

Management Plan
For
Cranberry & Otter Ponds



WILDWOOD
PROPERTY OWNERS ASSOCIATION, INC.

POND PRESERVATION COMMITTEE

Second Edition

August 2019

TABLE OF CONTENTS

This table can be used to jump to any given topic. Simply “click” on the relevant page at the right and you will be taken to that topic. To get back to the Title page at the top of the document hit “Home” if you are using a full PC keyboard or “fn-command-left arrow” if you are on an abbreviated Apple keyboard.

1. PURPOSE OF THIS DOCUMENT	5
2. POND PRESERVATION COMMITTEE	7
2.1 Membership.....	7
2.2 Meetings and Events	7
2.3 Committee Resources	7
2.4 Community Resources	9
3. THE BIG PICTURE	10
4. CHARACTER OF OUR PONDS AND WATERSHEDS.....	12
4.1 Cranberry Pond	12
4.2 Cranberry Pond Watershed	17
4.3 Cranberry Pond Dam.....	19
4.4 Cranberry Pond Cofferdam.....	23
4.5 Otter Pond	24
4.6 Otter Pond Watershed	27
4.7 Otter Pond Dam.....	29
4.8 Summary of Pond Characteristics	30
4.9 Great Pond Status	31
5. POND MANAGEMENT PLAN OVERVIEW.....	32
5.1 Actions for Pond Preservation	32
5.1.1 Monitoring.....	32
5.1.2 Prevention	32
5.1.3 Intervention.....	32
6. POND ASSESSMENT	33
6.1 Nutrient Levels.....	33
6.2 Physical Qualities	35

6.2.1 Clarity 35

6.2.2 Temperature, Dissolved Oxygen and the CP Thermocline..... 37

6.2.3 Conductivity, Alkalinity, and pH 38

6.2.4 Calcium 39

6.3 Aquatic Plants, Phytoplankton, and Cyanobacteria 40

6.3.1 Aquatic Plants 40

6.3.2 Phytoplankton and Cyanobacteria..... 43

6.4 Microbiological Safety 44

6.4.1 Wildwood’s Semi-public Bathing Beaches..... 44

6.4.2 Wildwood’s Transient Non-Community Public Water System 45

7. PREVENTION 47

7.1 WPOA Rules and Policies 47

7.1.1 Fertilizers and Pesticides..... 47

7.1.2 Washing Machines, Dishwashers..... 47

7.1.3 WPOA Laundry 48

7.1.4 Septic Systems..... 48

7.1.5 Watercraft..... 49

7.2 Laws of Massachusetts..... 51

7.3 Community Education..... 51

7.4 Prevention by Blockade 52

8. MEDIATION 55

8.1 Weed Pull 55

8.1.1 Cranberry Pond 55

8.1.2 Otter Pond 55

8.2 Drawdown..... 56

8.3 Beach Erosion 58

8.4 Notice of Intent / Order of Conditions..... 58

9. CHALLENGES AND FUTURE ACTIONS 60

9.1 Proliferation of Algae 61

9.2 Invasive Aquatic Plants..... 62

9.2.1 Phragmites: a case study 63

9.3	Invasive Aquatic Animals	65
9.4	Native Aquatic Animals	65
9.4.1	Mammals	65
9.4.2	Fish Diversity	66
9.5	Septic Systems	67
9.6	Shoreline Erosion	67
9.7	Forested Watersheds	68
9.8	Fiscal Planning	69
9.9	Bureaucratic Hurdles	70
10.	FISHING ENHANCEMENTS	72
10.1	Wildwood Fisheries	72
10.2	Trout Stocking	72
10.3	Fishermen's Exchange	73
11.	KEY TO APPENDICES	75
12.	ACKNOWLEDGEMENTS	76

1. PURPOSE OF THIS DOCUMENT

The Preamble of the Bylaws adopted by the Wildwood Property Owners Association in August 2012 sets forth the Association's mission as follows:

“The purposes of the WPOA are to manage its properties and activities for the benefit of its members, and to make Wildwood an attractive, enjoyable year-round vacation and recreation community in a natural environment.”

Article VII establishes a Pond Preservation Committee charged with these duties:

“POND PRESERVATION COMMITTEE – this committee will review the condition and management (short term as well as long term) of the Ponds of the WPOA, and will advise and assist the Board of Directors regarding prudent or necessary actions of the WPOA to preserve the integrity of the Ponds. It shall be a permanent standing committee. This committee may be assisted by a subcommittee on fishing and fish stocking.”

Within this context, the Pond Preservation Committee (PPC) developed the following mission statement in 2012:

“POND PRESERVATION COMMITTEE – The mission of this committee shall be to preserve Cranberry and Otter Ponds as the aesthetic and recreational centers of our community. The committee shall (1) develop appropriate water evaluation strategies, (2) arrange for the performance of biological, chemical, and physical water tests and procedures, (3) record and evaluate the testing results, (4) advise the WPOA Officers and Representatives especially when action by the Board is prudent or required, and (5) ensure that the results of mandated tests are reported to civil authorities. The committee shall be proactive in alerting the community to the introduction or appearance of invasive aquatic species of plants or animals at Wildwood and to activities in the WPOA watersheds that have the potential to affect pond water quality, either positively or negatively. This committee may have a subcommittee on fishing and fish stocking and shall be a permanent standing committee.”

This Management Plan document is presented by the PPC as an information source; it presents a general orientation in lake/pond ecology, historical and physical descriptions of Wildwood's two ponds, dams, and watersheds, and management strategies and philosophies to aid current and future decision making about the ponds and their watersheds. It details the ongoing set of activities aimed at preventing/detecting and controlling undesirable conditions in

the ponds. Appendices to the document provide information that can be updated as conditions warrant.

Presently the overall goal of the PPC is to be a diligent steward of our ponds and ultimately prevent, in so far as is possible, any undesirable condition from arising. But we recognize that our environment is constantly changing. So as new situations occur, their implications will be evaluated and, if warranted, specific and detailed action plans will be tailored to react to and hopefully eliminate (or at least mediate) the challenges they pose. These plans will be based not only on the technical knowledge of members of the PPC but also upon the recommendations of professional lake management companies and relevant state agencies.

2. POND PRESERVATION COMMITTEE

2.1 Membership

The current membership of the PPC is given in Appendix 1. Overall, the committee membership is strong and stable, and we are fortunate to have many long-time members with subject matter expertise and institutional knowledge. The PPC (through the WPOA) is a member of LAPA-West (the Lake and Pond Association of Western Massachusetts).

2.2 Meetings and Events

Usually two committee meetings are conducted each year, sometimes coinciding with the WPOA spring and fall meetings. Minutes from these meetings are available. Additionally, much committee work is conducted in partnership with other committees, via email, and at Board meetings. To keep abreast of developments related to ponds and lakes in western Massachusetts, members of the committee usually attend the fall meeting of LAPA West and other workshops. A log of recent activities can be found in Appendix 2.

2.3 Committee Resources

The Pond Preservation Committee has available various types of reference materials some of which have been acquired over the years and some of which are accessible via the Internet. The resources include:

Basics on how lakes and ponds work and do-it-yourself guides addressing lake and pond issues (oriented for the non-professional):

- (1.) Understanding Lake Data, B. Shaw, C. Mechenich, and L. Klessig, Univ. of Wisconsin Publication G3582
<https://www.uwsp.edu/cnr-ap/weal/Pages/Lake.aspx>
- (2.) The Lake Book - Actions You Can Take to Protect Your Lake, L. Moore, 1995, Maine Congress of Lake Associations
- (3.) The Massachusetts Lake and Pond Guide, Michelle Robinson, Massachusetts Department of Conservation and Recreation, 2004.

On-line resources that are relevant for Massachusetts (require slightly more technical expertise):

- (4.) Generic Environmental Impact Report on Eutrophication and Aquatic Plant Management in Massachusetts (GEIR) and its Companion Guide
<http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/practical-guide-no-pics.pdf>

And for the true aficionado, a text book:

- (5.) Limnology, 2nd Edition, R. G. Wetzel, 1983, Saunders College Publishing

Aquatic plants (oriented for the non-professional):

- (6.) Through the Looking Glass, A field Guide to Aquatic Plants, Wisconsin Lakes Partnership and the University of Wisconsin-Extension/Stevens Point
- (7.) A Guide to Aquatic Plants in Massachusetts, W. Kelly, 1999, New England Aquarium and Massachusetts Department of Environmental Management <http://archive.org/details/guidetoaquaticpl00kell>
- (8.) A Guide to Invasive Non-native Aquatic Plants in Massachusetts, C. B. Hellquist, 1997, Massachusetts Department of Environmental Management <http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/aquatic-species.pdf>
- (9.) A Guide to Selected Invasive Non-native Aquatic Species in Massachusetts, Michelle Robinson, Massachusetts Department of Conservation and Recreation, 2004.
- (10.) Guidance for Aquatic Plant Management in Lakes and Ponds, Massachusetts Department of Environmental Protection, 2004.

Watershed and Plant Buffers

- (11.) Surveying a Lake Watershed and Preparing an Action Plan, Massachusetts Department of Environmental Protection, 2001.
- (12.) The Massachusetts Buffer Manual, Massachusetts Department of Environmental Protection, 2003.
- (13.) Landscaping for Wildlife and Water Quality, C.L. Henderson, C.J. Dindorf, and F. J. Rozumalski, Minnesota Department of Natural Resources.
- (14.) More than Just a Yard: Ecological Landscaping Tools for Massachusetts Homeowners, Commonwealth of Massachusetts, Executive Office of Environmental Affairs.
- (15.) Understanding, Living with, and Controlling Shoreline Erosion: a Guide Book for Shoreline Property Owners, Tip of the Mitt Watershed Council, Conway Michigan, 1995.
- (16.) A Woodlot Owner's Guide: How to Get More Out of Owning a Woodland in Massachusetts, M. Mauri. 2003.

Freshwater Fish and Fisheries:

- (17.) Fish and Fisheries Management in Lakes and Reservoirs, J. P. Baker, H. Olem, C. S. Creager, M.D. Marcus, and B. R. Parkhurst, 1993, EPA 841-R-93-002, Terrene Institute and U. S. Environmental Protection Agency

U. S. Environmental Protection Agency publications:

- (18.) Lake and Reservoir Restoration Guidance Manual, 2nd Edition, H. Olem and G. Flock, eds. 1990, EPA 440/4-90-006, North American Lake Management Society and U. S. Environmental Protection Agency
- (19.) Monitoring Supplement to Lake and Reservoir Restoration, R. E. Wedepohl, D. R. Knauer, G. B. Wolbert, H. Olem, P. J. Garrison, and K. Kepford, 1990, EPA 440/490007, North American Lake Management Society and U. S. Environmental Protection Agency
- (20.) Lake and Reservoir Bioassessment and Biocriteria, various contributing authors, 1998, EPA 841-B-98-007.

Finally consultants' reports from studies of the ponds and watersheds of Wildwood are available (listed in Appendix 3).

2.4 Community Resources

Since 1995, members of the Pond Preservation Committee have prepared articles for the WPOA Newsletter under the header "Our Ponds." These articles have aimed to inform members of the community about the workings of watersheds and the measures needed to preserve them. There have also been articles about the wildlife in Wildwood, both animal and plant. A collection of past Newsletter columns can be found in a ring binder that is kept in the clubhouse for anyone to read. The Committee also presents a bulletin board with wildlife and environmental information in the clubhouse vestibule.

3. THE BIG PICTURE

To understand what management of lakes and ponds can accomplish, it is important to appreciate how these water resources are formed and that they have a finite lifetime in nature. In “The Practical Guide to Lake Management in Massachusetts,” which is available online

[\[http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/practical-guide-no-pics.pdf\]](http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/practical-guide-no-pics.pdf)

Ken Wagner, an eminent water resource manager in our state, put it this way:

*“The lakes in Massachusetts were created in two principal ways: by glacial activity approximately 12,000 years ago or by damming streams or small lake outlets, most of latter occurring during the early industrial age of the country for water power. In many respects, **lakes** are like people. They **are born, grow older and die**, with many possible conditions along the way. Through natural processes, lakes will become shallower and more eutrophic (nutrient-rich) and eventually fill in with sediment until they become wet meadows. The aging process is not identical for all lakes, however. Some lakes age quickly, others very slowly, and not all start out in the same condition. Many lakes that were formed by the glaciers no longer exist while others have changed little in 12,000 years. The rate of aging is determined by many factors including the depth of the lake, the nutrient richness of the surrounding watershed, the size of the watershed relative to the size of the lake, erosion rates, and human induced inputs of nutrients and other contaminants. Lakes are therefore highly variable in specific features, and goals for the management of each may vary as well.*

“Existing lakes can be subdivided into categories depending on their position along a continuum of fertility. Nutrient-poor lakes are termed oligotrophic, nutrient-rich lakes are eutrophic, and those in between are mesotrophic. Variations on this system are possible, and any system to boil the complexity of a lake into a single word will not be completely adequate to describe lakes. Lakes in one part of the Commonwealth may share many characteristics (depth, hydrology, fertility of surrounding soils) that cause them to be generally similar.

“Lakes that are created by damming streams may at first be eutrophic as nutrients in the previous stream’s floodplain are released into the water column. Over a period of decades, the initial productivity tends to change until the impoundment takes on conditions governed more by the entire watershed, with depth and detention time as critical determinants of response to watershed inputs. Impoundments may never completely escape the legacy of their creation. They are commonly shallow and the pre-existing nutrient-rich bottom sediments may provide nutrients for abundant aquatic plant growth early in the life of the lake.

*“Human activity can unduly accelerate the process of lake aging or, in the case of introduced species or pollutants, force an unnatural response. Unnatural responses include the elimination of aquatic species as a result of acid deposition, algal blooms resulting from excessive nutrient enrichment, and the development of a dense monoculture of a non-native aquatic plant. However, **it would be unrealistic to assume that managing cultural impacts on lakes can convert them all into infertile basins of clear water.** Understanding the causes of individual lake characteristics (i.e., understanding the lake ecosystem) is a fundamental part of determining appropriate management strategies.*

*“An ecosystem is a system of interrelated organisms and their physical-chemical environment. We need an operational unit that can be reasonably studied and will help explain all or most of the characteristics of the lake. The most useful definition of the **lake ecosystem is the lake and its watershed** because the watershed defines the terrestrial sources of the lake’s water. Most impacts on lakes can be related to characteristics of the watershed, although acid rain, mercury deposition and drought have demonstrated that not everything important to lakes occurs within the watershed. A lake is a web of interactions between hundreds of biological species, chemical compounds, hydrological processes and human actions, all in constant change. A tug on any part of the web ripples throughout the rest of the ecosystem. Ecology is the scientific study of these relationships and limnology is the study of freshwater ecology. Lake management involves the application of ecological principles and data to establish and maintain desirable conditions.”*

There are several important points to be taken from this text.

- An “infertile basin of clear water” is called a swimming pool not a lake or pond.
- A lake or pond is not forever. Mother Nature will see to it that a pond becomes a meadow. Over the long haul (geologic time) then, the goal implied by the name of the Pond *Preservation* Committee is futile. Mother Nature will win in the end. She always does.
- But in the short term (human generations), the rate at which a lake or pond undergoes the natural aging process can be influenced both positively and negatively by human activity, specifically human activity in the watershed and in the pond. From time to time there can be other influences, such as weather conditions and acid rain that originate outside the watershed.

It follows then that the work of the WPOA Pond Preservation Committee is to slow the aging process of Cranberry Pond (CP) and of Otter Pond (OP) so that they remain the aesthetic and recreational centers of our community, for at least this generation of property owners and potentially the next.

4. CHARACTER OF OUR PONDS AND WATERSHEDS

This Section will present an overview of the ecosystem of each WPOA pond. Note that the scientific bases or meanings of some characteristics presented in this Section are more fully explained in Section 6, often along with the methods employed to measure them.

The Massachusetts Generic Environmental Impact Report on Eutrophication and Aquatic Plant Management in Massachusetts (GEIR, found online at www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/main-geir.pdf) provides guidance on lake and pond issues and suggests attention to the following elements:

Include maps of watershed boundary, watercourses, drainage systems, geology, topography, soils, land use, any zoning, and pollutant sources. Provide maps of lake bathymetry and sediment types/depth. Collect data for hydrology and water quality and construct nutrient budgets. Model the system to the extent practical and necessary to predict results of management actions. Collect data for bacteria, algae, vascular plants, zooplankton, invertebrates, fish, reptiles, amphibians, birds and mammals, and check available maps and records for protected species.

4.1 Cranberry Pond

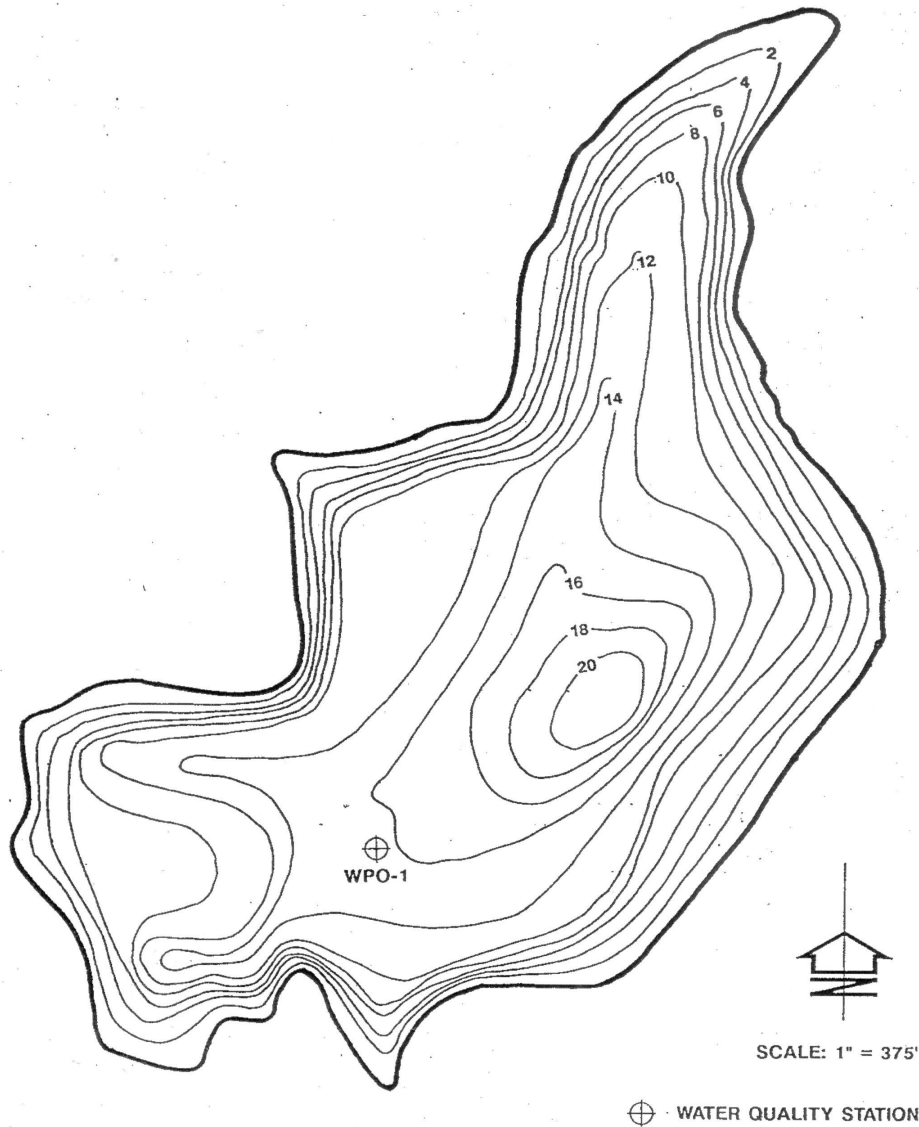
CP is a 75.3-acre man-made impoundment formed by an earthen embankment dam that is approximately 450 feet long and 24 feet high. When its original valve was closed for the first time in November of 1965, the pond that formed greatly enlarged an existing cranberry bog that gave the new pond its name. Today CP holds 278.3 million gallons (854 acre feet) of water and is 25.19 ft deep at its deepest point. Its average depth is 12.23 feet.

The pond is fed by springs in its bottom, by six inlets, and by runoff from snowmelt in the spring and rain throughout the warm seasons. Four of CP's six inlets are intermittent. The diagnostic study conducted by Baystate Environmental Consultants of East Longmeadow MA in 1992 indicated that nearly all the water in CP is replaced once in 1.07 years (391 days) or, to put it another way, the pond has a turnover of 0.93 times a year. A copy of that study is available in electronic form. With this turnover rate, CP would be expected to respond fairly well to efforts to decrease its nutrient input. For comparison, Lake Superior turns over once every 500 years!

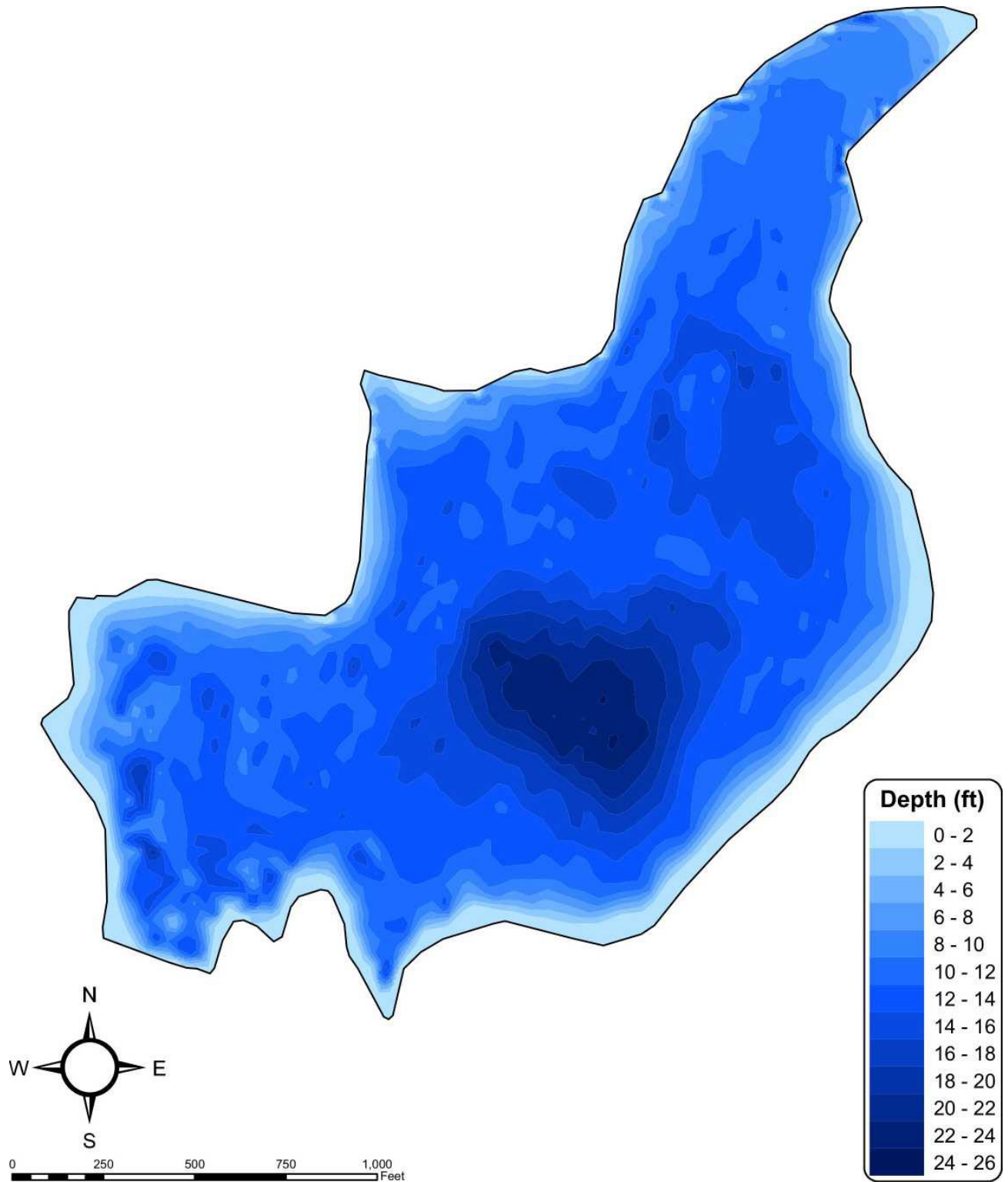
The contour map of the pond's bottom that was part of the 1992 consultant's study is presented on the next page. It was generated from limited data obtained by physically probing beneath the ice cover present on Jan 24, 1992. Since that time, GPS and sonar technology for measuring bottom contours has come on line, and in 2016 Aquatic Control Technology of Spencer MA was engaged to

map the bottoms of both ponds at Wildwood with the newest technology. The 2016 map for CP is seen on the page following the map from 1992.

FIGURE 4
CRANBERRY POND BATHYMETRIC MAP
(CONTOURS IN FEET)



This map of CP is from the diagnostic study conducted by Baystate Environmental Consultants of East Longmeadow MA in 1992.



A bathymetric map of CP is based upon sonar and GPS data collected by Solitude Lake Management of Spencer MA in 2016.

The figures for CP size, volume, and depth (both maximal and average) presented at the beginning of this Section are based upon the Solitude Lake Management bathymetric study. The study data also allow the following calculations that will be referenced in Sections on the thermocline (Section 6.2.2), aquatic plants (Sections 6.3.1 and 7.4), and drawdown (Section 8.2).

Table shows how the volume of water in CP decreases as water is removed in 2-foot increments.

CP Volume		
Depth (feet)	Acre feet below depth	Percent of total
0	854.0	100.0%
2	848.8	99.4%
4	839.9	98.3%
6	824.3	96.5%
8	796.2	93.2%
10	737.7	86.4%
12	560.2	65.6%
14	293.0	34.3%
16	163.6	19.2%
18	114.0	13.3%
20	81.5	9.5%
22	44.9	5.3%
24	0.7	0.1%

Table shows how much of the surface of CP lies at or up to a given depth.

CP Surface Area		
Depth (feet)	Acres at depth or above	Percent
0	0	0.0%
2	5.2	6.9%
4	8.2	10.9%
6	11.3	15.0%
8	15.3	20.3%
10	21.8	29.0%
12	37.9	50.3%
14	58.5	77.7%
16	67.1	89.1%
18	70.0	93.0%
20	71.7	95.2%
22	73.4	97.5%
24	75.3	100.0%

The water in CP has a reasonably “good” transparency (on a scale from “excellent” to “poor”) as indicated by Secchi disk measurements (see Section 6.2.1 for a description of Secchi dish measurements). These measurements vary throughout the season reflecting the annual rise and eventual end-of-summer decline of phytoplankton and cyanobacterial populations. The pH is generally neutral or slightly acidic (pH 6 to 7), and the water is low in dissolved mineral content (total alkalinity <10 mg/L and conductivity <60 μS/cm), meaning that the pond would be moderately vulnerable to acidification by acid rain. The alkalinity and conductivity are consistent with the low buffering capacity of the local geology and stands in contrast to the calcium carbonate-rich geology of the Berkshire region to the west.

CP is deep enough to allow a thermocline to form during the summer months. Essentially the pond in summer is stratified into two non-mixing layers of water, a warmer surface layer over a colder deep bottom layer, and the layers differ in other ways as well. For example, the measurements made in 2011 by K.

Wagner (Water Resource Service) using a Hatch-Hydrolab DS5 multi-probe instrument indicated a distinct discontinuity of temperature, pH, and dissolved oxygen at a depth between 9.8 and 13.1 feet, with a marked increase in conductivity and a total depletion of dissolved oxygen at 19.6 feet. Such a thermocline does not exist during the cold months when the temperature of the surface water decreases to approach that of the deepest part of the pond.

The bottom of CP did not benefit from glacial scouring during the last ice age. Rather, it is a man-made impoundment. While the dam was being built, the developer simply removed trees and bushes in the area that was to be underwater and left behind stumps, roots, decomposing vegetation on the forest floor, and much of the humus layer of the soil as well. Subsequent flooding of the area may have produced an enticing view for prospective buyers, but where Mother Nature had started the decomposition process, she would continue until she was done. The bacteria and fungi responsible for recycling the organic materials in the submerged vegetation and humus produce gas as a byproduct of their metabolic activities. In the summer when microbe action is most vigorous, the gas can become trapped in the humus and root masses, making parts of the pond bottom buoyant. The “summer islands” and floating bog mats are the result. The floating islands are likely to differ from the free-floating mats *only* by being anchored to the bottom via the tangled remnants of tree roots. Although these islands are fewer in number now than they were in the early days of Wildwood (see photo on next page), they keep appearing and will continue to do so until the decomposition process finishes.

Two points need to be recognized concerning management of today’s floating islands. First, their physical removal is costly and dangerous; during past, removal efforts, winched chains or cables attached to the islands have snapped as the tension upon them was increased. And second, removal does not guarantee that other islands will not appear in subsequent seasons, originating from different areas of the pond bottom. For the free-floating bog mats, on the other hand, we should continue our practice of moving them close to accessible collection areas near Lakeside Beach and Meadow Beach during the summer season and then removing them once drawdown is complete and the ground has frozen. It is encouraging that during the summer seasons since 2013 noticeably fewer floating islands appeared than in the preceding summers. If this trend continues, we may be witnessing the end of Mother Nature’s decomposition work.



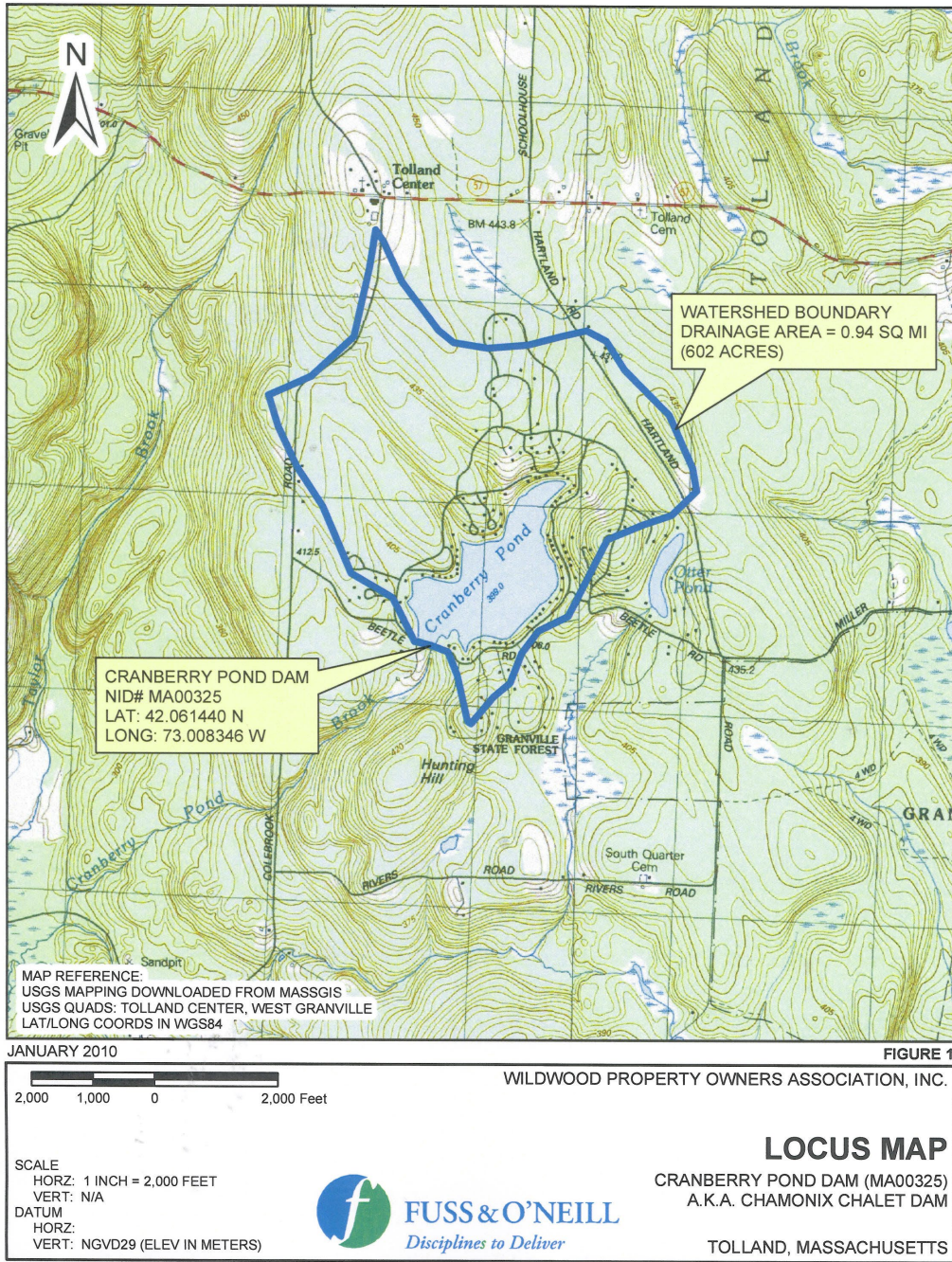
An aerial view of massive floating islands in CP in 1970

4.2 Cranberry Pond Watershed

The watershed of CP is approximately 602 acres or 0.94 square miles, making it about eight times larger than the pond itself. CP's watershed is largely forested and no part of it is used as farmland. A topographic map showing the boundaries of the watershed can be found on the next page. Approximately 63% of the CP watershed is located within the boundaries of Wildwood.

The soils adjacent to CP generally consist of a loam texture overlying glacial till. Full details can be found in the Baystate Environmental Consultants' report.

CP is surrounded by approximately 66 single-family homes, the majority of which are occupied on a seasonal basis, as are additional single-family homes located within the pond watershed. Very few houses outside of Wildwood are located within the CP watershed. Consequently, the household activities of Wildwooders themselves are likely to exert the greatest influence upon the nutrient load in the runoff or ground water that eventually finds its way to CP. It should be noted that parts of Fox Den Road, Owl's Nest Lane, and Woods Lane do not lie within the CP watershed.



This watershed map from the NOI submitted in support of the 2006 CP dam repair echoes that previously available in the report of Baystate Environmental Consultants, though in the latter the area of the watershed was estimated at 520 acres.

We are fortunate that the CP watershed outside Wildwood does not include any commercial farmland. Agricultural runoff can be a major source of nutrients that would adversely affect CP by stimulating phytoplankton and aquatic plant growth.

However there is a concern for the watershed outside Wildwood. The Tolland Public Works facility, which lies close to its northern tip, is the site for the storage of road salt. On January 30, 2006, at a meeting of the Board of Selectmen, Valerie Nickerson of the Tolland Board of Health reported serious health code violations at this town facility:

- Septic system backing up and entering the building.
- A large amount of mold and mildew growing on the walls, and ceiling through the building, although primarily in the “meeting room”.
- Ventilation system non-existent.
- Roof leaks, drainage problems throughout the building.
- Drinking water with a high amount of sodium that exceed limits for safe drinking.

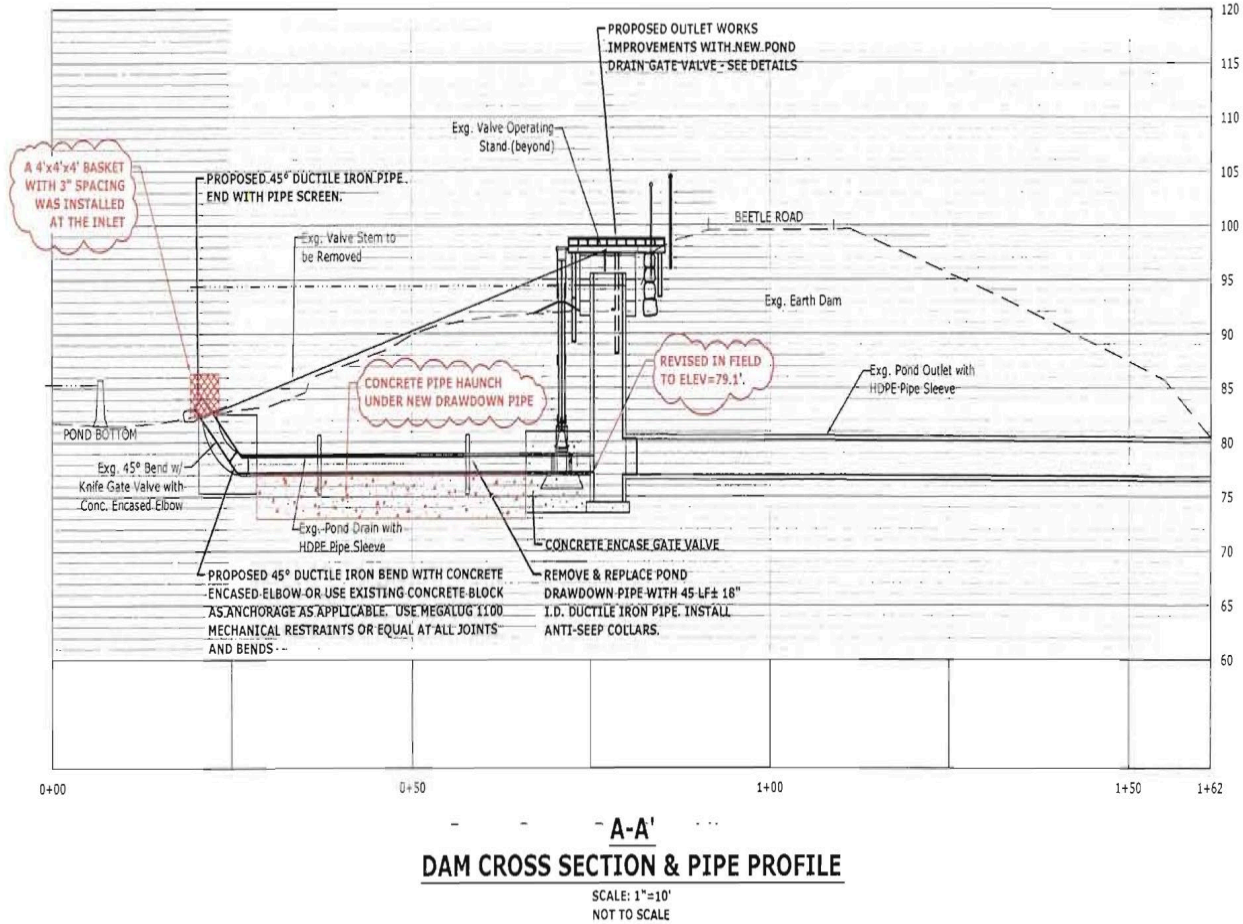
Because the drinking water was drawn from a well that served the facility, her findings meant that salt from the storage pile was leaching into the ground water. Sodium chloride, being quite soluble in water, is highly mobile in the soil, and the condition of the Town’s facility could become a concern for Wildwood in the future if funds for maintaining the building, especially the roof over the salt pile, are not allocated in a timely fashion by the Board of Selectmen. Testing for sodium levels in the water of the wells operated by the WPOA at three-year intervals is mandated by Massachusetts Drinking Water Regulations (see Section 6.2.4).

4.3 Cranberry Pond Dam

The dam was built in the mid-1960s by the Soil Conservation Service of the United States Department of Agriculture. The pond that it formed was known as Lake Chamonix for a short while in the 1970s thanks to the marketing efforts of the Wildwood developer. In various permits, registrations and legal documents, the dam has been called Chamonix (Chalet) Dam and Wildwood Dam. Now as “Cranberry Pond Dam” it bears the state identification number 1-7-297-9 and the national identification number MA00325.

The dam regulates the level of CP under “normal” weather conditions by means of a vertical overflow riser pipe adjacent to the dam crest: water that overtops the riser is conducted down to the base of the dam and then to the rear via a low-level discharge pipe (refer to the diagram on the next page).

During an extreme storm if the overflow riser were overwhelmed, water would find its way via an engineered low spot at the Main Beach end of the dam, across Beetle Road into the clubhouse parking lot, and down toward the WPOA maintenance shed.



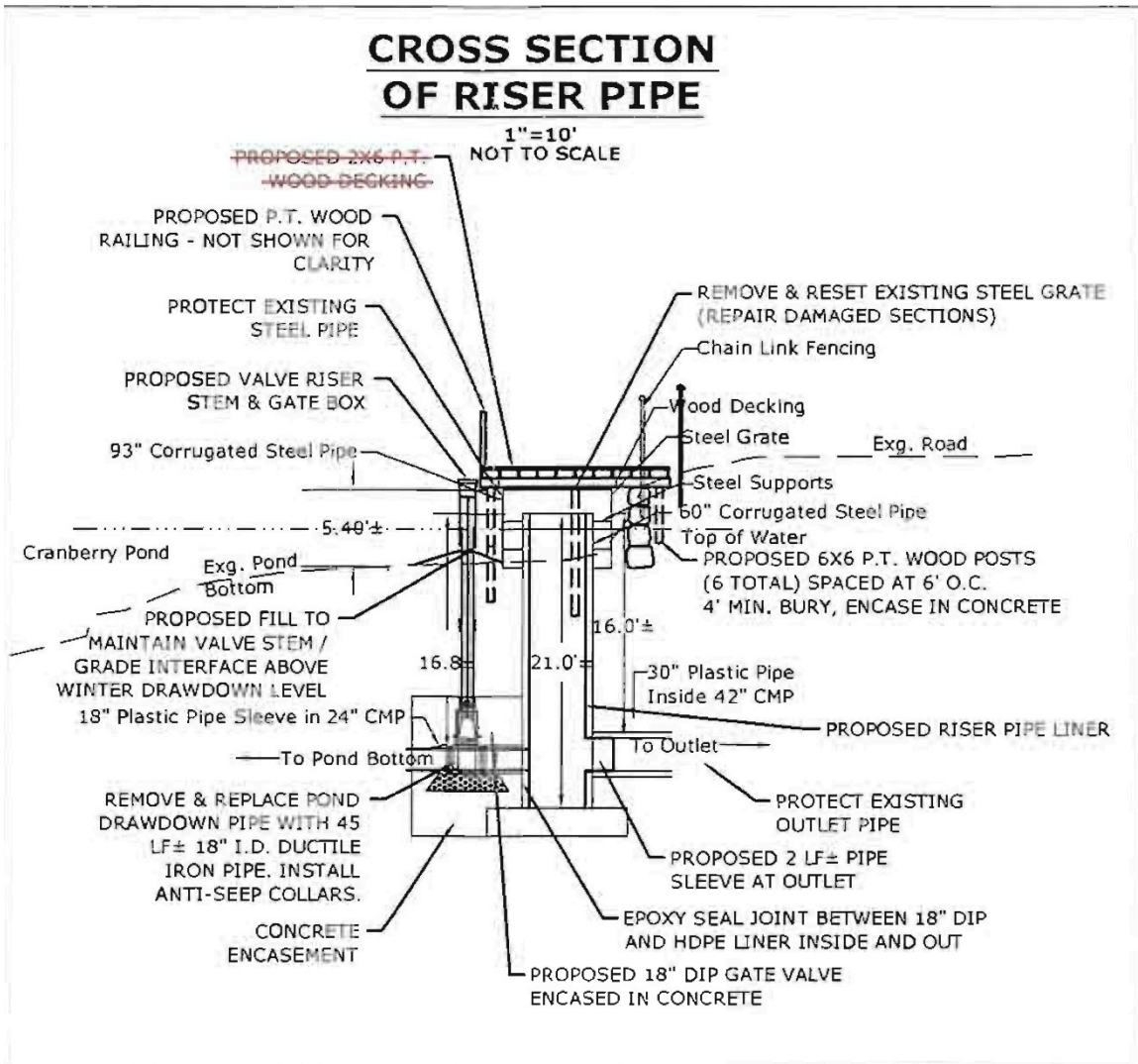
The current configuration of the CP dam showing the gate valve now near the base of the overflow riser.

In addition to the outlet riser and low-level discharge pipe, the dam originally also had a low-level inlet pipe extending from the bottom of the overflow riser approximately 45 feet out into the pond for the purpose of pond drawdown. Flow through this inlet pipe was controlled by a knife-gate valve located at its upstream end. A valve stem and hand-wheel were used to operate the valve from the crest of the embankment.

In the 1960s, the typical USDA dam design utilized corrugated metal pipe for overflow risers, low level outlets, and discharge barrels, and that was the material used in the original Wildwood structure. Corrugated metal pipe is susceptible to corrosion over time with a design life of approximately 30-40 years, and not surprisingly by the early 2000s, corrosion had breached the wall of the outflow barrel of the CP dam allowing passing water to begin eroding the dam from within. Silt could be seen in the outflow, and near the overflow riser a sinkhole formed. Further inspection also found corrosion breaching the low-level intake pipe behind the knife-gate. The deficiencies were addressed in the fall of 2006

under NOI/OOC (DEP File Number) 306-0022: both the intake and outflow corrugated pipes were slip-lined with HDPE (high density polyethylene) pipes, and the annular space between the old corrugated pipe and the new plastic pipe was filled with grout. The 48-inch corrugated outflow pipe received a 36-inch HDPE insert, and an 18-inch HDPE pipe was inserted into 24-inch the intake pipe. An HDPE elbow section was field welded to fit an angled fitting near the upstream end of the drawdown pipe, behind the valve. Toe drainpipes along the downstream base of the dam were also replaced, but the project did not address the corrugated metal overflow riser.

By 2010, the overflow riser was in need of slip lining, and because a portion of the intake pipe had collapsed, the opportunity to design an entirely new intake pipe and valve configuration was taken. The dam repairs done in 2011 (under NOI/ OOC [DEP File Number] 306-0049) incorporated these modifications as seen in the accompanying diagrams. A new iron inflow pipe, supported on a bed of concrete, replaces the old corrugated metal intake pipe. The intake end of the new pipe is fitted with an elbow opening to the pond floor and covered with a metal basket to prevent debris and large fish from entering the intake. A new gate valve is installed at the end of the intake pipe nearest the base of the overflow riser allowing operation of the valve from directly above (diagram on next page). The repairs included slip-lining the overflow riser and upgrading the grating and fencing at the top of the overflow riser.



Detail of the overflow riser and gate valve of CP dam.

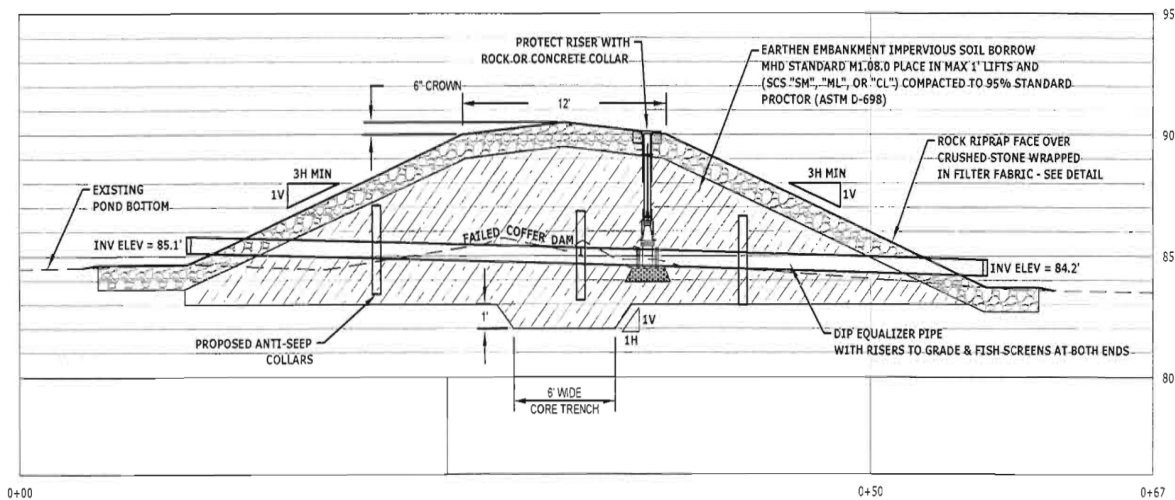
To close the discussion of CP dam, two points on its safety need to be made. First, because the CP dam is an earthen structure, it is crucial that its top and outflow face be kept free of woody bushes and trees because roots of such plants can provide channels for water infiltration. Presently this is accomplished by mowing the dam's grass and wildflowers at intervals during the growing season, a practice that *must not change*. As part of the 2006 dam repairs, trees needed to be removed from the right and left flanks of the dam's outflow face for just this reason. Guidance on this subject can be found online: Massachusetts Office of Dam Safety Policy on Trees on Dams.

<http://www.mass.gov/eea/agencies/dcr/conservation/dam-safety/policy-on-trees-on-dams.html>

Secondly, as Main Beach is nourished with fresh sand each spring, the engineered low spot at the Main Beach end of the dam must not be allowed to fill in over time because this low spot is intended to become the critical escape route preventing excess water from overtopping the dam during an extreme storm.

4.4 Cranberry Pond Cofferdam

The closing of the CP dam for the first time in 1965 submerged a portion of Beetle Road lying a short distance to the north-northeast of the dam. The remnants of this roadway, extending roughly from main beach to a point jutting into the pond on the opposite shore, became a secondary or cofferdam. When the valve of CP dam is opened for a draw down, the water level may fall until it reaches the height of the earthen cofferdam. If repairs to the main dam are needed, the cofferdam retains the remaining pond water so that the area immediately adjacent to the main dam can be dewatered further to provide access to the front of the dam. In the original design, a segment of the cofferdam consisted of sand bags that could be removed to manage the water level retained by the structure. As the time for the 2006 dam repairs went beyond the planned schedule, inflow into CP caused the water to overtop the cofferdam, and the resulting flow severely eroded the structure. Restoration and improvement of the cofferdam was part of the 2011 project. As shown in the diagram, a new cofferdam was built up and covered with a layer of riprap. A pipe now traverses the base of the dam, and the pipe has been fitted with a valve to allow management of the retained water level during any future repair of the main dam.



B-B'
COFFERDAM CROSS SECTION

Current configuration of the cofferdam in CP.

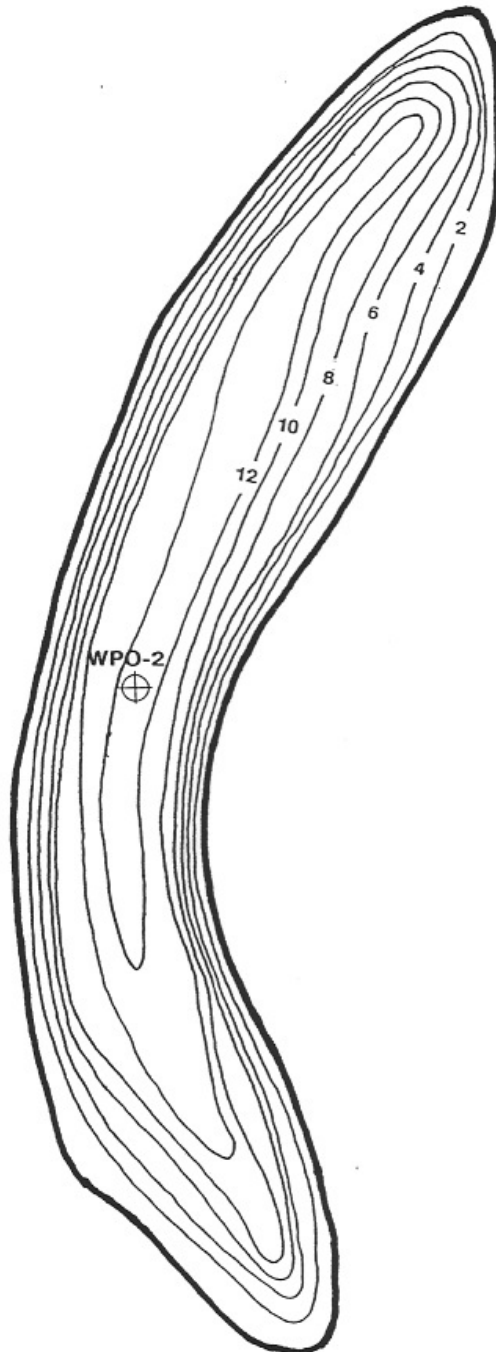
4.5 Otter Pond

OP is 7.1-acre man-made impoundment formed by a cement dam, 40 feet in length and 4 feet high. The deepest point in OP is 13.59 feet below the surface, and the pond holds roughly 14.5 million gallons (44.5 acre feet) of water, making it only about 5% as large as CP on the basis of volume. Its average depth is 8.27 feet. Area-wise OP is about 9.4% of CP. According to calculations made by Baystate Environmental Consultants of East Longmeadow, MA, the water in OP is replaced once every 0.29 years (106 days) or, to put it another way, the pond has a turnover of 3.4 times a year. This is roughly three times faster than the turnover for CP, making OP even more responsive to efforts to limit nutrient input. Although OP is free of the bog mat phenomenon noted for CP, it has an increasingly troublesome aquatic plant population, with a large and spreading stand of Watershield (*Brasenia schreberi*) across from the swimming beach and Cattails (*Typha latifolia*) dominating the northern end. Both of these aquatic plants spread via rhizomes that are difficult to remove from the pond bottom if the plants are simply pulled. This contrasts with the situation in 1992 when the Baystate Consultant's plant survey found "large mono-specific stands of aquatic plants are absent" from OP.

Comments on the general characteristics and mineral content of the water of CP in Section 4.1 also apply to the water of OP. With respect to water clarity, Secchi Dish measurements in OP are not always useful. When the Secchi disk remains visible all the way to the bottom at the deepest point of the pond, measurements have little meaning relative to those in CP. But in recent seasons, the point at which the Secchi Dish disappeared was above the pond bottom providing more meaningful information. For this reason, these measurements need to be made with regularity going forward. Subjectively, the water of OP appears more cloudy or turbid than that of CP. The shallowness of OP precludes the formation of a summertime thermocline.

Bathymetric maps of OP generated by the procedures discussed for CP in Section 4.1 are provided on the pages that follow.

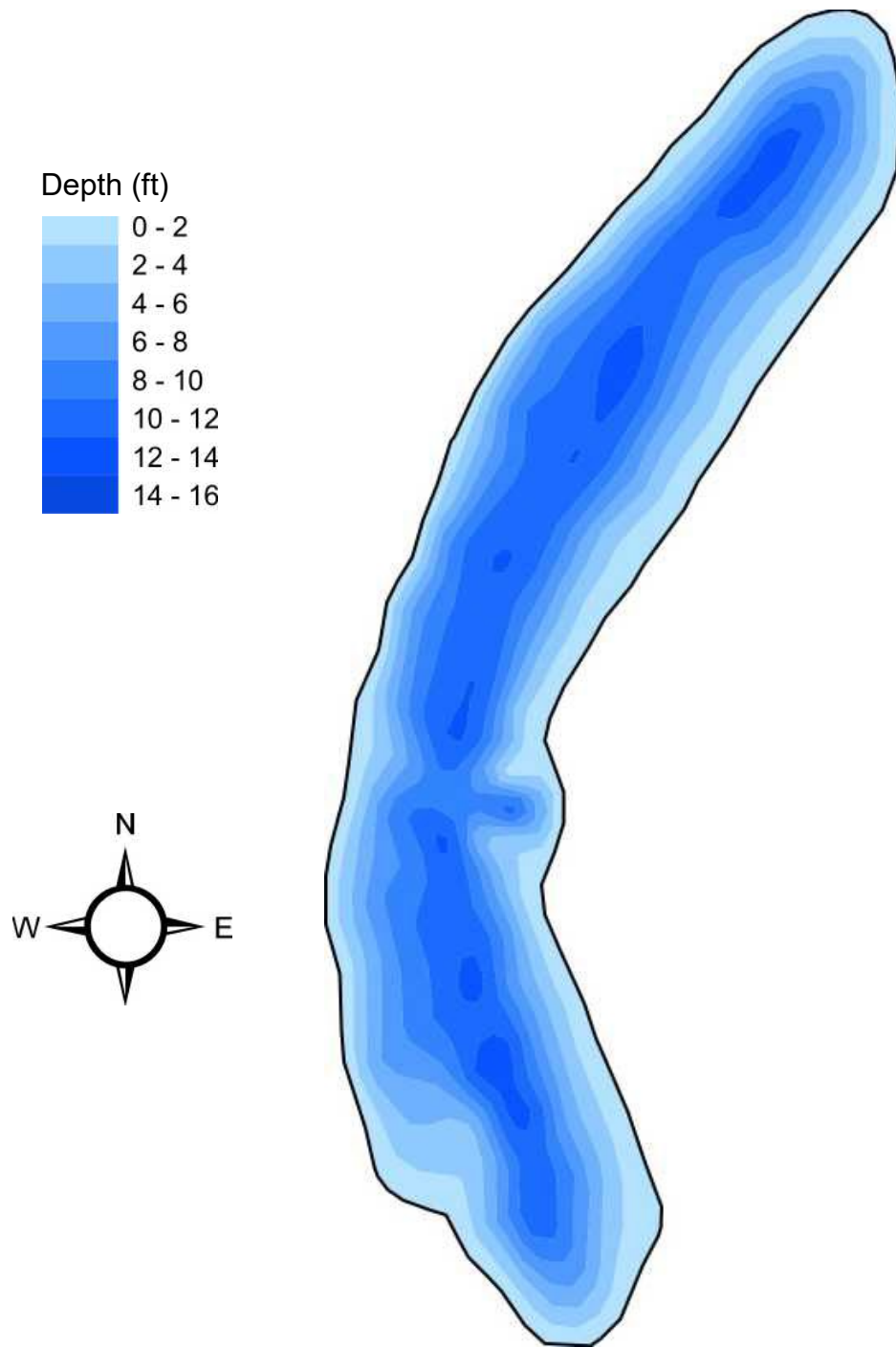
OTTER POND BATHYMETRIC MAP
(CONTOURS IN FEET)



SCALE: 1" = 160'

⊕ WATER QUALITY STATION

This bathymetric map of OP is from the diagnostic study conducted by Baystate Environmental Consultants of East Longmeadow MA in 1992.



A bathymetric map of OP is based upon sonar and GPS data collected by Solitude Lake Management of Spencer MA in 2016.

The figures for OP size, volume, and depth (both maximal and average) presented at the beginning of this Section are based upon the recent bathymetric study by the Solitude Lake Management. The study data also allow the following calculations that will be referenced in Sections on aquatic plants (Sections 6.3.1 and 7.4) and drawdown (Section 8.2).

Table shows how the volume of water in OP decreases as water is removed in 2-foot increments.

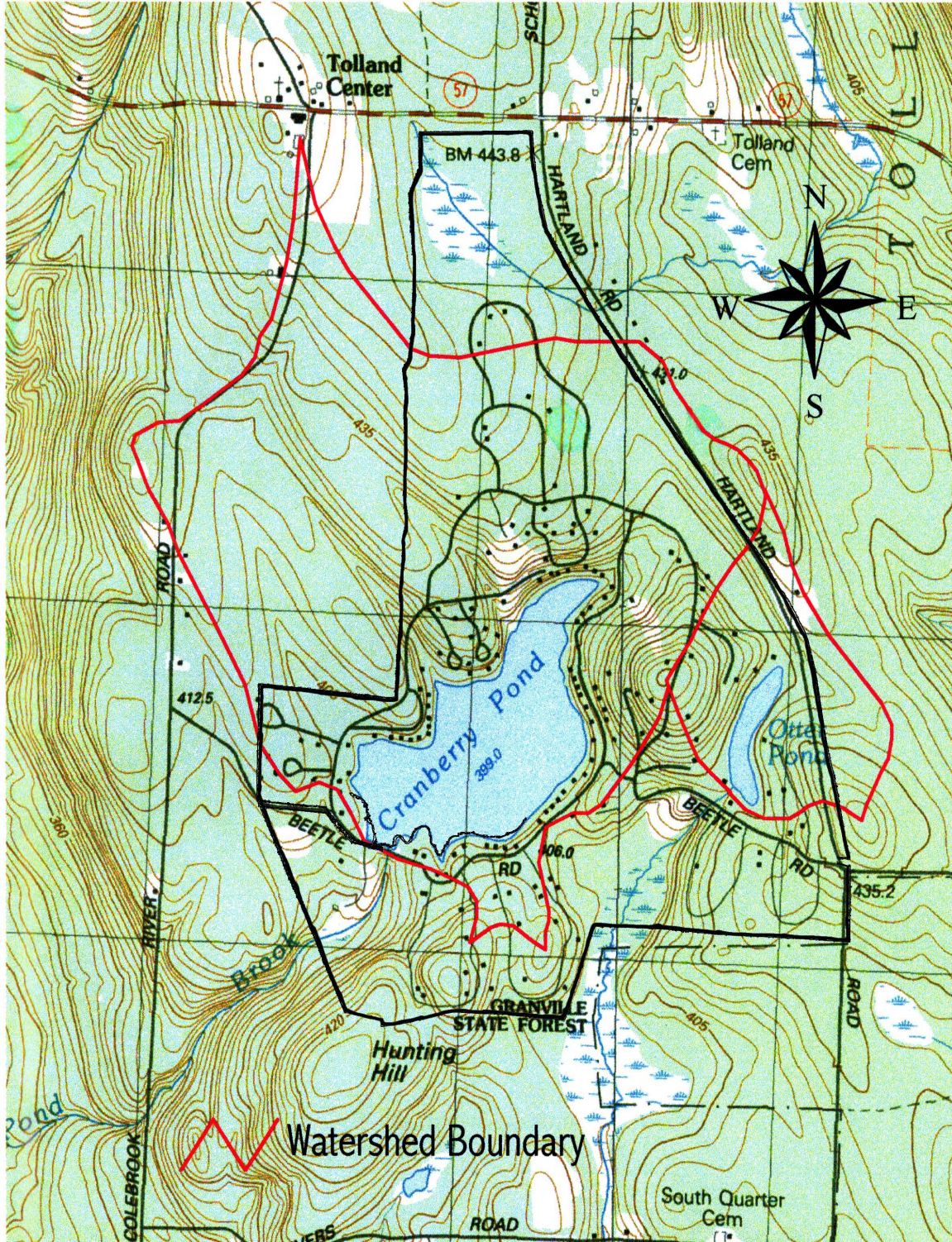
OP Volume		
Depth (feet)	Acre feet below depth	Percent of total
0	44.5	100.0%
2	43.1	96.9%
4	39.7	89.2%
6	35.0	78.7%
8	28.6	64.3%
10	18.9	42.5%
12	3.4	7.6%
14	0	0.0%

Table shows how much of the surface of OP lies at or up to a given depth.

OP Surface Area		
Depth (feet)	Acres at depth or above	Percent
	0	0.0%
2	1.4	19.7%
4	2.5	35.2%
6	3.4	47.9%
8	4.3	60.6%
10	5.4	76.1%
12	6.8	95.8%
14	7.1	100.0%

4.6 Otter Pond Watershed

A topographical map delineating the 88-acre OP watershed is presented on the next page (just to the right of the larger CP watershed). The watershed is approximately 12.4 times larger than the pond itself. Like the watershed of CP, that of OP is largely forested and not used as farmland. Approximately 65% of the OP watershed is located within the boundaries of Wildwood. Once again, most of houses in the watershed are those built within the boundaries of Wildwood, meaning that the household activities of Wildwooders themselves are likely to exert the greatest influence upon the nutrient load in the runoff or ground water that eventually finds its way to OP. It should be recognized, however, that Forest Road and South Village Road are largely outside the CP watershed. Also noteworthy is the fact that the homes surrounding OP are set back further from the shore than they are on CP, meaning that there is more chance for soil-attenuation of the nutrient content of septic tank leachate in this water shed.



A topographical map with the watersheds for CP and OP delineated in red and the boundaries (and roadways) of Wildwood in black.

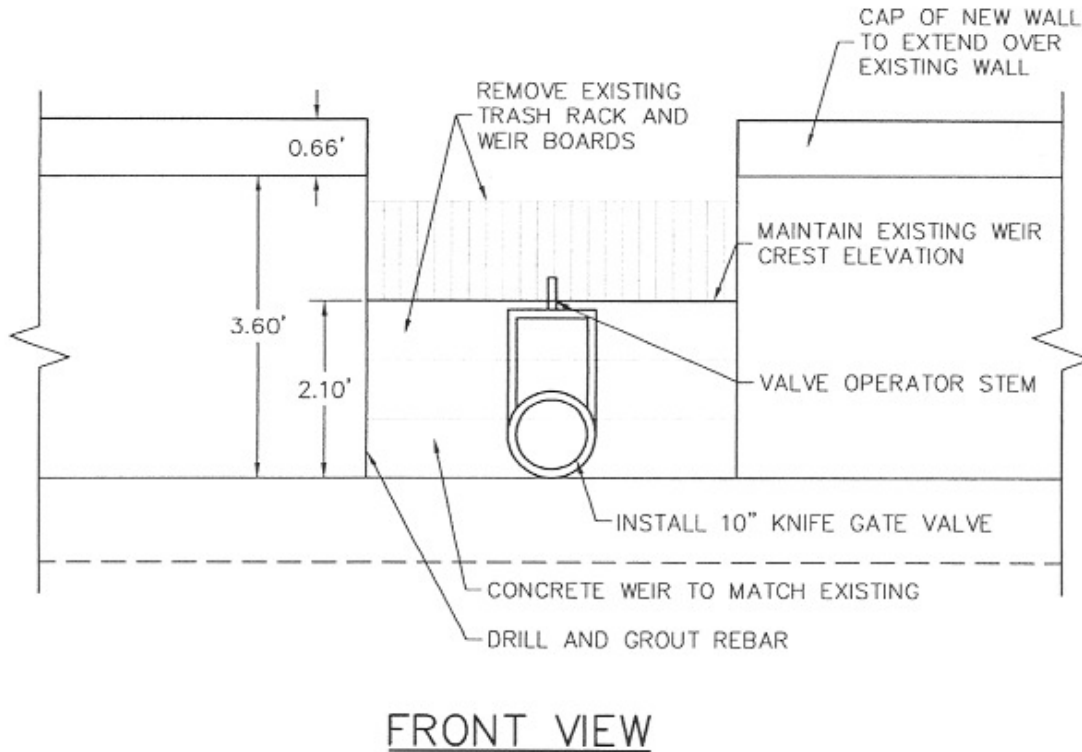
4.7 Otter Pond Dam

The original dam that dated from about the same time as the CP Dam, was a concrete structure approximately 40 ft long, 4 ft high, and 1 ft thick. Because of its small size, the dam did not need to be registered with the MA Office of Dam Safety or any national agency.

A spillway crest centrally located along the length of the original dam featured three removable horizontal wooden weir boards to control the depth of the pond. Over time, a vertical crack developed in the dam structure, and a portion of the dam shifted. Attempts to seal the crack were made, but the more significant issue was that the dam to the right and left of the spill crest was no longer in alignment. This trapped the weir boards rendering them immobile. As a consequence, drawdowns of OP were not possible for several years.

In 2006 the dam was repaired under NOI/OOC (DEP File Number) 306-0022, and a valve was installed to allow drawdown. During this repair, it was found that the footing of the original structure had not been poured into a form but rather into an irregular trench. Furthermore the concrete was not reinforced. For the repair, the spillway, the entire right wall (looking downstream) and 12.8 ft of left wall were demolished, a frame of steel reinforcement bar was constructed, and concrete was poured to generate a structure that was mostly new. But first a new footing was established to provide for maximal drawdown capability based on the elevation of the downstream channel. The new spillway is 4.35 ft wide with its height matching the height of the previous weir boards (*i.e.*, 3.9 ft above the height of the new footing). Walls, 12.8 ft in length, were poured on either side of the spillway. To the left of the spillway (looking downstream), the new concrete was matched to the portion of the original dam that had not been removed. A 10 inch knife valve and a PVC outflow pipe originally planned to be centered at the bottom of the spillway wall (see diagram) was actually installed in the left wall immediately above the footing and adjacent the end of the spillway wall to provide easier operation of the gate valve from above. Most of the outflow side of the wall flanking the spillway was backfilled to provide additional support.

To flush away any sediment buildup near the upstream face of the spillway, the knife valve should be opened and closed at least once every six months. Unusual and rapid accumulation of sediment or woody plant material in front of the spill way may indicate that a beaver has taken up residence in the pond since these animals instinctively act to obstruct water flow when they sense the gurgle of cascading water. Such was the case in 1997 and again in 2014.



Original plan for the new OP dam; in the version that was built, the outflow pipe and gate valve were located in the left wall adjacent to the spillway.

4.8 Summary of Pond Characteristics

The information in Sections 4.1 to 4.7 is summarized in this Table.

	Cranberry Pond	Otter Pond
Surface Area (acres)	75.3	7.1
Maximum Depth (ft)	25.19	13.59
Average Depth (ft)	12.23	8.27
Volume (acre feet)	854	44.5
Volume (gallons)	278.3 x10 ⁶	14.5 x10 ⁶
Annual Turnover (vol/yr)	0.93	3.4
Watershed Area (acres)	602	88
Area Ratio (watershed/pond)	8	12.4
Percent of Watershed within Wildwood (%)	60-65	60-65

4.9 Great Pond Status

Once the Developers acquired the tracts of land that became Chamonix Chalet Properties and allowed water to collect behind Cranberry Pond Dam, Beetle Road was flooded impeding the Right of Way that townspeople had been accustomed to utilizing for access to the much smaller body of water that had been Cranberry Pond. Controversy surrounded the flooding of Beetle Road for years thereafter. Rather than focus upon Beetle Road as an access route, some residents of Tolland took another tactic to attempt to maintain access to Cranberry Pond, viz., they invoked a law dating from the colonial period that granted citizens of Massachusetts free access to “Great Ponds.” Because you, dear reader, are wading through a rather dry text, perhaps reading the law from the 1640’s in its original form may revive and amuse you:

“Everie Inhabitant who is an hous-holder shall have free fishing and fowling, in any great Ponds, Bayes, Coves and Rivers so far as the Sea ebs and flows, within the precincts of the town where they dwell, unles the Free-men of the same town, or the General Court have otherwise appropriated them. Provided that no town shall appropriate to any particular person or persons, any great Pond, conteining more than ten acres of land: and that no man shall come upon anothers proprietie without their leave otherwise then as heerafter expressed; the which clearly to determin, it is declared that in all creeks, coves and other places, about and upon saltwater where the Sea ebs and flows, the Proprietor of the land adjoyning shall have proprietie to the low water mark where the Sea doth not ebb above a hundred rods, and not more wheresoever it ebs farther. Provided that such proprietor shall not by this libertie have power to stop or hinder the passage of boats or other vessels, in, or through any sea creeks, or coves to other mens houses or lands. And for great Ponds lying in common though within the bounds of some town, it shall be free for any man to fish and fowl there, and may passe and repase on foot through any mans proprietie for that end, so they trespasse not upon any mans com or meadow.”

The Tolland residents petitioned the state Attorney General to rule Cranberry Pond a “Great Pond.” It was not until 1996, well after the Town discontinued the Right of Way to the section of Beetle Road east of main entrance, that the WPOA received a written communication from the Massachusetts Department of Environmental Protection stating its determination that Cranberry Pond was not a Great Pond (President’s Note in the June 1996 issue of the WPOA Newsletter).

5. POND MANAGEMENT PLAN OVERVIEW

5.1 Actions for Pond Preservation

Our management plan has three elements: knowing, preventing, and intervening.

5.1.1 Monitoring

Knowledge of the ponds and their watersheds flows from observation and periodic assessment. The relevant parameters routinely monitored include:

- Nutrient levels
- Physical qualities
- Aquatic plant and phytoplankton status
- Biological safety

5.1.2 Prevention

The old wisdom about an ounce of prevention being better than a pound of cure is fully applicable here. Prevention at Wildwood takes several forms:

- Education of the community on the impacts of personal actions and decisions on the quality of our ponds
- Rules and recommendations intended to protect the ponds
- Protection of the ponds from undesirable influences originating outside our watersheds

5.1.3 Intervention

Presently the interventions utilized at Wildwood can be classified as biological (inasmuch as man is part of the biosphere) and physical.

- Aquatic plants are removed manually, either by volunteers during our annual weed pull in CP or by a scuba diver hired for the purpose for OP.
- Exposure of pond bottom along the periphery of each pond (*i.e.*, the "littoral zone") by our annual draw down mitigates the proliferation of perennial plants that do not propagate via seeds (*e.g.*, milfoil and fanwort) by exposing them to freezing temperatures.
- Shorelines are also protected from undermining and excessive erosion by the annual draw down.
- Control of storm runoff from the beaches minimizes silting in of the ponds.

The GEIR considers a lake or pond healthy if at least 70% of the surface is free of aquatic plant growth and there is less than 30% coverage of the bottom by these plants. In the history of Wildwood, we have experienced neither plant growth in excess of the GEIR guidelines nor large-scale algal or cyanobacterial blooms that might have called for other interventions or mitigation procedures. But clearly, we cannot rule out such actions in the future as local conditions and the general climate change.

6. POND ASSESSMENT

6.1 Nutrient Levels

Just as house construction requires a number of different raw materials, a living cell needs various components to build itself - that is to say - to grow and divide. For organisms these components are called nutrients. If nails become unavailable, a house construction project comes to a halt, and in the same way limiting the availability of nutrients restricts the proliferation of living organisms.

In lake and pond water of North America, phosphorus is usually the nutrient in shortest supply. Nitrogen is the second most critical nutrient. Phosphorus is needed to make “stuff-of-life” molecules such as DNA, RNA, and phospholipids whereas nitrogen is part of proteins and also DNA and RNA. Clearly, minimizing the input of various forms of phosphorus and nitrogen into our watersheds will limit the growth of plants and phytoplankton and thus be in our best interest because all of us would say that we want to enjoy a pond with clear water free of algal blooms and one not choked with aquatic plants. [Again, expectations must be realistic; a pond is not a swimming pool and anything less than 30% coverage of a pond surface by native aquatic plants is considered normal.]

In light of these considerations, the PPC tests the pond water for the levels of the following key nutrients at intervals during the year:

- Total phosphorus
- Ortho phosphorus
- Ammonia
- Nitrate
- Total Kjeldahl Nitrogen

The free phosphate (PO_4^{3-} measured at ortho phosphorus), ammonium (NH_4^+), and nitrate (NO_3^-) ions are the forms that are readily available to plants and algae as nutrients, whereas the “bound” forms found in organic molecules are the forms that have already been used to build biomolecules. Thus, total phosphorus includes free mineral phosphate ions (PO_4^{3-}) as well as phosphate esters that are part of molecules comprising the stuff-of-life. Nitrogen ions come in different flavors: ammonium, nitrate, and nitrite (NO_2^-). Each can be measured independently. For assessment of nitrogen bound up as part of organic molecules, a degradative chemical procedure developed by a Dane named Johan Kjeldahl is used to liberate the nitrogen bound as amines. The “total nitrogen said to be measured by the Kjeldahl procedure includes free ammonium as well as the amine nitrogen liberated degradatively. In 2014 we discontinued nitrite (NO_2^-) determinations with the concurrence of our consultant, Ken Wagner who finds this measurement of little relevance in ponds such as ours.

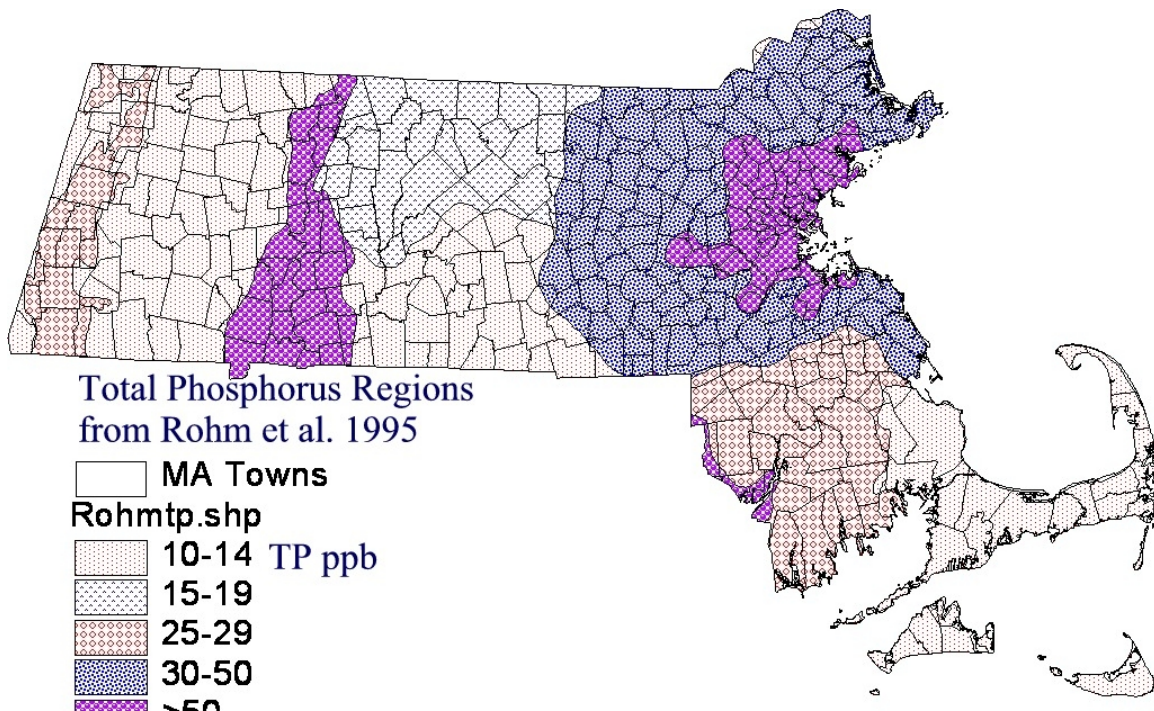
To assess the nutrient status of our ponds, it is important to take the first-of-the-season water samples early before CP has stratified into a warm and cold layer (thermocline; OP is too shallow to stratify). In this way samples truly

representative of each water body can be obtained. After the thermocline has formed we may expect that nutrient levels will increase in the deepest parts of CP owing largely to action of anaerobic bacteria decomposing the organic debris there. Once the cold weather arrives again, the thermocline dissipates and those nutrients will distribute throughout the water column. A late season sample could be an early warning for the next season, though some of the nutrients will be washed out with the drawdown. Occasionally samples are taken at the inlets to CP as a check that nutrients are not entering via those routes, for example through a septic system failure at a non-lakefront property.

Analyses of the nutrient levels are conducted by commercial water-testing laboratories: from 1997 to 2012 the samples were processed by Berkshire EnviroLabs of Lee, MA, and since 2013, the work is done by Premier Laboratory Inc. of Dayville CT with offices in Lee MA. Premier Laboratories are now a subsidiary of Microbac Laboratories.

According to the GEIR, when levels of total phosphorus are in the range of 0.010-0.020 mg/L and total nitrogen levels are at or below 0.300 mg/L, the likelihood of an algal bloom is small. Phosphorus levels of 0.050 mg/L or more virtually assure problematic algal and plant growth. Appendix 4 presents a summary of nutrient testing results obtained for CP (tab for Station B) and OP (tab for Station C) since 1997. In general there has been less variation in the phosphorus results than in the nitrogen results. CP as routinely had total phosphorus readings of 0.030 or less, with ortho phosphorus readings at or near the detection level of the assay (a single spike for both recorded on August 7, 2009). None of CP's inlets appears to represent a point source of phosphorus influx. These results have been accompanied by total Kjeldahl nitrogen readings at or near 0.300 mg/L. For OP, the story is much the same, including the total phosphorus spike on Aug. 7, 2009. When we changed to Premier Laboratory, it was a concern that they initially gave the lower detection limit for their Kjeldahl nitrogen assay procedure as 0.500 mg/L, meaning we would not know if total nitrogen levels were on the rise until they exceeded the detection limit. However as of 2015, the procedure was apparently modified to allow a detection limit of 0.100 mg/L, and now we can see where we are with respect to the important 0.300 mg/L level.

Overall as a community, we are fortunate (a) to have acceptable nutrient levels in the ponds, levels that have remained stable over the years, and (b) to be located in a region of Massachusetts where phosphorus levels are generally in the 10 to 14 ppb (0.010 to 0.014 mg/L) range (see Map on next page).



Regions of Massachusetts based on typical phosphorus levels in lakes.

6.2 Physical Qualities

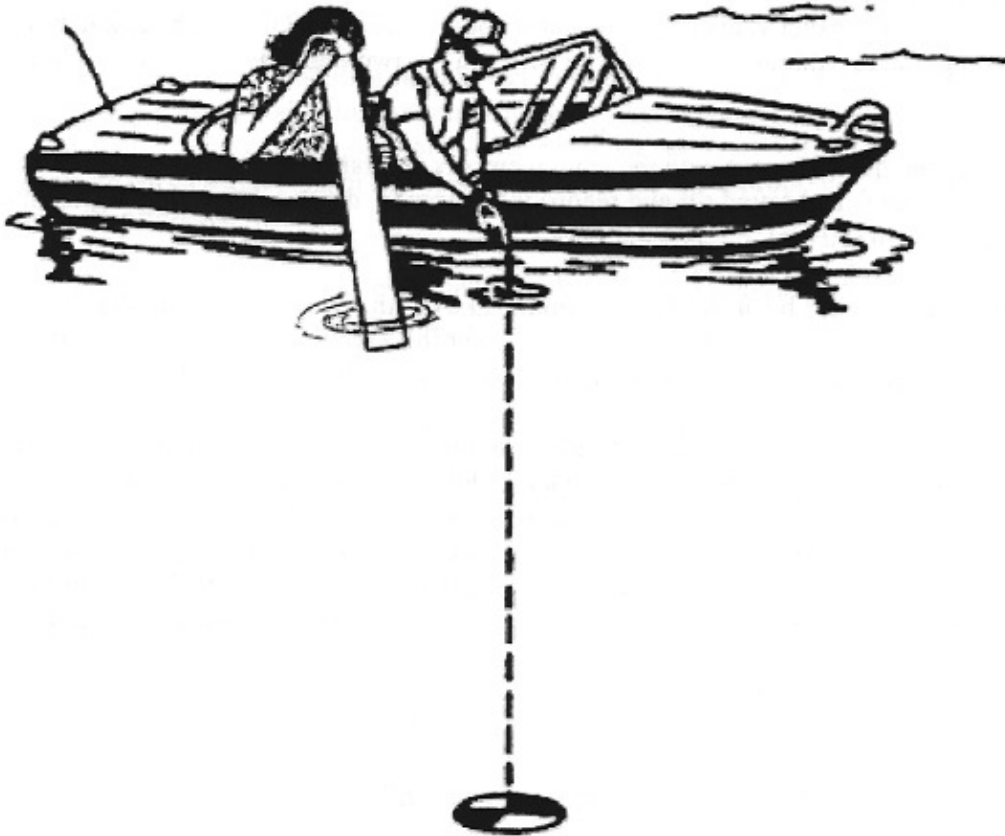
6.2.1 Clarity

Water clarity is routinely assessed by means of a Secchi disk, a black-and-white, sectored, metal disk that is lowered into the water on a non-stretchable surveyor's tape measure. The progress of the disk's descent is followed visually through a viewscope to minimize water surface reflection; a viewscope is a tube of opaque material with a glass or Plexiglas cap on the end that is inserted into the water. The depth at which the disk disappears from view provides the index of water clarity. The water column is most clear (Secchi depths the greatest) at the beginning and at the end of a season and least clear mid-season reflecting the warm-weather rise and fall of populations of phytoplankton and cyanobacteria. Since the rise of these populations is nutrient-dependent, Secchi measurements provide a *rapid* and *inexpensive* means of assessing nutrient availability in the ponds. The caveat, however, is that during windy or stormy periods, sediments may be disturbed affecting water clarity and thus Secchi measurements.

Secchi measurements are most consistent when done by the same volunteer and following a standard routine. Viewscopes are better than sunglasses or polarized lenses for minimizing the influence of glare. Various sources recommend that readings be made between 10AM-4PM, 10AM-2PM, or 9AM-3PM.

Secchi readings for CP and OP since 1997 are presented in Appendix 5. Very clear lakes can have Secchi readings of 32 ft whereas lakes with poor clarity yield readings of only 3 ft. On such a scale of Excellent to Poor, CP's readings, generally near 10-12 ft in mid-season, would be considered Good. For OP the measurements are less meaningful since at most times the disk is visible resting on the bottom at about 10 ft. There are years when the reading has decreased to approximately 7 ft in August. Alarming in 2014 the August reading was only 4 ft 6 inches. In 2015 OP was back to normal clarity. It is interesting to note that in the spring of 2014, a beaver took up residence in the pond. The same was true in 1997, but the clarity was fairly good in that year.

TAKING A SECCHI DISK MEASUREMENT



A Secchi Disk measurement aided by a viewscope.

6.2.2 Temperature, Dissolved Oxygen and the CP Thermocline

The temperature of pond water at the surface should approximate the prevailing air temperature. And that is exactly what the temperature data for CP and OP presented in both Appendix 5 and Appendix 6 indicate. With the data in Appendix 6, it can be seen that the wintertime water temperature at the bottom of each pond is the same as the temperature at its surface (no thermocline). For OP this situation persists throughout the summer. However for CP, careful measurement of temperature along with other parameters over a range of depths made in the summer of 2011 by K. Wagner (Water Resource Service) with a Hatch-Hydrolab DS5 multi-probe device showed an abrupt discontinuity of temperature. It occurred at a depth between 9.8 and 13.1 ft. Since colder water is denser than warmer water, this discontinuity indicates the presence of two non-mixing water layers in CP (a thermocline). Distinct discontinuities in pH and dissolved oxygen occurred in the same region as the temperature shift, showing that the physical conditions in the two water layers differ significantly.

The oxygen (O_2) content of water is usually expressed as percent of saturation rather than in mg/L. Usually when we think about solubility, the picture in our mind's eye is that of a solid substance such as salt or sugar being added to water. The solid disappears as it dissolves into the water until we reach the point when the water can accept no more, and the excess solid simply stays at the bottom of the container. The solution is considered saturated when no more of the substance can be dissolved. The warmer the water, the more the solid substance will dissolve in it, or to put it another way, the higher the concentration of the solid at saturation. Gases, for example O_2 , behave in a manner that runs counter to this mental image. They are actually more soluble in cold water than in warmer water; the initial bubbles we observe in boiling water are the dissolved gasses being driven out of solution. Thus, at the winter temperature of a pond (4 °C), it will take 13.11 mg of O_2 to saturate a liter of water. At a summer-time temperature of 24 °C (about 75 °F), saturation will occur at 8.42 mg/L. And at body temperature 37 °C, the O_2 content at saturation will be 6.73 mg/L. With such a range of solubility over a relatively small temperature range, oxygen content is routinely expressed as percent of saturations to give us an easy way to grasp how much O_2 is there relative to how much could be there, so that we don't have to consider the effect of temperature. Given all of this, we might expect more oxygen (in absolute terms, mg/L) at the bottom of CP where it is colder in the summer than at the surface. Yet what we find as we descend that O_2 goes from 98.6% to 97.7% of saturation from 0.65 to 9.8 ft, then to 29.6% of saturation by 13.1 ft (entering the thermocline), 2.4% at 16.4 ft, and finally 0% at 19.6 ft. [19.6 ft was at the bottom and the coldest region for this set of measurements.]

The abrupt drop in O_2 levels at 13 ft would make this and deeper depths of CP inhospitable for the fish population. The nearly total absence of O_2 at the bottom of the CP reflects very active metabolism of a bacterial population degrading the plant and other organic material there. Those bacterial species which require O_2 , utilize all of it, thereby making way for other species that can thrive in the

absence of O₂ (anaerobic bacteria). Bacterial activity is also responsible for the lower pH of the stagnant bottom layer. The significance of the thermocline for the overall behavior of the pond can be understood with reference to nutrients. Bacterial action within the denser lower layer of water converts complex organic materials to simpler nutrients in the summer. In the winter when the temperature gradient from top to bottom is eliminated, the simple nutrients (phosphate, for example) are free to mix throughout the water column especially when the pond water is mixed by spring winds. Bacterial activity in the thermocline sets the stage for the nutrients available in the water the following spring, although a portion of the nutrients will be lost during the drawdown. For this reason it is important to take the first measurement of nutrient levels relatively early in the year before the temperature of the pond rises to the level that allows growth of phytoplankton and aquatic plants. When considering the thermocline, it is important to bear in mind that it is a minor proportion of CP's water (perhaps only a third) that accounts for this deep, cold, and oxygen-poor region.

6.2.3 Conductivity, Alkalinity, and pH

Water is not a good conductor of electrical current unless there are inorganic salts dissolved in it to provide ions (charged atoms or complexes of atoms) to carry the flow of current. To put it another way, the purer the water is (that is, the lower its salinity), the greater its resistance to electrical flow. Consequently, the conductivity of water is an indication of its content of ions. Typically in North American lake and pond water, the predominant ions are calcium (Ca⁺²), magnesium (Mg⁺²), sodium, (Na⁺), potassium (K⁺), carbonate (CO₃⁻²), sulfate (SO₄⁻²), and chloride (Cl⁻).

Alkalinity of waters refers to the content (quantity and kinds) of ionic species present which collectively can shift the pH to the alkaline side of neutrality. Usually these are bicarbonates (HCO₃⁻), carbonates (CO₃⁻²), and hydroxides (OH⁻). Total alkalinity of a water sample is measured as the milliequivalents of acid necessary to neutralize a liter of water. The lower the alkalinity, the fewer milliequivalents needed and the more susceptible a waterbody would be to the effects of rain acidified by industrial pollution. Water bodies with alkalinities of 0-2 mg/L are highly sensitive to acidification. A moderate risk occurs when alkalinities are in the range of 2-10 mg/L. The risk is low with alkalinities of 10-25 mg/L and virtually absent when the values are greater than 25 mg/L.

The measure of the acidity of an aqueous solution is pH. A neutral solution has a pH of 7.0. An acid has a pH value below 7.0 and an alkali's pH is above 7.0. Natural waterbodies that are very acidic (pH values of 2.0) or very alkaline are known. Generally lakes with pH values less than 4.0 are in volcanic regions that are rich in strong mineral acids such as sulfuric acid. Those with high pH have exceedingly high concentrations of soda (Na₂CO₃). But the majority of lakes in North America have pH values between 6.0 and 9.0, though lower pH values are found in natural waters that are rich in organic matter such as bogs. In general the window for the biological world exists between pH values of about 4.5 and 9.5, but the optimal range within that window can be quite different from one

species to the next. And there are very specialized organisms that have evolved to thrive well outside the pH and temperature ranges of typical ponds.

Measurements of these parameters have occasionally been made in CP and OP. The results (see Appendix 6) show that their waters have low mineral content (<60 $\mu\text{S}/\text{cm}$) and low total alkalinity (<10 mg/L). pH measurements vary from time to time and location to location (Appendix 6, also Section 6.2.4) but are generally neutral or slightly acidic (pH 6 to 7). The mild acidity is consistent with the bog-like quality of areas of the bottom. Overall the waters are quite soft and moderately susceptible to acidification by industrial or coal-fired power plant pollution. The moderate buffering capacity (resistance to acidification) stems from the local geology.

6.2.4 Calcium

The mineral content of surface water is dictated primarily by the geology of the region. The extreme western part of Massachusetts is known for the marble quarries which provided stone for the façades of many governmental and commercial buildings throughout the state and the nation. Today, limestone remains a product of the region; an open-pit limestone facility may be seen off Route 102 when leaving Lee in the direction of Stockbridge. Marble is crystalline limestone. Given that limestone is mainly calcium carbonate (CaCO_3), it should not be surprising that the lakes and ponds of Berkshire county can have significant calcium content. Invertebrates such as mussels, snails, and crayfish can thrive in these waters because the chief mineral needed for their exoskeletons or shells is calcium carbonate. Without it, these animals would not be there. Stroll along the shore of a lake as close to Tolland as Lake Garfield in Monterey and you will see many snail shells.

In contrast, Tolland lies in a distinctly different geologic region where calcium is much less abundant. Indeed at Wildwood we have plenty of slugs but few, if any, snails. Despite this clear indication of low calcium in our ponds and because of concern regarding Zebra Mussels (*Dreissena polymorpha*), a non-native invasive species of mussel discovered in Laurel Lake (in the high calcium Berkshire region), the calcium content of CP has been assessed on several occasions with the following results:

Date	Calcium mg/L	pH
2008, May 16	3	6.74
2010, May 7	5	7.21
2010, August 27	3	6.56
2011, May 27	6	6.50

Similar results were obtained for OP. The Massachusetts DCR (Department of Conservation and Recreation) issued a fact sheet in November of 2009 regarding Zebra Mussel, which stated:

“calcium and pH are widely considered the most critical parameters in assessing the susceptibility of a waterbody to zebra mussel survival and reproduction; and low-risk waterbodies usually have pH below 7.4 and calcium below 12 mg/L.”

Our calcium levels are not high enough to support Zebra Mussels or other animals with calciferous exoskeletons or shells. This, taken with pH values that are generally on the acid side of neutrality (below pH 7.0), means that CP and OP are waterbodies with low-risk of Zebra Mussel invasion. Furthermore since geology does not vary seasonally or annually, calcium levels in CP and OP would be expected to be relatively stable; there is little need to assess calcium levels annually.

6.3 Aquatic Plants, Phytoplankton, and Cyanobacteria

6.3.1 Aquatic Plants

Descriptions and drawings or pictures of the aquatic plants of Massachusetts can be found at the following websites or in the book “Through the Looking Glass, A field Guide to Aquatic Plants” listed in Section 2.3:

<https://archive.org/details/guidetoaquaticpl00kell>

http://www.bio.brandeis.edu/fieldbio/Aquatic_Plants_Fishman_Kelly_Hankin/Pages/Homepage.html

Plants evolved to grow in the aquatic environment can be divided into those that

- grow from the bottom through the water column up to the surface (submerged),
- grow up from the bottom, through the surface, and into the air (emergent)
- display parts (leaves or bladders) that float at the surface (floating) – these can be rooted or free-floating

Rooted aquatic plants derive most of their nutrients from those present in the sediments at the bottom. To grow up from the bottom, the plant's structure must be able to withstand the weight of the water column above it. Most native species cannot withstand the hydrostatic pressure exerted by more than about 9 or 10 ft of water. With this in mind, the potential areas available for rooted aquatic plant growth in CP and OP can be appreciated from the bathymetric maps of these ponds presented in Sections 4.1 and 4.5. On the basis of the bathymetric maps of 2016, it can be estimated that 29% of the CP surface covers depths of 10 ft or less; the corresponding number for OP is 76%. Thus aquatic plants *could* populate a much greater proportion of OP than of CP. In CP the areas with depths less than 10 ft are primarily to the left of main beach extending along the western shoreline up to the pond's northern end. In OP they ring the pond.

The GEIR considers a lake or pond healthy if at least 70% of the surface is free of aquatic plant growth and there is less than 30% coverage of the bottom by

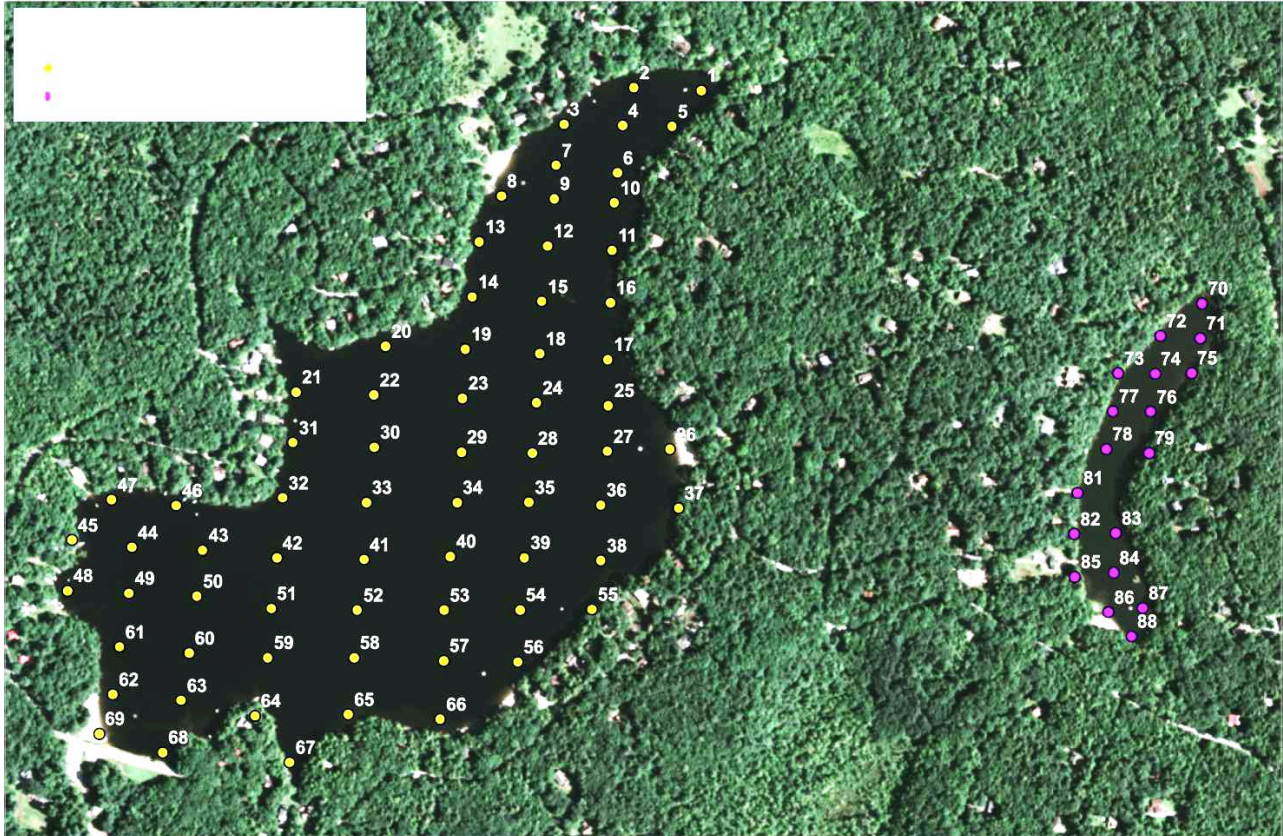
these plants. For CP, aquatic plants visible at the surface, even in the worst years, have not approached 30% surface coverage, and from the bathymetric maps even in the worst-case scenario coverage would be approximately 30%. For OP there is more at risk since its shallowness could allow more than 76% of the surface to have visible weed growth. But once again the coverage has not approached the 30% that the GEIR deems as healthy. That being said, in August of 2003, Low Watermilfoil proliferated to nuisance levels in OP and residents used garden rakes to skim the feather-boa-like plant from the surface. In 1992 the Baystate Environmental Consultants Report found that “large mono-specific stands of aquatic plants are absent” in OP. The 2003 Low Watermilfoil population has subsided, presently with only limited growth at the northern end of the pond. Now however, there are extensive and spreading stands of Watershield (*Brasenia schreberi*) to the right of and across from the swimming beach, and the species is establishing itself along the northeastern edge of the pond. In addition, Cattails (*Typha latifolia*) dominate the northern end. Clearly the plant population fluctuates more markedly in OP than in CP, and there is the present potential for substantial coverage of the OP surface specifically by the floating leaves of Watershield. For this reason a scuba diver has been employed in 2008, 2009, 2010, and 2014 to uproot and remove Watershield from OP. In the future the cost effectiveness of this approach needs to be compared with other removal modalities such as the use of glyphosate.

To become familiar with native and invasive aquatic plants, members of the Pond Preservation Committee have participated in training classes of the Massachusetts Weed Watchers, a group fostered by the Office of Water Resources: Lakes and Ponds Program within the MA Dept. of Recreation and Conservation. One such class was held in the Wildwood clubhouse. Members of the Pond Preservation Committee are on the lookout for any unusual plant growth in the ponds whenever they swim or boat in or on CP or OP and encourage members of the community to report to them any plant that appears unusual or that has not been noticed before.

On occasion, professional surveys of the plants in our ponds have been done by Water Resource Services (for summaries of the results, see Appendix 7 [Aquatic Plants tab]). The good news is that only species native to Massachusetts have been found to date. CP has a fairly diverse mix of submerged, emergent, and floating species with various types of pondweed (*Potamogeton* sp.) predominating. Between 1992 and 2011 the plant population has become more diverse, but after the severe 2013-2014 winter that diversity has diminished. For OP the predominant species has changed over the years as just discussed.

Although these surveys have not found non-native invasive plant species, it is important to understand that all that can be confidently said based upon the surveys is that populations of invasive plant species, if present in either pond, are below the detection limit of the methodology used in the study. The survey protocol does not examine every square inch of pond bottom but relies instead on examination of a statistically significant number of sites on the pond bottom and then generalizing from what is observed. In CP a grid encompassing 69

points on the bottom was considered a representative sample. The OP study examined 19 grid points. The locations of these points are shown in this map.



Satellite view of Wildwood Ponds showing locations of points examined during the aquatic plant survey conducted by Water Resource Services. Point 80 has been inadvertently omitted from Otter Pond.

To illustrate the limitations of the professional surveys, it may be noted that the latest study reports make no mention of Cattails (*Typha latifolia*) in CP, and yet they are clearly visible at several points along the shore of that pond. In addition, no reference is made to a stand of what appears to be *Phragmites australis* that is present along the CP shore a bit south of Lakeside Beach. This reed is considered an invasive in Massachusetts, although this status is controversial because archeological evidence suggests it has been in the region for centuries.

<http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/factsheet/phragmites.pdf>

(Stands of this plant are also present on land along Lakeside Drive and near the WPOA workshop.)

6.3.2 *Phytoplankton and Cyanobacteria*

Microscopic organisms in the aquatic environment include eukaryotic fungi and plankton (cells with nuclei) as well as bacteria (cells without defined nuclei). Plankton that do not require organic compounds to feed on are said to be autotrophic. They rely on sunlight for energy and carbon fixation and inorganic compounds as nutrients. In this regard, they resemble plants and consequently are called *phytoplankton*. Bacteria with similar nutritional capabilities fall into a group known as cyanobacteria (formerly referred to as blue-green algae or Cyanophyta). Typically these organisms utilize nutrients in the water column for their growth, though mats or biofilms can form on surfaces when conditions allow. Some Cyanophyta have the capacity to fix nitrogen.

Microscopic organisms cannot be seen by the naked eye unless their numbers become so great that they cause the water to become cloudy and to appear pigmented (what we would call a bloom) or they have aggregated into biofilms or mats on a rock or other surface. To examine the status of phytoplanktonic and cyanobacterial populations, a volume of water is examined in the microscope to identify and enumerate the various types present. Studies using this methodology have been done for the Wildwood ponds, and the results are presented in Appendix 7 (Algae tab and OP 2015 tab).

The variety of species found was not unusual, and the populations of these species rose and fell one year to another and also over one season. Neither pond is dominated by a species of high nuisance value. Data for the total biomass attributable to phytoplankton is summarized here:

Pond	Year	Phytoplankton Biomass ($\mu\text{g/L}$)
Cranberry	2011	1,980
	2014	2,373
	2017	670
Otter	2011	3,013
	2014	1,742
	2017	237

A biomass value less than 1,000 $\mu\text{g/L}$ is considered low and a value above 10,000 $\mu\text{g/L}$ would be very high. The values measured in our ponds fall into the moderate category. It is interesting in this connection to consider that Otter Pond usually appears cloudier than Cranberry Pond. This might be attributed to differences in the sizes of the photoplankton there because smaller particles impart more turbidity than the same weight of larger particles. Another factor in Otter Pond is that it that there are some years when animals such a beaver and otters attempt to call it a home, and the presence of a beaver correlates with more cloudy pond water even after the animal is relocated. This was observed in 2014.

Certain cyanobacteria are capable of producing toxins. Perhaps the most significant of these are the microcystins produced by most *Microcystis* strains. A

problem might occur if a bloom of this organism forms a film on the water surface and is then further concentrated by wind action to produce a local pocket of scum that would have a high local concentration of the toxin. Microcystin levels of typical pond and lake water are “below the level of detection.” But it would be prudent to avoid swimming through greenish blooms, especially if there is scum at the surface, at least until the organism that comprises the bloom is identified or the bloom is tested for cyanobacterial toxins.

There appears to be little cause for concern regarding the aquatic fungi in Wildwood’s ponds. When winds whip up the foam that occasionally collects on the swimming beaches, that foam is enriched in aquatic fungi. The fungi produce a volatile compound that imparts an “earthy” essence to the froth. [Foams that have a floral or perfume-like smell are a concern because they would likely originate from wash detergents and could be an indication of a septic failure. As such, their origin should be determined.]

6.4 Microbiological Safety

6.4.1 Wildwood’s Semi-public Bathing Beaches

Throughout its history, the PPC (under earlier names) periodically collected samples of pond water from the Association’s swimming beaches for assessment of its microbiological safety, more specifically, for evidence of fecal contamination. Assays were done for *Escherichia coli* (aka *E. coli*) a generally non-pathogenic bacterium found in large numbers in the lower gastrointestinal tract of mammals. Finding this bacterium in the water is presumptive evidence for the presence of significant pathogens, both bacterial and viral, that can inhabit the colon.

Initially members of the committee performed these assays at Wildwood, and later they were done by a commercial water-testing laboratory, Berkshire EnviroLabs of Lee MA. Testing for *E. coli* was done occasionally during the summer. With the adoption of 105 CMR 445.000 as part of Chapter VII of the Massachusetts Sanitary Code, each of Wildwood’s beaches fell into the category of a “*semi-public bathing beach*” (specified as “any bathing beach operated solely for the use of members and guests of an organization that maintains such a bathing beach”). The law required *E. coli* assays on a weekly basis during the swimming season and the reporting of the results of these assays to the local Health Department (*i.e.*, to Tolland in our case).

Because of the frequency of testing and the reporting requirements, water sampling and reporting were added to the services provided by Berkshire EnviroLabs of Lee, MA. However when this laboratory lost its standing with the state in 2012, we turned to a newly-formed company, Housatonic Basin Sampling & Testing of Lee, MA. Representatives of this firm collect the samples and file the requisite reports with the state, but the company sub-contracts the actual microbiological analyses to Premier Laboratory Inc. of Dayville, CT, now with offices in Lee MA. The swimming-water safety program is currently

administered by the WPOA Operations Manager; the Pond Preservation Committee reviews and maintains a tabulation of the results (see Fecal Coliform tab in Appendix 4).

The maximum allowable level of *E. coli* in swimming beach water is 235/100 mL. The table in the Appendix shows that our readings are generally less than a tenth of the allowable standard. Notable exceptions occurred at OP beach in September 2001 (230/100 mL) and June 2015 (517/100 mL) and at Main Beach in CP in August 2013 (210/100 mL). Happily all of these reflected transient situations with the numbers falling back into the normal range in follow-up measurements. As a result of hurricane Irene in August of 2011, the ponds at Wildwood received a tremendous amount of runoff and overflowed their banks; not surprisingly the subsequent *E. coli* numbers were abnormally high at all sampling locations. In this case too, they quickly returned to the normal range.

6.4.2 Wildwood's Transient Non-Community Public Water System

Under the terms of Massachusetts General Law Chapter 112 section 87DDDD and 310 CMR22.11B of the Massachusetts Drinking Water Regulations the WPOA is considered a Public Water Supplier because it operates four bathhouses and a clubhouse, each with well-supplied running water. Specifically we fall into the category of a *Transient Non-Community Public Water System* and have been assigned the PWS No. 1297008. The wells are identified as follows:

Well 01G	Clubhouse
Well 02G	Meadow Beach Bath House
Well 03G	Otter Pond Bath House
Well 04G	Lakeside Beach Bath House
Well 05G	Fox Den Bath House

Since 2006, the WPOA has been obligated to report annually the amount of water used from each source well and to be overseen by a licensed drinking water operator. The operator is responsible for assessing the microbiological safety of the water monthly during the months the wells are used (*i.e.*, May-Sept for Bath Houses, year-round for Clubhouse) and reporting the results to state agencies. The water is also tested for nitrate (annually) and nitrite and sodium (once every three years). At the start of this state-mandated monitoring regimen, the water was also tested for volatile organic compounds (VOCs).

Nitrate	June 2006 and each subsequent year
Nitrite	June 2006, then again in 2009, 2012, 2015, 2018, etc.
Sodium	June 2006, then again in 2009, 2012, 2015, 2018, etc.
VOCs	June 2006

Initially, Berkshire EnviroLabs of Lee, MA, was engaged as our Drinking Water Operator, but this laboratory lost its standing with the state in 2012. We now use Housatonic Basin Sampling & Testing of Lee, MA, which collects the samples and files the requisite reports with the state but sub-contracts the actual microbiological and chemical analyses to Microbac Laboratories of Dayville CT

with offices in Lee MA. The Sampling and Testing company also keeps track of the years in which the periodic tests are needed.

Though this committee, under the chairmanship of Walter Gay, was involved initially in assuring that the WPOA was in compliance with these state requirements, the program is now administered by the WPOA Operations Manager, with no involvement of the PPC.

7. PREVENTION

7.1 WPOA Rules and Policies

It would be hard to find an owner at Wildwood today who does not consider the ponds to be the major driver of the value of his/her real estate investment in the community. Preserving the natural character of Wildwood has been a priority ever since the WPOA was formed in 1966 and became the custodian of the common property in 1975.

The character of Wildwood's ponds could be altered by factors originating from within and without. Examples include nutrient loading and invasive aquatic plant species. To address these potential hazards the early officers of the WPOA and Ken Lawrence, one of the first chairmen of the Lake Management Committee (now the PPC) incorporated several principles in to the Rules of the Association. Some of those Rules now serve largely as guidance or "responsibilities" for members of the community in the updated regulations approved at the 2016 Annual Meeting.

7.1.1 Fertilizers and Pesticides

Responsibility 11 states: *"The use of all types of fertilizers is discouraged, to minimize the nutrient load in our ponds. If pesticides or herbicides need to be applied, those with the least environmental impact should be chosen so as to protect private wells and ponds."*

The rationale behind this Recommendation is straightforward. Fertilizers are plant food: they provide nutrients required for the growth of terrestrial plants as well as of aquatic plants and algae. This is true whether the fertilizers are "natural" (such as manure) or chemical (such as Miracle Grow). Typically fertilizers are characterized by three number sequence, the NPK rating, where N stands for the preparation's nitrogen content, P for its phosphorus content, and K for its potassium content. The importance of phosphorus and nitrogen as nutrients limiting the growth of plants and algae in our ponds has been discussed in Section 6.1. If fertilizers were applied to terrestrial plants (lawns and landscaping) on lots within a pond's watershed, some proportion of them would ultimately find their way into the pond itself. This is why we ask Wildwooders to avoid their use.

7.1.2 Washing Machines, Dishwashers

Responsibility 15 states: *"The use of washing machines and dishwashers should be avoided for the sake of the homeowner's septic field. When used, only non-phosphate detergents, dishwashing soaps or liquids shall be utilized, as is required by Massachusetts law."*

Initially this Responsibility (written as Rule 16) was adopted for the laudable goal of preventing the unnecessary loading of phosphorus into the watersheds of CP and OP and hence into the ponds themselves. At that time, common cleaning

detergents, like fertilizers, had high phosphorus content; automatic dishwasher detergents were the worst in this respect. The WPOA Rule made no distinction between homes within the watersheds of CP and OP and those situated outside the boundaries of these watersheds (see Sections 4.2 and 4.6).

Recently the Commonwealth of Massachusetts has enacted law that limits the amount of phosphorus in laundry detergents offered for sale in the state, making them virtually phosphorus free, and most dishwasher soap products now boast being “free of phosphorus.” But there is still a compelling reason to observe Responsibility 15 as we shall see in the discussion of septic systems that follows (Section 7.1.4).

7.1.3 WPOA Laundry

The WPOA maintains a fee-based laundry facility to encourage compliance with Responsibility 15.

Rule 35 states: *“In the interest of preserving our ponds and watershed, all residents are encouraged to utilize the laundry facility. Laundry hours are as established by the Board of Directors and posted in the Laundry.”*

7.1.4 Septic Systems

Although commercial detergents are no longer loaded with phosphorus, the relevance of Responsibility 15 has more to do with septic system function because automatic clothes washers and dishwashers can add significant water throughput to a septic system. If water is flushed through a septic system at too fast a rate, there may not be sufficient time for microbial digestion of the organic waste material, and undigested particulate material can be washed into the drainage field clogging the field. As a consequence the system may fail.

During the inception of Wildwood in the late 1960’s, the developer apparently gave little consideration to lot size as it related to the distance of waterfront dwellings from the shoreline or to the minimum area needed for the proper placement of a well and a septic system sized adequately for the dwelling. Today a typical house in Wildwood is on a small lot and still depends on a septic system that is as old as the dwelling itself. Making matters worse, many of the oldest houses at Wildwood are on waterfront lots, just where a septic failure could have immediate consequences for the ponds. Septic systems that were initially installed varied from little more than cement block-lined seepage pits to tanks serviced by drainage fields. Compared with modern “Title 5”-compliant installations, original septic systems are undersized and may not have been maintained effectively over time. In recent years several systems at Wildwood have failed, compelling homeowners to contract for remediation work that left them with bills in the “five-figure” range.

Accordingly, the justification for continuing to respect Responsibility 15 is that it is in the homeowner’s and the community’s best interest to prevent septic system failure and nutrient and microbiological contamination of the ponds that could result.

An article explaining all of this was published in the August 2014 Newsletter.

7.1.5 Watercraft

In recent times, several aquatic animal and plant species that are not native to Massachusetts have been found in the western part of the state.

Invasive Organism	Found in	When
Zebra Mussel (<i>Dreissena polymorpha</i>)	Laurel Lake Lee and Lenox	2009
Eurasian Milfoil (<i>Myriophyllum spicatum</i>)	Lake Onota Pittsfield	late 1990's
Rock Snot (<i>Didymosphenia geminate</i>)	West branch Farmington River Northwestern CT West branch of the Westfield River Chester MA	2011 2015

These organisms are problematic because they can displace native species and exert a negative impact upon the recreational use of the waters they inhabit.

These invaders are spread from one body of water to the next as hitchhikers on watercraft, boat trailers, and waterfowl. They can also be spread via fishing bait buckets and scuba diving gear.

The WPOA revised the following set of Rules in 2016 with the goal of preventing introduction of these species into our ponds via the boat route.

Rule 45. *“Boating permitted - Cranberry and Otter Ponds may be used by members of the WPOA and other persons having a right of access to these Ponds for boating in sailboats, canoes and other human-powered boats. No power driven boat other than those powered by electric motors less than five (5) horsepower are permitted on the ponds, with the exception of the WPOA work/safety boat. No guest/renter watercraft are allowed to enter the community.*

“All watercraft used on Cranberry and Otter Ponds must be registered with the WPOA, whether owned by members of the WPOA or by other persons otherwise having a right of access to Cranberry and Otter Ponds, and must have up-to-date WPOA boat stickers in plain view on the outside of both front sides of the watercraft.”

Rule 47. *“Watercraft launching and mandatory washing - Watercraft and boat trailers used outside Wildwood must be washed by the WPOA staff, by appointment only, to insure compliance with generally accepted methodologies for removal of aquatic weeds and animals before launching into WPOA pond.*

“Watercraft may never be moved from Otter Pond to Cranberry Pond, or from Cranberry Pond to Otter Pond unless such watercraft are first washed by WPOA staff.

“In addition, all trailered boats are subject to washing.

“Trailer and vehicular launching of watercraft is permitted only from the MAIN BEACH boat launching area. Watercraft which can be carried by hand may be launched by WPOA members in Good Standing from any beach or point on a shore to which such member has a right of access.

“Owners who are non-members of the WPOA, who have a right of access to use Cranberry and Otter Ponds, may use a designated right-of-way to the shoreline.”

Rule 59. “Commercial buckets of bait - Bait fish from commercial sources or from any source outside of Wildwood shall be removed from the original water and placed in a bucket of Wildwood pond water before being introduced into the ponds or surrounding areas. All water and any plant material from the original bait bucket must be disposed of in an area away from the ponds. Under no circumstances shall goldfish be used as bait, as they may be regarded as an invasive species. Leeches may not be used as bait in Wildwood ponds.”

To diminish the transport of boats into Wildwood by individuals who are neither part of the Wildwood community nor invited guests of members, the WPOA posts “greeters” at the main and back entrances to Wildwood throughout the weekends of the summer months. While coverage is not 24/7, vehicles towing boats have been turned away over the past few seasons. Whether and how to further strengthen this prevention function is an ongoing discussion at Wildwood. In a vote at the 2017 Annual Meeting, the community did not support the installation of gates at entrances to Wildwood.

The boat registration called for by Rule 45 is accomplished by the issuance to members of the Wildwood community of ID stickers that must be displayed on both sides of every boat used in our ponds. Boat registration is kept current through annual validation add-on stickers that become available when WPOA fees and dues are paid.

To ensure effective compliance with Rule 47, the WPOA has established a boat washing station next to the clubhouse where members of the WPOA maintenance staff, who have been instructed about the proper decontamination procedures, provide the washing service for boats and trailers. Washing must be scheduled through the WPOA office.

Despite these Rules and measures, waterfowl remain an uncontrollable wildcard in the spread of unwanted invasive species.

7.2 Laws of Massachusetts

The WPOA has been “ahead of the curve” with respect to enactments aimed at protecting our environment from internal and external hazards. Examples include restricting the use of washing machines for clothes and dishes that utilize detergents with high phosphorus content and encouraging washing of boats, canoes, and kayaks if they have been used outside of Wildwood. In both areas, the State has recently weighed in by enacting laws, one of which essentially eliminates phosphorus from clothes detergents sold in the state and thereby provides purveyors of dish washer detergents a marketing opportunity to follow suit and mark their product packages phosphorus-free. See Massachusetts General Laws, Part I, Title XVI, Chapter 111, Section 5R.

<https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXVI/Chapter111/Section5R>

A second recent law makes it mandatory for trailered boats to be washed at a state-certified facility before they can be launched at state run lake and reservoir access ramps. Craft that can be carried (canoes and kayaks) can easily circumvent this requirement. It is imperative that we maintain our resolve to limit watercraft access in Wildwood, to exclude craft not owned by Wildwood members, and to provide a washing service for watercraft of Wildwood residents that have been used outside our community. See Code of Massachusetts Regulations, Regulation Title 302, Section 18.

<http://www.mass.gov/eea/docs/dcr/legal/3021800.pdf>

7.3 Community Education

Members of the Wildwood community are a diverse group of people who may be used to urban, suburban or rural lifestyles. Despite these disparate backgrounds, it is likely that all were attracted to the community to some extent by the natural beauty, unspoiled condition, and tranquility of our forest and ponds. A major responsibility of the PPC is to raise community awareness about what life at Wildwood requires to ensure that our *wild wood* remains a pristine retreat from our everyday lives.

Consciousness-raising begins with the distribution of a Fact Sheet to all newcomers that is included in the Welcome Packet they receive. The latest version of this Fact Sheet is included as Appendix 8.

From time to time, articles are written for publication in the WPOA Newsletter appearing usually under the title “Our Ponds”. They attempt to explain how ponds work, how human activities can affect water quality, and what the responsibilities of life within a watershed are. Occasionally, often in the spring issue of the Newsletter, the column concerns wildlife at Wildwood. . A collection of Newsletter columns dating back to 1995 can be found in a ring binder that is kept in the clubhouse for anyone to read. A listing of the subjects of past articles is presented in Appendix 9.

Presentations to the community have been made at the WPOA Spring Meeting and the Annual Meeting. These present Wildwood members the opportunity to ask questions about issues that may be of concern to them.

A bulletin board in the vestibule of the Clubhouse is maintained with notices, articles, pictures, and brochures relating to environmental issues of concern to Wildwooders.

In previous years brochures published by various state agencies or by other organizations related to watersheds, septic systems, buffer zones, *etc.* have been made available to the community. Presently these can be accessed on-line, and the relevant links are provided.

In June 2010 a Weed Watcher Workshop was held at the clubhouse with approximately 20 in attendance.

In recent years, members of the PPC have presented materials on ecology, wildlife, and pond preservation at the annual WPOA Family Day (previously called Field Day).

7.4 Prevention by Blockade

The ponds of Wildwood can be influenced by factors not within our watersheds. Can these be managed completely by interdiction? To some extent, yes, but we must maintain realistic expectations. After all, living “Under the Dome” is a fictional TV drama.

Consider what the weather brings our way. We prepare for the potential consequences of storms and hurricanes by lowering water levels prior to the arrival of the storm and by having a spillway engineered into the design of the CP dam that provides an escape route for water that might otherwise threaten to overtop and potentially breach the dam (Section 4.3). The maximal rate that the ponds can be drawn down is set by the current Order of Conditions, and occasionally we cannot release enough water before the storm is upon us. The water release measure was not entirely successful in August 2011 when hurricane Irene delivered a tremendous amount of runoff and our ponds overflowed their banks. For other weather-related influences such as acid rain (to which we are vulnerable as discussed in Section 6.2.3), no prevention measure could be taken at the local level. Happily actions taken by the federal Environmental Protection Agency to regulate coal-fired power plant emissions that lead to acid rain have meant that this is no longer the issue it was over the last decades of the 20th century.

Exotic invasive species of plants and animals, as the phrase implies, originate outside the area that they threaten. And there are several such species that are currently a concern in Massachusetts and the surrounding states (see Section 9.2 for a listing of invasive plant species).

<http://www.mass.gov/eea/agencies/dcr/water-res-protection/lakes-and-ponds/aquatic-invasive-species.html>

Exotic species may gain access to Wildwood via watercraft and boat trailers, waterfowl, fishing bait, and fishing gear. But introduction is not enough; to lead to successful colonization, the physical and nutrient conditions must be appropriate. For example, when Zebra Mussels entered the lakes of Berkshire County, they were able to successfully establish themselves because those lakes were rich in calcium carbonate that the mussels need for the formation of their shells. [As an aside, the calcium carbonate content of those lakes makes them resistant to the effects of acid rain.] Wildwoods ponds are low in calcium, and that in combination with their pH which tends to the acid side of neutrality presents a biological barrier for the Zebra Mussel (Section 6.2.4).

Similarly, if an invasive aquatic plant would find its way into our ponds, it would need to find appropriate conditions and sufficient quantities of nutrients to prosper. We endeavor to limit the growth of aquatic plants, whether native or exotic, through our policies on fertilizers, clothes and dish washing machines and by monitoring nutrient levels in the ponds. An exotic invader would have to compete for nutrients with our native flora in order to succeed. But one reason that some exotics, are dangerously invasive is that they have evolved strategies to give them the edge in this competition. Consider the Eurasian Milfoil (*Myriophyllum spicatum*). It has three capabilities in its favor. First while most native aquatic plants cannot withstand the weight of a 10-ft water column and do not grow at a depth greater than that, the Eurasian Milfoil can grow from a rhizome bed with a 20-ft water column above it. About a third of the surface of CP covers a depth less than 10 ft, but 95% of the surface of CP would be available to the Eurasian Milfoil. With a maximal depth just over 13 ft, OP could be completely covered by this plant. But there is yet another trick up this crafty plant's sleeve. In the spring, Eurasian Milfoil's rhizomes start growing once the water warms to 60 °F, a temperature at which native aquatics are still dormant! This extended temperature range capability provides the Eurasian Milfoil with a head start in the race for sunlight, oxygen, and nutrients. But wait there is more! Even though the plant produces large numbers of seeds, most do not germinate; the spread of the plant comes about chiefly as a result of a third capability, namely, auto-fragmentation which usually occurs after flowering. The fragments released from the plant float to other areas, sink, and establish new rhizome beds. Faced with such biological cunning, our best hope is to prevent the Eurasian Milfoil from ever entering either of Wildwood's ponds.

Is this a realistic possibility given that access might be gained either by means of watercraft and boat trailers, waterfowl, fishing bait, or fishing gear? State officials have focused their attention on watercraft and their trailers as the most likely means of exotic species dissemination, claiming that the threat of waterfowl acting as vectors is remote (though, in truth, data to support this contention would be difficult to acquire). State laws (see Section 7.2) requiring the decontamination of watercraft and their trailers at state-certified wash stations when boats are moved from one body of freshwater to another have been well publicized and have raised awareness among boaters in the state. Here at Wildwood, awareness preceded the State actions; signage warning of the threat posed by invasives was posted, and boat washing stations were established, but

their use had been left largely to the discretion of the boat owner. In 2008, the washing of boats and trailers was restricted to a single station near the laundry facility, and locked gates were installed at the beach ramps that boaters might use to launch watercraft. Keys were available only to WPOA members. In 2010 with significant initiative and involvement from the Security Committee, a more forceful approach was established, requiring

- that watercraft owned by Wildwooders would be identified with annually-issued stickers,
- that watercraft and trailers owned by Wildwooders and used outside Wildwood would be subjected to a washing protocol conducted by a staff member, a protocol that is designed to remove plant fragments, and
- that watercraft and trailers not owned by Wildwooders would be denied access. This included boats owned by guests and renters.

As already mentioned in Section 7.1.5, the interdiction is enforced by greeters at our entrances. However, these personnel are on duty only on certain days of the week, only at certain times, and only in the warm months. It is up to all of us to ensure that watercraft brought into Wildwood and/or not displaying an up-to-date Wildwood boat sticker are not placed in our waters. Owners who rent their properties have a responsibility to inform their clients of this policy at the time the rental is arranged; renters should not arrive at our entrances with the expectation that watercraft that they bring can be used in CP or OP during their Wildwood vacations.

Despite the presence of greeters, the borders of Wildwood are porous, and nothing can realistically be done regarding most waterfowl. Measures to discourage the Canada Goose from choosing Wildwood as a summer home are being tried, but such measures are effective usually only for a limited time.

Fishermen have been encouraged not to empty unused live bait obtained commercially into the waters of our ponds because the sprig of greenery often provided in a bait bucket could be an unwanted colonizer ready to establish a foothold here. However, fishing gear (line, netting, flies, waders, etc.) is not often considered in connection with the spread of invasive species. In New Zealand, environmental officials facing the spread of the highly invasive freshwater alga, *Didymosphenia geminata*, known commonly as “Didymo” or “Rock Snot”, which forms thick cottony gray to brown mats on rocks in actively flowing streams and rivers, have established an inspection and certification procedure for sport-fishing gear to be used in water bodies that are not yet infested. When the PPC was co-chaired by Walter and Betsy Gay, they published an article in the August 2007 issue of the WPOA Newsletter warning that Didymo had entered Connecticut waters, and in August 2015 Massachusetts officials discovered it in the west branch of the Westfield River near Chester. Despite its proximity to Wildwood, Didymo would likely not find the still and slightly acidic waters of Wildwood ponds hospitable.

8. MEDIATION

8.1 Weed Pull

As a general rule, a lake or pond with up to 30% coverage by aquatic plants is considered normal and healthy. By this criterion, aquatic plant populations in both of our ponds are within normally accepted levels. Native aquatic plants offer fish habitat which is a good thing if angling is your passion. Since powerboats are not allowed on our ponds (except for electrically propelled ones), fowling of engine propellers or jets by the stems of aquatic plants is not an issue here at Wildwood. On the other hand, swimmers, as they move through the water can be spooked by the caresses of aquatic plants, and most people would always prefer to see few weeds when they look over a pond.

8.1.1 Cranberry Pond

During the summer, the most prominent submerged aquatic plants visible at the surface of CP are various species of *Potamogeton* or pondweed. Drawings of the plants in this group are posted on one of the bulletin boards of the Clubhouse. These plants are distributed throughout the length and breadth of the pond where water depths do not exceed 10 ft, and although coverage is generally sparse (not approaching confluent in any area of the pond), the weeds are numerous enough to inspire volunteers to manually remove plants, or large parts of them, from the pond. The hope is that by removing the cob-like fruiting stalks that emerge from the surface of the water in July, further expansion of the population next season can be slowed. Care should be taken to insure that the cobs remain intact as the plant is removed from the water. When the stems are pulled, seldom does the entire root system dislodge from the bottom muck, allowing growth from the remnants in the next season.

It is important weed pullers focus only on plants that can be removed largely intact from the water. Some species fragment easily, and disturbing them actually causes the opposite of the desired result, namely, the production of “pioneers” that can establish themselves in new areas of the pond bottom.

Signs announcing the weed pull and marking locations on the swimming beaches where the harvested weeds can be left for later pick up by our grounds keepers are posted by the Pond Preservation Committee.

8.1.2 Otter Pond

As discussed in Section 6.3.1, the risk from plant growth in OP is greater than in CP. More of the surface of OP covers depths of 10 ft or less and blooms of mono-cultures have been seen since 1992 when the pond did not have a significant stand of a single species. There was the Low Watermilfoil (*Myriophyllum humile*) proliferation to nuisance levels in 2003, and subsequently Watershield (*Brasenia schreberi*) appeared and become the dominant species in the shallows along the shore that is across from the swimming beach. The population spread around the end of the pond toward the swimming beach.

Inasmuch as the plant resembles a water lily, it can be appreciated that coverage of the pond appears much more substantial at the surface than on the bottom. The plant emerges from rhizomes that are difficult to remove from the pond bottom.

Were Wildwood in Japan, young leaves and stems of the Watershield would be in demand for the preparation of a vinegar-dressed salad. But in the absence of savvy, gastronomically-adventurous American cooks, we have hired Mr. Wayne Pierce, a scuba diver, to harvest the plants and as much of their rhizomes as possible. This was done in 2008, 2009, 2010 and 2014 with 18, 60, 5, and 10.5 hours of effort, respectively. This has brought the Watershield under control, but in the future it may be more cost-effective to utilize the herbicide glyphosate. As will be discussed later (*i.e.*, Section 9.2.1), Wildwood now plans to use glyphosate against *Phragmites* and cattails under the terms of NOI/OOC (DEP File) 306-0079. The possibility of treating Watershield in Otter Pond is a feature of that NOI/OOC.

8.2 Drawdown

The following is a discussion of drawdown from the MA GEIR – Practical Guide:

“Drawdown is a process whereby the water level is lowered by gravity, pumping or siphoning and held at that reduced level for some period of time, typically several months and usually over the winter. Drawdown can provide control of plant species that overwinter in a vegetative state, and oxidation of sediments may result in lower nutrient levels with adequate flushing.

“Several factors affect the success of drawdown with respect to plant control. While drying of plants during drawdowns may provide some control, the additional impact of freezing is substantial, making drawdown a more effective strategy during late fall and winter. However, a mild winter or one with early and persistent snow may not provide the necessary level of drying and freezing. The presence of high levels of groundwater seepage into the lake may mitigate or negate destructive effects on target submerged species by keeping the area moist and unfrozen. The presence of extensive seed beds may result in rapid re-establishment of previously occurring plant species, some of which may be undesirable. Re-colonization from nearby areas may be rapid, and the response of macrophyte species to drawdown is quite variable.”

The drawdown of CP has been conducted on an annual basis. One purpose is to mitigate the proliferation of perennial plants that do not propagate via seeds (*e.g.*, milfoil and fanwort) by exposing them to freezing temperatures. As pointed out in the GEIR text, little effect is expected on pondweed since it is a perennial that drops seeds and can grow in areas normally deeper than those exposed by the drawdown.

A second but perhaps equally important effect of the drawdown is to protect the shoreline of CP from undue erosion. When ice expands, it would push against the shoreline of CP if all the pond's water were left in place as freezing temperatures enveloped Wildwood. Such an expansion would tend to loosen the ground at the shoreline. In the spring, as the ice turns back to liquid and the water is driven by the winds, the loosened soil can be washed into the deeper parts of the pond and deposited as silt. Shoreline trees with their root systems destabilized in this way, lean toward the pond and over several seasons may topple into the water. Trees showing this evidence of shoreline erosion can already be seen at many points along the shores of CP, and every waterfront owner, unless he or she has a lot on a rock ledge, has noted that the shore of the lot is diminishing over time. Drawdown minimized wintertime damage to the shoreline by allowing the ice expansion to take place at some distance from the normal shore. In this case, the effect of the wintertime expansion of the ice is sensed as a sudden drop of a foot or so in the bottom when we waded out into the pond the next season. Thus, even though all benefits of a drawdown for management of aquatic plants are usually realized by the first major freeze, we generally do not allow refilling of the pond until spring.

Some animals overwinter buried in the bottom a pond or lake. Although pond bottom is exposed to freezing as a result of drawdown, frogs and turtles simply move as the water recedes and are not put at risk from drawdown. On the other hand, mussels cannot move as the water subsides, but since our ponds cannot support shellfish of any kind, our actions do not endanger the animal biota.

All mediation activities including weed pulls and drawdowns are governed by a Order of Conditions that is issued by the Tolland Conservation Commission in response to the filing of a Notice of Intent with the DEP. Further information on this subject will be presented in Section 8.4.

Generally our Order of Conditions provides drawdown guidelines such as these:

- Commence drawdown after the beginning of November
- Achieve target water level by the beginning of December
- Limit the CP drawdown rate to less than 3 inches per day
- Keep outflow during drawdown below 4 csm (cubic feet per second per square mile of watershed)
- Keep outflow during the refilling phase above 0.5 csm
- Achieve full lake/pond by the beginning of April

Drawdowns of WPOA ponds are not mandatory under our NOI, but if done, their magnitude is limited only by a sanctioned maximum. As noted in Section 4.7, damage to the old dam at OP prevented removal of its weir boards and thus the drawdown of OP for many years. However, gate valve of the new dam is fully functional, and 2-foot (maximal) drawdown of OP is now a part of its yearly cycle. Even in years of drought, OP has filled to capacity in the spring. These drawdowns appear to be limiting the proliferation of OP's Watershield (*Brasenia schreberi*).

The maximal drawdown of CP is 6 feet, and to accurately achieve this a marker was placed in the cofferdam during its last repair allowing the staff easily to see when the dam valve needs to be closed. But in a year of drought, the pond may not be able to refill to capacity in the spring following an autumnal 6-foot drawdown; this was the situation in 2015-16. A 4.5-foot drawdown of the pond's level is low enough so that the posts supporting most docks are out of the water and the summer shoreline should be protected from ice damage. Of course, a return to normal precipitation levels during such a limited drawdown may necessitate additional release of water during the late winter and early spring, something that has not been necessary following full 6-foot drawdowns.

8.3 Beach Erosion

The WPOA replenishes the swimming beaches with sand in the spring, and over time this sand is washed into the ponds by bathers, the wind, and storm runoff. Since we wish to minimize sedimentation, the Pond Preservation Committee has partnered with the Property Management Committee to implement landscaping measures to control storm runoff from the beaches. Past examples include:

- Main Beach – install curbing and plant buffering to minimize runoff impact in a high traffic location
- Meadow Beach – runoff diversion to prevent beach erosion
- Lakeside Beach – runoff diversion to prevent beach erosion

8.4 Notice of Intent / Order of Conditions

To protect the Commonwealth's wetland resources, the Massachusetts Wetlands Protection Act (General Law Chapter 131, Section 40) prohibits the removal, dredging, filling, or altering of wetlands without a permit.

<https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXIX/Chapter131/Section40>

“Altering” is a broad term but has been interpreted to include pond maintenance and management activities that are customary at Wildwood such as drawdown, weed pull, and dock construction as well as major activities such as dam repair.

The first step in obtaining a permit is filing a “Notice of Intent” (NOI) with the MA Dept. of Environmental Protection (DEP) and the Tolland Conservation Commission. The forms for this come in two flavors depending on the scope of the project for which permission is sought (WPA Form 3 and WPA Form 4). Both need to provide the DEP and Conservation Commission with a complete and accurate description of the:

- site: including the type and boundaries of resource areas under the Wetlands Protection Act, and
- proposed work: including all measures and designs proposed to meet the performance standards described in the Wetlands Protection Act Regulations, 310 Code of Massachusetts Regulations (CMR) 10.00.

<http://www.mass.gov/eea/docs/dep/service/regulations/310cmr10a.pdf>

Filing an NOI includes an application fee. A WPA Form 3 application is need for large projects (such as dam repairs and drawdowns) whereas a WPA Form 4 is considered an abbreviated application intended to simplify filing requirements for projects. Form 4 is appropriate for projects that are likely to result in limited impacts to wetland resource areas. The form may be used when:

- the proposed work is within the Buffer Zone as defined in 310 CMR 10.04; and
- the proposed work will disturb less than 1,000 square feet of surface area within the Buffer Zone and/or Land Subject to Flooding, provided the work conforms to the requirements of 310 CMR 10.58(4)(c)2.a. pertaining to analysis of alternatives; and neither a Department of Army permit nor a Chapter 91 Waterways license from the Department is required

The issuing authority may require may require the certification by a registered professional engineer when the complexity of the project warrants such certification. Examples would include instances when hydraulic and hydrologic calculations, critical elevations and inverts, or drawings for water control structures (such as head walls, dams, and retention areas) are needed. Other professional certifications may also be requested: architect, landscape architect, land surveyor, sanitarian, biologist, environmental scientist, geologist, or hydrologist.

A successful NOI will:

- properly characterize the resources involved,
- clearly identify the problems,
- demonstrate consideration of options,
- provide an evaluation of non-target impacts,
- show how interests of the Wetlands Protection Act are affected,
- provide and appropriate monitoring program,
- list follow-up and contingency actions,
- explain how other permitting processes apply, and
- identify who will be responsible for what actions.

Following a favorable review of the application, the Tolland Conservation Commission issues an “Order of Conditions” which specifies how certain aspects of the project are to be done and what mitigation measures need to be taken. The work may proceed when these caveats are taken into account.

Currently the WPOA has a multi-year “Order of Conditions” that permits all of the annual activities that we routinely do to maintain our ponds (drawdown, weed pull, *etc.*). The DEP File Number is 306-0031. It will cover us until July 2022.

9. CHALLENGES AND FUTURE ACTIONS

To reiterate points made in Sections 1 and 3 of this document, a lake or pond is not forever. Mother Nature wants a pond to become a meadow. So over the long haul (geologic time), the goal implied by the name of the Pond Preservation Committee is a pipe dream. Mother Nature will win in the end; she always does. The effort of the PPC proceeds on a different time scale: it is directed at slowing the aging process of CP and of OP so that these ponds will remain the aesthetic and recreational jewels of our community, at least for this generation of property owners and potentially the next.

We have seen that there are many factors that can exert a negative influence upon the quality of the ponds we enjoy. Many of them stem from our presence in the watershed and our own household activities. Mitigation of these is entirely within the community's control, and the Pond Preservation Committee has endeavored to raise the awareness of the Wildwood homeowners in respect of these.

As stewards of our ponds, the PCC monitors the ponds and encourages the WPOA Board to undertake actions (such as the annual drawdown) intended to prevent undesirable condition from arising.

Some negative influences are more regional and even global and therefore are beyond our direct control. Acid rain, drought, hurricanes, and climate change are some examples. It is safe to say that nature is constantly in flux and our environment is changing, but it would be naïve to think we can predict the specific challenges that lay ahead for us at Wildwood.

Nevertheless, a general approach may be outlined for the elimination (or at least mediation) of a future challenge:

- through awareness and monitoring by the PPC and community members or by the involvement of professional consultants, a developing threat will be defined and its relative importance for the community evaluated,
- for a significant challenge, an action plan will be developed to meet it based partly on the expertise of PPC members, possibly with the involvement of other Wildwood Committees, and, when necessary, with input from professional lake management firms or state agencies,
- the WPOA Board will be advised of the issue, and the release of funds to implement the action plan will be sought,
- the PPC will assist the Board in the preparation of a Notice of Intent to cover the work specified by the action plan, and
- the PPC will help to identify the entity that will conduct the prevention or mediation effort.

To illustrate, we will now discuss several issues that may require consideration and action in the near future or over the next decade.

9.1 Proliferation of Algae

There have not been large-scale algal blooms in either pond, even in drought years when the ponds were below capacity, conditions that might tend to concentrate nutrients. Nevertheless, we have observed very localized blooms in at least two recent summers off the shore of a property immediately adjacent to Meadow beach in CP. A homeowner reported that the bloom occurred above an area of pond bottom that was uncharacteristically white and the site of upwelling of very cold water and bubbles. Investigation by members of the PPC showed that the nitrogen content of the water in that vicinity was elevated and likely supporting the proliferation of the microscopic green algae comprising the bloom. [Green algae prefer high nitrogen to phosphorus ratios whereas blue-greens, a.k.a. cyanobacteria, may fix nitrogen and thrive at low N:P ratios.] Because fecal coliform counts were not markedly elevated in the area of nitrogen elevation and considering the temperature of the water, it seemed most likely that the site represented a spring upwelling rather than seepage from a septic field.

Normally microscopic algae are present throughout the water column where they can diminish the clarity of the water somewhat. When their growth is excessive, their numbers are so high as to make the water appear green and cloudy - what we call a bloom. The fact that the bloom under discussion was highly localized, means that the input of nitrogen was sufficient to support only a limited number of cells in a restricted area. If that amount of nitrogen were distributed to a larger volume of water, it would still support the growth of algal cells, but their number would be distributed throughout a larger volume. Being less crowded, the cells would no longer be seen as a bloom.

If a localized bloom appears again in this area of CP, it would seem that a remedy to this influx of nitrogen pollution would be dilution. By distributing the incoming but finite amount of nitrogen into a larger volume of water, algae would still utilize it for growth but they would not achieve a population density high enough to appear as a bloom. Devices for moving water directionally in a pond are commercially available and could be useful in addressing this phenomenon. But because they can erode the bottom if placed too close to it, their use may require permitting.

<http://www.aquaticbiologists.com/aeration>

We will need to monitor the inflow of nitrogen in this part of CP as it has the potential to become more generalized and thus more problematic.

Sections 7.1.5 and 7.4 drew attention to an invasive species of alga named *Didymosphenia geminate* which has been found in the west branch of the Farmington River in northwestern CT as well as the west branch of the Westfield River in Chester MA. This alga bears the nickname "Rock Snot" because it can form thick mats of brown muck on submerged rocks and tree limbs. It seems to prefer a habitat of cold running water, so the warmer calm waters of Wildwood

Ponds would seem inhospitable. Nevertheless, being attentive for reports of Didymo's spread to Massachusetts lakes and continued surveillance of our own ponds seems prudent.

9.2 Invasive Aquatic Plants

The list of invasive aquatic plants in Massachusetts includes:

- Variable Milfoil (*Myriophyllum heterophyllum*),
- Eurasian Milfoil (*Myriophyllum spicatum*),
- Fanwort (*Cabomba caroliniana*),
- South American Waterweed (*Egeria densa*),
- Curly-leaved Pondweed (*Potamogeton crispus*),
- European Naiad (*Najas minor*),
- Water Chestnut (*Trapa natans*),
- Common Reed (*Phragmites australis*), and
- Hydrilla (*Hydrilla verticillata*),

The watch list includes:

- Parrot Feather (*Myriophyllum aquaticum*)
- Yellow Floating Heart (*Nymphoides peltata*)
- Swollen Bladderwort (*Utricularia inflata*)

Among these, Eurasian Milfoil probably poses the most sobering challenge because of the three competitive biological capabilities it possesses as detailed in Section 7.4. It has the potential to foul virtually all of OP and a large part of CP, and do so rapidly. While our boating rules concerning decontamination and registration and our summer greeter program are important steps toward the exclusion of this and other invasive plants, Wildwood is not under a dome. From the point of view of a hitchhiking invasive, the main and back entrances are not the only ports of entry. For example, propagating nuts of the Water Chestnut can be attached to the feathers of waterfowl and carried as the birds fly from one body of water to another. It would be unrealistic to think that no invasive aquatic will find its way to Wildwood's waters and take up residence at some point in the future.

Indeed, the Common Reed (*Phragmites australis*), which has been considered by some a wetland invasive like Purple Loosestrife (*Lythrum salicaria*), is present in Wildwood. There are large stands of *Phragmites* along the road to the maintenance garage and on Owls Nest and small pioneer groups along Wildwood's portion of Beetle Road. More troubling are the medium sized stands growing *in the water* of CP just off the shore of 79 Lakeside and 393 Beetle.

Since *Phragmites* is an emergent plant that can produce tall stocks, spread from this colony could produce screens that effectively block views of the pond from the shore. But beyond the aesthetic consideration, thick stands can retain silt and organic matter and as a consequence accelerate pond eutrophication.

Phragmites rhizomes (underground roots) can extend down over 6.5 ft to reach deep ground water, and rhizomes often form dense mats on the earth's surface that deter other plants from becoming established. Manual removal of the rhizomes is a daunting and usually unsuccessful task. For this reason, we will pursue the possibility of placing benthic barriers over the aquatic *Phragmites* stands with the Tolland Conservation Commission by filing an RDA. Generally the DEP endorses the issuance of a Negative Determination of Applicability when manual harvesting or benthic barrier projects are conducted in accordance with the management techniques as given in the DRC document: Standard Operating Procedures: Using Hand Pulling and Benthic Barriers to Control Pioneer Populations of Non-Native Aquatic Species.

<http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/sop2007.pdf>

Thus, use of benthic barriers should not require the preparation, submission, and approval of a full NOI. The barriers would be deployed early in the spring before or just as new growth emerges from the pond bottom. A commercial product called a Lake Bottom Blanket is a non-porous membrane with gas release ports and sleeves for re-bar rods to provide the weight. It is durable and may be re-used; a variety of sizes are available, e.g., 10'x20' @ \$145, 10'x25' @ \$170, 10'x30' @ \$205, all the way to 10'x80' @ \$545, in five foot increments. The re-bar is sourced locally to save on shipping charges.

<http://lakebottomblanket.com>

It has the recommendation of Ken Wagner and has been used successfully against *Phragmites* in Otis Reservoir.

<https://www.slideshare.net/issuesc/lake-bottom-blanket-otis-reservoir>

9.2.1 *Phragmites*: a case study

In 2017, after the Tolland Conservation Commission verified that an NOI would not be required for use of benthic barriers (*i.e.*, it returned a negative determination for the RDA we filed), the WPOA Board of Directors approved the purchase of four benthic barriers. They were deployed early in 2018 at the two major sites of *Phragmites* growth in CP: off the shore of 79 Lakeside and 393 Beetle. The barriers were kept in place for the entire summer season and suppressed the growth of most of the *Phragmites* reeds that had been seen during the previous season. However, break through growth occurred along the peripheries of the mats and at points where the blankets overlapped. During that summer, members of the PPC and WPOA staff members carefully surveyed both ponds and property throughout Wildwood to identify the locations of other pioneer aquatic and terrestrial *Phragmites* stands. Seven aquatic stands were noted in CP (including the two under the benthic barriers). None appeared in OP, and nine terrestrial sites were identified, the major one being the very large

stand along the side of the WPOA maintenance shed. Clearly Wildwood was in the early stage of a significant *Phragmites* threat that, in the opinion of the Pond Preservation Committee, was best managed by means of the foliar systemic herbicide, glyphosate. This agent has a proven track record against *Phragmites* and its rhizomes. Of all the agents available, glyphosate is the safest and is readily biodegradable. It is targeted to enzymatic machinery that makes certain amino acids in the plant, machinery that is absent in humans and mammals. It is not toxic for fish, birds, or amphibians. It is approved for use in reservoirs and does not bio-concentrate. Commercial products formulated for use in fresh water (e.g., Rodeo, AquaPro) are available. Information on glyphosate provided by the Nature Conservancy can be found at this WEB site:

<http://www.invasive.org/gist/products/handbook/14.Glyphosate.pdf>

Furthermore, in January of 2015, the Tolland Conservation Commission had approved an NOI allowing the use of glyphosate for the control of *Phragmites* in Otis Reservoir.

There was precedent for the use of herbicides on terrestrial plants at Wildwood. On more than one occasion, the WPOA has contracted for spraying to control the growth of poison ivy along roadways.

After gaining the support of the Board of Directors late in 2017 for this approach to *Phragmites* management throughout Wildwood, the Pond Preservation Committee identified and contacted two Massachusetts companies licensed to make glyphosate applications in aquatic environments and then embarked on a year-long effort in 2018 to educate the community membership about glyphosate, since herbicide treatment of aquatic plants had never before been done and disquieting news stories were beginning to appear about glyphosate safety. The informational efforts included:

- A review of the scientific literature on glyphosate,
- The preparation of an article on the *Phragmites* threat for the 2018 spring newsletter,
- A presentation at the Spring Membership Meeting on the *Phragmites* threat, the properties of an “ideal” herbicide, and a comparison of glyphosate to the “ideal” herbicide.
- The preparation of fact sheets on *Phragmites* and glyphosate for distribution by the District Representatives at district Meetings,
- The inclusion of an Annual Report detailing the problem and the recommended approach,
- The convening of an open forum to address questions and concerns about glyphosate on the day before the Annual Meeting. (This forum was heavily attended, lasted for just under 2 hours, and covered virtually all aspects of the issue.)

At the 2018 Annual Meeting a proposal to use \$4,500 and up to \$8050 from various Reserve Funds for the eradication of *Phragmites* and the control of cattails in Wildwood through the use of glyphosate passed overwhelmingly, with 124 votes in favor and 11 against. The \$4,500 was to be taken from the NOI

Reserve and the \$8050 would come from the Cranberry and Otter Pond Preservation Reserves. The expenditure of up to \$8050 would occur over three years and begin in the fall of 2019. These amounts were based on budgets submitted by Solitude Lake Management (the only of the two companies that had made a site visit and had presented the Board with firm cost estimates for the project).

In view of this vote, Solitude Lake Management was engaged to prepare and submit the requisite NOI (covering not only *Phragmites* but also Cattails and potentially Water Shield and including two alternate herbicides should glyphosate be removed from the market). Licensed applicators from Solitude would perform the glyphosate treatments. On March 28, 2019, the Tolland Conservation Commission met to consider the NOI (DEP File 306-0079). Presentation was made by Josh Perry from Solitude and PPC members participated in the subsequent discussion. The NOI was accepted and an Order of Conditions was issued that included the requirement to restrict swimming in both ponds for 1 week following glyphosate use on the aquatic plants. This requirement was considered an abundance of caution by the TCC in that Solitude's usual recommendation is a 1 day restriction, and the product label does not call for any restriction.

Glyphosate application to eradicate aquatic and terrestrial *Phragmites* in Wildwood and to control the encroachment of cattails on waterfront lots in both ponds is planned for the fall of 2019 and, if needed, to be repeated in the fall of 2020 and again in 2021.

The Solitude employee making the glyphosate applications to terrestrial stands of the target plants will need permission to enter onto private lots and may need such permission for the aquatic shoreline plants as well (if these are not be approached by boat). Consequently, an Access Agreement has been circulated among the 29 lot-owners affected. By affixing his/her signature, the lot-owner will grant Solitude access and will also agree to hold Wildwood harmless for the service being provided.

9.3 Invasive Aquatic Animals

Though there has been much attention given to the Zebra Mussel in western Massachusetts, the organism should pose no concern to us at Wildwood for the reasons presented in Section 6.2.4.

9.4 Native Aquatic Animals

9.4.1 Mammals

From time to time, beavers and otters attempt to take up residence in our ponds. For CP the impact of beavers is usually noted in a limited area, with the harvesting of a few trees near the shore and the positioning of cut branches,

sometime under a dock, as a prelude to construction of a full-scale lodge. In OP their impact is greater. Beavers succeeded in building a lodge on at least two occasions: in 1997 abutting the large rock opposite the swimming beach and again in 2014 in the stand of cattail at the northern end of the pond. They also made attempts to block the outflow of water at the OP dam. We have noted that in the warm seasons following the springtime arrival of a beaver, the water in OP is discernably less clear. This was the case in 2014 but less so in 1997. Indeed the smallest Secchi depth seen in OP since measurements began in 1997 was noted in 2014. The lack of water clarity persisted well after the animals were relocated.

In addition to this consequence, the possibility exists that these native animals harbor *Giardia lamblia*, a microscopic parasite that causes the diarrheal illness known as giardiasis. The parasite is spread in the feces of infected animals and transmitted to humans via recreational water. Generally the main symptom is diarrhea, persisting for up to 2 weeks. Happily effective therapies are available. Water can be tested for the presence of *Giardia* but the test is elaborate and costly and therefore not done routinely. More information on this parasite can be found online:

<http://www.cdc.gov/parasites/giardia/general-info.html>

An oddly tidy pile of bones and fins on a rock at the shoreline can mark the site where an otter feasted on a fish. Such evidence may be observed long before otter, usually a family of otters, is/are actually sighted. Although Wildwood's fishermen may not appreciate the competition from the otters, usually no attempts are made to trap and remove these animals. Beaver, on the other hand, are trapped and relocated; a licensed trapper must be contracted for this purpose. Now that there is a reproducing population of yellow perch in OP, we may expect that the pond will host otter families more frequently. This could result in the need to restock the pond from time to time with yellow perch.

9.4.2 Fish Diversity

Recreational use of OP has fallen off over the past two years because of the pond's leech population. To keep leeches away from the area of the swimming beach during the summer, salt blocks are added periodically to the water in this part of OP. But salt is not toxic for leeches, and there are no pesticide products that are selective for leeches. These organisms remain a problem throughout the pond.

Leeches succeed in OP because, for much of the year, there are few predatory fish to keep their population size in check. The fish population of OP is not diversified. It consists largely of minnows and the trout that are released in the pond by the fishing subcommittee. The trout released in the Spring are essentially fished out by the summer leaving the pond without significant leech predators until the Fall stocking.

OP has been operated as a put-and-take fishery for many years. Current fish stocking budgets do not buy as many trout as a decade ago, and the trout that

are procured are being distributed more equitably between the two ponds. One approach for leech management might be to temporarily prohibit fishing in OP for a period of time after stocking has taken place. This approach could succeed but only as long as the prohibition is in force and is heeded.

Another more permanent approach would be to diversify OP's fish population by introducing another species of fish that would feed upon the leeches and establish a population capable of overwintering and proliferating in the waters of OP: one that would not be a primary target for fishermen. Panfish (sunfish, bluegills, and the like) are not appropriate for small ponds such as OP due to their high reproductive potential. Bottom feeders such as catfish and carp cannot be considered because they would degrade the clarity of the pond water as a result of their feeding habits. Yellow perch seem to be a reasonable possibility as they would establish an over-wintering population and are known to feed avidly on leeches. The PPC contacted the Mass Division of Fisheries and Wildlife to help evaluate this approach, identify a state-approved source of yellow perch, and learn of the licensing requirements. As a result, Hickling's Fish Farm in Edmeston, NY was identified as a source, and yellow perch have been introduced into Otter Pond: 100 in the fall of 2017 and 200 in the fall of 2018.

9.5 Septic Systems

In Section 7.1.4 we have seen that most of the septic systems at Wildwood are substandard with respect to the modern-day requirements. A saving grace is that most of these systems are utilized only seasonally. Nevertheless, the PPC should continue to call attention to the importance of properly maintaining the systems because a failure, especially one taking place on a shoreline lot, could have wide implications. In the case a failure on such a lot is suspected, fecal coliform counts should be monitored in the adjacent pond water, and the WPOA President asked to notify the Tolland Health Agent. If the coliform counts exceed the limits set by the state, swimming will need to be curtailed.

http://www.tolland-ma.gov/Public_Documents/TollandMA_Selectmen/Appointed_Officials

9.6 Shoreline Erosion

The reduced water level in CP that is maintained throughout the winter prevents ice from pressing against and thereby disrupting the shoreline. Despite this, there is significant shore erosion underway along the northwest edge of the pond as evidenced by the trees leaning over the banks and water. WPOA Rule 41 makes allowance for homeowners to mitigate shoreline erosion, but few homeowners take advantage of this provision presumably because of the cost and because an NOI could be needed.

Rule 41: *"No pond shore property owner is permitted to make alterations to the shoreline of such property, including the deposit of sand, gravel or similar material at the shoreline. Appropriate measures may be taken*

at the shoreline to prevent erosion, with the approval of the Tolland Conservation Commission and the Operations Manager or designee.”

The PPC should identify an expert who could make a presentation to the community on methods, costs, and regulatory requirements for shoreline stabilization.

9.7 Forested Watersheds

Wildwood is fortunate to have watersheds for both of its ponds that are forested because forests act a buffers for the absorption and utilization of water and nutrients. These forests are populated with white pine, hemlock, and northern hardwoods such as ash, maple, and beech. However, two of these species (*viz.*, hemlocks and ash) are under threat of insect attack. It seems highly likely that they will suffer considerable declines over the next decade because no widely-applicable, effective management techniques against the offending insects are presently available. Already many of the hemlock trees at Wildwood are infested with the woolly adelgid (*Adelges tsugae*) and are undergoing a slow death. The eastward march of the Emerald Ash Borer (*Agrilus planipennis*) has reached the central Berkshires. It seems an inexorable advance that dooms all the ash trees in its path.

But perhaps the most significant threat to our forests comes from invasive plants, especially the Oriental Bittersweet vine (*Celastrus orbiculatus*). This vine is prized for its decorative qualities in autumn décor but must be recognized for the tree killer that it is. In some instances, the vine envelops a tree entirely and cuts off sunlight to the tree's leaves dooming the tree to death. For certain tree species, the grip of the vine as it winds its way around the trunk it tight enough to girdle the tree to death by cutting off sap flow. Bittersweet vine is growing in Wildwood and must be stopped. Young plants can be pulled out by their roots, but established vines need to be have a segment of their base stem cut out. The latter measure will likely need to be repeated when the vine reappears from the roots that remain undisturbed.

Burning Bush or Winged Euonymous (*Euuonymus alatus*) is another large ornamental prized by homeowners for its colorful foliage display in the fall and its decorative berries which are often incorporated into holiday wreaths. It can for thick clumps more than 6 feet high. The ingestion of the berries by birds allows for the rapid dispersal of its seeds throughout our forest land, and Burning Bush can be seen sprouting up, often as clumps, everywhere throughout Wildwood. Young shoots can be pulled up by their roots but more established plants need to be cut.

Garlic Mustard (*Alliaria petiolate*) is a smaller plant that produces characteristic cross-shaped white flowers in the spring and the odor of garlic when crushed. Currently it is growing at many terrestrial locations in Wildwood. The threat posed by this plant results from its ability to actively suppresses the growth of neighboring plants. It does this by secreting one or more chemicals that inhibit

the development of root-associated fungi that play a critical role in making soil nutrients available to the native vascular plants. In this way Garlic Mustard is able to take over habitats where the native plant species had grown.

Presently Purple Loosestrife (*Lythrum salicaria*) is seen occasionally growing on the shores of CP. This purple-flowered plant has the potential to rapidly overtake vast swaths of wetland, as can be easily appreciated while driving the highways of Massachusetts. It can readily be distinguished from other plants bearing purple blooms by its stem which is square, rather than round, in cross section. Thus, rolling the stem between one's forefinger and thumb will reveal whether the plant needs to be pulled, placed in a bag, and disposed of.

According to "A Guide to Invasive Plants in Massachusetts" by Paul Summers (2008), other plants of concern in Wildwood include Giant Cane (*Arundo donax*), the herb Narrowleaf Bittercress (*Cardamine impatiens*), the Japanese Barberry bush (*Berberis thunbergii*) (a habitat for ticks), and Coltsfoot (*Tussilago farfara*).

However despite the challenges posed by invasives, there is good news on the horizon, and it concerns the American Chestnut. Before the Europeans arrived, New England forests were lush with towering examples of these trees. The wood had qualities that made it highly sought after, and the nuts provided a reliable source of nutrition for wildlife and people alike. However, a century ago a blight caused by the fungus, *Cryphonectria parasitica*, killed the trees and still today stunts the chestnuts that sprout yearly from viable chestnut roots that the fungus cannot infect. Since 1981 The American Chestnut Foundation has been hard at work genetically crossing the blight-resistant Chinese Chestnut with the American line in the hope of developing a new line of trees with the size and shape of the American Chestnut but with the disease resistance of the Chinese tree. Massachusetts joined the project in 2000, and there are now breeding orchards in Old Sturbridge Village, Wachusett Meadow Audubon Sanctuary, the Sibley Farm in Spencer, Garden in the Woods, Gould Meadow in Stockbridge, and the Berkshire Botanical Garden. These are now providing high-quality disease-resistant hybrid seeds for seed orchards. With luck over the coming decade or two, this hybrid, which is as closely equivalent to the American Chestnut as possible, can be introduced into the forests of Wildwood.

9.8 Fiscal Planning

A future challenge to one or both of our ponds could require action where time is of the essence. Therefore, it is prudent to build reserve funds for that contingency.

Presently the WPOA Budget lists the following reserve categories for which the Pond Preservation Committee advocates:

- Notice of Intent
- Aquatic Plant Inventory
- Cranberry Pond Dam

- Otter Pond Dam
- Cranberry Pond Preservation
- Otter Pond Preservation

Current balances in these categories may be found in the Treasurer's Reports in the Members Only section of the WPOA WEB site.

Our present NOI covering pond maintenance and drawdown will carry us to July 2019. Currently we are building NOI Reserves annually at a rate that aims to having \$6,000 on hand in that year.

It is anticipated that the Aquatic Plant Inventory will continue to be conducted at three-year intervals. The last one was done in 2014 at a cost of \$4,500, and the next is planned for 2017. If these periodic inventories are to continue (2020, 2023, 2026, 2029, etc.), the reserve category should be funded annually, with the target amount to be reached in a given inventory year based upon the cost of the preceding inventory.

The OP dam was last refurbished in 2006. The latest repairs to the CP dam were completed in 2012. We might now reasonably expect a functional life of 35-40 years for these structures. Annual contributions to the CP and OP Dam reserves are now approximately \$1,000 and \$500, respectively, and should be continued.

The Reserves in the "Pond Preservation" category might be expended in a variety of ways as the needs arise. The PPC requests the yearly addition of \$1,000 to the CP fund and \$500 to the OP fund. Other committees, notably the Security Management Committee, also request additions to these Preservation Reserves.

9.9 Bureaucratic Hurdles

If an invasive plant such as the Eurasian Milfoil were found in one of our ponds, measures to eradicate it would need to be initiated immediately, and those measures would likely involve application of herbicides. The brochure, "Guidance for Aquatic Plant Management in Lakes and Ponds" from the MA DEP, indicates that the only mitigation measures that need go no higher than the local Conservation Commission for approval are manual harvesting and benthic barriers.

<http://archives.lib.state.ma.us/bitstream/handle/2452/626378/ocn976169672.pdf?sequence=1&isAllowed=y>

Before mitigation with herbicides could begin, an NOI would need to be prepared and filed for review at the state level, and the Tolland Conservation Commission would need to issue an Order of Conditions. At a minimum, this could take two months. In the meantime the threatening species would be proliferating.

In an ideal world, a "contingency" Order of Conditions would be in place before the arrival of an invasive threat so that mitigation work could begin as soon as a threat is identified. Ken Wagner of Water Resources feels that town

Conservation Commissions in Massachusetts should issue blanket contingency Orders allowing each lake or pond within their jurisdictions to be treated for invasive plant species without further review or delay. Although he told us that this idea was gaining acceptance, a call to the Massachusetts Association of Conservation Commissions failed to identify a single Conservation Commission in the state that has embraced this anticipatory approach. Presently, Conservation Commissions are simply not in the business of issuing permits for work addressing problems that do not yet exist.

10. FISHING ENHANCEMENTS

10.1 Wildwood Fisheries

WPOA members in Good Standing, their guests, and other persons with a deeded right to fish, are permitted to fish in CP and OP. Massachusetts fishing licenses are not required, but other Massachusetts Fishing Laws are applicable.

The fish population in CP is diverse and includes bass, bluegills, sunfish, yellow perch, calico bass (crappies), minnows, and an occasional pickerel in addition to trout that are stocked annually. The pond is operated as a put-and-take fishery with fishermen encouraged to release all bass and any trout not caught for food; pickerel are not to be thrown back. This practice has allowed the bass population of CP to grow over recent years, and now bass are caught on a regular basis.

The situation is quite different in OP. First, as seen from the numbers presented in Section 4.8, OP has only 5% of the volume and 9.4% of the surface area of CP. Secondly, as already discussed in Section 9.4.2, the fish population there is not diverse, consisting almost exclusively of minnows and stocked trout. As the latter are fished out, the pond is temporarily left without predators, and a leech population can proliferate. Introducing yellow perch into OP to establish a resident population of intermediate predators that can overwinter and propagate should control the leeches and provide fishing thrills for children without significantly impacting the trout fishery.

Since commercially-obtained live bait such as minnows may be supplied in containers along with non-native plant material, fishermen are encouraged (indeed required by WPOA Rule 59) not to throw unused bait (and plant material) into the ponds but to share the unused bait with other fishermen or to dispose of it on land to prevent the introduction of unwanted invasives into our ponds.

10.2 Trout Stocking

Neither pond provides the conditions (primarily water temperature) that would allow a trout population to propagate successfully, though trout can overwinter in the ponds. Consequently the ponds are stocked with trout semiannually, once in the spring and again in the fall. The WPOA secures a Massachusetts Fish Stocking Permit annually; the current fee is \$15.

Historically, stocking included brown, brook, and rainbow trout. From 2000 to 2006 the expenditure for fish stocking was fairly stable ranging from \$2,650 to \$2,985. Since then, the annual amount spent has been somewhat erratic, anywhere from \$1,500 in 2011 to \$5,377 in 2007 (see Appendix 10). In the years since 2008 when Great Brook Trout Farm in Bolton MA became our supplier, the price per pound has risen approximately 30% from \$6.50 to \$8.50. The growth in our fish stocking budget has been slightly below this pace.

In 2013 in addition to the usual brown and brook trout, *tiger* trout were introduced for the first. Tiger trout are a sterile intergeneric hybrid resulting from a cross between the roe of brown trout and milt of brook trout. The hybrid, which derives its name from its markings, is thought to grow more rapidly than either of its parents and to surpass them with respect to aggressiveness and fighting ability. That year, 336 lb of the trout (95% brown and brook, 5% tiger) were purchased; approximately two-thirds were released into CP with OP receiving the remainder.

In 2014, 275 lb of brook, brown, and rainbow trout were obtained from our usual supplier, and an additional 192 lb of trout came from the Berkshire Hatchery Foundation in Monterey, a 501c3 non-profit. A tax-deductible \$300 donation was made to the foundation. The following year, the trout were exclusively sourced from Great Brook Trout Farm once again.

Since 2017, we have been obtaining fish from Hickling's Fish Farm, Edmeston NY, because there no longer appears to be a commercial trout hatchery in the state of Massachusetts. The disadvantages of using Hinckling's include a substantial delivery fee and the necessity of obtaining an MA importation license, but the major advantage is that the farm can supply various species of fish in addition to trout, including yellow perch and fathead minnows. The delivery fee can be offset somewhat by taking only one rather than two deliveries each year.

Going forward only rainbow trout will be stocked as this species is most capable of dealing with the warm-water conditions of the ponds in Wildwood.

Given OP's smaller size (both in volume and area), it has received proportionately more than its share of trout during stocking in past years; in some years nearly 30% of the delivered trout. An effort should be made going forward to distribute the trout that the WPOA purchases more equitably between the two ponds, especially now that yellow perch have been introduced into OP to maintain year-round pressure on the leech population.

10.3 Fishermen's Exchange

An important new tool for assessing the status of Wildwood's fish populations has been established thanks to Matt Lenge: the Fishermen's Exchange is an email address where the fishermen of Wildwood can submit their experiences and have them shared with other Wildwooders.

wildwoodfishing@gmail.com

In the 2018 and 2019 seasons, for example, the fishermen began to report that most of the large-mouth bass being caught in CP were below 2.5 lb. in weight or 15 inches in length. This suggested that the bass' food supply was limiting development of trophy-sized specimens. This was addressed in two ways. In the spring of 2019, 100 lb. of fathead minnows were released into Cranberry Pond. And to make more of this food available on a per capita basis a recommendation was made to the WPOA Board of Directors to cull the bass

population by temporarily suspending the catch and release policy for bass less than 15 inches. Fishermen would be allowed to keep bass 15 inches or shorter while returning larger specimens (the best breeders) back to the pond. The Board agreed to this change as a temporary measure with the former catch-and-release policy for all bass resuming at the end of the year.

11. KEY TO APPENDICES

1. Members of the Pond Preservation Committee
2. Recent Activities of the Pond Preservation Committee
3. Professional Studies of the Ponds at Wildwood
4. Record of Nutrient Levels of CP and OP and the Microbiological Quality of Their Beaches
5. Record of Secchi Measurements in CP and OP
6. Physical Characteristics of Water in CP and OP
7. Aquatic Plants and Phytoplankton in CP and OP
8. Wildwood Welcome Packet Enclosures
9. Index of Our Pond Articles in the WPOA Newsletter
10. Trout Stocking History

12. ACKNOWLEDGEMENTS

Scott Burghoff wrote the First Edition of this document. This Second Edition, prepared by Jan Tkacz, is a re-organization and expansion of the previous text with appendices put in place to accommodate information that needs to be updated annually or periodically. Several members of the PPC, notably Denis DiLallo, provided comments and criticisms that improved the draft text of the present edition. Thanks all around.

Thanks also to the previous leaders of this committee for their efforts to raise community awareness and ensure the preservation of the quality of our ponds:

- Bob Hensel
- Ken Lawrence
- Jan Tkacz
- Walter and Betsy Gay, and
- Scott Burghoff.