# Petition to Agency of Natural Resources to Amend the Vermont Use of Public Waters Rules Chapter 32 (2021)

## Proposed Change to § 3

## for Managing Wake Boats and Their Activities on Vermont Lakes and Ponds

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**Submitted on March 9, 2022** (*with corrections to June 11, 2022*)

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## EXECUTIVE SUMMARY

Given the explosive growth in the boating industry, especially among wake boats, proper management of Vermont's water bodies becomes ever more critical. In this petition, we:

- Define what a wake boat is (definition in Proposed Rule) and how its activities differ from those of other watercraft;
- Document how the fast-growing water sports of wakesurfing and wakeboarding, which will hence be referred to as "wakesports," are harmful to the lake environment, including water quality and bottom ecology; damaging to shorelines; and inconsistent with four of Vermont's lake-related statutes:
    - 2021 Vermont Use of Public Waters Rules Environmental Protection Rule Chapter 32 § 5.6.
    - Vermont Shoreland Protection Act.
    - 2017 Water Quality Standards (WQS) Environmental Protection Rule Chapter 29A.
    - 2017 Aquatic Invasive Species Transport Law.
- Describe the potential economic costs from lack of effective regulation of wake boats and wakesports, including water quality remediation costs, impacts on property values, and loss of tourism revenue;
- Detail how wakesporting done inappropriately is incompatible with traditional water uses, e.g., fishing, swimming, canoeing, kayaking, paddle boarding, sailing, and waterskiing;
- Provide evidence of widespread public support for the management of wakesport activities;
- Propose specific regulations for inclusion in the Use of Public Waters Rules:
    - Increase the 200 ft no-wake Shoreline safety zone distance from shore to 1000 ft for wakesports to reduce their resulting wave impacts to a more acceptable level.
    - Reduce the negative impact of the slipstream, the powerful jet of water driven by the propeller towards the lakebed, by permitting wakesports only in water depths greater than 20 ft.
    - Require a minimum 60-contiguous acre area for a Wake Sport Zone to provide an enjoyable experience for wakesporting boats that is compatible with other water recreational uses.

The establishment of new Vermont Public Water Use Rules that apply specifically to these new wakesporting activities is urgently needed to manage and reduce their adverse impacts while allowing everyone to engage safely in water-related activities in a fair and equitable manner. It is important to point out that a petition such as ours is not without precedent: a petition involving restrictions similar to the ones we are proposing was submitted in connection with the operation of personal watercraft and was granted more than a decade ago. It remains in effect today.

## PROPOSAL TO CHANGE THE VERMONT USE OF PUBLIC WATER RULES

### Statutory Authority

This petition is filed by Responsible Wakes for Vermont Lakes pursuant to 10 V.S.A. §1424 and is a request to the Vermont Department of Environmental Conservation to adopt a revised rule for boating use on lakes and ponds under the Vermont Use of Public Waters Rules.

### Existing Rules

This Proposed Rule will manage and regulate the operation of wake boats and their use in the activities of wakesurfing and wakeboarding on Vermont lakes and ponds. There are no current rules that apply specifically to wake boats or their use in wakesurfing and wakeboarding in Vermont. Current regulations prohibit operating a vessel at greater than "no wake speed" within 200 feet of the shoreline and other lake users and objects.

**Proposed Rule** to be added to § 3 of Vermont Use of Public Waters Rules Chapter 32 (2021).

*Use of wake boats for wakeboarding and wakesurfing is permitted only in defined areas of water bodies ("wake sports zones") where all the following conditions are met:*

*1) the distance from shore is greater than 1000 feet*

*2) the water depth is greater than 20 feet*

*3) the area of the water body satisfying 1) and 2) is more than 60 contiguous acres.*

*For water bodies where no such areas exist that satisfy all three conditions, vessels defined as wake boats are prohibited.*

*The Proposed Rule does not apply to use of a wakeboard behind a conventional vessel that has not been modified with wake enhancing equipment.*

### Associated Definitions

A "wake boat" is any powerboat vessel which, by design or modification, has one or more functional ballast tanks, bags, compartments, containers, plumbing, hull design or devices, or other similar devices or systems used to increase the displacement of the vessel or otherwise affect its performance for the purpose of enhancing or increasing its wake while under power.

"Wakesurfing" is the activity of propelling a person, on equipment similar to a surfboard, forward with a boat's wake. The person may be holding a rope or free riding. Equipment used in this activity may include but is not limited to wake surfboards, wakeboards, stand up paddleboards, and hydrofoils.

"Wakeboarding" is a water sport activity performed by a person being towed behind a wake boat and using a surfboard, wakeboard, or similar device to ride behind the boat.

"Wake Sport Zone" is the area of a lake or pond that meets the Proposed Rules for use of wake boats for wakeboarding and wakesurfing.

## SYNOPSIS OF PETITION

**1.0 Introduction to the need to manage wake boats and their associated watersport activities**

- Worldwide wake boat sales and their use are increasing at a dramatic rate, and their adverse impacts are described in this petition (pages 7-9).
- Waiting to act has the potential to result in significant safety, environmental, and property damage in Vermont, some of which may be permanent, particularly as wake boats become heavier, and more powerful in the future (pages 9-10).
- As evidenced in this petition, there is strong and widespread public support in Vermont and 17 other states to manage wake boat activity (pages 10)-12.
- **Inappropriate use of wake boats and wakesporting are incompatible with Vermont's Water Quality Standards and three other Vermont Statutes and need to be managed** (pages 12-13).

**2.0 Justification for 1000 ft shoreline protection zone** (pages 12-24)

- Waves approaching the shore from wakesporting too close to shore are, for most shoreline exposures, much larger than those from all but the most extreme wind conditions.
- Scientific studies have demonstrated that to produce breaking wave turbulence comparable to that from typical wind conditions, wakesporting needs to be approximately 1000 ft from the shoreline.
- The turbulence from wakesporting too close to shore causes shore erosion disturbing shoreline biota and destroying fish and wildlife habitat and damaging shoreline structures.
- Other studies have shown that to be comparable to skiing or cruising at a distance of 200 ft from shore (i.e., the current shoreline safety zone), wakesporting needs to be 500 to 1000 feet from shore, depending on which study and which wave characteristics are considered.
- When wake sporting occurs under current regulations consistent with the 200 ft "shoreline safety zone," these powerful waves pose an injury hazard to other boaters, swimmers, and those on floating shoreline structures.
- **The choice of 1000 ft considers both the evidence from scientific studies about the negative impacts of present wake boats and from the documented trend that wake boats are becoming larger and more powerful.**

**3.0 Justification for 20 ft minimum depth protection zone** (pages 25-30)

- A wake boat's design (stern weighted down by ballast tanks, downward-directed propellers, and other wake enhancing devices) generates propeller slipstream velocities capable of disturbing lake bottom sediment, adversely impacting lake biota and contributing to cyanobacterial algal blooms.
- State-of-the-art scientific instrumentation has detected significant and damaging bottom disturbances from propeller slipstream activity at depths of 20 ft.

- **Future wake boats being developed will be more powerful and generate even larger and more powerful wakes.**

**4.0 Justification for 60 contiguous acre Wake Sport Zone** (pages 30-34)

- An area of this size will provide for enjoyable wakesporting while reducing wake boats' adverse wave amplification impacts and will allow others to enjoy traditional recreational water activities.

**5.0 Result of Proposed Rule on Wake Boating Opportunities on Vermont Lakes and Ponds** (pages 34-35)

- If the proposed rule is adopted, we estimate that 19 of the 23 inland Vermont lakes larger than 500 acres in size will have the required characteristics and meet the existing permitted use rules to support Wake Sport Zones.
- This number of lakes, 19, is comparable with the 14 Vermont lakes over 500 acres that currently permit personal watercraft and the overall total of 26 lakes and ponds that permit personal watercraft.

**6.0 Justification for prohibiting wake boats from operating without their ballasts disabled on lakes with no Wake Sport Zones** (pages 35-40)

- The large ballast tanks in wake boats pose a very high risk for introducing aquatic invasive species due to: 1) the inability of wake boat ballasts to be completely drained; and 2) their inability to be inspected.

**7.0 Proposed Rule is consistent with the Vermont's environmental water statutes** (pg 40-45)

- Our recommendations to manage wake boats and wakesports are consistent with Vermont's Use of Public Waters Use policies and programs.
- The statutes examined and discussed include:
  - The Vermont Use of Public Waters Rules (pages 40-42).
  - The Vermont Shoreland Protection Act (page 42).
  - The Vermont Aquatic Nuance Control Program (pages 42-43).
  - The Vermont Water Quality Standards (pages 43-45).

8.0 **Compliance and Enforcement Recommendations** (pages 45-46)

- Any Water Use Rules changes made must include effective targeted implementation.
- Enforcement is feasible, with the aid of readily available maps showing wake sport zones and lists of lakes where no such zones exist.
- Based on prior successful implementation of the personal watercraft rule changes, educating wake boat users, traditional water recreation users, enforcement officials, and the public is critical to successfully changing water use rules.

**9.0 Responses to the arguments of those opposed to managing wake boats** (pages 46-49)

- In proposing changes to Vermont's Water Use Rules, it is important to consider the opposing arguments and the factual basis for their positions.
- We detail the points likely to be raised by the opposition and then address them in a manner that reduces misinformation.

## RATIONALE FOR THE ANR PETITION

### *1.0 Introduction to the need to manage wake boats and their associated watersport activities*

#### *1.1 Urgency of the problem*

Recreational boating is seeing a shift towards larger, more powerful boats, and foremost among them are wake boats. The new designs of wake boats demand that special attention be paid to managing the potentially detrimental effects of these boats on our increasingly crowded, space-limited public waters.

In January 2021, the National Marine Manufacturer's Association (NMMA, 2021) issued a press release stating that, based on estimated 2020 nationwide sales data, wake boats constitute the fastest-growing segment of new powerboat sales, although they currently represent only about 4% of total sales. Compared to 2019, wake boat sales in 2020 increased 20%, while personal watercraft increased by only 8% and freshwater fishing boats and pontoon boats by 12%. The same NMMA press release predicted that 2021 powerboat sales would remain high due to a backlog of orders caused by pandemic-related supply chain constraints. Similar industry projections have been made by others, e.g., Ski Wake Boat Market Report for 2019-2024 (Stratview, 2019):

> *"The global ski and wake boat market size is projected to grow at a healthy rate over the next five years to reach US$ 1.94 billion in 2024. Increasing number of participants in outdoor activities, growing new powerboat sales, increasing HNWI [wealthy "high net worth individuals" with investable assets in excess of $1M] population and increased affordability of recreational boats are major growth propellers of the ski and wake boat market… Based on regions, North America is expected to remain the largest ski and wake boat market during the forecast period with the USA being the growth engine."*

If these projections prove true, wake boats, which range in price from $50,000 up to $455,000 or more, will have an increasingly large impact on Vermont's lakes and ponds, and as described below, this impact will pose very significant problems in a number of areas.

The concern about wake boats takes on another dimension when one considers the next generation designs for these vessels. Wake boat manufactures emphasize the size of the wake in their marketing materials. In this industry, bigger is the goal. Pavati Wake Boat's website states in big bold text, "THE BIGGEST WAKE WAVE, PERIOD." They claim, "The only real competitor to a Pavati wave is an ocean surf wave." In the competitive race to *"…deliver the biggest wake surfing wave on Earth…,"* as a Pavati Wake Boat ad suggests, other wake boat designers have been busy ramping up their designs. One manufacturer, Gigawave, has made technological improvements to hull designs and increased hull weight (to as much as 30 tons) to produce what they call a "gigawave" – a wave so tall, it **flows over** the wakesurfer (see **Figure 1**). According to the January 29, 2021, issue of the Robb Report – "*the leading voice in the global luxury market*" – the Gigawave GW-X will become available in 2022 for approximately $600,000.

Figure 1A. Promotional materials for "Gigagwave," one of several next generation wake boats, states: *"Sculpted by the patented wave manipulation system and given its size from the largest displacement wake surfing hull ever built, the continuous, head-height wave matches the size and feel of ocean waves. It's big, powerful, and clean; delivering a massive barrel that will take the sport to new levels."*

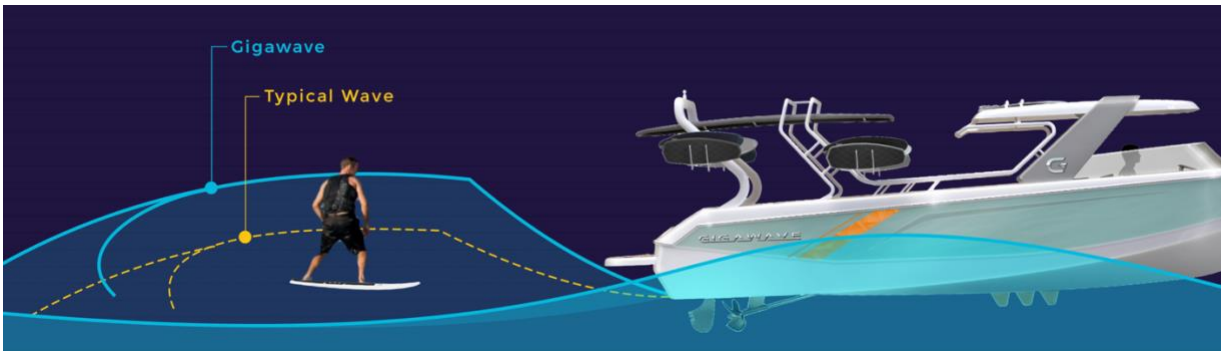



Figure 1B. Gigawave promotional materials include this schematic drawing illustrating the height of the current "Typical Wave" relative to the significantly greater future "Gigawave" wave height.

Given the problems created by existing wake boats, as detailed below in **Section 2.0**, and the wake boat industry's focus on "bigger is better" when it comes to wave size and ballast capacity, the magnitude of the problems created by larger, heavier vessels and the massive wakes will increase over time.

**The growing popularity of wakesports means their negative effects are felt throughout Vermont, and the world.** As a result, state and local governments, communities, academic institutions, lake associations, and groups like our Responsible Wakes for Vermont Lakes seek to define the parameters under which these sports may be enjoyed, while at the same time protecting the safety and enjoyment of Vermont's citizens, the beauty and sustainability the state's lake resources, and the values of its private and public properties. The 11 Vermont lakes and ponds sponsoring this petition represent a cross-section of all Vermont lakes over 20 acres in size (see **Appendix B**, *Characteristics of the Vermont Lakes and Ponds supporting this ANR petition*). The petition is supported by lakeshore residents and users without lakeshore properties (see **Appendix C**, *Evidence of Local Support for this ANR Petition from the Submitting Lakes and Ponds Groups*). They have expressed the need to manage wake boats and their wakesports before these activities result in additional permanent public safety risks, degradation of lakes,

and environmental and property damage. In many states, despite these impacts, wakesports are already ingrained in the boating culture, making them difficult to regulate. This is not yet the case in Vermont. In fact, because these sports are relatively new, many Vermonters are unfamiliar with these watercraft and their potential for adverse impacts. It is urgent that we make wise management decisions and adopt reasonable and appropriate rules now, while damage to the environment may still be avoided. Greater numbers of more powerful w**ake boats are coming to Vermont; policies need to be in place before their numbers make the problems too difficult to address.**

### *1.2 Economic costs of the adverse impacts of wake boats*

*Impact of wake boats on water degradation*

In recognition of the ecosystem benefits that Vermont's lakes and rivers provide and to comply with EPA mandates, the State has invested more than $300 M since 2016 to clean up surface waters, as part of the Vermont Clean Water Initiative. Much of this effort aims to reduce phosphorus loading. As explained later, the adverse impacts of wake boats on water quality are significantly greater than those of other motorboats; a major concern with wake boats is their potential to release phosphorus into lakes, which reduces water clarity, increases the growth of AIS (aquatic invasive species), and contributes to cyanobacteria blooms. Wakesports performed too close to the shore introduce phosphorus from wave-induced shoreline erosion; additionally, in shallow water, the wake boat's powerful propeller slipstream can significantly disturb the lakebed, causing bottom sediments' resuspension, inducing phosphorous release and increasing the spread of AIS that propagate upon fragmentation, e.g., Eurasian watermilfoil. Statewide requests for VT DEC's Aquatic Nuisance Control projects between 2019 and 2021 averaged approximately $2M/year, and far exceeded the available current State assistance funding of $450K/yr—an indication of just how serious a concern AIS is already among the public seeking to care for the wellbeing of Vermont's lakes and ponds.

*Degradation of water quality impacts to lakeshore property*

A UVM Lake Champlain study (Voigt B., Lees J., et al., 2015) found that for every meter of reduced water clarity, property values fell 3% for year-round lakeside residences and 37% for seasonal dwellings. Studies in Maine (Holly M.J., Boyle K.J., et al., 1996) and Minnesota (Krysel C., Boyer E., et al., 2003) also found a decline in lakeshore property values of up to several hundred dollars per frontage foot for each meter of water clarity lost. For a 1000-acre lake with 90% of its perimeter developed, this could amount to a $10M decline of lakeshore property values and property tax base. In the case of repeated algal blooms, losses can be substantial. In Georgia, VT, such blooms were blamed for a $50,000 decline in the value of each of 37 lakefront properties on St. Albans Bay—a $1.85M devaluation in the total tax base (Dobbs T., 2015). A similar result was seen in an AIS study in Washington State, where the presence of Eurasian milfoil significantly lowered sale prices of properties by an average $94,385 (Olden J.D. and Tamayo M., 2014). **Situations such as these demonstrate the need for management strategies that prevent the introduction of AIS, a risk associated with wakesports (see Section 5.0**).

*Costs of lost tourism*

Users of Vermont's inland lakes value water clarity when deciding on a suitable venue for traditional activities such as fishing, swimming, canoeing, kayaking, sailing, and waterskiing. As noted below in **Section 1.4**, the value to the state is embodied in Vermont's Water Quality Standards (WQS). Highly eutrophic lakes are unattractive aesthetically and recreationally to residents and visitors, who will go elsewhere in search of better recreational venues. Wake boats comprise a tiny fraction of the watercraft on Vermont lakes (see **Table 2** below), but unregulated, they pose a safety risk that could impact the enjoyment of traditional uses and hence the associated tourism revenue. The economic benefits of Vermont's lakes are summarized in **Table 1**. Later sections of this Rationale will explain how wakesports negatively impact many of the traditional uses that tourists enjoy.

**Table 1**. Economic Benefits of Vermont Tourism Relevant to Its Lakes (in 2013 dollars) (Picotte A., Sargent B., et al., 2013)

| Tourist Activity | Annual visitor expenditures/revenue generated |
|---|---|
| Visiting Lake-Based State Parks | $976,870 per State Park |
| Fishing | $131,223,000 |
| Wildlife Watching | $288,507,000 (National data) |
| Lakeshore Property Values | up to $200 per foot frontage for each one meter increase in water clarity |

### *1.3 Public support for managing wake boats*

Vermont is one of a growing number of states in the US—currently totaling 17—seeking the management of wake boats and their wakesports activities (**Figure 2**). Most of these efforts have encountered opposition from wake boat owners, small in number relative to other boating groups, but supported by a powerful, well-funded boating industry, and industry lobbying groups.

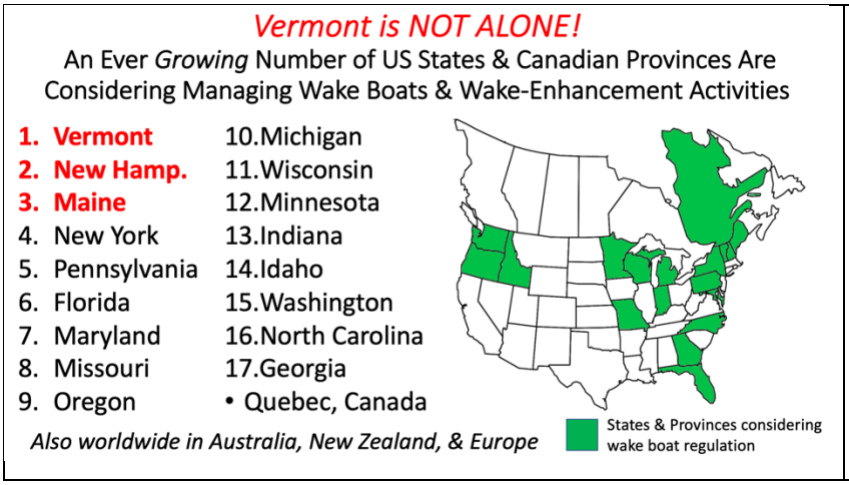



**Figure 2.** Vermont is not alone in hearing from concerned citizens and environmentally conscious groups seeking to manage wake boats and their water sports activities. Many states throughout the US and countries worldwide are addressing these concerns.

Members of our Responsible Wakes for Vermont Lakes group have observed that recreational lake users are quite concerned about wake sports and their negative impacts on traditional users of public waters, e.g., water-skiers, swimmers, and paddle sport enthusiasts, including canoeists, kayakers, and paddleboarders. The Vermont Public Access Greeter Program has identified these paddle craft as being the most common watercraft encountered on Vermont lakes and ponds. This increasing popularity of paddle sports among the public—particularly among young families—is not difficult to understand: these sports are relatively inexpensive to equip and maintain, kid-friendly, and easy to learn.

In discussions held with individual lake residents favoring the management of wakesports, there was a acknowledgement that such an action would result in restrictions being placed on the very small minority of their Vermont lake neighbors who currently enjoy wakesports (**Table 2**). However, lake residents and users also pointed to the restriction imposed on them by this minority of wakesport enthusiasts, i.e., the inability to confidently recreate on lakes due to concerns for safety while swimming or boating (**Appendix A**), and the loss of a peaceful lake environment due to the noise emitted by the large wake boat motors and their powerful audio systems. In weighing the competing rights of the two groups involved, it is our assertion that managing wake boat activities benefits a much more significant proportion of the public than would be the case if those activities were not regulated. More importantly, Vermont Use of Public Water Rules § 2.2b and § 2.3 require *"an appropriate mix of water-based recreational opportunities on a regional and statewide basis."* Such an appropriate user mix is threatened when wake activities are allowed to take place absent any regulation.

**Table 2**. Estimated number of wake boats relative to non-wake boats on 14 Vermont lakes in 2021

| | Lake or Pond | Number of homes or camps per lake/pond | Number of homes or camps with wake boats (%) | Average number of non-wake boat watercraft per home or camp? | Total number of non-wake boat watercraft per lake/pond | % Wake boats relative to all other watercraft per lake/pond |
|---|---|---|---|---|---|---|
| 1 | Echo Lake (Charleston) | 90 | 0 (0%) | 4 to 5 | 405 | 0.0% |
| 2 | Lake Elligo | 25 | 0 (0%) | 1 to 2 | 38 | 0.0% |
| 3 | Lake Elmore | 87 | 0 (0%) | 2.5 | 218 | 0.0% |
| 4 | Lake Fairlee | 114 | 2 (1.8%) | 4 to 5 | 743* | 0.3% |
| 5 | Lake Iroquois | 90 | 4 (4.4%) | 4 to 5 | 405 | 1.0% |
| 6 | Joe's Pond | 245 | 5 (2.0%) | 2.5 | 613 | 0.8% |
| 7 | Lake Parker | 93 | 0 (0%) | 4 to 5 | 419 | 0.0% |
| 8 | Lake Raponda | 76 | 3 (3.9%) | 3 to 4 | 266 | 1.1% |
| 9 | Shadow Lake | 109 | 0 (0%) | 4 | 436 | 0.0% |
| 10 | Woodbury Lake | 105 | 0 (0%) | 2 to 3 | 263 | 0.0% |
| 11 | Lake Dunmore | 387 | 8 to 12 (2.6%) | 3 to 4 | 1,355 | 0.7% |
| 12 | Greenwood Lake | 65 | 0 (0%) | 3 to 4 | 228 | 0.0% |
| 13 | Peacham Pond | 75 | 2 (2.7% | 3 to 4 | 263 | 0.8% |
| 14 | Lake Salem | 159 | 2 (1.3%) | 3 to 4 | 557 | 0.4% |
| | **TOTALS** | 1,720 | 28 (1.6%) | Avg=3.6 | 5,462 | 0.5% |

* This includes 230 watercraft at the five boys and girls camps on Lake Fairlee

To estimate current wake boat use in Vermont and the number of wake boat owners who would be affected by legislation, we have polled members of Responsible Wakes for Vermont Lakes group representing 14 lakes (**Table 2**). Our estimates indicate that wake boats currently account for ~0.5% of all lake watercraft and 1.6% of the lakeshore residences. During 2021, we estimated that a total of less than 5 wake boats operating on these lakes and ponds were not resident owned (with most likely arriving via State boat launch areas). **These estimates suggest that now is the time to establish policies, before the expected growth in wake boat arrivals to Vermont lakes occurs.** Where action to manage wakesports has not been taken, for example in Georgia (Lakes Rabun and Burton) and in North Carolina (Lake Auman), the adverse impacts of wake boating on the lake environment, lakeshore property, personal safety, and community relations have been significant (Lake Auman Watch, 2021; WEC, 2021).

Concerns about the potential adverse environmental impacts and safety issues when wake boats and wakesports are unmanaged and carried out inappropriately, i.e., too close to shorelines or in too shallow water, have been expressed worldwide (Ruprecht J., Glamore W.C., et al., 2015). Perhaps the most recent and comprehensive report on the subject is the 2021 study done on two lakes in the Water Environment Consultants report from Georgia (WEC, 2021). In addition to describing numerous anecdotal reports of adverse environmental, economic and safety events, this study provided evidence of strong support for developing policies to manage wake boat activities as voiced by many local residents who were members of the two lake associations participating in the study. Among this group, 82% (378 of the 462 total respondents) favored developing management policies (**Figure 3**).

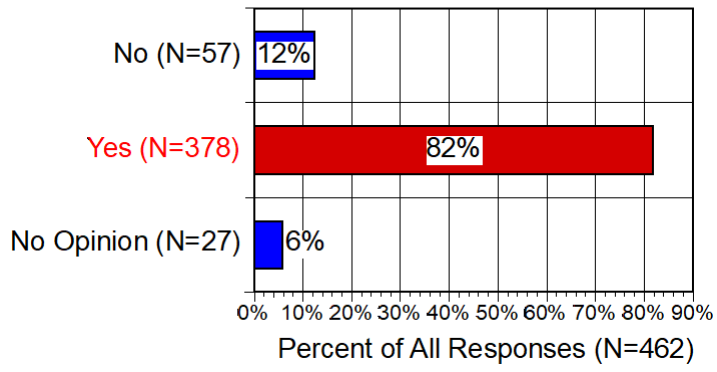



**Figure 3.** Evidence of public interest in and support for managing wake boat activity (WEC, 2021). The respondents were all members of the two lake associations on Lakes Rathbun and Burton in Georgia. Of the 462 respondents to the question regarding whether or not policies should be put in place to manage wake boat activities on these 2 lakes, a supermajority (82%) indicated their desire to have such policies enacted.

### *1.4 Incompatibility of unmanaged wakesporting with Vermont's Water Standards (WQS)*

In 1972, the federal government established the Clean Water Act to restore and maintain the chemical, physical, and biological integrity of our nation's waters. This Act required each state to develop, submit, and adopt state-specific EPA-approved WQS. The EPA WQS consist of three core components:

1. Designated and existing water uses.
2. Criteria to be evaluated to protect these uses.
3. Anti-degradation requirements.

Vermont's EPA-approved WQS include the following "designated and existing uses:"

1. *Aquatic biota and wildlife that may utilize or are present in the waters.*
2. *Aquatic habitat to support aquatic biota, wildlife, or plant life.*
3. *The use of waters for swimming and other primary contact recreation.*
4. *The use of waters for boating and related recreational uses.*
5. *The use of waters for fishing and related recreational uses.*
6. *The use of waters for the enjoyment of aesthetic conditions.*
7. *The use of the water for public water source.*

**All of these WQS-designated and existing uses are relevant to this petition because all are negatively impacted by the current unregulated use of wake boats in Vermont.** With their greatly enhanced, more energetic wakes and their far-reaching downward-directed propeller slipstream relative to wakes and propeller slipstreams of traditional motorboats, wake boats create adverse impacts when operated too close to shore. These include—but are not limited to:

1. Unsafe conditions for swimmers and other recreational boaters.
2. Failure to share the lake equitably with other boaters and swimmers because of the greatly enhanced wakes that wake boats generate.
3. Introduction of new AIS through wake boat ballast systems.
4. Erosion of shorelines and damage to shoreline buffers: trees, shrubs, natural borders and plantings.
5. Scouring of lake and pond bottoms, disturbing sediment that contains nutrients contributing to unnatural lake biota disturbances and to cyanobacterial blooms, and spreading of existing AIS.
6. Noise emissions that disrupt the enjoyment of aesthetic conditions and quiet solitude.

As detailed in this petition, criteria utilized to evaluate these designated and existing uses indicate that currently anti-degradation requirements are not being met in allowing unmanaged wake boat usage. Per the Vermont Water Quality Standards, Environmental Protection Rule Chapter 29A, the Secretary of the ANR may allow "… *limited reduction in the existing higher quality of such waters… only when it is shown that… after an analysis of alternatives, allowing lower water quality is necessary to prevent substantial adverse economic or social impacts on the people of the State.*" We contend that the required conditions do not exist to permit the reduction in water quality, and, moreover, that the cumulative effects of the adverse environmental impacts, property damage, and personal injury are so overwhelming when wakesporting occurs in inappropriate locations, that failure by the ANR to manage wake boats and these activities are incompatible with Vermont's WQS.

### *2.0 Justification for 1000 ft shoreline protection zone*

As a relative newcomer to Vermont inland lakes, the wake boat, when used for wakesurfing and wakeboarding, brings with it a step-up increase in wave height compared to traditional

watercraft. Wave height, as well as other wave properties as described below, contribute to shoreline erosion, damage littoral zone habitats, and endanger personal safety. Several studies have concluded, and we agree, that the current 200 ft shoreline "no wake" distance is inadequate to protect against the harmful impacts of these larger waves.

To truly understand the way in which wake boat waves are a threat to the environment, it is necessary to first understand their properties. Wave height is impacted by several wake boat design parameters. These include hull shape and trim including hydrofoils, the boat's weight and weight distribution (including the distribution of its ballast tank(s)), and the propeller thrust and angle. As these boat-generated wakes propagate towards shore, other parameters come into play influencing the attenuation of the wave height. These include the near-shore water depth profile and the presence of near-shore aquatic vegetation.

The collection of individual waves within a powerboat wake disturbance is called a wave train. Within this train, one can define for each individual wave a maximum wave height and the wave period (time between crests), both of which contribute to that wave's energy. The energies of all the waves can be summed to determine the total energy in the disturbance. Another important parameter is the peak power, which is the maximum rate of change of the energy in the wave train. Compared with more traditional motorboats, the wave trains generated by wakesport boats feature higher maximum wave heights, more total energy and greater peak power.

**Table 3** summarizes recent studies of the propagation of wakes produced by wake boats. All studies showed that wake boats operating in wakesurfing or wakeboarding modes generate wakes much larger than traditional boats, when measured 200 ft from the boat trajectory (the regulatory "shoreline safety zone" distance in Vermont). As noted in **Table 3**, these studies feature various experimental designs, utilizing different choices for reference case comparisons. While all propagation studies used similar instrumentation, none were comprehensive in gathering all data needed for relevant variables.

Of the many studies measuring wave train characteristics, the most relevant to this petition is the recently released University of Minnesota St. Anthony Falls Laboratory (SAFL) Wake Boat Wave Study (Marr J., Riesgraf A., et al., 2022). An important consideration in these studies is the reference case chosen for comparison. In view of the "traditional uses" aspect of the Vermont Use of Public Water Rules, the appropriate comparison should be between wake boats operating in wakesurfing mode at 10 mph and traditional motorboats used for skiing or tube towing and operating at approximately 20 mph. The SAFL Wave Study was designed with this in mind. Compared to earlier studies, this study also significantly increased the range of distances from the boat trajectory that are included in its dataset.

To gather the relevant wave data being sought, the SAFL Wave Study used two wake boat and two ski boat models operating under various conditions. For each condition, this study was able to acquire the wave elevation vs time waveforms for 12 to 17 distances extending typically from 80 to 600 ft from the boat trajectory (In hindsight, considering the results, we wish this had been extended to larger distances). **Figure 4** is taken from the SAFL Wave Study and compares wave heights from two wake boat models operated in wakesurfing mode at 10 mph (Condition 1a) with two models of traditional tow boats at 20 mph (Condition 2).

**Table 3.** Studies investigating the wave characteristics of wake boats under various conditions

| Study | Design | Methodology | Findings | Limitations | Comments |
|---|---|---|---|---|---|
| *A. Studies of wave propagation* | | | | | |
| (Marr J., Riesgraf A., et al., 2022) Univ. of Minnesota SAFL Wave Study (crowd-sourced funded) | Compares wake boat waves with those of other boats at various speeds, distances | Three mast mounted pressure sensors & 2 pad mounted ADCP probes with 4 boat transits provides wave elevation data from 10 to 600 ft | To reach values of wave height, wave energy, & wave peak power comparable to traditional tow boats at 200 ft, wake boats need to be greater than 500, 575, & 600 ft, respectively. | Probed waves from two wake boats & two reference boats. Did not investigate distances beyond 600 ft. Only one depth profile studied. | Derived formulas for extrapolation based on more extensive coverage of distance range. Independent technical peer review performed. |
| (WEC, 2021) Engineering consultant funded by Lakes Rabun & Burton Association ) | Compare wake boats in wakesurfing, wakeboarding and cruising/skiing modes | Mast mounted pressure sensors at 162 & 267 ft from the boat track | Found wake boats produce much bigger, more energetic waves in wakesurfing and wakeboarding operation. | Did not compare to traditional ski boats, only probed out to 267 ft. | Derived formulas for extrapolation. |
| ((Macfarlane G., 2018) Univ. of Tasmania collaboration with Winooski River | Compares wake boat waves with those of other boats at various speeds, distances | Mast mounted capacitance wave probe, boat transits at 100, 200, 300, & 400 ft | Wakesurfing waves heights comparable to reference (ski boat at 200 ft) at slightly more than 400 ft | Performed on river rather than lake. Did not investigate distances beyond 400 ft | Results show more rapid decay than SAFL Wave Study |
| (Goudey C.A. and Girod L.G., 2015) Engineering consultant funded by water sports industry | Analyze wave trains from a wake boat operated in cruising, wakeboarding, and wakesurfing modes in shallow and deep water sites & compare to wind waves. | 5 masts with capacitance probes & pressure sensors & different boat tracks yielding measurements to 425 ft from wake boat track for operating modes in shallow & deep shoreline profiles. | Waves from wakesports are much larger than those when in cruising mode. Concluded that the persistence of wind waves means their impact dominates shore erosion effects from wake boats. | Distances only out to 425 ft. Did not compare to traditional ski boats | Critique (Merritt 2020) pointed out deficiencies including invalid comparison with wind waves since shore erosion impacted more by power peaks than average energy. |
| (Ruprecht J., Glamore W.C., et al., 2015) (Univ. of New South Wales | Compare energy of wakeboarding and wakesurfing waves | Mast mounted pressure probes at 22, 35, 75 meters | Max energy 4x higher for wakesurfing vs wakeboarding | Did not compare to traditional ski boats | Found total wave train energy was nearly constant vs distance |
| *B. Studies of wave turbulence at the shoreline* | | | | | |
| (Mercier-Blais S. and Prairie H., 2014) Univ. of Quebec | Measure turbulence and sediment suspension at shore produced by wakes and compare to wind waves at two Quebec lakes | ADCP probes at shore to sample turbulent kinetic energy and filtered water samples for sediment suspension. Measured at 328, 492, and 656 ft | To be equivalent to impact of wind waves, wake boat distances should be 700 to 1000 ft from shore | Sediment measurements near limit of sensitivity. Did not compare wake boats wakes to those of other motorboats. | Only study to measure shoreline turbulence—an indicator of adverse littoral zone ecosystem impacts, e.g., erosion. |

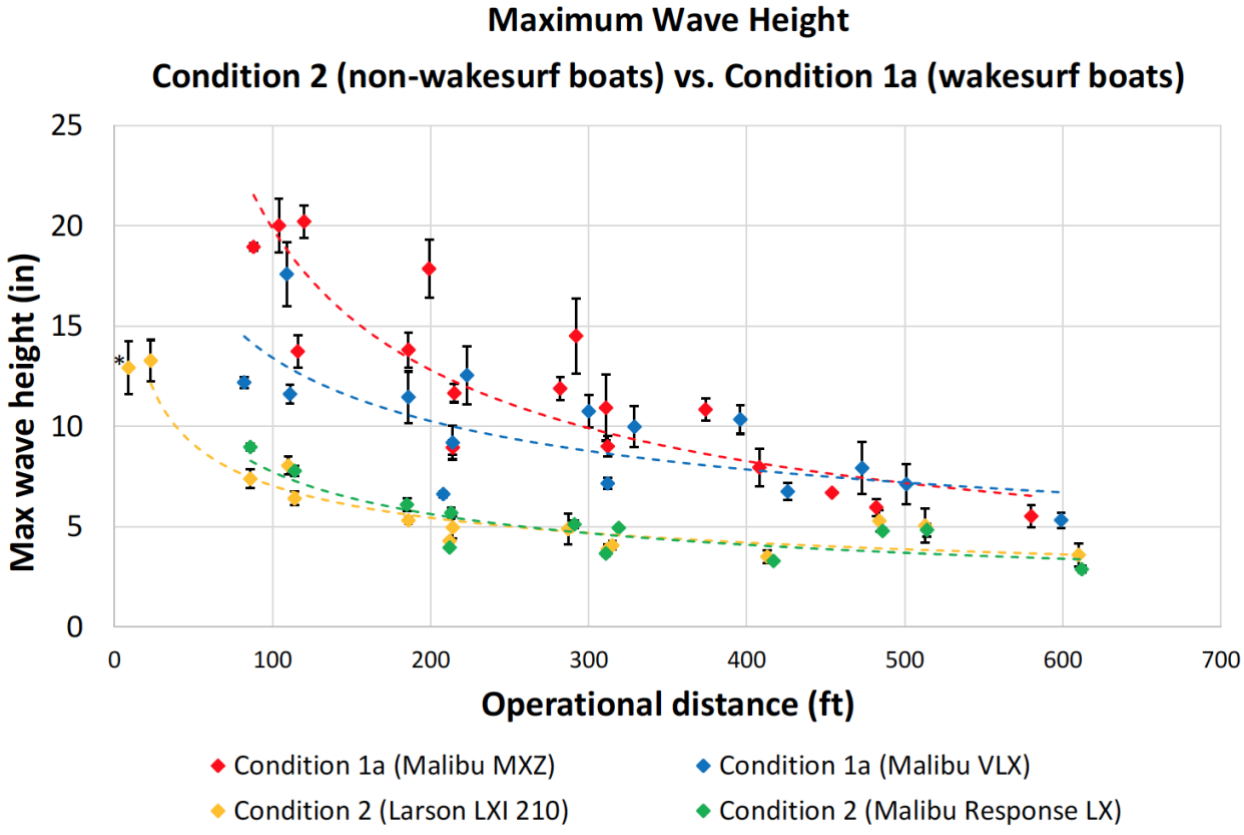



**Figure 4.** Maximum wave height (in inches) comparisons of wake boats (Malibu MXZ and Malibu VLX) versus non-wakesurf tow boats (Larson LXI and Malibu Response LX) from the SAFL Study (Marr J., Riesgraf A., et al., 2022). Condition 2 is at 20 mph and Condition 1a is at 10 mph. Error bars: standard deviations.

The dashed lines in **Figure 4** represent "best fit" formulas of the form $H = Ax^{-B}$ commonly used to characterize the decrease in the wave height H over distance x for the four boats studied. A and B are parameters determined from the data. The resulting formulas and associated curves help to distinguish the different boats amid scatter in the data and provide a means of predicting behavior at other distances. **Figure 5** below shows these same four curves and their formulas to guide the eye to illustrate the wave attenuation comparisons.

**Figure 5** illustrates that, to achieve the wave height of waves generated by traditional tow boats 200 ft from shore, the two wake boats included in the SAFL Wave Study need to be 981 ft and 756 ft from shore, respectively. Similar analyses performed to determine the equivalent distances for two other important wave parameters—total wave train energy and peak wave train power—are shown in **Table 4**.

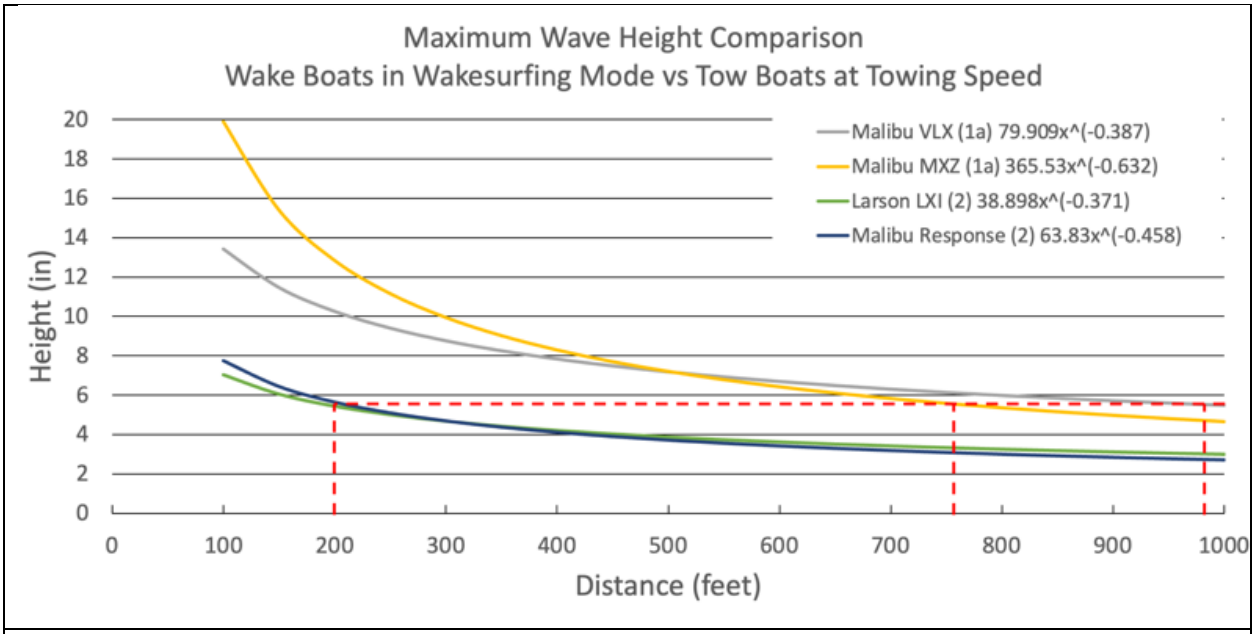



**Figure 5.** Comparison of wave attenuation curves for two wake boats (Malibu VLX and Malibu MXZ) in wakesurfing mode (Condition 1a) compared to two traditional tow boats (Larson LXI and Malibu Response) operating in non-wake boat mode at tow speeds (Condition 2). The dashed vertical red lines indicate that at 981 ft and 756 ft, respectively, the wave heights from the Malibu MXZ and the Malibu VLX are the same as the average heights of the two tow boats at 200 ft, i.e., Vermont's "shoreline no wake zone" distance. The formulas for these curves shown in the legend in the upper right are derived from the SAFL Wave Study (Marr J., Riesgraf A., et al., 2022).

**Table 4.** For each of the two wake boats in SAFL Wave Study (Marr J., Riesgraf A., et al., 2022), the equivalent distance (in feet) for the parameters listed in the left-most column to reach the average value of the same parameter for the tow boats at 200 ft. These values were computed using the formulas derived in the SAFL Wave Study.

| Parameter | Malibu VLX Condition 1a (feet) | Malibu MXZ Condition 1a (feet) |
|---|---|---|
| Maximum Wave Height | 981 | 756 |
| Total Wave Train Energy | 1179 | 2137 |
| Peak Wave Train Power | 1316 | 1013 |

Vermont's lake shorelines change over time. One of the drivers of change is exposure to waves from wind and boats. On large lakes, shorelines that are exposed to strong prevailing winds are "hardened" by this exposure and are more resilient to large waves from boats. But more sheltered shorelines in large and small lakes are vulnerable to erosion and sediment suspension from boat waves. Wind-sheltered shorelines may have been somewhat hardened by many decades of waves from traditional boats, but wakesports represent new risks. Shoreline erosion, near-shore sediment suspension, and shoreline structure damage are threshold phenomena,

meaning that stability exists until a critical parameter exceeds a threshold, triggering harm. We argue that future studies will demonstrate that peak wave train power is such a parameter, and that shoreline protection requires wakesports be regulated to occur beyond a distance that is in the range of those shown for peak power in **Table 4**.

The SAFL Wave Study did not examine the extremely significant impact of waves on shoreline erosion and shoreline structural damage—this is planned as the future Phase 3 of the SAFL Study—but many other studies have shown the impact of recreational boating on shoreline erosion, generally in rivers and bays (for example see (Johnson S., 1994) and (Bilkovic D., Mitchell M., et al., 2017).

In a lake study looking specifically at shore effects from wake boats (Mercier-Blais S. and Prairie H., 2014), researchers from the University of Quebec, using state-of-the-art Doppler equipment on Lakes Memphremagog and Lovering in Quebec, measured wake power along with the turbulent kinetic energy (TKE) in the wave train as it arrives at the shoreline (**Table 3**). This is an important topic of research because it is the turbulence created by waves arriving at the shoreline that can cause serious erosion and damage to the littoral zone ecosystem. The Quebec researchers took wave power and energy measurements while also studying the wake boat wave impacts on shoreline sediment at three distances from shore in wakeboarding and wakesurfing operating modes: 100, 150, and 200 meters, 328, 492, and 656 ft, respectively. Using multiple sites on both lakes, researchers compared the data to those measured during normal wind and weather conditions when no boats were present. This study measured the suspension of near-shore sediments under these conditions. Linear regression analysis was performed to extrapolate the distance from shore where wave energy and sediment resuspension reaches that of normal wind conditions. **Based on these regression analysis results, on Lake Memphremagog, wakesurfing boats needed to operate at 879 ft and 938 ft from shore to achieve results comparable to waves from normal wind and weather conditions as recorded by Doppler measurement of TKE and by suspended sediments, respectively. For Lake Lovering, these data were 1023 ft and 676 ft, respectively.**

**The studies mentioned above are part of a growing body of scientific evidence demonstrating that the present Vermont Use of Public Water Rule regulating motorboats to no-wake conditions within 200 ft of the shoreline needs revision to restore the shoreline protection Vermont inland lakes had prior to the introduction of wake boats. For simplicity of compliance and enforcement and considering the available science, we propose a value of 1000 ft as the shoreline protection distance, i.e., the minimum distance from shore, for both wakeboarding and wakesurfing**. **We recognize that this represents a conservative extrapolation of existing data. However, we assert that a review of the evolution of wake boats over the last 25 years provides a glimpse of what wake boats are likely to become in the future, i.e., heavier and more powerful, capable of producing progressively larger waves.**

To determine just how much the size of wake boats has changed over time, JDPower.com (i.e., under "Boat") was used to obtain data for two prominent wake boat manufacturers: Malibu and Nautique (formerly Correct Craft until 2012). This site lists specifications for most boat models annually. We collected data for the V-drive models that were the heaviest and had the most

horsepower for each year. Our findings reveal that the increases in dry weight (i.e., without ballast(s)) and horsepower of the heaviest, most powerful V-drive wake boat models closely tracked one another while approximately doubling over the past 26 years for the Malibu models (**Figure 6A**). Similar growth rates were observed for the Nautique models over the past 18 years (**Figure 6B**).

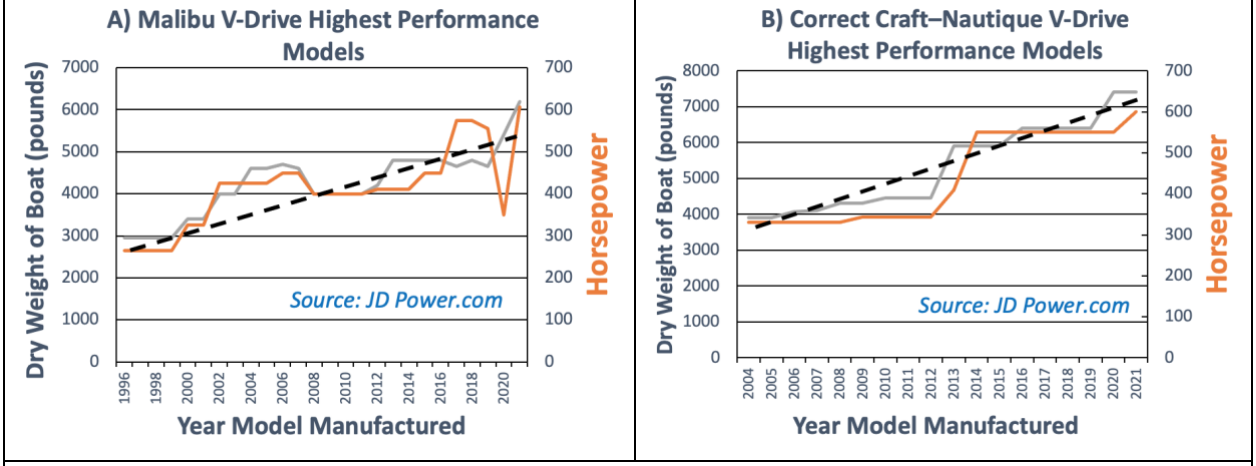



**Figure 6**. Annual increase in boat dry weight and horsepower for the Malibu V-drive wake boats and the Correct Craft-Nautique V-drive wake boats from JD Power.com boat data.

According to the National Marine Manufacturer's Association (NMMA, 2021), this trend is likely to continue since wake boats are predicted to remain an important growth segment of the recreational motorboat industry. One of the drivers of this growth will be the competition among manufacturers to develop ever bigger wakes. In addition to increases in dry weight and horsepower, advances in hydrofoils and wave shapers have also served to increase wave height over this period, and these technologies will continue to evolve with this end in mind.

The Robb Report, a luxury-lifestyle magazine, has reported on the 30-ton Gigawave GW-X, which is predicted to be available for sale in 2022 (**Figure 1**) and to produce 6-ft wakes for wake sports. Its website describes the Gigawave as "…an electric powered watercraft boasting the largest wave ever created."

**With the promise of heavier, more powerful wake boats engineered to make even larger wakes on the horizon, our Proposed Rule will help provide needed protection for Vermont lakes and the public for many years to come, while allowing wakesports enthusiasts the opportunity to enjoy their sport responsibly.**

*Why are bigger waves a problem?* Studies of wakes and wave propagation and their effects on shorelines have been performed for decades. Recent research and studies of wakes created by wakesports have highlighted serious safety risks, irreversible environmental damage to shorelines, and wildlife concerns when these activities are performed too close to shore, particularly on small and shallow lakes and ponds. These negative impacts include:

2.1. Disruption of littoral zone habitats due to nearshore wave energy dissipation. As wave energy dissipates near the shore, it causes suspension of shoreline sediments, increased turbidity, and degraded conditions for aquatic vegetation, with associated degradation to water quality from nutrient influx.

2.1.1 Recommendation regarding wakesport distance-to-shore requirement. The earlier cited study of the Mercier-Blais and Prairie study (Mercier-Blais S. and Prairie H., 2014) that measured turbulent kinetic energy (TKE) of wakesport wakes concluded: "*According to the findings of this research and in order to eliminate any additional impact on the shoreline caused by wake boat passes, we suggest that regulations limit the passage of wake boat type boats on lakes at least 300 m from the shores, with the aim of to avoid their erosion."* The 300 m distance from shore is equivalent to 984 ft.

2.2. Shoreline erosion with undercutting of vegetation root systems and impact to water quality from nutrient and sediment influx.

The predominant environmental threats caused by motorized boats operating too close to shore are shoreline erosion and resuspension of shore bottom sediments (Strayer D.L. and Findlay S.E.G., 2010). A seminal study on boat-induced erosion was performed during the summer of 1979 on the Chesapeake Bay in Maryland, where researchers found that there was a high likelihood that increased boat traffic, and especially boat traffic passing too close to shore, was responsible for accelerated rates of shoreline erosion (Zabawa C., Ostrom C., et al., 1980). Long-term research in the Chesapeake Bay demonstrated that boat traffic was responsible for accelerated shoreline erosion (Bilkovic D., Mitchell M., et al., 2017). Another study on the Mississippi River documented shoreline erosion due to the operation of large pleasure boats (Johnson S., 1994). Due to the extraordinary waves produced by wake boats, these shoreline threats are magnified by wakesporting too close to shore.

2.2.1 The shorelines of Vermont's inland lakes are adapted to normal waves from wind and customary boat traffic. However, when the larger and more powerful waves from wake boating activities reach shorelines, they cause enhanced erosion, undercutting shoreline vegetation and disrupting the littoral zone habitat. Eroded soil and resuspended sediment increase phosphorus loading, and a reduction in water quality occurs.

2.2.2 The WEC-2021 report indicates that "… wake energy from wakesurfing and wakeboarding vessels are much more likely to contribute to shoreline erosion than typical boat wakes or wind waves." At distances up to 500 ft, wakesurfing produces wave energies at the shore at least 5-times greater than the same vessel operating in cruising mode (WEC, 2021).

2.2.3 According to the Asplund report (Asplund T.R., 2000), *"… several researchers have documented a negative relationship between boat traffic and submerged aquatic plant biomass in a variety of situations… Other researchers have determined that scouring of sediment, uprooting of plants, and increased wave activity may also be factors."*

2.2.4 In their research on wake boats in Quebec, Canada, "Impact of Lake Navigation-Sediment Suspension Study: Lake Masson and Sand Lake Cases -2015," (Raymond S.

and Galvez-Cloutier R., 2015) the authors found that "*Wake Surfing practices and the power of boat engines continue to grow. These practices have a significant impact on the water column and would increase water turbidity, total phosphorus and orthophosphate concentration, dissolved oxygen near the bottom and thus the potential for oxydo-reduction and would reduce the sediment consolidation. Total phosphorus release and especially orthophosphate may be a factor in premature aging of lakes called eutrophication. This increase in phosphorus in the water column can also promote the development of cyanobacteria (Blue-Green Algae), which is becoming a major problem in many Quebec lakes. Thus, for a responsible and sustainable navigation it is necessary to prevent the impact of boats on shoreline erosion, on the suspension of sediments, and thus the availability of phosphorus in the water column."* Raymond and Galvez advocate that wake boats be utilized in areas at least 600 m wide (600 m is equal to 1860 ft) and 5 m deep (5 m = 15.5 ft).

2.2.5 A 2019 study, "Environmental Impacts of Wake Boats on Deep Creek Lake with Consideration of Recreation and Social Benefits," (Allen M., Brandenburg B., et al., 2019) reported that while typical boating activities affect turbidity, "*considering the mechanical aspects of wake boats including hull design and ballast weight, their [wake boat] impact should be greater on water turbidity"* and reduce water quality.

Damage to shorelines including aquatic plant life and a reduction in water quality caused by wakesports will likely occur more often and with greater severity unless the recommended 1000 ft distance from shore rule is adhered to.

2.3. Inundation of shorebird nests (esp. loons) and disruption of shoreline wildlife habitat.

Wildlife use of aquatic ecosystems depends upon several factors that are important for the survival and wellbeing of shoreline species. Among these are good water quality and the availability of suitable habitat. The large waves from wakesporting too close to shore impacts wildlife by disturbing nests along the shoreline. Such disturbances may cause some wildlife to vacate nests and homes, leaving their eggs and young vulnerable to predators. Loons, geese, and ducks all nest very close to the shoreline, and are therefore vulnerable to the effects of large, powerful wakes. Other species of affected shore birds that nest close enough to the shoreline to be disturbed by such activities include Pied-billed grebe, American bittern, Green heron, Virginia rail, Sora rail, Common gallinule, and Black tern. As with birds, the shoreline habitat of mammals (including mink, muskrat, beaver, and River otters) and reptiles and amphibians (turtles, snakes, and frogs) (Andrews J.S., 2021) may also be impaired by wake boat wakes.

Other, more indirect effects of these wakes include destruction of wildlife habitat, food sources and impaired water quality in littoral zone. For some species, these represent a temporary disturbance, while for a few, these effects can be long-term. In the case of species where unique habitats are disturbed by excessive wave action, an entire population can be adversely impacted.

Common loons are of particular interest to Vermonters. This is in part because of their history of decline and now, through the efforts of many, their recovery. It was only 2005

when loons came off Vermont's endangered list. Their resurgence was made possible through years of hard work and dedication of the many who protected nesting sites. Because loons are awkward on land, they nest close to shore to incubate their one to two eggs. When sitting on the nest, their awkwardness makes them susceptible to predators from the land and the sky. Hence, they instinctively choose nesting sites that are protected from the prevailing wind and close to the water's edge (**Figure 7**).

For the protection of their nest, 2021 VT Use of Public Waters Rules § 3.6 allows for placing signs and buoys or other clear on-site markings prohibiting persons and vessels from coming within 300 feet of loon nesting sites from May 1 to July 31. The 300 ft distance requirement is sufficient to protect nests from the effects of normal cruising/water skiing vessels. This is not the case for wake boats, however, as indicated in this quote from the attached support letter from the Vermont Center for Ecostudies and Audubon Vermont (**see Appendix D**):

> *"Loons, a species of greatest conservation need in Vermont, typically nest within two feet of the shoreline and only 2-8 inches above the water line, making them vulnerable to both flooding and large waves. These nests are often protected from natural waves by being built on shorelines not exposed to large open reaches of water where waves dissipate before reaching the nest site… In exposed conditions, wakes reaching the shoreline in excess of 3-6 inches can potentially flood or wash-out a nest site. Although nest flooding is rare when motorboats adhere to no wake zone rules within 200 ft of the shoreline, we are concerned by the increased use of watercrafts designed to create larger wakes and produce greater wave energy, especially in locations that do not normally receive larger, wind-caused wave action. The literature comparing wake size and wave energy from wake boats to other forms of motorized recreation is limited, though existing reports suggest wake boats may produce up to five times the wave energy and twice the wake height at 500 ft. as cruising boats (Goudey C.A. and Girod L.G., 2015; WEC, 2021). This form of recreation represents a new challenge to the expected protections offered by the current 200 ft. no wake zones."*

**Figure 7.** Adult Common loon incubating its egg(s) at a typical natural nesting site on Lake Dunmore. (Photo credit: Josh Cummings – 2021)

Based on the SAFL Wave Study, at a boat distance equal to the 300 ft loon protection zone, wakesurfing produces wave heights of 9 to 10 inches. In order to reach a wave height equivalent to a traditional tow boat at 300 feet, the wake boat distance must be greater than1000 feet from shore. As they currently operate, wake boats produce wakes with the potential to flood shoreline nests and dislodge eggs. An example of wake boat wakes disturbing a loon nesting platform is shown in **Figure 8**. It is not hard to understand how, without additional regulation, wakesports can threaten the long-term viability of this treasured species.

**Figure 8.** These two images were taken by a trail camera on Lake Kezar, Maine, to record loons on the nest in floating loon nesting platforms. The images show a large wake created by a wake boat about 250 feet to the left moving towards the shoreline to the right. The nesting platform was anchored on a small island. Judging from the height of the loon nesting platform, the wakes appear to be about 2 feet high. The tilting of the loon platform shown in the photo is sufficient to dislodge an egg from the nest into the water. Alternatively, a wake could wash through the nest in the nesting platform, cracking the egg or flushing it out into the lake. While loon nesting platforms are designed to absorb natural wave action, they cannot withstand the rocking motion caused by a close encounter with wake boat wakes (Griggs D., 2021) (Photo credit: KLWA Trail Cam – 2020).

2.4 Injury hazard to other boaters, swimmers, and those on floating shoreline structures, and risk of confrontation among users

2.4.1 Per US Coast Guard data, the wakes created by wake boats can create unsafe conditions for small craft such as canoes, kayaks, and sailboats. The result can be swamping, capsizing, and otherwise broaching recreational craft, leading to personal injury. Statistics from the US Coast Guard (USCG, 2021) indicated that "flooding/swamping" was the second most common type of boating accident reported in 2020 and the most common between 2016 and 2020, ahead of drownings and groundings. In addition, "Force of wave/wake" was one of the ten primary contributing factors in 2020 accidents, resulting in 14 deaths and 182 injuries. Similarly, data on Oregon marine accidents for 2010-2017 showed that, on average, 12% of all accidents were related to the force of wakes, with three people dying from wake-related accidents (Oregon, 2018). Finally, the Water Environment Consultants report (WEC, 2021) includes several similar

first-hand accounts from Lake Rabun Lake Association members indicating that large wake boats waves have significantly limited or eliminated normal lake activities, including swimming, waterskiing and boating.

2.4.2 Disruption of long-established uses, such as swimming, boating and waterskiing; the threat of personal injury; and damage to property (boats, docks, rafts, etc.) can lead to confrontations between property owners/renters, and wake boaters when governing agencies do not establish suitable shoreline safety zones. These confrontations will likely result in calls to VT State Police and Game Wardens, consuming their already limited time and resources, even though no current rules are violated.

2.5 Damage to shoreline structures and moored boats.

The WEC-2021 report evaluated the impacts of wake boats on the berthing conditions at docks and found that their *"… wakes can adversely impact vessels moored to docks either by causing damage to boats or docks, or by creating unsafe conditions for boarding and disembarking"* (WEC, 2021). Wake boat waves significantly exceed the industry standard of 0.6 ft high waves in marinas, even when operating 500 ft from these areas.

The effects of wake boat waves on vertical shoreline abutment walls are significant. *"Lateral wave forces from wakeboarding are 25 percent greater than those from cruising vessels, and the lateral wave forces from wakesurfing wakes are 131 percent greater than those from cruising vessels (i.e., the forces on the wall are more than double those from cruising vessels). Even with a 500-ft buffer distance, the lateral force from a wakesurfing wake is more than twice that of a cruising vessel at the same distance. These results indicate that these larger waves are more likely to cause damage to shoreline structures that are not built to withstand repeated exposure to these larger waves*" (WEC, 2021).

Thompson and Hadley found that waves reflecting on hard vertical shoreline walls create amplified wake energy that increases damage to shoreline structures (Thompson E.F. and Hadley L.L., 1995). In these situations, shoreline pilings or other dock support systems are undermined, resulting in damage not only to the docks themselves but also to moored boats attached to docks.

Wakesporting too close to shore also causes damage from waves "overtopping" shoreline structures and eroding shoreline areas behind these structures. Low-freeboard moored boats have been swamped by these wakes.

Reports of specific damages to shoreline structures and boats are documented in the Lake Rabun survey results (WEC, 2021), and in first-person accounts of similar damage in Vermont (see **Appendix A)**. Additionally, the Lake Ossipee Protective Association indicated that *"The waves smash watercraft against docks, creating potential damage. Small children playing on the shoreline have been knocked over by waves as wake boats pass by"* (Final Report of the Commission to Study Wake Boats, 2020).

**Unless the recommended 1000 ft shoreline protection zone is included in the rule changes, personal injury and damage to shoreline structures and moored boats are likely to occur more often and with greater severity, as increasingly powerful wake boats become the norm on Vermont's lakes.**

### *3.0 Justification for 20 ft minimum depth protection zone*

To propel motorboats forward, the motorboat propellors push back on the water, producing a slipstream. The slipstream from wakeboats, when operated in wake sport modes, is more powerful and is directed down at a higher angle than traditional boats. **Table 5** summarizes studies on the impacts of motorboat slipstreams in shallow lakes.

**Table 5.** Studies of motorboat propeller mixing and slipstream impacts

| Study | Design | Methodology | Findings | Limitations | Comments |
|---|---|---|---|---|---|
| Ray A., 2020) (Western Colorado Univ.) Prepared for Payette Lake Council | Slipstream modeling to assess sediment suspension. Wave analysis to compare to wind waves. | Modelled slipstream velocities for several wake boats. Used water level and wind data loggers. | Slip-streams from wake boats may disturb lakebed sediments at up to 33 ft depth. Recommending increasing no wake zone to 500 ft on Payette Lake | No measurements of slipstream velocities. No quantitative comparison of energy or power in wake boat vs. wind waves. | Show waves from wake-surfing at 950 ft with wave height of 4 in, slightly lower than expected from **Figure 5**. |
| Raymond S. and Galvez-Cloutier R., 2015) (Laval Univ.) funded by lake assns/ municipalities | Look at wake boat slip streams at various speeds and depths | ADCP probe mounted on bottom with wake boat traversing at various speeds with and without ballasts | Wake surfing with ballast impacts the water column to depths of at least 5 meters (16.4 ft) | Did not measure resulting turbidity or water quality. | |
| Anthony J.L. and Downing J.A., 2003 (Iowa State Univ. at Ames) | Correlate motorboat traffic and wind speed with measurements of turbidity and total phosphorus. | Continuously monitor temperature, pH, and turbidity with Sonde, boat traffic with camera, and wind speed/direction with anemometer and vane. | Turbidity and total phosphorus were correlated. Turbidity correlated with wind speed & boat activity. Concluded that enforcement of shoreline no wake zone had potential to improve water quality. | Did not look specifically at impacts of wake boats. Done in eutrophic lake with mean depth of 2.9 meters. | Used sediment samples & lake water to create turbidity gradient. Analyzed for T. phosphorus & obtained of TP relationship & turbidity |
| Beachler M.M. and Hill D.F., 2003 (Penn State Univ.) | Modelling and field measurements of impacts of propellor slip stream on bottom sediments | Use Acoustic Doppler Velocimeter to measure slipstream disturbance and optical backscatter to measure turbidity. | Disturbance a strong function of depth and boat speed, being maximum when speed in transition to plane. Slipstreams >25 cm/s can mobilize fine sediments | Did not look specifically at wake boat slipstreams. | |
| Asplund T.R. and Cook C.M., 1997). (Wisconsin DNR and Univ. of Wisc. – Stevens Point) | Compared plant growth in 12x6 m plots in open lake with similar plots isolated with solid plastic or plastic mesh that excluded motorboats | Measured dissolved oxygen, turbidity, suspended solids and plant abundance. | Saw no significant difference in water quality, but significantly lower plant abundance in plots exposed to motorboat activity due to bottom scouring. | Did not look specifically at impacts of wake boats. | |
| Yousef Y.A., McLellon W.M., et al., 1980 (Univ. of Central Florida) | Compared isolation chambers and natural habitat in 3 Florida lakes using changes in water quality with and without mixing due to motorboat or artificial means. | Used isolation chambers with and without mixing and locations with and without motorboat activity and measured several water quality parameters | In isolation chambers, found a rapid increase in turbidity & phos content during artificial mixing & slower decline after mixing. Increases also observed in natural habitats. | Used relatively low horsepower motorboats, no wake boats. Not a large range of depths studied. | In natural habitat, increases in total phosphorus were marginal compared to measurement uncertainties. |

Many Vermont lakes are shallow, with fine sediment muddy bottoms containing phosphorus from aquatic plant and animal decay. Beachler and Hill (Beachler M.M. and Hill D.F., 2003) showed that motorboat propeller-generated slipstream velocities exceeding 25 cm/sec (0.8 ft/sec) can disturb and suspend fine lake bottom sediments at the water-sediment interface. **When sediment is swept up and suspended for repeated and/or prolonged periods, phosphorus—the most critical plant and cyanobacteria growth nutrient—is released into the water column. Wakesporting in water that is too shallow can thereby reduce water quality.**

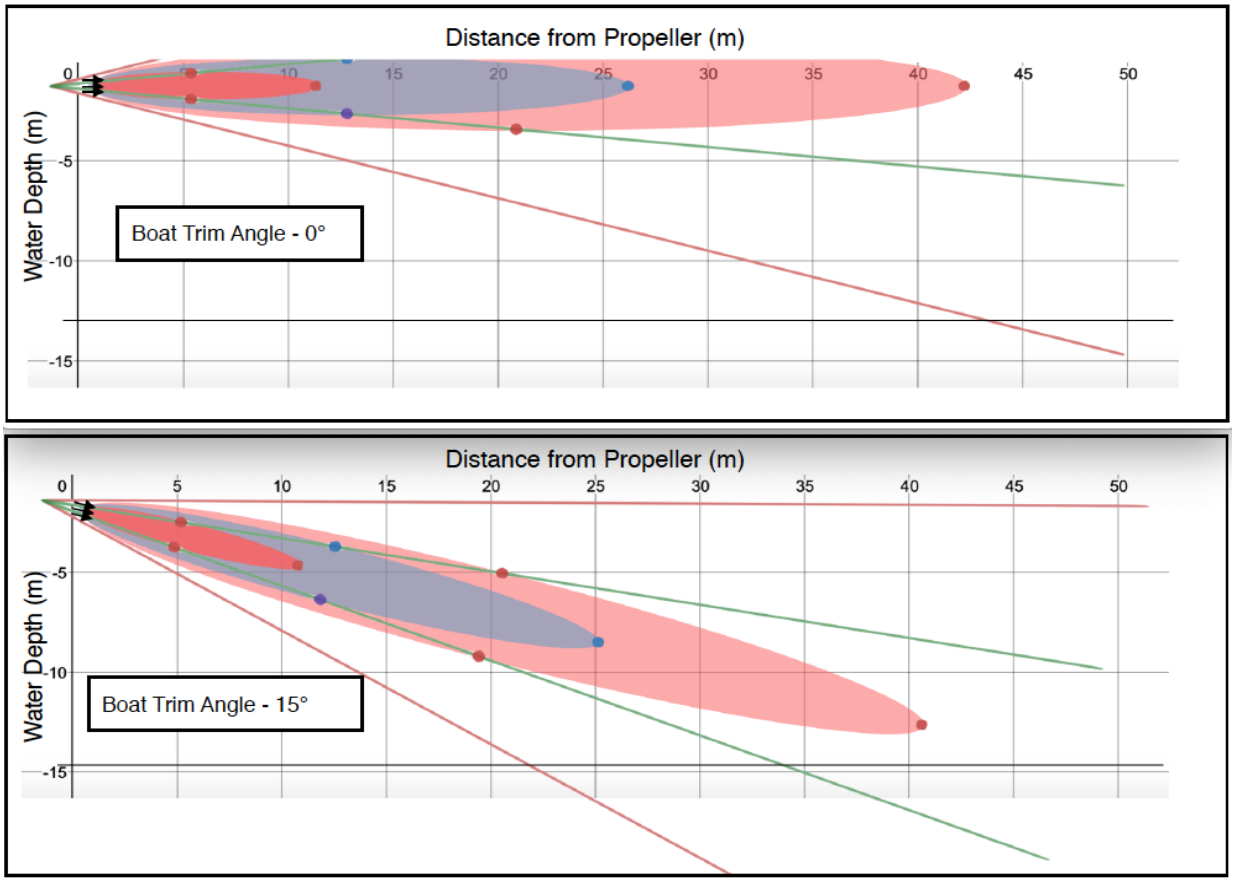



**Figure 9**. Propeller slipstream velocity data for two wake boat scenarios: 1) **Top:** conventional waterskiing 0˚ trim angle; and 2) **Bottom:** wake surfing 15° trim angle (Ray A., 2020). These data are for a 2016 Malibu LSV22 with a maximum slipstream velocity of 4.49 m/s @ 11 mph, and 2400 rpm. Dark pink is for slipstream velocity >0.90 m/s; light blue is for slipstream velocity >0.40 m/s; and light pink slipstream velocity >0.25 m/s.

Cruising and waterskiing activities are performed with 0˚ or minimal trim angles (i.e., the downward angle relative to the water's surface), and slipstream velocities from these activities do not penetrate beyond a few feet below the water's surface other than during the start of a waterski run, when trim angles temporarily increase. With wake boats' V-drive engines, heavy ballasts, and hull modifications, however, trim angles are directed downward at an angle as much as 30°. **Figure 9** is taken from a recent study done in Payette Lake, Idaho (Ray A., 2020), that determined model-validated slipstream velocity profiles for a Malibu LSV22 wake boat

operating in waterskiing **(Top**) and wakesurfing (**Bottom**) modes at a trim angles of 0˚ and 15°, respectively. Ray reported that slipstream velocities of 0.6 m/sec (2 ft/sec) were found to correlate with the disturbance of sediment particle sizes typically found in Lake Payette. At higher slipstream velocities, these particles are disturbed in Lake Payette with diameters up to 0.5 mm (1/50 inch), greatly exceeding the particle sizes found in muddy lake bottoms, and thus providing a sense of the degree of sediment disturbance a wake boat is capable of creating. An additional finding of the study is that **wake boat slipstream velocities may adversely impact lakebed sediments to depths of down to 33 ft** (Ray A., 2020).

Ray's results are consistent with those done in a Laval University, Quebec study (Raymond S. and Galvez-Cloutier R., 2015), in which acoustic Doppler current profile measurements of the slipstream velocities were taken from a vessel operating in wakesurfing mode with a trim angle of only 15˚. The Quebec study concluded that: *"Wake surfing and wake board practices impact the water column up to 5 m (16.4 ft)."*

**For ease of compliance and enforcement, a single depth threshold of 20 ft is proposed as the protective depth for wakesporting. This limit will protect the vulnerable littoral lake habitat, and also limit shredding and fragmenting of invasive plants, e.g., Eurasian watermilfoil, by wake boat propellers—an important mode of their spread in lakes (Asplund T.R., 2000). It is important to point out that as more powerful wake boats become available in the future, the slipstream effects will reach even greater depths**.

*Why is wakesporting slipstream a problem?* The following list details the negative impacts of the powerful, downward-directed slipstream when wakeboarding and wakesurfing occur in waters that are too shallow, i.e., less than 20 ft. For purposes of comparison, **Figure 10** illustrates the adverse impacts of conventional boating, which are much less pronounced.

3.1. Uprooting and fragmentation of aquatic vegetation in shallow lake bottoms.

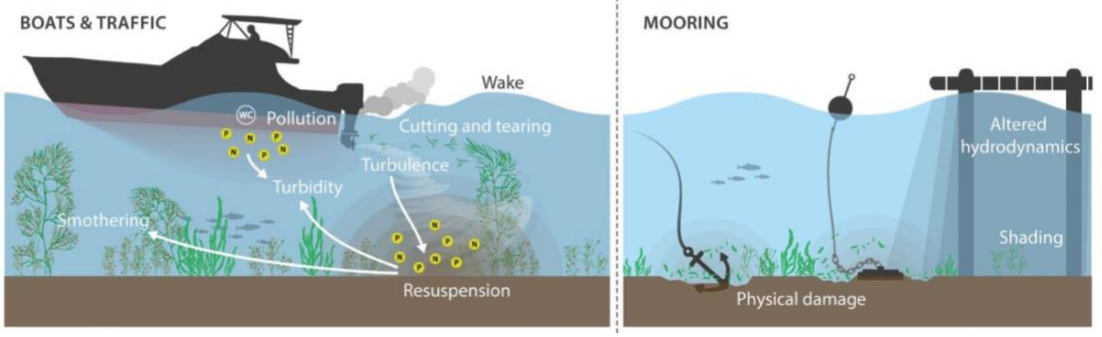



**Figure 10.** The effects of conventional recreational boating activities on sediment and vegetation (Sagerman J., Hansen J.P., et al., 2019).

Fragmentation of Eurasian watermilfoil by motorized vessels is a primary means of spread within a waterbody (Asplund T.R., 2000). Studies done to date have looked only at the effects of non-wake boats (Beachler M.M. and Hill D.F., 2003; PennState,

2001) (Asplund T.R. and Cook C.M., 1997). Given wake boats' stern-weighted configuration, their V-drive motors, and their operation at trim angles up to 30˚—which extends their propellers much farther below the water surface—it is expected that wakesports activity will cause significantly greater uprooting and fragmentation of aquatic vegetation than waterski and other traditional motorboats (Johnston J., 2020).

3.2. Disruption of littoral zone habitats of lake bottom biota.

Wave energy from wake boats causes lake bed scouring and resuspension of deep sediment and increased turbidity. As the sediment resettles, it can coat vegetation, blocking life-critical light. The littoral zone is where fish lay their eggs, and prop wash from wake sports in shallow water can disrupt lake bottom biota and adversely impact fish habitat, especially spawning areas (Asplund T.R., 2000; Chapman P.M., Hayward A., et al., 2017; Merritt R.G., 2020).

3.3. Suspension of bottom sediments and release of nutrients (e.g., phosphorus) otherwise bound in sediments.

The suspension of bottom sediment and release of nutrients leads to the degradation to water quality from nutrient influx, which contributes to cyanobacterial blooms. This takes place in a way analogous to spreading fertilizer on a lawn results in an acceleration of grass growth if the lawn is watered. There is little peer-reviewed research directly addressing wake boat impacts on cyanobacteria blooms. However, several processes impacted by wake boat activity are likely to influence bloom formation, which, in some cases, can be highly toxic to humans, pets, and wildlife (Cornell, 2019). Three potential mechanisms by which wake boat activity could contribute to cyanobacterial blooms are as follows:

1. *Disruption of rooted aquatic plants* (macrophytes) as a result of wave activity can result in increased phytoplankton biomass, including cyanobacteria. There is a large body of literature detailing the balance between shallow phytoplankton- and macrophyte-dominated lakes (Scheffer M. and Nes E.H., 2007; Scheffer M., Rinaldi S., et al., 1997), suggesting that some disturbances may result in shifts between "alternate stable states" that are difficult to reverse. This is a result of several mechanisms. First, there is direct competition between macrophytes and phytoplankton for nutrients and light. Some rooted macrophytes may also affect internal sediment nutrient release by transporting oxygen to their root tissues (Hupfer M. and Dollan A., 2003) resulting in increased oxidation of sediments and sequestration of phosphorus in iron-oxyhydroxides. Aquatic plants impact blooms through their impact on zooplankton populations (Jeppesen E., Jensen J.P., et al., 1999; Jeppesen E., Jensen J.P., et al., 1997) and also provide refugia from predation to herbivorous zooplankton, giving them a place to hide from fish and larger predatory zooplankton. In the absence of plants, herbivorous zooplankton are more exposed to predation and populations decline, reducing grazing pressure on phytoplankton and allowing the formation of blooms.
2. *Deep turbulence from motorized boats* can resuspend bottom sediments and cause the release of phosphorus (Yousef Y.A., McLellon W.M., et al., 1980). This is particularly true for wake boats because of the greater turbulence created, which

can extend down to 30 ft (Ray A., 2020). Even turbulence insufficient to cause resuspension may increase the phosphorus and ammonium flux from sediment porewaters (Anthony J.L. and Downing J.A., 2003; Thomas D.B. and Schallenberg M., 2008), so that enhanced release of sediment nutrients may occur even when there is no observed increase in water column turbidity. Increased wave activity can also increase phosphorus loading by eroding lake shorelines. Similarly, wake boat-induced turbulence may increase mixing of water across the lake thermocline in stratified lake areas, allowing nutrient-rich water from the hypolimnion to mix with the more nutrient-depleted surface water, causing an increase in nutrient concentrations in surface waters. Increased nutrients from both lake sediments and lake hypolimnia may contribute to blooms of cyanobacteria in surface waters, although the magnitude of this effect is difficult to quantify (and is dependent on the level of boat traffic).

3. *Resuspension of resting cyanobacteria cells from lake bottoms*—i.e., in addition to resuspending sediment or phosphorus, turbulence from boat wakes—results in higher recruitment of colonies to the water column and directly contributes to bloom formation. Recruitment of cyanobacteria cells overwintering on the sediment surface happens primarily in relatively shallow areas due to passive turbulent-driven resuspension, and the extent of recruitment can be a major factor in explaining the extent of summer cyanobacteria blooms, explaining 50-75% of the bloom extent (Verspagen J.M.H., Snelder E.O.F.M., et al., 2004). Wake boat activity, which can create deep turbulence, may therefore have a strong direct impact on cyanobacteria populations by contributing to recruiting resting colonies and seeding open-water cyanobacteria blooms.

The mechanisms described above (disruption of aquatic plant communities, sediment resuspension and increased sediment phosphorus loading, and increased recruitment of benthic cyanobacteria colonies) are likely to be most impactful in shallow lakes or shallow areas of deeper lakes. It is difficult to assess the relative importance of wake boat impacts in comparison to other influences on lake turbulence conditions, such as natural wind events. However, the US Army Corps of Engineers found that local impacts of normal (i.e., non-wake-boat) motorboat impacts on sediment resuspension in 3 ft of water were similar to the effects of 20 mph winds (USACE, 1994), and it is logical to assume that local wake-boat impacts would correspond to the impacts of considerably higher wind-speeds (which are rare in most places).

Given these considerations, what does the future hold for the possibility of more frequent cyanobacteria blooms in Vermont? The 2021 Vermont Climate Assessment (VCA) (VCA, 2021) predicted that global warming in Vermont will increase, and with it will come an increase in cyanobacteria blooms and their associated problems, e.g., toxicity to man and animals—including fish kills (**Figure 11**):

> *"With increased air temperature comes increased water temperature, leading to water quality issues—specifically in the form of invasive species and algae blooms…—often forcing popular beaches to close and creating areas for boaters and water enthusiasts to avoid."*

**Figure 11.** Dead fish washed ashore during golden alga toxic bloom (Photo credit: Michael Cooper. mhooper@usgs.gov).

Prepared by the Gund Institute for Ecological Economics and University of Vermont, the VCA based its predications on climate change and its impacts on the best available science. **Given the three potential mechanisms of harmful algae blooms noted above, it seems likely that unmanaged wake boating will contribute to an exacerbation of this problem. As the number of wake boats increases, their capacity for generating even greater wakes and stronger slipstreams will also increase.**

### *4.0 Justification for minimum 60 contiguous acre Wake Sport Zone*

*Rationale for a 60-acre contiguous minimum Wake Sport Zone*

Unlike most boats operating on Vermont waterways, wake boats produce large and powerful wakes, creating unique rulemaking challenges. Their enhanced wakes threaten the safety and enjoyment of others engaging in traditional recreational water uses, e.g., waterskiing, cruising, sailing, kayaking, canoeing, rowing, paddleboarding, fishing, and swimming. To address these concerns, we propose the creation of a 60-contiguous acre minimum Wake Sport Zone, which would provide adequate space for the operation of wake boats while allowing other traditional lake activities to continue. The 60-continuous acre minimum Wake Sport Zone requirement would also simplify compliance and enforcement, since larger areas are easier to distinguish.

The "Maximum Speed Limits and Other Operational Requirements" rule included in the 2021 Vermont Use of Public Water Rules, states in § 3.2(a):

> *"Vessels powered by motor shall, in addition to the requirements of 23 V.S.A. § 3311(a) pertaining to careless and negligent operation, not exceed five m.p.h. on lakes, ponds and reservoirs upon which the operation of vessels powered by motor at substantially higher speeds is not a normal use, or that have a surface area of 75*

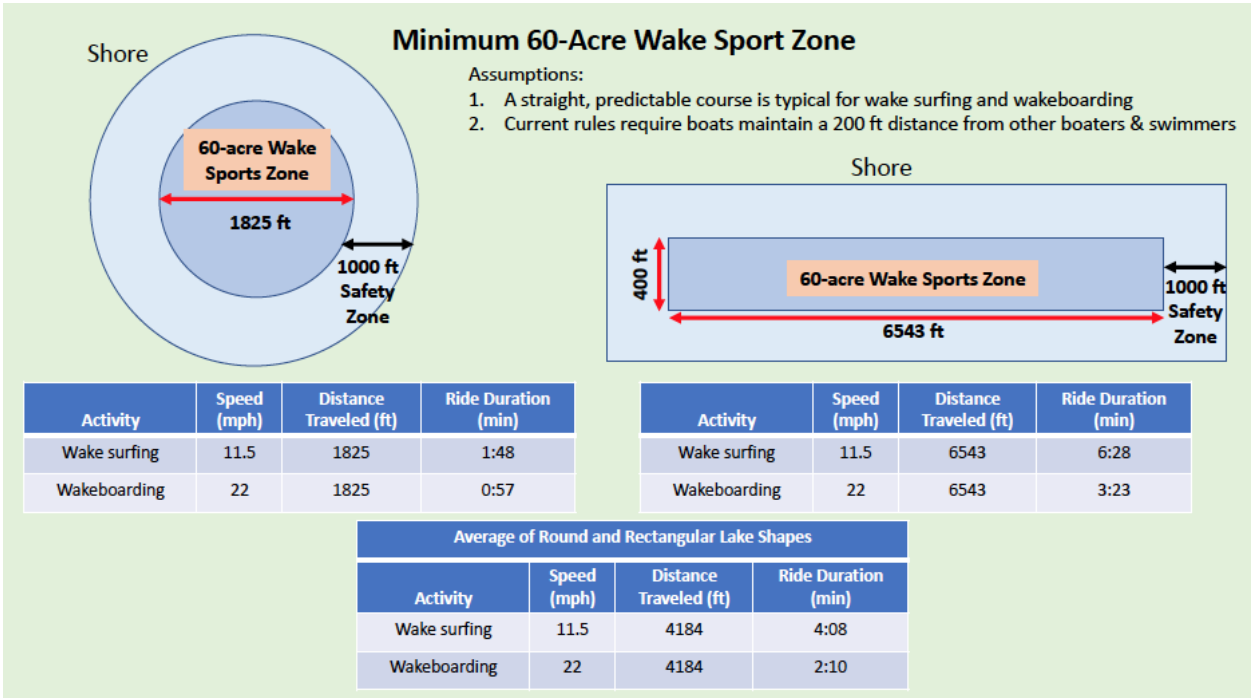
*acres or less, or **that have less than 30 contiguous acres outside the shoreline safety zone**, or upon which the use of internal combustion motors is prohibited..."*

This rule establishes precedence for a minimum contiguous acre area outside of a shoreline safety zone. However, wake boats are a very different type of vessel, with far greater impact, than those in use on Vermont lakes when the rule was drafted in 1995. It is reasonable to conclude that wake boats, with their large and powerful wakes, require a larger minimum operation area than that needed for the conventional craft that existed more than 25 years ago.

Considerations for establishing a 60-contiguous acre minimum Wake Sport Zone include:

1. *Having an adequate minimum wake boat operating area*

What is the minimum area required for the enjoyment of wake enhanced watersports activities? An adequate wake boat operation area depends on several factors, including desired watercraft speed, time or distance for a "reasonable" ride, pathway available for travel etc. To generate a typical enhanced surfable wake, wake boats typically operate at 11.5 mph for wakesurfing and 22 mph for wakeboarding (Ruprecht J., Glamore W.C., et al., 2015). Normally, wake boats travel in a straight a line while generating enhanced wakes for wakesurfing (Richman D., 2019) and wakeboarding (MonsterTower, 2020).




| Activity | Speed (mph) | Distance Traveled (ft) | Ride Duration (min) |
|---|---|---|---|
| Wake surfing | 11.5 | 1825 | 1:48 |
| Wakeboarding | 22 | 1825 | 0:57 |

| Activity | Speed (mph) | Distance Traveled (ft) | Ride Duration (min) |
|---|---|---|---|
| Wake surfing | 11.5 | 6543 | 6:28 |
| Wakeboarding | 22 | 6543 | 3:23 |

| Average of Round and Rectangular Lake Shapes | | | |
|---|---|---|---|
| Activity | Speed (mph) | Distance Traveled (ft) | Ride Duration (min) |
| Wake surfing | 11.5 | 4184 | 4:08 |
| Wakeboarding | 22 | 4184 | 2:10 |

**Figure 12.** Duration of a wake boat run in a 60 contiguous acre Wake Sport Zone within a circular and a rectangular lake. When averaged, the durations approximate those available on the average VT lake.

What shape is a lake where there is a Wake Sport Zone? **Figure 12** illustrates the dimensions of two "extreme" 60-acre Wake Sport Zone lake configurations: a circle and a long rectangle. The intent is to show the length of time for acceptable wakesurfing and

wakeboarding runs in the minimum 60 acre Wake Sport Zone for each configuration. The typical lake shape falls somewhere between these two configuration extremes.

The minimum 60-acre Wake Sport Zone circle has a diameter of 1825 ft, and the minimum 60-acre Wake Sport Zone rectangle has a length of 6543 ft. (The rectangular Wake Sport Zone assumes a width of 400 ft, i.e., 200 ft on each side of a wake boat traveling down the center of this rectangular Wake Sport Zone. 200 ft from other boats, docks, swimmers, etc. which is the distance required under existing rules). One can conclude that the longest straight run of an average lake will be the average of these two configurations' distances, i.e., 4184 ft. The tables included within **Figure 12** indicate the ride duration provided by circular, rectangular, and "average" shaped lake Wake Sport Zones. The more circular the lake or Wake Sport Zone, the shorter the ride duration; the more rectangular, the longer the ride. Taking into account the enhanced wake height and the power of wake boat wakes (see **Section 2.0**) and minimum Wake Sport Zone depicted, a 60-contiguous acre Wake Sport Zone is a reasonable minimum size to provide an adequate wake sport run without crowding out other activities. Representative examples of small and large Vermont lakes are shown in **Figure 13.**

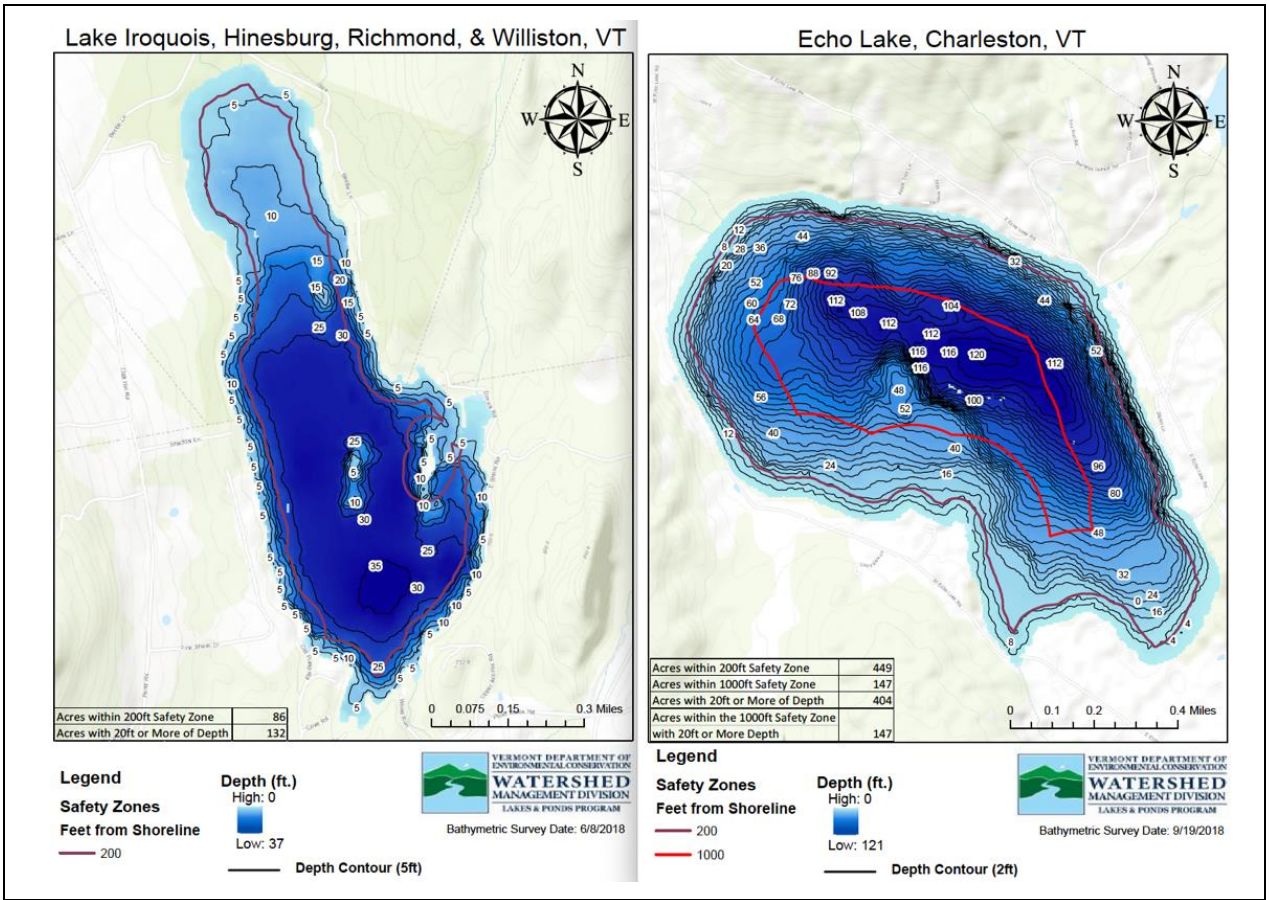



**Figure 13.** Representative examples of depth maps for two Vermont lakes. **Left**: a small, 247-acre lake with no Wake Sport Zone (Lake Iroquois); **Right:** a large, 546-acre lake with a Wake Sport Zone (indicated by the red line — towards the lake's center) as determined by the Proposed Rule (Echo Lake).

2. *Impact on other recreational activities*

   In deriving the minimum area required for a Wake Sport Zone, one must also consider the potential impact (i.e., enjoyment and safety) on other recreational activities competing for use of that space. Current rules require speeds of less than 5 mph and no wake within 200 feet of persons in the water and other vessels (in addition to 200 ft from the shoreline, docks, anchorages, etc.) Is the 200 ft distance from swimmers, paddlers and other vessels adequate when considering the enhanced, powerful wakes generated by wake boats? Will nearby wake boats decrease the safe enjoyment of other traditional activities, all of which are less environmentally impactful? An additional consideration is the statement in the Vermont Use of Public Water Rules § 2.2b and § 2.3 requiring "…*an appropriate mix of water-based recreational opportunities on a regional and statewide basis*." In other words, there is a requirement to allow people to engage in the activity of their choice, without one activity crowding out or dominating other activities. Thus, even if the water rules are changed and Wake Sport Zones created, wake enhanced activities should not have an exclusive right to be used in these areas.

   As detailed above in Section 2.1, the enhanced size of the wakes created by wake boats fosters unsafe conditions by virtue of their ability to capsize small watercraft—in particular, canoes, kayaks, and paddleboards. If the predicted rapid growth in the number of wake boats continues, with anticipated future enhancements making them more powerful and better able to generate even more powerful wakes, the adverse consequences of wakesports—unsafe, overcrowded conditions with greater shoreline erosion and bottom scouring—are likely to increase dramatically unless modifications are made to bring their activities more in line with the intent of Vermont's Use of Public Water Rules.

3. *Wave amplification in Wake Sport Zones*

   When multiple wake boats operate in the same Wake Sport Zone, the principle of superposition of waves becomes operative. This principle states that when two or more propagating waves interact, the resultant amplitude is equal to the vector sum of the amplitudes of the individual waves. This means that if a crest of a wave meets a crest of another wave, then the resulting crest is the sum of the individual amplitudes. Thus, multiple wake boats operating near one another can create massive wakes, due to the additive wave heights. Besides the tumultuous jostling of swimmers and boats, these "super" waves can cause passenger falls from their watercraft, possibly resulting in injury. Small craft, including canoes, kayaks, paddleboards and sailboats are at particular risk of being swamped, broached, or capsized by such waves (see **Section 2.1.1** for details of recreational boating accidents included in the U.S. Coast Guard's 2020 report (USCG, 2021).

**In summary, we propose a 60-contiguous acre minimum Wake Sport Zone for wake boat activities, which is in keeping with previous rulemaking and will help maintain the public benefit provided by the State for the enjoyment of other, less impactful, activities, such as waterskiing, cruising, canoeing, kayaking, sailing, paddleboarding, swimming, and fishing.**

***Why is including a minimum Wake Sport Zone important?*** As mentioned above, the negative impacts of a Wake Sport Zone that is too small include:

4.1. There is inadequate space for wakesurfing and wakeboarding, especially when multiple wake boats are considered.

Ride durations are too short to be enjoyable.

4.2. Personal safety problems increase, particularly with multi-wake boat usage

Fear of potential injury caused by large wakes and waves reduce the enjoyment of other, more traditional activities. These safety concerns and fears are real and supported by several of the personal accounts included in **Appendix A** and by the following quotes from the Wake Boat Impact Analysis at Lakes Rabun and Burton in Georgia (WEC, 2021):

- *"Two times ballast boat waves have come over the bow of my 22' open bow boat. I felt there was a danger of sinking. Generally, it is not pleasant to navigate rough water and big waves. This is ruining our boating experience."*
- *"With the wake boats so numerous and dominant out on the water now, I can't remember the last time being on the lake where I didn't fear for my family's safety at least once. This is true of time we spend on our boat, as well as time we spend swimming near our dock."*
- *"Difficult to enjoy the lake safely with small children. Can no longer do normal water skiing. Difficult to swim near our dock. Difficult and unpleasant to drive a pontoon boat."*

4.3. Compliance and enforcement are more difficult.

Depending on lake size, depth, and shape, without such a rule, there may be areas where wake sports are permitted, but where the area size is clearly insufficient to enjoy the activities and where other, traditional activities are threatened. The 60-continuous acre minimum Wake Sport Zone requirement simplifies compliance and enforcement, since larger areas are easier to identify and monitor, both for wake boaters interested in complying with the new rule and for enforcement officers.

### *5.0 Result of Proposed Rule on Wake Boating Opportunities on Vermont Lakes and Ponds*

If the proposed rule is adopted, we anticipate that the 23 inland Vermont lakes larger than 500 acres in size will have the required characteristics to support Wake Sport Zones (**Table 6**). However, four of these lakes: Somerset Reservoir, Star Lake, Chittenden Reservoir, and Green River, are not likely to have Wake Sport Zones because they currently have one or more of the following restrictions: 5 mph speed limit, internal combustion motors not allowed, and/or water skiing is prohibited. Thus 19 of the lakes larger than 500 acres have the potential to contain Wake Sport Zones. Since each lake has a unique shoreline shape and depth, ANR mapping of lakes will be required to confirm which of these lakes—and if any lakes smaller than 500 acres—

will include Wake Sport Zones as defined by our Proposed Rule. Lake Champlain, Lake Memphremagog, Lake Wallace, Moore Dam Reservoir, and Comerford Reservoir are not included in the lake count as they are not inland lakes that are fully within Vermont's borders; these five waterbodies will provide additional Wake Sport Zones.

The number of lakes, 19, estimated to support Wake Sport Zones under our Proposed Rule compares favorably with the 14 Vermont lakes and ponds over 500 acres that currently permit personal watercraft and the overall total of 26 lakes and ponds that permit personal watercraft. (VT DEC: Use of Public Waters Rules Table). The 19 lakes that could support Wake Sport Zones account for the majority (58%) of the 33 Vermont lakes greater than 300 acres in size.

It seems reasonable to restrict wake boat operation to lakes larger than the minimum 300 acre size requirement for personal watercraft in § 3.3 of the Vermont Use of Public Waters Rules due to wake boats' significantly greater safety concerns, crowding out of other watersports, and environmental impacts when compared with personal watercraft.

**Table 6.** Vermont's 23 largest inland lakes greater than 500 acres totally within Vermont's borders (from VT DEC: Lakes Greater than 10 Acres)

| | Water Body | Town | Area (acres) | | Water Body | Town | Area (acres) |
|---|---|---|---|---|---|---|---|
| 1 | Bomoseen | Castleton | 2,360 | 13 | Salem | Derby | 764 |
| 2 | Harriman (Whithm) | Wilmington | 2,040 | 14 | Crystal (Barton) | Barton | 763 |
| 3 | Seymour | Morgan | 1,769 | 15 | Maidstone | Maidstone | 745 |
| 4 | Willoughby | Westmore | 1,687 | 16 | Arrowhead Mt | Milton | 720 |
| 5 | Somerset Res* | Somerset | 1,525 | 17 | Chittenden Res* | Chittenden | 702 |
| 6 | Carmi | Franklin | 1,402 | 18 | Island | Brighton | 614 |
| 7 | Dunmore | Salisbury | 985 | 19 | Norton | Norton | 583 |
| 8 | Star* | Mt Holly | 904 | 20 | Green River* | Hyde Park/Eden | 554 |
| 9 | Waterbury Res | Stowe | 869 | 21 | Echo (Chartn) | Charleston | 550 |
| 10 | St. Catherine | Poultney | 852 | 22 | Morey | Fairlee | 547 |
| 11 | Big Averill | Essex | 828 | 23 | Hortonia | Hubbardton | 501 |
| 12 | Caspian | Greensboro | 789 | | | | |

** 5 mph speed limit, internal combustion motors not allowed, and/or waterskiing is prohibited*

### *6.0 Justification for prohibiting wake boats from operating without their ballasts disabled on lakes with no Wake Sport Zones*

While it is true that *all* watercraft traveling from one lake to another have the potential to introduce aquatic invasive species (AIS), wake boats pose a much greater risk than traditional motorboats or paddle sport vessels. There are ample data indicating that wake boats present a significant challenge to the VT DEC's efforts in controlling the spread of AIS (Campbell T.,

Verboomen T., et al., 2016; Dalton L.B. and Cottrell S., 2013). This is wholly attributable to two problems involving the ballast tanks:

1. Even after draining prior to transport to another water body, several gallons of water remain in the ballast tanks of wake boats;
2. Because the ballast tanks are situated in an inaccessible, sequestered housing, they cannot be inspected to rule out the presence of AIS (**Figure 14**).

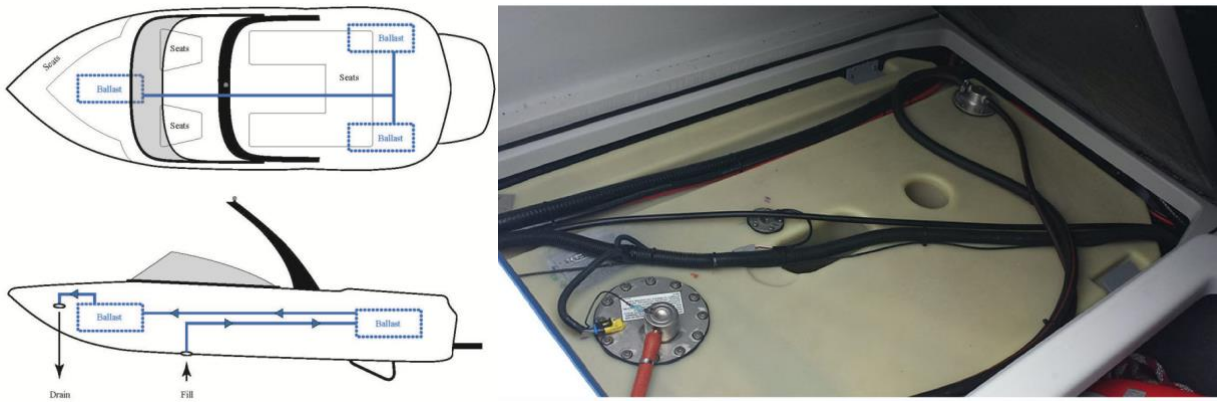



**Figure 14**. Wake boat ballast system (Mercier-Blais S. and Prairie H., 2014). To create enhanced wakes, wake boat ballasts hold from 2000 to 6000 pounds of water (equivalent to the weight of a sedan automobile) to increase their displacement. It is not possible to inspect tanks like those on the right as they cannot be completely drained and cleaned.

These two characteristics of wake boats greatly increase the probability of lake-to-lake spread of AIS and are in conflict with Vermont's law on the transport of aquatic plants and aquatic nuisance species (Title 10, Chapter 050 § 1454): "*A person shall not transport an aquatic plant, aquatic plant part, or aquatic nuisance species to or from any Vermont water."* The potential AIS threat that ballasted vessels pose, as well as the fact that there is currently no remedy for the problem, is acknowledged by boat manufacturers and groups such as Boat Owners Association of The United States (BoatUS). The situation was also noted in the 2020 NH Commission report on wake boats (Final Report of the Commission to Study Wake Boats, 2020). Despite recommendations for decontaminating ballasted boats made by the US Forest Service in 2007 (the last such recommendations), the American Boat & Yacht Council's most recent review of this topic in their 2018 technical bulletin states, **"*there is no national or international standard defining decontamination procedures*" for boats** (ABYC, 2018).

The introduction of new AIS results in adverse impacts to the public's enjoyment of recreational water activities (Havel J.E., Kovalenko K.E., et al., 2015). Despite the law banning AIS transport, the VT DEC continues to allow wake boat usage. Doing so incurs the potential for an even heavier economic burden for AIS mitigation and losses in property value and tax revenue (VANR, 2010). A 2005 study found that the mitigation costs in the US for aquatic invasive plants and mollusks were high (Pimentel D., Zuniga R., et al., 2005), and rising in Vermont in subsequent years. Total annual costs for AIS mitigation projects statewide averaged approximately $2M (presentation by K. Jensen at FOVLAP AIS Funding Seminar, January 2022).

A modeling study, by Dalton and Cottrell (Dalton L.B. and Cottrell S., 2013) concluded that, due to wake boat ballasts volumes being significantly larger than fishing boat live wells, wake boats were more than seven times as likely to transport invasive veligers (mussel and clam larvae) if these large ballasts are left undrained. A subsequent study has documented increased AIS veliger risk in wake boat ballasts (**Figure 15A**). Campbell et al. examined the contents of ballasts removed from 18 wake boats operating in Wisconsin (Campbell T., Verboomen T., et al., 2016). Onboard pumps indicated "empty" before ballast bags were removed for testing. The volume of the residual water was then removed, measured, and filtered to search for veligers and other invertebrates. **The residual volumes averaged 32 liters (8.5 gallons) with a maximum of 87 liters (23 gallons). Veligers were detected in two of the ballast bags.**

Although yet-to-be studied, organisms in wake boat ballast water could also spread pathogens affecting fish health (Maine, 2017). To address this concern, the importance of cleaning boats and equipment before moving between different bodies of water must be emphasized to boaters.

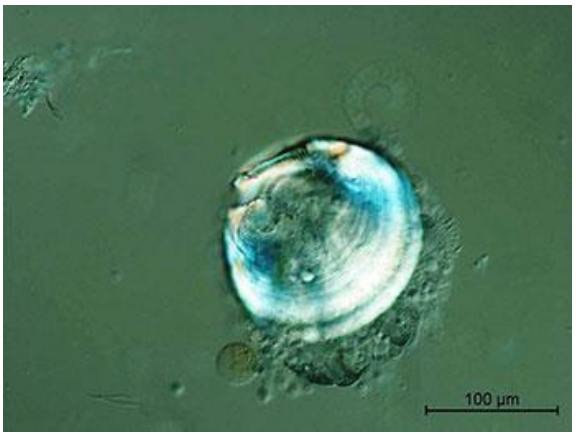



**Figure 15A.** This zebra mussel (*Dreissena polymorpha*) veliger (larval stage) is slightly greater than 100 microns in diameter or approximately 2x a human hair). Since veligers are free-floating in water at this stage, they are easily transported to new waterbodies in small amounts of water. They outcompete native species for plankton nutrients, clog water intake pipes and damage boat motors. Once established, infestations are nearly impossible to eradicate. (Photo credit – CA Department of Fish and Wildlife)

**Figure 15B.** Eurasian watermilfoil (*Myriophyllum spicatum)* fragments can easily be taken up into a wake boat ballast. Eurasian watermilfoil is the most prevalent and economically costly AIS in Vermont. It competes aggressively to displace and reduce the diversity of native aquatic plants. Monocultures can degrade water quality and can deplete dissolved oxygen levels. Typical dense beds restrict swimming, fishing and boating, clog water intakes and result in decaying mats that foul lakeside beaches. (Photo credit David Johnson, Lake Dunmore)

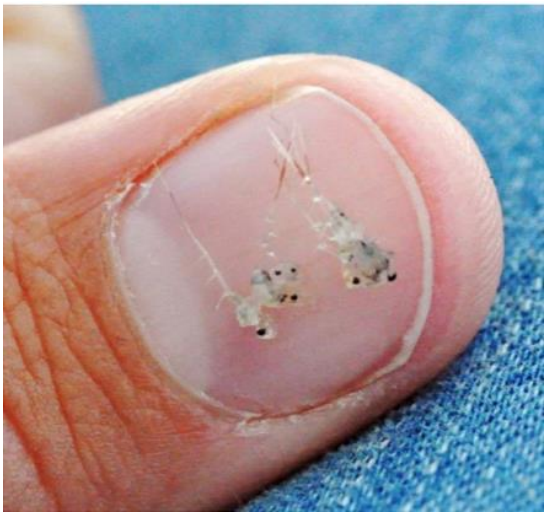


**Figure 15C**. As a result of its aggressive predatory behavior and rapid reproduction, the Spiny water flea (*Bythotrephes longimanus*) negatively impacts the zooplankton community structure by altering aquatic food web dynamics through its direct competition with small fish for zooplankton. This reduces species richness and population sizes within zooplankton communities. It also fouls fishing lines. (Photo credit Emily DeBolt)

**Figure 15D**. The Brittle naiad (*Najas minor*) plant fragments with seeds can easily be sucked into ballast tanks in one water body and re-introduced into another. Brittle naiad inhibits native plant species' growth by blocking sunlight during the early growing season, and outcompeting plants for resources such as space thus limiting recreational water activities. (Photo credit: Graves Lovell, Alabama Department of Conservation and Natural Resources)

Considering the higher risk of AIS transfer posed by such vessels and consistent with other efforts in Vermont to minimize AIS spread, our Responsible Wakes for Vermont Lakes group proposes that all **wake boats with operational ballasts** be excluded from lakes without designated wake sport zones. Our position is supported by the Vermont Center for Ecostudies and Audubon Vermont), whose comments expressed in their letter of support are as follows (see **Appendix D** for the full letter**)**:

> *"Wake boats also pose a threat to aquatic ecosystems due to their comparatively large ballasts, which carry special risks for spreading invasive species. Aquatic invasive species are easily dispersed by human activity and have the potential to negatively impact native biodiversity and aquatic ecosystem functioning (Havel J.E., Kovalenko K.E., et al., 2015). Specifically, invasive species alter the food web by outcompeting native food sources and offering little or no food value for native wildlife and may also affect the abundance or diversity of species that provide important habitat for native wildlife.*
>
> *"For these reasons, among others, preventing the spread of aquatic invasive species in ballasts and on the surface of watercraft is an ongoing concern in Vermont, where hundreds of thousands of dollars are spent per year on their eradication (VANR, 2010). Mitigating wake boats' potential spread of aquatic invasive species is complicated by the prevalence of ballast tanks that can neither be inspected visually nor completely drained*

> *and are not rated to withstand temperatures needed to successfully decontaminate their contents. Therefore, wake boats represent a greater risk of spreading invasive species than other forms of recreational watercraft on Vermont water bodies."*

*What does the Proposed Rule change mean for small lakes without a Wake Sport Zone?* If there are no Wake Sport Zones available, vessels with filled ballast tanks and other devices intended to enhance wakes will be denied access to operate in these waters. However, these boats would be allowed to operate if the owners/operators were to disable their ballast systems. This is easily and inexpensively achieved by switching off the circuit breakers to these systems, rendering wake boats functionally similar to standard non-ballasted vessels.

Allowing wake boats that have not had their wake enhancing components disabled to operate in lakes without Wake Sport Zones poses the following risks:

6.1 Increases the probability of lake-to-lake spread of AIS for wake boats that have previously operated on AIS-infested lakes, ponds, and rivers.

Because of the increased risk, wake boats pose in introducing AIS (Campbell T., Verboomen T., et al., 2016; Dalton L.B. and Cottrell S., 2013), their management in smaller lakes without Wake Sport Zones *should require* disabling of ballast systems and other wake enhancing components prior to their re-entry. All new AIS infestations can degrade aquatic ecosystems and water quality to some degree, with potentially significant economic consequences for the state, municipalities, lake property owners, and the public in general. The type of invasive introduced will determine the impact on recreational water sports, including fishing, swimming, boating, sailing, and/or water skiing/tubing. Vermont has a program to combat the AIS problem (Vermont Aquatic Nuisance Control Program). However, public funding to support this program already falls *far* short of the needs. Prohibiting functioning wake boat use in lakes without Wake Sport Zones will decrease the risk of spreading AIS, thereby reducing AIS prevention and management costs. For these reasons, our Responsible Wakes for Vermont Lakes group strongly encourages the VT DEC to take all feasible measures to enhance enforcement of the "Transport of aquatic plants and aquatic nuisance species" Statute (Title 10, Chapter 050 § 1454).

6.2 Increases the adverse safety, environmental, and economic impacts associated with their wake enhancing capabilities.

These adverse impacts are the same as those described in Sections 2.0 to 4.0 above.

*What might the Proposed Rule change in the management of wake boats mean for larger lakes with Wake Sport Zones?* If the Proposed Rule is adopted, Vermont lakes with Wake Sport Zones are likely to experience an increase in wake boat usage, which will increase the risk of introducing new AIS into these larger lakes. Our Responsible Wakes for Vermont Lakes group is adamantly opposed to this development, as it conflicts with Vermont's "Transport of aquatic plants and aquatic nuisance species" statute. We therefore propose that measures be taken to minimize this risk, such as:

- Prioritizing financial support for greeter programs in larger lakes;
- Consider establishment of State-sanctioned sites to certify that ballasted wake boats leaving larger lakes have had their ballast and wake-enhancing systems disabled if they will be returning to lakes without Wake Sport Zones;
- Encouraging and facilitating effective wash stations. On larger lakes with heavier boat traffic, such wash stations would receive greater use and thus be more cost-effective. If effective decontamination regimes for wake boat ballasts are developed by the boating industry and/or others in the future, these procedures the State should first implement these on larger lakes with Wake Sport Zones.

*Recommendations for enhancement of Vermont's Aquatic Nuisance Control (ANC) Program*. The high risk of AIS spread posed by the transport of residual water in wake boat ballasts deserves more attention from the ANC program. We suggest:

- The creation of a protocol for the decontamination of wake boat ballasts. Consultation with other states operating such programs is to be encouraged.
- An increase in educational outreach to inform boaters and greeters of the particular importance of "clean, drain, and dry" for wake boats.
- A renewed dialog between VT DEC and VT Fish and Wildlife focusing on the threat posed by AIS to fisheries and seeking cooperation in the siting of decontamination stations at public boat launches.
- A modification in the data collected by AIS greeters, so that wake boats encountered may be distinguished from other vessels.

### *7.0 Proposed Rule is consistent with the Vermont's environmental lake-related statutes*

The long-term health of Vermont's inland lakes and the continued enjoyment of these resources by traditional uses lie at the heart of many State programs. Are our recommendations to manage wake boats and the water sports associated with their use consistent with Vermont's Use of Public Waters Use policies and programs? Yes, as detailed in the following sections of Vermont law.

### 7.1 Vermont Use of Public Waters Rules

The Vermont Use of Public Waters Rules (Environmental Protection § 2.2 General criteria (b) states: "*The public waters shall be managed so that the various uses may be enjoyed in a reasonable manner, considering safety and the best interests of both current and future generations of citizens of the State and the need to provide an appropriate mix of water-based recreational opportunities on a regional and statewide basis."*

The petitioners addressed the concerns prompting the petition through presentations and discussions across Vermont in 2021 with numerous lake associations, individuals, and organizations. We have contacted town select boards, conservations commissions, and organizational stakeholders (e.g., Trout Unlimited), whose interests in the use of public waters

are represented in this petition. In July 2021, The Vermont Sierra Club hosted a virtual statewide Community Conversation about the environmental impacts of wake boats on Vermont's lakes and ponds. Concerned about aquatic environmental degradation, Federation of Vermont Lakes and Ponds (FOVLAP) included a presentation regarding the impacts of wakesport wakes at their September 2021 Annual Meeting co-sponsored by VT DEC. These interactions have drawn out many citizens' concerns about the problems posed by wake boats, and they illustrate the need for ANR to adopt reasonable management rules for the use of wake boats across the many lakes and ponds in Vermont used and enjoyed by the public. Fortunately, the petition process is a means for such groups to recommend management rules for wakesports in Vermont.

Section 2.3 above includes the following: "*Recreation-related criteria" states that: "In evaluating normal recreational and other uses, the following uses shall be among those considered: fishing, swimming, boating, waterskiing, fish and wildlife habitat, wildlife observation, the enjoyment of aesthetic values, quiet solitude of the water body, and other water-based activities*." Wake boats interfere with fishing, swimming, small boat operation, fish and wildlife habitat, wildlife observation, and the enjoyment of aesthetic values and quiet solitude.

The Public Use of Public Water Rules allow for regulation of boating activity. In § 2.6(a) "Use conflicts" states that: "*Use conflicts shall be managed in a manner that provides for all normal uses to the greatest extent possible consistent with the provisions of § 2.2 of these Rules."* Of central importance is the definition of "normal use." The term "normal use" is defined in § 5.6 as follows: "Normal use" means any lawful use of any specific body of public water that occurred on a regular, frequent, and consistent basis prior to January 1, 1993." Wake boats were invented in the 1980s and only became popular after 2000. Even now, their use is not widespread, although they are rapidly growing in popularity. Wake boats are not a "normal use" within the definitions of the Public Use Rules, and because these boats and their generation of large, enhanced wakes were not found before 1993, the applicable rules do not address the issues presented with these activities. There is precedent for regulating and prohibiting various types of boats on Vermont lakes and ponds. One statewide example is the restriction of operating personal watercraft on lakes less than 300 acres. Local lakes included in **Appendix A** of Vermont's Use of Public Waters Rules ("Lake-Specific Rules Regulating the Use of Public Waters." (10 V.S.A. § 1424) have also successfully petitioned the ANR for this purpose.

**The Proposed Rule, if adopted, would affect all inland Vermont lakes and ponds. It takes into consideration all normal uses and other recreation-related activities on Vermont's lakes and ponds. It is based on the size of our water bodies, both in area and depth of water. The Rule utilizes scientific evidence and takes into consideration other uses of lakes and ponds statewide in establishing reasonable locales for enhanced wake sports. The Rule recognizes that the use of wake boats and enhanced wakes can be appropriate and in bodies of water that are sufficiently large and deep enough to absorb the impact of the large waves and forceful slipstreams. The Rule anticipates the best interests of both current and future generations. Recreational use of standup paddleboards and kayaking have increased along with the introduction of wake sports in Vermont. However, these standard uses do not pose safety or environmental risks. While user conflicts and concerns over public safety are likely to continue, the Proposed Rule adopts a reasonable and**

**science-based approach to provide an appropriate mix of water-based activities throughout Vermont to ensure public safety and sustainable environmental quality.**

Because of the nature of the environmental and safety problems raised by wake sports, rules imposing a speed limit on wake boats or that designate times of usage in areas that are inappropriate for wake sports at any time would be insufficient as reasonable management rules for wake sports. On the other hand, adopting the Proposed Rule will significantly minimize user conflicts and allow wake sports to be enjoyed in Vermont.

### 7.2 Vermont Shoreland Protection Act

In 2014, the Vermont Legislature passed the Shoreland Protection Act (Chapter 49A of Title 10, §1441 et seq.) to prevent water quality degradation in lakes, preserve habitat and natural stability of shorelines, and maintain the economic benefits of Vermont lakes and their shorelands. The permit standards section (§ 1444. Permit standards(a)(4)(B)) states: "… *best management practices will be used to provide erosion control, bank stability, and wildlife habitat functionally equivalent to that which would be provided by clearing less than 40 percent of the protected shoreland area*."

The Proposed Rule has been carefully crafted to address the problem of shoreline erosion created by enhanced wakes. By establishing an appropriate distance from the impacted lake shores, the Proposed Rule is harmonized and is directly consistent with the purpose of the Lake Shoreland Protection Act and its standards.

As part of its attempt to improve its shorelands, the State initiated the Vermont Lake Wise Program with its goal to "… *establish a new normal, a new culture of lakeshore landscaping that is proven to help protect the lake."* **Recent Vermont lake science from the National Lake Assessment study shows that Vermont ranked lowest in the northeast region and the nation for degraded shallow water habitat.** Vermont's degraded conditions for aquatic habitat are directly related to harmful impacts from lakeshore development. "*The Lake Wise Program aims to inform, teach, and change the current lakeshore development practices from clearing shores and building sea walls to practices that are more lake friendly and known to effectively protect the lake."* The Proposed Rule offers another opportunity for the State to align its various lake-related policies aimed at reducing shoreline erosion throughout the State.

### 7.3 Vermont Aquatic Nuisance Control Program

The Vermont Aquatic Nuisance Control statute is directed at the transport of aquatic nuisance species, particularly in vessels that enter or leave Vermont waters. The statute addresses the inspection of vessels, the use of boat washes for decontamination, and the draining and cleaning of ballast tanks, valves, and other devices used on vessels.

The wake sport process of filling and emptying wake boat ballast tanks and the movement of ballasted boats from lake to lake is recognized as a significant cause for the spread of AIS relative to other motorized boats (Campbell T., Verboomen T., et al., 2016; Dalton L.B. and Cottrell S., 2013; UnivMinnesota, 2018). Vermont Aquatic Nuisance Control Program **(**10

V.S.A. § 1453) states: *"A person shall not transport an aquatic plant, aquatic plant part, or aquatic nuisance species to or from any Vermont water"* (10 V.S.A. § 1454(a)). As detailed in other sections included with this petition, the ballast tanks in wake boats cannot be adequately or entirely drained and are impracticable to properly clean. Further, these tanks cannot be visually inspected or safely treated with sufficient heat or disinfectants to kill zebra or quagga mussel veligers and invasive zooplankton species that may remain alive in a wake boat ballast tank for extended periods.

"*A person transporting a vessel to or from a water shall, prior to launching the vessel and upon leaving a water, inspect the vessel, the motor vehicle transporting the vessel, the trailer, and other equipment, and shall remove and properly dispose of any aquatic plants, aquatic plant parts, and aquatic nuisance species."* (10 V.S.A. § 1454(b)). Wake boat ballast tanks cannot be properly inspected for AIS. Aquatic plants, plant parts and nuisance species cannot easily be removed and properly disposed of. *"When leaving a water of the State and prior to transport away from the area where the vessel left the water, a person operating a vessel shall drain the vessel, trailer, and other equipment of water, including water in live wells, ballast tanks, and bilge areas."* (10 V.S.A. § 1454(d)(1)(A)). The Proposed Rule does not impose new regulations for eliminating veliger transport in wake boat ballast tanks. However, the Proposed Rule limits the number of Vermont lakes that witness the launching, retrieving, and transportation of wake boats. Further measures to deal with the potential of the spread of zebra and quagga mussels in Vermont lakes and ponds are appropriate and necessary. The Proposed Rule is consistent with the state's objective of minimizing the spread of invasive aquatic species in Vermont.

### 7.4 Vermont Water Quality Standards

The Vermont Water Quality Standards, established under Vermont's Clean Water Act (10 V.S.A. § 1252, Environmental Protection Rule § 29A) provide additional support for DEC's adoption of the Proposed Rule. The State's Water Quality Policy states: "*It is the policy of the State of Vermont to: (A) protect and enhance the quality, character, and usefulness of its surface waters and to assure the public health; … [and to] (D) assure the maintenance of water quality necessary to sustain existing aquatic communities"* (§ 29A-103(b)(1)). The policy goes on to state that: *"It is further the policy of the State to seek over the long term to upgrade the quality of waters and to reduce existing risks to water quality"* (§ 29A-103(b)(2)). Wake boats are a new phenomenon threatening water quality throughout the State. Existing Water Quality Standards charge the ANR to address this new and growing risk by adopting appropriate management rules.

The Vermont Water Quality Standards Antidegradation Policy, set out in § 29A-105, speaks to the importance of action to regulate and manage wake boat activity. This Antidegradation Policy states that: "*All waters shall be managed in accordance with these rules to protect, maintain, and improve water quality."* (§ 29A-105(a)) The Policy goes on to list factors that must be used to make determinations of management priority: *"Protection and Determination of Existing Uses. … In making a determination of the existing uses to be protected and maintained under this section and all other sections of these rules, the Secretary shall consider at least the following factors: (1) Aquatic biota and wildlife that utilize or are present in the waters; (2) Habitat that supports or is capable of supporting aquatic biota, wildlife, or plant life; (3) The use of the*

*waters for recreation or fishing"* (§ 29A(105(b). Wake boats have been demonstrated to impact all three factors negatively when wakesporting is too close to shore or in water that is too shallow. The Proposed Rule supports ANR in protecting water quality over time.

Examination of the Water Quality Standards section on Applicable Criteria (§ 29A-302) further emphasizes that the Proposed Rule is consistent with current water quality policy objectives. These various water quality criteria are accompanied by mandates to prevent environmental degradation. §2(A) deals with phosphorous and states: "*In all waters, total phosphorous loadings shall be limited so that they will not contribute to the acceleration of eutrophication or the stimulation of the growth of aquatic biota in a manner that prevents the full support of uses*." In Section 3.3 above, evidence shows that in inappropriate locations, wakesports can significantly contribute to increased phosphorous concentrations through a combination of bottom scouring and shoreline erosion.

Examination of the Water Quality Act's Use Specific Management Objectives and Criteria (10 V.S.A. § 1252 § 29A-306) demonstrates the Proposed Rule's relevance to the State's existing policy objectives. According to this section, "Class B(2)" waters are defined as: "Waters that are suitable for swimming and other primary contact recreation; irrigation and agricultural uses; aquatic biota and aquatic habitat; good aesthetic value; boating, fishing, and other recreational uses and suitable for public water source with filtration and disinfection or other required treatment." This classification clearly applies to the lakes and ponds in question. According to the section concerning Aquatic Biota, Wildlife, and Habitat: "*Waters shall be managed to achieve and maintain good biological integrity.*" With respect to Aesthetics: "*Waters shall be managed to achieve and maintain good aesthetic quality*." With respect to Recreation – Boating: "*Waters shall be managed to achieve and maintain a level of water quality compatible with good quality boating.*" Fishing: "*Waters shall be managed to achieve and maintain a level of water quality compatible with good quality fishing*." Swimming and Other Primary Contact Recreation: "*Where sustained direct contact with the water occurs, waters shall be managed to achieve and maintain a level of water quality compatible with good quality swimming and other primary contact recreation with very little risk of illness or injury from conditions that are a result of human activities.*" As noted in the sections above, wakesporting in inappropriate locations:

- Are damaging to aquatic biota and wildlife.
- Are damaging to biological integrity.
- Disrupt the aesthetic quality of Vermont's lakes and ponds.
- Interfere with good quality boating.
- Interfere with good quality fishing.
- Pose a real and substantial risk of public injury from conditions resulting from human activity.

Through the State's Clean Water Initiative (10 V.S.A. § 1387(a)(1)): *"The State has committed to implementing a long-term Clean Water Initiative to provide mechanisms, staffing, and financing necessary to achieve and maintain compliance with the Vermont Water Quality Standards for all State waters.*" The State currently spends approximately $25M annually to

improve water quality. Meanwhile, the opportunity exists to prevent further damage to lakes and ponds through sensible management of wake boats. This Proposed Rule is consistent with the State's efforts to improve water quality.

### *8.0 Compliance and Enforcement Recommendations*

This section reviews and offers suggestions for how compliance and enforcement of our Proposed Rule changes may be achieved. The education of the public, wake boat users and enforcement officials will be required for successful implementation of its provisions as well as the avoidance of potential conflicts among user groups.

This Vermont ANR petition to enact new water use rules is not without precedent. Similar restrictions were proposed and implemented more than a decade ago governing the operation of personal watercraft (aka "jet skis"). The personal watercraft use rule remains in effect today, and its adoption is viewed as a success. Enforcement of the rule was facilitated by the ease with which the public could identify the operation of personal watercraft, i.e., by sight and sound, so that individuals could notify appropriate law enforcement entities on their own. The operation of wake boats presents a similar situation; their ballast and other electronic wake enhancing systems are easily identified by their slow speed, downward stern-weighting, and their large wakes as they plow through the water. Because the Proposed Rule change for wake boats requires a Wake Sport Zone, an important enforcement component is the development of a means for determining if wake boats are operating in designated "Wake Sport Zones."

*How should the Proposed Rule changes, if adopted, be communicated and enforced?* Suggestions include:

7.1 Education. As part of a formal education plan relating to the adoption of the new rules, we recommend the following:

- Update the "Vermont Public Access Greeter Program Manual" to inform Greeters about changes regarding wake boats.
- Update the "The Handbook of Vermont Boating Laws and Responsibilities" by adding a section that outlines the new rules for wakesports.
- Create easily understood and readily available maps clearly indicating Vermont waters where "Wakesurfing" and "Wakeboarding" activities can occur, i.e., lakes that include a Wake Sport Zone of at least 60 contiguous acres. These maps should be made available on appropriate official State of Vermont websites.
- Develop smartphone apps that wake boaters and others can use to learn which Vermont lakes and ponds allow wakesporting and hopefully use the GPS capabilities of these devices to indicate current position on such maps.
- Update new and existing training materials with information relevant to the new wakesurfing and wakeboarding rules for groups and individuals responsible for enforcing Vermont boating laws, i.e., Vermont State Police, Vermont Game

Wardens, US Coast Guard officers, and any other authorized peace or law enforcement officers.

- Educate the public about wake boats by including descriptive materials, including photos, on the VT DEC and other websites. Many Vermonters are completely unfamiliar with this type of watercraft and the potential for problems that they pose.

7.2 Enforcement. The petitioners understand that the various public safety officials charged with enforcing Vermont's boating laws have numerous responsibilities, many which are not related to the enforcement of boating laws. To implement the proposed changes, it is recommended that state enforcement officials:

- Develop programs that inform and welcome public input and participation relevant to enforcement approaches, rules, regulations, and priorities that include how the public can assist with education and enforcement. While education is important for both boaters and enforcers, the added incentive of a rule combined with violation consequences is needed to maximize compliance and equity.

Because of the evidence-based concerns discussed in **Section 5.0** regarding the increased likelihood of introducing AIS into Vermont waters via wake boat ballast systems, the ANR is *strongly urged* to review its statutory requirements regarding the transport of AIS. In doing so, they are asked to especially consider the development and implementation of a cost-effective educational and enforcement approach to reduce the potential for the spread of new AIS into all Vermont waters from wake boat activities (see **Section 5.0**).

## *9.0 Responses to the arguments of those opposed to managing wake boats*

There will be opposition to the management of wake sports on Vermont lakes. We offer the following responses to the common opposing arguments, with the hope that doing so will help counter the misinformation that may be forthcoming following the online publication of this petition by the Vermont Agency of Natural Resources.

- Wakesport regulation is an affront to personal freedom in the enjoyment of a public resource.

  *Response*: Individuals acting in their own self-interest in the utilization of a public resource can pose safety hazards to other users and can, over time, destroy that resource to the detriment of the common good.

  This is a classic "tragedy of the commons" scenario and is one of the reasons that the Use of Public Waters Rules exists. As the General Criterion 2.2b states: *"The public waters shall be managed so that the various uses may be enjoyed in a reasonable manner, considering safety and the best interests of both current and future generations of citizens of the State and the need to provide an appropriate mix of water-based recreational opportunities on a regional and statewide basis."* This petition defines appropriate locations throughout the state where these sports can be enjoyed while minimizing their impact on the public's lake resources and on other traditional uses of these resources.

- Wake sports can be enjoyed by all generations in a family and promote family togetherness and other American family values (Final Report of the Commission to Study Wake Boats, 2020).

  *Response:* The same can be said for all traditional lake uses, which are associated with a much lower risk of personal injury, environmental concerns, and property damage.

  Children and seniors are particularly vulnerable to the safety hazards posed by the large wakes produced in wake sports. Practiced too close to shore, wake sports enjoyed by one family can disrupt the enjoyment of a much larger number of families along the shoreline and can show disdain for the American values of respect for one's neighbors and the environment. If the Proposed Rule is adopted, wake sport enthusiasts will be free to enjoy these activities in many locations without causing disruptions to others and damage to our lake resources.

- Boaters prefer operator education to regulation. Regulation puts a burden on enforcers and causes friction among neighbors (Final Report of the Commission to Study Wake Boats, 2020).

  *Response:* There are several issues here. First, show us the data that operator education is successful in modifying wake boating behavior. Regarding regulation, the rule regulating the use of personal watercraft (jet skis) has been highly effective in Vermont. This is attributable in large part to the ease with which the public is able to readily identify infractions and to immediately notify law enforcement so that action can quickly be taken. Wake sport activities are similarly easy for the public to identify, mitigating the need for monitoring by law enforcement. As for friction among neighbors, if changes to the Use of Public Water Rules are clear and enforceable, they should reduce tensions since regulation will come from the State, not from individuals or lake associations, and will settle the matter once and for all.

- Wake sport regulation will negatively impact lakeshore property values (Final Report of the Commission to Study Wake Boats, 2020).

  *Response:* Show us the data. Most of the property owners in Vermont place water quality and the availability of traditional uses at the top of their list in prioritizing where to buy lakeshore properties.

  Practiced too close to shore or in water that is too shallow, wake sports result in degraded water quality. As was argued in Section 1.2 above, declining water quality is documented to reduce lakeshore property values. The Proposed Rule defines locations where these sports may be practiced with minimum impact to water quality or traditional uses.

- Wake sport regulation will hurt Vermont's economy, due to economic losses in the boating industry.

  *Response:* Again, show us the data. We welcome an economic analysis done by an unbiased third party indicating who will be helped and who will be harmed by wake sport regulation. Wakesport enthusiasts will still be able to buy wake boats and enjoy these sports in lakes with Wake Sport Zones, knowing that they are reducing impacts on other boaters and the lake environment. Long term, the Vermont economy will benefit from the new rules, as lakeshore property values and the tourist industry will be preserved when water safety and water quality concerns are mitigated.

- Wake boats designed for wake sports can be used for many other activities.

  *Response:* We agree —and our Proposed Rule allows for these many other uses under the conditions proposed.

- What about existing wake boats purchased at significant expense?

  *Response:* Owners of existing wake boats can enjoy wakesports on lakes with designated Wake Sport Zones. On lakes without such zones, they can disable the ballasts and continue to use their wake boats for cruising, skiing, and family activities other than wakesports.

- Studies indicate that wakesports performed at least 200 ft from shore generate waves comparable to wind-driven waves and hence should be allowed.

  *Response:* This erroneous conclusion was obtained in a non-peer-reviewed study funded by the boating industry (Goudey C.A. and Girod L.G., 2015). The study's many flaws have been documented by the Merritt analysis (Merritt R.G., 2020).

  Other evidence-based studies cited above in Sections 2.0, 3.0, and 5.0 indicate adverse impacts to safety, water quality, AIS spread, shoreline property damage, and disruption to bottom and shoreline habitats at the distances recommended by the boating industry (Goudey C.A. and Girod L.G., 2015).

- If shoreline structure damage or damage to moored boats occurs, the property owners should have installed more robust structures and more appropriate mooring.

  *Response:* Installations by property owners and local installers are made to be robust to damage from severe conditions generated by wind and/or traditional boat wakes. However, wakesporting too close to shore results in wake forces far beyond this range, placing such installations at significant risk of damage. We seek to restrict these wakesports to locations where they can be enjoyed without such risk.

- If the lakeshore is eroded, the property owner should have stabilized the shore with rip-rap or some other means.

  *Response:* Same as response above. Also, we point out that modifying the shoreline with rip-rap or a seawall requires a permit from the state, and in most cases is not a good solution considering the long-term health of the lake and the long-term enjoyment of its users.

- Lake property owners just want the lake for themselves.

  *Response:* In Vermont, the inland lakes are public property, regulated by the State. By Statute, the State must resolve use conflicts through the process outlined in the Use of Public Waters Rules, with the goals of protecting traditional uses and the lake environment for future generations. Many lake shore property owners are members of lake associations who volunteer tremendous hours annually to help maintain water quality and other lake attributes of high value to all users.

- Wake boats are not unique in causing large waves, so why pick on wake sports to regulate?

  *Response:* Some motorized boats do produce very large wakes at the beginning of a towing run, but this effect is transient. Wake sports are unique in generating very large and powerful wakes many Vermont shorelines have never been previously exposed to.

- The SAFL Wave Study (Marr J., Riesgraf A., et al., 2022) is not representative of Vermont Lakes and only studied four boats, so results may not apply.

  *Response*: While it is true that individual boats produce different wakes and different lake shorelines vary in their vulnerability to these wakes. All studies looking at wave dynamics have demonstrated that the wakes from wakesports are much larger than those from waterskiing or cruising on plane (**Table 3**). These studies considered many different wake boat models and many different shoreline environments.

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