REPORT ON THE STATUS OF GULL POND

PREPARED FOR THE BOARD OF SELECTMEN

TOWN OF WELLFLEET

2008

THE GULL POND AREA CONSERVATION ASSOCIATION

INTRODUCTION

GUPACA has prepared this report on the status of Gull Pond in the fall of 2008 for the Wellfleet Board of Selectmen (BOS) as the first in a planned series of annual reports. The purpose of this effort is to create a concise source of information on one of Wellfleet's most valuable assets, Gull Pond, for the people who have the responsibility and authority for its wellbeing.

Most of the data in the report has been provided by the Cape Cod National Seashore (CCNS). Scientists from the CCNS have monitored Gull Pond for many years, in some cases going back to the 1970's. We, in Wellfleet, are extremely fortunate to have in our midst a federally funded group of scientists who monitor and study Gull Pond and other precious assets of this town. Over the years, not only has the CCNS generously shared this data with GUPACA, but also CCNS staff have made themselves available to the GUPACA Board and members to explain the data. The second source of data is GUPACA itself which has built a database of well-water quality and is building a database on usage of Gull Pond. Finally, the Wellfleet Health and Conservation Agent has provided the information on coliform monitoring.

The text of this report uses extracts from the larger data sets provided to GUPACA, which are contained in the appendix following the text. The full data sets are available online at the GUPACA website: www.gupaca.org. The web site also contains the full well-water test results and the paper on plant growth in Gull Pond prepared for GUPCA this fall by Stephen Smith, Ph.D., Plant Ecologist at the CCNS. Any serious review of the information provided in this report should refer to the full data sets.

As this report is prepared for the Wellfleet BOS, we assume the audience is familiar with Gull Pond and we have not included the historical background and contextual information that would normally be included in such a report.

When discussing the overall health of a pond such as Gull Pond, six criteria are used for classifying it into three categories of health or trophic levels. These are:

1. Oligotrophic: pristine ponds with clear water, few plants and low nutrients.
2. Mesotrophic: somewhat ecologically and culturally impacted
3. Eutrophic: culturally or naturally enriched with nutrients and organic matter: pond is filled with plants and water has low visibility.

The six criteria used to determine the trophic levels are:

1. Dissolved oxygen
2. Secchi Disk transparency: the depth in meters at which a disk lowered into the water is visible.
3. Phytoplankton abundance (drifting algae)
4. Nitrogen (TN)
5. Total phosphorus (TP)
6. Aquatic Vegetation

    Sparse

    Medium

    Dense

    Very Dense

These criteria provide the structure for this report.

A word about the Gull Pond Area Conservation Association (GUPACA): we are a private homeowners association that has been in existence for more than 25 years. GUPACA's focus is on the water quality in the Gull Pond chain of ponds. The Board of Directors of GUPACA are:

Herbert Gstalder, President

Dorothy Altman

Tina Browne

Barbara Gstalder

John Partridge

Joan Shapiro

Kathryn Weill.

Aggie Wolf

DESCRIPTION

Gull Pond is the largest and deepest kettle pond in Wellfleet, and in the Cape Cod National Seashore (CCNS), with an area of 106 acres and a maximum depth of 19 meters.

The ownership of Gull Pond includes a number of entities.

1. The Commonwealth of Massachusetts owns the bed of the pond;
2. Twenty-one families or private trusts own improved property bordering the pond;
3. The Town of Wellfleet owns a five acre parcel adjacent to the pond with 379 linear feet of shore on the western side of the pond which is used as a town beach. The town also owns a parcel of land on the west side of the sluice between Gull and Higgins ponds which it uses as a town beach as well.

4. The United States Department of the Interior through the National Park Service owns all other land surrounding Gull Pond. However, two parcels bordering the pond within the CCNS are encumbered with deeded rights of exclusive use by specific private property owners.

The Commonwealth of Massachusetts has the right to control and regulate the use of Great Ponds. It may convey the title of a Great Pond to the National Park Service, and has done so in the towns of Truro and Provincetown, but not in Wellfleet. Similarly, the Commonwealth can delegate regulatory authority to local towns, and has done so in Wellfleet.

Gull Pond is a significant and heavily used attraction.

1. Many of the private homes have been winterized so the owners are able to spend more time in the homes throughout the year.
2. The two town beaches are very popular in the summer. In addition to the bathing opportunity, the town provides racks for 68 privately owned canoes and several moorings in the pond. The town licenses a private boat rental concession at the main beach. On August 9th, 2008 there were 40 rental watercraft in use or available. On the last nice Sunday of the summer season, August 31, 2008, at 12:30 there were 32 people, one dog, 5 boats and 3 cars on or around the smaller town beach on the west side of the sluice.

SEPTIC SYSTEMS

All 21 houses on Gull Pond and the 7 houses on Higgins Pond have septic systems. The bathroom facilities at the main Town Beach are also on a septic system.

Of the 28 private homes, 9 have not upgraded their septic systems to Title V.

The locations of the properties are:

Map 4 Parcel 21	35 Way #657
Map 4 Parcel 22	179 Thorough Way
Map 4 Parcel 26	80 Valley Road
Map 4 Parcel 34	460 School House Road
Map 9 Parcel 614	220 Valley Road
Map 9 Parcel 615	240 Valley Road
Map 9 Parcel 619	99 Gull Haven Lane
Map 9 Parcel 620	87 Gull Haven Lane
Map 9 Parcel 630	60 Way #14.

WATER CLARITY

The standard method for measuring clarity of a body of water is to lower into the water a 30cm round disc with a black and white pattern attached to a pole. This is called a Secchi disc. It is generally accepted that visibility at 10 meters classifies a pond as Oligotrophic (pristine); visibility at 3 meters classifies a pond as Mesotrophic. In a Eutrophic pond the disc is barely visible. In Gull Pond, the clarity is influenced by phytoplankton biomass (floating algae), as there is little or no coloration in the Gull Pond water. Chlorophyll concentration in water is an indicator of floating algae density.

The CCNS has monitored the clarity of Gull Pond since 1975, the longest period of data collection made available to GUPACA. Visibility fluctuates significantly throughout the year. Accordingly, the CCNS for most years has taken several Secchi disc measurements in different seasons. We have presented in the appendix the deepest and shallowest Secchi depth reading for each year. At the deepest annual readings, Gull Pond is consistently in the Oligotrophic range, averaging about 7.5 meters over the years. At the lowest readings, Gull Pond is closer to Mesotrophic range. The full data set from the CCNS is available on the GUPCA web site.

The earliest Chlorophyll concentration data we have is from 1997. CCNS measured Chlorophyll annually from 1997 to 2002 and again in 2008. The high and low reading in 2008 was significantly higher than in the previous period.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Difference in water temperature at the surface of a body of water and the lower depths causes a reduction in the mixture of the varying levels of water. The greater the difference in temperature, the less the levels mix. Once isolated from atmospheric oxygen the bottom waters become oxygen-depleted (anoxic). In addition to not supporting fish life, bottom level oxygen-depleted water causes the release of phosphorus at the sediment surface.

Oxygen in water is measured in parts per million (ppm). The natural range of oxygen in water without mechanical aeration on the one hand or thermal stratification on the other is 7 to 14 ppm. Oxygen levels of 9 or 10 are considered very good. At 4 ppm fish begin to decline. Zero ppm defines anoxic.

The earliest CCNS water temperature data we have is from 1980. Since 1985 CCNS has recorded temperature data in centigrade for each year except for 1993. Beginning in 1994, oxygen measurements were included. The number of readings taken in each year varies. In the appendix, we selected the date that contained the highest recorded surface temperature for that year and then included a mid-level reading and the bottom temperature for that date. We selected the mid-level point at which there was a significant reduction in oxygen, between 11 and 13 meters. The full data on water temperature and oxygen levels on the GUPACA website is voluminous.

Water temperature stratification and differing oxygen levels are normal occurrences in kettle ponds. It is therefore the trends rather than the occurrence that is noteworthy. In this respect, the most noteworthy trend is the increase in surface water temperature. In 1980 through 1987, the average highest surface temperature was 25 degrees. For the four most recent years the average highest temperature has been 26.3 degrees.

NITRATES AND PHOSPHATES

The term “cultural eutrophication” refers to increase in nutrient loading in a pond or other body of water by human activities. The two most important nutrients are phosphates and nitrates as they stimulate algae and plant growth, leading to decreased water clarity and excessive plant growth. The CCNS has measured phosphates in Gull Pond sporadically since 1975 and more consistently since 1992; nitrogen starting in 1999, and consistently since 1992. In 1995 and 1996, Stephen Smith and Krista Lee conducted a study on the effects of nitrates and phosphates in the Cape Cod kettle ponds, including Gull Pond.

Their report, “Responses of periphyton to artificial nutrient enrichment in freshwater kettle ponds of Cape Cod National Seashore” is available on the GUPACA website.

Phosphates and Nitrates are measured in micromolars, represented by the symbol uM. Oligotrophic ponds have 0.4uM of Total Phosphate (TP) or less and 10uM of Total Nitrogen (TN) or less. However, even concentrations over 1 uM of TN may indicate nitrogen overloading. Gull Pond TP readings have averaged 0.45 in spring and 0.38 in summer, with the summer readings for the past three years significantly lower than the average. TP averages of 19 to 22 for spring, summer and fall readings are more than double the amount found in Oligotrophic (pristine) ponds and far beyond the level that indicates nitrogen overloading. Almost all the data provided by the CCNS is included in the appendix table and the full data is on the GUPACA website.

Major sources of phosphates in ponds are septic system effluents; detergents (especially dishwasher detergents), and urine from bathers in the water and on the shore. In addition Gull Pond specifically suffered from a high phosphorus loading from the large number of gulls that gathered on the pond prior to the closing of the landfill. The Kettle Pond Data Atlas estimated in 1990 that the gulls alone added 52 kilograms of phosphorus per year to the pond. Septic systems and urine are similarly major sources of nitrogen in the ponds. Lawn and garden fertilizers are an additional significant source of nitrogen. In the summary of the Kettle Pond Data Atlas, John Portnoy and his colleagues wrote: “The Wellfleet and Truro kettle ponds are especially sensitive to changes in acid balance and nutrient inputs because of their low acid-neutralizing capacity and phosphorus

concentrations…..cultural nutrient loading and consequent eutrophication continue to be the principal management concerns for kettle ponds."[1]

AQUATIC VEGETATION

There are several types of vegetation in Gull Pond. Macrophytes are aquatic plants that may be completely submerged, floating or extending above the water. Rushes and water lilies are examples of macrophytes. Algae may be floating, the phytoplankton referred to in the section on water clarity, or periphyton, algae attached to the bottom of the pond or to aquatic plants. Aquatic mosses cover the bottom of a pond. The quantity and the type of vegetation are measures of the Eutrophic state of the pond. Although the quantity is described along a continuum of *sparse, medium, dense and very dense*, we have not found an objective measurement of plant growth concentration that places an area along the eutrophic classification continuum. While the CCNS has studied plant growth in Gull Pond and scientists have published papers on plant growth in the kettle ponds, including Gull Pond, the CCNS does not have data on plant growth similar to the other data on Gull Pond included in the appendix. The CCNS studies have, however, generated a great deal of information about the plants in Gull Pond.

John Portnoy, along with Charles Roman and Nels Barrett, published "Aquatic Vegetation and Trophic Condition of Cape Cod Kettle Ponds" in the prestigious journal, Hydrobiologia in 2001. Of the five ponds studied, the authors placed Gull Pond on the Eutrophic end of the scale based on vegetation composition and on nitrate levels. The authors noted, however, that the dominant aquatic plants in Gull Pond were (and still are)

Lobelia dortmanna and Eleocharis acicularis, both of which are normally found in non-enriched or Oligotrophic water. This dichotomy was not addressed in the article.

GUPACA believes there has been significant and accelerating growth of emergent macrophytes (plants rising above the water) as well as periphyton attached to these plants and moss on the bottom of Gull Pond in the last ten years. After years of dialogue with CCNS scientists on this point, Stephen Smith of the CCNS prepared an extensive report for GUPACA in September of this year documenting the long history of plant growth in Gull Pond. Aerial photographs and some older land-level photographs show consistent, abundant plant growth in the littoral zones (shallow water near the shore) over many years. Unfortunately, it is often difficult to tell from the photographs the extent to which the mosses that create a thick mat on the pond bed may have increased at the base of the emergent, visible macrophytes. The report did show evidence of increased plant and periphyton growth in the northeast section of Gull Pond, where most GUPCA board members live. However, Smith argues that increased plant growth should be expected given the area's extensive shallow water. Smith's report is available on the GUPACA website.

The CCNS maintains 5 permanent vegetation monitoring transects in Gull Pond which GUPACA hopes will continue to provide data on plants in Gull Pond.

MERCURY

Signs posted by the CCNS warning that fish from Gull Pond should not be eaten are still present on Gull Pond. No further clarification has been provided.

WELL WATER QUALITY

GUPACA has requested its members to have their well water tested and allow GUPACA to share the results. Over the years a sufficient number of homeowners have complied to allow GUPACA to build a database of well water quality in the Gull Pond watershed from 1983 to the present. The Barnstable County Health Laboratory established the following standard limits for well water:

Nitrate as Nitrogen	10 mg/l
Copper	1.3 mg/l
Iron	.3 mg/l
Sodium	20 mg/l
Total Coliform	0
Conductance	No standard
pH	No standard

Well water test results have overwhelmingly shown high quality water. Nitrate, Copper and Iron are consistently within limits. In all the samples, only one result showed any amount of coliform. Sodium is the only concern. While most results are near or below the 20mg/l guideline, several have shown elevated sodium levels as high as 39. One result showed 62 mg/l, however the result is not consistent with other results from that property. There is a correlation between proximity to the ocean and higher sodium levels, suggesting salt water spray as the source of elevated sodium.

CONCLUSION

We have purposely omitted any interpretation to the data presented. Gull Pond and its watershed is a fragile and complicated ecological area. Our hope is that the information we have provided will serve as a basis for deeper and ongoing study and discussion. GUPACA would be pleased to respond to any questions or comments the BOS may have. We may be reached on-line at info@gupaca.org or by mail at P. O. Box 1113, South Wellfleet, MA 02663.

[1] Portnoy, J. W., Winkler, M. G., Sanford, P. R., Farris, C.N. *Kettle Pond Data Atla:; Paleoecology and Modern Water Quality.* Cape Cod National Seashore, National Park Service, U.S. Department of the Interior. 2001

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GULL POND WATER QUALITY MEASURES

YEAR	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999
GULL POND WATER CLARITY										
MAXIMUM DEPTH DISC VISIBLE										
Date	6/9/2008	6/22/2007	6/5/2006	9/6/2005	5/19/2004	9/11/2003	5/17/2002	5/22/2001	6/22/2000	9/9/1999
Depth in meters	9.425	7.9	9.4	8.5	7.5	7.9	8.5	8.5	8.5	8.8
MINIMUM DEPTH DISC VISIBLE										
Date	4/3/2008	3/30/2007	11/7/2006	11/7/2005	11/9/2004	4/25/2003	10/30/2002	4/3/2001	4/27/2000	11/19/1999
Depth in meters	3.6	3.5	3.9	4.7	3.3	3.2	4.5	4.4	3.2	3.4
ANNUAL AVERAGE	6.5	7	7.1	6.7	6.4	6.5	6.4	7.2	6.3	6.7
CHLOROPHYLL IN WATER										
Milligrams per square meter										
Spring	5.4						0.89	2.01	3.69	2.72
Summer	2.4						6.55	0.86	0.68	1.37
GULL POND HIGH WATER TEMPERATURE AND DISOLVED OXYGEN										
Date	8/4/2008	8/1/2007	7/31/2006	8/19/2005	8/3/2004	8/14/2003	8/19/2002	8/17/2001	8/9/2000	8/4/1999
Surface temperature in centrigrade	26.5	26.5	26.6	25.5	25.6	26.2	26.9	25	24.9	26.6
Surface oxygen in ppm	8	8	8	8.4	8	8.8	8.2	8.4	8.2	8
Mid-level temperature in centrigrade	8.1	8.5	8.4	10.4	8.2	8.6	11.8	8.8	10.3	8.9
Mid-level oxygen in ppm	6.7	4.5	1.8	4	8.8	5.1	4.5	4.3	0.8	2.4
Bottom temperature in centrigrade	6.8	7.2	6.8	7.3	6.9	7.4	8.4	7.4	9.9	8
Bottom oxygen in ppm	1.5	0.1	0.17	0.14	0.2	0.1	0.1	0.2	0.1	0.1
TOTAL PHOSPHATE										
Measured in uM: micromolars										
Spring	0.23	0.2	0.3		0.38	0.555	0.15	0.22	0.37	0.5
Summer		0.2		0.16	0.08	0.11	0.055		0.13	0.53
Fall		0.3	0.19	0.23						
TOTAL NITRATE										
Measured in uM: micromolars										
Spring	18.5	23.5	24		19.89	21.82				13.3
Summer		14.6	15.3	16.17	16.07	15.4	26.495			31.165
Fall		17.1	23.65	20.16						

GULL POND WATER QUALITY MEASURES

YEAR	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989
GULL POND WATER CLARITY										
MAXIMUM DEPTH DISC VISIBLE										
Date	5/5/1998	8/7/1997	5/14/1996	7/24/1995	8/30/1994	5/16/1993	9/28/1992	7/16/1991	9/1/1990	8/16/1989
Depth in meters	6.5	7.5	7.5	5.5	6.3	8	8.7	8.9	9.3	7.5
MINIMUM DEPTH DISC VISIBLE										
Date	11/4/1998	6/12/1997	4/19/1996	6/15/1995	6/15/1994	4/23/1993	7/7/1992	6/16/1991	7/16/1990	7/5/1989
Depth in meters	2.3	5	3.5	4.5	4	5.3	7.2	6.5	6.2	6.2
ANNUAL AVERAGE	5.1	5.9	5.1	4.9	5.6	6.7	7.9	8.2	7.6	6.8
CHLOROPHYLL IN WATER										
Milligrams per square meter										
Spring	1.94	0.53								
Summer	0.21	1.00								
GULL POND HIGH WATER TEMPERATURE AND DISOLVED OXYGEN										
Date	7/27/1998	8/7/1997	8/12/1996	7/24/1995	7/25/1994	No	7/22/1992	7/24/1991	7/27/1990	7/26/1989
Surface temperature in centrigrade	26.2	24.5	24.1	25.7	26.7	Data	24.1	27.1	25.5	26.1
Surface oxygen in ppm	9	8.7	10.5	7	7.4					
Mid-level temperature in centrigrade	8.7	9.7	9.1	8.1	10.1		8.5	9	9.3	11
Mid-level oxygen in ppm	2.4	1.4	2.9	1.8	3.5					
Bottom temperature in centrigrade	7.4	8.1	7.7	7.2	7.7		7.4	7.4	7.8	8.2
Bottom oxygen in ppm	0.1	0.1	0.6	0.1	0.1					
TOTAL PHOSPHATE										
Measured in uM: micromolars										
Spring		1.22	0.58							
Summer	1.25	0.48		0.55	0.21		0.87			
Fall										
TOTAL NITRATE										
Measured in uM: micromolars										
Spring										
Summer										
Fall										

GULL POND WATER QUALITY MEASURES

YEAR	1988	1987	1986	1985	1982	1980	1977	1976	1975
GULL POND WATER CLARITY									
MAXIMUM DEPTH DISC VISIBLE									
Date	8/16/1988	9/1/1987	5/1/1986	8/16/1985		8/1/1980	7/16/1977		9/1/1975
Depth in meters	7.1	8	6.7	8.2		7.2	8.6		10.3
MINIMUM DEPTH DISC VISIBLE									
Date	10/16/1988	5/1/1987	4/16/1986	3/1/1985		4/16/1980	2/1/1977		4/1/1975
Depth in meters	5	4	3.5	3		4	4.6		3
ANNUAL AVERAGE	5.9	6.6	5.3	5.4		5.2	6.24		6.85
CHLOROPHYLL IN WATER									
Milligrams per square meter									
Spring									
Summer									
GULL POND HIGH WATER TEMPERATURE AND DISOLVED OXYGEN									
Date	8/8/1988	7/17/1987	7/30/1986	7/31/1985		8/13/1980			
Surface temperature in centrigrade	27.7	25	24.9	24		24.8			
Surface oxygen in ppm									
Mid-level temperature in centrigrade	11.2	9.1	12.9	12.5		11.3			
Mid-level oxygen in ppm									
Bottom temperature in centrigrade	8	8.2	9	7.5		7.7			
Bottom oxygen in ppm									
TOTAL PHOSPHATE									
Measured in uM: micromolars									
Spring					0.52			0.52	0.61
Summer					0.27				
Fall									
TOTAL NITRATE									
Measured in uM: micromolars									
Spring									
Summer									
Fall									