Summit Lake and its Watershed: Restoration of Philmont's Natural Legacy

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Overview. This document was developed to provide a summary of six reports[i] that had been recently prepared on the Summit Lake and watershed. Behan Planning and Design has also considered these earlier studies and has provided its recommendations for a set of "next steps" to help the chart a course to address the concerns regarding the lake so the Philmont community can achieve its goals for an economically vibrant and environmentally sustainable future. These reports included a thorough review of the watershed, water quality, condition of the sediment in the lake bottom, a survey (bathymetric) of the lake bottom and a feasibility study for hydropower. This work is part of a comprehensive approach toward improving environmental quality and creating a sustainable economic future for Philmont as part of an innovative community revitalization program funded with a brownfield opportunity area grant from New York State Department of State.

Background. Summit Lake was formed as a mill pond behind the dam built by George Phillips between 1848 and 1848 as a source of water (hydro) power that drove the machinery of the mill complex he had developed as the leader of the High Rock Knitting Company. This type of hydro power was a key location factor for many of the villages and cities in upstate New York, with Niagara Falls perhaps the most famous. A key difference between the hydropower design at Niagara Falls and Summit Lake is that Niagara Falls does not rely on a constructed dam to raise the water elevation and hold it back. At Niagara Falls, the water level is kept elevated by the rock formation that creates the falls and some of the water flows freely over the falls and some of the water is conveyed by canals to the hydroelectric facilities located further downstream. As a result, there is not a pond or lake behind the Niagara Falls to slow down and holding back the water as in the case of Summit Lake. Because the dam holds back the creek and slows the flow, Summit Lake has slowly built up large amounts of silt, sand and other sediment in the past 170 years since the dam was build. These silt, sand, gravel and other particles settle in the lake when the speed of stream flow in the creek is slowed and dispersed into the lake.

These deposits are most evident where the stream enters the lake and the larger, heavier sand and gravel particles are heavily deposited where the channel widens and the stream flow slows and cannot carry these particles in suspension any longer. The finer clay and silt particles continue to be carried across the whole lake and are more evenly dispersed when they settle out.

As the soils upstream are slowly eroded by rain and snow melt and are carried to the lake, they carry with them nutrients like phosphorus and nitrogen. Important for plant growth, excessive amounts of these nutrients can be harmful to the lake as they act like a fertilizer contributing to algae and other plant growth in the lake. As these plants decompose, they consume oxygen in the water. And so, this process of accelerated sedimentation, increased plant growth and depletion of oxygen leads to accelerated aging of the lake, and, eventually—over a long, long time, the lake will disappear and become essentially filled in.

<u>Water and Sediment Quality Concerns.</u> Further complicating the situation is the fact that the water and sediments in the lake are not entirely pollution-free. The water and sediment sampling study conducted by CT Male Associates suggested the presence of potential contamination sources in the vicinity of the reservoir or upstream. The sampling of the surface water showed presence of the bacteria E-Coli (Escherichia coli) that is commonly found in the intestines of animals and humans. Some forms of E-coli can cause a number of illnesses. Concentrations above the drinking water standard were found for antimony and iron. All other metals analyzed were detected below their respective drinking water standard.

Test results of the sediments showed elevated levels of metals including arsenic and nickel. Levels of pollutants knows as VOC's or volatile organic compounds were found, though at levels below their respective sediment standards. Volatile organic compounds have been used as solvents for processing including metal cleaning and dry cleaning and have been identified as potentially harmful to human health through contact or ingestion. No pesticides or PCB's were detected. Iron, manganese and aluminum were also detected in elevated levels, but there are no sediment standards set for these metals.

CT Male Associates' bathymetric survey showed Summit Lake's underwater topography (bathymetry) in excellent detail. The survey showed the extent of sedimentation visible above the lake surface and the apparent extent of deposition of sediment below the water's surface. Sediment samples consisted of coarse sand and gravel with small amounts of silt at the surface with larger gravel with some cobbles evident as observed closer to the Agawamuck Creek outlet into the lake.

<u>The Watershed.</u> Summit Lake at approximately 21 acres in area is the focal point of a watershed encompassing some 13,700 acres where all of the output from storm events from that large watershed winds up in the small lake creating a large collection point or "sink" for significant sediment and nutrient load. Given the lake's size relative to the expanse of the watershed, Summit Lake will continue to capture and store a large proportion of sediment and nutrients carried by the Agawamuck Creek.

Fortunately, extensive woodlands make up the majority of the 21-square mile watershed area for Summit Lake, as forestland is the ideal land cover to keep a water body clean. Farmland, which is the second largest type of land cover in the watershed, when properly managed, can also be a contributor to good water quality. Low to moderate-density residential uses and highway corridors and their associated drainage systems are also a key elements that can impact water quality in Summit Lake. Land uses immediately adjacent to and near Summit Lake that drain into it are also important factors that contribute to lake water quality concerns.

The large delta which has formed at the mouth of the Agawamuck Creek as it enters Summit Lake has been caused by sediment deposition. While sediment deposition is a natural and normal environmental process, storm events and the removal of vegetation to protect the underlying soil can cause soil erosion and sedimentation and the release of phosphorous, nitrogen and other nutrients to occur at greatly accelerated rates which leads to a number of problems. Review of historic aerial images shows that the largest deposition in recent history likely occurred as a result of Tropical Storm Irene in 2011 as the large delta was not readily evident before that time. Nonetheless, increased sedimentation and nutrient loading is an ongoing concern and potential sources include:

- Logging activity (logging roads, stream crossings, etc.) conducted without proper design, operation/site restoration to prevent excessive erosion.
- Agricultural activity (manure, plowing, fertilizer application, etc.) conducted without manure/nutrient management planning, erosion and sedimentation protection (natural vegetated buffer strips, etc.).
- Excessive or improper use of lawn fertilizers.
- Excessive erosion along roadway drainage systems (excessive soil exposure during ditch clearing, drainage channels eroding, etc.).
- Potential pollutant loadings from storm runoff (oil, gasoline, metals) and from other sources (contaminated sites, improper material disposal, etc.).

Based on the study conducted by Renewage, LLC in March of 2016, it was apparent that sediment and nutrient loading is sourced more from certain areas where the land is steeper and there is less storage area in the stream corridor to capture sediment and hold back surface water. Several streams and small tributaries were found to carry high sediment loads due to valley erosion, channel and bank erosion, degraded/lack of vegetated buffers and steep road crossings. Conversely, there are several areas in the watershed where conditions are good for slowing down the speed of flow and thereby capture sediment and water-borne nutrients. These areas include the large complex of beaver ponds and wetlands in the lower portion of the Upper Agawamuck subwatershed and the pond area of the upper reservoir east of the Taconic.

<u>Enhanced Watershed Management</u>. Lake water quality and an improved aquatic ecosystem for Summit Lake can be achieved by reducing and controlling erosion and nutrient loading into the lake. Further, it will be important to identify potential sources of pollutants that have been identified and for these land uses to be addressed and cleaned up.

A common theme in each of the studies is that a watershed-based approach will be the most cost-effective way to reducing sources of sediment and nutrient loads—and to perform in-lake treatment only will not be cost-effective. Nonetheless, it must also be recognized that treatment of the lake itself is an important part of a comprehensive plan to protect and improve water quality in Summit Lake. Once sedimentation is controlled, some of the concepts recommended for the lake itself include water recirculation, aeration, and other best management practices.

These will help remove existing lake pollution, clear inappropriate/excessive aquatic vegetation and reduce excessive nutrients in the lake and thereby improving water quality.

Set a Water Quality Goal. Without treatment, the surface water in Summit Lake does not represent a source of drinking water. Fishing and boating and other "non-contact uses" appear feasible for the lake in its current condition. Looking ahead, it seems that such an important resource should not be limited in this way and the community should work with the New York State Department of Environmental Conservation and the local and state health departments to establish an achievable higher water quality goal for the lake. For example, would it be possible to target a water quality rating that would allow for swimming to be possible in the future. Given the overall high quality of the watershed and lack of extensive urban stormwater runoff, it seems such a goal would not be unattainable.

The Hydropower Connection. The history of Philmont and the history of hydropower development on the Agawamuck Creek are intertwined. Today, interest in renewable energy has become increasingly important as society recognizes that other energy sources, by definition, will one day be gone. Hydro-electric power generation has proven to be one of the most reliable and cost-effective sources of energy over time. The potential to capture the hydropower potential from the impoundment above the Summit Street Dam was documented in the study prepared by Alden Research Laboratory, Inc. In January 2016.

In some ways, one can think of hydropower as extremely concentrated solar power as the sun's energy is what causes water to evaporate and lifts it high into the atmosphere to be released from the clouds and rush downhill with tremendous force... When these clouds produce precipitation which falls on higher elevations, the forces of gravity send the water downstream as this runoff becomes concentrated in rivulets and small brooks, which feed larger streams which feed even larger water courses. And so, the village-owned Summit Street Dam is the collection point for a large mass of energy potential that has been impounded—ready to drop quickly downhill releasing tremendous energy—enough energy to power an entire mill complex, and today, capable of producing an average of approximately 181,000 kilowatt hours (kWh)of electricity every year.

The hydropower study considered three options for developing the site. Option 1 would be located entirely on town-owned property and would involve installing a new penstock (a large pipe) to convey water from the existing dam down to a new turbine/generator that would be located below the dam just upstream from Summit Street. Because this concept does not full advantage of the potential drop in elevation as Options 2 and 3, it would produce less energy (estimated net power at 50 kWh) but would cost less due to the simpler construction and avoidance of property acquisition.

Options 2 and 3 each involve extending the penstock to allow the turbine/generator to be located further downstream at a lower elevation which would create more power (70 kWh) than option 1—but would cost more due to the more extensive penstock and related construction and would require property acquisition at the area for the penstock extension and power plant would not be located on property currently owned by the village.

Hydropower Financial Analysis. The value of the energy produced or the price was the most important variable in determining whether a hydropower project would be financially feasible. If the power could only be sold at essentially the wholesale rate—the price utilities typically pay for energy—which was approximately $0.045/kWh or four and a half-cent per kilowatt hour, the project would not be financially viable as the costs would exceed the revenues.

However, if the project could be set up for "net metering" where the power generated could be used to replace power purchased at the net metering cost—say for the Town of Philmont's energy use—then the value (price) of the power would be based on the retail meter rates which were cited to range between $0.010 to $0.020 per kWh. Based on pricing at these retail rates, the hydropower project as analyzed would be feasible and would generate revenues that exceeded the costs, however the payback period on the investment would be extremely long (46 years).

Additional value could be achieved by selling renewable energy certificates (RECs) associated with the power production as the project would be using renewable energy. These certificates provide a way to incentive the use and production of renewable energy. While the report did not analyze the specific financial benefits of the potential for the sale of renewable energy certificates, it did note that this market should be further explored for the potential to provide an additional revenue source that could further increase the value of the energy output of a hydropower project at Summit Lake.

The hydropower study concluded that the hydroelectric project was technically feasible. If the project could achieve a net metering or retail pricing level coupled with a grant and/or sale of renewable energy certificates, the annual benefit could be as high as $18,000 to $25,000 per year during the period of project financing (initial capitalization of $350,000 for a loan period of 20 years at 2 percent interest) and then return a net income up to $40,000 once the debt was paid off from year 21 and on.

Hydropower Permitting. Obtaining all of the various permits, licenses and approvals for a hydroelectric power project can be a daunting task requiring coordination between several federal, state and local agencies. The Federal Energy Regulatory Commission or "FERC" authorizes hydroelectric power projects under a licensing program for a 30 to 50-year term. The licensing process is comprehensive in that it coordinates the environmental and other permitting review including the National Environmental Policy Act (NEPA), the New York State Environmental Quality Review Act regulations (SEQR). Permitting under the federal Clean Water Act and the state protection of waters regulations is coordinated by the New York State Department of Environmental Conservation and the U.S. Army Corps of Engineers among other agencies through the water quality certification (WQC) process. Other aspects considered include compliance with historic preservation, fish and wildlife protection including threatened and endangered species, and state energy permitting and licensing requirements.

Fortunately, the project would involve redevelopment of an existing dam which is much less onerous than development of a new dam project. Also, since there is the presence of a large waterfall downstream of the project site, there will not likely be a requirement to provide upstream passageways for Atlantic salmon or other migrating fish but this can only be fully determined as a result of the licensing process. To prevent impingement and entrainment of trout and other resident fish species in the turbine(s) it may likely be a requirement to provide for some fish passage downstream from the lake to below the dam. Other considerations and mitigation that may be required include (among other issues that may arise) provision for release of water over the spill way to oxygenate the water to help maintain water quality as well as for aesthetic purposes.

Conclusions and Next Steps. Summit Lake faces water quality issues that are shared with other similar water bodies. Fortunately, the water quality challenges facing Summit Lake are limited to a few pollutants and at relatively low levels in the surface water and in the sediment. As well, the watershed as a whole is of high overall land use and environmental quality but there is cause for concern—most pointedly in determining the source of the E. coli bacterial, the volatile organic compounds and metals found in the sampling study. Those pollution concerns coupled with the ongoing sedimentation and nutrient loading set the stage for the ongoing filling in and the continued degradation of lake water quality. If the lake is to remain an important community asset it will be important to continue these efforts to take action to restore the lake and help stabilize the watershed. Finally, the opportunity to create a state-of-the-art renewable energy project at the Summit Street Dam is surely worth advancing given the long-term projection of rising energy costs and the eventually depletion of non-renewable energy sources.

Summit Lake and it Watershed: A Parallel Track Approach. The lake and the larger watershed each need attention. The lake to accommodate more than a century and a half of stormwater management service; the watershed to help mitigate and reduce the impact of human activities so that the natural capacity of the surrounding land and water resources can perform their maximum duty to keep the water clean.

The lake would benefit from removal of excess silt and sediment and potentially deepening to help create a more resilient water body as well as installation of other best management practices. Increased water depths are important for fisheries habitat and to reduce potential for algal blooms. The restoration plan for the lake should also consider enhancing adjacent stream and wetland areas to better retain sediment that could be more easily be removed on a regular basis (e.g., establish a sedimentation basin near the mouth of the creek, just above the lake and provide equipment access) and provide naturalized enhancements through appropriate wetland and other plantings for nutrient management.

A watershed protection strategy would be a collaborative effort with property owners to reduce erosion and sedimentation through well-accepted methods including whole farm planning, sound forest management and timber harvest methods, improved roadside drainage corridor management and identification and elimination of identified pollution sources.

Summit Lake Dam: A Renewable Energy Opportunity. Hydropower is a proven performer and the elements of a feasible project has been identified. Additional research would be in order to document village and town municipal demands for electricity and whether the project would qualify for net metering which is a key to financial feasibility. Along with that work, additional design development and pre-permitting work would be important to carry out to more accurately estimate the scope of work and costs and to clarify potential permitting issues. Finally, coordination with municipal leaders and potential investment partners to explore development and management options would help advance this concept in a clear way.

Funding Support: Grants and Other Sources. The water and environmental quality aspects of these next steps are well aligned with long-standing public policy toward environmental protection and energy sustainability which makes these initiatives attractive to a number of potential funding sources. As these funding partners are identified, it will be important to demonstrate strong community support and to nurture those partnerships so that the community's goals are aligned with and can also advance the funding partners' goals. The potential to advance the state-of-the-art of water body restoration and watershed protection and low-impact hydroelectric generation and to share knowledge gained from those projects can be important aspects of successful grant-funded partnerships.

i 1. Summit Lake Reservoir Watershed Assessment. Warren County Soil and Water Conservation District for the Columbia County Soil and Water Conservation District. March 2014.

2. Summit Lake and Watershed Feasibility Report Cover Letter. Renewage, LLC. March 14, 2016

3. Summit Lake Water Quality Improvement Analysis Report. Renewage, LLC. March 2016

4. Summit Street Dam Hydropower Feasibility Study. Alden Research Laboratory, Inc. January 2016

5. Summary of Surface Water and Sediment Sampling—Summit Reservoir. CT Male Associates. September 17, 2015

6. Bathymetric Measurements Map - Summit Lake. CT Male Associates. June 25, 2016