Plate 6: Map Showing the Piezometric Surface of the Cameron Valley Sand Member of the Potomac Formation, and Other Aspects of Urban Hydrology
City of Alexandria and Vicinity

By Tony Fleming, March 2008

The basal 100 - 200+ feet of the Potomac Formation in Alexandria contains abundant large bodies of hydraulically interconnected sand deposited in the thalwegs of early Cretaceous river channels. This sandy, lower interval is given the informal name of "Cameron Valley sand" in this study to distinguish it from other parts of the formation that originated in different sedimentary environments and possess different lithological and hydrogeological properties. The Cameron Valley sand constitutes the principal aquifer system in the Potomac Formation and is broadly synonymous with the term "lower aquifer" used by previous workers, such as Froelich (1985) and Johnston and Larson (1977). Up until the early to mid 1970's, the aquifer system was a major source of water for many high-capacity industrial and public supply wells in the greater Old Town area; water levels in the eastern half of the map area were moderately to severely depressed by these withdrawals but appear to have partially recovered by 1976 with the cessation of most pumping. Water levels are likely to have rebounded even further in the 3 decades since then, but recovery is probably incomplete, however, because of ongoing high-capacity pumping and dewatering of the aquifer system in Indian Head, Maryland and other areas just southeast of the map area.

The map shows water levels in the Cameron Valley sand, as interpreted in early 2008 from a variety of data, including visible ground-water discharge from sand outcrops along the banks of many streams, indicating that those parts of the aquifer system are presently saturated. Water levels measured at widely disparate times in the past, in wells that are largely no longer extant, were also used to constrain the piezometric surface (Johnston, 1961 and Johnston and Larson, 1977). In addition, water levels reported much more recently from numerous uncased geotechnical borings and several cased ground-water monitoring wells that terminate in the Cameron Valley sand were also utilized for this study. Because of the widely divergent times and conditions under which these water-level data were collected, the contours should be regarded as a general guide to the configuration of the piezometric surface, rather than a precise indication of water levels at any specific point. In general, the contours are likely to be most accurate in the western half of the map area, where the aquifer system is in contact with and visibly discharging ground water to several perennial streams. Also, the stratigraphically higher parts of the aquifer system that crop out further to the east contain abundant bodies of silty clay that likely act as local confining units, thereby inhibiting hydraulic communication between the upper and lower portions of the system and potentially creating locally perched water-table conditions. Despite these limitations, the map pattern clearly shows that regional ground-water flow in the Cameron Valley sand is east-southeast, with many local variations around the larger streams. Local flow direction is likely to be perpendicular to, or obliquely downstream towards any stream in direct contact with the aquifer system. The map also shows extant and historical springs, swamps, wetlands, and other aspects of urban hydrology, many of which are associated with geologic units other than the Cameron Valley sand. A more complete account of the hydrogeology of Alexandria, this map, and how it was compiled can be found in the expanded explanation of Plate 6.

Explanation of Map Units and Symbols Related to the Cameron Valley Sand

Contour showing line of equal water level (piezometric surface) in the Cameron Valley sand, contour interval 25 feet

Area where the lower part of the Cameron Valley sand crops out or subcrops beneath alluvium, colluvium, and stream terraces, and is likely to be in direct hydraulic communication with streams in low parts of the landscape. The lower part of the Cameron Valley consists almost entirely of sand. Hydraulic head is likely to be well integrated throughout

Cv-Area where the upper part of the Cameron Valley sand crops out or subcrops beneath alluvium, colluvium, and stream terraces, and is likely to be in contact with streams. In this unit, bodies of silt and clay become increasingly numerous higher in the section and may act as local confining units that disrupt the continuity of hydraulic head at places, creating perched conditions and water levels that are considerably higher than what exists at greater depth in the aquifer system. Two large bodies of mostly fine-grained sediment that probably act as low-flow boundaries within the aquifer system are denoted by unit Cc

Approximate boundary of cone of depression in lower Potomac aquifer in 1976, as shown by contours in plate 2 of Johnston and Larson (1977). South and east of the hachured line, the aquifer system was increasingly dewatered by decades of high-capacity well pumpage prior to the mid 1970's, with water levels in some wells indicating 200-300 feet of long-term water-level decline. The degree to which water levels within this area have recovered since 1976 is largely unknown

Seepage faces, springs, and other evidence of active ground-water discharge observed in outcrops of the Cameron Valley sand along streams in 2007-2008

Seepage swamps developed on Cameron valley sand

Location of water well developed in Cameron valley sand, showing elevation of water level measured in 1961 or earlier. Data mainly from Johnston, 1961. Numbers followed by "BR" indicate wells open in bedrock beneath the Cameron valley sand; water levels are expected to be similar or slightly less

Location of water well developed in Cameron Valley sand, showing elevation of water level measured in 1976. Data from Johnston and Larson, 1977

Location of water well developed in Cameron Valley sand, no water level reported

Location of uncased geotechnical boring that terminates in Cameron Valley sand, showing elevation of water level measured between 1999 and 2006. Many of these are described as "stabilized" water levels, that is, the water level was measured at least 24 hours after completion of the boring

Location of ground-water monitoring well screened in Cameron Valley sand, showing elevation of water level measured between 1999 and 2004

Other Hydrological Features

Historical spring, now destroyed or obscured by urbanization

Existing spring

Seepage face or seepage swamp on uplands. Wetland hydrology at these places is characterized by ground-water discharge, and is commonly accompanied by hydric soil and relict wetland vegetation

Wetland hydrology on uplands resulting from surface water or shallow water table perched on fine-grained terrace sediment. Hydric soil profile is typical. Best-preserved examples are large swamps

Wet swales on upland terraces, showing drainage direction.

Outfall of urbanized ravine or other drainage. The reaches of these drainages upstream of the outfalls typically are partially to entirely filled. The source springs are usually destroyed or obscured

Approximate extent of three large, filled, historical wetlands in and adjacent to the Old Town terrace: Oronoco Bay, Hooff Run-Commonwealth swale, and lower Royal Street. Much of the Old Town terrace was a low-lying swamp and many smaller streams and wetlands were also destroyed when the city was settled, but the historical record of these is obscure. The valley bottoms of Cameron Run and Four Mile Run also comprise huge areas of filled swamps, sloughs, fens, and other wetlands

References

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