WAKESURFING ORDINANCES

ADDRESSING ENVIRONMENTAL CONCERNS AND THE SAFETY AND ENJOYMENT OF OTHERS

Carol Wood Phillips

BS Civil Engineering

MS Environmental Engineering

Former Registered Professional Engineer

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SHORE DAMAGE FROM SURFBOATS INCLUDES

- Moored boats tossed and damaged
- Damage to docks & structures
- Shoreline erosion

These are the problems you hear most about, because they are the most visible.

But that's just the tip of the iceberg!

ORDINANCES SHOULD ADDRESS:

- Damage to shorelines, docks, and moored boats
- Damage to lakebed and fish & wildlife habitats
- Water quality problems
- Safety and enjoyment of others
- Invasive species (ballast systems don’t drain completely)
- And, provide surf zones where these issues can be managed

AQUATIC INVASIVE SPECIES (AIS) SPREAD VIA BALLAST SYSTEMS

Root Cause: Manufacturers designed ballast systems that don't drain completely

(Evidenced by the fact that manufacturers say to add gallons of antifreeze to ballast system in winter)

Secondary Cause: Wisconsin doesn't enforce existing laws requiring draining completely

Result: Threat that AIS will spread via ballast systems. Some options include:

Default: Ignore AIS threat. When AIS occur, local and state taxpayers pay to remediate. There is no way to eliminate some AIS, like spiny waterfleas.

Option 1: Towns try to solve manufacturers' problem by trying to decontaminate complicated ballast systems and trying to make all ballasted boats visit decon stations. Local taxpayers pay.

Option 2: Towns adopt ordinances prohibiting lakewater ballast until manufacturers solve their own problem and the DNR has a way to confirm boats comply, and there is funding.

WHAT DO THE WAKE WAVES LOOK LIKE?

The surfboat's wake can be 3-4 feet high or more where surfing, about 10-15' behind the boat

The V-shaped wave pattern moves away from the boat's path and toward shore and other boaters

Waves are 22 inches high when reaching red line, 50’ from boat path

The wake breaks close to the boat (whitewater in photo) and it loses much height and energy quickly.

As the wake waves move away from the boat’s path, they dissipation some.

But, waves are still 16 inches high when 200’ from the boat’s path!

HOW DO WAVE HEIGHTS FOR SURFING COMPARE TO CRUISING/SKIING?

Distance from boat's path	Wave Height	
	Surfing (~11 mph)	Skiing or Cruising (~25mph)
10'	26"	**15"**
100'	20"	10"
200'	**16"**	7"
300'	13"	5"

Wave heights are from the Water Sports Industry Association (WSIA) study by Clifford Goudey, 2015, p iv. He didn't measure more than ~ 300' from the boat's path, but data appears generally consistent with the U of MN study.

Although the WSIA/Goudey data appears reasonable, there are problems with the analysis and conclusions.

UNIVERSITY OF MINNESOTA ST. ANTHONY FALLS LAB STUDY– PUBLISHED FEBRUARY 2022

Surfing waves are 6-12 times more powerful than ski boat waves.

A wakeboat in surf mode (top photo) would need to stay **over 600'** from shore to allow the wake waves to weaken enough to be similar to those of a ski boat (bottom) 200' from shore.

This crowd funded peer reviewed study justifies requiring a distance from shore of 600' or more in an ordinance.

Ordinances should also have:

- minimum depth (at least 20')
- minimum lake size (1500 acres?)
- manage AIS in ballast systems

HOW DOES WSIA's SUGGESTED 200' SETBACK MEASURE UP?

16" = height of surf boat's waves 200' from boat's path (WSIA)

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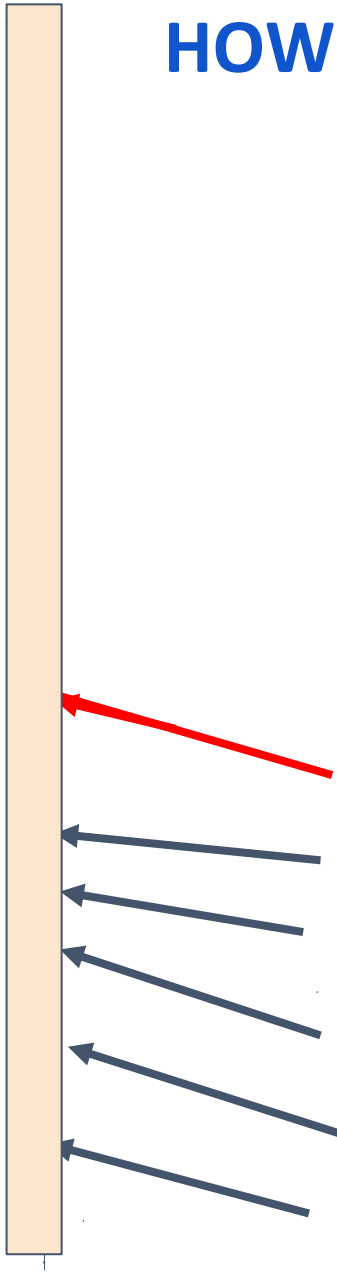


16" = height of surf boat waves 200' from boat's path (WSIA)

12" = Typical freeboard (height above water) small fishing boat

11" = Wind waves, 1 mile open water, 30 mph sustained wind

10" = Typical canoe freeboard

7" = Typical kayak freeboard

2-8"= Typical height above water for loon eggs

WHAT WOULD THE NORTHWOODS BE WITHOUT LOONS!

Loon eggs are just inches above water, so loons build nests in areas sheltered from wind driven waves

Eggs hatch in June - early July

Big wakes wash over the nests, chilling or toppling the eggs.

Young chicks are vulnerable to large wakes.

BIG WAVES DAMAGE DOCKS AND MOORED BOATS

As waves pass under the dock, the upward force can lift deck boards or entire sections of deck right off.

Fastening deck panels makes it worse, because then the wave pushes on the entire dock as a unit, posts and all.

The breaking waves scour the lakebed, eroding near the posts.

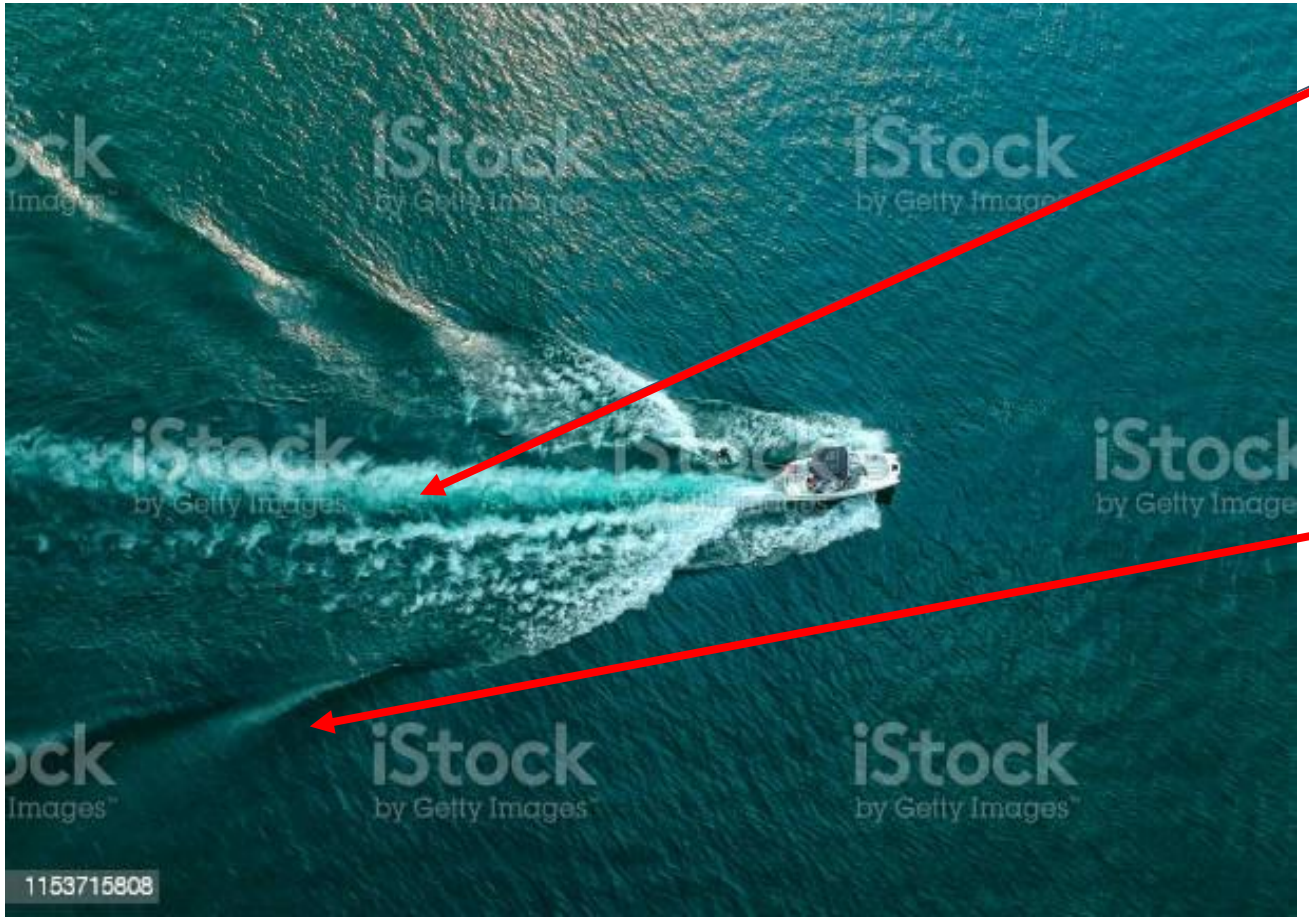
It's a perfect combination for destroying docks; eroding, lifting, plus moored boats banging against the dock.

Before Rhine (near Sheboygan) passed their ordinance, moored boats were damaged and residents had to pile cinder blocks on their docks to hold them in place.

Floating docks are damaged also.

WHAT'S HAPPENING UNDERWATER?

IT'S A ONE-TWO PUNCH!

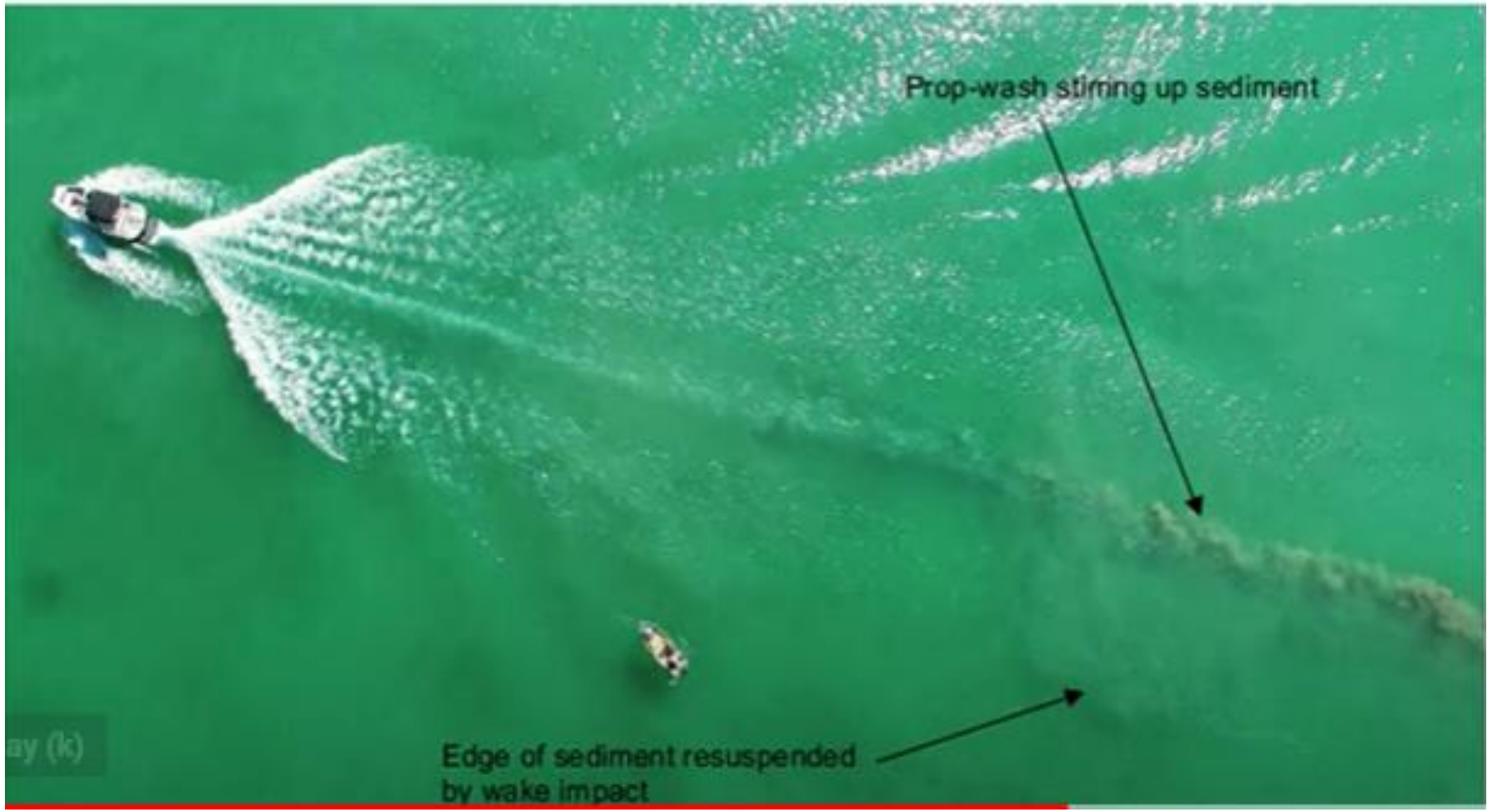


Damage is caused two very different ways:

First, propeller wash directly under the boat's path can scour the lakebed at least 20 feet deep, (maybe much deeper).

Second, the waves have underwater energy. Lakebed is disturbed as waves move toward shore and reach water about 10' deep or deeper.

FIRST PUNCH:
THE PROPELLER WASH FROM THE POWERFUL MOTOR AND DEEP DOWNWARD ANGLED PROPELLER



Sediment is disturbed

Plants damaged or uprooted

Fish and wildlife habitat are destroyed

Phosphorus, mercury, and other pollutants are freed

This photo shows what just 20 seconds of surfing can do.

WITH THIS MUCH DAMAGE IN JUST 20 SECONDS, IMAGINE THE HARM BY THE TIME THEY ARE DONE FOR THE DAY!

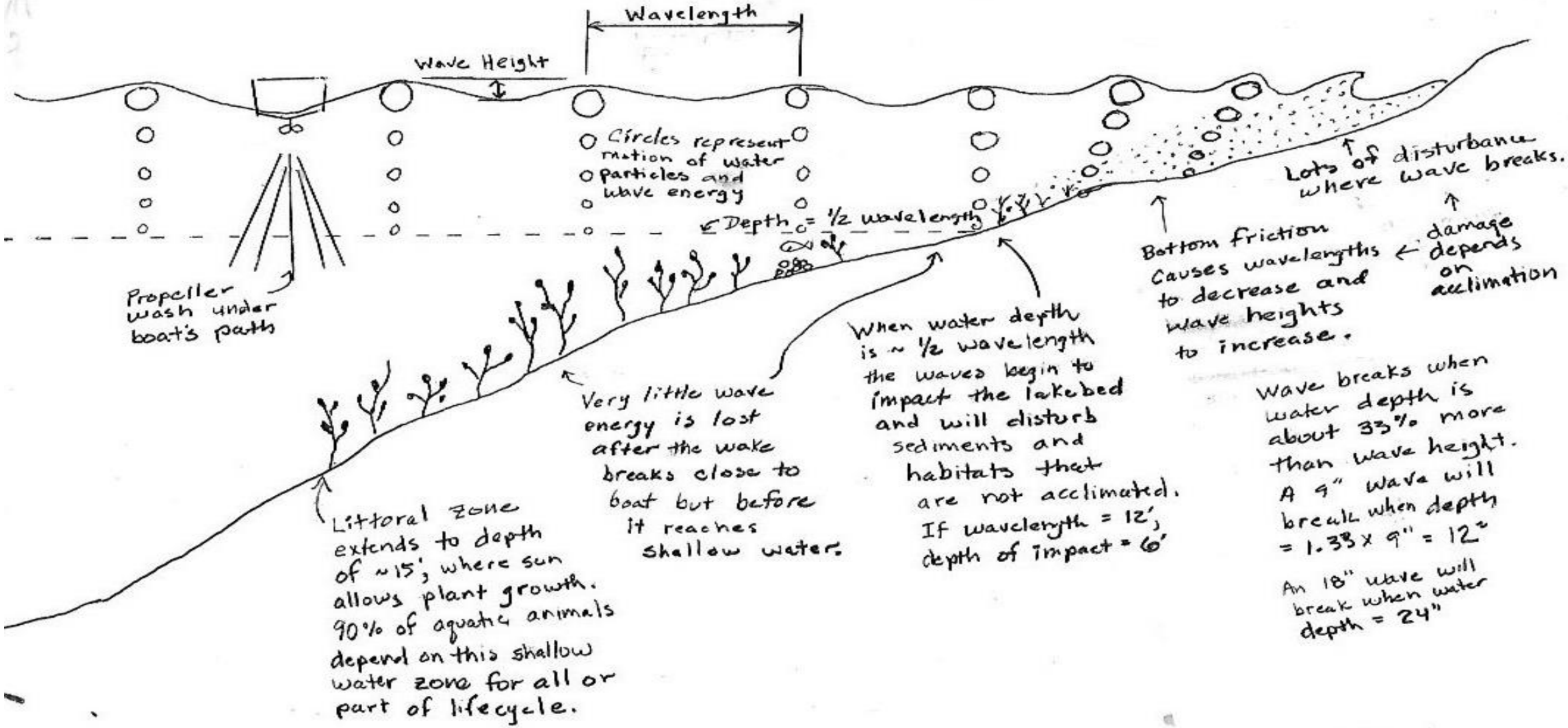
There is no minimum depth requirement for surfing in Wisconsin

Studies show a depth of at least 20 feet is needed to avoid propeller wash damage from wakesurfing. Some studies suggest 33’.

How Boats Impact the Environment two completely different ways

First, propeller wash under the boat's path disturbs lakebed, depending on boat and depth

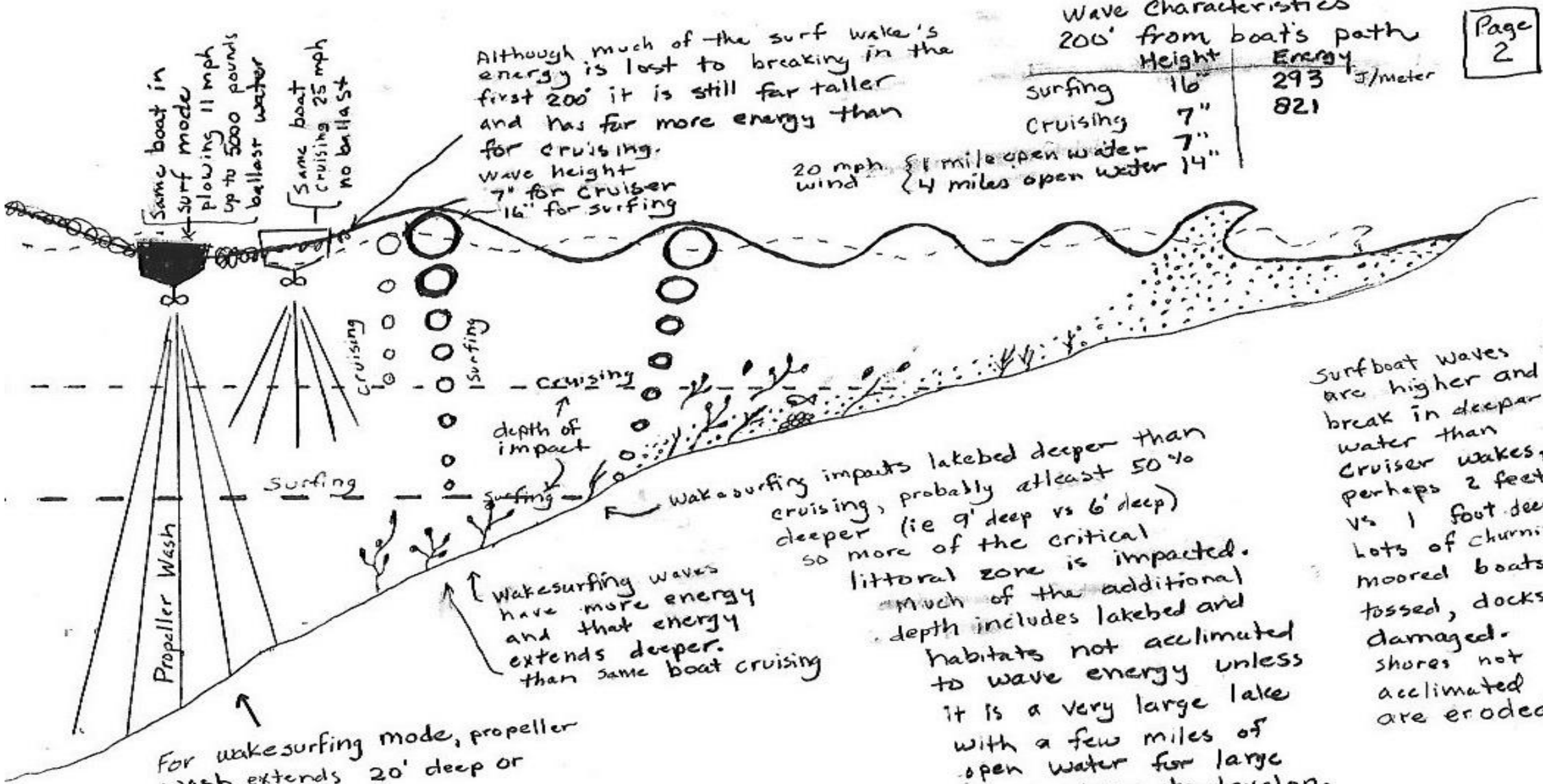
Second, the energy in the waves as they move away from the boat's path disturbs the lakebed when they reach shallow water.



Wave breaks when water depth is about 33% more than wave height. A 9" wave will break when depth = 1.33 x 9" = 12"

An 18" wave will break when water depth = 24"

Not intended to be to scale!



Wave Characteristics 200' from boat's path

	Height	Energy	
surfing	16"	293	J/meter
Cruising	7"	821	
20 mph wind	1 mile open water 7"		
	4 miles open water 14"		

For wakesurfing mode, propeller wash extends 20' deep or more due to:

- Downward angle of propeller
- More engine power needed because:
  - Boat is heavy, up to 5000 pounds ballast water
  - Boat maintains transition speed, plowing inefficiently

WATER PLANTS ARE VITAL TO LAKE ECOLOGY

Both propwash and the big waves coming ashore can destroy plants.

Small fish live among plants; fewer plants means fewer small fish for larger fish to feed on

Plants help stabilize lakebed sediment

They store and cycle nutrients

FISH SPAWNING SITES ARE DESTROYED BY BIG WAKES MOVING INTO SHALLOWER WATER

Largemouth bass nest near shore, a few feet deep, in calm areas sheltered from wind-driven waves and their bottom scour.

Eggs can be suffocated by silt, so they make a nest on gravel or hard bottoms

Large boat wakes scour lakebed and disturb eggs or cover them with silt

Largemouth lay eggs into July. Smallmouth spawned in August in a Nebish Lake study. Panfish spawn until August in similar nests.

Game fish won't grow big if there aren't plenty of panfish to eat!

PHOSPHORUS CHURNED UP BY PROP WASH AND BIG WAKES CAUSES ALGAE BLOOMS

Blue-green algae is actually Cyanobacteria. It can sicken people and kill dogs and livestock.

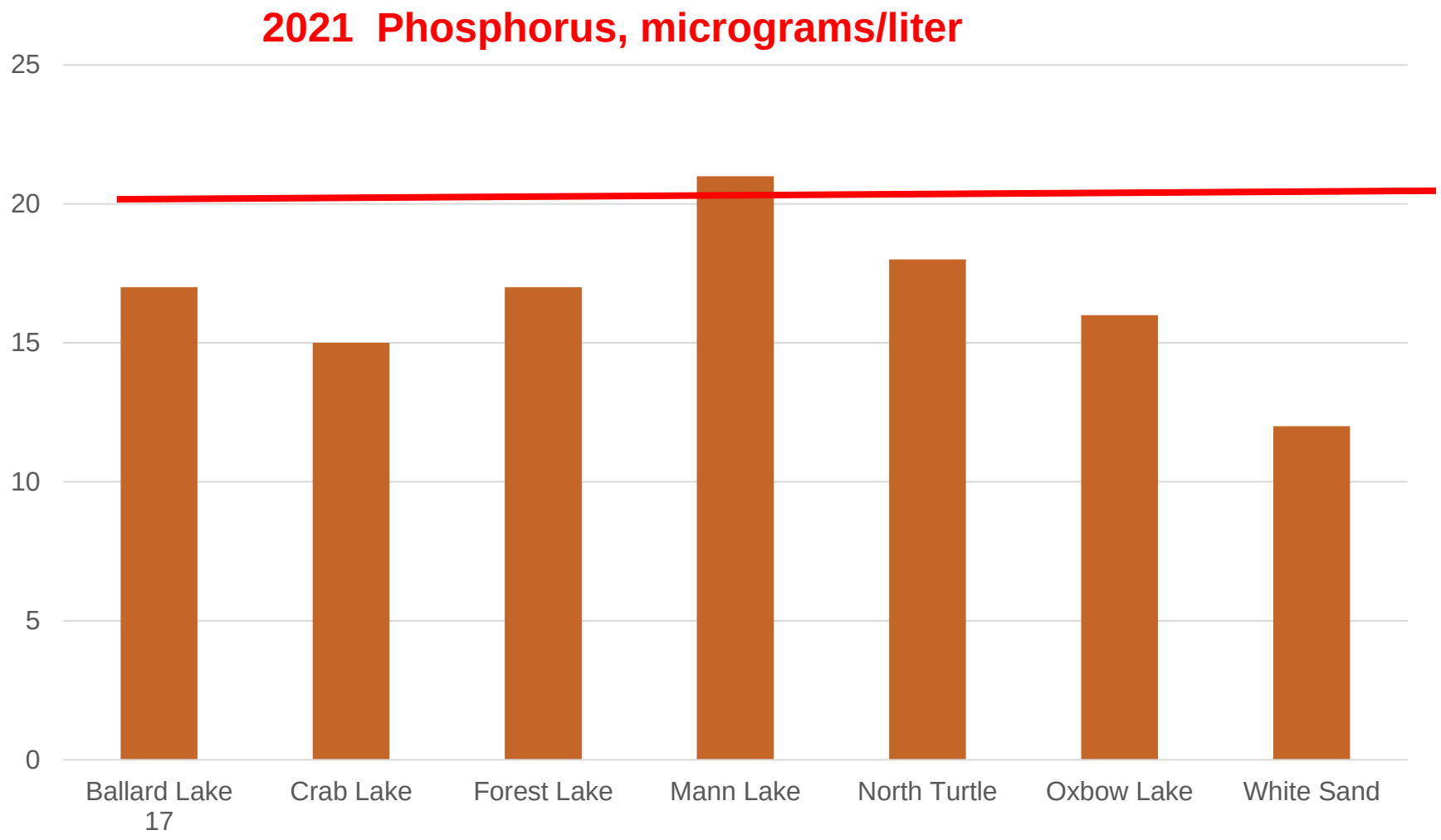
Filamentous green algae is not toxic, BUT algae, like all plants, makes oxygen in the day but USES oxygen dissolved in the water at night and when it dies and decomposes. Large blooms can use so much oxygen that fish die.

PHOSPHORUS IN MANY LOCAL LAKES IS ALREADY APPROACHING PROBLEM LEVELS

According to the DNR, phosphorus should be below 20 micrograms/liter to prevent algae blooms.

Most Vilas County lakes are already near 20.

In the North Lake Study, phosphorus levels increased 25% after two passes of a surf boat.



SAFETY CONCERNS

Capsizing and swamping other watercraft

Rocking boats, knocking over occupants

People blind-sided by 16” high wake from a surfboat that passed 200’ away

Poor forward visibility for wakeboat drivers due to bow-high position

Confrontations due to property damage, environmental harm, dangerous waves, one boat dominating the water. Wake boats impact a strip at least 1/4 mile wide

Wakeboat operators are often unaware of the danger and damage they cause. By the time their wake reaches a fisherman 200’ away, the wakeboat is already more than two football fields away, so they don’t see (or hear) the fisherman struggling.

WHEN IN SURF MODE THE BOW CAN BE SO HIGH THE DRIVER CAN'T SEE AHEAD

Can this driver see a small watercraft ahead?

Many wakeboat images and videos online show surfboat bows are often too high for safe operation.

People in an anchored canoe taking water samples were nearly broadsided by a wakeboat. The driver said they never saw the anchored canoe due to the wakeboat's high bow.

BENEFITS OF REQUIRING A MINIMUM LAKE SIZE, ABOUT 1500 ACRES

Very large lakes are acclimated to large waves. Wind waves can be as powerful as surf waves in very large lakes (areas with a few miles of open water for large waves to develop). Shores, lakebeds and habitats have adapted in those open portions of very large lakes.

Very large lakes can provide areas for others to safely enjoy the water. In just 3 minutes, one surfer makes over 80 acres unsafe or unpleasant for others, and many lakes have multiple surfers. Very large lakes could have zones where surfing is OK, and zones where all others can feel safe and enjoy their activities without worrying about the next big waves.

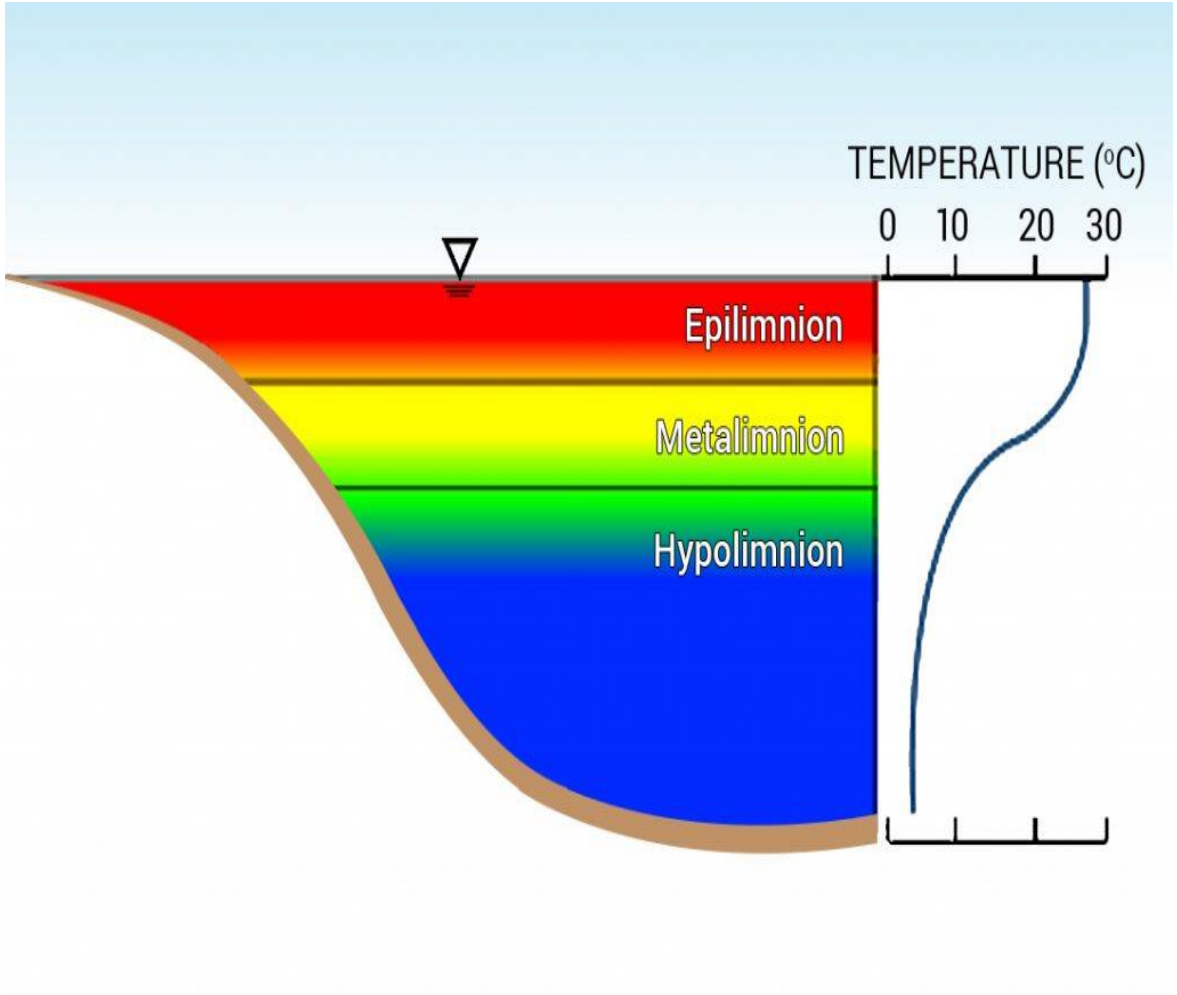
Control of aquatic invasive species (AIS) is more effective and less expensive. Ballast systems can't be drained completely between lakes, so AIS can be spread. Effective decontamination equipment for complex ballast systems is expensive to buy and operate. Tracking boats to confirm that they have been decontaminated is nearly impossible. By limiting surfing to a few very large lakes, fewer decontaminating systems are needed, and enforcement is easier.

BENEFITS OF REQUIRING A MINIMUM LAKE SIZE, CONTINUED

Minimize repetitive passes along a particular shore. The WSIA's "Wake Responsibly" campaign lists this as one of their three core points. Repetitive passes can only be avoided on the largest lakes, especially with multiple boats surfing.

Larger lakes have deeper thermoclines, because they are exposed to more wind mixing. Propeller wash is less likely to disrupt deeper thermoclines. Disruption impacts water quality and interferes with fish reproduction.

THE THERMOCLINE



In summer, most Wisconsin lakes "stratify", with denser colder water at the bottom and warmer less dense wind mixed water on top.

The "thermocline" is the transition zone between those layers, where temperature, dissolved oxygen, and chemical composition change abruptly.

Little is known about how the deep propeller wash from surfing will impact the thermocline.

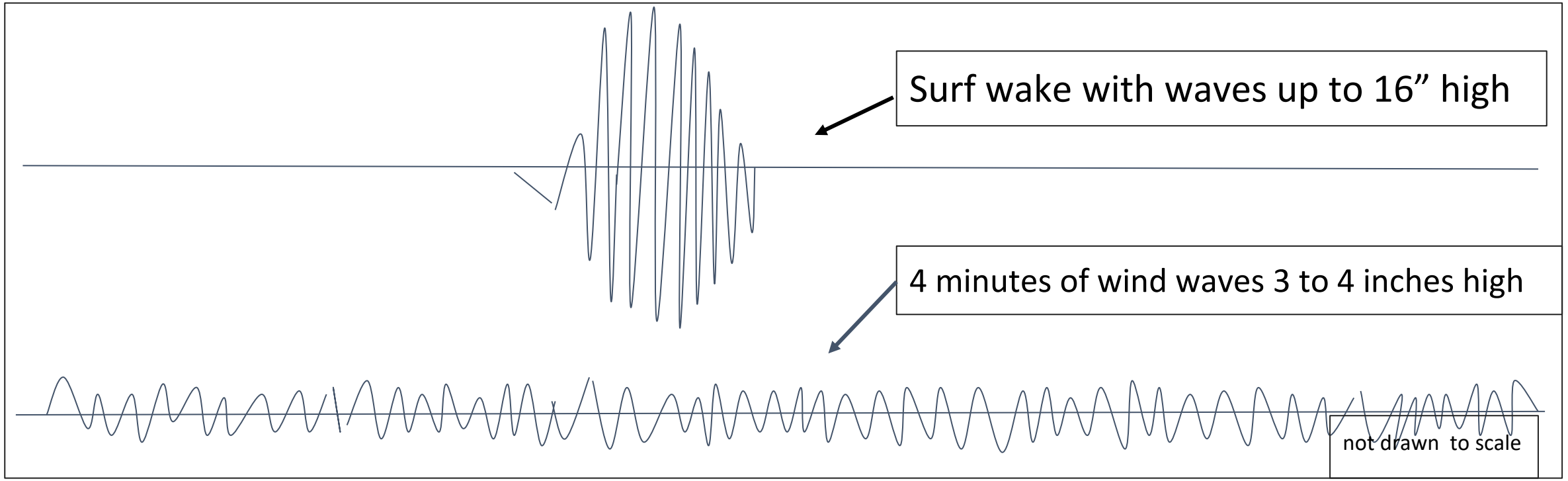
Fish are sensitive to temperature and oxygen levels. How will mixing the layers impact them?

How will mixing impact phosphorus and other pollutants?

Smaller lakes typically have shallower thermoclines than large lakes because small lakes have less wind mixing.

Scientists suggest much more study is needed.

HOW DID WSIA/GOUDEY "PROVE" SHORES ARE NOT DAMAGED BY 16" WAVES FROM SURFING 200' AWAY?



They equate the total energy in a surfboat wake coming ashore (waves up to 16" high) to the total energy in 4 minutes of small wind waves.

If your common sense tells you something's wrong, you're right!

It's like saying being pelted with marshmallows for four minutes….

is the same as one baseball!

The WSIA/Goudey method could even be used to “prove” that a tsunami is no worse than months of small wind waves.

Note that the sources Goudey cites don’t advocate his method. They say you must also compare the largest waves from each source to each other.

WSIA/Goudey (continued)

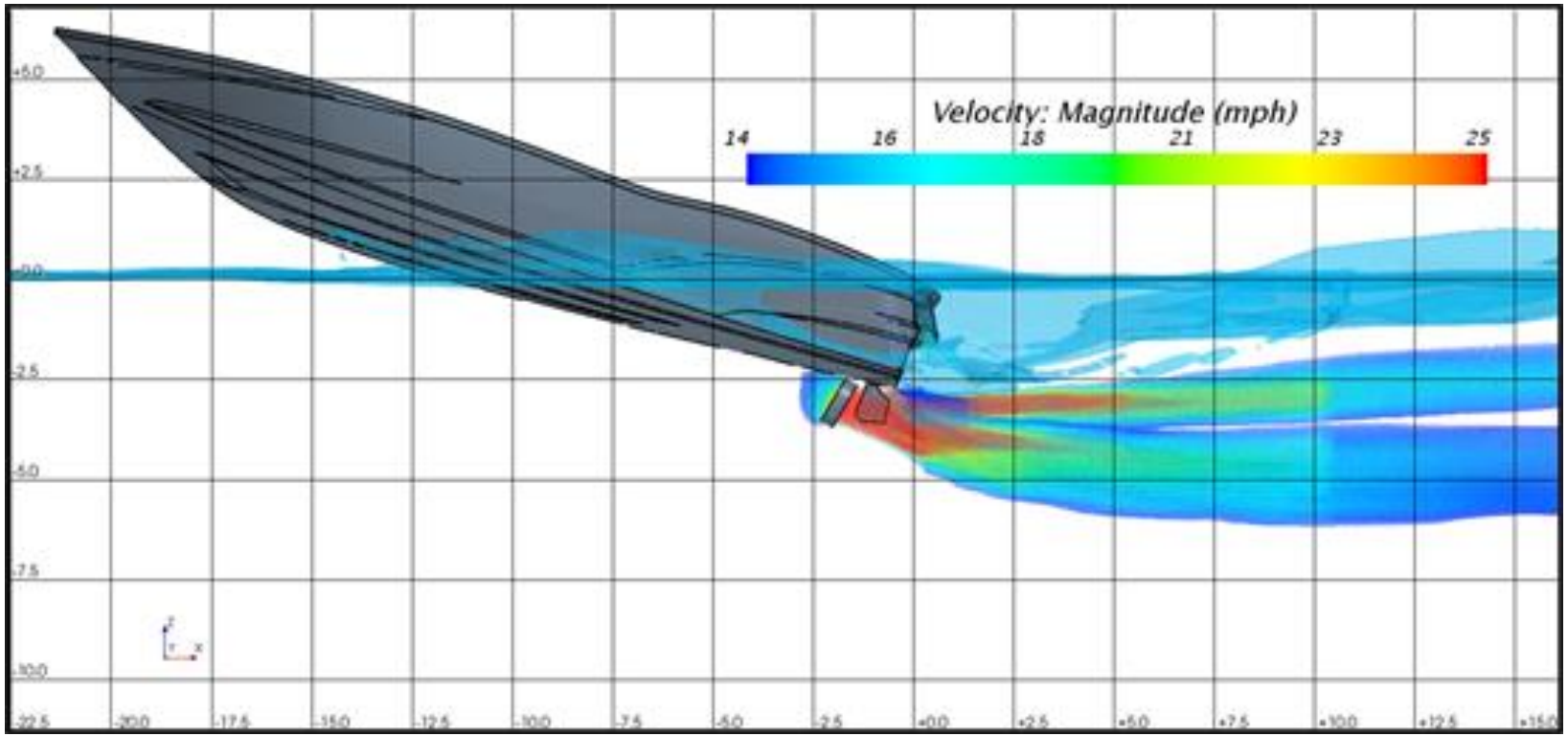
In the WSIA study they added up all the energy in about a dozen huge waves in the boat wake, some 16” high. Then they compared that to the energy in about 200 little waves from a 10 mph breeze, across a mile of open water. Those were only 3-4” high.

Hundreds of marshmallows won’t hurt you, but one fastball could break your jaw.

Those 200 small wind waves in 4 minutes may do no damage at all because shores, lakebeds, and fish & wildlife have acclimated to them over centuries. But 16” wake waves can destabilize all but the most exposed shores of the largest lakes.

And remember, their study only looks at “the tip of the iceberg”, shoreline damage. It was never intended to consider damage to lakebeds and habitats, or water quality, or safety and enjoyment of others, or invasive species in the ballast. And Goudey never mentions docks or moored boats.

WHAT ABOUT THE NMMA/FAY STUDY "PROVING" PROPELLER WASH EXTENDS ONLY 7.5 FEET DEEP?



This is a computer analysis (no field work) by Endicott Fay, paid for by the National Marine Manufacturers Association.

See four critiques discrediting it on Vermont's Department of Environmental Conservation site, posted at LastWildernessAlliance.org

The study was published in a "scientific journal",

BUT…..

NOW DAYS ANYONE CAN PUBLISH A "SCIENTIFIC JOURNAL"

"The Journal of Water Resource [sic] and Protection"

published the NMMA/Fay study. The "journal" didn't even catch the fact that, on the last page, Fay both thanks the NMMA for paying for the study, and claims "The authors declare no conflicts of interest regarding the publication of this paper."

THE JOURNAL OF ABSOLUTELY ACCURATE ARTICLES

Published and
Edited by
Carol Wood Phillips

WHAT ABOUT THE NMMA/FAY STUDY "PROVING" PROP WASH EXTENDS ONLY 7.5 FEET DEEP?

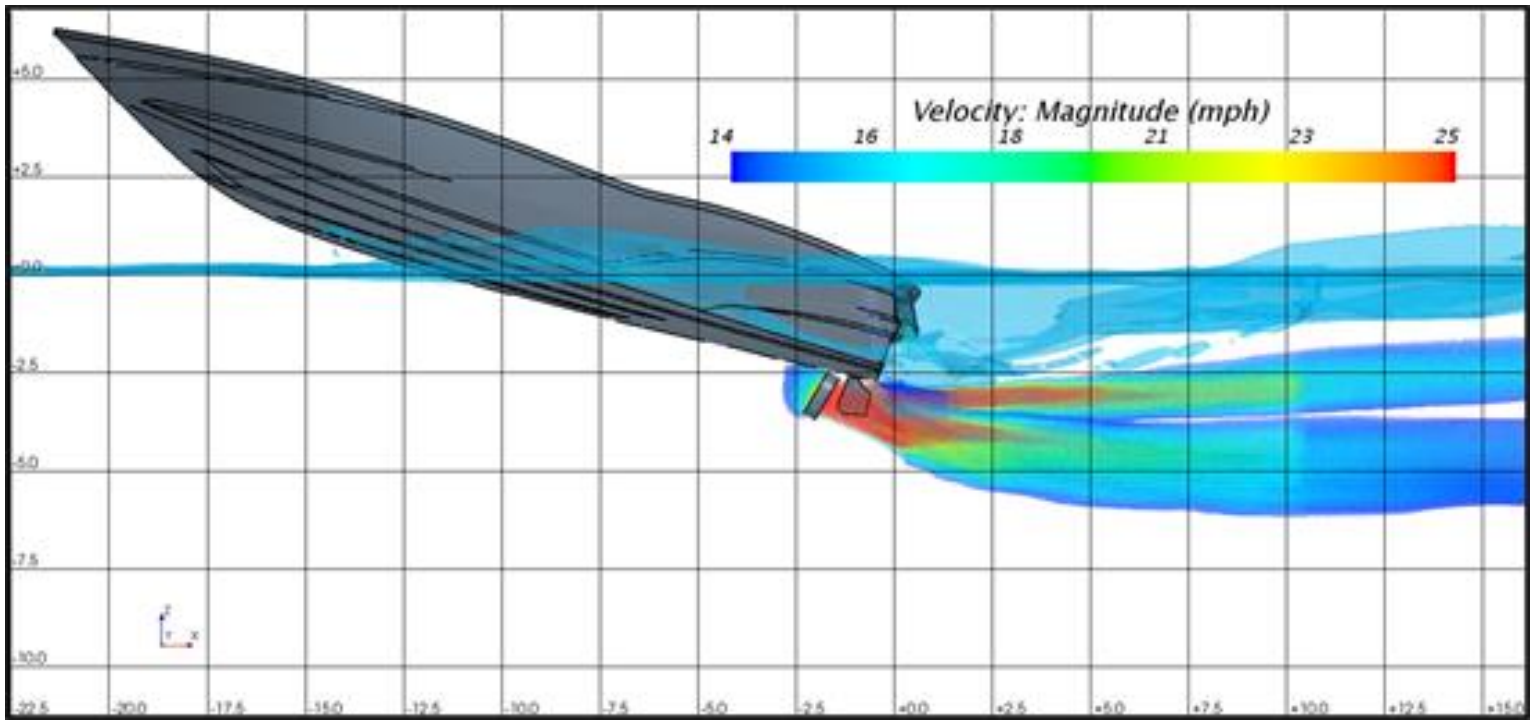
The National Marine Manufacturers association (NMMA) paid for this 2022 study by Endicott Fay et al. It's a computer simulation only, no field work. They conclude "the wash reaches approximately seven and a half feet below the surface with the propeller at approximately three feet below the surface" and the "recommended depth for wake surf operation is conservatively set at 10 ft".

Their computer image shows how the prop wash flow rate decreases from 25 mph (red) to 14 mph (blue).

A 14 mph current can move grapefruit size stones. Sand erodes at just 0.5 mph.

Why didn't they calibrate their computer model to include colors showing how deep sand and muck are disturbed?

Other studies measured propwash to depths of 16 to 33 feet.



EXPERTS CRITIQUE THE NMMA/FAY STUDY

This NMMA/Fay study has been discredited by multiple experts, including one of the main references Fay cites. Quotes from the four experts:

Gregory MacFarlane (cited by Fay): "...this study fails to provide the material and evidence from which to make any sound conclusions."

Matt Goodrich: "It is not a technically sound paper.

David Johnson: "...the comparison with wind induced waves as a justification for the 200 ft distance is invalid, ... the results for the penetration of the prop wash to justify the 10 ft depth is also invalid."

Prof Yves Prairie: He also criticizes NMMA/Fay's comparison to wind generated waves, saying "This is completely false."

References:

For the complete critiques of the NMMA?Fay study see: https://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/Critiques%20of%20NMMA%20CFD%20Study%2020220419.pdf

For a Wikipedia article about NMMA/Fay publisher, Scientific Research Publishing, SCIRP, see https://en.wikipedia.org/wiki/Scientific_Research_Publishing

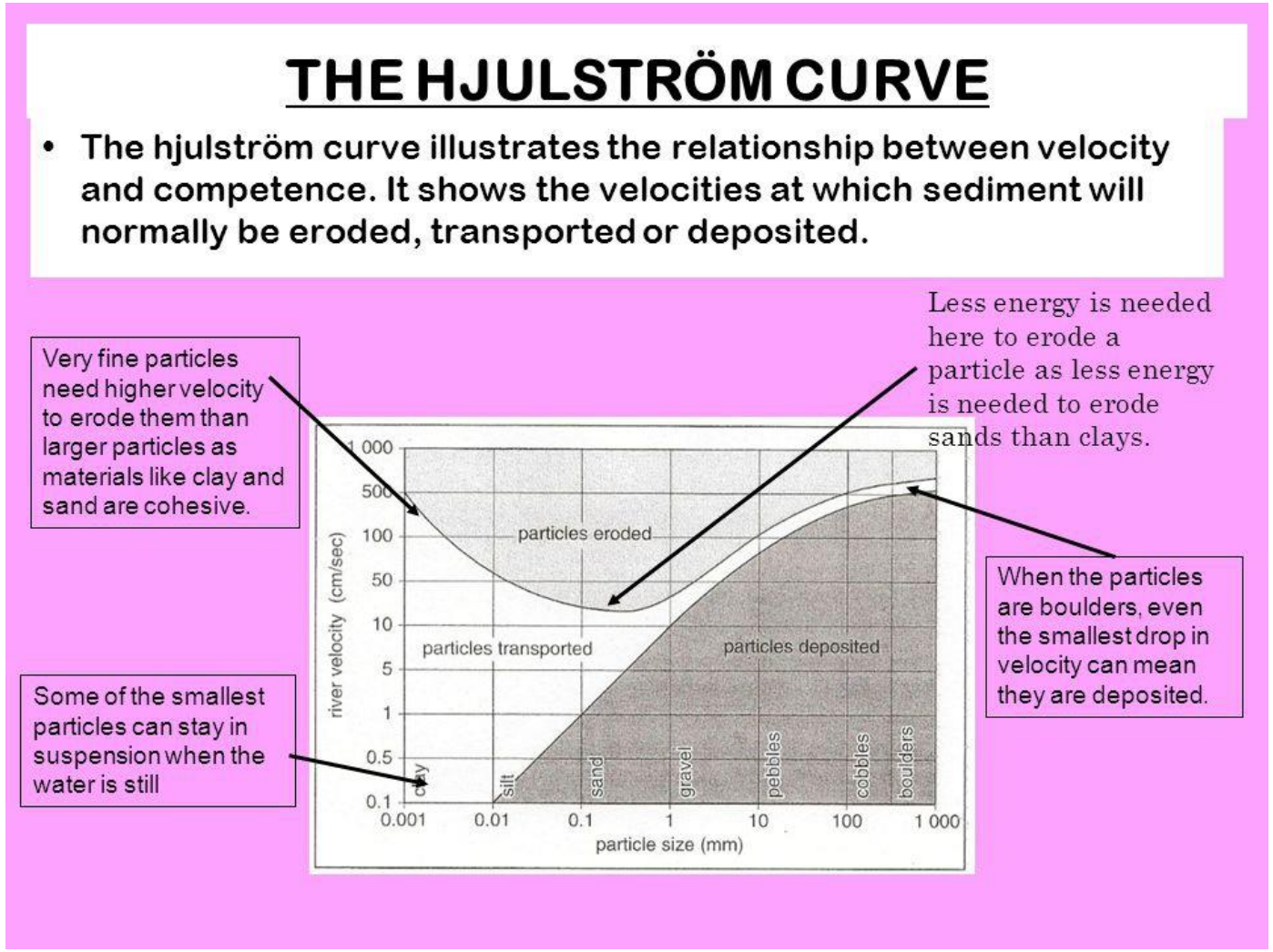
GRAPH SHOWING EROSION OF SEDIMENT

NMMA/Fay image shows propwash velocity is 14 cm/sec at about 7 ft depth

14 mph = 625 cm/sec

Grain size eroded is over 100 mm (over 4 inches)

Sand erodes at about 20 cm/sec, about 0.5 mph



CUT AND PASTE FROM THE NMMA/FAY STUDY

Acknowledgements

The development of this paper was supported financially by the National Marine Manufacturers Association (NMMA) in cooperation with its members. The computational fluid dynamic analysis was accomplished at Ohio State University's Supercomputer Center using OpenFOAM Version 8 [10].

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Also, two of the authors are employed by Mercury Marine.

You might want to took up the "journal" that published the study on Wikipedia.

Impact	Rule needed
Shoreline erosion, docks, moored boats	>700’ & >1500 ac
Lakebed sediment, plants, habitats	>700’ & >20’ & >1500 ac
Water quality	>700’ & >20’ & >1500 ac
Safety of others	>700’ & >1500 ac & safe zones
Safety and enjoyment of others	>700’ & >20’ & >1500 ac & safe zones
Thermocline	>1500 ac
Invasive species in ballast systems	Until DNR & manufacturers solve, no ballast

WSIA's WAKE RESPONSIBLY CAMPAIGN

Despite what the WSIA would like you to believe, a surfboat passing 200 feet from shore or other people and hitting them with a 16-inch wake would not meet the definition of "Wake Responsibly" to

- **a fisherman standing up in his boat to cast**
- **a kayaker with less than a foot of freeboard**
- **a waterskier hoping to find smooth water**
- **a family enjoying a pontoon ride**
- **a loon on its nest 6" above water**
- **a largemouth bass with a nest full of eggs in shallow water**
- **a fragile shoreline, lakebed sediments and water plants**
- **your dock, and the boat moored there, or**
- **the water quality at your lake**

NORTH LAKE STUDY BY CARROLL UNIVERSITY AND TERRA VIGILIS, SEPT 2020 -- A LAKEBED FREQUENTED BY WAKESURFERS

WILL THIS IMPACT THE LOCAL ECONOMY?

Our beautiful lakes are what draw people here to vacation, to purchase a second home, or retire

If people can't enjoy fishing, swimming, pleasure boating, paddling, water skiing, or nature watching then tourism, property values and business income will suffer

IS BOATER EDUCATION ALONE ENOUGH?

NO. ALL THE EDUCATION IN THE WORLD CAN'T CHANGE THE LAWS OF PHYSICS.

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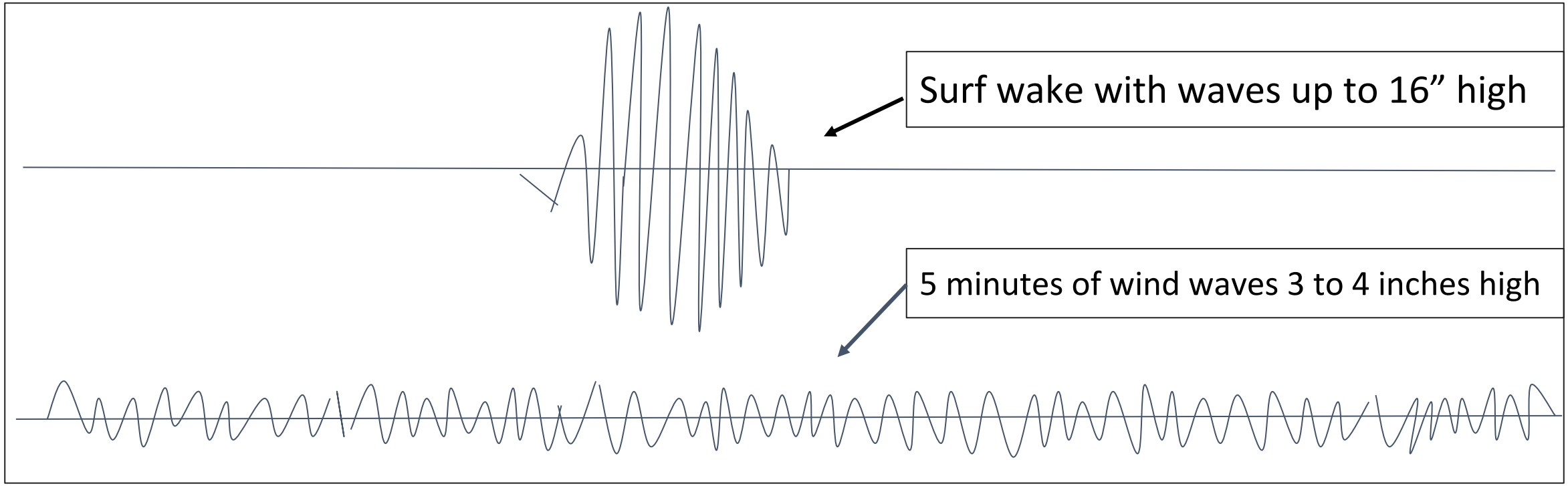

They equate the energy in a surfboat wake coming ashore, with waves up to 16" high, to the energy in 4.5 minutes of small wind waves.

If your common sense tells you something's wrong, you're right!

It's like saying being pelted with marshmallows for five minutes….

WHERE DOES THE WAVE ENERGY GO?

The WSIA and U of MN studies both show that the energy in the surfboat waves drops precipitously in the first 100’ or so due to the waves breaking close to the boat. But even after that the waves still have far more energy, power and height than waves from a cruiser.

After that initial breaking there is little energy loss until the waves reach shallow water, where some of the remaining energy is lost to friction with the lakebed (churning sediment, damaging habitats).

What energy doesn’t go to friction with the lakebed goes to breaking near shore (intense friction), shoreline erosion, and sometimes damaging docks and moored boats.

SECOND: UNDERWATER ENERGY IN THE V-SHAPED WAKE WAVES DISTURBS THE LAKEBED AS IT MOVES INTO SHALLOWER WATER

When in surf mode, the waves created by a wakeboat are not only taller, but their energy extends deeper. They start to disturb the lakebed in water roughly 50% deeper than for the same boat cruising at 25 mph, e.g. if cruising waves disturb 7’ deep, then surfing waves may disturb roughly 10’ deep.

Wind wave energy extends as deep as surf wave energy only in the most exposed parts of lakes more than a couple miles across.

Deep surf waves can disturb sediments that have been untouched by other boat waves or wind waves in all but the largest lakes, releasing pollutants and damaging habitats

HOW DID THE WSIA/ GOUDEY STUDY "PROVE" SHORES ARE NOT DAMAGED BY 16" WAVES FROM SURFBOATS 200' AWAY?

They assume that a few huge waves hitting the shore are no more destructive than hundreds of small waves.

If your common sense tells you that's wrong, you're right!

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In the WSIA study they added up all the energy in about a dozen huge waves in the boat wake, some 16" high. Then they compared that to the energy in about 200 little waves from a 10 mph breeze, those were only 3-4" high. Note that the sources they reference do not advocate this method.

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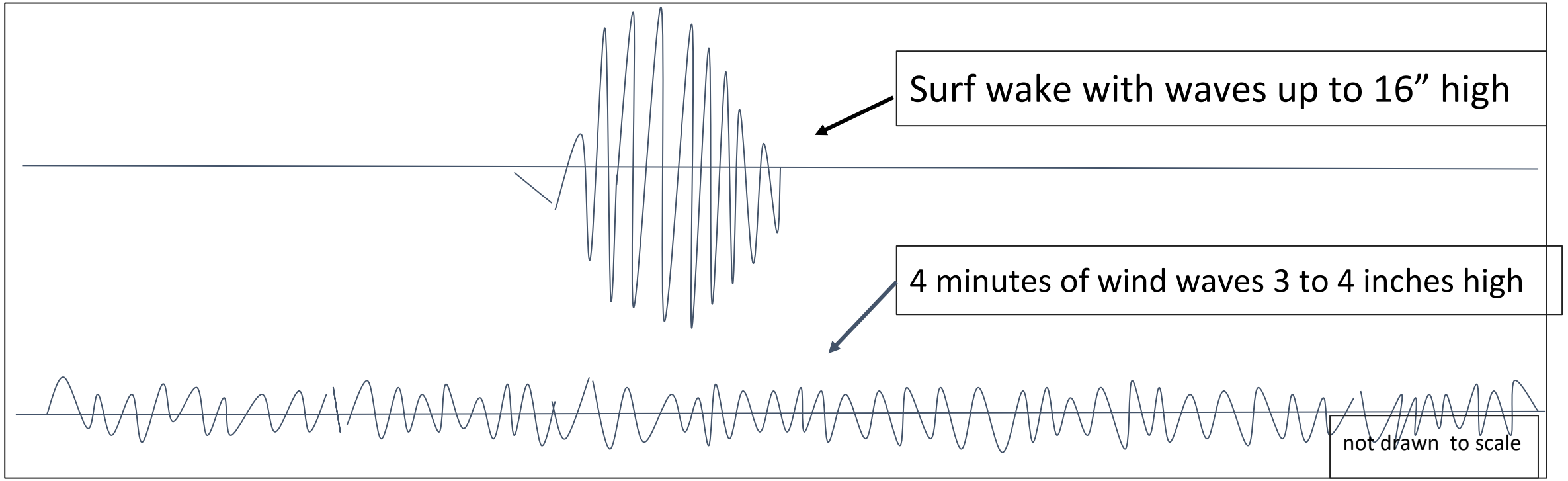

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