

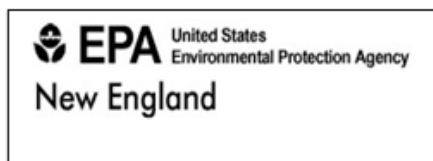


WATER CHESTNUT HAND HARVEST PROGRAM 2017

Vermont Department of Environmental Conservation
Montpelier, Vermont

A report prepared for the Lake Champlain Basin Program on water chestnut hand harvest activities in Lake Champlain and other waterbodies in Vermont

April, 2018



Cover photos (VTDEC): left, a VTDEC staff members shows off spoils from a successful volunteer harvest day; top right, a water chestnut rosette in Lake Champlain; bottom right, a VTDEC contractor pulls water chestnut from Bulwagga Bay

The Vermont Department of Environmental Conservation is an equal opportunity agency and offers all persons the benefits of participation in each of its programs and competing in all areas of employment regardless of race, color, religion, sex, national origin, age, disability, sexual preference, or other non-merit factors.

This document is available upon request in large print, Braille, or audio cassette.

VT Relay Service for the Hearing Impaired
1-800-253-0191 TDD>Voice – 1-800-253-0195 Voice>TDD

TABLE OF CONTENTS

Introduction	5
Methods	6
Results	8
Conclusions	12
Acknowledgements	13

List of Tables

Table 1. 2017 Water chestnut management funding sources and allocation	6
--	---

List of Figures

Figure 1. Sites surveyed in MNWR and GPS tracked survey in 2017 (source: USFWS, MNWR)	7
Figure 2. Control trends for all Lake Champlain hand harvesting sites	9
Figure 3. Control trends for the Otter Creek Region hand harvest sites in VT and NY.....	9
Figure 4. Control trends for Ticonderoga Central Region in VT and NY	10
Figure 5. Control trends for South Lake B Region in VT and NY	10
Figure 6. Control trends for other waterbody hand harvested sites.....	11
Figure 7. Missisquoi National Wildlife Refuge water chestnut control trends	12

List of Appendices

Appendix A. Individual Program Components	14
Appendix B. Maps and Site Information	16
Appendix C. Historical hand harvest summary for Lake Champlain sites.....	25
Appendix D. Historical hand harvest summary for other waterbody sites.....	28

2017 Water Chestnut Hand Harvest Program Report: Lake Champlain and Other Vermont Waterbodies

Introduction

The Vermont Department of Environmental Conservation (VTDEC) has actively managed water chestnut (*Trapa natans* L.) since 1982. However, many other partners also contribute significant annual efforts to control water chestnut in many areas of the Lake Champlain Basin.

Water chestnut is an annual aquatic plant that can form dense monocultures, choking out beneficial native plant species, reducing oxygen levels, negatively altering the recreation potential of the invaded water body, and reducing shoreline property values. This species was first confirmed in Vermont in Lake Champlain in the 1940s but has now spread to 85 sites in Lake Champlain¹. Most of these sites are in southern Lake Champlain, but a few locations exist in the northern lake as well. Water chestnut is also found in an additional 29 waterbodies in the Lake Champlain basin of Vermont (see Appendix D). Additional water chestnut sites exist in the Lake Champlain basin in the Province of Quebec and are under some level of management by Quebec partners.

VTDEC management goals for water chestnut are to significantly reduce the negative impacts of this invasive plant in Lake Champlain and other waters in Vermont, and to prevent its further spread. VTDEC's program involves hand and mechanical harvesting with most of the work conducted under contract. Hand harvesting is used to control sparse populations of water chestnut or populations inaccessible to mechanical harvesting equipment. Mechanical harvesting is used to control dense and easily accessible mats.

Awarded LCBP funds supported a portion of contracted water chestnut hand harvesting. Only the hand harvesting element of VTDEC's program is addressed in this report.

¹ An estimated 10 miles of South Lake Champlain, from Dresden south to Whitehall, New York, also support numerous water chestnut sites but these sites have not been delineated and are not included in the 85 sites known to support water chestnut.

Water Chestnut Management Funds

Funds supporting the hand harvesting element in 2017 totaled \$278,353 and were derived from six sources: the Lake Champlain Basin Program, the US Army Corps of Engineers, the US Fish and Wildlife Service Partnership Program, ANS Management Plan 2015 and 2016 funds, VTDEC, and the Missisquoi National Wildlife Refuge. VTDEC awarded two contracts and one grant to support the hand harvest element of the 2017 management program. Table 1 summarizes the sources and expended funds supporting the 2017 hand harvest element. Another \$308,649 was expended to support the mechanical harvest and compost elements of the full Program in 2017.

Table 1. 2017 Water chestnut Management Funding Sources and Allocation

SERVICES	LCBP	USACE	USFWS Partners	USFWS ANS (15, 16)	VTDEC	MNWR	Total
Personnel, Fringe, Indirect: Environmental Scientists (2); UVM Rubenstein intern; Seasonal staff position; Water chestnut volunteer coordinator				\$3,325 \$346	\$50,000 \$32,972		\$50,000 \$3,325 \$33,318
Hand Harvest Contract: Lakeside Restoration Services & Lannon Lakeside	\$97,666	\$76,982	\$10,000				\$184,648
Hand Harvest Grant: Friends of Missisquoi Bay				\$4,000		\$3,062	\$7,062
TOTAL	\$97,666	\$76,982	\$10,000	\$7,671	\$82,972	\$3,062	\$278,353

Permitting

Hand harvesting activities do not require a control permit in Vermont (10 VSA §1455); however, access for hand harvest activities at Vermont Department of Fish and Wildlife public access areas requires a Special Use Permit. A permit was applied for and authorized prior to the start of hand harvesting. In New York, water chestnut harvest activities in Lake Champlain and associated waters are authorized under Adirondack Park Agency Permit 2001-47A issued April 26, 2011 to the New York State Department of Environmental Conservation and VTDEC jointly. This permit authorizes hand and mechanical harvesting of water chestnut from Lake Champlain in the towns of Dresden, Putnam, Ticonderoga, Crown Point, and Moriah, New York and expires in April 2020.

Methods

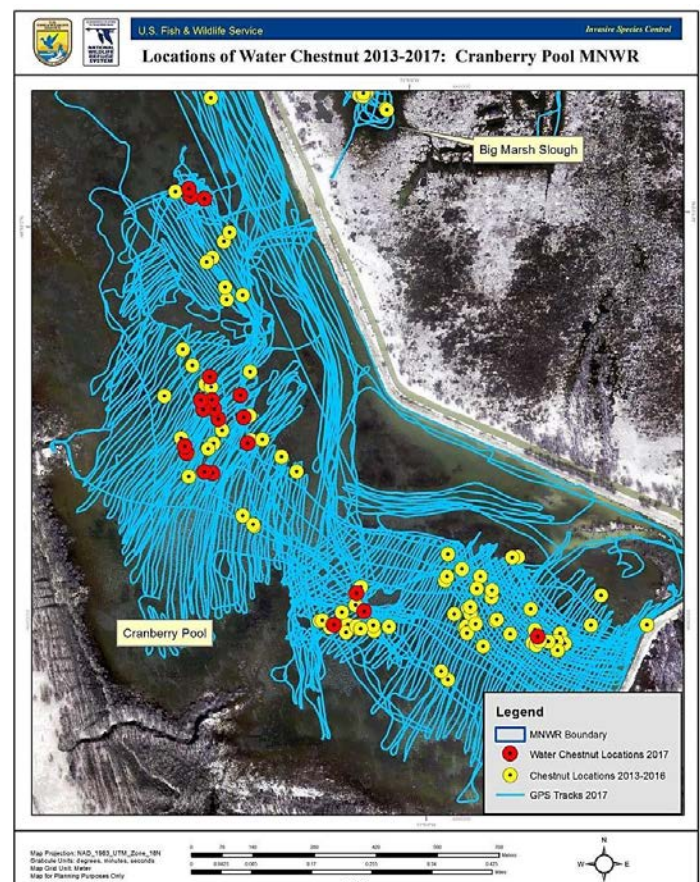
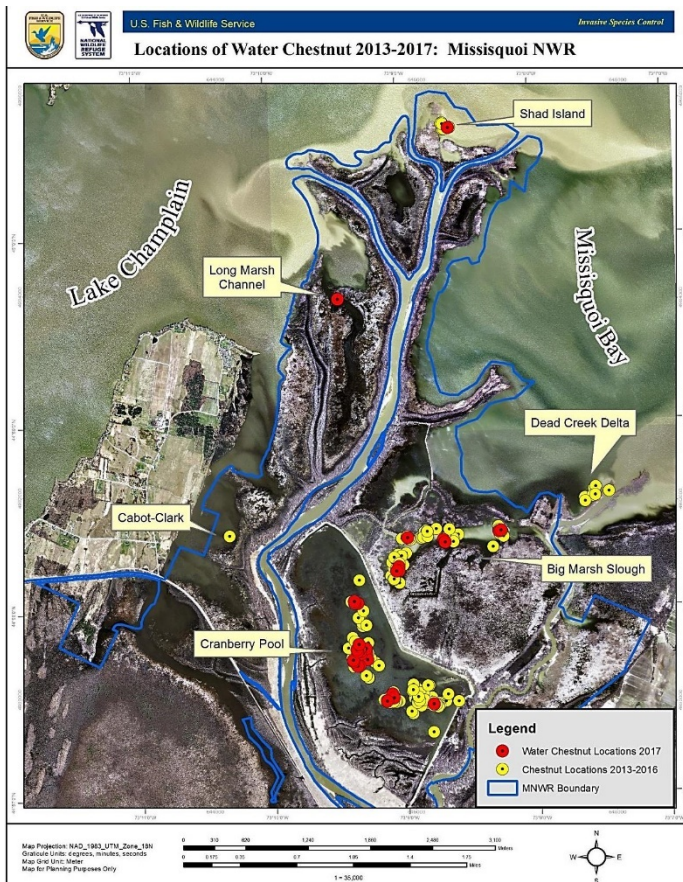
Research and the management efforts in Vermont have shown that continual, repeated harvesting significantly reduces water chestnut populations. As an annual species, repeated harvesting of water chestnut rosettes (plants) before mature seeds drop can significantly reduce populations and be an effective means of control. Due to water chestnut's rapid growth habits and long-term seed viability, constant management is required in any water body where a population has historically occurred. Although dense populations are still managed through mechanical means, hand harvesters are a vital to the success of the overall program, as they target smaller, hard-to-get populations.

The known Lake Champlain water chestnut sites are located on both sides of the lake from the most northern location at Rock River Bay in Highgate, Vermont to the most southern accessible location at Ottenburgh Ramp in Dresden, New York (See Appendix B for Maps). Of the 85 Lake Champlain sites, 77 were covered by hand harvesters in 2017.

In addition to the Lake Champlain water chestnut sites, 26 other waterbodies in Vermont have been managed on some level in the past. Of these 26 other water bodies, 21 of these were prioritized for management in 2017 using hand harvesting methods. Most locations historically targeted, but not in 2017, are now dry and have not been able to support aquatic plants for some time, and no water chestnut has been found at any locations that were not visited since 2011 at the earliest.

Motorized and non-motorized boats are used to access the all sites. Motorized boats transport contracted hand harvest crews to water chestnut sites not adjacent to access points. Kayaks and canoes are used to access other water body sites. (Figure 1 demonstrates an example of the site maps and how the areas are surveyed.) Go-Devil shallow water boats are used to access sites within the Missisquoi National Wildlife Refuge and are critical to accessing shallow and heavily vegetated sites.

Figure 1 (Left): Sites surveyed in MNWR in 2017. (Right): GPS Tracked Survey in 2017 (Source: USFWS, MNWR)



At each hand harvested site, systematic searches are conducted to search for and remove all water chestnut rosettes (multiple rosettes may grow from a single plant stem). Pulled water chestnut plants are collected in plastic baskets or sleds strapped to the front of kayaks, Gardeners Supply leaf tip bags or other containers. The number and weight of rosettes pulled are estimated by counting and weighing a subset. All pulled plants are disposed of at upland, non-wetland sites. When possible, hand harvest sites are targeted two or more times annually.

A VTDEC staff person provided administrative oversight for two contracts and one grant, reviewed and approved invoices, and tracked and summarized collected data. To insure success for the program, VTDEC obtains landowner permission for access and disposal of water chestnut, and conducts surveys, searches, and some water chestnut hand harvesting. Other VTDEC staff assist with removal efforts, surveys and searches, and conduct outreach efforts.

Results *(For specific details for each contract and location, see Appendix A: Individual Program Components. 2017 VTDEC historical hand harvest operations summaries for Lake Champlain and other waterbodies are provided in Appendix C and Appendix D.)*

Hand harvesting for water chestnut in the Lake Champlain basin began in late June and ended the last week of August. Additional monitoring continued into the fall of 2017.

With oversight from VTDEC, two contracted hand harvesting outfits targeted 65 Lake Champlain sites. The two outfits (Lakeside Restoration Services and Lannon Lakeside Services) and their crews scoured the waters and shores for roughly an 8-week season from late June through to late August. These crews covered roughly 136 miles of Lake Champlain shoreline between Ferrisburg and Benson, Vermont. The southernmost site targeted was Peters Bay, Benson, Vermont. Over 3,335 hours were spent removing approximately 11,667 lbs. or 14.73 tons of water chestnut from all 65 sites.

Twelve sites were also surveyed and harvested by VTDEC, volunteers, and other partners. Partnering groups included the Friends of Missisquoi Bay National Wildlife Refuge, the Lake Champlain Basin Program, and the Lake Champlain Committee.

The number of hand harvested rosettes from Lake Champlain steadily declined from 1999-2011 in the majority of locations (Figure 2), which demonstrates the effectiveness of this technique. As handpulling crews were deployed further south into areas previously managed only by mechanical harvesting, such as Peter's Bay, the number of rosettes pulled annually has risen. As handpulling continues in these areas in 2018 and beyond, the expectation is that the water chestnut populations in these areas will continue to decline.

Generally, locations that have been consistently managed by handpullers show a yearly decline in rosettes harvested. However, other factors can cause variability on a year-to-year basis, including funding availability, weather, and water levels. For example, the Otter Creek Region has exhibited significant declines in water chestnut populations since 1999 (Figure 3). However, abnormally low water levels in 2016 made access to many sites impossible by mid-summer. Therefore, some sites were not adequately covered, which probably contributed to the uptick in the number of rosettes harvested in 2017. This trend is mirrored in other regions and highlights the fact that managing water chestnut populations is a long process.

Figure 2. Number of rosettes removed by handpullers from Lake Champlain yearly (top blue line), and from individual sites (other lines).

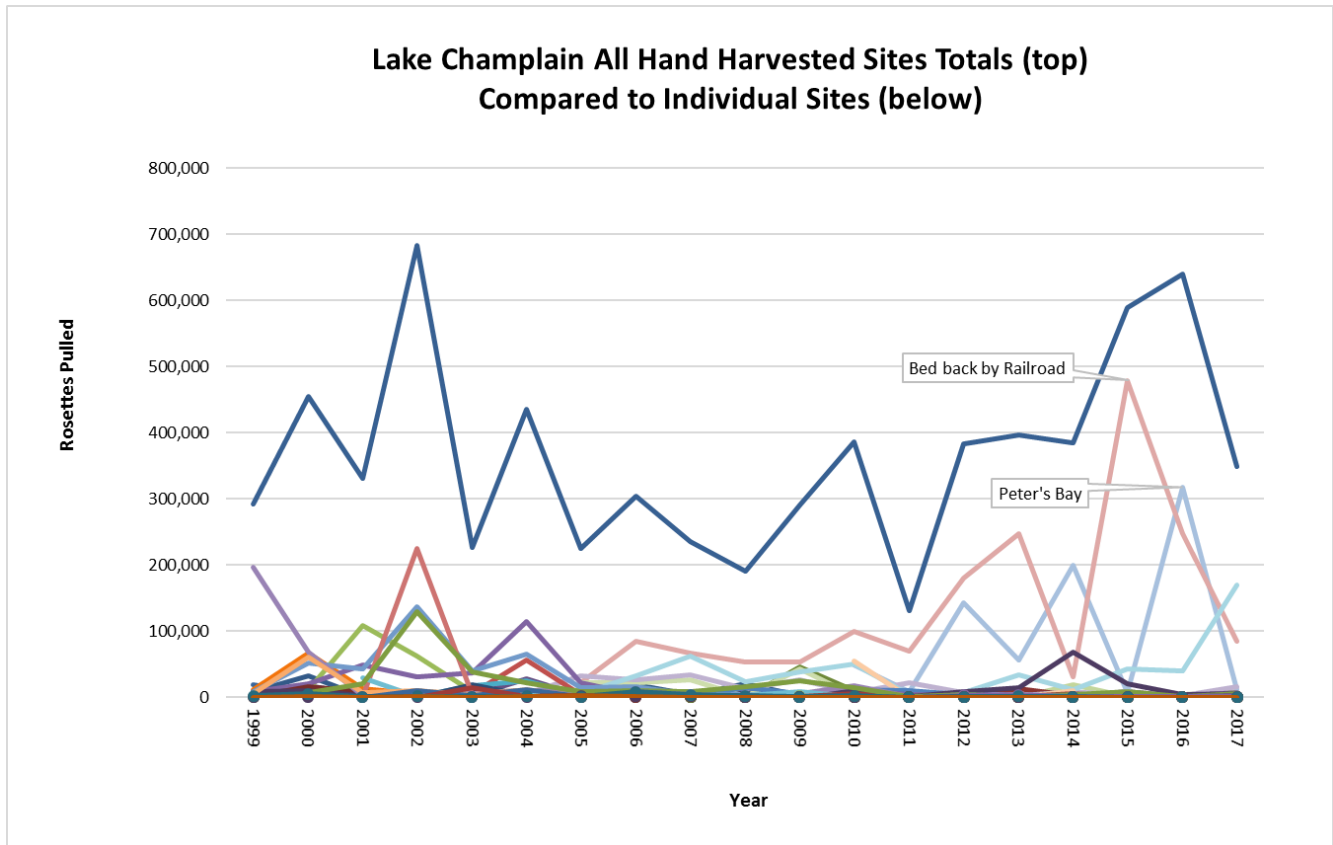
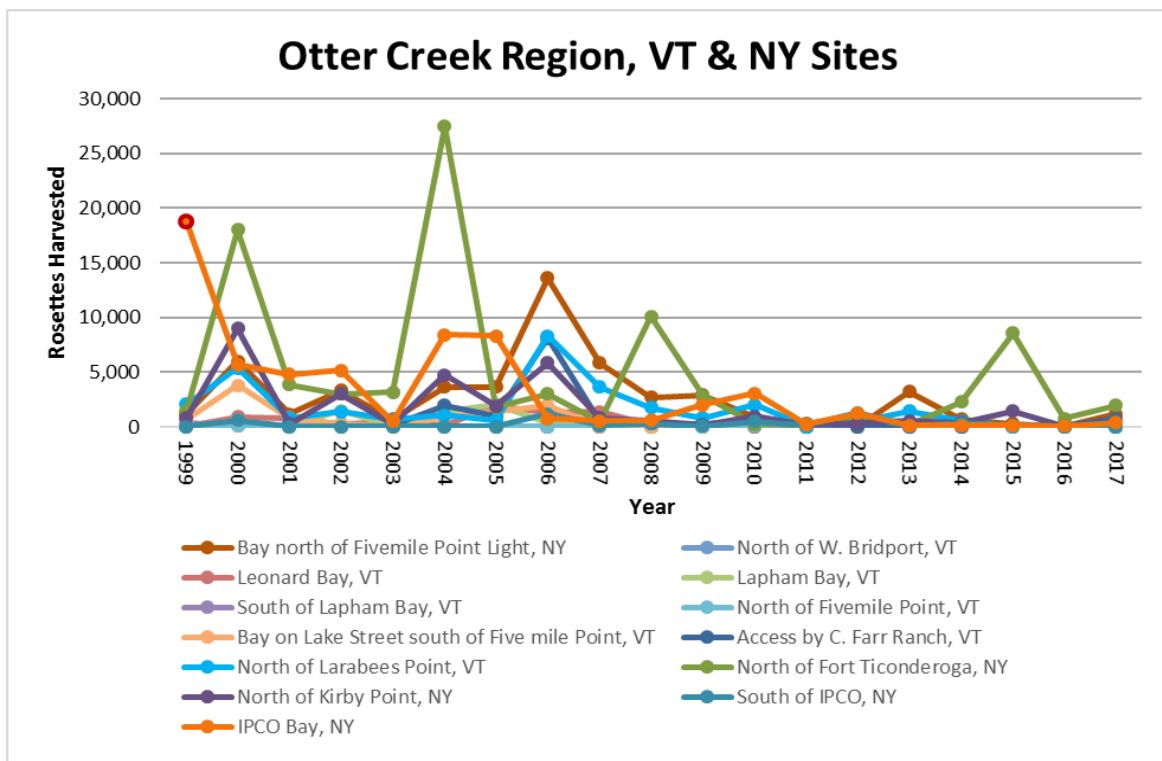


Figure 3. Number of rosettes removed by handpullers at all sites in the Otter Creek Region.



Of the 65 sites visited by contractors in 2017, 0 sites were new; 8 had no water chestnut; 15 (up from 11 in 2016) exhibited a decline in the amount harvested, and the remaining 42 sites had an increase in the amount harvested. Of these 42 sites, 26 had less than 1,000 harvested plants. The larger population areas were located in the Ticonderoga Central region (Figure 4) that was most recently phased out of the mechanical harvesting regime, and the South Lake B Region that continues to be managed with both mechanical harvesting and hand harvesting (Figure 5).

Figure 4. Control trends for Ticonderoga Central Region in Vermont and New York, including mechanical harvesting and handpulling data.

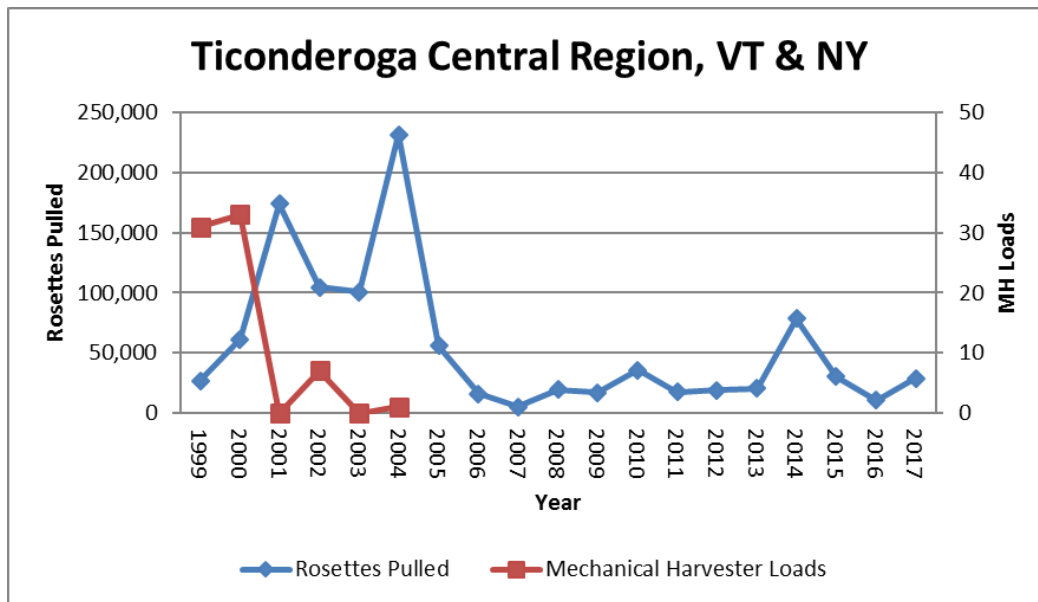
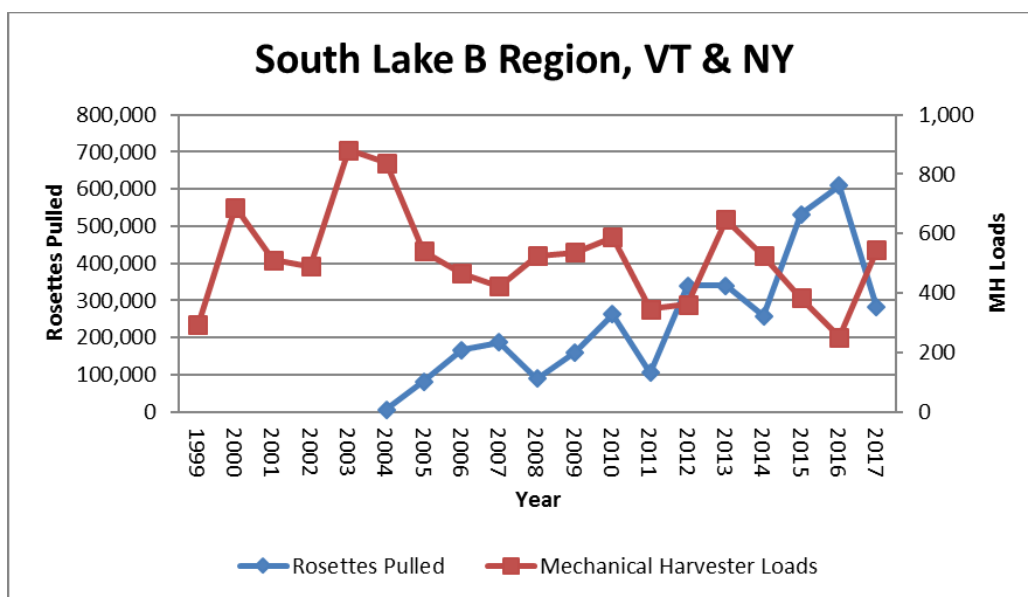


Figure 5. Control trends for South Lake B Region in Vermont and New York, including mechanical harvesting and handpulling data.



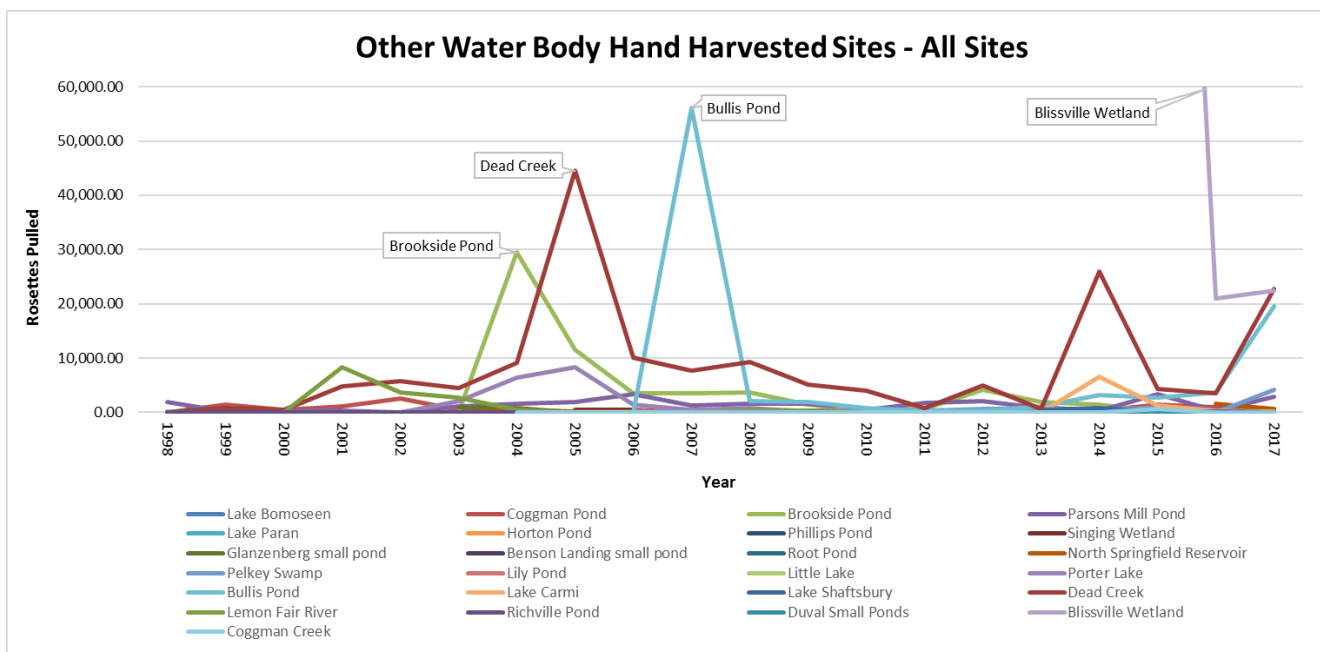
Other Waterbody Hand Harvested Sites

With oversight by VTDEC, the contracted hand harvesting outfit Lakeside Restoration Services targeted 16 other waterbody sites, which involved driving to and surveying the waters and shores for roughly an 8-week season from late June through late August. Five sites were also surveyed and harvested by VTDEC, volunteers, and other partners. Partnering groups included the Vermont Nature Conservancy, the Lake Champlain Basin Program, and the Lake Champlain Committee. On non-Lake Champlain waterbodies, 63,722 rosettes were harvested in Vermont in 2017.

Of the 21 sites visited, no water chestnut rosettes were found at five of them: Philips Pond (Benson), Benson Landing (Benson) Root Pond (Benson), the Lemon Fair River, and Cogman Creek. Another five sites were not visited, but are considered inactive: Glazenberg small pond (Bennington), Lake Bomoseen (Hubbardton), Singing wetland (Bennington), Lily Pond (Poultney), and Little Lake (Wells). No new other waterbody sites were discovered in 2017.

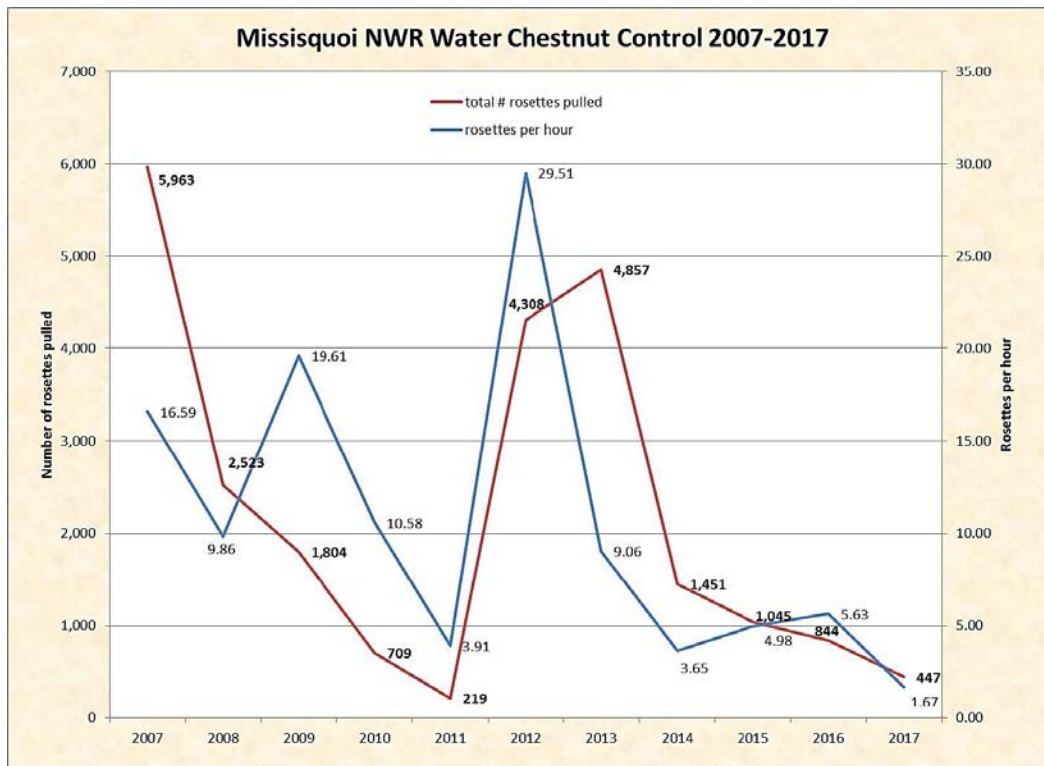
Overall, the amount of water chestnut that is hand harvested in other waterbodies exhibits a steady decline as shown in Figure 6, although populations have spiked in a few locations throughout the years. These spikes often indicate a substantial population found at a new site or in a new area. For example, Brookside Pond, a site of a large infestation, has steadily declined after a major hand pulling effort was completed in 2004. VTDEC leads the efforts to employ volunteers to assist in the hand pulling efforts within these areas annually.

Figure 6. Number of rosettes pulled annually at all non-Lake Champlain sites.



The Friends of Missisquoi National Wildlife Refuge (Friends Group) is another partner organization who works in tandem with US Fish and Wildlife Service (USFWS) staff and has similarly led surveying and hand pulling efforts in one region. The Friends Group initiated work in 2007 using grant funds and in-kind services to survey and harvest the Missisquoi National Wildlife Refuge. Throughout the years, nine sites have been surveyed and harvested. The harvested numbers within these sites is now less than 500 rosettes as the number of plants found each year continues to decline (See Figure 7).

Figure 7. Total number of rosettes pulled and rosettes pulled per hour in the Missisquoi National Wildlife Refuge.



Conclusions

As in the past, the main goal of the current program is to shift from intensive mechanical harvesting to maintenance hand harvesting using a north-to-south approach. Ongoing surveillance will continue in all areas, and prevention of further spread of water chestnut will be prioritized. Both Lake Champlain and other water body water chestnut sites managed annually generally continue to exhibit a pattern of decreasing water chestnut abundance, or at least population stabilization. However, there are exceptions. Generally, increases in harvested numbers are mainly due to weather and water level fluctuations that inhibit the access to the populations, and is a significant factor in yearly program success.

As management continue towards the main goal, less effort can be directed towards harvesting activities and more can put towards monitoring and low-density hand harvesting. VTDEC to continue to target the southern locations with mechanical and hand pulling efforts in tandem with hopes of eventually eliminating mechanical harvesting from the management program. In 2018, mechanical harvesters will be closely followed by hand pullers, which should lead to more complete removal of mechanically harvested populations.

Ultimately, VTDEC is working towards a ~10-mile section of Lake Champlain between Dresden and Whitehall, New York, which has sites with water chestnut populations and no consistent management effort. Since Lake Champlain flows north, reducing these populations is of principal concern. While VTDEC and partner harvesting efforts span 36 years at an expenditure of over \$13 million, significant milestones have been made in the reduction of water chestnut in Lake Champlain and other waterbodies in Vermont. These notable successes support the need for continued management. The extent and distribution of Lake Champlain and Vermont inland water body sites and the biology of water chestnut will necessitate some level of water

chestnut harvest and ongoing surveillance well into the future if this species is to be successfully managed. The reality of ongoing, annual water chestnut management must be realized and fiscally supported to prevent this non-native invasive species from rebounding at managed sites or spreading to other areas.

Acknowledgements

Funds supporting the 2017 Water Chestnut Management Program were provided by the Lake Champlain Basin Program, a funder and supporter of this effort since 1991; USFWS through the Lake Champlain Basin ANS Plan; a partnership with the USFWS Lake Champlain office; the United States Army Corps of Engineers Aquatic Plant Control Program; and VTDEC.

The 2017 water chestnut management effort would not have been possible or as successful without the many partners and volunteers involved in the program. Thank you: Paul Marangelo, TNC; Elizabeth Spinney, Vermont Department of Forests, Parks, and Recreation; Lake Champlain Basin Program staff; Chris Smith, USFWS Lake Champlain Office; Ken Sturm and Judy Sefchick Edwards, USFWS; MNWR; Pat Lombardi and Terry Sklarski; Laurie Callahan; Shane Lannon; Erin Vennie-Vollrath, Adirondack Park Invasive Plant Program; Lake Carmi Watershed Association; Tim Hunt; Vermont Electric Power Company; Ed Taube, SOLitude; Jack Barrett; Tad Fyles; ECO Americorps; the Town of Dresden, New York; and the many volunteers that came out to survey and pull water chestnut.

APPENDIX A
Individual Program Components

VTDEC Hand Harvesting

- One VTDEC staff person provided oversight of the two contracts and one grant, connected weekly with most contract/grant leads, reviewed and approved invoices, and tracked and summarized collected data.
- Staff conducted 14 water chestnut surveys between June 20th and August 28th visiting 3 Lake Champlain and associated tributaries sites, and 5 on other water body sites.
- Most Vermont Department of Fish and Wildlife public boat accesses in the Lake Champlain Basin were visited in 2017 to maintain aquatic invasive species warning signs with information about water chestnut and current Vermont transport laws. Aquatic invasive species transport law rack cards were stocked at many of these accesses and any damaged brochure boxes replaced.
- Two, ½ day Vermont Invasive Patrollers (VIP) workshops were attended by 29 people. Water chestnut is one of many species participants are trained on.
- Staff held five Public Access Greeter Program training workshops. In addition to greeter etiquette, these workshops provide specific information on water chestnut and other aquatic invasive species, and current Vermont transport laws.

Hand Harvesting Contract - Lakeside Restoration Services

- \$50,000 was awarded to Lakeside Restoration Services (Lakeside) of Fair Haven, Vermont for hand harvest services in a one-year contract beginning on June 26, 2017.
- Lakeside hand harvesting commenced on June 26th and ended on August 20, spanning 40 total work days.
- A crew of 2-4 individuals worked an average of 40 hours per week throughout the 8-week season.
- Lakeside targeted 54 Lake Champlain and associated tributaries sites, and 16 other waterbody sites.
- In Lake Champlain, the 54 sites targeted span roughly 136 miles of Lake Champlain shoreline between Ferrisburg and Benson, Vermont. The southernmost site targeted was Peters Bay, Benson, Vermont.
- Over 939 hours were spent removing approximately 9,470 lbs. or 4.73 tons of water chestnut from all 70 sites.

Hand Harvesting Contract - Lannon Lakeside Services

- \$135,000 was awarded to Lannon Lakeside Restoration Services (Lannon) of Benson, Vermont for hand harvest services in a one-year contract beginning on June 26, 2017.
- Lannon hand harvesting commenced on June 27th and ended on August 30, spanning 42 total work days.
- A crew of 2-11 worked an average of 40 hours per week throughout the 8-week season.
- Lannon targeted 57 Lake Champlain and associated tributaries sites.
- In Lake Champlain, the sites targeted span roughly 136 miles of Lake Champlain shoreline between Ferrisburg and Benson and the southernmost site targeted was Peters Bay, Benson, Vermont.

- Over 2,396 hours were spent removing approximately 21,976 or 10 tons of water chestnut.

Hand Harvesting Grant - Friends of Missisquoi Bay

- \$4,000 was awarded to the Friends of the Missisquoi National Wildlife Refuge to support a partnership with Missisquoi National Wildlife Refuge staff on water chestnut search and hand harvest efforts primarily within the Refuge.
- The Friends contributed an additional \$500 and \$541 in in-kind services. The Refuge contributed \$2,021 in in-kind services and staff oversight towards the 2017 effort.
- A crew of 2 commenced work on July 17th and ended on August 3rd for a total of 18 work days.
- Priority survey areas were determined by previous control operations – annually since 2007 - as well as biological sensitivity of Refuge wetlands during black tern breeding season. Operations were coordinated by a Refuge biologist to manage any potential conflict with other Refuge work, but also to maximize water chestnut removal in key problem areas.
- A total of 204 hours was spent surveying for and harvesting 447 (1,045 in 2016) water chestnut rosettes, an estimated 35 pounds from two Lake Champlain sites (Dead Creek Delta and Shad Island) and two other water body sites within the MNWR (Big Marsh Slough and Cranberry Pool).
- No water chestnut was found at three previously known sites, Dead Creek Delta, Cabot-Clark Marsh, and Rock River.
- Total area surveyed included a minimum of 526 acres.

Hand Harvesting Grant – Invasive Species Volunteer Coordinator

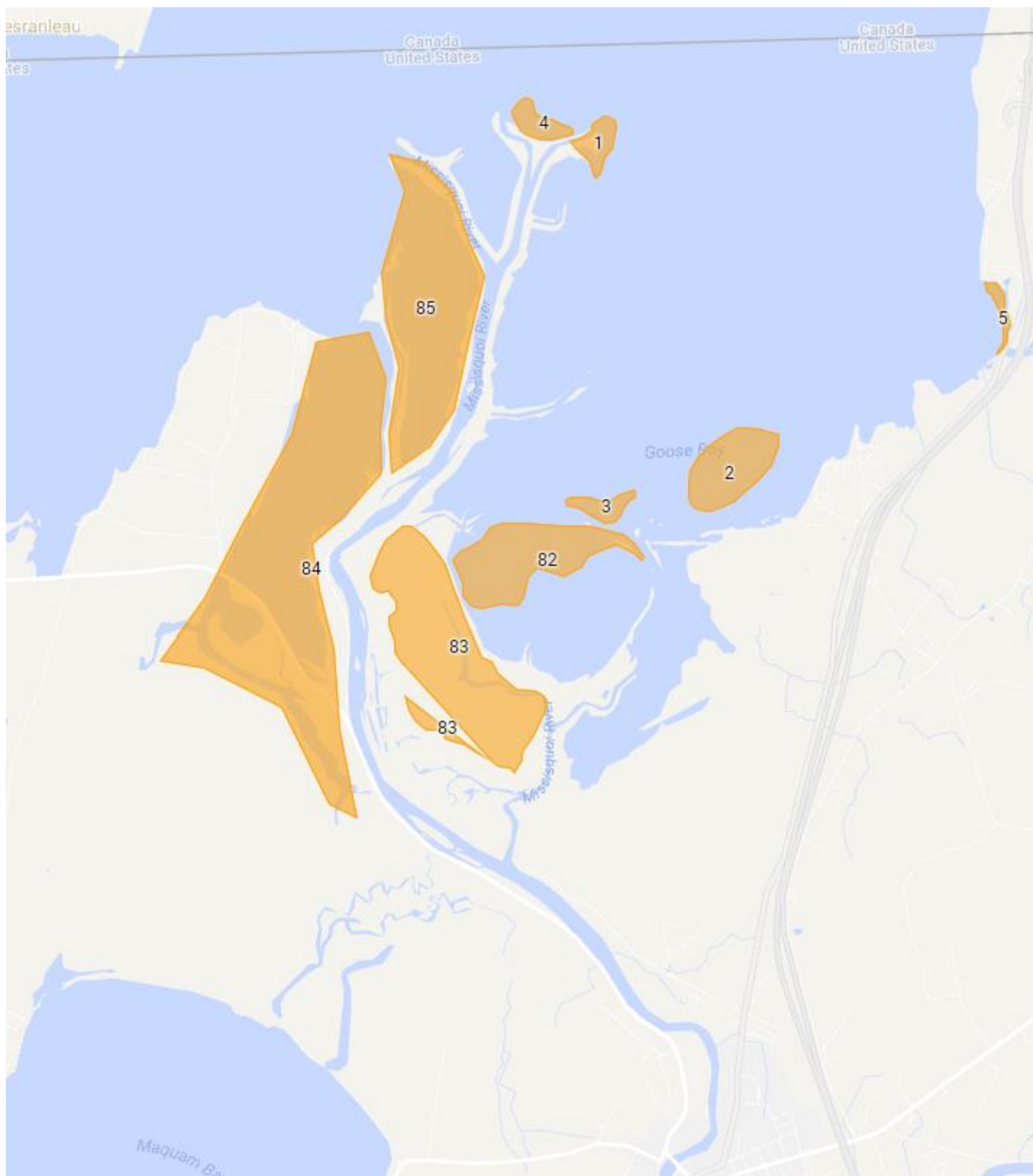
- In 2017, a \$10,000 was provided to the Department of Forest, Parks and Recreation to support water chestnut volunteer coordination efforts by an invasive species coordinator.
- The coordinator assisted VTDEC staff advertise for and conduct two volunteer workdays in 2017. These include the Black Creek Marsh on July 14 (26 participants), and the La Chute River on July 28 (16 participants).
- The volunteer day at the Black Creek Marsh site received coverage from multiple media outlets.

Appendix B. Maps and Site Information

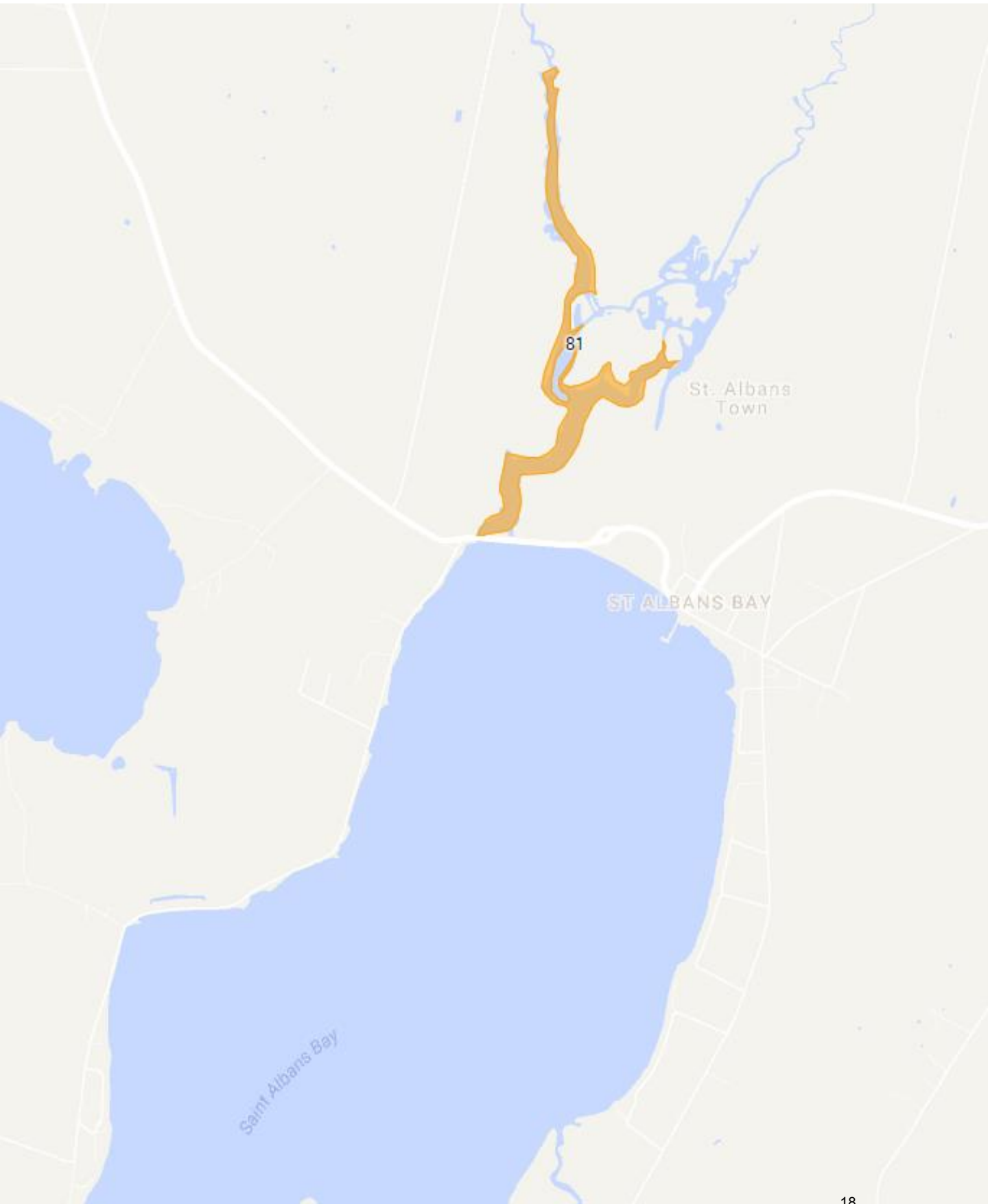
List of all Lake Champlain Water Chestnut Management Sites

Site #	Site Description	Site #	Site Description
1	MNWR Mouth of East Branch Missisquoi River, VT	44	Horton Marsh, VT
2	Dead Creek Delta, VT	45	Maple Bend, VT
3	MNWR Outside Entrance to Big Marsh Slough	46	Poultney River and associated sites
4	MNWR Shad Island	47	Ottenburgh, NY
5	Rock River Bay, VT	48	Barrel Bay, VT
6	Converse Bay F&W Access & Bay South, VT	49	Dresden Landing and South, VT
7	Town Farm Bay/Kimball Brook, VT	50	New York Light 14 and south, NY
8	Little Otter Creek (West Branch), VT	51	Pulpit Point, NY
9	Porter Bay, VT	52	Bed back by Railroad, NY
10	Mouth of Otter Creek, VT	53	NY Light 4, NY
11	Fields Bay, VT	54	60 Acre Site, NY
12	Otter Creek Fort Cassin Access south to Dead Creek, VT	55	Sixmile Point and south, NY
13	Basin Harbor, VT	56	South of Gourlie Point, NY
14	Hospital Creek, VT	57	Gourlie Point Bay, NY
15	Whitney Creek, VT	58	North of Gourlie Point, NY
16	McCuen Slang, VT	59	Charter Marsh, NY
17	Bridport Town Beach, VT	60	North of Charter Marsh, NY
18	Giards Bay, VT	61	Fort Ticonderoga Bay and south, NY
19	North of W. Bridport, VT	62	LaChute River, NY
20	Leonard Bay, VT	63	North of Fort Ticonderoga, NY
21	Lapham Bay, VT	64	North of Kirby Point, NY
22	South of Lapham Bay, VT	65	South of IPCO, NY
23	North of Fivemile Point, VT	66	IPCO Bay, NY
24	Bay on Lake Street south of Five Mile Point, VT	67	Bay north of Fivemile Point Light, NY
25	Access by C. Farr Ranch, VT	68	North of Crown Point, NY
26	North of Larabees Point, VT	69	Putnam Creek, NY
27	Beadles Cove, VT	70	Porters Marsh, NY
28	East Creek (Total), VT	71	Bay South of Burdick Crossing, NY
29	Shoreline between East Creek & Catfish Bay, VT	72	Bay at Burdick Crossing, NY
30	Catfish Bay, VT	73	South of Lapstone Point, NY
31	Buoy 39 Marina, VT	74	Shore btw. Lapstone Pt & bay S of Crown Pt bridge, NY
32	Dock at Curly Audette Farm, VT	75	Bay south of Crown Pt Bridge, NY
33	North shore Chipmans Point, VT	76	Bulwagga Bay, NY
34	Shoreline between Chipmans Point and Benson Bay, VT	77	Bulwagga Bay Campground, NY
35	Benson Bay, VT	78	Bulwagga Bay, West of train tracks, NY
36	Shoreline between Benson Bay and Stony Point, VT	79	Bulwagga Bay, north of 3616 RT9N
37	Stony Point, VT	80	Van Slooten Marina, NY
38	Shoreline between Stony Point and Benson Landing, VT	81	Black Creek Marsh
39	Benson Landing, VT	82	MNWR Big Marsh Slough
40	Dutchers and south, VT	83	MNWR Cranberry Pool
41	Peters Bay, VT	84	MNWR Cabot Clark Marsh
42	Red Rocks Bay, VT	85	MNWR Long Marsh Channel
43	Cold Spring Harbor, VT		

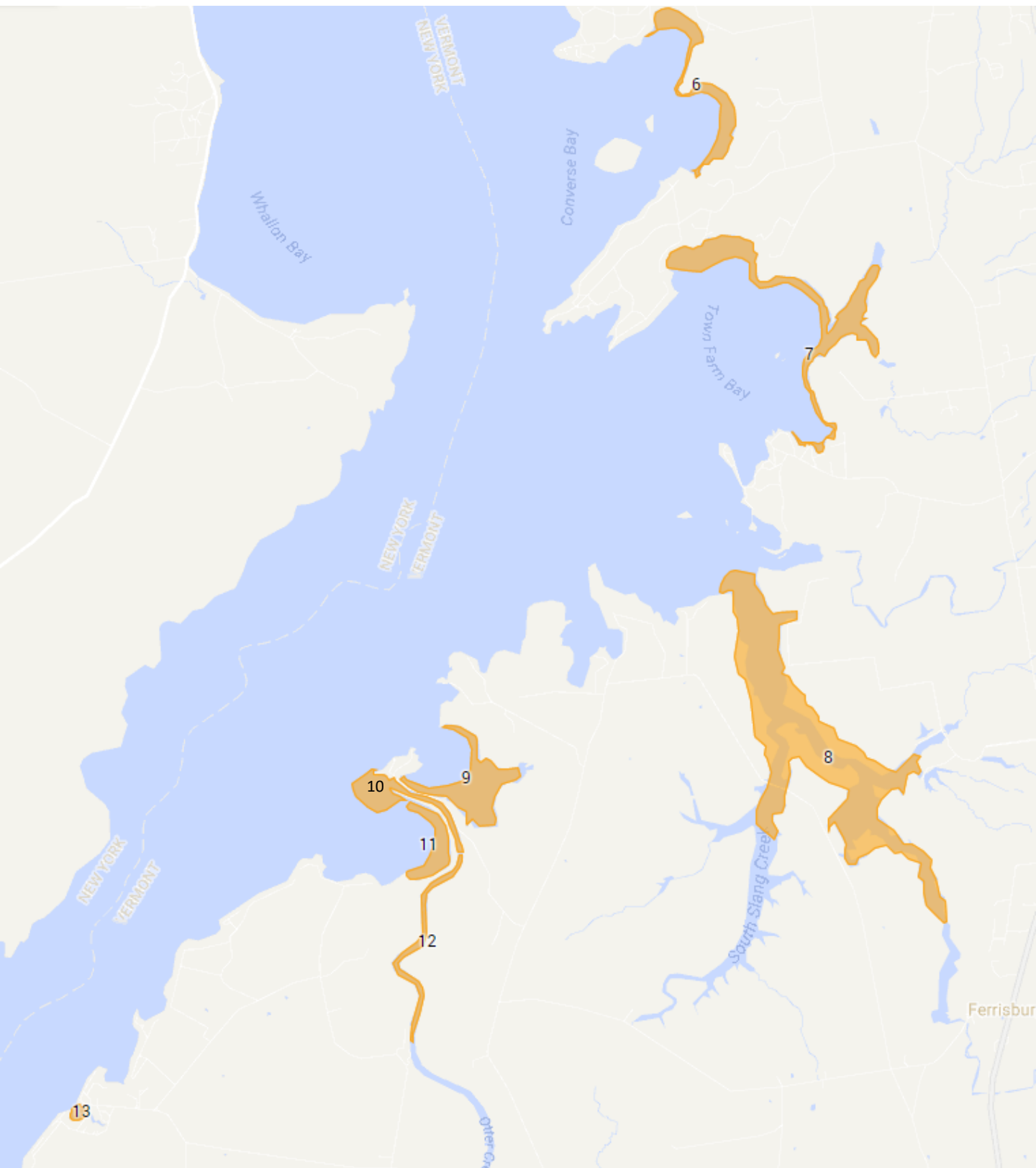
Water Chestnut Management Sites – Missisquoi Region



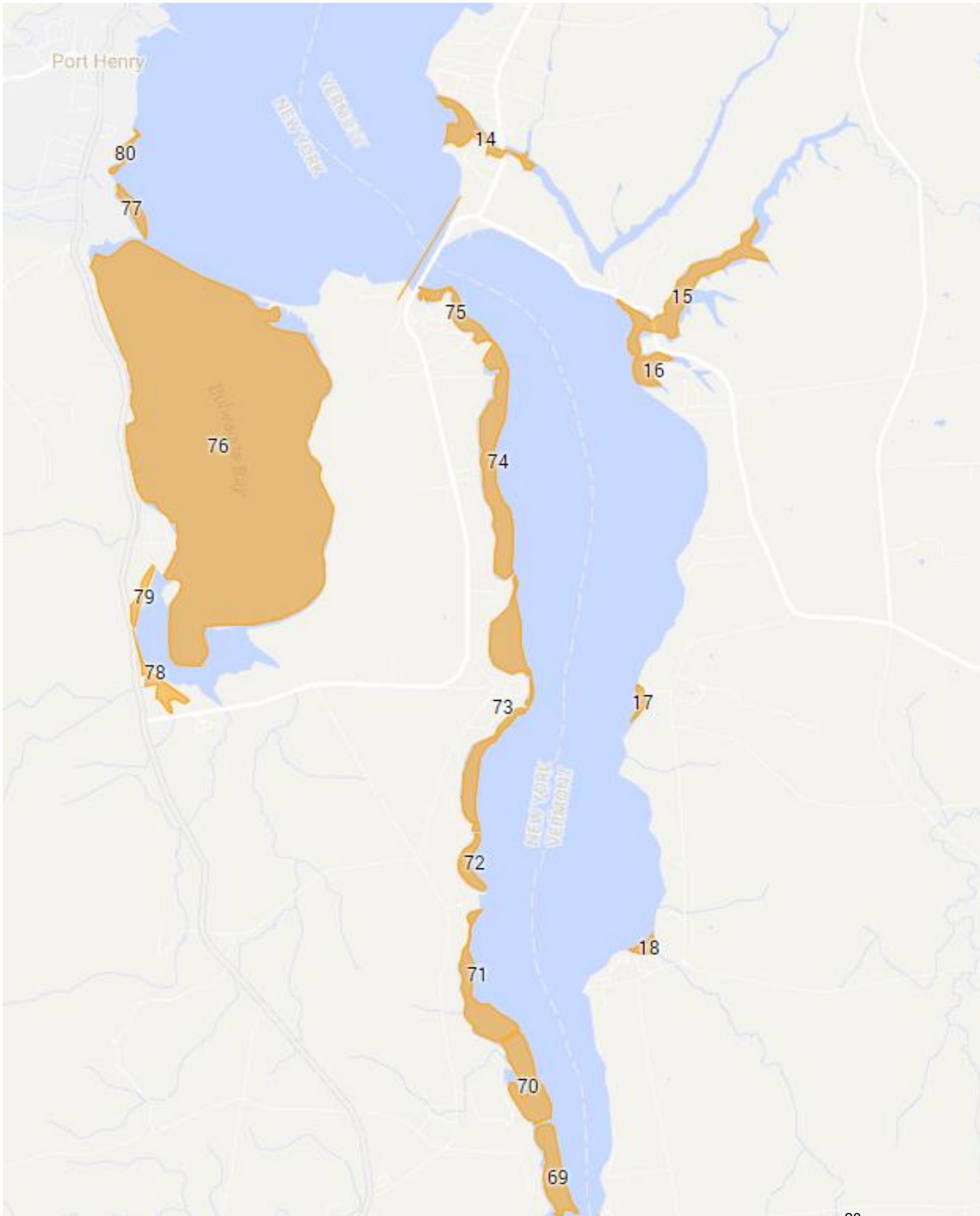
Water Chestnut Management Sites – St. Albans Bay



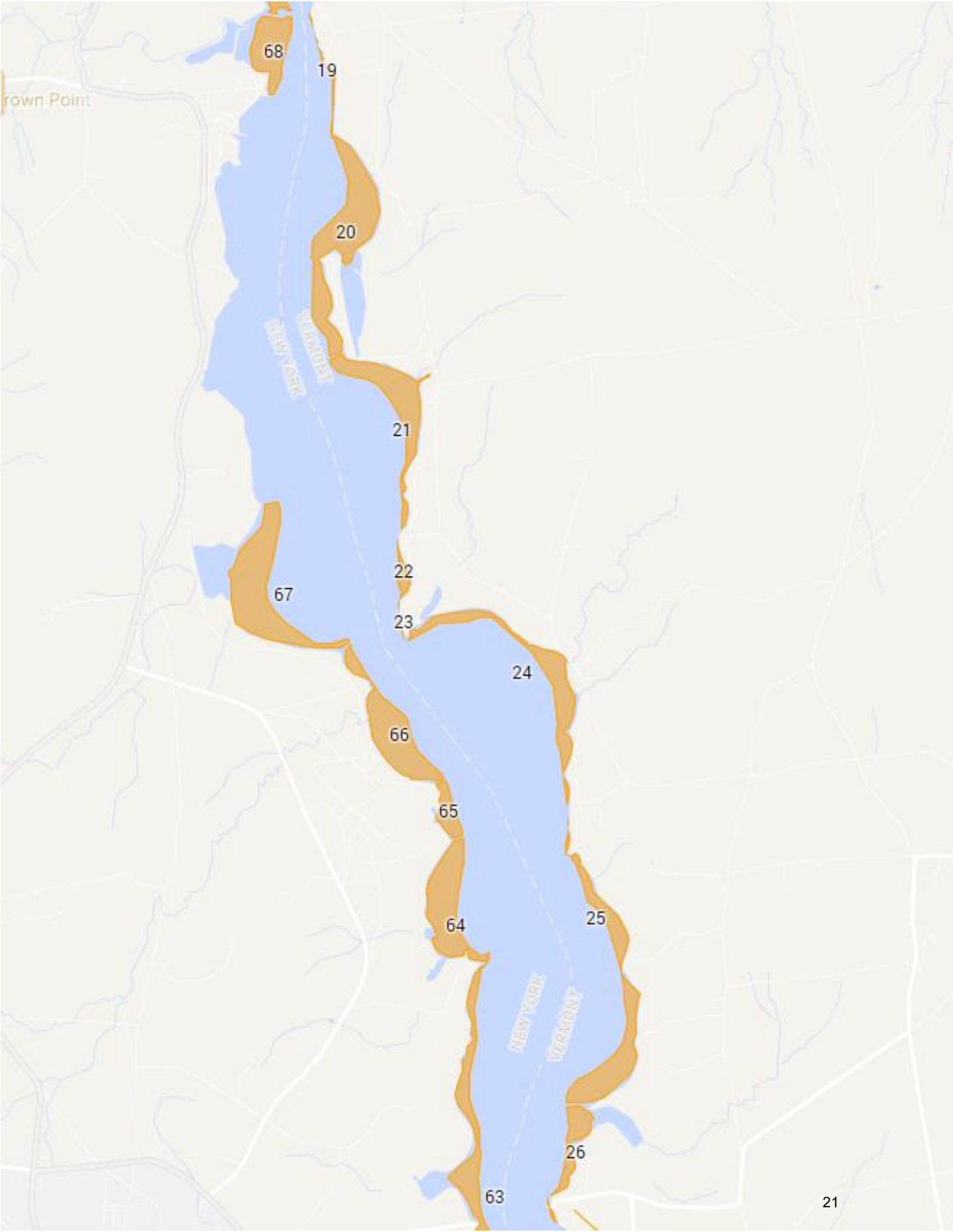
Water Chestnut Management Sites – Otter Creek Region



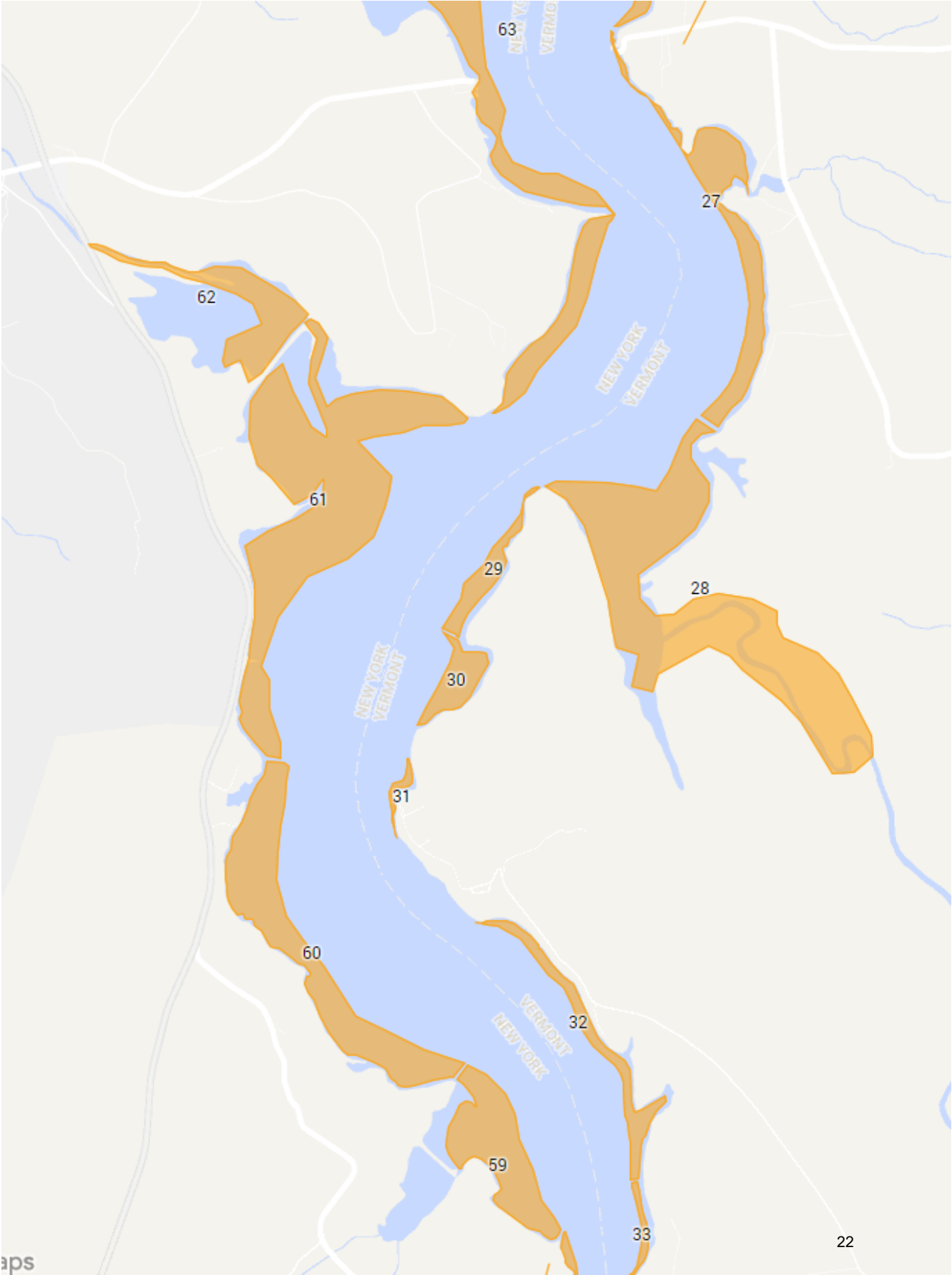
Water Chestnut Management Sites – Crown Point Region



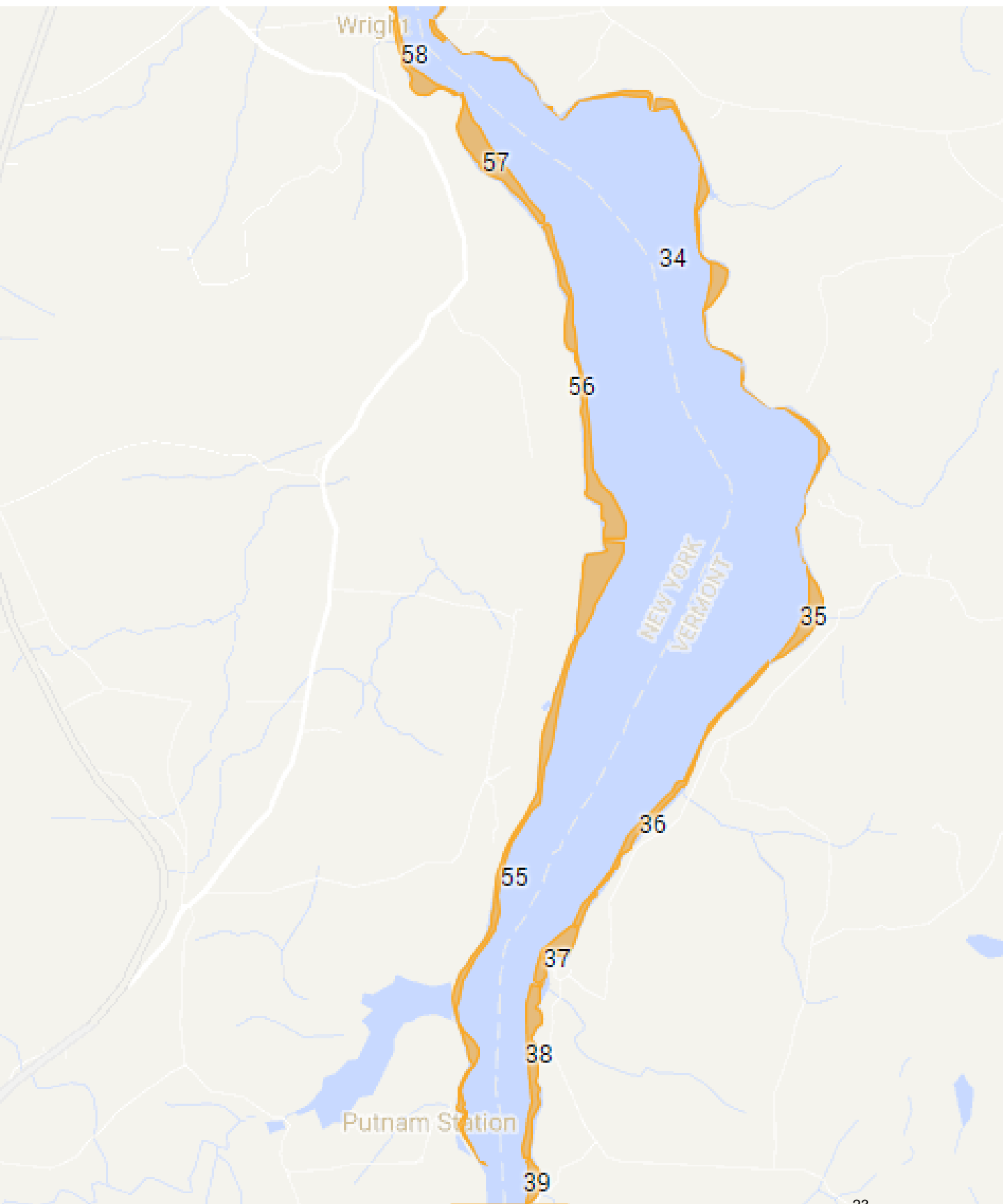
Water Chestnut Management Sites – North Ticonderoga Region



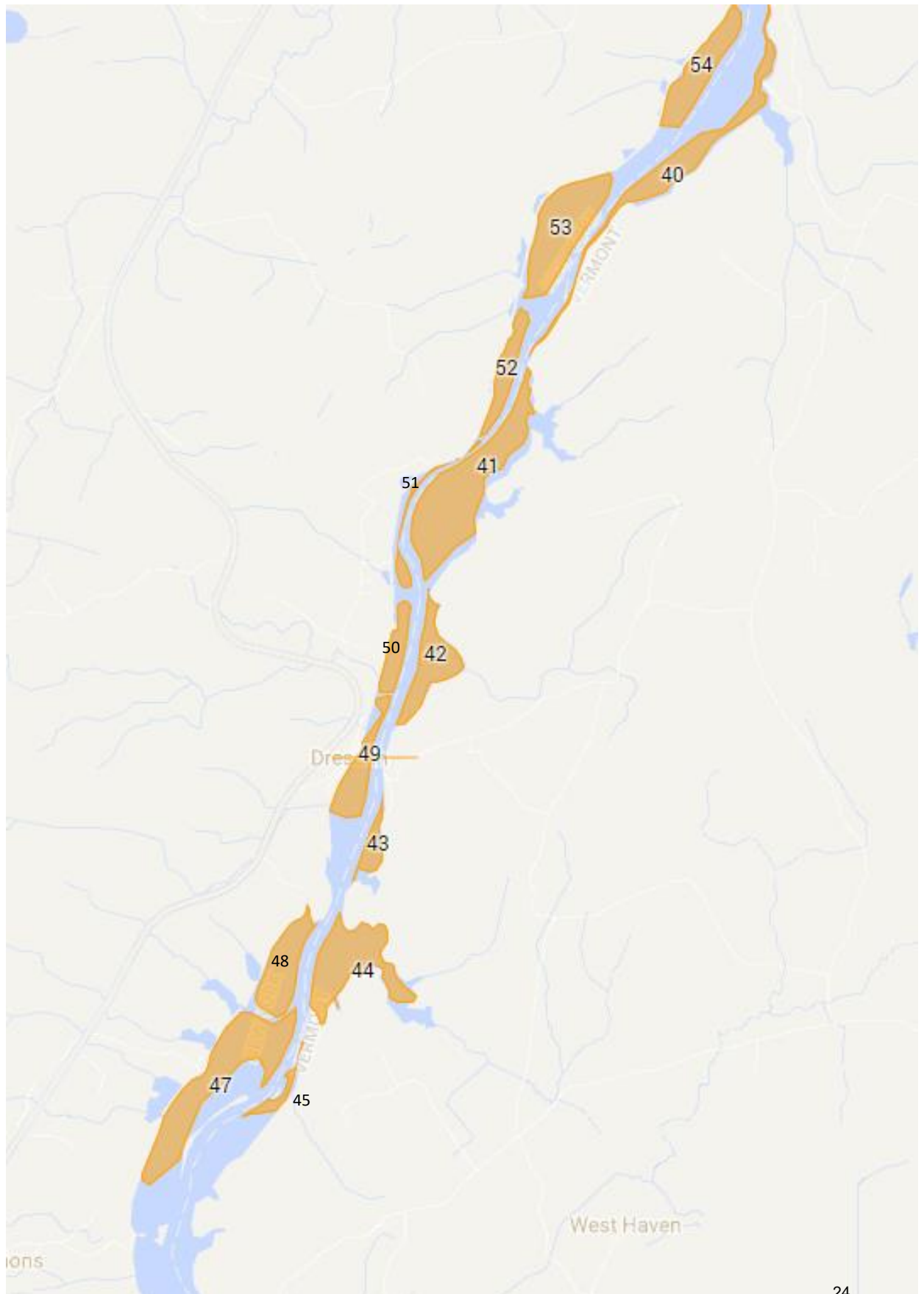
Water Chestnut Management Sites – Central Ticonderoga Region



Water Chestnut Management Sites – South Ticonderoga Region



Water Chestnut Management Sites – South Lake B Region



APPENDIX C

Total number of rosettes harvested by hand at Lake Champlain sites from 1999-2017

Site #	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	
2															279	501	24	6	0
3	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	
4														1,469	167	94	16	58	2
5															49	0	0		0
6	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0		0	
7	0	17	0	0	0	0	0	0	0	0	0	0	0	0	25	10	2	0	
8	0	9,600	4,862	4,500	983	29	740	99	71	94	245	190	7	1,132	102	18,219	742	3,905	8,936
9	80	800	49	100	139	211	86	18	13	0	38	89	21	2	74	19	0	30	89
10	132	400	6	12	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
11	11,790	67,000	13,135	5,800	1,760	700	635	406	476	2,242	534	1,692	227	653	1,618	658	1,820	3,412	1,914
12	132	200	0	12	0	0	0	0	0	4	0	1,720	191	10	0	3	0	7	0
13	50	400	1,300	300	7	42	12	2	0	0	0	0	0	0	0	0	0	0	
14	200	9,500	600	1,800	1,600	960	715	0	78	931	350	2,711	95	19	756	777	15	46	524
15	8,400	32,050	1,200	10,300	26	600	2,190	18,433	3,853	20,026	2,912	6,979	575	1,323	959	594	214	459	2,012
16	1,482	1,000	4,600	1,200	0	2,730	900	942	117	588	192	708	5	19	8	21	111	398	93
17	0	12	0	0	0	0	0	0	0	0	0	0	0	0	3	29	0	0	130
18	25	25	5,600	3,300	633	3,680	1,230	104	143	134	41	15	9	24	116	111	13	8	109
19	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	273	22	0	1
20	25	900	800	300	442	189	1,953	1,282	1,377	131	145	221	31	849	364	3	90	66	20
21	100	600	13	1,500	50	1,380	2,057	316	56	113	15	128	19	7	10	0	0	0	0
22	340	150	4	0	0	0	0	8	56	4	0	18	6	0	14	0	0	0	0
23	10	150	0	0	63	5	0	7	0	0	0	132	0	0	0	0	0	0	0
24	680	3,800	800	300	0	940	1,405	1,972	9	0	298	657	33	53	11	17	0	0	3
25	0	0	0	0	141	1,980	951	8,082	464	313	242	493	27	22	0	0	94	0	739
26	2,050	5,400	800	1,400	650	1,061	600	8,334	3,664	1,779	825	1,998	0	425	1,449	540	12	168	44
27	1,000	15,300	9,000	1,600	5,550	9,200	2,904	1,144	174	530	797	388	344	446	16	1,575	572	462	2,621
28	8,200	9,800	2,650	4,700	6,250	9,920	2,790	1,165	239	668	924	9,435	1,360	7,736	14,848	68,810	19,818	3,849	5,054
29		300	0	20	5	6	0	0	0	0	0	0	0	0	0	0	0	0	
30	270	3,800	2,100	2,700	450	960	1,512	616	50	142	248	182	43	0	56	1,398	2,510	392	3,068

Site #	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
31	5	0	0	0	1	4	0	0	0	0	0	0	0	17	0	0	0	0	3
32	50	0	8	0	19,434	2,880	608	510	38	323	113	29	38	0	67	13	0	0	2,288
33	40	0	600	800	18,000	24,450	2,681	255	87	1,067	82	308	27	137	0	23	3	0	1
34	7,900	51,950	42,404	136,256	39,980	65,043	15,012	16,502	3,492	4,239	1,640	3,105	164	3,904	995	105	263	858	39
35	196,100	68,850	2,780	6,500	5,000	10,088	7,871	1,617	1,648	1,589	4,700	17,061	637	48	407	7	86	19	20
36	4,800	60,000	6,658	10,000	3,190	11,850	777	278	27	218	310	176	9	680	490	12	24	5	138
37	1,100	0	5	5	5	2	3	5	6	488	96	984	9	660	83	5	218	11	5
38	200	0	0	9,200	2,640	11,850	777	278	27	2,210	96	1,780	73	670	83	57	548	96	175
39			30,000	1,000	480	5,413	2,337	774	1,280	2,510	8,954	605	340	71	93	53	158	33	84
40	0	0	0	0	0	5,400	31,752	26,662	33,067	12,692	26,956	7,228	21,692	7,288	2,695	8,316	2,589	2,820	15,473
41	0	0	0	0	0	0	0	0	0	0	0	48,929	8,568	142,415	55,580	199,173	7,310	317,479	11,204
46																			
51	0	0	0	0	0	0	0	0	0	0	0	54,390	0	0	0	9,394		NA	
52	0	0	0	0	0	0	22,521	85,088	66,183	53,404	53,127	99,542	69,445	180,399	248,017	30,301	479,354	247,987	84,983
53	0	0	0	0	0	0	5,004	32,192	61,685	23,232	37,965	49,640	4,264	7,392	33,803	10,810	42,007	39,809	169,974
54	0						21,900	22,330	25,803	936	42,176	2,552	1,496	2,867	346	523	176	507	699
55		6,200	19,885	129,600	38,120	22,480	8,466	9,164	8,970	15,484	25,479	14,541	478	3,333	257	4,648	8,071	384	5,247
56	100	0	0	0	13,760	872	3,151	2,233	502	486	270	4,921	4	488	826	4,728	49	80	276
57	800	0	600	225,400	3,800	2,180	1,618	5	0	3	123	458	3	6	11	0	14	0	3
58	2	4,650	0	1,200	350	38	1,737	4	0	296	89	193	13	5	1,920	0	23	2	14
59	8,500	10,750	108,950	61,750	7,940	2,660	11,056	4,490	908	904	3,848	1,694	1,363	2,123	1,206	2,475	27	1,267	6,368
60	25	1,000	2,000	2,000	5,750	56,780	4,013	229	198	558	104	406	17	396	33	11	0	6	42
61	8,750	20,200	48,600	31,150	37,450	114,920	22,351	3,776	1,614	1,512	5,870	11,672	4,424	4,479	2,302	1,742	3,667	2,297	7,186
62	0	0	0	0	0	10,000	8,000	3,754	2,057	13,749	4,965	11,699	9,760	3,688	1,971	2,553	3,928	2,505	2,096
63	1,516	18,000	3,850	3,000	3,146	27,480	1,822	3,027	522	10,123	2,878	252	196	933	105	2,256	8,563	756	1,970
64	813	9,000	300	3,000	250	4,760	1,890	5,851	836	562	163	944	180	334	535	416	1,432	52	208
65	50	600	12	24	8	18	0	1,167	148	301	75	488	205	1,278	83	315	127	0	13
66	18,750	5,700	4,800	5,160	500	8,400	8,327	758	551	624	2,003	3,089	255	1,240	136	117	151	58	366
67	1,200	6,000	1,200	3,310	694	3,640	3,640	13,626	5,850	2,691	2,934	884	276	43	3,219	725	310	82	1,161
68	680	1,450	1,210	3,901	800	2,000	1,872	6,660	63	278	2,247	14	24	108	27	185	52	15	42
69	0	0	0	0	0	0	0	0	0	0	2,235	2,012	65	0	1,944	282	1,025	0	742
70	1,750	14,160	2,400	3,800	25	2,500	2,350	1,783	83	564	41	407	8	44	48	11	288	46	156
71	0	0	0	4	2,400	0	0	0	0	0	0	8	0	2	0	9	0	0	

Site #	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
72	0	10	0	0	1	0	0	0	0	0	0	0	0	0	307	18	0	0	0
73	125	300	1,200	1,200	633	2,500	837	344	403	4,682	1,773	111	59	15	15	4,813	390	900	77
74	1,000	700	1,500	1,200	79	50	1,296	0	0	200	745	98	30	247	67	204	0	0	212
75	1,225	9,300	500	500	132	50	6,004	2,247	430	2,034	315	389	18	816	8	71	13	0	0
76	1,450	4,200	3,600	4,200	3,200	2,870	4,917	2,840	1,866	1,998	3,918	6,864	2,017	438	12,240	3,096	1,832	3,544	3,598
77	0	0	0	0	0	0	0	0	0	0	45,288	9,886	1,346	23	840	2,499	121	1,563	5,462
78																		30	344
79																		363	
80																		365	
81																		1,376	2,029
82								3,700	2,460	871	1,222	709	116	135	1,023	443	317	391	82
83								8,226	3,503	1,652	582	278	103	2,704	3,233	413	688	389	361
84															106	0	0	0	0
85								5	0	0	0	0	0	0	0	0	0	0	2
TOTALS	291,897	454,224	330,587	684,010	226,517	435,771	225,281	303,310	235,150	190,179	291,190	386,102	130,715	383,625	396,045	384,474	589,899	639,361	348,502

APPENDIX D

Total number of rosettes harvested by hand at other waterbodies from 1999-2017

Waterbody	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Lake Bomoseen	38	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0			
Coggman Pond	0	1,500	450	1,164	2,485	500	290	72	143	176	420	222	197	150	107	802	359	1,347	1,023	591
Brookside Pond							29,420	10,546	3,086	2,778	2,972	1,421	328	372	1,227	1,894	1,420	127	116	124
Parsons Mill Pond	1,900	225	300	300	40	1,140	1,215	1,494	2,641	1,149	1,343	1,362	391	1,337	1,041	416	272	3,141	325	2,798
Lake Paran	84	17	8	1	3	8	64	13	11	12	12	0	0	1	1	0	0	0	0	24
Horton Pond									160	43	6	352	704	99	66	54	129	12	0	48
Phillips Pond												336	180	68	45	8	8	4	0	0
Singing Wetland								415	468	7	23	2	0	9	dry	dry	dry			
Glanzenberg pond						1,000	757	48	12	3	0	0	0	0	0					
Benson Landing pond			5	5	5	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Root Pond	0						10	0	10	0	53	16	185	4	0	3	41	461	28	0
North Springfield Res.						21	538	144	145	2	10	26	0	0	0	0			1,580	685
Pelkeys Swamp		24	2	25	0	0	0	0	0	143	101	104	464	235	597	613	310	781	1	4,128
Lily Pond									350	209	0	1	2	1	0	0	0	0		
Little Lake														7	0	0	0	0		
Porter Lake						2,000	6,375	8,258	1,442	509	790	188	189	165	117	285	616	413	53	28
Bullis Pond										56,069	2,123	1,922	821	333	258	1,107	3,165	2,681	3,600	19,555
Lake Carmi			0		0							0					6,487	1,289	362	221
Lake Shaftsbury																501	784	112	134	5
Dead Creek		830	400	4,800	5,700	4,400	9,160	44,531	10,099	7,735	9,217	5,093	4,000	768	5,006	583	26,037	4,302	3,583	13,069
Lemon Fair River				8,387	3,600	2,695	468	25	16	54	262	273	12	0	0	0	0	0	0	0
Richville Pond					0					23	38	35	0	5	6	27	0	7	174	28
Duval small ponds																	36	180	63	22
Blissville Wetland																		221,874	20,966	22,410
Coggman Creek																		575	0	0
TNC Sites in Poultney R.							25,109	13,271	5,643	7,321	51,619	60,731	30,412	22,829	10,155	29,173	32,153	29,480	0	8