MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

Shoreline Trends and Best Management Practices: Combatting cumulative impacts through homeowner scale techniques

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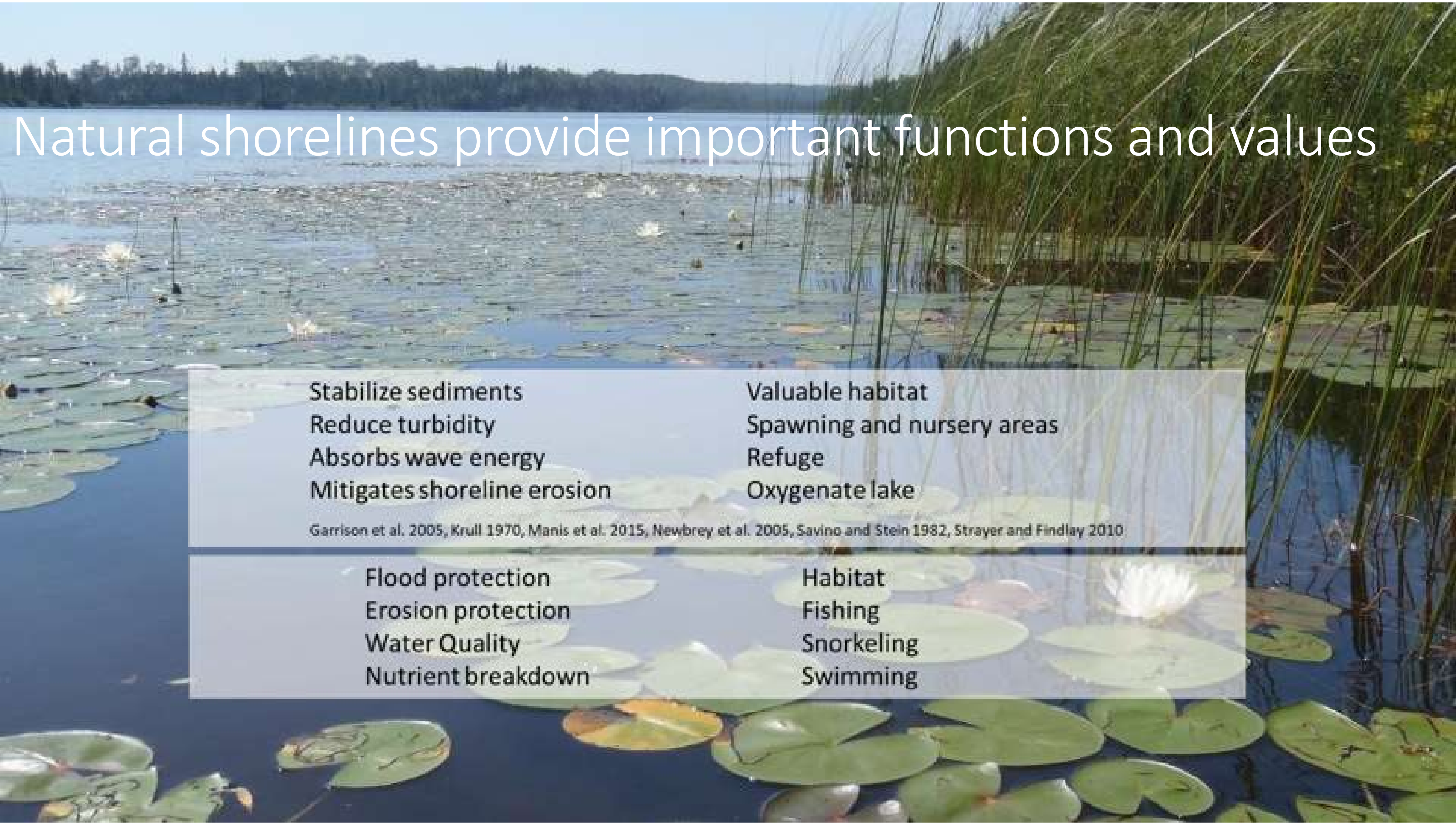
WETLANDS, LAKES, AND STREAMS PROGRAM



Natural shorelines provide important functions and values

- Stabilize sediments
- Reduce turbidity
- Absorbs wave energy
- Mitigates shoreline erosion

- Valuable habitat
- Spawning and nursery areas
- Refuge
- Oxygenate lake

Garrison et al. 2005, Krull 1970, Manis et al. 2015, Newbrey et al. 2005, Savino and Stein 1982, Strayer and Findlay 2010

- Flood protection
- Erosion protection
- Water Quality
- Nutrient breakdown

- Habitat
- Fishing
- Snorkeling
- Swimming

Shoreline simplification results in a loss of refugia and habitat heterogeneity that can cause negative impacts on littoral fish and wildlife communities

Christiansen et al. 1996, Jennings et al 1999, Garrison et al. 2005, Newbrey et al. 2005, Woodford and Meyer 2003, Radomski et al. 2010, Strayer and Findlay 2010

Physically complex shore zones support richer and more diverse communities

Tonn and Magnuson 1982, Strayer and Findlay 2010

Fish density, body size, and species richness is greater in structurally complex habitats with vegetation and woody structure

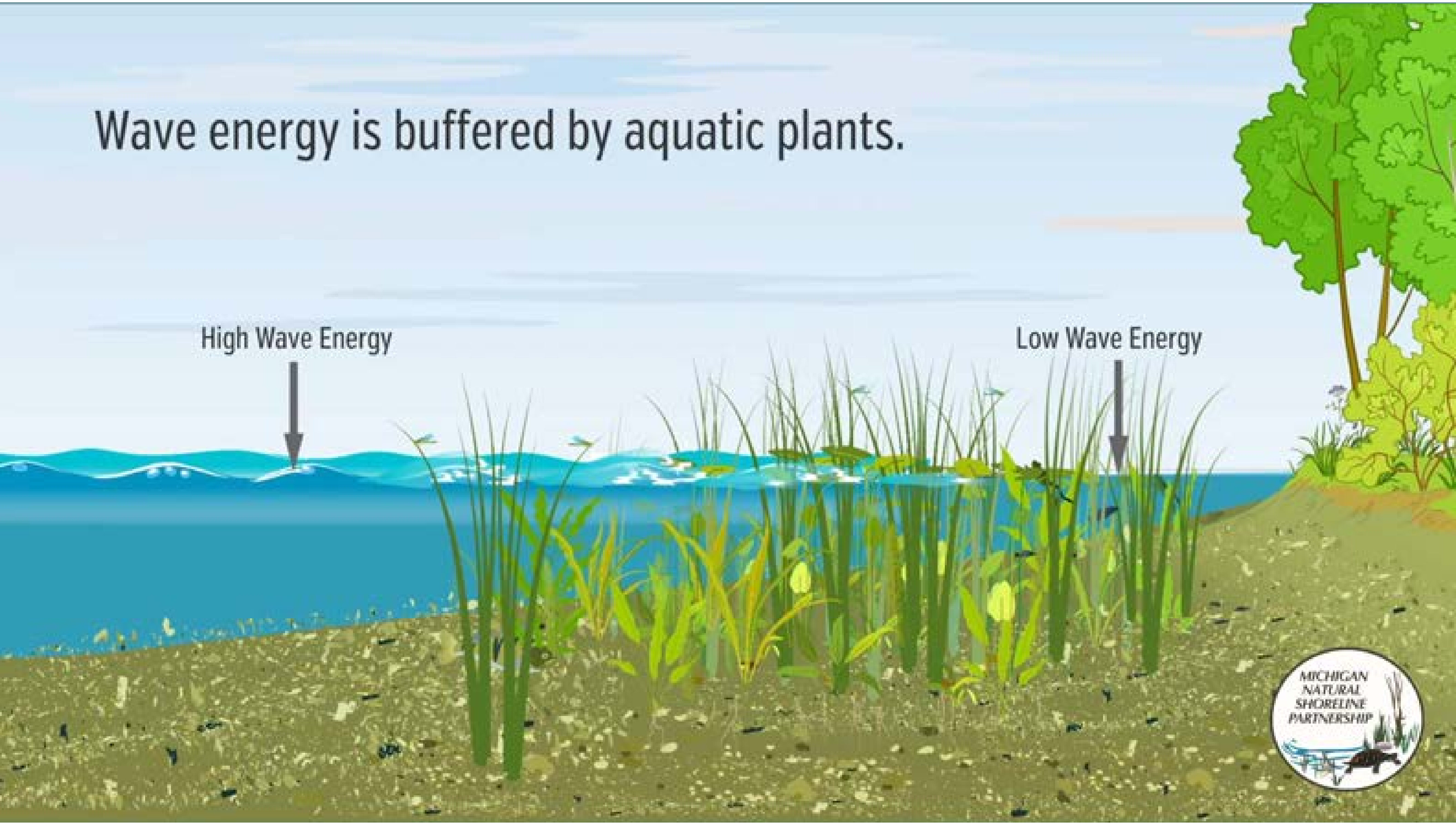
Barwick et al. 2004, Madjeczak et al. 1998, Jennings et al. 1999, Strayer and Findlay 2010

- 24 amphibian
- 25 reptile
- 87 bird
- 19 mammal

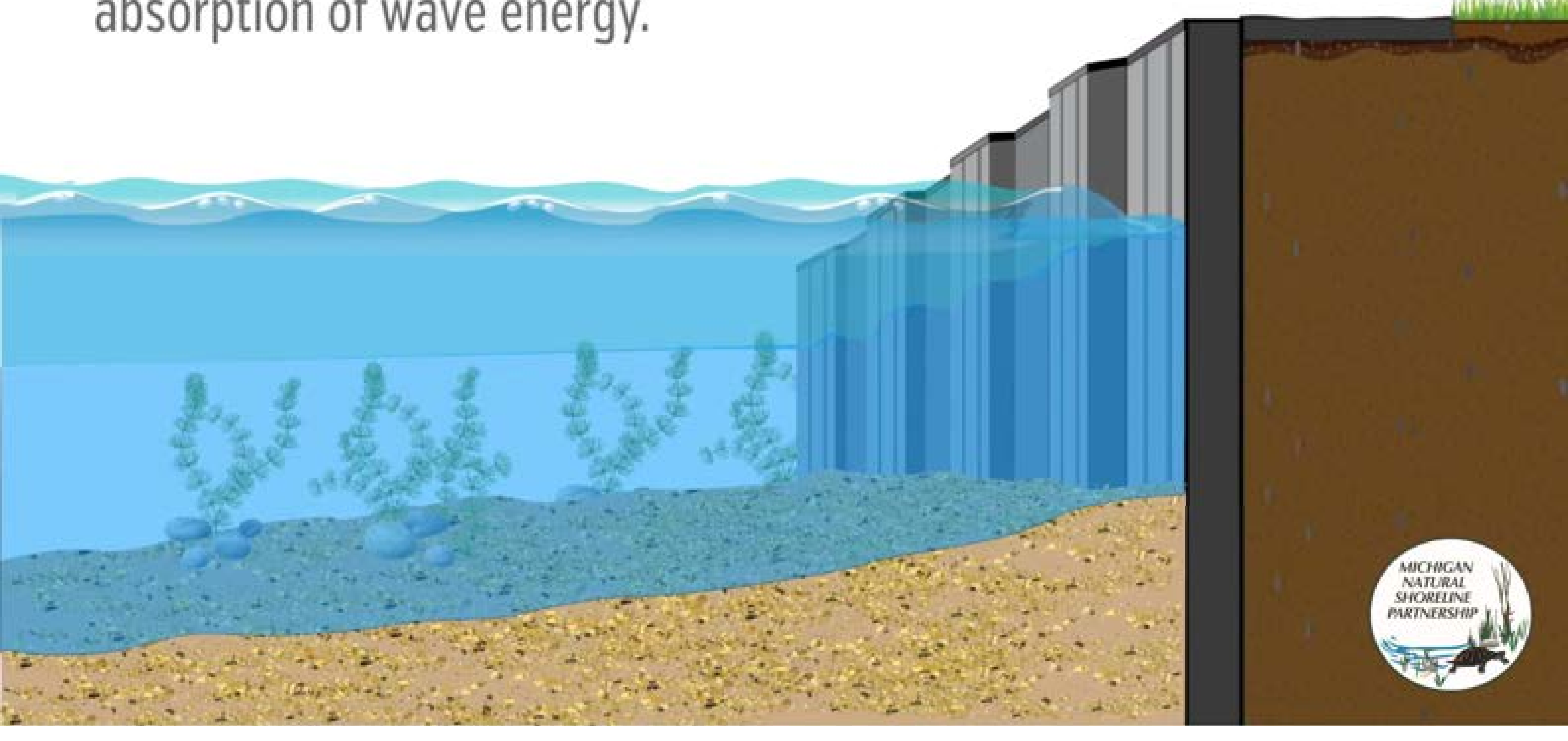
- Algae competition
- Water quality
- Beauty
- Invasion resistance

- Habitat for fish and other animals during all life stages
  - Food
  - Cover
  - Spawning
  - Nursury
- Oxygenate lake

- 65 species of Michigan native fish
- 18 of which are Species of Greatest Conservation Need (Michigan Wildlife Action Plan)

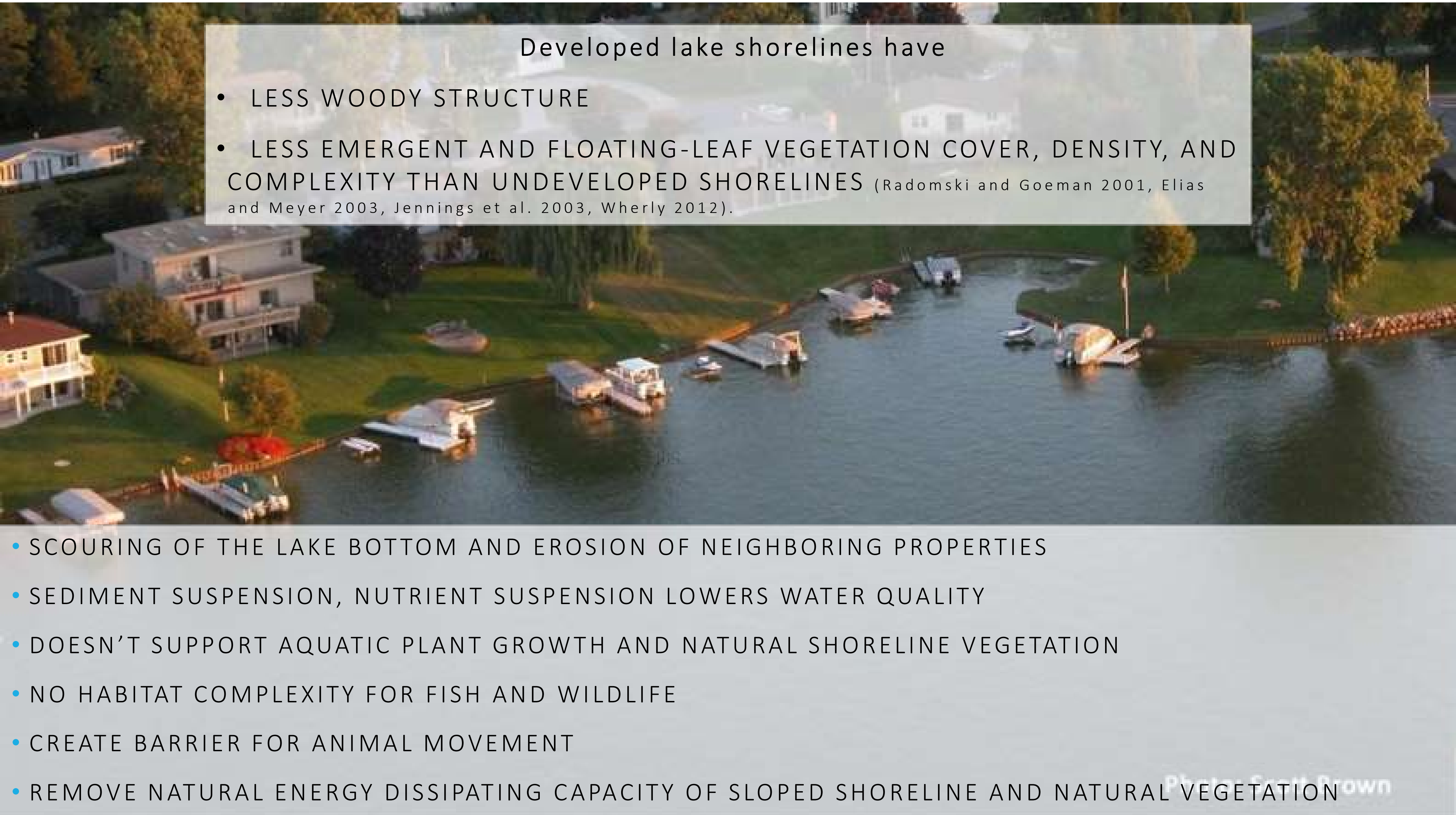

Wave energy is buffered by aquatic plants.
High Wave Energy
Low Wave Energy
MICHIGAN NATURAL SHORELINE PARTNERSHIP

Seawalls do not allow for the absorption of wave energy.



Developed lake shorelines have

- LESS WOODY STRUCTURE
- LESS EMERGENT AND FLOATING-LEAF VEGETATION COVER, DENSITY, AND COMPLEXITY THAN UNDEVELOPED SHORELINES (Radomski and Goeman 2001, Elias and Meyer 2003, Jennings et al. 2003, Wherly 2012).



- SCOURING OF THE LAKE BOTTOM AND EROSION OF NEIGHBORING PROPERTIES
- SEDIMENT SUSPENSION, NUTRIENT SUSPENSION LOWERS WATER QUALITY
- DOESN'T SUPPORT AQUATIC PLANT GROWTH AND NATURAL SHORELINE VEGETATION
- NO HABITAT COMPLEXITY FOR FISH AND WILDLIFE
- CREATE BARRIER FOR ANIMAL MOVEMENT
- REMOVE NATURAL ENERGY DISSIPATING CAPACITY OF SLOPED SHORELINE AND NATURAL VEGETATION

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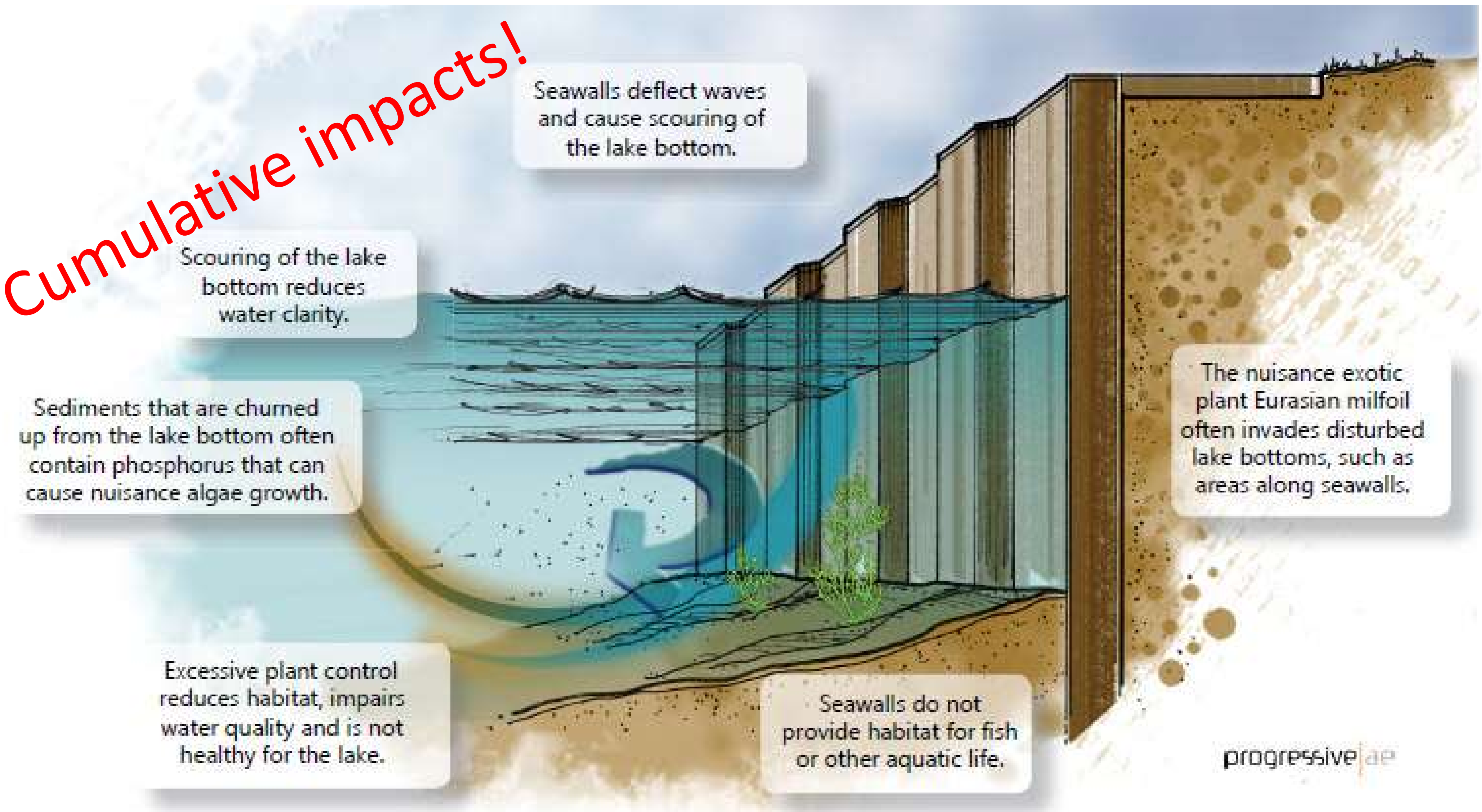
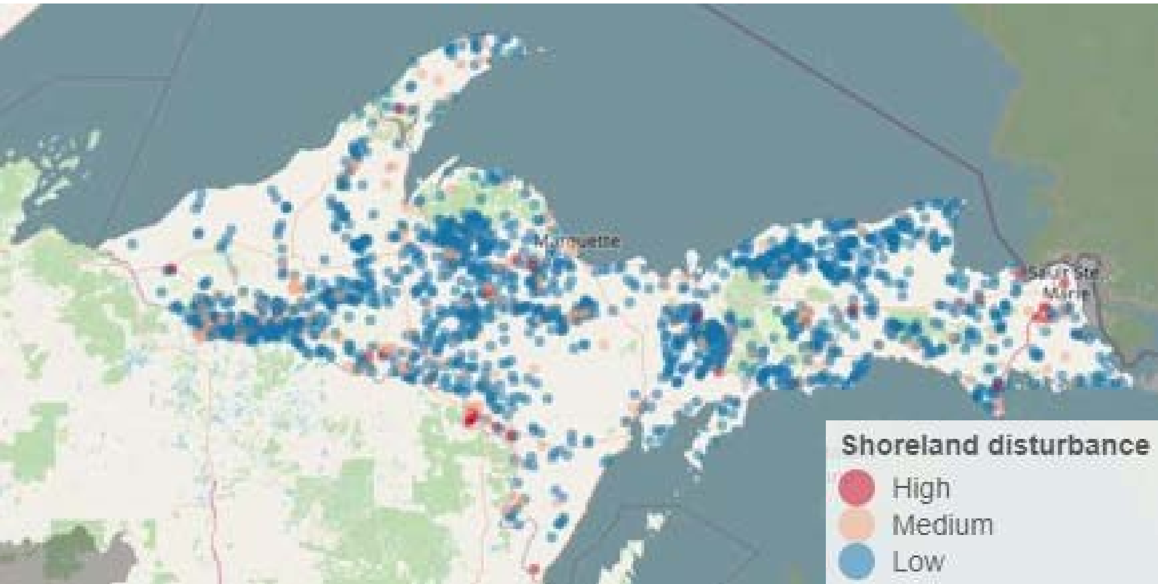
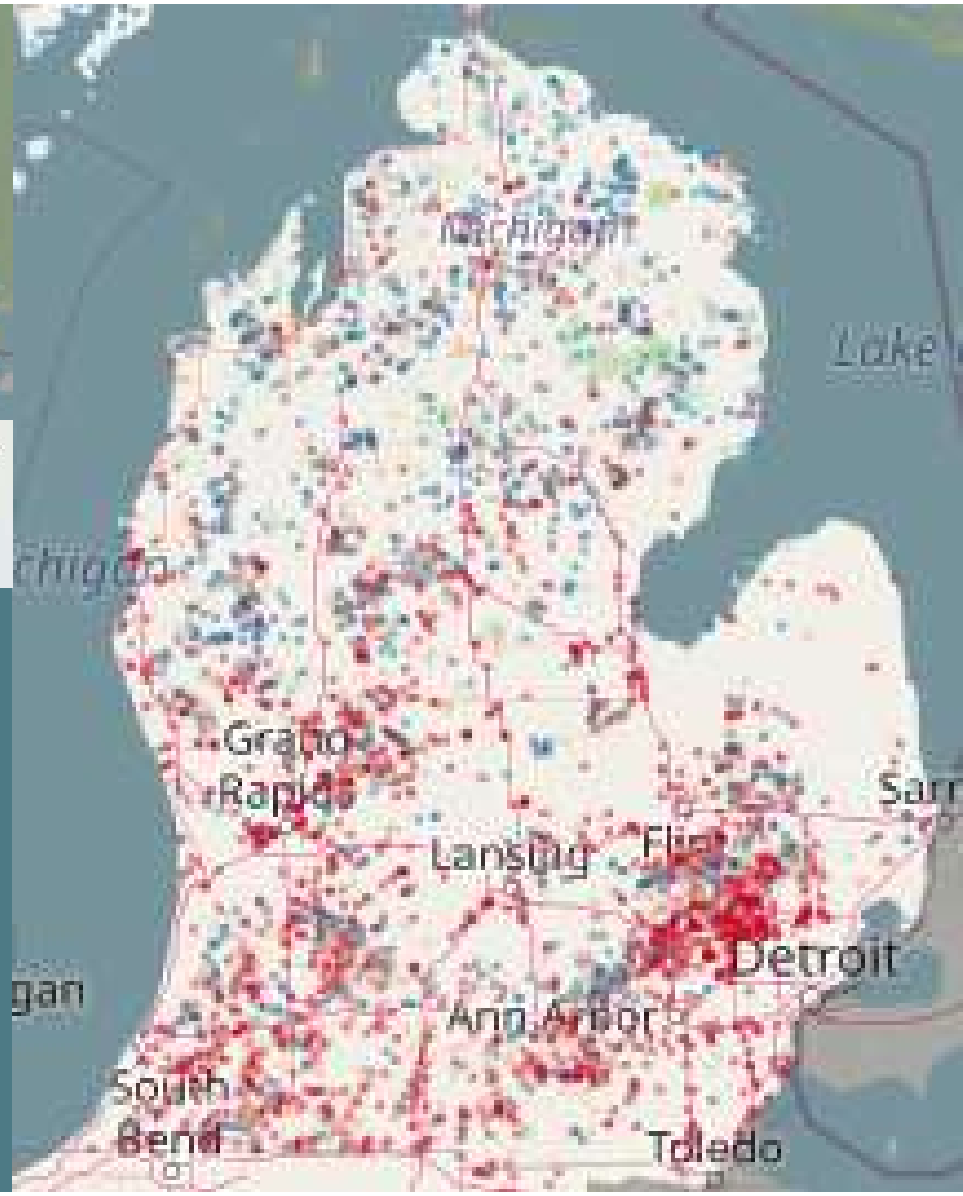

Cumulative impacts!
Seawalls deflect waves and cause scouring of the lake bottom.
Scouring of the lake bottom reduces water clarity.
Sediments that are churned up from the lake bottom often contain phosphorus that can cause nuisance algae growth.
The nuisance exotic plant Eurasian milfoil often invades disturbed lake bottoms, such as areas along seawalls.
Excessive plant control reduces habitat, impairs water quality and is not healthy for the lake.
Seawalls do not provide habitat for fish or other aquatic life.
progressive ae

Cumulative impacts

SECTION 404(B)1§230.11(G) OF THE CLEAN WATER ACT DEFINES “CUMULATIVE IMPACTS” AS:

“CUMULATIVE IMPACTS ARE THE CHANGES IN AN AQUATIC ECOSYSTEM THAT ARE ATTRIBUTABLE TO THE COLLECTIVE EFFECT OF A NUMBER OF INDIVIDUAL DISCHARGES OF DREDGED OR FILL MATERIAL. ALTHOUGH THE IMPACT OF A PARTICULAR DISCHARGE MAY CONSTITUTE A MINOR CHANGE IN ITSELF, THE CUMULATIVE EFFECT OF NUMEROUS SUCH PIECEMEAL CHANGES CAN RESULT IN A MAJOR IMPAIRMENT OF THE WATER RESOURCES AND INTERFERE WITH THE PRODUCTIVITY AND WATER QUALITY OF EXISTING AQUATIC ECOSYSTEMS.”

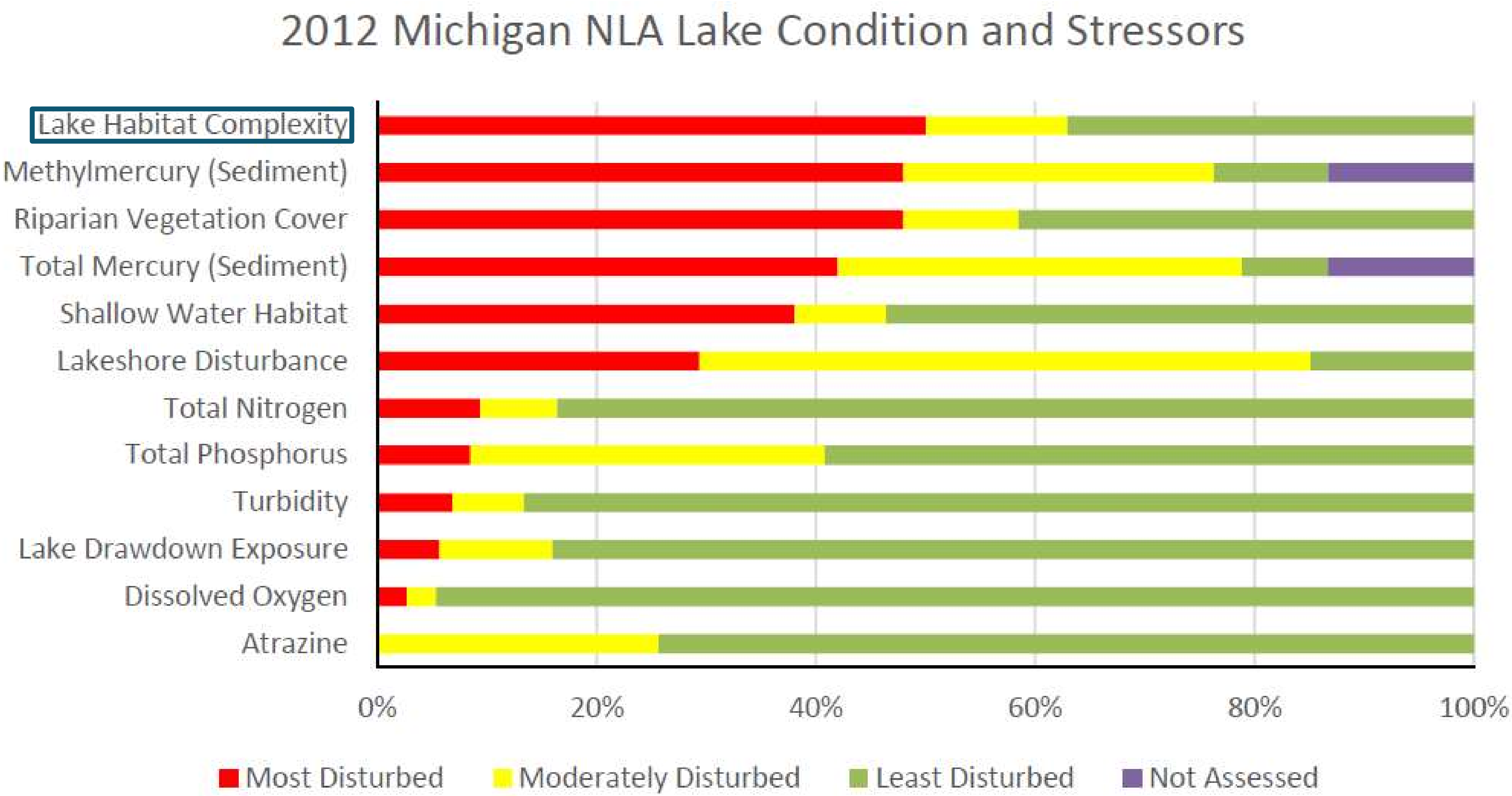


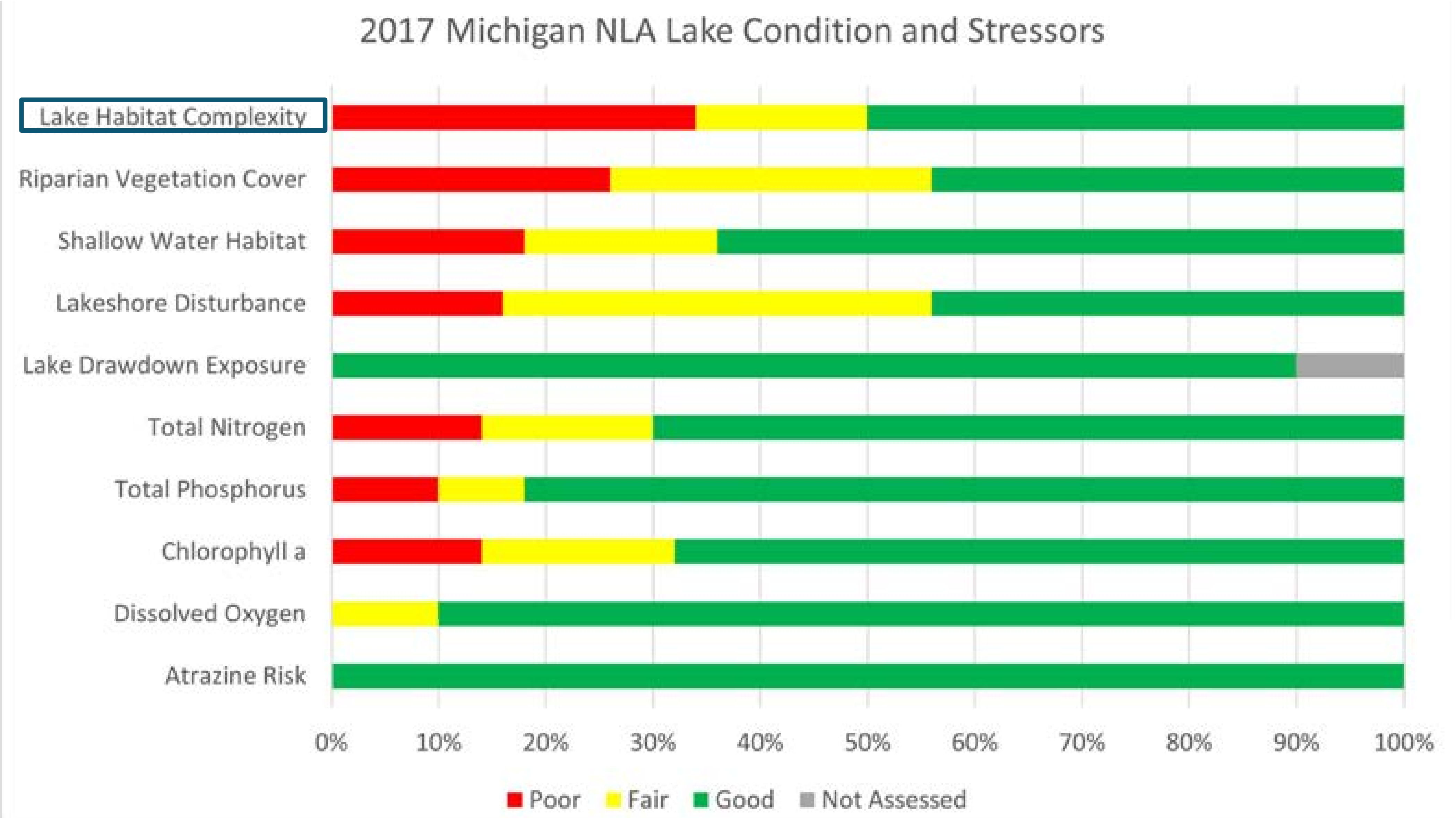


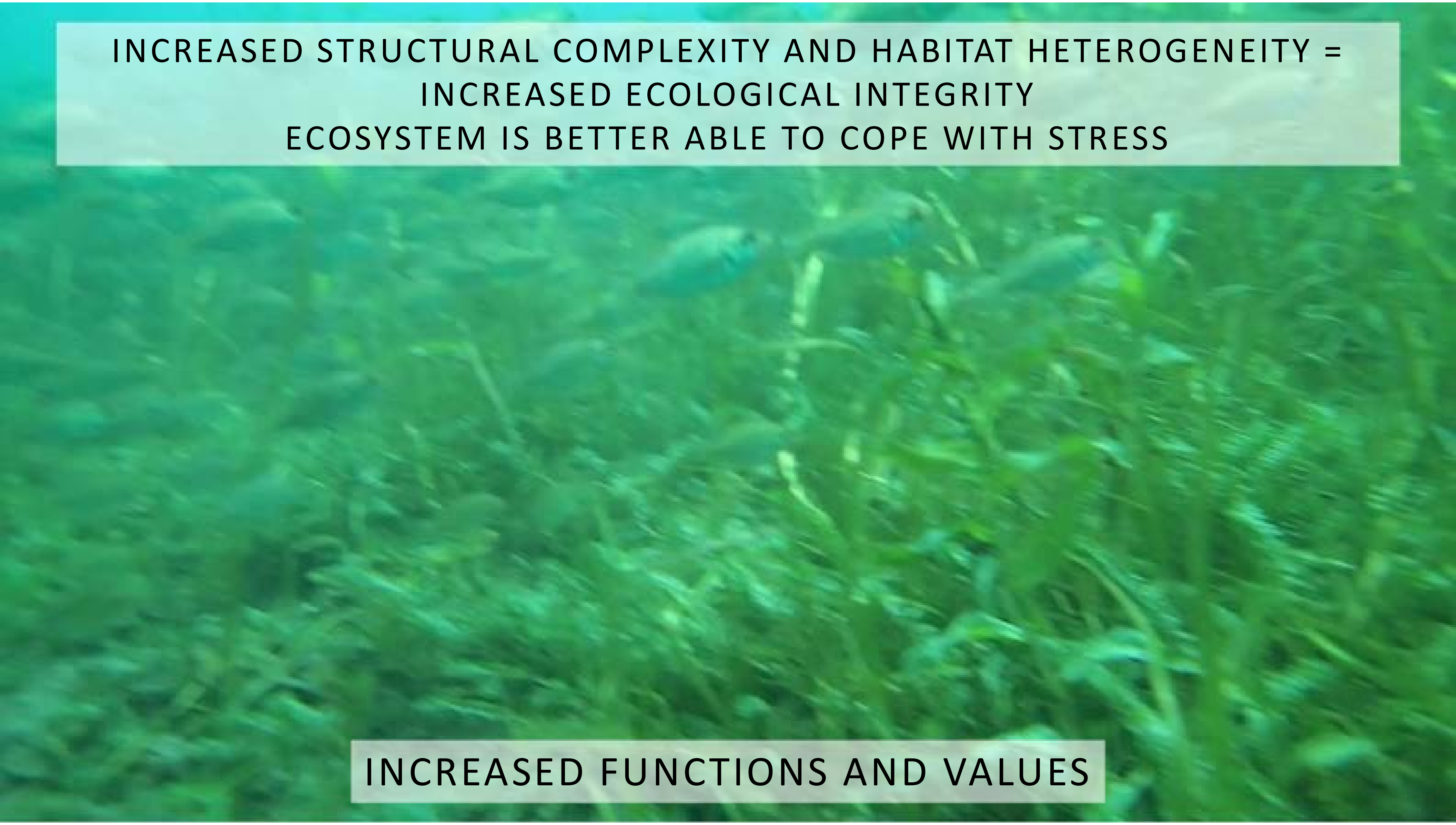
"OUR RESULTS [FROM MICHIGAN] TOGETHER WITH THE FINDINGS FROM [MULTIPLE STUDIES] FROM MINNESOTA AND WISCONSIN LAKES, SUGGEST THAT SHORELINE RESIDENTIAL DEVELOPMENT HAS CUMULATIVE EFFECTS ON LITTORAL HABITATS THAT ARE PERVASIVE AND WIDESPREAD"

WEHRLY ET AL. 2012

[LINK TO MGLP CONSERVATION PLANNER](#)


2012 Michigan NLA Lake Condition and Stressors
Lake Habitat Complexity
Methylmercury (Sediment)
Riparian Vegetation Cover
Total Mercury (Sediment)
Shallow Water Habitat
Lakeshore Disturbance
Total Nitrogen
Total Phosphorus
Turbidity
Lake Drawdown Exposure
Dissolved Oxygen
Atrazine
0%
20%
40%
60%
80%
100%
Most Disturbed
Moderately Disturbed
Least Disturbed
Not Assessed


2017 Michigan NLA Lake Condition and Stressors
Lake Habitat Complexity
Riparian Vegetation Cover
Shallow Water Habitat
Lakeshore Disturbance
Lake Drawdown Exposure
Total Nitrogen
Total Phosphorus
Chlorophyll a
Dissolved Oxygen
Atrazine Risk
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Poor
Fair
Good
Not Assessed


INCREASED STRUCTURAL COMPLEXITY AND HABITAT HETEROGENEITY =
INCREASED ECOLOGICAL INTEGRITY
ECOSYSTEM IS BETTER ABLE TO COPE WITH STRESS
INCREASED FUNCTIONS AND VALUES

Case Studies

SILVER LAKE, GENESEE COUNTY

LAKE CHARLEVOIX, CHARLEVOIX COUNTY

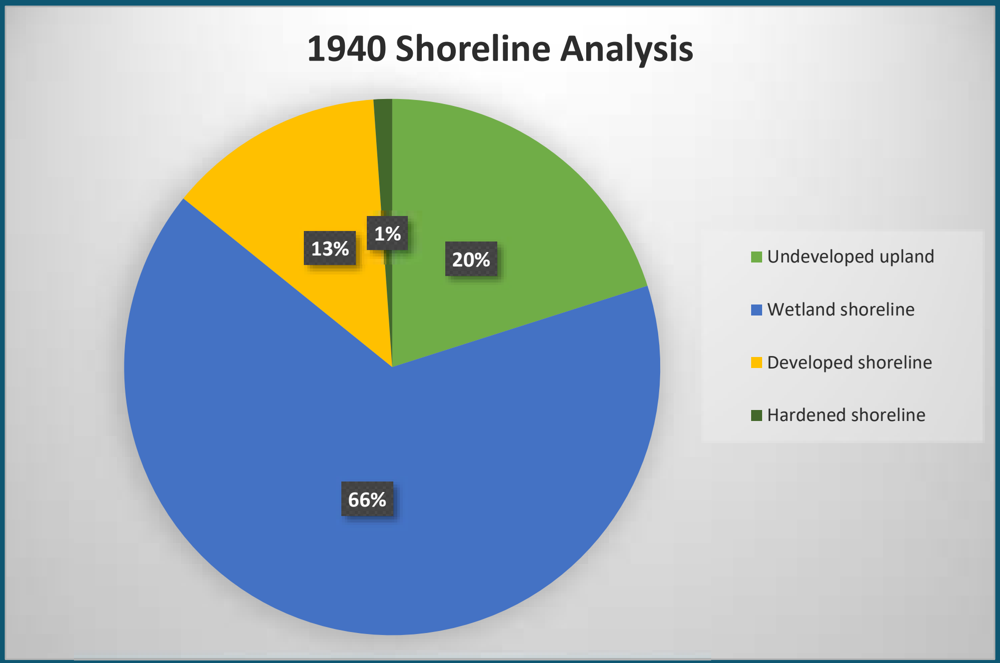
EGLE

SILVER LAKE, GENESEE COUNTY

- UNDEVELOPED UPLAND SHORELINE – UNDEVELOPED VEGETATED UPLAND AREAS
- WETLAND SHORELINE – EMERGENT WETLAND VEGETATION
- DEVELOPED SHORELINE – GRASS TO THE WATERS EDGE, STRUCTURES AND ROADS NEXT TO WATER
- HARDENED SHORELINE – SEAWALLS, RIPRAP

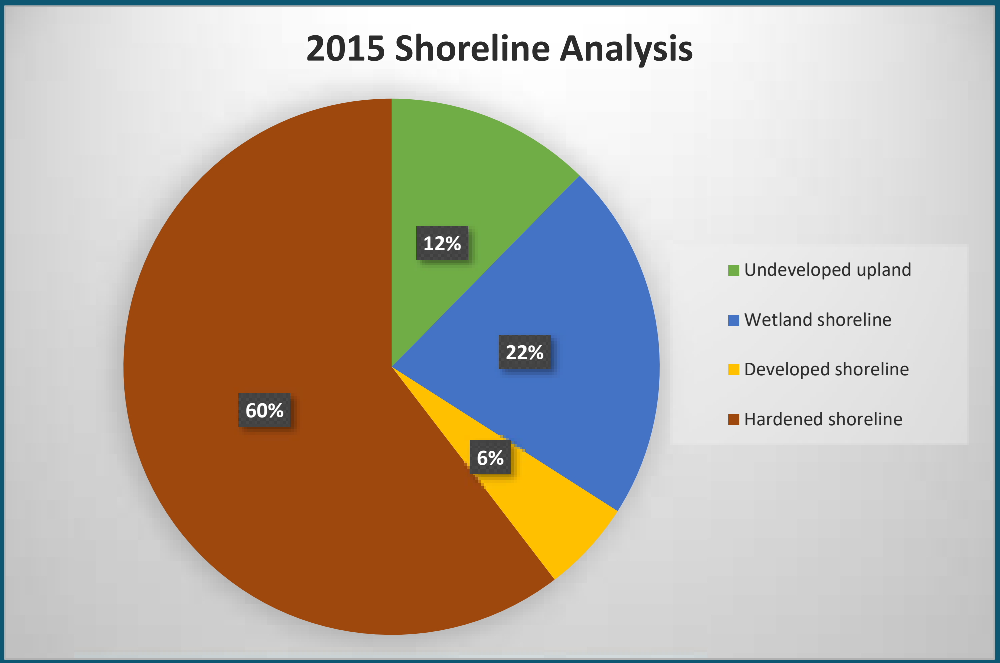
EGLE

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY



Shoreline Type	Miles
Undeveloped upland	1.26
Wetland shoreline	4.12
Developed shoreline	.82
Hardened shoreline	.07
Total	6.27

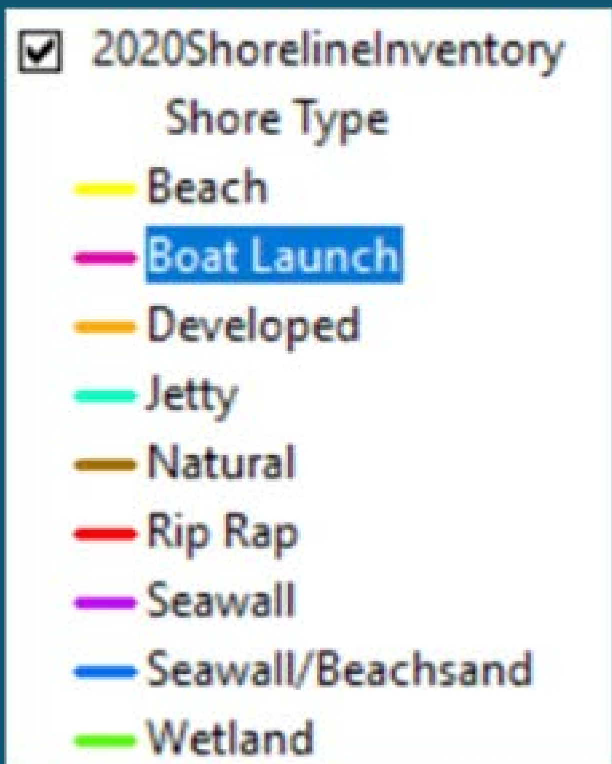
COMBINED 14% HARDENED/ DEVELOPED SHORELINE
COMBINED 86% UNDEVELOPED UPLAND/WETLAND SHORELINE

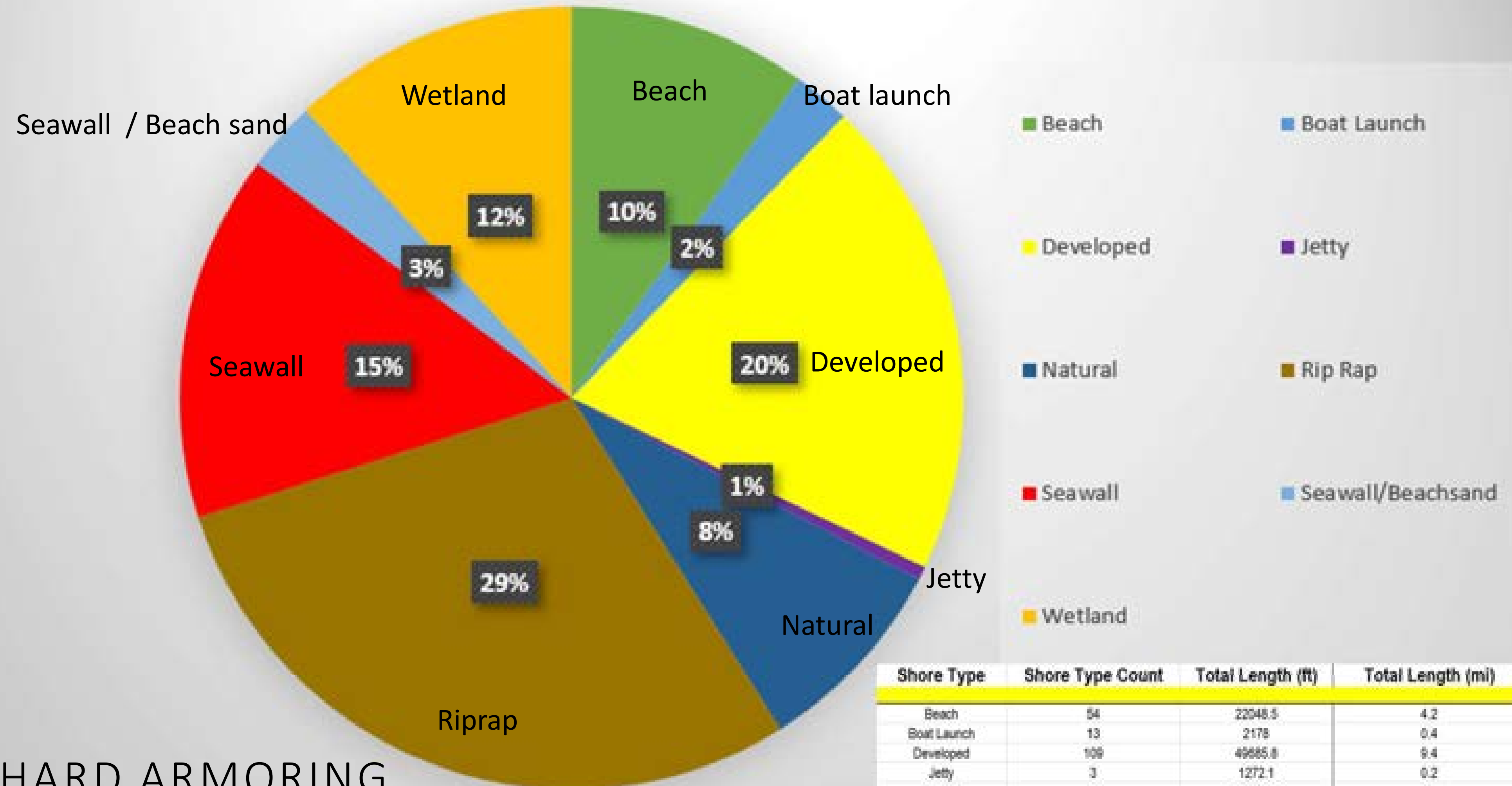


Shoreline Type	Miles
Undeveloped upland	.98
Wetland shoreline	1.72
Developed shoreline	.44
Hardened shoreline	4.79
Total	7.93

COMBINED 66% HARDENED / DEVELOPED SHORELINE
COMBINED 34% UNDEVELOPED UPLAND AND WETLAND SHORELINE

LAKE CHARLEVOIX, CHARLEVOIX COUNTY



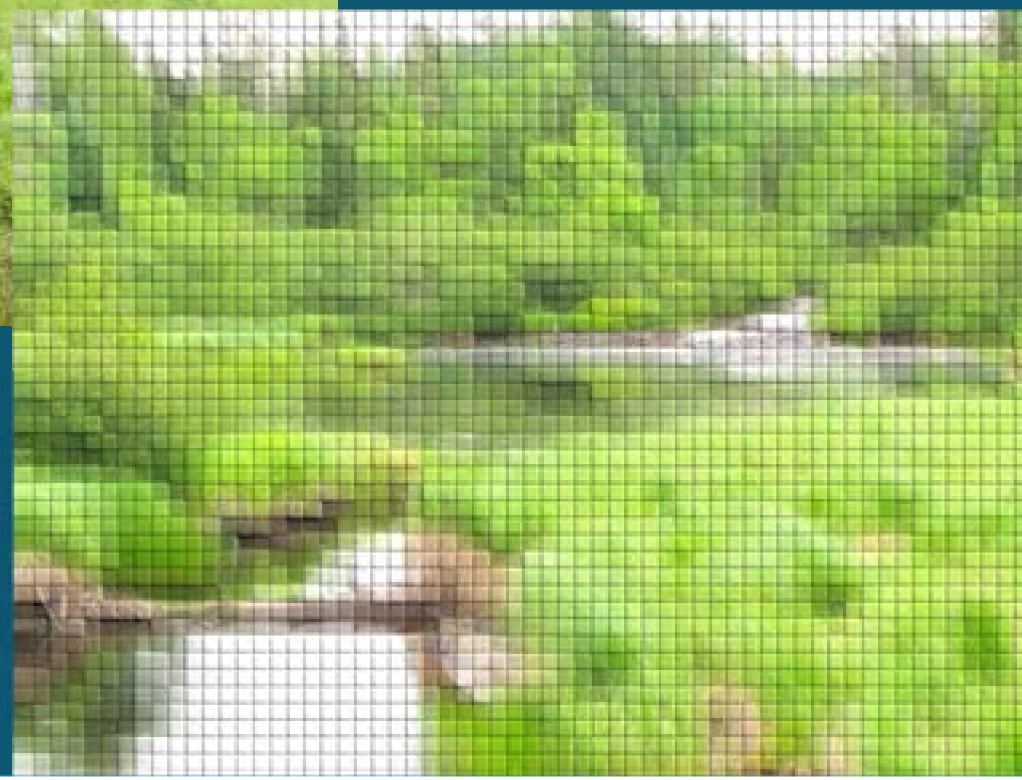


50% HARD ARMORING

Shore Type	Shore Type Count	Total Length (ft)	Total Length (mi)
Beach	54	22048.5	4.2
Boat Launch	13	2178	0.4
Developed	109	49685.8	9.4
Jetty	3	1272.1	0.2
Natural	46	24184.3	4.6
Rip Rap	159	118888.8	22.5
Seawall	83	55266.4	10.5
Seawall/Beachsand	16	7055.4	1.3
Wetland	65	53853.2	10.2
TOTAL	**548**	**334,432.50**	**63.34**

CHAD FIZZELL
WETLANDS GIS SPECIALIST
WETLANDS, LAKES, AND STREAMS UNIT

JEREMY JONES
WETLANDS GIS ANALYST
WETLANDS, LAKES, AND STREAMS UNIT



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MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

WALLOON LAKE,
EMMET COUNTY

1952

↓

2019

GUN LAKE,
BARRY COUNTY

1938

↓

2014

PORTAGE LAKE,
LIVINGSTON COUNTY

1938

↓

2022

AVOIDING AND MINIMIZING ENVIRONMENTAL IMPACTS AT THE INDIVIDUAL PROPERTY SCALE IS IMPORTANT.

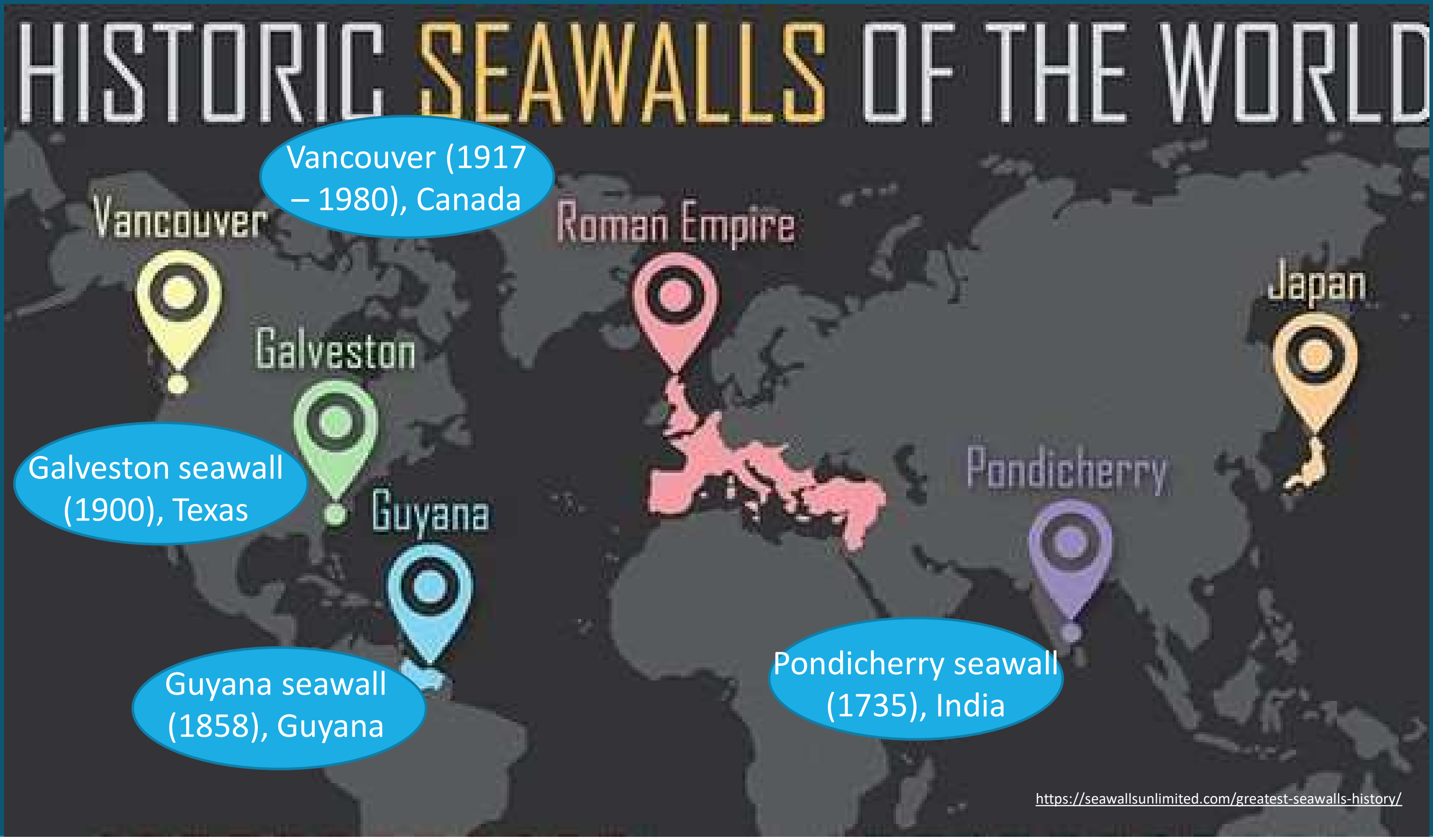
THINK CUMULATIVELY WHEN DESIGNING PROJECTS.

CONSERVING SMALL HABITAT FRAGMENTS HAVE MERIT.

EGLE

"Why are people so drawn to walls?"

FOR MANY PEOPLE, SEAWALLS ARE OFTEN THE FIRST THING THAT COMES TO MIND WHEN THINKING "SHORELINE PROTECTION"



Venice, Italy
Giethoorn, Netherlands
Argentina
Suzhc
https://i.natgeofe.com/n/6ba5ae9f-61e7-4fce-848
Stockholm, Sweden
https://lp-cms-production.imgix.net/image_browser/Original_JoeSills_Suzhou_Tongli_Cana
https://cdn.thecrazytourist.com/wp-
19/04/IMG_1870-1280x920.jpg

WALLS ARE IN OUR HISTORY

“We’ve always done it this way”

BECAUSE SEAWALLS ARE SO COMMON, IT IS OFTEN THE FIRST THING PEOPLE THINK OF WITHOUT UNDERSTANDING THE NEGATIVE IMPACTS

THE WAY WE'VE ALWAYS DONE IT ISN'T WORKING ANYMORE

THE CUMULATIVE IMPACTS OF SEAWALLS ON OUR INLAND LAKES HAVE BEEN SIGNIFICANT. WE'VE REACHED A POINT WHERE THE EDUCATION, TECHNOLOGY, AND INFRASTRUCTURE HAS MADE LESS IMPACTFUL ALTERNATIVES WIDELY AVAILABLE AND ACHIEVABLE

If walls are so bad, why not just make them illegal?

- LARGE SOCIAL CHANGES DO NOT HAPPEN QUICKLY
- EDUCATION IS THE FOUNDATION FOR CHANGE
- THE DEPARTMENT'S STANCE ON SEAWALL PERMITTING HAS EVOLVED BASED UPON DATA AND SCIENCE
- WE'RE NOW AT A POINT WHERE THE SCIENCE DEMONSTRATING THE NEGATIVE IMPACTS OF SHORELINE HARDENING AND THE TECHNOLOGY OF EFFECTIVE, LESS-IMPACTFUL ALTERNATIVES CAN BE APPLIED BROADLY AROUND THE STATE

How has EGLE addressed seawalls?

GRADUAL REGULATORY CHANGES THROUGH MINOR PROJECT CATEGORIES

EDUCATION

WORKING WITH PARTNERSHIPS

3-Tiered Permitting System

Public Notice Projects

$500-$2000

No public notice

Minor Projects

$100

General Permits

$50

Exempt Activities

MP 1. BIOENGINEERING PRACTICES
MP 22. FISH AND WILDLIFE HABITAT STRUCTURES
MP 42. REPLACEMENT OF EXISTING SEAWALLS

Minor Project Category (MP) Updates

- MPS UPDATED AT LEAST EVERY 5 YEARS
- INCORPORATE
  - NEW TECHNOLOGY
  - NEW SCIENCE
  - NEEDS OF PUBLIC AND STAKEHOLDERS
- PUBLIC NOTICED – JUNE 10 – JULY 23
  - EGLE WEBSITES
  - EMAILED TO ALL RESOURCE CONTACTS
- INCORPORATED CHANGES AND PUT INTO EFFECT ON AUG 12, 2021

Replacement of Existing Seawalls – 2021 MP changes

- RIPRAP OR COIR LOG/BIOENGINEERING DEPENDING ON ENERGY LEVEL AND SITE CONDITIONS
- RIPRAP
  - ALONG 100% OF LENGTH ON
  - 1:3 OR SHALLOWER, 6FT INTO WATER
  - MAX 18”
  - TOP OF WALL
- BEST MANAGEMENT PRACTICES
  - REDUCE SEAWALL LENGTH BY 25% AND USE RIPRAP OR BIOENGINEERING MPS FOR REMAINDER
  - COARSE WOODY STRUCTURE
  - MAINTAIN 6FT WIDE NO-MOW ZONE OR NATIVE PLANTED BUFFER – MINIMAL BREAKS ACCEPTABLE TO EXERCISE RIPARIAN RIGHTS
  - OTHER MEASURES APPROVED BY EGLE
- NOT IN WETLAND OR PLACED IN A WAY THAT IMPAIRS SURFACE WATER FLOW IN OR OUT OF WETLAND
- ONLY 1 PERMIT MAY BE AUTHORIZED UNDER THIS MP ON THE SAME PARCEL OF PROPERTY

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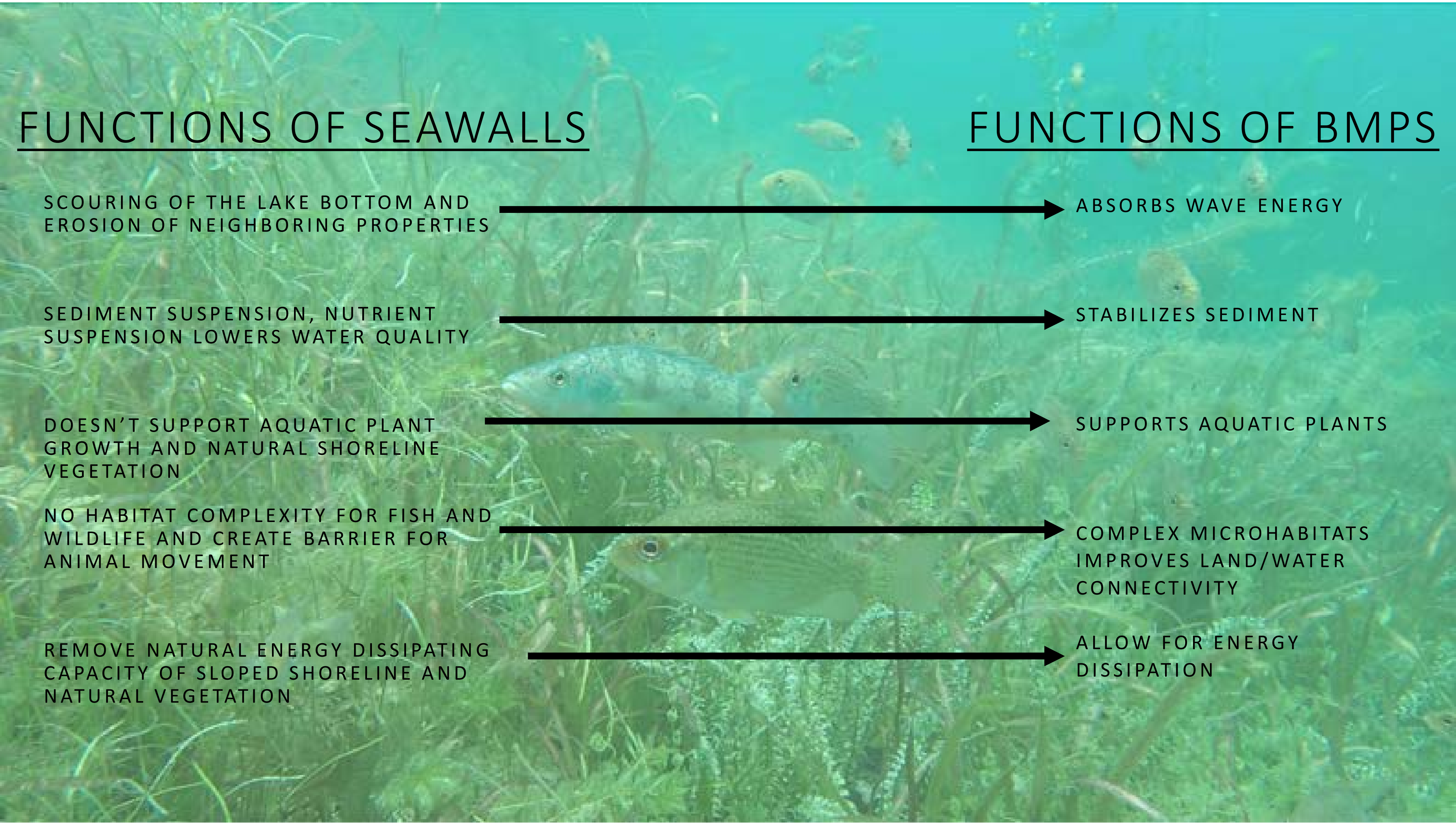
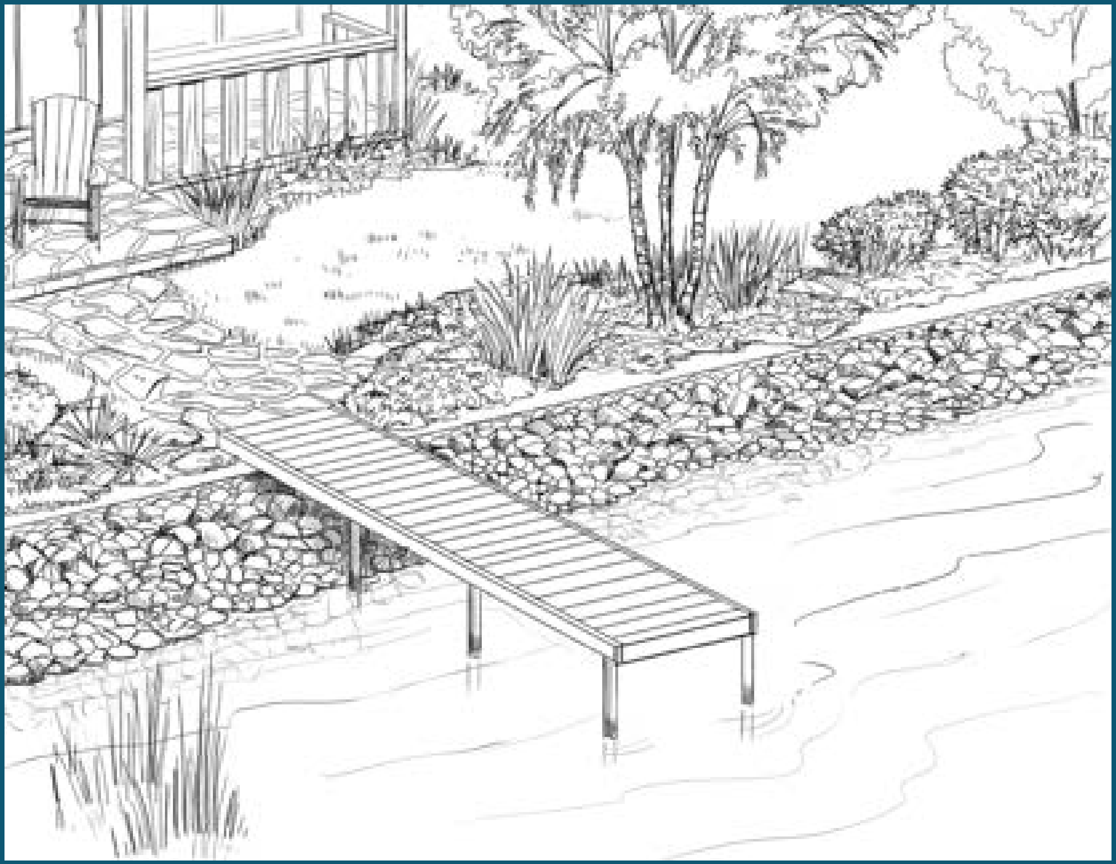
To BMP or not to BMP that is the question

A SEAWALL PROJECT WITH A BMP IS A LESS IMPACTFUL ALTERNATIVE TO A SEAWALL PROJECT WITHOUT A BMP



FUNCTIONS OF SEAWALLS	FUNCTIONS OF BMPS
SCOURING OF THE LAKE BOTTOM AND EROSION OF NEIGHBORING PROPERTIES	ABSORBS WAVE ENERGY
SEDIMENT SUSPENSION, NUTRIENT SUSPENSION LOWERS WATER QUALITY	STABILIZES SEDIMENT
DOESN'T SUPPORT AQUATIC PLANT GROWTH AND NATURAL SHORELINE VEGETATION	SUPPORTS AQUATIC PLANTS
NO HABITAT COMPLEXITY FOR FISH AND WILDLIFE AND CREATE BARRIER FOR ANIMAL MOVEMENT	COMPLEX MICROHABITATS IMPROVES LAND/WATER CONNECTIVITY
REMOVE NATURAL ENERGY DISSIPATING CAPACITY OF SLOPED SHORELINE AND NATURAL VEGETATION	ALLOW FOR ENERGY DISSIPATION



6FT WIDE BUFFER ALONG ENTIRE SEAWALL LENGTH

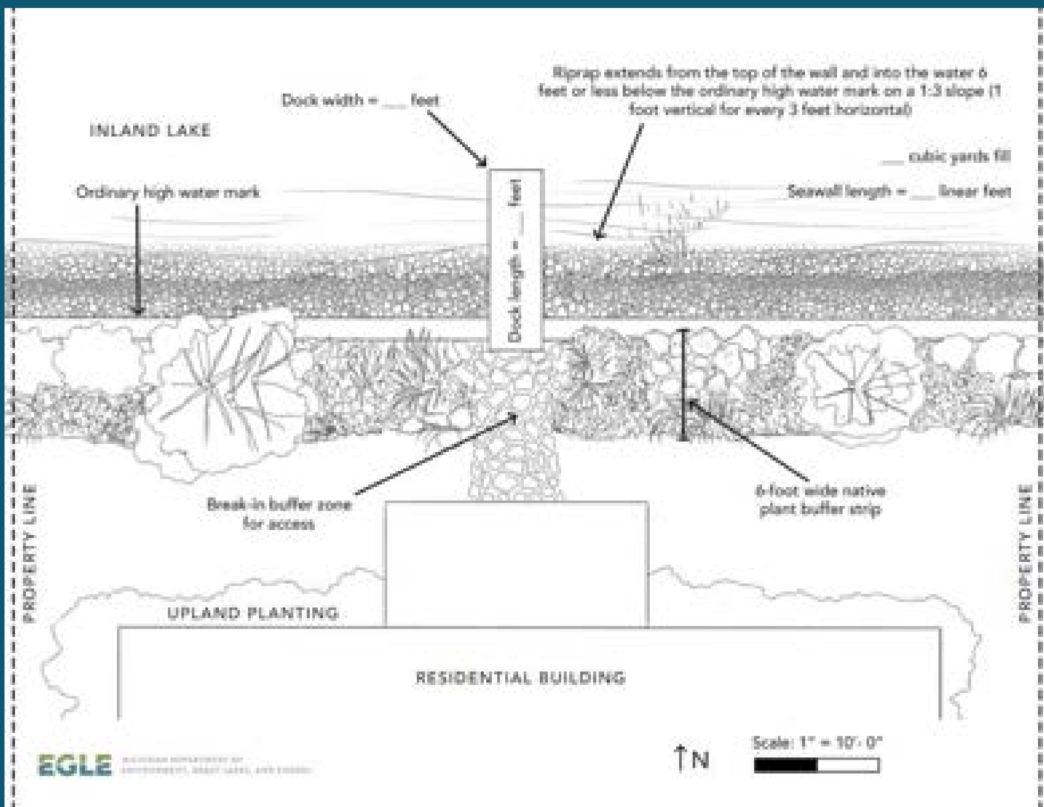
SHORELINE WOODY STRUCTURE

REDUCE SEAWALL LENGTH BY AT LEAST 25% AND USE RIPRAP OR BIOENGINEERING FOR THE REMAINDER

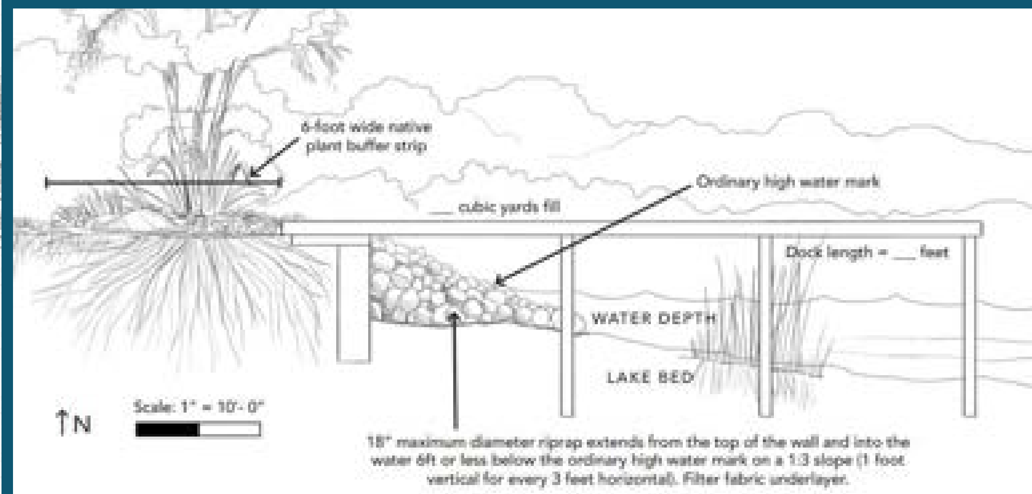
OTHER MEASURES APPROVED BY EGLE

6ft Buffer along entire seawall length

- DIFFERENT BUFFER ORIENTATIONS ARE OKAY IF DIRECTLY BEHIND THE FULL LENGTH OF THE WALL IS NOT POSSIBLE
  - MUST PROVIDE A CLEAR AND DIRECT BENEFIT
  - SWALE OR DISCHARGE AREAS
- PLANTING OR SEEDING IS ACCEPTABLE
- PLANTING PLAN AND SPECIES LIST



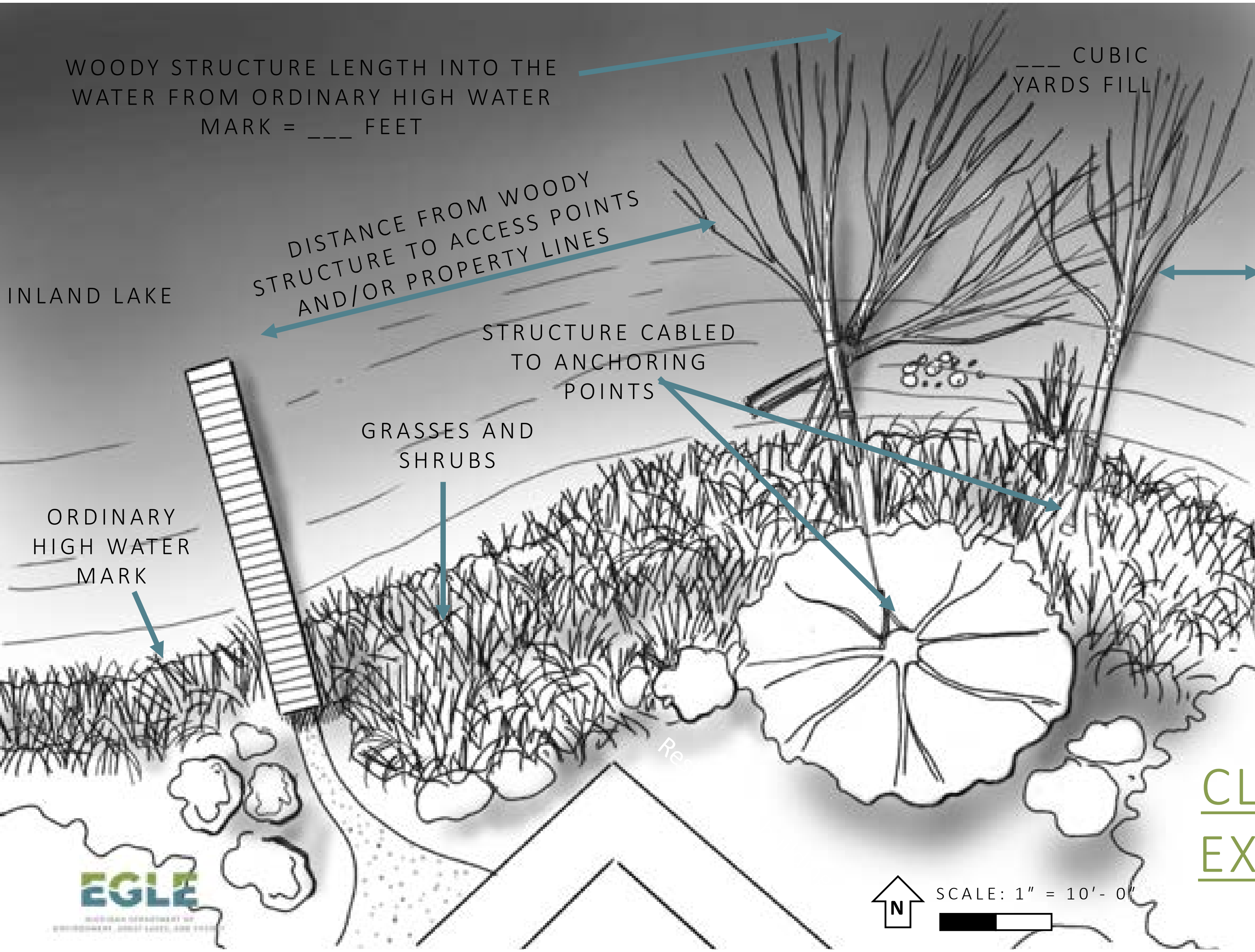
INLAND LAKE
Dock width = ___ feet
Riprap extends from the top of the wall and into the water 6 feet or less below the ordinary high water mark on a 1:3 slope (1 foot vertical for every 3 feet horizontal)
___ cubic yards fill
Seawall length = ___ linear feet
Ordinary high water mark
Dock length = ___ feet
Break-in buffer zone for access
6-foot wide native plant buffer strip
PROPERTY LINE
PROPERTY LINE
UPLAND PLANTING
RESIDENTIAL BUILDING
EGLE
↑N
Scale: 1" = 10'- 0"



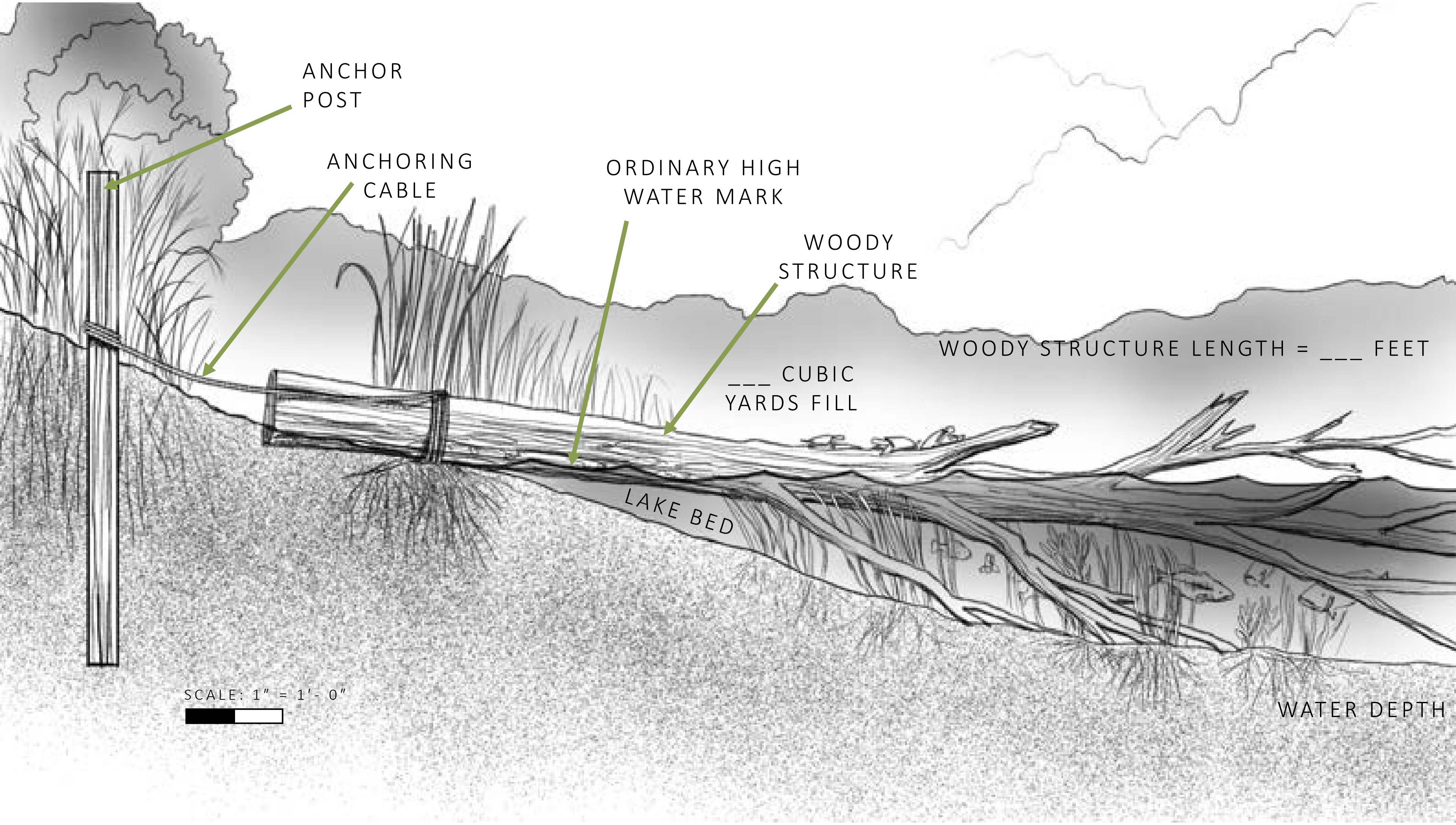
6-foot wide native plant buffer strip
Ordinary high water mark
___ cubic yards fill
Dock length = ___ feet
WATER DEPTH
LAKE BED
↑N
Scale: 1" = 10'- 0"
18" maximum diameter riprap extends from the top of the wall and into the water 6ft or less below the ordinary high water mark on a 1:3 slope (1 foot vertical for every 3 feet horizontal). Filter fabric underlayer.

Shoreline woody structure

- PROJECT DESIGNS THAT MIMIC NATURAL PROCESSES
- IN GENERAL – 1 SINGLE TREE PER 25FT OF SEAWALL SINGLE OR CLUSTERED
- ACCEPTABLE TYPES
  - FISH STICK CLUSTER
  - SINGLE FISH STICK
  - TURTLE LOGS
- NOT IMPEDING NAVIGATION
- ANCHORED SECURELY



[CLICK HERE FOR EXAMPLE PLANS]



ANCHOR POST
ANCHORING CABLE
ORDINARY HIGH WATER MARK
WOODY STRUCTURE
WOODY STRUCTURE LENGTH = ___ FEET
___ CUBIC YARDS FILL
LAKE BED
WATER DEPTH
SCALE: 1" = 1'- 0"

Example designs – Fish Sticks cluster


Freshly cut trees (within 3mo)
3-5 trees, 12”-16” diameter at base
Attached securely together and to shoreline/bottomland
Do not use trees that are currently along the shoreline!

Example designs – Single Fish Stick series


Freshly cut trees (within 3mo)
1 tree, 12”-16”diameter at base
Attached securely together and to shoreline/bottomland
Do not use trees that are currently along the shoreline!

Example designs – Turtle Log series

Example designs – Turtle Log series

1 tree, 12”-16”diameter at base

Freshly cut logs (within 3mo)

Attached securely together and to shoreline/bottomland

Do not use trees that are currently along the shoreline!

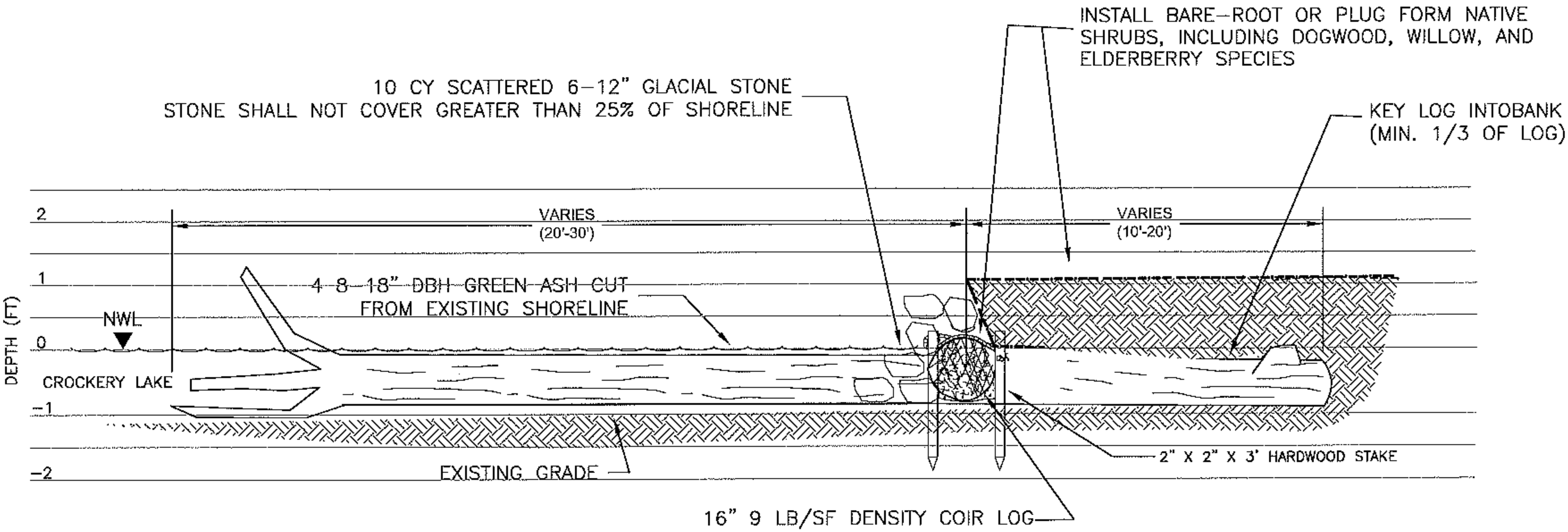

Sat Jul 23 2022
nearmap

STAKING TREES INTO BOTTOMLAND AND SHORELINE

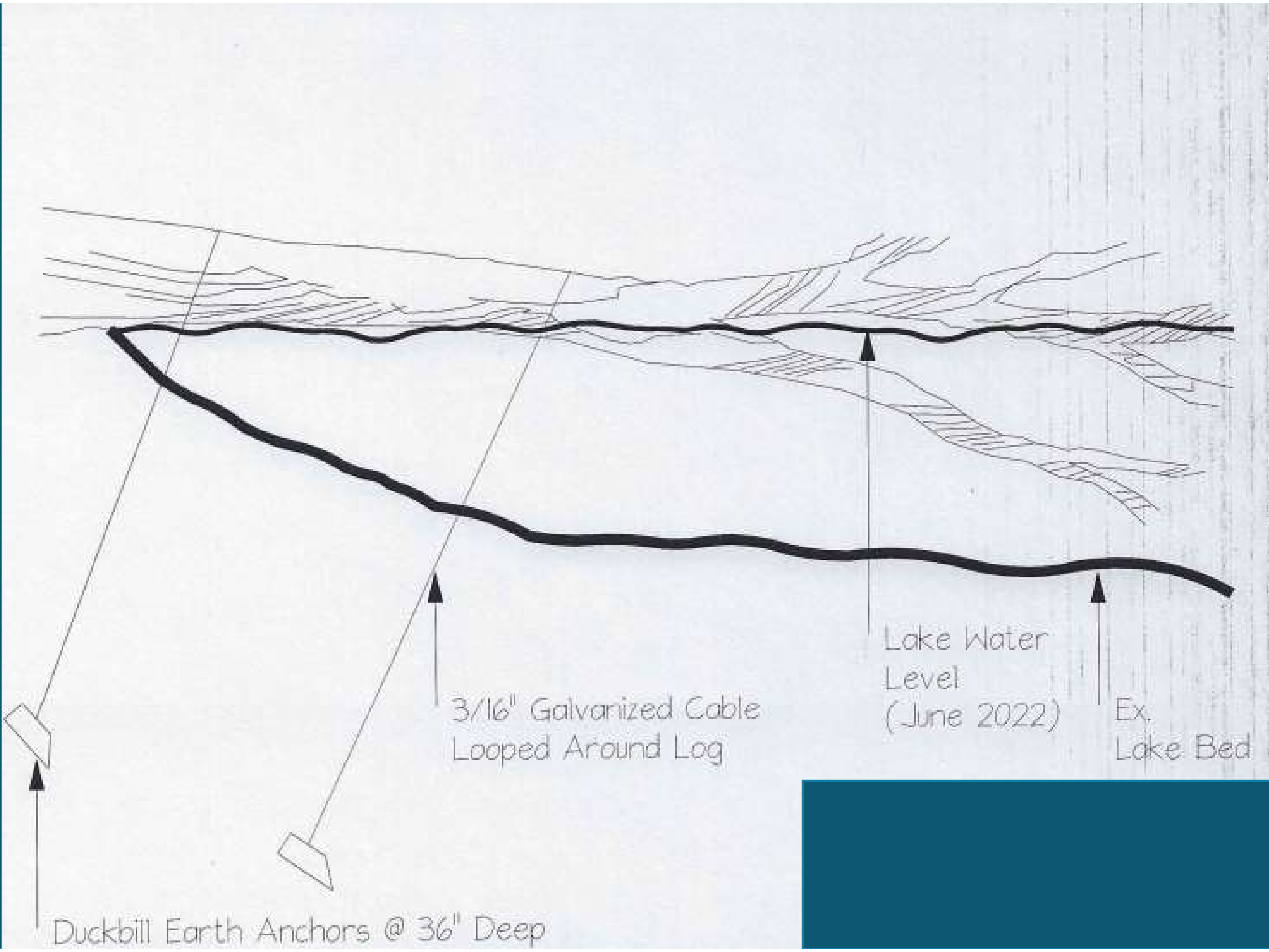
CABLING TREES INTO SECURE ANCHOR-POINT ON SHORE

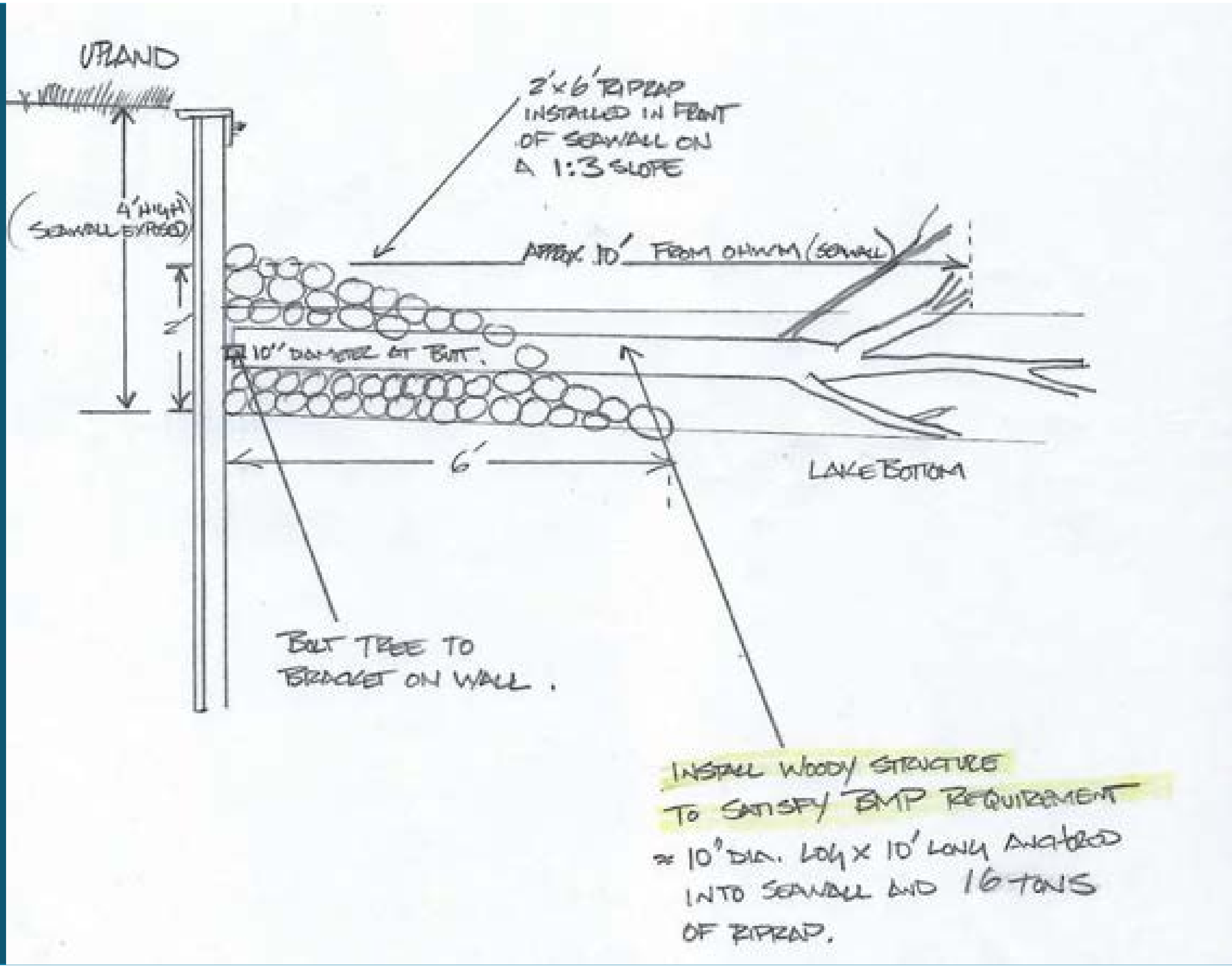
TREES KEYED-IN TO SHORELINE

HIGHER-ENERGY DESIGN

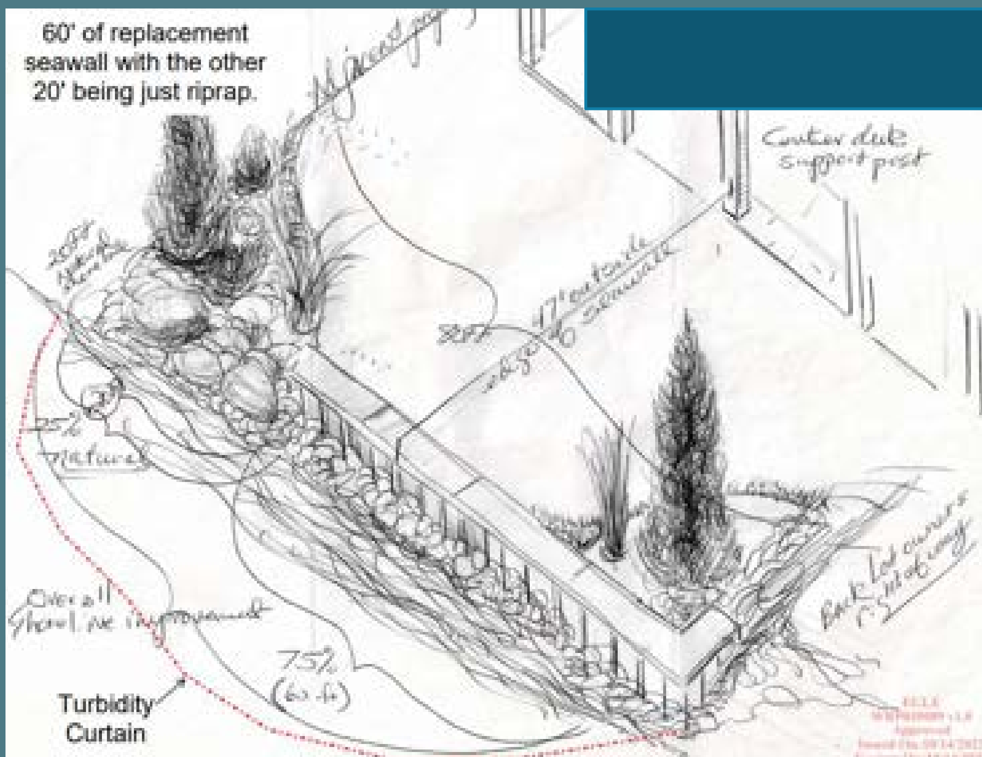


EGLE


Lake Water
Level
(June 2022)
3/16" Galvanized Cable
Looped Around Log
Ex.
Lake Bed
Duckbill Earth Anchors @ 36" Deep

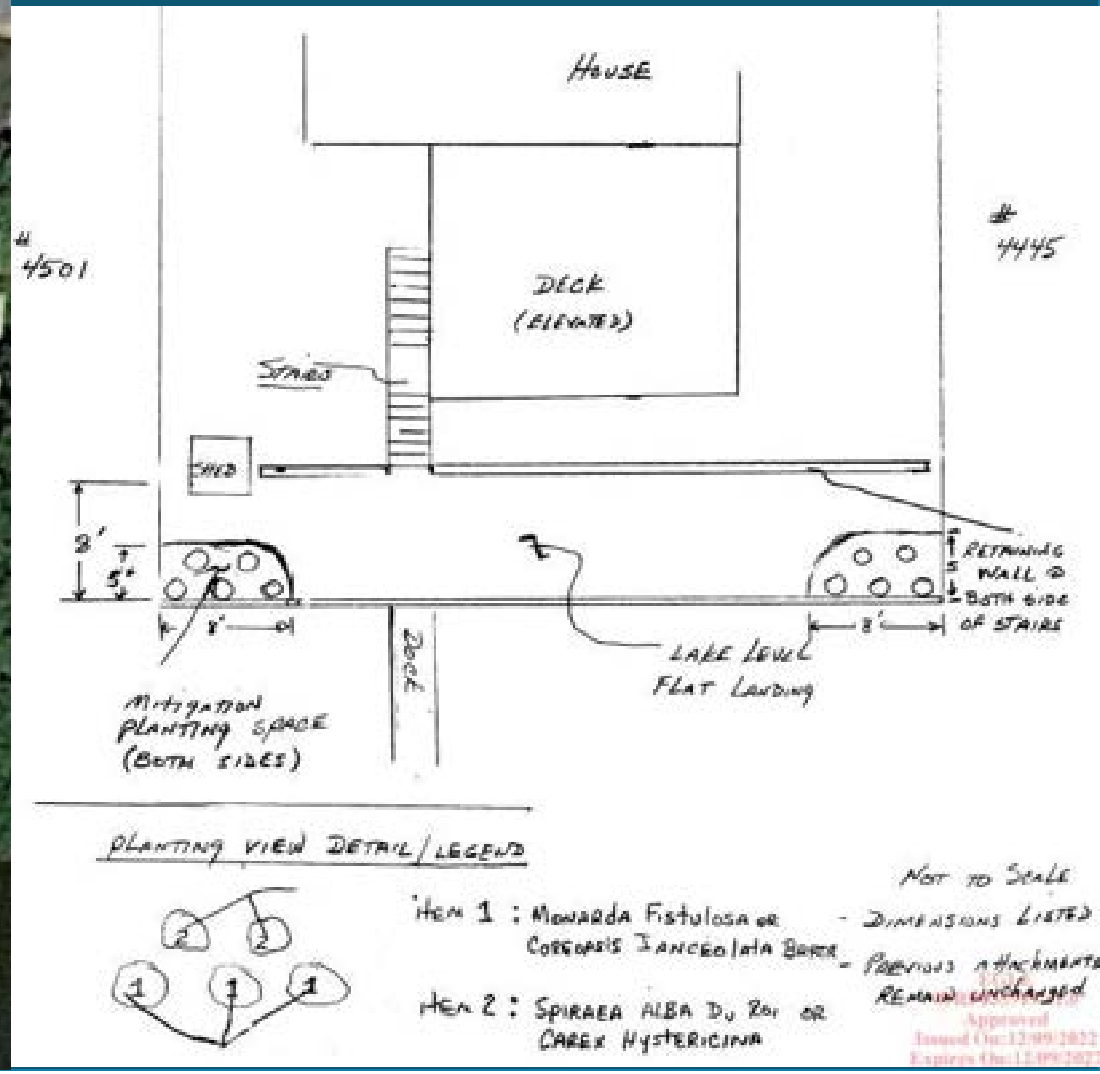

UPLAND
2'x6' RIPRAP
INSTALLED IN FRONT
OF SEAWALL ON
A 1:3 SLOPE
4' HIGH
(SEAWALL EXPOSED)
APPROX. 10' FROM OHWM (SEAWALL)
2'
10" DIAMETER AT BUTT.
6'
LAKE BOTTOM
BOLT TREE TO
BRACKET ON WALL.
INSTALL WOODY STRUCTURE
TO SATISFY BMP REQUIREMENT
* 10' DIA. LOG x 10' LONG ANCHORED
INTO SEAWALL AND 16 TONS
OF RIPRAP.

Wall reduction and other methods



- WALL REDUCTION
  - REDUCED AREA SHOULD FOLLOW RIPRAP OR BIOENGINEERING MPS
  - SHORELINE CAN BE PULLED BACK
- OTHER METHODS CAN INCLUDE
  - DESIGNS TO ACCOMMODATE PROPERTY-SPECIFIC ISSUES AND WANTS/NEEDS OF THE PROPERTY OWNER
  - OTHER BMPS NOT SPECIFICALLY LISTED THAT HAVE A CLEAR AND DIRECT BENEFIT TO THE LAKE
    - WATER QUALITY
    - HABITAT
    - LAND/WATER CONNECTIVITY

EVERY PROPERTY CAN DO SOMETHING



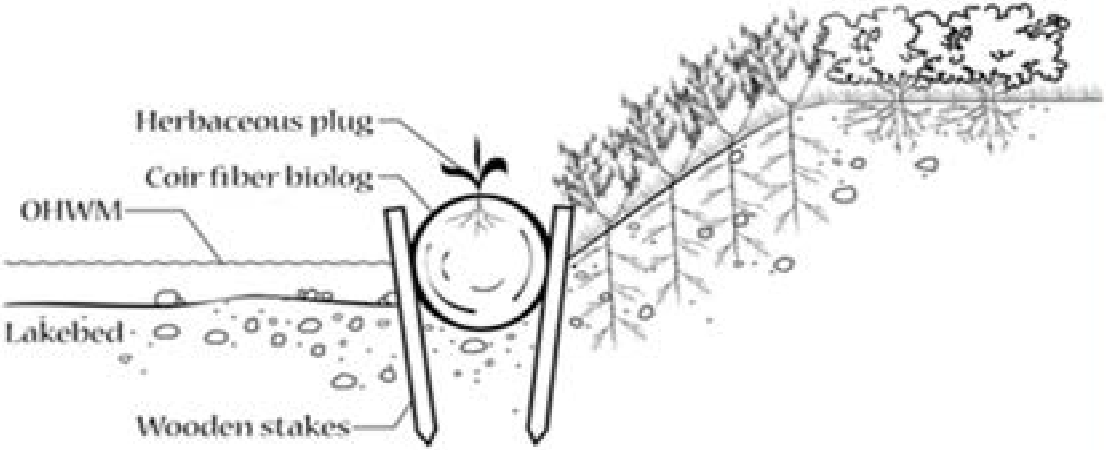
Bioengineering

Lower vs Higher Energy Sites
(See MP category document for details)

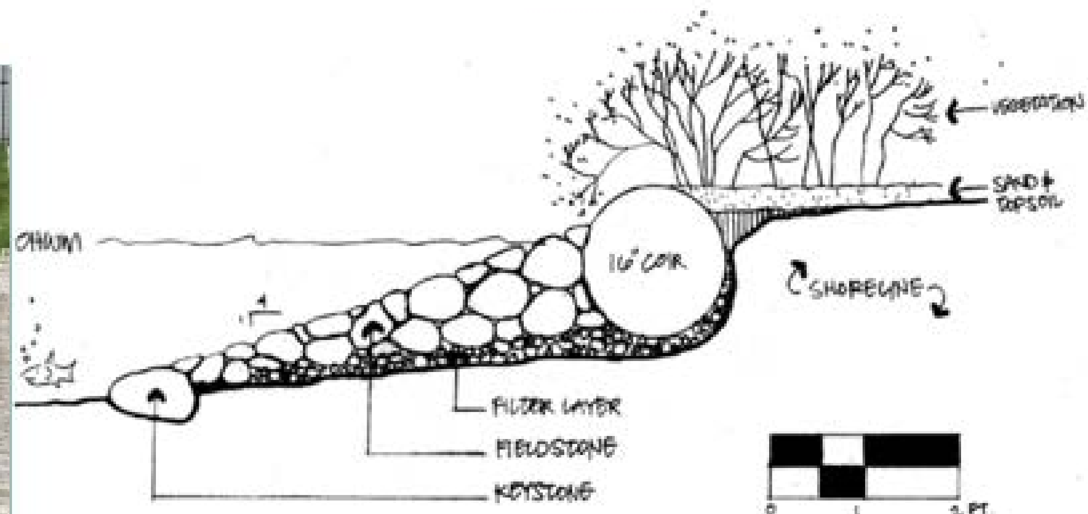
**Applicant must provide documentation of higher energy site conditions

- ≤ 1 MILE MAXIMUM FETCH
- NOT ADJACENT TO A HEAVILY USED BOATING ACCESS POINT OR MARINA
- NOT LOCATED ON A UNPROTECTED POINT, HEADLAND, OR ISLAND WHERE EROSIVE FORCES ARE HIGH
- SITE-SPECIFIC CONDITIONS WARRANT BIOENGINEERING – MUST BE NECESSARY TO PREVENT OR CONTROL EROSION

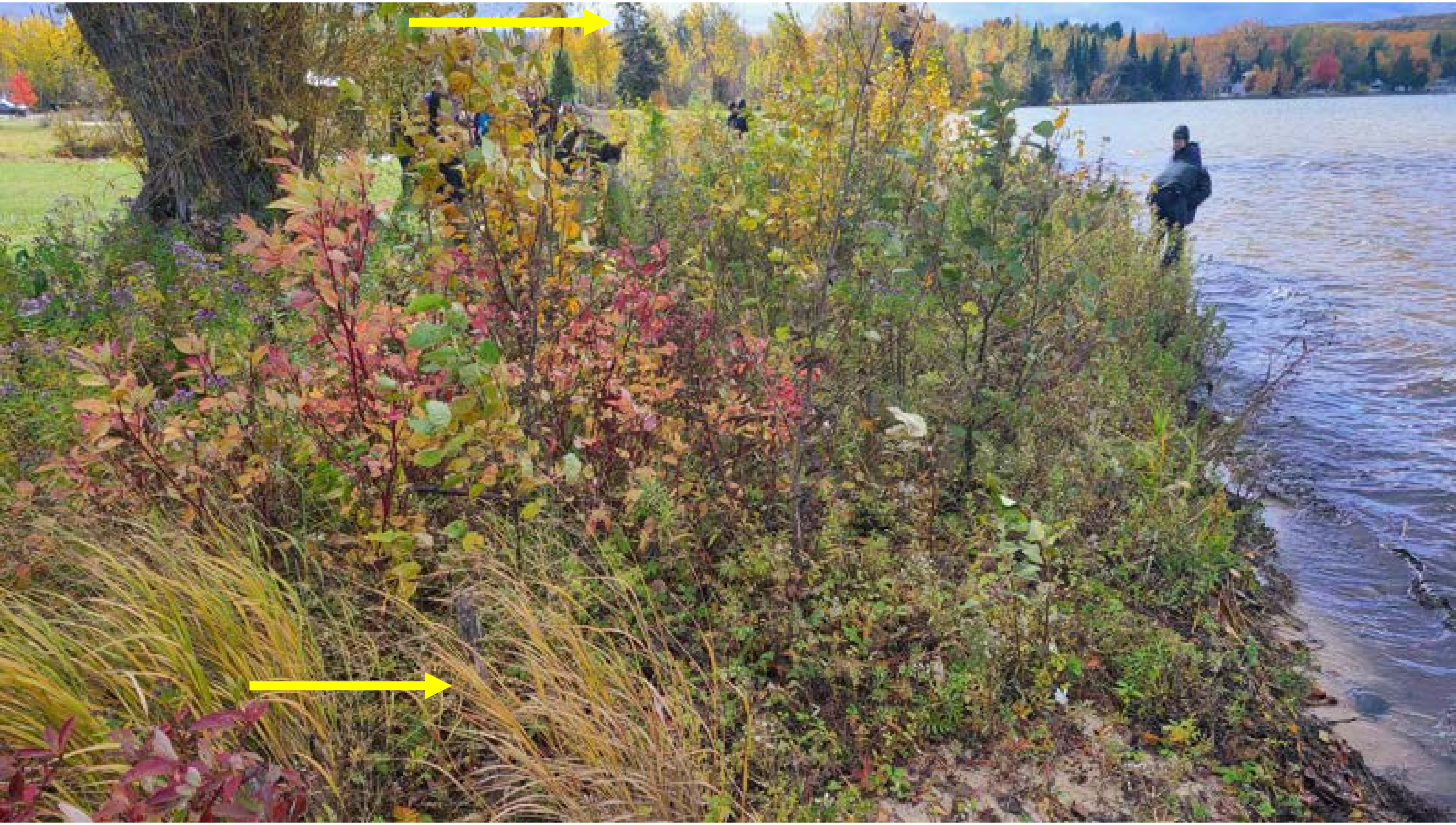
- >1 MILE MAXIMUM FETCH
- ADJACENT TO A HEAVILY USED BOATING ACCESS POINT OR MARINA
- LOCATED ON AN UNPROTECTED POINT, HEADLAND, OR ISLAND WHERE EROSIVE FORCES ARE HIGH
- EVIDENCE OF ONGOING EROSION OR IS WHERE AN EXISTING SEAWALL IS BEING REPLACED WITH BIOENGINEERING



Biolog Placement at Bank Toe




07/19/2013



THE SHORELINE IS NOT JUST PROPERTY!

- TRANSITION AREA THAT PROVIDES HABITAT AND CONTRIBUTES TO HEALTHY LAKE ECOSYSTEM
- SHORELINE DESIGN SHOULD ‘GIVE BACK’ <u>AND</u> INCORPORATE LANDOWNERS USE
- PERCEPTION SHIFT / CULTURAL CHANGE --- NORMALIZE NATIVE PLANTS AND WOODY STRUCTURE

Resources

DOCUMENTS AND WHERE TO GO FOR SUPPORT

BIOENGINEERING STORYMAP

BMP FACT SHEETS

ILLUSTRATION / PLAN FACT SHEETS

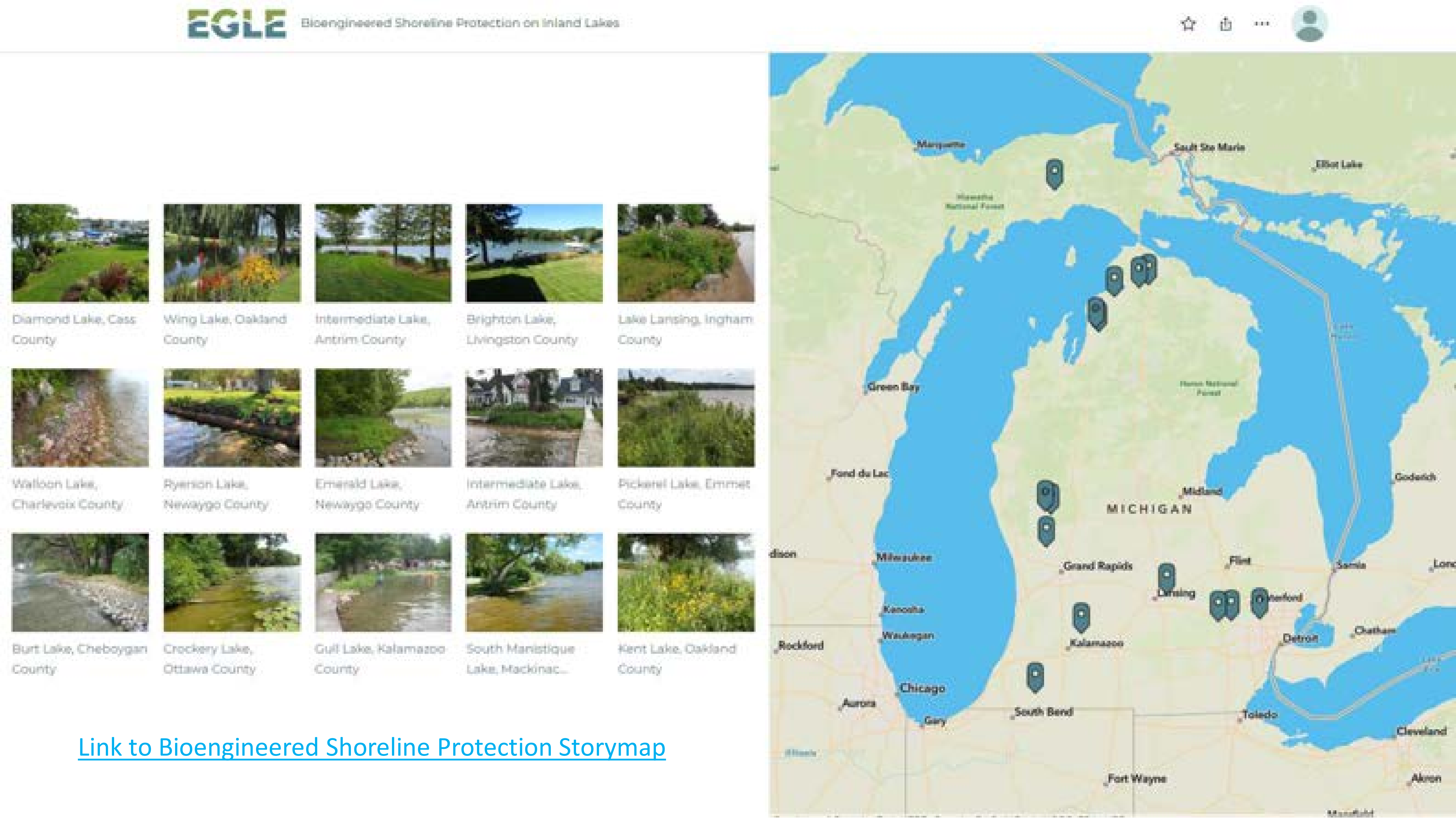
PERMITTING AND PROGRAM INFO

PRE-APPLICATION MEETING INFO

MICHIGAN NATURAL SHORELINE PARTNERSHIP

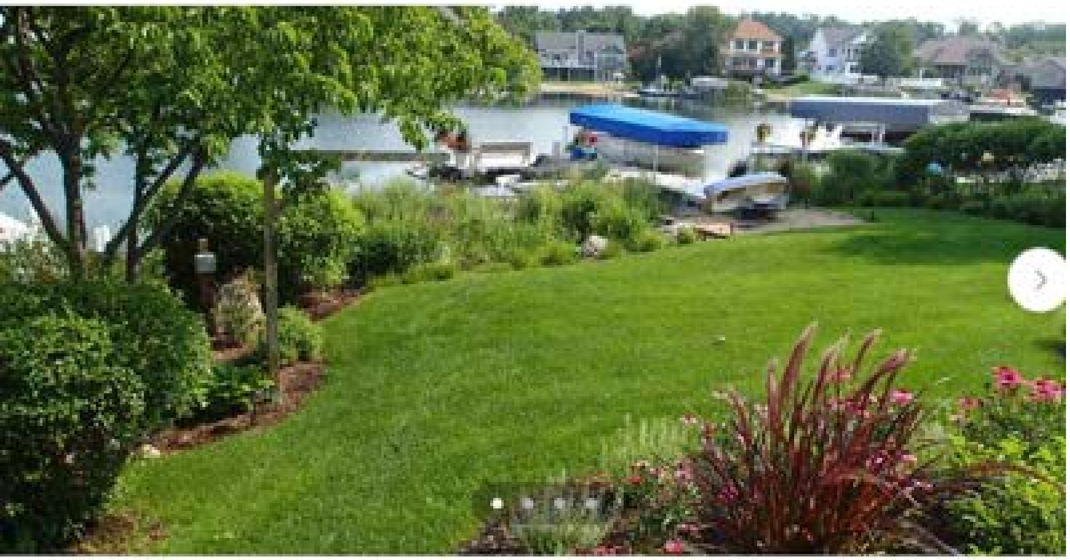
WOODY STRUCTURE AND PLANT INFO

LINK:
EGLE SHORELINE PROTECTION



[Link to Bioengineered Shoreline Protection Storymap]

EGLE Bioengineered Shoreline Protection on Inland Lakes



Diamond Lake, Cass County

Picture Description: The first and second pictures show the installed bioengineering project in 2021. The third image is the plans submitted with the permit application. The last picture shows this shoreline in 2017 before bioengineering was installed.

Design: Bioengineering

Installation date: 2017

Fetch and boating activity: Maximum fetch = 0.24 miles. Average depth across maximum fetch line = 1.6 feet. Maximum wave height = 0.47 feet. Site is near the inside of a smaller bay that is connected to a larger lake. Boat speeds are generally low and dominant watercraft consist mainly of pontoon boats, smaller vessels, and fishing boats.

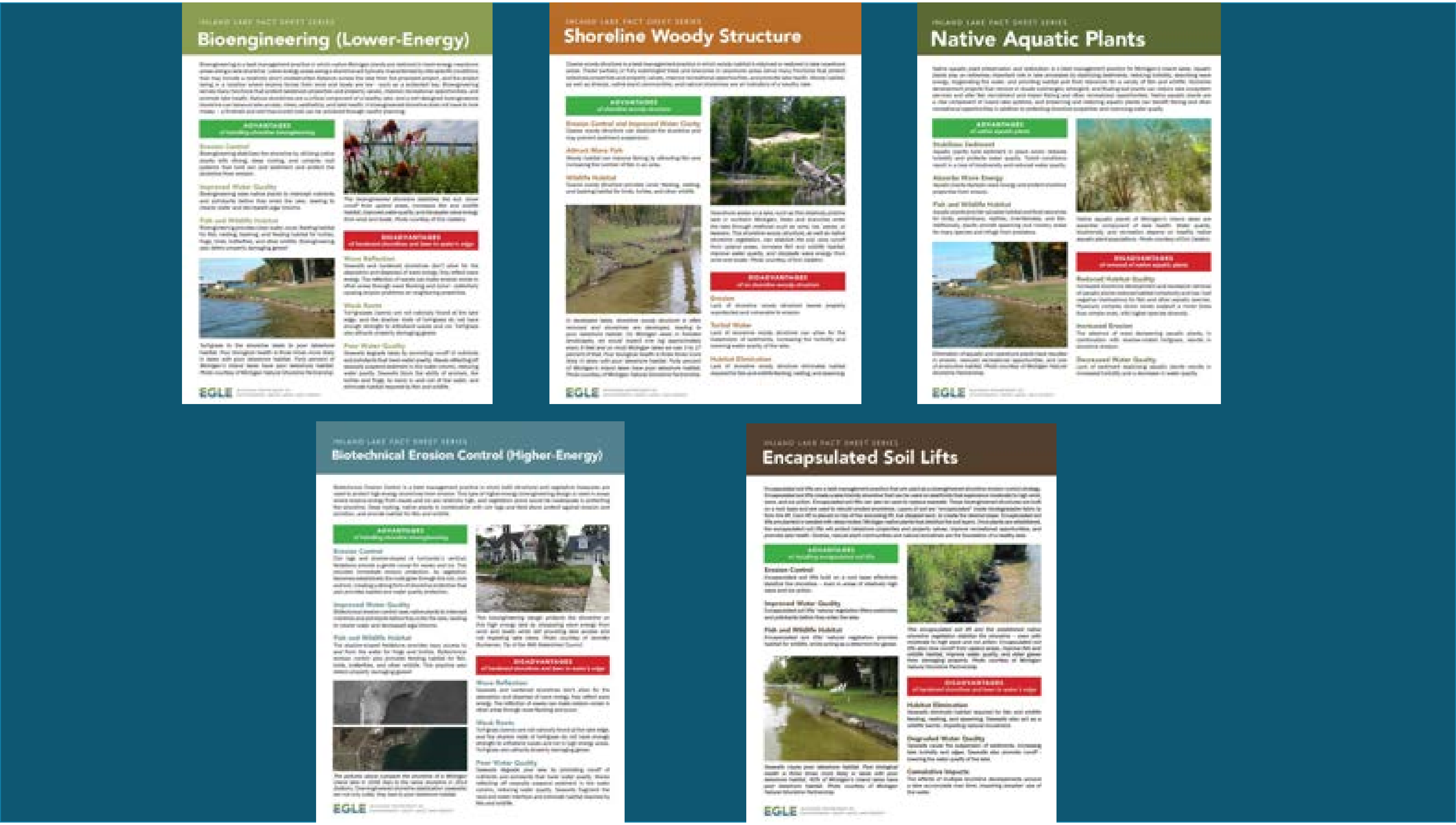
Consultant/Contractor: Upstream Waters Landscape, then North Star Landscape Design & Installation

Installation cost: ~$277 per linear foot. Included in that cost was the demolition and removal of the existing concrete seawall

Plant list: *Carex bricknelli*, various sedges, lilies, and vegetated coir mats, in addition to mixed upland plantings of native and hybrid plants.

Yearly maintenance activity: Weeding and plant trimming

Yearly maintenance cost: Approximately $1,500

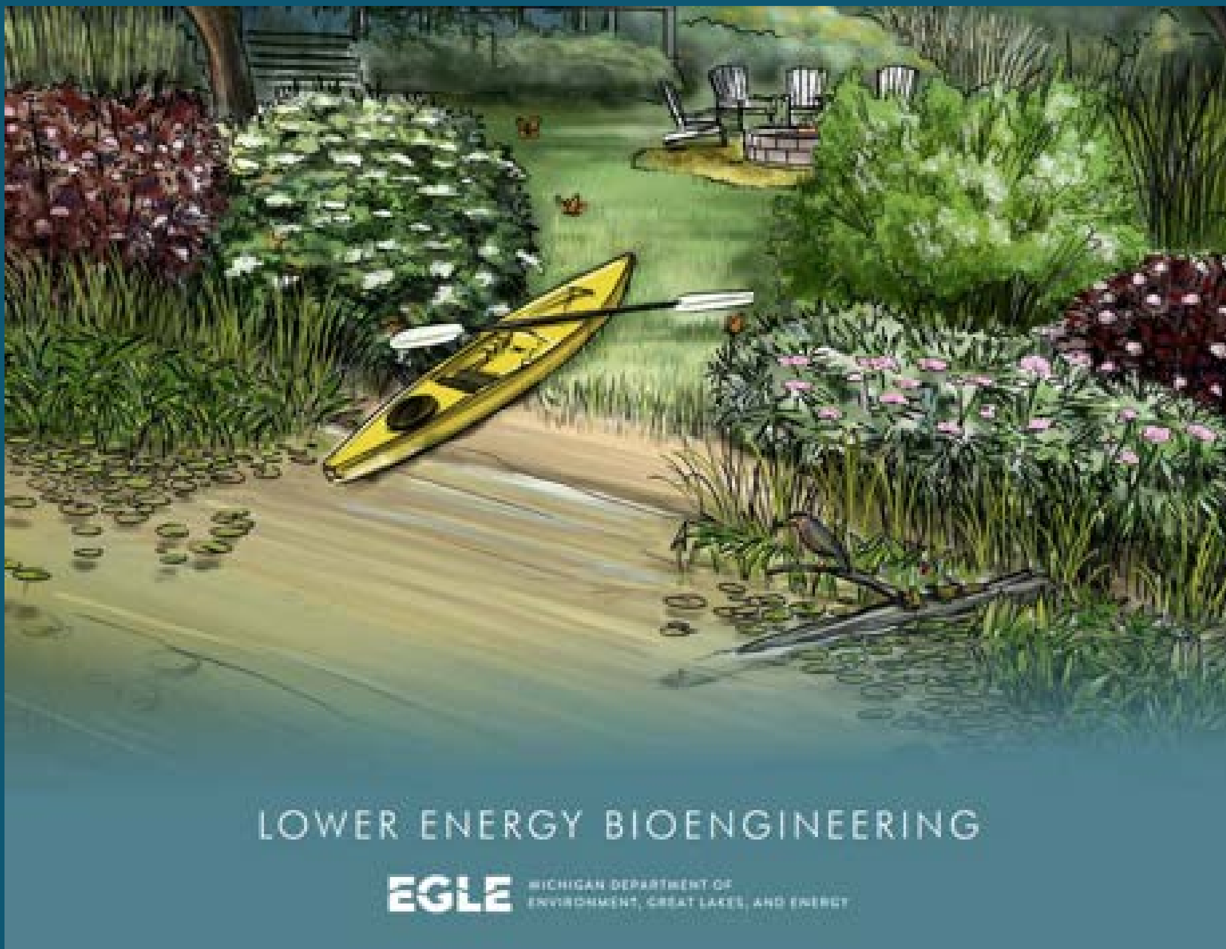

INLAND LAKE FACT SHEET SERIES
Bioengineering (Lower-Energy)

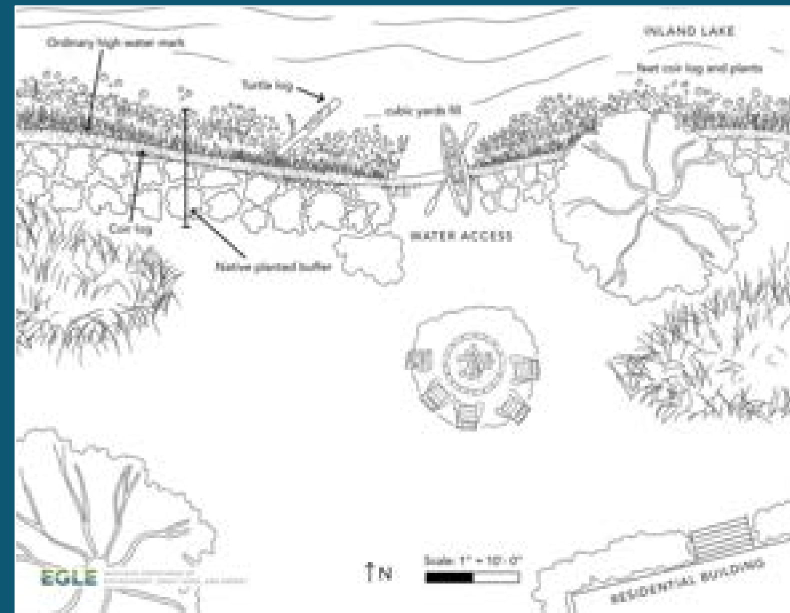
INLAND LAKE FACT SHEET SERIES
Shoreline Woody Structure

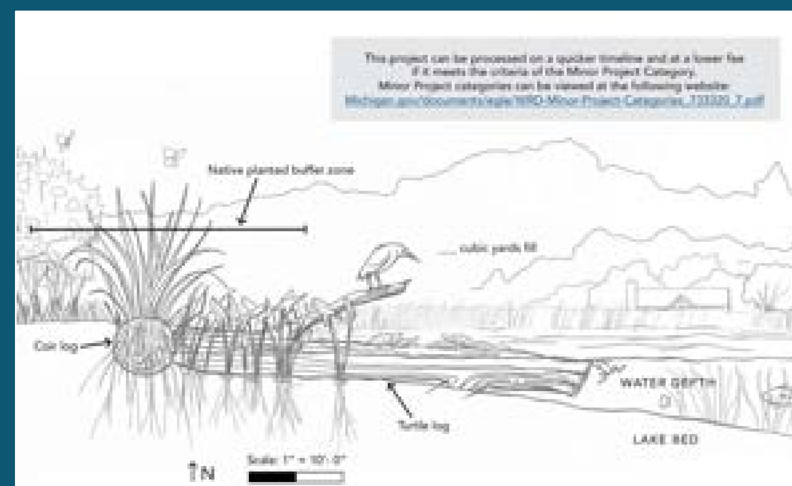
INLAND LAKE FACT SHEET SERIES
Native Aquatic Plants

INLAND LAKE FACT SHEET SERIES
Biotechnical Erosion Control (Higher-Energy)

INLAND LAKE FACT SHEET SERIES
Encapsulated Soil Lifts


LOWER ENERGY BIOENGINEERING
EGLE
MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY


INLAND LAKE
Ordinary high water mark
Turtle log
___ feet coir log and plants
___ cubic yards fill
Coir log
Native planted buffer
WATER ACCESS
EGLE
N
Scale: 1" = 10'- 0"
RESIDENTIAL BUILDING


This project can be processed on a quicker timeline and at a lower fee
if it meets the criteria of the Minor Project Category.
Minor Project categories can be viewed at the following website:
Michigan.gov/documents/egle/WRD-Minor-Project-Categories_723320_7.pdf
Native planted buffer zone
___ cubic yards fill
Coir log
WATER DEPTH
Turtle log
LAKE BED
N
Scale: 1" = 10'- 0"

EGLE

MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

ERIC CALABRO | CALABROE@MICHIGAN.GOV