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Sonar Scan Report for Hemlock Lake

Prepared for:
Hemlock Lake POA
12/10/2020

Sonar Scan and Mapping

A complete sonar scan of the lake was completed on November 11, 2020. The scan was accomplished with our Lowrance Elite-7 Ti² chartplotter with broadband sounder technology, built-in GPS antenna and high-definition mapping. The data obtained was uploaded to Biobase GIS, a cloud-based mapping service, to produce contour or bathymetry, bottom composition and vegetative biovolume maps.

These scans are an excellent way to help understand water body characteristics, compare changes over time and measure the progress of any restoration or improvement project. The information is generated based on thousands of data points, so it allows you to objectively determine how the lake changes over time under the surface where it matters most, without the potential for human error from manual measurements. The sonar signal can get distorted in water less than 3 feet and the accuracy of the maps can be diminished in those areas.

On the day of the sonar scan the water level of the lake was 10 inches below the beach rail tie and a 2” adjustment was made to match up with the initial scan elevation.

Contour Map

The contour map for the lake is shown in Figure 1. The scale goes from light blue (shallowest) to dark blue (deepest) in 1-foot increments. The deepest point in the lake was determined to be 18.43 feet and an average depth of approximately 8.8 feet. The calculated volume of the lake is 60.18 acre-feet which is an increase of 1.3 acre-feet from the scan last year. Overall, the lake deepens from the northern end (with depths up to 9 ft) toward the docks on the southern end (depths up to 18+ ft).

The depth map below shows that the lake has gained depth in both the northern half and in the deep hole. There was enough data registering 18+ feet deep to create a minor 18-foot contour. The 17 and 16 foot contours have also increase in size. The 7-foot contour that was broken into two separate contours has grown into a combined contour because of the increase in depth.

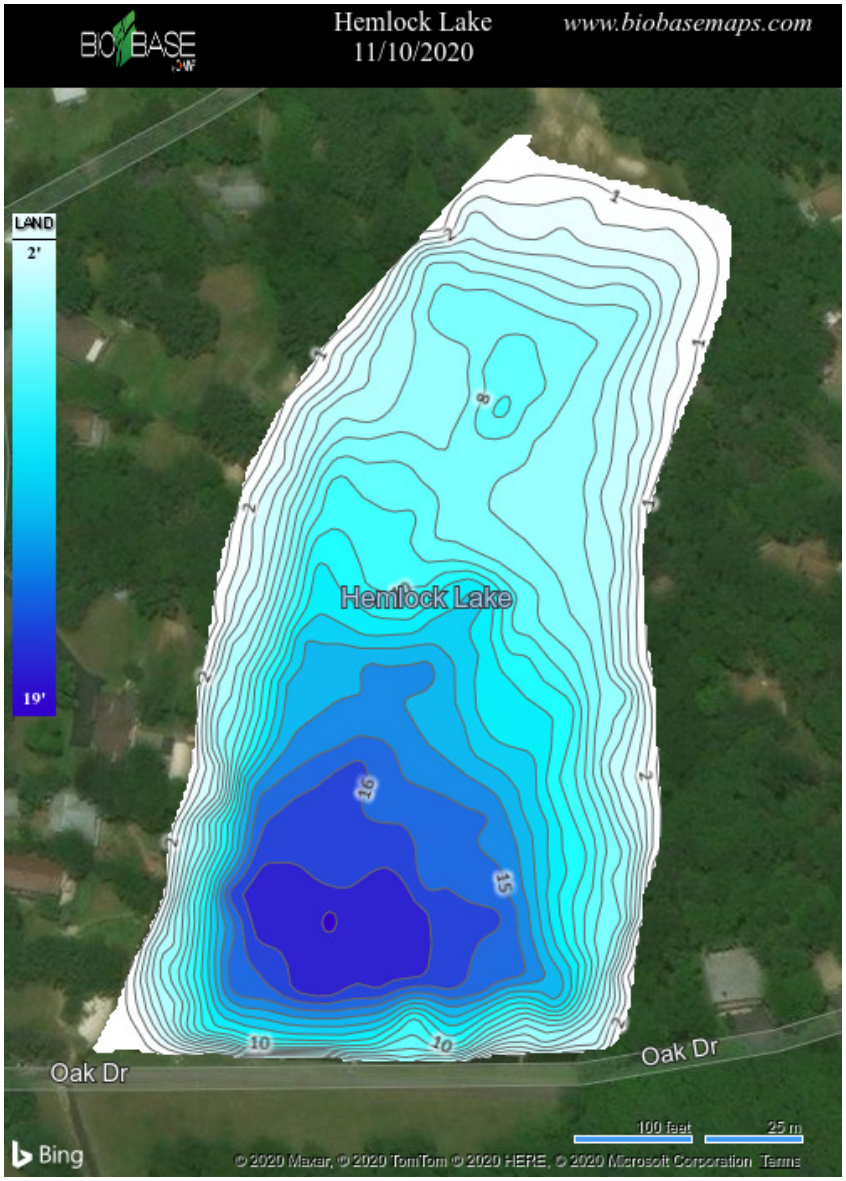

Figure 1. Depth Contours of Hemlock Lake based on sonar scan

Lakes that are fed by streams or rivers often receive sediment in the water flow. Much of the inorganic sediment will settle out closer to the inflow (near the beach) and reduce the water depth. Lighter organic sediment can be carried further into the water body and will settle into deeper areas further from the inflow. This scan can be used as a baseline to determine sedimentation in the future.

Bottom Composition

The bottom composition map for the lake along with a color-coded scale is shown in Figure 2 below. The scale expresses relative hardness of the sediment and goes from light tan (softest) to red (hard bottom). The softest areas contain large amounts of loose organic sediment. In areas where there is less organic sediment, the color changes to darker tan and ultimately red if there is no soft organic sediment.

Composition data from the sonar scan (see figures 2 and 3) show that soft- and medium-hardness sediments are consolidated in 13-feet and deeper region of the lake. The rest of the water body, which is comprised of the shallower areas of the lake, is harder in composition. There has been a considerable drop in soft sediment as well as medium hardness sediments since 2019.

It is important to note that the sonar signal can get distorted in water less than 3 feet and the accuracy of the maps can be diminished in those areas.

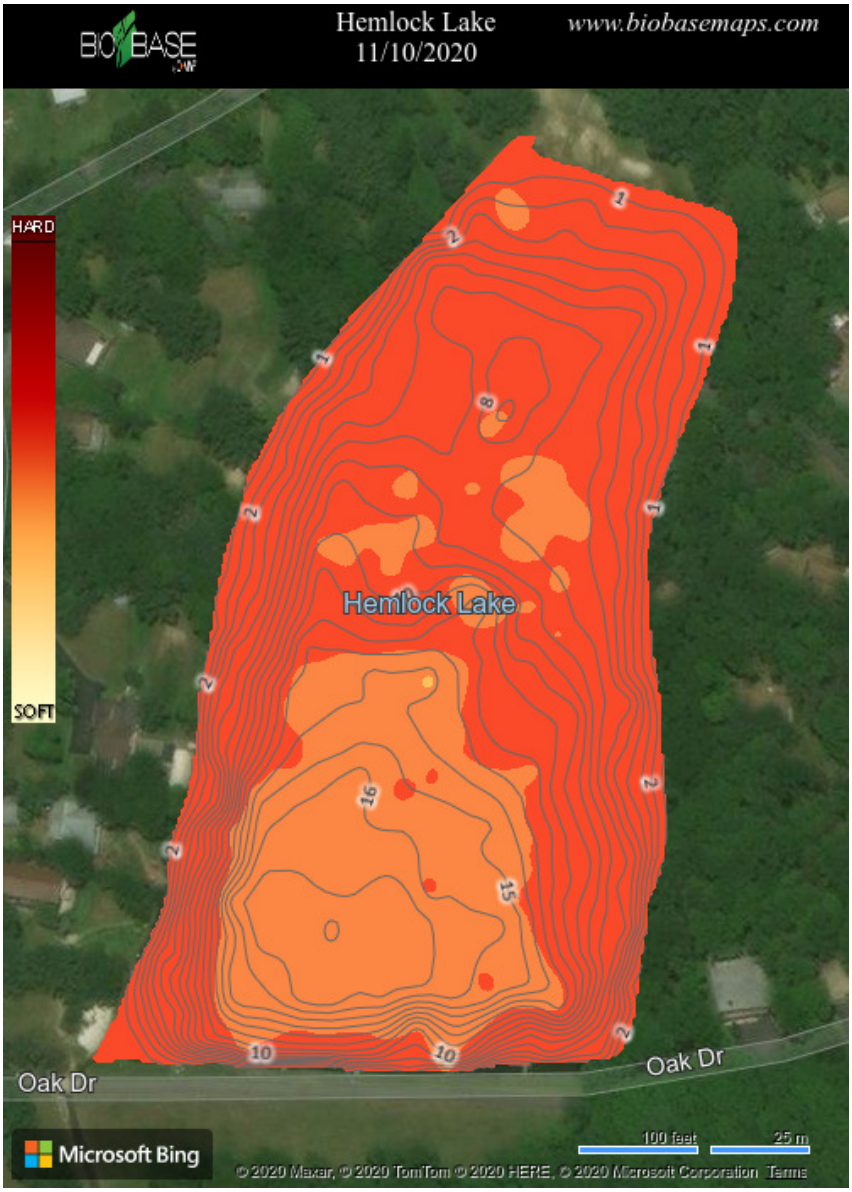

Figure 2. Bottom Composition (hardness) map of Hemlock Lake based on sonar scan

The chart below (Figure 3) shows the percentage of the sonar readings that registered hard, medium, or soft sediment. Based on our analysis, 33% of the readings registered hard

bottom sediments and 67% registered medium sediments. No soft sediment readings were recorded. This is progress from last year and will continue as treatment is continued.

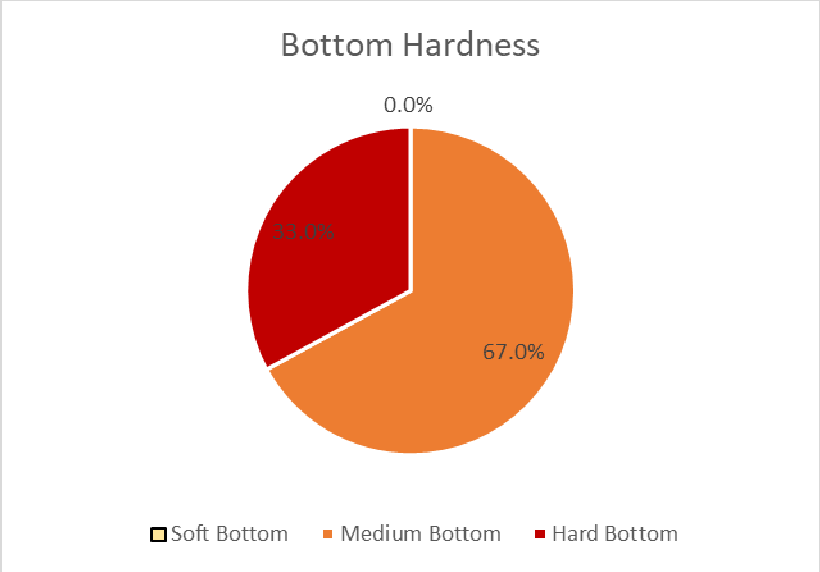

Figure 3. Bottom composition percentages based on sonar data

Vegetation Biovolume

The vegetation biovolume map (Figure 4) generated by Biobase using scan data can be found below. The biovolume map shows areas of vegetation and density of that vegetation. The measurement scale shows that red is the highest density of biovolume followed by yellow, green, then blue. The blue areas have little to no vegetation.

The Biovolume map (Figure 4) showed that the densest vegetation growth occurred along the eastern and western shores of the lake. Overall, there was light coverage of the northern half and shallow shoreline areas, and no vegetation in the southern deep hole.

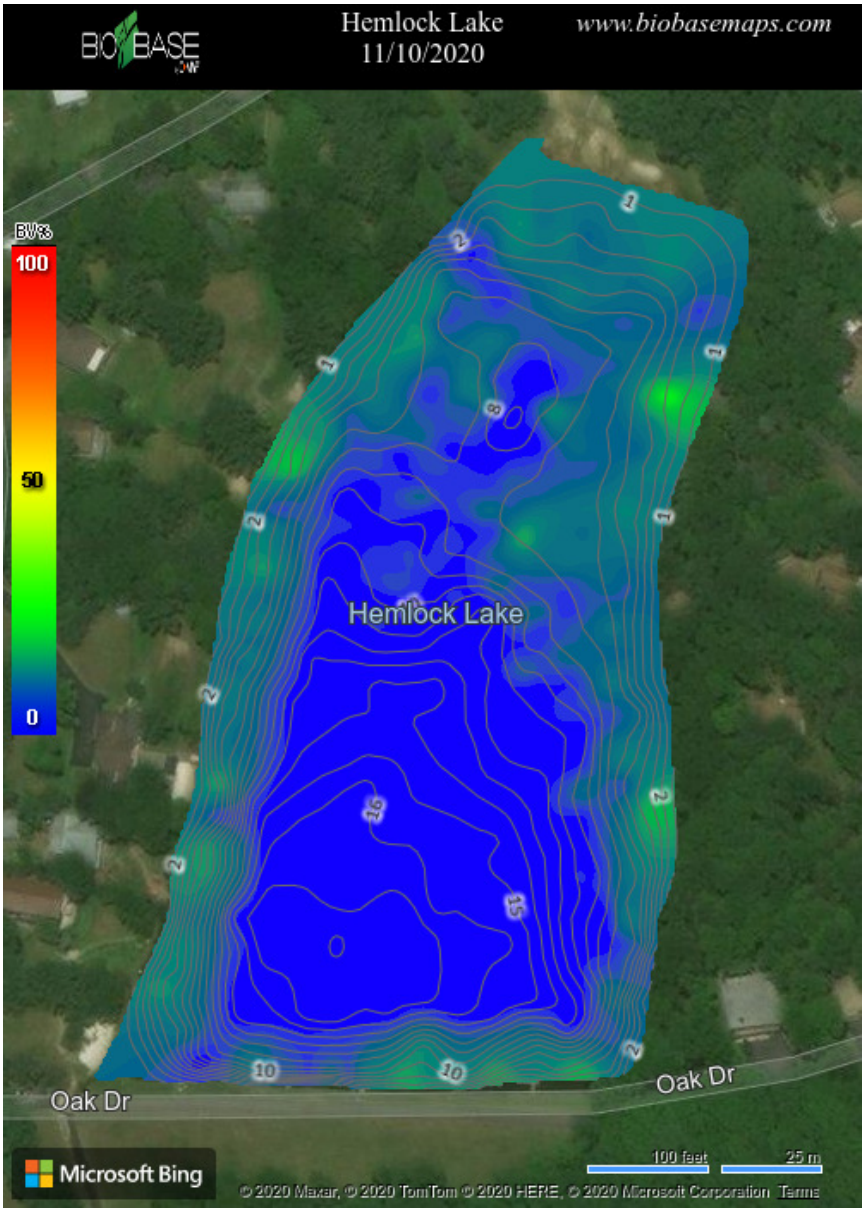

Figure 4. Biovolume map generated by Biobase using sonar scan data

A Glossary of terms used in the Biovolume report can be found below:

AOI

Area of Interest: Defines the individual transects or contiguous data samples as depicted by the color coding of each trip line. Seperate areas of interest can be generated through merging of multiple trips, appending data to a single sonar log or lapses in time (greater than five minutes) within a sonar log.

BVp

Biovolume (Plant): Refers to the percentage of the water column taken up by vegetation when vegetation exists. Areas that do not have any vegetation are not taken into consideration for this calculation.

BVw

Biovolume (All water): Refers to the average percentage of the water column taken up by vegetation regardless of whether vegetation exists. In areas where no vegetation exists, a zero value is entered into the calculation, thus reducing the overall biovolume of the entire area covered by the survey.

PAC

Percent Area Covered: Refers to the overall surface area that has vegetation growing.

Grid

Geostatistical Interpolated Grid: Interpolated and evenly spaced values representing kriged (smoothed) output of aggregated data points. The gridded data is most accurate summary of individual survey areas.

Point

Individual Coordinate Point: A single point represents a summary of sonar pings and the derived bottom and canopy depths. Individual point data create an irregularly spaced dataset that may have overlaps and/or gaps in the data resulting in a increased potential for error.

Based on the Biovolume report generated by Biobase, less than half the lake bottom (36% Grid PAC) has vegetation growth. The report also detailed that on average 2.8% of the overall lake water column was taken up by vegetation (see Grid Avg BVw in survey summary). Of the areas that registered plant growth, an average of 7.8% of the water column in those areas was taken up by vegetation (see Avg BVp). The depth region that saw the most vegetation in Hemlock Lake was the area in the lake that measured 0-6 ft (0-2 m) deep according to the Biovolume Analysis by Depth.

Biovolume Report

Survey Summary

	Type	PAC	Avg BVp	SD BVp	Avg BVw	SD BVw	Depth Range	Avg Depth	Distance	No.Points
Full Survey	Point	31.1%	8.2%	±4.1%	2.6%	±3.9%	1.94 - 18.59 ft	10.34 ft	1.41 miles	3024
	Grid	36.0%	7.8%	±2.3%	2.8%	±4.0%	0.19 - 18.07 ft	8.80 ft	-	694

Biovolume Analysis by Depth

Full Survey	Depth	Type	Count	PAC	Avg BVp	SD BVp	Avg BVw	SD BVw
	0-1m	Point	63	88.9%	13.1%	±8.9%	8.5%	±0.0%
	1-2m		644	83.9%	8.4%	±3.9%	3.7%	±0.0%
	2-3m		950	34.2%	7.2%	±2.3%	3.1%	±0.0%
	3-4m		405	4.9%	6.3%	±1.0%	1.3%	±0.0%
	4-5m		674	0.0%	0.0%	±0.0%	0.0%	±0.0%
	5-6m		288	0.0%	0.0%	±0.0%	0.0%	±0.0%
	6-7m		0	0.0%	0.0%	±0.0%	0.0%	±0.0%
	7-8m		0	0.0%	0.0%	±0.0%	0.0%	±0.0%
	8-9m		0	0.0%	0.0%	±0.0%	0.0%	±0.0%
	9-10m		0	0.0%	0.0%	±0.0%	0.0%	±0.0%
	0-1m	Grid	264	86.0%	8.5%	±2.7%	7.3%	±3.8%
	1-2m		285	73.6%	7.6%	±2.0%	5.6%	±3.8%
	2-3m		116	24.7%	7.2%	±1.9%	1.8%	±3.3%
	3-4m		28	10.0%	6.9%	±1.3%	0.7%	±2.1%
	4-5m		1	0.2%	5.3%	±0.2%	0.0%	±0.2%
	5-6m		0	0.0%	0.0%	±0.0%	0.0%	±0.0%

Sunlight penetration increases as lakes get shallower. If sediment continues to increase, sunlight penetration will also increase and may foster more plant growth. This will increase both the density of plant growth and the area covered by plant growth.

It is important to try to reduce watershed related sediment. Sediment coming into the lake during rain events is normally more inorganic than organic. Our process will reduce organic inputs, but not inorganic inputs. Once organic sediments are mostly reduced, the lake may get shallower mainly due to inorganic inputs.

Summary

The lake has a maximum depth of approximately 18.43 feet and has increased in volume to 60.18 acre-feet. That is an increase of 1.3 acre-feet in water volume. This means there was a reduction of at least 2,097 cubic yards of sediment. This is equivalent to 105 dump trucks of sediment being removed from the lake or an increase of 424,000 gallons of water.

Sediment hardness has seen positive changes as well. No soft sediment readings were detected and a drop in medium hardness readings was also observed (see both Figure 2 and 3). Hard sediment readings have increased since 2019 which is naturally due to reduced organic sediment.

The vegetation in Hemlock Lake seems to be at relatively healthy levels based on the analysis presented in the Biovolume report. Grid PAC has dropped roughly 10% from last year, which means vegetation coverage has decreased. Water column coverage has also decreased by roughly 2%.

If treatment consistency is maintained, our biotechnology will continue to reduce the organic fraction of the sediment to make the lake deeper, reduce the total nutrient load, improve overall water quality, reduce nuisance plant growth, and improve recreation and fishing.

Future scans will be undertaken to monitor progress in the coming years.