August 19, 2014

Developing a No-Build Zone Ordinance

St. Joseph, Michigan

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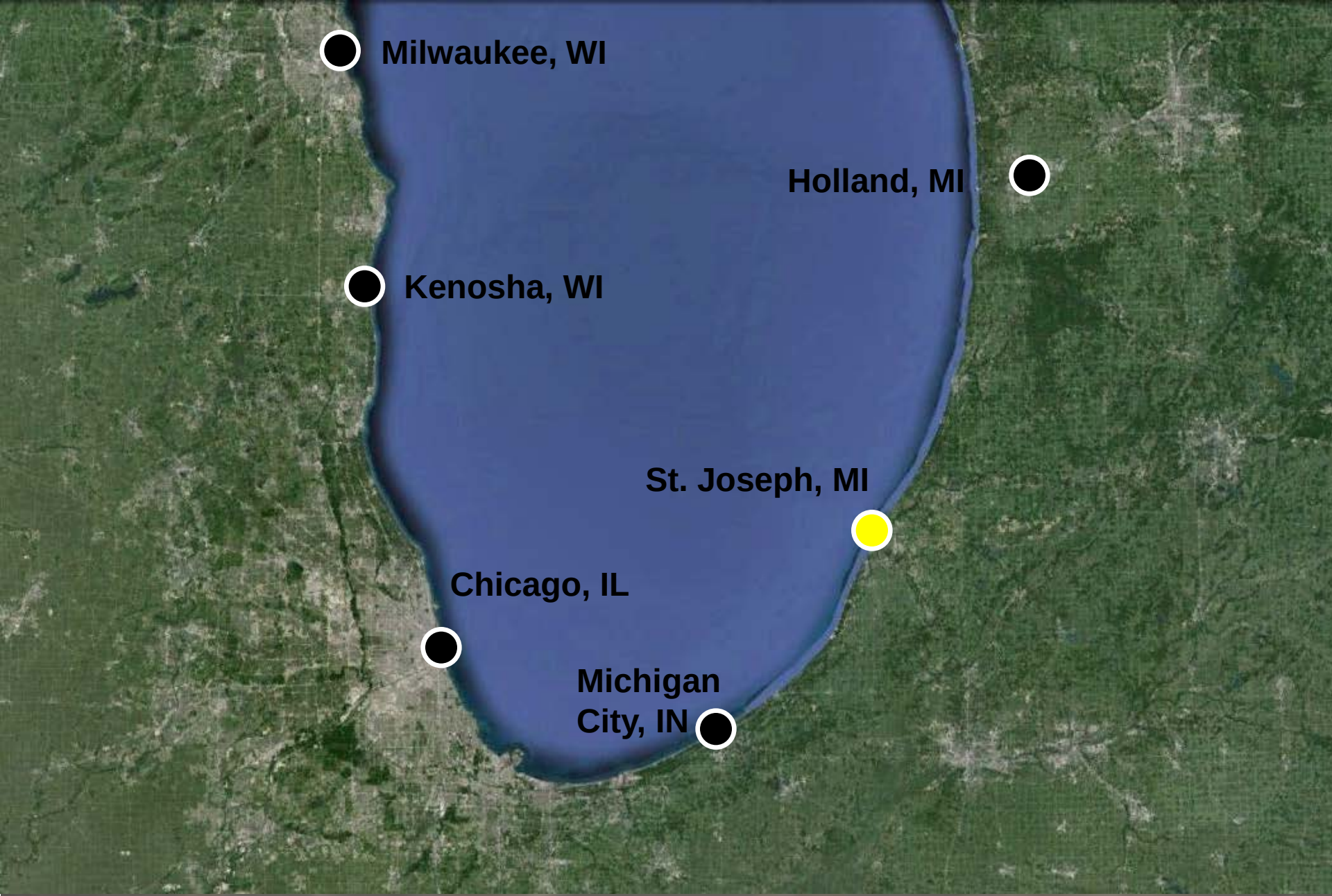
Introduction

- New waterfront home constructed in 2008-2009, seawall application followed in 2011-2012

- 2012 Study to evaluate the Lake Michigan Coast within the St. Joseph City Limits and provide recommendations for shoreline management within the study area.
  - Preserve the public trust access
  - Protect private property

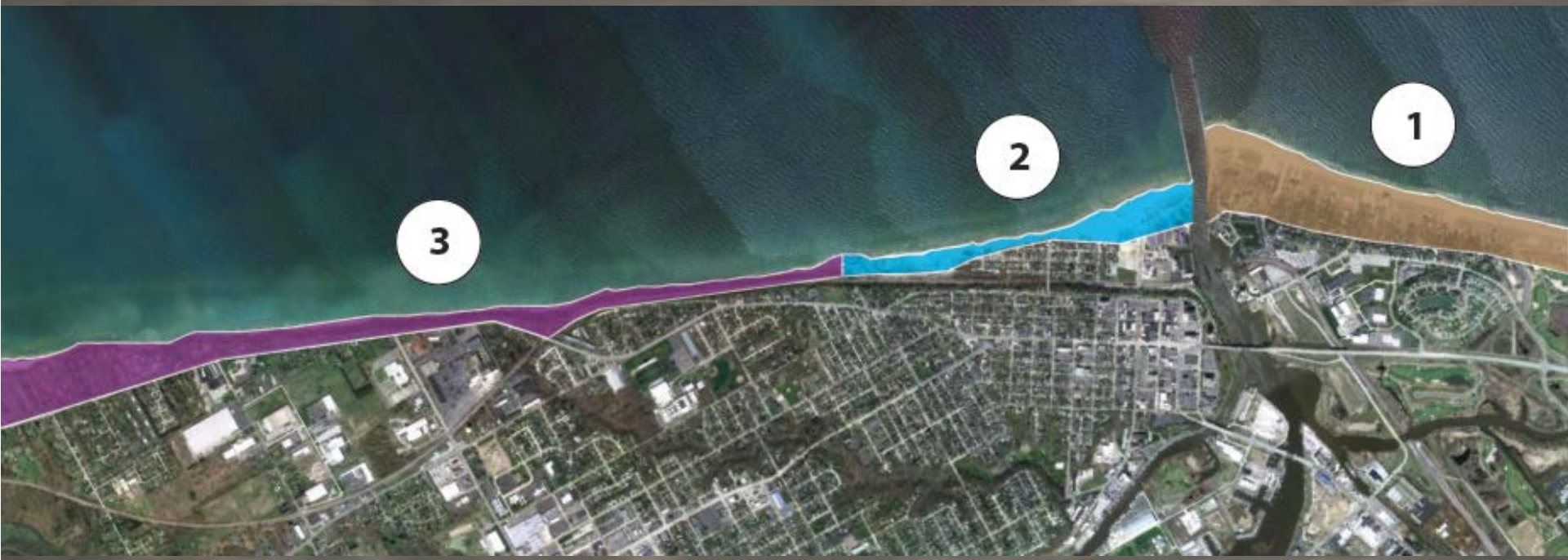
- Resulted in zoning ordinance amendment in November 2012



Developing a No-Build Zone Ordinance – St. Joseph, MI

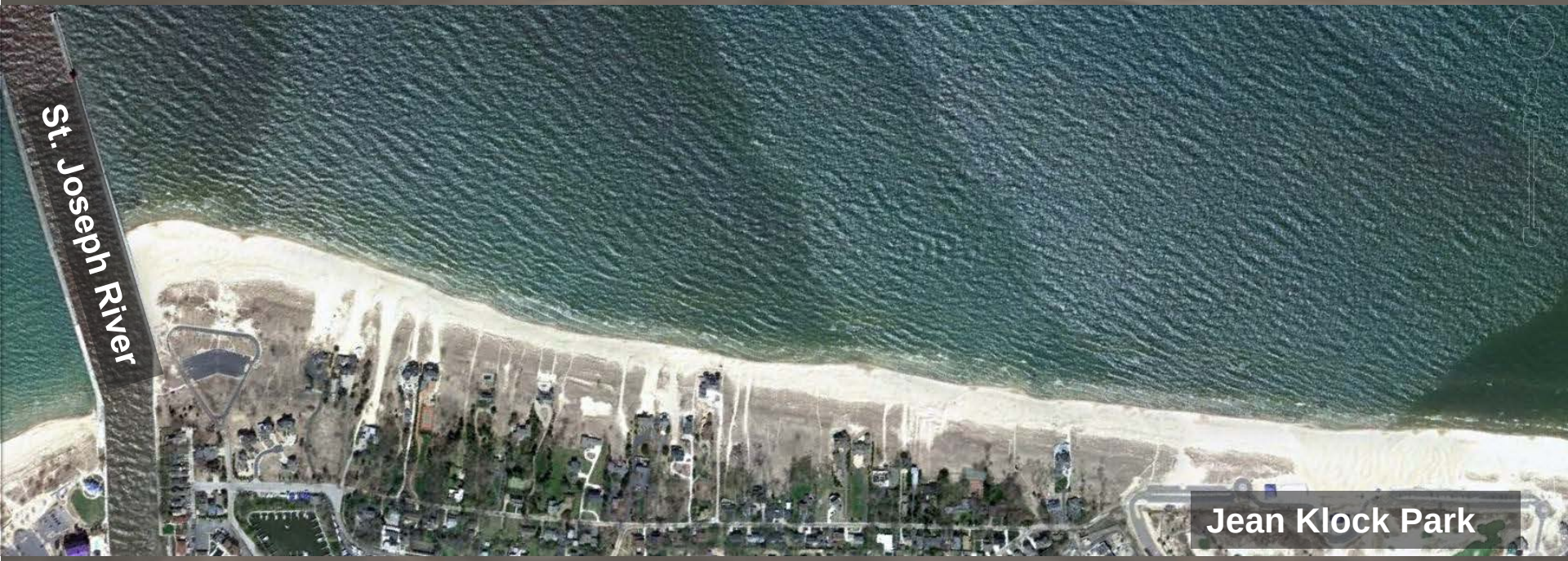
Lake Michigan Coastline within City of St. Joseph

- Area 1 – North of St. Joseph River
- Area 2 – South of St. Joseph River, adjacent residential
- Area 3 – South extent, adjacent rail and state highway



Area 1 Description

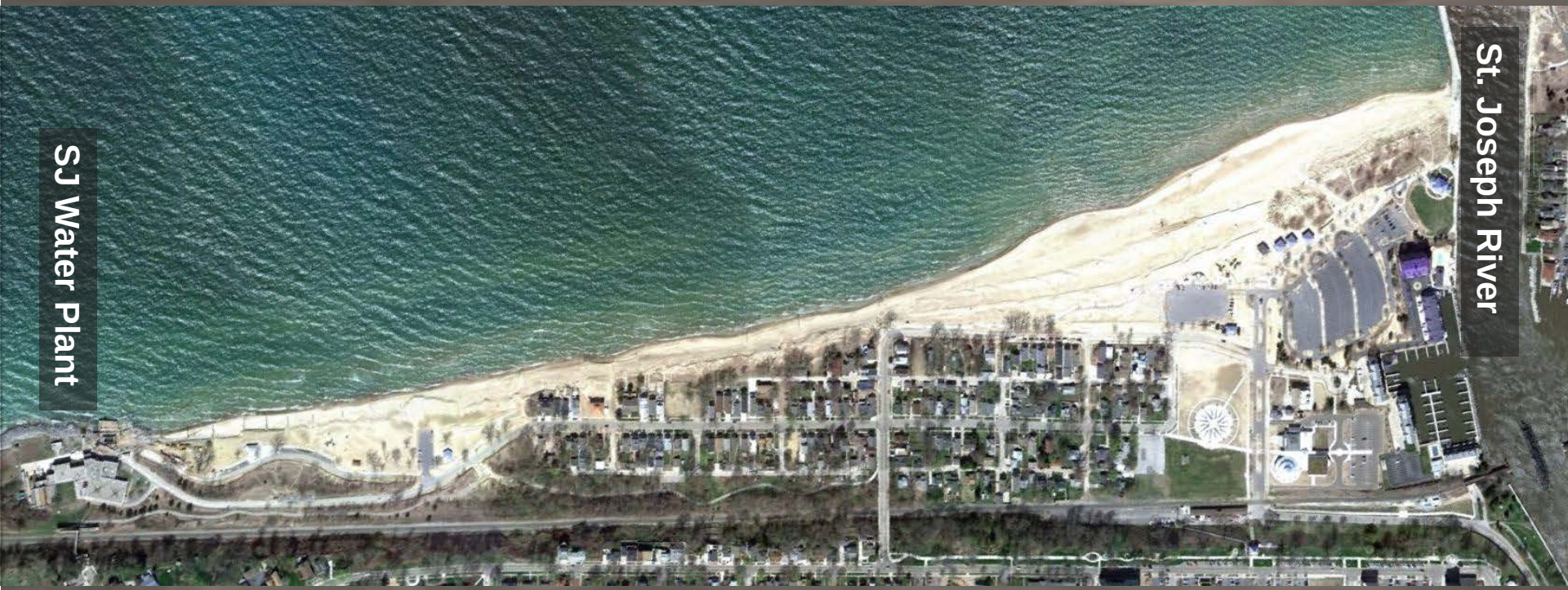
- Public parks at both ends
- Generally deep private lots, 600-800’ from road to Lake Michigan
- No existing shore protection structures
- Uninterrupted access along the public trust shoreline
- Sandy beach
- Accretion zone during recent low water years



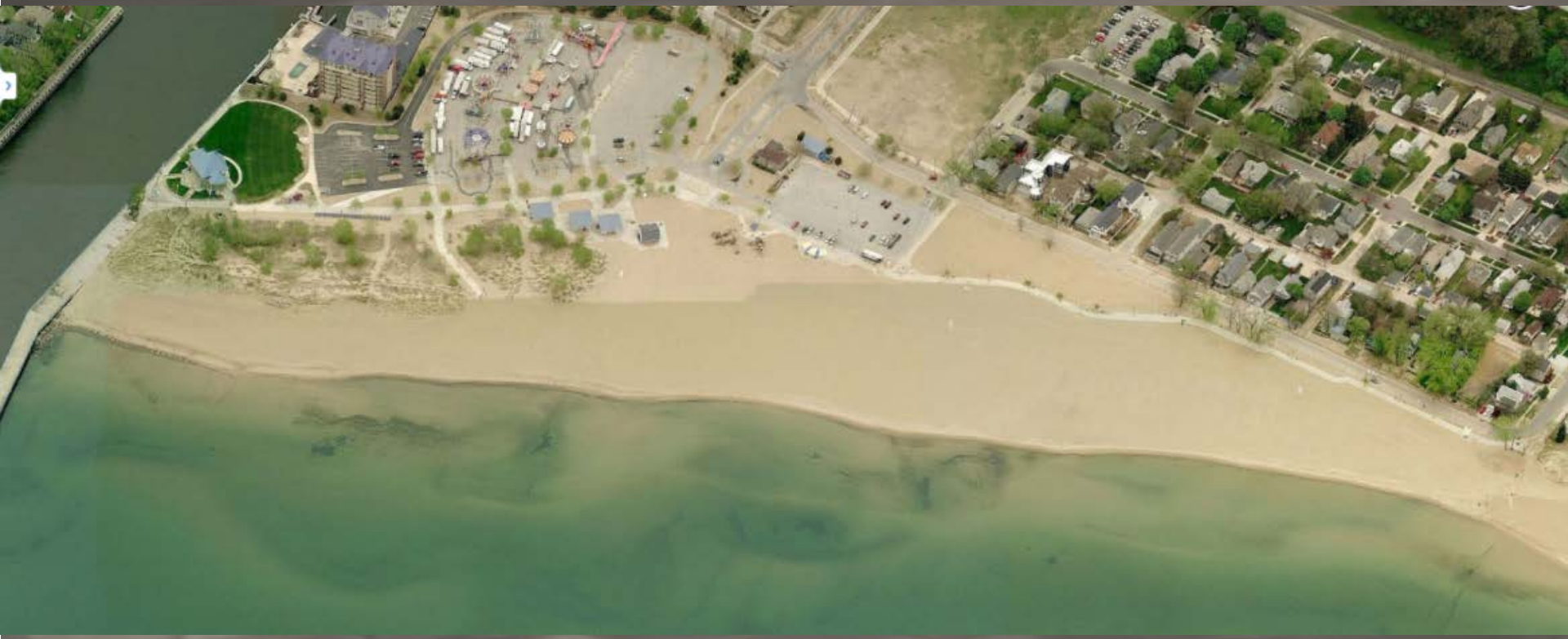

Area 1
600-800'

Area 2 Description

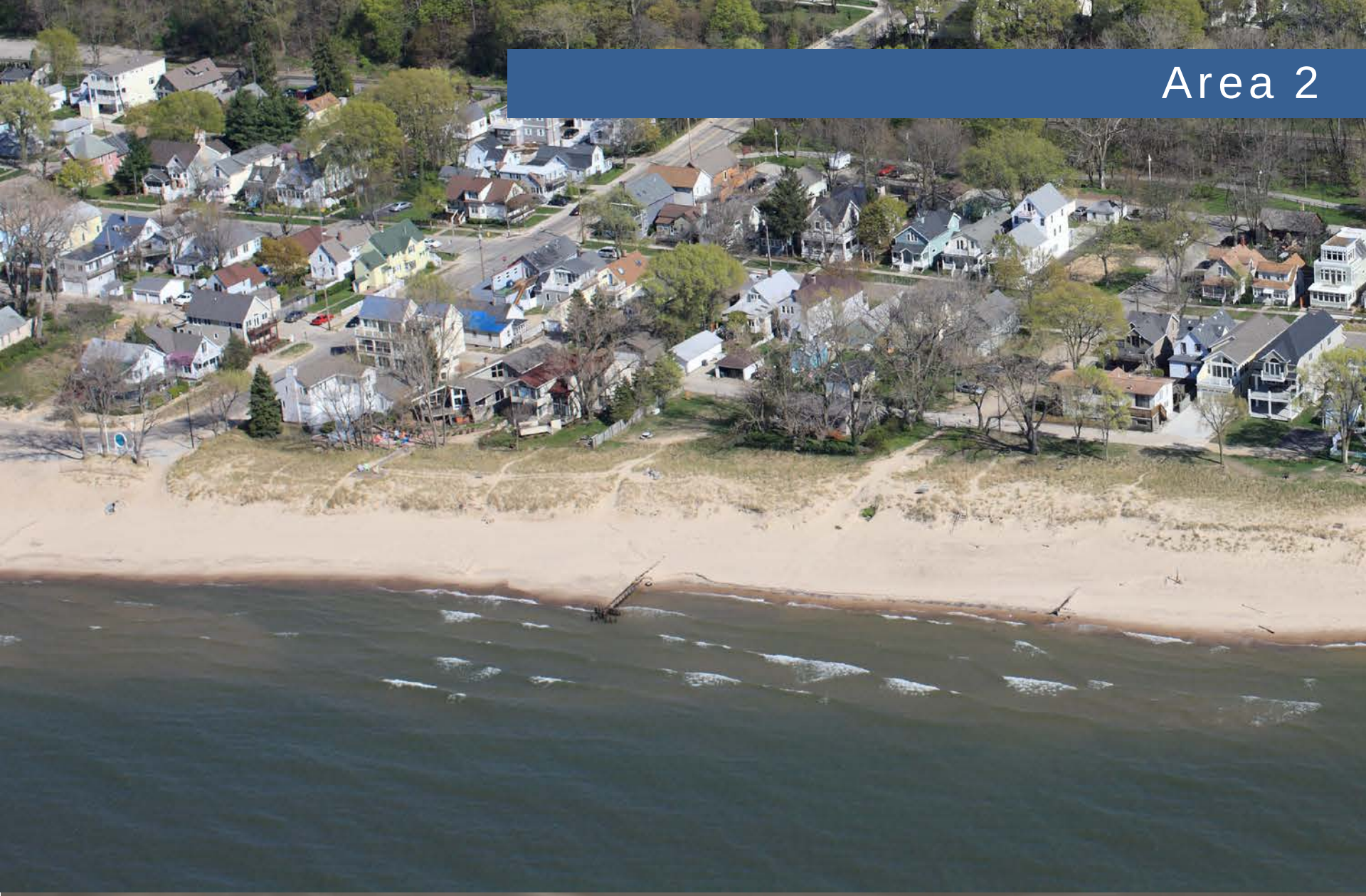
- Public parks at both ends and publicly-owned along water's edge
- Existing mix of shore protection structures
- Periodic federal beach nourishment
- Shallow properties
- Catastrophic erosion in 1950s and 1970s



Area 2



Area 2



Area 2 – 1951 Erosion

Area 2 – USACE Beach Nourishment

- 1970s–present; mitigation program tied to piers and harbor dredging
- Completed on an annual basis
- 20,000 –120,000 cubic yards/year
- USACE funding is an annual concern

Area 2 – USACE Beach Nourishment

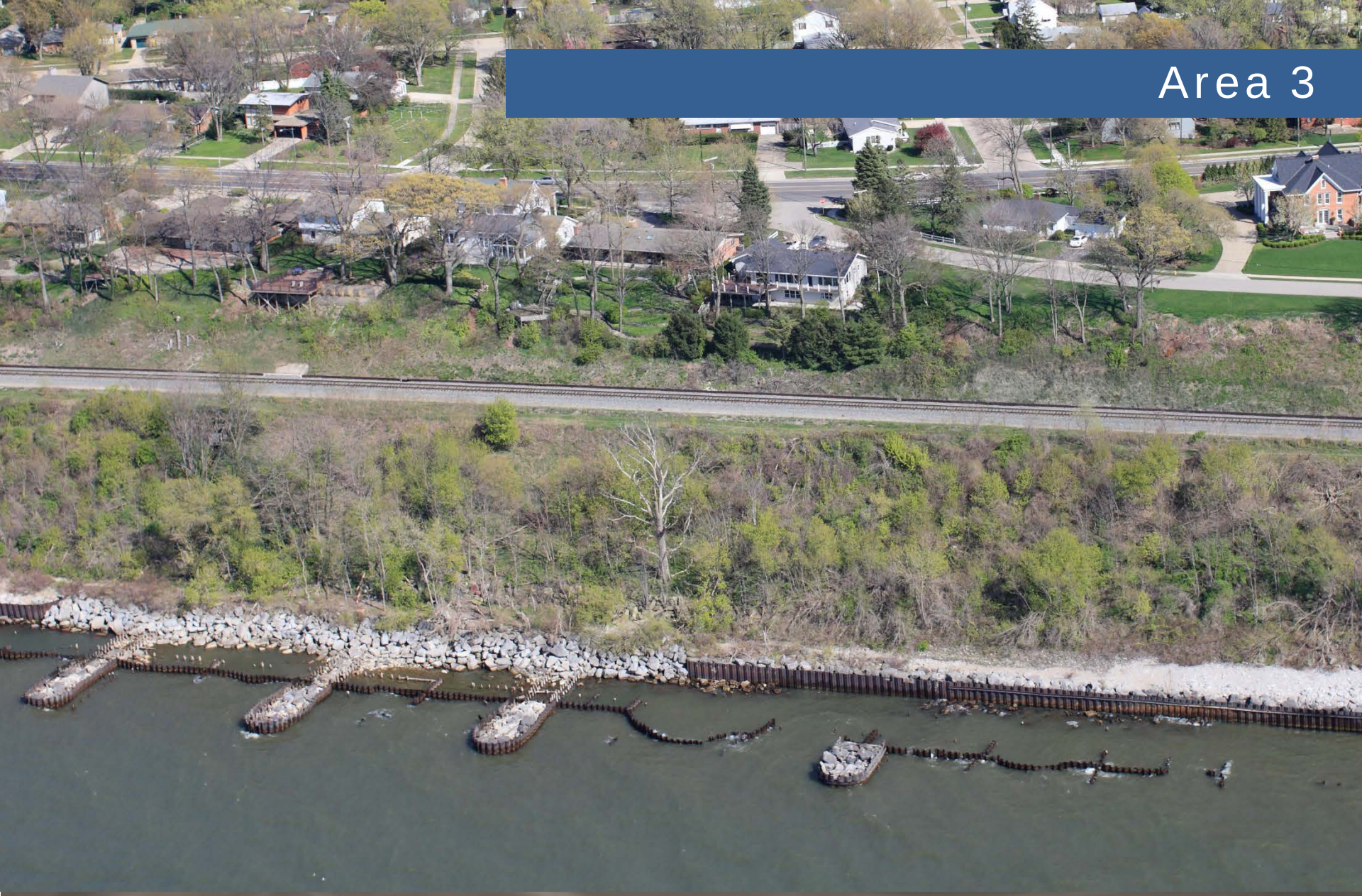
Area 2 – October 2004

Area 2 – December 2004

Area 3 Description

- Cohesive shores (bluffs) subject to erosion
- Shore protection along entire length of shore
- Limited to no public access
- Catastrophic erosion in 1950s

Area 3

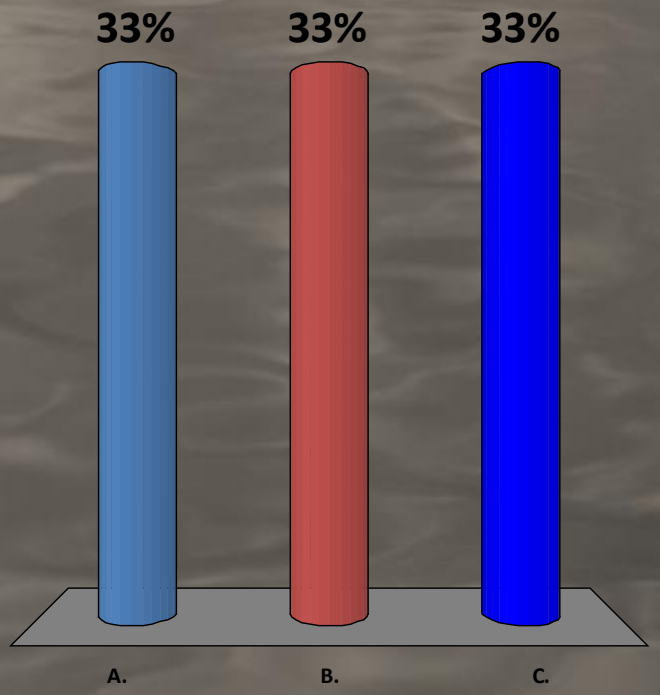


Area 3

Based on your technical understanding of shoreline processes…

…which situation do you believe best justifies additional public regulation of construction near the lake shore?

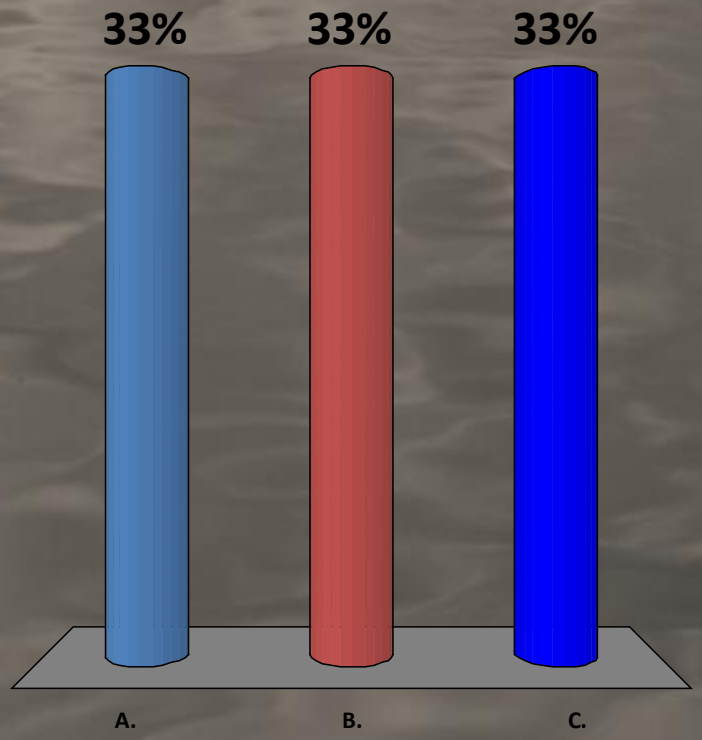
A. Area 1, North of the River
B. Area 2, South of the River
C. Area 3, South extent, rail and state highway



Based on your knowledge of human nature and the development of public policy…

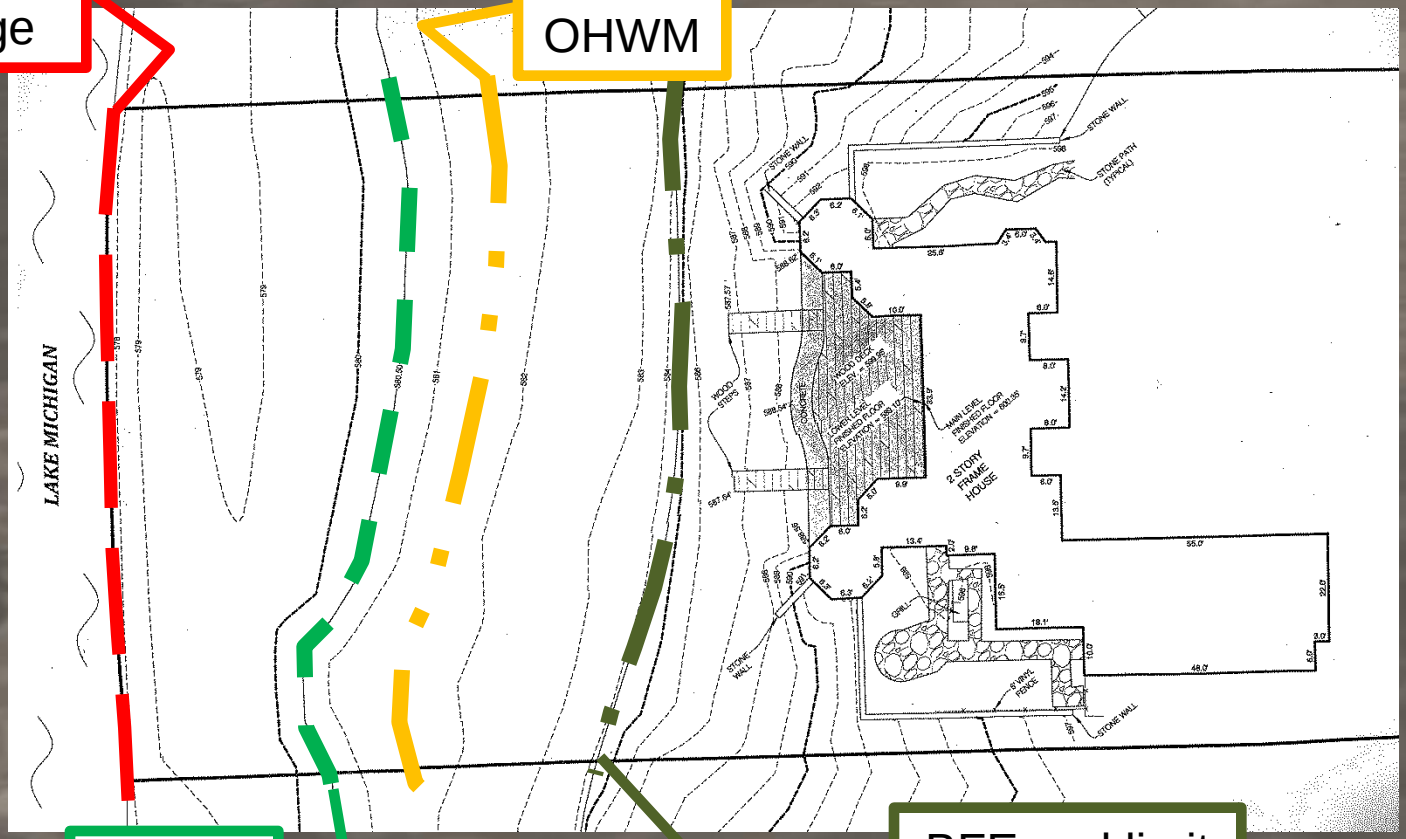
…which area do you believe was the main driver for developing additional public regulation of construction near the lake shore?

- ✓ **A. Area 1, North of the River**
- **B. Area 2, South of the River**
- **C. Area 3, South extent, rail and state highway**

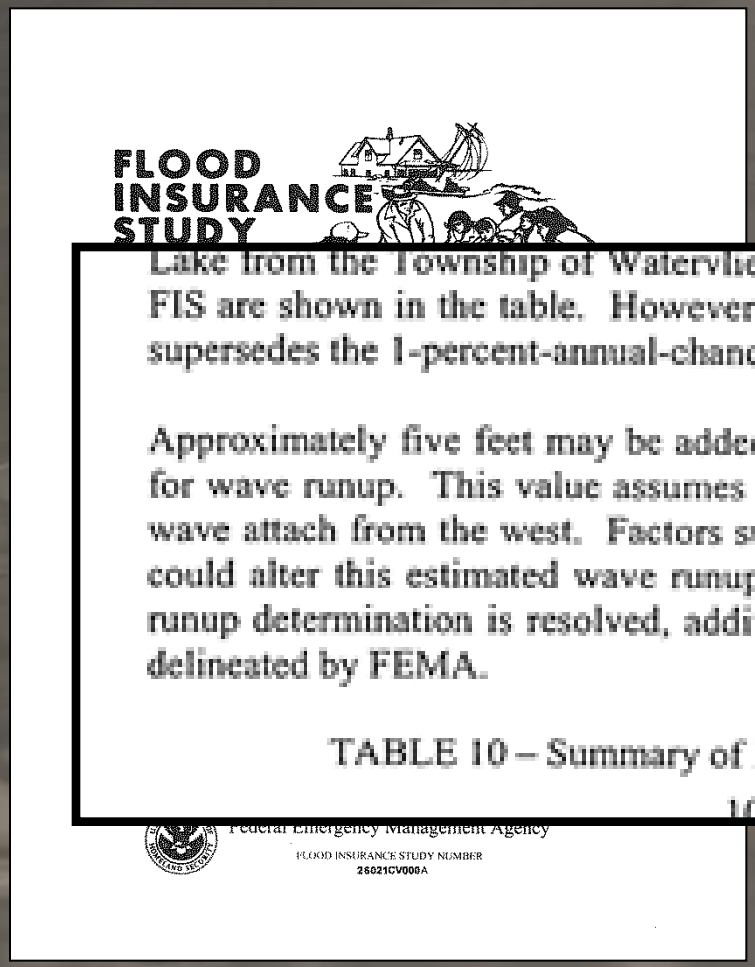


Area 1 – New Home

2008 – A new home



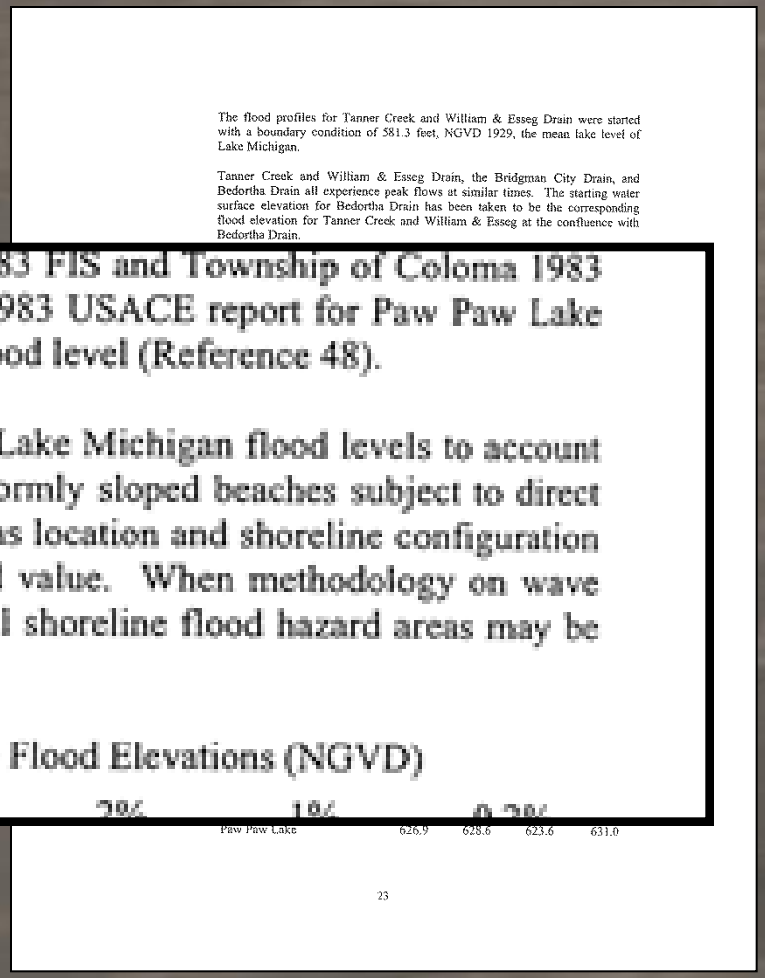
Base Flood Elevation (BFE)



FLOOD INSURANCE STUDY

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
26021CV000A



The flood profiles for Tanner Creek and William & Esseg Drain were started with a boundary condition of 581.3 feet, NGVD 1929, the mean lake level of Lake Michigan.

Tanner Creek and William & Esseg Drain, the Bridgman City Drain, and Bedortha Drain all experience peak flows at similar times. The starting water surface elevation for Bedortha Drain has been taken to be the corresponding flood elevation for Tanner Creek and William & Esseg at the confluence with Bedortha Drain.

Lake from the Township of Watervliet 1983 FIS and Township of Coloma 1983 FIS are shown in the table. However, a 1983 USACE report for Paw Paw Lake supersedes the 1-percent-annual-chance flood level (Reference 48).

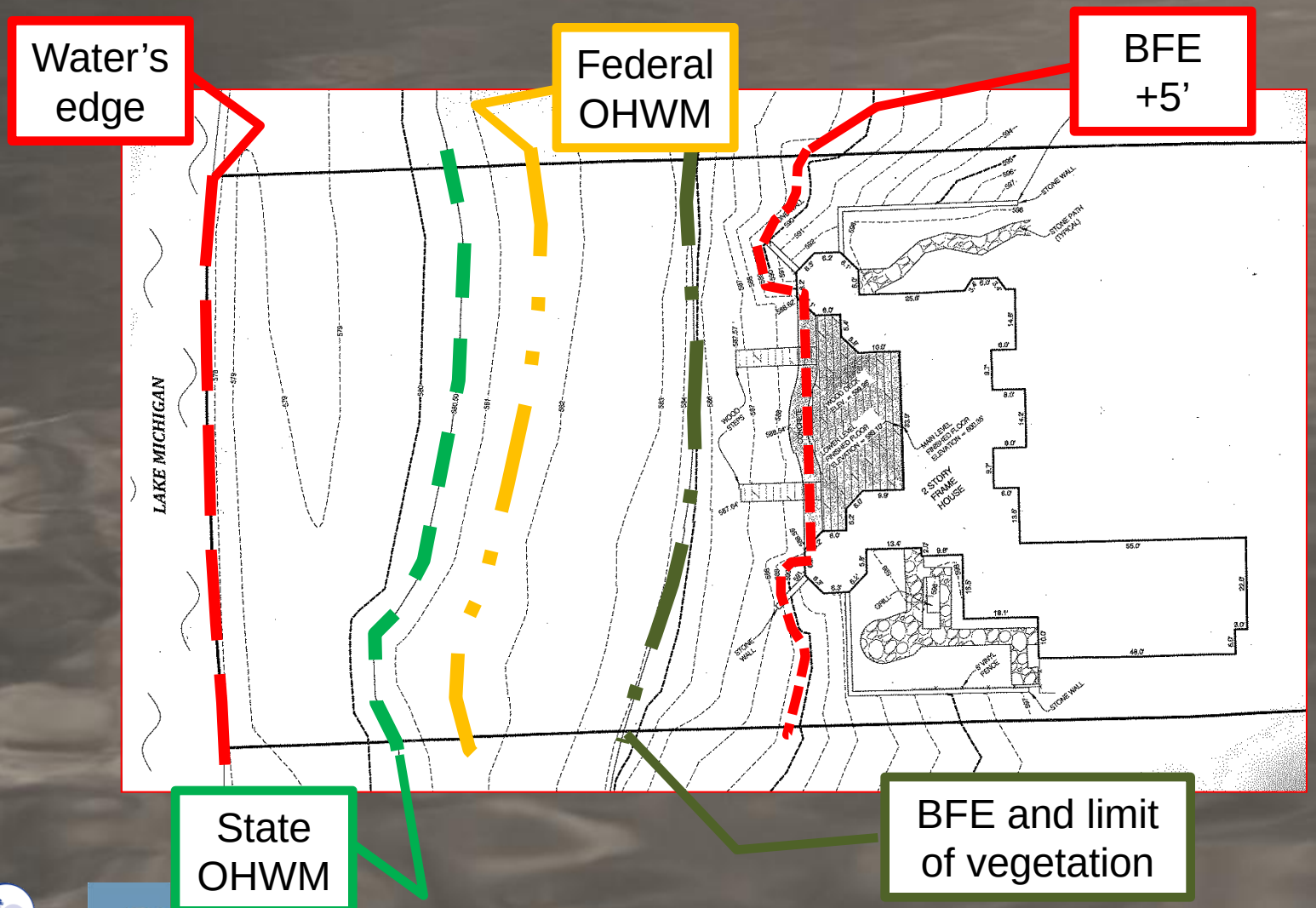
Approximately five feet may be added to Lake Michigan flood levels to account for wave runup. This value assumes uniformly sloped beaches subject to direct wave attach from the west. Factors such as location and shoreline configuration could alter this estimated wave runup and value. When methodology on wave runup determination is resolved, additional shoreline flood hazard areas may be delineated by FEMA.

TABLE 10 – Summary of Base Flood Elevations (NGVD)

	10%	2%	1%	0.2%
Paw Paw Lake	626.9	628.6	623.6	631.0

23

2008 - A new home



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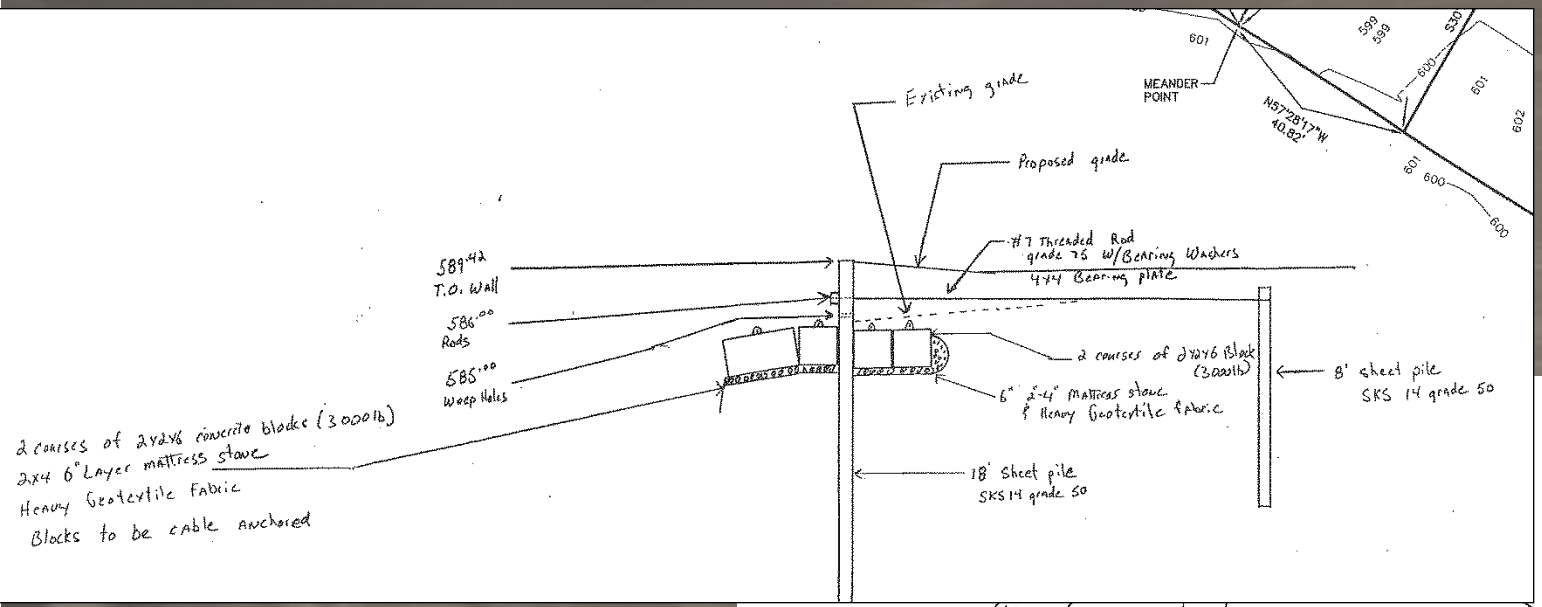
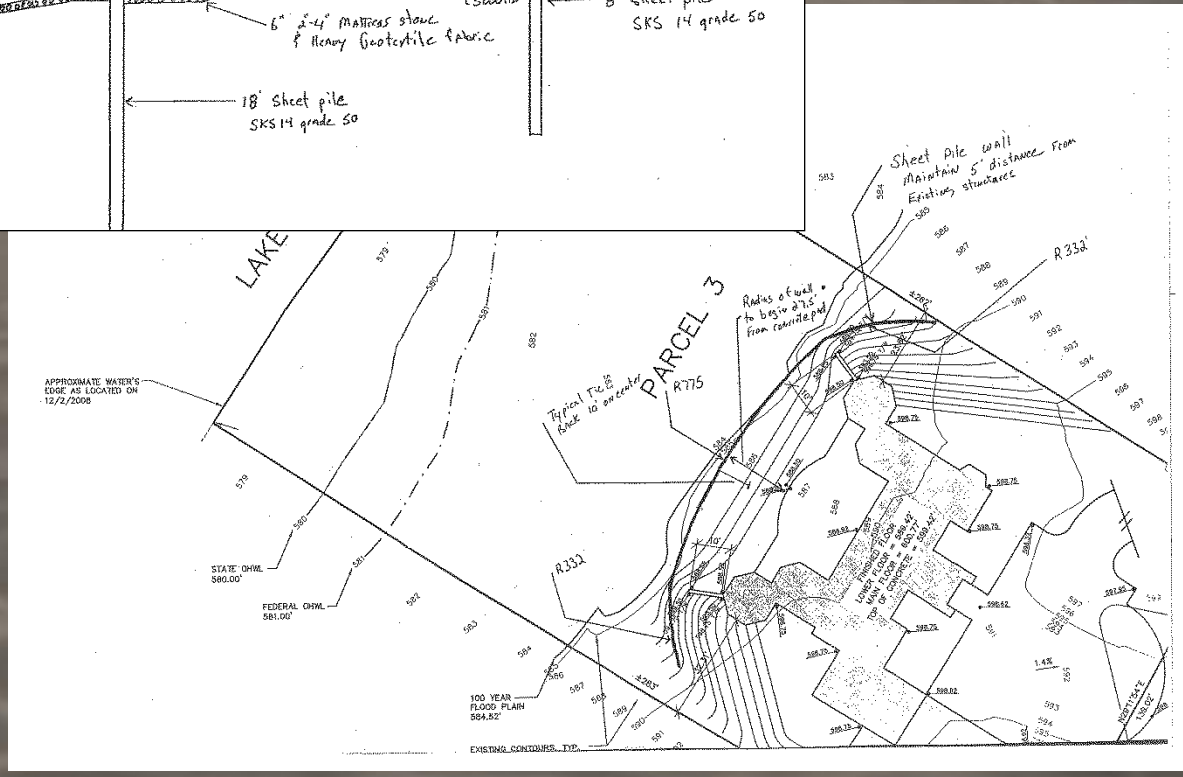
During the 1970's sand-bags were used to protect these four homes from wave damage

2011 - Seawall Application





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City Response

- City Commission held a public meeting within 2 weeks
  - Imposed a moratorium on seawall construction in Areas 1 & 2 while the subject was studied
  - Also on any construction within 200’ of OHWM in Area 1
  - Referred matter to Planning Commission

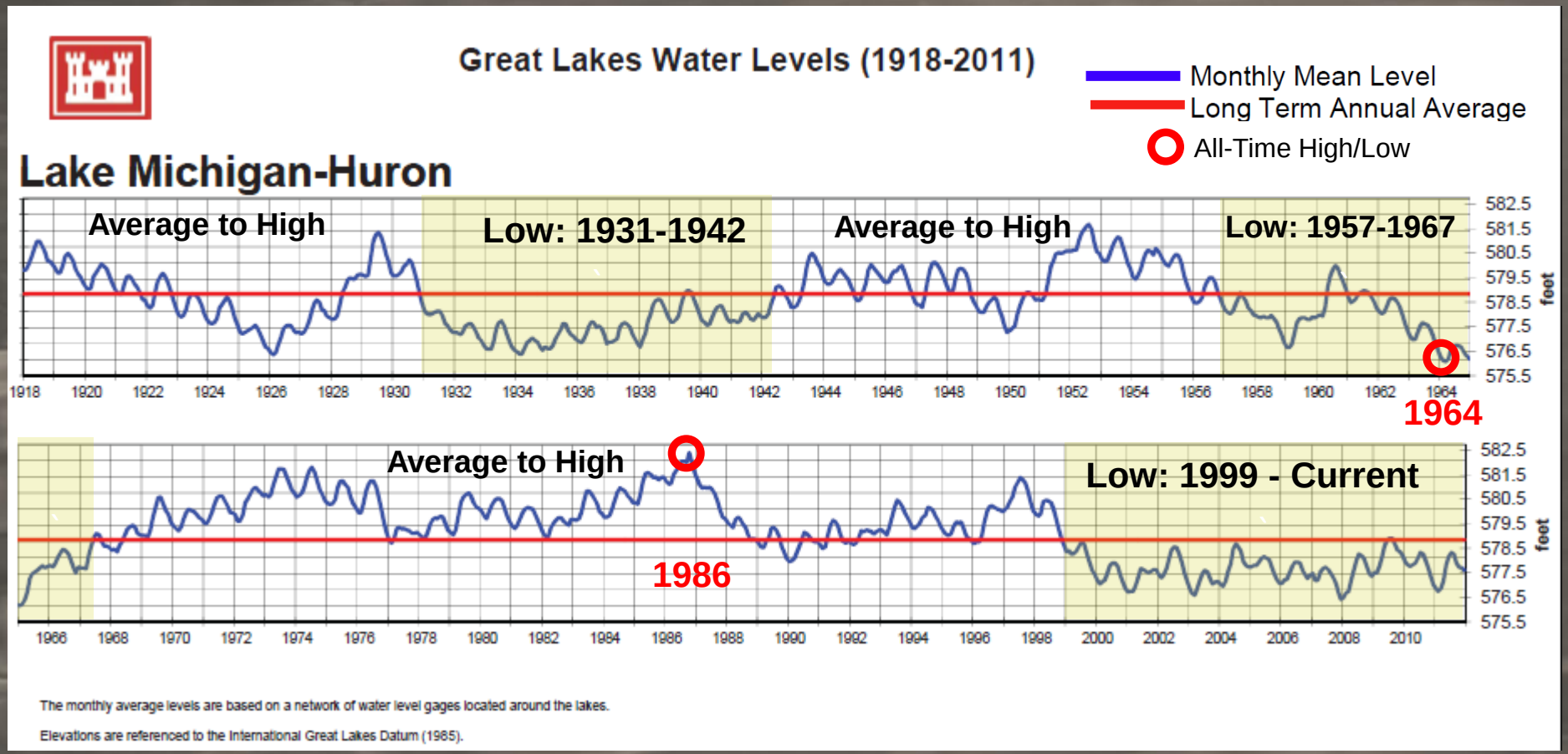
- Recognized need for technical and legal analysis
  - Obtained proposal for technical analysis - $45,000
  - Public funds not available; contributions funded study

- Provided updates and public hearings throughout 10 month study, ordinance development and adoption process

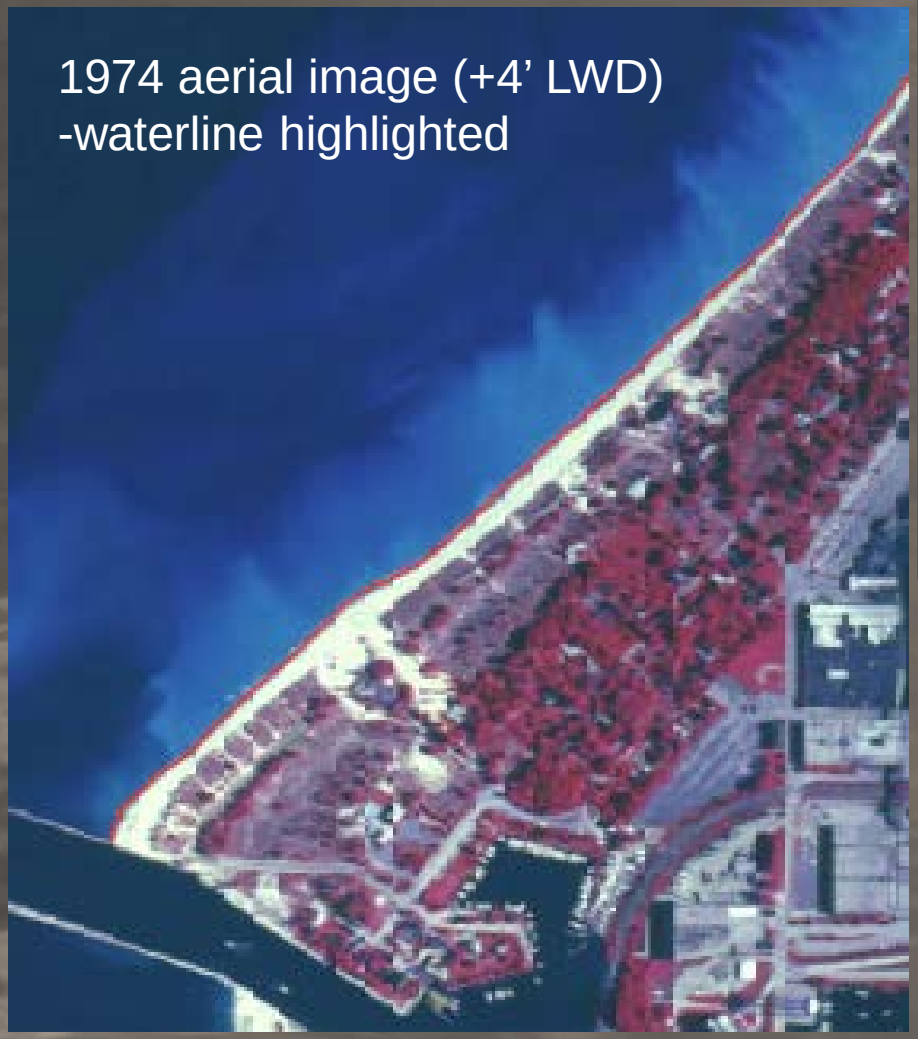
2012 Technical Study Components

Lake Michigan Water Levels (Long Term Cycle)

- Long term cycle: -1.3' LWD to +5 LWD (+0.4' on date of survey)
- Three 10-year low water periods, separated by average/high water
- Pre-1918 research shows water reached +6.6' LWD (1.6' above 1986)

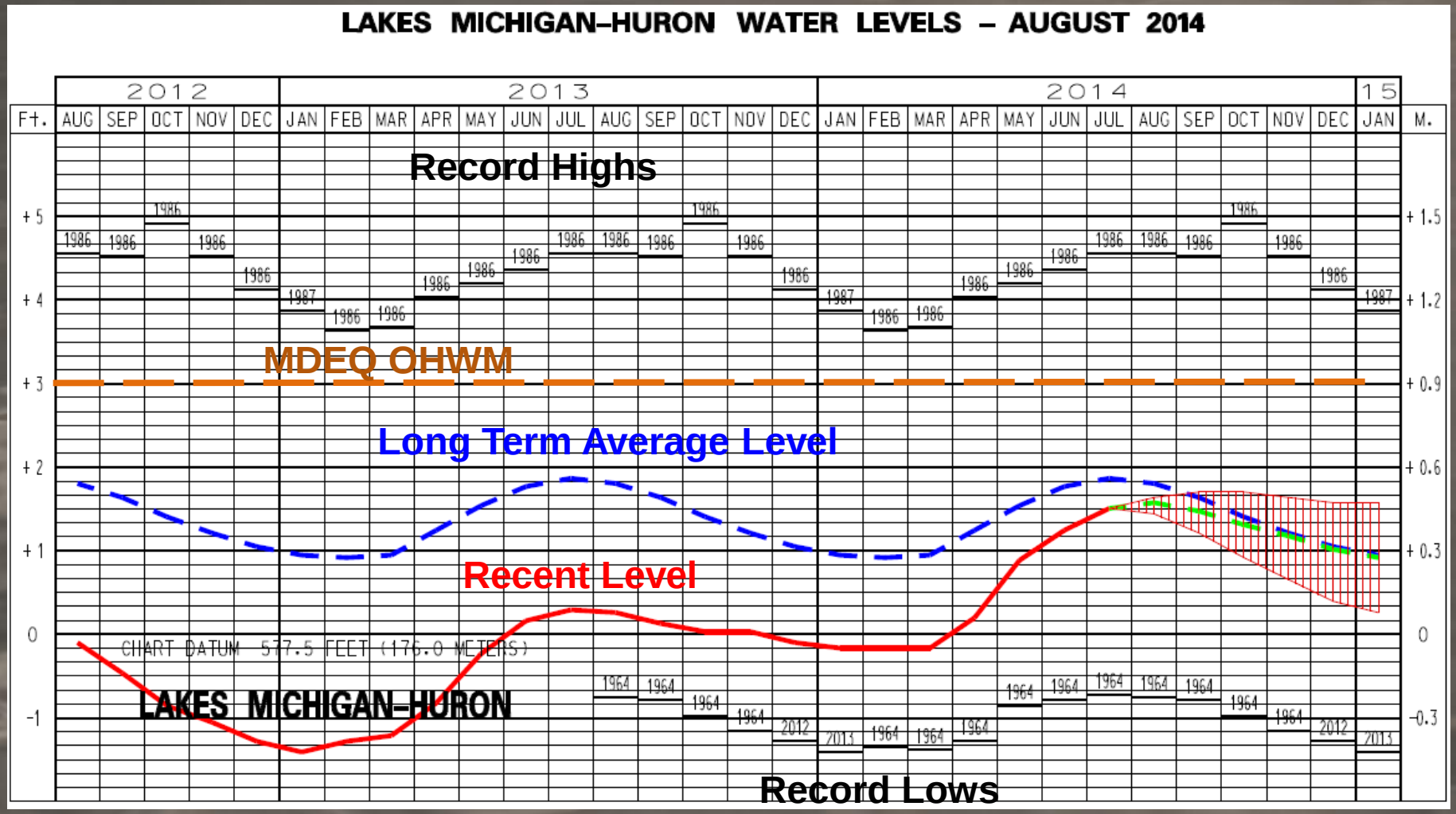


Lake Michigan Water Levels (Long Term Cycle)



Lake Michigan Water Levels (Annual Cycle)

- 1’ – 2’ swing annually
- Lower water in winter



Ordinary High Water Mark (OHWM)

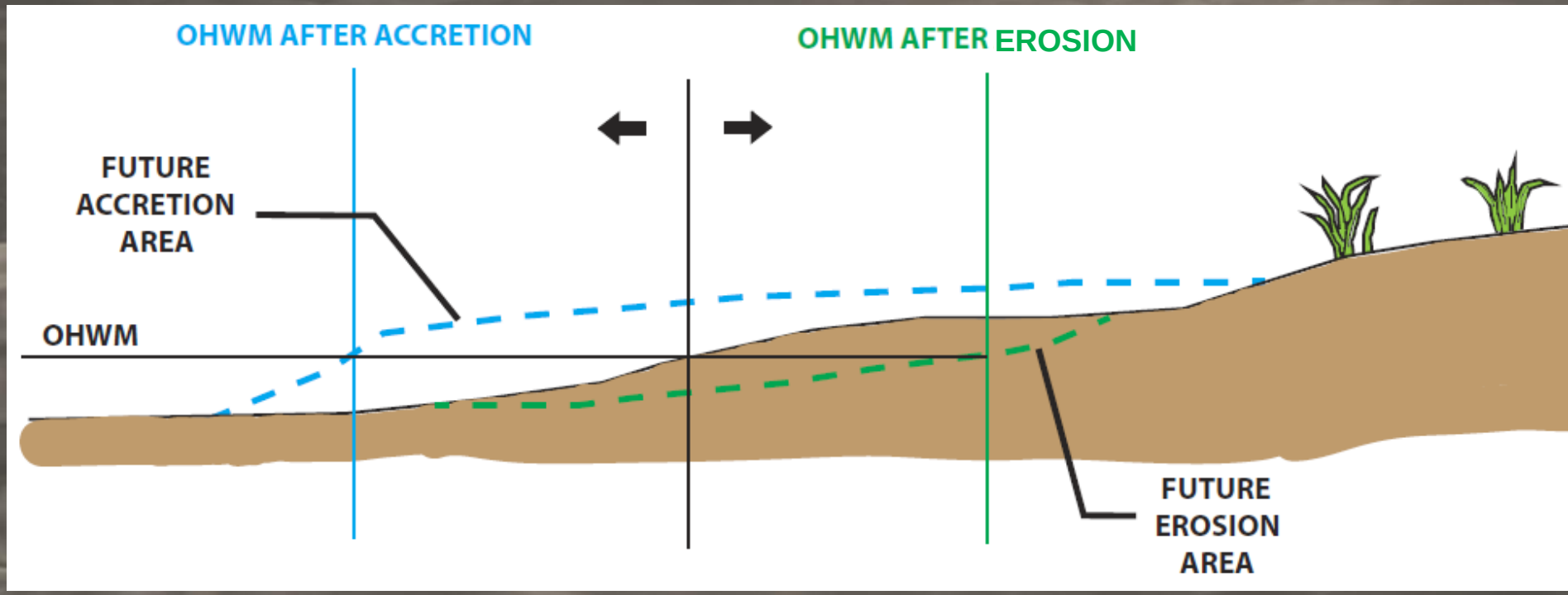
- State of Michigan
  - Lake Michigan OHWM – 580.5’ IGLD 85
    per MCL Part 325, Section 324.32502 (579.8’ IGLD 55 Datum)

- U.S. Army Corps of Engineers
  - Lake Michigan OHWM – 581.5’ IGLD 85

- Natural Ordinary High Water (NOHWM)
  - Physical evidence – vegetation, debris, etc.

Ordinary High Water Mark (OHWM)

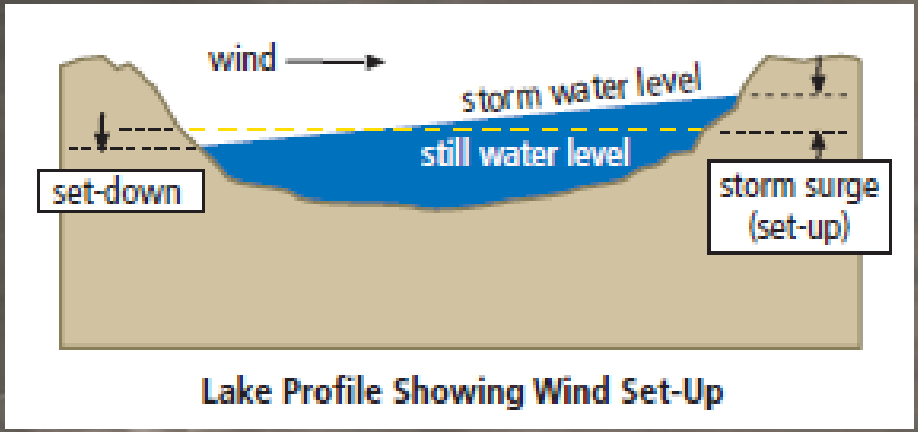
- Determines the limit of the public way and MDEQ jurisdiction
- The horizontal location of the OHWM changes.



Waves and Seiches

Storm Surge (Set-up) – An increase in water level caused by a sustained wind across open water and/or a sudden change in atmospheric pressure.

- Set-up can range 2’ to 3’ in St. Joseph



Lake Profile Showing Wind Set-Up

*Graphic from USACE/University of Wisconsin, “Living with the Coast” Booklet

Seiche – Periodic oscillations of lake levels resulting from a Storm Surge and sudden atmospheric changes. Seiches occur in many degrees of severity and can last seconds to minutes with intervals of tens of minutes to multiple hours.

- Seiches typically range from 1’ to 3’ in St. Joseph

Littoral Drift and Beach Nourishment

- Near shore transport of sediment

<u>1997 USACE Beach Nourishment Study</u>

- St. Joseph: Sediment typically moves north to south
- Accretion north of pier
- Stable fillet south of pier
- Channel dredging used to nourish beach south of fillet

"Effectiveness of Beach Nourishment on Cohesive Shores, St. Joseph, Lake Michigan" 1997

Wave Data Parameters

U.S. Army Corps of Engineers Wave Information Studies (WIS)

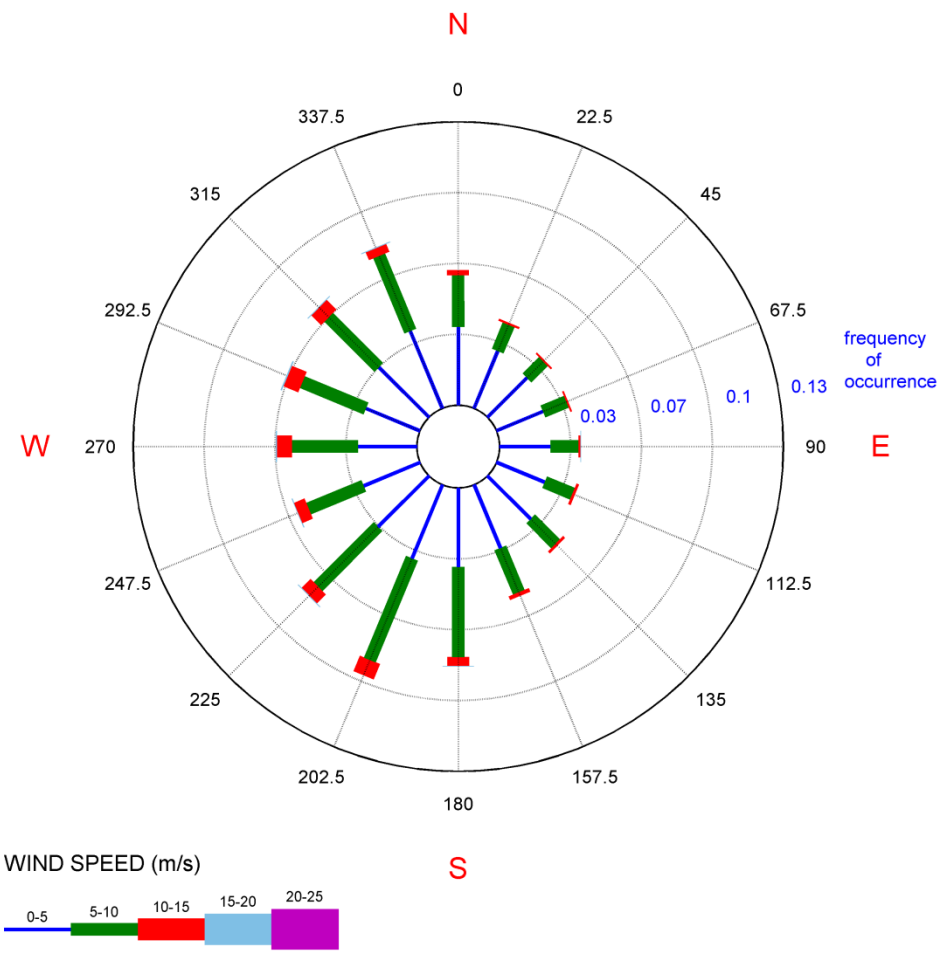
- Lake Michigan Station 94445

Wave Information Studies

Lake Michigan WIS Station 94445

01-Jan-1979 thru 30-Dec-2009
Long: -86.56° Lat: 42.12°
Total Obs : 271728

WIND ROSE



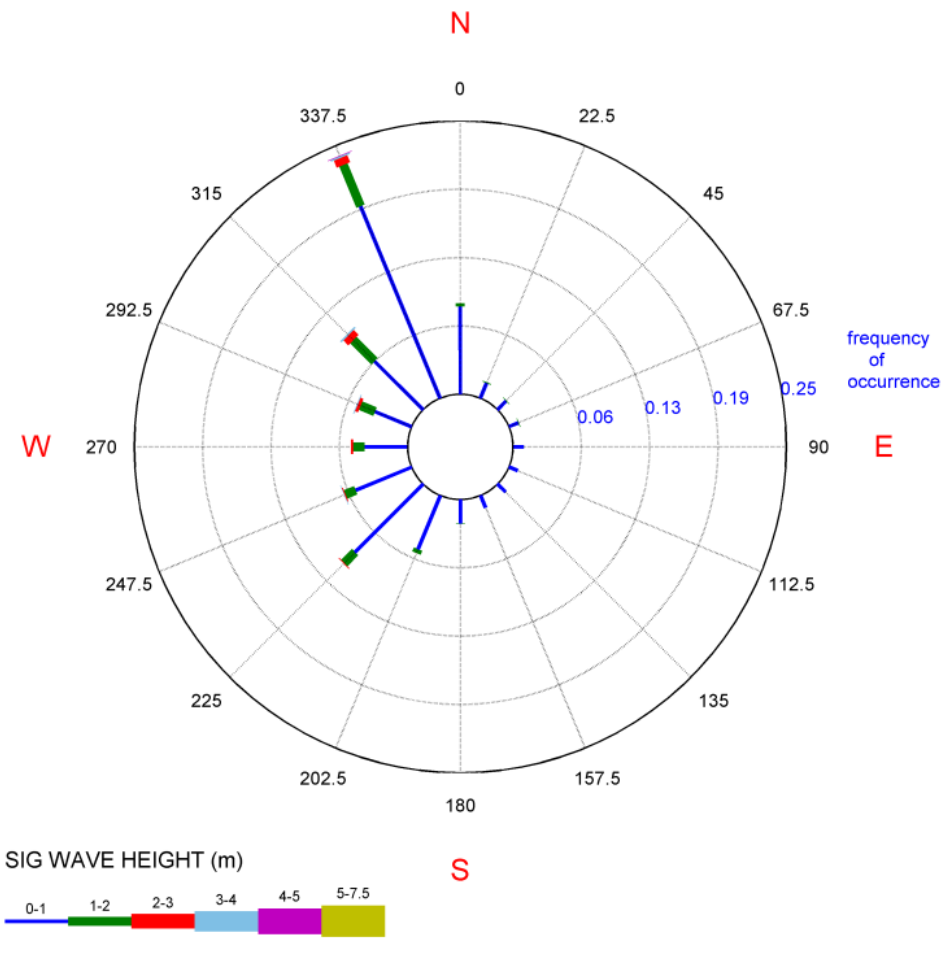
US Army Engineer Research & Development Center 09-Mar-2012

Wave Information Studies

Great Lakes WIS Station 94445

01-Jan-1979 thru 30-Dec-2009
Long: -86.56° Lat: 42.12° Depth:20 m
Total Obs / Total Ice : 271728 / 11592

WAVE ROSE



US Army Engineer Research & Development Center 01-Mar-2012

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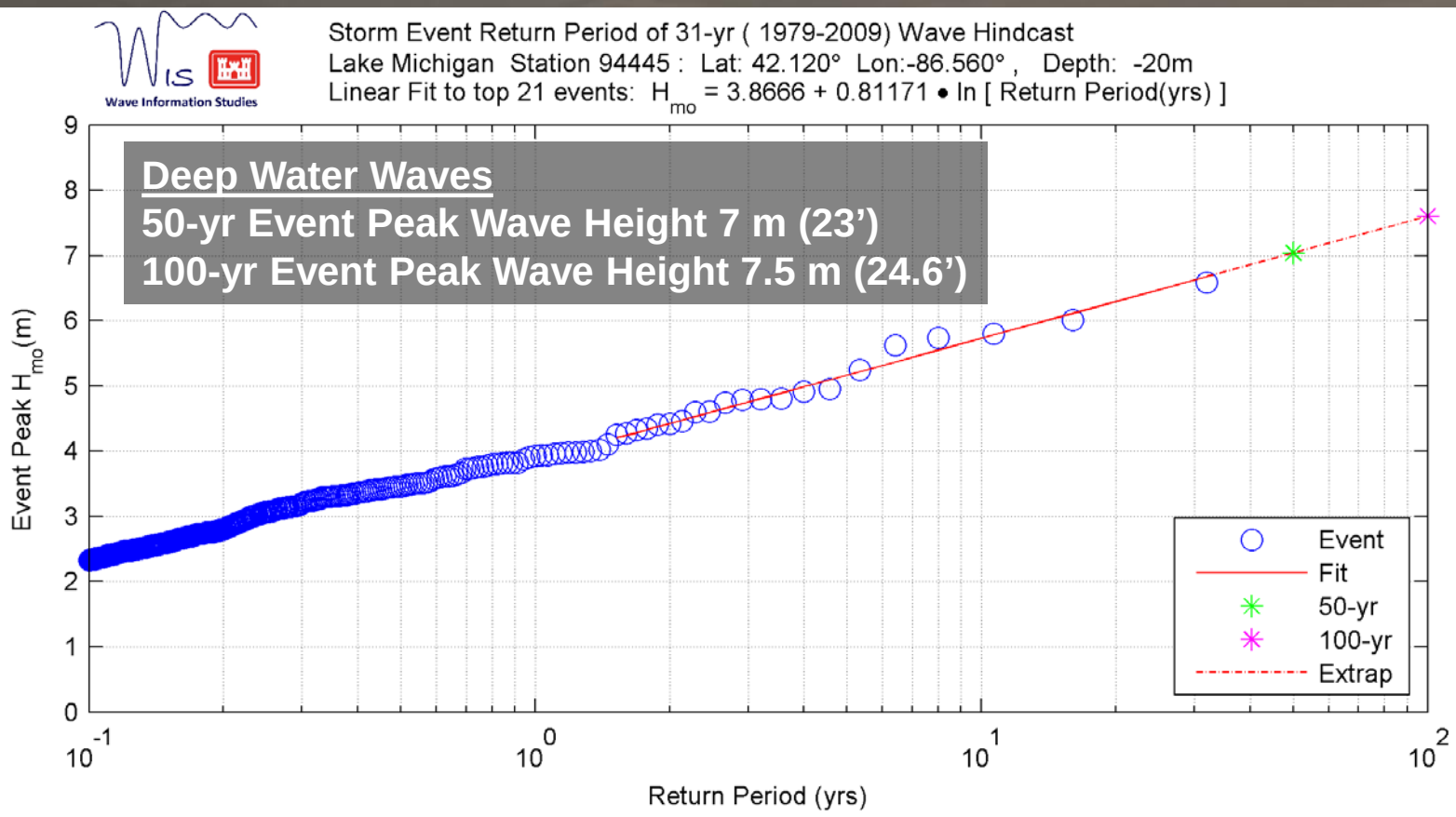

Top 10 events based on Peak H_{mo}

Event	Date/Time(UTC)	H_{mo}	T_p	θ_{mean}	Event	Date/Time(UTC)	H_{mo}	T_p	θ_{mean}
1	1987/02/08 17:00	6.59	11.17	338.0	6	1990/12/04 17:00	5.25	11.17	333.0
2	1998/03/09 17:00	6.01	11.17	340.0	7	1980/12/02 17:00	4.96	10.15	335.0
3	1990/02/24 17:00	5.80	10.15	325.0	8	1979/04/06 17:00	4.91	9.23	297.0
4	1985/01/25 17:00	5.74	10.15	329.0	9	1982/04/04 17:00	4.81	9.23	306.0
5	1990/01/25 17:00	5.62	10.15	320.0	10	1987/12/16 17:00	4.80	10.15	324.0

An event is defined as any period when H_{mo} > 2.00m

θ_{mean} is direction that waves are arriving from

ERDC US Army Engineer Research & Development Center

02-Apr-2012 13:29:50

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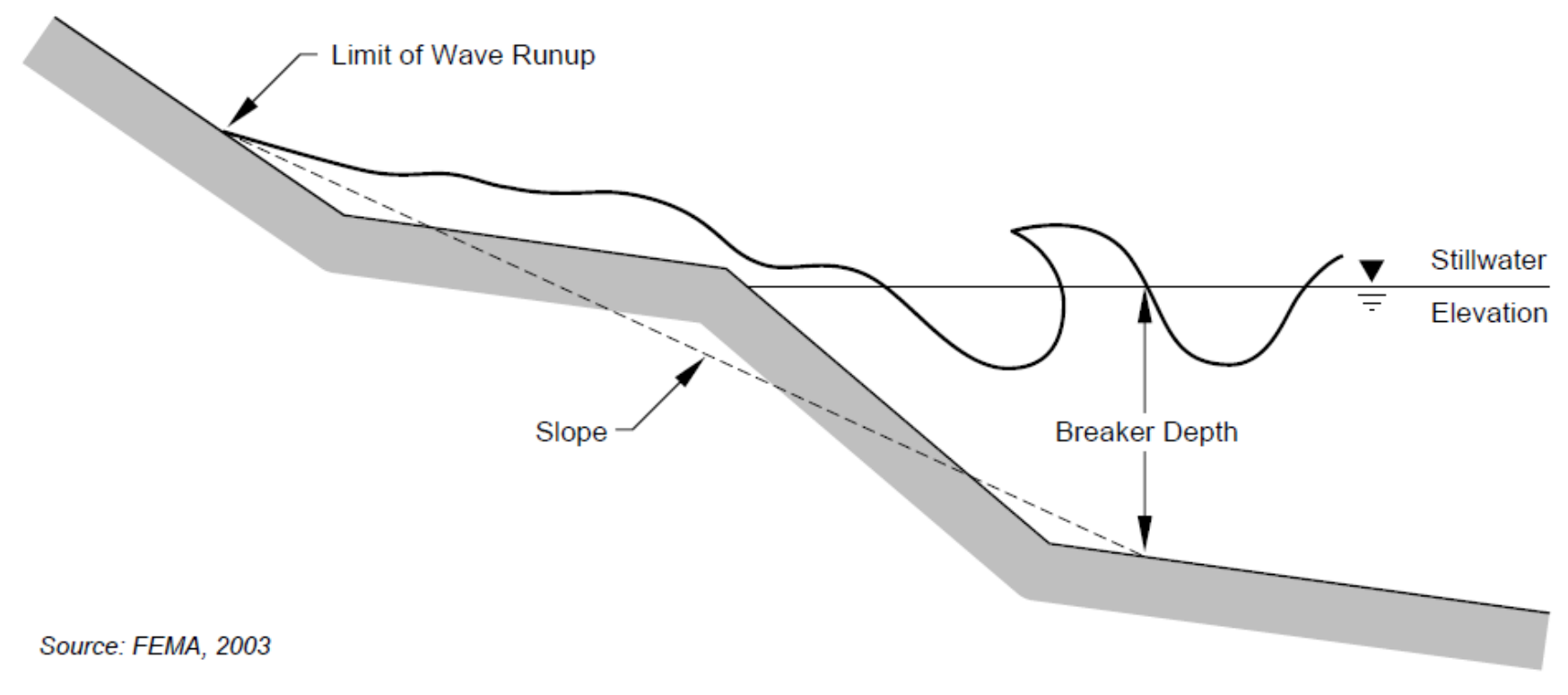
Wave Runup

- The extent over which waves act
- More technically: the landward extent of wave uprush measured vertically from the still water level



Wave Runup – Area 1

Existing Shoreline

- 50-year wave, deep water height=23', period=11.2 seconds
- Slope = 1:30
- 2% Wave Runup = **7.0'** (vertically, from still water elevation)

Projecting future sustained period of high water and erosion

- 50-year wave, deep water height=23', period=11.2 seconds
- Slope = 1:25 (due to erosion projection at high water*)
- 2% Wave Runup = **8.5'** (vertically, from still water elevation)

** Based on existing profile, historic lakebed elevations, and future sustained periods of high water*

USACE Coastal Eng. Manual-Part 3 Sec. 5 P. 48

US Army Corps of Engineers®

A. Setbacks and cliff stabilization.

(1) The two most important issues in the planning and management of cohesive shores relate to **implementing setbacks for development** and to managing human influences on the sediment supply.

(2) Many Jurisdictions along U.S. shorelines impose a setback for new development consisting of some multiple of the average annual recession rate (e.g., 30 to 100 times the average recession rate). The purpose of the setback is **to avoid the need for shore protection** within the life of the new development, **recognizing the irreversible and inevitable erosion that occurs** along cohesive shores (and some sandy shores as well).

Setbacks in the State of Wisconsin

Wisconsin Administrative Code Chapter NR 115:

"…The shoreland zoning ordinance adopted by each county shall control use of shorelands…At a minimum, the ordinance shall include…: (b) 1. 'Shoreland setback.' ..a setback of 75 feet from ordinary high-water mark of any navigable waters to the nearest part of a building or structure…"

- 75' minimum setback from OHWM for navigable waterways
- Primarily for protection of water quality, vegetation, habitat, etc.
- Some counties have increased setbacks – up to 225' from OHWM in some areas (Sheboygan County)
- Provides examples of setback reduction for shallow lots
  - Some simply require new structures to be setback as far as lots allow
  - Some average setbacks of adjacent substandard lots
  - Some use a formula approach to first reduce the roadway setback, then shoreline setback

- No similar statewide setbacks in Michigan, Indiana, or Illinois

Area 1 Recommendations

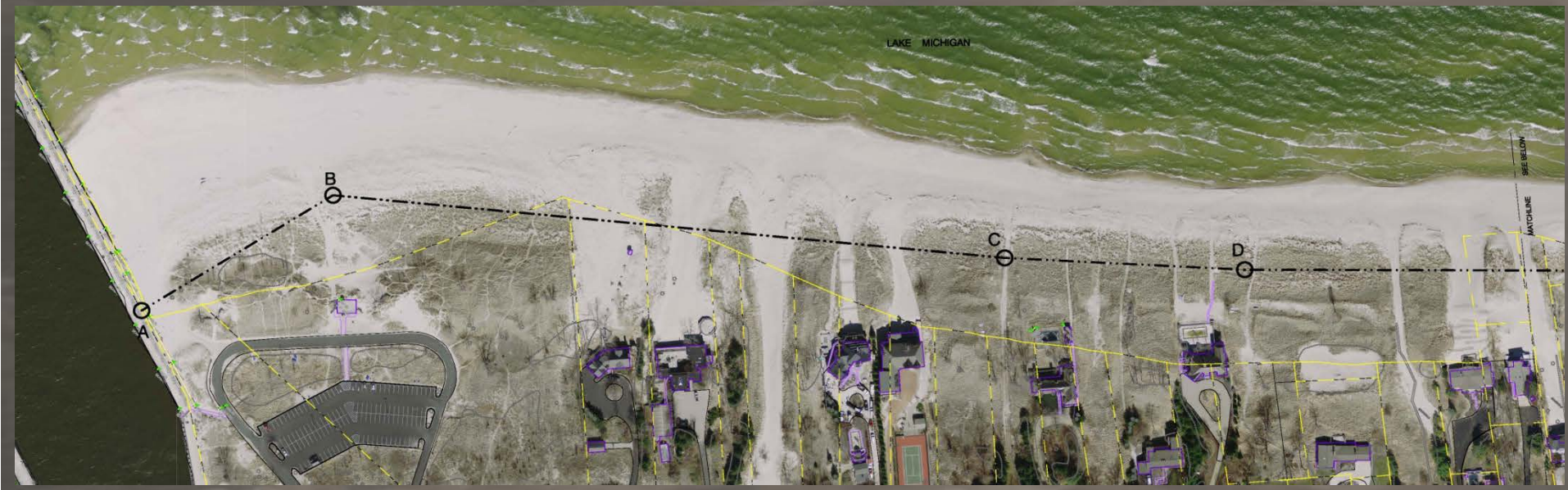
- Avoid the need for shoreline protection using existing profile, record high water, 2% wave runup, surge/seiche condition, and factor of safety
  - Prevent unnatural erosion & damage to shoreline/adjacent property

- Implement a fixed setback line
  - Preserves public trust property
  - Reduces risks of coastal hazards to private property
  - Maintains natural shoreline

Area 1 Proposed Setback Line

- Prohibit construction, erection, or expansion of Structures lake ward of the proposed line
- Setback line based upon coastal considerations including historic Lake Michigan water levels, storm surge, 50-year wave runup, Factor of Safety
- 'Structures' as defined by the Zoning Ordinance, with the following exceptions:
  - Walkways not attached to primary structures
  - Staircases of wood constructions not attached to primary structures
  - Free-standing signs
- Review/revisit setback line
  - Every ten years, at minimum
  - At change in Lake Michigan water level of four feet or more
  - Upon completion of FEMA's Great Lakes Coastal Flood Study (2014-2016)

Area 1 Proposed Setback Line – South Half



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Area 1 Proposed Setback Line – North Half

[redacted]

[redacted]

Area 2 Recommendations

- Creating setbacks is not practical
  - Shallow private lots – little flexibility in structure placement
  - More substantial shoreline protection may be required
  - Opportunity to take advantage of additional space provided by adjacent public shoreline

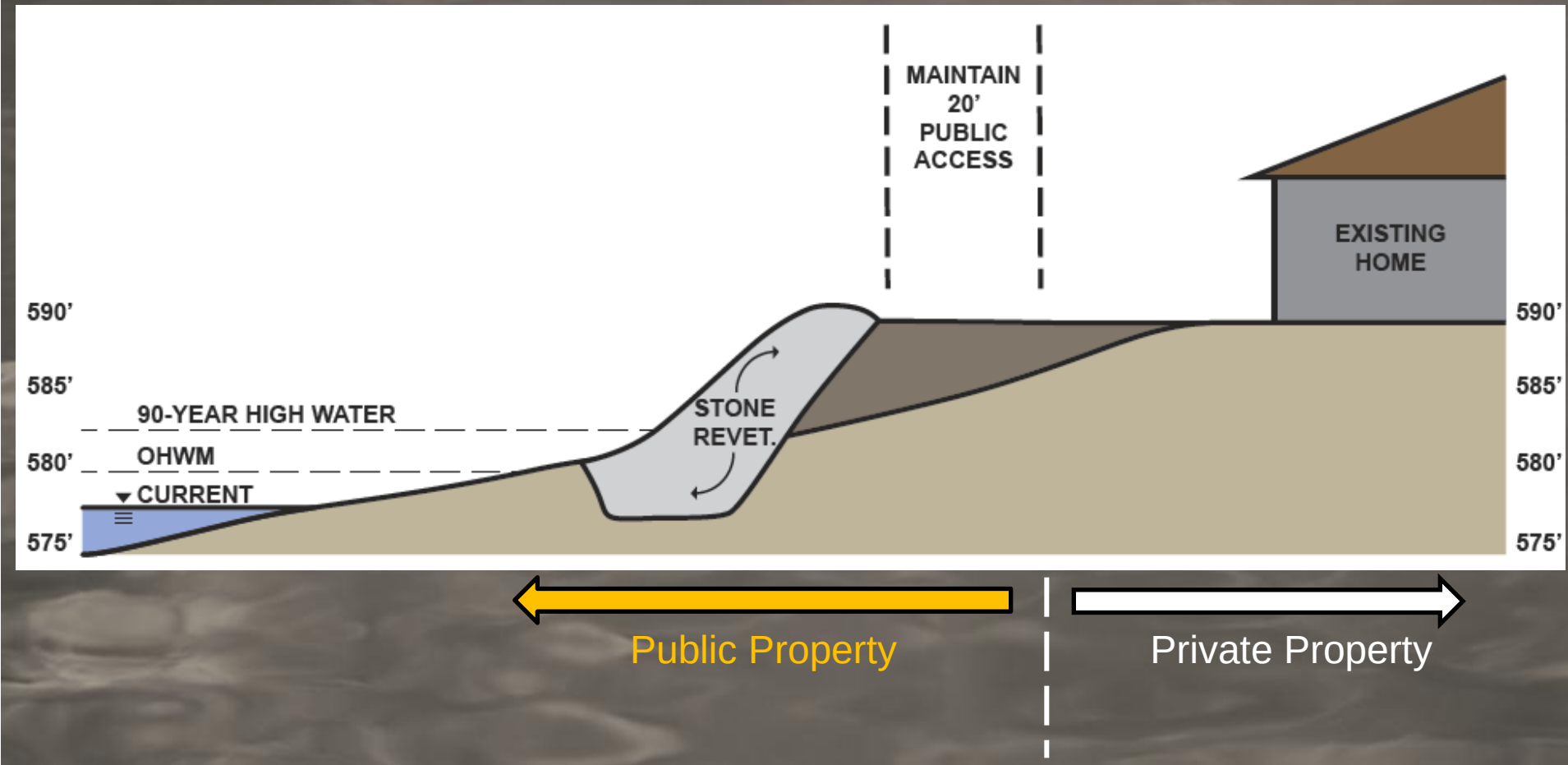
- Implement shoreline protection design guidelines
  - Balance preservation of public way with protection of structures
  - Allow property owners to construct properly designed shoreline protection structures, if necessary

Area 2 Shoreline Protection Design Guidelines

- Perpetual public access landward of the structure must be provided to ensure continued public access regardless of lake levels; structure would be constructed on public property under a license
- Structures must not adversely affect other/neighboring properties
- Structures must connect to adjacent shoreline structures, ultimately becoming one, unified structure
- Design must be prepared by a licensed professional engineer experienced with coastal engineering and must be approved by the City of St. Joseph City Engineer
- Vertical walls are prohibited
- Stone revetment of same type as St. Joseph water plant is recommended

Area 2 Recommendations

Area 2 Schematic Cross-Section



Area 3 Recommendations

- Shoreline Protection
  - Additional regulation beyond USACE/MDEQ regulation is unnecessary

Results

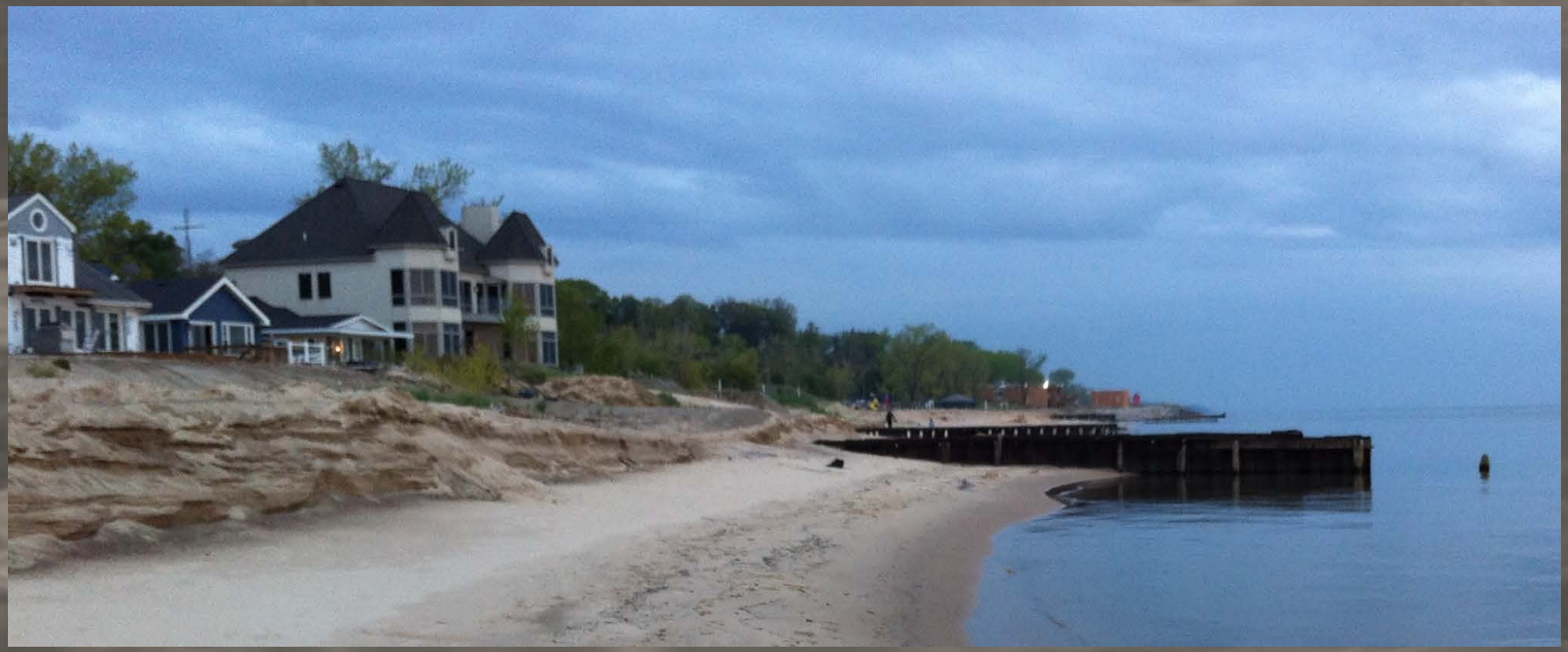
- The recommendations for Area 1 were adopted as an overlay district in the zoning ordinance and remain in effect
- No action was taken regarding the recommendations for Area 2
- No action was recommended for Area 3

The Good: Why did it work in Area 1?

- Perceived immediate and personal threat
- Community interest to protect neighborhood compatible with permissible public regulatory goals
- Significant public education/engagement on technical and legal analysis

The Bad: Why was no action taken in Area 2?

- Recent low water – no perceived immediate threat
- Limited options for protection & cost
- Drastic impact on public beach



The Ugly: A home within the reach of Lake Michigan

August 2014 Photo:

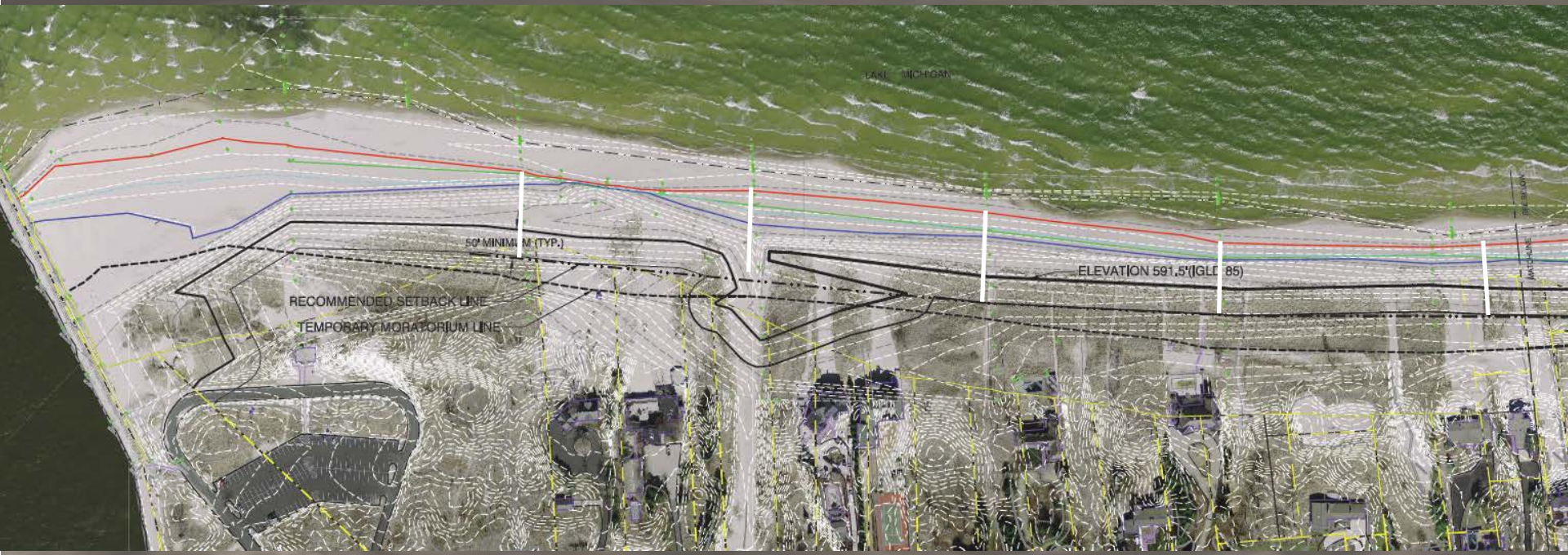
- minimal wave condition
- water level 3.5’ below record high

Thank You!
Questions/Comments?

Additional Reference Slides

Short Term Erosion of Accretion Area (North fillet)

Area 1 Proposed Setback Line

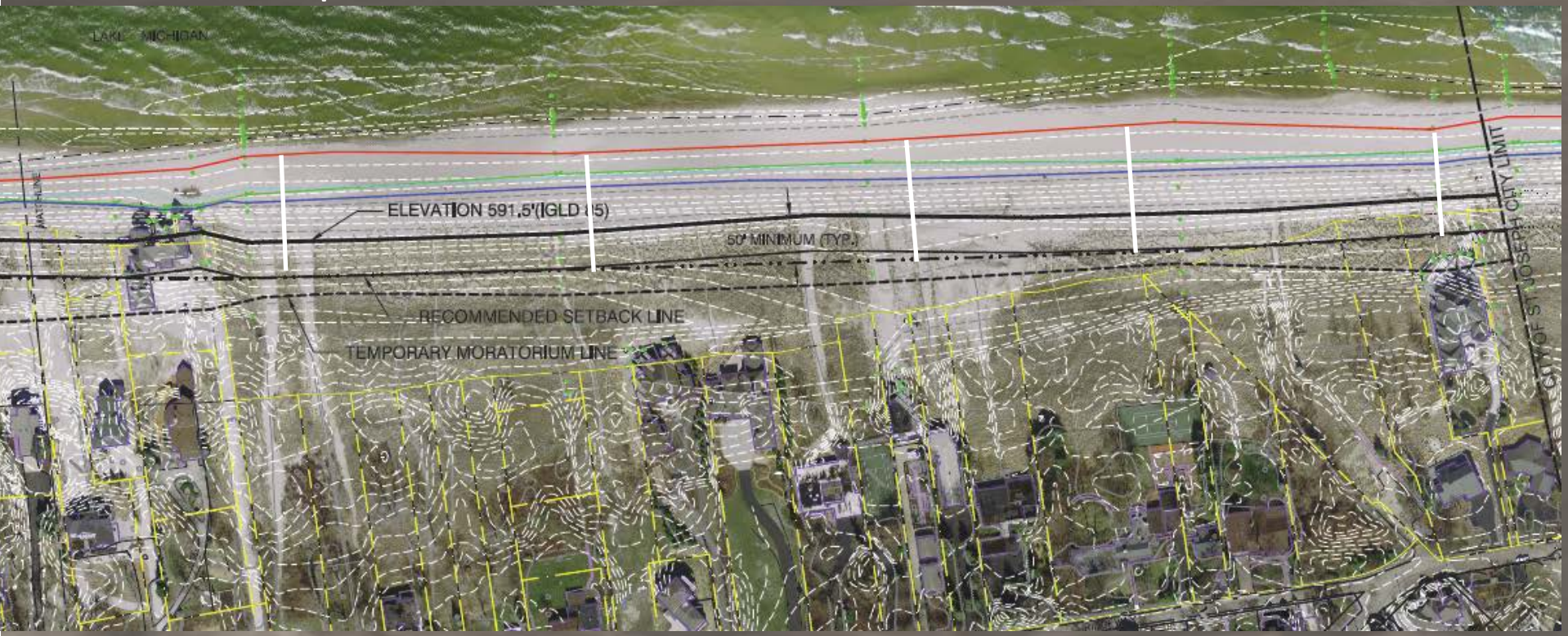


OHWM to Setback: 160’ 170’ 160’ 130’ 140’

LEGEND:

- EDGE OF WATER (578.0'(+.5' LWD) ON 4/19/2012)
- MDEQ O.H.W.M. (580.5')+3.0' LWD
- ALL TIME HIGH WATER(582.4')+4.9' LWD
- TEMP. MORATORIUM LIMIT PER ORDIN. 39-1-2
- VEGETATION LINE
- FEMA BASE FLOOD ELEVATION (584.1')+6.6' LWD
- PARCEL LINE
- BUILDING LINE

Area 1 Proposed Setback Line



OHWM to Setback: 175’ 165’ 170’ 180’ 150’

LEGEND:

- EDGE OF WATER (578.0'(+.5' LWD) ON 4/19/2012)
- MDEQ O.H.W.M. (580.5')+3.0' LWD
- ALL TIME HIGH WATER(582.4')+4.9' LWD
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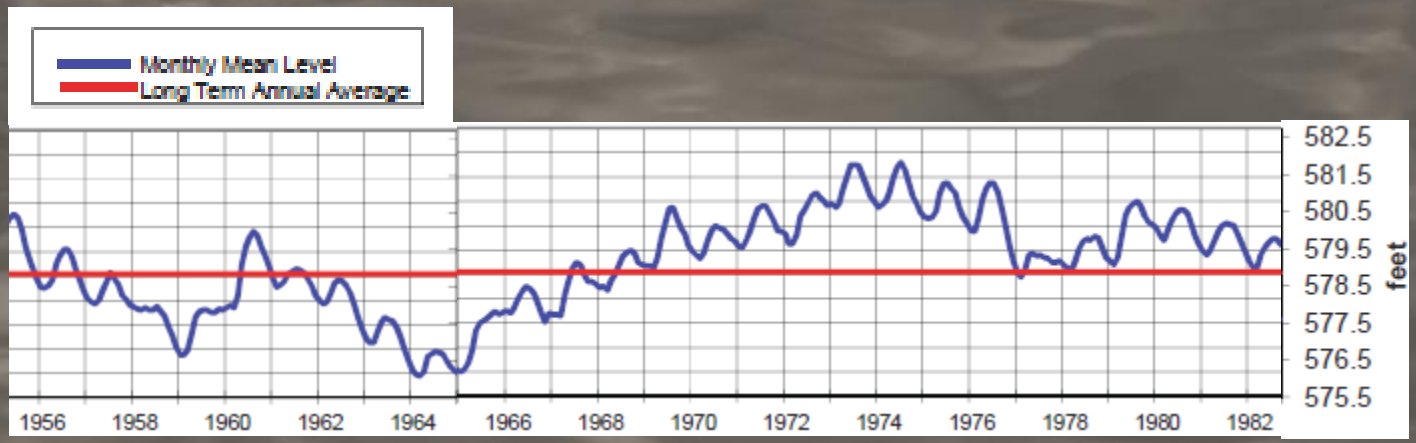
- BUILDING LINE

Berrien County Coastal Damage, 1957-1977

Case Study (1957-1977)

- 10 years of average to low water conditions, similar to today, followed by high to near record-high water conditions
- High water and severe storms resulted in significant damage along the shoreline
- President Nixon declared Berrien County a disaster area in 1973



1973 Jean Klock Park

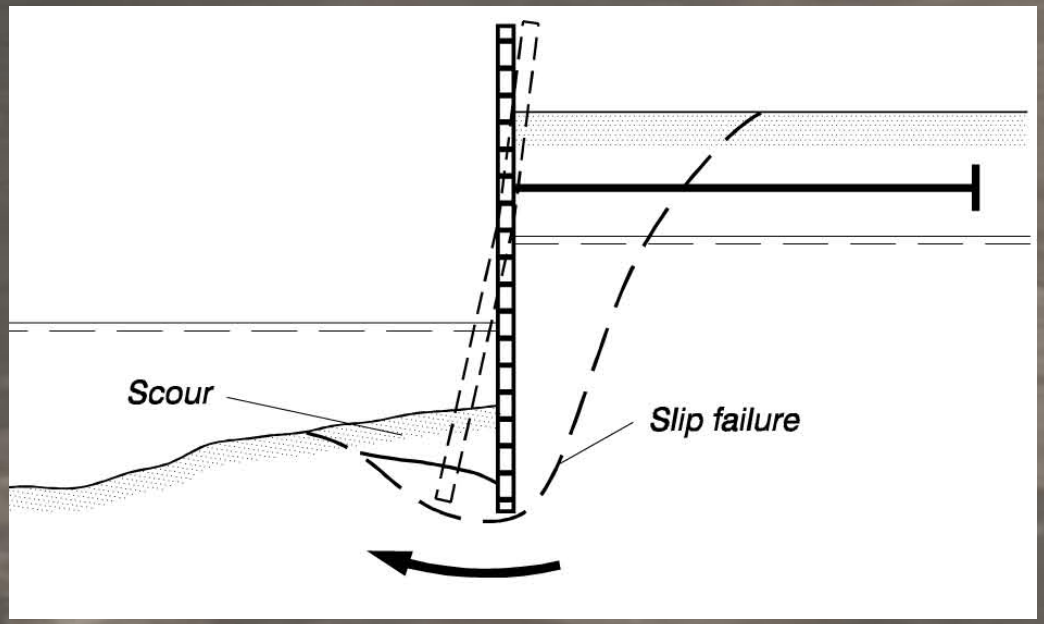
1973 Jean Klock Park

Shoreline Erosion Examples

Shoreline Erosion Examples

Shoreline Protection Considerations

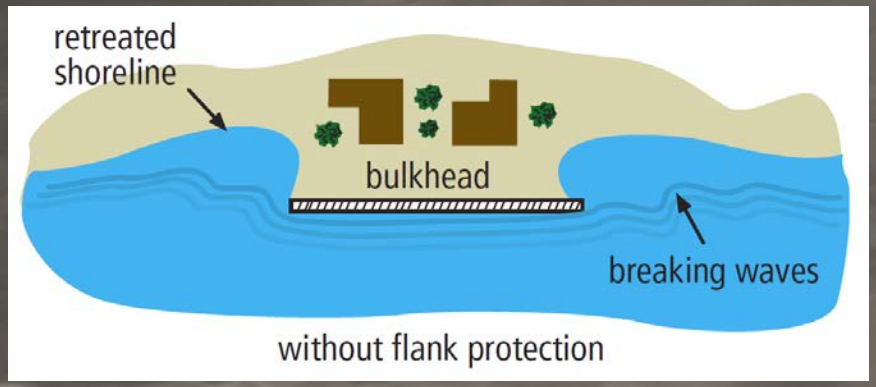
- **Toe protection** – prevents scour

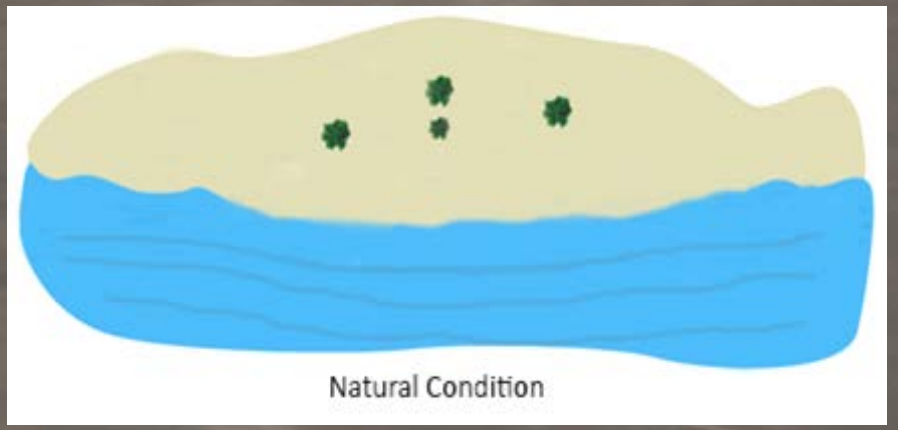


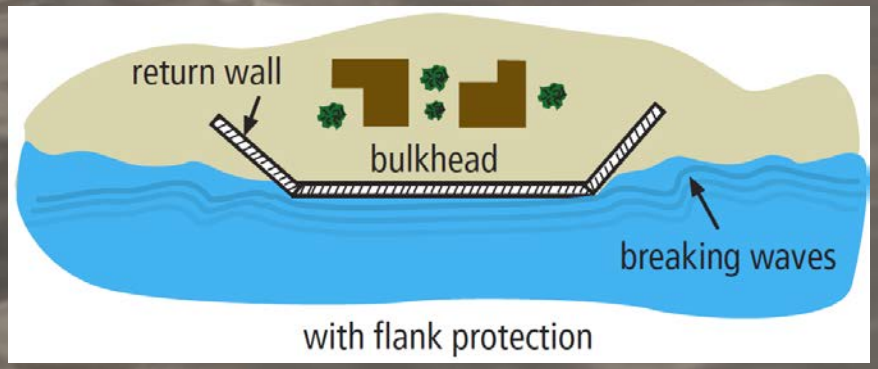
*Graphic from USACE Coastal Engineering Manual

Shoreline Protection Considerations

- **Length** – sufficient length and/or return walls are required to prevent flanking and adverse effects to neighbors







*Graphic from USACE/University of Wisconsin, "Living with the Coast" Booklet

Shoreline Protection Considerations

Flanking Examples – Berrien County

Shoreline Protection Considerations

Flanking Examples – Berrien County

Shoreline Protection Considerations

- **Height** – sufficient height above lake level to prevent wave overtopping
- **Depth** – sufficient penetration into the substrate/beach to prevent scour
- **Surface** – Irregular shapes and permeable materials absorb wave energy, while flat surfaces reflect and accelerate wave energy