

HISTORY AND HYDROLOGIC EFFECTS OF GROUND-WATER  
USE IN KINGS, QUEENS, AND WESTERN NASSAU COUNTIES, NEW YORK,  
1800'S THROUGH 1997

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Ground-water withdrawals from the aquifers beneath Kings and Queens Counties varied locally and temporally during the 20<sup>th</sup> century and caused extreme changes in water levels. Periods of heavy pumping were characterized by water-level declines, saltwater intrusion in near shore areas, and migration of contaminants from land surface into deeper aquifers. Conversely, decreased pumping rates resulted in water-level recoveries that in turn caused the flooding of subways and other underground structures and the eventual dilution and dispersion of contaminants.

The water table in Kings County and, to a lesser extent, Queens County, probably had declined measurably by the mid 1800's as a result of rapid population growth and a continued growing demand for shallow ground water. Another contributor to water-level declines was the installation of storm sewers and sanitary sewers in Kings County that discharged wastewater to the sea rather than returning it to the aquifers. The largest public-supply withdrawals in Kings County were in 1910, and the reported saltwater encroachment in coastal areas near Jamaica Bay as early as 1912 indicated that a landward gradient had developed. Despite the additional supply of upstate surface water provided through the completion of the NYC Water Tunnel #1 in 1917, water levels did not recover, probably because the demands on private water suppliers continued to increase as the ground-water withdrawals for industrial supply more than doubled.

By the late 1920's and early 1930's, continued saltwater encroachment resulted in a shift of pumping from the shallow, unconfined (upper glacial) aquifer, to the deeper Jameco aquifer in Kings County and the confined Jameco-Magothy aquifer system in Queens County. Hydraulic heads in the confined aquifers declined more rapidly in response to excessive pumping than in the upper glacial aquifer as a result of their low storage coefficients.

Combined withdrawals for public and industrial supply in Kings and Queens Counties were greatest (about 130 million gallons per day) during the 1930's. During this time, the water table in Kings County developed a large cone of depression that extended into southwestern Queens County. Water levels at the center of this depression were about 45 feet lower than in 1903, and the water table in most of Kings County was below sea level. The completion of NYC Water Tunnel #2 in 1936 did not cause ground-water withdrawals to decrease; probably because the water was used for public supply in newly developed areas.

By 1947, all public-supply withdrawals in the Flatbush Franchise area of Kings County were halted primarily because of saltwater intrusion. The cessation of pumping allowed water levels to begin recovering, and subway flooding was soon reported in this area. Industrial withdrawals in Kings and Queens Counties continued to decrease, and by 1951 the cone of depression in northern Kings County had diminished in size, and water levels had risen to 25 feet below sea level and were now above sea level in southern Kings County. This allowed basement and subway flooding to increase in areas west and

northwest of East New York in Kings County.

The years from 1955-76 saw a continued shift in pumping in Queens County--from the upper glacial aquifer to the deeper Magothy (and, to a lesser degree, the Lloyd aquifer) and a general increase in public-supply withdrawals. By 1961 many wells in Queens County had developed high chloride concentrations and were being abandoned, while new wells were being installed farther inland and eastward. Slight declines in the water table were observed throughout southern Queens County, and a cone of depression developed in southwestern Queens (Woodhaven Franchise area) in which water levels were about 35 feet lower than in 1903. In 1974 public-supply withdrawals were halted in the Woodhaven Franchise area of Queens County to prevent further saltwater intrusion. This caused the cone of depression to shift from the Woodhaven area toward the Jamaica area, where its greatest depth was 35 feet below the 1903 water levels and where public-supply withdrawals continued. Meanwhile, the water table throughout most of Kings County had risen as much as 40 feet by 1974 and was above sea level, close to its 1903 level, and chloride concentrations were decreasing.

Between 1981 and 1983 water level fluctuations of about 1 foot in Kings County indicated that a state of equilibrium had been reached. Water levels in northwestern and southwestern Queens County had risen slightly since 1974, although those in northeastern and southeastern Queens, and in extreme southwestern Nassau County had dropped slightly. Major reductions in public-supply withdrawals in the Jamaica area of Queens County by 1991 allowed water table recovery in that area, however, and continued reductions in withdrawals from the Jamaica area have allowed further recovery.

The water-level recoveries in the last 30 years have allowed dilution and dispersion of saline and nitrate-contaminated ground water in both counties. Several synthetic organic compounds were detected in water from wells in all three counties in 1992-93, 1995 and 1996, however. The most frequently detected compounds were tetrachloroethene, total trihalomethanes, trichloroethene and chloroform, in concentrations ranging from 0.5 to 220 micrograms per liter. In Queens and western Nassau Counties, these compounds were found more frequently in the Jameco and Magothy aquifers than in the upper glacial aquifer, whereas in Kings County they were detected more frequently in upper glacial aquifer than in the deeper aquifers. The most plausible explanation, given that the sources of these compounds were similarly distributed, is that the organic contaminants were drawn down from surface sources into deeper aquifers in Queens County during the 1960's and 1970's, when the large cone of depression was present, whereas in Kings County these compounds did not reach the deeper aquifers because of their limited use (or did not exist) before 1947, when the cone of depression was present in Kings County. Furthermore, any organic compounds that may have been drawn into the deeper aquifers in Kings County prior to 1947 would have had a longer period of time for degradation, dilution and dispersion than in Queens County.