# APPENDIX X

## Waterloo® Hydraulic Barrier Installation Specifications

**FYN PAINT & LACQUER CO., INC.**
**230 KENT AVENUE**
**BROOKLYN, KINGS COUNTY, NEW YORK**
**NYSDEC BCP SITE NO. C224154**
**INDEX NUMBER C224154-02-15**

## Waterloo® Hydraulic Barrier Installation Specifications

### 1.0 GENERAL

Kent Riverview LLC (the "Volunteer") has applied and been accepted into the Brownfield Cleanup Program (BCP) with the New York State Department of Environmental Conservation (NYSDEC) as a Volunteer to remediate the property located at 230 Kent Avenue in Williamsburg, Brooklyn, Kings County, New York (heretofore referred to as the "Site"). The Site is recorded under the Brownfield Cleanup Agreement (BCA) with a Site Name of Fyn Paint & Lacquer Co., Inc., Site Number C224154 and Index Number C224154-02-15. The Site is currently improved with an unoccupied building.

The proposed RAWP for the Site entails the performance of a Track 1 Remedy. Following the demolition of the current building and offsite disposal of approximately 700 tons of construction and demolition (C&D) debris, the remedial action will include excavation and offsite disposal of approximately 3,600 tons of contaminated soil within the entire property boundary. The excavation depth beneath the Site will extend to a minimum depth of 15 feet below grade (exclusive of areas where no soil contamination is present and soil quality meets Unrestricted Use SCOs). In contamination source areas (i.e., in the northeast corner of the Site), the excavation activities are expected to be advanced to a depth greater than 17 feet below grade. These excavations will be advanced below the groundwater table elevation. The soil excavation activities will therefore require structural excavation supporting and localized construction dewatering. Therefore, following completion of the building demolition, a Waterloo® Hydraulic Barrier (interlocking steel sheeting with grouted seams) will be installed surrounding the perimeter of the Site.

The hydraulic barrier will be installed to a depth of 25-30 feet below grade. Although there is no confining layer beneath the Site for keying the hydraulic barrier into at the termination depth, it will likely minimize the groundwater recharge rate during dewatering.

Additionally, the hydraulic barrier will prevent off-site contamination from migration onsite following completion of the remedy.

After the Waterloo® Hydraulic Barrier installation is complete, subsurface soils will be excavated from within the property boundaries. Contaminated soil will be removed from the Site and will encompass an area of approximately 101 ft x 54 ft x 15 ft deep (approximately 3,600 tons of material). The volumetric estimate for excavated material includes an off-set for the concrete slab on grade removed during building demolition and the sub-grade partial basement (void space). The excavation will encompass the most concentrated zone of contamination which is located in the northeastern corner of the Site. Accordingly it is anticipated that a significant volume of the subsurface contaminant mass will be removed as a result of the excavation activities.

The following sections outline the project requirements for the installation of the perimeter Waterloo® Hydraulic Barrier at the Site.

## 1.1 Scope

A. This specification details the technical and quality assurance requirements for the design, supply and installation of steel sheet piling to perform the soil remediation work as outlined in the Remedial Action Work Plan (RAWP). Information on existing subsurface conditions at the locations of the planned sheet piling can be found in the remedial subsurface investigation reports prepared by Leggette, Brashears & Graham, Inc. (LBG).

B. The work consists of designing and installing sheet piling required to provide excavation support for Site remediation work. The work will consist of installation of the sheet piling throughout the entire property perimeter of the Site. The bottom of to the remedial excavation shall be an elevation of 15-20 feet below grade. The sheeting shall be permanent and will remain in place after completion of the remediation work.

C. The work covered by this specification shall be performed in strict accordance with this specification and the applicable drawings generated by the sheeting contractor.

D. The work to be performed under this section of the specification includes, but is not limited to the following:

1. Design sheet piling system for support of the planned remedial excavation. A waterproof barrier such as Waterloo® or similar approved equal shall be used along the perimeter of the planned excavation (the property perimeter) for a length of 311 linear feet. The Contractor shall determine all size, embedment, bracing and appropriate steel type for the sheeting. The minimum depth of the Waterloo® sheet pile or approved equal shall be 30 feet below existing grade surface.

2. Furnishing all plant, labor, equipment, appliances and materials and, performing all operations in connection with the installation of steel sheet piling and driving of all steel sheet piling including special piling required for closures and corners.

3. Excavation, removal and disposal of all materials and obstructions of whatever nature encountered that interfere with the driving of the sheet piling.

4. Inspection and maintenance of excavation supports.

5. Monitoring the behavior of adjacent structures.

## 1.2 Referenced Codes, Standards and Specifications

A. The codes and standards referenced below shall be in effect at the time of award of contracts, unless otherwise approved by the Volunteer or the Volunteer's Representative. If there is, or appears to be a conflict between this specification and a referenced document, the matter shall be referred to the Volunteer or the Volunteer's Representative for resolution.

1. American Society for Testing and Materials (ASTM)
   a. A36 Specification for Carbon Structural Steel
   b. A328 Standard Specification for Steel Sheet Piling
   c. A572 Specification for High-Strength, Low-Allow Columbium-Vanadium Structural Steel

2. American Welding Society (AWS)
   a. D.1.1: Structural Welding Code – Steel

3. Specifications for Excavation/Dewatering

## 1.3 Submittals

A. The Contractor shall prepare design calculations, signed and sealed by a professional engineer registered in the State of New York for all sheet pile types and sizes to be utilized on the project. The calculations shall be submitted to the Volunteer and the Volunteer's Representatives no later than 10 days after Notice to Proceed and shall be reviewed by the Volunteer's Representatives prior to final approval of the sheet piling system proposed by the Contractor. Calculations shall address each stage of excavation.

B. The Contractor shall prepare, ten days after review and approval of the design calculations, complete and accurate shop drawings of all work covered by this

Section. The drawings shall include the size and spacing of all steel members. All members shall be numbered for identification in erection. Shop drawings shall give complete information necessary for fabrication of component parts of the structure, including location, type and size of all bolts and welds. Shop and field bolts and welds shall be clearly distinguished. Welding symbols used on shop drawings shall be all American Welding Society symbols. The types of steel used for component parts shown shall be noted on each shop drawing. Drawings shall complete dimensioned layout of all steel sheet piling.

C. Contractor shall submit checked shop drawings to the Volunteer's Representative for approval.

D. No steel shall be ordered until such drawings have been approved by the Volunteer's Representative.

E. Welder's certificates for the appropriate classes of welding: Welders shall not be employed on the project prior to their approval by the Volunteer's Representative.

F. The Contractor shall submit details of the quality control program planned for the sheet piling installation to ensure that the requirements of this specification have been met and shall be properly documented.

G. Certification of the License Agreement with Waterloo Barrier®, Inc. or Volunteer approved equal, for the provision of quality control services for the sheet pile installation and joint sealing.

H. Approval by the Volunteer's Representative covers general design of details only and if any change is made, which would cause members not to fit, or

would not give sufficient strength, the Contractor shall call the Volunteer's Representative's attention to the fact at once, in writing so that corrections may be made. If the Contractor fails to do this, the sole responsibility shall rest upon the Contractor.

I. Any error or omission on the Contractor's drawings even though approved, shall not relieve the Contractor from the responsibility of performing the work in accordance with the specifications.

J. Contractor shall submit complete description and plans for monitoring vibration and settlement at the existing structures north and west of the Site, including frequency and threshold movement limits.

K. Any details not sufficiently shown on the plans will be furnished to the Contractor by the Volunteer's Representative upon request.

**1.4 Storage**

A. Material covered by this specification will be stored by the Contractor in the Contractor's facilities, either at the jobsite or at a nearby location. Steel sheet piles and appurtenant materials shall be stacked in a neat, regular and stable fashion. Adequate dunnage shall be provided under and within stacks of sheets at positions to prevent distortion of the sheeting. All necessary precautions shall be taken to prevent damage to the sheeting when handling and transporting. Sheeting or appurtenant materials damaged or distorted in any way may be rejected.

B. The Contractor shall paint an identification number on the inside and outside face of each sheet pile within 2 feet of final grade. The identification number shall be placed on the sheet pile before driving is initiated.

## 1.5 Coordination

A. Notify the Volunteer's Representative at least 5 working days prior to beginning sheet piling operations.

B. The Contractor will be required to schedule work activities and work during installation of the Waterloo Barrier® in conjunction with Volunteer's approved inspector to complete the barrier wall installation in the scheduled time period and to the satisfaction of the Volunteer's Representative.

## 1.6 Quality Assurance

A. Before the Contractor starts the work under this section and/or before he awards a subcontractor the work under this section, the Contractor shall submit evidence satisfactory to the Volunteer's Representative indicating that he, or the firm whom he intends to award a subcontract can conform to the following requirements:

1. That they are experienced in the type of work required, that they have been engaged in performing such work for at least five years and that they have satisfactorily completed at least three projects for work comparable in type, quality, and approximate quantity to that required under this Contract.

2. That they have available for use on this project:
   a) equipment and facilities of adequate size, capacity and type in satisfactory condition;
   b) qualified and experienced design and field engineering personnel and workmen necessary to provide, install and, maintain the lateral support system required under this section.

## 1.7 Performance Requirements

A. Maximum seepage for the waterproof barrier to be installed along the north side, including the northwest corner shall be 1 x $10^{-7}$ cm/sec (centimeters per second).

B. Maximum allowable deflection of the sheeting shall be 2 inches typical and shall be no more than 1 inch along the north side.

## 1.8 Monitoring and Protection of Adjacent Structures

A. A program of pre-construction and post-construction condition surveys shall be planned and implemented to establish monitoring points and criteria for protection of buildings.

B. A series of settlement monitoring points shall be established to monitor the structures for settlement both due to deflection of excavation supports or construction vibration.

C. Vibration monitoring shall be performed at selected points on the structures in order to assess the effects of sheet pile driving.

D. A response plan shall be developed as part of the monitoring program to maintain the progress of the work. The following tentative action thresholds shall be considered part of the plan:

1. Settlement Threshold: Proceed with caution if settlement of 0.01 foot is measured. Stop and implement action if 2 consecutive positive readings are noted.

2. Vibration Threshold: Proceed with caution when readings of 0.5 inch per second peak particle velocity are recorded. Stop and implement corrective measures when velocity exceeds 1.0 inch per second.

## 2.0 PRODUCTS

### 2.1 Materials

A. Structural Steel: New sections with a minimum yield stress of 36,000 pounds per square inch.

B. Waterloo Barrier® Steel Sheet Piles and Joint Sealing System: WZ75 or WEZ95 sheet piles as required, as manufactured by Canadian Metal Rolling Mills (CMRM) shall be used along the Site perimeter for the remedial excavation area. An equivalent system may be approved if the water-tightness of the alternate system is better than or equal to that of the Waterloo Barrier® system.

C. The Contractor will be required to furnish the Volunteer's Representative with three (3) certified copies of the records of chemical and physical tests of steel sheet piling. One bending test will be required upon at least one piece taken at random from every 30 tons of sheet piling. The testing agency shall be approved by the Volunteer's Representative. All costs in connection with testing shall be borne by the Contractor.

## 3.0 EXECUTION

### 3.1 Installation

A. Install the excavation support system in accordance with the approved Contractor Drawings and in such a manner as to prevent movement, settlement or loss of ground, removal of fines from the adjacent ground and damage to, or movement of adjacent structures.

B. The Contractor shall ascertain the location of any utilities or drain lines that pass through the area in which sheet piling is to be driven, and shall protect same during installation of sheet piling.

C. Piles shall be carefully located as shown on the Contractor's Drawings, in accordance with approved shop drawings and driven in a plumb position, each pile interlocked with adjoining piles for its entire length. The Contractor shall drive all piles true to line and shall provide suitable temporary wales or guide structures to insure that the piles are driven in correct alignment. All piles shall be driven to depths shown on the Contractor's drawings and shall extend to the elevations indicated for the tops of the piles.

D. Driving

1. Piles shall be driven by approved methods in such a manner as not to subject the piles to serious injury and to insure proper interlocking throughout the length of the piles.

2. Pile hammers shall be of approved sizes and types and shall be maintained in proper alignment during driving operations by use of suitable leads or by guides attached to the hammer. A protecting cap of approved design shall be employed in driving when required, to prevent damage to the tops of the piles. Vibratory drivers/extractors are also acceptable. All piles shall be driven without the aid of a water jet, unless otherwise authorized.

3. If at any time, the forward or leading edge or the piling wall is found to be out of plumb in the plane of the wall, the piles already assembled and partly driven shall be driven to full depth and the Contractor shall pro-

vide and drive tapered piles or take other corrective measures to insure plumbness of succeeding piles. The maximum permissible taper for any tapered pile will be one eighth (1/8) of an inch per square foot of length.

4. Each run of piling shall be driven to grade progressively from the start and no pile shall be driven to a lower grade than those behind it in the same run, except when the piles behind it cannot be driven deeper. If the pile next to the one being driven tends to follow below the final grade, it may be pinned to the next adjacent pile.

5. Piles driven out of an interlock with adjacent piles or otherwise injured shall be removed and replaced by new piles at the Contractor's expenses. Piles shall not be driven within 100 feet of concrete that is less than 7 days old.

6. Records shall be kept of each sheet pile driven, including the initial length of pile, final pile depth, and final stick-up before cut-off to final elevation. Notes on any unusual behavior of the pile or pile damage shall also be made. Forms for this purpose shall be supplied by the Contractor and approved by the Volunteer or the Volunteer's Representative before installation of sheet piling one week before installation of sheet piling starts.

E. Plumbness and Alignment – The maximum permissible vertical tolerance (plumbness) in the Waterloo Barrier® sheet pile installation shall not be greater than a deviation of 1/5 inch per 1-foot vertical. The integrity of the interlock between adjacent piles shall be verified by flushing the joint. Joint inspection and flushing shall be performed by the Quality Assurance/Quality Control Technician (C3 Environmental Limited of alternate approved contractor). The

Waterloo Barrier® system pile installation (or approved equivalent) practices shall be strictly followed.

F. Cutting and Splicing Piles – Accepted piles driven to final tip depth and extending above cut-off elevation shall be cut-off to required grade. Piles driven below grade and piles which, because of damaged heads have been cut-off to permit further driving and are then too short to reach final grade shall be extended to the required grade by welding an additional length, when directed, without cost to the Volunteer. The Contractor shall trim the tops of piles damaged during driving, when directed to do so, at no cost to the Volunteer. Cut-offs shall become the property of the Contractor and shall be removed from the site.

G. If necessary, pre-excavate prior to installation of excavation support wall to remove obstructions.

H. Waterloo Barrier® system piles shall have a foot plate welded to the base of each female joint of the sealable sheet piling to prevent soil from entering the joint as the pile is driven into the ground. The Contractor shall be responsible for all cutting of sheet piles and attachment of the foot plates.

I. Joint Sealing

1. All sheet pile joints are to be sealed. Joint sealing shall be completed by C3 Environmental or alternate approved contractor.

2. Joint sealing shall not be performed within 100 feet of the sheet pile installation operation or until a satisfactory inspection is achieved.

3. Aster the sheet piling has been installed in the ground, all sealable cavities shall be checked by probing and flushing of the joints with pressurized water to remove any loose material.

4. A tremie hose or tube for pressure injection of the sealant shall be inserted into the sealable cavity. When the tube has reached the bottom of the hole, sealant injection will begin. The hose shall be withdrawn progressively up the hole as the sealant fills the space below. Keep tremie nozzle at least 1 foot below the rising surface of the sealant.

J. Provide accurate records of each sheet pile driven. Submitted records shall include the following information.

1. Pile Identification Number
2. Date and time of driving
3. Elevation of top of pile
4. Length of sheet pile in the ground when driving is complete
5. Driving logs showing the time to install each foot of each sheet pile
6. Detailed remarks concerning alignment, obstructions, etc.
7. Plumbness records of each sheet pile installed
8. Joint flushing records for each joint installed

**3.2 <u>Bracing for Support System</u>**

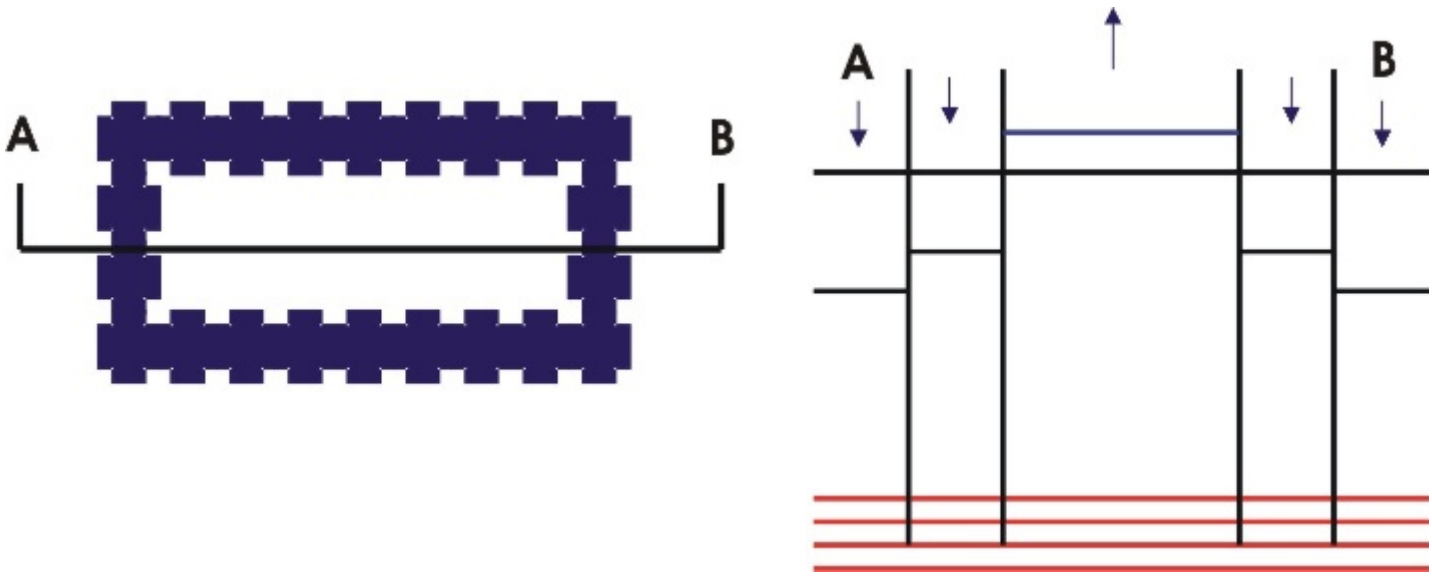
A. When wales are used, obtain tight bearing between wales and wall and ample bearing area with wedges and packing for load transfer.

B. Install and maintain internal support members in tight contact with each other and with the surface being supported.

# Performance

Since 1989, more than 20 test cells have been installed by UW for field research purposes at Borden and another site in southwestern Ontario. These have ranged in dimensions from 1 by 3 to 9 by 9 m, and have extended to depths ranging from approximately 3 to 15 m. Several of these cells have been constructed with concentric double walls, a configuration which facilitates rigorous hydraulic testing. Figure 1 shows a schematic diagram of such a double-walled cell in which a hydraulic test was undertaken. The cell extends to a depth of 14.7 m through a surficial sand aquifer into an underlying aquitard. The sealable cavities were injected with a benonite slurry. For the test, the water level in the moat bounded by the two walls was maintained at a constant level. At the start of the test, the water level in the internal cell was raised by approximately 1 m relative to the natural water table in the vicinity of the cell. As the test proceeded, the decline in water level in the internal cell was monitored with time. Corrections were made to these levels to account for losses by evaporation.

**Figure 1. Camp Borden Hydraulic Conductivity Testing Results**



In applying an analytical solution to assist in interpretation of data, it was assumed that the underlying aquitard was impermeable and that all leakage from the internal cell occurred laterally through the barrier wall. In reality, some vertical leakage into the underlying aquitard would have occurred, so this assumption would result in an overestimation of the hydraulic conductivity of the barrier. As shown in Figure 2, the bulk hydraulic conductivity of the cell wall was calculated to be 6 x $10^{-9}$ cm.sec. Similar tests in other cells, including those sealed with organic polymers, resulted in bulk hydraulic conductivities ranging from $10^{-8}$ to $10^{-10}$ cm/sec.

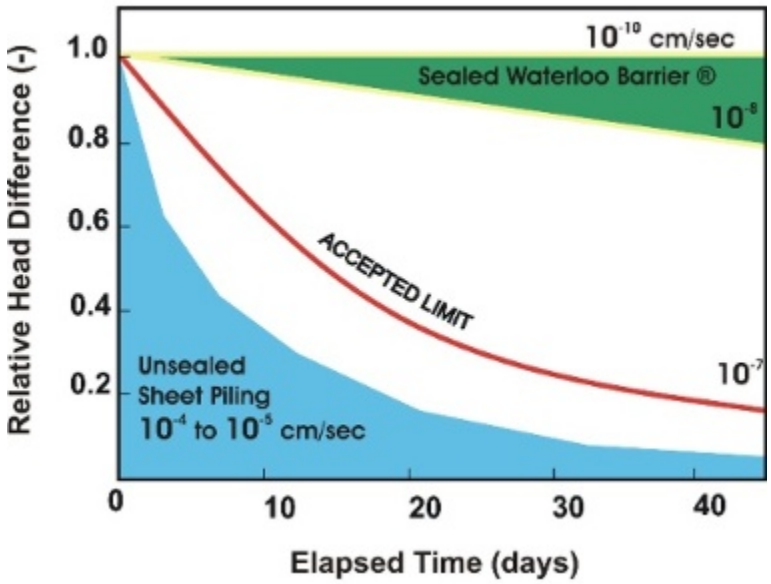
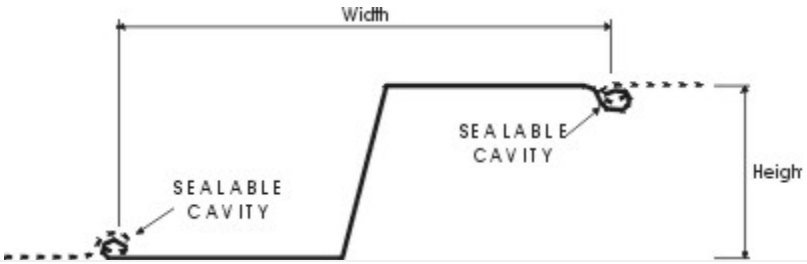



**Figure 2. Hydraulic Test Results**

# Specifications

The Waterloo Barrier® is available in two designs:

1. Medium wall - WZ75
2. Heavy wall - WEZ95




| Section | Thickness | Height | Nominal Width | Section Area | Weight | Weight | Moment of Inertia | Radius of Gyration | Section Modulus |
|---|---|---|---|---|---|---|---|---|---|
| | in (mm) | in (mm) | in (mm) | $in^2$ ($cm^2$) | lbs/lin. ft (kg/lin. m.) | $lbs/ft^2$ ($kg/m^{2)}$ | $in^4$/wall ft. ($cm^4$/wall m) | in (mm) | $in^3$/wall ft. ($cm^3$/wall m) |
| **WZ75** | 0.295 (7.50) | 8.72 (221) | 24.00 (610) | 10.7 (69.0) | 36.6 (54.3) | 18.3 (89.1) | 69.3 (9460) | 3.60 (91.4) | 15.9 (860) |
| **WEZ95** | 0.375 (9.50) | 10.81 (275) | 25.0 (635) | 14.9 (96.2) | 50.5 (75.2) | 24.3 (119) | 134 (18300) | 4.33 (110) | 24.9 (1340) |

**The Waterloo Barrier® is manufactured under license by Canadian Metal Rolling Mills in Cambridge, Ontario.**

## Raw Material:

- ASTM A572 GR50
- CSA G40.21 GR 350W

## Manufacturing:

- ASTM A6
- CSA G40.20

## Coatings:

1. GALVANIZED, ASTM A123, CSA G164
2. COAL TAR EPOXY, SSPC-16
3. FUSION BONDED EPOXY RESIN, ASTM A950

## Accessories:

- BENDS CAN BE SUPPLIED TO ANY ANGLE
- 'T' SECTIONS AND OTHER WELDED FABRICATIONS ARE AVAILABLE