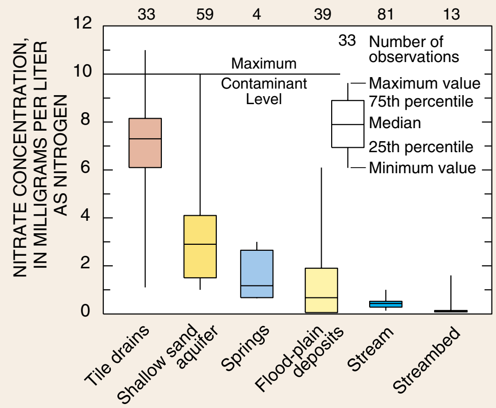
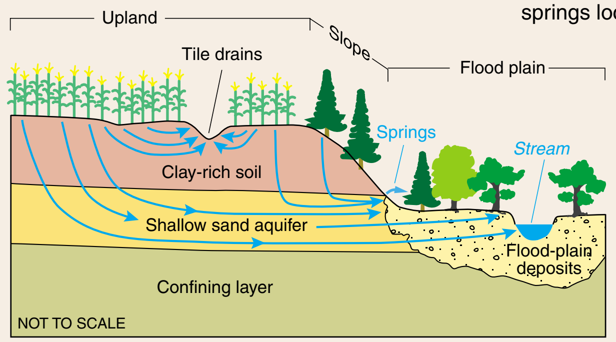
In some areas of the Nation, prolonged use of fertilizers or manure for crop production has led to high nitrate concentrations in shallow ground water that renders it unsafe for consumption by pregnant and nursing mothers, young infants, and young farm animals. In major crop-producing areas of the ACF River Basin, however, clay-rich upland soils and extensive forested flood-plain areas may reduce the risk of nitrate contamination of ground water and streams, respectively. A ground-water flow-system study site with these landscape and soil characteristics was studied to characterize (1) the spatial distribution of ground-water quality in relation to subsurface conditions and (2) the quality of water of the predominant ground-water discharge zones relative to that of the receiving stream.

Three distinctive subsurface environments were delineated on the basis of nitrate concentrations and other chemical indicators: (1) clay-rich soil, (2) shallow aquifer, and (3) flood plain deposits (see generalized cross section). In the farmed upland area, nitrate was present in ground water both above and below clay-rich soil layers. However, tile drainage from above the restrictive soil layers has higher nitrate and lower dissolved-solids concentrations than water from wells screened in the shallow aquifer located below these soil layers. The clay-rich soil layers impede the downward flow of water, so agricultural chemicals that are applied to cropland tend to stay in shallow soil layers where they are used by crops or degraded. In water from wells screened in flood-plain deposits, nitrate was absent or present at significantly lower concentrations than in the upland areas. Organic-rich layers within flood-plain deposits rarely contained nitrate because nitrate is chemically unstable in the reducing conditions that characterize these layers.

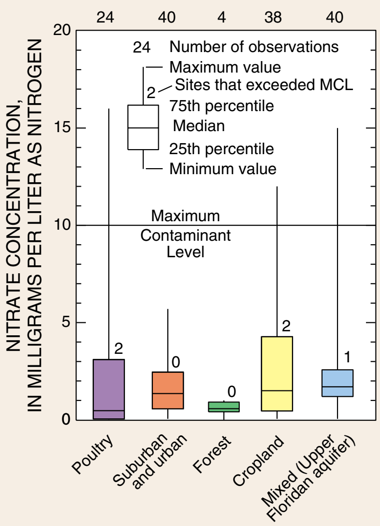
Three ground-water discharge zones also were delineated: (1) tile drains and ditches in upland draws, (2) a line of intermittent and perennial springs at the edge of the flood plain, and (3) seepage zones through the bed of the stream channel. Tile drains and ditches were sustained by a perennial discharge of ground water derived locally from the shallow subsurface overlying restrictive clay layers. Ground-water flow from the shallow aquifer sustains a line of springs as well as seepage through the streambed to the stream; however, seepage through the streambed only rarely contained detectable nitrate. Median nitrate concentrations of water samples analyzed from each discharge zone are 7.3, 1.2, and less than 0.05 milligrams per liter as nitrogen, respectively, or about 17, 2.7, and less than 0.10 times that of the median nitrate concentration of the receiving stream. Nitrate loadings from tile drains are very high relative to their discharge volumes, and where tile drains are present they represent an important pathway for transport of nitrate and other agricultural chemicals to streams during base-flow conditions (ground-water discharge) and during periods of storm runoff.





Upland soils in the Coastal Plain of the ACF River Basin commonly contain thick, continuous, clay layers. These clay layers impede the transport of agricultural chemicals to shallow and deeper aquifers.

Tile drains and ditch networks in farm fields are designed to drain areas where ground water is perched above clay layers. Runoff carried to streams by these drainage networks have higher concentrations of agricultural chemicals than (1) ground-water discharge from springs located along the edges of flood plains and (2) ground-water discharge to streams that first passes through organic-rich flood-plain deposits.



Although nitrate generally is present in ground water in each of the land-use settings and in the Upper Floridan aquifer, concentrations only rarely exceed the USEPA drinking-water standard of 10 milligrams per liter as nitrogen.