Not-quite-lakeside vacation

White Bear Lake in Minnesota has been shrinking: the level keeps going down, and beautiful lakeside homes are now swamp side homes. What's happening?

Somewhere along its bottom, White Bear Lake is leaking water through the ground into a connected aquifer. In this series of worksheets, we'll explore some data about the shape and size of White Bear Lake and think about how much water it is losing each year. First: how big *is* White Bear Lake? Let's model it as a cylindrical hole in the ground first. The surface of White Bear Lake has an area of 2427.66 acres and it is 83 feet deep at its deepest point.

1. If we wanted to model White Bear Lake as having a big circular shoreline, what would be its radius? First transform 2427.66 acres into square feet by using 1 acre $=$ 43560 square feet, and then use $A = \pi r^2$.

2. According to data from a 1998 Department of Natural Resources report, the volume of White Bear Lake is $50,000$ acre-feet when its surface area is 2427.66 acres. (This unit of acre-feet is used widely in older US reports on lakes and reservoirs.) What is the average depth of White Bear Lake using this data?

3. Model the lake as a cylinder, with a circular base and top and constant depth (which you found above). Write an equation for the volume V of the lake in terms of the variable d, depth in feet.

4. Since 2003, White Bear Lake has dropped more than five feet. What percentage of the volume of the lake has disappeared using your model if you assume that White Bear Lake has dropped exactly five feet?

Not-quite-lakeside vacation

5. It turns out that the Minnesota Department of Natural Resources says that in dropping about five feet, White Bear Lake has lost 25% percent of its volume. How close is that to your estimate?

6. Write down at least three ways in which you think the model we have constructed could be improved. (Hint: think about what is wrong about the model and how it could be fixed. Use your personal experience of lakes!)