February 13, 2024

David Neils
Chief Aquatic Biologist
Director, Jody Connor Limnology Center
Watershed Management Bureau, Water Division
NH Department of Environmental Services
29 Hazen Drive
Concord, NH 03302

RE: Response to NHDES February 5, 2024 comments on the "*Alum Treatment Plan: Lake Kanasatka, Moultonborough, NH*," submitted on January 12, 2024

Dear Mr. Neils,

Per item (1), NHDES requested that a 15- to 20-acre pilot treatment of Lake Kanasatka be completed at least two weeks in advance of the full treatment. The purpose of the pilot treatment is to assess the chemical and biological in-lake response to alum, as well as resolve logistical details associated with access points, staging areas, trucking, and chemical deployment. Because NHDES requested a two-week delay for lab processing between the pilot treatment and full treatment, the contractor will not be able to complete a full staging and application test run for the pilot treatment. Instead, the contractor will utilize their smaller barge to apply a single pass dose of 25 g/m^2 (supplied by one split tanker) over 15 acres in one day. If the permit is issued in time, the contractor would prefer to complete the pilot treatment in late April. It is possible that the contractor can accommodate both a pilot treatment and a full treatment of Lake Kanasatka in May, if the pilot treatment can be scheduled before mid-May. NHDES has indicated that a pilot treatment is highly desired but ultimately not required for final permit approval if the contractor's scheduling does not allow for it.

Per item (2), NHDES requested that the proposed treatment zones for Lake Kanasatka be mapped and the hydrologic characteristics of each treatment zone be provided in a table, including the treatment zone surface area, water volume, mean depth, and max depth. Refer to Table 1 for the hydrologic characteristics of the identified treatment zones for this project. Refer to Figure 1 for the mapped treatment zones. The pilot treatment zone is indicated as "pilot" in Table 1 and Figure 1. Justification for the identified treatment zones is provided below.

After discussions between the contractor and consultant when identifying treatment zones, the final treatment recommendation was adjusted to maximize the efficiencies of both cost and treatment effectiveness. Achieving between 10,000 and 15,000 gallons of chemical added in a single day is the most efficient cost and time wise for the contractor. Maintaining a single pass areal dose maximum of 25 g/m^2 to safeguard aquatic life (nonnegotiable), the contractor and consultant agreed to lower the total areal dose from 55 g/m^2 to 50 g/m^2, which represents an 18:1 Al:P binding ratio (compared to the original target of 20:1) that will treat the loosely bound and iron bound phosphorus and a portion of the labile organic phosphorus fraction in the top 10 cm of sediment of the 153-acre treatment area. Adjusting the total areal dose to 50 g/m^2 means two passes will be performed per treatment zone. Splitting the treatment area into three treatment zones of approximately 51 acres each with two passes per treatment zone equates to six active treatment days (not including the one-day pilot treatment). Alternatively, the

contractor initially proposed splitting the original 55 g/m^2 areal dose into three equal doses of roughly 18.3 g/m^2 (or three passes) over two treatment zones, equating to six active treatment days. A higher dose (at the maximum allowable for safeguarding aquatic life) over a smaller area was deemed safer by the consultant compared to a lower dose over a larger area. Treating larger areas regardless of the dose amount represents a stress to aquatic life who may not be as able to readily escape to non-treatment areas. Either option achieves the low end of the contractor's preferred range (~10,000 gallons of alum), but the former option is likely safer for aquatic life. For reference, the contractor applied between 8,275 to 10,887 gallons of alum each day to treatment zones covering between 13-16% of the surface area of Nippo Lake. The three treatment zones proposed for Lake Kanasatka will treat between 14-15% of the surface area of the lake in any given day, allowing opportunity for mobile aquatic organisms to migrate to non-treatment areas. The consultant would like to make a correction to the Lake Kanasatka treatment plan when it states that treatment zones representing 25% or less of the total treatment area should be rotated daily during the application period to avoid toxicity concerns and provide refuge for mobile aquatic organisms. Treatment zones should represent 25% or less of the total lake area.

Additionally, the contractor prefers working the six active treatment days consecutively, but it may be beneficial ecologically to pause halfway through the treatment. The contractor takes one day to set up and one day to break down before and after a treatment. If the set up occurred on a Monday, the contractor could apply the first pass to the three treatment zones from Tuesday through Thursday, then have at least one but not more than three (as requested by the contractor) rest days before the second pass to the three treatment zones is completed. The contractor can work any day of the week (including weekends). The consultant recommends one or two days of rest halfway through the treatment.

Table 1. Hydrologic characteristics of the proposed treatment zones for Lake Kanasatka.

	Surface Area (ac)	Max Depth (m)	Volume (m^3)	Mean Depth (m)
Lake Kanasatka	352.9	15.2	8,371,895	5.9
Non-Treatment Areas	200.1	7.5	6,860,269	3.3
Treatment Areas	152.9	15.2	1,511,627	9.3
Area A *(total)*	**50.1**	**9.4**	**329,811**	**8.3**
Area A1	1.7	7.8	6,426	7.5
Area A	48.4	9.4	323,385	8.3
Area B	**51.4**	**10.3**	**437,310**	**8.8**
Area C *(total)*	**51.3**	**15.2**	**744,505**	**10.6**
Area P	15.0	13.2	189,575	10.2
Area C	36.3	15.2	554,930	10.8

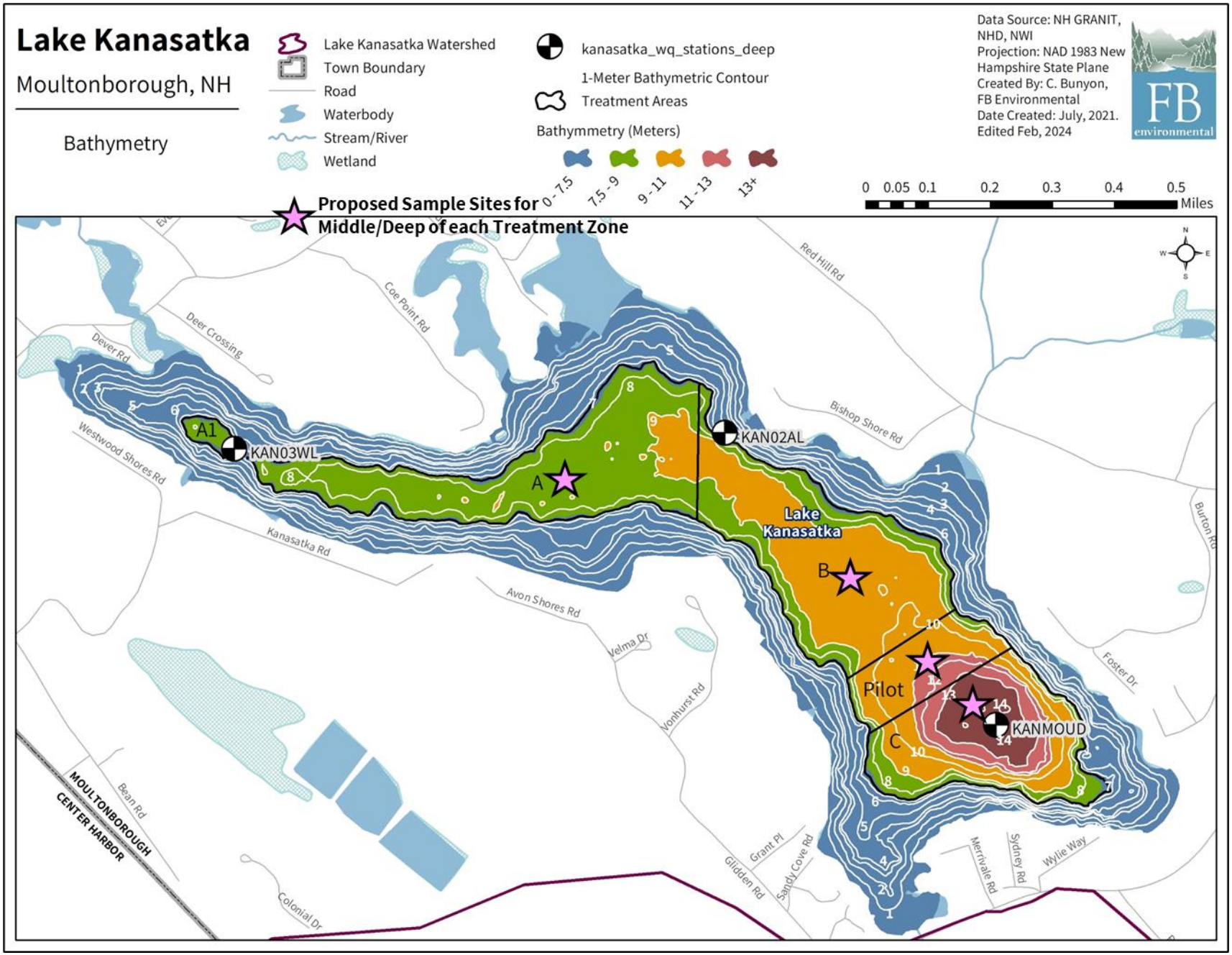
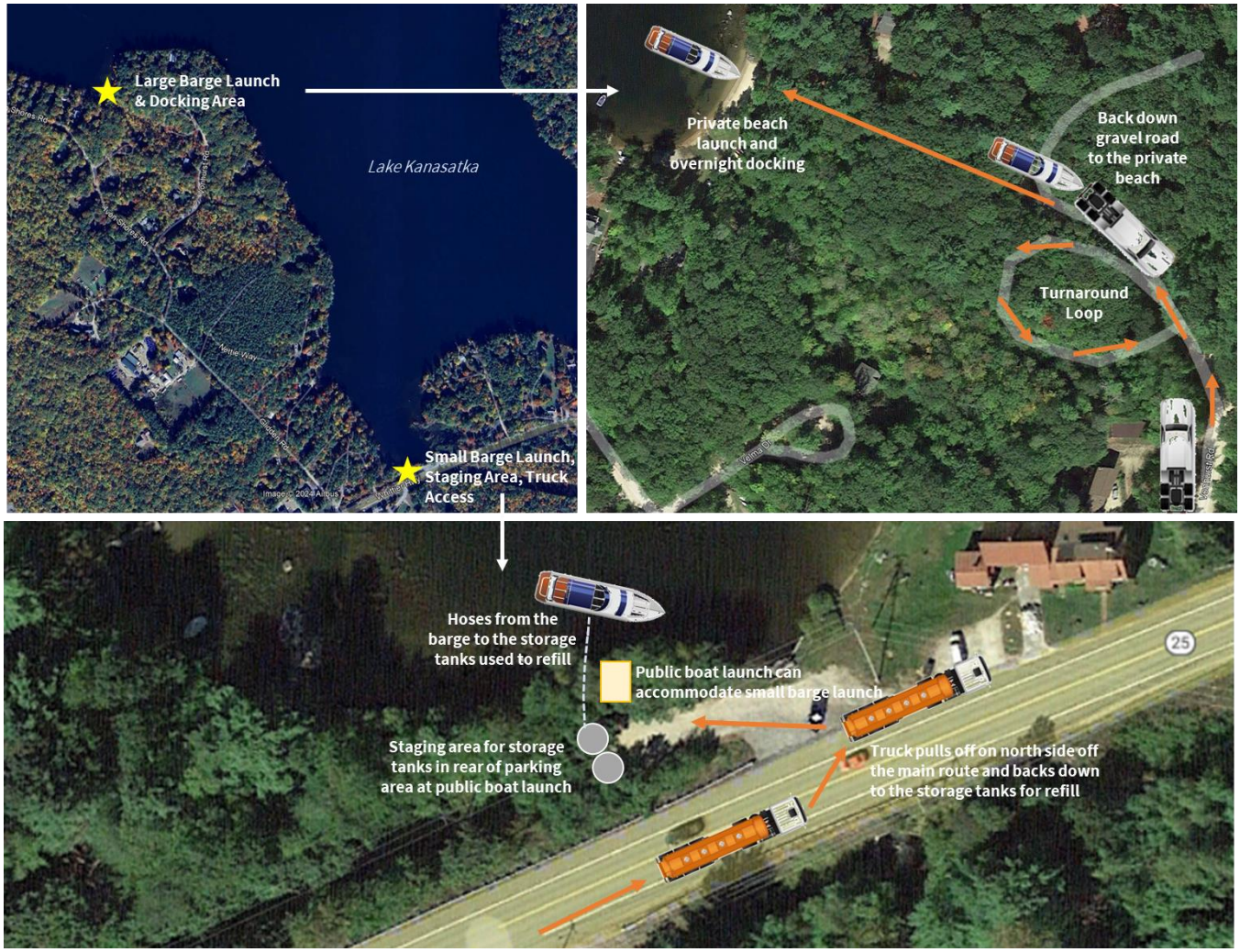


Figure 1. Proposed treatment zones (3 plus pilot within C) and sampling sites for the middle/deep of each treatment zone.

Per item (3), NHDES requested that additional details on the logistics of treatment execution be provided with the understanding that the final details will be provided by the contractor in an operations and management plan. Namely, NHDES requested that two or more potential staging and/or docking areas be identified with consideration for barge launching capacity, vessel docking facilities, tank truck access and chemical delivery, chemical storage capacity, and barge access to chemical storage.

The contractor met on-site with LKWA on February 8, 2024 to assess staging and docking logistics. For the pilot treatment, the contractor will be able to launch their small barge from the public boat launch by the dam. The contractor will refill the small barge from a split tanker parked in the boat launch parking area. Since the pilot treatment will be completed in a single day, there are no docking needs for the small barge. For the full treatment, the contractor will not be able to launch their large barge from the public boat launch by the dam and instead will launch the large barge from a private beach off Vonhurst Rd. There is a loop at the end of Vonhurst Rd where the contractor can turn around and back down a gravel road that leads to a private beach. There is no official launch at the beach and because of the shallow water and sandy soils at the private beach, the contractor plans to locally rent a telehandler forklift with an extendible arm to launch the barge into the water. The barge will be docked overnight at the private beach by beaching the front of the barge partially on the sand and tying off to a nearby tree or an installed post into the sand. Two 6,800-gallon upright poly storage tanks (18-20 ft high, 10 ft diameter) with lockable valves and set in a spill guard will be staged in the rear of the parking area at the public boat launch by the dam. From the water, the contractor will anchor the large barge near the launch to refill from the land-based storage tanks. Trucks will come from the west on Route 25 and can pull off on the north side of the road off the main route, safely allowing time for the trucks to back down to the storage tanks for refilling. Traffic control may therefore not be needed.



Aerial map highlighting logistics of launching, staging, storage, and access.

Public boat launch and parking area by the dam along Route 25. The storage tanks will be placed at the rear of the parking area (by the black car in the photo). The boat launch will be used for the small barge only. The large barge will anchor near the boat launch to refill from the land-based storage tanks.




There is a loop at the end of Vonhurst Rd where the contractor can turn around and back down a gravel road that leads to the private beach (top left). Private beach area for launching and docking the large barge (top right). Access points that lead down to the private beach (bottom left and right).



Staging and docking access examples from similar projects performed by the contractor.

Per item (4), NHDES requested that the monitoring plan be adjusted to include weekly monitoring for four weeks after the treatment is complete, adding two additional post-treatment sample events to the original proposed monitoring plan. Additional monitoring will also need to be performed surrounding the pilot treatment. A revised monitoring plan is provided in Table 2.

The revisions to the monitoring plan include the following:

- Composite mid-meta cores for alkalinity, hardness, and dissolved organic carbon
- Profile grabs at 1, 3, 5, 9, and 13 meters for total and dissolved aluminum (total of 200 samples)
- Nutrient sampling performed at 1-Deep nine times throughout the season (roughly monthly except for 3 weekly events one week after full treatment)
- Before treatment sample event combined with morning pre-treatment sample event for pilot treatment day
- Four sites sampled during before treatment sample event (representing the middle/deep of each treatment zone plus the pilot treatment zone)
- Pilot treatment will occur in one day with before treatment sampling the morning of treatment, during treatment sampling the day of treatment, and after treatment sampling the morning after treatment and one week after treatment (which should be one week prior to the full treatment)
- After treatment sampling the morning and week after the pilot treatment will occur at three sites (the middle/deep of the two adjacent treatment zones plus the pilot treatment zone)
- Full treatment will occur over six days for the three major zones (A, B, C) with sampling of the middle/deep sites of each major treatment zone in the morning and the active treatment zone in the afternoon after treatment is complete for the day
- After treatment sampling will occur at the three middle/deep sites of each major treatment zone the morning and week after the full treatment is complete and continue weekly for three weeks or until background concentrations in aluminum have been achieved
- Sampling will switch to monthly at 1-Deep for four months (ending in October)

Total laboratory fees are estimated to be between $16,065 to $22,391 but are dependent on quote confirmation from the selected labs: UNH Water Quality Analysis Laboratory, UNH Lakes Lay Monitoring Program, and DHHS Public Health Laboratory. Note that the original monitoring plan generated laboratory fees exceeding $50,000, which was deemed unnecessarily high.

We also recommend that five sediment cores be collected in late summer from the same locations within the treatment zone as collected in previous years and analyzed for phosphorus fractions. The average change in mobile and refractory phosphorus fractions before and after treatment can be used to assess the efficacy of the alum treatment, in addition to the calculation of internal phosphorus load reduction post-treatment.

Table 2. Revised monitoring plan. Blue colored parameters are in-field measurements. Dark orange parameters are of primary concern for assessing in-lake chemical response to the treatment. The dark yellow parameter is total phosphorus which is the target nutrient for reduction. Lighter yellow parameters are of prioritized research interest but are not a condition of the permit. Green parameters measure biological response to the treatment.

		Before Treatment	During Treatment (Pilot)		After Treatment (Pilot)	
When		1-3 weeks before treatment starts or day of pilot (1 event)	Active treatment	Within 1-2 hours of active treatment	1 day post pilot treatment	1 week post pilot treatment
Where		Middle/Deep of each treatment zone + pilot (4 sites)	In plume**	Middle/Deep of pilot treatment zone	Middle/Deep of adjacent treatment zones + pilot zone (3 sites, 1 event)	Middle/Deep of adjacent treatment zones + pilot zone (3 sites, 1 event)
Secchi Disk Transparency ***	Secchi disk & scope	•			•	•
Profile (1-m intervals): Dissolved Oxygen/Temp ***	YSI EXO2 (UNH CFB)	•			•	•
Profile (1-m intervals): Conductivity/pH/Temp/Turbidity^	YSI EXO2 (UNH CFB)	•	•	•	•	•
Alkalinity (mid-meta core)^	Lab Analysis (PHL)	4		1	3	3
Hardness (mid-meta core)^	Lab Analysis (PHL)	4		1	3	3
Dissolved Organic Carbon (mid-meta core)^	Lab Analysis (PHL)	4		1	3	3
Total and dissolved aluminum (1, 3, 5, 9, 13 m) ^	Lab Analysis (PHL)	16		4	12	12
Total Phosphorus (1, 3, 5, 7, 9, 11, 13 m)	Lab Analysis (UNH CFB)	7				
Total Nitrogen (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH CFB)*	7				
Nitrate-Nitrite (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH WQAL)*	7				
Ammonium (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH WQAL)*	7				
Ortho-phosphate (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH CFB)*	7				
TDP (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH CFB)*	7				
TDN (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH WQAL)*	7				
Chlorophyll-a (mid-meta core)	Lab Analysis (UNH CFB)	4				
Phytoplankton (mid-meta core)	Lab Analysis (UNH CFB)	4			3	3
Zooplankton (mid-meta tow)	Lab Analysis (UNH CFB)	4			3	3
Fish & Aquatic Life [1]	Visual Assessments	•	•	•	•	•
Floc evaluation with camera	GoPro (FBE)		•	•		

*** continuously ~ 2 meters depth between 15-60 meters behind the barge*

**** volunteers to aim for weekly readings before and after treatment*

^ collection of monthly aluminum, alkalinity, hardness, DOC, turbidity samples may be discontinued once background levels of aluminum are achieved (within 10%) following treatment

[1] surveyors observe shoreline areas for fish, shellfish, snail, amphibian, and bird fatalities, insect hatches, and other signs of potential aluminum or pH toxicity, particular focus on downwind shoreline areas

Table 2. Revised monitoring plan (*continued*). Blue colored parameters are in-field measurements. Dark orange parameters are of primary concern for assessing in-lake chemical response to the treatment. The dark yellow parameter is total phosphorus which is the target nutrient for reduction. Lighter yellow parameters are of prioritized research interest but are not a condition of the permit. Green parameters measure biological response to the treatment.

		During Treatment (Full)			After Treatment			
When		AM daily pre-treatment (6 days)	Active treatment	Within 1-2 hours of active treatment	1 day post final treatment (1 event)	1 week post final treatment (1 event)	Weekly post final treatment (3 events)	Monthly (4 events)
Where		Middle/Deep of each treatment zone (3 sites, 6 events)	In plume**	Middle/Deep of active treatment zone (3 sites, 2 days each)	Middle/Deep of each treatment zone (3 sites, 1 events)	Middle/Deep of each treatment zone (3 sites, 1 events)	Middle/Deep of each treatment zone (3 sites, 3 events)	1 Deep
Secchi Disk Transparency ***	Secchi disk & scope	•			•	•	•	•
Profile (1-m intervals): Dissolved Oxygen/Temp ***	YSI EXO2 (UNH CFB)	•			•	•	•	•
Profile (1-m intervals): Conductivity/pH/Temp/Turbidity^	YSI EXO2 (UNH CFB)	•	•	•	•	•	•	•
Alkalinity (mid-meta core)^	Lab Analysis (PHL)	18		6	3	3	9	*TBD*
Hardness (mid-meta core)^	Lab Analysis (PHL)	18		6	3	3	9	*TBD*
Dissolved Organic Carbon (mid-meta core)^	Lab Analysis (PHL)	18		6	3	3	9	*TBD*
Total and dissolved aluminum (1, 3, 5, 9, 13 m) ^	Lab Analysis (PHL)	72		24	12	12	36	*TBD*
Total Phosphorus (1, 3, 5, 7, 9, 11, 13 m)	Lab Analysis (UNH CFB)					7	21	28
Total Nitrogen (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH CFB)*					*7*	*21*	*28*
Nitrate-Nitrite (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH WQAL)*					*7*	*21*	*28*
Ammonium (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH WQAL)*					*7*	*21*	*28*
Ortho-phosphate (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH CFB)*					*7*	*21*	*28*
TDP (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH CFB)*					*7*	*21*	*28*
TDN (1, 3, 5, 7, 9, 11, 13 m)	*Lab Analysis (UNH WQAL)*					*7*	*21*	*28*
Chlorophyll-a (mid-meta core)	Lab Analysis (UNH CFB)					3	9	4
Phytoplankton (mid-meta core)	Lab Analysis (UNH CFB)	18			3	3	9	4
Zooplankton (mid-meta tow)	Lab Analysis (UNH CFB)	18			3	3	9	4
Fish & Aquatic Life [1]	Visual Assessments	•	•	•	•	•	•	•
Floc evaluation with camera	GoPro (FBE)		•	•				

*** continuously ~ 2 meters depth between 15-60 meters behind the barge*

**** volunteers to aim for weekly readings before and after treatment*

^ collection of monthly aluminum, alkalinity, hardness, DOC, turbidity samples may be discontinued once background levels of aluminum are achieved (within 10%) following treatment

[1] surveyors observe shoreline areas for fish, shellfish, snail, amphibian, and bird fatalities, insect hatches, and other signs of potential aluminum or pH toxicity, particular focus on downwind shoreline areas

Per item (5), NHDES requested that additional details be provided on the public notification strategy. LKWA will be responsible for mailing out notification letters to all shorefront property owners around Lake Kanasatka within one month of scheduled treatment. Notifications will also be posted at all public access points around the lake and on social media (LKWA's Facebook page) leading up to and during the treatment. A public hearing has been scheduled for mid-March during which a project overview presentation will be given and questions by the public answered by the consultant and NHDES.

The timeline for public notifications is estimated as follows:

- NHDES will send out a 30-day notice for a public hearing to be scheduled for late March
- LKWA will forward the 30-day notice through their email list and Facebook page
- LKWA will mail out notification letters to all shorefront property owners around the lake within one month of the scheduled treatment (no later than mid-April)
- LKWA will post notification signs at all public access points around the lake within one week of the scheduled treatment (mid-April at the earliest)
    - Posting sites will include the one public access point to the lake at the public boat launch and at all roads leading to the waterfront (both public and private), similar to posting sites during cyanobacteria bloom advisories
- LKWA will post notification information on their Facebook page within at least one week of the scheduled treatment (mid-April at the earliest) and will supply at least weekly updates on treatment progress (with photos) (throughout May)

Lake access will not be formally restricted at any time, even during the alum treatment. The notifications will advise the public to refrain from recreational use of or water withdrawal from the lake during and within 24 hours of the completed treatment as a precaution; otherwise, users can still swim, fish, and boat as normal and even pull water from the lake for household use as normal, especially since many of these activities occur outside of the treatment (i.e., along the shoreline). If recreational boating or use of any watercraft occurs during the treatment, the users must maintain a minimum distance of 300 feet from the barge for safety. Recreational use and water withdrawal is expected to be very low in May.

The final details of the treatment plan will be included in an operations and management plan to be completed and submitted by the contractor, as a condition of the permit. The contractor has agreed to have the operations and management plan ready within two weeks of final treatment plan approval by NHDES. The contractor also agreed to have a final quote ready by February 23, 2024 or sooner if NHDES approval of the treatment modifications occurs by February 20, 2024 or sooner, in time for application to the Cyanobacteria Mitigation Fund due by the end of the month.

Please let us know if we can provide additional information to facilitate the in-lake treatment permitting process.

Sincerely,

Eric Carlson
Camp Quinebarge

Kirk Meloney
Lake Kanasatka Watershed Association

Laura Diemer
FB Environmental Associates