ENSR | AECOM

May 16, 2007

Alan H. Bergren
Town Manager
Town of East Hampton
20 East High Street
East Hampton, CT 06424

Dear Mr. Bergren,

ENSR has completed the 2006 stormwater and in-lake sampling on behalf of the Town of East Hampton. The 2006 stormwater sampling targeted the same areas as the 2005 sampling. These areas are upgradient of existing ENSR sampling locations as well as locations previously sampled by the Lake Study Group (LSG) in 1991-1992 and locations where little stormwater sampling has been conducted. In-lake sampling occurred in the western deep basin (Oakwood Basin; LP-2). In addition to water samples, ENSR collected phytoplankton and zooplankton samples from LP-2 for analysis. Phytoplankton samples were also collected from Sears Park In July and September.

ENSR identified 20 stormwater sampling locations throughout the Lake Pocotopaug watershed for the targeted sampling (Figure 1). Stations previously sampled by ENSR or LSG, as well as new stations, were labeled accordingly for easy comparison between years (i.e., LP-11(26) indicates ENSR station 11 and LSG station 26). In-lake water sampling was conducted on June 30, 2006. Dry weather tributary and storm drain sampling occurred on July 11, 2006. Wet weather tributary and storm drain sampling occurred on July 12, 2006. Wet weather sampling (first flush) was conducted using passive storm samplers during a precipitation event yielding 0.40 inches of rainfall (from www.weatherunderground.com) following a period of dry weather. Details regarding the use of passive samplers are provided in Lake Pocotopaug Lake and Watershed Restoration Evaluation East Hampton, Connecticut (ENSR, 2002).

<u>Watershed Results</u>

On July 11th a suitable storm for wet weather sampling occurred in East Hampton. The magnitude of the storm was reported as 0.40 inches in Hartford, CT and consisted of short periods of heavy rain and thunderstorms. The storm event occurred after at least 72 hours of dry weather with 0.26 inches of rain reported for the Hartford area over the previous 7 days. Passive stormwater samplers were in place in tributary channels and at storm drain outfalls just prior to the onset of the storm on July 11th and were collected the following day (July 12th, 2006).

The results of the 2006 sampling are provided in Tables 1-2, and are illustrated in Figures 2-9. In 2006, dry weather, stormwater and in-lake water samples were analyzed for total phosphorus, dissolved phosphorus, turbidity and conductivity. Dry weather watershed total phosphorus values ranged from 0.07-1.03 mg/L, dissolved phosphorus ranged from <0.01-0.23 mg/L, turbidity values ranged from 4-89 NTU and conductivity ranged from 99-181 umhos/cm (Table 1). Wet weather total phosphorus values ranged from 0.09-5.10 mg/L, dissolved phosphorus ranged from 0.02-0.33 mg/L, turbidity values ranged from 5-1266 NTU and conductivity ranged from 94-144 umhos/cm (Table 2). Values for dissolved phosphorus are lower compared to 2005 (0.05-4.62 mg/L), but are still elevated. The 2006 stormwater results have a higher range of total phosphorus compared to 2005 (0.53-4.75 mg/L) and are also elevated. Dry weather dissolved phosphorus values were elevated throughout the watershed. The four highest values (0.11-0.23 mg/L) were reported from the western portion of the watershed. Dry weather total phosphorus and turbidity values were also high throughout the watershed, although there doesn't appear to be any one location where higher values were measured. Dry weather turbidity levels were much higher than expected for non-storm samples. Typically, non-storm turbidity readings would be in the single digits in areas with no obvious direct impacts. The high dry weather samples suggest direct impacts from nearby activities or severe erosion.

Wet weather dissolved phosphorus values (0.02-0.33 mg/L) were slightly elevated compared to the 2006 dry weather values, with the higher values found in the west and southeastern parts of the watershed. The wet weather total phosphorus values (0.09-5.10 mg/L) are again higher than anticipated. There is no spatial pattern of higher values in a particular area of the watershed. High total phosphorus values were reported from all areas of the watershed. Wet weather turbidity values were high (5-1266 NTU) and spread throughout the watershed. The turbidity levels from wet weather are very high and may be associated with site work on adjacent properties.

Stations 31 and 32 represent a developed area on the western shore of Lake Pocotopaug that was first sampled by ENSR in 2005 and returned very high phosphorus values. In 2006, stations 31 and 32 again returned high values for dissolved phosphorus (0.12 and 0.22 mg/L), total phosphorus (5.10 and 0.90 mg/L), and turbidity (1266 and 89 NTU) respectively. Unknown inputs between upstream station 32 and downstream station 31 are responsible for the large differences between sample values. However, no obvious nearby excavations or site work were apparent.

Unlike 2005, 2006 dissolved and total phosphorus values did not decrease in the downstream direction. In fact, in many cases the values increased in the downstream direction. No clear hot spots were identified. The 2006 stormwater data suggest that activities within and around specific areas may be responsible for the high values in that area.

<u>In-lake Results</u>

Results of the in-lake water sampling are presented in Table 3. These data are within the range of reported values for previous in-lake samples. Total phosphorus values were 0.03 and 0.03 mg/L for surface and bottom samples respectively. Dissolved phosphorus was 0.01 mg/L for both surface and bottom samples. The ammonium level was low at the surface (0.05 mg/L) but elevated at the bottom. This pattern of lower ammonium at the surface, increasing with depth is consistent with sampling in previous years.

Phytoplankton were collected on three dates between late June and late September, with the intent of tracking the rise of any blooms, especially a cyanophyte (blue-green) *Anabaena aphanizomenoides*. Samples were preserved in gluteraldehyde and viewed under a microscope after at least three days of settling and sample concentration to a factor of about 10. This way, the dominant plankton were immediately evident and other species present were encountered in less than half an hour of sample examination. Phytoplankton density and biomass were calculated from each of the collected samples.

During the summer of 2006 the Lake Pocotopaug phytoplankton community was dominated Cyanophytes (Table 4). The three most abundant species were *Anabaena* sp., *Anabaena aphanizomenoides* and *Oscillatoria* sp. These species were also dominant in terms of biomass. *Anabaena aphanizomenoides* was detected in every sample collected in 2006. In addition, high levels of Anabaena sp. were detected in June and July. The highest levels of *A. aphanizomenoides* were present in 6/30/2006, followed by 7/21/2006. Density of *Anabaena* sp. followed the same pattern over the sampling dates. Between late July and late September, the numbers of both *Anabaena* sp. and *A. aphanizomenoides* decreased and *Oscillatoria* became the dominant alga.

Zooplankton were sampled in lake Pocotopaug on one date in 2006 (Table 5). Zooplankton were present but not abundant in the June 30, 2006 sample. No especially large-bodied forms were detected, although some *Daphnia* were present. Overall, body size of zooplankton was moderate to high. The increased body size of zooplankton present in 2006, compared to 2004 may suggest that stocking of walleye is influencing the zooplankton community. Ideally, walleye predation of small planktivorous perch will result in increased zooplankton body size and abundance. More data are needed to be sure, however.

<u>Discussion</u>

Between 2001 and 2005 there was some perception that the intensity of the blooms was subsiding, and it is possible that the reduction in available sediment phosphorus due to the alum treatment was responsible. Based on the number of complaints, it appears that the frequency and intensity of blooms increased in 2006. In September 2006, a resident of East Hampton brought water samples to the town hall during a bloom and believed the alga *Microcystis* was responsible. ENSR was notified approximately 1 week later and collected a water sample on September 21, 2006, but found no evidence of *Microcystis* in the sample. Further monitoring of algae is warranted.

The results of the 2006 data reinforce the idea that nutrient loading to the lake during wet weather is a concern. It is impossible to say for sure what is responsible for such high nutrient values with limited data, but two potential causes are lawn fertilizers and land disturbances. Although 2006 dissolved phosphorus values are reduced compared to 2005, they are still high and may be related to lawn fertilizers.

Ideally, given the high variability of the 2005 and 2006 results, stormwater sampling should be conducted on at least a monthly basis, beginning in April and continuing through November, as well as delineating each drainage area and obtaining a direct measure of flow so that a loading analysis can be conducted. The loading analysis would provide a mechanism to prioritize areas for additional investigation and management. The stormwater data reported here are only concentration values, and it would be more useful if coupled with drainage area calculations to determine nutrient load values. The areas with the highest concentration values may not be responsible for the largest load to the lake. It is important to understand that the 2006 stormwater sampling is only a snapshot of the stormwater runoff and additional information is needed before any specific management techniques can be recommended.

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It is apparent that there are water quality problems in almost all tributaries to the lake in response to storm events, and that there is little consistency among these tributaries from storm to storm. A variety of human practices may be responsible, but the interaction with precipitation is complex and does not result in a pattern of water quality that is clearly indicative of any one area or type of source as the primary contributor. It would be appropriate to take storm water management actions throughout the watershed, with priority given to the larger basins, but if a more detailed priority listing is desired, more detailed sampling will be needed.

Sincerely,

Jim Berg
Environmental Scientist

Wendy Gendron
Aquatic Ecologist

Table 1. 2006 East Hampton, CT dry weather results for 20 stations sampled on July 11, 2006.

Station Number	Dissolved Phosphorus	Total Phosphorus	Turbidity	Conductivity
	mg/L	**mg/L**	**NTU**	**umhos/cm**
LP-1	0.11	0.20	17	135
LP-10	N/A	N/A	N/A	N/A
LP-3C	0.02	0.08	7	181
LP-3B(7)	0.04	0.33	23	99
LP-3(4)	0.19	1.03	89	135
LP-32	<0.01	0.50	44	105
LP-31	0.23	0.86	80	142
LP-13	0.01	0.57	48	110
LP-5C	<0.01	0.07	5	107
LP-5B	<0.01	0.11	11	115
LP-5A(14)	<0.01	0.08	7	101
LP-5(11)	0.04	0.43	45	102
LP-6(15)	0.12	0.48	52	102
LP-19	0.04	0.28	21	108
LP-8(21)	0.02	0.24	16	104
LP-9	N/A	N/A	N/A	N/A
LP-25	0.02	0.07	4	104
LP-23	0.03	0.20	15	105
LP-11A(27)	0.02	0.30	26	106
LP-11(26)	0.02	0.58	44	104
MIN	<0.01	0.07	4	99
MAX	0.23	1.03	89	181

Table 2. 2006 East Hampton, CT wet weather results for 20 stations sampled on July 12, 2006.

	Stormwater Results for Storm Samples			
Station Number	Dissolved Phosphorus	Total Phosphorus	Turbidity	Conductivity
	mg/L	**mg/L**	**NTU**	**umhos/cm**
LP-1	0.03	1.78	179	103
LP-10	0.03	0.86	64	106
LP-3C	0.05	0.64	57	102
LP-3B(7)	0.10	0.34	40	112
LP-3(4)	0.05	4.44	776	106
LP-31	0.12	5.10	1266	142
LP-32	0.22	0.90	89	129
LP-13	0.02	0.30	24	111
LP-5C	0.06	0.18	18	106
LP-5B	0.06	0.09	5	115
LP-5A(14)	0.08	4.16	644	102
LP-5(11)	0.07	0.97	98	109
LP-6(15)	0.08	1.86	255	104
LP-19	0.07	1.17	124	94
LP-8(21)	0.08	1.66	316	118
LP-9	0.04	0.69	49	103
LP-25	0.33	1.24	172	144
LP-23	0.09	3.26	616	112
LP-11A(27)	0.10	0.79	66	111
LP-11(26)	0.21	0.94	83	129
MIN	0.02	0.09	5	94
MAX	0.33	5.10	1266	144

Table 3. 2006 in-lake sampling results for Oakwood Basin, LP-2 on June 30, 2006.

	In-lake Water Samples			
Station Number	Dissolved Phosphorus	Total Phosphorus	Ammonium	Nitrate
	mg/L	**mg/L**	**mg/L**	**mg/L**
LP-2 surface	0.01	0.03	0.05	<0.01
LP-2 bottom	0.01	0.03	0.23	0.01

Table 4. 2006 in-lake phytoplankton density and biomass results.

	Pocotopaug LP-2 surface 6/30/2006	Pocotopaug LP-2 bottom 6/30/2006	Pocotopaug Sears Park 7/21/2006	Pocotopaug Sears Park 9/21/2006
DENSITY (CELLS/ML) SUMMARY				
BACILLARIOPHYTA	2204	1185	72	560
Centric Diatoms	475	180	18	420
Araphid Pennate Diatoms	1653	960	18	40
Monoraphid Pennate Diatoms	0	0	18	0
Biraphid Pennate Diatoms	76	45	18	100
CHLOROPHYTA	418	75	72	3920
Flagellated Chlorophytes	304	0	0	0
Coccoid/Colonial Chlorophytes	76	30	72	720
Desmids	38	45	0	3200
CHRYSOPHYTA	0	30	0	100
Flagellated Classic Chrysophytes	0	30	0	100
CRYPTOPHYTA	114	0	18	0
CYANOPHYTA	27778	600	52380	28400
Unicellular and Colonial Forms	38	0	720	0
Filamentous Nitrogen Fixers	27740	600	51660	400
Filamentous Non-Nitrogen Fixers	0	0	0	28000
EUGLENOPHYTA	0	15	0	20
PYRRHOPHYTA	0	0	0	0
TOTAL	30514	1905	52542	33000
CELL DIVERSITY	0.46	0.70	0.33	0.38
CELL EVENNESS	0.39	0.62	0.34	0.29

	Pocotopaug LP-2 surface 6/30/2006	Pocotopaug LP-2 bottom 6/30/2006	Pocotopaug Sears Park 7/21/2006	Pocotopaug Sears Park 9/21/2006
BIOMASS (UG/ML) SUMMARY				
BACILLARIOPHYTA	1453.5	763.5	36	288
Centric Diatoms	138.7	51	1.8	136
Araphid Pennate Diatoms	1255.9	678	14.4	32
Monoraphid Pennate Diatoms	0	0	1.8	0
Biraphid Pennate Diatoms	58.9	34.5	18	120
CHLOROPHYTA	114	39	7.2	2712
Flagellated Chlorophytes	30.4	0	0	0
Coccoid/Colonial Chlorophytes	30.4	3	7.2	152
Desmids	53.2	36	0	2560
CHRYSOPHYTA	0	3	0	150
Flagellated Classic Chrysophytes	0	3	0	150
CRYPTOPHYTA	49.4	0	3.6	0
CYANOPHYTA	4698.7	78	8978.4	352
Unicellular and Colonial Forms	1.9	0	7.2	0
Filamentous Nitrogen Fixers	4696.8	78	8971.2	52
Filamentous Non-Nitrogen Fixers	0	0	0	300
EUGLENOPHYTA	0	15	0	20
PYRRHOPHYTA	0	0	0	0
TOTAL	6315.6	898.5	9025.2	3522
BIOMASS DIVERSITY	0.57	0.53	0.28	0.56
BIOMASS EVENNESS	0.49	0.48	0.29	0.43

Table 5. 2006 in-lake zooplankton density and biomass results.

ZOOPLANKTON DENSITY (#/L)		ZOOPLANKTON BIOMASS (UG/L)	
	Pocotopaug		Pocotopaug
	LP-2b surf		LP-2b surf
	6/30/2006		6/30/2006
Taxon		Taxon	
ROTIFERA		ROTIFERA	
Keratella	0.3	Keratella	0.027
Trichocerca	0.15	Trichocerca	0.006
COPEPODA		COPEPODA	
Copepoda-Cyclopoida		Copepoda-Cyclopoida	
Mesocyclops	0.15	Mesocyclops	0.1875
Copepoda-Calanoida		Copepoda-Calanoida	
Diaptomus	1.2	Diaptomus	0.576
Other Copepoda-Nauplii	0.3	Other Copepoda-Nauplii	0.795
CLADOCERA		CLADOCERA	
Bosmina	0.3	Bosmina	0.294
Chydorus	0.15	Chydorus	0.147
Daphnia pulicaria	0.6	Daphnia pulex	3.48
Diaphanosoma	2.85	Diaphanosoma	2.793
SUMMARY STATISTICS		SUMMARY STATISTICS	
DENSITY		BIOMASS	
PROTOZOA	0	PROTOZOA	0
ROTIFERA	0.45	ROTIFERA	0.033
COPEPODA	1.65	COPEPODA	1.5585
CLADOCERA	3.9	CLADOCERA	6.714
OTHER ZOOPLANKTON	0	OTHER ZOOPLANKTON	0
TOTAL ZOOPLANKTON	6	TOTAL ZOOPLANKTON	8.3055
TAXONOMIC RICHNESS		S-W DIVERSITY INDEX	0.7087
PROTOZOA	0	EVENNESS INDEX	0.7427
ROTIFERA	2		
COPEPODA	3	MEAN LENGTH (mm): ALL F(	0.6775
CLADOCERA	4	MEAN LENGTH: CRUSTACE.	0.7243
OTHER ZOOPLANKTON	0		
TOTAL ZOOPLANKTON	9		

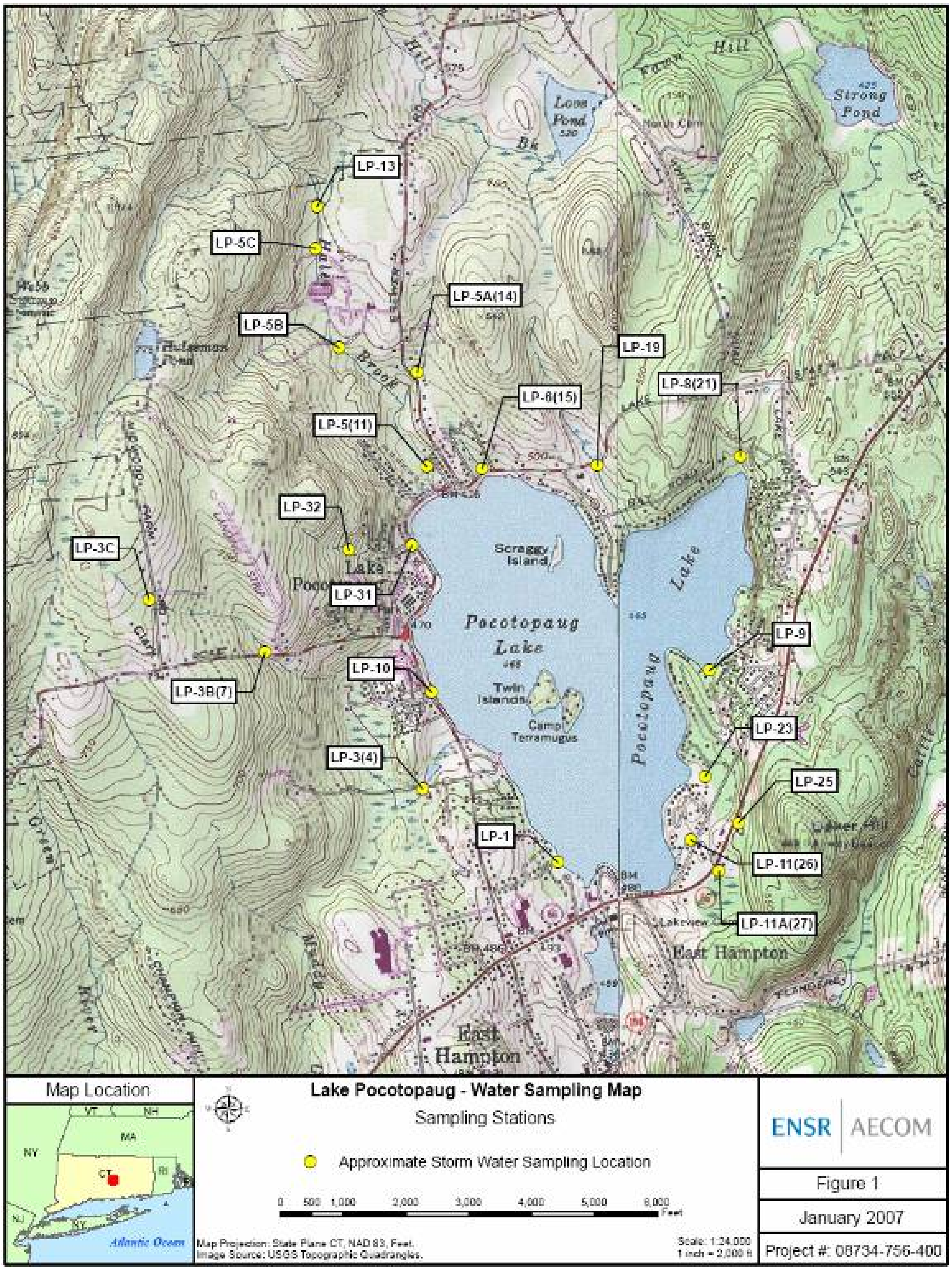

Figure 1. 2006 stormwater sampling locations.

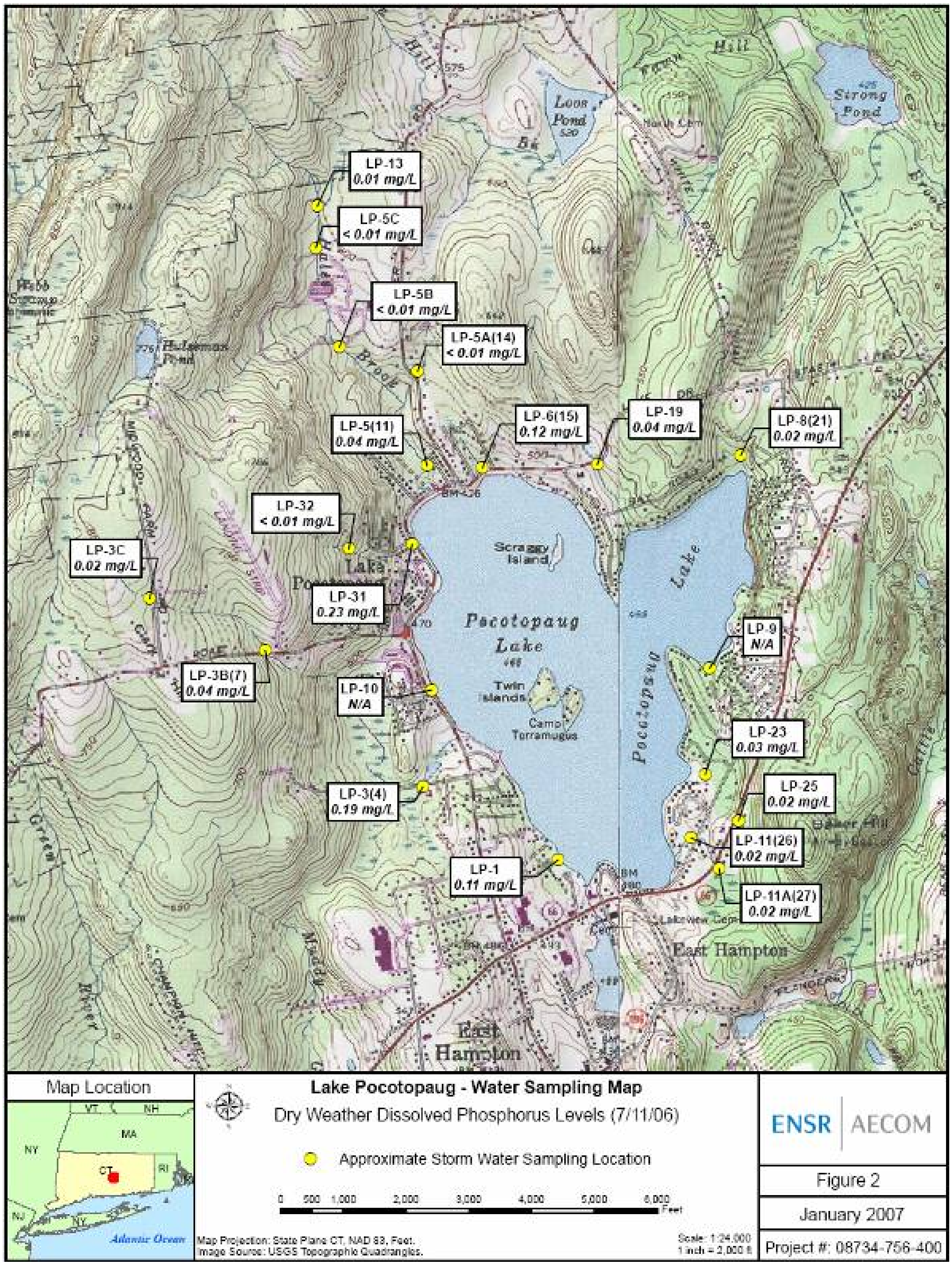

Figure 2. 2006 dry weather dissolved phosphorus results (mg/L).

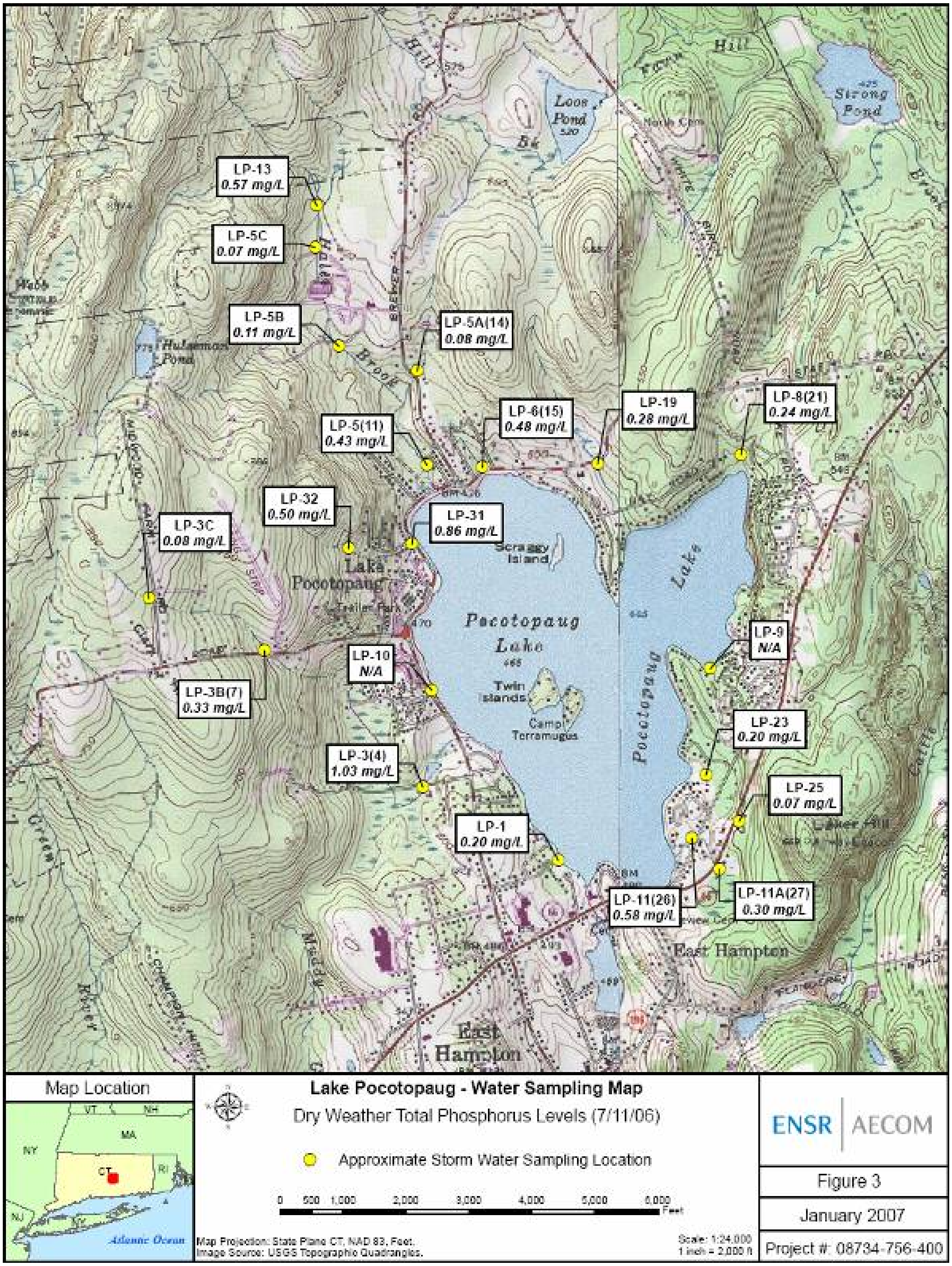

Figure 3. 2006 dry weather total phosphorus results (mg/L).

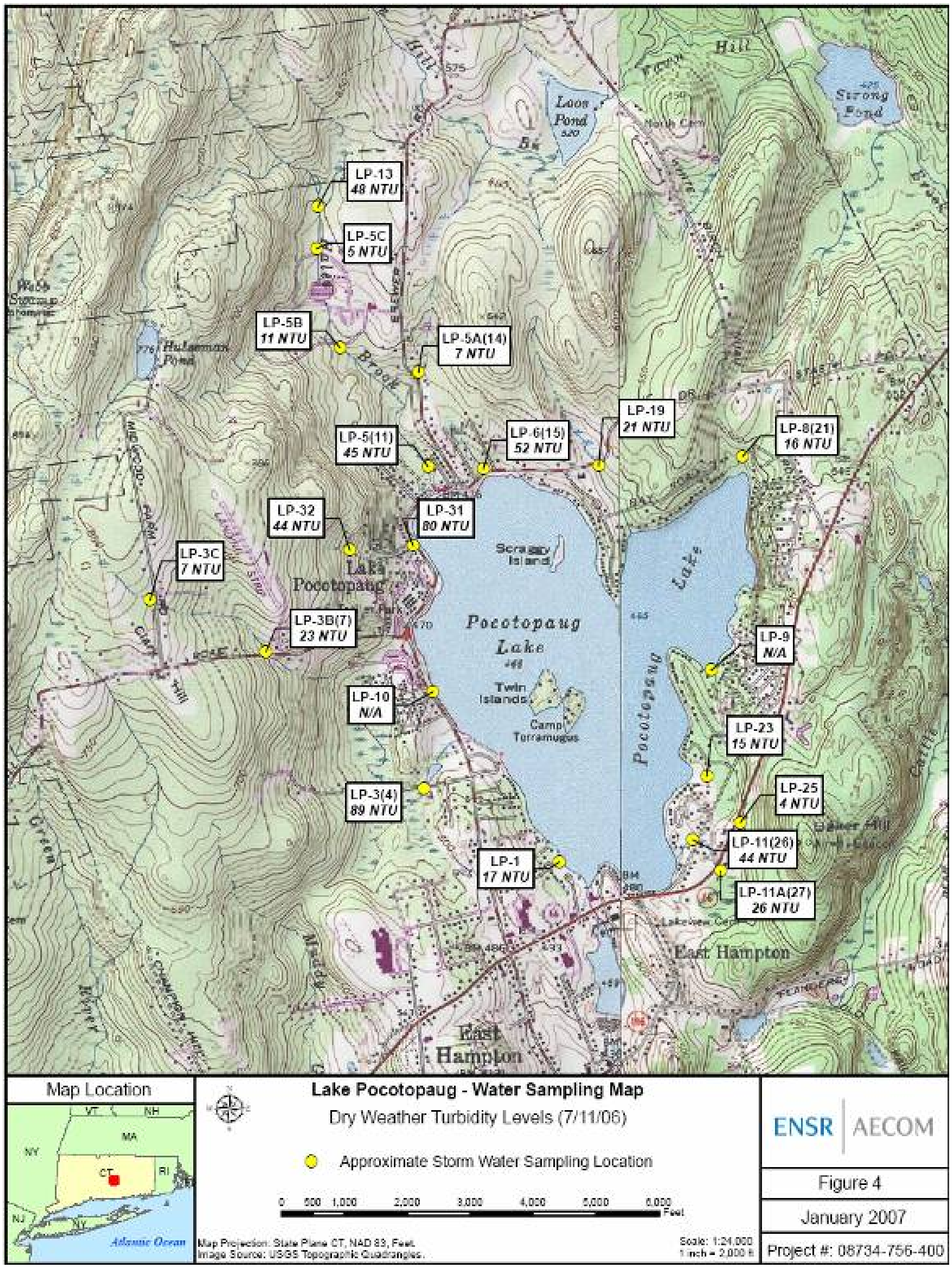

Figure 4. 2006 dry weather turbidity results (NTU).

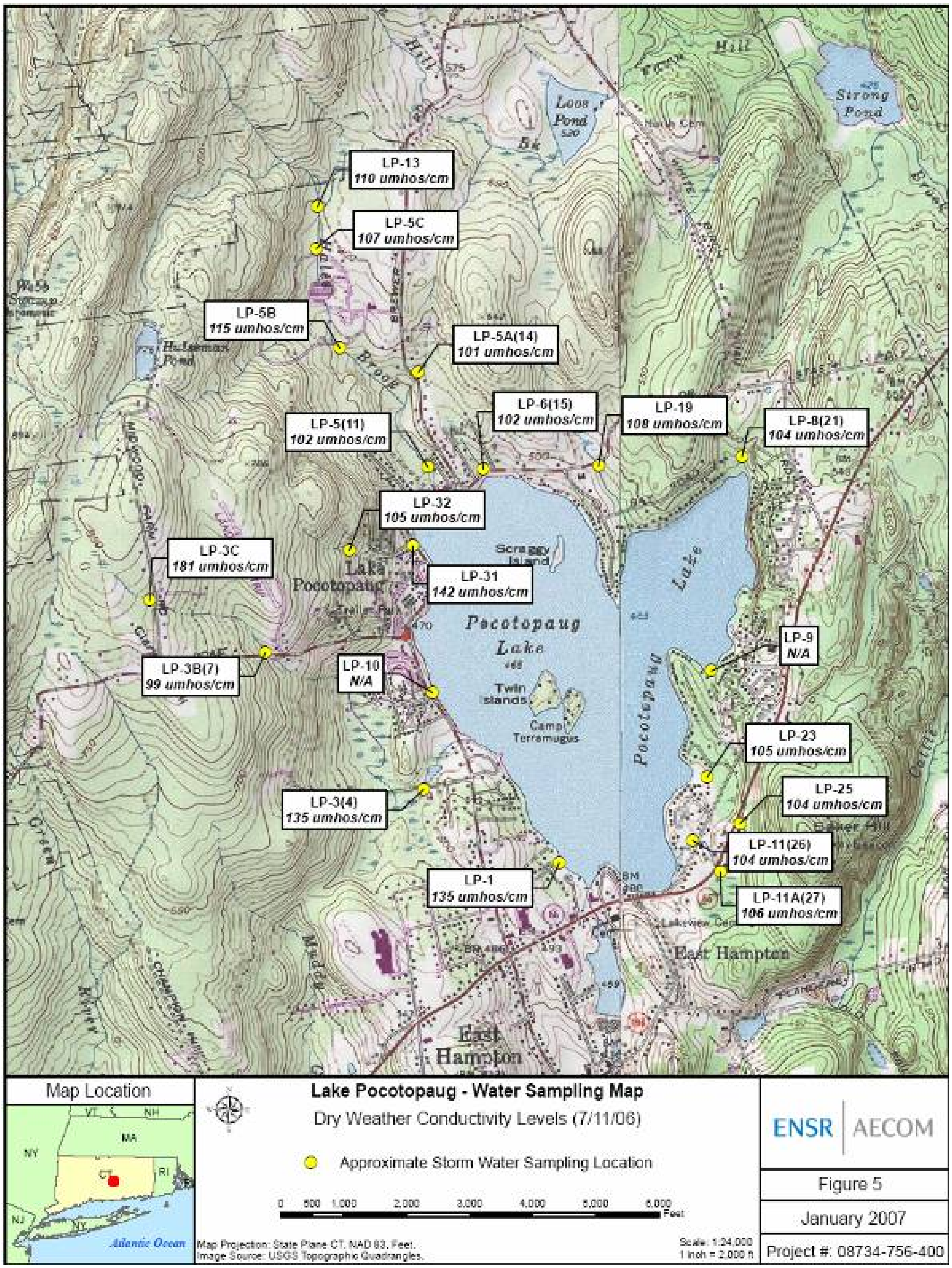

Figure 5. 2006 dry weather conductivity results (umhos/cm).

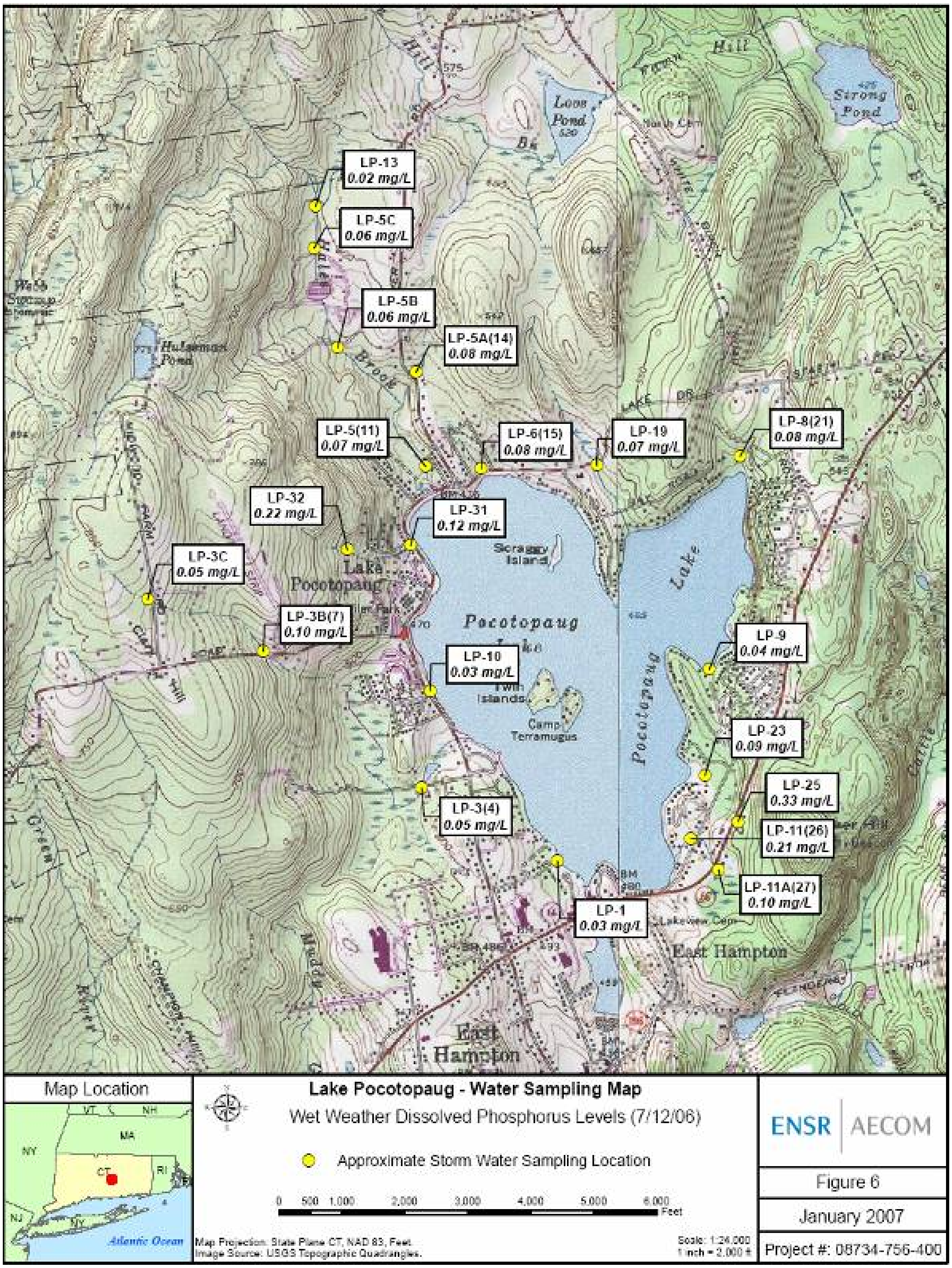

Figure 6. 2006 wet weather dissolved phosphorus results (mg/L).

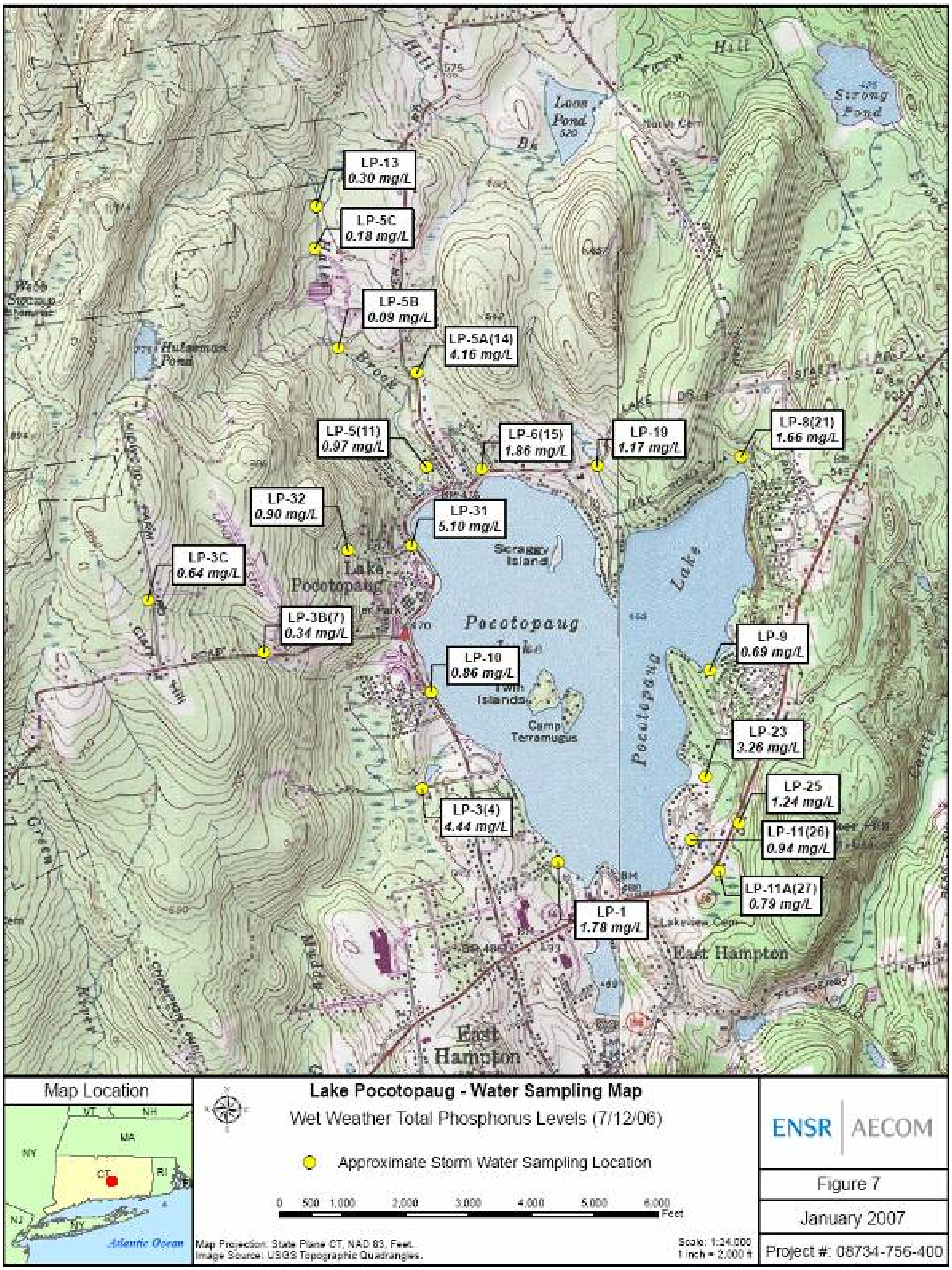

Figure 7. 2006 wet weather total phosphorus results (mg/L).

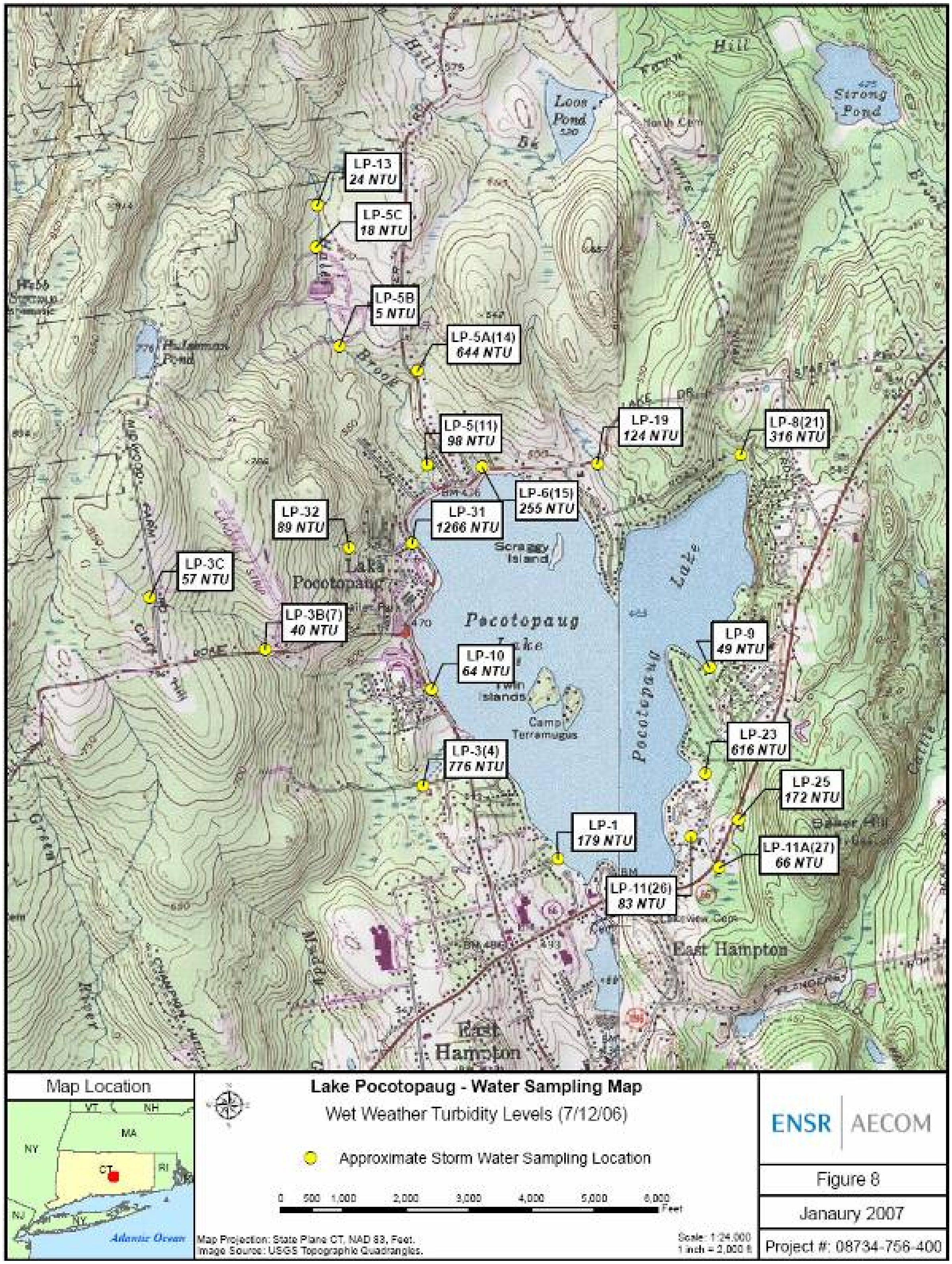

Figure 8. 2006 wet weather turbidity results (NTU).

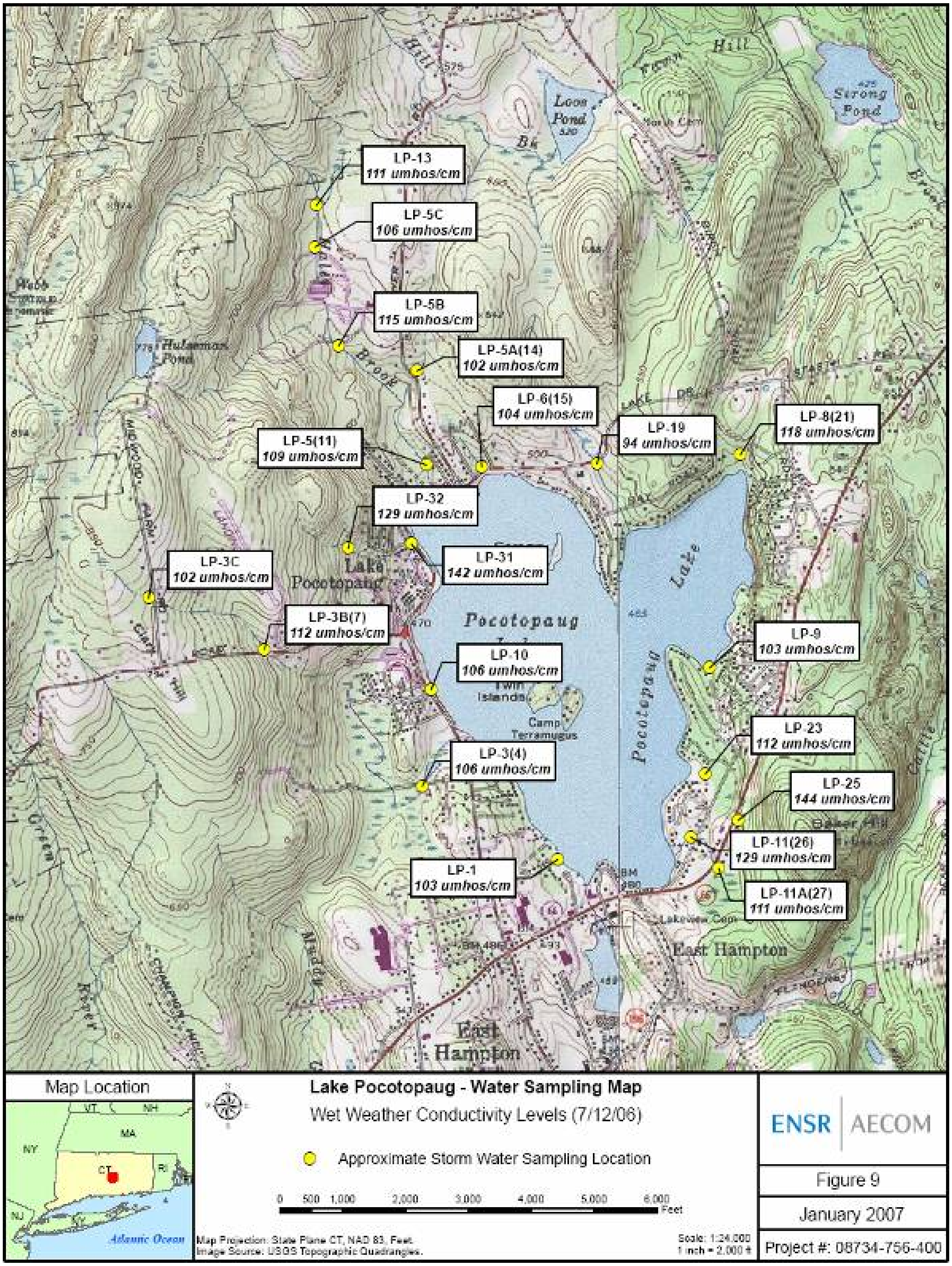

Figure 9. 2006 wet weather conductivity results (umhos/cm)