Coastal Structures Risk Communication
Western Lake Superior Harbors

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US Army Corps of Engineers
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Introduction and Agenda

Purpose:

Communicate the risk of breakwater and structure conditions to local stakeholders and navigation system users. With a focus on structure condition, function, and economic consequences of coastal structures on the Great Lakes.

Focus Topics:

1. Coastal Structure Risk Communication
2. Condition Assessment of Coastal Structures
3. Harbor Infrastructure Inventory Process
4. Next Steps and Open Discussion

Regional Risk Communication Meetings

Regional Meetings

#1	15 Aug2011
#2	8 Nov 2011
#3	18 Jan 2012
#4	18 Jul 2012
#5	30 Aug2012
#6	15 Oct 2012
#7	17 May 2013
#8	20 June 2013
#9	E. UP/N. MI (Aug 13)
#10	UP/N. WI (Sept 13)
#11	East Ont (Sept 13)

Coastal Structures

Great Lakes Navigation

- 104+ miles of navigational structures on the Great Lakes
- Most built between 1860 and 1940
- Timber crib construction (typical)
- Low Lake water levels since the 1990's have accelerated deterioration

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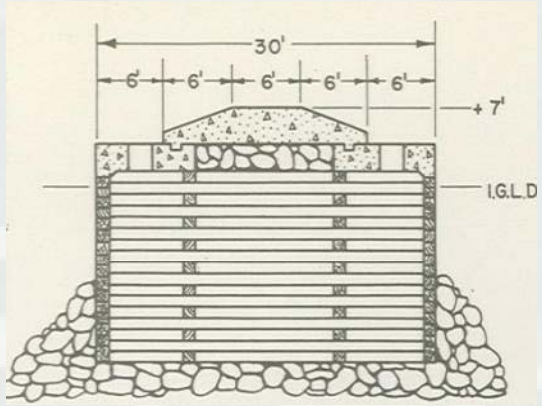
Typical Coastal Structures

Steel Sheet Pile Structures

Rubble Mound/Laid-Up Stone Structures

Other Components: safety (railings, walking surface, etc.)



Typical Wood Crib/ Concrete Cap Structures Cross-section

Structure Function/Consequences

Contain and reduce shoaling in navigation channel

Protect navigation channel and shoreline infrastructure

Control wave climate within navigation channel and harbor

Coastal Structure Communication Objective

Program Objective: Communicate the risk of breakwater and structure conditions to local stakeholders and navigation system users

Process:

1. **Conduct Condition Assessments**
   - Commercial Harbors- Use detailed Breakwater Assessment Team (BAT) Evaluation
   - Recreational Harbors- Rely on expert elicitation
2. **Conduct Harbor Infrastructure Inventory on all structures**
3. **Prepare summary document** that conveys the current condition of the harbor infrastructure as well as the risk involved in the event of failure
4. **Share with stakeholders** in regional meetings

Harbor Infrastructure Inventory Process

- Gather information on critical infrastructure protected by federally maintained navigation structures
  - Review Documents:
    - Project Drawings
    - Harbor Fact Sheet
    - Aerial/Satellite Photography; Photo document critical infrastructure
  - Identify Critical Infrastructure to Visit
  - Research Identified Critical Infrastructure
- Site Visit Tasks
  - Met with Local Officials, Port Authority, Harbor Master, when available
  - Visit Identified Areas/Critical Infrastructure & Gather Information
- Post Site Visit Tasks
  - Create Report Following the Standard Report Template

Harbor Infrastructure Inventory Report Content

- **HARBOR LOCATION**
- **PROJECT DESCRIPTION**

  Authorization, harbor type (commercial or recreational), length of breakwater structures and channel
- **DATE OF SITE VISIT**
- **SUMMARY OF STRUCTURES**

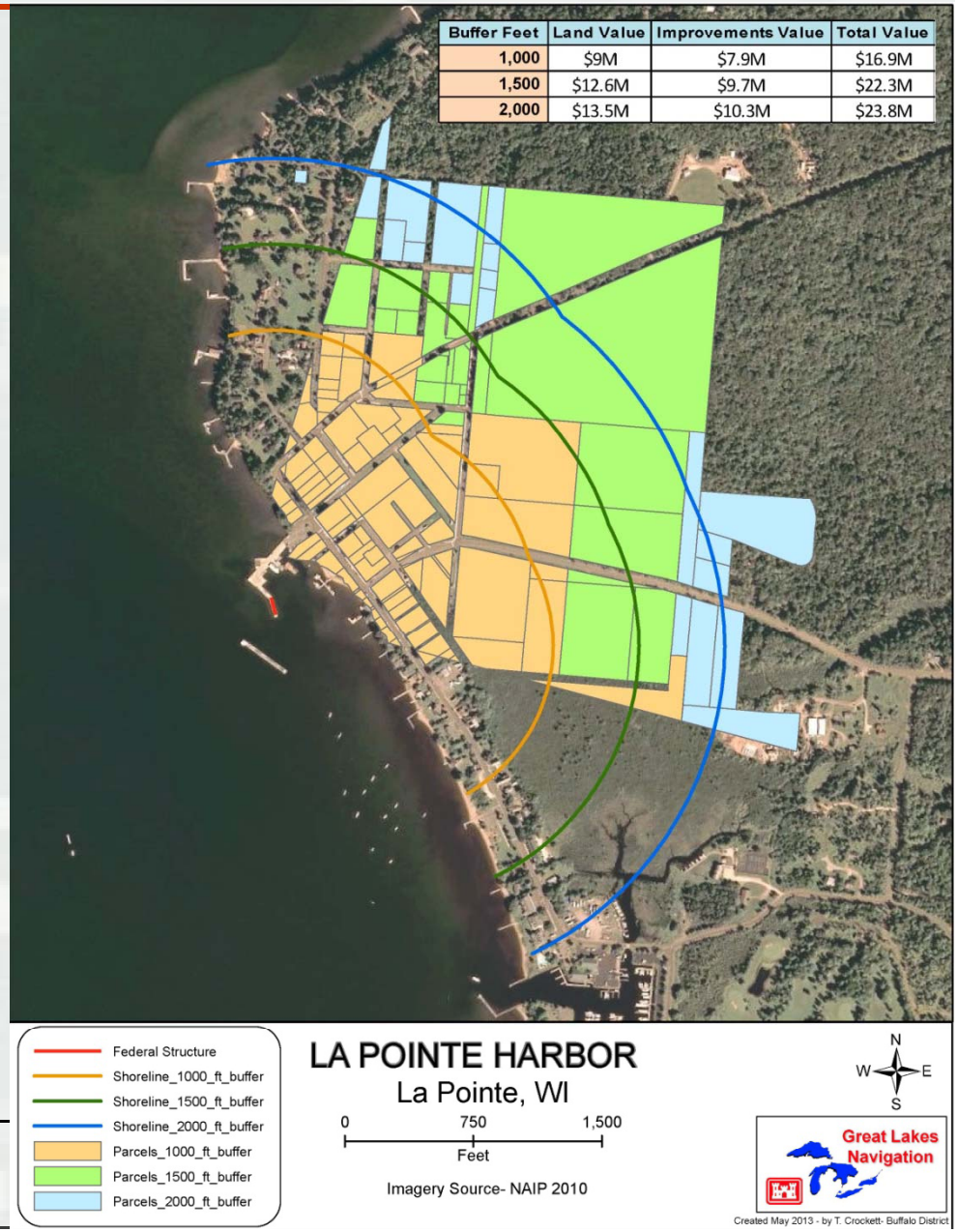
  Lists all structures and facilities that are believed to be protected by the federal navigation structures; also identify any other potential stakeholders
- **SUMMARY OF IMPACT**

  Summarizes any potential damage that could be experienced if the federal breakwater fails.
- **DESCRIPTION OF STRUCTURES**

  Aerial photo with all potential affected structures shown along with pictures and a brief description of each potentially affected structure

High Level Display of Potential Impact Areas

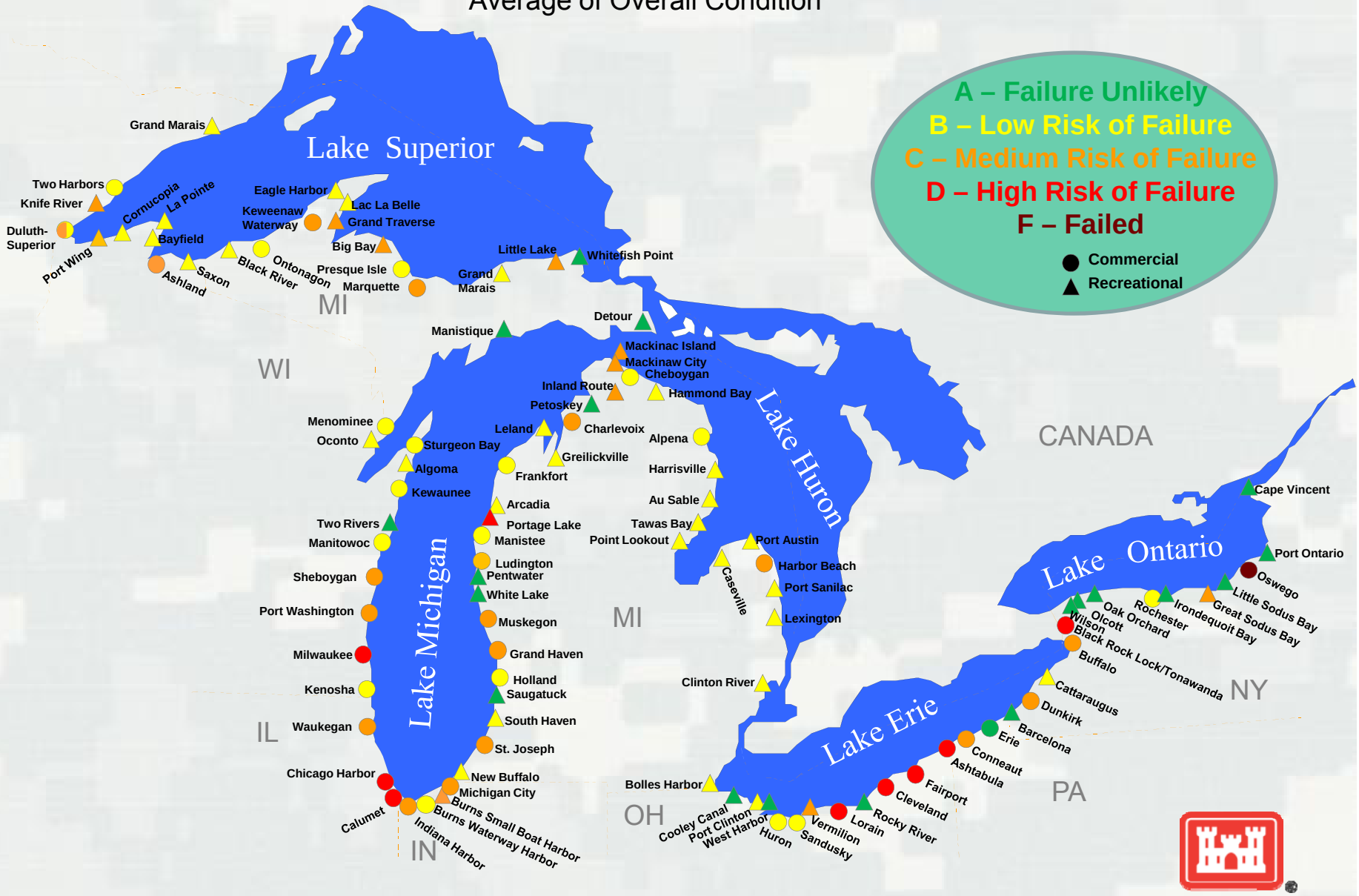
- Three potential impact areas were defined at 500 ft intervals
- Shows potential value of land and infrastructure within each "potential impact area" based on tax assessment data



Buffer Feet	Land Value	Improvements Value	Total Value
1,000	$9M	$7.9M	$16.9M
1,500	$12.6M	$9.7M	$22.3M
2,000	$13.5M	$10.3M	$23.8M

Harbor Structure Condition Assessments

Average of Overall Condition



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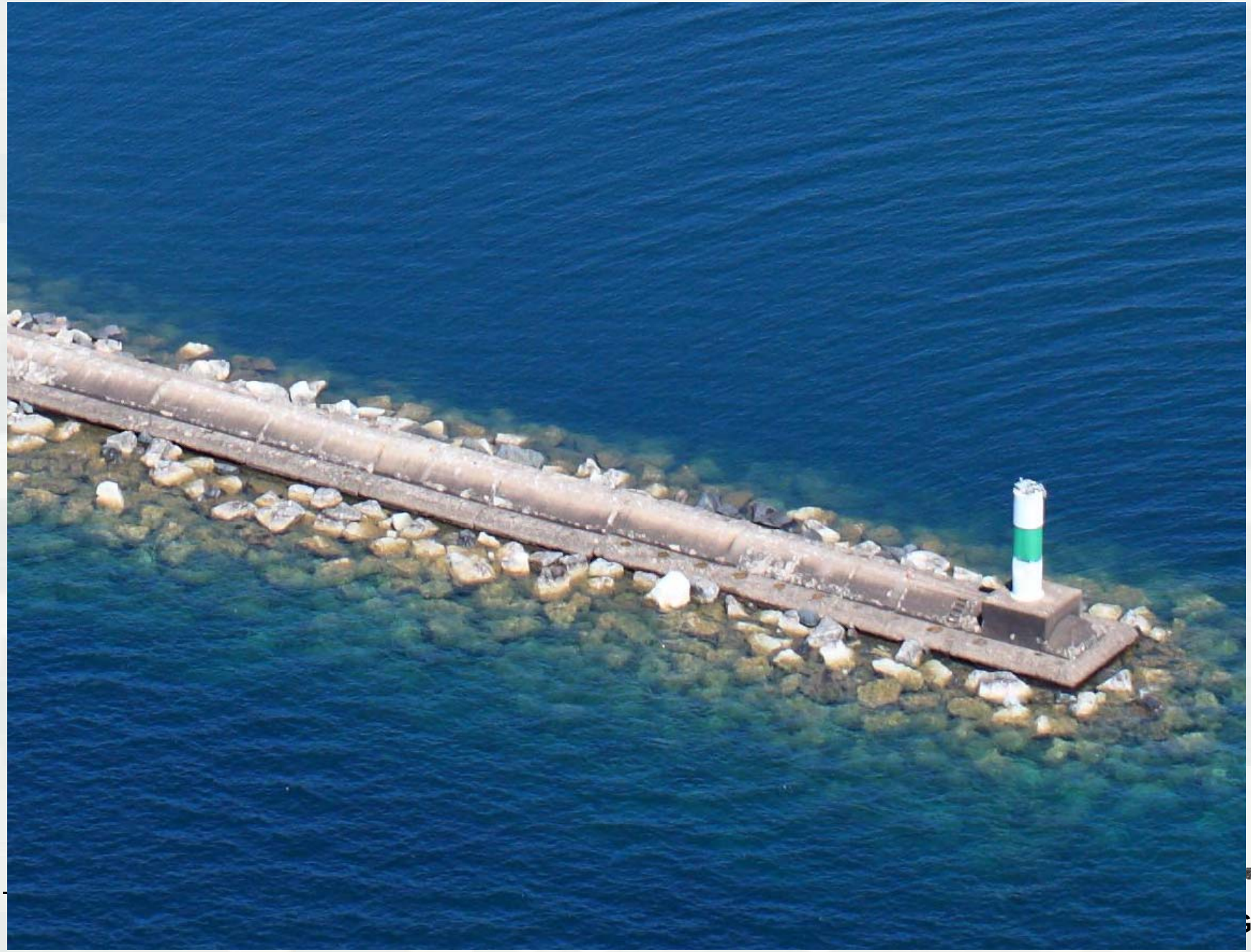
Harbors
of
Western Lake Superior

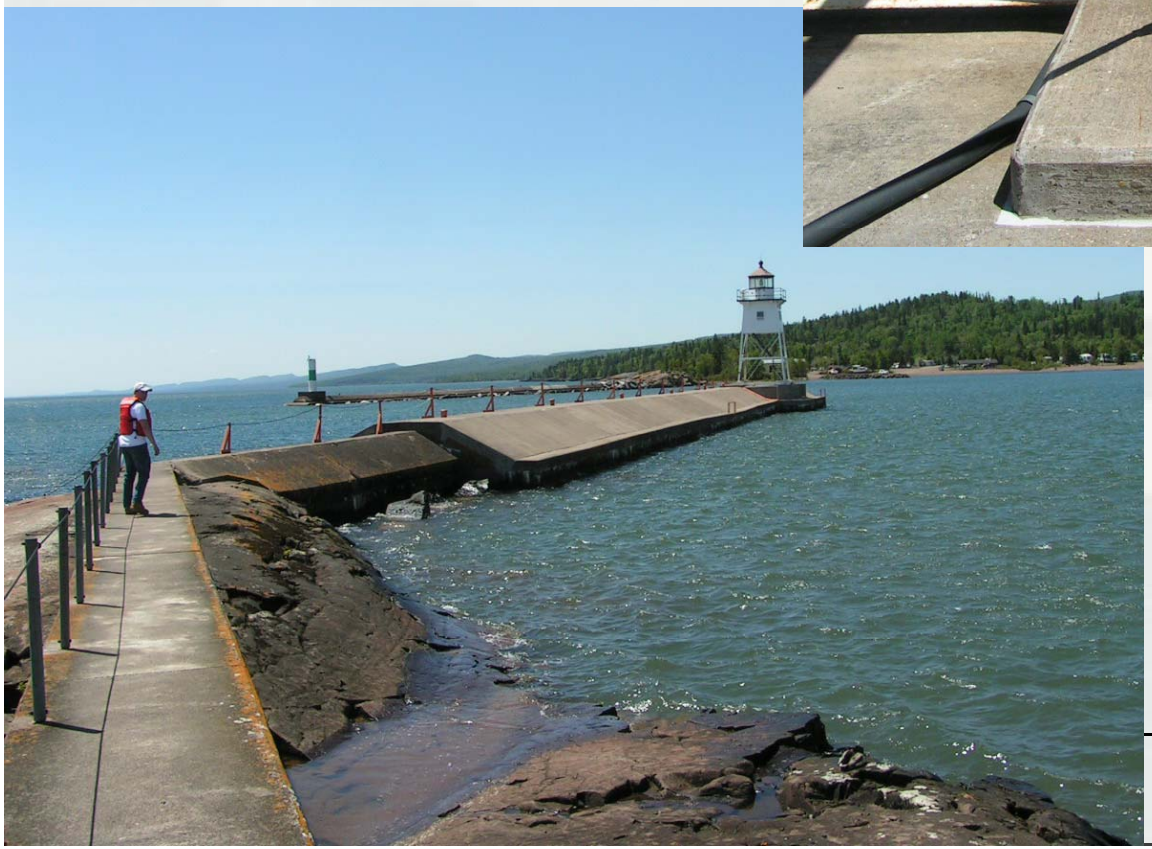
Grand Marais Harbor:
B – Low Risk of Failure

Grand Marais Harbor – West Breakwater



Grand Marais Harbor –

East breakwater



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Grand Marais Harbor –

Inner Breakwater

Grand Marais Harbor:

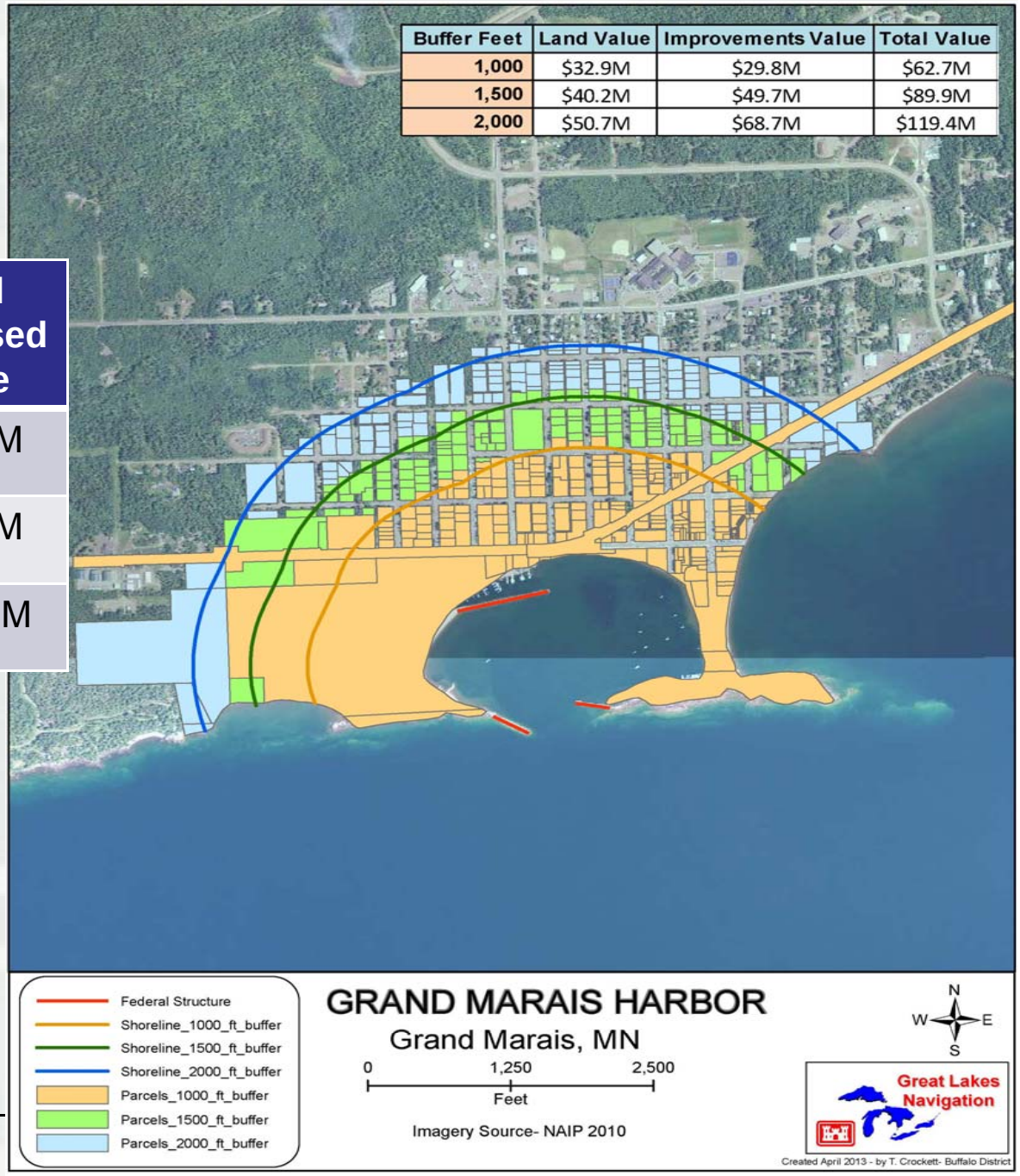
Infrastructure:

1. U.S. Coast Guard Station and Border Patrol Station
2. Grand Marais Yacht Club
3. Cobblestone Cove Villa Town Home Complex
4. Grand Marais Marina
5. Grand Marais Recreation Area
6. Grand Marais Water Treatment Plant

Grand Marais Harbor:

Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	$32.9M	$29.8M	$62.7M
1,500	$40.2M	$49.7M	$89.9M
2,000	$50.7M	$68.7M	$119.4M



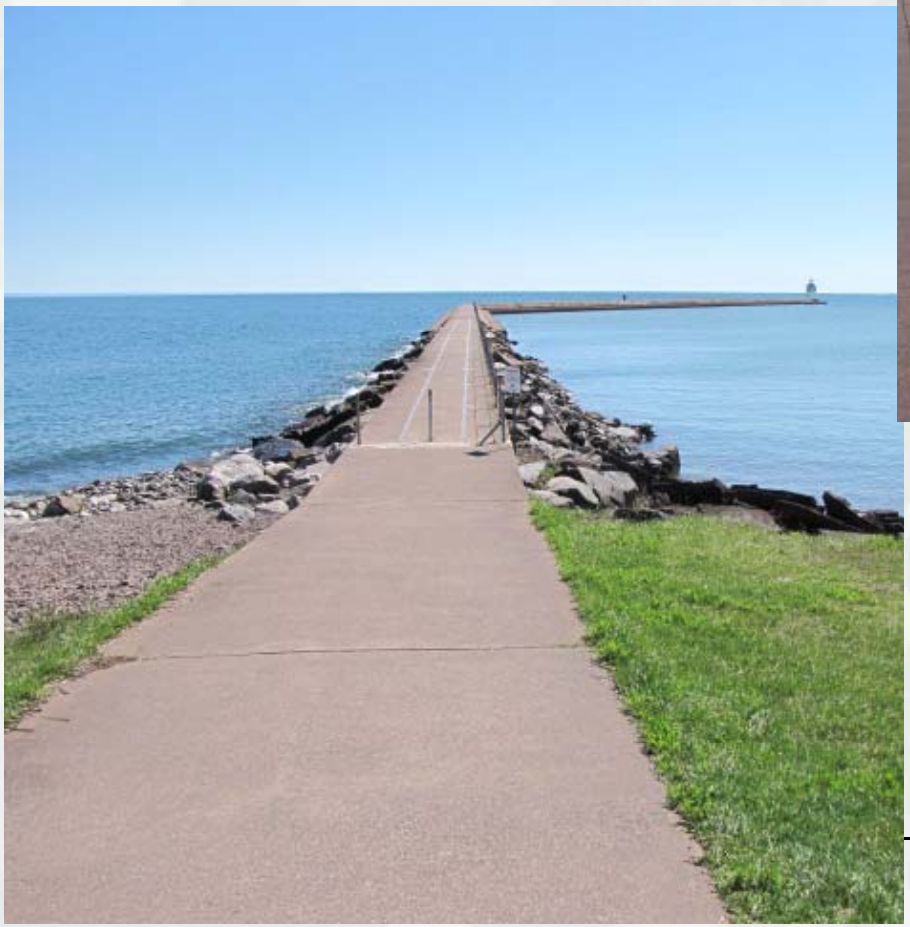
Two Harbors Harbor:
B – Low Risk of Failure

Two Harbors –

Concrete spalling, particularly at ice plates, ladders.

Two Harbors

Isolated location where scour stone is lo longer at design slope.



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Two Harbors:

Infrastructure:

1. Canadian National Railway Ore Docks
2. MNDNR Public Water Access
3. Two Harbors WWTP

Two Harbors:

Potential Impact Areas

Knife River Harbor:
C – Medium Risk of Failure

Knife River Harbor --

Some loss of armor stone

Knife River Harbor --

Knife River Harbor:

Infrastructure:

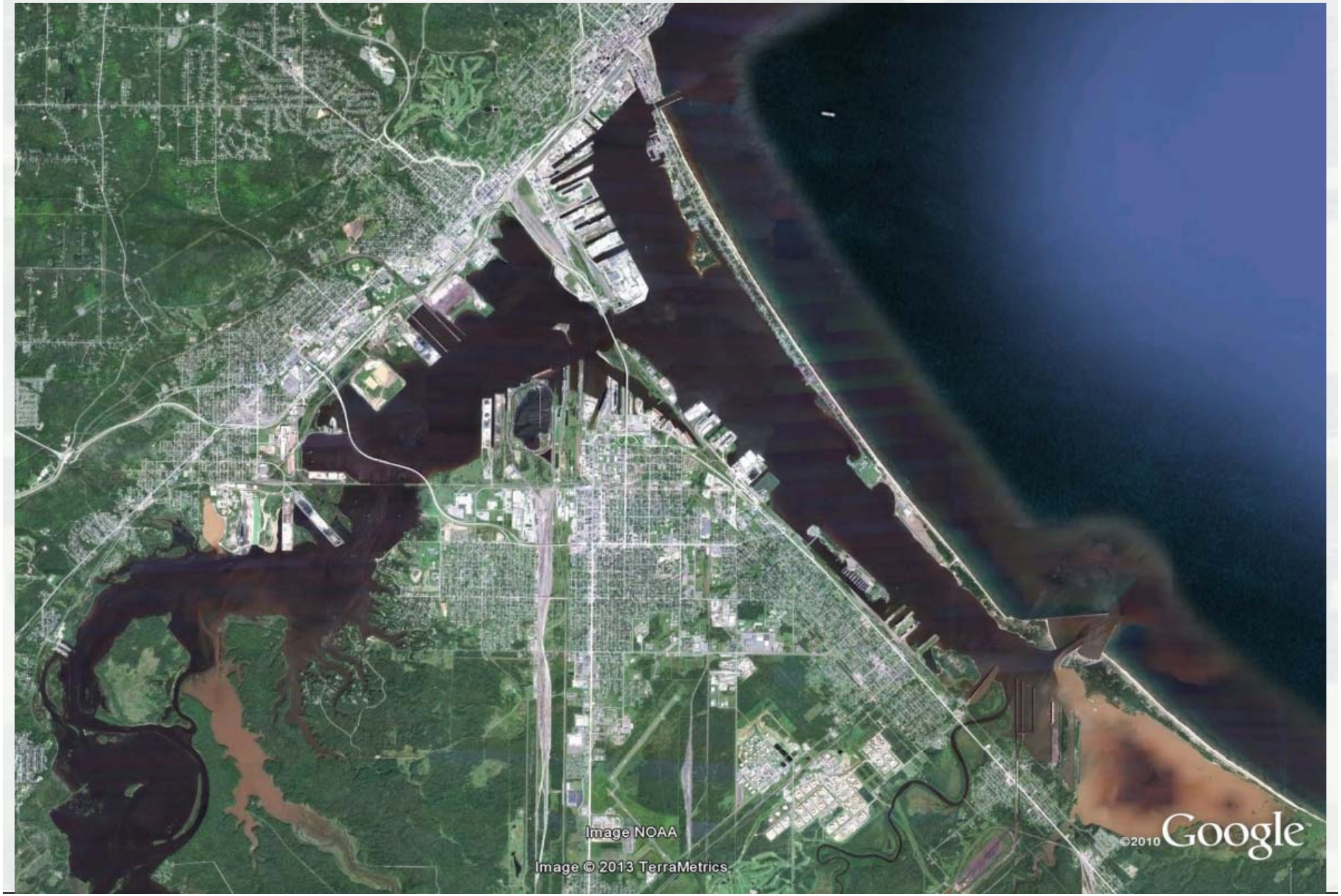
1. Knife River Marina

Knife River Harbor:

Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	$4.3M	$2.5M	$6.8M
1,500	$4.4M	$2.5M	$6.9M
2,000	$4.5M	$2.7M	$7.2M

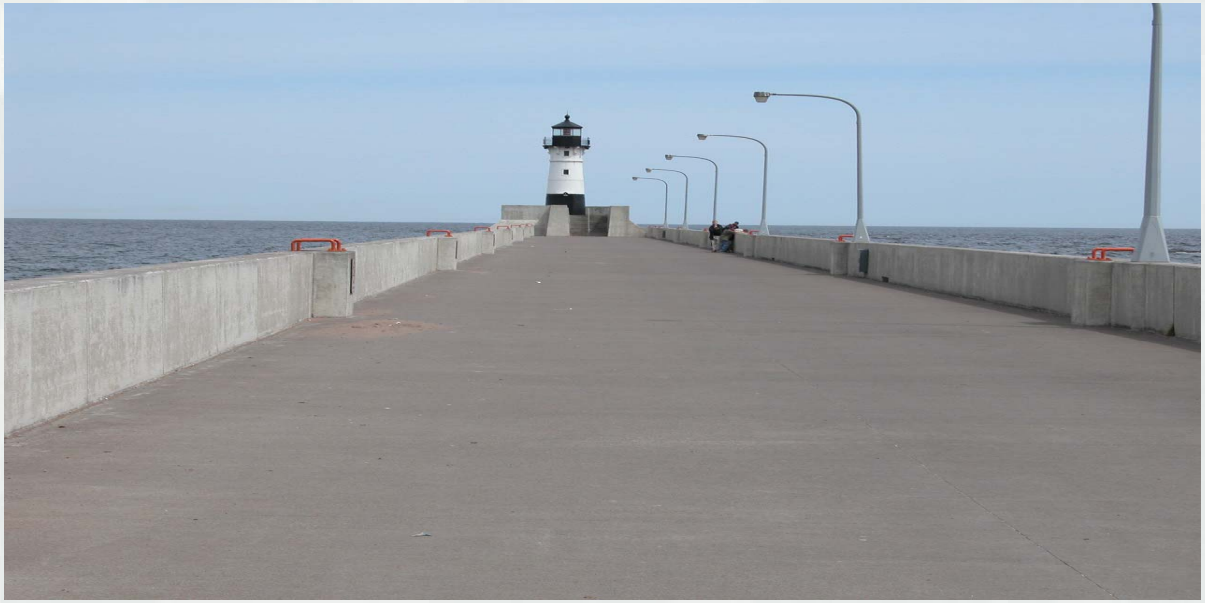
Duluth-Superior Harbor:
B/C – Low/Medium Risk of Failure



Duluth Harbor:

Duluth Harbor

Duluth Entry, North Pier facing East



Duluth Entry, North Pier facing West

Duluth Harbor

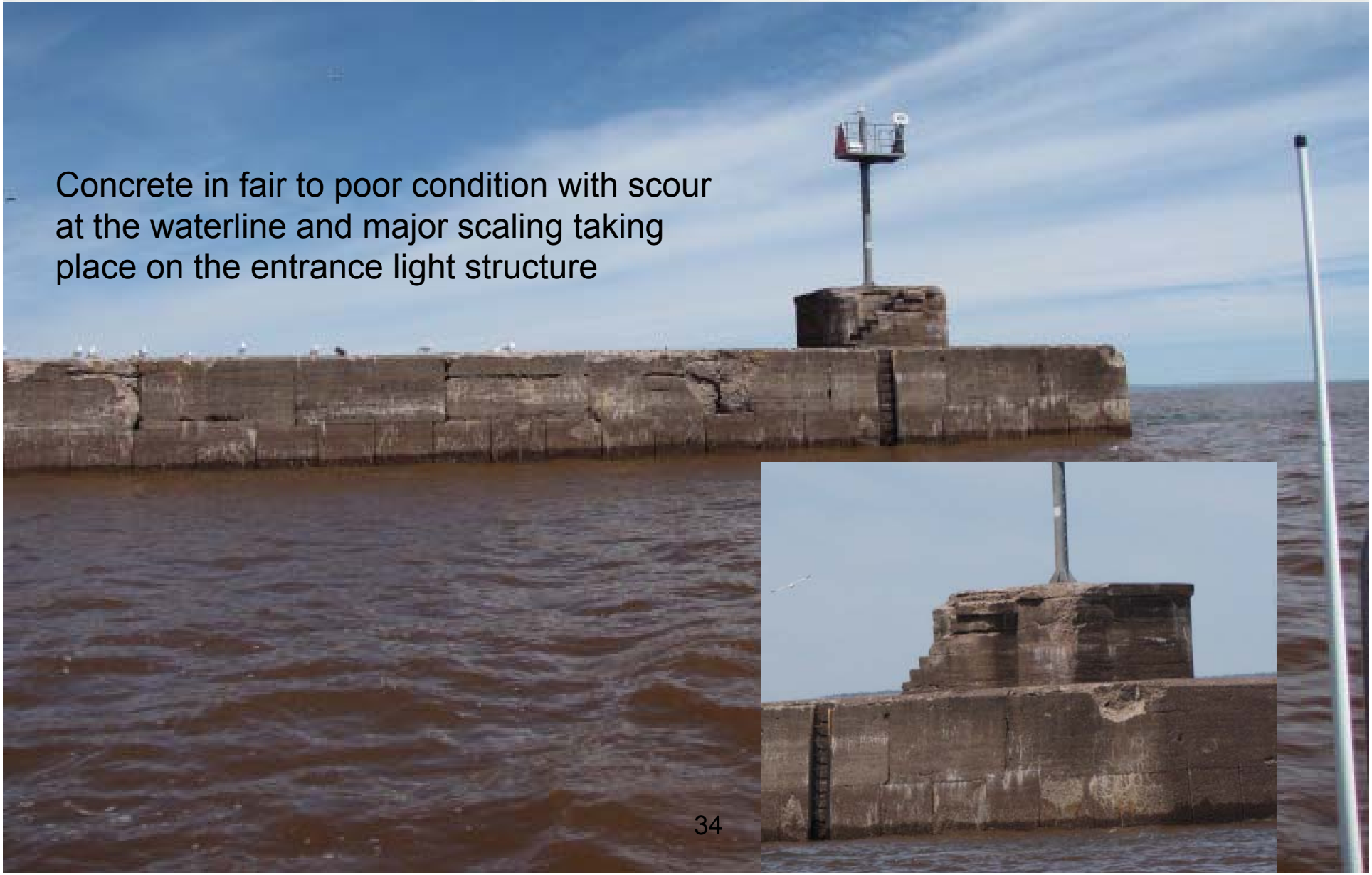
Duluth Entry, South Pier facing East

Duluth Entry, South Pier facing West

Superior Harbor

Superior Harbor –

Superior Entry North Concrete Entrance Pier and North Concrete Breakwater



Superior Harbor

Superior Entry North Concrete Entrance Pier and North Concrete Breakwater

Sinkholes present behind the structure indicate pathway under or through the structure to the channel side.

Damage to top timber crib is visible at the water line. Corrosion is starting to impact the steel connection to the timber crib.

Superior Harbor –

Superior Entry South Concrete Entrance Pier and South Concrete Breakwater

Slope of lakeside scour/wave stone has sloughed, particularly at pier head

Damage/deterioration of concrete cap block, particularly at joints where concrete corners have delaminated or have been lost.

Superior Harbor –

Superior Entry Rubble Mound Breakwater

Minor displacement and settling of armor stone at isolated locations

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Superior Harbor –

Superior Entry Rubble Mound Breakwater

Minor flattening of slope of armor stone

Much of the older stone is beginning to show signs of minor wear and aging

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Duluth-Superior Harbor:

Infrastructure:

1. Duluth Canal Park Visitor Center and Historical Museum
2. USACE Duluth Area Office
3. Duluth Aerial Lift Bridge
4. Paulucci Professional Building
5. Duluth Entertainment Convention Center
6. Great Lakes Aquarium
7. South Pier Inn
8. USACE Duluth Vessel Yard
9. General Mills Duluth Grain Elevator
10. Duluth Storage

Duluth-Superior Harbor:

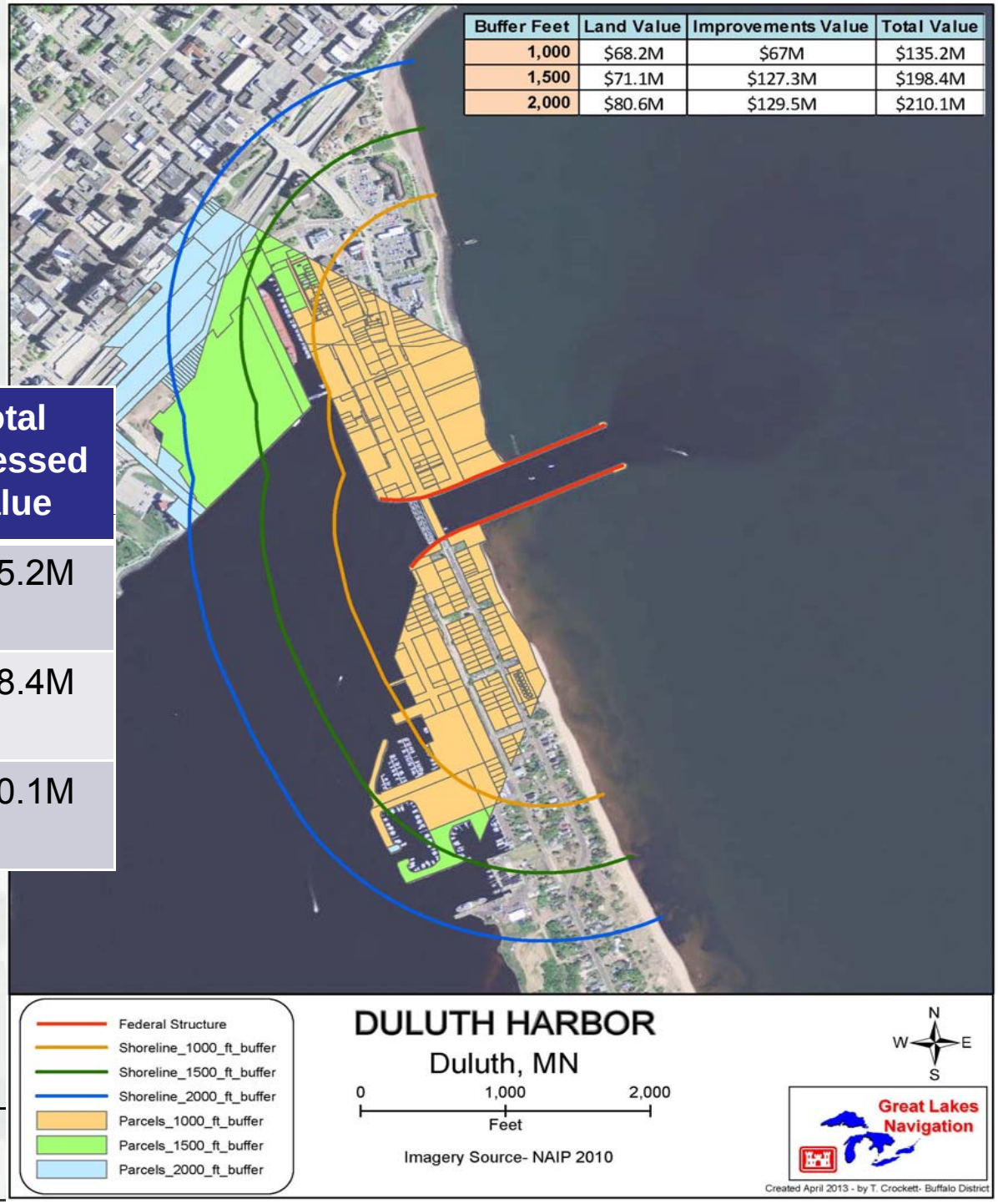
Infrastructure:

11. Holcim Inc.
12. Duluth-Seaway Port Authority
13. Fraser Shipyards
14. Gavilon Grain, LLC
15. Lafarge Corporation
16. Hansen-Mueller – Superior, WI Elevators
17. Burlington Northern Sante Fe (BNSF) Ore Dock

Duluth Harbor:

Potential Impact Areas

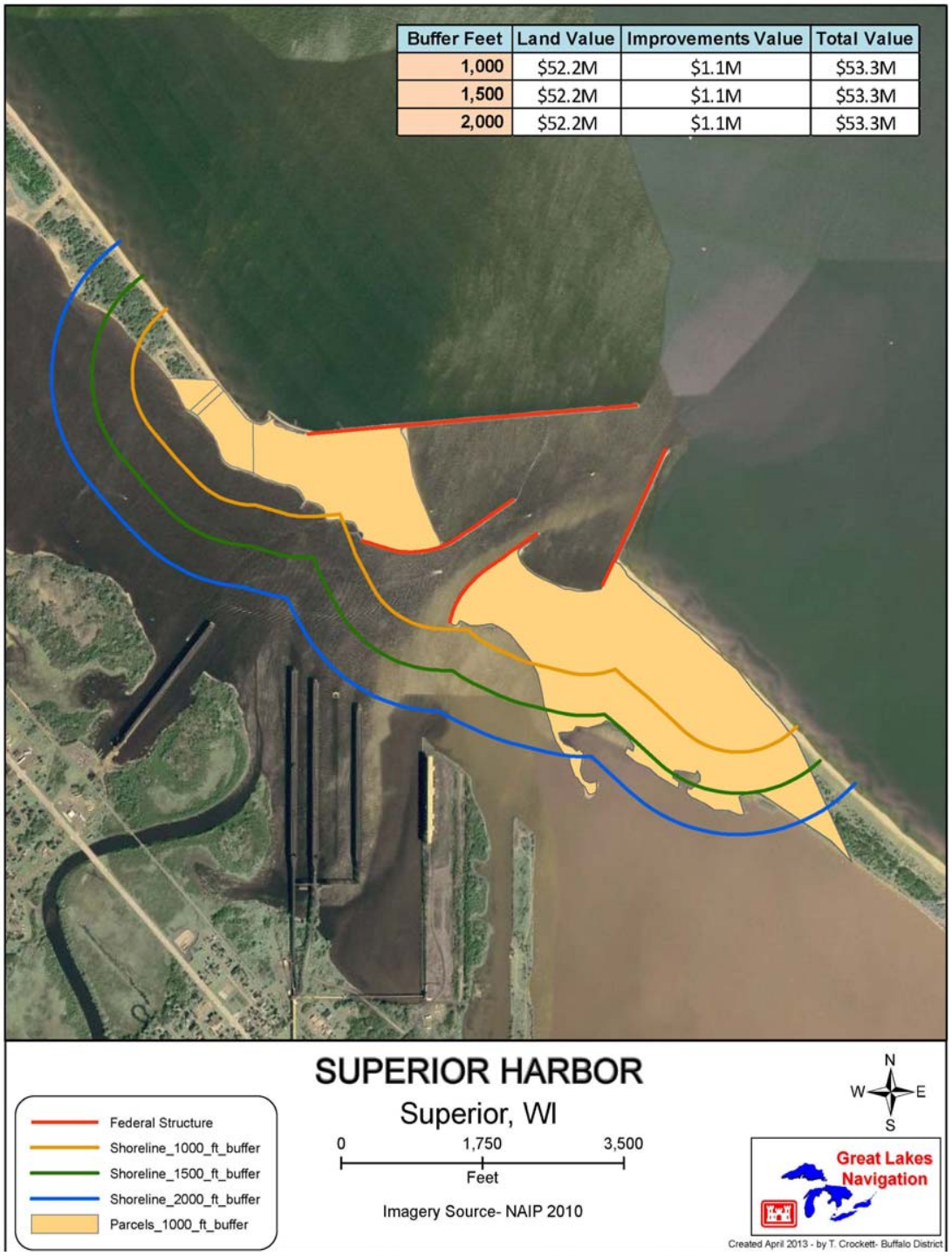
Buffer Feet	Land Value	Improv.Value	Total Assessed Value
1,000	$68.2M	$67M	$135.2M
1,500	$71.1M	$127.3M	$198.4M
2,000	$80.6M	$129.5M	$210.1M



Superior Harbor:

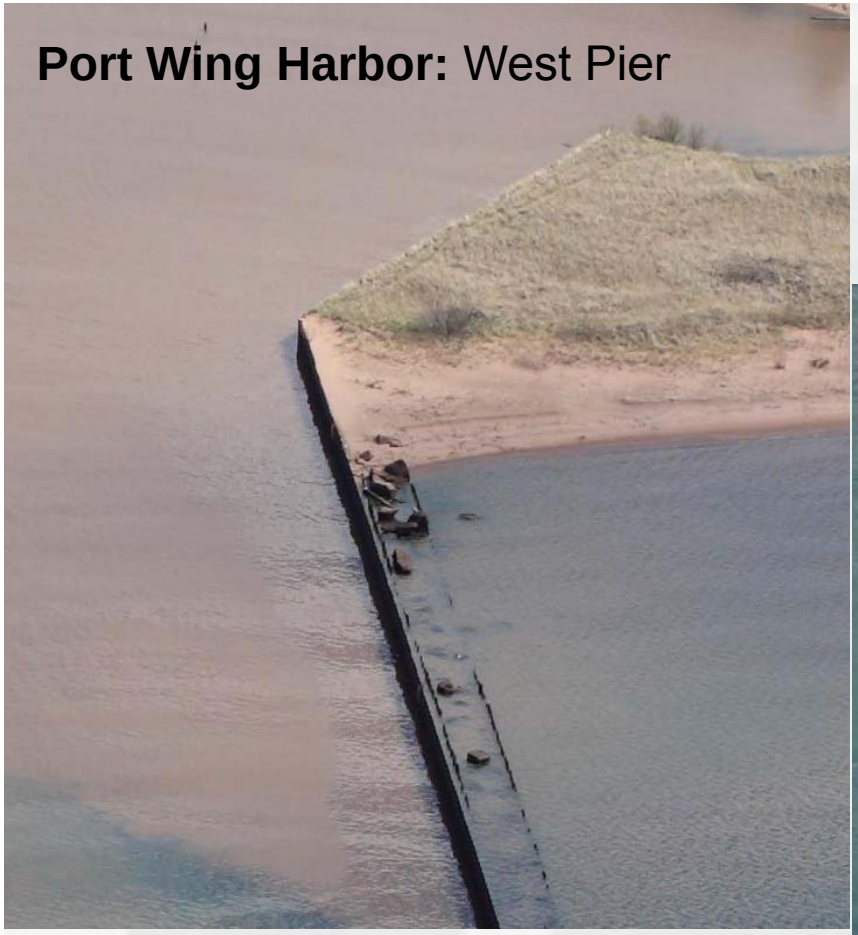
Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	$52.2M	$1.1M	$53.3M
1,500	$52.2M	$1.1M	$53.3M
2,000	$52.2M	$1.1M	$53.3M



Port Wing Harbor:
C – Medium Risk of Failure

Port Wing Harbor: West Pier



Port Wing Harbor:

East Pier Pile Revetment

Concrete in fair condition – severe spalling is present at waterline.

Port Wing Harbor:

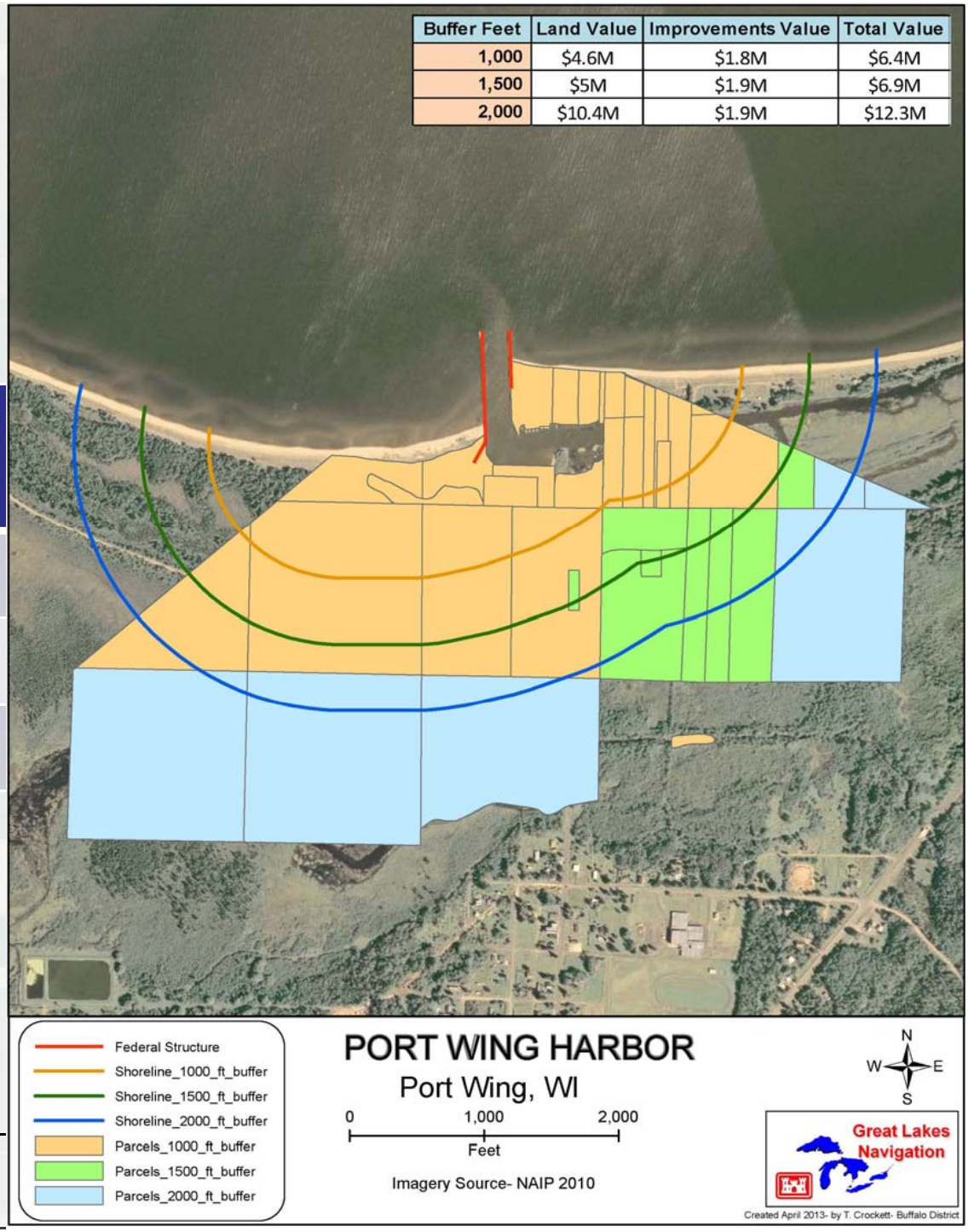
Infrastructure:

1. Port Wing Marina
2. Everett's Fisheries
3. Charter Boats operations

Port Wing Harbor:

Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	$4.6M	$1.8M	$6.4M
1,500	$5M	$1.9M	$6.9M
2,000	$10.4M	$1.9M	$12.3M



Cornucopia Harbor:
B – Low Risk of Failure

Cornucopia Harbor –

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Cornucopia Harbor –

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Cornucopia Harbor:

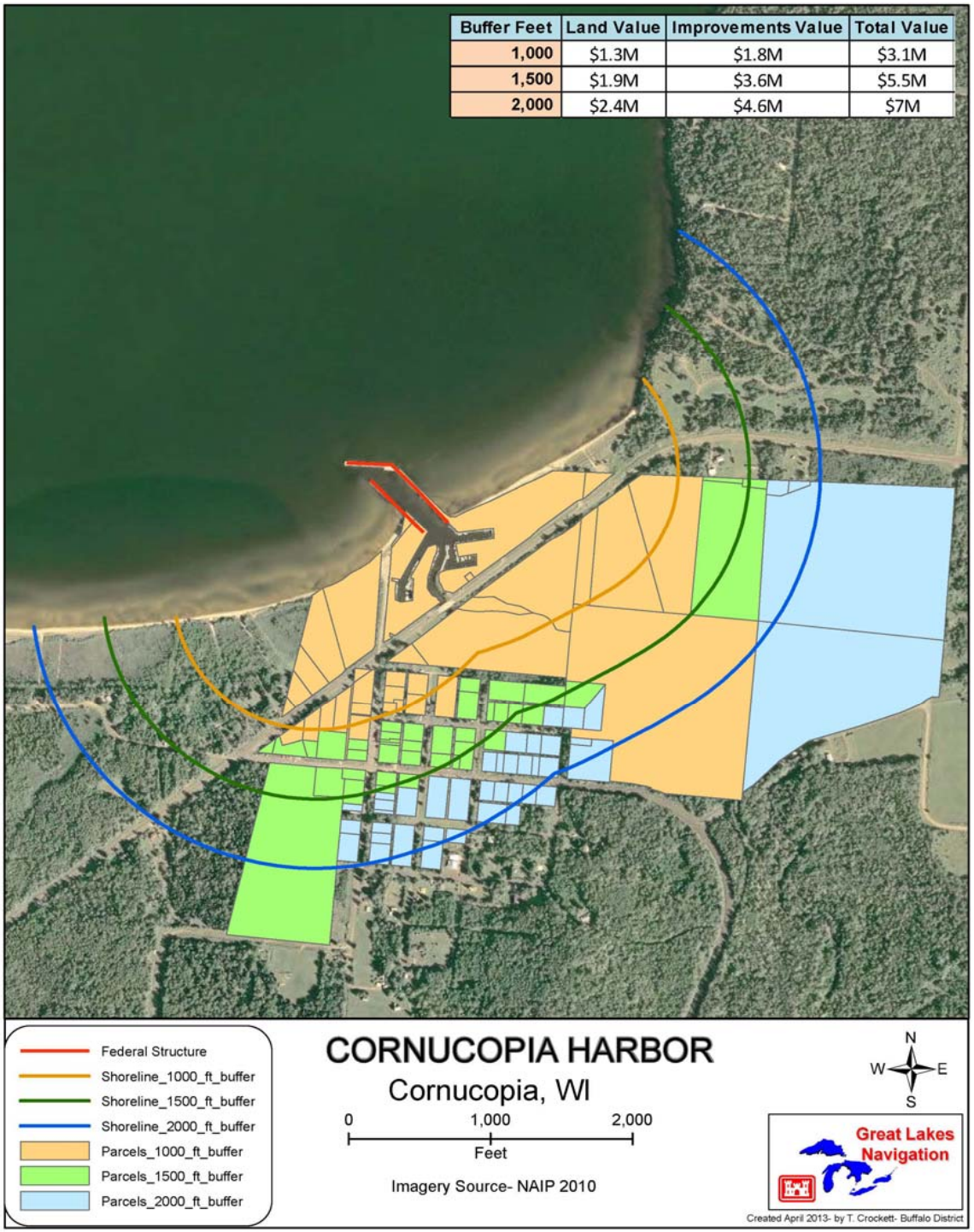
Infrastructure:

1. Halvorson's Fisheries
2. Siskiwit Bay Marina
3. Bell Marina
4. Day-O Charters
5. Cornucopia Historical Museum
6. Good Earth Shop
7. Sea Hag Art, Antiques Gift Shop

Cornucopia Harbor:

Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	$1.3M	$1.8M	$3.1M
1,500	$1.9M	$3.6M	$5.5M
2,000	$2.4M	$4.6M	$7M



La Pointe Harbor:
B – Low Risk of Failure

La Pointe Harbor

Evidence of concrete cracking & spalling on sections B & C which should be monitored for further deterioration.

La Pointe Harbor –
SSP in good condition

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La Pointe Harbor:

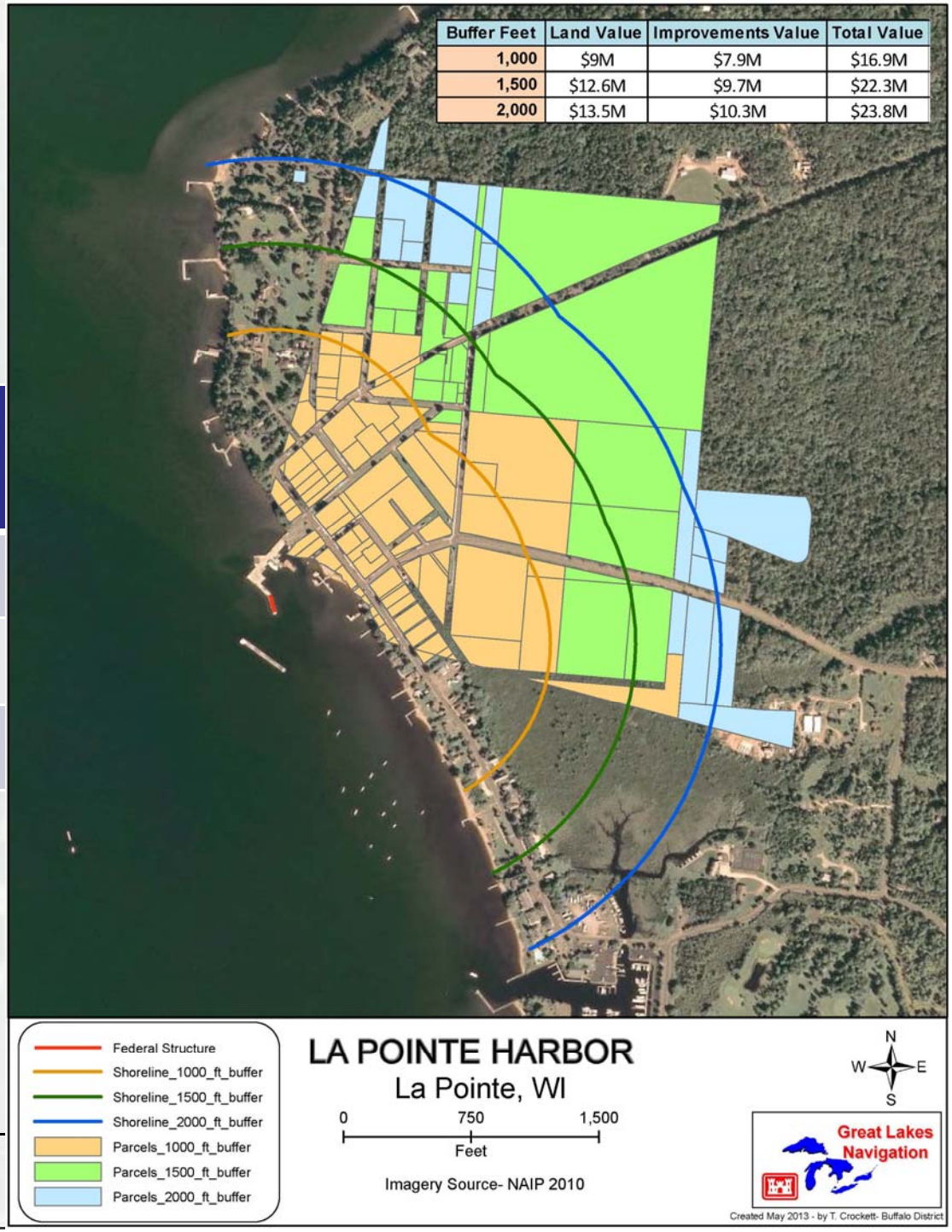
Infrastructure:

1. Madeline Island Ferry Line

La Pointe Harbor:

Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	$9M	$7.9M	$16.9M
1,500	$12.6M	$9.7M	$22.3M
2,000	$13.5M	$10.3M	$23.8M



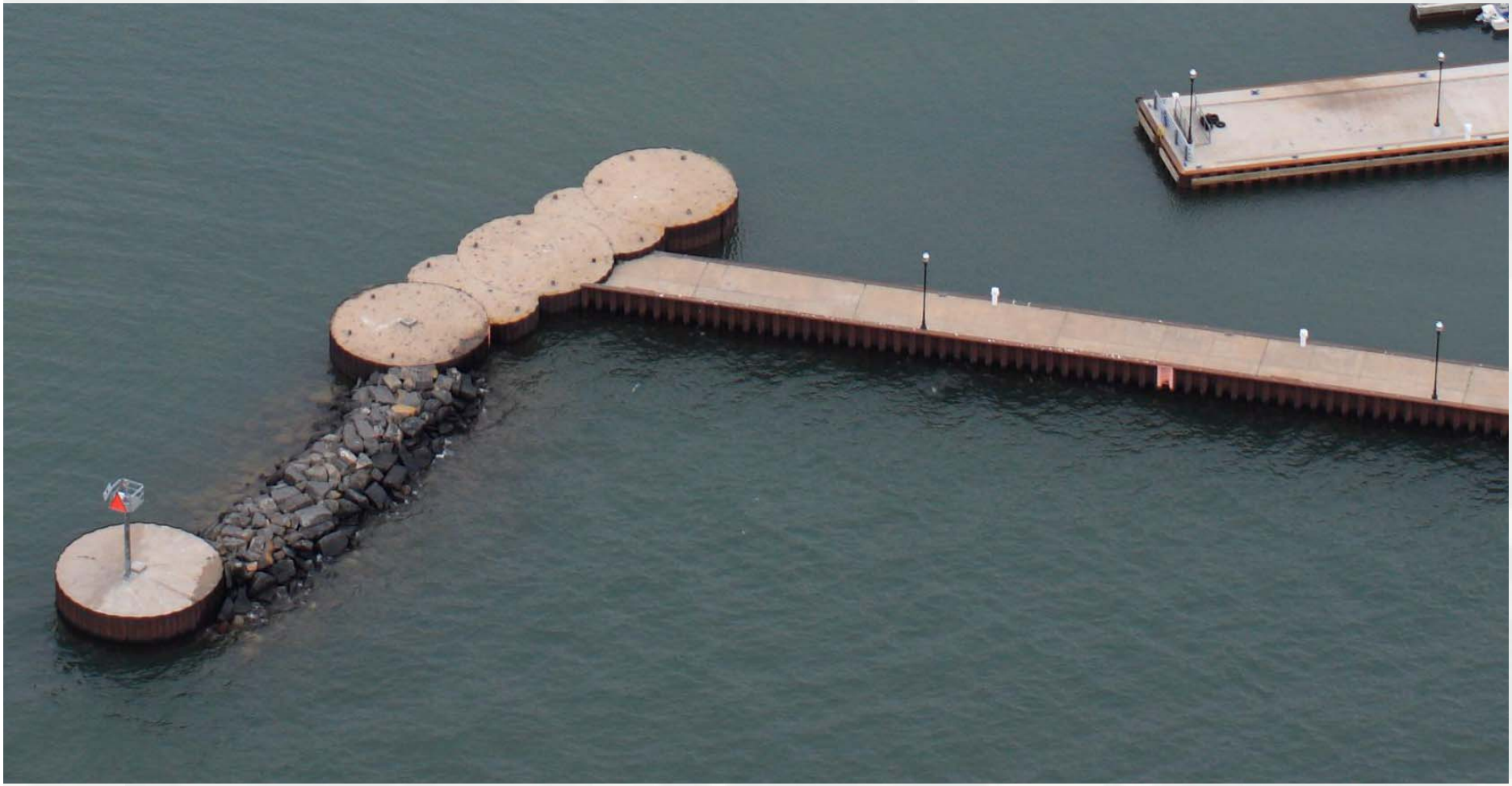
Bayfield Harbor:
B – Low Risk of Failure

Bayfield Harbor –

South breakwater

Bayfield Harbor –

North breakwater



Bayfield Harbor –

Evidence of some cracking and spalling on the SSP cells at the ends of the north and south city breakwater piers

Bayfield Harbor –

Evidence of some cracking and spalling on the SSP cells at the ends of the north and south city breakwater piers

Bayfield Harbor

City has made repairs to breakwaters in the last few years.

Bayfield Harbor:

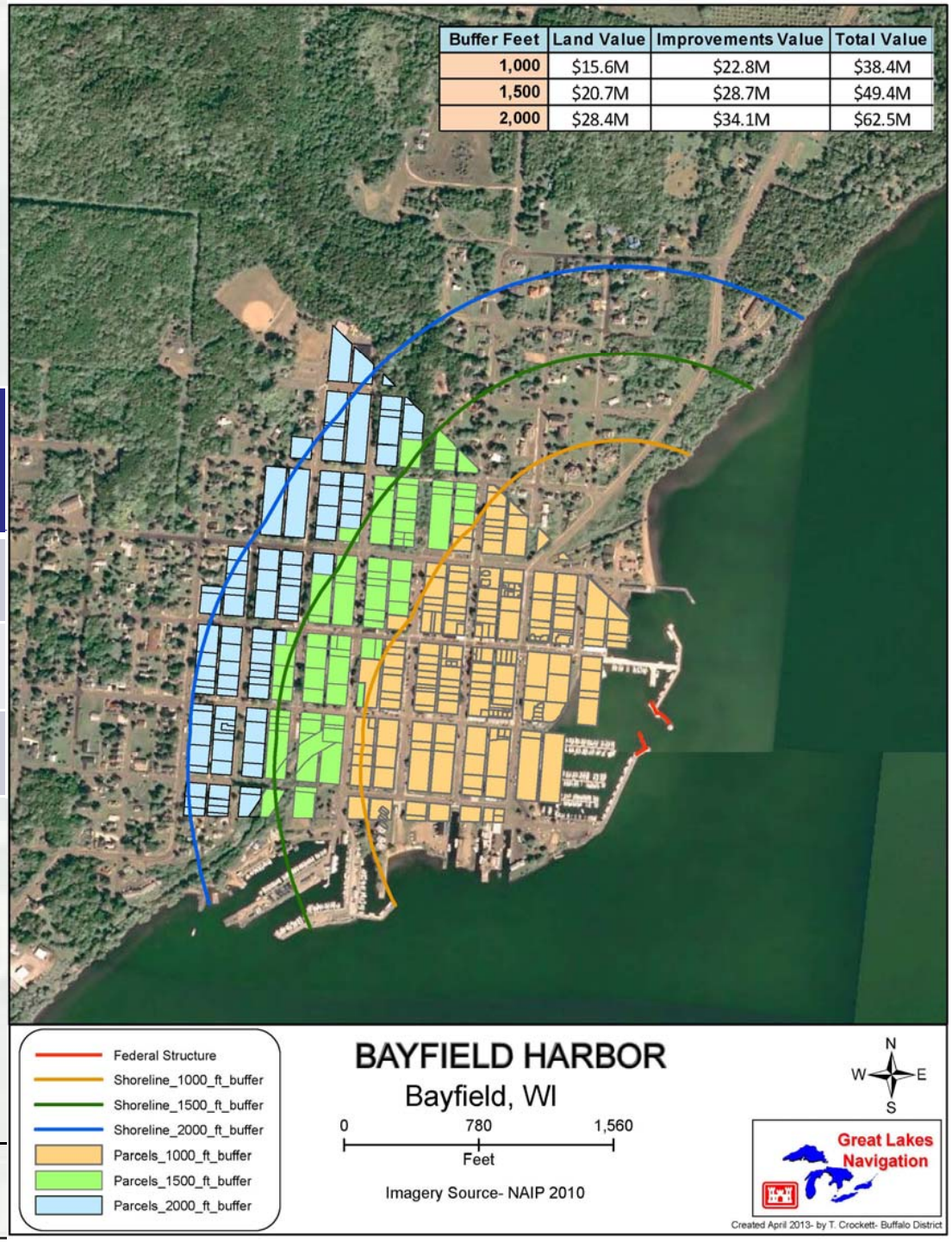
Infrastructure:

1. Apostle Island Marina
2. Madeline Island Ferry Line
3. Apostle Islands Cruise Service

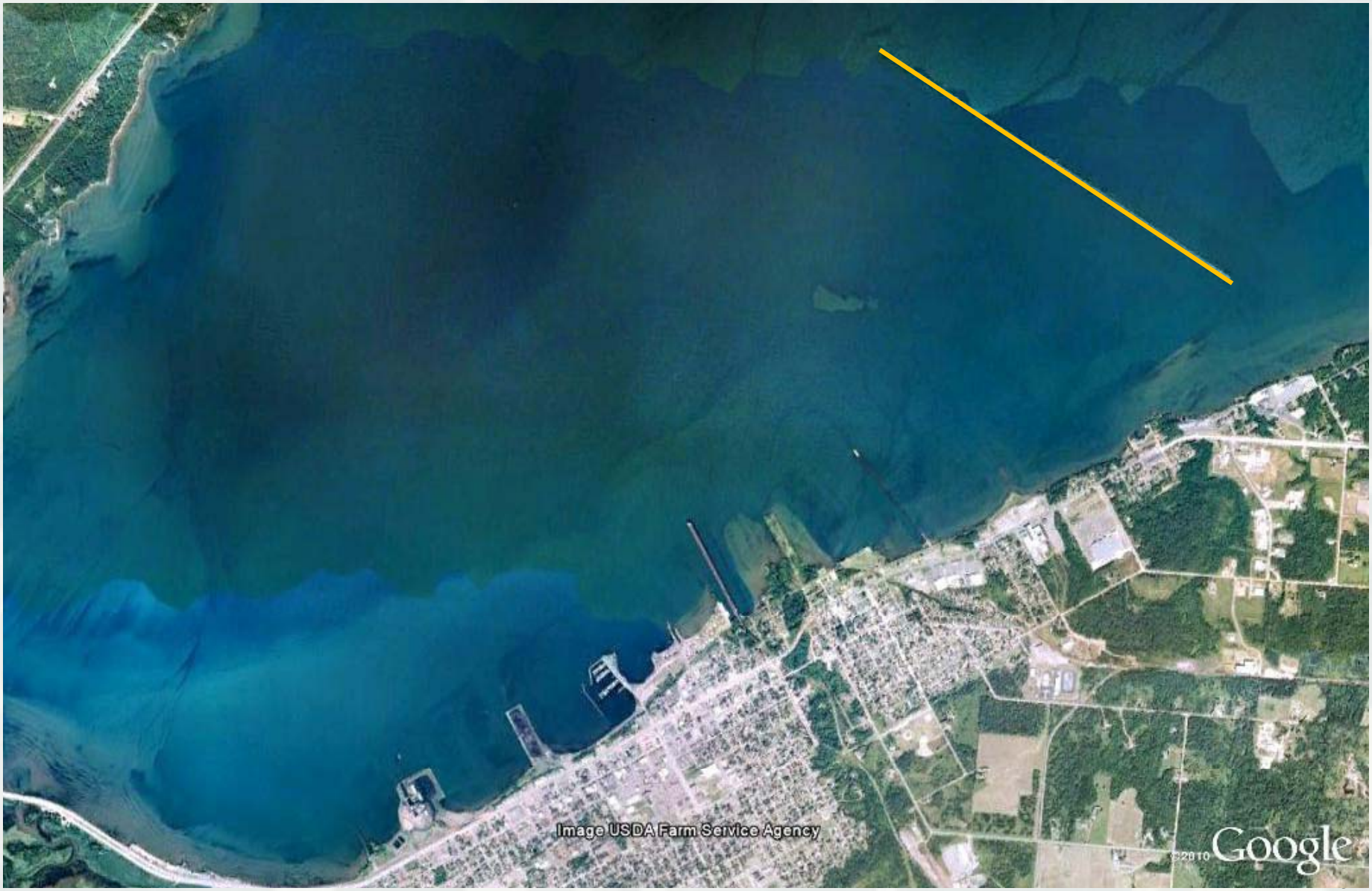
Bayfield Harbor:

Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	$15.6M	$22.8M	$38.4M
1,500	$20.7M	$28.7M	$49.4M
2,000	$28.4M	$34.1M	$62.5M



Ashland Harbor:
C – Medium Risk of Failure



Ashland Harbor –

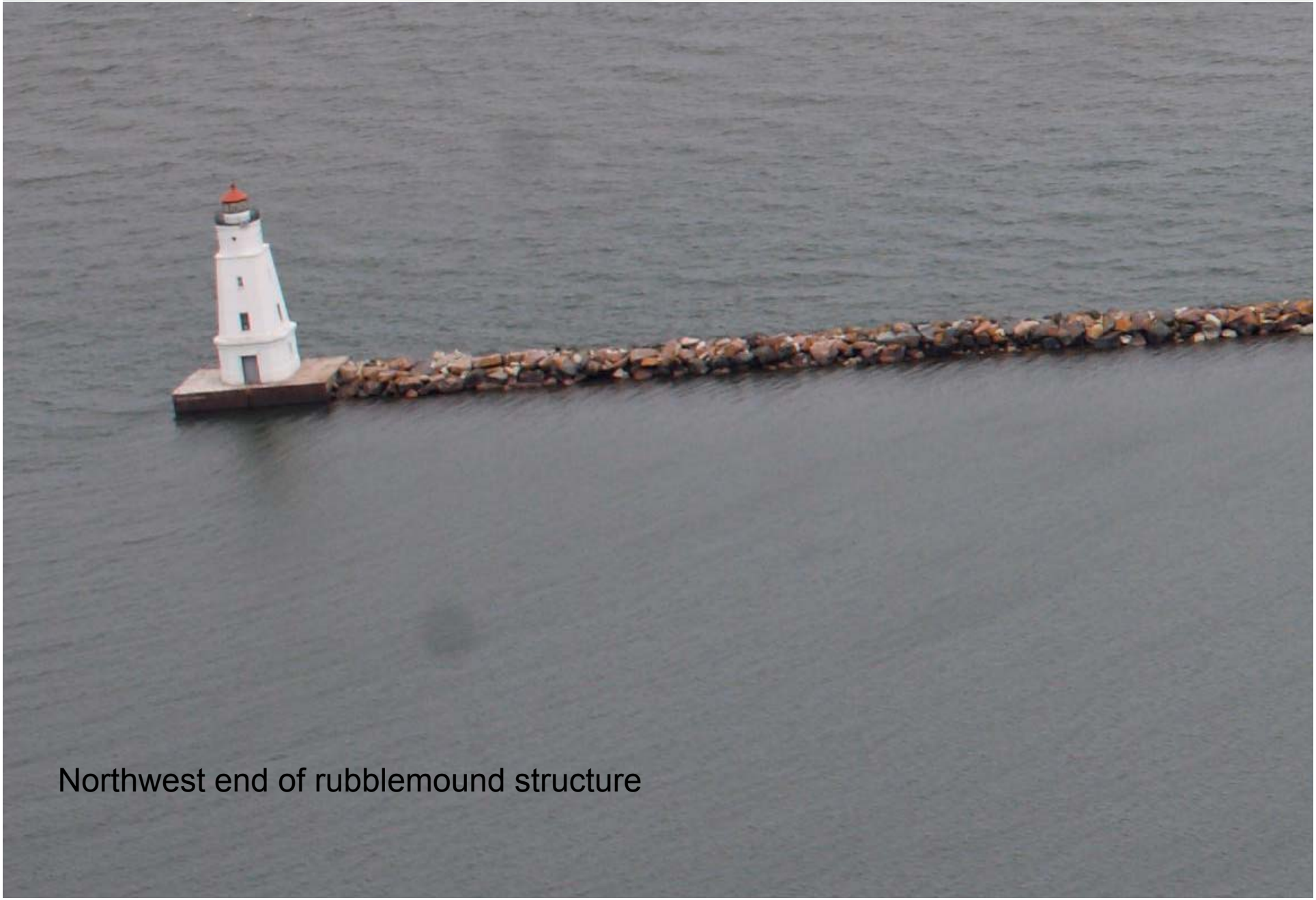
Voids under top armor stone, crib exposed. Sporadic areas where breaching appears likely in the future.

Armor slope varies significantly throughout the reach.

Ashland Harbor –

Repaired 1800 ft of Breakwater.
Placed 8500 Tons of Armor 1 Stone.

Ashland Harbor –



Asland Harbor:

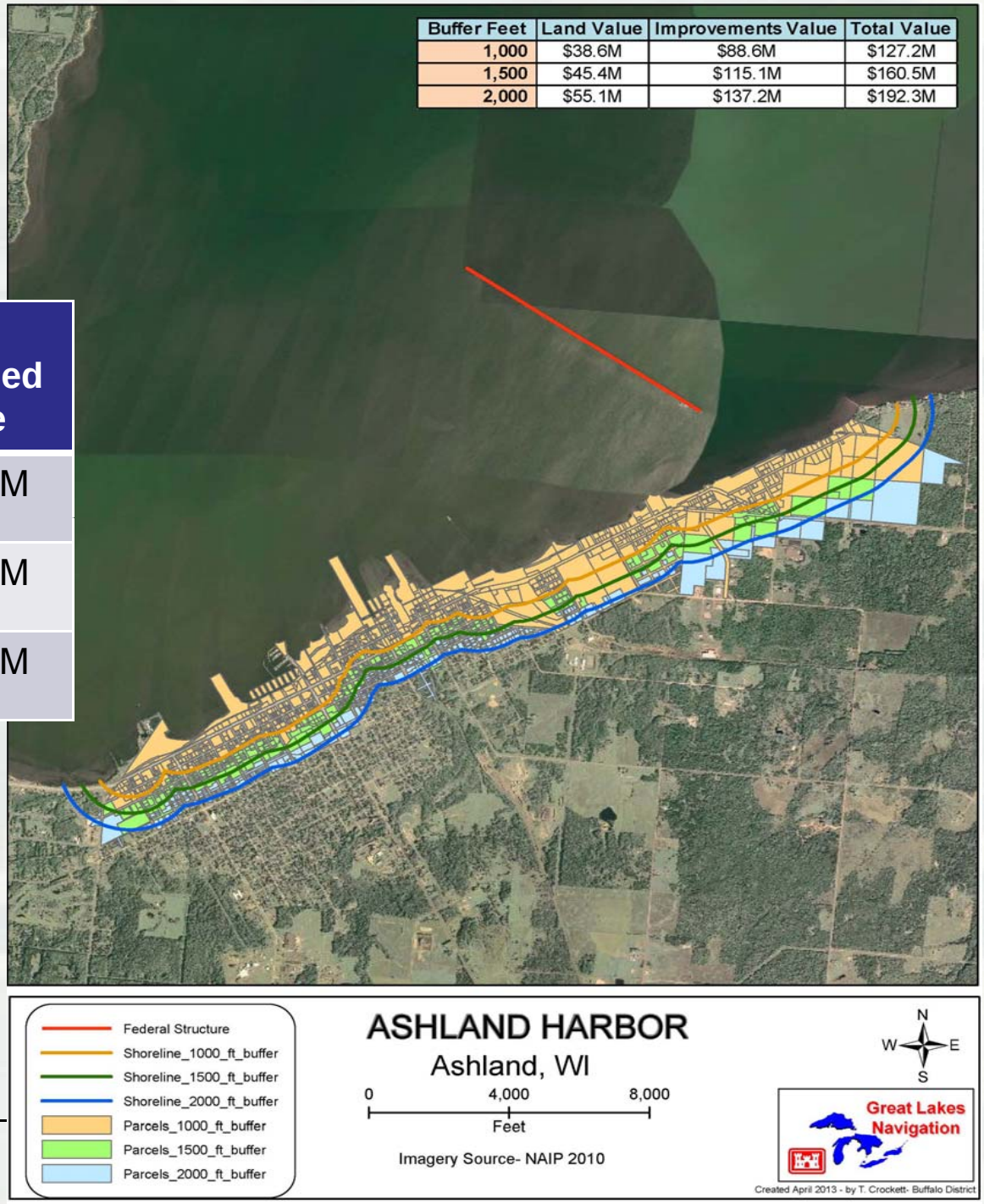
Infrastructure:

1. Ashland Marina
2. Xcel Energy
3. C. Reiss Coal Company
4. Ashland Toyota
5. Kreher Park

Ashland Harbor:

Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	$38.6M	$88.6M	$127.2M
1,500	$45.4M	$115.1M	$160.5M
2,000	$55.1M	$137.2M	$192.3M



Saxon Harbor:

B – Low Risk of Failure

Saxon Harbor:

East Rubblemound breakwater

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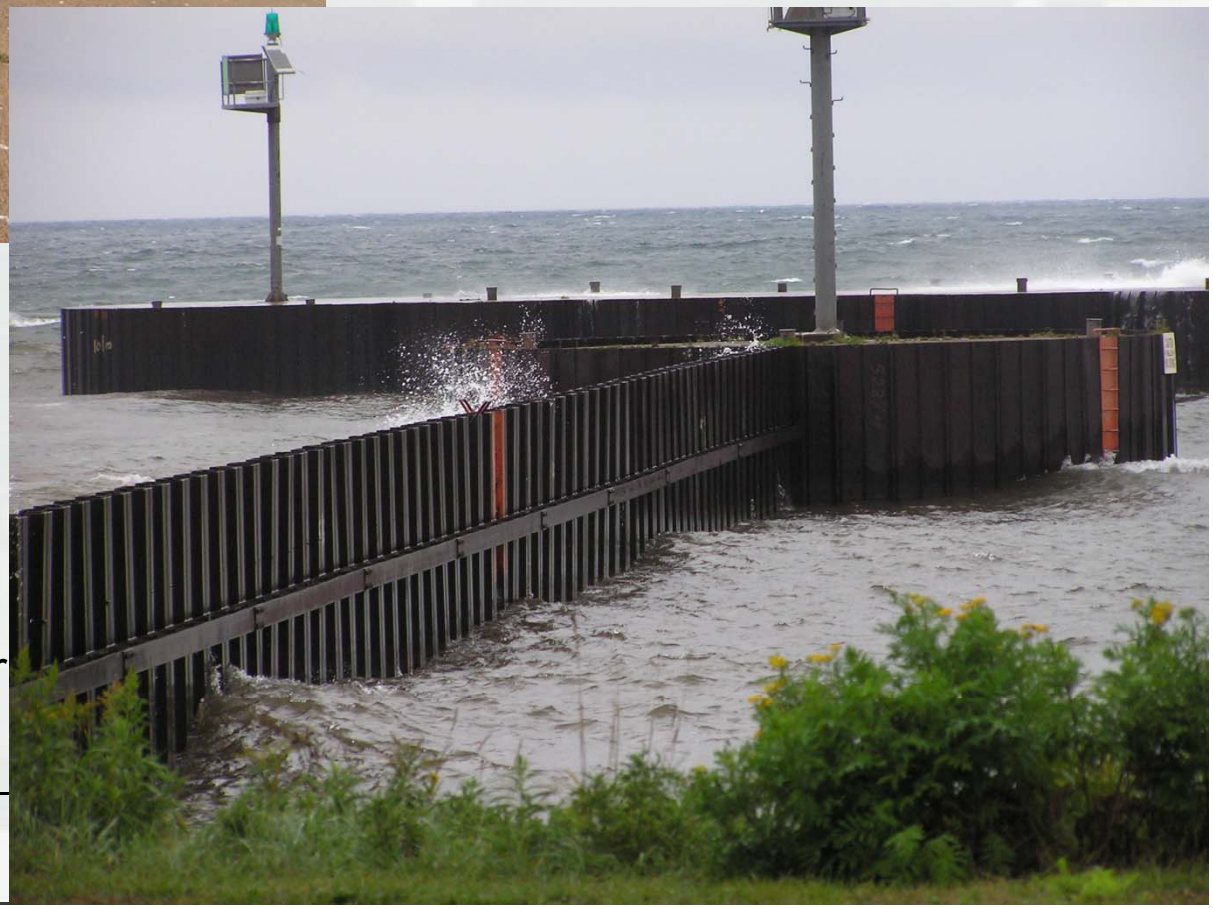
Saxon Harbor:

East breakwater



West breakwater

Saxon Harbor:

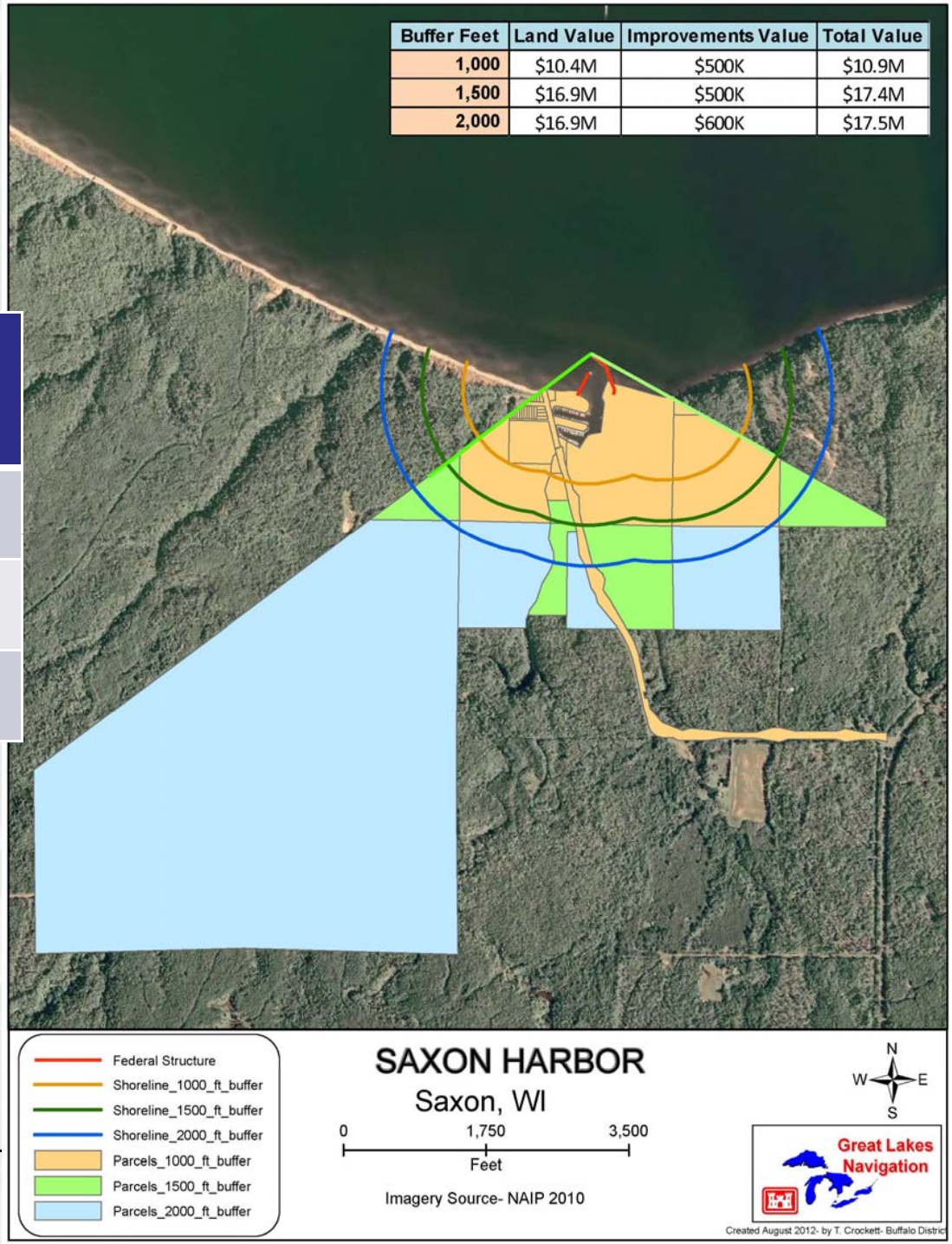
Infrastructure:

1. Saxon Harbor Marina
2. Charter Boat Operations
3. Iron County Park

Saxon Harbor:

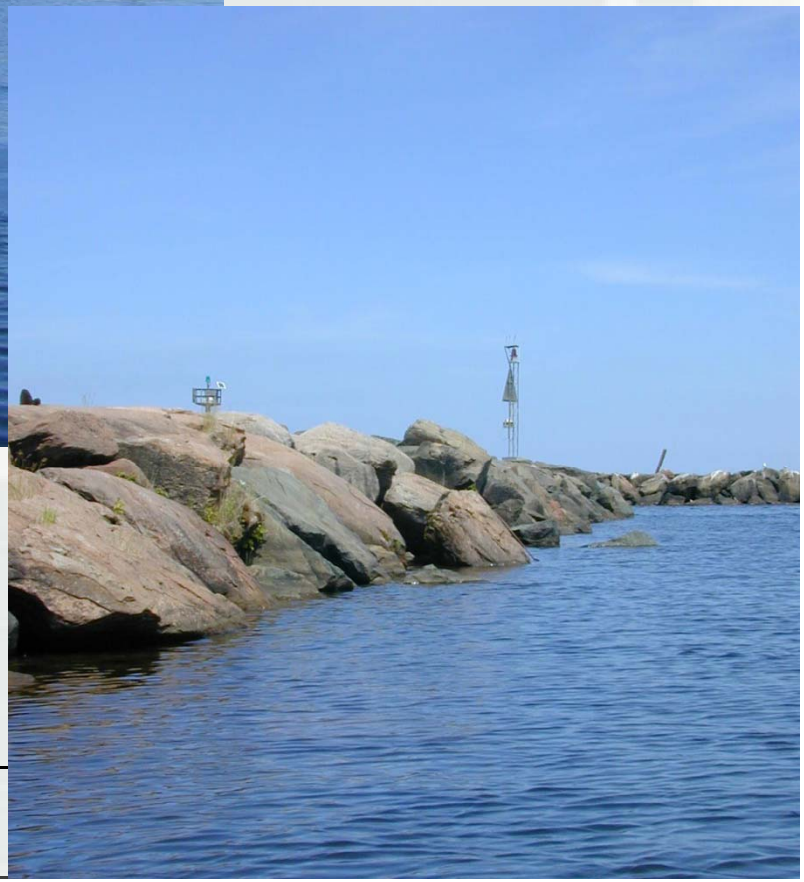
Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	$10.4M	$500K	$10.9M
1,500	$16.9M	$500K	$17.4M
2,000	$16.9M	$600K	$17.5M



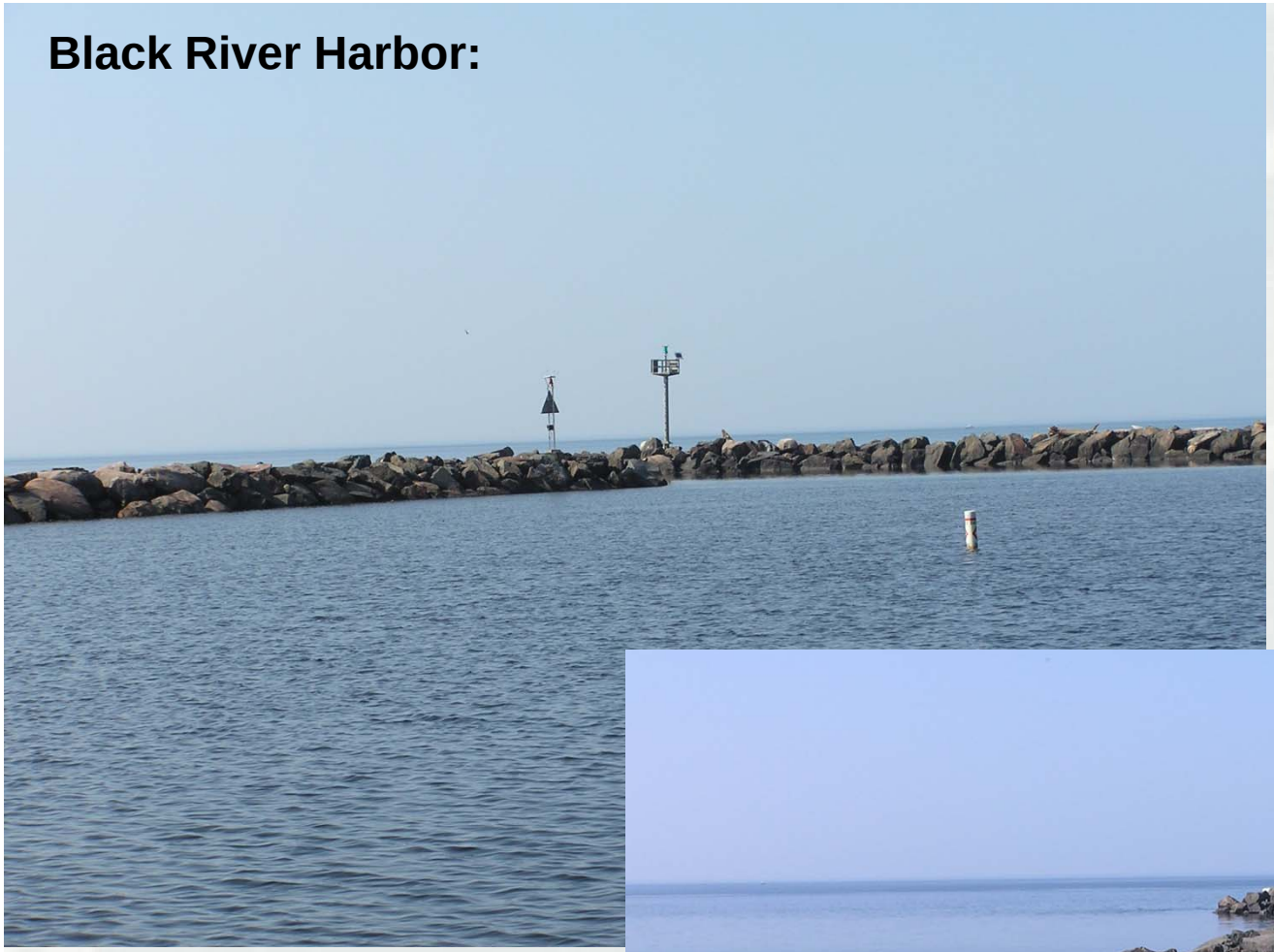
Black River Harbor:
B – Low Risk of Failure

Black River Harbor:



East Breakwater has several armor stones which have been displaced, and should be re-set on the wall.

Black River Harbor:



Breakwater shows signs of slippage of armor stones and vegetation present on structure

Black River Harbor:

Infrastructure:

1. Black River Marina

Black River Harbor:

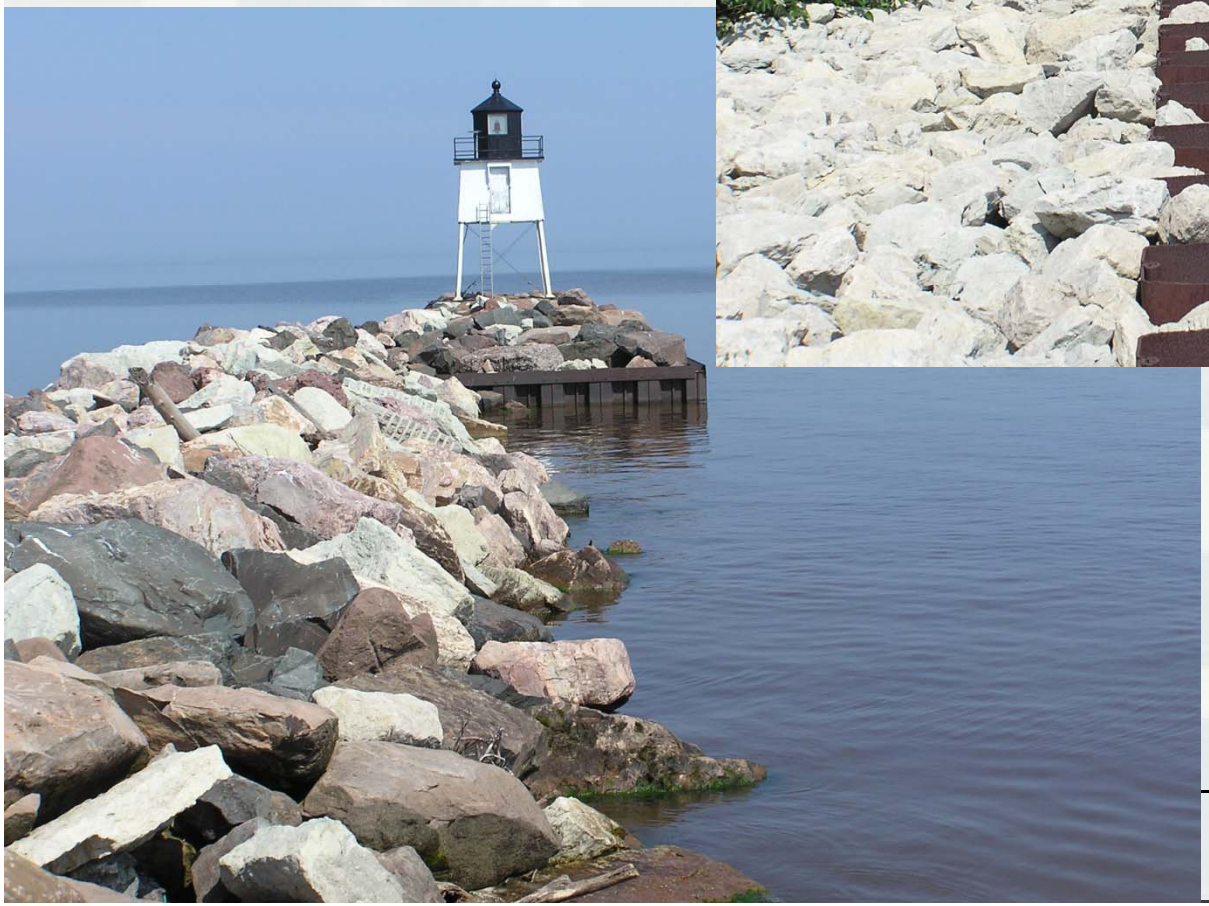
Potential Impact Areas

Ontonagon Harbor:
B – Low Risk of Failure

Ontonagon Harbor:

All sections have been rebuilt in recent years, except for section D. All sections in “B” rated condition

Ontonagon Harbor:



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Ontonagon Harbor:

Infrastructure:

1. Ontonagon Lighthouse
2. Oldenburg Group Incorporated
3. Gitche Gumee Landing
4. Ontonagon County River Front Park
5. Ontonagon Marina

Ontonagon Harbor:

Potential Impact Areas

What Can Be Done?

- Federal Funding
  - ▶ Funding request through the Federal Budget process each fiscal year
    - Contract structural repair
    - Government floating plant repair
- Local Funding
  - ▶ Mechanisms in place to accept local funding
- Transfer to State/Local Entity
  - ▶ Section 216 Process

Visit our website for more information:

www.lre.usace.army.mil/Missions/GreatLakesNavigation.aspx

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Great Lakes Navigation System

The Great Lakes navigation system is a continuous 27-foot deep draft waterway that extends from the western end of Lake Superior at Duluth, MN to the Gulf of St. Lawrence on the Atlantic Ocean, a distance of over 2,400 miles. This bi-national resource is composed of the five Great Lakes, the connecting channels of the Great Lakes, the St Lawrence River and the Gulf of St. Lawrence. The U.S. portion of the system includes 140 harbors (60 commercial; 80 recreational), two operational locks, 104 miles of breakwaters and jetties, and over 600 miles of maintained navigation channels. In addition, the GLNS is connected to several other shallow draft waterways (Illinois Waterway, New York State Barge Canal, etc.) to form an important waterborne transportation network, reaching deep into the continent.

Contact GLNAVIGATION@USACE.ARMY.MIL to submit comments or questions related to the U.S. Army Corps of Engineers' role in Great Lakes navigation.

Great Lakes Navigation System

Contact Us

To submit comments or questions related to the U.S. Army Corps of Engineers' role in Great Lakes navigation, send email to GLNAVIGATION@usace.army.mil

Navigation Info

Great Lakes Harbors Information: Click for Great Lakes Harbors Fact Sheets and Fully Functional Harbor Maps.

Structure Risk Communication Meeting: The U.S. Army Corps of Engineers Great Lakes Navigation Team is in the process of planning a series of regional meetings to initiate a dialogue with state and local officials to inform them of the current condition of coastal infrastructure and the

Budgetary and Dredging Info

Fiscal Year 2014 President's Budget

FY14 Budget Summary - for the Great Lakes Navigation Business Line (Operations & Maintenance)

FY14 President's Budget - Detailed Spreadsheet

Fiscal Year 2013 President's Budget

FY13 President's Budget - Detailed Spreadsheet

Other Navigation Info

Great Lakes Navigation Informational Pamphlets

Great Lakes Navigation System brochure (PDF) - The Great Lakes Navigation System brochure gives information on the navigation system,

Questions?