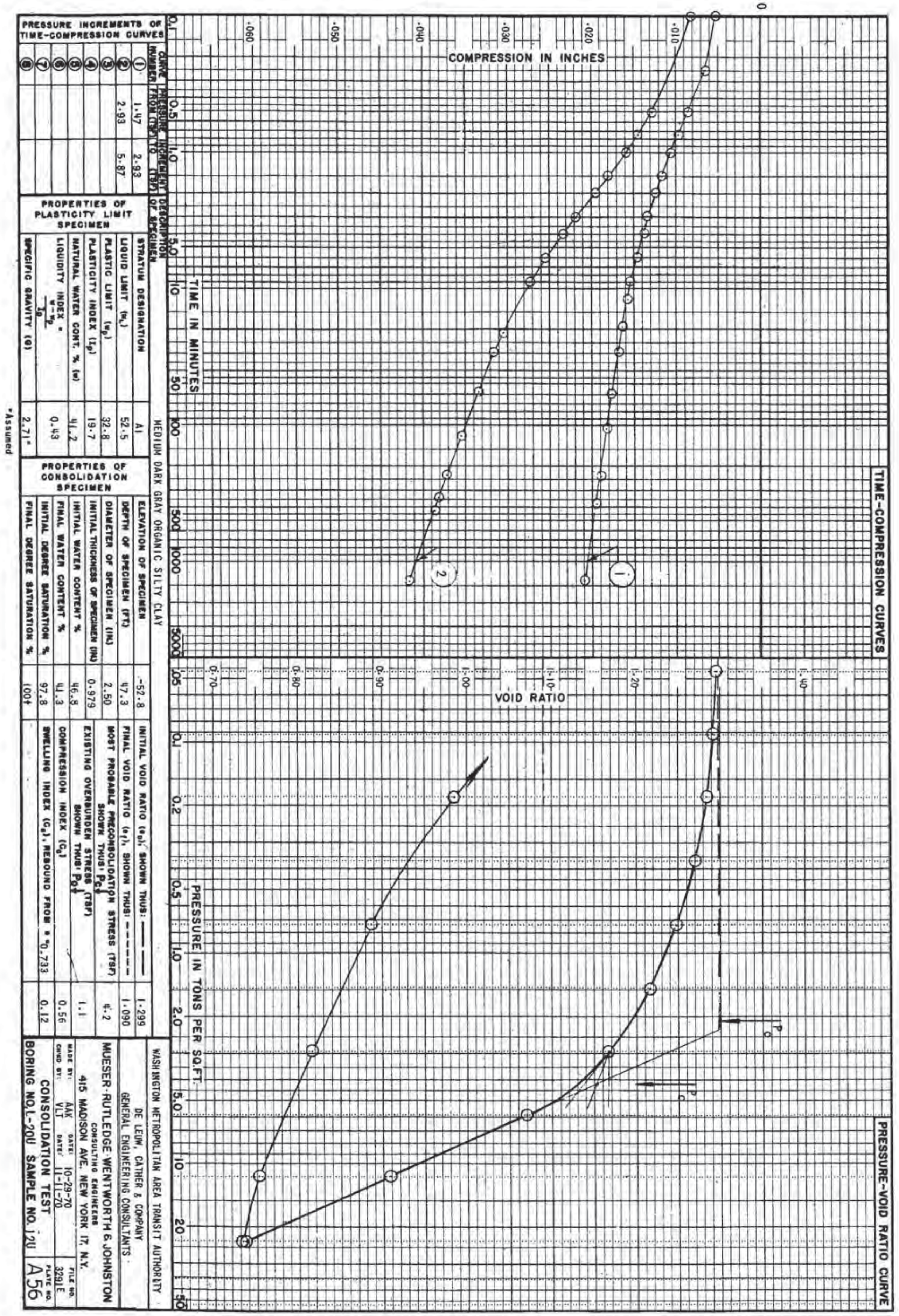
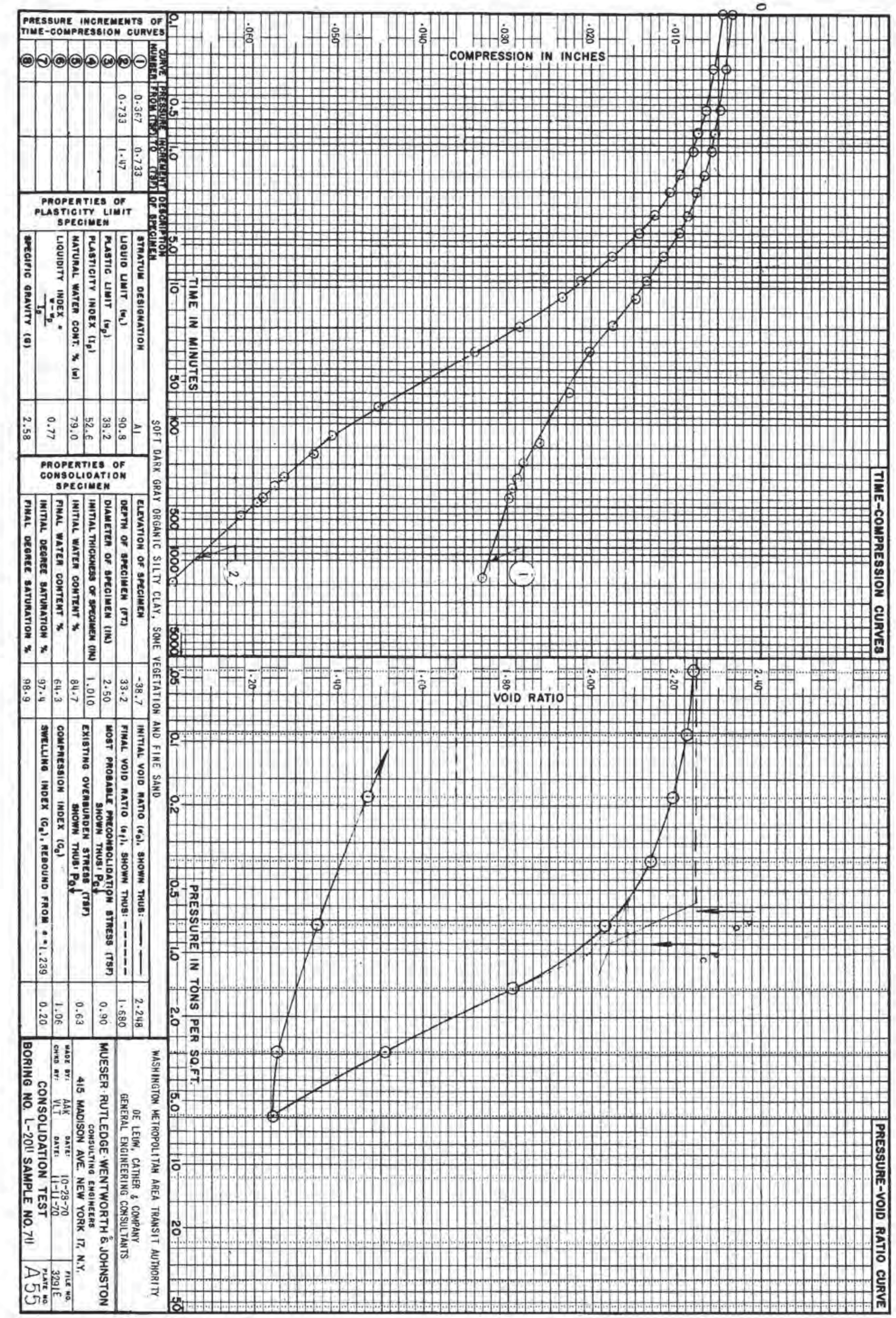
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST
BORING NO. L-17U SAMPLE NO. 19U
A 51

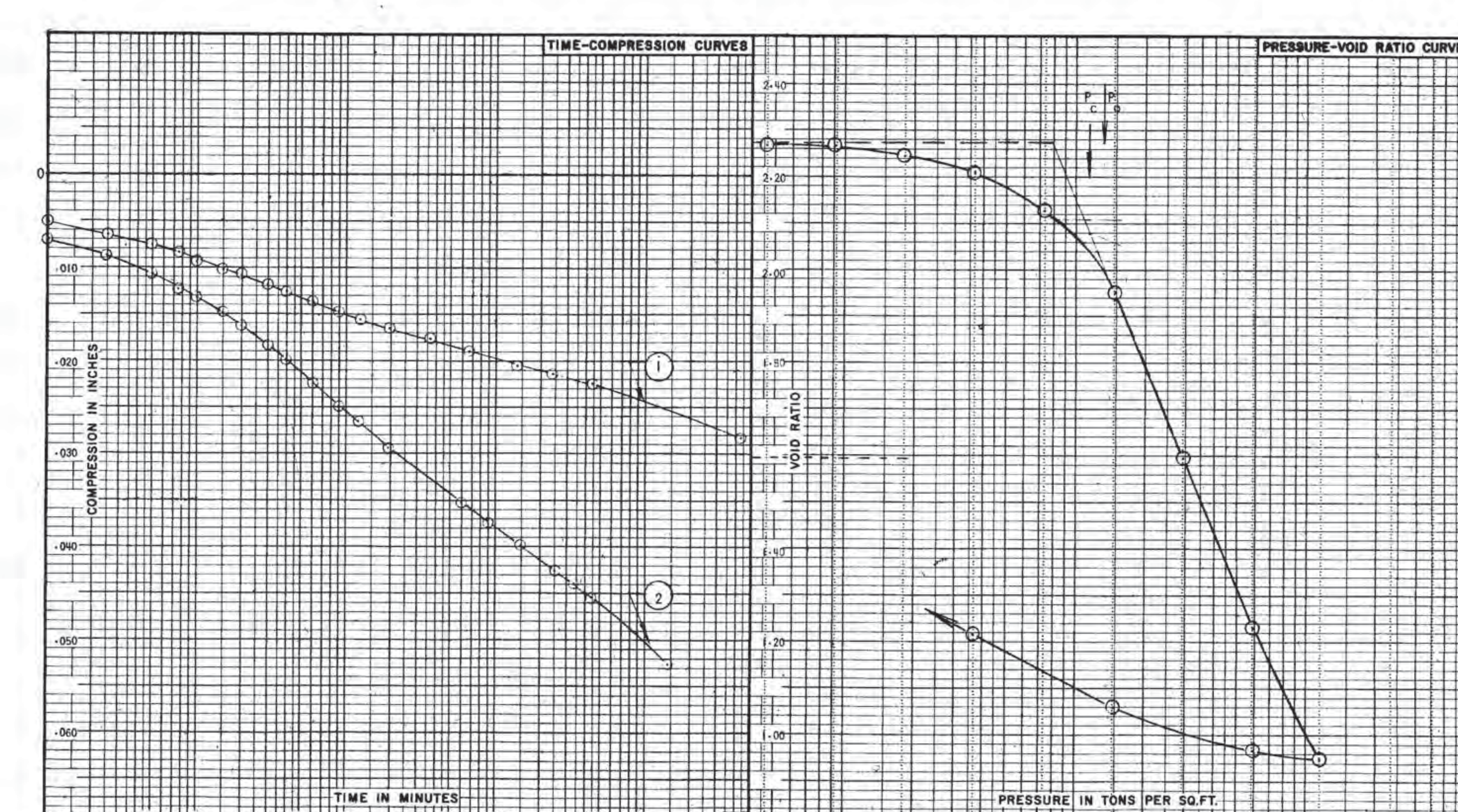

TIME-COMPRESSION CURVES
COMPRESSION IN INCHES
TIME IN MINUTES
PRESSURE-VOID RATIO CURVE
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE VEGETATION AND FINE SAND POCKETS
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANTS
MUESER·RUTLEDGE·WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST
BORING NO. L-201 SAMPLE NO. 6U
A54


TIME-COMPRESSION CURVES
COMPRESSION IN INCHES
TIME IN MINUTES
PRESSURE-VOID RATIO CURVE
VOID RATIO
PRESSURE IN TONS PER SQ.FT.
SOFT DARK GRAY ORGANIC SILTY CLAY, TRACE DECOMPOSED WOOD
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANTS
MUESER·RUTLEDGE·WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.
CONSOLIDATION TEST
BORING NO. L-201 SAMPLE NO. 5U
A53

APPENDIX 2
SCHNABEL ENGINEERING, LLC
Sheet: 90/91







PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES: CURVE NUMBER	PRESSURE INCREMENT FROM (TSF)	TO (TSF)
①	0.367	0.733
②	0.733	1.47
③		
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: DARK BROWN ORGANIC SILTY CLAY, SOME VEGETATION

PROPERTIES OF PLASTICITY LIMIT SPECIMEN	
STRATUM DESIGNATION	A1
LIQUID LIMIT (w_L)	228.0
PLASTIC LIMIT (w_p)	161.5
PLASTICITY INDEX (I_p)	66.5
NATURAL WATER CONT. % (w)	132.4
LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	-0.44
SPECIFIC GRAVITY (G)	2.10

PROPERTIES OF CONSOLIDATION SPECIMEN	
ELEVATION OF SPECIMEN	-5.5
DEPTH OF SPECIMEN (FT.)	24.4
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	1.021
INITIAL WATER CONTENT %	106.1
FINAL WATER CONTENT %	80.2
INITIAL DEGREE SATURATION %	97.0
FINAL DEGREE SATURATION %	100+

INITIAL VOID RATIO (e_0), SHOWN THUS: ———	2.271
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - -	1.595
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS: P_c↓	1.2
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS: P_o↓	1.3
COMPRESSION INDEX (C_c)	1.20
SWELLING INDEX (C_s), REBOUND FROM e 0.943	0.26

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANTS

MUESER RUTLEDGE WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE. NEW YORK 17, N.Y.

MADE BY: AAK DATE: 10-30-70
CH'KD BY: VLT DATE: 11-11-70
FILE NO. 3291E

CONSOLIDATION TEST
BORING NO. L-37U SAMPLE NO. 5U
PLATE NO. A57

APPENDIX 3

Selected sheets from As-built WMATA Metro Section L-1, for L'Enfant Plaza – Pentagon Route, dated November 1975, prepared by Harry Weese & Associates General Architectural Consultant and De Leuw Cather & Company General Engineering Consultant

23 Sheets

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

metro

SECTION L-1

L'ENFANT PLAZA - PENTAGON ROUTE

WASHINGTON CHANNEL CROSSING

1L0011

NOVEMBER 1975

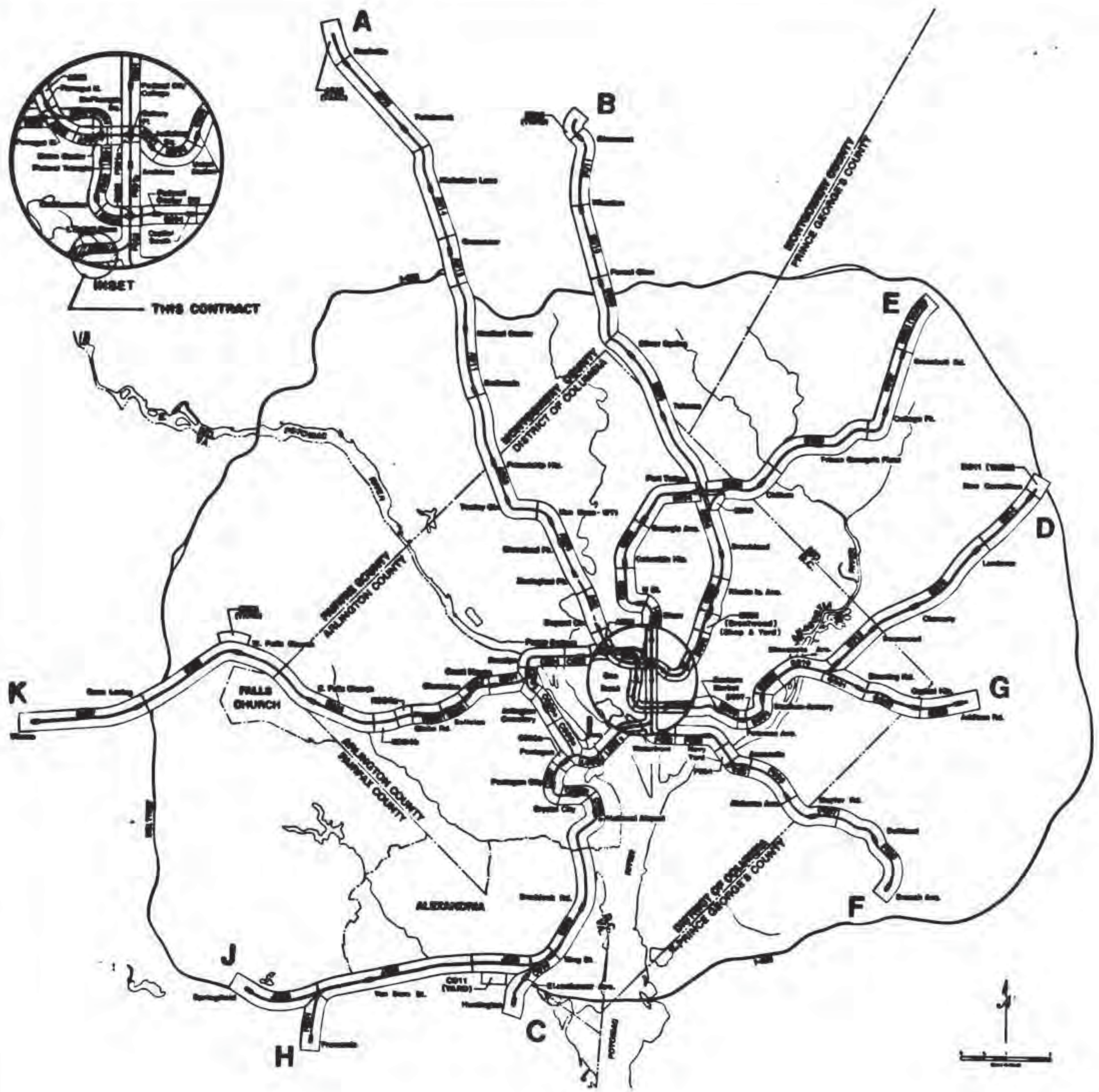
PRAEGER KAVANAGH WATERBURY

SECTION DESIGNER

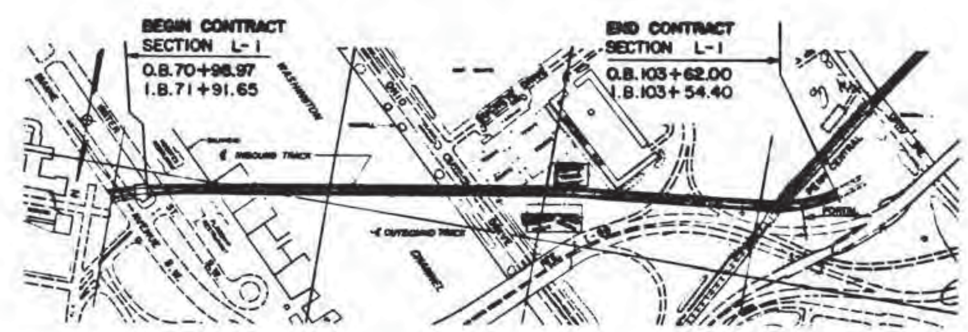
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
metro
AS-BUILT CONDITION
BY: RESIDENT ENGINEER
OCT 26 1979
DATE

DE LEUW CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT



KEY PLAN OF SYSTEM



GENERAL CONSTRUCTION SITE PLAN

SCALE: 1" = 400'

Note: For Contractor's staging areas, see Dwg. No. L1-G-10.

CONTRACT DRAWINGS, FILE NOS. M124-1 TO M124-276
APPROVED FOR CONSTRUCTION
CHIEF OF DESIGN AND CONSTRUCTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

DESIGNED	E.C.	7-73
DRAWN	R.S.	8-73
CHECKED	L.P.	2-74
APPROVED	W.I.	2-74

REFERENCE DRAWINGS

NUMBER	DESCRIPTION

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

SUBMITTED

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

APPROVED

KEY PLAN OF SYSTEM AND
GENERAL CONSTRUCTION SITE PLAN
SECTION NO. L1

SCALE: AS SHOWN

DRAWING NO. ST-C-1

M124-1

ABBREVIATIONS

ALIGNMENT

P.O.C.	POINT ON CIRCULAR CURVE
P.O.T.	POINT ON TANGENT
I	TOTAL INTERSECTION ANGLE
Δ	CENTRAL ANGLE OF CIRCULAR CURVE
R	RADIUS OF CIRCULAR CURVE
T	TANGENT LENGTH OF CIRCULAR CURVE
L	LENGTH OF CIRCULAR CURVE
E	EXTERNAL DISTANCE
S.E.(Ea)	SUPERELEVATION (ACTUAL)
S.E.(Eu)	SUPERELEVATION (UNBALANCED)
Ls	TOTAL LENGTH OF SPIRAL
θs	CENTRAL ANGLE OF SPIRAL
T.S.	POINT OF CHANGE FROM TANGENT TO SPIRAL
S.C.	POINT OF CHANGE FROM SPIRAL TO CIRCULAR CURVE
C.S.	POINT OF CHANGE FROM CIRCULAR CURVE TO SPIRAL
S.T.	POINT OF CHANGE FROM SPIRAL TO TANGENT

HORIZONTAL

P.I.	POINT OF INTERSECTION OF MAIN TANGENTS
P.I.C.	POINT OF INTERSECTION OF CIRCULAR CURVE
P.I.S.	POINT OF INTERSECTION OF SPIRAL
P.C.	POINT OF CHANGE FROM TANGENT TO CIRCULAR CURVE
X	TANGENT DISTANCE AT S.C. OR C.S.
Y	TANGENT OFFSET AT S.C. OR C.S.
Ts	TANGENT DISTANCE FROM T.S. OR S.T. TO MAIN P.I.
P	OFFSET FROM THE INITIAL TANGENT TO THE P.C. OF THE SHIFTED CIRCLE
K	ABSCISSA OF THE SHIFTED P.C. REFERRED TO THE T.S.
LT	LONG TANGENT
ST	SHORT TANGENT
LC	LONG CHORD
TAN.	TANGENT
P.T.	POINT OF CHANGE FROM CIRCULAR CURVE TO TANGENT

VERTICAL

V.C.	VERTICAL CURVE LENGTH
P.V.C.	BEGINNING POINT OF VERTICAL CURVE
P.V.T.	END POINT OF VERTICAL CURVE
P.V.I.	POINT OF INTERSECTION OF VERTICAL TANGENTS
M.O.	MID ORDINATE

MISCELLANEOUS ABBREVIATIONS

APPROX.	APPROXIMATE
AVE.	AVENUE
B.C.	BOTTOM OF CURB
BLDG.	BUILDING
B.M.	BENCH MARK
BR.	BRICK
BSMT.	BASEMENT
CONC.	CONCRETE
℄	CENTER LINE
DWG.(S)	DRAWING(S)
EL., ELEV.	ELEVATION
ESMT.	EASEMENT
EQN.	EQUATION
EXIST.	EXISTING
₿	BASE LINE
EXPWY.	EXPRESSWAY
F.H.	FIRE HYDRANT
FUT.	FUTURE
HORIZ.	HORIZONTAL
I.B.	INBOUND
INV.	INVERT
M.H.	MANHOLE
M.P.H.	MILES PER HOUR
NO. #	NUMBER
N.I.C.	NOT IN CONTRACT
N.C.T.A.	NATIONAL CAPITAL TRANSPORTATION AGENCY
O.B.	OUTBOUND
PROP.	PROPOSED
RAD., R	RADIUS
REINF.	REINFORCED
RES.	RESERVATION
R.O.W.	RIGHT OF WAY
RTE.	ROUTE
STA.	STATION
ST.	STREET
STY.	STORY
T.C.	TOP OF CURB
T/R	TOP OF RAIL
U.S.C.&G.S.	UNITED STATES COAST AND GEODETIC SURVEY
VERT.	VERTICAL
W.M.A.T.A.	WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

SYMBOLS

- TREE
- STATION EQUATION
- BLDG. OUTLINE
- 226 — NUMBER - ALIGNMENT CURVE
- CURB OPENING
- CURB LINE
- 13.50 — EXISTING ELEVATION
- GROUND LINE
- L-10 — HORIZONTAL CONTROL POINT
- BENCH MARK
- 20 — NEW CONTOUR LINE
- EXISTING CONTOUR LINE
- EXISTING FENCE

GENERAL NOTES

1. ALL COORDINATES AND BEARINGS AS SHOWN ON THE DRAWINGS ARE BASED ON A PROJECT COORDINATE SYSTEM. UNLESS SPECIFICALLY NOTED OTHERWISE, COORDINATES ARE CONVERTED TO MARYLAND STATE PLANE COORDINATES BY MULTIPLYING THE PROJECT COORDINATE BY 0.9[illegible]430

2. ALL ELEVATIONS AND B.M.(S) ARE ESTABLISHED USING U.S.C. & G.S. MEAN SEA LEVEL DATUM, 1929 GENERAL ADJUSTMENT. RELATIONSHIPS BETWEEN PROJECT DATUM AND OTHER DATUM PLANES COMMON TO THE WASHINGTON D.C. AREA AS FOLLOWS:

DATUM

ELEVATION RELATIVE TO PROJECT DATUM (FEET)	
ABOVE PROJECT DATUM	
0.94	WASHINGTON AQUEDUCT AND FILTRATION PLANTS (W.A.D.)
0.70	DISTRICT OF COLUMBIA ENGINEERING DEPARTMENT Potomac Electric Power Company Washington Gas Light Company C. & P. Telephone Company D.C. Engineering Departments
0.57	PENNSYLVANIA RAILROAD
0.00	PROJECT DATUM = SEA LEVEL DATUM (1929 GENERAL ADJUSTMENT) U.S. Coast & Geodetic Survey U.S. Geological Survey Naval Research Laboratory ([illegible]) R. F. & P. Railroad B. & O. Railroad (Alexandria Branch) Arlington County
BELOW PROJECT DATUM	
0.15	SEA LEVEL DATUM (1912 GENERAL ADJUSTMENT) ※ Washington Suburban Sanitary Commission ※ Montgomery County
1.41	LOW WATER DATUM - WASHINGTON HARBOR (L.W.D.) Baltimore District, Corps of Engineers (Except Washington Aqueduct) National Park Service Public Roads Administration Washington National Airport
1.63	BOLLING AIR FORCE BASE
4.50	NAVAL GUN FACTORY
4.70	ANACOSTIA NAVAL AIR STATION

※ NOTE: The Washington Suburban Sanitary Commission and Montgomery County also use sea level datum (1929 general adjustment) in some areas.

3. FOR ADDITIONAL ABBREVIATIONS, SYMBOLS AND GENERAL NOTES, SEE UTILITY DWG. ST-U-14

DESIGNED	E.C.	12-73 DATE
DRAWN	R.S.	12-73 DATE
CHECKED	L.R.	2-74 DATE
APPROVED	J.I.	2-74 DATE

REFERENCE DRAWINGS: NUMBER | DESCRIPTION

REVISIONS: DATE | BY | DESCRIPTION

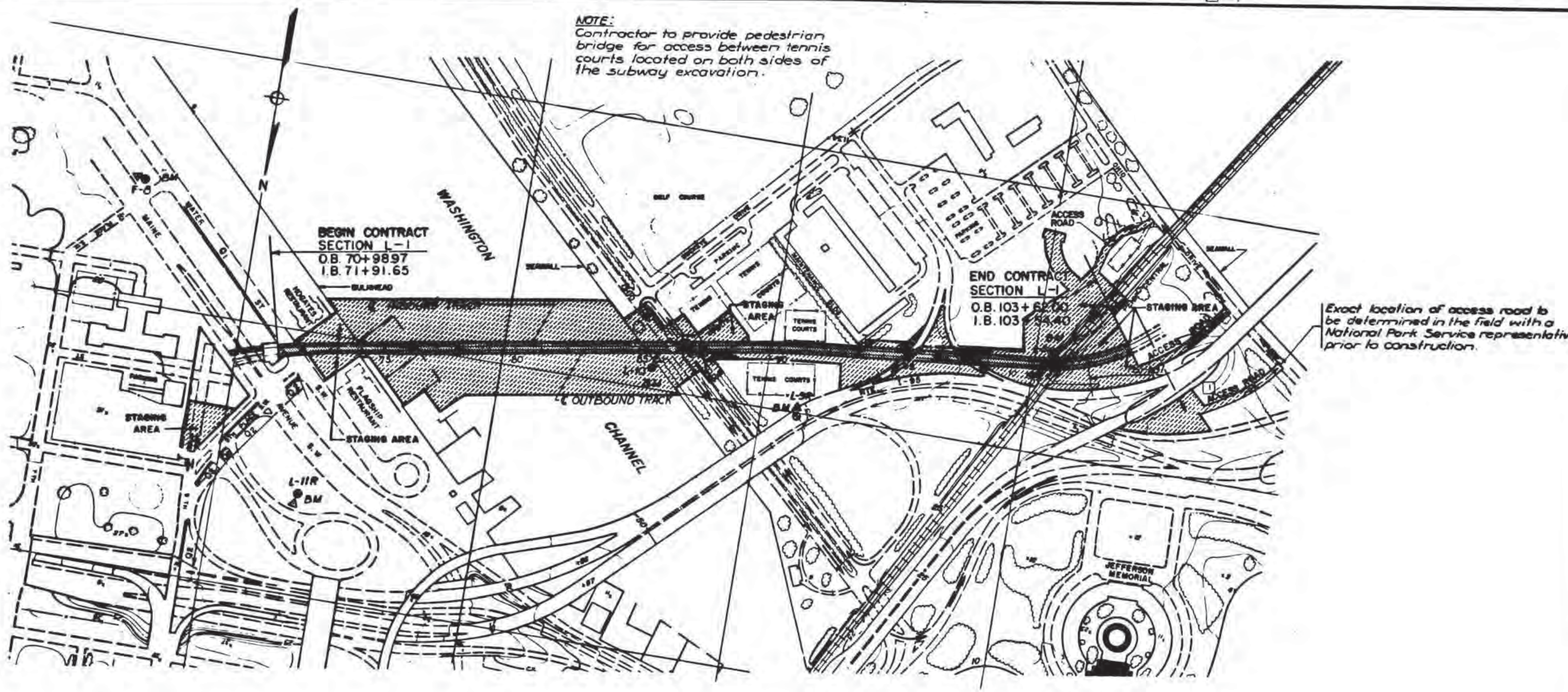
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS
SUBMITTED [signature]

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
APPROVED [signature]

L'ENFANT PLAZA-PENTAGON ROUTE
GENERAL NOTES, ABBREVIATIONS & SYMBOLS

SCALE: NONE | DRAWING NO. LI-G-3 | M124-6



NOTES:

THIS DRAWING SHOWS AN OVERALL VIEW OF THE ENTIRE PROJECT, CONSTRUCTION EASEMENTS, STAGING AREAS, ACCESS ROADS AND TRUCK QUEUING ARFAS. THE FOLLOWING RESTRICTIONS AND SPECIAL PROVISIONS ARE NOTED:

EAST POTOMAC PARK

1. ACCESS TO THE PARK FROM BOTH DIRECTIONS OF I-95 IS INDICATED BY FLOW ARROWS.
2. CONTRACTORS TRUCKS WILL GENERALLY BE LIMITED TO THE CONSTRUCTION EASEMENTS PROVIDED ALONG THE SUBWAY ALIGNMENT.
3. TRUCK TRAFFIC ON OHIO DRIVE, BOTH ALONG THE CHANNEL AND ALONG THE RIVER, WILL BE LIMITED TO THE ARFAS CONTAINING FLOW ARROWS.
4. NO TRUCK TRAFFIC WILL BE PERMITTED ON BUCKEYE DRIVE.

WATER STREET AREA

Q1 - TRUCK QUEUING AREA: 10:00 P.M. TO 9:30 A.M.
Q2 - TRUCK QUEUING AREA: ALL OTHER TIMES.

DESIGNED	E.C.	9-73
DRAWN	R.S	10-73
CHECKED	L.P	2-74
APPROVED	J.I	2-74

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
C-1	Horizontal & Vertical Control
R-1106	R.O.W. Plan

REVISIONS

DATE	BY	DESCRIPTION
?-28-79	THUY	1 CONST. EASEMENT LIMITS REV. PER FIELD COND., "AS-BUILT"

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

SUBMITTED [signature]
APPROVED [signature]

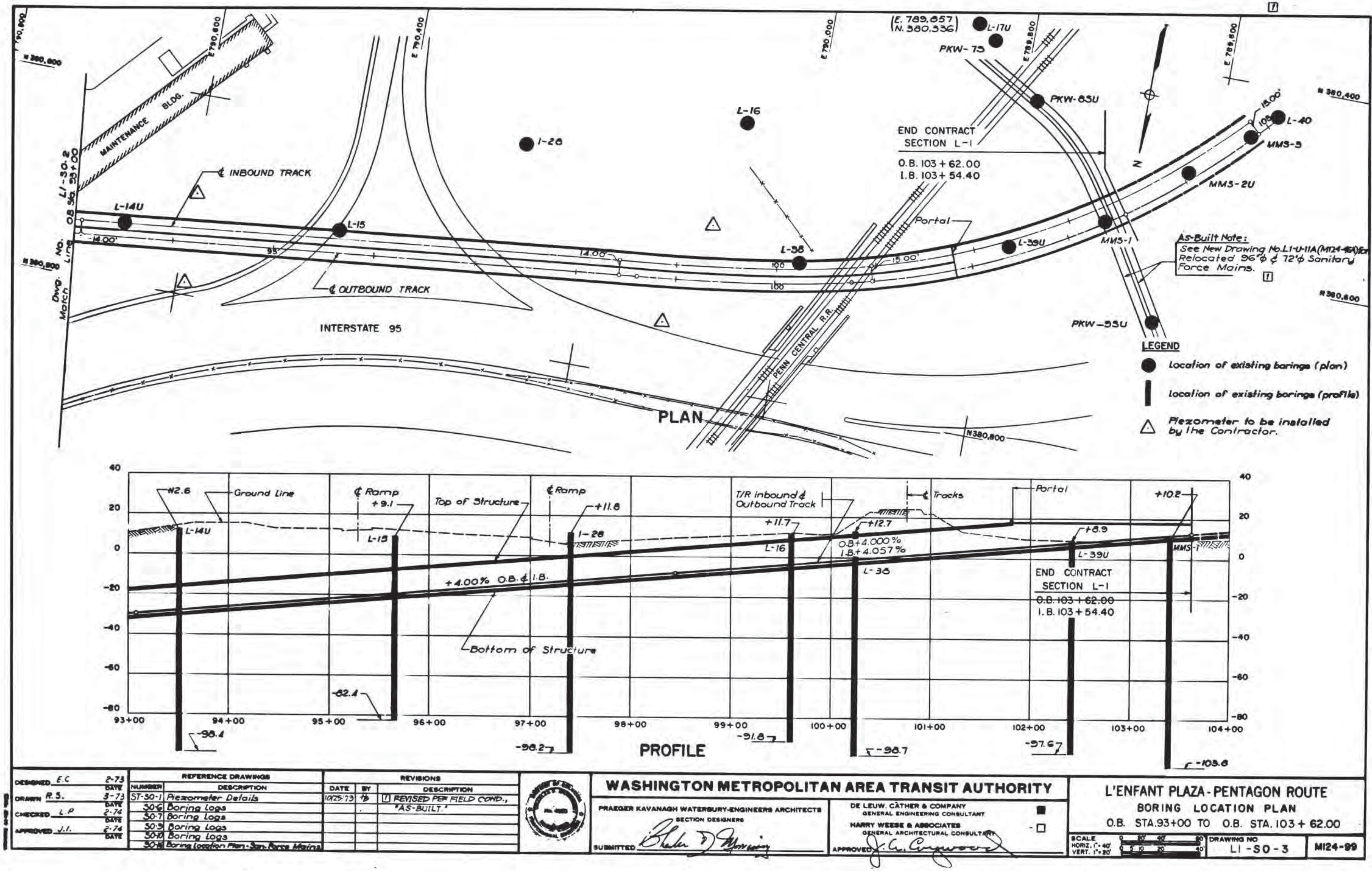
L'ENFANT PLAZA - PENTAGON ROUTE
GENERAL CONDITIONS

SCALE 1" = 200' 0 100' 200' 400'

DRAWING NO. L1 - G - 10

M124-13

APPENDIX 3
SCHNABEL ENGINEERING, LLC
Sheet: 5/23



BORING NUMBER L-4
Ground surface elevation + 11.9

Depth (ft)	Sample	Blows	Description	Strata
0			Asphalt pavement	0.5'
				GREEN SANDY CLAY, FILL 6.0'
5	1D	6,3,4	Gray fine to medium sandy clay (Fill) (CL)	LIGHT GRAY COARSE TO MEDIUM SAND 13.0'
10	2D	9,6,7	Light gray coarse to medium sand, some gravel (SP)	
15	3D	3,3,4	Top: Orange-brown oxidized medium to fine sandy clay, some gravel (CL) Bot: Gray silty clay (CL)	ORANGE-BROWN TO GRAY SILTY CLAY 21.5'
20	4D	3,3,3	Gray silty clay (CL)	
25	5D	21,21 19	Light gray silty medium to fine sand, some gravel (SP)	GRAY TO BROWN MEDIUM TO FINE SAND, TRACE SILT AND GRAVEL
30	6D	7,10, 15	Orange-brown medium to fine sand, trace gravel (SP)	
35	7D	6,9, 11	Do. 6D (SP)-(SM)	40.0'
40	8D	19*, 26*, 16*	Light brown coarse to medium sand & gravel (GP)-(GM)	C-M SAND & GRAVEL 44.5'
45	9D	9,7, 13	Light gray to gray-brown clayey fine sand (SC-SM)	LT GRAY F-M SAND 48.0'
50	10D	11,14 16	Gray-green silty clay (Weathered Cretaceous) (CL)	GRAY-GREEN SILTY OR SANDY CLAY 58.0'
55	11D	20,31 33	Top: Gray-green f sandy clay & lignite (CL) Bot: Gray-green clayey medium to fine sand (SC)	
60	12D	27,55 44	Green-gray clayey fine sand (SC)	GREEN-GRAY CLAYEY FINE SAND
65	13D	21,33 39	Do. 12D (SC)	
70	14D	34,46 56	Do. 12D (SC)	
75	15D	29,36 49	Do. 12D (SC)	
	16D	16,42 47	Do. 12D (SC)	78.0'

Casing blows (0–50 ft): 63, 53, 13, 10, 4, 5, 5, 6, 8, 18, 13, 24, 25, 22, 30, 7, 10, 19, 11, 13, 18, 18, 40, 70, 95, 34, 45, 52, 44, 47, 29, 31, 51, 45, 50, 30, 37, 56, 39, 42, 60, 150, 230, 112, 151, 47, 63, 177, 584, 279, 50, 103, 160, 247, 214

Boring started 5-11-70, completed 5-12-70
Final depths:
Boring = 78.0' Casing = 55.0'
Casing diameter = 2-1/2"
Average depth of ground water = 16.0' = El.-4.1

REMARKS:
6" Asphalt pavement at surface.
Sampler blows for Sample 8D are with 300 lb. hammer falling 18".
Observation well consisting of 1/2" steel pipe installed with tip at 65' depth

BORING NUMBER L-5
Ground surface elevation -22.1

Depth (ft)	Sample	Blows	Description	Strata
0	1D	WR	Very soft gray organic silty clay (OH)	VERY SOFT ORGANIC SILTY CLAY 8.5'
5	2D	WR	Do. 1D (OH)	
10	3SD	P	Do. 1D, medium soft (OH)	MEDIUM STIFF DARK GRAY-BROWN ORGANIC SILTY CLAY, BECOMING STIFFER WITH DEPTH, OCCASIONAL SMALL POCKETS OF SAND AND LENSES OF ORGANIC MATTER
15	4S	P	Do. 3SD (OH)	
20	5S	P	Do. 3SD (OH)	
25	6SD	P	Medium gray-brown organic silty clay with layers of sand & lenses of organic materials (OH)	
30	7D	3,1,1	Do. 6SD (OH)	
	8SD	P	Do 6SD, with some large gravel (OH)	
35	9S	P	Do. 6SD (OH)	
40	10S	P	Do. 6SD (OH)	
45	11S	P	Do. 6SD (OH)	47.0'
50	12D	100/6	Gray coarse sand & gravel (SP & GP)	V COMP SAND AND GRAVEL 52.0'
55	13D	11,20 21	Gray-green clayey fine sand (Cretaceous) (SC)	COMPACT CLAYEY FINE SAND 56.2'
	14SD	P	Do. 13D, with some gravel (SC)	

Casing blows (10–56 ft): 6, 3, 6, 6, 9, 9, 8, 8, 8, 4, 7, 6, 5, 5, 7, 13, 14, 21, 11, 17, 20, 19, 21, 31, 26, 25, 21, 22, 19, 17, 16, 17, 19, 31, 28, 34, 42, 121, 143, 169, 89, 193, 176, 184, 193, 194, 281

Boring started 4-27-70, completed 4-28-70
Final depths:
Boring = 56.2' Casing = 56.0'
Casing diameter = 3-1/2"
Average depth of ground water = —— = El.+0 (Open water)

REMARKS:
Boring made in open water.
Casing went down under its own weight from 0 to 9' depth.

BORING NUMBER L-6
Ground surface elevation -23.0

Depth (ft)	Sample	Blows	Description	Strata
0	1D	WR	Very soft dark gray organic silty clay (OH)	SOFT GRAY ORGANIC SILT SOME CLAY 8.0'
5	2D	WR	"Do 1D" (OH)	
10	3S	P	Soft dark Gray Brown organic silty clay, trace sand (OH)	SOFT TO MEDIUM STIFF DARK GRAY BROWN ORGANIC SILTY CLAY - BECOMING STIFFER WITH DEPTH
15	4D	P	Medium "Do 2D" (OH)	
20	5S	P	"Do 3S" (OH) more plastic	
25	6S	P	"Do 3S" (OH)	
30	7S	P	"Do 3S" (OH)	
35	8S	P	"Do 3S" (OH)	
40	9S	P	"Do 3S" (OH)	
45	10S	P	"Do 3S" (OH)	
50	11D	1,1,1	"Do 4D (OH) Trace dec. wood	
55	12D	2,2,2	"Do 4D" (OH)	61.0'
60	13D	4,18, 23	Top "Do 4D" (OH) Bottom: Gray coarse sand & gravel (SP) & (GP)	SAND & GRAVEL 63.5
65	14D	24,39 42	Light gray clayey fine to medium sand with pockets of gray green clayey silt (Cretaceous) (SC)	VERY COMPACT GRAY GREEN CLAYEY SAND GRAVEL INCREASING W/ DEPTH
70	15D	28,42 60	"Do 14D" with trace gvl (SC)	
75	16D	87,85 50	Gray green clayey sand Some gravel (SC)	76.5'

Casing blows (55–63 ft): 4, 4, 5, 6, 7, 18, 92, 123, 137, 162

Boring started 4-29-70, completed 4-30-70
Final depths:
Boring = 76.5' Casing = 65.0'
Casing diameter = 3-1/2"
Average depth of ground water = —— = El.+0 (Open water)

REMARKS:
Boring made in open water.
Hole washed ahead of casing to 60' depth and driven from 60' to 65' depth.

BORING NUMBER L-7U
Ground surface elevation -23.0

Depth (ft)	Sample	Blows	Description	Strata
0	1D	WR	Very soft dark gray organic silty clay (OH)	VERY SOFT DARK GRAY ORGANIC SILTY CLAY 9.0'
5	2D	WR	'Do 1D' (OH)	
10	3U	P	Gray-brown organic silty clay. Trace of fine sand (OH)	SOFT TO MEDIUM STIFF DARK GRAY-BROWN ORGANIC SILTY CLAY WITH TRACE OF FINE SAND & OCC WOOD FGMTS. CONSISTENCY INCR. WITH DEPTH
15	4UD	P	"Do 3U" (OH)	
20	5U	P	"Do 3U" (OH)	
25	6U	P	"Do 3U" (OH)	
30	7U	P	"Do 3U" (OH)	
35	8U	P	"Do 3U" (OH)	
40	9U	P	"Do 3U" (OH)	
45	10UD	P	"Do 3U" (OH)	
50	11U	P	"Do 3U" (OH)	
55	12U	P	"Do 3U" (OH)	
60	13U	P	Gray silty clay with trace of fine sand moderately organic (OH)	
65	14D	P	Medium dark gray organic silty clay, tr fine sand (OH)	67.5'
70	15D	30,38 60	Light gray-green clayey medium fine sand, trace to some gravel, (Cretaceous) (SC)	VERY COMPACT FINE TO MEDIUM SAND SOME CLAY, TRACE GRAVEL
75	16D	34,82 97	Light gray green medium - fine sand, trace-some clay trace small gravel (SP) & (SC)	76.5'

Casing blow at 10 ft: 12

Boring started 5-11-70, completed 5-12-70
Final depths:
Boring = 76.5' Casing = 10.0'
Casing diameter = 4'
Average depth of ground water = = El.+

REMARKS:
Boring made in open water.
Casing went down under its own weight from 0 to 9'.
Hole washed with chopping bit and jet auger from 10' to 75' depth.

DEPTH BELOW GROUND SURFACE, FEET

LEGEND FOR L-SERIES BORING LOGS

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

Ⓐ = DEPTH BELOW GROUND SURFACE IN FEET.

Ⓑ = NUMBER OF BLOWS OF 300 LB. HAMMER FALLING 18" REQUIRED TO DRIVE CASING OF THE SIZE NOTED ONE FOOT.

Ⓒ = NUMBER AND TYPE OF SAMPLE:
SUFFIX "D" = DRY SAMPLE TAKEN WITH 2" OD SPLIT SPOON;
SUFFIX "S" = SHELBY SAMPLE TAKEN WITH 2" OD THIN TUBE;
SUFFIX "R" = DRY SAMPLE TAKEN IN OPEN END DRILL ROD;
SUFFIX "U" = UNDISTURBED SAMPLE TAKEN WITH 3" OD THIN TUBE USING PISTON SAMPLER;
SUFFIX "UD" = 3" OD THIN TUBE SAMPLE, [illegible] SAMPLING;
NR = SAMPLE ATTEMPTED BUT NOT RECOVERED;
SUFFIX "C" = ROCK CORE RUN USING NX SIZE DOUBLE TUBE DIAMOND CORE BARREL;
CORE = CORING IN OVERBURDEN OR CORING IN BEDROCK WITH SAWTOOTH BIT

Ⓓ = SAMPLER PENETRATION RESISTANCE IN BLOWS PER 6" OF DRIVING, EXCEPT WHERE SPECIFIC DISTANCE IS NOTED. SAMPLER DRIVEN WITH 140 LB. HAMMER FALLING 30".
P = THIN TUBE SAMPLER ADVANCED BY PUSHING;
T = THIN TUBE SAMPLER ADVANCED BY TAPPING;
(R SAMPLES DRIVEN WITH 300 LB. HAMMER FALLING 18")
70/25 — LENGTH OF ROCK CORE RECOVERY EXPRESSED AS A PERCENT OF LENGTH OF CORE RUN. ROCK QUALITY DESIGNATION, R.Q.D. IN PER CENT.

Ⓔ = DESCRIPTION OF INDIVIDUAL SOIL SAMPLE, INCLUDING UNIFIED SOIL CLASSIFICATION SYMBOL, OR DESCRIPTION OF INDIVIDUAL ROCK CORE RUN.

Ⓕ = DESCRIPTION OF PRINCIPAL SOIL STRATA OR PRINCIPAL DIVISIONS OF BEDROCK. STRATA DIVISION LINES ARE NOTED WITH DEPTH BELOW GROUND SURFACE.

NOTES FOR L-SERIES BORING LOGS

1. BORINGS NOS. L-1 TO L-15 WERE MADE BY WARREN GEORGE, INC. FROM APRIL 27 TO MAY 13,1970 UNDER THE SUPERVISION OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON.

   BORINGS NOS. L-16 TO L-37U WERE MADE BY SPRAGUE & HENWOOD, INC. FROM SEPTEMBER 8 TO NOVEMBER 2,1970 UNDER THE SUPERVISION OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON.

2. FOR BORING LOCATIONS SEE DRAWING NOS. SO-1 TO SO-3.

3. THE DEGREE OF CONSISTENCY OR COMPACTNESS OF SAMPLES ARE NOT GIVEN IN THE BORING LOG DESCRIPTIONS BUT ARE INDICATED BY THE FOLLOWING VALUES OF STANDARD SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT:

   FINE GRAINED SOILS, SILTS AND CLAYS:
   LESS THAN 2 BPF - VERY SOFT
   2 TO 4 BPF - SOFT
   4 TO 8 BPF - MEDIUM STIFF
   8 TO 15 BPF - STIFF
   15 TO 30 BPF - VERY STIFF
   GREATER THAN 30 - HARD

   COARSE GRAINED SOILS, SANDS AND GRAVELS:
   LESS THAN 4 BPF - VERY LOOSE
   4 TO 10 BPF - LOOSE
   10 TO 30 BPF - MEDIUM COMPACT
   30 TO 50 BPF - COMPACT
   GREATER THAN 50 - VERY COMPACT

4. ABBREVIATIONS:

   COLOR: BLACK: blk; BROWN: brn; DARK: dk; GRAY: gry; GREEN: grn; LIGHT: lt; MOTTLED: mtld

   MATERIAL TYPE: CLAY: cl; GRAVEL: gvl; SAND: sa; SILT: sl; SILTY CLAY: si cl; DITTO PREVIOUS SAMPLE: Do; BOTTOM OF SAMPLE: Bot

   GRAIN SIZE: COARSE: c; COARSE TO FINE: c-f; COARSE TO MEDIUM: c-m; FINE: f; FINE TO COARSE: f-c; FINE TO MEDIUM: f-m; MEDIUM: m; MEDIUM TO COARSE: m-c; MEDIUM TO FINE: m-f

   MISCELLANEOUS: FRAGMENTS: fgmt; LAYER: lyr; MATERIAL: mtl; MATTER: mat; MEDIUM (CONSISTENCY): med; OCCASIONAL: occ; POCKET: pkt; ROCK QUALITY DESIGNATION: RQD; SLIGHTLY: sl; SOME: sm; TRACE: tr; VEGETAL: veg; WITH: w/

5. BORING LOGS HAVE BEEN REPRODUCED WITHOUT ALTERATION FROM "FINAL REPORT, SUBSURFACE INVESTIGATIONS L'ENFANT PLAZA-PENTAGON ROUTE STATIONS [illegible] TO [illegible] DATED DECEMBER 1970 AND ARE PRESENTED FOR INFORMATION ONLY.

6. THE SUBSURFACE INVESTIGATIONS REPORT AND THE RELATED SOILS SAMPLES ARE AVAILABLE FOR INSPECTION THROUGH WMATA.

7. ALL ELEVATIONS REFER TO USC & GS MEAN SEA LEVEL DATUM OF 1929, DESIGNATED AS PROJECT DATUM.

8. THE GROUNDWATER LEVELS NOTED ON THE BORING LOGS REPRESENT TYPICAL LEVELS OBSERVED DURING THE PERIOD OF THE BORING OPERATIONS OR SHORTLY AFTER COMPLETION OF THE BOREHOLE. THESE OBSERVATIONS MAY NOT REFLECT SEASONAL FLUCTUATIONS IN THE WATER TABLE OR THE EFFECTS OF INTENSE RAINFALL OR RUNOFF.

*INDICATES SAMPLER DRIVEN WITH 300LB. HAMMER

DESIGNED	E.L.	1-73	DATE
DRAWN	A.L.D.	1-73	DATE
CHECKED	C.F.	2-74	DATE
APPROVED	J.L.	2-74	DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
—	boring Location Plan

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

SUBMITTED [signature]
APPROVED [signature]

L'ENFANT PLAZA-PENTAGON ROUTE
LEGEND, NOTES AND BORING LOGS
L-4, L-5, L-6 AND L-7U

SCALE: Not to Scale
DRAWING NO. LI-SO-4
M124-101

BORING NUMBER L-38

Ground surface elevation + 12,7

DEPTH BELOW GROUND SURFACE, FEET

Depth (ft)	Sample	Blows	Description	Stratum
0	1D	3,6,12	brown clayey coarse-fine sand, broken gravel, trace cinder (Fill) (SC)	BROWN CLAYEY FINE-MEDIUM SAND, BRICK (FILL)
5	2D	5,7,14	Brown coarse-fine sand, some silt, trace brick (Fill) (SM)	9.0'
10	3D	3,3,3	Gray-brown moderately organic clayey silt, trace coarse-fine sand & gravel (OH)	SOFT-MEDIUM STIFF DARK GRAY ORGANIC SILTY CLAY
15	4D	6,2,9	Dark gray-brown organic silty clay, trace decomposed wood (OH)	
20	5D	7,12,14	Do 4D, slightly oxidized (OH)	
			WATER LOSS FROM 22' TO 28'	
	NR	10,8,95	Possible gravel at 29'	
30	6D	4,6,4	Do 5D, trace shells, layers gray fine-medium sand (OH)	35.0'
35	7D	6,12,13	Gray fine-medium sand, pockets silty clay (SP)	MEDIUM COMPACT DARK GRAY FINE-MEDIUM SAND WITH POCKETS SILTY CLAY
40	NR	7,8,11	Probable fine sand from 40' to 43'	
	NR	8,10,12		45.0'
45	8D	7,5,5	Dark gray orgainic fine sandy silt, trace shells (OH)	MEDIUM COMPACT GRAY FINE-MEDIUM SAND, TRACE SILT, TURNS VERY COMPACT AT 55'
50	9D	9,8,7	Gray fine-medium sand, trace- some silt (SM)	
55	10D	37,51,51	Do 9D (SP-SM)	58.0'
60	11D	6,6,6	Dark gray organic silty clay (OH)	MEDIUM STIFF DARK GRAY ORGANIC SILTY CLAY
65	12D	5,5,7	Do 11D, trace decomposed wood & fine sand layers (OH)	69.0'
70	13D	9,10,12	Gray slightly organic silty fine sand (SM)	MEDIUM COMPACT DARK GRAY SLIGHTLY ORGANIC SILTY FINE-MEDIUM SAND WITH POCKETS DARK GRAY SILTY CLAY
75	14D	9,11,13	Dark gray organic fine sandy clay, some silty fine sand layers (OH)	
80	15D	10,9,12	Dark gray organic silty fine-medium sand, some organic silty clay layers (SM)	83.0'
85	16D	7,9,11	Soft dark gray organic silty clay, trace decomposed wood (OH)	MED STIFF TO STIFF DK GRY SI CL, TR DEC WOOD
90	17D	6,7,6	Do 16D (OH)	92.0'
95	18D	10,12,11	Gray organic silty fine-medium sand, some clay (SM)	ORGANIC SILTY SAND 97.0'
100	19D	16,32,29	Dark gray silty fine-medium sand (SM)	VERY COMPACT DARK GRAY MEDIUM-SAND, TRACE SILT & GRAVEL
105	20D	95,100/4"	Dark gray medium-fine sand, some silt, trace gravel (SP-SM)	107.0'

Casing blows per foot (0–104 ft): 5, 21, 21, 19, 21, 58, 32, 47, 42, 5, 5, 2, 3, 5, 5, 7, 7, 5, 7, 8, 67, 9, 12, 16, 17, 27, 23, 27, 130, 139, 14, 16, 18, 24, 15, 22, 31, 34, 41, 47, 46, 47, 47, 28, 24, 51, 48, 35, 31, 25, 52, 51, 68, 44, 51, 46, 53, 64, 69, 54, 90, 65, 62, 55, 44, 65, 54, 57, 47, 57, 47, 46, 42, 33, 34, 34, 39, 36, 31, 41, 36, 38, 43, 43, 56, 46, 49, 47, 45, 170, 95, 81, 64, 64, 161, 199, 142, 136, 111, 150, 127, 140, 215, 340

(Continued)

BORING NUMBER L-38 (Continued)

Depth (ft)	Sample	Blows	Description	Stratum
110	21D	35,50,100/5"	Gray-green clayey fine-medium sand & fine sandy clay, trace gravel (Cretaceous) (SC & CL)	CLAYEY SAND 111.4'

Boring started 11-16-71 , completed 11-20-71
Final depths:
Boring = 111.4' Casing = 104'
Casing diameter = 2-1/2"
Average depth of ground water = 19.5' = El.- 6.8

REMARKS:
Washed ahead of casing from 14' to 21' depth; casing blows not indicative of consistency.
Wash water loss noted between 22' to 25' depth.
Observed ground water level probably not realistic.

BORING NUMBER L-39U

Ground surface elevation + 8.9

Depth (ft)	Sample	Blows	Description	Stratum
0			Five feet of sand fill at the surface	MED CMPT BRN F-M SA 5.0'
5	1D	3,7,3	Dark gray organic silty clay, some fine sand & gravel, trace vegetal (OH)	LOOSE-MEDIUM COMPACT SILTY FINE-MEDIUM SAND, SLIGHTLY ORGANIC, OCCASIONAL ORGANIC SILT LENSES
	2U	P	Dark gray organic fine sandy silt (MH)	
10	3U	P	Gray fine-medium sand, trace silt (SP)	
			Wash indicates relatively clean sand from 12' to 13'	
15	4UD	P	Gray silty fine sand, pockets of clay (SM)	
20	5U	P	Dark gray organic silt, trace-some fine sand, trace vegetal matter (OL) & (SP-SM)	
	6U	P	Gray silty fine-medium sand (OL) & (SM)	
25	7D	6,3,3	Dark gray slightly organic silty fine-medium sand (SM)	
30	8D	4,7,5	Gray organic silty medium-fine sand, trace clay (SM)	
			Dark gray silty fine sand, some organic silty clay layers (SM)	
35	9D	4,2,2		
	10UD	P	Do 9D (SM)	38.0'
40	11D	4,4,3	Dark gray organic silty clay, some gray fine-medium sand (OH)	MEDIUM STIFF-STIFF DARK GRAY ORGANIC CLAY, LAYER FINE-MEDIUM SAND
	12U	P	Do 11D (OH)	
	13U	P	Dark gray organic silty clay, some fine-medium sand (OH)	
45	14D	5,4,4	Medium dark gray organic silty clay, trace fine sand (OH)	
	15U	P	Gray medium-fine sand, trace organic silty clay (SP)-(SM)	52.0'
55	16D	9,7,7	Dark gray organic silty clay, layer fine-medium sand & decomposed vegetal matter (OH)	MEDIUM STIFF-STIFF DARK GRAY ORGANIC SILTY CLAY, LAYERS GRAY FINE-MEDIUM SAND & VEGETAL MATTER
60	17U	P	Dark gray organic silt, trace fibrous material (OH)	
65	18U	P	Do 16D (OH)	
75	19U	P	Do 16D (OH)	
	20U	P	Do 16D (OH)	
80	21U	P	Do 16U (OH)	
85	22D	5,5,7	Dark gray organic silty clay, lense gray fine-medium sand, layer of vegetal matter (OH)	
90	23D	6,6,10	Do 22D (OH)	
95	24D	7,16,14	Top: Do 23D (OH) Bot: Gray fine-medium sand, some silt (SP-SM)	96.0' SAND, SOME SILT 99.0'
100	25U	32,53,64	Gray-green clayey fine-medium sand, trace clay layers (Cretaceous) (SC)	VERY CMPT GRY-GRN CLAYEY FINE-MEDIUM SAND
105	26D	28,43,51	Do 25D, fine sandy clay (SC) & (CL)	106.5'

Boring started 11-23-71 , completed 12-14-71
Final depths:
Boring = 106.5' Casing = 80'
Casing diameter = 4"
Average depth of ground water = 7.4' = El.+1.5

REMARKS:
Washed ahead of casing from 16' to 19' depth; casing blows not indicative of consistency.
Observation well consisting of 1-1/2" steel pipe installed with tip at 63.5' depth.

NOTES

1. FOR LEGEND AND NOTES, SEE DWG. NO. SO-4
2. FOR BORING LOCATIONS, SEE DWG. NO. SO-3
3. BORING NOS. L-38 AND L-39U WERE MADE BY A BORING CONTRACTOR UNDER THE SUPERVISION OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON
4. BORING LOGS HAVE BEEN REPRODUCED WITHOUT ALTERATION FROM: REPORT NO. 13, CONTRACT MODS. NO. 3Z7022-005 & 020 (REPORT NO. 71 MRWJ SERIES). SECTION L002, L'ENFANT-PENTAGON ROUTE, SUBSURFACE INVESTIGATION, AND ARE PRESENTED FOR INFORMATION ONLY.
5. THE SUBSURFACE INVESTIGATIONS REPORT AND THE RELATED SOILS SAMPLES ARE AVAILABLE FOR INSPECTION THROUGH WMATA

DESIGNED	E.L.	1-73 DATE
DRAWN	A.L.Q.	1-73 DATE
CHECKED	L.P.	2-74 DATE
APPROVED	J.I.	2-74 DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
SO-3	Boring Location Plan

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

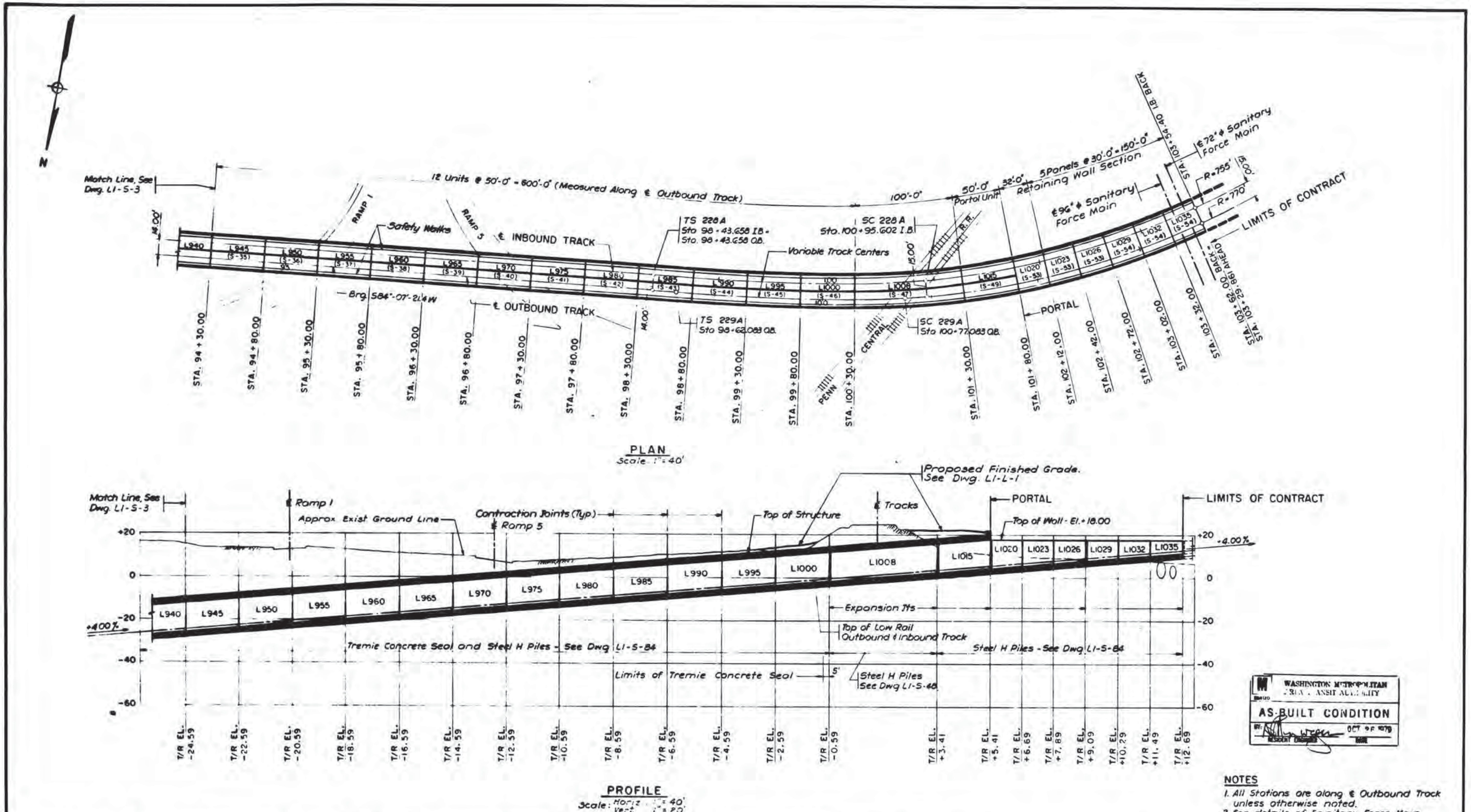
PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS
SUBMITTED [signature]

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
APPROVED [signature]

L'ENFANT PLAZA - PENTAGON ROUTE
BORING LOGS
L-38 AND L-39U

SCALE: Not to Scale
DRAWING NO. LI-SO-10
M124-105

APPENDIX 3
SCHNABEL ENGINEERING, LLC
Sheet: 8/23



NOTES
1. All Stations are along ℄ Outbound Track unless otherwise noted.
2. For details of Sanitary Force Main Crossing, see Dwg. L1-S-93

DESIGNED	M S R. 12-22-72
DRAWN	P L. 12-29-72
CHECKED	M S R 1-4-73
APPROVED	J I 4-9-74

REFERENCE DRAWINGS: PP3 PLAN AND PROFILE

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

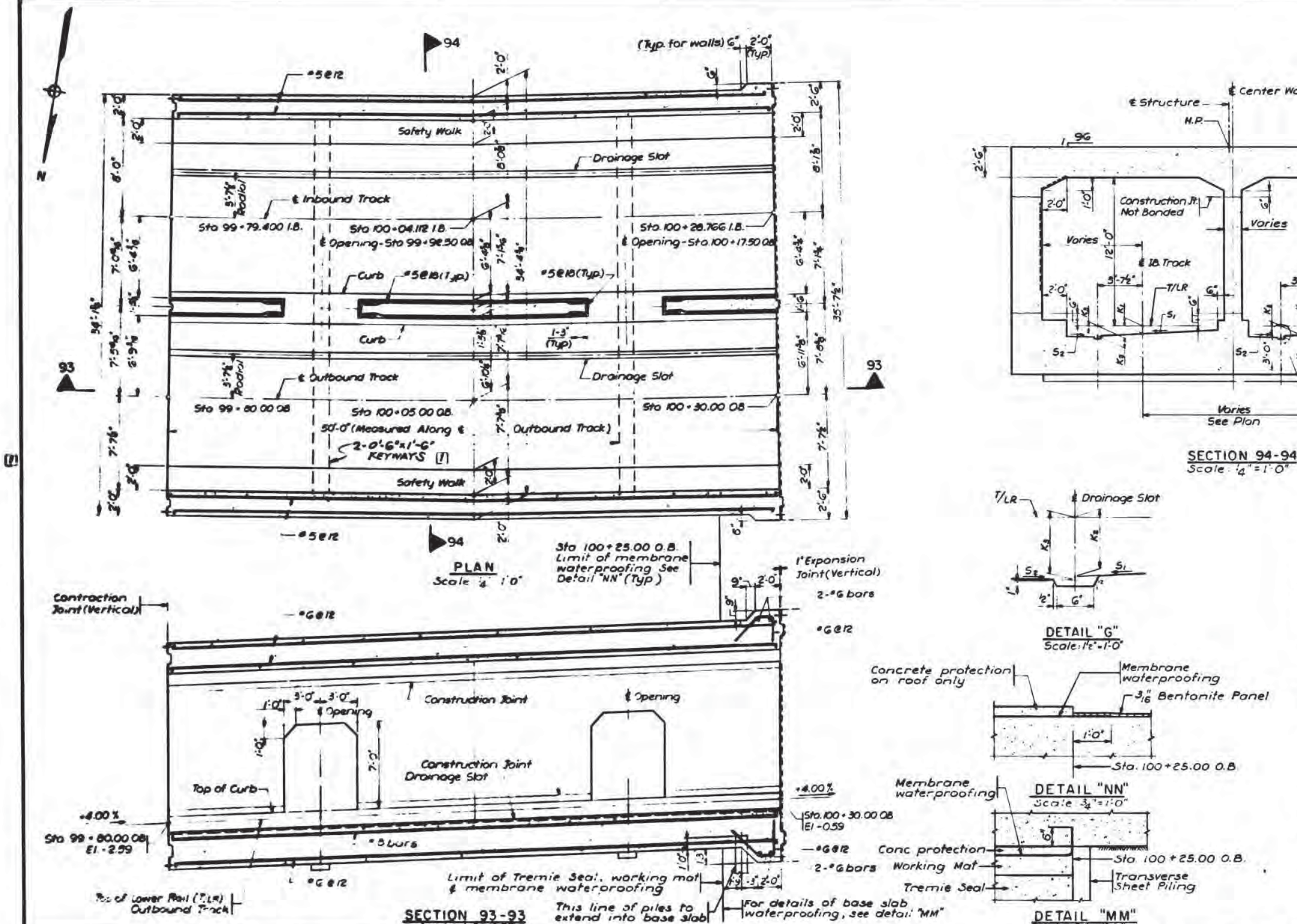
PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS, SECTION DESIGNERS

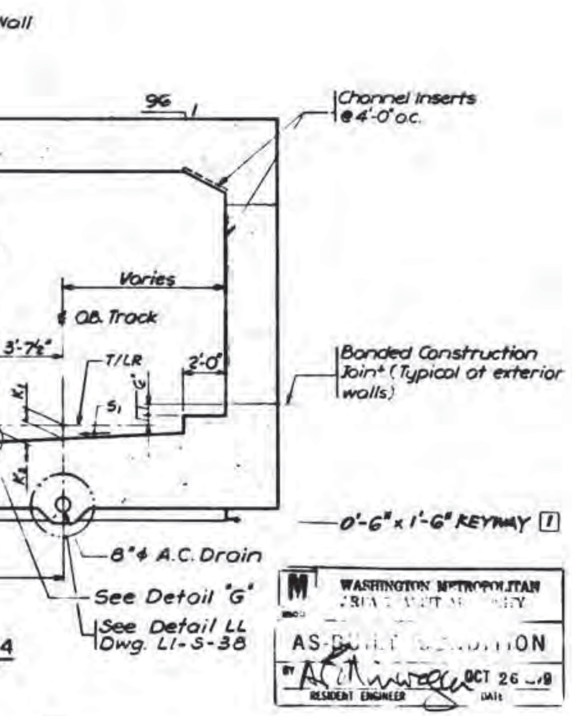
DE LEUW, CATHER & COMPANY, GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES, GENERAL ARCHITECTURAL CONSULTANT

L'ENFANT PLAZA - PENTAGON ROUTE
STRUCTURAL KEY PLAN IV
STA. 94+30.00 TO STA. 103+62.00 O.B.

SCALE: AS NOTED
DRAWING NO. L1-S-4
M124-118





INVERT DIMENSIONS						
STA.	S.E. (IN)	S_1 (IN/IN)	S_2 (IN/IN)	K_1 (IN)	K_2 (IN)	K_3 (IN)
99+80.00 O.B.	2 3/16	.0388	.0200	7 3/8	9 9/16	10
100+05.00 O.B.	2 11/16	.0471	.0200	7 11/16	9 11/16	10 1/4
100+30.00 O.B.	3 1/8	.0553	.0200	7 7/16	9 13/16	10 7/16
99+79.400 I.B.	2 1/8	.0381	.0200	7 15/16	9 9/16	10
100+04.112 I.B.	2 9/16	.0451	.0200	7 3/8	9 11/16	10 3/16
100+28.766 I.B.	2 15/16	.0520	.0200	7 1/2	9 13/16	10 3/8

Note

Superelevation varies linearly from 0" on tangent to 4" on full circular curve. For determination of invert dimensions between Specified Stations see Table, Dwg. L1-S-50.

NOTES

1. For General Notes, see Dwg. L1-S-1
2. For location of Structure Unit, see Dwg. L1-S-4
3. For typical reinforcement details, see Dwg. L1-S-51
4. For Electrical Bonding Details, see Dwg. ST-S-7
5. For details of channel inserts, see Dwg ST-E-15
6. For details of contraction joint, see Dwg. L1-S-50
7. Elevations shown are at Top of Low Rail (T/LR)
8. Walls and Safety Walks to be constructed on chords between dimensioned lines.
9. For waterproofing details, see Dwg. L1-S-50
10. For Pile Location Plan, See Dwg. L1-S-84
11. For details of expansion joint, see Dwg. L1-S-47.

DESIGNED KKC 1-11-73
DRAWN PL 1-18-73
CHECKED MSR 1-29-73
APPROVED JI 4-9-74

REFERENCE DRAWINGS: NUMBER | DESCRIPTION

REVISIONS: DATE | BY | DESCRIPTION
-2-79 | | [1] KEYWAYS ADDED PER PCO-58 AS-BUILT.

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

SUBMITTED

APPROVED

L'ENFANT PLAZA - PENTAGON ROUTE

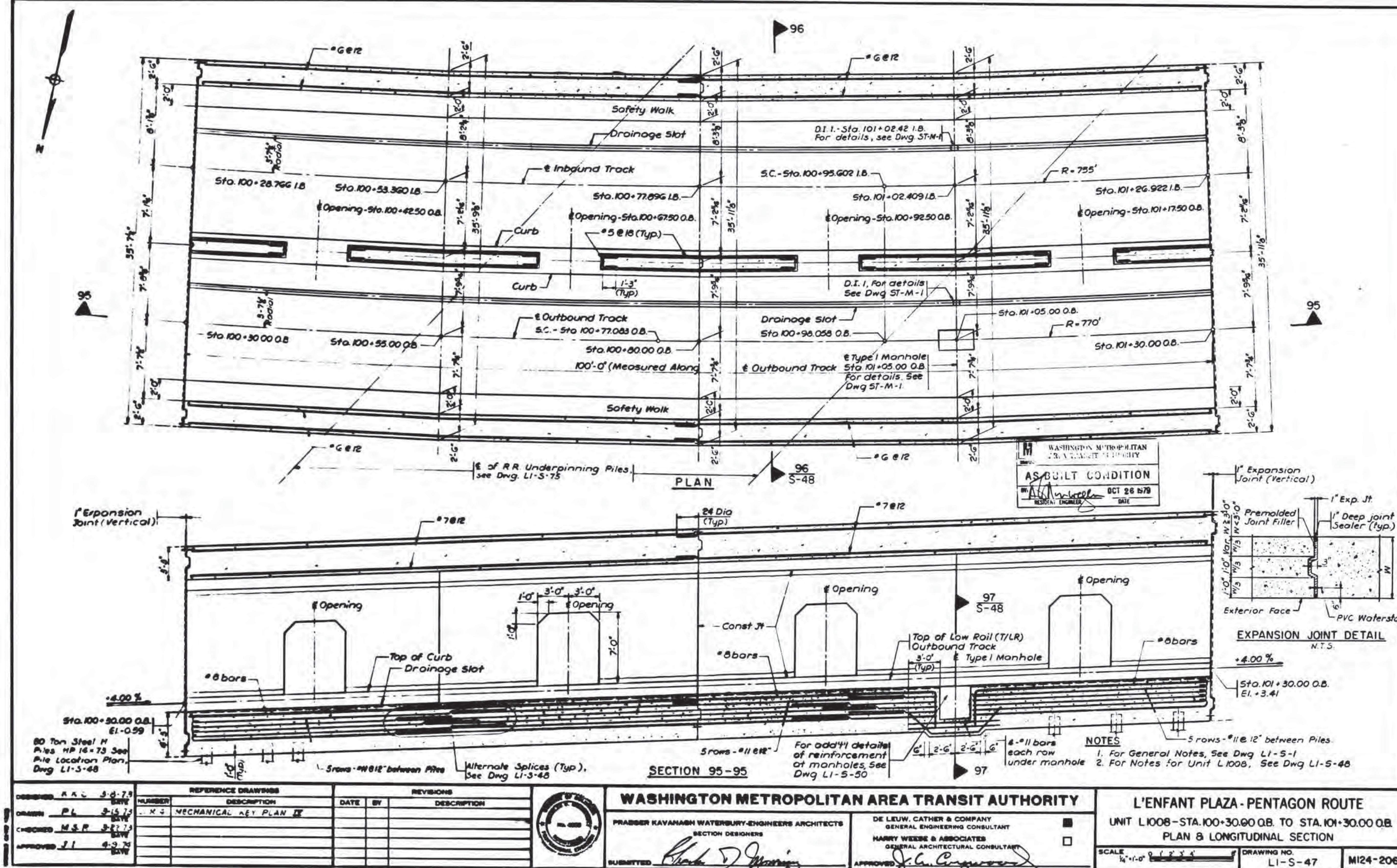
UNIT L 1000

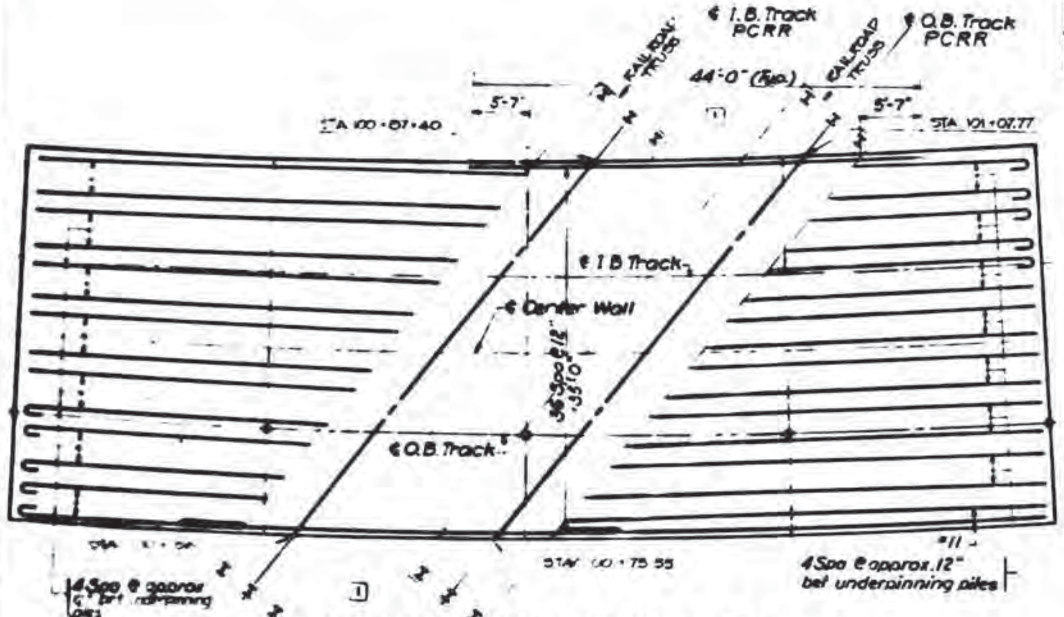
STA. 99+80.00 O.B. TO STA. 100+30.00 O.B.

SCALE 1/4" = 1'-0" AND AS NOTED

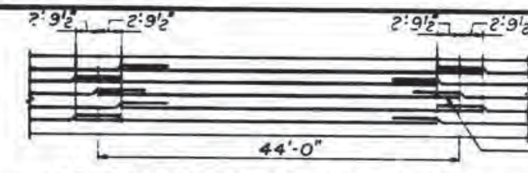
DRAWING NO. L1-S-46

M124-205

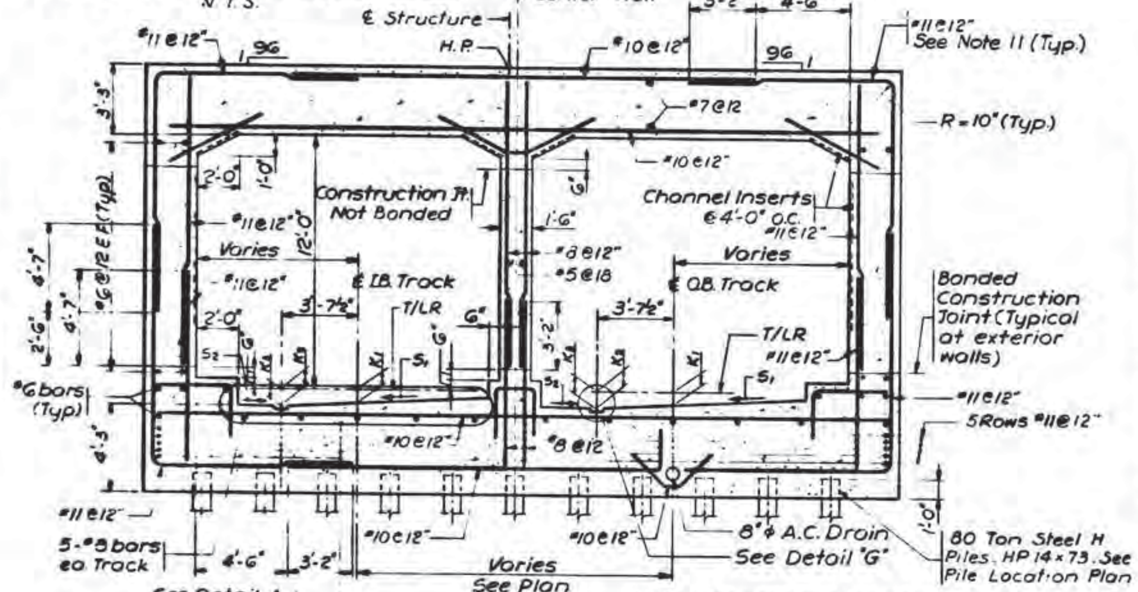

PLAN
SECTION 95-95
EXPANSION JOINT DETAIL
N.T.S.
Safety Walk
Drainage Slot
℄ Inbound Track
℄ Outbound Track
Curb
Sta. 100+28.766 I.B.
Sta. 100+53.360 I.B.
Sta. 100+77.896 I.B.
S.C.-Sta. 100+95.602 I.B.
Sta. 101+02.409 I.B.
Sta. 101+26.922 I.B.
Sta. 100+30.00 O.B.
Sta. 100+55.00 O.B.
Sta. 100+80.00 O.B.
Sta. 101+30.00 O.B.
R=755'
R=770'
D.I. 1.-Sta. 101+02.42 I.B. For details, see Dwg ST-M-1
℄ Opening-Sta. 100+42.50 O.B.
℄ Opening-Sta. 100+67.50 O.B.
℄ Opening-Sta. 100+92.50 O.B.
℄ Opening-Sta. 101+17.50 O.B.
100'-0" (Measured Along
℄ Type I Manhole Sta 101+05.00 O.B. For details, See Dwg ST-M-1
℄ of R.R. Underpinning Piles, see Dwg. L1-S-75
AS BUILT CONDITION
OCT 26 1979
1" Expansion Joint (Vertical)
Premolded Joint Filler
1" Deep joint Sealer (typ.)
Exterior Face
PVC Waterstop
+4.00 %
Sta. 100+30.00 O.B. El.-0.59
Sta. 101+30.00 O.B. El.+3.41
80 Ton Steel H Piles HP 14×73 See Pile Location Plan, Dwg L1-S-48
Alternate Splices (Typ.), See Dwg L1-S-48
For add'l details of reinforcement at manholes, See Dwg L1-S-50
5 rows-#11@12" between Piles
NOTES
1. For General Notes, See Dwg L1-S-1
2. For Notes for Unit L100B, See Dwg L1-S-48
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
L'ENFANT PLAZA - PENTAGON ROUTE
UNIT L100B-STA. 100+30.00 O.B. TO STA. 101+30.00 O.B.
PLAN & LONGITUDINAL SECTION
L1-S-47
M124-206



BOTTOM SLAB REINFORCEMENT PLAN
Scale 1/8" = 1'-0"
(#8 bars at top of slab not shown)

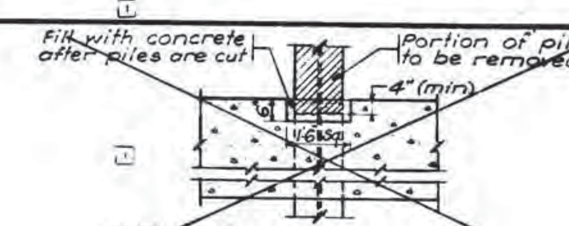


BOTTOM SLAB SPLICING DETAIL
N.T.S.



SECTION 96-96/S-47
Scale: 1/4" = 1'-0"

Note: For details of reinforcement in fillets, safety walks and curbs, see Dwg. L1-S-51

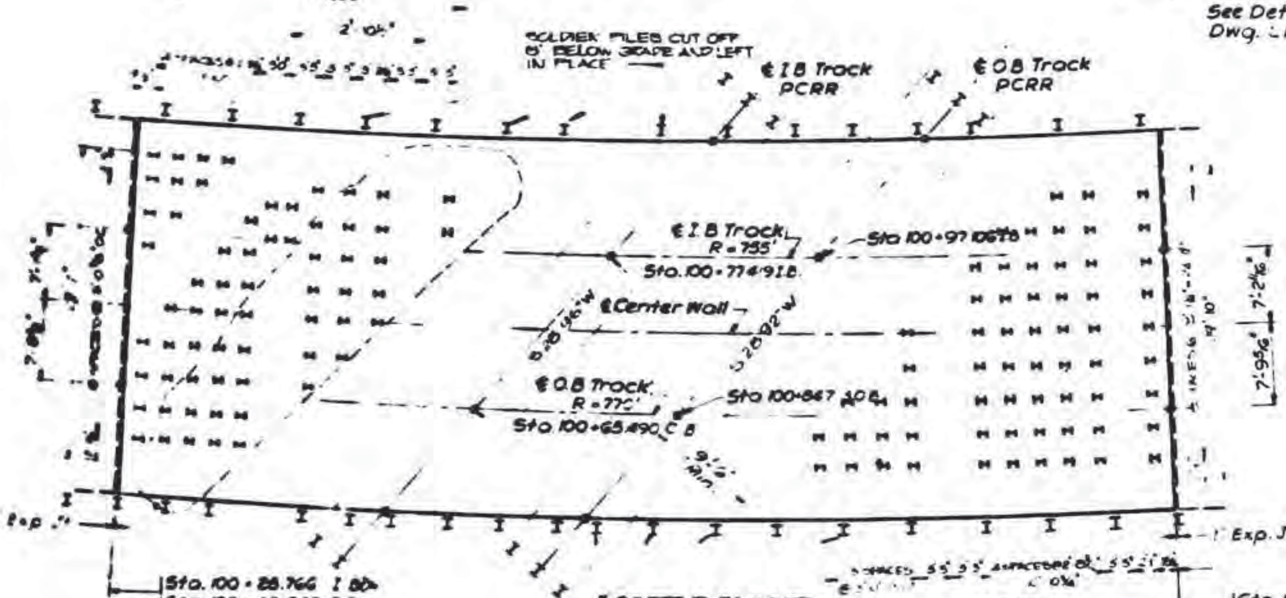


DETAIL AT UNDERPINNING PILES
Scale: 1/2" = 1'-0"
Base Slab shown (Roof similar)

INVERT DIMENSIONS						
STA.	S.E. (IN)	S_1 (IN/IN)	S_2 (IN/IN)	K_1 (IN)	K_2 (IN)	K_3 (IN)
100+30.00 O.B.	3 1/8	.0553	.0200	7 7/16	9 13/16	10 7/16
100+55.00 O.B.	3 9/16	.0635	.0200	7 3/16	9 15/16	10 5/8
100+77.083 O.B.	4	.0708	.0200	7	10 1/16	10 13/16
100+80.00 O.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+05.00 O.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+30.00 O.B.	4	.0708	.0200	7	10 1/16	10 13/16
100+28.766 I.B.	2 15/16	.0520	.0200	7 1/2	9 13/16	10 3/8
100+53.360 I.B.	3 5/16	.0589	.0200	7 5/16	9 7/8	10 1/2
100+77.896 I.B.	3 3/4	.0658	.0200	7 1/8	10	10 11/16
100+95.602 I.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+02.409 I.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+26.922 I.B.	4	.0708	.0200	7	10 1/16	10 13/16

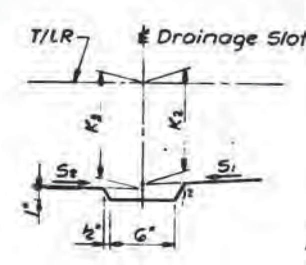
Note

Superelevation varies linearly from 0" on tangent to 4" on full circular curve. For determination of invert dimensions between Specified Stations see Table, Dwg. L1-S-50

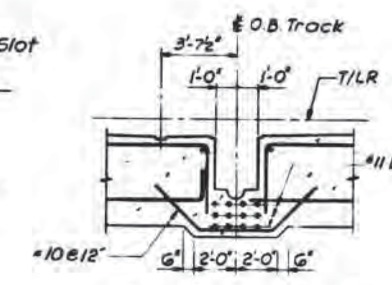


PILE LOCATION PLAN
Scale 1/8" = 1'-0"

Piles within this region must be driven before the start of the relocation of the Duct Bank. See Step 1, Construction Sequence, Dwg L1-S-75



DETAIL "G"
Scale 1 1/2" = 1'-0"



SECTION 97-97/S-47
Scale 1/4" = 1'-0"

LEGEND

H Typical Piles extending one foot into base slab.

ADDITIONAL ELECTRICAL BONDING NOTES

1. At the expansion joints of each end of this unit, only the top and bottom layers of both slab long reinf. are to be welded to the transverse ring bars. Top slab & wall bonding details are typical.
2. Additional continuous transverse ring bars (one in each face) are to be provided at the center of the unit, similar to the end rings.

NOTES

1. For General Notes, see Dwg. L1-S-1
2. For location of Structure Unit, see Dwg. L1-S-4
3. For detail of reinforcement at opening in center wall, see Dwg. L1-S-51.
4. For Electrical Bonding Details, see Dwg. ST-S-7
5. For details of channel inserts, see Dwg. ST-E-15
6. For details of expansion joints, see Dwg L1-S-47.
7. Elevations shown are at Top of Low Rail (T/LR).
8. Walls and Safety Walks to be constructed on chords between dimensioned lines.
9. For additional details of construction of this unit and treatment of underpinning piles. See Dwg L1-S-75
10. Typical spacing for all slab reinforcement not specifically located may have to be varied in field to miss underpinning piles.

AS-BUILT CONDITION
OCT 26 1979
RESIDENT ENGINEER DATE

DESIGNED M.S.R. | DRAWN P.L. | CHECKED M.S.R. | APPROVED

REFERENCE DRAWINGS: NUMBER / DESCRIPTION
REVISIONS: DATE / BY / DESCRIPTION

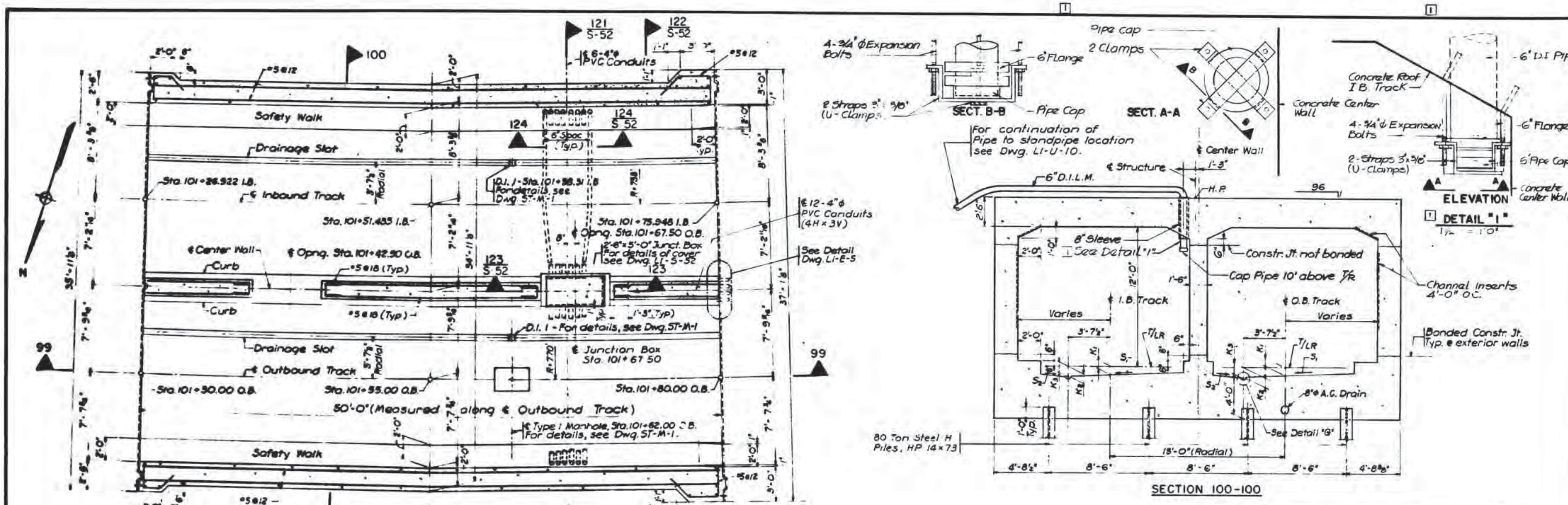
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

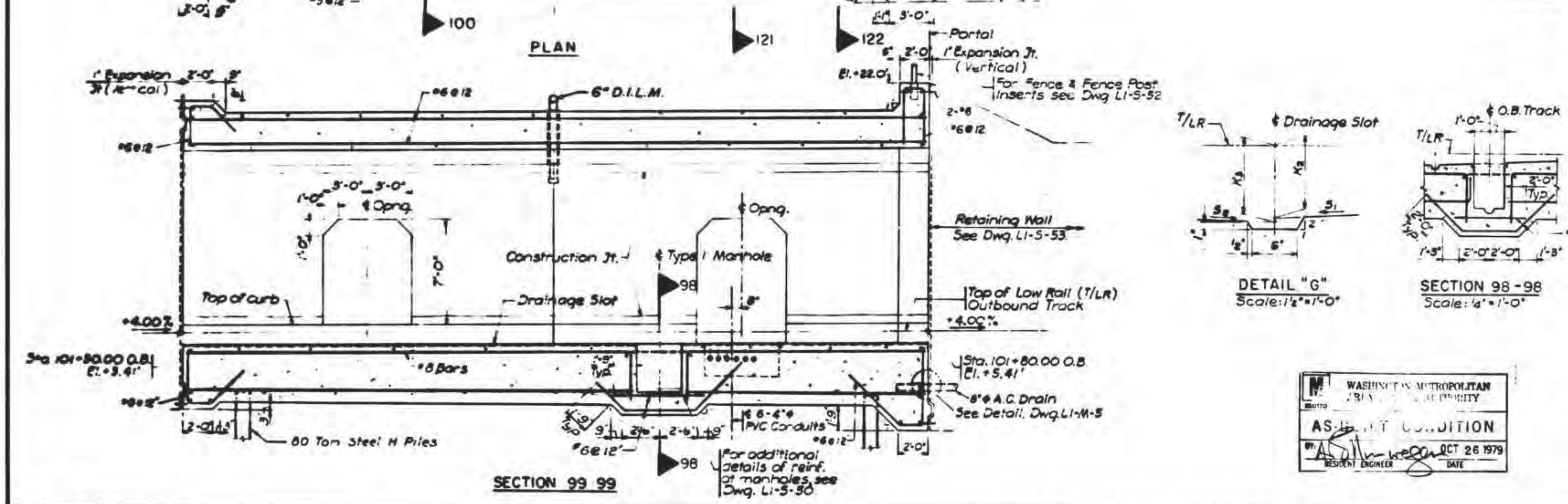
PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS
SUBMITTED

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
APPROVED

L'ENFANT PLAZA - PENTAGON ROUTE
UNIT L1008 - STA. 100+30.00 O.B. TO STA. 101+30.00 O.B.
SECTIONS & DETAILS

SCALE: AS NOTED | DRAWING NO. L1-S-48 | MI24-207





INVERT DIMENSIONS						
STA.	S.E. (IN)	S_1 (IN/IN)	S_2 (IN/IN)	K_1 (IN)	K_2 (IN)	K_3 (IN)
101+30.00 O.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+55.00 O.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+80.00 O.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+26.922 I.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+51.435 I.B.	4	.0708	.0200	7	10 1/16	10 13/16
101+75.948 I.B.	4	.0708	.0200	7	10 1/16	10 13/16

NOTES
1. For General Notes, see Dwg. L1-S-1.
2. For location of Structure Unit, see Dwg. L1-S-4.
3. For typical reinforcement details, see Dwg. L1-S-51.
4. For Electrical Bonding Details, see Dwg. ST-S-7.
5. For details of channel inserts, see Dwg. ST-E-15.
6. For details of expansion joints, see Dwg. 47 & L1-S-52.
7. Elevations shown are at Top of Low Rail (T/LR).
8. Walls and Safety Walks to be constructed on chords between dimensioned lines.
9. For additional details of Portal, see Dwg. L1-S-52.
10. For details of grading around Portal, see Dwg. L1-L-1.
11. For Pile location Plan, see Dwg. L1-S-84.
12. For spacing of conduits entering Junction Box, see Dwg. L1-S-52
13. For numbering of conduits entering Junction Box, see Dwg. L1-E-4.

DESIGNED R.K.C. 3-22-73
DRAWN M.G.H. 3-29-73
CHECKED M.S.R. 4-5-73
APPROVED J.I. 4-9-74

REFERENCE DRAWINGS	
NUMBER	DESCRIPTION
M-4	MECHANICAL KEY PLAN IX
E-4	ELECTRICAL KEY PLAN IX

REVISIONS		
DATE	BY	DESCRIPTION
		REVISED AS PER FIELD CONDITION, "AS BUILT"

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

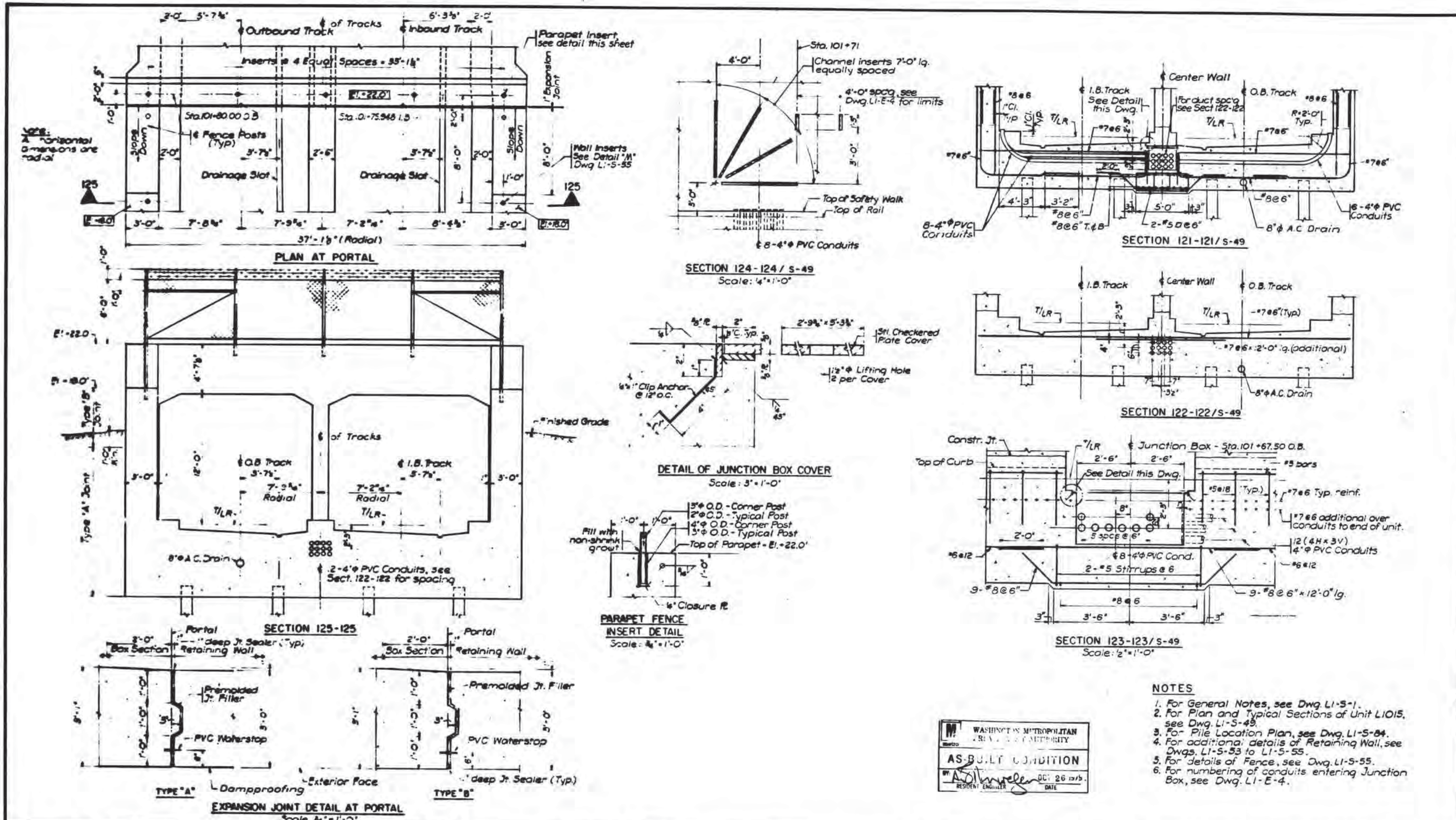
SUBMITTED [signature]
APPROVED [signature]

L'ENFANT PLAZA - PENTAGON ROUTE

UNIT L1015 - STA.101+30.00 O.B. TO STA.101+80.00 O.B.
TRACK LEVEL PLAN & SECTIONS

SCALE ¼"=1'-0" AND AS NOTED
DRAWING NO. L1-S-49
M124-208

APPENDIX 3
SCHNABEL ENGINEERING, LLC
Sheet: 13/23



NOTES
1. For General Notes, see Dwg. L1-S-1.
2. For Plan and Typical Sections of Unit L1015, see Dwg. L1-S-49.
3. For Pile Location Plan, see Dwg. L1-S-84.
4. For additional details of Retaining Wall, see Dwgs. L1-S-53 to L1-S-55.
5. For details of Fence, see Dwg. L1-S-55.
6. For numbering of conduits entering Junction Box, see Dwg. L1-E-4.

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY — AS-BUILT CONDITION — OCT 26 1975 — RESIDENT ENGINEER

DESIGNED	M S R	4-12-73
DRAWN	H C H	4-19-73
CHECKED	M S R	4-26-73
APPROVED	J I	4-9-74

REFERENCE DRAWINGS — NUMBER — DESCRIPTION; REVISIONS — DATE — BY — DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

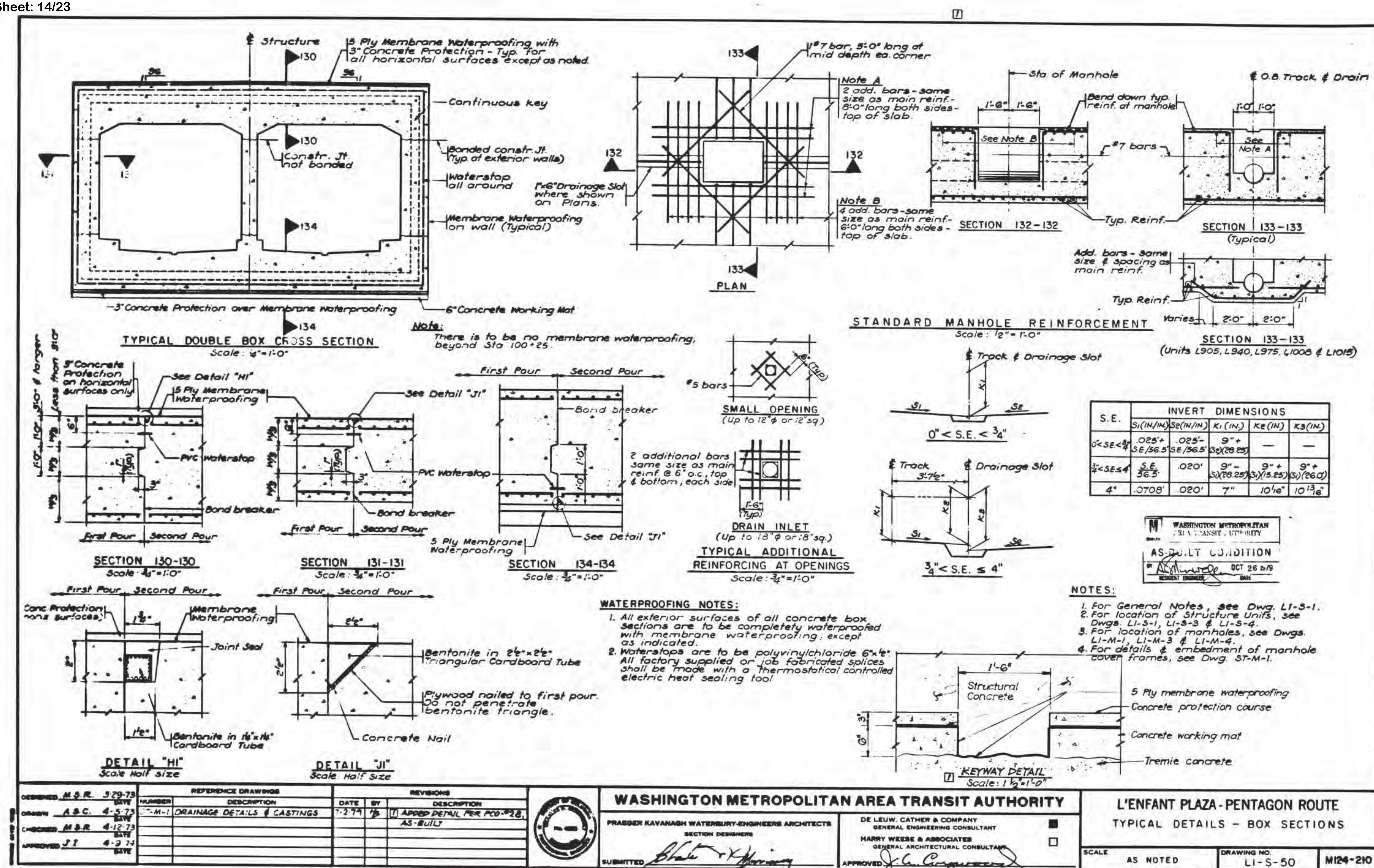
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

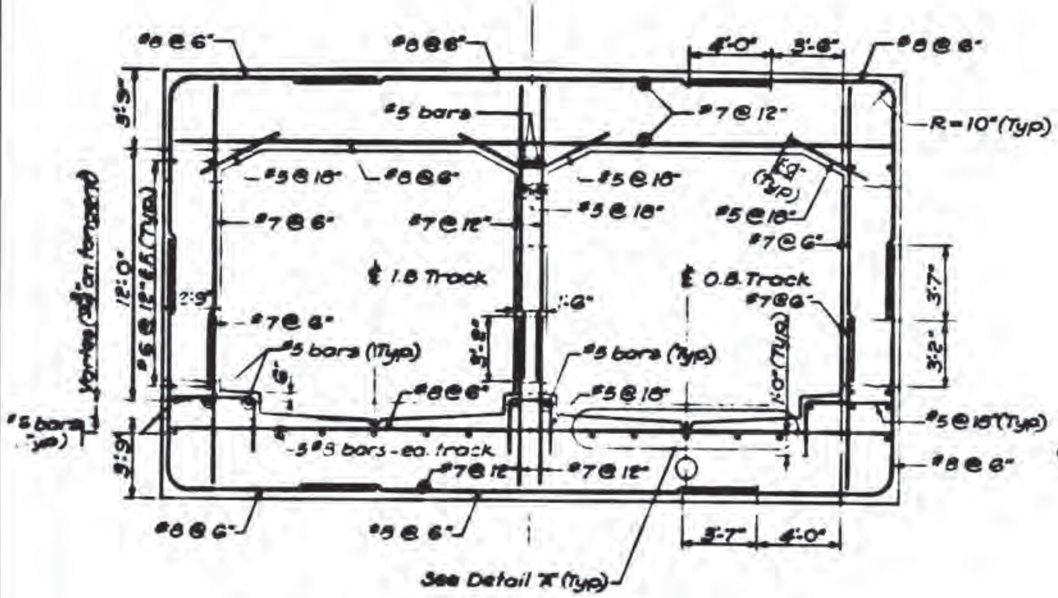
SUBMITTED — APPROVED

L'ENFANT PLAZA - PENTAGON ROUTE
UNIT L1015 - STA.101+30.00 O.B. TO STA.101+80.00 O.B.
SECTIONS & DETAILS

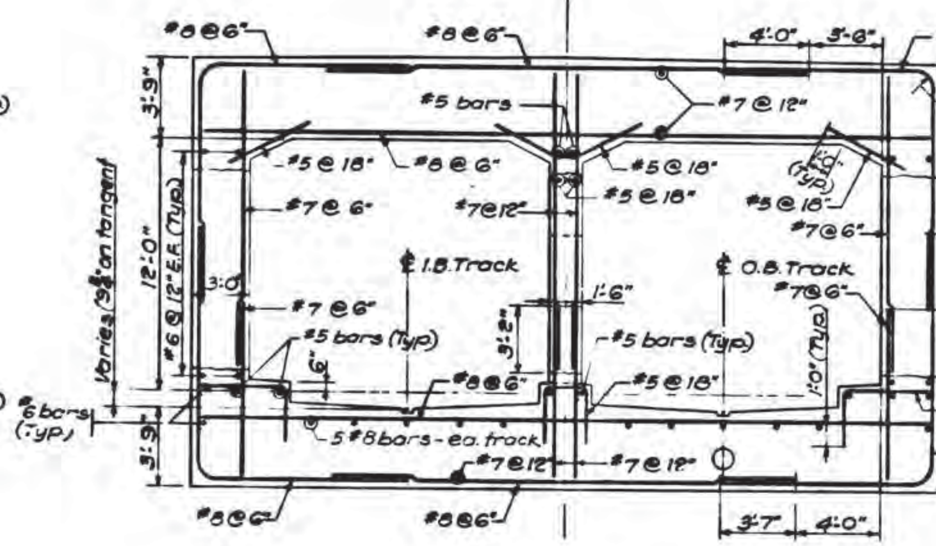
SCALE ¼"=1'-0" AND AS NOTED — DRAWING NO. L1-S-52 — M124-209

APPENDIX 3
SCHNABEL ENGINEERING, LLC
Sheet: 14/23

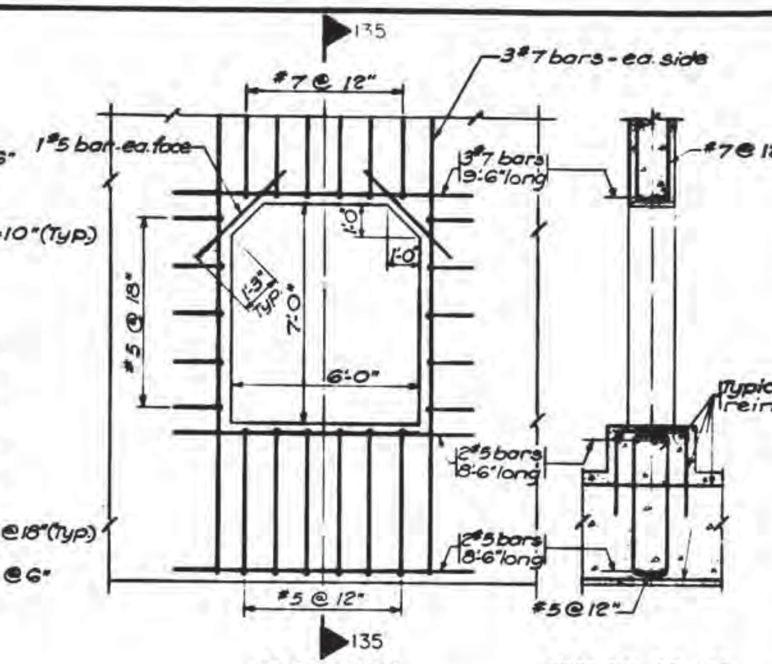




UNITS L855 THRU L865 & L895 THRU L920
Scale: ¼" = 1'-0"



UNITS L870 THRU L890
Scale: ¼" = 1'-0"

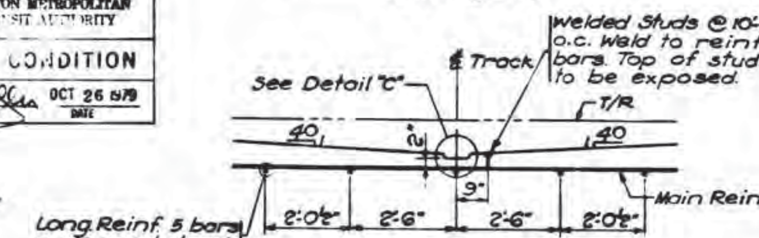


ELEVATION

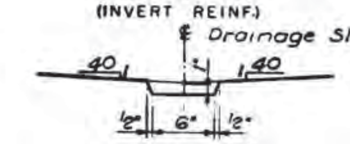
SECTION 135-135

CENTER WALL OPENING
Scale: ⅜" = 1'-0"

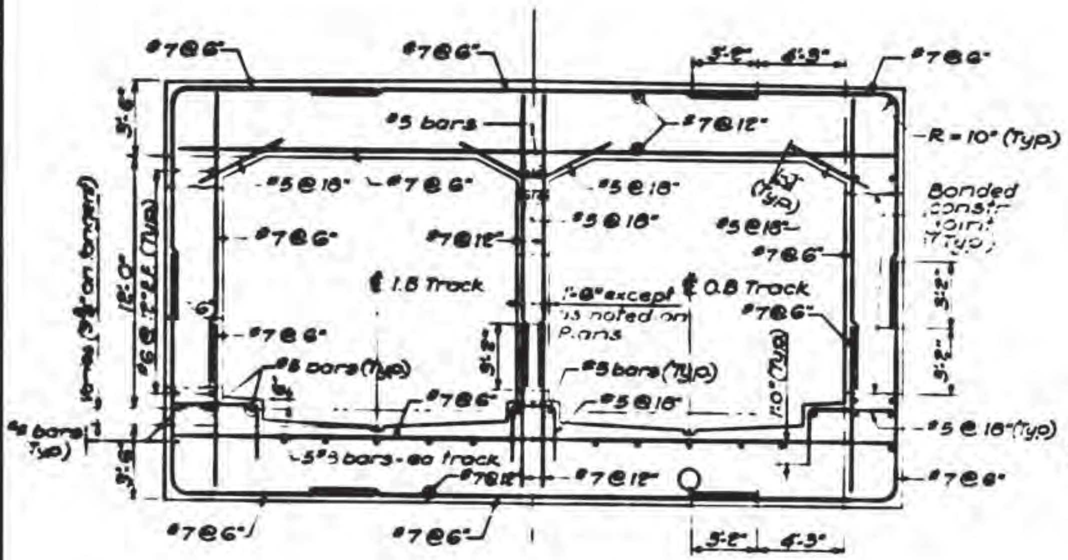
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
AS-BUILT CONDITION
OCT 26 1979



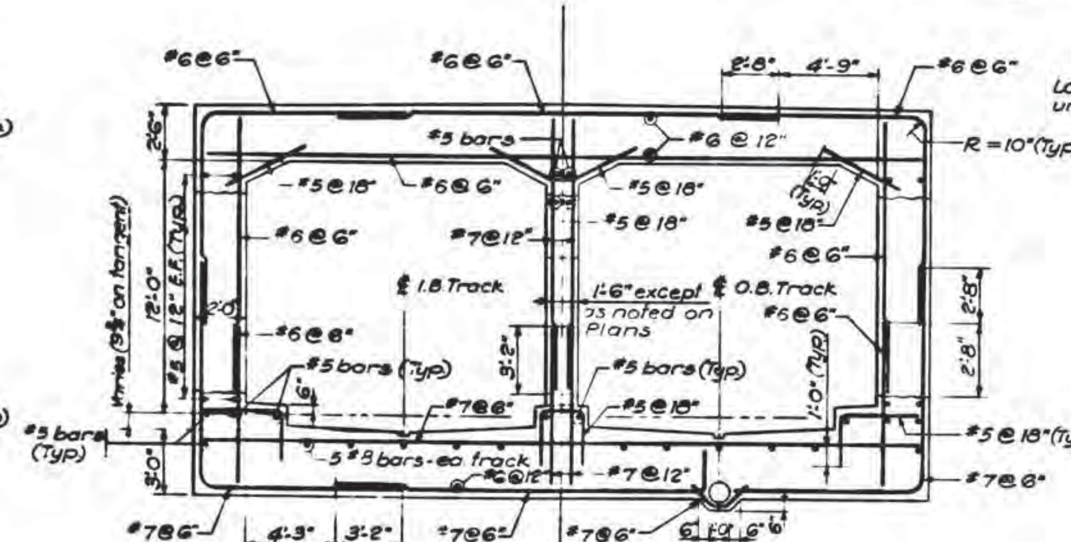
DETAIL "A"
Scale: ½" = 1'-0"
(INVERT REINF.)



DETAIL "C"
Scale: 1½" = 1'-0"



UNITS L925 THRU L955
Scale: ¼" = 1'-0"



UNITS L970 THRU L1000 & L1015
Scale: ¼" = 1'-0"

NOTES:

1. For General Notes, see Dwg. L1-S-1.
2. For location of Structure Units, see Dwgs. L1-S-3 & L1-S-4.
3. The surfaces of bonded construction joints shall be clean and rough before placing new concrete with the aggregate exposed by sand blasting or water jet.
4. For details of contraction joints between units, see Dwg. L1-S-50.
5. For Pile Location Plans & Sections, see Dwgs. L1-S-83 thru L1-S-85.
6. For Payment Lines, see Dwg. L1-S-86.
7. For reinforcement in units not shown, see individual unit drawings.
8. For reinforcements of units L748 through L845 for Cut and Cover Alternate see Dwg. L1-S-123.

DESIGNED	R.K.C.	4-5-73	DATE
DRAWN	ASC	4-12-73	DATE
CHECKED	MSR	4-13-73	DATE
APPROVED	JI	4-9-74	DATE

REFERENCE DRAWINGS: NUMBER | DESCRIPTION

REVISIONS: DATE | BY | DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

SUBMITTED

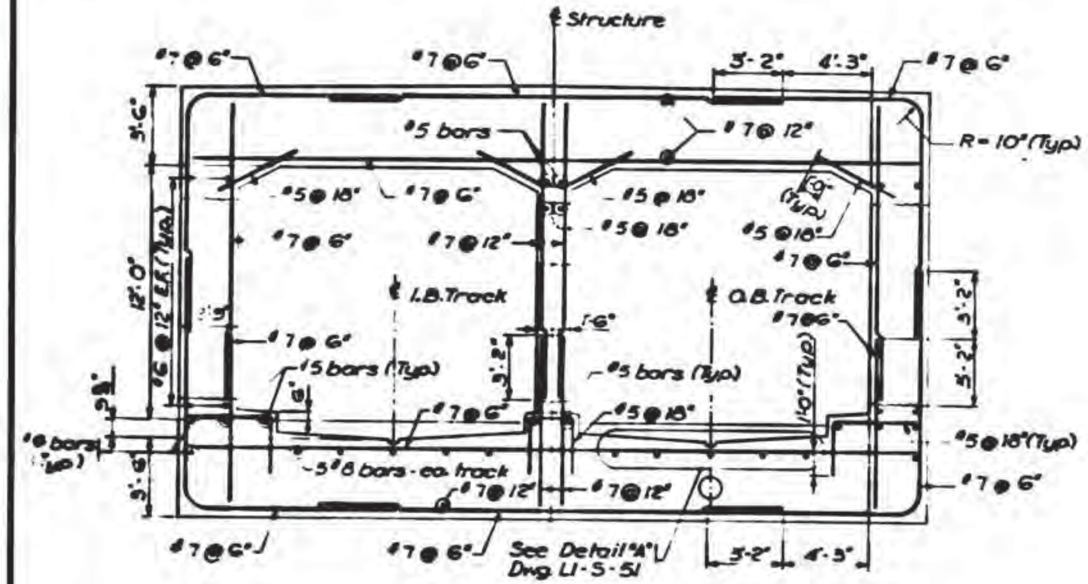
APPROVED

L'ENFANT PLAZA - PENTAGON ROUTE
TYPICAL REINFORCEMENT DETAILS

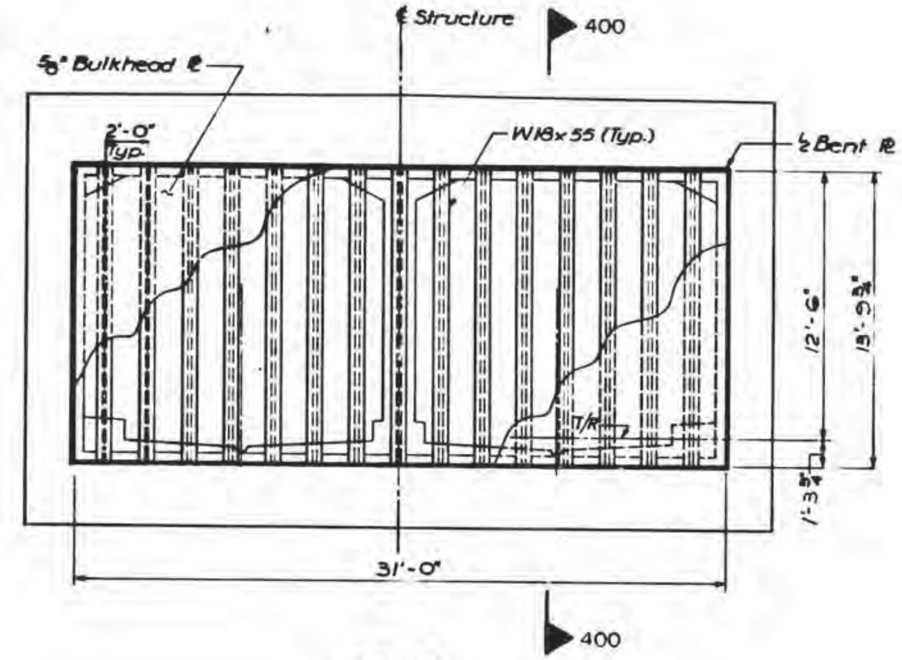
SCALE ¼" = 1'-0" AND AS NOTED

DRAWING NO. L1-S-51

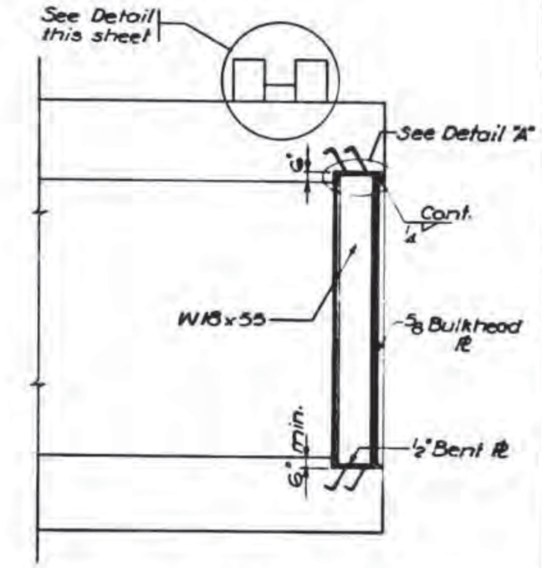
M124-211



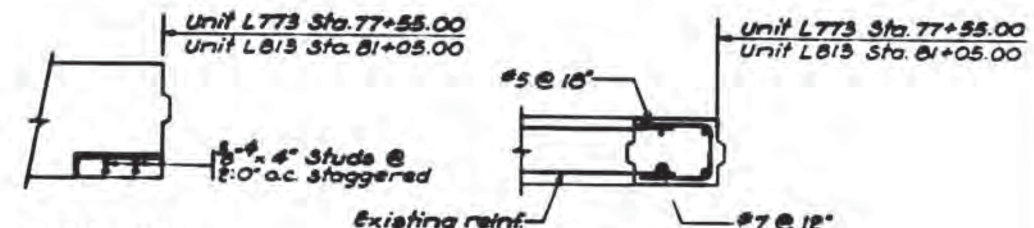
UNITS L748 THRU L843
Scale: ¼" = 1'-0"



ELEVATION
Scale: ¼" = 1'-0"



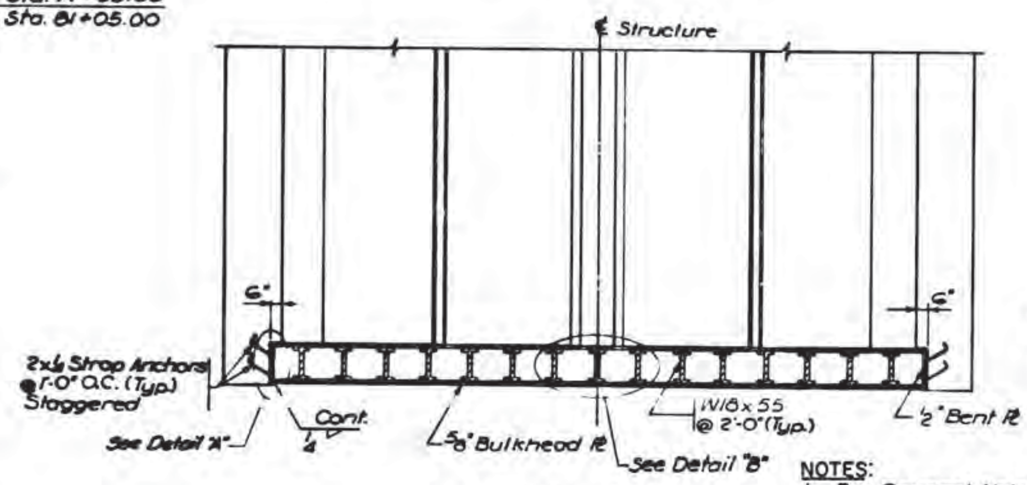
SECTION 400-400
Scale: ¼" = 1'-0"



DETAIL "A"
(Typical - Exterior Walls, Roof and Base Slab)

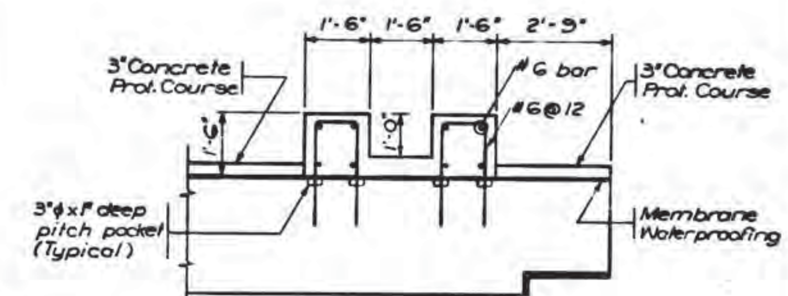
DETAIL "B"
(Typical - Interior Wall)

RECESS FOR BULKHEAD ASSEMBLY
AFTER BULKHEAD REMOVAL
Scale: ½" = 1'-0"



PLAN SECTION
Scale: ¼" = 1'-0"

BULKHEAD DETAILS
WEST END OF UNIT L773
EAST END OF UNIT L813



CLOSURE WALL SLOT DETAIL
Scale: ½" = 1'-0"

NOTES:

1. For General Notes, see Dwg. LI-S-1
2. For location of Structure Units, see Dwg. LI-S-2A.
3. The surfaces of bonded construction joints shall be clean and rough before placing new concrete with the aggregate exposed by sand blasting or water jet.
4. For details of contraction joints between units, see Dwg. LI-S-50.
5. For Pile Location Plans & Sections, see Dwg. LI-S-82A.
6. For Payment Lines, see Dwg. LI-S-86

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
AS BUILT CONDITION
OCT 26 1979
RESIDENT ENGINEER DATE

DESIGNED	M.S.R.
DRAWN	R.S.
CHECKED	M.S.R.
APPROVED	J.I.

REFERENCE DRAWINGS: NUMBER | DESCRIPTION

REVISIONS: DATE | BY | DESCRIPTION

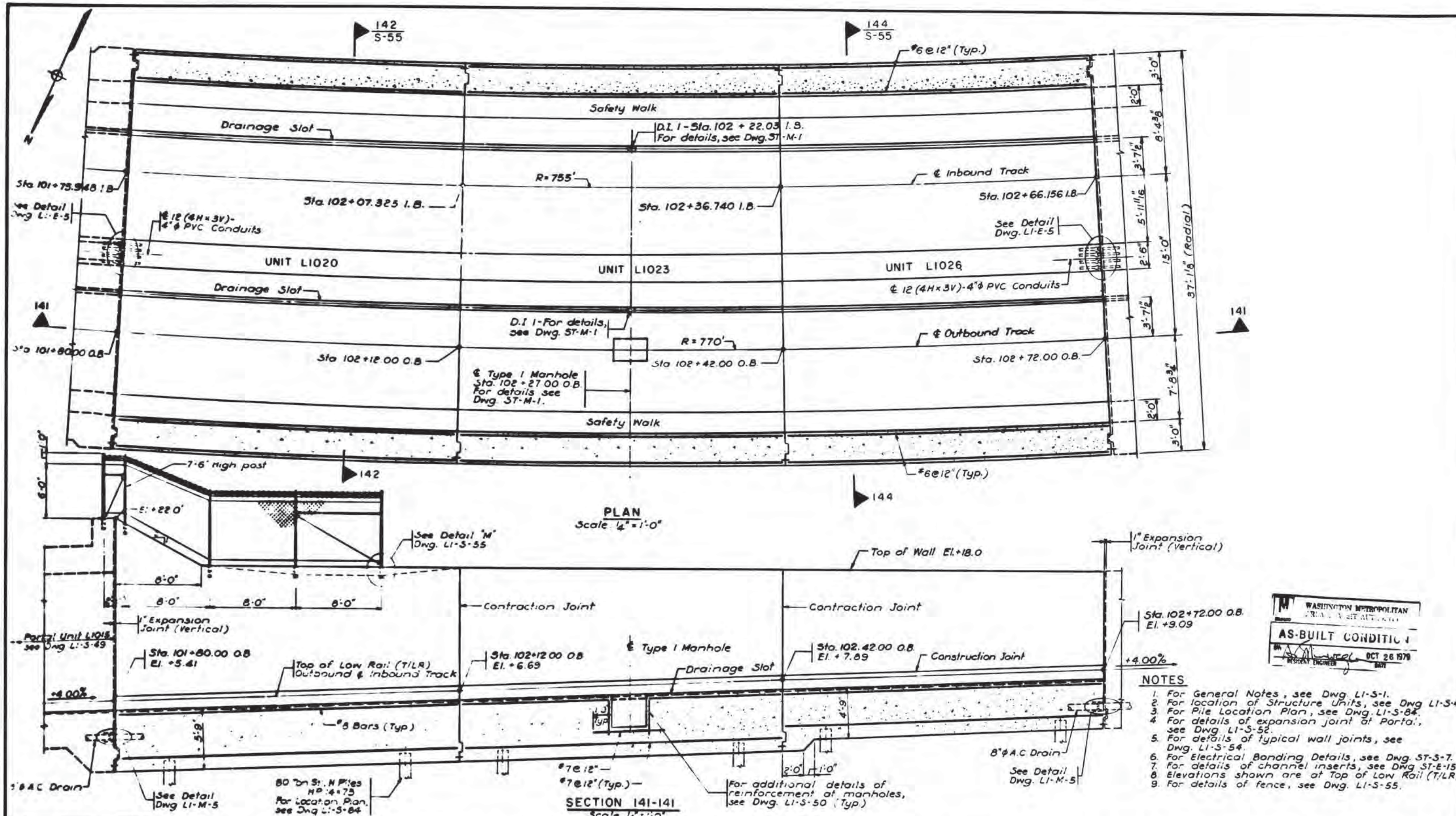
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS
SUBMITTED

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
APPROVED

L'ENFANT PLAZA - PENTAGON ROUTE
TYPICAL DETAILS - BOX SECTIONS FOR CUT AND COVER ALTERNATE

SCALE: AS NOTED
DRAWING NO. LI S - 123
M124-212



NOTES

1. For General Notes, see Dwg. L1-S-1.
2. For location of Structure Units, see Dwg. L1-S-4.
3. For Pile Location Plan, see Dwg. L1-S-84.
4. For details of expansion joint at Portal, see Dwg. L1-S-52.
5. For details of typical wall joints, see Dwg. L1-S-54.
6. For Electrical Bonding Details, see Dwg. ST-S-7.
7. For details of channel inserts, see Dwg. ST-E-15.
8. Elevations shown are at Top of Low Rail (T/LR).
9. For details of fence, see Dwg. L1-S-55.

DESIGNED K.K.C.	7-5-73	DATE
DRAWN B.H.	7-16-73	DATE
CHECKED M.S.R.	7-19-73	DATE
APPROVED J.I.	8-9-73	DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
V-4	MECHANICAL KEY PLAN IV

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

SUBMITTED [signature]

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

APPROVED [signature]

L'ENFANT PLAZA - PENTAGON ROUTE

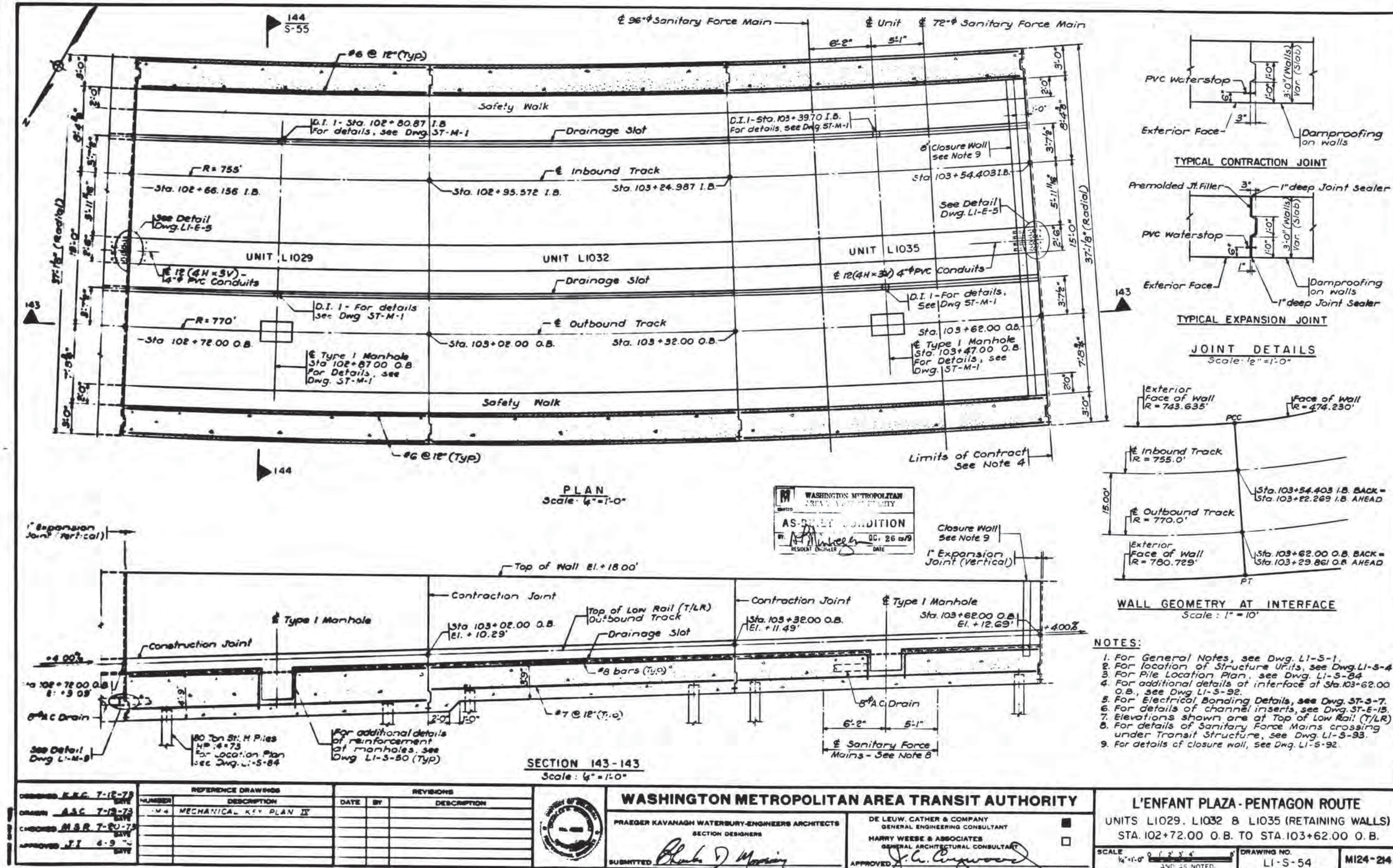
UNITS L1020, L1023 & L1026 (RETAINING WALLS)
STA. 101+80.00 O.B. TO STA. 102+72.00 O.B.

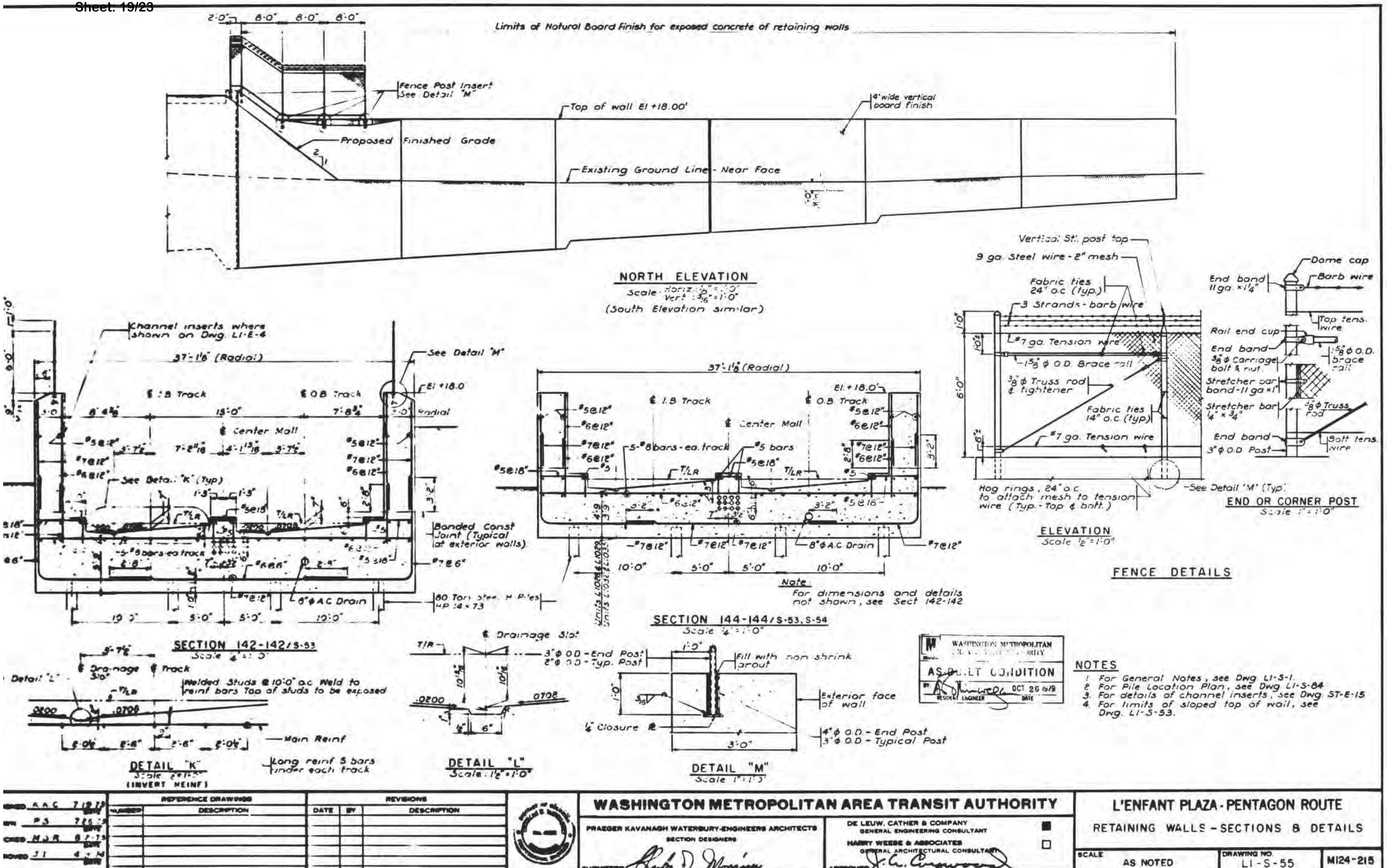
SCALE 1/4" = 1'-0"

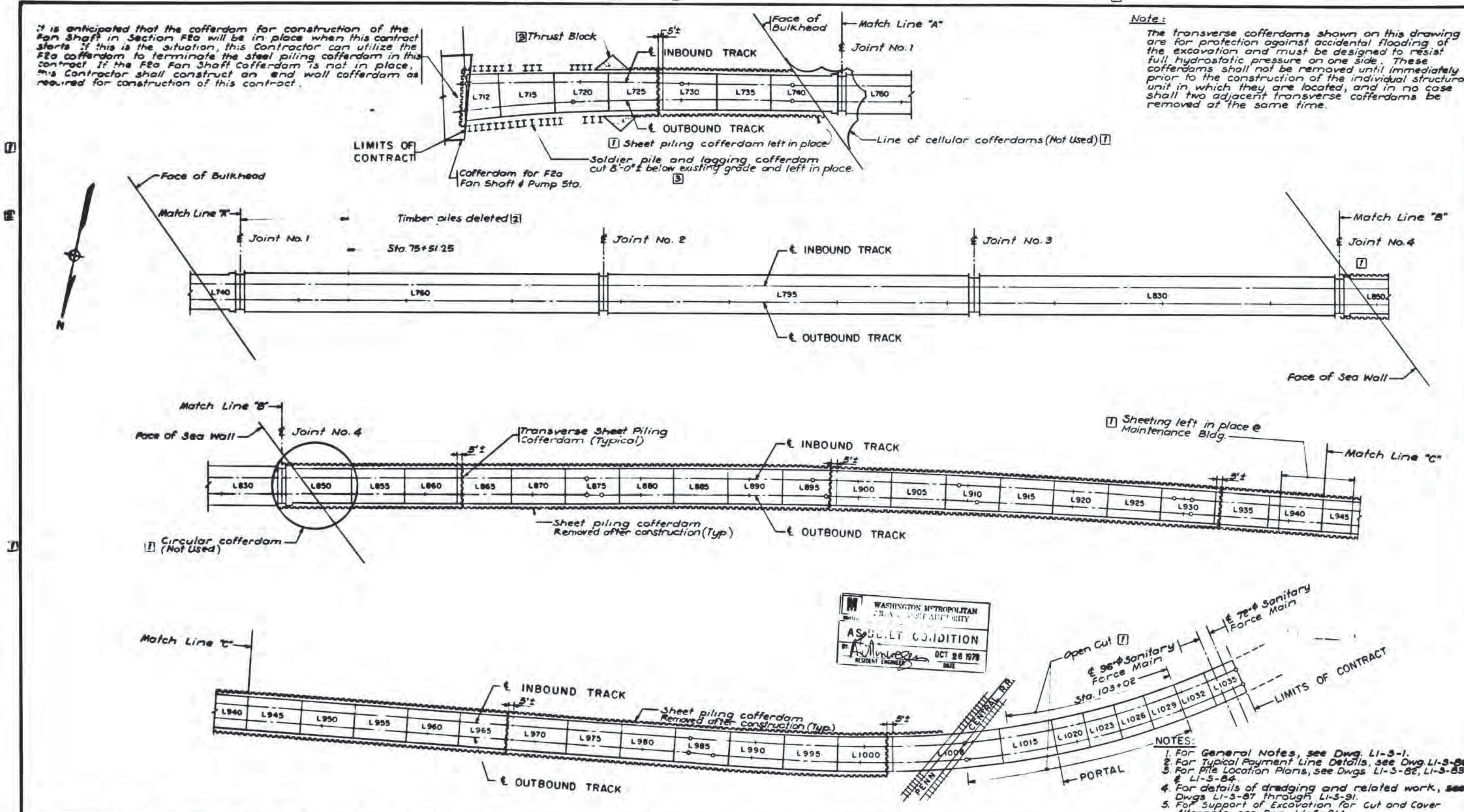
DRAWING NO. L1-S-53

M124-213

APPENDIX 3
SCHNABEL ENGINEERING, LLC
Sheet: 18/23




Limits of Natural Board Finish for exposed concrete of retaining walls
Fence Post Insert See Detail "M"
Top of wall El +18.00'
4" wide vertical board finish
Proposed Finished Grade
Existing Ground Line - Near Face
NORTH ELEVATION
(South Elevation similar)
Channel inserts where shown on Dwg. L1-E-4
37'-1 1/8" (Radial)
See Detail "M"
El +18.0
Radial
See Detail "K" (Typ)
Bonded Const Joint (Typical at exterior walls)
6" Φ A C Drain
80 Ton Steel H Piles HP 14 x 73
SECTION 142-142/S-53
5-#8 bars - ea. track
#5 bars
8" Φ A.C. Drain
Note: For dimensions and details not shown, see Sect 142-142
SECTION 144-144/S-53, S-54
Drainage Slot
3" Φ O.D - End Post
2" Φ O.D - Typ. Post
Fill with non shrink grout
Exterior face of wall
1/4" Closure
4" Φ O.D. - End Post
3" Φ O.D - Typical Post
Welded Studs @ 10'-0" o.c Weld to reinf bars Top of studs to be exposed
Main Reinf
Long reinf 5 bars under each track
DETAIL "K"
(INVERT REINF)
DETAIL "L"
DETAIL "M"
Vertical Stl. post top
9 ga. Steel wire - 2" mesh
Fabric ties 24" o.c (typ.)
3 Strands - barb wire
#7 ga. Tension wire
1 5/8" Φ O.D. Brace rail
3/8" Φ Truss rod & tightener
Fabric ties 14" o.c (typ)
Hog rings, 24" o.c to attach mesh to tension wire (Typ. - Top & bott.)
See Detail "M" (Typ)
ELEVATION
Scale 1/2" = 1'-0"
Dome cap
Barb wire
End band 11 ga. x 1 1/4"
Top tens. wire
Rail end cup
End band
3/8" Φ Carriage bolt & nut
Stretcher bar band - 11 ga x 1"
Stretcher bar 1/4" x 3/4"
3" Φ O.D Post
Bott tens. wire
END OR CORNER POST
Scale 1" = 1'-0"
FENCE DETAILS
AS-BUILT CONDITION
OCT 26 1979
NOTES
1. For General Notes, see Dwg L1-S-1.
2. For Pile Location Plan, see Dwg L1-S-84
3. For details of channel inserts, see Dwg ST-E-15
4. For limits of sloped top of wall, see Dwg. L1-S-53.
REFERENCE DRAWINGS
REVISIONS
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
L'ENFANT PLAZA - PENTAGON ROUTE
RETAINING WALLS - SECTIONS & DETAILS
SCALE AS NOTED
DRAWING NO. L1-S-55
M124-215



DESIGNED	M.S.R.	6-18-73
DRAWN	A.S.C.	6-22-73
CHECKED	M.S.R.	6-29-73
APPROVED	J.I.	4-9-74

REVISIONS

DATE	BY	DESCRIPTION
2-27-79		1 Rev per field condition, AS-BUILT
2-28-79		2 Revised per PCO #1, AS-BUILT
2-28-79		3 Replaced steel sheeting with soldier pile & lagging per PCO #7, AS-BUILT

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

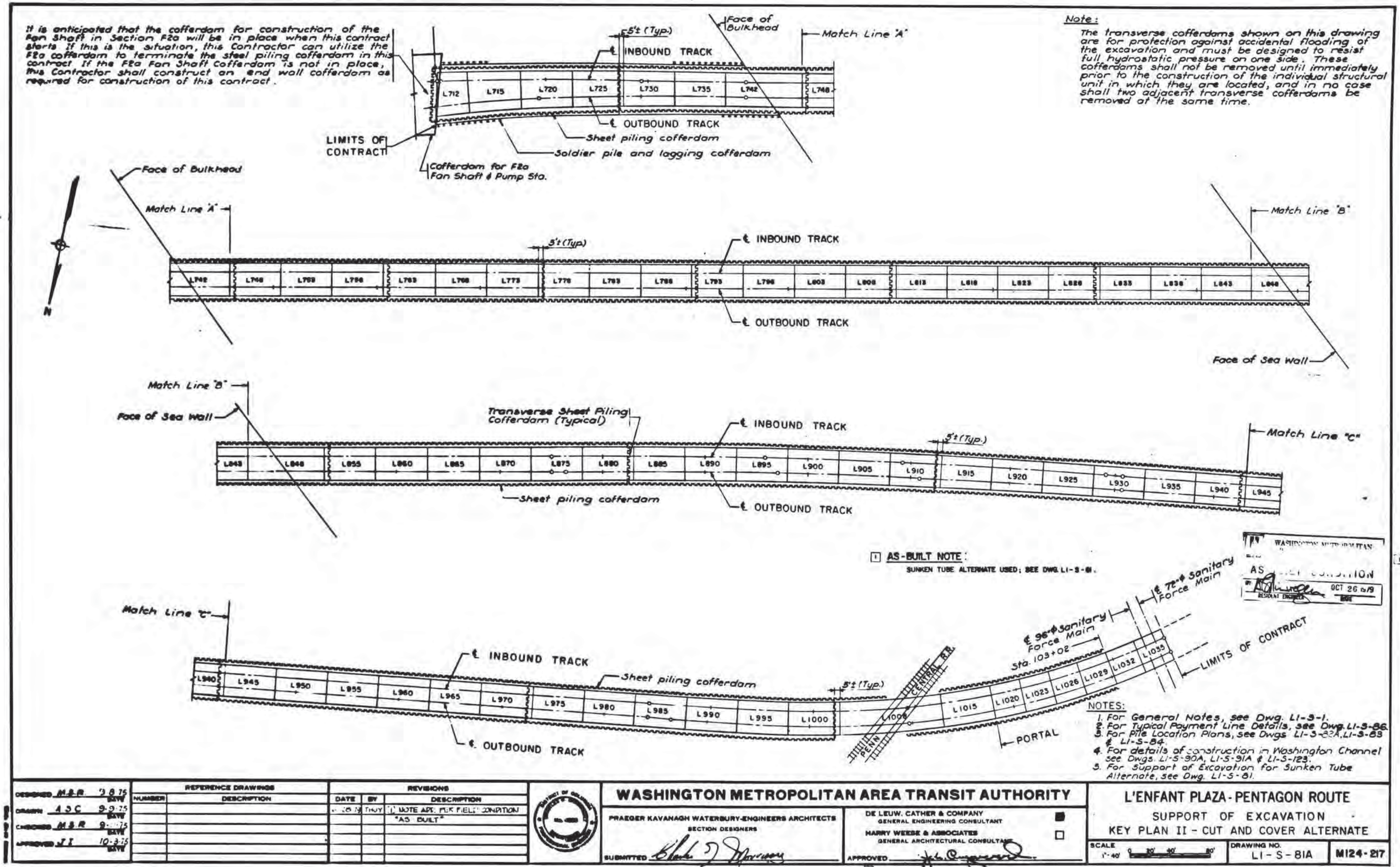
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

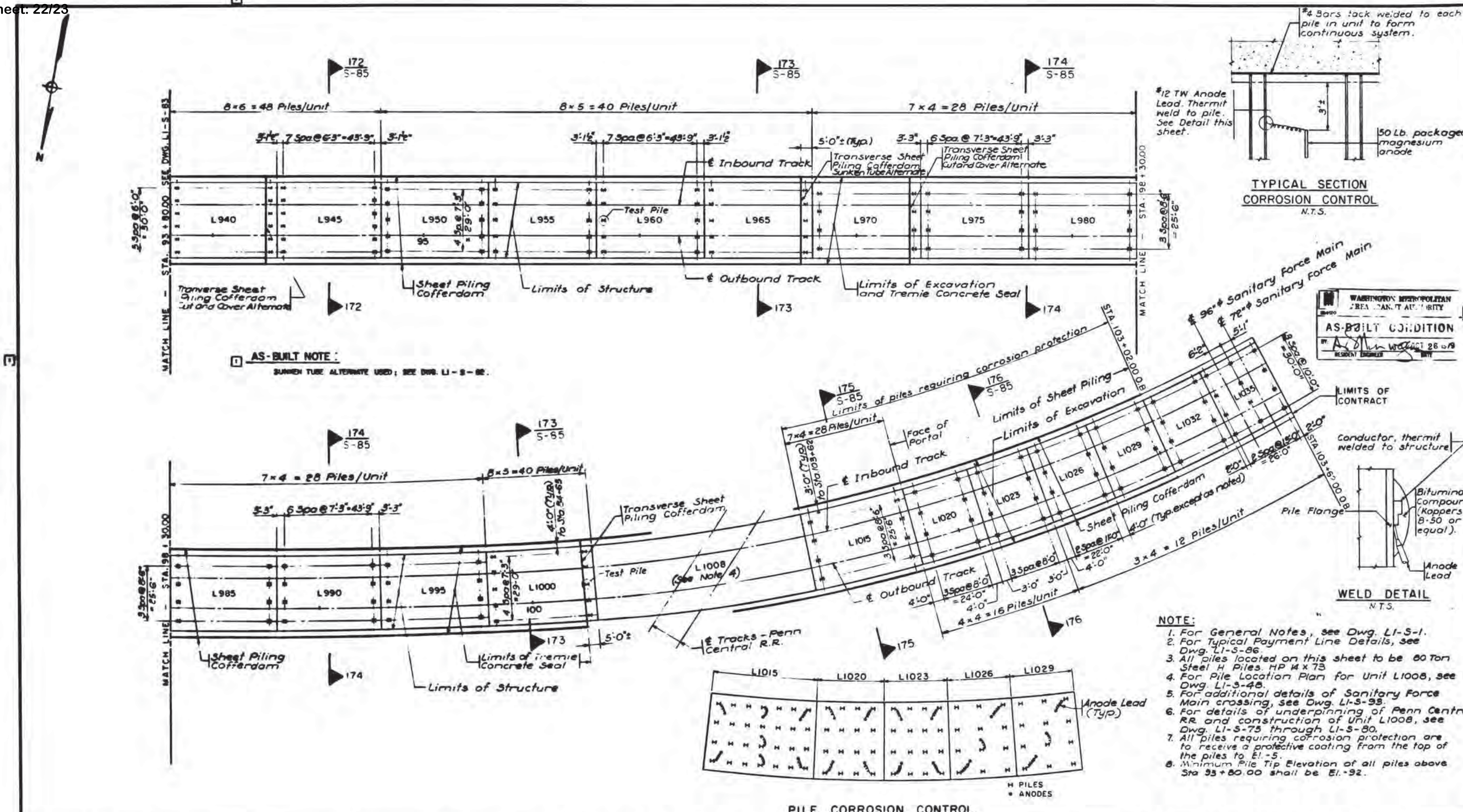
SUBMITTED
APPROVED

L'ENFANT PLAZA - PENTAGON ROUTE
SUPPORT OF EXCAVATION
KEY PLAN I - SUNKEN TUBE ALTERNATE

SCALE 1" = 40'
DRAWING NO. L1-S-81
M124-216

APPENDIX 3
SCHNABEL ENGINEERING, LLC
Sheet: 21/23





NOTE:

1. For General Notes, see Dwg. LI-S-1.
2. For Typical Payment Line Details, see Dwg. LI-S-86.
3. All piles located on this sheet to be 80 Ton Steel H Piles. HP 14 x 73
4. For Pile Location Plan for Unit L1008, see Dwg. LI-S-48.
5. For additional details of Sanitary Force Main crossing, see Dwg. LI-S-93.
6. For details of underpinning of Penn Central RR and construction of Unit L1008, see Dwg. LI-S-75 through LI-S-80.
7. All piles requiring corrosion protection are to receive a protective coating from the top of the piles to El. -5.
8. Minimum Pile Tip Elevation of all piles above Sta 93+80.00 shall be El. -92.

DESIGNED M.S.R. 7-25-73
DRAWN A.S.C. 8-2-73
CHECKED M.S.R. 8-3-73
APPROVED J.I. 8-9-74

REFERENCE DRAWINGS — NUMBER | DESCRIPTION

REVISIONS — DATE | BY | DESCRIPTION: NOTE AS-BUILT CONDITION "AS BUILT"

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

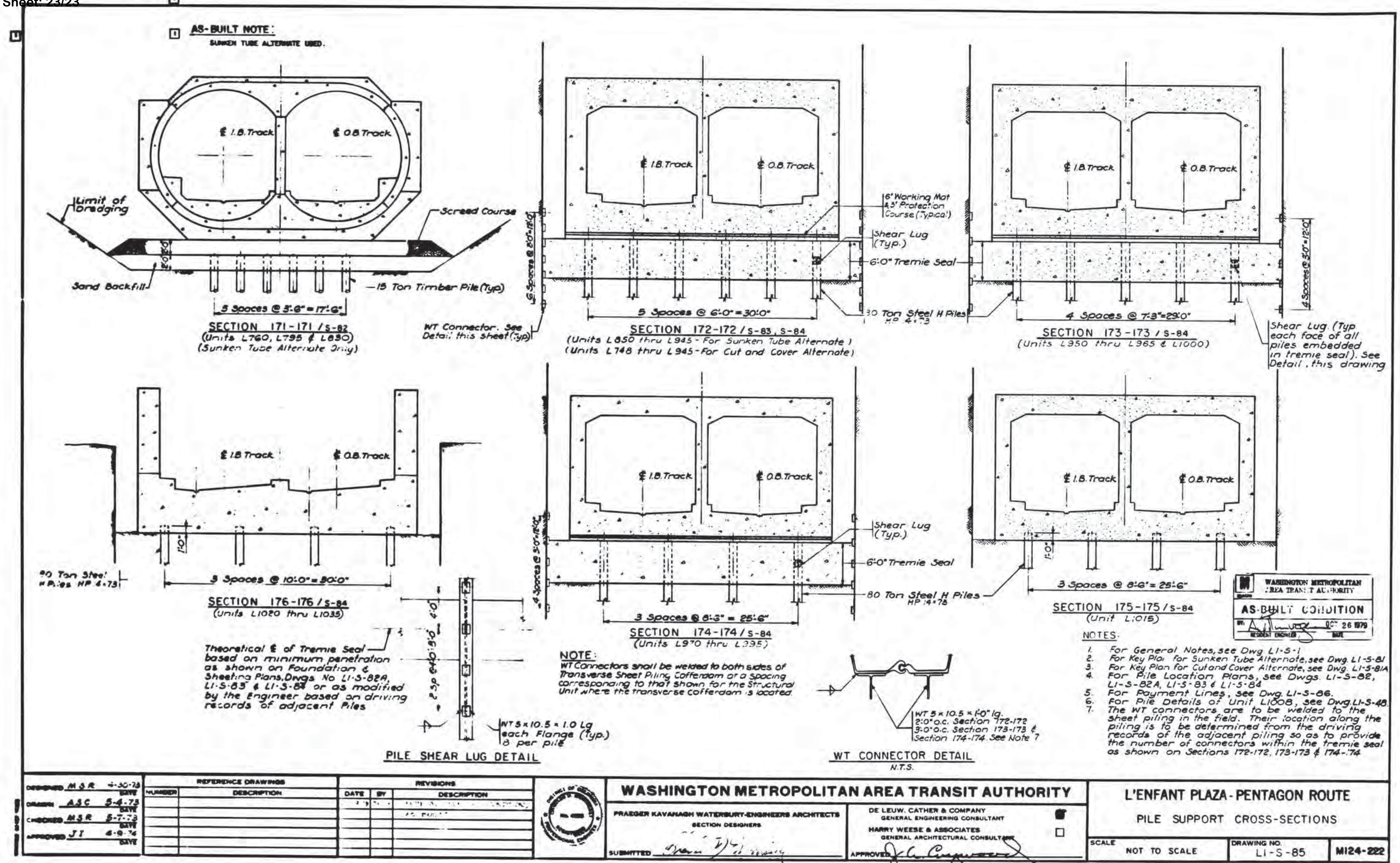
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

SUBMITTED
APPROVED

L'ENFANT PLAZA - PENTAGON ROUTE

FOUNDATION & SHEETING PLAN III
STA. 93 + 80.00 TO STA. 103 + 62.00 O.B.

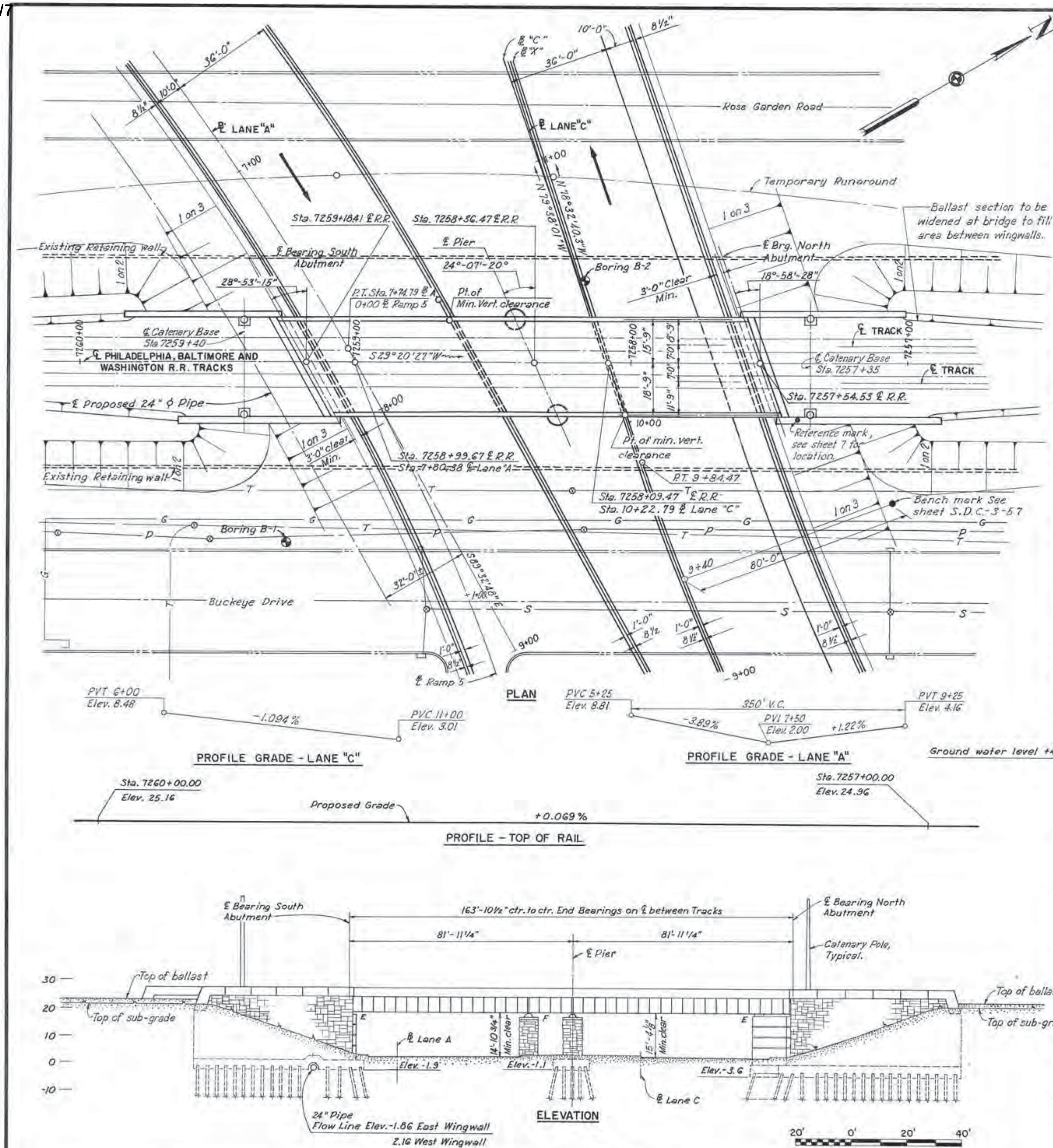
SCALE 1" = 20'
DRAWING NO. LI-S-84
MI24-221

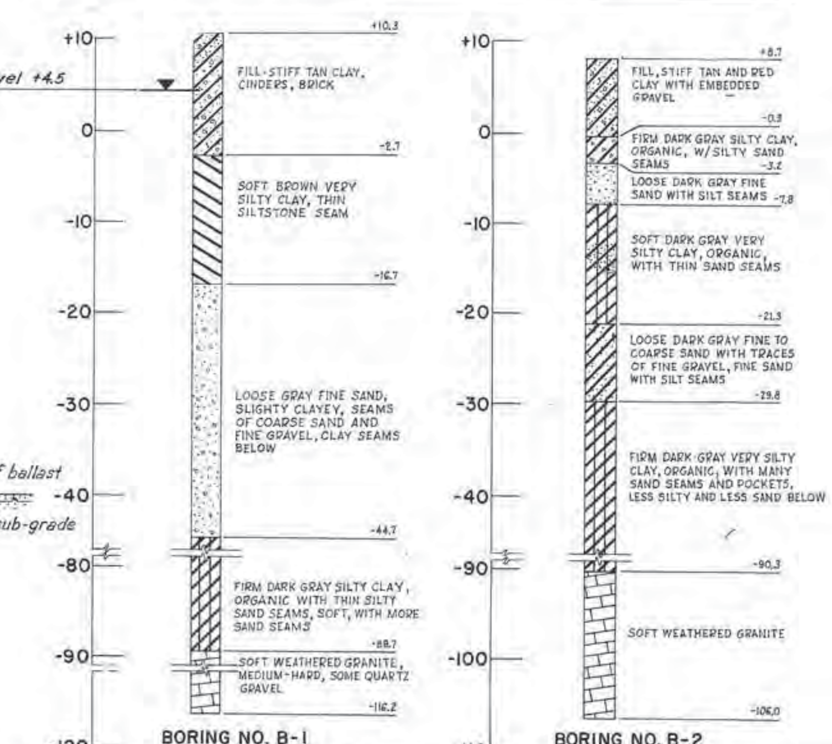

AS-BUILT NOTE:
SUNKEN TUBE ALTERNATE USED.
SECTION 171-171 / S-82
(Units L760, L795 & L830)
(Sunken Tube Alternate Only)
Limit of Dredging
Screed Course
Sand Backfill
15 Ton Timber Pile (Typ)
5 Spaces @ 3'-6" = 17'-6"
WT Connector. See Detail this sheet (Typ)
SECTION 172-172 / S-83, S-84
(Units L850 thru L945 - For Sunken Tube Alternate)
(Units L748 thru L945 - For Cut and Cover Alternate)
5 Spaces @ 6'-0" = 30'-0"
6" Working Mat & 3" Protection Course (Typical)
Shear Lug (Typ.)
6'-0" Tremie Seal
80 Ton Steel H Piles HP 14×73
SECTION 173-173 / S-84
(Units L950 thru L965 & L1000)
4 Spaces @ 7'-3" = 29'-0"
Shear Lug (Typ each face of all piles embedded in tremie seal). See Detail, this drawing
SECTION 176-176 / S-84
(Units L1020 thru L1035)
3 Spaces @ 10'-0" = 30'-0"
80 Ton Steel H Piles HP 14×73
Theoretical ℄ of Tremie Seal based on minimum penetration as shown on Foundation & Sheeting Plans, Dwgs No. L1-S-82A, L1-S-83 & L1-S-84 or as modified by the Engineer based on driving records of adjacent Piles
SECTION 174-174 / S-84
(Units L970 thru L995)
3 Spaces @ 8'-3" = 25'-6"
SECTION 175-175 / S-84
(Unit L1015)
3 Spaces @ 8'-6" = 25'-6"
℄ I.B. Track
℄ O.B. Track
NOTE:
WT Connectors shall be welded to both sides of Transverse Sheet Piling Cofferdam at a Spacing corresponding to that shown for the Structural Unit where the transverse cofferdam is located.
PILE SHEAR LUG DETAIL
WT 5×10.5 × 1.0 Lg each Flange (Typ.) 8 per pile
WT CONNECTOR DETAIL
N.T.S.
WT 5×10.5 × 1'-0" lg.
2'-0" o.c. Section 172-172
3'-0" o.c. Section 173-173 & Section 174-174. See Note 7
NOTES:
1. For General Notes, see Dwg L1-S-1
2. For Key Plan for Sunken Tube Alternate, see Dwg. L1-S-81
3. For Key Plan for Cut and Cover Alternate, see Dwg. L1-S-81A
4. For Pile Location Plans, see Dwgs. L1-S-82, L1-S-82A, L1-S-83 & L1-S-84
5. For Payment Lines, see Dwg. L1-S-86.
6. For Pile Details of Unit L1008, see Dwg. L1-S-48
7. The WT connectors are to be welded to the sheet piling in the field. Their location along the piling is to be determined from the driving records of the adjacent piling so as to provide the number of connectors within the tremie seal as shown on Sections 172-172, 173-173 & 174-174
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
AS-BUILT CONDITION
OCT 26 1979
RESIDENT ENGINEER
DESIGNED MSR 4-30-73
DRAWN ASC 5-4-73
CHECKED MSR 5-7-73
APPROVED JI 6-9-74
REFERENCE DRAWINGS
REVISIONS
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
PRAEGER KAVANAGH WATERBURY-ENGINEERS ARCHITECTS
SECTION DESIGNERS
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT
SUBMITTED
APPROVED
L'ENFANT PLAZA - PENTAGON ROUTE
PILE SUPPORT CROSS-SECTIONS
SCALE NOT TO SCALE
DRAWING NO. L1-S-85
M124-222

APPENDIX 4

Selected sheets from the New West Highway Bridge and Approaches over Potomac River, Vicinity of 14th Street, Washington DC, dated April 1959, prepared by Howard, Needles, Tammen & Bergendoff for the Department of Highways and Traffic, District of Columbia

7 Sheets





B. P. R. REG. NO.	STATE	FED. AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
2	D. C.	[illegible]	88	126

ESTIMATED QUANTITIES

ITEM	DESCRIPTION	UNIT	SUBSTRUCTURE N. ABUT.	SUBSTRUCTURE PIERS	SUBSTRUCTURE S. ABUT.	SUPER-STRUCT.	TOTAL
1	Unclassified Excavation	Cu.Yd.					8859
70	Structure Excavation	Cu.Yd.	1735	190	1580		3505
71	Backfill	Cu.Yd.	930		920		1850
72	Porous Backfill	Cu.Yd.	175		165		340
73	Steel H-Beam Piles 14 BP73	Lin.Ft.	9205	3506	9467		22,178
75	Substructure Concrete	Cu.Yd.	780	75	750		1605
76	Superstructure Concrete	Cu.Yd.				135	135
78	Bituminous Concrete	Sq.Yd.				483	483
79	Reinforcing Steel	Lbs.	43,840	17,650	43,850	4510	109,850
80	Structural Low Alloy Steel	Lbs.				271,750	271,750
81	Structural Carbon Steel	Lbs.		3460		587,040	590,500
82	Wrought Iron Deck Plate	Lbs.				124,885	124,885
83	Wrought Iron Drains	Lin.Ft.				350	350
84	Perforated Drainage Pipe, 8"	Lin.Ft.	164		166		330
87	Damp-proofing	Sq.Yd.	367		343		710
88	Waterproofing, 3 ply A.R.E.A. Type C.	Sq.Yd.				483	483
90	Field Painting	L. S.					—
91	Temporary Railroad Run-Around	L. S.					—
92	Removal of Existing Bridge	L. S.					—
95	Conduit, 4½" I.D. Asbestos Cement	Lin.Ft.				2045	2045
100	Class B Stone Masonry	Cu.Ft.	1400	365	1250		3015

Note: Wingwall quantities are included with respective abutments.

GENERAL NOTES

Design Specifications:
Superstructure; A.R.E.A. Specifications For Steel Railway Bridges, For Fixed Spans Not Exceeding 400 ft. in Length, 1956.
Abutments & Piers; A.R.E.A. Specifications for Concrete & Reinforced Concrete Railroad Bridges and other structures.
Construction Specifications:
District of Columbia, Department of Highways, General Provisions and Standard Specifications, Structures 1957 as modified by the Special Provisions.
Design Live Loading:
Cooper E-72, each track with steam impact.
Concrete:
Concrete shall be Class B-B
Structural Steel:
All Structural Carbon Steel to be A.S.T.M. A-373
All Structural Low Alloy Steel to be A.S.T.M. A-242 Welding Grade. All rivets to be 7/8" ϕ
Reinforcing Steel:
Reinforcing Steel is to be intermediate Grade.
All bending dimensions are shown as "out" to "out" of bar. Bar sizes are indicated on the plans by the Mark number. The first digit in three digit marks and the first two digits of four digit marks, indicate the bar size.
Example: 401 indicates a #4 bar, 1101 indicates a #11 bar,
Use 2" clear cover on all reinforcing unless otherwise shown.
Stationing:
Railroad stationing refers to the stationing used on the Philadelphia, Baltimore, and Washington Railroad Company Electrification Plan.
Elevations:
Elevations refer to the District of Columbia datum which is 2.11' above mean low water.
Design Loading for Piles:
14 BP73-64.4 tons per pile. Piles shall be driven until a firm bearing on rock is secured. Rock is assumed at elevation -97 for quantity purposes.

LEGEND

Storm Sewer — Manhole, Catch Basin — S
Power Conduit — Manhole — P
Telephone Conduit — Manhole — T
Gas Line — G

D.C.,D.P.W. Archives Drawing No. (Transportation Construction Services)
TCS 1-1-2-1120

NO.	DESCRIPTION	NAME	DATE

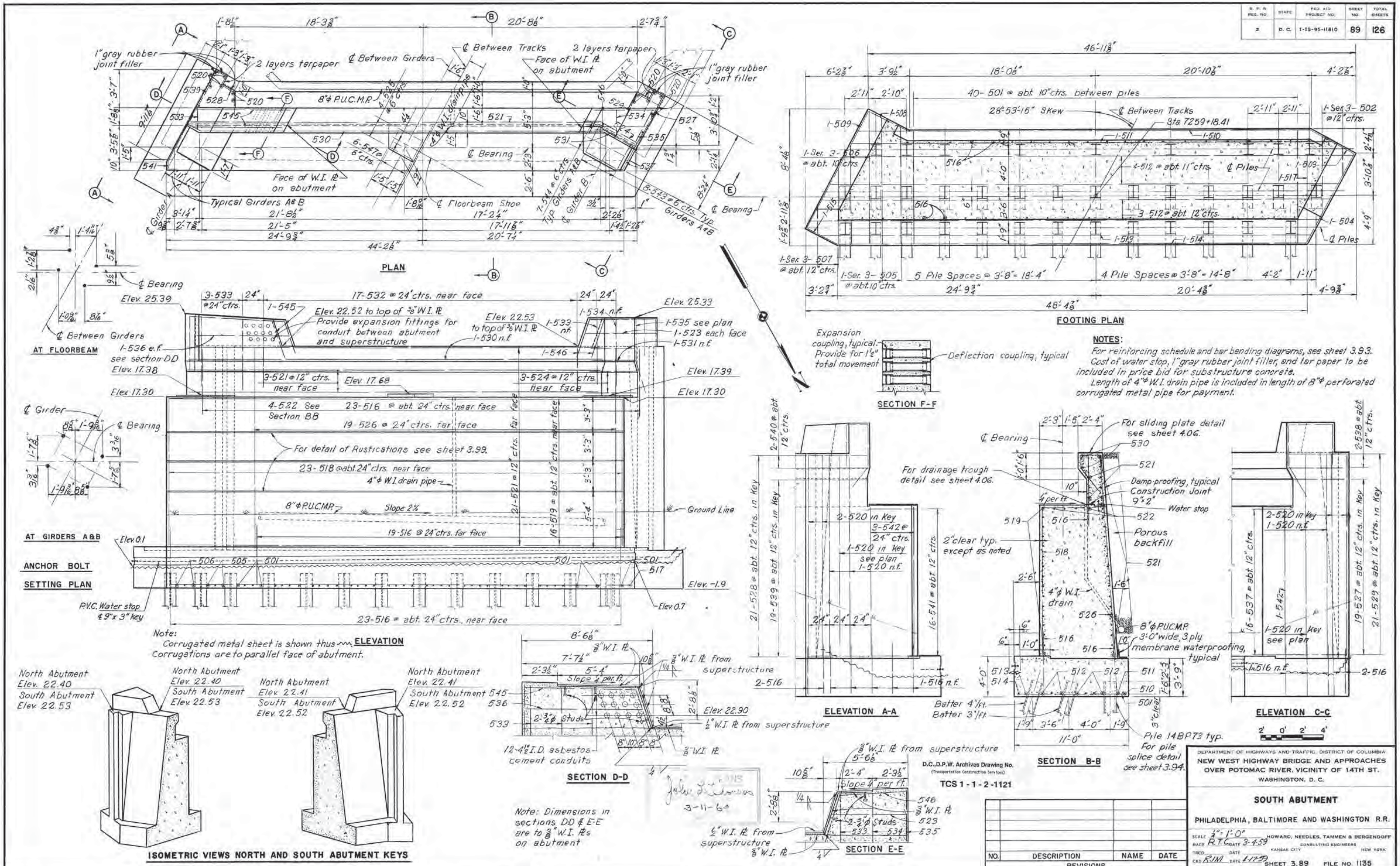
REVISIONS

DEPARTMENT OF HIGHWAYS AND TRAFFIC DISTRICT OF COLUMBIA
NEW WEST HIGHWAY BRIDGE AND APPROACHES OVER POTOMAC RIVER, VICINITY OF 14TH ST. WASHINGTON, D. C.

GENERAL PLAN AND ELEVATION
PHILADELPHIA, BALTIMORE AND WASHINGTON R.R.

SCALE 1" = 20'
MADE PH DATE 2-10-59
TRCD TER DATE 5-27-59
CKD RSG DATE 4-22-59
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS KANSAS CITY NEW YORK
SHEET 3.88 FILE NO. 1135

APPENDIX 4
SCHNABEL ENGINEERING, LLC
Sheet: 2/7



NOTES:
For reinforcing schedule and bar bending diagrams, see sheet 3.93.
Cost of water stop, 1" gray rubber joint filler, and tar paper to be included in price bid for substructure concrete.
Length of 4"φ W.I. drain pipe is included in length of 8"φ perforated corrugated metal pipe for payment.

F. P. R. REG. NO.	STATE	FED. AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
2	D. C.	I-IG-95-1(81)0	89	126

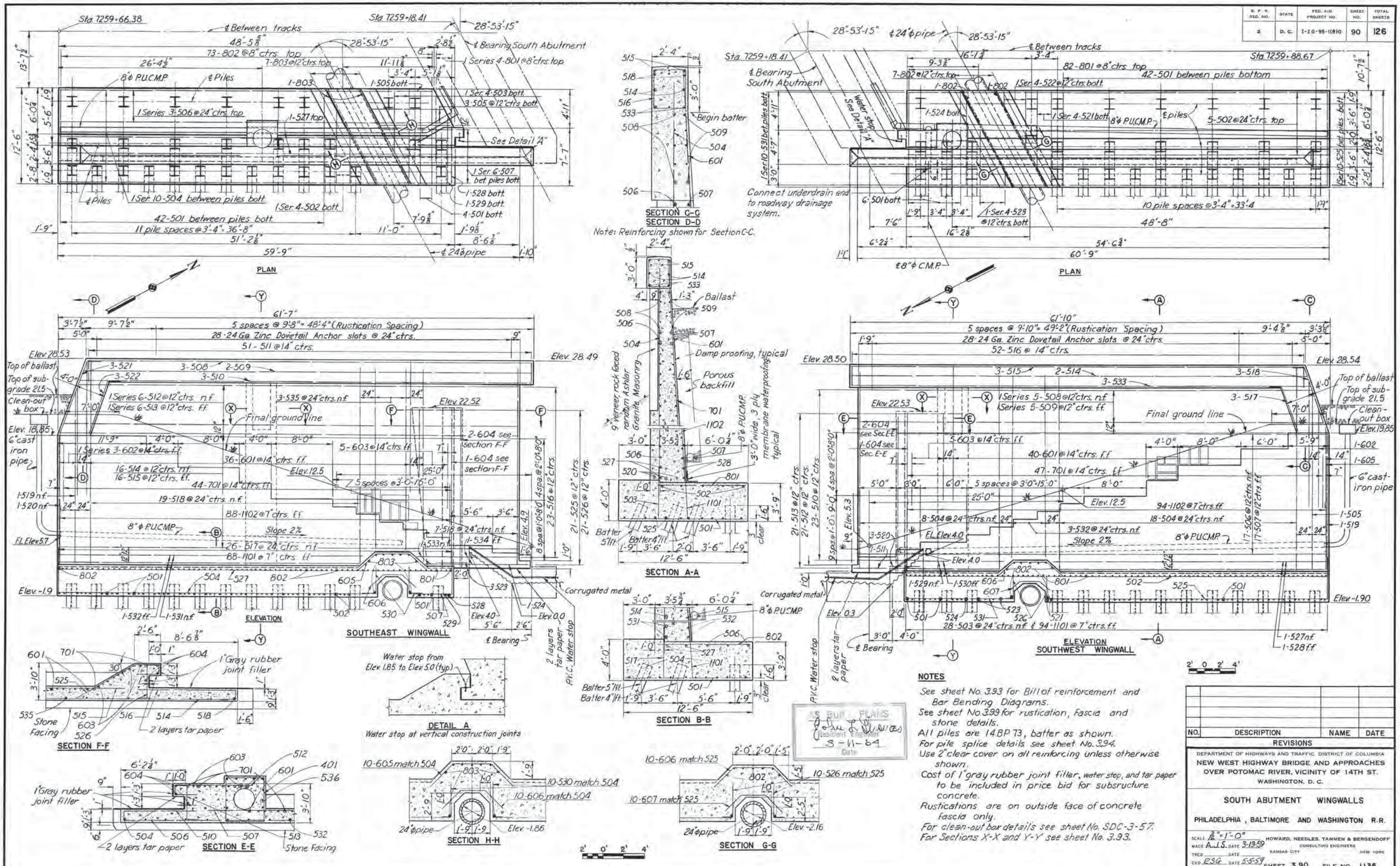
DEPARTMENT OF HIGHWAYS AND TRAFFIC, DISTRICT OF COLUMBIA
NEW WEST HIGHWAY BRIDGE AND APPROACHES OVER POTOMAC RIVER, VICINITY OF 14TH ST. WASHINGTON, D. C.

SOUTH ABUTMENT

PHILADELPHIA, BALTIMORE AND WASHINGTON R.R.

SCALE 3/8" = 1'-0"
MADE R.T.C. DATE 3-4-59
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS KANSAS CITY NEW YORK
CKD. RJM DATE 4-17-59
SHEET 3.89 FILE NO. 1135

NO.	DESCRIPTION	NAME	DATE
	REVISIONS		



NOTES

See sheet No. 3.93 for Bill of reinforcement and Bar Bending Diagrams.
See sheet No. 3.99 for rustication, fascia and stone details.
All piles are 14BP73, batter as shown.
For pile splice details see sheet No. 3.94.
Use 2" clear cover on all reinforcing unless otherwise shown.
Cost of 1" gray rubber joint filler, water stop, and tar paper to be included in price bid for substructure concrete.
Rustications are on outside face of concrete fascia only.
For clean-out box details see sheet No. SDC-3-57.
For Sections X-X and Y-Y see sheet No. 3.93.

B.P.R. REG. NO.	STATE	FED. AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
2	D.C.	I-IG-95-1(8)0	90	126

NO.	DESCRIPTION	NAME	DATE
	REVISIONS		

DEPARTMENT OF HIGHWAYS AND TRAFFIC, DISTRICT OF COLUMBIA
NEW WEST HIGHWAY BRIDGE AND APPROACHES OVER POTOMAC RIVER, VICINITY OF 14TH ST.
WASHINGTON, D. C.

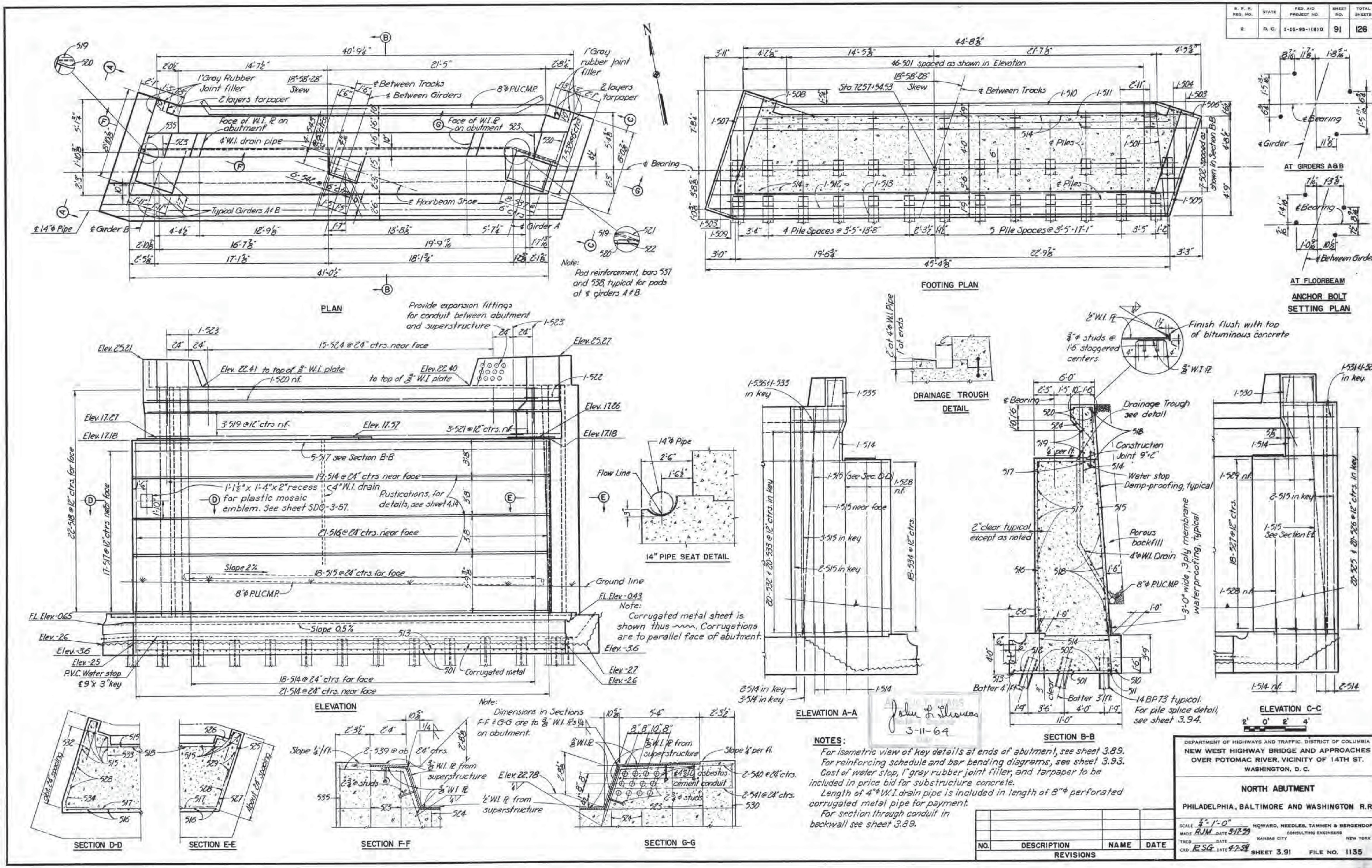
SOUTH ABUTMENT WINGWALLS

PHILADELPHIA, BALTIMORE AND WASHINGTON R.R.

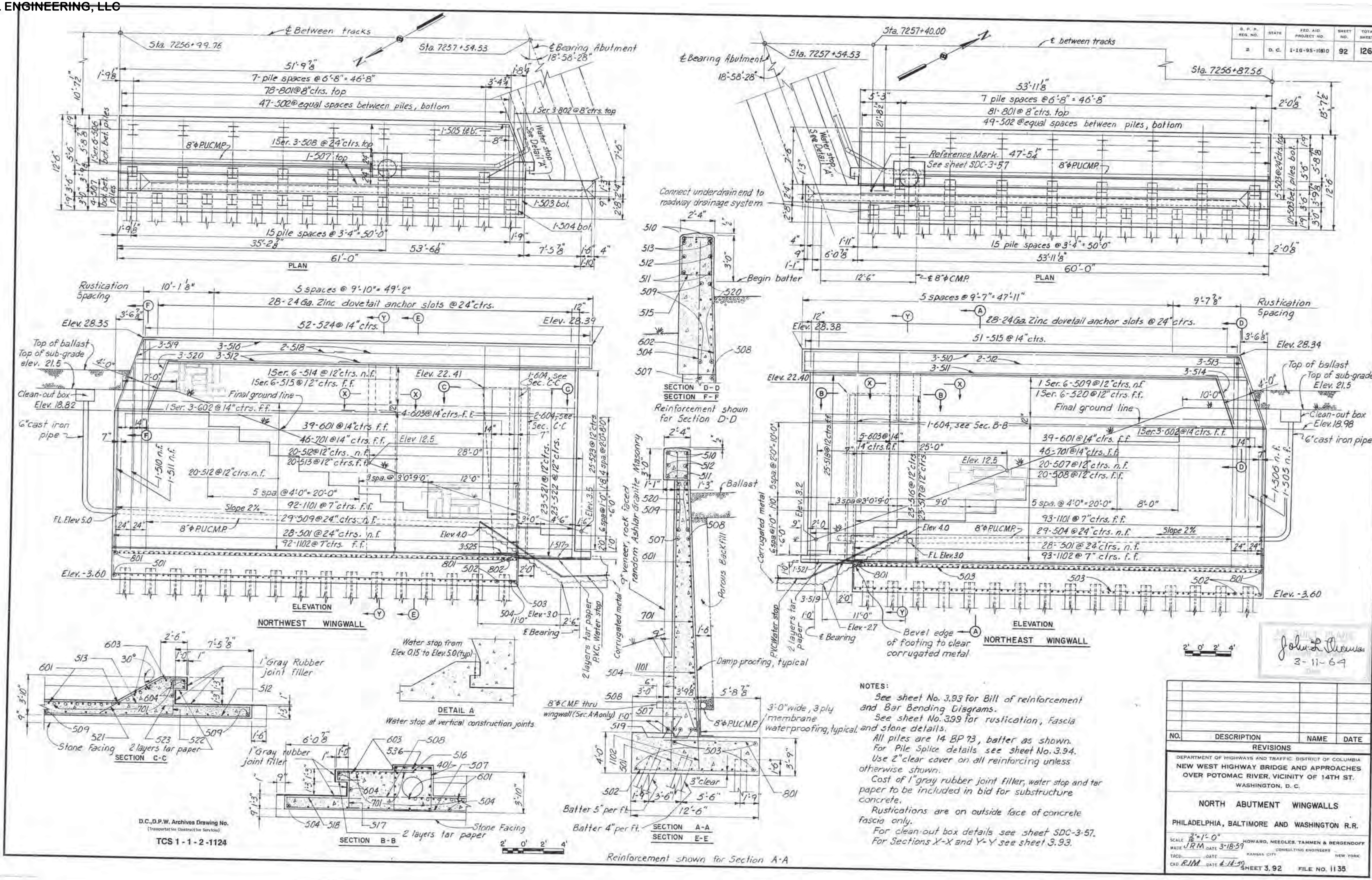
SCALE 1/4" = 1'-0"
MADE A.J.S. DATE 3-13-59
TRCD ___ DATE ___
CKD B.S.G. DATE 5-5-59
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS KANSAS CITY NEW YORK
SHEET 3.90 FILE NO. 1135

D.C.D.P.W. Archives Drawing No. (Transportation Construction Services)
TCS 1-1-2-1122

APPENDIX 4
SCHNABEL ENGINEERING, LLC
Sheet: 4/7

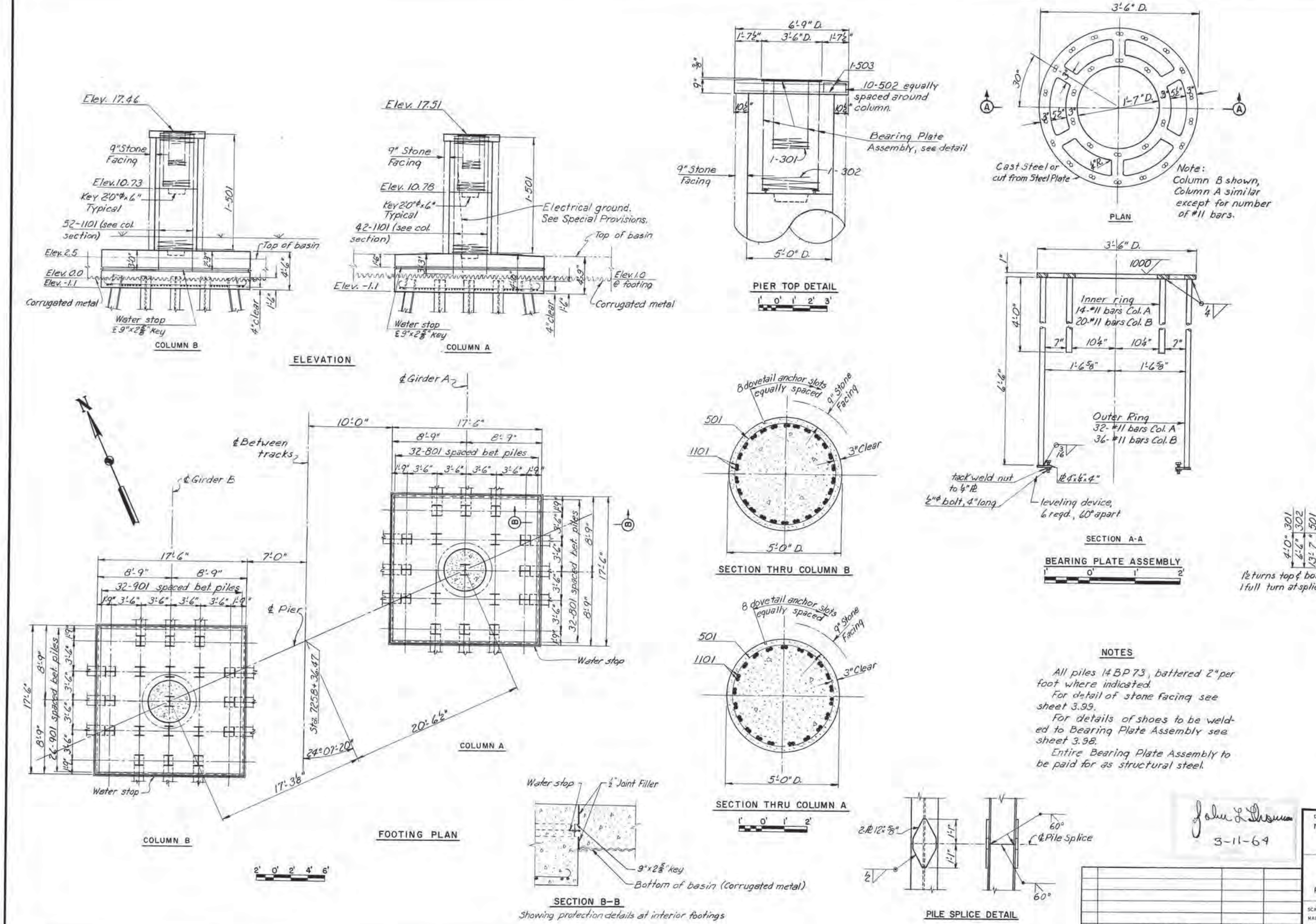


D.C.D.P.W. Archives Drawing No.
TCS 1-1-2-1123


PLAN
NORTHWEST WINGWALL
ELEVATION
NORTHEAST WINGWALL
ELEVATION
SECTION D-D
SECTION F-F
Reinforcement shown for Section D-D
SECTION A-A
SECTION E-E
Reinforcement shown for Section A-A
SECTION C-C
SECTION B-B
DETAIL A
Water stop at vertical construction joints
Water stop from Elev. 0.15 to Elev. 5.0 (typ)
Sta. 7256+99.76
Sta. 7257+54.53
Sta. 7257+40.00
Sta. 7256+87.56
℄ Between tracks
℄ Bearing Abutment
18°-58'-28"
Connect underdrain end to roadway drainage system
9" veneer, rock faced random Ashlar Granite Masonry
Porous Backfill
Damp proofing, typical
3'-0" wide, 3 ply membrane waterproofing, typical
2 layers tar paper
P.V.C. Water stop
Corrugated metal
1" Gray Rubber joint filler
Stone Facing
Bevel edge of footing to clear corrugated metal
Rustication Spacing
Top of ballast
Top of sub-grade elev. 21.5
Clean-out box
6" cast iron pipe
Final ground line
28-24 Ga. Zinc dovetail anchor slots @ 24" ctrs.
NOTES:
See sheet No. 3.93 for Bill of reinforcement and Bar Bending Diagrams.
See sheet No. 3.99 for rustication, Fascia and stone details.
All piles are 14 BP 73, batter as shown.
For Pile Splice details see sheet No. 3.94.
Use 2" clear cover on all reinforcing unless otherwise shown.
Cost of 1" gray rubber joint filler, water stop and tar paper to be included in bid for substructure concrete.
Rustications are on outside face of concrete fascia only.
For clean-out box details see sheet SDC-3-57.
For Sections X-X and Y-Y see sheet 3.93.
AS BUILT PLANS
John L. Thomas
3-11-64
NO. | DESCRIPTION | NAME | DATE
REVISIONS
DEPARTMENT OF HIGHWAYS AND TRAFFIC, DISTRICT OF COLUMBIA
NEW WEST HIGHWAY BRIDGE AND APPROACHES OVER POTOMAC RIVER, VICINITY OF 14TH ST. WASHINGTON, D. C.
NORTH ABUTMENT WINGWALLS
PHILADELPHIA, BALTIMORE AND WASHINGTON R.R.
SCALE 3/8"=1'-0"
MADE JRM DATE 3-18-59
CKD RJM DATE 4-14-59
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS
KANSAS CITY NEW YORK
SHEET 3.92
FILE NO. 1135
2 | D. C. | I-IG-95-1(810) | 92 | 126
D.C.,D.P.W. Archives Drawing No.
TCS 1-1-2-1124

APPENDIX 4
SCHNABEL ENGINEERING, LLC
Sheet: 6/7

B. P. R. REG. NO.	STATE	FED. AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
2	D. C.	I-IG-95-1(810)	94	126



BILL OF REINFORCEMENT			
MARK	NO.	LENGTH	TYPE
301	2	119'-5"	Bent
302	2	309'-5"	Bent
501	2	812'-2"	Bent
502	20	2'-2"	Bent
503	4	20'-8"	Bent
801	64	19'-0"	Bent
901	58	19'-4"	Bent
1101	94	16'-10"	Str.

NOTES

All piles 14 BP 73, battered 2" per foot where indicated.

For detail of stone facing see sheet 3.99.

For details of shoes to be welded to Bearing Plate Assembly see sheet 3.98.

Entire Bearing Plate Assembly to be paid for as structural steel.

D.C.,D.P.W. Archives Drawing No.
TCS 1-1-2-1126

3-11-64

NO.	DESCRIPTION	NAME	DATE
	REVISIONS		

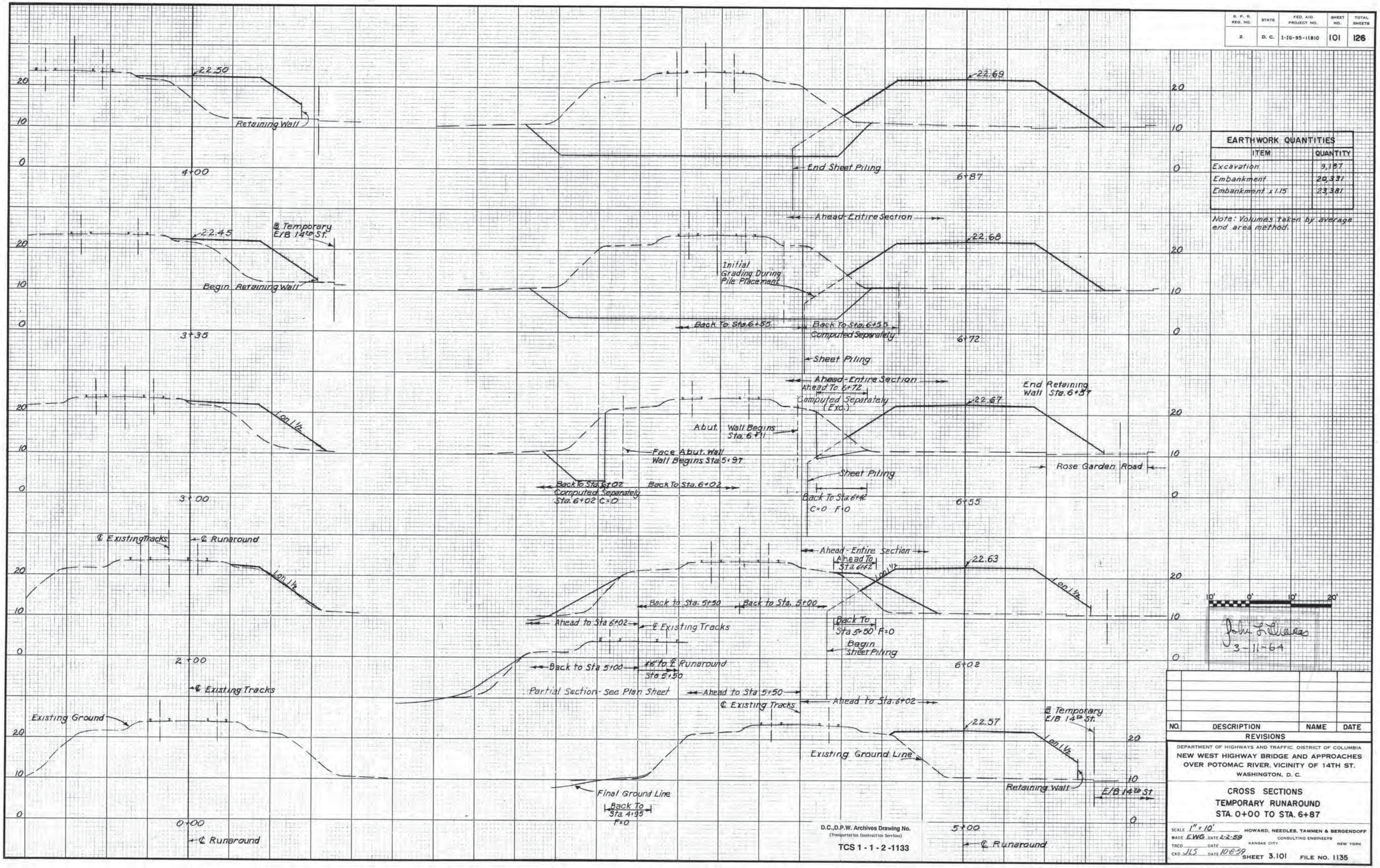
DEPARTMENT OF HIGHWAYS AND TRAFFIC DISTRICT OF COLUMBIA
NEW WEST HIGHWAY BRIDGE AND APPROACHES OVER POTOMAC RIVER, VICINITY OF 14TH ST. WASHINGTON, D. C.

PIER

PHILADELPHIA, BALTIMORE AND WASHINGTON R.R.

SCALE As Noted
MADE R.S.G. DATE 2-27-59
CKD. RJM DATE 2-31-59
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS KANSAS CITY NEW YORK
SHEET 3.94 FILE NO. 1135

APPENDIX 4
SCHNABEL ENGINEERING, LLC
Sheet: 7/7

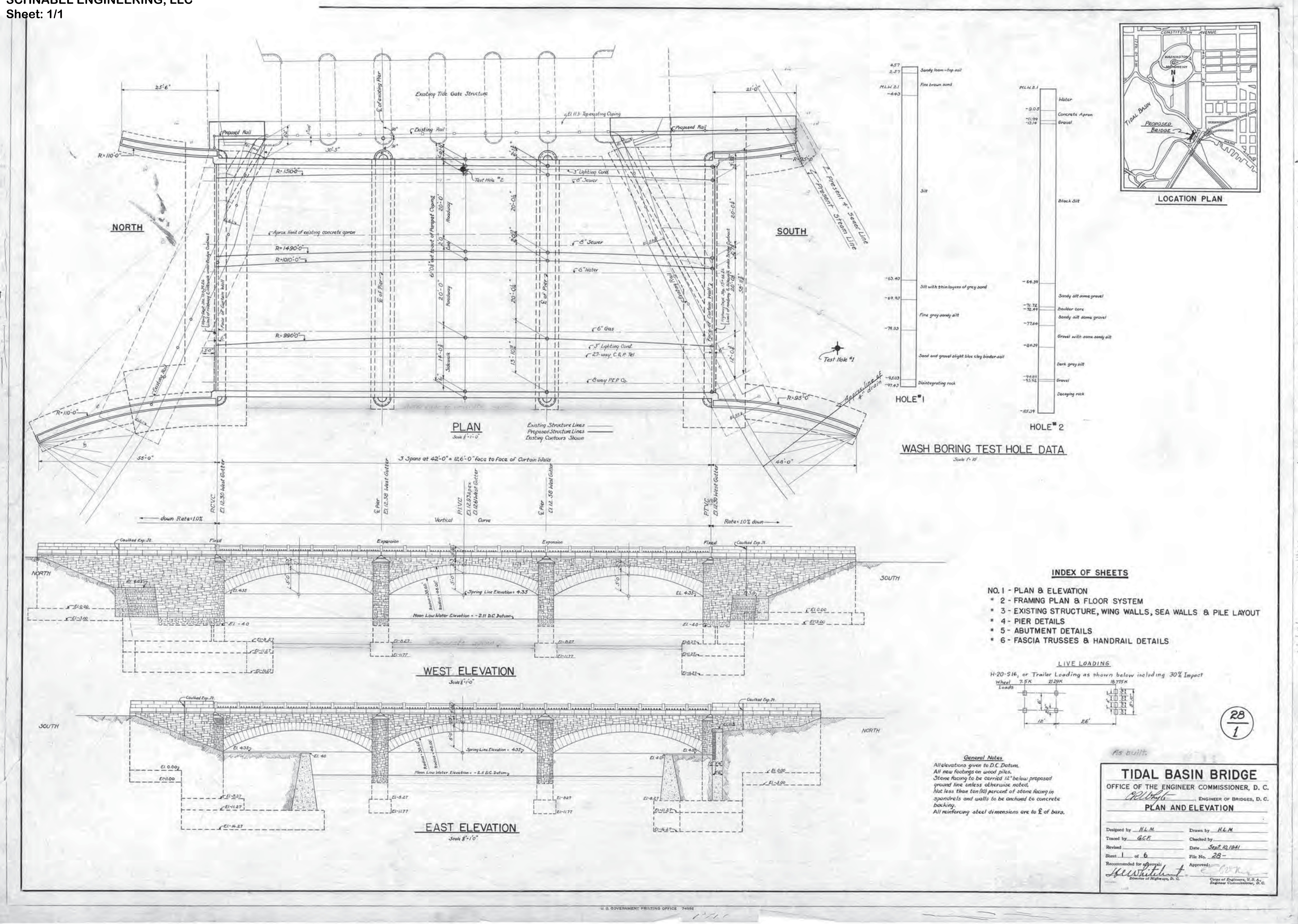


APPENDIX 5

Selected sheets from the Tidal Basin Bridge, dated September 1941, prepared for the Office of the Engineer Commissioner, DC

1 Sheet

APPENDIX 5
SCHNABEL ENGINEERING, LLC
Sheet: 1/1



APPENDIX 6

Selected sheets from the As-Built Drawings for the Plan of Proposed Extension Maine Avenue Underpass East of 14th St. SW, under Penn RR, dated May 1943, approved by the Corps of Engineer USA Engineer Commissioner for the Office of the Engineer Commissioner DC

15 Sheets

FED ROAD DIST NO	STATE	FEDERAL AID PROJECT NO	SHEET NO	TOTAL SHEETS
10	DC	F A G M 24-B	1	13

DISTRICT OF COLUMBIA
DEPARTMENT OF HIGHWAYS

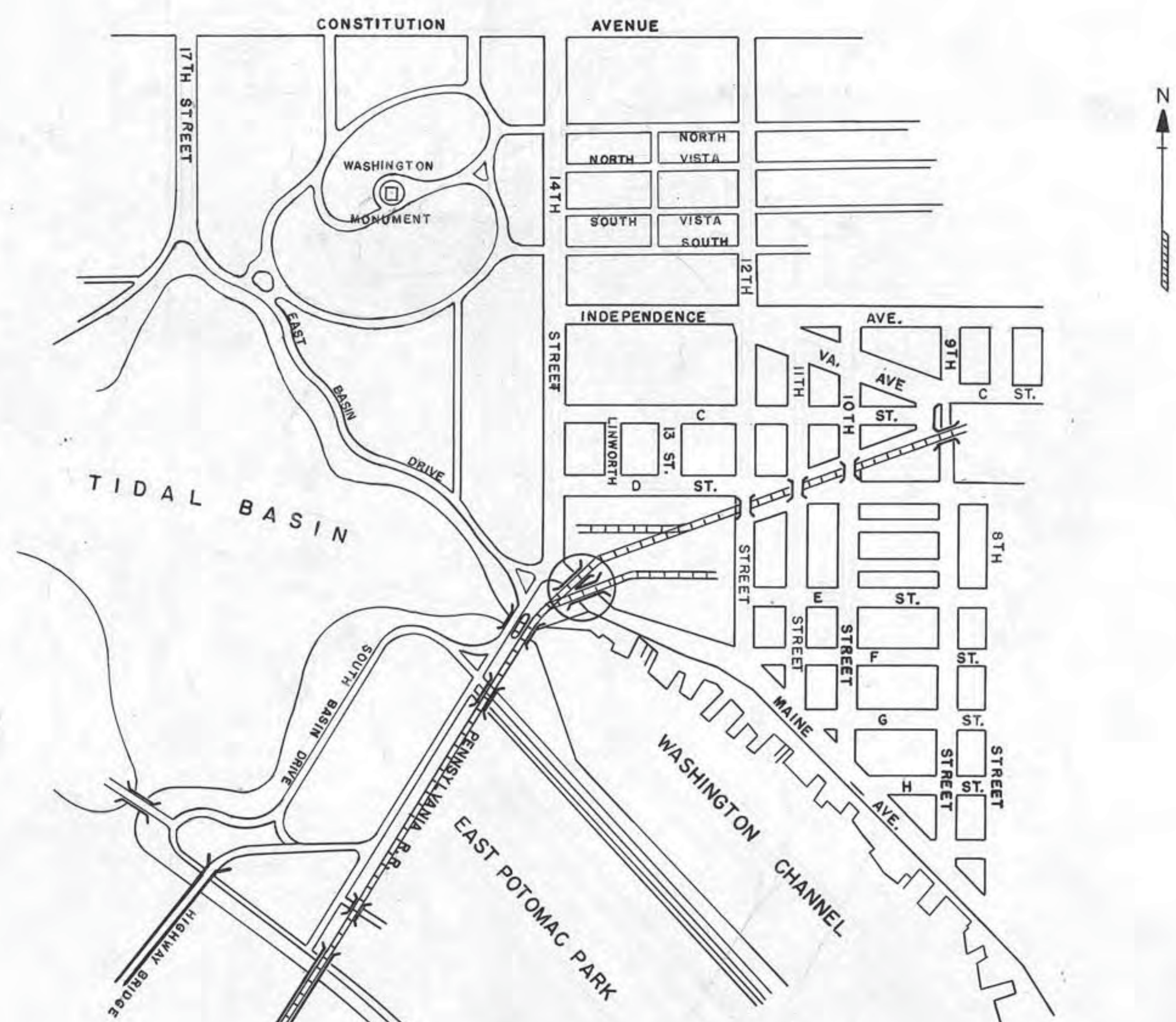
PLAN OF PROPOSED EXTENSION

MAINE AVENUE UNDERPASS

EAST OF 14TH ST. S.W., UNDER PENN. R.R.

FEDERAL AID GRADE CROSSING PROJECT

F.A.G.M. 24-B



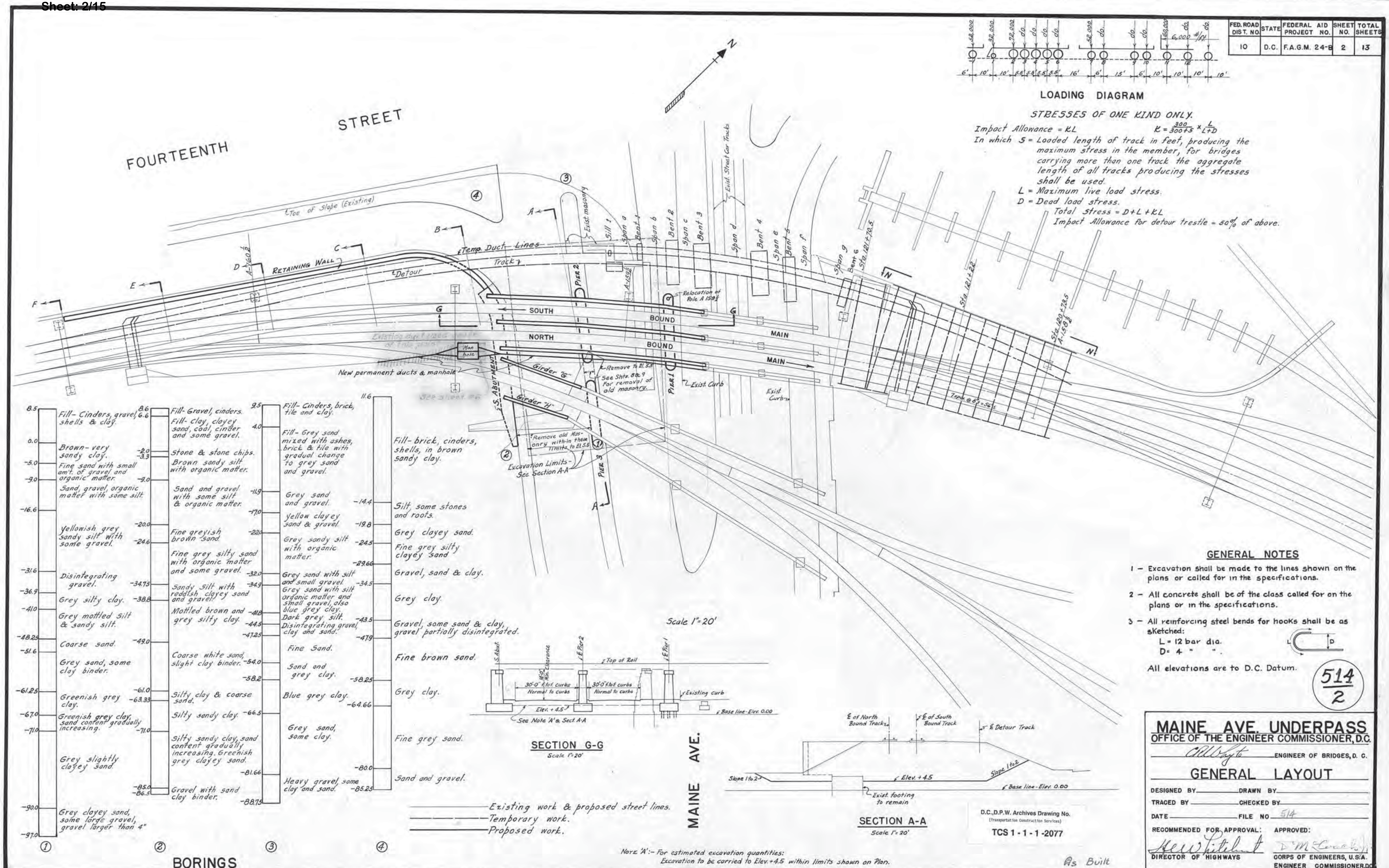
INDEX OF SHEETS

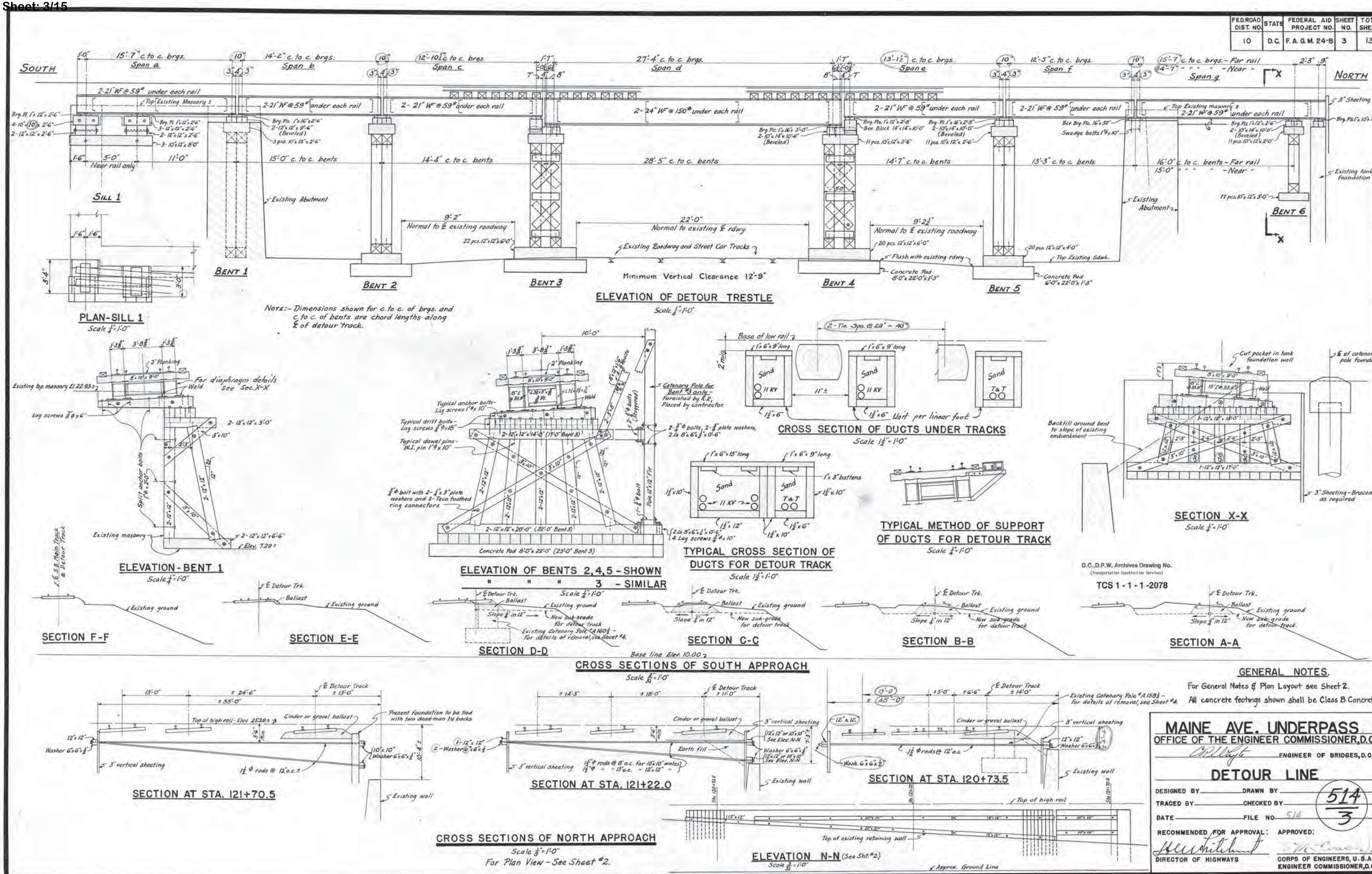
1. Title Sheet.
2. General Layout.
3. Detour Line.
4. Electrical Details.
5. Construction Details.
6. Construction Details Spur Line.
7. Pier No. 1.
8. Pier No. 2.
9. Pier No. 3.
10. Abutment.
11. Spur Line Details.
12. Main Line Details.
13. Retaining Wall.

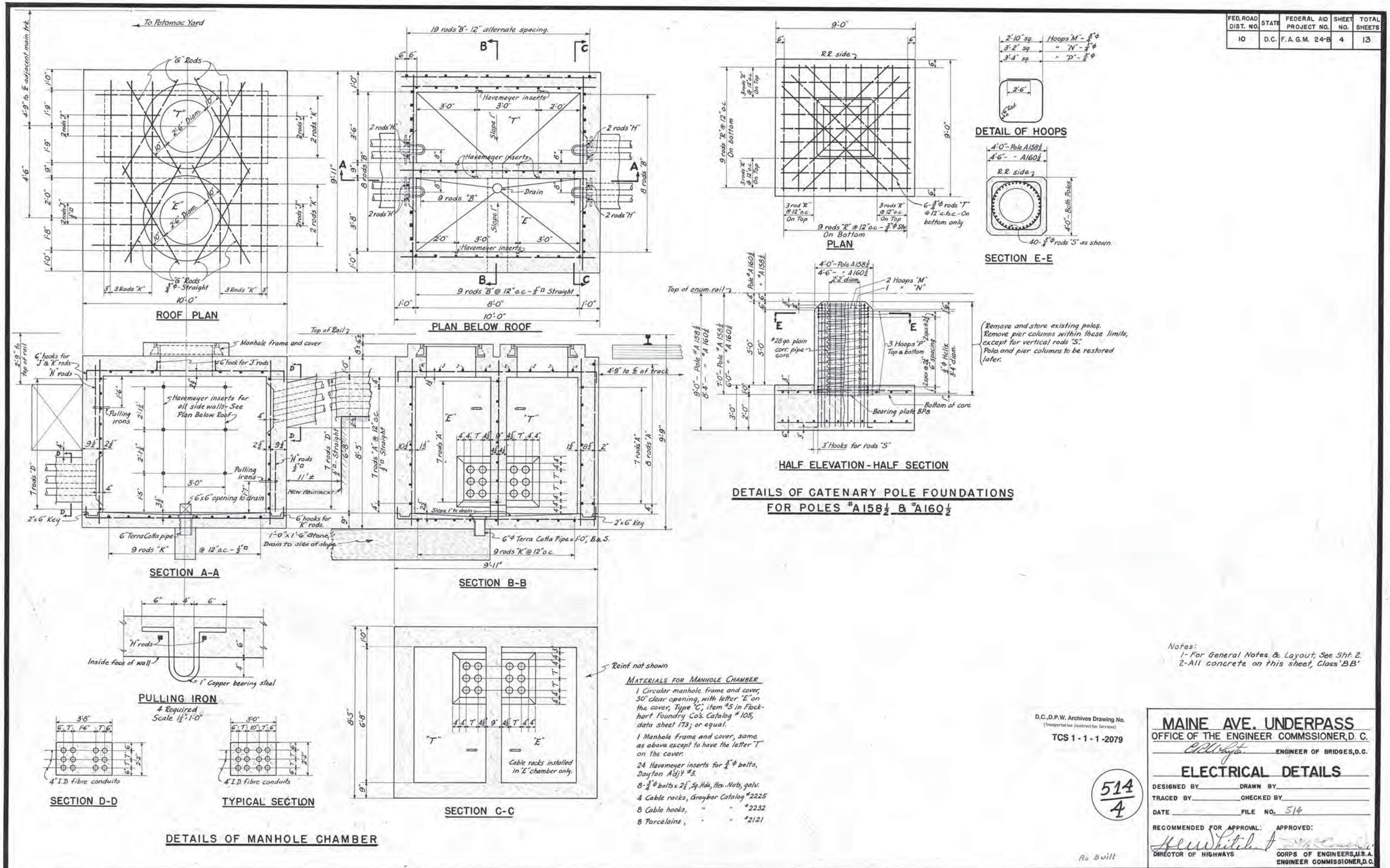
D.C., D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1-1-1-2076

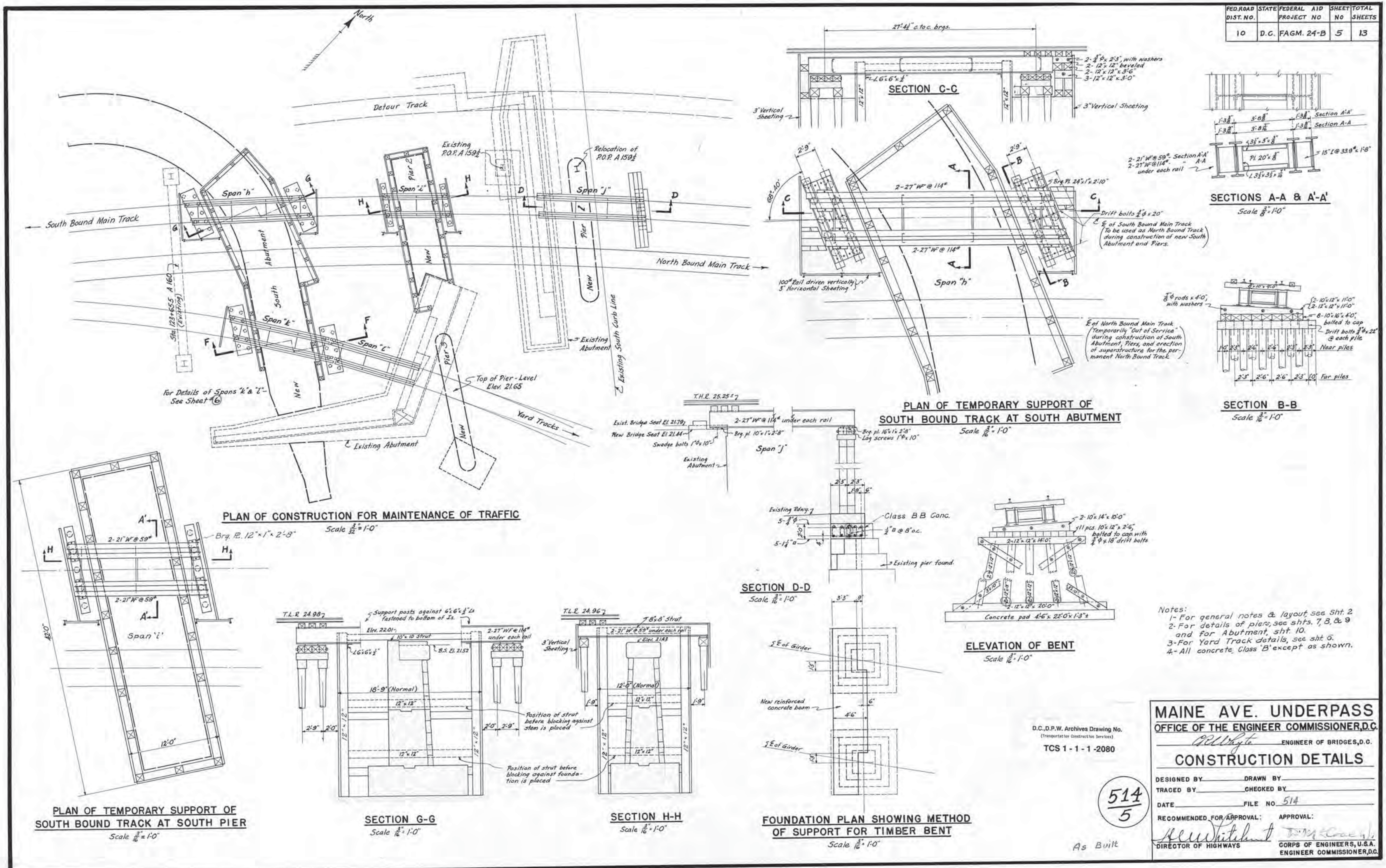
514
1

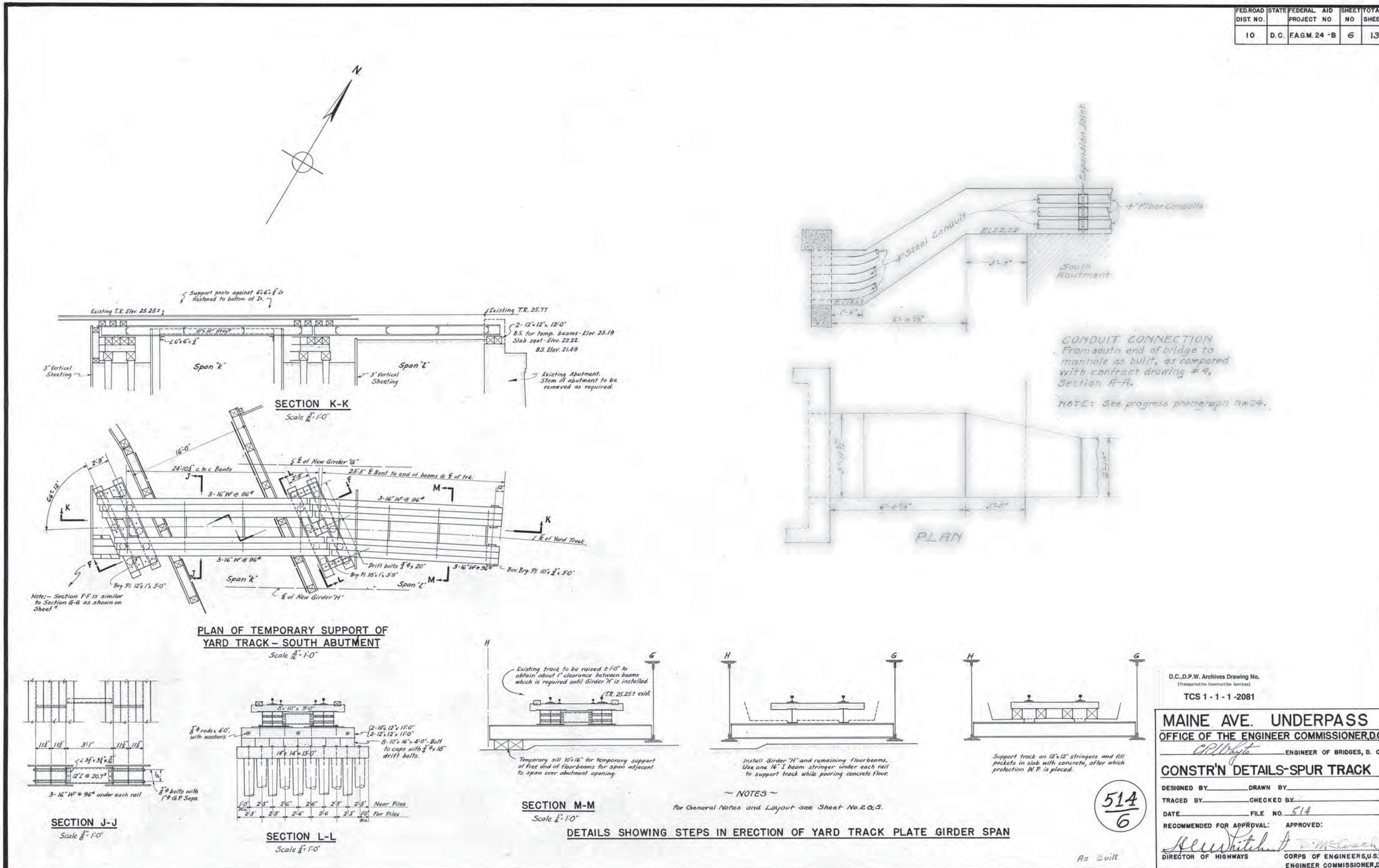
DISTRICT OF COLUMBIA DEPARTMENT OF HIGHWAYS	FEDERAL WORKS AGENCY PUBLIC ROADS ADMINISTRATION
SUBMITTED FOR APPROVAL	RECOMMENDED FOR APPROVAL
ENGINEER OF BRIDGES	[redacted] DISTRICT ENGINEER
DIRECTOR OF HIGHWAYS	APPROVED
APPROVED	[redacted] COMMISSIONER
ENGINEER COMMISSIONER	
DATE	DATE


FED. ROAD DIST. NO. | STATE | FEDERAL AID PROJECT NO. | SHEET NO. | TOTAL SHEETS
10 | D.C. | F.A.G.M. 24-B | 2 | 13
LOADING DIAGRAM
STRESSES OF ONE KIND ONLY.
Impact Allowance = KL   K = 300/(300+S) × L/(L+D)
In which S = Loaded length of track in feet, producing the maximum stress in the member, for bridges carrying more than one track the aggregate length of all tracks producing the stresses shall be used.
L = Maximum live load stress.
D = Dead load stress.
Total Stress = D+L+KL
Impact Allowance for detour trestle = 50% of above.
FOURTEENTH STREET
Toe of Slope (Existing)
RETAINING WALL
Temp. Duct Lines
Track
Detour
SOUTH BOUND MAIN
NORTH BOUND MAIN
New permanent ducts & manhole
Girder "G"
Girder "H"
Excavation Limits - See Section A-A
Remove old Masonry within these limits to El. 5.5
See Shts. 8 & 9 For removal of old masonry.
Relocation of Pole A 159
Exist. Curb
Exist. Street Car Tracks
Exist. masonry
PIER 1
PIER 2
PIER 3
Sill 1
Span a
Bent 1
Span b
Bent 2
Span c
Bent 3
Span d
Bent 4
Span e
Bent 5
Span f
Span 9
Bent 6
Sta. 121+70.5
Sta. 121+84
Sta. 120+78.5
BORINGS
① 8.5 Fill- Cinders, gravel, shells & clay. 0.0 Brown- very sandy clay. -5.0 Fine sand with small am't. of gravel and organic matter. -9.0 Sand, gravel, organic matter with some silt. -16.6 Yellowish grey sandy silt with some gravel. -31.6 Disintegrating gravel. -36.9 Grey silty clay. -41.0 Grey mottled silt & sandy silt. -48.25 Coarse sand. -51.6 Grey sand, some clay binder. -61.25 Greenish grey clay. -67.0 Greenish grey clay, sand content gradually increasing. -71.0 Grey slightly clayey sand. -90.0 Grey clayey sand, some large gravel, gravel larger than 4". -97.0
② 8.6 Fill- Gravel, cinders. 6.6 Fill- clay, clayey sand, coal, cinder and some gravel. -2.0 Stone & stone chips. -3.3 Brown sandy silt with organic matter. -9.0 Sand and gravel with some silt & organic matter. -20.0 Fine greyish brown sand. -24.6 Fine grey silty sand with organic matter and some gravel. -34.75 Sandy silt with reddish clayey sand and gravel. -38.8 Mottled brown and grey silty clay. -49.0 Coarse white sand, slight clay binder. -61.0 Silty clay & coarse sand. -63.33 Silty sandy clay. -71.0 Silty sandy clay, sand content gradually increasing. Greenish grey clayey sand. -85.0 -86.5 Gravel with sand clay binder.
③ 9.5 Fill- Cinders, brick, tile and clay. 4.0 Fill- Grey sand mixed with ashes, brick & tile with gradual change to grey sand and gravel. -11.9 Grey sand and gravel. -17.0 Yellow clayey sand & gravel. -22.0 Grey sandy silt with organic matter. -32.0 Grey sand with silt and small gravel. -34.9 Grey sand with silt organic matter and small gravel, also blue grey clay. -41.8 Dark grey silt. -44.5 Disintegrating gravel, clay and sand. -47.25 Fine Sand. -54.0 Sand and grey clay. -58.2 Blue grey clay. -66.5 Grey sand, some clay. -81.66 Heavy gravel, some clay and sand. -88.75
④ 11.6 Fill- brick, cinders, shells, in brown sandy clay. -14.4 Silt, some stones and roots. -19.8 Grey clayey sand. -24.5 Fine grey silty clayey sand. -29.66 Gravel, sand & clay. -34.5 Grey clay. -43.5 Gravel, some sand & clay, gravel partially disintegrated. -47.9 Fine brown sand. -58.25 Grey clay. -64.66 Fine grey sand. -80.0 Sand and gravel. -85.25
Scale 1" = 20'
Top of Rail
30'-0" f. to f. curbs Normal to curbs
Existing curb
Elev. +4.5
Base line - Elev. 0.00
See Note 'A' & Sect. A-A
SECTION G-G
Scale 1" = 20'
MAINE AVE.
℄ of North Bound Track
℄ of South Bound Track
℄ Detour Track
Slope 1 to 2
Elev. +4.5
Exist. footing to remain
Base line - Elev. 0.00
SECTION A-A
Scale 1" = 20'
Existing work & proposed street lines.
Temporary work.
Proposed work.
Note 'A':- For estimated excavation quantities: Excavation to be carried to Elev. +4.5 within limits shown on Plan.
D.C. D.P.W. Archives Drawing No.
TCS 1-1-1-2077
As Built
GENERAL NOTES
1 - Excavation shall be made to the lines shown on the plans or called for in the specifications.
2 - All concrete shall be of the class called for on the plans or in the specifications.
3 - All reinforcing steel bends for hooks shall be as sketched: L = 12 bar dia. D = 4 " ".
All elevations are to D.C. Datum.
514/2
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D.C.
GENERAL LAYOUT
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A. ENGINEER COMMISSIONER, D.C.

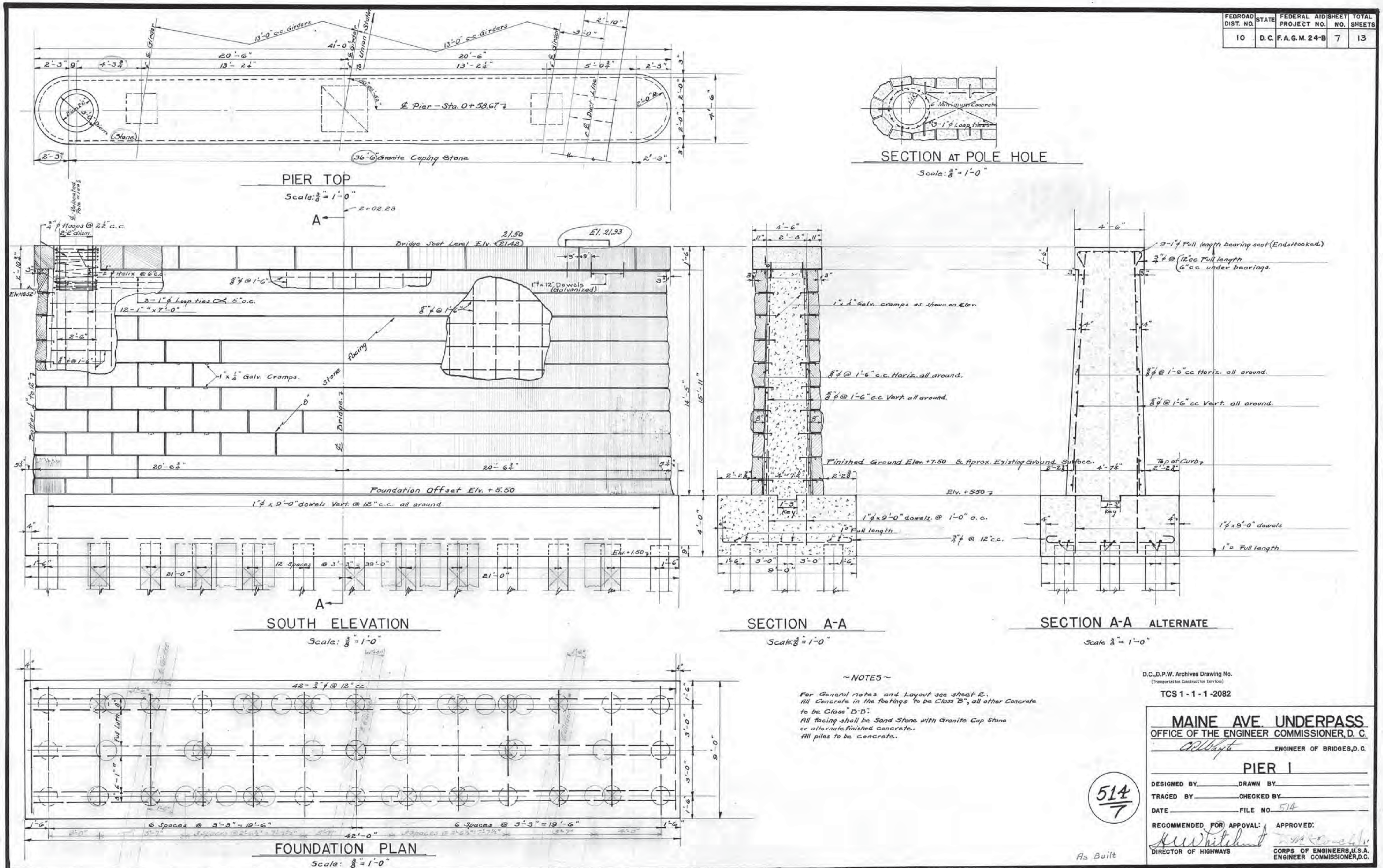

FED.ROAD DIST. NO. 10
STATE D.C.
FEDERAL AID PROJECT NO. F.A.G.M. 24-B
SHEET NO. 3
TOTAL SHEETS 13
SOUTH
NORTH
Span a
Span b
Span c
Span d
Span e
Span f
Span g
2-21" WF @ 59# under each rail
2-24" WF @ 150# under each rail
Existing Abutment
Existing tank foundation
SILL 1
BENT 1
BENT 2
BENT 3
BENT 4
BENT 5
BENT 6
Existing Roadway and Street Car Tracks
Minimum Vertical Clearance 12'-9"
ELEVATION OF DETOUR TRESTLE
Scale 1/8" = 1'-0"
PLAN-SILL 1
Scale 1/2" = 1'-0"
NOTE:- Dimensions shown for c. to c. of brgs. and c. to c. of bents are chord lengths along ℄ of detour track.
ELEVATION - BENT 1
Scale 1/4" = 1'-0"
ELEVATION OF BENTS 2,4,5 - SHOWN
" " " 3 - SIMILAR
Scale 1/4" = 1'-0"
CROSS SECTION OF DUCTS UNDER TRACKS
Scale 1 1/2" = 1'-0"
TYPICAL CROSS SECTION OF DUCTS FOR DETOUR TRACK
Scale 1 1/2" = 1'-0"
TYPICAL METHOD OF SUPPORT OF DUCTS FOR DETOUR TRACK
Scale 1/4" = 1'-0"
SECTION X-X
Scale 1/4" = 1'-0"
D.C.,D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1-1-1-2078
SECTION F-F
SECTION E-E
SECTION D-D
SECTION C-C
SECTION B-B
SECTION A-A
CROSS SECTIONS OF SOUTH APPROACH
Scale 1/32" = 1'-0"
Base line Elev. 10.00
GENERAL NOTES.
For General Notes & Plan Layout see Sheet 2.
All concrete footings shown shall be Class B Concrete.
SECTION AT STA. 121+70.5
SECTION AT STA. 121+22.0
SECTION AT STA. 120+73.5
CROSS SECTIONS OF NORTH APPROACH
Scale 1/8" = 1'-0"
For Plan View - See Sheet #2.
ELEVATION N-N (See Sht. #2.)
Scale 1/32" = 1'-0"
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D.C.
DETOUR LINE
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
514/3
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A. ENGINEER COMMISSIONER, D.C.
As Built


FED. ROAD DIST. NO. 10
STATE D.C.
FEDERAL AID PROJECT NO. F.A.G.M. 24-B
SHEET NO. 4
TOTAL SHEETS 13
To Potomac Yard
ROOF PLAN
PLAN BELOW ROOF
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
TYPICAL SECTION
PULLING IRON
4 Required
Scale 1½"=1'-0"
DETAILS OF MANHOLE CHAMBER
PLAN
DETAIL OF HOOPS
SECTION E-E
HALF ELEVATION-HALF SECTION
DETAILS OF CATENARY POLE FOUNDATIONS
FOR POLES #A158½ & #A160½
Remove and store existing poles.
Remove pier columns within these limits, except for vertical rods "S".
Poles and pier columns to be restored later.
Reinf. not shown
MATERIALS FOR MANHOLE CHAMBER
1 Circular manhole frame and cover, 30" clear opening, with letter "E" on the cover, Type "C", item #5 in Flockhart Foundry Co's. Catalog #105, data sheet 173; or equal.
1 Manhole frame and cover, same as above except to have the letter "T" on the cover.
24 Havemeyer inserts for ¾"φ bolts, Dayton Adj't #3.
8-¾"φ bolts x 2¼", Sq. Hds., Hex. Nuts, galv.
4 Cable racks, Graybar Catalog #2225
8 Cable hooks, " " #2232
8 Porcelains, " " #2121
Notes:
1- For General Notes & Layout, See Sht. 2.
2- All concrete on this sheet, Class "BB"
D.C., D.P.W. Archives Drawing No.
TCS 1-1-1-2079
514
4
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMSSIONER, D.C.
ENGINEER OF BRIDGES, D.C.
ELECTRICAL DETAILS
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A.
ENGINEER COMMISSIONER, D.C.
As Built

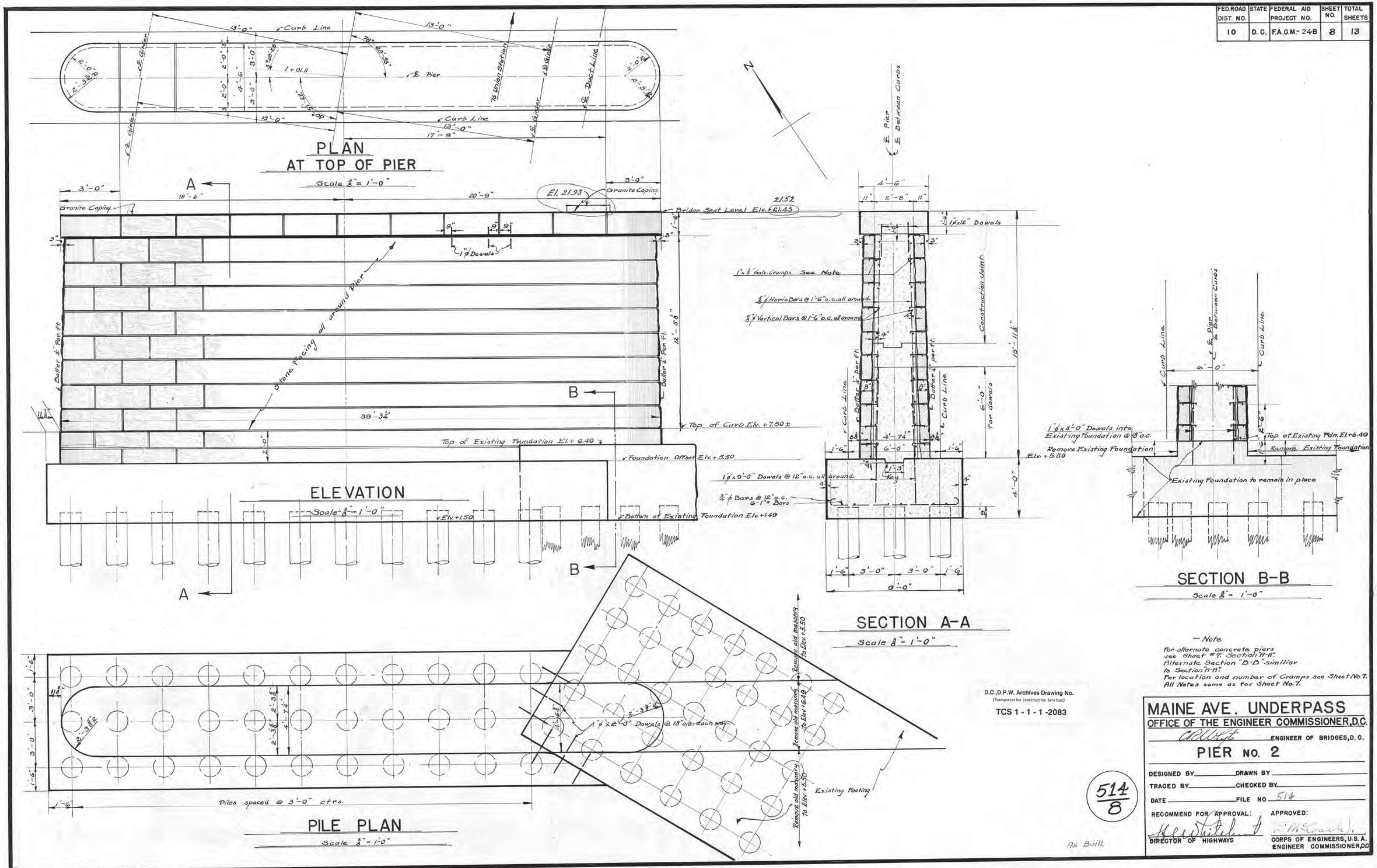

FED. ROAD DIST. NO. 10
STATE D.C.
FEDERAL AID PROJECT NO FAGM. 24-B
SHEET NO 5
TOTAL SHEETS 13
North
Detour Track
South Bound Main Track
North Bound Main Track
Yard Tracks
Existing Abutment
Existing South Curb Line
Span "h"
Span "i"
Span "j"
Span "k"
Span "l"
Pier 2
Pier 3
New Pier 1
New South Abutment
Existing P.O.P. A 159½
Relocation of P.O.P. A 159½
Top of Pier - Level Elev. 21.65
Sta. 123+65.5 A 160 (Existing)
For Details of Spans "k" & "l" - See Sheet #6
PLAN OF CONSTRUCTION FOR MAINTENANCE OF TRAFFIC
Scale 3/32" = 1'-0"
SECTION C-C
3" Vertical Sheeting
100# Rail driven vertically, 3" Horizontal Sheeting
2-27" WF @ 114#
Drift bolts ¾" ɸ x 20"
℄ of South Bound Main Track To be used as North Bound Track during construction of new South Abutment and Piers.
℄ of North Bound Main Track Temporarily "Out of Service" during construction of South Abutment, Piers, and erection of superstructure for the permanent North Bound Track.
PLAN OF TEMPORARY SUPPORT OF SOUTH BOUND TRACK AT SOUTH ABUTMENT
Scale 1/8" = 1'-0"
SECTIONS A-A & A'-A'
Scale 3/8" = 1'-0"
SECTION B-B
Scale 1/2" = 1'-0"
Near piles
Far piles
Existing Abutment
Span "j"
SECTION D-D
Scale 1/2" = 1'-0"
Class BB Conc.
Existing pier found.
New reinforced concrete beam
FOUNDATION PLAN SHOWING METHOD OF SUPPORT FOR TIMBER BENT
Scale 1/4" = 1'-0"
Concrete pad 4'-6" x 22'-0" x 1'-3"
ELEVATION OF BENT
Scale 1/2" = 1'-0"
Brg. Pl. 12" x 1" x 2'-8"
2-21" WF @ 59#
Span "i"
PLAN OF TEMPORARY SUPPORT OF SOUTH BOUND TRACK AT SOUTH PIER
Scale 3/16" = 1'-0"
Position of strut before blocking against stem is placed
Position of strut before blocking against foundation is placed
SECTION G-G
Scale 1/2" = 1'-0"
SECTION H-H
Scale 1/2" = 1'-0"
Notes:
1- For general notes & layout, see Sht. 2
2- For details of piers, see shts. 7, 8, & 9 and for Abutment, sht. 10.
3- For Yard Track details, see sht. 6.
4- All concrete Class 'B' except as shown.
D.C., D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1-1-1-2080
514
5
As Built
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D.C.
CONSTRUCTION DETAILS
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
RECOMMENDED FOR APPROVAL:
APPROVAL:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A.
ENGINEER COMMISSIONER, D.C.

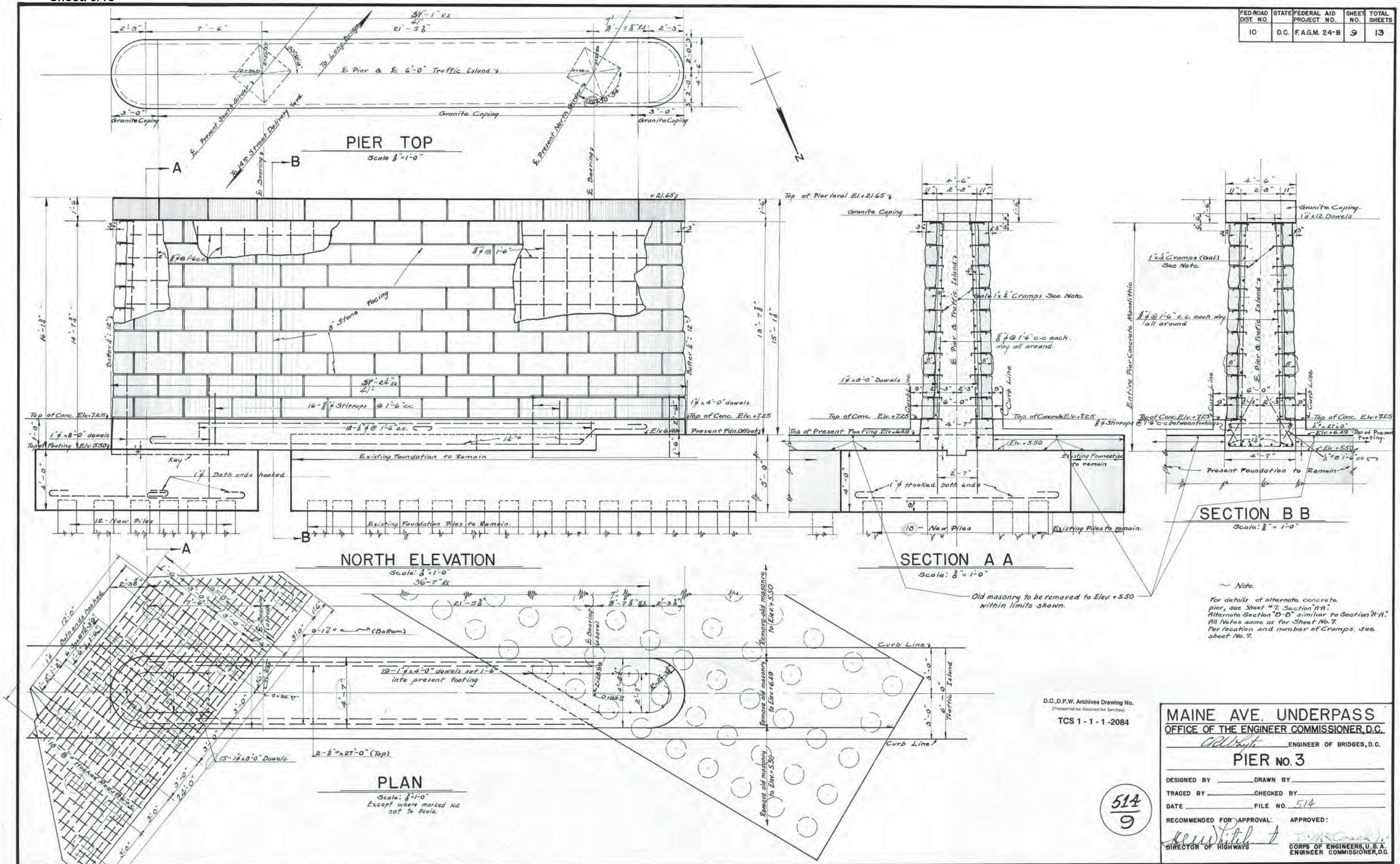

FED.ROAD DIST. NO. 10
STATE D.C.
FEDERAL AID PROJECT NO F.A.G.M. 24-B
SHEET NO 6
TOTAL SHEETS 13
N
SECTION K-K
Scale 3/16" = 1'-0"
PLAN OF TEMPORARY SUPPORT OF YARD TRACK - SOUTH ABUTMENT
Scale 3/16" = 1'-0"
Note:- Section F-F is similar to Section G-G as shown on Sheet 4
CONDUIT CONNECTION
From south end of bridge to manhole as built, as compared with contract drawing # 4, Section A-A.
NOTE: See progress photograph No 24.
PLAN
SECTION J-J
Scale 3/8" = 1'-0"
SECTION L-L
Scale 1/2" = 1'-0"
SECTION M-M
Scale 1/4" = 1'-0"
Existing track to be raised ±1'-0" to obtain about 1" clearance between beams which is required until Girder "H" is installed.
Temporary sill 10"x16" for temporary support of free end of floorbeams for span adjacent to span over abutment opening.
Install Girder "H" and remaining floorbeams. Use one 16" I beam stringer under each rail to support track while pouring concrete floor.
Support track on 12"x12" stringers and fill pockets in slab with concrete, after which protection W.P. is placed.
~ NOTES ~
For General Notes and Layout see Sheet No. 2 & 5.
DETAILS SHOWING STEPS IN ERECTION OF YARD TRACK PLATE GIRDER SPAN
D.C.,D.P.W. Archives Drawing No.
TCS 1-1-1-2081
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D. C.
CONSTR'N DETAILS-SPUR TRACK
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A. ENGINEER COMMISSIONER, D.C.
514/6
As Built

APPENDIX 6
SCHNABEL ENGINEERING, LLC
Sheet: 7/15

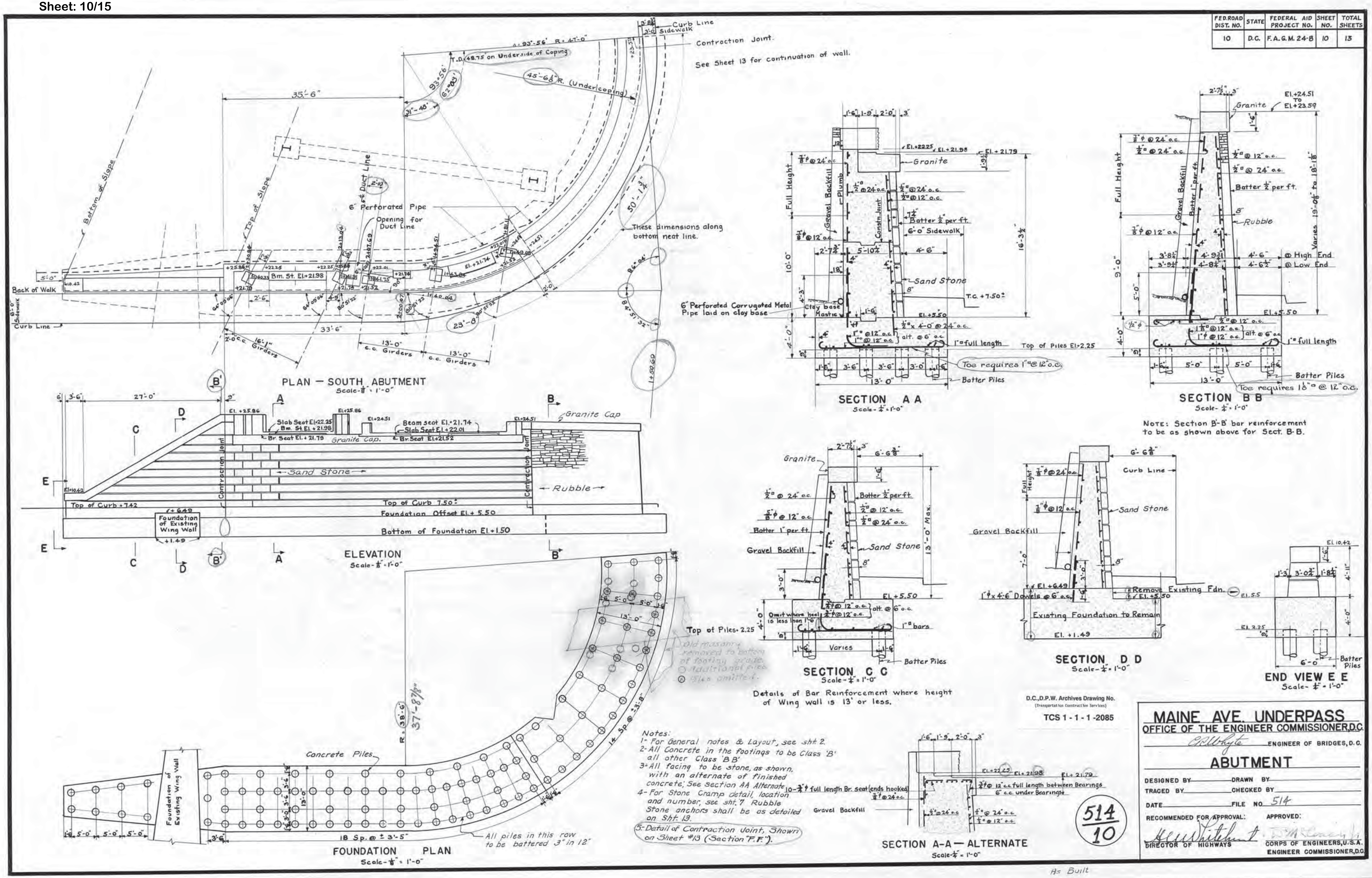


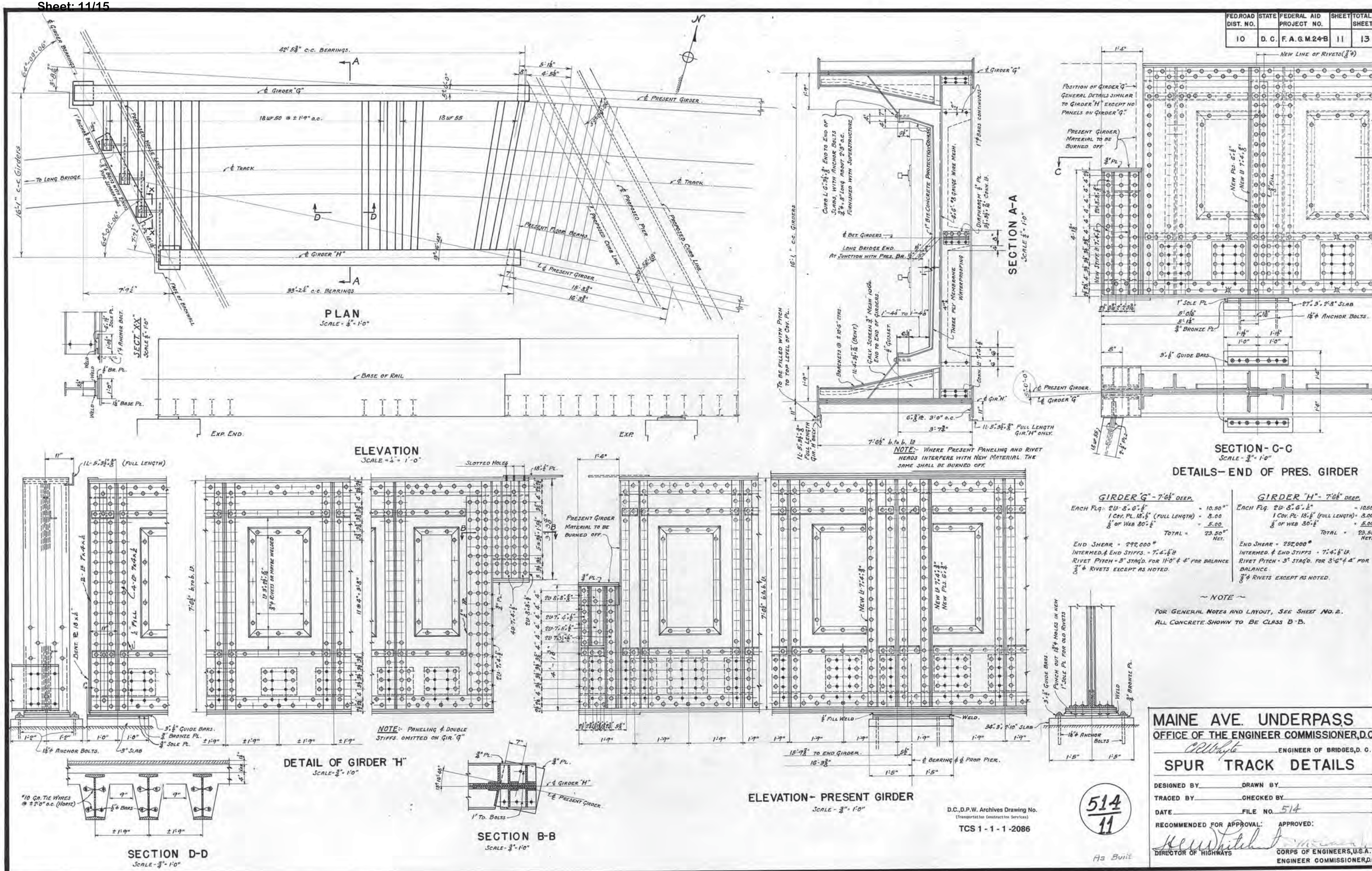
APPENDIX 6
SCHNABEL ENGINEERING, LLC
Sheet: 8/15




FED. ROAD DIST. NO. 10
STATE D.C.
FEDERAL AID PROJECT NO. F.A.G.M. 24-B
SHEET NO. 9
TOTAL SHEETS 13
PIER TOP
Scale 1/8"=1'-0"
℄ Pier & ℄ 6'-0" Traffic Island
Granite Coping
To Long Bridge
To 14th Street Delivery Yard
℄ Present South Girder
℄ Present North Girder
NORTH ELEVATION
Scale: 1/8"=1'-0"
8" Stone Facing
Existing Foundation to Remain
Existing Foundation Piles to Remain
12 - New Piles
Top of Conc. Elv. +7.25
Top of Footing Elv. 5.50
Present Fdn. Offset
Top of Pier level El. +21.65
SECTION A A
Scale: 3/8" = 1'-0"
Gal. 1"x1/4" Cramps See Note
Top of Present Footing Elv. +6.49
10 - New Piles
Existing Piles to remain
SECTION B B
Scale: 3/8" = 1'-0"
Granite Coping
1"x4" Cramps (Gal.) See Note
Entire Pier Concrete Monolithic
Present Foundation to Remain
Old masonry to be removed to Elev. +5.50 within limits shown.
Note
For details of alternate concrete pier, see Sheet #7, Section "A-A".
Alternate Section "B-B" similar to Section "A-A".
All Notes same as for Sheet No. 7.
For location and number of Cramps, see sheet No. 7.
PLAN
Scale: 1/8"=1'-0"
Except where marked N.S. not to Scale.
Curb Line
Traffic Island
Remove old masonry to Elev. +5.50
Remove old masonry to Elev. +6.49
19-1"φx4'-0" dowels set 1'-6" into present footing
15-1"φx8'-0" Dowels
D.C., D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1-1-1-2084
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D.C.
PIER NO. 3
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A. ENGINEER COMMISSIONER, D.C.
514
9

As Built


FED. ROAD DIST. NO. 10
STATE D.C.
FEDERAL AID PROJECT NO. F.A.G.M. 24-B
SHEET NO. 10
TOTAL SHEETS 13
Curb Line
Sidewalk
Contraction Joint.
See Sheet 13 for continuation of wall.
These dimensions along bottom neat line.
6" Perforated Pipe
Opening for Duct Line
Bottom of Slope
Top of Slope
Back of Walk
Curb Line
6" Perforated Corrugated Metal Pipe laid on clay base
PLAN — SOUTH ABUTMENT
Scale-1/8" = 1'-0"
Slab Seat El.+22.25
Bm. St. El.+21.98
Br. Seat El.+21.78
Granite Cap.
Beam Seat El.+21.74
Slab Seat El.+22.01
Br. Seat El.+21.52
Granite Cap
Sand Stone
Rubble
Contraction Joint
Top of Curb +7.42
Top of Curb 7.50±
Foundation Offset El.+5.50
Foundation of Existing Wing Wall
Bottom of Foundation El.+1.50
ELEVATION
Scale-1/8" = 1'-0"
SECTION A A
Scale-1/2" = 1'-0"
Toe requires 1"⌀@12" o.c.
Batter Piles
Top of Piles El.+2.25
SECTION B B
Scale-1/2" = 1'-0"
Toe requires 1 1/8"⌀ @ 12" o.c.
NOTE: Section B'-B' bar reinforcement to be as shown above for Sect. B-B.
SECTION C C
Scale-1/2" = 1'-0"
Details of Bar Reinforcement where height of Wing wall is 13' or less.
SECTION D D
Scale-1/2" = 1'-0"
Existing Foundation to Remain
Remove Existing Fdn.
END VIEW E E
Scale-1/2" = 1'-0"
Top of Piles 2.25
Old masonry removed to bottom of footing grade. Additional piles. Piles omitted.
Concrete Piles
All piles in this row to be battered 3" in 12"
FOUNDATION PLAN
Scale-1/8" = 1'-0"
Notes:
1- For General notes & Layout, see sht 2.
2- All Concrete in the footings to be Class 'B' all other Class 'BB'
3- All facing to be stone, as shown, with an alternate of finished concrete; See Section AA Alternate.
4- For Stone Cramp detail, location and number, see sht. 7. Rubble Stone anchors shall be as detailed on Sht. 13.
5- Detail of Contraction Joint, Shown on Sheet #13 (Section "F-F").
SECTION A-A — ALTERNATE
Scale-1/2" = 1'-0"
D.C., D.P.W. Archives Drawing No.
TCS 1-1-1-2085
514/10
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D.C.
ABUTMENT
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A.
ENGINEER COMMISSIONER, D.C.
As Built


FED.ROAD DIST. NO. 10
STATE D. C.
FEDERAL AID PROJECT NO. F. A. G. M. 24-B
SHEET 11
TOTAL SHEETS 13
PLAN
SCALE - 1/8" = 1'-0"
ELEVATION
SCALE - 1/8" = 1'-0"
SECTION A-A
SCALE - 3/4" = 1'-0"
SECTION - C-C
SCALE - 3/4" = 1'-0"
DETAILS - END OF PRES. GIRDER
DETAIL OF GIRDER "H"
SCALE - 3/4" = 1'-0"
SECTION D-D
SCALE - 3/4" = 1'-0"
SECTION B-B
SCALE - 3/4" = 1'-0"
ELEVATION - PRESENT GIRDER
SCALE - 3/4" = 1'-0"
SECT. "XX"
SCALE 3/4" = 1'-0"
NOTE:- WHERE PRESENT PANELING AND RIVET HEADS INTERFERE WITH NEW MATERIAL, THE SAME SHALL BE BURNED OFF.
NOTE:- PANELING & DOUBLE STIFFS. OMITTED ON GIR. "G"
GIRDER "G" - 7'-6 1/2" DEEP.
GIRDER "H" - 7'-6 1/2" DEEP.
~ NOTE ~
FOR GENERAL NOTES AND LAYOUT, SEE SHEET NO. 2.
ALL CONCRETE SHOWN TO BE CLASS B-B.
D.C.,D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1 - 1 - 1 -2086
514
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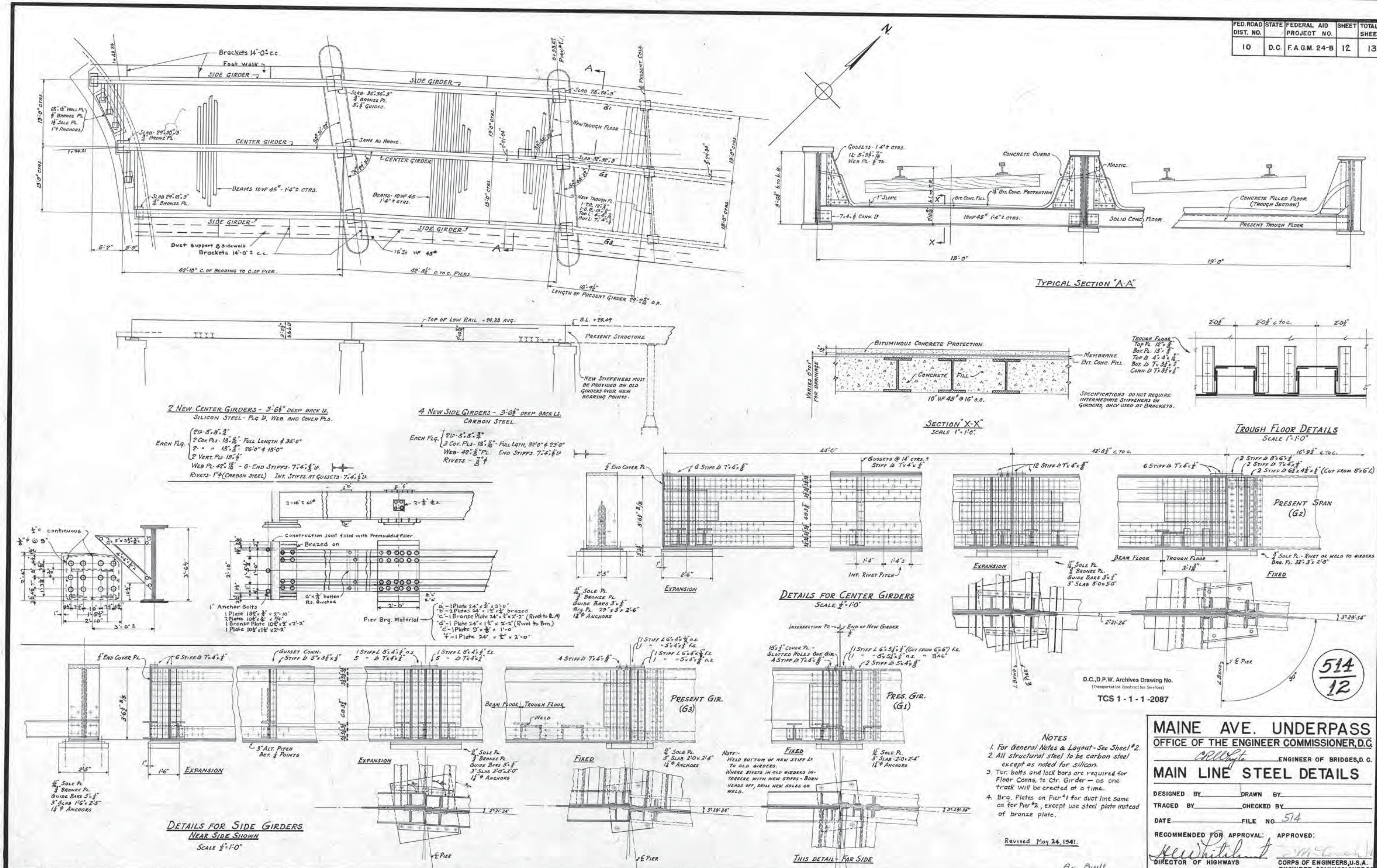
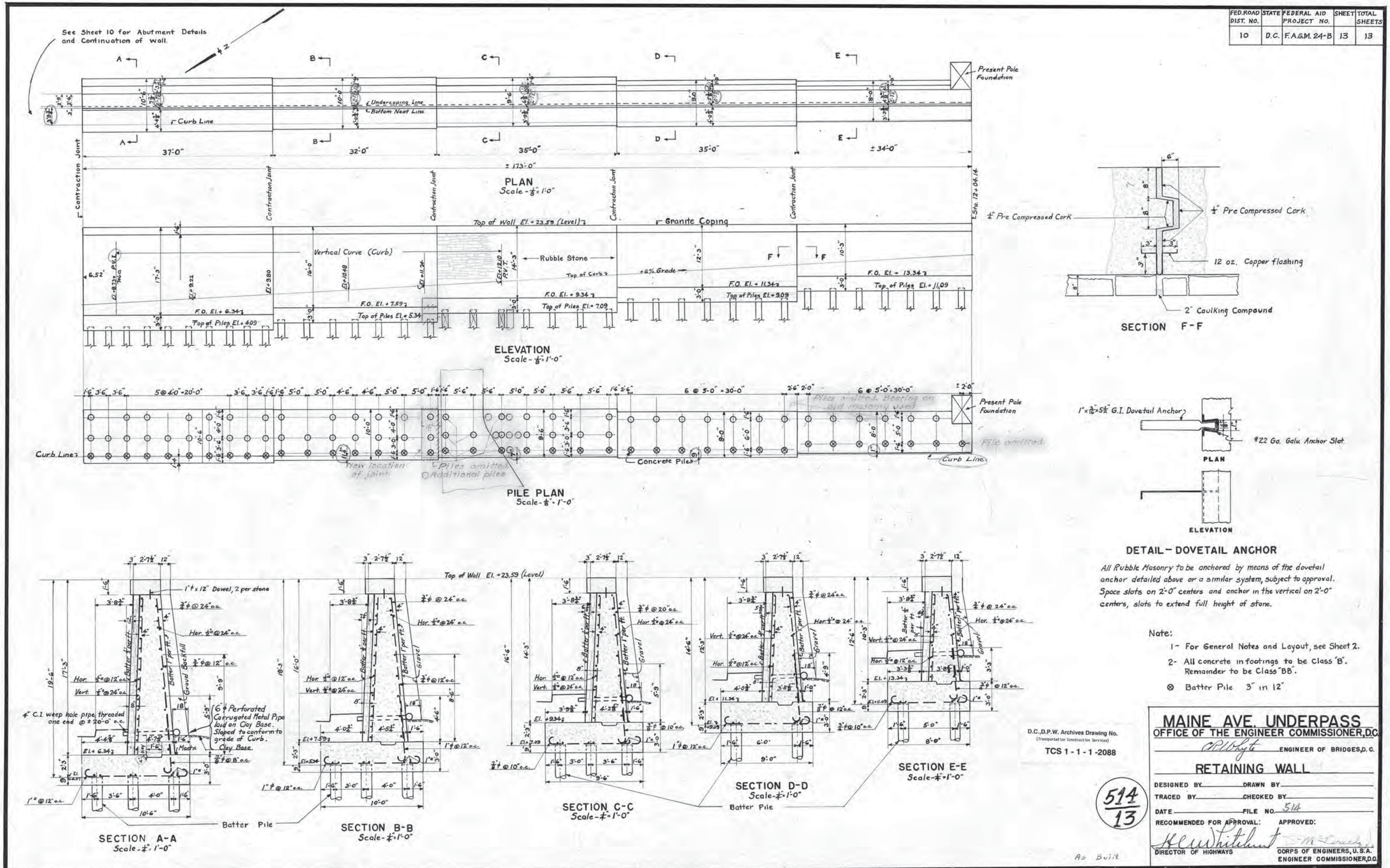
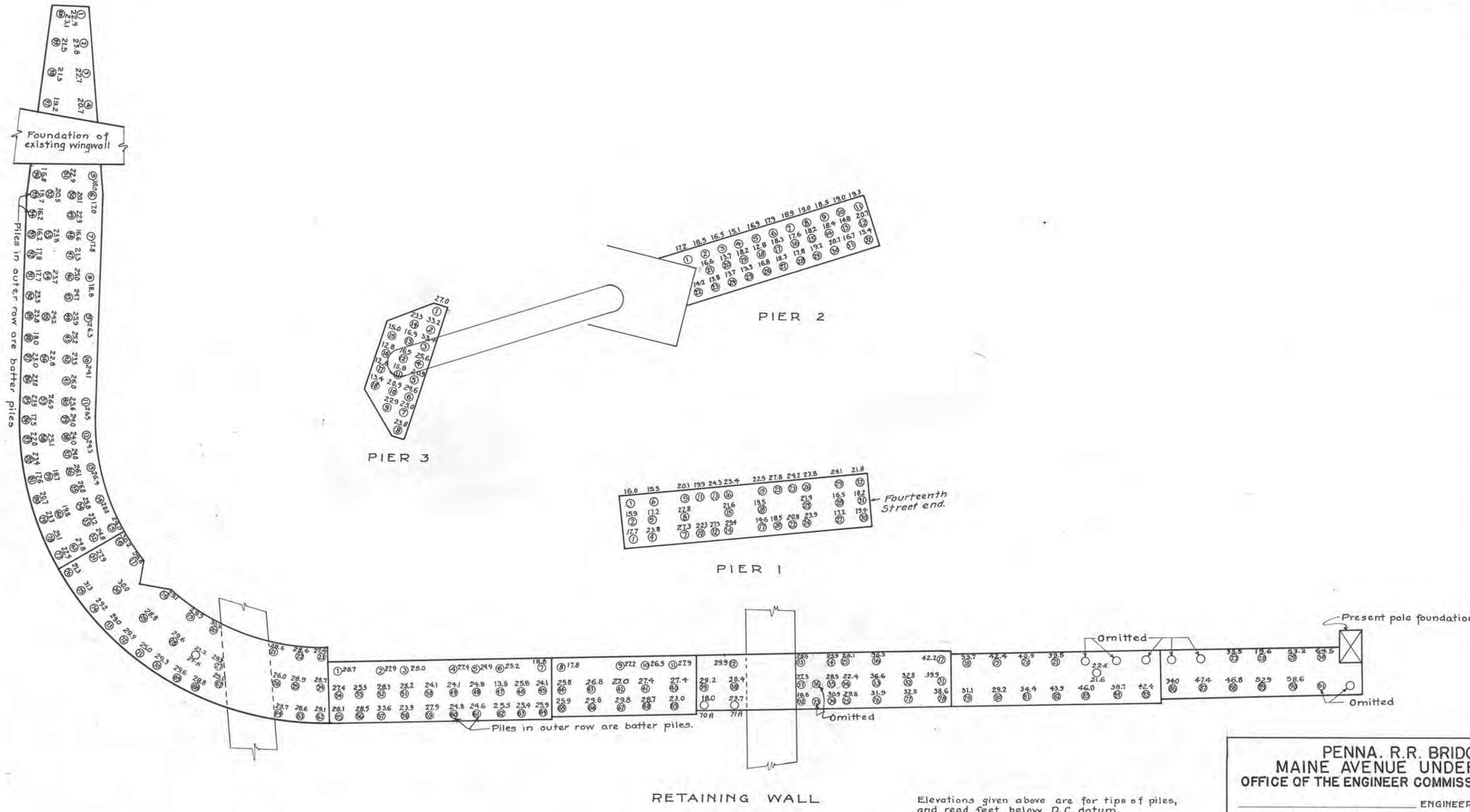
As Built
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D. C.
SPUR TRACK DETAILS
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO. 514
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A.
ENGINEER COMMISSIONER, D.C.


FED. ROAD DIST. NO. 10
STATE D.C.
FEDERAL AID PROJECT NO. F.A.G.M. 24-B
SHEET 12
TOTAL SHEETS 13
N
Brackets 14'-0" c.c.
Foot Walk
SIDE GIRDER
CENTER GIRDER
Beams 10WF 45# - 1'-4" ctrs.
NEW TROUGH FLOOR
Duct Support & Sidewalk Brackets 14'-0" c.c.
42'-10" c. of bearing to c. of pier.
LENGTH OF PRESENT GIRDER
PRESENT STRUCTURE
Top of Low Rail
NEW STIFFENERS MUST BE PROVIDED ON OLD GIRDERS OVER NEW BEARING POINTS.
CONCRETE CURBS
MASTIC
CONCRETE FILLED FLOOR (TROUGH SECTION)
PRESENT TROUGH FLOOR
SOLID CONC. FLOOR
13'-0"
TYPICAL SECTION "A-A"
BITUMINOUS CONCRETE PROTECTION
MEMBRANE
BIT. CONC. FILL
CONCRETE FILL
10" WF 45# @ 16" o.c.
SECTION "X-X"
SCALE 1"=1'-0"
SPECIFICATIONS DO NOT REQUIRE INTERMEDIATE STIFFENERS ON GIRDERS, ONLY USED AT BRACKETS.
TROUGH FLOOR DETAILS
SCALE 1"=1'-0"
2 NEW CENTER GIRDERS - 3'-6½" DEEP BACK Ls.
SILICON STEEL - FLG. Ls. WEB AND COVER PLS.
4 NEW SIDE GIRDERS - 3'-6½" DEEP BACK Ls.
CARBON STEEL.
PRESENT SPAN (G2)
EXPANSION
FIXED
DETAILS FOR CENTER GIRDERS
SCALE ½"=1'-0"
Construction Joint filled with Premoulded Filler
Brazed on
Pier Brg. Material
1" Anchor Bolts
PRESENT GIR. (G3)
PRES. GIR. (G1)
BEAM FLOOR
TROUGH FLOOR
DETAILS FOR SIDE GIRDERS
NEAR SIDE SHOWN
SCALE ½"=1'-0"
THIS DETAIL - FAR SIDE
D.C.,D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1 - 1 - 1 -2087
514
12
NOTES
1. For General Notes & Layout - See Sheet #2.
2. All structural steel to be carbon steel except as noted for silicon.
3. Tur. bolts and lock bars are required for Floor Conns. to Ctr. Girder - as one track will be erected at a time.
4. Brg. Plates on Pier #1 for duct line same as for Pier #2, except use steel plate instead of bronze plate.
Revised May 24, 1941.
As Built
MAINE AVE. UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.
ENGINEER OF BRIDGES, D.C.
MAIN LINE STEEL DETAILS
DESIGNED BY
DRAWN BY
TRACED BY
CHECKED BY
DATE
FILE NO 514
RECOMMENDED FOR APPROVAL:
APPROVED:
DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A.
ENGINEER COMMISSIONER, D.C.

APPENDIX 6
SCHNABEL ENGINEERING, LLC
Sheet: 13/15





D.C.,D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1 - 1 - 1 -2089

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PENNA. R.R. BRIDGE,
MAINE AVENUE UNDERPASS
OFFICE OF THE ENGINEER COMMISSIONER, D.C.

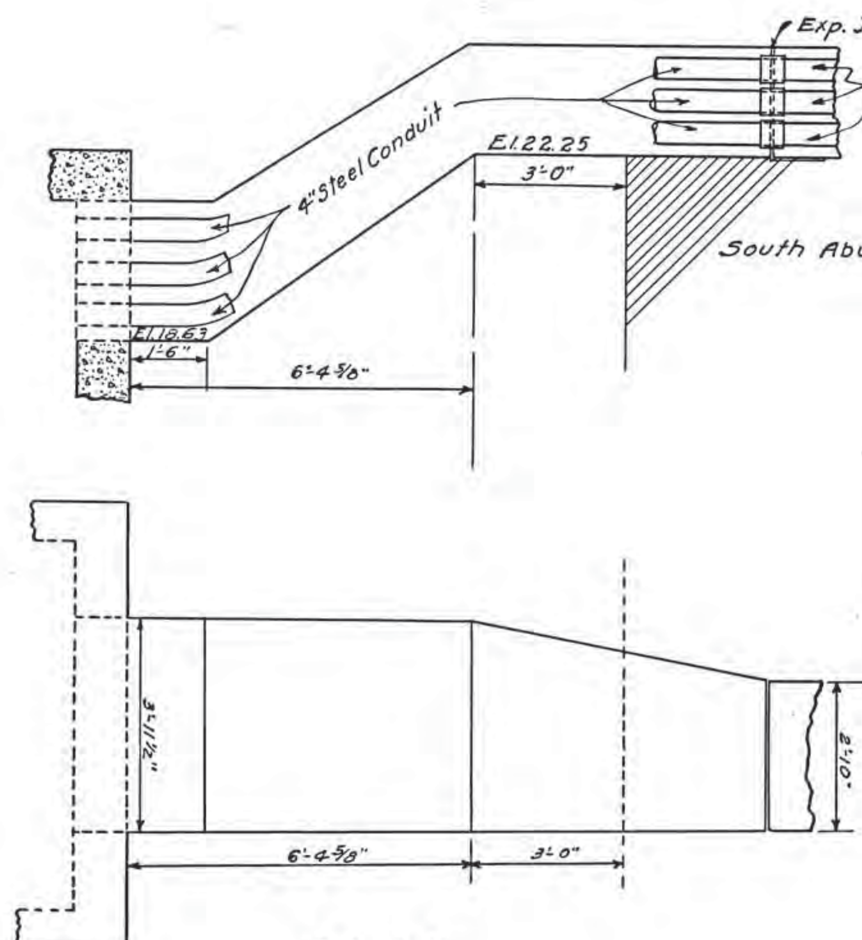
ENGINEER OF BRIDGES, D.C.

AS BUILT PILE SHEET

DESIGNED BY ______ DRAWN BY L.S.G.
TRACED BY L.S.G. CHECKED BY ______
DATE 5-13-43 FILE NO. ______
RECOMMENDED FOR APPROVAL: APPROVED:

DIRECTOR OF HIGHWAYS
CORPS OF ENGINEERS, U.S.A. ENGINEER COMMISSIONER, D.C.

Note:
See progress photograph #24



PLAN

D.C.,D.P.W. Archives Drawing No.
(Transportation Construction Services)
TCS 1-1-1-2090

MAINE AVENUE UNDERPASS

Traced from paper tracing.
L.S.G.

Conduit connection from South end of bridge to manhole as built as compared with contract drawing #4, Section A-A.

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APPENDIX 7

Selected sheets from the Construction Plans for Maryland Avenue Over Conrail, dated July 1989, prepared by Dewberry and Davis for The Portals Development Associates

56 Sheets

Scale: 1" - 800'

Dewberry & Davis

Vicinity Map

Construction Plans For:

Maryland Avenue Over Conrail

Developed By

Portals Development Associates

3000 K Street, N.W. Washington, D.C. 20007

THE PORTALS

1250 Maryland Avenue *Washington, D.C. 20024*

INDEX OF SHEETS

SHEET No.	DESCRIPTION
B1	TITLE SHEET
B2	INDEX OF SHEETS AND GENERAL NOTES
B3	GENERAL PLAN AND SECTION
B4	LANDSCAPING PLAN - PHASE I
B5	LANDSCAPING PLAN - PHASE II
B6	SECTION 2
B7	SECTION 3
B8	SECTION 4
B9	SECTION 5
B10	SECTION 6
B11	SECTIONS - 1
B12	SECTIONS - 2
B13	SECTIONS - 3
B14	MARYLAND AVENUE PROFILE
B15	NORTHTRACK B PROFILE
B16	SOUTHTRACK A PROFILE
B17	SUBSTRUCTURE LAYOUT AND SLOPE PROTECTION
B18	SUBSTRUCTURE LAYOUT - 1
B19	SUBSTRUCTURE LAYOUT - 2
B20	SUBSTRUCTURE LAYOUT - 3
B21	JOINT AND FRAMING PLAN LAYOUT
B22	FRAMING PLAN 1
B23	FRAMING PLAN 2
B24	FRAMING PLAN 3
B25	FRAMING PLAN 1, 2, AND 3, DECK TRANSVERSE SECTION
B26	PARAPET DETAILS
B26a	FENCE DETAILS
B27	FRAMING PLAN 1, 2, AND 3, SLAB ELEVATIONS
B28	TYPE SIII-48A & SIII-48B BEAM DETAILS
(3) B28a	TYPE SIII-48C BEAM DETAILS
B29	TYPE SIV-48 BEAM DETAILS
B30	FRAMING PLAN 4
B31	FRAMING PLAN 4, GIRDER ELEVATIONS - 1
B32	FRAMING PLAN 4, GIRDER ELEVATIONS - 2
B33	FRAMING PLAN 4, CAMBER
B34	FRAMING PLAN 4 AND 5, BEARING DETAILS
B35	SLAB PLAN 4
B36	SLAB PLAN 4, SLAB ELEVATIONS AND DEAD LOAD DEFLECTIONS
B37	FRAMING PLAN 5
B38	FRAMING PLAN 5, GIRDER ELEVATIONS AND DETAILS - 1
(4) B38a	FRAMING PLAN 5, GIRDER ELEVATIONS AND DETAILS - 2
B39	FRAMING PLAN 5, CROSS FRAME DETAILS
B40	FRAMING PLAN 5, CAMBER AND SLAB ELEVATIONS
B41	SLAB PLAN 5
B42	SLAB PLAN 5, SECTIONS AND TREE BOX DETAILS
B42a	SLAB PLAN 6
B43	COMPRESSION SEALER DETAILS - 1
B43a	COMPRESSION SEALER DETAILS - 2
B44	PIER 1 - BAY 1, PLAN, ELEVATION, AND FOOTING PLAN
B45	PIER 1 - BAY 2, PLAN, ELEVATION, AND FOOTING PLAN
B46	PIER 1 - BAY 3, PLAN, ELEVATION, AND FOOTING PLAN
B47	PIER 1 - BAY 4, PLAN, ELEVATION, AND FOOTING PLAN
B48	PIER 1 - BAY 5-6, PLAN, ELEVATION, AND FOOTING PLAN
(3) B48a	PIER I - BAY 7-8 PLAN, ELEVATION, AND FOOTING PLAN
B49	PIER 1 - BAY 9, PLAN, ELEVATION, AND FOOTING PLAN
B50	PIER 1 - BAY 10, PLAN AND FOOTING PLAN
B51	PIER 1 - BAY 10, ELEVATION
B52	PIER 2 - BAY 1, PLAN, ELEVATION, AND FOOTING PLAN
B53	PIER 2 - BAY 2, PLAN, ELEVATION, AND FOOTING PLAN
B54	PIER 2 - BAY 3, PLAN, ELEVATION, AND FOOTING PLAN
B55	PIER 2 - BAY 4, PLAN, ELEVATION, AND FOOTING PLAN
B56	PIER 2 - BAY 5-8, PLAN, ELEVATION, AND FOOTING PLAN
B57	PIER 2 - BAY 9, PLAN, ELEVATION, AND FOOTING PLAN
B58	PIER 2 - BAY 10, PLAN, ELEVATION, AND FOOTING PLAN
B59	PIER 3 - BAY 1, PLAN, ELEVATION, AND FOOTING PLAN
B60	PIER 3 - BAY 2, PLAN, ELEVATION, AND FOOTING PLAN
B61	PIER 3 - BAY 3, PLAN, ELEVATION, AND FOOTING PLAN
B62	PIER 3 - BAY 4, PLAN, ELEVATION, AND FOOTING PLAN
B63	PIER 3 - BAY 5-8, PLAN, ELEVATION, AND FOOTING PLAN
B64	PIER 3 - BAY 9, PLAN, ELEVATION, AND FOOTING PLAN
B65	PIER 3 - BAY 10, PLAN, ELEVATION, AND FOOTING PLAN
B65a	PIER 4 - BAY 1, PLAN, ELEVATION, AND FOOTING PLAN
(4) B65b	PIER 4 - BAY 2, PLAN, ELEVATION, AND FOOTING PLAN
B66	PIER 4 - BAY 3, PLAN, ELEVATION, AND FOOTING PLAN
B67	PIER 4 - BAY 4, PLAN, ELEVATION, AND FOOTING PLAN
B68	PIER 5 - BAY 3, PLAN AND FOOTING PLAN
B69	PIER 5 - BAY 3, ELEVATION
B70	PIER 5 - BAY 4, PLAN AND FOOTING PLAN
B71	PIER 5 - BAY 4, ELEVATION
B72	PIER SECTIONS - 1
B73	PIER SECTIONS - 2
B74	PIER SECTIONS - 3
(6) B74a	JUNCTION BOX / INLET AND FOOTING DETAILS
B75	ABUTMENT 1, PLAN & ELEVATION
B76	ABUTMENT 2, PLAN & ELEVATION
B77	ABUTMENT 3, PLAN & ELEVATION
B78	ABUTMENT 4, PLAN & ELEVATION
B79	ABUTMENT 5, PLAN & ELEVATION
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B81	APPROACH SLAB B
B82	DRAINAGE LAYOUT
B82a	STORM SEWER PROFILES
B82b	STORM SEWER PROFILES
B82c	DRAINAGE SCHEMATICS
B83	DRAINAGE SCUPPER DETAILS
(8) B83a	DRY STANDPIPE PLAN, SECTION, AND RISER DIAGRAM
B84	MARYLAND AVE. SITE LIGHTING PLAN AND DETAILS
B84a	PLAZA SITE LIGHTING PLAN
B84b	LIGHTING DETAILS AND SPECIFICATIONS
B85	TEMPORARY CONCRETE BARRIER
B86	VENTILATION PLAN - PART 1
B87	VENTILATION PLAN - PART 2
B88	VENTILATION PLAN - PART 3
B89	LIGHTING PLAN - PART 1
B90	LIGHTING PLAN - PART 2
B91	LIGHTING PLAN - PART 3
B91a	LIGHTING DETAILS AND SPECIFICATIONS
(3) B91b	GROUNDING AND CONDUIT LOCATION DETAILS
B92	SIGNAL RELAY BUILDING RETAINING WALL
B93	RETAINING WALL SECTION AND DETAILS
B93a	REINFORCED EARTH WALL - 1
B93b	REINFORCED EARTH WALL - 2
B93c	REINFORCED EARTH WALL - 3
B94	12TH STREET MODIFICATIONS
(7) B94a	12TH STREET SIGNALIZATION DETAILS
B95	BORING LOGS
B96	LANDSCAPE FEATURES - LAYOUT PLAN
B96a	LANDSCAPE FEATURES - GRADING PLAN
B96b	LANDSCAPE FEATURES - PLAN DETAILS
B97	LANDSCAPE FEATURES - LAYOUT PLAN
B97a	LANDSCAPE FEATURES - GRADING PLAN
B98	LANDSCAPE FEATURES - DETAILS
B98a	LANDSCAPE FEATURES - DETAILS
B99	LANDSCAPE FEATURES - DETAILS
B99a	LANDSCAPE FEATURES - DETAILS
B99b	LANDSCAPE FEATURES - DETAILS
B100	PLANTING PLAN
B101	PLANTING PLAN
B101a	PLANTING DETAILS
B101b	IRRIGATION PLAN
B101c	IRRIGATION PLAN
B101d	TYPICAL IRRIGATION DETAILS
B102	RAILROAD CROSS SECTIONS - 1
B103	RAILROAD CROSS SECTIONS - 2
B104	RAILROAD CROSS SECTIONS - 3
B105	RAILROAD CROSS SECTIONS - 4
(5) B101e	CONRAIL DUCTBANK RELOCATION PLAN
B101f	CONRAIL DUCTBANK PROFILE

GENERAL NOTES

GENERAL

SPECIFICATIONS

AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 1983, AND SUBSEQUENT INTERIM SPECIFICATIONS; AND AASHTO/AWS BRIDGE WELDING CODE D1.5-88.

ALL CONSTRUCTION MATERIALS AND PROCEDURES SHALL BE GOVERNED BY THE "STANDARD SPECIFICATIONS FOR HIGHWAYS AND STRUCTURES", DATED 1974, SUPPLEMENTAL SPECIFICATIONS JUNE 1, 1981, ISSUED BY THE DISTRICT OF COLUMBIA DEPARTMENT OF PUBLIC WORKS, EXCEPT AS AMENDED OR SUPPLEMENTED BY THE SPECIAL PROVISIONS.

COORDINATES

COMPUTED IN THE STATE PLANE COORDINATE SYSTEM OF THE STATE OF MARYLAND.

ELEVATIONS

ALL ELEVATIONS REFER TO D.C. DATUM.

DESIGN LOAD

THE ROADWAY SURFACES AND PLAZA AREA ARE DESIGNED FOR HS20-44 LIVE LOADING AS SPECIFIED IN THE 1983 AASHTO SPECIFICATIONS, INCLUDING INTERIM SPECIFICATIONS.

THE MARYLAND AVENUE MEDIAN IS DESIGNED FOR H10-44 LIVE LOADING OR ALTERNATE LOADING OF 100 PSF LIVE LOAD, WHICHEVER PRODUCES THE GREATER STRESS.

VERIFICATION OF EXISTING DIMENSIONS AND ELEVATIONS

PRIOR TO CONSTRUCTION AND PREPARATION OF SHOP DRAWINGS, THE CONTRACTOR SHALL CHECK THE DIMENSIONS AND ELEVATIONS OF THE EXISTING STRUCTURE. IF THESE DIMENSIONS AND ELEVATIONS DO NOT AGREE WITH THOSE SHOWN ON THE INFORMATIONAL DRAWINGS, THE CONTRACTOR SHALL MAKE THE NECESSARY ADJUSTMENTS TO DIMENSIONS AND PROFILE GRADES SHOWN ON THE CONTRACT PLANS TO INSURE THAT THE NEW CONSTRUCTION WILL PROPERLY FIT ONTO THE EXISTING STRUCTURE.

SECTIONS

(A/2-5) SECTION "A" TAKEN ON SHEET NO. 2 AND SHOWN ON SHEET NO. 5

(A/9) SECTION "A" TAKEN AND SHOWN ON SHEET NO. 9.

STRUCTURAL STEEL

ALL STRUCTURAL STEEL IN GIRDER WEBS, FLANGES, SPLICE PLATES AND ROLLED BEAMS SHALL BE ASTM A572, GRADE 50. ALL OTHER STRUCTURAL STEEL SHALL BE ASTM A36. (4)

CONCRETE AND REINFORCING STEEL

DESIGN METHOD

POURED IN PLACE REINFORCED CONCRETE MEMBERS ARE DESIGNED BY THE SERVICE LOAD DESIGN METHOD AS SPECIFIED IN THE CURRENT AASHTO SPECIFICATIONS.

CONCRETE MIX

ALL PCC FOR STRUCTURAL WORK, INCLUDING SUPERSTRUCTURE, APPROACH SLABS, PIERS, ABUTMENTS, WALLS AND FOOTINGS, SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH F'c=4,500 PSI, AND AN ALLOWABLE DESIGN COMPRESSIVE STRESS Fc=1,800 PSI.

REINFORCEMENT

DEFORMED REINFORCING BARS SHALL CONFORM TO ASTM A615, GRADE 60. ALL REINFORCING STEEL OF DECK SLAB, TOPPING SLAB, BACKWALLS, AND ALL PARAPETS ON SUPERSTRUCTURE SHALL BE EPOXY COATED. ALL REINFORCING BAR DIMENSIONS ON THE DETAILED DRAWINGS ARE TO CENTERS OF BARS EXCEPT WHERE OTHERWISE NOTED AND ARE SUBJECT TO FABRICATION AND CONSTRUCTION TOLERANCES.

MINIMUM CONCRETE COVER

TOP OF DECK SLAB = 3"
BOTTOM OF DECK SLAB = 1-1/2"
ALL OTHER LOCATIONS = 2" UNLESS OTHERWISE SHOWN

BEVELED EDGES

ALL EXPOSED EDGES SHALL BE BEVELED 3/4" UNLESS OTHERWISE NOTED.

PRESTRESS

DESIGN STRESSES

Fs = 24,000 PSI FOR REINFORCING STEEL (EPOXY COATED) (4)
F's = 270,000 PSI FOR PRESTRESSING STRANDS
F'c = 5,000 PSI
Fc = 2,000 PSI
N = 6

DESIGN METHOD

PRECAST SECTIONS ARE DESIGNED BY THE LOAD FACTOR METHOD.

PRESTRESSING REINFORCEMENT

PRESTRESSING REINFORCEMENT SHALL BE 1/2 INCH NOMINAL DIAMETER UNCOATED SEVEN-WIRE STRESS-RELIEVED STRAND CONFORMING TO THE REQUIREMENTS OF GRADE 270, AASHTO DESIGNATION M203, CURRENT EDITION.

MASONRY

DESIGN STRESSES

f'_m = 1,500 PSI (8 C.M.U. ALL CELLS GROUTED)
f_s = 20,000 PSI
F_m = 500 PSI
N = 20

SPECIAL INSPECTION

SPECIAL INSPECTION SHALL BE PROVIDED FOR ALL MASONRY WALLS.

MORTAR

MORTAR SHALL BE TYPE M.

ACOUSTIC BLOCK

WHERE SPECIFIED ON DRAWINGS, SOUNDBLOX TYPE Q ACOUSTIC BLOCK UNITS SHALL BE USED, AND SHALL ACCOMODATE VERTICAL REINFORCEMENT.

FOUNDATIONS

ALL H-PILES IN ABUTMENTS AND PIERS SHALL BE DRIVEN TO A BEARING CAPACITY OF [illegible] TONS PER PILE UNLESS NOTED OTHERWISE ON SHEETS 17 THROUGH 20. ESTIMATED PIPE TIP ELEVATION - 60.00. (6)

FOOTINGS FOR RETAINING WALLS SHALL REST ON FIRM MATERIAL. BEARING CAPACITY OF FOUNDATION SHALL BE 1.25 TONS/SQ. FT. MINIMUM.

SUBSURFACE INVESTIGATION & REPORT

PROFESSIONAL SERVICE INDUSTRIES, INC. "SOILS EXPLORATION AND REVISED FOUNDATION RECOMMENDATIONS FOR THE PROPOSED PORTALS PROJECT, PHASE I" DATED APRIL 25, 1989.

BENCHMARKS

N 382068.0279 E 791172.0701 BM#1 SET TOP OF SEAWALL 250(±) WEST OF WASH. MARINA BLDG. @ CORNER OF WALL 9.78'

N 382260.0873 E 790910.9700 BM#2 N.E. CORNER CONCRETE ABUT. OF OLD RAILROAD BRIDGE 10.38', D.C. DATUM

N 383091.9440 E 790879.7885 BM#3 STEPS OF TREASURY BLDG. 28.71', D.C. DATUM

N 382985.5509 E 790912.2946 BM#4 SET TOP OF WALL WEST CORNER OF TREASURY BLDG. @ N.E. CORNER INTX. OF 14TH & 'D' ST. S.W. 30.13

N 382926.2234 E 791941.6013 BM#5 SET TOP GRANITE CURB @ P.C. S.E. CORNER @ INTX. 12TH & 'D' ST. S.W. 36.94

BM#6 NORTH CORNER STEPS @ DEPT. OF AGRICULTURE 37.43'

REVISIONS

No.	Description	Date
8	ADD SHEET B83a	3-7-91
7	ADD SHEET 94a	8-20-90
6	Added A Sheet. Changed Pile Tip El., Capacity	5-23-90
5	Added Sheets	5-10-90
4	Added Sheets, Notes	1-19-90
3	AS NOTED	9-19-89
2	Added Sheet 26a	9-6-89
1	Added Sheets	8-14-89

ENGINEERS SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors
8401 Arlington Blvd., Fairfax, VA 22031
703 849-0100

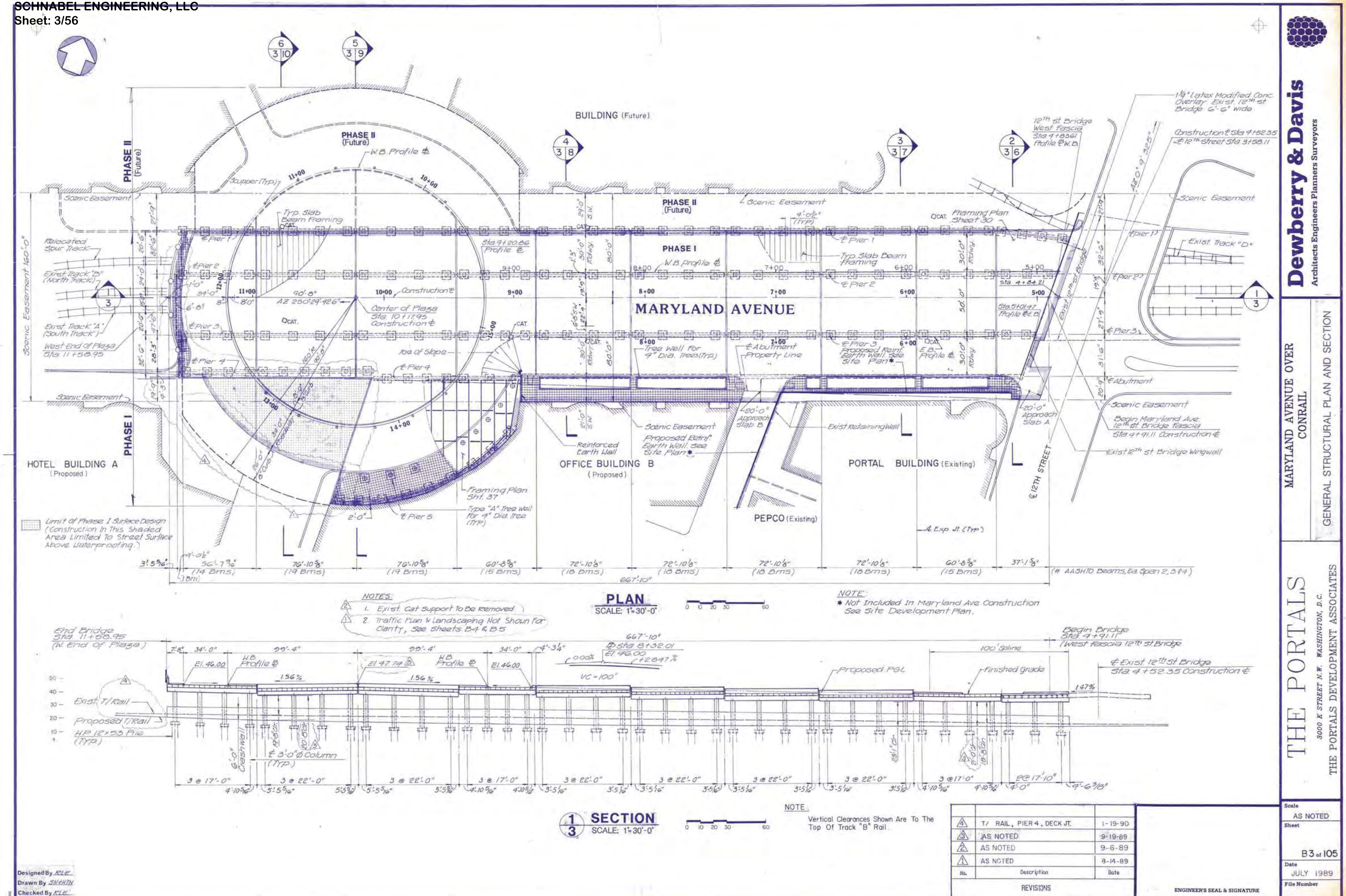
MARYLAND AVENUE OVER CONRAIL

INDEX OF SHEETS AND GENERAL NOTES

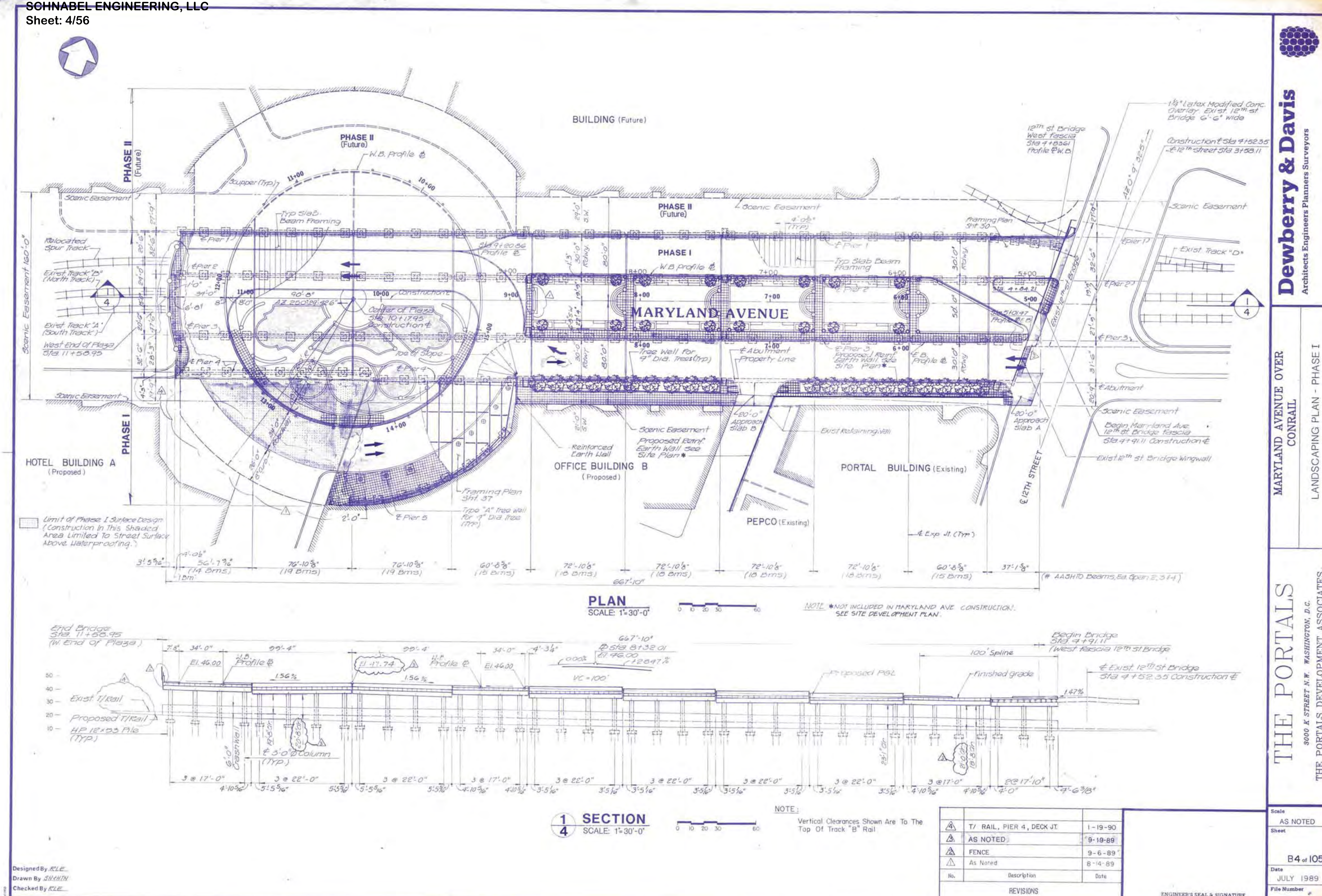
THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

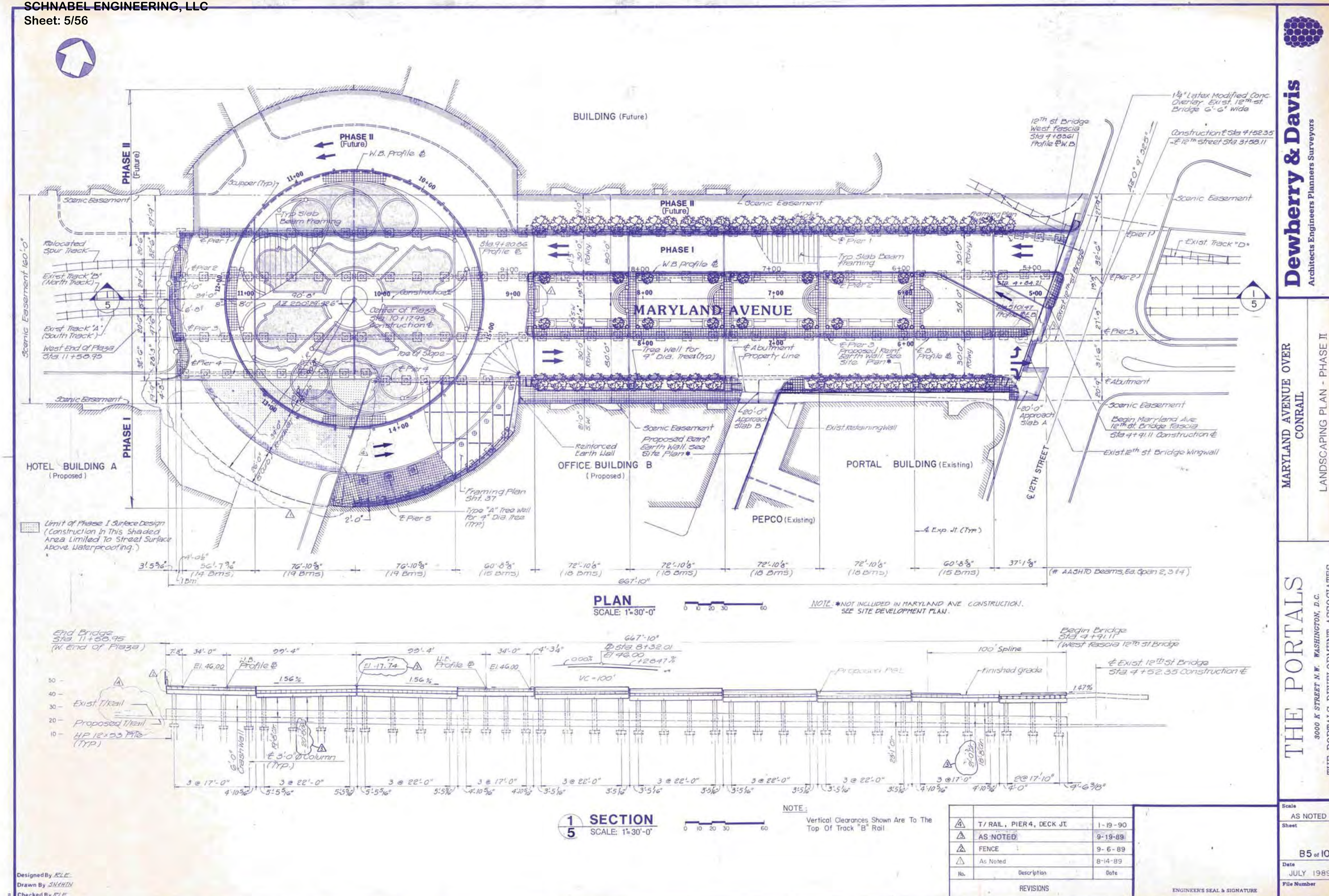
Drawn By TTN
Designed By CL
Checked By CL
Date JULY 1989
Scale NONE
Plan Number
Zoned
Sheet B2 of 105
File Number

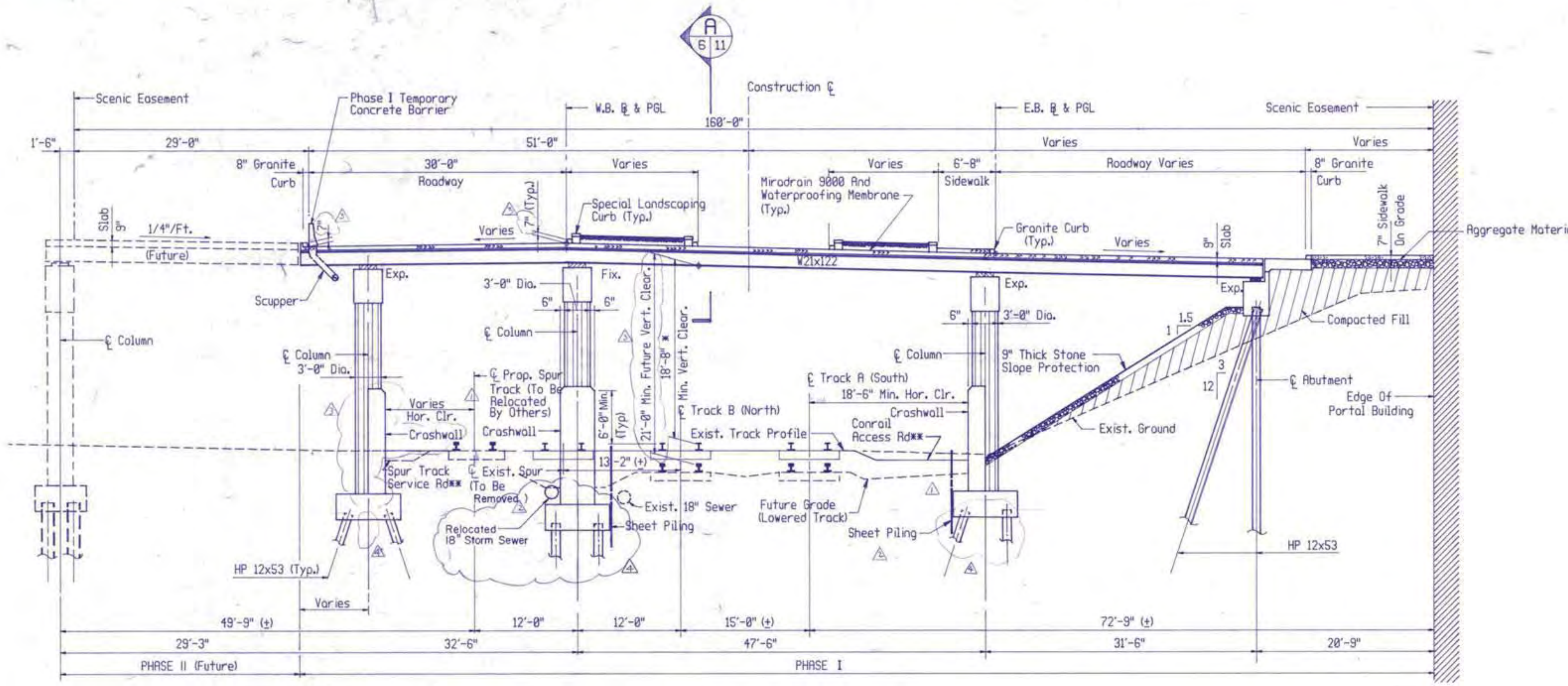
PORTAL20 - GNOTES


BUILDING (Future)
PHASE II (Future)
PHASE II (Future)
PHASE I
PHASE I
MARYLAND AVENUE
HOTEL BUILDING A (Proposed)
OFFICE BUILDING B (Proposed)
PORTAL BUILDING (Existing)
PEPCO (Existing)
12TH STREET
Scenic Easement
Relocated Spur Track
Exist. Track "B" (North Track)
Exist. Track "A" (South Track)
West End Of Plaza Sta. 11+58.95
Center of Plaza Sta. 10+17.95 Construction ℄
Construction ℄
W.B. Profile ℄
Typ. Slab Beam Framing
Framing Plan Sheet 30
Framing Plan Sht. 37
Type "A" Tree Well for 4" Dia. Tree (TYP)
Tree Well for 4" Dia. Trees (Typ)
Reinforced Earth Wall
Proposed Reinf. Earth Wall. See Site Plan
Exist. Retaining Wall
Property Line
℄ Abutment
℄ Pier 1
℄ Pier 2
℄ Pier 3
℄ Pier 4
℄ Pier 5
Approach Slab A
Approach Slab B
1 3/4" Latex Modified Conc. Overlay. Exist. 12th St. Bridge 6'-6" wide
Construction ℄ Sta 4+52.35 - ℄ 12th Street Sta 3+58.11
12th St. Bridge West Fascia Sta 4+85.61 Profile ℄ W.B.
Begin Maryland Ave. 12th St. Bridge Fascia Sta 4+91.11 Construction ℄
Exist 12th St Bridge Wingwall
Exist. Track "D"
℄ Exp. Jt. (Typ)
Limit of Phase I Surface Design (Construction In This Shaded Area Limited To Street Surface Above Waterproofing.)
667'-10"
(# AASHTO Beams, Ea. Span 2, 3 & 4)
NOTES:
1. Exist. Cat Support To Be Removed
2. Traffic Plan & Landscaping Not Shown For Clarity, See Sheets B4 & B5
PLAN
SCALE: 1"=30'-0"
NOTE:
* Not Included In Maryland Ave Construction See Site Development Plan.
End Bridge Sta 11+58.95 (W. End Of Plaza)
Begin Bridge Sta 4+91.11 (West fascia 12th St Bridge)
℄ Exist 12th St Bridge Sta 4+52.35 Construction ℄
Exist. T/Rail
Proposed T/Rail
H.P. 12x53 Pile (TYP.)
Crash Wall
℄ 3'-0" Ø Column (Typ.)
Proposed PGL
Finished Grade
100' Spline
VC = 100'
1.56%
1.47%
SECTION
SCALE: 1"=30'-0"
NOTE:
Vertical Clearances Shown Are To The Top Of Track "B" Rail.
4 T/ RAIL, PIER 4, DECK JT. 1-19-90
3 AS NOTED 9-19-89
2 AS NOTED 9-6-89
1 AS NOTED 8-14-89
No. Description Date
REVISIONS
ENGINEER'S SEAL & SIGNATURE
Designed By RLF
Drawn By SH/HTN
Checked By RLF
Dewberry & Davis
Architects Engineers Planners Surveyors
MARYLAND AVENUE OVER CONRAIL
GENERAL STRUCTURAL PLAN AND SECTION
THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES
Scale AS NOTED
Sheet B3 of 105
Date JULY 1989
File Number

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 4/56




BUILDING (Future)
PHASE II (Future)
PHASE II (Future)
PHASE I
PHASE II (Future)
PHASE I
MARYLAND AVENUE
HOTEL BUILDING A (Proposed)
OFFICE BUILDING B (Proposed)
PORTAL BUILDING (Existing)
PEPCO (Existing)
12TH STREET
Scenic Easement
Relocated Spur Track
Exist. Track "B" (North Track)
Exist. Track "A" (South Track)
West End of Plaza Sta. 11+58.95
Center of Plaza Sta. 10+17.95 Construction ℄
Toe of Slope
Tree Well for 9" Dia. Trees (Typ.)
℄ Abutment Property Line
Proposed Reinf. Earth Wall See Site Plan*
Reinforced Earth Wall
Scenic Easement
Proposed Reinf. Earth Wall. See Site Plan*
Exist. Retaining Wall
Framing Plan Sht. 37
Type "A" Tree Well for 9" Dia. Tree (Typ)
12th St. Bridge West Fascia Sta. 4+85.61 Profile ℄ W.B.
1 1/4" Latex Modified Conc. Overlay. Exist. 12th St. Bridge 6'-6" wide
Construction ℄ Sta. 4+52.35 - ℄ 12th Street Sta. 3+58.11
Begin Maryland Ave 12th St. Bridge Fascia Sta 4+91.11 Construction ℄
Exist. 12th St. Bridge Wingwall
Exist. Track "D"
Limit of Phase I Surface Design (Construction In This Shaded Area Limited To Street Surface Above Waterproofing.)
(# AASHTO Beams, Ea. Span 2, 3 & 4)
667'-10"
PLAN
SCALE: 1"=30'-0"
NOTE: *NOT INCLUDED IN MARYLAND AVE CONSTRUCTION. SEE SITE DEVELOPMENT PLAN.
End Bridge Sta. 11+58.95 (W. End of Plaza)
Begin Bridge Sta 4+91.11 (West Fascia 12th St Bridge)
℄ Exist. 12th St Bridge Sta. 4+52.35 Construction ℄
100' Spline
Finished grade
Exist. T/Rail
Proposed T/Rail
HP 12x53 Pile (Typ)
℄ 3'-0" Ø Column (Typ.)
1 SECTION
5 SCALE: 1"=30'-0"
NOTE: Vertical Clearances Shown Are To The Top Of Track "B" Rail
T/RAIL, PIER 4, DECK JT. 1-19-90
AS NOTED 9-19-89
FENCE 9-6-89
As Noted 8-14-89
No. Description Date
REVISIONS
ENGINEER'S SEAL & SIGNATURE
Designed By RLE
Drawn By SNAHIN
Checked By RLE
Dewberry & Davis
Architects Engineers Planners Surveyors
MARYLAND AVENUE OVER CONRAIL
LANDSCAPING PLAN - PHASE II
THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES
Scale AS NOTED
Sheet B5 of 105
Date JULY 1989
File Number



SECTION

2/3|6

SCALE: 1/8"=1'-0"

Notes:

1. * Less Than Required Minimum Vertical Clearance In Area Near Existing 12th Street Bridge.
2. ** See Site Plan. Not In Maryland Ave. Construction.
3. See Railroad Specifications For Sheet Pile Design Requirements.

No.	Description	Date
4	Added Relocated 18" Sewer	5-23-90
3	Curb Height, Crash Wall	9-19-89
2	As Noted	9-6-89
1	As Noted	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

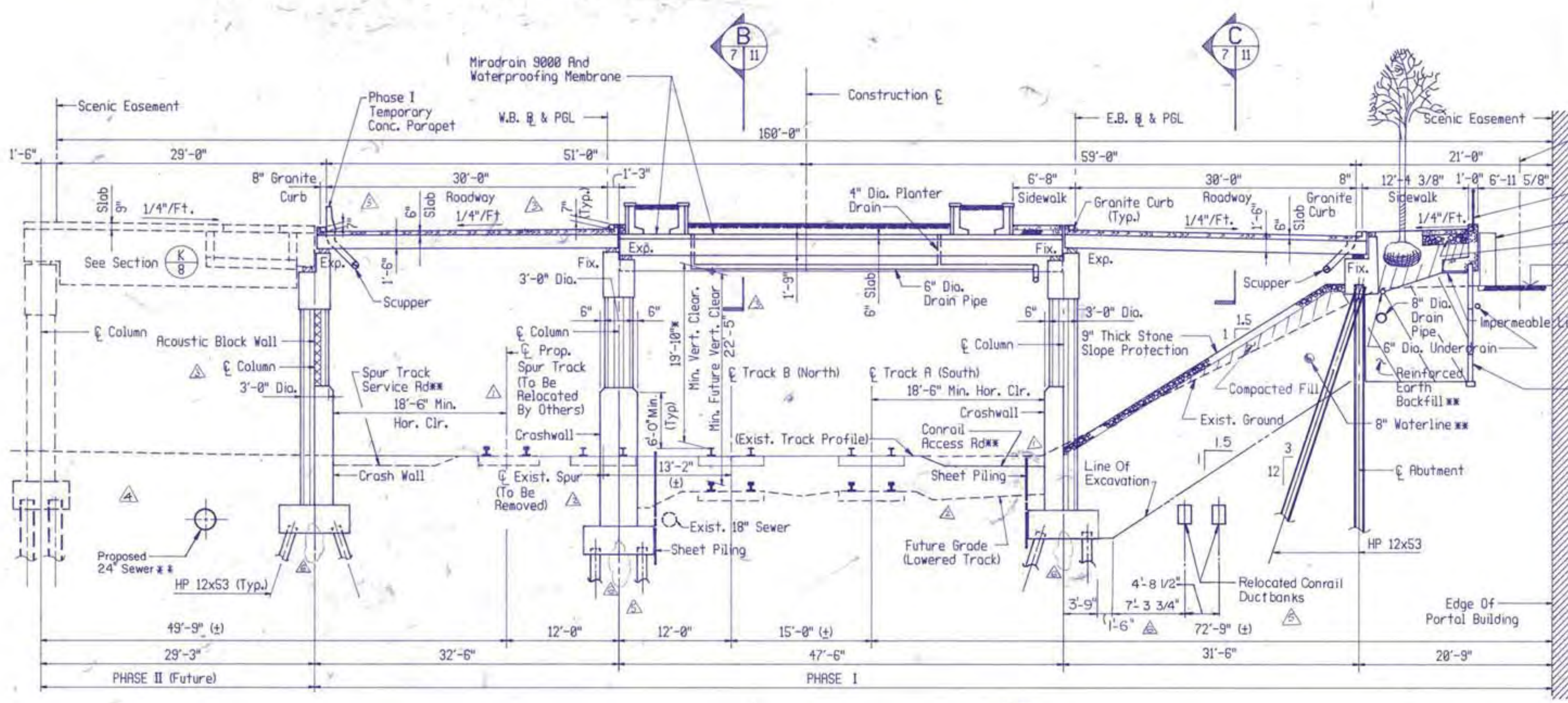
SECTION 2

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By: LH
Designed By: CL
Checked By: RLE
Date: JULY 1989
Scale: As Noted
Plan Number:
Zoned:
Sheet: B6 of 105
File Number:

PORTAL20 - ELEVB

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 7/56



3/3-7 SECTION
SCALE: 1/8"=1'-0"

NOTES:

1. ✱Less Than Required Minimum Vertical Clearance In Area Near Existing 12th Street Bridge
2. ✱✱See Site Development Plan, Not In Maryland Ave. Construction.
3. See Railroad Specifications For Sheet Pile Design Requirements.

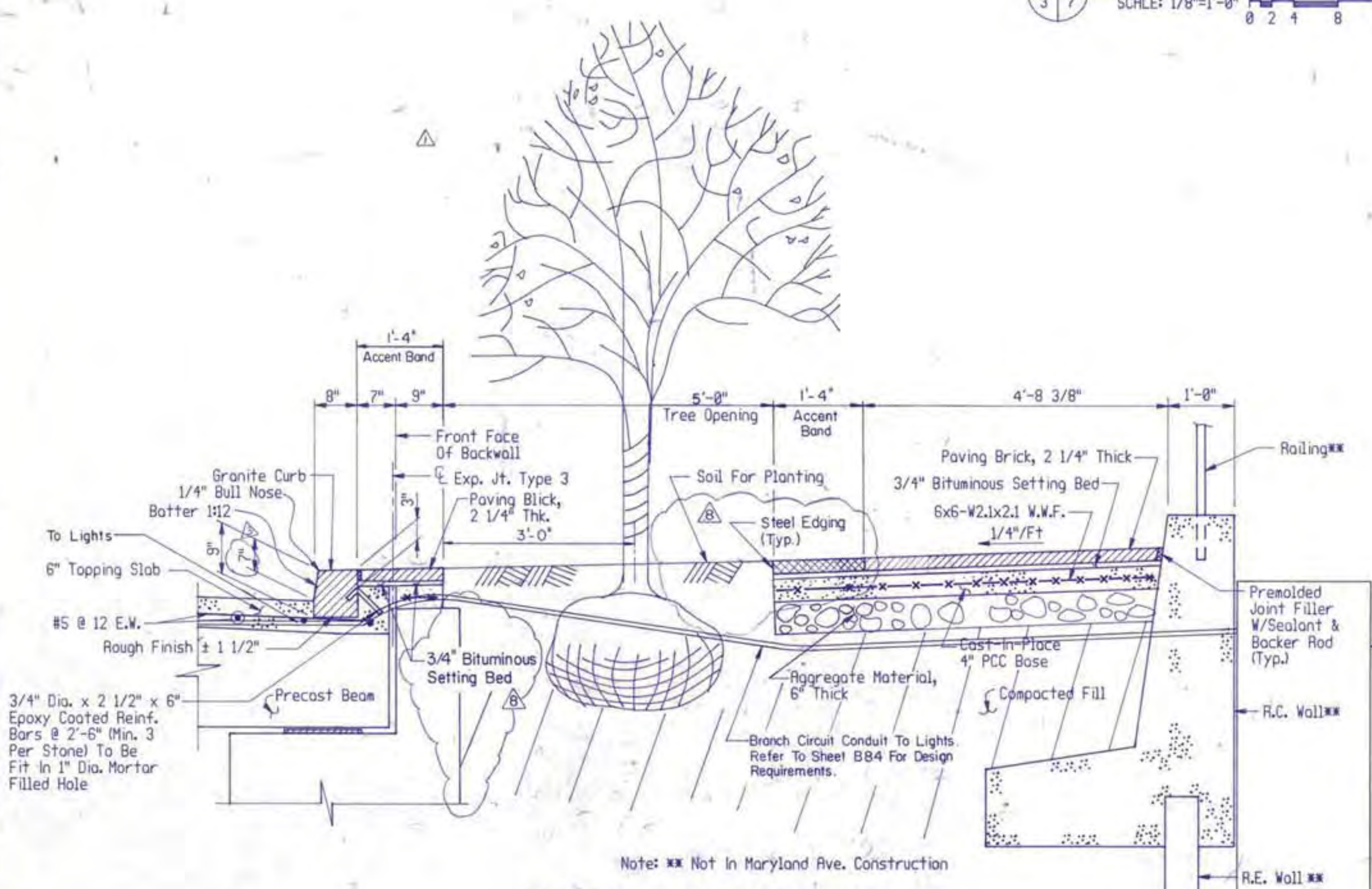
CONSTRUCTION SEQUENCE FOR REINFORCED EARTH WALL AND ABUTMENT

Option A: Drive Abutment Piles Before Building R.E. Wall

1. Drive Abutment Piles.
2. Excavate And Build R.E. Wall. Place Waterline, Sewer Pipe, And Underdrain During R.E. Backfill Operation.
3. Build Abutment.
4. Backfill Abutment.

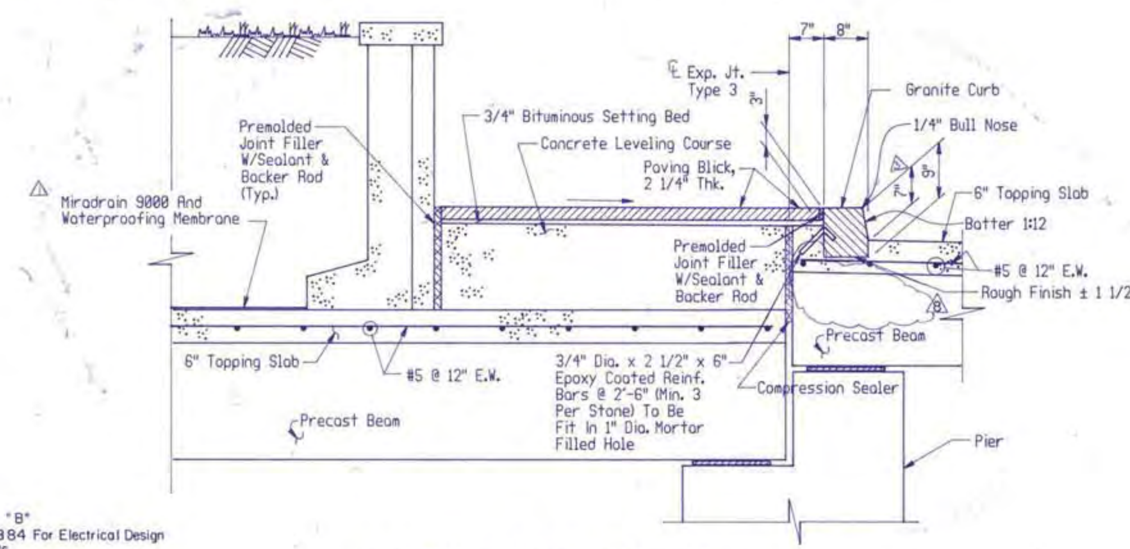
Option B: Drive Abutment Piles After Building R.E. Wall

1. Excavate And Build R.E. Wall. Place Waterline, Sewer Pipe, And Underdrain During R.E. Backfill Operation. Reserve Abutment Pile Positions By Placing Sonotubes At Pile Locations.
2. Backfill In Front Of R.E. Wall To Level Of Existing Grade And Compact.
3. Drive Abutment Piles. Pile Driving Equipment Shall Not Be Allowed Within 3 Feet Of Face Of R.E. Wall.
4. Build Abutment.
5. Backfill Abutment.



Note: ✱✱ Not In Maryland Ave. Construction

SIDEWALK AT ABUTMENT DETAIL
Scale: 3/4"=1'-0"



SIDEWALK AT PIER DETAIL
Scale: 3/4"=1'-0"

No.	Description	Date
8	Removed Mortar Setting Bed	3-7-91

No.	Description	Date
7	REVISED TREE WELL, L.C. "B"	12-17-90
6	Revised Pile Pattern & Ductbank Spacing	5-23-90
5	Added Conrail Ductbanks	5-10-90
4	PROPOSED SEWER	1-19-90
3	Curb Height, Crash Wall	9-19-89
2	As Noted	9-6-89
1	As Noted	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

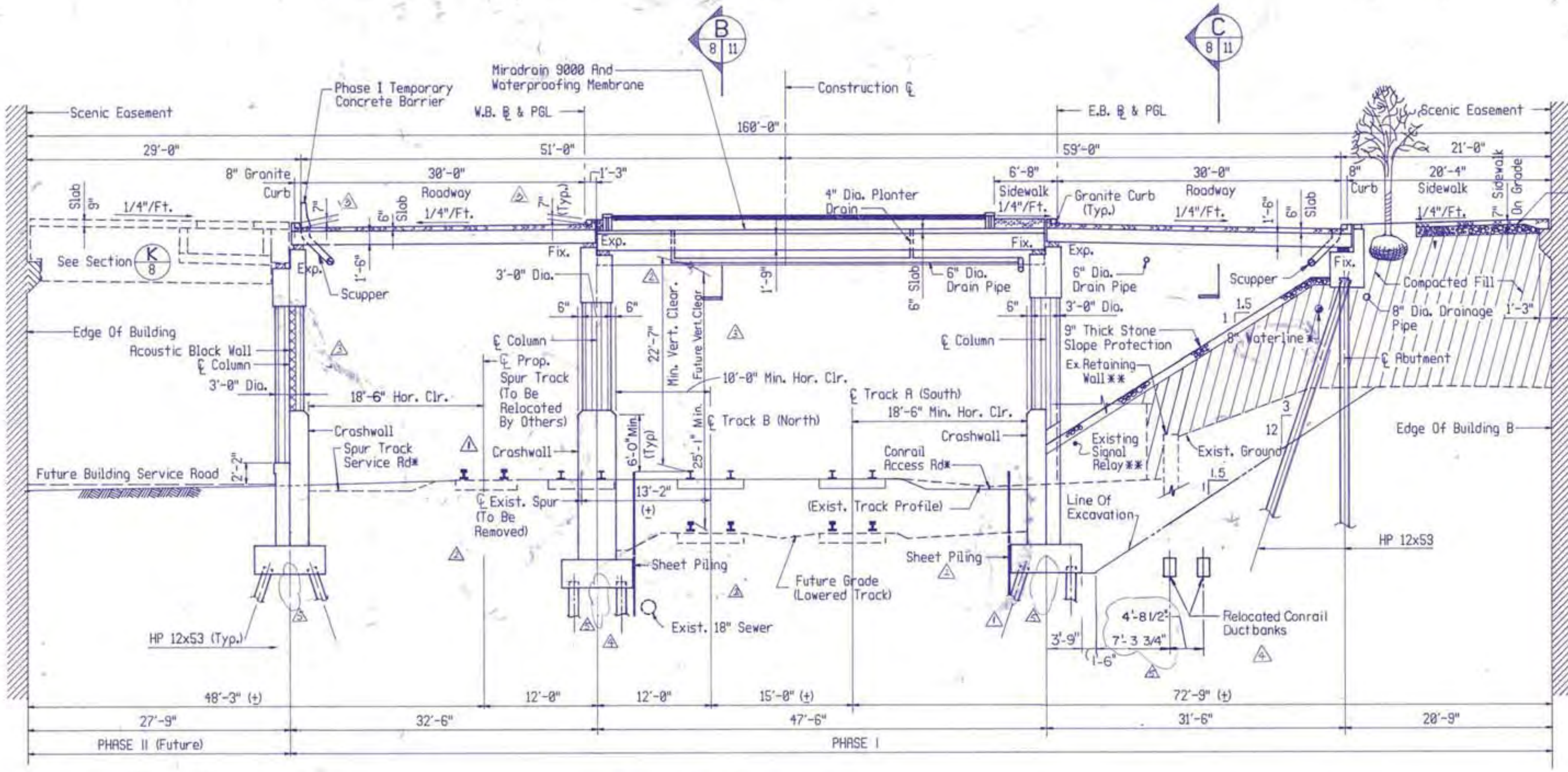
Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL
SECTION 3

THE PORTALS
300 E STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By HT
Designed By RLE
Checked By CL
Date JULY 1989
Scale As Noted
Plan Number
Zoned
Sheet B7 of 105
File Number

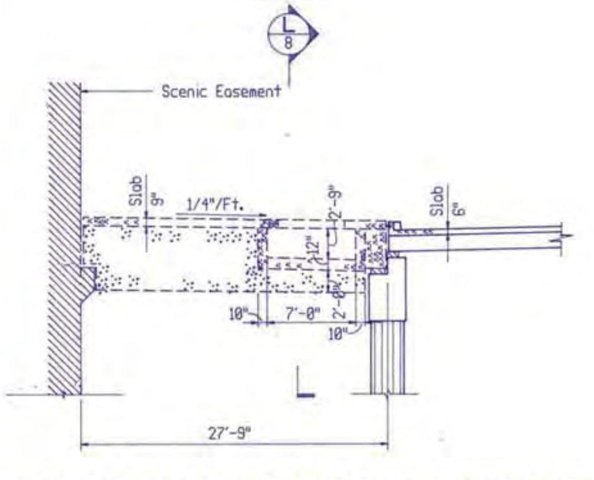
PORTAL20 - ELEVC



4/3 8 SECTION

SCALE: 1/8"=1'-0" 0 2 4 8 12

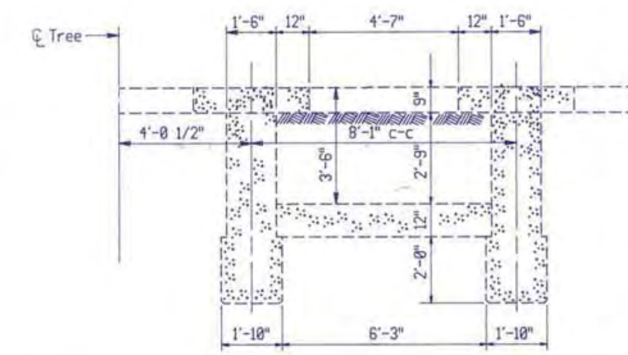
Notes: 1. ✱ See Site Plan. Not In Maryland Ave. Construction
2. See Railroad Specifications For Sheet Pile Design Requirements.
3. ✱✱ To Be Removed. Coordinate With Conrail Before Start.



K/8 PROPOSED SECTION @ TREE WELL (PHASE II)

(Future) SCALE: 1/8"=1'-0" 0 2 4 8 12

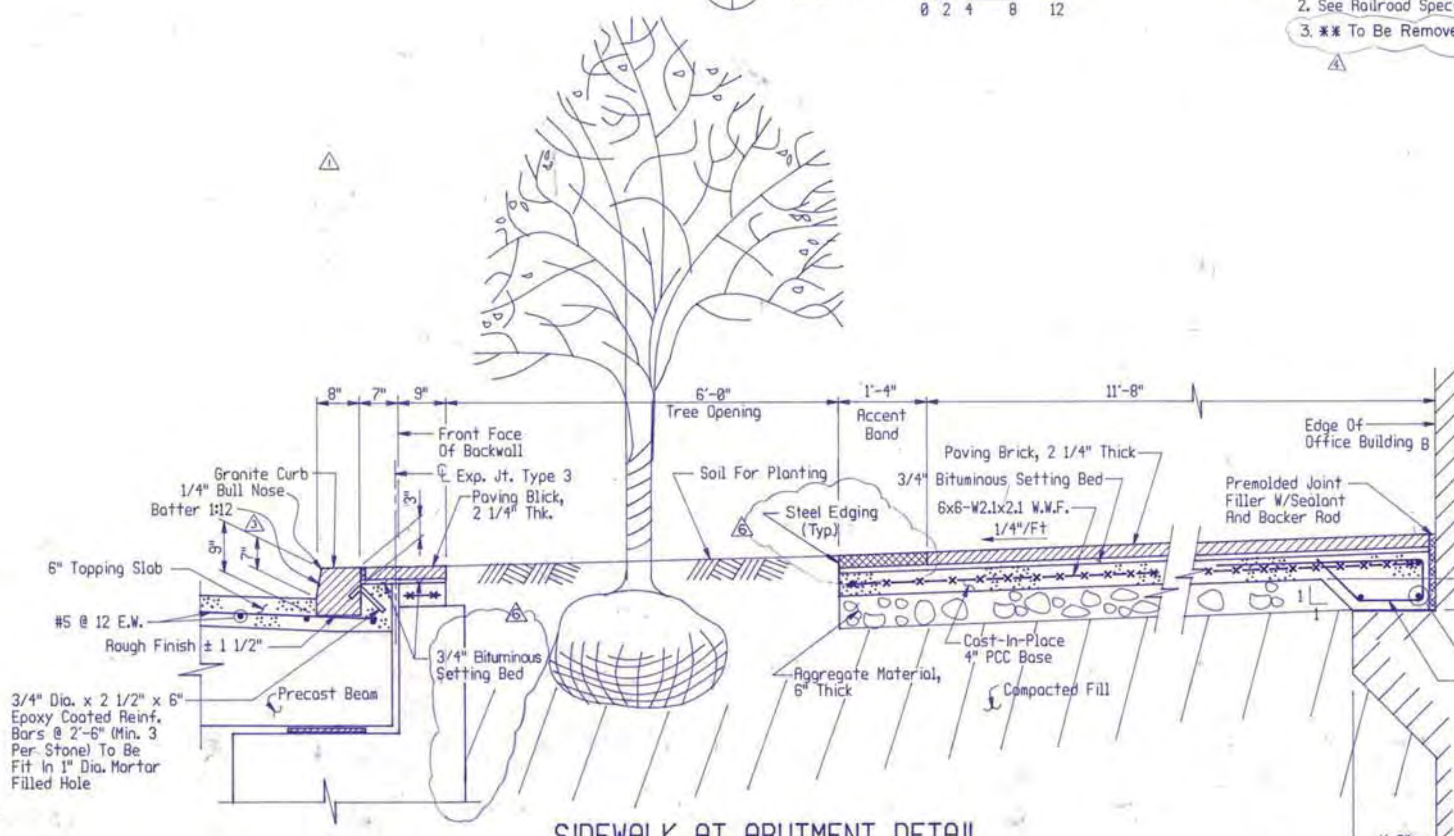
(Not Maryland Ave. Construction)



L/8 PROPOSED SECTION @ TREE WELL (PHASE II)

(Future) SCALE: 3/8"=1'-0" 0 1 2 4

(Not Maryland Ave. Construction)



SIDEWALK AT ABUTMENT DETAIL

Scale: 3/4"=1'-0" 0 .5 1 2

No.	Description	Date
6	Removed Mortar Setting Bed	3-7-91

REVISIONS

No.	Description	Date
5	Revised Pile Pattern & Ductbank Spacing	5-23-90
4	Added Conrail Ductbanks	5-10-90
3	Curb Height, Crashwall	9-19-89
2	As Noted	9-6-89
1	As Noted	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

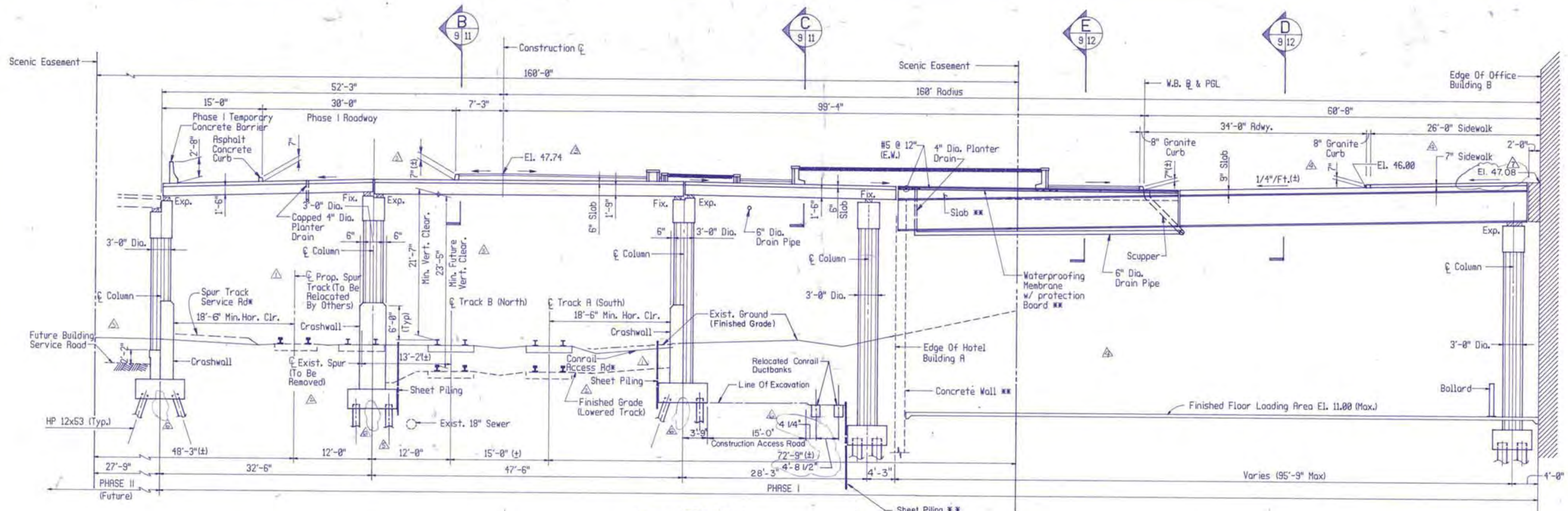
SECTION 4

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By LH
Designed By CL
Checked By RLE
Date JULY 1989
Scale As Noted
Plan Number
Zoned
Sheet B8 of 105
File Number

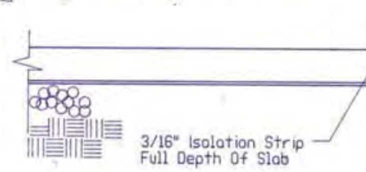
PORTAL20 - ELEV0

13



5 (3 | 9) SECTION
SCALE: 1/8"=1'-0"

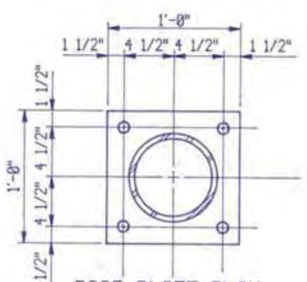
Notes: 1. For Deck Waterproofing, See Landscaping Sheets 96 - 99.
2. * See Site Development Plan. Not In Maryland Ave. Construction.
3. See Railroad Specifications For Sheet Pile Design Requirements.
4. ** Design By Othres, Not In This Contract.



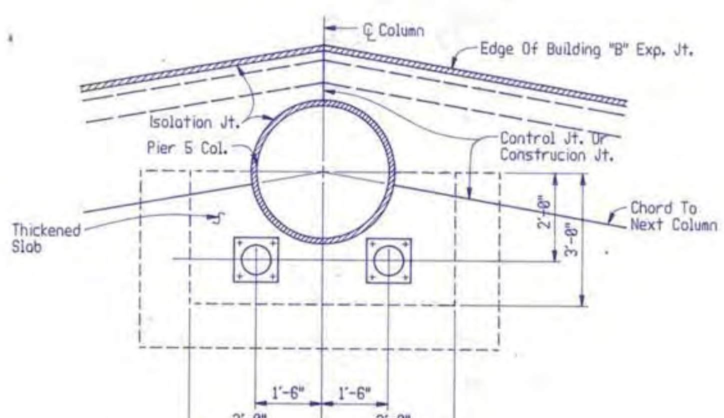
ISOLATION JOINT

Slab Notes:

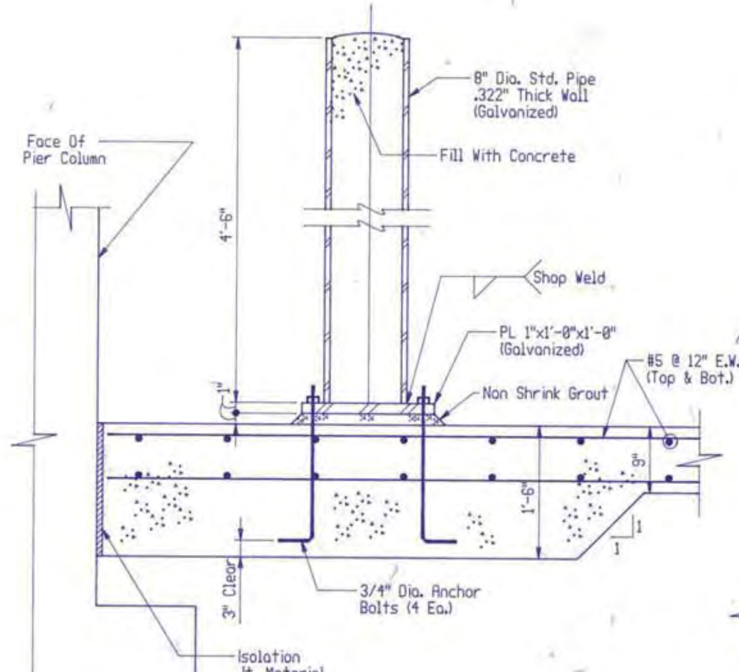
1. SEE SUBSTRUCTURE LAYOUT - 1 FOR LOCATION OF JOINTS.
2. PROVIDE CONSTR. JOINT TO DIVIDE SLAB INTO NEAR SQUARE SHAPES NOT TO EXCEED 2,500 SQ. FT. IN AREA.
3. SAW CUT CONTROL JOINTS TO DIVIDE SLAB INTO NEAR- SQUARE SHAPES NOT EXCEEDING 900 SQ. FT. IN AREA WHEN CONC. HAS HARDENED SUFFICIENTLY TO PERMIT CUTTING WITHOUT CHIPPING, SPALLING , OR TEARING.
4. CONSTRUCTION JOINT MAY REPLACE CONTROL JOINT.
5. PROVIDE SUPPORT TO HOLD REINF. IN BOTTOM.



BASE PLATE PLAN

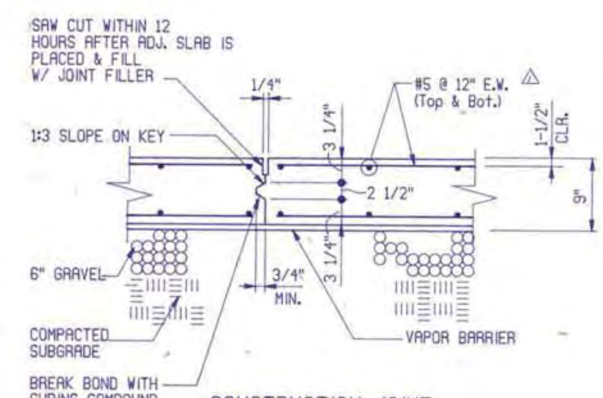


PLAN

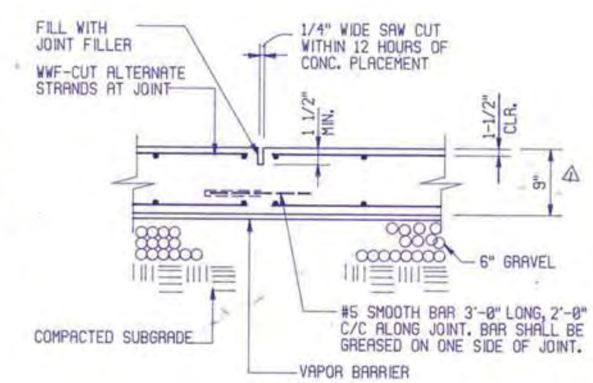


SECTION

BOLLARD DETAILS
N.T.S.

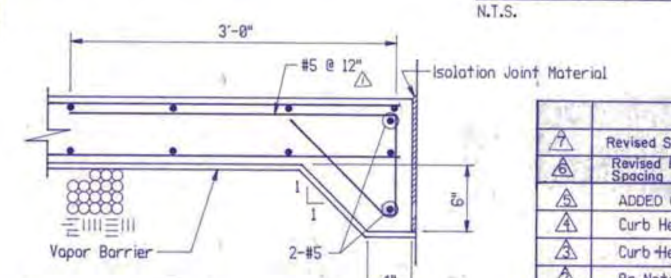


CONSTRUCTION JOINT



CONTROL JOINT

LOADING AREA SLAB JOINTS
N.T.S.



EDGE OF SLAB DETAIL
N.T.S.

No.	Description	Date
7	Revised Sidewalk Slope	12-17-90
6	Revised Pile Pattern & Ductbank Spacing	5-23-90
5	ADDED CONRAIL DUCTBANKS	5-10-90
4	Curb Height, Moved Pier 4	1-19-90
3	Curb Height, Crash Wall	9-19-89
2	As Noted	9-6-89
1	As Noted	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

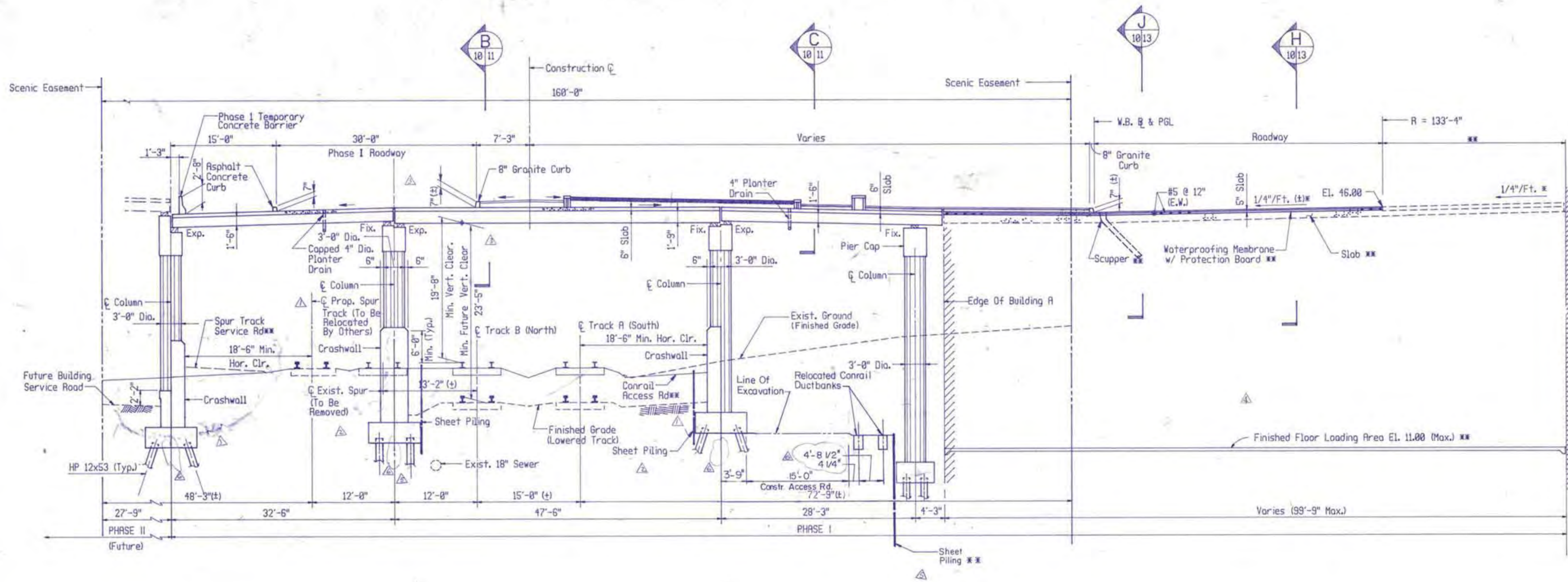
MARYLAND AVENUE OVER CONRAIL
SECTION 5

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By LH
Designed By CL
Checked By RLE
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B9 of 105
File Number

PORTAL20 - SECT5
13

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 10/56



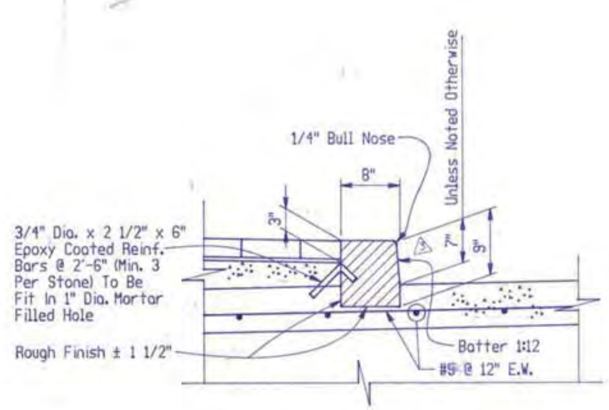
6
3 | 10

SECTION

SCALE: 1/8"=1'-0"

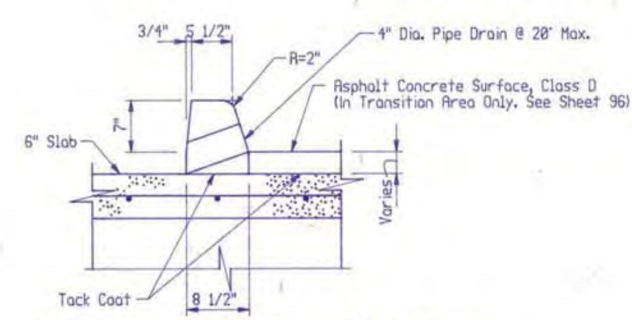
Notes:

1. * Slope Shown Are In Radial Direction.
2. ** Design By Others, Not In This Contract.
3. For Deck Waterproofing See Landscaping Sheets 96 - 99.
4. See Railroad Specifications For Sheet Pile Design Requirements.



PLAZA GRANITE CURB DETAIL

Scale: 1"=1'-0"



ASPHALT CONCRETE CURB DETAIL

Scale: 1"=1'-0"

REVISIONS

No.	Description	Date
6	Revised Pile Pattern & Ductbank Spacing	5-23-90
5	Added Conrail Ductbanks	5-10-90
4	Moved Pier 4, Removed Sidewalk	1-19-90
3	Curb Height, Crashwall	9-19-89
2	As Noted	9-6-89
1	As Noted	8-14-89

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

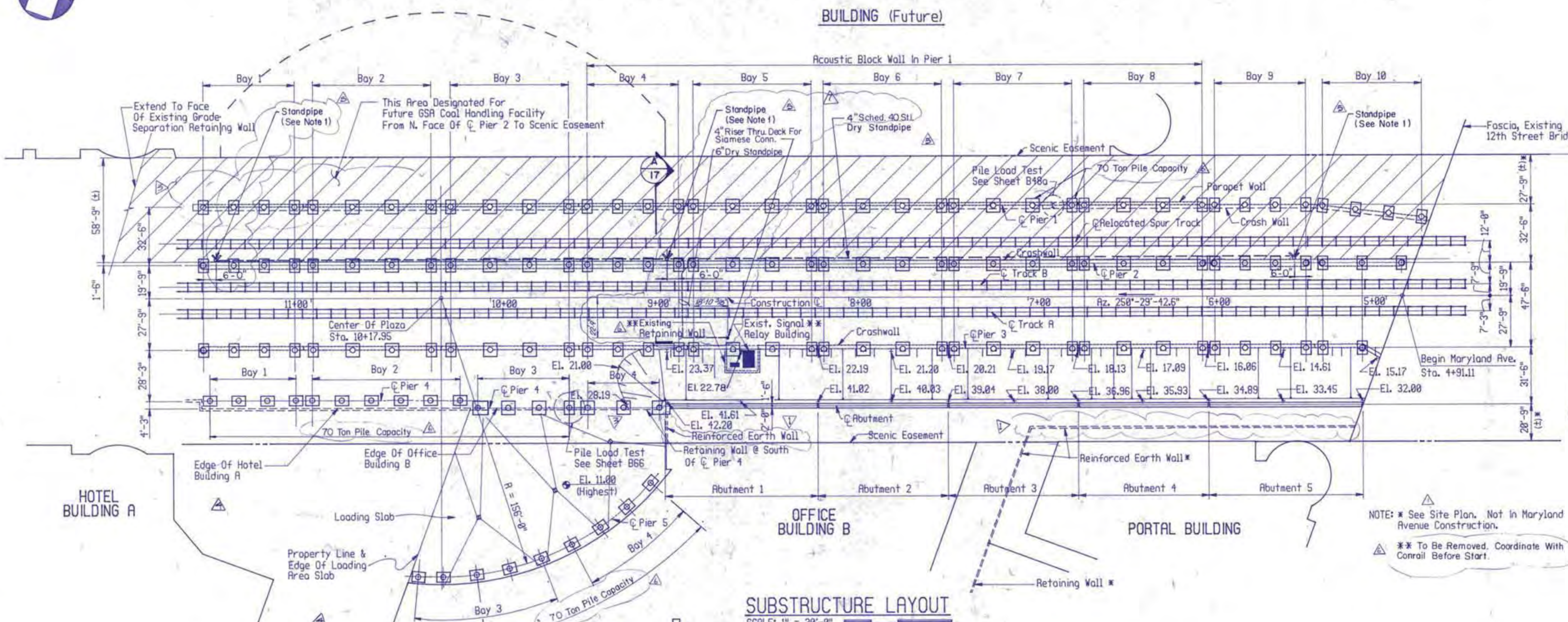
SECTION 6

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By LH
Designed By CL
Checked By RLE
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B10 of 105
File Number

PORTAL20 - SECT6

13



SUBSTRUCTURE LAYOUT

SCALE: 1" = 30'-0"

NOTE: For Additional Substructure Details, See Sheets 18 Through 20.

NOTE: * See Site Plan. Not In Maryland Avenue Construction.

** To Be Removed. Coordinate With Conrail Before Start.

NOTE 1:

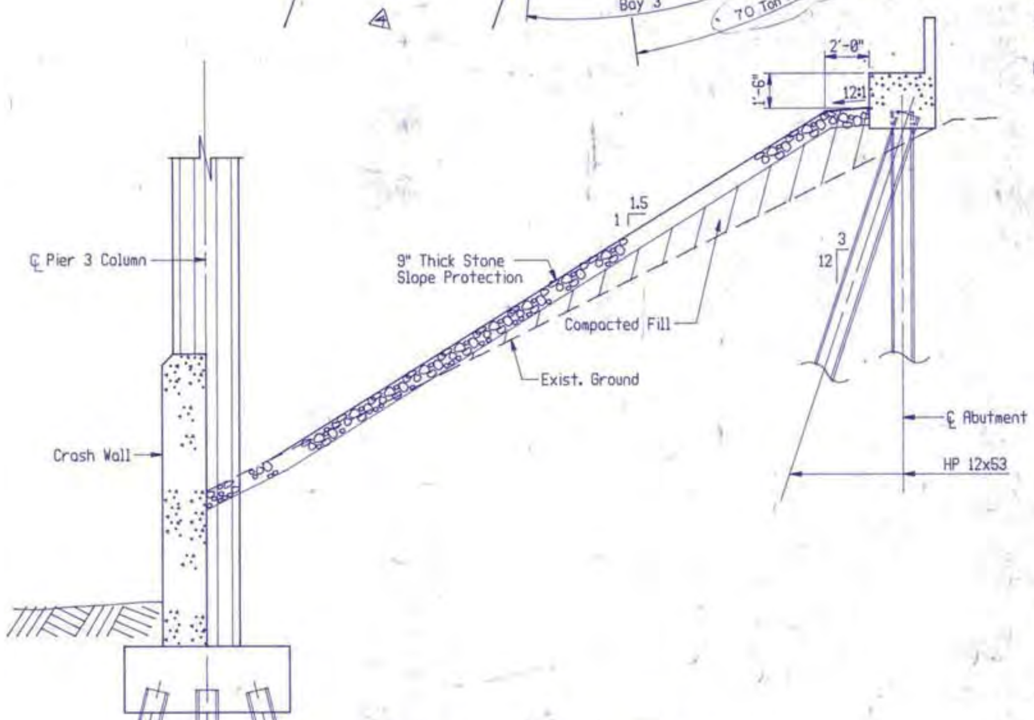
SCHED. 40 STEEL PIPE, PAINTED RED.

DUAL 2 1/2" FIRE DEPT. HOSE VALVES WITH 2 1/2" TO 1 1/2" REDUCERS, CAPS AND CHAINS. VALVES TO BE BRASS UL LISTED.

PROVIDE FLEXIBLE, EXPANSION COMPENSATING JOINTS ON STANDPIPE. VICTAULIC STYLE 75 OR EQUAL. PROVIDE VALVED DRAIN AT LOW POINTS OF STANDPIPE. USE 6"x4" REDUCERS OR REDUCING ELBOWS TO CHANGE PIPE SIZE. PROVIDE HANGERS AS NECESSARY.

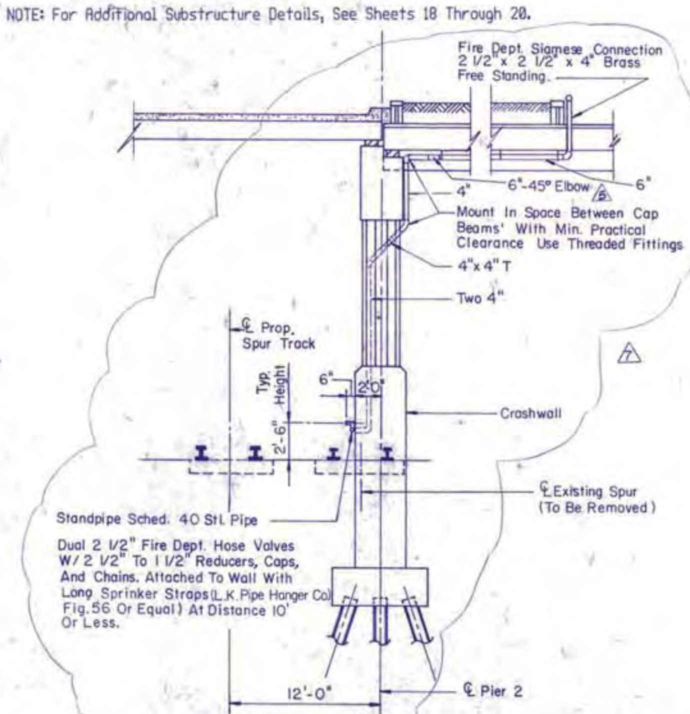
DRY STANDPIPE SHALL BE IN ACCORDANCE WITH ANSI/NFPA STANDARD 14.

FOR STANDPIPE DETAILS SEE SHEET B83a



SLOPE PROTECTION SECTION

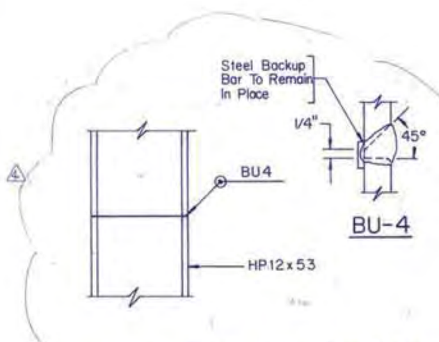
Scale: 1/4"=1'-0"



Note: For Information Only. For Details, See Sheet B83a

A/17 DRY STANDPIPES TYP. SECTION

NOT TO SCALE



PILE SPLICE DETAIL

NOT TO SCALE

No.	Description	Date
7	Revised Dry Standpipes	3-7-91
6	Showed Signal Bldg. & Wall To Be Removed, Pile Capacity	5-23-90
5	Added Dry Standpipes	3-22-90
4	Pier 4, 5 Changed, Pile Splice	1-19-90
3	As Noted	9-19-89
1	R.E. Walls & Loading Area	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

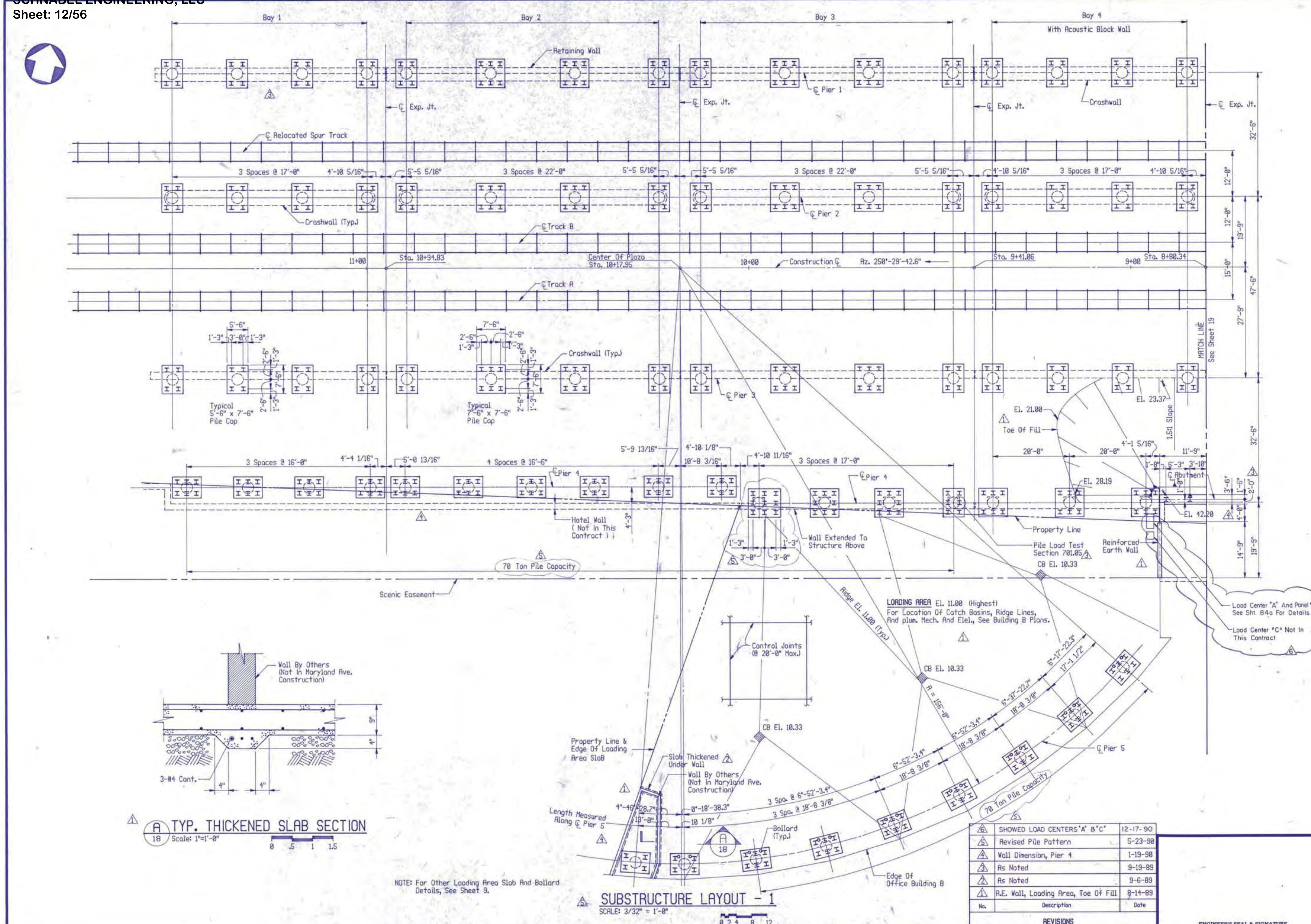
MARYLAND AVENUE OVER CONRAIL

SUBSTRUCTURE LAYOUT AND SLOPE PROTECTION

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By LH
Designed By CL
Checked By RLE
Date JULY 1989
Scale As Noted
Plan Number
Zoned
Sheet B17 of 105
File Number

PORTAL20 - SUBSTRLY



No.	Description	Date
6	SHOWED LOAD CENTERS 'A' & 'C'	12-17-90
5	Revised Pile Pattern	5-23-90
4	Wall Dimension, Pier 4	1-19-90
3	As Noted	9-19-89
2	As Noted	9-6-89
1	R.E. Wall, Loading Area, Toe Of Fill	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

SUBSTRUCTURE LAYOUT - 1

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By: LH
Designed By: CL
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Date: JULY 1989
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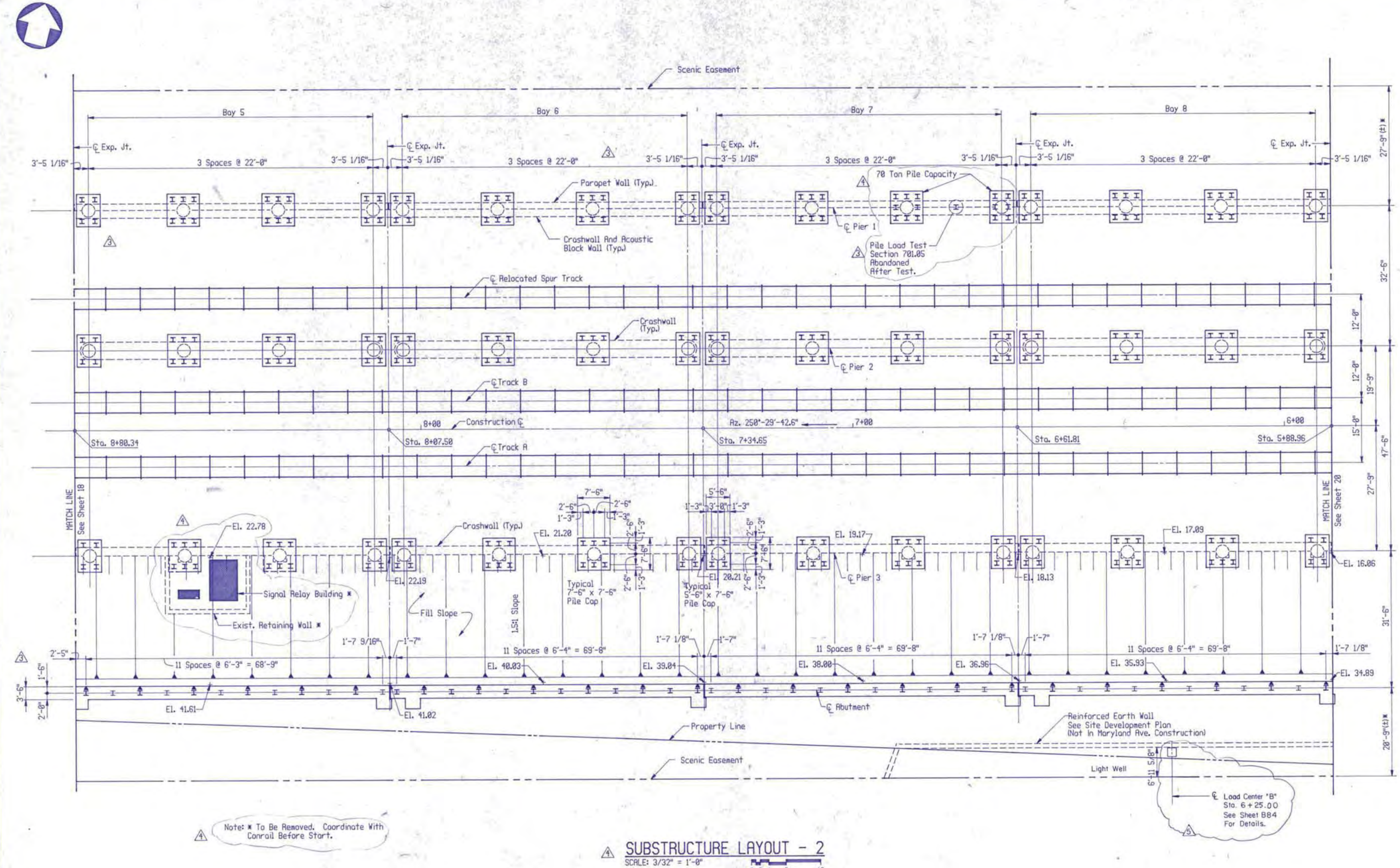
Plan Number
Zoned
Sheet: B18 of 105
File Number



No.	Description	Date
5	Added Load Center "B"	12-17-90
4	Revised Pile Pattern Removed Signal Bldg. & Wall	5-23-90
3	As Noted	9-19-89
2	Piles In Footing	9-6-89
1	Light Pole Support & R.E. Walls	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

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MARYLAND AVENUE OVER CONRAIL

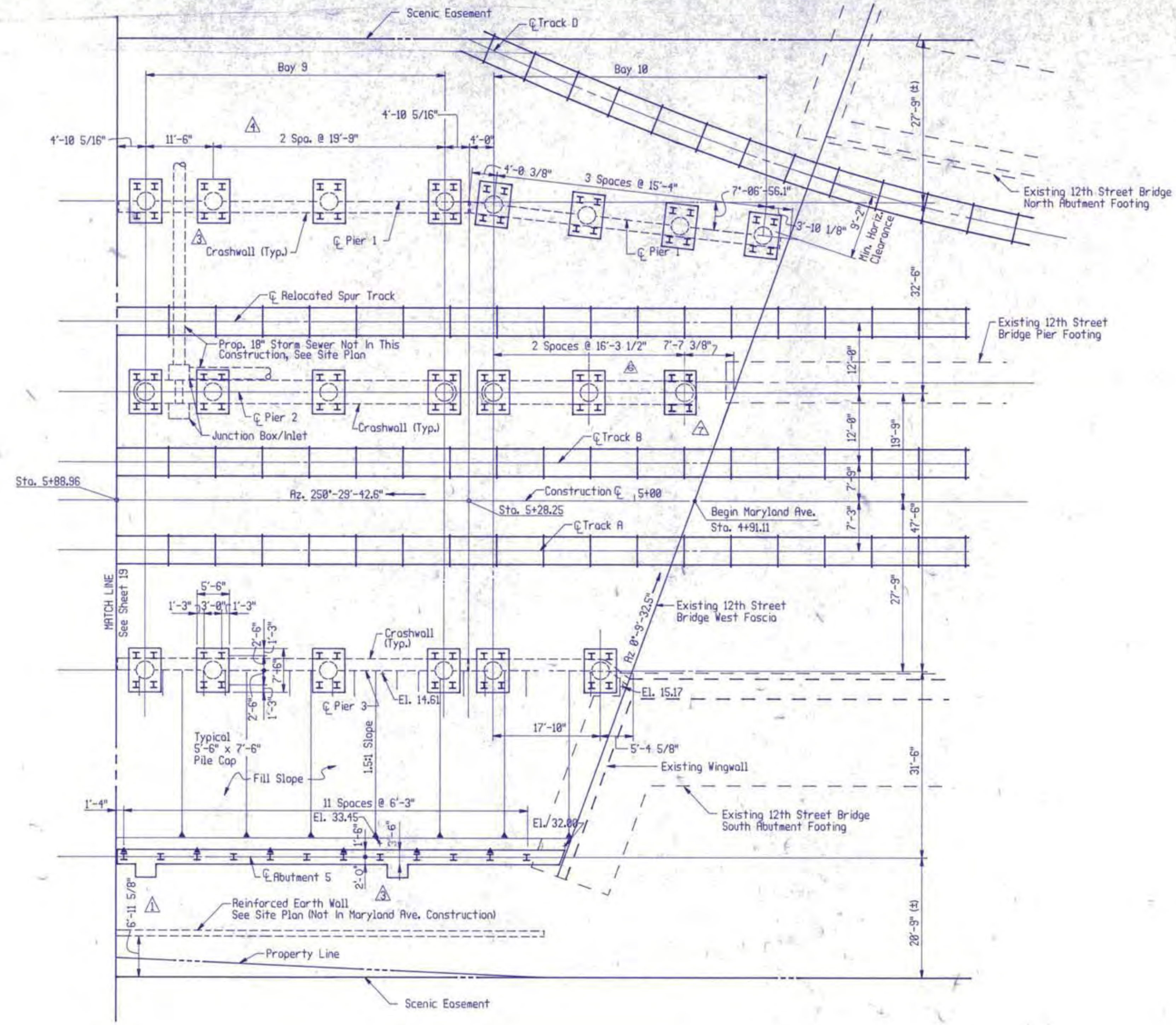
SUBSTRUCTURE LAYOUT - 2

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

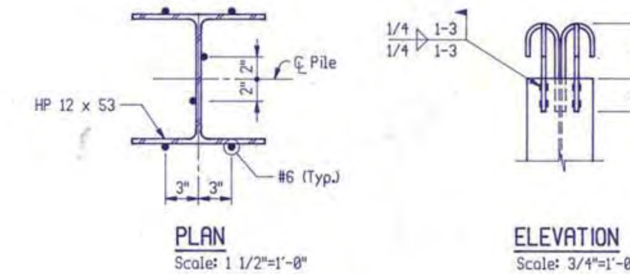
Drawn By LH
Designed By CL
Checked By RLE
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B19 of 105
File Number

13

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 14/56



SUBSTRUCTURE LAYOUT -3
SCALE: 3/32" = 1'-0"



STEEL PILE ANCHORAGE DETAIL

Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

SUBSTRUCTURE LAYOUT - 3

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

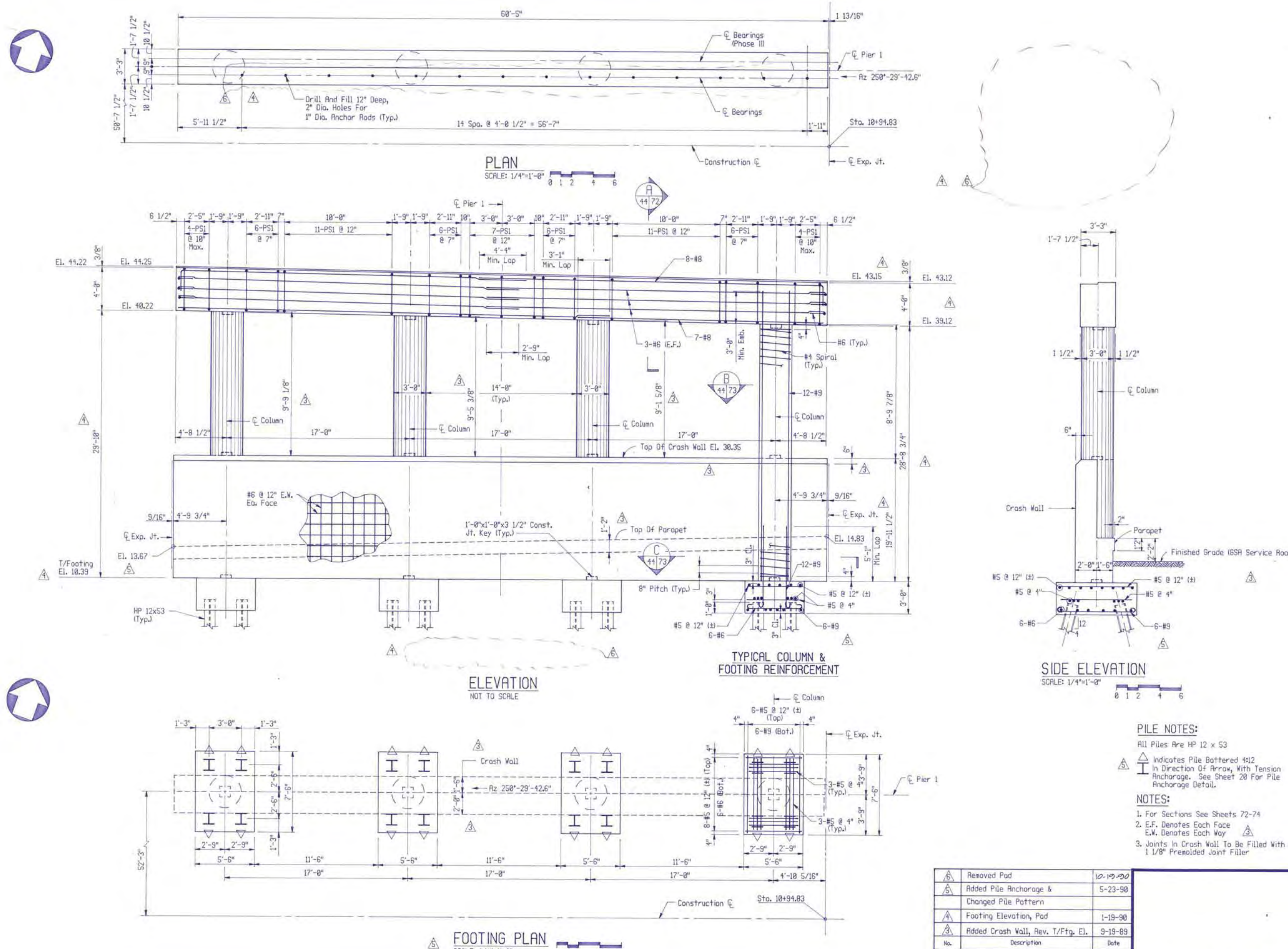
Drawn By LH
Designed By CL
Checked By RLE
Date JULY 1989
Scale As Noted
Plan Number
Zoned
Sheet B20 of 105
File Number

REVISIONS

No.	Description	Date
7	Moved A Footing	7-24-90
6	Revised Pile Pattern	5-23-90
5	Added Pile Anchorage Detail	3-22-90
4	Changed Pier Bay 9 Column Spacing	3-2-90
3	As Noted	9-19-89
1	Light Pole Support & R.E. Wall	8-14-89

ENGINEER'S SEAL & SIGNATURE

PORTAL20 - SUBSTR3
13



PILE NOTES:

All Piles Are HP 12 x 53

Indicates Pile Battered 4:12 In Direction Of Arrow, With Tension Anchorage. See Sheet 20 For Pile Anchorage Detail.

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
6	Removed Pad	10-19-90
5	Added Pile Anchorage & Changed Pile Pattern	5-23-90
4	Footing Elevation, Pad	1-19-90
3	Added Crash Wall, Rev. T/Ftg. El.	9-19-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

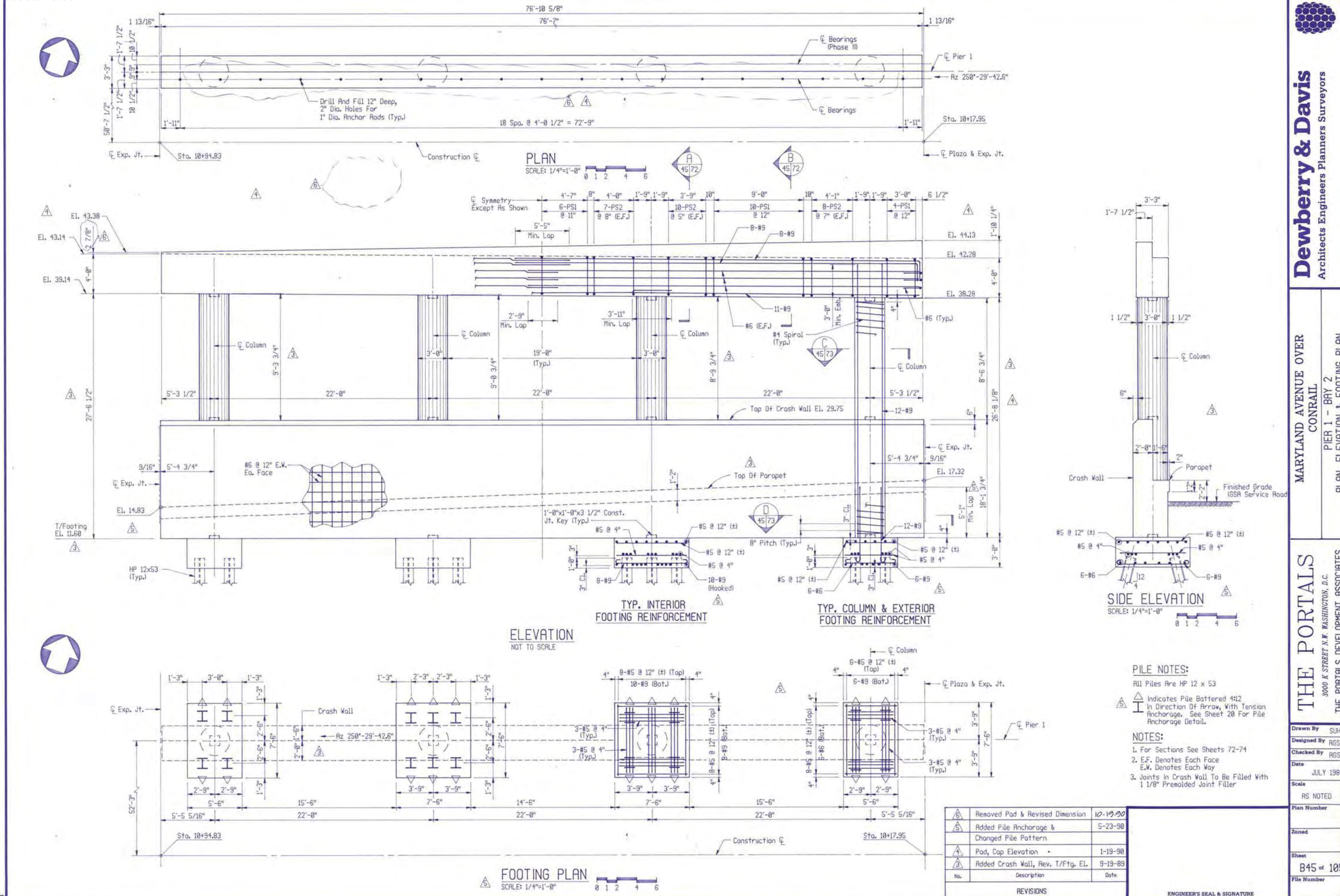
MARYLAND AVENUE OVER CONRAIL
PIER 1 - BAY 1
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

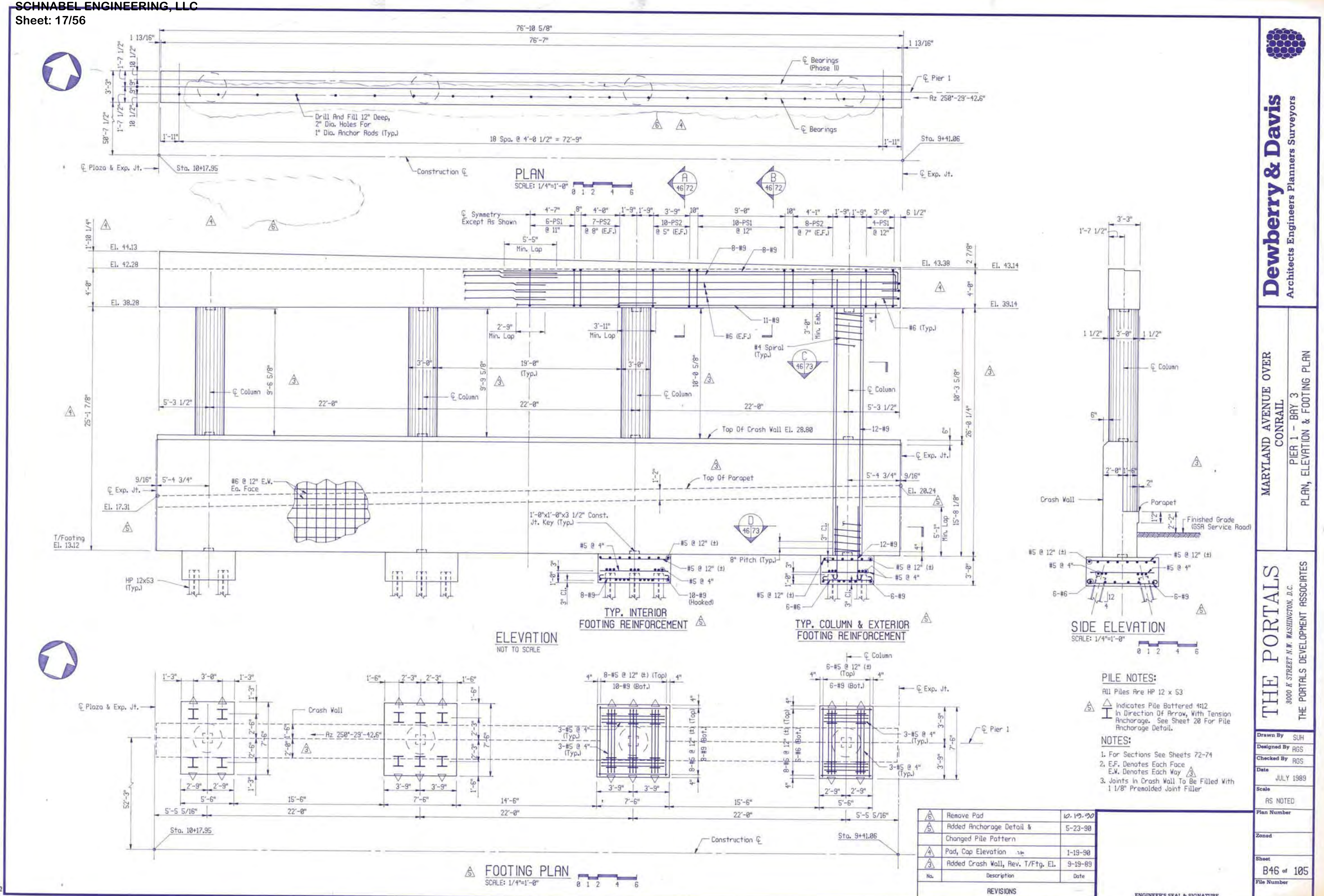
Drawn By: SUH
Designed By: RGS
Checked By: RGS
Date: JULY 1989
Scale: AS NOTED
Sheet: B44 of 105

PORTAL20 - PIER1I
13

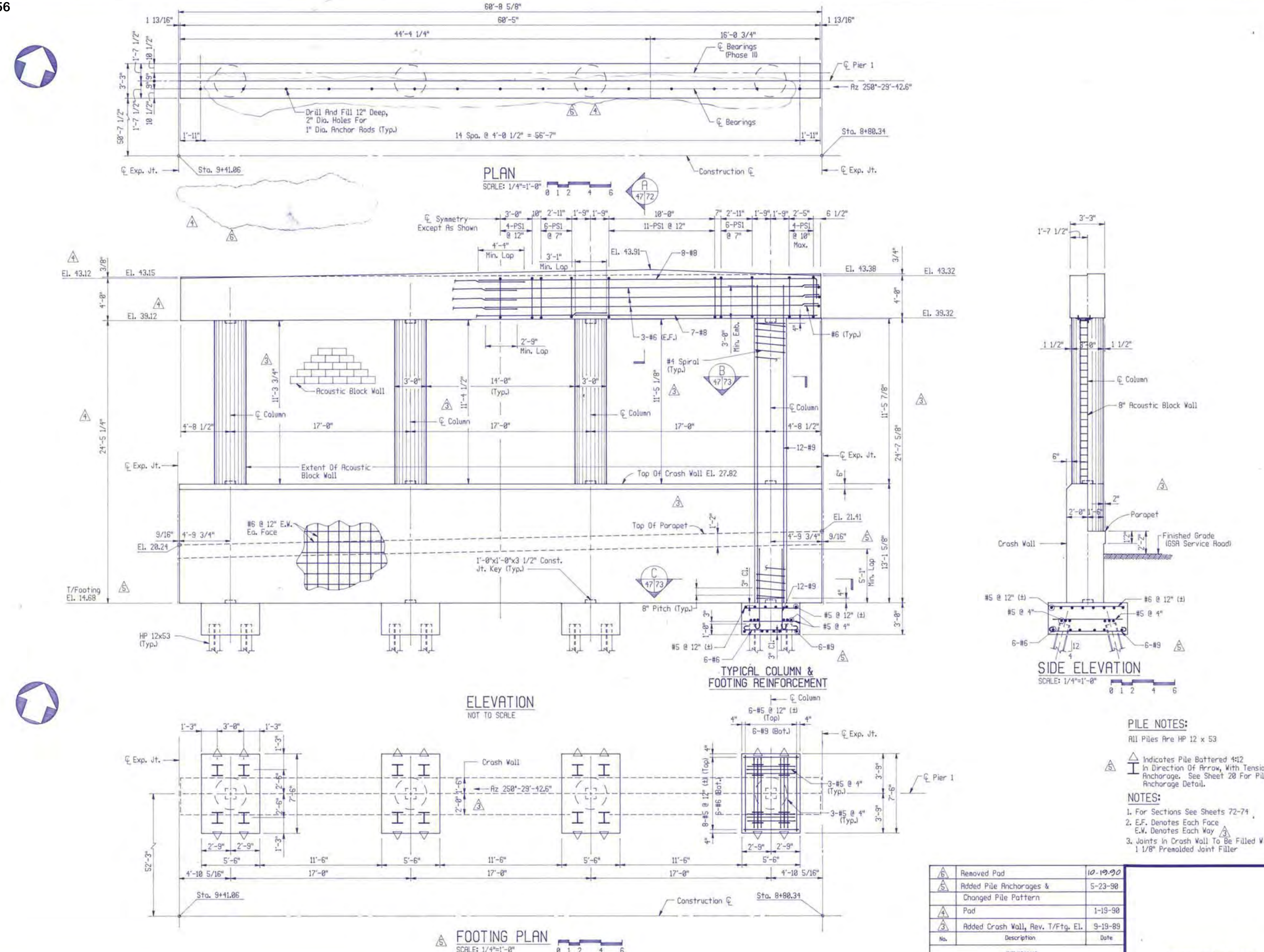
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 16/56



APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 17/56



APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 18/56



PILE NOTES:

All Piles Are HP 12 x 53

Indicates Pile Battered 4:12 In Direction Of Arrow, With Tension Anchorage. See Sheet 20 For Pile Anchorage Detail.

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
6	Removed Pad	10-19-90
5	Added Pile Anchorages & Changed Pile Pattern	5-23-90
4	Pad	1-19-90
3	Added Crash Wall, Rev. T/Ftg. El.	9-19-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

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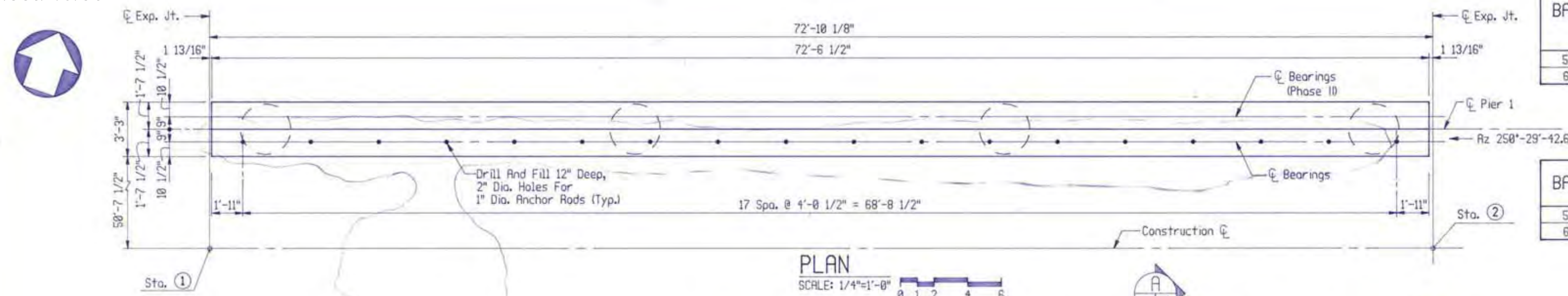
MARYLAND AVENUE OVER CONRAIL
PIER 1 - BAY 4
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By SUH
Designed By RGS
Checked By RGS
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B47 of 105
File Number

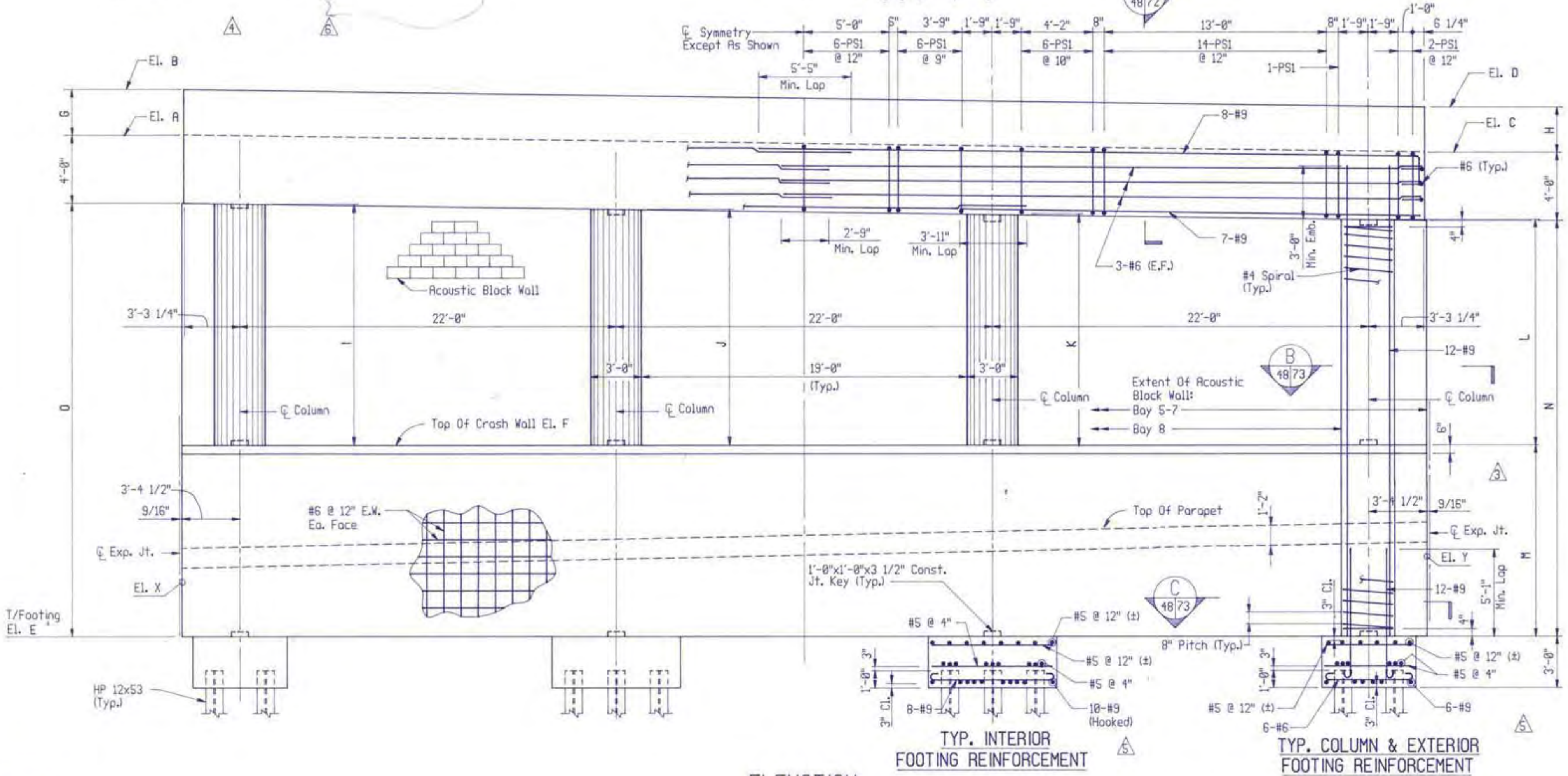
PORTAL20 - PIER14



PLAN
SCALE: 1/4"=1'-0"

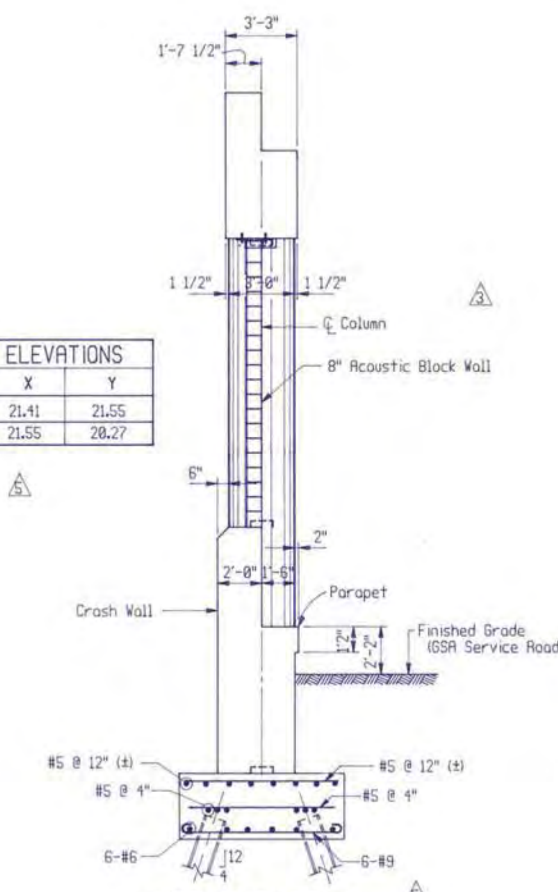
BAY	STATIONS		ELEVATIONS							
	①	②	A NORTH	B SOUTH	C NORTH	D SOUTH	E	F	G	H
5	8+80.34	8+07.50	40.67	43.30	39.88	42.52	15.89	27.03	2'-7 5/8"	2'-7 5/8"
6	8+07.50	7+34.65	39.87	42.51	37.90	40.54	15.21	26.12	2'-7 5/8"	2'-7 5/8"

BAY	DIMENSIONS						
	I	J	K	L	M	N	O
5	9'-7"	9'-4 1/8"	9'-1 1/4"	8'-10"	11'-1 5/8"	19'-11 7/8"	20'-9 3/8"
6	9'-7 1/2"	9'-0 1/4"	8'-5 1/8"	7'-10"	10'-10 7/8"	18'-8 1/4"	20'-7 7/8"

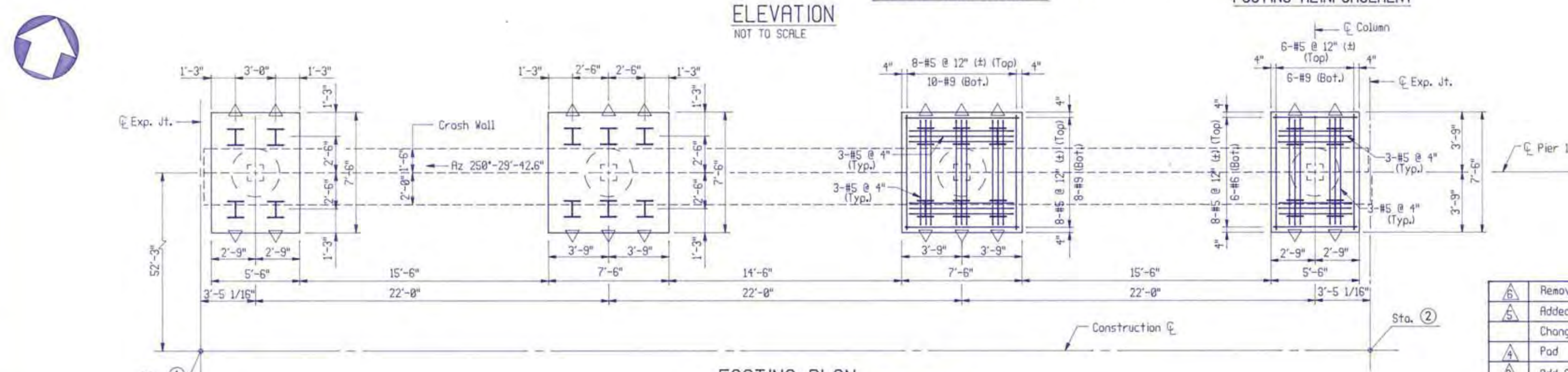


BAY	ELEVATIONS	
	X	Y
5	21.41	21.55
6	21.55	20.27

ELEVATION
NOT TO SCALE



SIDE ELEVATION
SCALE: 1/4"=1'-0"



FOOTING PLAN
SCALE: 1/4"=1'-0"

PILE NOTES:

All Piles Are HP 12 x 53

Indicates Pile Battered 4:12 In Direction Of Arrow, With Tension Anchorage. See Sheet 20 For Pile Anchorage Detail.

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
6	Removed Pad	10-19-90
5	Added Pile Anchorages & Changeed Pile Pattern	5-23-90
4	Pad	1-19-90
3	Add Crash Wall, Rev. T/Ftg. El.	9-19-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

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MARYLAND AVENUE OVER CONRAIL
PIER 1 - BAY 5-6
PLAN, ELEVATION & FOOTING PLAN

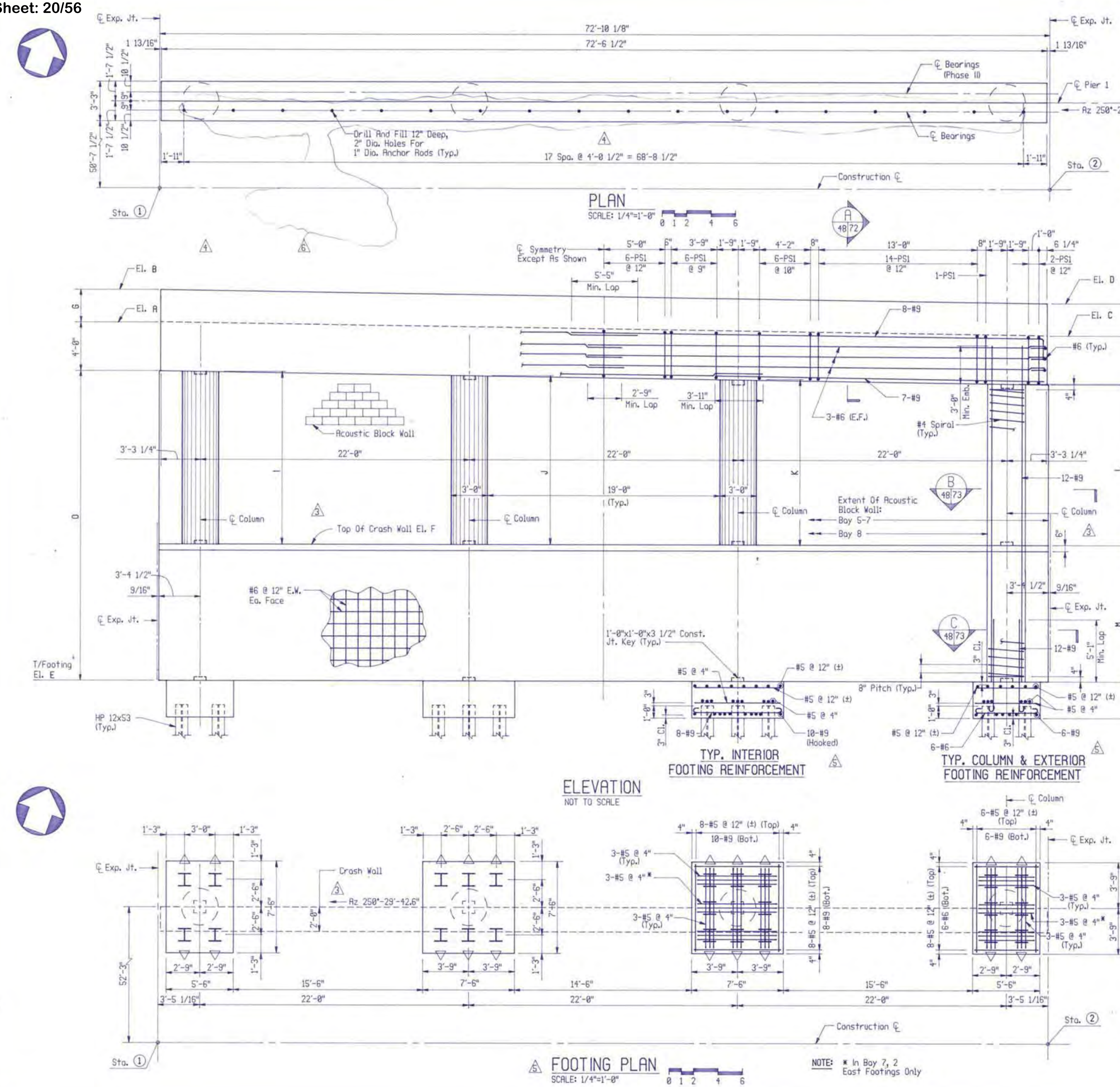
THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

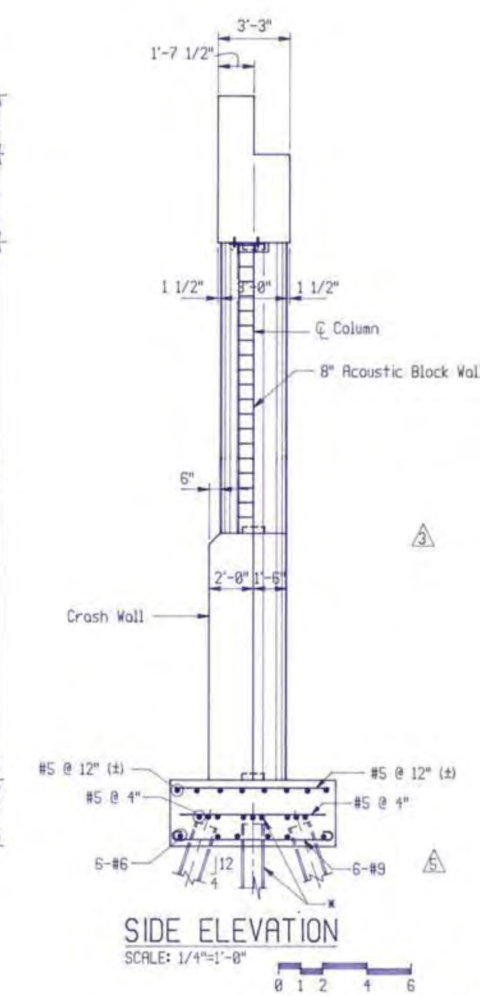
Drawn By SUH
Designed By RGS
Checked By RGS
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B48 of 105
File Number

PORTAL28 - PIER1S-6

BAY	STATIONS		ELEVATIONS							
	①	②	A NORTH	B SOUTH	C NORTH	D SOUTH	E	F	G	H
7	7+34.65	6+61.81	37.89	40.53	35.83	38.46	14.35	25.26	2'-7 5/8"	2'-7 5/8"
8	6+61.81	5+88.96	35.82	38.45	33.75	36.39	13.40	24.39	2'-7 5/8"	2'-7 5/8"

BAY	DIMENSIONS						
	I	J	K	L	M	N	O
7	8'-5 7/8"	7'-10 1/2"	7'-3"	6'-7 1/2"	10'-10 7/8"	17'-5 3/4"	19'-6 1/2"
8	7'-3 1/2"	6'-8"	6'-0 1/2"	5'-4 7/8"	10'-11 7/8"	16'-4 1/4"	18'-5"





PILE NOTES:

All Piles Are HP 12 x 53

- Indicates Vertical Pile In Bay 7 Only
- Indicates Pile Battered 4:12 In Direction Of Arrow, With Tension Anchorage. See Sheet 20 For Pile Anchorage Detail.

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
6	Removed Pad	10-19-90
5	Added Pile Anchorages & Revised Pile Pattern	5-23-90
4	Pad	1-19-90
	Added This Sheet, B48a	
3	Add Crash Wall, Rev. T/Ftg. El.	9-19-89

REVISIONS

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MARYLAND AVENUE OVER CONRAIL

PIER 1 – BAY 7-8
PLAN, ELEVATION & FOOTING PLAN

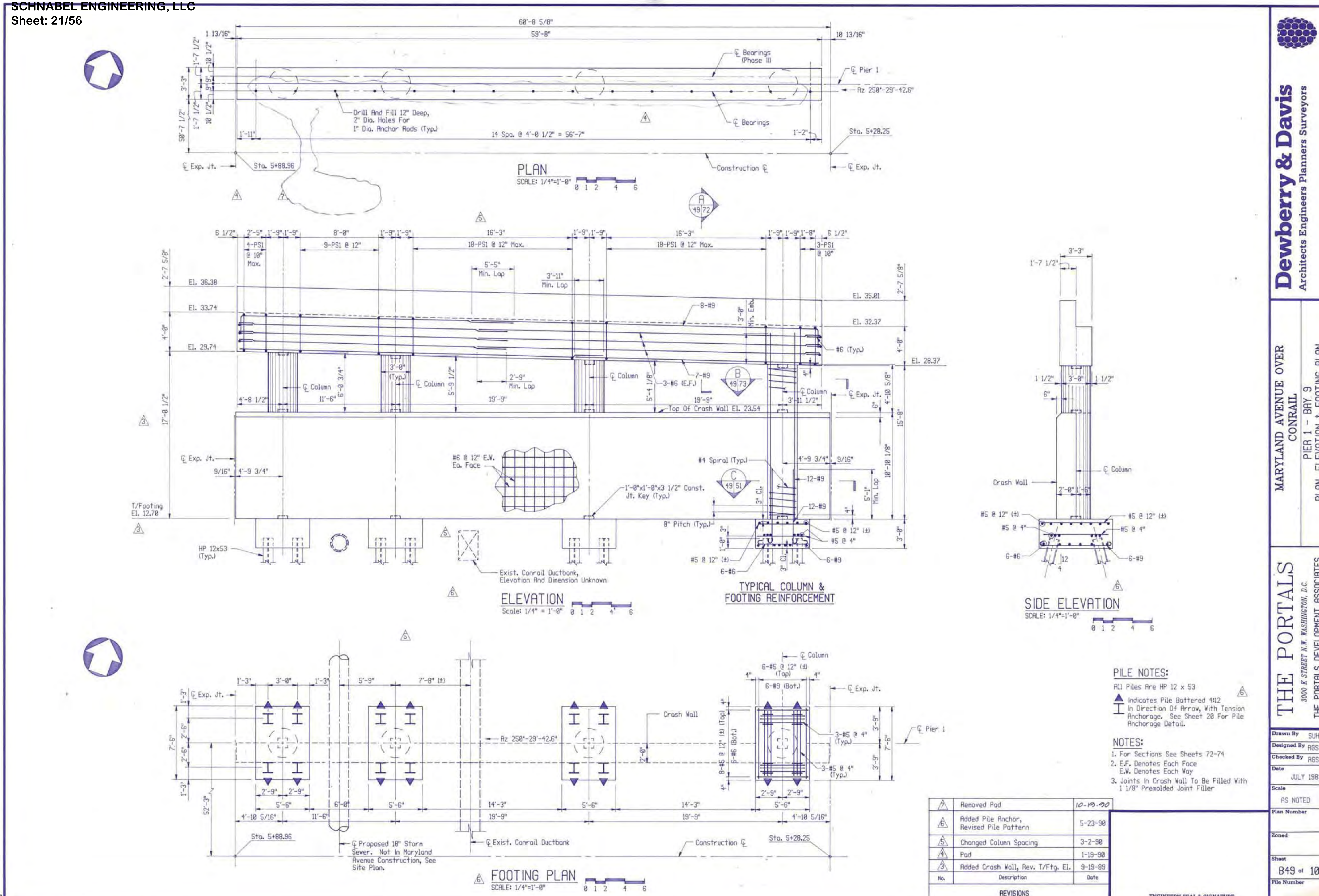
THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

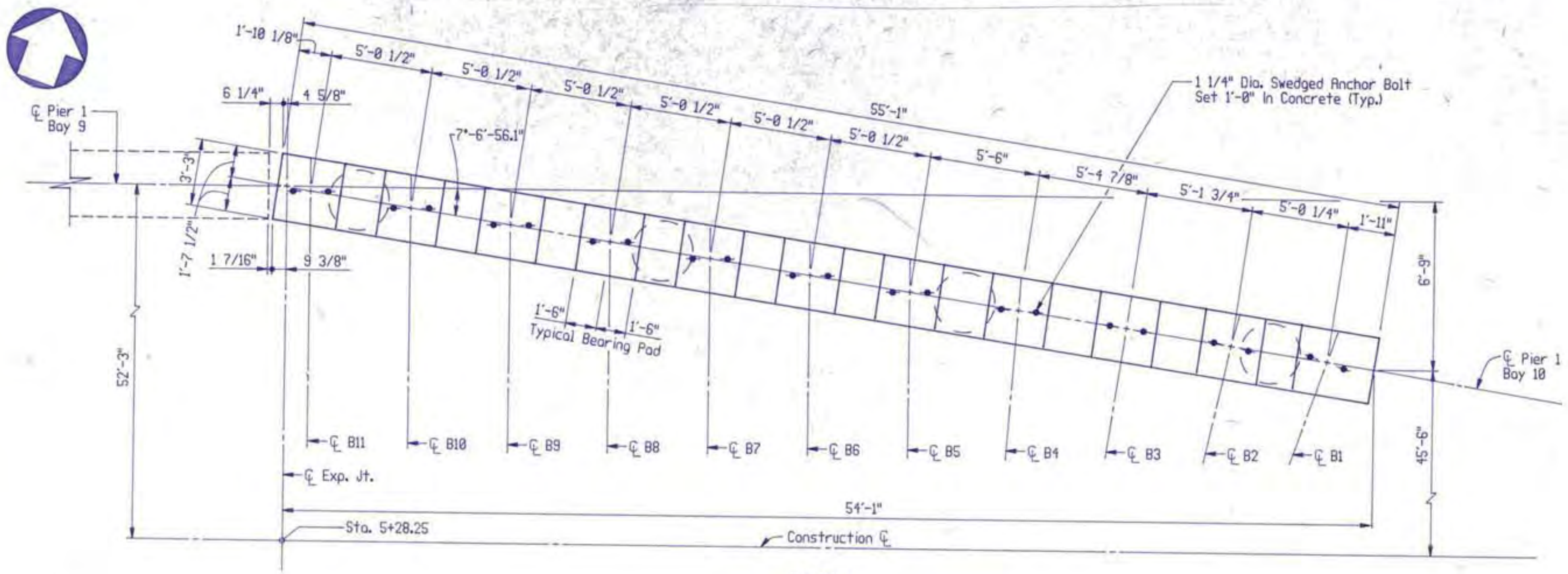
Drawn By SUH
Designed By RGS
Checked By RGS
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B48a of 105
File Number

PORTAL20 – PIER17-8

13

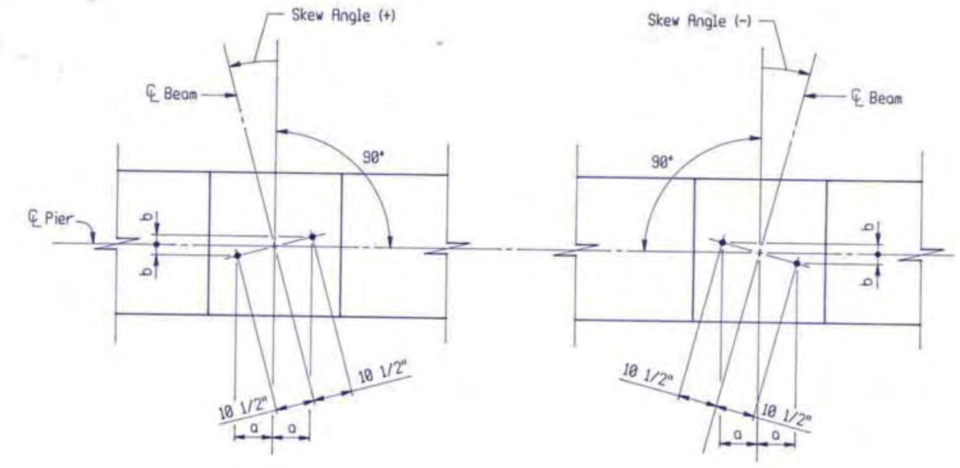
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 21/56





PLAN

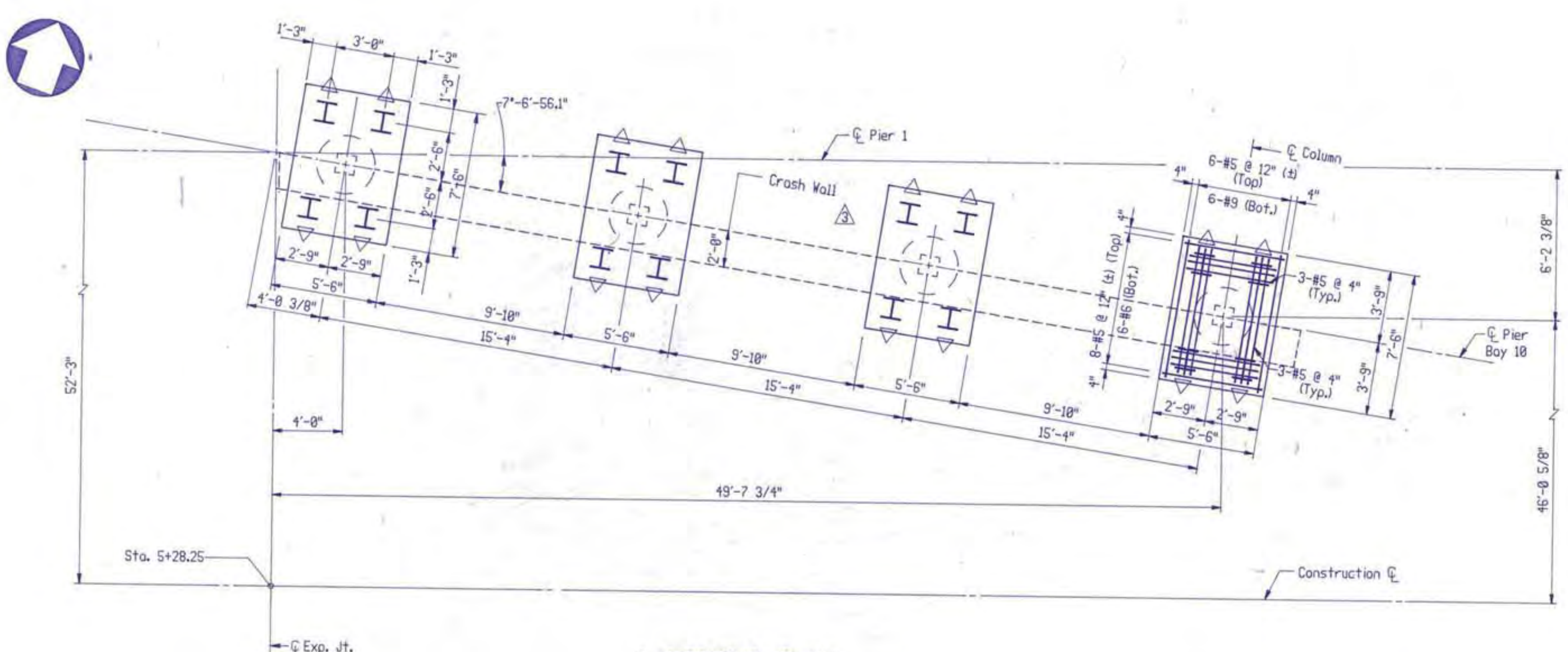
Scale: 1/4" = 1'-0"



ANCHOR BOLT LAYOUT

Scale: 1/2" = 1'-0"

BEAM	Skew Angle	a	b
B1	- 12°-32'-53.8"	10 1/4"	2 5/16"
B2	5 -7°-9'-56.3"	10 7/16"	1 5/16" 5
B3	- 1°-30'-48.7"	10 1/2"	1/4"
B4	2°-46'-35.3"	10 1/2"	1/2"
B5-B11	7°-6'-56.1"	10 7/16"	1 5/16"



4 FOOTING PLAN

SCALE: 1/4"=1'-0"

PILE NOTES:

All Piles Are HP 12 x 53

4 Indicates Pile Battered 4:12 In Direction Of Arrow, With Tension Anchorage. See Sheet 20 For Pile Anchorage Detail.

No.	Description	Date
5	Revised Beam Skew	10-10-90
4	Changed Pile Pattern & Added Pile Anchorages	5-23-90
3	As Noted	9-19-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

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Architects Engineers Planners Surveyors
8401 Arlington Blvd., Fairfax, VA 22031
703 849-0100

MARYLAND AVENUE OVER CONRAIL

PIER 1 - BAY 10
PLAN & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By: LH
Designed By: RGS
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Date: JULY 1989
Scale: AS NOTED
Plan Number:
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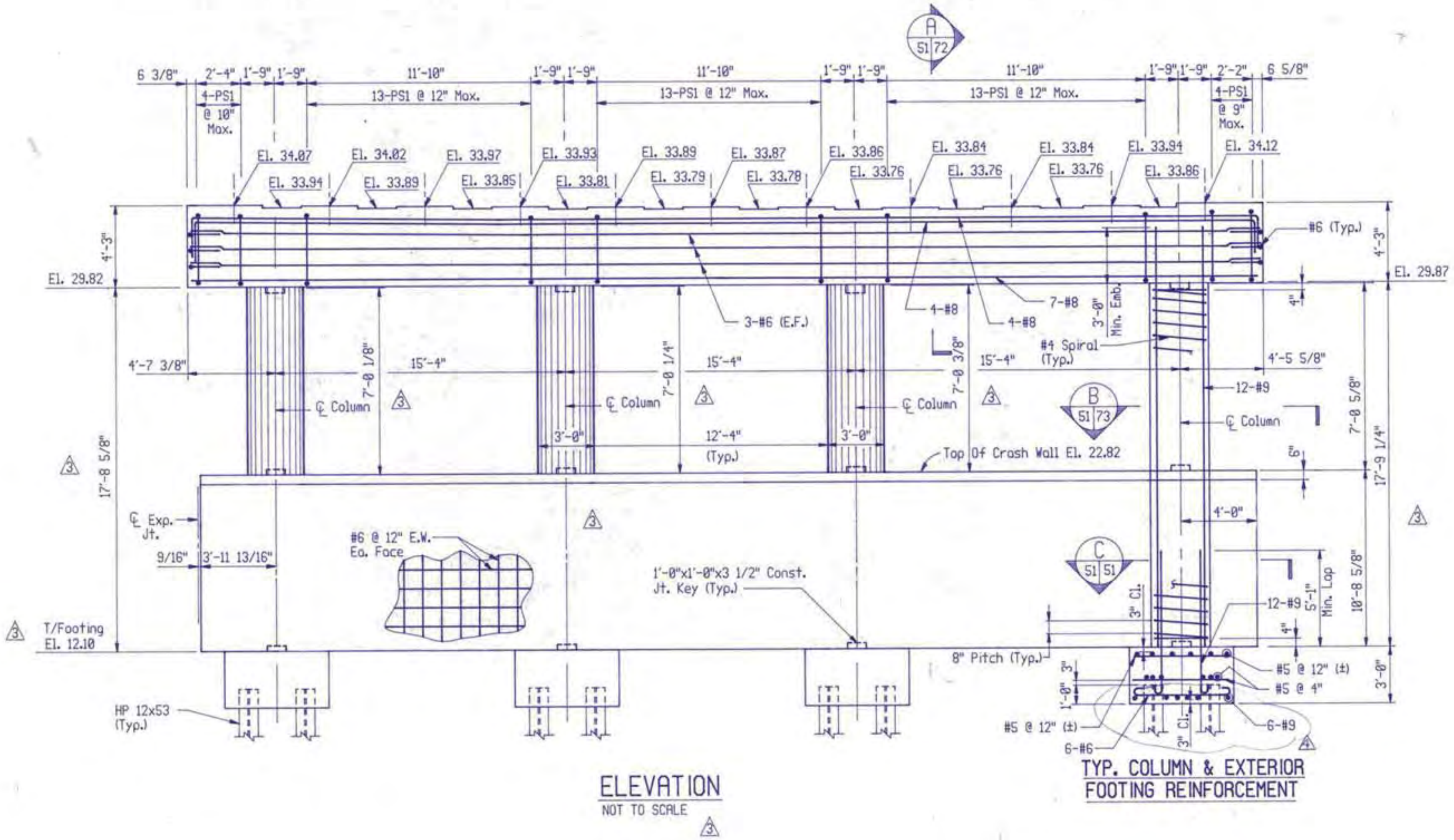
Sheet: B50 of 105
File Number:

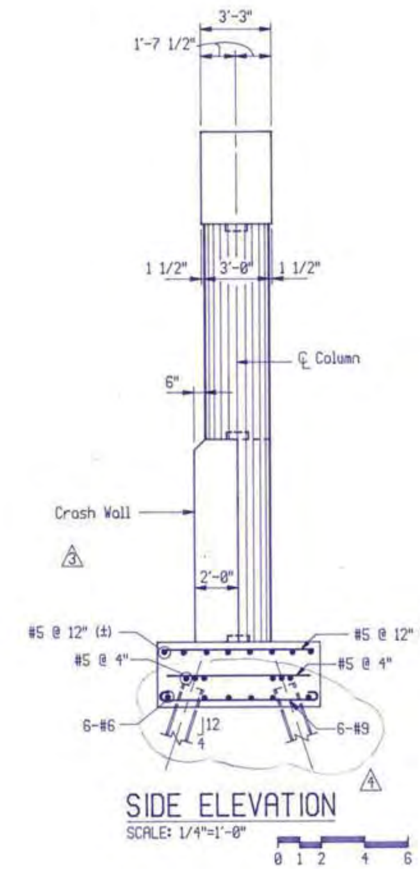
PORTAL20 - PIER10

13

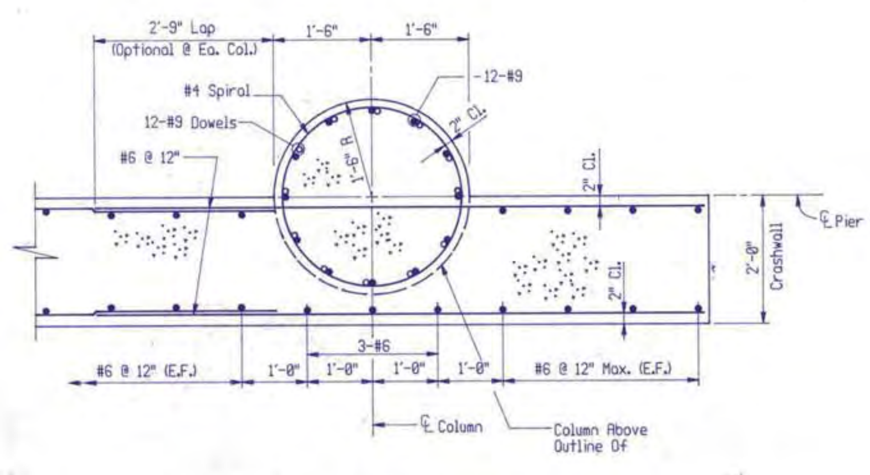


ELEVATION
NOT TO SCALE

TYP. COLUMN & EXTERIOR FOOTING REINFORCEMENT



SIDE ELEVATION
SCALE: 1/4"=1'-0"



C 49/51 C 51/51 SECTION
SCALE: 3/4"=1'-0"

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
4	Revised Pile Pattern & Reinf.	5-23-90
3	Added Crash Wall, Rev. T/Ftg. El.	9-19-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

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Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

PIER 1 - BAY 10 ELEVATION

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By	LH
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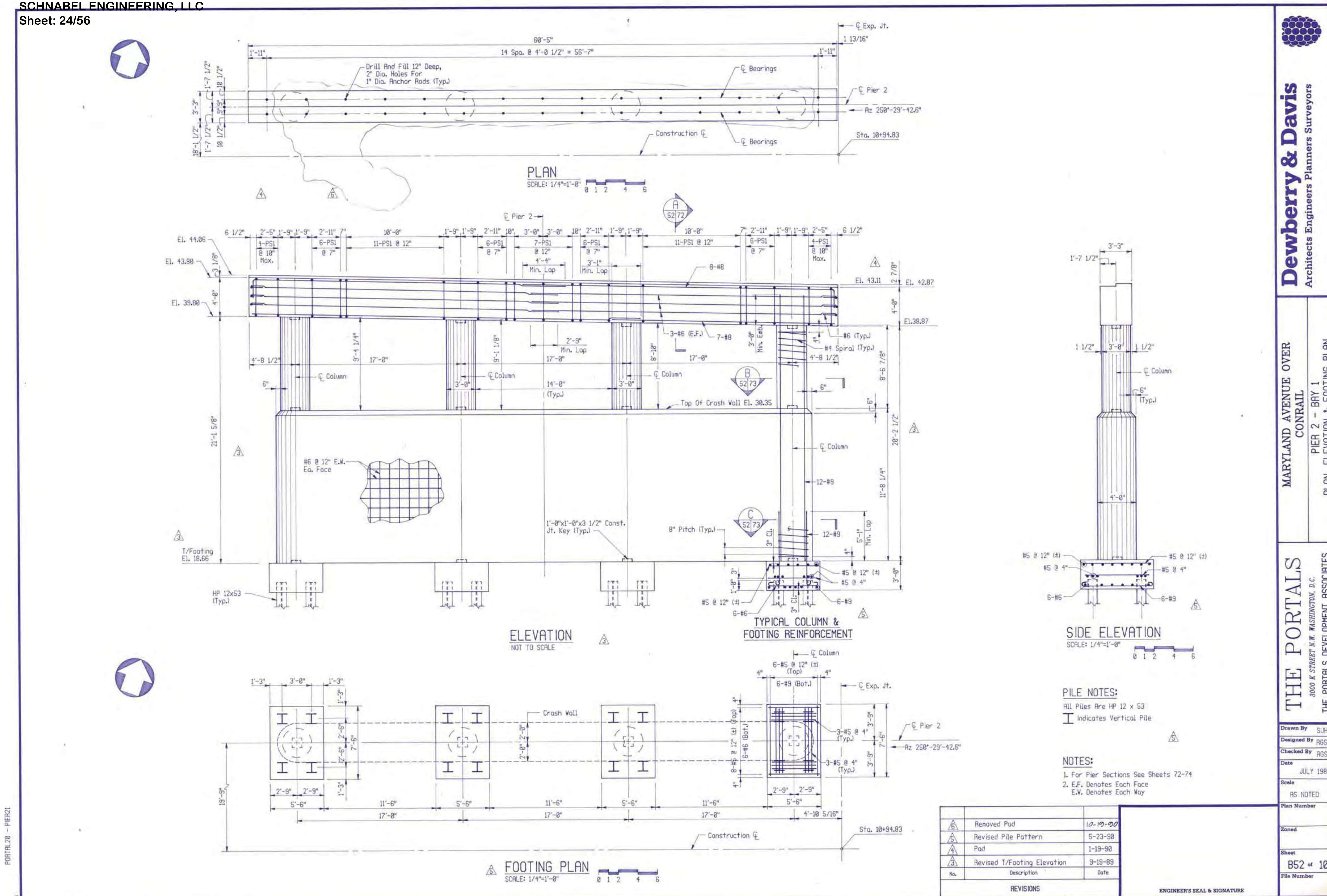
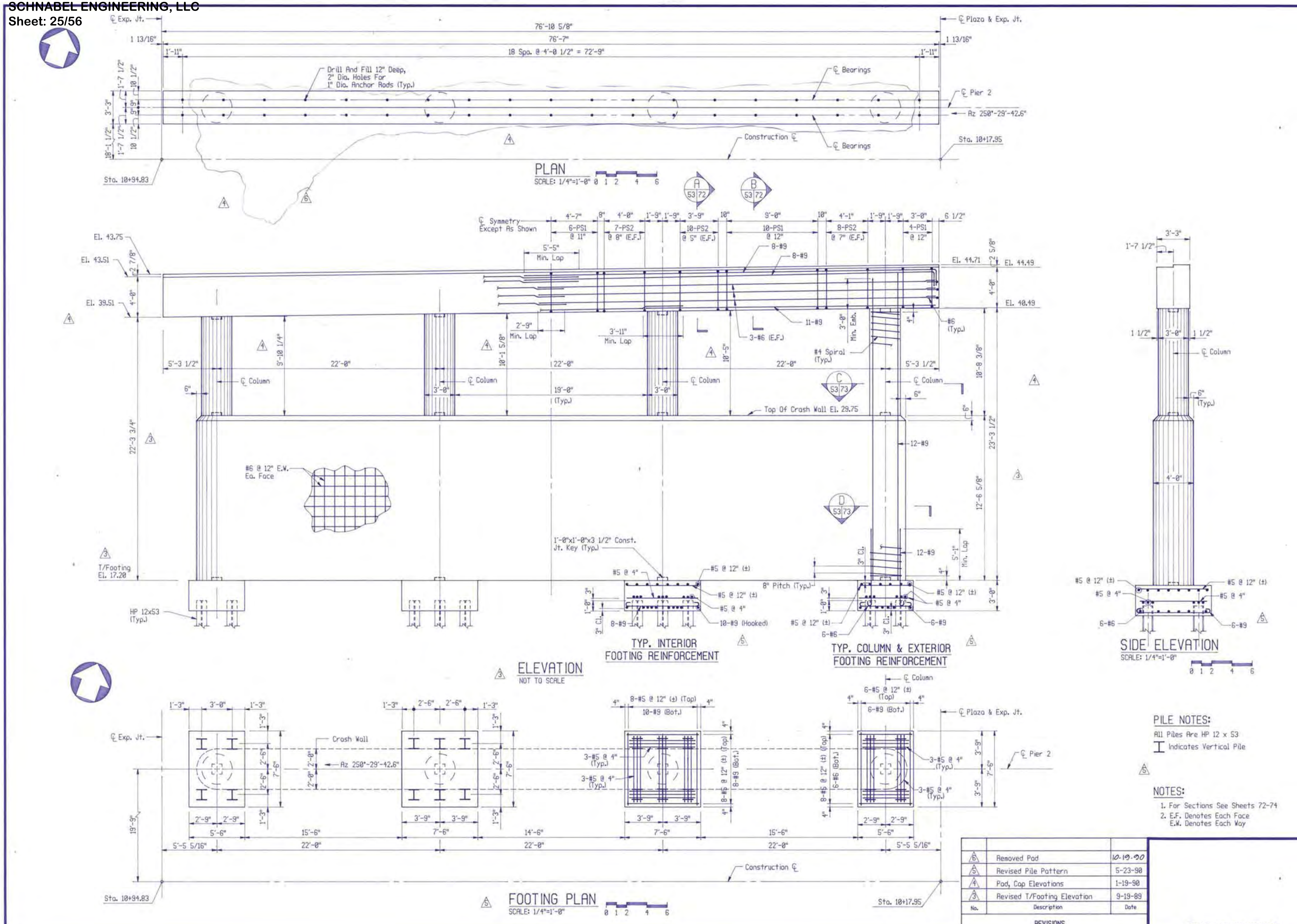
Checked By	RGS
Date	JULY 1989
Scale	AS NOTED
Plan Number	
Zoned	
Sheet	B51 of 105
File Number	

PORTAL20 - PIR110EL

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 24/56





PILE NOTES:
All Piles Are HP 12 x 53
Ɪ Indicates Vertical Pile

NOTES:
1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
E.W. Denotes Each Way

No.	Description	Date
6	Removed Pad	10-19-90
5	Revised Pile Pattern	5-23-90
4	Pad, Cap Elevations	1-19-90
3	Revised T/Footing Elevation	9-19-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

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Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL
PIER 2 - BAY 2
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

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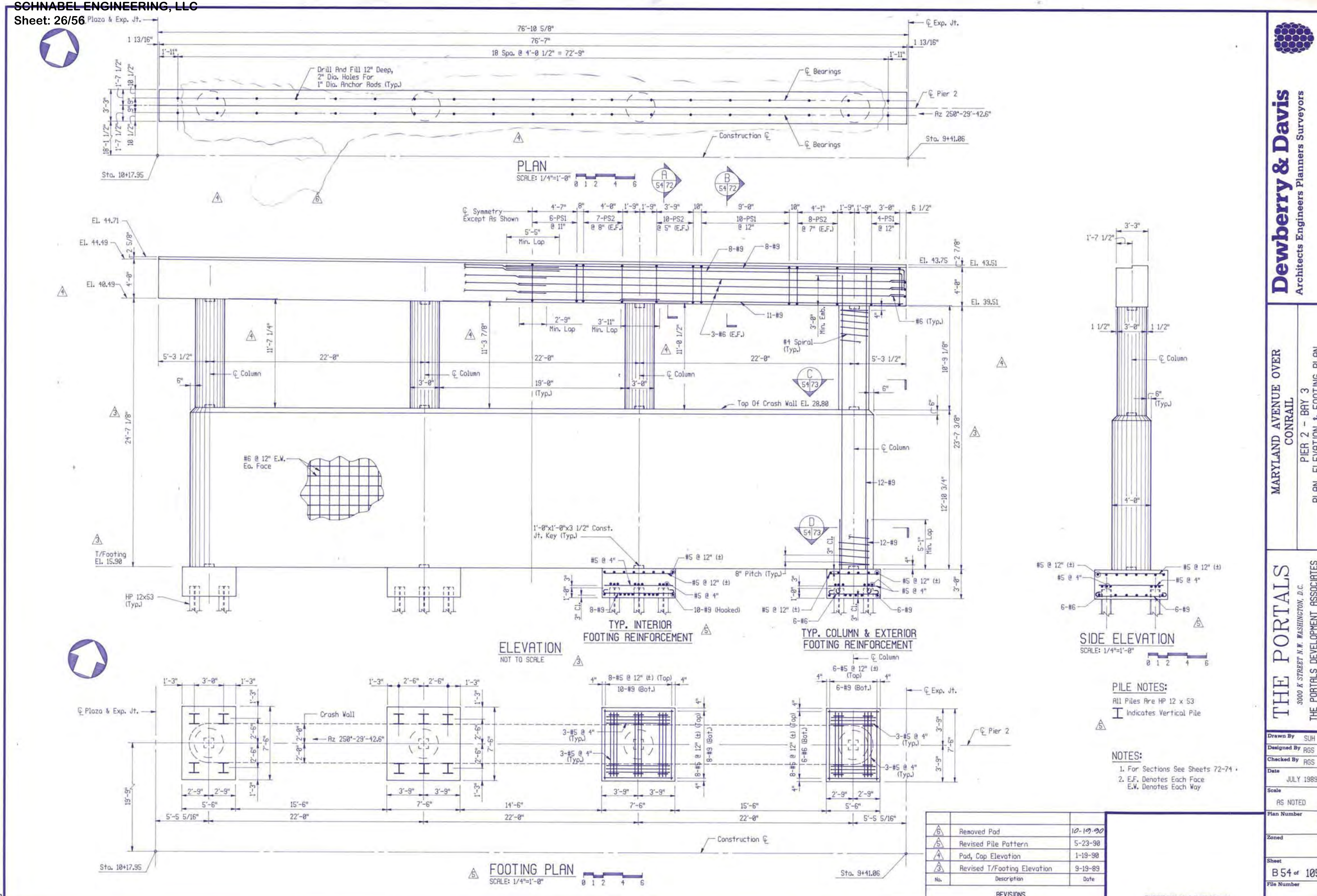
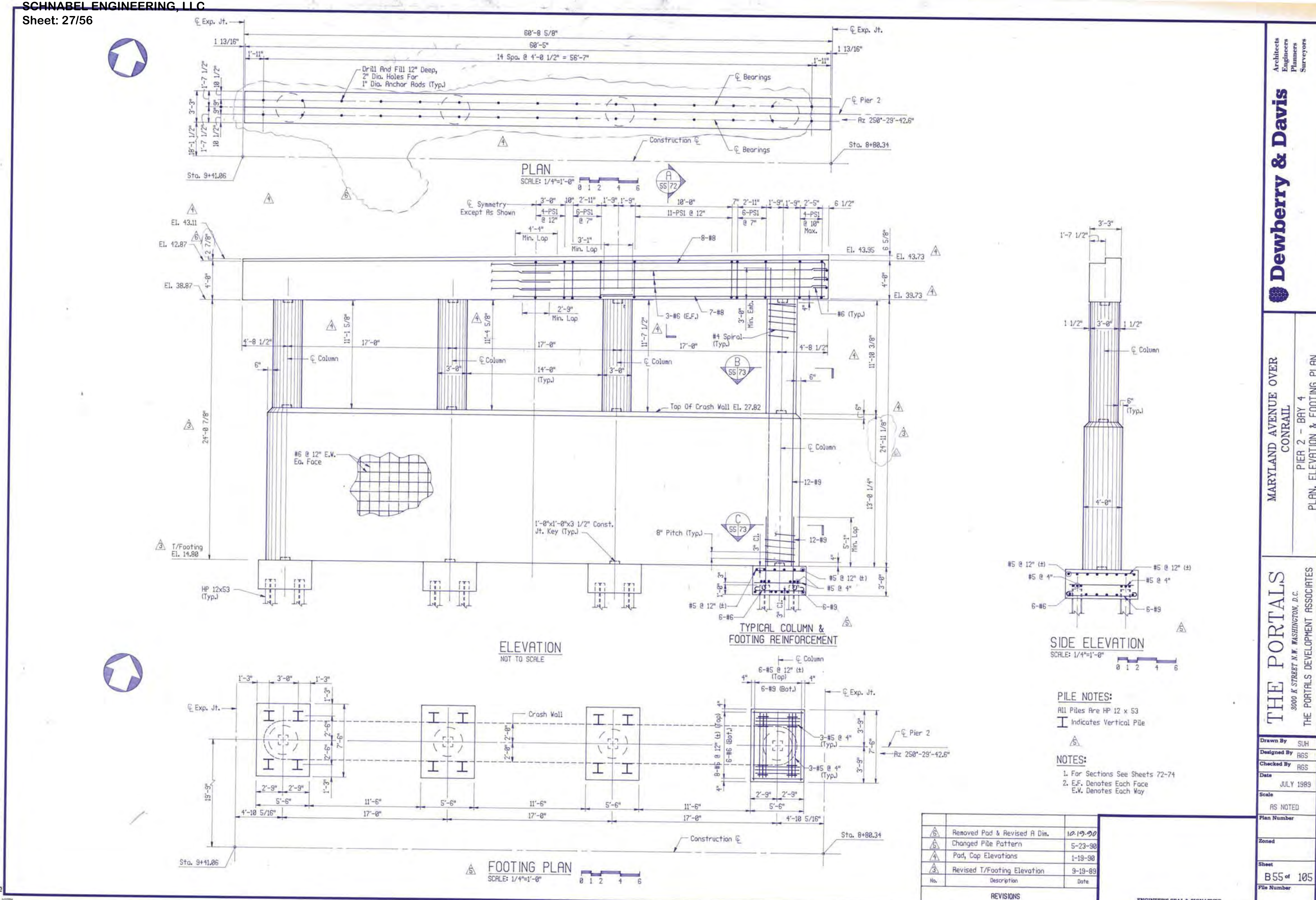
Checked By RGS
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B53 of 105
File Number

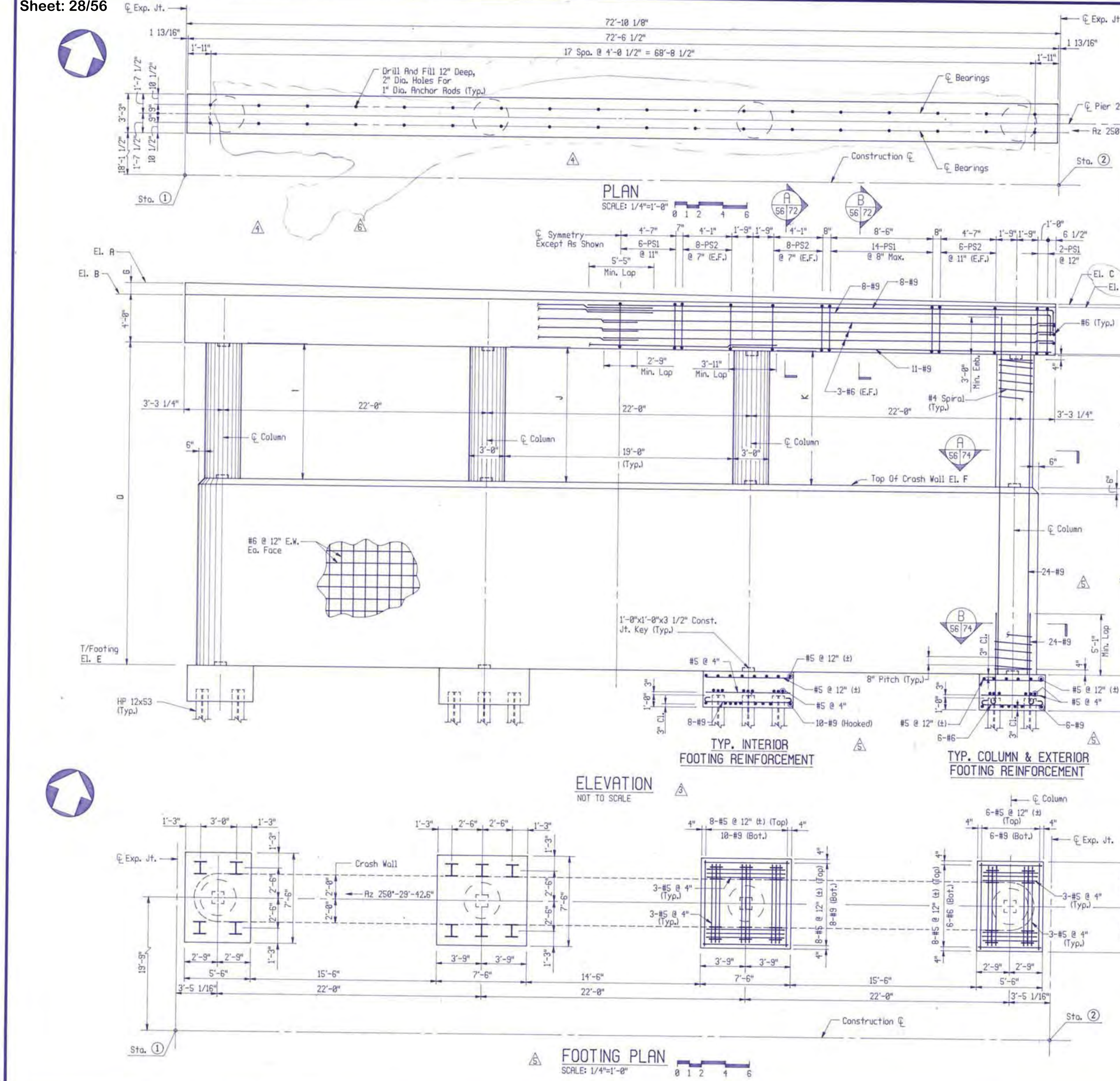
PORTAL20 - PIER22

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 26/56



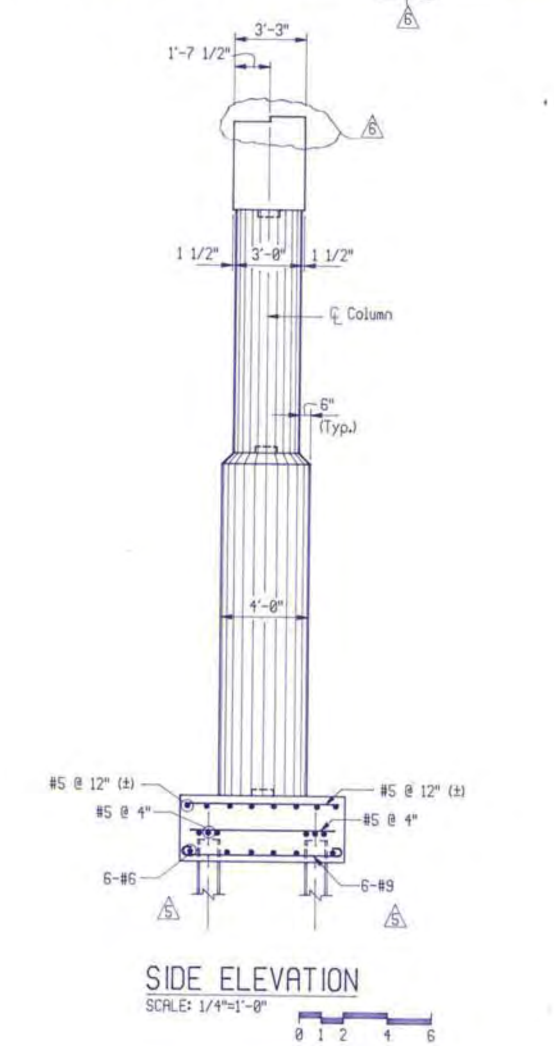
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 27/56





BAY	STATIONS		ELEVATIONS							
	①	②	A NORTH	B SOUTH	C NORTH	D SOUTH	E	F	G	H
5	8+80.34	8+07.50	43.95	43.71	43.16	43.07	13.54	27.03	0'-2 7/8"	0'-1 1/8"
6	8+07.50	7+34.65	43.16	42.14	41.18	41.09	12.45	26.12	1'-0 1/4"	0'-1 1/8"
7	7+34.65	6+61.81	41.17	40.07	39.11	39.01	11.55	25.26	1'-1 1/4"	0'-1 1/4"
8	6+61.81	5+88.96	39.10	38.00	37.03	36.94	10.84	24.39	1'-1 1/4"	0'-1 1/8"

BAY	DIMENSIONS						
	I	J	K	L	M	N	O
5	12'-7 5/8"	12'-5 3/8"	12'-3"	12'-0 5/8"	13'-5 7/8"	25'-6 3/8"	26'-2"
6	11'-11 3/8"	11'-7 5/8"	11'-3 3/4"	11'-0"	13'-8"	24'-7 5/8"	25'-8 1/4"
7	10'-8 7/8"	10'-5"	10'-1 1/8"	9'-9 1/4"	13'-8 1/2"	23'-5 1/2"	24'-6 1/4"
8	9'-6 1/2"	9'-2 5/8"	8'-10 3/4"	8'-6 7/8"	13'-6 5/8"	22'-1 1/4"	23'-1 7/8"



SIDE ELEVATION
SCALE: 1/4"=1'-0"

PILE NOTES:
All Piles Are HP 12 x 53
Indicates Vertical Pile

NOTES:
1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
E.W. Denotes Each Way

No.	Description	Date
6	Removed Pad & Revised Dims.	10-19-90
5	Changed Pile Pattern	5-23-90
4	Pad	1-19-90
3	Revised T/Footing Elevation	9-19-89
1	Revised Cap Elevations	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

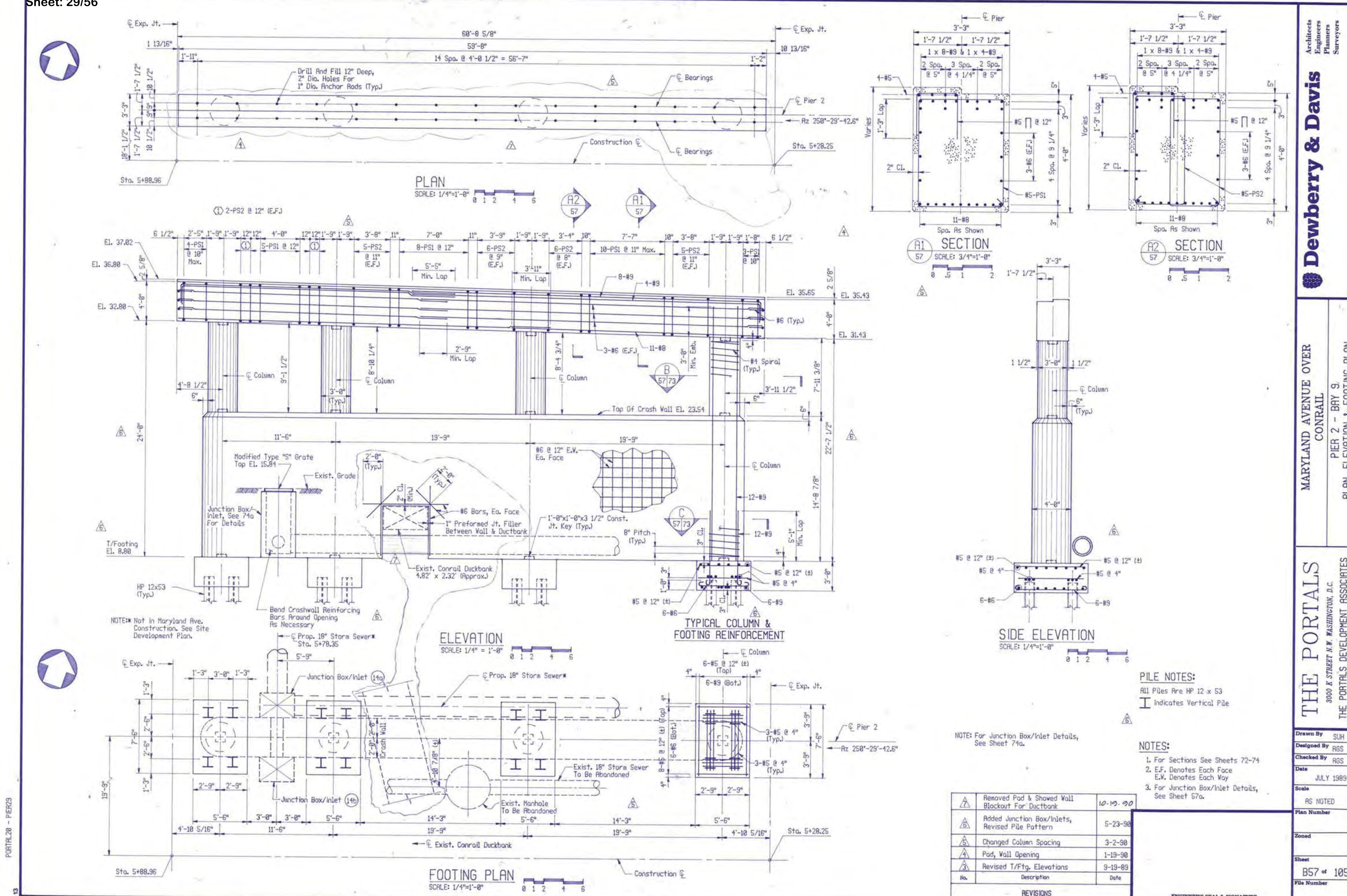
Dewberry & Davis
Architects Engineers Planners Surveyors

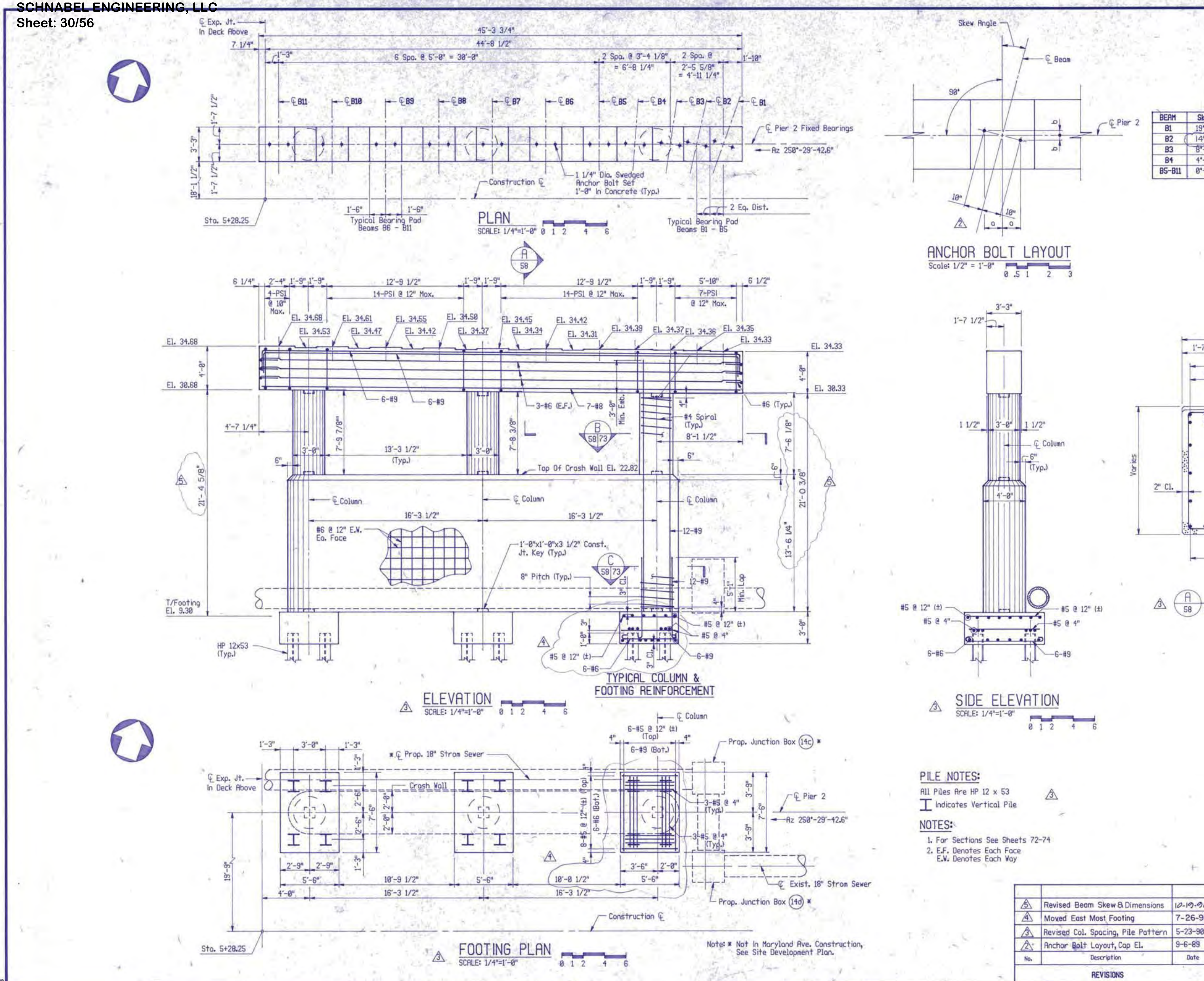
MARYLAND AVENUE OVER CONRAIL
PIER 2 - BAY 5-8
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By SUH
Designed By RGS
Checked By RGS
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B56 of 105
File Number

PORTAL20 - PIER25-8


PLAN
SCALE: 1/4"=1'-0"
Drill And Fill 12" Deep, 2" Dia. Holes For 1" Dia. Anchor Rods (Typ.)
℄ Exp. Jt.
℄ Bearings
℄ Pier 2
Az 250°-29'-42.6"
Construction ℄
Sta. 5+28.25
Sta. 5+88.96
60'-8 5/8"
59'-8"
14 Spa. @ 4'-0 1/2" = 56'-7"
ELEVATION
SCALE: 1/4" = 1'-0"
Top Of Crash Wall El. 23.54
Modified Type "S" Grate Top El. 15.84
Exist. Grade
Junction Box/Inlet, See 74a For Details
#6 @ 12" E.W. Ea. Face
#6 Bars, Ea. Face
1" Preformed Jt. Filler Between Wall & Ductbank
1'-0"x1'-0"x3 1/2" Const. Jt. Key (Typ.)
Exist. Conrail Ductbank 4.82' x 2.32' (Approx.)
Bend Crashwall Reinforcing Bars Around Opening As Necessary
HP 12x53 (Typ.)
T/Footing El. 8.80
NOTE:* Not In Maryland Ave. Construction. See Site Development Plan.
TYPICAL COLUMN & FOOTING REINFORCEMENT
SECTION A1 57
SCALE: 3/4"=1'-0"
SECTION A2 57
SCALE: 3/4"=1'-0"
SIDE ELEVATION
SCALE: 1/4"=1'-0"
FOOTING PLAN
SCALE: 1/4"=1'-0"
℄ Prop. 18" Storm Sewer* Sta. 5+78.35
Junction Box/Inlet (14a)
Junction Box/Inlet (14b)
Exist. 18" Storm Sewer To Be Abandoned
Exist. Manhole To Be Abandoned
℄ Exist. Conrail Ductbank
PILE NOTES:
All Piles Are HP 12 x 53
Indicates Vertical Pile
NOTE: For Junction Box/Inlet Details, See Sheet 74a.
NOTES:
1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
E.W. Denotes Each Way
3. For Junction Box/Inlet Details, See Sheet 57a.
REVISIONS
7 Removed Pad & Showed Wall Blockout For Ductbank 10-19-90
6 Added Junction Box/Inlets, Revised Pile Pattern 5-23-90
5 Changed Column Spacing 3-2-90
4 Pad, Wall Opening 1-19-90
3 Revised T/Ftg. Elevations 9-19-89
ENGINEER'S SEAL & SIGNATURE
Dewberry & Davis
Architects Engineers Planners Surveyors
MARYLAND AVENUE OVER CONRAIL
PIER 2 - BAY 9.
PLAN, ELEVATION & FOOTING PLAN
THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES
Drawn By SUH
Designed By RGS
Checked By RGS
Date JULY 1989
Scale AS NOTED
Sheet B57 of 105
PORTAL20 - PIER29



BEAM	Skew Angle	a	b
B1	19°-39'-49.9"	9 7/16"	3 3/8"
B2	14°-16'-52.4"	9 11/16"	2 7/16"
B3	8°-37'-44.9"	9 7/8"	1 1/2"
B4	4°-20'-20.8"	10"	3/4"
B5-B11	0°-00'-00.0"	10"	0"

PILE NOTES:

All Piles Are HP 12 x 53

I Indicates Vertical Pile

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way

REVISIONS

No.	Description	Date
5	Revised Beam Skew & Dimensions	10-19-90
4	Moved East Most Footing	7-26-90
3	Revised Col. Spacing, Pile Pattern	5-23-90
2	Anchor Bolt Layout, Cap El.	9-6-89

ENGINEER'S SEAL & SIGNATURE

Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL
PIER 2 - BAY 10
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

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Designed By RGS
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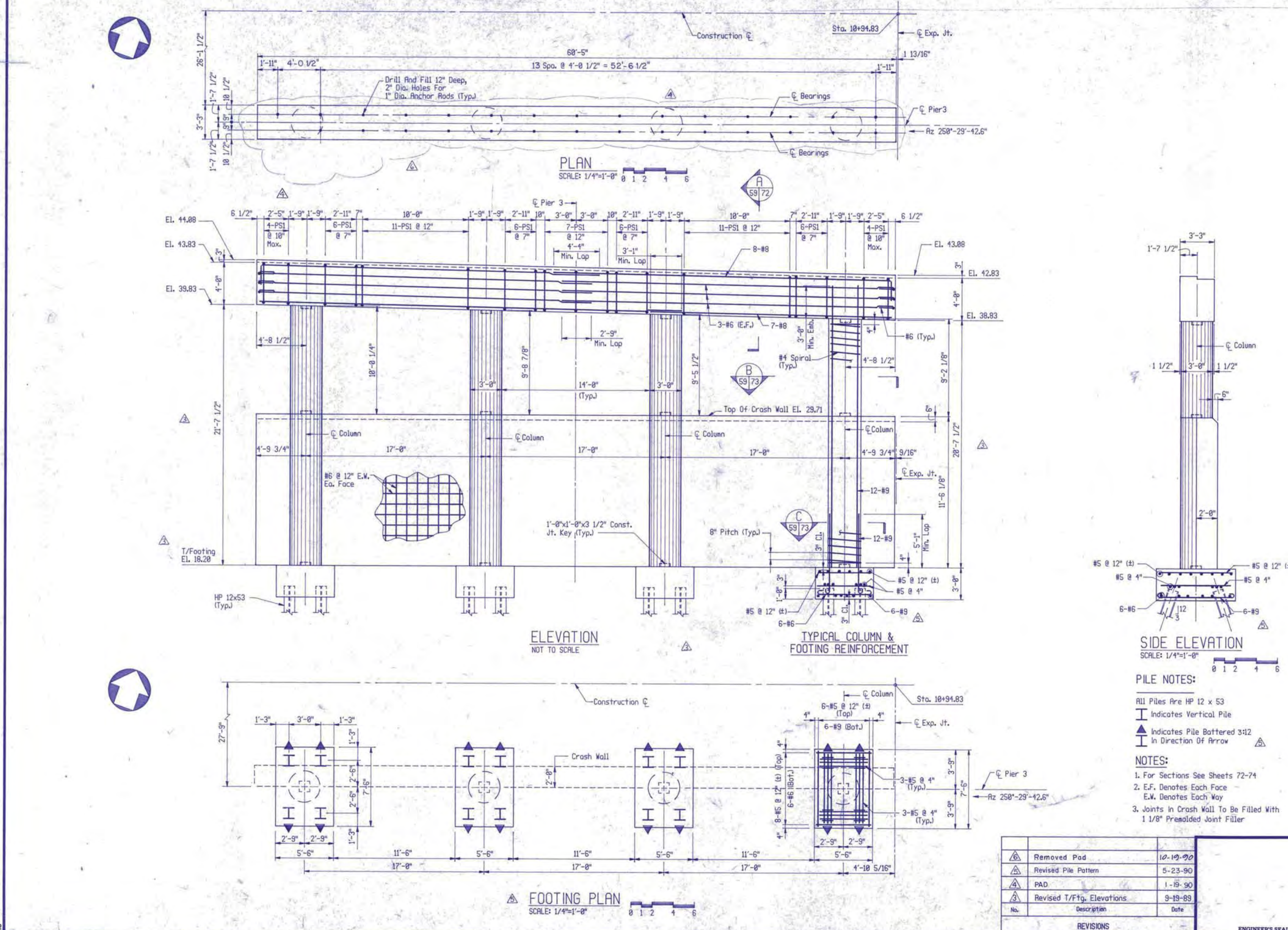
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B58 of 105
File Number



PILE NOTES:

All Piles Are HP 12 x 53
Indicates Vertical Pile
Indicates Pile Battered 3:12 In Direction Of Arrow

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
6	Removed Pad	10-19-90
5	Revised Pile Pattern	5-23-90
4	PAD	1-19-90
3	Revised T/Ftg. Elevations	9-19-89

REVISIONS

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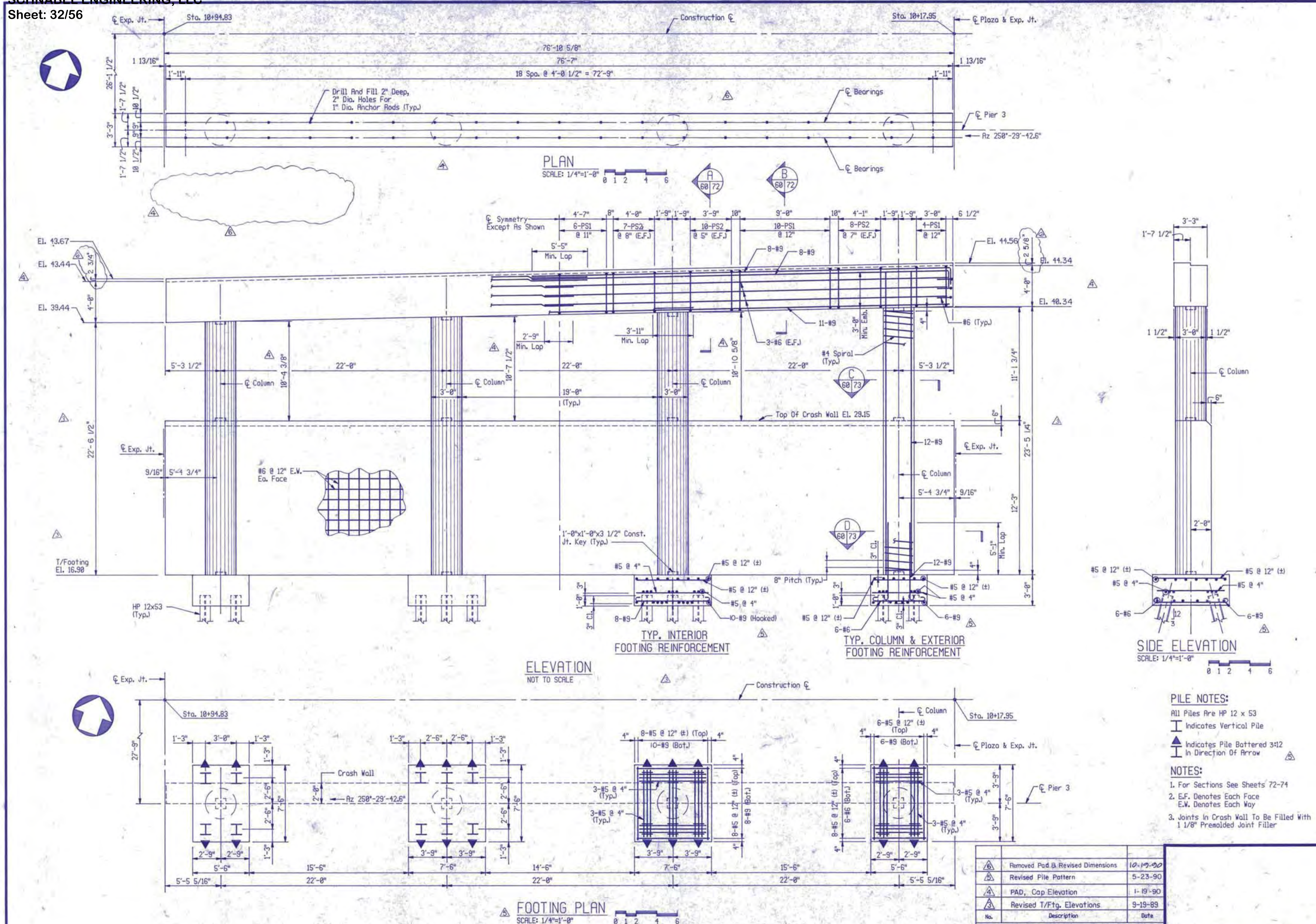
MARYLAND AVENUE OVER CONRAIL
PIER 3 - BAY 1
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By SUH
Designed By RGS
Checked By RGS
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B59 of 105
File Number

PORTAL20 - PIER31



PILE NOTES:

All Piles Are HP 12 x 53

Indicates Vertical Pile

Indicates Pile Battered 3:12 In Direction Of Arrow

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
   E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
6	Removed Pad & Revised Dimensions	10-19-90
5	Revised Pile Pattern	5-23-90
4	PAD, Cap Elevation	1-19-90
3	Revised T/Ftg. Elevations	9-19-89

REVISIONS

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MARYLAND AVENUE OVER CONRAIL

PIER 3 - BAY 2
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

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Designed By	RGS
Checked By	RGS
Date	JULY 1989
Scale	AS NOTED
Plan Number	
Zoned	
Sheet	B60 of 105
File Number	

PORTAL20 - PIER32

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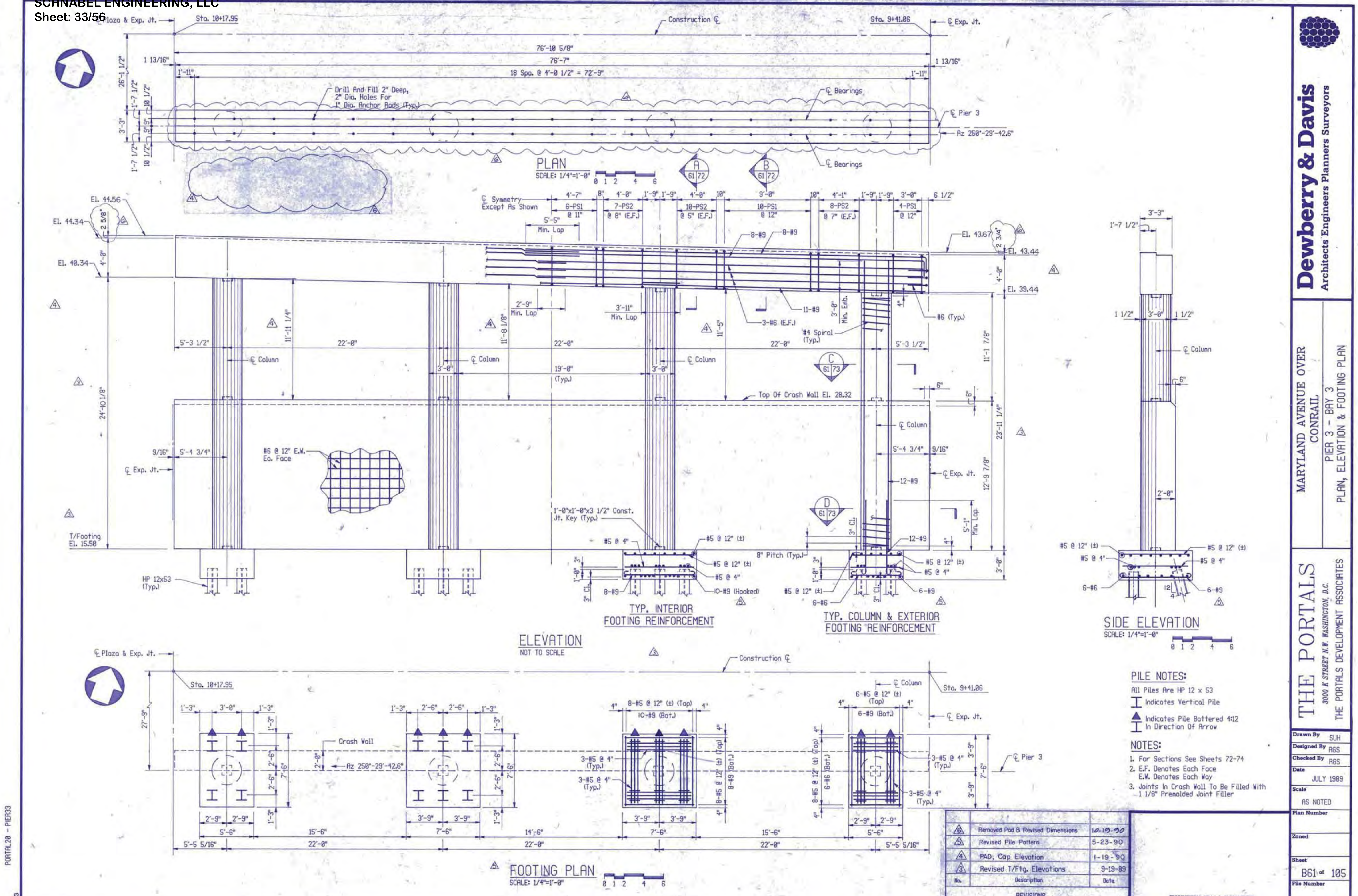
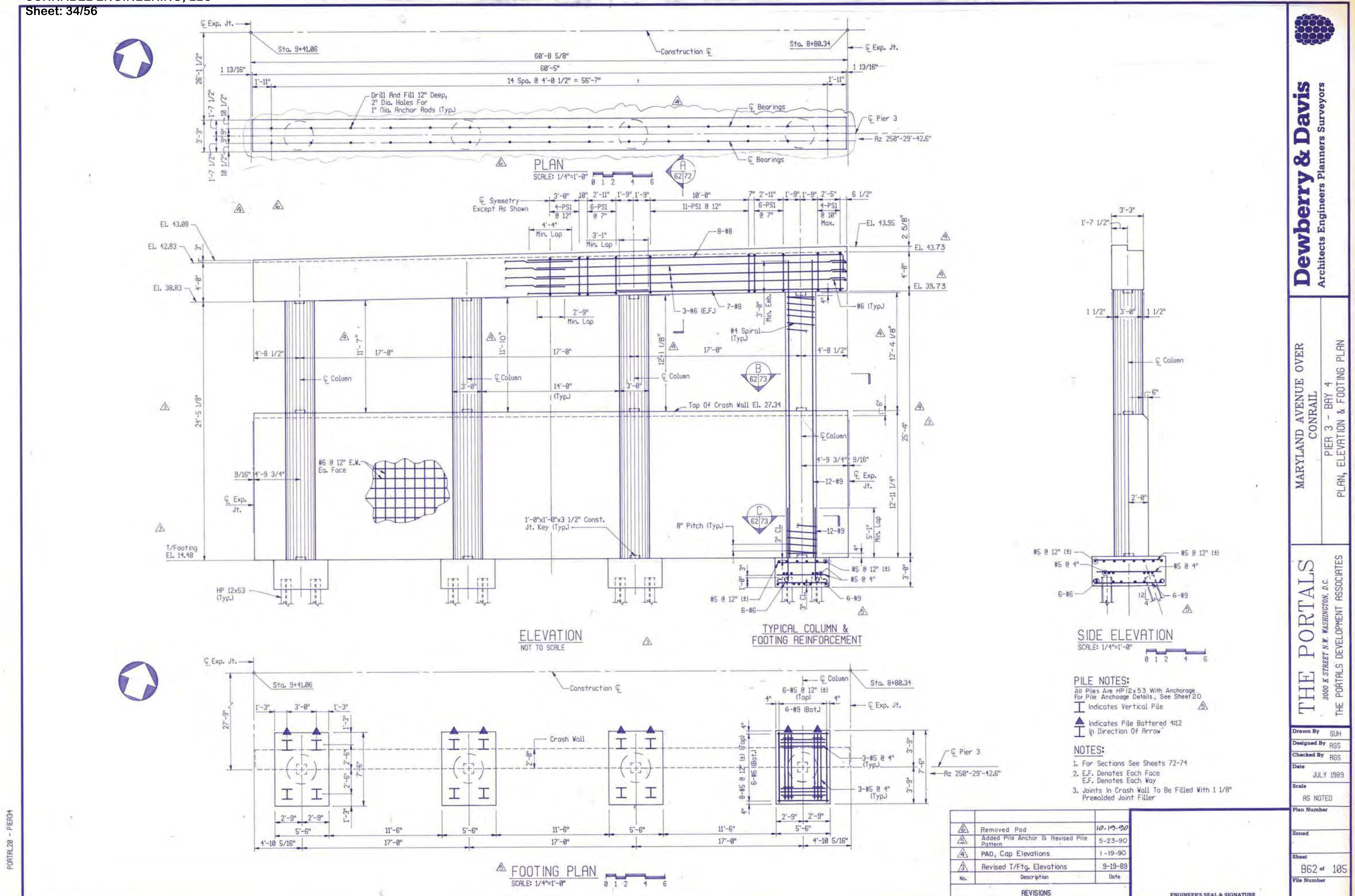
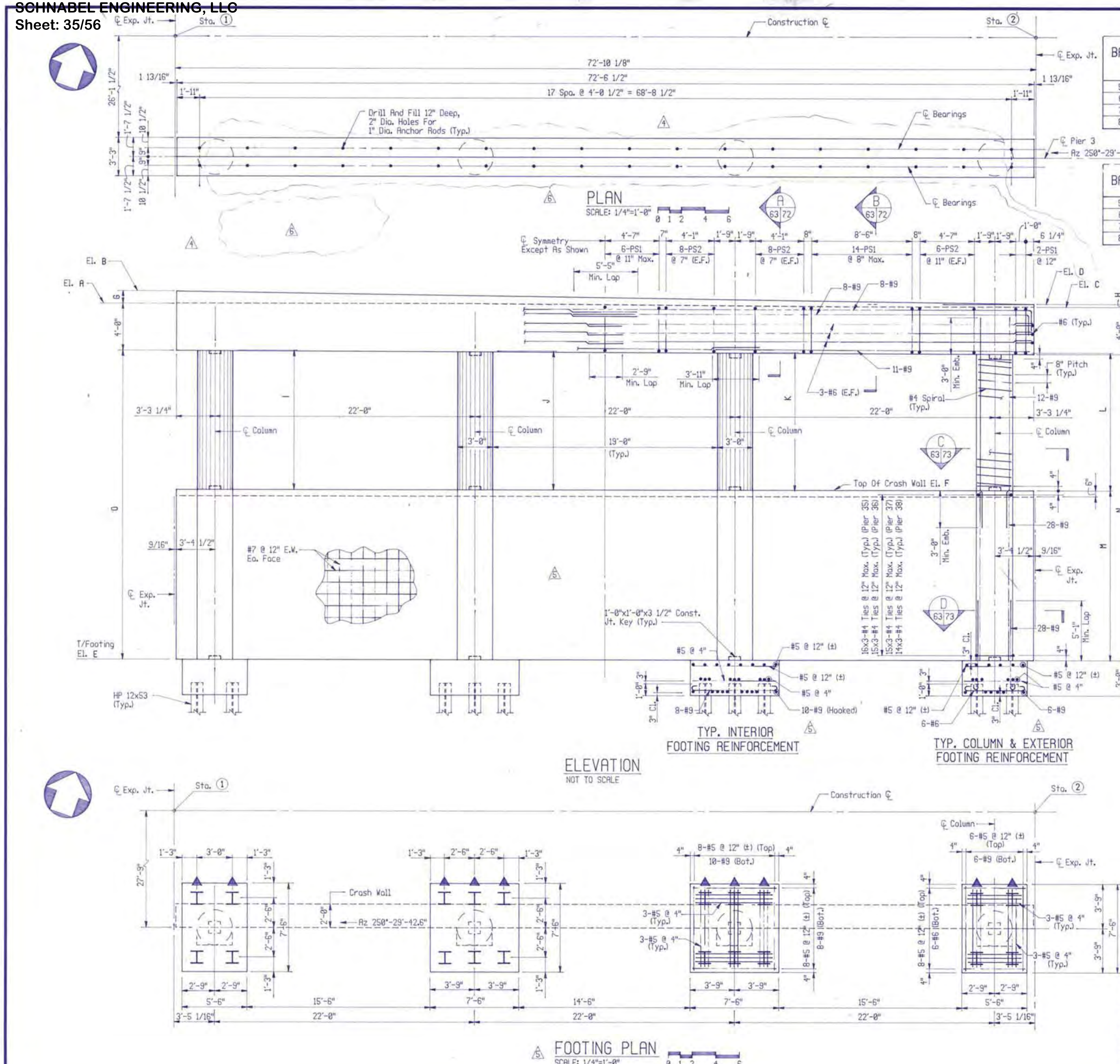
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 33/56



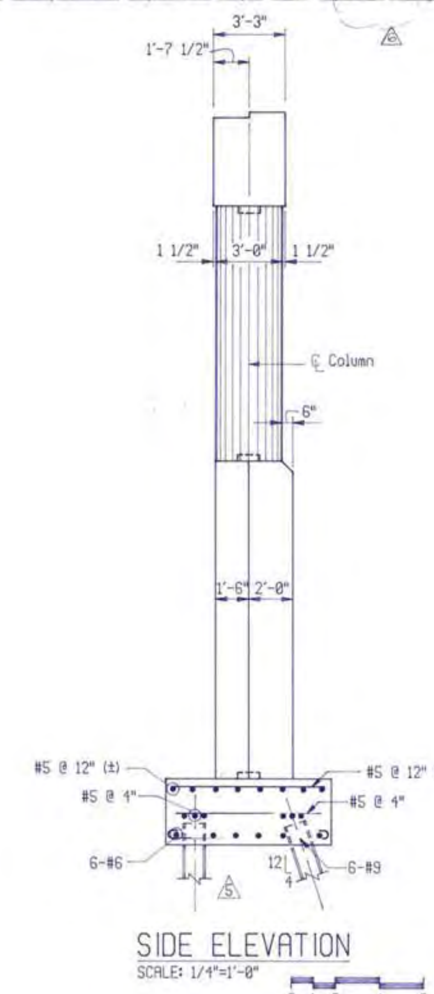
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 34/56





BAY	STATIONS		ELEVATIONS							
	①	②	A NORTH	B SOUTH	C NORTH	D SOUTH	E	F	G	H
5	8+80.34	8+07.50	43.71	43.95	43.07	43.16	13.10	26.56	0'-2 7/8"	0'-1 1/8"
6	8+07.50	7+34.65	42.14	43.16	41.09	41.18	12.10	25.54	1'-0 1/4"	0'-1 1/8"
7	7+34.65	6+61.81	40.07	41.17	39.01	39.11	11.20	24.59	1'-1 1/4"	0'-1 1/4"
8	6+61.81	5+88.96	38.00	39.10	36.94	37.03	10.50	23.74	1'-1 1/4"	0'-1 1/8"

BAY	DIMENSIONS						
	I	J	K	L	M	N	O
5	13'-1 1/4"	12'-11"	12'-8 5/8"	12'-6 1/4"	13'-5 1/2"	25'-11 5/8"	26'-7 3/8"
6	12'-6 3/8"	12'-2 1/2"	11'-10 3/4"	11'-6 7/8"	13'-5 1/4"	24'-11 7/8"	26'-0 1/2"
7	11'-4 7/8"	11'-1 1/8"	10'-9 1/4"	10'-5 3/8"	13'-4 3/8"	23'-9 3/4"	24'-10 1/2"
8	10'-2 1/4"	9'-10 3/8"	9'-6 5/8"	9'-2 3/4"	13'-2 7/8"	22'-5 1/4"	23'-6"



PILE NOTES:

All Piles Are HP 12 x 53 With Anchorage. For Anchorage Detail See Sheet 20.

I Indicates Vertical Pile

▲ Indicates Pile Battered 4:12 In Direction Of Arrow

NOTES:

1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face; E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
6	Removed Pad & Rev. Dims.	10-19-90
5	Added Pile Anchor, Removed Wall Opening, Revised Pile Pattern	5-23-90
4	Pad	1-19-90
3	Revised T/Ftg. Elevations	9-19-89
1	Revised Cap Elevations	8-14-89

REVISIONS

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Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

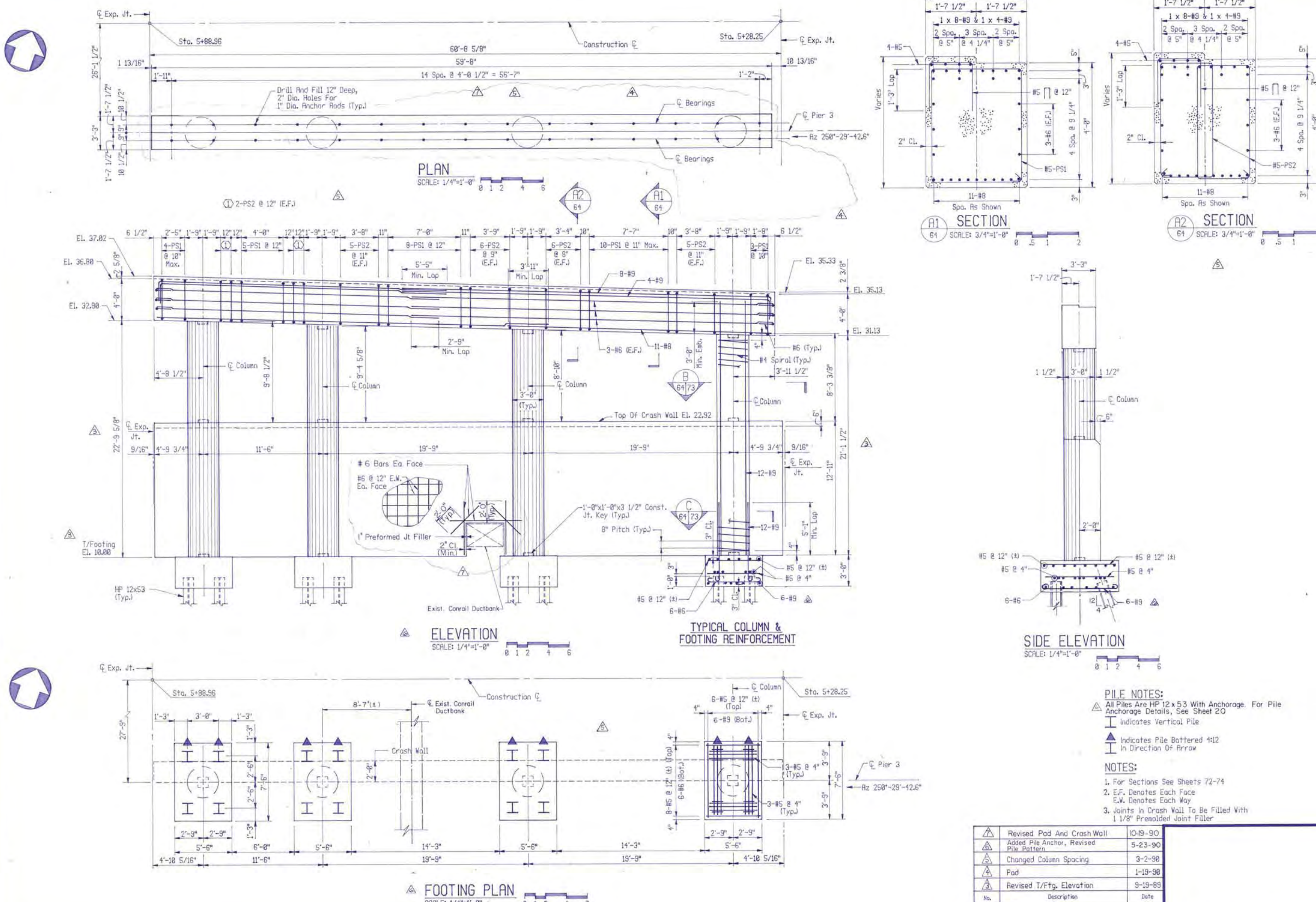
PIER 3 - BAY 5-8
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By: SUH
Designed By: RGS
Checked By: RGS
Date: JULY 1989
Scale: AS NOTED
Plan Number
Zoned
Sheet: B63 of 105
File Number

PORTAL20 - PIER35-8

13



PILE NOTES:
All Piles Are HP 12 x 53 With Anchorage. For Pile Anchorage Details, See Sheet 20
Indicates Vertical Pile
Indicates Pile Battered 4:12 In Direction Of Arrow

NOTES:
1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

REVISIONS

No.	Description	Date
7	Revised Pad And Crash Wall	10-19-90
6	Added Pile Anchor, Revised Pile Pattern	5-23-90
5	Changed Column Spacing	3-2-90
4	Pad	1-19-90
3	Revised T/Ftg. Elevation	9-19-89

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MARYLAND AVENUE OVER CONRAIL
PIER 3 - BAY 9
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

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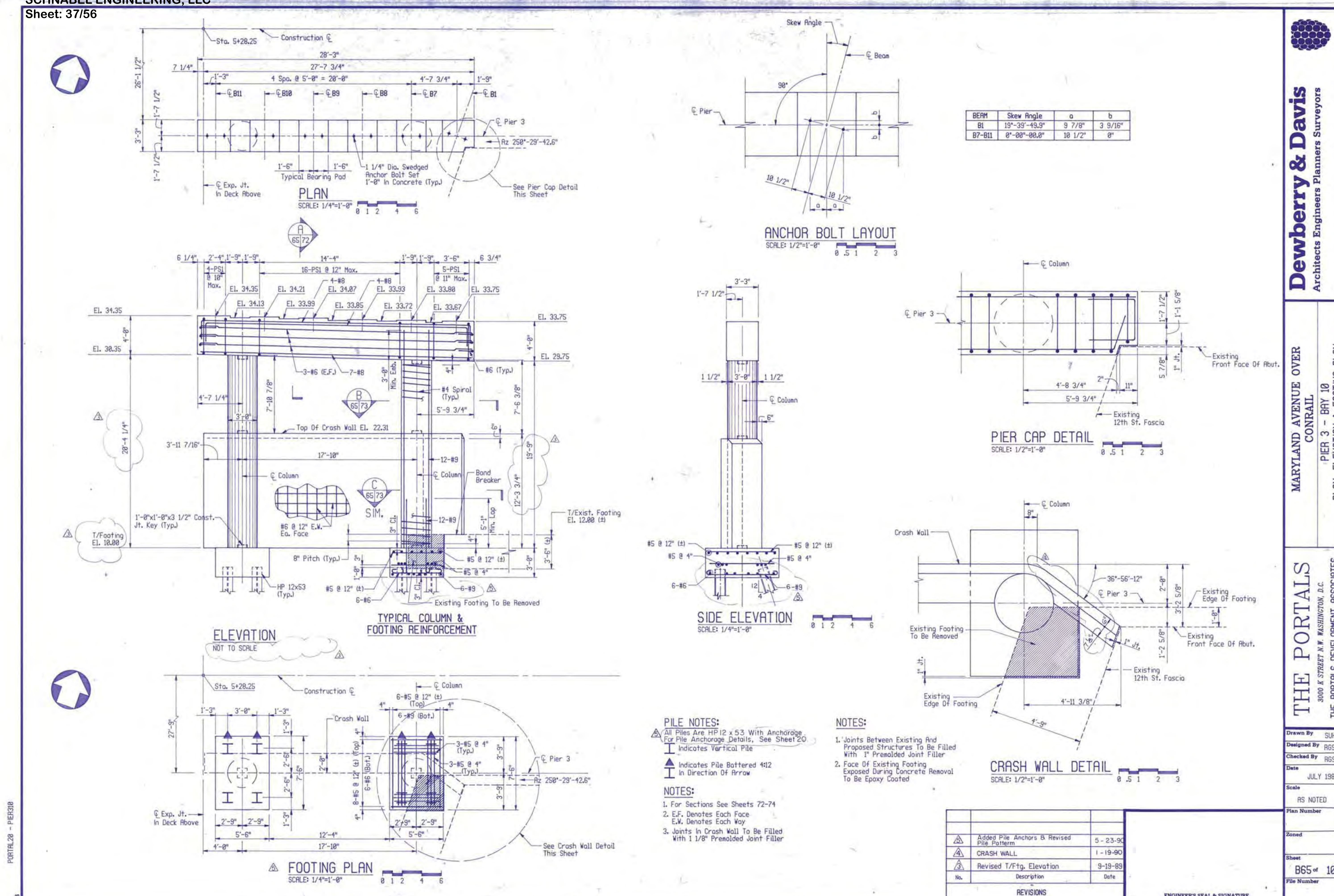
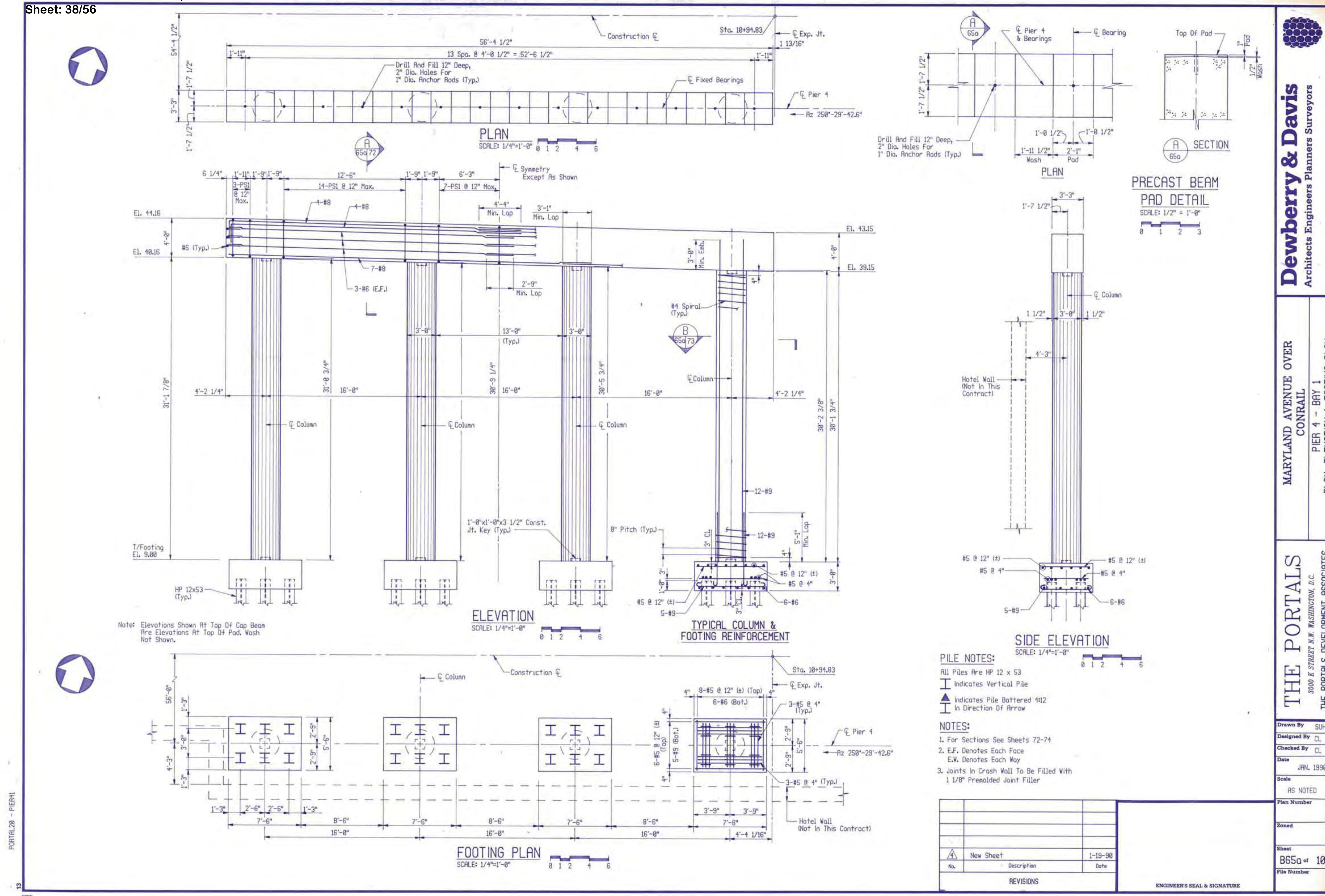
Checked By	RGS
Date	JULY 1989
Scale	AS NOTED
Plan Number	
Zoned	
Sheet	B64 of 105
File Number	

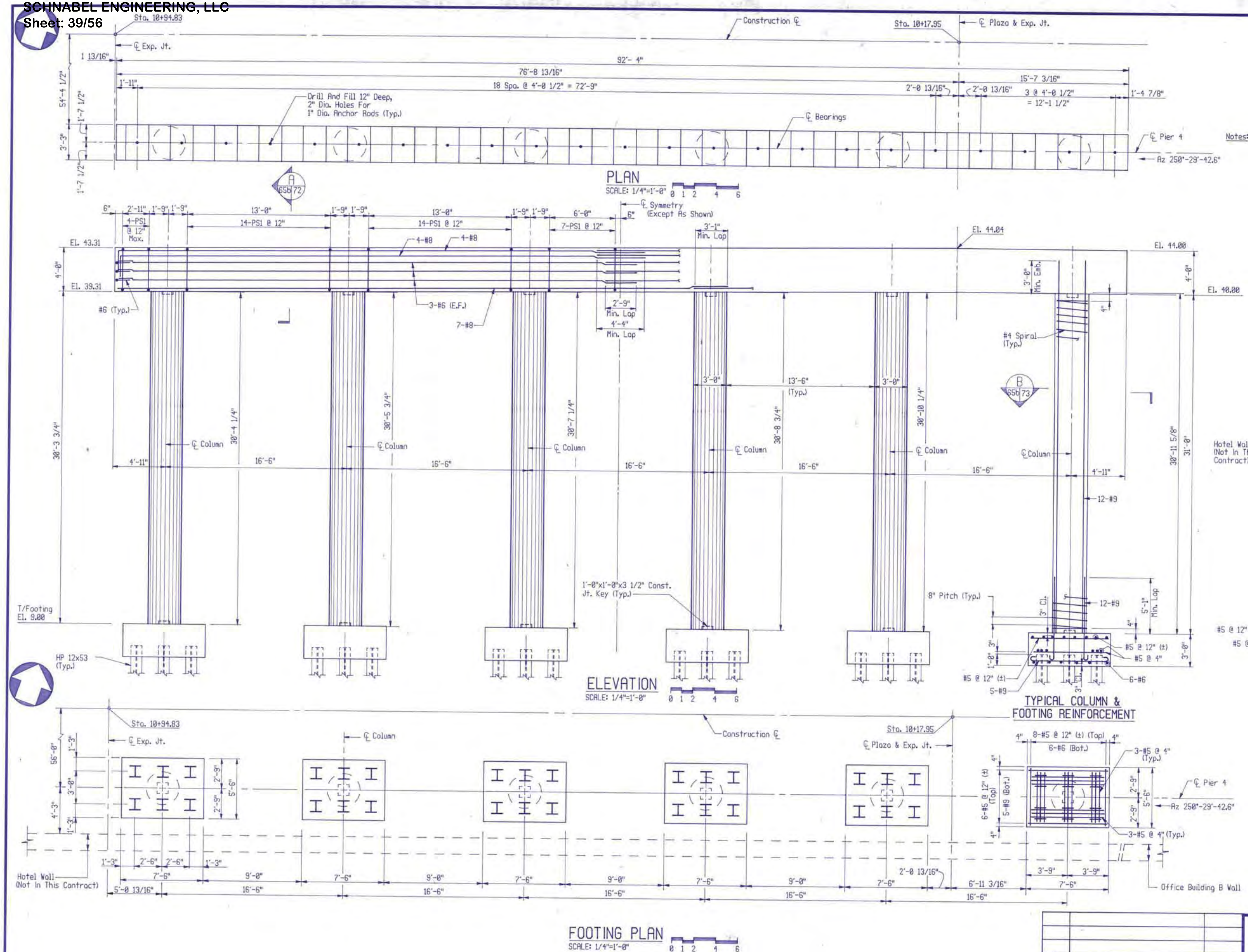
PORTAL20 - PIER39

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 37/56



APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 38/56





Notes:
1. For Typical Pad Detail See Sheet 65a.
2. Elevations Shown At Top Of Cap Beam Are Elevations At Top Of Pad. Wash Not Shown On Elevation View.

PILE NOTES:
All Piles Are HP 12 x 53
I Indicates Vertical Pile With Tension Anchorage. See Sheet 20 For Anchorage Detail.

NOTES:
1. For Sections See Sheets 72-74
2. E.F. Denotes Each Face
E.W. Denotes Each Way
3. Joints In Crash Wall To Be Filled With 1 1/8" Premolded Joint Filler

No.	Description	Date
5	Added Tension Anchorages	3-22-90
4	New Sheet	1-19-90

REVISIONS

ENGINEER'S SEAL & SIGNATURE

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Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL
PIER 4 - BAY 2
PLAN, ELEVATION & FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

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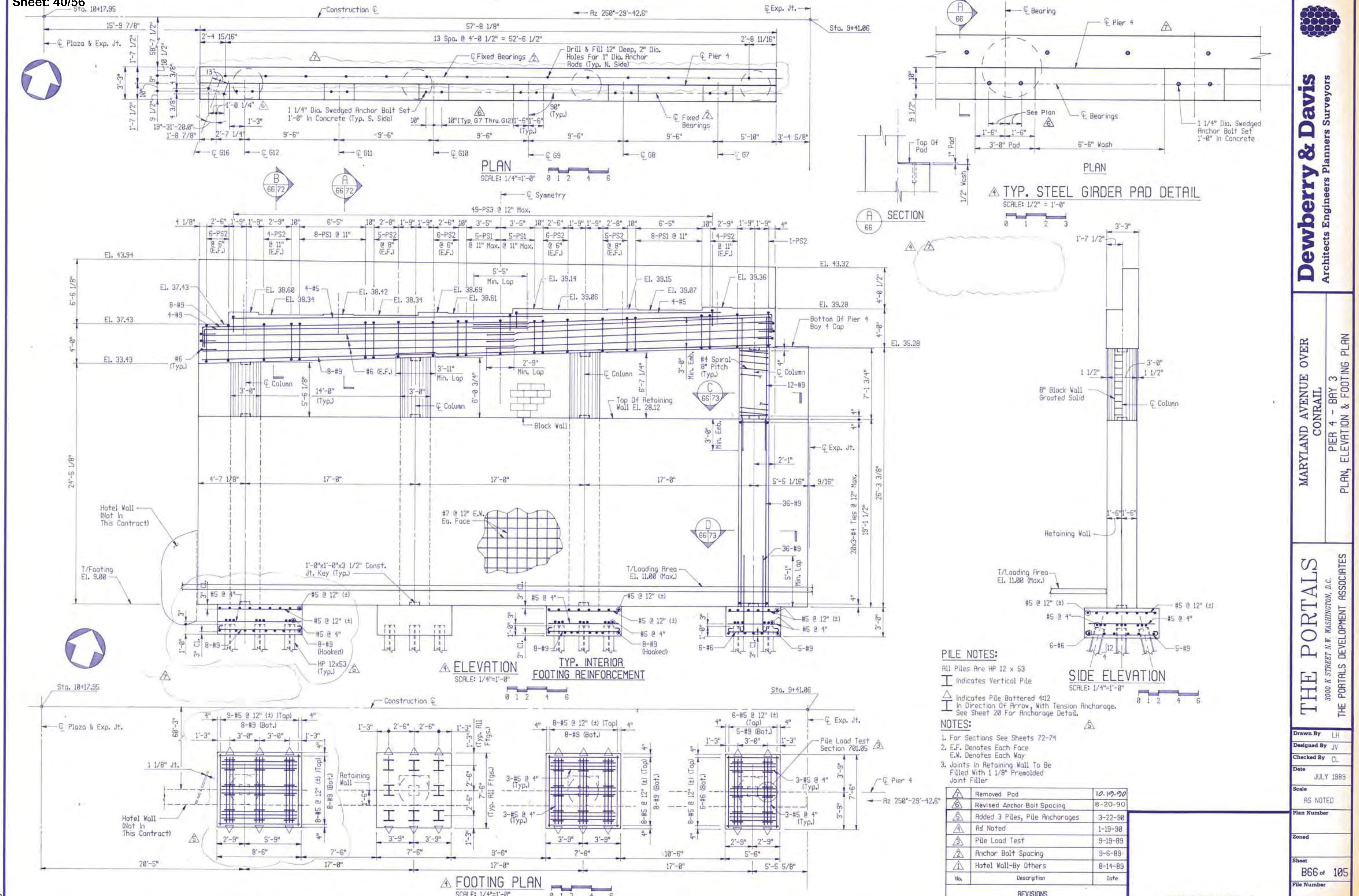
Date: JAN. 1990
Scale: AS NOTED
Plan Number
Zoned
Sheet: B65b of 105
File Number

PORTAL20 - PIER42

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 40/56



APPENDIX 7
SCHNABEL ENGINEERING, LLC
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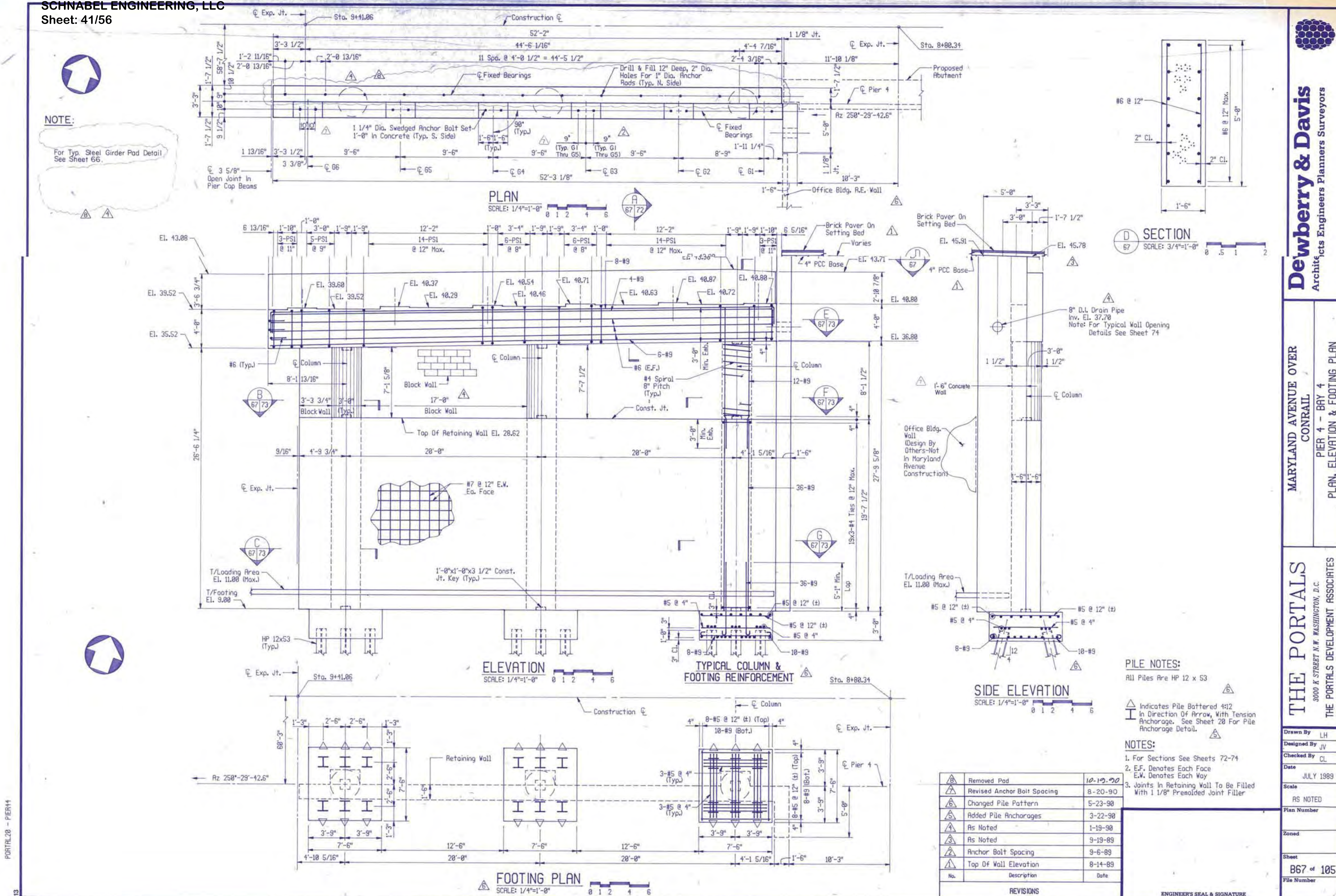
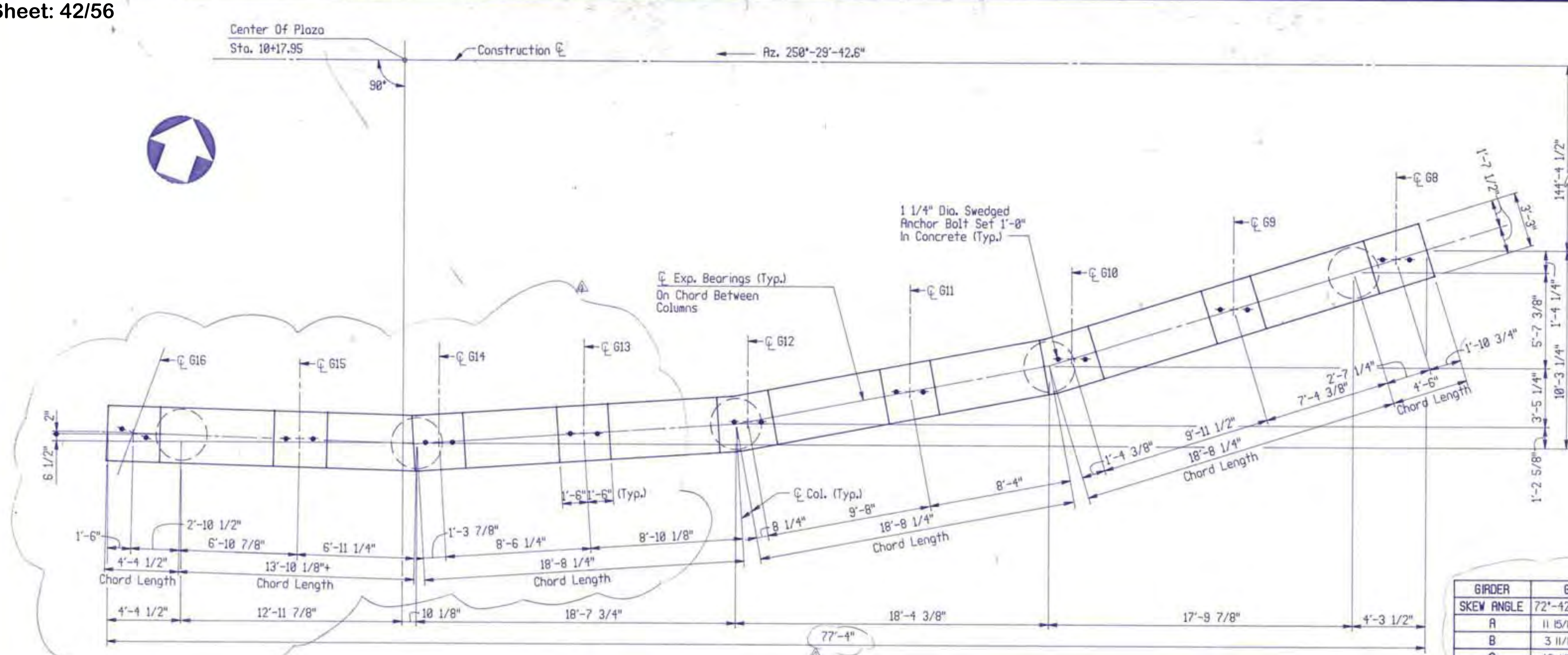
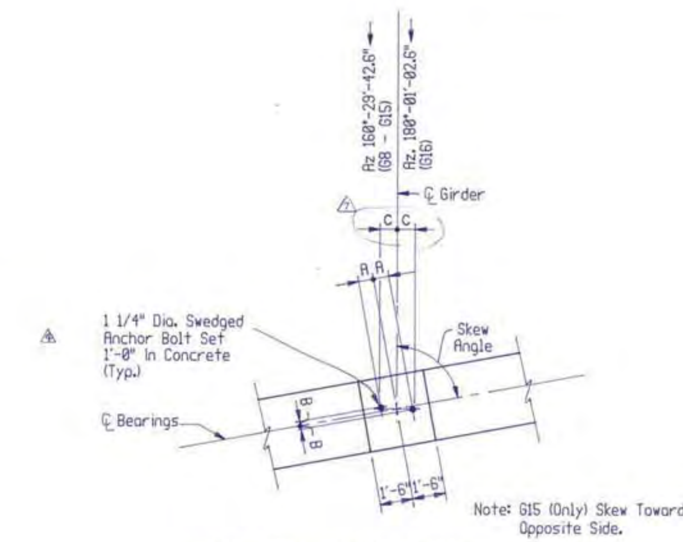




PLAN

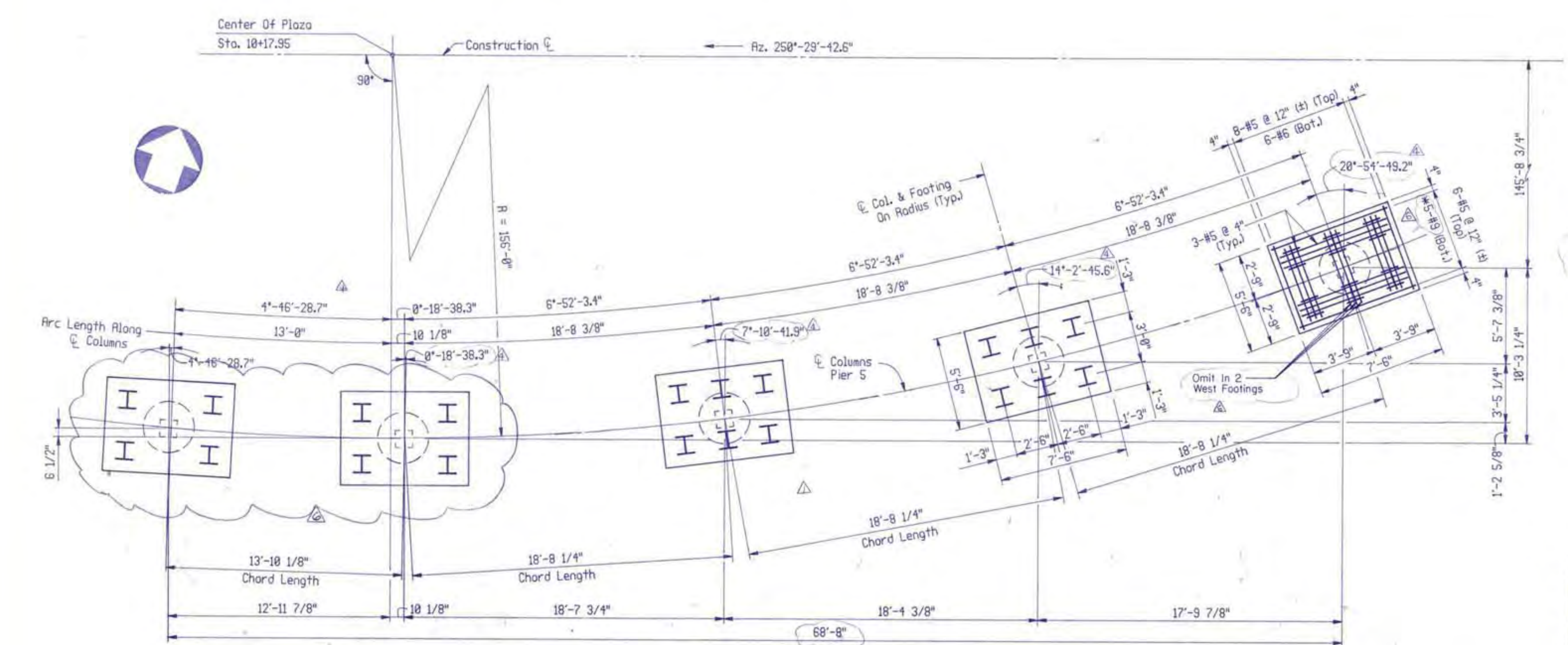
SCALE: 1/4" = 1'-0"



ANCHOR BOLT LAYOUT

SCALE: 1/4" = 1'-0"

GIRDER	G16	G15	G14	G13	G12	G11	G10	G9	G8
SKEW ANGLE	72°-42'-35"	92°-13'-55"	86°-15'-20"	86°-15'-20"	79°-23'-16"	79°-23'-16"	72°-31'-13"	72°-31'-13"	72°-31'-13"
A	11 15/16"	9 1/2"	9 1/2"	10 1/2"	10 5/16"	10 5/16"	10"	10"	10"
B	3 11/16"	-3/8"	5/8"	11/16"	1 15/16"	1 15/16"	3 1/8"	3 1/8"	3 1/8"
C	12 1/2"	9 1/2"	9 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"



FOOTING PLAN

SCALE: 1/4" = 1'-0"

NOTE :
* 6-#9 (Bottom) For 2 West Footings

PILE NOTES:
All Piles Are HP 12 x 53
I Indicates Vertical Pile With Tension Anchorage. See Sheet 20 For Anchorage Detail.

NOTES:
1. For Pier Elevation See Sheet 69

No.	Description	Date
7	Revised Anchor Bolt Spacing	8-20-90
6	Revised Pile Pattern	5-23-90
5	Added Tension Anchorages	3-22-90
4	Relocated A Column	1-19-90
3	Anchor Bolt Layout	9-6-89
1	Revised Pile Orientation	8-14-89

REVISIONS

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MARYLAND AVENUE OVER CONRAIL
PIER 5 - BAY 3
PLAN AND FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By LH
Designed By JV
Checked By CL
Date JULY 1989
Scale AS NOTED
Plan Number
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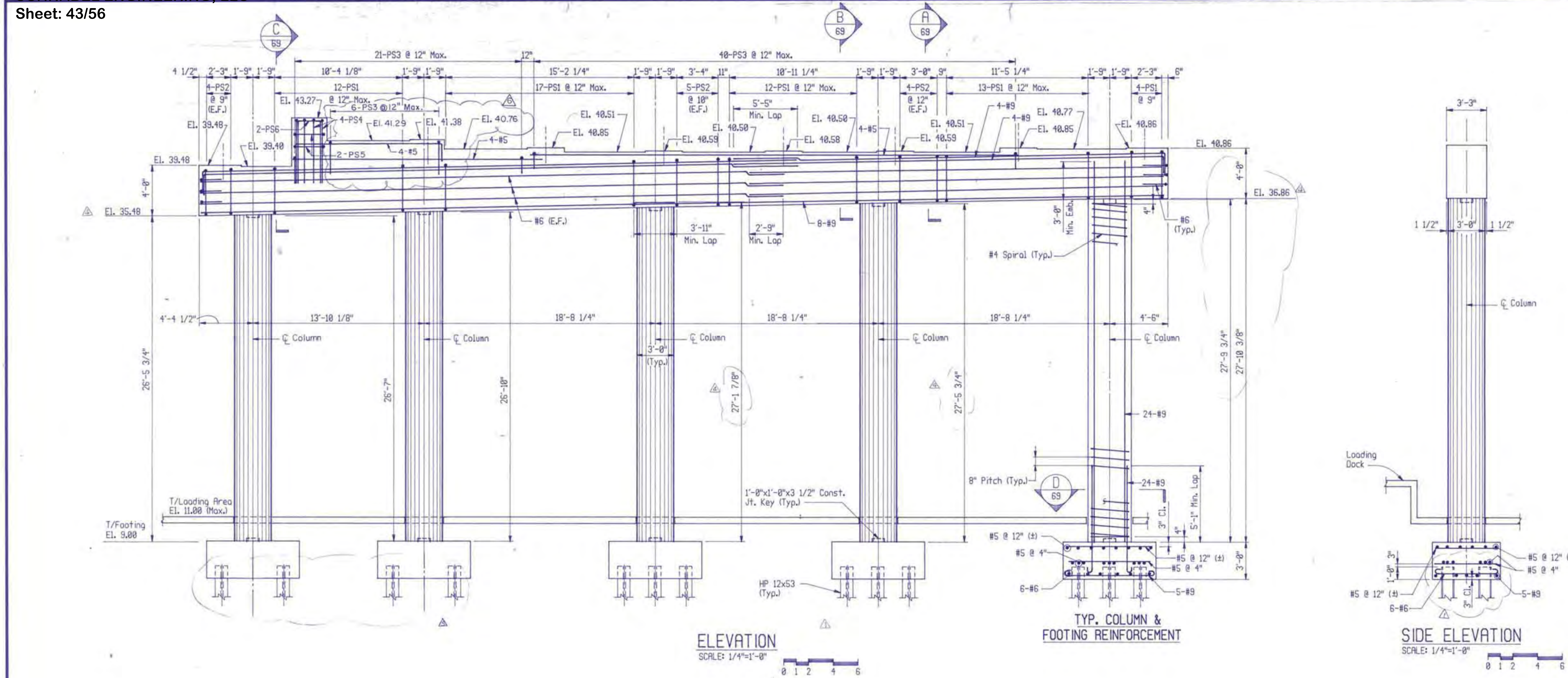
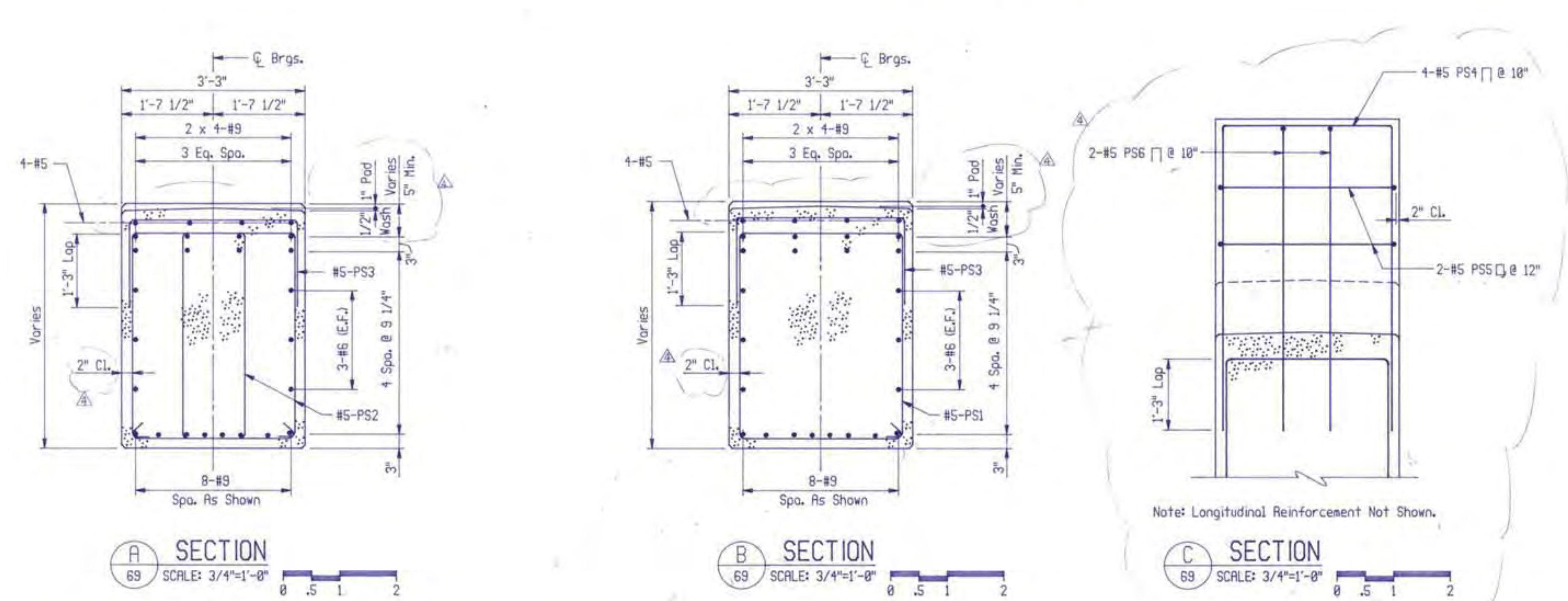
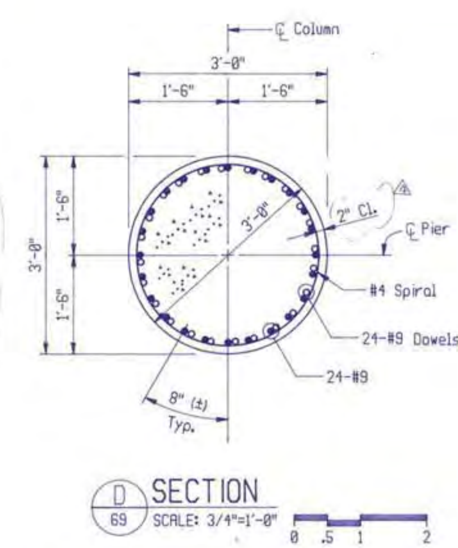
Sheet B68 of 105
File Number

PORTAL20 - PIERS3

13







NOTES:

1. For Pier Plan And Footing Plan See Sheet 68
2. E.F. Denotes Each Face
   E.W. Denotes Each Way

No.	Description	Date
5	Revised Pad Elevation	8-20-90
4	Revised Pile Pattern	5-23-90
3	Pad, Relocated A Column	1-19-90
1	Revised Pile Orientation	8-14-89

REVISIONS

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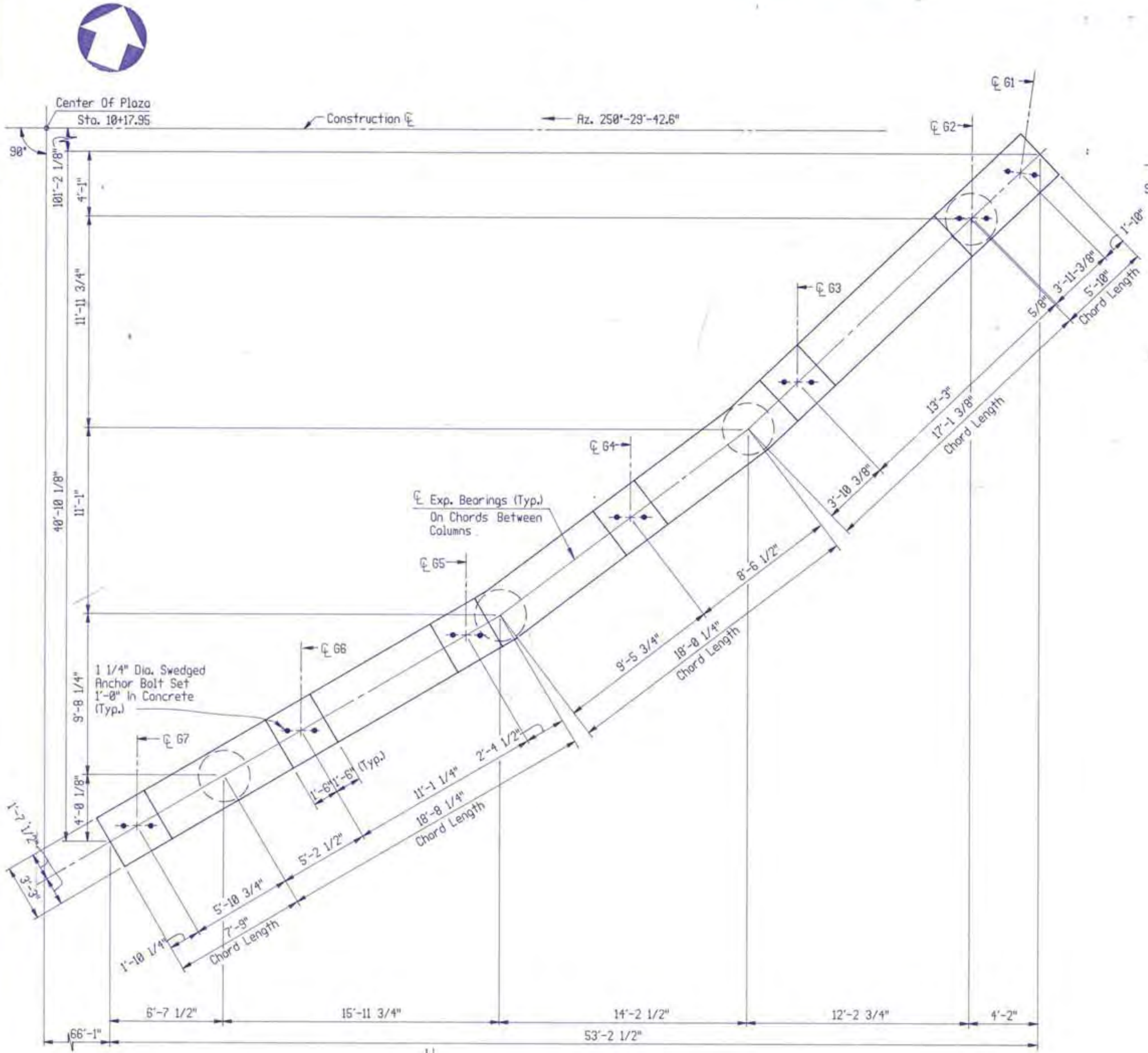
MARYLAND AVENUE OVER CONRAIL
PIER 5 - BAY 3 ELEVATION

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

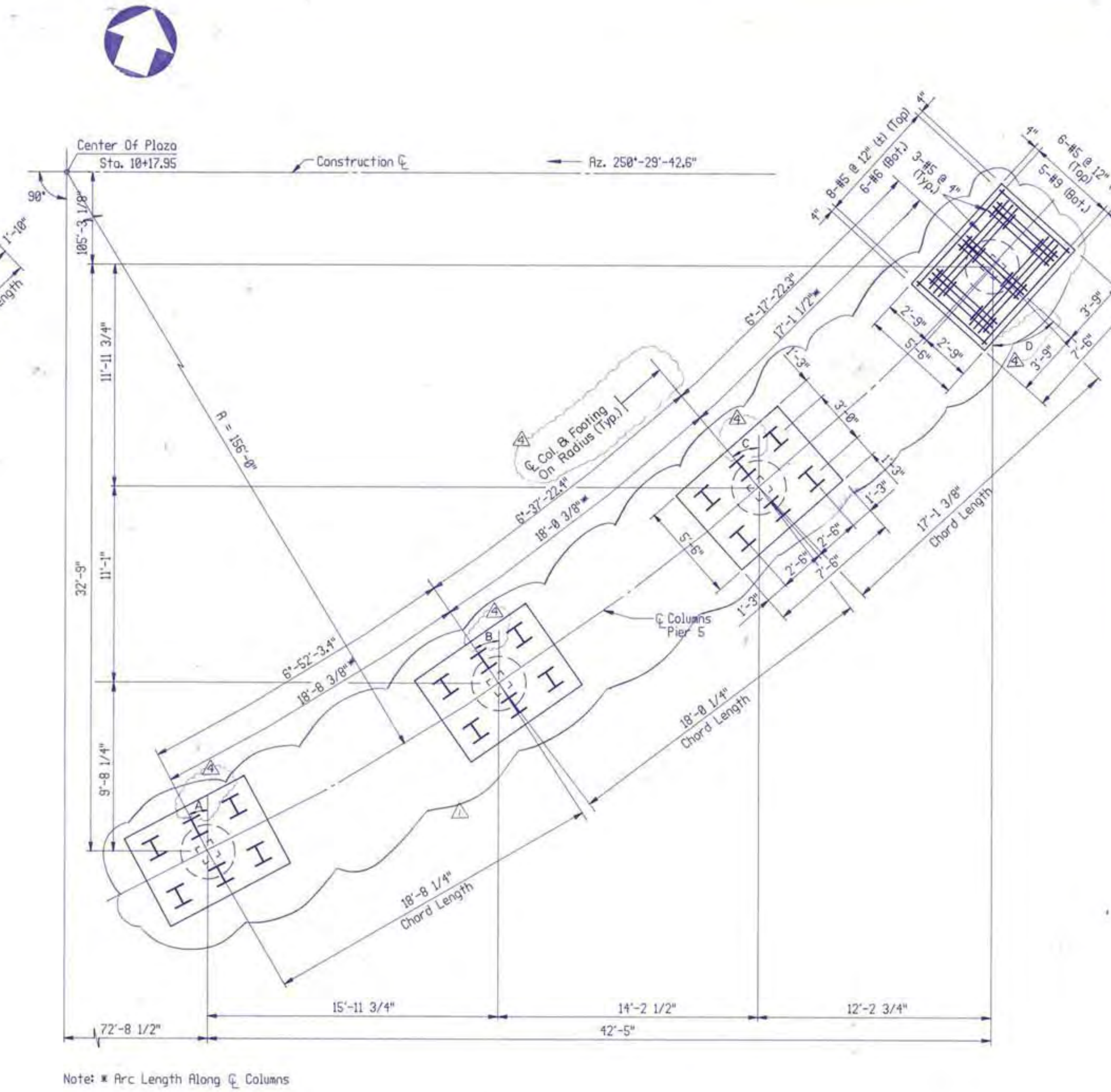
Drawn By LH
Designed By JV
Checked By CL
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B69 of 105
File Number

PORTAL20 - PIER53EL
13

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 44/56



PLAN
SCALE: 1/4" = 1'-0"



Note: * Arc Length Along ℄ Columns

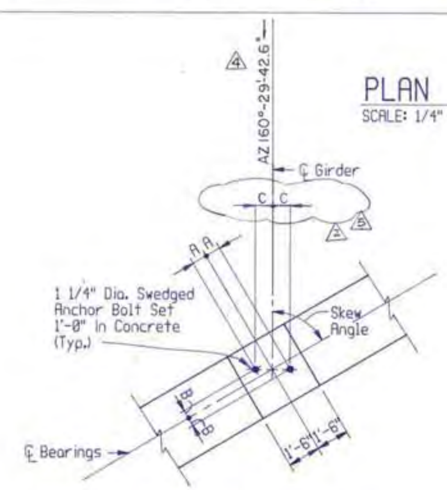
FOOTING PLAN
SCALE: 1/4" = 1'-0"

PILE NOTES:
All Piles Are HP 12 x 53

I Indicates Vertical Pile With Tension Anchorage. See Sheet 20 For Anchorage Detail.

NOTES:
1. For Pier Elevation See Sheet 71

FOOTING SKEW ANGLE			
A	B	C	D
27°46'-52.8"	34°38'-56.5"	41°-16'-18.9"	47°33'-41.2"



ANCHOR BOLT LAYOUT
SCALE: 1/4" = 1'-0"

GIRDER	G7	G6	G5	G4	G3	G2	G1
SKEW ANGLE	58°-47'-06"	58°-47'-06"	58°-47'-06"	52°-02'-22"	45°-35'-00"	45°-35'-00"	37°-25'-38"
A	9"	9"	8 1/8"	7 1/2"	6 13/16"	6 13/16"	5 3/4"
B	5 7/16"	5 7/16"	4 15/16"	5 13/16"	6 5/8"	6 5/8"	7 9/16"
C	10 1/2"	10 1/2"	9 1/2"	9 1/2"	9 1/2"	9 1/2"	9 1/2"

No.	Description	Date
6	Revised Anchor Bolt Spacing	8-20-90
5	Added Tension Anchorages	3-22-90
4	Col. Skew Angles	1-19-90
3	Anchor Bolt Layout	9-6-89
1	Revised Pile Orientation	8-14-89

REVISIONS

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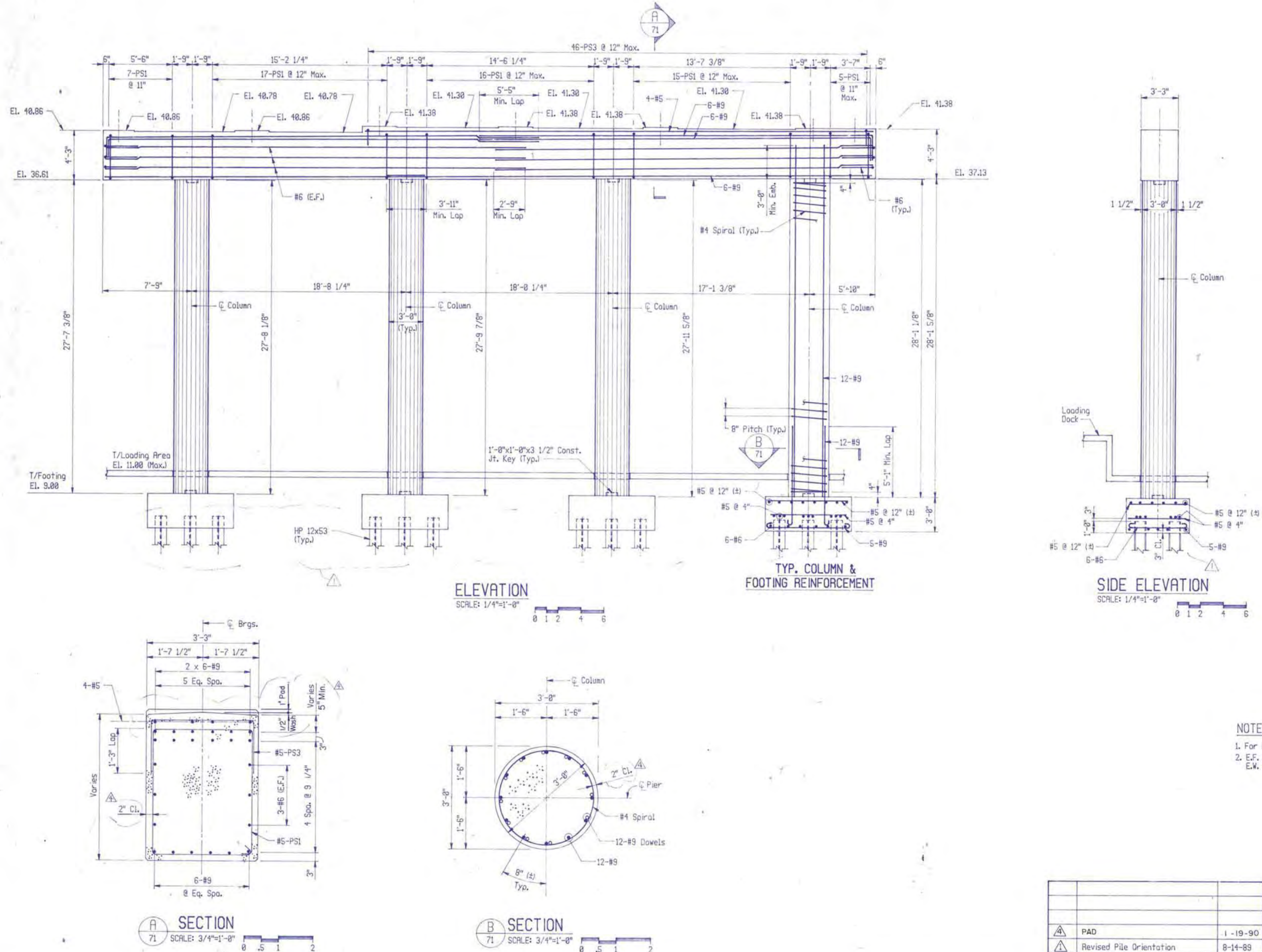
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL
PIER 5 - BAY 4
PLAN AND FOOTING PLAN

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By LH
Designed By JY
Checked By CL
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B70 of 105
File Number

PORTAL20 - PIER54
13



NOTES:

1. For Pier Plan And Footing Plan See Sheet 70
2. E.F. Denotes Each Face
   E.W. Denotes Each Way

No.	Description	Date
4	PAD	1-19-90
1	Revised Pile Orientation	8-14-89

REVISIONS

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Architects Engineers Planners Surveyors
8401 Arlington Blvd, Fairfax, VA 22031
703 849-0100

MARYLAND AVENUE OVER CONRAIL

PIER 5 - BAY 4 ELEVATION

THE PORTALS
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THE PORTALS DEVELOPMENT ASSOCIATES

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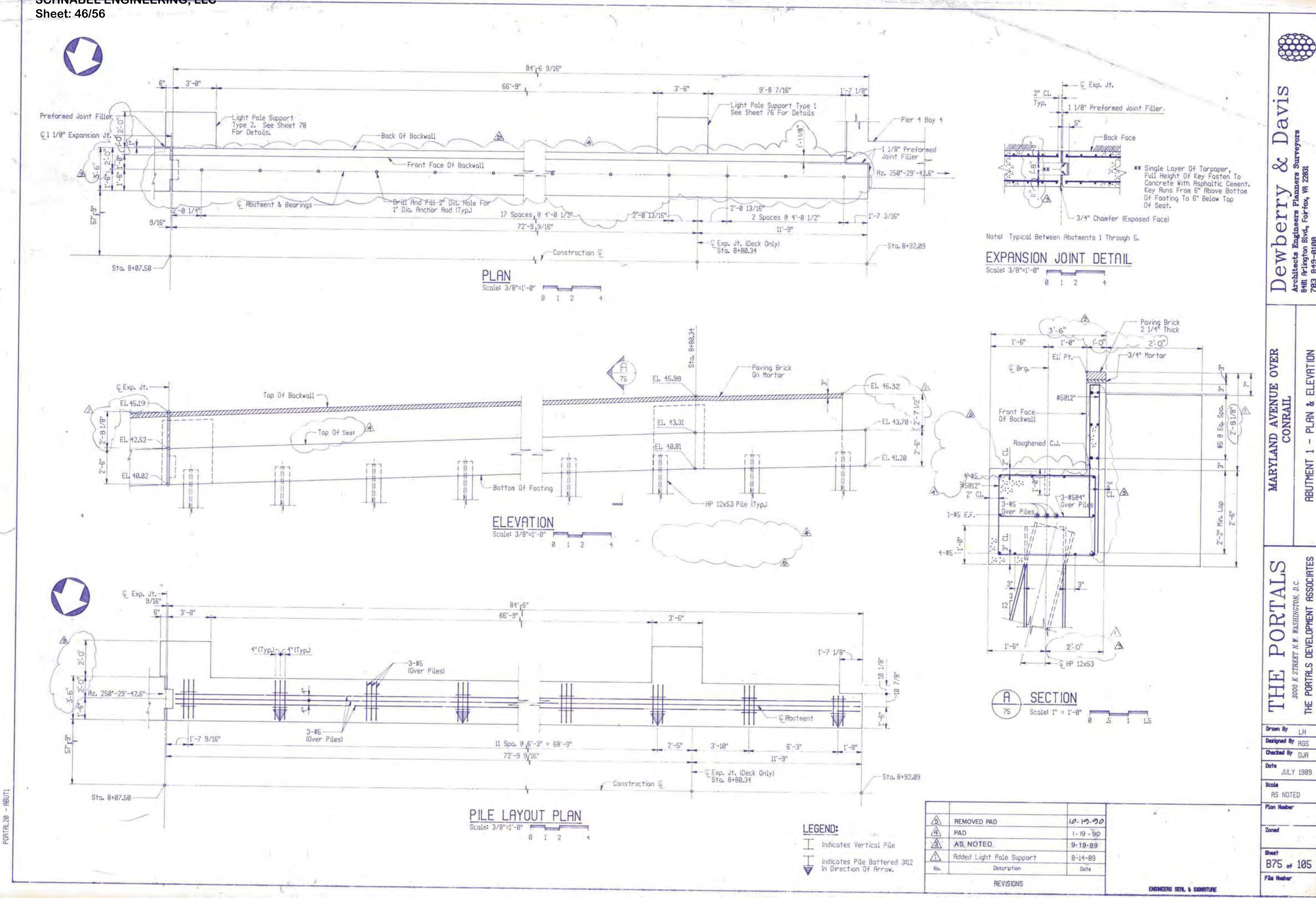
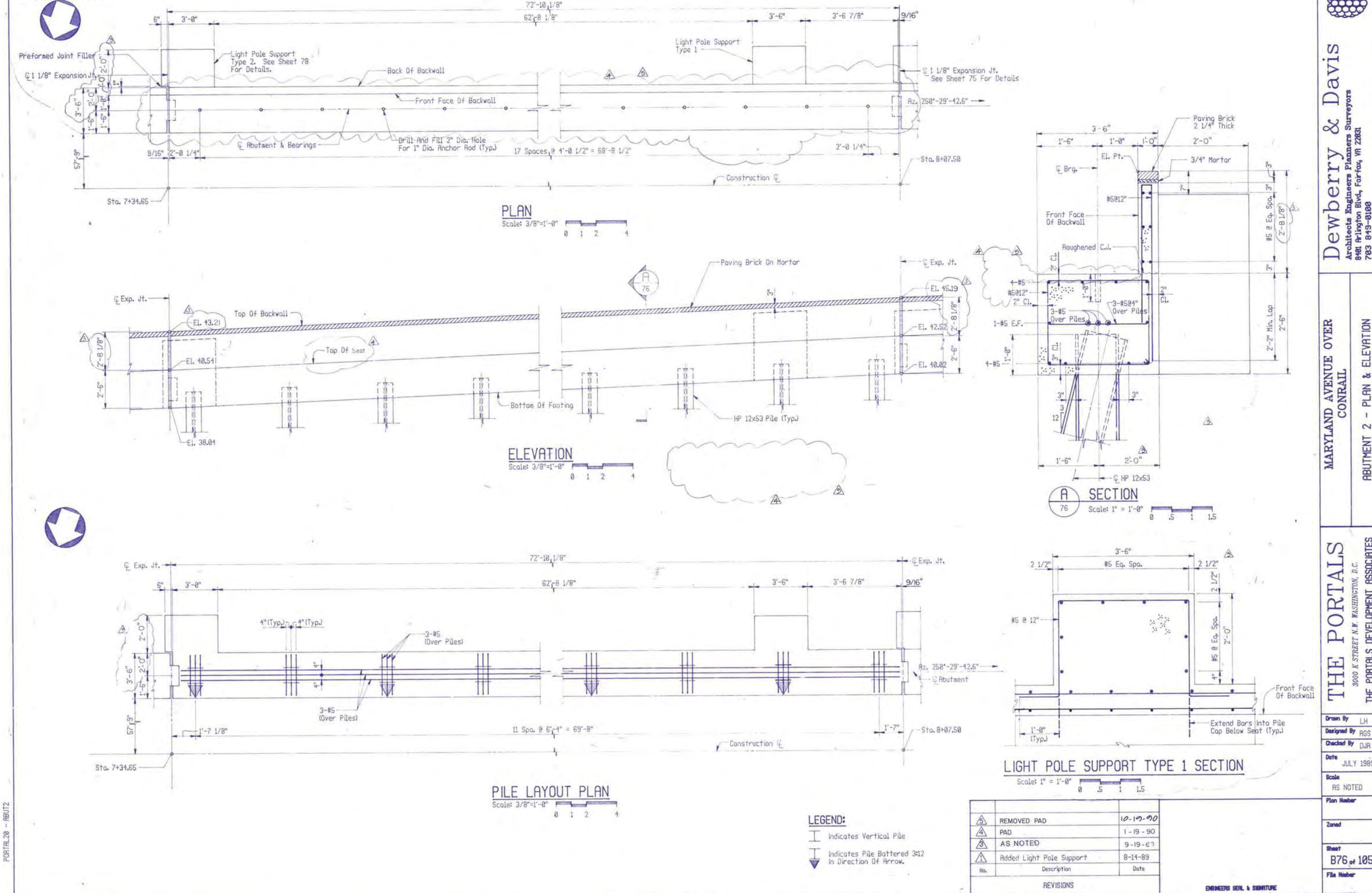
Designed By	JV
Checked By	CL
Date	JULY 1989
Scale	AS NOTED
Plan Number	
Zoned	
Sheet	B71 of 105
File Number	

PORTAL20 - PIERS4EL

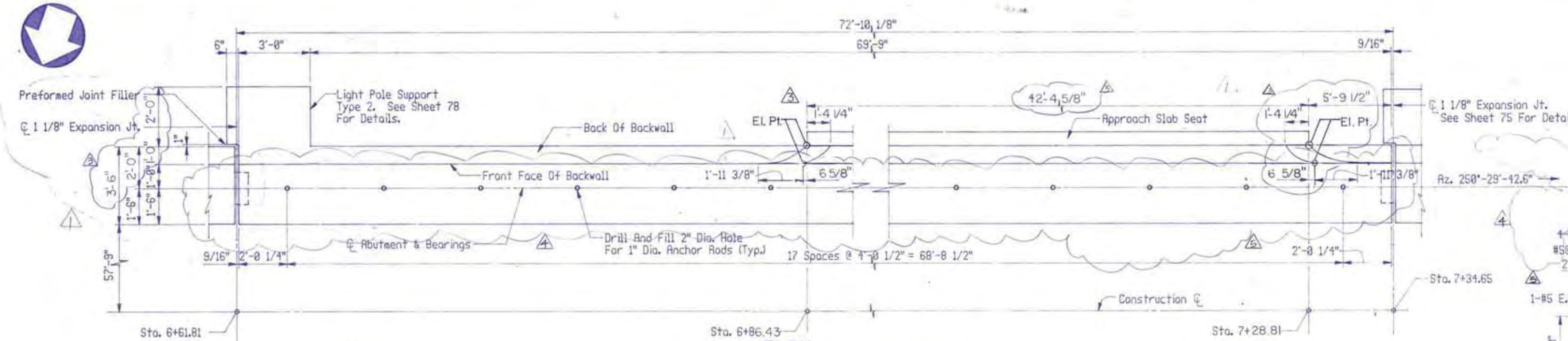
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 46/56



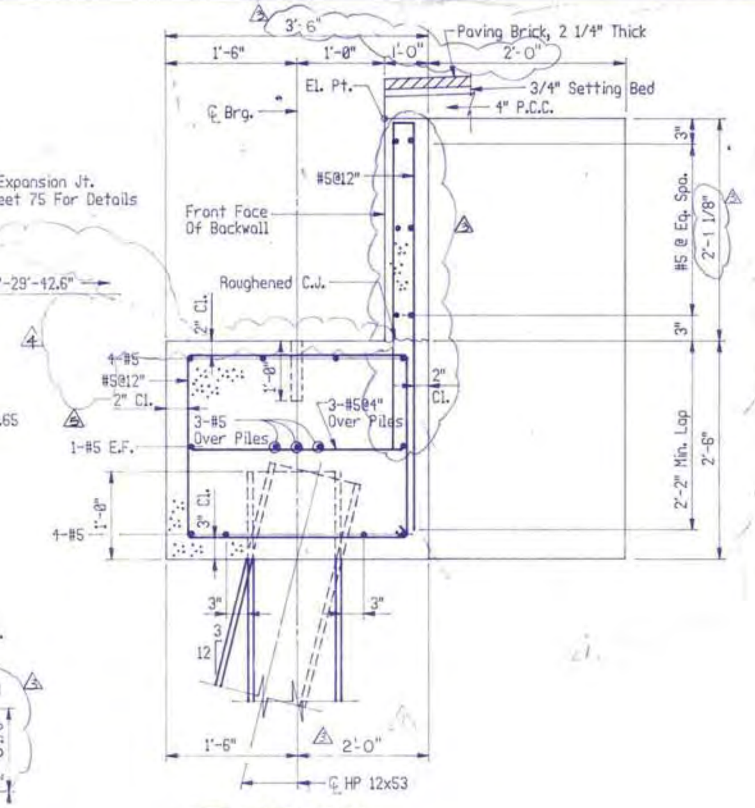
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 47/56



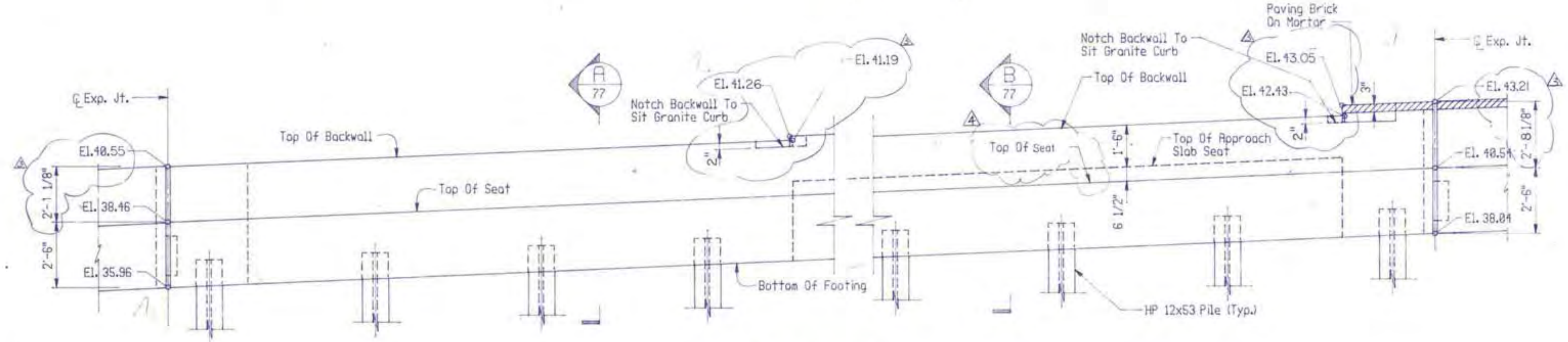
APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 48/56



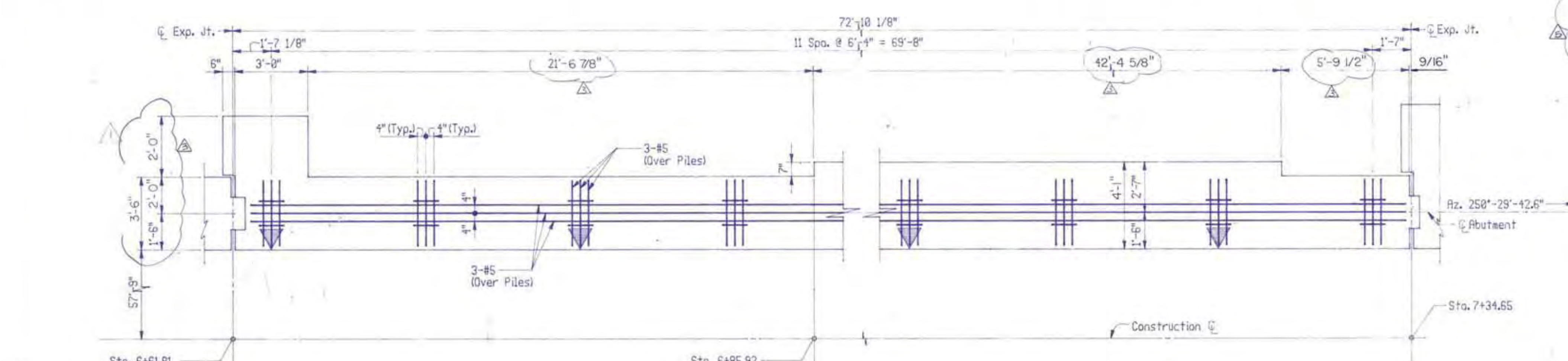
PLAN
Scale: 3/8"=1'-0"



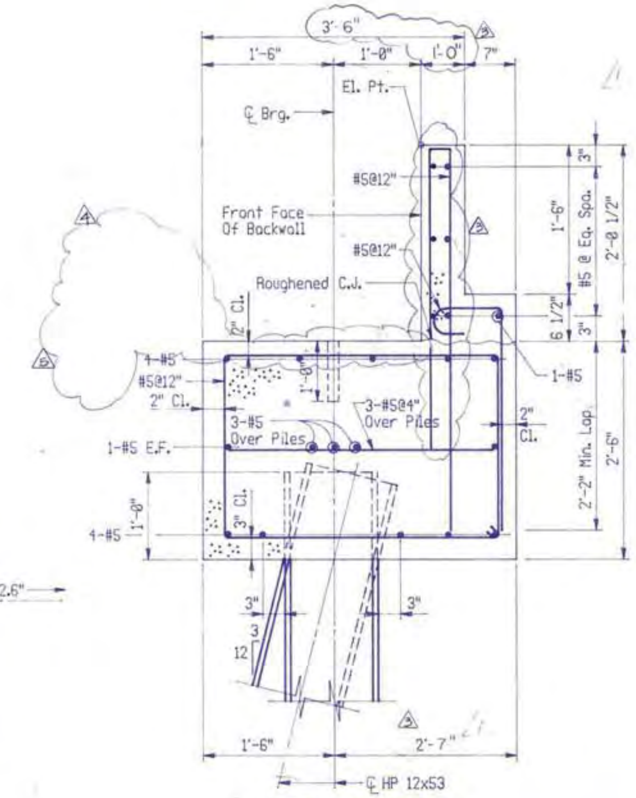
SECTION A/77
Scale: 1" = 1'-0"



ELEVATION
Scale: 3/8"=1'-0"



PILE LAYOUT PLAN
Scale: 3/8"=1'-0"



SECTION B/77
Scale: 1" = 1'-0"

LEGEND:
- Indicates Vertical Pile
- Indicates Pile Battered 3:12 In Direction Of Arrow.

No.	Description	Date
5	REMOVED PAD	10-19-90
4	PAD	1-19-90
3	AS NOTED	9-19-89
1	Added Light Pole Support	8-14-89

REVISIONS

ENGINEERS SEAL & SIGNATURE

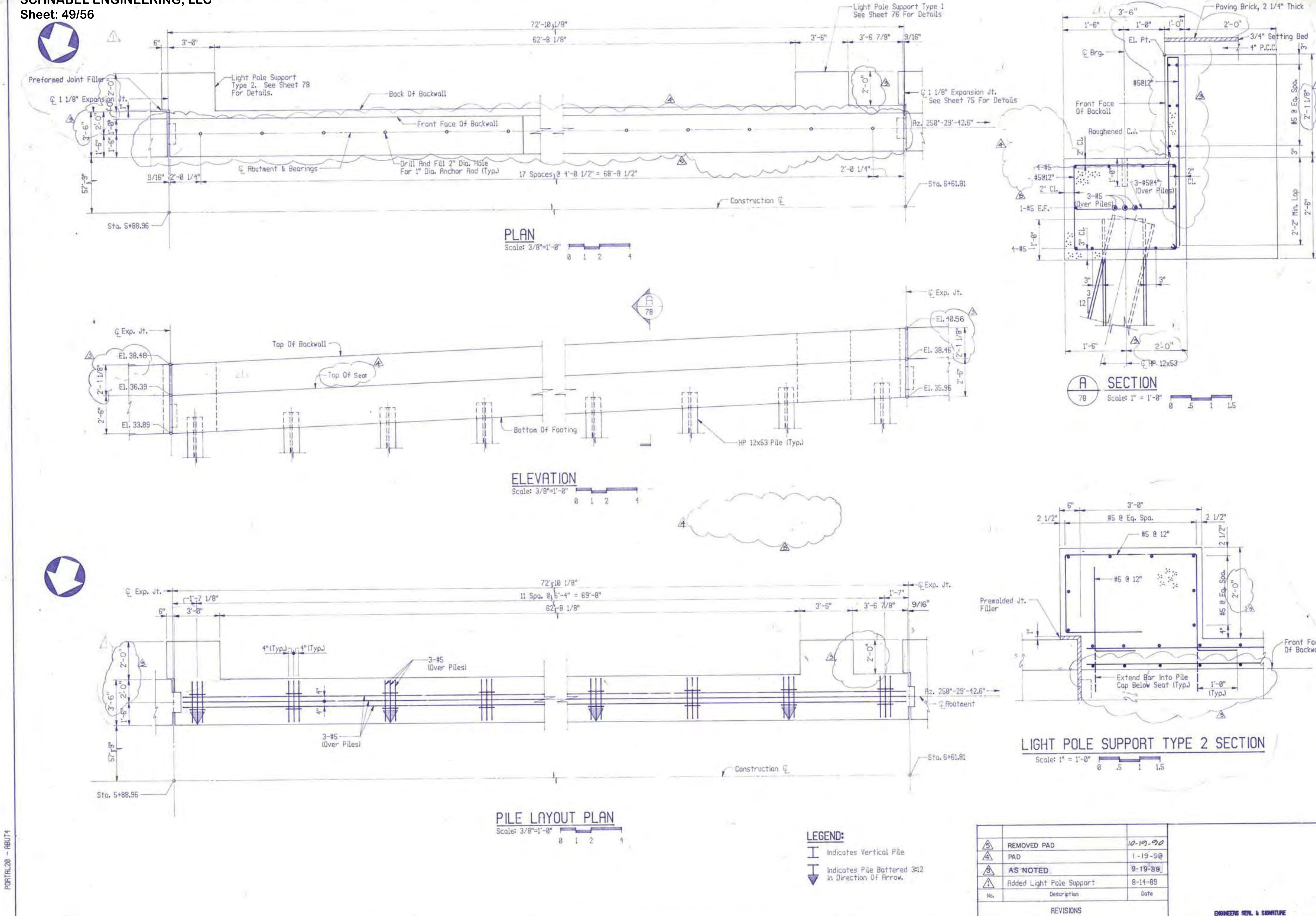
PORTAL20 - ABUT3

Dewberry & Davis
Architects Engineers Planners Surveyors
8401 Arlington Blvd., Fairfax, VA 22031
703 849-0100

MARYLAND AVENUE OVER CONRAIL
ABUTMENT 3 - PLAN & ELEVATION

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By LH
Designed By RGS
Checked By DJR
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B77 of 105
File Number



No.	Description	Date
5	REMOVED PAD	10-19-90
4	PAD	1-19-90
3	AS NOTED	9-19-89
1	Added Light Pole Support	8-14-89

REVISIONS

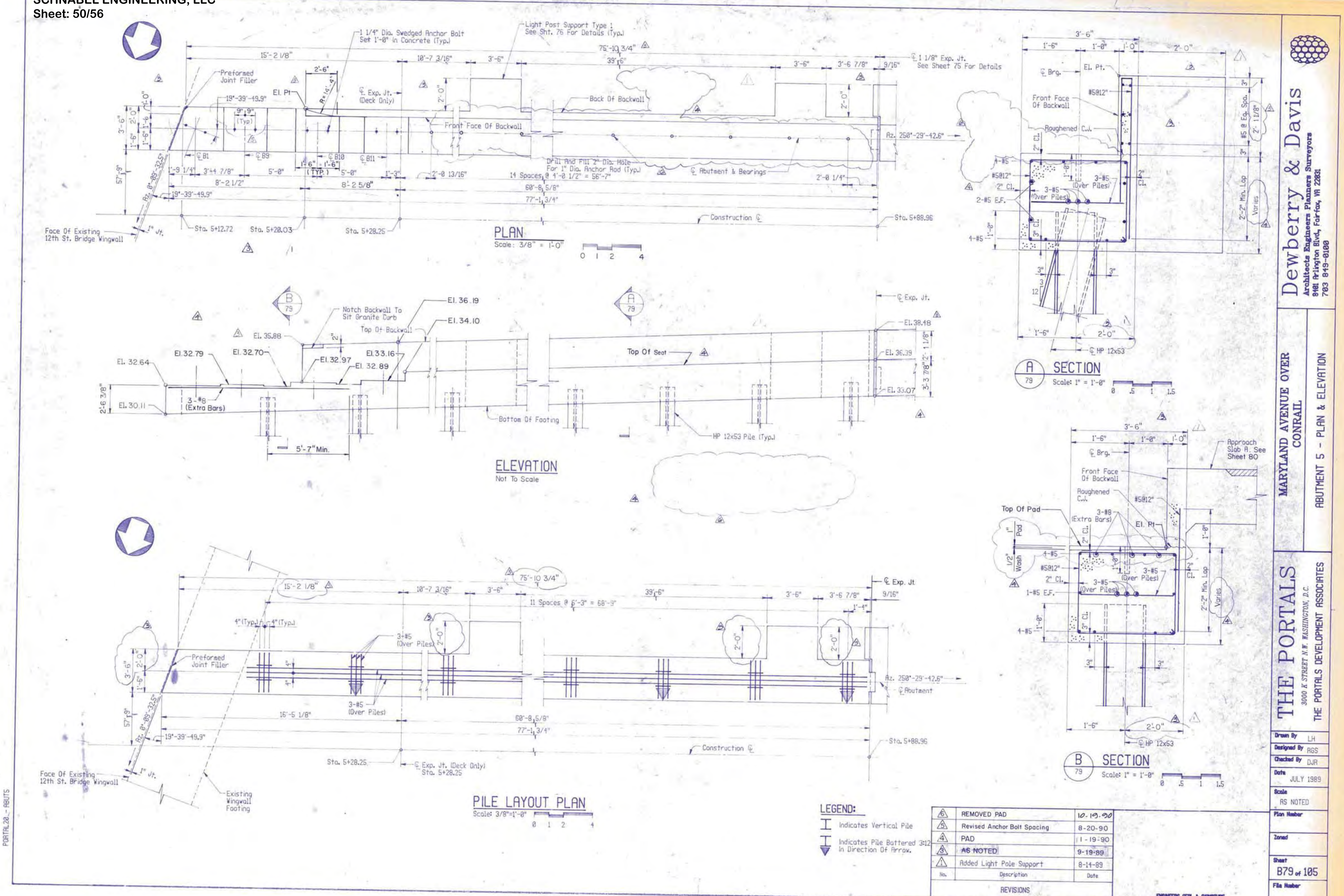
Dewberry & Davis
Architects Engineers Planners Surveyors
8401 Arlington Blvd, Fairfax, VA 22031
703 849-0100

MARYLAND AVENUE OVER CONRAIL
ABUTMENT 4 - PLAN & ELEVATION

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By: LH
Designed By: RGS
Checked By: DJR
Date: JULY 1989
Scale: AS NOTED
Plan Number:
Zoned:
Sheet: B78 of 105
File Number:

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 50/56



reinforced earth®

2010 CORPORATE RIDGE, SUITE 1000, McLEAN, VA 22102. (703) 821-1175

GENERAL NOTES

DESIGN CRITERIA

■ 1. DESIGN IS BASED ON THE ASSUMPTION THAT THE MATERIAL WITHIN THE REINFORCED EARTH VOLUME, METHODS OF CONSTRUCTION AND QUALITY OF PREFABRICATED MATERIAL SHALL CONFORM TO THE CONTRACTING AGENCY'S TECHNICAL SPECIFICATIONS FOR REINFORCED EARTH WALLS.

■ 2. ASSUMED SOILS CHARACTERISTICS:

SELECT GRANULAR BACKFILL

ϕ = 34 degrees, c = 0 p.s.f., γ = 125 p.c.f.

RANDOM BACKFILL

ϕ = 30 degrees, c = 0 p.s.f., γ = 125 p.c.f.

FOUNDATION MATERIAL

ϕ = 30 degrees, c = 0 p.s.f.

IF THE ACTUAL CHARACTERISTICS OF THE SOIL MATERIALS DIFFER FROM THOSE ABOVE, THE REINFORCED EARTH COMPANY SHOULD BE NOTIFIED PRIOR TO CONSTRUCTION TO EVALUATE THE NEED FOR REDESIGN OF THE WALL.

■ 3. THE MAXIMUM APPLIED BEARING PRESSURE AT THE FOUNDATION LEVEL IS AS SHOWN ON THE WALL ELEVATIONS FOR EACH DESIGN CASE. IT IS THE RESPONSIBILITY OF THE OWNER TO DETERMINE THAT THIS CALCULATED APPLIED BEARING PRESSURE IS ALLOWABLE FOR THAT LOCATION.

■ 4. ANY UNSUITABLE FOUNDATION MATERIAL BELOW THE REINFORCED EARTH VOLUME, AS DETERMINED BY THE ENGINEER, SHALL BE EXCAVATED AND REPLACED WITH SUITABLE MATERIAL OR OTHERWISE STABILIZED AS DIRECTED BY THE ENGINEER.

LEGEND:

■ NOTE APPLIES TO THIS PROJECT.

□ NOTE DOES NOT APPLY TO THIS PROJECT.

WALL CONSTRUCTION

■ 1. STATIONS SHOWN ARE ALONG CENTERLINE AND/OR BASELINE OF ROADWAYS.

□ 2. REINFORCED EARTH WALLS, IN CURVES, WILL FORM A SERIES OF SHORT CHORDS OF 4.92' EACH TO MATCH DESIRED WALL ALIGNMENT.

■ 3. FOR LOCATION ~~AND ALIGNMENT~~ OF REINFORCED EARTH WALLS, SEE CONTRACT DRAWINGS.

□ 4. MANHOLES AND DROP INLETS SHALL BE LOCATED AS SHOWN ON WALL ELEVATIONS.

■ 5. PILES WITHIN THE REINFORCED EARTH VOLUME SHALL BE DRIVEN PRIOR TO THE CONSTRUCTION OF THE REINFORCED EARTH WALL.

■ 6. BACKFILL MATERIAL SHALL BE COMPACTED, IN ACCORDANCE WITH THE SPECIFICATIONS FOR REINFORCED EARTH WALLS, TO A LEVEL OF 2"(±) ABOVE THE TIE STRIPS EMBEDDED IN THE PANELS. INSTALLATION OF REINFORCING STRIPS SHALL BE PERMITTED ONLY AFTER PLACEMENT AND COMPACTION OF THE BACKFILL MATERIAL HAS REACHED THE REQUIRED LEVEL.

■ 7. COMPACTION AND OPERATION EQUIPMENT SHALL BE KEPT A MINIMUM DISTANCE OF 3'- 0" FROM BACK FACE OF REINFORCED EARTH PANEL. COMPACTION WITHIN 3'- 0" OF THE REINFORCED EARTH PANELS SHALL BE ACHIEVED WITH AT LEAST THREE (3) PASSES OF A LIGHTWEIGHT MECHANICAL TAMPER, ROLLER OR VIBRATORY SYSTEM.

■ 8. FOR STRUCTURES IN EXCESS OF 20' IN HEIGHT, THE FINISHED GRADE IN FRONT OF THE WALL SHALL BE PLACED AND COMPACTED BEFORE WALL CONSTRUCTION EXCEEDS A HEIGHT OF 20'. FINISHED GRADE BACKFILL SHALL BE COMPACTED TO 95% OF AASHTO T-180, METHOD "D" UNLESS OTHERWISE DIRECTED BY ENGINEER. (4)

□ 9. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE LOCATION OF GUARDRAIL POSTS BEHIND THE REINFORCED EARTH PANELS, PRIOR TO PLACEMENT OF THE TOP LAYER OF REINFORCING STRIPS. INDIVIDUAL STRIPS MAY BE SKEWED, IF AUTHORIZED BY THE REINFORCED EARTH COMPANY, PRIOR TO PLACEMENT. ANY DAMAGE DONE TO THE REINFORCING STRIPS DUE TO THE INSTALLATION OF THE GUARDRAIL SHALL BE REPAIRED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE.

■ 10. IF STRUCTURES WITHIN THE REINFORCED EARTH VOLUME INTERFERE WITH THE NORMAL PLACEMENT OF REINFORCING STRIPS, THE CONTRACTOR SHALL NOTIFY THE REINFORCED EARTH COMPANY TO DETERMINE THE EFFECT ON THE DESIGN OF THE WALL BY SKEWING THESE STRIPS.

■ 11. ALL DETAILING AND CHECKING OF REINFORCING STEEL FOR ANY C.I.P. CONCRETE WORK IS THE RESPONSIBILITY OF THE CONTRACTOR.

■ 12. ABBREVIATIONS:

R.E. - REINFORCED EARTH
F.F. - FRONT FACE
B.F. - BACK FACE
R.S. - REINFORCING STRIP
T.S. - TIE STRIP
W.W. - WING WALL

APPROXIMATE QUANTITIES

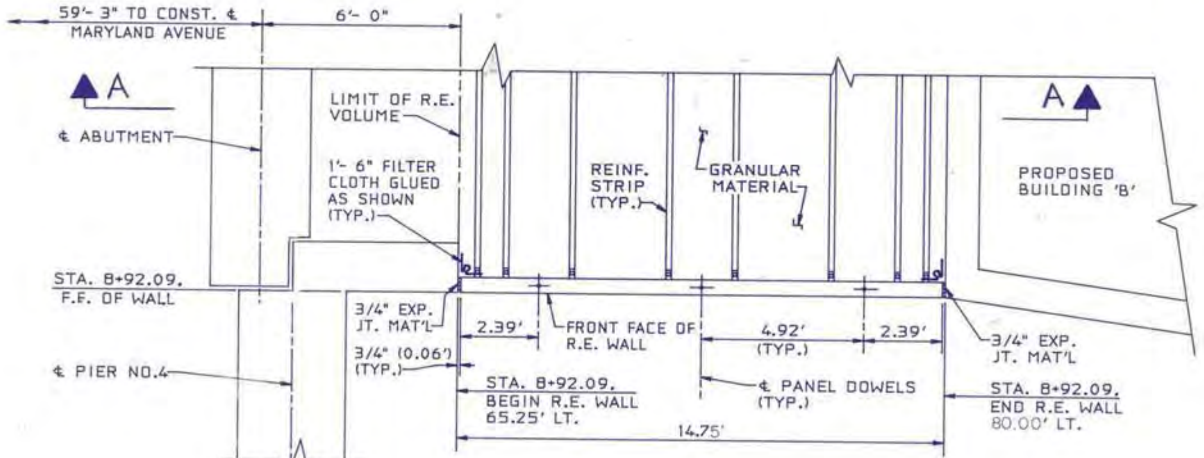
PRECAST PANEL AREA: 480 S.F.
GRANULAR BACKFILL: 460 C.Y.

THE DESIGN CONTAINED ON THESE DRAWINGS IS BASED ON INFORMATION PROVIDED BY THE OWNER. ON THE BASIS OF THIS INFORMATION, THE REINFORCED EARTH COMPANY HAS DESIGNED, AND IS RESPONSIBLE FOR THE INTERNAL STABILITY OF THE STRUCTURE ONLY. EXTERNAL STABILITY, INCLUDING FOUNDATION AND SLOPE STABILITY, IS THE RESPONSIBILITY OF THE OWNER.

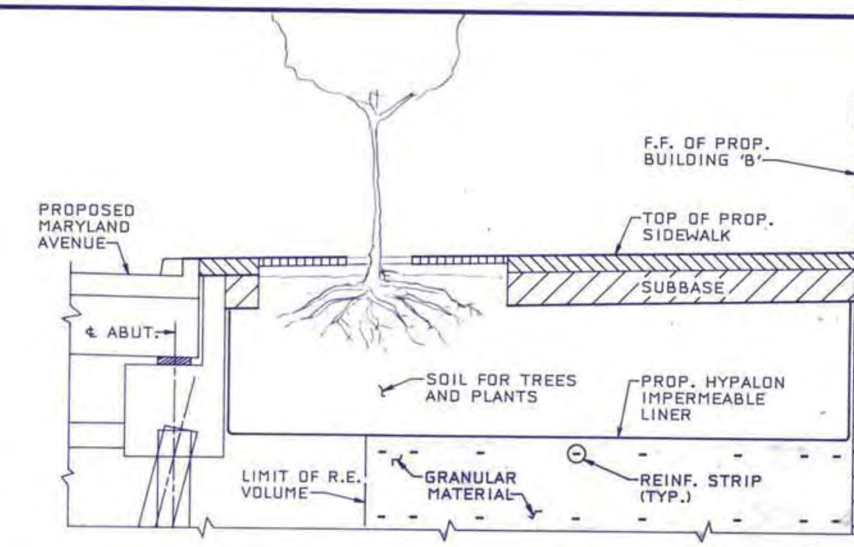
The Reinforced Earth Company

REV. NO.	DATE	DESCRIPTION
4	1-19-90	AS NOTED
1	8-14-89	NEW SHEET

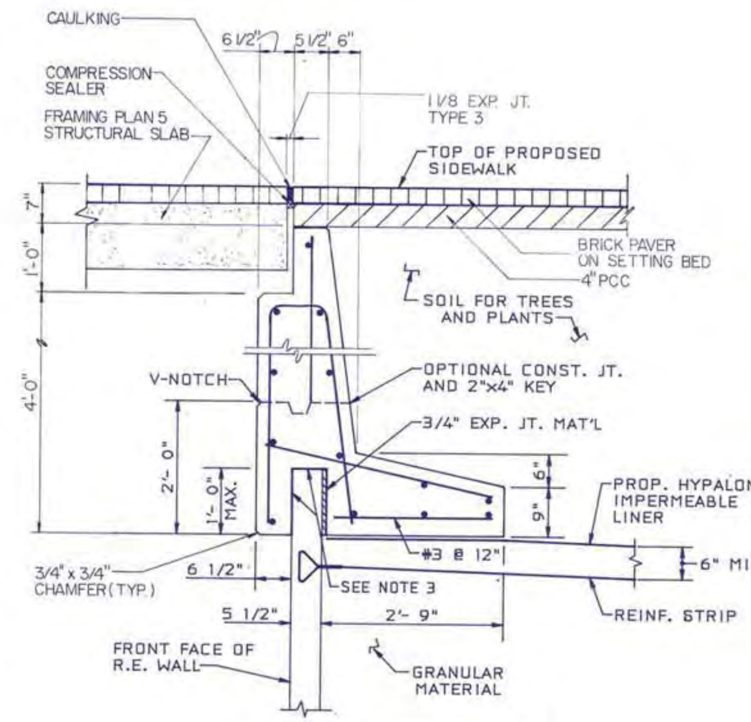
Structure	REINFORCED EARTH WALL
Location	THE PORTALS
	WASHINGTON D.C.
Owner	THE PORTALS DEVELOPMENT ASSOC.
DESIGNED BY	HKT
PROJECT ENGR.	KT
CHECKED BY	
DATE	8-14-89
CONTRACT NO.	R.E. 3419A
DRAWING NO.	1 OF 3
SCALE	AS SHOWN
	GENERAL NOTES AND QUANTIES



PARTIAL PLAN
SCALE: 3/8" = 1'- 0"

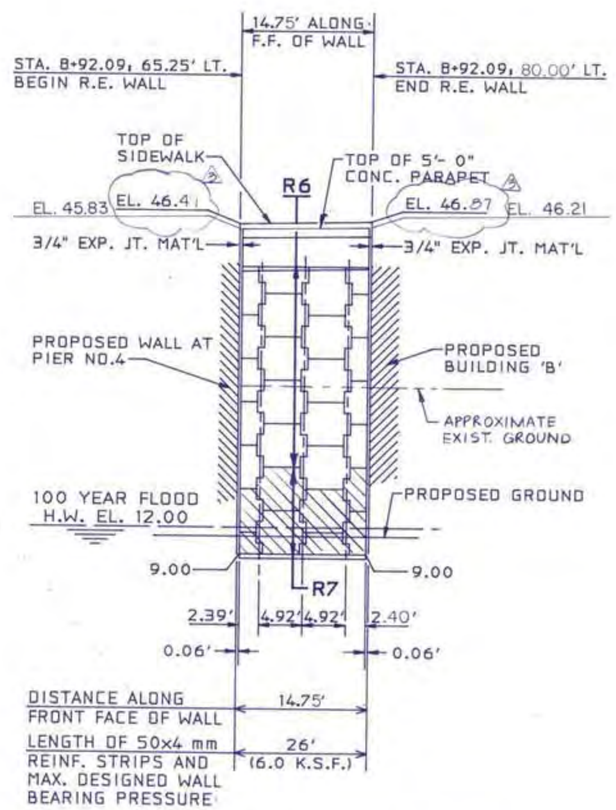


SECTION A-A
SCALE: 3/8' = 1'- 0"

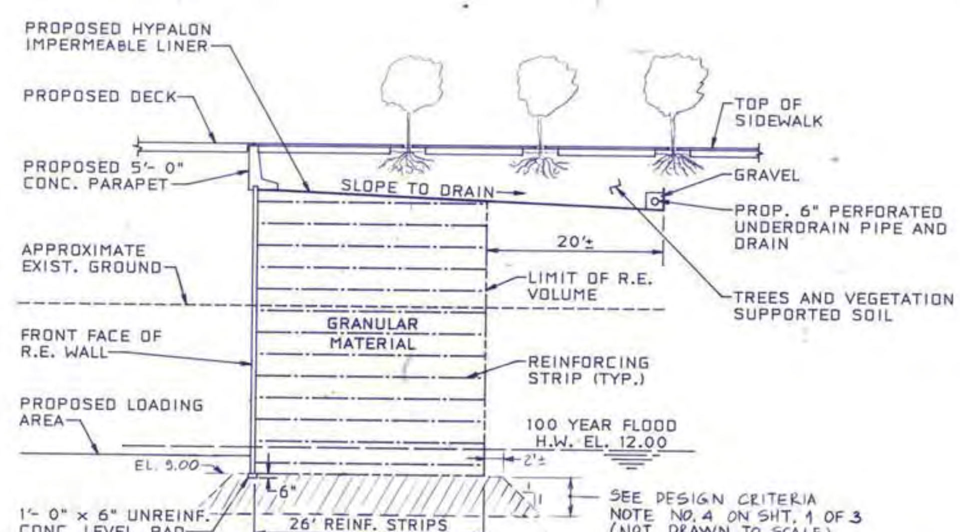


PARAPET SECTION
SCALE: 3/4" = 1'- 0"

NOTES:
1. ALL REINFORCEMENTS ARE #4 @ 12" OR AS SHOWN.
2. DETAILING OF REINFORCEMENT IS THE RESPONSIBILITY ON THE CONTRACTOR.
3. PROVIDE BOND BREAKER MATERIAL BETWEEN C.I.P. CONC. AND PRECAST CONC. PANELS.



ELEVATION - FRONT FACE
SCALE: 1" = 10'



WALL SECTION
SCALE: 1" = 10'

LEGEND:

"R6" PANEL REINFORCEMENT (PLAIN AREA)

"R7" PANEL REINFORCEMENT (HATCHED AREA)

No.	Description	Date
3	AS NOTED	9-19-89

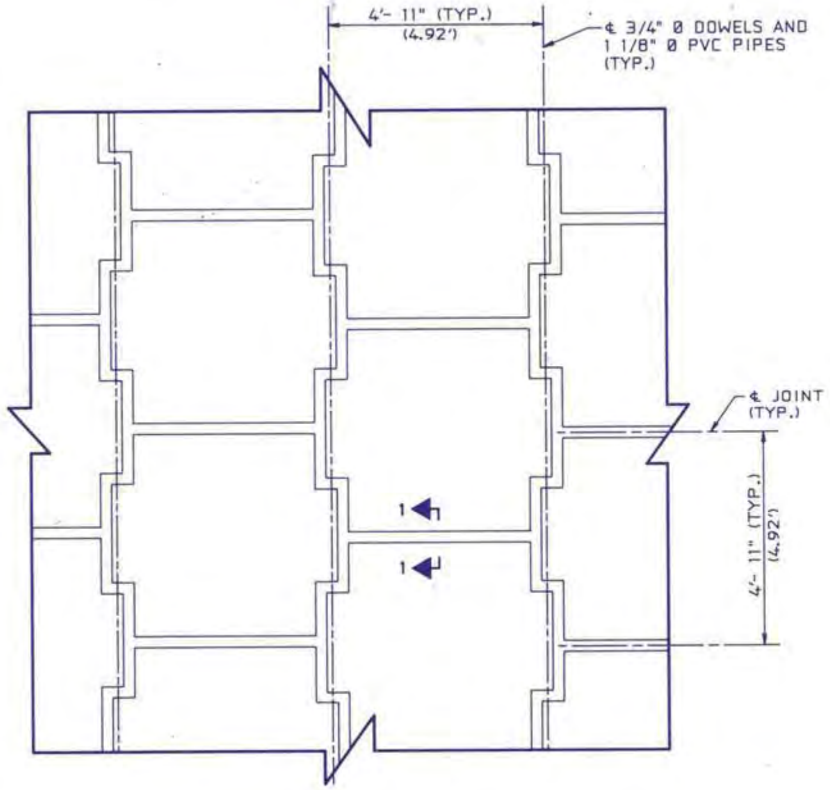
REVISIONS

THE DESIGN CONTAINED ON THESE DRAWINGS IS BASED ON INFORMATION PROVIDED BY THE OWNER. ON THE BASIS OF THIS INFORMATION, THE REINFORCED EARTH COMPANY HAS DESIGNED, AND IS RESPONSIBLE FOR THE INTERNAL STABILITY OF THE STRUCTURE ONLY. EXTERNAL STABILITY, INCLUDING FOUNDATION AND SLOPE STABILITY, IS THE RESPONSIBILITY OF THE OWNER.

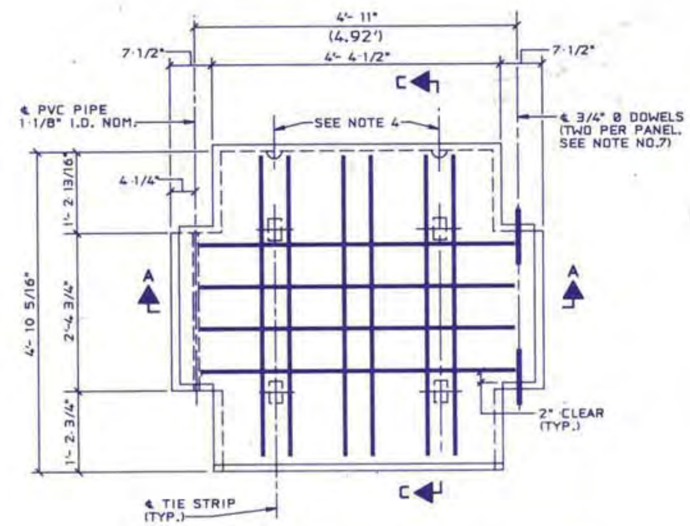
The Reinforced Earth Company

REV. NO.	DATE	DESCRIPTION
3	9-19-89	AS NOTED
1	8-14-89	NEW SHEET

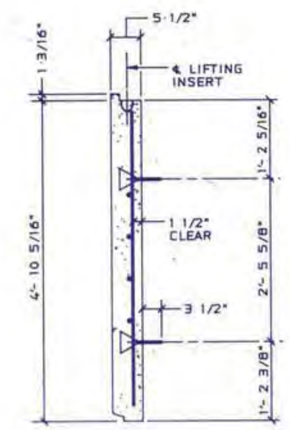
Structure	REINFORCED EARTH WALL		
Location	THE PORTALS		
	WASHINGTON D.C.		
Owner	THE PORTALS DEVELOPMENT ASSOC.		
DESIGNED BY:	HKT	DATE	CONTRACT NO. R.E. 3419A
PROJECT ENGR:	KT	8-14-89	DRAWING NO. 2 OF 3
CHECKED BY:			
PLAN, ELEVATION & DETAILS			SCALE AS SHOWN



TYPICAL PANEL LAYOUT
PARTIAL ELEVATION - FRONT FACE
NO SCALE



PANEL TYPE "A" - FRONT FACE
(WITH "R6" REINFORCEMENT)
SCALE: 3/4" = 1'- 0"

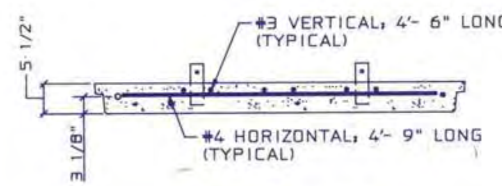


SECTION C-C
SCALE: 3/4" = 1'- 0"

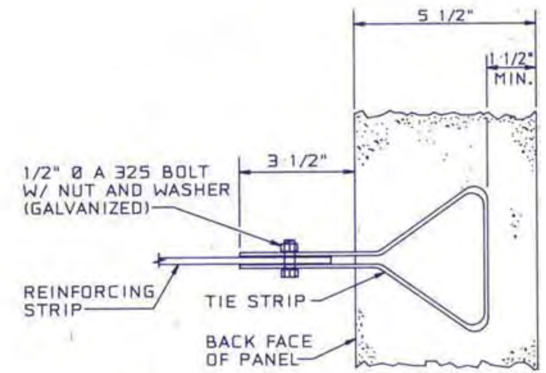
PANEL THICKNESS	REINFORCEMENT DESIGNATION	PANEL REINFORCEMENT A_s (in.^{2})	MAXIMUM ALLOWABLE HORIZONTAL STRESS AT FACING (K.S.F.)
5½"	"R6"	0.66 VERTICAL 0.78 HORIZONTAL	1.33
	"R7"	1.18 VERTICAL 1.77 HORIZONTAL	2.58

NOTES:

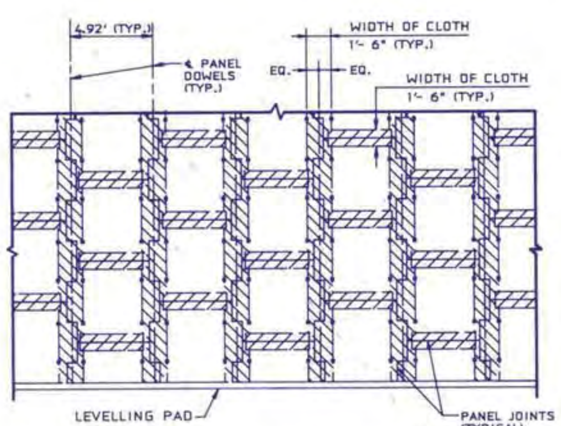
1. REINFORCING STEEL TO BE A 615 GRADE 60.
2. 3/8" x 3/8" CHAMFER SHALL BE PROVIDED ON ALL EXPOSED EDGES (FRONT FACE ONLY).
3. ALL PANEL TYPES AND OTHER RELATED ELEMENTS WILL BE DETAILED ON SHOP DRAWINGS.
4. ALL PANELS SHALL HAVE TWO LIFTING INSERTS OF ONE TON CAPACITY EACH.
5. PANEL DESIGN THICKNESS IS 5 1/2". THICKNESS OF CONCRETE MUST INCREASE TO ACCOMODATE ANY ARCHITECTURAL SURFACE FINISH THAT MAY BE SPECIFIED.
6. ACTUAL PANEL REINFORCEMENT FOR ALL PANEL TYPES ON THIS PROJECT IS DESIGNATED ABOVE. "R6" ILLUSTRATED FOR INFORMATION ONLY.
7. EACH 3/4" Ø DOWEL SHALL HAVE A MINIMUM LENGTH OF 10". DOWELS MAY BE GALVANIZED STEEL OR PVC ROD. A SINGLE FULL LENGTH DOWEL MAY BE USED AT THE DISCRETION OF THE MANUFACTURER.



SECTION A-A
SCALE: 3/4" = 1'- 0"

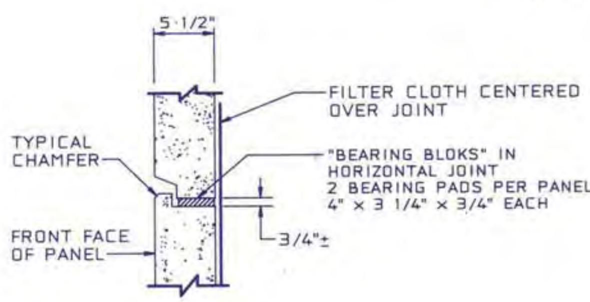


CONNECTION DETAIL
NO SCALE

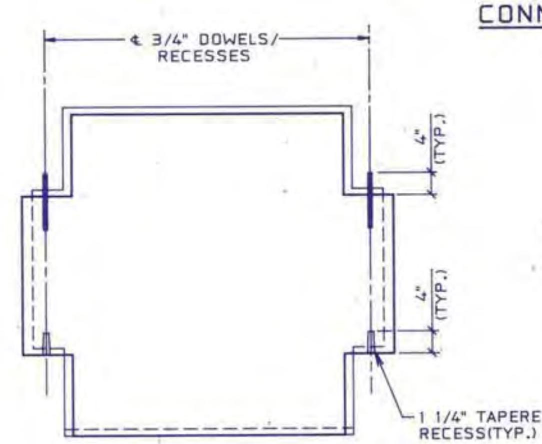


NOTE:
STRIPS OF FILTER CLOTH SHALL BE PLACED ON BACK FACE OF PANEL, OVER PANEL JOINTS. FILTER CLOTH SHALL BE ADHERED TO BACK FACE OF PANELS USING AN ADHESIVE COMPOUND SUPPLIED BY THE REINFORCED EARTH COMPANY.

TYPICAL FILTER CLOTH DETAIL
PARTIAL ELEVATION - BACK FACE
NO SCALE



SECTION 1-1
NO SCALE



ALTERNATE DOWEL PLACEMENT DETAIL
SCALE: 3/4" = 1'- 0"

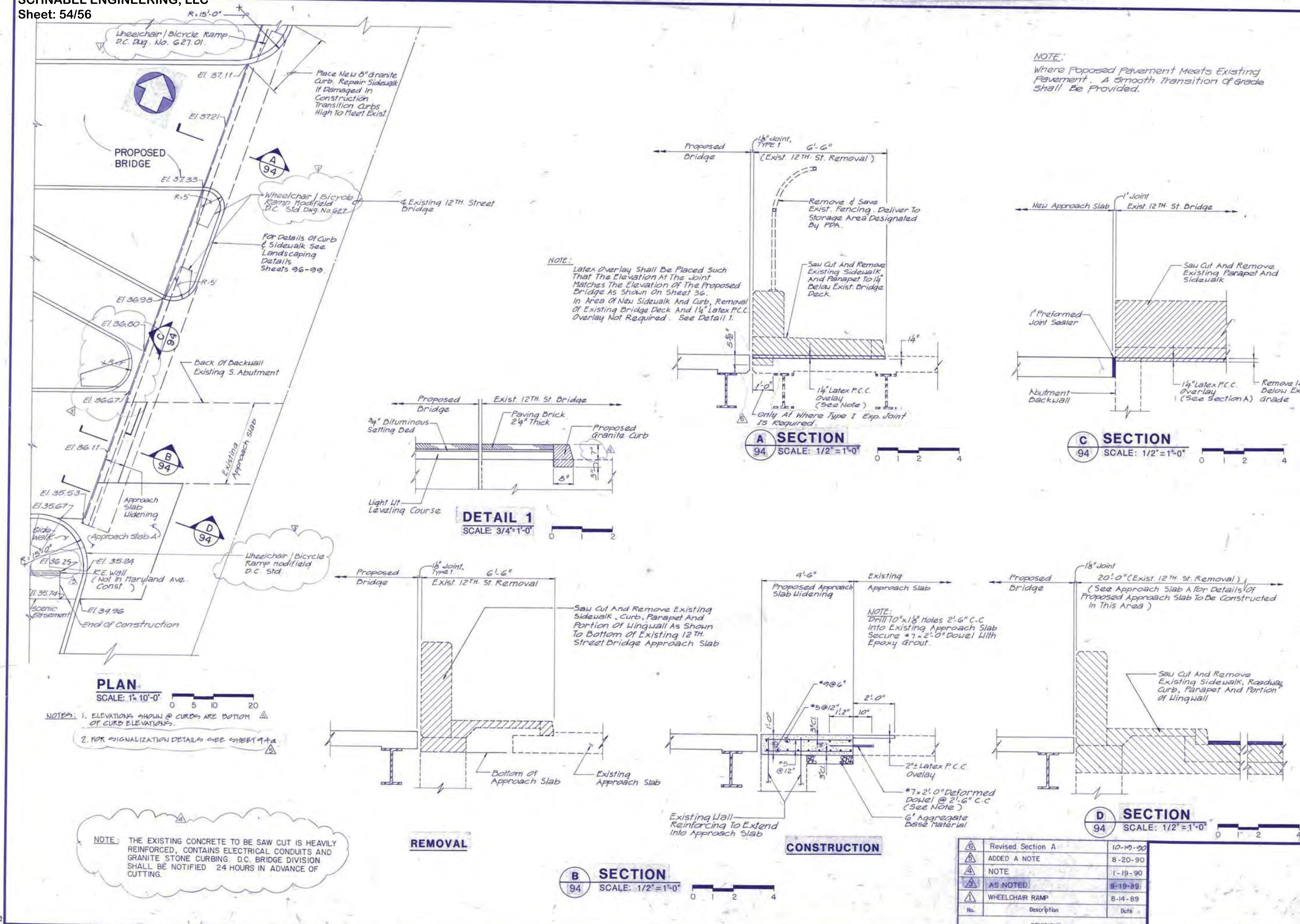
THE DESIGN CONTAINED ON THESE DRAWINGS IS BASED ON INFORMATION PROVIDED BY THE OWNER. ON THE BASIS OF THIS INFORMATION, THE REINFORCED EARTH COMPANY HAS DESIGNED, AND IS RESPONSIBLE FOR THE INTERNAL STABILITY OF THE STRUCTURE ONLY. EXTERNAL STABILITY, INCLUDING FOUNDATION AND SLOPE STABILITY, IS THE RESPONSIBILITY OF THE OWNER.

The Reinforced Earth Company

Structure	REINFORCED EARTH WALL
Location	THE PORTALS WASHINGTON D.C.
Owner	THE PORTALS DEVELOPMENT ASSOC.
DESIGNED BY	HKT
PROJECT ENGR.	KT
CHECKED BY	
DATE	8-14-89
CONTRACT NO.	R.E. 3419A
DRAWING NO.	3 OF 3
SCALE	AS SHOWN
TITLE	STANDARD 'A' PANEL DETAILS

REV NO.	DATE	DESCRIPTION
1	8-14-89	NEW SHEET

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 54/56



No.	Description	Date
6	Revised Section A	10-19-90
5	ADDED A NOTE	8-20-90
4	NOTE	1-19-90
3	AS NOTED	9-19-89
1	WHEELCHAIR RAMP	8-14-89

REVISIONS

ENGINEER'S SEAL & SIGNATURE

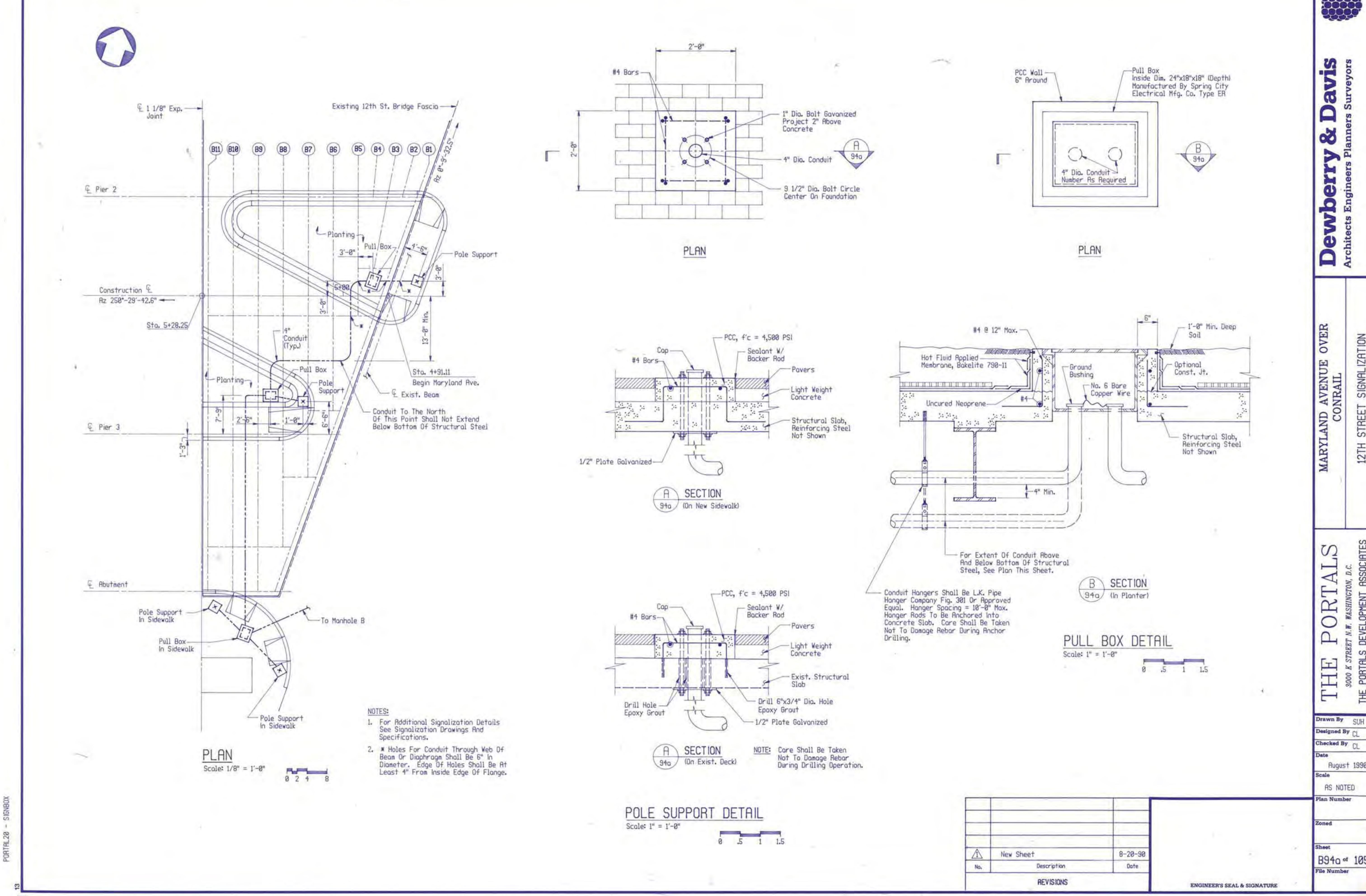
Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL
12 TH. STREET MODIFICATIONS

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By TTN
Designed By JDD
Checked By JDD
Date JULY 1989
Scale AS NOTED
Plan Number
Zoned
Sheet B94 of 105
File Number

APPENDIX 7
SCHNABEL ENGINEERING, LLC
Sheet: 55/56



B-9

SITE LOCATION: 14TH & D STREET, S.W. WASHINGTON D.C.

SURFACE ELEVATION: 19.1

Sample No.	Sample Type	Sample Distance (in)	Recovery (in)	Description of Material	Standard Penetration Blows/Ft.
				Sandy Clay-Orange Brown-Very Stiff-Moist (CL)	
1	SS	18	10		22
				Silty Clay-Brown & Gray-Hard-Moist (CH)	
2	SS	18	14		22
				Fine to Coarse Sand & Gravel with Silt-Brown & Orange Brown-Dense to Medium Dense-Moist to Wet (SP)	
3	SS	18	16		44
4	SS	18	12		19
				Silt-Trace Fine Sand-Blackish Gray-Loose-Moist (ML)	
5	SS	18	18		7
6	SS	18	16		20
				Fine to Coarse Sand with Gravel & Silt-Brown, Gray & Greenish Brown-Medium Dense to Dense-Wet (SP)	
7	SS	18	12		24
8	SS	18	12		18
9	SS	18	12		32
10	SS	18	14		32
11	SS	18	16		56
				Silty Clay-Trace Fine Sand-Blue Gray-Hard-Moist (CH)	
12	SS	18	18		50 (*4.5)
				Silty Clay-Trace Fine Sand-Blue Gray-Hard-Moist (CH)	
13	SS	18	18		40 (*4.5+)
14	SS	18	18		18
				Clayey, Fine to Coarse Sand-Trace Gravel & Silt-Brown & Reddish Brown-Extremely Dense-Moist (SC)	
15	SS	18	16		100 (*4.5+)
16	SS	15	15		100

END OF BORING

NOTE: HOLLOW STEM AUGER USED

O* CALIBRATED PENETROMETER (TSF)

B-10

SITE LOCATION: 14TH & D STREET, S.W. WASHINGTON D.C.

SURFACE ELEVATION: 19.6

Sample No.	Sample Type	Sample Distance (in)	Recovery (in)	Description of Material	Standard Penetration Blows/Ft.
				Fine to Coarse Sand & Gravel-Trace Silt-Reddish Brown-Dense to Medium Dense-Moist (SP)	
1	SS	18	16		38
2	SS	18	12		31
3	SS	18	12		22
4	SS	18	14	Silt with Fine Sand-Trace Gravel-Blackish Gray-Dense-Moist (ML)	31
				Fine to Coarse Sand & Gravel-Trace Silt-Brown & Orange Brown-Dense-Wet (SP)	
5	SS	18	14		62
6	SS	18	14		39
				Fine to Coarse Sand & Gravel-Trace Silt-Brown & Orange Brown-Dense-Wet (SP)	
7	SS	4	4		100/4"
8	SS	18	9		32
				Fine to Coarse Sand-Trace Fine Gravel-Orange Brown-Medium Dense-Wet (SP)	
9	SS	18	12		21
10	SS	18	12		23
11	SS	18	12		13
12	SS	18	12		20

END OF BORING.

NOTE: HOLLOW STEM AUGER USED

B-13

SITE LOCATION: 14th & D STREET, S.W. WASHINGTON D.C.

SURFACE ELEVATION: 25.9

Sample No.	Sample Type	Sample Distance (in)	Recovery (in)	Description of Material	Standard Penetration Blows/Ft.
				Fill-Clayey Fine to Coarse Sand-Trace Gravel-Brown, Black & Reddish Brown-Medium Dense-Moist (FILL)	
1	SS	18	14		16
				Fine to Coarse Sand-Trace Clay & Gravel-Brown-Dense to Medium Dense-Moist (SP)	
2	SS	18	16		40
3	SS	18	16		27
				Silty, Fine to Medium Sand-Dark Brown-Medium Dense-Moist (SM)	
4	SS	18	16		24
				Silt-Trace Fine Sand-Blackish Gray-Very Loose-Moist to Wet (ML)	
5	SS	18	18		3
6	ST	24	24		
7	SS	18	16		5
				Silt-Trace Fine Sand-Blackish Gray-Very Loose-Moist to Wet (ML)	
7	SS	18	16		4
8	SS	18	16		3
9	SS	18	14	Silty, Fine to Coarse Sand-Trace Gravel-Brown & Gray-Medium Dense	15
10	SS	18	12		16
11	SS	18	12		22
12	SS	18	14		26
				Silt-Blackish Gray-Dense-Moist (ML)	
13	SS	18	14		32
				Silt-Blackish Gray-Dense-Moist (ML)	
				Fine to Coarse Sand & Gravel-Trace Silt-Brown & Gray-Very Dense-Wet (SP)	
14	SS	18	1		73
15	SS	18	10		69
16	SS	18	16	Clayey, Fine to Medium Sand-Trace Silt-Greenish Gray-Dense-Moist (SC)	42
17	SS	18	16		47

END OF BORING

B-17

SITE LOCATION: 14th & D STREET, S.W., WASHINGTON D.C.

SURFACE ELEVATION: 28.0

Sample No.	Sample Type	Sample Distance (in)	Recovery (in)	Description of Material	Standard Penetration Blows/Ft.
				Silty Fine Sand-Trace Clay-Reddish Brown-Medium Dense-Moist Note: Possible Fill (SM)	
1	SS	18	16		17
2	SS	18	12		12
				Fine to Coarse Sand & Gravel-Trace Silt-Brown & Greenish Brown-Very Dense to Medium Dense-Moist (SP)	
3	SS	18	14		64
4	SS	18	15		49
5	SS	18	16		28
6	SS	18	16	Very Fine Sandy Silt-Trace Clay-Blackish Gray-Loose-Moist (ML)	4
7	SS	18	16		7
				Very Fine Sandy Silt-Trace Clay-Blackish Gray-Loose-Moist (ML)	
8	SS	18	16		4
9	SS	18	14	Fine to Coarse Sand-Trace Silt & Gravel-Brown, Grayish Brown & Orange Brown-Extremely Dense to Medium Dense-Wet (SP)	82
10	SS	18	12		26
11	SS	18	16		42
12	SS	18	12		19
13	SS	18	10		19
14	SS	18	12		21
				Fine to Coarse Sand-Trace Silt & Gravel-Brown, Grayish Brown & Orange Brown-Extremely Dense to Medium Dense-Wet (SP)	
15	SS	18	12		36

END OF BORING.

Dewberry & Davis
Architects Engineers Planners Surveyors

MARYLAND AVENUE OVER CONRAIL

BORING LOGS

THE PORTALS
3000 K STREET N.W. WASHINGTON, D.C.
THE PORTALS DEVELOPMENT ASSOCIATES

Drawn By	TTN
Designed By	
Checked By	CL
Date	JULY 1989
Scale	NONE
Plan Number	
Zoned	
Sheet	B95 of 105
File Number	

APPENDIX 8

Selected sheets from the Geotechnical Engineering Report, dated August 1999, prepared by Schnabel Engineering for the Mandarin Oriental Hotel at the Portals, Maryland Avenue, SW Washington DC

20 Sheets

File

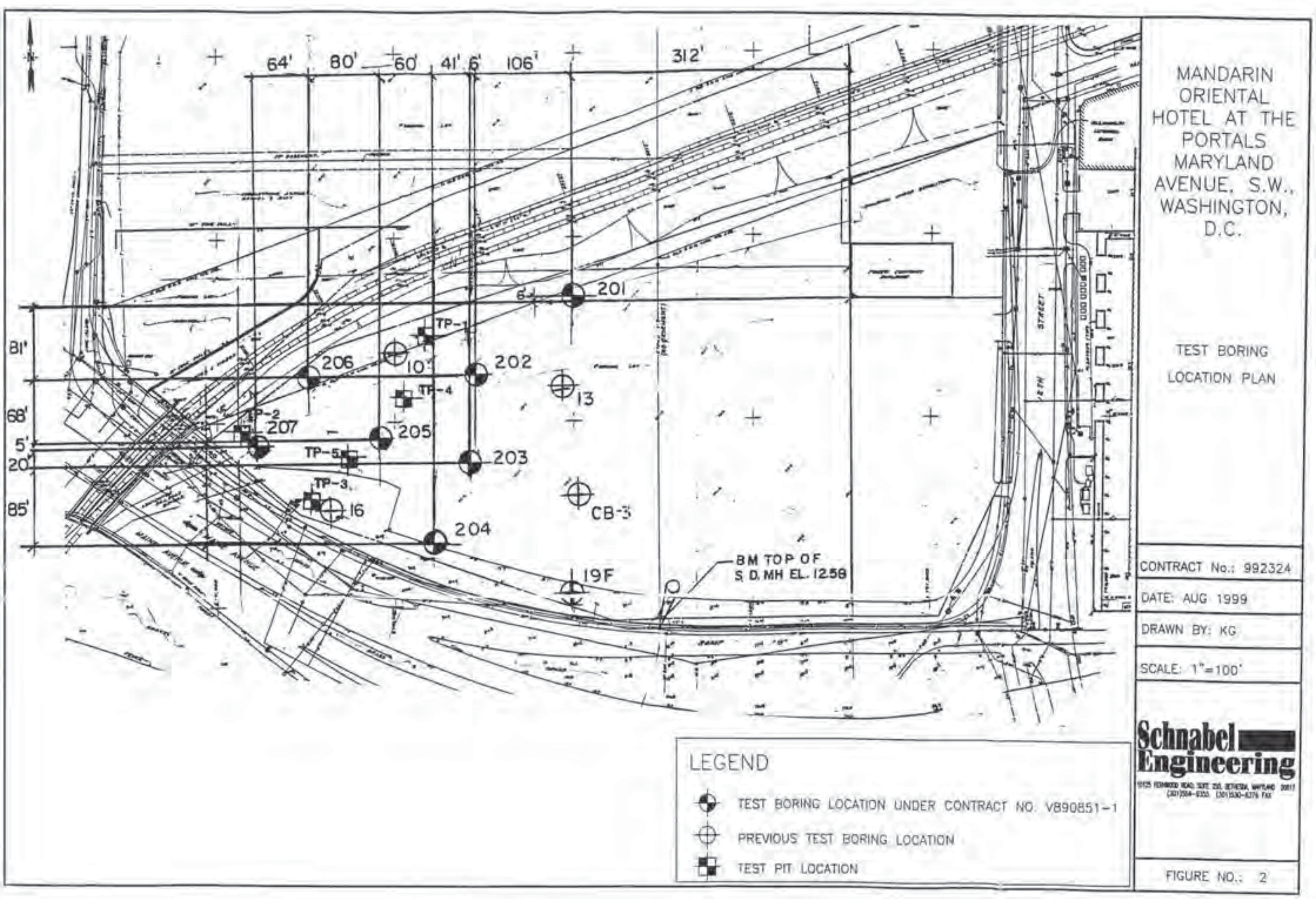
Geotechnical Engineering Report
Mandarin Oriental Hotel at the Portals
Maryland Avenue, S.W.
Washington, D.C.

8 1/2 mix concrete
40 foundation
10-15 days Post tensioning

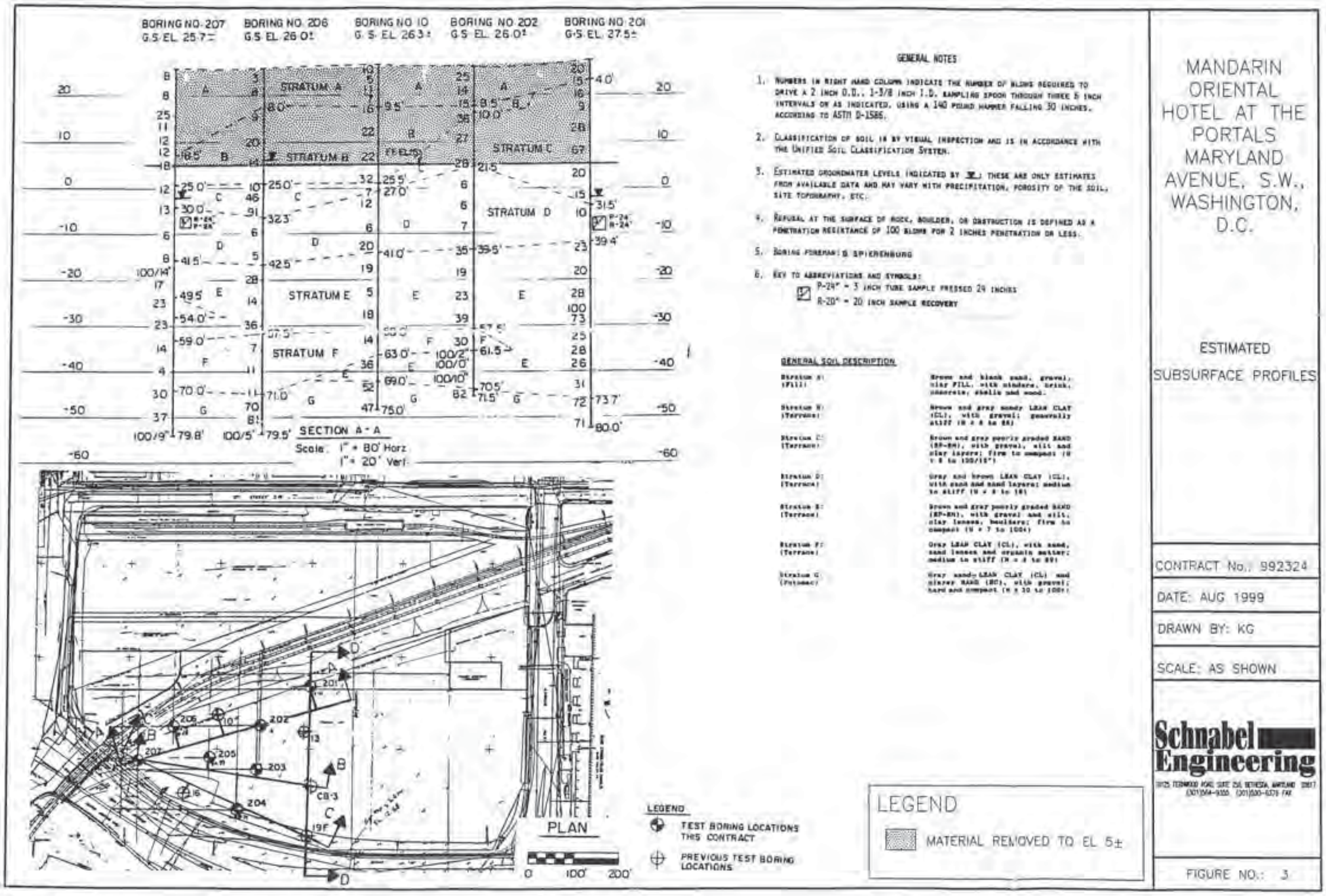
FIGURE 1
VICINITY MAP

MANDARIN ORIENTAL HOTEL AT THE PORTALS
WASHINGTON, D.C.
SCALE: 1" = 2000'
COPYRIGHT ADC THE MAP PEOPLE
PERMITTED USE NO. 20598757

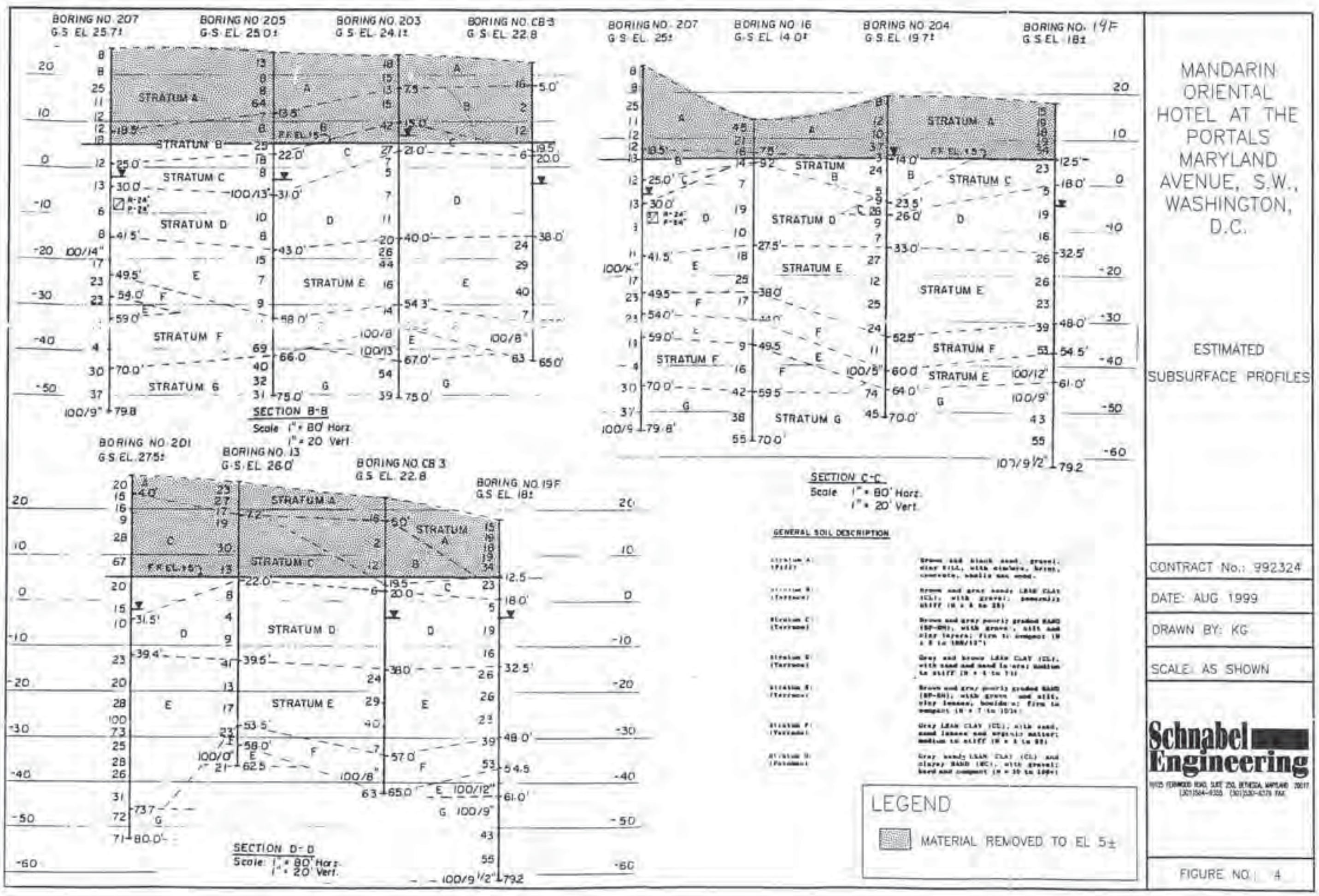
APPENDIX 8
SCHNABEL ENGINEERING, LLC
Sheet: 3/20



APPENDIX 8
SCHNABEL ENGINEERING, LLC
Sheet: 4/20



APPENDIX 8
SCHNABEL ENGINEERING, LLC
Sheet: 5/20



Contract

SUMMARY OF SOIL LABORATORY RESULTS

Contract W890851

BORING NO.	DEPTH (ft.)	SAMPLE TYPE	DESCRIPTION OF SOIL SPECIMEN	STRATUM DESIGNATION	PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS			NATURAL MOISTURE (%)	NATURAL DENSITY		Gs	SOIL PARAMETERS	REMARKS
						LL	PL	PI		WET (pcf)	DRY (pcf)			
201	34-36	3 INCH TUBE	LEAN CLAY (CL), gray	D	88.9	37	21	16	31.5	121.9	92.7	2.60	q_u = 2730	See: Gradation, Unconfined Compression & Consolidatoin Curves
204	19.0	JAR	LEAN CLAY (CL) with sand, gray	E	71.9	26	16	10	23.7	—	—	—		—
205	24.0	JAR	silty SAND (SM), gray	C	38.1	—	—	—	24.5	—	—	—		See: Gradation Curve
205	58.5	JAR	SILT (ML) with sand, gray	F	76.8	NP	NP	NP	62.0	—	—	—		—
207	32-24	3 INCH TUBE	LEAN CLAY (CL) with sand, gray	D	76.6	34	20	14	33.2	120.9	90.8	—	q_u = 2110	See: Unconfined Compression and Consolidation Curves

NOTES:

1. Soil tests in accordance with applicable ASTM standards.
2. Soil classification symbols are in accordance with Unified classification system, based on testing indicated and visual identification.
3. Visual identification of samples is in accordance with the system used by this firm.
4. Natural moisture content determinations were performed on samples from Boring Nos. 204 and 205. Results are shown on the test boring report.
5. Key to abbreviations: LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; NP = Nonplastic; Gs = Specific Gravity; q_u = Unconfined Compressive Strength, psf

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 201 Sheet: 1 Of 2

Boring Contractor: FOUNDATION TEST SERVICE, INC.

Boring Foreman: Spierenburg
Drilling Method: 2¼" HOLLOW STEM AUGER
Drilling Equipment: CME 55 #3

SEA Representative: Skep Nordmark

Dates Started: 07/21/89 Completed: 07/24/89

Location:

Ground Surface Elevation: 27.5 ±

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	7-21	5:20	23.5	23.5	
Completion	7-24	7:00	27.5	78.5	-
Casing Pulled	7-24	5:30	27.5	-	*
	3-11	10:15	29.9	—	*

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	w (%)	REMARKS
0.1	asphalt & 0.8 concrete		27.4	A		10+11+9		
4.0	sand gravel & brick FILL, moist, brown & black		23.5		5	6+7+8		
	poorly graded SAND, moist, brown	SP				4+8+8		
	with gravel below 14'				10	3+3+6		
	with silt at 24'				15	9+10+18		
	with lean clay layer at 28'			C	20	15+18+49		
					25	3+12+8		
					30	9+8+7		
31.5	LEAN CLAY with sand, moist, gray	CL	-4.0			4+4+6		
				D	35	3T 24/24		
39.4	poorly graded SAND with gravel and silt, wet, brown	SP-SM	-11.9		40	6+15+8		
	with lean clay lenses at 49'				45	25+10+10		
					50	14+18+10		

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 201 Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	w (%)	REMARKS
				E		21+44+56		
					55	32+34+39		
						6+10+15		
					60			
						9+10+18		
					65	8+11+15		
					70	9+11+20		
73.7	sandy LEAN CLAY, moist, gray	CL	-46.2	G		15+25+47		
					75			
						22+23+48		
80.0	BOTTOM OF BORING @ 80.0 FT.		-52.5		80			

Comments:
* In water observation well, well tip at 45.5 depth

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 202 Sheet: 1 Of 2

Boring Contractor: FOUNDATION TEST SERVICE, INC.

Boring Foreman: Spierenburg
Drilling Method: 2¼" HOLLOW STEM AUGER
Drilling Equipment: CME 55 #3

SEA Representative: Skep Nordmark

Dates Started: 07/14/89 Completed: 07/14/89

Location:

Ground Surface Elevation: 26.0 ±

Groundwater Observations	Date	Time	Depth	Casing	Caved
Encountered	7-14	9:00	29.0	28.5	-
Completion	7-17	6:15	19.5	70.0	-
Casing Pulled	7-17	7:30	NONE	-	12.0
	7/19	6:35	NONE	-	12.0

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
0.2	asphalt		25.8			13+10+15		
	sand gravel & cinder FILL with clay, moist, brown & black			A	5	6+4+10		
						7+6+9		
8.5	sandy LEAN CLAY, moist, brown & gray	CL	17.5	B	10	8+16+20		
10.0	poorly graded SAND with gravel, moist, brown	SP	16.0	C	15	8+10+17		
					20	20+15+13		
21.5	LEAN CLAY with sand and sand lenses, moist, gray	CL	4.5	D		3+3+3		
					25			
					30	3+2+4		
					35	3+3+4		
39.5	poorly graded SAND with gravel, moist, gray		-13.5	E	40	3+10+25		
					45	9+9+10		Running Sand from 43.5 to 53.5'
					50	5+7+16		

SCHNABEL ENGINEERING ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS
TEST BORING LOG

Project: Fairmont Hotel

Contract Number: W890851
Boring Number: 202
Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	w (%)	REMARKS
					55	15+22+17		
57.0	LEAN CLAY with sand and organic matter, moist, gray	CL	-31.0	F	60	37+18+12		
61.5	poorly graded SAND with gravel, moist, brown cored 8" granite boulder at 64.4'		-35.5	E	65	100/2" 100/0" 65+35/4"		
70.5	sandy LEAN CLAY, moist, gray	CL	-44.5	G	70	25+38+44		
71.5	BOTTOM OF BORING @ 71.5 FT.		-45.5					

Comments:

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 203 Sheet: 1 Of 2

Boring Contractor: FOUNDATION TEST SERVICE, INC.

Boring Foreman: Spierenburg
Drilling Method: 2¼" HOLLOW STEM AUGER
Drilling Equipment: CME 55 #3

SEA Representative: Skep Nordmark

Dates Started: 07/17/89 Completed: 07/17/89

Location:

Ground Surface Elevation: 24.1 ±

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	7-17	5:30	19.0	19.0	-
Completion	7-17	12:00	57.5	73.5	-
Casing Pulled	7-17	1:00	NONE	-	16.0
	7-19	6:30	17.0	-	17.0

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
0.2	asphalt		23.9					
	clayey sand FILL with gravel & cinders, moist, brown to black			A		12+11+7		
					5	10+8+7		
7.5	sandy LEAN CLAY with gravel, moist, brown	CL	16.6			3+5+8		
				B	10	5+7+6		
15.0	poorly graded SAND with gravel & & silt, moist, brown	SP-SM	9.1		15	9+17+25		
				C				
					20	8+12+15		
21.0	LEAN CLAY with sand and sand layers, moist, gray with gravel at 39'	CL	3.1			3+4+3		
					25	2+2+3		
				D	30	3+3+4		
					35	4+5+6		
40.0	poorly graded SAND, with gravel & silt, moist, brown gray	SP-SM	-15.9		40	5+10+10		
						12+9+17		
				E	45	10+23+21		
					50	5+6+10		

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 203 Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	w (%)	REMARKS
54.3	LEAN CLAY with sand & organic matter, moist, gray	CL	-30.2	F	55	5+6+8		
59.5	poorly graded SAND with gravel, wet, brown	SP	-35.4	E	60	7+40+60/2"		
						60+26+14/1"		
					65			
67.0	sandy LEAN CLAY, moist, gray	CL	-42.9	G		20+23+31		
					70			
						18+18+21		
75.0	BOTTOM OF BORING @ 75.0 FT.		-50.9		75			

Comments:

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 204 Sheet: 1 Of 2

Boring Contractor: FOUNDATION TEST SERVICE, INC.

Boring Foreman: Spierenburg
Drilling Method: 2¼" HOLLOW STEM AUGER
Drilling Equipment: CME 55 #3

SEA Representative: Skep Nordmark

Dates Started: 07/17/89 Completed: 07/17/89

Location:

Ground Surface Elevation: 19.7 ±

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	7-18	6:15	21.5	21.5	-
Completion	7-18	9:15	62.5	68.5	-
Casing Pulled	7-18	10:00	16.5	-	22.5
	7-19	6:40	14.0	-	18.5

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
	clayey sand FILL with brick, shells & cinders, moist, brown & black			A		2+3+5		
	with concrete at 7'				5	4+5+7		
						5+5+5		
					10	12+18+19		
						2+1+2		
14.0	sandy LEAN CLAY, moist, brown	CL	5.7	B	15	10+10+14		
					20	3+2+3		
						5+4+5	22.4	
23.5	poorly graded SAND with gravel, wet, brown	SP	-3.8	C	25	30+20+8	26.4	
26.0	LEAN CLAY with sand, moist, gray & brown	CL	-6.3	D		3+4+5		
					30	4+4+3	27.6	
33.0	poorly graded SAND with gravel & silt, wet, brown	SP-SM	-13.3	E	35	25+9+16		
					40	5+5+7	24.3	
					45	5-10+15		
					50	12+14+10		

SCHNABEL ENGINEERING ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS
TEST BORING LOG

Project: Fairmont Hotel

Contract Number: W890851
Boring Number: 204
Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	w (%)	REMARKS
52.5	LEAN CLAY with sand and sand lenses & organic matter, moist, gray	CL	-32.8	F	55	6+5+6	33.1	
						100/5"		
60.0	poorly graded SAND with gravel, moist, gray	SP	-40.3	E	60	18+29+45		
64.0	sandy LEAN CLAY, moist, gray	CL	-44.3	G	65	14+21+24		
70.0	BOTTOM OF BORING @ 70.0 FT.		-50.3		70			

Comments:

SCHNABEL ENGINEERING ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS
TEST BORING LOG

Project: Fairmont Hotel

Contract Number: W890851
Boring Number: 205
Sheet: 1 Of 2

Boring Contractor: FOUNDATION TEST SERVICE, INC.

Boring Foreman: Spierenburg
Drilling Method: 2¼" HOLLOW STEM AUGER
Drilling Equipment: CME-55 #3

SEA Representative: Skep Nordmark

Dates Started: 07/18/89 Completed: 07/19/89

Location:

Ground Surface Elevation: 25.0 ±

Groundwater Observations	Date	Time	Depth	Casing	Caved
Encountered	7-18	11:15	19.0	19.0	-
Completion	7-19	8:00	DRY	73.5	-
Casing Pulled	7-19	8:45	14.5	-	27.5
	7-24	6:00	27.5	-	45.0

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
0.2	asphalt		24.8			10+8+5		
	clayey sand FILL, with gravel & cinders, moist, brown & black				5	3+3+5		
	with brick @ 9'			A		5+4+4		
					10	25+36+28		
13.5	sandy LEAN CLAY, moist, brown	CL	11.5			3+3+4	20.5	
				B	15	3+3+5		
					20	10+11+14	23.9	
22.0	poorly graded SAND, with gravel & silt, wet, gray & brown	SP-SM	3.0			3+5+13	23.3	
				C	25	5+3+5		
					30	35+55+10/1"	8.5	
31.0	LEAN CLAY, with sand, moist, gray	CL	-6.0			3+4+6	34.5	
				D	35			
					40	4+4+4	31.9	
43.0	poorly graded SAND, with lean clay layers, moist, gray & brown	SP-SC	-15.0			9+5+7	20.5	Running Sand From 43.5' to 55.5'
					45			
				E	50	4+3+4	24.2	

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 205 Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRA-TUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
					55	4+4+5	19.7	
58.0	LEAN CLAY, with sand & organic matter, moist, gray	CL	-33.0	F	60	4+5+6		
					65	7+24+45		
66.0	sandy LEAN CLAY, moist, gray	CL	-41.0	G		15+19+21		
					70	12+14+18		
					75	14+15+16		
75.0	BOTTOM OF BORING @ 75.0 FT.		-50.0					

Comments:

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 206 Sheet: 1 of 2

Boring Contractor: FOUNDATION TEST SERVICE, INC.

Boring Foreman: Spierenburg
Drilling Method: 2¼" HOLLOW STEM AUGER
Drilling Equipment: CME-55 #3

SEA Representative: Skep Nordmark

Dates Started: 07/20/89 Completed: 07/20/89

Location:

Ground Surface Elevation: 26.0 ±

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	7-20	10:00	29.0	29.0	-
Completion	7-20	1:45	26.0	78.5	-
Casing Pulled	7-20	3:40	20.5	-	45.5
	7-24	6:00	20.0	-	27.0

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
0.2	asphalt		25.8					
	sand, gravel & cinders FILL, moist, brown & black			A		3+2+1		
					5	2+3+5		
8.0	sandy LEAN CLAY, moist, brown	CL	18.0	B	10	2+3+6		
					15	9+9+11		
					20	5+6+6		
25.0	poorly graded SAND, with gravel, and silt, moist, brown	SP-SM	1.0	C	25	3+4+6		
						5+20+26		
					30	19+40+51		
32.3	LEAN CLAY, with sand and sand layers, moist, gray	CL	-6.3	D	35	3+3+3		
					40	2+2+3		
42.5	poorly graded SAND, moist, brown & gray	SP	-16.5	E	45	14+15+13		
					50	5+6+6		

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 206 Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	w (%)	REMARKS
					55	9+15+21		
57.5	LEAN CLAY, with sand & organic matter, moist, gray	CL	-31.5	F	60	2+3+4		
					65	6+5+6		
					70	4+5+6		
71.0	clayey SAND, with gravel, moist, gray	SC	-45.0	G		20+36+34		
					75	20+30+51		
						25+100/5"		
79.5	BOTTOM OF BORING @ 79.5 FT.		-53.5					

Comments:

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W890851 Boring Number: 207 Sheet: 1 Of 2

Boring Contractor: FOUNDATION TEST SERVICE, INC.

Boring Foreman: Spierenburg
Drilling Method: 3¼" HOLLOW STEM AUGER
Drilling Equipment: CME-55 #3

SEA Representative: Skep Nordmark

Dates Started: 07/19/89 Completed: 07/20/89

Location:

Ground Surface Elevation: 25.7 ±

Groundwater Observations	Date	Time	Depth	Casing	Caved
Encountered	7-19	9:30	25.0	24.0	-
Completion	7-20	6:30	27.0	78.5	-
Casing Pulled	7-20	8:15	33.0		*
	7-24	8:45	26.0	-	*
	8-11	10:15	27.8	—	*

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
0.2	topsoil		25.5			2+3+5		
	clayey sand FILL, with gravel & shells & cinders, moist, brown & black with wood @ 8.5' with cinders @ 14.0'			A	5	3+2+6		
						35+16+9		
					10	11+6+5		
					15	8+6+6		
						3+5+7		
18.5	sandy LEAN CLAY, moist, gray	CL	7.2	B	20	6+8+10		
25.0			0.7		25	3+5+7		
	poorly graded SAND, with gravel, moist, brown	SP		C				
30.0	LEAN CLAY, with sand and sand layers, moist, gray	CL	-4.3	D	30	18+10+3		
						3T 24/24		
					35	2+3+3		
					40	2+3+5		
41.5	poorly graded SAND, with gravel, wet, brown	SP	-15.8	E		42+40+15/2"		
					45	16+9+8		
49.5	LEAN CLAY, with sand and sand	CL	-23.8		50	8+9+14		

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: Fairmont Hotel	Contract Number: W590651 Boring Number: 207 Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
	layers and organic matter, moist, gray			F				
54.0	poorly graded SAND, with clay layers, wet, gray	SP	-28.3	E	55	5+9+14		
59.0	LEAN CLAY, with sand, moist, gray	CL	-33.3	F	60	4+6+8		
					65	2+1+3		
70.0	sandy LEAN CLAY, moist, gray with gravel @ 78.0'	CL	-44.3	G	70	12+10+20		
					75	18+17+20		
						26+45+55/3"		
79.5	BOTTOM OF BORING @ 79.8 FT.		-54.1					

Comments:
Top of Wellpoint @ 77.5'
80' x 1½ PVC Pipe
1-5' Wellpoint
1 in Water Observation Well