Schoharie Seiche (Frequently Asked Questions)

Q: What is a seiche?

A: A seiche ('sāsh/'sēch/'seɪʃ/***SAYSH***) is a standing or repeating wave in an enclosed or partially enclosed body of water. Seiches have been observed within lakes, reservoirs, bays, harbors, and seas. In NY state seiches are observed in the Great Lakes, Finger Lakes, and other water bodies (including NYC reservoirs (See Rusello 2012). Seiches can be observed on the surface (e.g., similar to a storm surge) or internal (i.e., underwater, not observed on the surface, and impacts the water column's thermal structure).

The seiche we observe at Schoharie Reservoir is internal, which means it cannot be seen from the surface.

Q: What causes a seiche?

A: Meteorological effects (e.g., wind) and seismic activity (e.g., earthquake, landslides) can cause seiches to form by pushing water to one side of the basin. A wave is formed during these events and water will return ("slosh") back and forth.

The internal seiche observed at Schoharie Reservoir is caused by wind temporarily piling up water at one end of the reservoir to begin a rocking motion below the surface. Seismic activity is measured at the Gilboa Dam and does not play a factor in the internal seiche observed at Schoharie.

Q: What impacts the magnitude and periodicity of the seiche?

A: Orientation of the basin, size of the basin, basin depth, basin contours, water temperature, and the strength of the initial energy input (e.g., wind) can influence the wave's signature.

The Schoharie Reservoir is oriented North (at the dam) to South (near the input). The northern area of the reservoir is relatively deep whereas the southern area of the reservoir is flat and relatively shallow. The Schoharie Intake Chamber is located in the southern area of the reservoir. Winds in Schoharie County are higher than the NY average in late summer, but even moderate and light winds can produce a seiche. We generally see a seiche on a daily basis at Schoharie Reservoir in the June through October period.

Q: What is the relationship between water temperature and a seiche?

A: Lakes and reservoirs develop thermal structure through the summer, which prevents mixing. The surface layer becomes warm, less dense, and deepens with time. The bottom layer remains cold, dense, and may reduce in volume with time due to withdrawals and heating from the surface. And a transitional area of rapidly changing temperature with depth develops between the surface and bottom. This transitional layer prevents mixing of the surface and the bottom waters. The sharpest change in temperature in the transitional layer is called the thermocline. A wind-induced seiche would pile up warm surface waters at one end of the reservoir,

temporarily depressing and squeezing out the colder denser waters of the bottom. Upon cessation of the wind, the thermals structure rebounds and the cold, dense waters return. This accumulation of warm surface waters and subsequent return of cold bottom waters results in a back and forth tilting motion (oscillation) of the thermal structure. During late fall, winter, and spring when the thermal structure disappears (overturns) and the reservoir is well mixed, the internal seiche is not observed.

In the early fall periods at Schoharie Reservoir we often observe bottom cold waters routinely (e.g., daily) rising up into the water column. In the summer, we may observe warmer waters periodically entering the level of the intake. Vertical proximity of the thermocline to the intake elevation is dependent on the time of year.

Q: What effects does a seiche have on water quality within Schoharie Reservoir?

A: Depending on the time of year, an internal seiche can produce noticeable spikes in turbidity in the water column near the intake. We have observed turbidity fluctuations greater than 100 NTU in a single day in water diverted from the reservoir. Turbidity, from suspended particles, may be stuck in the cold, dense waters of the hypolimnion. Settling of particles is slowed in denser waters. The sloshing/rocking of the thermal structure brings these turbidity causing particles from the deeper bottom areas to the level of the intake. The rocking motion of the internal wave can also cause resuspension of easily erodible sediments that had settled along the reservoir bottom. Finally, summer storms that have left turbid waters at the vicinity of the thermocline during an interflow can impact waters diverted from the system at the intake when the thermocline oscillates in depth.

Q: Is the seiche at Schoharie Reservoir a new phenomenon?

A: No. We have observed a seiche in Schoharie Reservoir in every year that we have looked (e.g., 2005-present). Other researchers (e.g., Owens et al. 2011, Rusello 2012, UFI 2014) have noted the presence of the seiche and its effects in Schoharie Reservoir.

Q: What makes the effects of the seiche worse in some years and not so bad in others?

A: Pre-existing conditions such as the presence of a large load of suspended materials from previous storms (e.g., Hurricane Irene) and/or spring runoff events would exacerbate the effects of the seiche, by providing materials that would be mobilized during seiche activity.

Summers that have little or no storm activity or that produce little wind would result in less seiche activity.

Summers that have frequent or intense storm activity would carry additional sediment into the reservoir through the Schoharie Creek. This sediment could wind up settling on the thermocline or in bottom waters that could be pulled into the intake when the thermal structure tilts from seiche activity.

References

Owens, E.M., Gelda, R.K. Effler, S.W., Russello, Cowen, E.C. Pierson, D.C. 2011. Modeling resuspension in a Dynamic Water Supply Reservoir. Journal of Environmental Engineering. July 2011. Pages 585-595.

Rusello, Peter J. 2012. "Turbulence in Low Energy Lacustrine Environments at the Sediment Water Interface - A Dissertation Presented to the Faculty of the Graduate School of Cornell University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy."

Upstate Freshwater Institute. 2014. Short-term Variations in Temperature and Turbidity at Shandaken Tunnel Intake: Internal Wave Activity in Schoharie Reservoir. Report to NYCDEP. Syracuse, NY. January 2014. 40pp.