TODD GROUNDWATER

October 5, 2016

MEMORANDUM

To: Nikki Fowler, Monterey County Health Department

From: Gus Yates, Senior Hydrologist

Re: PLN040183, Paraiso Springs Resort: Response to MCHD Comments

Your memorandum dated August 22, 2016 to John Ford of RMA Planning requested some additional analysis regarding potential impacts of the Paraiso Springs Resort project on flow at Pura Spring, which serves two residences downgradient of the Resort. This memorandum provides that analysis.

Comment 1. Determine if hydrologic connectivity exists between the referenced [Pura] spring and [Project] wells No. 1 or No. 2. In the event interconnectivity exists, an analysis of whether the aquifer would receive adequate recharge to offset the increased pumping must be completed.

Project well No. 1 pumps from the same alluvial aquifer that supplies the discharge at Pura Spring. Although Well No. 2 is screened below the alluvium, the analysis here and in the Comprehensive Hydrogeologic Report (Todd Groundwater, 2014) conservatively assumed that it also draws water from the alluvium. Although the two project wells are 2,500 feet upgradient of Pura Spring, they are connected by groundwater flow through the alluvial aquifer. The water balance analysis and groundwater modeling presented in the Comprehensive Report accordingly assumed that the wells and spring are interconnected and draw from the same source.

The water balance analysis in the Comprehensive Report (Chapter 8, pages 18-21) concluded that average annual recharge to the alluvial aquifer is on the order of 797 AFY. Net consumptive use of groundwater by the resort project would amount to 12.7 AFY or 1.6 percent of annual recharge. Metered flow data for Pura Spring during June-September 2016 indicate that it discharges at a quite constant rate equivalent to 1.6 AFY, or 0.2 percent of average annual recharge. Thus, the alluvial aquifer beneath Paraiso Springs Valley could easily support the Resort project and replacement water to the Pura Spring users, if needed. The Comprehensive Report also confirmed that sufficient yield would be available to meet those demands during droughts (p. 30).

The peer review of the Comprehensive Report (Balance Hydrologics, May 2016) questioned the estimated average annual recharge value. In our response to the peer review (Todd Groundwater, July 2016), we pointed out that even if an alternative—and in our opinion

unrealistic—estimate of only 216 AFY of recharge is assumed, consumptive use by the Resort plus replacement water for Pura Spring or the wetlands would equal only 11 percent of the recharge (p. 6).

Therefore, the Resort wells and alluvial aquifer system will be capable of supplying replacement water for Pura Spring users, if needed.

Comment 2. Evaluate the size and location of the proposed wastewater treatment system underground storage tank and potential impacts to the Pura Spring source.

If the Resort Project opts to use an underground tank to provide seasonal storage of recycled water, the tank would be constructed beneath one of the lower parking lots along the entrance drive to the Resort. The tank would be 228 feet long and 20 feet deep, oriented across the slope (perpendicular to prevailing groundwater flow). The cross-sectional area of the tank would be 4,560 square feet. The alluvial aquifer at that location is about 1,200 feet wide and 100 feet deep. A minimum estimate of aquifer cross sectional area is obtained if the cross section is assumed to be triangular rather than U-shaped. The triangular assumption results in a cross-sectional area of 60,000 square feet. The recycled water storage vault would therefore obstruct as much as 7.6 percent of the cross-sectional area of the aquifer. To maintain groundwater flow down the valley, the hydraulic gradient beside and beneath the box would increase by 7.6 percent. The existing gradient is about 0.121 ft/ft (Comprehensive Report p. 13), so it would increase to about 0.130 ft/ft. Over a downgradient distance of 115 feet (the maximum vault width if Phase 2 is completed), this corresponds to 15 feet of additional water-level differential. That is, the water table would likely rise by 7.5 feet near the upgradient side of the vault and decline by 7.5 feet on the downgradient side. This local stair-step effect in the groundwater profile would diminish downgradient. Pura Spring is about 900 feet downgradient of the proposed vault location, or about 9 times the aquifer thickness. The water table at the spring would be essentially the same as under existing conditions.

It is recommended that the vault be constructed on a gravel bed that would convey groundwater under the vault such that overall aquifer transmissivity is approximately the same as under existing conditions thus eliminating any potential for water-table rise on the upgradient side of the vault and associated soil saturation problems. The hydraulic conductivity of gravel ranges from about 340 to 34,000 ft/d (Freeze and Cherry, 1979), or 10-10,000 times greater than the average hydraulic conductivity of alluvial materials in Paraiso Springs Valley. Thus, a 1-foot-thick bed of gravel beneath the 20-foot-deep vault would be more than adequate to offset the flow obstruction caused by the vault. It would also further ensure that the water table elevation at Pura Spring would not be affected.

Comment 3. Per the Balance Hydrologics recommendation, a baseline of water diversions should be collected at Pura Spring so that compensatory water may be provided in the event negative impacts are confirmed once the project is operational. Impacts of the compensatory water must be evaluated since it would increase the overall demand for the project.

In our response to the Balance Hydrologics peer review, we noted that the Resort project applicant had installed a meter and commenced monitoring Pura Spring discharge in June 2016. Early measurements indicated a flow of 1 gallon per minute. Our reply memo extrapolated that to an annual flow of roughly 1.6 AFY (Todd Groundwater, July 2016, p. 8). Based on a similar analysis of providing 2.0 AFY of supplemental water to wetlands (p.6), the reply memo concluded that additional pumping to replace the entire Pura Spring flow would only increase total project pumping to between 2 and 11 percent of average annual basin recharge (depending on the recharge estimate selected). Calculations were also presented to confirm that the wells and aquifer could meet the replacement water needs under peak day demand conditions (p. 6), when total water demand for the resort plus Pura Spring replacement water would amount to only 16 percent of the combined capacities of Well No. 1 and Well No. 2.

I hope this memorandum addresses your concerns regarding potential Pura Spring impacts. However, if you have any further questions please do not hesitate to contact me by phone (510-747-6920 x108) or email (gyates@toddgroundwater.com).

References Cited

Balance Hydrologics, Inc. May 25, 2016. Peer Review of Comprehensive Hydrogeologic Investigation Report for the Paraiso Springs Resort. Berkeley, CA. Prepared for EMC Planning Group, Monterey, CA.

Freeze, R.A. and J.C. Cherry. 1979. Groundwater. Prentice-Hall, Inc. Englewood Cliffs, NJ.

Todd Groundwater. August 26, 2014. Comprehensive Hydrogeologic Report, Paraiso Hot Springs Resort. Alameda, CA. Prepared for Thompson Holdings, Inc. Springhouse, PA.

Todd Groundwater. July 25, 2016. Responses to Peer Review of Comprehensive Hydrogeologic Report for the Paraiso Springs Resort. Memorandum to EMC Planning Group, Monterey, CA.