UPPER GREENWOOD LAKE PROPERTY OWNERS ASSOCIATION
BOARD OF TRUSTEES Regular Meeting Minutes
March 12, 2024

Attendance

Burr, Rob	P	Grayson, Doug	E	Nietzer, Laura	E
Culhane, Margie	P	Hartig, Jason	P	Quirk, Andrew	P
Decina, Dennis	E	Jones, Jim	P	Sarnowski, Karen	P
Cytowicz, Will	P	Lizotte, Travis	P	Tonnessen, Linda	P
Ezratty, Steven	P	Manzo, Rene	P		
Giannantonio, Anthony	P	Morrison, Debra	E	Open 1	
Gianniotis, Terry	P	Nicosia, Jessica	P	Open 2	

P = Present E = Excused A = Absent R* = Remote – non-voting/quorum

Attorney Present – James Romer **Y**/N

Public Session:
1. Jonathan Durant, owner 25 Audubon, 25 Main, and 82 Fairview (rental properties) – asked for information about road maintenance and repair.

With a quorum present, the meeting was called to order at 6:43pm by Vice President Anthony Giannantonio.

A motion was made at 6:46pm to approve the February Regular Meeting and Executive Session Minutes by Margie Culhane, seconded by Rob Burr.

In Favor 8 Opposed 0 Abstentions 3

Treasurer's Report:

A motion was made at 6:52pm to approve 3% raises for Tanya Mekelberg and Genny Sinopoli by Jess Nicosia, seconded by Karen Sarnowski.

In Favor 11 Opposed 0 Abstentions 0

A motion was made to approve the February Financials at 6:48pm by Jessica Nicosia, seconded by Rob Burr.

In Favor 11 Opposed 0 Abstentions 0

UPPER GREENWOOD LAKE PROPERTY OWNERS ASSOCIATION
BOARD OF TRUSTEES Regular Meeting Minutes
March 12, 2024

Membership Secretary Report:

Membership Numbers:	Feb 2024	Feb 2023	
POA Members	241	125	
Double dock	5	2	
Total POA	246	127	
Tenants (Renters)	2	1	
Specials (Stevens' Estate)	1	1	
Total Tenants & Specials	3	2	Diff
Total POA, TEN, SPC	249	129	120
Total Easement	593	262	331

Correspondence:

1. Chris Verillo – email re downed tree on POA lot next door.
2. The Middle School requests access to the Clubhouse at 5:00pm Friday April 5th for photos. Granted.
3. 24 Melrose – request to waive late fees.
4. 442 Lakeshore - request to waive late fees.

A motion was made at 6:56pm to waive the easement late fees of $27.65 for 24 Melrose Avenue by Rob Burr, seconded by Karen Sarnowski.

In Favor 11 Opposed 0 Abstentions 0

A motion was made at 6:57pm to waive the easement late fees of $27.65 for 442 Lakeshore by Karen Sarnowski, seconded Rob Burr.

In Favor 11 Opposed 0 Abstentions 0

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5. A property owner responded to a 3rd notification sent 2-5-24 about their failure to repair their dock.
6. A thank you note was received from the family of Julia Held for the bench donated in her name in honor of her many contributions to our community.
7. 241 Point Breeze, notice of renovation of STR.

8. Request by dock owners to assess their dock spot since the new bulkhead has narrowed the space and made it quite difficult to fit a boat there. Committee will contact them and do site visit.

A motion was made at 7:10pm to move to Executive Session by Rob Burr, seconded by Andrew Quirk.

In Favor 11 Abstentions 0 Opposed 0

A motion was made at 7:18pm to exit Executive Session by Rob Burr, seconded by Terry Gianniotis.

In Favor 11 Abstentions 0 Opposed 0

A motion was made at 7:24pm to approve the $12,500 retainer for Aquatic Analysts for weed and algae control by Rene Manzo, seconded by Rob Burr.

In Favor 12 Abstentions 0 Opposed 0

Committee Reports:

A) Activities: no chair, no report

B) Beach: Linda Tonnessen
Samples of sand were shared with the board and discussed.

C) Boathouse: Travis Lizotte, no report

D) Clubhouse: Anthony Giannantonio
Updating the capital replacement schedule was discussed.

E) Dam: Andrew Quirk
Work is proceeding with updating the Emergency Action Plan so that it is complete before our Regular Inspection in the Spring. Len Ferraro has been contacted to perform the annual maintenance on the valve.

F) Bylaws, Rules & Regs: no chair, no report

G) Docks: Karen Sarnowski
Dock work is beginning to ramp up with Spring approaching. There have been many members inquiring as to their application, and we have had some relinquished docks for the upcoming season.

If weather holds (no snow, sleet or ice and weather comfortable enough to spend longer periods outside), we will begin the process of assigning.

Noted attendance at last meeting by members required to give up their second dock to allow for assignment to someone on the Dock Waiting List and will be discussed at March meeting.

Contact was also made regarding a second property asked to move their dock which is currently on accessible parklands to a location off of their own lake abutting property. Property owner called office and will be called back from office when schedule allows. Met with Jay from Mountain Landscaping on plan for planting of grasses on Parklands adjacent to 51 Racetrack Drive at abandoned, burned down home. At the time of the meeting at the site, there were numerous household items on UGLPOA parklands which will require volunteers to put back on the homeowner's property so a general cleanup of this property can be conducted.

An email to the township's zoning official confirmed that we have the right to remove items from our property and move back to property owner's property. The status of what is happening with this property is unknown, since there is no mail forwarding address and the location of the property owner at this time is unknown. Entry door at rear of property has an outdoor lock affixed with a notice of no entry. During this visit there was noted an underground pipe running from the house to the lake, which is noted on the property survey but its use is not. Pipe outlet is visible at lake. It may have been a collector of rooftop rainwater but there is currently no roof leader going to indicated start of pipe. We may or may not want to look into this more, but right now that would be impossible without a property owner available.

Jay has indicated that he now has plants in hand and would like to schedule as soon as weather conditions allow, which means we need to get a group of volunteers together to clean up the area before planting. Tentatively, looking at March 24th as a possibility. If you are able to pitch in for even an hour of time it would be great, please let us know and will keep everyone informed if this date is good!

Current Dock List has 68 Applicants; some of which are lakefront properties which just need to go through the process of meeting with property owner for a quick review of existing dock, Rules&Regs, etc. Therefore, we do not need 68 spaces, but the number is extremely high. There are also requests in Dock Committee email for changes of assigned location that need to be added to items the committee needs to address. Should be a busy season, but once all available spaces are assigned it will slow down to when current assigned spots are relinquished and the next in line will be assigned.

H) Dredging: Will Cytowicz
The committee further researched the vacuum dredging option. On 2/28, Travis trekked to Connecticut to see the site conditions for such a project. He came back with bad news and good news. The bad news is that it would not be a feasible option if a cove was not previously worked on since we have obstacles that result from an artificial lake like left behind stumps and boulders. However, the good news is that vacuuming should be a great option for the maintenance of those areas that have had previous mechanical dredging.

At this point, this year's goal may be focused on cleaning up storm drain grit remains such as that on the corner of Warwick Turnpike and the northern end of Lakeshore Drive. This may only need an 18-24" drawdown and the permitting process for such a cleanup is much more friendly than a mechanical dredge.

The committee will have an in-person meeting in the next few weeks prior to the April regular meeting to discuss a concrete pathway.

I) Easement: Will Cytowicz no report
J) Entertainment: no chair, no report

K) Environmental: Andrew Quirk
Watershed Implementation Plan now available, see attachment A.

The spring Lake Cleanup will be on April 27th and coincides with the Township Beautification Day. Kathy Straubel will run the event. A repeat of the Macroinvertebrate Count will be held if there is interest from a local youth group. Generally, the Committee is looking for ways to increase community outreach and participation and will consider various options.

It was decided that Aquatic Analysts will direct UGLPOA if a Harmful Algae Bloom is suspected as a result of our initial testing and observations. Montclair State University may also be used for water testing. The aerator pump will be tested again in the summer, but this year in Yardville Cove.

The Committee again stated its position that drawdowns should only occur once every five years and will photograph all outfalls around the lake during the next one. A drone may be used to capture the degree of erosion and silt build-up.

It was moved that residents receive the opportunity to donate money to a "Wildlife Fund" when paying their annual membership fees.

Volunteers will be sought for Canada Geese egg addling and the public asked to notify the Committee if they see nesting pairs.

A procedures manual will be prepared for any future hazardous waste spill or boat sinking.

The Township has indicated that the owner of 10 Parlin Court plans to submit a second application for a septic system that will be on his property and not on the "paper road" that he had previously selected.

The Committee reviewed the Final Watershed Implementation Plan (see attached) and decided to pursue the Dover Road and Island Trail recommendations. The Committee viewed the Princeton Hydro WIP report as underwhelming and with many very impractical suggestions. Stream water as it enters the Lake will be treated with Biochar as suggested in the report and previously done by Aquatic Analysts.

Discussions are ongoing with the new Director of Public Works about animal crossing signs and new DEP guidance regarding storm drains.

Tim Dalton reported that the West Milford Environmental Commission expects the State to enact new tree removal and replacement provisions.

L) Insurance: Debra Morrison no report
M) Legal: Terry Gianniotis FOR EXECUTIVE SESSION

N) Master Plan: no chair
Rob Burr - Next month he would like the Master Plan submission to be approved.

O) Parklands: Jim Jones
-The barge will likely be put in the water in April.
-Proposed 51 Racetrack cleanup – PO threw their garbage from the house onto adjacent Parklands. Town gave us permission to move it back to the PO's property. Neither the Township nor the UGLPOA has contact info for the PO. A volunteer cleanup is scheduled for 10am on Beautification Day.

Bulkheads: Andrew Quirk, no report

Encroachments: Will Cytowicz

- The committee is in the process of preparing a point-in-time survey that will require board input in the late spring and early summer. By June, the committee should be prepared with a presentation that will explain what the process is and what it will cost. This may lead to a line-item request at the next easement budget meeting.
- 2608/2 - 51 Racetrack Dr. (Nancy Dacruz Ferraro)
    - This abandoned house has significant Parklands in the backyard. The committee has established the property boundaries for this property. The issue that's currently being faced is the Township and the POA do not have good contact information for the owner. In the near future, the committee will look for support in cosmetically improving this site as well as further defining the physical property boundaries.
- Riverside. Through the efforts of many hands, most of the Riverside cleanup projects are completed. We would especially like to extend a huge thanks to Margie, Jim, and Travis. Karen followed up with Barbaris and now boulders have also been laid out to keep storage off of Parklands. Riverside Road is a long-term vision project that will look to a full board to express what we would like to see beautify this local treasure. For example, pathways, boardwalks, bird blinds and other such projects would truly cast light on this stretch of Parklands.
- 78 Riverside. A letter has been sent to the homeowner stating that the sign saying "78 Riverside" needs to be removed because it is on our property.

P) Publicity & Public Relations: no chair, no report

IT: Steve Ezratty
- Enabled Anti Click Fraud / Rage Clicking feature to protect our site from being crashed by a hacker
- Created offline PDF of Web Site Point in Time if ever needed

- Web Site Idea: Discuss with Board New Web Site Section

Q) Security: Laura Nietzer no report
R) Stumps: Jim Jones no report

S) Weeds: Rene Manzo
Reviewed Aquatic Analysts proposal for weed and algae control for 2024. Recommend a motion to approve $12,500 retainer for 2024. His prices are still less expensive than other proposals we reviewed in the past. He comes every two weeks with his fan boat and does whole lake surveys.

T) West Milford Lakes Association: Andrew Quirk, representative
First meeting of the year will be on March 18th.

NJCOLA: Next meeting March 23rd.

A motion to adjourn was made at 8:59pm by Jessica Nicosia.
Approved by acclamation.

Respectfully submitted,
Margie Culhane, Recording Secretary

Watershed Implementation Plan

2.17

UPPER GREENWOOD LAKE

No NJDEP monitoring events were noted at Upper Greenwood Lake; however, Aquatic Analysts, Inc has conducted routine monitoring over the past several summers since at least 2016. Their observations noted Secchi depths between1.7m and 2.1m, indicating good water clarity. The presence of a variety of different SAV species throughout many different regions of the lake was also noted, along with recommendations to treat areas where plant growth had become dense. Particular areas that were repeatedly recommended for treatments were Audubon Cove, Firehouse Cove, Behind Islands, Yardville Cove & Bridge Cove, with various other sites also being listed. The ample plant growth suggests good water clarity, as light can penetrate further into the water column.

3.0 HYDROLOGIC AND POLLUTANT LOADING ANALYSIS 3.0 METHODS Watersheds and subwatersheds were delineated for each lake using USGS's Stream stats tool, the Stroud Research Center's Model My Watershed tool, and watershed tools on ERI's ArcMAP 10.8.1. Subwatersheds were edited in ESRI's ArcMAP and QGIS Desktop. Subwatersheds that were too small for proper analysis with GWLF-E were combined with neighboring subwatersheds. For the purposes of this study, watershed areas listed exclude the area of the main waterbody itself. Maps displaying watersheds and subwatersheds for each lake are provided in Appendix I. GIS shapefiles for each subwatershed and total watershed were imported into Model My Watershed, which produced a .gms file containing hydrologic and nutrient data for a 30-year period. This file was subsequently entered into Penn State's Generalized Watershed Loading Functions-Enhanced (GWLF-E) tool. Edits to the .gms file were made in Model my Watershed prior to export and in GWLF-E. In order to assess septic system loading, all houses within each watershed were counted (excluding sewered locations), with the number of houses within 15 m of a lake or stream were also noted. Populations within 15m of the lake or any inflowing waterways, as well as 5% of the total population, were assumed to "short circuit" or contribute nutrients to waterways and/or groundwater prematurely; these systems usually contribute higher amounts of nutrients than systems with no issues. Many of the lakes in West Milford are inhabited by a population of Canada goose (Branta canadensis) or other waterfowl. While these birds can be a nuisance to lake users for several reasons, their droppings can also negatively impact water quality by adding excess phosphorus and nitrogen. These loads were estimated using GWLF-E's farm animal module, as well as coefficients for each nutrient yielded by each goose each day (Manny et al., 1975). Bacterial loads contributed to Canada geese were modeled using the same estimated loading rate use in the GWLF-E model for turkeys. Each lake was estimated to contain at least two Canada geese and were modeled for larger numbers of birds if field observations indicated a larger population. A migratory population of an estimated three times the resident population. For each lake, an average was calculated of geese numbers, assuming a year-round number for 11 months and a migration population for 1 month.

Goose-based nutrient modeling was only applied to full watersheds. It should be noted that the Canada goose population numbers in each scenario are estimates; this model may be fine-tuned in the future using Canada goose and other waterfowl count data collected in West Milford. GWLF-E was run for a 30-year period following all necessary data edits. The model simulates loading and transport for each day based on actual weather records during the period of record. The data output includes monthly and annual averages. Dry fall, or atmospheric nitrogen and phosphorus loads, were calculated by multiplying pre-established coefficients by the total area of the watershed and lake. Nitrogen was estimated to occur at a rate of 0.4 kg/ha/yr, while phosphorus was estimated to occur at a rate of 0.002 kg/ha/yr (USEPA, 1980). As with waterfowl loading, dry fall was only calculated for full watersheds. In addition to watershed-based loading, internal loading of phosphorus in each lake was calculated using a loading coefficient of 6 mg TP/m^2/day for loading of phosphorus into the water column from sediments under anoxic conditions, whereas minor loading under oxic conditions during the growing season (May-September, 153 days) is represented by a loading coefficient of 0.6 mg TP/m^2/day. The number of days each waterbody was estimated to experience bottom anoxia, as well as the area of each waterbody at which anoxic conditions were estimated to occur, were determined based on dissolved oxygen and temperature data collected in the field during water quality sampling events and bathymetric data, when available. It should be noted that a majority of the lakes in this study did not have readily available bathymetric data;

UPPER GREENWOOD LAKE

Upper Greenwood Lake is one of the largest lakes in the study by surface area at approximately 412 acres, with a watershed of approximately 4,229 acres. Approximately half of the watershed is classified as forested land, with an additional approximately 24% of the area classified as wetlands. Approximately 20% of the watershed is classified as urban land. The watershed contains Mt. Laurel Lake and Lake Lookover and these lakes' full watersheds. Mt. Laurel Lake feeds immediately into Upper Greenwood Lake through a dam, with this being one of the lake's primary inlets, the other being Sawmill Pond Brook, which enters the southeastern side of the lake. The outlet and dam are located at the northern end of the lake. This stream, known as Longhouse Creek, flows northeast into New York, eventually joining Wawayanda Creek. Descriptions of the lake's subwatersheds are as follows: • Fairlawn: This approximately 239-acre subwatershed is situated along the northwestern shoreline of the lake and contains Fairlawn Dr., Hewitt Rd., and several other streets and the adjacent developed areas. The area consists mainly of urbanized land, with forested land also making up a notable percentage of the subwatershed. • Landing: This approximately 168-acre subwatershed is located along the southeastern shoreline, containing the length of North Lake Shore Dr. and several smaller streets. The area is approximately 67% forested, with urbanized land making up a majority of the remaining space. • Longhouse: This approximately 1,336-acre subwatershed is located south of the lake, containing both Mt. Laurel Lake and Lake Lookover, as well as the major inlet Longhouse Creek. The area is approximately 66% forested. Organisms % Farm Animals and Waterfowl 3 This approximately 288-acre subwatershed contains the length of North Lake Shore Drive, as well as the development to the east of the lake's outlet stream. The area is mostly (approximately 70%) forested, with much of the remaining land being

classified as urban. • North Islands: As the name suggests, this subwatershed contains the island in the northern half of the lake. The area is approximately 86% urbanized, with the remaining area classified mostly as forested land and wetlands. • Northwest: This approximately 129-acre subwatershed contains the lake community's clubhouse and boat launch, as well as a minor inlet and the developed areas along Paterson, Tansboro, and Verona Roads. Approximately half of the area is classified as urbanized, with a majority of the remaining land being classified as forested land. • Sawmill Pond Brook: This is the largest of Upper Greenwood Lake's subwatersheds at approximately 1,933 acres, containing one of the lake's major inlet streams. Approximately 90% of the area is classified as forested land or wetlands. South Islands: This is the smallest of Upper Greenwood Lake's subwatersheds at approximately 39 acres. The area is classified as approximately 72% developed area, with the remaining land mostly consisting of forested land and wetland.

UPPER GREENWOOD LAKE

In-situ water quality Two sampling stations were analyzed at Upper Greenwood Lake during the 2022 season, including a Dam and South station. Sampling events took place on 17 May, 26 July and 5 October 2022. Surface temperatures were variable across sampling stations during each sampling event, with higher temperatures routinely measured at the Dam station. Surface temperatures ranged between 10.78 °C at the South station in October and 28.31 °C at the Dam station in August. Thermal stratification was not observed during the 2022 season, and the waterbody was well-mixed thermally at each sampling station. DO was ample throughout the season, with surface concentrations ranging from 7.24 mg/L in July to 10.33 mg/L in October. Adequate DO was noted from the surface to bottom during each sampling event, declining to a minimum concentration of 6.92 mg/L at the South station during July. Water clarity was consistently adequate, with Secchi depths ranging from 1.2 m at the South station in May to 2.8 m at the Dam in October. Clarity extended to the sediments at the South station in July and both stations in October. The poorest Secchi depths were noted in May, caused by a dense phytoplankton community. pH was relatively consistent during each sampling event, with surface measures between 7.53 and 7.95. Slight declines were observed with depth, but overall pH measures were comparable throughout the water column

Discrete water quality TP concentrations were relatively consistent in the surface and deep samples during each sampling event. Overall, TP ranged from 0.01 mg/L to 0.02 mg/L, remaining well below the NJDEP threshold of 0.05 mg/L throughout the 2022 season. Each sampling event yielded low SRP concentrations below the lab detection limit of 0.002 mg/L throughout the water column at Upper Greenwood Lake. Chlorophyll a concentrations declined as the season progressed in both the surface and deep-waters. The peak seasonal concentration of 10 µg/L was measured in the deep-water during May, declining to the seasonal minimum of 2.4 µg/L in October. Conversely, TSS concentrations increased from 1 mg/L to 10 mg/L as the season progressed, ultimately remaining low and not of concern. Overall, nitrate-N concentrations within the lake remained low throughout the season, with a peak concentration of 0.09 mg/L in the deep water in

May to a minimum concentration of 0.02 mg/L in the surface water in July. Ammonia-N concentrations remained low in the surface water during the 2022 season, reaching a maximum measure of 0.05 mg/L in May. Deep-water concentrations were slightly elevated in comparison during this first sampling event, yielding a concentrations of 0.14 mg/L. Plankton and macrophytes The May event yielded a very dense phytoplankton community with a bloom of Dinobryon and an abundance of Pseudanabaena. Densities declined overall by the July sampling event. A total of 11 genera were noted during this event, most of which were listed as present or rare. Moderate densities of Pediastrum were also observed during this time. Peak species richness of 13 identified genera were observed during the October event. Moderate densities of Melosira and Microcystis were observed, while the remaining genera were listed as present or rare. The poorest zooplankton richness was observed during the May event, with 6 genera identified. Codominance was exerted by the rotifers Conochilus and Asplanchna. Conversely, peak richness was observed in July and remained a healthy diverse community. Dominance was shared by Bosmina and Conochilus at that time. Densities declined overall, with the dominant copepods and rotifers listed as common. Overall, little vegetation was visually observed during the 2022 sampling period. Brittle naiad was identified in the shallow areas of the boat launch cove during a stream sampling event.

UPPER GREENWOOD LAKE

Surface total phosphorus concentrations in Upper Greenwood Lake were relatively low over the course of the 2022 season, with the summer concentration yielding a phosphorus-based TSI of 47.35. This value is typically consistent with mesotrophic systems. Summer chlorophyll a concentrations obtained from the top of the water column were also relatively low, yielding a chl. a-based TSI of 43.17, also consistent with mesotrophic conditions. Water clarities during the summer event were moderate, yielding a Secchi-based TSI of 49.31, suggestive of a mesotrophic-to-eutrophic system. TSI residuals are plotted below in Figure 121. All sampling events are represented by points located close to the x-axis, suggesting that algae densities and chlorophyll a production was largely a product of phosphorus concentrations. The point representing the May event is also located close to the y-axis, suggesting that water clarity was largely impacted by algae growth. The points representing the summer and autumn events are located to the left of the y-axis, suggesting that the plankton community was dominated by smaller celled organisms. It should be noted that the Secchi depth collected during the autumn event was equal to the total depth of the sampling station, suggesting that the Secchi-based TSI for this date may in fact be lower and would place the point representing this date closer to the figure's origin.

When assessed with the Kirchner-Dillon model, Upper Greenwood Lake yielded a phosphorus retention coefficient of 0.65, suggesting that approximately two-thirds of the phosphorus entering the waterbody is retained and utilized by primary producers. When this value is used in the Dillon-Rigler model, the lake is estimated to feature a springtime phosphorus concentration of approximately 0.02 mg/L, or 0.03 mg/L if internal loading is also accounted for, aligning with the surface total phosphorus concentration of 0.02 mg/L obtained during the spring sampling event. Walker's predictive phosphorus model yielded higher spring phosphorus predictions at 0.04 mg/L or 0.05 mg/L when internal loading is included in the model. Walker's trophic state model estimates

that the lake has an approximately 25% likelihood of being mesotrophic and a 75% likelihood of being eutrophic. This diverges slightly from the results of Carlson's TSI, which yielded values more representative of a mesotrophic waterbody. Carlson's predictive chlorophyll model predicted a summertime chlorophyll a concentration of 8.87 µg/L when the Dillon Rigler model result is used and a concentration of 8.57 µg/L when the result of the Vollenweider model is used. These are overestimations when compared to the surface chlorophyll a concentration of 3.6 µg/L collected during the summer sampling event. Vollenweider's model yielded a predicted spring phosphorus concentration of 0.02 mg/L, while Reckhow's model yielded a concentration of 0.04 mg/L. While some of the models predicted springtime phosphorus concentrations fairly accurately, Carlson's predicted summertime chlorophyll a model yielded overestimations. While aquatic macrophytes were not observed during most of the 2022 surveys, Princeton Hydro staff have observed notable macrophyte densities in the lake in previous years, and these may serve to sequester a portion of the lake's phosphorus load, resulting in lower concentrations of surface water phosphorus and chlorophyll a.

UPPER GREENWOOD LAKE

Upper Greenwood Lake is one of the larger waterbodies in the study by surface area and features a relatively large watershed. As with many of the other waterbodies in the study, the lake features a largely developed shoreline and receives a large annual load of nutrients from septic systems in the watershed. The lake was not observed to feature bottom anoxia in 2022, however this may occur during other years. Based on these observations, Princeton Hydro recommends the following:

WATERSHED-BASED RECOMMENDATIONS

Upper Greenwood Lake's watershed affords multiple potential projects. Princeton Hydro recommends the stabilization of the eroding banks on both sides of Spruce Point Trail. An MTD may also be installed in line with the stormwater system receiving runoff from Spruce Point Trail and Warwick Turnpike. Another potential project involves the installation of a porous or vegetative paving system at the Greenwood Baptist Church's parking lot in order to reduce stormwater runoff. A rain garden may also be installed between this parking lot and the lake. In the open green space adjacent to the inlet south of Dover Road, a bioretention system may be installed in order to retain stormwater, increase groundwater infiltration, and sequester nutrients. Invasive species present in the riparian buffer in this area can be removed and native vegetation can also be planted to reduce erosion. A bioretention system is also recommended at the northern end of the lake where open green space exists between the lake and North Lake Shore Drive. A riparian buffer could also be planted in this area at the shoreline to reduce erosion and sediment inputs into the lake. Princeton Hydro also recommends the installation of porous pavement or vegetated pavers in a parking area near the intersection of North Lakeshore Drive and Papscoe Road. The compacted lawn in this area may also be replaced with native meadow vegetation in order to increase soil infiltration and remove sediment and some pollutants from stormwater. A porous or vegetated paving system can also be installed at the Living Word Alliance Church's parking lot. Small raingardens could also be

installed to capture runoff from the leaders that drain the church's roof. More details regarding these potential projects is provided in the following report section.

IN-LAKE RECOMMENDATIONS

Biochar – Upper Greenwood Lake may benefit from the addition of biochar. These would be installed in the form of buoys with biochar bags suspended underneath. Biochar bags could be placed in multiple areas of the lake to absorb some of the nutrients introduced to the water column through internal loading or from the watershed. Areas of known concentrated stormwater input are also preferred, so incoming nutrients can be intercepted. These bags would likely be installed in spring at the start of the growing season and replaced approximately halfway through the growing season. EutroSORB F® Bags – A notable amount of nutrients are modeled to enter Upper Greenwood Lake from its tributaries. This may be mitigated with the use of the SePro product EutroSORB F®, a compound designed to remove SRP from flowing water. These products can be installed in streams to remove phosphorus prior to entry into a lake. It should be noted however that EutroSORB F® bags need to be systemically changed upon expiration to achieve continued proper removal rates. Additionally, installation of bags into the stream may require permits through the NJDEP. Floating Wetland Islands – Upper Greenwood Lake may also benefit from the installation of floating wetland islands. These structures serve to absorb some nutrients from the water column before they can be used by algae and would be best placed in the shallower southern end of the waterbody, as well as by the inflow from the small pond to the north. They also can provide habitat for fish and other aquatic animals. Nutrient Inactivation and/or Sequestration - The application of products such as Alum or Phoslock® can be used to remove phosphorus from the water column, making it unavailable to algae. Upper Greenwood Lake may benefit from applying alum during instances of increased algae growth during the summer. Due to the tendency of alum to lower the pH of water, prior to application, an alum bench test must first be performed. The purpose of this test is to assess the approximate amount of alum that can be applied to the waterbody before the pond's pH drops to a level dangerous to fish and other aquatic life.

7A Bank stabilization and vegetated conveyance along Spruce Point Trail 60 - 80 $7,500 - $15,000

7B Manufactured Treatment Device along Warwick Turnpike / Spruce Point Trail See N.J.A.C. 7:8-5.7(d)2 $750,000 - $1,500,000

8A Conversion of a portion of the Greenwood Baptist Church parking lot to porous pavement 80 $400,000 - $700,000

8B Rain garden / bioretention system in the Greenwood Baptist Church parking lot 60 - 90 $40,000 - $70,000

9A Bioretention system adjacent to the N Lake Shore Drive and Dover Road Inlet 90 $50,000 - $125,000

9B Riparian buffer establishment and invasive species treatment along the N Lake Shore Drive and Dover Road inlet 60 - 80 $12,500 - $25,000

10A Bioretention system(s) between N Lake Shore Drive and the northern cove 90 $90,000 - $175,000

10B Establishment of a shoreline buffer along the northern cove shoreline 60 - 80 $40,000 - $60,000
11A Conversion of a portion of the parking lot on N Lakeshore Dive to porous pavement 80 $250,000 - $450,000

11B Establishment of a shoreline buffer near N Lakeshore Drive and Papscoe Road 60 - 80 $30,000 - $55,000

12A Conversion of a portion of the Living Word Alliance Church parking lot to porous pavement 80 $500,000 - $800,000

12B Rain gardens or downspout planters in front of the Living Word Alliance Church 60 - 80 $5,000 - $15,000

8.3 UPPER GREENWOOD LAKE

Upper Greenwood Lake is located north of and downstream of Mt. Laurel Lake. Thus, the entire Mt. Laurel Lake watershed, which also includes the Lake Lookover watershed, is located within the Upper Greenwood Lake watershed. The lake receives the majority of its inflow from Mt. Laurel Lake. The two lakes are separated by a few small roads and/or bridges and it is likely that there is some mixing between the two lakes through the existing large culverts when the water level is at normal height. Given the above, all of the watershed restoration measures for both of the above-named lakes would function to reduce the pollutant load to Upper Greenwood Lake. Although there is dense residential development around the shoreline of Upper Greenwood Lake, especially on the western shoreline, the watershed is mostly forested, accounting for approximately 57% of total watershed area while wetlands account for approximately26%.

SITE 7: ISLAND TRAIL A large culvert located under Island Trail, just off of Warwick Turnpike separates the southeast part of Upper Greenwood Lake from the eastern part of Lower Mt. Laurel Lake. The water feature at this location is narrow and resembles a canal. The water on both sides of the culvert was stagnant during the site visit in April 2022, with minor algal growth and a film across the surface. There are multiple catch basins on Island Trail and Warwick Turnpike that discharge directly into this side channel. Surface runoff from Island Trail also appears to drain directly into the side channel at multiple locations, resulting in extensive erosion of both the asphalt road edge above the culvert, as well as the banks of the channel directly adjacent to Island Trail. Erosion of the asphalt troad edge was extensive on the eastern side and the pavement was becoming compromised. The bank of the channel adjacent to a section of concrete bulkhead on the southwest side of Spruce Point Trail was steep and poorly vegetated, resulting in additional erosion.

Recommendation Site 7:

The primary recommendation (Site 7A) for this site is the stabilization of the eroding banks of the channel on both sides of Island Trail, with an emphasis on the southwest and northeast portions. This would include the stabilization of the compromised portion of the asphalt road and the installation of curbs or a similar, simple stormwater conveyance system that would direct the surface flow to defined sections of the stabilized banks rather than over the middle of the channel where it's currently eroding. A secondary recommendation (Site 7B) involves the installation of a MTD with filter media in line with the existing subsurface stormwater system currently receiving drainage from Island Trail and Warwick Turnpike. Additional investigation into the volume of water that passes through the stormwater system in this location would need to be conducted, but based on the size of the outlet pipe, it appears to be substantial. As noted above, the water in the channel is shallow and appears stagnant. Algae, including both surface filamentous algae and potentially harmful cyanobacteria, thrive in nutrient rich stagnant water. A MTD with filter media would reduce the accumulation of sediment in the channel thereby preventing further filling in and reduction in water depths. Additionally, an MTD reduces the amount of nutrients discharging into the lake by settling and sequestering the material inside the device, thereby reducing the available nutrients that feed algal growth. Cost Site 7A: The approximate cost for design, permitting, and implementation of bank stabilization and installing a vegetated conveyance is between $7,500 and $15,000. Asphalt repair and/or installation of concrete curbing in lieu of vegetated conveyance is not included in the above estimate. Cost Site 7B: The approximate cost for design, permitting, and implementation of an MTD is anticipated to be between $750,000 and $1,500,000 depending on size and depth.

SITE 8: GREENWOOD BAPTIST CHURCH

Greenwood Baptist Church is located on the eastern side of Warwick Turnpike, on the southwestern shoreline of Upper Greenwood Lake. There is a gravel parking lot measuring approximately 7,500 square feet adjacent to the church building. Portions of the parking lot appeared to be remnant asphalt indicating it may have been fully paved at one time. The gravel parking lot extends to the steep shoreline of the lake which has little vegetation other than a single row of trees. The parking lot was in poor condition at the time of the site visit with multiple large potholes that have formed as a result of traffic patterns and erosion from stormwater flows. Improving the management of stormwater and drainage throughout the parking lot would not only improve aesthetics, but also minimize loose gravel and sediment transportation to the lake during precipitation

Recommendation Site 8: The first recommendation (Site 8A) for this site is the installation of a porous or vegetative paving system throughout the parking area. Introducing an option such as stabilized, permeable grass pavers would reduce pothole formation and standing water as well as infiltrating and slowing stormwater velocity as it flows to the lake either on or below grade. The presence of vegetation and stone subbase enables infiltration and allows for sediment settling and

pollutant removal, which is especially important in parking areas where oils and other fluids drip onto the ground from vehicles. This option would preserve the number of and help delineate parking spaces within the existing lot. This approach can be combined with options given below or approached as a stand-alone project. An additional option (Site 8B) to address drainage in the parking lot is the installation of a rain garden at the rear of the parking lot between the lot and the lake. Rain gardens and similar BMPs increase site resilience to the effects of climate change and provide enhanced visual aesthetics for properties. Given the space requirements, available parking space may be minimally reduced. Given the lot's location directly adjacent to the lake, new planting within the rain garden would also serve to enhance the existing, sparse riparian area and stabilize the bank soils.

Cost Site 8A: The approximate cost for design, permitting, and implementation of converting the entire parking lot to porous pavement is between $400,000 and $700,000.

Cost Site 8B: The approximate cost for design, permitting, and implementation of a rain garden or small bioretention area is between $40,000 and $70,000 depending on depth and the need for imported media.

SITE 9: NORTH LAKE SHORE DRIVE AND DOVER ROAD INLET There is an area of open green space and a gravel pull-off located adjacent to a drainage stream that receives stormwater from a substantial portion of the surrounding neighborhood. Part of this area is designated as a fire lane and water draft site which may limit what, if any, modifications can be done in this location. There are overhead power lines along the side of North Lake Shore Drive which may present additional site constraints. The recommendations provided below assume there remains enough room between the stream and fire lane to incorporate GI. A large puddle was present between the grass and road during the site visit in.

April 2022 indicating poor drainage. Additionally, loose gravel was present in this area which likely enters the lake during rainfall events. The stream was lacking sufficient vegetative buffer and the bank was eroding in one location. Greenwood Lake is located approximately 80 – 90 feet from North Lake Shore Drive, south of the stream, and the stream itself has a total length of approximately 80 – 100 linear feet. Multiple BMP options are presented for this site since there will likely be considerable site constraints to consider. Depending on site constraints, these measures can be implemented independently or in conjunction with one another.

Recommendation Site 9: The first recommendation (Site 9A) for this site is the implementation of a bioretention system in the open grass area between the drainage stream and the fire lane; this could also include a portion of the gravel area between the road and the grass. The creation of a bioretention system and minor regrading would create a sheet flow connection from the road, allowing for stormwater retention, infiltration and the sequestration of nutrients through native vegetation and soil media. A portion of the runoff from North Lake Shore Drive drains to a catch basin located directly across the street from the lake and then travels under the grass area via a small pipe that discharges into the drainage stream. Depending on site constraints and elevations, the subsurface pipe could be modified to discharge directly into the bioretention system. Further investigations would need to be conducted to determine the depth to groundwater given the

proximity to the lake. A second recommendation (Site 9B) that could be done independently or in addition to the bioretention system involves the enhancement of the stream riparian buffer through management of invasive plant species and planting new, native vegetation. The root structures of native plants will increase streambank integrity and reduce erosion caused by stormwater that discharges into the stream from the pipe off of North Lakeshore Drive. Rip rap could be added at the pipe outlet as an additional method of attenuating erosive flows.

Cost Site 9A: The approximate cost for design, permitting, and implementation of a bioretention area is between $50,000 and $125,000 depending on depth and size.

Cost Site 9B: The approximate cost for design, permitting, and implementation of an aquatic riparian buffer planting and invasive species treatment is between $12,500 and $25,000 depending on size and extent of treatment required.

SITE 10: NORTH LAKE SHORE DRIVE COVE There are a series of catch basins on North Lake Shore Drive around the small cove at the northern end of the lake that receive stormwater runoff from the community north and west of the cove. The cove is lined with small docks for boat mooring but there is a large area of open green space between the cove and the road. The stormwater pipes from the catch basins travel under this grassy area before discharging directly into the lake. There are at least three main pipes that discharge into the cove at this location with two of the pipes in relatively close proximity to each other along the western half of the cove. Portions of the open space, including the shoreline, were in poor condition, with little grass and signs of compaction and erosion. Much of the shoreline was lacking a vegetative buffer aside from a few small trees.

Recommendation Site 10: The first recommendation (Site 10A) for this site is the implementation of a bioretention system in the open grass area between North Lake Shore Drive and the lake. The system could consist of one large bioretention system that receives drainage from multiple catch basins, or the creation of multiple, smaller bioretention systems that each receive drainage from one catch basin. In addition to stormwater from the catch basins, a bioretention system could receive sheet flow from directly from the road that bypasses the catch basins, which likely occurs during heavy rain. Further investigation would need to be conducted to determine the contributing drainage areas and depth to groundwater given the close proximity to the lake to ensure proper design and sizing.

A second recommendation (Site 10B) that could be considered independently or in addition to the bioretention system is the creation of a vegetated shoreline buffer through new native plantings. The root structures of these plants would strengthen the slopes and soils of the existing shoreline, reduce erosion and further limit sediment inputs into the lake.

Cost Site 10A: The approximate cost for design, permitting, and implementation of a bioretention area is between $90,000 and $175,000 depending on depth and size.

Cost Site 10B: The approximate cost for design, permitting, and implementation of an aquatic shoreline buffer planting and invasive species treatment is between $40,000 and $60,000.

SITE 11: PARKING LOT ON NORTH LAKESHORE DRIVE NEAR PAPSCOE ROAD

There is a small asphalt parking lot on the west side of North Lake Shore Drive, near the intersection with Papscoe Road, along the northeast shoreline of the lake. The lot is approximately 5,500 square feet and extends to North Lake Shore Drive, with no curbs or other separation between the lot and road. Based on the existing grades, the parking lot likely receives some stormwater runoff from the road. There is one catch basin in the southern corner of the parking lot which collects the majority of the runoff from the lot. There is a circular, concrete structure in the center of the parking lot with two manholes; however, it's function was not evident at time of observation, but should be confirmed prior to further design recommendations. A grass area between the parking lot and the lake that is approximately 3,300 square feet in area leads to the shoreline of the lake which is lined with large rocks and a large patch of the invasive Phragmites australis was observed growing along the entire length of shoreline

Recommendation Site 11: The first recommendation (Site 11A) for this site is the installation of a porous or vegetated paving system throughout the parking area. Introducing an option such as permeable grass pavers would aid in slowing stormwater runoff and giving it time to infiltrate before it reaches the lake via sheet flow or the catch basin outlet pipe. The gravel media and vegetation allow for infiltration of water into the ground where sediment settling and pollutant removal would occur.

A second recommendation (Site 11B) involves removing some or all of the compacted lawn and replacing it with native meadow vegetation that has deeper root systems to increase natural soil drainage and filter additional stormwater of sediments and select pollutants. This type of planting strategy will also help reduce the presence of geese on the site and thereby reduce the additional nitrogen source created by their droppings.

Cost Site 11A: The approximate cost for design, permitting, and implementation of converting the entire parking lot to porous pavement is between $250,000 and $450,000 depending on type and depth of storage zone.

Cost Site 11B: The approximate cost for design, permitting, and implementation of an aquatic shoreline buffer planting and invasive species treatment is between $30,000 and $55,000

SITE 12: LIVING WORD ALLIANCE CHURCH

Living Word Alliance Church is located on the southeastern shoreline of Upper Greenwood Lake on North Lake Shore Drive. The church is located directly along the water and a larger asphalt parking lot (14,000 square feet) associated with the church is located directly across North Lake Shore Drive. There is a catch basin in the center of the large parking lot that appears to receive stormwater from the entire parking lot, though at the time of visiting, there was a large puddle around the

structure following a rain event the previous night. The parking lot also appears to receive additional stormwater runoff from a portion of North Lake Shore Drive due south of the parking lot. Across the street, there is a strip of grass and a small shrub bed located between the front of the church and the uncurbed road. Leaders from the church roof discharge directly onto the grass area where signs of erosion and sodden grass were present.

Recommendation Site 12:

The first recommendation (Site 12A) for this site is the conversion of the asphalt surface to a porous or vegetated paving system in the large parking lot. Reducing the volume of runoff from this lot will also reduce the transportation of debris, sediments and nutrients that get carried into the system during rainfall events which are likely contributing to the clogging of the existing catch basin.

The second recommendation (Site 12B) for this site is the creation of at least two small-scale rain gardens or downspout planters in front of the church that receive runoff from the two leaders that drain the roof. The native vegetation and enhanced soil media in these systems would infiltrate stormwater into the void spaces and trap sediments and/or nutrients before they can enter runoff and eventually the lake.

Cost Site 12A: The approximate cost for design, permitting, and implementation of converting half of the parking lot to porous pavement is between $500,000 and $800,000 depending on type and depth of storage zone.

Cost Site 12B: The approximate cost for design, permitting, and implementation of downspout planters is between $5,000 and $15,000.