Effects of Pumped Storage Hydropower Activity on Candlewood Lake

By Chen Y. Irene, September 10th, 2025

Abstract:

Candlewood Lake is a manmade reservoir located in Western Connecticut, built in the 1920s for the purpose of generating hydroelectric power. It is connected to the Housatonic River, with which it frequently exchanges water during pump-ups and let-downs to generate and store energy. In its near century of existence, little research has been conducted to investigate the potential impacts of PSH activity on Candlewood Lake's limnology and ecology, despite the fact that pumping activity, especially in open-loop systems[1], has been shown to have the ability to significantly alter reservoirs physically and chemically[2]. This study aimed to fill this gap, utilizing Van Dorn bottles and water quality sondes at select points in the lake and river to gather information on the temperature, conductivity, DO, pH, Na, K, and nutrient levels of different layers of the lake at various locations. What we found was that pumping activity was associated with higher levels of dissolved oxygen, salinity, and nutrients in Candlewood Lake. However, it is still unclear the level of significance these additions pose to the lake, as well as what portion of these changes are attributable to pumping activity.

Introduction:

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[1] Saulsbury, Bo. A Comparison of the Environmental Effects of Open-Loop and Closed-Loop Pumped Storage Hydropower. *HydroWIRES U.S Department of Energy*, 2020.

[2] Kobler UG, Wüest A, Schmid M. Effects of Lake–Reservoir Pumped-Storage Operations on Temperature and Water Quality. *Sustainability*. 2018; 10(6):1968.

Candlewood Lake holds great significance as the first PSH (pumped storage hydropower) system ever established in the United States. Beginning in 1926 and ending in 1928, construction involved clearing the Rocky River Valley and building dams and dykes at select locations, before finally flooding the valley with Housatonic River waters. The two reservoirs are directly connected through a penstock located in the northernmost area of the lake, where the Rocky River Pumped Hydro Storage Station resides. The lake, as well as the RRPHSS, is owned by FirstLight Power Resources, who manages pumping activity. Existing research has shown that pumping activity can indeed have a measurable impact on both the lower and upper reservoirs in PSH systems by changing the behavior of the water column[3] . However, each lake and system is unique, and observations at one site may not apply to another.

Ever since 1972, the Candlewood Lake Authority has been primarily involved in the management and preservation of the lake, conducting routine checks and surveys at five select locations annually since 1983. This presented a significant research gap, as there was little to no water quality information regarding locations closer to the penstock, which is where the most exchange between the Candlewood Lake and the Housatonic River occurs. Our study aimed to bridge this gap by deviating from the established sampling sites and gathering samples in areas closer to the intake point, as well as areas in the Housatonic River. Going into this study, we hoped to address one general research inquiry: whether PSH activity has a significant impact on the limnology and ecology of Candlewood Lake. We had additional inquiries as well; for example, the New Milford arm of the lake, which is closest to the penstock, was observed to have two oxygenated layers, as opposed to following the expected pattern of a uniform decline in dissolved oxygen concentrations as depth increased. Could this be due to the incoming Housatonic waters from the penstock? Our expectations were that the PHS activity did meaningfully contribute to the duo-oxygenated layers in the New Milford area, due to its proximity to the penstock and uniqueness as the only sampling site to display these patterns in

[3] Anderson, M. A. Influence of pumped-storage hydroelectric plant operation on a shallow polymictic lake: Predictions from 3-D hydrodynamic modeling. *Lake and Reservoir Management*, *26*(1), 1–13. (2010).

DO. However, our expectations for the rest of the data were much less confident given the lack of preexisting information regarding water quality in locations closer to the penstock.

The rest of this paper will cover the selected sites we chose, as well as our methodology, our findings, and finally our conclusions.

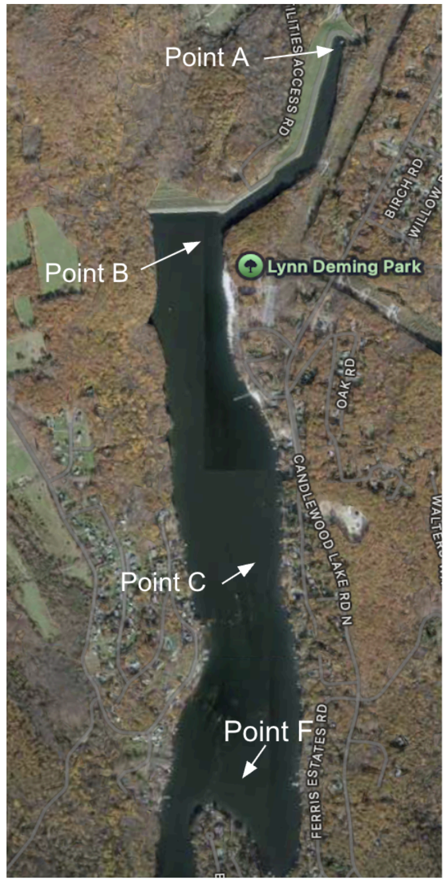
Study Sites:

Candlewood Lake (41.49°N, 73.45°W) is an 18km wide and 3.2km wide manmade reservoir, bordering the towns of New Milford, Danbury, New Fairfield, Sherman, and Brookfield. It is the largest lake in Connecticut and the New York metropolitan area, amounting to a total surface area of around 5,064 acres[4]. Its average surface elevation is 429 ft above sea level and its average depth is 40 ft, with its deepest point located in New Milford at around 90 ft. The penstock is located on the northeastern most reaches of the lake, in the New Milford area.

The lower reservoir of the PSH system is the Housatonic River, which extends to around 149 miles, flowing through southwestern Massachusetts and Connecticut. Besides being the host of several invasive species - which was a potential concern regarding the transfer of water between the two bodies - the Housatonic also generally has a higher DO saturation and conductivity levels than the Candlewood Lake.

For this project, we collected samples from five different study sites, including three sites from Candlewood Lake and two sites from the Housatonic River. Point A refers to the location as close to the intake point as possible, which is located in a zone owned by FirstLight. Due to logistical limitations, we were only able to sample once at Point A, on July 30th. Point B refers to the location closest to the exclusion zone near Lynn Deming Park. Point C refers to a location further south of Point B in the New Milford area of the Candlewood Lake, between Point B and Point F - the preexisting New Milford monitoring site annually sampled by the CLA.

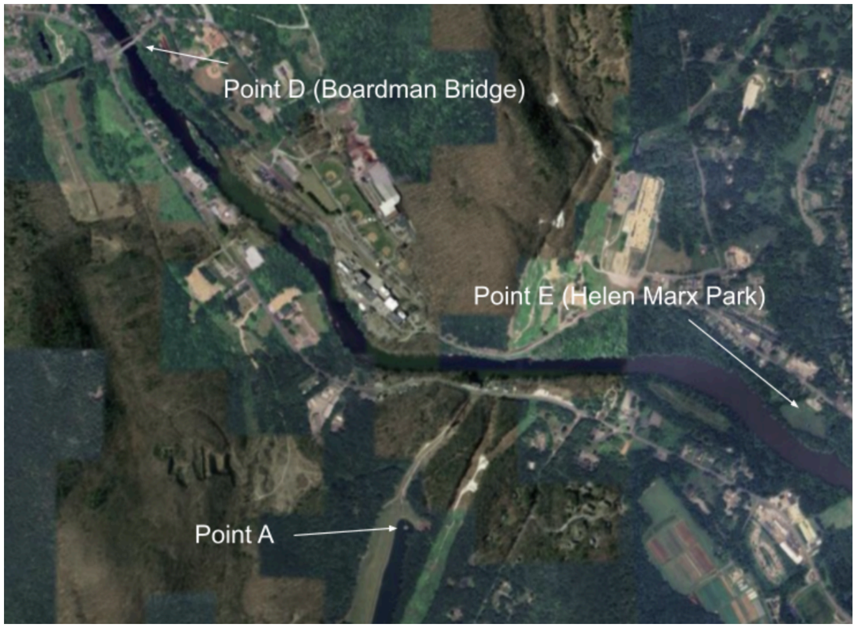
[4]Stalter, N. J. *Water Quality Monitoring of Candlewood Lake & Squantz Pond 2023*, 2023.



Map 1.

An aerial view of the New Milford area of Candlewood Lake with Points A, B, C, and F.

Point D refers to Boardman Bridge, a bridge positioned over the Housatonic River upstream from the penstock. Lastly, we sampled from Point E, which refers to Helen Marx Park, a public park in New Milford downstream from the penstock with direct access to the Housatonic. We sampled each of these locations four times, with the exception of Point A, as mentioned earlier, and Point E, due to difficulties accessing the shore. This led to a total of one sample further downstream near the New Milford Memorial Bridge, one sample at Point A, four samples at Points B, C, and D, and three samples at Point E.



Map 2.

An aerial view of the Housatonic River and the northern tip of Candlewood Lake containing Points A, D, and E.

The reasoning behind the placement of these sample locations was to gain a comprehensive look at how the water in Candlewood Lake changed as distance from the penstock increased, bridging the gap between the established New Milford sample site and the intake point. The chosen sample sites of one upstream and one downstream location were made to obtain a clear vision of the qualities of Housatonic waters before and after the influence of PSH activity.

Methodology:

We gathered data using two primary methods: Manta+ water quality sondes, and Van Dorn bottles. The Manta+ sonde is a multiparameter probe that allows us to measure depth, HDO saturation, pH, conductivity, and temperature. At each of the locations with the exception of Points B and E, we used the probe to measure these qualities at each meter of depth. The probe is connected to a phone, which displays these measurements live.

Additionally, a Van Dorn bottle was used to collect water from the epilimnion, metalimnion, and hypolimnion of each sample site in Candlewood Lake. The epilimnion samples and chlorophyll samples were taken from the 1st meter, while the metalimnion samples were taken at the depth of the most extreme change in temperature. The hypolimnion measurements were taken at one meter above lake bottom, which could be determined using sonar.

The samples were gathered on a weekly basis over four weeks, then labeled and sent to the UCONN Center for Environmental Science and Engineering lab for nutrient assessment. The combined data from the Manta+ sonde and the UCONN lab was then formatted into Google Sheets, and analyzed from there.

While there isn't an official schedule for pumping, FirstLight's pumping activities could be roughly estimated through their phone line, which details the daily level of Candlewood Lake in centimeters. On a daily basis from July 19th to August 10th, we called the phone line to determine the lake level, and thus extrapolate whether the lake was in a pump-up or letdown phase.

Results:

Based on our results from FirstLight's phone line, we were able to create a chart displaying the change in Candlewood's water level over the course of late July to early August. From this, we can assume that before July 19th the lake experienced a pump-up period, based on the similarity to the heights from August 5th-10th. From July 19th to 21st the lake was coming off of this pumping period, and from July 22nd to August 1st, the water level dropped, indicating that water was being drained from the Candlewood Lake into the Housatonic during a let-down phase. Lake levels increased from August 2nd to August 7th, indicating that water was being pumped back into the lake from the Housatonic, and remained stagnant until the end of the sampling period.

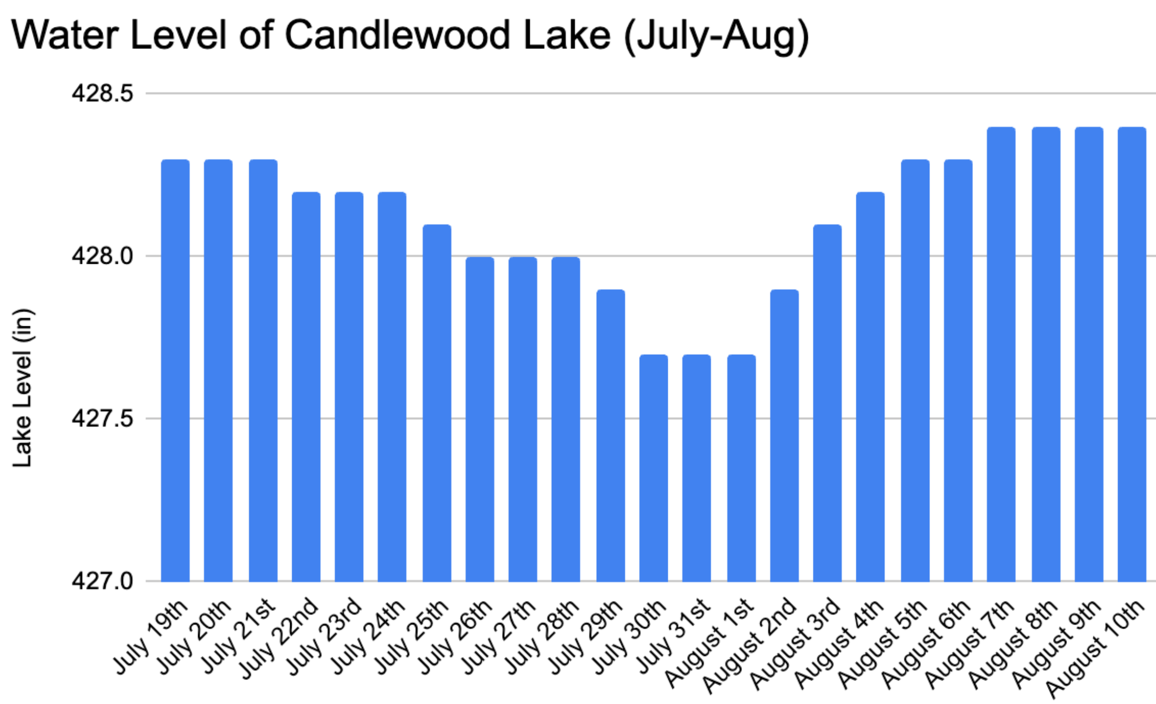


Figure 1.

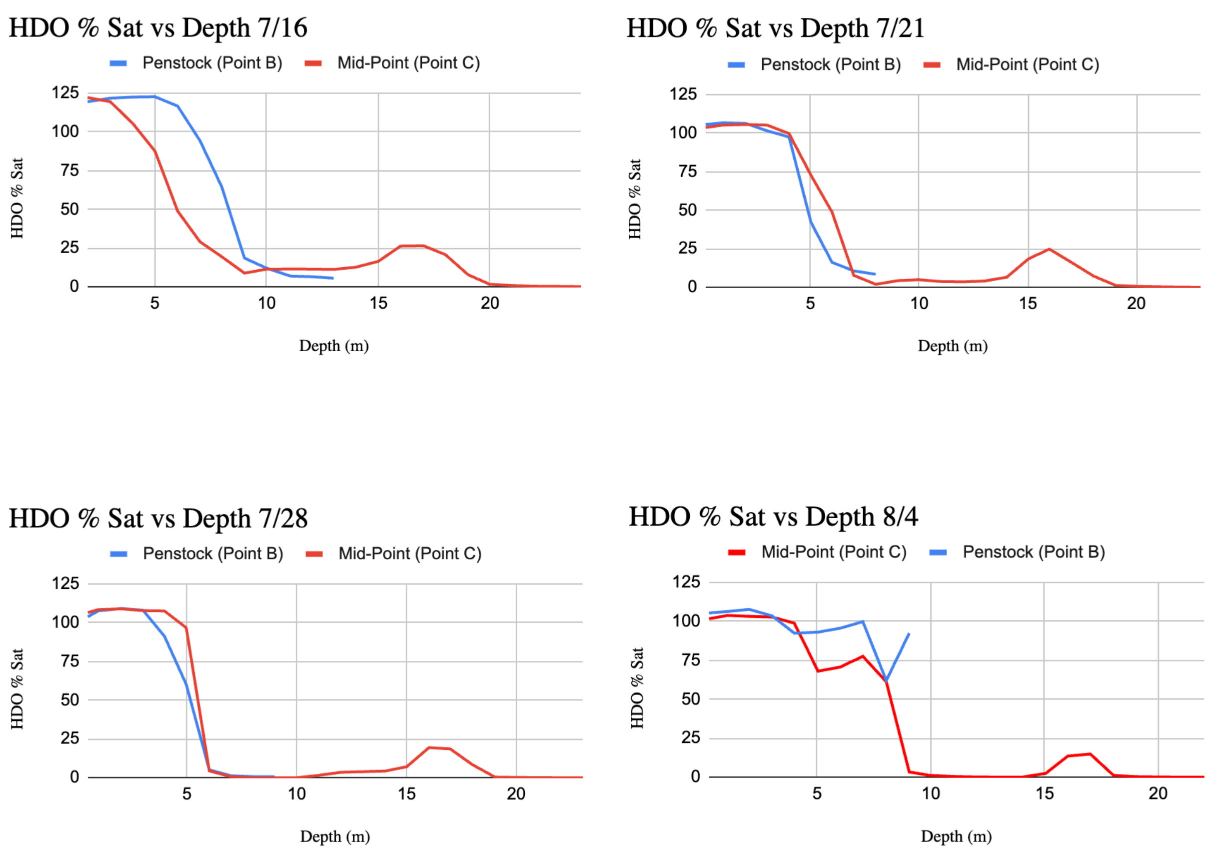
Bar chart displaying the daily change in water level (in cm) from July 19th to August 10th.

Our samples of Points B, C, D, and E took place on four dates: July 16th, July 21st, July 28th, and August 4th. The only exception to this was our first sample at Point E, which was taken on July 18th at a location further downstream, as previously mentioned. Point A was sampled once, on July 30th. This places our first sampling date (7/16) near the height or coming off of the end of a pump-up period, our second sample at the beginning of the letdown period, our third sample near the peak of the letdown period, and our fourth sample during the middle of a pump-up.

This is relevant as it provides the framework for our data moving forward, as our results will vary depending on whether water is transferring into or out of the lake.

First, we will discuss our findings on dissolved oxygen concentrations, before transitioning to our findings related to conductivity, nutrient levels, and other observations.

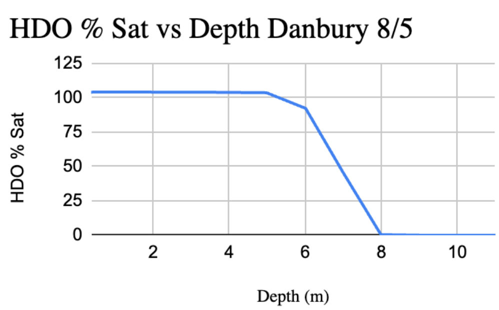
Consistent with our findings from previous years, the New Milford area of Candlewood Lake contained two anoxic zones, with two separate layers of higher dissolved oxygen concentrations in the epilimnion and upper hypolimnion (see Figures 2 - 5). This contrasts with other areas of the lake, such as in Danbury, New Fairfield, and Sherman, which display the standard pattern of oxygenation decreasing with depth (see Figures 6 -8).

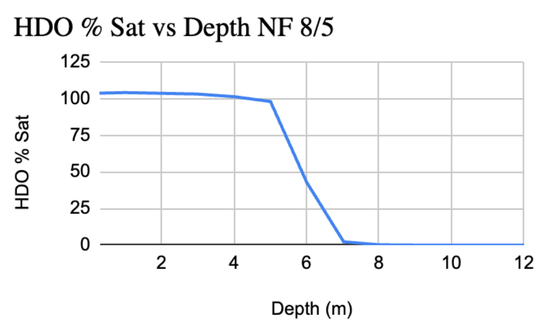


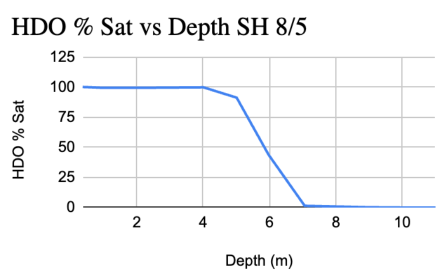
Figures 2 - 5.

Charts displaying the change in HDO % saturation as depth increases on all four sample dates. The blue line indicates measurements from Point B (at Lynn Deming Beach), and the red line indicates measurements taken from Point C (Mid-Point).

Additional observations include how the DO concentrations at Point B were higher than DO concentrations at Point C on 7/16 and 8/4, which coincide with pump-up dates, and that DO concentrations at Point B were either closer to or lower than DO concentrations at Point C on 7/21 and 7/28, the peak letdown periods.







Figures 6 - 8.

Charts displaying the change in dissolved oxygen concentrations as depth increases. Samples were taken from the Candlewood Lake areas of Danbury, New Fairfield, and Sherman during the CLA's routine sampling.

Moving past our findings on dissolved oxygen, we were able to obtain some interesting information regarding conductivity levels. The conductivity - or the saltiness - of the New Milford area has always been significantly higher than in other arms of the lake (see Figure 9).

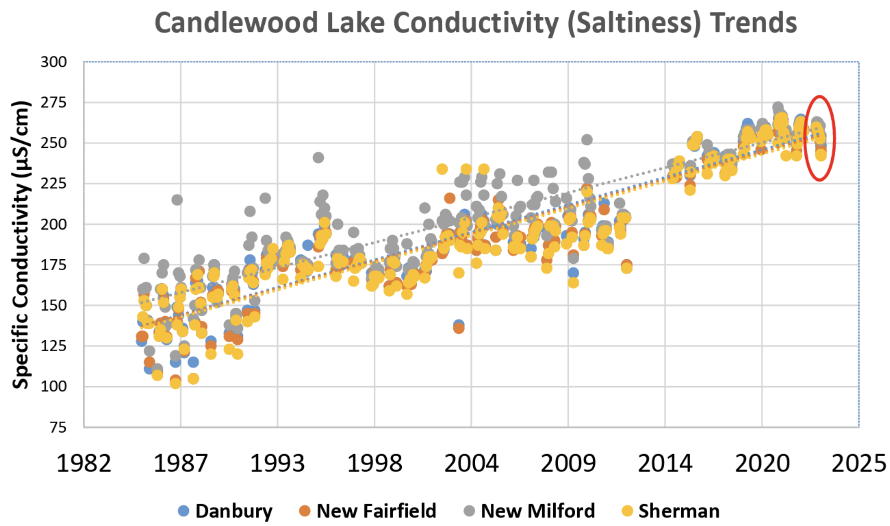


Figure 9.

Chart taken from the Water Quality Monitoring of Candlewood Lake & Squantz Pond 2023 report. It displays conductivity levels at Danbury, New Fairfield, New Milford, and Sherman from the span of 1982 to 2023. Conductivity levels in the lake have been rising overall, possibly due to runoff - a concerning trend. As shown here, New Milford consistently displays higher conductivity levels than other locations.

This was reflected in this year's data, from which we can draw several observations. New Milford consistently had the highest conductivity between Danbury, New Fairfield, Sherman, and Squantz Pond. This could potentially be attributed to the fact that the New Milford sampling site has the greatest depth of all the sites, and conductivity in lakes usually increases with depth. However, data taken exclusively from the top 11 meters of the New Milford location (total depth 22m), still overtook the conductivity levels of other locations, demonstrating the unusually high salinity of the New Milford arm (see Figure 10).

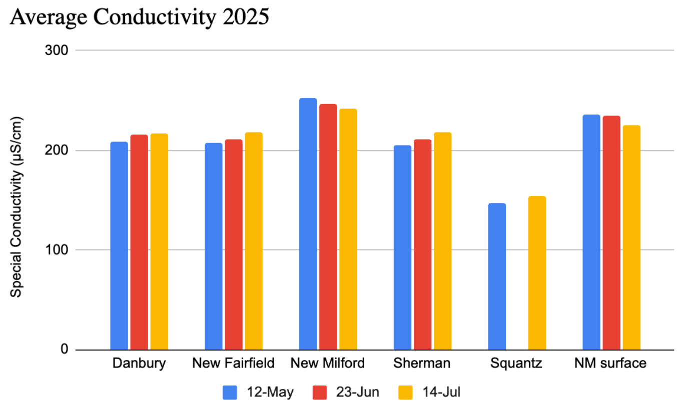


Figure 10.

Chart displaying data taken from the 2025 WQ Master Google Sheet on Danbury, New Fairfield, New Milford, Sherman, Squantz (data missing for 6/23), and the upper half of the New Milford arm.

Data from Points B, C , and D also reveal some information about the relationship between the Candlewood Lake and the Housatonic's conductivity levels. As previously known, the Housatonic has a higher average conductivity than Candlewood Lake, which is clearly displayed in Figure 11. Point D contains the highest conductivity levels out of all three sites on all four sampling dates, while Point C has marginally higher conductivity rates than Point B. An interesting pattern, however, is that conductivity levels at Point B and Point C decrease on July 21st and July 28th, which coincide with the period in which Candlewood Lake was discharging into the Housatonic (Figures 12 - 15).

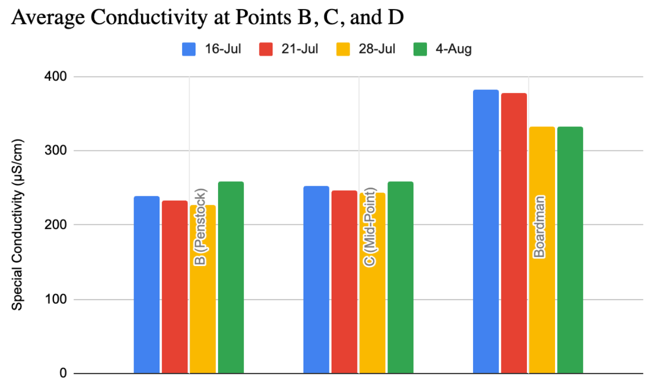
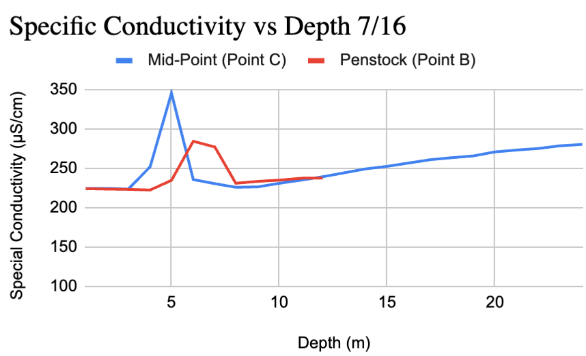
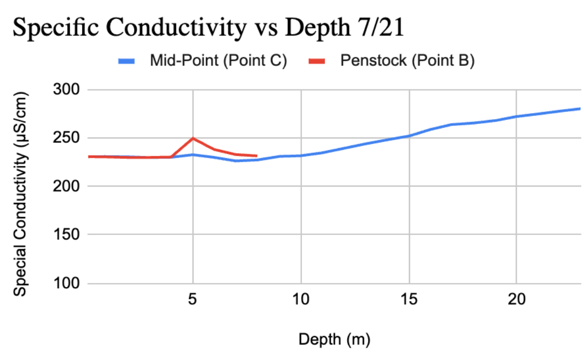


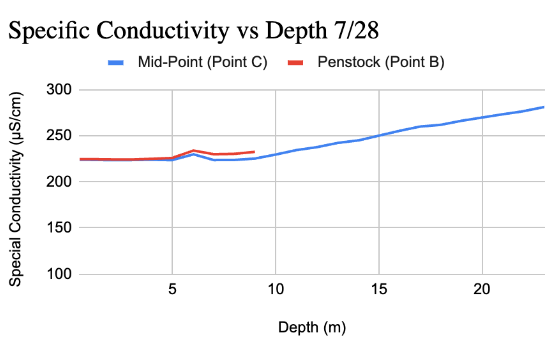
Figure 11.

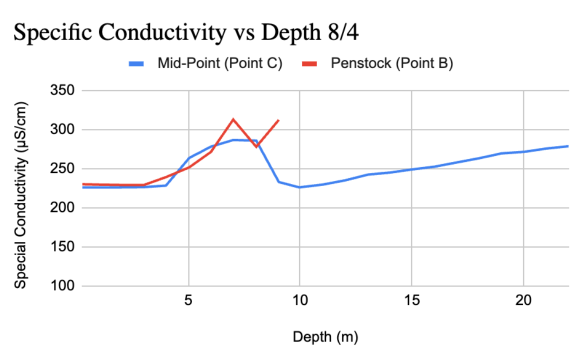
Chart comparatively displaying the conductivity levels between Point B, Point C, and Point D.

Specific conductivity levels of the Candlewood locations show a consistent peak in conductivity levels near the bottom of the epilimnion at around 5 meters, again with conductivity peaks becoming less prominent on the 21st and 28th.





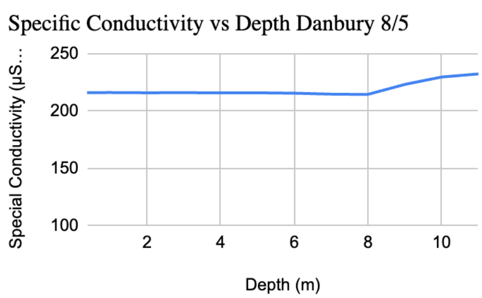


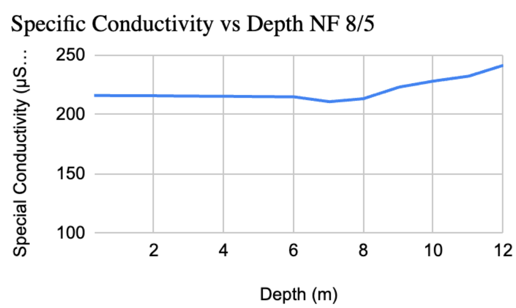


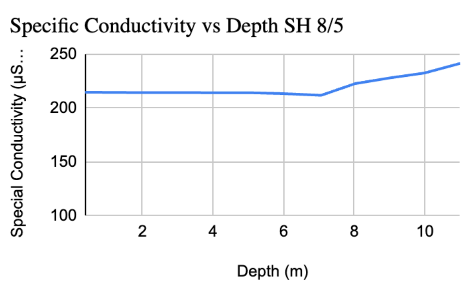
Figures 12 - 15.

Charts displaying specific conductivity values at Point B and Point C on our four sample dates, in a format similar to Figures 2 - 5.

Data taken from Danbury, New Fairfield, and Sherman on August 5th, however, show different patterns than the New Milford location. As shown in Figures 16-18, conductivity levels usually remain stagnant until around 8 meters of depth, at which point they then begin increasing. As with the dissolved oxygen levels, there is a marked difference between conductivity patterns between New Milford and the other locations.





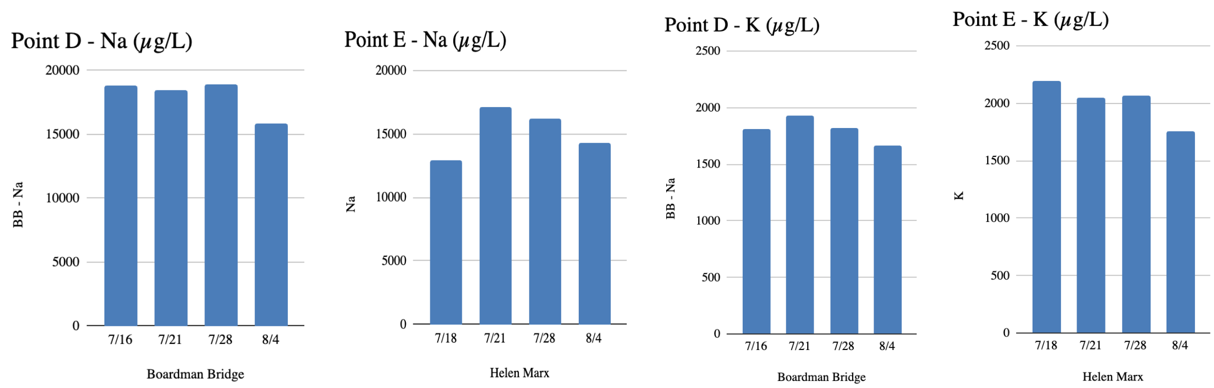


Figures 16 - 18.

Charts displaying the specific conductivity levels at Danbury, New Fairfield, and Sherman on August 5th.

We can break down our information regarding conductivity even further utilizing our data on K and Na concentrations received from the UCONN CESE lab. Results from Point D and

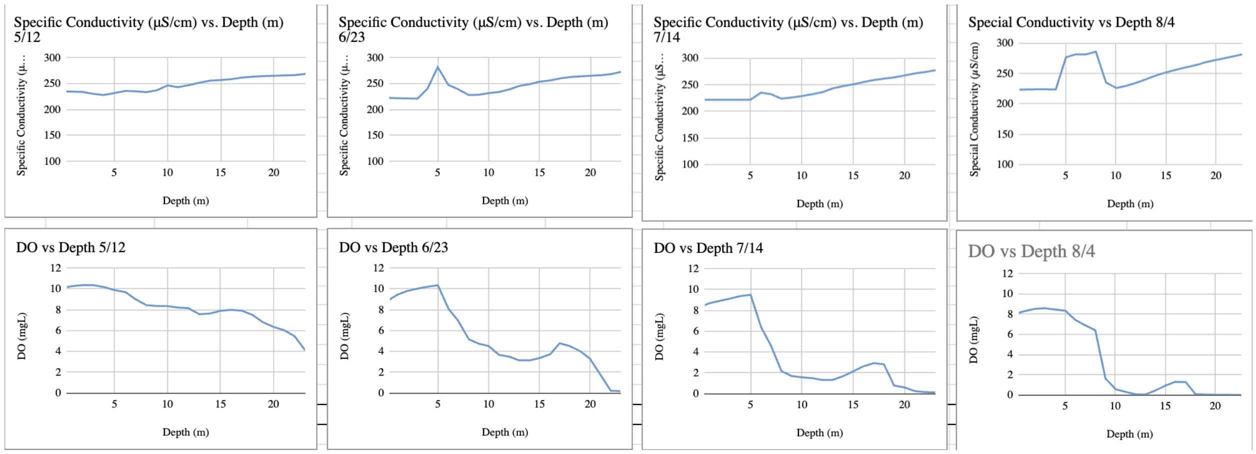
E show that Point D, Boardman Bridge, displayed on average higher concentrations of Na than Point E (Figures 23-26). However, Point E also notably displayed higher concentrations of K than Point D.



Figures 19 - 22.

Charts displaying the Na and K concentrations of Point D (Boardman Bridge) and Point E (Helen Marx).

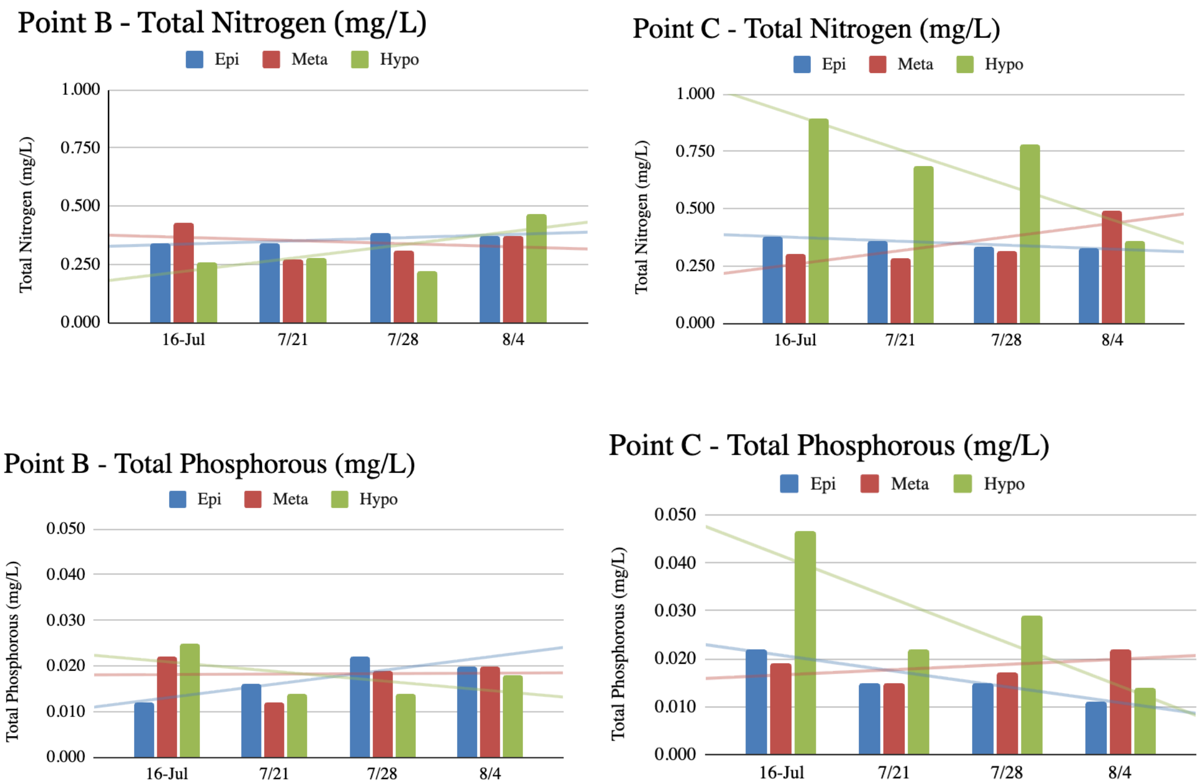
Some last observations regarding conductivity and dissolved oxygen can be made by analyzing data from the CLA's routine testing this year. At New Milford, we can observe an overall increase in prominence of two distinctive anoxic zones, as well as an overall decrease in DO, which is most likely due to seasonal changes (see Figures 23 - 30). There is also a noticeable increase in prominence of the previous spike in conductivity near the bottom of the epilimnion that we observed at Point B and Point C.



Figures 23 - 30.

Charts made from data taken at the CLA's New Milford sampling site from May to August 2025.

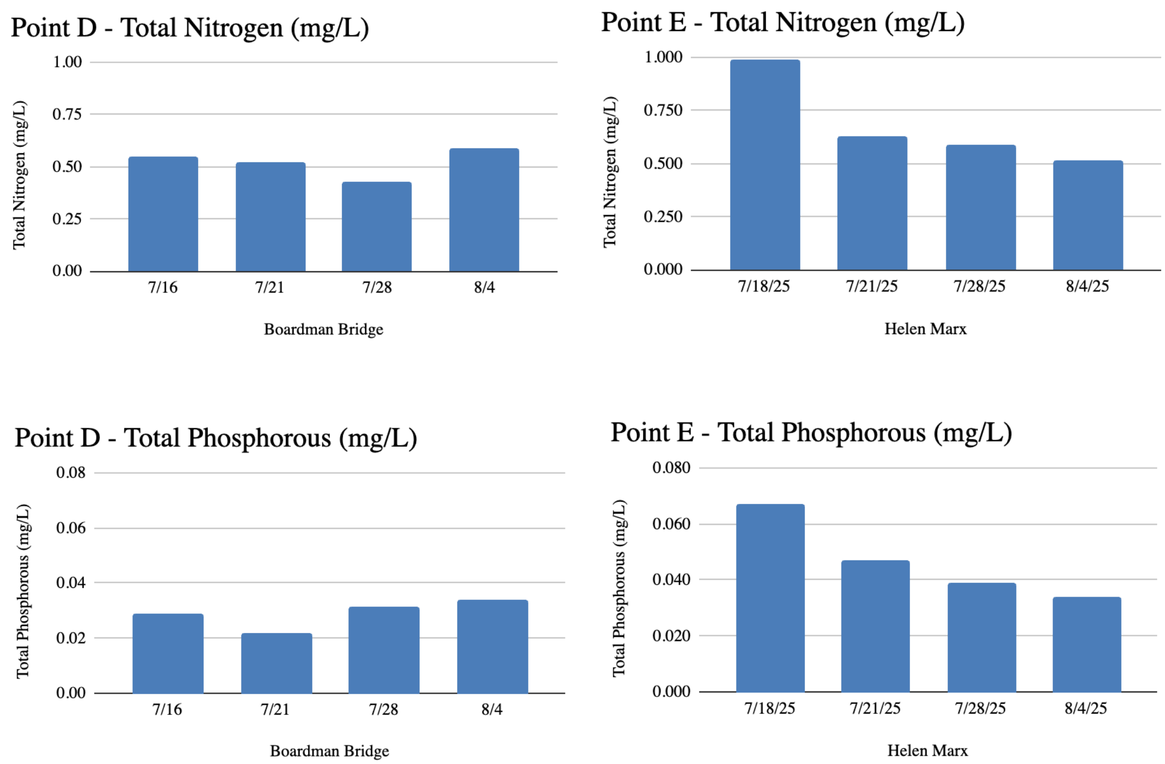
Lastly, the UCONN CESE lab gave us valuable information regarding nutrient levels at Candlewood Lake and the Housatonic River. The two nutrients that were tested for were TN (Total Nitrogen) and TP (Total Phosphorus). Nutrient levels at Point B seem to be, overall, lower than nutrient levels further from the penstock at Point C, with drastic differences between TN and TP values at the hypolimnion (Figures 31 - 34). While TN and TP levels in the epilimnion and the metalimnion are relatively the same between Points B and C, TN and TP levels in the hypolimnion are much higher at Point C than Point B. This matches the results from the Water Quality Monitoring of Candlewood Lake and Squantz Pond 2023 report, which showed much higher TP and TN levels in the New Milford hypolimnion than any other testing site.



Figures 31 - 34.

Charts depicting the Total Nitrogen and Total Phosphorous concentrations at Point B and Point C.

Additionally, TN and TP concentrations were higher at Point E than Point D, with the highest nutrient levels coming from the first sample date, which was taken from further downstream, decreasing from there. Overall, both Housatonic locations contain significantly greater concentrations of nutrients than the Candlewood locations - findings consistent with previous years of data and what we know about the two bodies' properties.



Figures 35 - 38.

Chart displaying the TN and TP values at Boardman Bridge and Helen Marx Park throughout the four sampling dates.

Before analyzing our findings further, it is important to acknowledge some limitations regarding our data. For example, we were confined to only four sampling dates, which could potentially diminish the accuracy of our results, and thus our confidence in them. Additionally, of the four sampling dates, we were only able to obtain one sample on a date (8/4) during a definitive pump-up cycle, and the day in which we were able to sample at Point A occurred at the peak of letdown, which unfortunately doesn't reveal much about the quality of water being pumped into the lake. The sampling sites of Point D and Point E were not ideal either, but were chosen out of convenience and practicality as there were a limited number of easily accessible locations. The Rocky River, as well as other channels, flow into the Housatonic between Boardman Bridge, the penstock, and Helen Marx, which could have influenced our data, and the

Helen Marx sampling location was located adjacent to a creek - which again, could have influenced our data in a matter not reflective of the Housatonic's general water quality. Our first downstream sample of the Housatonic River was also taken from a point much further downstream than Helen Marx Park due to logistical reasons, which could call to question the validity of the 7/18 sample of Point E.

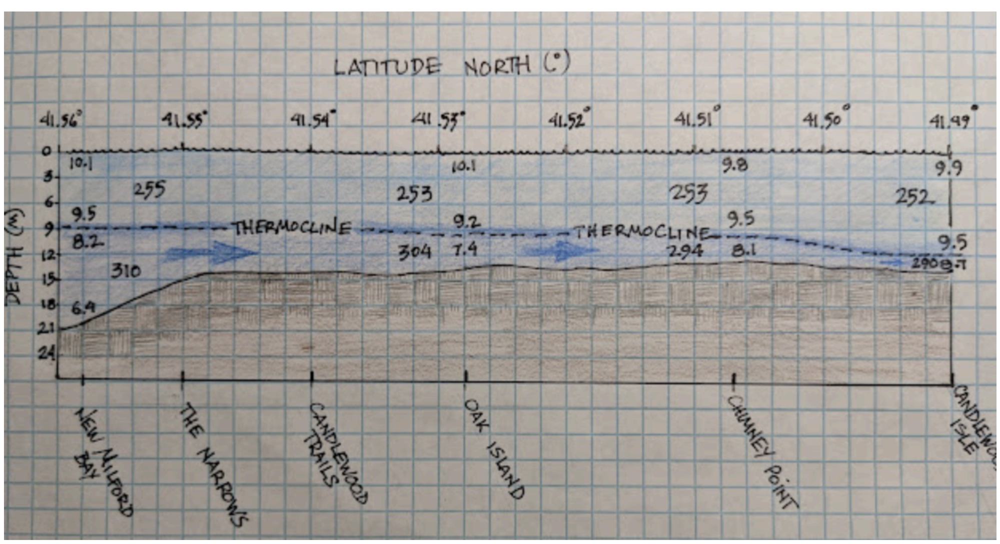
Lastly, a lack of pumping cycle history and quantitative measurements of how much water transfers between the two bodies makes it difficult to quantitatively assess the relative importance of the Housatonic's contributions to Candlewood Lake.

Despite these limitations, however, we were still able to draw some intriguing results regarding the influence of Housatonic waters introduced from the penstock on the lake.

Discussion:

Analyzing our results, we can conclude that PSH activity in Candlewood Lake can indeed have measurable impacts on variables such as dissolved oxygen, conductivity, and nutrient levels; or at least, during the sampling period, our results produced trends that heavily indicated this conclusion. For example, take Figures 2 through 5. As gathered from Figure 1, the 8/4, and most likely 7/16, samples coincided with pump-up activity, in which water was being transported from the Housatonic into the lake. During all four sampling dates, Point C displayed prominent oxic zones both at the surface and at meters 15 to 17, which was previously suspected to be attributed to PSH activity, though not yet confirmed. Our results back this hypothesis, as on 7/16 and 8/4, Point B contained higher DO concentrations than Point C. This could be due to the accumulation of oxygen from pumping activities, which bring in oxygen-rich waters from the Housatonic. Following this logic, sampling dates 7/21 and 7/28 should then show a decrease in DO levels near the penstock, which was reflected in our results. DO levels at Point B and Point C overlapped, and the second oxic zone on 7/28 (around the peak of the letdown period) was noticeably less prominent than on 7/16, most likely as a result of a lack of incoming oxygen-rich Housatonic waters. This combination of findings leads us to conclude that it is highly likely that the increase in oxygen at the depth of around 15-17 meters is due to the infiltration of oxygen-rich waters from the Housatonic.

Starting in late May to early June when the lake begins stratifying, the saltier, colder, and denser water pumped up from the Housatonic travels along the bottom of the canal, resulting in the double-anoxic layer feature we have been observing in New Milford. As the weather gets colder and stratification becomes less intense, the water column begins to mix - thus allowing pumped-in Housatonic waters to reach higher layers in the New Milford area, which was documented by in a similar research study performed by Steve Kluge during the winter of 2020[5]. The study observed the formation of a “lens” of colder, saltier Housatonic water moving along the bottom of the lake at around 9 meters of depth, gradually warming from gained heat from the upper layers before dissipating. Given that the penstock is located at the deepest point in the water column, it makes sense that colder, saltier, nutrient-rich and oxygen-rich waters would enter at the hypolimnion, then gradually disperse as distance from the penstock increases.



[5] Kluge, Steve. *Housatonic Pump-Up into Candlewood Lake*. Steve Kluge’s Geoscience News. 2020.

Figure 39.

Hand-drawn chart included in *Housatonic Pump-Up Into Candlewood Lake*.

As per the CLA's 2023 water quality report, conductivity levels in Candlewood Lake have exhibited a positive trend since 1987 (see Figure 9). The penstock is a viable explanation for why New Milford consistently displays higher conductivity levels than other locations, as the Housatonic River is on average saltier than the lake (see Figure 11), and Figures 12 - 15 displayed similar patterns as Figures 2 - 5, with conductivity peaking on pump-up dates.

At regular monitoring sites, all 2024 levels were lower than the last few years (at around 210 μS/cm). 2025 levels were also favorable at around under 220 μS/cm, with the exception of the New Milford arm, which was around 250 μS/cm, in line with the long-term positive trend. While the penstock could explain the difference between conductivity patterns at New Milford and other branches, it most likely does not account for this general increasing trend in salinity. An explanation for this trend could be an increase in pumping activity - however - the major contributor to the overall increase is still runoff, wastewater discharge, and other forms of pollution have increased dissolved ion concentrations in the lake.

In summary, while the penstock may contribute to higher concentrations of conductivity in the New Milford arm, it is unsure how significant of a role it plays in the overall increase of conductivity. Due to a lack of information on past pumping schedules, it is hard to conduct a quantitative analysis for how significant incoming Housatonic waters are, as opposed to runoff and other tributaries, and further studies should be conducted.

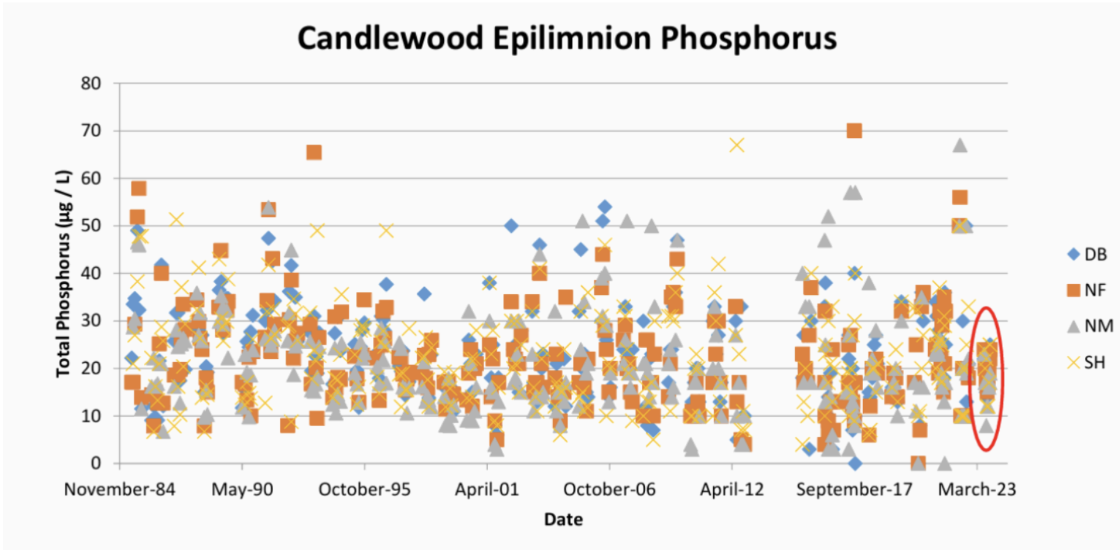


Figure 40.

Chart taken from the 2023 water quality report on the phosphorus levels at Danbury, New Fairfield, New Milford, and Sherman from November 1984 to March 2023.

As demonstrated by Figures 31 - 34 and Figures 35 - 38, TN and TP levels were overall much higher in the Housatonic than in the lake.

Unexpectedly, nutrient levels taken at Point A were the lowest of all the other points. However, this can be explained by the fact that our sampling date, July 30th, coincided with the peak of a letdown period, and thus the sampled waters were entirely from the lake. The sample was also taken from the very surface of the water, further explaining the low nutrient concentrations.

A reason why nutrient levels at Point E are higher than nutrient levels at Point D could possibly be because of the Rocky River, which flows in between Boardman Bridge and Helen Marx, and could contribute to higher nutrient concentrations. However, the more likely explanation has to do with the sampling location that was chosen for Point E, which was taken close to a creek. Creeks often act as entry points for nutrient pollution to the larger body, which could have contributed to the higher TN and TP levels at Point E.

Following the previous patterns exhibited by DO and conductivity, Housatonic water enters the lake at the hypolimnion, contributing to the high nutrient yields in the New Milford hypolimnion.

Though the river could be a positive contributor of TP and TN to the lake, historically, TP levels in New Milford do not display a significant difference from TP levels at other branches (see Figure 40). A possible explanation for this could be how phosphorus and oxygen interact at lake bottoms. In anoxic conditions, trapped phosphorus in the sediment releases, contributing to high nutrient levels at lake bottoms[6]. However, the presence of the deep oxic zone in New Milford could help prevent the release of phosphorus, leading to a situation where incoming high DO and nutrient concentrations at the New Milford arm "cancel" each other out.

Another interesting observation to note is that Point C contained much higher amounts of TN and TP than Point B, especially in the hypolimnion, which conflicts with the idea that the penstock brings in nutrient-rich water, as then Point B would be more nutrient-rich than Point C. However, this can be explained by the depths at Points C and B. While Point C is 22 meters deep, B is less than 10 meters deep. The same pattern of high nutrient concentrations at the New Milford hypolimnion was also found in 2023. Due to the taller water column at Point C, a greater amount of nutrients are able to accumulate at the lake bottom, thus accounting for the greater nutrient concentrations. This is also likely because during the summer and even through late fall, the New Milford arm had not been fully mixed, leading to a great difference in nutrients depending on thermal layers.

In summary, our findings lead us to conclude that it is very plausible the pump-up is responsible for contributing notifiable changes to the Candlewood Lake's water quality. For a while now, PSH activity has been suspected to encourage the formation of the two anoxic zones in the New Milford arm, and thus also likely contributes to other changes in value such as higher conductivity and nutrient levels. As shallow water from the Housatonic enters the deep layers of

[6] Hoverson, D. *Phosphorus Release from Sediments in Shawano Lake, Wisconsin*. College of Natural Sciences, University of Wisconsin. 2008.

Candlewood Lake, Housatonic water interacts with oxygen-poor and nutrient-poor waters, gradually rising through the water column and facilitating mixing. While these findings are intriguing, it is hard to measure the overall impact that PSH activity has on the lake.

Suggested future actions include gathering more data regarding PSH activity during periods not covered by previous studies (July - August and November) at the same locations and possibly at additional sites. It would also be useful to have more information on nutrient levels at Point A on a pump-up date, as well as at different depths. Ideally, we would have also chosen another downstream sampling site, preferably closer to the penstock or at least further from any other water sources such as creeks or streams. Further communication between the CLA and FirstLight would also prove beneficial, as this would lend us more accurate information regarding pumping schedules, durations, the quantity of water transferred between the two bodies, and thus the relative significance of Housatonic waters on Candlewood Lake. Other possible areas of impact to explore include the transferral of invasive species, industrial contaminants[7], and erosion.

While these results do indicate shifts in water quality in the New Milford arm (and in some cases even further) due to pumping activities, without additional information and an increased amount of sample dates, it is hard to verify our findings with complete certainty, and measure just how significant these impacts are.

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[7] Understanding PCB Risks at the GE-Pittsfield/Housatonic River Site. *United States Environmental Protection Agency*, 2025.

References:

1. Saulsbury, Bo. A Comparison of the Environmental Effects of Open-Loop and Closed-Loop Pumped Storage Hydropower. *HydroWIRES U.S Department of Energy*, 2020.
   https://www.energy.gov/sites/prod/files/2020/04/f73/comparison-of-environmental-effects-open-loop-closed-loop-psh-1.pdf

2. Kobler UG, Wüest A, Schmid M. Effects of Lake–Reservoir Pumped-Storage Operations on Temperature and Water Quality. *Sustainability*. 2018; 10(6):1968.

   https://doi.org/10.3390/su10061968

3. Anderson, M. A. Influence of pumped-storage hydroelectric plant operation on a shallow polymictic lake: Predictions from 3-D hydrodynamic modeling. *Lake and Reservoir Management*, 26(1), 1–13. (2010).

   https://www.tandfonline.com/doi/full/10.1080/10402380903479102#d1e592

4. Stalter, N. J. Water Quality Monitoring of Candlewood Lake & Squantz Pond 2023. CLA, 2023.

   https://candlewoodlakeauthority.org/files/galleries/WQ_Year-End_Report_2023.pdf

5. Kluge, Steve. Housatonic Pump-Up into Candlewood Lake. Steve Kluge's Geoscience News, 2020.

   https://klugegeoscience.blogspot.com/2020/

6. Hoverson, D. Phosphorus Release from Sediments in Shawano Lake, Wisconsin. College of Natural Sciences, University of Wisconsin, 2008.

   https://www3.uwsp.edu/cnr-ap/watershed/documents/hoverson.pdf

7. Understanding PCB Risks at the GE-Pittsfield/Housatonic River Site. *United States Environmental Protection Agency*, 2025.

   https://www.epa.gov/ge-housatonic/understanding-pcb-risks-ge-pittsfieldhousatonic-river-site