

# Coastal Structures Risk Communication Mid-Northern Michigan Harbors

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Detroit District

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US Army Corps of Engineers  
**BUILDING STRONG**®



# Introduction and Agenda

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## **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



# Coastal Structures

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## 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





# Typical Coastal Structures

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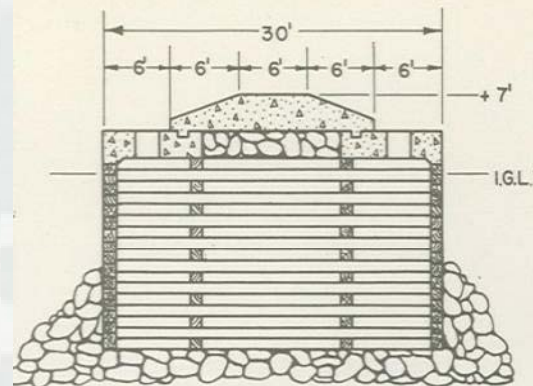
Steel Sheet  
Pile  
Structures



Rubble  
Mound/Laid-Up  
Stone Structures



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



Typical Wood  
Crib/ Concrete  
Cap Structures  
Cross-section



# Structure Function/Consequences

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**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

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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

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- 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

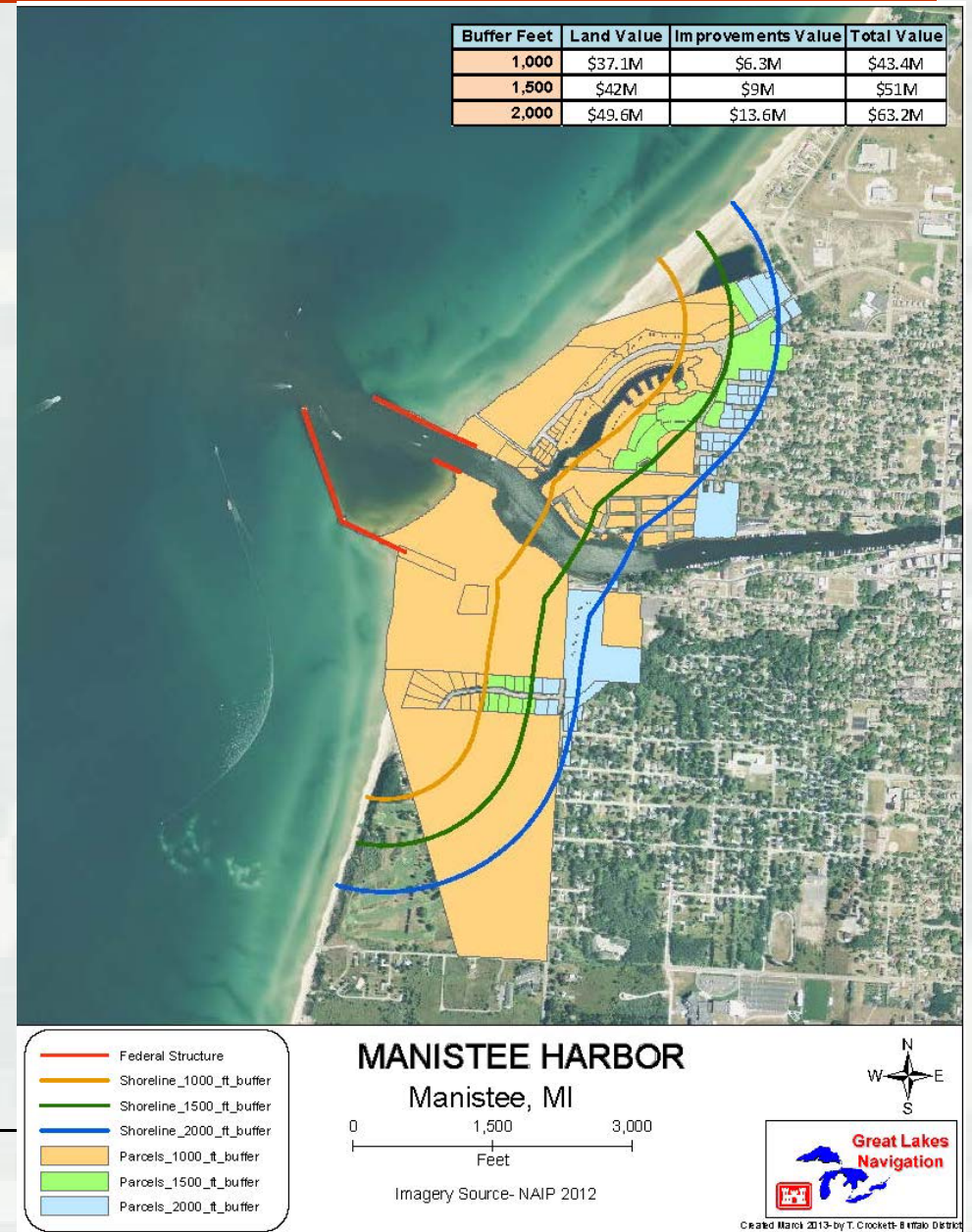
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- **HARBOR LOCATION**
- **PROJECT DESCRIPTION**
  - Authorization, harbor type (commercial or recreational), length of breakwater structures and channel
- **DATE OF SITE VISIT**
- **SUMMARY OF STRUCTURES**
  - Lists all structures and facilities that 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



# Harbor Structure Condition Assessments

Average of Overall Condition

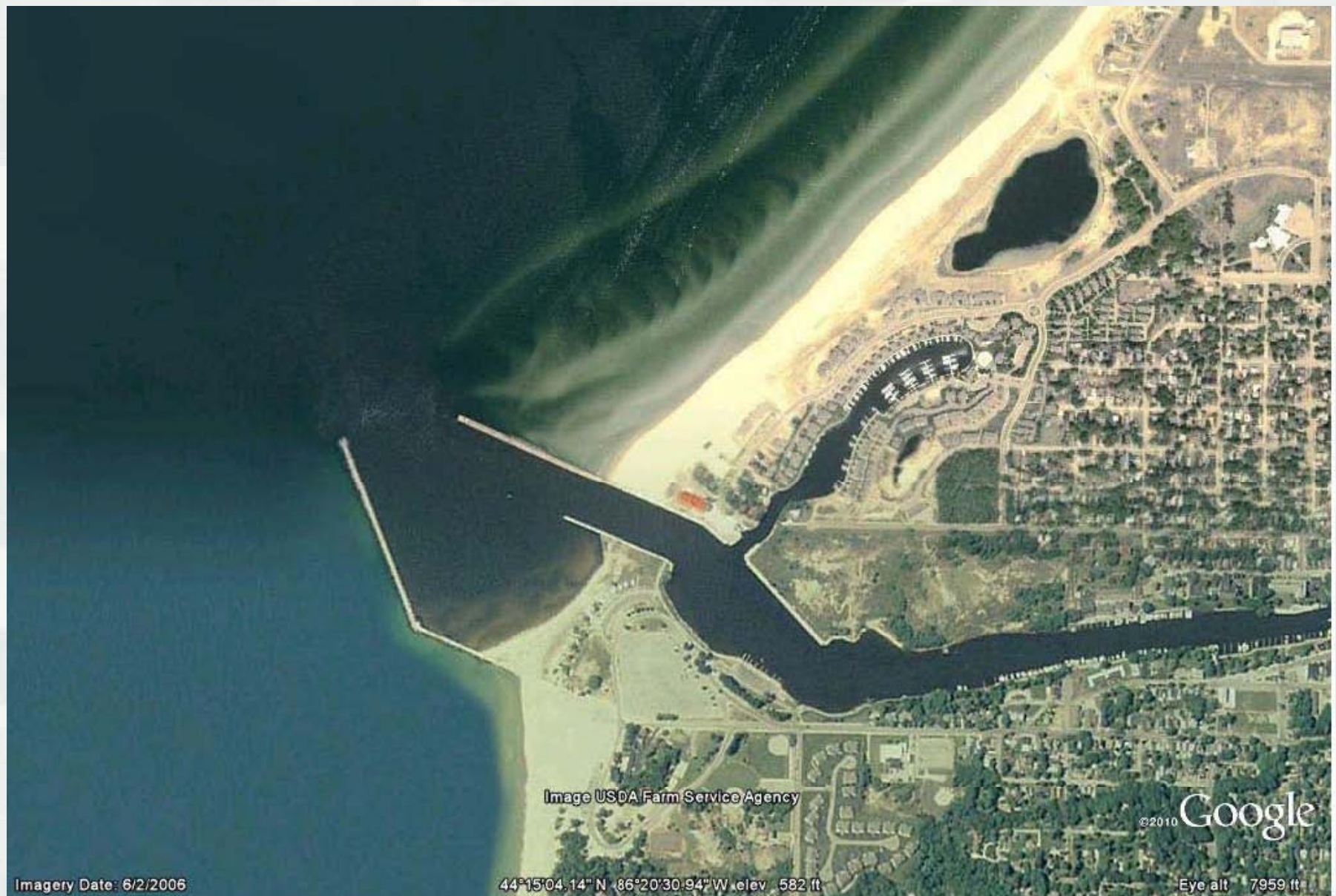


# Harbors of “Mid-Northern” Michigan





## Manistee Harbor: B – Low Risk of Failure





## Manistee Harbor – North Breakwater & Pier



Cracks, Fractures & spalling are most evident at the SSP pans and ladders. Caulk and backer rod is completely gone at most expansion joints.

Some repairs have been made in past 15 years.





## Manistee Harbor – S. Breakwater

Heavy Spalling, chipping and cracking is increasing at and side slopes on concrete cap. Loss of crib stone is sign of timber crib damage. The crib is exposed with low water levels.



Boat strike. S.S.P. damage, sections of the railing bent



## Manistee Harbor – S. Breakwater

Riprap stone on lake side is displaced and settled.





# Manistee Harbor:

## Infrastructure:

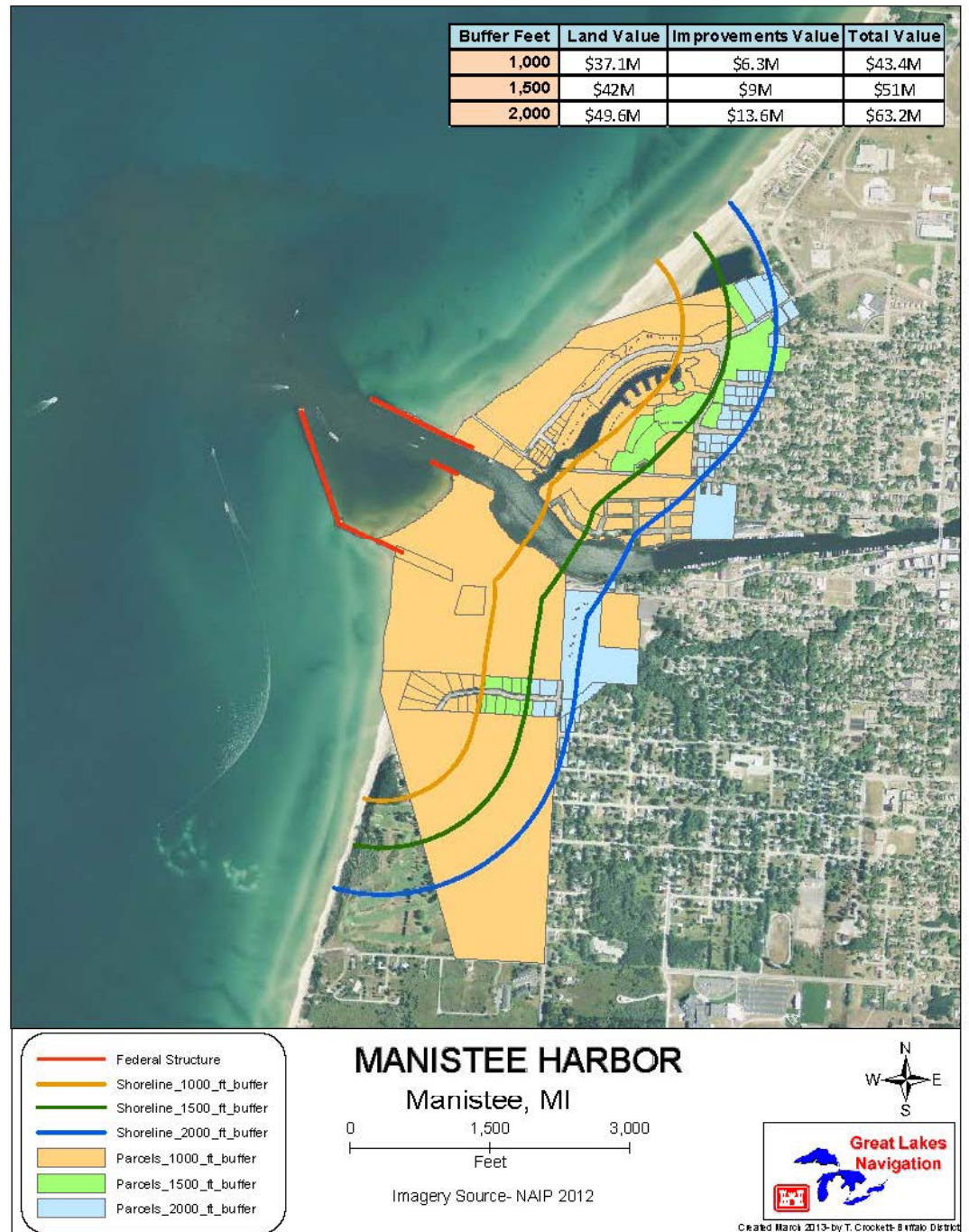
1. Douglas Park
2. Fifth Avenue Beach
3. United States Coast Guard – Manistee Station
4. Harbor Village
5. Boardwalk
6. River front houses
7. Ship Watch Condominiums and Lake Ridge Landings



# Manistee Harbor:

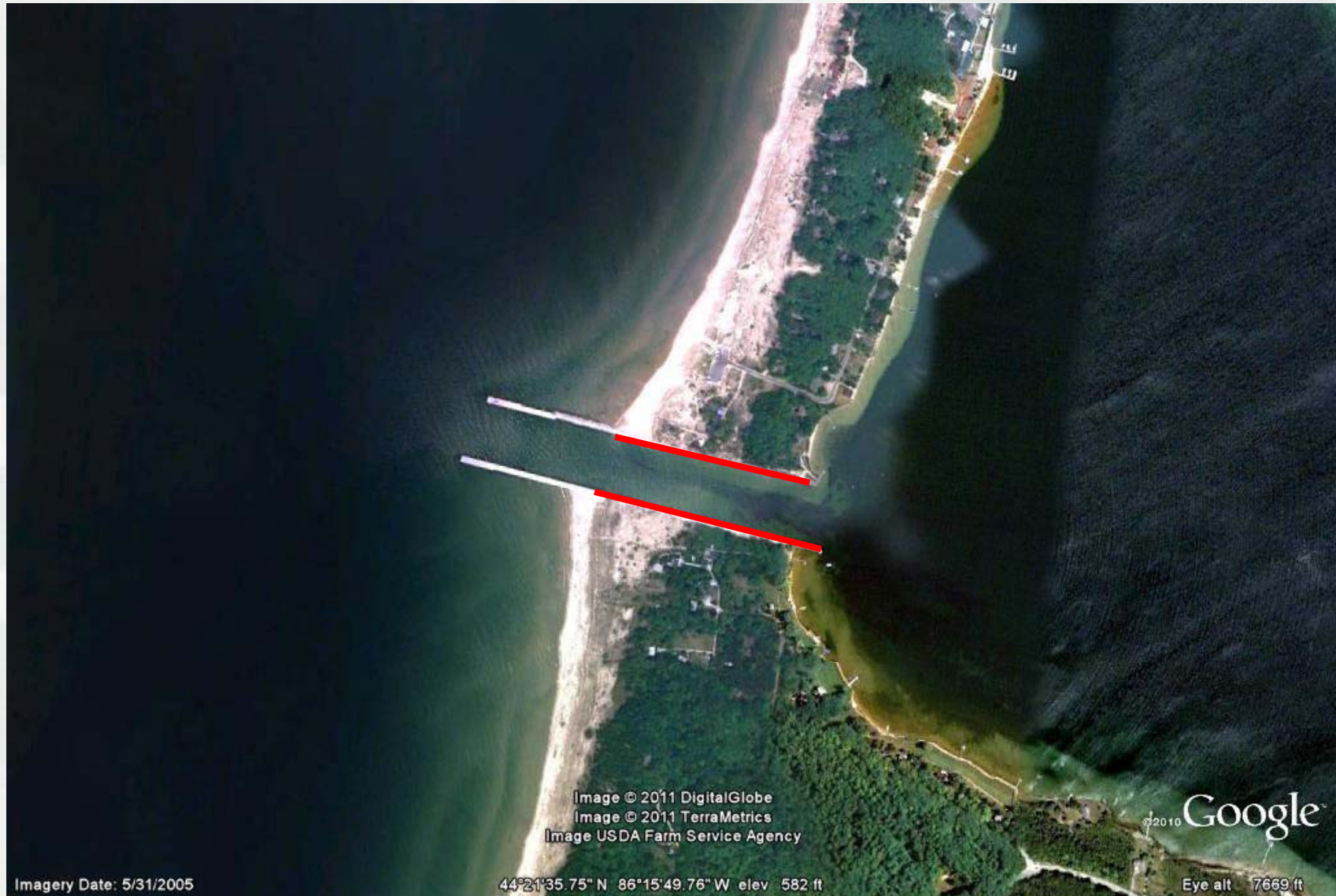
## Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	\$37.1M	\$6.3M	\$43.4M
1,500	\$42M	\$9M	\$51M
2,000	\$49.6M	\$13.6M	\$63.2M





## Portage Lake Harbor: D – High Risk of Failure





## Portage Lake Harbor – Southside revetment



Backfill stone has been replenished, but there are still many signs of undermining of substructure





**Portage Lake Harbor** – Low water has exposed the timber crib, Backfill material migrating under the revetment and with the tilting wall indicates at least some of the timber cribbing has failed or is at near failure condition.





## Portage Lake Harbor –

The entire wall is tilting to the north. There is block misalignment and settlement in areas.



← The concrete cap has spalling that is increasing



# Portage Lake Harbor:

## Infrastructure:

1. Crescent Beach Court Houses (residential)
2. 2<sup>nd</sup> Street houses (residential)
3. Portage Point Inn
4. Village of Onekama

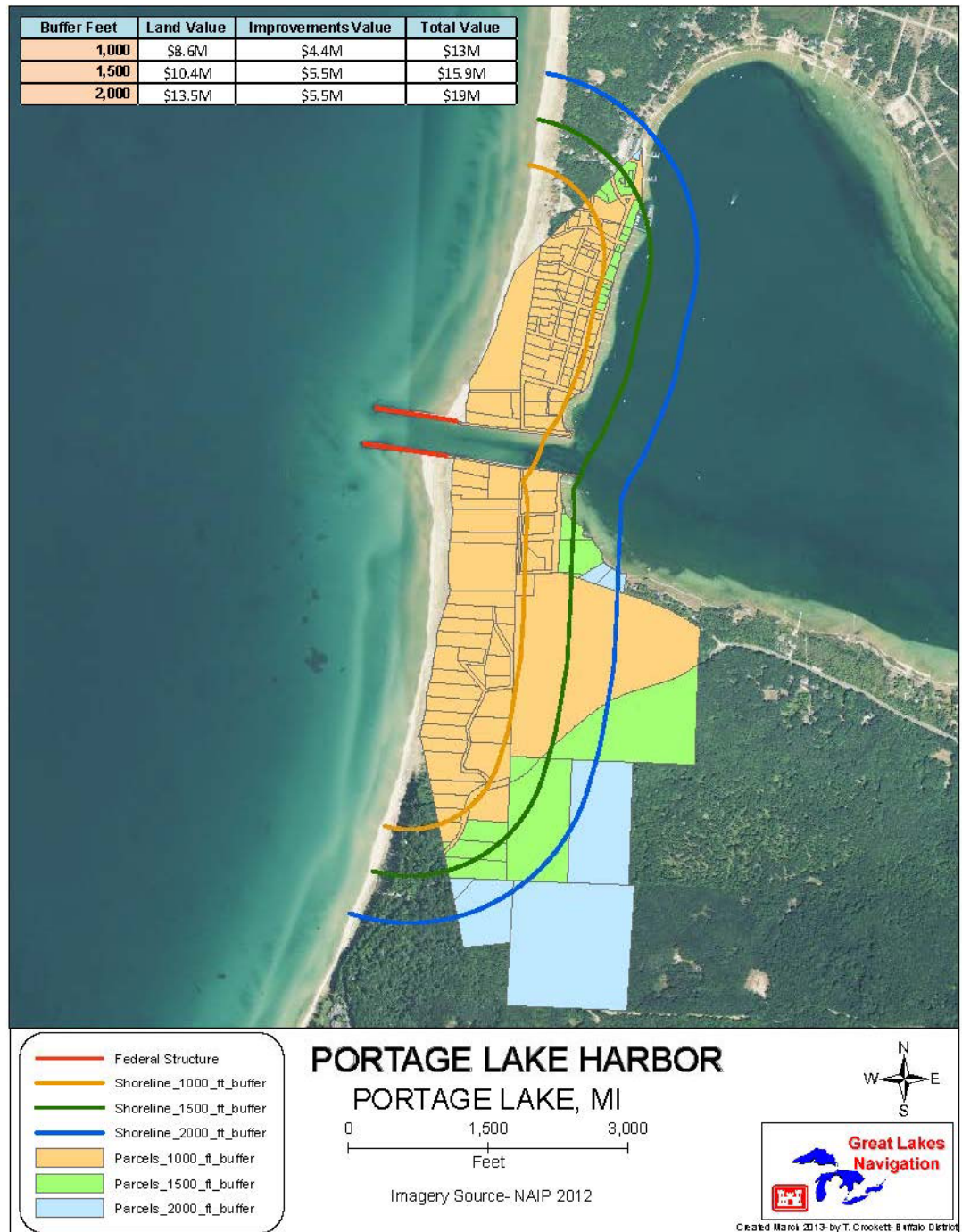




# Portage Lake Harbor:

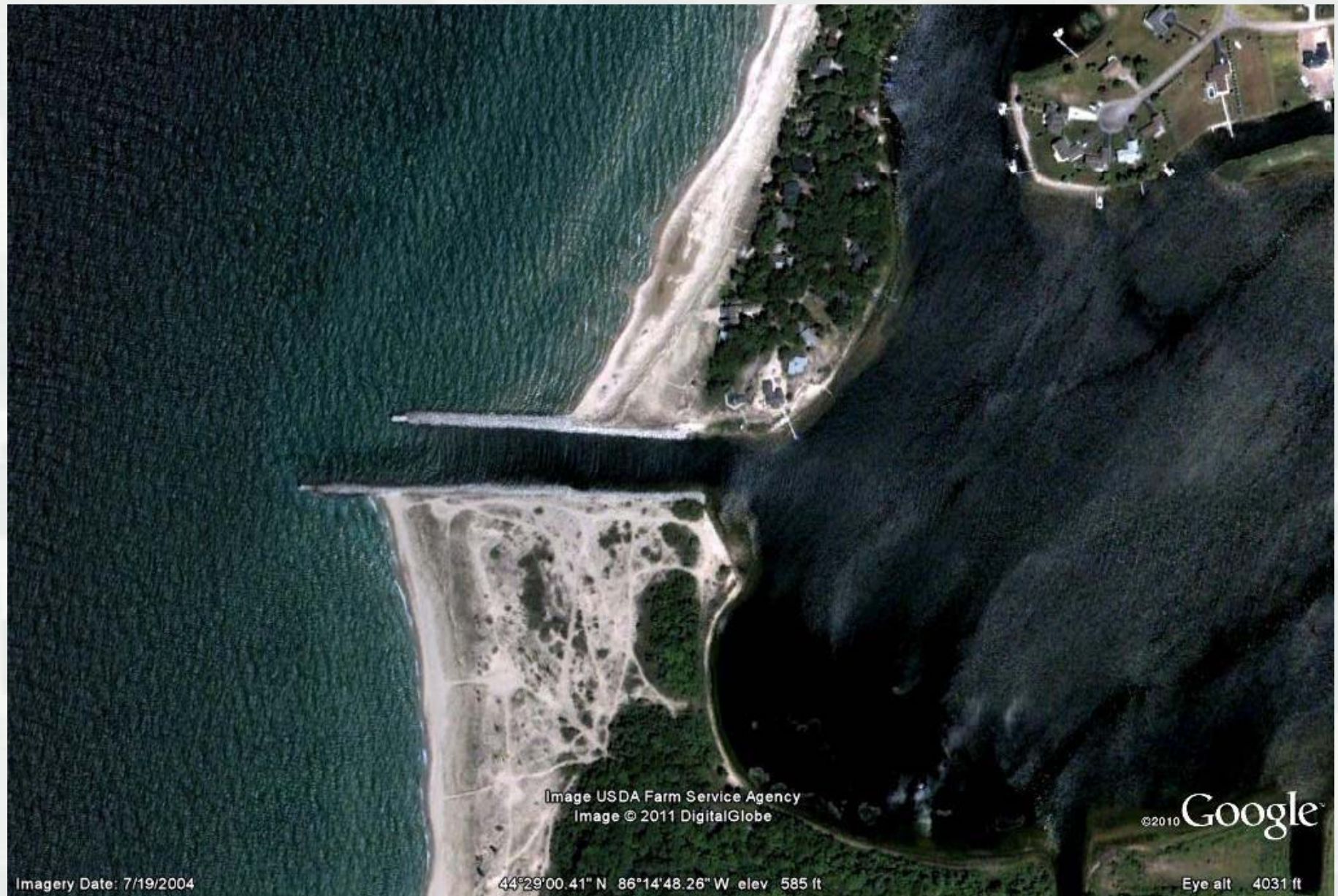
## Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	\$8.6M	\$4.4M	\$13M
1,500	\$10.4M	\$5.5M	\$15.9M
2,000	\$13.5M	\$5.5M	\$19M





## Arcadia Harbor: B – Low Risk of Failure





## Arcadia Harbor --

-Some stone settlement on  
the channel side

-Chinking stone should be  
added to secure the armor



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## Arcadia Harbor --

Vegetation growing along portions of the structure



# Arcadia Harbor:

## Infrastructure:

1. Houses and undeveloped land
2. Starkey Road houses (residential)
3. Arcadia Beach Natural Area
4. Michigan Highway 22

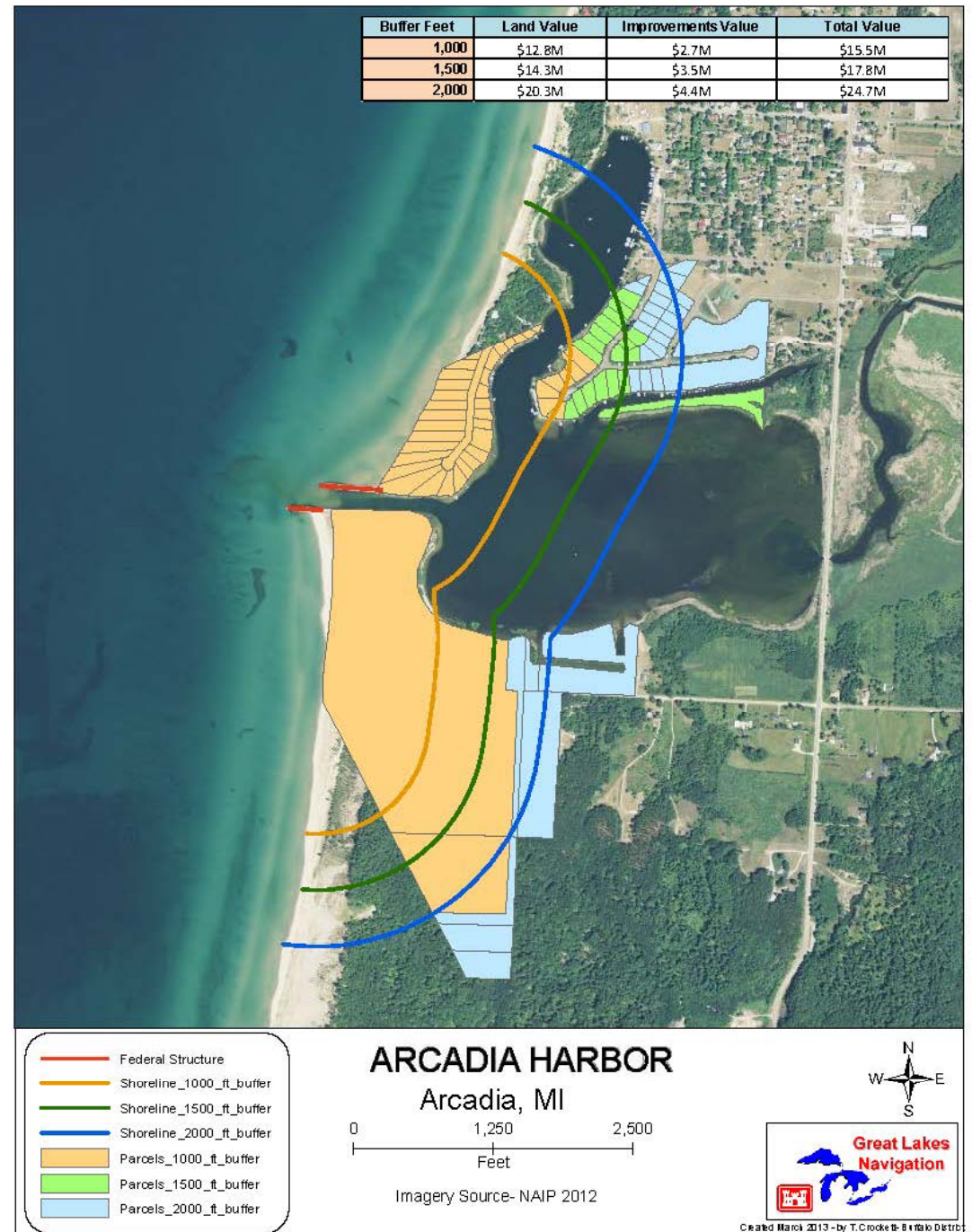




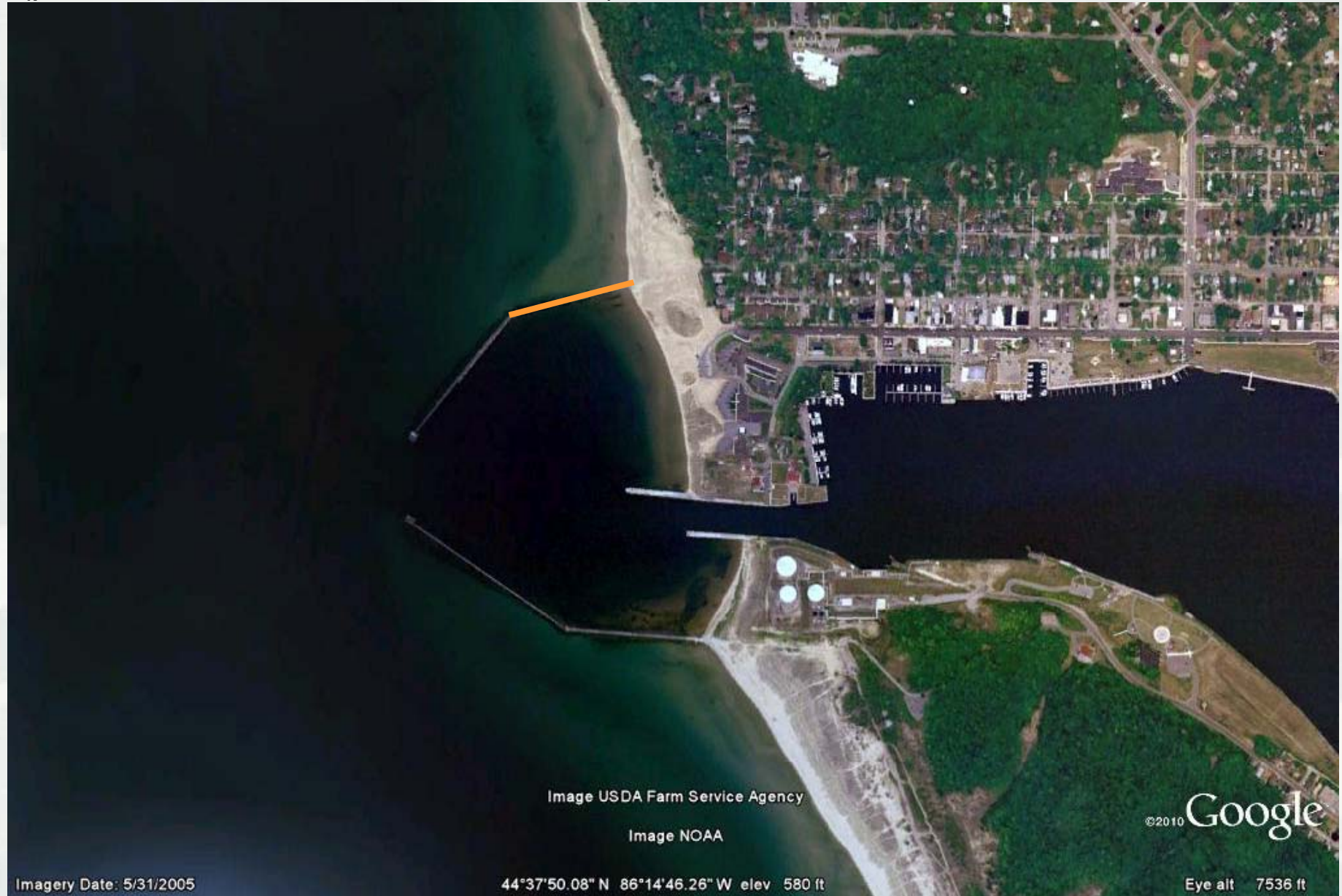
# Arcadia Harbor:

## Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	\$12.8M	\$2.7M	\$15.5M
1,500	\$14.3M	\$3.5M	\$17.8M
2,000	\$20.3M	\$4.4M	\$24.7M



**Frankfort Harbor:**  
B – Low Risk of Failure  
(portion of North connector rated a 'C')





## Frankfort Harbor – North Breakwater



Heavy cracking ;  
some completely  
through the concrete  
block

Ladders need  
paint; ladders  
have all rungs, a  
few bent rungs at  
water level from  
ice.







## Frankfort Harbor – North Breakwater

Heavy cracking. Severe chipping at block edge, rounded corners with re-rod exposed, numerous areas of spalling.

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## Frankfort Harbor – North Connector



- Some timber crib headers are missing at basin side. Tie rods are broken and are visible hanging out of the crib.
- No riprap on either side of the structure.
- Settlement visible in the grouted cells (that was repaired in 2000)





## Frankfort Harbor – South Breakwater





## Frankfort Harbor – South Breakwater

Caulk failure at expansion joints in the concrete blocks is causing chipping. Water surges through block seams with minor wave action.



The seam joints need to be cleaned and resealed as grass and large weeds are growing through them.

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# Frankfort Harbor:

## Infrastructure:

1. Frankfort Public Beach
2. United States Coast Guard – Frankfort Station
3. Gold Coast Marina
4. Jacobsen Marina Resort
5. Luedkte Engineering Marine Contractor
6. Frankfort Municipal Marina
7. Benzie Shores District Library
8. City of Frankfort Park
9. City of Frankfort Beach

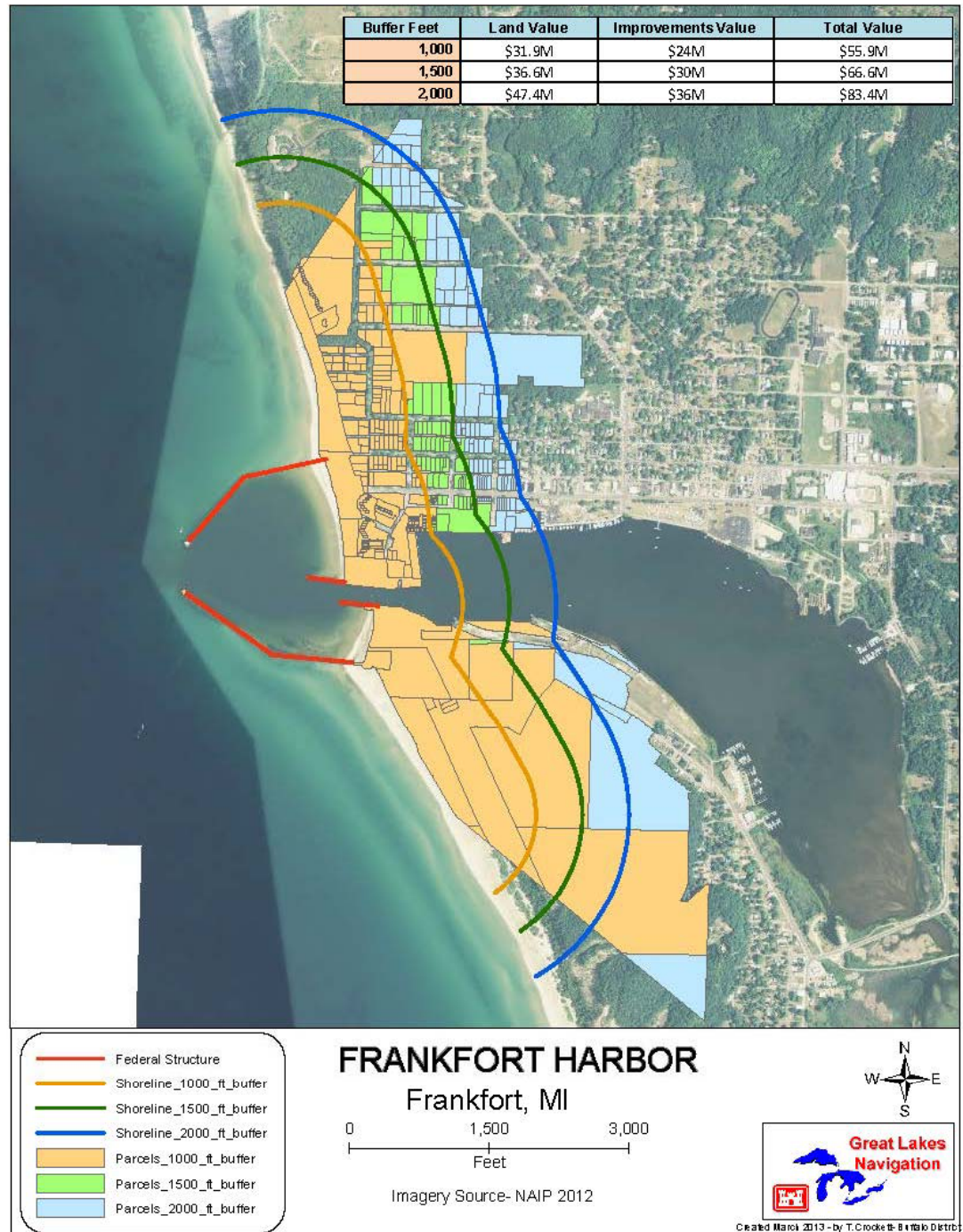




# Frankfort Harbor:

## Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	\$31.9M	\$24M	\$55.9M
1,500	\$36.6M	\$30M	\$66.6M
2,000	\$47.4M	\$36M	\$83.4M





## Greilickville Harbor: B – Low Risk of Failure

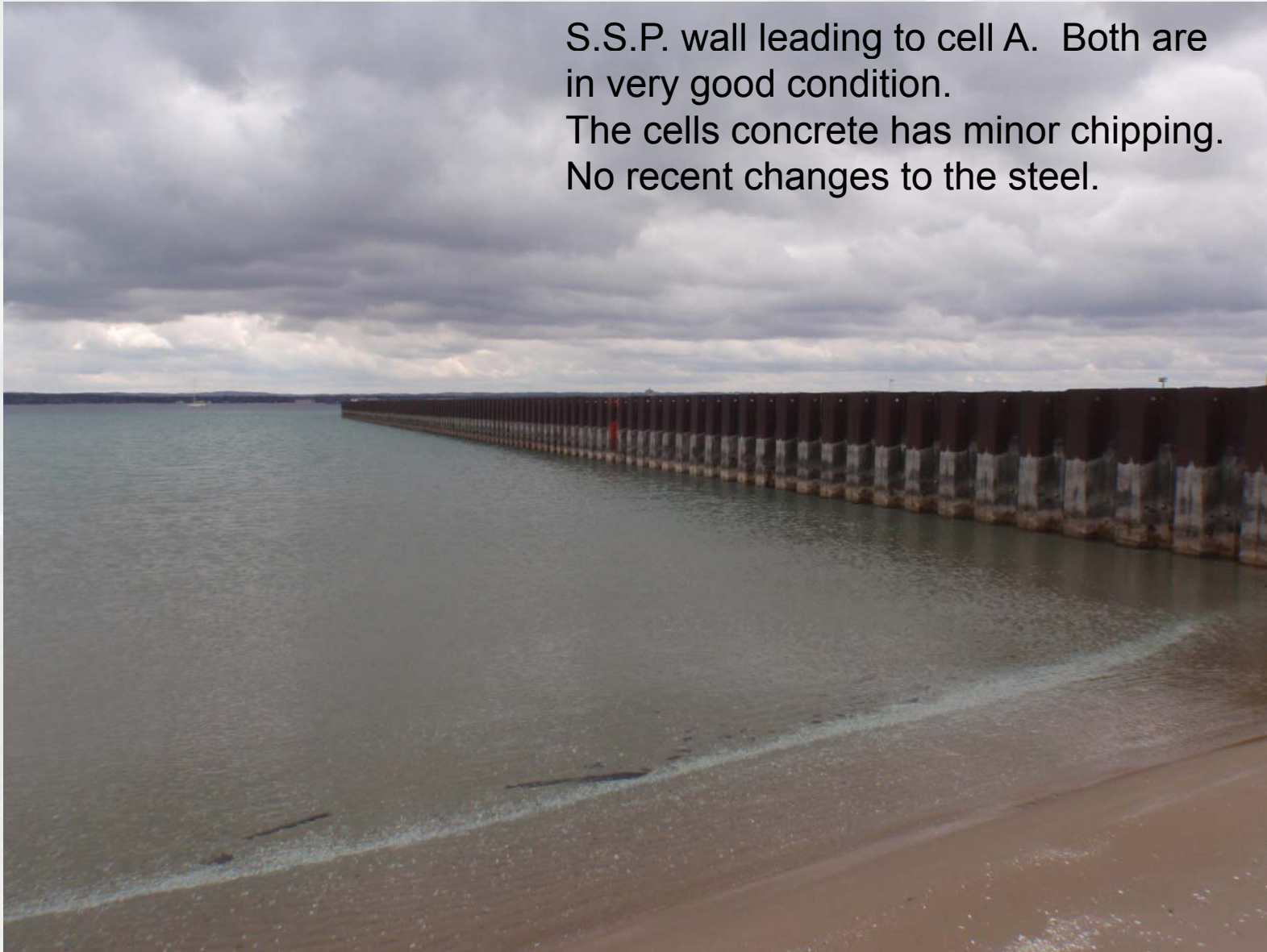




## Greilickville Harbor:



## Greilickville Harbor:



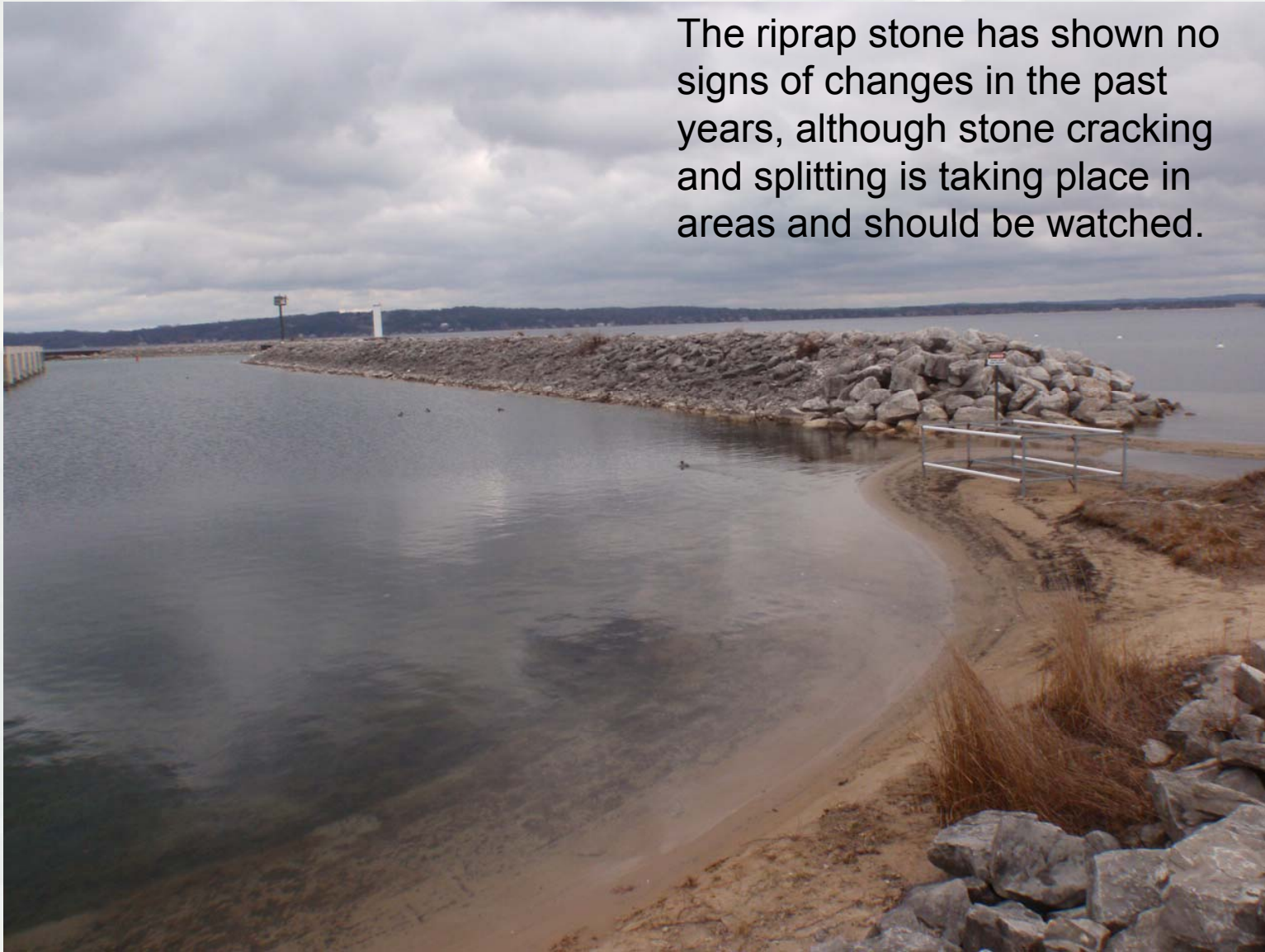
S.S.P. wall leading to cell A. Both are in very good condition. The cells concrete has minor chipping. No recent changes to the steel.





## Greilickville Harbor:

The riprap stone has shown no signs of changes in the past years, although stone cracking and splitting is taking place in areas and should be watched.



# Greilickville Harbor:

## Infrastructure:

1. Harbor West Yacht Club
2. Bay Breeze Yacht Sales
3. Elmwood Municipal Marina

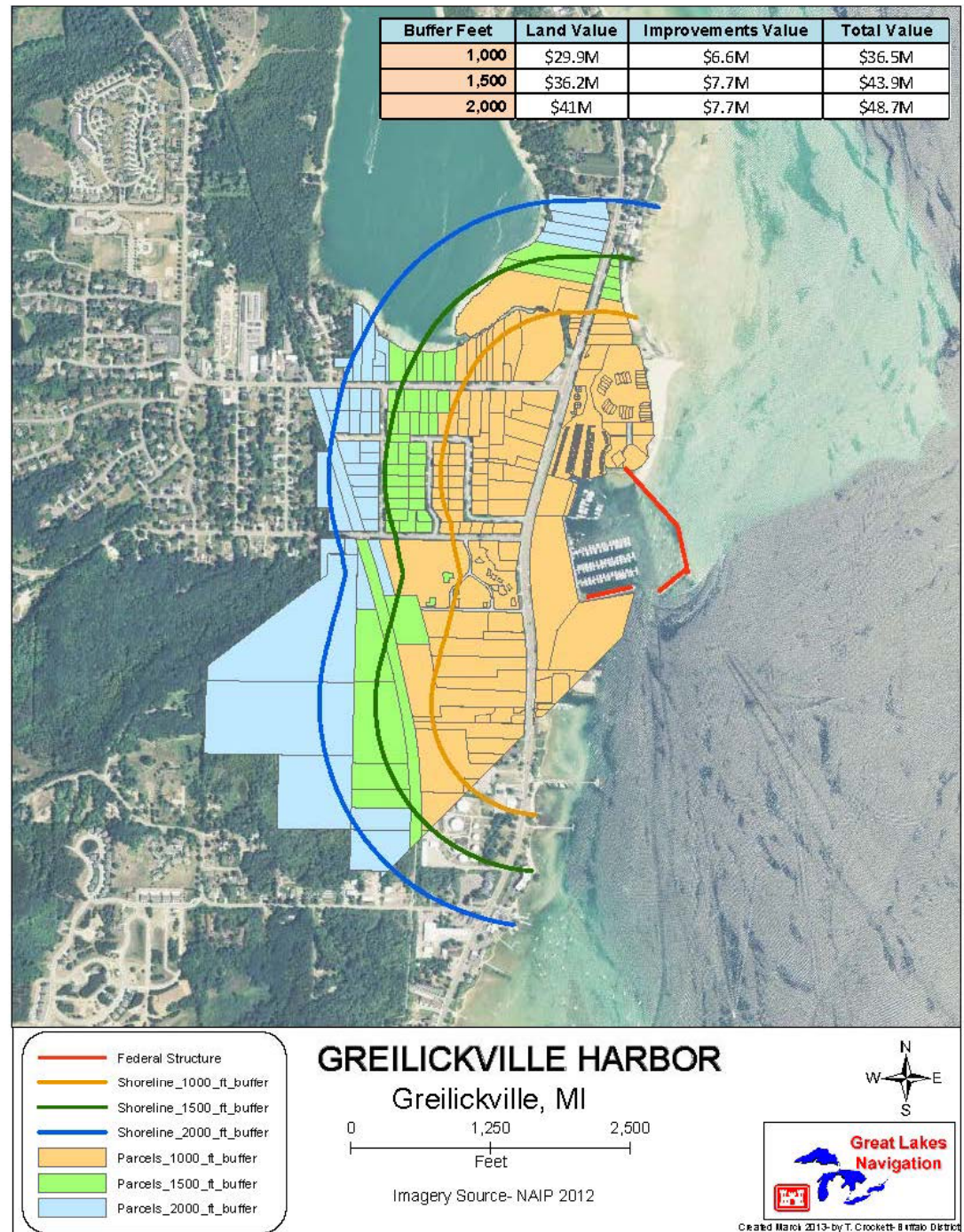




# Greilickville Harbor:

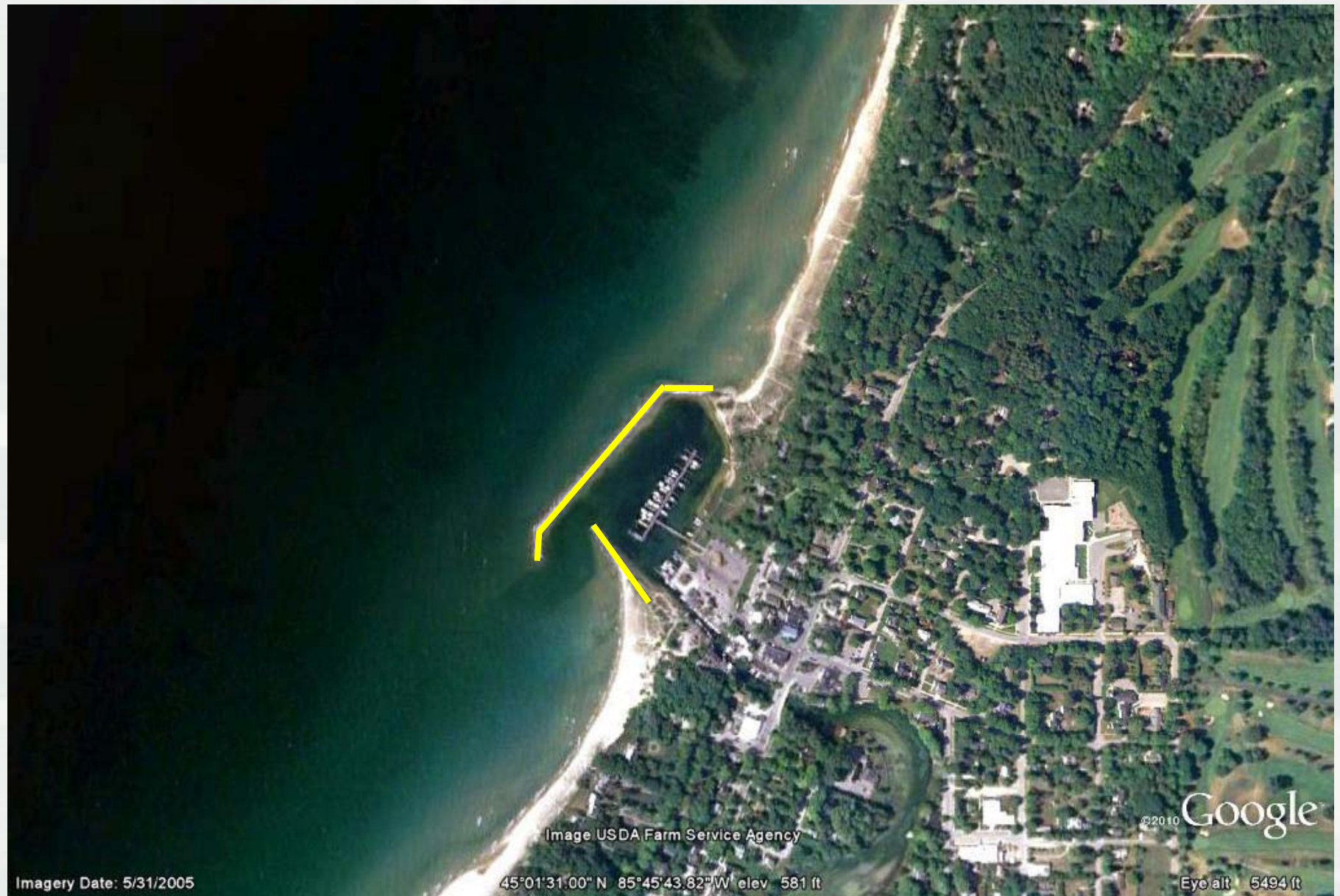
## Potential Impact Areas

Buffer Feet	Land Value	Improv .Value	Total Assessed Value
1,000	\$29.9M	\$6.6M	\$36.5M
1,500	\$36.2M	\$7.7M	\$43.9M
2,000	\$41M	\$7.7M	\$48.7M





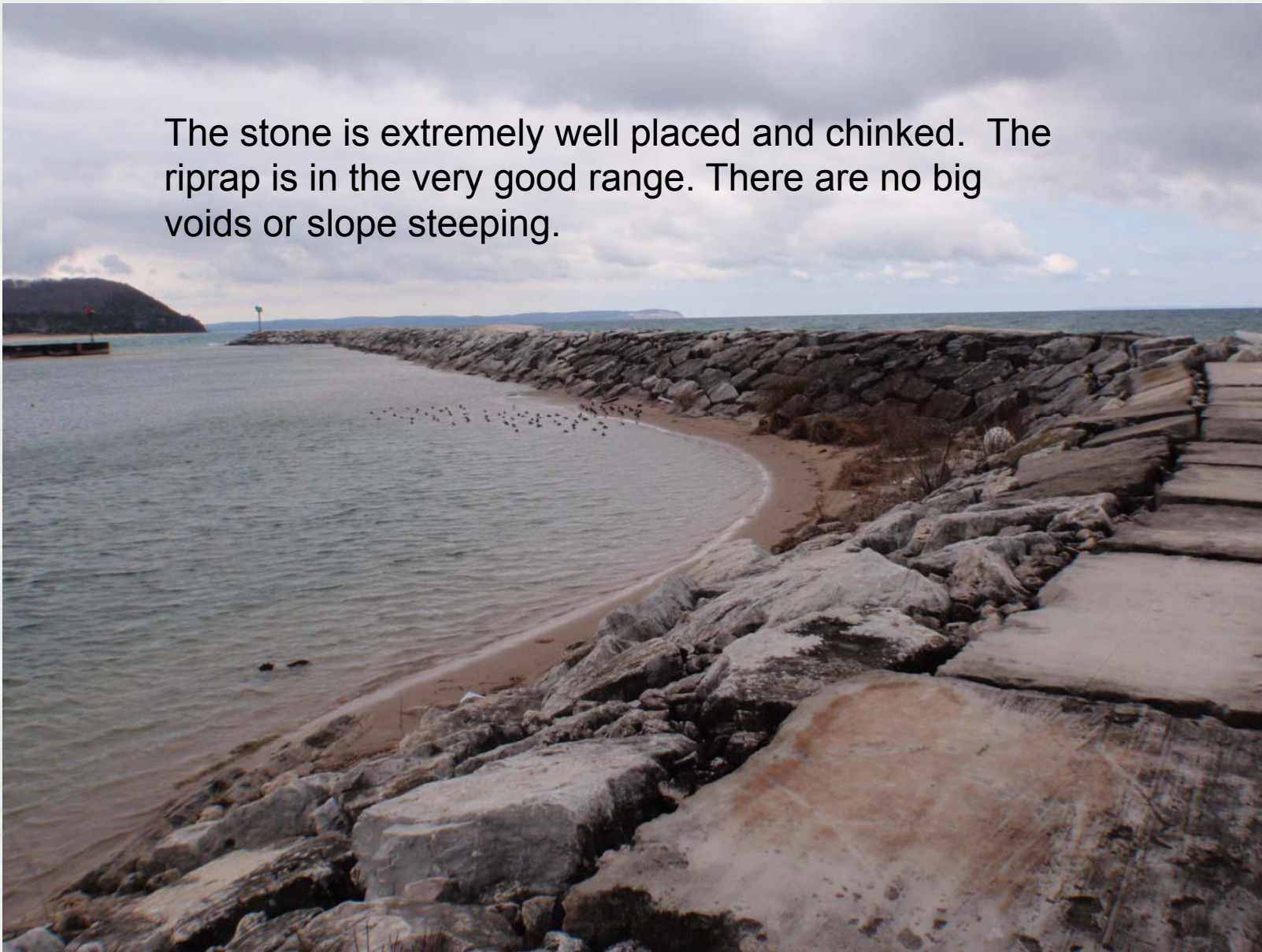
**Leland Harbor:**  
B – Low Risk of Failure





## Leland Harbor – North Rubblemound breakwater

The stone is extremely well placed and chinked. The riprap is in the very good range. There are no big voids or slope steeping.





## Leland Harbor – North Rubblemound breakwater





## Leland Harbor – South Pier



The three cells have exposed stone inside that shows slight settling since the 2007 inspection.

The stone is a bit loose, it could be replenished and use chinking.



# Leland Harbor:

## Infrastructure:

1. Leland Harbor Marina
2. Fisherman's Village

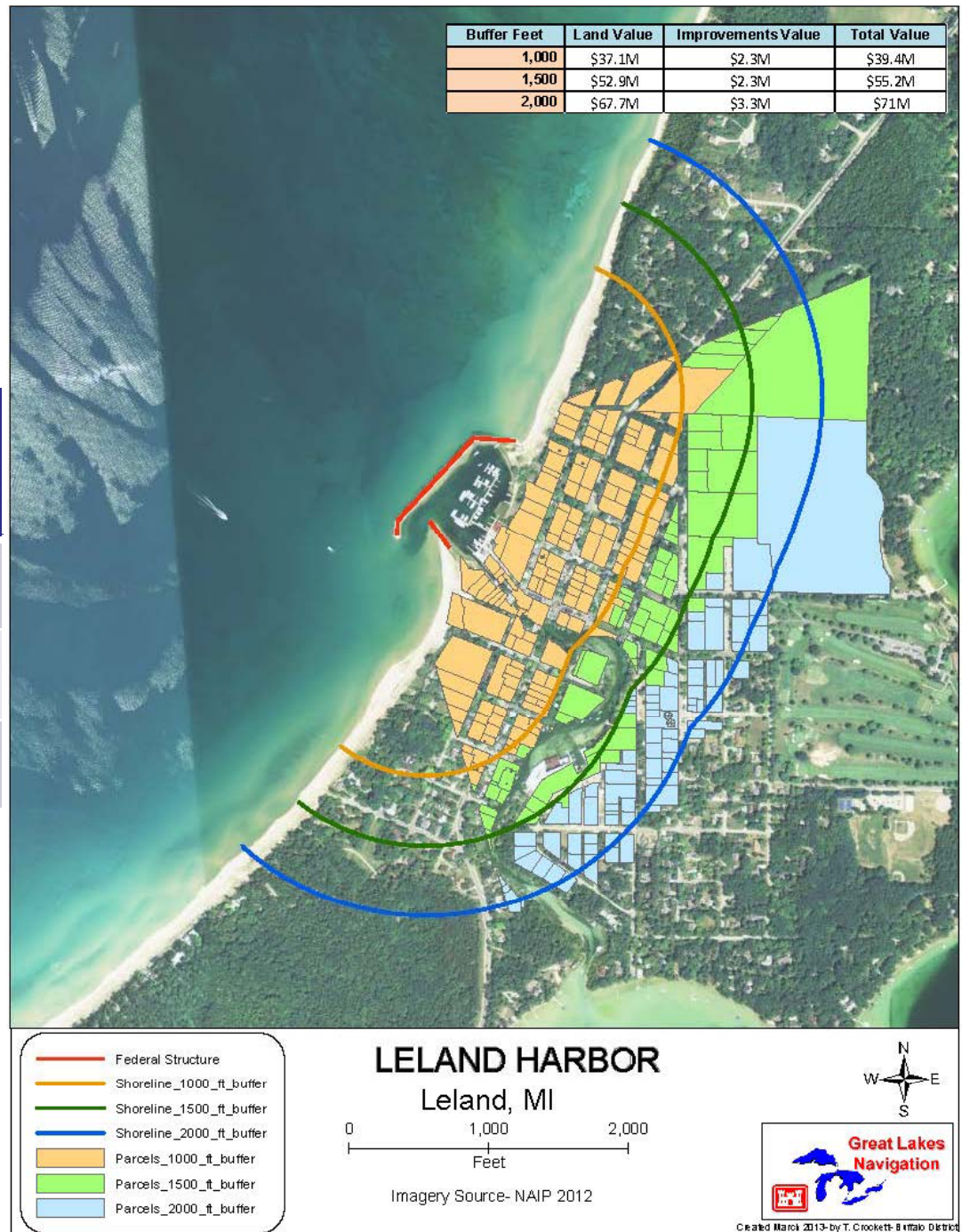




# Leland Harbor:

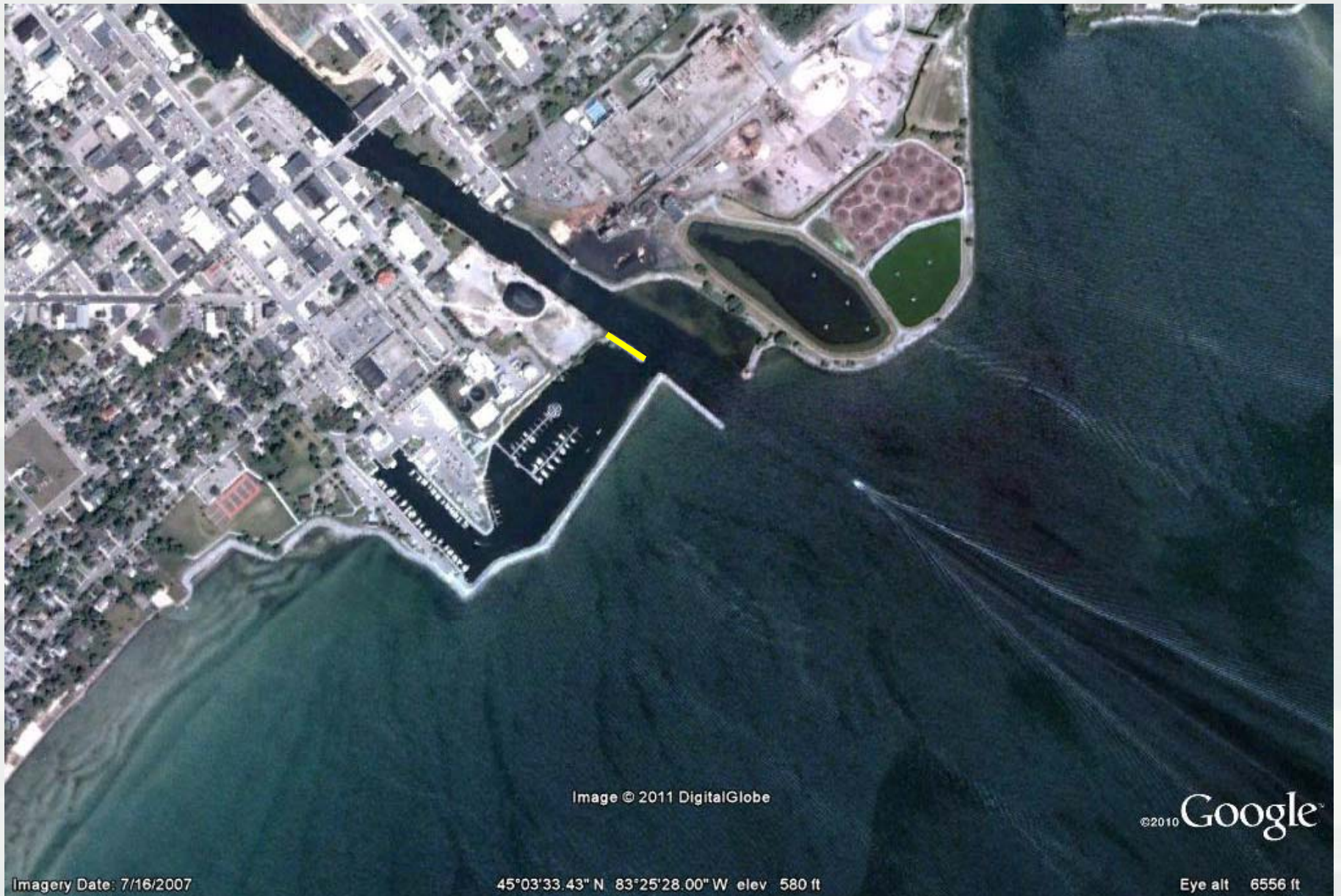
## Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	\$37.1M	\$2.3M	\$39.4M
1,500	\$52.9M	\$2.3M	\$55.2M
2,000	\$67.7M	\$3.3M	\$71M





## Alpena Harbor: B – Low Risk of Failure



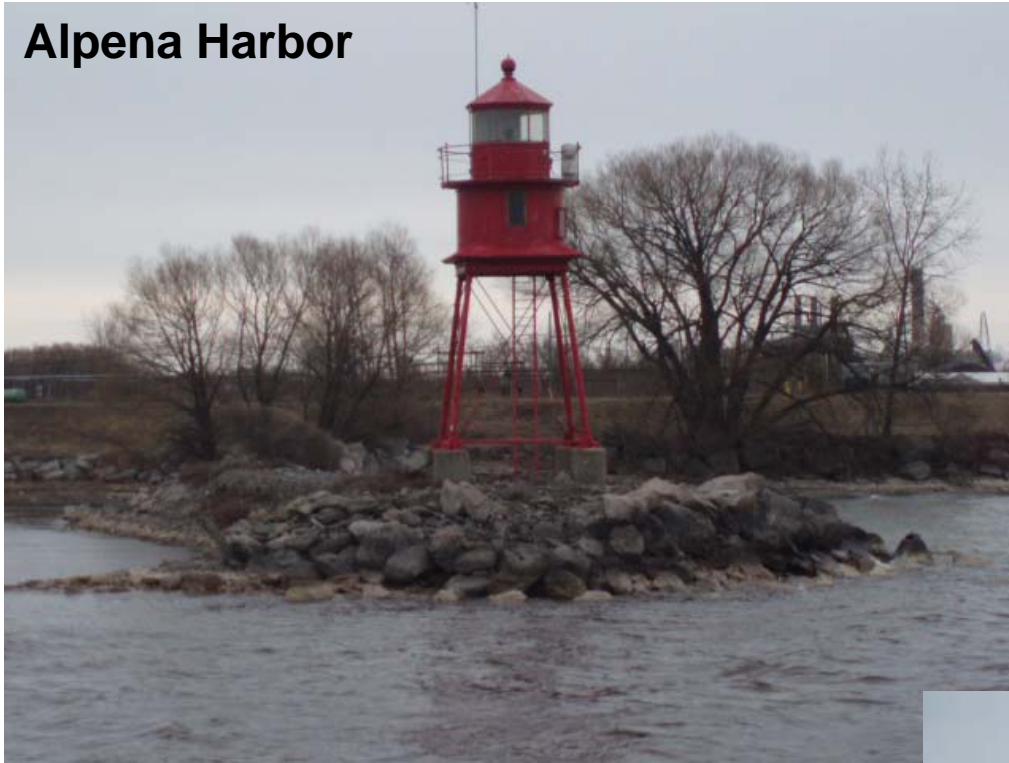


## Alpena Harbor

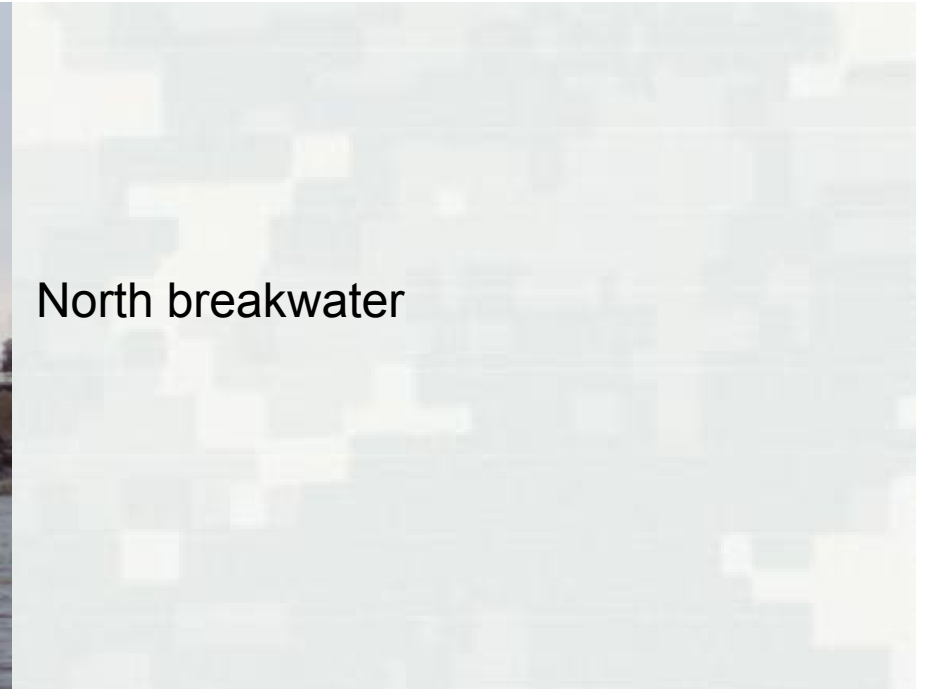
Rubblemound breakwaters – minimal stone loss and movement



## Alpena Harbor



North breakwater



Rubblemound breakwaters –  
minimal stone loss and movement

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South breakwater





## Alpena Harbor

Rubblemound breakwaters – paint and signage are needed



# Alpena Harbor:

## Infrastructure:

1. Alpena Oil Company
2. Alpena Municipal Marina





# Alpena Harbor:

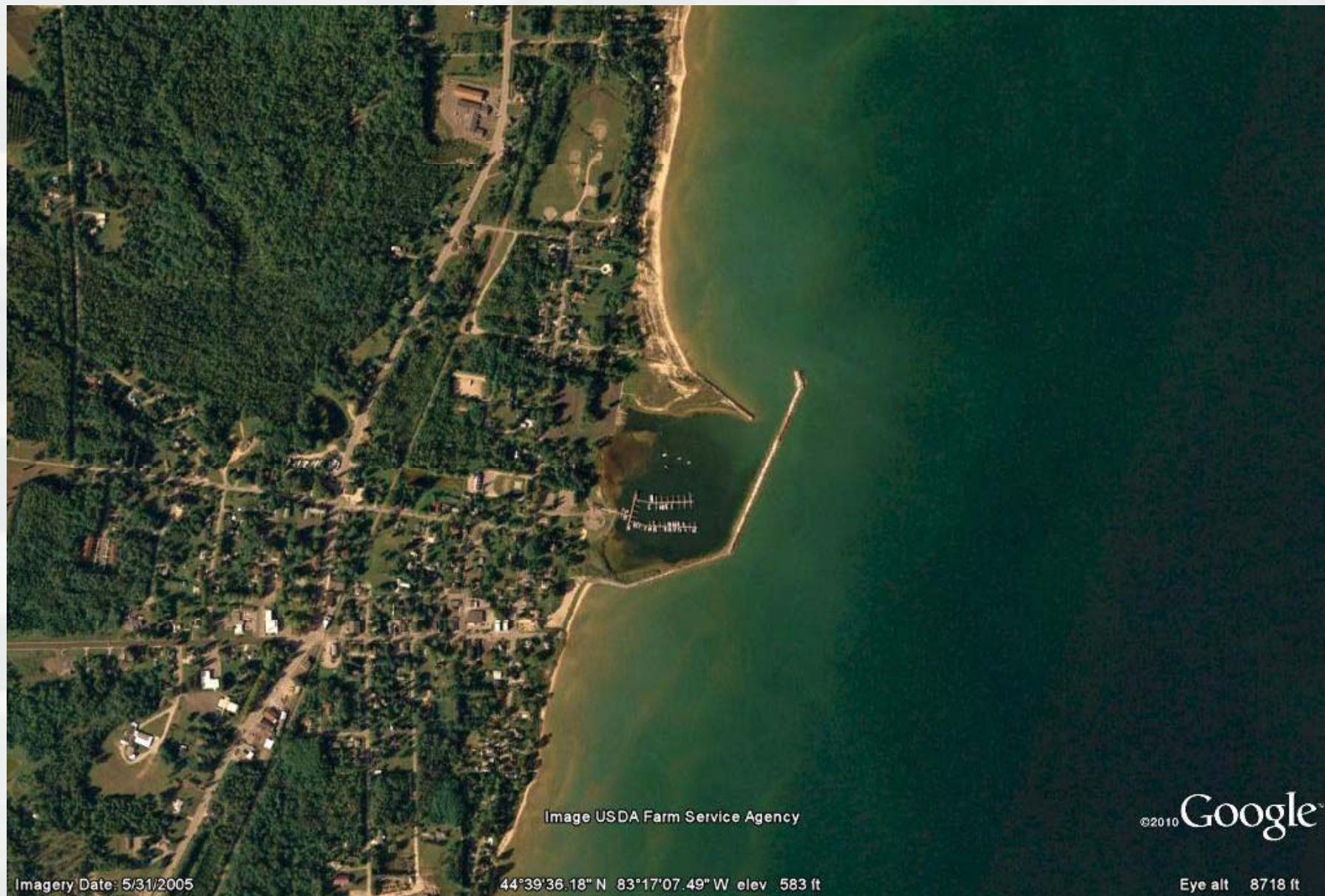
## Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	\$3.8M	\$900K	\$4.7M
1,500	\$4.1M	\$4.5M	\$8.6M
2,000	\$5.1M	\$11.5M	\$16.6M





## Harrisville Harbor: B – Low Risk of Failure





## Harrisville Harbor – South Breakwater

Vegetation between armor stone



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## Harrisville Harbor – North Breakwater





# Harrisville Harbor:

## Infrastructure:

1. Harrisville Harbor  
MDNR Boat Access Site
2. Harrisville Municipal  
Marina



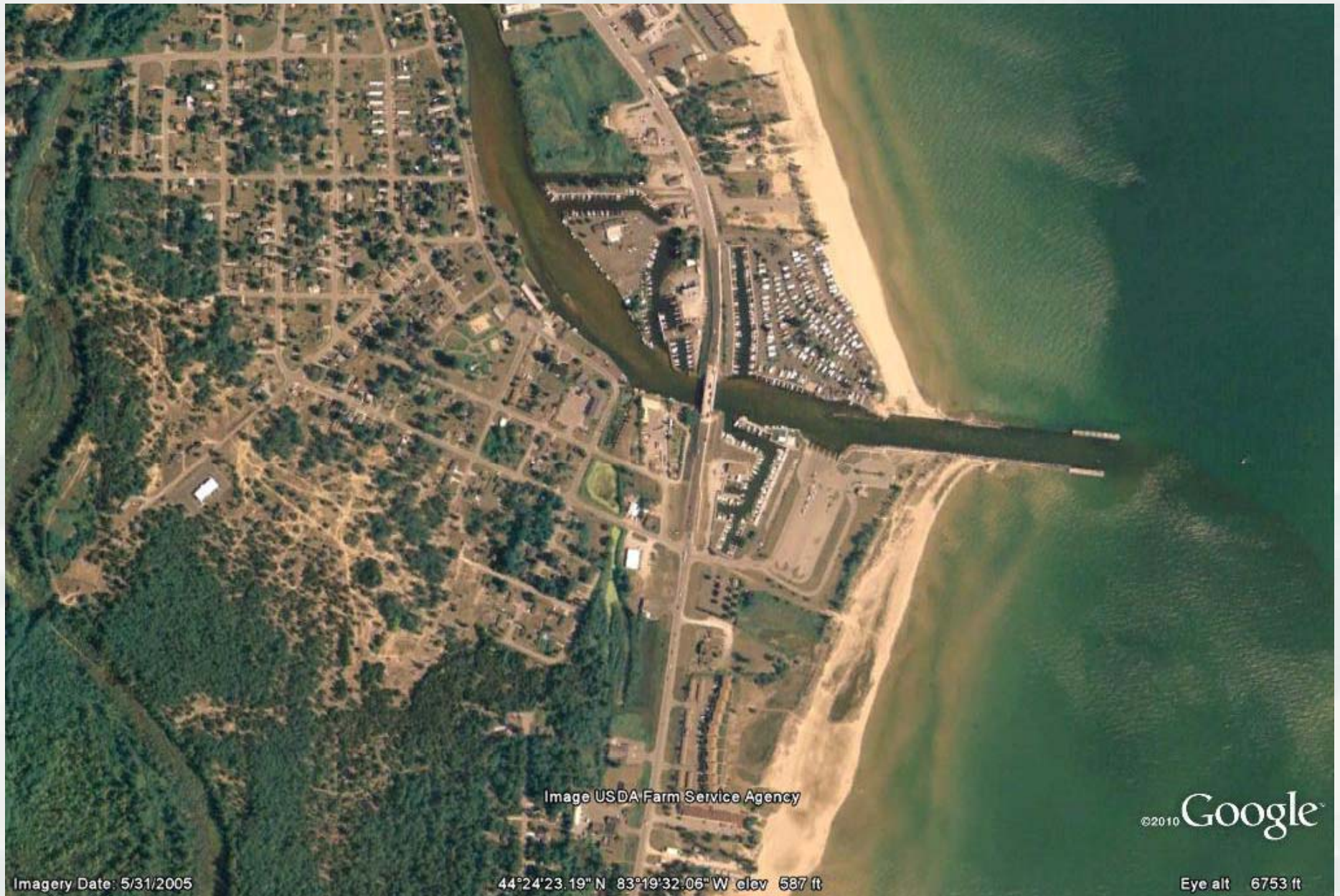
# Harrisville Harbor:

## Potential Impact Areas





## Au Sable Harbor: B – Low Risk of Failure



## **Au Sable Harbor –**

Paint surface of cover on top of Steel Sheet Pile wall is badly worn





## **Au Sable Harbor –**

Spalled concrete patches where re-bar steel was placed near surface, and bent ladder rails



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# Au Sable Harbor:

## Infrastructure:

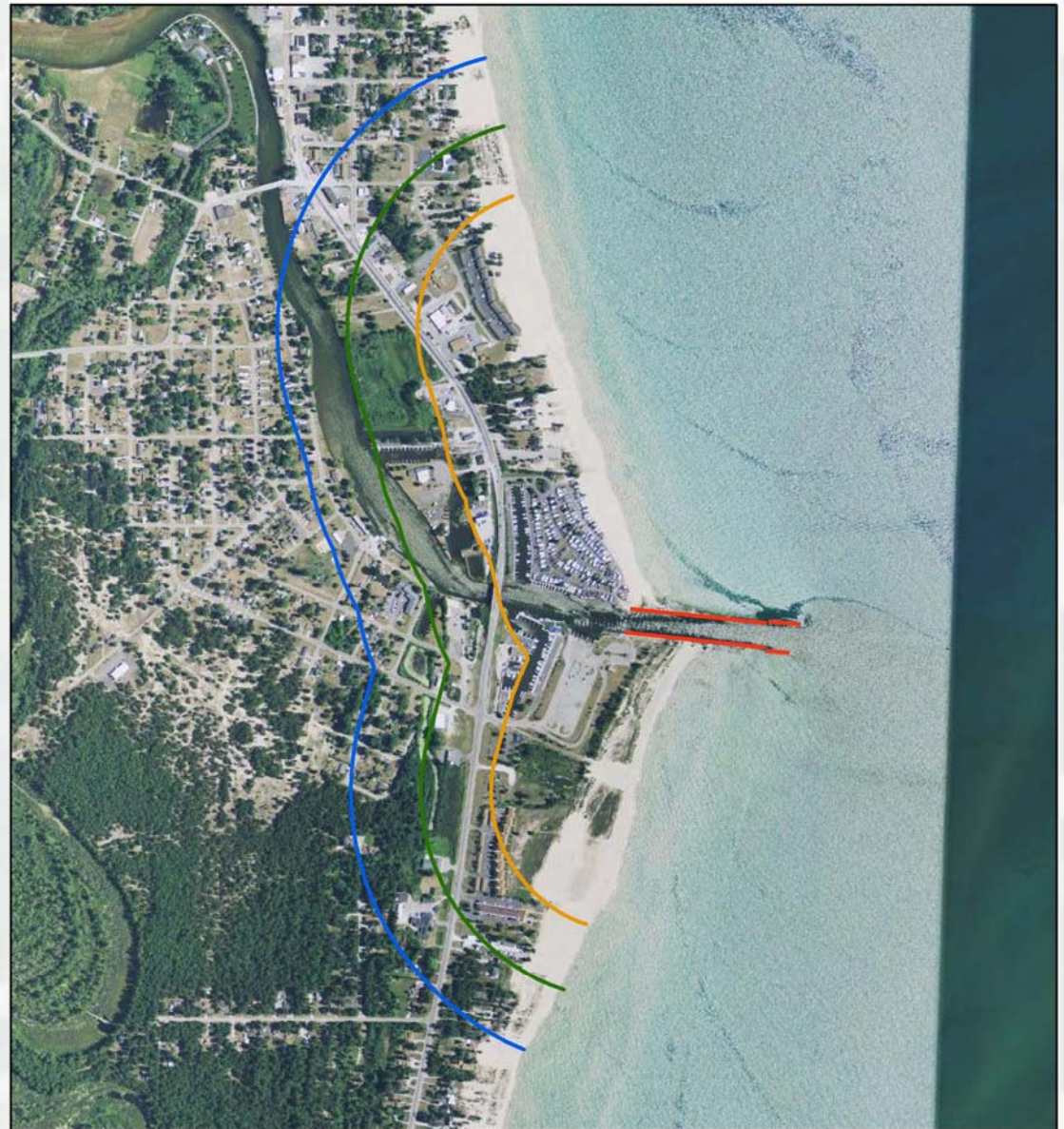
1. Main Pier  
Condominiums and  
Marina
2. Au Sable Shoreline  
Park
3. Au Sable Huron  
Condominiums
4. Au Sable River  
Mouth Boat Access
5. Bunyan Town Marina





# Au Sable Harbor:

## Potential Impact Areas



### AU SABLE HARBOR Au Sable, MI

0 1,000 2,000  
Feet

Imagery Source- NAIP 2012

- Federal Structure
- Shoreline\_1000\_ft\_buffer
- Shoreline\_1500\_ft\_buffer
- Shoreline\_2000\_ft\_buffer



Created August 2012- by T. Crockett- Buffalo District



## Tawas Bay Harbor: B – Low Risk of Failure

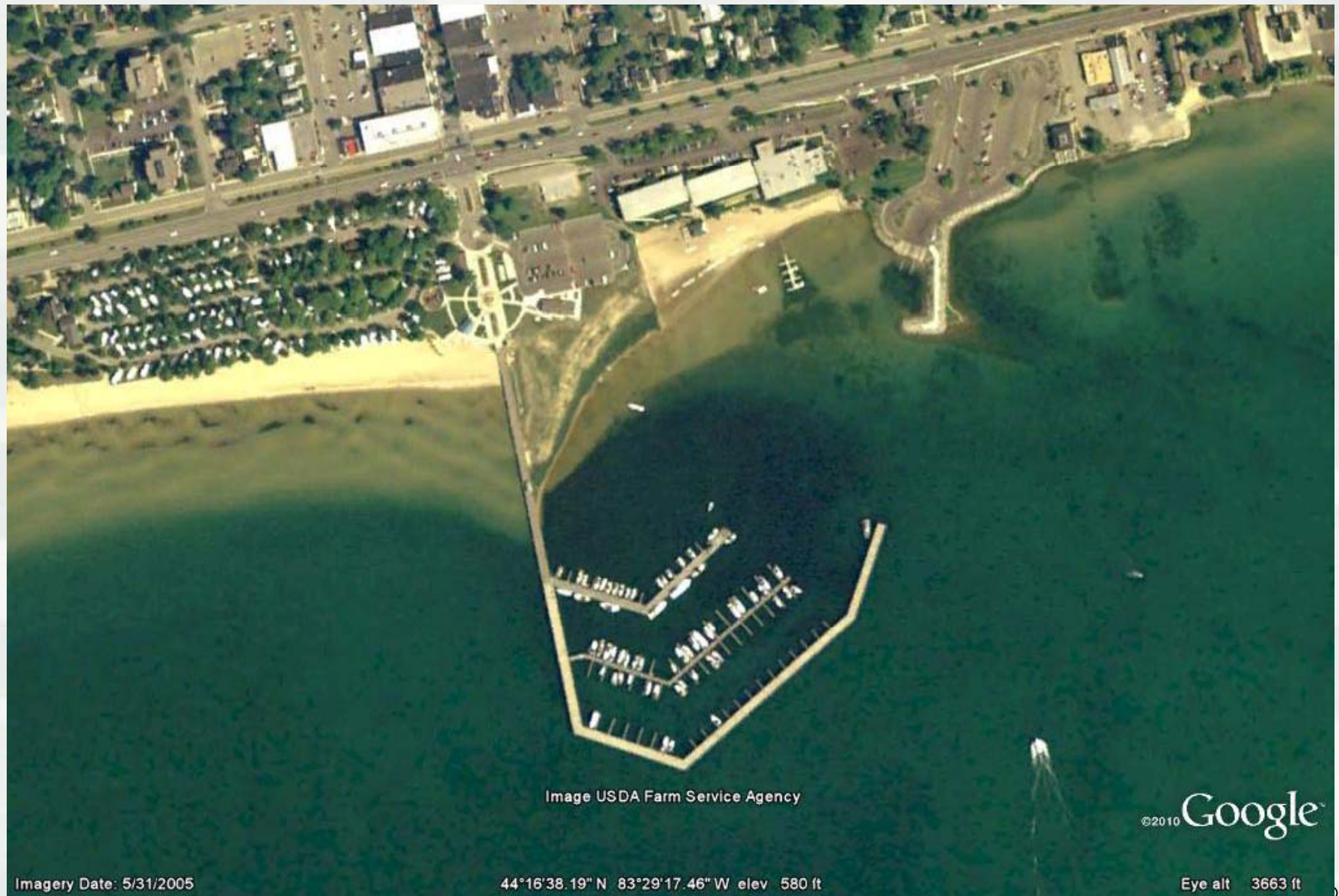


Image USDA Farm Service Agency

©2010 Google™

Imagery Date: 5/31/2005

44°16'38.19" N 83°29'17.46" W elev 580 ft

Eye alt 3663 ft



## **Tawas Bay Harbor:**

Section B: Broken concrete openings along walkway (similar conditions on all sections)



**Tawas Bay Harbor:**

Steel Sheet Pile SSP wall in good condition



Ladders in good condition; painting needed in some areas.



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# Tawas Bay Harbor:

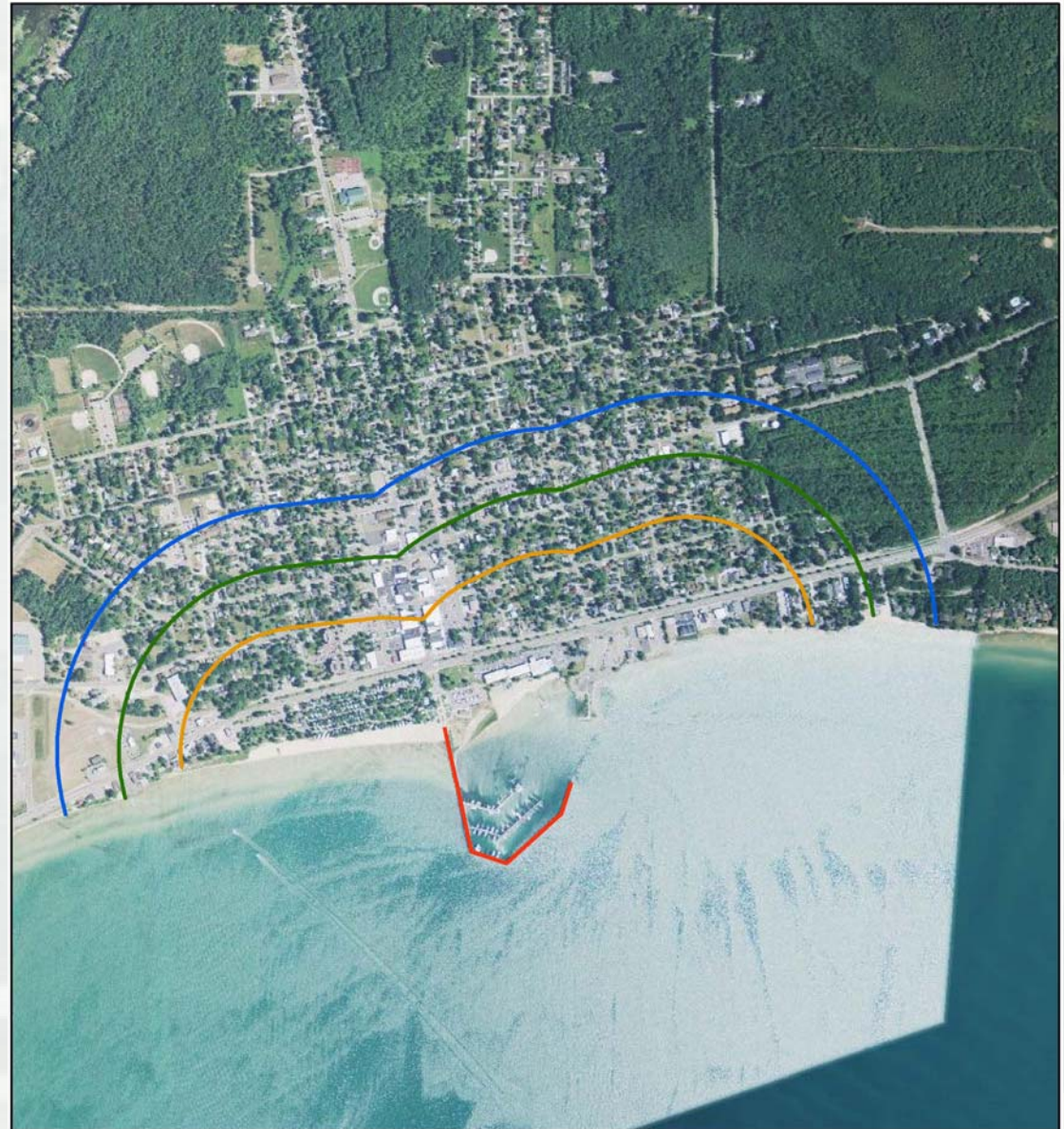
## Infrastructure:

1. East Tawas State Dock
2. Charity Island Excursions
3. East Tawas City Park
4. Tawas Bay Beach Resort



# Tawas Bay Harbor:

## Potential Impact Areas



### TAWAS BAY HARBOR East Tawas, MI

- Federal Structure
- Shoreline\_1000\_ft\_buffer
- Shoreline\_1500\_ft\_buffer
- Shoreline\_2000\_ft\_buffer

0 1,250 2,500  
Feet

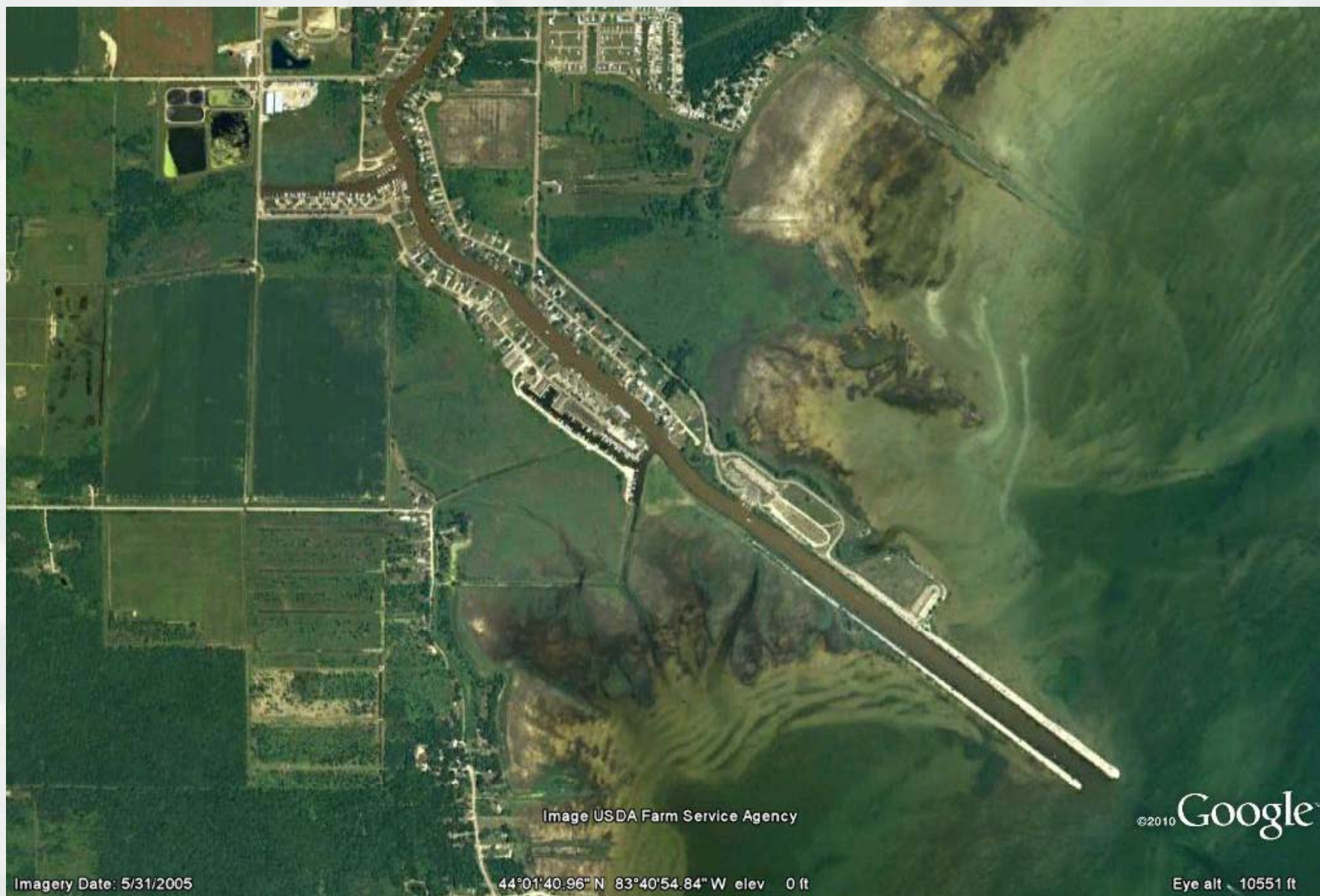
Imagery Source- NAIP 2012



Created February 2013 - by T. Crockett- Buffalo District



## Point Lookout Harbor: B – Low Risk of Failure



**Point Lookout Harbor:**  
Stone placement is still in good condition.



Safety Rail is in need of paint



## Point Lookout Harbor:

Stone placement is still in good condition.



Damaged safety rail, and Poor Alignment of hand rail. Over-grown vegetation present on breakwater



Concrete walkway has spalling and uneven surfaces; due to freeze, thaw and settlement movement beneath slabs



# Point Lookout Harbor:

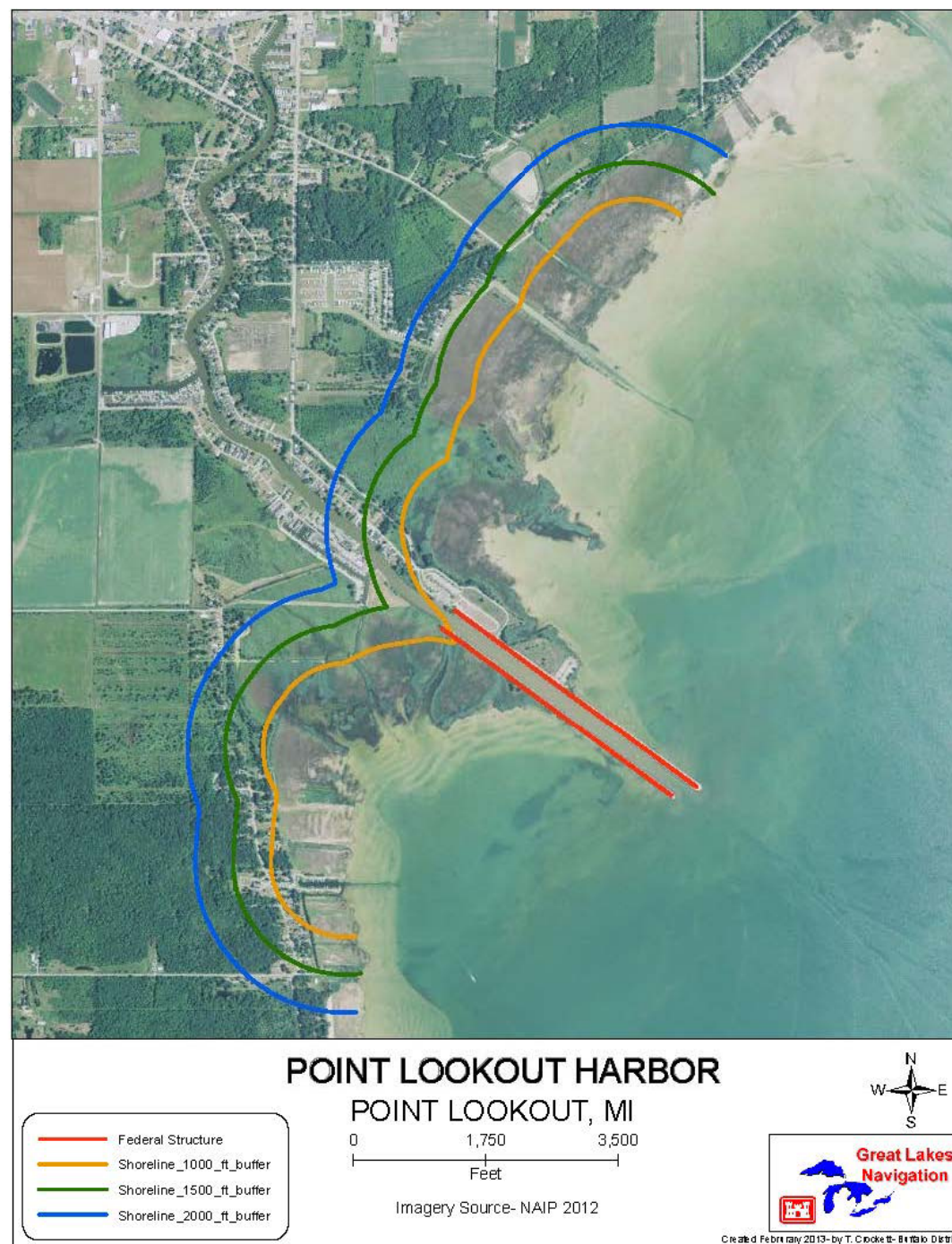
## Infrastructure:

1. Michigan Dept. of Natural Resources Boat Launch Facility
2. Au Gres Yacht Club
3. Au Gres Yacht Club Condominiums
4. City of Au Gres Waste Water Treatment Plant





## Potential Impact Areas



# What Can Be Done?

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- 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](http://www.lre.usace.army.mil/Missions/GreatLakesNavigation.aspx)



[HOME](#) > [MISSIONS](#) > GREAT LAKES NAVIGATION

## 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](mailto: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](mailto: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?

