PUBLIC-SUPPLY PUMPAGE IN KINGS, QUEENS, AND NASSAU COUNTIES, NEW YORK, 1880-1995 pdf

1: in Western Long Island, New York | Paul Misut - www.enganchecubano.com

Public-supply pumpage in Kings, Queens, and Nassau Counties, New York, Open-File Report By: Anthony Chu, Jack Monti Jr., and A.J. Bellitto Jr.

Geological Survey Groundwater Resources Program began a regional assessment of the Appalachian Plateaus aquifers in that incorporated a hydrologic landscape approach to estimate all Geological Survey Scientific Investigations Report â€”, 77 p. Prior to storm landfall, the U. Geological Survey Scientific Investigations Report â€”, 75 p. Geological Survey USGS , in cooperation with State and local agencies, systematically collects groundwater data at varying measurement frequencies to monitor the hydrologic conditions on Long Island, New York. Each year during April and May, the USGS conducts a synoptic survey of water levels to define the spatial distribution of the Geological Survey Scientific Investigations Map , 4 sheets, scale 1: Monti, Jack; Como, Michael D. This major source of water provides for public and domestic supply and serves as a vital source of freshwater for industrial and agricultural uses throughout the region. Population increases and land-use and climate changes Geological Survey Scientific Investigations Report â€”, 76 p. The goal of this National assessment is to Measurements of chloride concentrations and water levels in from the deep, confined aquifers indicate active saltwater intrusion in response to public Monti, Jack; Misut, Paul E. Geological Survey USGS , in cooperation with State and local agencies, systematically collects ground-water data at varying measurement frequencies to monitor the hydrologic situation on Long Island, New York. Each year during March and April, the USGS conducts a synoptic survey of hydrologic conditions to define the spatial distribution Monti, Jack; Busciolano, Ronald J. The borehole-logging techniques included natural gamma, single-point resistance, short-normal resistivity, Geological Survey Open-File Report , p. Annual total nitrogen loads transported to Monti, Jack; Scorca, Michael P. The nitrogen contributes to algal blooms, which consume oxygen as the algae die and decompose. Hydraulic properties and boundary conditions of an existing regional ground-water-flow model of Long Island with a uniform

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2: Full text of "Withdrawal of Ground Water on Long Island"

Public-supply pumpage in Kings, Queens, and Nassau counties, New York, pumpage in Kings, Queens, and Nassau counties, Nassau counties, New York.

Graphs showing average dally withdrawal of water for public supply from the different source formations In Kings, Queens, and Nassau Counties, N. State Water Power and Control Commission and with Nassau and Suffolk Counties, has been carry- ing on an intensive investigation of these resources. The investigation in all its many phases and the preparation of the results for publication are necessarily slow processes, and for this reason it has seemed desirable to publish the results of separate phases of the work as soon as these phases have progressed sufficiently,, The present report deals with the withdrawal or pumpage of ground water, chiefly from wells used for public supply. This phase of the investigation has been pursued in order to obtain basic data on chronologic s geographic, and geologic distribution of withdrawals of ground water and changes in trends of these factors. The pumpage from public-supply wells in Suffolk County is so small and so scat- tered that it has not yet been studied,, In the present report the withdrawals are considered only on an annual basis. A more detailed consideration of the monthly withdrawals from some individual stations is contemplated in a subsequent report describing the nature and cause of the fluctuation of ground-water levels on Long Island, The preparation of the present report has involved a historical study of records of the different water-supply systems to discover the depths of several hundred wells, the formations from which they draw, and changes in these factors from time to time as new wells were drilled and old wells were abandoned. On this basis two men worked on the study most of the time for more than 2 years. At different times the study has been under the direct supervision of Kyle Forrest, W. Monroe, or one or the other of the writers. However, for the purpose of this study it has been desirable to divide the water-bearing beds into three major groups based on the geo- logic age of the water-bearing beds. These are called the post-Jameco beds in this report because they lie above and are geologi- cally younger than the next deeper important water-bearing formation, which is known as the Jameco gravel. They consist of glacial outwash sand and gravel. They have been and will probably continue to be the principal water-bearing beds on the island, because of their widespread occurrence and the fact that in general they are probably more permeable than any of the other formations. In certain areas the post-Jameco beds are underlain by fine sand and clay, which generally are not abundantly water-bearing and below which oc- curs the Jameco gravel. Where this gravel is well developed it is gener- ally permeable and a good water-bearing formation. However, it is not nearly as widespread as the other water-bearing beds, and the total quan- tity of water pumped from it is somewhat less than from other formations. The Jameco gravel is believed to have been deposited by streams flowing from the continental glacier when it stood in Long Island Sound, and ac- cordingly this gravel is confined to areas that could be reached by such streams. It may be present along the shore at the extreme east end of the island, but that is not yet proved. In many places beneath the Jameco gravel, or beneath the post-Jameco beds where the Jameco gravel Is not present, is a series of water-bearing beds of Cretaceous age. In earlier years the Lloyd sand was the only Cre- taceous water-bearing bed definitely recognized. H rnv-eriu joara guuu supplies of water have been obtained at several places in Cretaceous beds of sand and gravel that lie several hundred feet above the Lloyd sand. For many locali- ties on Long Island the available data are not yet sufficient to subdivide the Cretaceous beds, and no effort is made to do so in the present report. Water is available from public-supply systems in practically all parts of Kings, Queens, and Nassau Counties. In these areas very little water is used from privately owned wells for domestic purposes, but in Kings County and to a less extent in Queens County large quantities of water for industrial purposes are obtained from private wells. In Suffolk County public water-supply systems are confined to the more thickly settled territories in or very near to the villages, and a rela- tively large percentage of the population obtain domestic water supply from, individually owned wells. In both Nassau and Suffolk Counties very little ground water is used for industrial purposes, but a comparatively small quantity of water is used for irrigating truck crops. Within the part of New York City on Long Island, comprising Kings end Queens Counties, water for public supply is furnished largely by the city, but large ireas in these counties are served chiefly by two private water companies. The greater part of the water served to New York City is obtained from upstate surface sources, including the great Cat skill system. However, the quantity of ground water served to the Long Island part of New York City is of considerable magnitude,, In the population of Kings and Queens Coun- ties was about 3,,, and the total consumption of water for public supply was about ,, gallons a day. Of this amount about ,, gallons a day, or more than 33 percent, was derived from ground-water sources. On this basis it is estimated that in almost 1,, people in the Long Island part of New York City used ground water. The quantity of ground water used for public supply in New York City varies somewhat from year to year, depending largely upon the abundance or scarcity of surface water from the upstate sources. Prom to , with the ex- ception of two years, more than 50 percent of the ground water served by New York City in Kings and Queens Counties came from Nassau County. In some of the years the percentage was considerably more than 50 percent. In Nassau County the population dependent on ground water for public supply in was about ,, and in Suffolk County it was about , Water from privately owned wells is extensively used for industrial purposes In Kings and Queens Counties. Unfortunately it has not been pos- sible to compile accurate data for pumpage from private wells, because such information is widely scattered, and adequate records are lacking. On the basis of a comparison with records of industrial employment, T. These figures do not incliide any estimate for the compara- tively small withdrawals from privately owned wells in Nassau County. For some of the smaller water supplies in Nassau County, where no such records were available, it was necessary to estimate the withdrawals. Only about 12 percent of the total withdrawal in Nassau County from to by public supply systems not owned by Hew York City was estimated, and the average daily pump age estimated ranged from about 6,, gallons in to about , gallons in In other words, of the total daily withdrawal for public supply in Kings, Queens, and Nassau Counties from to , ranging from 50,, to ,, gallons, only about , to 6,, gallons had to be estimated. Thus it is apparent that the probable error resulting from estimates amounts to only a small percentage of the total given. The withdrawals in Nassau County from to by public supply systems not owned by Hew York City are wholly estimated. Hot York, Paper , p. Paper 44, pp , The year by year withdrawals by these two systems in Queens County show a gradual and regu- lar increase during this period. Although the estimates of withdrawals from to determined by this method are not accurate, they probably give a fair approximation. In any case these quantities are small and do not materially affect the totals. In early years and to a less extent in recent years considerable water for public supply has been withdrawn from ponds, chiefly in Nassau County, by New York City. Strictly speaking, the water in ponds and lakes is sur- face water in that it occurs on the surface of the earth. The ponds and lakes receive all the direct surface run-off from their drainage basins ex- cept as such water is diverted around them. However, surface run-off is small on Long Island as compared with many other localities, and much of the water in the lakes and ponds is ground water that seeps Into them. It has been pointed out by earlier workers that these ponds and lakes may be considered huge open wells, because they extend below the water table, and water withdrawn from them is in reality largely ground water. In the surface run-off entering the Hempstead storage reservoir, one of the chief sources of pond water, was diverted around the reservoir, and since that date essentially no surface run-off has entered the reservoir. Although it is recognized that the water withdrawn from ponds is in large part ground water it has seemed desirable to show the pond-water withdrawals by a different pattern in some of the accompanying illustrations. Most of the ponds from which water has been withdrawn are located in the so-called Ridgewood system, in the southern part of Queens and Nassau Counties. The water from most of these ponds flows by gravity Into a conduit that extends closely parallel to the Montauk branch of the Long Island Railroad from a point near the eastern boundary of Nassau County to the Ridgewood pumping station, In eastern Eings County. In the present study these records were used to com- pute by the submerged orifice formula the gravity discharge from ponds. The computations were made for Massapequa, ffantagh and Freeport East Meadow Ponds and the Hempstead storage reservoir, These ponds are the only ones from which appreciable quantities of water were withdrawn by gravity. The water from some of the ponds is pumped to the con- duit , and the records of this pump age are of course included in the figures given for total pond withdrawal. The amount of water withdrawn at the pumping stations in the Ridgewood system was determined by the pump-displacement method. The deter- mination of pumpage in this way is subject to considerable error, as well as to considerable variation In the degree of error from time to time as the pumps are repacked. If the records were accurate, the sum of the with- drawals from the pumping stations along the conduit and the gravity dis- charge from the ponds should represent the total withdrawal from the Ridge- wood sTstem. The water delivered to the distribution system, how- ever, Is measured by venturi meters at two booster stations, and frequent- ly these records do not check with the sum of the records of the pumping stations and gravity ponds. This is doubtless due to inaccuracies in com- puting the withdrawals from the pumping stations and gravity ponds, to loss or gain by leakage along the conduit, to changes in conduit storage, etc. The figures given In this report, so far as they concern withdraw- als by New York City in the Ridgewood system, are based on venturi -meter records. The difference between these records and the sum of the records of the pumping stations and gravity ponds has been dis- tributed on a percentage basis between the ground-water withdrawals and the pond withdrawals. Thus the total height of the columns In figure 1 is fairly accurate, but the position of the boundaries between the bars representing pond water and ground water is less accurate. The pond withdrawals represented, however, are believed to show the general order of magnitude and permit fairly accurate year by year comparisons. At erne time or another during the 31 years to many differ- ent public water-supply units have been operated In numerous localities. Some of these pumping units consist of groups of a few to many wells that are pumped, by a central suction P ump. Other units consist of only one well pumped by an Individual pmnp, still others con- sist of infiltration galleries pumped from a central well. At different times during the year period Hew York City operated a total of 48 ground-water pumping units- 5 in Kings Comity, 30 in Queens County. The total withdrawal In the three counties for public supply has varied considerably from year to year, owing largely to variations in the use of ground water to meet the defi- ciencies in the upstate surface-water sources. City system Other systems Total N. City system Other systems Total i gn Q 1. City system Other systems Total York City o. However, in the withdrawal of ground water by the city again began to increase and in a secondary peak was reached. In February more upstate surface water was made available by the delivery of Schoharie Creek water through the Shandaken tunnel. The de- mand for Long Island ground water therefore decreased somewhat during and , but In another secondary peak was reached. Additional upstate surface water was again made available by the completion of the Schoharie reservoir in The demand for Long Island ground water again decreased, but in a major peak was again readied, undoubtedly owing in part to the drought of The downward trend from to was perhaps in part the result of the depression and no doubt in part due to more normal precipitation and the availability of greater quanti- ties of upstate surface water. Figure 2, in which the withdrawals by lew York City are plotted separately, shows the trends just described in more detail. These same trends are likewise apparent in the grapiis showing the withdrawals in each of the three counties, particularly in Nassau Councy. It is worthy of note that in the earlier years withdrawal from ponds in Nassau County gradually decreased at about the same rate as the pumpage from wells and galleries increased. It should be kept in mind that the graphs accompanying this report do not include industrial pumpage. In figure 2 the withdrawals from these stations prior to this change of ownership are Included in the columns for systems not owned by New York City, and the withdrawals after this change are in- cluded in the columns for New York City. The withdrawals from these sta- tions in averaged about 10,, gallons a day and in less than 6,, gallons a day. If this change of ownership had not taken place the and columns for withdrawal by New York City in Queens County, as shown in figure 2, would have been smaller and the columns for other water-supply systems would have been larger. Thus the transfer of. Other changes of ownership have taken place, but they involved only small quantities of water. The major trends as shown in figure 1 are caused by variations in use of upstate surface water by New York City. In figure 2 the with- drawals by New York City show in greater detail the effect of variations in use of upstate surface water. As noted on page. During , , and Hew York City used a very small amount of Long Island ground water , but thereafter its withdrawals considerably increased, varying chiefly with the availability of upstate surface water. New York City has withdrawn very little ground water from Kings County since Cat skill water became available, but in Queens and Nassau Counties its withdrawals have been large, particularly In and The withdrawals by water-supply systems not owned by New York City show a year by year trend unaffected by variations in use of upstate sur- face water.

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3: Search Results - "Nassau County, New York"

*Public-supply pumpage in Kings, Queens, and Nassau counties, New York, (SuDoc I) [Anthony Chu] on www.enganchecubano.com *FREE* shipping on qualifying offers.*

New York City obtains about 99 percent of its freshwater from a surface-water system. The supply could run short, however, during a prolonged drought or as a result of a system malfunction. The coastal-plain aquifers are recharged by abundant precipitation and currently provide about 1 percent of the total supply for New York City. In , the U. This abstract summarizes the coastal-plain aquifer system, describes the model and the initial conditions, and presents some results of interface-movement scenarios. The ground-water system on western Long Island Brooklyn and Queens consists of four unconsolidated aquifers and two confining units and is underlain by gently southward sloping impermeable bedrock fig. The bedrock crops out in the northwest, is about m below sea level in the southeast along the south shore, and about m below sea level in the southwest along the south shore. The sequence of unconsolidated deposits, from the bedrock upward, consists of the Lloyd aquifer, the Raritan clay, and the Magothy aquifer, all of Cretaceous age, and the Jameco aquifer, the Gardiners Clay, and the upper glacial aquifer with outwash and moraine zones , all of Pleistocene age. These six units vary in thickness locally and pinch out in some areas Smolensky and others, At several locations, the Gardiners Clay contains erosional holes that provide vertical hydraulic 1 connections. The water table is mostly in the upper glacial aquifer. The response of the seawater interface to the sea-level rise since the Pleistocene has been delayed by hundreds to thousands of years in the Lloyd aquifer beneath the Atlantic Ocean as a result of confinement by the overlying Raritan Clay Meisler and others, Pumping during the midth century caused increased salinity in water pumped from wells screened in the upper glacial, Jameco, and Magothy aquifers and necessitated the shutdown of all public-supply wells in Brooklyn in Soren, Inflows to and outflows from the aquifers are currently near steady state. About half of the annual precipitation 1. Natural outflow occurs mostly near the shore, but partly as freshwater seepage to ponds and streams and as subsea discharge. The water supply that is piped from upstate surface-water reservoirs discharges to the sanitary-sewer system, bypassing the ground-water system. The New York City MODFLOW models used fixed no-horizontal-flow boundaries in combination with vertical leakage across confining units into constant-head boundaries to represent seawater interfaces. The SHARP models provided only a limited physical mechanism to represent movement of seawater interfaces in response to pumping. A raster format was used to store hydrogeologic and hydrologic data at a resolution of 30 m to match available satellite imagery. Raster-formatted data were interpolated onto points corresponding to finite-element meshes; these point-wise data were then imported into a graphical user interface for SUTRA. Specified flux was used to represent the ground-water recharge mechanism. Five distributions of recharge were prepared to correspond to rates under the following conditions: The predevelopment period was assigned a uniform recharge distribution of 0. The simplified historical stages were represented by two zones that change historically in size and shapeâ€”an undeveloped zone, which was assigned a recharge rate of 0. The current-conditions distribution of recharge 2 was based on satellite imagery. The drought-simulation period entailed a scalar reduction in the current-conditions distribution. Pressures at sea-floor nodes were calculated from NOAA bathymetric data http: A no-flow boundary was used to represent the model bottom bedrock. A graphical user interface facilitated rediscretization through a one- step interpolation process that allows the model results to be used as initial conditions for a later run with a different mesh fig. Meshes were designed with varying grid density to represent: The dimensions of all of these meshes were designed to meet the requirements of being small enough to be held in RAM, yet large enough to minimize element sizes and provide the greatest accuracy. The meshes each consisted of about 70 layers of 2, elements, and each element represented an average area of about 2. Ten layers were needed to represent convection flow patterns in each hydrogeologic unit fig. Time discretization of model runs also varied, depending on the purpose; the maximum time step in the simulation of sea-level rise did not exceed 10 yr, and simulations of manmade stresses pumping generally used 0. The position of the seawater interface in the Lloyd aquifer and Raritan Clay still reflects the lowered sea level of the Wisconsin glaciation, about 10, years ago. Exploratory SUTRA simulations were conducted to investigate the post-glacial interface movement and to generate initial conditions for pumpage-evaluation runs that start at the present and allow the interfaces to move slowly landward. Runs that started with a model domain saturated completely with freshwater and applied time-invariant boundary conditions corresponding to current sea level did not approach inferred current interface positions within a 10,yr post-glacial period; they took much longer. Therefore, simulation of pre-glacial conditions may also be required. Furthermore, the inferred current interface configuration was never reached during these simulations. One explanation for this is the presence of holes in the Gardiners Clay, which are slightly below the present sea level and thus become exposed to seawater at some undetermined time leading up to the present as sea level rises. The arrival of the rising sea at a Gardiners Clay hole opens a new path of least resistance for density-driven downward flow of seawater. The rate of sea-level rise is uncertain, however, and this process cannot be represented by time-invariant boundary conditions in which sea level is fixed. Finally, an analysis was done to calculate rates of interface movement in a pre-development simulation, with current sea level, in which the interfaces were started at their inferred current position. Only the interfaces in the Lloyd and Raritan moved significantly and it can be assumed that the interfaces of the Magothy, Jameco, and upper glacial aquifers are at steady state at the current time. The urbanization period was then simulated and 3 provided results that were satisfactory as initial conditions for the pumpage-evaluation runs. Parameters were adjusted during a sequence of about 50 model calibration runs to attain the best match of simulated pressures and concentrations to field data. Final values of the most sensitive parameters are as follows: Except for the upper glacial aquifer, hydraulic properties of hydrogeologic units are uniform, and entail extrapolation to the offshore part of the model domain, where little data was available to calibrate against. The drought-emergency reactivation scenario entailed rehabilitating wellfields that were taken out of service and replaced by surface-water supply. Each of these wells is screened in either the Magothy, the Jameco, or the upper glacial aquifer. The location of the seawater interface in the Lloyd aquifer is not critical for this particular simulation, but other scenarios are being considered that involve new wells in the Lloyd aquifer. Areas with a potential for seawater intrusion were identified through an analysis of contours of change in solute-mass fraction from current conditions to the simulation result after 2 yr of pumping fig 5 and fig 6. The pumping period was limited to 2 yr because longer periods resulted in landward water table gradients from the coast to the pumping wells. The shortest distance between an area with significant intrusion potential and a pumping well exceeds 3 km; therefore, the risk of well contamination within 2 yr of supplemental pumping is small. Geological Survey Professional Paper , 49 p. P, and Knobel, L. Geological Survey Water-Supply Paper , 28 p. Geological Survey Open-File Report , p.

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4: Full text of "Withdrawal of ground water on Long Island, N.Y."

Average daily withdrawals of water for public supply in Kings, Queens, and Nassau Counties, New York Open-File Report In cooperation with the New York Water Power and Control Commission, Nassau County Department of Public Works, Suffolk County Board of Supervisors, Suffolk County Board of Supervisors, Suffolk County Water Authority.

Page Share Cite Suggested Citation: The National Academies Press. It has a total area of about mi2 and is mi long by up to 20 mi wide. It includes the counties of Kings and Queens in New York City, which have been population centers for centuries; Nassau County, which grew in population remarkably from the s to about ; and Suffolk County, where population growth has been rapid since the s. The island developed slowly for the first three cen- turies after European settlement in the seventeenth century. The principal use of the land east of New York City was ag- ricultural. Following World War II the rate of suburban de- velopment increased, and in this expansion a great deal of farm and estate land changed to housing, light industrial, and com- mercial development. Fresh groundwater stored in unconsolidated sand aquifers underlies virtually the entire island. Kings and part of Queens Counties are supplied with water by sources outside the island, but the remainder of the island relies on this groundwater reservoir. Although an abundant supply of groundwater made development possible anywhere on the island, the effect of discharges in and on the ground has affected the water quality. Nonpoint contamination is nearly island wide because urbanization and agriculture have both contrib- uted to the problem. These deposits are underlain by crystalline bedrock of very low permeability. Over most of the island these unconsolidated deposits contain freshwater down to the bedrock. The top of this groundwater reservoir is overlain by glacially related de- posits that are mostly of high permeability. Overall the unconsolidated sediments can be separated into four aquifers and two confining beds Figure 9. The Lloyd aquifer overlies bedrock that is the bottom of the groundwater reservoir. The Lloyd ranges in thickness from about ft in the north to about ft along the southern edge of the island, where it is about ft below the surface. The Lloyd aquifer is overlain by a confining layer of about ft of silty and solid clay and sand, called the Raritan clay. The Lloyd aquifer is not extensively used areally but is im- portant for some south-shore communities as it is their only source of freshwater and, being at the bottom of the system, is least altered by contaminants from above. Freshwater is found in the Lloyd throughout the main part of the island; however, freshwater encounters saltwater near the periphery of the island or offshore. The interface on the southern side of the island is seaward of the shore but curves inland in the vicinity of the island7s north and south forks. The Magothy aquifer overlies the Raritan clay confining beds and currently is the most heavily pumped water-bearing unit on the island. It is up to ft thick along the south shore and about ft thick along the north shore. As the aquifer thickens toward the south shore, the transmissivity in the southern part of the island is about twice that of the northern part. Details of the saltwater-freshwater interface in the Ma- gothy are known only in southeastern Queens and southwest- ern Nassau Counties, where it is landward of the ocean. In the remainder of the south shore it lies seaward of the barrier beaches Lusczynski and Swarzenski, The extent of the part of the fresh groundwater reservoir seaward of the land is unknown and could be sizable. The Jameco aquifer, composed mainly of sand and gravel, overlies the Magothy locally on the west end of the island and along the north shore. The Gardiners clay and the ft clay are important confining beds of up to ft in thickness McClymonds and Franke, separating the Magothy and lameco from the overlying upper glacial aquifer along the south part of the island. The upper glacial aquifer covers the surface of the island and consists largely of those deposits left by the latest episodes of glaciation. It consists of moraine and outwash deposits of sandy, gravelly character. Under natural con- ditions, the reservoir of freshwater underlying the island moves from the water table downward and outward through the res- ervoir to discharge around the periphery of the island by streams, by subsurface flow into bays and saltwater bodies surrounding the island, and by evaporation. Streams are an important groundwater discharge about 40 percent of the recharge to groundwater discharges through streams Cohen et al. In nonurbanized areas where runoff is not channeled directly into the stream and the water table has not been artificially lowered, about 90 percent of stream flow is derived from groundwater. Consequently, the quality of shallow ground- water in a stream basin is reflected in the base flow of the stream. This feature has been used by some to evaluate the effect of mitigation measures on the water quality. Beginning in the s stormwater recharge basins were used extensively in Nassau and Suffolk Counties as a measure to facilitate the recharge of water and to dispose of storm runoff. Street runoff is funneled into these basins, where it percolates down to the water table. The effect of these basins on the quality of ground- water has not been studied in detail, but de-icing salts applied to highways and streets must yield some amount of soluble ions such as chloride in the recharge water. Although the dan- ger exists for contamination to enter the groundwater system, the basins have not been found to contribute significantly to pollution. About 50 percent of this was from Nassau County, an area somewhat less than one quarter of the island. Most of the pumpage is from wells screened from to ft below the surface in the Magothy aquifer. Groundwater is the sole source for freshwater in Nassau and Suffolk Counties and was so designated by the U. It also has a low pH and, sometimes, a bothersome iron content Franke and McClymonds, , p. Dissolved materials consist mostly of sodium, potassium, magnesium, chloride, sulfate, carbonate, and bicarbonate. Ni- trate-nitrogen concentration is less than 0. A well-known example of this occurred in Kings County Brook- lyn between about and when overpumping caused encroachment of salty water. Groundwater encroach- ment in previous freshwater environments resulted in chloride and TDS content sufficient to render them unpotable. As other sources of public water were available for Brooklyn, withdrawal for public supply ceased. Public supply pumpage in southern Queens County, which averages about 60 mad, continues to cause a sizable, below- sea-level depression in the water table. Although Soren reported some encroachment of freshwater by salty water in other parts of Queens County, seawater has not been a con- taminant for these wells. Contamination from above as opposed to saltwater encroachment from the side has been a major problem. In southeastern Queens and southwestern Nassau Counties, Lusczynski and Swarzenski defined three wedges of salty water in the Magothy and above-lying deposits; the deepest of these lies along the base of the Magothy aquifer and threatens Nonpoint Contamination of Groundwater southwest Nassau County supply wells that are screened near it. However, movement of the entire wedge was not mea- surable from to Cohen and Kimmel, The effect of the withdrawal of even mad in Nassau County produces a very slow movement of the saltwater wedge. This movement will continue as pumpage exceeds recharge. Further east from the middle of the south shore of Nassau County, the saltwater-freshwater wedge in the Magothy lies offshore. It returns to shore in central Suffolk County, off the Hampton Bay area. In the Lloyd aquifer, the interface is off- shore in the southwestern part of the island. In one location on the south shore of Nassau County, salty water has not been encountered after perhaps 40 yr of pumping with hydraulic pressures in the aquifer below sea level. These features suggest that a considerable quantity of fresh, virtually uncontaminable water lies beneath and off the south shore of the central part of the island and could still be considered for development should costs for treatment of contaminated water further into the island become excessive. The full extent of the freshwater south of the island is unknown. Nitrate is soluble with respect to groundwater and con- servative nonreactive in regard to sorption. The widespread use of individual waste-disposal systems e. The use of these systems as urbanization spread eastward on the island contributed a major load of nitrate as well as TDS, sulfate, and chloride. Sewerage, which began in Brooklyn about , moved eastward over the island, somewhat behind pop- ulation growth. Most of Nassau County was only recently sew- ered after about 30 years of urbanization. In the later part of the s the nitrate content of streams draining urbanized portions of Nassau County contained 14 times more nitrate than urbanized portions of Suffolk County Koch, The earliest source of widespread NO3 contamination may have been the use of manure fertilizer on farmland in the nineteenth and early twentieth centuries. Nitrogen fertilizers are still an important source of nitrate in groundwater in both urbanized and agriculture areas. A surprising amount of this, tons, is estimated to come from fertilizers, principally lawn fertilizers; other sources are individual waste-disposal systems, exfiltration from sewers, recharge basins, animal pet wastes, rainfall and runoff, land- fills, and sewage treatment plants. Although nitrate from individual waste-disposal systems was found to be a significant source of the total N load in Nassau County, according to Ragone et al. Landfills, a point source, contribute extensive areas of nitrate contamination if located far enough into the island, and the reduced form of nitrogen, ammonia, is oxidized to nitrate. Environmental Protection Agency, ; consequently, this forms a basis for rejecting water for potable purposes. In recent years nitrate concentra- tions greater than this have been found in many parts of Long Island. The depth of nitrate penetration in the aquifer system in Nassau County was examined by Perlmutter and Koch , Ku and Sulam , and Ragone et al. They found alterations of pristine-quality water extending to the base of the Magothy aquifer, some to ft below the surface in the center of the island. Nitrate contamination follows the regional flow of groundwater in the system and, in the Magothy aquifer, extends about halfway between the central part of the island and the south shore. Concentrations greater than 6. It was concluded that nitrogen came from exfiltration of sewers. Except in areas of point-source contamination, heavy metals have not been found in appreciable amounts. Contam- ination from metals is not a nonpoint problem. Concentrations of arsenic, barium, cadmium, chromium, lead, mercury, and silver were not found to exceed EPA standards but in some cases may be above that of background concentrations. Copper, which can be dissolved from household plumbing and flushed through septic and cesspool systems, is widespread in urban- ized areas but has not been found to exceed 0. In , 13 public supply wells screened in the upper glacial and Magothy aquifers in southeastern Queens County con- tained SOC; 6 of the 13 were closed. Trichloroethylene and tetrachloroethylene were the main organic chemicals present. In a Nassau County Department of Health survey dis- closed that at least , gallons of SOC, principally solvents and cleaning fluids, were used there. Many of these chemicals are deposited directly into individual disposal systems and in- filtrate to groundwater. In about 58 mix of densely pop- ulated, unsewered area remained in Nassau County. In that year, the county estimated that 67, gallons of cesspool cleaner and the like were sold locally. Evaluation of the cleaner found that over 80 percent was composed of aromatic and halogenated organic solvents. Petroleum distillates make up the remainder of the cleaner. A survey of the distribution of SOC in the upper glacial aquifer Koppelman, found the chemicals widespread. Although this aquifer is little used for public supply, it feeds the Magothy with contaminants as a result of the recharge relation between the upper glacial and Magothy aquifers. Past use and disposal of SOC can be expected to cause similar problems in Suffolk County, where sewerage is less extensive. These chemicals are synthetic detergents added largely through the discharge of individual waste-disposal sys- tems, but leaking sewers and sewage waste disposal in landfills are also contributors. Coin-operated laundries in unsewered areas are large contributors and initially drew attention to the problem. Initially, the synthetic detergents industry used alkyl ben- zene sulfonate ABS. This compound was found to persist in the environment, which led to the use of biodegradable linear alkyl sulfonate LAS in ; however, under anerobic con- ditions, even this compound may persist.

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