nationalgrid

Interim Remedial Measure 100% Design for the 50 Kent Avenue Property Holder Area

Brooklyn, Kings County, New York

Prepared for:

National Grid
One MetroTech Center
Brooklyn, New York 11201

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June 2015

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100% DESIGN
FOR THE
50 KENT AVENUE PROPERTY HOLDER AREA
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TABLE OF CONTENTS

Page No.

TABLES

DRAWINGS

APPENDICES

Appendix A	Groundwater Modeling Report
Appendix B	Calculations
Appendix C	Haul Routes
Appendix D	Community Environmental Response Plan
Appendix E	Vibration, Settlement and Noise Monitoring Plan for Soil Excavation

LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Administrative Order on Consent
amsl	above mean sea level
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
BUG	The Brooklyn Union Gas Company
CAMP	Community Air Monitoring Plan
CB	cement-bentonite
cm/sec	centimeters per second
CQCP	Construction Quality Control Plan
DSNY	New York City Department of Sanitation
ELAP	Environmental Laboratory Accreditation Program
ft	foot (feet)
HASP	Health and Safety Plan
IC	Institutional Control
ips	inches per second
IRM	Interim Remedial Measure
MGP	Manufactured Gas Plant
mg/kg	milligrams per kilogram
NAPL	non-aqueous phase liquid
NYCRR	New York Code of Rules and Regulations
NYCPR	New York City Parks and Recreation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PDI	Pre-Design Investigation
PPV	Peak Particle Velocity
psi	pounds per square inch
RDWP	Remedial Design Work Plan
RI	Remedial Investigation
TCB	Temporary Containment Building
VMS	Vapor Management System
yd^3	cubic yards

EXECUTIVE SUMMARY

This 100% Design Plan describes the elements of the design for the soil excavation and solidification Interim Remedial Measure (IRM) at the 50 Kent Avenue property ("the Site" or the "Holder Area") in the Williamsburg neighborhood of Brooklyn, New York. The Site was formerly the location of gas holders, and coal carbonization and gas generation operations were not conducted at this Site. The report documents the background, decision making process, and rationale behind the design of an IRM that includes excavating soil in and around former holder tanks, solidification of soil within one former holder tank, and excavating shallow soils elsewhere on the Site. The report also presents current Site conditions, the objectives of the IRM, an overview of the remedial design, critical design parameters, how the remediation will be completed, monitoring activities that will be conducted during the remediation, and post-remediation monitoring and maintenance.

The purpose of the IRM is to address contaminated soil at the Site through the excavation/off-site disposal and solidification of certain contaminated soils in and around former holder tanks. The IRM will primarily address the three holder tanks located in the southeast end of the property. One of these holder tanks, that associated with holder No. 2, and the soil immediately underlying it, is comparatively less contaminated and will be addressed by mixing the soil and fill located inside the tank with cementitious grout to reduce the mobility of contaminants present there. The other two holders tanks, those associated with holder No. 1 and the relief holder, contain NAPL and are a presumed source of NAPL present immediately adjacent to the outside of the tanks. These tanks their foundations, and the soil immediately adjacent to them, will be excavated and disposed off-site.

Excavation will be supported by installation of sheetpile placed within a cement-bentonite slurry trench surrounding the two tanks being excavated creating an excavation support wall. This impermeable support wall will remain in place following backfill, which will restrict the ability of contamination, if present outside the excavation area, to migrate into the placed backfill.

In the remaining areas on the 50 Kent Avenue property (with the exception of a 55-foot strip at the northwest end of the property), shallow soil will be excavated to 5 feet below ground surface or to the groundwater surface (whichever is shallower) and backfilled to protect persons against dermal exposure.

Excavated soil with PAH concentrations over 500 mg/kg, including all soil with visible NAPL contamination, will be sent offsite for treatment by thermal desorption. Soil with total PAH concentrations below 500 mg/kg will be used for backfill within the deeper excavation at holder No. 1 and the relief holder and at depths greater than five feet below ground surface.

The deep excavations will be performed using the excavation support wall with tie backs or internal bracing. The groundwater elevation in the area of deep excavation will be lowered through a groundwater extraction program. Extracted groundwater will be treated onsite and discharged to a New York City Department of Environmental Protection (NYCDEP) sanitary sewer for further treatment at a publically-owned treatment works (POTW).

The Site will be restored with a minimum two foot thick soil cover meeting NYSDEC restricted residential standards as follows: an eighteen-inch cover of clean soil and six inches of topsoil. A demarcation layer will be installed above remaining site soils delineating the surface below which pre-remediation site soils may be present.

In addition to these planned elements, National Grid has installed 13 NAPL recovery wells in the locations shown on DWG-3. The installation of these wells, and the ongoing recovery of NAPL from them, is an integral part of the overall IRM for the Site.

1.0 INTRODUCTION

1.1 Scope

This 95% Design Plan provides the plan and design basis for implementing an Interim Remedial Measure (IRM) at the 50 Kent Avenue property (“the Site” or the “Holder Area”). The Site is located in the Williamsburg neighborhood of Brooklyn, New York along North 12th and North 11th Streets, and Kent Avenue (DWG-1). The Site was formerly the location of manufactured gas holders. These structures, when in operation, consisted of a foundation installed well below the ground surface; a cylindrical masonry tank structure, built on the foundation and designed to hold water; and finally the metal holders themselves, which rose or lowered depending on the volume of gas held and which were sealed by the water in the tank.

The IRM scope consists of 1) shallow soil excavation (to roughly 5 feet below ground surface [bgs] or the depth of groundwater, whichever is less) across the entire Site (with the exception of a 55-foot wide strip of no excavation at the northwest end adjacent to a neighboring building), 2) deep excavation and removal of two former gas holder tanks and their foundations to a maximum depth of 30 feet bgs, and 3) in-situ solidification via bucket-mixing within a third holder tank. The locations of the three holder footprints and other related structures associated with the Site are shown on DWG-2. Because of the depth of the holder tanks and their extent below the groundwater surface, shoring and dewatering will be required. The excavations will be backfilled with a combination of site soils and/or crushed concrete and brick with concentrations of total polycyclic aromatic hydrocarbons (PAHs) less than 500 milligrams per kilogram (backfill greater than 5 foot bgs final grade) and clean imported soil.

1.2 Project Background

1.2.1 Site Location

The Site is New York City Tax Block 2287, Lot 1 (DWG-2). The Site is bordered by North 12th Street to the northeast, Kent Avenue to the southeast, North 11th Street to the southwest, and Block 2287, Lot 16 to the northwest.

1.2.2 Previous Investigations and Reports

2006 Investigation

A comprehensive investigation for the Site was performed in 2006 by Metcalf and Eddy for the City of New York in anticipation of transforming properties into a part of Bushwick Inlet Park. The 2006 investigation studied the Site, the accessible corridors along 11^{th} and 12^{th} streets between the Site and the East River, and sediments in the East River. Results of the investigation were summarized in a Site Investigation Report (Metcalf and Eddy, 2006). The 2006 investigation advanced 28 soil borings and 9 sediment borings, installed 9 monitoring wells, and sampled the 9 new and 2 existing wells. Historic fill, was reported to be present to depths of up to 9 to 42 feet below ground surface (bgs), and consisted mainly of sand with gravel, brick, ash, and cinders.

2009-2010 RI Investigations at 50 Kent Avenue

During 2009-2012, GEI, a National Grid consultant, performed a Remedial Investigation (RI) of the former Williamsburg Works Manufactured Gas Plant (MGP), and the separate Holder Area. The portions of the RI activities on the 50 Kent Avenue property were conducted in 2009-2010 and included advancement of 18 soil borings, excavation of 6 test pits, groundwater sampling from 5 monitoring wells. The results of the investigation, including for the 50 Kent Avenue property, were reported to NYSDEC by National Grid in an interim data transmittal letter prepared by GEI and dated August 2010 and later in a draft RI Report dated January 2015.

2012 PDI

URS performed a Pre-Design Investigation (PDI) in 2012 in support of the planned IRM for the Site. Results are presented in detail in a report entitled *Interim Remedial Measure Pre-Design Investigation Report* (URS, February 2013). The PDI was designed to collect the data necessary to design the IRM, including geotechnical data needed for designing shoring systems required for excavations. Additional objectives were performance of treatability tests for possible solidification treatment, subsurface utility location, background sound and vibration monitoring, and collection of information on adjacent building foundation construction to evaluate the viability of shoring techniques. For the 2012 PDI work, URS installed eleven borings for delineation and/or geotechnical analyses, installed three monitoring wells, and excavated fourteen test pits throughout the Site. Slug testing indicated that the soils have moderate to low permeability. This information was used in the groundwater modeling effort to suggest that closely spaced wells or sumps would be required to lower the groundwater surface for soil excavation. The 2012 geotechnical evaluation concluded that the soils are poorly sorted and are considered moderately to very dense based on blow counts. Cobble lenses were encountered. The basal clay layer was observed to be very stiff. The geotechnical properties of the soil are conducive to the installation of shoring to aid in excavation, with the fines content assisting to reduce permeability. However, the presence of cobbles and fill debris would make some technologies, such as sheet pile, difficult to install.

The 2012 test pits were installed along the perimeter of the southeast end of the Holder Area and revealed frequent obstacles such as walls, pipes, and former holder tank walls that would require removal during the implementation of the IRM.

2013 Supplemental PDI

URS performed a Supplemental PDI in 2013 to obtain geotechnical data to close identified data gaps prior to preparation of the IRM design. The supplemental exploratory boring program specifically targeted the southeast half of the Site where the holders were formerly located, for the purpose of understanding the Holder Area specifically, especially along the locations where shoring will be installed and on the location of utilities near the Site. Results are presented in detail in a report entitled *Interim Remedial Measure Supplemental Pre-Design Investigation Report* (URS, July 2013). The 2013 Supplemental PDI consisted of seven geotechnical borings along with geotechnical laboratory testing of select samples. The data collected generally confirmed previous findings but with a more precise delineation of geotechnical stratigraphy, and suggesting a greater presence of cobbles in the subsurface than previously observed. Details of the drilling and laboratory testing results from the report are summarized below.

The Supplemental PDI indicated evidence of cobbles within the native soil underlying the fill zone at boring locations GR-4, GR-5, and GR-6. This indicates that cobbles are more widespread than indicated by previous investigations, although sporadic as previously seen, and should be anticipated throughout during support of excavation (SOE) installation and excavation near holder No. 1. These three supplemental PDI borings indicated cobbles 25 to 50 feet bgs. Previous investigations indicated a maximum cobble depth of about 40 feet bgs.

The results of the Supplemental PDI geotechnical investigations as they relate to the stratigraphic layers at the Site are presented in Section 2.1.1 of this report.

1.2.3 2014 Holder No. 2 Investigation

Based on a review of the previous site investigation and pre-design investigation data, the need to excavate Holder No. 2 was not clear. Further, excavation of holder No. 2 to the ~30-feet depth that would be required to remove the foundation, presents a number of constructability risks associated with damaging the deep sewer located within Kent Avenue with the tie-back system considered for the support of excavation in order to avoid other utilities. Based on these considerations, URS implemented a boring program in and around holder No. 2 to determine if the excavation of holder No. 2 was warranted. The boring program focused on evaluating the presence of impacts at depth along the inner edge of holder No. 2, where greater amounts of contamination may be present due to the typical convex shape of holder tank foundations. Six borings were installed. Four borings were advanced within the holder No. 2 tank, near the walls, and two advanced outside the holder wall between holder No. 2 and holder No. 1. Based on visual observation of impacts within the holder (which did not include any NAPL saturated material), the four borings installed within the holder tank were advanced through the bottom of the tank foundation to evaluate the presence of impacts below the foundation.

1.2.4 2014 Physical Obstructions Documentation Design Investigation

With the proposed location of the SOE being made more definite during the design, URS conducted a field program in December 2014 and January 2015 to characterize more precisely the presence of possible obstructions to SOE installation. This information has been used to refine the position of the SOE walls and provides a better description of the existing conditions to allow bidders to better select the means and methods for installing the SOE. This field effort also included test pits to provide better documentation of existing foundations in areas of proposed shallow excavation.

1.2.5 Soil Pre-Characterization Sampling

During March and April 2015, URS performed a soil precharacterization effort. This sampling event collected the information needed to determine the suitability of the soil for disposal at off-site thermal desorption facilities. The collected data have been sent to the disposal facilities that are identified in the design for their approval for disposal.

This study also showed that composite samples from all shallow (less than 5 feet deep) soils contained less than 500 mg/kg of total PAHs. Provided these soils do not exhibit strong odors or visible contamination upon excavation, they are suitable for use as backfill below 5 feet below surface in the holder excavation area.

1.3 Report Organization

This report has been organized using the following sections:

- Section 1 – Introduction
- Section 2 – Site Conditions
- Section 3 – Objectives and Scope of the IRM
- Section 4 – Design Overview
- Section 5 – Implementation
- Section 6 – References

2.0 SITE CONDITIONS

2.1 Geology and Hydrogeology

2.1.1 Geology

The stratigraphy at the Site consists of, from top down, the following:

- Fill of a granular nature up to approximately 30 feet thick. The supplemental PDI borings confirmed this.
- (Upper) Sandy silty native soil zone appearing to be a minimum of approximately 25 feet thick.
- Clay starting as shallow as approximately 53 feet bgs, extending to as deep as approximately 90 feet bgs (consist of alternating layers about 1-foot thick of clay and silt/sand).
- (Lower) Sandy silty native soil about 10 feet thick.
- Bedrock encountered at approximately 100 feet bgs.

Fill

The fill layer appears to be primarily silty sand that also contains clay and brick materials. Based on blow count information, this layer appears generally medium dense to dense with some loose material, as well. The geotechnical laboratory test data show that the non-plastic sandy portion of the fill contains enough fines (i.e., silt and clay sizes) to prohibit relatively free flowing groundwater. For example, 12 percent fines were observed in WW-SB-102. Fines content of about 10 to 15 percent by weight is considered sufficient to prevent free flowing condition. This observation corresponds to the relatively low hydraulic conductivities measured by the slug tests (see discussion in Section 4.4.1)

However, since fill is likely highly variable, its properties are also more highly variable than a naturally deposited soil, and such variability and predictability should be expected. For example, zones of material that contain no fines at all and are highly pervious may very well exist. Additionally, debris such as the cemented brick found in this layer can hinder the installation of shoring, particularly if debris pieces are concentrated together, so shoring operations must account for the reduction in size or removal of such debris before and/or during its construction.

(Upper) Silty Sand/Silt Soil

The native silty sand/silt layer appears to contain a minimum of about 10 to 12 percent fines, based on geotechnical laboratory testing. Samples for geotechnical testing were collected from borings WW-SB-102, WW-SB-103, GR-3, GR-5, GR-6, and GR-7 from zones where the least apparent fines were observed. There also is present sporadic evidence of clay lenses (e.g., a 2-foot thick lens that starts at 20 feet bgs at WW-SB-104 and a 10-foot thick lens that starts at 22 feet bgs at GR-1). Also, cobble zones should be expected. The laboratory test data show that there is occasionally a few percent of clay or clay-size soil present in the most cohesionless (i.e., predominantly granular) soil which can also help to inhibit free flow of groundwater into the construction area.

Significantly high blow counts are generally represented in this layer. Blow counts over 30 per foot in granular material denote dense soil. Except for soils shallower than about 30 feet deep in the supplemental PDI borings, where loose and medium dense soils are found, the blow counts indicate dense soil and/or gravel. That is, the data indicate loose and medium dense soil within the 30-foot planned excavation zone, and dense soil beneath that.

Regarding the excavation work inside of the shoring, native soil above 30 feet bgs will be directly excavated and no additional excavation procedures or concerns are foreseen there. The native soils from 30 feet bgs down to top of clay will remain in place in their current condition. However, such soils will be displaced by shoring so those portions are addressed here.

Note that it should be recognized that the presence of coarse gravel can skew blow counts to a high value not necessarily representative of the in-situ compactiveness of soils. That is, there is gravel in these Site soils that possibly caused blow counts to indicate values associated with dense soils. This is shown by, for example, and discussed below, blow counts exceeding 100 over a few inches. The gravel cannot advance into the split-spoon sampler and does not get pushed aside by the sampler. Thus, blow counts in such zones are not necessarily representative or a true measure of the native soil density. A better gauge is to view the zones where there is nearly or fully 100 percent recovery of soils by the sampler. In the 30-foot bgs to 60-foot bgs zone near full or full recovery soils demonstrated blow counts of about 30 to 100 per foot, which are very dense. Boring WW-SB-100 from about 35 to 45 feet bgs is a good example of why gravel and not merely dense soil is presumed to exist there. The blow counts exceed 100 in this zone with recovery typically less than 50 percent. Geotechnical laboratory test data show these soils to contain significant fines and clay that would prevent otherwise cohesion-less soil from falling out of the sampler. Thus, it appears that gravel, shown on the boring log to exist at that interval, prevented full recovery. Conversely, soil with high blow counts and full recovery such as that encountered in boring WW-GR-5 at 44 feet bgs indicate, much more reliably, dense characterizations. Regardless of apparent blow counts, the widespread and consistent nature of blow counts will generally be considered an indication of soils toward the dense spectrum.

Clay

Based on previous investigations and the supplemental PDI borings, the clay layer appears to typically exist as a minimum 10-foot thick low permeability barrier underneath the silty sand/silt native soil. The blow counts for the clay layer typically were indicative of a hard soil (i.e., blow counts greater than 32 per foot). Cohesive soil classified as "very stiff" falls in the blow count range of 16 to 32 per foot. This clay is thus denser than "very stiff" soil. The three unconfined compressive strength tests in the laboratory from the 2012 PDI showed an average unconfined compressive strength (UCS) of about 21 pounds per square inch (or 3,000 pounds per square foot) which is closer to a stiff material (i.e., not as compact as "hard" material). There was no gravel of note to skew blow counts to the high side so the UCS laboratory testing appeared to underestimate the strength. The three hydraulic conductivity tests from the 2012 PDI showed a narrow range of values from about 2×10^{-8}centimeters per second (cm/sec) to 6×10^{-8} cm/sec, serving as a very low permeability seepage barrier.

The Supplemental PDI investigation confirmed what was previously thought to be an anomaly shown by 2012 boring WW-SB-103. WW-SB-103 exhibited stratigraphy showing the deep clay in this area was not a continuous unit but rather a discontinuous layer of alternating clay and sand layers. Borings that displayed at least a few feet of sand layer beneath a few feet of first-encountered-clay included WW-SB-103, GR-2, GR-5, and GR-6. These borings surround the Holder No. 1 area.

Except for at the locations of borings WW-SB-103 and GR-1, there appears to be a typically thick, uninterrupted clay zone starting at about 55 to 60 feet bgs. Boring WW-SB-103 is near North 11th Street and boring GR-1 is near North 12th Street so some discontinuity in the clay layer across the Site cannot be discounted. These two borings seem to indicate sand seams or beds less than one inch thick to sandy lenses up to about one foot thick; boring GR-1 also shows a 6 or 7-foot thick silty sand lens that contains clay seams, all within the clay layer. It should be noted that the apparent sand/silt lens within the clay in GR-1 was targeted for laboratory testing and it indicated a relatively high fines content of 32.2% such that the hydraulic conductivity of the lens would be expected to be low.

(Lower) Sandy Silty Native Soil

As described in the 2012 PDI report, the sandy silty native soil that exists underneath the clay appears very similar to the sandy silty native soil above the clay and, based on limited boring data, appears to be at least 8 to 10 feet thick. Remedial construction such as shoring and excavation is not planned to extend to the sandy silty native soil underneath the clay.

Bedrock

As indicated in the 2012 PDI report, boring WW-SB-102 shows bedrock to exist about 100 feet bgs. Remedial construction such as shoring and excavation is not planned to extend to the bedrock layer.

2.1.2 Hydrogeology

A round of groundwater levels was obtained on April 23, 2012 from 16 of the 19 new and existing monitoring wells on-site. Groundwater was found at relatively shallow depths across the Site, at an average of between 3.5 to 4.5 feet bgs. Groundwater elevations in the shallow monitoring wells across the study area ranged from 1.58 feet amsl at WW-MW-13, downgradient of the property, to 10.05 feet amsl at WW-MW-07. The average on-site groundwater elevation in the shallow monitoring wells is 8 feet amsl. In the western portion of the property, groundwater flow is northwest towards the East River. Because of the proximity to the East River, the groundwater levels are tidally influenced. There is a groundwater mound in the vicinity of WW-MW-07 along the northern extent of the property, adjacent to the relief holder. This local mound impacts the regional (northwestern) direction and with a radial flow of groundwater to the north, east and south. Groundwater measured within the gas holder tanks was elevated relative to the surrounding groundwater surface. Groundwater immediately outside holder structures was also elevated relative to the surrounding groundwater surface.

The groundwater elevation in the intermediate zone (approximately 47 to 59 feet bgs) ranged from 2.23 feet amsl (WW-MW-100I) to 3.84 feet amsl (WW-MW-102I). The groundwater elevation below the clay layer in the deep zone (WW-MW-102D) was at 3.74 feet amsl.

Hydraulic conductivities were determined from the August 2012 PDI slug tests. Mean hydraulic conductivity for the shallow soils (0 to 22 feet bgs) was 4.34 x 10^{-4} centimeters per second (cm/s). Mean hydraulic conductivities for the intermediate (47 to 59 feet bgs) and deep zones (90 to 100 feet bgs) were 7.11 x 10^{-5} cm/s and 5.87 x 10^{-4} cm/s, respectively. These hydraulic conductivities were on the same order of magnitude (although slightly lower) compared to the hydraulic conductivity tests measured during the Remedial Investigation.

2.2 Soil Properties

The IRM Pre-Design Investigation Report (URS, February 2013) describes the soil geotechnical properties and stratigraphy known at that time. In particular, the top down stratigraphy was described as fill, (upper) sandy silty native soil, clay, (lower) sandy silty native soil, and bedrock. The Supplemental PDI focused on the soils from the clay layer upwards since that is the zone where construction features and dewatering will be concentrated and better delineation was therefore required.

The geotechnical data that was acquired during the Supplemental PDI was focused and limited to essential parameters of blow counts and soil index properties, meaning grain size distribution and Atterberg limits (plasticity type properties) to distinguish between sands, silts, and clays. The results of the Supplemental PDI geotechnical investigations, as they relate to the stratigraphic layers at the Site, are presented in Section 3.1.1 of this report.

2.2.1 Soil Descriptions

The geotechnical evaluation concluded that the soils are poorly sorted and are considered moderately to very dense based on blow counts. Cobble lenses were encountered. The basal clay layer was observed to be very stiff.

The geotechnical properties of the soil are conducive to the installation of shoring to aid in excavation, with the fines content assisting to improve strength and reduce permeability.

2.3 Infrastructure and Development

The Holder Area is owned by NYC Parks & Recreation (NYCPR) which uses it for parking and storage and as a venue for various activities, including a flea market, in the summer. The current cover is asphalt pavement and a former building slab; there are no permanent aboveground structures on the property. The Holder Area is surrounded on three sides by sidewalks and bordered by North 12th Street to the northeast, Kent Avenue to the southeast, North 11th Street to the southwest, and Block 2287, Lot 16 to the northwest. Known utilities at and around the Holder Area are shown on DWG-4.

2.4 Adjacent Building Assessment

URS reviewed documents at the Brooklyn Borough Office building department at 210 Joralemon Street, 8th Floor, Brooklyn, NY 11201 to examine building foundation records of the buildings which are in the scope of work. The record review was supplemented with subsequent observation by field personnel. Building locations are provided by Block and Lot on DWGs 2 and 3. The following information was obtained:

- Block 2287, Lots 16 and 30 (west of the Site): The former two story warehouse building was demolished after a fire destroyed the structure in January 2015.
- Block 2295 (across from Kent Avenue and south of N. 11th St.): No record was found.
- Block 2277 Lot 1 (north of the Site and north of N. 12th St.): There are two buildings in this block:
    - Building No. 1 at address 1 N. 12th St, Brooklyn, NY is a four-story building located 140 feet to the northwest of the Site. Record drawings show the building is on piles (unknown pile type). URS personnel inquired about the basement of the building and were informed by the building Superintendent that the building had no basement.
    - Building No. 2 is approximately 75 feet west of Kent Avenue and 65 feet from the south curb line of 12th Street. No record was found for this building. Based on visual observations, the building appeared to be a one story garage/storage facility.

- Block 2288 Lot 1 (east of the Site, across Kent Avenue): No foundation record was found. Building is a one story warehouse type supported on steel column.
- Block 2294 Lot 1 (south of the Site and south of N. 11th St.): The building is located approximately 46 feet from the north sidewalk curb of N. 11th Street. Record drawing showed a two story warehouse on shallow foundation (strip footing and individual footing for column). However, the building in the 1912 record drawing has been demolished and has been replaced by the current document storage building. A record drawing of the current building foundation was not found.

This evaluation only identified record drawings of existing buildings from one adjacent parcel (Block 2271) across N. 12th St. from the Holder Area. However, considering that, for this IRM, NYSDEC is allowing excavation activities to remain a minimum of 55 feet away from adjacent buildings, there are no special procedures such as underpinning that must be implemented to preserve these features. However, monitoring, such as vibration and survey monitoring, and a preconstruction condition survey of the buildings will be implemented.

3.0 BASIS OF DESIGN AND OBJECTIVES AND SCOPE OF THE IRM

The intent of the IRM is to implement a remedy appropriate to holder operations and impacts and to employ measures that would be considered final. This IRM would allow for the Holder Area to be used by the property owner (the NYCPR) with few or no restrictions.

3.1 Basis of Design

The data collected during the prior investigations, described in Section 1.2.2, provide the basis for the design described in the remainder of this document. The IRM will primarily address the three holder tanks located in the southeast end of the property. One of these holder tanks, that associated with former holder No. 2, and the soil immediately underlying it, is comparatively less contaminated and will be addressed by mixing the soil and fill located inside the tank with cementitious grout to reduce the mobility of contaminants present there. The other two holder tanks, those associated with holder No. 1 and the relief holder, contain NAPL and are a presumed source of NAPL present immediately adjacent to the outside of the tanks and their foundations. These tanks, their foundations, and the soil immediately adjacent to them, will be excavated and all soil/fill (except soil determined to be suitable for use as deep backfill as described in Section 5.7) will be disposed off-site.

Excavation will be supported by installation of a sheetpile wall placed within a cement-bentonite (CB) slurry trench surrounding the two tanks being excavated. This impermeable support wall will remain in place following backfill, which will restrict the ability of contamination, if present outside the excavation area, to migrate into the placed backfill.

In the remaining areas on the 50 Kent Avenue property (with the exception of a 55-foot strip at the northwest end of the property), shallow soil will be excavated to 5 feet below ground surface or to the groundwater surface (whichever is shallower), used as backfill in the deeper portions of the deep excavation area, or disposed off site if determined to be unsuitable for use as deep backfill as described in Section 5.7. These shallow excavation areas will be backfilled with clean offsite materials to protect persons against dermal exposure.

In addition to these planned elements, National Grid has installed 13 NAPL recovery wells in the locations shown on DWG-3. The installation of these wells, and the ongoing recovery of NAPL from them, is an integral part of the overall IRM for the Site.

3.2 Objectives and Scope of the IRM

Pursuant to agreements with NYSDEC, National Grid has committed to implementing an IRM that:

- Excavates and removes soil in and around the holder No. 1 tank and the relief holder tank, to a depth of approximately 30 feet below ground surface;
- Solidifies soil within the holder No. 2 tank by mixing the material, to the extent possible, with a cementitious grout;
- Excavates and removes shallow soil everywhere on the Site except a 55-foot strip along the northwest end of the property; and
- Restores the Site, excluding a 55-foot strip of no excavation on the northwest end of the Site, to a grass field that will be part of Bushwick Inlet Park.

The IRM will be conducted at areas of the Site as shown on DWG-5.

4.0 DESIGN OVERVIEW

4.1 Remedial Design Approach

The primary components of the IRM will consist of the following:

- Installation of a CB slurry trench and placement of sheet piles for the SOE wall.
- Performance of In-Situ Solidification (ISS) excavator mixing inside and above the holder No. 2 tank and foundation, respectively, and within a temporary containment structure. The fill inside the holder No. 2 tank will be solidified using best-effort ISS bucket mixing.
- Moving and extending the temporary containment structure to the deep excavation area.
- Dewatering of the deep excavation area, with treatment of the extracted water prior to discharge to a Publicly-Owned Treatment Works (POTW).
- Deep soil excavation, with tank removal, of one approximately 22,000 square-foot area containing two ~90-foot diameter holder tanks to a depth below the tank foundations. Based on boring refusal in the relief holder (WW-SB-08 at 24 ft bgs) and holder No. 1 (WW-SB-06 at 25.5 ft bgs) and allowing for a foundation thickness of about two feet, the expected depth of excavation would be about 28 to 29.5 feet bgs. To account for potential variations in depth from these data points excavation is designed to extend to 30 feet bgs).
- Backfilling the deep excavation area with a combination of re-used on-site soil and/or crushed concrete and brick and imported backfill meeting restricted residential use criteria. Site-derived soils with concentrations of total PAHs less than 500 mg/kg (unless they exhibit significant odors or have visible contamination) and/or site-derived concrete and brick rubble four inches or less in size may be used as backfill in the deep excavation.
- Shallow soil excavation to 5 feet bgs or to the groundwater surface (whichever is shallower) in the area west of the holders to 55 feet from the western property line and in the portion of the Site within 95 feet of the boundary with Kent Avenue. However, if NAPL saturated material is observed, additional excavation to a greater depth will be conducted in a localized area(s) to the extent possible without dewatering, shoring, or sloping. No more than 10% additional excavation volume of

the originally planned excavation volume in the shallow soil excavation area will occur.

- Backfilling the shallow excavation area with clean compacted soil meeting Part 375 restricted residential use criteria.
- During backfilling, the installation of a demarcation layer above the highest elevation of site-derived backfill material and above the unexcavated surface in the shallow excavation area.
- Seeding with grass for subsequent use by NYCPR.
- Installation of fencing and gates surrounding the site, and repair of sidewalks damaged during construction.

4.2 Excavator Mixing In-Situ Solidification

Soil and fill located inside the holder No. 2 tank will be solidified by mixing the material with solidifying agents such as cement and ground granulated blast furnace slag to reduce the permeability of the material. By reducing the permeability, less water will infiltrate the material and thus less contamination will migrate via the groundwater. Solidification also provides a physical barrier to direct exposure to contaminants should excavation be performed in this area in the future.

Excavation to a depth of seven feet below ground surface prior to solidification will be performed in the vicinity of the the holder No. 2 footprint. This will lower the surface of operation to reduce the required depth of mixing.

Solidification will be performed in approximately eight-foot strips. At each strip, the upper three feet are removed and disposed offsite to create a zone for the mixed soil/fill/grout mixture to expand into. For both the initial seven feet of excavation and the subsequent three feet of excavation in each strip, dewatering will be required.

To solidify the remaining soil, cementitious reagents are added as a liquid grout. The excavator mixes the soil with the grout in layers to blend the soil/fill and grout together.

There are some inherent limitations as to the uniformity achievable from excavator-mixed ISS. Limitations include the inability to visually establish when all soil has been thoroughly mixed with grout, and the limits to which excavator buckets can fully reach soil along the curved surface of the inside of the holder tank. The contractor will be required to mix with the excavator bucket until material taken from any interval (as determined by the engineer) of the excavation cell retrieves visibly well-mixed material. Once this visible criterion is met, samples will be taken from the bucket, formed into specimens, be allowed to cure for 28 days, and then be required to exhibit a permeability of no greater than 1×10^{-6} cm/sec and an unconfined compressive strength of 50 pounds per square inch (psi).

4.3 Excavation Areas and Depths

4.3.1 Design Extent

Shallow soils will be excavated from west of the holders and in the portion of the Site within approximately 95 feet of the border with Kent Ave. as shown on DWG-5. There is only limited data on the extent of shallow soil contamination throughout the Holder Area. However, to prepare the Holder Area for future use as parkland, shallow soil will be removed throughout the Site and be replaced with appropriate backfill, eliminating direct contact exposure pathways from shallow soils. None of the previously installed borings demonstrated the presence of visible MGP contamination in soil above the groundwater surface. Soil will be excavated to 5 feet bgs or to the groundwater surface (whichever is shallower) throughout the shallow soil excavation areas.

In the deep excavation area, contaminated soil will be excavated to a depth below the gas holder tank foundations, which are reported to be present to depths of 24 to 28 feet bgs. The support of excavation design accommodates an excavation depth of 30 feet bgs. Dewatering will be required to excavate these structures and soils.

4.4 Shallow Excavation

4.4.1 Excavation

As the Holder Area is planned for use by NYCPR, soil excavation to 5 feet bgs or to the groundwater surface (whichever is shallower) and backfill is recommended to protect persons against dermal exposure. By excavating to no deeper than the groundwater surface, no dewatering would be required.

4.4.2 Stockpiling and Disposal

Soils, concrete, and brick excavated from the shallow excavation areas will be segregated for either use as suitable onsite backfill or disposal. Site soils with concentrations of total PAHs less than 500 milligrams per kilogram (but do not exhibit visible signs of contamination or exhibit strong odors) and/or site-derived concrete and brick rubble less than four inches in size will be stockpiled onsite for use as backfill within the deep excavation area. Soil that falls outside these concentrations will be handled and disposed as contaminated material. Soil has been pre-characterized prior to construction to facilitate segregation during construction.

4.4.3 Backfill

The shallow excavation areas will be backfilled with imported soil meeting the quality requirements and using the backfill and compaction techniques described in Section 5.7. A demarcation layer such as snow fence fabric will be placed at the interface between the unexcavated soil and the imported backfill.

4.5 Deep Excavation

4.5.1 Dewatering

4.5.1.1 Groundwater Flow Modeling

URS performed modeling to estimate the rate of groundwater extraction that would be needed during the IRM excavation. The modeling effort consisted of developing a model simulating the conditions at the Site (*i.e.*, the existing conditions), and then using this model to predict extraction rates and groundwater level depression during remediation (*i.e.*, conditions during the IRM). The model was calibrated to existing conditions. The mean difference between the modeled elevations and the actual existing elevations (the mean calculated residual) was 0.01 feet and the scaled root mean square error was 1.5%. The model correctly captured the groundwater mounding in the vicinity of the former holder tanks due the presence of holder tank walls impeding the lateral flow of groundwater. A full summary of the modeling effort, including a description of the groundwater zone layers and assumptions regarding how the holder tanks influence groundwater flow, is presented in Appendix A.

Following calibration, the groundwater model was used to predict the rate of dewatering that would be required to dewater the excavation area, and predict the extent of drawdown outside the excavation area. The modeling was run to reflect a rate of dewatering that mirrored the rate of excavation. Although the sequence of deep excavation will be determined by the contractor, for modeling purposes, it was assumed that the surface of the excavation would be uniformly lowered over the course of 100 calendar days of excavation. The model was thus run to achieve a groundwater surface within the excavation area dropping at a comparable rate.

Prior to dewatering, soil will be solidified within the holder No. 2 tank (as described in section 4.5), and impermeable shoring will be installed around the deep excavation area to a depth of 48 feet (described in section 4.5.2).

Two dewatering scenarios were evaluated. The first scenario used the model as originally calibrated. This calibrated model used a relatively low hydraulic conductivity (0.44 ft/day) for the Site soils within the top 30 feet. Higher hydraulic conductivities were observed in some onsite wells. Thus a second scenario using a hydraulic conductivity of 1.0 ft/day (closer to the geometric mean of the rising head hydraulic conductivities of monitoring wells WW-MW-04, WW-MW-05, and WW-MW-07, which are all located on-site in this layer of the model) was run. The higher hydraulic conductivity may be more representative of conditions that would be observed during remediation, although it is noted that the presence of NAPL within the pore spaces of the soil acts to decrease overall hydraulic conductivity.

The model predicts that groundwater extraction rate to maintain the required rate of groundwater surface lowering within the deep excavation area would gradually increase to about 1.3 gallons per minute (gpm) in the lower hydraulic conductivity scenario and about 1.8 gpm in the higher hydraulic conductivity scenario. The depression of the water surface would be relatively symmetrical around the excavation area. The drawdown at the edge of building across 11th St. is estimated to be less than 1 to 1.5 feet, depending on the hydraulic conductivity assumed for modeling.

4.5.1.2 <u>Dewatering Technique</u>

Dewatering the excavation will be performed through the use of extraction wells installed in the excavation area. Excavation would proceed around these wells. The contractor will be required to maintain the water level at least two feet below the bottom of the deep excavation surface.

4.5.1.3 Water Pretreatment

The groundwater model estimated that between 1.3 and 1.8 gpm would be required on a continuous basis to depress the water surface at a rate needed to maintain the water level below the excavation surface. However, the contractor may elect to store water and operate the system for only 8 hours per day. Under this condition, the base flow rate would be 4 to 6 gpm. To estimate the treatment rate, the base flow rate needs to be increased to account for equipment downtime, possible changes in site conditions (e.g. weather conditions, construction delays, etc.), and the limitations of modeling. To be conservative, however, the contractor will be required to mobilize a system that is capable of treating up to 20 gpm on a continuous basis. On this basis, the estimated treatment rate is approximately 20 gpm on a continuous basis and approximately 40 gpm assuming treatment for 8 hours per day. And finally, to provide a contingency factor to address uncertainties in the modeling, as well as to account for the need to occasionally treat surface water accumulation in reusable soil stockpiles, a water treatment capacity of 100 gpm will be required.

The quality of the influent to the treatment system may be represented by data collected from WW-MW-05 which is in the vicinity of the proposed excavation. This data was collected in November 2009 and was reported in the Draft Remedial Investigation Interim Data Summary that was submitted to NYSDEC in August 2012. Data is summarized in Table 4-1. This table includes concentrations for all the analytes detected in the groundwater sample collected from WW-MW-05 in November 2009. Additionally, URS collected groundwater from a NAPL recovery well (NRW-09) adjacent to the deep excavation area. This water was analyzed for the parameters required to be monitored by the New York City Department of Environmental Protection for discharge to city sewers. The BTEX and naphthalene concentrations measured in that sample were of similar order of magnitude (although uniformly higher) than observed in WW-MW-05.

Treated water would be discharged to the 18-inch combined sewer running under Kent Ave. This sewer flows to the Newtown Creek Water Treatment Control Facility, a Publicly Owned Treatment Works (POTW). The contractor will be required to obtain a permit to discharge from the New York City Department of Environmental Protection (NYCDEP) Bureau of Wastewater Treatment. Discharge to the New York City sewer system requires authorization and sampling data demonstrating that the groundwater meets the City's discharge criteria. A treatability test was performed at the Site by pumping water from a 6-inch diameter NAPL recovery well (NRW-09) located immediately north of planned deep excavation area. This well was selected as it was immediately adjacent to the deep excavation area. The required limitations for effluent to combined sewers mandated by the NYCDEP were met. These limitations are presented on Table 4-2.

Extracted groundwater and other water managed by the pretreatment system would first be filtered using bag filters. The filters will serve two purposes. One is to extend the life of the carbon adsorbers by preventing solids in the water from clogging the units. The second benefit to removing the solids is that the fine sediment and suspended particles in the water often also contain a significant amount of adsorbed contamination. By removing the solids, it is expected that the contaminant concentrations in the groundwater will be decreased. Due to the temporary nature of the discharge, a simple filter-bag type unit (as opposed to a media type unit such as a sand filter) is proposed.

For the contaminants detected at levels above the effluent limitations (BTEX and naphthalene) aqueous phase carbon adsorption would be used for removal of these contaminants prior to discharge. Carbon would also remove the trace amounts of pesticides and most other organics detected in the groundwater. The contaminated water is pumped through the carbon unit, where the contaminants have an affinity to adsorb onto the surface of the carbon particles. Aqueous phase carbon adsorption units are well suited to the temporary construction-type environment proposed for the Site. Depending on the flow rate that the contractor uses and space requirements, the carbon system can be designed for either large flow rate units, or smaller flow rate units operating in parallel.

It is possible that NAPL could be present in the subsurface and that some NAPL could be extracted during dewatering operations. These NAPLs may or may not be related to holder operations as there are known and adjacent off-site contaminant sources. Consequently, the contractor will be required to include an oil/water separator in the treatment system and/or skimmers in tanks to remove NAPL prior to discharge, for when NAPL is extracted during excavation dewatering.

In addition to filters, carbon units, and NAPL removal, the treatment system will include the following:

- A primary settling tank(s) to remove all easily settleable solids from water extracted from the excavation area.
- A storage tank(s) for the retention and storage of water to allow flexibility in treatment operations.
- Pumps to transfer extracted water between the different treatment system components.
- Instrumentation (e.g. flow meters, pressure gauges, alarms, etc.) as required to operate the system efficiently and safely.

The contractor will be responsible for operation and maintenance of the system that will include, but not be limited, to the following:

- Replacement of filter bags, activated carbon, and other expendables as required.
- Cleaning of all equipment prior to transporting off site.
- Disposal or recycling of residuals resulting from treatment (e.g. solids, carbon, etc.).

4.5.2 Deep Excavation Support Barrier

The deep soil excavation of the gas holder remediation area includes the Relief Holder and holder No. 1. The proposed excavation area will be an approximately 22,000 square-foot area with a depth up to 30 feet bgs, as presented in section 4.1. Calculations for the design of the SOE system are included in Appendix B.

The Site location has limited space due to adjacent roadways and structures and the proposed excavation will need to be performed inside a temporary containment building (TCB) so that the vapors can be contained and treated through a vapor management system before release. In addition, the groundwater level is shallow, approximately 5 feet below existing grade; therefore, the groundwater drawdown at adjacent structures during construction dewatering is another concern. With all these constraints, a sloped excavation option is not feasible. Therefore, a structural SOE system will be needed to complete the proposed soil remediation activities.

The selection of an appropriate shoring system and the installation method is dependent on the project conditions and requirements. As presented in section 2.1.1, the subsurface conditions generally consist of 30 feet of medium dense to dense granular fill with debris, 30 feet of dense silty sand / silt, underlain by a thick clay layer. The pre-design investigation (PDI) indicates that there are obstructions, such as cobbles, boulders, concrete debris, and other buried and abandoned concrete structures. In addition, brick foundation walls were observed around the existing holder tanks. When such obstructions are encountered, it will be difficult for the structural support system to be driven into the ground to the required depth. This could result in damaged or non-plumb piles and the vibrations could be unacceptable. Hence, from the perspective of pile drivability, driven piles are not recommended.

Since the groundwater level is shallow, construction dewatering will be required during excavation. If a soldier pile wall with timber lagging or other permeable SOE systems are used, the groundwater drawdown behind the SOE wall could extend underneath adjacent properties. For certain soil conditions, this could result in ground settlement, which could possibly result in some settlement of structures located within the groundwater drawdown area and this is a concern. In addition, a relatively permeable SOE wall will result in the need to treat more groundwater. Therefore, URS recommends the use of a relatively impermeable SOE wall. URS recommends excavation of a trench and use of a CB slurry to maintain the stability of the trench. Steel sheet piles will then be placed within the excavated trench. The slurry trench will reduce the concern regarding the potential difficulty of driving steel sheet piles to the desired tip elevation. The combination of the CB slurry trench and the steel sheet piles will form a continuous relatively impermeable wall that will reduce the potential for groundwater drawdown outside the excavation, and will reduce the amount of groundwater that needs to be treated and discharged.

There are two basic types of SOE walls: cantilevered and anchored/braced walls. A cantilevered wall is installed to a sufficient depth into the ground to become fixed as a vertical cantilever. A cantilevered wall derives lateral resistance through sufficient soil embedment, and the structural element (e.g., steel sheet pile) has sufficient strength so that the wall does not require anchors or bracing. An anchored/braced wall derives lateral resistance primarily from anchors, such as tiebacks or internal bracing. Anchored/braced walls are most commonly installed when wall deflections become a concern or the structural element becomes impractically large. Excavations greater than approximately 15 feet are not typically supported by cantilevered walls. Therefore, considering that the proposed excavation depth for removal of the holder tanks will be up to 30 feet, cantilevered walls are not recommended. It is recommended that the excavation be supported with an anchored and/or braced wall. Anchors typically consist of tiebacks, which are composed of high strength steel bars or strands grouted into a drilled hole. Anchors obtain their resistance within the soil located outside the excavation; therefore, there will be less interference with construction operations, relative to internal bracing, during excavation operations. Based on the current utility information, there are two 78" brick sewers along North 12th Street that have an invert depth of approximately 14.5 feet. A tieback angle of 30 degrees from horizontal will avoid interference with these sewers and other shallow utility lines as shown on drawing DWG-11. Alternatively, the contractor will be installing internal bracing. Designs for both bracing techniques will be included in the Contract Documents, and the final selection of a bracing technique will be based on bid costs for each alternative.

As noted in the PDI, a perimeter wall foundation is present around portions of the proposed excavation area that border Kent St, 11th St, and 12th St. The following test pit photographs show the foundation wall at two locations:

Test Pit WW-TP-103
between Relief Holder and 12th St.

Test Pit WW-TP-112
between Holder No. 1 and 11th St.

The December 2014 field investigation described in Section 1.2.4 provided additional information for refinement in the 100% design. Specifically, the depth of the perimeter wall was measured by drilling through the wall. This information was used to decide to demolish the perimeter wall during installation of SOE.

4.5.2.1 Steel Sheet Pile, Cement-Bentonite (CB) Slurry Trench, and Bracing

The proposed excavation support system includes steel sheet piles placed in a CB slurry trench and retained by two levels of tieback anchors with rakers in the vicinity of holder No. 2 for internal bracing (alternative 1) or internal bracing (alternative 2). The lateral pressure, acting on the SOE walls, due to earth pressure, water pressure, and construction surcharge, are transferred through walers (steel sections that span across the sheets) to the tieback anchors, rakers, or to internal bracing elements. Regarding the general construction sequence, steel sheet piles are to be placed in the CB slurry trench while it is being excavated, which will form a continuous and closed SOE wall. After that the earth is excavated inside the SOE wall, and the selected bracing alternative will then be installed to provide additional lateral resistance as the excavation proceeds. The SOE wall design is based on the requirements of structural capacity and stability of the sheet pile, and resistance against soil erosion piping caused by seepage.

Vibration and optical survey monitoring at various locations around the Site will be performed during the installation of the SOE system and during excavation activities. Also, utilities should be pre-located and marked and will be included in the work.

Analyses were performed to determine the required sheet pile size and other bracing system element sizes. The analyses were based on the following parameters and assumptions:

- Maximum depth of excavation: 30 ft
- The following soil stratigraphy and strength parameters:
    - Soil layer 1 : Fill (loose to medium, φ=30º) from 0 ft to 17 ft
    - Soil layer 2 : Medium dense Sand (φ=32º) from 17 ft to 60 ft
- The groundwater inside the excavation will be lowered to the bottom of the excavation. The groundwater outside the excavation is assumed to stay at a depth of about 5 feet.
- A 250 pounds per square foot (psf) construction surcharge load was included.
- Two alternatives of bracing systems were designed:

- Alternative 1: Tieback Anchor and Rakers
- Alternative 2: Corner Braces and Cross Lot Strut

Design design calculations indicate that the SOE system will include the following:

- Steel Sheet Pile: PZ-35

  Minimum pile length: 48 ft

  Minimum yield strength: 50 ksi
- Cement Bentonite Slurry Trench: 1.5 ft wide (min.)
- Cement Bentonite Mix:
  - Bentonite-Water Slurry – Bentonite mixed with water as a precursor to make CB grout. Bentonite slurry shall contain a minimum of 3% bentonite by weight of water and a fluid density of 63 pcf, pH greater than 9, and a Marsh Funnel viscosity of about 30 seconds.
  - Cement Bentonite Slurry – A mixture of cement [PC and/or BFS] with bentonite slurry. The fluid CB grout shall have a minimum of 30% cement by weight of water and a fluid density of 74 pcf, or greater, with a pH greater than 12. The CB slurry shall harden to a material with a clay-like strength and impermeability.
  - The fully-cured CB mixture shall demonstrate a minimum UCS of 35 psi.

- Alternative 1 - Tieback anchor and rakers:
  - Tieback Anchors: Titan Hollow Bar 75/53, grade 75, Waker – Double C12×30
  - Upper: Elevation +1 ft

    Maximum design load = 110 kips

    Anchor Spacing = 7.53 ft

    Estimated minimum anchor length = 80 ft
  - Lower: Elevation -9 ft

    Maximum design load = 110 kips

    Anchor Spacing = 7.53 ft

    Estimated minimum anchor length = 45 ft
  - Rakers: W14×90, grade 50, Waler – W14×99
- Alternative 2 – Corner Brace and Cross Lot Strut

- Corner Brace: W14×90, grade 50
- Cross Lot Strut: W14×159, grade 50
- Waler: W14X120, grade 50
- Support Pile: 13.375 dia. With 0.514 thick wall, grade 80

The calculations are included in Appendix B.

4.5.3 <u>Deep Excavation Sequence</u>

Recommended deep excavation sequences for each alternative are:

Alternative 1- Tieback Anchor and Rakers:

1. Excavate CB slurry trench and install steel sheet piles as excavation proceeds.
2. Install the large TCB and the VMS.
3. Initiate dewatering.
4. Excavate to two feet below the elevation of the upper level tiebacks.
5. Install upper level tiebacks and perform tieback load testing.
6. Maintain temporary earthen berm as excavation proceeds at raker location.
7. Construct concrete footblock and install upper level rakers.
8. Excavate to two feet below the elevation of the lower level tiebacks.
9. Install lower level tiebacks and perform tieback load testing.

7. Along the raker area, excavate the temporary earthen berm to el. -11 ft.
8. Install lower level rakers.
9. Complete excavation.
10. Backfilling according to related specifications.

Alternative 2- Internal Brace Alternative:

1. Excavate CB slurry trench and install steel sheet piles as excavation proceeds.
2. Install the large TCB and the VMS.
3. Initiate dewatering.
4. Excavate the site to el. -1'.
5. Install upper walers at the upper brace locations.
6. Install upper cross lot strut and corner braces.
7. Excavate to el. -11', install lower walers at the lower brace locations.
8. Install lower cross lot strut and corner braces.

9. Excavate to the bottom of excavation and complete demolition of the holder structure.
10. Start backfilling according to related specifications.
11. Remove corner braces, support beams, and cross lot brace after backfilling to 2 feet below the brace level.
12. Remove temporary container buildings.

4.5.4 Temporary Containment Building

The ISS work and the majority of excavation and load out activities for deep excavation areas with MGP contamination will be conducted under TCBs. The TCBs will meet the design requirements for the local geographic area (such as wind and snow loads and foundation requirements) and will be delivered and assembled during the project preparation phase. The TCBs will be a coated membrane structure with cargo doors on the side walls.

One TCB (the large TCB) will initially be installed over the footprint of holder No. 2 to control odors from ISS work in that area. Following completion of ISS, the TCB will be placed over the footprint of holder No. 1. The TCB will be expanded by adding additional sections until it reaches 12th Street and covers the relief holder area.

Another TCB (the soil staging TCB) will be installed adjacent to the final location of the large TCB. This second, smaller TCB, will be used for staging of contaminated soil prior to offsite disposal. Trucks will be loaded with contaminated soil inside this TCB to control odors during this process.

The TCBs will be equipped with a VMS that is designed to provide a sufficient rate of air exchange to maintain a negative pressure inside the structure and to process recovered air from within the structure. The VMS will be equipped with a blower, particulate filter with breakthrough indicator, and vapor phase carbon adsorber. Placement of the VMS will be coordinated with excavation sequencing to ensure there is sufficient room for ancillary equipment outside of the TCBs. Emissions from the VMS will be routinely monitored using a PID and/or detector tubes, if needed, to monitor emissions.

4.5.5 Excavation and Removal of Gas Holder Tank and Foundations

Excavation will proceed with excavation equipment within the excavation support perimeter. The presence of the gas holder tanks and foundations necessitates demolition equipment and personnel within the excavation support perimeter. It is anticipated that the contractor will choose to remove the material via loaders and an access ramp, as this is the most cost and schedule efficient method. However, because of the presence of the TCBs, there may be conditions where the contractor may need to use other methods to remove the material.

The existing groundwater mounding around the gas holder area suggests that the gas holders are intact and are causing the observed adjacent groundwater to rise up around these structures. The contractor will select extraction well locations based on their planned excavation sequencing, taking into consideration that the lowering of groundwater in and around the holders could be uneven due to the presence of holder walls acting as vertical barriers to flow.

4.5.6 Stockpiling and Disposal

In general, the excavation will include the removal of gas holder tanks, their foundations, and soil to a depth of 30 feet bgs. Contaminated excavated structures, foundations, and debris will be hauled off-site for treatment and disposal.

Visually clean soils that are excavated and have concentrations of PAHs below 500 mg/kg and do not exhibit significant odors, as well as visibly clean bricks and concrete that do not exhibit significant odors will be stockpiled on-site for reuse as backfill. These materials will be stockpiled outside the TCB, but will be required to be managed such that no run off from the stockpile leaves the Site.

Contaminated soils with total PAHs above 500 mg/kg that are excavated will be treated off-site at a thermal desorption facility. Soil has been pre-characterized prior to construction to facilitate segregation during construction. These soils will be direct loaded for offsite disposal or briefly staged in the contaminated soil staging TCB prior to transportation.

4.5.7 Backfilling of Deep Excavation Area

The deep excavation area will be backfilled with a combination of imported material and site-derived reusable material. The quality requirements and compaction techniques are described in Section 5.7. Based on backfill calculations included in Appendix B, the estimated volume of site soils that may be available for reuse would not be sufficient to fill the entire depth of the deep excavation. For the purposes of the quantity calculation, conservatively high estimates were used to estimate possible available reuse soil and materials (this calculation will be updated once results of the precharacterization are available). Therefore, all reusable soils will be placed in the deep excavation, and not used for backfill in the shallow excavation areas.

The contractor would start backfilling with imported soil to raise the bottom of the excavation. However, the initial backfilling with imported soil would reach no higher than about 17 feet from the proposed final surface elevation, as shown in this calculation. This will allow enough space for on-site reuse material (including reuse material stockpiled during excavation of the deep excavation) to be reused but still maintain a final elevation less than or equal to 5 feet below the proposed final surface elevation.

A demarcation layer such as snow fence fabric will be placed at the upper interface between the backfilled reused soil and the imported soil placed in the top five feet.

5.0 IMPLEMENTATION

5.1 Construction Sequencing

The following construction sequence is proposed for the IRM but is subject to change based on the remediation contractor's work plan and means and methods:

1. Contractor mobilization.
2. Establishment of support areas (field office trailers, material staging and equipment laydown areas).
3. Installation of temporary construction fences, traffic control measures, and erosion/sediment control measures on the Site.
4. Installation of community air monitoring system and collecting background data.
5. Installation of vibration monitoring equipment and establishment of settlement monitoring points.
6. Installation of water pretreatment system.
7. Erection of contaminated soils staging TCB
8. Decommissioning of monitoring wells and piezometers
9. Initiation of installation of SOE wall and sheet pile excavation support system.
10. Erection of the large TCB over holder No. 2 area, including VMS set-up.
11. Excavation and in-situ solidification via bucket mixing within holder No. 2 and dewater as required/specified.
12. Place five feet of temporary backfill over solidified holder No. 2.
13. Completion of installation of SOE wall and sheet pile excavation support system.
14. Off-site disposal of material from construction of SOE wall.
15. Movement and extension of the large TCB over the deep excavation area.
16. Installation of dewatering system for the deep excavation area.
17. Excavation of soils and former structures from the deep excavation area, including the holder No. 1 and the relief holder footprints and disposal off-site. Segregation and stockpiling on-site of soils suitable for use as backfill.
18. As excavation progresses, dewatering and installation tie back anchors or internal bracing.

19. Upon completion of deep excavation, initiation of backfilling using all stockpiled soil suitable for reuse followed by imported fill to an elevation no more than 17.1 feet below the top of the proposed final restoration grade.
20. Removal of the large TCB from the deep excavation area.
21. Shallow excavation of remaining areas of the Site, excluding 55-foot strip of no excavation on the west side of the Site. Soil unsuitable for reuse sent off-site for disposal, and remaining soil stockpiled on-site for reuse as backfill or used directly as backfill in the deep excavation area. Upper portions of the SOE wall removed.
22. Completion of backfilling of deep excavation area with on-site derived material.
23. Backfilling shallow excavated areas and the top five feet of the deep excavation area with imported fill meeting restricted residential standards.
24. Demobilization of the dewatering and water pretreatment systems.
25. Topsoil placement and seeding.
26. Remove erosion/sediment controls and community air monitoring system.

5.2 Well Decommissioning

Monitoring wells within the excavation areas, shown on DWG-3, will be decommissioned in accordance with NYSDEC procedures (NYSDEC, 2003) prior to excavation activities. Wells planned to be decommissioned that are within the deep excavation area and are less than 30' total in depth, may be excavated and do not require to be decommissioned. These include WW-MW-07, BPB-18/MW-7, B-9/MW-9, WW-MW-05, and B-4/MW-4. Field verification of the well depths will be verified. Any dewatering wells installed by the Contractor in the deep excavation area are required to be removed prior to backfilling, or else decommissioned after backfilling.

5.3 Handling and Disposal of Contaminated Materials

The handling and disposal of contaminated material will be conducted in compliance with Title 6 New York Code of Rules and Regulations Part 364, *Waste Transporters Permit*, and Part 372, *Hazardous Waste Manifest System Related to Standards for Generators, Transporters and Facilities*.

As part of a comprehensive Health and Safety Plan (HASP) for the excavation work, specific precautions for site personnel will be identified for handling and disposing of contaminated material. Whenever there is a possibility for exposure to contaminated materials, personnel will be required to wear proper personal protective equipment (PPE).

Before any material is moved off-site, the analytical data (from the waste pre-characterization sampling and from samples of spoils and soil collected on an on-going basis, if necessary) will be provided to the disposal facilities to verify the acceptability of the material under the facility's permit. Initial acceptance will be based on data collected in-situ during the waste disposal pre-characterization sampling event to facilitate the direct loading of material. Continued acceptance will be based upon samples collected during the remediation, if necessary. A record of all material disposed off-site will be obtained from the disposal facility(s).

All transport equipment used to haul contaminated materials will be equipped with liners to prevent loss or leakage of material during transport. Trucks will be cleaned and inspected prior to departure from the Site to ensure that contaminated material cannot be spilled or tracked off-site.

Excavated materials will be shipped from the Site via truck to the Brooklyn-Queens Expressway, and from there to the final disposal areas. The designated truck routes are provided in Appendix C.

5.4 Dust/Vapor/Odor Management and Air Monitoring

The TCBs and VMSs will serve as the primary odor and dust control measure employed at the Site during deep excavation activities where the highest levels of contamination are expected to be present. The majority of earthwork known to present the biggest point source of odor will be performed within the temporary enclosure. Foam and foaming devices will be used during excavation work, if necessary, to control odors and VOC emissions.

Dust control measures will be implemented to minimize the potential for dust generation during soil excavation and handling, and placement of fill. The main dust control device will include water applied via hoses or sprinklers connected to off-site hydrants. Truck routes exiting the Site will be continuously monitored for excessive dirt or dust, and heavily traveled truck routes will be wet down to minimize dust emissions. Other dust control devices/methods will be stabilized construction entrances/exits and proper cleaning of trucks.

Stabilized construction entrances/exits consisting of smoothly graded areas large enough to accommodate equipment and truck traffic will be constructed at exit points to clean tires of transport trucks exiting the Site. The base of the entrances/exits will be covered with non-woven geotextile (for non-slippage) and coarse aggregate and will be maintained and redressed while in use.

The entrances and exits will be inspected during high truck traffic periods for excessive dirt or dust. Proper cleaning of trucks exiting the Site will help control off-site dust on adjacent roadways. Transport trucks exiting the Site will pass through an inspection area and/or be inspected to ensure tires and undercarriages are clean and that tarps are secured. Excessive mud and loose dirt observed on the trucks will be manually removed with brooms and brushes as necessary.

Odor will be monitored during excavation and handling of impacted soils from the Site. In the event that odors are migrating off-site, controls will be implemented. Controls will also be implemented as directed by National Grid, its representatives, and/or NYSDEC. Odor controls will include foam and foaming devices or tarps to cover open excavations or stockpiles.

Odor will be controlled by sequencing excavation in a manner that will result in manageable areas of open excavation. Offensive odors will be mitigated, if necessary, by placing a layer of non-odorous soils or polyethylene sheeting over the excavation area or stockpile (overnight and off-hours). If necessary, spray-on odor suppressing materials such as Rusmar Foam may be used to reduce potential VOC emissions or odors during transit. In addition, foam application equipment and an adequate supply of odor reducing foaming agent and formulations such as BioSolve® Pinkwater® will be available for application to the excavation areas or stockpiles as needed. Contingency monitoring and actions will be implemented in accordance with the Community Air Monitoring Plan (CAMP) if odor complaints are received from the neighboring community.

Perimeter and work zone air monitoring will be performed in accordance with the CAMP and the remediation contractor's HASP to evaluate the effectiveness of dust and odor control measures. In general, real time air monitoring equipment will be utilized to monitor dust and total VOC levels. If visible dust is generated or work zone and/or perimeter air monitoring results are above action levels, corrective action measures will be implemented. Corrective action measures may include increasing water coverage, controlling or temporarily ceasing select activities during high wind, reducing speed of equipment that may reduce dust generation, and utilizing different sizes or types of equipment that may cause less dust generation.

5.5 Noise and Vibration Monitoring

The Contactor will be required to implement mitigation measures to reduce noise and vibrations generated during the IRM in accordance with the Noise, Vibration and Settlement Monitoring Plan (Appendix E) and as directed by National Grid, its representatives, and/or the NYSDEC. Potential mitigation measures that could be implemented are identified in the specifications. Preventive and mitigation measures for noise may include a combination of the following:

- Properly functioning equipment;
- Minimized idling of trucks;
- Modified general construction practices;
- Modifications to construction equipment; and
- Acoustical or sound attenuating panels placed adjacent to noise-generating equipment and/or near sensitive receptors.

Construction activities have the potential to produce vibration levels that may cause damage to adjacent structures. Architectural and even structural damage to existing structures surrounding a site could occur if appropriate precautions are not taken. The construction activities of the project will include movement of loaded trucks at the Site. Measurements of vibration used in this evaluation are expressed in terms of the peak particle velocity (PPV) in the unit of inches per second (ips). The PPV, a quantity commonly used for vibration measurements, is the maximum velocity experienced by any point in a structure during a vibration event. It is an indication of the magnitude of energy transmitted through vibration. PPV is an indicator often used in determining potential damage to buildings from stress associated with construction activities.

One of the more frequently used action vibration thresholds for prevention of structural damage is established by the United States Bureau of Mines and includes a figure with varying threshold levels as a function of the vibration frequency. In addition, the New York City Landmarks Preservation Commission (NYCLPC) requires an action threshold of 0.5 ips for landmarked buildings located within 90 feet of a construction site. There are no known landmark buildings within 90 feet of the Site. The table below shows typical levels of vibration for construction activities, based on data from the Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, April 1995.

Typical Levels of Vibration for Construction Equipment Similar to that Proposed for Construction

Construction Activity	PPV at 75 feet (ips)	PPV at 50 feet (ips)	PPV at 25 feet (ips)
Caison Drilling/Large Bulldozer	0.0	0.03	0.089
Loaded Trucks	0.0	0.027	0.076
Jack Hammer	0.0	0.015	0.035

Sources: Federal Transit Administration (FTA), *Transit Noise and Vibration Impact Assessment*, April 1995.

Notes: PPV at 25 feet are based on FTA 1995. To calculate PPV at other distances, the following equation (FTA 1995) was used:

PPV at Distance D = PPV (at 25 ft) * [(25/D)^1.5]

Even though the values shown in the table are much less than the 0.5 ips criteria for a landmarked structure, a vibration monitoring plan, (Appendix E) will be implemented during construction. This plan sets a warning action limit at 0.25 ips and a stop work action limit at 0.5 ips at the monitoring points shown in the plan.

5.6 Settlement Potential During Construction

Construction dewatering will be required for the proposed excavation. Groundwater modeling (Appendix A) indicates that the maximum drawdown underneath the buildings of adjacent properties is less than 1.5 ft. This amount of dewatering will not cause settlement problems. Regardless, settling will be monitored in accordance with the Noise, Vibration and Settlement Monitoring Plan (Appendix E). In accordance with this plan, groundwater levels will be monitored and optical survey points will be established and regularly monitored on the adjacent buildings.

5.7 Backfill Requirements

Imported material will include clean fill (described as "general fill"), and NYSDOT Type 1 coarse aggregate (select stone fill and stone cover). Any use of coarse aggregate materials will be from a NYSDOT-approved certified clean source and will meet NYSDOT gradation requirements or as otherwise required by the project specifications. Proposed source(s) for other general fill materials will be approved by National Grid and its representatives prior to delivery to the Site. Once the source(s) are approved, samples will be obtained for each fill type per source at a frequency of one sample for every 5,000 cubic yards (yd^3) brought on-site and analyzed at a NYSDOH certified Environmental Laboratory Accreditation Program (ELAP) approved laboratory for total PAH's, total VOCs and metals in accordance with the listing in 6 NYCRR Part 375 Table 375-6.8 (b) for restricted residential use.

Backfill in the deep excavation will also include site soils with concentrations of total PAHs less than 500 mg/kg and/or site-derived brick and concrete rubble less than four inches in size exhibiting no visual contamination or significant odors and clean imported soil.

Imported backfill will be placed in all areas within five feet of proposed final grade (or less if shallow excavation is limited to shallower excavation due to the presence of groundwater). The fill will be placed in approximately 8-inch lifts and compacted with a roller, or hand-operated compaction equipment when near sensitive structures. In-place quality control compaction testing will be performed by an independent geotechnical testing firm to ensure specified compaction has been achieved. Each lift will be tested at a frequency of one test per 2,500 square feet, with a minimum of two tests per backfill lift per each backfill area. Each backfill lift should be compacted to 95% compaction.

Following geotechnical testing, a surface cover will be placed in a non-compacted single six-inch lift over the general fill layer and spread with the dozer to establish final grades as agreed with NYCPR. The surface cover will include a topsoil and seed layer. Topsoil, seed, mulch and fertilizer will meet the requirements of New York State Standards and Specifications for Soil Erosion and Sediment Control for Permanent Critical Area Plantings.

5.8 Storm Water Pollution Prevention

Currently, runoff from the Site discharges to the street. During construction, storm water will be managed in two ways: 1) all areas not in contact with contamination will continue to drain in the same fashion and 2) areas in contact with contamination will be managed on the Site.

Areas not in contact with contamination include:

- Support areas to the west of the deep excavation area, exclusive of stockpiles for soil to be reused as backfill.
- The portion of the Site east of the TCBs, which, after solidification treatment, will be used for placement and operation of the TCB VMS units.
- The roofs of the TCBs.

To minimize sediment migration from these portions of the Site, erosion control features as shown on Drawing DWG-21 will be used at the perimeter of the Site, with the exception of the Site entrance and exit, which will be maintained at slightly higher elevation compared to the adjacent site boundary. The runoff from the TCB roofs will be directed to the street.

Areas in contact with contamination are limited to the reusable soil stockpile (deep excavation and solidification will be performed under TCBs). The reusable soil stockpile will be required to be constructed on native soil and fill (existing concrete/asphalt removed) to allow for infiltration of runoff and be bermed to contain all surface water. This surface water will be pumped from the containment area to the water pretreatment area. In the event of extreme rain events (greater than can be handled by the water pretreatment system), the clean soil stockpile area will be allowed to overflow into the deep excavation area on a temporary basis.

During shallow excavation, which is sequenced towards the end of the project, the ground surface will be below the surrounding environment, preventing runoff from the Site.

The contractor will abide by the requirements of the NYSDEC State Pollutant Discharge Elimination System (SPDES) General Permit for Storm Water Discharges from Construction Activities. Furthermore, as this project is being performed in part pursuant to an administrative order on consent with the NYSDEC, the project is exempt from the administrative requirement to obtain a construction SPDES General Permit so as not to unnecessarily delay the timely initiation of the construction work. It is intended to file a Notice of Intent (NOI) with the Department for informational purposes.

After construction, the volume of storm water runoff will be significantly reduced from that under the impervious existing conditions (i.e., pavement and concrete) by the permeable grassed surface of the restored area. The grading of the restoration plan shows that storm water runoff from the grass will generally flow from the southeast to the northwest.

5.9 Permits

The contractor will be required to obtain all permits required for performing the work. A partial list of applicable permits includes:

- Department of Buildings Excavation Permit, Temporary Structures Permit, and Temporary Electrical Permit;
- Department of Environmental Protection Discharge permit; and
- Department of Transportation Permits for sidewalk closures.

The engineer will initiate the permit process during the design, but the contractor will be required to pull the permits.

5.10 Management of Public Impacts

Appendix D (Community And Environmental Response Plan) provides information on how public outreach and communications will be conducted during remedial construction activities, identifies construction phases and durations of each, and describes how construction activities will be managed to minimize or mitigate community impacts.

5.11 Site Restoration

The Site will be restored to support future use or development as a park in coordination with NYCPR. DWG-22 provides a grading plan.

5.12 Construction Quality Control

All remedial construction activities will be performed in accordance with the Construction Quality Control Plan (CQCP) to be developed by the contractor in accordance with requirements outlined in the Contract Documents. The CQCP will at a minimum include the following:

- Procedures for controlling activities related to inspection, testing and documentation, including those of contractors, suppliers and laboratories, as necessary.
- Control, verification and acceptance testing procedures for each specific test, to include the test name, test equipment to be utilized, specification section and paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test.
- Procedures for tracking inspections, verification, and acceptance tests including documentation.
- Procedures for tracking construction deficiencies for identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

The contractor is required to maintain, as the work is performed, sufficient records to furnish documentary evidence that QA/QC testing has been performed in accordance with the approved CQCP. The records will include the results of reviews, inspections, tests, and audits as well as the procedures, equipment used, date, the name of the inspector, results, inspections, and corrective measures. These records will be maintained in an identifiable, meaningful, and organized manner and be submitted (via the Construction Manager) to National Grid and/or the Engineer for review as they become available. Records will also be stored on-site and be readily retrievable.

5.13 Construction Schedule and Sequencing

Construction phases, approximate durations, and approximate start/finish dates for the IRM are identified below. The contractor's schedule will be provided separately for NYSDEC review.

Activity	Approximate Duration (Weeks)	Approximate Start	Approximate Finish
100% Design Submittal	12	December 2014	June 2015
Construction Bidding	6	July 2015	August 2015
Review Bids and Award Construction Contract	16	August 2015	September 2015

Project Hazard Analysis	8	September 2015	October 2015
Preparation & Approval Submittals	8	September 2015	October 2015
Contractor Mobilization	4	October 2015	November 2015
ISS, Excavation, Backfill, Restoration	70	November 2015	March 2017
Contractor Demobilization	4	March 2017	April 2017
Construction Completion Report	12	April 2017	June 2017

5.14 Institutional Controls

Due to the nature/composition of the soil and fill that will be left in place, Institutional Controls (ICs) will likely be required to restrict activities on the Site after the remediation has been completed. The ICs may include any or a combination of the following:

- Site Management Plan;
- An environmental easement pursuant to Title 36, Article 71 of the New York State Environmental Conservation Law; or

The environmental easement, if necessary, will impose land use limitations or requirements that may be needed to protect current or future users from environmental contamination. Requirements and limitations may include restrictions on property uses, controls for certain site uses such as construction of basements or trenches, and/or operation or maintenance of engineering controls and reporting.

5.15 Construction Completion Report

A Construction Completion Report will be prepared at the conclusion to the remediation to document all remedial actions that have been undertaken at the Site. The report will be prepared in accordance with the DER-10, *Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010).

6.0 REFERENCES

GEI, August 2010, *Draft Remedial Investigation Interim Data Summary, Williamsburg Works Former Manufactured Gas Plant (MGP) Site, Brooklyn, New York 11211, Index No. A2-055-0606, Site No. 224055*

GEI, August 2011, *Final Interim Remedial Measure Design Work Plan, 50 Kent Avenue Parcel, Williamsburg Works Former MGP Site, Brooklyn, New York, Index No. A2-055-0606, Site No. 224055*

Metcalf & Eddy, November 2006, *Site Investigation Report, Property West of Kent Avenue Between and Including North 10th and North 12th Streets Block 2287, Lot 1, 16, & 30, Block 2294, Lot 1 & 5 Brooklyn, New York*

NYSDEC, April 2003. *Groundwater Monitoring Well Decommissioning Procedures.*

NYSDEC, 6 NYCRR *Part 375, Environmental Remediation Programs Subparts 375-1 to 375-4 & 375-6.*

NYSDEC, October 2010. *CP-51 / Soil Cleanup Guidance*

NYSDEC, May 2010. *DER-10 Technical Guidance for Site Investigation and Remediation.*

URS, February 2013, *Interim Remedial Measure Pre-Design Investigation Data Report for the 50 Kent Avenue Parcel Former Williamsburg Works MGP Site ID No. 224055 Brooklyn, Kings County, New York*

URS, April 2013, *Interim Remedial Measure Design and Implementation Plan for the 50 Kent Avenue Property Former Williamsburg Works MGP Site ID No. 224055 Brooklyn, Kings County, New York*

URS, July 2013, *Interim Remedial Measure Supplemental Pre-Design Investigation Report for the 50 Kent Avenue Parcel Former Williamsburg Works MGP Site ID No. 224055 Brooklyn, Kings County, New York*

TABLES

Table 4-1
Summary of Analytical Data for WW-MW-05

Parameter	Parameter Class	Units	Concentration
Benzene	VOC	µg/L	9,200
Toluene	VOC	µg/L	13,000
Ethylbenzene	VOC	µg/L	2,700
Xylene, total	VOC	µg/L	6,200
Styrene	VOC	µg/L	2,600
Acenaphthalene	SVOC	µg/L	270
Fluorene	SVOC	µg/L	37
2-Methylnphthalene	SVOC	µg/L	720
Naphtahlene	SVOC	µg/L	6,600
4-Metylphenol	SVOC	µg/L	34
2-Methylphenol	SVOC	µg/L	34
Beta-BHC	Pesticide	µg/L	0.140
Delta-BHC	Pesticide	µg/L	0.057
Endosufan I	Pesticide	µg/L	0.052
Aluminum	Metal	mg/L	0.105
Barium	Metal	mg/L	0.250
Calcium	Metal	mg/L	56.2
Chromium	Metal	mg/L	0.001
Cobalt	Metal	mg/L	0.005
Copper	Metal	mg/L	0.007
Iron	Metal	mg/L	2.84
Magnesium	Metal	mg/L	10.8
Manganese	Metal	mg/L	0.566
Nickel	Metal	mg/L	0.033
Potassium	Metal	mg/L	45.3
Sodium	Metal	mg/L	779
Vanadium	Metal	mg/L	0.005
Zinc	Metal	mg/L	0.008
Cyanide, total	Other	µg/L	94.7

Table 4-2

Limitations For Effluent To Sanitary Or Combined Sewers

Parameter[1]	Daily Limit	Units	Sample Type	Monthly Limit
Non-polar material[2]	50	mg/l	Instantaneous	---
pH	5-12	SU’s	Instantaneous	---
Temperature	< 150	Degree F	Instantaneous	---
Flash Point	> 140	Degree F	Instantaneous	---
Cadmium	2 0.69	mg/l mg/l	Instantaneous Composite	--- ---
Chromium (VI)	5	mg/l	Instantaneous	---
Copper	5	mg/l	Instantaneous	---
Lead	2	mg/l	Instantaneous	---
Mercury	0.05	mg/l	Instantaneous	---
Nickel	3	mg/l	Instantaneous	---
Zinc	5	mg/l	Instantaneous	---
Benzene	134	ppb	Instantaneous	57
Carbontetrachloride	---	---	Composite	---
Chloroform	---	---	Composite	---
1,4 Dichlorobenzene	---	---	Composite	---
Ethylbenzene	380	ppb	Instantaneous	142
MTBE (Methyl-Tert- Butyl-Ether)	50	ppb	Instantaneous	---
Naphthalene	47	ppb	Composite	19
Phenol	---	---	Composite	---
Tetrachloroethylene	20	ppb	Instantaneous	---
Toluene	74	ppb	Instantaneous	28
1,2,4-Trichlorobenzene	---	---	Composite	---
1,1,1-Trichloroethane	---	---	Composite	---
Xylenes (Total)	74	ppb	Instantaneous	28
PCBs (Total)[3]	1	ppb	Composite	---
Total Suspended Solids (TSS)	350[4]	mg/l	Instantaneous	---
CBOD[5]	---	---	Composite	---
Chloride[5]	---	---	Instantaneous	---
Total Nitrogen[5]	---	---	Composite	---
Total Solids[5]	---	---	Instantaneous	---

1. All handling and preservation of collected samples and laboratory analyses of samples shall be performed in accordance with 40 C.F.R. pt. 136. If 40 C.F.R. pt. 136 does not cover the pollutant in question, the handling, preservation, and analysis must be performed in accordance with the latest edition of “Standard Methods for the Examination of Water and Wastewater.” All analyses shall be performed using a detection level less than the lowest applicable regulatory discharge limit. If a parameter does not have a limit, then the detection level is defined as the least of the Practical Quantitation Limits identified in NYSDEC’s Analytical Detectability and Quantitation Guidelines for Selected Environmental Parameters, December 1988.
2. Analysis for non-polar materials must be done by EPA method 1664 Rev. A. Non-Polar Material shall mean that portion of the oil and grease that is not eliminated from a solution containing N–Hexane, or any other extraction solvent the EPA shall prescribe, by silica gel absorption.
3. Analysis for PCBs is required if both conditions listed below are met:
   1) if proposed discharge ≥ 10,000 gpd;
   2) if duration of a discharge > 10 days.
   Analysis for PCBs must be done by EPA method 608 with MDL=<65 ppt. PCB’s (total) is the sum of PCB-1242 (Arochlor 1242), PCB-1254 (Arochlor 1254), PCB-1221 (Arochlor 1221), PCB-1232 (Arochlor 1232), PCB-1248 (Arochlor 1248), PCB-1260 (Arochlor 1260) and PCB-1016 (Arochlor 1016).
4. For discharge ≥ 10,000 gpd, the TSS limit is 350 mg/l. For discharge < 10,000 gpd, the limit is determined on a case by case basis.
5. Analysis for Carbonaceous Biochemical Oxygen Demand (CBOD), Chloride, Total Solids and Total Nitrogen are required if proposed discharge 10,000 gpd. Total Nitrogen = Total Kjeldahl Nitrogen (TKN) + Nitrite (NO2) + Nitrate (NO3).

DRAWINGS

EXCAVATION- AND SOLIDIFICATION-BASED INTERIM REMEDIAL MEASURE FOR SOIL AND MGP STRUCTURES

FOR THE

THE 50 KENT AVENUE PROPERTY HOLDER AREA

BROOKLYN, KINGS COUNTY, NEW YORK

PREPARED BY:

URS Corporation

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PREPARED FOR:

nationalgrid

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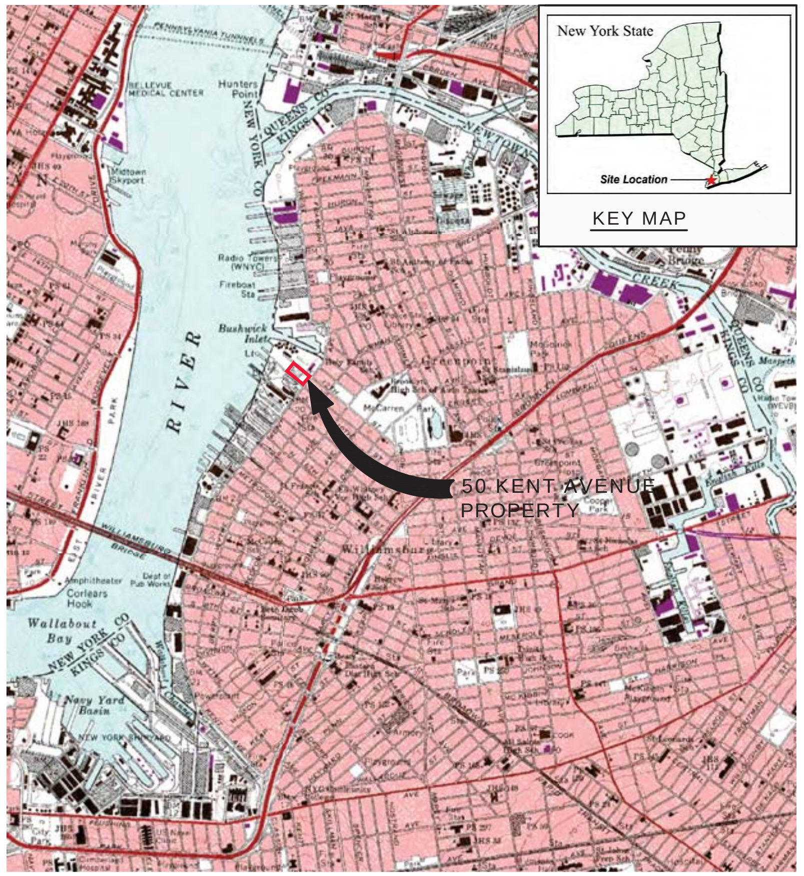
BROOKLYN, NEW YORK 11201

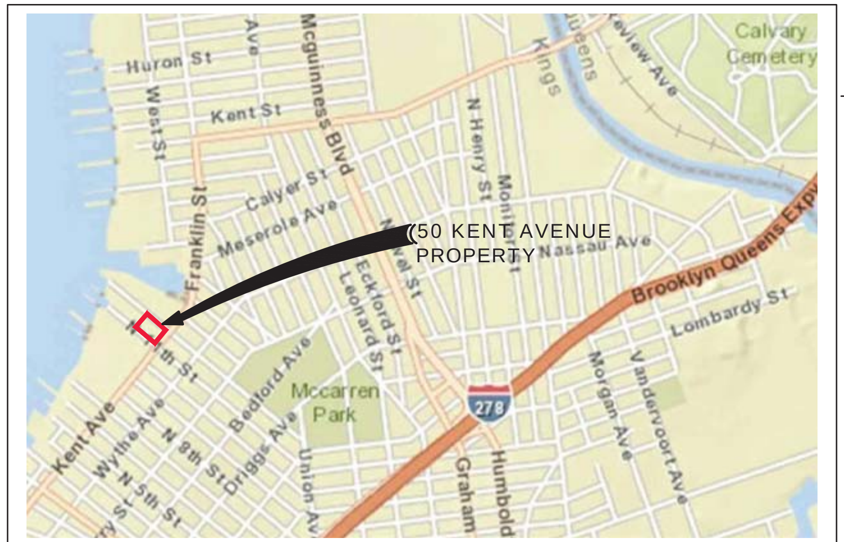
JUNE 2015



SOURCE:
USGS 7.5 MINUTE SERIES
TOPOGRAPHICAL
QUADRANGLES:
BROOKLYN, NY (1977)

LOCATION MAP

2,000' 0 2,000'
SCALE IN FEET



SOURCE:
GOOGLE MAPS

VICINITY MAP

NOT TO SCALE

LEGEND - EXISTING

LOCATION OF EXISTING STRUCTURE
EXISTING UNDERGROUND ELECTRIC
EXISTING OVERHEAD ELECTRIC
EXISTING GAS LINE
EXISTING WATER LINE
EXISTING SEWER LINE
EXISTING FUEL OIL LINE
EXISTING WATER VALVE
EXISTING GAS VALVE
EXISTING SEWER MANHOLE
EXISTING ELECTRIC MANHOLE
EXISTING WATER MANHOLE
EXISTING LIGHT POLE
WW-MW-102I EXISTING MONITORING WELL
EXISTING FENCE

APPROXIMATE 50 KENT AVENUE PARCEL BOUNDARY

NRW-13 RECOVERY WELL LOCATION

SEE NOTE 7, THIS SHEET

ABBREVIATIONS

A.C.	ASPHALT CONCRETE	ND	NOT DETECTED
BGS	BELOW GROUND SURFACE	OHW	OVERHEAD WIRE (ELECTRIC)
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENE	RCP	REINFORCED CONCRETE PIPE
℄	CENTERLINE	RGS	RIGID GALVANIZED STEEL
ELEV.	ELEVATION	PAH	POLYCYCLIC AROMATIC HYDROCARBONS
FT	FEET	PLST	PLASTIC GAS LINE PIPE
INC.	INCORPORATED	ROW	RIGHT–OF–WAY
INV	INVERT	TCB	TEMPORARY CONTAINMENT BUILDING
MET	METEOROLOGICAL	TEL	TELEPHONE
MGP	MANUFACTURED GAS PLANT	TYP.	TYPICAL
MH	MANHOLE	SAN	SANITARY
MUTCD	MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES	SICPP	SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE
NAPL	NONAQUEOUS PHASE LIQUID	ST	STORM
NAVD	NORTH AMERICAN VERTICAL DATUM	ug/L	MICROGRAMS PER LITER
NEUT	NEUTRAL	UK	UNKNOWN
NYSDOTSS	NEW YORK STATE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS, LATEST EDITION	UP	UTILITY POLE
		VMS	VAPOR MANAGEMENT SYSTEM

GENERAL NOTES

1. SOURCE BASE MAP IS URS CORPORATION TOPOGRAPHIC SURVEY PREPARED BY YEC, INC. DATE OF SURVEY APRIL 30, 2013 AND JUNE 5, 2013.
2. HORIZONTAL DATUM IS REFERENCED TO US STATE PLANE 1983 ZONE.
3. VERTICAL DATUM IS REFERENCED TO NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88).
4. THE TYPES, LOCATIONS, SIZES AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THESE DRAWINGS WERE OBTAINED FROM VARIOUS SOURCES AND SHALL BE CONSIDERED THE BEST AVAILABLE INFORMATION WITH COMPLETENESS AND ACCURACY UNKNOWN. THE CONTRACTOR IS CAUTIONED THAT ONLY EXCAVATION WILL REVEAL THE ACTUAL TYPES, EXTENT, SIZES, LOCATIONS, AND DEPTHS OF SUCH UNDERGROUND UTILITIES. OTHER BURIED OBJECTS OR UTILITIES, NOT SHOWN ON THESE DRAWINGS, MAY BE ENCOUNTERED.
5. SHOWN PROPERTY LINES WERE OBTAINED FROM A SURVEY PREPARED BY YEC, INC. DATE OF SURVEY APRIL 30, 2013 AND JUNE 5, 2013.
6. PRIOR TO CONSTRUCTION, ALL DIMENSIONS AND CONDITIONS OF EXISTING STRUCTURES AND UTILITIES IN AND ADJACENT TO THE DELINEATED REMEDIATION AREAS SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR.
7. FOR OTHER LEGEND INFORMATION, REFER TO THE OTHER DRAWINGS, AS APPLICABLE.

INDEX OF DRAWINGS

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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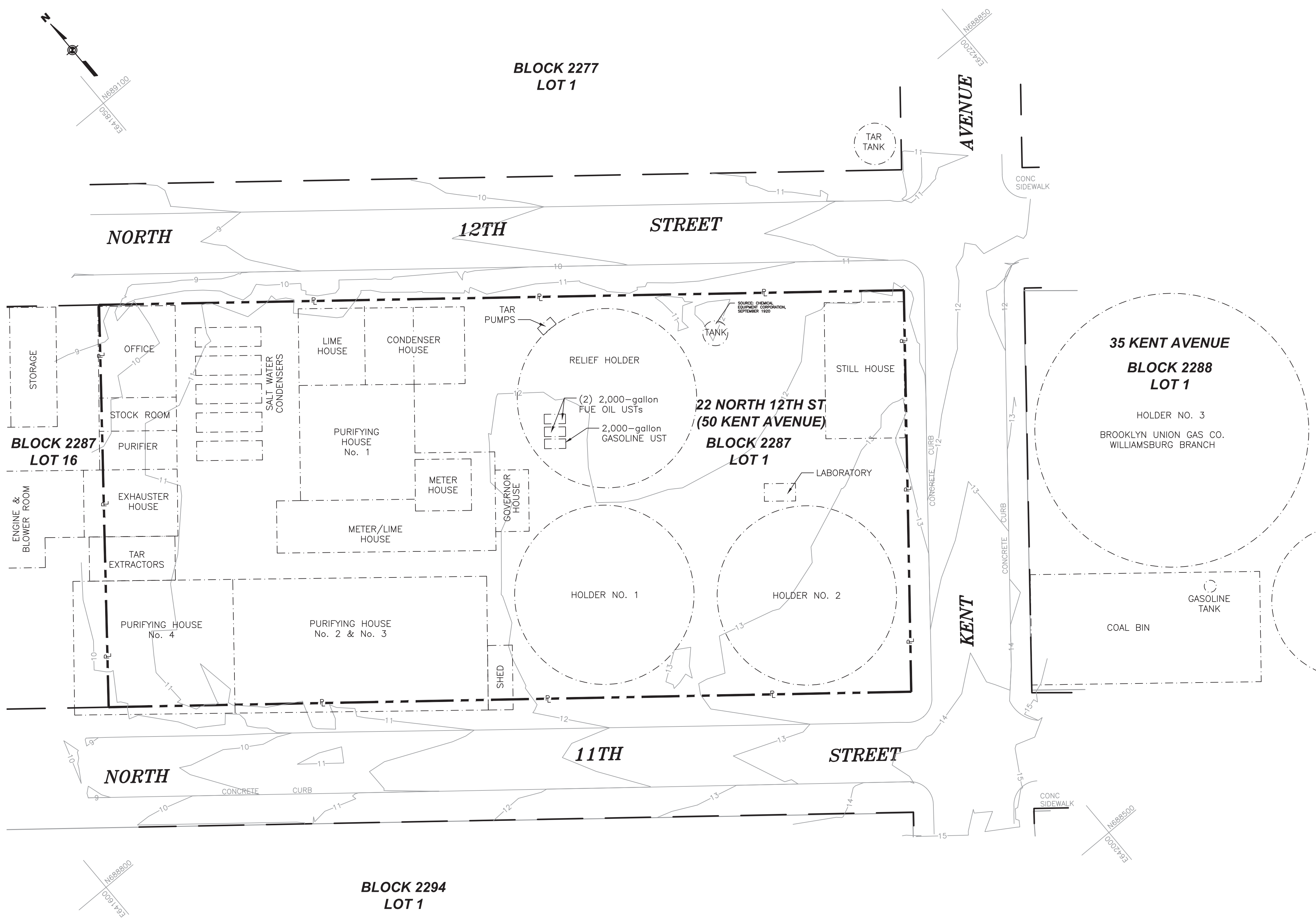
INDEX OF DRAWINGS, ABBREVIATIONS, NOTES, LEGEND AND LOCATION MAP

Scale: AS SHOWN | Date: JUNE 2015 | DWG–1



LEGEND

- APPROXIMATE 50 KENT AVENUE PROPERTY BOUNDARY
- APPROXIMATE R.O.W.
- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE

NOTES:

1. THE HORIZONTAL COORDINATE SYSTEM IS BASED UPON THE NEW YORK STATE PLANE COORDINATE SYSTEM, EAST ZONE, 1983 ADJUSTMENT.
2. THE VERTICAL INFORMATION IS EXPRESSED IN FEET AND IS BASED ON THE NORTH AMERICAN VERTICAL DATUM (NAVD 88).
3. EXISTING TOPOGRAPHY WAS OBTAINED FROM DRAWING DATED APRIL 30, 2013 AND JUNE 5, 2013, PREPARED BY YEC, INC., ENTITLED "WILLIAMSBURG WORKS FORMER MGP SITE."
4. FORMER MGP STRUCTURES SOURCES: "THE BROOKLYN UNION GAS CO. WILLIAMSBURG WORKS" DRAWING 2-G-130, DATED JULY 1921.

30' 0 30'
SCALE IN FEET

J:\Projects\11176638\CAD\RDWP 2013\DWG-2.dwg 6/12/15-ELB

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IT IS A VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON OTHER THAN WHOSE SEAL APPEARS ON THIS DRAWING, TO ALTER IN ANY WAY AN ITEM ON THIS DRAWING. IF AN ITEM IS ALTERED, THE ALTERING ENGINEER SHALL AFFIX TO TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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50 KENT AVENUE PROPERTY
HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK

EXISTING SITE PLAN SHOWING FORMER MGP STRUCTURES

Scale: AS SHOWN | Date: JUNE 2015 | DWG-2

LEGEND

	EXISTING CHAIN LINK FENCE
10	EXISTING GRADE CONTOUR
	PROPOSED SHALLOW EXCAVATION AREA
	PROPOSED SUPPORT OF EXCAVATION SYSTEM FOR DEEP (HOLDER) EXCAVATION AREA
	EXISTING STRUCTURE
MW	EXISTING MONITORING WELL LOCATION TO REMAIN
MW	EXISTING MONITORING WELL TO BE DECOMMISSIONED
MW	EXISTING MONITORING WELL TO BE EXCAVATED
NRW-13	EXISTING RECOVERY WELL LOCATION
GR-5	EXISTING IRM DESIGN INVESTIGATION SOIL BORING
WW-TP-100	EXISTING IRM DESIGN INVESTIGATION TEST PIT
WW-SB-22 BPB-19 WW-SB-06	EXISTING SOIL BORING LOCATION
GD-06	EXISTING GEOTECNICAL DESIGN SOIL BORING
GTP-03	EXISTING GEOTECHNICAL DESIGN TEST PIT

NOTES:

1. THE HORIZONTAL COORDINATE SYSTEM IS BASED UPON THE NEW YORK STATE PLANE COORDINATE SYSTEM, EAST ZONE, 1983 ADJUSTMENT.
2. THE VERTICAL INFORMATION IS EXPRESSED IN FEET AND IS BASED ON THE NORTH AMERICAN VERTICAL DATUM (NAVD 88).
3. EXISTING TOPOGRAPHY WAS OBTAINED FROM DRAWING DATED AUGUST 2013, PREPARED BY YEC, INC., ENTITLED "WILLIAMSBURG WORKS FORMER MGP SITE."
4. EXISTING WELLS WITHIN PROPOSED EXCAVATION AREAS TO BE DECOMMISSIONED IN ACCORDANCE WITH SPECIFICATIONS. EXISTING RECOVERY WELLS SHALL BE PROTECTED FROM DAMAGE.

30' 0 30'
SCALE IN FEET

J:\Projects\11176638\CAD\RDWP 2013\DWG-3.dwg 7/17/15-RAL

WARNING
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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION
1	AJZ	JAS	7/20/15	REVISED DRAWN LIMITS OF SHALLOW EXCAVATION

REVISIONS

DESIGNED BY: AJZ
DRAWN BY: EB
CHECKED BY: MG
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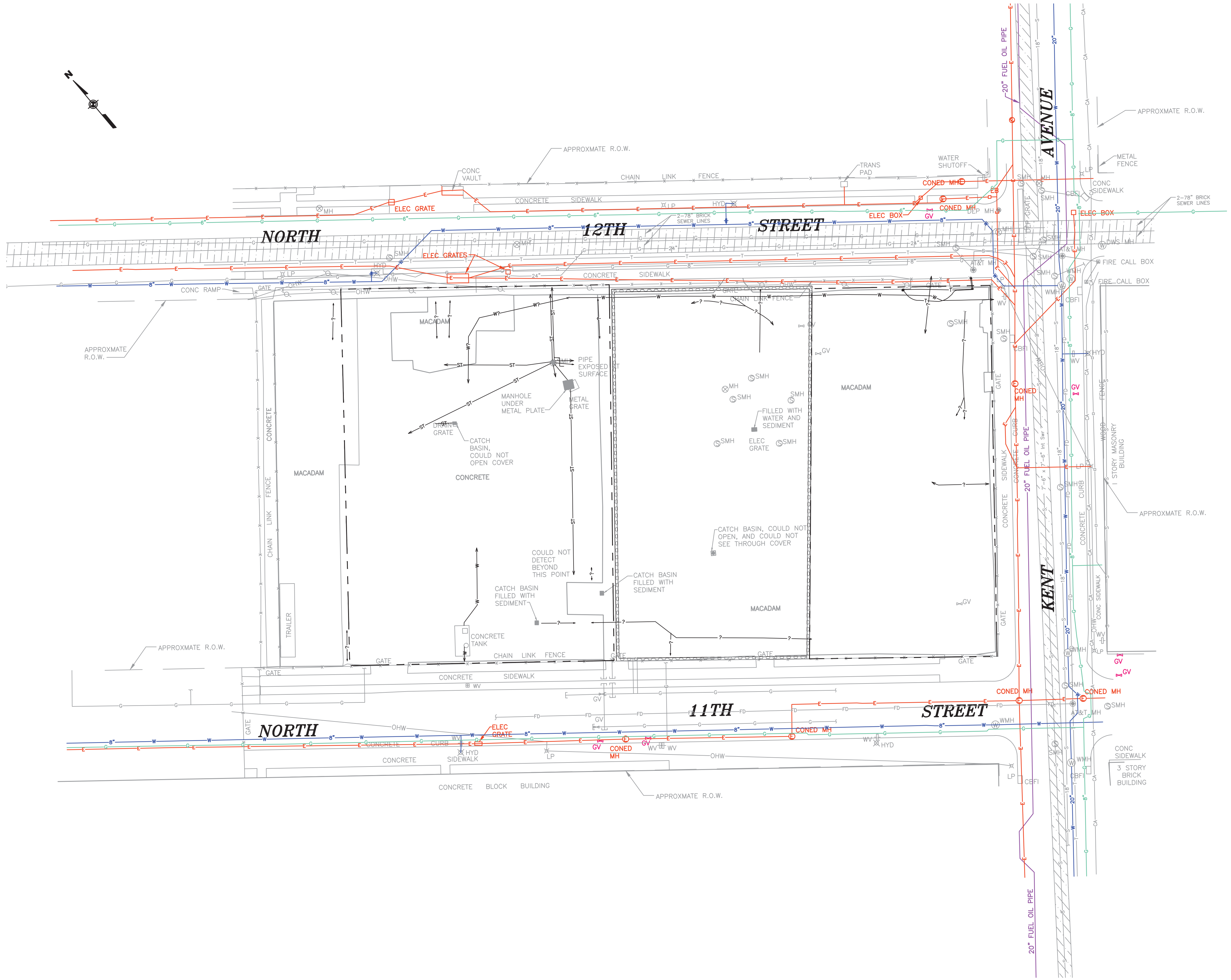
HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK

EXISTING TOPOGRAPHY AND WELL LOCATIONS

Scale: AS SHOWN | Date: JUNE 2015 | DWG-3



LEGEND

—E—	EXISTING UNDERGROUND ELECTRIC
—OHW—	EXISTING OVERHEAD ELECTRIC
—G—	EXISTING GAS LINE
—W—	EXISTING WATER LINE
—S—	EXISTING SEWER LINE
—FD—	EXISTING FDNY LINE
—FO—	EXISTING FUEL OIL LINE
WV	EXISTING WATER VALVE
GV	EXISTING GAS VALVE
	EXISTING SEWER MANHOLE
	UNIDENTIFIED MANHOLE
	CATCH BASIN GRATE
	EXISTING UTILITY POLE
	EXISTING ELECTRIC MANHOLE
	EXISTING WATER MANHOLE
LP	EXISTING LIGHTPOLE
	EXISTING FENCE
	PROPOSED SUPPORT OF EXCAVATION SYSTEM FOR DEEP (HOLDER) EXCAVATION AREA
	PROPOSED SHALLOW EXCAVATION AREA

UTILITIES FROM GEOPHYSICAL SURVEY PREPARED BY NAEVA GEOPHYSICS, INC. DATED APRIL 2012

—?—	UNKNOWN UNDERGROUND FEATURE
—ST—	STORM SEWER LINE
—T—	EXISTING TELEPHONE LINE
—w—	WATER LINE

NOTES:

1. UNDERGROUND UTILITY INFORMATION OBTAINED FROM A DRAWING DEVELOPED BY METCALF & EDDY/AECOM, TITLED "SOIL BORING, SEDIMENT WELL AND MONITORING WELL LOCATIONS", DATED NOV. 2006; AND OTHER UTILITY AND HISTORICAL DRAWINGS.
2. CONTRACTOR SHALL RETAIN AN UNDERGROUND PROTECTION FACILITIES ORGANIZATION FOR UTILITY MARKOUT, IN ACCORDANCE WITH SPECIFICATION SECTION 01056 – PROTECTION OF THE WORK AND PROPERTY.
3. THE CONTRACTOR SHALL LOCATE, MARKOUT AND MAP ALL SUBSURFACE UTILITIES IN ACCORDANCE WITH THE LEVEL A SUBSURFACE UTILITY ENGINEERING PROCESS AS DEFINED BY CI/ASCE 38-02.
4. ANY EXISTING STRUCTURAL SUPPORT OF UTILITIES NOT KNOWN.
5. EXISTING PIPING THAT CROSSES THE PROPOSED LIMITS OF EXCAVATION AREA OR TRENCHES SHALL BE SEALED ON THE EXTERIOR SIDE OF THE EXCAVATION AREA OR TRENCH. SEE SPECIFICATION SECTION 02220 – DEMOLITION.

30' 0 30'
SCALE IN FEET

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REVISIONS

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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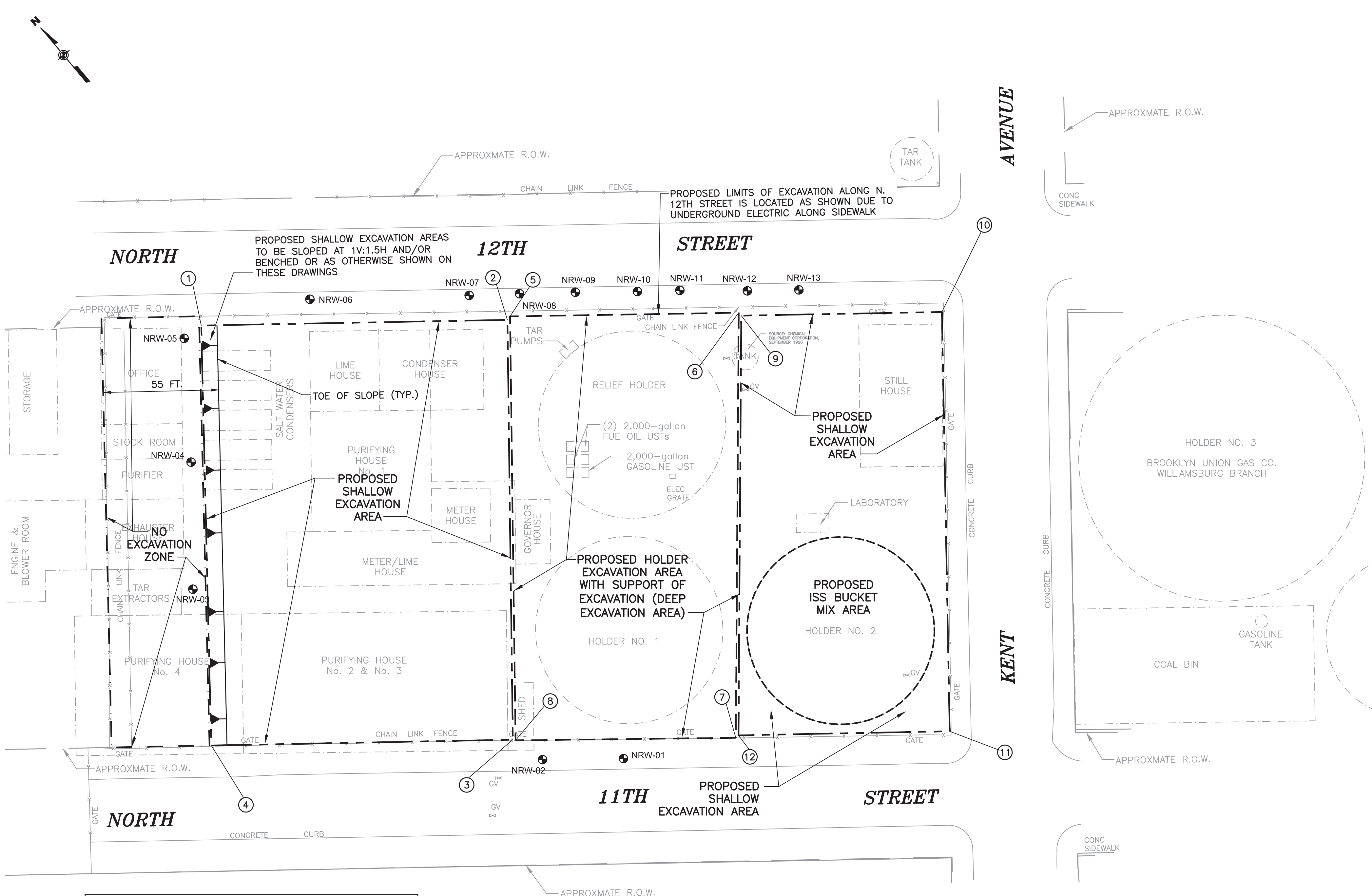
HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK

EXISTING SITE UTILITIES

Scale: AS SHOWN | Date: JUNE 2015 | DWG-4



EXCAVATION LAYOUT COORDINATE TABLE			
I.D.	DESCRIPTION	NORTHING	EASTING
1	N.E. COR. SHALLOW EXCAVATION	688,994.61	641,820.72
2	S.E. COR. SHALLOW EXCAVATION	688,902.02	641,935.25
3	S.W. COR. SHALLOW EXCAVATION	688,746.99	641,808.57
4	N.W. COR. SHALLOW EXCAVATION	688,838.11	641,695.63
5	N.E. COR. DEEP EXCAVATION	688,903.29	641,936.29
6	S.E. COR. DEEP EXCAVATION	688,834.55	642,020.94
7	S.W. COR. DEEP EXCAVATION	688,680.14	641,889.59
8	N.W. COR. DEEP EXCAVATION	688,746.72	641,808.35
9	N.E. COR. SHALLOW EXCAVATION	688,833.47	642,020.03
10	S.E. COR. SHALLOW EXCAVATION	688,772.54	642,095.40
11	S.W. COR. SHALLOW EXCAVATION	688,616.99	641,969.70
12	N.W. COR. SHALLOW EXCAVATION	688,681.02	641,890.33

LEGEND

- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE
- PROPOSED DEEP (HOLDER) EXCAVATION AREA
- PROPOSED SHALLOW EXCAVATION AREA
- PROPOSED IN-SITU SOLIDIFICATION (ISS) BUCKET MIXING AREA
- BUFFER ZONE (NO EXCAVATION PERMITTED)
- AREAS TO BE SLOPED AND/OR BENCHED
- NRW-13 EXISTING RECOVERY WELL LOCATION

SUGGESTED GENERAL CONSTRUCTION SEQUENCE (SEE NOTE 1, THIS SHEET)

1. CONTRACTOR MOBILIZATION:
   a. ESTABLISHMENT OF SUPPORT AREAS (E.G., FIELD OFFICE TRAILERS, MATERIAL STAGING AND EQUIPMENT LAYDOWN AREAS).
   b. INSTALLATION OF TEMPORARY CONSTRUCTION FENCES, TRAFFIC CONTROL MEASURES, AND EROSION/SEDIMENT CONTROL MEASURES ON THE SITE.
   c. INSTALLATION OF WATER PRETREATMENT SYSTEM.
   d. ERECTION OF CONTAMINATED SOILS STAGING TCB (SEE DWG-6 FOR LOCATION).
2. DECOMMISSIONING OF MONITORING WELLS AND PIEZOMETERS.
3. INITIATION OF INSTALLATION OF SOE WALL AND SHEET PILE EXCAVATION SUPPORT SYSTEM.
4. HOLDER NO. 2 AREA:
   a. ERECTION OF THE LARGE TCB OVER HOLDER NO. 2 AREA, INCLUDING VMS SET-UP.
   b. EXCAVATION AND IN-SITU SOLIDIFICATION VIA BUCKET MIXING WITHIN HOLDER NO. 2 AND DEWATER AS REQUIRED/SPECIFIED. STOCKPILE SOILS EXCAVATED PRIOR TO ISS.
   c. REPLACE STOCKPILED SOIL AS TEMPORARY BACKFILL OVER SOLIDIFIED HOLDER NO. 2.
5. DEEP EXCAVATION PREPARATION:
   a. COMPLETION OF INSTALLATION OF SOE WALL AND SHEET PILE EXCAVATION SUPPORT SYSTEM.
   b. OFF-SITE DISPOSAL OF MATERIAL FROM CONSTRUCTION OF SOE WALL.
   c. MOVEMENT AND EXTENSION OF THE LARGE TCB OVER THE DEEP EXCAVATION AREA.
6. INSTALLATION OF DEWATERING SYSTEM FOR THE DEEP EXCAVATION AREA.
7. DEEP EXCAVATION:
   a. EXCAVATION AND DISPOSAL OF SOILS AND FORMER STRUCTURES FROM THE DEEP EXCAVATION AREA, INCLUDING THE HOLDER NO. 1 AND THE RELIEF HOLDER FOOTPRINTS AND DISPOSE OFF-SITE.
   b. AS EXCAVATION PROGRESSES, DEWATER AND INSTALL TIE BACK ANCHORS OR INTERNAL BRACING. REFER TO DWG-10 OR DWG-14 FOR RECOMMENDED CONSTRUCTION PROCEDURE FOR INSTALLING THE TIE BACK AND RAKER ALTERNATIVE OR THE INTERNAL BRACING ALTERNATIVE, RESPECTIVELY.
   c. UPON COMPLETION OF DEEP EXCAVATION, INITIATION OF BACKFILLING USING ALL STOCKPILED SOIL SUITABLE FOR REUSE FOLLOWED BY IMPORTED FILL TO AN ELEVATION NO MORE THAN 17 FEET BELOW THE TOP OF THE PROPOSED FINAL RESTORATION GRADE.
   d. REMOVAL OF THE LARGE TCB FROM THE DEEP EXCAVATION AREA.
8. SHALLOW EXCAVATION:
   a. SHALLOW EXCAVATION OF REMAINING AREAS OF THE SITE, EXCLUDING 55-FOOT STRIP OF NO EXCAVATION ON THE WEST SIDE OF THE SITE. SOIL UNSUITABLE FOR REUSE SENT OFF-SITE FOR DISPOSAL, AND REMAINING SOIL STOCKPILED ON-SITE FOR REUSE AS BACKFILL OR USED DIRECTLY AS BACKFILL IN THE DEEP EXCAVATION AREA. UPPER PORTIONS OF THE SOE WALL REMOVED.
9. FINAL BACKFILL AND DEMOBILIZATION:
   a. COMPLETION OF BACKFILLING OF DEEP EXCAVATION AREA WITH ON-SITE DERIVED MATERIAL.
   b. BACKFILLING SHALLOW EXCAVATED AREAS AND THE TOP FIVE FEET OF THE DEEP EXCAVATION AREA WITH IMPORTED FILL MEETING RESTRICTED RESIDENTIAL STANDARDS.
   c. DEMOBILIZATION OF THE DEWATERING AND WATER PRETREATMENT SYSTEMS.
   d. TOPSOIL PLACEMENT AND SEEDING.
   e. INSTALL FENCE AND GATES.
   f. REMOVE EROSION/SEDIMENT CONTROLS AND COMMUNITY AIR MONITORING SYSTEM.

NOTES:

1. ACTUAL CONSTRUCTION SEQUENCING AND SCHEDULING SHALL REQUIRE NATIONAL GRID APPROVAL AND BE COORDINATED WITH TIME ALLOWANCES REQUIRED BY ALL UTILITIES FOR THEIR REQUIRED PROTECTION MEASURES, NOTIFICATIONS, REVIEW AND APPROVALS. THE SEQUENCE SHOWN ON THIS DRAWING DOES NOT DEMONSTRATE ALL OF THE REQUIREMENTS TO PERFORM THE WORK. THE SEQUENCE SHOWN ON THIS DRAWING MAY BE MODIFIED BY THE CONTRACTOR, SUBJECT TO PRIOR APPROVAL BY THE CONSTRUCTION MANAGER.
2. FOR EXCAVATION REQUIREMENTS, INCLUDING DUST AND ODOR CONTROL, DURING EXCAVATIONS, REFER TO SPECIFICATION SECTION 02230. REFER TO SPECIFICATION SECTION 01056 FOR NOISE/VIBRATION REQUIREMENTS DURING EXCAVATIONS.
3. FOR EXAMPLE LAYOUT OF TEMPORARY FACILITIES, REFER TO DWG-6.

30' 0 30'
SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION
1	AJZ	JAS	7/20/15	REVISED COORDINATES & DRAWN LIMITS OF SHALLOW EXCAVATION

REVISIONS

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DRAWN BY: EB
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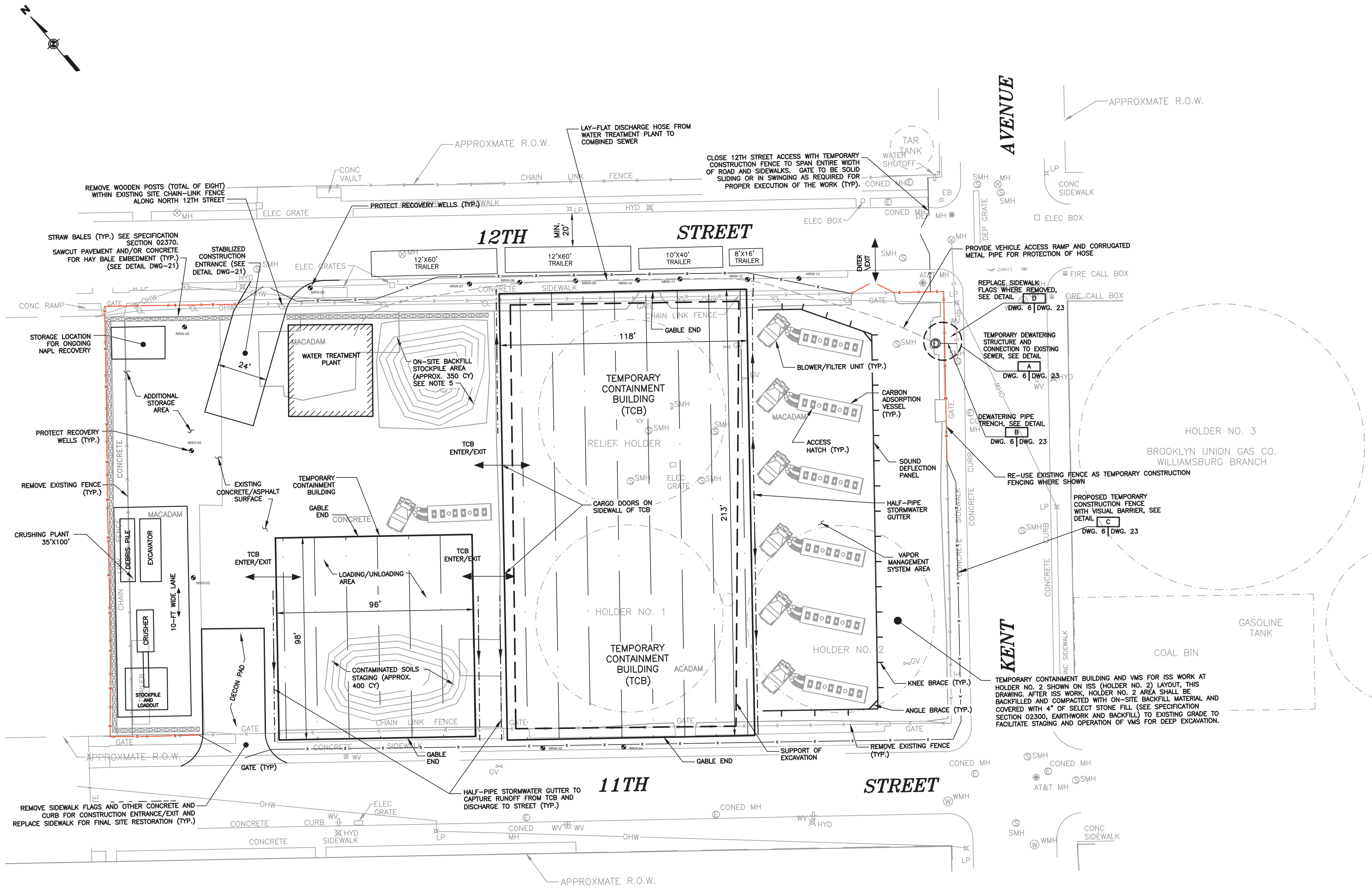
HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK

PLANNED IRM ACTIVITIES

Scale: AS SHOWN | Date: JUNE 2015 | DWG–5

LEGEND

- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE
- NRW-13 EXISTING RECOVERY WELL LOCATION
- PROPOSED TEMPORARY FENCE WITH VISUAL BARRIER
- EXISTING FENCE AS TEMPORARY FENCE WITH VISUAL BARRIER
- PROPOSED TEMPORARY DEWATERING STRUCTURE
- PROPOSED DEEP (HOLDER) EXCAVATION AREA
- STRAW BALES

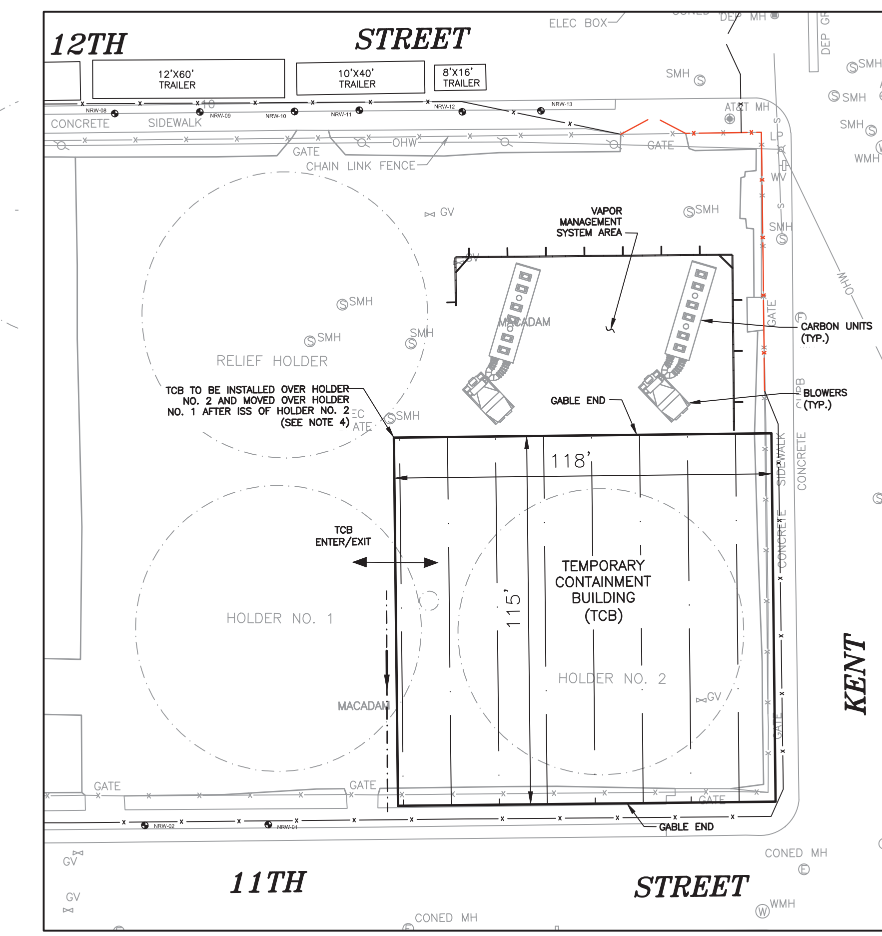


DEEP (HOLDER) EXCAVATION LAYOUT

30' 0 30'
SCALE IN FEET

NOTES:

1. EXISTING TOPOGRAPHY WAS OBTAINED FROM DRAWING DATED AUGUST 2013, PREPARED BY YEC, INC., ENTITLED "WILLIAMSBURG WORKS FORMER MGP SITE."
2. AREA INSIDE THE TEMPORARY CONTAINMENT BUILDING(S) CAN BE USED AS TEMPORARY STOCKPILE AREAS DEPENDANT ON EXCAVATION SEQUENCING AND AS APPROVED BY CONSTRUCTION MANAGER.
3. THE CURRENT PROPOSED SUPPORT OF EXCAVATION HAS BEEN DETERMINED CAPABLE OF WITHSTANDING SURCHARGES FROM THE LAYOUT AS SHOWN. IF THE CONTRACTOR PROPOSES AN ALTERNATE FACILITIES LAYOUT, THE CONTRACTOR SHALL SUBMIT TO ENGINEER A DESCRIPTION AND DRAWING OF THE PROPOSED ALTERNATE FACILITIES LAYOUT FOR DETERMINATION OF SUPPORT OF EXCAVATION COMPATIBILITY WITH THE SURCHARGE FROM THAT ALTERNATE FACILITIES LAYOUT.
4. TEMPORARY CONTAINMENT BUILDING TO BE INSTALLED OVER HOLDER NO. 2 FOR IN-SITU SOLIDIFICATION ACTIVITIES. TEMPORARY CONTAINMENT BUILDING TO BE MOVED ONE TIME TO HOLDER NO. 1 AFTER COMPLETION OF ISS WORK AND AN EXTENSION OF THE TCB OVER RELIEF HOLDER TO BE CONSTRUCTED.
5. AREA DESIGNATED AS "ON-SITE BACKFILL STOCKPILE AREA" SHALL BE STRIPPED OF EXISTING CONCRETE AND ASPHALT TO ONE FOOT BELOW EXISTING GRADE. AREA SHALL BE GRADED TO PROMOTE ON-SITE STORM WATER DRAINAGE TO A SUMP FOR PUMPING TO THE WATER TREATMENT SYSTEM. PRECIPITATION THAT ACCUMULATES DURING LARGE STORM EVENTS BEYOND THE CAPACITY OF THE WATER PRE-TREATMENT PLANT SHALL BE ALLOWED TO OVERFLOW INTO THE DEEP EXCAVATION. CONTRACTOR SHALL PROVIDE A BERM AROUND THE STOCKPILE TO THE EXTENT NECESSARY TO DIRECT WATER FROM LARGE STORM EVENTS TO THE DEEP EXCAVATION ONLY.



ISS (HOLDER NO.2) LAYOUT

30' 0 30'
SCALE IN FEET

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REVISIONS

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BROOKLYN, KINGS COUNTY, NEW YORK

EXAMPLE TEMPORARY FACILITIES LAYOUT

Scale: AS SHOWN | Date: JUNE 2015 | DWG-6

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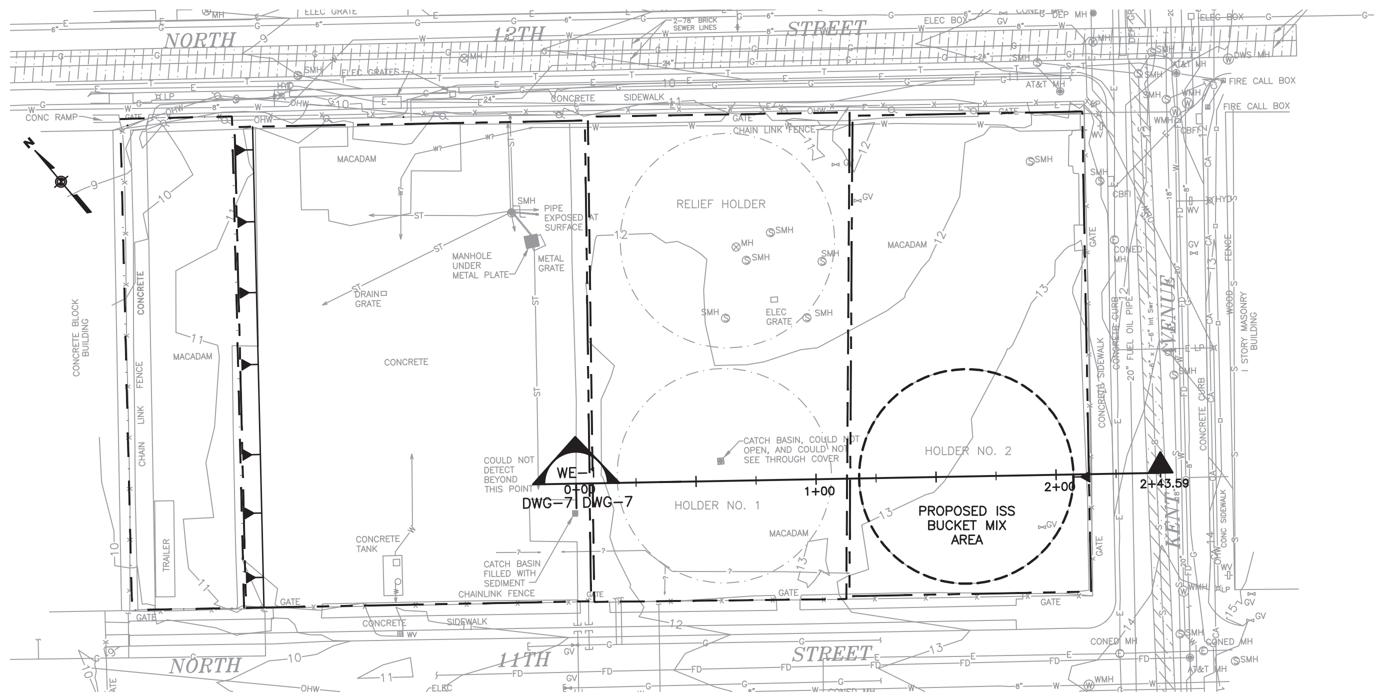


PLAN

40' 0 40'

SCALE IN FEET

LEGEND

NW	NORTHWEST
NE	NORTHEAST
SW	SOUTHWEST
SE	SOUTHEAST

PROPOSED DEEP (HOLDER) EXCAVATION AREA

PROPOSED SHALLOW EXCAVATION AREA

PROPOSED BUFFER ZONE

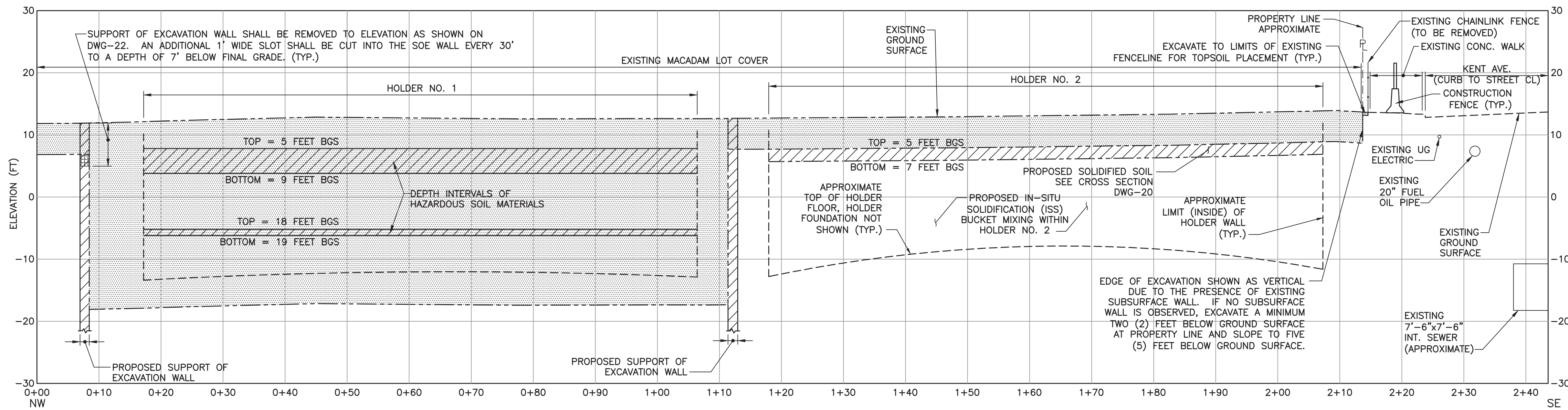
APPROXIMATE LIMITS (INSIDE) OF HOLDER WALLS AND FOUNDATION

PROPOSED IN-SITU SOLIDIFICATION (ISS) BUCKET MIXING AREA

PROPOSED LIMITS OF EXCAVATION (SECTION VIEW ONLY)

NOTES:

1. THE TYPES, LOCATIONS, SIZES AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THESE DRAWINGS WERE OBTAINED FROM VARIOUS SOURCES AND SHALL BE CONSIDERED THE BEST AVAILABLE INFORMATION WITH COMPLETENESS AND ACCURACY UNKNOWN. THE CONTRACTOR IS CAUTIONED THAT ONLY EXCAVATION WILL REVEAL THE ACTUAL TYPES, EXTENT, SIZES, LOCATIONS, AND DEPTHS OF SUCH UNDERGROUND UTILITIES. OTHER BURIED OBJECTS OR UTILITIES MAY BE ENCOUNTERED BUT WHICH ARE NOT SHOWN ON THESE DRAWINGS.
2. SHALLOW EXCAVATION DEPTH SHOWN AS FIVE (5) FEET. IF GROUNDWATER ENCOUNTERED ABOVE 5-FOOT DEPTH, TERMINATE EXCAVATION AT GROUNDWATER DEPTH.
3. SHALLOW EXCAVATION TO EXTEND TO SEVEN (7) FEET IN HOLDER NO. 2 TO FACILITATE ISS. DEWATERING MAY BE REQUIRED.
4. HAZARDOUS MATERIALS AT THE ELEVATIONS SHOWN SHALL BE SEGREGATED AND MANAGED IN ACCORDANCE WITH SPECIFICATION SECTION 02110 – WASTE MANAGEMENT AND HANDLING OF CONTAMINATED MATERIAL.
5. MECHANICAL EXCAVATION SHALL NOT BE PERFORMED WITHIN TOLERANCE ZONES OF ACTIVE UTILITIES AS DEFINED BY OSHA AND THE UTILITY OWNER AND/OR MARKED OUT DURING THE UTILITY SURVEY. CONTRACTOR SHALL USE ONLY THOSE EXCAVATION TECHNIQUES (HAND EXCAVATION AND VACUUM) ALLOWED BY THE UTILITY WITHIN THE TOLERANCE ZONE.



SECTION WE-1 DWG-7 | DWG-7

10' 0 10'

SCALE IN FEET HORIZ. & VERT.

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1	AJZ	JAS	7/20/15	REVISED LIMITS OF SHALLOW EXCAVATION

REVISIONS

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CHECKED BY: MG
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CROSS SECTIONS
(SHEET 1 OF 3)

Scale: AS SHOWN
Date: JUNE 2015

DWG-7

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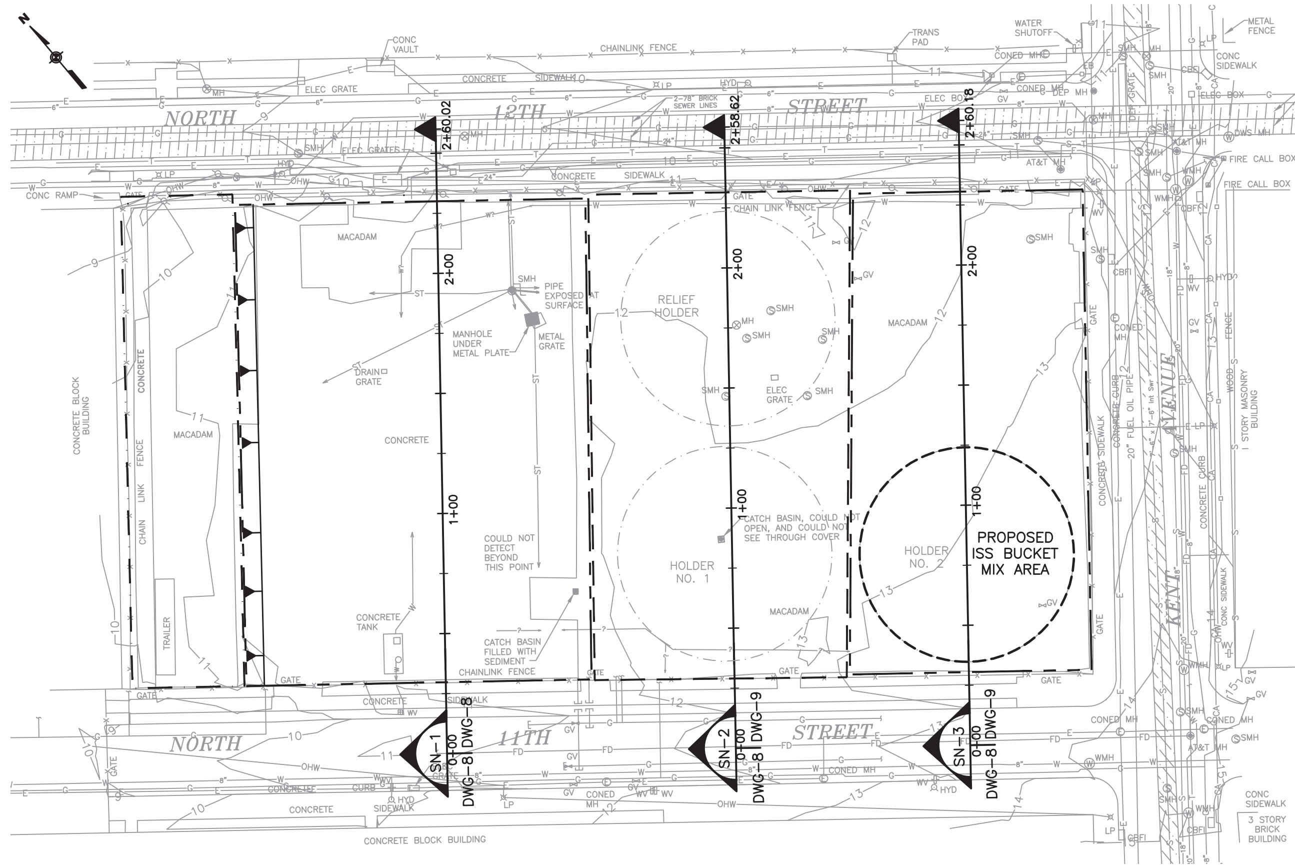


PLAN

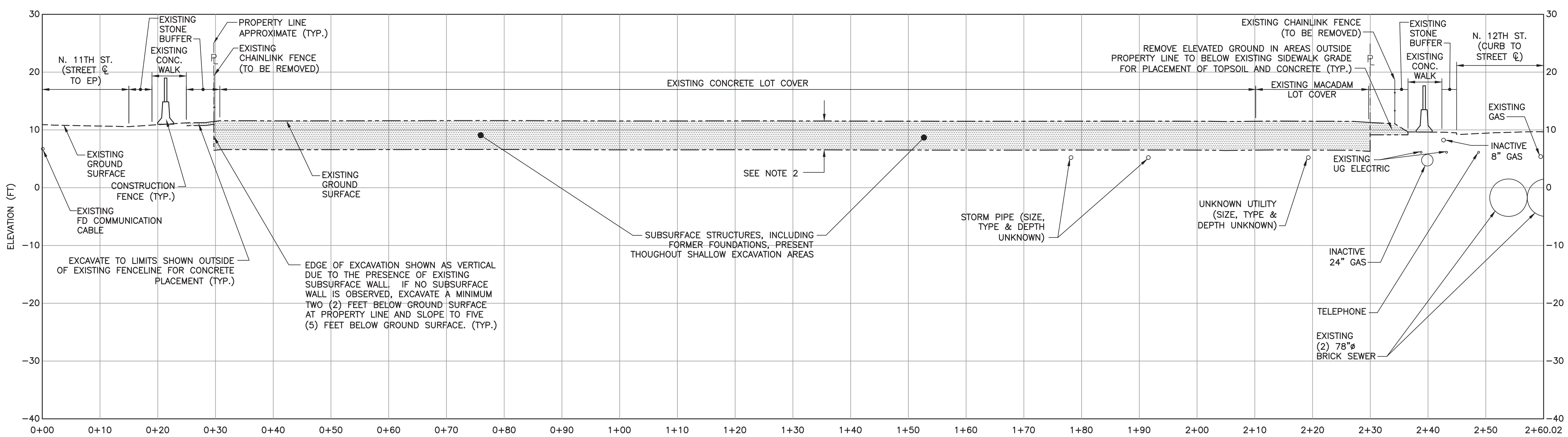
40' 0 40'
SCALE IN FEET

LEGEND

NW	NORTHWEST
NE	NORTHEAST
SW	SOUTHWEST
SE	SOUTHEAST
— — — — —	PROPOSED DEEP (HOLDER) EXCAVATION AREA
——— – – ———	PROPOSED SHALLOW EXCAVATION AREA
– · — · — ·	PROPOSED BUFFER ZONE
– – – – – –	APPROXIMATE LIMITS (INSIDE) OF HOLDER WALLS AND FOUNDATION
– – – – – –	PROPOSED IN-SITU SOLIDIFICATION (ISS) BUCKET MIXING AREA
(shaded)	PROPOSED LIMITS OF EXCAVATION (SECTION VIEW ONLY)

NOTES:

1. THE TYPES, LOCATIONS, SIZES AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THESE DRAWINGS WERE OBTAINED FROM VARIOUS SOURCES AND SHALL BE CONSIDERED THE BEST AVAILABLE INFORMATION WITH COMPLETENESS AND ACCURACY UNKNOWN. THE CONTRACTOR IS CAUTIONED THAT ONLY EXCAVATION WILL REVEAL THE ACTUAL TYPES, EXTENT, SIZES, LOCATIONS, AND DEPTHS OF SUCH UNDERGROUND UTILITIES. OTHER BURIED OBJECTS OR UTILITIES MAY BE ENCOUNTERED BUT WHICH ARE NOT SHOWN ON THESE DRAWINGS.
2. SHALLOW EXCAVATION DEPTH SHOWN AS FIVE (5) FEET. IF GROUNDWATER ENCOUNTERED ABOVE 5-FOOT DEPTH, TERMINATE EXCAVATION AT GROUNDWATER DEPTH.
3. SHALLOW EXCAVATION TO EXTEND TO SEVEN (7) FEET IN HOLDER NO. 2 TO FACILITATE ISS. DEWATERING MAY BE REQUIRED.
4. MECHANICAL EXCAVATION SHALL NOT BE PERFORMED WITHIN TOLERANCE ZONES OF ACTIVE UTILITIES AS DEFINED BY OSHA AND THE UTILITY OWNER AND/OR MARKED OUT DURING THE UTILITY SURVEY. CONTRACTOR SHALL USE ONLY THOSE EXCAVATION TECHNIQUES (HAND EXCAVATION AND VACUUM) ALLOWED BY THE UTILITY WITHIN THE TOLERANCE ZONE.



SECTION SN-1 DWG-8 | DWG-8

10' 0 10'
SCALE IN FEET
HORIZ. & VERT.

J:\Projects\11176638\CAD\RDWP 2013\DWG-8.dwg 7/17/15-ELB

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REVISIONS

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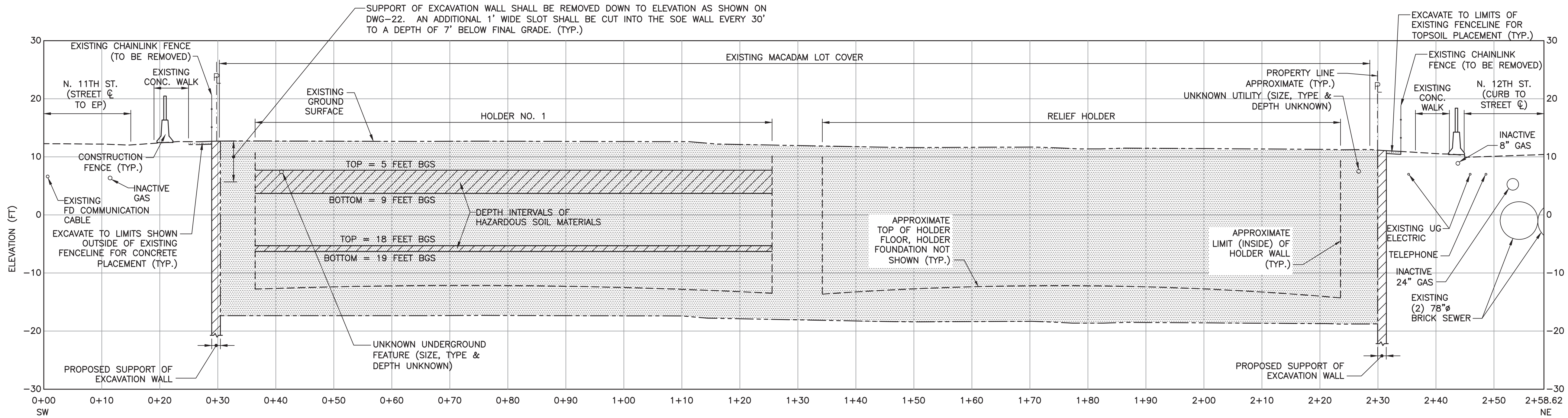
CROSS SECTIONS
(SHEET 2 OF 3)

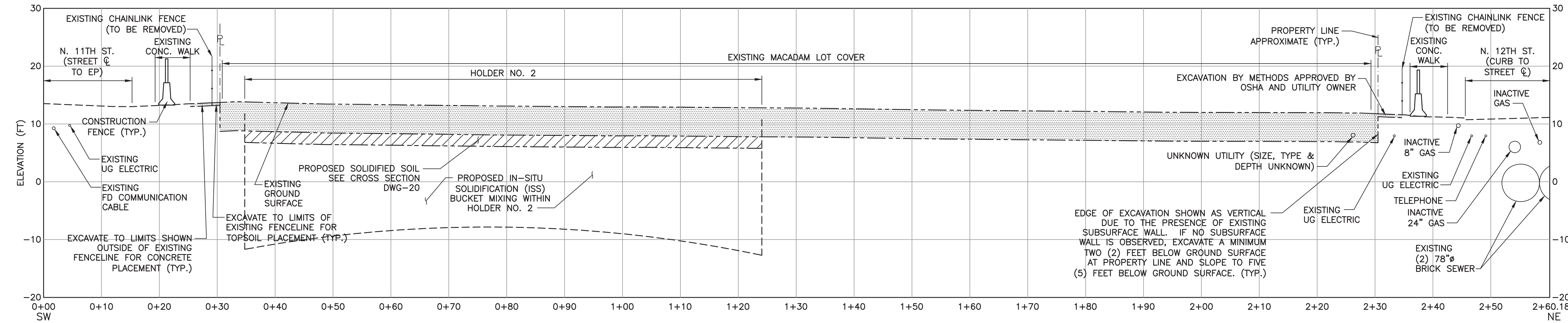
Scale: AS SHOWN | Date: JUNE 2015 | DWG-8



SECTION SN-2 DWG-8 | DWG-9

10' 0 10'

SCALE IN FEET
HORIZ. & VERT.



SECTION SN-3 DWG-8 | DWG-9

10' 0 10'

SCALE IN FEET
HORIZ. & VERT.

NOTES:

1. FOR LEGEND AND NOTES, REFER TO DWG-8.

j:\Projects\11176638\CAD\RDWP 2013\DWG-9.dwg 7/17/15-ELB

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION
1	AJZ	JAS	7/20/15	REVISED LIMITS OF SHALLOW EXCAVATION

REVISIONS

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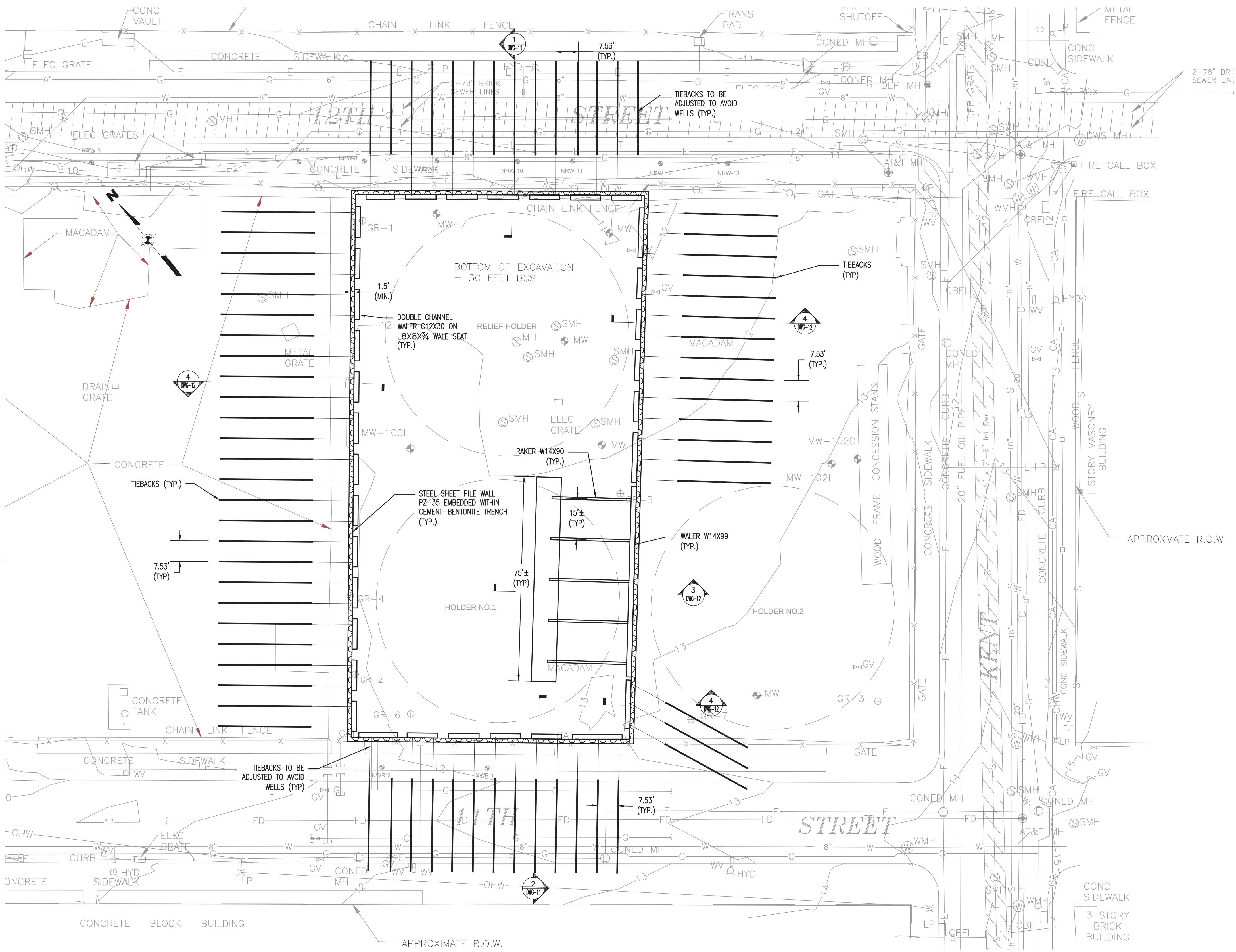
CROSS SECTIONS
(SHEET 3 OF 3)

Scale: AS SHOWN | Date: JUNE 2015 | DWG-9



PLAN
SCALE: 1"=20'

20' 0 20'
SCALE IN FEET

GENERAL NOTES:

1. EXISTING TOPOGRAPHY WAS OBTAINED FROM DRAWING DATED APRIL 30, 2013 AND JUNE 5, 2013, PREPARED BY YEC, INC., ENTITLED "WILLIAMSBURG WORKS FORMER MGP SITE."
2. ALL WORK TO BE PERFORMED IN ACCORDANCE WITH REQUIREMENTS OF NEW YORK CITY BUILDING CODE. CONTRACTOR SHALL GIVE REQUIRED NOTICE TO THE NEW YORK CITY DEPARTMENT OF BUILDINGS 24 TO 48 HOURS PRIOR TO COMMENCEMENT OF WORK.
3. COORDINATE THESE PLANS WITH OTHER DRAWINGS FOR THE PROPOSED EXCAVATION.
4. ALL ELEVATIONS SHOWN REFER TO NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88).
5. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS.
6. CONTRACTOR SHALL VERIFY THE PRESENCE OF EXISTING STRUCTURES, UTILITIES AND COORDINATE ALL DIMENSIONS AND CHECK FOR CLEARANCES PRIOR TO START OF WORK.
7. CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS.
8. CONTRACTOR SHALL BE RESPONSIBLE FOR SITE SAFETY AND PROVIDE A SAFETY PLAN CONFORMING TO OSHA STANDARDS.
9. SUPPORT OF EXCAVATION, INCLUDING SHEETING, SHORING AND BRACING, ARE SUBJECT TO SPECIAL INSPECTION AS PER THE NEW YORK CITY BUILDING CODE.
10. A 250 PSF UNIFORM VERTICAL SURCHARGE HAS BEEN ASSUMED. IF CONTRACTOR PLANS TO EXCEED THIS SURCHARGE, CONTRACTOR SHALL PROVIDE PROPOSED SURCHARGE VALUE SO THAT THE DESIGN CAN BE MODIFIED, AS NECESSARY.
11. WELDING SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE AMERICAN SOCIETY FOR WELDING IN BUILDING CONSTRUCTION AWS D1.1-88. WELDING ELECTRODES TO BE E7018.

SUPPORT OF EXCAVATION SYSTEM RECOMMENDED CONSTRUCTION PROCEDURE:

1. EXCAVATE TO TWO FEET BELOW THE ELEVATION OF THE UPPER LEVEL TIEBACKS.
2. INSTALL UPPER LEVEL TIEBACKS AND PERFORM TIEBACK LOAD TESTING.
3. MAINTAIN TEMPORARY EARTHEN BERM AS EXCAVATION PROCEEDS AT RAKER LOCATION.
4. CONSTRUCT CONCRETE FOOTBLOCK AND INSTALL UPPER LEVEL RAKERS.
5. EXCAVATE TO TWO FEET BELOW THE ELEVATION OF THE LOWER LEVEL TIEBACKS.
6. INSTALL LOWER LEVEL TIEBACKS AND PERFORM TIEBACK LOAD TESTING.
7. ALONG THE RAKER AREA, EXCAVATE THE TEMPORARY EARTHEN BERM TO EL.-11 FT.
8. INSTALL LOWER LEVEL RAKERS.
9. COMPLETE EXCAVATION.

LEGEND

STEEL SHEET PILES INSIDE CEMENT-BENTONITE WALL

1 DWG-11 CROSS-SECTION

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SUPPORT OF EXCAVATION PLAN AND NOTES - TIEBACK ALTERNATIVE

Scale: AS SHOWN
Date: JUNE 2015
DWG-10

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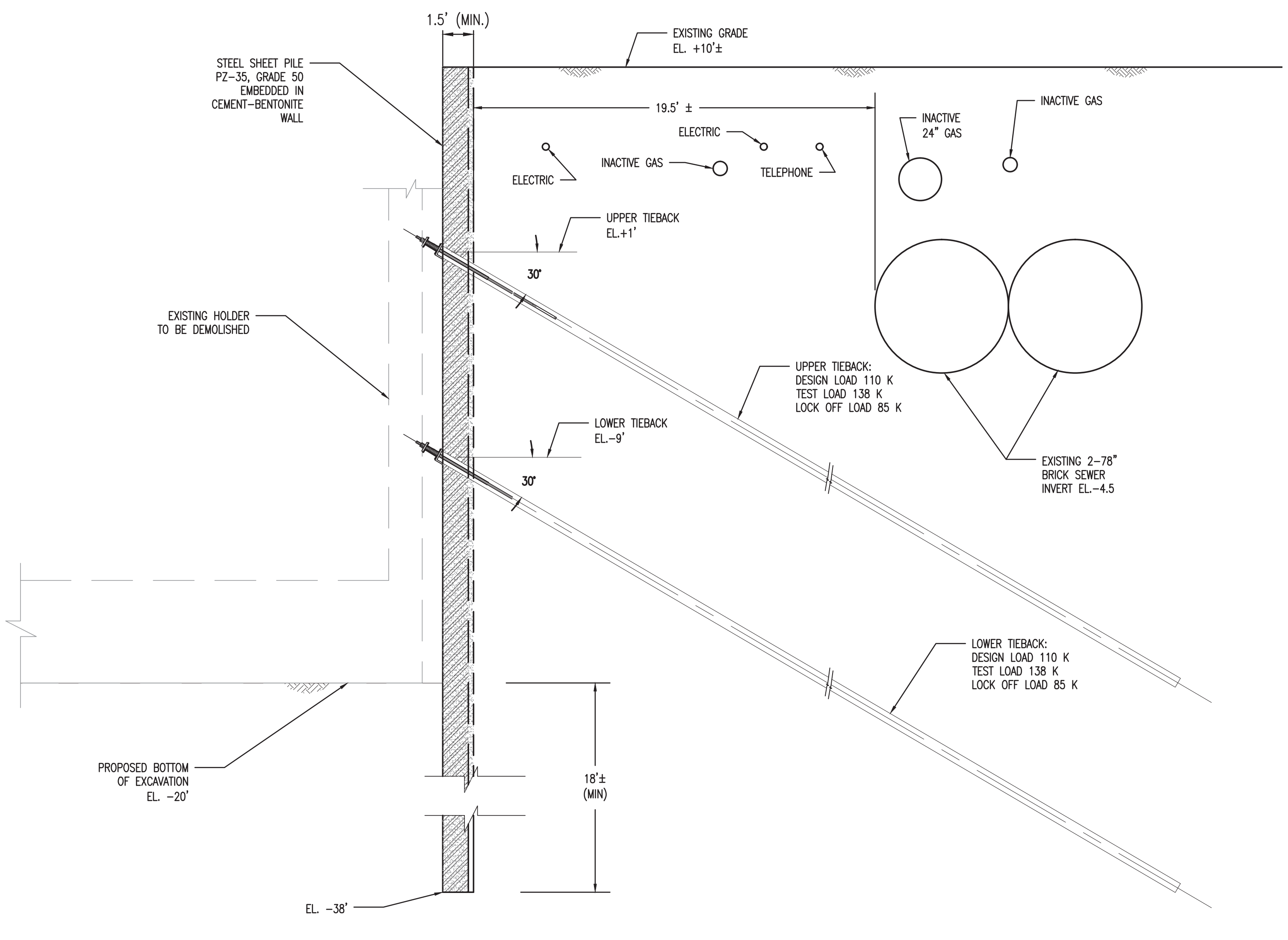
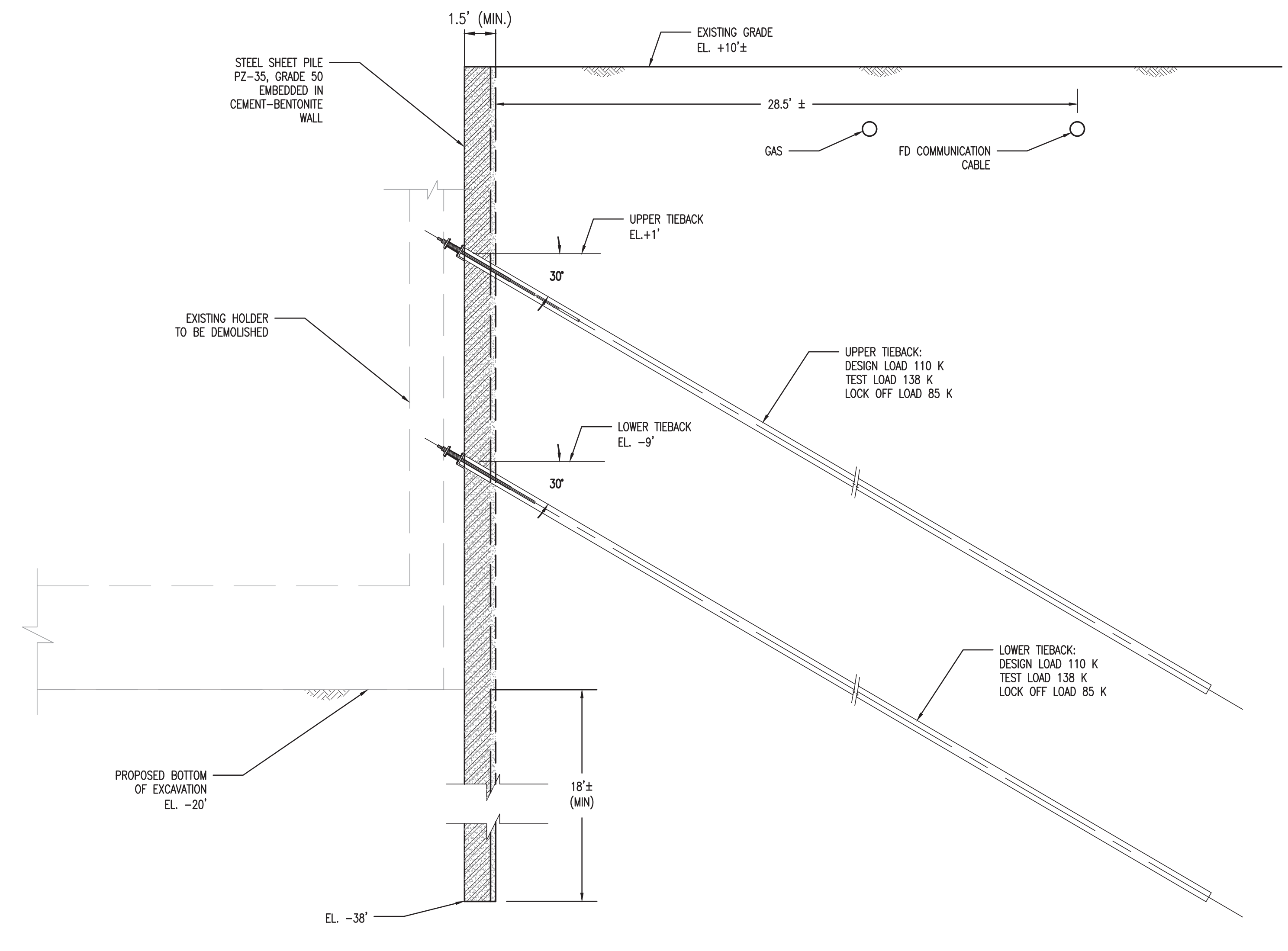


1 DWG-11 SECTION ALONG 12TH STREET

SCALE: 1" = 4'



2 DWG-11 SECTION ALONG 11TH STREET

SCALE: 1" = 4'

NOTES:

1. THE TYPES, LOCATIONS, SIZES AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THESE DRAWINGS WERE OBTAINED FROM VARIOUS SOURCES AND SHALL BE CONSIDERED THE BEST AVAILABLE INFORMATION WITH COMPLETENESS AND ACCURACY UNKNOWN. THE CONTRACTOR IS CAUTIONED THAT ONLY EXCAVATION WILL REVEAL THE ACTUAL TYPES, EXTENT, SIZES, LOCATIONS, AND DEPTHS OF SUCH UNDERGROUND UTILITIES. OTHER BURIED OBJECTS OR UTILITIES MAY BE ENCOUNTERED BUT WHICH ARE NOT SHOWN ON THESE DRAWINGS.
2. ANY EXISTING STRUCTURAL SUPPORT OF UTILITIES NOT KNOWN.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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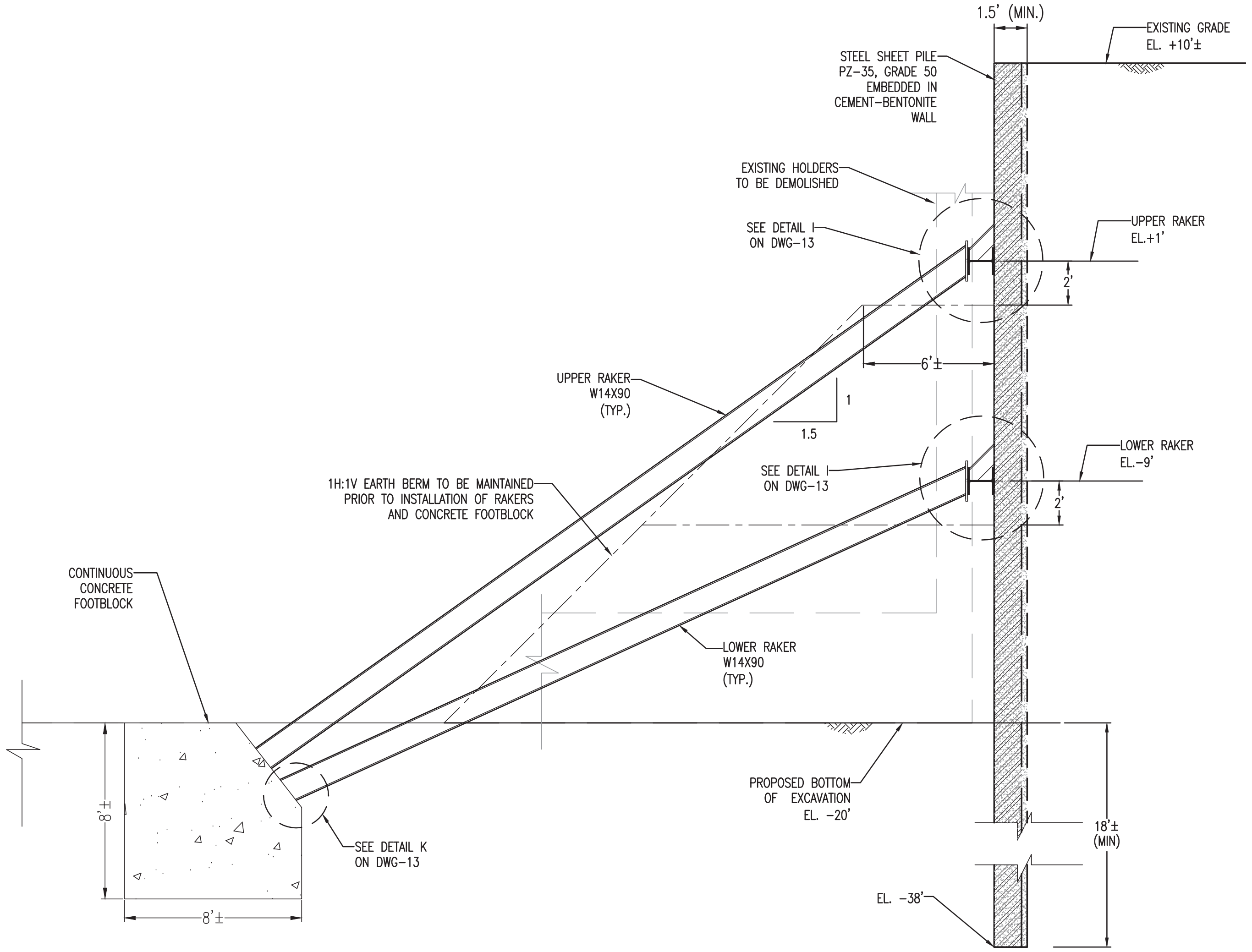
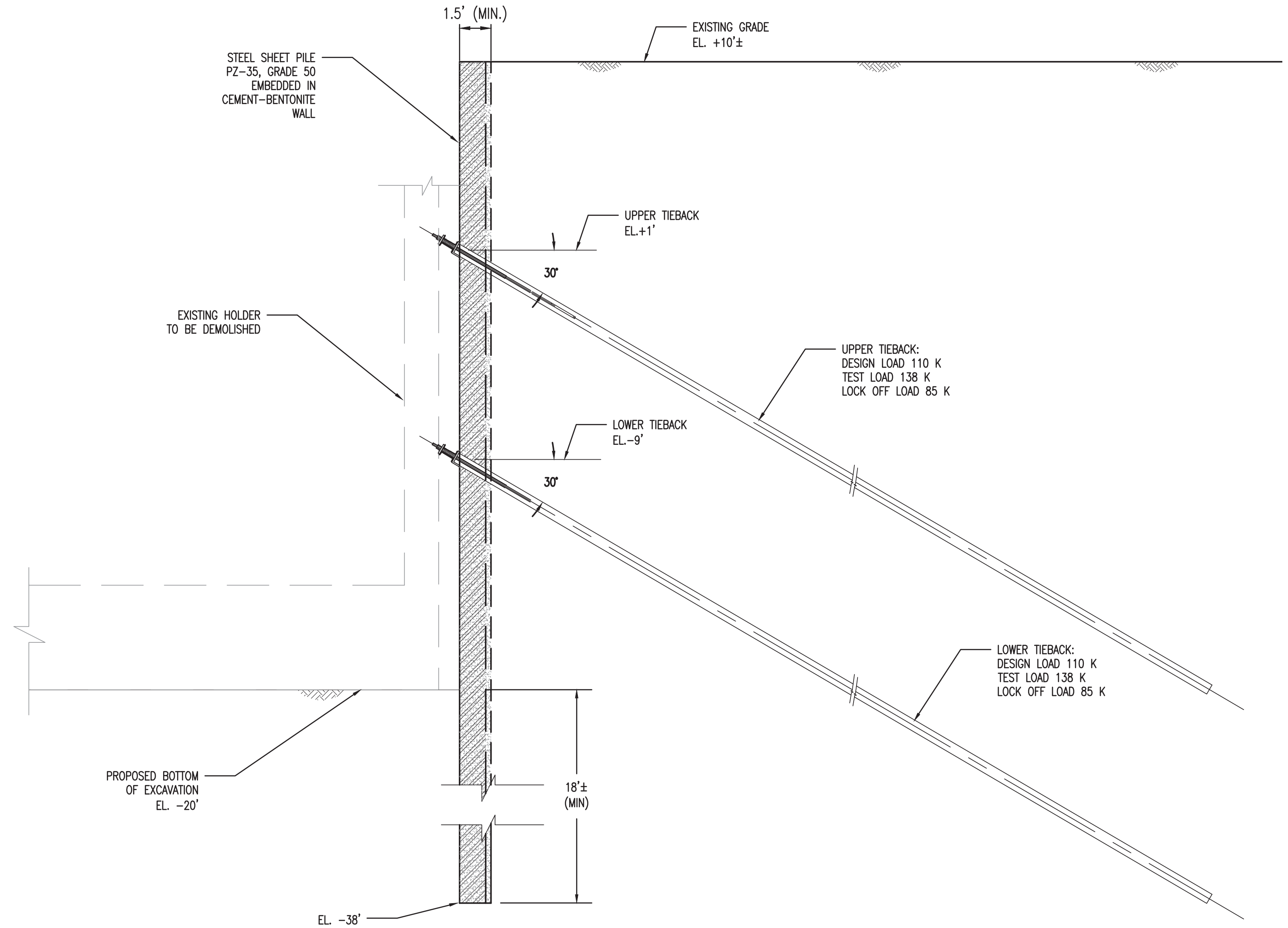
SUPPORT OF EXCAVATION
SECTIONS -
TIEBACK ALTERNATIVE

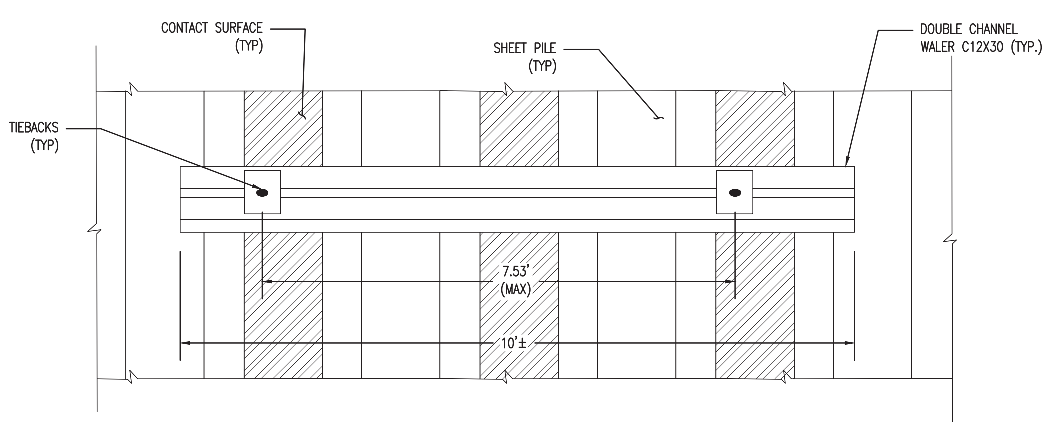
Scale: AS SHOWN | Date: JUNE 2015 | DWG-11



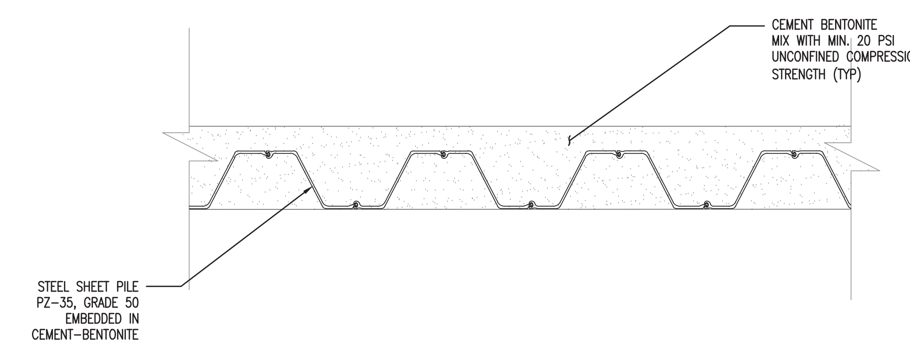
3
DWG-12
SECTION
SCALE: 1" = 4'



4
DWG-12
INTERIOR SECTIONS
SCALE: 1" = 4'



E
DWG-12
TYPICAL SHEET PILE AND TIEBACK
N.T.S.



F
DWG-12
SECTION
N.T.S.

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SUPPORT OF EXCAVATION
SECTIONS AND DETAILS -
TIEBACK ALTERNATIVE

Scale: AS SHOWN | Date: JUNE 2015 | DWG-12

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TIEBACK TESTING PROCEDURES:

1. TIEBACK ANCHORS SHALL BE INSTALLED BY ROTARY METHODS AND CONSIST OF A GROUTED ANCHOR ZONE, GROUTED FREE LENGTH (ANCHOR PREVENTED FROM BONDING WITH GROUT OR SOIL) AND AN ANCHOR HEAD ASSEMBLY. INSTALLATION PROCEDURES SHALL BE USED TO PREVENT THE LOSS OF OVERBURDEN MATERIALS DUE TO EROSION OR JETTING. TIEBACK ANCHORS SHALL CONTAIN SPACERS, WHICH WILL CENTRALLY LOCATE THE ANCHOR WITHIN THE DRILLED HOLE.

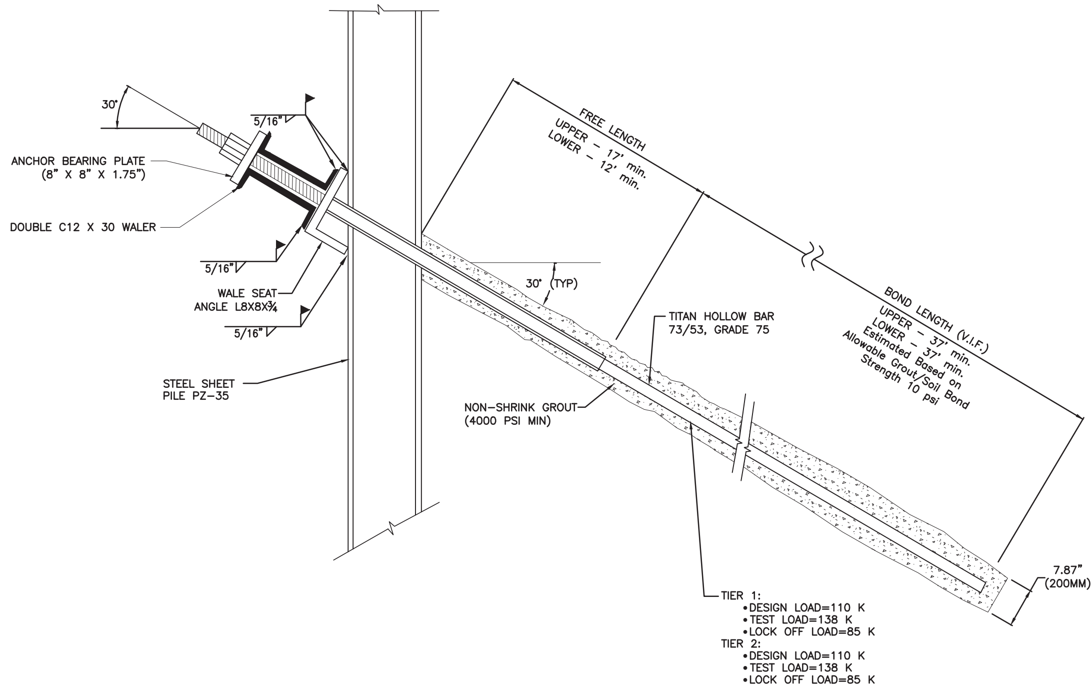
2. ALLOW ANCHORS TO CURE FOR A MINIMUM OF 72 HOURS BEFORE LOAD TESTING. GROUT SHALL CURE TO AT LEAST 3,000 PSI BEFORE TESTING.

3. PROOF TEST ALL TIEBACKS, PRIOR TO CONTINUING FURTHER EXCAVATIONS. PROOF TESTING SHALL CONSIST OF RECORDING MOVEMENTS FOR THE FOLLOWING LOAD INCREMENTS: 0.25DL, 0.50DL, 0.75DL, 1.00DL, AND 1.25DL. THE MAXIMUM LOAD WILL BE HELD FOR TEN MINUTES AND THE TOTAL MOVEMENT RECORDED. IF THE TOTAL MOVEMENT MEASURED BETWEEN ONE (1) MINUTE AND TEN (10) MINUTES EXCEEDS 0.04 INCHES, HOLD THE LOAD FOR AN ADDITIONAL 50 MINUTES AND TAKE MOVEMENT READINGS AT 15, 20, 30, 40, 50 AND 60 MINUTES. THE LOCK-OFF LOAD SHALL BE 75% OF THE DESIGN LOAD.

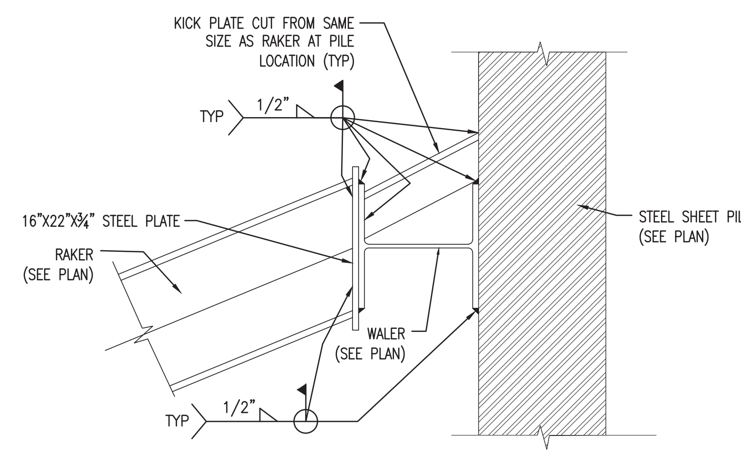
4. PROOF TEST ACCEPTANCE CRITERIA:

   A. A 10 MINUTE PROOF TEST SHALL BE ACCEPTABLE IF:
      - THE GROUND ANCHOR DEVELOPS MAXIMUM REQUIRED LOAD DURING TESTING.
      - THE GROUND ANCHOR RESISTS THE MAXIMUM TEST LOAD WITH LESS THAN 0.04 INCHES OF MOVEMENT BETWEEN ONE (1) MINUTE AND TEN (10) MINUTES.
      - TOTAL MOVEMENT AT THE MAXIMUM TEST LOAD EXCEEDS 80 PERCENT OF THE THEORETICAL ELASTIC ELONGATION OF THE UNBONDED LENGTH.

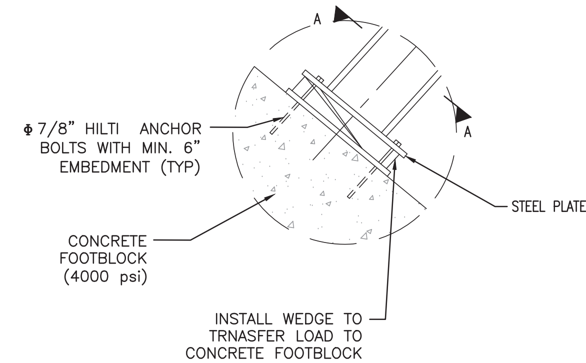
   B. A 60 MINUTE PROOF TEST SHALL BE ACCEPTABLE IF:
      - THE GROUND ANCHOR DEVELOPS MAXIMUM REQUIRED LOAD DURING TESTING.
      - GROUND ANCHOR RESISTS THE MAXIMUM TEST LOAD WITH A CREEP RATE THAT DOES NOT EXCEED 0.08 INCHES OF MOVEMENT BETWEEN ONE (1) MINUTE AND SIXTY (60) MINUTE.

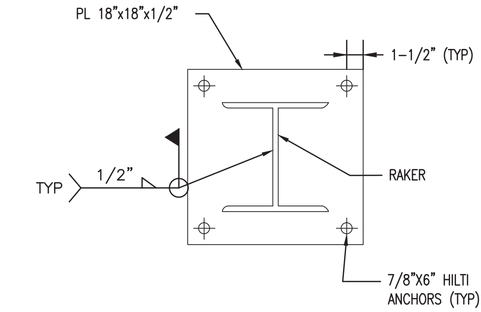


G DWG-13 TYPICAL TIEBACK DETAIL
N.T.S.



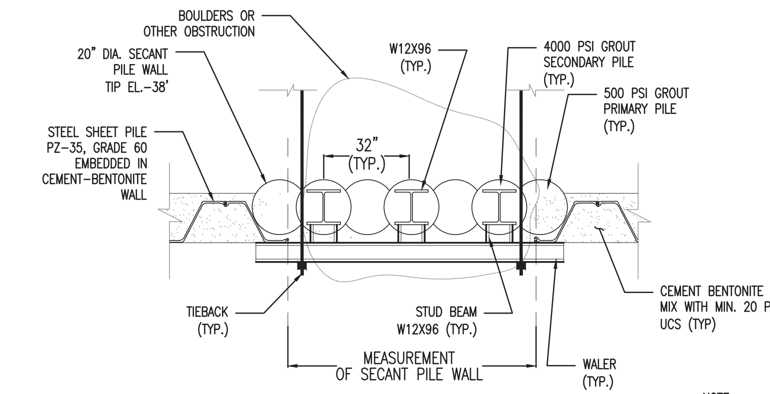
I DWG-13 SIDE VIEW OF RAKER-WALER CONNECTION DETAIL
N.T.S.





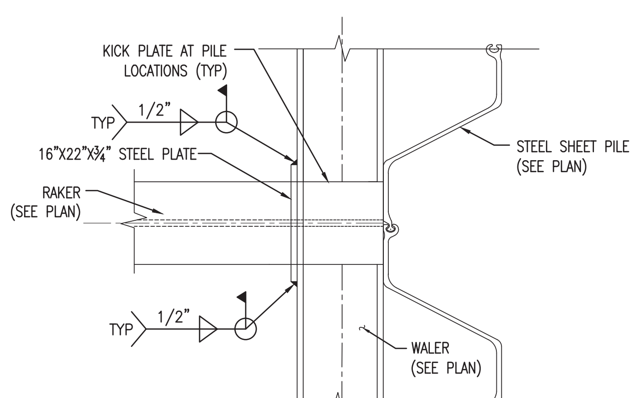
SECTION A–A

K DWG-13 TYPICAL RAKER TO FOOTBLOCK CONNECTION
N.T.S.

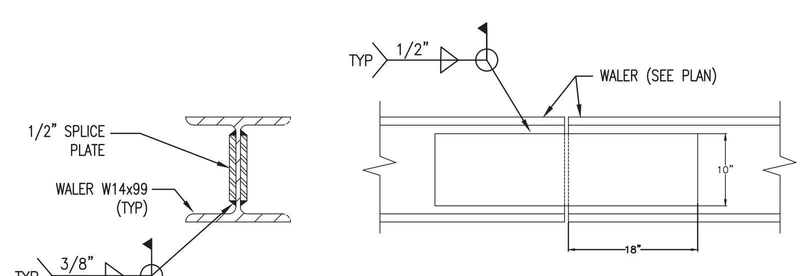


NOTE:
SEE SPECIFICATION SECTION 02260 FOR REQUIREMENTS OF ALTERNATE DESIGN.

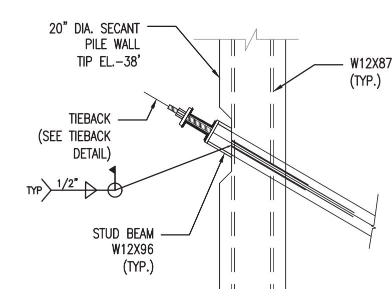
L DWG-13 OBSTRUCTION LOCATION DETAIL
N.T.S.



H DWG-13 TOP VIEW OF RAKER WALER–CONNECTION
N.T.S.



J DWG-13 WALER SPLICE DETAIL
N.T.S.



M DWG-13 SECANT PILE WALL SECTION
N.T.S.

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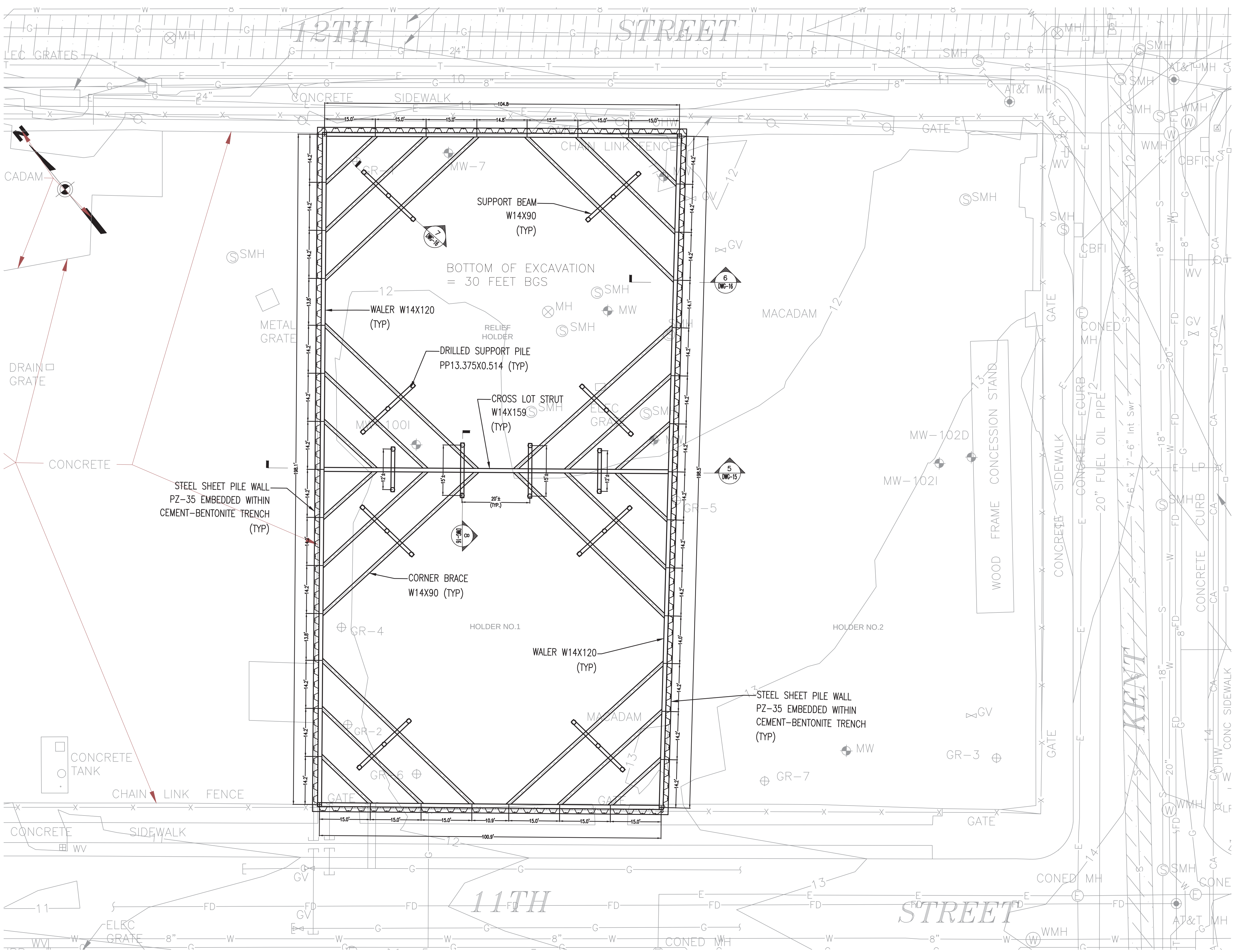
SUPPORT OF EXCAVATION
DETAILS -
TIEBACK ALTERNATIVE

Scale: AS SHOWN | Date: JUNE 2015 | DWG-13



PLAN
SCALE: 1"=16'

16' 0 16'
SCALE IN FEET

GENERAL NOTES:

1. SEE GENERAL NOTES ON DWG-10.

SUPPORT OF EXCAVATION SYSTEM RECOMMENDED CONSTRUCTION PROCEDURE:

1. EXCAVATE THE SITE TO EL. −1'. INSTALL UPPER WALERS AT THE UPPER BRACE LOCATIONS.
2. INSTALL UPPER CROSS LOT STRUT AND CORNER BRACES.
3. EXCAVATE TO EL. −11', INSTALL LOWER WALERS AT THE LOWER BRACE LOCATIONS.
4. INSTALL LOWER CROSS LOT STRUT AND CORNER BRACES.
5. COMPLETE EXCAVATION
6. REMOVE CORNER BRACES, SUPPORT BEAMS, AND CROSS LOT BRACE AFTER BACKFILLING TO 2 FEET BELOW THE BRACE LEVEL.

LEGEND

- STEEL SHEET PILES
- CEMENT−BENTONITE WALL
- CROSS−SECTION

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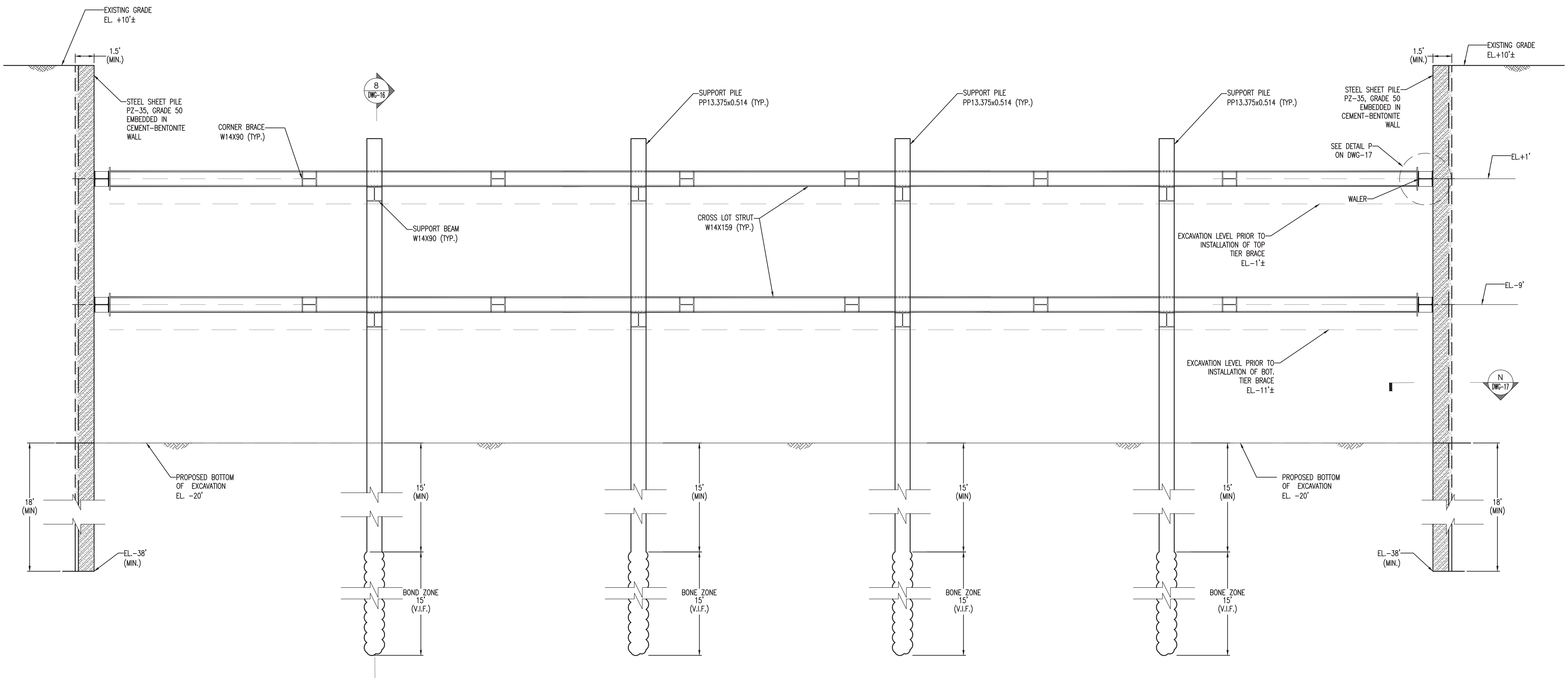
SUPPORT OF EXCAVATION
PLAN AND NOTES -
INTERNAL BRACE ALTERNATIVE

Scale: AS SHOWN | Date: JUNE 2015 | DWG-14



5
DWG-15
SECTION
SCALE: 1" = 4'

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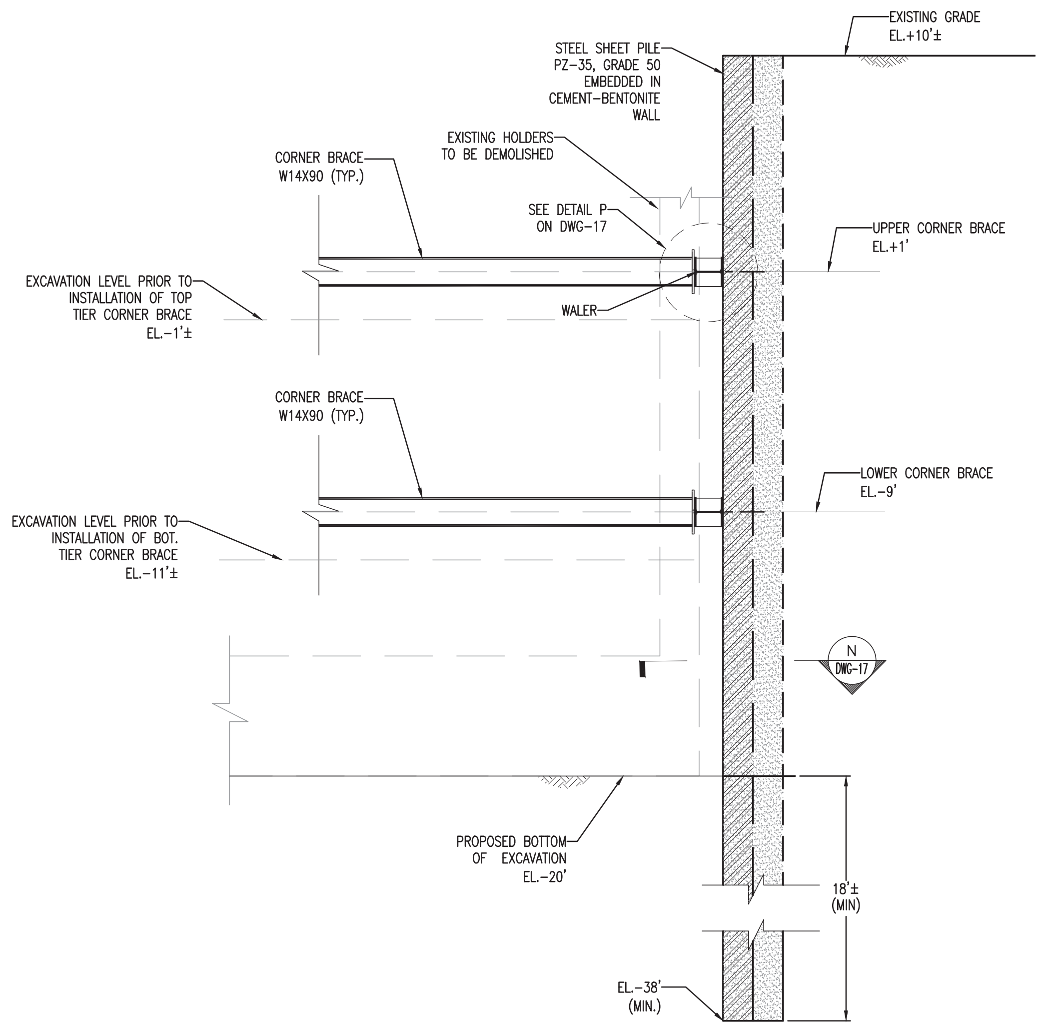
SUPPORT OF EXCAVATION
SECTION -
INTERNAL BRACE ALTERNATIVE

Scale: AS SHOWN | Date: JUNE 2015 | DWG-15



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DWG-16
SECTION
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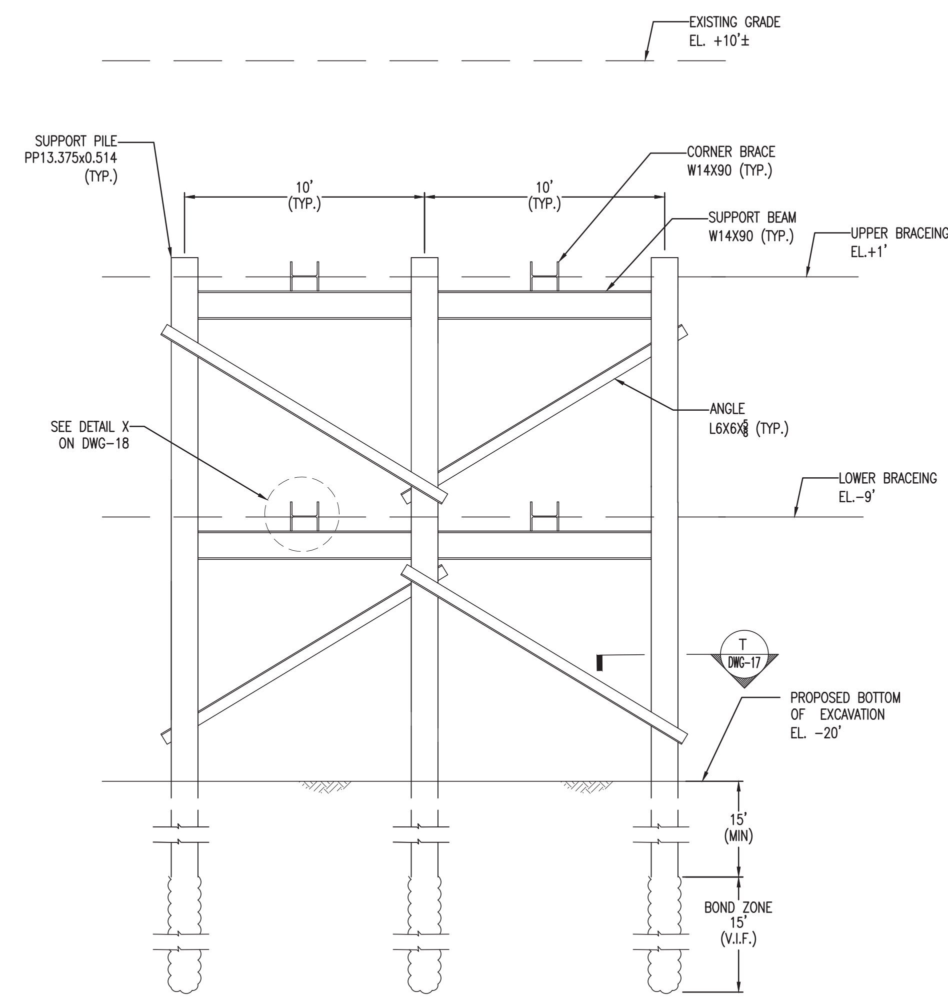

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DWG-16
SECTION
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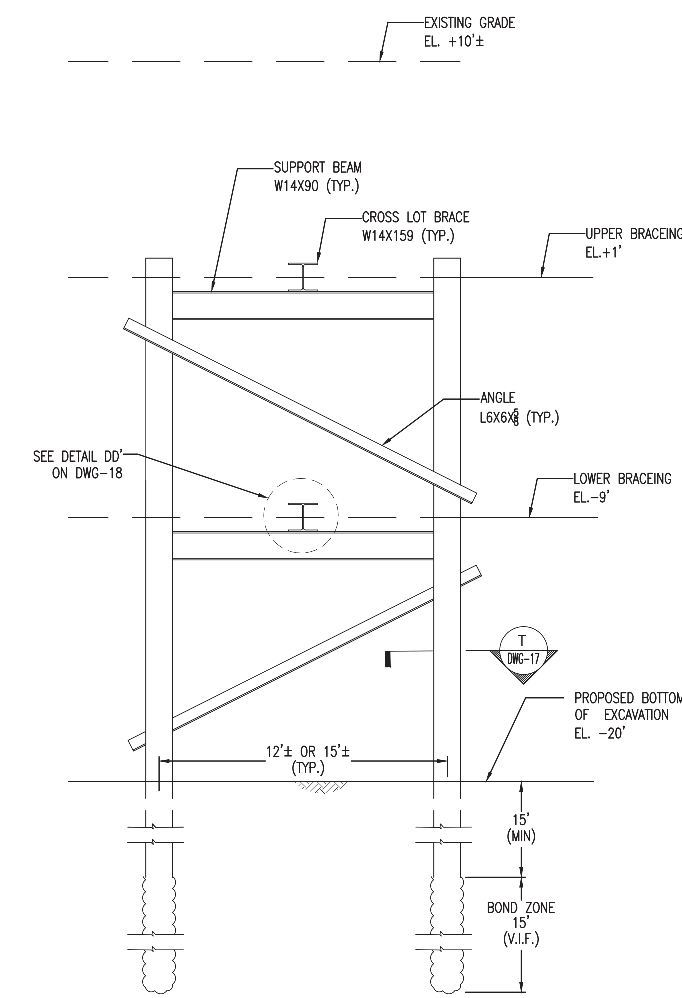

8
DWG-16
SECTION
SCALE: 1" = 4'

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SUPPORT OF EXCAVATION
SECTIONS -
INTERNAL BRACE ALTERNATIVE

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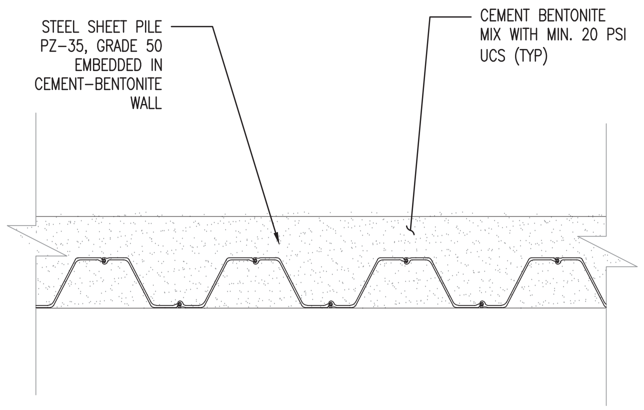
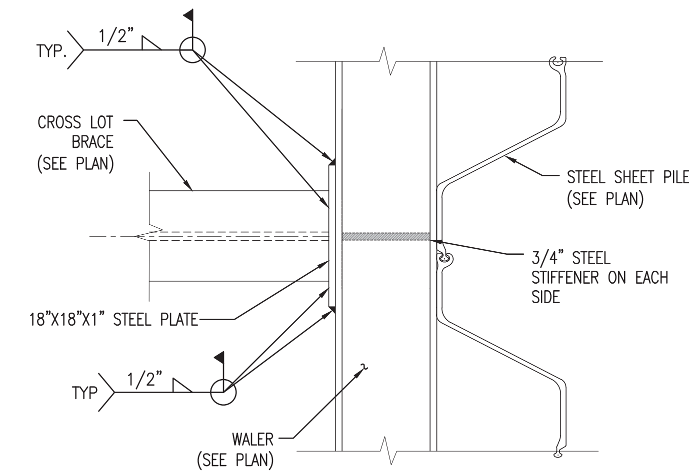


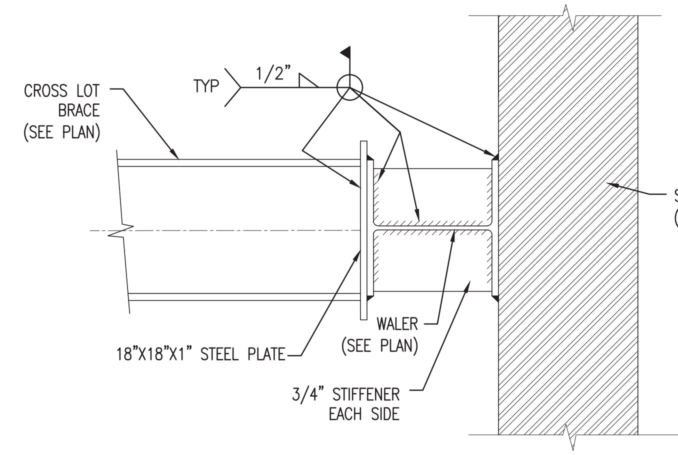
N DWG-17 SECTION

N.T.S.



O DWG-17 TOP VIEW OF CROSS LOT BRACE TO WALER CONNECTION DETAIL

N.T.S.



P DWG-17 SIDE VIEW OF CROSS LOT BRACE TO WALER CONNECTION DETAIL

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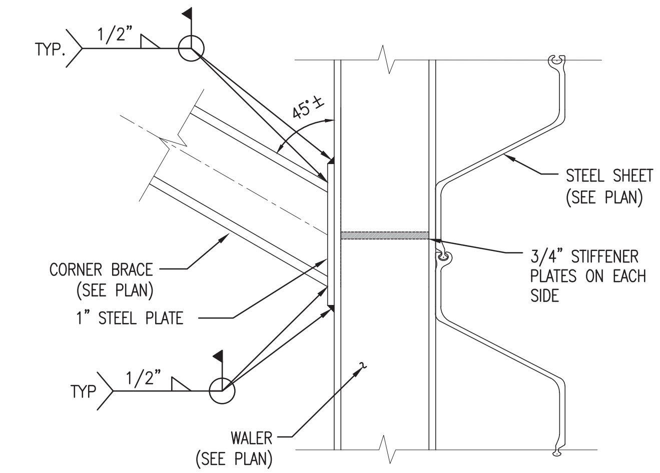
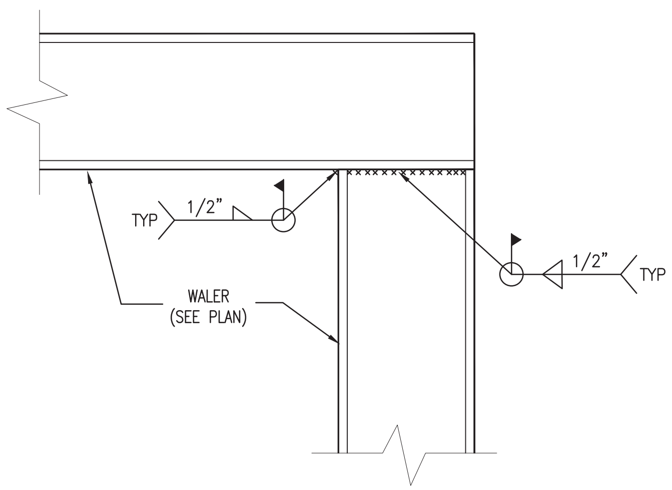


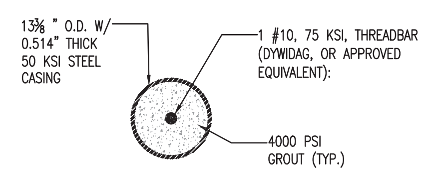
Q DWG-17 TOP VIEW OF CORNER BRACE TO WALER CONNECTION DETAIL

N.T.S.



S DWG-17 WALER TO WALER CONNECTION DETAIL

N.T.S.

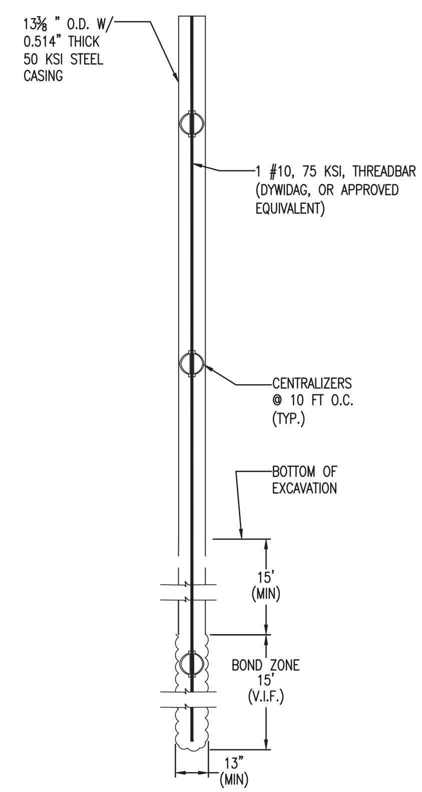


T DWG-17 SUPPORT PILE DETAIL

SCALE: N.T.S.

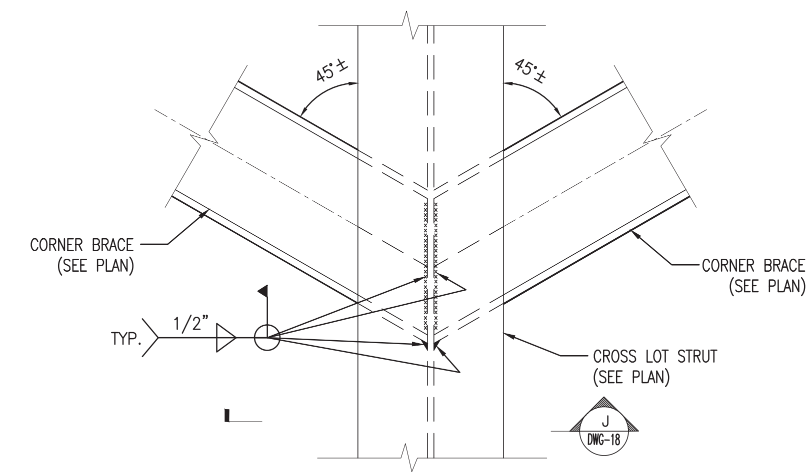
SUPPORT PILE NOTES:

1. SUPPORT PILES SHALL BE INSTALLED BY APPROPRIATE DRILLING EQUIPMENT AND METHODS THAT IS SUITABLE FOR DRILLING THROUGH THE CONDITIONS TO BE ENCOUNTERED. THE DRILLHOLE MUST BE OPEN ALONG ITS FULL LENGTH TO AT LEAST THE MINIMUM DRILLHOLE DIAMETER SHOWN ON THE CONTRACT PLANS PRIOR TO PLACING GROUT AND REINFORCEMENT. THE CASINGS SHALL BE INSTALLED USING ROTARY DRILLING TECHNIQUES. VIBRATORY OR IMPACT PILE DRIVING HAMMERS SHALL NOT BE USED TO ADVANCE THE CASINGS.
2. SUPPORT PILES SHALL HAVE AN ALLOWABLE COMPRESSION STRENGTH OF 30 TON.
3. ONE AXIAL COMPRESSION TESTS SHALL BE PERFORMED, IN ACCORDANCE WITH THE PROCEDURES OF ASTM D1143 (LATEST EDITION). ALL PILE LOAD TESTS SHALL BE CONDUCTED IN ACCORDANCE WITH THE PROVISIONS OF THE NEW YORK CITY BUILDING CODE, SUBCHAPTER 11, ARTICLE 8, SECTION 27–700(D)(4). THE TOTAL TEST LOAD SHALL BE TWICE THE PROPOSED WORKING LOAD (30 TON) OF THE PILE. THE TOTAL TEST LOAD SHALL REMAIN IN PLACE UNTIL SETTLEMENT DOES NOT EXCEED ONE ONE–THOUSANDTH OF A FOOT IN FORTY–EIGHT HOURS.



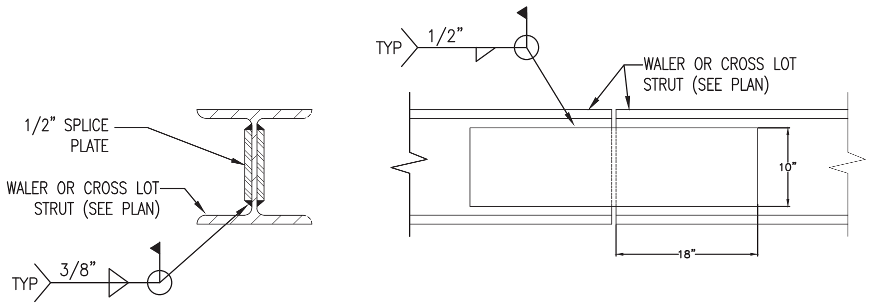
U DWG-17 SUPPORT PILE DETAIL

SCALE: N.T.S.



V DWG-17 TOP VIEW OF CORNER BRACE TO CROSS LOT STRUT CONNECTION DETAIL

N.T.S.



R DWG-17 SPLICE DETAIL

N.T.S.

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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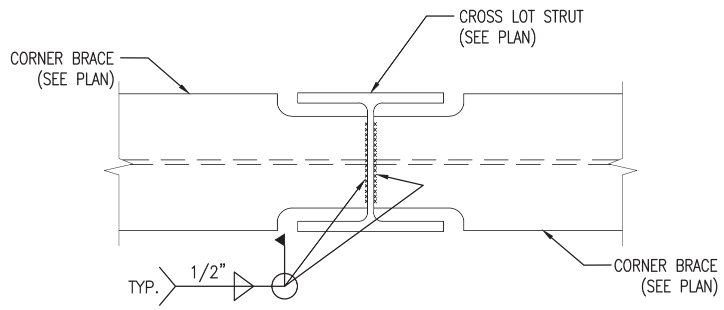
BROOKLYN, KINGS COUNTY, NEW YORK

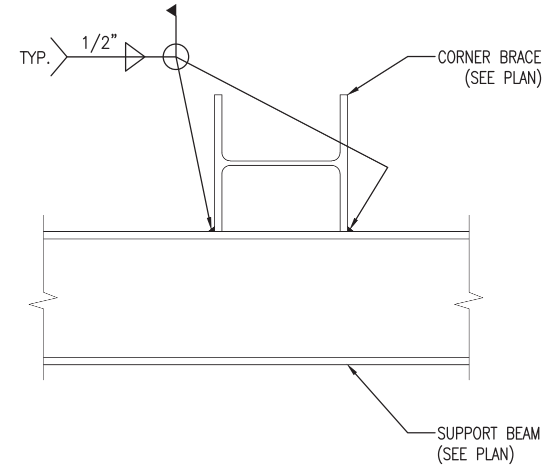
SUPPORT OF EXCAVATION DETAILS - INTERNAL BRACE ALTERNATIVE

Scale: AS SHOWN | Date: JUNE 2015 | DWG-17



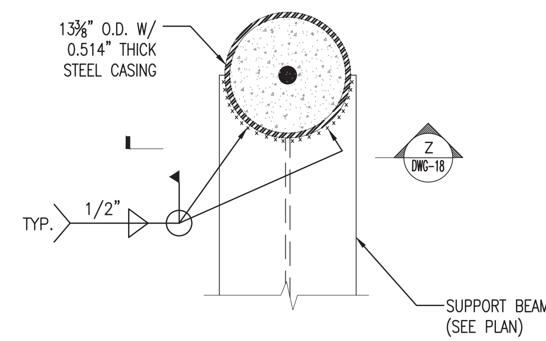
W / DWG-18 SECTION OF CORNER BRACE TO CROSS LOT BRACE CONNECTION DETAIL

N.T.S.



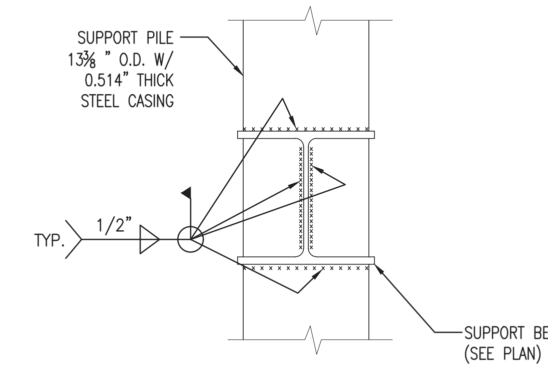
X / DWG-18 CORNER BRACE TO SUPPORT BEAM CONNECTION DETAIL

N.T.S.



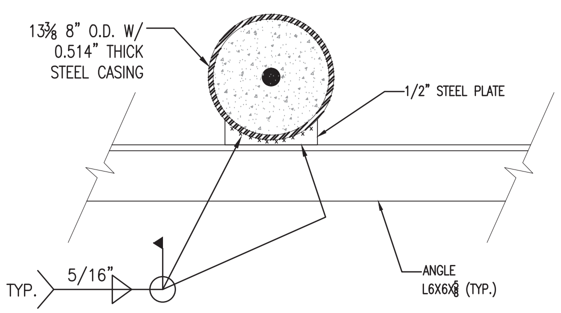
Y / DWG-18 TOP VIEW OF SUPPORT BEAM TO SUPPORT PILE CONNECTION DETAIL

N.T.S.



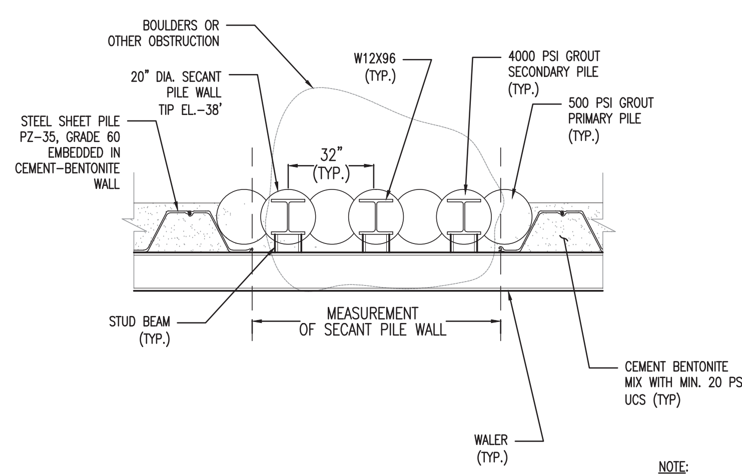
Z / DWG-18 SECTION VIEW OF SUPPORT BEAM TO SUPPORT PILE CONNECTION DETAIL

N.T.S.



AA / DWG-18 TOP VIEW OF ANGLE BRACE TO SUPPORT PILE CONNECTION DETAIL

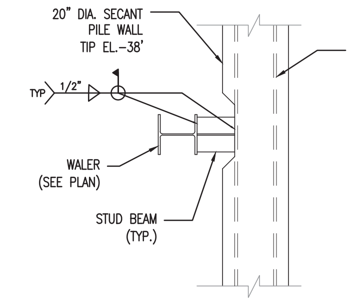
N.T.S.



NOTE:
SEE SPECIFICATION SECTION 02260 FOR REQUIREMENTS OF ALTERNATE DESIGN.

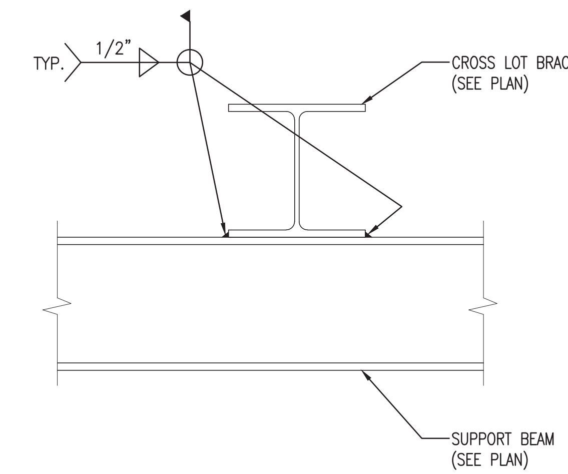
BB / DWG-18 OBSTRUCTION LOCATION DETAIL

N.T.S.



CC / DWG-18 SECANT PILE WALL SECTION

N.T.S.



DD' / DWG-18 CROSS LOT BRACE TO SUPPORT BEAM CONNECTION DETAIL

N.T.S.

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SUPPORT OF EXCAVATION
DETAILS -
INTERNAL BRACE ALTERNATIVE

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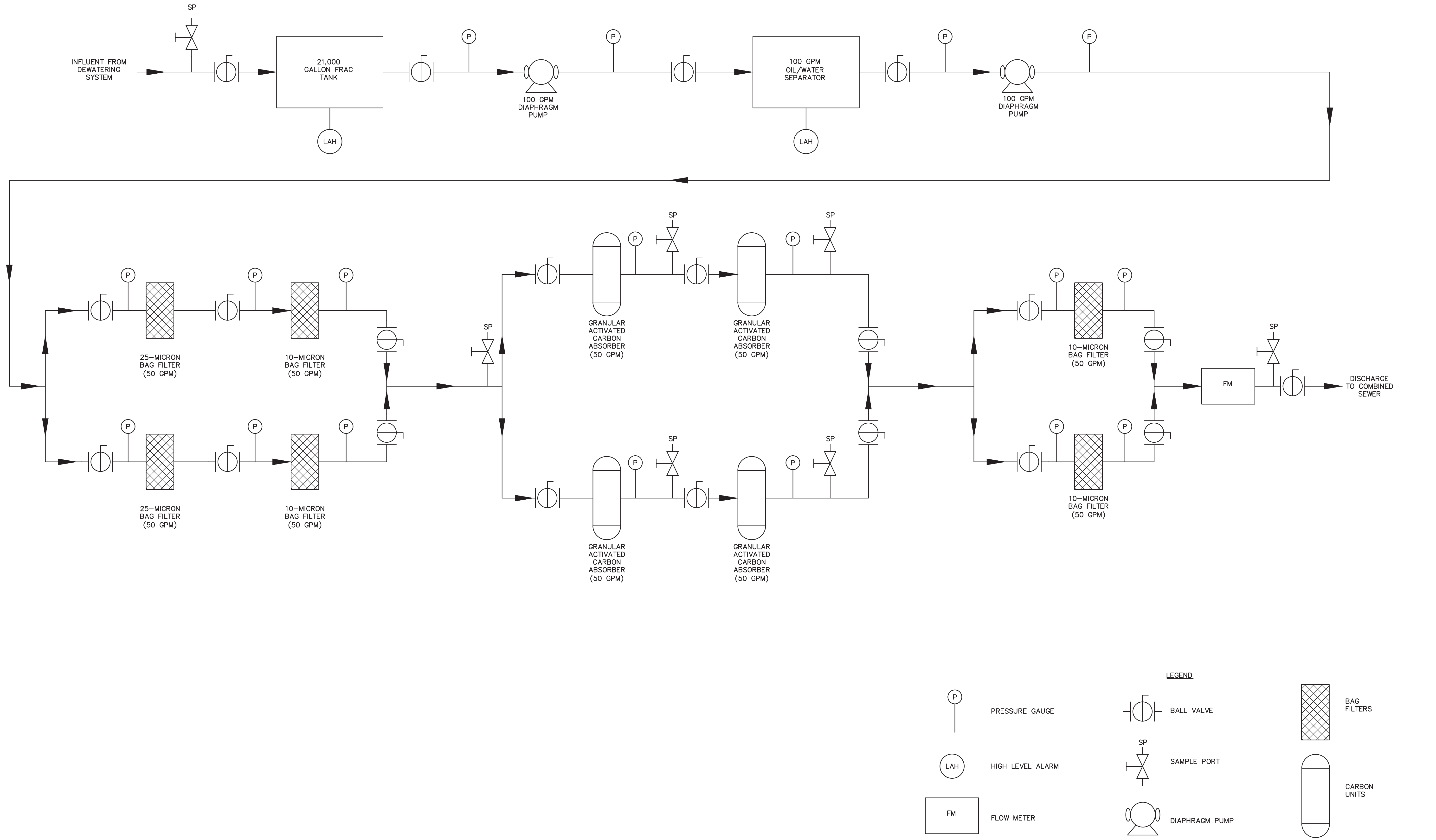

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WATER PRETREATMENT PROCESS FLOW DIAGRAM

Scale: AS SHOWN | Date: JUNE 2015 | DWG–19

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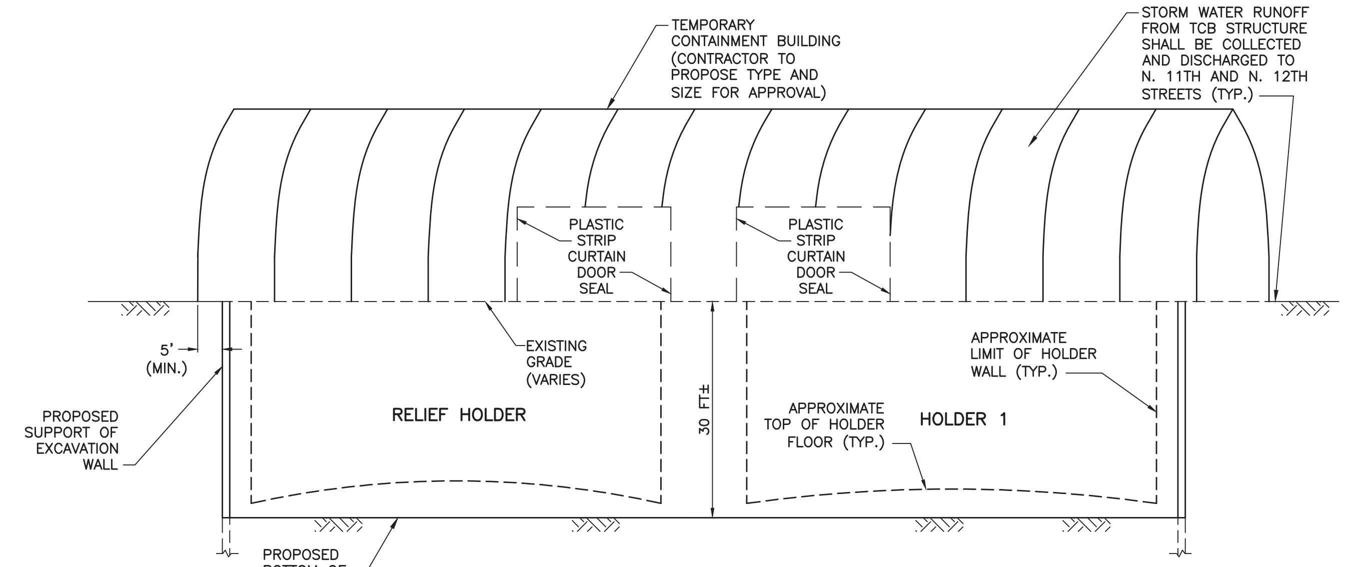
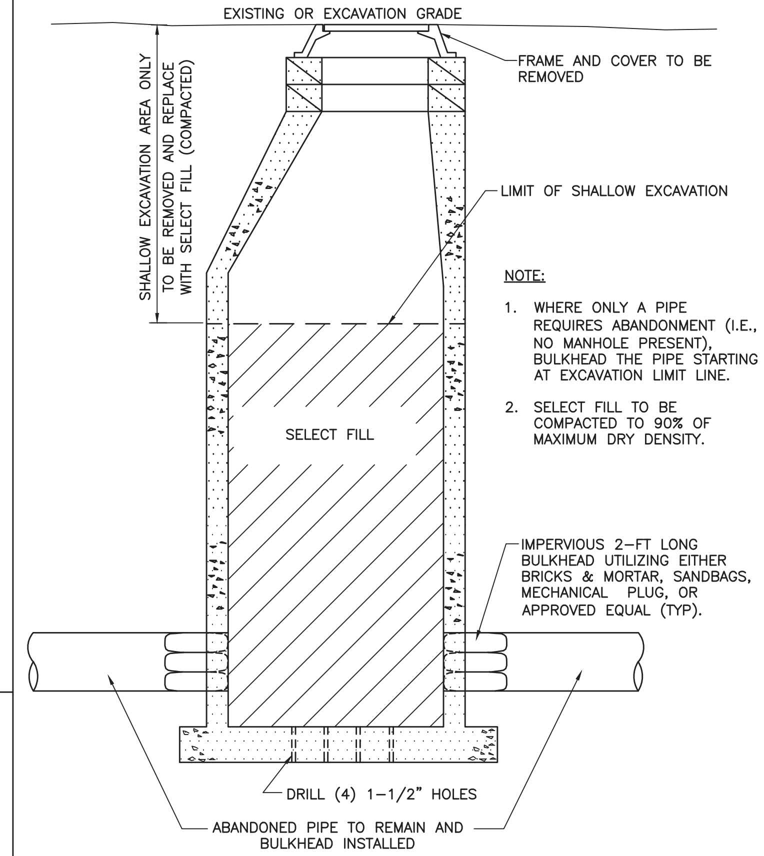


EXCAVATION AND CONTAINMENT DETAIL (TYP.)
DEEP EXCAVATION AREA LOOKING EAST

NOT TO SCALE

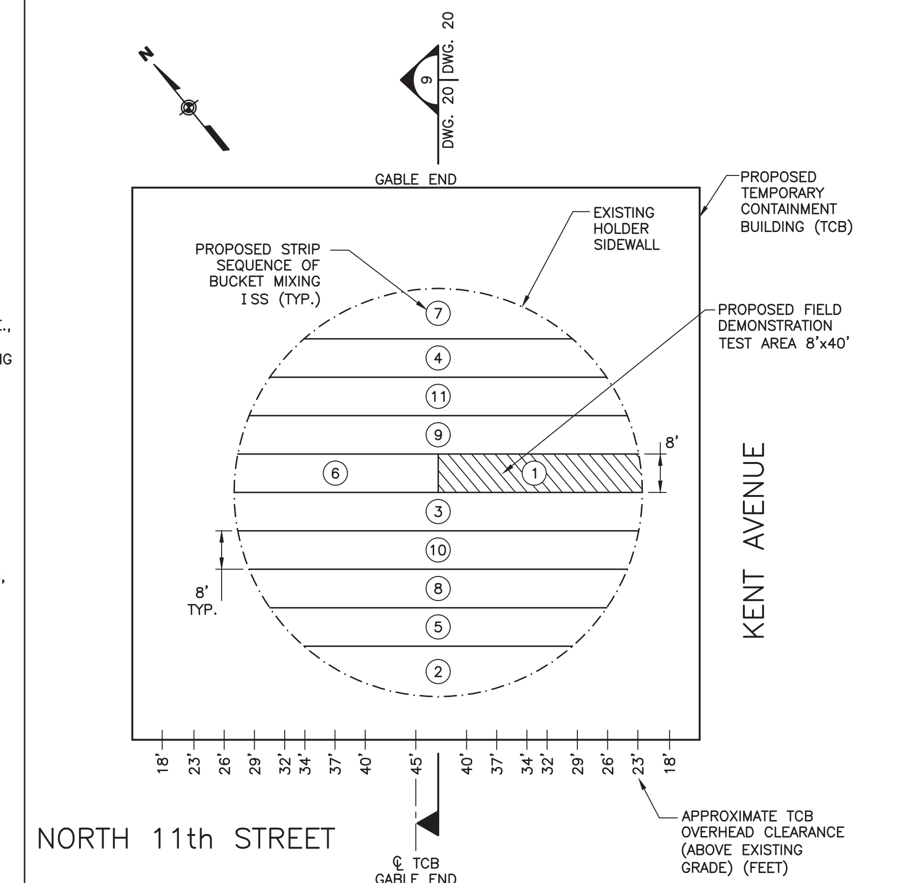


NOTE:

1. WHERE ONLY A PIPE REQUIRES ABANDONMENT (I.E., NO MANHOLE PRESENT), BULKHEAD THE PIPE STARTING AT EXCAVATION LIMIT LINE.
2. SELECT FILL TO BE COMPACTED TO 90% OF MAXIMUM DRY DENSITY.

MANHOLE AND PIPE ABANDONMENT

NOT TO SCALE

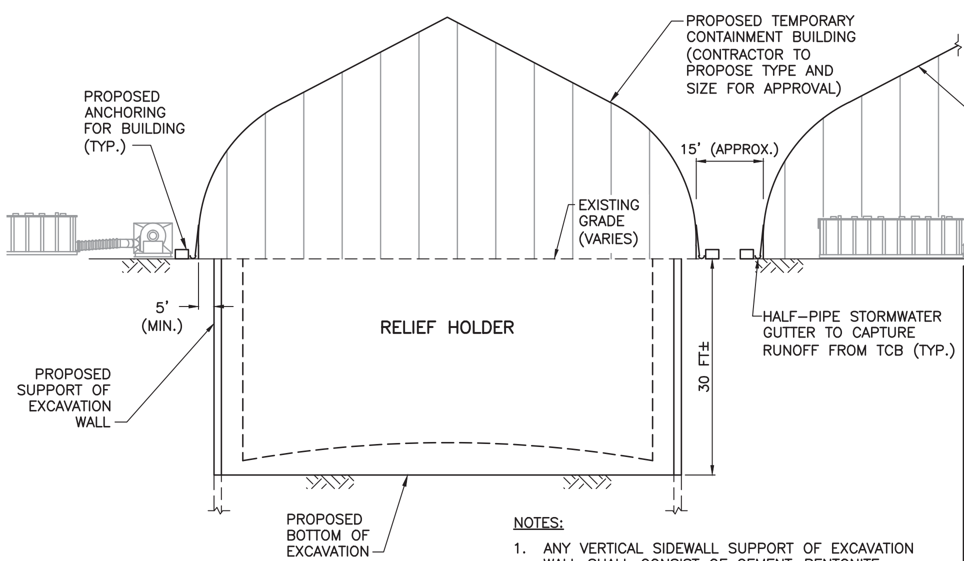


NOTES:

1. REMOVE 7 FEET OF EXISTING HOLDER COVER/SOIL/FILL FROM ENTIRE HOLDER AREA BEFORE COMMENCING ISS MIXING. STOCKPILE SOIL AS DIRECTED BY CONSTRUCTION MANAGER.
2. DEWATER AS NECESSARY.
3. PRIOR TO TREATING EACH STRIP, REMOVE THREE (3) FEET OF SOIL TO ALLOW FOR EXPANSION DURING GROUT ADDITION.
4. TEMPORARILY STOCKPILE SOIL FROM EACH STRIP TO BE SOLIDIFIED OR BACKFILLED AT A LATER TIME.

ISS BUCKET MIXING SEQUENCING DETAIL

NOT TO SCALE

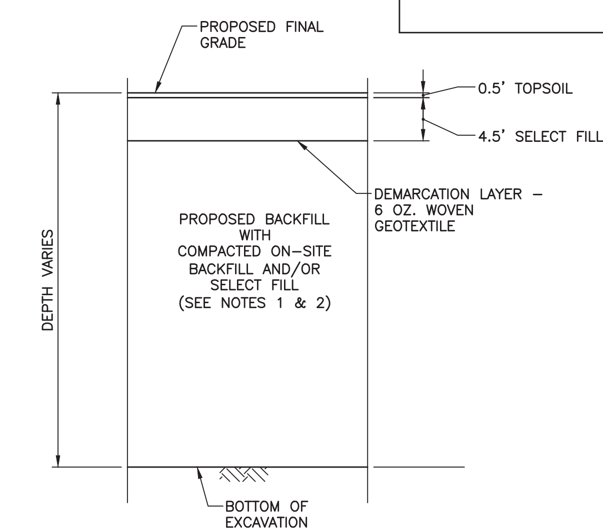


NOTES:

1. ANY VERTICAL SIDEWALL SUPPORT OF EXCAVATION WALL SHALL CONSIST OF CEMENT–BENTONITE SLURRY AND SHEET PILE.
2. CONTRACTOR SHALL PROVIDE ADEQUATE SPACING FOR ALL VAPOR MANAGEMENT SYSTEM COMPONENTS PER MANUFACTURER SPECIFICATIONS.

EXCAVATION AND CONTAINMENT DETAIL (TYP.)
DEEP EXCAVATION AREA LOOKING SOUTH

NOT TO SCALE

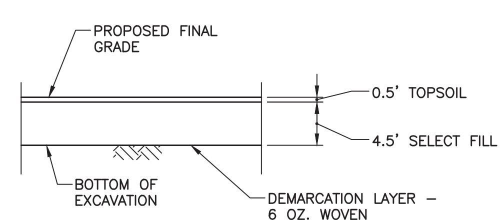


DEEP EXCAVATION BACKFILL DETAIL (TYP.)

NOT TO SCALE

NOTES:

1. ON–SITE EXCAVATED SOIL MAY BE USED AS BACKFILL IN ACCORDANCE WITH SPECIFICATION SECTION 02300 – EARTHWORK AND BACKFILL, BUT NO CLOSER THAN FIVE (5) FOOT FROM PROPOSED FINAL GRADES.
2. SELECT FILL MATERIAL SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02300 – EARTHWORK AND BACKFILL.

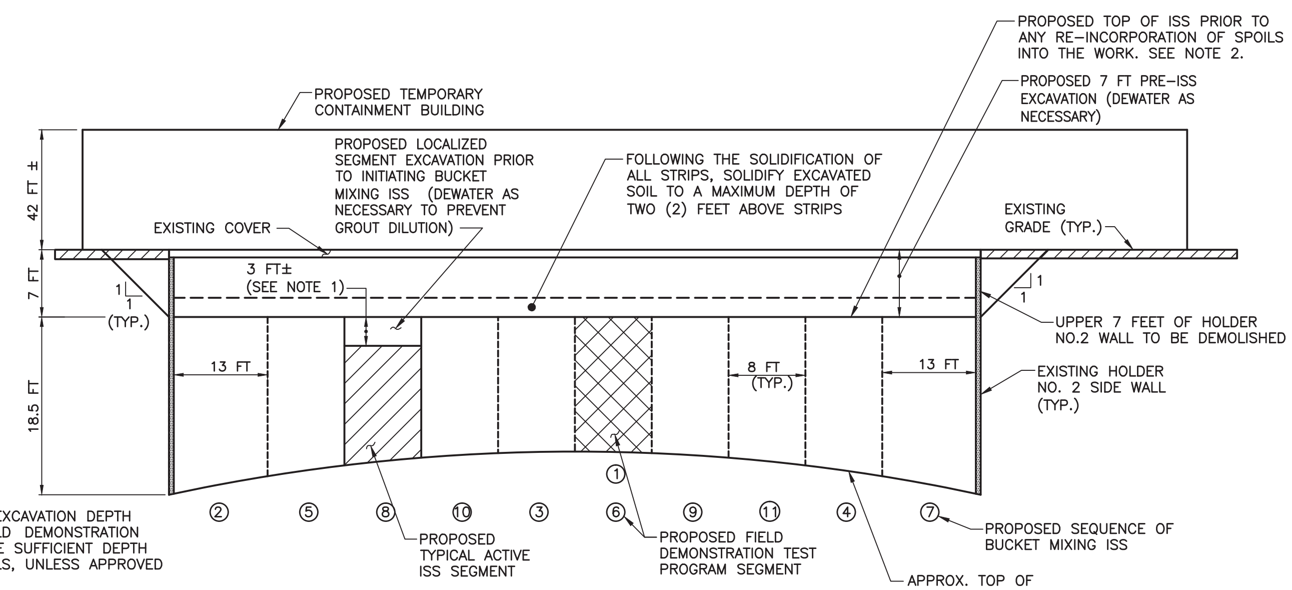


SHALLOW EXCAVATION BACKFILL DETAIL (TYP.)

NOT TO SCALE

NOTES:

1. SELECT FILL MATERIAL SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02300 – EARTHWORK AND BACKFILL.



NOTES:

1. SHOWN LOCALIZED SEGMENT EXCAVATION DEPTH SHALL BE CONFIRMED BY FIELD DEMONSTRATION TEST PROGRAM AND SHALL BE SUFFICIENT DEPTH TO CONTAIN GENERATED SPOILS, UNLESS APPROVED OTHERWISE.
2. TOP OF SOLIDIFIED SURFACE SHALL EXTEND UPWARD NO CLOSER THAN FIVE (5) FEET FROM PROPOSED FINAL GRADE.

CROSS–SECTION 9 DWG. 20 | DWG. 20

NOT TO SCALE

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REMEDIATION DETAILS

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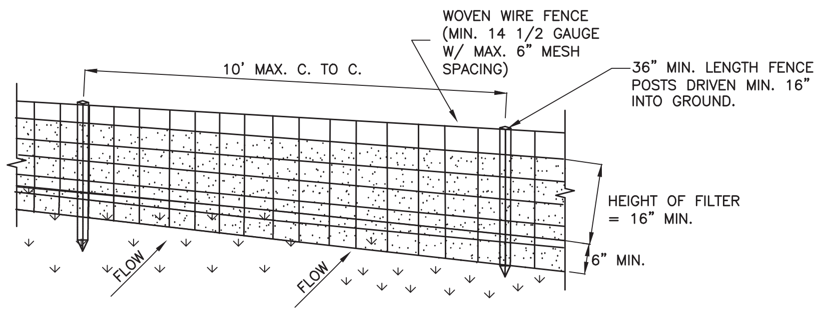
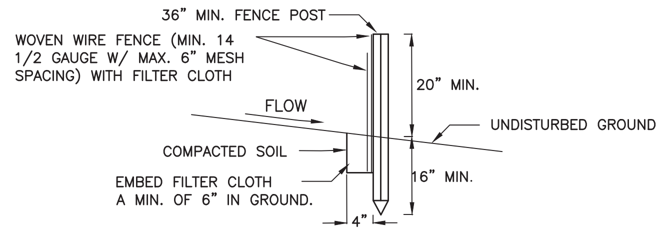


PERSPECTIVE VIEW

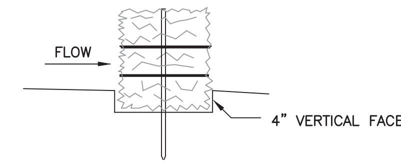


SECTION VIEW

CONSTRUCTION SPECIFICATIONS

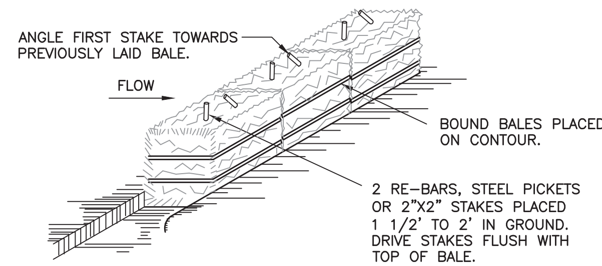
1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES. POSTS SHALL BE STEEL EITHER "T" OR "U" TYPE OR HARDWOOD.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION. FENCE SHALL BE WOVEN WIRE, 14 1/2 GAUGE, 6" MAXIMUM MESH OPENING.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVER-LAPPED BY SIX INCHES AND FOLDED. FILTER CLOTH SHALL BE MIRAFI 100X, OR APPROVED EQUIVALENT.
4. PREFABRICATED UNITS SHALL BE GEOFAB, ENVIROFENCE, OR APPROVED EQUIVALENT.
5. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

TYPICAL SILT FENCE
NOT TO SCALE



BEDDING DETAIL
NOT TO SCALE

DRAINAGE AREA NO MORE THAN 1/4 ACRE PER 100 FEET OF STRAW BALE DIKE FOR SLOPES LESS THAN 25%.

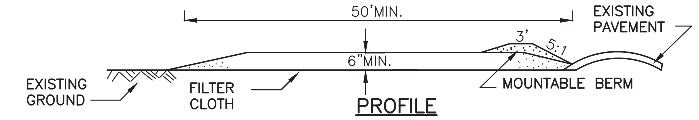


ANCHORING DETAIL
NOT TO SCALE

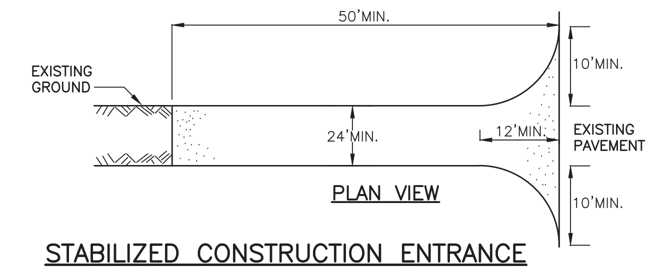
CONSTRUCTION SPECIFICATIONS

1. BALES SHALL BE PLACED AT IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. EACH BALE SHALL BE EMBEDDED IN THE GROUND A MINIMUM OF 4", AND PLACED SO THE BINDINGS ARE HORIZONTAL.
3. BALES SHALL BE SECURELY ANCHORED IN PLACE BY EITHER TWO STAKES OR RE-BARS DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER. STAKES SHALL BE DRIVEN FLUSH WITH THE BALE.
4. INSPECTION SHALL BE FREQUENT AND REPAIR/REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
5. BALES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFULLNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

TYPICAL STRAW BALE DIKE
NOT TO SCALE



PROFILE

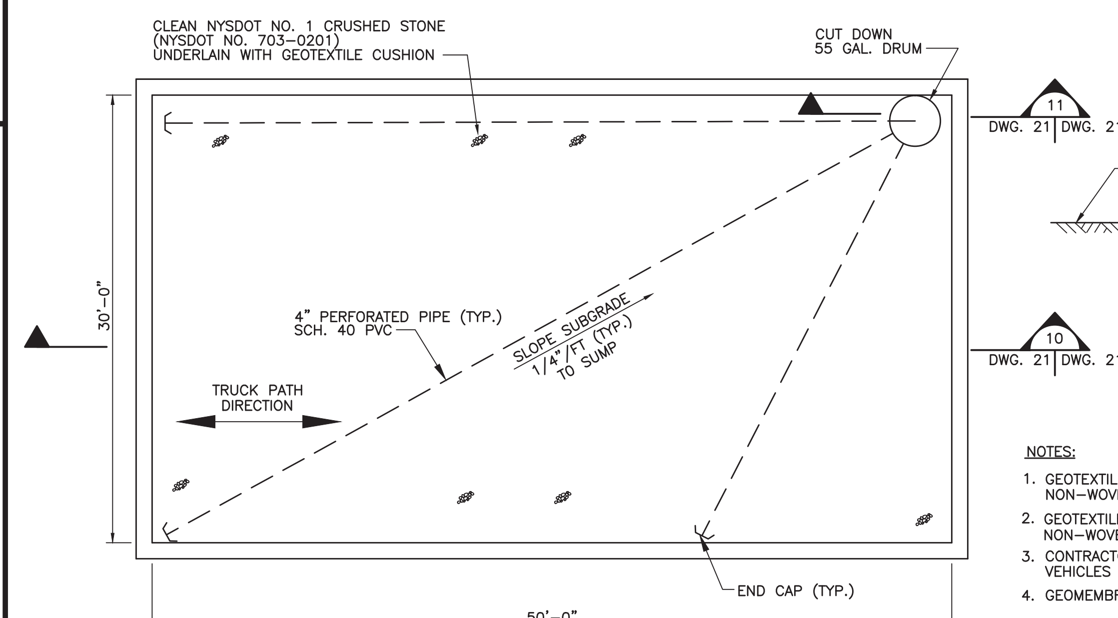


PLAN VIEW

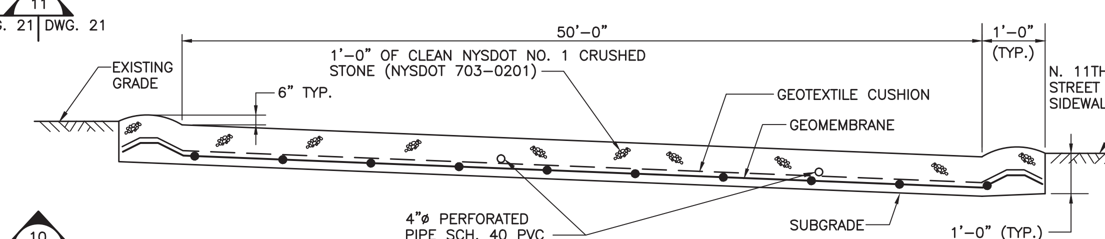
STABILIZED CONSTRUCTION ENTRANCE
NOT TO SCALE

CONSTRUCTION SPECIFICATIONS

1. STONE SIZE – USE 2" STONE, OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.
2. LENGTH – NOT LESS THAN 50 FEET.
3. THICKNESS – NOT LESS THAN 6".
4. WIDTH – 12' MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS. 24' IF SINGLE ENTRANCE TO SITE.
5. FILTER CLOTH – SHALL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING OF STONE.
6. SURFACE WATER – ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM WITH 1V:5H SLOPES WILL BE PERMITTED.
7. MAINTENANCE – THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY SHALL BE REMOVED IMMEDIATELY.
8. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE.
9. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED AFTER EACH RAIN.



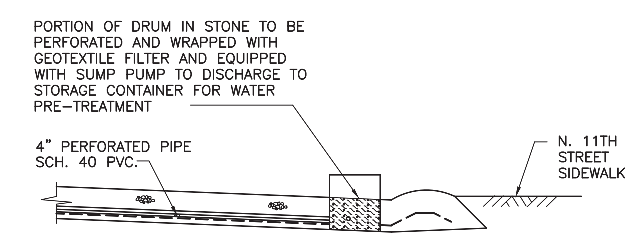
PLAN



SECTION 10
DWG. 21 DWG. 21

NOTES:

1. GEOTEXTILE CUSHION SHALL BE 16 OZ./SY NON-WOVEN.
2. GEOTEXTILE FILTER SHALL BE 6 OZ/SY NON-WOVEN.
3. CONTRACTOR SHALL WASH DOWN ALL VEHICLES PRIOR TO VEHICLES LEAVING THE SITE.
4. GEOMEMBRANE SHALL BE 40 MIL LLDPE.



SECTION 11
DWG. 21 DWG. 21

VEHICLE DECON FACILITY PAD DETAIL
NOT TO SCALE

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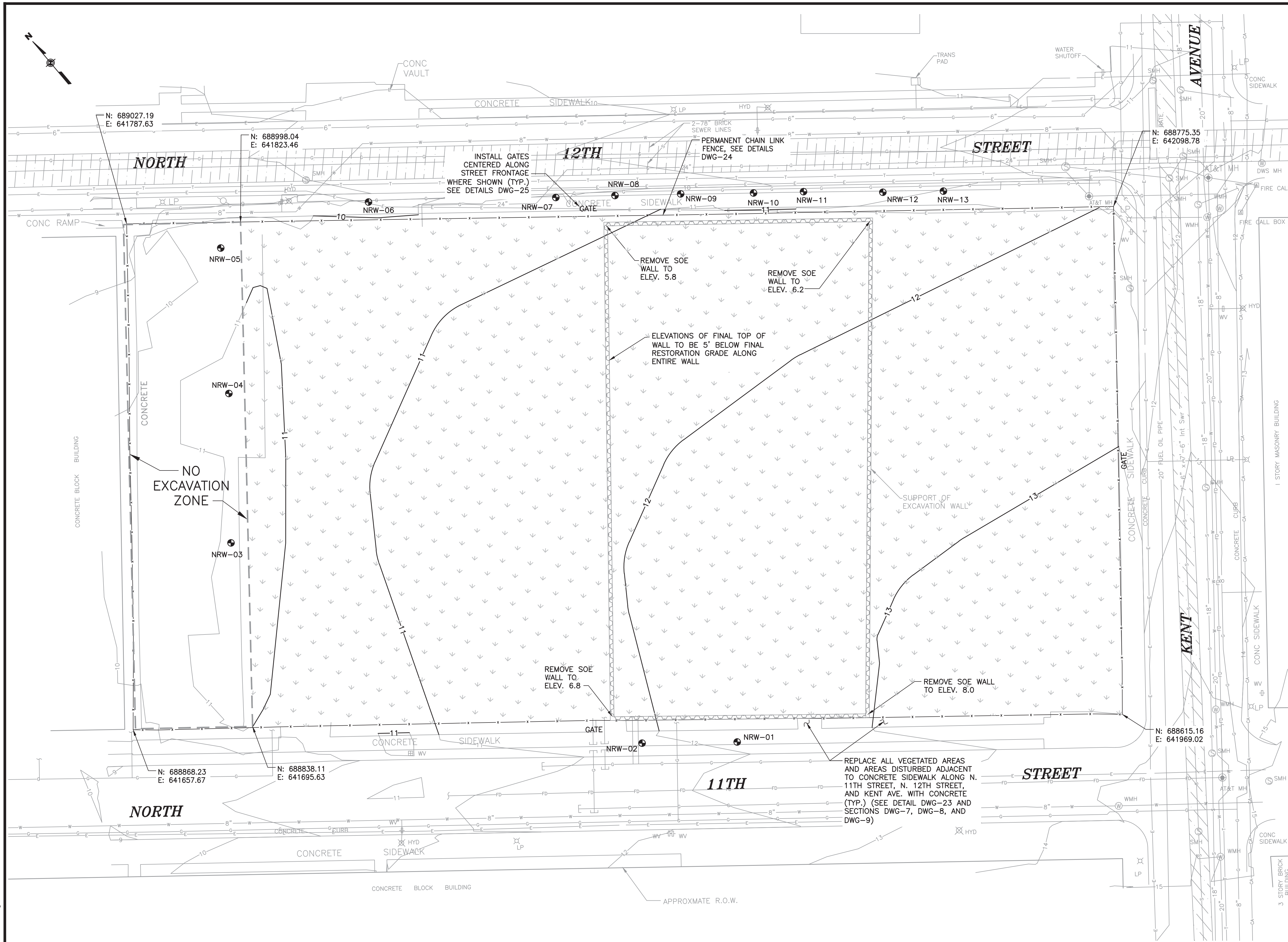
EROSION AND SEDIMENT CONTROL DETAILS

Scale: AS SHOWN | Date: JUNE 2015 | DWG-21



LEGEND

- EXISTING STRUCTURE
- 10 EXISTING CONTOUR
- 10 PROPOSED FINAL GRADE CONTOUR (AMSL)
- GATE PROPOSED FENCE AND GATES
- EXISTING RECOVERY WELL LOCATION
- LIMIT OF TOPSOIL AND SEEDING

NOTES:

1. EXISTING TOPOGRAPHY WAS OBTAINED FROM DRAWING DATED AUGUST 2013, PREPARED BY YEC, INC., ENTITLED "WILLIAMSBURG WORKS FORMER MGP SITE."
2. REPLACE/REPAIR ANY AND ALL DAMAGED CONCRETE SIDEWALK FLAGS, ROADS, AND CURB TO NEW CONDITION IN ACCORDANCE WITH SPECIFICATION SECTION 02775.
3. INSTALL 6" OF TOPSOIL AND SEED IN ACCORDANCE WITH SPECIFICATION SECTION 02920. THIS APPLIES TO THE AREA SHOWN ON THIS DRAWING.

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION
1	AJZ	JAS	7/20/15	ADDED COORDINATES OF TOPSOIL AREA AND FENCE

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BROOKLYN, KINGS COUNTY, NEW YORK

SITE RESTORATION PLAN

Scale: AS SHOWN | Date: JUNE 2015 | DWG-22

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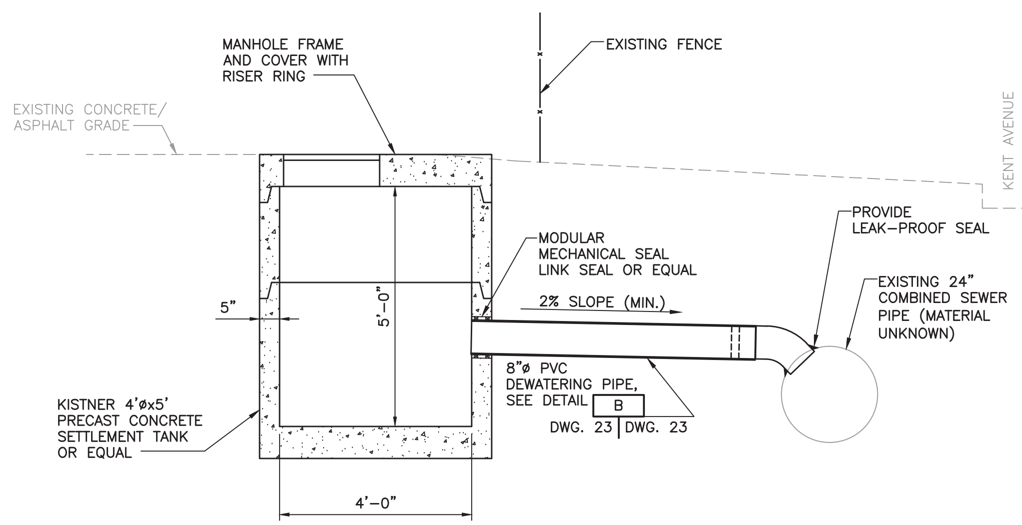
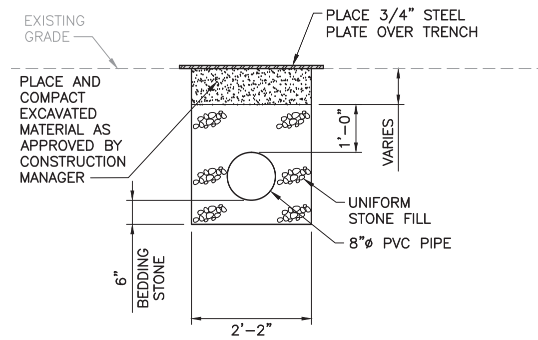


TEMPORARY DEWATERING STRUCTURE AND CONNECTION TO EXISTING SEWER DETAIL A

NOT TO SCALE DWG. 6 | DWG. 23

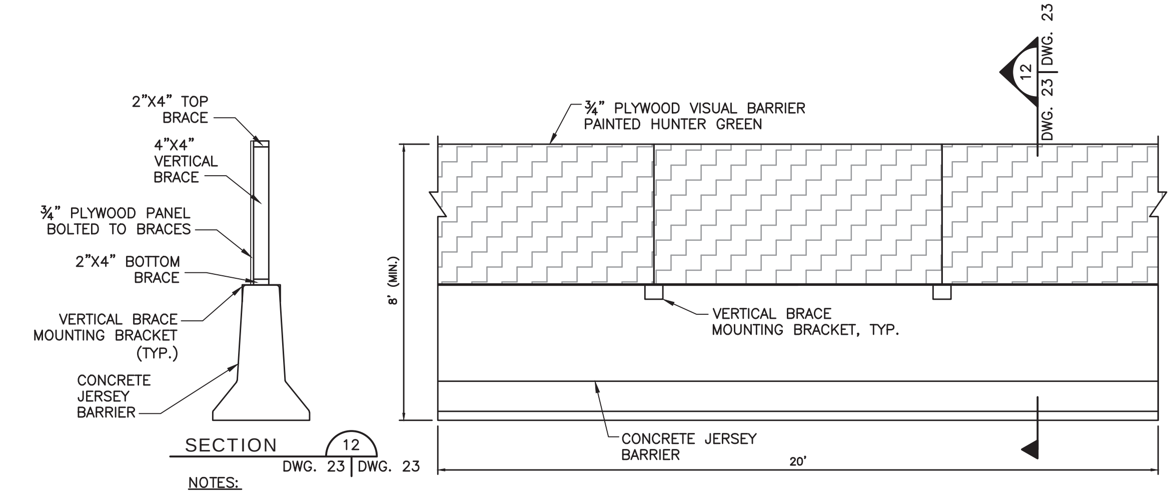


DEWATERING PIPE TRENCH DETAIL B

DWG. 6 | DWG. 23

0' 2' 4'

SCALE: 1/2"= 1'–0"

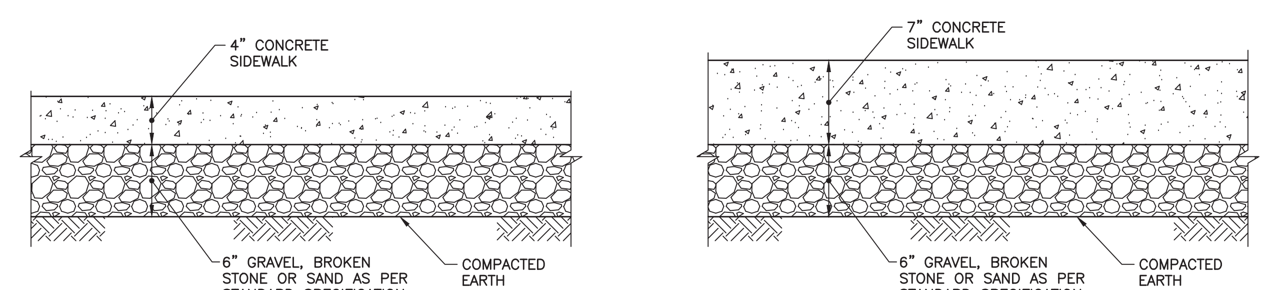


NOTES:

1. INCLUDE VIEWING PANELS, AT A RATE OF ONE FOR EVERY 25 LINEAR FEET PER FRONTAGE, WITH A MINIMUM OF ONE PER STREET FRONTAGE. VIEWING PANELS SHALL BE 12 X 12 INCHES IN SIZE AND SHALL BE BLOCKED WITH PLEXIGLASS OR AN EQUIVALENT NON-FRANGIBLE MATERIAL. THE TOP OF THE VIEWING PANEL SHALL BE LOCATED NO MORE THAN 6 FEET ABOVE THE LEVEL OF THE GROUND, AND THE BOTTOM OF THE VIEWING PANEL SHALL BE LOCATED NO LESS THAN 3 FEET ABOVE THE LEVEL OF THE GROUND.

CONSTRUCTION FENCE WITH VISUAL BARRIER DETAIL C

NOT TO SCALE DWG. 6 | DWG. 23

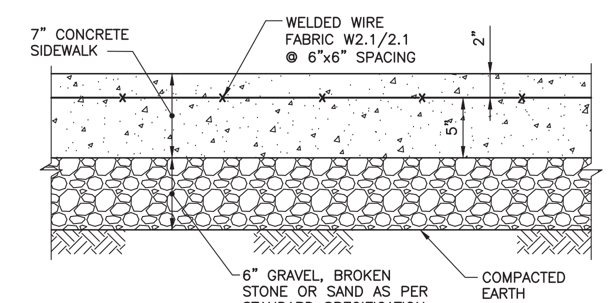


TYPE I - SIDEWALK, OUTSIDE DRIVEWAY AND CORNER QUANDRANTS

NOT TO SCALE

TYPE II - SIDEWALK, IN DRIVEWAY AND IN CORNER QUANDRANTS

NOT TO SCALE



TYPE III - SIDEWALK WITH WELDED WIRE FABRIC

NOT TO SCALE

NOTES:

1. ALL MATERIALS AND CONSTRUCTION METHODS USED ARE TO CONFORM TO SECTION #4.13 OF THE NYC DEPARTMENT OF TRANSPORTATION (DOT) STANDARD HIGHWAY SPECIFICATIONS.

2. WELDED WIRE FABRIC, WHERE SPECIFIED, SHALL BE ASTM DESIGNATION A–185, GAUGE W2.1–2.1 AT 6"x6" SPACING, AND CONFORM TO SECTION #2.25 OF THE NYCDOT SANDARD HIGHWAY SPECIFICATION.

CONCRETE SIDEWALK DETAILS D

NOT TO SCALE DWG. 6 | DWG. 23

J:\Projects\11176638\CAD\RDWP 2013\DWG–23.dwg, DWG 23, 1:1, 6/25/15 –1 ELB

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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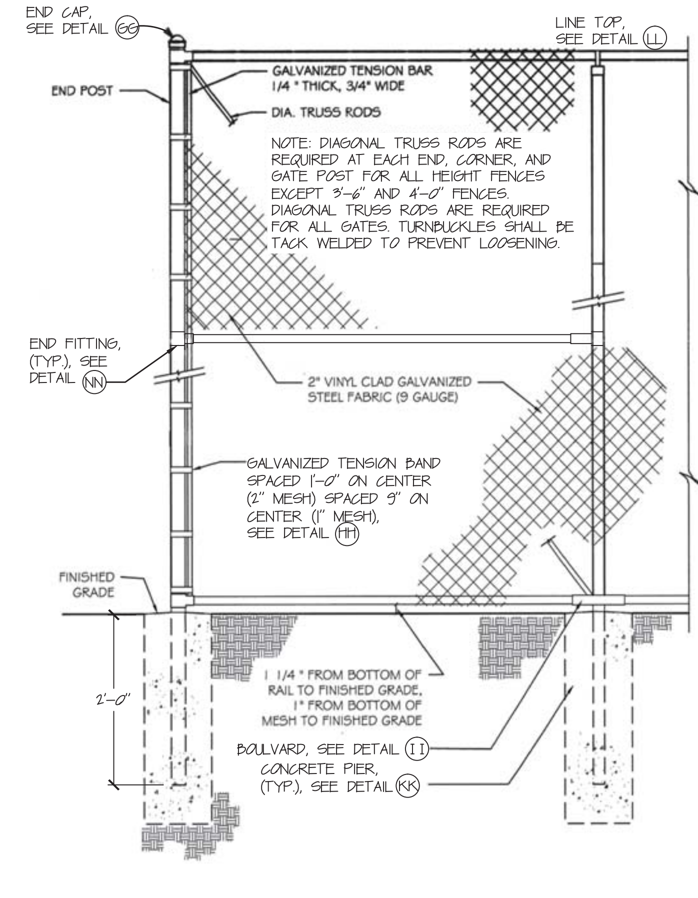
BROOKLYN, KINGS COUNTY, NEW YORK

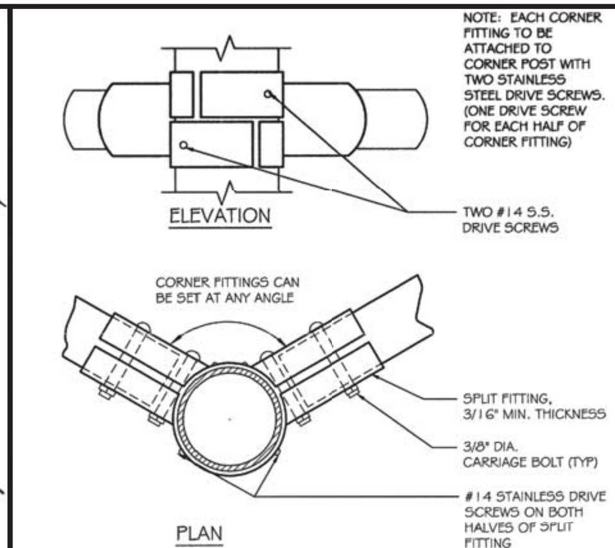
SITE RESTORATION AND DEWATERING DETAILS

Scale: AS SHOWN | Date: JUNE 2015 | DWG–23



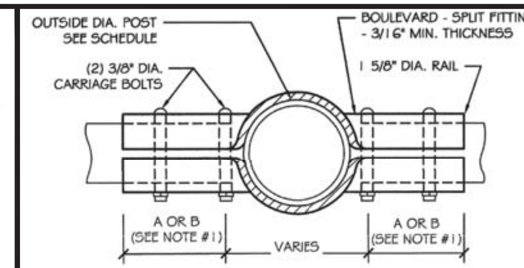
DD 8'-0" HIGH CHAIN LINK FENCE DETAIL

NOT TO SCALE



FF CORNER FITTING DETAIL

NOT TO SCALE



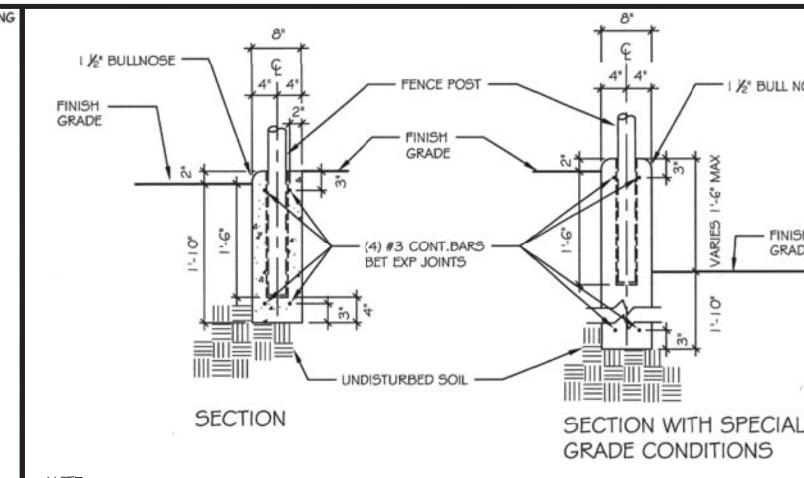
NOTES:

1. A= 1 3/4" FOR 1 7/8" - 4 1/2" O.D. POST
   B= 1 5/8" FOR 1 7/8" O.D. OR SMALLER POST
2. ALL CORNERS TO BE ROUNDED

EXCEPTION:
FOR POSTS LESS THAN 2 3/8" OD. (SEE SCHEDULE OF SIZES OF MEMBERS), ONLY ONE (1) CARRIAGE BOLT IS REQUIRED FOR EACH SIDE OF BOULVARD.

II BOULEVARD DETAIL

NOT TO SCALE



NOTE:
EXPANSION JOINT (SEE DETAIL OO) SPACED 16'-0" MAX. TO LINE UP W/CENTER OF EVERY OTHER PANEL FOR 6'-0" TO 9'-0" CLF AND SPACED 18'-0" CENTER TO CENTER MAX. TO LINE UP WITH CENTER OF EVERY THIRD PANEL FOR 6'-0" CLF.

KK CONCRETE CURB 6'-0" TO 9'-0" CLF DETAIL

NOT TO SCALE

THE MESH SHALL BE PLACED ON THE OUTSIDE OF THE POSTS OF ALL EXTERIOR CHAINLINK FENCES INCLUDING HOODED BACKSTOPS AND HANDBALL COURT FENCES WHERE THESE ARE AN INTEGRAL PART OF THE EXTERIOR FENCE.

WHERE HOODED BACKSTOPS AND HANDBALL COURT FENCES ARE IN INTERIOR AREAS, THE MESH SHALL BE PLACED ON THE INSIDE OF THE POSTS.

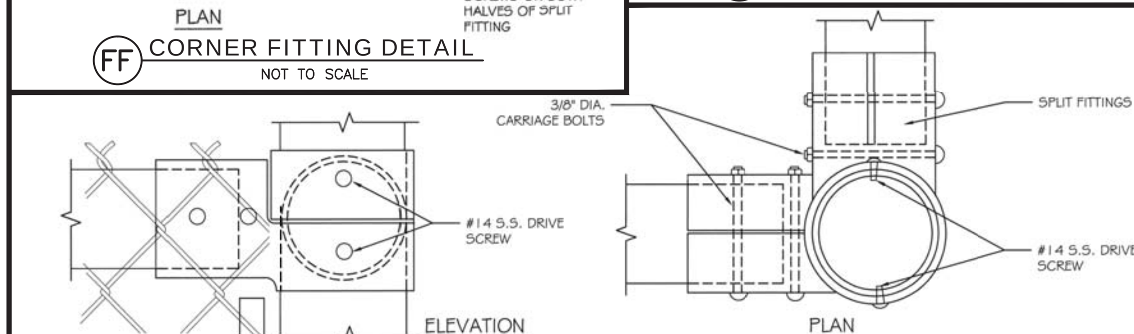
WIRE FABRIC NOTES

FENCE POSTS AND RAILS SHALL BE EITHER TYPE I OR TYPE II:

TYPE I - ROUND MEMBERS SHALL BE HOT DIPPED GALVANIZED CONFORMING TO ASTM F1083 STANDARD WEIGHT SCHEDULE 40.

TYPE II - ROUND MEMBERS SHALL BE MANUFACTURED FROM STEEL CONFORMING TO ASTM A1011/A1011M COLD ROLLED WELDED AND HAVE TENSILE STRENGTH OF 50,000 PSI AND GIVEN CORROSION PROTECTION PER ASTM F1043 TYPE B FOR EXTERNAL COATING AND TYPE D FOR INTERNAL COATING, SUCH AS SS-40.

POST & RAIL NOTES



JJ CORNER SPLIT FITTING DETAIL

NOT TO SCALE

SS-40

TRADE SIZE DIAMETER	ACTUAL O.D. SIZE	ACTUAL I.D. SIZE	PIPE WALL THICKNESS	WEIGHT (LBS/FOOT)
1 5/8"	1.660	1.438	0.111	1.84
1 7/8"	1.900	1.660	0.120	2.28
2 3/8"	2.375	2.115	0.130	3.12
2 7/8"	2.875	2.555	0.160	4.64
3 1/2"	3.500	3.180	0.160	5.71
4"	4.000	3.680	0.160	6.56

SCHEDULE 40

TRADE SIZE DIAMETER	ACTUAL O.D. SIZE	ACTUAL I.D. SIZE	PIPE WALL THICKNESS	WEIGHT (LBS/FOOT)
1 5/8"	1.660	1.380	0.140	2.27
1 7/8"	1.900	1.610	0.145	2.72
2 3/8"	2.375	2.067	0.154	3.65
2 7/8"	2.875	2.469	0.203	5.79
3 1/2"	3.500	3.068	0.216	7.58
4"	4.000	3.548	0.226	9.11

PIPE THICKNESS CHARTS

PEEN END OF ALL BOLTS.

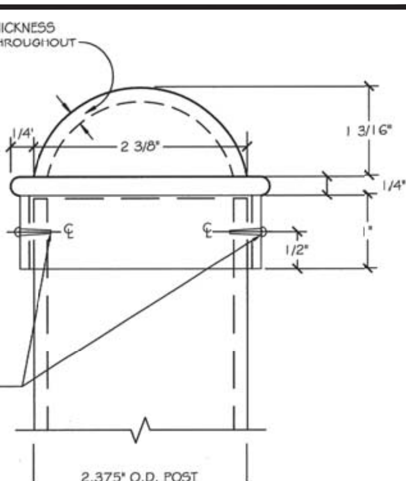
BOLTS WHICH ARE INSTALLED 6" OR LESS ABOVE GRADE SHALL NOT PROTRUDE MORE THAN 1/4" BEYOND THE NUT AFTER TIGHTENING. ALL ROUGH EDGES SHALL BE FILED SMOOTH TO THE SATISFACTION OF THE CONSTRUCTION MANAGER.

ON FENCES OVER 12 FEET HIGH WHERE THE TWO WIDTHS OF FABRIC ARE REQUIRED, THE BOTTOM PIECE SHALL BE KNUCKLED TOP AND BOTTOM AND THE TOP PIECE KNUCKLED AT BOTTOM AND BARBED AT TOP.

THE TWO PIECES SHALL BE SPLICED IN SUCH A WAY AS TO GIVE A FINISHED NEAT APPEARANCE.

FABRIC TO BE KNUCKLED AT TOP AND BOTTOM RAILS ON FENCES UP TO AND INCLUDING 6'-0" HIGH AND BARBED AT TOP RAIL ON FENCES OVER 6'-0" HIGH.

BOLT AND FABRIC NOTES



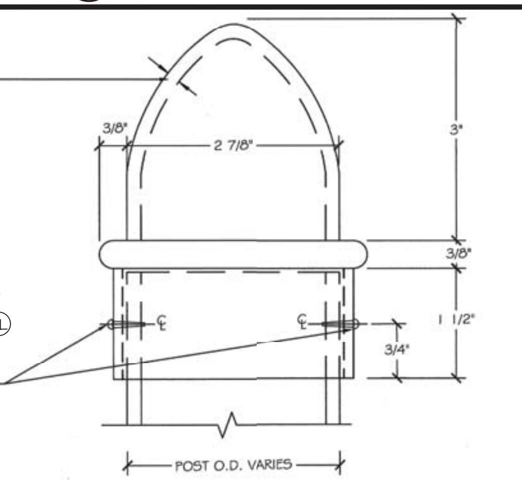
NOTE: POST CAP IS TO BE OF MALLEABLE IRON OR PRESSED STEEL.

CAP TOP FOR 3'-6" AND 4'-0" HIGH FENCE TO BE A SMOOTH "DOME" SHAPE. FOR 6'-0" HIGH FENCES, POST CAPS CAN BE "DOME" OR "BULLET" SHAPED.

POST CAP IS TO FIT SNUGLY OVER POST AND IS TO BE FIXED IN PLACE WITH TWO #14 STAINLESS STEEL DRIVE OR SET SCREWS.

EE SMALL POST CAP DETAIL

NOT TO SCALE



WALL THICKNESS TO BE 3/16" THROUGHOUT

NOTE: POST CAP IS TO BE OF MALLEABLE IRON.

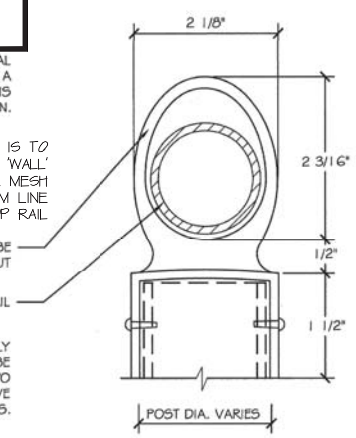
FOR 4" OUTSIDE DIAMETER POST, POST CAP SHALL POSSESS DIMENSIONS THAT ARE IN PROPORTION TO DIMENSIONS BELOW FOR 2 7/8" OUTSIDE DIA. POST CAP

CAP TOPS FOR 3" OUTSIDE DIA. AND 4" OUTSIDE DIA/POSTS ARE TO POSSESS A SMOOTH "BULLET" SHAPE FOR 2 3/8" OUTSIDE DIA. POST CAP – SEE DETAIL LL

POST CAP IS TO FIT SNUGLY OVER POST AND IS TO BE FIXED IN PLACE WITH TWO # 14 STAINLESS STEEL DRIVE OR SET SCREWS.

GG END, CORNER, & GATE POST CAP DETAIL

NOT TO SCALE



NOTE: WIDTH OF LINE TOP OVAL TO BE MINIMUM OF 5/8" AND A MAXIMUM OF 7/8". LINE TOP IS TO BE OF MALLEABLE IRON.

INSIDE OF LINE TOP OVAL IS TO BE ALIGNED WITH OUTSIDE 'WALL' OF LINE POST. CHAIN LINK MESH SHALL BE STRAIGHT FROM LINE POST TO TOP RAIL

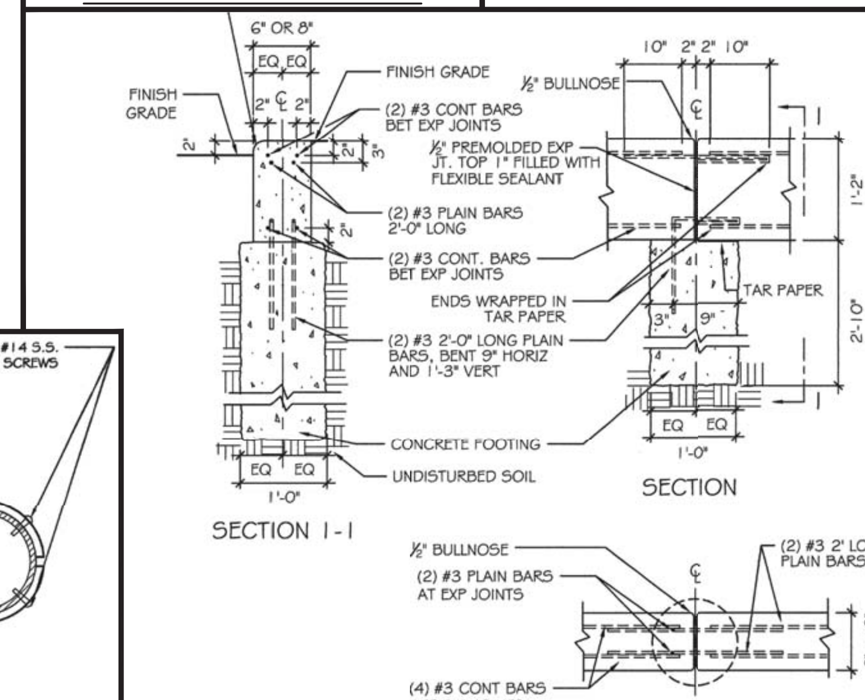
WALL THICKNESS TO BE 3/16" THROUGHOUT

1 5/8" DIA TOP RAIL

POST CAP IS TO FIT SNUGLY OVER POST AND IS TO BE FIXED IN PLACE WITH TWO # 14 STAINLESS STEEL DRIVE OR SET SCREWS.

LL POST LINE TOP DETAIL

NOT TO SCALE



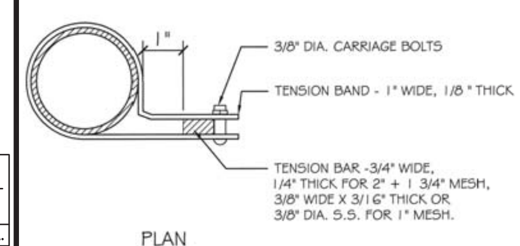
OO EXPANSION JOINT IN CONCRETE CURB/GENERAL DETAIL

NOT TO SCALE

HEIGHT OF FENCE	DIAMETER OF LINE POSTS	POST SPACING MAX.	CORNER & END POST	TOP RAIL	MID RAILS	BOTTOM RAIL	DEPTH OF POST INTO CURB AND FTG AT: LINE POST	DEPTH OF POST INTO CURB AND FTG AT: END/CORNER/GATE POST	HORIZONTAL BRACES AT CORNER & END POST	DIAGONAL BRACES
8'–0"	2 3/8"	8'–0"	2 7/8"	1 5/8"	0	1 5/8"	1'–8"	2'–0"	1 AT 1 5/8"	1/2" DIA.

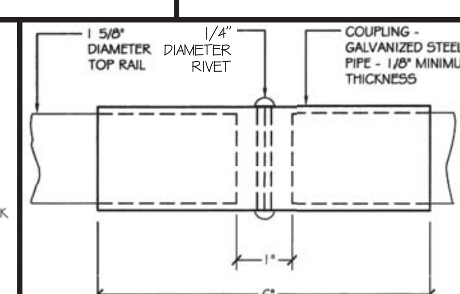
SCHEDULE OF SIZES OF MEMBERS

NOTE:
ALL PIPE DIAMETERS ARE TRADE SIZE DIAMETERS AS SPECIFIED IN ASTM F1043, TABLE 1.
SEE "PIPE THICKNESS CHARTS" FOR ACTUAL O.D. AND THICKNESS OF PIPE.



HH TENSION MEMBERS DETAIL

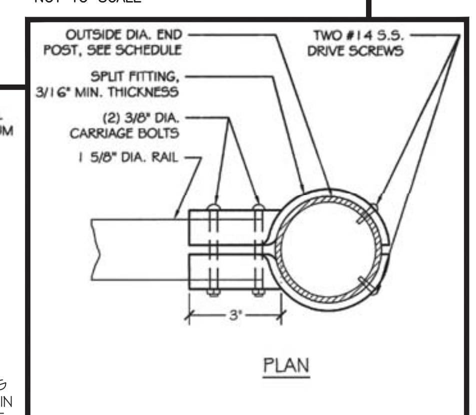
NOT TO SCALE



NOTE: FURNISH ONE COUPLING FOR EACH LENGTH OF PIPE IN TOP RAIL – FULL LENGTH OF PIPE EQUALS 21'-0"

MM TOP RAIL COUPLING DETAIL

NOT TO SCALE



NOTE: MINIMUM WIDTH OF END FITTING TO BE 2 1/4"

NN END FITTING DETAIL

NOT TO SCALE

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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DRAWN BY: EB
CHECKED BY: MG
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FENCE DETAILS
(SHEET 1 OF 2)

Scale: AS SHOWN | Date: JUNE 2015 | DWG–24

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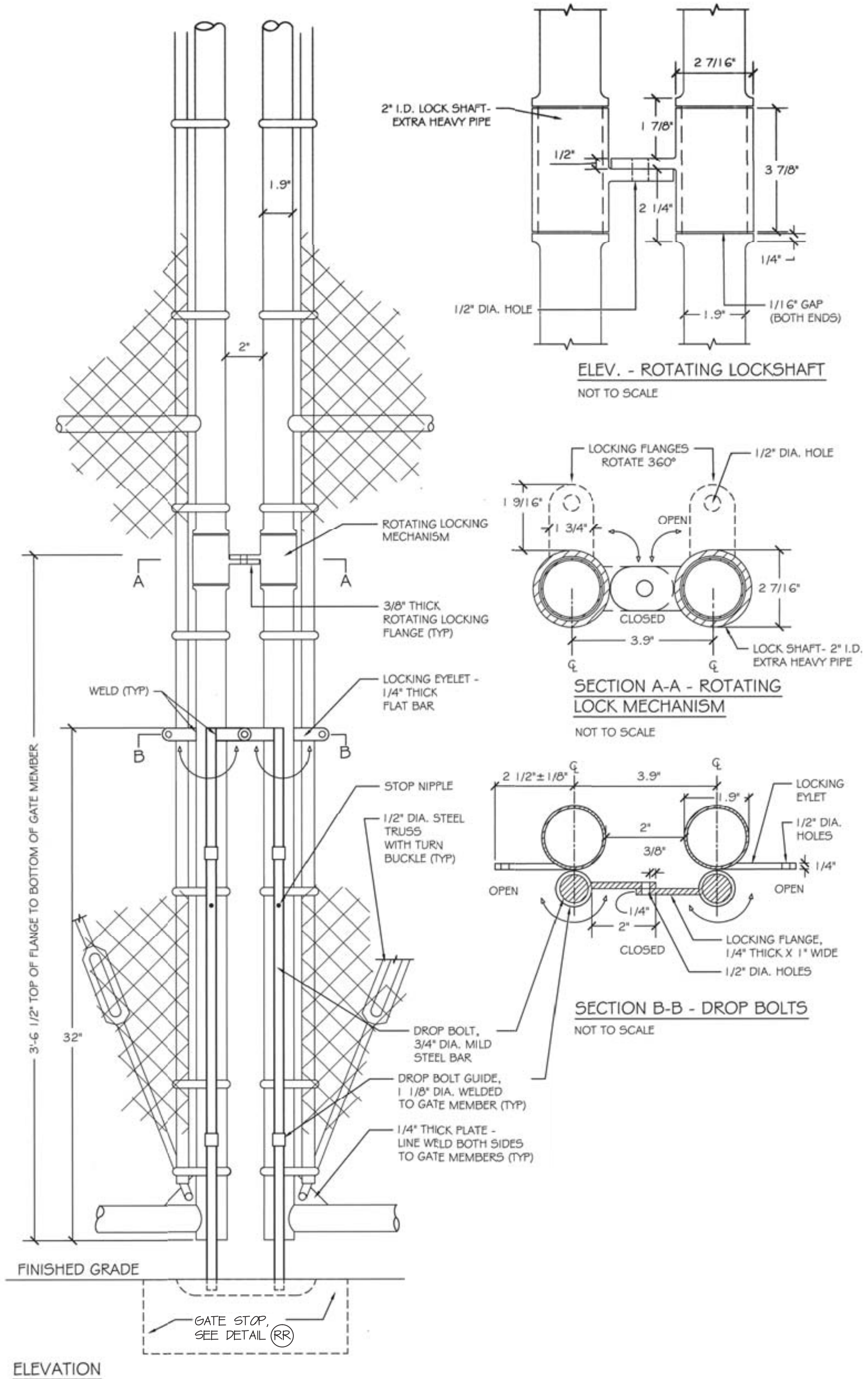
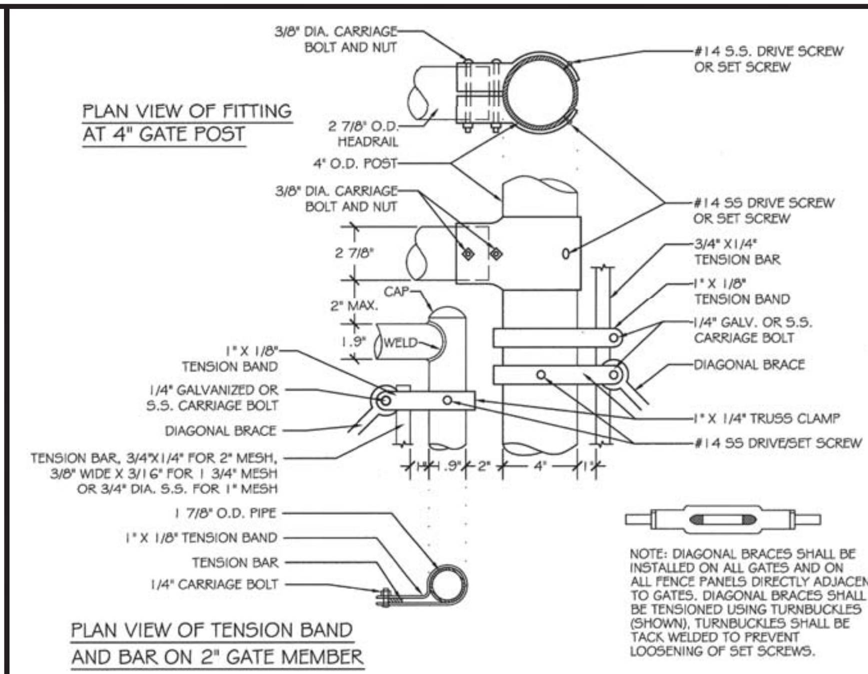
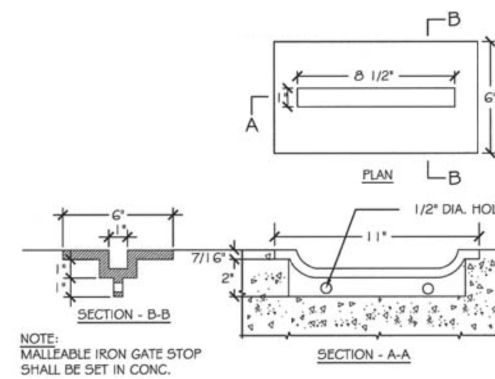


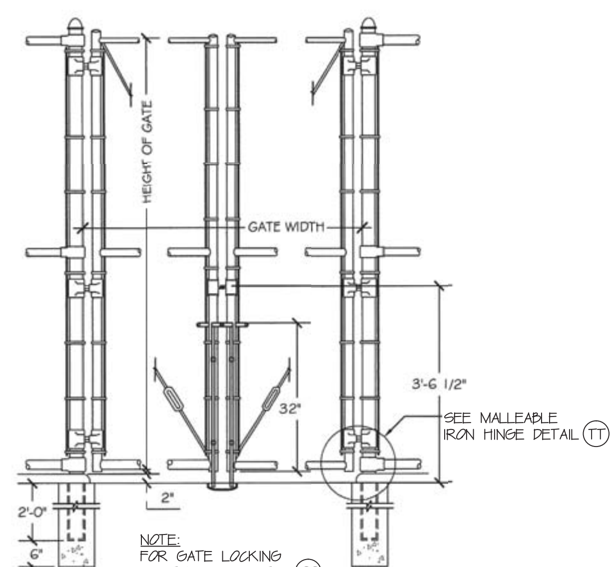
PP GATE LOCKING SYSTEM - DOUBLE GATE DETAIL
NOT TO SCALE



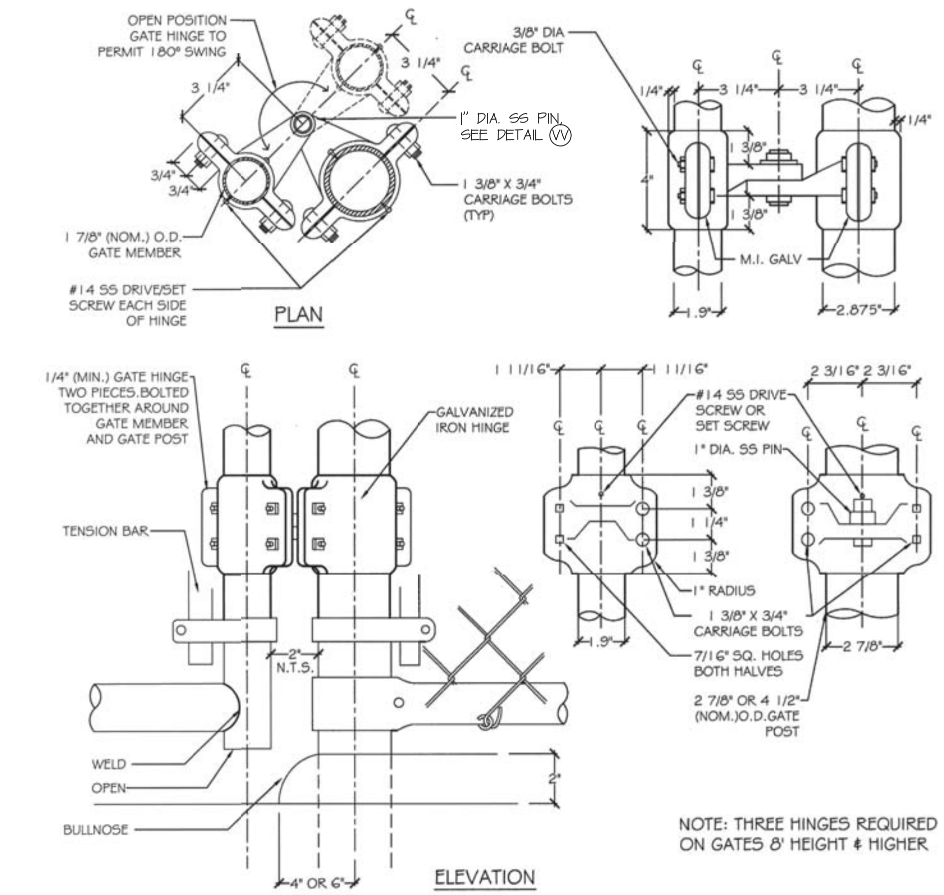
QQ HEAD RAIL AND TENSIONING ELEMENTS DETAIL
NOT TO SCALE



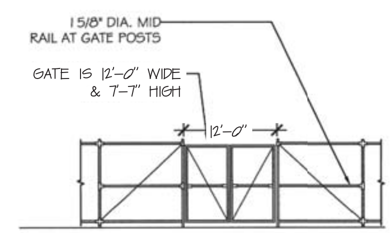
RR GATE STOP DETAIL
NOT TO SCALE



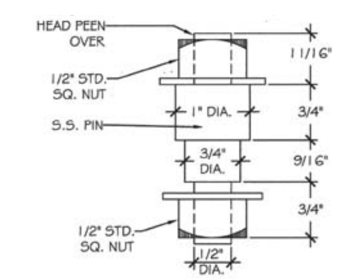
SS 8'-0" DOUBLE GATE FENCE DETAIL
NOT TO SCALE



TT MALLEABLE IRON HINGE DETAIL
NOT TO SCALE



UU 8'-0" FENCE DETAIL
NOT TO SCALE



VV HINGE PIN DETAIL
NOT TO SCALE

TYPE I: ROUND MEMBERS SHALL BE HOT DIPPED GALVANIZED CONFORMING WITH ASTM F1083 STANDARD WEIGHT SCHEDULE 40.

TYPE II: ROUND MEMBERS SHALL BE MANUFACTURED FROM STEEL CONFORMING TO ASTM-A1011/A1011M COLD ROLLED WELDED, HAVE A TENSILE STRENGTH OF 50,000 P.S.I. AND BE GIVEN CORROSION PROTECTION PER ASTM F1043 TYPE B FOR EXTERNAL COATING AND TYPE D FOR INTERNAL COATING.

PIPE POSTS & RAILS SHALL BE TYPE I OR TYPE II.

HEIGHT OF FENCE	DIAMETER OF LINE POSTS	POST SPACING MAX.	GATE POST	HORIZONTAL BRACE AT GATE POST	SIZE OF GATE MEMBERS	HORIZONTAL BRACE ON GATES	DOUBLE GATE HEIGHT	DOUBLE GATE WIDTH	DIAGONAL TRUSS ON GATE	DIAGONAL TRUSS–FENCE PANELS	PORTAL	HEAD RAIL	DEPTH OF POST FOOTING
8'–0"	2 3/8"	8'–0"	2 7/8"	(1) 1 5/8"	1 7/8"	1 5/8"	7'–7"	12'–0"	1/2" DIA.	1/2" DIA.	NO	0	2'–0"

SCHEDULE OF SIZES OF MEMBERS

NOTE:
ALL PIPE DIAMETERS ARE TRADE SIZE DIAMETERS AS SPECIFIED IN ASTM F1043, TABLE 1.
SEE "PIPE THICKNESS CHARTS" FOR ACTUAL O.D. AND THICKNESS OF PIPE.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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DRAWN BY: EB
CHECKED BY: MG
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FENCE DETAILS
(SHEET 2 OF 2)

Scale: AS SHOWN | Date: JUNE 2015 | DWG–25

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APPENDIX A

GROUNDWATER MODELING REPORT

Appendix A

Groundwater Modeling

To Support Dewatering Design for Soil Excavation

at Williamsburg Former MGP Site

July 2014

1. Site Hydrogeological Conditions

The Williamsburg Works former MGP site (the "MGP Site") is located in the Williamsburg neighborhood of Brooklyn, New York (Figures 5 and 6 of GEI (2011) (Attachment). The site consists of four parcels located along North 12th and North 11th Streets, Kent Avenue, and the East River. The 50 Kent Avenue parcel, the IRM Site, also labeled as 22 North 12th Street, is at Block 2287, Lot 1 and was the location for purifying operations, condensers and three gas holders. The 50 Kent Avenue parcel is bordered by North 12th Street to the northeast, Kent Avenue to the southeast, North 11th Street to the southwest, and Block 2287, Lot 16 to the northwest. The 50 Kent Avenue parcel is herein referred to as the "Site".

In order to evaluate potential dewatering scenarios for soil excavation, the site conditions that may affect dewatering were reviewed based on the previous site investigation results and summarized below.

1.1. Hydrology

The surrounding area of the Site is an industrial area (Figures 5 and 6 of GEI (2010). The East River is to the west and Bushwick Inlet is to the north.

The annual precipitation in New York averages to 47.25 inches or 1,200 mm per year. The seasonal variation of precipitation appears minor as shown in the following table.

Average Precipitation													
	Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
in.	47.25	3.42	3.27	4.08	4.2	4.42	3.67	4.35	4.01	3.89	3.56	4.47	3.91
mm	1200	86	83	103	106	112	93	110	101	98	90	113	99

As the ground surface in the industrial area is paved by either concrete or asphalt (although with numerous cracks) surface water runoff is expected to be high. Groundwater recharge as result of direct precipitation is expected to be relatively low.

1.2. Geology

As shown on geological cross-sections on Plates 1 and 2 and Figure 1 of GEI (2010) and further defined in the IRM Pre-Design Investigation (PDI) (URS, 2013), the subsurface geological materials underlying the Site consist of fill material and glacial deposits. The artificial fill material consists of sand and silty sand with crushed stone, wood, concrete, ash, cinders, coal, and brick. The fill material thickness ranges from 0 to 42 feet (ft), with thicknesses increasing to the north and west beneath the Site. Below the fill material the lithology predominantly consists of poorly sorted sand with layers of silty sand and silt (i.e., glacial material). A clay layer (i.e., glacial material) is present beneath the site and is encountered at a depth ranging from 32 to 90 ft below ground surface (bgs), with a thickness ranging from 10 to 31 ft. Beneath the Site this clay layer is continuous based on GEI (2010) and URS boring logs from the IDI. The glacial materials underlying this area are stratified drift and till materials with variable fractions of clay, silt, sand, and gravel that are usually poorly sorted with relatively impermeable zones (i.e., the clay and silt zones).

1.3. Hydrogeology

The groundwater level contour lines are represented on Figures 5 and 6 of GEI (2010) and Figure 3-5 of the PDI report (URS, 2013). Groundwater flows to the west and northwest towards East River and Bushwick Inlet. The upgradient groundwater levels were at 6.37 to 6.40 ft amsl (WW-MW-01). The downgradient groundwater levels were around sea level at the East River.

Groundwater elevations measured at high tide (Figure 5, GEI, 2010) and at low tide (Figure 6, GEI, 2010) are not significantly different at the Site. The tidal influence on groundwater levels appears extended approximately 300 ft away from East River (near WW-MW-08 on Figures 5 and 6 of GEI (2010)), and is not in the vicinity of the Site.

At the Site, groundwater has been encountered between 1 to 16 ft bgs historically. As shown in Figures 5 and 6 of GEI (2010) and Figure 3-5 of the PDI report (URS, 2013), groundwater mounding has been observed near the three gas holder tanks at the Site.

The hydraulic conductivity of saturated geological materials at the Site ranges from 0.05 to 5.68 feet per day (ft/d) (or 1.71E-05 to 2.00E-03 cm/s) based on the URS slug tests at eight monitoring wells. The estimated geometric mean of the shallow hydraulic conductivity was 1.23 ft/d based on the slug tests at five shallow wells (WW-MW-04, WW-MW-05, WW-MM-07, WW-MW-08, and WW-MW-17). The estimated geometric mean of the intermediate hydraulic conductivity was 0.2 ft/d based on the slug tests at two wells (WW-MW-100I and WW-MW-102I). The deep hydraulic conductivity beneath the clay layer was estimated to be 1.66 ft/d based on the slug test at WW-MW-102D. There is uncertainty associated with the K values estimated from the slug test, as the Site's heterogeneous geologic materials (Section 1.5) and the local boundary conditions (Section 1.4) could not meet the ideal conditions (homogeneous and boundary is far away) assumed in the analytical solutions. Based on the groundwater mounding at the Site and the NAPL saturation in the subsurface, the slug tests may overestimated the shallow K values at the Site. Further discussion on the K values used in modeling is presented in sections 3.1 and 3.2.

1.4. Gas Holder Foundations

There are three foundations of former gas holders located on the Site and two foundations of former gas holders located east of the Site. These foundations remain underground. The bottom of the gas holder foundations are concrete, and are approximately 27 to 28 ft bgs. The walls of the foundations are brick and in some cases contain rings of metal that were part of the former tanks. These foundations are filled with saturated soils.

Groundwater mounding is observed in the vicinity of the gas holder foundations at WW-MW-04, WW-MW-05, WW-MW-06, and WW-MW-07, ranging from7.34 to 9.58 ft amsl, as shown on Figures 5 and 6 of GEI, 2010, which were elevated about 1 to 3 ft higher than the upgradient water levels (WW-MW-01 (6.37 – 6.40 ft amsl)). The observed groundwater elevations in August 2012 from the shallow monitoring wells are posted on Figure 3. In addition, the observed groundwater elevations at wells screened in the lower portion of the soil but above the clay layer are substantially lower (WW-MW-100I, 2.23 ft, amsl and WW-MW-102I, 3.84 ft amsl) than the groundwater elevations in the upper portion. These observations indicate that the foundation floor may act as a vertical barrier and holder walls may act as a horizontal barrier to groundwater flow.

1.5. Subsurface NAPL Distribution

The site is characterized by substantial non-aqueous phase liquids (NAPLs) in the subsurface inside and outside of the gas holders. The degree of NAPL saturation in the soils varies from location to location and from depth to depth. Some boring logs indicate 100% NAPL saturation and heavy black coating. Recently installed NAPL recovery wells had in excess of 15 feet of product accumulated within a month of installation.

The substantial presence of NAPL in the subsurface has significant impact to the hydraulic property of the subsurface soils. When two fluids (water and NAPL) are mixed in soil, the relative permeability of each fluid is greatly reduced by the saturation of the other fluid (Newell, et al., 1995). The mobility of NAPL is reduced, so is the mobility of water.

The observed persistent groundwater mounding in the vicinity of the gas holders may be largely attributed to the locally reduced hydraulic conductivity of the subsurface soils due to the NAPL saturation.

2. Groundwater Flow Model Development

A groundwater flow model was developed based on the available data at the Site, for the purpose of evaluating potential dewatering scenarios for soil excavation. The USGS three-dimensional groundwater flow model code MODFLOW-2005 (Harbaugh, 2005) is used and Groundwater Vistas Version 5 is used as graphic processing utility (Rumbaugh and Rumbaugh, 1996 – 2007).

2.1. Model Domain

The model domain covers a large area (1,550 ft by 2,100 ft) as shown in Figure 1. The model domain includes much larger area than the Site, to avoid any potential boundary effect to the proposed dewatering.

The model origin is at x = 640,600 ft and y = 688,850 ft with rotation of -39 degrees in state plane coordinates.

The model domain includes 150 rows and 210 columns. Model cell is 10 ft by 10 ft uniformly over the entire model domain.

2.2. Model Layers

The hydrostratigraphy beneath the Site includes three layers: fill/glacial deposits, clay, and native glacial deposits. Due to presence of the gas holders and according to the proposed soil excavation plan, the layer above the clay is further divided into three layers.

Totally, the model includes five layers (Figure 2):

- Layer 1 – Filled materials and/or glacial deposits as well as gas holders
- Layer 2 – Silty sand and silt
- Layer 3 – Silty sand and silt
- Layer 4 – Clay
- Layer 5 – Sandy silt, silt, and silty sand

The top of Layer 4 (the clay layer), is specified following the clay contour map (Figure 4 of GEI, 2010) with limited modification and based on URS boring logs in the PDI report. Outside of the area where clay contours are not available, the top of Layer 3 was specified based on extrapolation.

Following the top elevations of Layer 4, the bottom elevations of the other layers were specified accordingly. The bottom of Layer 1 was specified to be approximately 27 ft bgs (or – 17 ft, amsl) to allow simulation of the concrete bottom of the gas holders as bottom of Layer 1. The bottom of Layer 2 was specified to be approximately 45 ft bgs (or - 35 ft amsl) to allow simulation of the proposed impermeable rectangular wall to a depth of 45 ft bgs. The thickness of Layer 4 (clay layer) was assumed to be five ft. The bottom of Layer 4 was assumed to be at – 90 ft amsl uniformly for the entire model domain.

2.3. External Boundary Conditions

As shown in Figure 1, the East River and Bushwick Inlet were specified as MODFLOW River Boundary condition; the east, south, and northeast boundaries were specified as General Head Boundary condition. The river stage was assumed to be at the average level of high tide and low tide (Figures 5 and 6 of GEI, 2010) to be 1.42 ft amsl. The hydraulic heads along the General Head Boundaries were extrapolated following the interpreted groundwater contour lines on Figures 5 and 6 of GEI (2010).

No-flow boundary was assumed for model Layer 4 (clay layer), as it is considered as an aquitard. The general head boundaries were specified for model Layers 2, 3, and 5, similar to Layer 1.

2.4. Gas Holder Foundation Effect

The gas holder foundations were simulated for their hydrogeological effects to the groundwater flow in the model calibration (Section 3). As shown in Figure 1, the wall of each gas holder is simulated as horizontal hydraulic barrier using MODFLOW horizontal flow barrier package or "wall" in the model. The thickness of the wall was assumed to be one foot and the hydraulic conductivity of the wall was assumed to be 0.001 ft/d during model calibration (Section 3).

The hydraulic effect of the gas holder bottom (concrete) was simulated using a high vertical anisotropic ratio of horizontal vs. vertical hydraulic conductivity of Layer 1 within the gas holder cycles to be 10,000 : 1.

2.5. Groundwater Recharge

Groundwater recharge was estimated to be 3 inches/year, which is approximately 6.5% of the long-term annual precipitation (Section 1.1). This recharge rate is considered reasonable based on the paved ground surface condition (concrete or asphalt with cracks) in this area.

3. Groundwater Flow Model Calibration

Observed hydraulic heads during August 2010 (GEI, 2010) were used as the model calibration targets. The model calibration was conducted to adjust the hydraulic parameters for the geologic materials at the Site and in the area. The slug test results (Section 1.3) were used as general guidance for estimation of hydraulic conductivity values.

Model calibration was conducted three times for Base Case, Alternative Case I, and Alternative Case II. The two alternative case calibrations were conducted to address the concern for that the estimated K value of the shallow soils at the Site was substantially lower than the one estimated by the slug test results.

3.1. Base Case Calibration

The model calibrated groundwater level contour lines of Layer 1 are presented on Figure 3 in comparison with the observed hydraulic heads of August 2012. The calibration statistics are: the residual mean = 0.01 ft and the scaled root mean square error (RMSE) = 2%. The calibration statistics are considered reasonable for the objective of modeling, and in comparison to the general rule of thumb that calibration statistics should have the RMS within 10% to 15%.

The model estimated shallow K distribution is presented in Figure 4. The estimated hydraulic conductivity of Layer 1 (fill/glacial) in the vicinity of the gas holders is 0.12 ft/d, and the estimated hydraulic conductivity of the rest area of Layer 1 ranges from 0.44 ft/d, 1.9 ft/d, and 6 ft/d. The low K value of 0.12 ft/d was estimated to match the local groundwater mounding in the vicinity of the gas holder (Figure 3), which may not be unreasonable in consideration of the high saturation of NAPL in subsurface (Section 1.5). The estimated K value at the Site in Layer 2 is 0.44 ft/d, which may be representative of the mixture of fill/glacial (silt/sand) in the surrounding area. This model calibration accurately matched observed hydraulic heads under steady state conditions at the site. However, the assumed K value of the shallow layer was much lower than was predicted by evaluating slug test results.

The vertical anisotropic ratios of horizontal vs. vertical hydraulic conductivities were estimated to be 10:1 for most layers at the Site. The vertical anisotropic ratio of Layer 1 was estimated to be 20:1 in the vicinity of the Site where groundwater mounding was observed. The assumed vertical anisotropy ratio was 1,000:1 in Layer 1 to simulate the concrete bottom of the gas holders.

3.2. Alternative Case Calibrations

In order to make the shallow K values to be closer to the slug test results, two alternative calibrations were conducted by using higher K values at the Site. In Alternative Case I, the shallow K value at the Site was assumed to be 0.44 ft/d, and in Alternative Case II, the shallow K value at the Site was assumed to be 1.0 ft/d.

In both alternative cases, the steady state groundwater flow models were calibrated to match the observed hydraulic heads of August 2012. These two alternative cases serve as sensitivity analyses to evaluate the uncertainty of model calibration and model prediction.

The reason for alternative case calibration is as follows. If simply replacing the calibrated K value of 0.12 ft/d (Section 3.1) in Layer 1 with a higher value, the simulated initial water levels at the Site would be substantially lower than the observed ones, or the saturated thickness of the surrounding area would be much less than the observed saturated thickness. To have a comparable saturated thickness in the dewatering simulation, the uncertainty evaluation should be based on a calibrated model that matches the observed hydraulic heads.

Alternative Case I Calibration

In Alternative Case I, the hydraulic conductivity of Layer 1 was assumed at 0.44 ft/d to be comparable to the commonly accepted value of silt and sand. Although this value is less than the values estimated from the slug tests (geometric mean of 1.23 ft/d), it is greater than the hydraulic conductivity in the Base Case. In order to match the observed hydraulic heads of August 2012, the vertical anisotropic ratio between horizontal vs. vertical hydraulic conductivity was increased to 100:1, which means the vertical hydraulic conductivity was further reduced. In addition, the shallow hydraulic conductivity in the upgradient area was increased to 6 ft/d to allow more flux coming from upgradient.

Alternative Case II Calibration

In Alternative Case II, it was assumed the hydraulic conductivity of Layer 1 at the Site was equal to 1.0 ft/d to be further close to the estimated K value of the slug test results. The hydraulic conductivity in the rest of area of Layer 1 and in all areas of Layers 2 and 3 are the same as in Alternative Case I. The recharge at the Site was increased to 3.5 inches/yr, which is higher than the surrounding area (3 inches/yr). This was also considered to be one of the possible factors that may contribute to the observed groundwater mounding at the Site.

The calibrated groundwater levels in this alternative case match the observed heads in August 2010. However, the area with a higher vertical anisotropy ratio (100: 1) of horizontal vs. vertical hydraulic conductivity was required to be larger than in Alternative Case I. In other words, to reasonably match the groundwater elevations in the vicinity of the gas holders, the vertical hydraulic conductivity in the shallow layer and the middle layer is required to be further reduced while the horizontal hydraulic conductivity is further increased in Layer 1.

4. Evaluation of Dewatering Plan

A transient groundwater flow model was developed to simulate the dewatering process along with the soil excavation. To prepare initial hydraulic heads for the transient flow model, a steady state groundwater flow model was developed to simulate the construction work plan prior to dewatering.

4.1. Steady State Flow Model Prior to Dewatering

According to the proposed dewatering plan, two conditions were prepared prior to dewatering:

- Solidifying the east gas holder as an impermeable cylinder
- Installing a rectangular impermeable construction wall to a depth at 45 ft bgs surrounding the two west gas holders

The model setup for the two conditions and the simulated groundwater level contours of the Base Case prior to dewatering are shown in Figure 4. It is assumed that the hydraulic conductivity of the impermeable cylinder is 1.0E-07 cm/s (2.8E-04 ft/d) and the groundwater recharge on the cylinder is reduced to 0.3 inches/yr due to the impermeability of the cylinder; and the rectangular impermeable construction wall was assumed to be 0.01 ft thick with an assumed hydraulic conductivity of 1.0E-09 cm/s (2.28E-06 ft/d).

The steady state flow model prior to the transient dewatering water model was applied to the three cases to prepare the initial hydraulic heads, respectively.

4.2. Transient Dewatering Model

In the transient dewatering flow model, it was assumed that

- Specific yield is 0.05 and specific storage coefficient is 0.0001 1/ft, to be relatively conservative for estimation of dewatering rate;
- Dewatering sumps are located inside and outside of the two gas holders and dewatering sumps are simulated using MODFLOW Drain cells;
- The dewatering progress is assumed downward at a rate of 0.3 ft/d (approximately a couple ft per week);
- Following the daily dewatering progress for 100 days (simulated as 100 stress periods), the final depth to water within the rectangular wall needs to be at 30 ft bgs approximately as proposed;
- The simulated groundwater levels in the associated steady state flow models prior to dewatering (Section 4.1) are assumed as the initial water levels prior to dewatering.

4.3 Estimated Groundwater Level Drawdown and Dewater Rates

The transient dewatering model was applied to the three calibrated cases. The simulation results of the three transient dewatering models are discussed below.

The predicted maximum drawdown of the groundwater table (Layer 1 hydraulic heads) by 100 days are presented for Base Case, Alternative Case I, and Alternative Case II, on Figures 5, 6, and 7, respectively. Inside of the rectangular construction wall, the water table drawdown is 25 ft below the initial water level in all the cases. As the initial water level is approximately 3 ft bgs, the drawdown inside of the construction wall is approximately 28 ft bgs.

Outside of the rectangular wall, the water table drawdowns for the three cases are different. On Figure 5 (Base Case) the water table drawdown varies from 2.5 ft at the Site to 0.5 ft covering an area of approximately 670 ft in diameter. On Figure 6 (Alternative Case I), the water table drawdown varies from 0.5 ft to 1.5 ft between the gas holders. On Figure 7, there is almost no water table drawdown away from the Site except 0.5 ft near the construction wall.

The simulated daily dewatering rates over 100 days for the three cases are presented on Figures 8, 9, and 10, respectively.

For Base Case (Figure 8), the simulated daily dewatering rates during the first a few days are low and then gradually increase to 3 gallon per minute (gpm). During the earlier period, the water available to sumps is primarily from Layer 1 inside of the rectangular wall. After Day 51, when sumps move downward into Layer 2 (Layer 1 is dry within the rectangular wall), the dewatering rates increase fast up to 6 gpm by Day 100. The higher rate of dewatering is due to the upward vertical flux from Layer 3 below the construction wall. The estimated total volume of water dewatered during the 100 days is 330,000 gallons.

For Alternative Case I (Figure 9), the simulated daily dewatering rate increases from 0.1 gpm to 1.8 gpm in the first five days during which the water available to sumps varies within the rectangular construction wall due to the variation of shallow soil saturation. Then the dewatering rate increases at a slow and stable rate up to 2.3 gpm by 51 days. During the later period when sumps move downward into Layer 2 dewatering rate increases faster, as some water available to sumps is vertically from Layer 3. The maximum dewatering rate increases to almost 3.5 gpm by Day 100. The estimated total volume of water during the 100 days is 353, 000 gallons.

For Alternative Case II (Figure 10), the simulated daily dewatering rate is relatively higher, varying from 1.3 gpm to 1.8 gpm in the first five days. Then the dewatering rate increases at a slow and stable rate up to 2.2 gpm by Day 52. During the later period when sumps move downward into Layer 2 dewatering rate increases slowly up to 3 gpm. The reason for lower dewatering rate in later period in Alternative Case II is that water vertically from Layer 3 is limited due to the small vertical leakance estimated in the model calibration. The estimated total volume of water during the 100 days is 337, 000 gallons.

The relatively higher drawdown and higher later-period dewatering rate predicted in Base Case indicate that the dewatered water is primarily from Layer 3 beneath the construction wall. This result may be reasonable based on the site conditions where the shallow soils at the Site are more impacted by the NAPL saturation while the deeper soils are less impacted by the NAPL saturation. Thus when sumps move downward into Layer 2, upward vertical flux comes from Layer 3 beneath the construction wall.

In the alternative cases, as the vertical hydraulic conductivity was forced to be reduced in the model calibrations, when sumps move downward into Layer 2, only limited upward vertical flux moving upward from Layer 3. Thus, the simulated water table drawdown is less and the later-period dewatering rate is not increased much.

5. Summary and Discussion

Groundwater modeling was conducted to simulate the hydrostratigraphy and the subsurface gas holder remaining at the Site. Three model calibrations (base case and alternative cases) were conducted to estimate the hydraulic properties of the shallow soils. Construction dewatering was simulated using transient flow model for 100 days.

Following the proposed construction work plan, which involves solidification of east gas holder and installation of a rectangular construction wall around the two west gas holders, the maximum groundwater table drawdown by 100 days of dewatering and the daily dewatering rate were estimated using the three calibrated cases.

Comparison of the three sets of simulation results allowed reasonableness evaluation of the prediction results. The prediction results of Base Case appear to be more reasonable than the two alternative cases, although the predicted impact of either the cases is limited, given most of water is primarily comes from the saturated soils within the rectangular construction wall.

The uncertainty evaluation results based on alternative model calibrations also suggest that the impact of NAPL saturation to the hydraulic properties of the shallow soils at the Site may be significant. Even the model calibration had intension to increase the shallow hydraulic conductivity at the Site to be closer to the slug test results, the estimated hydraulic conductivities were required to be reduced for the shallow soils either in horizontal or vertical directions; otherwise the model cannot be calibrated.

6. References

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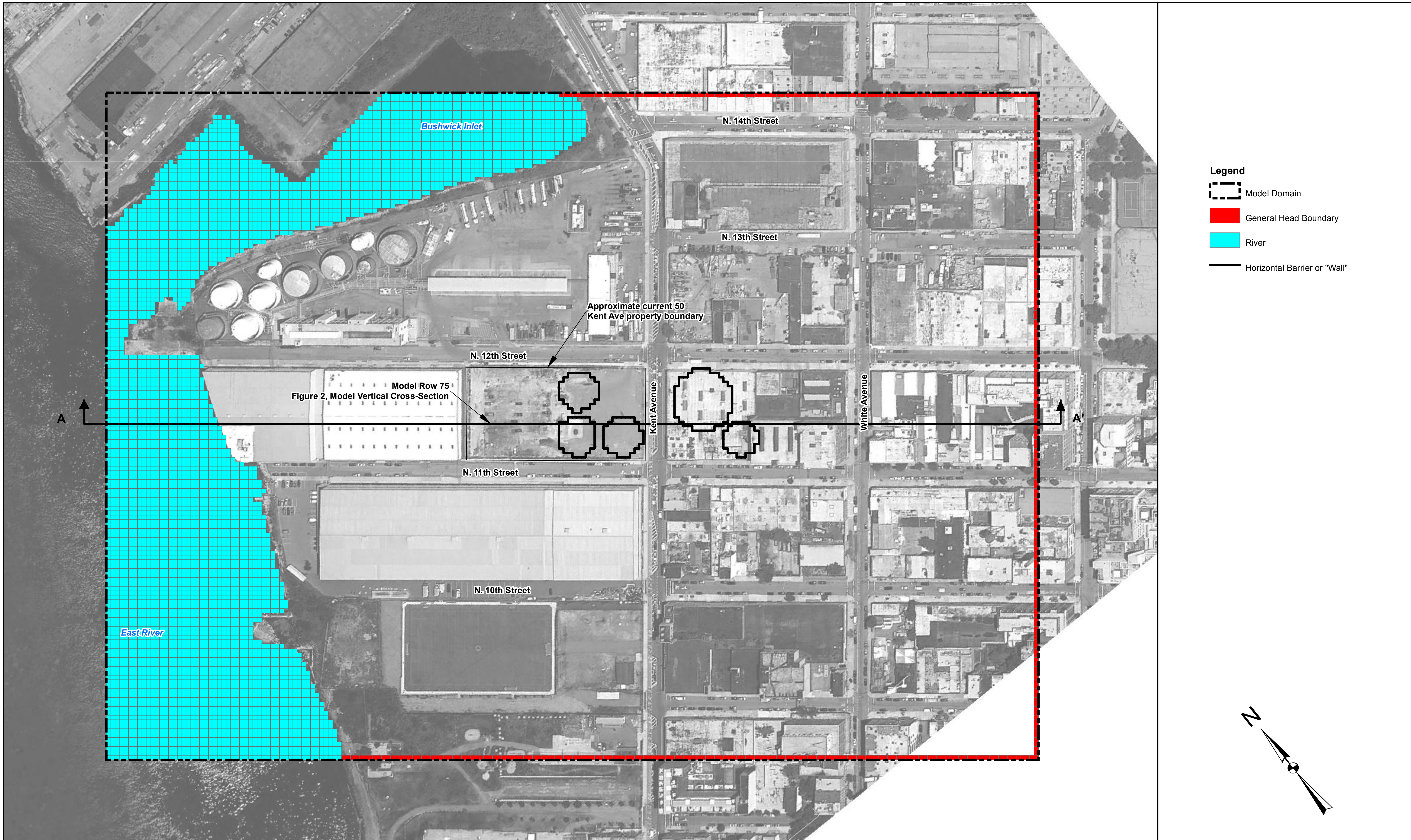

Path: W:\General\Williamsburg\GIS\maps2014\Fig01 Model Domain.mxd

PHOTOGRAPH OBTAINED FROM GOOGLE EARTH TM ©2009, IMAGE ©2010 DIGITAL GLOBE, ACCESSED ON 10/20/10.

IRM DESIGN INVESTIGATION
50 KENT AVENUE PARCEL OF THE
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Model Domain with Boundary Conditions

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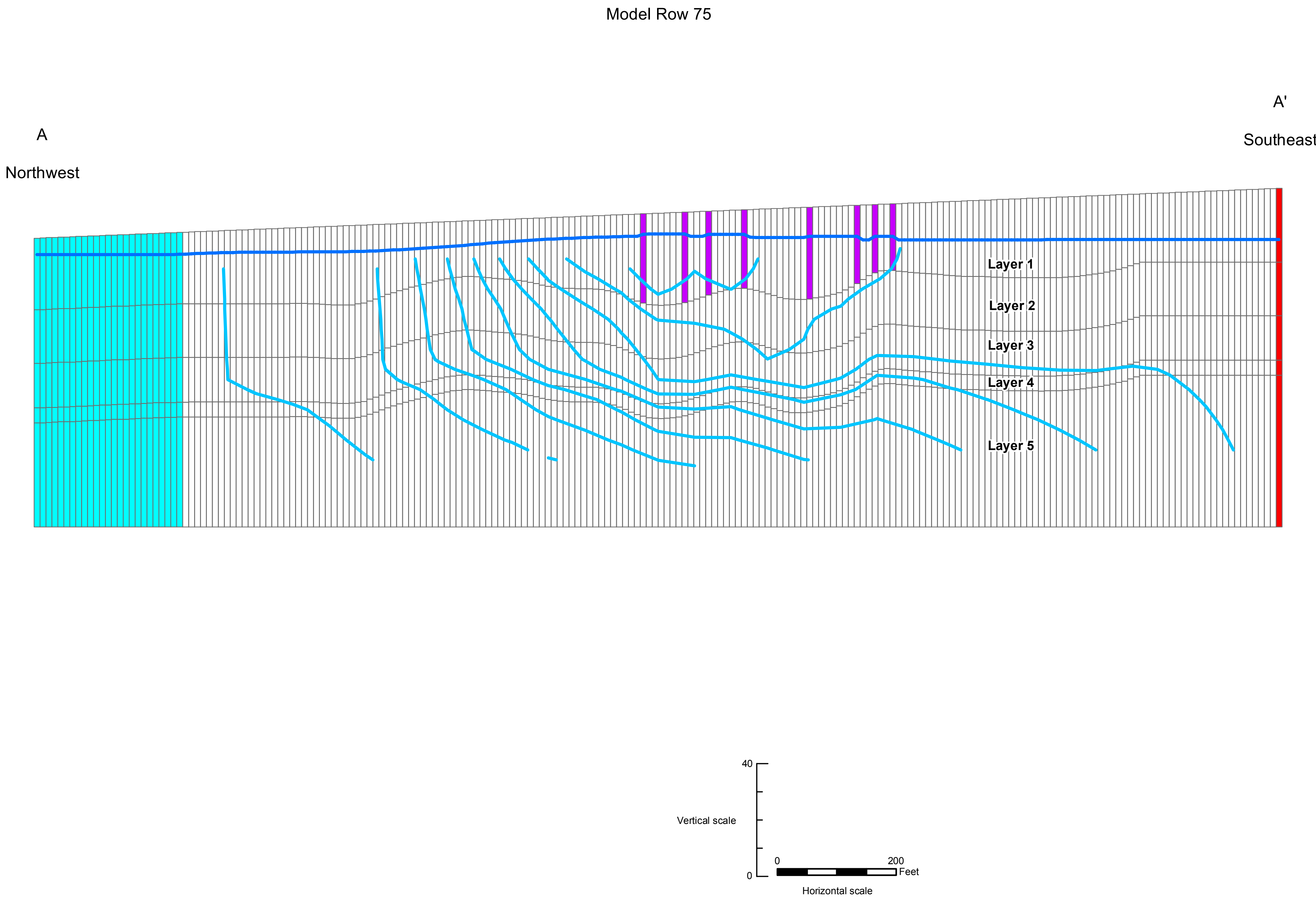
Figure 1



Legend

- Simulated Hydraulic Head
- Simulated Water Table
- General Head Boundary
- River
- Horizontal Barrier or Wall
- Grid

Location of Model Row 75 is shown on Figure 1

Path: W:\General\Williamsburg\GIS\maps2014\Fig02 Model XSection.mxd

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Model Vertical Cross-Section

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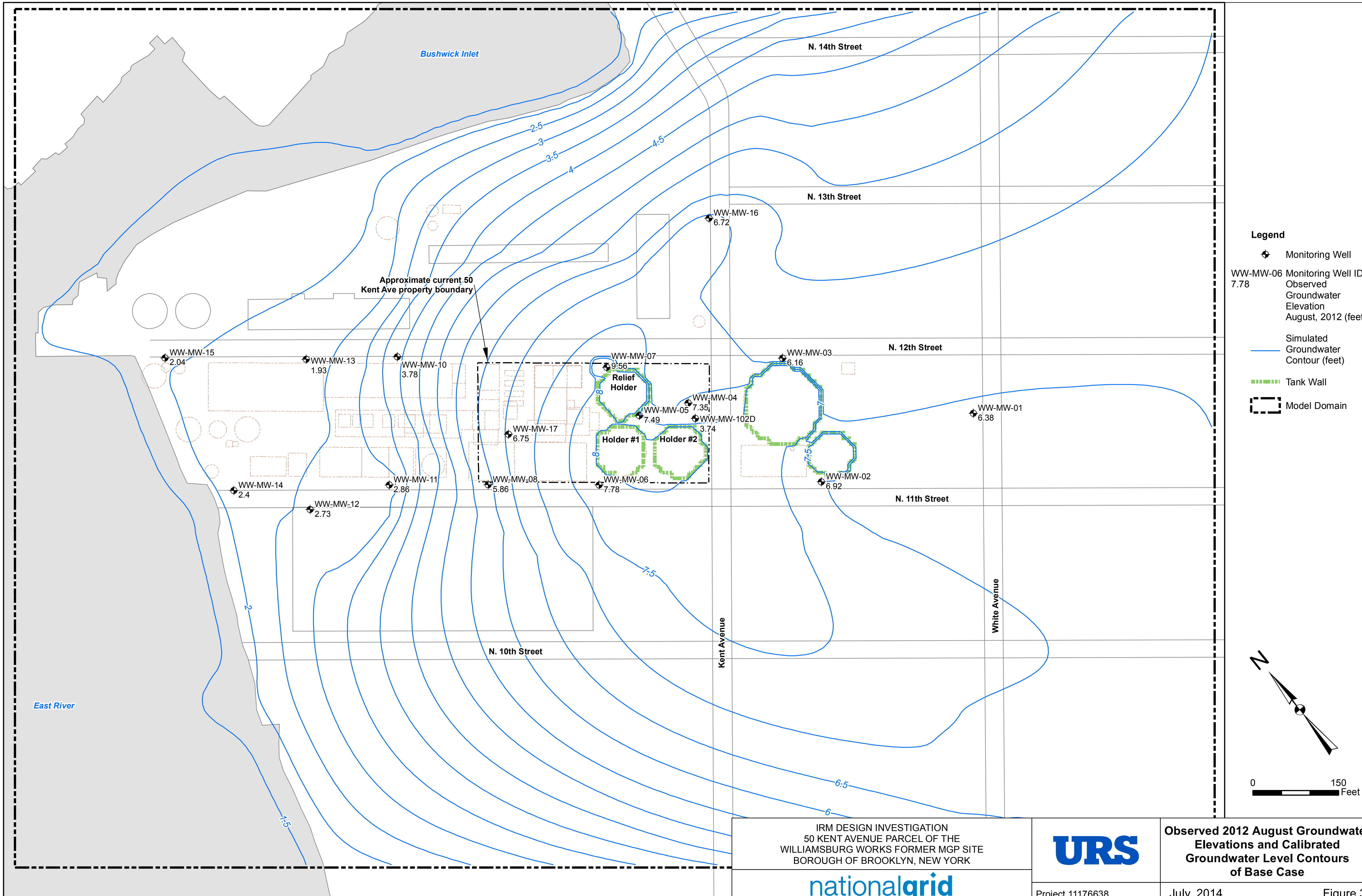
Figure 2



Path: W:\General\Williamsburg\GIS\maps2014\Fig03 Simulated Steady State GW.mxd

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Observed 2012 August Groundwater Elevations and Calibrated Groundwater Level Contours of Base Case

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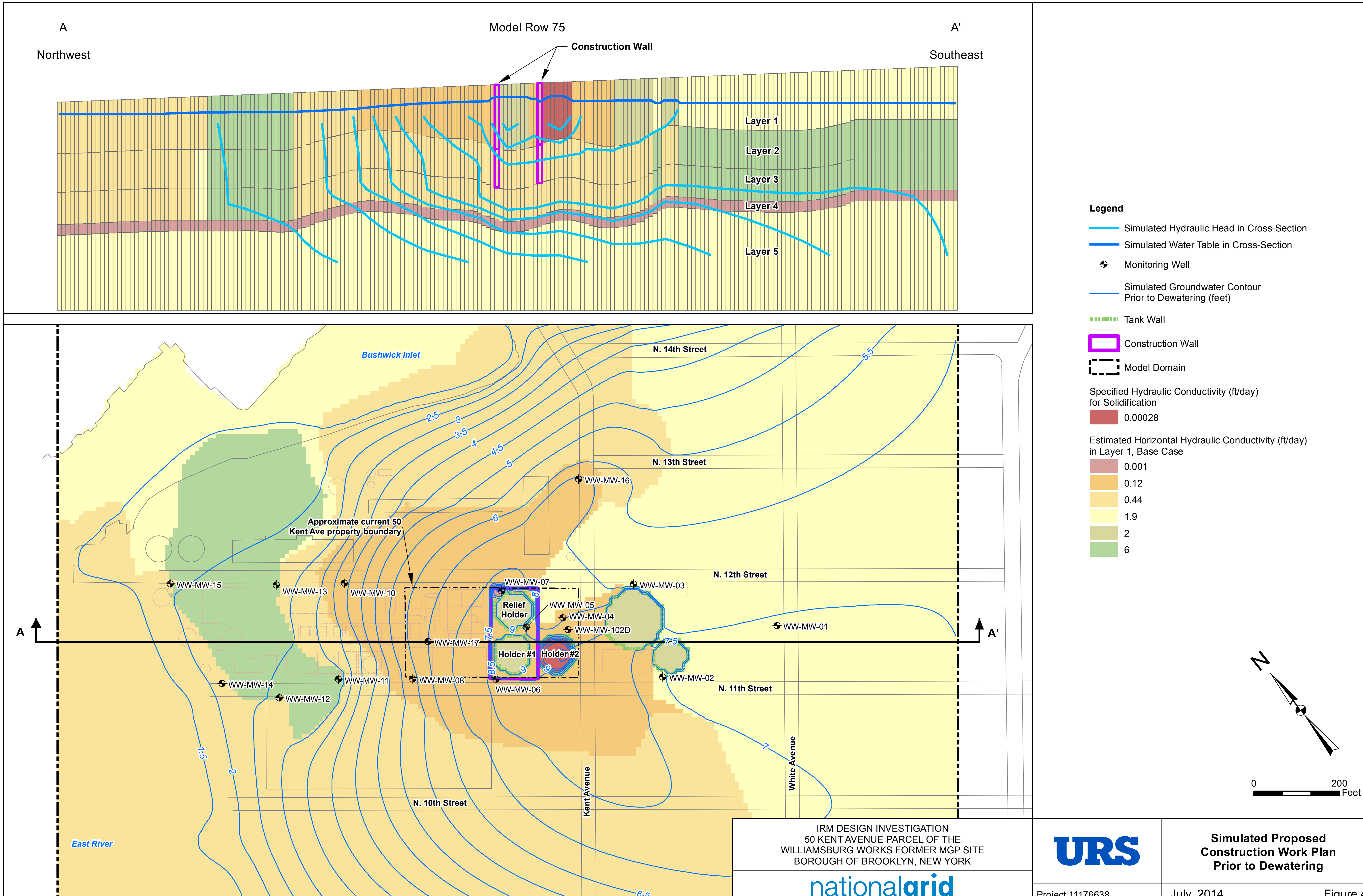
Figure 3



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Simulated Proposed Construction Work Plan Prior to Dewatering

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Figure 4

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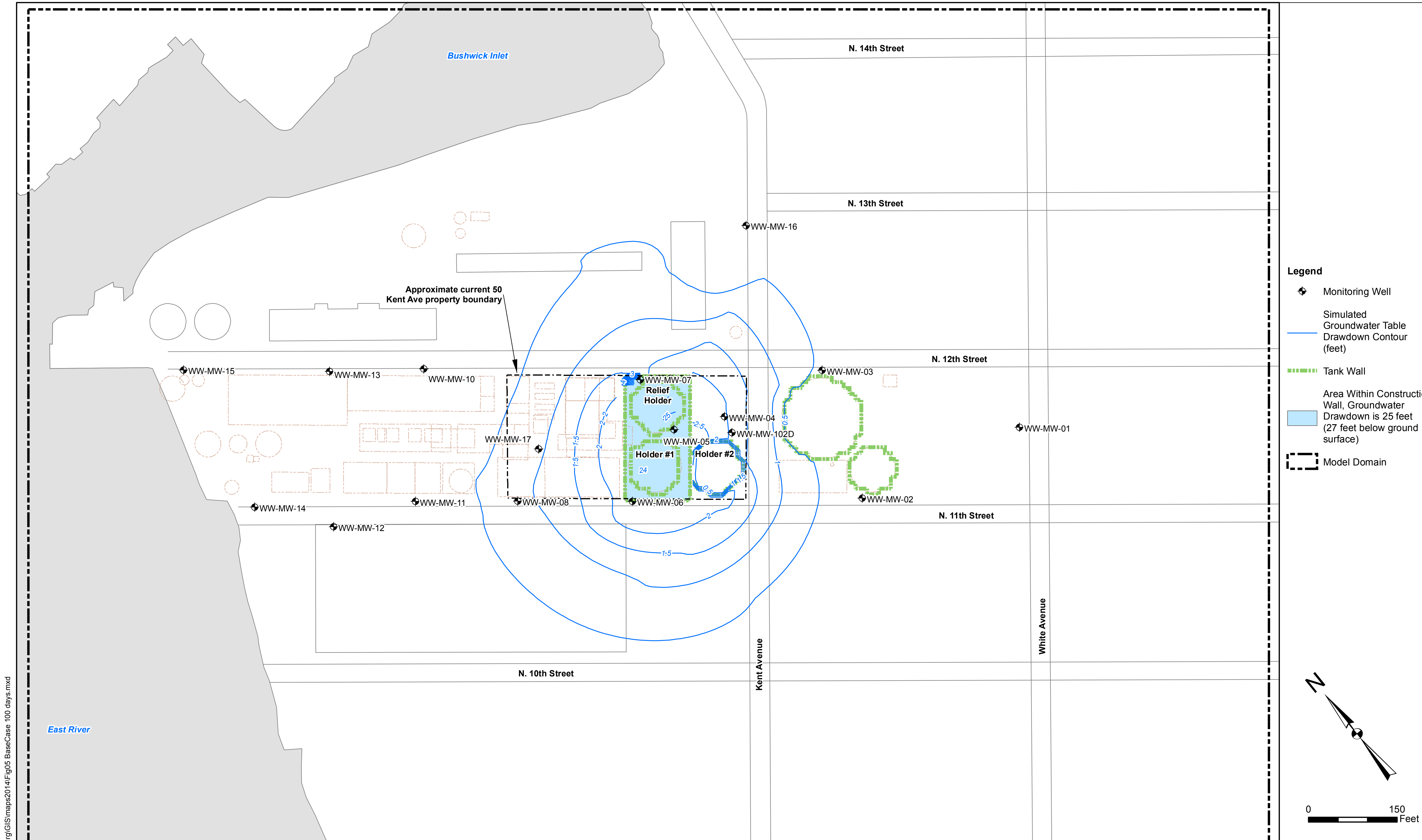

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Simulated Groundwater Table Drawdown by 100 days of Dewatering - Base Case

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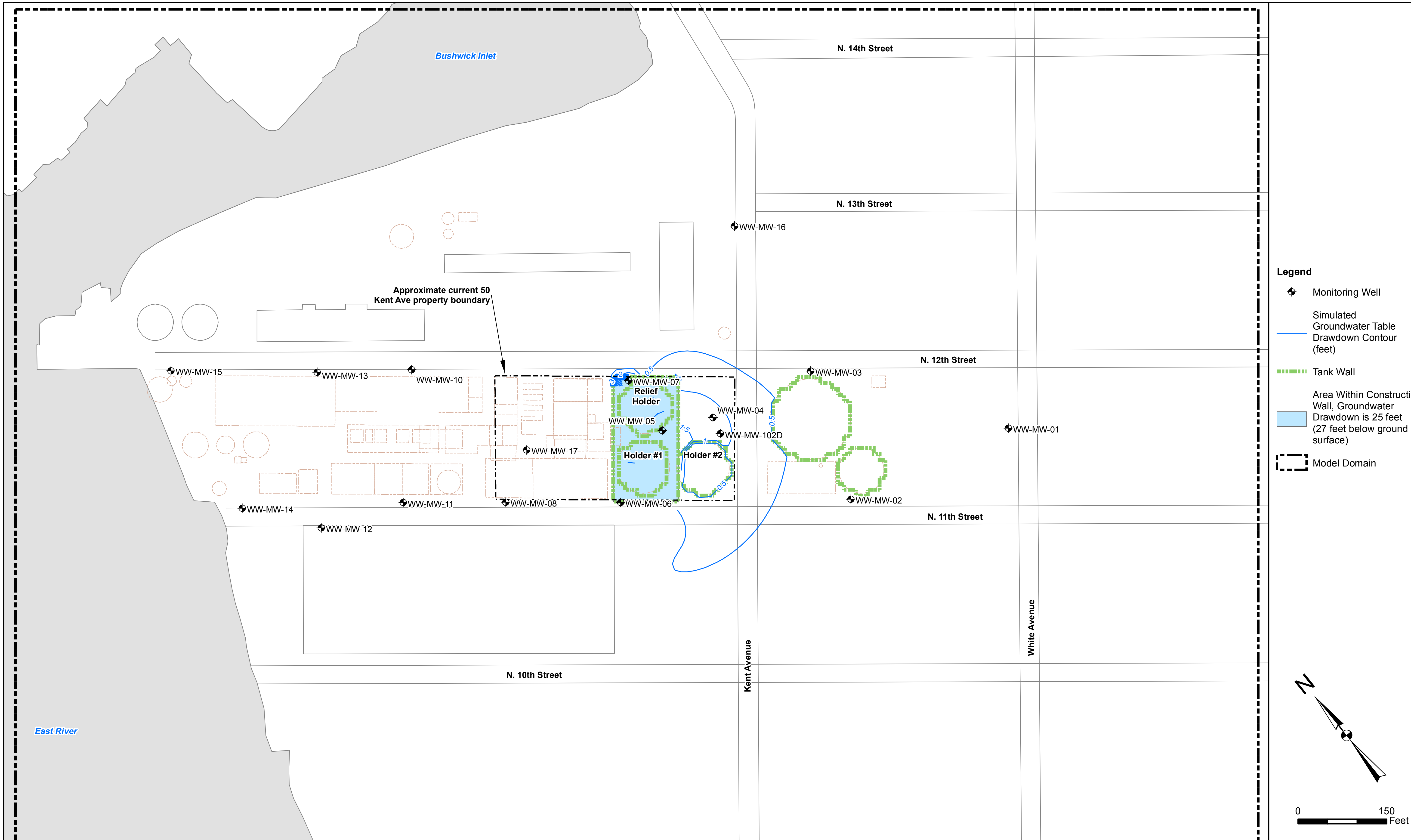
Figure 5



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Simulated Groundwater Table Drawdown by 100 days of Dewatering - Alternative Case I

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Figure 6

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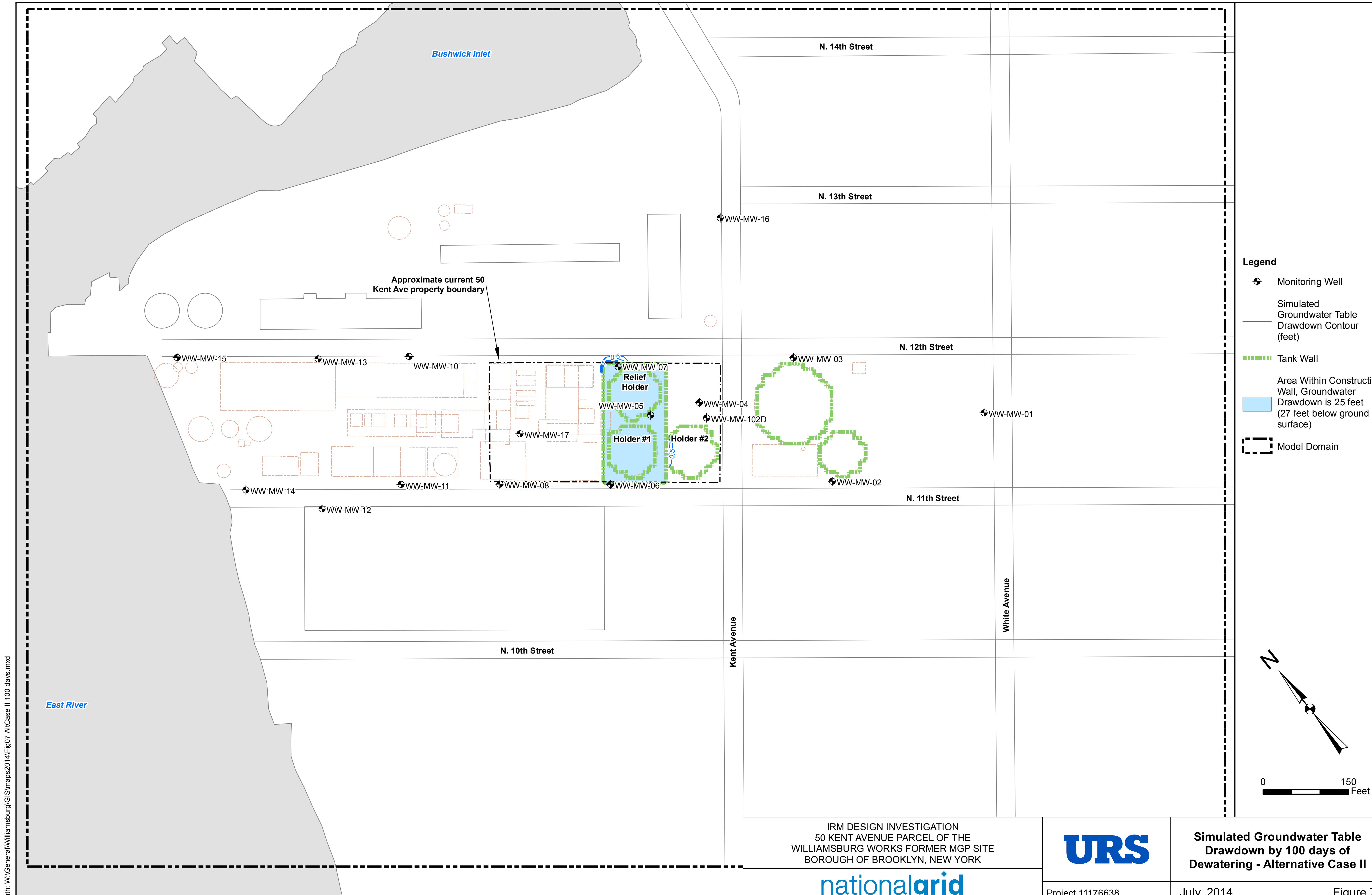

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Simulated Groundwater Table Drawdown by 100 days of Dewatering - Alternative Case II

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Figure 7

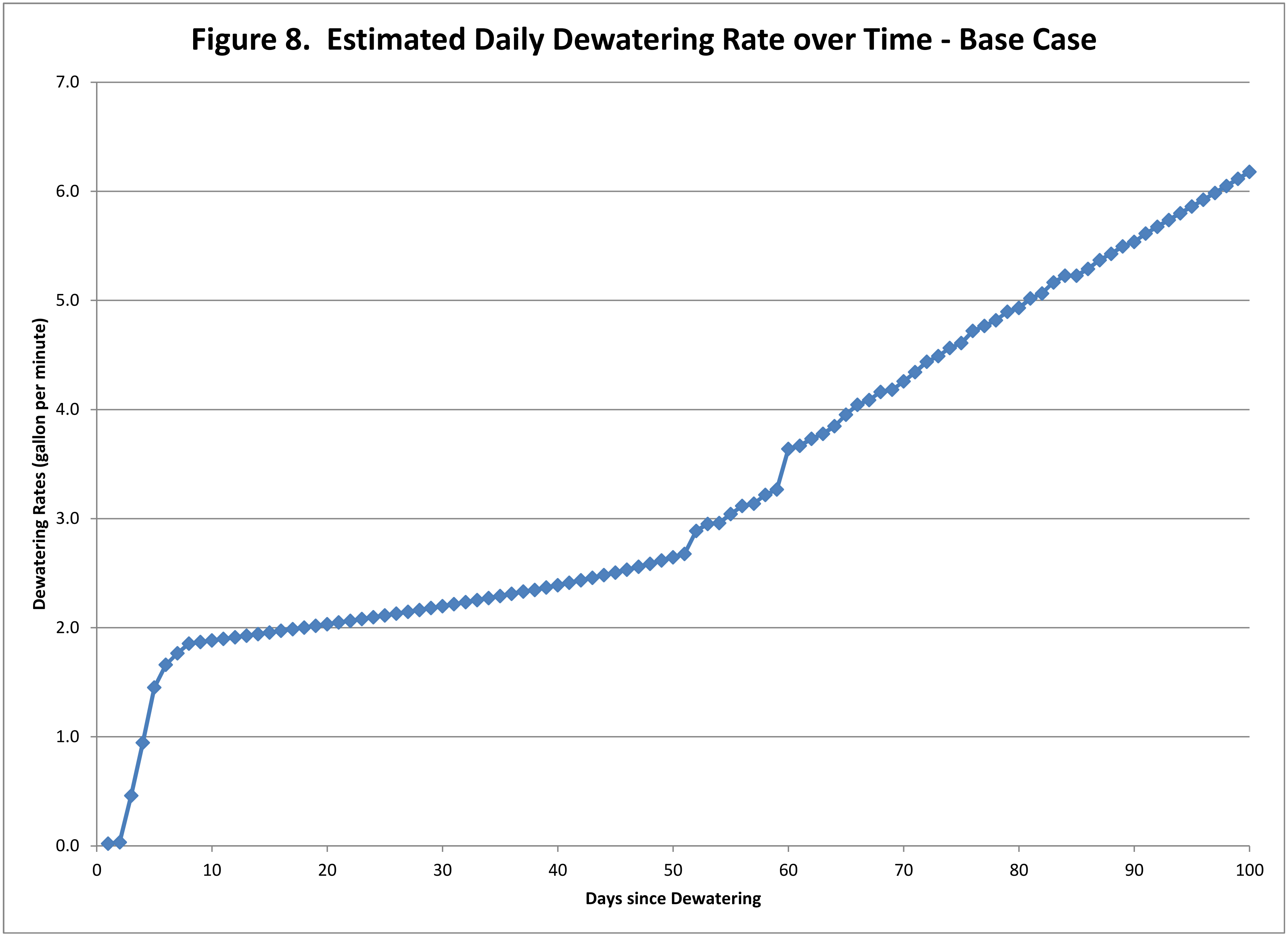


Figure 8. Estimated Daily Dewatering Rate over Time - Base Case
Dewatering Rates (gallon per minute)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
100
Days since Dewatering

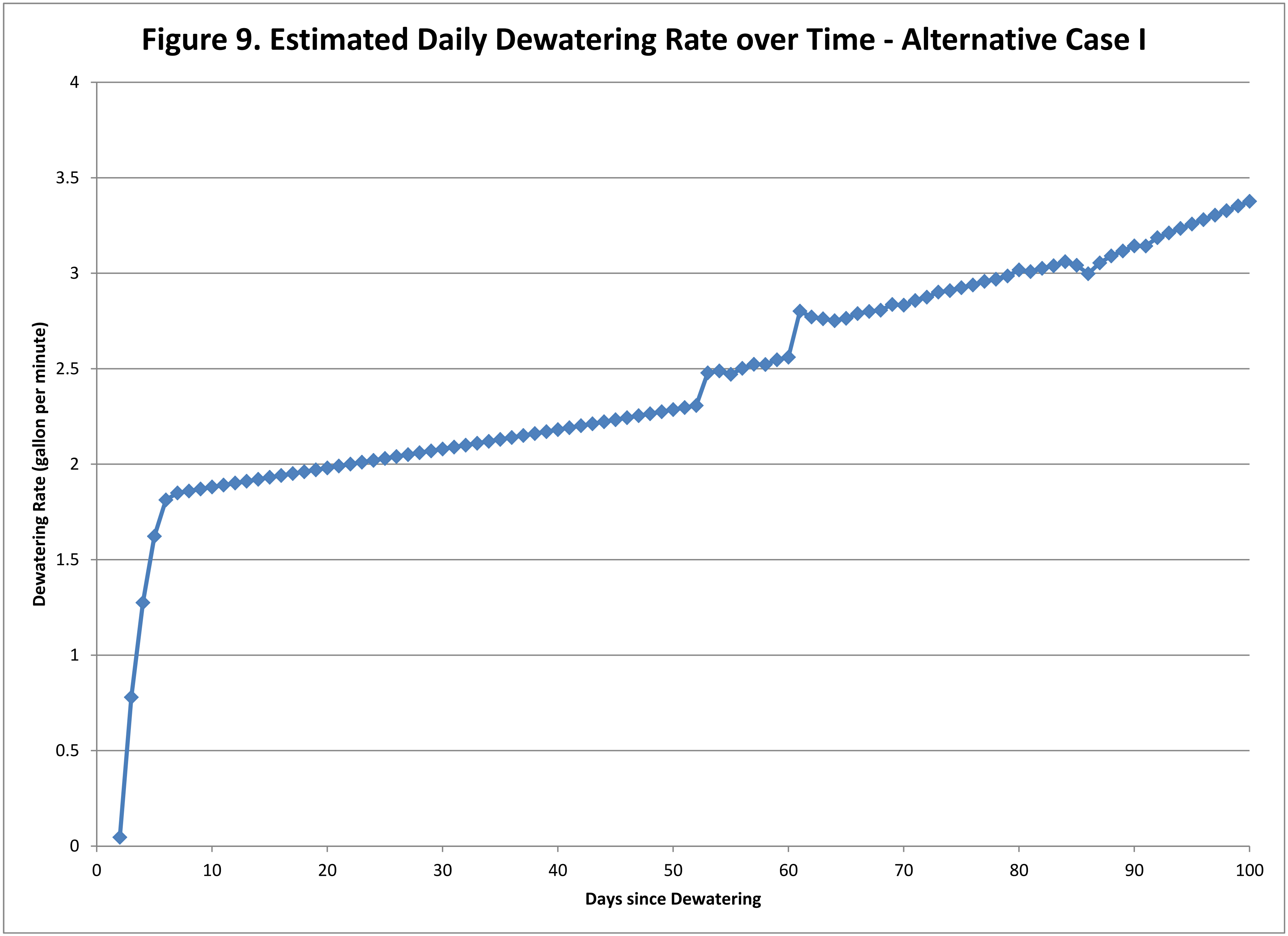


Figure 9. Estimated Daily Dewatering Rate over Time - Alternative Case I
Dewatering Rate (gallon per minute)
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80
90
100
Days since Dewatering

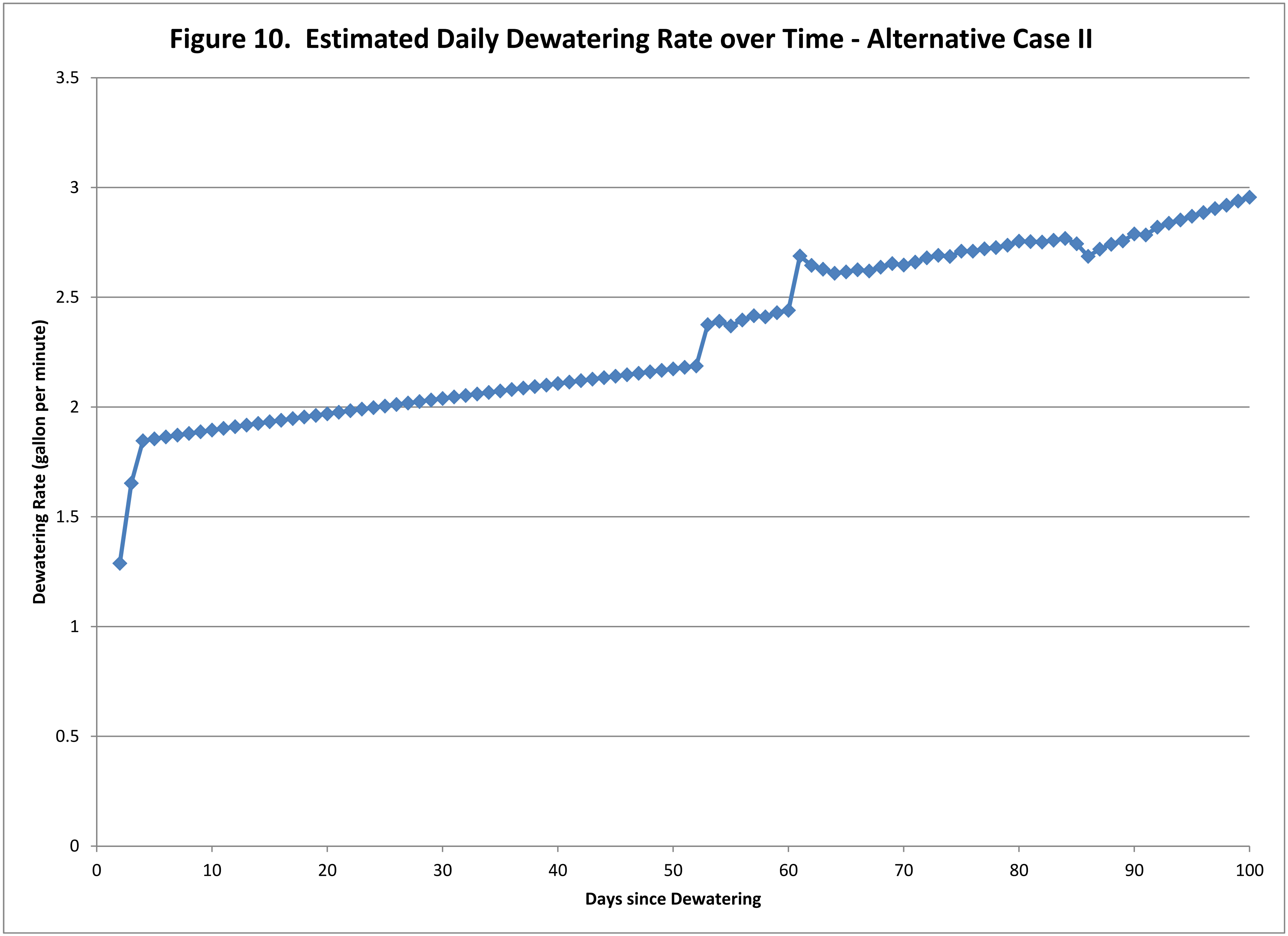


Figure 10. Estimated Daily Dewatering Rate over Time - Alternative Case II
Dewatering Rate (gallon per minute)
Days since Dewatering
0
0.5
1
1.5
2
2.5
3
3.5
0
10
20
30
40
50
60
70
80
90
100

APPENDIX B

CALCULATIONS

QMS Form 3-3 (MM)
Rev. 2013 QMS Date: 28 Feb 2013

URS Quality - *It's Good Business*

IE QMS - Americas	Detail Check - Calculations

Project Name	50 Kent Ave	**Client**	National Grid
Project Location	Brooklyn, NY	**PM**	Jon Sundquist
Project Number	11176988	**PIC**	Enter PIC Name

IDENTIFYING INFORMATION

(This section is to be completed by the Originator.)

Calculation Medium: ☐ Electronic File Name: Enter File Name.

(Select as appropriate) ☒ Hard-copy Unique Identification: CP-2

Number of pages *(including cover sheet)*: Enter number of pages.

Discipline:	Support of Excavation Design – Geotechnical & Structural
Title of Calculation:	SOE system design – 95% design
Calculation Originator:	Dongsheng Lu
Calculation Contributors:	Sun-hwa Lee
Calculation Checker:	Thomas Thomann

DESCRIPTION & PURPOSE

The calculation is to analyse and design a SOE system by using steel sheet pile wall, embedded in Cement bentonite trench, with tieback anchors & internal braces (rakers and corner brace). The proposed excavation support system includes steel sheet pile, placed in a CB slurry trench and retained by two levels of tieback anchors or internal braces. The earth pressure, acting on the steel sheet pile wall is transferred to the braces through walers (steel sections that span between the soldier piles). Regarding the general construction sequence, steel sheet piles are to be placed in the slurry trench while excavating the CB slurry trench, and the earth is excavated along one side of the sheet piles. Then tiebacks or internal braces will be installed to provide additional lateral resistance. The steel sheet pile wall design is based on the requirements of structural strength, and global stability.

BASIS / REFERENCE / ASSUMPTIONS

Analyses were performed to determine the required pile size and tieback strength. The analyses were based on the following parameters and assumptions:

- Maximum height of excavation: 30 ft;
- The following soil stratigraphy and strength parameters:
  - Soil layer 1 : Fill (loose to medium, $\varphi=30^o$) from 0 ft to 17 ft
  - Soil layer 2 : Medium dense Sand ($\varphi=32^o$) from 17 ft to 60 ft;
- The groundwater will be lowered to the bottom of the excavation.
- A 250 pounds per square foot (psf) construction surcharge load was included.
- Two levels of tiebacks or internal braces were designed.

ISSUE / REVISION RECORD

Checker comments, if any, provided on: ☒ hard-copy ☐ electronic file ☐ Form 3-5

No.	Description	P	S	F	Originator Initials	Date	Checker Initials	Date
0	50% design package	☐	☐	☐	DL	7/23/14	TGT	7/23/14
1	95% design package	☐	☐	☐	DL	12/25/14	TGT	12/29/14
2	Click here to enter text.	☐	☐	☐	XXX	Date.	XXX	Date.
3	Click here to enter text.	☐	☐	☐	XXX	Date.	XXX	Date.

For a given Revision, indicate either P (Preliminary), S (Superseding) or F (Final). If there are no revisions to the Initial Issue, check F (Final).

URS Quality - It's Good Business	QMS Form 3-3 (MM)
	Rev. 2013 QMS Date: 28 Feb 2013
IE QMS - Americas	**Detail Check - Calculations**

APPROVAL and DISTRIBUTION

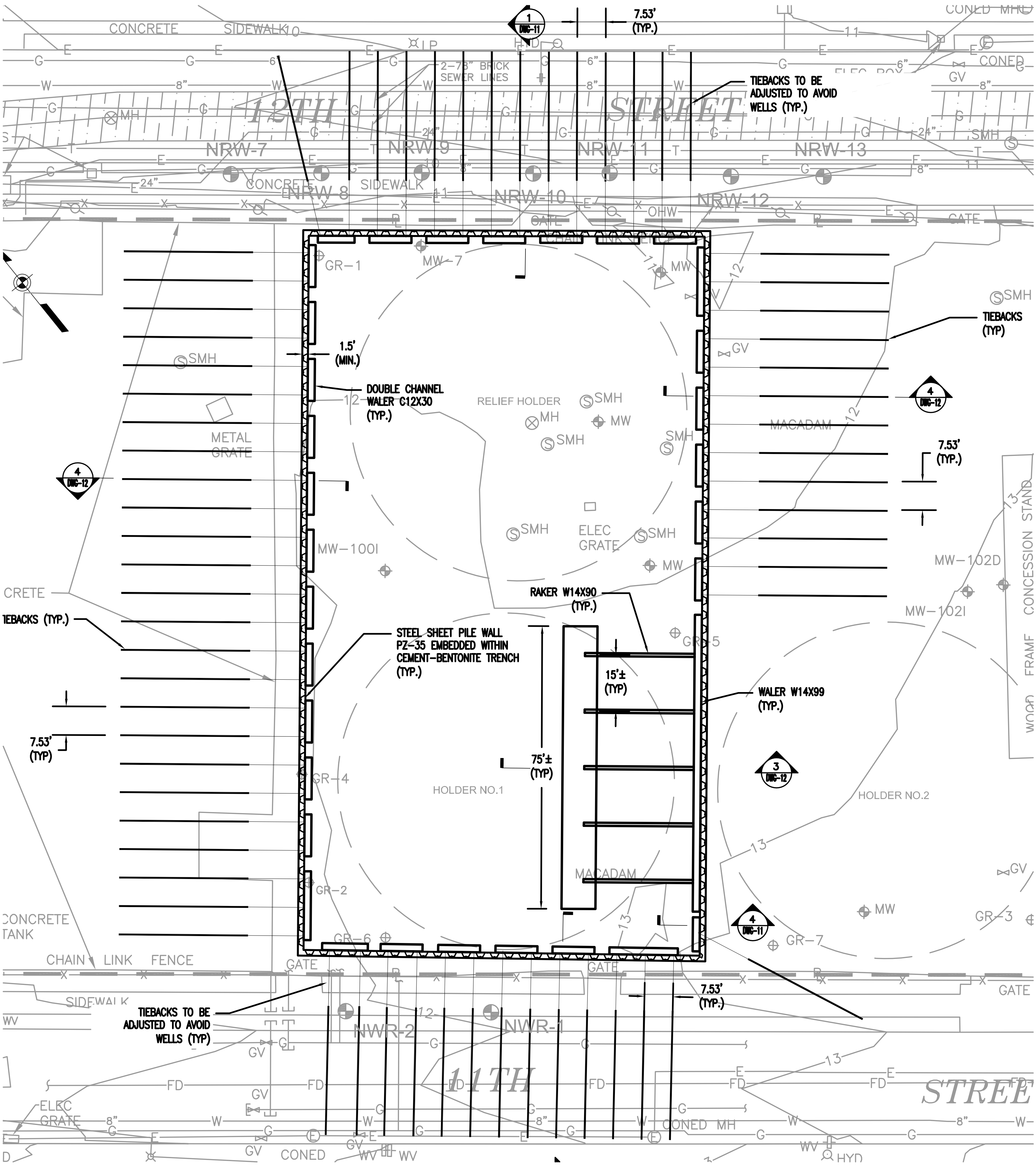
☒ The below individuals assert that the Detail Check – Calculations is complete.

Dongsheng Lu	December 30, 2014
Originator Signature	**Date**
Thomas A. Thomann	December 30, 2014
Checker Signature	**Date**
	December 30, 2014
Project Manager (or Designee) Signature	**Date**

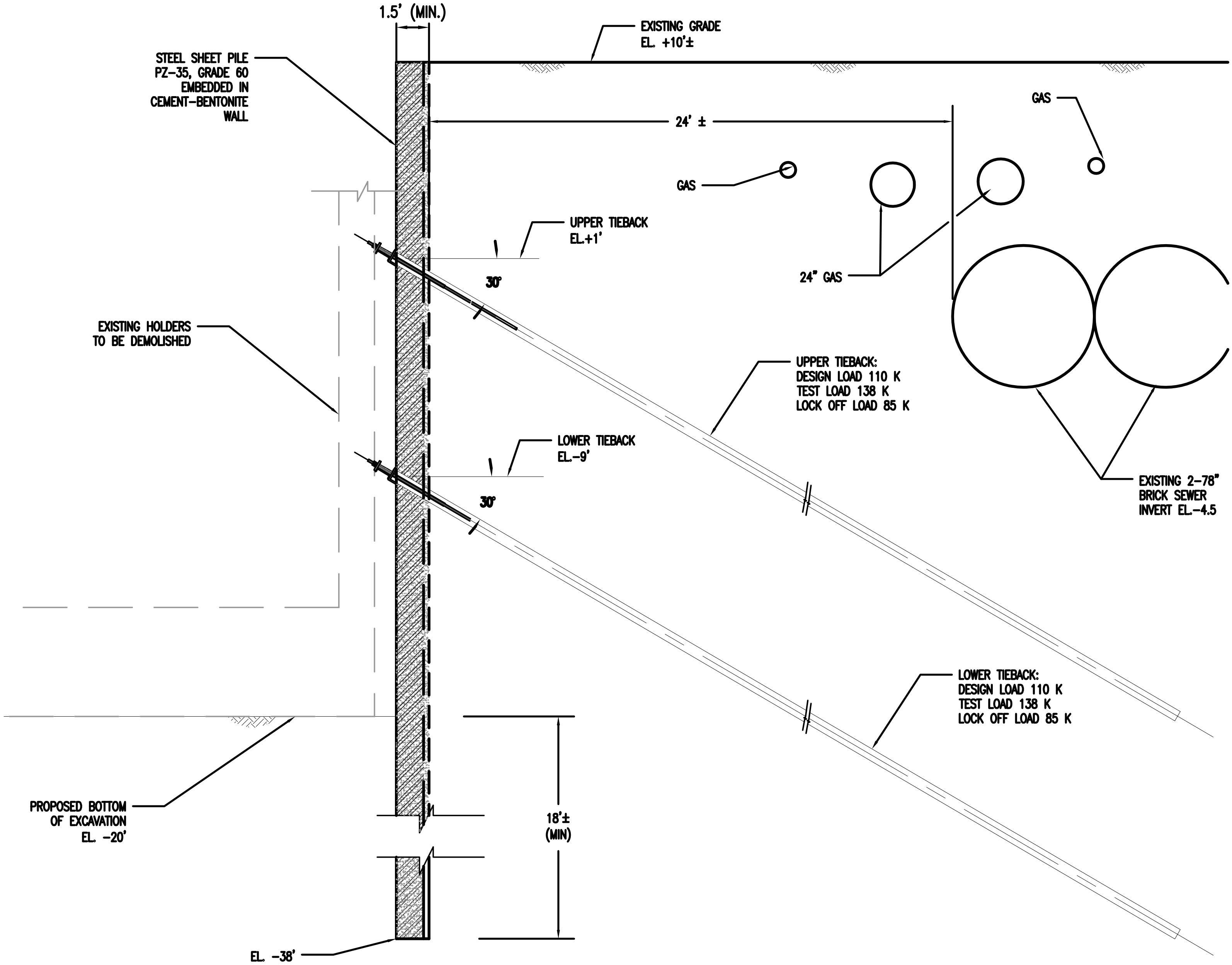
Distribution:

Project Central File – Quality File Folder

Other – Specify: Enter names here.



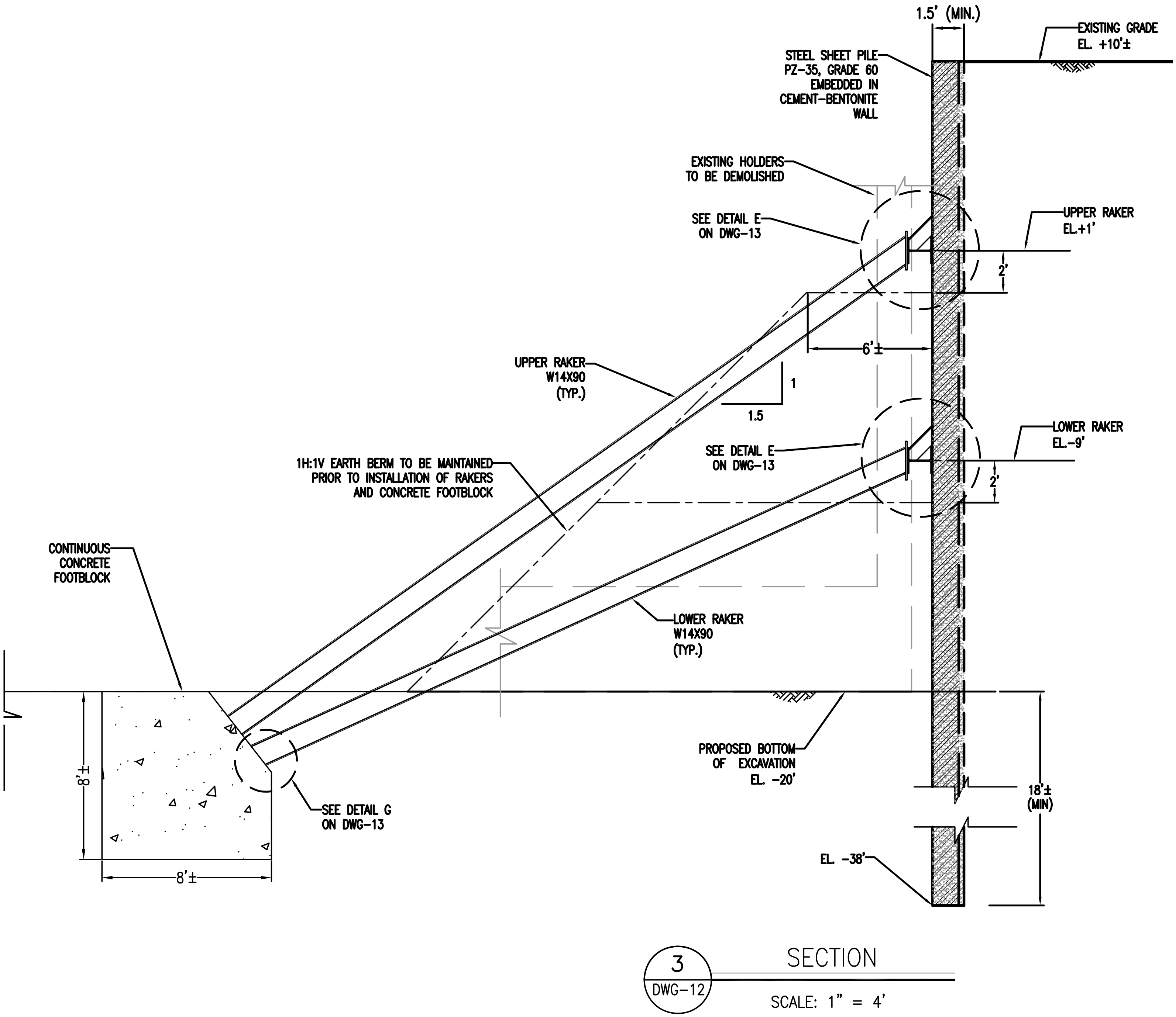
SOE OPTION 1 - TIEBACK WITH RAKER



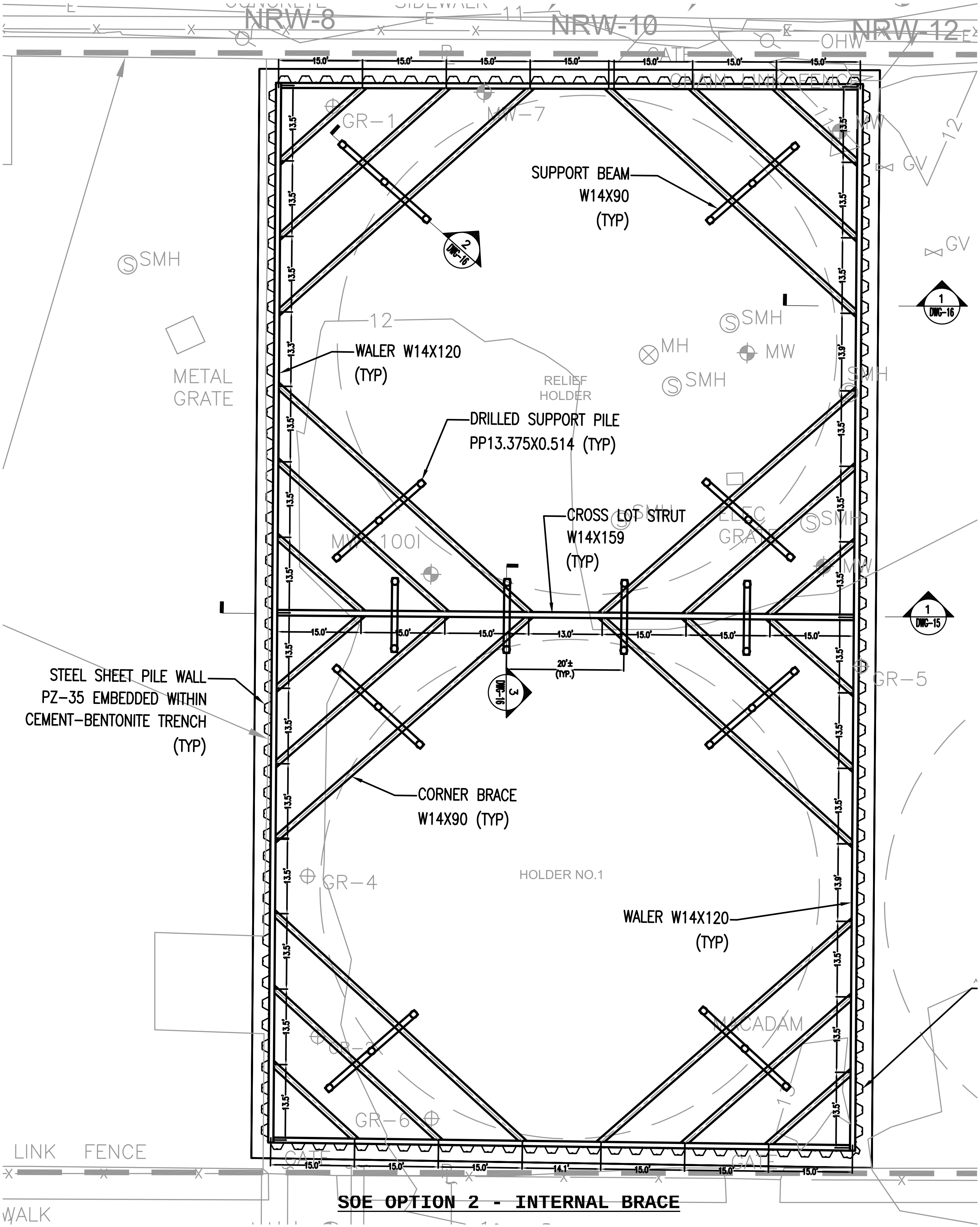
1 DWG-11 SECTION ALONG 12TH STREET

SCALE: 1" = 4'

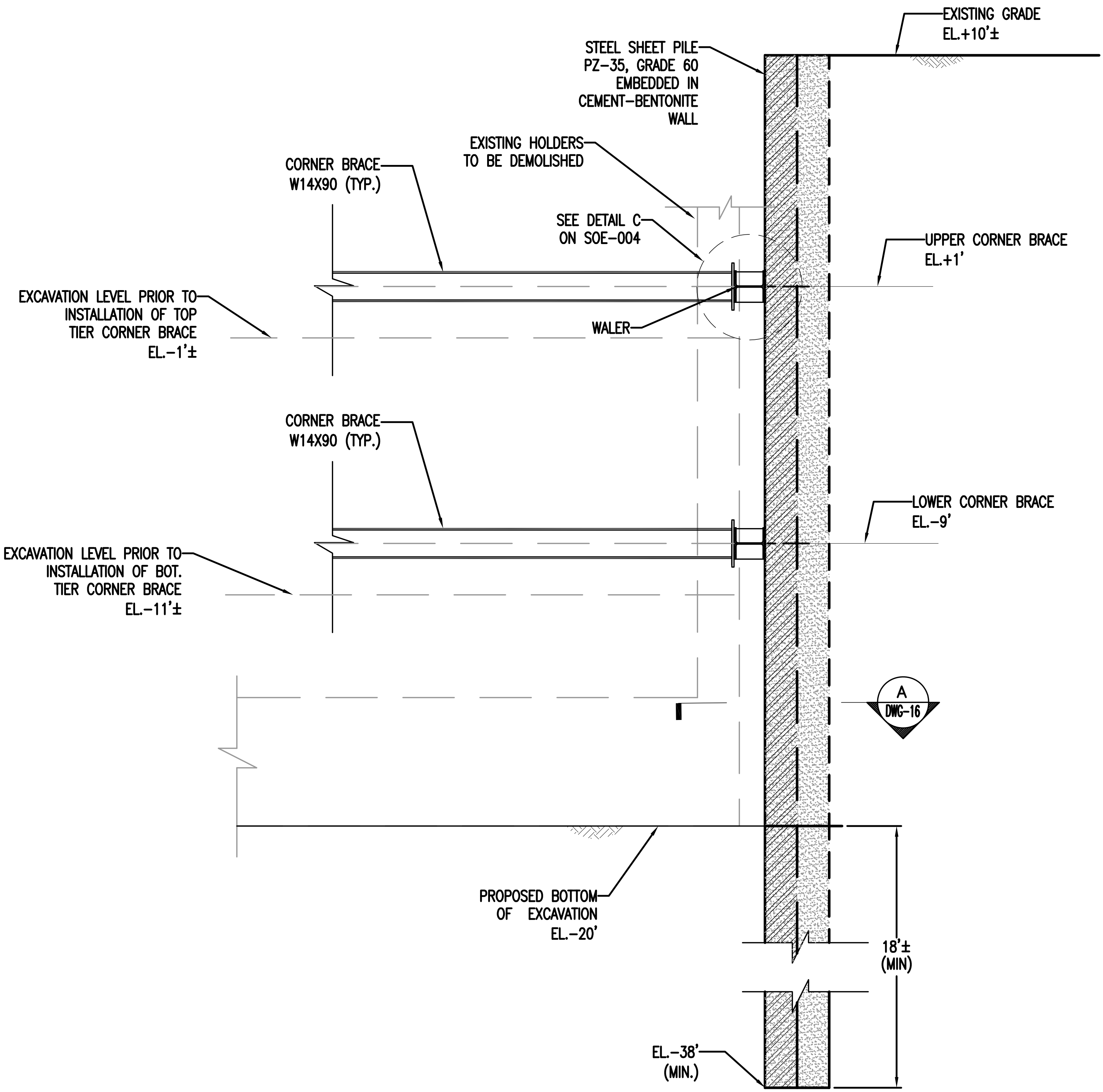
SOE OPTION 1 - TIEBACK WITH RAKER



SOE OPTION 1 - TIEBACK WITH RAKER



SOE OPTION 2 - INTERNAL BRACE

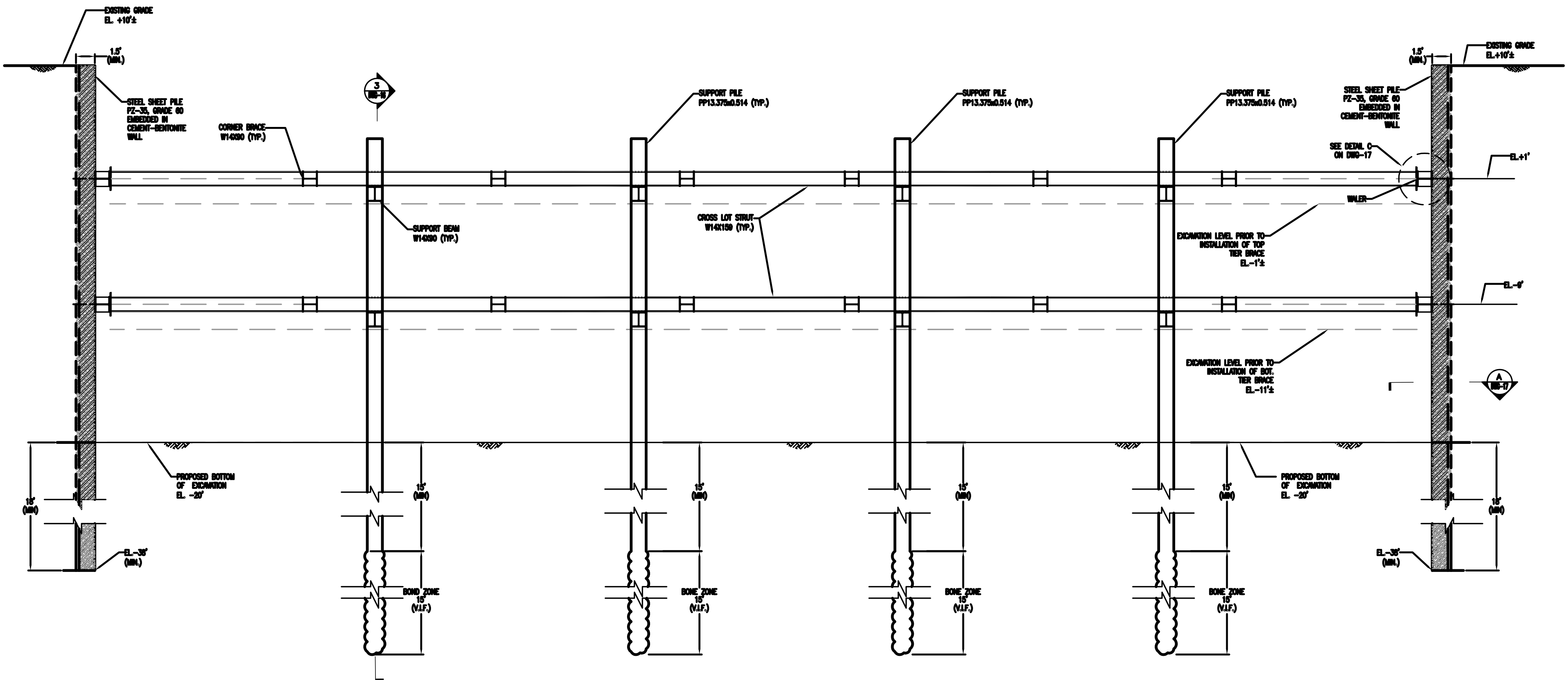


1
DWG-16

SECTION

SCALE: 1" = 4'

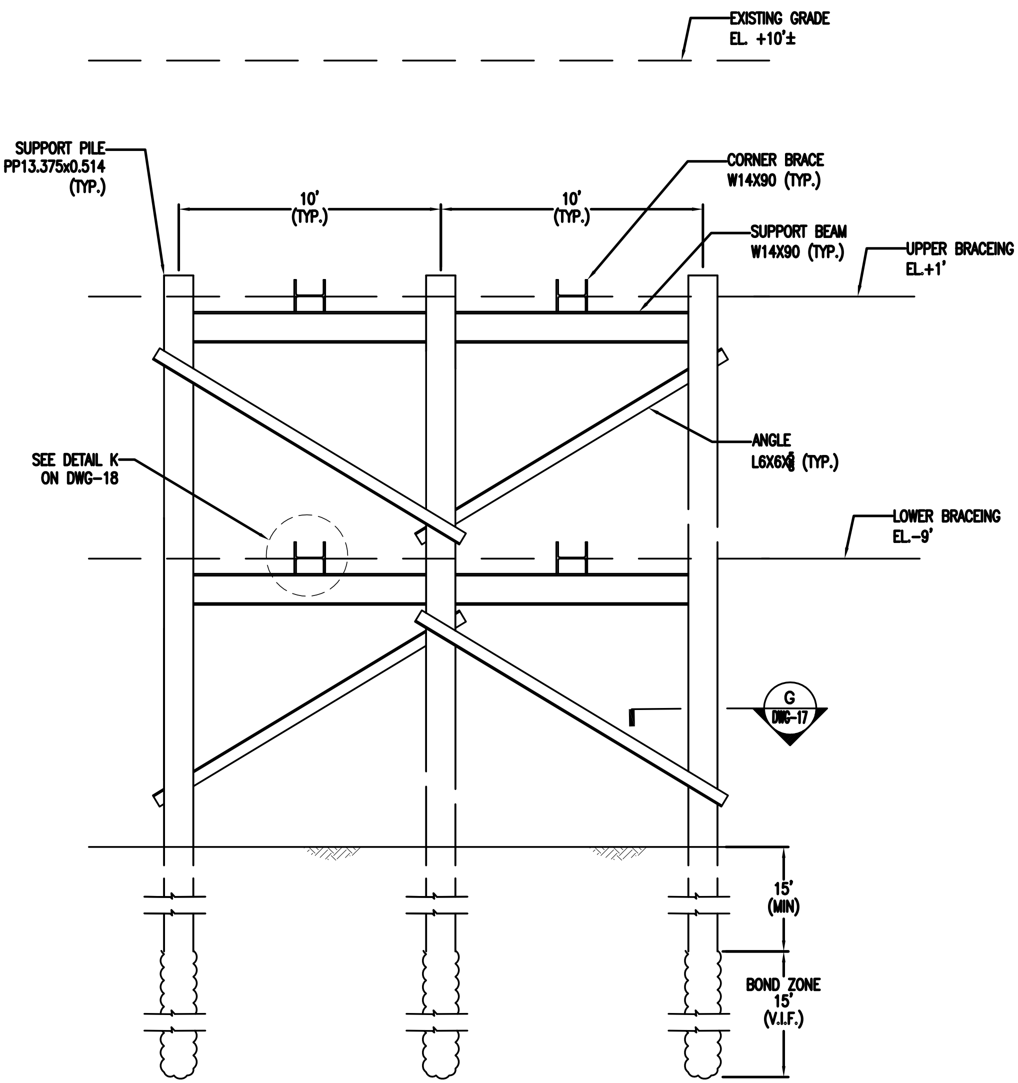
SOE OPTION 2 - INTERNAL BRACE



1 DWG-15 SECTION

SCALE: 1" = 4'

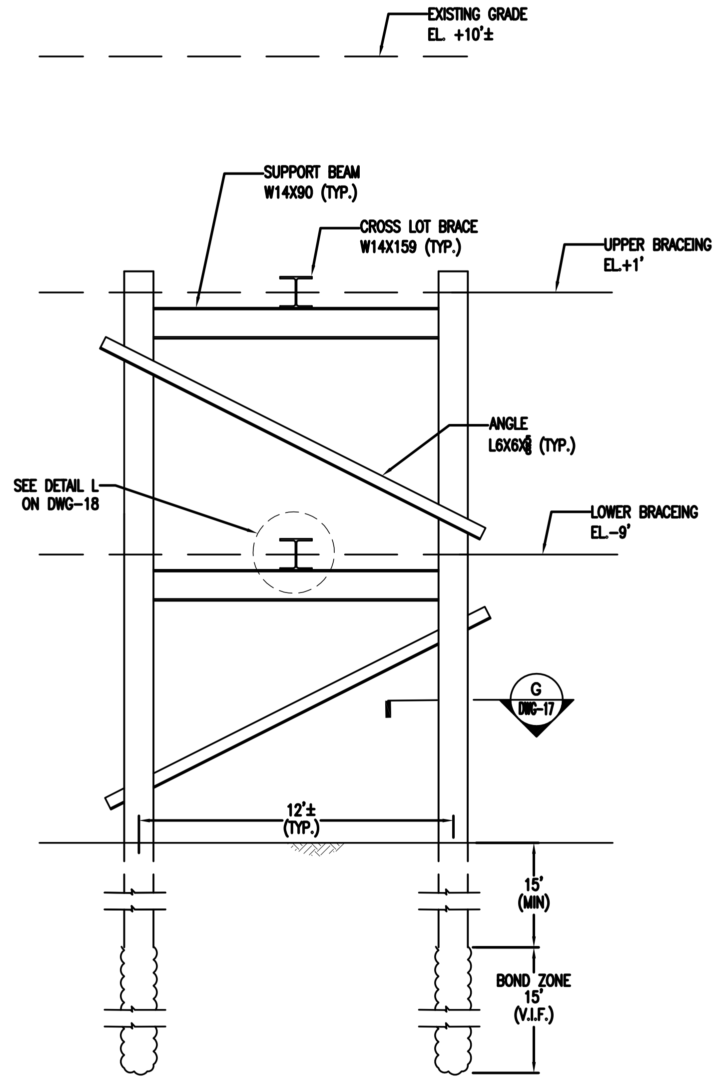
SOE OPTION 2 - INTERNAL BRACE



2
DWG-16

SECTION

SCALE: 1" = 4'



3
DWG-16

SECTION

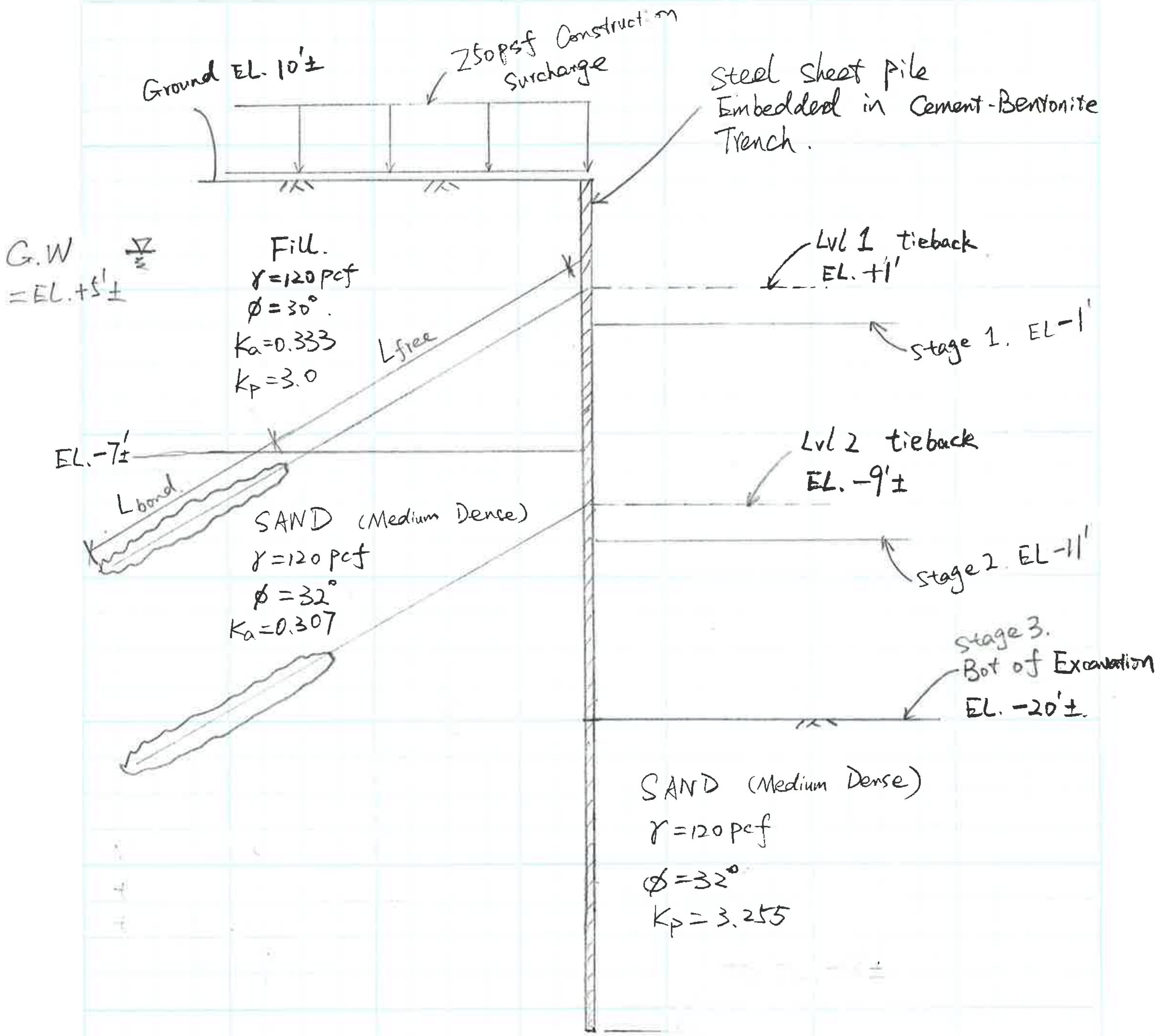
SCALE: 1" = 4'

SOE OPTION 2 - INTERNAL BRACE

URS

Job: 50 Kent Ave	Project No. 11176638	Page ___ of ___	
Description	Computed by: DL	Sheet ___ of ___	Date: 7/22/14
Design Section (SOE)	Checked by: TGT		Date: 7/24/14

Reference

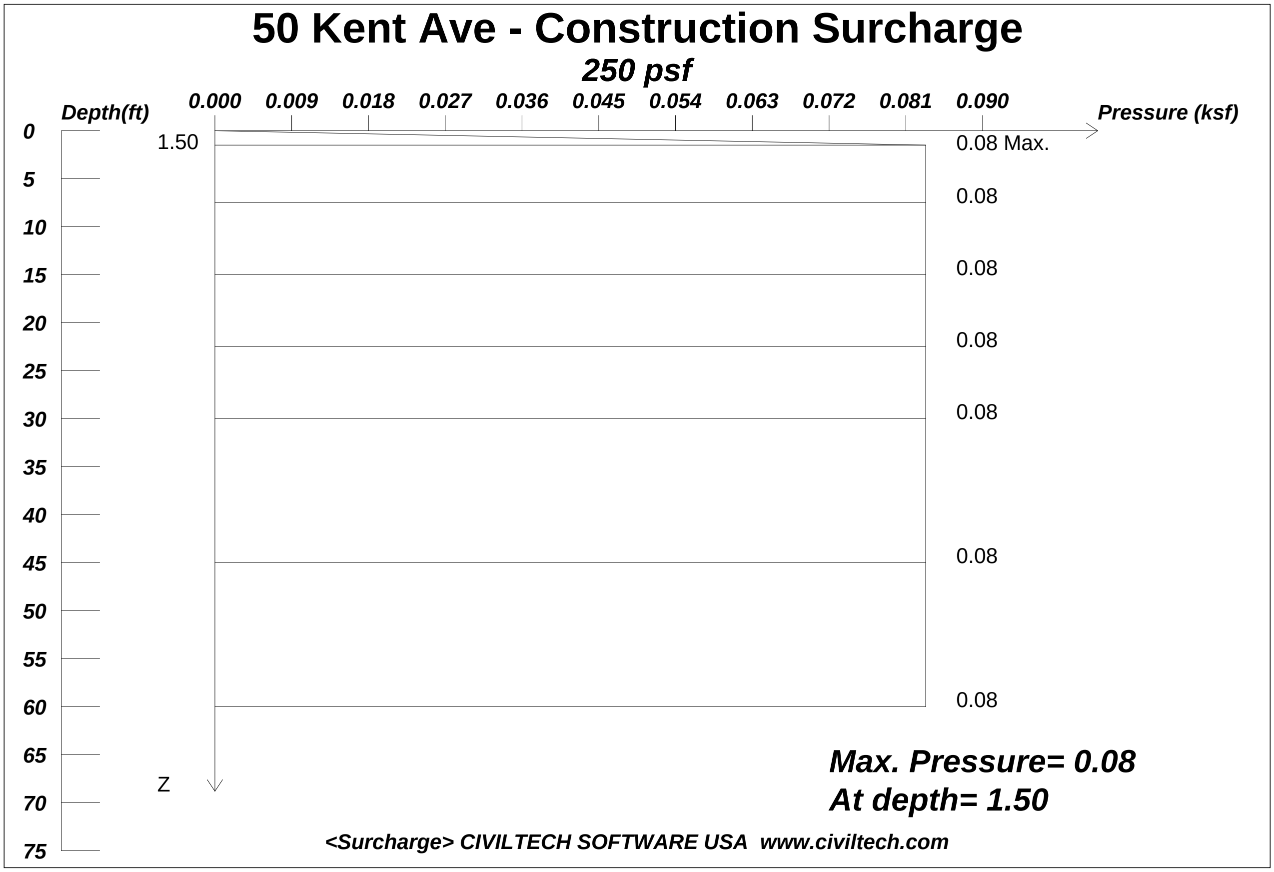


The soil profile was developed based on soil borings in the excavation area.

Calculation Summary of CT-Shore

Run No.	STAGE	Wall Height	Pile Type	Required Embedment	Required Length of Pile	Required Section Modulus	Section Modulus of Selected Section	Horizontal Brace Force		Top Deflection
								1-tier (-9')	2-tier (-19')	
		ft		ft	ft	in3	in3	kip/ft	kip/ft	in
Stage 1: Cantilevered Case										
1	1	11	PZ35	22	33.0	16.8	48.5	N/A	N/A	0.53
Stage 2: 1-Level Brace										
2	2	21	PZ35	14	35.0	19.5	48.5	**12.9**	N/A	0.49
Stage 3: 2-Level Brace (trianbular earth pressure) [2]										
3	3	30	PZ35	18	48.0	31.2	48.5	~~6.8~~	~~14.1~~	0
Stage 3: 2-Level Brace (apparent earth pressure) [2]										
3	3	30	PZ35	18	48.0	~~29.6~~	48.5	12	**12.7**	0.09

Note:
1. Yield Strength of Steel Sheet Pile is 50ksi.
2. Stage 3 used two earth pressure distribution. The triangular earth pressure distribution was used to determine the maximum required wall section modulus; while the apparent earth pressure distribution was used to determine the brace force.



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Date: 12/29/2014 File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieba

Wall Height, H= 30 Load Depth at Surface, D= 0

Load Factor of Surcharge Loading = 1

Flexible Wall Condition -- Movement or deflection are allowed.

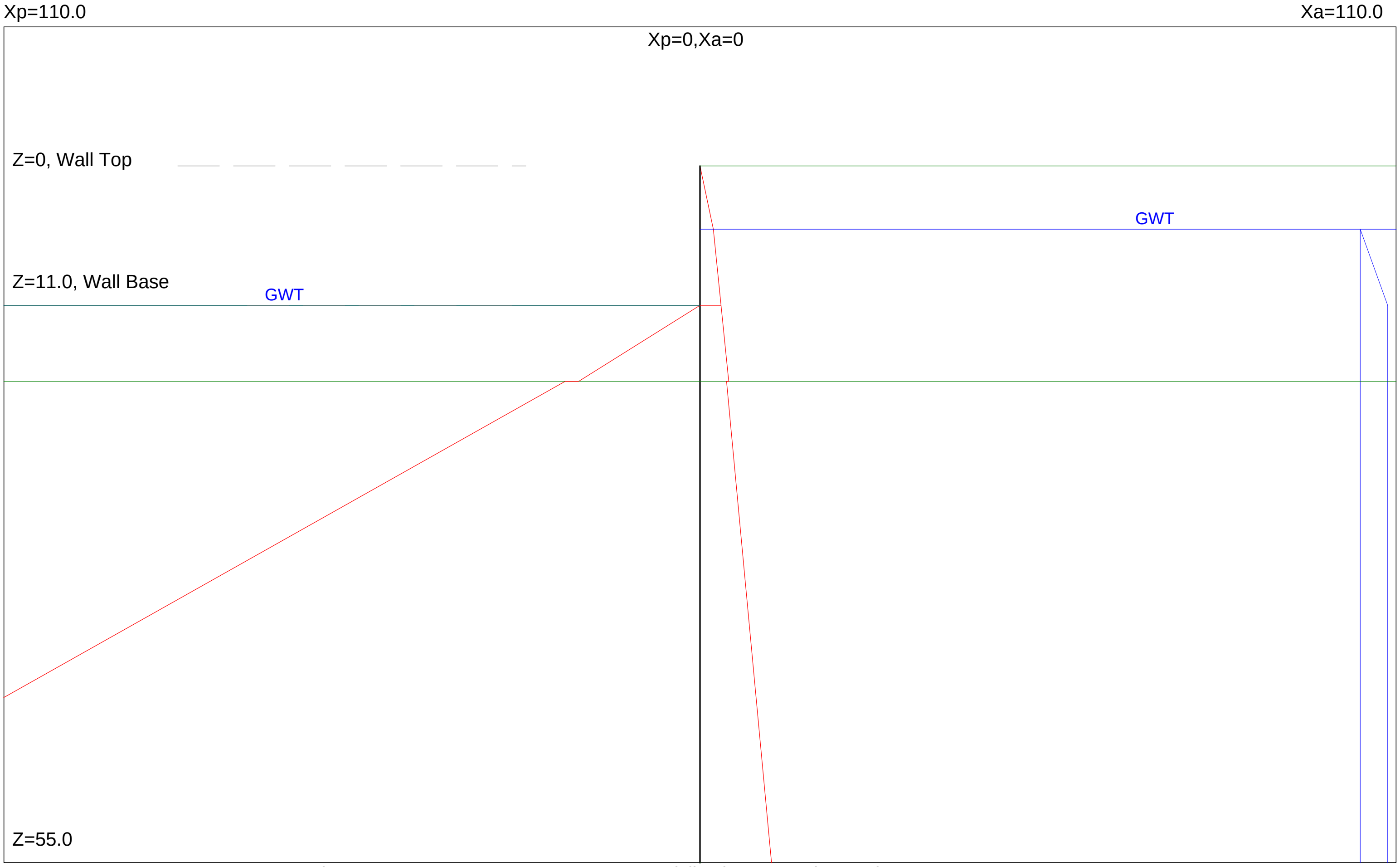
Max. Pressure = 0.083 at depth = 1.50

Infinite Surcharge, Q=0.25 Active Wedge Approach * (see below)

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

50 Kent Ave - Earth Pressure

Stage 1 - Tieback Option



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 12/29/2014   File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 1.ep8

* INPUT DATA *

Wall Height=11.0   Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	120.0	30	0.0	0	4	Fill
2	120.0	120.0	32	0.0	0	4	Sand 1
3	120.0	120.0	20	0.7	0	2	Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	17.0	0.0	17.0	800.0	2	Sand 1
3	60.0	0.0	60.0	800.0	3	Clay

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	11.0	0.0	11.0	800.0	1	Fill
2	17.0	0.0	17.0	800.0	2	Sand 1
3	60.0	0.0	60.0	800.0	3	Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	11.0	0.0
2	11.0	800.0

Wall Friction Options: 3. Both sides (for formulary solution)
Wall Friction = 14
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 1.86 per one linear foot (or meter) width along wall height
Total Static Force above Base= 1.86

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	5.00	0.18	0.0363	0.3026
5.00	0.18	11.00	0.29	0.0174	0.3026

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
11.00	0.29	17.00	0.39	0.0174	0.3026
17.00	0.36	55.00	0.97	0.0161	0.2801

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
11.00	0.00	17.00	1.66	0.276	4.7902
17.00	1.84	55.00	13.49	0.307	5.3214

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	5.00	0.00	11.00	0.37	0.06
1	11.00	0.37	55.00	0.37	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 12/29/2014 File Name: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 1.ep8

****
EARTH PRESSURE ANALYSIS SUMMARY
<EarthPres>
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Title 1: 50 Kent Ave - Earth Pressure
Title 2: Stage 1 - Tieback Option

Input data: ***

Wall Height = 11.00
Depth of Ground at Active Side = 0.00
Depth of Ground at Passive Side = 11.00
Apparent Pressure Envelope: 1.* Actual Pressures (All walls, All soils)
Pressure Type: 1.* Active, Ka
Earthquake Loading Apply to: 1. No Earthq. Loads
    Earthquake Horizontal Acceleration, Kh = 0
    Earthquake Vertical Acceleration, Kv = 0
Calculation Methods: 3. Formulary Solution (Coulomb Equation)
Wall Friction Options: 3. Both sides (for formulary solution)
    Wall Friction = 14
    Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip
User's Settings
    Ignore Passive from Depth = 0
    Multiplier of Active Pressure = 1
    Multiplier of Passive Pressure = 1
    Multiplier of Water Pressure = 1
    Multiplier of Earthq. Pressure = 1
    Estimated Embedment: Deep: 5H
Program's Settings
    Max. Height, Hmax = 110.00
    Analysis Segment, dz = 0.28
    No. of Active Segment at H, nz0 = 2
    No. of Active Segment at Hmax, nz = 5
    No. of Passive Segment, nzp = 3
    Active Depth at H, Zh = 11.00
    Active Depth at Hmax, Z = 110.00
    Passive Depth at Hmax, Zp = 110.00
    Max. Pressure = 19.56

Total Soil Types= 3

Soil	Weight	W(S)	Phi	Cohesion	Nspt	Type	Description
1	120.0	120.0	30	0.0	0	4	Fill
2	120.0	120.0	32	0.0	0	4	Sand 1
3	120.0	120.0	20	0.7	0	2	Clay

Soil Type: 1 Equivalent Clay; 2 Clay; 3 Silt; 4 Sand; 5 Gravel

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.
1	0.0	0.0	0.0	800.0	1
2	17.0	0.0	17.0	800.0	2
3	60.0	0.0	60.0	800.0	3

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.
1	11.0	0.0	11.0	800.0	1
2	17.0	0.0	17.0	800.0	2
3	60.0	0.0	60.0	800.0	3

Water Table at Passive Side:

Point	Z-water	X-water
1	11.0	0.0
2	11.0	800.0

Output data: ***

Total Force above Base= 1.86 per one linear foot (or meter) width along wall height
Static Force above Base= 1.86

Apparent Pressure above Base - Output to Shoring
Active/At-Rest Force above Base, Ea = 1.86

No	Z1	P1	Z2	P2	Slope	Coef.
0	0.0	0.00	5.0	0.18	0.0363	0.3026
1	5.0	0.18	11.0	0.29	0.0174	0.3026

Driving Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Ka or Ko
0	11.0	0.29	17.0	0.39	0.0174	0.3026
1	17.0	0.36	60.0	1.06	0.0161	0.2801
2	60.0	0.72	110.0	1.98	0.0251	0.4365

Passive Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Kp
0	11.0	0.00	17.0	1.66	0.2759	4.7902
1	17.0	1.84	60.0	15.02	0.3065	5.3214
2	60.0	10.71	110.0	19.19	0.1695	2.9436

Water Pressure - Output to Shoring

No	Z1	P1	Z2	P2	Slope
0	5.0	0.00	11.0	0.37	0.06
1	11.0	0.37	110.0	0.37	0.00

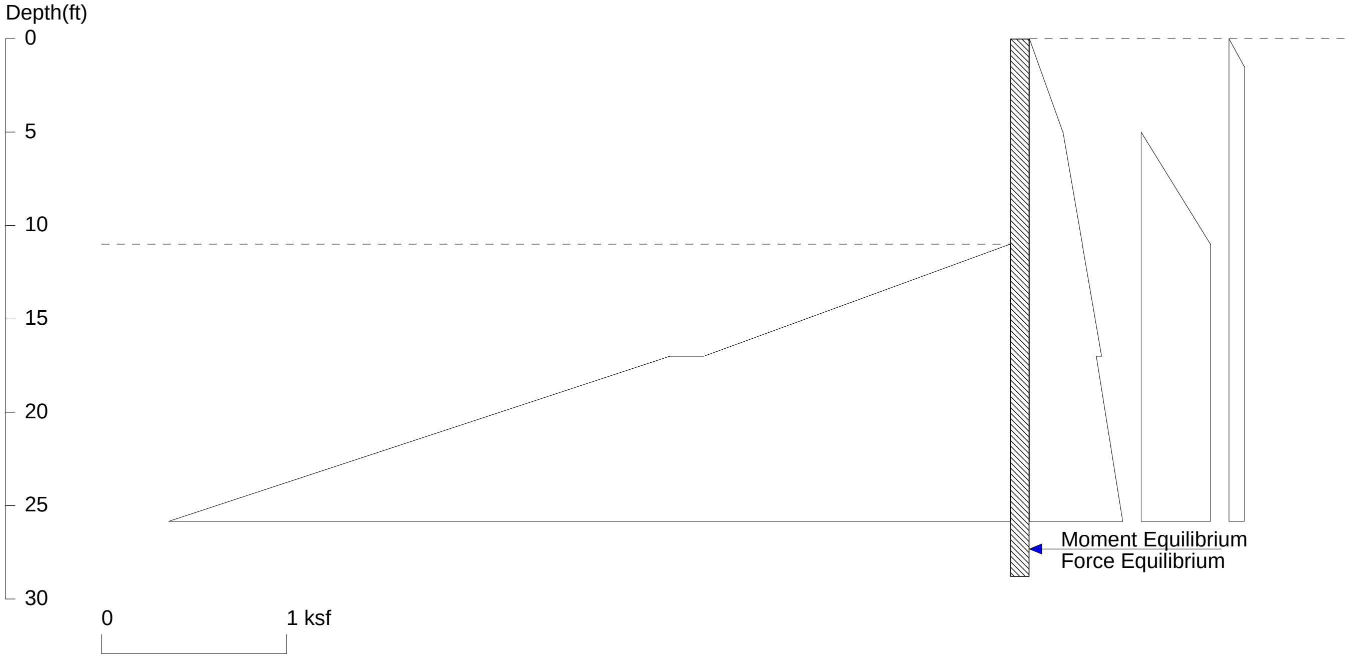
****
DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Z, Xa, Xp - Coordinates of ground lines
Z- Depth measured from wall top
Xa - Distance measure from wall to active side.
Xp - Distance measure from wall to passive side

Z1, P1, Z2, P2 - Four values to define a pressure diagram
Z1- Top depth of the diagram
P1- Top pressure of the diagram
Z2- Bottom depth of the diagram
P2- Bottom pressure of the diagram
Slope - (P2-P1)/(Z2-Z1), Slope of the diagram. It also called
    Equivalent fluid density.

Coef. - Pressure Coefficient = Slope/Unit We9ight
Ka - Active Earth Pressure Coefficient
Ko - At-Rest Earth Pressure Coefficient
Kp - Passive Earth Pressure Coefficient

50 Kent Ave - Shoring
Stage 1 - Tieback Option



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File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 1.s

Wall Height=11.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=17.80 Min. Pile Length=28.80 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=46.23 per Pile Spacing=1.0 at Depth=19.60

PILE SELECTION:
Request Min. Section Modulus = 16.8 in3/ft=903.84 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
PZ35 has Section Modulus = 48.5 in3/ft=2607.36 cm3/m. It is greater than Min. Requirements!
Top Deflection = 0.53(in) based on E (ksi)=29000.00 and I (in4)/foot=361.2

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	5.000	0.182	0.036310
5.000	0.182	11.000	0.286	0.017429
*	Below	Base		
11.000	0.286	17.000	0.391	0.017429
17.000	0.362	60.000	1.055	0.016132
*	Water	Pres.		
5.000	0.000	11.000	0.374	0.062400
11.000	0.374	99.000	0.374	0.000000
*	Sur-	charge		
0.000	0.000	1.500	0.083	0.055556
1.500	0.083	3.000	0.083	0.000000
3.000	0.083	4.500	0.083	0.000000
4.500	0.083	6.000	0.083	0.000000
6.000	0.083	7.500	0.083	0.000000
7.500	0.083	9.000	0.083	0.000000
9.000	0.083	10.500	0.083	0.000000
10.500	0.083	12.000	0.083	0.000000

12.000	0.083	13.500	0.083	0.000000
13.500	0.083	15.000	0.083	0.000000
15.000	0.083	16.500	0.083	0.000000
16.500	0.083	18.000	0.083	0.000000
18.000	0.083	19.500	0.083	0.000000
19.500	0.083	21.000	0.083	0.000000
21.000	0.083	22.500	0.083	0.000000
22.500	0.083	24.000	0.083	0.000000
24.000	0.083	25.500	0.083	0.000000
25.500	0.083	27.000	0.083	0.000000
27.000	0.083	28.500	0.083	0.000000
28.500	0.083	30.000	0.083	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
11.000	0.000	17.000	1.655	0.275915
17.000	1.839	60.000	15.019	0.306510

ACTIVE SPACING:

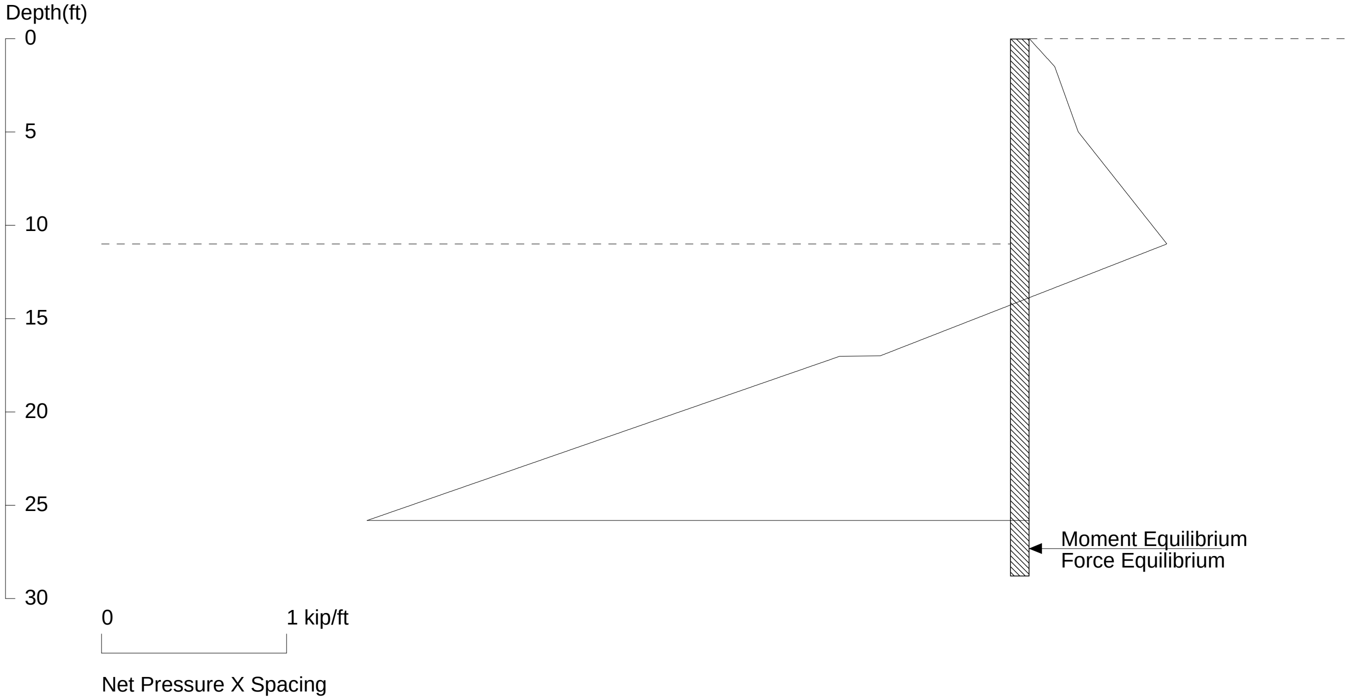
No.	Z depth	Spacing
1	0.00	1.00
2	11.00	1.00

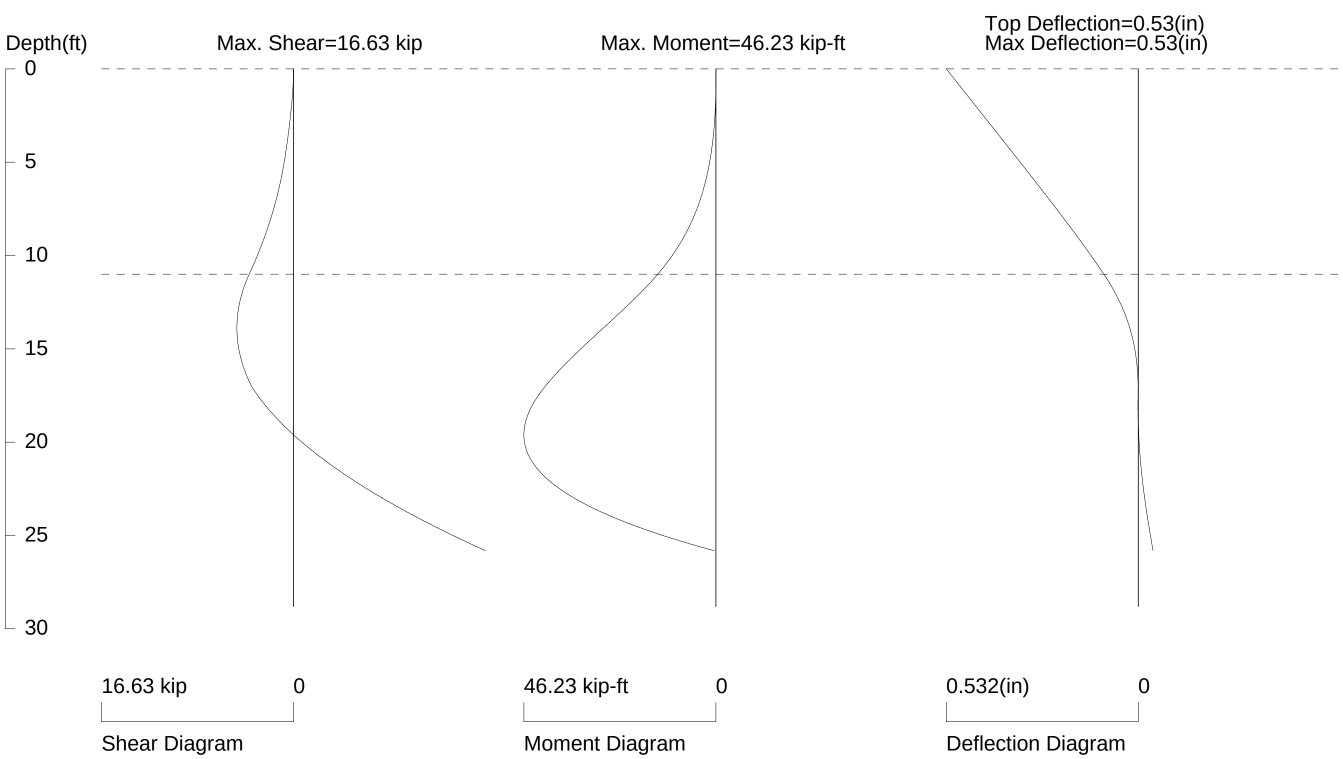
PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

50 Kent Ave - Shoring
Stage 1 - Tieback Option





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, PZ35: E (ksi)=29000.0, I (in4)/foot=361.2

File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 1.sh8

****

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software

www.civiltech.com

****

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft,
Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Title: 50 Kent Ave - Shoring
Subtitle: Stage 1 - Tieback Option

**********************************INPUT DATA**********************************

Wall Type: 1. Sheet Pile
        Wall Height: 11.00
        Pile Diameter: 1.00
        Pile Spacing: 1.00
        Factor of Safety (F.S.): 1.00
Lateral Support Type (Braces): 1. No
        Top Brace Increase (Multi-Bracing): No
Embedment Option: 1. Yes
        Friction at Pile Tip: No
Pile Properties:
        Steel Strength, Fy: 50 ksi = 345 MPa
        Allowable Fb/Fy: 0.66
        Elastic Module, E: 29000.00
        Moment of Inertia, I: 361.20
        User Input Pile: PZ35

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		
2	0.000	0.000	5.000	0.182	0.036310
3	5.000	0.182	11.000	0.286	0.017429
4	*	Below	Base		
5	11.000	0.286	17.000	0.391	0.017429
6	17.000	0.362	60.000	1.055	0.016132
7	60.000	0.720	99.000	1.700	0.025140
8	*	Water	Pres.		
9	5.000	0.000	11.000	0.374	0.062400
10	11.000	0.374	99.000	0.374	0.000000
11	*	Sur-	charge		

12	0.000	0.000	1.500	0.083	0.055556
13	1.500	0.083	3.000	0.083	0.000000
14	3.000	0.083	4.500	0.083	0.000000
15	4.500	0.083	6.000	0.083	0.000000
16	6.000	0.083	7.500	0.083	0.000000
17	7.500	0.083	9.000	0.083	0.000000
18	9.000	0.083	10.500	0.083	0.000000
19	10.500	0.083	12.000	0.083	0.000000
20	12.000	0.083	13.500	0.083	0.000000
21	13.500	0.083	15.000	0.083	0.000000
22	15.000	0.083	16.500	0.083	0.000000
23	16.500	0.083	18.000	0.083	0.000000
24	18.000	0.083	19.500	0.083	0.000000
25	19.500	0.083	21.000	0.083	0.000000
26	21.000	0.083	22.500	0.083	0.000000
27	22.500	0.083	24.000	0.083	0.000000
28	24.000	0.083	25.500	0.083	0.000000
29	25.500	0.083	27.000	0.083	0.000000
30	27.000	0.083	28.500	0.083	0.000000
31	28.500	0.083	30.000	0.083	0.000000
32	30.000	0.083	33.000	0.083	0.000000
33	33.000	0.083	36.000	0.083	0.000000
34	36.000	0.083	39.000	0.083	0.000000
35	39.000	0.083	42.000	0.083	0.000000
36	42.000	0.083	45.000	0.083	0.000000
37	45.000	0.083	48.000	0.083	0.000000
38	48.000	0.083	51.000	0.083	0.000000
39	51.000	0.083	54.000	0.083	0.000000
40	54.000	0.083	57.000	0.083	0.000000
41	57.000	0.083	60.000	0.083	0.000000
42	60.000	0.083	66.000	0.083	0.000000
43	66.000	0.083	72.000	0.083	0.000000
44	72.000	0.083	78.000	0.083	0.000000
45	78.000	0.083	84.000	0.083	0.000000
46	84.000	0.083	90.000	0.083	0.000000
47	90.000	0.083	96.000	0.083	0.000000
48	96.000	0.083	102.000	0.083	0.000000
49	102.000	0.083	108.000	0.083	0.000000
50	108.000	0.083	114.000	0.083	0.000000
51	114.000	0.083	120.000	0.000	-0.013889

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* PASSIVE PRESSURE *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	11.000	0.000	17.000	1.655	0.275915
3	17.000	1.839	60.000	15.019	0.306510
4	60.000	10.710	99.000	17.322	0.169549

----

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	11.00	1.00

----

* PASSIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00

----

*For Tieback: Input1 = Diameter; Input2 = Bond Strength
*For Plate: Input1 = Diameter; Input2 = Allowable Pressure
*For Deadman: Input1 = Horz. Width; Input2 = Allowable Pressure; Angle = 0

```
********************************CALCULATION*********************************
```

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

```
        |      D1=0.00
        |
        |
        |
      ==|==    D2=11.00
        |
        |
        |      D3=28.80
```

D1 - TOP DEPTH
D2 - EXCAVATION BASE
D3 - PILE TIP (20% increased, see EMBEDMENT Notes below)

MOMENT BALANCE: M=0.00   AT DEPTH=25.84 WITH EMBEDMENT OF 14.84
FORCE BALANCE: F=0.00   AT DEPTH=28.80 WITH EMBEDMENT OF 17.80

The program calculates an embedment for moment equilibrium, then increase the embedment by 20% to reach force equilibrium.
A Balance Force=16.76 is developed from depth=25.84 to depth=28.80
Total Passive Pressure = Total Active Pressure,   OK!

```
*********************************RESULTS*****************************************
```

* EMBEDMENT Notes *
Based on USS Design Manual, first calculate embedment for moment equilibrium, then increased by 20 to 40 % to reach force equilibrium.
The embedment for moment equilibrium is 14.84
* The 20% increased embedment for force equilibrium is 17.80 (Used by Program)
The 30% increased embedment for force equilibrium is 19.29
The 40% increased embedment for force equilibrium is 20.77

Based on AASHTO 2002 Standard Specifications, first calculate embedment for moment equilibrium, then add safety factor of 30% for temporary shoring; add safety factor of 50% for permanent shoring.
The embedment for moment equilibrium is 14.84
Add 30% embedment for temporary shoring is 19.29
Add 50% embedment for permanent shoring is 22.26

* BASED ON USS DESIGN MANUAL (20% increased), PROGRAM CALCULATED MINIMUM EMBEDMENT = 17.80
TOTAL MINIMUM PILE LENGTH = 28.80

* MOMENT IN PILE (per pile spacing)*
Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.
Overall Maximum Moment = 46.23 at 19.60
Maximum Shear = 16.63
Moment and Shear are per pile spacing: 1.0 foot or meter

* VERTICAL LOADING *

Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00

****************************SPECIFIED PILE ***********************************

Overall Maximum Moment = 46.23 at 19.60
The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 16.81 in3/ft = 903.84 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

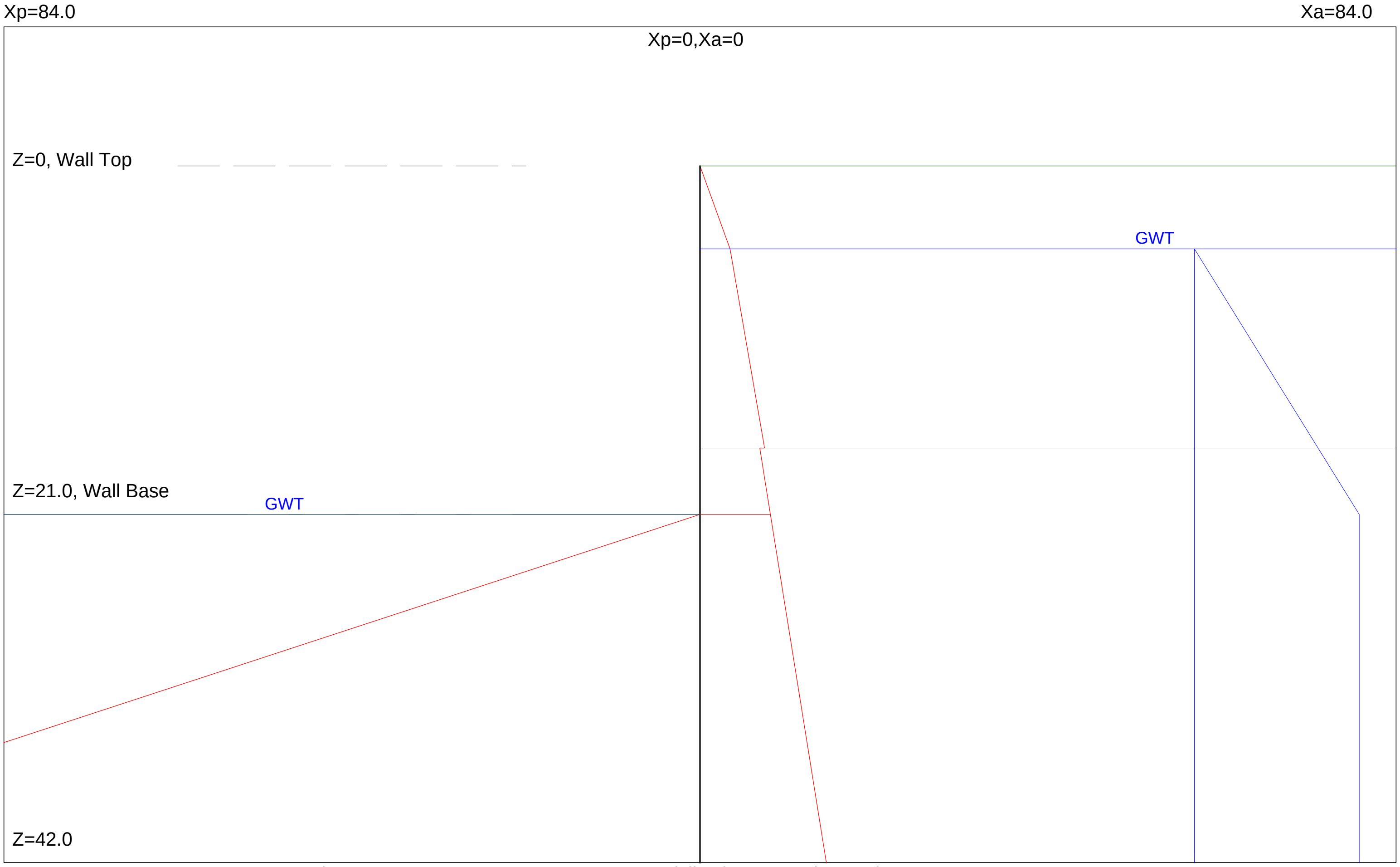
PZ35 has been found in Sheet Pile list!
PZ35(English):   Sx= 48.50 in3/ft Ix= 361.20 in4/ft   Weight= 35.00 lb/ft
PZ35(Metrics):   Sx= 2607.36 cm3/m Ix= 493.25 x100cm4/m   Weight= 0.511 kN/m

* Note: All the pile dimensions are in English Units per one foot width.

PZ35 is capable to support the shoring!
I (in4)/foot=361.20
Top deflection = 0.532(in)
Max. deflection = 0.532(in)

50 Kent Ave - Earth Pressure

Stage 2 - Tieback Option



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 12/29/2014 File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 2.ep8

* INPUT DATA *

Wall Height=21.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	120.0	30	0.0	0	4	Fill
2	120.0	120.0	32	0.0	0	4	Sand 1
3	120.0	120.0	20	0.7	0	2	Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	17.0	0.0	17.0	800.0	2	Sand 1
3	60.0	0.0	60.0	800.0	3	Clay

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	21.0	0.0	21.0	800.0	2	Sand 1
2	60.0	0.0	60.0	800.0	3	Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	21.0	0.0
2	21.0	800.0

Wall Friction Options: 3. Both sides (for formulary solution)
Wall Friction = 14
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 5.46 per one linear foot (or meter) width along wall height
Total Static Force above Base= 5.46

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	5.00	0.18	0.0363	0.3026
5.00	0.18	17.00	0.39	0.0174	0.3026
17.00	0.36	21.00	0.43	0.0161	0.2801

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
21.00	0.43	42.00	0.76	0.0161	0.2801

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
21.00	0.00	42.00	6.44	0.307	5.3214

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	5.00	0.00	21.00	1.00	0.06
1	21.00	1.00	42.00	1.00	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

```
*****************************************************************
                 EARTH PRESSURE ANALYSIS SUMMARY
                          <EarthPres>
            Software Copyright by CivilTech Software
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*****************************************************************
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Date: 12/29/2014           File: I:\Projects\11176638 Williamsburg Site (50 kent
Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 2.ep8

Title 1:  50 Kent Ave - Earth Pressure
Title 2: Stage 2 - Tieback Option

Input data: *************************************************

Wall Height = 21.00
Depth of Ground at Active Side = 0.00
Depth of Ground at Passive Side = 21.00
Apparent Pressure Envelope: 1.* Actual Pressures   (All walls, All soils)
Pressure Type: 1.* Active, Ka
Earthquake Loading Apply to: 1. No Earthq. Loads
        Earthquake Horizontal Acceleration, Kh = 0
        Earthquake Vertical Acceleration, Kv = 0
Calculation Methods: 3. Formulary Solution (Coulomb Equation)
Wall Friction Options: 3. Both sides (for formulary solution)
        Wall Friction = 14
        Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip
User's Settings
        Ignore Passive from Depth = 0
        Multiplier of Active Pressure = 1
        Multiplier of Passive Pressure = 1
        Multiplier of Water Pressure = 1
        Multiplier of Earthq. Pressure = 1
        Estimated Embedment: Very Shallow: 2H
Program's Settings
        Max. Height, Hmax = 210.00
        Analysis Segment, dz = 0.53
        No. of Active Segment at H, nz0 = 3
        No. of Active Segment at Hmax, nz = 5
        No. of Passive Segment, nzp = 2
        Active Depth at H, Zh = 21.00
        Active Depth at Hmax, Z = 210.00
        Passive Depth at Hmax, Zp = 210.00
        Max. Pressure = 35.45

Total Soil Types= 3
Soil    Weight  W(S)   Phi   Cohesion   Nspt   Type   Description
1       120.0   120.0   30      0.0     0       4       Fill
2       120.0   120.0   32      0.0     0       4       Sand 1
3       120.0   120.0   20      0.7     0       2       Clay
Soil Type:  1 Equivalent Clay; 2 Clay; 3 Silt; 4 Sand; 5 Gravel

Ground Surface at Active Side:
Line    Z1      Xa1      Z2      Xa2       Soil No.
1       0.0     0.0     0.0     800.0           1
2       17.0    0.0     17.0    800.0           2
3       60.0    0.0     60.0    800.0           3
```

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.
1	21.0	0.0	21.0	800.0	2
2	60.0	0.0	60.0	800.0	3

Water Table at Passive Side:

Point	Z-water	X-water
1	21.0	0.0
2	21.0	800.0

Output data: ***

Total Force above Base= 5.46 per one linear foot (or meter) width along wall height
Static Force above Base= 5.46

Apparent Pressure above Base - Output to Shoring
Active/At-Rest Force above Base, Ea = 5.46

No	Z1	P1	Z2	P2	Slope	Coef.
0	0.0	0.00	5.0	0.18	0.0363	0.3026
1	5.0	0.18	17.0	0.39	0.0174	0.3026
2	17.0	0.36	21.0	0.43	0.0161	0.2801

Driving Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Ka or Ko
0	21.0	0.43	60.0	1.06	0.0161	0.2801
1	60.0	0.72	210.0	4.49	0.0251	0.4365

Passive Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Kp
0	21.0	0.00	60.0	11.95	0.3065	5.3214
1	60.0	9.01	210.0	34.45	0.1695	2.9436

Water Pressure - Output to Shoring

No	Z1	P1	Z2	P2	Slope
0	5.0	0.00	21.0	1.00	0.06
1	21.0	1.00	210.0	1.00	0.00

****
DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

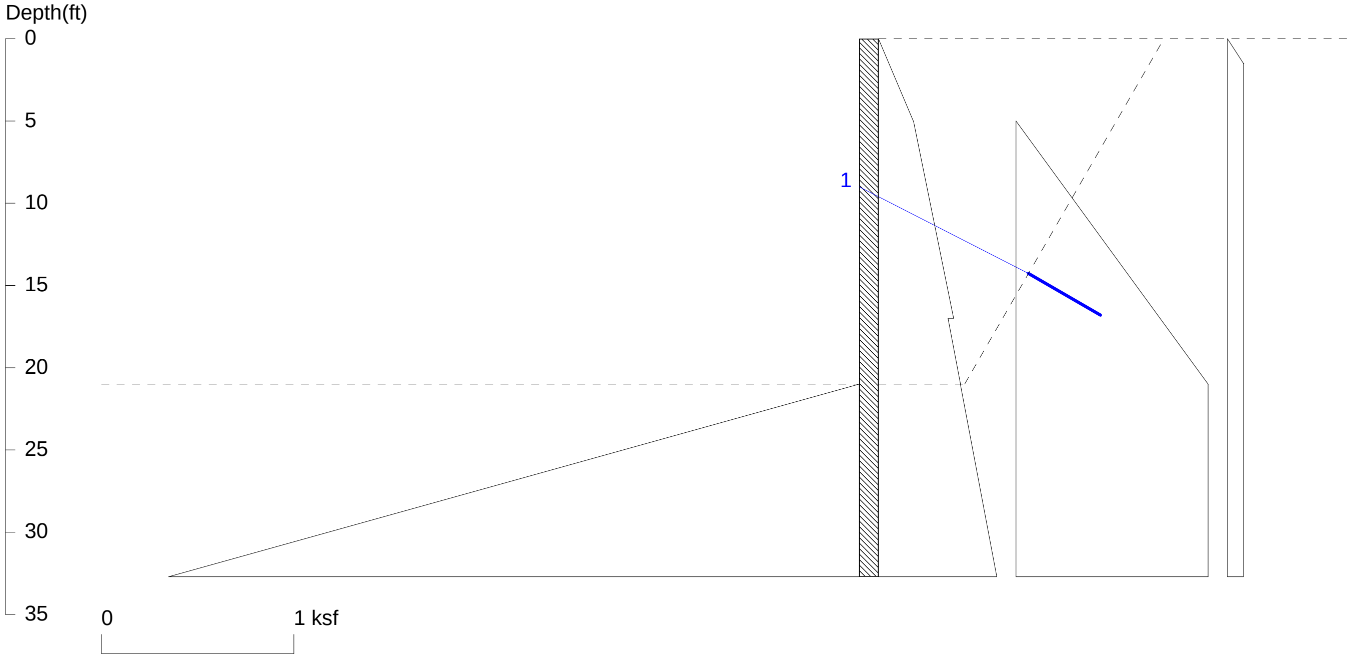
Z, Xa, Xp - Coordinates of ground lines
Z- Depth measured from wall top
Xa - Distance measure from wall to active side.
Xp - Distance measure from wall to passive side

Z1, P1, Z2, P2 - Four values to define a pressure diagram
Z1- Top depth of the diagram
P1- Top pressure of the diagram
Z2- Bottom depth of the diagram
P2- Bottom pressure of the diagram
Slope - (P2-P1)/(Z2-Z1), Slope of the diagram. It also called
    Equivalent fluid density.
Coef. - Pressure Coefficient = Slope/Unit We9ight
Ka - Active Earth Pressure Coefficient

Ko - At-Rest Earth Pressure Coefficient
Kp - Passive Earth Pressure Coefficient

50 Kent Ave - Shoring

Stage 2 - Tieback Option



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File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 2.s

Wall Height=21.0   Pile Diameter=1.0   Pile Spacing=1.0   Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=11.71   Min. Pile Length=32.71 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=53.74 per Pile Spacing=1.0 at Depth=19.43

PILE SELECTION:
Request Min. Section Modulus = 19.5 in3/ft=1050.60 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=.66
PZ35 has Section Modulus = 48.5 in3/ft=2607.36 cm3/m. It is greater than Min. Requirements!
Top Deflection = -0.49(in) based on E (ksi)=29000.00 and I (in4)/foot=361.2

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	9.0	30.0	1.0	14.9	12.9	7.4	10.5	5.1

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	5.000	0.182	0.036310
5.000	0.182	17.000	0.391	0.017429
17.000	0.362	21.000	0.426	0.016132
*	Below	Base		
21.000	0.426	60.000	1.055	0.016132
*	Water	Pres.		
5.000	0.000	21.000	0.998	0.062400
21.000	0.998	168.000	0.998	0.000000
*	Sur-	charge		
0.000	0.000	1.500	0.083	0.055556
1.500	0.083	3.000	0.083	0.000000
3.000	0.083	4.500	0.083	0.000000

4.500	0.083	6.000	0.083	0.000000
6.000	0.083	7.500	0.083	0.000000
7.500	0.083	9.000	0.083	0.000000
9.000	0.083	10.500	0.083	0.000000
10.500	0.083	12.000	0.083	0.000000
12.000	0.083	13.500	0.083	0.000000
13.500	0.083	15.000	0.083	0.000000
15.000	0.083	16.500	0.083	0.000000
16.500	0.083	18.000	0.083	0.000000
18.000	0.083	19.500	0.083	0.000000
19.500	0.083	21.000	0.083	0.000000
21.000	0.083	22.500	0.083	0.000000
22.500	0.083	24.000	0.083	0.000000
24.000	0.083	25.500	0.083	0.000000
25.500	0.083	27.000	0.083	0.000000
27.000	0.083	28.500	0.083	0.000000
28.500	0.083	30.000	0.083	0.000000
30.000	0.083	33.000	0.083	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
21.000	0.000	60.000	11.954	0.306510

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	21.00	1.00

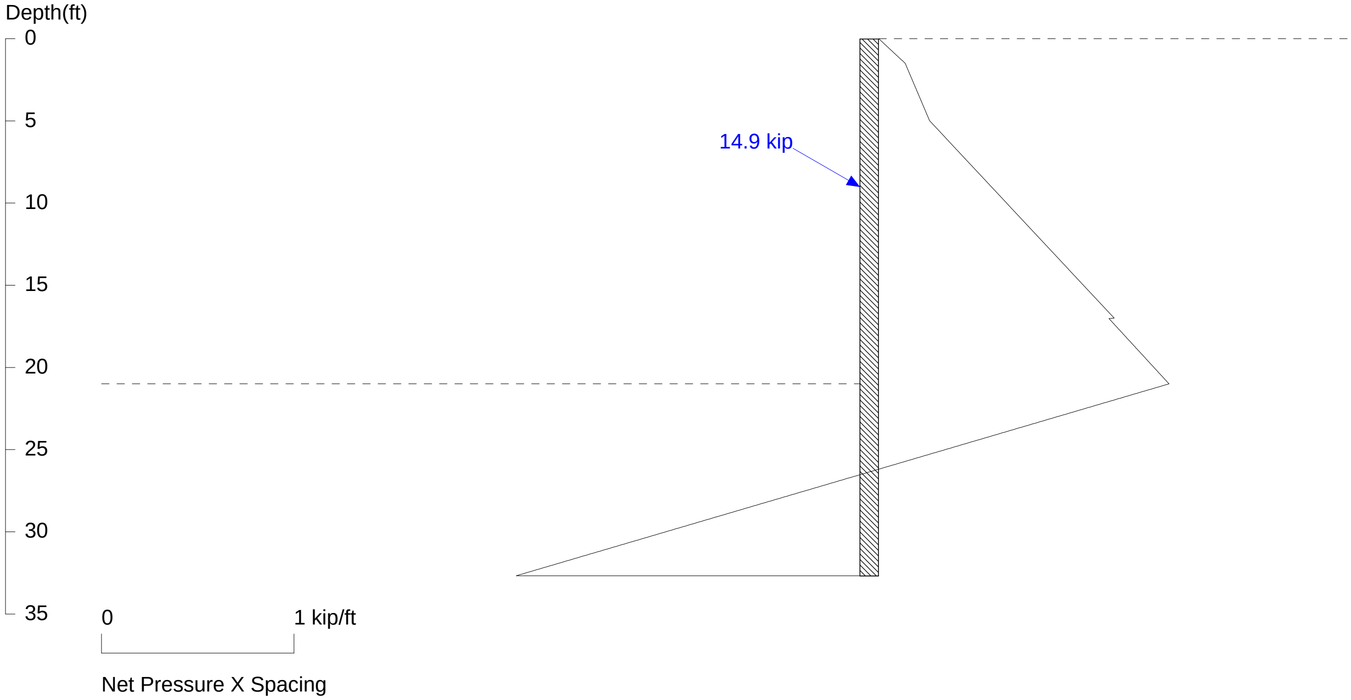
PASSIVE SPACING:

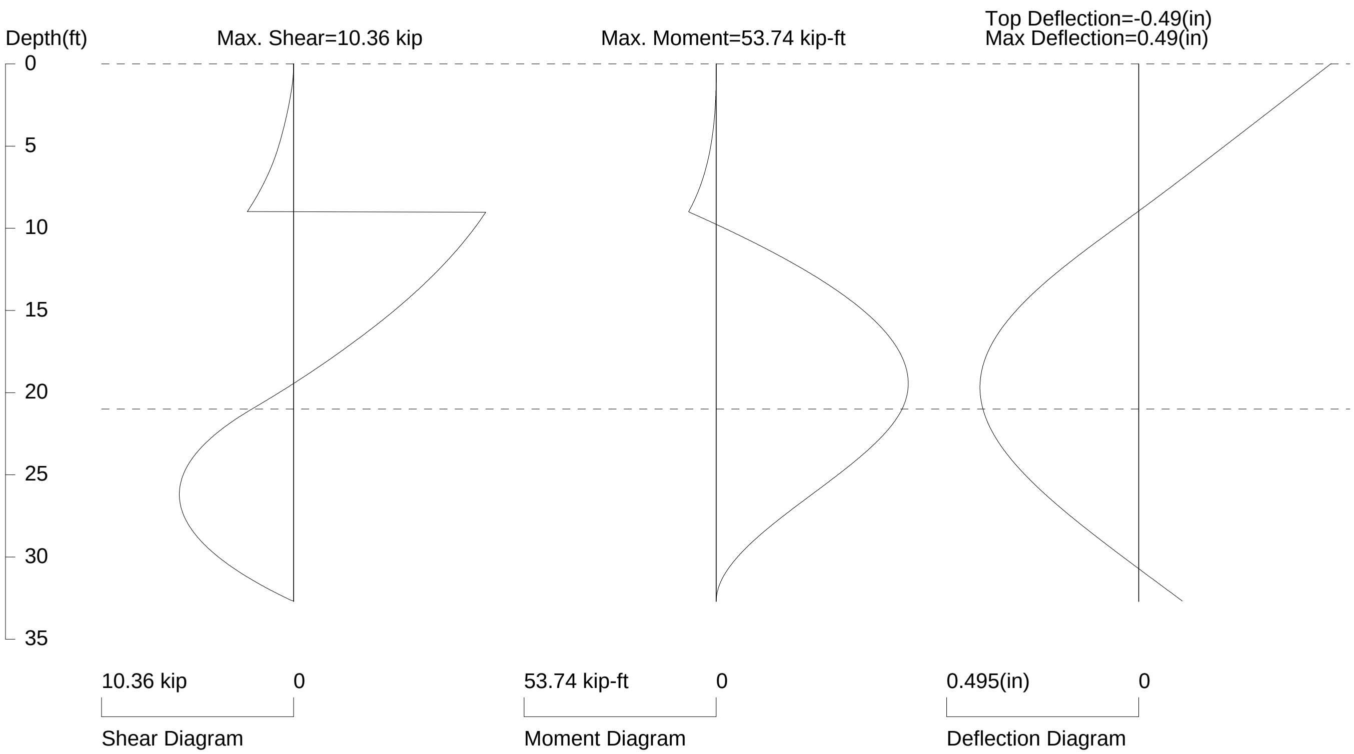
No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

50 Kent Ave - Shoring

Stage 2 - Tieback Option





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, PZ35: E (ksi)=29000.0, I (in4)/foot=361.2

File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 2.sh8

```
*******************************************************************************

                     SHORING WALL CALCULATION SUMMARY
               The leading shoring design and calculation software
                    Software Copyright by CivilTech Software
                             www.civiltech.com

*******************************************************************************
ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:
    1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
    2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
    3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
    4. TRENCHING AND SHORING MANUAL Revision 12, California Department of
       Transportation, January 2000
    6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
    5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31
March 1994
    7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
    8. AASHTO HB-17, American Association of State and Highway Transportation
Officials, 2 September 2002

UNITS:   Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft,
Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in
------------------------------------------------------------------------------
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Date: 12/29/2014  File: I:\Projects\11176638 Williamsburg Site (50 kent
Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 2.sh8

Title:  50 Kent Ave - Shoring
Subtitle: Stage 2 - Tieback Option

*********************************INPUT DATA**********************************
Wall Type: 1. Sheet Pile
        Wall Height: 21.00
        Pile Diameter: 1.00
        Pile Spacing: 1.00
        Factor of Safety (F.S.): 1.00
Lateral Support Type (Braces): 3. Tieback
        Top Brace Increase (Multi-Bracing): No
        Brace Position (One Brace Case): Normal Brace*
No-Load Zone:
        Vertical Depth for No-Load Zone: 21.00
        H-Distance (Input H/V ratio) for No-Load Zone: 0.25
        Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
        Friction at Pile Tip: No
Pile Properties:
        Steel Strength, Fy:  50 ksi = 345 MPa
        Allowable Fb/Fy: .66
        Elastic Module, E: 29000.00
        Moment of Inertia, I: 361.20
        User Input Pile: PZ35
```

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		
2	0.000	0.000	5.000	0.182	0.036310
3	5.000	0.182	17.000	0.391	0.017429
4	17.000	0.362	21.000	0.426	0.016132
5	*	Below	Base		
6	21.000	0.426	60.000	1.055	0.016132

7	60.000	0.720	168.000	3.435	0.025140
8	*	Water	Pres.		
9	5.000	0.000	21.000	0.998	0.062400
10	21.000	0.998	168.000	0.998	0.000000
11	*	Sur-	charge		
12	0.000	0.000	1.500	0.083	0.055556
13	1.500	0.083	3.000	0.083	0.000000
14	3.000	0.083	4.500	0.083	0.000000
15	4.500	0.083	6.000	0.083	0.000000
16	6.000	0.083	7.500	0.083	0.000000
17	7.500	0.083	9.000	0.083	0.000000
18	9.000	0.083	10.500	0.083	0.000000
19	10.500	0.083	12.000	0.083	0.000000
20	12.000	0.083	13.500	0.083	0.000000
21	13.500	0.083	15.000	0.083	0.000000
22	15.000	0.083	16.500	0.083	0.000000
23	16.500	0.083	18.000	0.083	0.000000
24	18.000	0.083	19.500	0.083	0.000000
25	19.500	0.083	21.000	0.083	0.000000
26	21.000	0.083	22.500	0.083	0.000000
27	22.500	0.083	24.000	0.083	0.000000
28	24.000	0.083	25.500	0.083	0.000000
29	25.500	0.083	27.000	0.083	0.000000
30	27.000	0.083	28.500	0.083	0.000000
31	28.500	0.083	30.000	0.083	0.000000
32	30.000	0.083	33.000	0.083	0.000000
33	33.000	0.083	36.000	0.083	0.000000
34	36.000	0.083	39.000	0.083	0.000000
35	39.000	0.083	42.000	0.083	0.000000
36	42.000	0.083	45.000	0.083	0.000000
37	45.000	0.083	48.000	0.083	0.000000
38	48.000	0.083	51.000	0.083	0.000000
39	51.000	0.083	54.000	0.083	0.000000
40	54.000	0.083	57.000	0.083	0.000000
41	57.000	0.083	60.000	0.083	0.000000
42	60.000	0.083	66.000	0.083	0.000000
43	66.000	0.083	72.000	0.083	0.000000
44	72.000	0.083	78.000	0.083	0.000000
45	78.000	0.083	84.000	0.083	0.000000
46	84.000	0.083	90.000	0.083	0.000000
47	90.000	0.083	96.000	0.083	0.000000
48	96.000	0.083	102.000	0.083	0.000000
49	102.000	0.083	108.000	0.083	0.000000
50	108.000	0.083	114.000	0.083	0.000000
51	114.000	0.083	120.000	0.000	-0.013889

* PASSIVE PRESSURE *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	21.000	0.000	60.000	11.954	0.306510
3	60.000	9.014	168.000	27.326	0.169549

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	21.00	1.00

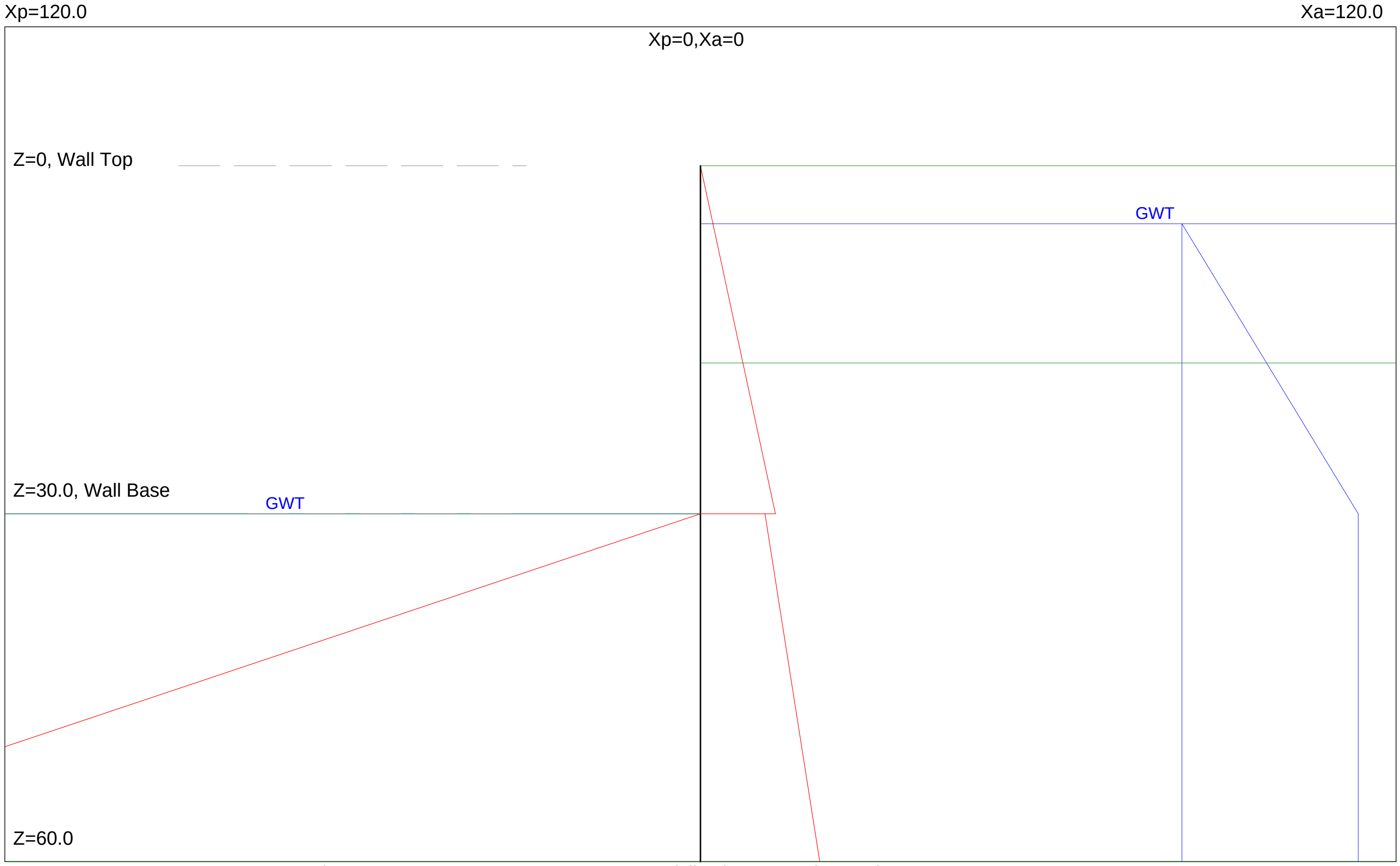
* PASSIVE SPACE *

```
 No.    Z depth         Spacing
-----------------------------------------------------------------------------
 1      0.00            1.00
-----------------------------------------------------------------------------

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *
 No.    Z brace         Angle           Spacing         Input1*         Input2*
Type
--------------------------------------------------------------------------------------
---------------------
 1      9.00            30.0            1.00            0.65            1.44
Tieback
--------------------------------------------------------------------------------------
---------------------
*For Tieback:  Input1 = Diameter;  Input2 = Bond Strength
*For Plate:  Input1 = Diameter;  Input2 = Allowable Pressure
*For Deadman:  Input1 = Horz. Width;  Input2 = Allowable Pressure; Angle = 0


********************************CALCULATION**********************************

   The calculated moment and shear are per pile spacing.  Sheet piles are per one
foot or meter; Soldier piles are per pile.

   Top Pressures start at depth =  0.00


   NUMBER OF BRACE LEVEL = 1


        |      D1=0.00
        |
        |<--   D2=9.00         R1=12.88
        |
        |
        |
      ==|==    D3=21.00
        |
        |      D4=32.71

        D1 - TOP DEPTH
        D2 - BRACE DEPTH        R1 - REACTION
        D3 - EXCAVATION BASE
        D4 - PILE TIP

   TOTAL REACTION: R1 = 12.88
   TOTAL PRESSURES ACTING ON WALL = 12.88
      Total Reactions = Total Pressures,    OK!
   __________________________________________________
   BRACE NO.1 AT DEPTH = 9.00
       R1 = Brace Load = 12.88
   __________________________________________________


*********************************RESULTS*****************************************

* EMBEDMENT *
MINIMUM EMBEDMENT = 11.71,  TOTAL MINIMUM PILE LENGTH = 32.71

* MOMENT IN PILE (per pile spacing)*
Pile Spacing:  sheet piles are one foot or one meter; soldier piles are one pile.
 No.    Depth           M @ Brace       Mmax in Span    Depth of Mmax
-----------------------------------------------------------------------------
```

```
 1      9.00            7.59            53.74           19.43
-----------------------------------------------------------------------------
Overall Maximum Moment = 53.74 at 19.43
Maximum Shear = 10.36
Moment and Shear are per pile spacing: 1.0 foot or meter

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *
The calculated brace force are per brace spacing.

 No.    DEPTH           Tangle          SPACING         HORIZONTAL      VERTICAL
TOTAL LOAD
--------------------------------------------------------------------------------------
----------
 1      9.00            30.0            1.00            12.88           7.44
14.88

 No.    DEPTH           Free length     Type and Data
--------------------------------------------------------------------------------------
----------
 1      9.00            10.55           Tieback, Bond length = 5.06
--------------------------------------------------------------------------------------
----------

* VERTICAL LOADING *
Vertical Loading from Braces = 7.44
Vertical Loading from External Load = 0.00
Total Vertical Loading = 7.44


*****************************SPECIFIED PILE ***********************************

   Overall Maximum Moment = 53.74 at 19.43
   The pile selection is based on the magnitude of the moment only. Axial force is
neglected.

   Request Min. Section Modulus = 19.54 in3/ft = 1050.60 cm3/m, Fy= 50 ksi = 345
MPa, Fb/Fy=.66

   PZ35 has been found in Sheet Pile list!
   PZ35(English):    Sx= 48.50 in3/ft  Ix= 361.20 in4/ft   Weight= 35.00 lb/ft
   PZ35(Metrics):    Sx= 2607.36 cm3/m  Ix= 493.25 x100cm4/m   Weight= 0.511 kN/m

   * Note: All the pile dimensions are in English Units per one foot width.


   PZ35 is capable to support the shoring!
   I (in4)/foot=361.20
   Top deflection = -0.495(in)
   Max. deflection = 0.495(in)
```

50 Kent Ave - Earth Pressure

Stage 3 - Tieback Option - Triangular



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=30.0   Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	120.0	30	0.0	0	4	Fill
2	120.0	120.0	32	0.0	0	4	Sand 1
3	120.0	120.0	20	0.7	0	2	Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	17.0	0.0	17.0	800.0	2	Sand 1
3	60.0	0.0	60.0	800.0	3	Clay

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	30.0	0.0	30.0	800.0	2	Sand 1
2	60.0	0.0	60.0	800.0	3	Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	30.0	0.0
2	30.0	800.0

Wall Friction Options: 3. Both sides (for formulary solution)

Wall Friction = 14

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 9.95 per one linear foot (or meter) width along wall height

Total Static Force above Base= 9.95. Distributed in Triangular Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	30.00	0.66	0.0221	0.1843

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
30.00	0.57	60.00	1.06	0.0161	0.2801

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
30.00	0.00	60.00	9.20	0.307	5.3214

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	5.00	0.00	30.00	1.56	0.06
1	30.00	1.56	60.00	1.56	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 12/30/2014 File Name: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3 - Tria

```
****************************************************************
                 EARTH PRESSURE ANALYSIS SUMMARY
                          <EarthPres>
            Software Copyright by CivilTech Software
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****************************************************************
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Date: 12/29/2014           File: I:\Projects\11176638 Williamsburg Site (50 kent
Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3.ep8

Title 1:  50 Kent Ave - Earth Pressure
Title 2: Stage 3 - Tieback Option

Input data: *************************************************

Wall Height = 30.00
Depth of Ground at Active Side = 0.00
Depth of Ground at Passive Side = 30.00
Apparent Pressure Envelope: 3. Rectangular Envelope (Braced, Sand and Silt)
Pressure Type: 1.* Active, Ka
Earthquake Loading Apply to: 1. No Earthq. Loads
        Earthquake Horizontal Acceleration, Kh = 0
        Earthquake Vertical Acceleration, Kv = 0
Calculation Methods: 3. Formulary Solution (Coulomb Equation)
Wall Friction Options: 3. Both sides (for formulary solution)
        Wall Friction = 14
        Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip
User's Settings
        Ignore Passive from Depth = 0
        Multiplier of Active Pressure = 1
        Multiplier of Passive Pressure = 1
        Multiplier of Water Pressure = 1
        Multiplier of Earthq. Pressure = 1
        Estimated Embedment: Very Shallow: 2H
Program's Settings
        Max. Height, Hmax = 300.00
        Analysis Segment, dz = 0.75
        No. of Active Segment at H, nz0 = 3
        No. of Active Segment at Hmax, nz = 5
        No. of Passive Segment, nzp = 2
        Active Depth at H, Zh = 30.00
        Active Depth at Hmax, Z = 300.00
        Passive Depth at Hmax, Zp = 300.00
        Max. Pressure = 49.74

Total Soil Types= 3
Soil    Weight  W(S)   Phi   Cohesion   Nspt   Type   Description
1       120.0   120.0   30      0.0     0       4       Fill
2       120.0   120.0   32      0.0     0       4       Sand 1
3       120.0   120.0   20      0.7     0       2       Clay
Soil Type:  1 Equivalent Clay; 2 Clay; 3 Silt; 4 Sand; 5 Gravel

Ground Surface at Active Side:
Line    Z1      Xa1      Z2      Xa2       Soil No.
1       0.0     0.0     0.0     800.0          1
2       17.0    0.0     17.0    800.0          2
3       60.0    0.0     60.0    800.0          3
```

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.
1	30.0	0.0	30.0	800.0	2
2	60.0	0.0	60.0	800.0	3

Water Table at Passive Side:

Point	Z-water	X-water
1	30.0	0.0
2	30.0	800.0

Output data: ***

Total Force above Base= 9.95 per one linear foot (or meter) width along wall height
Static Force above Base= 9.95. Distributed in Apparent Envelope along wall height.
Ignore soil layers and water line

Apparent Pressure above Base - Output to Shoring
Active/At-Rest Force above Base, Ea = 9.95

No	Z1	P1	Z2	P2	Slope	Coef.
0	0.0	0.43	30.0	0.43	0.0000	0.0000

Driving Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Ka or Ko
0	30.0	0.57	60.0	1.06	0.0161	0.2801
1	60.0	0.72	300.0	6.75	0.0251	0.4365

Passive Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Kp
0	30.0	0.00	60.0	9.20	0.3065	5.3214
1	60.0	7.49	300.0	48.18	0.1695	2.9436

Water Pressure - Output to Shoring

No	Z1	P1	Z2	P2	Slope
0	5.0	0.00	30.0	1.56	0.06
1	30.0	1.56	300.0	1.56	0.00

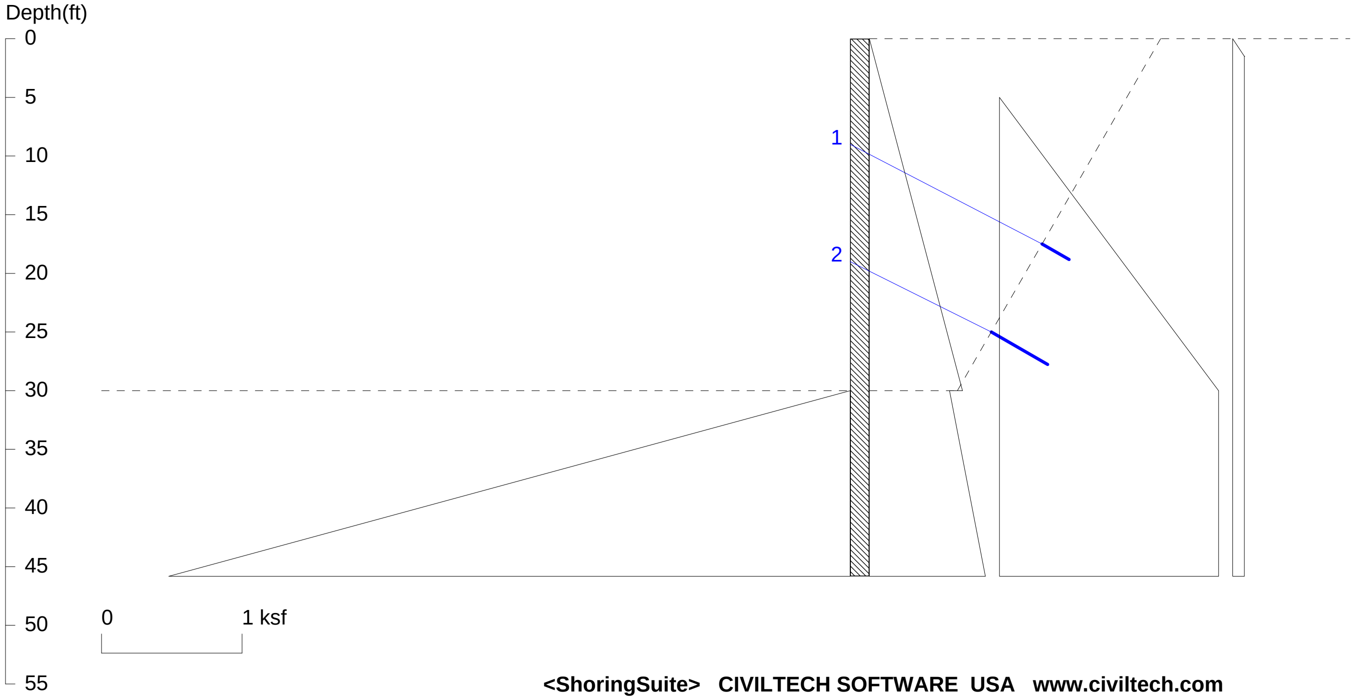
****
DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Z, Xa, Xp - Coordinates of ground lines
Z- Depth measured from wall top
Xa - Distance measure from wall to active side.
Xp - Distance measure from wall to passive side

Z1, P1, Z2, P2 - Four values to define a pressure diagram
Z1- Top depth of the diagram
P1- Top pressure of the diagram
Z2- Bottom depth of the diagram
P2- Bottom pressure of the diagram
Slope - (P2-P1)/(Z2-Z1), Slope of the diagram. It also called
    Equivalent fluid density.
Coef. - Pressure Coefficient = Slope/Unit We9ight
Ka - Active Earth Pressure Coefficient
Ko - At-Rest Earth Pressure Coefficient

Kp - Passive Earth Pressure Coefficient

50 Kent Ave - Earth Pressure
Stage 3 - Tieback Option - Triangular



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File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3 -

Wall Height=30.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=15.82 Min. Pile Length=45.82 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=85.72 per Pile Spacing=1.0 at Depth=29.97

PILE SELECTION:
Request Min. Section Modulus = 31.2 in3/ft=1675.66 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=.66
PZ35 has Section Modulus = 48.5 in3/ft=2607.36 cm3/m. It is greater than Min. Requirements!
Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in4)/foot=361.2

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	9.0	30.0	1.0	7.8	6.8	3.9	17.0	2.7
2. Tieback	19.0	30.0	1.0	16.3	14.1	8.2	12.0	5.5

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	30.000	0.663	0.022115
*	Below	Base		
30.000	0.571	60.000	1.055	0.016132
*	Water	Pres.		
5.000	0.000	30.000	1.560	0.062400
30.000	1.560	210.000	1.560	0.000000
*	Sur-	charge		
0.000	0.000	1.500	0.083	0.055556
1.500	0.083	3.000	0.083	0.000000
3.000	0.083	4.500	0.083	0.000000
4.500	0.083	6.000	0.083	0.000000

6.000	0.083	7.500	0.083	0.000000
7.500	0.083	9.000	0.083	0.000000
9.000	0.083	10.500	0.083	0.000000
10.500	0.083	12.000	0.083	0.000000
12.000	0.083	13.500	0.083	0.000000
13.500	0.083	15.000	0.083	0.000000
15.000	0.083	16.500	0.083	0.000000
16.500	0.083	18.000	0.083	0.000000
18.000	0.083	19.500	0.083	0.000000
19.500	0.083	21.000	0.083	0.000000
21.000	0.083	22.500	0.083	0.000000
22.500	0.083	24.000	0.083	0.000000
24.000	0.083	25.500	0.083	0.000000
25.500	0.083	27.000	0.083	0.000000
27.000	0.083	28.500	0.083	0.000000
28.500	0.083	30.000	0.083	0.000000
30.000	0.083	33.000	0.083	0.000000
33.000	0.083	36.000	0.083	0.000000
36.000	0.083	39.000	0.083	0.000000
39.000	0.083	42.000	0.083	0.000000
42.000	0.083	45.000	0.083	0.000000
45.000	0.083	48.000	0.083	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
30.000	0.000	60.000	9.195	0.306510

ACTIVE SPACING:

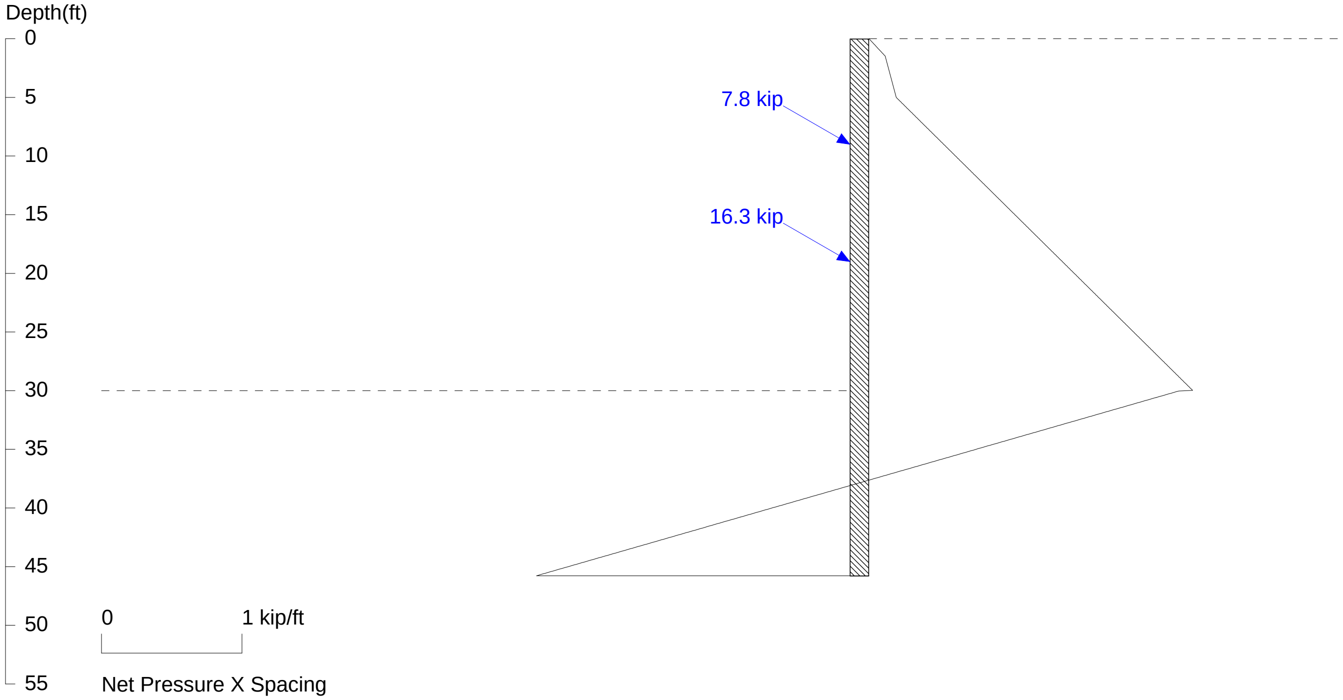
No.	Z depth	Spacing
1	0.00	1.00
2	30.00	1.00

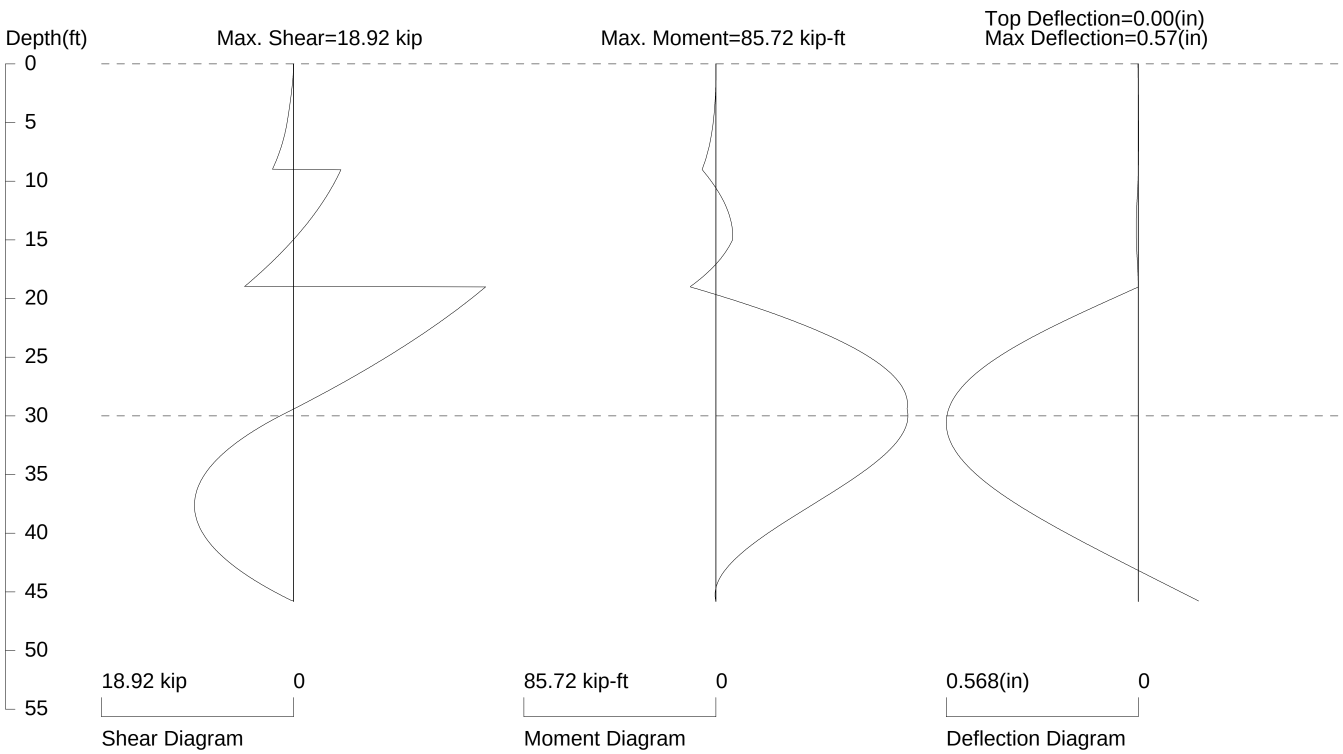
PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

50 Kent Ave - Earth Pressure
Stage 3 - Tieback Option - Triangular





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, PZ35: E (ksi)=29000.0, I (in4)/foot=361.2

File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3 - Triangular Earth Pressure.sh8

```
******************************************************************************

                    SHORING WALL CALCULATION SUMMARY
             The leading shoring design and calculation software
                   Software Copyright by CivilTech Software
                          www.civiltech.com

******************************************************************************
ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:
    1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
    2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
    3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
    4. TRENCHING AND SHORING MANUAL Revision 12, California Department of
       Transportation, January 2000
    6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
    5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31
March 1994
    7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
    8. AASHTO HB-17, American Association of State and Highway Transportation
Officials, 2 September 2002

UNITS:   Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft,
Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in
-----------------------------------------------------------------------------
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Date: 12/30/2014  File: I:\Projects\11176638 Williamsburg Site (50 kent
Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3 - Triangular Earth
Pressure.sh8

Title:  50 Kent Ave - Earth Pressure
Subtitle: Stage 3 - Tieback Option - Triangular

**********************************INPUT DATA**********************************
Wall Type: 1. Sheet Pile
        Wall Height: 30.00
        Pile Diameter: 1.00
        Pile Spacing: 1.00
        Factor of Safety (F.S.): 1.00
        As Continuous Span Beam
Lateral Support Type (Braces): 3. Tieback
        Top Brace Increase (Multi-Bracing): No
        Assuming a Pin at Dredge Line for Multiple Brace Calculation
No-Load Zone:
        Vertical Depth for No-Load Zone: 30.00
        H-Distance (Input H/V ratio) for No-Load Zone: 0.25
        Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
        Friction at Pile Tip: No
Pile Properties:
        Steel Strength, Fy:  50 ksi = 345 MPa
        Allowable Fb/Fy: .66
        Elastic Module, E: 29000.00
        Moment of Inertia, I: 361.20
        User Input Pile: PZ35

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
 No.    Z1 top          Top Pres.       Z2 bottom       Bottom Pres.    Slope
-----------------------------------------------------------------------------
 1      *               Above           Base
 2      0.000           0.000           30.000          0.663           0.022115
 3      *               Below           Base
 4      30.000          0.571           60.000          1.055           0.016132
```

5	60.000	0.720	210.000	4.491	0.025140
6	*	Water	Pres.		
7	5.000	0.000	30.000	1.560	0.062400
8	30.000	1.560	210.000	1.560	0.000000
9	*	Sur-	charge		
10	0.000	0.000	1.500	0.083	0.055556
11	1.500	0.083	3.000	0.083	0.000000
12	3.000	0.083	4.500	0.083	0.000000
13	4.500	0.083	6.000	0.083	0.000000
14	6.000	0.083	7.500	0.083	0.000000
15	7.500	0.083	9.000	0.083	0.000000
16	9.000	0.083	10.500	0.083	0.000000
17	10.500	0.083	12.000	0.083	0.000000
18	12.000	0.083	13.500	0.083	0.000000
19	13.500	0.083	15.000	0.083	0.000000
20	15.000	0.083	16.500	0.083	0.000000
21	16.500	0.083	18.000	0.083	0.000000
22	18.000	0.083	19.500	0.083	0.000000
23	19.500	0.083	21.000	0.083	0.000000
24	21.000	0.083	22.500	0.083	0.000000
25	22.500	0.083	24.000	0.083	0.000000
26	24.000	0.083	25.500	0.083	0.000000
27	25.500	0.083	27.000	0.083	0.000000
28	27.000	0.083	28.500	0.083	0.000000
29	28.500	0.083	30.000	0.083	0.000000
30	30.000	0.083	33.000	0.083	0.000000
31	33.000	0.083	36.000	0.083	0.000000
32	36.000	0.083	39.000	0.083	0.000000
33	39.000	0.083	42.000	0.083	0.000000
34	42.000	0.083	45.000	0.083	0.000000
35	45.000	0.083	48.000	0.083	0.000000
36	48.000	0.083	51.000	0.083	0.000000
37	51.000	0.083	54.000	0.083	0.000000
38	54.000	0.083	57.000	0.083	0.000000
39	57.000	0.083	60.000	0.083	0.000000
40	60.000	0.083	66.000	0.083	0.000000
41	66.000	0.083	72.000	0.083	0.000000
42	72.000	0.083	78.000	0.083	0.000000
43	78.000	0.083	84.000	0.083	0.000000
44	84.000	0.083	90.000	0.083	0.000000
45	90.000	0.083	96.000	0.083	0.000000
46	96.000	0.083	102.000	0.083	0.000000
47	102.000	0.083	108.000	0.083	0.000000
48	108.000	0.083	114.000	0.083	0.000000
49	114.000	0.083	120.000	0.000	-0.013889

* PASSIVE PRESSURE *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	30.000	0.000	60.000	9.195	0.306510
3	60.000	7.488	210.000	32.921	0.169549

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	30.00	1.00

* PASSIVE SPACE *

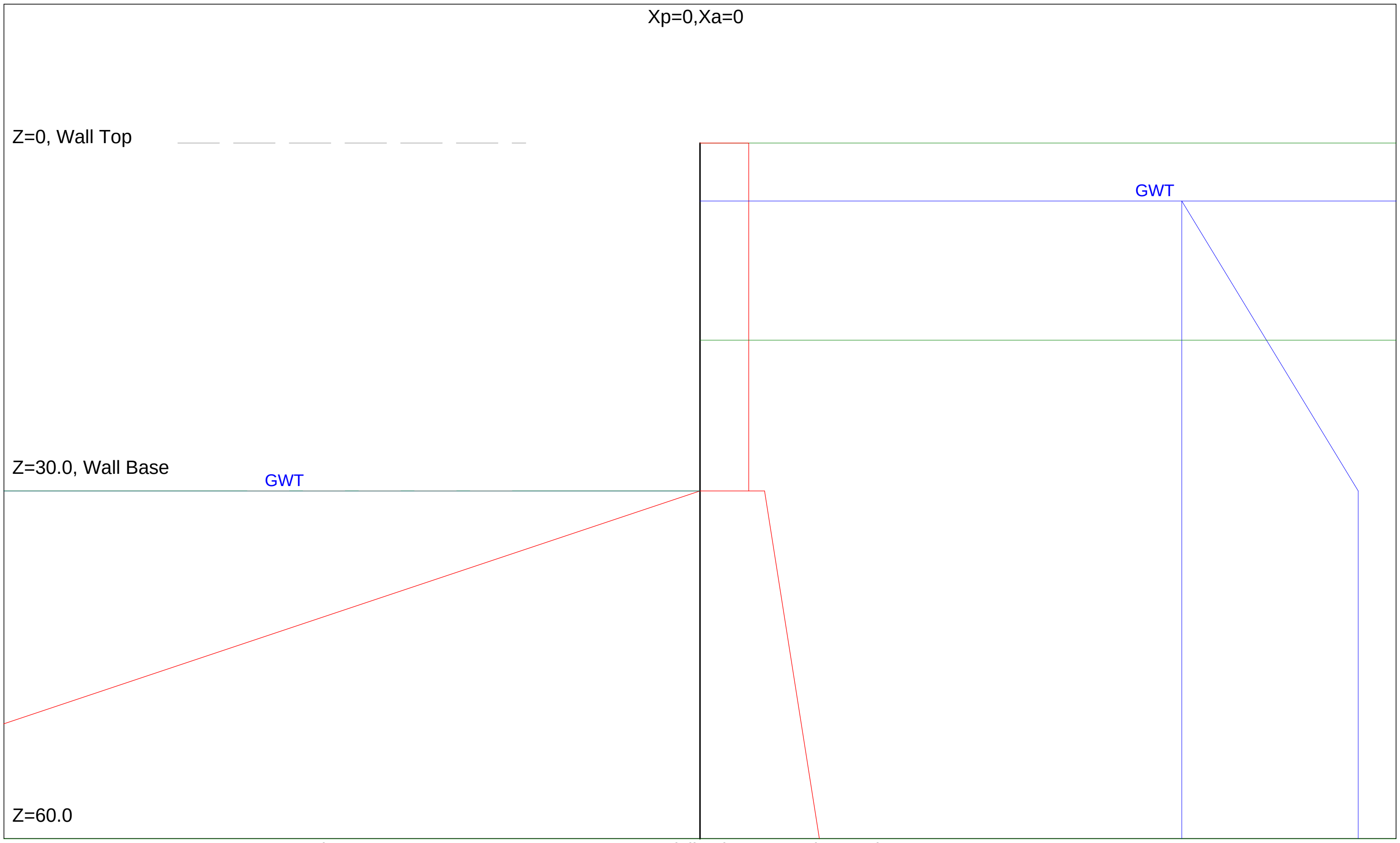
```
 No.    Z depth         Spacing
-----------------------------------------------------------------------------
 1      0.00            1.00
-----------------------------------------------------------------------------

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *
 No.    Z brace         Angle           Spacing         Input1*         Input2*
Type
--------------------------------------------------------------------------------
---------------------
 1      9.00            30.0            1.00            0.65            1.44
Tieback
 2      19.00           30.0            1.00            0.65            1.44
Tieback
--------------------------------------------------------------------------------
---------------------
*For Tieback:  Input1 = Diameter;  Input2 = Bond Strength
*For Plate:  Input1 = Diameter;  Input2 = Allowable Pressure
*For Deadman:  Input1 = Horz. Width;  Input2 = Allowable Pressure; Angle = 0


********************************CALCULATION**********************************

   The calculated moment and shear are per pile spacing.  Sheet piles are per one
foot or meter; Soldier piles are per pile.

   Top Pressures start at depth =  0.00

*  CALCULATE REQUEST EMBEDMENT  *

        |<--   D1=19.00
        |
     ==|==     D2=30.00
        |
        |      D3=45.82

        D1 - TOP DEPTH          R1 - TOP REACTION
        D2 - EXCAVATION BASE
        D3 - PILE TIP

   TOTAL REACTION: R1 = 18.94
   TOTAL PRESSURES ACTING ON WALL = 18.94
      Total Reactions = Total Pressures,    OK!
      The Calculated Embedment, Yend = 15.82

-------------------------MULTIPLE BRACE / TIEBACK CASE-------------------------
** Use the calculated embedment, Yend = 15.82 for graphics and analysis.

   NUMBER OF BRACE LEVEL=  2


*  CANTILEVER SPAN, N0.0 *

        |      D1=0.00
        |
        |
        |<--   D2=9.00         R2=2.08, with Cantilever Moment=6.19

        D1 - TOP DEPTH
        D2 - BOTTOM DEPTH         R2 - BOTTOM REACTION

   TOTAL REACTION: R2 = 2.08
   TOTAL PRESSURES ACTING ON WALL = 2.08
```

```
   Total Reactions = Total Pressures,    OK!
________________________________________________
BRACE NO.1 AT DEPTH = 9.00
    R2 of Span No.0
                            } Sum of Reaction = Brace Load = 6.77
    R1 of Span No.1
________________________________________________

*  MIDDLE SPAN NO.1  *

     |<--   D1=9.00         R1=4.69
     |
     |
     |<--   D2=19.00         R2=4.86

     D1 - TOP DEPTH          R1 - TOP REACTION
     D2 - BOTTOM DEPTH       R2 - BOTTOM REACTION

  TOTAL REACTION: R1+R2 = 9.54
  TOTAL PRESSURES ACTING ON WALL = 9.54
     Total Reactions = Total Pressures,    OK!
________________________________________________
BRACE NO.2 AT DEPTH = 19.00
    R2 of Span No.1
                            } Sum of Reaction = Brace Load = 14.13
    R1 of Last Span
________________________________________________

*  LAST SPAN  (To Dredge Line and Assuming a Pin at Dredge Line) *

     |<--   D1=19.00         R1=9.28
     |
     |
     |<--   D2=30.00         R2=10.98

     D1 - TOP DEPTH          R1 - TOP REACTION
     D2 - DREDGE LINE (EXCAVATION BASE)       R2 - BOTTOM REACTION

  TOTAL REACTION: R1+R2 = 20.26
  TOTAL PRESSURES ACTING ON WALL = 20.26
     Total Reactions = Total Pressures,    OK!

*********************************RESULTS*****************************************

* EMBEDMENT *
MINIMUM EMBEDMENT = 15.82,  TOTAL MINIMUM PILE LENGTH = 45.82

* MOMENT IN PILE (per pile spacing)*
Pile Spacing:  sheet piles are one foot or one meter; soldier piles are one pile.
 No.    Depth          M @ Brace       Mmax in Span    Depth of Mmax
-----------------------------------------------------------------------------
 1      9.00           6.08            7.50            14.68
 2      19.00          11.34           85.72           29.97
-----------------------------------------------------------------------------
Overall Maximum Moment = 85.72 at 29.97
Maximum Shear = 18.92
Moment and Shear are per pile spacing: 1.0 foot or meter

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *
The calculated brace force are per brace spacing.

 No.    DEPTH          Tangle          SPACING         HORIZONTAL      VERTICAL
TOTAL LOAD
```

```
----------------------------------------------------------------------------------------------
 1      9.00            30.0            1.00            6.77            3.91
7.81
 2      19.00           30.0            1.00            14.13           8.16
16.32

 No.    DEPTH           Free length     Type and Data
----------------------------------------------------------------------------------------------
 1      9.00            17.00           Tieback, Bond length = 2.66
 2      19.00           12.00           Tieback, Bond length = 5.55
----------------------------------------------------------------------------------------------

* VERTICAL LOADING *
Vertical Loading from Braces = 12.07
Vertical Loading from External Load = 0.00
Total Vertical Loading = 12.07


****************************SPECIFIED PILE ***********************************

   Overall Maximum Moment = 85.72 at 29.97
   The pile selection is based on the magnitude of the moment only. Axial force is
neglected.

   Request Min. Section Modulus = 31.17 in3/ft = 1675.66 cm3/m, Fy= 50 ksi = 345
MPa, Fb/Fy=.66

   PZ35 has been found in Sheet Pile list!
   PZ35(English):    Sx= 48.50 in3/ft  Ix= 361.20 in4/ft   Weight= 35.00 lb/ft
   PZ35(Metrics):    Sx= 2607.36 cm3/m  Ix= 493.25 x100cm4/m   Weight= 0.511 kN/m

   * Note: All the pile dimensions are in English Units per one foot width.


   PZ35 is capable to support the shoring!
   I (in4)/foot=361.20
   Top deflection = 0.000(in)
   Max. deflection = 2.367(in)
```

50 Kent Ave - Earth Pressure

Stage 3 - Tieback Option



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 12/29/2014 File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3.ep8

* INPUT DATA *

Wall Height=30.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	120.0	30	0.0	0	4	Fill
2	120.0	120.0	32	0.0	0	4	Sand 1
3	120.0	120.0	20	0.7	0	2	Clay

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	17.0	0.0	17.0	800.0	2	Sand 1
3	60.0	0.0	60.0	800.0	3	Clay

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	30.0	0.0	30.0	800.0	2	Sand 1
2	60.0	0.0	60.0	800.0	3	Clay

Water Table at Passive Side:

Point	Z-water	X-water
1	30.0	0.0
2	30.0	800.0

Wall Friction Options: 3. Both sides (for formulary solution)
Wall Friction = 14
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 9.95 per one linear foot (or meter) width along wall height
Total Static Force above Base= 9.95. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.43	30.00	0.43	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
30.00	0.57	60.00	1.06	0.0161	0.2801

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
30.00	0.00	60.00	9.20	0.307	5.3214

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	5.00	0.00	30.00	1.56	0.06
1	30.00	1.56	60.00	1.56	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 12/29/2014 File Name: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3.ep8

```
****************************************************************
                 EARTH PRESSURE ANALYSIS SUMMARY
                          <EarthPres>
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****************************************************************
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Date: 12/29/2014           File: I:\Projects\11176638 Williamsburg Site (50 kent
Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3.ep8

Title 1:  50 Kent Ave - Earth Pressure
Title 2: Stage 3 - Tieback Option

Input data: *************************************************

Wall Height = 30.00
Depth of Ground at Active Side = 0.00
Depth of Ground at Passive Side = 30.00
Apparent Pressure Envelope: 3. Rectangular Envelope (Braced, Sand and Silt)
Pressure Type: 1.* Active, Ka
Earthquake Loading Apply to: 1. No Earthq. Loads
        Earthquake Horizontal Acceleration, Kh = 0
        Earthquake Vertical Acceleration, Kv = 0
Calculation Methods: 3. Formulary Solution (Coulomb Equation)
Wall Friction Options: 3. Both sides (for formulary solution)
        Wall Friction = 14
        Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip
User's Settings
        Ignore Passive from Depth = 0
        Multiplier of Active Pressure = 1
        Multiplier of Passive Pressure = 1
        Multiplier of Water Pressure = 1
        Multiplier of Earthq. Pressure = 1
        Estimated Embedment: Very Shallow: 2H
Program's Settings
        Max. Height, Hmax = 300.00
        Analysis Segment, dz = 0.75
        No. of Active Segment at H, nz0 = 3
        No. of Active Segment at Hmax, nz = 5
        No. of Passive Segment, nzp = 2
        Active Depth at H, Zh = 30.00
        Active Depth at Hmax, Z = 300.00
        Passive Depth at Hmax, Zp = 300.00
        Max. Pressure = 49.74

Total Soil Types= 3
Soil    Weight  W(S)   Phi   Cohesion   Nspt   Type   Description
1       120.0   120.0   30      0.0     0       4       Fill
2       120.0   120.0   32      0.0     0       4       Sand 1
3       120.0   120.0   20      0.7     0       2       Clay
Soil Type:  1 Equivalent Clay; 2 Clay; 3 Silt; 4 Sand; 5 Gravel

Ground Surface at Active Side:
Line    Z1      Xa1      Z2      Xa2       Soil No.
1       0.0     0.0     0.0     800.0          1
2       17.0    0.0     17.0    800.0          2
3       60.0    0.0     60.0    800.0          3
```

Water Table at Active Side:

Point	Z-water	X-water
1	5.0	0.0
2	5.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.
1	30.0	0.0	30.0	800.0	2
2	60.0	0.0	60.0	800.0	3

Water Table at Passive Side:

Point	Z-water	X-water
1	30.0	0.0
2	30.0	800.0

Output data: ***

Total Force above Base= 9.95 per one linear foot (or meter) width along wall height
Static Force above Base= 9.95. Distributed in Apparent Envelope along wall height.
Ignore soil layers and water line

Apparent Pressure above Base - Output to Shoring
Active/At-Rest Force above Base, Ea = 9.95

No	Z1	P1	Z2	P2	Slope	Coef.
0	0.0	0.43	30.0	0.43	0.0000	0.0000

Driving Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Ka or Ko
0	30.0	0.57	60.0	1.06	0.0161	0.2801
1	60.0	0.72	300.0	6.75	0.0251	0.4365

Passive Pressure below Base - Output to Shoring

No	Z1	P1	Z2	P2	Slope	Kp
0	30.0	0.00	60.0	9.20	0.3065	5.3214
1	60.0	7.49	300.0	48.18	0.1695	2.9436

Water Pressure - Output to Shoring

No	Z1	P1	Z2	P2	Slope
0	5.0	0.00	30.0	1.56	0.06
1	30.0	1.56	300.0	1.56	0.00

****
DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

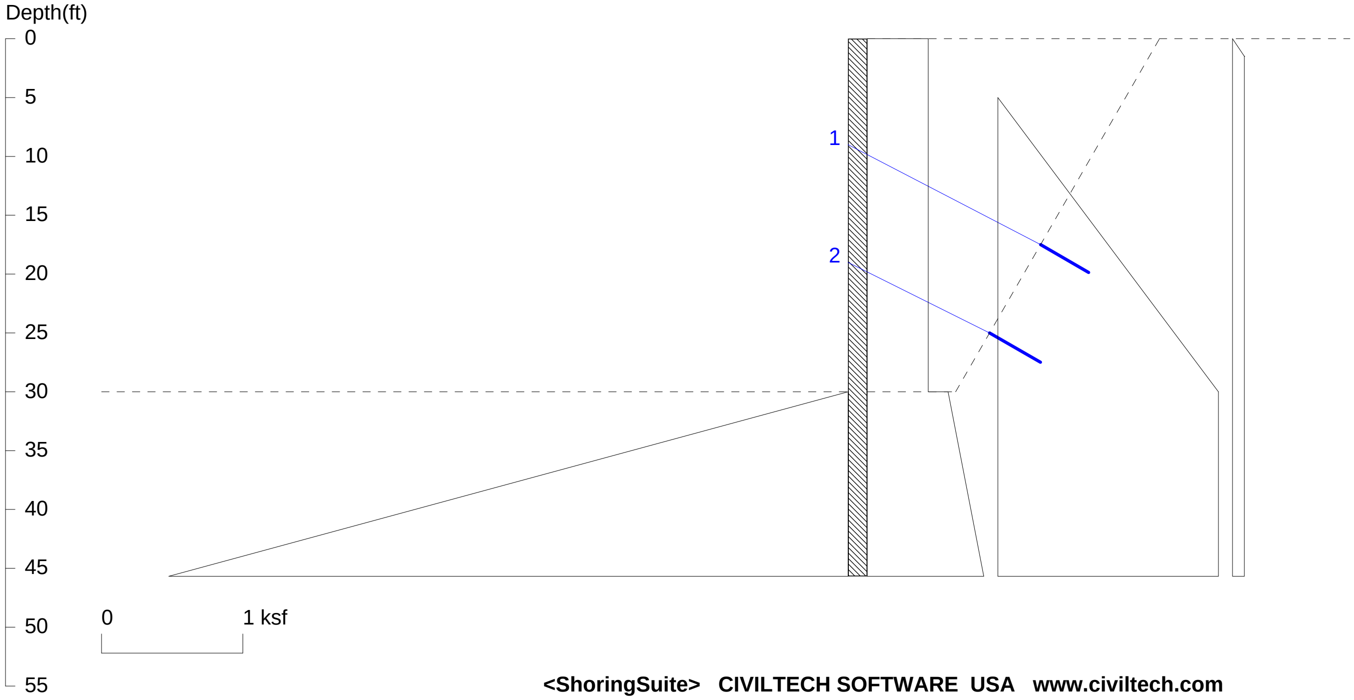
Z, Xa, Xp - Coordinates of ground lines
Z- Depth measured from wall top
Xa - Distance measure from wall to active side.
Xp - Distance measure from wall to passive side

Z1, P1, Z2, P2 - Four values to define a pressure diagram
Z1- Top depth of the diagram
P1- Top pressure of the diagram
Z2- Bottom depth of the diagram
P2- Bottom pressure of the diagram
Slope - (P2-P1)/(Z2-Z1), Slope of the diagram. It also called
    Equivalent fluid density.
Coef. - Pressure Coefficient = Slope/Unit We9ight
Ka - Active Earth Pressure Coefficient
Ko - At-Rest Earth Pressure Coefficient

Kp - Passive Earth Pressure Coefficient

50 Kent Ave - Shoring

Stage 3 - Tieback Option



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File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3.s

Wall Height=30.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=15.68 Min. Pile Length=45.68 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=81.28 per Pile Spacing=1.0 at Depth=30.13

PILE SELECTION:
Request Min. Section Modulus = 29.6 in3/ft=1589.01 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=.66
PZ35 has Section Modulus = 48.5 in3/ft=2607.36 cm3/m. It is greater than Min. Requirements!
Top Deflection = 0.09(in) based on E (ksi)=29000.00 and I (in4)/foot=361.2

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	9.0	30.0	1.0	13.9	12.0	6.9	17.0	4.7
2. Tieback	19.0	30.0	1.0	14.7	12.7	7.3	12.0	5.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.431	30.000	0.431	0.000000
*	Below	Base		
30.000	0.571	60.000	1.055	0.016132
*	Water	Pres.		
5.000	0.000	30.000	1.560	0.062400
30.000	1.560	210.000	1.560	0.000000
*	Sur-	charge		
0.000	0.000	1.500	0.083	0.055556
1.500	0.083	3.000	0.083	0.000000
3.000	0.083	4.500	0.083	0.000000
4.500	0.083	6.000	0.083	0.000000

6.000	0.083	7.500	0.083	0.000000
7.500	0.083	9.000	0.083	0.000000
9.000	0.083	10.500	0.083	0.000000
10.500	0.083	12.000	0.083	0.000000
12.000	0.083	13.500	0.083	0.000000
13.500	0.083	15.000	0.083	0.000000
15.000	0.083	16.500	0.083	0.000000
16.500	0.083	18.000	0.083	0.000000
18.000	0.083	19.500	0.083	0.000000
19.500	0.083	21.000	0.083	0.000000
21.000	0.083	22.500	0.083	0.000000
22.500	0.083	24.000	0.083	0.000000
24.000	0.083	25.500	0.083	0.000000
25.500	0.083	27.000	0.083	0.000000
27.000	0.083	28.500	0.083	0.000000
28.500	0.083	30.000	0.083	0.000000
30.000	0.083	33.000	0.083	0.000000
33.000	0.083	36.000	0.083	0.000000
36.000	0.083	39.000	0.083	0.000000
39.000	0.083	42.000	0.083	0.000000
42.000	0.083	45.000	0.083	0.000000
45.000	0.083	48.000	0.083	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
30.000	0.000	60.000	9.195	0.306510

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	30.00	1.00

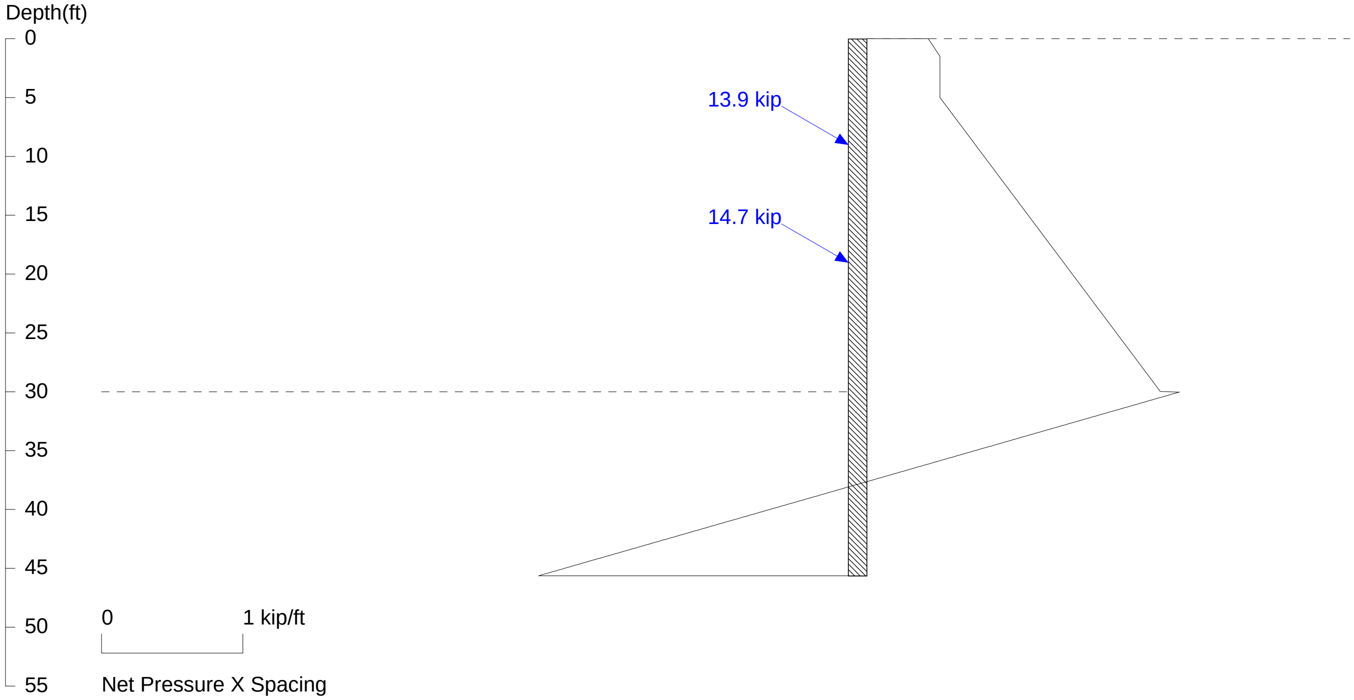
PASSIVE SPACING:

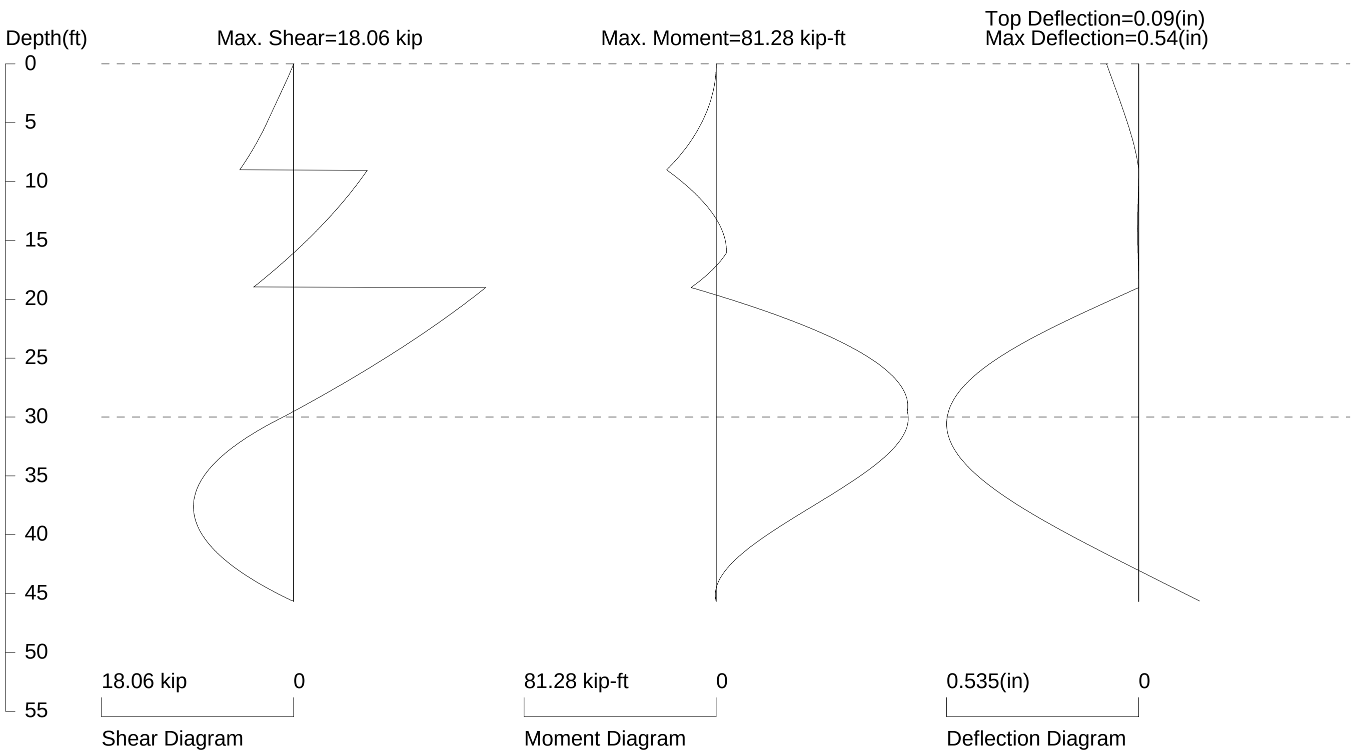
No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

50 Kent Ave - Shoring

Stage 3 - Tieback Option





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, PZ35: E (ksi)=29000.0, I (in4)/foot=361.2

File: I:\Projects\11176638 Williamsburg Site (50 kent Ave)\HolderExcavations\SOE\CT-Shoring\Tieback_Option 1\Stage 3.sh8

****

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
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****
ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Title: 50 Kent Ave - Shoring
Subtitle: Stage 3 - Tieback Option

**********************************INPUT DATA**********************************

Wall Type: 1. Sheet Pile
- Wall Height: 30.00
- Pile Diameter: 1.00
- Pile Spacing: 1.00
- Factor of Safety (F.S.): 1.00
- As Continuous Span Beam

Lateral Support Type (Braces): 3. Tieback
- Top Brace Increase (Multi-Bracing): No
- Assuming a Pin at Dredge Line for Multiple Brace Calculation

No-Load Zone:
- Vertical Depth for No-Load Zone: 30.00
- H-Distance (Input H/V ratio) for No-Load Zone: 0.25
- Angle from H. Line for No-Load Zone: 60.00

Embedment Option: 1. Yes
- Friction at Pile Tip: No

Pile Properties:
- Steel Strength, Fy: 50 ksi = 345 MPa
- Allowable Fb/Fy: .66
- Elastic Module, E: 29000.00
- Moment of Inertia, I: 361.20
- User Input Pile: PZ35

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		
2	0.000	0.431	30.000	0.431	0.000000
3	*	Below	Base		
4	30.000	0.571	60.000	1.055	0.016132
5	60.000	0.720	210.000	4.491	0.025140

6	*	Water	Pres.		
7	5.000	0.000	30.000	1.560	0.062400
8	30.000	1.560	210.000	1.560	0.000000
9	*	Sur-	charge		
10	0.000	0.000	1.500	0.083	0.055556
11	1.500	0.083	3.000	0.083	0.000000
12	3.000	0.083	4.500	0.083	0.000000
13	4.500	0.083	6.000	0.083	0.000000
14	6.000	0.083	7.500	0.083	0.000000
15	7.500	0.083	9.000	0.083	0.000000
16	9.000	0.083	10.500	0.083	0.000000
17	10.500	0.083	12.000	0.083	0.000000
18	12.000	0.083	13.500	0.083	0.000000
19	13.500	0.083	15.000	0.083	0.000000
20	15.000	0.083	16.500	0.083	0.000000
21	16.500	0.083	18.000	0.083	0.000000
22	18.000	0.083	19.500	0.083	0.000000
23	19.500	0.083	21.000	0.083	0.000000
24	21.000	0.083	22.500	0.083	0.000000
25	22.500	0.083	24.000	0.083	0.000000
26	24.000	0.083	25.500	0.083	0.000000
27	25.500	0.083	27.000	0.083	0.000000
28	27.000	0.083	28.500	0.083	0.000000
29	28.500	0.083	30.000	0.083	0.000000
30	30.000	0.083	33.000	0.083	0.000000
31	33.000	0.083	36.000	0.083	0.000000
32	36.000	0.083	39.000	0.083	0.000000
33	39.000	0.083	42.000	0.083	0.000000
34	42.000	0.083	45.000	0.083	0.000000
35	45.000	0.083	48.000	0.083	0.000000
36	48.000	0.083	51.000	0.083	0.000000
37	51.000	0.083	54.000	0.083	0.000000
38	54.000	0.083	57.000	0.083	0.000000
39	57.000	0.083	60.000	0.083	0.000000
40	60.000	0.083	66.000	0.083	0.000000
41	66.000	0.083	72.000	0.083	0.000000
42	72.000	0.083	78.000	0.083	0.000000
43	78.000	0.083	84.000	0.083	0.000000
44	84.000	0.083	90.000	0.083	0.000000
45	90.000	0.083	96.000	0.083	0.000000
46	96.000	0.083	102.000	0.083	0.000000
47	102.000	0.083	108.000	0.083	0.000000
48	108.000	0.083	114.000	0.083	0.000000
49	114.000	0.083	120.000	0.000	-0.013889

* PASSIVE PRESSURE *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	30.000	0.000	60.000	9.195	0.306510
3	60.000	7.488	210.000	32.921	0.169549

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	30.00	1.00

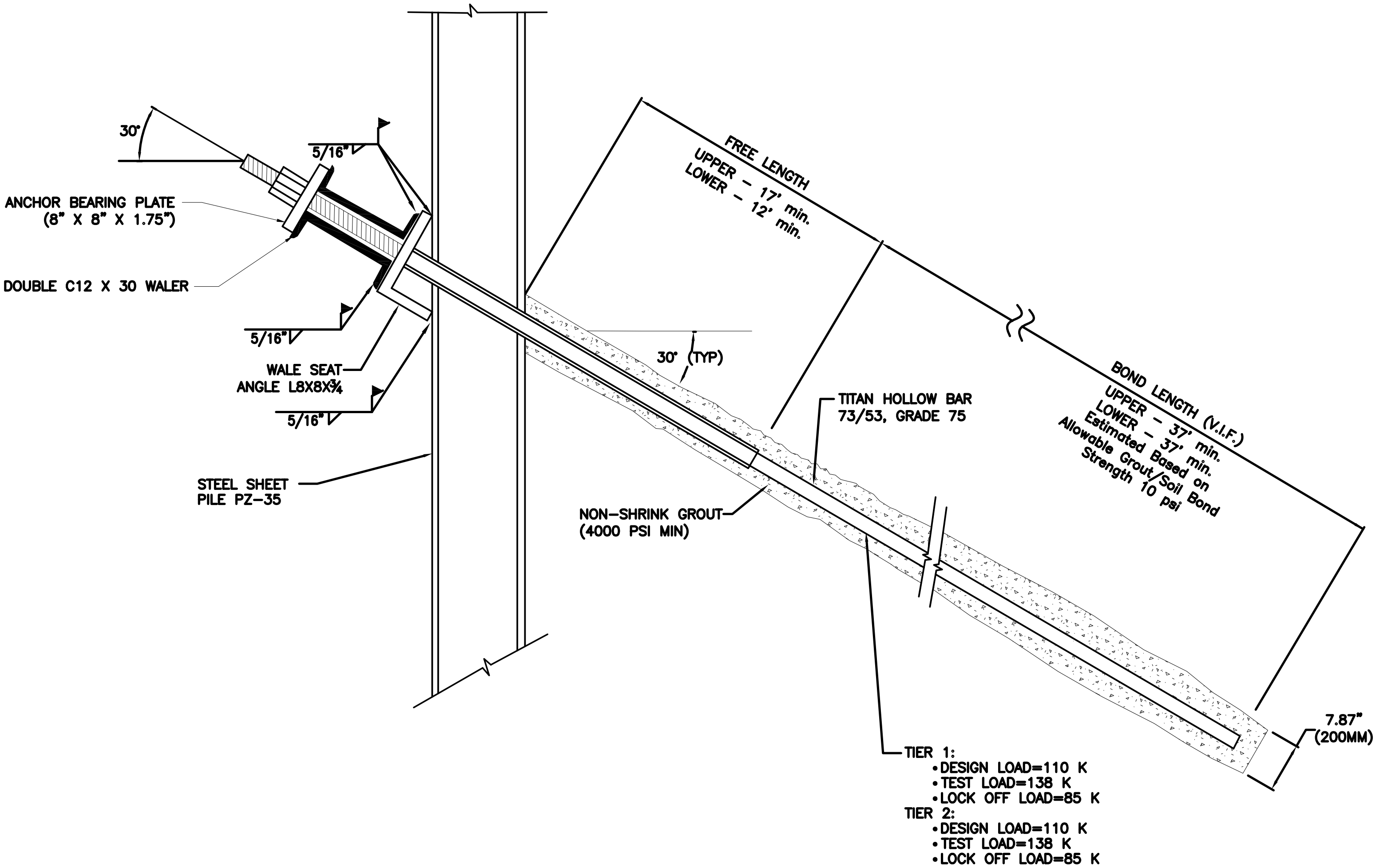
* PASSIVE SPACE *

No.	Z depth	Spacing

```
--------------------------------------------------------------------------------
 1      0.00           1.00
--------------------------------------------------------------------------------

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *
 No.    Z brace         Angle           Spacing         Input1*         Input2*
Type
------------------------------------------------------------------------------------------
---------------------
 1      9.00           30.0            1.00            0.65            1.44
Tieback
 2      19.00          30.0            1.00            0.65            1.44
Tieback
------------------------------------------------------------------------------------------
---------------------
*For Tieback:  Input1 = Diameter;  Input2 = Bond Strength
*For Plate:  Input1 = Diameter;  Input2 = Allowable Pressure
*For Deadman:  Input1 = Horz. Width;  Input2 = Allowable Pressure; Angle = 0


********************************CALCULATION**********************************

   The calculated moment and shear are per pile spacing.  Sheet piles are per one
foot or meter; Soldier piles are per pile.

   Top Pressures start at depth =  0.00

*  CALCULATE REQUEST EMBEDMENT  *

        |<--   D1=19.00
        |
      ==|==    D2=30.00
        |
        |      D3=45.68

        D1 - TOP DEPTH          R1 - TOP REACTION
        D2 - EXCAVATION BASE
        D3 - PILE TIP

   TOTAL REACTION: R1 = 18.06
   TOTAL PRESSURES ACTING ON WALL = 18.06
      Total Reactions = Total Pressures,    OK!
      The Calculated Embedment, Yend = 15.68

-------------------------MULTIPLE BRACE / TIEBACK CASE-------------------------
** Use the calculated embedment, Yend = 15.68 for graphics and analysis.

   NUMBER OF BRACE LEVEL=  2


*  CANTILEVER SPAN, N0.0 *

        |      D1=0.00
        |
        |
        |<--   D2=9.00         R2=5.06, with Cantilever Moment=20.96

        D1 - TOP DEPTH
        D2 - BOTTOM DEPTH         R2 - BOTTOM REACTION

   TOTAL REACTION: R2 = 5.06
   TOTAL PRESSURES ACTING ON WALL = 5.06
      Total Reactions = Total Pressures,    OK!
```

```
   ___________________________________________________
   BRACE NO.1 AT DEPTH = 9.00
       R2 of Span No.0
                               } Sum of Reaction = Brace Load = 12.02
       R1 of Span No.1
   ___________________________________________________

*  MIDDLE SPAN NO.1  *

        |<--   D1=9.00         R1=6.95
        |
        |
        |<--   D2=19.00         R2=3.80

        D1 - TOP DEPTH          R1 - TOP REACTION
        D2 - BOTTOM DEPTH       R2 - BOTTOM REACTION

   TOTAL REACTION: R1+R2 = 10.76
   TOTAL PRESSURES ACTING ON WALL = 10.76
      Total Reactions = Total Pressures,    OK!
   ___________________________________________________
   BRACE NO.2 AT DEPTH = 19.00
       R2 of Span No.1
                               } Sum of Reaction = Brace Load = 12.69
       R1 of Last Span
   ___________________________________________________

*  LAST SPAN  (To Dredge Line and Assuming a Pin at Dredge Line) *

        |<--   D1=19.00         R1=8.89
        |
        |
        |<--   D2=30.00         R2=10.15

        D1 - TOP DEPTH          R1 - TOP REACTION
        D2 - DREDGE LINE (EXCAVATION BASE)       R2 - BOTTOM REACTION

   TOTAL REACTION: R1+R2 = 19.04
   TOTAL PRESSURES ACTING ON WALL = 19.04
      Total Reactions = Total Pressures,    OK!

*********************************RESULTS*****************************************

* EMBEDMENT *
MINIMUM EMBEDMENT = 15.68,  TOTAL MINIMUM PILE LENGTH = 45.68

* MOMENT IN PILE (per pile spacing)*
Pile Spacing:  sheet piles are one foot or one meter; soldier piles are one pile.
 No.    Depth          M @ Brace       Mmax in Span    Depth of Mmax
-----------------------------------------------------------------------------
 1      9.00           20.93           4.36            15.96
 2      19.00          10.58           81.28           30.13
-----------------------------------------------------------------------------
Overall Maximum Moment = 81.28 at 30.13
Maximum Shear = 18.06
Moment and Shear are per pile spacing: 1.0 foot or meter

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *
The calculated brace force are per brace spacing.

 No.    DEPTH          Tangle          SPACING         HORIZONTAL      VERTICAL
TOTAL LOAD
------------------------------------------------------------------------------------
```

```
----------
 1      9.00            30.0            1.00            12.02           6.94
13.88
 2      19.00           30.0            1.00            12.69           7.33
14.66

 No.    DEPTH           Free length     Type and Data
-------------------------------------------------------------------------------------
----------
 1      9.00            17.00           Tieback, Bond length = 4.72
 2      19.00           12.00           Tieback, Bond length = 4.98
-------------------------------------------------------------------------------------
----------

* VERTICAL LOADING *
Vertical Loading from Braces = 14.27
Vertical Loading from External Load = 0.00
Total Vertical Loading = 14.27


*****************************SPECIFIED PILE ***********************************

   Overall Maximum Moment = 81.28 at 30.13
   The pile selection is based on the magnitude of the moment only. Axial force is
neglected.

   Request Min. Section Modulus = 29.56 in3/ft = 1589.01 cm3/m, Fy= 50 ksi = 345
MPa, Fb/Fy=.66

   PZ35 has been found in Sheet Pile list!
   PZ35(English):    Sx= 48.50 in3/ft  Ix= 361.20 in4/ft   Weight= 35.00 lb/ft
   PZ35(Metrics):    Sx= 2607.36 cm3/m  Ix= 493.25 x100cm4/m   Weight= 0.511 kN/m

   * Note: All the pile dimensions are in English Units per one foot width.


   PZ35 is capable to support the shoring!
   I (in4)/foot=361.20
   Top deflection = 0.090(in)
   Max. deflection = 0.535(in)
```



<u>SOE OPTION 1 - TIEBACK AND RAKER</u>

1) Based on CT-Shore results, the Horizontal top level design load & Lower level design load are 12.9 kip/ft & 12.7 kip/ft, respectively.

2) Considering the width of one pair PZ 35 is approx. 3.75',
try tieback spacing 3.75' × 2 = 7.5'.

3) Assuming the tieback angle is 30°, the tieback design load are as follows.

top tieback $T_t = 12.9 \text{ K/ft} \times 7.5 \text{ ft} \div \cos 30^\circ = 112$ kips. say 110K

bottom tieback. $T_b = 12.7 \text{ K/ft} \times 7.5' \div \cos 30^\circ = 110$ kips say 110K.

4). try 7.87" dia. hole, & 10 psi bond strength.

$$L_{bond} = \frac{T_t}{\pi \cdot d \cdot \sigma_b} = \frac{110 \text{ Kip} \times 1000 \frac{\text{lb}}{\text{Kip}}}{3.14 \times 7.87'' \times 10 \text{psi}} = 445'' = 37'$$

Total Estmated Length.

$L_1 = 37' + 17' = 54'$ (top level tieback)

$L_2 = 37' + 12' = 49'$ (bot level tieback).

URS

Page ______ of ______

Job 50 Kent Ave.

Project No. 11176988

Sheet ______ of ______

Description Wale Size - tieback option

Computed by DL

Date 7/11/14

Checked by TGT

Date 7/11/14

Reference

Check the wale size,

$$M = \frac{1}{8} \times \frac{12.9\,k/ft}{\cos 30^\circ} \times (7.5\,ft)^2 = 105\ \text{kip-ft}.$$

$$S_{req} = \frac{M}{0.6\,f_y} = \frac{(105 \times 12)\ \text{kip-in}}{0.6 \times 50\,ksi} = 42\ in^3.$$

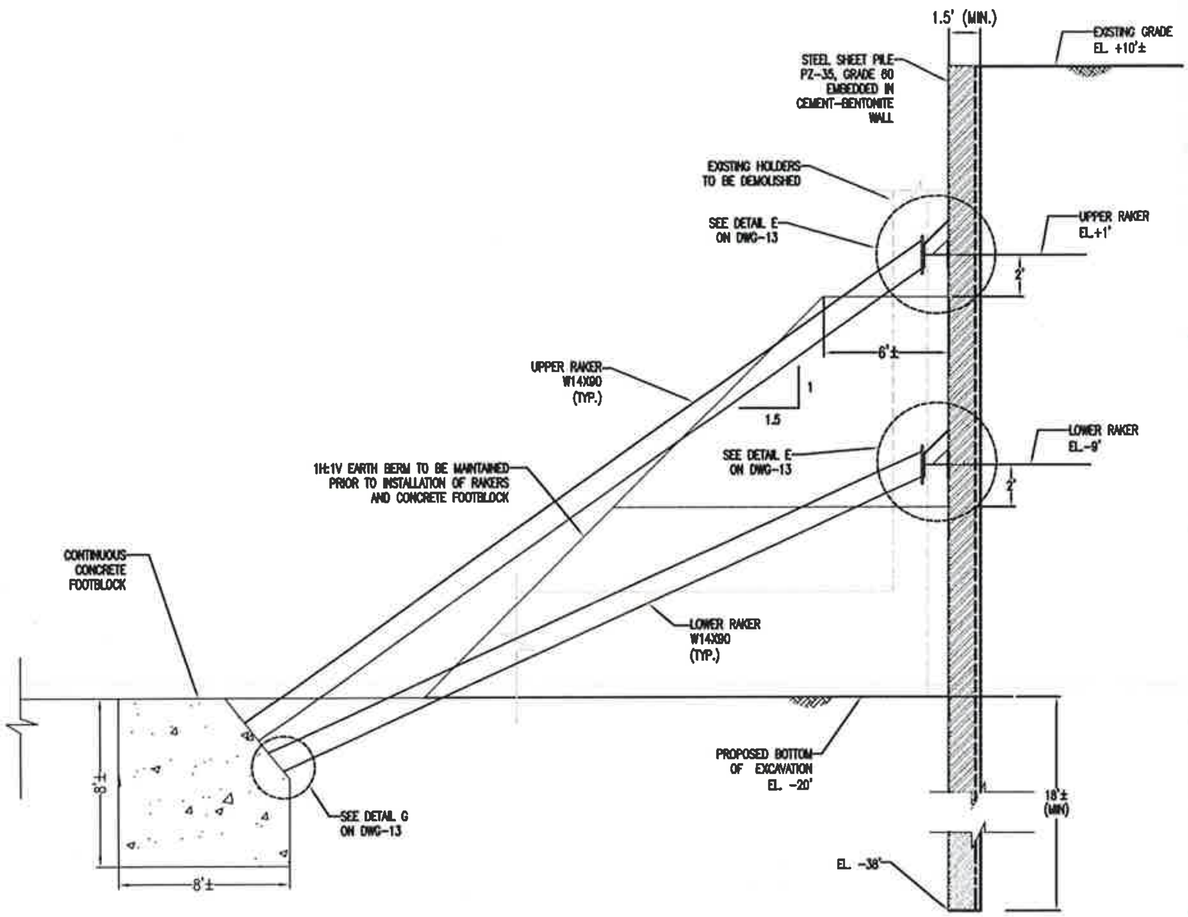
Use 2 C12×30. ($S_x = 27\,in^3 \times 2 = 54\,in^3$)

Say OK.

URS

Job 50 Kent Ave	Project No. 11176638	Page ___ of ___	
		Sheet ___ of ___	
Description Raker Design	Computed by DL	Date 12/30/14	
	Checked by	Date	

Reference



From CT-Shore Summary Tabe of Tieback, the brace Load is same for raker.

The maximum raker design load. (axial) is as follows:

angle $\alpha = \tan^{-1}\frac{1}{1.5} = 33.7°$

raker spacing

Design Load $T_D = \frac{12.9\,k/ft \times 15\,ft}{\cos 33.7°} = 232.5$ kips

Project: ***50 Kent Avenue***
Racker Design

Project No.: **11176638**
Calc. By: **SL** **11/19/2014**
Chk. By: **DL** **12/3/2014**

Try Section W14X90

: Input
: Output

Section Properties:	$D=$	14.020	inch	$b_f=$	14.5	inch	$t_w=$	0.4	inch	
	$t_f=$	0.710	inch	$W_t=$	90.0	lb/ft	$A_s=$	26.5	$inch^2$	
	$S_x=$	143.000	$inch^3$	$I_x=$	999.0	$inch^4$	$r_x=$	6.1	inch	
	$S_y=$	49.900	$inch^3$	$I_y=$	362.0	$inch^4$	$r_y=$	3.7	inch	
	$A_f=$	10.309	$inch^2$	$E=$	29000	ksi				
	$F_y=$	50.0	ksi							

Design Parameters:	$p_x=$	15.5	kip/ft	(Distributed Load on Strong Axis)	$L_b=$	37.6	ft	(Unbraced length)
	$p_y=$		kip/ft	(Distributed Load on Weak Axis)				
	$P_a=$	232.5	kip	(Axial Load)	$L_x=$	37.6	ft	(Effective length)
					$L_y=$	37.6	ft	(Effective length)
Stress Calculations:	$f_a=$	8.8	ksi	(Compressive Stress)				
	$M_x=$	15.9	kip-ft	(Moment in Strong Axis)				
	$M_y=$		kip-ft	(Moment in Weak Axis)				
Slenderness Ratio:	$K=$	1.0		(Effective Length Coeff.)				
	$KL_x/r_x=$	73.5		(S.R of Strong Axis)	$KL/r=$	122.1	(Max S.R)	
	$KL_y/r_y=$	122.1		(S.R of Weak Axis)	$C_c=$	107.0		
				KL/r > Cc, so the column is a long column.				
Allowable Comp. Stress:	$F_a=$	10.0	ksi					

Chk. Sect. Compactness:

Flange:	$b_f/2{*}t_f=$	10.2	$\lambda_{fp}=$	9.19	***Flange is Non-Compact***
Web:	$D/t_w=$	31.9	$\lambda_{wp}=$	36.35	***Web is Compact!***

Allowable Bending Stress:	$L_c=$	13.0	ft	(Critical unbraced length)	
	$C_b=$	1.0			
	$r_T=$	4.0	in		Case 5
	$F_{bx}=$	30.0	ksi		
	$F_{by}=$	35.7	ksi		

Case	F_{bx}
1	33.0
2	32.3
4	30.0
5	30.0

Actural Bending Stress:	$f_{bx}=$	1.3	ksi		
	$f_{by}=$	0.0	ksi		
Check Combined Stresses:	$f_a/F_a=$	0.876			
	$F_{ex}'=$	27.7	ksi	$C_{mx}=$	1
	$F_{ey}'=$	10.0	ksi	$C_{my}=$	1

fa/Fa>0.15, Case 2. $\Sigma F=$ **0.941** & **0.337** **Combined factor less than 1.0 say OK!**

URS

Job 50 Kent Ave

Description Design Section – Internal Brace Option

Project No. 11176638

Computed by DL

Checked by

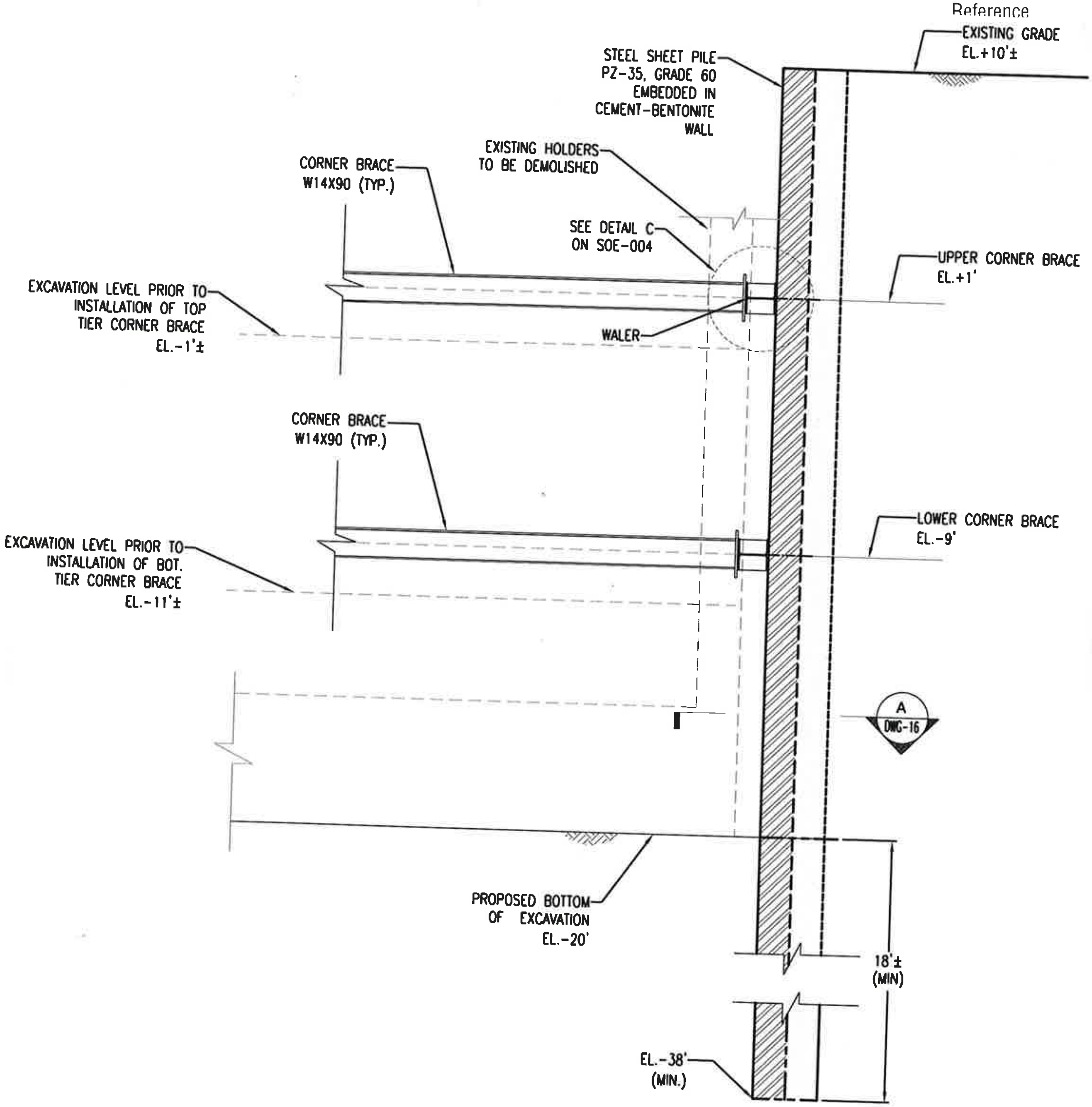
Page ___ of ___

Sheet ___ of ___

Date 12/24/14

Date

Reference



The Lateral Design Load for brace is 12.9 kip/ft.

Waler.

The waler is welded to the sheet pile wall.

Unbraced length will be equal to the width of one pair PZ-35. $L_u = 3.75$ ft.

The maximum moment:

$$M_{max} = \frac{1}{10} \times 12.9 \text{ kip/ft} \times 15^2 = 290 \text{ kip-ft}.$$

The axial force on the waler:

$$F_{max} = 12.9 \text{ kip/ft} \times 50 \text{ ft} = 645 \text{ kip}.$$

Corner Brace.

max. Unbraced Length: $L_u = 30$ ft.

Max. axial force:

$$F_{max} = \frac{12.9 \text{ kip/ft}}{\cos 45^\circ} \times 15 \text{ ft} = 273.6 \text{ kip}.$$

Moment due to self-weight:

$$M_y = \frac{1}{8} \times 0.09 \text{ kip/ft} \times (30 \text{ ft})^2 = 10.1 \text{ kip-ft}.$$

URS

		Page ____	of ____
Job: 50 Kent Ave	Project No. 11176638	Sheet ____	of ____
Description: Internal Brace Option. Strut Design	Computed by: DL	Date: 12/30/2014	
	Checked by: ____	Date: ____	

Reference

Cross-Lot Strut:

The maximum axial force is in the center of the cross-lot strut, the distributed width of lateral force is approximately 94'.

$$F_{max} = 12.9\ \text{kip/ft} \times 94\ \text{ft} = \underline{1212.6}\ \text{kip}$$

Unbrace Length $L_u \approx 20\ \text{ft}$.

The weight of corner brace act on the strut.

$$\frac{0.09\ \text{kip/ft} \times 30\ \text{ft} \times 2}{2} = 2.7\ \text{kip}.$$

The moment due to the corner brace weight.

$$\frac{1}{4} \times 2.7 \times 20\ \text{ft} = \underline{13.5}\ \text{kip-ft}.$$

The moment due to self-weight.

$$\frac{1}{8} \times 0.159\ \text{kip/ft} \times (20\ \text{ft})^2 = 8\ \text{kip-ft}.$$

$\Rightarrow M \approx 22\ \text{kip-ft}.$

Project: 50 Kent Avenue
Waler Design

Project No.: **11176638**
Calc. By: **SL** **11/19/2014**
Chk. By: **DL** **12/3/2014**

Try Section W14X120

: Input
: Output

Section Properties:

$D=$	14.480	inch	$b_f=$	14.7	inch	$t_w=$	0.6	inch
$t_f=$	0.940	inch	$W_t=$	120.0	lb/ft	$A_s=$	35.3	$inch^2$
$S_x=$	190.000	$inch^3$	$I_x=$	1380.0	$inch^4$	$r_x=$	6.3	inch
$S_y=$	67.500	$inch^3$	$I_y=$	495.0	$inch^4$	$r_y=$	3.7	inch
$A_f=$	13.790	$inch^2$	$E=$	29000	ksi			
$F_y=$	50.0	ksi						

Design Parameters:

$p_x=$ 12.9 kip/ft (Distributed Load on Strong Axis) $L_b=$ 3.8 ft (Unbraced length)
$p_y=$ kip/ft (Distributed Load on Weak Axis)

$P_a=$ 645.0 kip (Axial Load) $L_x=$ 15.0 ft (Effective length)
$L_y=$ 3.8 ft (Effective length)

Stress Calculations:

$f_a=$ 18.3 ksi (Compressive Stress)
$M_x=$ 290.3 kip-ft (Moment in Strong Axis)
$M_y=$ kip-ft (Moment in Weak Axis)

Slenderness Ratio:

$K=$ 1.0 (Effective Length Coeff.)
$KL_x/r_x=$ 28.8 (S.R of Strong Axis) $KL/r=$ 28.8 (Max S.R)
$KL_y/r_y=$ 12.0 (S.R of Weak Axis) $C_c=$ 107.0
KL/r <= Cc, so the column is an intermediate column.

Allowable Comp. Stress: $F_a=$ 27.3 ksi

Chk. Sect. Compactness:

Flange: $b_f/2*t_f=$ 7.8 $\lambda_{fp}=$ 9.19 ***Flange is Compact!***
Web: $D/t_w=$ 24.5 $\lambda_{wp}=$ 36.35 ***Web is Compact!***

Allowable Bending Stress:

$L_c=$ 13.1 ft (Critical unbraced length)
$C_b=$ 1.0
$r_T=$ 4.1 in Case 1
$F_{bx}=$ 33.0 ksi
$F_{by}=$ 37.5 ksi

Case	F_{bx}
1	33.0
2	34.0
4	30.0
5	30.0

Actural Bending Stress:

$f_{bx}=$ 18.3 ksi
$f_{by}=$ 0.0 ksi

Check Combined Stresses: $f_a/F_a=$ 0.669

$F_{ex}'=$ 2807.5 ksi $C_{mx}=$ 0.85
$F_{ey}'=$ 1007.1 ksi $C_{my}=$ 0.85

fa/Fa>0.15, Case 2. $\Sigma F=$ **1.145** & **1.165** **Less than 1.2, say OK for Temp. Structure!**

Project: ***50 Kent Avenue***
Corner Brace Design

Project No.: **11176638**
Calc. By: **SL** **11/19/2014**
Chk. By: **DL** **12/3/2014**

Try Section W14X90

: Input
: Output

Section Properties:

D=	14.020	inch	**b_f=**	14.5	inch	**t_w=**	0.4	inch
t_f=	0.710	inch	**W_t=**	90.0	lb/ft	**A_s=**	26.5	$inch^2$
S_x=	143.000	$inch^3$	**I_x=**	999.0	$inch^4$	**r_x=**	6.1	inch
S_y=	49.900	$inch^3$	**I_y=**	362.0	$inch^4$	**r_y=**	3.7	inch
A_f=	10.309	$inch^2$	**E=**	29000	ksi			
F_y=	50.0	ksi						

Design Parameters:

p_x= 18.2 kip/ft (Distributed Load on Strong Axis) **L_b=** 30.0 ft (Unbraced length)
p_y= kip/ft (Distributed Load on Weak Axis)

P_a= 273.6 kip (Axial Load) **L_x=** 30.0 ft (Effective length)
L_y= 30.0 ft (Effective length)

Stress Calculations:

f_a= 10.3 ksi (Compressive Stress)
M_x= kip-ft (Moment in Strong Axis)
M_y= 10.1 kip-ft (Moment in Weak Axis)

Slenderness Ratio:

K= 1.0 (Effective Length Coeff.)
KL_x/r_x= 58.6 (S.R of Strong Axis) **KL/r=** 97.4 (Max S.R)
KL_y/r_y= 97.4 (S.R of Weak Axis) **C_c=** 107.0
KL/r <= Cc, so the column is an intermediate column.

Allowable Comp. Stress: **F_a=** 15.3 ksi

Chk. Sect. Compactness:

Flange: **$b_f/2{*}t_f$=** 10.2 λ_{fp}= 9.19 ***Flange is Non-Compact***
Web: **D/t_w=** 31.9 λ_{wp}= 36.35 ***Web is Compact!***

Allowable Bending Stress:

L_c= 13.0 ft (Critical unbraced length)
C_b= 1.0
r_T= 4.0 in Case 5
F_{bx}= 30.0 ksi
F_{by}= 35.7 ksi

Case	**F_{bx}**
1	33.0
2	32.3
4	30.0
5	30.0

Actural Bending Stress:

f_{bx}= 0.0 ksi
f_{by}= 2.4 ksi

Check Combined Stresses:

f_a/F_a= 0.675

F_{ex}'= 43.4 ksi **C_{mx}=** 0.85
F_{ey}'= 15.7 ksi **C_{my}=** 0.85

fa/Fa>0.15, Case 2. **ΣF=** **0.843** **&** **0.412** **Combined factor less than 1.0 say OK!**

Project: *50 Kent Avenue*
Cross-lot Strut - 1

Project No.: **11176638**
Calc. By: **SL** **11/19/2014**
Chk. By: **DL** **12/3/2014**

Try Section W14X159

: Input
: Output

Section Properties:

D=	14.980	inch	b_f=	15.6	inch	t_w=	0.7	inch
t_f=	1.190	inch	W_t=	159.0	lb/ft	A_s=	46.7	$inch^2$
S_x=	254.000	$inch^3$	I_x=	1900.0	$inch^4$	r_x=	6.4	inch
S_y=	96.200	$inch^3$	I_y=	748.0	$inch^4$	r_y=	4.0	inch
A_f=	18.522	$inch^2$	E=	29000	ksi			
F_y=	50.0	ksi						

Design Parameters:

p_x= 12.9 kip/ft (Distributed Load on Strong Axis) L_b= 20.0 ft (Unbraced length)
p_y= kip/ft (Distributed Load on Weak Axis)

P_a= 1212.6 kip (Axial Load) L_x= 20.0 ft (Effective length)
L_y= 13.0 ft (Effective length)

Stress Calculations:

f_a= 26.0 ksi (Compressive Stress)
M_x= 22.0 kip-ft (Moment in Strong Axis)
M_y= kip-ft (Moment in Weak Axis)

Slenderness Ratio:

K= 1.0 (Effective Length Coeff.)
KL_x/r_x= 37.6 (S.R of Strong Axis) KL/r= 39.0 (Max S.R)
KL_y/r_y= 39.0 (S.R of Weak Axis) C_c= 107.0
KL/r <= Cc, so the column is an intermediate column.

Allowable Comp. Stress: F_a= 26.0 ksi

Chk. Sect. Compactness:

Flange: $b_f/2*t_f$= 6.5 λ_{fp}= 9.19 ***Flange is Compact!***
Web: D/t_w= 20.1 λ_{wp}= 36.35 ***Web is Compact!***

Allowable Bending Stress:

L_c= 13.9 ft (Critical unbraced length)
C_b= 1.0
r_T= 4.3 in Case 5
F_{bx}= 30.0 ksi
F_{by}= 37.5 ksi

Case	F_{bx}
1	33.0
2	34.9
4	30.0
5	30.0

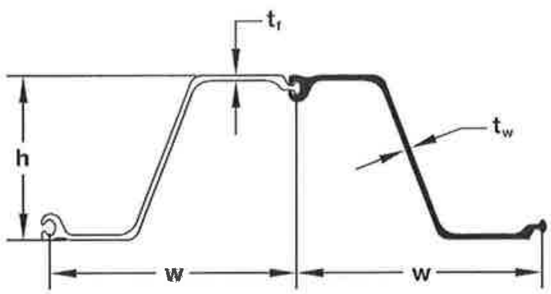
Actural Bending Stress:

f_{bx}= 1.0 ksi
f_{by}= 0.0 ksi

Check Combined Stresses: f_a/F_a= 1.000

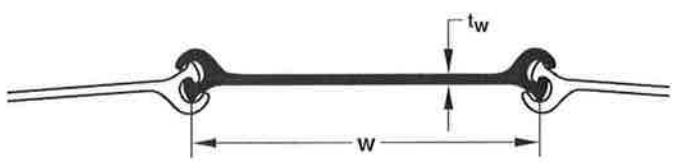
F_{ex}'= 105.5 ksi C_{mx}= 0.85
F_{ey}'= 41.5 ksi C_{my}= 0.85

fa/Fa>0.15, Case 2. **ΣF=** **1.039** **&** **0.900** **Less than 1.2, say OK for Temp. Structure!**



PZ

SECTION	Width (w) in	Height (h) in	THICKNESS: Flange (t_f) in	THICKNESS: Wall (t_w) in	Cross Sectional Area in²/ft	WEIGHT: Pile lb/ft	WEIGHT: Wall lb/ft²	SECTION MODULUS: Elastic in³/ft	SECTION MODULUS: Plastic in³/ft	Moment of Inertia in⁴/ft	COATING AREA: Both Sides ft²/ft of single	COATING AREA: Wall Surface ft²/ft² of wall
PZ 22	22.0	9.0	0.375	0.375	6.47	40.3	22.0	18.1	21.79	84.38	4.48	1.22
PZ 27	18.0	12.0	0.375	0.375	7.94	40.5	27.0	30.2	36.49	184.20	4.48	1.49
PZ 35	22.6	14.9	0.600	0.500	10.29	66.0	35.0	48.5	57.17	361.22	5.37	1.42
PZ 40	19.7	16.1	0.600	0.500	11.77	65.6	40.0	60.7	71.92	490.85	5.37	1.64



PS

SECTION	Width (w) in	Web (t_w) in	Maximum Interlock Strength k/in	Minimum Cell Diameter* ft	Cross Sectional Area in²/ft	WEIGHT: Pile lb/ft	WEIGHT: Wall lb/ft²	Elastic Section Modulus in³/sheet	Moment of Inertia in⁴/sheet	COATING AREA: Both Sides ft²/ft of single	COATING AREA: Wall Surface ft²/ft² of wall
PS 27.5	19.69	0.4	24	30	8.09	45.1	27.5	3.3	5.3	3.65	1.11
PS 31	19.69	0.5	24	30	9.12	50.9	31.0	3.3	5.3	3.65	1.11

* Minimum cell diameter cannot be guaranteed for piles over 65 feet in length, or if piles are spliced. 58 Piles are needed to make a 30 foot diameter cell.

URS **CALCULATION COVER SHEET** Quality

Project Name:	Williamsburg Former MGP	Project Number:	11176638
Project Location:	Williamsburg	Client Name:	National Grid
PM Name:	Jon Sundquist	PIC Name:	Jack Wilcox

IDENTIFYING INFORMATION

(This section is to be completed by the Originator.)

Calculation Medium: ☐ Electronic File Name:

(Select as appropriate) ☒ Hard-copy Unique Identification:

Number of pages
(including cover sheet): 52

Discipline: Engineering

Title of Calculation: Temporary Containment Building Ventilation

Calculation Originator: Allen Zgaljardic

Calculation Contributors:

Calculation Checker: Jon Sundquist

DESCRIPTION & PURPOSE

Estimate number of ventilation systems needed for TCB ventilation

BASIS / REFERENCE / ASSUMPTIONS

6 air changes per hour.

ISSUE / REVISION RECORD

Checker comments, if any, provided on: ☐ hard-copy ☐ electronic file ☐ Form 3-5 (MM)

No.	Description	P	S	F	Originator Initials	Date	Checker Initials	Date
0	Initial Issue	☐	☐	☐	[ ]	[ ]	[ ]	[ ]
1		☐	☐	☐	[ ]	[ ]	[ ]	[ ]
2		☐	☐	☐	[ ]	[ ]	[ ]	[ ]
3		☐	☐	☐	[ ]	[ ]	[ ]	[ ]

Note: For a given Revision No. Check off either P (Preliminary), S (Superseding) or F (Final). If there are no revisions to the Initial Issue check off F (Final). Comments may be provided on the hard-copy calculations, electronic file or on Form 3-5 (MM).

APPROVAL and DISTRIBUTION

☒ The calculations associated with this Cover Sheet have been checked.

Allen Zgaljardic 7/16/2014
Originator Signature Date

Jon Sundquist 7/16/2014
Checker Signature Date

Jon Sundquist 7/16/2014
Project Manager Signature Date

Distribution:
Project Central File – Quality file folder
Other Specify: _____

URS

Project Number: 11176638

CALCULATION BY: Allen Zgaljardic DATE: July 16, 2014

CHECKED BY: Jon Sundquist DATE: July 16, 2014

PROJECT: Williamsburg Soil Excavation

SUBJECT: Temporary Containment Building Ventilation

Objective: To estimate the number of carbon units needed to provide negative air pressure to within the temporary containment building

Attached References:

A. All-Site Corporation TCB cut sheet
B. TIGG Carbon cut sheet

General Assumptions and Design Parameters:

1. Area to be covered encompasses Holder No. 1 and the Relief holder. Holder No.2 ISS work is not included.
2. TCB length is 213 ft (one TCB), TCB used for Holder No. 2 ISS will be moved and joined to additional 115 ft to cover excavation of Holder No. 1 and Relief holder.
3. TCB width is 118'
4. TCB height is 45' but because of the arch, the cross sectional area of the TCB is about 2/3 of the 45' x 118' area.
5. Depth of excavation is 30'. However, no more than 67% of the total volume of excavation will be empty at any given time.
6. Width of excavation under each TCB is 111'
7. Capacity of the TIGG Blowers is 20,000 CFM
8. 6 air exchanges an hour are required.

The attached table uses the above assumptions to calculate the number of air hadler units required. Calculations are done in Excel.

Conclusion: 6 air handling units are required.

URS

Project Number: 11176638

CALCULATION BY: Allen Zgaljardic DATE: July 16, 2014

CHECKED BY: Jon Sundquist DATE: July 16, 2014

PROJECT: Williamsburg Soil Excavation

SUBJECT: Temporary Containment Building Ventilation

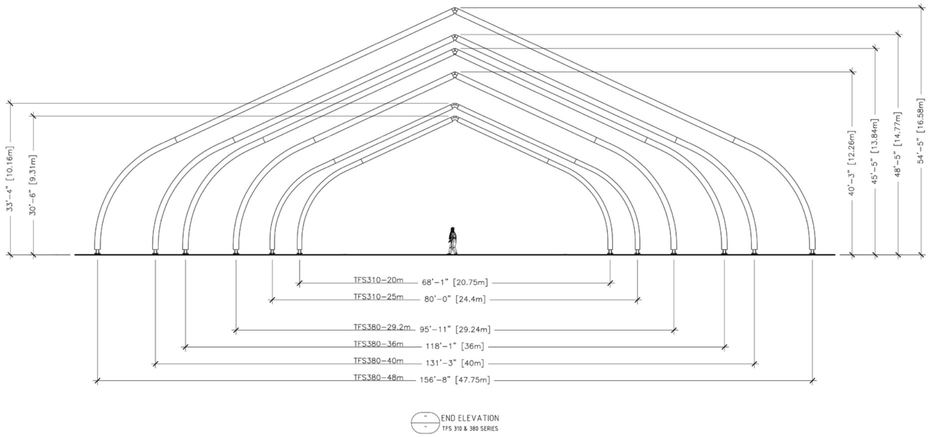
TCB height	45	ft	
TCB width	118	ft	
sloped roof factor	0.67		(i.e. cross section area is this fraction of HxW)
TCB 1 length	213	ft	
TCB 2 length	0	ft	
depth of excavation	30	ft	
width of excavation	111	ft	
total length of excavation	200	ft	(includes both TCBs)
maximum percentage excavated	67%		(i.e. never fully excavate 100% of hole - some areas will have been backfilled already or have not yet been excavated)
	757,790	CF	volume TCB 1, not including excavation
	0	CF	volume TCB 2, not including excavation
	446,220	CF	total excavation hole volume
	1,204,010	CF	total
each air unit capacity	20,000	CFM	
number of air exchanges per hour	6		
	6.0	number of units required	

allsite
STRUCTURE RENTALS
ANYWHERE, ANY SIZE, ANY TIME

REMEDIATION







WHEN RESPONSE MATTERS

At Allsite Structure Rentals, we understand the need to control remediation sites quickly, in order to contain contaminants and reduce environmental impact.

We have a large inventory for global despatch available, we respond quickly and can deliver and install a structure within days of your request.

We deliver it when you need it and we remove when the job is done.

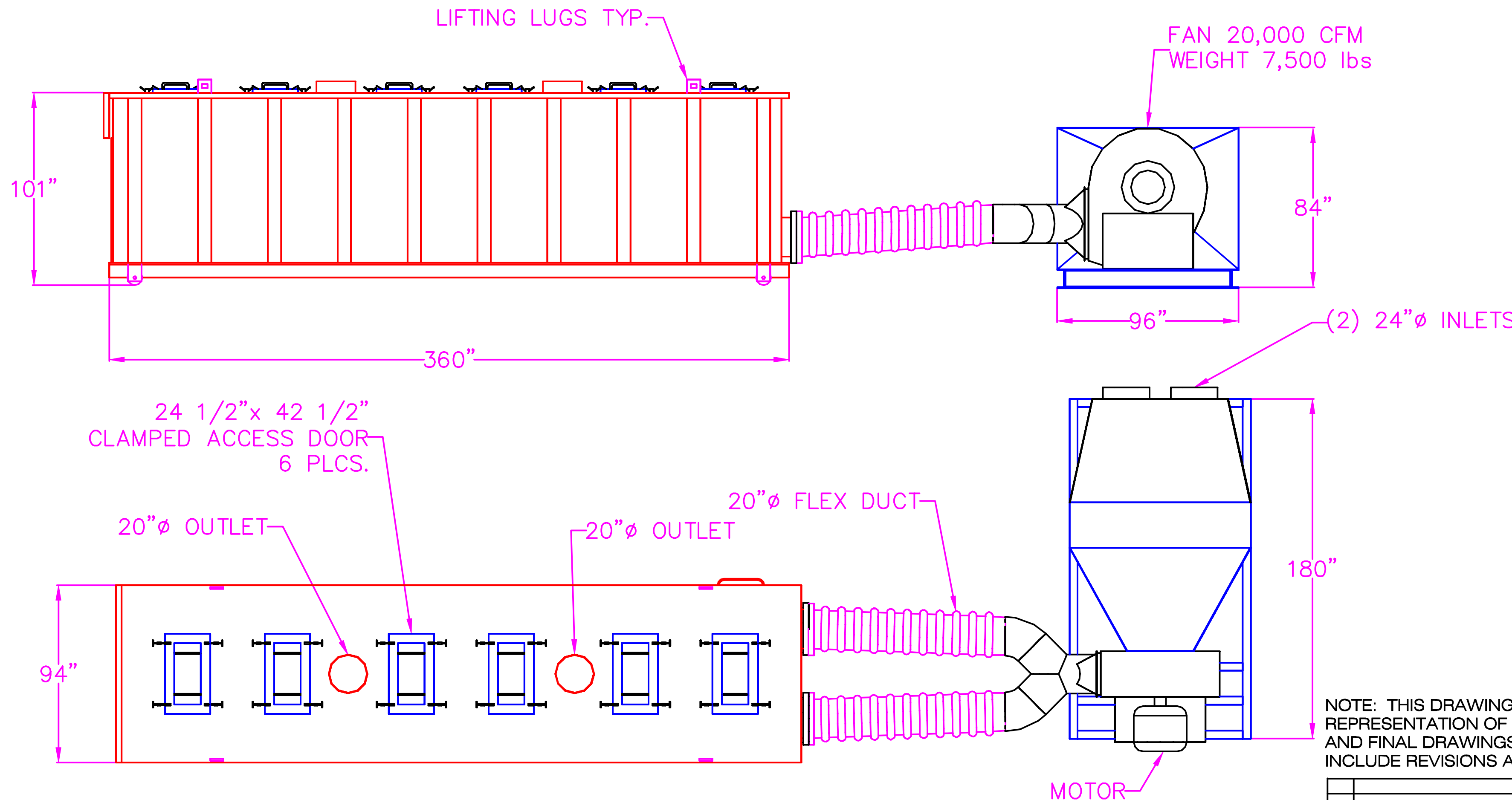
Allsite Structure Rentals provides technical, engineering and project management from your initial enquiry through to project completion.

- Turn-Key Installation
- Installation and dismantling supervision for your crew
- Permit Assistance
- Fast Repairs and maintenance service during your rental

Allsite Structure Rentals have built a reputation of delivering a reliable and responsive service, from crisis control to planned remediation services.

WE CAN PROVIDE THE SERVICE YOU NEED, WHERE AND WHEN YOU NEED IT

info@allsitestructures.com
t 888 599 5112



NOTE: THIS DRAWING IS A REPRESENTATION OF THE DESIGN AND FINAL DRAWINGS WILL INCLUDE REVISIONS AS REQUIRED.

NOTE: TIGG CORPORATION RESERVES THE RIGHT TO CHANGE ANY AND ALL DIMENSION-DESIGNS OVERALL OUT TO OUT DIMENSIONS AND INLET/OUTLET LOCATIONS ARE FIXED.

NOTE: CONTAMINATED AIR SHALL ENTER UNIT THROUGH BOTH INLETS AND MUST EXIT USING BOTH OUTLETS.

NO.	REVISION	BY	DATE
1	CHANGE BLOWER	JB	10/04/01

PROJECT

GENERAL LAYOUT

PROJ. NO.	
P.O. NO.	
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	
DATE	10/03/01
SCALE	NTS

TIGG corporation

CARBON ADSORBER, AIR HANDLING SYSTEM

DWG. NO. NB-20-1002 REV. 1

URS Quality - It's Good Business	QMS Form 3-3 (MM) Rev. 2013 QMS Date: 28 Feb 2013
IE QMS - Americas	**Detail Check - Calculations**

Project Name	Williamsburg MGP	**Client**	National Grid
Project Location	Williamsburg	**PM**	Jon Sundquist
Project Number	60414000	**PIC**	Mark Lang

IDENTIFYING INFORMATION

(This section is to be completed by the Originator.)

Calculation Medium: *(Select as appropriate)*

☐ Electronic — File Name:

☒ Hard-copy — Unique Identification:

Number of pages *(including cover sheet)*: 5

Discipline:	Engineer
Title of Calculation:	Depth of clean and reused backfill in deep excavation
Calculation Originator:	Jon Sundquist
Calculation Contributors:	
Calculation Checker:	Allen Zgaljardic

DESCRIPTION & PURPOSE

Depth of clean and reused backfill in deep excavation

BASIS / REFERENCE / ASSUMPTIONS

Doesn't include 55' buffer. 100% of shallow reused, 0% of deep reused

ISSUE / REVISION RECORD

Checker comments, if any, provided on: ☐ hard-copy ☐ electronic file ☐ Form 3-5

No.	Description	P	S	F	Originator Initials	Date	Checker Initials	Date
0		☐	☐	☐				
1		☐	☐	☐				
2		☐	☐	☐				
3		☐	☐	☐				

For a given Revision, indicate either P (Preliminary), S (Superseding) or F (Final). If there are no revisions to the Initial Issue, check F (Final).

APPROVAL and DISTRIBUTION

☒ The below individuals assert that the Detail Check – Calculations is complete.

Jon Sundquist	6/11/15
Originator Signature	**Date**
Allen Zgaljardic	6-9-15
Checker Signature	**Date**
Jon Sundquist	6/9/15
Project Manager (or Designee) Signature	**Date**

Distribution:

Project Central File – Quality File Folder

Other – Specify:

JOB NO.: 11176638

MADE BY: Jon Sundquist DATE: June 9, 2015

CHECKED BY: Allen Zgaljardic DATE: June 9, 2015

PROJECT: Williamsburg MGP

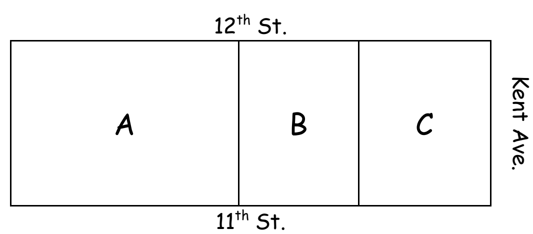
SUBJECT: Depth of clean and reused backfill in deep excavation

1. **Purpose**

   Estimate how far to backfill the deep excavation with offsite fill before contractor should stop to allow room for re-used soil from shallow excavation.

2. **Background**

   Excavation will occur over three areas:



Areas A & C are shallow excavation with excavation to 5 ft below original surface.
Area B is a deep excavation to 30 ft below original surface.

The attached spreadsheet printout provides the areas of each area

Excavated soils with no odor or visible contamination can be used as backfill, so long as PAHs are below 500 mg/kg

Reusable soil can only be placed in the deep excavation (Area 2). Even if 100% of the shallow soil met the reuse criteria, it would not fill up the deep excavation. We will want to start the backfill of the deep excavation with imported soil (for odor control and to assist in TCB tear-down) but need to know when to stop in order to allow enough room to place the excavated shallow soil.

We will have no re-used soil present closer than 5' of the final grade.

3. Assumptions

- 100% of the shallow soils are reusable
- None of the deep soils are reusable

4. Calculation

Calculation is performed in the spreadsheet located at

J:\Projects\11176638\Design\Excavation\Calculations\backfill\backfill-volume-calculator rev2.xlsx

The depth to the top of the backfill, if only reusable soil were backfilled (with no imported soil used), would be 19 feet below the original ground surface.

To this, we would have to add 14 feet of imported soil to get the backfilled elevation to an elevation 5 ft below the original surface.

The plan is to add the imported soil first. The reason is that the shallow soil is difficult to excavate when the TCB is still present, yet we want to keep the TCB erected as long as possible for odor control. Therefore, this 14feet of imported fill would be added first.

Because the proposed final grade is slightly different than the original grade, we will specify it not as feet from the bottom of excavation, but rather feet below the proposed final elevation: 16 ft.

However, to be conservative and leave enough room so that we can use all the shallow soil, select the depth to be 17 feet below final elevation.

ATTACHMENT 1

Area C (along Kent)	18,525	SF (95' x 195')
Area B (deep)	21,210	SF (105' x 202')
Area A (west)	28,140	SF (140' x 201') - doesn't include the buffer

Assumed fraction of shallow soil reusable: 100%
Assumed fraction of deep soil reusable: 0%

Depth of shallow excavation 5 ft
Depth of deep excavation 30 ft

Amount of soil removed deep excavation
636,300 CF 23,567 CY

Amount of soil removed shallow excavation
233,325 CF 8,642 CY

Amount of shallow soil excavated & available for deep backfill:
233,325 CF 8,642 CY

Amount of deep soil excavated & available for deep backfill:
0 CF 0 CY

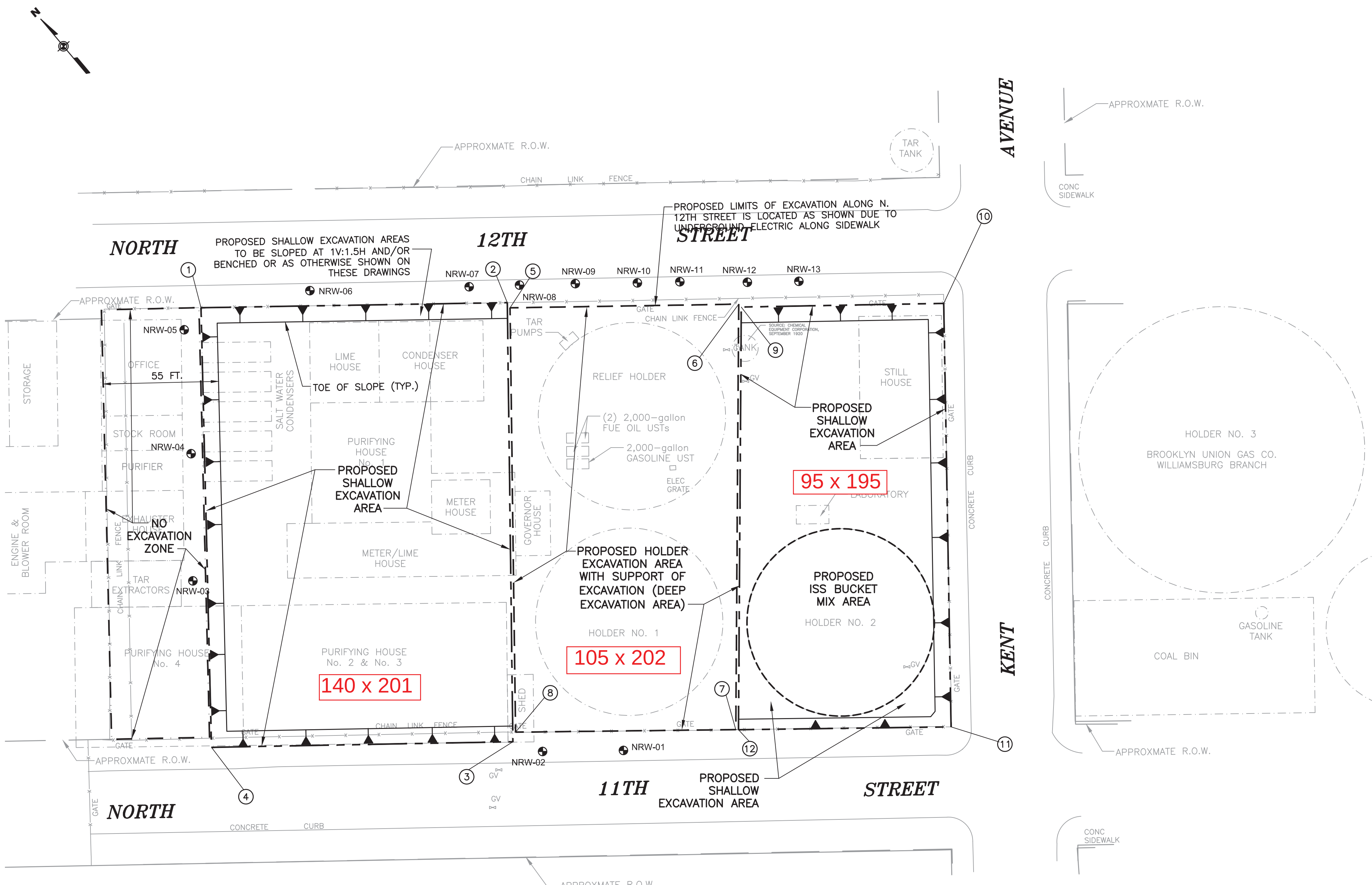
Depth bgs following backfill of deep zone with all reusable soil:
19.0 ft

Vertical feet of clean soil to back fill first so that top of re-used soil is @ 5 feet below original surface:
14.0 ft

If this clean soil was placed in the deep hole first, it would be this many feet below the original surface:
$\boxed{16.0}$

Amount of restricted residential fill (incl. topsoil and drainage stone) needed just for top five feet:
12,569 CY (note *yards*)

Amount of additional restricted residential fill needed, ignoring differences between original and final surface elevations:
10,997 CY (note *yards*)



LEGEND

- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE
- PROPOSED DEEP (HOLDER) EXCAVATION AREA
- PROPOSED SHALLOW EXCAVATION AREA
- PROPOSED IN-SITU SOLIDIFICATION (ISS) BUCKET MIXING AREA
- BUFFER ZONE (NO EXCAVATION PERMITTED)
- AREAS TO BE SLOPED AND/OR BENCHED
- NRW-13 EXISTING RECOVERY WELL LOCATION

EXCAVATION LAYOUT COORDINATE TABLE			
I.D.	DESCRIPTION	NORTHING	EASTING
1	N.E. COR. SHALLOW EXCAVATION	688,998.04	641,823.46
2	S.E. COR. SHALLOW EXCAVATION	688,905.23	641,937.87
3	S.W. COR. SHALLOW EXCAVATION	688,743.20	641,805.48
4	N.W. COR. SHALLOW EXCAVATION	688,834.38	641,692.65
5	N.E. COR. DEEP EXCAVATION	688,903.29	641,936.29
6	S.E. COR. DEEP EXCAVATION	688,834.55	642,020.94
7	S.W. COR. DEEP EXCAVATION	688,680.14	641,889.59
8	N.W. COR. DEEP EXCAVATION	688,746.72	641,808.35
9	N.E. COR. SHALLOW EXCAVATION	688,833.47	642,020.03
10	S.E. COR. SHALLOW EXCAVATION	688,771.99	642,096.08
11	S.W. COR. SHALLOW EXCAVATION	688,615.16	641,969.02
12	N.W. COR. SHALLOW EXCAVATION	688,680.09	641,889.54

NOTES:

1. ACTUAL CONSTRUCTION SEQUENCING AND SCHEDULING SHALL REQUIRE NATIONAL GRID APPROVAL AND BE COORDINATED WITH TIME ALLOWANCES REQUIRED BY ALL UTILITIES FOR THEIR REQUIRED PROTECTION MEASURES, NOTIFICATIONS, REVIEW AND APPROVALS. THE SEQUENCE SHOWN ON THIS DRAWING DOES NOT DEMONSTRATE ALL OF THE REQUIREMENTS TO PERFORM THE WORK. THE SEQUENCE SHOWN ON THIS DRAWING MAY BE MODIFIED BY THE CONTRACTOR, SUBJECT TO PRIOR APPROVAL BY THE CONSTRUCTION MANAGER.
2. FOR EXCAVATION REQUIREMENTS, INCLUDING DUST AND ODOR CONTROL, DURING EXCAVATIONS, REFER TO SPECIFICATION SECTION 02230. REFER TO SPECIFICATION SECTION 01056 FOR NOISE/VIBRATION REQUIREMENTS DURING EXCAVATIONS.
3. FOR EXAMPLE LAYOUT OF TEMPORARY FACILITIES, REFER TO DWG-6.

SUGGESTED GENERAL CONSTRUCTION SEQUENCE (SEE NOTE 1, THIS SHEET)

1. CONTRACTOR MOBILIZATION:
   a. ESTABLISHMENT OF SUPPORT AREAS (E.G., FIELD OFFICE TRAILERS, MATERIAL STAGING AND EQUIPMENT LAYDOWN AREAS).
   b. INSTALLATION OF TEMPORARY CONSTRUCTION FENCES, TRAFFIC CONTROL MEASURES, AND EROSION/SEDIMENT CONTROL MEASURES ON THE SITE.
   c. INSTALLATION OF WATER PRETREATMENT SYSTEM.
   d. ERECTION OF CONTAMINATED SOILS STAGING TCB (SEE DWG-6 FOR LOCATION).
2. DECOMMISSIONING OF MONITORING WELLS AND PIEZOMETERS.
3. INITIATION OF INSTALLATION OF SOE WALL AND SHEET PILE EXCAVATION SUPPORT SYSTEM.
4. HOLDER NO. 2 AREA:
   a. ERECTION OF THE LARGE TCB OVER HOLDER NO. 2 AREA, INCLUDING VMS SET-UP.
   b. EXCAVATION AND IN-SITU SOLIDIFICATION VIA BUCKET MIXING WITHIN HOLDER NO. 2 AND DEWATER AS REQUIRED/SPECIFIED.
   c. PLACE FIVE FEET OF TEMPORARY BACKFILL OVER SOLIDIFIED HOLDER NO. 2.
5. DEEP EXCAVATION PREPARATION:
   a. COMPLETION OF INSTALLATION OF SOE WALL AND SHEET PILE EXCAVATION SUPPORT SYSTEM.
   b. OFF-SITE DISPOSAL OF MATERIAL FROM CONSTRUCTION OF SOE WALL.
   c. MOVEMENT AND EXTENSION OF THE LARGE TCB OVER THE DEEP EXCAVATION AREA.
6. INSTALLATION OF DEWATERING SYSTEM FOR THE DEEP EXCAVATION AREA.
7. DEEP EXCAVATION:
   a. EXCAVATION OF SOILS AND FORMER STRUCTURES FROM THE DEEP EXCAVATION AREA, INCLUDING THE HOLDER NO. 1 AND THE RELIEF HOLDER FOOTPRINTS AND DISPOSE OFF-SITE. SEGREGATION AND STOCKPILING ON-SITE OF SOILS SUITABLE FOR USE AS BACKFILL.
   b. AS EXCAVATION PROGRESSES, DEWATER AND INSTALL TIE BACK ANCHORS OR INTERNAL BRACING. REFER TO DWG-10 OR DWG-14 FOR RECOMMENDED CONSTRUCTION PROCEDURE FOR INSTALLING THE TIE BACK AND RAKER ALTERNATIVE OR THE INTERNAL BRACING ALTERNATIVE, RESPECTIVELY.
   c. UPON COMPLETION OF DEEP EXCAVATION, INITIATION OF BACKFILLING USING ALL STOCKPILED SOIL SUITABLE FOR REUSE FOLLOWED BY IMPORTED FILL TO AN ELEVATION NO MORE THAN 17 FEET BELOW THE TOP OF THE PROPOSED FINAL RESTORATION GRADE.
   d. REMOVAL OF THE LARGE TCB FROM THE DEEP EXCAVATION AREA.
8. SHALLOW EXCAVATION:
   a. SHALLOW EXCAVATION OF REMAINING AREAS OF THE SITE, EXCLUDING 55-FOOT STRIP OF NO EXCAVATION ON THE WEST SIDE OF THE SITE. SOIL UNSUITABLE FOR REUSE SENT OFF-SITE FOR DISPOSAL, AND REMAINING SOIL STOCKPILED ON-SITE FOR REUSE AS BACKFILL OR USED DIRECTLY AS BACKFILL IN THE DEEP EXCAVATION AREA. UPPER PORTIONS OF THE SOE WALL REMOVED.
9. FINAL BACKFILL AND DEMOBILIZATION:
   a. COMPLETION OF BACKFILLING OF DEEP EXCAVATION AREA WITH ON-SITE DERIVED MATERIAL.
   b. BACKFILLING SHALLOW EXCAVATED AREAS AND THE TOP FIVE FEET OF THE DEEP EXCAVATION AREA WITH IMPORTED FILL MEETING RESTRICTED RESIDENTIAL STANDARDS.
   c. DEMOBILIZATION OF THE DEWATERING AND WATER PRETREATMENT SYSTEMS.
   d. TOPSOIL PLACEMENT AND SEEDING.
   e. REMOVE EROSION/SEDIMENT CONTROLS AND COMMUNITY AIR MONITORING SYSTEM.

30' 0 30'
SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: AJZ
DRAWN BY: EB
CHECKED BY: MG
PROJ. MGR. JAS

URS Corporation
New York
257 West Genesee Street, Suite 400
Buffalo, New York 14202-2657
(716)856-5636 - (716)856-2545 fax

JOB NO. 11176638

nationalgrid
ONE METROTECH CENTER
BROOKLYN, NEW YORK 11201

50 KENT AVENUE PROPERTY
HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK

PLANNED IRM ACTIVITIES

Scale: AS SHOWN | Date: JUNE 2015 | DWG-5

J:\Projects\11176638\CAD\RDWP 2013\DWG-5.dwg 6/8/15-ELB

JOB NO.: 11176638

MADE BY: Jon Sundquist DATE: June 8, 2015

CHECKED BY: Rob Pirog DATE: June 8, 2015

PROJECT: Williamsburg MGP

SUBJECT: Depth of excavation prior to ISS

1. Purpose

Estimate how much excavation should be performed after the initial 7 feet of excavation has been completed at the holder No. 2 ISS area, in order to accommodate potential spoils/expansion due to grout addition.

2. Background

Prior to ISS, the contractor will excavate 7 feet of soil from above holder No. 2 to reduce the depth to which the ISS excavator has to reach to mix to the bottom of the holder.

In addition to this, at each segment ("mixing strip") of ISS, the contractor will excavate more to provide room into which the soil/fill expand into upon grout addition and mixing. It is this depth we are calculating.

3. Assumptions

- The results of the Williamsburg site treatability study are used (attachment 1). This treatability study found:
  - Use of 7% (dry reagent wt.: dry soil wt.) meets performance goals, with a 3:1 ratio of GGBFS:cement mass ratio.
  - The amount of water added to the reagents to create the grout is 1.67 as a mass ratio of water to dry grout reagents
  - The wet soil density ranged from 114.0 to 120.4 lb/ft^3 with an average of 116.2 lb/ft^3
  - The dry soil density ranged from 90.1 to 98.5 lb/ft^3 with an average of 93.2 lb/ft^3

- The grout density can be calculated directly as a mixture of the densities of the components (cement, GGBFS, and water)

- The specific gravities of cement and GGBFS are 3.15 and 2.93, respectively.
- Once the initial 7 feet of soil is excavated, the average depth to the bottom of the holder is 18 feet (e.g. average depth of the inside of the holder is ~25 ft.

4. Calculation of Swell Volume

First, calculate the density of the grout.

Density of cement is

$(3.15\ g/cm^3) * (2.2\ lb/1000\ g) * (30.48\ cm/ft)^3 = 196\ lb/ft^3$

Density of GGBFS is

$(2.93\ g/cm^3) * (2.2\ lb/1000\ g) * (30.48\ cm/ft)^3 = 183\ lb/ft^3$

Density of water is $62.4\ lb/ft^3$

Density of mixed grout: Use as a basis 100 lb of cement

Cement:	$(100\ lb) / (196\ lb/ft^3) = 0.51\ ft^3$
GGBFS:	$(3 * 100\ lb) / (183\ lb/ft^3)= 1.64\ ft^3$
Water:	$(1.67 * (100 + 300lb)) / (62.4\ lb/ft^3) = 10.68\ ft^3$

Density = $(100+300 + (1.67*(100+300lb)))/(0.51+1.64+10.68\ ft^3) = 83.1\ lb/ft^3$

Second, calculate mass of each component.

Define:

S:	dry soil mass
SW:	native soil moisture
R:	dry reagent
RW:	water added to reagent

From the treatability study, (SW + S)/S = 116.2/93.2, or:

SW = 0.25S

Reagent ratio is selected from the treatability data as 7%, so

R = 0.07S

From the treatability study, the moisture in the mixed grout is

RW = 1.67R

Use as a basis, 1 ft^3 of soil, or S + SW = 116.2 lb

S = 93.2 lb (from treatability study)
SW = 0.25 * 93.2 = 23.0 lb
R = 0.07 * 93.2 = 6.52 lb
RW = 1.67 * 6.52 = 10.87 lb

Soil: The volume of the S + SW is 1 ft^3 per the basis

Grout: The volume of R + RW = (6.52 + 10.87 lb)/(83.1 lb/ft^3) = 0.2 ft^3

<u>So swell is 20%</u>

Define D as the depth of the soil after the additional excavation in each ISS segment. After adding the grout and mixing, the elevation will rise back to 18, which we assume is the average depth of soil after the initial 7 feet of excavation. So:

D + 0.2D = 18 feet
D = 15 feet

Conclusion: must excavate 18 – 15 = <u>3 feet</u> in each segment prior to grout addition.

5. Calculation of Regent Mass Additions

In support of paragraph 1.6.1 of specification section 13280, the amount (mass units) of solidification materials needs to be provided on the basis of a volume of untreated soil.

If 1 ft^3 of soil, or $S_1 + SW_1 = 116.2$ lb
Then 1 yd^3 of untreated soil is $S_{27} + SW_{27} = 27\ ft^3 * 116.2\ lb/ft^3 = 3{,}137$ lb

$S_{27} = 93.2$ lb * 27 = 2,516 lb
$SW_{27} = 0.25 * 2{,}516 = 629$ lb = 10.1 ft^3 = 75.6 gallons
$R_{27} = 0.07 * 2{,}516 = 176$ lb
$RW_{27} = 1.67 * 176 = 294$ lb = 4.7 ft^3 = 35.2 gallons

So, for each CY of untreated soil, add:

35.2 gallons of water
176 * 75% = 132 lb of GGBFS
176 * 25% = 44 lb of cement

ATTACHMENT 1

TIMELY ENGINEERING SOIL TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

SUMMARY of TESTING

T.E.S.T. Project Number: 1510-02

Project Name: Williamsburg Works Former MGP Site

Sample Identification					USCS	Admix	Curing		Moisture	Grain Size Distribution			Atterberg Limits			Unit Weight		Hydraul.
T.E.S.T. Sample No.	Client Base Material No.	Mix Design No.	Batch No.	Spec. No.		GGBFS/ Cem. (3/1) %	Age, days	UCS, psi	Content, %	% Finer 3/8" Sieve	% Finer #4 Sieve	% Finer #200 Sieve	LL, %	PL, %	PI, %	Wet Density, pcf	Dry Density, pcf	Conduct. cm/sec
1510-02-1																		
19429	Sample A	-	-	-	SM	-	-	-	26.2	99.1	91.9	19.7	NP	NP	NP	114.2	90.5	-
19430	Sample B	-	-	-	SM	-	-	-	26.6	98.6	92.3	17.3	NP	NP	NP	114.0	90.1	-
19431	Sample C	-	-	-	SM	-	-	-	24.7	98.4	92.8	19.5	NP	NP	NP	114.8	92.1	-
19432	Sample D	-	-	-	SM	-	-	-	26.3	98.5	92.9	27.3	NP	NP	NP	114.8	90.9	-
19433	Sample E	-	-	-	SM	-	-	-	22.2	97.2	93.8	27.3	27	23	4	120.4	98.5	-
19434	Sample F	-	-	-	SM	-	-	-	22.5	98.4	92.8	25.5	NP	NP	NP	118.8	97.0	-
19429	Sample A	1	1	1	-	7	7	85.0	26.7	-	-	-	-	-	-	119.2	94.0	-
19429	Sample A	1	1	2	-	7	14	151.0	26.1	-	-	-	-	-	-	118.9	94.2	-
19429	Sample A	1	1	3	-	7	28	356.0	26.1	-	-	-	-	-	-	119.3	94.6	-
19429	Sample A	1	1	4	-	7	7	-	26.3	-	-	-	-	-	-	118.8	94.1	2.9E-07
19429	Sample A	1	1	5	-	7	14	-	25.6	-	-	-	-	-	-	119.6	95.2	4.2E-08
19429	Sample A	1	1	6	-	7	28	-	24.8	-	-	-	-	-	-	119.1	95.4	2.2E-08
19429	Sample A	2	1	1	-	10	7	161.0	27.0	-	-	-	-	-	-	119.2	93.8	-
19429	Sample A	2	1	2	-	10	14	293.0	26.6	-	-	-	-	-	-	118.6	93.7	-
19429	Sample A	2	1	3	-	10	28	527.0	26.2	-	-	-	-	-	-	118.9	94.2	-
19429	Sample A	2	1	4	-	10	7	-	26.5	-	-	-	-	-	-	119.3	94.3	7.8E-08
19429	Sample A	2	1	5	-	10	14	-	26.0	-	-	-	-	-	-	118.4	94.0	2.6E-08
19429	Sample A	2	1	6	-	10	28	-	25.5	-	-	-	-	-	-	118.7	94.6	1.6E-08
19429	Sample A	3	1	1	-	$10^{B=2\%}$	7	142.0	29.4	-	-	-	-	-	-	117.3	90.6	-
19429	Sample A	3	1	2	-	$10^{B=2\%}$	14	252.0	29.1	-	-	-	-	-	-	117.0	90.6	-
19429	Sample A	3	1	3	-	$10^{B=2\%}$	28	475.0	29.0	-	-	-	-	-	-	117.5	91.1	-
19429	Sample A	3	1	4	-	$10^{B=2\%}$	7	-	28.6	-	-	-	-	-	-	117.0	91.0	4.6E-08
19429	Sample A	3	1	5	-	$10^{B=2\%}$	14	-	27.8	-	-	-	-	-	-	116.7	91.3	2.2E-08
19429	Sample A	3	1	6	-	$10^{B=2\%}$	28	-	27.8	-	-	-	-	-	-	117.3	91.8	1.3E-08

TIMELY ENGINEERING SOIL TESTS, LLC
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Phone: 770-938-8233
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Web: www.test-llc.com

SUMMARY of TESTING

T.E.S.T. Project Number: 1510-02

Project Name: Williamsburg Works Former MGP Site

Sample Identification					USCS	Admix	Curing	UCS,	Moisture	Grain Size Distribution			Atterberg Limits			Unit Weight		Hydraul.
T.E.S.T. Sample No.	Client Base Material No.	Mix Design No.	Batch No.	Spec. No.		GGBFS/ Cem. (3/1) %	Age, days	psi	Content, %	% Finer 3/8" Sieve	% Finer #4 Sieve	% Finer #200 Sieve	LL, %	PL, %	PI, %	Wet Density, pcf	Dry Density, pcf	Conduct. cm/sec
19430	Sample B	1	1	1	-	7	7	36.0	26.8	-	-	-	-	-	-	117.8	92.9	-
19430	Sample B	1	1	2	-	7	14	68.0	26.5	-	-	-	-	-	-	117.3	92.7	-
19430	Sample B	1	1	3	-	7	28	242.0	26.3	-	-	-	-	-	-	118.0	93.3	-
19430	Sample B	1	1	4	-	7	7	-	26.0	-	-	-	-	-	-	119.2	94.6	1.3E-06
19430	Sample B	1	1	5	-	7	14	-	25.9	-	-	-	-	-	-	118.5	94.1	3.9E-07
19430	Sample B	1	1	6	-	7	28	-	25.5	-	-	-	-	-	-	117.8	93.9	5.8E-08
19430	Sample B	2	1	1	-	10	7	77.0	27.1	-	-	-	-	-	-	117.8	92.7	-
19430	Sample B	2	1	2	-	10	14	205.0	26.5	-	-	-	-	-	-	117.5	92.9	-
19430	Sample B	2	1	3	-	10	28	474.0	26.4	-	-	-	-	-	-	118.1	93.3	-
19430	Sample B	2	1	4	-	10	7	-	26.4	-	-	-	-	-	-	118.6	93.8	6.0E-07
19430	Sample B	2	1	5	-	10	14	-	25.9	-	-	-	-	-	-	117.3	93.2	8.5E-08
19430	Sample B	2	1	6	-	10	28	-	25.3	-	-	-	-	-	-	118.2	94.3	2.8E-08
19430	Sample B	3	1	1	-	$10^{B=2\%}$	7	75.0	29.9	-	-	-	-	-	-	115.8	89.1	-
19430	Sample B	3	1	2	-	$10^{B=2\%}$	14	186.0	29.1	-	-	-	-	-	-	116.1	89.9	-
19430	Sample B	3	1	3	-	$10^{B=2\%}$	28	430.0	29.3	-	-	-	-	-	-	116.0	89.7	-
19430	Sample B	3	1	4	-	$10^{B=2\%}$	7	-	29.1	-	-	-	-	-	-	116.7	90.4	2.5E-07
19430	Sample B	3	1	5	-	$10^{B=2\%}$	14	-	28.5	-	-	-	-	-	-	116.5	90.7	4.3E-08
19430	Sample B	3	1	6	-	$10^{B=2\%}$	28	-	27.8	-	-	-	-	-	-	116.4	91.1	2.3E-08
19431	Sample C	1	1	1	-	7	7	99.0	24.9	-	-	-	-	-	-	120.1	96.1	-
19431	Sample C	1	1	2	-	7	14	207.0	24.1	-	-	-	-	-	-	120.5	97.1	-
19431	Sample C	1	1	3	-	7	28	436.0	24.5	-	-	-	-	-	-	120.9	97.1	-
19431	Sample C	1	1	4	-	7	7	-	24.6	-	-	-	-	-	-	120.9	97.0	2.3E-07
19431	Sample C	1	1	5	-	7	14	-	24.1	-	-	-	-	-	-	121.0	97.5	7.7E-08
19431	Sample C	1	1	6	-	7	28	-	23.6	-	-	-	-	-	-	121.1	98.0	3.1E-08
19431	Sample C	2	1	1	-	10	7	183.0	25.3	-	-	-	-	-	-	120.4	96.0	-

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SUMMARY of TESTING

T.E.S.T. Project Number: 1510-02

Project Name: Williamsburg Works Former MGP Site

Sample Identification					USCS	Admix GGBFS/ Cem. (3/1) %	Curing Age, days	UCS, psi	Moisture Content, %	Grain Size Distribution			Atterberg Limits			Unit Weight		Hydraul. Conduct. cm/sec
T.E.S.T. Sample No.	Client Base Material No.	Mix Design No.	Batch No.	Spec. No.						% Finer 3/8" Sieve	% Finer #4 Sieve	% Finer #200 Sieve	LL, %	PL, %	PI, %	Wet Density, pcf	Dry Density, pcf	
19431	Sample C	2	1	2	-	10	14	357.0	24.8	-	-	-	-	-	-	120.1	96.2	-
19431	Sample C	2	1	3	-	10	28	594.0	25.1	-	-	-	-	-	-	120.2	96.0	-
19431	Sample C	2	1	4	-	10	7	-	25.9	-	-	-	-	-	-	119.2	94.7	6.7E-08
19431	Sample C	2	1	5	-	10	14	-	25.1	-	-	-	-	-	-	120.0	95.9	2.2E-08
19431	Sample C	2	1	6	-	10	28	-	23.6	-	-	-	-	-	-	120.0	97.1	1.4E-08
19431	Sample C	3	1	1	-	$10^{B=2\%}$	7	124.0	27.6	-	-	-	-	-	-	117.4	92.0	-
19431	Sample C	3	1	2	-	$10^{B=2\%}$	14	324.0	27.4	-	-	-	-	-	-	117.6	92.3	-
19431	Sample C	3	1	3	-	$10^{B=2\%}$	28	555.0	27.5	-	-	-	-	-	-	117.9	92.5	-
19431	Sample C	3	1	4	-	$10^{B=2\%}$	7	-	27.8	-	-	-	-	-	-	118.0	92.3	3.4E-08
19431	Sample C	3	1	5	-	$10^{B=2\%}$	14	-	26.8	-	-	-	-	-	-	118.3	93.3	2.0E-08
19431	Sample C	3	1	6	-	$10^{B=2\%}$	28	-	26.4	-	-	-	-	-	-	118.4	93.7	1.1E-08
19432	Sample D	1	1	1	-	7	7	159.0	26.7	-	-	-	-	-	-	118.8	93.7	-
19432	Sample D	1	1	2	-	7	14	290.0	26.5	-	-	-	-	-	-	119.8	94.7	-
19432	Sample D	1	1	3	-	7	28	499.0	24.9	-	-	-	-	-	-	119.4	95.5	-
19432	Sample D	1	1	4	-	7	7	-	25.2	-	-	-	-	-	-	120.2	96.0	7.6E-08
19432	Sample D	1	1	5	-	7	14	-	25.7	-	-	-	-	-	-	119.0	94.7	3.4E-08
19432	Sample D	1	1	6	-	7	28	-	24.5	-	-	-	-	-	-	119.1	95.7	2.3E-08
19432	Sample D	2	1	1	-	10	7	289.0	27.0	-	-	-	-	-	-	118.5	93.2	-
19432	Sample D	2	1	2	-	10	14	432.0	27.3	-	-	-	-	-	-	118.2	92.9	-
19432	Sample D	2	1	3	-	10	28	687.0	26.8	-	-	-	-	-	-	118.5	93.4	-
19432	Sample D	2	1	4	-	10	7	-	25.9	-	-	-	-	-	-	118.5	94.1	4.6E-08
19432	Sample D	2	1	5	-	10	14	-	25.4	-	-	-	-	-	-	118.3	94.3	2.6E-08
19432	Sample D	2	1	6	-	10	28	-	26.3	-	-	-	-	-	-	118.1	93.5	1.6E-08
19432	Sample D	3	1	1	-	$10^{B=2\%}$	7	236.0	28.9	-	-	-	-	-	-	117.2	90.9	-
19432	Sample D	3	1	2	-	$10^{B=2\%}$	14	421.0	29.2	-	-	-	-	-	-	117.4	90.9	-

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T.E.S.T. Project Number: 1510-02
Project Name: Williamsburg Works Former MGP Site

Sample Identification					USCS	Admix	Curing		Moisture	Grain Size Distribution			Atterberg Limits			Unit Weight		Hydraul.
T.E.S.T. Sample No.	Client Base Material No.	Mix Design No.	Batch No.	Spec. No.		GGBFS/ Cem. (3/1) %	Age, days	UCS, psi	Content, %	% Finer 3/8" Sieve	% Finer #4 Sieve	% Finer #200 Sieve	LL, %	PL, %	PI, %	Wet Density, pcf	Dry Density, pcf	Conduct. cm/sec
19432	Sample D	3	1	3	-	$10^{B=2\%}$	28	634.0	28.6	-	-	-	-	-	-	116.8	90.8	-
19432	Sample D	3	1	4	-	$10^{B=2\%}$	7	-	25.9	-	-	-	-	-	-	116.6	92.6	2.2E-08
19432	Sample D	3	1	5	-	$10^{B=2\%}$	14	-	28.0	-	-	-	-	-	-	116.4	90.9	1.7E-08
19432	Sample D	3	1	6	-	$10^{B=2\%}$	28	-	27.9	-	-	-	-	-	-	116.6	91.2	1.2E-08
19433	Sample E	1	1	1	-	7	7	188.0	22.9	-	-	-	-	-	-	123.1	100.1	-
19433	Sample E	1	1	2	-	7	14	326.0	23.1	-	-	-	-	-	-	123.7	100.4	-
19433	Sample E	1	1	3	-	7	28	633.0	22.8	-	-	-	-	-	-	122.3	99.6	-
19433	Sample E	1	1	4	-	7	7	-	22.5	-	-	-	-	-	-	124.1	101.3	5.8E-08
19433	Sample E	1	1	5	-	7	14	-	22.4	-	-	-	-	-	-	123.9	101.2	4.7E-08
19433	Sample E	1	1	6	-	7	28	-	21.9	-	-	-	-	-	-	123.0	100.9	2.6E-08
19433	Sample E	2	1	1	-	10	7	333.0	23.6	-	-	-	-	-	-	122.8	99.4	-
19433	Sample E	2	1	2	-	10	14	538.0	23.6	-	-	-	-	-	-	122.8	99.3	-
19433	Sample E	2	1	3	-	10	28	803.0	23.1	-	-	-	-	-	-	122.3	99.3	-
19433	Sample E	2	1	4	-	10	7	-	21.9	-	-	-	-	-	-	123.0	100.9	4.3E-08
19433	Sample E	2	1	5	-	10	14	-	22.7	-	-	-	-	-	-	122.8	100.1	2.4E-08
19433	Sample E	2	1	6	-	10	28	-	22.6	-	-	-	-	-	-	123.0	100.3	1.6E-08
19433	Sample E	3	1	1	-	$10^{B=2\%}$	7	263.0	25.6	-	-	-	-	-	-	120.2	95.7	-
19433	Sample E	3	1	2	-	$10^{B=2\%}$	14	460.0	26.1	-	-	-	-	-	-	120.3	95.3	-
19433	Sample E	3	1	3	-	$10^{B=2\%}$	28	710.0	25.4	-	-	-	-	-	-	120.5	96.0	-
19433	Sample E	3	1	4	-	$10^{B=2\%}$	7	-	25.3	-	-	-	-	-	-	120.4	96.1	2.3E-08
19433	Sample E	3	1	5	-	$10^{B=2\%}$	14	-	25.0	-	-	-	-	-	-	121.0	96.8	1.5E-08
19433	Sample E	3	1	6	-	$10^{B=2\%}$	28	-	25.3	-	-	-	-	-	-	121.0	96.6	1.1E-08
19434	Sample F	1	1	1	-	7	7	149.0	23.3	-	-	-	-	-	-	122.6	99.4	-
19434	Sample F	1	1	2	-	7	14	258.0	23.0	-	-	-	-	-	-	123.4	100.2	-
19434	Sample F	1	1	3	-	7	28	597.0	22.9	-	-	-	-	-	-	122.4	99.5	-

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Sample Identification					USCS	Admix GGBFS/ Cem. (3/1) %	Curing Age, days	UCS, psi	Moisture Content, %	Grain Size Distribution			Atterberg Limits			Unit Weight		Hydraul. Conduct. cm/sec
T.E.S.T. Sample No.	Client Base Material No.	Mix Design No.	Batch No.	Spec. No.						% Finer 3/8" Sieve	% Finer #4 Sieve	% Finer #200 Sieve	LL, %	PL, %	PI, %	Wet Density, pcf	Dry Density, pcf	
19434	Sample F	1	1	4	-	7	7	-	20.7	-	-	-	-	-	-	124.1	102..8	7.0E-08
19434	Sample F	1	1	5	-	7	14	-	21.5	-	-	-	-	-	-	123.2	101.4	4.0E-08
19434	Sample F	1	1	6	-	7	28	-	22.7	-	-	-	-	-	-	124.0	101.1	2.9E-08
19434	Sample F	2	1	1	-	10	7	370.0	22.9	-	-	-	-	-	-	122.3	99.4	-
19434	Sample F	2	1	2	-	10	14	604.0	20.6	-	-	-	-	-	-	122.9	101.8	-
19434	Sample F	2	1	3	-	10	28	948.0	23.0	-	-	-	-	-	-	122.3	99.4	-
19434	Sample F	2	1	4	-	10	7	-	18.6	-	-	-	-	-	-	122.9	103.6	3.9E-08
19434	Sample F	2	1	5	-	10	14	-	19.8	-	-	-	-	-	-	122.6	102.3	2.8E-08
19434	Sample F	2	1	6	-	10	28	-	22.6	-	-	-	-	-	-	123.5	100.7	2.0E-08
19434	Sample F	3	1	1	-	$10^{B=2\%}$	7	310.0	25.0	-	-	-	-	-	-	119.4	95.5	-
19434	Sample F	3	1	2	-	$10^{B=2\%}$	14	527.0	25.1	-	-	-	-	-	-	119.6	95.5	-
19434	Sample F	3	1	3	-	$10^{B=2\%}$	28	848.0	26.2	-	-	-	-	-	-	119.2	94.4	-
19434	Sample F	3	1	4	-	$10^{B=2\%}$	7	-	25.3	-	-	-	-	-	-	120.2	95.9	2.3E-08
19434	Sample F	3	1	5	-	$10^{B=2\%}$	14	-	24.3	-	-	-	-	-	-	119.5	96.1	1.8E-08
19434	Sample F	3	1	6	-	$10^{B=2\%}$	28	-	25.6	-	-	-	-	-	-	120.7	96.1	1.1E-08

Note: $10^{B=2\%}$ represents mix with 10% of slag/cement (3/1) with addition of 2% Bentonite

APPENDIX C

HAUL ROUTES

APPENDIX C

HAUL ROUTES

50 KENT AVENUE PROPERTY HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK

Prepared for:

National Grid
One Metrotech Center
Brooklyn, New York 11201

Prepared by:

URS Corporation
257 West Genesee Street
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Buffalo, New York 14202

June, 2015

TABLE OF CONTENTS

Page No.

FIGURES

1. SCOPE LIMITATIONS

This report identifies haul routes within the borough of Brooklyn, NY, whereby excavated and backfill materials can be transported across local streets between the subject site and designated truck routes in compliance with the New York City Traffic Rules and Regulations Section 4-13(e).

2. OVERVIEW

National Grid has prepared an interim remedial measure to address soil contamination at a property located at 50 Kent Avenue, along the west side of Kent Avenue between N 11th and N 12th Streets, in the borough of Brooklyn, NY (the Site). The remediation activities will involve off-site transport of the excavated soil and on-site delivery of equipment and backfill materials. The majority of the off-site transport will be performed by dump trucks. It is assumed that these trucks will access the Site from and return to I-278.

3. SITE LOCATION AND ACCESS

The Site is located about 1 mile northwest of the Brooklyn Queens Expressway (I-278) between exits 32 and 34 and ½ mile west of McGuinness Avenue. The travel area includes one-way streets and designated local truck routes.

It is recommended that trucks entering the site use N 12th Street and trucks exiting the Site use N 11th Street. This assignment was determined based on the best available routes and in consideration of separating the haul routes.

4. DEVELOPMENT OF POTENTIAL TRUCK ROUTES

Within the confines of New York City, including Brooklyn, truck traffic is required to travel on designated local and/or through truck routes. Section 4-13(a) of the New York City Traffic Rules and Regulations (2012) defines a truck to be: "…any vehicle or combination of vehicles designed for the transportation of property, which has either of the following characteristics: two axles, six tires; or three or more axles." Local and Through Routes in Brooklyn are defined in NYC Traffic Rules and Regulations Section 4-13(e) as follows:

Through Truck Route: Trucks having neither an origin nor a destination within the Borough of Brooklyn. Such vehicles shall restrict their routes to the street segments designated as Through Truck Routes.

Local Truck Route: Trucks with an origin or destination for the purpose of delivery, loading or servicing within the Borough of Brooklyn, may only operate such vehicle over the designated local truck routes, except that an operator may operate on a non-designated street for the purpose of arriving at the destination. This shall be accomplished by leaving a designated truck route via the most direct route to the destination, and then returning to the nearest designated truck route by the most direct route. If the operator has multiple destinations in the same general area the most direct route to these destinations can be used without returning to a designated truck route, provided that traveling to these destinations does not involve crossing a designated truck route.

Based on the NYCDOT Truck Route Map the local truck routes in the area of the Site consist of the following streets: N 10^{th}, N 11^{th}, Kent Avenue, Union Avenue, Greenpoint Avenue, McGuinness Boulevard, Meeker Avenue (eastbound only), Marcy Avenue, and Metropolitan Avenue. These are shown in Exhibit A.

There are also certain vehicle dimensions and weight restrictions that apply. According to the NYC Traffic Rules and Regulations Section 4-15(b) the following restrictions apply:

- Width: no more than 98 inches
- Height: no more than 13.5 feet, from the underside of tire to top of vehicle, including its load
- Length: no more than 35 feet, including load and bumpers. Note that this does not apply to semitrailers
- Weight: no more than 800 pounds per inch width of tire, when loaded. Alternatively:
    - The weight on two axles of a vehicle equipped with pneumatic tires, when loaded, and when such axles are spaced fewer than 10 feet from center to center, shall not be more than 36,000 pounds.
    - The weight on three axles or more of a vehicle equipped with pneumatic tires, when loaded, must be less than 34,000 pounds, plus 1,000 pounds for each foot and major fraction of a foot of the distance from the center of the foremost axle to the center of the rearmost axle

To determine the haul routes to travel from the site to I-278 and vice-versa, the following additional considerations were taken:

- Posted truck restrictions. One such restriction was found on the exit 32B ramp, where trucks must make a left turn. This is shown in Figure 1.

- Travel time and distance. High-traffic areas and routes with numerous stop and go intersections were avoided when possible.
- Geometric constraints of intersections.

5. DESCRIPTION OF HAUL ROUTES

Four haul routes were considered: (1) from the Site to I-278 eastbound; (2) from the Site to I-278 westbound; (3) from I-278 eastbound to the Site; and (4) from I-278 westbound to the Site. The haul routes are provided in the descriptions below. Note that travel times are estimates provided by Google Maps, 2013. Actual travel times may vary based on vehicle type and weight, and current traffic conditions. Distances were also acquired using Google Maps, 2013.

<u>SITE TO I-278 EASTBOUND</u>

Exit site on N 11th Street. Turn left onto Kent Avenue. Turn right onto Greenpoint Avenue. Continue on Greenpoint Avenue through the McGuinness Boulevard intersection. Continue on Greenpoint Avenue over the John Jay Byrne Bridge. Continue on Greenpoint Avenue. Turn right onto I-495 south ramp (at Exit 17W). This route leads to I-278 East or I-495 South. The route takes approximately 9 minutes to travel and is 2.9 miles long. See Figure 3 for a graphical view of this route.

<u>SITE TO I-278 WESTBOUND</u>

Exit site on N 11th Street. Go straight on 11th Street. Turn right onto Union Avenue. Turn right onto Meeker Avenue. Bear right onto Metropolitan Ave, and then immediately turn left onto Marcy Ave to enter I-278 West. This route takes approximately 6 minutes to travel and is 1.1 miles long. See Figure 4 for a graphical view of this route.

<u>I-278 EASTBOUND TO THE SITE</u>

The only exit on I-278 East leading to a truck route in the area is Exit 32.

Take Exit 32 onto Rodney Street. Rodney Street becomes Meeker Avenue. Turn left onto Union Avenue. Turn left onto N. 10th Street. At the end of N. 10th Street turn right onto Kent Avenue. Turn left onto N 12th Street to enter site. This route takes approximately 5 minutes to travel and is 1.1 miles long. See Figure 5 for a graphical view of this route.

There are no other options for this route.

I-278 WESTBOUND TO THE SITE

The only exit on I-278 West leading to a truck route in the area is Exit 32B. This exit also has a posted restriction that trucks must turn left at the bottom of the exit and go to Metropolitan Avenue (see Figure 2), even though Union Avenue (northbound)is a valid local truck route. The option of turning right onto Rodney Street and then using Union Avenue was also considered; however, the geometry of the turn is not suitable for trucks.

> Take Exit 32B. Turn left onto Union Avenue (southbound). Turn right onto Metropolitan Avenue. Continue on Metropolitan Avenue. Turn right onto Kent Avenue. Turn left onto N. 12th Street to enter site. This route takes approximately 6 minutes to travel and is 1.5 miles long. See Figure 6 for a graphical view of this route.

There are no other options for this route.

FIGURES

Figure 1: NYCDOT Truck Routes Map
(zoomed in to the area in consideration)
Blue indicates Local Route; Red indicates Through Route
Full map found at: www.nyc.gov/trucks

Figure 2: End of Exit 32B

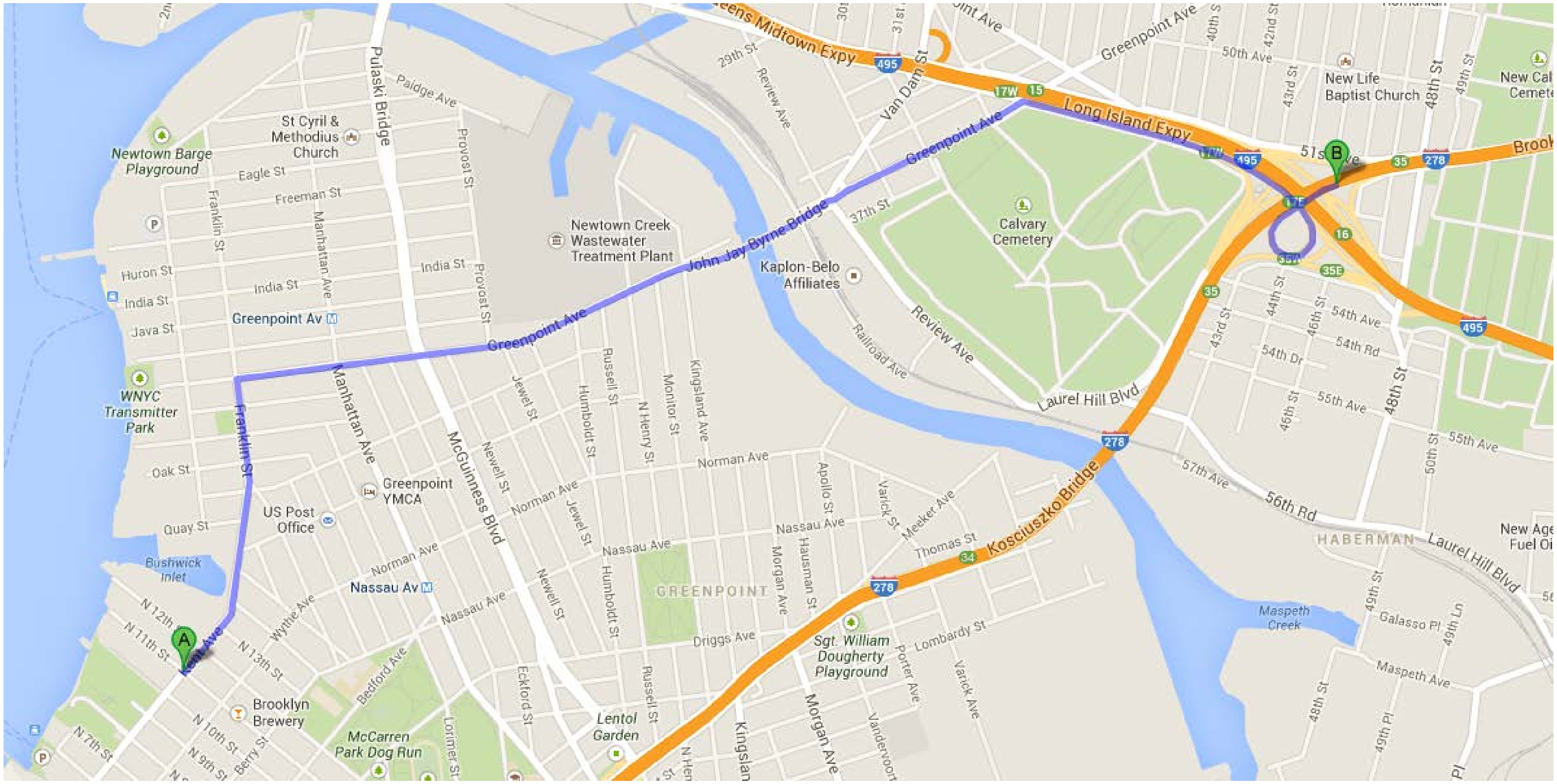


Figure 3: Site to I-278 East – Recommended Route

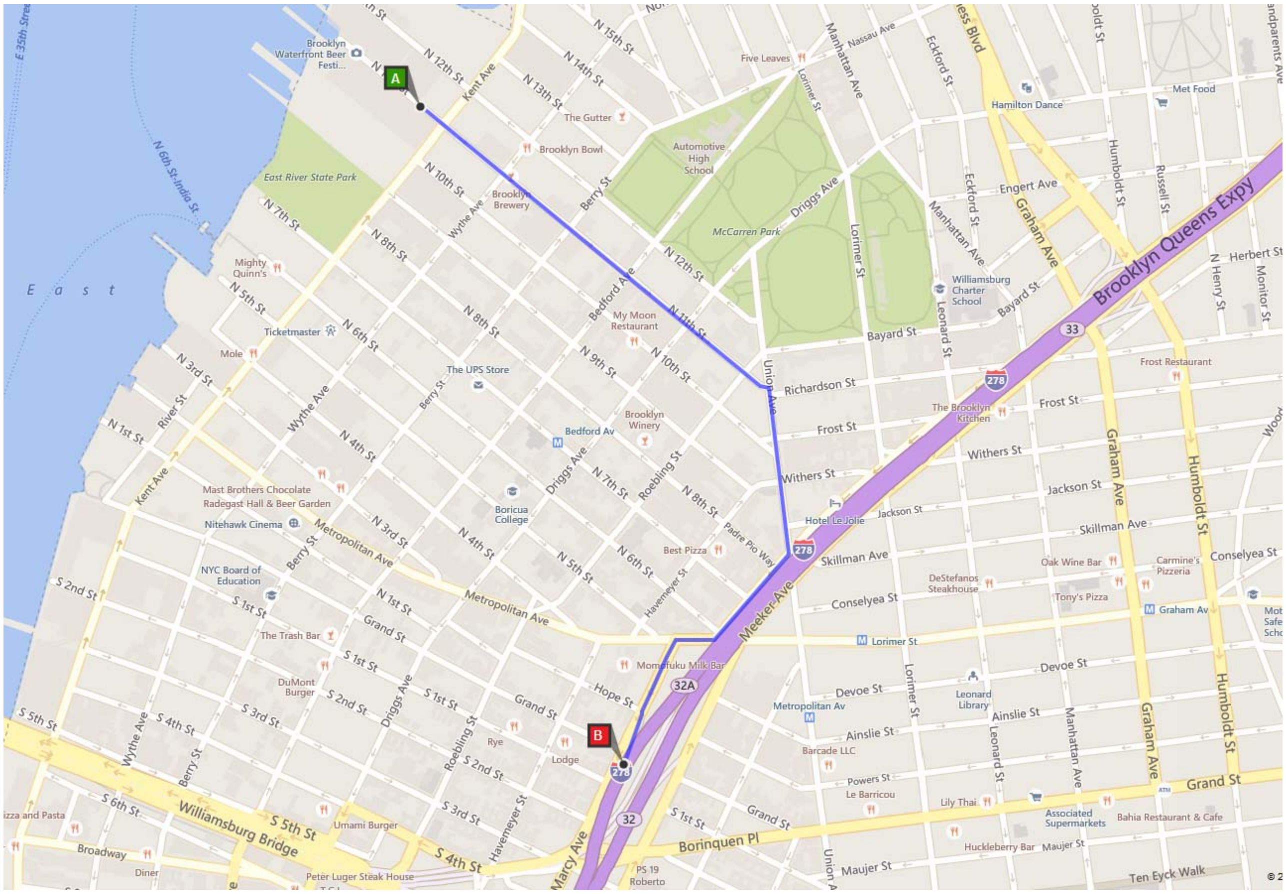


Figure 4: Site to I-278 West – Recommended Route

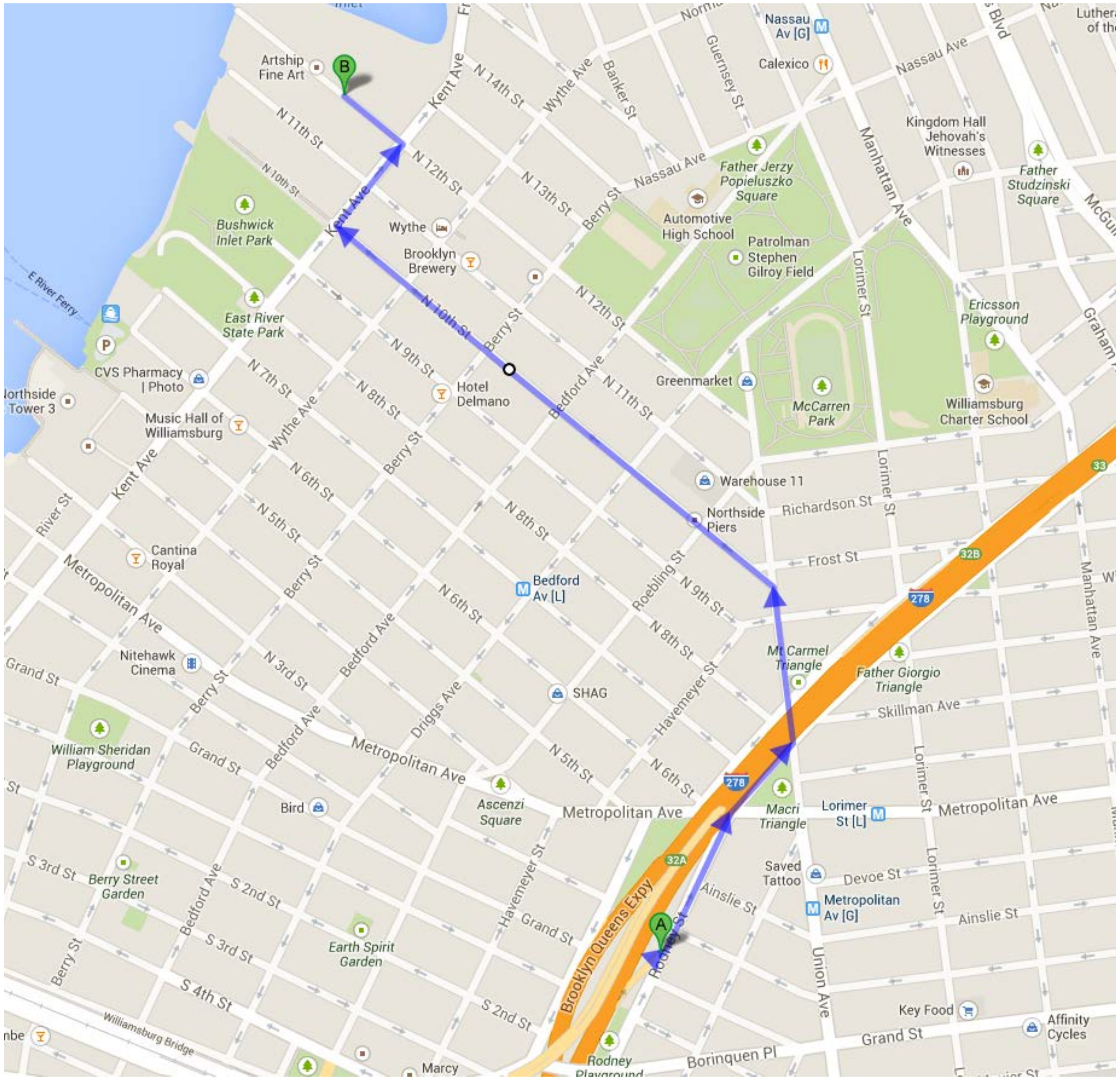


Figure 5: I-278 East to Site – Recommended Route

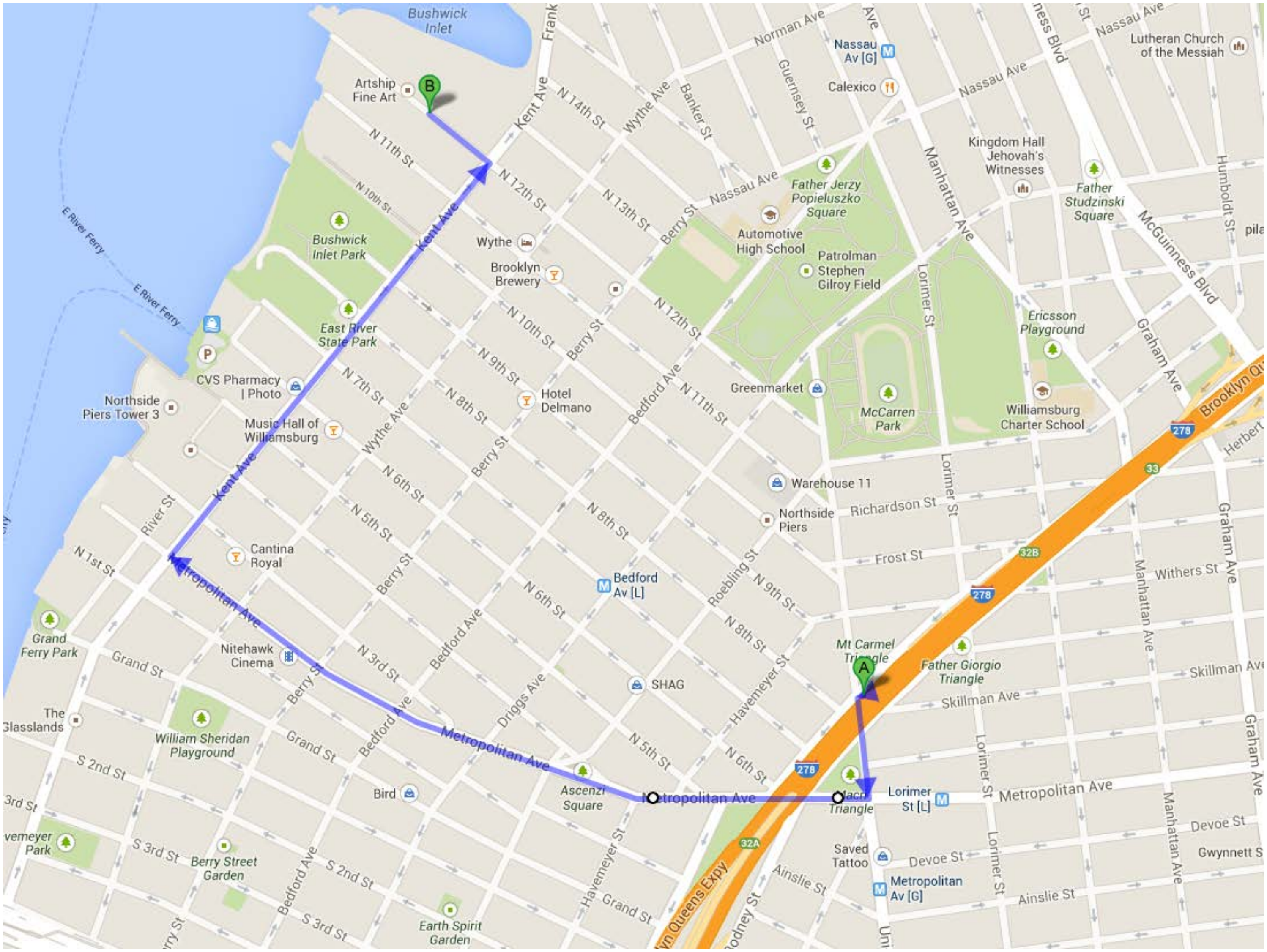


Figure 6: I-278 West to Site – Recommended Route

APPENDIX D

COMMUNITY ENVIRONMENTAL RESPONSE PLAN

APPENDIX D

**COMMUNITY AND ENVIRONMENTAL RESPONSE PLAN
FOR INTERIM REMEDIAL MEASURE**

**50 KENT AVENUE PROPERTY HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK**

Prepared for:

**National Grid
One Metrotech Center
Brooklyn, New York 11201**

Prepared by:

**URS Corporation
257 West Genesee Street
Suite 400
Buffalo, New York 14202**

June, 2015

TABLE OF CONTENTS

Page No.

TABLES

FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
BOD	Basis of Design
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAMP	Community Air Monitoring Program
CPP	Citizen Participation Plan
dBA	decibel(s)
HASP	Health and Safety Plan
ips	inches per second
IRM	Interim Remedial Measure
MGP	manufactured gas plant
NAPL	non-aqueous phase liquid
NYCDPR	New York City Department of Parks and Recreation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAHs	polycyclic aromatic hydrocarbons
PEC	Project Emergency Coordinator
PELs	Permissible Exposure Limits
PPV	peak particle velocity
RDWP	Remedial Design Work Plan
SHSO	Site Health and Safety Officer
VMS	vapor management system
VOC	volatile organic compound(s)

1.0 INTRODUCTION

National Grid has prepared this Community and Environmental Response Plan (CERP) to summarize the controls, monitoring, and work practices that will be implemented during the interim remedial measures (IRM) at the 50 Kent Avenue property ("the Site" or the "Holder Area") of the former Williamsburg Works manufactured gas plant (MGP), which was located in the Williamsburg neighborhood of Brooklyn, New York. The CERP addresses the potential for short-term impacts to the surrounding community or environmental resources.

The CERP is a concise summary of the controls, monitoring, and work practices, and how they combine to provide the necessary protection of the community and ecological resources. Additional details regarding how these controls will be implemented are contained in the project's Design Package. The purpose of the CERP is to provide members of the community with information on the steps and programs that have been put in place in order to protect their health and minimize the disturbance caused by construction activity.

The IRM will be performed under the approval and oversight of the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH). This CERP has been prepared in accordance with NYSDEC Final DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010.

1.1 Site Location and Description

The former Williamsburg Works MGP is located on land which is now divided into four separate properties. These properties are 2 North 11th Street, 20 North 12th Street, 35 Kent Avenue, and 50 Kent Avenue, and they are generally situated west of Kent Avenue between North 12th and North 11th Streets and the East River. The exception is the 35 Kent Avenue property, which is located east of Kent Avenue. The planned IRM addresses solely the 50 Kent Avenue component of the former MGP. This component is at Block 2287, Lot 1 and, in addition to gas holders, was the location for toluol recovery operations, purifying operations, and condensers The 50 Kent Avenue property is bordered by North 12th Street to the northeast, Kent Avenue to the southeast, North 11th Street to the southwest, and Block 2287, Lot 16 to the northwest. (Figure 1). The Site is owned by the New York City Department of Parks and Recreation (NYCDPR)

The Site and surrounding area are generally flat with the ground surface gently sloping to the East River to the northwest. The Site is currently paved and is secured with a perimeter fence. There are no permanent aboveground structures on the Site.

1.2 Project Description

The IRM includes the excavation of shallow soils throughout the Site (with the exception of a 55-foot no-excavation area along the northwestern portion of the Site) and the deep (to 30 feet below ground surface) excavation of the soils encompassing two of the former gas holder tanks and foundations (Figure 2)

The primary organizations involved with the project are National Grid (Owner), NYSDEC, NYSDOH, NYCDPR, the Design Engineer (URS Corporation), the Construction Manager (de maximis, inc.), the Air Monitoring Consultant (to be determined), the Noise and Vibration Monitoring Consultant (to be determined), and the Contractor (to be determined). The authority and responsibilities of these organizations are summarized below.

- National Grid is responsible for the design, construction, and maintenance of the project and has the authority to select the organizations involved with the project.
- NYSDEC is the lead regulatory agency and will review and approve the 100% Design Plan for the IRM. NYSDEC will also provide oversight during construction activities and has the authority to review project documentation after construction.
- NYSDOH will review the project's plans and construction monitoring data to determine compliance with regulations and policies for the protection of public health.
- The Design Engineer has been hired by National Grid and will be the Engineer of Record (Engineer), which is responsible for ensuring that the IRM is implemented as designed.
- The Construction Manager has been hired by National Grid and will assist as a liaison between National Grid and the regulatory agencies, will review and approve Contractor proposals and submittals, will oversee construction progress and quality control activities, and will manage construction meetings.

- The Air Monitoring Consultant will be hired by National Grid to install, operate, and report the results of a Community Air Monitoring Program (CAMP) that will be implemented during remedial construction activities.
- The Vibration, Movement, and Noise Monitoring Consultant will be hired by National Grid to install, operate, and report the results of a noise and vibration monitoring plan that will be implemented during remedial construction activities.
- The Contractor will be hired by National Grid to implement the IRM in accordance with the design criteria, plans, and specifications.

2.0 PUBLIC COMMUNICATION AND OUTREACH

2.1 Citizen Participation Plan

A Citizen Participation Plan (CPP) has been established for the Site IRM to inform and involve community residents, public and private leaders, and other stakeholders about the IRM at the Site. The CPP outlines a variety of communication methods that are based on NYSDEC regulations and guidance to provide constructive communication among project stakeholders and other interested parties. Project management contacts are listed in Table 1. Affected and/or interested parties are listed in Table 2.

Goals of the CPP include:

- Communicating goals, major milestones, actions, and outcomes of the IRM.
- Informing citizens and others of on-going project activities, status, and progress.
- Providing stakeholders a forum for input and comment.
- Facilitating a public understanding of Site contaminants, their potential exposure pathways to human health and the environment, and appropriate plans to mitigate any potential exposure pathways.

The following actions are taken to achieve the CPP goals:

- Consistently communicate goals, accomplishments, and the status of the IRM to community leaders, public officials, and the community.
- Establish, maintain, update, and utilize contact lists.
- Educate the community about the nature and magnitude of potential Site risks including instructions for mitigating risk (if appropriate) and assurances that the environment and worker/public health and safety are protected.
- Provide interested parties the opportunity to review and comment on technical reports generated through the remedial program.
- Provide interested parties the opportunity to present opinions and ideas during the remedial program.
- Provide responses for public review and comment.
- Provide the news media with interviews or press releases to ensure accurate coverage of the IRM.

- Provide a designated project spokesperson as a point of contact through which community inquiries can be addressed.
- Periodically review the effectiveness of the CPP activities and make adjustments the in the methods or activities, if necessary.

The following repositories have been established to make project-related documents available for community reference and review.

Williamsburg Branch
Brooklyn Public Library
240 Division Avenue
Brooklyn, NY 11211
Telephone: 718-302-3485

Brooklyn Community Board 1
435 Graham Avenue
Brooklyn, NY 11211
718-389-0009
District Manager:
Gerald A. Esposito

NYSDEC
625 Broadway, 11th Floor
Albany, NY 12233-7014
Telephone: 800-402- 9564

2.2 Regulatory Agency Contact Information

NYSDEC
Henry Willems
Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7014
(518) 402-9564

NYSDOH
Bridget Boyd
Bureau of Environmental Exposure Investigation
Corning Tower
Empire State Plaza
Albany, NY 12237
(518) 402-7860

2.3 Public Meetings

Public meetings are held at critical milestones of the remedial program to inform the public and discuss comments on the proposed remedial plans and results. NYSDEC mailings are used to notify the public about the scheduled meetings. In addition, legal notices of the meetings are published in the local newspapers to solicit comments and questions from interested parties. During the meetings, the NYSDEC, NYSDOH, and National Grid summarize project activities and results and answer questions about the project. Public questions, comments, and concerns voiced during the public meetings and comment period are collected and addressed by the NYSDEC. Responses are published in a Responsiveness Summary.

2.4 Information Newsletters

Information newsletters are prepared and distributed to announce major project milestones and accomplishments of the IRM.

2.5 Telephone Hotline

National Grid maintains a telephone hotline (718-403-3053) that can be used by local residents, project stakeholders and other interested parties to provide questions or comments. The hotline also provides updates in the Site IRM.

2.6 Project Website

National Grid maintains a website (**www.williamsburgmgpsite.com**) that provides descriptions of the Site and remedial activities, project updates, and key project documents.

2.7 Emergency Contacts

Emergency contacts for the project are presented in Table 3.

3.0 COMMUNITY AIR MONITORING PLAN

Community air monitoring will be performed to measure, document, and respond to potential airborne contaminants during significant ground intrusive activities associated with the IRM and will be performed in accordance with the approved CAMP. The community air monitoring program will include monitoring of airborne contaminants at the Site perimeter and will compliment work zone monitoring that will be conducted in accordance with the Contractor's HASP, which will be implemented to protect Site workers and visitors.

The CAMP will be based upon guidelines established by the NYSDOH in the NYSDEC *DER-10 Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC, 2010). The CAMP will include monitoring procedures, alert limits, action limits, and contingency measures if action limits are approached. An alert limit is a contaminant concentration or odor intensity that will serve as a screening mechanism to trigger contingent measures, if necessary, to assist in minimizing offsite transport of contaminants and odors during remedial activities. An action limit is a contaminant concentration or odor intensity that triggers work stoppage.

The objectives of the CAMP are as follows:

- Provide an early warning system to alert National Grid that concentrations of VOCs or respirable particulate in ambient air are approaching action levels due to Site activities.
- Provide details for a Site contingency plan that is designed to reduce the off-Site migration of contaminants/odors if established action limits are approached or exceeded.
- Determine whether construction controls are effective in reducing ambient air concentrations to below action limits and make appropriate and necessary adjustments.
- Develop a permanent record that includes a database of perimeter air monitoring results and meteorological conditions, equipment maintenance, calibration records, and other pertinent information.

During times of ground intrusive activities, fence line perimeter air monitoring will be conducted using a combination of real-time air monitoring at fixed (24 hours a day/7 days a week) and portable stations. Contaminants that will be monitored include VOCs, and respirable particulates. Relative odor intensity will also be monitored using American Society for Testing

Materials (ASTM) method E544. A contingency plan included in the CAMP defines the alert levels, action levels, and specific response activities to be implemented during working hours if an exceedance of an alert limit or action limit occurs. The response actions are intended to prevent or significantly reduce the migration of airborne contaminants from the Site. The CAMP also specifies data management and analysis procedures.

4.0 PUBLIC PROTECTION MEASURES

4.1 Working Hours

Intrusive work activities will be limited to those allowed by the New York City Noise Code (7:00 AM to 6:00 PM). The Contractor will be required to notify National Grid and/or the Construction Manager, at least one week in advance, if a change from the normal working hours is required.

4.2 Stabilized Construction Entrance

Existing paved entrance/exits are located off of 11th Street and 12th Street. However, these will not be usable during construction because of the proximity of the deep excavation zone. A new entrance will be established on 12th Street and a new exit will be established on 11th Street. The construction exit will be covered with coarse aggregate to clean truck tires prior to exiting the Site. The construction exit will be inspected and redressed as needed while in use. Trucks will be inspected prior to exiting the Site to ensure contamination is not migrating onto off-site roadways via truck tires. A vehicle decontamination pad will be constructed at the exit to decontaminate trucks and equipment as needed. Truck routes on and off Site will be monitored for excessive dirt or dust. Proper cleaning of trucks exiting the Site will aid in minimizing dusty conditions on roadways. A water truck will be used on Site to wet down on and off-Site travel routes.

5.0 DUST AND ODOR CONTROL

Dust and odor control measures will be implemented to minimize the potential for dust generation and odors during soil excavation and handling and the placement of fill. During shallow soil excavation, odor will be controlled through the use of foam, and dust will be controlled through the application of water and foam. During deep excavation, where greater amounts of coal tar are expected to be encountered, a temporary enclosure and a vapor management system (VMS) will serve as the primary odor and dust control measure.

Other dust and odor controls may also be implemented as directed by National Grid and/or NYSDEC.

5.1 Dust

The frequently traveled vehicle routes at the Site will be wet down with a water truck to minimize dust emissions. Vehicle routes on Site will be continuously monitored for excessive dirt or dust. Proper cleaning of trucks exiting the Site will aid in minimizing/eliminating dusty conditions. Stabilized construction entrances/exits will be constructed at exit points to clean tires of trucks exiting the Site. The entrances/exits will be maintained and redressed while in use.

Truck routes on and off Site will be inspected during high truck traffic periods for excessive dirt or dust. Trucks exiting the Site will pass through an inspection area and/or be inspected to ensure tires and undercarriages are clean and that tarps are secured. Excessive mud and loose dirt observed on the trucks will be manually removed with brooms and brushes as necessary.

Perimeter and work zone air monitoring will be performed in accordance with the CAMP to evaluate the effectiveness of dust control measures. In general, real time air monitoring equipment will be used to monitor dust and volatile organic compound (VOC) levels. If visible dust is generated or work zone and/or perimeter air monitoring results show exceedences, corrective action measures will be implemented. Corrective action measures may include increasing water coverage, ceasing select activities during high wind, reducing speed of equipment that may reduce dust generation, and utilizing different sizes or types of equipment that may cause less dust generation.

5.2 Odor

Odor will be monitored and controlled during significant intrusive activities such as the excavation and handling of MGP contaminated soils, and deep soil mixing. Odor will be controlled by sequencing the operations in a manner that will result in manageable areas. Odor controls will further include the use of foam and foaming devices or tarps to cover open excavations or stockpiles. The odor reducing foam will be applied to excavation areas if MGP odors are detected above alert levels that are established in the CAMP. Contingency monitoring and actions will be implemented in the event an odor complaint is received from the neighboring community.

6.0 CONSTRUCTION NOISE MITIGATION

Activity at the Site will comply with the New York City Noise Code (Local Law 113 of 2005). The noise code prohibits noise that exceeds the ambient sounds level by more than 10 decibels as measured from 15 feet from the source as measured from inside any property or on a public street. The contractor will be required to prepare and follow a noise mitigation plan to comply with the code. The code restricts construction operation to between 7:00 AM and 6:00 PM on weekdays. Work may take place after hours and on weekends only with express authorization from the New York City Departments of Buildings and Transportation.

The NYSDEC has published a policy and guidance document titled Assessing and Mitigating Noise Impacts (NYSDEC, 2001). This document provides guidance on when noise due to projects has the potential for adverse impacts and requires review and possible mitigation in the absence of local regulations. The NYSDEC guidance indicates that it should not supersede local noise ordinances or regulations. The guidance indicates that a noise increase of 10 decibels (dBA) deserves consideration of avoidance and mitigation measures in many cases.

Background noise in the vicinity of the Site area within the local community is predominantly from vehicular traffic (heavy vehicular traffic, cars, trucks and buses idling, automobile acceleration, loud mufflers, car horns, loud car stereos, car alarms, brakes squealing, ambulance/police sirens, etc.). Noise influences from off-site commercial shops and facilities, and people talking are also present at the Site area.

Noise will be monitored in accordance with the Vibration, Movement, and Noise Monitoring Plan (URS 2015).

7.0 VIBRATION AND MOVEMENT MONITORING

Structures will be monitored for movement during construction to determine whether vibration or ground settlement is impacting the structures. Vibration and movement monitoring will be conducted in accordance with the Vibration, Movement, and Noise Monitoring Plan (URS 2015). A summary of the vibration and movement monitoring components of this plan are presented below.

7.1 Scope of Monitoring

Monitoring will be performed for both vibration and movement. Structures located near the Site will be subject to a pre- and post-construction survey, to document their condition before and after the remedial construction. If an access agreement is already in place, the vibration monitoring points will be placed as close as practicable to the existing structures. For properties where an access agreement has not been negotiated, the vibration monitoring points will be placed near the property line of the potentially affected property.

The following structures are located within 90 feet of the limits of proposed construction near the Site which will be monitored for any impacts resulting from construction activities:

- One story garage/storage building (Block 2277, Lot 1, north of the Site and north of N. 12th St. – approx. 75 feet away from deep excavation activities)
- Three story commercial building (Block 2295, Lot 107, southeast of the site, diagonally across the intersection of 11th St. and Kent Ave. – approx. 90 feet away from the site and approx. 175 feet away from deep excavation activities).
- Two story warehouse building (Block 2294 Lot 1, south of the Site - 60 feet away from deep excavation activities)
- One story warehouse building (Block 2288 Lot 1, east of the Site – approx. 60 feet away from the Site and approx. 160 feet away from deep excavation activities)

7.2 Baseline Vibration Monitoring

A pre-construction vibration survey was performed during the 2012 predesign investigation. Measurements were taken of the longitudinal component (L) (measurement in a direct line from the source to the monitoring location), and vertical (V) and transverse (T) components (both perpendicular to the longitudinal component). The results of this survey are shown in the following table.

Geophone Location	Measured Peak Particle Velocity (in/sec)	Percent of Measured Frequency		
		< 20 Hz	20-40 Hz	> 40 Hz
Location #1 20 N. 12th Street Block 2287 - Southwest Corner	0.020 (L)	0 .00% (L)	0 .00% (L)	100% (L)
	0.015 (T)	0.04% (T)	0.05% (T)	99.91% (T)
	0.040 (V)	0.06% (V)	0.29% (V)	99.65% (V)
Location #2 Block 2294 Lot 1 North Side of Building	0.040 (L)	0.03% (L)	0.28% (L)	99.69% (L)
	0.020 (T)	0.29% (T)	0.55% (T)	99.16% (T)
	0.055 (V)	0.00% (V)	0.09% (V)	99.91% (V)
Location #3 51 Kent Avenue North Corner	0.085 (L)	0.01% (L)	0.02% (L)	99.97% (L)
	0.040 (T)	0.04% (T)	0.22% (T)	99.74% (T)
	0.090 (V)	0.03% (V)	0.09%(V)	99.88% (V)
Location #4 35 Kent Avenue Block 2288 Lot 1 - North Corner	0.015 (L)	0.00% (L)	0.01% (L)	99.99% (L)
	0.030 (T)	59.46% (T)	12.49% (T)	28.05% (T)
	0.080 (V)	6.96% (V)	30.74% (V)	62.30% (V)
Location #5 Block 2277 Lot 1 7 feet South of Building	0.025 (L)	0.01% (L)	0.03% (L)	99.96% (L)
	0.015 (T)	0.00%(T)	0.01% (T)	99.99% (T)
	0.060 (V)	0.01% (V)	0.03% (V)	99.96% (V)
Location #6 20 N. 12th Street Block 2287 - Northeast Corner	0.035 (L)	0.00% (L)	0.00% (L)	100% (L)
	0.045 (T)	0.00% (T)	0.00% (T)	100% (T)
	0.100(V)	0.00% (V)	0.00% (V)	100% (V)

Pre-construction vibration conditions will be confirmed through monitoring for a week prior to the initiation of any activity at the Site. The vibration monitors will record the vector sum of the wave velocity in inches per second. The objective of the vibration survey is to corroborate previous measurements of baseline ground motions caused by vehicular traffic (buses, cars, trucks, and other vibration sources) near the sensitive structures selected surrounding the Site. These vibration levels will be compared to vibrations induced during construction and may be used to revise threshold limitations for vibration induced damage.

7.3 Existing Structures Condition Survey

An existing condition survey of the surrounding buildings and structures will be performed prior to construction as detailed in Section 8.0. Pre-construction surveys will include inspecting building foundations, exterior, and interior elements and documenting any pre-existing defects such as cracks, settlement, subsidence, corrosion, or water damage. Defects that should be monitored during construction will be noted and, where appropriate crack monitors installed prior to the start of construction. The surveys will be documented through notes and photography to establish the pre-construction conditions. At the end of construction, a similar set of photos will be taken for comparison. Post-construction photographs will be compared with the initial pre-construction photographs to establish the growth of any pre-existing crack or the onset of any new cracks.

7.4 Vibration Monitoring

At each vibration monitoring location, the peak vibration levels from the construction equipment and trucks will be measured during construction activities. The following construction activities are currently proposed as part of the remedial activity:

- Equipment mobilization;
- Mobilization and demobilization of temporary fabric structure (s);
- In-Situ Solidification of Holder No. 2
- Cement Bentonite (CB) Slurry Wall and sheetpile installation;
- Dewatering; and,
- Subsurface structure demolition activities, soil excavation, shipment, and soil compaction

The vibration monitoring plan consists of performing vibration monitoring of construction activities, evaluating it daily and preparing weekly summary reports of the vibration readings. The vibration monitoring plan includes:

- A layout for the vibration monitoring equipment and a schedule for vibration monitoring. The equipment layout will involve placing monitoring units equipped with geophones capable of triaxial displacement measurements next to buildings and/or structures adjacent to the construction areas. The monitoring units will be installed and secured at locations where firm subgrade is exposed. The layout and schedule will depend on the contractor's proposed construction sequence.

- Performing continuous vibration monitoring during each of the construction activities to adequately document the ground-borne vibration from the construction activities. PPV limits will be developed that will be used as "warning action limits" and "stop work action limits". These limits will be used as threshold values for the vibration mitigation plan during the construction activities. Vibration levels will be monitored to detect construction operations that cause vibrations above the recommended vibration action limits.
- The vibration monitoring will be performed continuously from the start to end of each construction work shift. Data recording will commence prior to the start of each shift. At the end of each shift, data collected will be downloaded, reviewed and a summary report will be submitted.
- If the vibration "warning action limit", which may be revised after pre-construction survey is completed, is exceeded, the situation will be reviewed and the cause of the vibration will be identified. A corrective action plan will be formulated, implemented and monitored. If the vibration "stop work action limit" is exceeded or abnormal monitoring data is recorded, work should stop to allow for review of the vibration data. In the event that the vibrations exceed the stop work action limit, the monitoring units will set off an alarm that will signal for the stop of construction work. The causes of vibration will be investigated and vibration mitigation procedures can then be reviewed and implemented as needed before work proceeds. Additional monitoring units might be required to further mitigate excessive vibrations.
- At the end of construction, the data will be summarized in a report. Summary tables of the peak particle velocities recorded, and histogram plots for the vibration monitoring data will be included in this summary memo.

Two vibration thresholds will be observed during the IRM. The first threshold ("warning threshold") will be triggered if vibration levels equal or exceed 0.5 inch per second (ips) peak particle velocity (PPV) in proximity to adjacent structures. Exceedance of this threshold during the IRM will trigger a review of Site construction practices in order to identify potential causes and evaluate modifications to those practices.

The second threshold level ("stop work") will be triggered if vibration levels exceed 2.0 ips in proximity to adjacent structures. Exceedance of this threshold during the IRM will result in a temporary suspension of work in the area of the affected structure(s). The structure(s) will then be evaluated for potential structural impacts and mitigative measures will be considered based on the nature and extent of the impact. Also, once the vibration-causing activities are halted, a portable vibration monitor will be installed directly on the affected structure and the activity temporarily resumed. If vibration levels remain below the maximum vibration limit then operations may be continued. If vibration levels continue to exceed the maximum vibration limit then modifications to the procedures and/or equipment will be implemented until the vibration levels are at or below the acceptable range.

7.5 Movement Monitoring

Movement monitoring will be conducted for surrounding buildings and the excavation wall during construction. Vertical and horizontal movement monitoring conducted will include optical survey marks set at the first floor and roof on the exterior wall, and on top of the excavation wall. The movement shall be measured using a conventional or digital surveyors' level. Initial monitoring of each movement point shall start within 24 hours of CB Slurry wall installation and shallow excavation to obtain a baseline and then when the excavation occurs as described below. The instrument reading schedule for the movement points shall be:

- Three initial sets of readings prior to any site excavation.
- Daily when CB Slurry wall installation is within 100 feet of the movement point, but not less than 3 sets of readings after the initial 3 sets.
- Weekly when CB Slurry wall installation is greater than 100 feet away from the movement point and/or excavating within 100 feet of the movement point.
- Increase frequency of readings where action limits are reached.
- Monthly after completion of backfilling or until measurements remain stable over three consecutive readings.
- Concurrence to stop monitoring must be obtained from the Engineer in writing.

Additional movement points may be installed if required by the Engineer.

7.6 Exceedance and Mitigation

Detailed review and interpretation of all geotechnical and structural monitoring data will be made in order to determine whether vibrations or settlement have reached an action limit.

In the event that a "Warning Action Limit" is reached:

- The Contractor must meet with the Project Team to discuss the need for mitigation actions;
- The Engineer will prepare a plan of action for the activity or activities responsible for the exceedance;
- If directed by the Engineer or the Construction Manager, the Contractor must implement the plan of action within 24 hours of submittal of the plan of action so that the “Stop Work Action Limit” is not reached; and
- The monitoring frequency of the affected instrument will be increased and additional instruments installed if necessary.

In the event that a “Stop Work Action Limit” is reached:

- The Contractor must cease all construction activities and meet with the Project Team to discuss the need for mitigation actions;
- The Engineer will prepare a plan of action for the activity or activities responsible for the exceedance;
- If directed by the Engineer or the Construction Manager, the Contractor must implement the plan of action within 12 hours of submittal of the plan of action so that the “Stop Work Action Limit” is not exceeded further; and
- Install additional instrumentation if necessary.

8.0 PRE AND POST-CONSTRUCTION SURVEY PROGRAM

Structures such as warehouses and businesses that are nearby may be contacted by National Grid to arrange for a pre- and post-construction survey of their property.

A pre-construction survey is conducted by a third party consultant of the Engineer and/or National Grid. The goal is to document the condition of the property and any structures that are on it prior to the start of work on the Site. A survey of this nature is typically conducted on the interior and exterior portion of the structures on a property and can be completed on the order of a few hours, depending on the size and number of the structures to be inspected. Still photos or video recordings may be taken in some places to document pre-existing damage to structures.

A post-construction survey is similar to a pre-construction survey, but is conducted after the completion of work at the Site. It is performed to document the condition of structures after the work to serve as a record for damages caused, if any, by the nearby construction.

An individual report will be sent to each property owner containing the findings of any pre-construction or post-construction surveys conducted on their structures. Copies of the pre- and post-construction survey results are kept by National Grid, and can be used as evidence in the event of claims of damage to structures caused by construction-related activities. Likewise the survey results can also be used to defend the Contractor against false damage claims.

9.0 SITE SECURITY

The Contractor will control access to the Site and maintain continuous, 24-hour, seven (7) days per week, Site security. All visitors, workers and subcontractors will be required to sign a daily log maintained by the Contractor. The log will include date, name of visitor, company, address, and time on and off-Site. The Site will be secured at day's end and gates will be locked during non-working hours. Keys to the Site will be provided to National Grid and the Construction Manager. The presence of unauthorized personnel will be immediately communicated to National Grid and the Construction Manager and appropriate actions will be taken as directed.

The Contractor will develop a Site Security Program that will establish the means and methods for managing the overall security of the Site after hours. The Contractor will use a subcontracted security company to provide manned Site security for 24-hours, seven (7) days per week.

The Contractor will provide an area designated for security operations. This area may be part of the Contractor's offices, or a separate enclosure and will contain, as a minimum, a designated phone line and two-way radios, if more than one guard or attendant is utilized. The Contractor may install additional security fencing for localized security measures with approval by National Grid and/or the Construction Manager.

The following security controls will be implemented during both working and non-working hours:

- One independent telephone line and telephone will be provided.
- Control of all persons, equipment, and vehicles entering and leaving the Site will be provided by the Contractor in coordination with National Grid's requirements.
- The Contractor will maintain a list of persons authorized for Site entry.
- The Contractor will require all personnel and visitors having access to the Site to sign in and sign out, and will keep a record of all Site access. A log of all visitors will be maintained in coordination with National Grid's existing security requirements.
- Site visitors will not be permitted to enter active work areas unless authorized by National Grid and/or the Construction Manager.

- Vehicular access will be restricted to authorized vehicles only. National Grid and/or the Construction Manager will reserve the right to search all Contractor vehicles.
- The perimeter of the Site and North 12th Street will be secured and locked and maintained during hours of non-production. Perimeter security checks will be performed hourly and conditions will be logged.
- Any perimeter fence that will be removed or modified to allow for construction activities to occur will be temporarily replaced with fence panels and all connections will be bolted together. Anchors may also be utilized along with privacy screening fabric.

In the event of forced entry, trespass and/or vandalism to the Site, security personnel will notify the Contractor and engage the local police and law enforcement. Signs of forced entry (successful or otherwise), trespass and/or vandalism will be investigated to fully understand the circumstance by which the event happened. Law enforcement will be engaged as needed to ensure that the proper attention and notifications are provided.

At no time will the security personnel have the capacity to use firearms, restraint tools (electrical shock devices, nets, etc.), or any weaponry associated with criminal intervention. Damage to property resulting from forced entry will be repaired as soon as possible by the Contractor.

10.0 EROSION AND SEDIMENT CONTROL MEASURES

The soil erosion and sediment control plan is intended to minimize soil erosion, and control storm water, on the Site.

10.1 Implementation of Erosion Control Measures

The Contractor will install and maintain the following erosion control measures for the duration of the excavation work. Additional erosion control measures may be needed due to events beyond the control of National Grid. The Contractor will install any additional measures necessary to prevent erosion as directed by National Grid.

- Hay Bales: Hay Bales will be installed along the perimeter of work areas as shown on the contract drawings.
- Silt Fence: Silt Fence may be used in place of hay bales and for erosion and sediment control after placement of final cover.
- Stabilized Construction Entrance: The Site entrance and exit will be equipped with a construction entrance; a stabilized pad of aggregate which reduces or eliminates the tracking of sediment onto public streets.
- Decontamination Pad: The Site exit will be equipped with a decontamination pad, where trucks exiting the Site can be washed, removing contaminants and dirt from trucks before they exit the Site and travel on public roadways. Truck wash water is collected within the decontamination pad sump and treated by the onsite water pre-treatment plant.

10.2 Stormwater Runoff Control

The work does not meet the substantive requirements of a State Pollution Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity (GP-0-15-002). Erosion will be prevented and sediment will be controlled during all on-site earthwork activities in accordance with the applicable New York State guidance. Stormwater run-off will be controlled to prevent contact with impacted soils. Any stormwater that does contact impacted soils will be diverted to the onsite water pre-treatment plant. Hay bales and silt fence will be used as necessary to prevent erosion of exposed soils.

On-site decontamination pads will be used to remove mud from truck tires and prevent tracking of mud and impacted soil onto the streets. Drawings and specifications for erosion and sediment control are provided in the Design Package.

11.0 WASTE MANAGEMENT

This section identifies the procedures for managing, treatment, and disposal of waste materials generated as a result of the IRM. All wastes removed from the Site will be transported from the Site by properly permitted and/or licensed waste haulers directly to the National Grid-approved disposal facilities. All trucks will be inspected to ensure the proper placards, decals and permits are displayed. Trucks will utilize the approved truck route through Brooklyn and then the most direct hauling route to the disposal facility as indicated in Section 12.

Impacted soils and other materials removed from the excavation will be directly loaded into trucks for shipment for the approved treatment facility. Impacted soils and other materials will be stock-piled on-site and covered as per the Specifications when direct loading is not possible. Trucks will not be allowed to stage on local roadways, however staging will be allowed on the closed portion of North 12th Street. The Contractor will schedule trucks in a manner that will minimize the wait time for loading.

Vehicles containing excavated materials will be covered with a solid plastic tarp. If necessary, spray-on odor suppressing materials such as Rusmar Foam may be used to reduce potential VOC emissions or odors during transit.

The impacted materials will be shipped to a thermal desorption treatment facility. At the facility the impacted soils are placed in a rotary kiln that heats the soil which volatilizes the organic contaminants in the soil. The contaminant laden vapors are then collected and treated at the facility. The treated soil is then re-used for beneficial uses such as cover materials at landfills or as aggregate for asphalt or concrete.

12.0 WATER MANAGEMENT AND TREATMENT MEASURES

Extracted groundwater and other wastewater generated during remediation will be managed by on on-site pretreatment system

The wastewater will first be filtered using bag filters. The filters will serve two purposes. One is to extend the life of downstream carbon adsorbers by preventing solids in the water from clogging the units. The second purpose is that the fine sediment and suspended particles in the water often also contain a significant amount of adsorbed contamination. By removing the solids, it is expected that the contaminant concentrations in the groundwater will be decreased. Due to the temporary nature of the discharge, a simple filter-bag type unit (as opposed to a media type unit such as a sand filter) is proposed.

Subsequently, activated carbon will be used to remove hydrocarbons and other organics detected in the groundwater. The contaminated water will be pumped through the carbon unit, where the contaminants have an affinity to adsorb onto the surface of the carbon particles. Aqueous phase carbon adsorption units are well suited to the temporary construction-type environment proposed for the Site.

It is possible that NAPL could be present in the subsurface and that some NAPL could be extracted during dewatering operations. These NAPLs may or may not be related to holder operations as there are known on-site and adjacent off-site contaminant sources, including non-MGP contaminant sources. Consequently, the Contractor will be required to include an oil/water separator in the treatment system and/or skimmers in tanks to remove NAPL prior to discharge, for when NAPL is extracted during excavation dewatering.

In addition to filters, carbon units, and NAPL removal, the treatment system will include the following:

- A primary settling tank(s) to remove all easily settleable solids from water extracted from the excavation area.
- A storage tank(s) for the retention and storage of water to allow flexibility in treatment operations.

- Pumps to transfer extracted water between the different treatment system components.
- Instrumentation (e.g. flow meters, pressure gauges, alarms, etc.) as required to operate the system efficiently and safely.

The Contractor will be responsible for operation and maintenance of the system that will include, but not be limited, to the following:

- Replacement of filter bags, activated carbon, and other expendables as required.
- Cleaning of all equipment prior to transporting off-site.
- Disposal or recycling of residuals resulting from treatment (e.g. solids, carbon, etc.).

Treated water would be discharged to the 18-inch combined sewer running under Kent Ave. This sewer flows to the Newtown Creek Water Treatment Control Facility, a Publicly Owned Treatment Works (POTW). The contractor will be required to obtain a permit to discharge from the New York City Department of Environmental Protection (NYCDEP) Bureau of Wastewater Treatment. Discharge to the New York City sewer system will require an authorization and sampling data demonstrating that the groundwater meets the City's discharge criteria.

13.0 TRANSPORTATION PLAN

13.1 Traffic Controls

The purpose for the Transportation Plan at the Site is to describe the objectives for traffic control and address any potential concerns. Pending approval from the New York City Department of Transportation, 12th Street will be closed to traffic from Kent Avenue to the East River during the IRM. Access to the Site will be from the closed portion of 12th Street. Traffic exiting the Site will exit onto 11th Street, which will remain open during construction, and then continue on to Kent Avenue.

The Contractor will provide traffic control personnel when all trucks are exiting the Site onto North 11th Street. Traffic control personnel will also direct traffic as needed upon delivery of equipment, trailers, excavation support materials, etc. Trucks will not be allowed to queue on local streets; however staging will be allowed on the closed portion of North 12th Street and possibly on the former Bayside Oil Terminal. All the roadways utilized by the Contractor during the work will be checked daily for spillage and seepage, and cleaned to the satisfaction of National Grid, as necessary.

All material hauled to and away from the Site will be performed by companies that are appropriately licensed to perform such work in the state of New York. Additionally, all truck drivers must read and sign a truck driver orientation training program.

Upon arrival to the Site, each truck will be visually inspected to ensure appropriate permits are in place. The truck will be initially lined with polypropylene plastic tarp along their beds to prevent water from seeping out of the soil onto local streets. When applicable, odorous truckloads of soil will be foamed to control odors. The trucks will also utilize a heavy tarp which will be extended over the cargo area and overlap the sides and rear of the cargo area to prevent soil being removed from the truck by wind. Before each vehicle leaves the Site it will pass through a decontamination station as described in subsection 4.2.

13.2 Transportation Route

Transport of materials to and from the Site will be limited to the following routes outlined in the Haul Routes Plan (URS 2015):

13.2.1 Site to I-278 Eastbound

Exit site on N 11th Street. Turn left onto Kent Avenue. Turn right onto Greenpoint Avenue. Continue on Greenpoint Avenue through the McGuinness Boulevard intersection. Continue on Greenpoint Avenue over the John Jay Byrne Bridge. Continue on Greenpoint Avenue. Turn right onto I-495 south ramp (at Exit 17W). This route leads to I-278 East or I-495 South. The route takes approximately 9 minutes to travel and is 2.9 miles long.

13.2.2 Site to I-278 Westbound

Exit site on N 11th Street. Go straight on 11th Street. Turn right onto Union Avenue. Turn right onto Meeker Avenue. Bear right onto Metropolitan Ave, and then immediately turn left onto Marcy Ave to enter I-278 West. This route takes approximately 6 minutes to travel and is 1.1 miles long.

13.2.3 I-278 Eastbound to the Site

The only exit on I-278 East leading to a truck route in the area is Exit 32.

Take Exit 32 onto Rodney Street. Rodney Street becomes Meeker Avenue. Turn left onto Union Avenue. Turn left onto N. 10th Street. At the end of N. 10th Street turn right onto Kent Avenue. Turn left onto N 12th Street to enter site. This route takes approximately 5 minutes to travel and is 1.1 miles long.

There are no other options for this route.

13.2.4 I-278 Westbound to the Site

The only exit on I-278 West leading to a truck route in the area is Exit 32B. This exit also has a posted restriction that trucks must turn left at the bottom of the exit and go to

Metropolitan Avenue (see Image 1), even though Union Avenue (northbound)is a valid local truck route. The option of turning right onto Rodney Street and then using Union Avenue was also considered; however, the geometry of the turn is not suitable for trucks.

Take Exit 32B. Turn left onto Union Avenue (southbound). Turn right onto Metropolitan Avenue. Continue on Metropolitan Avenue. Turn right onto Kent Avenue. Turn left onto N. 12th Street to enter site. This route takes approximately 6 minutes to travel and is 1.5 miles long. See Image 5 for a graphical view of this route.

There are no other options for this route.

14.0 REFERENCES

National Grid. March, 2009. *Citizen Participation Plan for the Former Manufactured Gas Plant at 2 North 11th Street; 20 and 21 North 12th Street and 35 Kent Avenue, Brooklyn, Kings County, NY*

NYSDEC. February, 2001. *Assessing and Mitigating Noise Impacts*

NYSDEC. May, 2010 *DER-10 Technical Guidance for Site Investigation and Remediation*

URS, 2015. *Haul Routes, Williamsburg Interim Remedial Measure, 50 Kent Avenue Property Holder Area, Brooklyn, New York*

URS, 2015. *Vibration and Settlement Monitoring Plan for Soil Excavation, Williamsburg Works Former Manufactured Gas Plant, Brooklyn, New York*

TABLES

**Table 1
Project Management Contacts**

New York State Department of Environmental Conservation

Henry Willems
Project Manager
NYSDEC, Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7017
(518) 402-9662

New York State Department of Health

Bridgett Boyd
Public Health Specialist
Bureau of Environmental Exposure Investigation
New York State Department of Health
Corning Tower
Empire State Plaza
Albany, NY 12237
518 402-7860

National Grid

April Dubison
Community Relations Representative
Fleet Services Building
287 Maspeth Ave
Brooklyn, NY 11211
Williamsburg Project Hotline Telephone – 718-403-3053

**Table 2
Affected and/or Interested Parties**

Local Government Representatives

City Council Member	Stephen Levin 410 Atlantic Ave. Brooklyn, NY 11217 (718) 875-5200 slevin@council.nyc.gov
Assemblyperson	Joseph Lentol 619 Lorimer Street Brooklyn, NY 11211 718-383-7474 lentolj@assembly.state.ny.us
State Senator	Daniel Squadron 250 Broadway, Suite 2011 New York, NY 10007 Tel: 212-298-5565
Congressional Representative	Carolyn Maloney 619 Lorimer Street Brooklyn, NY 11211 (718) 349-5972

Community Organizations

Community Board	Brooklyn Community Board #1 Dealice Fuller, Chair Gerald A. Esposito, District Manager 435 Graham Avenue Brooklyn, NY 11211 718-389-0009 bk01@cbnyc.gov

Local Newspapers

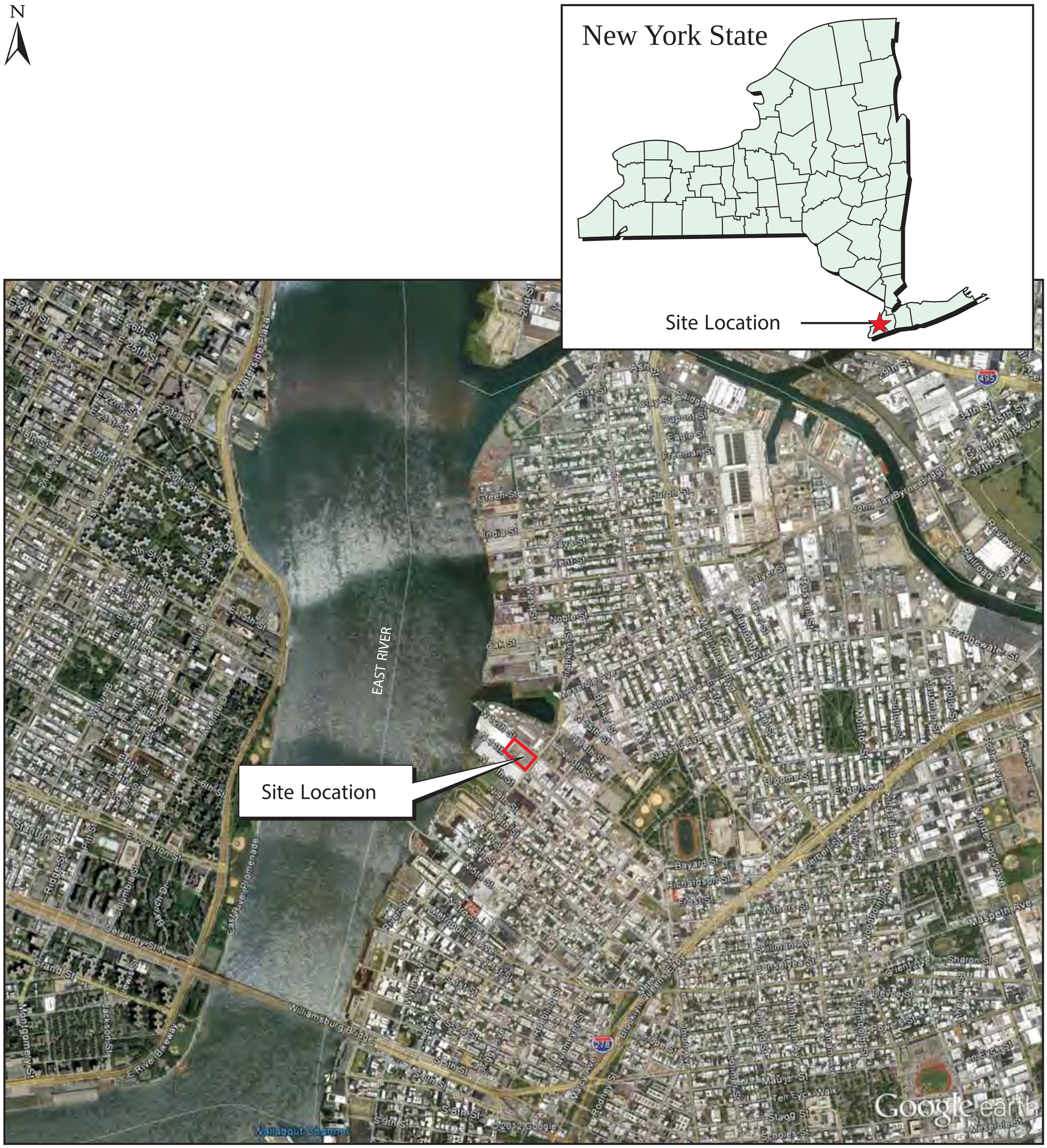
Greenpoint-Williamsburg Gazette Editor: Maria Bednarek	597 Manhattan Ave 718-383-8083 weeklygazette@comcast.net

Table 3

Emergency Contacts

Emergency Response Agencies	
Ambulance	911 - Emergency
Fire Department	911 - Emergency
Police Department	911 - Emergency
Woodhull Medical Center 760 Broadway, Brooklyn, NY	718-963-8000
Occupational & Environmental Health Center 35 E. 35th Street, New York, NY	
National Response Center	800-424-8802
NYSDEC Spill Report Hotline	800-457-7362
EPA National Response Center	800-424-8802
Center for Disease Control	404-488-4100
Project Personnel	
National Grid Project Manager (Donald Campbell)	Office: 718-963-5453 Cell: 347-452-5973
Contractor (Site Superintendent)	Office: Cell:
Contractor (Site Health and Safety Officer)	Office: Cell:
Construction Manager (Site Manager)	Office: Cell:
NYSDEC (Site Representative)	Office: Cell:
NYSDEC (Project Manager)	518-402-9662 [Henry Willems]
NYSDOH	518-402-7880 [Bridget Boyd]

FIGURES



Source: Google Earth Pro - © 2012 Google

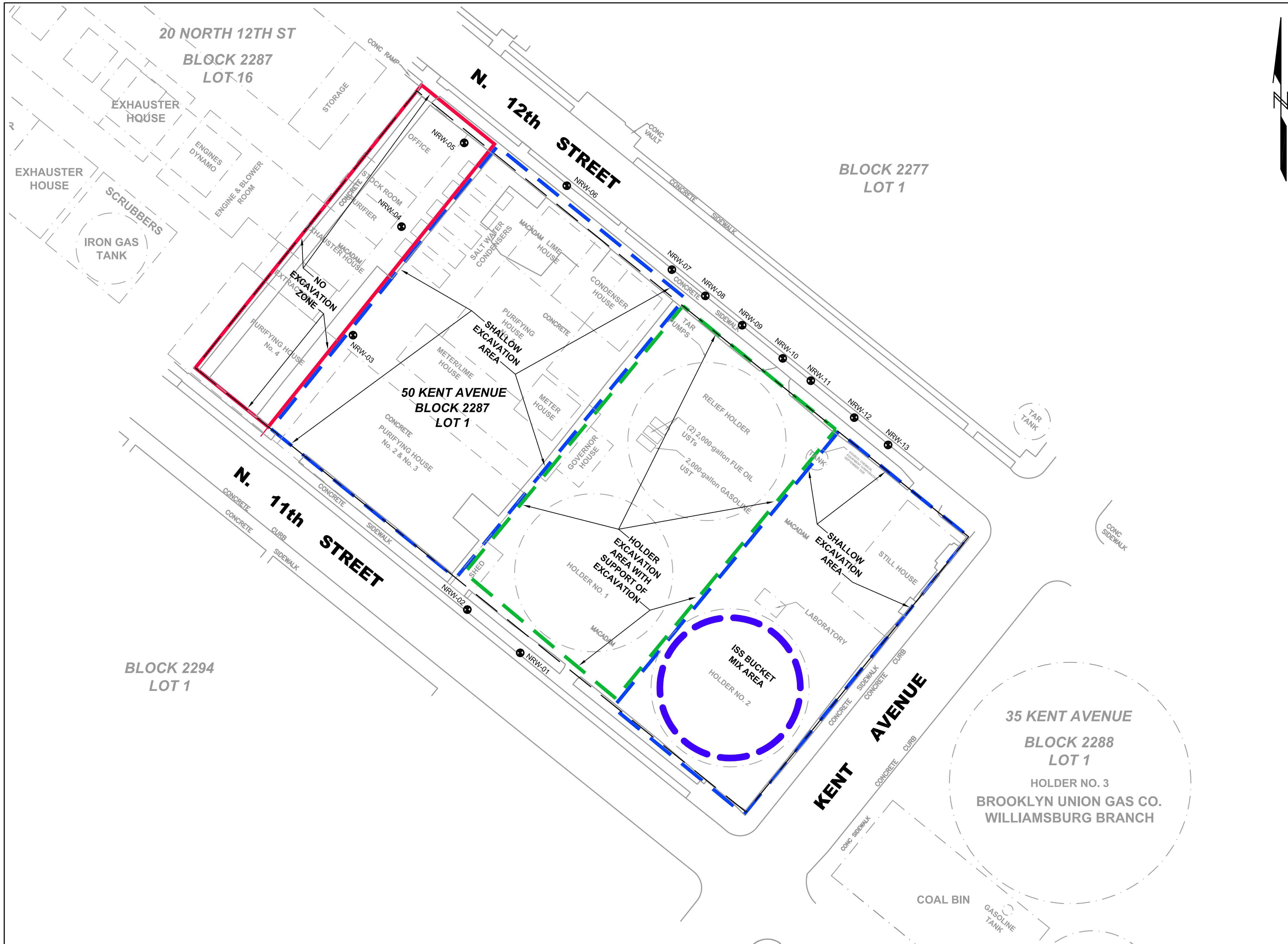
APPROXIMATE SCALE IN FEET

2000 0 2000

URS

INTERIM REMEDIAL MEASURE
50 KENT AVENUE HOLDER AREA
WILLIAMSBURG WORKS FORMER MGP SITE
BOROUGH OF BROOKLYN, NEW YORK

Figure 1
Site Location



LEGEND

- APPROXIMATE 50 KENT AVENUE PARCEL BOUNDARY
- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE
- DEEP (HOLDER) EXCAVATION AREA (EXCAVATION TO 30' BELOW GROUND SURFACE)
- SHALLOW EXCAVATION AREA
- IN-SITU SOLIDIFICATION (ISS) BUCKET MIXING
- 55' BUFFER ZONE (NO EXCAVATION)
- NRW-13 RECOVERY WELL LOCATION

NOTES:

1. SURVEYED INFORMATION SHOWN FROM DRAWING DATED AUGUST 2013, PREPARED BY YEC, INC., ENTITLED "WILLIAMSBURG WORKS FORMER MGP SITE."
2. THE HORIZONTAL COORDINATE SYSTEM IS BASED UPON THE NEW YORK STATE PLANE COORDINATE SYSTEM, EAST ZONE, 1983 ADJUSTMENT.
3. FORMER MGP STRUCTURES SOURCES: "THE BROOKLYN UNION GAS CO. WILLIAMSBURG WORKS" DRAWING 2-G-130 AND DRAWING PROVIDED BY GEI CONSULTANTS, INC., DATED AUGUST 2011.

0 60 120

SCALE, FEET

IRM DESIGN AND IMPLEMENTATION PLAN 50 KENT AVENUE HOLDER AREA WILLIAMSBURG WORKS FORMER MGP SITE BOROUGH OF BROOKLYN, NEW YORK	URS	LOCATION OF PLANNED IRM ACTIVITIES
nationalgrid	Project 11176638.00014	Figure 2

J:\PROJECTS\11176638\CAD\RDWP 2013\FIGURE 2; APP D - COMMUNITY IMPACTS.DWG

APPENDIX E

VIBRATION AND SETTLEMENT MONITORING PLAN FOR SOIL EXCAVATION

APPENDIX E

VIBRATION, MOVEMENT, AND NOISE MONITORING PLAN
FOR INTERIM REMEDIAL MEASURE

50 KENT AVENUE PROPERTY HOLDER AREA
BROOKLYN, KINGS COUNTY, NEW YORK

Prepared for:

National Grid
One Metrotech Center
Brooklyn, New York 11201

Prepared by:

URS Corporation
257 West Genesee Street
Suite 400
Buffalo, New York 14202

June, 2015

TABLE OF CONTENTS

1. INTRODUCTION

URS has prepared this Vibration, Movement, and Noise Monitoring Plan (Plan) for the proposed interim remedial measures (IRM) at the 50 Kent Avenue property ("the Site" or the "Holder Area") of the former Williamsburg Works manufactured gas plant (MGP), which was located in the Williamsburg neighborhood of Brooklyn, New York. As part of this remediation, it is proposed to address contaminated soil at the Site through the excavation/off-site disposal and solidification of certain contaminated soils in and around former gas holder tanks. The former gas holder tank foundations are approximately 30 feet below the ground surface. In order to remove the gas holder tank foundations, a temporary support of excavation (SOE) system has been designed. The excavation will be supported by installation of a sheetpile wall placed within a cement-bentonite slurry trench surrounding the two tanks being excavated.

The remedial activities will include temporary fabric structure mobilization and demobilization, subsurface structure demolition, in-situ solidification bucket mixing, deep and shallow soil excavation adjacent to public streets, dewatering, and truck transportation, and soil compaction. Monitoring will be required for these activities, and may be required for other activities as well.

The Plan has been prepared to provide National Grid with procedures that will be employed to monitor ground vibration, and movement of the adjacent structures (including measurement of groundwater levels which may contribute to building movement), and noise levels outside the work area. The Plan identifies the proposed monitoring locations, the frequency of monitoring readings, threshold levels, and the procedures to be implemented for responding to observed exceedances of the threshold levels.

The Plan is intended to be a framework within which the vibration, movement, noise, and groundwater levels from the remedial activities are documented and recorded. Any changes to the proposed remedial construction activities will be updated in a revised Plan, as necessary. Evaluations of the vibration and movement monitoring programs and requirements by the Engineer will be completed periodically to determine if more or less monitoring is required.

This Plan does not preclude the use of other mitigation technologies, or techniques designated in other design documents.

2 BASELINE AND PRECONSTRUCTION SURVEYS

2.1 GENERAL

The proposed monitoring locations and additional information is shown in Figure 1.

2.2 PRE-CONSTRUCTION SURVEYS

Structures located near the Site will be subject to a pre-construction survey to document their condition before and after the remedial construction. If an access agreement is already in place, the vibration monitoring points will be placed as close as practicable to the existing structures. For properties where an access agreement has not been negotiated, the vibration monitoring points will be placed near the property line of the potentially affected property.

Structures proposed to be subject to movement monitoring are:

- S-1: One story garage/storage building (Block 2277, Lot 1, north of the site and north of N. 12th St. – approx. 75 feet away from deep excavation activities)
- S-2: Three story commercial building (Block 2295, Lot 107, southeast of the site, diagonally across the intersection of 11th St. and Kent Ave. – approx. 90 feet away from the site and approx. 175 feet away from deep excavation activities)
- S-3: Two story warehouse building (Block 2294 Lot 1, south of the site - 60 feet away from deep excavation activities)
- S-4: One story warehouse building (Block 2288 Lot 1, east of the site – approx. 60 feet away from the site and approx. 160 feet away from deep excavation activities)

The pre-construction survey will include inspecting building exterior and interior elements and documenting any pre-existing conditions such as cracks, movement, subsidence, corrosion, water damage, etc. Conditions that should be monitored during construction will be noted and, where appropriate, crack monitors installed prior to the start of construction. Survey marks to be used for movement monitoring will be surveyed. The survey will be documented through notes and photography to establish the pre-construction existing conditions.

2.3 VIBRATION BASELINE SURVEY

A pre-construction vibration survey was performed during the 2012 predesign investigation. Measurements were taken of the longitudinal component (L) (measurement in a direct line from the source to the monitoring location), and vertical (V) and transverse (T) components (both perpendicular to the longitudinal component). The results of this survey are shown in Table 2-1.

Table 2-1: Ambient Vibration Data Measured at Each Location - April 2012

Geophone Location	Measured Peak Particle Velocity (in/sec)	Percent of Measured Frequency		
		< 20 Hz	20-40 Hz	> 40 Hz
Location #1 20 N. 12th Street Block 2287 - Southwest Corner	0.020 (L)	0 .00% (L)	0 .00% (L)	100% (L)
	0.015 (T)	0.04% (T)	0.05% (T)	99.91% (T)
	0.040 (V)	0.06% (V)	0.29% (V)	99.65% (V)
Location #2 Block 2294 Lot 1 North Side of Building	0.040 (L)	0.03% (L)	0.28% (L)	99.69% (L)
	0.020 (T)	0.29% (T)	0.55% (T)	99.16% (T)
	0.055 (V)	0.00% (V)	0.09% (V)	99.91% (V)
Location #3 51 Kent Avenue North Corner	0.085 (L)	0.01% (L)	0.02% (L)	99.97% (L)
	0.040 (T)	0.04% (T)	0.22% (T)	99.74% (T)
	0.090 (V)	0.03% (V)	0.09%(V)	99.88% (V)
Location #4 35 Kent Avenue Block 2288 Lot 1 - North Corner	0.015 (L)	0.00% (L)	0.01% (L)	99.99% (L)
	0.030 (T)	59.46% (T)	12.49% (T)	28.05% (T)
	0.080 (V)	6.96% (V)	30.74% (V)	62.30% (V)
Location #5 Block 2277 Lot 1 7 feet South of Building	0.025 (L)	0.01% (L)	0.03% (L)	99.96% (L)
	0.015 (T)	0.00%(T)	0.01% (T)	99.99% (T)
	0.060 (V)	0.01% (V)	0.03% (V)	99.96% (V)
Location #6 20 N. 12th Street Block 2287 - Northeast Corner	0.035 (L)	0.00% (L)	0.00% (L)	100% (L)
	0.045 (T)	0.00% (T)	0.00% (T)	100% (T)
	0.100(V)	0.00% (V)	0.00% (V)	100% (V)

Pre-construction vibration conditions will be confirmed through monitoring for a week prior to the initiation of any activity at the Site. The vibration monitors will record the vector sum of the wave velocity in inches per second. The objective of the vibration baseline survey is to corroborate previous measurements of baseline ground motions caused by vehicular traffic (buses, cars, trucks, and other vibration sources) near the sensitive structures selected surrounding the Site. These vibration levels will be compared to vibrations induced during construction and may be used to revise threshold limitations for vibration induced damage.

2.4 NOISE BASELINE SURVEY

A pre-construction noise survey was performed during the 2012 predesign investigation during one period in April and period in November. Six sound level monitoring systems were used to conduct unattended monitoring for up to seven days. The sound level system was mounted on a tripod approximately five feet above the ground and the microphone was equipped with a wind screen. The six April locations are described in the Table 2-2.

Table 2-2: Ambient Noise Monitoring Locations - April 2012

Location	Description	Coordinates
1	20 N. 12th Street Block 2287 - South Corner	N 40° 43’ 24.02” W 73° 57’ 38.02”
2	Block 2294 Lot 1 - North Side of Building	N 40° 43’ 22.24” W 73° 57’ 36.30”
3	51 Kent Avenue - North Corner	N 40° 43’ 20.67” W 73° 57’ 33.76”
4	35 Kent Avenue Block 2288 Lot 1 - North Corner	N 40° 43’ 22.62” W 73° 57’ 31.43”
5	Block 2277 Lot 1 - South of Building	N 40° 43’ 24.27” W 73° 57’ 33.02
6	20 N. 12th Street Block 2287 - Northeast Corner	N 40° 43’ 25.49” W 73° 57’ 36.07”

In addition to the six stations deployed, two systems were used to conduct 1 hour spot checks at each of the six monitoring locations. The sound level system was mounted on a tripod approximately five feet above the ground and the microphone was equipped with a wind screen. During these spot check tests, specific information regarding singular events which occurred near the monitoring location or were evident during each sound level test period were noted. Weather conditions during the testing are also recorded.

An identical week-long ambient noise monitoring study was performed from November 21 to November 27, 2012. Since a microphone was stolen during the April study, for added security, all six sound level monitors for the November study were placed within the fenced area of the 50 Kent Avenue parcel. The monitor numbering (#1 through #6) corresponded to the same numbering scheme as the April study. But, location #'s 2, 3, 4, and 5 were slightly different, as indicated in Table 2-3 below.

Table 2-3: Ambient Noise Monitoring Locations - November 2012

Location	Description	Coordinates
1	Northwest corner of site, along 11th Street	N 40° 43' 24.02" W 73° 57' 37.76"
2	West side of site, along 11th Street	N 40° 43' 22.79" W 73° 57' 35.69"
3	South Corner of site - Intersection of Kent Ave. and 11th Street	N 40° 43' 21.55" W 73° 57' 33.73"
4	Southeast Corner of site - Intersection of Kent Ave. and 12th Street	N 40° 43' 23.07" W 73° 57' 32.13"
5	East side of site, along 12th Street	N 40° 43' 24.22" W 73° 57' 33.96"
6	North corner of site, along 12th Street	N 40° 43' 25.51" W 73° 57' 36.13"

The installed sound level systems recorded ambient noise in terms of A-weighted decibels (dBA). A dBA sound level measurement weighs the various frequency components of a sound as perceived by the human ear in order to yield a single number indicator of its relative loudness. The effect of noise is usually monitored based on the exceedance level (L_n) and the equivalent sound level (L_{eq}) values. L_n is defined as the percentage of time of the total measurement period that the level was exceeded. For example, if L_{10} is 50 dBA, for 10 percent of the test period, the sound level present was 50 dBA or above. L_{eq}, describes a receiver's cumulative noise exposure from all noise events for a period of time. The ambient noise in dBA was measured by the sound level monitoring system, and L_{eq} and L_n values were calculated based on the measured data. The sound level systems were laboratory calibrated by the manufacturer prior to the study. The systems were also calibrated after installation and removal.

2.4.1 April 2012 Measurements

The daily maximum measured sound levels at six locations ranged from 88.2 dBA to 124.1 dBA, the daily minimum measured sound levels at six locations ranged from 39.3 dBA to 42.6 dBA, and the equivalent measured sound levels at six locations ranged from 56.4 dBA to 71.8 dBA. The 1 hour spot checks were in general agreement with the measured values. The highest overall maximum dBA was measured at location #3. This might be attributed to routine urban activities near this location. Table 2-4below presents the overall maximum dBA, overall minimum dBA, overall equivalent dBA, and several L_n values.

Table 2-4: Ambient Noise Levels Measured at Each Location - April 2012

Location	*1*	*2*	*3*	*4*	**5*	*6*
Overall Maximum dBA	88.2	92.9	124.1	115.8	107	103.9
Overall Minimum dBA	39.6	40.2	41.7	42.6	40.5	39.3
Overall Leq	56.4	60.4	71.8	69.4	63.5	63.4
Ln 10	58.7	63.2	72.4	71.8	64.2	61.6
Ln 20	55.9	59.7	68.9	68.8	61.3	57.9
Ln 30	50.5	57.0	65.9	66.3	59.6	55.5
Ln 50	50.5	53.4	60.6	61.6	57.1	52.1
Ln 90	45.2	47.2	49.1	51.2	53.1	45.5
Ln 95	44.2	45.8	47.4	49.2	52.4	44.2

* Data up to time of microphone theft.

2.4.2 November 2012 Measurements

The daily maximum measured sound levels at six locations ranged from 88.2 dBA to 103.5 dBA, the daily minimum measured sound levels at six locations ranged from 36.9 dBA to 43 dBA, and the equivalent measured sound levels at six locations ranged from 54.5 dBA to 67.5 dBA. The 1 hour spot checks were in general agreement with the measured values. The highest overall maximum dBA was measured at location #4. This might be attributed to routine urban activities near this location. Table 2-5 below presents the overall maximum dBA, overall minimum dBA, overall equivalent dBA, and several L_n values.

Table 2-5: Ambient Noise Levels Measured at Each Location - November 2012

Location	*1*	*2*	*3*	*4*	*5*	*6*
Overall Maximum dBA	102.2	89.3	100.6	103.5	88.2	89.7
Overall Minimum dBA	37.6	39.2	40.9	43.0	40.1	36.9
Overall Leq	58.9	54.8	66.0	67.5	57.4	54.5
Ln 10	60.9	57.3	68.4	72.1	59.5	55.6

Ln 20	56.6	55.2	64.9	67.7	57.5	53.4
Ln 30	54.5	53.6	62.2	64.6	55.3	51.9
Ln 50	51.0	50.8	57.9	58.8	52.3	49.2
Ln 90	43.7	45.1	49.2	49.7	46.4	43.0
Ln 95	42.7	44.1	47.6	47.7	44.9	41.9

Overall, measured sound levels were higher during the April study. This may be attributable, in part, to the fact that the November study period encompassed Thanksgiving. Therefore, commercial activity in the area at this time may have been reduced when compared to normal business weeks.

2.5 GROUNDWATER BASELINE SURVEY

A groundwater level baseline survey will be undertaken prior to the initiation of any activity at the Site. In addition to the existing non-aqueous phase liquid (NAPL) recovery wells NRW-01 through NRW-13, a piezometer will be installed along Kent Ave. These wells will be used to obtain groundwater elevation during both high tide and low tide conditions. Because of tidal influences on groundwater elevations, groundwater elevations will be taken at both high tide and low tide conditions prior to construction to generate an average starting elevation. These data will be used together with elevation measurements that are taken on a (at a minimum) weekly basis (where access is available) during NAPL collection activities to generate appropriate pre-construction groundwater elevation conditions.

3 CONSTRUCTION MONITORING

The monitoring will be conducted in coordination with the Contractor and the Construction Manager. The Contractor will provide the proposed construction sequence to the construction manager a minimum of 2 weeks prior to mobilization to allow mobilization for monitoring installation. The Contractor will provide a minimum of 48-hour notice to the construction manager before they mobilize. The Construction Manager will coordinate placement of the monitoring equipment with the Contractor.

The monitoring program presented herein will depend on the Contractor's construction plan and duration of the construction operations. Depending on levels observed during initial construction, additional monitoring locations may be required. Periodic evaluation of the monitoring program will be performed to determine the program's adequacy and continuing requirements.

3.1 VIBRATION MONITORING

3.1.1 Vibration Basics

A source (such as using a backhoe hammer to demolish large pieces of subsurface concrete structures) can excite the adjacent ground, creating vibration waves that propagate (or move) through the various soil and rock strata, potentially reaching the foundations of nearby buildings and then throughout the parts of the building structure. Although ground-borne vibration is sometimes noticeable outdoors, it is almost exclusively an indoor problem. The effects of ground-borne vibration can include perceptible movement of the building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. Vibration effects can range from simply causing annoyance to people inside buildings, to minor (cosmetic) damage to walls and ceiling, to major structural damage, although the latter is an extremely rare occurrence. Differences in these vibration outcomes is related to the magnitude of the vibration that propagates to nearby structures. Vibrations of greater magnitude may cause building damage but vibrations at much lower levels may be felt by humans but be too low to cause building damage.

Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods employed. Operation of construction equipment causes ground vibrations that spread through the ground and diminish in strength with distance. Buildings founded on the soil in the vicinity of the construction site respond to these vibrations, with varying results ranging from no perceptible effects at the lowest levels, low rumbling sounds and perceptible vibrations at moderate levels, and slight damage at the highest levels. Ground vibrations from construction activities do not often reach the levels that can damage structures, but they can achieve the audible and feelable ranges in buildings very close to the Site. A possible exception is the case of fragile buildings, many of them old, where special care may need to be taken to avoid damage.

Evaluation criteria for determining vibration impacts due to construction activities include thresholds for (1) human perception, annoyance, and interference and (2) damage to fragile and historical buildings. Although no standardized vibration criteria for construction activities have been established, exceedances of certain vibration levels may typically cause community reactions.

Vibration energy is measured as peak particle velocity (PPV). PPV is appropriate for evaluating vibration associated with construction activities, and the resulting stresses that potentially are damaging to buildings. PPV represents the maximum instantaneous positive or negative peak of a vibration signal, and is commonly used to measure and evaluate impulse vibrations associated with blasting or pile driving. The U.S. Bureau of Mines (USBM) publishes guidelines based on PPV that are frequently used to set acceptable vibration limits for various types of structures.

Excessive vibration levels from construction activities, although temporary in duration, may create a nuisance condition at nearby receptors. Ground-borne vibrations from construction activities very rarely reach the levels that can damage structures; however, the vibrations can achieve the audible and perceptible ranges in buildings that are very close to those experienced on the active work area [FTA, 2006]. The types of construction activities that typically generate the greatest vibrations are blasting and impact pile driving. Neither of these activities are expected during the construction work.

Annoyance from vibration occurs when vibration levels exceed the thresholds of human perception. These criteria are well below vibration levels at which damage might be expected to occur in buildings. In other words, a person may be able to feel or perceive vibration at levels that are much lower than levels that could cause structural damage [Jones and Stokes, 2004]. It is important to note that the term "damage", when used in the context of acceptable levels of ground vibrations, refers to threshold damage as defined by the USBM. The definition states "the occurrence of cosmetic damage; that is, the most superficial interior cracking of the type that develops in all homes independent of blasting." It should be noted that the occurrence of PPV values greater than the threshold value does not imply that cosmetic cracking will occur, but that it could occur.

3.1.2 Vibration Monitoring Activities

At each proposed location, shown on Figure 1, the peak vibration levels from the construction equipment and trucks will be measured during each of the construction activities. The following construction activities are currently proposed as part of the remedial activity:

- Equipment mobilization;
- Mobilization and demobilization of temporary fabric structure (s);
- In-Situ Solidification of Holder No. 2;
- Cement Bentonite (CB) Slurry Wall and sheetpile installation;
- Dewatering; and,
- Subsurface structure demolition activities, soil excavation, shipment, and soil compaction

The vibration monitoring plan consists of performing vibration monitoring of construction activities, evaluating it daily and preparing weekly summary reports of the vibration readings. The vibration monitoring plan includes:

- A layout for the vibration monitoring equipment and a schedule for vibration monitoring. The equipment layout will involve placing monitoring units equipped with geophones capable of triaxial displacement measurements next to buildings and/or structures adjacent to the construction areas. The monitoring units will be installed and secured at locations where firm subgrade is exposed. The layout and schedule will depend on the Contractor's proposed construction sequence.
- Performing continuous vibration monitoring during each of the construction activities to adequately document the ground-borne vibration from the construction activities. PPV limits will be developed that will be used as "warning action limits" and "stop work action limits". These limits will be used as threshold values for the vibration mitigation plan during the

construction activities. Vibration levels will be monitored to detect construction operations that cause vibrations above the recommended vibration action limits.

- The vibration monitoring will be performed continuously from the start to end of each construction work shift. Data recording will commence prior to the start of each shift. At the end of each shift, data collected will be downloaded and reviewed and a summary report will be submitted.
- If the vibration "warning action limit", which may be revised after the pre-construction survey is completed, is exceeded, the situation will be reviewed and the cause of the vibration will be identified. The Engineer will require the Contractor to develop plan of action will be formulated, implemented and monitored. If the vibration "stop work action limit" is exceeded or abnormal monitoring data is recorded, work will stop to allow for review of the vibration data. In the event that the vibrations exceed the stop work action limit, the monitoring units will set off an alarm that will signal for the stop of construction work. The causes of vibration will be investigated and vibration mitigation procedures can then be reviewed and implemented as needed before work proceeds. Additional monitoring units may be required to further mitigate excessive vibrations.
- At the end of construction, the data will be summarized in a report. Summary tables of the peak particle velocities recorded, and histogram plots for the vibration monitoring data will be included in this summary memo.

3.2 CRACK MONITORING

Tell-tale crack monitors (or strain gauges) will be used at each of the receptors, where necessary, to document the status of existing cracks in the building structures. Prior to the start of the construction activities, crack gauges will be installed at existing cracks identified at the receptor locations. Crack gauge measurements will be collected once a week during the construction activities. If high vibration levels are recorded during vibration monitoring, more frequent crack monitoring may be conducted at the discretion of the Engineer.

3.3 GROUNDWATER MONITORING

Groundwater level monitoring will be completed to supplement the movement monitoring. Significant drawdown on the outboard of the sheet pile wall has the potential to result in settlement. By monitoring groundwater level, settlement issues resulting from dewatering drawdown may potentially be prevented.

Groundwater elevation levels will be measured and recorded on a daily basis. Measurements will be taken at the NAPL collection wells along 11th and 12th Streets, and a new piezometer on Kent Ave., as shown on Figure 1. Standing water elevation in the deep excavation will also be recorded on a daily basis.

3.4 MOVEMENT MONITORING

Movement monitoring will be conducted for surrounding buildings and the excavation wall during construction. Vertical and horizontal movement monitoring conducted will include optical survey marks set at the first floor and roof on the exterior wall, and on top of the excavation wall. The movement shall be measured using a conventional or digital surveyors' level. Initial monitoring of each movement point shall start within 24 hours of CB Slurry wall installation and shallow excavation to obtain a baseline and then when the excavation occurs as described below. The instrument reading schedule for the movement points shall be:

- Three initial sets of readings prior to any site excavation.
- Daily when CB Slurry wall installation is within 100 feet of the movement point, but not less than 3 sets of readings after the initial 3 sets.
- Weekly when CB Slurry wall installation is greater than 100 feet away from the movement point and/or excavating within 100 feet of the movement point.
- Increase frequency of readings where action limits are reached.
- Monthly after completion of backfilling or until measurements remain stable over three consecutive readings.
- Concurrence to stop monitoring must be obtained from the Engineer in writing.

Additional movement points may be installed if required by the Engineer. Additional monitoring shall be performed as directed by the Engineer.

3.5 NOISE MONITORING

Noise monitoring will be conducted for surrounding buildings. Noise levels will be measured and recorded on a daily basis. Local Laws of the City of New York for the year 2005 - No. 113, Subchapter 5, "Prohibited Noise, Specific Noise Sources - Sound Level Standard" Subsection 24-228 - Construction, exhausts and other devices, state:

(a) No person shall operate or use or cause to be operated or used a construction device or combination of devices in such a way as to create an unreasonable noise. For the purposes of

this section unreasonable noise shall include but shall not be limited to sound that exceeds the following prohibited noise levels:

(1) Sound, other than impulsive sound, attributable to the source or sources, that exceeds 85 dB(A) as measure 50 or more feet from the source or sources at a point outside the property line where the source or sources are located or as measure 50 or more feet from the source or sources on a public right-of-way
(2) Impulsive sound, attributable to the source, that is 15 dB(A) or more above the ambient sound level as measure at any point within a receiving property or as measure at a distance of 15 feet or more from the source on a public right-of-way. Impulsive sound levels shall be measured in the A-weighting network with the sound level meter set to fast response. The ambient sound level shall be taken in the A-weighted network with the sound level meter set to slow response.

The proposed construction equipment to be operated at the Site will generate steady state (non-impulsive) sound. Instances of impulsive sound, such as the impact of an excavator shovel on the ground, may be produced. As per the New York City Noise Code the allowable limit for construction noise is 85 dB(A).

4 VIBRATION, MOVEMENT DAMAGE AND NOISE THRESHOLDS

4.1 VIBRATION THRESHOLD LEVELS

The threshold levels are defined for various buildings and structures depending on the structure's strength and ability to absorb ground-borne vibration. Since all buildings are continually exposed to seismic vibration, buildings are generally designed to withstand elevated ground-borne vibration levels without resulting in stress fractures or hairline cracks. For most buildings, the likelihood of damage or even minor cosmetic damage is highly unlikely unless there are pre-existing faults with the building structure and there is nearby blasting or excessive pounding from construction equipment (such as pile driving). The generally accepted damage criteria listed in Table 4-1 were developed by the USBM [Nicholls, 1971] as well as European construction and tunnel authorities [Association of Swiss Highway Professionals, 1992].

By definition, the peak particle velocity (PPV) is the maximum rate of change of position (displacement) with respect to time as measured on the ground surface. The velocity amplitudes are given in units of inches per second (ips) zero to peak amplitude. The frequency of vibration is the number of oscillations that occur in 1 second. The frequency units given are in hertz (cycles per second). The dominant frequency is usually defined as the frequency at the maximum particle velocity, which will be calculated visually from the seismograph strip chart for the half cycle that has its peak, the maximum velocity. The particle velocity must be recorded in three (3) mutually perpendicular axes, with the maximum allowable peak particle velocity being in the maximum measure along any of three axes.

Thresholds of vibration induced cracking are generally site specific and depend on the type and age of the structure, the frequency of ground vibration, and type of soil supporting the structure. Research by the U.S. Bureau of Mines (USBM) and other investigative groups have established criteria relating the occurrence of structural damage to certain frequencies and level of ground motion. According to the USBM, within the range of 4 to 12 hertz, the maximum particle velocity recommended to preclude the threshold damage to plaster-on-wood for old structures is 0.5 ips and 0.1 ips established for historic monuments.

Table 4-1: Construction Vibration Damage Criteria (in PPV)

Land-Use/Building Category	Peak Particle Velocity[1]	
	mm/s	in/s
Industrial buildings (and other structures of substantial construction)	100	4
Residential, new construction	50	2
Residential, poor condition	25	1
Residential, very poor condition	12.7	0.5
Reinforced-concrete, steel, or timber (no plaster)	12.7	0.5
Engineered concrete and masonry (no plaster)	7.62	0.3
Non-engineered timber and masonry buildings	5.08	0.2
Historic buildings	3	0.12
Historic buildings, poor condition	2	0.08

[1] PPV levels are reported in both metric and English units

A PPV of 2 in/s is the generally accepted threshold of minor cosmetic damage due to repeated construction activities and there is research that suggests that many single family residences and other structures can sustain substantially higher vibration levels without damage. However, recent research has demonstrated that historic or fragile buildings may be more susceptible to potential damage at lower levels depending on the condition of their foundations. The New York City Department of Buildings (NYCDOB) has developed a set of policy and procedures (PPN # 10/88) in order to avoid potential damage to historical structures resulting from adjacent construction, and for any existing structure designated by the Commissioner. The procedures require a monitoring program to reduce the likelihood of construction damages to adjacent historical structures and to detect at an early stage the beginnings of damage so that construction procedures can be changed. PPN # 10/88 includes a PPV threshold of 0.5 in/s for potential vibration damage [NYSDOB, 1988]. However, these structure types and conditions do not exist at the Site. The vibration threshold limits to be used are summarized in Table 3-2.

Table 4-2: Preliminary Vibration Threshold Limits (in PPV)

Vibration Monitoring Location	Vibration Threshold Limits (PPV)	
	Warning Action Limit (inches/s)	Stop Work Action Limit (inches/s)
S1, 2, 3, & 4	0.5	2.0

Construction vibration should be assessed quantitatively in cases where there is significant potential for impact from construction activities. Such activities include blasting, pile-driving, vibratory compaction, demolition, and drilling or excavation in close proximity to sensitive structures. There are no sensitive structures nearby the Site that would be impacted by the construction activities. For reference purposes, a quantitative assessment of the vibration from the Site construction activities has been completed below. The recommended procedure for estimating vibration impact from construction activities is as follows:

- Select the equipment and associated vibration source levels at a reference distance of 25 feet from Table 4-3.
- Make the propagation adjustment according to the following formula [(this formula is based on point sources with normal propagation conditions); FTA, 2006]:

  $PPV_{equip} = PPV_{ref} \times (25/D)^{1.5}$

  where: $PPV_{(equip)}$ is the peak particle velocity in in/s of the equipment adjusted for distance

  $PPV_{(ref)}$ is the reference vibration level in in/s at 25 feet from (Table 3-3)

  D is the distance from the equipment to the receiver.
- Apply the vibration damage threshold limits from Table 4-2.

Table 4-3: Vibration Source Levels for Construction Equipment

Equipment		Peak Particle Velocity at 25 ft	
		mm/s	in/s
Pile Driver (impact)	upper range	38.5	1.518
	typical	16.3	0.644
Pile Driver (vibratory)	upper range	18.6	0.734
	typical	4.3	0.170
Clam shovel drop (slurry wall)		5.1	0.202
Hydromill (slurry wall)	in soil	0.2	0.008
	in rock	0.4	0.017
Vibratory Roller		5.3	0.210
Hoe Ram		2.3	0.089
Large bulldozer		2.3	0.089
Caisson drilling		2.3	0.089
Loaded trucks		1.9	0.076
Jackhammer		0.9	0.035
Small bulldozer		0.1	0.003

The above methodology was used to calculate the expected vibration levels at the receptors neighboring the Site. The results are presented below for the Pile Driver (Impact); however this construction equipment is not expected to be used and is provided for a conservative comparison to the CB Slurry Wall and sheetpile installation:

Table 4-4: Maximum Vibration Impacts Expected at Neighboring Receptors

Receptor	Distance (feet)	Peak Particle Velocity
		in/s
S1	75	0.29
S2	175	0.08
S3	60	0.41
S4	160	0.09

4.2 GROUNDWATER THRESHOLD LEVELS

Historically, groundwater elevations typically fluctuate seasonally. A groundwater elevation action limit is set to be two feet below the established baseline and is provided in Table 4-5. The action level may be updated as the work progresses based on observed field conditions.

Table 4-5: Groundwater Elevation Threshold Limits

Groundwater Drawdown Threshold Limits Warning Action Limit (feet below preconstruction elevation)
2.0

It is noted that currently a groundwater mound exists along 12th Street near the holder foundations, possibly as a result of the presence of these holders. Groundwater levels along 12th Street may decrease by greater amounts during construction.

If the threshold limit is attained, the Engineer will evaluate whether to increase the frequency of monitoring building movement.

4.3 MOVEMENT THRESHOLD LEVELS

The movement threshold levels will be uniform for all adjacent buildings to be monitored and shall be as follows:

Table 4-6: Movement Limits

Receptor Type	Action Levels (inches)	
	Warning Action Limit	Stop Work Action Limit
Building S1, 3 & 4	0.125	0.25

The definition of the required action that must be taken should any geotechnical or structural instrument achieve an action limit is defined in Table 4-7 below:

Table 4-7: Required Action for "Warning Action Limit" or "Stop Work Action Limit"

Action Limit	Required Action
Warning Action Limit	The value of the geotechnical or structural instrumentation reading at which the Engineer and Contractor jointly assess the necessity of either or all of the following: • Evaluate the activity responsible for the exceedance • Altering the method of excavation or construction • Altering the rate of excavation or construction • Altering the sequence of excavation or construction • Change excavation or construction machinery • Increase frequency of monitoring of affected instrument
Stop Work Action Limit	The value of the geotechnical or structural instrumentation reading at which the Engineer and Contractor jointly assess the necessity of either or all of the following: • Make site and affected properties secure • Take necessary predetermined measures to mitigate movements and assure the safety of the public and the Work • Restart excavation or construction operations The Stop Work Action Limit for each instrument represents the absolute maximum permissible ground or structure movement and the maximum permissible vibration.

4.4 NOISE THRESHOLD LEVELS

The noise threshold level will be uniform for all adjacent buildings to be monitored and shall be as follows:

Table 4-8: Noise Limits

Receptor Type	Action Levels (inches)	
	Warning Action Limit [dB(A)]	Stop Work Action Limit [dB(A)]
Building S1, 3 & 4	80	90

5 EXCEEDANCE AND MITIGATION

5.1 GENERAL

Notwithstanding the specific threshold levels specified in Section 3, mitigation measures listed below will be utilized to minimize, to the greatest extent feasible, the impacts of the proposed construction:

- Inform people living and working in the vicinity about construction method, possible effects, quality control measures, and precautions to be used; and the channels of communication available to them;
- Route truck traffic and heavy equipment to avoid impacts to sensitive receptors, if applicable;
- Operate earth-moving equipment on the Site as far away from adjacent sites as possible;
- Phase demolition, earth-moving, and ground-impacting operations so as not to occur in the same time period;
- Select demolition methods not involving impact, where possible;
- Minimize the use of impact devices, such as jackhammers, pavement breakers, and hoe rams. Where possible, use concrete crushers or pavement saws rather than hoe rams for tasks such as holder wall demolition.
- Avoid vibratory rollers near sensitive areas; and
- Minimize the duration of any high vibration activities.

The following procedures are recommended if a measured level exceeds the damage thresholds or if the crack monitors indicate new or larger cracks.

5.2 VIBRATION AND MOVEMENT MITIGATION

In the event that a “Warning Action Limit” is reached:

- The Contractor must meet with the Project Team to discuss the need for mitigation actions;
- The Contractor will prepare a plan of action for the activity or activities responsible for the exceedance;
- If directed by the Engineer or the Construction Manager, the Contractor must implement the plan of action within 24 hours of submittal of the plan of action so that the “Stop Work Action Limit” is not reached; and

- The monitoring frequency of the affected instrument will be increased and additional instruments installed if necessary.

In the event that a "Stop Work Action Limit" is reached:

- The Contractor must cease all construction activities and meet with the Project Team to discuss the need for mitigation actions;
- The Contractor will prepare a plan of action for the activity or activities responsible for the exceedance;
- If directed by the Engineer or the Construction Manager, the Contractor must implement the plan of action within 12 hours of submittal of the plan of action so that the "Stop Work Action Limit" is not exceeded further; and
- Install additional instrumentation if necessary.

The crack monitors (strain gauges) will be checked to determine if there has been any change since the last recording. Work procedures will be evaluated and modified to prevent further exceedance of the monitoring criteria. All work activities will proceed only at the discretion of the Engineer and after the source of the exceedance has been determined and corrected.

5.3 CRACK MONITORING EXCEEDANCE

In the event that there is a change in an existing crack or if new cracks are observed during visual inspections, all site work should stop until the Engineer can evaluate the integrity of the monitored structures. Similar to the vibration monitoring exceedance, the recent activities and machinery will be evaluated to determine the correlation between the ongoing activities and the onset of structural cracks. Work procedures will be evaluated and modified to prevent further exceedance of the monitoring criteria. All work activities will proceed only at the discretion of the Engineer and after the source of the exceedance has been determined and corrected.

5.4 GROUNDWATER DRAWDOWN EXCEEDANCE

If the groundwater drawdown "warning action limit" is exceeded (i.e., groundwater drawdown value greater than the threshold value), the situation will be assessed by the Engineer. The cause of groundwater elevation drop will be identified (construction dewatering drawdown or other), and signs of settlement will be evaluated. If warranted, a corrective action plan will be formulated, implemented, and monitored. Construction dewatering may be suspended under the direction of the Engineer.

5.5 NOISE MITIGATION

According to the DEP Environmental Protection Citywide Construction Noise Mitigation regulations, several noise mitigation efforts should be made to reduce noise at the receptor locations. The following list represents mitigations efforts which may be necessary to comply with the DEP regulations.

- The use of manufacturer’s noise reduction device(s) on construction equipment;
- Keep engine housing doors closed; the use of noise-insulating material mounted on the engine housing; and operating the machinery at lower engine speeds;
- Cover portable compressors, generators, pumps, and other such devices with noise-insulating fabric;
- Prevent the idling of vehicles on site;
- The use of quieter backup alarms which are in conformance with OSHA standards;
- The fabrication of perimeter noise barriers in accordance with the standards set forth in the DEP Citywide Construction Noise Mitigation regulations Chapter 28-107 - Perimeter Noise Barriers; and
- Construction activities limited to between the hours of 7:00 A.M. to 6:00 P.M on weekdays

6 POST CONSTRUCTION SURVEY

The post-construction survey will include inspecting building exterior and interior elements and documenting any conditions such as cracks, movement, subsidence, corrosion, water damage, etc. that were not noted during the pre-construction survey.

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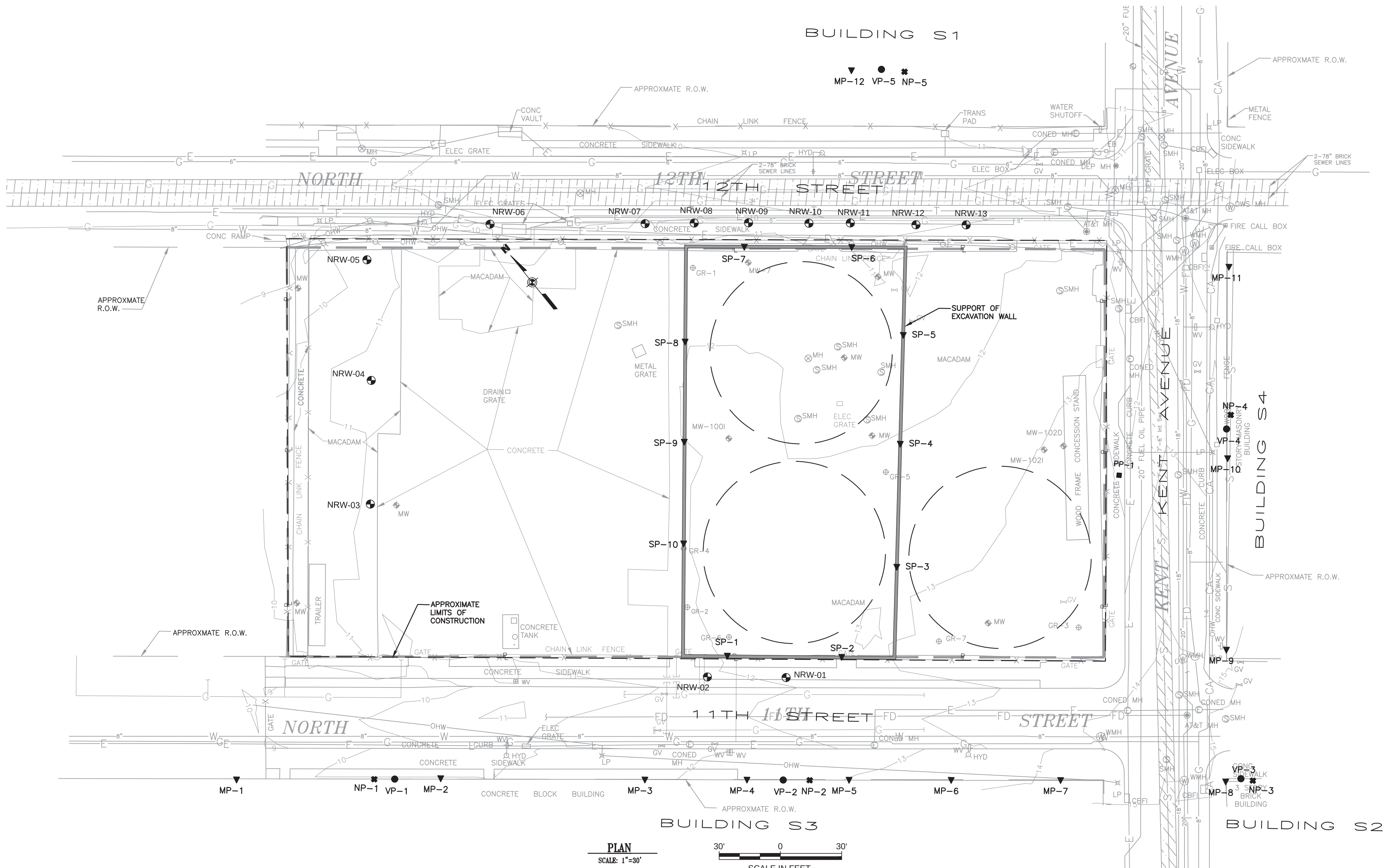
FIGURE



LEGEND:

- MP-1 ▼ VERTICAL AND HORIZONTAL OPTICAL SURVEY MARK SET AT FIRST FLOOR AND ROOF ON EXTERIOR WALL
- SP-1 ▼ VERTICAL AND HORIZONTAL OPTICAL SURVEY MARK SET ON TOP OF THE PROPOSED SUPPORT OF EXCAVATION WALL
- VP-1 ● VIBRATION MONITORING LOCATION
- PP-1 ■ PIEZOMETER LOCATION
- NP-1 ✖ NOISE MONITOR LOCATION
- NRW-13 EXISTING RECOVERY WELL LOCATION

SUMMARY OF CONSTRUCTION MONITORING ACTIVITIES

DURING CONSTRUCTION MONITORING ACTIVITY	DESCRIPTION OF MONITORING SYSTEM	DATA AQUISITION AND MONITORING FREQUENCY (MIN)	DATA ANALYSIS FREQUENCY FOR THRESHOLD OCCURENCE (MIN)	THRESHOLD CRITERIA	WRITTEN COMPILATION DATA REPORTING FREQUENCY
VIBRATION MONITORING	REMOTE AUTOMATED SEISMIC UNIT MOUNTED IN LOCATIONS SHOWN ON PLAN	SEMI-CONTINUOUS DATA ACQUISITION AND MONITORING DURING CONSTRUCTION (UNIT PRESET WITH OPERATING TIMER MODE; DATA MEASUREMENTS MADE AT PRESET FREQUENCY)	SEISMIC UNIT CONTINUOUSLY MONITORS READINGS; UNIT TRIGGERS SIGNAL TO THE SERVER AND TRANSMITS E-MAIL NOTIFICATION ON PRESET THRESHOLD LIMIT	WARNING ACTION LIMIT=0.5 in./sec. STOP WORK ACTION LIMIT=2 in./sec.	WEEKLY
EXISTING BUILDING MOVEMENT MONITORING	MANUAL OPTICAL SURVEYING EQUIPMENT	DAILY WHEN CB SLURRY WALL INSTALLATION IS WITHIN 100 FEET, OR WHEN EXCAVATING WITHIN 25 FEET; WEEKLY WHEN CB SLURRY WALL INSTALLATION IS GREATER THAN 100 FEET AWAY	MONITORING POINT DATA IS IMMEDIATELY PROCESSED UPON ACQUISITION BY THE SURVEYOR; RELATIVE MOVEMENT IS IMMEDIATELY IDENTIFIED AND REPORTED TO RESPONSIBLE PERSON AT SITE	WARNING ACTION LIMIT=1/8 in STOP WORK ACTION LIMIT=1/4 in	WEEKLY
EXISTING BUILDING CRACK MONITORING	PERMANENTLY MOUNTED "TELLTALE" CRACK GAUGE	MANUAL ONCE A WEEK WITH PHOTOGRAPHS OF TELLTALES DURING CONSTRUCTION AND MONTHLY THEREAFTER	RELATIVE MOVEMENT IS IMMEDIATELY IDENTIFIED BY MONITORING TECHNICIAN BY COMPARISON WITH EARLIER READINGS AND REPORTED TO RESPONSIBLE PERSON AT SITE	ALL MOVEMENT ANALYZED IN CONJUNCTION WITH VIBRATION AND BUILDING MOVEMENT DATA	WEEKLY

WARNING
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CONSTRUCTION MONITORING PLAN

Scale: AS SHOWN | Date: JUNE 2015 | FIG-1