ephemeral streams are treated the same because they only flow if the groundwater table is high enough to support the discharge. If the potentiometric surface is below the discharge point, the spring does not discharge groundwater.

Another source of groundwater withdrawal is the extraction of groundwater from private wells and springs for onsite use, such as for a rural home. In areas without public sanitary sewers, most of the water extracted from the well is returned to the groundwater via an on-lot septic system, forming a localized loop of water withdrawal and discharge. For this reason, the groundwater withdrawal due to private, on-lot water systems was not included in the hydrogeologic model.

7.3 Groundwater Flow Model

In addition to the volumetric flow budget, the hydrogeologic model also generates groundwater flow vectors that identify paths along which groundwater flows. Because groundwater flows from high to low piezometric areas, it typically moves perpendicular to surface contour lines under isotropic conditions. It exits the model through stream discharge and withdrawals from wells and springs. Using a particle tracking algorithm, the flow paths can be traced from a point of origin (*e.g.*, recharge area) to a discharge point (*e.g.*, well). The groundwater contours wrap around the production well in response to groundwater withdrawal. As the water level drops in response to pumping, a cone of depression forms around the well. Water within the cone of depression will flow towards the well to be withdrawn by the pump. By running the groundwater flow model backwards, the source of the extracted groundwater can be determined. These extrapolated flow traces then form the basis of the source water protection areas as described below. A groundwater flow path map, illustrating the interpreted paths groundwater takes to the discharge point, is presented in **Figure 9**.