# Phase 1 Preliminary Assessment

# Water Resources

# Seneca Compressed Air Energy Storage Project

# New York State Electric and Gas

**Town of Reading**
**Schuyler County, New York**

**Environmental Resources Management**
**399 Boylston Street**
**Boston, MA 02116**

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## *1.0 WATER RESOURCES*

This report presents a preliminary assessment of the water resources within the vicinity of the Seneca Compressed Air Energy Storage (CAES) Project and identifies potential impacts from the construction and operation of the Project on these resources. The proposed CAES Project will be a 130 to 180 MW compressed air energy storage plant that consists of an electrically driven compression cycle and a turbine expansion cycle that will produce electricity. The CAES plant is intended to provide sufficient storage to allow full operation during peak demand time periods in support of transmission system and market needs (approximately 10 hours per day). The CAES Project will be located west of Seneca Lake in Reading, Schuyler County, New York off State Route 14A (see Figure 1). The CAES property will occupy approximately 18 acres, of which, approximately 13 acres of the property will be developed with CAES process equipment, support buildings, storm water retention pond, and parking areas.

### *1.1 EXISTING CONDITIONS*

#### *1.1.1 Overview*

The overall CAES Project footprint will include the generating plant, underground water and natural gas pipelines, and overhead power lines. The underground water pipelines (one for water withdrawal and the other for wastewater discharge) will extend into Seneca Lake and cross two tributaries mapped by New York State Department of Environmental Conservation (NYSDEC) on the western shore of Seneca Lake. Seneca Lake, which is one of the eleven Finger Lakes in upstate New York, spans Seneca, Schuyler, and Yates Counties, and its watershed includes Chemung and Ontario Counties (see Figure 2). Net water flow in Seneca Lake is from south to north toward the Seneca River. The Seneca River travels north and then turns east toward the confluence with the Oneida River where it becomes the Oswego River, which flows into Lake Ontario.

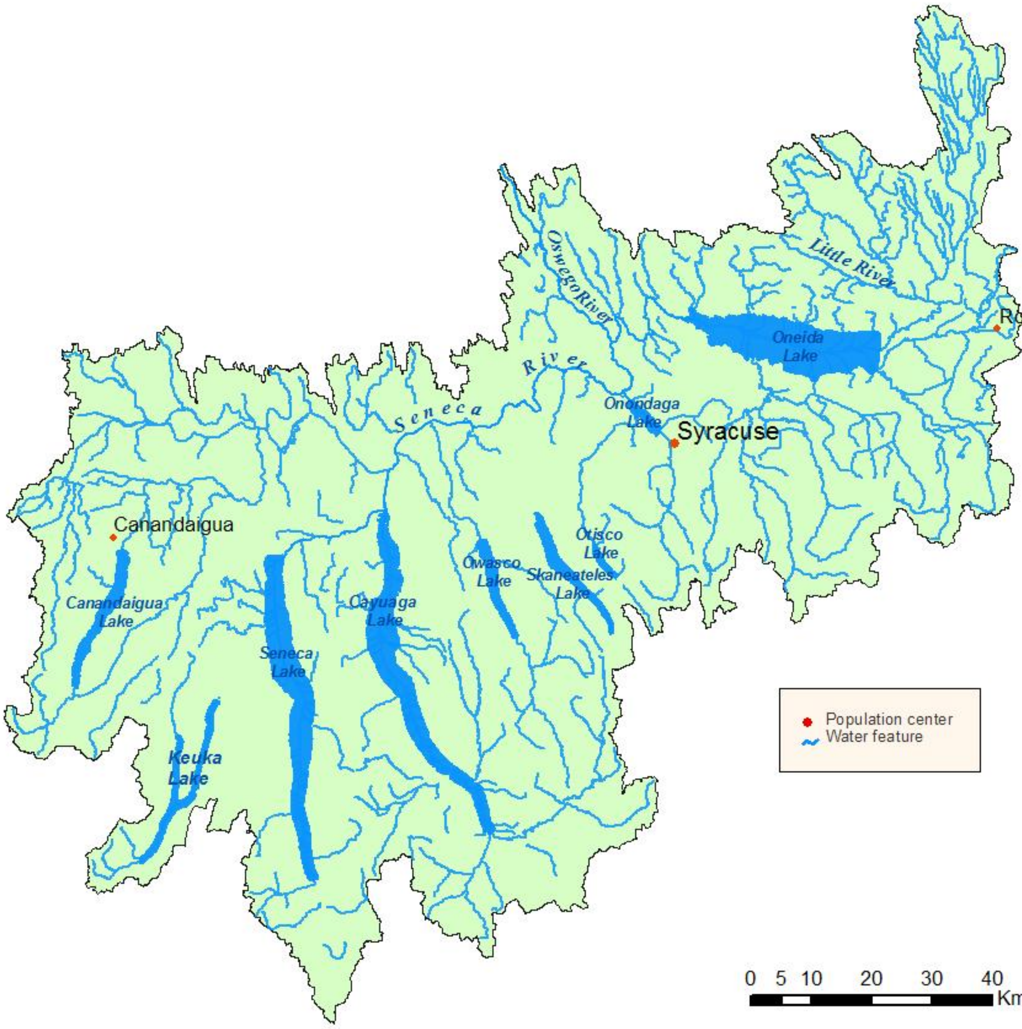


*Figure 2. Oswego River/Finger Lakes Watershed Map (NYSDEC, 2001).*

The Seneca Lake Watershed is subject to the watershed management activities of the Genesee/Finger Lakes Regional Planning Council (G/FLRPC), which began the process of developing and implementing the Seneca Lake Watershed Management Plan in 1996 (G/FLRPC, 1999). The aim of the Seneca Lake Watershed Management Plan is to "protect and enhance Seneca Lake and its surrounding watershed through the encouragement of sound management practices and cooperation at the local level to develop a comprehensive approach for improving the quality of life and water in the Seneca Lake Watershed." In 1999, the G/FLRPC published an in-depth description and analysis of the Seneca Lake Watershed titled "Setting a Course for Seneca Lake: The State of the Seneca Lake Watershed." Currently, the G/FLRPC is updating this report and plans to publish an updated study in 2014. In a parallel effort, the NYSDEC published the results of a NYSDEC water quality study of the Finger Lakes in 2001.

### 1.1.2 *Hydrology*

#### 1.1.2.1 *Surface Water*

With approximately 42,646 acres (172.6 million square meters) of surface area, Seneca Lake has the greatest surface area of all the Finger Lakes. With an average depth of 290 feet (88 meters) and maximum depth of 651 feet (198 meters), Seneca Lake is also the deepest Finger Lake. Seneca Lake and the other Finger Lakes were formed by glacial activity that began approximately 2 million years ago and ended 10,000 years ago as continental glaciers moved southward from the Hudson Bay area, accentuating existing river valleys to form the present-day Finger Lakes. Table 1 provides a summary of the geometric characteristics of Seneca Lake.

*Table 1: Geometric characteristics of Seneca Lake (NYSDEC, 2001).*

| Mean Depth (ft) (m) | Max Depth (ft) (m) | Length (mi) (km) | Volume ($10^6$ gal) ($10^6$ $m^3$) | Surface Area ($mi^2$) ($km^2$) | Watershed Area ($mi^2$) ($km^2$) | Elevation above MSL (ft) (m) |
|---|---|---|---|---|---|---|
| 291 (88.6) | 651 (198.4) | 35.1 (56.6) | 4,105,000 (15,539) | 67.7 (175.4) | 455.8 (1180.6) | 444.9 (135.6) |

With a volume of approximately 4.1 trillion gallons (15.5 billion cubic meters), Seneca Lake represents almost 50% of the combined volume of all eleven Finger Lakes. According to the 2001 NYSDEC report, its shoreline is approximately 75 miles (121 kilometers) and its hydraulic residence time is approximately 18.1 years.

#### 1.1.2.2 *Groundwater*

According to the United States Geological Survey (USGS) (2005), groundwater withdrawal from the counties surrounding Seneca Lake ranges from 1.0 to 9.9 million gallons per day (mgd). At the location of the CAES Project, the USGS does not define any unconsolidated aquifers; however, south of the project site in the area of Watkins Glen, the USGS defines both unconfined and confined aquifers (USGS, 1987). The nearest primary-supply aquifer to the CAES Project is located east of Ithaca, NY. The vast majority of drinking water for the towns surrounding Seneca Lake is derived from surface water sources including Seneca Lake (NYSDEC, 2005).

### 1.1.3 *Watershed*

The United States Geological Survey (USGS) assigns an 8-digit Hydrologic Unit Code (HUC) to all watersheds across the United States as identification and tracking system. The HUC for Seneca Lake is 04140201

(EPA, 2011). As presented in Table 1, the watershed draining into Seneca Lake is approximately 456 square miles (1181 square kilometers), including the catchment area of Keuka Lake, which flows into Seneca Lake at its northwestern bank. Seneca Lake is part of the larger Oswego River/Finger Lakes Watershed, as presented in Figure 2.

The Seneca Lake sub-watershed consists of 29 sub-watersheds covering 32 local municipalities, totaling 40 communities (see Figure 3). The water level of Seneca Lake is controlled by hydroelectric plant operations and facilities at Waterloo Falls and Seneca Falls (G/FLRPC, 1999). During winter, Seneca Lake is drawn down to approximately 445 feet above mean sea level (msl) to minimize ice and wind damage to shoreline structures and properties and to provide storage for the spring runoff and ice melt. In summer, the elevation of Seneca Lake is maintained at approximately 446 feet above msl to support recreational activities (G/FLRPC, 1999).

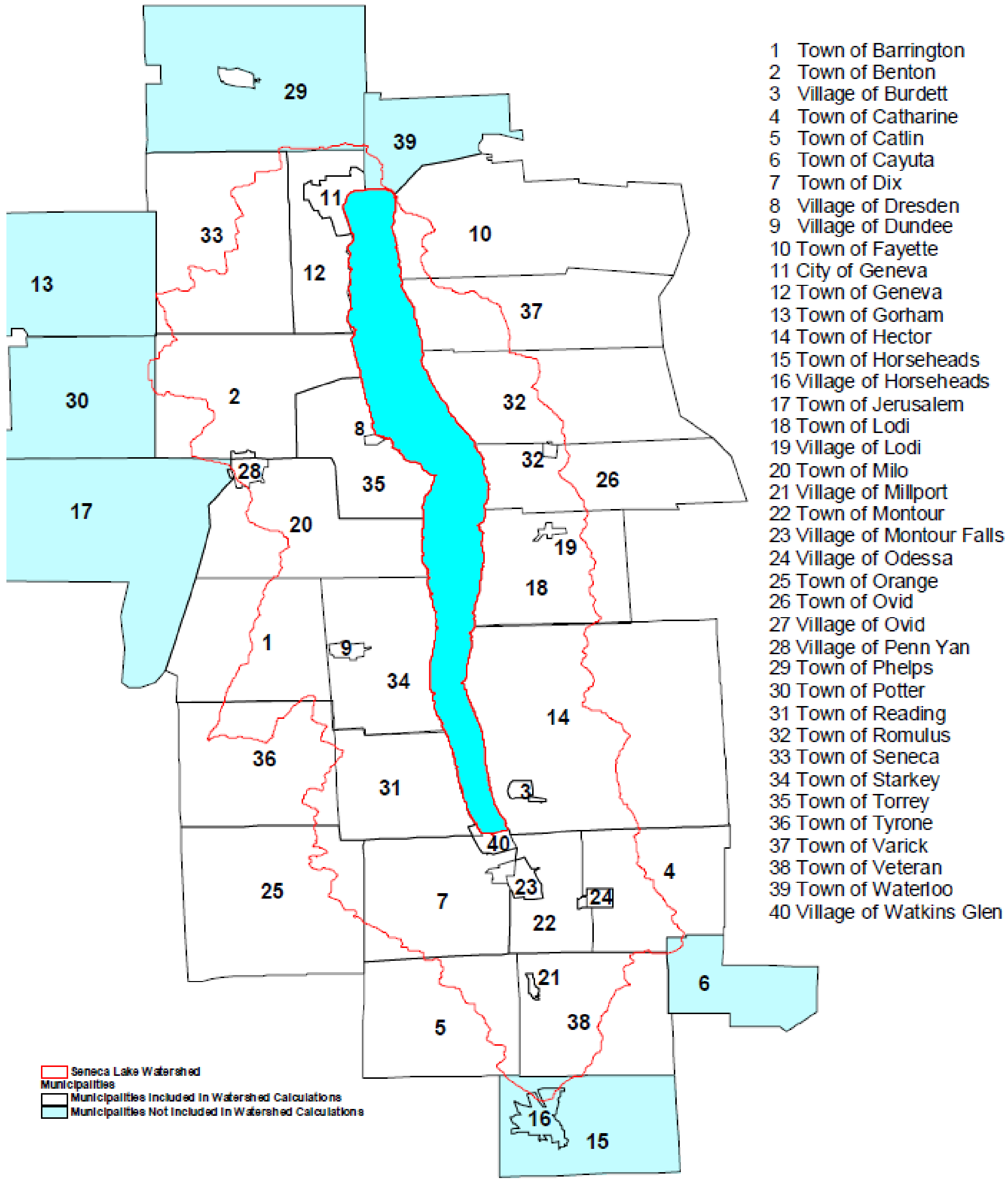


*Figure 3. Seneca Lake sub-watershed map (G/FLRPC, 1999).*

#### *1.1.3.1 Land Use*

Land use in the Seneca Lake Watershed consists of agriculture (39.1%), undeveloped forest (41.3%), idle/undeveloped land (11.3%), and developed land (commercial, industrial, and residential) (8.3%) (G/FLRPC, 1999). From the 1970s to 1997, the land use distribution in the watershed area experienced a decrease in agricultural practices and an expansion and maturation of forests. According to the 2008 Schuyler County Agriculture Development and Farmland Protection Plan, between 1997 and 2007, Schuyler County experienced an increase in agricultural land. Of the land use categories, residential development has changed the most since the 1970s as lot sizes and house footprints in the county have been steadily increasing. See the Phase 1 Land Use Report for additional discussion of land use in the CAES Project area.

#### 1.1.3.2 *Climate*

The Finger Lakes region is characterized by cold winters and humid summers. According to the National Oceanic and Atmospheric Administration (NOAA) Climate Visualization System (CLIMVIS), average precipitation for the region is 34 inches per year with the average driest months between 1951 and 2011 being January and February (see Figure 4). The region is one of the driest in New York, but supports agriculture and horticulture practices in the area. Snowmelt occurs in spring (late-March through April) and the wettest months are June through September. Figure 5 summarizes the average temperature data between 1951 and 2011 for the Central Lakes Region of New York (CLIMVIS, 2011). On average, July is the hottest month and January the coldest. The average maximum temperature is 69 degrees Fahrenheit (F) and the average minimum temperature is 24 degrees F.

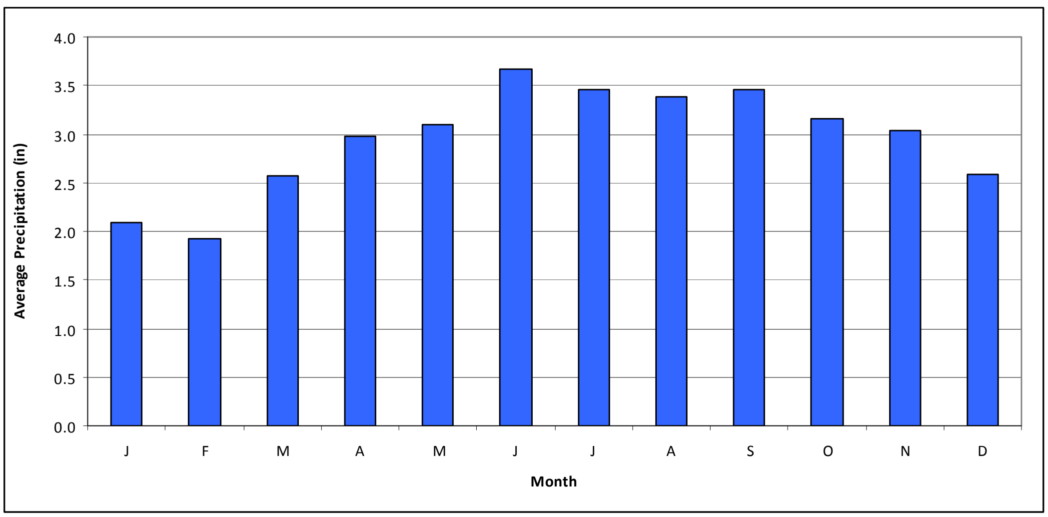


*Figure 4. Average monthly precipitation in the Central Lakes Region (CLIMVIS, 2011).*

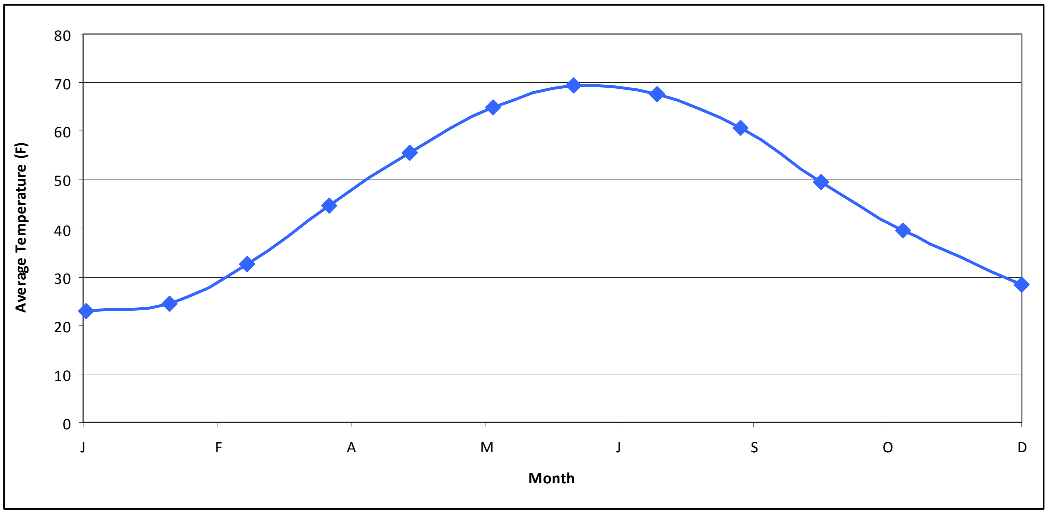


*Figure 5. Average monthly temperature for the Central Lakes Division of New York (CLIMVIS, 2011).*

### 1.1.4 Water Quality

#### 1.1.4.1 NYSDEC Classification

NYSDEC regulations assign classification, use and quality standards to surface waters throughout New York. According to NYSDEC classifications for 2010, Seneca Lake is indexed into four sections under the index designation Ont. 66-12-P 369:

1. The portion of Seneca Lake from the northernmost point southward 2.4 miles to an imaginary east-west line across the lake passing through Pastime Park;
2. The portion of Seneca Lake within a 1-mile radius of the mouth of Keuka Lake Outlet coming into Seneca Lake;
3. The portion of Seneca Lake beginning at an imaginary east-west line across the lake passing through Pastime Park extending southerly approximately 32 miles, excluding any area within section 2; and
4. The portion of Seneca Lake southerly of an imaginary line across the lake passing through Quarter Mile Creek.

Sections 1, 2, and 4 of Seneca Lake are classified as Class B, Standards B(T)[1]. Section 3 of Seneca Lake, where the intake and discharges of the proposed project would occur, is classified as Class AA, Standards AA(T).

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[1] The standard designation of (T) indicates that, according to NYSDEC, "the classified waters…are trout waters. Any water quality standard, guidance value, or thermal criterion that specifically refers to trout or trout waters, applies."

The two tributaries feeding into Seneca Lake that will be crossed by linear corridors of the Project are classified as Class C waters.

NYSDEC Chapter X, Division of Water, Part 701: Classifications-Surface Waters and Groundwaters describes the Class AA ranking as:

"The best usages of Class AA waters are: a source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival. This classification may be given to those waters that, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, meet or will meet New York State Department of Health drinking water standards and are or will be considered safe and satisfactory for drinking water purposes."

NYSDEC describes the Class B ranking as:

"The best usages of Class B waters are primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival."

NYSDEC describes the Class C ranking as:

"The best usage of Class C waters is fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes."

In addition to the NYSDEC 303(d) List of Impaired/TMDL Waters and the Part 701 classifications, NYSDEC publishes a list of "Priority Water Bodies" in its "Waterbody Inventory/Priority Waterbodies List." This list is a statewide inventory of water bodies in New York that characterizes water quality, supported water uses, progress toward identifying water quality problems and sources, and activities to restore and protect each water body. According to this list, which was most recently updated in June 2010, Section 2 of Seneca Lake (as described above) has the use impairment of "Water Supply POSSIBLY THREATENED."

Seneca Lake is not listed on the 303(d) List of Impaired/TMDL Waters or list of "Other Impaired Water Body Segments Not Listed" for 2010 (NYSDEC, 2010). As such, Seneca Lake does not require development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of pollutants that restrict water body uses to restore and protect those uses.

#### 1.1.4.2 *In-Lake*

Various entities conduct water quality monitoring at Seneca Lake, including the Finger Lakes Institute (founded by Hobart and William Smith Colleges in Geneva, New York), Seneca Lakes Pure Waters Association, and NYSDEC via its Citizens Statewide Lake Assessment Program (CSLAP). Each entity monitors different parameters, however the most comprehensive data include water temperature, specific conductance, chlorophyll, and turbidity. As mentioned in section 1.1.1 Overview, NYSDEC and the G/FLRPC have published reports assessing the water quality of Seneca Lake. Data used to develop these reports were gathered mostly between 1996 and 1999.

The trophic status of a lake is determined by examining water quality parameters including dissolved oxygen (DO), nutrients, chlorophyll, and turbidity. Trophic status describes the biological productivity of a water body and ranges from low/oligotrophic, to high/eutrophic. According to NYSDEC and G/FLRPC, the current trophic state of Seneca Lake is borderline oligotrophic-mesotrophic. This indicates that Seneca Lake has low biological activity, is nutrient poor, and has very clear waters.

Water temperature in Seneca Lake varies seasonally and experiences thermal stratification during summer. The onset of thermal stratification usually occurs between mid-June and early-July (G/FLRPC, 1999). Seneca Lake remains stratified until mid-October to early-November when changes in temperature and wind force the lake to turn-over and de-stratify. Water temperature affects oxygen solubility with colder water permitting higher DO concentrations. In Seneca Lake, dissolved oxygen concentrations are near saturation throughout the water column during the entire year, showing relative insensitivity to temperature. This is consistent with the oligotrophic status, since low biological productivity does not affect the oxygen demand. Furthermore, this makes any potentially adverse effects of stratification on dissolved oxygen virtually non-existent. Figure 6 provides a graph of dissolved oxygen concentrations and water temperatures in Seneca Lake when not stratified (June) and when stratified (August).

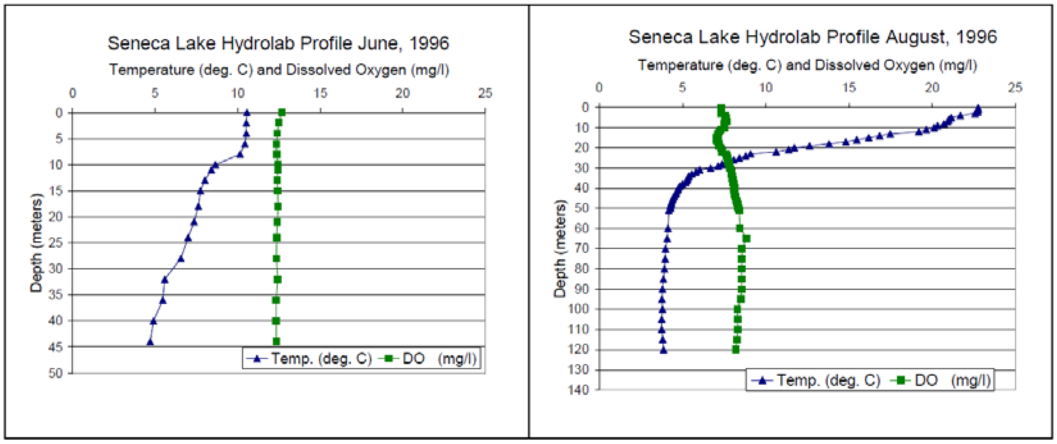


*Figure 6. Temperature and dissolved oxygen profiles for Seneca Lake (NYSDEC, 2001).*

Nitrate concentrations in Seneca Lake show range from 100 to 600 ug/L (much greater than the 10 ug/L NYSDEC standard; see Table 2) and phosphate concentrations range from 0.1 to 10 ug/L. Chlorophyll-a in Seneca Lake ranges from below detection limits to 10 ug/L (G/FLRPC, 1999); average chlorophyll-a concentrations, as reported by NYSDEC, are approximately 2.4 ug/L. As expected, concentrations of chlorophyll-a decrease as depth below the lake surface increases.

Owing to the relatively low biological productivity of Seneca Lake, water transparency can be quite high. Secchi disk (a circular disk used to measure water transparency in lakes) depths are shallower during summer when productivity is highest and deeper during fall and spring when productivity is lowest. The G/FLRPC reports a range of Secchi depths from a minimum of 1 meter to a maximum of 11 meters, with NYSDEC reporting an average Secchi disk depth of 6 meters.

Outside of these water quality parameters, other constituent concentrations are important to the health of a water body and its flora and fauna. Both NYSDEC and G/FLRPC report a variety of water quality constituents for Seneca Lake. Table 2 provides a summary of concentrations of constituents detected in Seneca Lake and shows the corresponding NYSDEC Class AA water quality standards.

*Table 2: Seneca Lake water quality.*

| | | NYSDEC[1] | USGS[2] | GFLRPC[3] | | | NYSDEC[4] |
|---|---|---|---|---|---|---|---|
| **Constituent** | Units | Avg | Max | Min | Avg | Max | Standard |
| Total Phosphorous | ug/L | 9.8 | -- | -- | -- | -- | -- |
| Chlorophyll a | ug/L | 2.4 | -- | 1.0 | | 5.0 | -- |
| Secchi Disk Depth | m | 6 | -- | 1 | | 11 | -- |
| Total Cations | mEq | 6.13 | -- | -- | -- | -- | -- |
| Total Anions | mEq | 6.3 | -- | -- | -- | -- | -- |
| pH | -- | -- | -- | 8 | | 9 | >6.5 and <8.5 |
| Calcium | mg/L | ~41 | -- | -- | -- | -- | -- |
| Magnesium | mg/L | ~10 | -- | -- | -- | -- | 35 |
| Potassium | mg/L | ~2.55 | -- | -- | -- | -- | -- |
| Sodium | mg/L | ~75 | -- | -- | -- | -- | 20 |
| Chloride | mg/L | ~130 | -- | -- | 150 | -- | 250 |
| Sulfate | mg/L | ~37 | -- | -- | -- | -- | 250 |
| Alkalinity | mg/L | ~98 | -- | -- | -- | -- | -- |
| Atrazine | ug/L | -- | 0.143 | 0.05 | 0.13 | 0.23 | 7.5 |
| Metachlor | ug/L | -- | 0.017 | -- | -- | -- | -- |
| Calcium Carbonate (CaCO3) | mg/L | -- | -- | 140 | | 150 | -- |
| Deep Water Temperature | °C | -- | -- | -- | 4 | -- | -- |
| Surface Water Temperature | °C | -- | -- | 0 | -- | 20 | -- |
| Nitrate | ug/L | -- | -- | 100 | -- | 600 | 10 |
| Phosphate | ug/L | -- | -- | 0.1 | -- | 10 | -- |
| Dissolved Silica | ug/L | -- | -- | 50 | -- | 4000 | -- |

**Notes**

1. Constituent concentrations as reported by the New York State Department of Environmental Conservation (NYSDEC) are for the average of measurements taken between 1996 and 1999, excluding 1998.

2. The United States Geological Survey (USGS) conducted sampling for current-use pesticides in the Finger Lakes in the late 1990s.

3. In 1999, the Genesee Finger Lakes Regional Planning Council (GFLRPC) reported water quality data for Seneca Lake. Data presented were collected and analyzed weekly at four offshore stations in the northern portion of Seneca Lake. Five additional sites in the southern portion of Seneca Lake were sampled in 1998.

4. Standards taken from NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groudwater Effluent Limitations.

#### *1.1.4.3 Outlet*

Seneca Lake is fed by groundwater inflow and tributaries, with the largest inflows from Catherine Creek and Keuka Lake. Most outflow from Seneca Lake is to the Cayuga-Seneca Canal, otherwise known as the Seneca River. Portions of the Seneca River are on the NYSDEC 2010 303(d) List of Impaired/TMDL Waters. However, those portions are far downstream of the Seneca Lake outlet.

The USGS monitors the Seneca River at the city of Seneca Falls that is approximately 8 miles downstream from the outlet of Seneca Lake. At this gauging location (Station No. 07051057, Seneca River in Seneca Falls), the USGS collected water quality data between May and November 2007. Water quality measured at this location is assumed to be representative of water quality leaving the outlet of Seneca Lake – only two small tributaries contribute to Seneca River after it outlets from Seneca Lake before this gauging station. Table 3 provides a summary of these data.

*Table 3: Seneca River water quality.*

| | | USGS[1] | | | NYSDEC[2] |
|---|---|---|---|---|---|
| **Constituent** | Units | Min | Avg | Max | Standard |
| Alkalinity, Carbonate as CaCO3 | mg/L | 86.3 | 94.7 | 105 | -- |
| Aluminum | ug/L | ND[3] | 96.7 | 175.0 | -- |
| Ammonia as NH3 | mg/L | 0.03 | 0.05 | 0.10 | -- |
| Cadmium | ug/L | ND | 0.125 | 0.212 | -- |
| Calcium | mg/L | 33.6 | 40.5 | 46.5 | -- |
| Total Organic Carbon (TOC) | mg/L | 2.44 | 2.86 | 3.34 | -- |
| Chloride | mg/L | 122 | 137 | 153 | 250 |
| Copper | ug/L | 1.9 | 2.8 | 3.5 | -- |
| Dissolved Oxygen | mg/L | 5.7 | 8.3 | 12.4 | > 6.0 |
| Fecal Coliform | #/100mL | 12 | 66.7 | 180 | -- |
| Lead | ug/L | ND | 0.26 | 0.61 | -- |
| Nickel | ug/L | 1.1 | 1.7 | 2.4 | -- |
| pH | – | 7.2 | 8.3 | 9.3 | >6.5 and <8.5 |
| Potassium | mg/L | 2.37 | 2.70 | 3.03 | -- |
| Sodium | mg/L | 86.9 | 111.7 | 157 | 20 |
| Total Suspended Solids (TSS) | mg/L | ND | 3.1 | 10.1 | -- |
| Specific Conductance | uS/cm | 753 | 871 | 1169 | -- |
| Temperature | °C | 5.6 | 17.6 | 24.5 | -- |
| Turbidity | NTU | 0.88 | 3.05 | 10.2 | < 5 |

**Notes**

1. The United States Geological Survey (USGS) monitored water quality parameters at the Seneca River at Seneca Falls between May and November 2007.

2. Standards taken from NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groudwater Effluent Limitations.

3. "ND" denotes "non detect" which indicates that the consitutent was below the detection limit of the sampling instrumentation.

### 1.1.5 *Sediment Characterization*

In addition to water quality monitoring, NYSDEC completed a sediment core investigation of Seneca Lake between 1997 and 1998. Cooperating with Hobart and William Smith Colleges, one sediment core was collected from Seneca Lake at a depth of 130 meters. This location is at approximately the same latitude as Sampson State Park on the eastern shore of Seneca Lake (see Figure 7).


*Figure 7. Location of sediment core (arrow) and Sampson State Park (point A) (Google, 2011).*

Sediments are a combination of organic and inorganic material deposited by erosion, aerial deposition, biological growth and decay, and transport from other water bodies. Findings from the NYSDEC sediment investigation indicate a sediment accumulation rate of 0.23 centimeters per year in Seneca Lake. Due to a sampling oversight, total organic carbon (TOC) was not measured. However, organic and inorganic chemical data were collected. The only organics detected in Seneca Lake sediment were dichloro-diphenyl-trichloroethane (DDT) and its metabolites, and polychlorinated biphenols (PCB) congeners. The DDT concentration exceeded its threshold-effect level (TEL) but did not reach the probable-effect level (PEL)[2]; conversely PCB congener concentrations exceeded its PEL. Inorganic chemical findings for Seneca Lake sediment include measurements for arsenic, cadmium, calcium, chromium, copper, lead, mercury, nickel, and zinc. Table 4 presents the existing concentrations of

[2] The TEL represents the chemical concentration below which adverse effects are expected to occur infrequently. The PEL represents a second threshold value, above which adverse effects are expected to be frequently observed.

each constituent as measured in the Seneca Lake sediment core. Note further evaluation of potential impacts to aquatic life due to the disturbance of lake bed sediments during construction will be performed under Phase 2 of the Project after the design of the underwater infrastructure has been finalized.

*Table 4: Constituent concentrations in Seneca Lake sediment core.*

| Measurement | Units | NYSDEC[1] Avg |
|---|---|---|
| $^{137}$Cs marker depth (peak) | cm | 7 |
| $^{137}$Cs marker depth (horizon) | cm | 15 |
| Sediment Accumlation rate (peak)[2] | cm/yr | 0.23 |
| Sediment Accumlation rate (horizon)[4] | cm/yr | 0.33 |
| Sediment Accumlation rate[3] | cm/yr | 0.32 |
| Peak Sum of DDT (8-10cm depth) | ppb | 153 |
| Surface Sum of DDT | ppb | 40 |
| Sum of PCB Cogeners | ppb | 466 |
| Adjusted Sum of PCB Cogeners[4] | ppb | 408 |
| Dieldren | ppb | ND |
| Arsenic (peak [occurred at surface]) | ppm | 19 |
| Arsenic (surface) | ppm | 19 |
| Cadmium (peak [at 6-8cm, ~1970]) | ppm | 2.2 |
| Calcium (peak [at 4-6cm, ~1978]) | ppm | 37200 |
| Chromium (peak [at 6-8cm, ~1970]) | ppm | 30.1 |
| Copper (peak [6-8cm, ~1970]) | ppm | 61.8 |
| Lead (peak [6-8cm, ~1963]) | ppm | 84.6 |
| Manganese (peak [0-2cm, 1994]) | ppm | 2450 |
| Nickel (peak [6-8cm, ~1970}) | ppm | 46.1 |
| Zinc (peak [6-8cm, 1970]) | mg/kg | 176 |

**Notes**

1. Constituent concentrations as reported by the New York State Department of Environmental Conservation (NYSDEC) are for the average of measurements taken between 1996 and 1997
2. Sediment accumlation rate based on $^{137}$Cs.
3. Sediment accumulation rate based on $^{210}$Lead
4. Total sum of cogeners minus IUPAC-85 and DDE.

### 1.1.6 *Water Use*

Forty communities have at least some portions of their jurisdictions in the Seneca Lake Watershed. Currently, Seneca Lake serves as a source of public water supply for the surrounding communities of Geneva, Ovid, Waterloo, and Watkins Glen and is the drinking water source for over 70,000 people in the Finger Lakes region (NYSDEC, 2001). In 2001, there were four permitted withdrawals with a total permitted withdrawal of approximately 9 million gallons per day (mgd) (NYSDEC, 2001) with the estimated actual surface water withdrawal of 7.9 mgd (USGS, 2010). Potable water from the lake to residents meets all drinking water standards published by the United States Environmental Protection

Agency (EPA) under the Safe Drinking Water Act (SDWA). Before it is distributed, drinking water from Seneca Lake is tested for heavy metals, volatile organics, organics, microbes, pesticides, and herbicides (G/FLRPC, 1999).

### 1.1.7 *Aquatic Resources*

#### 1.1.7.1 *Aquatic Life*

Seneca Lake supports fisheries with lake trout (*Salvelinus namaycush)*, smallmouth bass (*Micropterus dolomieu)*, and yellow perch (*Perca flavescens)* serving as the mainstay of the lake since the first survey of Seneca Lake in 1927. Other species in the lake include rainbow trout (*Oncorhynchus mykiss)*, brown trout (*Salmo trutta* sp.), land-locked Atlantic salmon (*Salmo salar)*, northern pike (*Esox lucius)*, large mouth bass (*Micropterus salmoides)*, alewives (*Alosa pseudoharengus)*, and rainbow smelt (*Osmerus mordax)*. According to the 1999 G/FLRPC report, Seneca Lake is stocked annually with 60,000 lake trout, 65,000 brown trout, and 24,000 Atlantic salmon. Rainbow trout are sustained entirely by natural reproduction in Seneca Lake tributaries. Much of the perimeter of the lake supports a band of rooted aquatic vegetation consisting of Eurasian milfoil (*Myriophyllum spicatum*) primarily, and pondweeds (*Potamogeton* sp.), waterweeds (*Elodea* sp.), water plantain (*Alisma* sp.), stoneworts (*Chara connivens*), and muskgrass (*Chara* sp.), as well.

Both NYSDEC and G/FLRPC report that Seneca Lake is impacted by Zebra mussels and possibly Quagga mussels. Introduced to the United States in the late 1980s, Zebra mussels are an exotic species that can substantially alter aquatic ecosystems and impact human-made structures within a lake (e.g., clogging water intake pipes). About the size of a fingernail, Zebra mussels filter-feed on plankton. In its 1999 report, the G/FLRCP notes that phytoplankton populations in Seneca Lake decreased between 1992 and 1998, hypothetically corresponding with the timeframe in which Zebra mussels had established in the lake. It bares mention that calcium is often the limiting nutrient to Zebra mussel productivity and growth; therefore, increases in calcium concentrations within Seneca Lake could lead to exacerbated Zebra mussel populations.

## 1.2 *PRELIMINARY ASSESSMENT OF POTENTIAL IMPACTS*

### 1.2.1 *Proposed Action and Potential Impacts*

The CAES plant site is approximately 2000 feet (609.6 meters) west of Seneca Lake, immediately west of the intersection of State Route 14 and

Route 14A. Construction of the CAES plant is scheduled to begin in December 2013 with a target in-service date of late 2014. The CAES Project will use and impact water in various ways via its cooling water, make-up water, wastewater management, and stormwater management systems. Construction of the plant, the underground water and natural gas pipelines, and the aboveground power lines may also temporarily impact Seneca Lake and two tributaries during the construction phase of the Project.

#### *1.2.1.1 Water Demand*

For the CAES Project, two expansion cycle process alternatives are currently being evaluated. The first expansion cycle (Cycle 1) will employ expansion turbine generators with a natural gas combustor (i.e., process heater) to heat the stored air prior to entering the expansion turbine generators. The second expansion cycle (Cycle 2) will consist of a natural gas-fired combustion turbine with a heat exchanger downstream of the combustion turbine exhaust that will be used to heat the air prior to entering the expansion turbine generators.

Cycle 1 and Cycle 2 have different water budgets due to varying thermodynamic conditions between the two cycles. The driving variable affecting the water budget is ambient weather conditions, with ambient temperature being the most important. Figure 8 shows the average-demand water budget for Cycle 1 and Figure 9 shows the average-demand water budget for Cycle 2. Both cycles will withdraw water from Seneca Lake for use as:

1. Nitrogen oxide (NOx) emissions control for the process heater (Cycle 1 only),
2. Combustion turbine water wash tank (Cycle 2 only),
3. Cooling tower make up,
4. Evaporative cooler (Cycle 2 only),
5. Service water, and
6. Potable water.

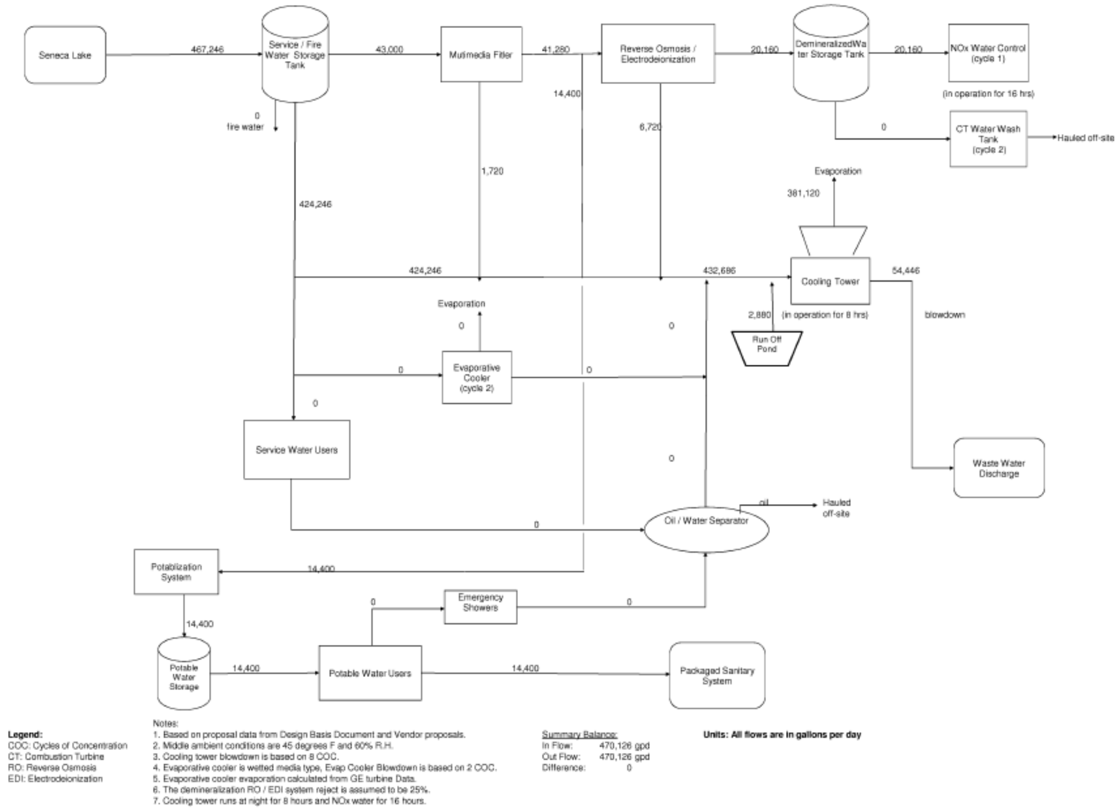


*Figure 8. Cycle 1 average usage (WorleyParsons, 2011).*

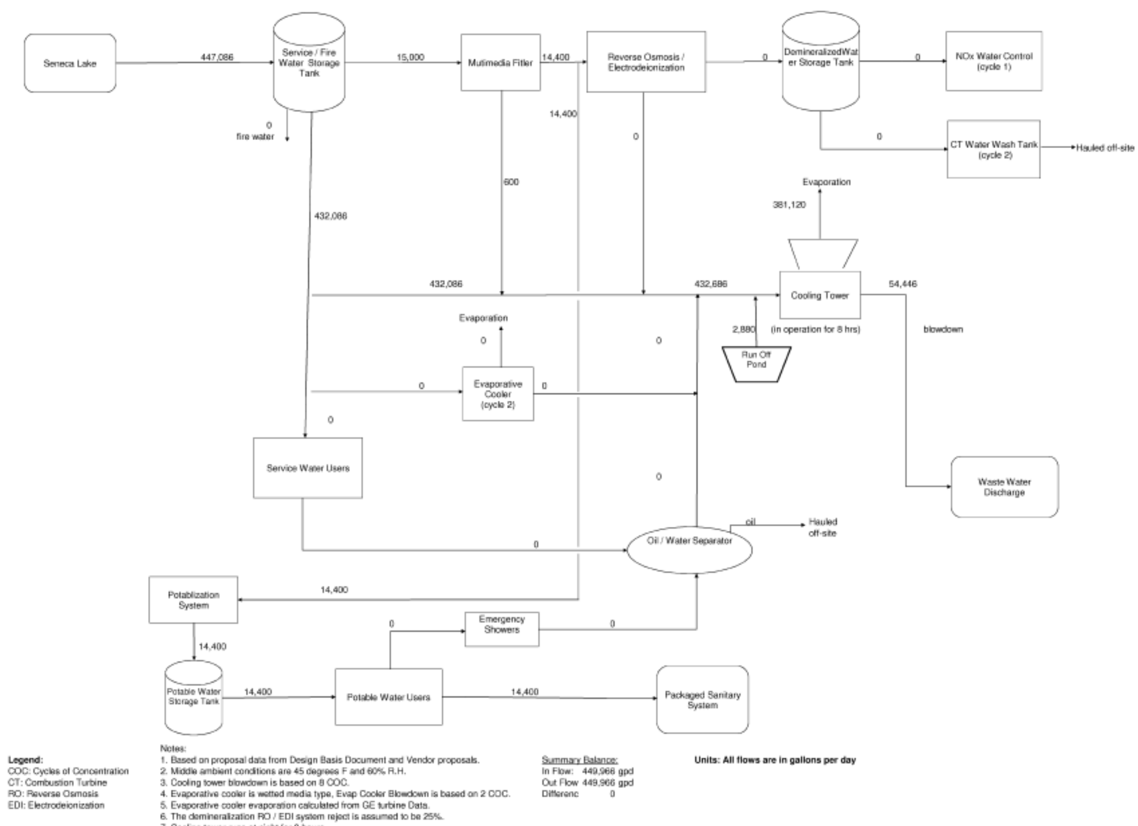


*Figure 9. Cycle 2 average usage (WorleyParsons, 2011).*

As presented in Figures 8 and 9, Cycle 1 and Cycle 2 will use water withdrawn from Seneca Lake and delivered to the facility via an underground pipeline. Approximately 12% of the water withdrawn from Seneca Lake will be returned to the lake (via an underground pipe) as wastewater produced from Cooling Tower blowdown. The balance of the water consumed by the CAES plant is evaporated from the Cooling Tower, water used for NOx control for the Cycle 1 process heaters, combustion turbine water wash that will be hauled off-site (Cycle 2 only), or water disposed of via the on-site sanitary (septic) system.

For average ambient climatic conditions, it is expected that the CAES facility will withdrawal approximately 0.45 to 0.47 million gallons per day (mgd) from Seneca Lake, depending on Cycle design. In addition to water withdrawn from Seneca Lake, the CAES plant will use approximately 2,880 gallons per day supplied from the storm water retention pond to meet the make-up water demand of the cooling tower and lessen the amount of water needed to be withdrawn from Seneca Lake. According to the 2001 NYSDEC report, the average inflow to Seneca Lake is approximately 172,000 million gallons per year (approximately 470 mgd). As such, the average ambient climatic conditions CAES water intake rate of 0.46 mgd represents approximately 0.1 percent of the average inflow to Seneca Lake from tributaries and groundwater inflow. Through corresponding evaporation, blowdown, NOx control, the combustion turbine water wash tank, and the on-site septic system, CAES Cycles 1 and 2 will consume between 395,000 and 415,000 gallons per day, respectively, which represents 0.08 percent and 0.09 percent, respectively of the average inflow to Seneca Lake.

#### 1.2.1.2 *Water Storage*

A 700,000 gallon service/fire water storage tank will be placed in service at the CAES facility to moderate water balance flows during operational periods.

The CAES plant will employ stormwater management at the site. The stormwater management system will collect runoff within the property boundaries and store the runoff in an on-site retention pond. As much as practicable, this water will be used to supplement the cooling tower make up water demand and thus help minimize the amount of water withdrawn from Seneca Lake, as described above.

#### 1.2.1.3 *Water Discharge*

The Cooling Tower blowdown, which will be discharged into Seneca Lake, will be the principal wastewater discharge from the facility.

Preliminary design information provided for the CAES plant includes an analysis of the "raw water" that the facility will receive from Seneca Lake and the cooling tower blowdown. Table 5 identifies key water quality parameters and associated concentrations for the cooling tower blowdown and raw intake water.

*Table 5. Constituent concentrations in CAES intake and blowdown (WorleyParsons, 2011).*

| Constituent[1] | Units | Blowdown | Intake Water | Difference | % Difference | Standard[2] |
|---|---|---|---|---|---|---|
| Calcium (as $CaCO_3$) | mg/L | 336.0 | 42.0 | +294 | 700% | -- |
| Magnesium (as $CaCO_3$) | mg/L | 88.0 | 11.0 | +77 | 700% | 35 |
| Sodium (as Na) | mg/L | 1072 | 134.0 | +938 | 700% | 20 |
| Potassium (as K) | mg/L | 21.6 | 2.7 | +18.9 | 700% | -- |
| Total Hardness | mg/L | 424 | -- | N/A | N/A | -- |
| Chloride (as Cl) | mg/L | 1112 | 139.0 | +973 | 700% | 250 |
| Sulfate (as $SO_4$) | mg/L | 1052 | 38.0 | +1014 | 2668% | 250 |
| Silica (as $SiO_2$) | mg/L | 14.4 | 1.8 | +12.6 | 700% | -- |
| Phosphate (as $PO_4$) | mg/L | 85.6 | 10.7 | +74.9 | 700% | -- |
| Nitrate | mg/L | 4.0 | 0.5 | +3.5 | 700% | 10 |
| Total Alkalinity | mg/L | 46 | 106 | -60 | -57% | -- |
| pH | -- | 7.0 | -- | N/A | N/A | >6.5 and <8.5 |
| Max Temperature | °F | 80 | 60 | +20 | 33% | -- |
| Suspended Solids | mg/L | 12 | 1.5 | +10.5 | 700% | -- |

**Notes**

1. Data based on preliminary calculations conducted by the designer of the CAES plant in 2011.

2. Standards taken from NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groudwater Effluent Limitations.

As Table 5 reveals, each constituent, with the exception of total alkalinity, increases during water use at the CAES facility, which is not unexpected given the concentrating effect inherent in cooling tower blowdown. For the most part, the concentration of almost all of the parameters increases by a considerable amount.

The CAES plant will employ a packaged sanitary system to manage its domestic wastewater. The plant will generate domestic wastewater from its potable water uses such as on-site restrooms; no industrial wastewater enters the septic system. The packaged sanitary system will be equipped with a standard below-ground leach field. Approximately 14,400 gallons per day will flow through this system. Based on the modern design of the sanitary system no impacts to groundwater are anticipated.

#### 1.2.1.4 *Water Availability*

As discussed in section 1.2.1.1 Water Demand, on average the CAES facility will withdraw approximately 0.46 mgd, which is approximately 0.1 percent of the average inflow to Seneca Lake from tributaries and groundwater inflow. It is anticipated that the facility will return approximately 55,000 gallons per day (gpd) or 12 percent of the withdrawal volume to Seneca Lake, with the balance of approximately 405,000 gpd associated with consumptive use.

### 1.2.1.5 *Water Quality*

As discussed in section 1.1.4.4 NYSDEC Classification, in the vicinity of the proposed CAES water intake and discharge structures, Seneca Lake is classified as Class AA. As promulgated by NYSDEC in Chapter X Division of Water Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Class AA water quality limitations apply to various water quality constituents (as shown in Table 2, Table 3, and Table 4). During the operational phase of the Project, water discharged from the CAES plant would be diluted and mixed with water in Seneca Lake.[3] For purposes of this preliminary assessment and to present one scenario, it is assumed that a mixing zone exists in the vicinity of the CAES wastewater discharge outfall in Seneca Lake. It is important to recognize, however, that the evaluation of the impacts of discharging cooling tower blowdown into Seneca Lake will require consultation with NYSDEC to determine acceptable analysis methodologies. These discussions would occur during Phase 2 of the Project.

That being said, performing a hydrodynamic simulation of the mixing zone would be one of the best methods to evaluate the horizontal and vertical extent of the mixing zone. Such a simulation would be performed under Phase 2 of the Project. However, as a first cut assessment, a simplistic approach is to conduct a dilution analysis to approximate the dilution that would be required to reduce effluent constituent concentrations to Class AA standards.

Data for the CAES facility indicate that the concentration of salt (sodium) in the cooling tower blowdown is on the order of 1000 mg/L. As presented in Table 5, the concentration of sodium in the CAES blowdown is seven times greater than the ambient sodium concentration in Seneca Lake. NYSDEC Class AA standards limit sodium concentration to 20 mg/L. However, as discussed above, discharge from the CAES facility will be diluted and mixed with water in Seneca Lake. With a discharge of 55,000 gallons per day to Seneca Lake, a simple dilution analysis yields a mixing volume of approximately 50 times the daily discharge volume (i.e., 2,750,000 gallons) to dilute the blowdown to 20 mg/L (as presented in Table 6).

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[3] Note: At this point in time, it is assumed that the cooling tower blowdown will be discharged through an underground pipeline into Seneca Lake and not discharged into the nearby tributary or treated on-site prior to discharge to a receiving water body.

Similar dilution calculations were performed for the concentration of magnesium, chloride, and sulfate projected for the cooling tower blowdown. Table 6 presents the results of this dilution analysis.

*Table 6. Dilution requirements to reduce blowdown concentrations to Class AA standards.*

| Constituent | Cooling[1] Tower Blowdown (mg/L) | NYSDEC Class AA Standard[2] (mg/L) | Volume Required to Dilute Blowdown to Class AA Standard[3] (gal) |
|---|---|---|---|
| Magnesium (as $CaCO_3$) | 88.0 | 35 | 138,286 |
| Sodium (as Na) | 1072 | 20 | 2,948,000 |
| Chloride (as Cl) | 1112 | 250 | 244,640 |
| Sulfate (as $SO_4$) | 1052 | 250 | 231,440 |
| Nitrate | 4.0 | 10 | -- |

**Notes**

1. Data based on preliminary calculations conducted by the designer of the CAES plant in 2011.
2. Standards are Class AA standards from NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groudwater Effluent Limitations.
3. Discharge from the CAES facility is approximtely 55,000 gallons per day.

As presented above, a mixing volume of approximately 2.5 times the daily discharge volume (i.e., 140,000 gallons) is required to dilute the concentration of magnesium in the CAES blowdown (88.0 mg/L) to the Class AA standard (35 mg/L). Similarly, a mixing volume of approximately 4.5 times the daily discharge volume (i.e., 250,000 gallons) is required to dilute the concentration of chloride in the CAES blowdown (1,112 mg/L) to the Class AA standard (250 mg/L); and a mixing volume of approximately 4.2 times the daily discharge volume (i.e., 230,000 gallons) is required to dilute the concentration of sulfate in the CAES blowdown (1,052 mg/L) to the Class AA standard (250 mg/L). As presented in Table 6, the concentration of nitrate in the CAES blowdown is below the Class AA standard. Similarly, as shown in Table 5, the pH of the CAES blowdown is within the Class AA standard, as well.

Again, at this preliminary assessment phase of the CAES Project and as mentioned above, it is not known if the use of a mixing zone would be accepted by NYSDEC to meet water quality standards. Discussions with NYSDEC should be initiated as soon as possible during Phase 2 of the Project. If the use of a mixing zone is not allowed, achieving the water quality standards or prescribed NYSDEC state pollutant discharge elimination system (SPDES) permit limits would be required to be met at the discharge outfall in Seneca Lake.

Furthermore, with respect to reducing impacts on surface water quality, implementation of proper erosion and sedimentation controls, such as perimeter controls, silt curtains, and sediment basins during the construction phase of the CAES Project will minimize adverse impacts to Seneca Lake and the two small Class C tributaries to Seneca Lake across which the underground pipelines and overhead power lines are proposed.

In the event that an alternate scenario is selected for the discharge of wastewater from the CAES plant to one of the nearby tributaries to Seneca Lake, as opposed to discharging into Seneca Lake, additional analyses would be required relative to potential impacts to water quality.

#### *1.2.1.6 Aquatic Resource and User Impacts*

As discussed in section 1.1.7.1 Aquatic Life, calcium is often the limiting nutrient to Zebra mussel productivity and growth. According to the 2001 NYSDEC report, the calcium threshold for Zebra mussel development ranges between 25 to 30 milligrams per liter, where calcium concentrations below this level do not appear to support the establishment of Zebra mussels. As such, increases in calcium concentrations within Seneca Lake could lead to exacerbated Zebra mussel populations. As shown in Table 5, the predicted calcium concentration in the cooling tower blowdown is considerably greater than that reported occurring in Seneca Lake. Any additional calcium delivered to the ecosystem has the potential to foster Zebra mussel growth especially immediately within the area surrounding the outfall of the cooling tower blowdown discharge. It is important to note that the current reported calcium concentration in Seneca Lake already exceeds the threshold for Zebra mussel development.

According to the 2001 NYSDEC report, Zebra mussel infestations can result in significant economic impacts by clogging of water supply intake pipes and other man-made structures. There is the potential for Zebra mussels to impact the function of the CAES plant intake and outfall structures, so both preventative and routine maintenance measures will need to be taken to ensure that Zebra mussel populations do not interfere with the functioning of these structures. Options for controlling Zebra mussels include in-line filter pumps to protect interior plumbing and ceramic filters. Many companies install equipment to pre-oxidize water at the point of intake to inhibit Zebra mussel populations. Similarly, physical barriers and chemical coatings can prevent Zebra mussels from attaching to structures. Removal of Zebra mussels can be accomplished with mechanical scrapers.

Additionally, given the classification of AA(T) in the section of Seneca Lake where the water intake and discharge pipes are proposed, a more detailed evaluation of potential impacts to the trout population and other fisheries will need to be performed under Phase 2 of the project after the specific locations of the water intake and discharge pipes have been identified and in conjunction with assessing potential water quality impacts. Also, a thorough assessment of the applicability of §316(b) of the Clean Water Act (or comparable NYSDEC regulation or interpretative policy/guidance) that requires that the location, design, construction and capacity of cooling water intake structures apply best technology available for minimizing adverse environmental impact will need to be completed. Note that while the CAES project water withdrawal volumes may be below §316(b) applicability thresholds, NYSDEC state-specific regulations, New York State Public Service Commission's Article X provisions, or the New York State Environmental Quality Review Act SEQR process may require impingement and entrainment analyses and intake structure design considerations to be performed as part of the environmental approval process.

Furthermore, under Phase 2 of the project, after the locations of the water intake and discharge pipes have been identified, a survey of aquatic vegetation is recommended within Seneca Lake along the proposed alignment and intake/discharge points. Identification of the plant species present, if any, will allow a final assessment of the potential impacts to this resource.

### *1.2.17 Potential Regulatory Permitting Considerations*

Using the results of this Phase 1 Preliminary Assessment coupled with the findings of WorleyParsons' Phase 1 engineering report, a comprehensive list of federal, state and local environmental permitting requirements will be developed prior to commencing Phase 2 of the CAES Project. This list will identify all applicable regulatory agency pre-construction permitting and approval obligations. As noted in this Phase 1 report, as the CAES Project design progresses, more in-depth analyses will be required regarding potential impacts to sensitive water quality concerns and aquatic resources associated with Seneca Lake. Addressing these concerns, in particular the following two key issues, will be critical to successfully positioning the CAES Project to meet the various federal, state, and local permitting and agency approval requirements relating to water resources:

- The potential exists that no mixing zone would be recognized by the regulatory agencies to allow dilution of the cooling tower blowdown wastewater discharged into Seneca Lake (a Classified AA(T) water resource. The result would be a requirement to meet the surface water quality standards or other restrictive limits at the outlet of the discharge pipe in Seneca Lake.
- Presently the §316(b) implementing regulations are under revision. A draft of the new regulations is anticipated to be issued in early

2012. These new regulations may have implications on the CAES Project in terms of the water withdrawal volume applicability threshold and requirements regarding impingement and entrainment at the water intake structure. Regardless of the changes to the regulations, impingement and entrainment impacts and design considerations are anticipated to be required by the permitting authorities and likely to be raised by interested stakeholder groups.

Table 7 provides a preliminary listing of the water resources-related permits, reviews, and approvals that may be required for the CAES Project. A final determination of which of these requirements will be applicable will depend on the CAES design and project configuration ultimately selected.

*Table 7. Listing of Potential Required Environmental Approvals.*

| | | |
|---|---|---|
| U.S. Army Corps of Engineers (USACE) | River & Harbor Act Section 10 - Navigable Waterways | Required when doing any work in, over, or under navigable waters of the United States. It is a detailed process that requires environmental surveys and may require mitigation. |
| | Clean Water Act – Section 404 – Discharge of Dredge or Fill Materials | Required when dredging or filling wetlands and crossing navigable waters. It is a detailed process that requires environmental surveys and may require mitigation. |
| U.S. Environmental Protection Agency | Clean Water Act NPDES Permits | Regulates discharges of pollutants into the waters of the United States |
| | Title 40 Code of Federal Regulations (CFR) Parts 110 and 112 - Spill Prevention Control and Countermeasure | An SPCC Plan will be required for the project. The plan identifies spill prevention measures, spill response actions and procedures for timely notifications. |
| | Clean Water Act Section 316(a) and 316(b) | Evaluation and design of cooling water discharge and intake facilities to manage, minimize and avoid adverse thermal impacts from cooling water discharges and fish impingement or entrainment from cooling water intakes |

| | | |
|---|---|---|
| New York State Department of Environmental Conservation (NYSDEC) | Protection of Waters - Section 401 Water Quality Certification/ Stream Protection Permits | Discharge of Dredged or Fill Materials; Modification or disturbance of stream beds. Applicants for a Federal license or permit for activities (including but not limited to the construction or operation of facilities that may result in any discharge into waters of the United States) are required to apply for and obtain a Water Quality Certification from NYSDEC indicating that the proposed activity will not violate water quality standards. |
| | Environmental Impact Assessment in New York State via NYS Environmental Quality Review Act (SEQR). [Statutory authority: Environmental Conservation Law Sections 3-0301(1)(b), 3-0301(2)(m) and 8-0113] (Note for the CAES Project this requirement may be replaced by decision to file under New York State Public Service Commission Article X) | Most projects or activities proposed by a state agency or unit of local government, and all discretionary approvals (permits) from a NYS agency or unit of local government, require an environmental impact assessment. This process must be complete and the project deemed approvable through an Issuance of Findings Statement before State and Local permits can be issued. In general, any land use proposal requiring a permit from a local or state government, and requiring discretion on the part of the permitting agency, is subject to SEQR. |
| | Environmental Conservation Law (ECL) Article 15 - Freshwater Wetland Permit | Almost any activity that may adversely impact the natural values of the wetlands or their adjacent areas (within 100 feet of the wetland boundary as designated on the official NYSDEC freshwater wetlands map or as determined through site inspection) is regulated. Typically the wetland must be 12.4 acres or greater to be regulated under this program. Smaller wetlands can be |

| | | |
|---|---|---|
| | | regulated if certain criteria are met. |
| | Environmental Conservation Law (ECL) Article 15 - Protection of Waters Permit - Excavation or Placement of Fill in Navigable Waters and their Adjacent and Contiguous Wetlands | A Protection of Waters Permit is required for excavating or placing fill in navigable waters of the state, below the mean high water level, including adjacent and contiguous marshes and wetlands |
| | Environmental Conservation Law (ECL) Article 15 - Protection of Waters Permit - Major Construction, Reconstruction or Expansion of Docking and Mooring Facilities. | A Protection Of Waters Permit is required for constructing, reconstructing, or repairing docks or platforms and installing moorings on, in or above navigable waters to create docking facilities, mooring areas or to facilitate other activities. |
| | Environmental Conservation Law (ECL) Article 15 - Stream Bed or Bank Disturbance Permit | Required in any stream with a class C(T) or higher water quality classification and up for any activity that will affect drainage swales or water quality by disturbance of stream bed or bank. This permit would be required if utility lines will disturb stream beds or banks of qualifying streams. |
| | Environmental Conservation Law (ECL) Article 11 - Endangered Species | Provide review and evaluation of these potential impacts and make recommendations to the lead agency regarding suitability of the project. |
| NYSDEC | EPA's Phase II Stormwater Rules; NYSDEC GP-02-01 requires Spill Prevention, Control and Countermeasure Plan (SPCC), State Pollutant Discharge Elimination System (SPDES) Permit including a Stormwater Pollution Prevention Plan (SWPPP) | Required for construction or use of an outlet or discharge pipe (point sources) of wastewater discharging into the surface waters) or ground water of the State. |
| Local | Flood Hazard Area Permit | Required for the construction of any structure within areas classified by the Federal Emergency Management Agency as being in a flood hazard area (within the 100 -year flood plain). |

| | | |
|---|---|---|
| | Site Plan Review | Site plan reviews are required to review the layout and design of a development site. It is completed to insure that the development is in harmony with the character of the area in which it is located and that important resources will be protected and to ensure compliance with local zoning and subdivision ordinances. |

## *2.0 REFERENCES*

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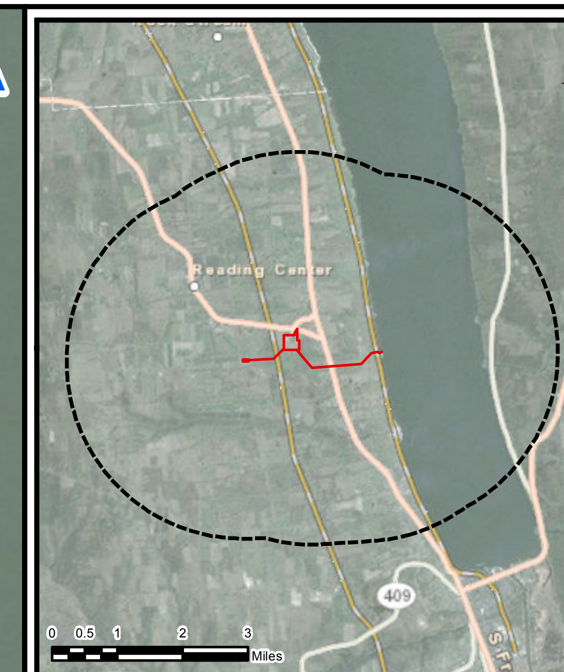


## Legend

Approximate Site Location

2 Mile Buffer of Project Area

**NYS DEC - Stream**

Classification - C

**2010 TIGER / Line**

Roads

NOTE: Site Location is approximate

0 250 500 1,000 1,500 Feet

1 in = 750 ft

**Figure 1: General Site Area**

NYSEG
Seneca Compressed Air Energy Storage (CAES) Project
Town of Reading
Schuyler County, NY

ERM

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