

### Design Example A

*The following example demonstrates the design of an armor stone revetment as erosion protection at a site with high (50 to 60-foot) bluffs along the shore. The project site is fictitious but similar to the coastal features common to Ashtabula County and eastern Lake County.*

### Project Purpose

The purpose of Example Project A is to protect the toe of the glacial till bluffs from erosion due to wave action. An armor stone revetment was selected to best achieve the project purpose at this site.

### Site Description

The Design Example A site is located along the shore of Lake Erie in Saybrook Township, Ashtabula County, Ohio, approximately 6 miles west of the Ashtabula Port. The shore along this stretch is fairly uniform with small embayments and headlands. The project shore is oriented from southwest to the northeast. The predominant direction of sediment transport in the littoral zone is from west to east.

The shore at the project site consists of 50 to 55 foot glacial till bluffs reaching an elevation of 630 feet as referenced to the International Great Lakes Datum of 1985 (IGLD 1985). The toe of the bluff is located at approximately 575 feet IGLD 1985 and is covered with concrete rubble fill. A narrow, 10 to 15-foot wide, sand and gravel beach is perched above a wall of existing concrete block modules.



The geology of the area consists of a thin layer of top soil or fill over a thick (25 to 30-foot) layer of soft glacial till. Below is a thick (30 to 35-foot) layer of hard glacial till over shale bedrock at approximately 570 feet of elevation (referenced to IGLD 1985). Shale bedrock is exposed in the nearshore and slopes at 3 to 4 degrees for the first 100 feet then continues at a shallower (1 degree) slope farther offshore.

The site is exposed to storm waves from all angles from west-southwest to east-northeast. A review of historic wave information results in a significant wave height of 3.3 feet at a period of 4.3 seconds. The most frequent wave direction was from the southwest. The largest wave recorded over the 32 year study was 16.4 feet with a 9.0 second wave period, from the west. The average direction of the largest waves was 264.0 degrees. Wave data was measured at WIS station E14 located approximately 10 miles north of the project site in 72-foot deep water.

The project site is located in a designated Coastal Erosion Area based on the Final 2010 mapping with an expected erosion rate of 34.2 to 42.9 feet over 30 years. There are no surface drainage issues causing erosion at the project site.

The shoreline in this area is generally consistent; the eastern and western adjacent properties are similar to the project site. The bluff and upland topography are constant in this area. Both the eastern and western

adjoining properties include a small sand and gravel beach held in place with large concrete blocks and vertical concrete sewer pipes. The concrete rubble at the toe of the bluff is continuous across the site and adjoining properties.

## Field Survey

The upland parcel is located within Connecticut Western Reserve district of Ohio's Public Lands Survey System more specifically part of Original Lot (O.L.) 55, Fractional Section 3, Town 13 North, Range 4 West. Being within Saybrook Township and outside of any incorporated municipal boundaries, the parcel boundary extends to the centerline of the county road with a sixty (60) foot right of way reservation for public ingress and egress centered on said centerline.

Horizontal control was established for this site by evaluating the location of published monumentation through the National Geodetic Survey (NGS) website: [www.ngs.noaa.gov](http://www.ngs.noaa.gov). The closest station to this site was determined to be "Woodring" (PID MB2112) which is approximately one (1) kilometer east. Based upon the NGS datasheet, the horizontal accuracy of the station is Third Order with reports that attempt to recover the station failed in 1993 and 1996. Therefore this station was not used within the horizontal control network.

*These photos show the view from standing atop the bluff looking out at Lake Erie (this page) and from standing on the beach (left page) looking toward the bluff. This site has similar characteristics to Design Example A.*



Global Positioning System (GPS) observations of approximately 30 minutes in length were performed on two control stations along Lake Road West. The raw data files were uploaded to the NGS Online Positioning User Service (OPUS) for the rapid-static sessions. The resultant Ohio State Plane 3401(NAD 83) coordinates provided by the OPUS solution were utilized as the controlling stations for an adjusted closed field traverse.

Vertical control was established for this site by evaluating the location of published monumentation through the NGS website. The closest station to this site was determined to be “P 8” (PID MB1001) which is approximately 4 kilometers southeast. Based upon the NGS datasheet the vertical accuracy of the station is First Order Class II with reports that attempt to recover the station were successful in 1993 and 2009. The U.S. Coast and Geodetic Survey disk, established in 1934, has a reported dynamic height of 645.93 feet at 45 degrees latitude. NGS Vertical Datum Transformation software (VDatum) was used to adjust for the hydraulic corrections for the project location based upon the latitude and longitude positions in the OPUS solution. The resultant adjusted elevations provided by a closed level circuit were utilized for the project after confirming the elevation, relative to IGLD 1985, of the control stations by benching into the water level on a calm day with minimal wave activity and comparing that value to the water level station data retrieved from NOAA’s Great Lakes Online website: [www.glakesonline.nos.noaa.gov/monitor.html](http://www.glakesonline.nos.noaa.gov/monitor.html) for station #9063053 (Fairport Harbor).

With the horizontal and vertical control network established, recovery of boundary evidence was performed. Monumentation found and held as controlling stations included a ¾-inch iron pin in a monument box at the southwest corner of O.L. 55 and a 2-inch splined axel shaft at the southeast corner of O. L. 55. Subsequent intermediate points were located along Lake Road West including P-K nails found at the southwest and southeast corners of the subject parcel and were used in the final determination of the upland parcel boundary lines.

A topographic survey was performed that located the cultural (i.e. buildings, survey monuments,

coastal structures) and natural (i.e. top and toe of bluff) features on the subject parcel and adjoiners. Presence of concrete modules and rubble along the bluff and shore indicate that fill material has been placed artificially and has altered the location of the natural shoreline.

### Analysis

A technical assistance request was made to the ODNR Office of Coastal Management to help in identifying the location of the natural shoreline prior to the artificial placement of the concrete material. A drawing was provided to the consultant that depicted the location of the natural shoreline on the April 1973 aerial photograph. This location was transferred to the site and compared to the descriptions within the current and previous title deeds. The natural shoreline was slightly adjusted based upon the description within the 1971 general warranty deed for the subject parcel.

Parcel data provided by the Ashtabula County Auditor’s Office was imported into the computer-aided design (CAD) drawing to establish a general orientation of the shoreline for a reach of approximately 1.5 kilometer. Methodology for partitioning the boundaries between the littoral adjoiners was examined including extending the upland parcel boundary lakeward without deflection and a radial projection from the general alignment of the 1.5 kilometer reach of shore from the intersection of the natural shoreline and the parcel sidelines. The radial projection method provided the most equitable distribution between the subject parcel and the east and west adjoiners.

A base map was provided to the engineering consultant that depicted the locations of the existing site improvements relative to the established parcel boundaries and littoral partitions. A general statement that the survey and plat were prepared that conforms to Ohio Administrative Code (OAC) Section 4733-37 was included and the Ohio registered professional surveyor’s signature and seal were affixed to the plat of survey (see *Existing Site Plan “A”*).

## Design

The maximum slope normally considered for the long-term stability of an armor stone revetment is 1.5 horizontal to 1 vertical. Based on the wave climate in the area of the project site a slope of 2 horizontal to 1 vertical was selected for a conservative design, which also matches the planned re-graded upland slope. The existing concrete modules are to be removed and re-used as part of the revetment core. This allows the toe of the revetment to be placed at the 569.8 foot IGLD 1985 elevation of the shale bedrock at the shore.

The project site is located in the Saybrook to Kingsville reach of the “Revised Report on Great Lakes Open Coast Flooding” (USACE 1988) and has a design water level of 575.0 feet IGLD 1985 for a 30-year return period.

A 5.2-foot structure depth was calculated based on the lake bottom elevation at the structure toe and the design water level. Using the breaking wave equation presented in Chapter 3, a design wave height of 4.1 feet was calculated for this case.

Since the toe of the structure was designed to be entrenched 2.5 feet into the shale bedrock, the depth of the structure at the base of the toe will be 7.7 feet. Future scouring at the toe of the structure due to the fractures and wear of the shale would result in an increase in water depth from 5.2 to 7.7 feet and a design wave height of 6.0 feet for this conservative case. The scour of shale bedrock may not always be a reasonable assumption, but for this example, it was assumed that the fractures caused during entrenchment would lead to scour, aided by the presence of a significant amount of cobble and gravel along the nearshore that could abrade the shale.

Hudson’s Equation was used to calculate the median armor stone size to resist displacement due to wave action. Using the unit weight for the specified limestone, the minimum median armor stone size is 0.3 tons for the non-scour case. The minimum median armor stone size was 1.0 ton per unit if the toe of the structure is scoured.

A factor of safety of 2.0 was selected for the armor stone size to account for potential effects of ice forces, and long-term fracturing of the stone. Using the conservative 1.0 ton per unit value from Hudson’s Equation, the safety factor results in a lower limit for the armor stone of 2.0 tons per unit. The resulting design specification of a 2 to 4-ton range for the

armor stone layer also provides additional mass that improves the long-term ability of the revetment to resist earth forces from the upland. A double layer of 2 to 4-ton limestone will be stacked in a 6-foot thick armor layer.

The filter layer was specified as stone or clean concrete rubble about 1/3 of the diameter of the armor stone. For economy of design, the existing concrete modules and concrete rubble at the toe of the bluff will be relocated to form the filter layer for the revetment. Due to the variability of the filter layer material and the fine-grained till composition of the bluff a geotextile filter fabric is specified.

Wave run-up on the structure was calculated using the empirical formula introduced in Chapters 3. Wave run-up of 5.4 feet to an elevation of 580.4 feet IGLD 1985 was calculated for the initial design case. If the toe of the structure is scoured the wave run-up increases to 7.4 feet to an elevation of 582.4 feet IGLD 1985. The crest of the revetment was placed at 583.0 feet IGLD 1985.

To stabilize the upper portion of the bluff face the existing bluff will be re-graded to a 2 horizontal to 1 vertical slope above the revetment. To protect the re-graded bluff face from erosion resulting from spray, a splash apron was included in the design. The splash apron was specified as new ODOT 601 Type “B” stone and will extend to an elevation of 586.0 feet IGLD 1985.

To prevent sliding failure along the slope of the revetment, larger stones are placed at the lakeward base for toe protection. In this case 4 to 5-ton armor stones are to be entrenched 2.5 feet into the shale bedrock. Toe stones are typically specified to be 1 to 2 tons heavier than stones used for the armor layer.

To reduce the risk of causing increased erosion on adjacent properties and to prevent potential failure of the ends of structure, it is essential to appropriately terminate the structure at the property boundaries. To mitigate end effects, the ends of revetment are curved back into the bluff face. In this case, the ends of the structure are rounded off with a radius approximately equal to the plan view width of the armor layer.

### Discussion

To reduce the overall project footprint and minimize effects on littoral processes and adjacent properties the revetment has been placed with the armor layer immediately adjacent to the existing bluff face. The revetment has also been designed to closely follow the shape of the shore. The revetment will extend a maximum of 36.2 feet from the existing bluff toe. This distance is determined by the required crest elevation and revetment slope and can not be reduced without compromising the functionality or stability of the structure. In this way it has been appropriately designed to minimize effects on lake processes and adjacent properties.

The revetment is intended to prevent wave-based erosion of the existing bluff and will therefore decrease the amount of material added to the littoral system. Sand or gravel in the footprint of the revetment must be excavated and sidecast into the lake prior to construction to prevent sediment from being permanently removed from the littoral system.

As the structure will extend approximately 36 feet lakeward of the bluff toe, it will affect the littoral transport of material along the shore. In this case, the impact is expected to be minimal due to the location of concrete modules and rubble on adjacent properties. The structure may also cause changes in wave energy that could adversely affect adjacent properties. This risk has been reduced with the use of rough, angular limestone placed at a slope of 2H:1V. Much of the wave energy will be absorbed and dissipated by the revetment, minimizing the wave energy reflected in the nearshore zone.

### Final Survey Products

Based on the design from the Ohio registered professional engineer, a plat that depicted the boundaries of the submerged lands lease was prepared. The adjusted historic natural shoreline serves as the southern limit of the lease. Due to the use of the artificially placed fill material (concrete rubble) two separate lease parcels are depicted according to the definitions provided within OAC 1501-6-01. (see Submerged Lands Plat "A")

Two metes and bounds descriptions have been written for the areas depicted on the plat of survey with direct relationship to the upland parcel boundaries as required in Ohio Revised Code Section 1506.11(B). (see Submerged Lands Lease descriptions for Parcel "A" and "B").



JOB EXAMPLE A - HIGH BLUFF

SAMPLE ENGINEERING AND SURVEYING INC.  
STREET ADDRESS

SHEET NO. 2 OF 3

CALCULATED BY MPC DATE 02/01/11

CHECKED BY DLB DATE 02/01/11

SCALE \_\_\_\_\_

REVETMENT DESIGN (CONT.)

CONSERVATIVE CASE, IF TOE OF STRUCTURE IS SCoured

BREAKING WAVE HEIGHT =  $H_b = 6.0$  FT

$$W_{50} = \frac{(1.65 \text{ LB/FT}^3) (6.0 \text{ FT})^3}{2.0 (1.65/62.4 - 1)^3 (2.0)} = 2004 \text{ LB} = 1.0 \text{ TON}$$

MEDIAN STONE SIZE =  $W_{50} \times F_5 = 1.0 \text{ TON} \times 2.0 = 2.0 \text{ TON}$

TO BE CONSERVATIVE USE 2 TO 4 TON ARMOR STONE

\*NOTE: ACES CALCULATIONS SUPPORT RESULTS

INITIAL DESIGN CASE

$W_{50} = 1221 \text{ LB} = 0.6 \text{ TON}$

ARMOR LAYER THICKNESS = 3.9 FEET

CONSERVATIVE DESIGN CASE

$W_{50} = 3453 \text{ LB} = 1.7 \text{ TON}$

ARMOR LAYER THICKNESS = 5.5 FEET

C. WAVE RUNUP AND OVERTOPPING

EMPIRICAL FORMULA:  $R = \frac{H_b (a \times \xi)}{1 + (b \times \xi)}$

REFERENCE: "WAVE PERIOD EFFECT ON THE STABILITY OF RIPRAP" ASCE, 1975, P 1019- 1034.

$a = 0.775$  FOR DOUBLE LAYER WITH CORE OR FILTER LAYER

$b = 0.361$  FOR DOUBLE LAYER WITH CORE OR FILTER LAYER

REFERENCE: "COST-EFFECTIVE OPTIMIZATION OF RUBBLE-MOUND BREAKWATER CROSS SECTIONS" USACE, 1986, P 45-53.

IRIBARREN NO. =  $\xi = \frac{\tan \theta}{\sqrt{(2\pi H_b / g T^2)}}$

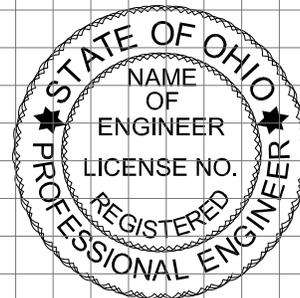
REFERENCE: "COASTAL ENGINEERING MANUAL" USACE, 2006, PAGE VI-5-6.

$\theta$  = ANGLE OF STRUCTURE FACE

$g = 32.2 \text{ FT/SEC}^2$

T = WAVE PERIOD = 8 SECOND PERIOD ASSUMED\*

\*AN 8 SECOND PERIOD IS A CONSERVATIVE ESTIMATE BASED ON WIS DATA. THE LARGEST WAVE RECORDED AT WIS STATION E 14 OVER A 32 YEAR STUDY (1956-1987) HAD A PERIOD OF 9.0 SECONDS. - REFERENCE: "WIS REPORT 22, HINDCAST WAVE INFORMATION FOR THE GREAT LAKES: LAKE ERIE" USACE, 1991, P A86.



Engineer Signature  
mm/dd/yyyy

**SAMPLE ENGINEERING AND SURVEYING INC.**  
**STREET ADDRESS**

JOB EXAMPLE A - HIGH BLUFF  
 SHEET NO. 3 OF 3  
 CALCULATED BY MPC DATE 02/01/11  
 CHECKED BY DLB DATE 02/01/11  
 SCALE \_\_\_\_\_

REVTMENT DESIGN (CONT.)

INITIAL CASE

$$\text{IRIBARREN NO.} = \xi = \frac{(1/2.0)}{\sqrt{2\pi (4.1 \text{ FT}) / (32.2 \text{ FT/SEC}^2) (8 \text{ SEC})^2}} \quad \xi = 4.5$$

$$\text{WAVE RUNUP: } R = \frac{(4.1 \text{ FT}) (0.775 \times 4.5)}{1 + (0.361 \times 4.5)}$$

R = 5.4 FT (FOR INITIAL CASE)

RUNUP ELEVATION = 575.0 FT IGLD 1985 + 5.4 FT = 580.4 FT IGLD 1985

CONSERVATIVE CASE, IF TOE OF STRUCTURE IS SCoured

$$\text{IRIBARREN NO.} = \xi = \frac{(1/2.0)}{\sqrt{2\pi (6.0 \text{ FT}) / (32.2 \text{ FT/SEC}^2) (8 \text{ SEC})^2}} \quad \xi = 3.7$$

$$\text{WAVE RUNUP: } R = \frac{(6.0 \text{ FT}) (0.775 \times 3.7)}{1 + (0.361 \times 3.7)}$$

R = 7.4 FT (FOR CONSERVATIVE CASE)

RUNUP ELEVATION = 575.0 FT IGLD 1985 + 7.4 FT = 582.4 FT IGLD 1985

CONSERVATIVE DESIGN: SET TOP OF ARMOR STONE AT 583.0 FT IGLD 1985  
SET TOP OF SPLASH APRON AT 586.0 FT IGLD 1985

\*NOTE: ACES CALCULATIONS SUPPORT RESULTS

INITIAL: RUNUP = 5.4 FT TO AN ELEVATION OF 580.4 FT IGLD 1985

CONSERVATIVE: RUNUP = 7.4 FT TO AN ELEVATION OF 582.4 FT IGLD 1985

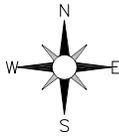
\*NOTE: THE CALCULATIONS INCLUDED IN THIS EXAMPLE WERE ORIGINALLY COMPUTED USING EXCEL SPREADSHEETS. THE SOFTWARE DISPLAYS A SPECIFIED NUMBER OF SIGNIFICANT FIGURES BUT RETAINS THE ORIGINAL NUMBER FOR OPERATIONS. AS A RESULT SMALL ROUNDING ERRORS ARE INTRODUCED IN TRANSCRIBING THE STEP-BY-STEP CALCULATIONS. THESE ERRORS ARE ACCEPTABLE CONSIDERING THE OVERALL ACCURACY OF THE CALCULATION METHODS AND THE PURPOSE OF THIS DESIGN MANUAL.



*Engineer Signature*  
 mm/DD/YY



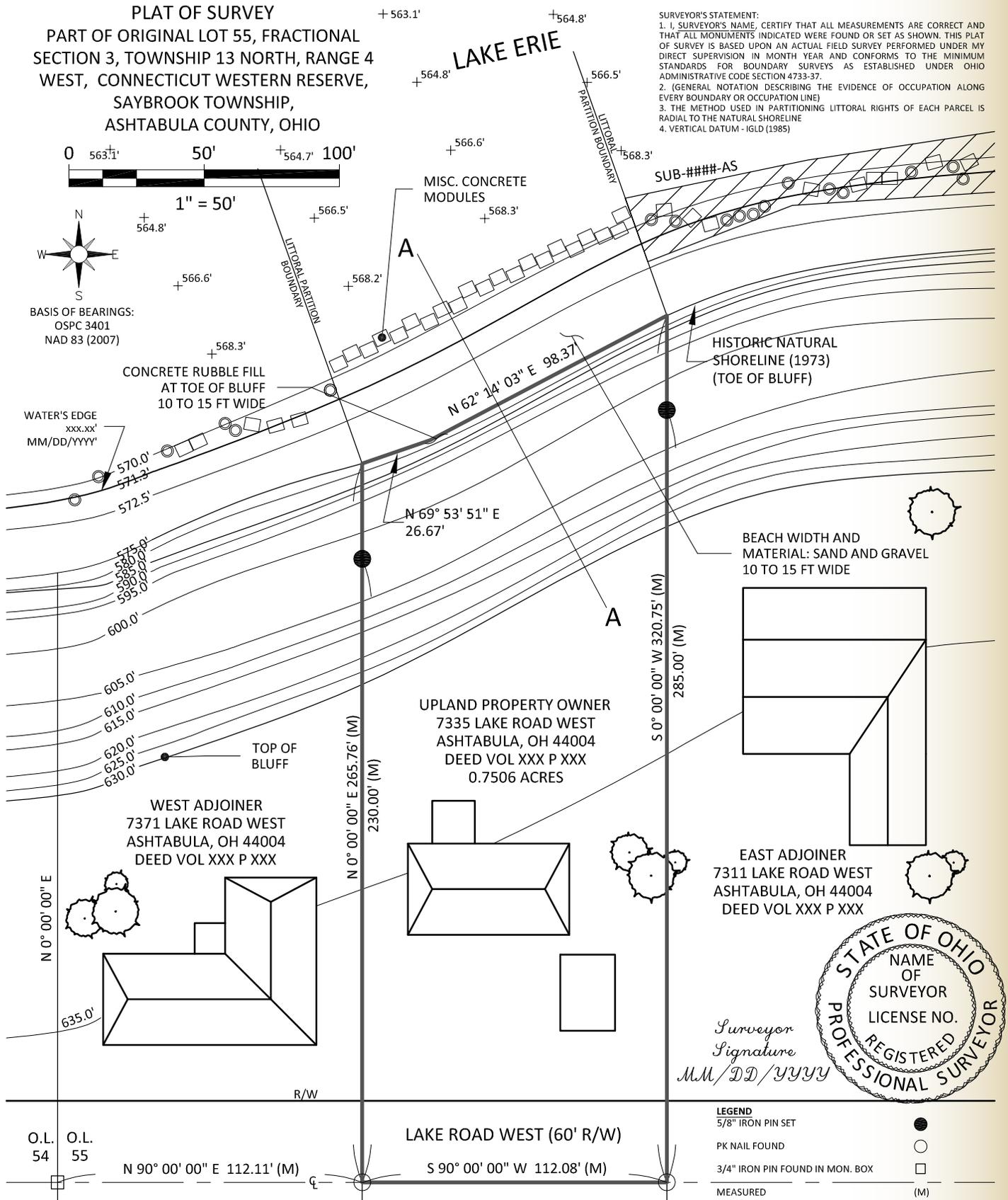
**PLAT OF SURVEY**  
 PART OF ORIGINAL LOT 55, FRACTIONAL  
 SECTION 3, TOWNSHIP 13 NORTH, RANGE 4  
 WEST, CONNECTICUT WESTERN RESERVE,  
 SAYBROOK TOWNSHIP,  
 ASHTABULA COUNTY, OHIO



BASIS OF BEARINGS:  
 OSPC 3401  
 NAD 83 (2007)

**SURVEYOR'S STATEMENT:**

1. I, SURVEYOR'S NAME, CERTIFY THAT ALL MEASUREMENTS ARE CORRECT AND THAT ALL MONUMENTS INDICATED WERE FOUND OR SET AS SHOWN. THIS PLAT OF SURVEY IS BASED UPON AN ACTUAL FIELD SURVEY PERFORMED UNDER MY DIRECT SUPERVISION IN MONTH YEAR AND CONFORMS TO THE MINIMUM STANDARDS FOR BOUNDARY SURVEYS AS ESTABLISHED UNDER OHIO ADMINISTRATIVE CODE SECTION 4733-37.
2. (GENERAL NOTATION DESCRIBING THE EVIDENCE OF OCCUPATION ALONG EVERY BOUNDARY OR OCCUPATION LINE)
3. THE METHOD USED IN PARTITIONING LITTORAL RIGHTS OF EACH PARCEL IS RADIAL TO THE NATURAL SHORELINE
4. VERTICAL DATUM - IGLD (1985)

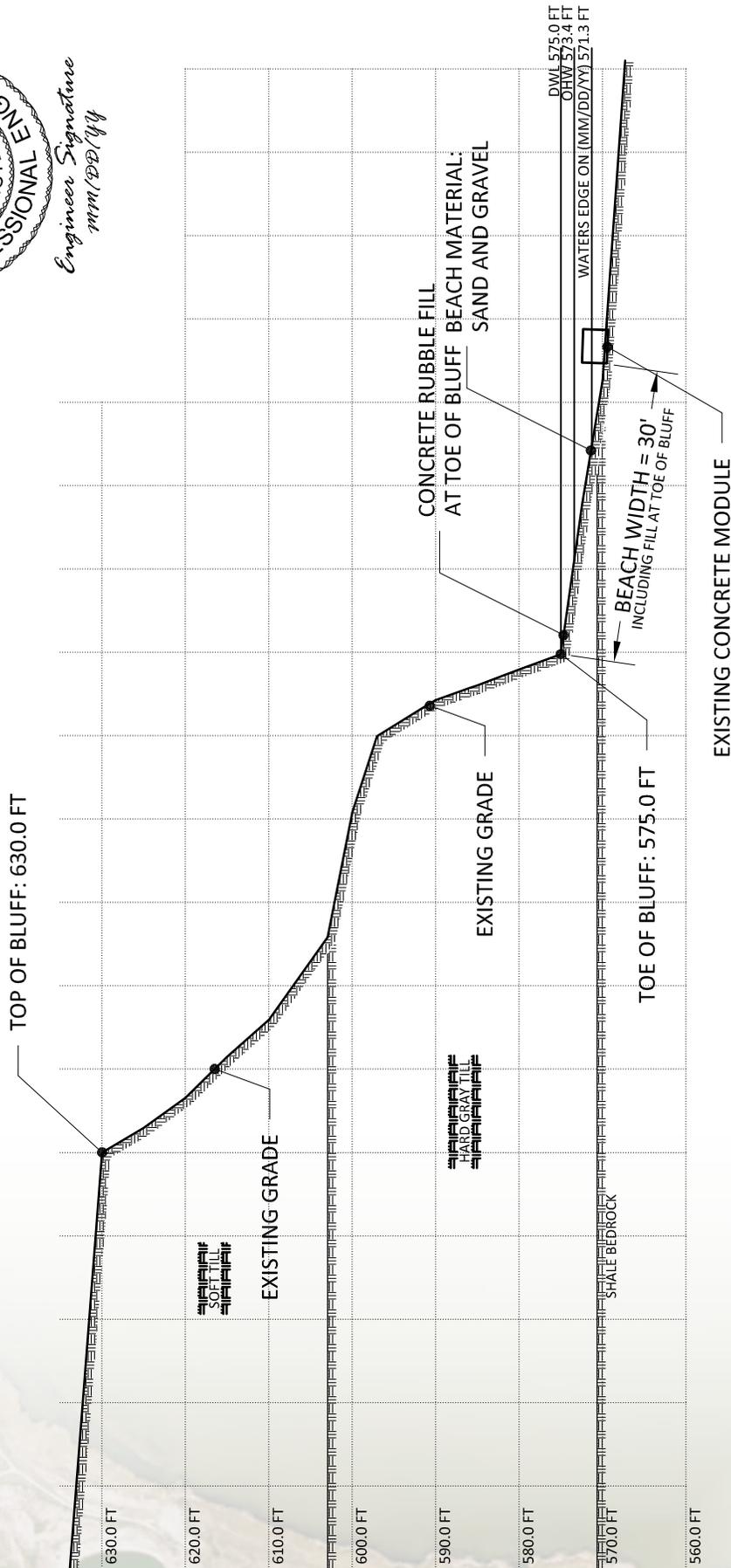


Surveyor  
 Signature  
 MM/DD/YYYY

- LEGEND**
- 5/8" IRON PIN SET
  - PK NAIL FOUND
  - 3/4" IRON PIN FOUND IN MON. BOX
  - MEASURED  (M)

|  |   |   |                            |
|--|---|---|----------------------------|
| <b>PROJECT:</b><br>ARMOR STONE REVETMENT   | <b>TITLE:</b><br>EXISTING SITE PLAN   | <b>PREPARED BY:</b><br>SAMPLE SURVEYING AND<br>ENGINEERING INC.<br>STREET ADDRESS |                            |
| <b>ADJACENT PROPERTY OWNERS:</b><br>WEST ADJOINER<br>7371 LAKE RD WEST, ASHTABULA, OH 44004<br>EAST ADJOINER<br>7311 LAKE RD WEST, ASHTABULA, OH 44004 | <b>APPLICANT:</b><br>APPLICANT<br>7335 LAKE ROAD WEST,<br>ASHTABULA, OH 44004 | <b>SHEET:</b><br>2 OF 5   | <b>DATE:</b><br>02/01/2011 |

VERTICAL DATUM: IGLD 1985



PREPARED BY:

SAMPLE ENGINEERING AND SURVEYING INC.  
STREET ADDRESS

SHEET: 3 OF 5      DATE: 02/01/11

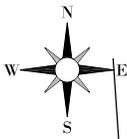
TITLE: SECTION A-A: EXISTING SITE

PROJECT: ARMOR STONE REVETMENT

ADJACENT PROPERTY OWNERS:  
WESTERN ADJACENT PROPERTY OWNER  
7371 LAKE RD WEST, ASHTABULA, OH 44004  
EASTERN ADJACENT PROPERTY OWNER  
7311 LAKE RD WEST, ASHTABULA, OH 44004

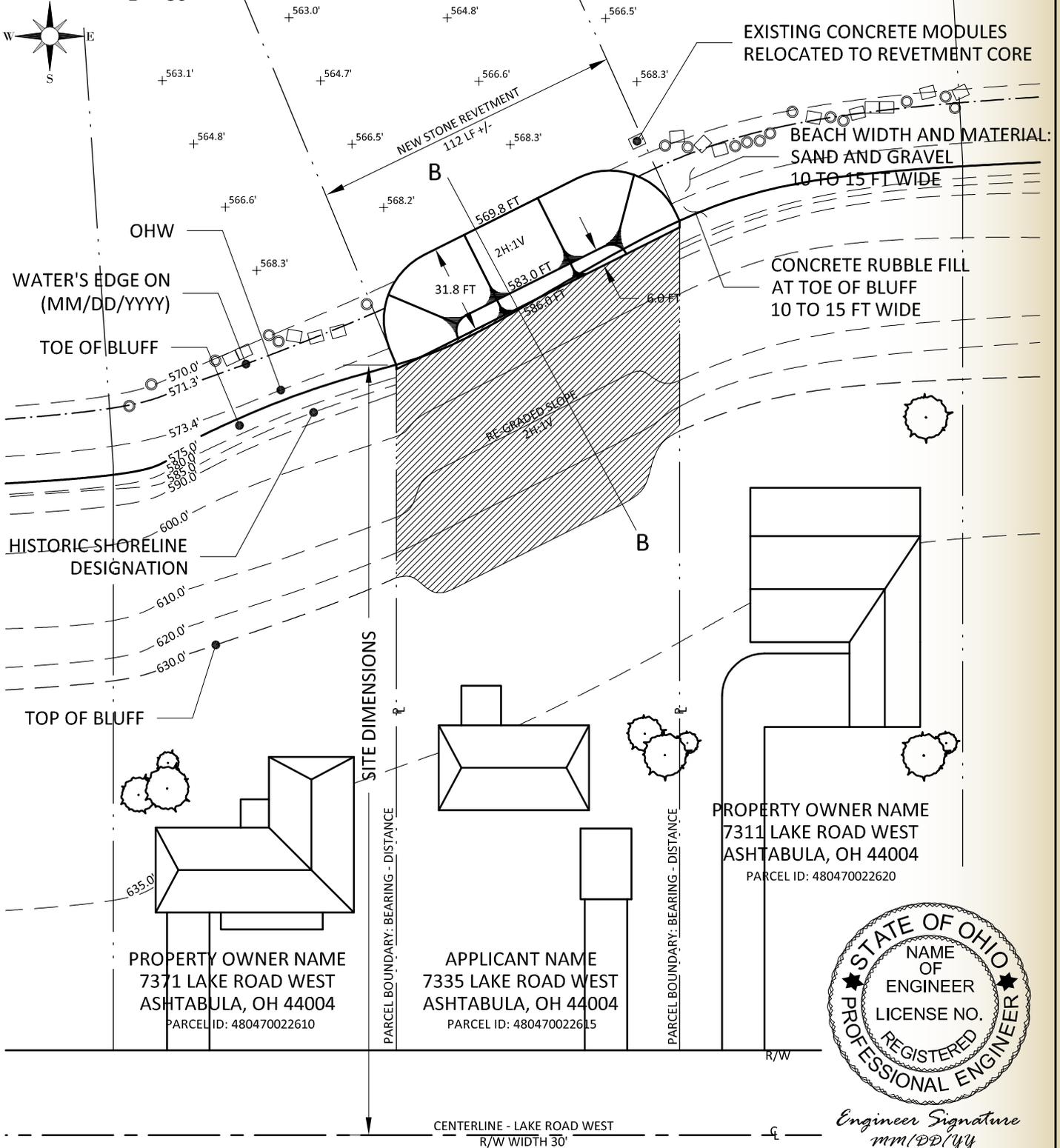
APPLICANT:  
SAMPLE PROPERTY OWNER  
7335 LAKE ROAD WEST,  
ASHTABULA, OH 44004

VERTICAL DATUM: IGLD 1985



# LAKE ERIE

- NOTES:
1. LITTORAL RIGHTS BOUNDARIES BASED ON HISTORIC SHORELINE DESIGNATION BY ODNR OFFICE OF COASTAL MANAGEMENT PROVIDED: MM/DD/YYYY
  2. DATE OF SURVEY: MM/DD/YYYY



|  |   |  |
|--|---|--|
| <b>PROJECT:</b><br>ARMOR STONE REVETMENT   | <b>TITLE:</b><br>PROPOSED SITE PLAN   | <b>PREPARED BY:</b><br>SAMPLE ENGINEERING AND SURVEYING INC.<br>STREET ADDRESS |
| <b>ADJACENT PROPERTY OWNERS:</b><br>WESTERN ADJACENT PROPERTY OWNER<br>7371 LAKE RD WEST, ASHTABULA, OH 44004<br>EASTERN ADJACENT PROPERTY OWNER<br>7311 LAKE RD WEST, ASHTABULA, OH 44004 | <b>APPLICANT:</b><br>SAMPLE PROPERTY OWNER<br>7335 LAKE ROAD WEST,<br>ASHTABULA, OH 44004 | <b>SHEET:</b> 4 OF 5<br><b>DATE:</b> 02/01/11                                  |



Lake Erie Submerged Lands Legal Description Parcel "A"  
Adjacent to 7335 Lake Road West, Saybrook Township

Situate in the State of Ohio and located within the waters of Lake Erie, County of Ashtabula, Saybrook Township, Township 13 North, Range 4 West of the Connecticut Western Reserve, adjacent to a portion of fractional Section 3, Original Lot 55 conveyed to (NAME OF UPLAND OWNER) by Deed Volume (XXX), Page (XXX), of the deed records of said county and being more particularly described as follows:

Commencing at a 3/4 inch solid iron pin found in a monument box at the intersection of the centerline of sixty (60) foot Lake Road West and the westerly line of Original Lot 55, said point also being the southwest corner of a parcel of land conveyed to (NAME OF WEST ADJOINER) by Deed Volume (XXX), Page (XXX);

Thence along the centerline of sixty (60) foot Lake Road West, also being the south line of said (NAME OF WEST ADJOINER) parcel, North 90 degrees, 00 minutes, 00 seconds East, 112.11 feet to a P-K nail found, also being the southwest corner of said (NAME OF UPLAND OWNER);

Thence along the west line of said (NAME OF UPLAND OWNER) parcel, North 00 degrees, 00 minutes, 00 seconds East, 265.76 feet, and passing for reference, a 5/8 inch solid iron pin set at 230.00 feet witnessing the location of the natural shoreline of Lake Erie present in (1973) as determined by the Ohio Department of Natural Resources, also being the northwest corner of said (NAME OF UPLAND OWNER) parcel; said point being the True Point of Beginning of the Lease Property described;

Thence departing the northwest corner of said (NAME OF UPLAND OWNER) parcel, along the littoral partition boundary between said (NAME OF UPLAND OWNER) and (NAME OF WEST ADJOINER) as determined by radial means, North 19 degrees, 29 minutes, 45 seconds West, 25.00 feet to a point not monumented due to the location on submerged lands of Lake Erie;

Thence departing the littoral partition boundary across the open waters of Lake Erie, North 62 degrees, 32 minutes, 04 seconds East, 125.22 feet to a point, not monumented due to the location on submerged lands of Lake Erie, on the littoral partition boundary of said (NAME OF UPLAND OWNER) parcel's east line as determined by radial means, also being the westerly boundary of Lake Erie Submerged Lands Lease File Number SUB-####-AS conveyed to (NAME OF EAST ADJOINER) by Lease Volume (XXX), Page (XXX) of the lease records of said county;

Thence along the littoral partition boundary between said (NAME OF UPLAND OWNER) parcel and (NAME OF EAST ADJOINER) as determined by radial means, also being the westerly boundary said Lake Erie Submerged Lands Lease File Number SUB-####-AS, South 19 degrees, 29 minutes, 45 seconds East, 27.93 feet to a point not monumented due to location on submerged lands of Lake Erie, also being the location of said natural shoreline and the northeast corner of said (NAME OF UPLAND OWNER) parcel;

Thence along said natural shoreline, South 62 degrees, 14 minutes, 03 seconds West, 98.37 feet to a point not monumented due to location on submerged lands of Lake Erie;

Thence continuing along said natural shoreline, South 69 degrees, 53 minutes, 51 seconds West, 26.67 feet to the True Point of Beginning of the submerged parcel herein described. Said parcel contains 3457 square feet (0.0794 acres) more or less and subject to all legal highways, easements, restrictions, and covenants of records. Based on a field survey performed by (NAME OF SURVEYOR), P.S. (#XXXX State of Ohio) performed in (MONTH, YEAR).

Basis of Bearings: The alignment of the centerline of Lake Road West (North 00 degrees, 00 minutes, 00 seconds East) as determined by the Ohio State Plane Coordinate System North Zone (3401) NAD 83 (2007).

\_\_\_\_\_  
(NAME OF SURVEYOR)  
Registered Surveyor (#XXXX)

**SEAL**

Lake Erie Submerged Lands Legal Description Parcel "B"  
Adjacent to 7335 Lake Road West, Saybrook Township

Situate in the State of Ohio and located within the waters of Lake Erie, County of Ashtabula, Saybrook Township, Township 13 North, Range 4 West of the Connecticut Western Reserve, adjacent to a portion of fractional Section 3, Original Lot 55 conveyed to (NAME OF UPLAND OWNER) by Deed Volume (XXX), Page (XXX), of the deed records of said county and being more particularly described as follows:

Commencing at a 3/4 inch solid iron pin found in a monument box at the intersection of the centerline of sixty (60) foot Lake Road West and the westerly line of Original Lot 55, said point also being the southwest corner of a parcel of land conveyed to (NAME OF WEST ADJOINER) by Deed Volume (XXX), Page (XXX);

Thence along the centerline of sixty (60) foot Lake Road West, also being the south line of said (NAME OF WEST ADJOINER) parcel, North 90 degrees, 00 minutes, 00 seconds East, 112.11 feet to a P-K nail found, also being the southwest corner of said (NAME OF UPLAND OWNER);

Thence along the west line of said (NAME OF UPLAND OWNER) parcel, North 00 degrees, 00 minutes, 00 seconds East, 265.76 feet, and passing for reference, a 5/8 inch solid iron pin set at 230.00 feet witnessing the location of the natural shoreline of Lake Erie present in (1973) as determined by the Ohio Department of Natural Resources, also being the northwest corner of said (NAME OF UPLAND OWNER) parcel;

Thence departing the northwest corner of said (NAME OF UPLAND OWNER) parcel, across the open waters of Lake Erie, along the littoral partition boundary between said (NAME OF UPLAND OWNER) and (NAME OF WEST ADJOINER) as determined by radial means, North 19 degrees, 29 minutes, 45 seconds West, 25.00 feet, to a point not monumented due to location on submerged lands of Lake Erie, said point being the True Point of Beginning of the Lease Property described;

Thence continuing along said littoral partition boundary across the open waters of Lake Erie, North 19 degrees, 29 minutes, 45 seconds West, 19.00 feet to a point not monumented due to location on submerged lands of Lake Erie;

Thence departing said littoral partition boundary, across the open waters of Lake Erie, North 63 degrees, 10 minutes, 11 seconds East, 125.03 feet, to a point not monumented due to location on submerged lands of Lake Erie on the littoral partition boundary of said (NAME OF UPLAND OWNER) parcel east line as determined by radial means, also being the westerly boundary of Lake Erie Submerged Lands Lease File Number SUB-####-AS conveyed to (NAME OF EAST ADJOINER) by Lease Volume (XXX), Page (XXX) of the lease records of said county;

Thence across the open waters of Lake Erie, along the littoral partition boundary between said (NAME OF UPLAND OWNER) and said (NAME OF EAST ADJOINER) parcel as determined by radial means, also being the westerly boundary of said Lake Erie Submerged Lands Lease File Number SUB-####-AS, South 19 degrees, 29 minutes, 45 seconds East, 17.60 feet to a point not monumented due to location on submerged lands of Lake Erie;

Thence across the open waters of Lake Erie, South 62 degrees, 32 minutes, 04 seconds West, 125.22 feet to the True Point of Beginning of the submerged parcel herein described. Said parcel contains 2269 square feet (0.0509 acres) more or less and subject to all legal highways, easements, restrictions, and covenants of records. Based on a field survey performed by (NAME OF SURVEYOR), P.S. (#XXXX State of Ohio) performed in (MONTH, YEAR).

Basis of Bearings: The alignment of the centerline of Lake Road West (North 00 degrees, 00 minutes, 00 seconds East) as determined by the Ohio State Plane Coordinate System North Zone (3401) NAD 83 (2007).

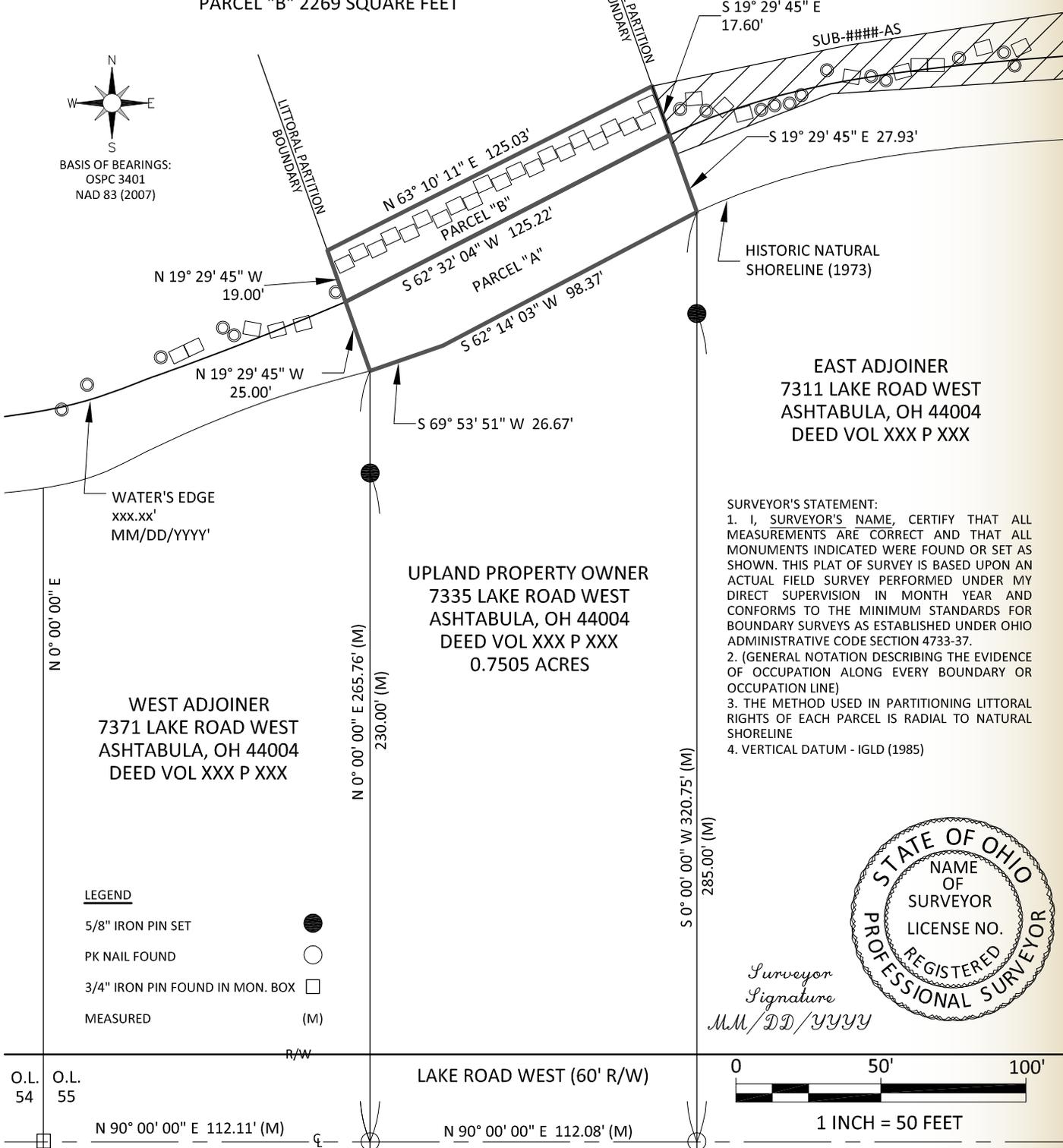
**SEAL**

(NAME OF SURVEYOR)  
Registered Surveyor (#XXXX)

**SUBMERGED LANDS LEASE PLAT OF SURVEY**

SUBMERGED LANDS ADJACENT TO ORIGINAL LOT 55, FRACTIONAL SECTION 3,  
TOWNSHIP 13 NORTH, RANGE 4 WEST, CONNECTICUT WESTERN RESERVE,  
SAYBROOK TOWNSHIP, ASHTABULA COUNTY, OHIO  
PARCEL "A" 3457 SQUARE FEET  
PARCEL "B" 2269 SQUARE FEET

**LAKE ERIE**



**SURVEYOR'S STATEMENT:**  
 1. I, SURVEYOR'S NAME, CERTIFY THAT ALL MEASUREMENTS ARE CORRECT AND THAT ALL MONUMENTS INDICATED WERE FOUND OR SET AS SHOWN. THIS PLAT OF SURVEY IS BASED UPON AN ACTUAL FIELD SURVEY PERFORMED UNDER MY DIRECT SUPERVISION IN MONTH YEAR AND CONFORMS TO THE MINIMUM STANDARDS FOR BOUNDARY SURVEYS AS ESTABLISHED UNDER OHIO ADMINISTRATIVE CODE SECTION 4733-37.  
 2. (GENERAL NOTATION DESCRIBING THE EVIDENCE OF OCCUPATION ALONG EVERY BOUNDARY OR OCCUPATION LINE)  
 3. THE METHOD USED IN PARTITIONING LITTORAL RIGHTS OF EACH PARCEL IS RADIAL TO NATURAL SHORELINE  
 4. VERTICAL DATUM - IGLD (1985)



Surveyor Signature  
 MM/DD/YYYY

|   |  |   |  |   |  |
|---|--|---|--|---|--|
| PROJECT:<br><b>ARMOR STONE REVETMENT</b>  |  | TITLE:<br><b>SUBMERGED LANDS PLAT</b>   |  | PREPARED BY:<br><b>SAMPLE SURVEYING AND ENGINEERING INC.<br/>STREET ADDRESS</b> |  |
| ADJACENT PROPERTY OWNERS:<br>WEST ADJOINER<br>7371 LAKE RD WEST, ASHTABULA, OH 44004<br>EAST ADJOINER<br>7311 LAKE RD WEST, ASHTABULA, OH 44004 |  | APPLICANT:<br><b>APPLICANT<br/>7335 LAKE ROAD WEST,<br/>ASHTABULA, OH 44004</b> |  | SHEET: <b>1 OF 1</b> DATE: <b>02/01/2011</b>                                    |  |