

WAVE IMPACTS TO LAKE BEULAH

A Phased Study by Terra Vigilis Environmental Services Group June 16, 2025



INTRODUCTION

This presentation covers the principal findings associated with a two phased study that includes in-lake studies of both surface and subsurface wave impacts to the lake.

LAKE BEULAH STUDY PHASES



Phase I...Winter lake bottom video survey with submersibles at multiple sites
Phase 2A...In-lake study of propeller downwash impacts to lake bottom with sediment redistribution and aquatic plant disruption
Phase 2B...In-lake study of wave propagation impacts and minimum buffer distances

PHASE 1 LAKE BOTTOM VIDEO SURVEY

- Video survey findings demonstrate aquatic plant disruption at 20- and 25-foot depths at multiple sites
- 15-foot depths showed significant absence of aquatic vegetation
- Similar "sand traps" have been observed at Big Cedar and Pewaukee Lakes
- Provides baseline for future comparisons



PHASE 2A SUBSURFACE PROPELLER DOWNWASH IMPACTS

- Study findings demonstrate propeller downwash impact from a wake boat in surf mode of at least 21 feet for both startups and passes. This impact does not occur with conventional planing (water ski) boats.
- Deep water videography also established bottom impacts from wake boats in surf mode including sediment redistribution into the water column and native aquatic plant disruption. This impact does not occur with conventional planing (water ski) boats.
- Bottom penetration data are comparable with similar studies nationwide.

PHASE 2B SURFACE WAVE IMPACTS

- Notable differences were found in wave characteristics between wake boats in "surf mode" and conventional planing (water ski) boats on Lake Beulah.
- Wave heights for wake boat in surf mode were 2X higher compared to conventional planing (water ski) boat at the same 200' distance.
- Comparative wave energy calculations will require a 500-foot buffer minimum for wake boats in surf mode from near shore, other vessels and sensitive areas of the lake.
- The minimum buffer distances are consistent with similar studies nationwide.

Test Sites



WAVE IMPACT STUDY VIDEOGRAPHY

Video 1: Wake Boat Surf Mode Pass at Site A in 15' of water (subsurface)

• **Key Observation**: significant disturbance of Sediment and Aquatic plants at 15' depth.

Video 2: Planing Boat Pass at Site A in 15' of water (subsurface)

• Key Observation: No water movement at 15' depth.

Video 3: Wake Boat Surf Mode Pass at Site B in 21' of water (subsurface)

• Key Observation: significant movement of Aquatic plants (Chara) at 21' depth.

Video 4: Pass 200 feet from shoreline at Site D

 Key Observations: Fishing boat tied to dock pitches dramatically with a wake surf wave produced 200' away. Wake surf waves produced 200' away significantly impact the shoreline.

LAKE BEULAH IN-LAKE STUDY CONCLUSIONS

- 1. Wake boat surf mode operations are producing lake bottom impacts in Lake Beulah which are notable for disturbance to aquatic plant habitat areas. These impacts do not appear to be produced by water ski operations under similar test conditions.
- 2. Wake boat surf mode operations (propeller downwash) are producing sediment disruption and re-distribution impacts to the water column. The composition of these sediments was not within the scope of the current study. Similar impacts were not seen with water ski boats in planing mode.
- 3. Recent plant survey data supports sensitive area impacts to aquatic plants considered favorable to game fish and lake water quality in Lake Beulah including Pondweed, Coontail and Chara.

LAKE BEULAH IN-LAKE STUDY CONCLUSIONS

- 4. There is a sizable population of "home lake" wake boats capable of surf mode operations on Lake Beulah. This number is aggravated by off-lake Wake boats which also utilize Lake Beulah.
- 5. A DNR "Critical Habitat Area" study has established that areas being impacted by Wake boat surf mode operations are occurring in and adjacent to several of the designated critical habitat areas in Lake Beulah.
- 6. The wake boat obtained for use in the testing project was a current model, with a lower powered engine (350 hp), with auto wake controls, compared to more typical wake boats with higher engine power, larger ballasting capacity and more extreme bow-deck angles.
- 7. Opinion should be obtained from a subject matter expert (SME) with specific expertise in aquatic plant root structures and fish habitat influenced by plants found to be impacted in the current study.

CRITICAL HABITAT AREAS

Lake Beulah has eight sensitive areas designated by the DNR in 1994. These were further designated as critical habitats by the DNR.



LAKE BEULAH, WISCONSIN WISCONSIN DNR CRITICAL HABITAT DESIGNATION

"Under NR 1.06 of the Wisconsin Administrative Codes, a "Critical Habitat" designates an area in a lake which is particularly important for the health and sustainability of aquatic plants and animals. These areas are considered "Critical Habitat" because they are **crucial for various life stages of fish**, wildlife and even endangered species, with near shore zones being especially significant."



Wake Enhancing Impacts Summary

There is an impressive consistency to the studies being conducted which demonstrates larger, faster, high energy, displacement wave risks across multiple areas including:

- Surface safety threats to other vessels and lake users
- Near shore disruptions
- Bottom scrubbing effects
- Shoreline structure impacts
- Nutrient release events to the water column
- Deep penetration propeller downwash effects
- Wave attenuation distances prompting changes to traditional buffer distances