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Attn: Mr. Alex Hill & Dan Baskins

Geotechnical Consultation
Additional Hydrogeologic Information
The Meridian Extraction Area
Jefferson County, Washington
Job No.FredHill.Wahl.L4

Based on our discussions with you and Mr. Joel Purdy of GeoEngineers, Inc. (Jefferson County consultant), we understand that additional information is need regarding groundwater levels/flow direction, potential adverse impacts to spring flow in the southwest portion of the site, and potential adverse impacts to the Bridgehaven water supply well.

Attached are updated groundwater maps for the Meridian Extraction Area and the Thorndyke Mineral Resource Extraction Area, Figures GW-1 and GW-2. Groundwater levels were measured in the observation wells in July 2011. The recent water level readings included both the older Observations Wells (1 through 19) and the more recent ones (20 through 22) completed for a resource evaluation conducted in 2010 for Athabasca Minerals. The water level data is presented in Table 1, attached.

In general, the measured water levels indicate that groundwater flows to the south-southwest throughout the Thorndyke Mineral Resource Area, with the Meridian Extraction Area being situated within that broader area. As expected, towards the east (Shine and Bridgehaven areas), groundwater flow is to the east-southeast.

Site reconnaissance in the Meridian Extraction Area during June and July 2011 did not identify any active spring flow in the southwest portion of the site (towards Thorndyke Creek). However, based on the existing topography and groundwater levels, we understand and expect that localized seeps or springs occur in this area during winter and early spring months when groundwater levels rise to intersect with the local topography. Specifically, in the extreme southwest corner near Observations Wells 11, 12 and 20. These site conditions will be further documented during the required site specific evaluations/studies required for site development permits.

Per the county conditions for the Thorndyke Mineral Resource Area, mining will be restricted to 10 feet above the high groundwater level within the Meridian Extraction Area, similar to the Wahl Extraction Area. Mining activity will be conducted in accordance with Washington State and Jefferson County regulations, and WDNR Best Management Practices. Therefore, no adverse impact is expected to water quality or quantity. In fact, during the temporary mining activity at the site, groundwater recharge will increase locally while vegetation is absent. Once mining reclamation is achieved and vegetation is re-

established, groundwater recharge will return to pre-extraction levels. Because the active mine area will account for only a small portion of the overall recharge area, little or no measurable change in recharge will be observed.

Mining at the Meridian and Wahl Extraction Areas will be incremental with segmental reclamation and replantings. Any changes in surface water infiltration are expected to be similar to changes that have historically occurred during the ongoing and historic timber harvesting activities throughout the region. Mining will remain a minimum of 10 feet above the Vashon groundwater table. The observation wells completed in the area will be utilized to monitor groundwater levels prior to and during mining operations. It is therefore our opinion that there will be no measureable adverse impact, cumulative or otherwise, related to the proposed mining activities. The proposed mining activity is a temporary use with the long term reclaimed use being forestry.

Relative to the potential impacts to the Bridgehaven water supply well from mining activities at the Meridian and Wahl Extraction Areas, borings and observation wells completed in these and the surrounding Thorndyke Mineral Resource Area indicate that there are several aquifer systems that occur at varying depths in this region. The upper aquifer encountered over most of the Thorndyke Mineral Resource Area occurs within the Vashon outwash sand and gravel materials. Based on the water levels measured in the observation wells, the surface of the Vashon aquifer is at approximately Elevation 316 near SR 104, dropping to Elevation 210 in the south near Thorndyke Lake. Wells completed in the south portion of the TMR area did not encounter this aquifer. The groundwater flow of this aquifer is to the south-southwest, as previously indicated.

The Bridgehaven (and other shoreline community) well(s) withdraw water from a significantly deeper pre-Vashon aquifer. The pre-Vashon aquifer system is overlain by a thick sequence of generally impermeable lacustrine silt/clay layer (aquitard) in the Thorndyke Mineral Resource Area, a confined aquifer. The Bridgehaven well is completed in an aquifer that is at approximately Elevation –50, an additional 100 feet or more below the pre-Vashon aquifer beneath the site. Based on the available geologic information, the water-producing unit of the Bridgehaven well is the Double Bluff Formation and may or may not extend regionally. As previously discussed, this aquifer is overlain by the fine grained soils of the Whidbey Formation, generally considered an aquitard. The static water elevations of these wells range from approximately –10 to +30 and typically have head pressures of between 50 and 60 feet, therefore considered a confined aquifer. Based on previous work completed in the area by Robinson & Noble, Inc., a 10 year capture zone for the Bridgehaven well, which is completed within Double Bluff aquifer, would extend west-northwest approximately 7,000 feet, thus not reaching the Thorndyke Mineral Resource, Wahl or Meridian Extraction areas.

No adverse impacts to the groundwater systems have been identified since mining began at the Shine and Thorndyke sites, over 20 years ago. Mining permits at the Meridian Extraction Area will require further site specific evaluation and study. Once mining operations begin, they will be monitored by a variety of State and Jefferson County regulatory agencies on an on-going basis. Monitoring of the existing observation wells will continue during mining at the TMR site.

If you have any questions regarding this report or need additional information please call.

Yours Very Truly,
GeoResources, LLC

Bradley P. Biggerstaff, LEG, LHG
Hydrogeologist

DocID:FredHill.MeridianExt.L4

Citations

GeoResources previous reports and documents.

Economic and Engineering Services, Inc., and Pacific Groundwater Group, 1994, Eastern Jefferson County Groundwater Characterization Study, Prepared for PUD No. 1 of Jefferson County.

Grimstad, Peder, and Carson, Robert J., 1981 Geology and Groundwater Resources of Eastern Jefferson County, Washington: Water Supply Bulletin No. 54.

Jefferson County Critical Aquifer Recharge Area Ordinance, Jefferson County, Washington, 2003.

Robinson & Noble, Inc., 1999, CARA Report for Ace Paving, Shine Pit - proposed asphalt batch plant near Port Ludlow, Jefferson County, Washington. (Attached)

Robinson & Noble, Inc., 1992, South Aquifer Study: Port Ludlow-Shine Area, Jefferson County, Washington, prepared for Pope Resources.

Shannon & Wilson, Inc., Thorndyke Conveyor – Jefferson County, Washington, 2001.

U.S. Soil Conservation Service, 1975, Soil Survey of Jefferson County Area, Washington.