Public Notice

U.S. Army Corps
of Engineers
Buffalo District
CELRB-TD-R

Applicant: Cleveland Metropolitan Park District

Published: February 22, 2016
Expires: March 23, 2016

Application No: 2015-00372
Section: OH

All written comments should reference the above Application No. and be addressed to:
US Army Corps of Engineers, Buffalo District
Regulatory Branch (Attn: Joseph Krawczyk)
1776 Niagara Street
Buffalo, NY 14207

THE PURPOSE OF THIS PUBLIC NOTICE IS TO SOLICIT COMMENTS FROM THE PUBLIC REGARDING THE WORK DESCRIBED BELOW. NO DECISION HAS BEEN MADE AS TO WHETHER OR NOT A PERMIT WILL BE ISSUED AT THIS TIME.

Application for Permit under Authority of Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (33 U.S.C. 1344).

APPLICANT: Cleveland Metropolitan Park District, 4101 Fulton Parkway, Cuyahoga County, Cleveland, Ohio 44144.

WATERWAY & LOCATION: The project site is located in Lake Erie, at Euclid Beach/Villa Angela Park, East 156th Street, City of Cleveland, Cuyahoga County, Ohio.

LATITUDE & LONGITUDE: Latitude North: 41.587
Longitude West: 81.567

EXISTING CONDITIONS: The entire Euclid Beach/Villa Angela Park swimming area along Lake Erie measures approximately 1,700 linear feet in width. The swimming area is protected by six off-shore breakwaters, which concentrate water flow between them and scour away the sandy lakebed. This results in the formation of deep (≥10 foot) scour channels. Due to the murky waters, bathers are unable to see the hidden channels, lose their footing, and have difficulty recovering due to the steep channel side slopes and loose lake bottom material. The proposed work – which would improve public safety and enjoyment of the beach area – would be located along the easternmost (approximately 850 linear foot) portion of the existing swim

area, between breakwaters 5 and 6 (counting upwards from the western-most breakwater). Site photographs of existing conditions are contained in Attached Appendix D.

PROPOSED WORK: The Applicant proposes the following work, water-ward of the Lake Erie Ordinary High Water (OHW) elevation of 573.4' International Great Lakes Datum (IGLD) 1985 (see attached sheets 5 and 6 of 6 and Appendix C):

a. Construction of two submerged sills to connect existing breakwaters 4, 5, and 6:

- The westernmost sill (between breakwaters 4 and 5) would measure approximately 120 feet in length by 50 feet in width at the base, with a crest width of approximately 20 feet.
- The easternmost sill (between breakwaters 5 and 6) would measure approximately 136 feet in length by 50 feet in width at the base, with a crest width of approximately 20 feet.
- The sills would be constructed with a single layer of 4 to 6 ton limestone armor units placed over a concrete rubble core at a 1.5 horizontal to 1.0 vertical slope to a crest elevation of 567.5' IGLD 1985.
- The placement of concrete rubble would entail the discharge of approximately 550 cubic yards below the Ordinary High Water (OHW) elevation of Lake Erie, and the placement of limestone armor units would entail the discharge of approximately 1,930 cubic yards of material below OHW.
- The underwater sills would likely be constructed with the use of a barge or floating platform.

b. Grading of the existing beach slope (above and below OHW):

- The existing beach profile (see attached drawings 3 and 4 of 6) would be re-graded along the eastern approximately 840 linear feet of beach, to reduce beach slopes and water depths in the swim area, in order to improve swimmer safety (see attached sheet 6 of 6).
- Beach grading would likely be performed by and excavator and/or bulldozer, to achieve the desired slopes.

c. Placement of sand pre-fill:

- Producing the desired beach grade would also require the placement of approximately 2,115 cubic yards of sand pre-fill material on the shoreward-side of the proposed underwater sills. The sand pre-fill material – from a clean upland source - would be used to fill the existing scour channels (see attached sheets 5 and 6 of 6).
- The sand prefill material would likely be staged near the upland back-beach area (near the toe of the existing beach bluff) and would likely be moved to the placement areas via an excavator.

In total the Applicant proposes the placement of 4,595 cubic yards of material below OHW.

PROJECT PURPOSE:
Basic: Swim beach improvements
Overall: To improve swimmer safety by: a. re-grading the below OHW beach profile; b. adding sand pre-fill material to fill-in existing scour channels; and c. reducing wave energy and scouring between existing breakwaters, resulting in decreased sand transport and a more stable beach profile.
Water Dependency Determination: The proposed project will not impact a Special Aquatic Site and is a water dependent activity.

AVOIDANCE AND MINIMIZATION INFORMATION:

Preferred Design Alternative (PDA): Underwater sills would be constructed with 40-foot crest widths (see attached Appendix A). The 40-foot crest widths of the PDA were estimated to allow a maximum of a 3.2-foot transmitted wave at average water levels (assumed to be 571.5 feet IGLD 1985).

The PDA would also include re-grading the existing beach profile, to reduce beach slopes and water depths in the swim area, and would require the placement of 2,011 cubic yards of sand pre-fill material.

In total, the PDA would require the placement of 8,393 cubic yards of material below OHW; including 5,354 cubic yards of armor stone (limestone), 1,028 cubic yards of concrete rubble, and 2,011 cubic yards of sand pre-fill material.

Minimum Degradation Alternative (MDA): The MDA is the currently proposed design alternative, which is described under the *Proposed Work* section above (see attached Appendix A).

The 20-foot crest widths of the MDA are estimated to allow a maximum of a 3.9-foot transmitted wave at average water levels (assumed to be 571.5 feet IGLD 1985).

In total, the MDA would require the placement of 4,595 cubic yards of material below OHW; including 1,930 cubic yards of armor stone (limestone), 550 cubic yards of concrete rubble, and 2,115 cubic yards of sand pre-fill material.

Non-Degradation Alternative (NDA): Under the NDA (not illustrated) no discharge of material would occur below the OHW elevation of Lake Erie and the project would not be constructed. Under the NDA, wave energy could not be reduced between the existing breakwaters and sand transport between landward of the existing detached breakwaters could not be reduced. The existing steep beach slopes and deep water depths throughout the swim area would remain.

Minimization:

- Underwater sill crest widths ranging from 5 to 30 feet were considered as alternatives. A crest width of 20 feet was selected based on the criteria of not allowing a transmitted wave greater than 3.9 feet at typical summer levels (assumed to be about 571.5 feet IGLD 1985). The 20-foot crest width represents the best mix of level of protection versus the fill footprint.
- Construction of underwater sills would be performed from a barge or floating platform. Materials and equipment for the construction of the submerged sills would also likely be transported by barge.
- The 1.5:1 horizontal to 1 vertical slope of the submerged sills is the minimum customarily allowable considering structural stability.

PROPOSED MITIGATION:

In order to offset potential "downstream" impacts of the proposed underwater sills on sand transport within the littoral system, the Applicant has provided a *Sand Monitoring Plan* (see attached Appendix B for full details).

Through the *Sand Monitoring Plan* the Applicant proposes to:

- Perform a pre-construction survey of the beach and near-shore area two weeks prior to the performance of any authorized work
- Perform a post-construction survey of the beach and near-shore area within two weeks of any authorized sand pre-fill placement and beach grading
- Conduct annual monitoring surveys, for a period of 5 years, following the construction of any authorized underwater sill construction
- Provide annual monitoring reports to the U.S. Army Corps of Engineers (USACE) and the Ohio Department of Natural Resources (ODNR)
- Re-grade and or place (contingent upon USACE and ODNR approval) additional sand pre-fill material into littoral system, if the annual monitoring surveys determine that sand transport within the littoral cell landward of the detached breakwaters has resulted in unfavorable conditions for a public swim area.

Location and details of the above described work are shown on the attached maps and drawings.

Comments or questions pertaining to the work described in this notice should reference the Application Number **2015-00372** and be directed to the attention of Joseph W. Krawczyk, who can be contacted at the above address, by calling (716) 879-4186, or by e-mail at: joseph.w.krawczyk@usace.army.mil. A lack of response will be interpreted as meaning that there is no objection to the work as proposed.

The applicant has certified that the proposed activity complies with Ohio's approved Coastal Zone Management Program and will be conducted in a manner consistent with that program. Any comments on the consistency of the proposed activity with Ohio's Coastal Zone Management Program should be forwarded to:

Mr. John Kessler
Ohio Department of Natural Resources
Office of Real Estate
2045 Morse Rd.
Columbus, OH 43229-6605
phone: 614-265-6621
email: john.kessler@dnr.state.oh.us

The following authorization is required for this project:

Water Quality Certification (or waiver thereof) from the Ohio Environmental Protection Agency

Based on preliminary findings, there do not appear to be any properties listed in, or eligible for listing in, the National Register of Historic Places within the permit area as shown on attached sheets 5 and 6 of 6). This notice constitutes initiation of consultation with the Ohio Historic Preservation Office (SHPO) per Section 106 of the National Historic Preservation Act. All currently available historic resource information pertaining to this proposed project if any has been provided to the SHPO. Additional information concerning historic properties should be submitted to the Corps before the end of the comment period of this notice. The Corps will forward that information to the SHPO for their review.

Pursuant to Section 7 of the Endangered Species Act (16 U.S.C. 1531), the Corps of Engineers is consulting, under separate cover, with the USFWS to evaluate any potential impacts to the: endangered Indiana Bat (*Myotis sodalis*); threatened Northern Long-eared Bat (*Myotis septentrionalis*); endangered Kirtland's Warbler (*Setophaga kirtlandii*); endangered Piping Plover (*Charadrius melodus*); and the threatened Rufa Red Knot (*Calidris canutus rufa*), and to ensure that the proposed activity is not likely to jeopardize their continued existence or result in the destruction or adverse modification of critical habitat.

This notice is promulgated in accordance with Title 33, Code of Federal Regulations, parts 320-330. Any interested party desiring to comment on the work described herein may do so by submitting their comments, in writing, so that they are received no later than 4:30 pm on the expiration date of this notice.

Comments submitted in response to this notice will be fully considered during the public interest review for this permit application. All written comments will be made a part of the administrative record which is available to the public under the Freedom of Information Act. The Administrative Record, or portions thereof may also be posted on a Corps of Engineers internet web site. Due to resource limitations, this office will normally not acknowledge the

receipt of comments or respond to individual letters of comment.

Any individual may request a public hearing by submitting their written request, stating the specific reasons for holding a hearing, in the same manner and time period as other comments.

Public hearings for the purposes of the Corps permit program will be held when the District Commander determines he can obtain additional information, not available in written comments, that will aid him in the decision making process for this application. A Corps hearing is not a source of information for the general public, nor a forum for the resolution of issues or conflicting points of view (witnesses are not sworn and cross examination is prohibited). Hearings will not be held to obtain information on issues unrelated to the work requiring a permit, such as property ownership, neighbor disputes, or the behavior or actions of the public or applicant on upland property not regulated by the Department of the Army. Information obtained from a public hearing is given no greater weight than that obtained from written comments. Therefore, you should not fail to make timely written comments because a hearing might be held.

The decision to approve or deny this permit request will be based on an evaluation of the probable impact, including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among these are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the people.

The Corps of Engineers is soliciting comments from the public; Federal, state and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

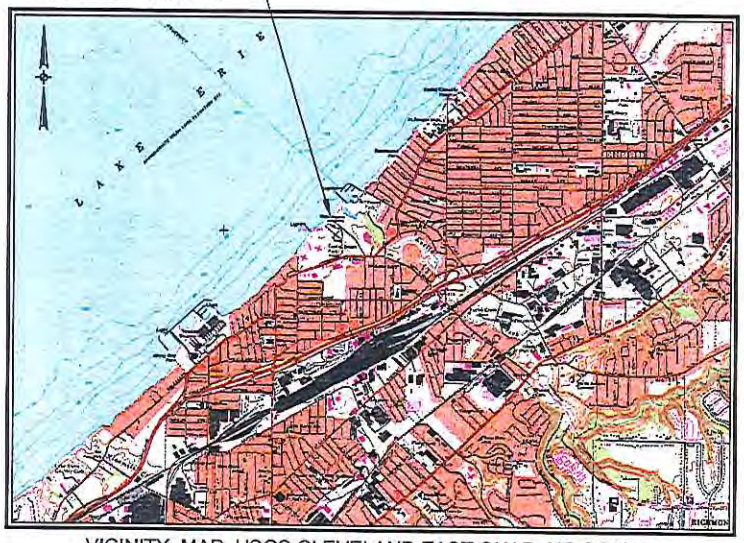
SIGNED

Diane C. Kozlowski
Chief, Regulatory Branch

NOTICE TO POSTMASTER: It is requested that this notice be posted continuously and conspicuously for 30 days from the date of issuance.

CLEVELAND METROPARKS
EUCLID BEACH/VILLA ANGELA IMPROVEMENTS

PROJECT AREA



VICINITY MAP, USGS CLEVELAND EAST QUAD, NO SCALE

DRAWING TITLE	SHEET NO.
TITLE SHEET	1
EXISTING SITE PLAN	2
SITE PLAN	3
SECTION A-A	4
SECTION B-B	5

GENERAL NOTES:

1. CONTRACTOR SHALL FIELD VERIFY DIMENSIONS AND ELEVATIONS AS NOTED ON THE DRAWINGS. THE CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY OF ANY INCONSISTENCIES BETWEEN THE DRAWINGS AND THE FIELD MEASUREMENTS.
2. AT LEAST TWO WORKING DAYS PRIOR TO EXCAVATION THE CONTRACTOR SHALL CONTACT THE CITY OF CLEVELAND AND OUPS TO DETERMINE THE LOCATION OF ANY EXISTING UNDERGROUND UTILITIES NOT INDICATED ON THE PRINTS. IF UNCHARTED UTILITIES ARE ENCOUNTERED THE CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY.

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

STATE OF O
MARK P. CENCER
E-74234
REGISTERED
PROFESSIONAL

Cleveland Metroparks
D/A Processing No. 2015-00372
Cuyahoga County, Ohio
Quad: OH – East Cleveland
Sheet 1 of 6

MARK P. CENCER, P.E. OHIO REG. NO. 74234 — 12-15-15 DATE

OHIO Utilities Protection SERVICE
Call Before You Dig
1-800-362-2764
CALL TWO WORKING DAYS BEFORE YOU DIG (NON MEMBERS MUST BE CALLED DIRECTLY)

1. UNDERGROUND UTILITIES ARE SHOWN FROM RECORDS AND FIELD MARKINGS PROVIDED BY UTILITY COMPANIES AND AGENCIES. ACTUAL LOCATIONS MAY VARY. CONTACT OHIO UTILITIES PROTECTION SERVICE (OUPS) AT 1-800-362-2764 AT LEAST 48 HOURS PRIOR TO EXCAVATION.
2. VISIBLE SURFACE UTILITIES HAVE BEEN FIELD LOCATED UNLESS OTHERWISE NOTED.

REVISIONS	DATE	BY
	-	

ADJACENT PROPERTY OWNERS
AE PORTFOLIO LLC
123 EAST 156TH STREET, CLEVELAND, OH 44110
DONALD A. JOHNSON
16815 EAST PARK AVE, CLEVELAND, OH 44119
DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

DATE: 12/15/2015
DRAWN BY: KS
CHK'D BY: MPC
DWG. NAME: 14242-1-1
PATH:
F.B.

KS ASSOCIATES
KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
P 440 365 4730
F 440 365 4790
www.ksassociates.com

TITLE SHEET
EUCLID BEACH/VILLA ANGELA
CLEVELAND METROPARKS
LAKEFRONT RESERVATION
4101 FULTON PARKWAY, CLEVELAND, OHIO 44114

SHEET 1 OF 7
JOB NO. 14242-1

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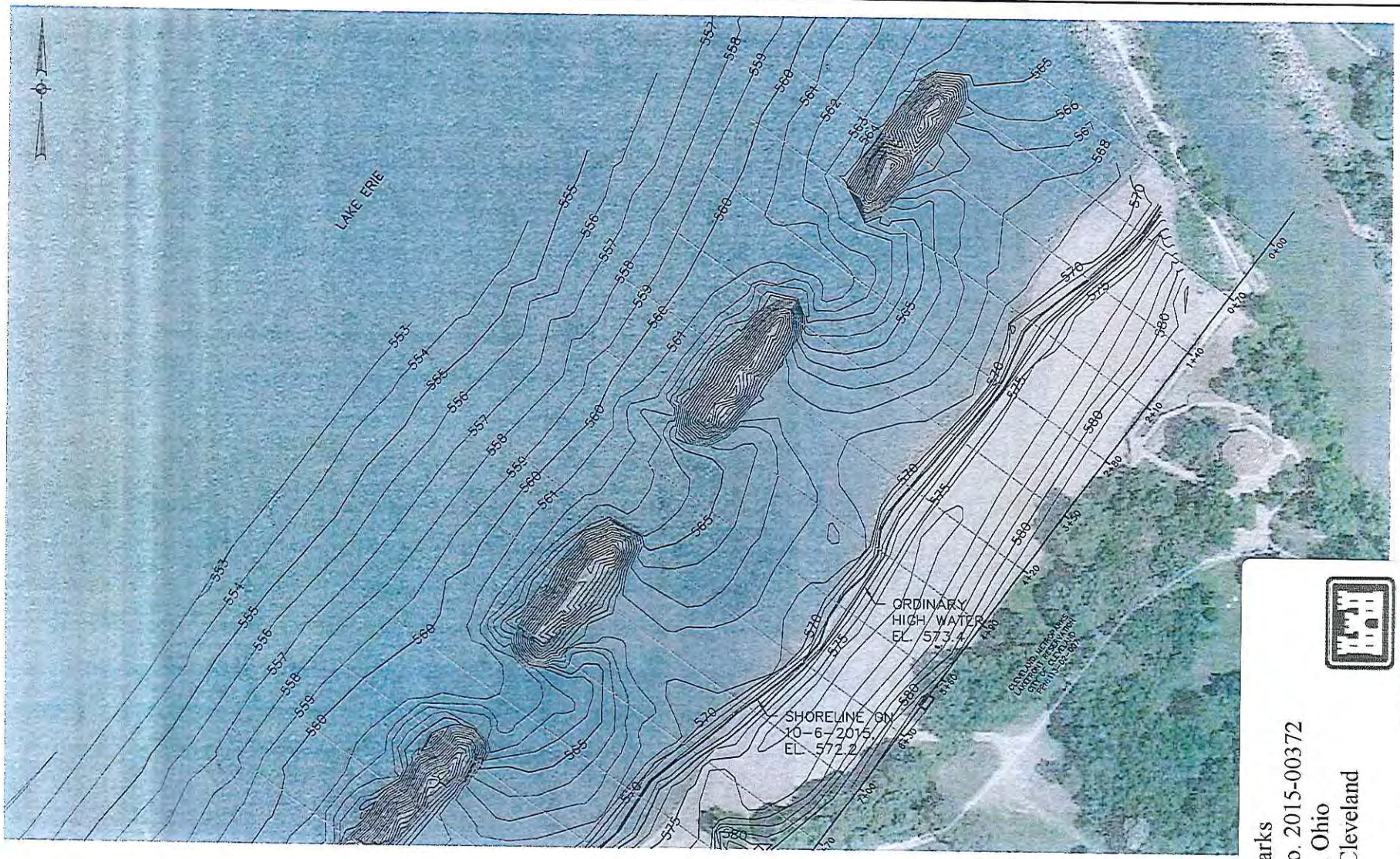

NOTES

1. VERTICAL DATUM IS IGLD 1985.
2. BATHYMETRIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/06/2015.
3. TOPOGRAPHIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/07/2015.
4. WATER ELEVATION OF 10/06/2015 WAS 572.2 FEET IGLD 1985.
5. BACKGROUND IMAGE FROM GOOGLE EARTH. IMAGE DATE 05/14/2014.

EXISTING SITE PLAN

75 0 75 150

SCALE IN FEET
SCALE 1"=150'

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

STATE OF OHIO
JARROD R. SCHNELL
S-8623
REGISTERED
PROFESSIONAL SURVEYOR

12-15-15

STATE OF OHIO
PROFESSIONAL ENGINEER

Cleveland Metroparks
D/A Processing No. 2015-00372
Cuyahoga County, Ohio
Quad: OH – East Cleveland
Sheet 2 of 6

DATE	BY	ADJACENT PROPERTY OWNERS
–		AE PORTFOLIO LLC 123 EAST 156TH STREET, CLEVELAND, OH 44110 DONALD A. JOHNSON 16815 EAST PARK AVE, CLEVELAND, OH 44119

REVISIONS

DATE: 12/15/2015
DRAWN BY: KS
CKD BY: KRC
DWG. NAME: 14242-1-2
PATH:
F.S.:

KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
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www.ksassociates.com
KS ASSOCIATES

EXISTING SITE PLAN
EUCLID BEACH/VILLA ANGELA
CLEVELAND METROPARKS
LAKEFRONT RESERVATION
4101 FULTON PARKWAY, CLEVELAND, OHIO 44114

SHEET 2 OF 7

JOB NO. 14242-1

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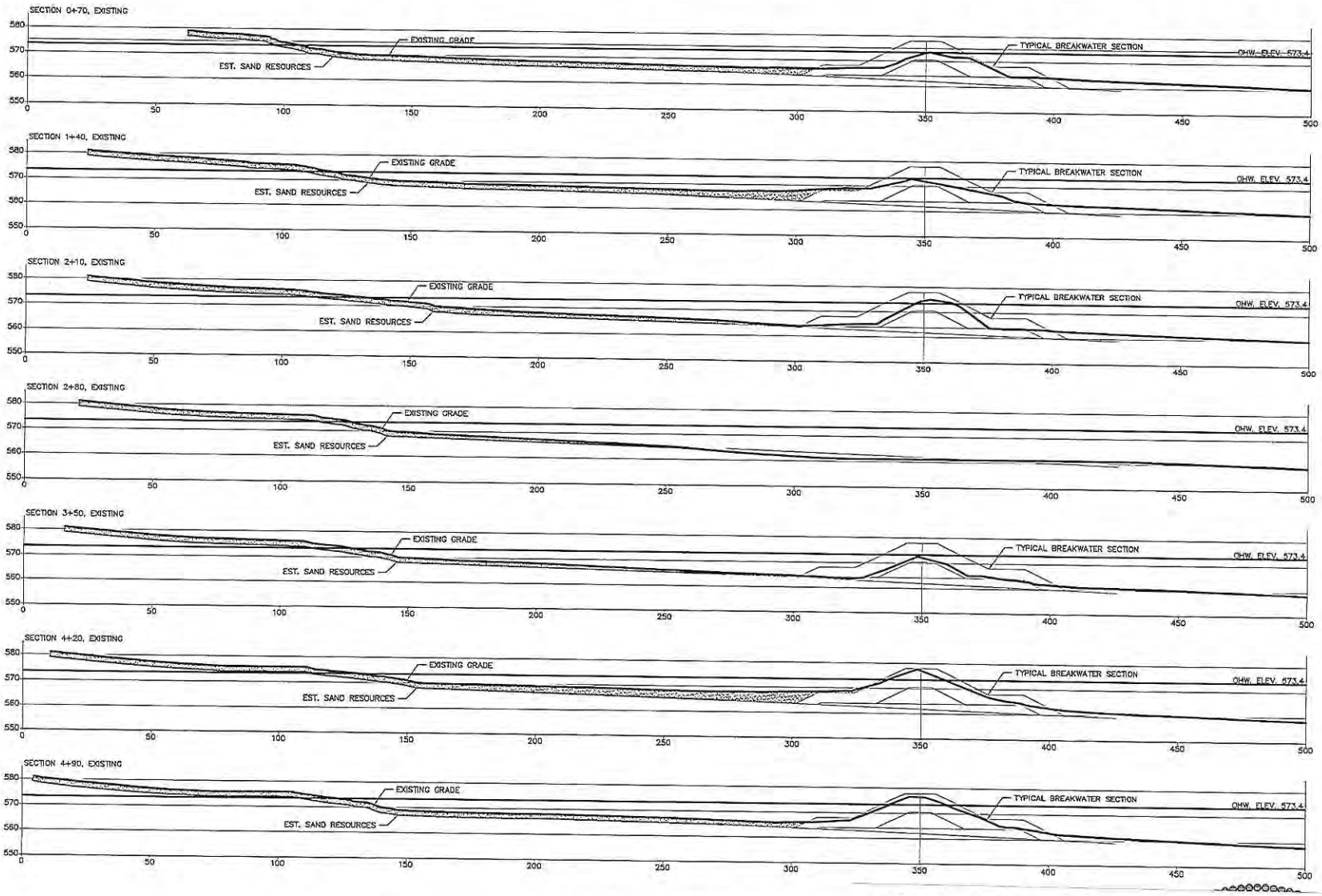

EXISTING SECTIONS

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SCALE IN FEET
SCALE 1"=60'

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LEGEND

EXISTING SAND RESOURCES EXPECTED TO BE AVAILABLE FOR RE-GRADING.

Cleveland Metroparks
D/A Processing No. 2015-00372
Cuyahoga County, Ohio
Quad: OH – East Cleveland
Sheet 3 of 6

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER

DATE	BY	REVISIONS

ADJACENT PROPERTY OWNERS
AE PORTFOLIO LLC
123 EAST 156TH STREET, CLEVELAND, OH 44110
DONALD A. JOHNSON
16815 EAST PARK AVE, CLEVELAND, OH 44119

DATUM: 0.0 LND = 569.2 FEET IGLD 1985

DATE: 12/15/2015
DRAWN BY: KS
CK'D BY: MCG
DWG. NAME: 14242-1-3
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F.B.

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EXISTING SECTIONS
EUCLID BEACH/VILLA ANGELA
CLEVELAND METROPARKS
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SHEET 3 OF 7

JOB NO. 14242-1

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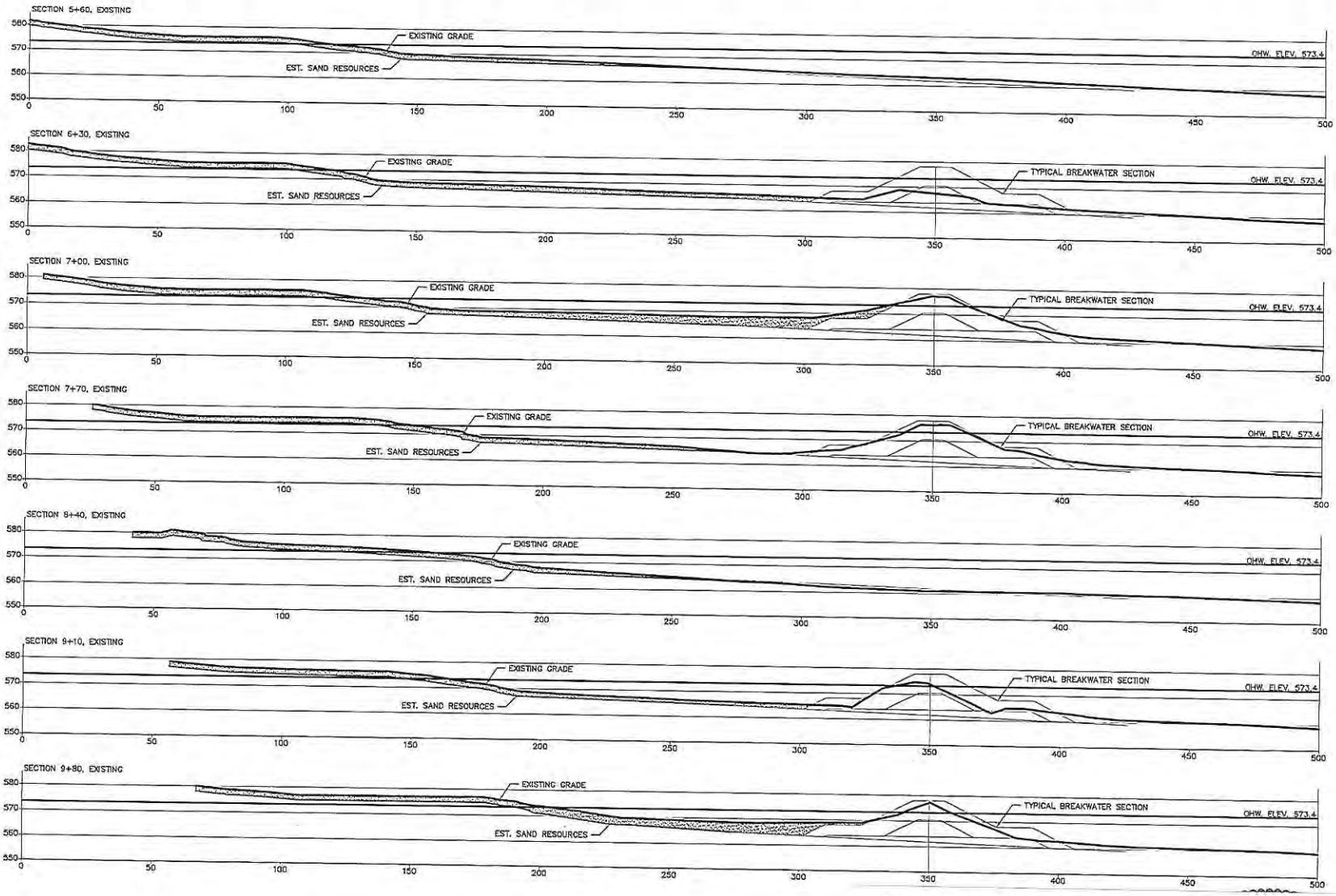

EXISTING SECTIONS

30 0 30 60

SCALE IN FEET
SCALE 1"=60'

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LEGEND

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Cleveland Metroparks
D/A Processing No. 2015-00372
Cuyahoga County, Ohio
Quad: OH – East Cleveland
Sheet 4 of 6

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER

DATE	BY	ADJACENT PROPERTY OWNERS
–		AE PORTFOLIO LLC 123 EAST 156TH STREET, CLEVELAND, OH 44110
		DONALD A. JOHNSON 16815 EAST PARK AVE, CLEVELAND, OH 44119
		DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

REVISIONS

DATE: 12/15/2015
DRAWN BY: KS
CH'D BY: MPC
DWG. NAME: 14242-1-3
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EXISTING SECTIONS
EUCLID BEACH/VILLA ANGELA
CLEVELAND METROPARKS
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SHEET 4 OF 7

JOB NO. 14242-1

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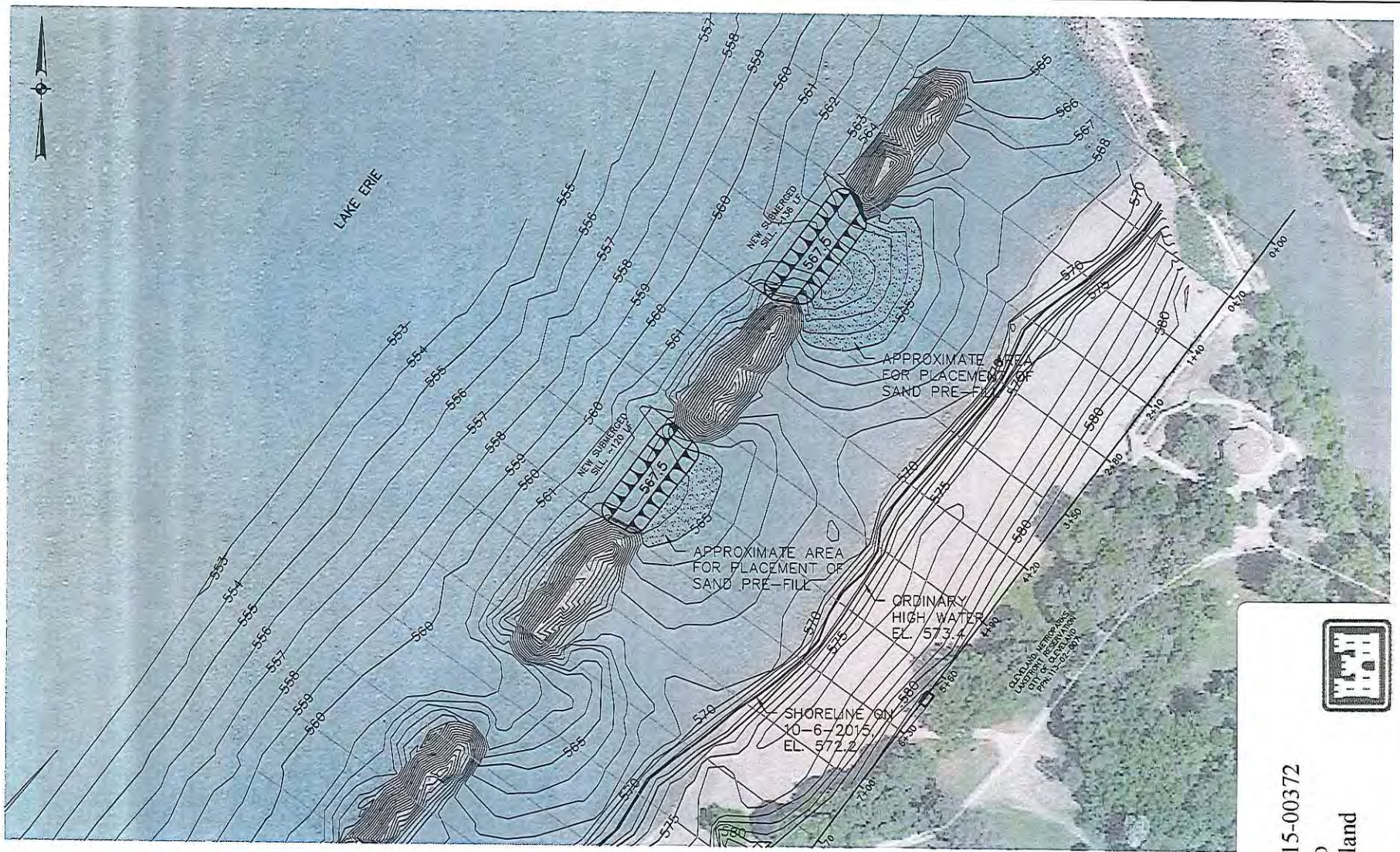

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4. WATER ELEVATION OF 10/06/2015 WAS 572.2 FEET IGLD 1985.
5. BACKGROUND IMAGE FROM GOOGLE EARTH, IMAGE DATE 06/14/2014.
6. APPROXIMATELY 2,115 CUBIC YARDS OF SAND PRE-FILL SHALL BE PLACED IN THE AREAS SHOWN.
7. SAND PREFILL SHALL BE FROM AN APPROVED UPLAND SOURCE AND SHALL BE NO FINER THAN THE FOLLOWING GRADATION:

SIEVE SIZE	% PASSING
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
#4	100.0
#8	99.7
#10	99.5
#15	96.8
#20	92.3
#30	80.0
#40	48.8
#50	18.6
#100	0.7
#200	0.1

SITE PLAN

75 0 75 150

SCALE IN FEET
SCALE 1"=150'

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

Cleveland Metroparks
D/A Processing No. 2015-00372
Cuyahoga County, Ohio
Quad: OH – East Cleveland
Sheet 5 of 6

REVISIONS		
DATE	BY	
-		

ADJACENT PROPERTY OWNERS
AE PORTFOLIO LLC
123 EAST 156TH STREET, CLEVELAND, OH 44110
DONALD A. JOHNSON
16815 EAST PARK AVE, CLEVELAND, OH 44119
DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

DATE: 12/15/2015
DRAWN BY: KS
CKD BY: MPC
DWG. NAME: 14242-1-4
PATH:
F.B.:

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KS ASSOCIATES

SITE PLAN
EUCLID BEACH/VILLA ANGELA
CLEVELAND METROPARKS
LAKEFRONT RESERVATION
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SHEET 5 OF 7

JOB NO. 14242-1

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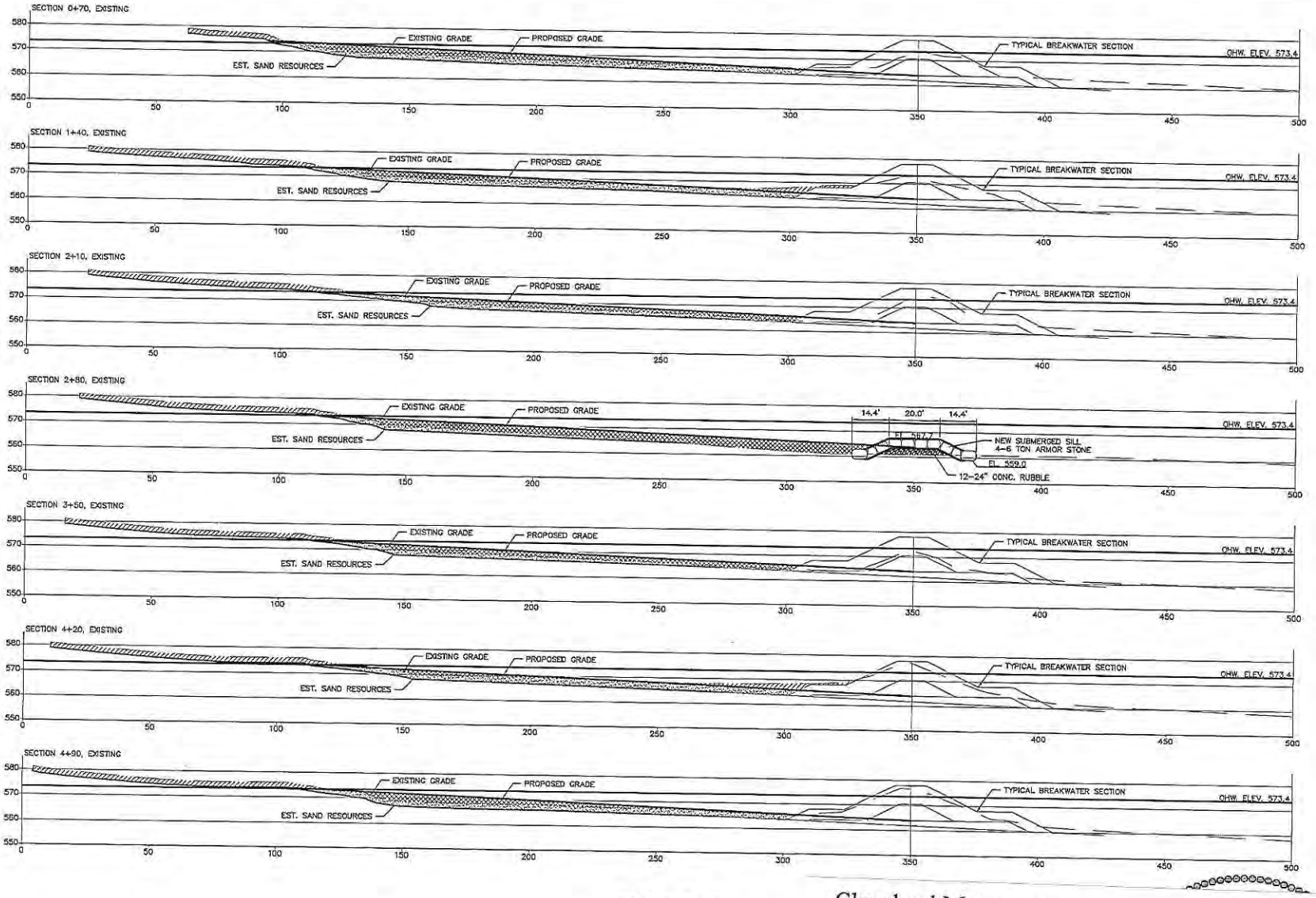

SECTIONS

30 0 30 60

SCALE IN FEET
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LEGEND

- EXISTING SAND LEFT IN PLACE
- CUT SAND, RE-GRADED ON BEACH SLOPE
- FILL SAND, RE-GRADED OR NEW

Cleveland Metroparks
D/A Processing No. 2015-00372
Cuyahoga County, Ohio
Quad: OH – East Cleveland
Sheet 6 of 6

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER

REVISIONS		
DATE	BY	

ADJACENT PROPERTY OWNERS
AE PORTFOLIO LLC
123 EAST 156TH STREET, CLEVELAND, OH 44110
DONALD A. JOHNSON
16815 EAST PARK AVE, CLEVELAND, OH 44119

DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

DATE: 12/03/2015
DRAWN BY: KS
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DWG. NAME: 14242-1-5
PATH:
F.B.:

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SECTIONS
EUCLID BEACH/VILLA ANGELA
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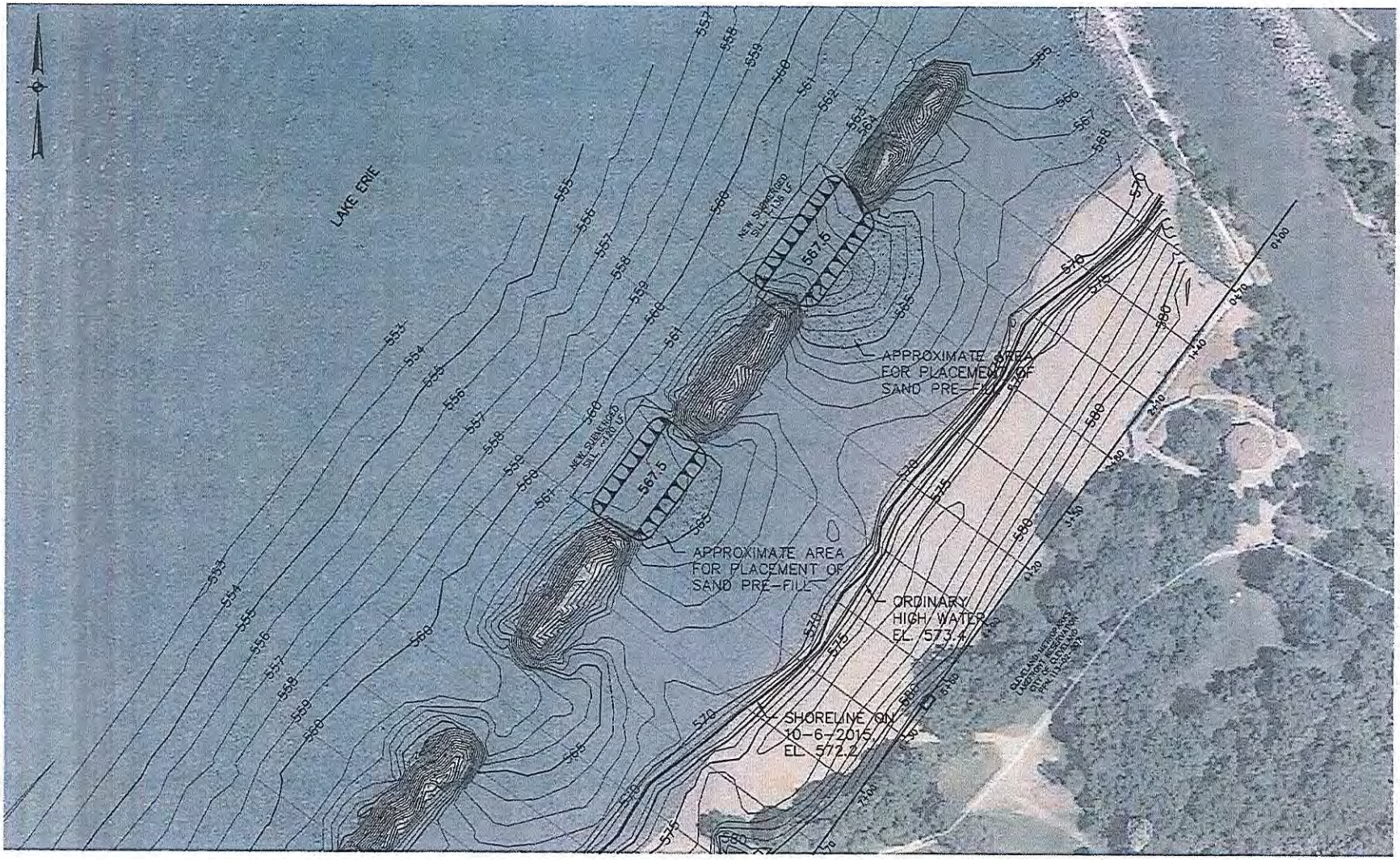
SHEET 6 OF 7

JOB NO. 14242-1

R:\14000\14242-1\DRAWINGS\2015-12-15 APPLICATION SUBMITTALS\14242-1-5 SECTIONS 121515.DWG 12/15/2015 2:22 PM

APPENDIX A – PREFERRED DESIGN ALTERNATIVE (PDA) DRAWINGS



NOTES

1. VERTICAL DATUM IS IGLD 1985.
2. BATHYMETRIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/06/2015.
3. TOPOGRAPHIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/07/2015.
4. WATER ELEVATION OF 10/06/2015 WAS 572.2 FEET IGLD 1985.
5. BACKGROUND IMAGE FROM GOOGLE EARTH, IMAGE DATE 06/14/2014.
6. APPROXIMATELY 2,011 CUBIC YARDS OF SAND PRE-FILL SHALL BE PLACED IN THE AREAS SHOWN.
7. SAND PREFILL SHALL BE FROM AN APPROVED UPLAND SOURCE AND SHALL BE NO FINER THAN THE FOLLOWING GRADATION:

SIEVE SIZE	% PASSING
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
#4	100.0
#8	99.7
#10	99.5
#15	96.8
#20	92.3
#30	80.0
#40	48.8
#50	18.6
#100	0.7
#200	0.1

PREFERRED ALTERNATIVE – SITE PLAN

75 0 75 150

SCALE IN FEET
SCALE 1"=150'

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

STATE OF OHIO
2-8-2016
MARK P. CENCER
E-74234
REGISTERED
PROFESSIONAL ENGINEER

DATE	BY	ADJACENT PROPERTY OWNERS
–		AE PORTFOLIO LLC 123 EAST 156TH STREET, CLEVELAND, OH 44110
		DONALD A. JOHNSON 16815 EAST PARK AVE, CLEVELAND, OH 44119
		DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

REVISIONS

DATE: 01-20-2016
DRAWN BY: KS
CHKD BY: MPC
DWG. NAME: 14242-1-6
PATH:
F.B.

KS ASSOCIATES
KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
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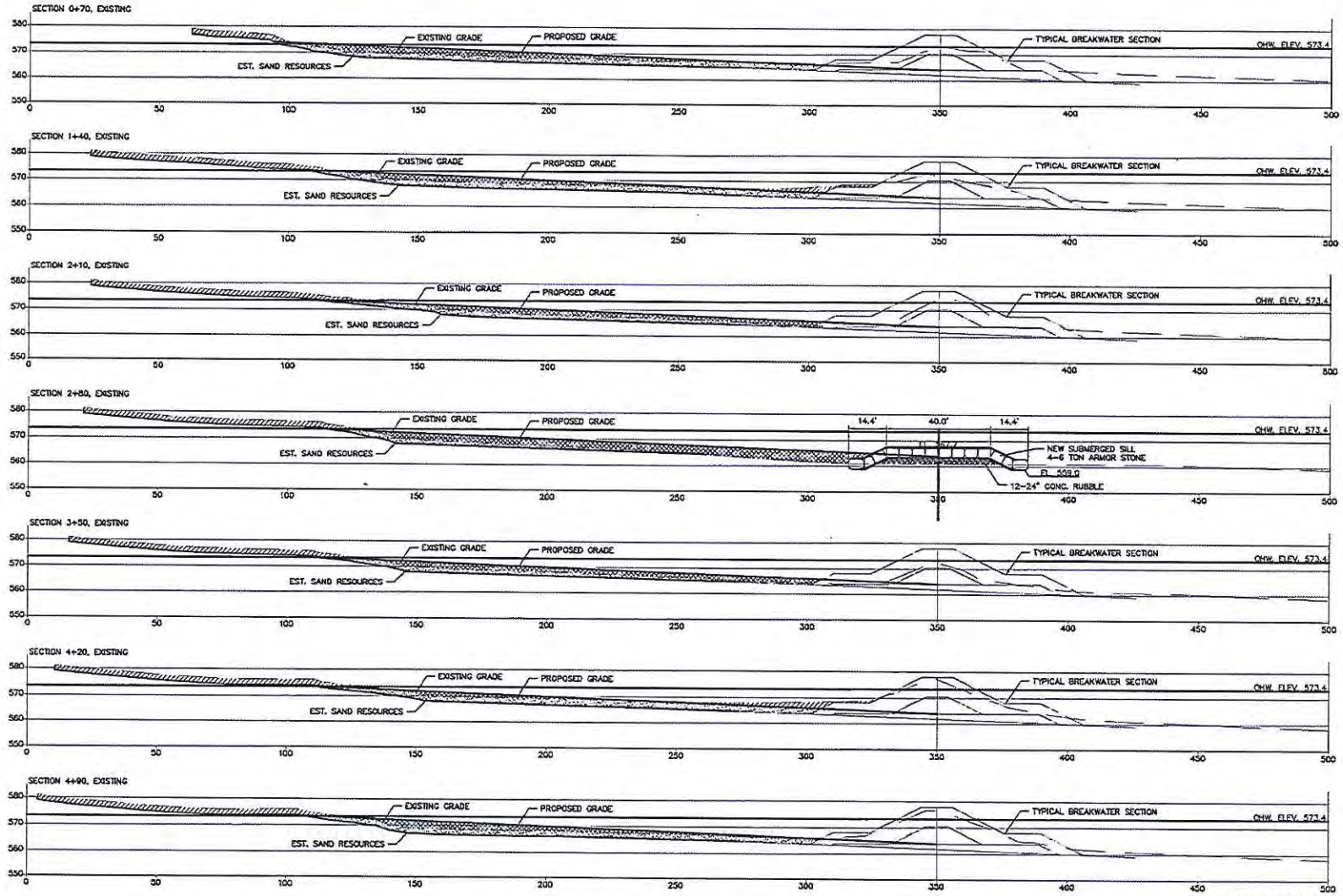
F 440 365 4790
www.ksassociates.com

PREFERRED ALTERNATIVE - SITE PLAN
EUCLID BEACH/VILLA ANGELA
CLEVELAND METROPARKS
LAKEFRONT RESERVATION
4101 FULTON PARKWAY, CLEVELAND, OHIO 44114

SHEET 1 OF 3

JOB NO. 14242-1

C:\USERS\CENCERM\DESKTOP\KS JUMP DRIVE 011516\14242-1 EUCLID BEACH\DRAWINGS\2016-01-20 OEPA APP DRAWINGS PRELIM\14242-1-6 PREFERRED ALT SITE PLAN 012016.DWG 2/8/2016 8:19 AM



PREFERRED ALTERNATIVE – SECTIONS

30 0 30 60

SCALE IN FEET
SCALE 1"=60'

NOTES

1. VERTICAL DATUM IS IGLD 1985.
2. BATHYMETRIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/06/2015.
3. TOPOGRAPHIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/07/2015.
4. WATER ELEVATION OF 10/06/2015 WAS 572.2 FEET IGLD

LEGEND

- EXISTING SAND LEFT IN PLACE
- CUT SAND, RE-GRADED ON BEACH SLOPE
- FILL SAND, RE-GRADED OR NEW

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

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2-8-2016
MARK P. CENCER
E-74234
REGISTERED
PROFESSIONAL ENGINEER

DATE	BY	ADJACENT PROPERTY OWNERS
–		AE PORTFOLIO LLC 123 EAST 156TH STREET, CLEVELAND, OH 44110
		DONALD A. JOHNSON 16815 EAST PARK AVE, CLEVELAND, OH 44119
		DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

REVISIONS

DATE: 12/13/2015
DRAWN BY: RS
CHK'D BY: MPC
DWG. NAME: 14242-1-7
P.A.
F.B.

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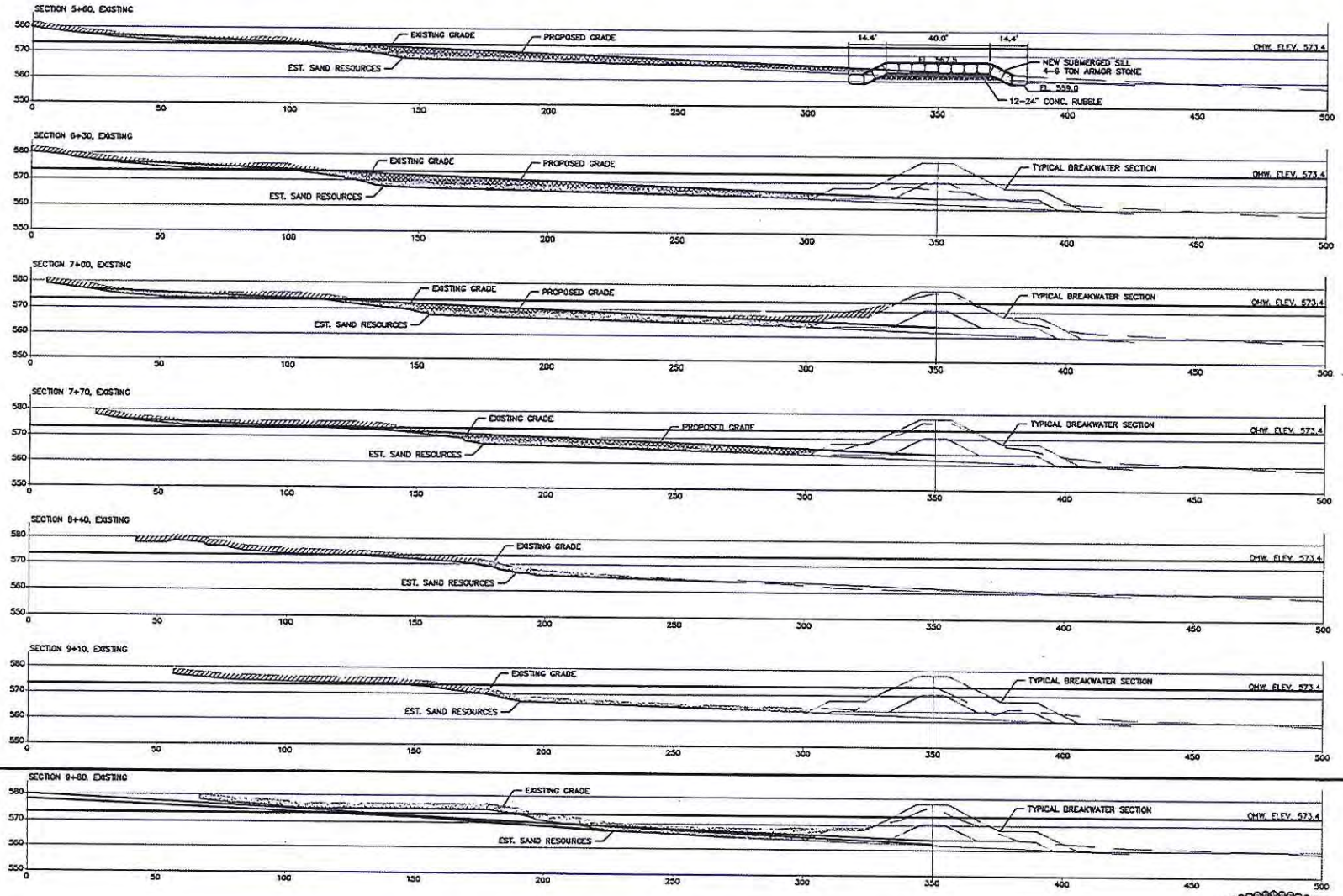
CLEVELAND METROPARKS
LAKEFRONT RESERVATION
4101 FULTON PARKWAY, CLEVELAND, OHIO 44114

SHEET 2 OF 3

JOB NO. 14242-1

C:\USERS\CENCERM\DESKTOP\KS JUMP DRIVE 011516\14242-1 EUCLID BEACH\DRAWINGS\2016-01-20 OEPA APP DRAWINGS PRELIM\14242-1-7 PREFERRED ALT SECTIONS 012016.DWG 2/8/2016 8:20 AM



PREFERRED ALTERNATIVE – SECTIONS

30 0 30 60

SCALE IN FEET
SCALE 1"=60'

NOTES

1. VERTICAL DATUM IS IGLD 1985.
2. BATHYMETRIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/06/2015.
3. TOPOGRAPHIC SURVEY PERFORMED BY CLEVELAND METROPARKS ON 10/07/2015.
4. WATER [illegible]VATION OF 10/06/2015 WAS 572.2 FEET IGLD [illegible]

LEGEND

- EXISTING SAND LEFT IN PLACE
- CUT SAND, RE-GRADED ON BEACH SLOPE
- FILL SAND, RE-GRADED OR NEW

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

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2-8-2016
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E-74234
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DATE	BY	REVISIONS
–		

ADJACENT PROPERTY OWNERS
AE PORTFOLIO LLC
123 EAST 156TH STREET, CLEVELAND, OH 44110
DONALD A. JOHNSON
16815 EAST PARK AVE, CLEVELAND, OH 44119

DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

DATE: 12/08/2015
DRAWN BY: KS
CHK'D BY: MPC
DWG. NAME: 14242-1-7
PAGE:
F.B.:

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PREFERRED ALTERNATIVE - SECTIONS
EUCLID BEACH/VILLA ANGELA
CLEVELAND METROPARKS
LAKEFRONT RESERVATION
4101 FULTON PARKWAY, CLEVELAND, OHIO 44114

SHEET 3 OF 3

JOB NO. 14242-1

C:\USERS\CENCERM\DESKTOP\KS JUMP DRIVE 011516\14242-1 EUCLID BEACH\DRAWINGS\2016-01-20 OEPA APP DRAWINGS PRELIM\14242-1-7 PREFERRED ALT SECTIONS 012016.DWG 2/8/2016 8:20 AM

APPENDIX B – SAND MONITORING PLAN

Cleveland Metroparks
Lakefront Reservation
Euclid Beach/Villa Angela Park

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Sand Monitoring Plan
Cleveland Metroparks
Lakefront Reservation, Euclid Beach/Villa Angela Park

The following beach monitoring shall be performed at Euclid Beach/Villa Angela Park:

1. **Pre-construction survey**

   A pre-construction survey shall be performed within two weeks prior to any work below the Ordinary High Water mark (573.4 feet IGLD 1985) or when weather permits an accurate survey to be performed. The pre-construction survey shall include the area from the toe of the embankment at the upland beach berm to approximately 100 feet lakeward of the existing detached breakwaters. The survey shall include the area from the Euclid Creek west jetty extending west approximately 1,500 feet.

2. **Post-construction baseline survey**

   A post-construction survey shall be performed within two weeks of the placement of sand pre-fill and final beach grading or when weather permits an accurate survey to be performed. The post-construction survey shall include the same survey area as the pre-construction survey. The post-construction survey shall include the area from the toe of the embankment at the upland beach berm to approximately 100 feet lakeward of the existing detached breakwaters. The survey shall include the area from the Euclid Creek west jetty extending west approximately 1,500 feet. This survey shall be used as a baseline for comparing beach profiles and sand quantities for future annual monitoring surveys.

3. **Annual monitoring surveys**

   Annual spring monitoring surveys shall be performed prior to the opening of the beach for swimming each year for 5 years following the construction of the submerged sills. The annual monitoring surveys shall include the same survey area as the post-construction baseline survey. The annual monitoring surveys shall include the area from the toe of the embankment at the upland beach berm to approximately 100 feet lakeward of the existing detached breakwaters. The survey shall include the area from the Euclid Creek west jetty extending west approximately 1,500 feet.

   In addition to the survey data, Cleveland Metroparks shall monitor beach conditions with annual photographs taken at the time of each monitoring survey. The photographs shall include but are not limited to the following:

   a. One photograph looking southwest along the line of detached breakwaters from the walking path on the Euclid Creek jetty.
   b. One photograph looking southwest along the shoreline from the east end of the beach.
   c. One photograph looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 6th (eastern-most) detached breakwater.
   d. One photograph looking lakeward from the landward end of the beach at a location approximately aligned with the gap between the 5th and 6th detached breakwaters.

e. One photograph looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 5th detached breakwater.
f. One photograph looking lakeward from the landward end of the beach at a location approximately aligned with the gap between the 4th and 5th detached breakwaters.
g. One photograph looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 4th detached breakwater.
h. One photograph looking lakeward from the landward end of the beach at a location approximately aligned with the gap between the 3rd and 4th detached breakwaters.
i. One photograph looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 3rd detached breakwater.
j. One photograph looking northeast along the shoreline from a location approximately aligned with the center of the 3rd detached breakwater.
k. One photograph looking southwest along the shoreline from a location approximately aligned with the center of the 3rd detached breakwater.

4. **Annual monitoring reports**

Annual monitoring reports shall include the following:

a. A site plan drawing of the entire survey area showing topography and bathymetry with 1-foot contours.
b. Cross section drawings at 70-foot spacing aligned with the section stationing shown in the permit drawings. The cross section drawings shall depict the beach profile from the post-construction baseline survey and the beach profile from the current annual monitoring survey.
c. The date of the survey and lake level at the time of the survey shall be noted on the drawings.
d. Copies of the photographs taken during the annual monitoring survey, as described in Section 3 of this Sand Monitoring Plan.
e. Verifiable estimates of net sand accretion or erosion in the littoral cell landward of the existing detached breakwaters and between the groin near the center of the 3rd detached breakwater and Euclid Creek jetty.
f. Estimates of the amount of sand to be re-graded or added to the beach system prior to the opening of the beach for public swimming.

Annual monitoring reports shall be submitted to:

U.S. Army Corps of Engineers
Buffalo District Regulatory Office
1776 Niagara Street
Buffalo, New York 14207

Ohio Department of Natural Resources
Office of Coastal Management
105 West Shoreline Drive
Sandusky, Ohio 44870

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5. **Beach maintenance**

If an annual monitoring survey determines that sand transport within the littoral cell landward of the detached breakwaters has resulted in unfavorable conditions for a public swim area, Cleveland Metroparks may request authorization to re-grade the beach or add additional sand pre-fill. No grading or beach nourishment shall be performed until written approval is received from the U.S. Army Corps of Engineers and Ohio Department of Natural Resources. All sand used for beach nourishment shall be from an approved upland source. The U.S. Army Corps of Engineers and Ohio Department of Natural Resources shall be notified 5 days prior to any beach maintenance activities requiring grading or placement of additional sand as beach nourishment.

6. **Contingency plan**

If the annual monitoring surveys demonstrate the beach profile is stable during the first five years of monitoring, additional monitoring surveys shall not be required to be submitted to the U.S. Army Corps of Engineers or Ohio Department of Natural Resources. Annual beach monitoring may still be performed following year five at the option of Cleveland Metroparks. If beach maintenance is proposed following year five, the monitoring survey demonstrating the need for beach maintenance shall be submitted to the U.S. Army Corps of Engineers and Ohio Department of Natural Resources in the form of a monitoring report as described in Section 4 of this Sand Monitoring Plan.

If the annual monitoring surveys demonstrate the need for annual beach maintenance during the first five years, additional monitoring surveys shall be required to be submitted to the U.S. Army Corps of Engineers and Ohio Department of Natural Resources on a year-by-year basis. The U.S. Army Corps of Engineers and Ohio Department of Natural Resources shall make the determination of whether additional annual monitoring is required.

No beach maintenance shall be performed until written approval is received from the U.S. Army Corps of Engineers and/or Ohio Department of Natural Resources, as required by Section 5 of this Sand Monitoring Plan.

Any modifications to or waiver of the requirements of this Sand Monitoring Plan shall be obtained in writing by coordinating with the U.S. Army Corps of Engineers and/or Ohio Department of Natural Resources.

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APPENDIX C – SUBMERGED SILL DESIGN CALCULATIONS

Submerged Sill Design

The performance of the proposed submerged sills will be dependant on water level and wave conditions. The structures should be designed considering a range of conditions.

Assume the following elevations for the cross section of the proposed sills:

Crest elevation	567.5	feet IGLD 1985 (based on results of Baird cross shore modeling)
Toe elevation	559.0	feet IGLD 1985 (from beach profiles between breakwaters)

Consider range of water levels from 569.0 to 576.0 feet IGLD 1985.

Review of wave record

USACE Wave Information Station 92067		-Hmo based on linear fit of extremes analysis
Return period	30.0 years	using top 54 wave events from 1960-2013.
Design wave height, H_{mo}	17.1 ft	USACE, Wave Information Station 92067
Period	9.4 sec	

Note: there is minimal difference between 30 year, 50 year and 100 year wave events (17.1, 18.0, 19.1')

Wave transformation from deep water wave to water depth at the toe of the breakwater:
Use Goda irregular transformation to find 30-year, significant wave height at breakwater based on significant wave height from WIS data (using ACES software). This method accounts for shoaling, refraction, wave setup, surf beat and wave breaking. Note: This calculation is based on the assumption that the WIS data represents deep water conditions (in about 55.8 feet of water).

Example ACES output for wave conditions at 30 year design water level (575.5 feet IGLD 1985):

Case: 30-year wave

Irregular Wave Transformation (Goda's Method)

Item	Subject Wave	Deepwater Wave	Units	Item	Subject Wave	Deepwater Wave	Units
Wave height (Ho)		17.100	ft	Hs	9.510	17.146	ft
Sig wave period (Ts)	9.400	9.400	sec	Hmean	6.670	10.702	ft
Water depth (d)	16.500	452.222	ft	Hms	7.158	12.076	ft
Nearshore slope (cot phi)	100.000	100.000		H10%	10.810	21.754	ft
Principal dir (theta)	0.000	0.000	deg	H02%	11.738	26.723	ft
				Hmax	12.259	30.887	ft
Shoaling Coeff. (Ks)	1.527	1.000		Effec refract coeff (Kr)	0.934		
Surf Beat RMS (zeta)	0.629	0.168	ft	Depth/height (d/Ho)	0.940	26.447	
Wave setup (Sw)	0.217	-0.014	ft	Rel water depth (d/Lo)	0.036	1.000	
Wave steepness (Ho/Lo)	0.038	0.038					

Apply wave transmission formula by van der Meer and d'Angremond for rock armored low-crested, submerged and reef breakwaters (EM 1110-2-1100 Table VI-5-15)

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KS Associates, Inc.
260 Burns Rd. Suite 100
Elyria, Ohio 44035

Job	14242-1 Euclid Beach		
Sheet No.	2	of	10
Calculated By	MPC	Date	12/15/2015
Checked By		Date	

Calculate wave transmission coefficient and transmitted wave height for range of water levels and incident wave heights

$$H_t = C_t H_i$$

H_t Transmitted wave height
C_t Wave transmission coefficient
H_i Incident wave height

$$C_t = \left(0.031\frac{H_s}{D_{n50}} - 0.24\right)\frac{R_c}{D_{n50}} - 5.42 s_{op} + 0.0323\frac{H_s}{D_{n50}} - 0.0017\left(\frac{B}{D_{n50}}\right)^{1.84} + 0.51$$

H_s Significant wave height of incident waves
D_{n50} Median nominal armor stone diamater, assume: 4 ft
R_c Freeboard (negative for submerged structure)
s_{op} Deepwater wave steepness corresponding to peak period (ACES output)
B Crest width

It is not practical, based on the project budget, to construct sills that would reduce wave energy to prevent mobilization of sand under all water level and wave conditions.

Consider a range of structure crest width and minimal option based on criteria from Baird Hydrodynamic study.

For 10-foot crest width

Case	Water Level (ft IGLD85)	D_s (ft)	H_s (ft)	R_c (ft)	S_{op}	B (ft)	C_t	H_t (ft)
1	569	10	6.2	-1.5	0.038	10	0.4169	2.6
2	569.5	10.5	6.5	-2	0.038	10	0.442	2.9
3	570	11	6.7	-2.5	0.04	10	0.4557	3.1
4	570.5	11.5	7.0	-3	0.038	10	0.4907	3.4
5	571	12	7.3	-3.5	0.038	10	0.5143	3.7
6	571.5	12.5	7.6	-4	0.038	10	0.5373	4.1
7	572	13	7.9	-4.5	0.038	10	0.5598	4.4
8	572.5	13.5	8.2	-5	0.038	10	0.5817	4.8
9	573	14	8.3	-5.5	0.038	10	0.6035	5.0
10	573.5	14.5	8.5	-6	0.038	10	0.6247	5.3
11	574	15	8.8	-6.5	0.038	10	0.6451	5.7
12	574.5	15.5	9.2	-7	0.038	10	0.6647	6.1
13	575	16	9.3	-7.5	0.038	10	0.6851	6.3
14	575.5	16.5	9.5	-8	0.038	10	0.7043	6.7
15	576	17	9.9	-8.5	0.038	10	0.722	7.1

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12-15-2015
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260 Burns Rd. Suite 100
Elyria, Ohio 44035

Job	14242-1 Euclid Beach		
Sheet No.	3	of	10
Calculated By	MPC	Date	12/15/2015
Checked By		Date	

For 15-foot crest width

Case	Water Level (ft IGLD85)	D_s (ft)	H_s (ft)	R_c (ft)	S_{op}	B (ft)	C_t	H_t (ft)
1	569	10	6.2	-1.5	0.038	15	0.4067	2.5
2	569.5	10.5	6.5	-2	0.038	15	0.4319	2.8
3	570	11	6.7	-2.5	0.04	15	0.4455	3.0
4	570.5	11.5	7.0	-3	0.038	15	0.4805	3.4
5	571	12	7.3	-3.5	0.038	15	0.5041	3.7
6	571.5	12.5	7.6	-4	0.038	15	0.5271	4.0
7	572	13	7.9	-4.5	0.038	15	0.5496	4.3
8	572.5	13.5	8.2	-5	0.038	15	0.5715	4.7
9	573	14	8.3	-5.5	0.038	15	0.5933	4.9
10	573.5	14.5	8.5	-6	0.038	15	0.6146	5.2
11	574	15	8.8	-6.5	0.038	15	0.6349	5.6
12	574.5	15.5	9.2	-7	0.038	15	0.6545	6.0
13	575	16	9.3	-7.5	0.038	15	0.675	6.2
14	575.5	16.5	9.5	-8	0.038	15	0.6941	6.6
15	576	17	9.9	-8.5	0.038	15	0.7118	7.0

For 20-foot crest width

Case	Water Level (ft IGLD85)	D_s (ft)	H_s (ft)	R_c (ft)	S_{op}	B (ft)	C_t	H_t (ft)
1	569	10	6.2	-1.5	0.038	20	0.3932	2.4
2	569.5	10.5	6.5	-2	0.038	20	0.4184	2.7
3	570	11	6.7	-2.5	0.04	20	0.432	2.9
4	570.5	11.5	7.0	-3	0.038	20	0.467	3.3
5	571	12	7.3	-3.5	0.038	20	0.4906	3.6
6	571.5	12.5	7.6	-4	0.038	20	0.5136	3.9
7	572	13	7.9	-4.5	0.038	20	0.5361	4.2
8	572.5	13.5	8.2	-5	0.038	20	0.558	4.6
9	573	14	8.3	-5.5	0.038	20	0.5798	4.8
10	573.5	14.5	8.5	-6	0.038	20	0.601	5.1
11	574	15	8.8	-6.5	0.038	20	0.6214	5.5
12	574.5	15.5	9.2	-7	0.038	20	0.641	5.9
13	575	16	9.3	-7.5	0.038	20	0.6615	6.1
14	575.5	16.5	9.5	-8	0.038	20	0.6806	6.5
15	576	17	9.9	-8.5	0.038	20	0.6983	6.9

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For 25-foot crest width

Case	Water Level (ft IGLD85)	D_s (ft)	H_s (ft)	R_c (ft)	S_{op}	B (ft)	C_t	H_t (ft)
1	569	10	6.2	-1.5	0.038	25	0.3766	2.3
2	569.5	10.5	6.5	-2	0.038	25	0.4017	2.6
3	570	11	6.7	-2.5	0.04	25	0.4153	2.8
4	570.5	11.5	7.0	-3	0.038	25	0.4503	3.2
5	571	12	7.3	-3.5	0.038	25	0.4739	3.4
6	571.5	12.5	7.6	-4	0.038	25	0.497	3.8
7	572	13	7.9	-4.5	0.038	25	0.5195	4.1
8	572.5	13.5	8.2	-5	0.038	25	0.5413	4.4
9	573	14	8.3	-5.5	0.038	25	0.5632	4.7
10	573.5	14.5	8.5	-6	0.038	25	0.5844	5.0
11	574	15	8.8	-6.5	0.038	25	0.6047	5.3
12	574.5	15.5	9.2	-7	0.038	25	0.6243	5.7
13	575	16	9.3	-7.5	0.038	25	0.6448	6.0
14	575.5	16.5	9.5	-8	0.038	25	0.6639	6.3
15	576	17	9.9	-8.5	0.038	25	0.6817	6.7

For 30-foot crest width

Case	Water Level (ft IGLD85)	D_s (ft)	H_s (ft)	R_c (ft)	S_{op}	B (ft)	C_t	H_t (ft)
1	569	10	6.2	-1.5	0.038	30	0.3568	2.2
2	569.5	10.5	6.5	-2	0.038	30	0.3819	2.5
3	570	11	6.7	-2.5	0.04	30	0.3956	2.7
4	570.5	11.5	7.0	-3	0.038	30	0.4306	3.0
5	571	12	7.3	-3.5	0.038	30	0.4542	3.3
6	571.5	12.5	7.6	-4	0.038	30	0.4772	3.6
7	572	13	7.9	-4.5	0.038	30	0.4997	3.9
8	572.5	13.5	8.2	-5	0.038	30	0.5216	4.3
9	573	14	8.3	-5.5	0.038	30	0.5434	4.5
10	573.5	14.5	8.5	-6	0.038	30	0.5646	4.8
11	574	15	8.8	-6.5	0.038	30	0.585	5.2
12	574.5	15.5	9.2	-7	0.038	30	0.6046	5.5
13	575	16	9.3	-7.5	0.038	30	0.625	5.8
14	575.5	16.5	9.5	-8	0.038	30	0.6442	6.1
15	576	17	9.9	-8.5	0.038	30	0.6619	6.5

Select 20-foot crest width as it results in less than 4.0 foot transmitted wave at average water levels. Some reforming of beach profiles should be expected in extreme water level or wave events.

Sills are proposed in each of the breakwater gaps. Phase 1 of the project will include construction of two sills between the 4th and 6th breakwaters (counting from the west). The performance of the proposed sills will be evaluated for the design of the additional sills in later phases.

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Proposed Beach Profile

Swim area criteria:

1 Under water gradient should be as smooth as possible
2 Beach slopes range from 2 to 5%
3 Water depths not to exceed 6 feet (at 100 feet landward of breakwaters)

Water depths are based on average summer lake levels (ranging from 571.5 to 572 feet IGLD 1985)

The proposed beach profile is to be based on re-grading existing beach slope and supplementing (as required) with additional sand prefill. Based on soil borings performed at the west end of the beach and recent beach grading by Cleveland Metroparks in the project area, a minimum of two feet of sand is expected to be available for grading in the existing beach profile.

The proposed profile is generated by extending a proposed grade line at a 4% slope from an elevation of 574 at about 250 feet landward of the existing breakwater centerline. The proposed grade line intersects the sill profile just above the expected rubble core layer to prevent excessive loss of sand during typical lake conditions.

Beach profiles are generated at 70-foot stations (based on the length and spacing of the existing breakwaters).

The profiles can be used to calculate the volume of sand expected to be available for re-grading and the volume of additional sand pre-fill required.

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Calculated By	MPC	Date	12/15/2015
Checked By		Date	

Estimate of Existing Sand Resources

Calculate existing sand resources landward of eastern three breakwaters at Euclid Beach/Villa Angela.

Station	Est. Sand Area (sf)	Avg. Est. Sand Area (sf)	Distance (ft)	Est. Sand Volume (cy)	Total (cy)
0+00	488.4				
		494.75	70	1283	1283
0+70	501.1				
		567.2	70	1471	2753
1+40	633.3				
		551.6	70	1430	4183
2+10	469.9				
		420.25	70	1090	5273
2+80	370.6				
		411.35	70	1066	6339
3+50	452.1				
		601.5	70	1559	7899
4+20	750.9				
		673.7	70	1747	9645
4+90	596.5				
		515	70	1335	10981
5+60	433.5				
		505.9	70	1312	12292
6+30	578.3				
		678.75	70	1760	14052
7+00	779.2				
		614.35	70	1593	15645
7+70	449.5				
		417.55	70	1083	16727
8+40	385.6				
		409.4	70	1061	17789
9+10	433.2				
			Total	**17789**	**cy**

*This estimate only includes sand in top two feet of the beach profile. This represents the quantity of sand expected to be available for re-grading based on soil borings and elevations where rubble was encountered during the 2015 beach grading project. Approximately 26,000 cubic yards of sand pre-fill was placed as part of the construction of the eastern three detached breakwaters. Based on a review of historical aerial photos, there was very little beach present prior to the construction of the detached breakwaters. Beach profile elevations likely sloped from about 573 feet IGLD 1985 along shore to about 564 feet IGLD 1985 in the area of the breakwaters. Current grades exceed 580 feet IGLD 1985 at the landward beach berm. Based on current beach profiles it is estimated that very little sand pre-fill has been displaced from the littoral system. This demonstrates that the Euclid Beach/Villa Angela littoral cell is largely independent of littoral processes in the surrounding area.

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Sand quantity to be left in place

Calculate volumes of sand to be re-graded and volume of sand that is in the layer available for re-grading but is planned to be left in place based on the proposed beach profile:

Station	Est. Sand Area (sf)	Avg. Est. Sand Area (sf)	Distance (ft)	Est. Sand Volume (cy)	Total (cy)
0+00	0				
		209.85	70	544	544
0+70	419.7				
		409.95	70	1063	1607
1+40	400.2				
		332.8	70	863	2470
2+10	265.4				
		215.6	70	559	3029
2+80	165.8				
		201.85	70	523	3552
3+50	237.9				
		334.45	70	867	4419
4+20	431				
		402.25	70	1043	5462
4+90	373.5				
		335	70	869	6330
5+60	296.5				
		361.75	70	938	7268
6+30	427				
		464.25	70	1204	8472
7+00	501.5				
		372.8	70	967	9438
7+70	244.1				
		185.6	70	481	9920
8+40	127.1				
		161	70	417	10337
9+10	194.9				
			Total	**10337**	**cy**

Sand to be re-graded

Sand available	17789 cy
Sand to be left in place	10337 cy
Sand to be re-graded	7452 cy

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Of the 17789 cubic yards of sand estimated to be available in the top two feet of the existing beach profile, approximately 10,337 cubic yards falls within the proposed beach profile and will be left in-place. Of the 7,452 cubic yards of sand to be re-graded approximately 5,712 is to be relocated from above OHW to below OHW.

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Sand fill required

Calculate additional sand pre-fill required based on the proposed beach profile:

Station	Est. Sand Area (sf)	Avg. Est. Sand Area (sf)	Distance (ft)	Est. Sand Volume (cy)	Total (cy)
0+00	0				
		107.4	70	278	278
0+70	214.8				
		87.6	70	227	506
1+40	-39.6				
		4.15	70	11	516
2+10	47.9				
		212.85	70	552	1068
2+80	377.8				
		238.55	70	618	1687
3+50	99.3				
		-70.15	70	-182	1505
4+20	-239.6				
		-98	70	-254	1251
4+90	43.6				
		125.85	70	326	1577
5+60	208.1				
		189.45	70	491	2068
6+30	170.8				
		7.6	70	20	2088
7+00	-155.6				
		-66	70	-171	1917
7+70	23.6				
		76.6	70	199	2115
8+40	129.6				
			Total	**2115**	**cy**

*All sand pre-fill is to be placed below Ordinary High Water

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Submerged Sills Structural Design

Armor stone should be sized for maximum wave forces expected, based on 30-year design conditions.

The crest of a structure designed to be submerged will undergo the heaviest wave action when the crest is exposed in the trough of a wave. (SPM Pg 7-204)

Consider range of water levels and calculate largest wave resulting in the structure crest becoming emergent assuming sinusoidal wave form (linear wave theory).

Case	Water level (ft IGLD 85)	Wave height (ft) for emergent crest	$H_{10\%}$ Incident	Water depth (ft)	Depth limited Hb (ft)
1	569	3	7.1	10	7.8
2	569.5	4	7.4	10.5	8.2
3	570	5	7.6	11	8.6
4	570.5	6	7.9	11.5	9.0
5	571	7	8.2	12	9.4
6	571.5	8	8.6	12.5	9.8
7	572	9	8.9	13	10.1
8	572.5	10	9.3	13.5	10.5
9	573	11	9.4	14	10.9
10	573.5	12	9.6	14.5	11.3
11	574	13	10.0	15	11.7
12	574.5	14	10.4	15.5	12.1
13	575	15	10.6	16	12.5
14	575.5	16	10.8	16.5	12.9
15	576	17	11.2	17	13.3

This method considers both 30-year return period wave heights from WIS station 92067 (H10%) calculated using Goda method for irregular wave transformation and depth limited waves.

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Calculate required stone size based on EM 1110-2-1100 Table VI-5-25 & 26 for submerged breakwaters

Relative eroded area, S	2	(assume no damage condition)
Max. elevation of crest	567.5	ft IGLD 1985
Min. elevation of toe	559.0	ft IGLD 1985
Local wave steepness	0.038	at peak spectral period (ACES output)
Specific weight ratio, S_r	2.64	
Sr-1, Δ	1.6	
Unit weight of stone, ω_r	165	lb/ft³

Water depth, h — varies by case
Height of structure, h'c — varies by case

Spectral stability no, $N_s^* = -\frac{1}{0.14} \ln\left[\frac{h'c/h}{(2.1+0.1S)}\right]$

Armor stone diameter, $D_{n50} = \frac{H\, S_p^{-1/3}}{\Delta N_s^*}$

Armor unit weight, $W_{50} = \omega_r D_{n50}{}^3$

Case	Water level (ft IGLD85)	h (ft)	h'c (ft)	Ns*	H (ft)	D_{n50} (ft)	W_{50} (lb)
1	569	10.0	8.5	7.1	7.8	1.98	1290
2	569.5	10.5	8.5	7.5	8.2	1.99	1298
3	570	11.0	8.5	7.8	8.6	2.00	1314
4	570.5	11.5	8.5	8.1	9	2.01	1336
5	571	12.0	8.5	8.4	9.4	2.02	1363
6	571.5	12.5	8.5	8.7	9.8	2.04	1394
7	572	13.0	8.5	9.0	10.1	2.03	1388
8	572.5	13.5	8.5	9.3	10.5	2.05	1427
9	573	14.0	8.5	9.5	10.9	2.07	1469
10	573.5	14.5	8.5	9.8	11.3	2.09	1514
11	574	15.0	8.5	10.0	11.7	2.12	1561
12	574.5	15.5	8.5	10.2	12.1	2.14	1611
13	575	16.0	8.5	10.5	12.5	2.16	1664
14	575.5	16.5	8.5	10.7	12.9	2.18	1718
15	576	17.0	8.5	10.9	13.3	2.21	1774

Assume H is largest of $H_{10\%}$ and H_b (depth limited)

Required W50 is approximately 1500 lbs. The minimum stone size to be used is 2 to 4-ton. A double layer of 2 to 4-ton stone would be about 6.5 feet thick and would not allow sufficient space for core stone, resulting in a porous structure. Increase stone size to 4 to 6-ton with single armor layer over 12-24" concrete rubble to prevent migration of sand through the structure.

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APPENDIX D – SITE PHOTOGRAPHS

Cleveland Metroparks
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Photograph 1: Looking southwest along the line of detached breakwaters from the walking path on the Euclid Creek jetty. 12/4/15.

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Photograph 2: Looking southwest along the shoreline from the east end of the beach. 12/4/15.

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Photograph 3: Looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 6th (eastern-most) detached breakwater. 12/4/15.

Cleveland Metroparks
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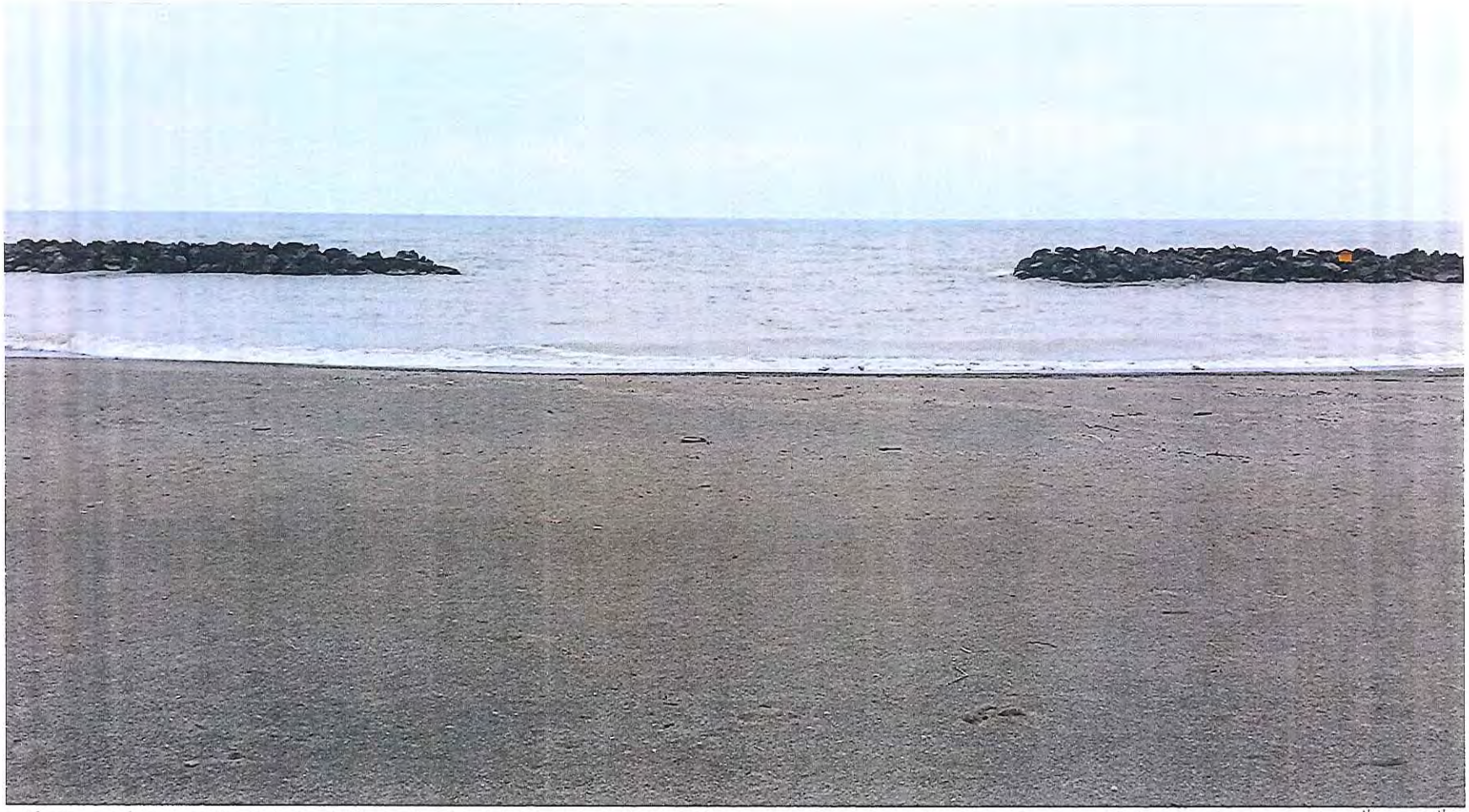
Euclid Beach/Villa Angela Park



Photograph 4: Looking lakeward from the landward end of the beach at a location approximately aligned with the gap between the 5th and 6th detached breakwaters. 12/4/15.

Cleveland Metroparks
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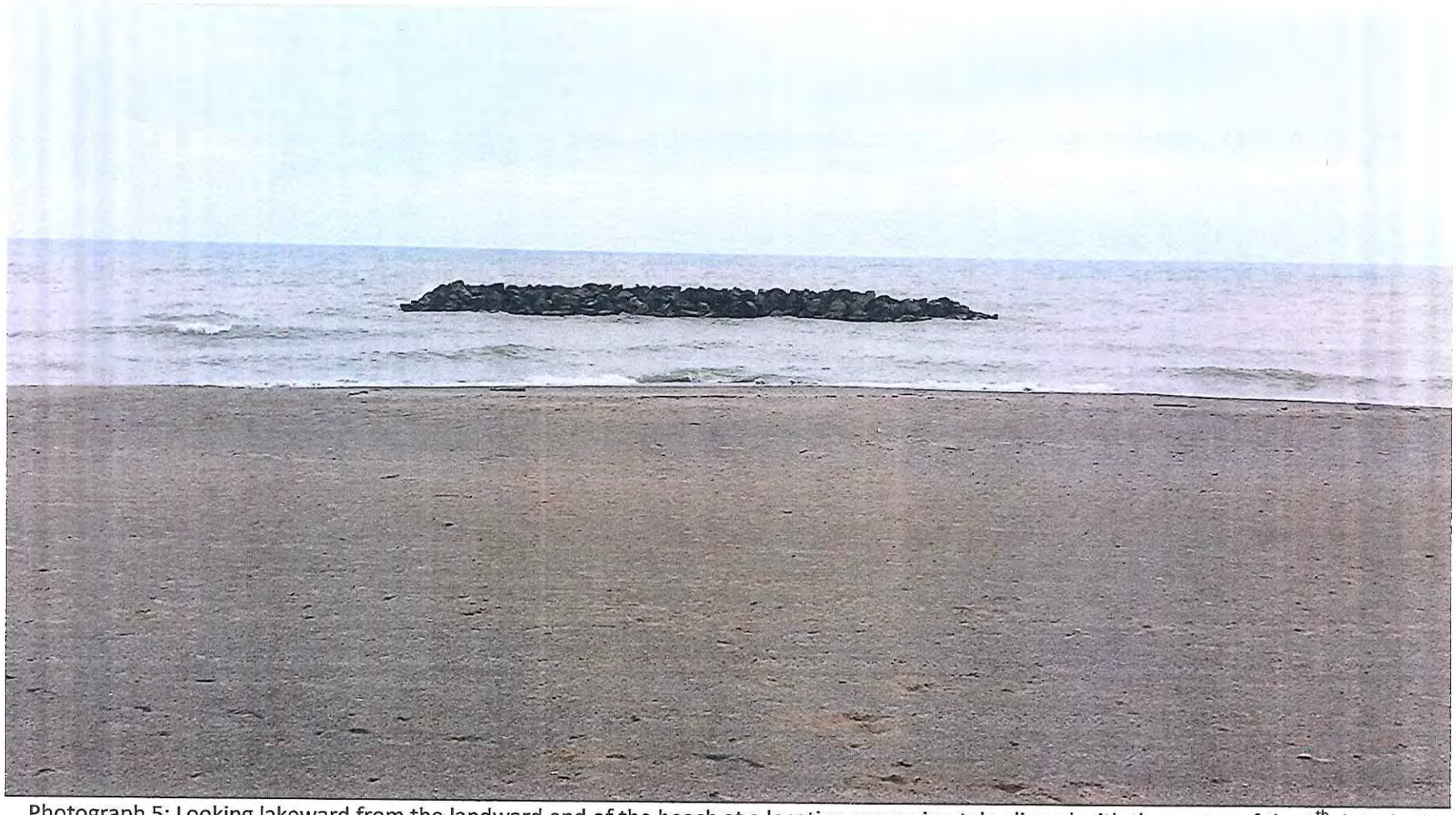
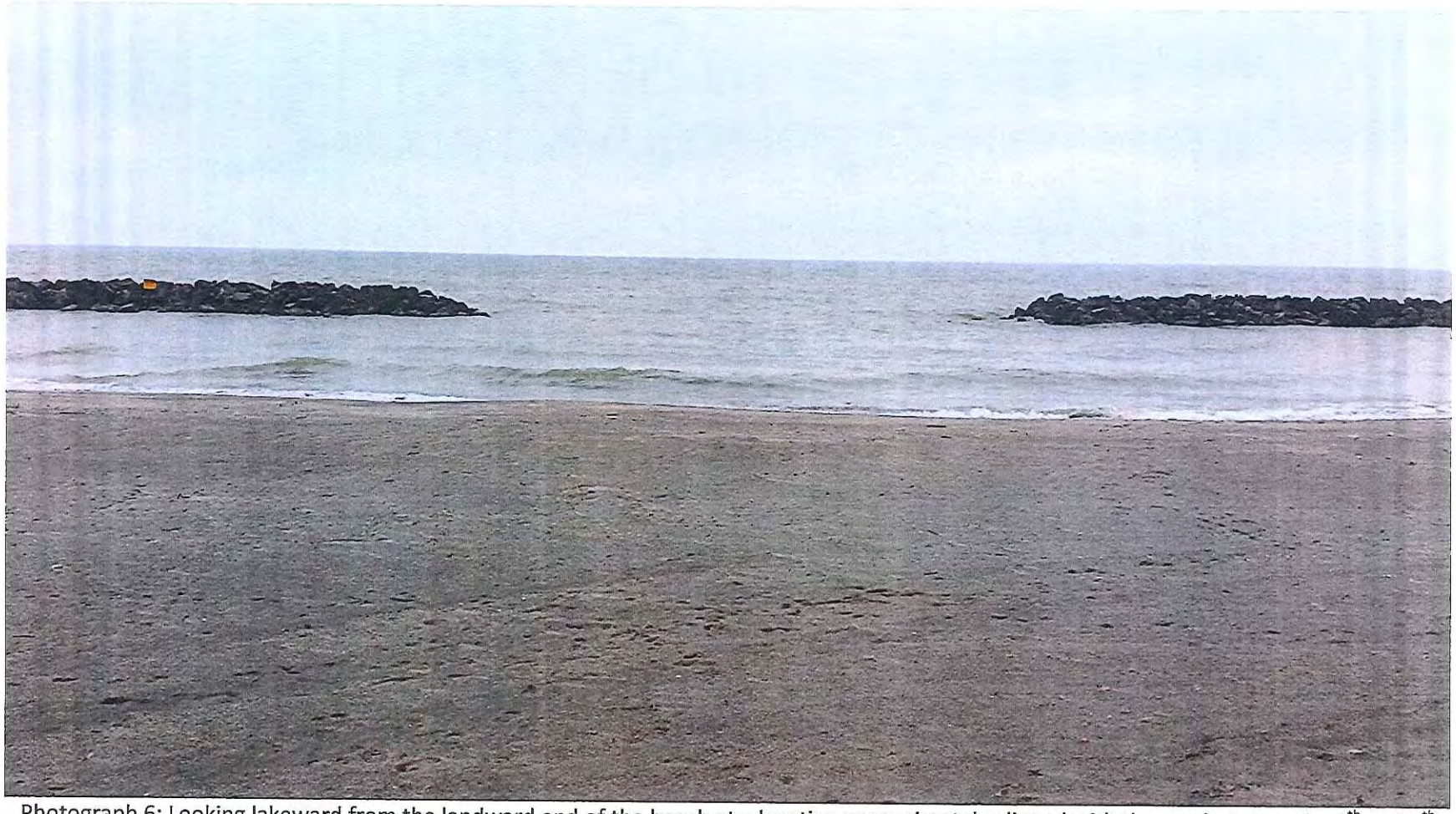
Euclid Beach/Villa Angela Park



Photograph 5: Looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 5th detached breakwater. 12/4/15.

Cleveland Metroparks
Lakefront Reservation
Euclid Beach/Villa Angela Park



Photograph 6: Looking lakeward from the landward end of the beach at a location approximately aligned with the gap between the 4th and 5th detached breakwaters. 12/4/15.

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Euclid Beach/Villa Angela Park

Photograph 7: Looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 4th detached breakwater. 12/4/15.

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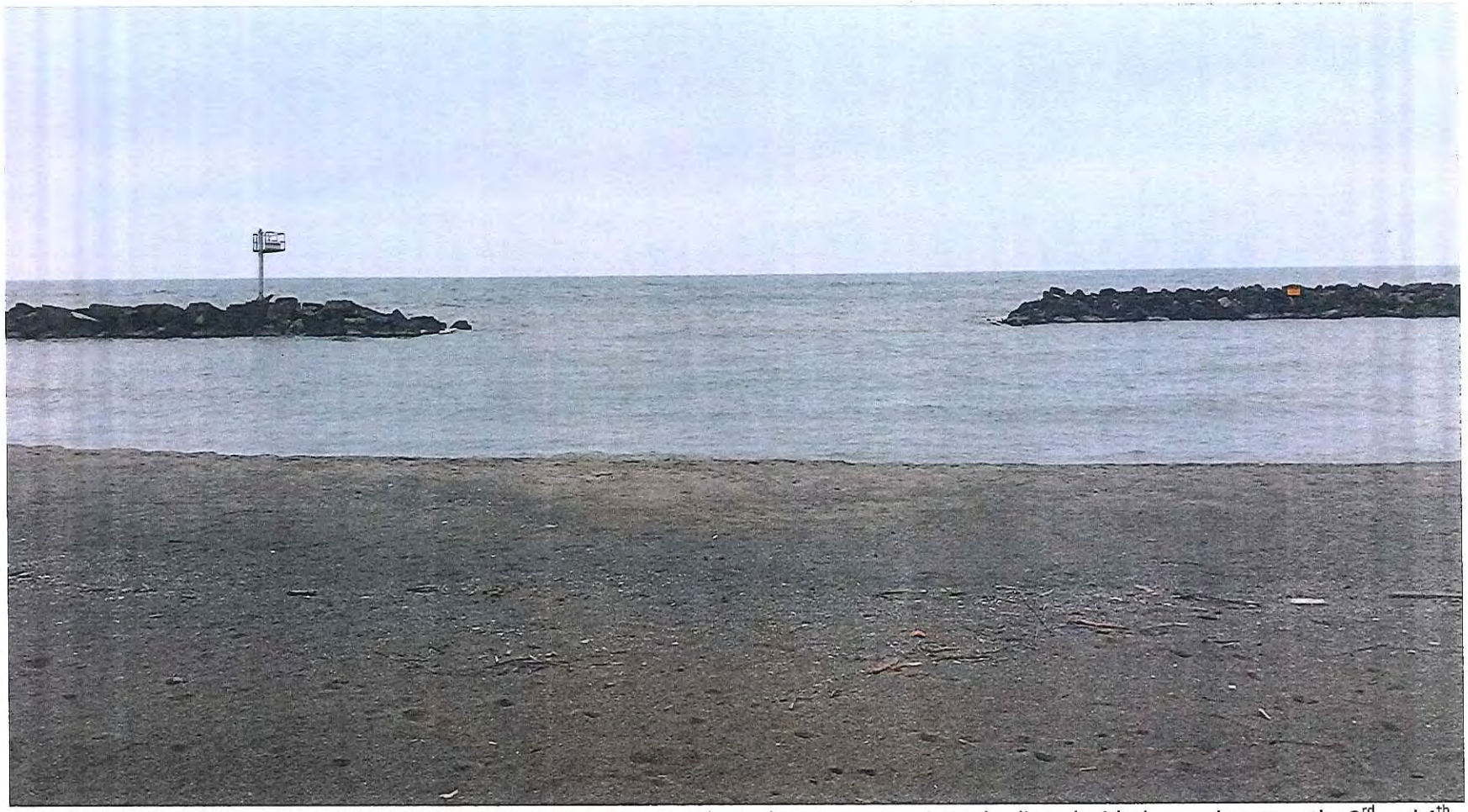

Photograph 8: Looking lakeward from the landward end of the beach at a location approximately aligned with the gap between the 3rd and 4th detached breakwaters. 12/4/15.

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Photograph 9: Looking lakeward from the landward end of the beach at a location approximately aligned with the center of the 3rd detached breakwater. 12/4/15.

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Photograph 10: Looking northeast along the shoreline from a location approximately aligned with the center of the 3rd detached breakwater. 12/4/15.

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Photograph 10: Looking northeast along the shoreline from a location approximately aligned with the center of the 3rd detached breakwater. 12/4/15.

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Photograph 11: Looking southwest along the shoreline from a location approximately aligned with the center of the 3rd detached breakwater. 12/4/15.