L. Elliott Jones

417 Callan Circle, Atlanta, GA 30307• lejones417@bellsouth.net
h 404-371-8687 • c 404-468-9990

February 17, 2020

Mr. Bill Sapp
Southern Environmental Law Center
10 Tenth Street NW
Suite 1050
Atlanta, GA 30309

Subject: Comments on Mark A. Hutson's letter review of *Impact of the Proposed Twin Pines Mine on the Trail Ridge Hydrologic System:* prepared for: Twin Pines Minerals, LLC, Proposed Heavy Minerals Mine, St. George, Charlton County, Georgia, by Dr. Robert L. Holt and others, TTL, Inc.

Dear Bill:

Thank you for giving me the opportunity to comment on the subject review. As the notes I was jotting about the review grew longer, I thought it would be simpler to include my observations in a letter to you, rather than explaining them on the phone or in an email.

I have only been in possession of the TTL modeling report for a week now, and have not had time to review the modeling assumptions in as much detail as Mr. Hutson has done. Thus, I will reserve comment for now on the details of the TTL modeling that Mr. Hutson discusses under the heading: Comments on Specific Report Items.

Based on my long familiarity with Georgia Coastal Plain geohydrology in general, and the geohydrology of the Atlantic Coast of Georgia in particular, some concerns came to mind while reading Mr. Hutson's bulleted comment under the heading: Comments on Items Not Discussed in Report, beginning on p. 1 of his review. My notes on Mr. Hutson's comments provide some background for my overarching concern in the summary paragraph following.

Comments on Items Not Discussed in Report

- *No contaminant fate and transport modeling in the TTL model.* Yes, water quality issues are always critical in mining operations. All heavy-metal mining operations produce copious by-products containing other heavy metals, which will be disposed of somewhere on site and will pose a threat to shallow groundwater. The report and model do not include any consideration of contaminant transport, even though a crude approximation technique, such as particle tracking, could be performed using the TTL MODFLOW model.

- *Effect of 1.44 Mgal/d groundwater withdrawal from the Upper Floridan aquifer*. The Miocene-aged Hawthorne Group underlies the shallow aquifer system included in the LLC model, and overlies the Oligocene-aged Suwanee Limestone that forms the top of the Upper Floridan aquifer (Williams and Kuniansky, 2015, plates 2 and 15). In previously published groundwater models of the Upper Floridan aquifer in the Coastal Georgia area, the Hawthorn Group is typically considered a confining unit between the underlying Upper Floridan aquifer

and the overlying shallow aquifers (locally named the upper and lower Brunswick aquifers in the Glynn County area and along the Atlantic Coast). Along their Generalized Hydrogeologic Cross Section I–I' (plate 15), Williams and Kuniansky (2015) indicate that near the coast (well D-2386), about 40 miles east of the proposed mine, the Hawthorn Group is about 310 ft thick (from about 70 to 380 ft below sea level), and is comprised of mostly silt, mixed with some dolostones and sands. Based on lithology alone, it would be safe to assume the Hawthorn Group is a reasonable confining unit in this area. Unfortunately, the next well along Section I–I', the closest well in the section to the proposed titanium mine (well P410, about 15 miles south), does not have a lithologic description of the Hawthorn Group, which is about 345 ft thick (from about 15 to 360 ft below sea level). However, at the next well in the section (well P666), about 35 miles west of the proposed mine, the Hawthorn is much thinner, about 130 ft thick (from about 100 ft above sea level to 30 ft below sea level). Also, the lithology is much different than the well near the coast, being comprised of mostly limestone and dolostone and thinner layers of sand and no silt. Based on the lithology, the Hawthorn Group in this location would be considered a poor confining unit, if at all.

As Mr. Hutson points out, Kitchens and Rasmussen (1995) documented leakage through the Hawthorn Group based on water-level fluctuations in the Okefenokee Swamp (assumed to be hydraulically connected and have similar water levels to the shallow aquifers) and in the underlying Upper Floridan aquifer. They also noted, "The magnitude of leakage between the swamp and the aquifer is uncertain because of a lack of knowledge about the specific storage coefficient in the aquitard [the Hawthorn Group] separating the swamp and the aquifer, which has not been explicitly measured." I would suggest that not only is knowledge of aquifer properties lacking to qualify the capacity of the Hawthorn Group to act as a confining unit, but even the basic lithology of the unit at the location of the mine is not well known. This lack of understanding of the Hawthorn Group is indicative of an overarching lack of basic hydrologic data on all the stratigraphic units near the proposed mine site. Any model of the shallow system, the Hawthorn Group as a confining unit, and even the Upper Floridan aquifer in the vicinity of the proposed mine would be fraught with substantial uncertainty because of the lack of reliable hydrologic studies conducted in the area.

I fully concur with Mr. Hutson that the effects of relatively large withdrawals (1.44 Mgal/d) from the Upper Floridan aquifer has not been addressed. Furthermore, attempts to address the effects of pumping in a groundwater model that includes the addition of the Hawthorn Group and the Upper Floridan aquifer would be highly problematic due to the lack of lithologic and hydrologic-property data (as Kitchens and Rasmussen suggest above). An expanded model (one that includes the Hawthorn Group and the Upper Floridan aquifer as active model layers) could be considered reliable only if aquifer properties of the Hawthorn Group assumed in the model were confirmed by: (1) exploratory drilling to characterize the lithology of the Hawthorn Group from analysis of cuttings; and (2) controlled aquifer tests of the unit to determine hydrologic characteristics and whether it provides adequate confinement between the surficial aquifer system and the underlying Upper Floridan aquifer.

- *No consideration of induced recharge*. I agree, all the model deficiencies noted in my discussion above are equally applicable to any modeling exercises involving induced recharge to the shallow aquifers due to pumping from the Upper Floridan aquifer discussed here.

- *40% cuts to model recharge and stream boundary flow rates.* I will need to read section on model recharge and modeled stream boundaries to understand and address this concern. (This bullet may belong in the subsequent section on Specific Report Items.)

In summary, the geohydrology in the area around Okefenokee Swamp—including the surficial aquifers, the Hawthorn Group (whether it can appropriately be considered a confining unit), and the underlying Upper Floridan aquifer—is poorly understood. Because the area is remote and sparsely populated, groundwater use near the Swamp is minimal compared to the municipal and industrial centers along the Atlantic Coast. Low water demand in the area has all but eliminated the need for costly state-of-the-science hydrologic investigations, which consequently are lacking. Without such investigations providing necessary background information, such as defensible aquifer-property data and reasonable assumptions for boundary conditions, construction of a reliable groundwater-flow or contaminant fate-and-transport model is impossible.

My expressed opinions are based on my more than 30-year career as groundwater hydrologist with the U.S. Geological Survey, focused primarily on groundwater studies in the Georgia Coastal Plain.

Please let me know if you have any questions or comments.

Regards:

L. Elliott Jones, P.E.
Georgia License No. PE032222
Issued: 6/19/2007; expires 12/31/2020

References:

TTL, 2020, *Impact of the Proposed Twin Pines Mine on the Trail Ridge Hydrologic System*: Twin Pines Minerals, LLC, Proposed Heavy Minerals Mine, Saint George, Charlton County, Georgia, January 14, 2020, 91 p., https://twinpinesmineralscharlton.com/environmental-studies/.

Kitchens, Susannah, and Rasmussen, T.C., 1995, *Hydraulic Evidence for Vertical Flow from Okefenokee Swamp to the Underlying Floridian Aquifer in Southeast Georgia*: in, *Proceedings of the 1995 Georgia Water Resources Conference*, held April 11 and 12, 1995, at The University of Georgia, Kathryn J. Hatcher, Editor, Carl Vinson Institute of Government, The University of Georgia, Athens, Georgia, p 156-157, https://smartech.gatech.edu/handle/1853/44003.

Williams, L.J., and Kuniansky, E.L., 2015, *Revised hydrogeologic framework of the Floridan aquifer system in Florida and parts of Georgia, Alabama, and South Carolina*: U.S. Geological Survey Professional Paper 1807, 140 p., 23 pls., http://dx.doi.org/10.3133/pp1807.