

# Memo DRAFT

**To:** Joel Purdy  
**From:** Brad Biggerstaff  
**CC:** Alex Hill, Dan Baskins  
**Date:** July 30, 2013  
**Re:** Groundwater – Thorndyke Area

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This memo provides information related to your June 18, 2012 memo. We understand that an updated groundwater level map is being prepared based on our recent site visit and water level readings. That will address several of the data/information requests presented in our memo; specifically the potentiometric surface data and map for the site area (No. 1).

No. 2: Water quality baseline data from the project area and the downstream area are required prior to mining activity. Typically this would occur once the project approval is received and prior to mining activity. The installation of the observations wells at the site was/is for this purpose. This will include several wells at the down gradient limit of the mining area, as well as any potential discharge area, per the WDOE permit requirements. Down gradient surface water quality (Thorndyke Creek) is not required at this time. The monitoring of the downgradient wells would detect any change in water quality prior the water reaching Thorndyke Creek.

No. 3: Potential effects of the mining activity on groundwater conditions, specifically recharge, have been evaluated and presented in several of the previous project reports and documents, including the potential effects on the vadose zone. As previously indicated, the potential groundwater impacts for a mine site is related to the relationship between precipitation, surface water runoff, shallow subsurface flow, the temporary changes in evapotranspiration during active mining (prior to reclamation), and ground water recharge. Although the Thorndyke area is identified as a large aggregate resource area, active mining will always be limited to a very small area relative to the surrounding long-term forest management area. Once approved and the site is prepared for mining, a portion of the natural vegetative cover will be replaced with the process area and first segment of the active mine area. The removal of vegetation in these areas will result in a slight, but temporary, decrease in evapotranspiration because of the localized temporary loss of vegetation. This temporary change in site conditions (decrease in vegetation) will result in a potential consequent increase in runoff and/or groundwater recharge in the active/unvegetated portions of the site. It is unlikely that there will be any runoff from the active area as the soils are extremely permeable. The permeable soils will allow rapid infiltration of any runoff and/or precipitation. The net result of the mine activity will essentially be a temporary but minor increase in groundwater recharge at the site. Relative to the overall recharge area of Thorndyke Creek, the change in recharge will be insignificant, and not likely measurable.

Once mining is completed in an area, that area will be reclaimed back to a forested condition. As previously stated, the removal of vegetation will be limited to the active mine and processing areas, and

similar in nature to timber harvest activities. The topsoil material will be stored during site preparation, and amended for use in the reclamation activities, thus mimicking the pre-existing conditions of the vadose zone. As no significant change in groundwater recharge will occur, no measurable changes in groundwater flow will occur.

Mining activity at the site will be conducted in accordance with the BMPs (Best Management Practices) for the gravel mining industry, and the regulations of Jefferson County and Washington State. Mining will remain a minimum of 10 feet above the underlying water table level and will not extend into the aquifer below the site. The observation wells completed in the area will be utilized to monitor groundwater levels prior to and during mining operations. Select observation wells will be utilized to monitor water quality immediately prior to mining (baseline) and during mining activity. The undisturbed native sand and gravel that remains above the groundwater table at the site will continue to act as a filter and protect the underlying groundwater system from potential contaminants from above.

As discussed in the previous hydrogeologic reports for this and the Shine site, the deeper aquifers in this area are confined systems that occur below a protective aquitard. We do not expect any adverse effects on the recharge condition of the deep confined aquifers. No direct recharge to the deeper aquifers occurs in the site area by infiltration of rainfall through the overlying aquifers and aquitards. Because there is not direct connection between the shallow and deeper aquifers, and recharge of the perched aquifer will not be measurably affected, the recharge of the deep aquifers will not be adversely affected. It should also be noted that the recharge area for the aquifers, in particular the deeper aquifers, essentially occurs over the entire east Peninsula area. This surface area of the site relative to the total recharge area is insignificant.

Relative to the proposed mining activity at the site, potential water quality impacts are generally related to equipment operation and stormwater runoff. No fuel or hazardous material storage is planned to occur at the site. Fuel for on-site equipment will be provided by service trucks. The on-site equipment and site activities will be closely monitored. The mine/processing plant staff will be trained and spill prevention plans and kits will be kept on-site. The remaining undisturbed native soils, minimum of 10 feet, above the groundwater system at the site will provide a buffer against potential contamination from equipment/site activities. The deeper aquifers are protected from possible contamination by the filtering effect of the overlying sand and gravel and the thick zone of very stiff fine-grained silt and clay that occur below the site and surrounding area.

Storm runoff collected at the site will be directed to infiltration areas located at the site. Based on the results of the subsurface explorations, the soils in this area have adequate storage and permeability to infiltrate the stormwater runoff. This is discussed below in the “**Stormwater Control**” section of this report.

Typically, stormwater runoff from gravel mine sites is minimal. The granular nature of the soils allows for rapid infiltration of any precipitation that falls on them. The native soils disperse the infiltrated water over the site and recharges the shallow groundwater system similar to what is occurring at the site now. The only significant difference is the temporary reduction in the vegetative cover in the active mine areas. Once reclaimed, the new vegetation will closely match the effects of previous site vegetation.

This section may change based on the new map

Storm water infiltrated at the site will disperse into the underlying sand and gravel soils. The local direction of flow for the underlying groundwater system is generally to the south. Thorndyke creek is located approximately 200 feet or more south and west of the proposed mine site. The native soils will act to filter the infiltrated stormwater. Based on the nature of the sand and gravel soils, the distance from the infiltration areas and the direction of groundwater flow, no adverse impact to Thorndyke Creek is expected.

The deeper pre-Vashon aquifer within the site and adjacent area is separated from the Vashon aquifer and the overlying minable sand and gravel soils by a thick sequence of lacustrine silty fine sand, silt and clay materials. These soils form an aquitard that restricts the downward migration of the overlying groundwater and thereby protects the underlying pre-Vashon aquifer.

The still deeper aquifer that supplies water to the Squamish, Bridgehaven and Thorndyke area wells along the shoreline areas east and south of the site area is situated below an additional layer/thickness of impermeable silt and clay soils of the Whidbey Formation. This deeper aquifer is over two hundred feet below the proposed mining depth at the site area. The Bridgehaven wells, which are the closest off-site wells to the site, are situated more than 1.5 miles east-southeast of the proposed mine site.

As previously discussed, in addition to the above geologic and hydrologic conditions that will preclude any significant adverse impact to the underlying aquifer systems, mining operations at the site will be conducted in accordance with BMPs (Best Management Practices) and current regulatory requirements. The active mining area will be limited in surface area. As new areas within the site are opened to mining, previously mined areas will be reclaimed and replanted in accordance with the required DNR Reclamation Permit. This is encouraged through the application of the reclamation bond, which is based on the amount of disturbed area, unreclaimed.

No adverse impacts to the groundwater systems have been identified since mining began at the Shine and Thorndyke sites, greater than 40 years ago. Mining and processing activity at the Shine and Wall Extraction sites is and 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 activity at the site.

I will stick some references that we previously used for No. 4.