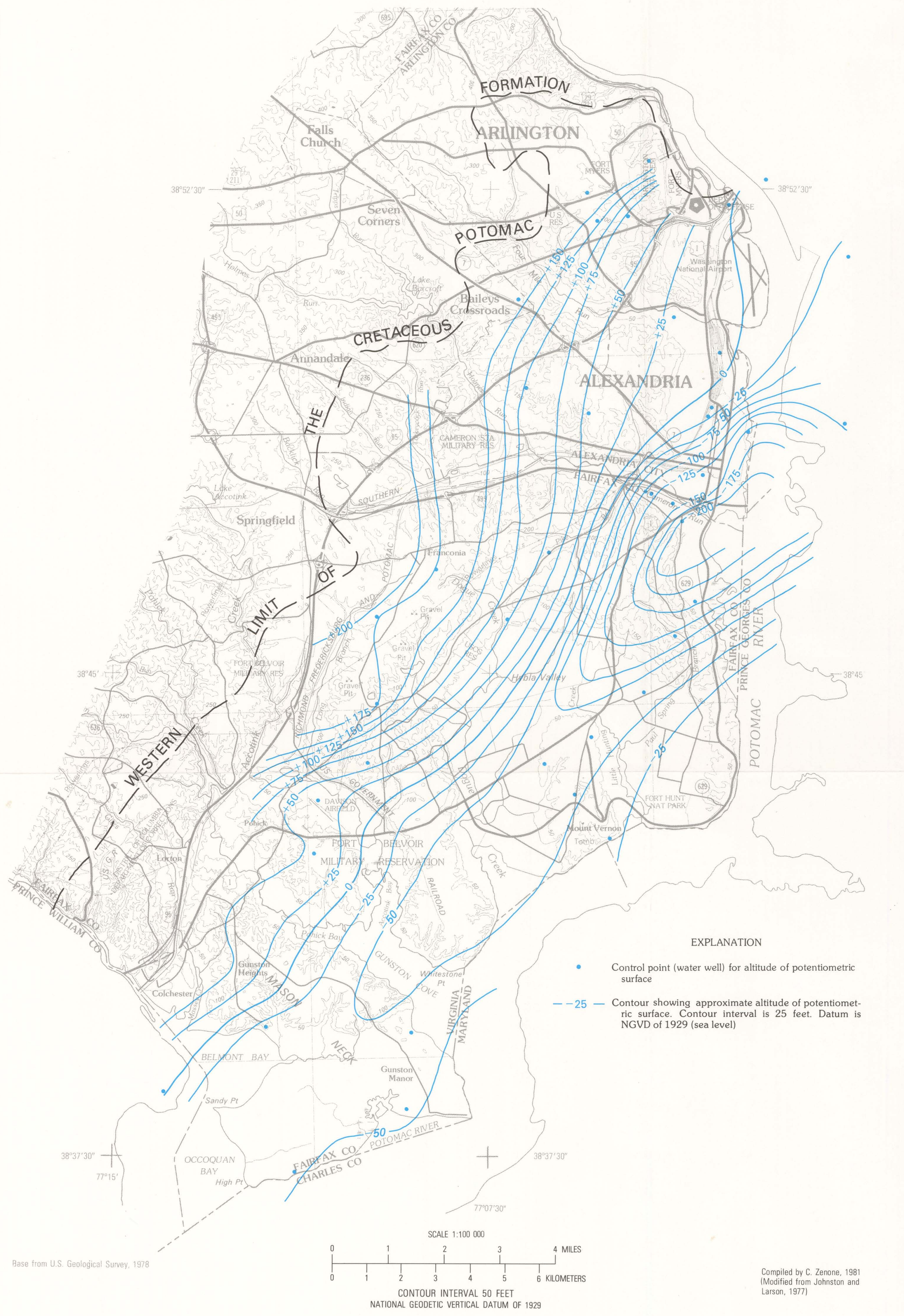
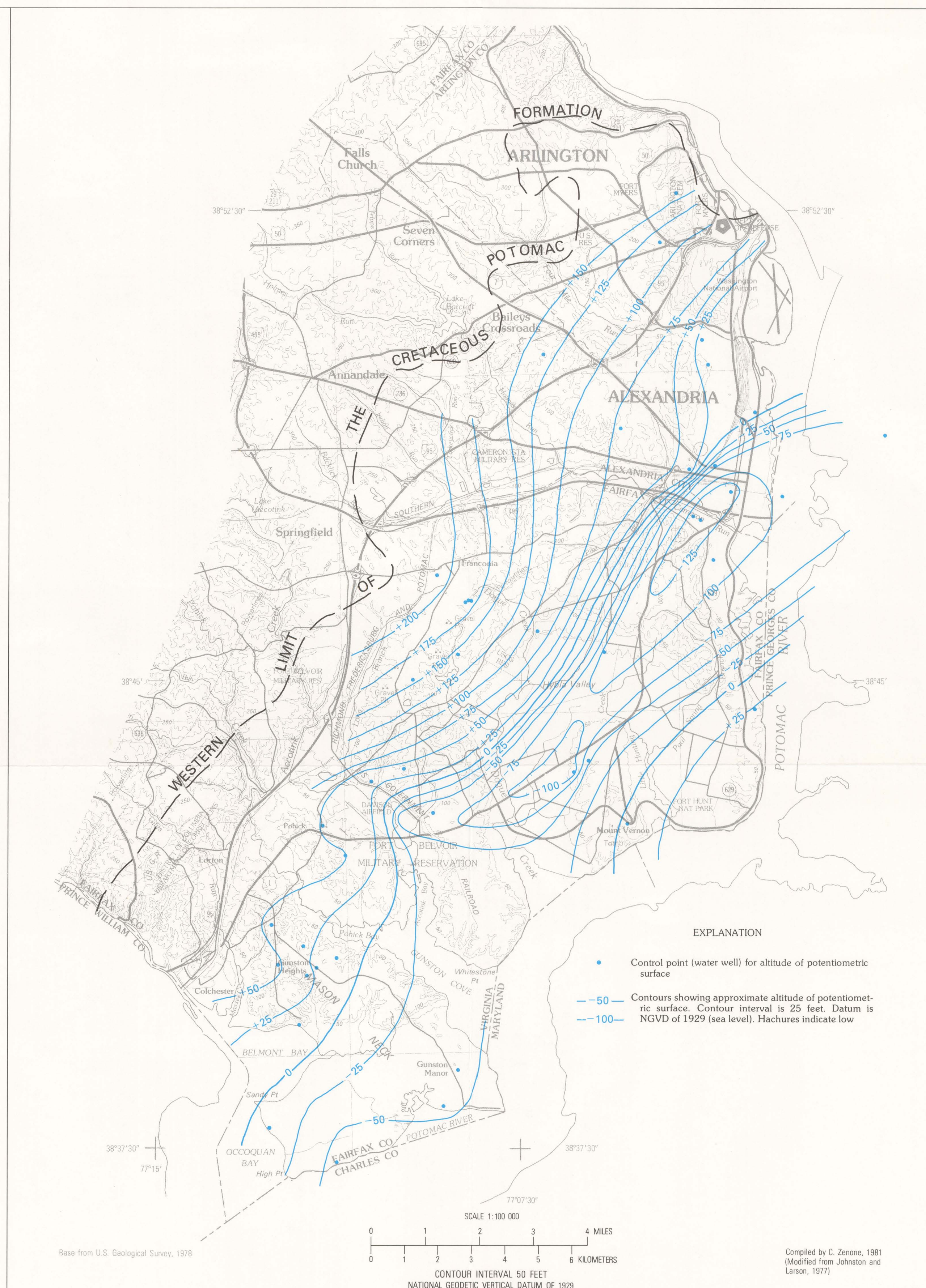
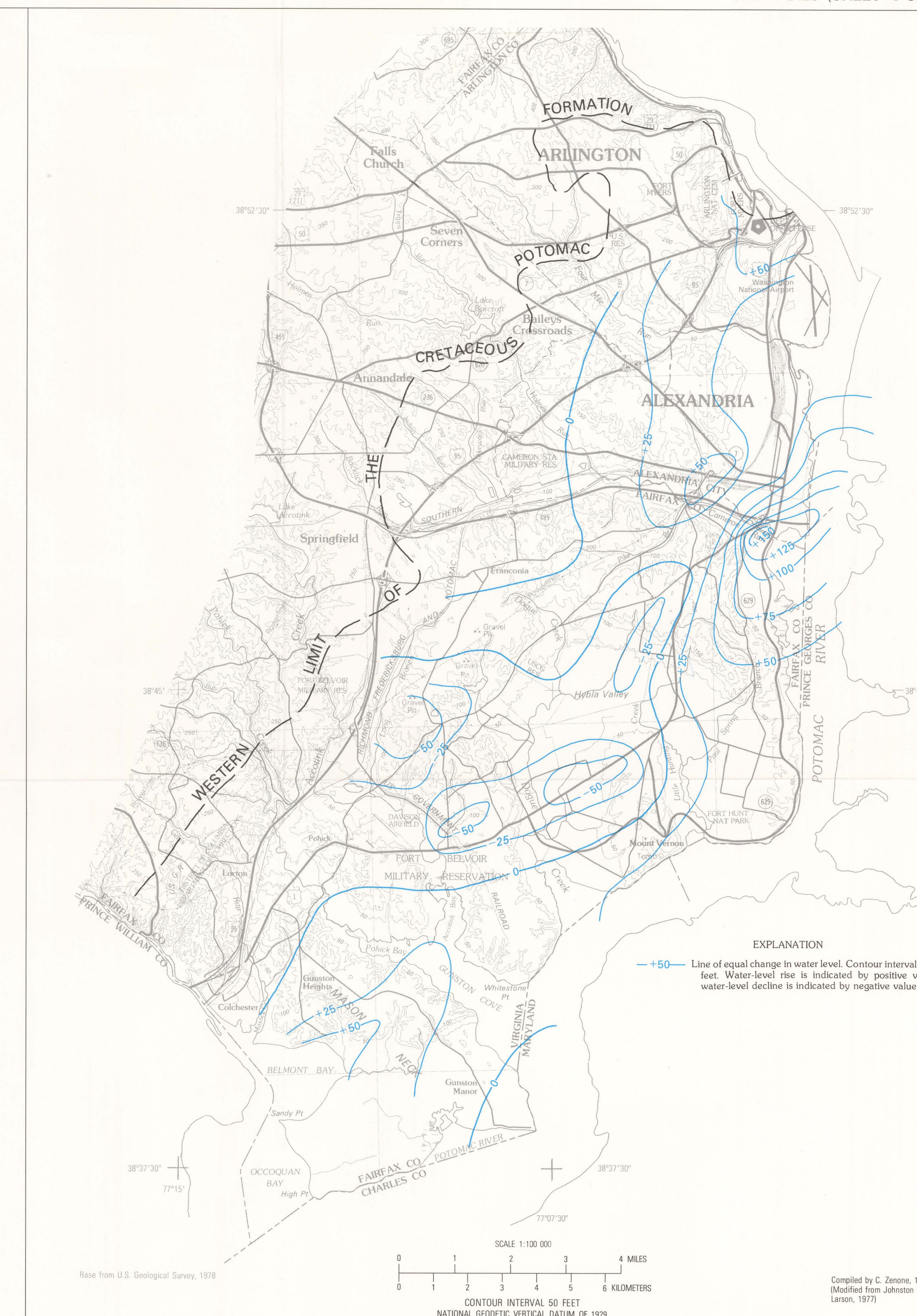


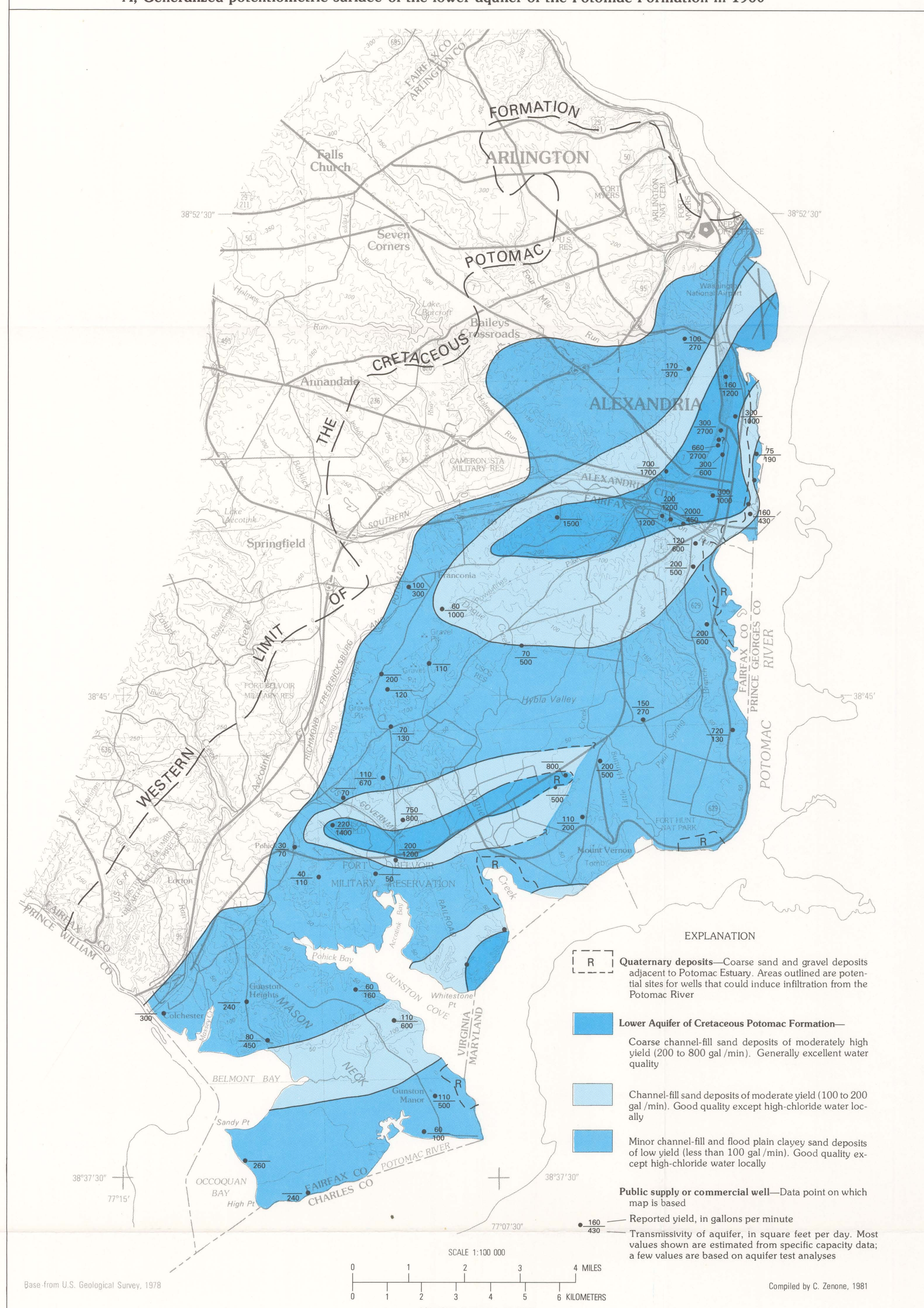
***A*, Generalized potentiometric surface of the lower aquifer of the Potomac Formation in 1960**



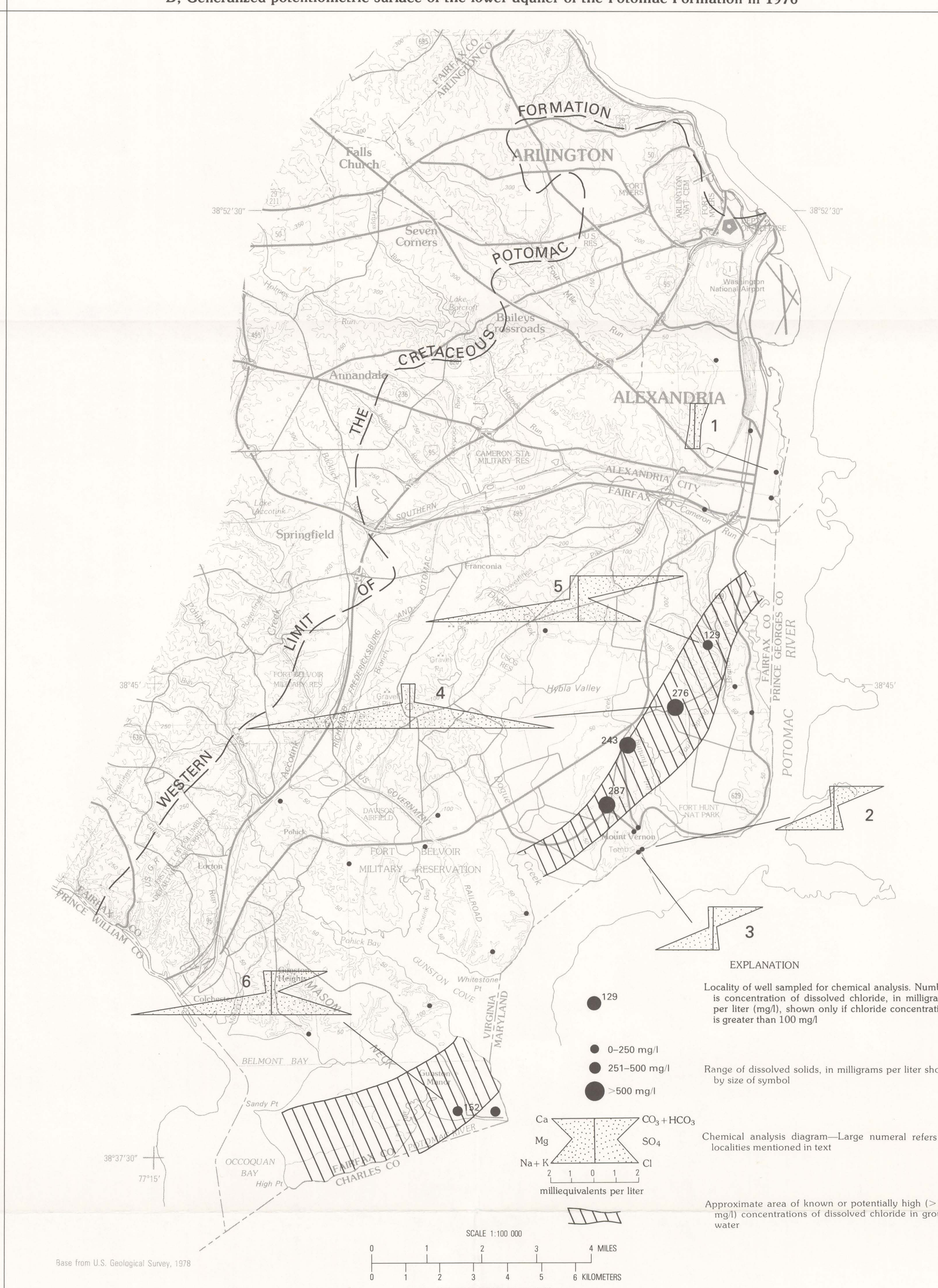
***B*, Generalized potentiometric surface of the lower aquifer of the Potomac Formation in 1976**



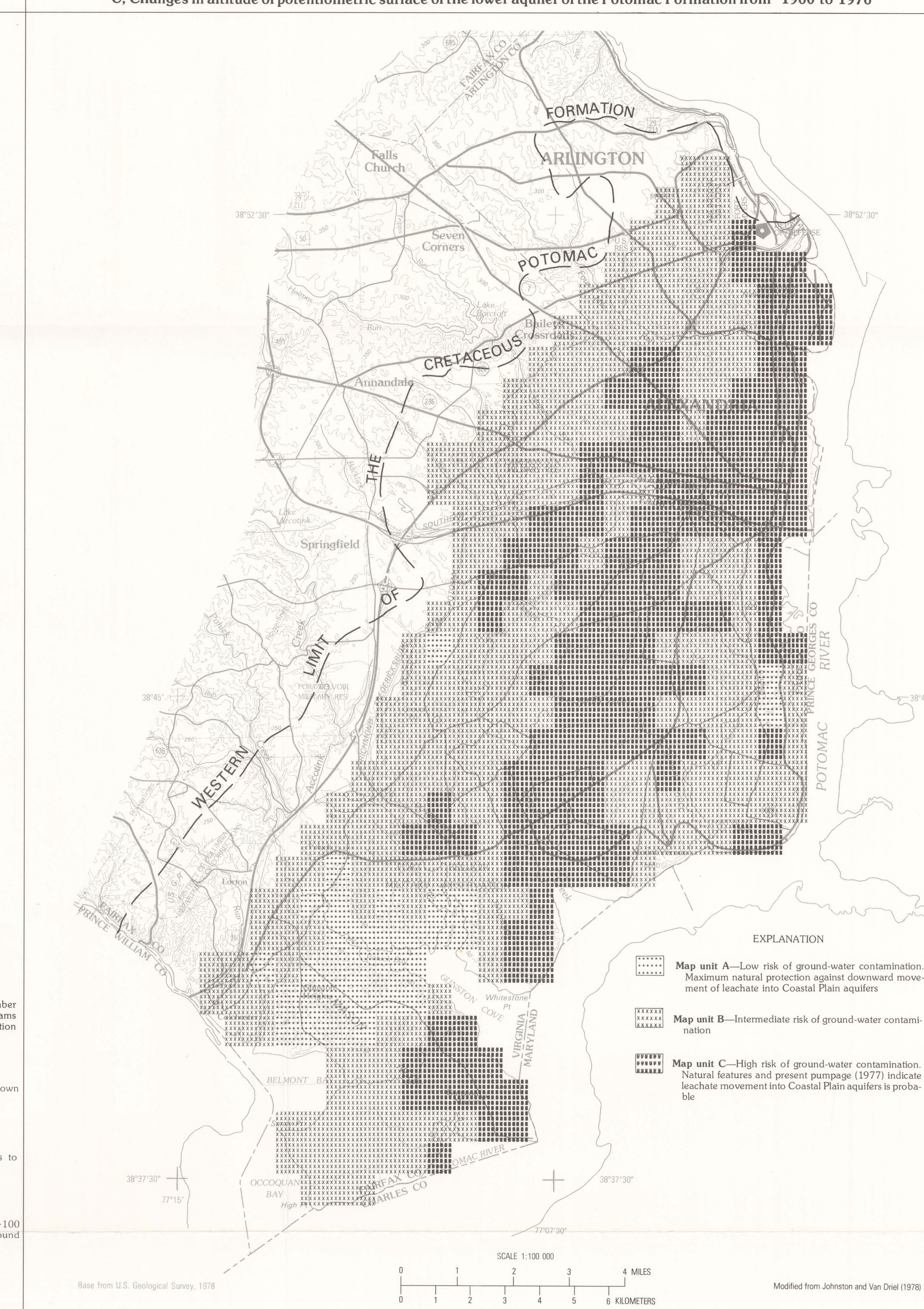
***C*, Changes in altitude of potentiometric surface of the lower aquifer of the Potomac Formation from 1960 to 1976**



***D*, Principal sources of ground water in the Coastal Plain**



***E*, Chemical quality of ground water in the Coastal Plain**



***F*, Susceptibility of Coastal Plain aquifers to contamination, Fairfax County, Virginia—A computer composite map**

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The principal water-bearing unit in the Coastal Plain of Fairfax County and vicinity is the Cretaceous Potomac Formation, a sequence of interbedded sands, silts, and clays. The sands are fluvial channel-fill deposits that occur as relatively narrow, elongate lenses. The greatest number of lenses and the thickest sand sections occur in the lower 100 feet (30 m) of the Potomac Formation. Collectively these sand lenses form an important water-bearing zone, referred to as the lower Potomac aquifer. Most high-yielding wells in the Coastal Plain of Fairfax County and vicinity tap this lower aquifer.

In recent years water levels in the lower aquifer have fluctuated considerably due to changes in the location and withdrawal rates of pumping wells. Altitudes of water levels measured at wells in the late 1950's and early 1960's and the approximate configuration of the potentiometric surface as it existed in 1960 are shown on map ***A***. The map is not intended to give precise water-levels at specific sites. Datum for the water level is National Geodetic Vertical Datum of 1929 (NGVD of 1929).

Map ***B*** shows the potentiometric surface in the lower aquifer in 1976. All water-level measurements used to compile this map were made between March and June, 1976, thus the map is a more accurate representation of the potentiometric surface at a specific time than is map ***A***. Both maps ***A*** and ***B*** show a regional hydraulic gradient, or direction of ground-water flow, to the southeast. The regional gradient is locally distorted by cones of depression around pumping wells. A large cone of depression was present southeast of the city of Alexandria in 1960 (map ***A***). This cone was reduced in size in 1976 (map ***B***), and a small cone had formed east of Fort Belvoir.

Map ***C***, which is derived from maps ***A*** and ***B***, shows the net water-level changes between 1960 and 1976. The general rise of water levels in the northern and eastern part of the mapped areas is attributed to a sharp decline in pumpage from about 4 million gallons per day (M gal/d) (15 million liters per day (M l/d)) in 1960 to about 1 M gal/d (3.8 M l/d) in 1976. The decline in ground-water withdrawal is due to abandonment of aging wells and the conversion to surface-water sources by major water users in the area.

The principal sources of ground water in the Coastal Plain sediments are summarized in map ***D***. Wells tapping the lower channel-fill sand aquifer of the Potomac Formation are some of the best producers in the area. Well yields range from 100 to 800 gallons (380 to 3030 l) per minute in the thicker sands, but some wells penetrate only clay and clayey sand in the same intervals and produce very little water. High transmissivity (greater than 1000 feet squared (93 meters squared) per day) is related to the presence of major sand channels in the lower aquifer. Three such sand bodies have been identified as shown on map ***D***; sustained yields of a few hundred gallons per minute per well can be developed in these areas. Wells completed in the Potomac sand aquifers are usually constructed with 6-to-10-inch (15 to 25 cm) steel casing and either slotted casing or well screens opposite water-bearing sands.

The recent decline in ground-water withdrawal from the lower aquifer of the Potomac Formation (map ***C***) was discussed above. Although the full potential of this aquifer is uncertain, increased pumpage of 3 M gal/d (11.4 M l/d) in the same areas would likely bring a return to water-level conditions similar to those in 1960. Probably a realistic minimum of 6 to 7 M gal/d (23 to 26.5 M l/d) of sustained yield is available from the lower Potomac aquifer in Fairfax County and Alexandria, based on a consideration of past head declines and withdrawal rates and assuming proper well design and spacing.

A potential but as yet unexplored source of water is the Pleistocene sand and gravel deposits adjacent to the Potomac Estuary (Froelich and others, 1978). These deposits underlie Hybla Valley, Mason Neck, and parts of the shoreline along the estuary. Although relatively thin (0–160 feet (0–50 m)), some parts of the Pleistocene deposits offer the possibility for development of water supplies by inducing infiltration of water from the Potomac River to the wells—a method that has proved highly efficient elsewhere (Winslow and others, 1965). The rate of infiltration depends upon the permeability of the present riverbed material, the transmissivity of the aquifer, and the hydraulic gradient, which would be steepened by pumping, from the river to the wells. To date (1981) neither the hydraulic characteristics of the Pleistocene deposits nor the distribution and thickness of silty riverbed material is known.

The natural chemical quality of ground water in the Potomac Formation in Fairfax County and vicinity is shown on map ***E***. The water is generally of excellent chemical quality, but locally the water is only marginally acceptable for some uses.

Water in the sand aquifers of the Potomac Formation is primarily a soft sodium bicarbonate water (map ***E***, chemical analysis diagrams 1, 2 and 3) with locally high concentrations of iron. The water of marginal quality is a sodium chloride type (diagram 4) or a mixed sodium bicarbonate-chloride type (diagrams 5 and 6). These chloride-rich ground waters coincide with a band of clayey sand flood-plain sediments bordering coarse sand and gravel channel deposits of ancestral Potomac River, described in the text for map ***D*** on this sheet. Chemical analyses of ground water from the Coastal Plain in Fairfax County and vicinity are tabulated by Larson (1978).

The permeability of earth materials immediately underlying a waste disposal site is the primary factor affecting the potential for contamination of ground water beneath the site. The importance of this and other hydrologic and geologic factors in retarding or enhancing the movement of contaminants into the Coastal Plain aquifers was analyzed to produce map ***F***, a computer-composite map that depicts the relative susceptibility of the aquifers to contamination. This map is based on very generalized information and therefore should be used with caution. A complete discussion of how the map was compiled and the limitations to its application is included in Johnston and Van Driel (1978). The three map units are labeled A, B, and C, in order of increasing risk of ground-water contamination. Areas covered by unit A offer the greatest natural protection against movement of contaminants into sand aquifers. The favorable rating may result from the presence of thick clay beds above an aquifer, upward movement of ground water in the area, the absence of the lower Potomac aquifer at depth, or some combination of these factors. The upper sketch in the accompanying diagram (fig. 1) illustrates these features. Areas covered by unit C offer the least protection against contaminant movement into the aquifers. The presence of permeable sands above an aquifer, coupled with downward movement of ground water (either naturally or induced by pumping from wells), accounts for the unfavorable rating. These features are illustrated in the lower sketch of the diagram (fig. 1). Areas in unit B offer intermediate or uncertain protection for the ground-water resource. Such areas may be underlain by a good aquifer but have only locally thick overlying clay beds and low rates of downward water movement, or be underlain by an aquifer in which ground-water movement is upward, or by some combination of these factors.

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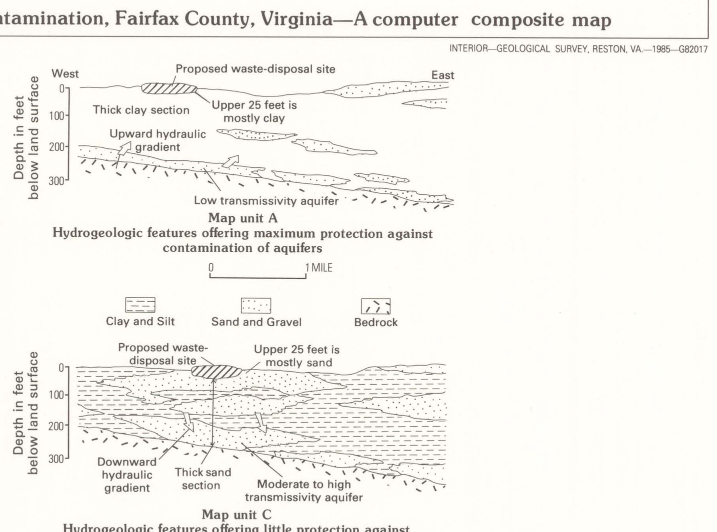

Figure 1.—**Diagrammatic sections showing features affecting susceptibility of Coastal Plain aquifers to contamination. Map units are defined on map *F*.**

Sheet 4 of 5: Maps showing the distribution and quality of ground water in the Coastal Plain deposits of Fairfax County and vicinity, Virginia

FOLIO OF GEOLOGIC AND HYDROLOGIC MAPS FOR LAND-USE PLANNING IN THE COASTAL PLAIN OF FAIRFAX COUNTY AND VICINITY, VIRGINIA

By
A. J. Froelich

1985