Mats Mats Quarry Final EIS
Chapter 3.1 – Earth pp 3.1-5 to 3.1-9

Unconsolidated Deposits

Subsequent to the formation of the basalt bedrock, sediments were deposited throughout thePuget Lowland during several glacial and non-glacial intervals over the last 2.4 million years. Sediments from the most recent glacial episode, the Fraser Glaciation, are widely exposed at the surface in the Puget Lowland. Exposures of older glacial and non-glacial deposits are typically limited to bluffs and river valley walls. The Fraser Glaciation consists of multiple stades (episodes of glacial deposition). These sediments are present over a majority of the ground surface in the Mats Mats area (refer to Appendix I for detail on area geology).

The presence of mapped outcrops of the Crescent Formation basalt in the Chimacum Valley indicates that basalt is located beneath the glacial deposits. The unconsolidated glacial/non-glacial deposits are relatively thin north of the quarry where the Crescent Formation basalt is present at or near ground surface. North and northwest of Mats Mats Bay the thickness of the unconsolidated deposits is variable, ranging from approximately 20 to 80 feet. The major units of unconsolidated deposits in the Mats Mats area include Undifferentiated PreFraser Deposits (Qpfu), Vashon Advance Outwash (Ova), Vashon Lodgement Till (Ovt) and Vashon Drift Over Basalt (Cd) (refer to Appendix I for additional detail).

Site Geology

As for the region, geologic units at the Mats Mats Quarry include basalt (Crescent Formation), and unconsolidated deposits consisting of Vashon lodgement till, and Vashon Drift (see Figure 3.1-4). Beach sand and fill are also present. A geologic cross section summarizing surface and subsurface geology at the site is presented in Figure 3.1-5.

For the basalt bedrock, four distinct layers are present:

1) At the base of a flow is an approximately one foot thick zone consisting of aphanitic (microcrystalline) basalt. This zone commonly has good rock quality and is rather impermeable.
2) Above the aphanitic zone is massive columnar jointed basalt that can be up to several tens of feet thick. This zone cooled more slowly but is still fine grained and is characterized by interlocking polygonal cooling fractures that run perpendicular to the cooling surface creating a series of parallel columns. This zone is also characterized by relatively good rock quality and is relatively impermeable.
3) Overlying the columnar jointed section is a layer of pillow lavas and pillow breccias (broken pillows) that are bulbous shaped to cobble-like. This zone can be up to about 15 feet thick at the site and represents the top of an individual lava flow which has reacted significantly with sea water. The pillow shape is caused by seawater cooling. This zone has reacted the most with sea water and therefore contains an abundance of secondary minerals. Solidified gas cavities, or vesicles, are also abundant in this upper zone and the cavities have generally been filled with

whitish minerals such as calcite, aragonite, and quartz. The abundance of soft secondary minerals gives this zone poor rock quality. The brecciated character could also facilitate groundwater seepage.

4) As the basalt flow cooled, small fragments of rock debris and volcanic glass (now altered to soft chlorite) settled atop the pillowed zone. The sedimentation continued uninterrupted until the next lava flow covered this sedimentary "break" (layer of sediment deposited between lava flows). The thickness of a sedimentary break is a measure of the length of time between lava flows. Thick sedimentary breaks indicate a long time between lava flows. Thin to nonexistent breaks indicate that the flow of lava continued relatively uninterrupted from one flow to the next. When a sedimentary break became covered with next lava flow, the heat of the overlying flow baked the underlying sediments creating shale. The shale "breaks" are typically friable, with poor rock quality and the potential for allowing groundwater seepage.

After a period of several million years, the lava flows and sediments were tilted to their present35-degree northward dip with the uplift of the Olympic Mountains. During the uplift the basalt flows were offset by a number of relatively small-scale faults that cut across the basalt flows at relatively high angles.

Unconsolidated sediments that historically covered portions of the basalt within the "active" mine area have been removed during past mining operations.

Fill soils at the site consist of native soils that have been removed from the active mine area and imported soils (prior to placement on the site for reclamation, all imported soils were tested to confirm that the soils were clean - see Appendix VI for the Clean soil Acceptance Policy). Fillsoils consisting of stripped native soil at the mine were encountered in several borings completed in the buffer zone. Fill soils were likely placed in the buffer zone during past mining operations at the site, as no mining or reclamation activities are currently occurring in the buffer zone. Fill soils are also present in the vicinity of the abandoned Mats Mats Bay slip, the Admiralty Inlet barge loading dock, and in multiple stockpiles throughout the active mine area. Stockpiles consisting of imported fill soils are present at several locations within the active mine area.

Groundwater movement in the vicinity of the quarry is restricted for the most part to the flowtops and interflow sediments of the basalt. The direction of groundwater flow is thereforestrongly controlled by the east-west fabric of the individual basalt flows. Some groundwater movement could also occur along the high angle faults, but these zones are relatively narrow. Very little groundwater moves in a north-south direction across the site, as the groundwater would have to flow through several relatively thick layers of nearly impermeable columnar basalt. Based on the site geology, flows and sediments, taken as a collective unit, have very low permeabilities and are considered an aquiclude (barrier to groundwater flow). Please refer to the Water Section for additional detail on groundwater.