

EXECUTIVE SUMMARY

INTRODUCTION

The Eastern Shore of Virginia depends entirely on ground water as a source of drinking water. To protect this critical resource, the counties of Accomack and Northampton have enacted a number of protection measures by means of comprehensive planning, zoning ordinances, and the establishment of resource protection and management areas. Even with existing measures, however, some residential developments have a significant potential to reduce the quality or availability of ground water by overpumpage or contamination from surface sources. This report documents the results of a modeling investigation into the potential effects of residential development on ground water availability and quality on the Eastern Shore of Virginia (hereafter Eastern Shore), and is intended to provide a technical basis for development of local water resource protection ordinances and implementation of effective management practices.

To evaluate potential contamination of the ground water from residential landuse activities, LEWASTE, a model developed by USEPA for delineating wellhead protection areas, was used. Specific types of contaminants modeled were nitrate-nitrogen and herbicide (2,4-D) from developments of varying lot density. Simulated sources of nitrogen included normal fertilizer application to lawns and septic system effluent. The USGS model SHARP was used to simulate the effects of development-related pumping on saltwater intrusion and ground water levels. Both LEWASTE and SHARP were applied to two hydrogeologic settings on the Eastern Shore: a central recharge spine setting and a near-shore setting.

FINDINGS

Results from the landuse modeling indicate that normal rates of fertilizer application to more than ten percent of the pervious area of a development can cause nitrate-nitrogen concentrations to exceed the drinking water standard of 10 mg/L in shallow ground water, regardless of the size and number of lots. Septic systems were predicted to cause exceedance of the nitrate drinking water standard in ground water

beneath developments that are comprised of 0.5-acre (or smaller) lots unless subsurface conditions favored denitrification. However, normal rates of pesticide application were not predicted to cause exceedances of Virginia ground water standards.

Developments greater than 50 lots, or adjacent to other developments having an aggregated size greater than 50 lots, have a significant potential to adversely impact the ground water resource either through saltwater intrusion or loss of well yield from lowered ground water levels. For developments with small lot sizes ($\frac{1}{4}$ acre) and a large number of lots (greater than 250), the potable water demand can result in significant saltwater intrusion and lower ground water levels, both for inland and coastal areas. For lot sizes one acre and larger, irrigation demand during the summer can result in both saltwater intrusion and excessively lowered ground water levels. The impacts for coastal areas are much greater than impacts for inland areas, such that most of the scenarios evaluated for a coastal area predict impacts from overpumping.

RECOMMENDATIONS

In order to protect the shallow aquifer system from high loading rates of nitrogen, it is recommended that homeowners apply the *minimum* fertilizer application rate for the soil and grass type on their lot. A centralized wastewater collection and treatment system (WCTS) should be constructed for any new developments with a minimum of 50 lots and an average lot size of 0.25 acre or less. Protective measures should also be implemented on new developments of 50 or more lots with an average lot size between 0.25 and 0.5 acres if soils are predominantly sand and if the seasonal water table is less than 10 feet deep.

Protection of the ground water resource from overpumping can be accomplished through alternate well design, conservation measures, or an appropriately designed central water supply. New developments which exceed 50 lots, or new developments located adjacent to existing ground water users which exceed an aggregated 50 lot demand should either institute conservation measures or employ alternate well designs. Effective conservation measures include use of low flow plumbing fixtures, irrigation only in the evenings and metered irrigation, and the use of landscaping that requires minimal water use. The alternate well design resulting in the greatest reduction in

impacts is a two-well system. With the two-well system, potable water would be pumped from a confined (preferably upper Yorktown aquifer) well and non-potable water from the water table aquifer. This would require separate plumbing to prevent cross connects between the two systems.

A centralized water system can also provide significant benefit for the larger residential areas (greater than 50 lot developments) by buffering the peak water demand. A centralized potable water system withdrawing from a confined aquifer with non-potable irrigation water supplied by individual residential wells pumping from the water table aquifer provides the greatest protection from saltwater intrusion and loss of yield due to over pumping.

For developments greater than 50 lots located in or near the spine recharge area, screening the potable water wells in the upper or middle Yorktown aquifer will reduce the potential for saltwater intrusion. Lot sizes of one acre or greater should pump non-potable irrigation water from the water table aquifer or implement conservation measures to reduce irrigation demand. Very large developments (greater than 250 lots) should consider both pumping non-potable water from the water table aquifer and implementing conservation measures to prevent adverse impacts. Many of the impacts can be reduced with a properly designed central supply system, where peak demands are buffered by the system.

Impacts to the ground water resource are more severe in the coastal area, and the recommendations extend to smaller developments with smaller lot sizes. All developments that are 50 lots or greater should obtain their potable water supply from the upper Yorktown aquifer. All developments greater than 50 lots should also obtain their non-potable (irrigation) water from the water table aquifer. Residential developments that are greater than 250 lots should implement conservation measures to reduce demand or develop a centralized water supply system to prevent adverse impacts to the ground water resource.