

## 7.0 Groundwater Investigations of Dredged Material Disposal Sites

7.1 Geology and Groundwater. The study area lies within the coastal plain physiographic province and is underlain by unconsolidated sands and clays of Cretaceous, Tertiary, and Quaternary age. These sediments overlie bedrock which consists of metamorphic and igneous rocks of the upper Precambrian age. The unconsolidated formations dip to the southeast and generally thicken oceanward. The older formations are at or near the surface of the Delaware River and are progressively deeper toward the Atlantic Ocean. Rock outcrops will be encountered in the vicinity of Marcus Hook, Pennsylvania, during the channel deepening. The unconsolidated sediments consist of pervious and impervious layers which form a series of aquifers and aquicludes.

The primary aquifer units along the Delaware River are the Potomac-Raritan-Magothy formations and the Cape May and Columbia formations. The Potomac-Raritan-Magothy aquifers are exposed at various locations at or near the surface in a narrow band along both sides of the Delaware River between Trenton and Pennsville, New Jersey. The Cape May and Columbia formations cover practically all of Delaware and portions of Southern New Jersey. In many locations in or adjacent to the Delaware River, these aquifer units are mantled by sands and clays of recent alluvial deposits. The municipal water wells in southern New Jersey generally withdrawal their water from the Potomac-Raritan-Magothy formation. It is considered the sole source aquifer for the region.

The thickness of the Potomac-Raritan-Magothy formations is as much as 500 feet. Many industries and public water companies in the region obtain groundwater from this formation. There are four major aquifers within the formation. In the vicinity of the project's four new disposal areas, the uppermost aquifer is 50 to 120 feet below the surface, the second ranges from 105 feet to 250 feet, the third from 300 feet to 390 feet, and the lowermost aquifer is 400 feet to 500 feet below the surface. The upper water bearing zone is usually artisan and is separated from the surface sediments by clay beds with a minimum ten-foot thickness in the vicinity of the disposal areas. Communities along the river obtain their water from the basal part of the lower aquifer. Impermeable clay layers separate all of the water bearing zones.

Groundwater flow is generally toward the main river in a typical river basin. However, the groundwater regime in the project area, specifically the New Jersey side of the river, has been disturbed by urbanization. This information has been documented in numerous reports. The U.S.G.S. Atlas HA-697 dated 1986 estimates a leakage of 70 million gallons per day (MGD) from the Delaware River into the Potomac-Raritan-Magothy aquifer system in the project area. A reversal of the natural groundwater flow due to overpumping of the aquifer has occurred. Prior to municipal

and industrial pumping, water flow in the aquifer was towards the river. Where large groundwater withdrawals have locally reversed the original aquifer flow patterns, aquifer recharge by river water results. This is due to the fact that permeable sand and gravel in the river are in direct contact with the sediments which comprise the Potomac-Raritan-Magothy system. Although a large volume of river water is presently infiltrating the aquifer from the river, no contamination or salinity problems have been reported. Since the amount of aquifer recharge from the river is controlled by the pumping rate of private and public wells, any deepening of the channel will not increase the amount of intrusion.

## 7.2 Dredged Material Disposal Area Groundwater

The confined upland dredged material disposal areas, previously discussed in Sections 3.2 and 6.0, will be utilized to provide 50 years of capacity for the 45 foot project in Reaches A through D. All of the sites (proposed and existing) other than Reedy Island North and South, are located in New Jersey (See Plates 1 - 4). The sites are all situated near the Delaware River shore, have similar subsurface conditions, contain varied amounts of fine grained dredged material, and overlie the Potomac-Raritan-Magothy aquifer.

The existing 40 foot navigation project has historically been maintained through the use of annual maintenance dredging. The material dredged from the existing 40 foot channel has been deposited in upland dredged material disposal areas in New Jersey for long term storage. As part of the proposed 45 foot deepening project, four new upland disposal areas will be used in conjunction with existing Federal sites. Several concerns have been raised in regards to the use of these sites. The main concern involves the potential impact to drinking water aquifers from leachate generated by the disposal operations. It is hypothesized that water could percolate through the dredged material, leach out potential contaminants such as heavy metals, and carry them to the groundwater. As a first step in the investigation, sediment testing of the Delaware River channel and channel bends was conducted. The sediment testing, discussed earlier in the report in Section 4.0, concluded that the materials are sufficiently clean to meet all NJDEP Impact to Ground Water Soil Cleanup Criteria.

As a supplement to the sediment testing efforts, the United States Geological Survey was tasked with performing an evaluation of potential contaminant travel times from the proposed project disposal sites to nearby drinking water and industrial production wells. The report entitled, "Evaluation of Groundwater Flow from Dredged Material Disposal Sites in Gloucester and Salem Counties, New Jersey" (USGS. 1995), determined that the disposal sites would not impact local wells as the sites provide a very small percentage of well recharge and potential contaminant travel times were on the order of fifty to one hundred years. The mean

travel times for groundwater from the new proposed disposal areas to reach any potential water supply well is in excess of 50 years, except for a cluster of wells near area 15G where the report states that "travel time to these wells could be relatively short, perhaps on the order of several years". The proposed (site 15G) and existing (Oldmans, Pedricktown North and South) disposal areas are in the contributing area to these wells. Oldmans disposal area is centrally located among the sites between areas 15G and Pedricktown North. This site has been used over 40 years by the Corps of Engineers for disposal of maintenance material from the existing Delaware River 40 foot project. Recently, a detailed groundwater investigation of the Oldmans disposal area has been completed by the Corps of Engineers. The investigation concluded that potential environmental impacts to this site should not preclude further expansion and continued use of this site as a dredged material disposal area.

It is important to consider all of the contributing factors when evaluating the potential negative impact of the travel times from all disposal areas. First, the existence of 20-40 feet of fine grained material from past dredging within the disposal areas greatly impedes the flow of water from the areas and increases the travel times substantially. In addition, the new dredged sediments from the 45 foot project contain no harmful levels of contamination; so in the event that the water were to reach the well from the disposal area, it would have no impact on water quality.

The aforementioned conditions with respect to travel time, recharge, contamination levels, and conclusions from the recent groundwater investigation conducted by the Corps of Engineers at Oldmans disposal area indicate that possible risk of groundwater impacts at the dredged material disposal sites is negligible. The disposal of material in the proposed areas will have a negligible impact on the groundwater/aquifer system in both the local and regional area.