

# UNDERWATER INSPECTION REPORT

LAKEFRONT WALKWAY  
AND  
CLEVELAND MEMORIAL SHOREWAY  
Job Number 12160OH11.00



**DECEMBER 6, 2012**

PREPARED FOR THE



OHIO DEPARTMENT OF TRANSPORTATION

BY



**INFRASTRUCTURE  
ENGINEERS, INC.**

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## **1.1 Purpose and Scope**

On December 3<sup>rd</sup>, 4<sup>th</sup>, and 6<sup>th</sup>, Infrastructure Engineers, Inc. performed an inspection of the shoreline protection elements at the Lakefront Walkway and Cleveland Memorial Shoreway in Cleveland, Ohio. The inspection limits were from 3-feet above the waterline to the channel bottom. This report includes a general description of each shoreline protection element inspected, a description and evaluation of the observed conditions, and recommendations for repairs.

## **1.2 General Facility Description**

The elements inspected at this facility consist of approximately 1,711 linear feet of steel sheet pile bulkhead and 1,805 linear feet of concrete jetties and riprap revetments. The West Bulkhead is located adjacent to North Marginal Road. The South Bulkhead is located adjacent to the Cleveland Memorial Shoreway (I-90). The riprap revetments and concrete jetties surround the intake and outflow canals for the adjacent power plant. Refer to Figure 1 on Page B-1 for a plan sketch of the facility.

Circular steel sheet pile cells that were backfilled and topped with concrete make up the West and South Bulkheads. Refer to Photograph 1 for a view of the typical bulkhead construction. Refer to Photographs 2 and 3 for views of a typical portion of riprap revetment and concrete jetty, respectively.

In addition to the shoreline protection elements, two circular steel sheet pile dolphins located between the intake and outflow canals for the adjacent power plant were also inspected. Each dolphin is constructed of a circle of steel sheet pile backfilled with earth; each dolphin is approximately 30-feet in diameter. The west side of the West Dolphin could not be inspected since it is obstructed by the adjacent concrete jetty. Refer to Photographs 4 and 5 for views of the east and west dolphins, respectively.





### **1.3 Method of Investigation**

The underwater inspection team consisted of four commercial diver inspectors including two NBIS qualified bridge inspection team leaders. This inspection consisted of a visual/tactile hands on inspection supplemented with ultrasonic thickness measurements taken on the steel sheet piling and underwater acoustic imaging.

Underwater acoustic imaging of each element and the channel bottom in the vicinity of the riprap revetments and concrete jetties were taken. The diving inspection consisted of a 100% Level 1 inspection of the West and South bulkheads. Ultrasonic thickness measurements were taken at the waterline and at the channel bottom at 100-foot intervals along each bulkhead. These areas were cleaned of marine growth to allow a visual/tactile inspection of the surface beneath and for the ultrasonic thickness measurements.

### **2.0 Inspection Findings**

At the time of inspection, the waterline was located 10-feet below the top of the West Bulkhead. Based on the available plans, this translates to waterline ELEV. 570.3.

All steel sheet pile joints are tightly interlocked with no evidence of backfill loss. All of the steel sheet piling has light to moderate surface corrosion, pitting, and section loss from 3-feet above the waterline to 2-feet below the waterline. Refer to Photographs 6 through 8 for views of the typical steel sheet pile condition at the waterline and below water.





The original thickness of the steel sheet pile is 0.375-inch. At the channel bottom, both bulkheads have more than 80% of their original section remaining on average.

At the waterline, the West Bulkhead has approximately 72% of its original section remaining on average. At one isolated location, 500-feet from the south end, the West Bulkhead has a minimum of 53% of the original section remaining at the waterline. On average, the South Bulkhead has 75% of its original section remaining at the waterline.

Table 2.1 shows a summary of the ultrasonic thickness measurements taken on the West and South Bulkheads. Refer to Table 1 in Appendix C for a detailed list of all ultrasonic thickness measurements taken during this inspection.

**Table 2.1 – Steel Sheet Pile Ultrasonic Thickness Measurements**

Element	Location				Average % Remaining (Waterline)
	Waterline		Channel Bottom		
	Average Thickness (in.)	Minimum Thickness (in.)	Average Thickness (in.)	Minimum Thickness (in.)	
West Bulkhead	0.270	0.200	0.332	0.315	72%
South Bulkhead	0.281	0.240	0.335	0.310	75%
West Dolphin	0.357	0.330	0.362	0.345	95%
East Dolphin	0.343	0.315	0.346	0.330	91%

No evidence of significant scour or migration of the riprap revetments or concrete jetties was observed. Refer to Figures 2 through 5 in Appendix B for views of the acoustic images along the bulkheads, revetments, and jetties.



### **3.0 Evaluation and Assessment**

The submerged portions of the West and South Bulkheads are generally in fair condition due to the corrosion and section loss at the waterline. Areas of section loss greater than the average are isolated. Based on the average section loss and the cell type construction of the bulkheads, the deterioration does not likely have a significant effect on the performance of the bulkheads.

The East and West Dolphins are in good condition. Both dolphins have minor deterioration that does not significantly affect their structural capacity.

The riprap revetments and concrete jetties are in good condition. There are no noteworthy deficiencies and no significant scour or migration was observed.

### **4.0 Recommendations**

- Clean and coat the West and South Bulkheads from 3-feet above the waterline to 3-feet below the waterline with a suitable protective system (splash zone A-788 or similar) to prevent further corrosion and section loss.
- There are no repair recommendations for the riprap revetments or concrete jetties at this time.



**Appendix A**  
**Photographs**





Photograph 1: West Bulkhead looking northwest, typical of the West and South Bulkheads.



Photograph 2: Riprap revetment east of the intake canal, typical of all riprap revetments.







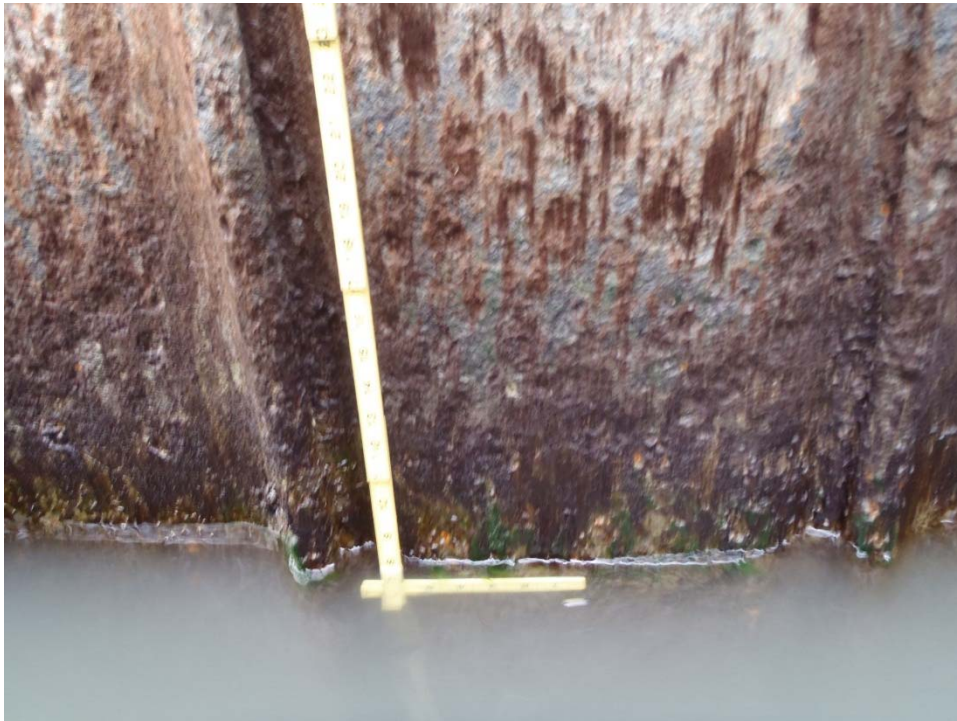
Photograph 3: Concrete jetty at the north end of the intake canal, typical of all concrete jetties.



Photograph 4: East Dolphin.



Photograph 5: West Dolphin.

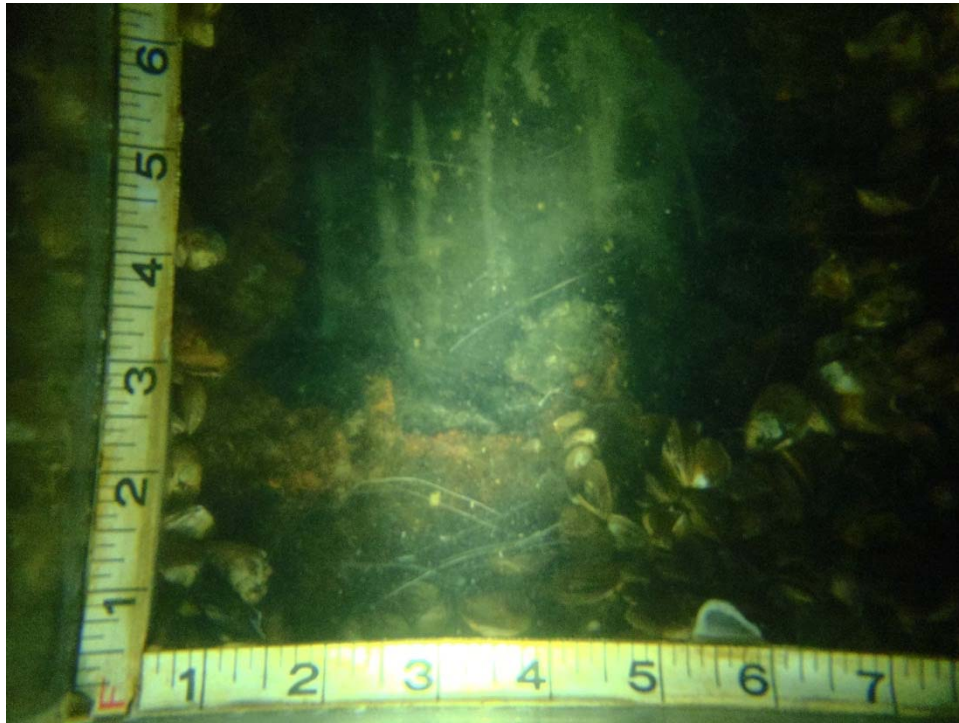


Photograph 6: Typical steel sheet pile condition at the waterline.





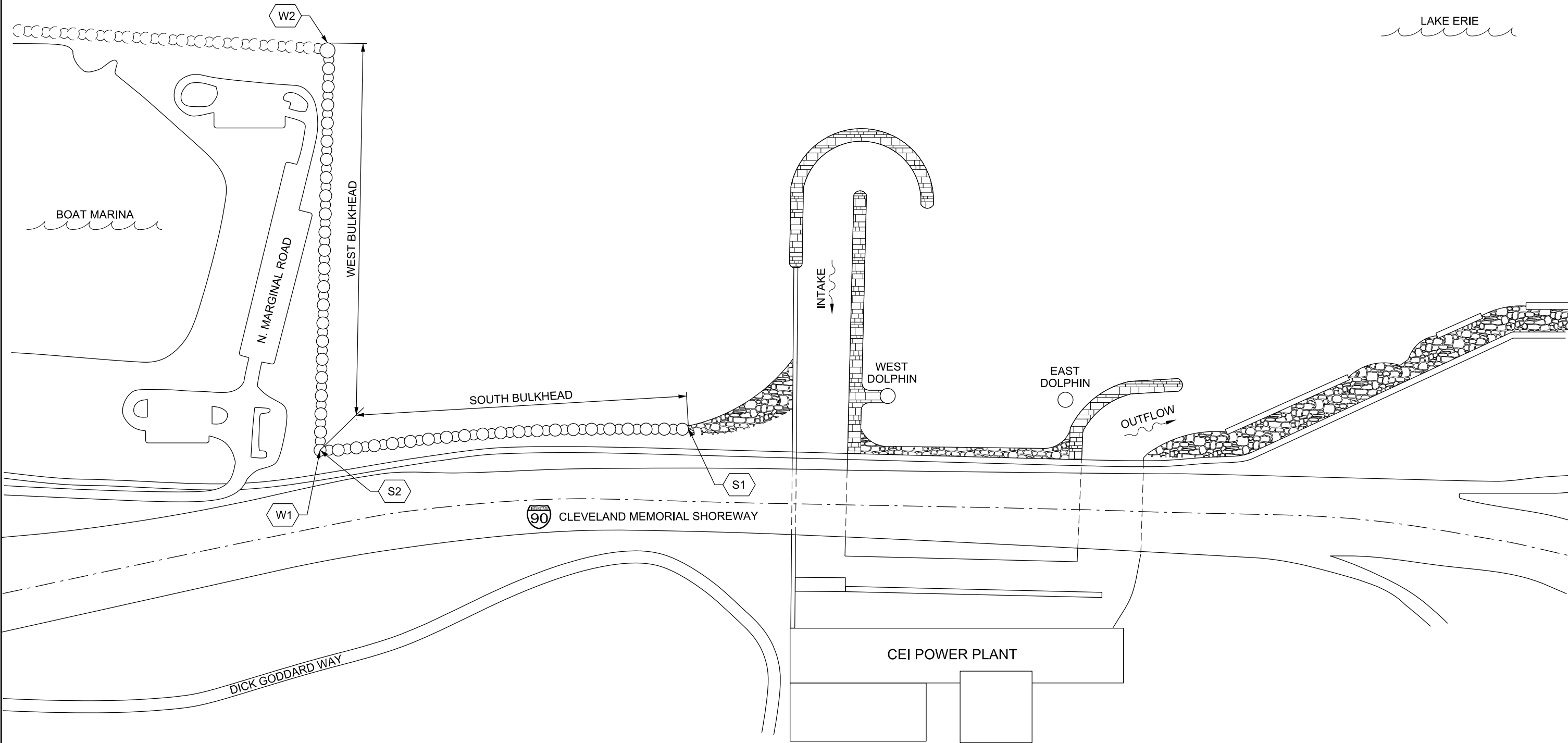
Photograph 7: Typical steel sheet pile condition in a cleaned area at the waterline.







Photograph 8: Typical steel sheet pile condition in a cleaned area below the waterline.

# **Appendix B**

## **Figures**



- LEGEND:**
-  STEEL SHEET PILE BULKHEAD
  -  RIPRAP SLOPE PROTECTION
  -  CONCRETE BLOCK JETTY
  -  ACOUSTIC IMAGE REFERENCE POINT

PROJECT OVERVIEW PLAN  
NOT TO SCALE


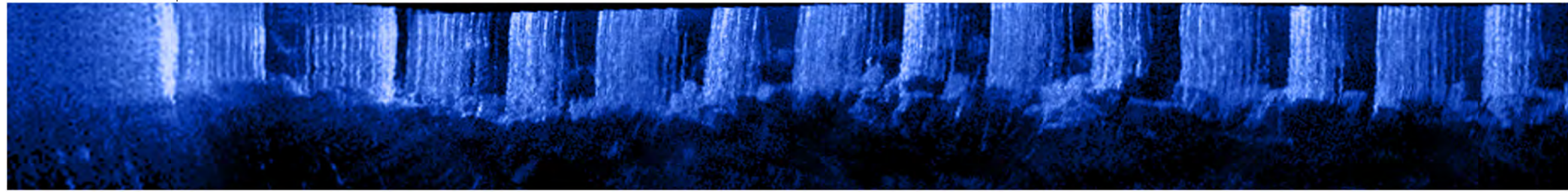
 200 E. Campus View Blvd. Suite 200 Columbus, OH 43235 614-310-3048 INFRASTRUCTURE ENGINEERS, INC.	DATE	 OHIO DEPARTMENT OF TRANSPORTATION JOB NO. 12160OH11	LAKEFRONT WALKWAY AND CLEVELAND MEMORIAL SHOREWAY	FIGURE 1
	DEC, 2012		GENERAL SITE PLAN	PAGE B-1



FIGURE 1 REFERENCE POINT



NORTH



MATCHLINE "A"

NORTH



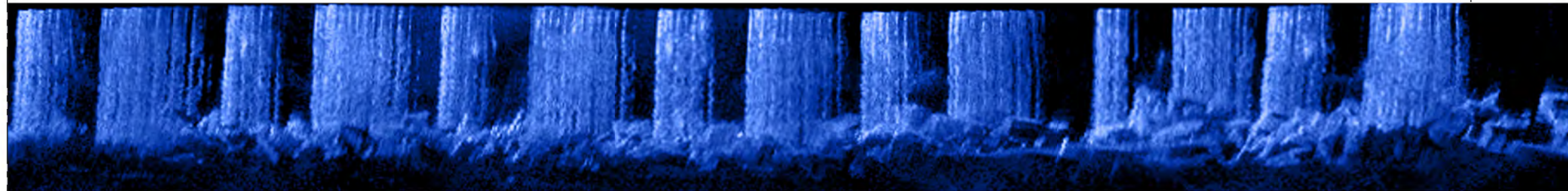
MATCHLINE "A"

MATCHLINE "B"

FIGURE 1 REFERENCE POINT



NORTH



MATCHLINE "B"

WEST BULKHEAD  
(EAST ELEVATION)


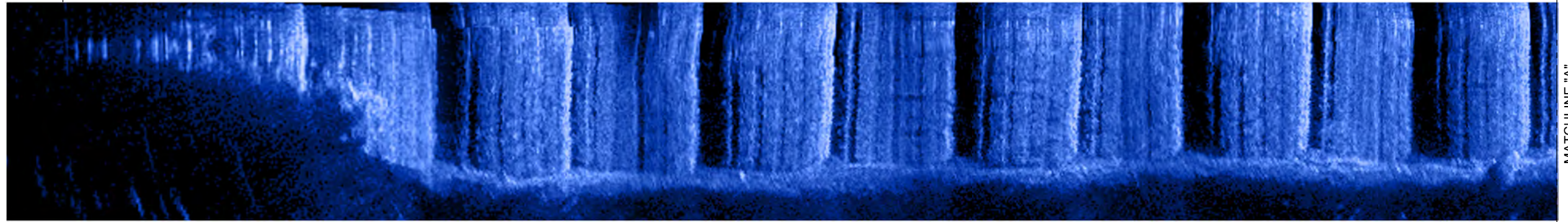
 200 E. Campus View Blvd. Suite 200 Columbus, OH 43235 614-310-3048 <b>INFRASTRUCTURE ENGINEERS, INC.</b>	DATE	 OHIO DEPARTMENT OF TRANSPORTATION JOB NO. 12160OH11	LAKEFRONT WALKWAY AND CLEVELAND MEMORIAL SHOREWAY	FIGURE 2
	DEC, 2012		WEST BULKHEAD ACOUSTIC IMAGING (EAST ELEVATION)	PAGE B-2



FIGURE 1 REFERENCE POINT

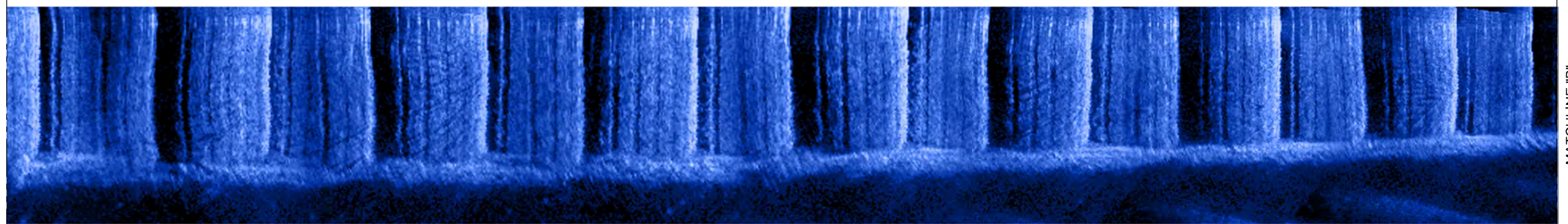
S1

WEST



MATCHLINE "A"

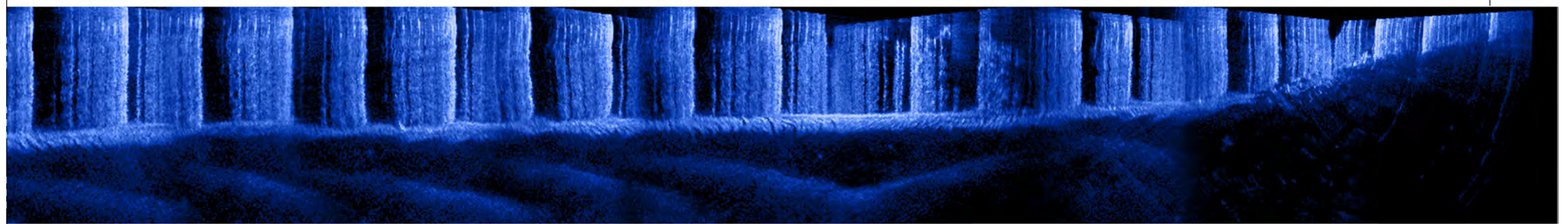
WEST



MATCHLINE "A"

MATCHLINE "B"

WEST



MATCHLINE "B"

FIGURE 1 REFERENCE POINT

S2

SOUTH BULKHEAD  
(NORTH ELEVATION)



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JOB NO. 12160OH11

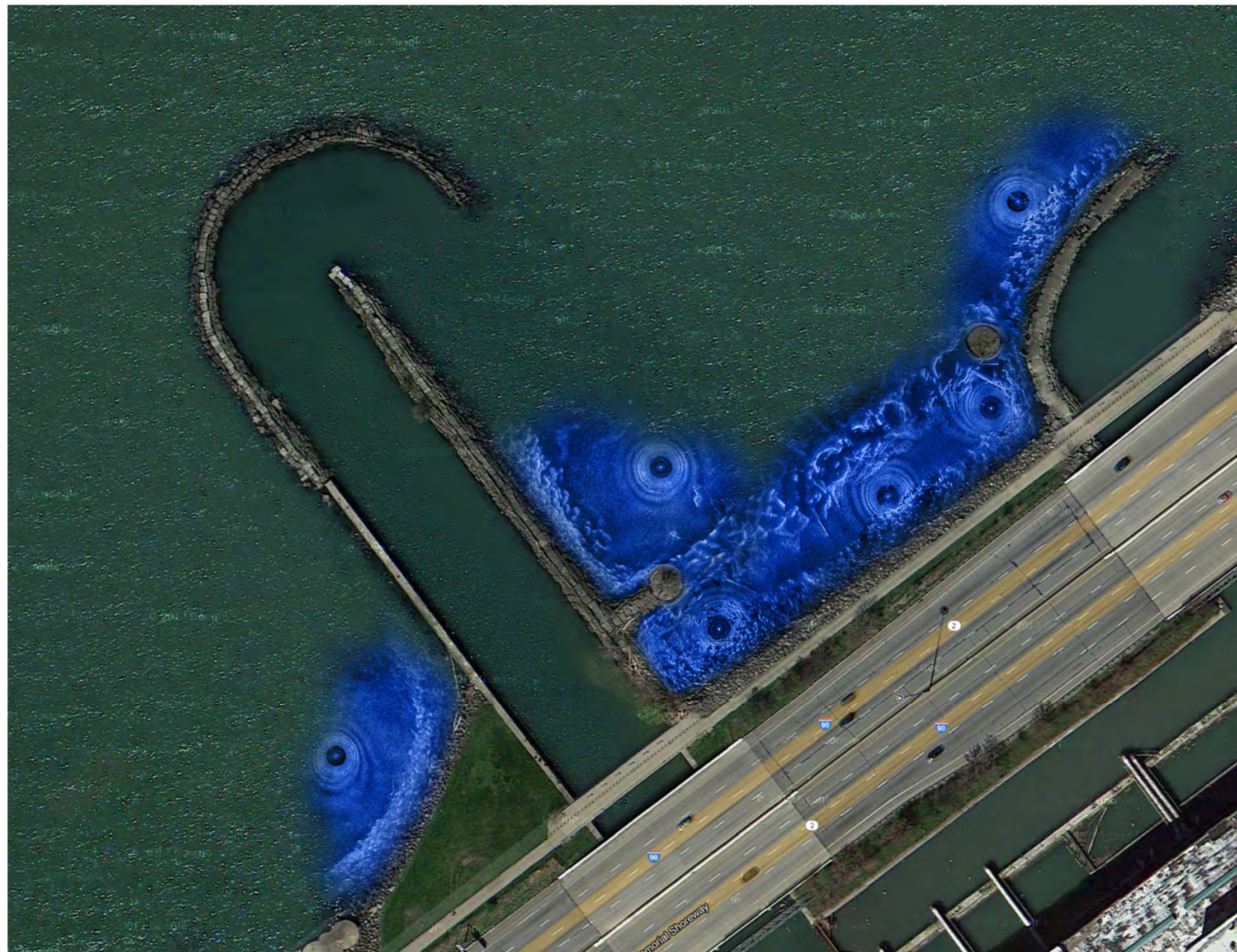
LAKEFRONT WALKWAY AND  
CLEVELAND MEMORIAL SHOREWAY

SOUTH BULKHEAD ACOUSTIC IMAGING  
(NORTH ELEVATION)


FIGURE  
3

PAGE  
B-3

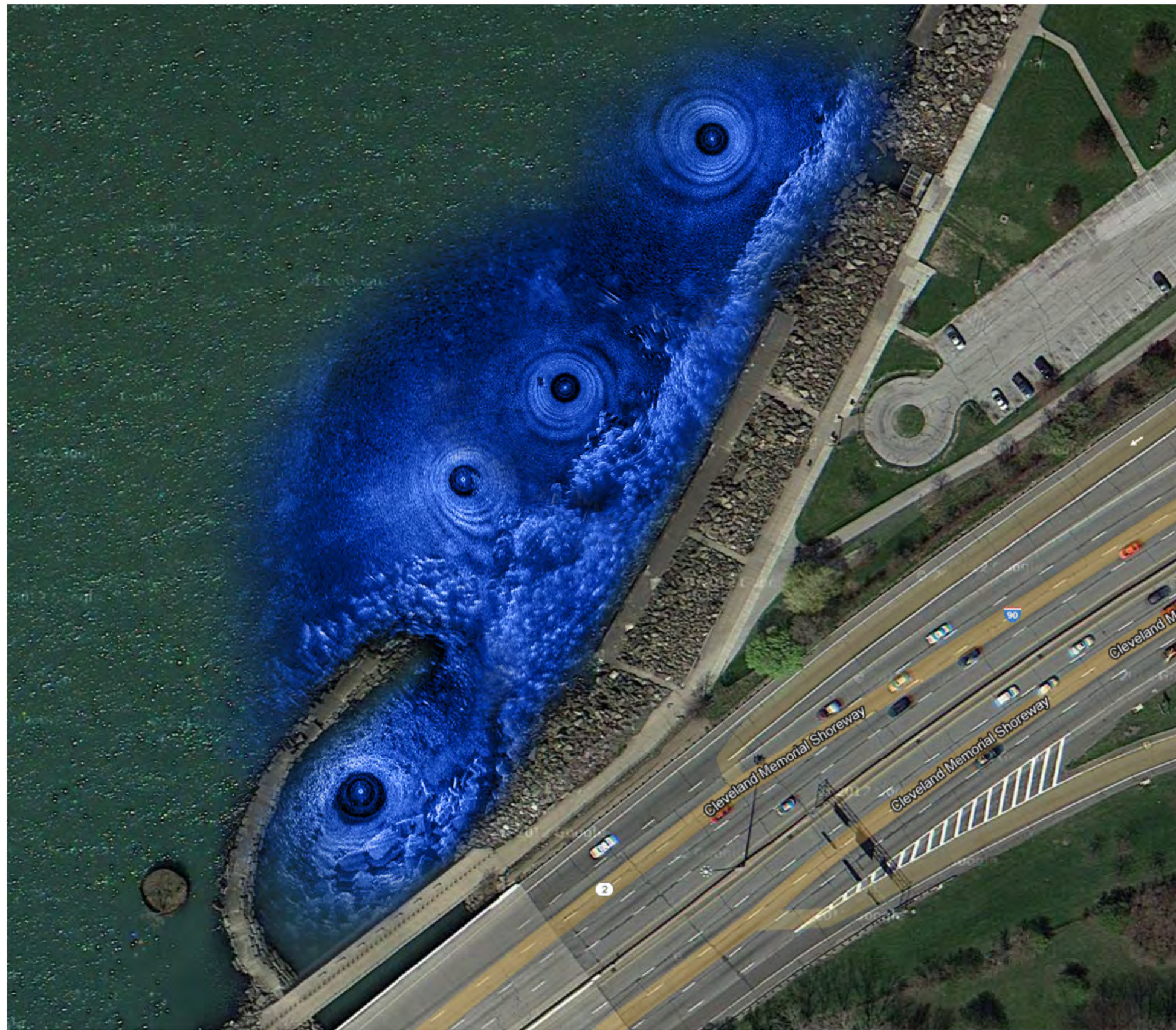





INTAKE SHORELINE ACOUSTIC IMAGING

 <p>200 E. Campus View Blvd. Suite 200 Columbus, OH 43235 614-310-3048</p> <p>INFRASTRUCTURE ENGINEERS, INC.</p>	<p>DATE</p> <p>DEC, 2012</p>	 <p>OHIO DEPARTMENT OF TRANSPORTATION</p> <p>JOB NO. 12160OH11</p>	<p>LAKEFRONT WALKWAY AND CLEVELAND MEMORIAL SHOREWAY</p> <p>INTAKE SHORELINE ACOUSTIC IMAGING (INTAKE SHORELINE PROTECTION PLAN)</p>	<p>FIGURE 4</p> <p>PAGE B-4</p>
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OUTFLOW SHORELINE ACOUSTIC IMAGING

 <p>200 E. Campus View Blvd. Suite 200 Columbus, OH 43235 614-310-3048</p> <p>INFRASTRUCTURE ENGINEERS, INC.</p>	<p>DATE</p> <p>DEC, 2012</p>	 <p>OHIO DEPARTMENT OF TRANSPORTATION</p> <p>JOB NO. 12160OH11</p>	<p>LAKEFRONT WALKWAY AND CLEVELAND MEMORIAL SHOREWAY</p> <p>OUTFLOW SHORELINE ACOUSTIC IMAGING (OUTFLOW SHORELINE PROTECTION PLAN)</p>	<p>FIGURE 5</p> <p>PAGE B-5</p>
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**Appendix C**  
**Reference Materials**



**Table 1 – Full List of Ultrasonic Thickness Measurements**  
(All Measurements in Inches)

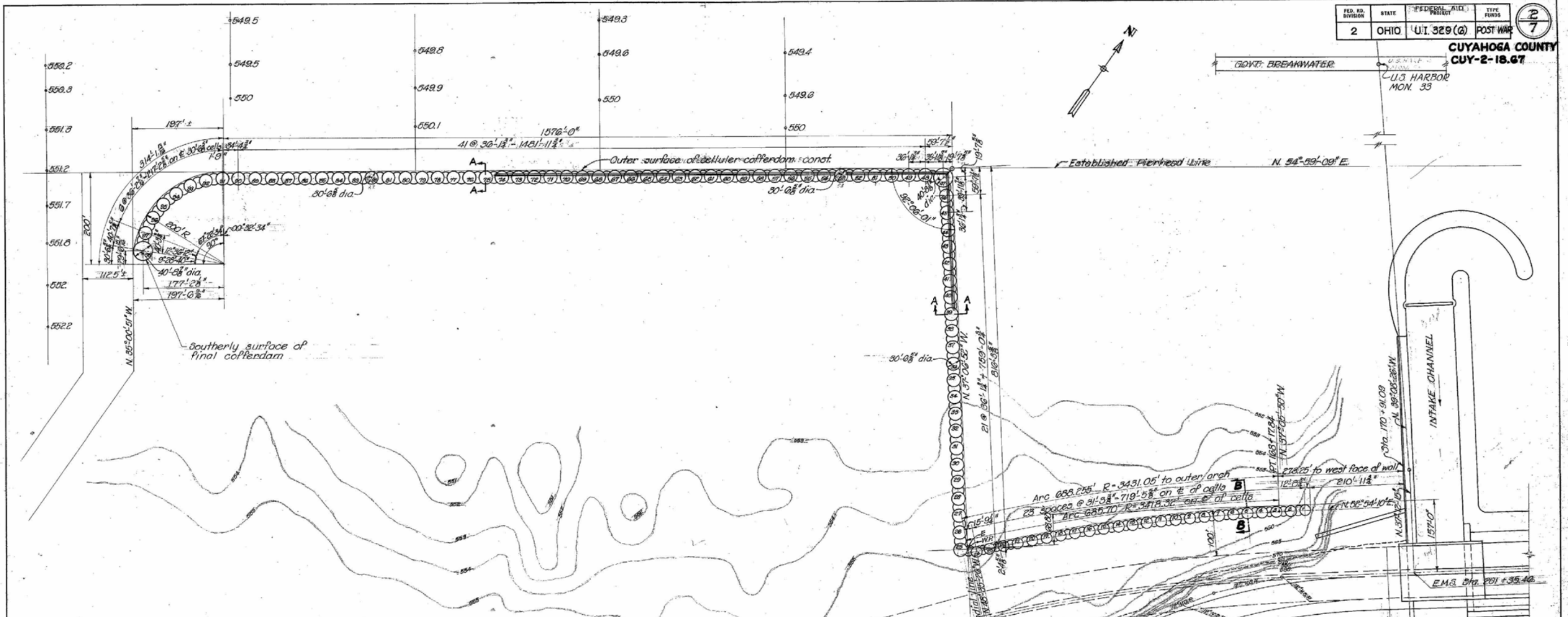
<b>West Bulkhead</b>		
	Original Thickness=	0.375
Location from South End (ft)	Waterline (in)	Channel Bottom (in)
0	0.245	0.350
100	0.290	0.320
200	0.300	0.330
300	0.340	0.350
400	0.285	0.315
500	0.200	0.340
600	0.280	0.315
700	0.250	0.320
800	0.225	0.345
Average:	0.268	0.332
Median	0.280	0.330
Mode:	N/A	0.350
Minimum:	0.200	0.315
Average Section Loss:	28.4%	11.6%
Maximum Section Loss:	46.7%	16.0%
Average % Remaining:	71.6%	88.4%
Minimum % Remaining:	53.3%	84.0%

<b>South Bulkhead</b>		
	Original Thickness=	0.375
Location from East End (ft)	Waterline (in)	Channel Bottom (in)
0	0.315	
50	0.285	0.320
150	0.275	0.310
250	0.285	0.340
350	0.315	0.345
450	0.240	0.340
550	0.265	0.325
650	0.275	0.365
750	0.275	
Average:	0.281	0.335
Median	0.275	0.340
Mode:	0.275	0.340
Minimum:	0.240	0.310
Average Section Loss:	25.0%	10.7%
Maximum Section Loss:	36.0%	17.3%
Average % Remaining:	75.0%	89.3%
Minimum % Remaining:	64.0%	82.7%

<b>West Dolphin</b>		
	Original Thickness=	0.375
Location from East End (ft)	Waterline (in)	Channel Bottom (in)
North	0.375	0.345
South	0.330	0.365
East	0.365	0.375
West		
Average:	0.357	0.362
Minimum:	0.330	0.345
Average Section Loss:	4.9%	3.6%
Maximum Section Loss:	12.0%	8.0%
Average % Remaining:	95.1%	96.4%
Minimum % Remaining:	88.0%	92.0%

<b>East Dolphin</b>		
	Original Thickness=	0.375
Location from East End (ft)	Waterline (in)	Channel Bottom (in)
North	0.335	0.345
South	0.355	0.360
East	0.315	0.330
West	0.365	0.350
Average:	0.343	0.346
Minimum:	0.315	0.330
Average Section Loss:	8.7%	7.7%
Maximum Section Loss:	16.0%	12.0%
Average % Remaining:	91.3%	92.3%
Minimum % Remaining:	84.0%	88.0%





**ESTIMATED QUANTITIES**

WALL CELLS #1 TO #24 INCL.				WALL CELLS #25 TO #98 INCL.			
ITEM	UNIT	DESCRIPTION	QUANTITY	ITEM	UNIT	DESCRIPTION	QUANTITY
Special	Cu yds.	Fill in cells	15,200	Special	Cu yds.	Fill in cells	14,800
Special	Lbs.	Steel sheet piling	2,608,700	Special	Cu yds.	Fill along heel of wall	18,300
				5-1	Cu yds.	Class "E" concrete, slab f wave roll back	6,420
				5-4	Lbs.	Reinforcing steel	700,000
				5-9	Lbs.	Expansion joint plates	22,000
				Special	Lbs.	Steel sheet piling	12,995,600
				Special	Each	6" dia. extra strong pipe sleeves - 1'-9" long	594
				Special	Sq. Ft.	Asphalt cement	12,000
				Special	Tons	Stone toe protection	10,000
				Special	Lin. Ft.	Wapco No. 38 joint sealing compound or equiv.	5,900

NOTE: Elevations & soundings are in feet & tenths and are referred to Low Water Datum El. 570.6

CELL NOS	ELEVATION	ELEVATION
	TOP OF SHEET PILES	BOTTOM OF SHEET PILES
1 to 24 incl.	578.25	538.0
25 and 26	578.25	538.0
27, 28 and 29	578.25	533.0
30, 31 and 32	578.25	530.0
33, 34 and 35	578.25	528.0
36, 37 and 38	578.25	528.0
39 to 98 incl.	578.25	520.6

Top of sheet piling cross walls in cell 47 & 98 shall be at El. 578.25 with bottoms at El. 520.6.

Cells nos 25 to 98 shall be capped with rein. concrete, varying from 14" to 20" in thickness. Wave roll back on top of cells shall extend from cell No 25 to cell No 98.

Circular segment walls shall have tops at elevation of adjacent cell piles with bottoms at lowest elevation of piling in adjacent cells.

STATE OF OHIO  
DEPARTMENT OF HIGHWAYS

**LOCATION PLAN AND ESTIMATED QUANTITIES**

**EAST 55<sup>TH</sup> STREET SEA WALL**

CUYAHOGA COUNTY  
SECT. CUY-2-18.67

DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
CEI	CEI	NEY	CEI	WHE	6-10-52	6-10-52