Urbanization and Its Effect on the Temperature of the Streams on Long Island, New York

By EDWARD J. PLUHOWSKI

HYDROLOGY AND SOME EFFECTS OF URBANIZATION ON LONG ISLAND, NEW YORK

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Thermal patterns of five streams on Long Island, N.Y., are defined and analyzed

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SYMBOLS

a	Empirical parameter
b	Empirical parameter
C_b	Empirical parameter
E	Evaporation
F	Forest cover
ϵ, e_a	Vapor pressure of air
ϵ_0, e_w	Saturation vapor pressure of water-surface temperature
ϵ_t	Vapor pressure of air 8 meters above the surface
K	Thermal conductivity of the bed material
k	Empirical parameter
J	Heat-conversion constant
L	Latent heat of vaporization
ly	Langley, 1 gram calorie cm^{-2}
l	Length of reach
n	Cloud cover
P	Atmospheric pressure
Q	Stream discharge
Q_a	Atmospheric radiation
Q_{ao}	Clear-sky atmospheric radiation
Q_{ar}	Reflected atmospheric radiation
Q_{bw}	Long-wave radiation emitted from the water surface
Q_e	Evaporative heat flux
Q_f	Forest radiation
Q_{fh}	Fluid-friction heat
Q_{fr}	Reflected forest radiation
Q_{gw}	Advected heat from ground water
Q_h	Convective heat loss to or gain from the atmosphere
Q_{hb}	Energy conducted to or from the streambed
Q_{in}	Advected heat conducted into reach by streamflow
Q_{net}	Net radiation
Q_{out}	Advected heat conveyed out of reach by streamflow
Q_r	Reflected solar radiation
Q_s	Solar radiation
ΔQ	Net change in stored energy
R	Bowen ratio
s	Water-surface slope
T	Absolute air temperature
T_a	Air temperature
T_{gw}	Ground-water temperature
T_0	Water temperature
t, Δt	A unit of time
U	Average wind velocity
U_8	Average wind velocity 8 meters above the surface
z	Depth below stream
ϵ	Emissivity
ω	Specific weight of water
ρ	Density of evaporated water
σ	Stephan-Boltzman constant

URBANIZATION AND ITS EFFECT ON THE TEMPERATURE OF STREAMS ON LONG ISLAND, NEW YORK

By Edward J. Pluhowski

ABSTRACT

To isolate and evaluate the effect of man-imposed changes on stream temperature, the thermal patterns of five streams on Long Island, N.Y. are defined and analyzed. Included is a control stream (Connetquot River), the upper part of which is virtually in its natural state. Urban development on the remaining four drainage basins ranges from slight at Swan River to nearly complete at East Meadow Brook. All five streams are similar in most other aspects, owing to fairly uniform geologic and climatic conditions.

Modifications of the natural environment of streams due to man's activities have increased average stream temperatures in summer by as much as 5°–8°C (Celsius, or centigrade). Concurrent temperature differences between sites along the same stream of as much as 8°–10°C have been observed in summer on days of high solar output. These large temperature differences are ascribed to a variety of urban factors, including the introduction of ponds and lakes, clearcutting of vegetation from streambanks, increased storm runoff to streams, and a reduction in the amount of ground-water inflow. By way of contrast, winter stream temperatures in man-affected reaches average about 1.5°–3°C lower than in unaffected reaches. During the spring and fall, changes in thermal patterns due to man's activities are minimal and barely identifiable. Analysis of variance tests indicate that the observed temperature patterns among the five study streams are significantly different during the summer.

The introduction of large quantities of storm water into watercourses from urbanized areas in Nassau County and southwestern Suffolk County may, under some meteorologic conditions, sharply alter stream-temperature patterns. Mixing of relatively large quantities of storm-water runoff with streamflow during August 25 and 26, 1967, raised temperatures 5.5°C at an upstream site on East Meadow Brook and 8.5°C at Swan River. The impact of stormflow on thermal patterns diminishes downstream as the ratio of direct runoff to total streamflow decreases.

On-site observations at Connetquot River show that shading along this stream may reduce incoming solar radiation by as much as 70 percent. Wide seasonal variations in the ratio of actual solar energy absorbed to maximum possible were observed at three sites under varying degrees of forest cover. Energy-budget analyses on Connetquot River shows that short-wave (solar) radiation and ground-water seepage are among the most important heat sources controlling the thermal patterns in Long Island streams. These particular energy sources are also most amendable to change due to man's activities. Modifications in the natural environments of streams may be assessed by the energy-budget techniques that were used to predict temperature changes at Connetquot River.

INTRODUCTION

BACKGROUND, PURPOSE, AND SCOPE OF THE WATER-BUDGET STUDY

Long Island, which extends from the southeastern part of the mainland of New York State eastward about 120 miles into the Atlantic Ocean, has a total area of about 1,400 square miles (fig. 1). Two boroughs of New York City (Kings and Queens Counties) occupy slightly less than 200 square miles of the western part of the island, and have a combined population of more than 4.5 million people. Nassau and Suffolk Counties have areas of about 290 and 920 square miles, respectively, and had a combined population of about 2.3 million people in 1965.

Although the New York City part of Long Island derives most of its water supply from upstate surface-water sources, Nassau and Suffolk Counties derive their entire water supply from wells tapping the underlying ground-water reservoir. Because of present large demands on the local ground-water system, particularly in Nassau and Suffolk Counties, and because of the prospect of increased demands as Long Island continues to rapidly develop, knowledge about the hydrologic system—with special emphasis on water conservation and management—is a matter of vital concern to the present population and to the millions of people who will depend on the island's water resources in the future.

Considerable information is available about the water resources of Long Island as a result of studies made during more than 30 years by the U.S. Geological Survey in cooperation with New York State and county

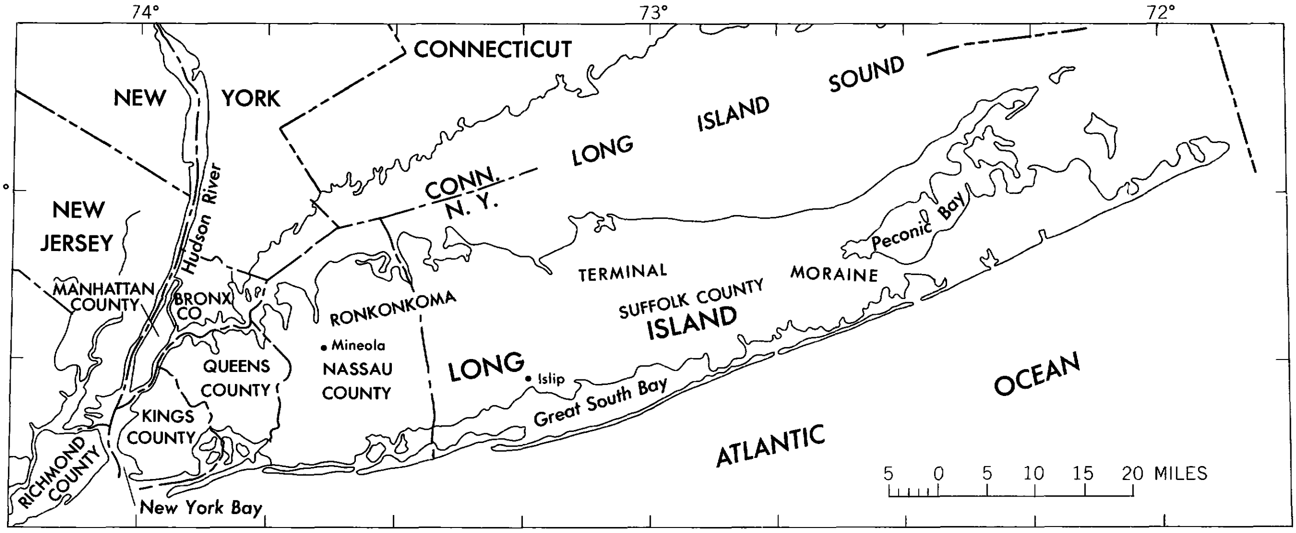

FIGURE 1.—Location and general geographic features of Long Island.

agencies. Although those studies meet many of the needs for information on specific problems and areas of Long Island, better quantitative information about the islandwide hydrologic system, and the relations between the various components of the system, is needed for water-management purposes.

The major objectives of the water-budget study are (1) to summarize and interpret pertinent existing information about the hydrologic system of Long Island and (2) to fill several gaps in the knowledge of the hydrologic system. The results of these studies are being published in a series of coordinated reports. The present report, which was supported entirely with Federal funds, was not prepared as part of the water-budget study. However, it is included as a chapter in this series because the subject matter compliments and expands on information presented in the water-budget study.

PURPOSE AND SCOPE OF THIS REPORT

Man's tendency to cluster in urban environments, particularly during the past several decades, is probably the single most important factor governing the regimen of streams in recent geologic history. Widespread alterations in the natural environment have sharply reduced the infiltration capacity of soils, thereby increasing storm runoff to streams in many urban areas. Not only has the volume of runoff increased, but there has been a reduction in the arrival time of runoff to watercourses. The combination of these factors has generated sharply higher flood peaks in most streams that drain urban areas. In addition, man has greatly increased the sediment load that streams must carry. Sediment yields of streams in urban environments have often increased twentyfold above natural conditions shortly after the arrival of bulldozers and draglines.

The water quality of streams has been altered further by the discharge of pollutants into watercourses. In particular, the thermal patterns of many streams have undergone wide changes with the advent of powerplants and large dams. Owing to the rather obvious dangers of heated water to the ecology of streams, increased attention has been given recently to the problem of thermal pollution. Far less obvious, but nevertheless real, are the effects on stream-temperature patterns of such factors as storm runoff, clearcutting of vegetation adjacent to rivers, relocation of channels, and the construction of recreation ponds and lakes.

This report analyzes man's impact on the temperature patterns of five streams on Long Island, N.Y. Connetquot River near Oakdale was selected as a control because of its unique unaltered environment. The remaining drainage basins have been subjected to varying degrees of urban development, ranging from slight (Swan River) to nearly complete (East Meadow Brook). Statistical comparisons employing analysis of variance procedures were used to determine the extent of the man-induced temperature changes.

A second objective of the report is to define the principal energy-budget components controlling stream temperature. A study of the heat flux to Connetquot River was prepared along with estimates of the effect of urbanization on the various energy-budget elements. The effect of altered natural temperature patterns on stream ecology was dealt with in general terms—no attempt was made to relate the consequences of thermal changes on the development of specific plants or animals.

ACKNOWLEDGMENTS

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REVIEW OF THE LITERATURE

RESERVOIR EFFECTS

Moore (1967) states that the major factors governing the effect of reservoirs on downstream water temperatures include the volume and depth of impounded water, the depth from which water is withdrawn, and the amount of release as compared to the natural or unregulated flow. The seasonal effect of impoundments on downstream temperatures was outlined in general terms by Sylvester (1963) who related the relative size of impoundments to downstream effects. He observed that large and deep impoundments will decrease downstream water temperatures in the summer and increase them in winter, if withdrawals are made below the thermocline of the impounded upstream waters. Pluhowski (1961) found exactly the opposite effect in a stream on Long Island affected by numerous shallow ponds. July temperatures were about 3°C higher than those observed in a nearby stream that had far fewer ponded reaches. January temperatures, on the other hand, were about 1.5°C lower in the ponded stream. In a study of stream-temperature patterns in the upper Delaware River basin of New York, Williams (1968) found that releases from New York City's Cannonsville Reservoir caused a drop in temperature during the summer of 14.5°C, 8.1 miles downstream, and 4.5°C, 44.3 miles downstream. Releases from Pepacton Reservoir have caused a drop of 11°C, 31 miles downstream, and of 3°C, 59.4 miles downstream. The use of reservoirs as water management tools to control stream temperatures was described by Moore (1968) who attributed higher water temperatures below Bonneville Dam on the Columbia River to operations of the Hanford Atomic Energy Plant at Richland, Wash. Owing to a cooperative intragency arrangement, releases of cooler water from two large upstream impoundments materially reduced the thermal pollution originating from the atomic plant. Jaske and Goebel (1967) state that the erection of low-head reservoirs on the main stem of the Columbia River has not produced significant change in the average temperature of the river.

ENVIRONMENT—ITS RELATION TO STREAM TEMPERATURE

The effect of climate on stream temperatures was illustrated by Collins (1925) who concluded that the mean monthly temperature of a stream at any place is generally within a few degrees of the mean monthly air temperature when the air temperature is above freezing.

The maximum water temperature in any of the warmer months is usually from 1° to 3°C higher than the mean monthly water temperature. During July, Mangan (1946) concluded that both air and water temperatures in Pennsylvania are usually at their maximum and mean water temperature may exceed the mean air temperature by as much as 4°C. The maximum daily water temperature during July will generally average 3°–4°C above the mean monthly water temperature for that month.

Geiger (1965) quotes the work of Eckel and Reuter to show the effect of river depth on summer temperature variations. Predicted temperature changes were based on the solution of a series of differential equations for four sets of inflow temperatures and river depths. At the greatest river depth, 300 cm (centimeters), the maximum daily temperature fluctuation is only about 2°C, whereas at the shallowest depth, 30 cm, the corresponding range of daily temperature was computed to be about 10°C. Eckel also found that rivers of the eastern Alps did not achieve equilibrium temperature even after flowing 100–400 km (kilometers) from their sources. On the other hand, Macan (1958) found that small streams warm up and reach equilibrium in very short distances from their sources and that their average temperature is not greatly different from that of the air.

Orientation was discovered to have an important bearing on the temperature of a stream (Moore, 1967). Temperatures in Oregon streams oriented east-west were observed to be 2°–4°C warmer during the summer than in similar streams with north-south orientation. Doubtless this discrepancy was associated with differences in absorbed solar radiation for, as Geiger (1965) shows, east-west oriented streams receive from 7 to 19 percent more sunshine than do north-south streams.

The importance of shading on stream-temperature patterns was illustrated by Macan (1958) who found that temperatures in a small stream that he studied in England fell nearly 4° C after the stream passed through a tunnel slightly longer than 100 meters. He also found temperatures to be 1.6° C lower at the end of a heavily wooded reach than at an upstream site in an open field. A reduction of 5°–6° C in the temperature of a small spring-fed stream in Wisconsin during a summer afternoon was effected by shortening the channel 67 percent and routing the water through a heavily shaded stand of willow (Stoeckeler and Voskuil, 1959).

TEMPERATURE PREDICTION

Several researchers have attempted to evaluate the temperature field below sites of heavy thermal pollution. The bulk of such studies have been concerned with the dissipation of heat below powerplants. Messenger (1963) applied the energy-budget concept to the West Branch Susquehanna River at Showville, Pa. Working with a 24-hour prediction period in a 5-mile reach, he found that the predicted temperatures were 2° C above observed temperatures. Heated discharge into the Tittabawassee River, at Midland, Mich., was studied by Velz and Gannon (1960) who computed temperature profiles for a 23-mile reach of the river. These predictions were then compared with observed temperatures over the 5-day study period at sites located 4 and 16 miles below the point of entry of the heated discharge. The predictions were within 2.5° C of mean daily observed temperature for each day of the study period at the 4-mile site. Seaders and Delay (1966) applied the energy-budget equation to Umpqua River of Oregon. They based their predictions on heat changes during periods of 5- to 7-hours' duration averaged over 10-day time spans. The method was tested under field conditions in August 1963 on Coast Fork of the Williamette River below Dorena Dam. Analysis of the data revealed poor correlation between predicted and measured stream temperatures at night (Seaders and Slotta, 1966).

Duttweiler and others (1961) found the equilibrium-temperature-theory method superior to the energy-budget analysis for prediction, owing to the simplicity of the former approach. Duttweiler (1963) developed a mathematical model to predict temperatures below a heat source by first estimating equilibrium temperatures, then computing the initial temperature increment due to thermal loading and reducing the increment exponentially downstream. A mathematical model employing the energy-budget and equilibrium-temperature theories was developed by Edinger and Geyer (1965).

Although a number of stream-temperature studies have been completed and substantial progress made in the field of temperature prediction, much more needs to be done, particularly with respect to increasing the accuracy of some of the terms in the energy budget. Very little has been accomplished to explain some of the effect of man's interference with the natural landscape on stream-temperature regimen.

GEOGRAPHY

All five study streams flow in a general southward direction draining much of south-central Nassau County and southwestern Suffolk County, N.Y. (fig. 2). East Meadow Brook in Nassau County, the westernmost stream, is only about 7 miles east of the New York City line and is within 25 miles of Manhattan. This stream drains part of the town of Hempstead, which had an estimated population in excess of 825,000 people in January 1967. The basin has undergone a very rapid population growth since 1940 when the town's population was 406,000.

Swan River at East Patchogue is the easternmost stream and lies about 33 miles from East Meadow Brook. Connetquot River near Oakdale, about 25 miles east of East Meadow Brook, was selected as a control because it flows through natural environment within a sportsman's club for practically its entire length. Champlin Creek at Islip and Sampawams Creek at Babylon drain areas undergoing rapid urbanization; these streams are, respectively, 19 and 14 miles east of East Meadow Brook. All streams, except for East Meadow Brook, are in Suffolk County.

CLIMATE

METEOROLOGIC CONTROLS

The climate of the study area may best be described as a modified continental type. Despite its close proximity to the ocean, Long Island's climate is controlled by continental air masses, owing to the prevailing west to east circulation in the upper atmosphere. The ocean's effect on weather systems over the island is, nevertheless, of considerable importance. Moisture laden storms spawned in the Gulf of Mexico or off the southeastern coast of the United States occasionally yield copious quantities of precipitation. Average annual precipitation is fairly uniform over the area, ranging from slightly less than 42 inches over north-central Nassau County to 48–50 inches near Lake Ronkonkoma. The heaviest precipitation falls along the low-lying hills formed by the Ronkonkoma terminal moraine. Precipitation is well-distributed throughout the year with the

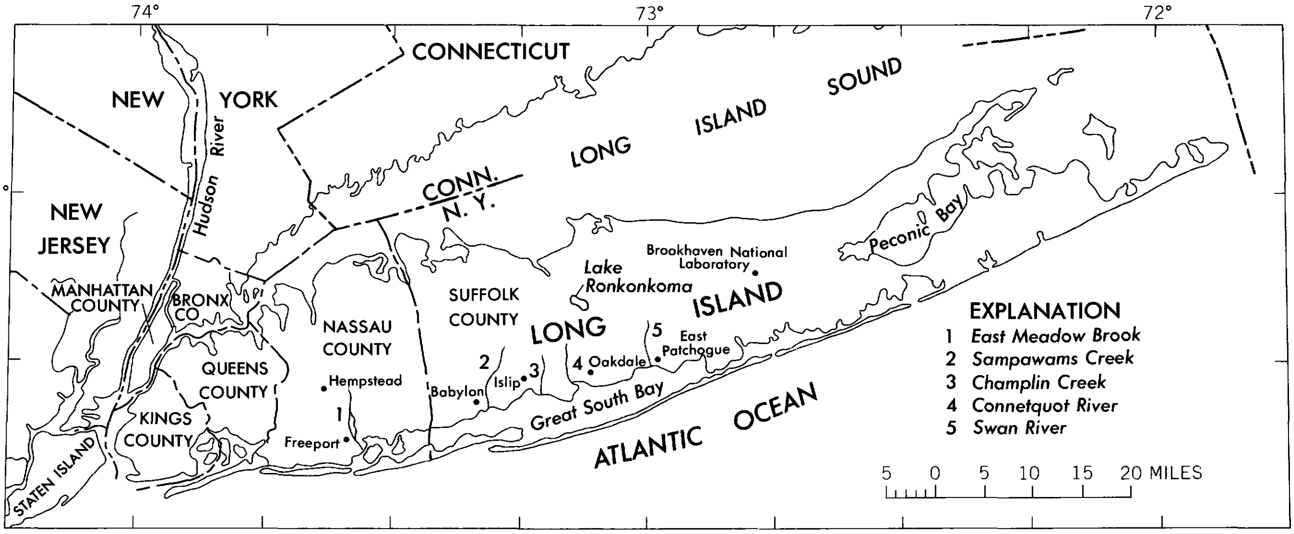

Figure 2.—Location of streams studied in this report.

heaviest generally falling in August (4–5 in.), and the least amount, in November (2–3 in.).

Mean annual temperatures on Long Island range from from 54° F in New York City to 50° F or slightly less in the cooler areas away from the coasts. The coldest month is February (28°–32° F) and the warmest, July (70°–75° F). Maritime influences on the air-temperature patterns of Long Island may be very pronounced under favorable meteorologic conditions. For example, maximum daily readings as high as 106° F have been recorded in New York City; however, temperatures very rarely reach 90° F along the barrier beaches or on the eastern end of Long Island. The moderating influence of the ocean is also exhibited in the early morning hours, when, under clear skies, temperature contrasts of as much as 15°–20° F are not uncommon between coastal and the colder interior part of the island. The large early morning thermal contrasts commonly observed under clear sky conditions are virtually eliminated under cloudy skies. Heavy continuous cloud layers effectively reduce net radiational losses from the ground by sharply limiting the outflow of terrestrial radiation.

Evaporation is a cooling process which, under favorable meteorologic conditions, may be a significant factor in reducing water-surface temperatures. As might be anticipated, evaporation losses are greatest on Long Island in summer and least in winter. Total annual evaporation from the land-pan at Mineola averages about 48 inches. Evaporation during the summer (June–August) averages about 21 inches, whereas only about 3 inches is evaporated during the winter (December–February). The amount of water one might expect to lose in a lake is estimated to be about 34 inches, obtained by applying the standard coefficient of 0.7 to the observed evaporation from the land-pan. The actual amount lost by streams is less than 34 inches, owing to the shelter from the sun's rays provided by trees, reduced wind velocities near streams, and the generally lower temperatures in streams during periods of high evaporation.

URBANIZATION AND ITS EFFECT ON CLIMATE

Superimposed on changes in the climate of Long Island induced by physical proximity to the ocean is the "city effect" created by New York City and its outlying metropolitan areas. By producing and disposing of enormous quantities of heat energy to the atmosphere, urban "heat-islands" are created around the industrialized cores of cities. Chandler (1965), by making numerous temperature traverses through London, England, illustrated a very well defined heat island at the core of that city.

To help define the combined effect of urban and physical environments on the temperature patterns of Long Island, the author made a temperature traverse on November 22, 1966, beginning at 0400 hours in New York City and ending at 0730 hours at the Sampawams Creek gaging station (fig. 3). With the exception of four observations, all readings were obtained manually by attaching a thermistor probe outside the rear window of an automobile. All windows of the vehicle were sealed with heavy tape to insure that little or no heat escaped from the interior of the automobile past the sensing element. Continuous air-temperature records were available at the four sites not visited by the author. The continuous records indicate that temperatures shown in figure 3 were within 2°F of the minimum for the day in the western part of the traverse area and just about

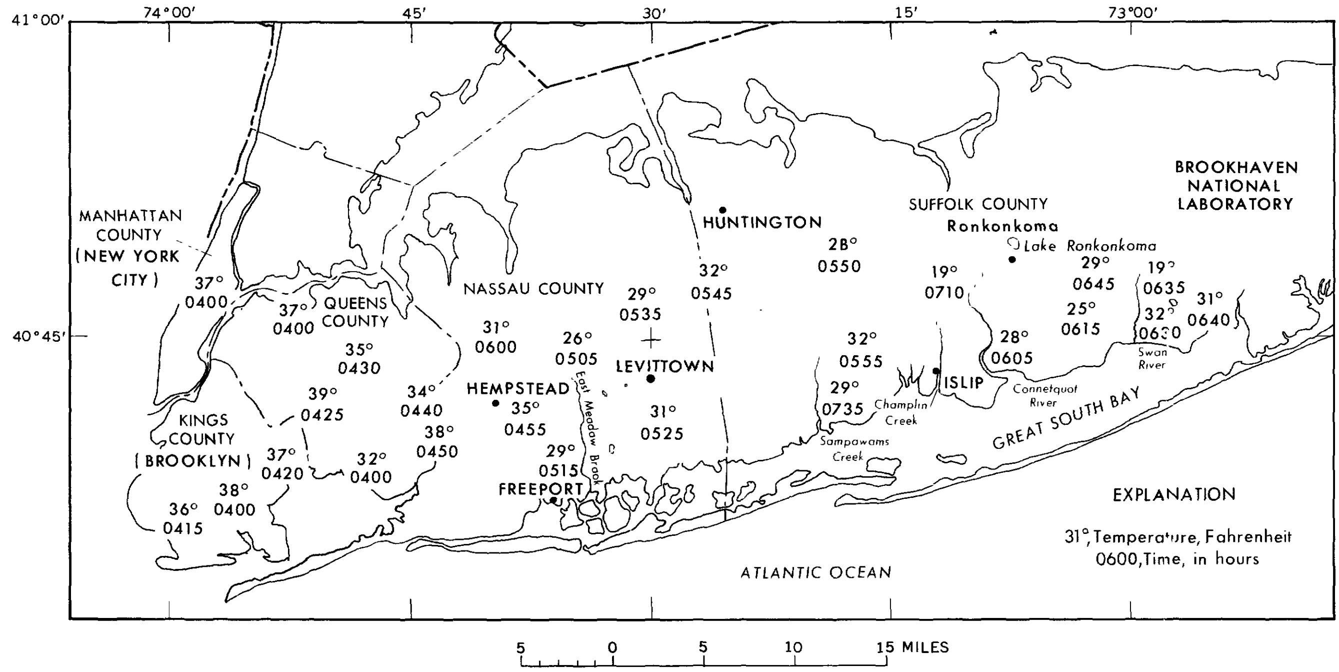

FIGURE 3.—Air temperature during the period 0400–0735 hours, November 22, 1966.

at the minimum in eastern sections. Thus, figure 3, in effect depicts a synoptic thermal field for the region surveyed.

Temperatures in Brooklyn and Queens are 3°–11°F higher than in neighboring Nassau County and as much as 20°F higher than in the colder parts of Suffolk County. Adjusting for time differences, it seems that temperatures in the urban heat island were about 3°–7°F higher than in suburban areas on the morning of the survey. Of perhaps greater importance is the very sharp thermal gradient between coastal areas of Suffolk County and some of the interior observation sites. For example, at 0630 hours at the Swan River gaging station the observed temperature was 32°F, but just a few miles inland, air temperatures as low as 19°F were observed, producing a 13°F differential. At Connetquot River the difference between temperatures at the mouth and source was 9°F. Such large air-temperature differences due to natural environmental controls could conceivably have a significant effect on the water-temperature patterns of both streams. It does not seem that the urbanized areas of Nassau County or Suffolk County have much effect on air temperatures. In general, temperature patterns appear very similar in both counties, so that there is little evidence of artificial heating.

In addition to affecting air temperature, cities tend to have increased cloudiness, fog, and precipitation, owing to the availability of condensation nuclei in the atmosphere. Landsberg (1958) reports both lower wind speed and solar radiation in cities. Chandler (1967) states that relative humidities in towns are nearly always less than in nearby rural areas. Variations in relative humidity are, of course, a function of temperature as well as the vapor content of the air. In general, the thermal control is strongest, and patterns of relative humidity usually show a close inverse relationship with temperature.

The influence of urban areas on evaporation is difficult to assess because evaporation is a function of many meteorologic parameters. Reduced wind speeds and solar radiation in cities tend to lower evaporation. On the other hand, lower relative humidities and higher nighttime air temperatures will tend to increase evaporation. Overall, evaporation in cities probably is somewhat less than that in the outlying rural areas.

Relative to the study area, it is doubtful that urban influence on climate is a significant factor in the heat budget of the streams. The climatic regimen of the East Meadow Brook basin in suburban Nassau County is little different from the four study basins in neighboring Suffolk County. Of greater significance is the microclimatic influence of the ocean, which seems to be of particular importance in the Connetquot River and Swan River basins. As previously noted, under certain early morning meteorologic situations, large air-temperature gradients are established between the nearshore and inland parts of both basins (fig. 3). However, averaged over a period of 1 week or so, it is doubtful that the local climatic vagaries introduced by location with respect to the coast could have more than a minor influence on the stream-temperature patterns of the five study streams. Thus, significant differences found among temperature patterns of the study streams cannot be ascribed to climatic variations.

HYDROLOGY

STREAMS AND PONDS

Surface-water resources have played a significant role in the growth of Long Island since it was first settled. In the 19th century many gristmills and sawmills were constructed using low head dams to develop power. A gristmill, built near the mouth of Connetquot River in 1860, still stands today at its original site. When steam and electric power came into use, gristmills and sawmills were abandoned, and now the principal use of streams and ponds is for recreation.

In the early 1900's, New York City constructed a complex water-gathering system which involved every major stream in southern Nassau County. Water-supply reservoirs were constructed, and a large conveyance tunnel was built to connect all reservoirs with the city's distribution system. A similar proposal to tap the waters of Suffolk County was defeated by foresighted local planners who envisioned the day when this invaluable resource might be required for local use. The East Meadow Ponds situated on East Meadow Brook are part of the New York water-supply system. Use of the Long Island system has largely been curtailed in recent years, although the watershed was pressed into service during the 1949–50 and 1962–66 drought periods.

In addition to the reservoirs created by New York City, recreation ponds were built along the lower reaches of practically every sizable stream on the island. The method of construction involves building a stoplog dam which may be used to raise or lower pond levels. Low earthfill dams are constructed on the flanks of the stop-log dam to complete the structure. Examples illustrating these construction features are shown in figure 4. The mean depths of most ponds is generally less than 5 feet. Several natural lakes are found in the central and northern parts of Long Island.

Throughout most of their lengths, streams on Long Island are ground-water drains which, under natural conditions, receive less than 5 percent of their flow from surface runoff. Losing watercourses are confined to streams which have impoundments large enough to reverse local ground-water gradients. Such conditions are most prevalent along the upper reaches of streams, particularly during periods of drought when the regional water table is low. At such times it is very likely that lake levels may rise above the height of the local ground-water table, thereby causing surface water to return to the ground-water reservoir.

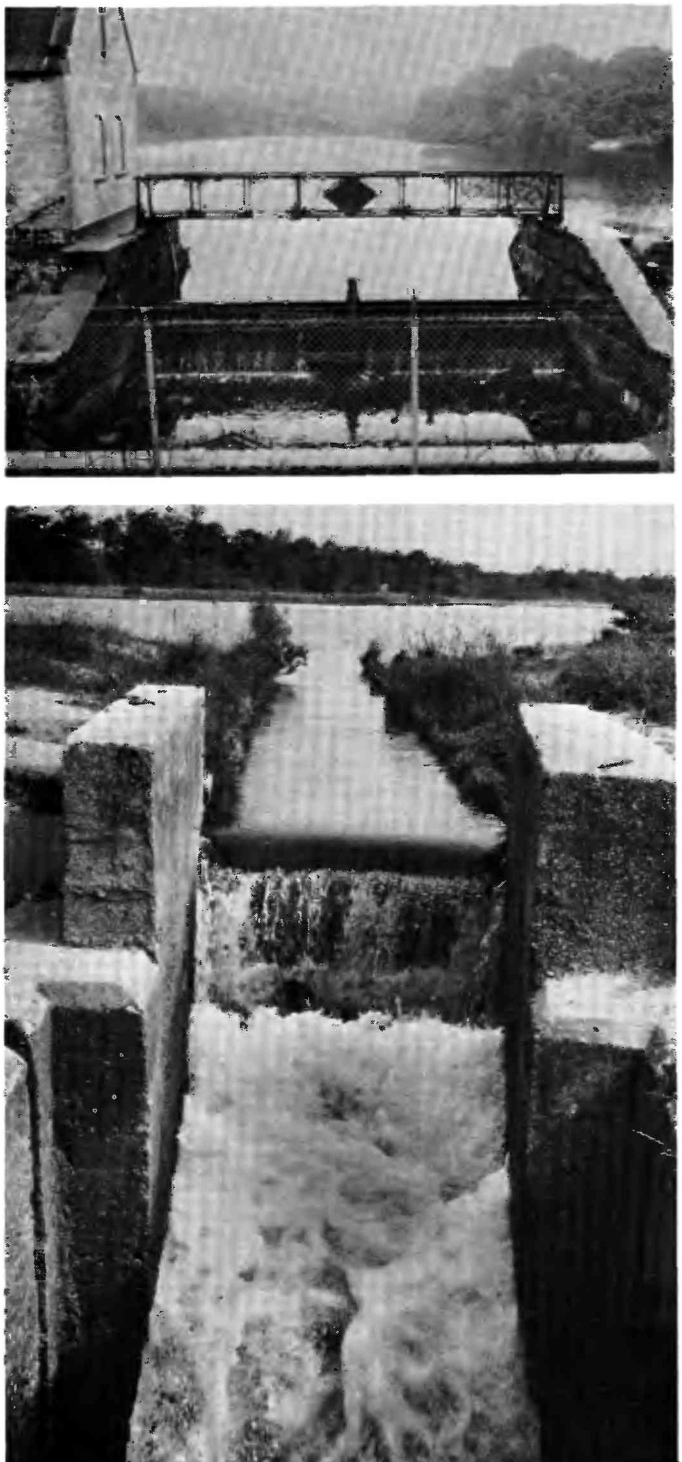

FIGURE 4.—Outlets of West Lake, East Meadow Brook (upper) and Swan Lake at Swan River (lower).

The importance of ground water to the regimen of streams on the island is shown by flow-duration curves. These curves inevitably "flatten" at low discharges, indicating substantial accretions of ground water to the stream. With the advent of rapid urbanization, large quantities of storm water have been discharged into some streams. Sharply higher flood peaks are being reported from three of the five study streams. The total volume of direct runoff contributed to streams has risen sharply—in some cases as much as fivefold.

Under natural conditions, highly permeable surficial deposits and generally low relief on Long Island combine to maintain the percentage contribution of storm runoff to total streamflow at very low levels (about 3 percent). A raindrop that falls a few feet from a stream channel would most likely percolate directly into the ground (if not first evaporated), eventually reaching the stream as ground-water inflow. Accordingly, there is usually only a casual relation at best between basin size and the magnitude of runoff in streams draining the basin. A more meaningful index of stream discharge on Long Island may be obtained by considering ground-water contributing areas. In this report the magnitude of ground-water inflow was obtained by making discharge measurements of streamflow at five sites on each of the study streams. These measurements were obtained during dry-weather periods, so that each reflects base flow conditions. Accordingly, no storm runoff is included, and the amount of ground-water inflow (pickup) between sites is obtained by subtracting measured discharge at the upstream site from that obtained at the downstream site.

Aside from the construction of ponds and storm-sewer outfalls, man has further altered the environment of streams by clearcutting trees and shrubs from streambanks. Much of this work is done in connection with home and road construction. Occasionally, the long-term effects of such changes on a stream's environment are modified by replanting of trees for beautification or shade. Parts of several streams in Nassau County have been placed underground in man-made tunnels. Several streams have been relocated in places and made to flow through concrete lined channels because of local drainage problems. A declining water table has completely dried up several streams in southwestern Nassau County. Moreover, dwindling outflow from the ground-water reservoir has markedly reduced the total volume of runoff in several streams in the more highly urbanized parts of Long Island. Last, but by no means least, the esthetic value of practically all watercourses has been reduced by debris and litter cast into streams by careless individuals.

GROUND-WATER TEMPERATURE

Collins (1925, p. 98) states that for practical purposes ground water obtained at any depth from 20 to 200 feet will have a uniform temperature ranging from about 1.5° to 3° C above the mean annual temperature. This statement is not corroborated by data obtained from several shallow wells adjacent to Sampawams Creek and Champlin Creek. Temperature data from wells indicate that under forest cover mean annual temperatures ranged from 0° to 1.5° C below the mean annual air temperature at nearby Babylon, N.Y. All wells are screened in the upper glacial aquifer at depths ranging from 3 to 60 feet below land surface. Only under residential environments did the average annual ground-water temperature exceed that of the air, and then only by a maximum of 1.1° C in one well screened 16 feet below land surface. Greater shading of the ground and therefore less absorbed solar radiation results in lower ground-water temperatures in the forested environment (Pluhowski and Kantrowitz, 1963).

Both the maximum and mean annual ground-water temperatures decrease with depth to a level of at least 60 feet below land surface. At some depth between 60–200 feet a reversal of this trend occurs, for De Luca and others (1965) have indicated that ground-water temperatures increase about 0.6° C for each 60–100 feet of depth below about 200 feet. Minimum temperatures are lowest at the water table, but they rise rapidly with depth. The range of yearly temperatures at the 60-foot depth is only about 1.5° C; however, this increases to nearly 11° C when the depth to water is 10 feet or less. The time of occurrence of high and low temperature of ground water lags behind that of the air by 1–2 months at shallow depths and 3–4 months at the 60-foot level. Daily temperature fluctuations rarely occur within the ground-water reservoir. Such changes are usually limited to shallow aquifers where the depth to water is 10 feet or less.

STREAM TEMPERATURES—THEIR RELATION TO AIR AND GROUND-WATER TEMPERATURES

As might be anticipated, stream-temperature fluctuations are greater than those in nearby ground-water bodies, but they normally exhibit less variability than concurrent air-temperature observations. This is particularly true of Long Island streams that normally received large accretions of ground water—a factor tending to stabilize daily and seasonal stream-temperature changes. The relationships among air, stream, and ground-water temperatures are illustrated in figure 5. Highest and lowest stream temperatures at both Sampawams and Champlin Creeks occur in the same months as the highest and lowest air temperatures, whereas the insulating effect of soil cover causes extremes of ground-water temperature to lag by about 2 months.

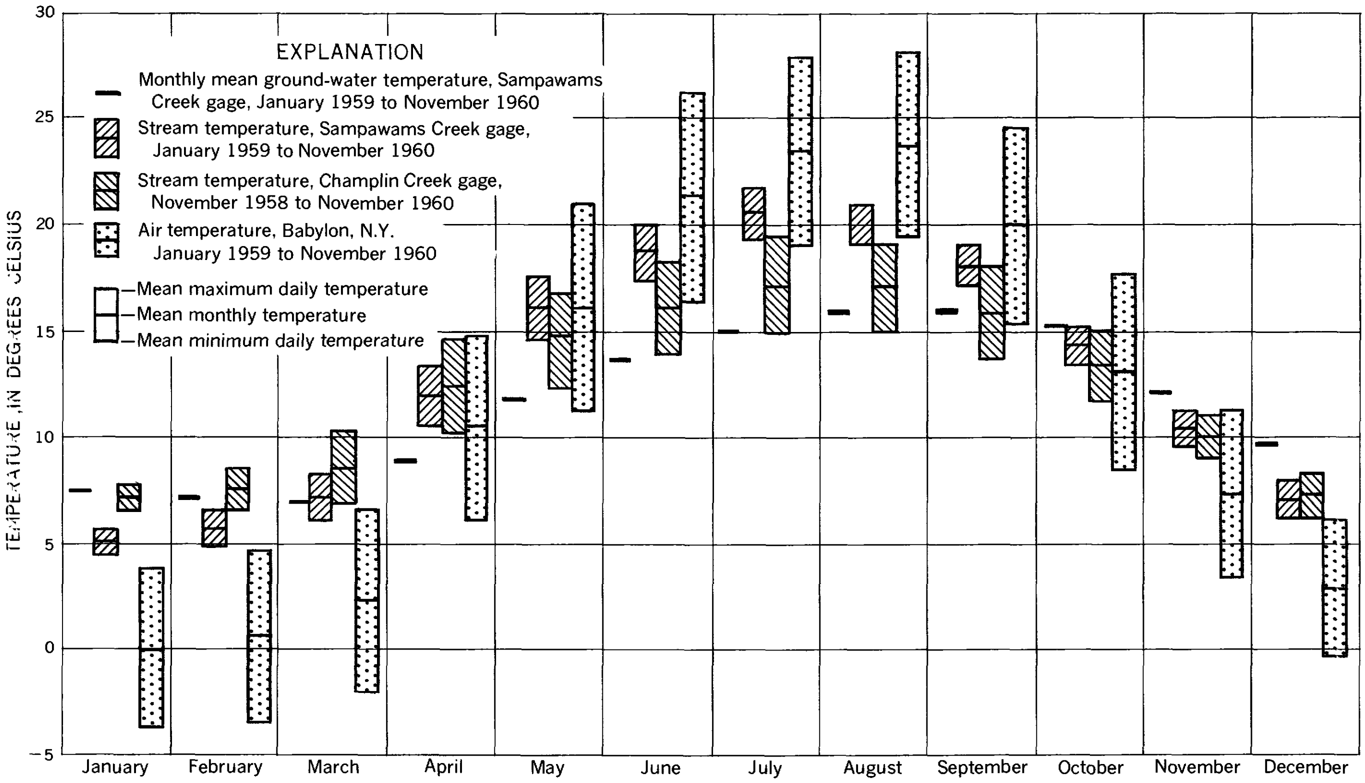

FIGURE 5.—Comparison of monthly and daily temperature of Sampawams and Champlin Creeks with temperature of air and ground water.

Daily air temperatures at Babylon varied from 8° to 11°C on the average throughout the year; temperatures in both streams fluctuated 1°–2°C diurnally during the winter, but in May this increased to 3°C at Sampawams Creek and to 4.5°C at Champlin Creek. No daily change in temperature was detected in the ground-water data.

Seasonal temperature fluctuations follow a similar pattern—air temperatures exhibit the largest variation, and ground-water temperature, the least. Although winter air temperatures averaged near freezing, stream temperatures remained above 4°C, reflecting warmth added to the stream by ground-water inflow which, in winter, normally ranges from 7° to 10°C. In summer, air temperatures were generally between 20°–26°C; however, stream temperatures were about 6°C cooler. Lower summertime stream temperatures are due primarily to seepage from the ground-water reservoir that entered the streams at temperatures near 15°C. Obviously, ground-water inflow must be considered in any evaluation of stream-temperature patterns on Long Island.

The mean annual stream temperature of Champlin Creek is 12.2°C; Sampawams Creek is slightly warmer, averaging 12.8°C over a 2-year period (1959–60). The temperature in both streams averaged above the mean daily air temperature of 11.6°C for the period recorded at Babylon.

DESCRIPTIONS OF THE STUDY STREAMS

SELECTION CRITERIA

The need for a basis of comparison or a "control" is, without doubt, the most important criterion of any study concerned with man-induced modifications of the hydrologic cycle. Accordingly, one of the first objectives of this study was to find a stream that was relatively unaffected by man, but, which also was comparable in size and in other characteristics to the remaining selected for analysis. The author was indeed fortunate to find such a stream, Connetquot River, which almost ideally fits the requirements of a control needed for this study. Although affected by artificial ponds in its lower reaches, Connetquot River is almost entirely free of man-made detention ponds in its upper and middle reaches. Moreover, the river is one of the largest streams on Long Island, so that the size criterion could be met only by selecting a segment of the stream rather than the entire river. For virtually its entire length, the Connetquot River flows through natural cover that extends at least 1,000 feet on either side of the stream.

This heavily forested land has been a natural preserve since the turn of the century.

After choosing a control stream, the next step was to select for intensive study, four additional streams under varying degrees of urbanization. For the purposes of this report, urbanization is defined as any man-made change either in the drainage area of a stream or along the stream itself. Thus, activities such as the building of dams, channel relocation, and stripping of vegetation along stream channels are considered to be urban activities as well as home construction, sewering operations, and street paving. The streams had to be reasonably close together so that a man could visit each one at least once daily. Three streams west of Connetquot River—namely, East Meadow Brook, Sampawams Creek, and Champlin Creek, and one to the east, Swan River, were selected for analysis. Although no two of the streams are exactly alike, owing principally to varying intensity of development, they are sufficiently similar so that meaningful comparisons of their hydrologic characteristics could be made. By way of illustration, all have approximately similar geologic, climatic, and topographic characteristics, thereby reducing the effects of these important factors on temperature regimen.

To obtain sufficient definition of the thermal patterns, five sites were chosen for detailed study along each stream. Thus, a total of 25 sites (five streams with five study sites on each) were analyzed under a wide variety of man-made changes in the natural environment. A compilation of pertinent physical data relating to the study streams is presented in table 1.

EAST MEADOW BROOK

The perennial part of this stream begins at the foot of a diversion dam about 1,000 feet above Jerusalem Avenue (fig. 6). East Meadow Brook drains a large part of central Nassau County which is heavily residential but which has some light industry, particularly in the area north of Hempstead Turnpike. The combined population of the six villages flanking the stream south of Hempstead Turnpike was 145,000 in 1960. This basin is, by far, the most urbanized of all study streams.

TABLE 1.—*Summary of physical and hydrologic data for five study streams*

[The mean discharge at the downstream end of each reach is the average of 5 measurements made during the period November 1966–August 1967]

Reach	Location: From:	Location: To:	River mile (above tidewater)	Channel: Mean width (ft)	Channel: Area (sq ft)	Ponded area (acres)	Mean discharge at downstream end (cfs)	Average shading index
Champlin Creek at Islip								
1	Source	Spur Drive N. (site 1)	2.82–2.33	4	10,000	0.9	0.3	4.[illegible]
2	Spur Drive N. (site 1)	Beech St. (site 2)	2.33–1.82	6	16,000	----------	0.7	4.[illegible]
3	Beech St. (site 2)	Islip Blvd. (site 3)	1.82–1.31	9	22,000	1.6	2.8	4
4	Islip Blvd. (site 3)	Gaging Sta. (site 4)	1.31– .85	13	26,000	6.7	4.7	2.[illegible]
5	Gaging Sta. (site 4)	Montauk Hwy. (site 5)	.85– .40	(1)	(1)	28[illegible]	5.0	1.[illegible]
Connetquot River near Oakdale								
1	Source	Veterans Hwy. (site 1)	4.34–3.79	10	30,000	2.8	1.4	4.[illegible]
2	Veterans Hwy. (site 1)	Site 2	3.79–3.36	40	104,000	----------	3.4	4.[illegible]
3	Site 2	Site 3	3.36–2.86	30	87,000	----------	7.1	3.[illegible]
4	Site 3	Site 4	2.86–2.37	40	93,000	----------	12.2	4.[illegible]
5	Site 4	"At bridge" (site 5)	2.37–1.92	65	185,000	----------	16.8	2.[illegible]
East Meadow Brook at Freeport								
1	Source	Jerusalem Ave. (site 1)	3.12–2.94	5	5,000	3.2	0.63	3.[illegible]
2	Jerusalem Ave. (site 1)	Site 2	2.94–2.22	15	35,000	56	1.79	1.[illegible]
3	Site 2	Site 3	2.22–1.51	12	27,000	67	2.92	3
4	Site 3	Gaging Sta. (site 4)	1.51– .85	15	48,000	2.2	3.95	4
5W	Gaging Sta. (site 4)	Sunrise Hwy. (site 5W)	.85– .19	13	20,000	76	2.6	1.[illegible]
5E	Gaging Sta. (site 4)	Sunrise Hwy. (site 5E)	.85– .19	15	17,000	134	3.9	1.[illegible]
Sampawams Creek at Babylon								
1	Source	Hunter Ave. (site 1)	2.64–2.23	13	16,000	13	1.8	4
2	Hunter Ave. (site 1)	Sunrise Hwy. (site 2)	2.23–1.56	11	25,000	35	2.7	3.[illegible]
3	Sunrise Hwy. (site 2)	Wyandanch Ave. (site 3)	1.56–1.09	16	27,000	22	5.2	3.[illegible]
4	Wyandanch Ave. (site 3)	Gaging Sta. (site 4)	1.09– .62	19	37,000	7.7	6.3	3.[illegible]
5	Gaging Sta. (site 4)	Montauk Hwy. (site 5)	.62– .00	25	78,000	6.9	8.3	2.[illegible]
Swan River at East Patchogue								
1	Source	Circle Drive N. (site 1)	2.01–1.82	3	3,000	----------	0.1	4.[illegible]
2	Circle Drive N. (site 1)	Barton Ave. (site 2)	1.82–1.53	7	8,000	1.6	.6	4
3	Barton Ave. (site 2)	Sunrise Hwy. (site 3)	1.53–1.02	9	24,000	----------	4.7	4
4	Sunrise Hwy. (site 3)	Rose St. (site 4)	1.02– .55	12	29,000	----------	8.6	3.[illegible]
5	Rose St. (site 4)	Gaging Sta. (site 5)	.55– .10	(1)	(1)	137	10.0	1.[illegible]

[1] Completely ponded.

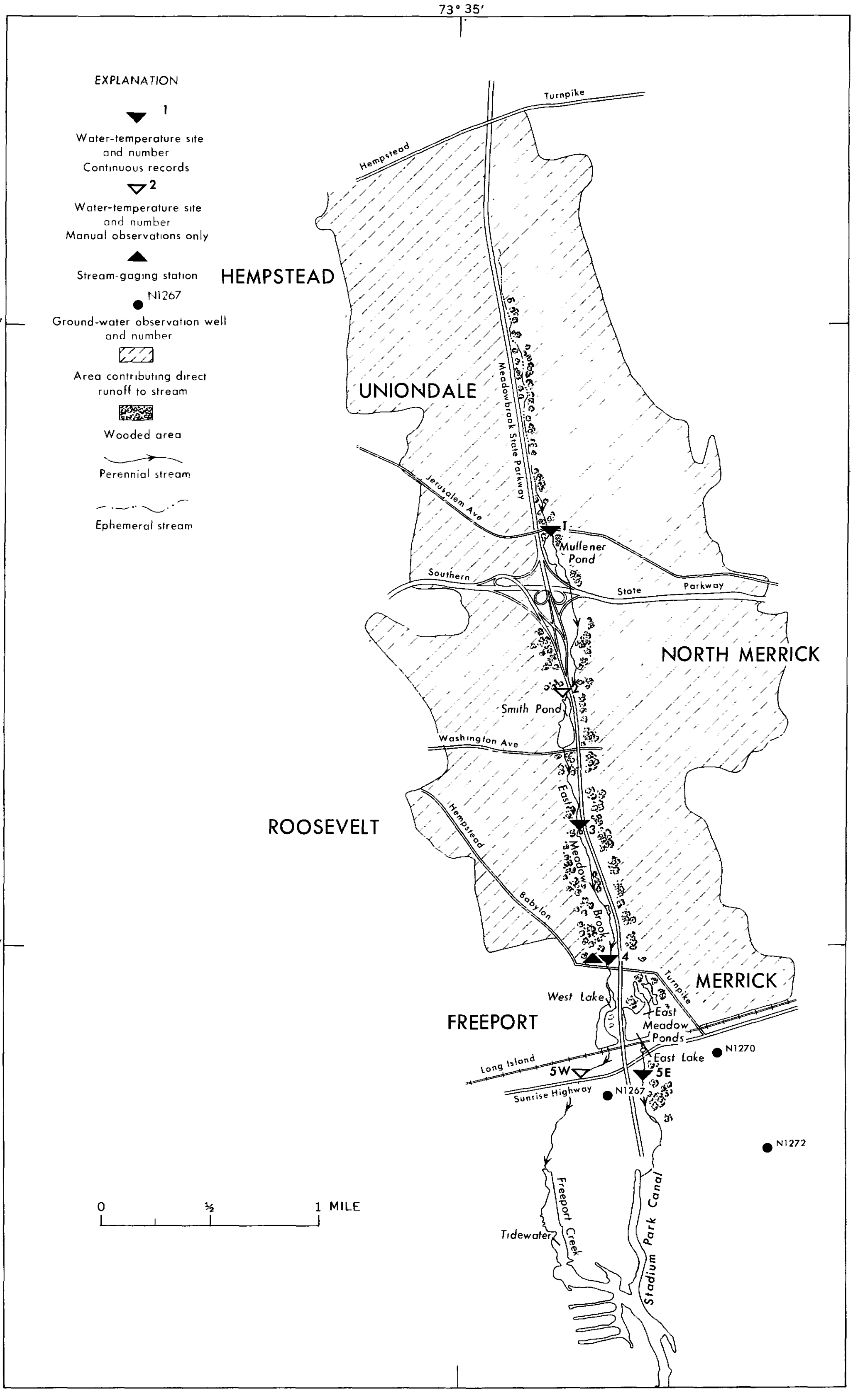

FIGURE 6.—Measurement sites and forested and urbanized areas adjacent to East Meadow Brook.

STREAMFLOW CHARACTERISTICS

The surface drainage area is about 31 square miles measured at the gaging station (temperature site 4); mean annual discharge at the gaging station is 16.6 cfs (cubic feet per second) (1937–66). The channel is straight and there are only a few short tributaries. The stream enters West Lake a short distance below the gaging station. West Lake and East Lake are the principal units of the group of ponds known as the East Meadow Ponds (fig. 6). Both lakes have separate outlets dividing the stream into two branches below the Long Island Railroad. The average gradient of the stream is 2 feet per 1,000 feet (fig. 15).

As might be expected, covering the basin with buildings and paved areas has produced some large changes in the volume of direct runoff to the stream. Seaburn (1969) computed the increase in direct runoff to the stream as follows:

Period	*Average annual direct runoff (acre-feet)*
1937–43	920
1944–51	1,170
1952–59	2,200
1960–62	3,400

The overall increase in the volume of direct runoff from the initial (1937–43) to the final period is 270 percent.

Five discharge measurements were made at each temperature site to evaluate ground-water inflow to the stream. These measurements were obtained during base flow conditions—that is, during dry weather periods to minimize the effect of direct runoff. The average flow was then computed and plotted as shown in figure 15. Ground-water seepage is less than 0.5 cfs per 1,000 feet of channel above the gaging station and about 0.8 cfs per 1,000 feet below the station.

MODIFICATIONS PRODUCED BY MAN

With a few exceptions, almost every reach of this stream has been, at some time or other, altered to some degree by man. The first major change occurred at the turn of the century with the construction of the East Meadow Ponds by New York City as part of its effort to obtain new supplies of water. The principal units in this system of ponds are East Lake (surface area, 134 acres) and West Lake (76 acres). Along with the construction of the lakes (fig. 4), the channels downstream were straightened to increase the conveyance capacity of the stream. Two other large ponds were built sometime later, namely, Mullener Pond (56 acres) and Smith Pond (67 acres), providing a total ponded-water surface area of 333 acres exposed to the sun's rays compared to the natural stream surface area of only 9 acres.

Construction and the recent widening of Meadowbrook State Parkway has led to channel realinement and clearcutting of trees along several reaches. In addition to the removal of trees and shrubs along the banks, most realined channels have been widened beyond their original widths so that the proportion of surface area to volume of water in the reach may be increased sharply locally. The reaches most affected by highway construction include virtually the entire stream above Smith Pond and a short reach just above the gaging station. About the only reach that appears to have been untouched by highway construction or the creation of ponds is that below Smith Pond to a point about 1,000 feet above the gaging station.

Numerous storm drains ranging in size from 12 to 36 inches in diameter are utilized to convey storm drainage to East Meadow Brook from the urbanized areas shown in figure 6. The sharply higher volume of storm runoff entering the stream has affected not only peak discharges but stream-temperature regimen as well. Additionally, a 54-inch culvert (fig. 8) just below East Lake is situated somewhat below the regional water table. As a result, a small, but steady flow of cool ground water issues from the culvert at all times. This flow, as will be shown below, has altered temperature patterns in the East Branch of the stream. There is no indication of any thermal pollution entering the stream from industries or homes.

Aside from these direct effects on the stream's environment, a general lowering of the water table has occurred in the basin owing to excessive pumping and the loss of recharge. Sawyer (1963) estimated the loss of recharge at 63,000 gallons per day during the period 1952–60. Franke (1968) estimates that ground-water levels in the interstream areas of southwestern Nassau County have declined an average of 10 feet relative to similar areas in Suffolk County. He attributes about 7 feet of this decline to sewering. Although East Meadow Brook flows somewhat to the east of the sewered area, substantial declines in ground-water levels must have occurred near the stream, owing to the widespread regional lowering of water levels along the western periphery of the basin.

SHADING

One of the principal factors affecting the energy balance of any stream is the amount of shade provided by its banks or by trees, shrubs, or man-made structures. To delineate the relative amounts of shading along such streams, the author subjectively classified reaches according to five possible degrees of shade. A solid forest canopy (in summer) over any particular reach was ranked as "heavy" shade; or, quantitatively, one might estimate that less than 20 percent of the total incoming solar radiation penetrates to such a reach. On the other end of the scale, reaches estimated to receive 80–100 percent of possible incoming solar radiation were said to have little or no shade effect. To compute an overall average stream shade index, open reaches were classified by the number 1, whereas heavily forested reaches were ranked 5; other shade gradations were subjectively ranked accordingly (fig. 7). On this basis the overall shade index for East Meadow Brook is 2.9 as computed from figure 8, lowest of any of the study streams. It should be stressed that shading was estimated during the summer when all deciduous trees were at full leaf. Shading indices in winter would be at least one unit lower than that shown for all shade classifications given, except for ponded reaches where no greater penetration of solar energy could occur.

As illustrated in figure 8, the only reaches with greater than 60 percent shade is that in the vicinity of temperature site 3 and in the East and West Branches of the stream. Shading of the West Branch below Sunrise Highway was 100 percent because the stream was recently placed in a cement box culvert in that particular reach. This stream presently receives far more radiation from the sun than it would have under natural conditions which are closely simulated in the reach below Smith Pond.

SAMPAWAMS CREEK

The source of this stream was just below Southern State Parkway (fig. 9) throughout the 12-month study period which began November 1966. During the early 1960's, the source of the stream was about 1 mile above the Guggenheim Lakes at a point nearly 6,000 feet above the present (1968) source. The unprecedented drought that began in 1962 dropped ground-water levels to such an extent that the lakes become nearly dry and have not yet recovered to their normal levels.

Sampawams Creek drains about 23 square miles in southwestern Suffolk County. Much of the basin is residential—particularly areas flanking the perennial part of the stream. The creek flows nearly due south and has no tributaries of any consequence. Mean annual discharge at the gaging station (temperature site 4) is 9.6 cfs (1944–66). The mean gradient of the stream is 2.2 feet per 1,000 feet.

STREAMFLOW CHARACTERISTICS

Sampawams Creek has shown sharply increasing rates of storm runoff in recent years much the same as East Meadow Brook. The bulk of this direct runoff originates from a large area north of Hunter Avenue (fig. 9). Further increases in storm runoff are anticipated as areas north of Southern State Parkway continue to come under development.

Ground-water pickup below Southern State Parkway ranges from about 0.6 cfs per 1,000 feet of channel length in the reach between the gaging station and Wyandanch Avenue to 1.3 cfs per 1,000 feet between Sunrise Highway and Wyandanch Avenue (fig. 18). These rates of inflow are somewhat lower than those observed in stream draining less urbanized environments. Although no tangible evidence is available, the lower rates of ground-water seepage to Sampawams Creek suggests a general lowering of the water table due, in part, to urbanization. The low ground-water inflow in the reach between the gaging station and Wyandanch Avenue may be the direct result of pumping near the right bank of the stream. Although the bulk of the pumped water is derived from the Magothy aquifer, some direct loss of water from the stream may result during periods of heavy withdrawal.

MODIFICATIONS PRODUCED BY MAN

Throughout the study period, extensive modifications were being made to parts of the middle and lower reaches of Sampawams Creek, owing to a road construction project. The roadbed of the new highway has sliced through the basin, radically changing the stream environment locally. By way of illustration, Hawleys Lake, just above temperature-site 5, was completely destroyed (fig. 10); the channel in the immediate vicinity of the gaging station has been diverted (fig. 10); part of a small pond between sites 2 and 3 was filled in, and much of the channel near site 2 was completely rebuilt and stripped of vegetation. In addition to these changes, the new road went through the center of a small pond above Sunrise Highway. Despite the active road construction, parts of the stream below Sunrise Highway escaped with little or no change.

Numerous culverts discharge storm water directly into the stream. An additional source of direct runoff will shortly be provided by the new road which will dump storm water into the stream. Moreover, the possibility exists that Hawleys Lake will be rebuilt as part of a park site for the village of Babylon.

SHADING

Based on a field survey made in August 1967, the overall shade index of the stream was 3.2 at that time. Most upper reaches are in fairly heavy shade (fig. 11), but ponding and clearcutting of trees has reduced natural vegetative cover rather sharply elsewhere along the stream. Fairly good cover remains in the vicinity of site

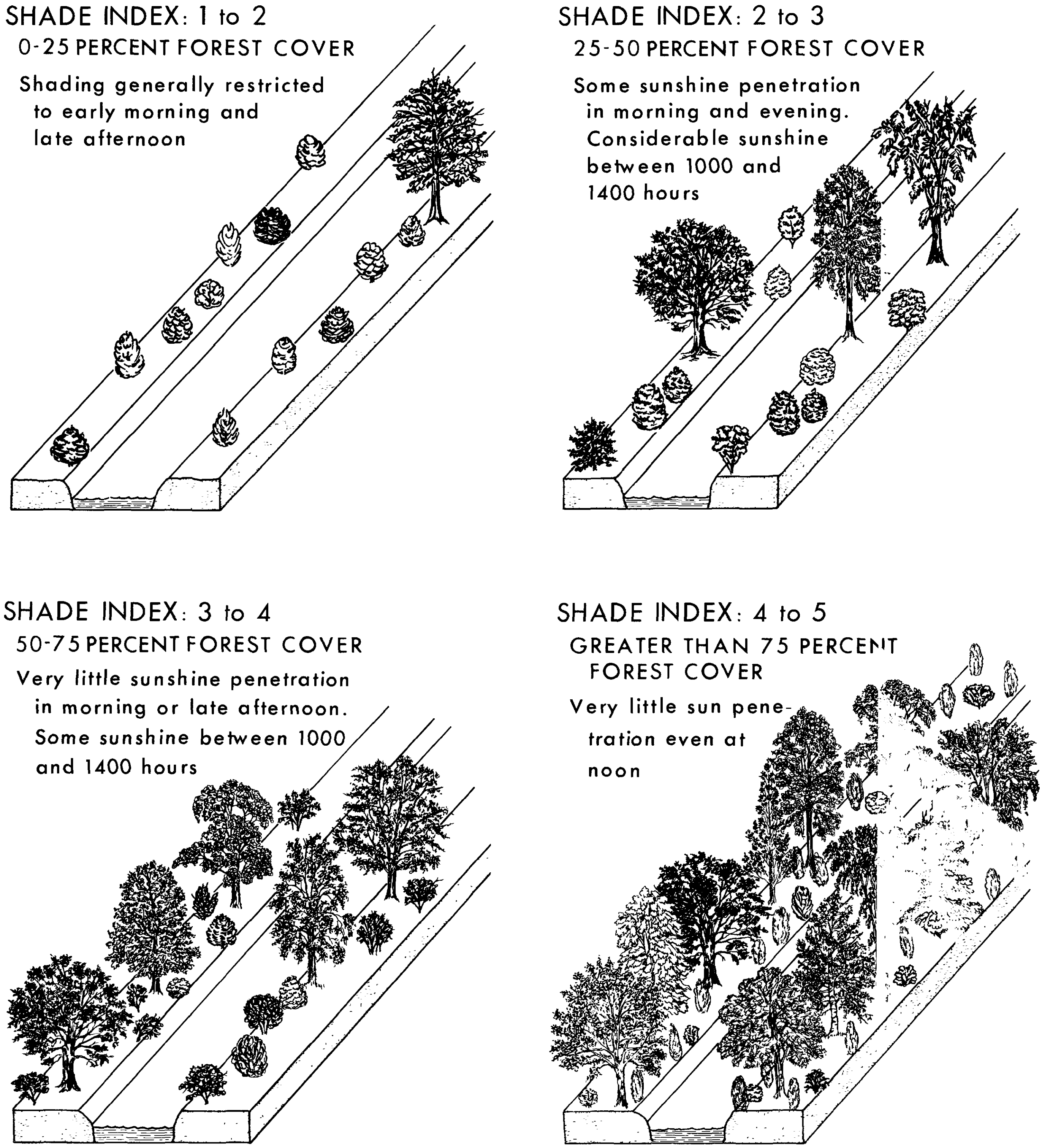

FIGURE 7.—General relationship of forest cover to shade index.

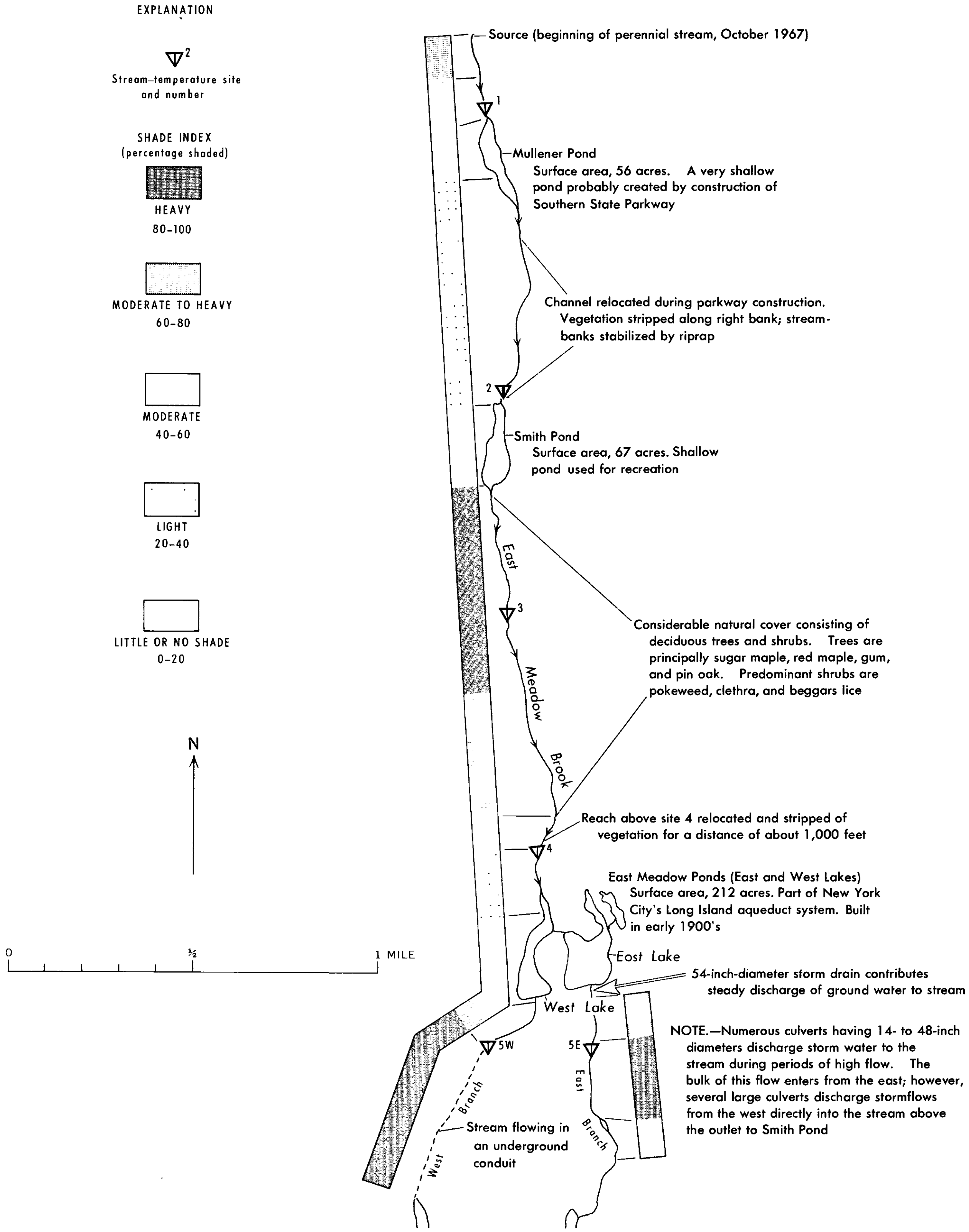

FIGURE 8.—Shading index and environmental features of East Meadow Brook.

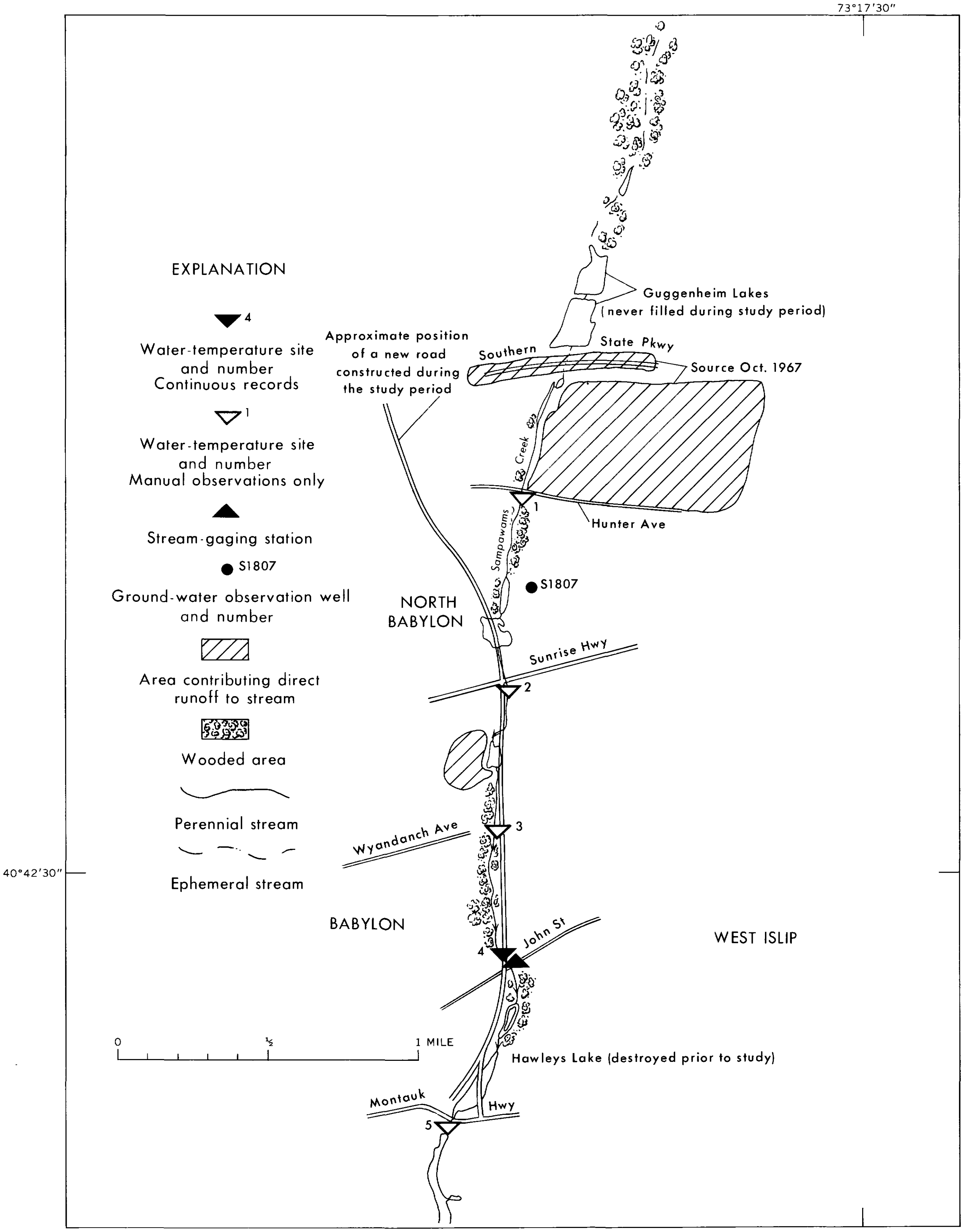

FIGURE 9.—Measurement sites and forested and urbanized areas adjacent to Sampawams Creek.

FIGURE 10.—Sites of former Hawleys Lake, November 1966 (upper) and the gaging station, August 1967 (lower).

3, which, so far, has escaped the effects of the bulldozer. Shading, under natural conditions, is provided by 30- to 40-foot-high sugar maple, sweet gum, and pin oak trees, which are the dominant tree species adjacent to the creek.

CHAMPLIN CREEK

This stream rises about half a mile above Spur Drive North (temperature-site 1), as indicated in figure 12. Much of the flow in the reach above Spur Drive North is effluent discharge from the Central Islip State Hospital. The outfall for the hospital is located just a short distance below the source as shown in figure 13. The stream meanders through much of its upper part; however, below Beech Street the channel is nearly straight. Established residential areas flank the lower parts of Champlin Creek, but parts of the basin above Islip Boulevard are, as yet, undeveloped. The Champlin Creek basin ranks as the third most urbanized basin of the five study streams.

STREAMFLOW CHARACTERISTICS

Mean annual discharge of the gaging station (site 4) is 7.3 cfs (1948–66). Mean annual discharge at the mouth of Champlin Creek is about 10 cfs, lowest of any of the five study streams. The impact of urbanization on peak discharges has not been as great at Champlin Creek as it has been on streams nearer to New York City. Some increase in flood volume has occurred since the gaging station was first established, but effect of the increased storm runoff has, to date, been minor.

The pattern of ground-water inflow is rather striking as shown in figure 18. Pickup rates increase rapidly from the source to the middle reaches of the stream; thereafter, they fall to about 0.7 cfs per 1,000 feet of channel and stabilize at that level. The increased pickup is probably related to steep water-table gradients found near Islip Boulevard. Thus, the bulk of the increased ground-water outflow is due to a greater lateral inflow of water from the shallow aquifer flanking the stream. This particular pickup regime—that is, maximum seepage rates midway between mouth and source—is found in other streams on Long Island where man's activities have not yet significantly modified streamflow patterns.

MODIFICATIONS PRODUCED BY MAN

Much of the storm runoff entering Champlin Creek does so at Islip Boulevard where a 36-inch culvert discharges runoff from a large section of Islip Terrace. The extension of Southern State Parkway which crosses the stream just below site 1 has increased storm runoff. However, the effect of this project on the stream's immediate environment has not been nearly so great as at Sampawams Creek where the centerline of a newly built road nearly parallels the thread of the stream.

Effluent from the sedimentation tanks of Central Islip State Hospital is channeled into a series of infiltration beds located about 3,000 feet northeast of site 1. Owing to the lack of observational data, the effect of this sewage on regional ground-water levels is difficult to assess. The flow-through volume of the plant is about 1.3 million gallons per day. However, the water level in an observation well midway between temperature site 1 and the sewage lagoons appears to be at a normal altitude for the general area.

Only two small ponds are above the stream-gaging station. Knapps Lake, 282 acres just below the gage, is a large man-made lake used for recreation. Two smaller lakes are situated between Montauk Highway and the head of tidewater.

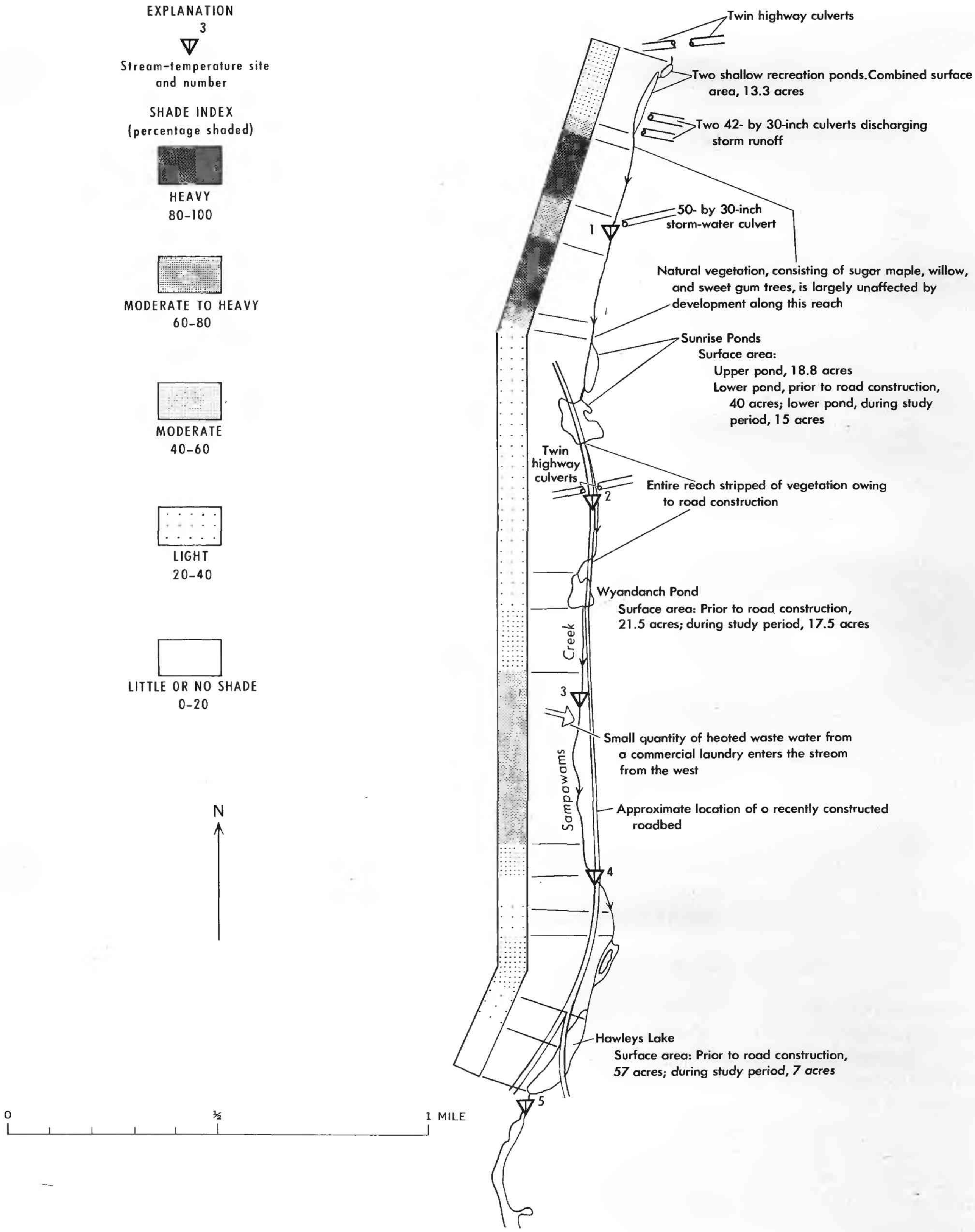

FIGURE 11.—Shading index and environmental features of Sampawams Creek.

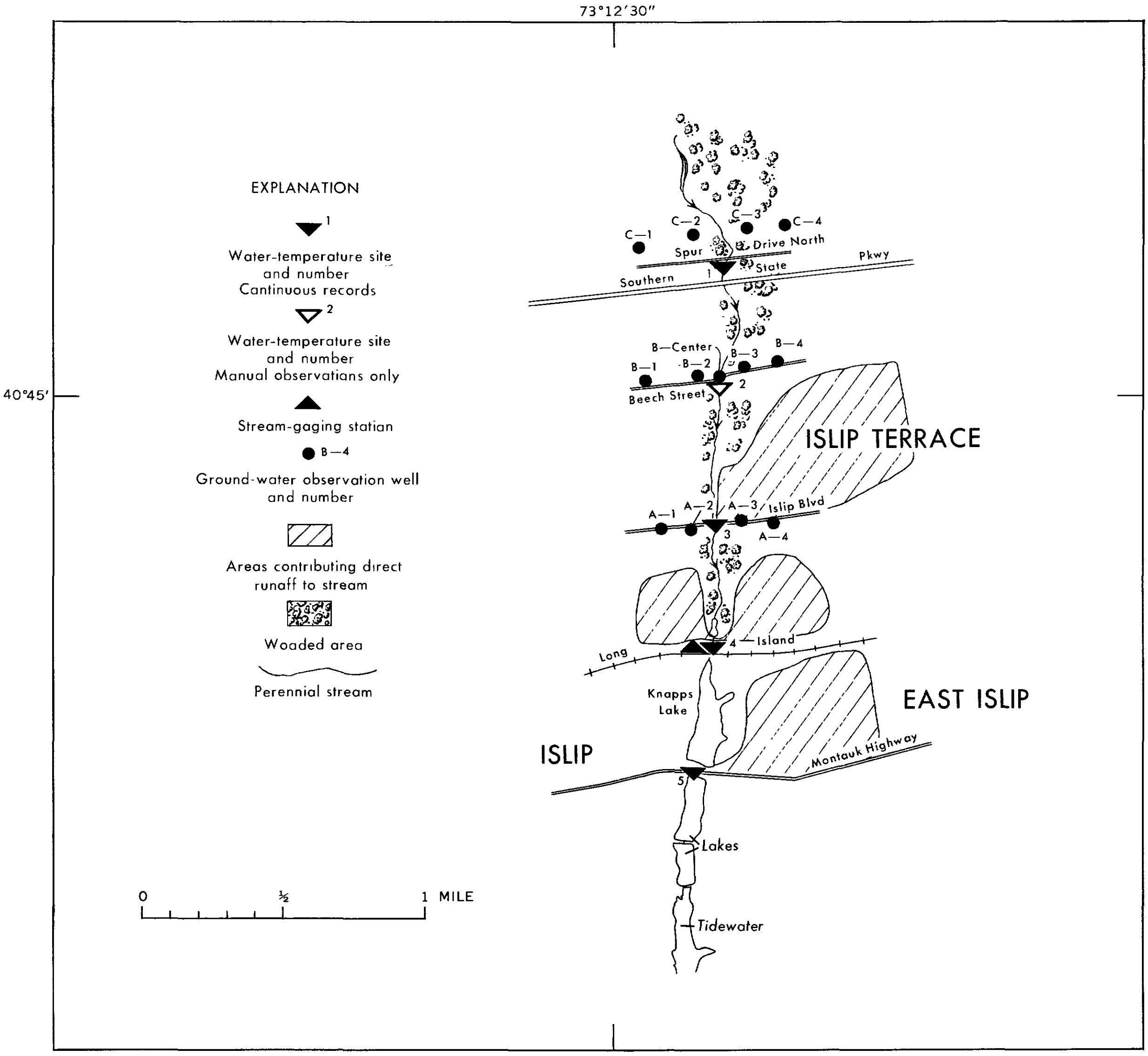

FIGURE 12.—Measurement sites and forested and urbanized areas adjacent to Champlin Creek.

SHADING

The overall shade index for Champlin Creek is 3.6. Deciduous trees are the predominant source of shade. However, some pine trees as much as 40 feet in height are found along the upper reaches of the stream. Despite the residential nature of much of the reach between Islip Boulevard and the gaging station, a fair amount of shade is apparent (fig. 13). The homes in this area are at least 20 years old, and many of the owners have planted fast-growing willow trees adjacent to the stream. These trees are now full grown, so that they yield considerable shade.

CONNETQUOT RIVER

Throughout the study period (November 1966–October 1967) the source of Connetquot River was just south of the Long Island Railroad (fig. 14). The river flows southwest initially, it then makes a large bend to the southeast near its midpoint emptying into tidewater at the main stem gaging station on Sunrise Highway. To avoid distortion of natural water-temperature patterns caused by ponding along the lower reaches of the river and to meet the size criterion referred to on page D9, studies were limited to only the upper half of this relatively large stream. Throughout its entire

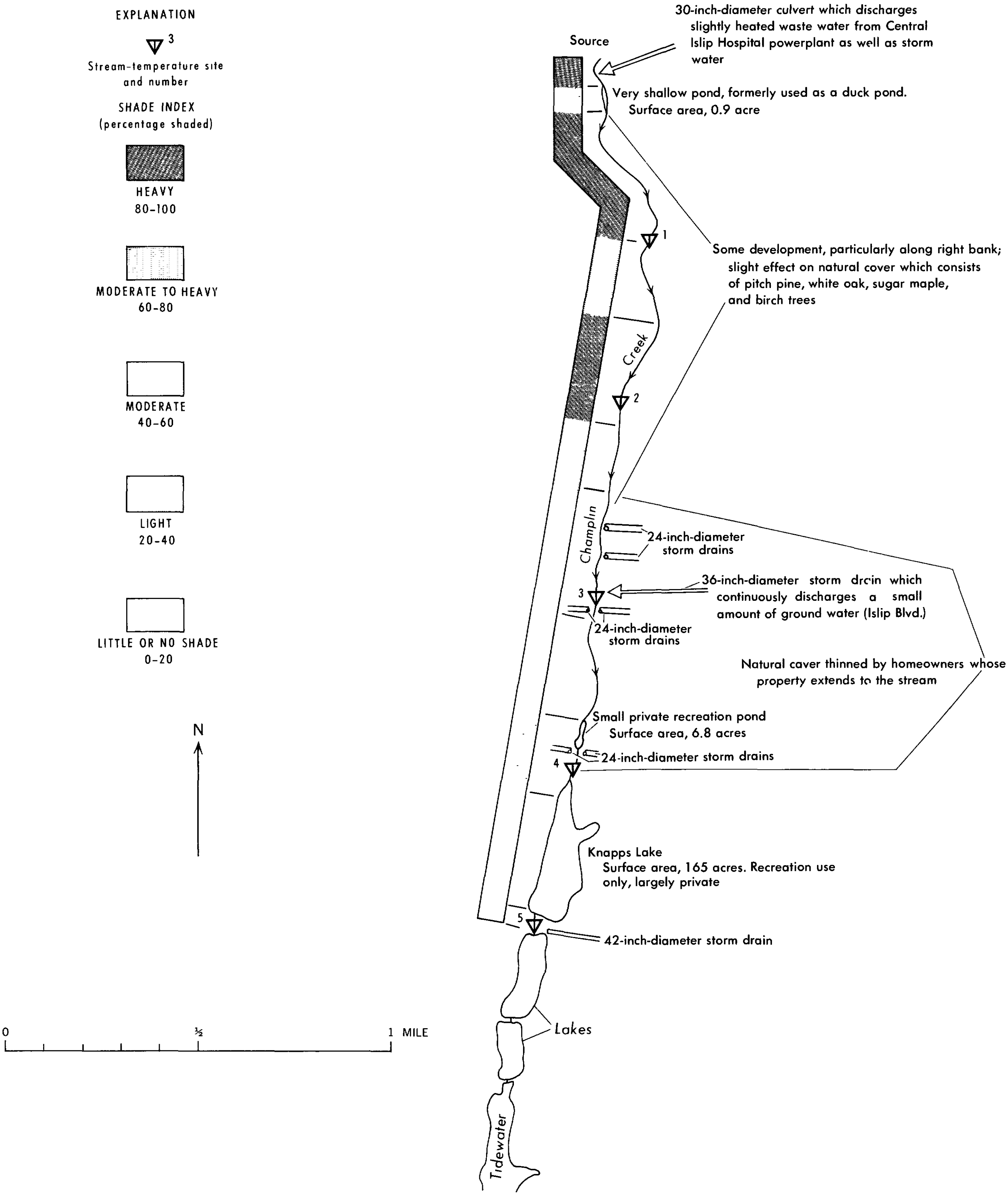

FIGURE 13.—Shading index and environmental features of Champlin Creek.

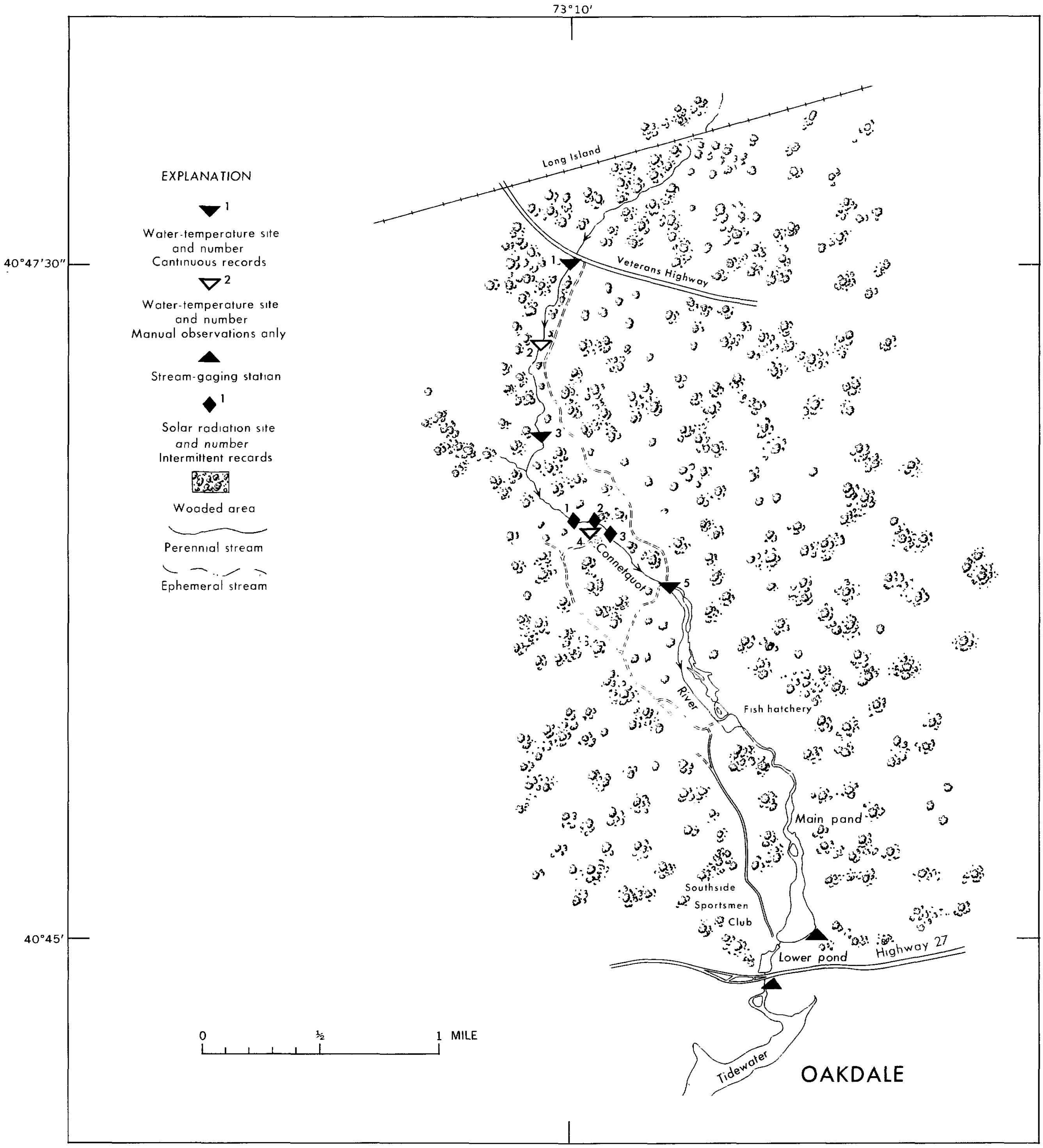

FIGURE 14.—Measurement sites and forested areas adjacent to Connetquot River.

length, the river flows through heavy stands of natural vegetation in a private hunting and fishing preserve. Some representative views along the stream may be seen in figure 36.

STREAMFLOW CHARACTERISTICS

Discharge at the head of tidewater is 38.8 cfs (1943–66) or over twice the flow of the second largest study stream (Swan River). Mean discharge at temperature site 5 was just over 16 cfs during the study period, a figure more in line with discharge at the other four study streams. The surface drainage area above the head of tidewater is about 24 square miles.

Owing to the natural environment of this basin, very little water reaches the stream as direct runoff. For example, the ratio of storm-water discharge to total discharge was computed to be 2.9 percent at the gaging station. This figure compares with nearly twice that amount (5.7 percent) at Sampawams Creek. Overbank flooding is very rare anywhere along the stream because of the attenuated flood hydrographs. It is likely that much of the direct runoff represents rain falling directly on the water surface and on the streambanks.

Ground-water seepage into the stream is heavy along the middle reaches of the river (fig. 15). Rates of inflow as much as 2 cfs per 1,000 feet of channel length are common between sites 3 and 5. The pickup (seepage) pattern is similar to that of Champlin Creek, Swan River, and, to a lesser extent, Sampawams Creek.

MODIFICATIONS PRODUCED BY MAN

Aside from Veterans Highway, there have been no significant environmental changes anywhere along the stream above site 5. Stormflow of relatively small volume enters the stream at the Veterans Highway overpass. Some stormflow may enter ephemeral reaches of the river above the Long Island Railroad; such accretions are small, however.

Many years ago, the left bank of the stream above site 5 was stripped of some of its vegetation for a distance of about 1,000 feet. No other significant modifications to the stream's environmental are known to the author.

SHADING

The overall shade index for the stream above site 5 is 3.8, highest of any of the study streams. Much of the upper part of the stream is about 80 percent shaded (fig. 16). Shading gradually decreases in the downstream direction, principally because the river becomes wider and thereby allows more sunlight to penetrate to the stream.

SWAN RIVER

Swan River has the shortest overall length of any of the five study streams. Perennial flow begins just upstream of Circle Drive North (fig. 17) about 1,000 feet below Woodside Avenue. The length of the perennial reach is just over 2 miles. Despite its short length, the stream ranks second in quantity of flow discharged to tidewater. The basin currently (1968) represents the eastern boundary of urban development which began in western Nassau County in the 1920's. The perennial flow channel has a mean gradient of about 2.3 feet per 1,000 feet. There are no tributaries of any consequence. The river has a surface drainage area of about 8.8 square miles.

STREAMFLOW CHARACTERISTICS

Flow patterns of this stream are characterized by heavy ground-water inflow in its middle reaches (fig. 18). Swan River flows through a well-developed valley so that the elevation of its channel is probably well below that of the water table flanking the stream. As a result, steep water-table gradients exist, generating greater-than-normal lateral ground-water discharge. Artificially high water-surface levels created by Swan Lake, on the other hand, are doubtless responsible for the sharp drop in ground-water pickup in the reach between Rose Street and the gaging station.

MODIFICATIONS PRODUCED BY MAN

Swan Lake (fig. 4) was built prior to the establishment of the gaging station in 1946. The lake, impounded behind an earthfill dam with a timber flume outlet, has a surface area of 137 acres. The only other ponded area on the stream is that above Barton Avenue where a small pond of less than 4 acres was created by the Barton Avenue roadbed.

Residential building activity adjacent to the stream is confined north of Barton Avenue where several developments have been constructed in the past few years. Several off-channel recharge basins have been built near sites 1 and 2 (fig. 19) to facilitate storm-water removal from these newly created urban areas. The basins are dry, except following periods of heavy rainfall when, as shown in the lower part of figure 20, they may contribute substantial flood runoff to the stream. Direct runoff from paved streets may also contribute to flood flows, as indicated in the upper view of figure 20. The only other residential area contributing direct runoff to the stream is found north of Rose Street. Homes in this area are at least 20 years old, and locally, little or no construction is currently in progress.

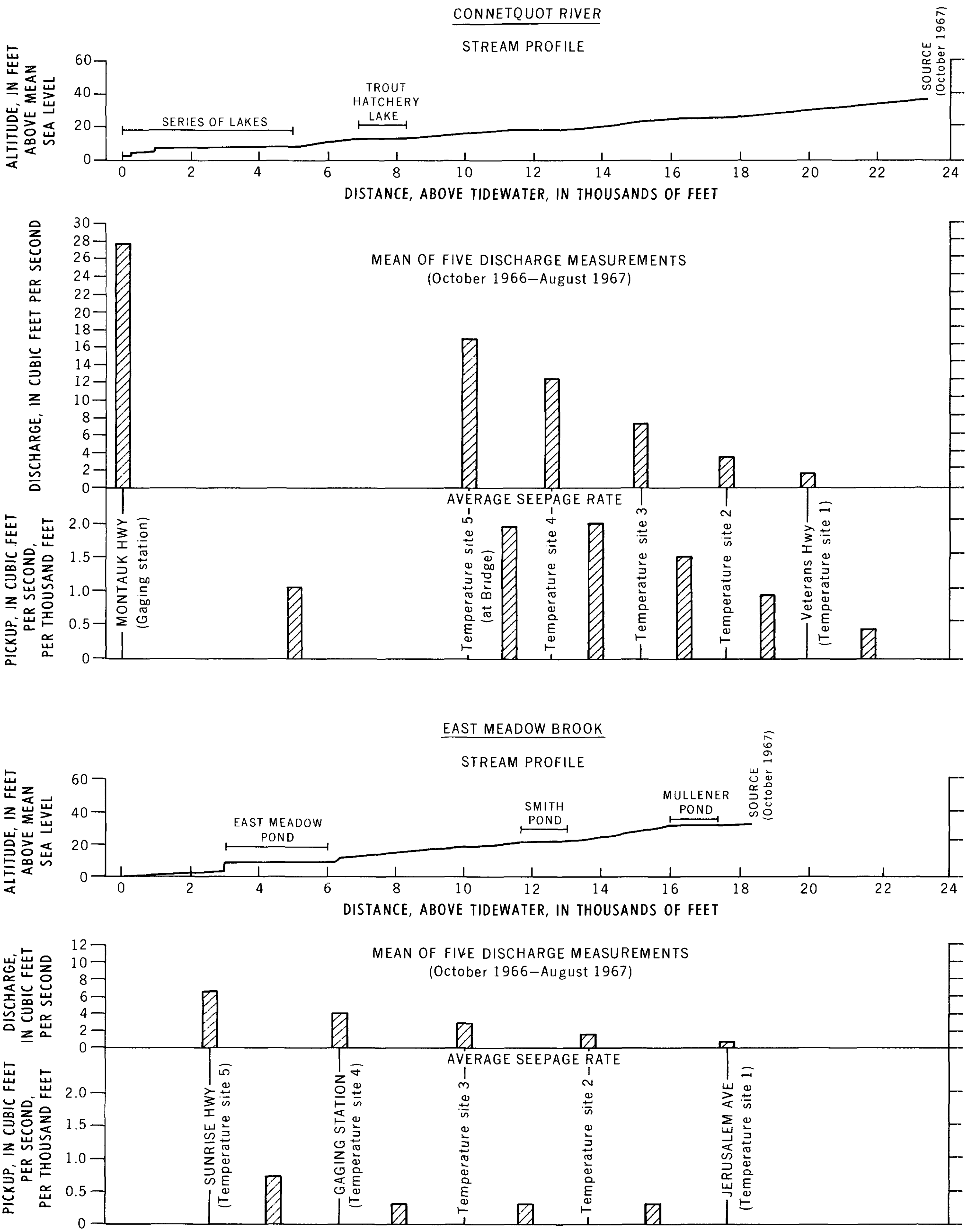

FIGURE 15.—Profiles, mean discharge at selected sites, and average seepage rates (pickup) for Connetquot River and East Meadow Brook.

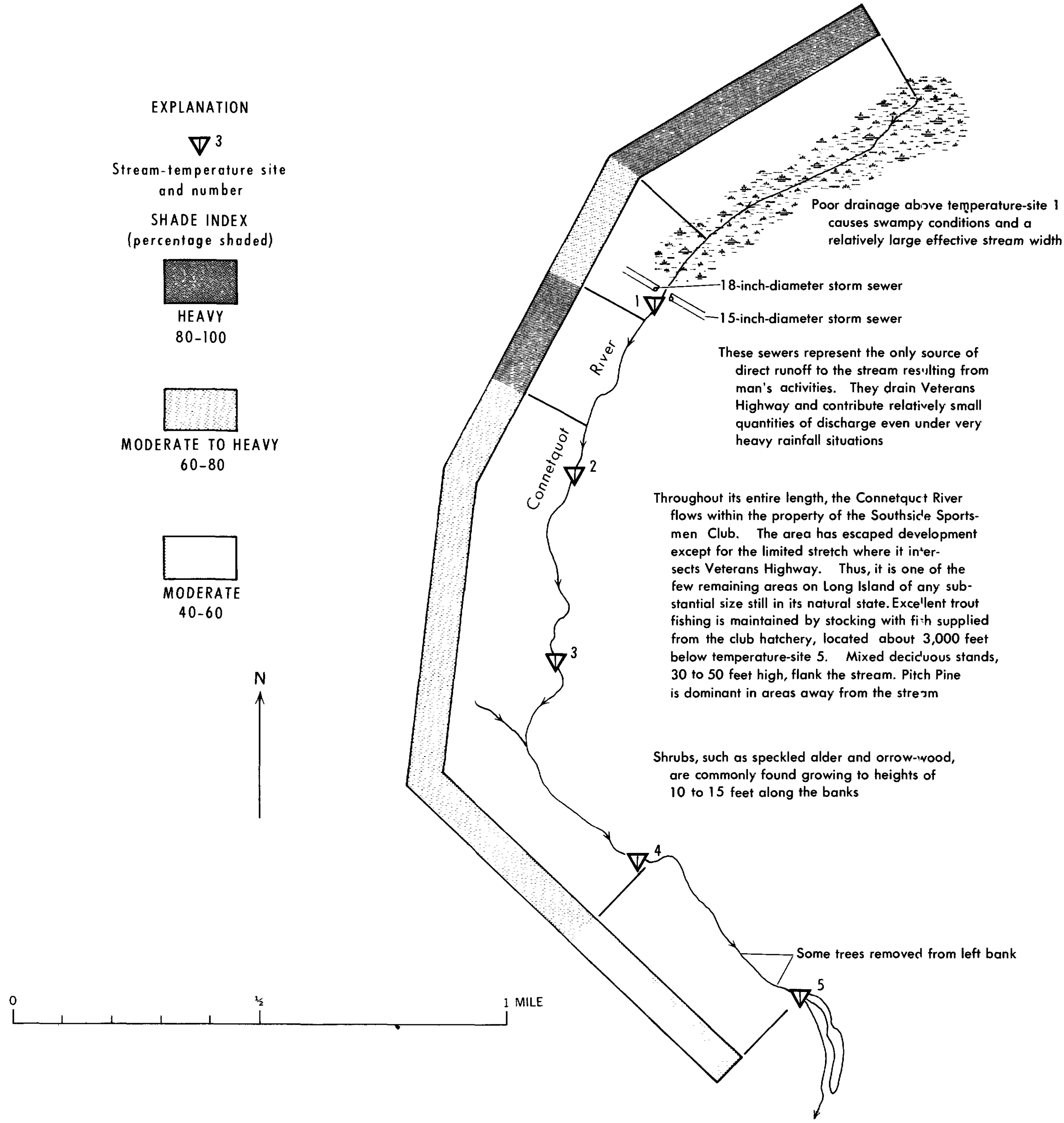

FIGURE 16.—Shading index and environmental features of Connetquot River.

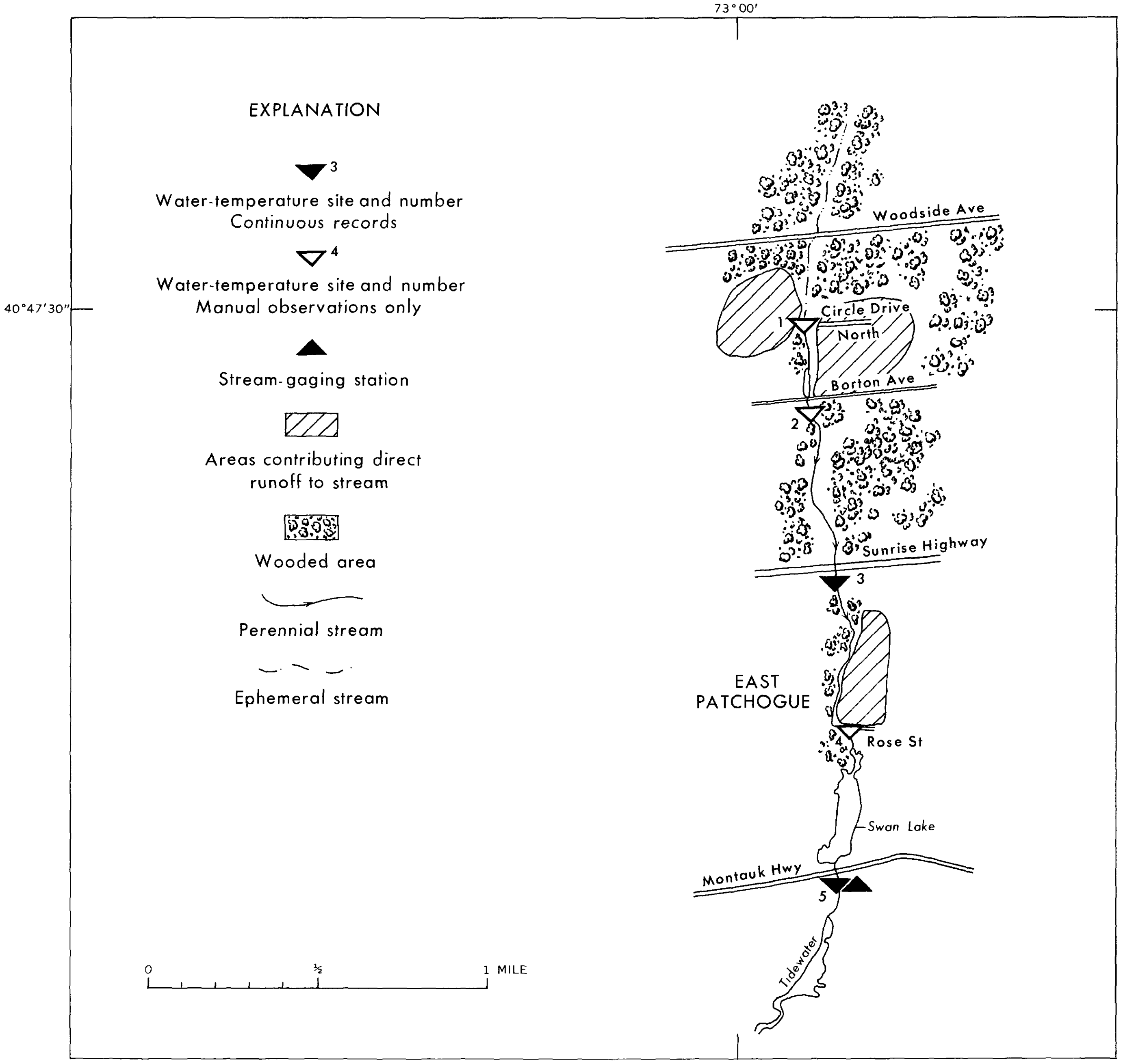

FIGURE 17.—Measurement sites and forested and urbanized areas adjacent to Swan River.

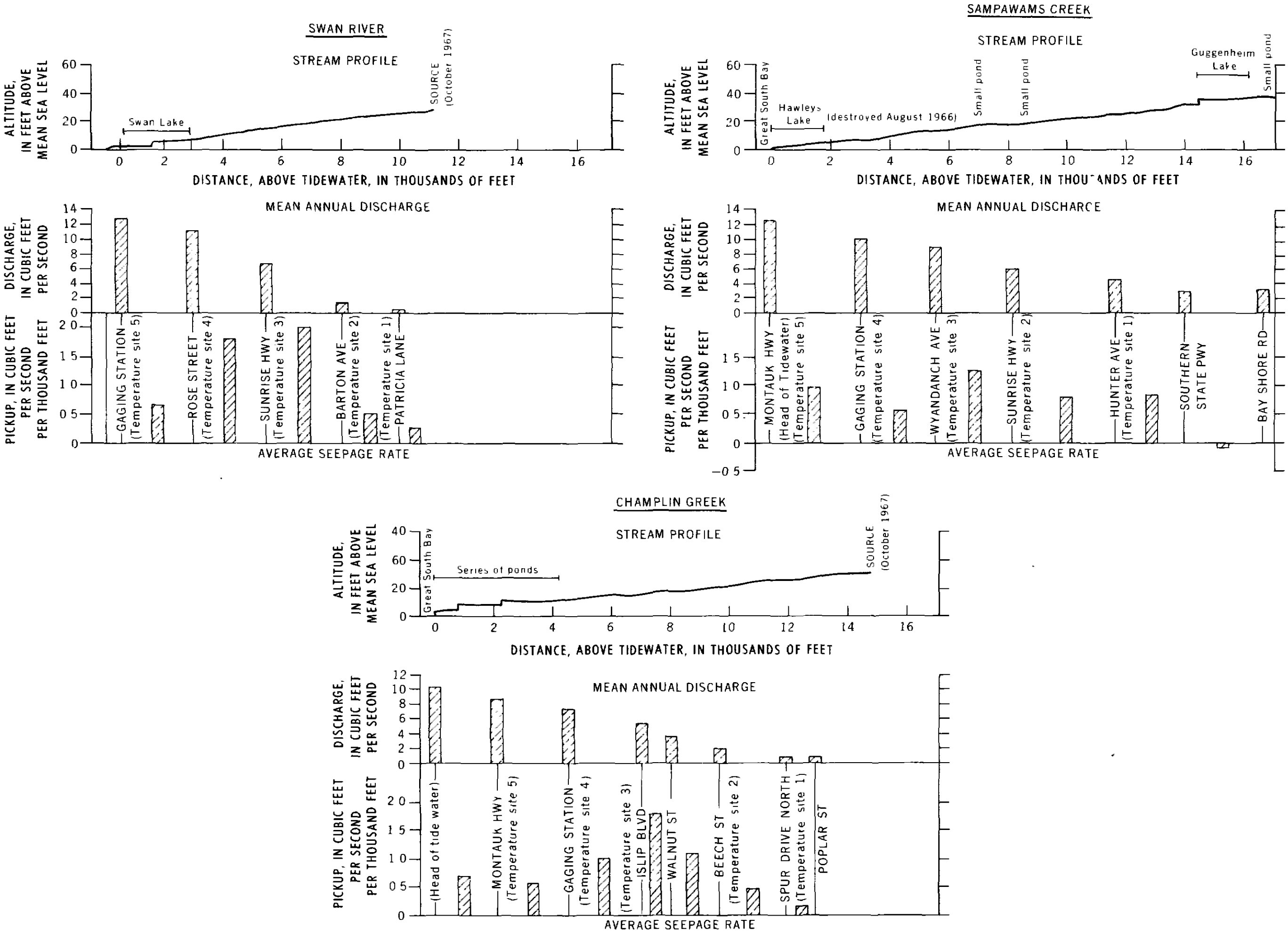

FIGURE 18.—Profiles, mean annual discharge at selected sites, and average seepage rates (pickup) for Swan River and Sampawams and Champlin Creeks.

Although the effects of urban activity on stream characteristics have been minimal in this basin to date, it is clear that the recently developed residential areas will, if they have not already done so, significantly alter the volume of flood runoff to the stream. Swan River is ranked fourth among the five study streams in degree of urban development.

SHADING

The overall shade index as computed from data portrayed in figure 19 is 3.0. Only two reaches are still in their natural state—a short stretch below the source and practically the entire reach between temperature sites 2 and 3. Shading is provided mainly by red and sugar maples and, in residential areas, by willows and other shade trees. Too, much shading is also derived from heavy growths of shrubs along the banks, which often attain heights of 6–8 feet. Noteworthy breaks in natural stream cover are readily apparent near Barton Avenue and throughout the reach between sites 4 and 5.

INSTRUMENTATION

Clearly, one of the most important considerations in any temperature study is the quality and dependability of the temperature sensing instruments. Ideally, such instruments should be compact, rugged, portable, and above all, they should be capable of maintaining their calibration over extended periods of time. The telethermometer, a remote reading instrument, was selected as the basic spot temperature measuring device. This instrument is powered by flashlight batteries housed in a small console. Using extension leads, the instrument (accurate to within 0.5° C) can easily be adapted for use in obtaining ground-water temperatures in standard 2-inch-diameter observation wells.

Ryan 8-day Model D water-proof thermographs were used at all continuous recording locations except one. These instruments have a bimetallic coil sensing element with a clock-wind drive, and they record on a pressure sensitive strip chart. They are 6½ inches in

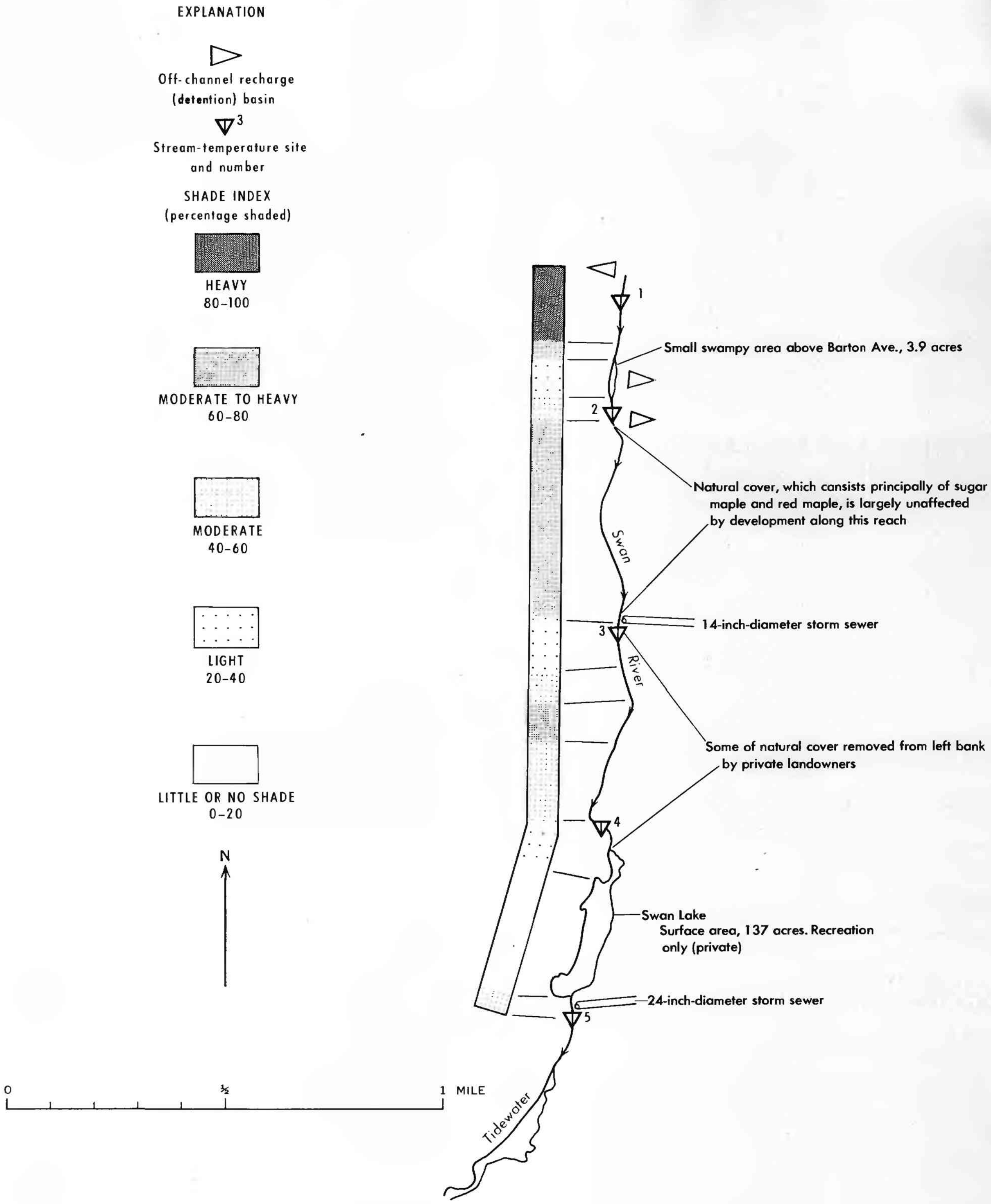

FIGURE 19.—Shading index and environmental features of Swan River.

FIGURE 20.—Views of Swan River below Barton Avenue showing street runoff (upper) and stormflow from an off-channel recharge basin (lower).

height, 3¼ inches in diameter, weigh 4 pounds, and are accurate to within 0.5° C. The small diameter of the Ryan recorder is narrow enough to permit housing the unit in 4-inch pipe casings. At exposed sites subject to vandalism, the recorders were placed in 4-inch pipe wells fabricated and fastened with steel straps to concrete abutments as shown in figure 21.

The only non-Ryan thermograph used in the study was a Bendix-Friez three-element recorder installed initially at the Sampawams Creek gaging station but subsequently moved to the Swan River gage. This clock-wind drive instrument was used to record simultaneously air and stream temperatures. It produced excellent reliable records.

Two Belfort pyranometers were used for recording solar radiation in energy-budget studies performed at Connetquot River. One instrument was placed in the Rockaway Road recharge basin in Mineola to obtain observations of unimpeded solar radiation; the othe was placed on a portable platform that was set up i the stream. In addition to these installations, continuou records of short-wave and net radiation were obtaine from the Meteorology Group at the Brookhaven Na tional Laboratory. The Brookhaven short-wave radia tion data were obtained from an Eppley pyranome ter, and the net-radiation data, from a Suomi-typ radiometer.

A minimum-maximum thermometer was hung fron the north side of a tree near the stream to obtain dail air-temperature extremes. Sling psychrometers wer used for relative humidity determinations. For win movement, a totalizing anenometer was attached to th same platform that supports the solar radiation instru ment (fig. 36).

Supplemental data available to the author include daily land-pan evaporation data as well as continuou rainfall and temperature data from the Geologica Survey's cooperative weather station at the Rockawa Road recharge basin. Streamflow measurements wer made with a pygmy meter.

ANALYSES OF TEMPERATURE SURVEYS

The plan of attack followed by the author to asses man's impact on water-temperature patterns consiste of obtaining the synoptic temperature fields in all fiv study streams over 7-day periods. It was felt that 1-week study period would be the minimum time spa needed to obtain a fair variety of meteorologic situ ations. To identify seasonal modifications in wate temperature patterns, five temperature surveys wer made at selected intervals over a 1-year period. Th dates of these runs are as follows:

Survey	*Period*
1	Nov. 15–21, 1966.
2	Jan. 25–31, 1967.
3	Apr. 19–25, 1967.
4	June 7–13, 1967.
5	Aug. 24–30, 1967.

Ideally, the best method of delineating the some times subtle changes in stream-temperature pattern resulting from urbanization would be one employin continuous temperature recorders at each study sit However, this approach was deemed impractical, owin to need for pipe-well installations to prevent vandalisn at nearly all exposed sites. As an alternative, manua spot temperature readings were obtained at each of th five study sites on every stream used in the analysis At least one continuous recorder was in operation o each of the study streams. Estimates of daily maximur and minimum temperature at each site were obtaine by correlating temperatures at nonrecording sites wit those registered by thermographs.

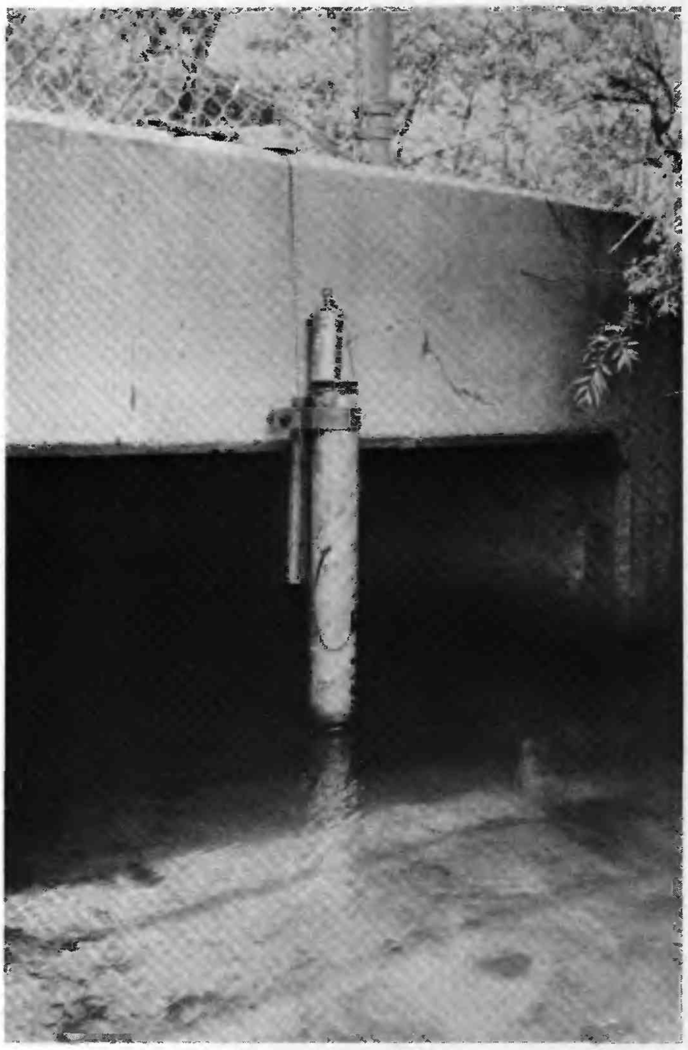

FIGURE 21.—Thermograph pipe-well installations at East Meadow Brook, site 4 (upper left) and site 5 (lower left) ; at Champlin Creek, site 5 (above).

Stream temperatures across any section orthogonal to the direction of flow generally varied within close limits. Owing to the turbulent conditions in most reaches, mixing is complete and temperature differences of more than 0.3°C are uncommon. Accordingly, on most reaches, recording instruments may be placed anywhere in the channel, and representative observations are assured. Occasionally, temperatures may differ by as much as 1°C across a section, owing to some local anomaly. For example, temperature differences at the East Meadow Brook, site 4, pipe-well installation occasionally deviated by 0.5°–1°C above or below temperatures observed at midstream. This is due primarily to the concrete control dam just downstream which causes ponding of water at the pipe well creating, in turn, sluggish flow conditions. As a result, lateral mixing with the active flow in midstream is sharply reduced. Such thermal anomalies are largely eliminated, however, by making all calibration temperature observations in the active flow part of the cross section. A similar situation exists at the Champlin Creek thermograph installation (site 4). Here, too, all calibration check temperature readings were obtained at midstream to correct for the local thermal anomaly. Aside from these two instances, thorough mixing insured a uniform temperature distribution across the stream at each of the other sites.

The remainder of this chapter is devoted to presenting a description of each temperature survey, highlighting significant thermal contrasts among the various sites and, whenever possible, identifying the causes of the discrepancies.

TEMPERATURE SURVEY 1, NOVEMBER 15–21, 1966

WEATHER

A frontal passage in the early morning hours of November 15 heralded the onset of generally fair, cool weather for the 15th and 16th. As the fair-weather producing high pressure system moved over Long Island to a position off the eastern coast of the United States on the 16th, a broad southwesterly flow of air was generated over the area. The resulting influx of warm moist air from the Gulf of Mexico caused a rise in air temperatures beginning on the 16th which culminated on the 18th when air temperatures were about 10° F above seasonal levels. A trough of low pressure triggered showers over the project area on the 18th. Rapid clearing set in on the 19th. Much cooler weather prevailed on the 20th and 21st as the new surge of cold Canadian air overspread the area. Skies were nearly completely clear during the last 2 days of the survey with air temperatures averaging 5°–10° F below the normal levels of 42°–46° F. The summary of data on page D62–D68 contains meteorologic data for the study period.

SYNOPTIC STREAM-TEMPERATURE PATTERNS

Spring and fall represent transition periods with temperature patterns somewhere between warm and cold season extremes. During these seasons, such important stream-temperature controls as air temperature and solar radiation are seldom far from their long-term annual means. Accordingly, one might anticipate that any distortions of the natural seasonal temperature patterns of a stream due to man's activities are likely to be at a minimum in the spring and fall and at a maximum during the summer and winter.

Data obtained during this survey tend to bear out this point. For example, the average temperature of the five streams given in table 2 ranges from 9.8° C at East Meadow Brook to 8.4° C at Champlin Creek, or a range of just 1.4° C for the November 1966 survey. Mean temperatures among the 25 sites do, of course, exhibit greater variability. The highest mean temperature was recorded at site 5E on East Meadow Brook (11.6° C), and the lowest, at site 1 on Champlin Creek (6.6° C). The high temperature at East Meadow Brook was due in large measure to the discharge of a steady flow of ground water from a large culvert below the outlet of East Lake. This inflow, at times, accounts for as much as 50 percent of the flow past site 5E (fig. 6). At the time of the survey, ground-water inflow was about 12° C or about 3° C higher than the temperature of the overflow from the upstream reservoir. Ground water is normally warmer than the surface-water bodies into which it discharges during the cooler parts of the year, whereas the reverse is true during the warm season. Fairly heavy forest cover, low discharge, and sluggish flow conditions are the principal environmental and physical factors governing water temperatures at site 1 on Champlin Creek. This combination of factors reduces the importance of solar radiation and the heat-storage capacity of the stream in controlling stream temperatures while amplifying the importance of air

TABLE 2.—*Mean temperatures, in degrees Celsius, for five study streams, November 15–21, 1966*

Temperature site	Stream: East Meadow Brook	Sampawams Creek	Champlin Creek	Connetquot River	Swan River
1	8.8	9.5	6.6	8.7	7.4
2	10.4	8.5	7.3	8.5	9.2
3	9.0	8.7	10.6	8.9	9.9
4	9.2	9.2	9.4	9.1	10.3
5	[1] 11.6	9.4	8.2	8.3	7.7

[1] Recorded at site 5E (fig. 6).

temperatures in controlling of stream temperatures. Accordingly, stream temperatures at site 1 were very close to mean air temperatures (4.5°–5.5° C) during the survey.

A statistical analysis using a two-way analysis of variance was employed to test for possible significant variations in the data presented in table 2. The results of this analysis are presented in table 3.

TABLE 3.—*Two-way analysis of variance applied to the November 15–21, 1966, water-temperature survey*

Source of variation	Sum of squares	Degrees of freedom	Mean square	Variance ratio
Among sites	5. 29	4	1. 32	1. 14
Among streams	5. 39	4	1. 35	1. 16
Error	18. 55	16	1. 16	
Total	29. 23	24		

The F-ratio for significance at the 95 percent level with 4 and 16 degrees of freedom (*df*) is 3.01. Thus, as was anticipated, the differences in mean water temperatures obtained during this survey are not significant. In other words, the observed differences could have been obtained by chance—so that they cannot be ascribed, specifically, to any particular factor or combination of factors.

Despite the relatively stable temperature patterns of the streams, a few anomalies do exist. The drop of 2.6° C between sites 4 and 5 on Swan River suggests that Swan Lake just below site 4 may have caused the cooling trend. The sharp rise in temperatures between sites 1 and 3 on Champlin Creek (4.0° C) and Swan River (2.5° C) are doubtless due to heavy ground-water inflows between the sites. Other comparisons are possible, but these are best illustrated in subsequent thermal surveys.

The summary of data on page D97–D98 contains hourly temperature records for the five continuous thermographs used in this survey.

TEMPERATURE SURVEY 2, JANUARY 25–31, 1967

WEATHER

Air temperatures throughout the period were characterized by a pronounced downward trend. Unseasonally warm temperatures on January 24 set numerous high-temperature records for the date throughout the island. The trend toward cooler weather set in early on the 25th when cool moist maritime air overspread the area. Despite the influx of cooler air temperatures on the 25th and 26th, temperatures averaged nearly 20° F above the seasonal normal of 30°–33° F. A rapidly deepening low pressure system in the Ohio River valley moved just south of Long Island on the 27th, inducing a flow of strong northeast winds and triggering light to moderate rainfall. Air temperatures during the precipitation period were mostly in the upper 30's and low 40's. Colder, and somewhat drier, air began to move into the area in the wake of the low pressure system during the early morning hours of the 28th. Temperatures fell below freezing by noon on the 28th for the first time in nearly a week. A weak center of high pressure moved southeastward out of the Great Lakes area on the 29th, bringing with it clearing, but cold, weather. Temperatures fell into the low 20's and upper teens during the morning hours of the 29th and 30th. The survey period ended with a slight warming trend that set in during the afternoon of the 31st. Air temperatures during the last 3-days of the study period averaged 3°–7° F below seasonal levels.

SYNOPTIC STREAM-TEMPERATURE PATTERNS

In response to the abnormally warm weather at the beginning of this survey, stream temperatures initially were more nearly representative of fall rather than winter. Mean-daily water temperatures averaged near 10° C on both January 25 and 26, but a gradual decline began on the 27th. Mean-daily temperatures were at their lowest levels on the 30th and 31st when they ranged from 1° C at site 2 on Champlin Creek to 8.6° C at site 3 on the same stream.

As indicated in table 4, the range of mean temperatures among the five sites at Connetquot River, the control stream, was 0.8° C. The range of temperatures in all other streams is at least twice that amount, with the largest observed on Champlin Creek (4.1° C). The relatively large range in temperature of Champlin Creek occurred between two successive sites (2, 3), and was due to a combination of two factors. Average streamflow at site 2 (Beech St.) was only 0.5 cfs, and, as shown in figure 13, above Beech Street the stream flows through heavily wooded areas. Low streamflow results in a very large exposed surface area compared with the volume of water in most natural reaches. With air temperatures colder than water temperatures, heat is quickly lost by the stream and water temperatures fall rapidly. Despite the fact that many of the trees were devoid of leaves, some shade is provided by tree trunks and limbs, and by shrubs lining the channel. Thus, natural vegetation tends to reduce the incoming heat from the sun, preventing any substantial recovery in temperature during the day. The second factor responsible for the large temperature variation between the sites is the heavy inflow of ground-water common to the reach. Discharge at Islip Boulevard was 2.1 cfs or four times the flow at Beech Street. The bulk of this flow seeped into the stream at temperatures ranging from 10° to 11° C.

TABLE 4.—*Mean temperatures, in degrees Celsius, for five study streams, January 25–31, 1967*

Temperature site	Stream				
	East Meadow Brook	Sampawams Creek	Champlin Creek	Connetquot River	Swan River
1	7.3	7.7	5.8	7.0	5.2
2	7.6	5.9	5.0	7.3	6.2
3	6.2	7.4	9.1	7.6	8.7
4	6.9	7.8	8.0	7.8	9.0
5	[1] 8.8 [2] 5.0	7.4	6.3	7.0	6.1

[1] Recorded at site 5E.
[2] Recorded at site 5W (fig. 6).

It should be stressed that the recorded difference in temperature of 4.1° C between Beech Street and Islip Boulevard is a 7-day mean—daily mean temperature differences between these sites of as much as the 7.4° C observed on the final day of the survey are not uncommon in winter. Clearly, any reduction of ground-water inflow during the winter will result in a drop in stream temperature along this reach. Moreover, the loss of warm ground-water inflow will affect the temperature patterns of all downstream reaches.

The effect of removing natural shade and constructing ponds on winter thermal patterns is illustrated in figure 22. As shown in the upper left graph of figure 22, on January 31, 1967, temperatures were moderately cold, and clear skies in the morning were followed by a rapid increase in cloudiness during the early afternoon. Strong radiational heating occurred through much of the day despite the nearly complete afternoon cloud cover. Stream temperatures rose rapidly beginning at 1000 hours at Connetquot River. The general shapes of the temperature curves at all three sites are very similar, owing to the undisturbed natural conditions along the stream. The thermal patterns observed along Swan River, on the other hand, are very different. Although thermal fluctuations at Barton Avenue (fig. 17) are similar to those of the control stream, the overall range in temperature is about 2° C larger. Minimum temperatures at the gaging station (site 5) were fully 5.5° C lower than at Rose Street (site 4). Temperature fluctuations at both Rose Street and the gaging station were much less than at Barton Avenue. Moreover, the time of occurrence of the maximum temperature at site 5 was at 2200 hours, or about 5 hours later than at either Barton Avenue on Rose Street.

Reaches upstream from both sites 2 and 5 on Swan River are affected by ponds of widely differing sizes. There is a small shallow pond (average depth, 0.5 ft.) above Barton Avenue and a much larger body of water (Swan Lake, average depth, about 3 ft.) above the gaging station. The heat-storage capacity of the shallow pond is small in relation to its surface area, so that the pond is subject to large heat losses at night, and it gains heat rapidly during the day, especially if the sun is strong. Swan Lake, on the other hand, requires a considerable amount of heat to produce even a modest temperature rise, owing to its relatively large volume. Furthermore, time is needed to redistribute the heat absorbed at the surface of the lake, which may account for the maximum temperature time lag at site 5. Thus, the net effect of these ponds on daily-temperature fluctuations is (1) to amplify temperature changes for the shallow pond and (2) to attenuate temperature fluctuations below the much larger pond. The Rose Street site is subject to heavy accretions of ground water in reaches just upstream (fig. 18). Clearly, ground-water inflow not only raises cold-season water temperatures, but it also has a pronounced tendency to attenuate daily-temperature fluctuations.

The tendency of ponds of all but the smallest sizes to depress average stream temperatures in winter is also shown in table 4. By way of illustration, there were declines of 1.4° C and 1.9° C at East Meadow Brook in the reaches between sites 2 and 3, and 4 and 5W (fig. 6), respectively. The apparent anomaly in the reach between sites 4 and 5E (+1.9° C) is due entirely to the heavy accretion of warm ground-water inflow issuing from a storm-water culvert. A drop of 1.7° C between sites 4 and 5 at Champlin Creek and 2.9° C between the same points at Swan River are the result of relatively large ponds situated between the temperature sites. Slight increases in temperature were observed, on the other hand, between sites 1 and 2 on both East Meadow Brook and Swan River where shallow ponds of less than 1 foot in average depth have been created. Under certain meteorologic conditions, temperature downstream from the larger ponds may be 5°–7° C lower than concurrent temperatures just upstream.

As previously noted, virtually all man-made ponds on Long Island have timber stoplog control dams, and there is no way of releasing water from the ponds except over the top of the highest plank in the dam. Some leakage does, of course, occur between the planks, but this flow is usually small compared with that coming over the top of the dam. Releases from the middle and lower levels of ponds would tend to raise winter stream temperatures somewhat. However, in view of the relatively small volume of water stored in even the longest ponds on Long Island, it is doubtful whether the higher downstream temperatures would amount to much more than 0.5°–1° C.

The light to moderate rainfall that fell throughout the study area during the afternoon of January 27 was quickly absorbed and retained by drought-parched soils. Runoff to the streams was, therefore, much less

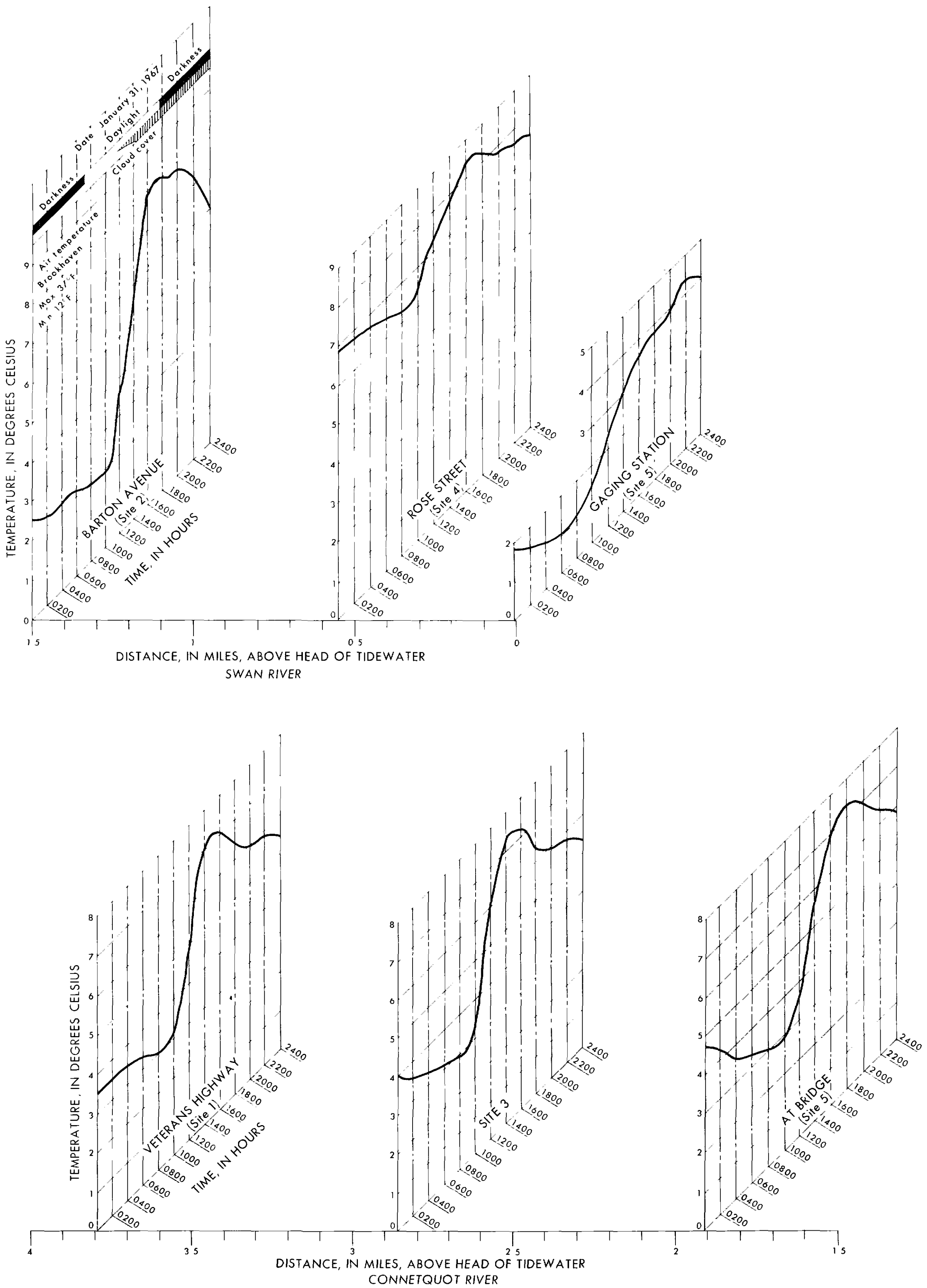

Figure 22.—Stream temperatures at selected study sites on Swan River and Connetquot River, January 31, 1967.

than might be expected from a rainfall of 0.5–1.0 inch, which much of the area experienced. The continuous record obtained at site 4 (fig. 6) on East Meadow Brook did, however, show a drop in stream temperatures of about 1° C during the rain period. Much of this drop in temperature can be attributed to incoming storm runoff, which was 3°–4° C colder than ambient stream temperatures.

The results of an analysis of variance test of significance are given in table 5.

TABLE 5.—*Two-way analysis of variance applied to the January 25–31, 1967, water-temperature survey*

Source of variation	Sum of squares	Degrees of freedom	Mean square	Variance ratio
Among sites	9.25	4	2.31	1.83
Among streams	.98	4	.24	.19
Error	20.11	16	1.26	
Total	30.34	24		

NOTE.—Temperatures observed at site 5W on East Meadow Brook are not included in this analysis.

The variance ratios indicate that, statistically, the observed differences in temperature are not significant. The relatively large variance ratio found among the sites is due principally to the tendency to encounter heavy ground-water inflow in the middle reaches of Long Island watercourses. This inflow, in turn, raises water temperature in these reaches in winter relative to temperatures observed in the lower and upper reaches of most streams.

Nine continuous thermographs were used in this survey, and the hourly temperatures observed at each are shown in the summary of data on page D98–D100.

TEMPERATURE SURVEY 3, APRIL 19–25, 1967

WEATHER

Unstable cyclonic circuation around a storm off New England produced generally cloudy cool weather on April 19. A high pressure cell moving southeastward out of eastern Canada resulted in a rapid clearing trend and seasonable temperatures on the 20th. Cloudiness gradually increased during the next 2 days, as a complex low-pressure system over the Great Lakes drifted eastward to the St. Lawrence River valley on the 22d. Despite the rather intense storm center, only light showers were reported over Long Island on the 22d. With the passage of the storm, clear cool weather returned the following day. A poorly organized, but intensifying low-pressure system moved eastward to a position south of Long Island on the 24th. This storm system pumped cold moist air from the ocean, triggering light continuous rainfall during the forenoon and early afternoon of the 24th. Air temperatures fell far below seasonal levels during the rain period, reaching the low thirties near midday in parts of the island. Rapid clearing set in early on the 25th as the storm center moved out into the ocean. See summary of data on page D76–D82 for a tabulation of pertinent meteorologic data, during the survey period.

SYNOPTIC STREAM-TEMPERATURE PATTERNS

Mean temperatures among the 25 sites studied during this survey were, by far, the most uniform of any of the five temperature surveys. Somewhat paradoxically, the average range of daily temperatures during the April run were among the largest of any temperature survey. Mean daily site temperatures, as given in table 6, were within 2.4°C of each other, whereas the mean range of daily temperatures varied from 2.0°C at site 5E on East Meadow Brook to 7.6°C at site 2 on Swan River.

TABLE 6.—*Mean temperature and average daily temperature range (figures in parentheses), in degrees Celsius, for five study streams, April 19–25, 1967*

Temperature site	Stream: East Meadow Brook	Sampawams Creek	Champlin Creek	Connetquot River	Swan River
1	11.0	11.9	12.8	11.1	10.6
	(5.0)	(4.3)	(7.1)	(7.0)	(4.8)
2	11.9	12.1	11.3	11.0	12.4
	(6.6)	(3.6)	(5.6)	(6.6)	(7.6)
3	11.6	11.7	11.1	10.9	11.0
	(4.2)	(3.1)	(3.7)	(5.8)	(4.3)
4	12.0	11.9	12.0	11.1	11.7
	(5.0)	(3.1)	(4.9)	(5.9)	(4.7)
5	[1] 11.6	13.0	11.7	11.4	11.0
	(2.0)	(4.4)	(2.8)	(5.4)	(2.6)

[1] Recorded at site 5E (fig. 6).

The amount of temperature fluctuation which a given reach will undergo during any particular day is a function of the weather, the amount of surface area exposed to solar radiation, the volume of water stored in the reach, and the quantity of advected heat above the study site. Of great importance in determining diurnal temperature fluctuations is amount of solar radiation that is absorbed by the reach. Under natural conditions, stream-temperature fluctuations on a cloudy dull day are not likely to be very large. On the other hand, diurnal fluctuations may be surprisingly large under cloudless skies in the spring or early summer when the intensity of solar radiation is high. To illustrate this point, the temperature patterns of selected sites on two study streams are plotted in figure 23 for April 25, 1967, a nearly cloudless day. Shortly after sunrise, temperatures at the upstream sites of both streams began a rapid rise which terminated at 140

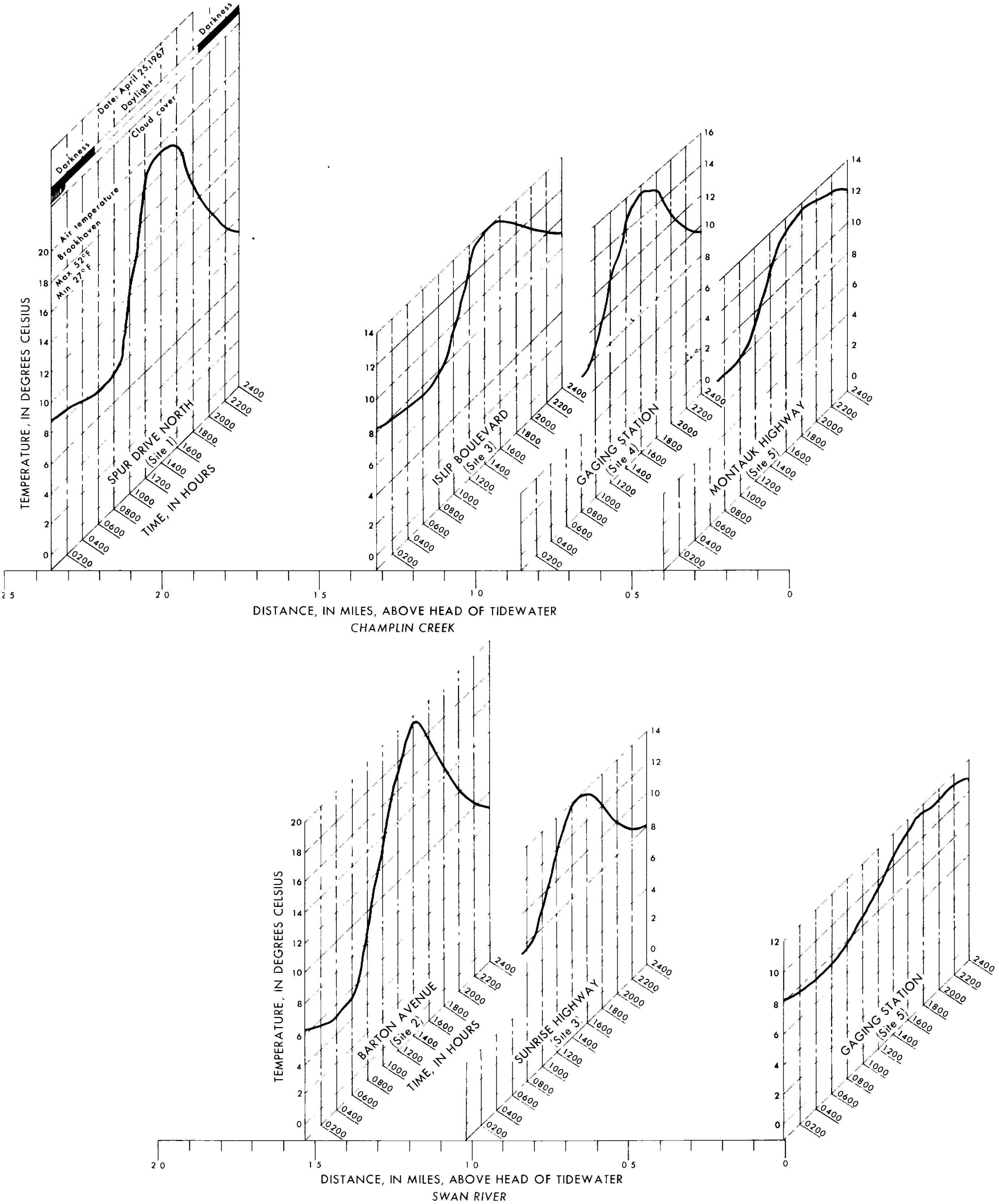

Figure 23.—Stream temperatures at selected study sites on Swan River and Champlin Creek, April 25, 1967.

hours. The range of temperatures was 11.6°C at site 1 on Champlin Creek, and 13.9°C at site 2 on Swan River, far more than the average for the study period as given in table 6. Clearcutting of trees and a shallow impoundment just above Barson Avenue at Swan River increased the effect of absorbed radiation on temperature to near optimal levels. The daily temperature patterns quickly attenuate downstream at Swan River because of (1) the relatively larger discharges, (2) the stabilizing effects of substantial quantities of ground water entering the stream at uniform temperature above Sunrise Highway, and (3) the substantial heat-storage capacity of Swan Lake just upstream from the gaging station.

The effect of ponding on diurnal-temperature fluctuations between adjacent sites along Swan River is illustrated in figure 24. Site 2 at Barton Avenue just below a very shallow pond normally exhibits diurnal-temperature changes up to twice the amplitude of that at site 1. The situation between sites 4 and 5 (dashed lines on the graph) of the same stream is exactly the opposite. Ponding by the relatively large lake above the gaging station sharply attenuates daily-temperature fluctuations along the reach. A similar dampening of daily temperatures between site 4 and 5 on Champlin Creek is portrayed by the dashed lines in figure 25. In this graph, solar intensity in langleys per day (1 langley is equal to 1 gram calorie per square centimeter) is plotted against standard deviation of hourly temperature which was computed over daily time spans. This latter statistic gives an index of variability—the

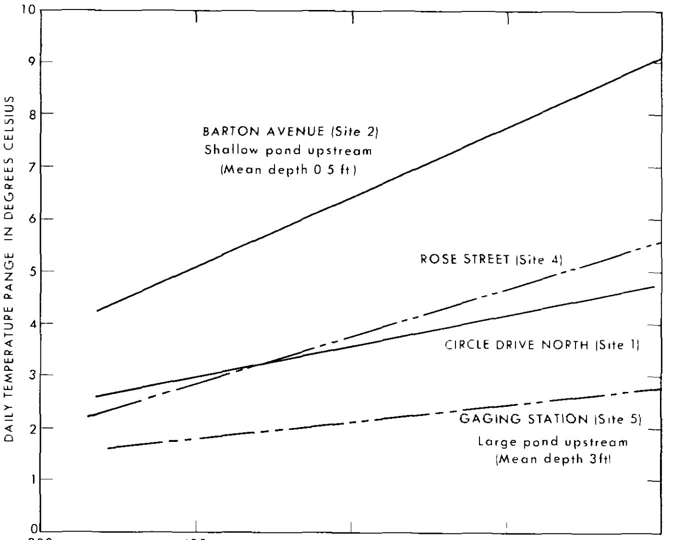

FIGURE 24.—Range of daily temperature at selected sites on Swan River during the period June 7–13, 1967.

higher the standard deviation the greater the daily-temperature change. The reduced range in daily temperature between sites 4 and 5E on East Meadow Brook is due to a combination of ponding and the additional stabilizing effect of substantial quantities of ground-water being discharged from a storm sewer between the sites.

The cause of the large temperature fluctuation at site 1 on Champlin Creek (fig. 23) is not immediately apparent. Although discharge at this point averages only about 1 cfs, a factor favoring large thermal variations, the upstream reach is heavily forested, which tends to reduce diurnal temperature changes. However, deciduous trees are the dominant form of vegetation, so that a considerable amount of sunlight penetrates to the stream prior to the appearance of leaves. Thus, the ability of natural cover to dampen daily temperatures is, under these circumstances, something less than optimal.

As shown in figure 23, the range in temperature at the Champlin Creek gaging station is somewhat larger than at the next upstream site (Islip Blvd.) principally because of a small pond (fig. 13) between the sites. Aside from this one instance, there is a general decrease in daily-temperature change in the downstream direction along the stream—this same pattern is exhibited at Connetquot River (table 6). Owing to the short lengths of all Long Island streams, it is not possible to state positively that, under natural conditions, daily-temperature changes will decline in the downstream direction. However, this statement appears reasonable, since most streams undergo proportionately larger increases in volume of water stored than in surface area gain in the downstream direction. Therefore, substantial heat-storage capacity is gained in the lower reaches of streams, a factor which tends to dampen short-period thermal variations.

To assess the effect of forest cover on diurnal fluctuations, five thermographs were installed at each of the Connetquot River temperature sites. The study period covered a 5-day span (Aug. 13–17, 1968). Calibration checks were made on each instrument at least once daily in order to correct for possible instrument "drift." Shading indices for each reach are average values of a series of observations spaced about 275 feet apart along the length of the stream. Connetquot River was selected because there is no significant pondage above the "at bridge" (site 5) location, thereby eliminating the effect of this important factor on stream-temperature fluctuations.

The mean daily range of temperature was about 4.5°–5° C along the heavily forested upper reaches of the stream (fig. 26). Although other factors, such as

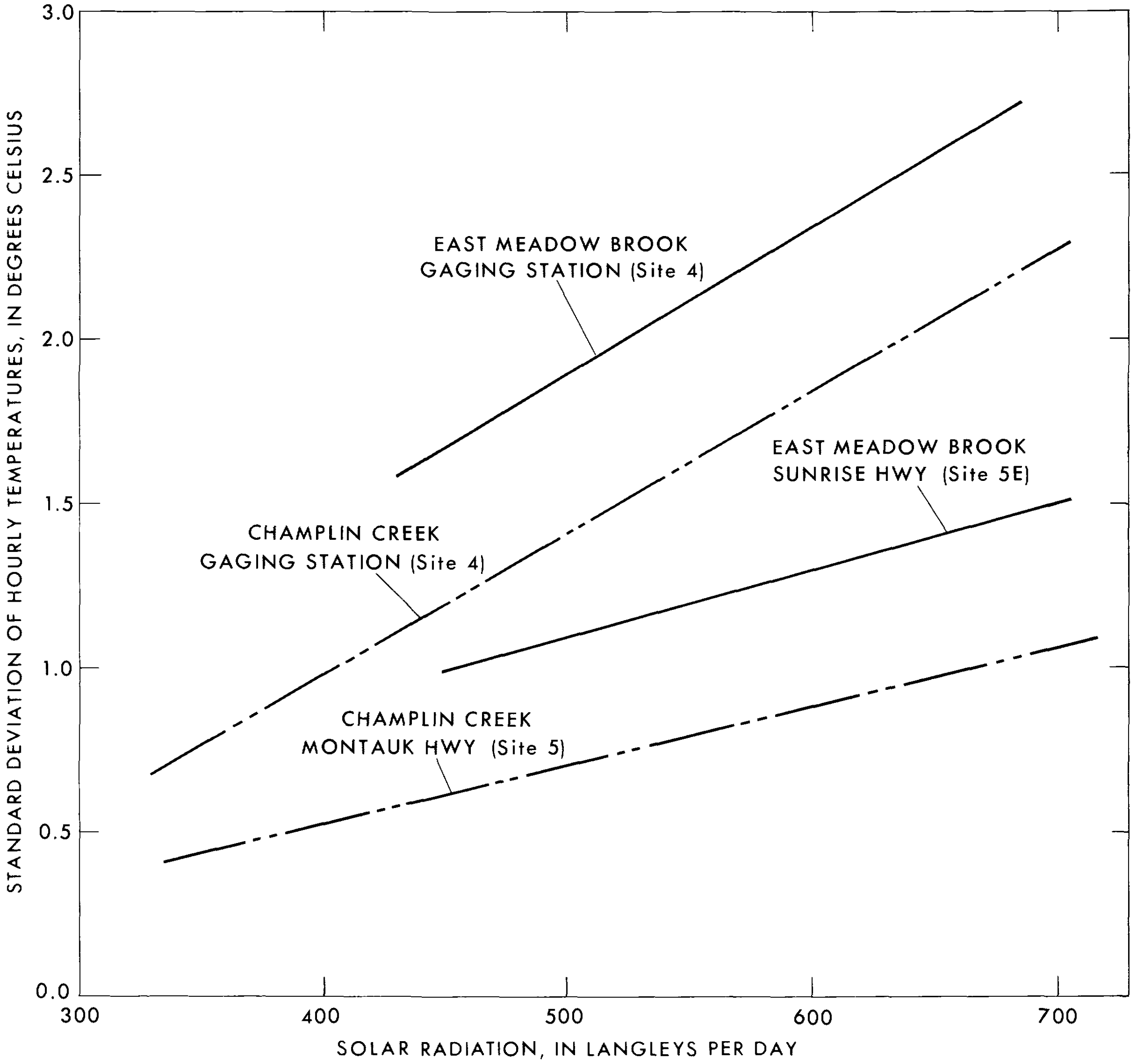

FIGURE 25.—Variability of daily temperature at selected sites on Champlin Creek and East Meadow Brook.

the surface area-to-volume ratio, tend to complicate the analysis, there is a definite increase in daily-temperature fluctuation as the shade effect of bank vegetation diminishes. For example, based on the trend line in figure 26, the mean range of daily stream temperatures increased by about 1.7° C as the shade index decreased from 4.2 to 2.8.

The heat-flux factor most affected by variable forest cover is solar radiation. Daytime, especially afternoon stream temperatures are likely to be altered with changes in forest cover. Therefore, the bulk of the increase in the diurnal range of stream temperatures due to varying vegetative cover is reflected in the daily maxima. Accordingly, by extending the trend line in figure 26, it may be stated that clearcutting of all vegetation in the heavily forested reaches of the Connetquot River would increase maximum daily temperatures by as much as 3.5° C during the summer.

The seasonal relationships between diurnal temperature fluctuations and the intensity of solar radiation, expressed in langleys per day, are shown in figure 27. From this graph it is apparent that a strong seasonal effect exists which governs diurnal stream-temperature fluctuations. Under a similar radiation input, the temperature response may be four times greater in winter and in the early spring as it is during the summer. These wide variations are due almost entirely to the shade provided by the forest canopy. In summer, under full leaf development, forest cover is very effective in intercepting solar energy before it reaches the stream. Therefore, temperature fluctuations are not nearly so large as in the early spring when the

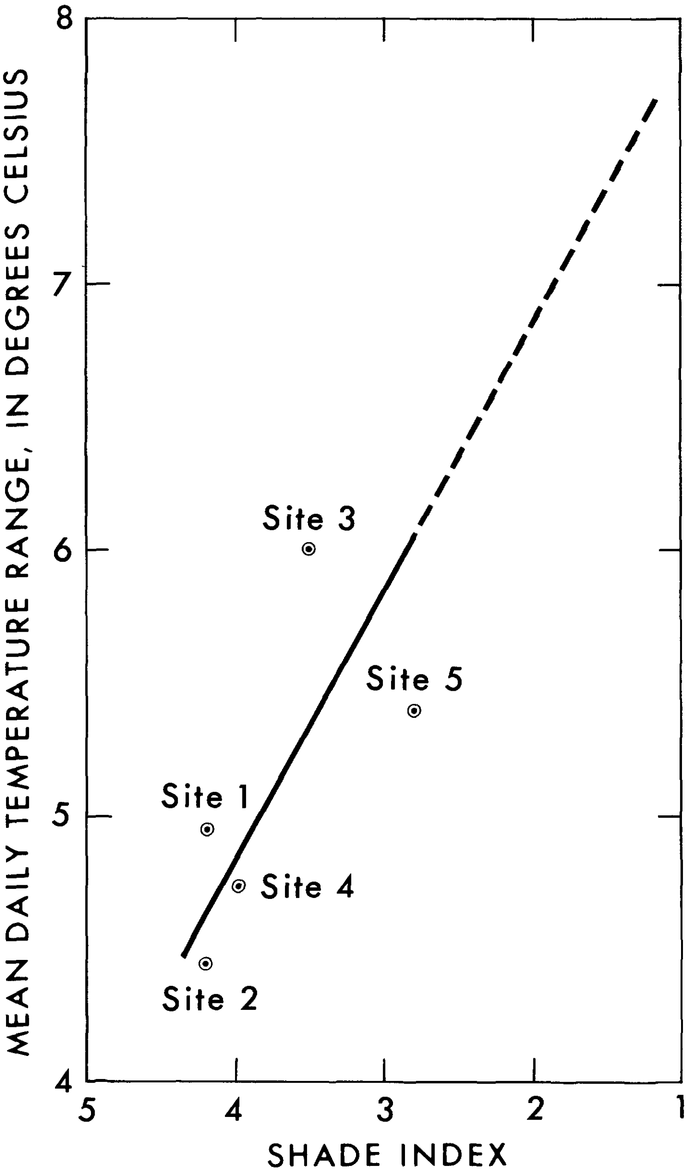

FIGURE 26.—Relation of diurnal range of temperature to forest cover in the upper reaches of Connetquot River, August 13–17, 1968.

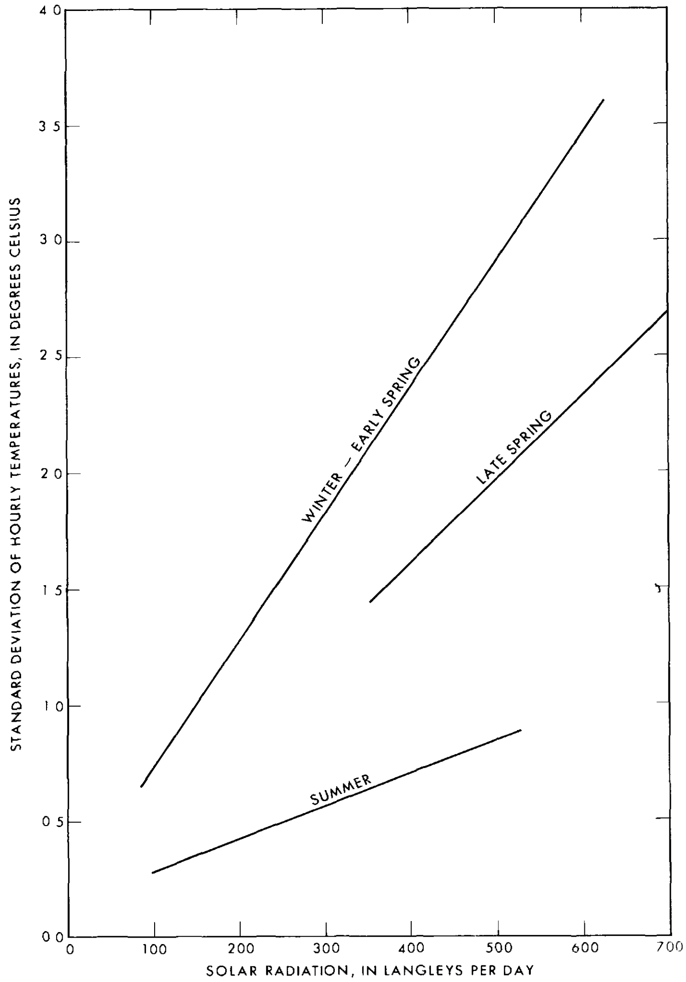

FIGURE 27.—Seasonal variation of daily-temperature fluctuations at Veterans Highway (site 1), Connetquot River.

trees are bare. This same general relationship holds for all other forested reaches in this study.

Light rainfall on April 24, 1967, generated sufficient runoff to permit a study of the effect of storm runoff on stream-temperature patterns. As previously noted, the rain fell at a time when air temperatures were far below seasonal levels. If, under saturated atmospheric conditions, it is assumed that the temperature of precipitation is equal to the wet-bulb temperature, it may be inferred that the temperature of the rainfall on April 24, 1967, was equivalent to ambient air temperature, since relative humidity during the rain period was nearly 100 percent. The temperature of the runoff generated on the 24th was close to that of the precipitation (1.5°–3° C). Stream temperatures ranged from 7° to 10° C so that a "cold" runoff situation existed—that is, runoff entering the streams generally lowered stream temperatures.

Throughout the rainfall period, little or no change in stream temperature was observed on the control stream. The thermograph at site 1 on the Connetquot River recorded a temperature decline of less than 0.5° C, which was due to runoff from Veterans Highway being discharged by a culvert just above the thermograph. There was no discernible change in stream temperature at sites 3 and 5. Temperatures at site 1 on East Meadow Brook (the most urbanized study basin) dropped nearly 3° C, owing to heavy incoming street runoff; much smaller declines were observed at site 1, above which there is little direct runoff to the stream. Temperatures at site 5 on both Champlin Creek and Swan River fell 2.2° C and 3.3° C, respectively, owing to a combination of storm runoff and direct contact of cold precipitation with the extensive surface-water areas of upstream lakes.

As in the two previous surveys, there were no statistically significant differences in average temperatures among streams or sites (table 7).

TABLE 7.—*Two-way analysis of variance applied to the April 19–25, 1967, water-temperature survey*

Source of variation	Sum of squares	Degrees of freedom	Mean square	Variance ratio
Among sites	0. 94	4	0. 23	0. 79
Among streams	3. 10	4	. 77	2. 66
Error	4. 68	16	. 29	
Total	8. 72	24		

NOTE.—Temperatures observed at site 5W on East Meadow Brook are not included in this analysis.

TEMPERATURE SURVEY 4, JUNE 7–13, 1967

WEATHER

A nearly stationary frontal system across upper New York State induced a broad southwesterly flow of air over Long Island for almost the entire study period. A succession of clear to partly cloudy days began just prior to the survey period and extended through June 12. Air temperatures were near seasonal levels on the 7th, but they gradually increased until the 12th when 90°F reading were common over western Long Island in areas away from the coast. This early season heat wave represented some of the warmest weather of a summer noted for its cool cloudy wet weather. It was not until the early morning hours of the 13th when the front slipped south of Long Island that any real change in weather occurred. But even with this development, the only significant weather change was a drop in temperature to near-normal levels and some increase in cloudiness. Little or no rainfall fell during the survey period. See summary of data on page D83–D89 for a tabulation of pertinent meteorologic data.

SYNOPTIC STREAM-TEMPERATURE PATTERNS

The fine warm weather presented an excellent opportunity to study summer stream temperatures averaged above 20°C at several sites, as shown in table 8. Average temperatures among the 25 sites ranged from 13.9°C. at site 3 at Swan River to 22.5°C at site 2 at Sampawams Creek.

Temperature patterns for Connetquot River and Champlin Creek, typical of sunny warm-weather situations, are illustrated in figure 28. The absorption of solar energy was near the maximum possible at all sites owing to the clear-sky conditions. In response to the flood of heat energy, temperatures at all sites rose sharply beginning about 0800 hours. Temperature patterns along the control stream were once again, all very similar. The range of temperature was 5° C at site 3 and nearly 7° C at sites 1 and 5 on Connetquot River. Strikingly dissimilar patterns were recorded at Champlin Creek. The high temperatures at site 1 are primarily the result of warm effluent from the Central Islip State Hospital (fig. 13). The cooling effect of heavy ground-water inflow is readily apparent in the temperature-time plot for Islip Boulevard (fig. 28). Temperatures at that point were 5°–7° C below concurrent temperatures at sites 1 and 5. Temperatures at the gaging station fell between the extreme values of sites just upstream and downstream; however, a much larger temperature fluctuation is apparent. Shallow ponds and the removal of natural vegetation upstream from the gaging station contributed to rapid rise of temperatures at site 4 during the day. The warm temperatures at site 5, particularly at night, are due to the large heat capacity of Knapps Lake and the relatively slow release of that heat to the atmosphere at night.

TABLE 8.—*Mean temperature and average daily temperature range (figures in parentheses), in degrees Celsius, for five study streams, June 7–13, 1967*

Temperature site	Stream: East Meadow Brook	Sampawams Creek	Champlin Creek	Connetquot River	Swan River
1	17. 0	17. 8	20. 6	15. 3	14. 4
	(7. 3)	(6. 1)	(4. 4)	(6. 5)	(4. 1)
2	21. 1	22. 5	16. 8	15. 6	18. 6
	(9. 8)	(6. 0)	(5. 4)	(6. 1)	(7. 5)
3	21. 9	20. 7	15. 3	15. 7	13. 9
	(7. 8)	(5. 8)	(3. 6)	(5. 7)	(3. 9)
4	20. 0	20. 7	17. 2	15. 9	14. 9
	(6. 3)	(5. 6)	(5. 1	(5. 8)	(4. 5)
5	[1] 17. 4	20. 7	22. 3	15. 9	20. 4
	(3. 6)	(8. 8)	(2. 5)	(6. 1)	(2. 8)

[1] Recorded at site 5E (fig. 6).

Without exception, temperature increases of more than about 1° C in the data given in table 8 between successive sites in the downstream direction are due to the exposure of large water surfaces to the sun's radiation. Much of the sharp rise between sites 1 and 2 on East Meadow Brook and Sampawams Creek is due to the creation of shallow ponds and stripping of natural cover from the banks of both streams. From the Connetquot River data it may be inferred that, under natural conditions, maximum temperature differentials of only 0.5°–1.5° C can be expected between any two measuring sites. The extreme variation of mean temperature for the study period among sites on the four urban affected streams ranges from 4.7° C at Sampawams Creek to 7.0° C at Champlin Creek. Concurrent temperature differentials between sites of nearly 8.5° C were observed

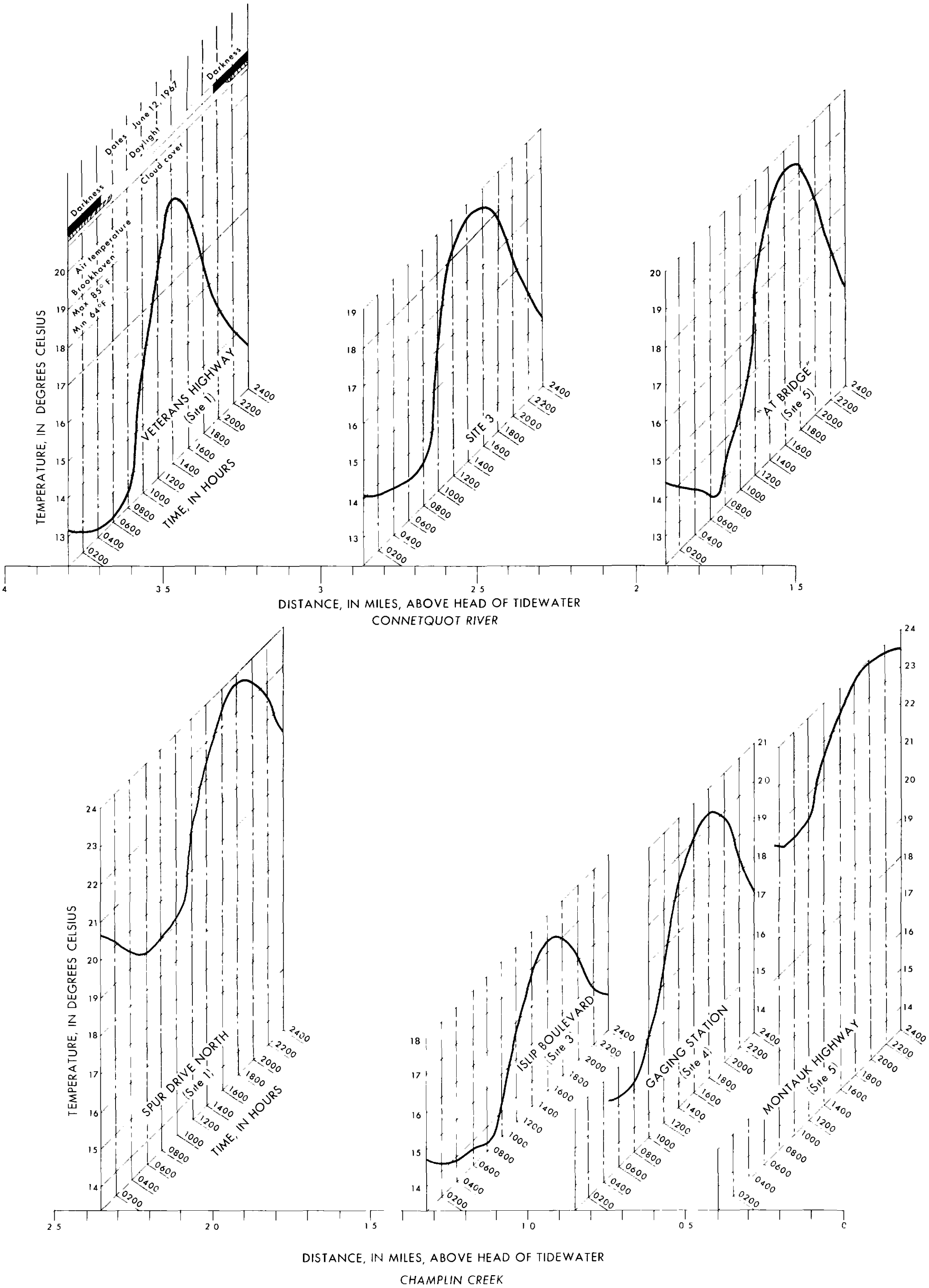

FIGURE 28.—Stream temperatures at selected study sites on Connetquot River and Champlin Creek, June 12, 1967.

at Champlin Creek during this survey, and under natural conditions this differential would have been, at most, only about 2° C.

A comparison of the range of daily temperatures during June with those observed in April shows that the most urban-affected streams, East Meadow Brook and Sampawams Creek, had larger daily temperature changes in June; but that the remaining streams experienced either about the same daily fluctuation, or slightly higher diurnal changes during April. Assuming all other factors to be equal, owing to longer days the amount of solar radiation absorbed in June would be greater than that absorbed in April. In natural or near-natural environments, however, the increase in shading between April and June seems to more than counteract the increase in available solar energy. The role of natural cover, however, is reduced sharply where such activities as clearcutting of trees, relocation of natural channels, and pond construction have occurred, as at both East Meadow Brook and Sampawams Creek. Therefore, the effect of shade differences stemming from vegetal cover on daily water-temperature patterns is sharply reduced in urban settings, and the number of hours of sunshine becomes the dominant factor controlling diurnal temperature changes.

The overall seasonal temperature differences among the study streams are portrayed in figure 29. The spread (shaded areas) between the temperatures obtained during these surveys (Jan. 25–31 and June 7–13, 1967) provides an index of the actual winter-summer range of temperature. Temperatures at Connetquot River are very stable from reach-to-reach and seasonal differences are only about 8°C. Widely varying temperature pattens are noted at most other streams. The distortions in this plot of seasonal temperature fluctuations among the various sites is, of course, due to man-made alterations in the natural environment of the affected streams. Much of the thermal variation in the Champlin Creek and Swan River plots is related to the increased absorption of solar energy caused by man's activities. Another less obvious factor that doubtless has contributed to increasing the seasonal spread of temperatures is reduced ground-water inflow to East Meadow Brook and, to a lesser extent, to Sampawams Creek. The low rate of pickup in both these streams (figs. 15, 18) suggests that a depletion of ground-water inflow due to urbanization has taken place. The reduction of inflow from the ground-water reservoir, by itself, would decrease winter temperatures and increase summer temperatures of all affected streams. That such thermal changes have occurred at East Meadow Brook is beyond question, but assessing the extent of the overall change due to reduced seepage is a very difficult matter. This is particularly true because no seepage studies were conducted prior to urban development, so that the loss of pickup (ground-water inflow) cannot be evaluated with any great degree of accuracy.

Results of a statistical analysis applied to the data in table 8 are summarized in table 9.

TABLE 9.—*Two-way analysis of variance applied to the June 7–13, 1967, water-temperature survey*

Source of variation	Sum of squares	Degrees of freedom	Mean square	Variance ratio
Among sites	19.33	4	4.83	0.98
Among streams	81.48	4	20.37	[1] 4.16
Error	78.54	16	4.90	
Total	179.35	24		

[1] Significant at the 95-percent level.

NOTE.—Sum of squares determined after first subtracting 10.0 from all values in Table 8. Temperatures observed at site 5W on East Meadow Brook are not included in this analysis.

The hypothesis underlying this test is that there is no real difference among the sites and streams—that is, the observed differences were due to chance. For the degrees of freedom available, a variance ratio exceeding 3.01 is significant at the 95-percent level. Thus, the temperature differences among the streams is considered real and is attributed to man's activity.

Thirteen continuous thermographs were used in this survey, and the hourly temperatures observed at each are given in the summary of data on page D104–D105.

TEMPERATURE SURVEY 5, AUGUST 24–30, 1967

WEATHER

A stationary front over southern Virginia on August 24 drifted slowly northward during the next 2 days, causing rainfall on Long Island by the 25th. Moderate to heavy shower activity was widespread on the morning of the 25th, and intense rainfall fell on the East Meadow Brook basin late the same night. Rainfall amounts averaged 2 inches or more on the 25th in all parts of the study area. Unsettled weather continued through the 27th when a high pressure area began drifting eastward from the lower Mississippi Valley. Fine late summer weather prevailed from August 28–30 as a result of the eastward moving high-pressure system. Pertinent meteorologic data for this survey are given in the summary of data on page D90–D96.

SYNOPTIC STREAM-TEMPERATURE PATTERNS

With the possible exception of the last few days of this survey, weather conditions were sharply different from the June study period. Runoff generated by the heavy precipitation during the early and middle periods

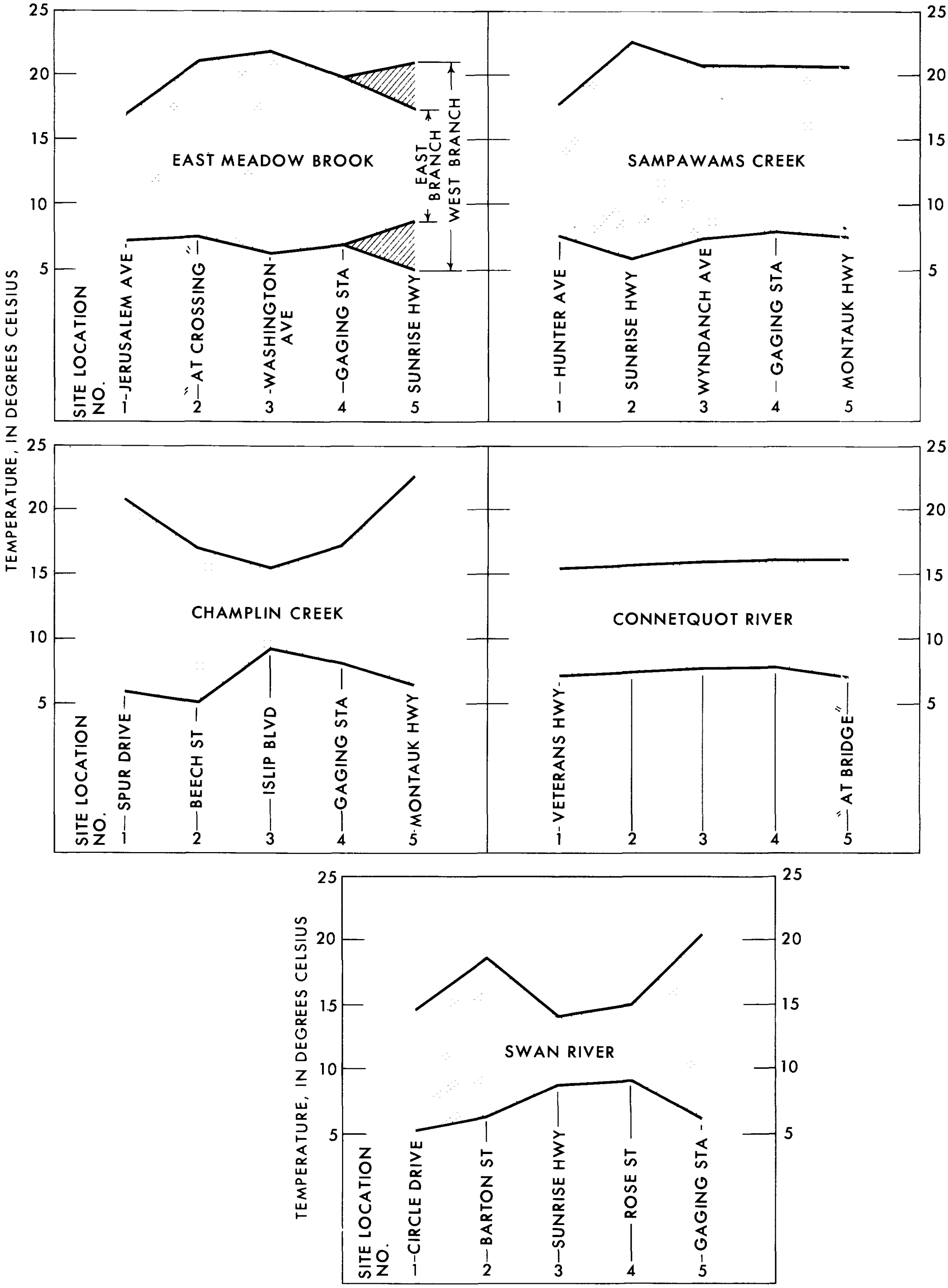

FIGURE 29.—Mean temperature for five study streams during the June (upper curves) and January (lower curves) 1967 temperature surveys.

of this survey provided a unique opportunity to study the effect of storm runoff on stream-temperature patterns. Overall, water temperatures during this survey were 1.5°–2°C cooler than during the June study period as shown in table 10. Daily-temperature fluctuations were down sharply from those of June, owing to the shorter days, but more importantly, to the generally cloudy conditions during the August survey. Temperatures of the control stream were remarkably uniform as shown by the range of temperatures (0.2° C) among the five sites.

TABLE 10.—*Mean temperature and average daily temperature range (figures in parentheses), in degrees Celsius, for five study streams, August 24–30, 1967*

Temperature site	Stream: East Meadow Brook	Sampawams Creek	Champlin Creek	Connetquot River	Swan River
1	18.4 (2.2)	18.1 (2.7)	20.4 (2.2)	13.7 (1.8)	14.9 (3.3)
2	20.3 (3.4)	18.4 (2.6)	17.4 (2.2)	13.6 (2.2)	16.3 (5.0)
3	20.4 (2.0)	18.0 (1.9)	15.2 (1.8)	13.7 (2.0)	13.5 (2.1)
4	19.3 (2.3)	17.9 (2.0)	16.0 (2.1)	13.8 (2.2)	13.8 (2.7)
5	[1] 19.3 (1.4)	18.0 (2.6)	19.5 (1.8)	13.8 (2.7)	18.3 (1.6)

[1] Recorded at site 5E (fig. 6).

The effect of storm runoff on stream-temperature patterns is portrayed in figure 30. As shown in the upper left section of the figure, cloudiness was complete during August 25, 1967, and heavy intense rainfall beginning just before 0400 hours gradually tapered off during the forenoon, stopping around 1400 hours. Another intense burst of rain lasting about 1 hour began at 2100 hours. Air temperatures were near 60° F during the early morning and then rose slowly, leveling off near 60° F (lower left part of fig. 30). Mean daily discharge at the East Meadow Brook gaging station was 3.7 cfs on August 24, but this rose to 95 cfs on the 25th, a 2,500 percent increase. Discharge at the Connetquot River gaging stations was 29 cfs on August 24, and 42 cfs on the 25th, a 70 percent increase.

Stream temperatures at Connetquot River (control stream) showed little change throughout August 25. A slight rise in temperature at site 1 was probably due to incoming stormflow from Veterans Highway. Overall, it is apparent that under natural conditions the heavy rainfall on the 25th had very little effect on the temperature patterns of Connetquot River. The situation at East Meadow Brook is very different. Temperatures at Jerusalem Avenue (site 1) started to rise shortly after the rain began. This was doubtless due to street runoff which entered the stream at temperatures ranging from 1° to 2°C above ambient air temperatures. Stream temperatures continued to rise throughout the day in response to the slowly rising air temperatures. A sharp increase in stream temperature occurred just prior to 2200 hours in response to an intense rain shower at that time. Temperatures continued to rise at this site for several hours beyond midnight of the 25th, reaching a peak of nearly 21°C during the early morning hours of the 26th. Thus, the effect of storm runoff altered temperatures by as much as 5.5°C at this upstream site.

Temperature changes at the East Meadow Brook gaging station (site 4), on the other hand, showed little apparent response to the heavy runoff. There were two slight rises due to rapidly rising discharges, but no definite trend is discernible. Temperatures at site 5E show a fairly sharp rise of nearly 3.5°C between 0400 and 1200 hours. Much of this rise can be ascribed to a flushing action of the East Meadow Ponds (fig. 6) which contained a large quantity of warm water. Increased inflow simply displaced much of the water in residence in the lakes, and the movement of this water past the thermograph resulted in the sharp rise in temperatures at site 5E.

The extent to which direct runoff may alter stream-temperature patterns depends on such factors as the difference in temperature between the incoming runoff and the stream, the quantity of runoff entering the stream and its magnitude relative to streamflow, and the existence man-made "improvements" which may create anomalous temperature patterns as at site 5E on East Meadow Brook. The temperature of the incoming runoff is a function principally of (1) the temperature of the precipitation that is generating overland runoff, (2) ground temperature, and (3) the distance and time required to convey runoff to the stream.

Under natural conditions little, if any, runoff is generated much beyond the banks of Long Island streams. Accordingly, only item 1 is of any consequence in altering temperatures of nonurbanized streams under wet-weather conditions. Since the bulk of the "runoff" which reaches natural streams on Long Island is precipitation falling directly on the stream itself, the ratio of total stormflow to total base flow (dry-weather flow) is normally much less than unity. Stream temperatures are, therefore, seldom changed by much more than a few degrees during rainy periods. As a basin becomes urbanized, progressively greater amounts of runoff are conveyed to streams. In the highly urbanized East Meadow Brook basin the volume of storm runoff past the gaging station is more than twice the amount received from ground water for storms yielding 1.5 inches or more of rain (G. E. Seaburn, oral commun., 1968). Clearly, if the temperature difference between the base

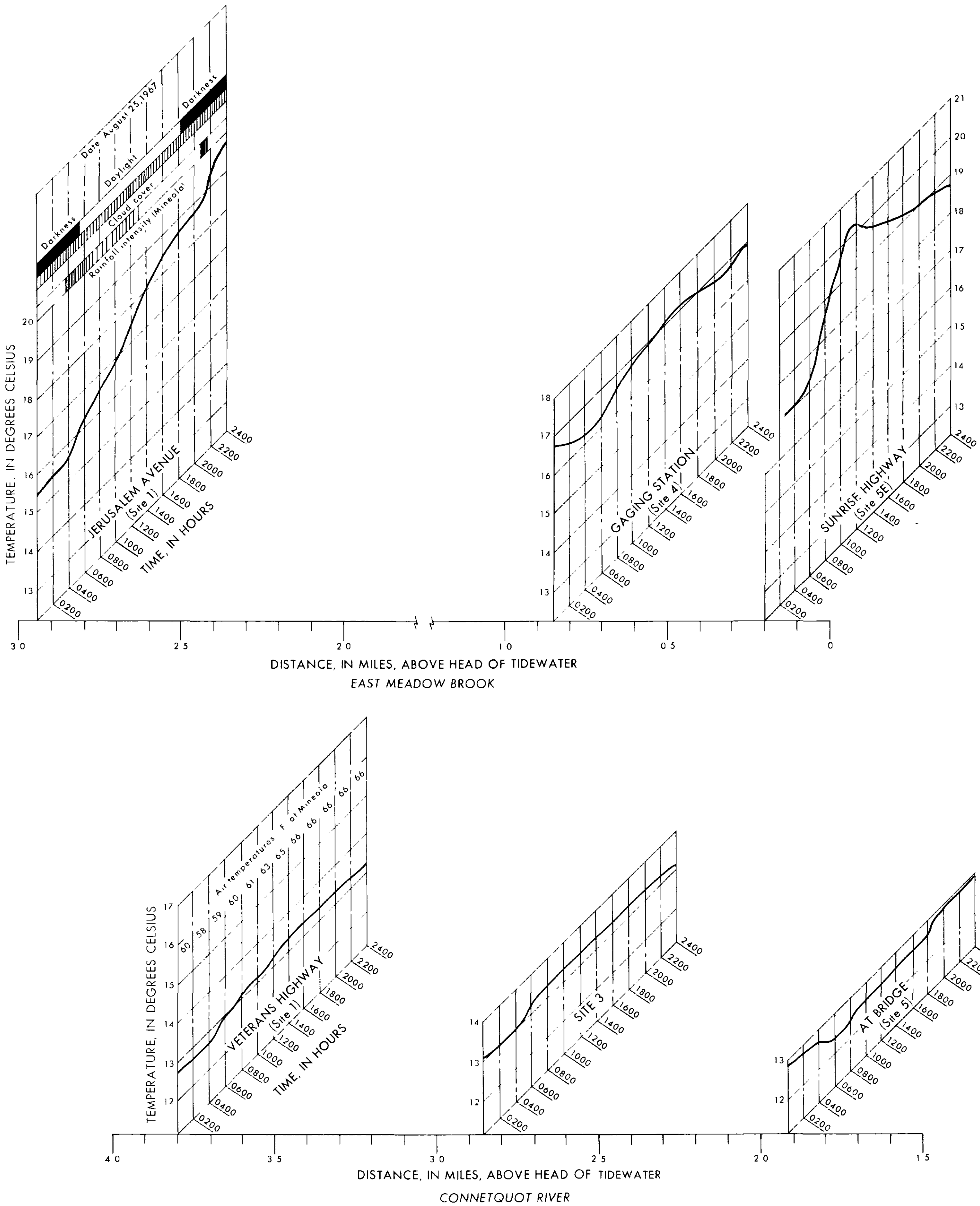

FIGURE 30.—Stream temperatures at selected study sites on East Meadow Brook and Connetquot River, August 25, 1967.

flow past the gaging station and the storm runoff is large, then significant stream-temperature changes will result.

The heavy shower activity on August 26, 1967, is used to illustrate the magnitude of the temperature changes that may occur when large thermal differences exist between incoming street runoff and the stream itself. This discussion is limited to Swan River where the time of travel of stormflow to the stream is fairly constant from source to mouth, thereby minimizing the effects of item 3 on stream temperature. Pertinent data are given in table 11.

TABLE 11.—*Temperatures, in degrees Celsius, at Swan River at East Patchogue, August 26, 1967*

Time (hours, e.s.t.)	Circle Drive North (site 1)	Barton Avenue (site 2)	Sunrise Highway (site 3)	Gaging Station (site 5)
1300 (prior to storm)	13	14	12	16
1430 (at or near peak discharge)	22	22	16	18
Increase due to storm runoff	+9	+8	+4	+2

Air temperatures were near 21° C at the time of the shower which yielded about 0.75 inch. Because the relative humidity was near 100 percent throughout the period of rain which fell from 1315 to 1500 hours, the temperature of the precipitation is also assumed to have been about 21° C. Street runoff entering the stream averaged about 23° C—slightly higher than the precipitation, owing to heat gained from warm street surfaces.

An overflowing off-channel recharge basin above Circle Drive North (site 1) poured relatively large quantities of warm street runoff into Swan River from an 18-acre housing development just west of the stream (fig. 17). The resultant mixture of storm runoff (23° C) and base flow (13° C) produced a temperature of 22° C at site 1, 9° C above prestorm levels. A similar situation existed at Barton Avenue (site 2) where runoff from a 50-acre housing tract entered the stream above the temperature site. The ratio of storm runoff to base flow decreased sharply downstream from site 2, owing to heavy ground-water inflow. Accordingly, the effect of the warm storm runoff on stream temperatures at sites 3 and 5 is much less than at the upstream sites. Despite much heavier rainfall on August 25, 1967, little water-temperature change occurred on that date because both stream and overland runoff temperatures were very similar.

The analysis of variance of mean temperatures recorded during the August survey (table 12) shows that the variance ratio associated with thermal differences among streams, by chance is much smaller than 0.01 (one chance in a hundred). Much of the variability in the analysis is due to the high temperatures at East Meadow Brook relative to the temperatures recorded at Connetquot River and Swan River. The high ratio of storm runoff to ground-water inflow at East Meadow Brook and, to a lesser extent, at Sampawams Creek, during the study period doubtless aided in raising temperatures in both streams. However, because the average pickup rate at East Meadow Brook was only 0.4 cfs per 1,000 feet of channel compared with 1.6 cfs per 1,000 feet at Connetquot River and 1.1 cfs per 1,000 feet at Swan River, it is clear that the decrease of relatively cool ground-water inflow due to man's activities also contributed to the high summer temperatures at East Meadow Brook.

TABLE 12.—*Two-way analysis of variance applied to the August 24–30, 1967, water-temperature survey*

Source of variation	Sum of squares	Degrees of freedom	Mean square	Variance ratio
Among sites	9.99	4	2.50	1.41
Among streams	107.42	4	26.86	[1] 15.2
Error	28.31	16	1.77	
Total	145.72	24		

[1] Significant at the 99-percent level.

NOTE.—Sum of squares determined after first subtracting 10.0 from all values in table 10. Temperatures observed at site 5W on East Meadow Brook are not included in this analysis.

As previously noted, Hawleys Lake on Sampawams Creek between the gaging station (site 4) and Montauk Highway (site 5) was destroyed prior to the first thermal survey (fig. 9). As part of another study, the author gathered temperature data along the stream during 1959–60. By selecting days from the current survey that were similar with respect to type of weather and season and comparing them with days from the earlier study, it was possible to evaluate the effect of the lake on thermal patterns. For example, the hourly temperature differences between sites 4 and 5 are plotted in figure 31. Where the histogram lies above the 0-mark along the ordinate, temperatures at site 5 (below the lake) were warmer than at site 4 (above the lake); the reverse is true where the histogram lies below the 0-mark. A histogram of concurrent temperature differences on August 13, 1959, when the lake was intact, shows that stream temperatures run nearly 3°C higher at site 5 than at site 4 during the late afternoon. On August 29, 1967, a day meteorologically very similar, temperatures at site 5 were only about 0.5°C higher during the late afternoon than concurrent temperatures at the gaging station. No significant thermal differences between the days were observed during the predawn hours during either survey.

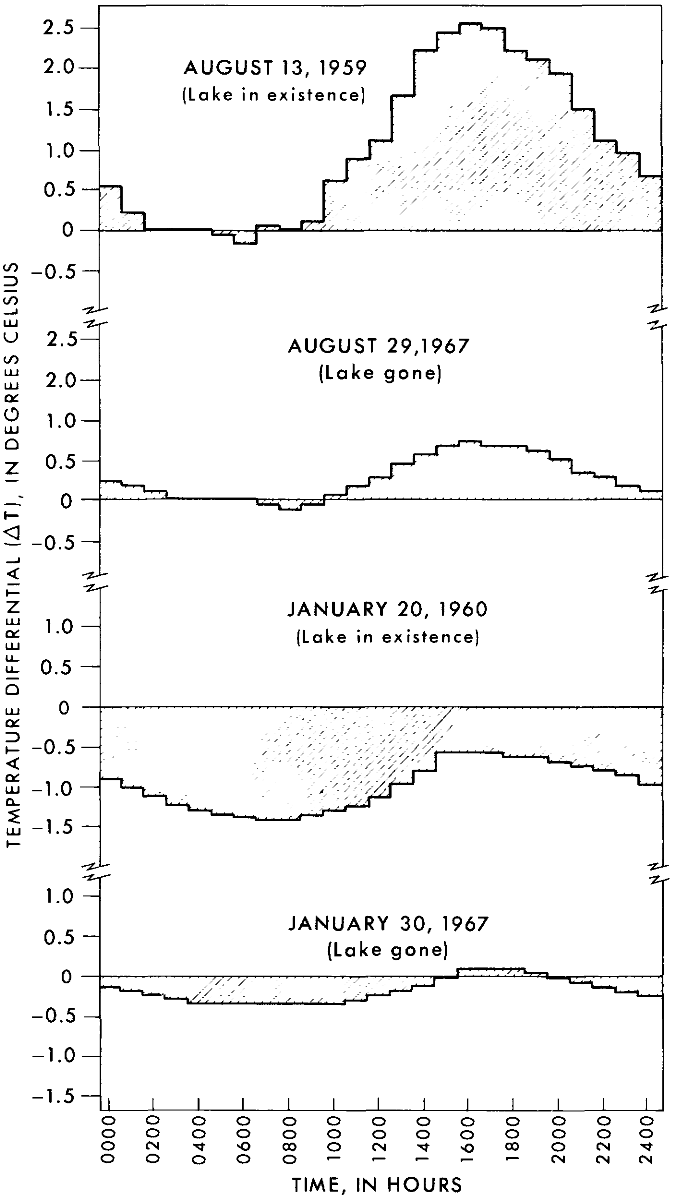

FIGURE 31.—Concurrent stream temperature differences between site 4 (gaging station) and site 5 (Montauk Highway) at Sampawams Creek. Negative or positive values indicate that site 5 is colder (−) or warmer (+) than site 4.

The situation in winter is reversed—prior to the destruction of the lake, temperatures were 0.5°–1°C colder at site 5 than at the gaging station, as indicated by a comparison of concurrent temperature differentials on January 20, 1960, and January 30, 1967, again 2 days which were meteorologically quite similar. Clearly, the destruction of Hawleys Lake has reduced the annual range of temperature downstream by lowering temperatures in summer and raising them in winter.

Records of 13 continuous recorders used during this survey are tabulated in the summary of data on page D106–D108.

SOME ECOLOGICAL OBSERVATIONS

To even the casual observer, it is readily apparent that there are certain distinct differences in the varieties of fish and aquatic vegetation found among the study streams. Trout inhabit Connetquot River, the middle reaches of Swan River, and Champlin Creek. Carp may be seen in the lower reaches of Champlin Creek and East Meadow Brook. Filmy colonies of blue-green algae abound in many reaches along East Meadow Brook, Champlin Creek, and Sampawams Creek. In short, there appears to be a direct relationship between types of aquatic growths and fish life on the one hand and stream-temperature regimen on the other. Trout are found principally along reaches that maintain relatively uniform temperatures throughout the year—that is, along reaches where ground-water inflow is large. Carp, sun fish, and bluegill are found in the larger lakes and in reaches downstream from the lakes.

The numerous clumps of water cress observed in many sections of the Connetquot River and in other reaches characterized by heavy ground-water inflow are seldom seen in East Meadow Brook or Sampawams Creek, both of which have been extensively affected by urbanization. An abrupt change in the types of aquatic growths found along East Meadow Brook is apparent in the vicinity of an area where a concentrated flow of ground water enters the stream at all times. Heavy growths of eelgrass shown in the lower part of figure 32, are commonly found in the East Branch below a culvert that continuously discharges ground water. Moderate temperatures found throughout the year in the East Branch are likely of critical importance to the survival of the eelgrass which is not found elsewhere in the streams.

Another form of aquatic growth that is dominant in the heavy ground-water fed reach between sites 3 and 4 on Swan River is pictured in the upper part of figure 32. These dark-green aquatic growths thrive in the cool even-temperature waters common to this channel. This particular growth provides excellent cover for trout and other fish found in the middle part of Swan River. In contrast to the lush aquatic growths founds in even-temperature reaches, little vegetation is seen during the summer in such high-temperature reaches as that between sites 1 and 3 on East Meadow Brook, near site 2 on Sampawams Creek, and above site 2 on Champlin Creek. The dominant growth in these channels is a slimy pond scum that accumulates in stagnant pools.

TEMPERATURE PATTERNS—SOME UNUSUAL TYPES

During the course of this investigation several unusual thermograph traces were recorded, two of which are portrayed in figure 33. The thermograph record (middle trace) shown in the upper part of the figure was obtained at site 5 just below Swan Lake on Swan River during a period of strong winds. These pulses span a 5° F (2.8° C) range of temperature during the afternoon hours of June 8 and 10, which coincides with the period of peak wind velocities. The normal mixing patterns of the lake were disturbed so that streams of alternately cool and warm waters passed over the outlet weir, and these sharply changing temperature patterns were large enough to be recorded by the sensitive Friez recorder in the gage house.

The effect of warm storm runoff entering the stream above the Swan River gaging station is illustrated in the lower part of figure 33. The actual volume of storm inflow relative to streamflow is very small, so that only slight temporary changes occurred.

Local regulation caused by the withdrawal of streamflow above the Sampawams Creek gaging station resulted in the unusual downward temperature drops recorded at the gage as shown in the upper part of figure 34. In this instance, relatively warm streamflow was removed by an upstream pumping station, thereby decreasing temperatures by momentarily increasing the importance of ground-water inflow in controlling stream temperatures in the reach between the pumping station and the gaging station. Since ground-water was entering the stream at temperatures close to 50°F (10° C), an immediate drop in temperature was recorded at the gaging station. Temperatures quickly recovered when pumping stopped.

A fairly rare event in thermal studies of Long Island streams are temperatures at or near freezing. Such an event occurred at Sampawams Creek on January 5, 1959, during a period of very cold weather accompanied by very strong northwest winds. Normally, turbulent mixing is quite complete, so that incoming ground-water seepage is thoroughly diffused with streamflow soon after the ground water enters the stream. Owing to the large differential between stream and ground-water temperatures on this date (about 15° F) and the strong downchannel winds, mixing was incomplete at the gaging station; this showed as a wide band on the thermograph record, suggesting rapid temperature changes of 3°–°F (fig. 34, lower).

An opportunity to study the effect of a heavy snowfall on stream temperatures was provided by the storm of November 30, 1967, which deposited 4–5 inches of snow on the study area, beginning during the afternoon of that date and ending early on December 1. Four continuous recorders were in operation during the period—one each at the East and West Branches of East Meadow Brook and two at Swan River. Temperatures began to drop shortly after the snow began falling and continued to fall gradually until the end of the storm. Total temperature declines ranged from 1° C at East Branch of East Meadow Brook to 2.8° C at site 5 on Swan River.

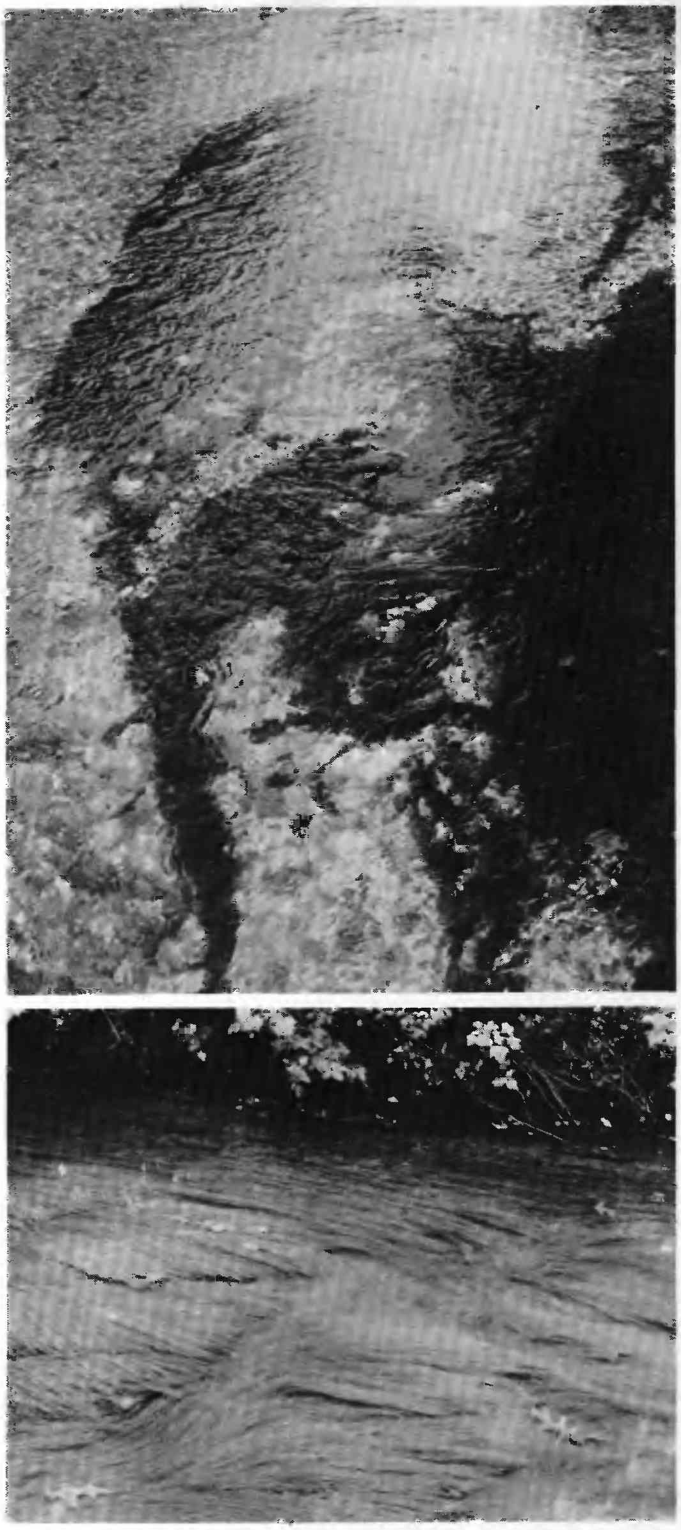

FIGURE 32.—Aquatic vegetation in the channel at Swan River between sites 3 and 4 (upper) and at East Branch of East Meadow Brook (lower).

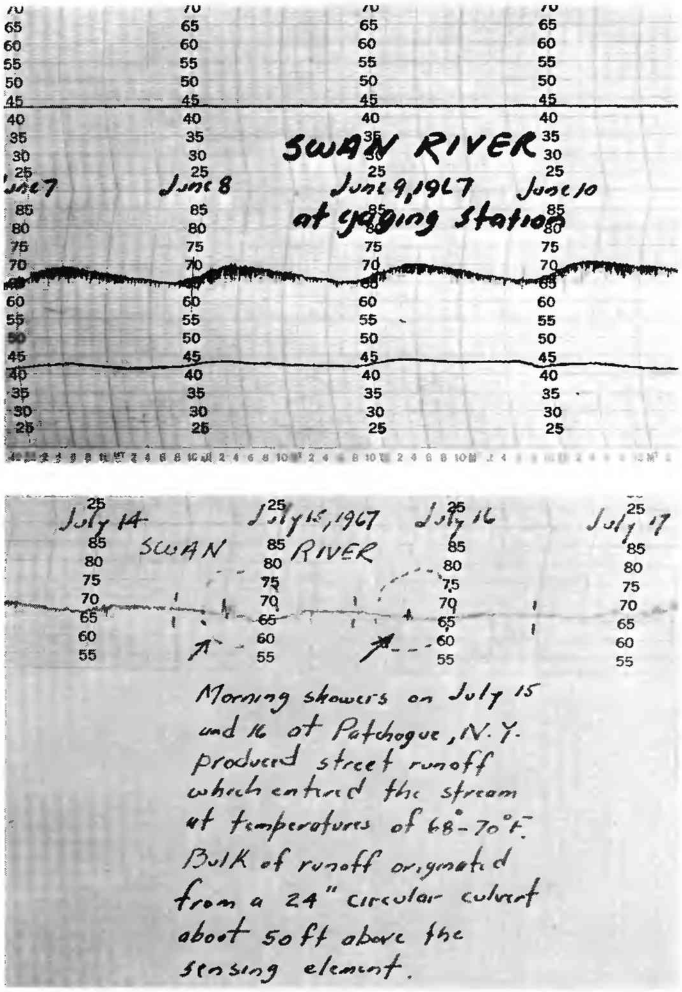

FIGURE 33.—Thermograph traces at Swan River, site 5, for selected periods during June and July 1967. Chart temperatures, in degrees Fahrenheit.

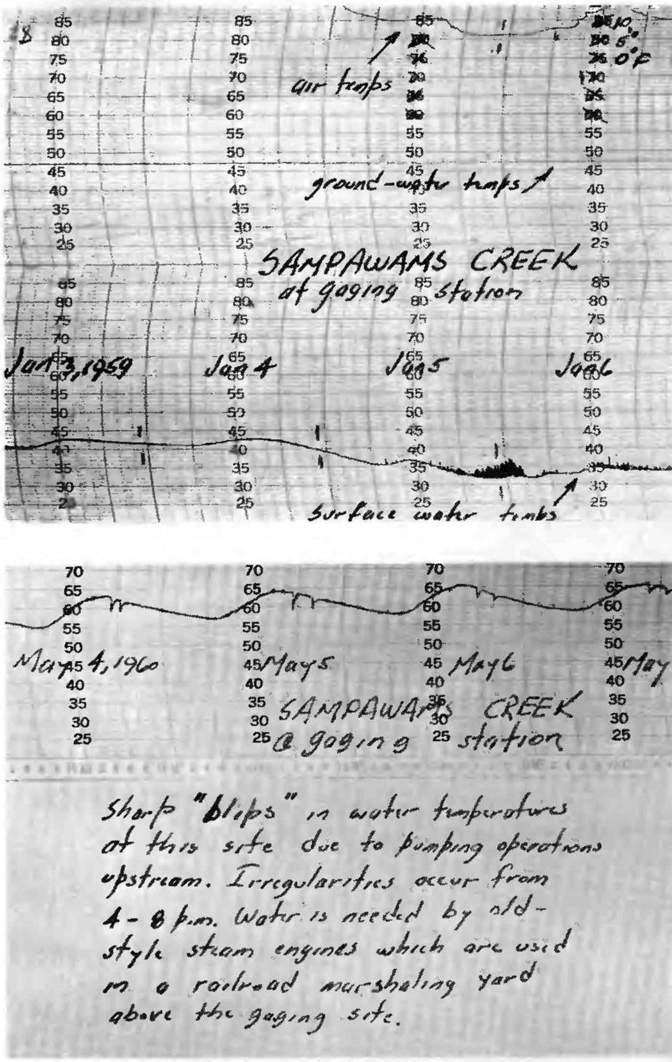

FIGURE 34.—Thermograph traces at Sampawams Creek, site 4 for selected periods during January 1959 and May 1960. Chart temperature, in degrees Fahrenheit.

Air temperatures during the snow period were at, or slightly below, freezing, and little or no direct runoff was generated during the snowfall. The drop in temperature probably was the result of a chilling effect created when the snow hit relatively warm-water surfaces. This probability is strongly suggested by the close correspondence of the beginning and ending of the temperature decline in the streams and the period of actual snowfall.

An examination of previous temperature records at Champlin Creek indicates a similar situation at the gaging station (site 4). For example, a drop in stream temperatures of nearly 4.5° C occurred at that station during a blizzard which began December 11, 1960, and which ended the following day. This very sharp drop in stream temperature occurred during the period of snowfall only, and despite the fact that air temperatures following the storm were colder than during the storm, no further decline in stream temperatures took place.

ENERGY-BUDGET STUDIES

One of the objectives of this report is to analyze the various factors that govern stream-temperature patterns so that the most important controlling influences can be identified. To accomplish this task, the energy-budget technique is utilized to identify the most significant components in the heat balance of Long Island streams. To test the validity of this approach, predicted daily temperature patterns based on the flux of energy to a selected stream were compared with observed temperature data.

The energy-budget concept is usually applied to streams by dividing the stream into a series of reaches. It is helpful to think of the reach as a "free body" in space, exchanging energy with the sky and atmosphere above, the riverbed and the ground-water reservoir be low, the riverbanks along the sides, and the river itself at each end. Along the top surface of the free body, energy exchange is in the form of long-wave and short-wave radiation (incoming and outgoing), convection (transfer of sensible heat), mass transfer (evaporation or condensation), and advection (precipitation or lateral runoff). Along the bottom and sides, the exchange is by fluid friction, conduction, or advection (ground-water inflow or outflow). At the upstream end of the reach, heat enters with the inflow water and leaves with the outflow at the lower end of the reach.

Mathematical analysis of such a system may be simplified if the reach and period of study are selected so that—

1. Precipitation is negligible.
2. There are no heat additions due to man's activities.
3. Complete mixing occurs so that lateral and vertical temperature variations are small.

To conform with these limitations and to evaluate thermal patterns under natural conditions, Connetquot River was selected for study during June 7–11, 1967, a period when little or no precipitation fell on the basin.

THE ENERGY-BUDGET EQUATION

The various factors affecting the heat balance of streams are illustrated schematically in figure 35 where

Q_s=incoming short-wave solar radiation (direct and diffuse);
Q_a=atmospheric radiation (long wave);
Q_r=reflected solar radiation;
Q_{ar}=reflected atmospheric radiation;
Q_{fr}=reflected forest radiation;
Q_{bw}=back radiation from the water surface (long wave);
Q_e=energy used by evaporation;
Q_h=energy gained or lost by convection;
Q_{hb}=heat conducted to the streambed and banks;
Q_{gw}=heat entering the reach from the ground-water reservoir;
Q_{in}=heat content of streamflow entering the reach; and
Q_{out}=heat content of streamflow leaving the reach.

Missing from the above are energy contributions from biological and chemical processes. The amount of heat added to the stream from these sources is assumed to be minor so that they can be disregarded. The increase in temperature in the downstream direction due to fluid friction may be computed as follows:

$$Q_{fh}=\frac{Q\varpi s}{J}\,l, \qquad (1)$$

where

Q_{fh}=frictional heat added to the stream, owing to boundary roughness;
Q=discharge (cfs);
ϖ=specific weight of water (62.4 lb ft^{-3});
s=slope of the reach;
l=length of the reach; and
J=a constant (778 ft-lb Btu^{-1}).

From the equation above, it is estimated that 32,500 Btu are added to the reach between temperature sites 1 and 3 on the Connetquot River over the 3-hour period required for water to flow between the sites. This amount of heat will raise temperatures in the reach by less than 0.01°C, a temperature differential too small to be detected by the instrumentation used in this study. Accordingly, temperature changes due to fluid friction were also disregarded in the heat-flux analysis.

Energy enters the reach from the following sources:

$$\text{Inflow}=Q_s+Q_a+Q_h+Q_{gw}+Q_{in}. \qquad (2)$$

Energy leaves the reach in the following ways:

$$\text{Outflow}=Q_r+Q_{ar}+Q_{fr}+Q_{bw}+Q_e+Q_{hb}+Q_{out}. \qquad (3)$$

The net quantity of heat added to the reach (ΔQ) is:

$$\Delta Q=\text{Inflow}-\text{Outflow}, \qquad (4)$$

or

$$\Delta Q=(Q_s-Q_r)+(Q_a-Q_{ar})+(Q_f-Q_{fr})+Q_h+Q_{gw}-Q_{bw}-Q_e-Q_{hb}+(Q_{in}-Q_{out}), \qquad (5)$$

where the bracketed terms have been grouped for convenience.

From equation 5 it is possible to compute the difference in stream temperature at the outlet section relative to that at the inflow section at the end of whatever time period is used in the analysis.

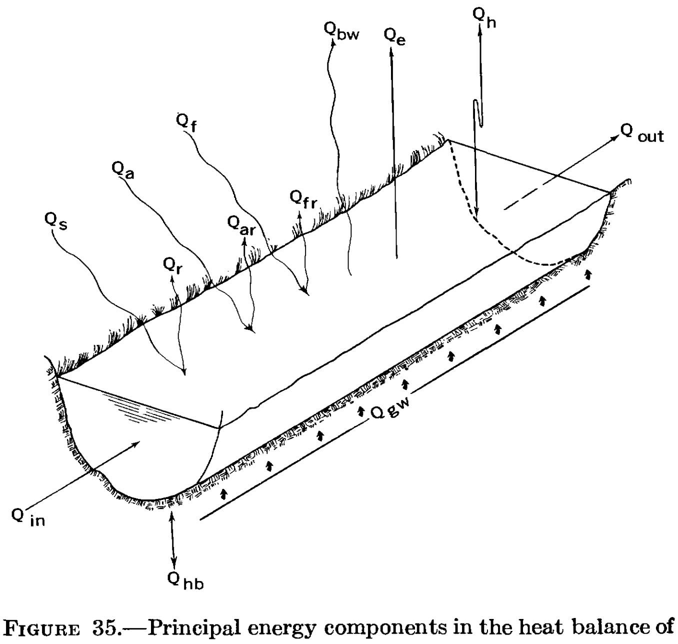

FIGURE 35.—Principal energy components in the heat balance of Long Island streams.

FIGURE 36.—Energy-budget instrumentation at Connequot River. *Upper*, Solar site 1; *Lower*, solar site 2; *center*, solar site 3.

The heat delivered to, or removed from, the study reach by flow in the stream itself ($Q_{in}-Q_{out}$) or by the ground-water reservoir (Q_{gw}) is, for any given temperature, a direct function of stream discharge or the rate of ground-water inflow to the reach. Thus, the flow of water is a means of conveying heat to or from the reach. For example, doubling the inflow (Q_{in}) to a reach with no temperature change also doubles the quantity of heat added to the reach. Another group of terms, the first three bracketed items on the right-hand side of equation 5, represent the energy absorbed by the stream from solar, atmospheric, and vegetative sources, respectively. In other words, the energy that is actually entering the stream from these sources is equal to the amount impinging on the water surface less the amount that is reflected back to the atmosphere. Convective heat flux (Q_h) is considered positive—that is, toward the stream because the air was warmer than the stream throughout the June 7–11, 1967, study period.

EVALUATION OF ENERGY-BUDGET COMPONENTS

SOLAR RADIATION

The importance of solar radiation in governing stream-temperature patterns was stressed repeatedly in previous sections of this report. Pyranometers are used to measure the total short-wave radiation from the sun and sky incident on a horizontal surface at the ground. Standard installation procedures at most weather stations require that solar-radiation instruments be free of any shading effects from trees, buildings, or other nearby obstructions.

Because Connetquot River is heavily shaded particularly in its upper reaches, it was deemed desirable to obtain some index of the actual amount of solar radiation that penetrates to the stream. Accordingly, three reaches considered representative of a heavily forested situation (solar site 1), moderate to heavy forest cover (solar site 2), and a moderate forest cover (solar site 3) were selected for study. These sites correspond to a shading index of 5 in figure 16 at solar site 1, an index of 4 at solar site 2, and an index of 3 at solar site 3. Locations of the solar sites are given in figure 12, and photographs of the sites and instrumentation are shown in figure 36. Channel widths are about 15 feet at solar site 1, 25 feet at solar site 2, and 40 feet at solar site 3.

The effect of shading from natural vegetation on solar radiation at the three sites is summarized in table 13. Owing to the heavy natural cover throughout the Connetquot River basin, it was not feasible to obtain direct measurements of unobstructed solar radiation at the study sites. However, by placing one recorder at the Rockaway Road recharge basin in Mineola, 25 miles

TABLE 13.—*Summary of solar-radiation data for Mineola, Brookhaven, and the Connetquot River sites*

Solar site	Dates	Mean-daily solar radiation in langleys: for the indicated periods				Ratio = Connetquot River observed / Connetquot River unobstructed
		Mineola	Brookhaven	Connetquot River estimated	Connetquot River observed	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Jan. 30, 31, 1967	235	244	240	148	0.62
2	Jan. 28, 29, 1967	148	130	137	96	.70
3	Jan. 25, 26, 1967	135	135	135	104	.77
1	Apr. 21–23, 1967	466	464	465	343	.74
	Apr. 16–18, 1968	452	502	502	389	.77
2	Apr. 19, 20, 1967	436	386	429	384	.90
3	Apr. 24–26, 1967	408	411	410	401	.98
1	June 9–11, 1967	600	599	599	254	.42
2	June 7, 8, 1967	664	671	669	531	.79
3	June 12–14, 1967	527	523	525	443	.84
1	Aug. 26–28, 1967	275	260	266	78	.29
2	Aug. 22–24, 1967	277	328	308	162	.53
3	Aug. 29, 30, 1967	504	484	492	338	.69
1	Nov. 28, 29, 1967	204	------------	204	86	.42

NOTE.—Radiation data in column 5 are estimated unobstructed horizon values for Connetquot River based on data from Mineola and Brookhaven (cols. 3, 4).

west of the basin, and having access to the Eppley pyranometer data from Brookhaven, about 16 miles to the east of the basin, it was possible to obtain fairly accurate estimates of solar energy received at the study sites by interpolating between the two stations. This was the procedure used for estimating unobstructed radiation at the solar sites in most instances. Occasionally, unusual cloud conditions at either Brookhaven or Mineola resulted in a wide variation of recorded solar energy between the two sites. Under such circumstances preference was given to one record or the other in making the estimates, depending upon the observations at Connetquot River. If, for example, the observed radiation at any of the three Connetquot River sites was much larger than that observed at Mineola (or Brookhaven), it was assumed that sky conditions at Mineola (or Brookhaven) were significantly different from those at Connetquot River. Under these circumstances the anomalous record was not used to estimate unobstructed radiation at the solar sites, and full weight was given to the remaining unaffected record.

As shown in table 13, there is a wide variation in the ratio of observed radiation to estimated unobstructed radiation (col. 7) both among the sites during any particular period and seasonally at each site. Peak radiation penetration occurred in April, and the minimum amount was recorded during August. Despite the fact that the trees were bare in January as well as April, a greater percentage of the total solar energy reached the stream during April. This undoubtedly is due to the higher solar altitudes attained in April—much of the radiation at lower altitudes was probably blocked by the thick stand of shrubs along the banks. With the appearance of leaves, the increased shading quickly reduces the incoming solar energy so that by late summer less than one-third of the sun's energy reaches the stream at solar site 1.

During the June study period, solar site 3 received twice as much radiant energy as did solar site 1, but there was only a slight reduction between sites 2 and 3. Clearly, any energy-budget analysis of streams must take into account shading provided by natural vegetation. Changes in this important factor in the energy budget of the magnitude shown in table 13 is bound to have an important effect on the budget. It must be stressed that values shown in table 13, although accurate for the specific sites, are merely indices of the radiation reaching any particular reach. Too, the Connetquot River is a fairly small stream relative to many other watercourses in the country, and it is likely that a much higher proportion of the available solar energy will reach most other streams.

ATMOSPHERIC RADIATION

Atmospheric radiation may be measured indirectly by the use of two radiometers, one to measure total (long-wave and short-wave) radiation and the other to record short-wave radiation only. Subtracting the first value from the second will yield the radiation flux from the atmosphere. Results, accurate within 10 percent, are obtained by use of the Brunt (1932) equation:

$$Q_{ao}=\epsilon\sigma T^4(a+b\sqrt{e}), \tag{6}$$

where

Q_{ao}=clear-sky radiation;
ϵ =emissivity of the atmosphere;
σ =Stephan-Boltzman constant;
T =absolute temperature of the air near the ground;
e =Vapor pressure of the air near the ground;

and a and b are empirical constants.

Atmospheric emissivity is assumed to be 0.87. Values of the empirical coefficients are estimated to be $a=0.61$, and $b=0.05$ close to the median values of 22 evaluations as computed by Sellers (1965). Vapor pressure may be determined with the aid of a sling psychrometer—observations obtained at Connetquot River were then correlated with the continuous records at Kennedy International Airport. By this method it was feasible to obtain estimates of vapor pressure for any time of the day at the study stream.

Atmospheric radiation calculated from equation 6 is clear-sky radiation. Since water vapor is the most important source of long-wave radiation in the atmosphere, it is obvious that a greater downward flux of atmospheric radiation may be expected under cloudy skies than under clear skies. Geiger (1965) suggests the following equation to evaluate atmospheric radiation under cloudy skies:

$$Q_a=Q_{ao}(1+kn^2), \tag{7}$$

where

Q_{ao}=clear-sky atmospheric radiation;
n =cloud-cover expression in tenths (complete cloud cover=1.0); and
k =a function of the type of cloud cover which varies as follows:

Cloud type	*k*
Cirrus	0.04
Cirro-stratus	.08
Alto-cumulus	.17
Alto-stratus	.20
Cumulus	.20
Stratus	.24

FOREST RADIATION

Somewhat analogous to the radiation from clouds is the radiation from the forest canopy. A solid canopy approximates a black body ($\epsilon=1.0$) in the long-wave part of the spectrum, absorbing and emitting all possible radiation. The effective leaf temperature can be equated to ambient air temperature. Field estimates of effective forest cover are required to estimate the part of the incoming long-wave radiation that can be ascribed to vegetal cover. Forest radiation to the stream is computed as follows:

$$Q_t=\epsilon\sigma T^4 \tag{8}$$

where

$\epsilon=1.0$;
σ=Stephan-Boltzman constant; and
T=absolute temperature of the air near the ground.

The reflectivity of the water surface is estimated to average 5 percent with respect to solar (short-wave) radiation and 3 percent relative to long-wave radiation (Harbeck and others, 1958). Thus, 95 percent of the incident solar radiation and 97 percent of the incoming atmospheric and forest radiation are assumed to be absorbed by the streams.

STREAM BACK RADIATION

Countering the downward fluxes of energy from the sun, atmosphere, and forest, is the long-wave radiation emitted by the stream itself. Long-wave radiation emitted from the stream (Q_{bw}) was computed according to the Stephan-Boltzman law for black-body radiation, with an emissivity factor of 0.97 for water (Anderson, 1954).

EVAPORATION

The evaporation of water is a cooling process, since heat is removed from the stream during the transition from the liquid to the vapor state. For each gram of water evaporated at 10°C, about 592 calories are removed from the parent water body. The rate of evaporation depends on numerous factors, such as air and stream temperature, vapor pressure gradient across the air-stream interface, wind velocity, solar radiation turbulence in the stream and the relative humidity of the overlying air. There is no way to measure directly the loss of heat due to the vaporization process. Many empirical formulas have been evolved, principally for lakes, which permit fairly accurate determinations of evaporation. The Dalton-type equation given below formed the basis for the empirical relationship derived at Lake Hefner (Marciano and Harbeck, 1954):

$$E=6.25\times10^{-4}U_8(e_0-e_8), \tag{9}$$

where

E=centimeters per unit time;
U_8=average wind velocity 8 meters above the water surface in knots;
e_0= vapor pressure of saturated air at the temperature of the water surface; and
e_8= vapor pressure of the ambient air 8 meters above the water surface (mb).

The heat lost by evaporation may then be computed as follows:

$$Q_e = EL\rho, \tag{10}$$

where

Q_e=evaporative flux (cal/cm²/unit time);
E=centimeters per unit time;
L=latent heat of vaporization of the evaporated water; and
ρ=density of evaporated water (g/cm³).

CONVECTIVE HEAT FLUX

Convective heat exchanges occur at the stream surface. The transfer of sensible heat to or from the stream is largely a function of the temperature gradient between the stream and the overlying air mass. Bowen (1926) related the convective flux to evaporative heat loss as follows:

$$R = \frac{Q_h}{Q_e}, \tag{11}$$

where

R=The Bowen ratio;
Q_e=evaporation heat flux (cal/cm²/unit time); and
Q_h=convective heat flux (cal/cm²/unit time)

The Bowen ratio, expressed algebraically is:

$$R = C_b \frac{(T_0 - T_a)}{(e_o - e_a)} \frac{P}{1{,}000}, \tag{12}$$

where

C_b=0.61;
T_o=water-surface temperature (°C);
T_a=air temperature (°C);
e_o=saturation vapor pressure at water-surface temperature (mb);
e_a=vapor pressure of the air (mb); and
p =atmospheric pressure, (mb);

CONDUCTION

Heat is gained or lost through the streambed, depending on the direction of the heat flux in the material underlying the stream, the intensity of the thermal gradient, and the thermal conductivity of the bed material. This may be written as

$$Q_{hb} = K \frac{dT}{dz}, \tag{13}$$

where

Q_{hb} = conduction (cal/cm²/unit time) to or from the streambed;
$\frac{dT}{dz}$ = temperature gradient in the bed material (°C/cm); and
K= thermal conductivity of the bed material (cal/cm/sec/°C).

A study was made of the ground-water temperature field at Champlin Creek where extensive data on the thermal patterns beneath the stream are available. Champlin Creek is only about 5 miles east of Connetquot River, so that it was assumed that temperature patterns beneath Connetquot River are virtually the same as those at Champlin Creek. A drilling unit was set up at two sites along Champlin Creek (Islip Boulevard and Poplar Street), and temperatures were obtained at 1-foot intervals to depths of 7 feet beneath the streambed. The results of this study are illustrated in figure 37. There is a sharp drop in temperature for the first 2 feet beneath the bed at both sites. Thereafter, the decline is very gradual probably down to a depth of at least 60 feet. The gradual rise in temperature from well B-center to the sharp break in the temperature curve probably reflects the influence of warm ground-water moving laterally toward the stream from the interstream areas. The sharp increase in temperature above the 2-foot depth, on the other hand, reflects the conductive heat flux from the stream to the underlying material. Based on these observations, and long-term records for the B-center well, mean ground-water temperature is estimated to be 10°C 2 feet beneath the bed of Connetquot River. The thermal gradient beneath the stream was then computed by subtracting 10°C from equilibrium stream temperature.

ADVECTED HEAT

The heat conveyed into, and out of, the study reach by the stream itself was determined by measuring inflow and outflow discharge with a current meter and utilizing thermographs for water-temperature data. The average stream temperature at both ends of the reach was computed for selected increments of a day. The difference between average stream temperature and an arbitrary base temperature was then multiplied by the volume of water entering or leaving the reach and the specific heat of water to provide a measure of heat inflow or outflow. Subtracting heat flow out of the reach from that entering indicates the amount of heat being advected to or from the reach.

Discharge measurements were also used to compute ground-water inflow (pickup) to the stream. The effective temperature of incoming ground water was estimated to be the average between the temperature at 2 feet below the streambed (10°C) and the predawn equilibrium temperature of streamflow.

ENERGY BUDGET APPLIED TO CONNETQUOT RIVER

The energy-evaluation techniques described above were used on the reach of the Connetquot River between sites 3–5 (fig. 12). The flow-through time of

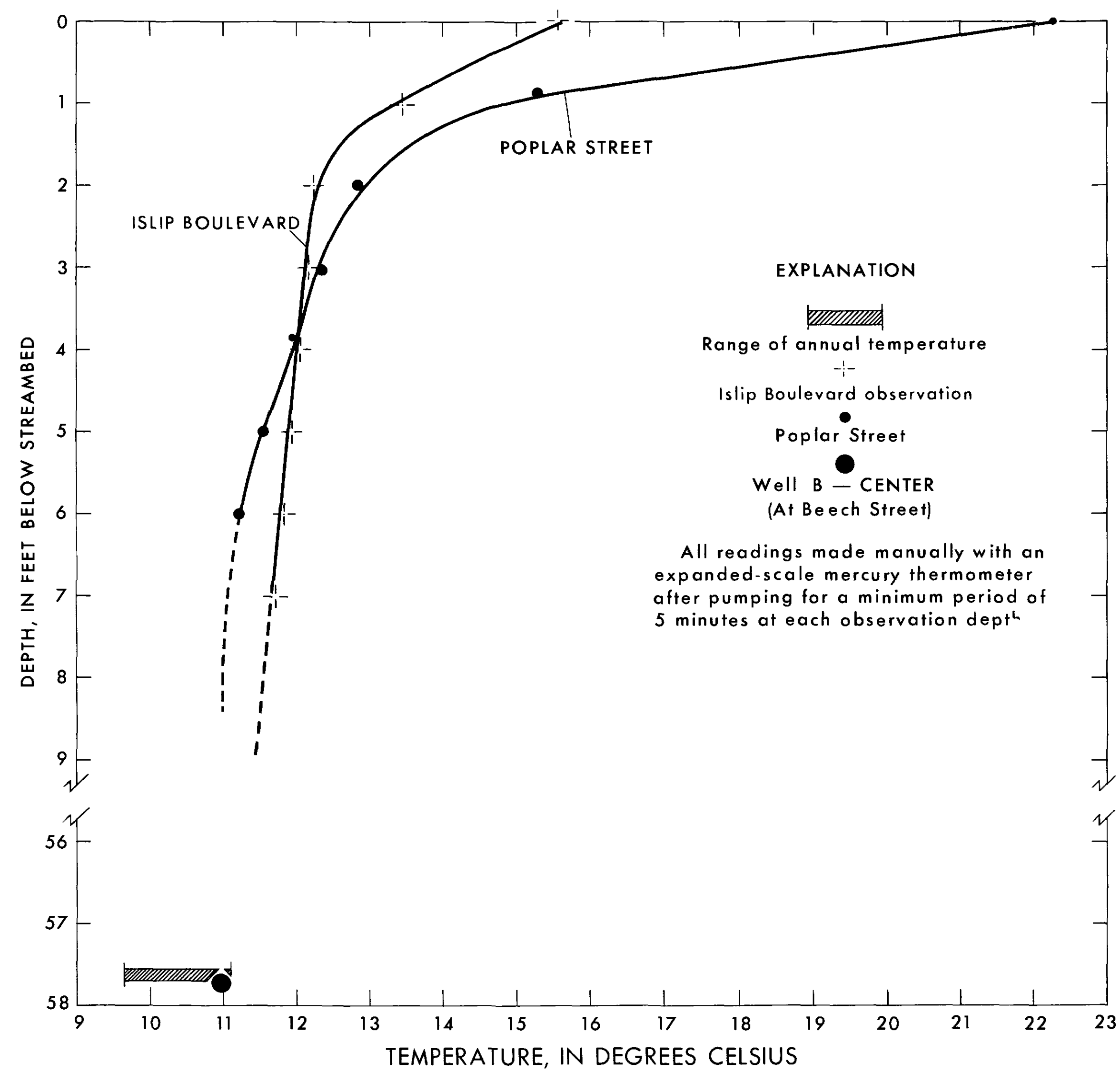

FIGURE 37.—Ground-water temperature gradient beneath Islip Boulevard and Poplar Street at Champlin Creek, September 1959.

water between these sites is about 4–5 hours as determined by time-of-travel studies. Eight-hour time periods were used in temperature prediction, 0800–1600, 1600–2400, and 0000–0800 hours. The beginning of the first period represents the time that minimum temperatures are normally observed, whereas maximum temperatures usually occur shortly after the beginning of the second time period. To minimize the effects of anomolous meteorologic situations, only averages over the entire temperature survey period (June 7–11, 1967) were used in this analysis. Computations were started by calculating the average stream temperature at 0800 hours at the upper end of the study reach. After computing the net radiation flux to the reach for each of the three time periods, a prediction of the increase or decrease in temperature at the lower end of the reach was made and subsequently compared with observed temperature.

The procedure is best illustrated by an example. Table 14 summarizes the various steps needed to perform the energy-budget computations as outlined in this report. This particular series of heat-flux computations is for the time period 0800–1600 hours. The surface area and volume of the reach shown in table 14 (item 1) were obtained from cross sections of width and depth made during the study period. Average stream temperature in the reach during this particular 8-hour period was determined from temperatures at site 4 midway between the upper and lower ends of the reach (fig. 14).

TABLE 14.—*Energy-budget computations for Connetquot River near Oakdale, N.Y., for the period June 7–11, 1967*

[1 ly (langley) = 1 gram calorie cm^{-2}]

Stream reach (1):		
Beginning at site 3, river mile		2.86
Ending at site 5, river mile		1.92
Surface area		0.259×10^9 cm^2
Volume		6.394×10^9 cm^3
Time (2):		
Hour		0800–1600
Δt	hr	8
Discharge (3):		
At site 3	cfs	8.1
At site 5	cfs	18.7
Stream temperature (4):		
Initial (site 3 at 0800 hr)	°C	12.8
Average for reach during study period	°C	16.5
Solar radiation (5):		
Q_s (reduced 5 percent to include albedo losses)	ly	330
Atmospheric radiation (6):		
(incoming long-wave radiation)		
T_a, air temperature	°C	24.5
Relative humidity	percent	60
e_a, vapor pressure of air	mb	18.4
ϵ, emissivity		0.87
Q_{ao}, clear-sky radiation	ly	221
Correction for cloud cover	ly	+8
Q_{ar}, reflected atmospheric radiation	ly	−7
Q_a, absorbed atmospheric radiation	ly	222
Forest radiation (7):		
ϵ, emissivity		1.0
Q_f, incoming forest radiation	ly	306
Q_{fr}, reflected forest radiation	ly	−9
Q_f, absorbed forest radiation	ly	297
Incoming long-wave radiation (8):		
(radiation absorbed by stream from atmosphere and forest)		
F, forest cover		0.55
Atmospheric component (0.45×222 ly)	ly	100
Forest component (0.55×297 ly)	ly	163
Total incoming long-wave radiation	ly	263
Outgoing long-wave radiation (9):		
(radiation from stream to atmosphere):		
ϵ, emissivity		0.97
Q_{bw}, back radiation	ly	−266
Evaporation (10):		
U, average wind speed	mph	4.5
e_w, vapor pressure of water	mb	18.8
Q_e, evaporative heat flux	ly	−2
Conduction (11):		
(at streambed):		
T_{gw}, ground-water temperature below stream	°C	10
Q_{hb}, conductive heat flux	ly	−12
Convection (12):		
(at air-water interface):		
P, atmospheric pressure	mb	1018
Q_h, convective heat flux	ly	27
Advected energy (13):		
(incoming energy from upstream reach):		
Base temperature	°C	10
Average temperature of incoming streamflow	°C	16.5
Inflow to study reach		229,000 cm^3 sec^{-1}
Q_{in}, heat entering reach		42.9×10^9 cal
Temperature of ground-water entering reach	°C	11.7
Ground-water inflow		300,000 cm^3 sec^{-1}
Q_{gw}, heat from ground-water reservoir		14.7×10^9 cal
(Outgoing energy):		
Average temperature of outgoing streamflow	°C	16.2
Discharge from reach		530,000 cm^3 sec^{-1}
Q_{out}, heat leaving reach		94.6×10^9 cal
Heat-flux summary (14):		
Net heat flux to stream	ly	340
(includes all energy sources except advected heat)		
Heat added to stream (340 ly×surface area)		87.94×10^9 cal
Q_{in}, heat entering reach		42.94×10^9 cal
Q_{gw}, heat entering reach from ground-water reservoir		14.70×10^9 cal
Subtotal		145.58×10^9 cal
Q_{out}, heat leaving reach		−94.55×10^9 cal
Net heat change		+51.03×10^9 cal
Predicted temperature (15):		
(downstream section at 1600 hr):		
Temperature change due to heat gain	°C	+8.0
Final temperature	°C	20.8
Remarks (16):		
A positive heat flux indicates incoming energy to the reach, whereas a negative heat flux denotes a loss of energy.		

Solar energy was apportioned among the 8-hour periods according to the hourly distribution of solar radiation as recorded by the Eppley pyranometer at Brookhaven. Owing to the heavy shade along parts of the stream, the unobstructed radiation recorded at Brookhaven could not be applied directly to Connetquot River. On-site radiation data obtained from the three solar sites were used as an index of incoming solar radiation. On the basis of these data, it is estimated that about 60 percent of the sun's energy penetrated to the reach during the study period. Included in the 330 langley figure shown in item 5 of table 14 is a 5-percent loss caused by the reflectivity of water (item 6).

After computing forest long-wave radiation, it became necessary to combine the actual long-wave contribution to the stream from both forest and sky radiation. As indicated in item 8, forest cover is 0.55 for the reach. Accordingly, the amount of energy from both forest and sky radiation was apportioned as shown in item 8, yielding 263 langleys as the total incoming long-wave radiation during the 8-hour period.

The energy flux that is directed toward the reach is considered positive in this paper and that directed away is negative. As shown in item 9, long-wave radiation from the stream represents a sizable "negative" flux (266 ly).

Evaporation (item 10) was computed using a formula suggested by Delay and Seaders (1963) for use in streams, which, when expressed to yield a result in langleys per unit time becomes

$$Q_e = 0.15U(e_w - e_a)t, \quad (14)$$

where

Q_e = evaporative energy flux, in langleys per unit time;
U = wind speed, in knots;
e_w = saturation vapor pressure at water-surface temperature, in millibars;
e_a = vapor pressure of the air, in millibars; and
t = a unit of time.

Heat gain or loss by convection (item 12) across the air-water interface was computed by use of equation 11. The transfer of sensible heat through the streambed was computed using equation 13 with a value of thermal conductivity of 3.94×10^{-3} cal cm^{-1} sec^{-1} °C^{-1} for water-saturated sands and gravel mixtures.

Advected heat (item 13) was calculated as previously outlined. In computing heat advected into the reach from ground-water inflow, the temperature of the ground-water as it enters the stream is estimated to be 11.7°C or the mean of 10°C (ambient ground-water temperature at a depth of 2 feet below the stream) and 13.4°C (equilibrium stream temperature at dawn).

In item 14, all energy sources are entered and algebraically summed to yield the net inflow or outflow of heat to the reach. The predicted water-temperature change at the outlet section is then a function of the heat gain or loss and the volume of water heated.

The results of these calculations are plotted in figure 38. Temperature predictions are for the end section of the reach which correspond to temperature site 5. Good results (within 2°C) between actual and predicted temperatures were obtained. This study serves to emphasize the importance of on-site instrumentation in energy-budget studies of all but perhaps the largest rivers. It would be almost impossible to obtain an accurate temperature-prediction model without such instrumentation.

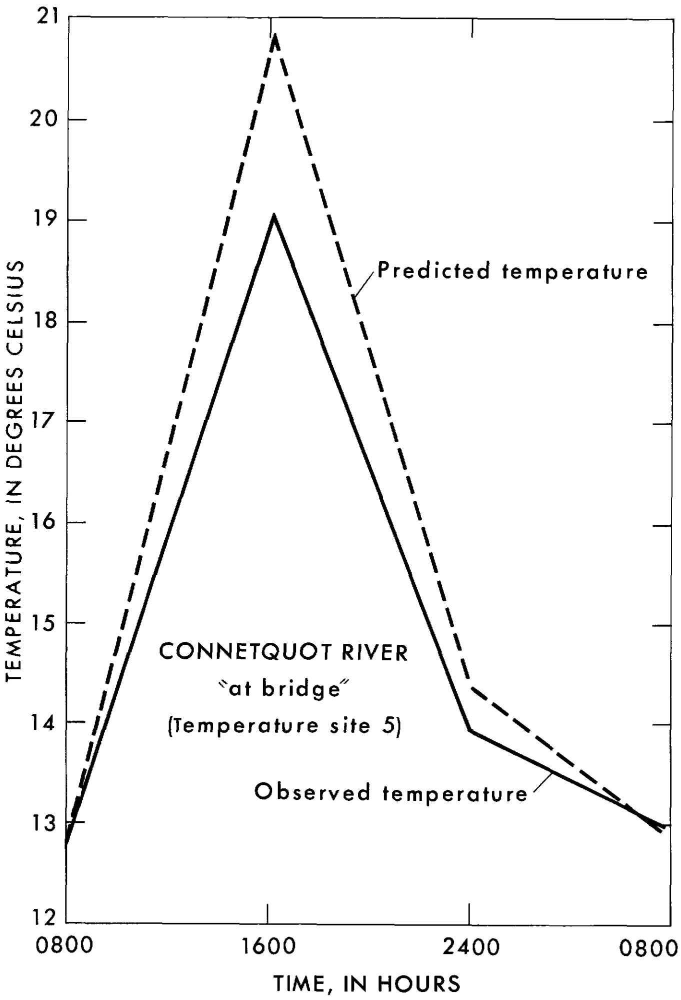

FIGURE 38.—Predicted and observed temperatures of site 5. Connetquot River, June 7–11, 1967.

A net radiometer was employed to improve temperature predictions during a survey made on August 13–17, 1968. The net radiometer measures the difference between the incoming short-wave and long-wave radiation and the outgoing long-wave and reflected short-wave radiation parts of the electromagnetic spectrum. Specifically, net radiometers measure the following fluxes of the heat budget:

$$Q_{net}=(Q_s-Q_r)+(Q_a-Q_{ar})+(Q_f-Q_{fr})-Q_{bw}. \quad (15$$

Missing from the above are the conductive, con vective, evaporative, and advected heat flows. Th conduction, convection, and evaporation components o the heat budget must be estimated by empirica formulations, whereas the advected-heat items ar computed by discharge and water-temperature meas urements. During the June 7–11, 1967, predictio period, all items on the right side of equation 15 wer estimated by empirical formulas except Q_s, which wa measured with a pyranometer. The net radiometer wa attached to a microvolt recorder during the Augus 1968 study period to provide a continuous record o net heat flux. The radiometer was set up at solar sites and 3 to span the range of forest cover conditions foun in the reach.

Predicted temperatures using the net radiometer were within 1.3°C of observed readings, whereas predictions based wholly on empirical formulas were as much as 3°C higher than observed values (fig. 39). The predicted

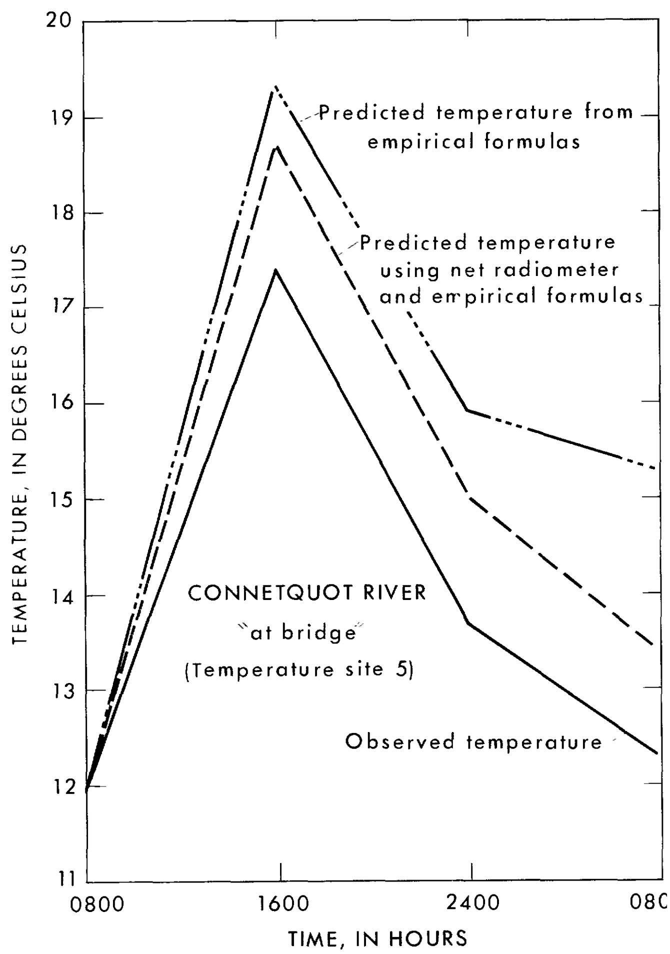

FIGURE 39.—Predicted and observed temperatures at site 5, Co netquot River, August 13–17, 1968.

temperatures were, with one exception, higher than observed in both the June 1967 and August 1968 study periods. This indicates that the estimate of forest cover may have been too low—that is, shading is even greater than estimated by the writer.

Additional refinements in temperature predictions radiometer which would be carried from point-to-point may be obtained by the concurrent use of a portable net along the reach. The net heat flux from numerous cross sections along the reach could be obtained and correlated with the continuous recording unit. Such a procedure would permit a better estimate of the heat flow to the entire reach.

To evaluate which of the various fluxes has the greatest bearing on stream-temperature patterns, a compilation of all energy-budget components, exclusive of advected heat terms, was prepared for the study reach (table 15). From this summary it is obvious that energy gains or losses from the evaporative, convective, and conductive heat fluxes are of considerably less importance relative to the solar, atmospheric and back-radiation terms. Because of low stream temperatures, the evaporative term, which depends in large measure on the vapor-pressure gradient between the stream and the overlying air mass, was often close to zero during this study period and little evaporation occurred. This situation should reverse in winter when the relatively warm stream will tend to lose fairly large quantities of heat to the colder air through the evaporative process.

TABLE 15.—*Energy flux, in langleys, to the reach between temperature sites 3 and 5, Connetquot River, June 7–11, 1967*

Energy-budget component	Period, in hours		
	0000 to 0800	0800 to 1600	1600 to 2400
Solar radiation (Q_s)	42	330	36
Incoming long-wave radiation (Q_f+Q_a)	235	263	244
Outgoing back radiation (Q_{bw})	−254	−266	−266
Evaporation (Q_e)	3	−2	−9
Convection (Q_h)	6	27	7
Conduction to streambed (Q_{hb})	−6	−12	−12
Net radiation exclusive of advected-heat terms	+26	+340	0

The terrestrial energy components consisting of atmospheric and stream radiation although large, are very conservative—that is, they are seldom greatly modified by man's activities. However, the quantity of heat reaching a stream from the sun can be, and is, greatly altered by urban development. Streams can easily be stripped of much of their natural cover, or they may be completely enclosed. On the one hand, solar radiation is sharply increased, resulting in higher maximum daily temperatures under certain weather conditions, and on the other, it is reduced to zero, thereby attenuating both diurnal- and seasonal-temperature variation. Clearly, solar radiation, a highly variable heat source of relatively large magnitude, is of paramount importance in determining the thermal patterns of streams.

Changes in the amount of advected heat from the ground-water reservoir to streams is a major cause of thermal change (p. D41). The relatively large, constant heat flow from the ground-water system tends to stabilize seasonal- and diurnal-temperature fluctuations. It is estimated that a 50-percent decrease in ground-water inflow to Connetquot River would result in a 3°–5°C rise in temperature during the summer and a similar drop in temperature in winter. The effect of excessive declines in ground-water inflow to streams may cause even greater changes in the range of daily temperatures. Since ground water is cooler than streamflow in summer, energy derived from the advection of ground water to the stream may be considered "negative" heat—positive heat contributions are made to streams during the winter.

SUMMARY AND CONCLUSIONS

Long Island streams may be characterized as having low "thermal inertia"—that is, they possess only a small capacity for heat storage. Accordingly, nearly all Long Island streams tend to respond rapidly to heat inputs. In particular, the incoming energy from solar radiation under clear skies is relatively large when compared to the heat-storage capacity of the streams. On days of high solar radiation, large diurnal-temperature fluctuations may be observed in many streams. Moreover, under natural conditions, maximum temperatures tend to occur at nearly the same time everywhere along the streams. Urbanization predisposes stream-temperature patterns to significant change both seasonally and diurnally, owing to ease with which solar energy to a stream may be altered by man's activities. This fact, coupled with the normally low thermal inertia exhibited in Long Island streams, makes stream-temperature patterns in the area particularly vulnerable to landscape changes by man.

The streams whose temperature patterns were intensively studied in this report are listed below in descending order of urban development within their basins:

1. East Meadow Brook near Freeport.
2. Sampawams Creek near Babylon.
3. Champlin Creek near Islip.
4. Swan River at East Patchogue.
5. Connetquot River near Oakdale.

Connetquot River, one of the largest streams on Long Island, flows through a heavily forested preserve for practically its entire length. Above a point near mid-length, the river is virtually free of any man-made changes in its natural environment; accordingly, this part of the stream was selected as a "control." It is assumed that the thermal regimen of the upper Connetquot River, in essence, reflects natural-temperature patterns similar to those that would have been observed in nearly all other streams were it not for man's interference.

All five study streams were selected so as to be comparable with one another in all respects except with regard to the degree of urban development. The study basins are very similar with reference to topography, flow direction, overall channel length, geologic and climatic environment, and natural-vegetation cover. Thus, the effect of these factors on stream temperatures has been minimized. Because only one factor varies significantly, statistical analyses of the temperature data reveal the extent to which the variable element (urban change) affects temperature regimen.

Considerable diurnal- and seasonal-temperature stability is a characterictic of most Long Island streams that are unaffected by man. This stability, or the uniformity of temperature, is due in large measure to the normally large outflow of ground water to streams.

Shading, provided by a variety of deciduous trees, including sugar and red maples, beech, and pin oak, is another factor contributing to the temperature stability of natural streams. Shade is not only significant in helping to attenuate seasonal temperatures, but it is of paramount importance in reducing daily-temperature fluctuations. By shielding surface waters from the highly variable short-wave (solar) radiation component of the energy budget, forest vegetation effectively diverts large quantities of incoming energy away from the streams.

A third, but somewhat less critical factor in thermal pattern of streams, is the increasing volume of storm runoff to which all urban streams are subjected. The precise effect that a given volume of storm runoff will have on the temperature regimen of downstream reaches is a function, among other factors, of the relative volume of storm runoff to streamflow, the ambient temperature differences between the two, and whether the storm runoff enters the stream as a concentrated mass or whether it is distributed along the channel.

Five temperature surveys spaced about 2 months apart were used to assess the extent to which man has modified the temperature patterns of Long Island streams. Some salient points brought out by these surveys are that:

1. Under natural conditions exhibited at the control stream, temperature patterns from reach to reach are very similar in shape under a wide variety of weather regimes.
2. Lakes and ponds have a strong impact on downstream-temperature patterns. Diurnal-temperature fluctuations in reaches below lakes and ponds are largely a function of the mean depth of the lake. Very shallow ponds (average depth, less than 1 ft.) tend to amplify diurnal fluctuations, whereas deeper bodies of water attenuate downstream daily-temperature changes.
3. Pumpage of ground water in southwestern Nassau County and the loss of recharge due to paving and home construction have lowered temperatures in winter at East Meadow Brook and Sampawams Creek and raised them in summer.
4. Variations in average temperature among the 25 study sites were statistically significant only in summer—that is, the observed variations were not likely due to chance but rather to some fundamental difference among the sites.
5. The basic effect of most man-made changes is to raise temperatures in summer and lower them in winter—that is, the seasonal variation of temperature is increased.
6. Diurnal-temperature fluctuations are principally a function of the absorbed solar energy—the greater the absorbed solar energy on any particular day the greater will be the range in daily-stream temperature.
7. Under natural conditions, diurnal fluctuations are greatest in the spring and early summer preceding the period of maximum solar energy from 1 to 2 months.
8. The impact of man's activity on stream-temperature patterns are small during the spring and fall.
9. Concomitant temperature differences between sites on the same stream of 5°–7°C were observed in winter and 8°–10°C in summer, owing principally to environmental modifications along the stream.

An energy-budget analysis was made along the upper reaches of the Connetquot River during June 7–11, 1967 to evaluate the relative importance of the numerous heat sources and sinks controlling the thermal regimen of Long Island streams. Records of solar radiation obtained during the temperature surveys shows that this component of the heat balance is greatly affected by vegetation. In heavily forested reaches the ratio of actual observed radiation at the stream's surface to maximum possible ranged from 0.75 in April to 0.29 in August. Even a fairly open reach (forest cover, about 25 percent) showed a 30 percent reduction in the

...ount of solar energy reaching its surface in August. ...ch wide variations in solar energy in both time and ...pace amplify the need for on-site instrumentation in ...l heat-balance studies of small streams.

...Of the numerous factors affecting stream tempera...ures, the most important include:

1. Short-wave solar energy.
2. Atmospheric long-wave energy.
3. Back long-wave radiation from the stream.
4. Advected heat from the ground-water reservoir.
5. Advected heat from direct (street) runoff where such runoff is a significant part of the streamflow.

...Items (2) and (3) are highly stable, so that they are ...nly slightly affected by urbanization. Item (1) is easily ...ltered by a number of man's activities, particularly ...y the direct loss of recharge or through excessive with...rawals from the ground-water reservoir. In addition, ...e introduction of advected heat from storm sewers ...item 5) can, under certain meteorologic conditions, ...aterially change the energy budget of all streams.

...Changes in the natural-temperature patterns of ...reams due to man's activity can often be modified by ...aintaining as much shade as possible. Clearly, every ...fort should be made to ensure that vegetation along ...e banks of streams is not removed. Wherever practi...ble, multiple outlets to ponds could be installed as a ...eans of regulating downstream temperatures. Addi...onally, it may be feasible to intercept ground water ...y installing drainage tiles just below lakes and to use ...e ground water to cool downstream reaches in sum...er and warm them in winter.

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SUMMARY OF METEOROLOGIC DATA AND OF HOURLY STREAM TEMPERATURES

Compilation of meteorologic data, November 15–21, 1966

Sky cover given in tenths (cols. 4, 5). Positive values in cols. 9 and 10 indicate a downward radiation flux. Negative net-radiation values indicate a resultant ground-to-sk flux. Connetquot River temperatures were obtained near solar site 3. A summation of data is given for a complete 24-hr period beginning 0001 hr on the indicated date. Relative humidity (col. 6) is given in percent. Precipitation is in inches as measured in the liquid state. "Ken." denotes Kennedy International Airport. All temperatu data are in degrees Fahrenheit. Radiation data are expressed in langleys.

November 15, 1966

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	44	37	0		56	0	12		−8.1
2									−8.4
3									−8.4
4	42	35	0		58		10		−8.4
5									−9.0
6									−7.2
7	41	35	1	1	55		6	0.1	−9.0
8				1				5.4	−5.4
9				3				17.6	3.6
10	45	43	8	5	47		12	23.6	14.4
11				3				32.4	19.2
12								33.9	24.6
13	48	46	3	2	41		10	33.0	24.0
14				2				30.6	19.8
15				1				22.0	13.2
16	48	46	2	1	34		15	11.5	3.6
17								1.8	−8.4
18								.1	−9.0
19	44	42	3		42		7		−9.0
20									−9.0
21									−8.4
22	39	38	0		48		10		−8.4
23									−7.8
24									−7.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	47	30	
Connetquot River			
East Patchogue			
Kennedy International Airport	49	36	—
Mineola	48	35	—

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	22
Brookhaven	Net	—
Mineola	Direct	
Connetquot River (solar site)	do	

	Total miles
Wind movement:	
Mineola	6
Connetquot River (solar site)	

	Inches
Evaporation:	
Mineola	0.0

Compilation of meteorologic data, November 15–21, 1966—Continued

November 16, 1966

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	36	35	0		59	0	7		−7.8
2									−7.8
3									−7.8
4	36	30	3		64		4		−7.2
5									−7.2
6									−6.6
7	33	30	0	0	75		5	0.1	−6.6
8				0				6.3	−3.0
9				0				16.2	6.0
10	45	46	5	1	54		5	25.9	15.6
11								32.0	21.6
12								34.6	24.6
13	51	51	9		59		9	29.8	21.6
14				8				21.3	15.0
15				10				15.2	6.6
16	51	50	10	10	71		14	5.4	−1.2
17								1.4	−3.6
18									−3.6
19	50	50	10		74		12		−3.6
20									−3.6
21									−4.2
22	49	49	10		80		7		−3.6
23									−3.6
24									−3.0

Location			
Air temperatures (° F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	50	19	
Connetquot River			
East Patchogue			
Kennedy International Airport	52	31	−4
Mineola	51	28	−5
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		188
Brookhaven	Net		27
Mineola	Direct		
Connetquot River (solar site)	do		
Wind movement:			*Total miles*
Mineola			89
Connetquot River (solar site)			
Evaporation:			*Inches*
Mineola			0.03

Compilation of meteorologic data, November 15–21, 1966—Continued

November 17, 1966

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	48	48	8		80	0	8		−3.6
2									−3.6
3									−4.8
4	48	47	10		86		7		−1.8
5									−1.2
6									−3.0
7	48	47	9	5	89		7		−3.0
8				4				1.8	−.6
9				3				9.6	2.4
10	53	53	4	1	77		9	20.4	10.8
11								29.2	21.0
12								32.6	22.8
13	56	58	10	10	67		8	29.2	21.0
14				10				19.8	13.2
15				10				13.5	6.6
16	53	56	10	10	80		9	4.0	−1.2
17								.7	−4.2
18									−4.2
19	50	48	10		96		5		−5.4
20									−2.4
21									−1.8
22	53	51	10		74		6		−3.6
23									−1.8
24									−1.2

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	60	46	
Connetquot River			
East Patchogue			
Kennedy International Airport	58	47	+7
Mineola	59	47	+8

Total radiation:	*Type*	*Langleys*
Brookhaven	Direct	161
Brookhaven	Net	50
Mineola	Direct	
Connetquot River (solar site)	do	

Wind movement:	*Total miles*
Mineola	59
Connetquot River (solar site)	

Evaporation:	*Inches*
Mineola	0.02

Compilation of meteorologic data, November 15–21, 1966—Continued

November 18, 1966

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	52	52	10		83		6		−1.8
2									−4.2
3									−3.0
4	50	52	10		96		3		−4.2
5									−5.4
6									−4.8
7	52	50	10		86		9		−3.6
8				10				0.1	−3.6
9				10		.05		.7	−5.4
10	55	53	9	10	77	.05	6	1.4	−1.8
11				10				11.7	3.0
12								16.2	8.4
13	57	57	9		87		9	15.4	13.2
14				10				15.4	10.8
15				10				6.1	5.4
16	55	55	10		86	.04	4	1.8	.6
17								.4	−.6
18									−3.0
19	57	57	10		78		8		−3.0
20									−3.6
21									−4.8
22	56	58	10		80		12		−5.4
23									−6.6
24									−5.4

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (° F):			
Brookhaven	59	50	
Connetquot River			
East Patchogue			
Kennedy International Airport	58	50	+9
Mineola	59	50	+11

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	69
Brookhaven	Net	−29
Mineola	Direct	
Connetquot River (solar site)	do	

	Total miles
Wind movement:	
Mineola	176
Connetquot River (solar site)	

	Inches
Evaporation:	
Mineola	0.09

Compilation of meteorologic data, November 15–21, 1966—Continued

November 19, 1966

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	56	59	8		78	0	14		−5.4
2									−7.2
3									−5.4
4	49	49	10		48		19		−5.4
5									−5.4
6									−4.2
7	45	44	10		51		20		−3.0
8				10				1.8	−1.2
9								6.3	3.0
10	44	42	10	9	51		18	10.1	6.0
11				7				15.9	13.2
12				2				28.7	18.6
13	45	44	4		44		18	28.7	18.0
14								27.9	16.8
15				0				19.1	8.4
16	45	42	1	0	37		15	8.6	−1.2
17								.9	−8.4
18									−9.0
19	39	37	0		39		14		−9.0
20									−9.0
21									−9.0
22	36	35	0		42		12		−9.0
23									−8.4
24									−8.4

Location	*Maximum*	*Minimum*	*Departure from norma[l]*
Air temperatures (°F):			
Brookhaven	56	34	
Connetquot River			
East Patchogue			
Kennedy International Airport	57	34	+
Mineola	59	34	+

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	1[illegible]
Brookhaven	Net	−[illegible]
Mineola	Direct	
Connetquot River (solar site)	do	

	Total miles
Wind movement:	
Mineola	1[illegible]
Connetquot River (solar site)	

	Inches
Evaporation:	
Mineola	0.[illegible]

Compilation of meteorologic data, November 15–21, 1966—Continued

November 20, 1966

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	33	32	0	--	52	0	14	--	−8.4
2									−8.4
3									−8.4
4	32	30	0	--	54	--	10	--	−8.4
5									−9.0
6									−9.0
7	30	28	0	--	61	--	8	--	−9.0
8								4.0	−7.8
9				0				15.1	−.6
10	36	34	0	0	50	--	11	25.2	9.6
11				0				32.4	19.2
12				0				35.6	24.0
13	42	40	0	1	41	--	4	35.1	24.0
14								30.6	18.6
15								20.7	10.2
16	42	41	1	--	40	--	7	9.7	−.6
17								1.6	−8.4
18									−8.4
19	36	29	0	--	57	--	5	--	−8.4
20									−7.8
21									−7.8
22	34	26	0	--	62	--	5	--	−7.2
23									−7.2
24									−6.6

Location			
temperatures (° F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	40	15	--
Connetquot River	--	--	--
East Patchogue	--	--	--
Kennedy International Airport	43	29	−9
Mineola	41	25	−10

tal radiation:	*Type*	*Langleys*
Brookhaven	Direct	210
Brookhaven	Net	−26
Mineola	Direct	--
Connetquot River (solar site)	do	--

nd movement:	*Total miles*
Mineola	13
Connetquot River (solar site)	--

aporation:	*Inches*
Mineola	0.01

Compilation of meteorologic data, November 15–21, 1966—Continued

November 21, 1966

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	34	24	0		67	0	5		−6.6
2									−6.6
3									−7.2
4	32	24	0		72		5		−7.2
5									−7.2
6									−7.2
7	32	24	0		79		6		−7.2
8				0				6.5	−5.4
9				0				17.8	2.4
10	42	42	0	0	53		7	24.1	13.8
11								31.3	19.8
12								35.3	24.0
13	48	46	0	0	32		6	35.1	22.8
14								29.7	17.4
15								20.7	7.8
16	48	45	0		32		6	9.0	−3.0
17								.9	−7.8
18									−7.8
19	37	34	0		55		6		−7.8
20									−7.8
21									−7.2
22	36	29	0		57		6		−7.2
23									−7.2
24									−7.2

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	47	17	
Connetquot River			
East Patchogue			
Kennedy International Airport	50	30	—
Mineola	47	24	—

Total radiation:	*Type*	*Langleys*
Brookhaven	Direct	21
Brookhaven	Net	−1
Mineola	Direct	
Connetquot River (solar site)	do	

Wind movement:	*Total miles*
Mineola	3
Connetquot River (solar site)	

Evaporation:	*Inches*
Mineola	0.0

Compilation of meteorologic data, January 25–31, 1967

Sky cover given in tenths (cols. 4, 5). Positive values in cols. 9 and 10 indicate a downward radiation flux. Negative net-radiation values indicate a resultant ground-to-sky flux. Connetquot River temperatures were obtained near solar site 3. A summation of data is given for a complete 24-hr period beginning 0001 hr on the indicated dates.

Relative humidity (col. 6) is given in percent. Precipitation is in inches as measured in the liquid state. "Ken." denotes Kennedy International Airport. All temperature data are in degrees Fahrenheit. Radiation data are expressed in langleys. Land-pan evaporation readings suspended during the winter.

January 25, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	48	48	9		93	0	5		1.2
2									1.2
3									.6
4	46	47	10		96		5		1.2
5									1.2
6									0
7	45	44	8		96		7		0
8								0.9	−.6
9				8				6.8	2.4
10	47	47	10	9	89		11	18.9	11.4
11				9				21.6	15.6
12								26.1	19.2
13	52	56	8	9	83		9	25.6	18.6
14				10				29.2	22.2
15				10				20.7	14.4
16	47	52	6		96		7	9.0	4.2
17								1.4	.6
18									−.6
19	44	46	10		100		5		−1.2
20									−1.2
21									−1.2
22	40	43	7		100		3		−1.8
23									−1.2
24									−1.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (° F):			
Brookhaven	57	41	
Connetquot River	55	43	
East Patchogue	52	43	
Kennedy International Airport	53	38	+14
Mineola	57	42	+19

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	160
Brookhaven	Net	104
Mineola	Direct	142
Connetquot River (solar site 3)	do	106

Compilation of meteorologic data, January 25–31, 1967—Continued

January 26, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	39	40	5		100	0	3		−3.0
2									−3.0
3									−3.0
4	39	38	5		100		5		−3.6
5									−4.2
6									−4.2
7	41	39	5		96		4		−3.6
8				10				0.2	−1.8
9				10				2.0	2.4
10	51	49	10	10	90		6	2.7	3.6
11								7.2	6.6
12				9				13.5	12.0
13	59	57	6	5	65		10	20.2	16.8
14								27.2	22.2
15				5				22.3	15.0
16	55	55	8		67		10	11.5	6.6
17								2.5	−1.2
18									0
19	49	50	10		71		9		0
20									−.6
21									−1.8
22	44	44	3		71		10		−1.8
23									−3.0
24									−4.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (° F):			
Brookhaven	58	36	
Connetquot River	59	32	
East Patchogue	56	39	
Kennedy International Airport	60	38	+17
Mineola	57	37	+16

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	109
Brookhaven	Net	46
Mineola	Direct	128
Connetquot River (solar site 3)	do	100

Compilation of meteorologic data, January 25–31, 1967—Continued

January 27, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	42	43	9		68		11		−1.8
2									0
3									0
4	43	43	10		71		14		−.6
5									.6
6									.6
7	43	42	10		73		13		−1.8
8				10					.6
9				10				1.6	1.2
10	42	42	10	10	86		20	2.9	2.4
11				10				3.8	3.0
12								3.6	2.4
13	41	41	10	10	93		27	3.2	2.4
14				10		0.14		1.9	−1.2
15				10		.09		4.0	1.2
16	40	40	10	10	93	.09	28	2.2	0
17				10		.22		.2	−.6
18						.01			−1.2
19	41	40	10		93	.30	18		−.6
20						.04			−.6
21						.05			−.6
22	40	39	10		96	.10	13		0
23						.04			0
24						.02			0

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperature (°F):			
Brookhaven	42	37	
Connetquot River	43	38	
East Patchogue	44	38	
Kennedy International Airport	44	38	+9
Mineola	43	39	+10

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	23
Brookhaven	Net	5
Mineola	Direct	21
Connetquot River (solar site 2)	do	21

Compilation of meteorologic data, January 25–31, 1967—Continued

January 28, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	40	39	10		93	0.01	9		0
2						.01			0
3									0
4	39	39	10		93		17		0
5									−.6
6									−.6
7	36	36	8		76		18		−1.2
8				10					−1.8
9								1.1	−1.2
10	34	34	10	9	70		16	6.5	3.6
11				8				16.9	11.4
12								16.6	12.0
13	33	34	6		67		23	15.1	13.2
14								11.8	10.8
15				7				7.9	6.0
16	32	33	8	5	61		20	6.1	3.6
17								1.8	0
18								.2	−4.2
19	32	32	7		56		15		−4.8
20									−3.6
21									−3.0
22	31	32	5		59		17		−1.8
23									−1.8
24									−1.8

Location	*Maximum*	*Minimum*	*Departure from norma*
Air temperatures (°F):			
Brookhaven	38	29	
Connetquot River	38	29	
East Patchogue	38	29	
Kennedy International Airport	40	28	+
Mineola	39	29	+

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	[illegible]
Brookhaven	Net	[illegible]
Mineola	Direct	[illegible]
Connetquot River (solar site 2)	do	[illegible]

Compilation of meteorologic data, January 25–31, 1967—Continued

January 29, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	29	29	10		85	0.01	14		−1.8
2						.01			−1.8
3						.02			−3.0
4	29	29	10		85		12		−3.0
5									−4.8
6									−7.2
7	28	27	8		89		14		−4.8
8								2.0	−3.0
9				10				12.6	−1.8
10	24	25	10		71		22	23.8	4.2
11				4				20.7	6.0
12				2				27.0	13.8
13	26	26	6	3	58		20	36.4	18.0
14				3				25.6	15.6
15								20.2	7.8
16	25	25	8		53		23	6.8	0
17								1.8	−3.6
18									−6.6
19	25	25	7		55		16		−5.4
20									−3.6
21									−3.6
22	27	27	5		59		18		−4.8
23									−8.4
24									−9.0

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	29	21	
Connetquot River	29	23	
East Patchogue	29	24	
Kennedy International Airport	30	23	−5
Mineola	30	24	−4

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	177
Brookhaven	Net	−11
Mineola	Direct	164
Connetquot River (solar site 2)	do	90

Compilation of meteorologic data, January 25–31, 1967—Continued

January 30, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	27	26	4		55	0	17		−9.0
2									−9.0
3									−8.4
4	25	25	0		58		20		−9.0
5									−7.8
6									−8.4
7	24	25	0		60		18		−8.4
8				0				3.2	−7.8
9				0				14.8	−.6
10	27	27	0	0	53		19	25.8	10.2
11				0				35.6	19.8
12				0				47.7	27.6
13	33	33	0	0	42		17	49.0	29.4
14				0				38.7	25.8
15				0				29.7	18.6
16	34	33	0	0	35		16	21.6	7.8
17								5.0	−3.6
18								.4	−9.0
19	30	30	0		31		15		−10.2
20									−10.2
21									−10.2
22	27	27	0		37		16		−9.0
23									−9.0
24									−9.0

Location	*Maximum*	*Minimum*	*Departure from norma*
Air temperatures (°F):			
Brookhaven	36	22	
Connetquot River	35	23	
East Patchogue	36	24	
Kennedy International Airport	35	23	—
Mineola	34	25	—

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	27
Brookhaven	Net	
Mineola	Direct	27
Connetquot River (solar site 1)	do	15

Compilation of meteorologic data, January 25–31, 1967—Continued

January 31, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	22	22	0		50		8		−9.0
2									−10.2
3									−9.0
4	20	20	0		57		5		−9.0
5									−9.0
6									−9.0
7	19	21	0	0	65		5		−8.4
8				0				2.2	−7.8
9				0				14.4	−3.0
10	28	27	2	0	53		6	25.6	9.6
11				2				35.6	19.2
12								40.0	25.8
13	32	34	10	8	59		7	40.0	27.6
14				9				30.2	18.6
15			10	10				18.0	10.2
16	32	32	10	10	61		7	9.4	1.2
17								2.7	−3.6
18									−4.8
19	34	33	10		70		10		−3.0
20									−1.2
21									−1.2
22	31	32	10		96	0.02	3		−4.2
23						.03			−1.2
24									−4.2

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	37	12	
Connetquot River	36	11	
East Patchogue	36	20	
Kennedy International Airport	36	18	−5
Mineola	38	17	−3

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	218
Brookhaven	Net	14
Mineola	Direct	200
Connetquot River (solar site 1)	do	137

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Compilation of meteorologic data, April 19–25, 1967

Sky cover given in tenths (cols. 4, 5). Positive values in cols. 9 and 10 indicate a downward radiation flux. Negative net-radiation values indicate a resultant ground-to-sky flux. Connetquot River temperatures were obtained near solar site 3. A summation of data is given for a complete 24-hr period beginning 0001 hr on the indicated dates. Relative humidity (col. 6) is given in percent. Precipitation is in inches as measured in the liquid state. "Ken." denotes Kennedy International Airport. All temperature data are in degrees Fahrenheit. Radiation data are expressed in langleys.

April 19, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	46	47	6	10	71	0	15		−1.2
2				10					−1.2
3									−3.0
4	46	43	10		71		15		−3.0
5									−3.0
6								0.9	−1.2
7	42	40	10	10	83		15	4.5	2.4
8				10				12.2	10.2
9				10				12.6	10.8
10	45	44	10	10	68		12	27.4	24.6
11				10				31.6	26.4
12				10				19.4	15.6
13	50	50	10	10	61		26	18.4	15.6
14				10				12.6	10.8
15				10				14.8	13.2
16	51	50	10	10	61		15	12.6	10.2
17								5.4	4.2
18								2.2	.6
19	46	45	10		71		20	.7	−.6
20									−3.0
21									−3.6
22	45	44	7		65		20		−5.4
23									−7.2
24									−4.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	50	40	
Connetquot River	52	40	
East Patchogue	54	41	
Kennedy International Airport	53	41	−3
Mineola	51	40	−5

Total radiation:	*Type*	*Langleys*
Brookhaven	Direct	175
Brookhaven	Net	107
Mineola	Direct	250
Connetquot River (solar site 2)	do	229

Wind movement:	*Total miles*
Mineola	95
Connetquot River (solar site 2)	

Evaporation:	*Inches*
Mineola	0.15

Compilation of meteorologic data, April 19–25, 1967—Continued

April 20, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	44	44	0		65	0	13		−4.8
2									−7.2
3									−7.8
4	43	43	1		68		10		−7.8
5									−7.2
6								2.2	−5.4
7	47	46	0	1	61		6	14.8	6.0
8				1				32.0	18.0
9				1				49.5	33.0
10	54	50	0	0	45		12	62.6	47.4
11				0				70.6	55.8
12				0				73.8	60.0
13	62	60	3	0	29		12	73.8	60.0
14				0				68.4	56.4
15				0				58.5	45.6
16	64	63	0	0	24		18	45.4	33.0
17				0				28.4	18.0
18								12.2	3.6
19	58	58	7		24		16	1.4	−7.8
20									−9.0
21									−8.4
22	53	50	3		32		9		−7.8
23									−7.8
24									−7.8

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	61	41	
Connetquot River	64	39	
East Patchogue	59	40	
Kennedy International Airport	65	40	+2
Mineola	63	42	+2
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		594
Brookhaven	Net		348
Mineola	Direct		624
Connetquot River (solar site 2)	do		540
Wind movement:			*Total miles*
Mineola			98
Connetquot River (solar site 2)			
Evaporation:			*Inches*
Mineola			0.32

Compilation of meteorologic data, April 19–25, 1967—Continued

April 21, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	47	43	2		44	0	10		−7.8
2									−7.2
3									−7.2
4	43	43	5		53		6		−4.2
5									−4.8
6								3.6	−.6
7	46	45	8		44		7	9.4	5.4
8				8				28.8	18.6
9				2				52.2	34.2
10	53	54	8	1	31		11	65.2	47.4
11				2				72.4	55.8
12				3				68.4	55.8
13	48	52	9	6	44		12	65.6	45.6
14				7				48.6	37.2
15				8				44.6	36.0
16	48	48	10	10	46		14	21.2	15.0
17								11.0	6.6
18								5.4	1.2
19	46	47	10		74		9	.7	−3.0
20									−1.8
21									−1.2
22	47	47	10		89		3		−.6
23									−.6
24									−1.2

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	55	30	
Connetquot River	59	33	
East Patchogue	59	41	
Kennedy International Airport	53	42	—
Mineola	55	42	—

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	4[illegible]
Brookhaven	Net	31
Mineola	Direct	4[illegible]
Connetquot River (solar site 1)	do	3[illegible]

	Total miles
Wind movement:	
Mineola	1
Connetquot River (solar site 1)	

	Inches
Evaporation:	
Mineola	0.1

Compilation of meteorologic data, April 19–25, 1967—Continued

April 22, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	48	47	10		89	0	3		−1.2
2									−1.2
3									−1.2
4	46	47	10		100		7		−1.2
5									−.6
6								0.4	0
7	46	46	10		96		6	2.2	1.2
8				10				4.1	2.4
9				9				11.7	6.6
10	52	53	9	8	96		8	36.9	26.4
11				10				40.5	35.4
12				10				43.2	38.4
13	64	66	10	10	81		15	40.5	36.6
14				9				14.4	11.4
15				7				32.0	27.6
16	69	74	3	3	61		12	39.2	30.6
17								22.5	15.6
18								7.2	.6
19	71	73	5		29		17	.4	−8.4
20									−7.8
21									−8.4
22	62	63	1		35		18		−9.0
23									−9.0
24									−8.4

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	67	45	
Connetquot River	64	46	
East Patchogue	53	46	
Kennedy International Airport	71	45	+7
Mineola	75	46	+9
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		295
Brookhaven	Net		176
Mineola	Direct		339
Connetquot River (solar site 1)	do		220
Wind movement:			*Total miles*
Mineola			76
Connetquot River (solar site 1)			
Evaporation:			*Inches*
Mineola			0.38

Compilation of meteorologic data, April 19–25, 1967—Continued

April 23, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	52	49	3		45	0	20		−8. 4
2									−9. 0
3									−9. 2
4	47	46	2		46		17		−8. 4
5									−8. 4
6								1. 8	−6. 6
7	48	45	5		44		12	14. 0	3. 6
8				2				31. 1	18. 0
9				2				47. 7	32. 4
10	49	48	5	1	44		18	61. 6	45. 6
11				1				71. 1	55. 8
12								75. 6	61. 8
13	48	48	8		44		19	75. 6	64. 2
14				2				72. 0	59. 4
15				3				54. 9	42. 0
16	55	54	3		34		20	41. 8	30. 0
17								3[illegible]. 3	22. 8
18								16. 2	7. 2
19	51	51	0		38		12	3. 2	−6. 6
20									−9. 0
21									−9. 0
22	46	40	0		46		6		−8. 4
23									−7. 8
24									−7. 8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	56	28	
Connetquot River	57	30	
East Patchogue	56	46	
Kennedy International Airport	56	42	−[illegible]
Mineola	55	36	−[illegible]

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	60[illegible]
Brookhaven	Net	34[illegible]
Mineola	Direct	57[illegible]
Connetquot River (solar site 1)	do	42[illegible]

	Total miles
Wind movement:	
Mineola	
Connetquot River (solar site 1)	

	Inches
Evaporation:	
Mineola	0. 2[illegible]

Compilation of meteorologic data, April 19–25, 1967—Continued

April 24, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	43	34	5		60		5		−7.8
2									−4.2
3									−1.8
4	44	41	10		58		5		−1.8
5									−1.8
6									−.6
7	43	42	10		60		10	1.4	0.6
8				10		.02		1.8	−3.0
9				10		.02		4.0	0
10	37	34	10	10	96	.15	16	3.2	−1.2
11				10		.11		3.6	−.6
12				10		.07		3.6	.6
13	37	37	10	10	96	.05	11	4.0	2.4
14				10		.03		5.4	3.0
15				10		.04		9.0	5.4
16	45	44	9		58	.02	15	18.0	10.2
17						Trace		20.7	11.4
18								1.3	−1.2
19	43	43	6		56		11	.4	−3.6
20									−3.6
21									−3.6
22	41	40	6		65		18		−3.0
23									−1.8
24									−4.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	43	33	
Connetquot River	43	27	
East Patchogue		38	
Kennedy International Airport	45	34	−12
Mineola	45	34	−13

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	77
Brookhaven	Net	−11
Mineola	Direct	99
Connetquot River (solar site 3)	do	82

	Total miles
Wind movement:	
Mineola	29
Connetquot River (solar site 3)	

	Inches
Evaporation:	
Mineola	0.06

Compilation of meteorologic data, April 19–25, 1967—Continued

April 25, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	41	40	4		65	Trace	17		−1.8
2						0.01			−3.6
3						.07			−7.8
4	40	39	0		61		15		−9.0
5									−8.4
6								3.2	−7.2
7	40	39	0	0	57		16	21.6	2.4
8				0				35.1	17.4
9				0				50.4	33.0
10	46	43	0	0	37		23	65.7	46.2
11				0				74.7	56.4
12				0				77.0	61.8
13	50	48	0	0	31		15	76.5	62.4
14				0				71.8	57.6
15				0				63.2	48.0
16	53	52	0	0	30		13	49.0	36.0
17								31.0	21.0
18								13.5	6.0
19	49	48	0		33		20	1.8	−7.3
20									−9.0
21									−8.4
22	46	46	0		37		10		−8.4
23									−7.8
24									−7.8

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	52	27	
Connetquot River	56	27	
East Patchogue	49	36	
Kennedy International Airport	54	37	−6
Mineola	52	38	−8

Total radiation:	*Type*	*Langleys*
Brookhaven	Direct	634
Brookhaven	Net	361
Mineola	Direct	641
Connetquot River (solar site 3)	do	630

Wind movement:	*Total miles*
Mineola	68
Connetquot River (solar site 3)	

Evaporation:	*Inches*
Mineola	

Compilation of meteorologic data, June 7–13, 1967

Sky cover given in tenths (cols. 4, 5). Positive values in cols. 9 and 10 indicate a downward radiation flux. Negative net-radiation values indicate a resultant ground-to-sky flux. Connetquot River temperatures were obtained near solar site 3. A summation of data is given for a complete 24-hr period beginning 0001 hr on the indicated dates. Relative humidity (col. 6) is given in percent. Precipitation is in inches as measured in the liquid state. "Ken." denotes Kennedy International Airport. All temperature data are in degrees Fahrenheit. Radiation data are expressed in langleys.

June 7, 1967

Hour	Temperature of air (°F.)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	59	59	2		84	0	5		−7.2
2									−7.2
3									−7.2
4	57	54	2		90		6		−6.6
5								0.4	−5.4
6								8.6	−1.2
7	64	70	2	0	81		7	23.8	10.2
8				0				41.8	24.0
9				0				58.0	37.2
10	68	73	1	0	73		10	69.8	49.8
11				0				76.5	58.8
12				0				79.7	66.0
13	70	75	0	0	64		17	79.2	65.4
14				0				74.7	61.8
15				0				67.0	52.8
16	69	73	5		66		18	53.1	38.4
17								36.9	24.0
18								18.9	10.2
19	63	63	7		87		16	6.2	−1.2
20								.9	−7.8
21									−7.8
22	60	62	0		90		12		−7.8
23									−7.2
24									−7.2

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	77	51	
Connetquot River	80	50	
East Patchogue	68	61	
Kennedy International Airport	72	55	−4
Mineola	78	53	−1

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	695
Brookhaven	Net	425
Mineola	Direct	698
Connetquot River (solar site 2)	do	559

	Total miles
Wind movement:	
Mineola	96
Connetquot River (solar site 2)	12.6

	Inches
Evaporation:	
Mineola	0.30

Compilation of meteorologic data, June 7–13, 1967—Continued

June 8, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	61	61	2		84	0	6		-6.6
2									-6.6
3									-5.4
4	59	58	8		90		6		-5.4
5								0.4	-4.8
6				2				7.2	-1.8
7	65	65	5	1	78		9	21.2	13.2
8				2				37.8	21.0
9				3				51.8	33.6
10	75	78	5	3	58		8	64.8	48.6
11				3				72.0	58.8
12				3				73.3	61.8
13	69	78	7	4	68		11	74.2	63.0
14				4				68.8	57.6
15				6				63.4	50.4
16	69	73	7		66		18	52.2	38.4
17								34.2	24.6
18								19.4	10.2
19	64	65	8		73		18	5.0	0
20								.4	-5.4
21									-6.6
22	62	63	3		81		8		-6.6
23									-6.6
24									-6.6

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	80	58	
Connetquot River	80	58	
East Patchogue	70	61	
Kennedy International Airport	77	57	-1
Mineola	84	57	+4
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		646
Brookhaven	Net		419
Mineola	Direct		630
Connetquot River (solar site 2)	do		503
Wind movement:			*Total miles*
Mineola			83
Connetquot River (solar site 2)			10.6
Evaporation:			*Inches*
Mineola			0.31

Compilation of meteorologic data, June 7–13, 1967—Continued

June 9, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	58	61	3	------------	90	0	6	------------	−6.6
2	------------	------------	------------	------------	------------	------------	------------	------------	−6.6
3	------------	------------	------------	------------	------------	------------	------------	------------	−6.6
4	58	58	4	------------	90	------------	6	------------	−6.6
5	------------	------------	------------	------------	------------	------------	------------	0.4	−4.8
6	------------	------------	------------	5	------------	------------	------------	8.6	0
7	64	65	8	5	78	------------	8	22.5	12.0
8	------------	------------	------------	1	------------	------------	------------	39.2	24.0
9	------------	------------	------------	1	------------	------------	------------	56.2	36.0
10	69	76	6	1	71	------------	9	66.2	48.6
11	------------	------------	------------	1	------------	------------	------------	72.4	57.6
12	------------	------------	------------	2	------------	------------	------------	76.0	62.4
13	76	76	6	3	66	------------	15	75.6	61.8
14	------------	------------	------------	3	------------	------------	------------	68.8	57.6
15	------------	------------	------------	5	------------	------------	------------	62.6	48.6
16	69	73	6	------------	68	------------	20	50.8	37.2
17	------------	------------	------------	------------	------------	------------	------------	35.1	24.0
18	------------	------------	------------	------------	------------	------------	------------	18.4	10.2
19	64	67	6	------------	78	------------	18	5.4	−.6
20	------------	------------	------------	------------	------------	------------	------------	.4	−5.4
21	------------	------------	------------	------------	------------	------------	------------	------------	−5.4
22	61	64	3	------------	84	------------	13	------------	−4.8
23	------------	------------	------------	------------	------------	------------	------------	------------	−4.8
24	------------	------------	------------	------------	------------	------------	------------	------------	−4.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	78	58	----------
Connetquot River	77	57	----------
East Patchogue	70	62	----------
Kennedy International Airport	71	57	−5
Mineola	78	57	+1

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	659
Brookhaven	Net	423
Mineola	Direct	656
Connetquot River (solar site 1)	do	2[illegible]5

	Total miles
Wind movement:	
Mineola	96
Connetquot River (solar site 1)	32.8

	Inches
Evaporation:	
Mineola	0.30

Compilation of meteorologic data, June 7–13, 1967—Continued

June 10, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	60	61	4		87	0	7		−4.8
2									−4.8
3									−4.8
4	59	59	1		87		5		−4.8
5								0.4	−3.6
6								7.2	1.2
7	68	69	5	7	68		8	19.5	13.2
8				7				34.6	21.6
9				7				46.4	33.6
10	74	78	7		62		10	57.2	45.0
11								67.1	54.6
12				1				71.1	60.0
13	71	85	8	3	68		12	50.4	34.2
14								56.2	47.4
15								60.8	47.4
16	69	76	8		71		13	50.4	34.2
17								34.2	19.2
18								17.6	6.6
19	66	68	10		78		14	5.4	−1.8
20								.4	−3.6
21									−4.2
21									
22	64	67	10		81		3		−4.2
23									−4.2
24									−4.2

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from norm*
Brookhaven	85	62	
Connetquot River	84	60	
East Patchogue	71	63	
Kennedy International Airport	78	59	
Mineola	85	59	+

Total radiation:	*Type*	*Langleys*
Brookhaven	Direct	5
Brookhaven	Net	5
Mineola	Direct	5
Connetquot River (solar site 1)	do	2

Wind movement:	*Total miles*
Mineola	45
Connetquot River (solar site 1)	18.

Evaporation:	*Inches*
Mineola	0.

Compilation of meteorologic data, June 7–13, 1967—Continued

June 11, 1967

Hour (1)	Temperature of air (° F) Kennedy (2)	Temperature of air (° F) Mineola (3)	Sky cover Kennedy (4)	Sky cover Project area (5)	Relative humidity, Kennedy (6)	Precipitation, Brookhaven (7)	Wind (knots), Kennedy (8)	Radiation, Brookhaven Solar (9)	Radiation, Brookhaven Net (10)
1	65	66	8	------------	81	0	7	------------	−4.2
2									−3.6
3									−3.6
4	65	63	7	------------	84	------------	6	------------	−3.6
5								0.4	−1.8
6								5.4	3.0
7	65	70	5	0	78	------------	5	17.1	12.0
8				0				31.1	22.8
9				0				45.9	34.2
10	77	82	2	0	58	------------	7	57.1	44.4
11								64.4	52.2
12								66.6	55.8
13	72	85	6	------------	71	------------	11	66.6	54.6
14								64.4	51.0
15								57.6	42.6
16	68	75	3	------------	78	------------	15	44.6	31.8
17								23.4	10.8
18								9.9	2.4
19	64	71	0	------------	81	------------	16	4.5	−1.8
20								.4	−4.8
21									−5.4
22	62	66	8	------------	87	------------	8	------------	−5.4
23									−5.4
24									−6.6

Location			
ir temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	89	62	----------
Connetquot River	86	56	----------
East Patchogue	70	64	----------
Kennedy International Airport	77	61	0
Mineola	89	63	+8
otal radiation:	*Type*		*Langleys*
Brookhaven	Direct		559
Brookhaven	Net		371
Mineola	Direct		585
Connetquot River (solar site 1)	do		242
'ind movement:			*Total miles*
Mineola			29
Connetquot River (solar site 1)			15.3
'aporation:			*Inches*
Mineola			0.28

Compilation of meteorologic data, June 7–13, 1967—Continued

June 12, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	60	63	3		87	0	8		−6.6
2									−6.6
3									−5.4
4	60	60	3		90		6		−5.4
5								0.4	−4.2
6				0				7.6	3.0
7	64	68	2	0	84		8	21.6	10.8
8				0				37.8	21.6
9				0				53.1	36.0
10	73	81	0	0	71		10	63.9	46.2
11				0				70.6	55.8
12				0				73.4	61.2
13	73	87	0	0	71		14	73.8	61.8
14								69.3	57.6
15								59.4	48.0
16	73	81	0		71		14	49.0	36.0
17								32.8	22.8
18								17.6	10.2
19	70	75	0		71		12	3.6	−1.8
20								.4	−4.8
21									−4.2
22	70	73	4		68		3		−5.4
23									−5.4
24									−5.4

Location			
Air temperatures (° F):	*Maximum*	*Minimum*	*Departure from norma*
Brookhaven	85	64	
Connetquot River	84	59	
East Patchogue	75	64	
Kennedy International Airport	77	59	−
Mineola	88	59	+
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		63
Brookhaven	Net		41
Mineola	Direct		6
Connetquot River (solar site 3)	do		5
Wind movement:			*Total miles*
Mineola			42
Connetquot River (solar site 3)			27.
Evaporation:			*Inches*
Mineola			0.

Compilation of meteorologic data, June 7–13, 1967—Continued

June 13, 1967

Hour	Temperature of air (° F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	68	68	5		76	0	2		−5.4
2									−4.8
3									−1.8
4	65	66	4		84		6		−1.2
5									−1.2
6								0.9	.6
7	60	60	10	10	93		13	5.4	4.2
8				10				12.2	8.4
9				9				14.8	12.0
10	65	73	9	9	75		11	36.9	30.6
11				9				67.5	54.0
12				8				37.8	30.6
13	66	71		10	70		13	32.0	26.4
14				10				32.0	27.6
15				10				26.4	21.6
16	62	68	10	10	75		17	21.2	17.4
17								16.6	13.2
18								9.4	6.6
19	59	63	10		75		14	2.2	.6
20								.4	−1.8
21									−3.6
22	58	61	10		81		11		−4.2
23									−4.2
24									−1.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	72	54	
Connetquot River	73	59	
East Patchogue	65	58	
Kennedy International Airport	71	58	−5
Mineola	73	58	−3
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		316
Brookhaven	Net		224
Mineola	Direct		458
Connetquot River (solar site 3)	do		352
Wind movement:			*Total miles*
Mineola			40
Connetquot River (solar site 3)			24.5
Evaporation:			*Inches*
Mineola			0.18

Compilation of meteorologic data, August 24–30, 1967

Sky cover given in tenths (cols. 4 5). Positive values in cols. 9 and 10 indicate a downward radiation flux. Negative net-radiation values indicate a resultant ground-to-sky flux. Connetquot River temperatures were obtained near solar site 3. A summation of data is given for a complete 24-hr period beginning 0001 hr on the indicated dates. Relative humidity (col. 6) is given in percent. Precipitation is in inches as measured in the liquid state. "Ken" denotes Kennedy International Airport. All temperature data are in degrees Fahrenheit. Radiation data are expressed in langleys.

August 24, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	59	59	2		84		5		−6.6
2									−5.4
3									−4.8
4	59	59	4		87		5		−4.2
5									−4.2
6				10				0.4	−3.0
7	62	63	9	10	67		8	5.4	2.4
8				10				19.4	11.4
9				10				28.8	15.6
10	66	66	10	10	65		12	28.4	15.6
11				10				33.8	22.8
12				10				36.4	24.6
13	67	67	10	10	63		8	39.2	25.8
14				10				33.8	21.6
15				10				28.0	15.0
16	61	61	10	10	88		8	16.6	9.6
17								9.9	4.2
18						0.02		4.5	.6
19	59	60	10		90	.01	10	.9	−3.6
20						Trace			−3.0
21						Trace			−3.6
22	59	59	10		93	Trace	8		−5.4
23						Trace			−3.0
24						.01			−1.8

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	69	50	
Connetquot River	66	50	
East Patchogue	64	59	
Kennedy International Airport	68	58	−1[illegible]
Mineola	68	59	−[illegible]

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	28[illegible]
Brookhaven	Net	12[illegible]
Mineola	Direct	20[illegible]
Connetquot River (solar site 2)	do	11[illegible]

	Total miles
Wind movement:	
Connetquot River (solar site 2)	

	Inches
Evaporation:	
Mineola	0.0[illegible]

Compilation of meteorologic data, August 24–30, 1967—Continued

August 25, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation Brookhaven,	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	60	60	10		93	0.01	7		−1.8
2						.01			−1.2
3						.01			−1.2
4	58	58	10		96	.01	8		−.6
5						Trace			−.6
6				10		Trace			0
7	60	60	10	10	97	.20	9	0.9	.6
8				10		.80		1.4	.6
9				10		.60		2.2	1.2
10	62	62	10	10	93	.13	9	5.0	3.0
11				10		.01		12.2	6.6
12				10		.01		8.6	4.2
13	65	65	10	10	97	.07	10	12.2	6.0
14				10		.13		9.0	4.2
15				10		.08		7.2	3.6
16	67	66	10	10	93	.01	11	7.6	3.6
17						.01		4.0	2.4
18						.01		2.2	.6
19	66	66	10		97	Trace	9	.4	0
20						Trace			0
21						.02			0
22	68	66	10		97	.02	4		0
23						.01			0
24									0

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	64	57	
Connetquot River	65	59	
East Patchogue	65	61	
Kennedy International Airport	68	58	−11
Mineola	66	58	−8

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	73
Brookhaven	Net	31
Mineola	Direct	63
Connetquot River (solar site 2)	do	42

	Total miles
Wind movement:	
Mineola	
Connetquot River (solar site 2)	[1] 8.9

	Inches
Evaporation:	
Mineola	0.00

[1] (Aug. 24, 25.)

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Compilation of meteorologic data, August 24–30, 1967—Continued

August 26, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	66	66	10		97		5		0
2									0
3									0
4	64	65	10		100		4		0
5									0
6				10					0
7	64	64	10	10	100		4	1.8	1.2
8				10				10.8	3.0
9				10				16.2	8.4
10	67	66	10	10	97		3	15.8	7.8
11				10				15.3	7.8
12				10				17.6	10.2
13	69	69	10	10	93	0.02	11	10.8	6.0
14				10		.24		4.0	0
15				10		.30		3.2	1.2
16	70	68	10	10	93	.06	4	15.8	7.2
17				10		.01		8.3	3.0
18								2.2	.6
19	69	69	10		97		7	.4	0
20									0
21									0
22	69	70	10		100		5		0
23									0
24									.6

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (°F):			
Brookhaven	70	64	
Connetquot River	70	64	
East Patchogue		65	
Kennedy International Airport	70	64	−6
Mineola	70	64	−4

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	122
Brookhaven	Net	57
Mineola	Direct	95
Connetquot River (solar site 1)	do	31

	Total miles
Wind movement:	
Mineola	[1] 46
Connetquot River (solar site 1)	

	Inches
Evaporation:	
Mineola	0.00

[1] (Aug. 25, 26)

Compilation of meteorologic data, August 24–30, 1967—Continued

August 27, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	70	69	10		97		10		0.6
2									0
3									0
4	69	69	10		97		5		-.6
5						0.03			0
6						.10			-.6
7	70	70	10		93	.07	7	6.3	3.0
8						.01		11.2	5.4
9						.01		21.2	11.4
10	75	78	7		87		8	20.7	13.2
11								29.2	19.8
12								33.3	26.4
13	71	77	10		97		8	32.8	21.0
14								25.6	19.2
15								25.0	17.4
16	71	75	10		100		9	13.0	10.2
17								6.8	4.2
18								3.2	1.2
19	69	70	10		97		7	.4	0
20									0
21									0
22	70	71	10		93		11		-.6
23									0
24									0

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	76	70	
Connetquot River	75	69	
East Patchogue	72	68	
Kennedy International Airport	75	68	−1
Mineola	79	65	+1
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		229
Brookhaven	Net		152
Mineola	Direct		304
Connetquot River (solar site 1)	do		66
Wind movement:			*Total miles*
Mineola			4
Connetquot River (solar site 1)			[1] 18.8
Evaporation:			*Inches*
Mineola			0.23

[1] (Aug. 26, 27).

Compilation of meteorologic data, August 24–30, 1967—Continued

August 28, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	70	70	10		90	0	10		−0.6
2									−.6
3									0
4	70	70	9		90		8		0
5									−1.8
6									−1.2
7	69	69	9	10	93		7		4.2
8				8					6.0
9				7					13.2
10	74	73	10	5	74		7		37.8
11				6					50.4
12				4					55.8
13	77	78	8	4	56		13		57.6
14				3					51.0
15				2					44.4
16	75	77	8		54		12		30.6
17									10.8
18									2.4
19	70	72	5		61		12		−6.6
20									−7.2
21									−7.2
22	68	67	4		73		9		−7.2
23									−7.2
24									−7.2

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departu from norn*
Brookhaven	81	59	
Connetquot River	79	58	
East Patchogue		66	
Kennedy International Airport	78	67	
Mineola	79	65	
Total radiation:	*Type*		*Langley*
Brookhaven	Direct		
Brookhaven	Net		
Mineola	Direct		
Connetquot River (solar site 1)	do		
Wind movement:			*Total mil*
Mineola			3
Connetquot River (solar site 1)			1
Evaporation:			*Inches*
Mineola			0.

Compilation of meteorologic data, August 24–30, 1967—Continued

August 29, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar D	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	67	64	8		73	0	7		−5.4
2									−5.4
3									−5.4
4	64	64	0		81		5		−5.4
5									−6.6
6				0					−4.8
7	66	66	0	0	76		4		0
8				0					14.4
9				0					27.6
10	74	73	0	0	58		4		41.4
11				1					52.2
12				3					58.2
13	80	77	8	5	47		4		55.2
14				7					37.2
15				8					34.2
16	79	81	7		62		4		21.6
17									14.4
18									.6
19	72	74	2		82		4		−5.4
20									−5.4
21									−5.4
22	70	68	0		87		5		−4.8
23									−6.6
24									−6.6

Location			
Air temperatures (°F):	*Maximum*	*Minimum*	*Departure from normal*
Brookhaven	80	55	
Connetquot River	79	53	
East Patchogue	70	63	
Kennedy International Airport	80	62	−2
Mineola	81	63	+1
Total radiation:	*Type*		*Langleys*
Brookhaven	Direct		
Brookhaven	Net		290
Mineola	Direct		520
Connetquot River (solar site 3)	do		330
Wind movement:			*Total miles*
Mineola			
Connetquot River (solar site 3)			17.6
Evaporation:			*Inches*
Mineola			

Compilation of meteorologic data, August 24–30, 1967—Continued

August 30, 1967

Hour	Temperature of air (°F)		Sky cover		Relative humidity, Kennedy	Precipitation, Brookhaven	Wind (knots), Kennedy	Radiation, Brookhaven	
	Kennedy	Mineola	Kennedy	Project area				Solar	Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	67	65	0		90	0	7		−6.6
2									−6.6
3									−5.4
4	66	62	0		93		7		−4.4
5									−4.8
6				0				0.4	−4.2
7	68	64	0	0	84		5	7.2	.6
8				0				22.0	17.4
9				0				36.4	29.5
10	73	80	2	0	84		6	47.7	40
11				0				56.7	49.5
12				0				60.3	52.5
13	77	83	2	0	79		11	60.3	53
14				0				54.0	45.5
15				0				44.6	37.5
16	75	78	2	0	82		17	32.0	24
17								18.0	12
18								6.3	.5
19	72	72	2		87		12	.9	−4.5
20									−5
21									−6
22	70	70	0		87		10		−7
23									−7
24									−7

Location	*Maximum*	*Minimum*	*Departure from normal*
Air temperatures (° F):			
Brookhaven	82	58	
Connetquot River	80	55	
East Patchogue	75	62	
Kennedy International Airport	78	65	—
Mineola	83	61	+

	Type	*Langleys*
Total radiation:		
Brookhaven	Direct	44
Brookhaven	Net	29
Mineola	Direct	48
Connetquot River (solar site 3)	do	34

	Total miles
Wind movement:	
Mineola	[1] 77
Connetquot River (solar site 3)	24.

	Inches
Evaporation:	
Mineola	[1] 0.4

[1] (Aug. 29, 30.)

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, November 15–21, 1966

Hour	East Meadow Brook, site 4 gaging station	Sampawams Creek, site 4 gaging station	Champlin Creek, site 4 gaging station	Connetquot River, site 1 Veterans Highway	Swan River, site 5 gaging station
			November 15, 1966		
1	7.8	9.1	8.3	7.5	8.1
2	7.4	8.9	8.1	7.2	--
3	7.4	8.9	7.8	7.2	7.8
4	7.2	8.8	7.5	7.2	--
5	7.2	8.4	7.5	6.9	7.5
6	6.9	8.4	7.5	6.9	--
7	6.9	8.0	7.5	6.9	7.5
8	6.8	8.1	7.5	6.7	--
9	6.8	8.3	7.5	6.7	7.2
10	6.9	8.9	8.3	6.9	--
11	7.3	9.4	9.2	7.2	7.2
12	8.1	10.2	9.4	7.5	--
13	8.9	10.8	9.7	7.8	7.2
14	10.0	11.1	10.0	8.9	--
15	10.3	10.8	10.0	9.7	7.2
16	10.6	10.4	10.3	10.0	--
17	10.3	10.6	10.0	10.0	7.2
18	9.4	10.3	10.0	9.4	--
19	9.2	10.0	9.7	9.2	7.2
20	9.0	9.9	9.7	8.9	--
21	8.4	9.6	9.4	8.6	7.2
22	8.1	9.3	9.2	8.3	--
23	7.9	9.2	8.9	8.1	7.2
24	7.7	8.9	8.6	7.8	--
			November 16, 1966		
1	7.5	8.3	8.1	7.5	7.5
2	7.2	7.8	7.8	7.3	--
3	7.1	7.5	7.8	7.2	7.5
4	6.8	7.5	7.5	7.1	--
5	6.7	7.4	7.3	6.9	7.4
6	6.7	7.2	7.2	6.7	--
7	6.6	7.1	7.2	6.7	7.2
8	6.1	7.2	7.1	6.6	--
9	7.2	7.6	7.2	6.6	6.9
10	8.1	8.2	7.5	6.7	--
11	9.0	8.9	8.1	7.2	6.6
12	9.7	9.6	9.0	7.7	--
13	10.3	10.0	9.3	8.8	7.1
14	10.6	10.0	9.9	9.4	--
15	10.6	9.9	10.1	9.9	7.2
16	10.6	9.9	10.3	10.1	--
17	10.4	9.7	10.4	10.3	7.3
18	10.4	9.6	10.5	10.3	--
19	10.1	9.4	10.6	10.2	7.5
20	10.0	9.4	10.6	10.2	--
21	9.9	9.3	10.5	10.1	7.6
22	9.8	9.4	10.4	10.1	--
23	9.7	9.3	10.3	10.0	7.7
24	9.7	9.3	10.3	9.9	--
			November 17, 1966		
1	9.7	9.1	10.0	9.9	7.9
2	9.6	9.1	10.0	9.8	--
3	9.6	9.0	9.9	9.8	7.9
4	9.5	8.9	9.9	9.8	--
5	9.6	8.9	9.9	9.7	8.1
6	9.6	9.0	9.9	9.7	--
7	9.6	9.0	9.9	9.6	8.1
8	9.6	9.1	9.9	9.6	--
9	9.7	9.4	10.0	9.6	8.3
10	10.1	9.7	10.2	9.6	--
11	11.0	10.1	10.4	9.6	8.6
12	11.5	10.7	10.9	9.7	--
13	11.9	11.1	11.4	10.0	9.1
14	12.2	11.3	11.8	11.1	--
15	12.2	11.4	12.1	11.9	9.2
16	12.3	11.4	12.2	11.9	--
17	12.3	11.3	12.4	11.9	9.4
18	12.1	11.1	12.3	11.7	--
19	11.9	10.9	12.2	11.4	9.7
20	11.7	10.9	12.1	11.2	--
21	11.6	10.8	12.1	11.1	10.0
22	11.3	10.8	11.8	10.8	--
23	11.3	10.7	11.7	10.7	10.0
24	11.3	10.6	11.6	10.6	--

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, November 15–21, 1966—Continued

Hour	East Meadow Brook, site 4 gaging station	Sampawams Creek, site 4 gaging station	Champlin Creek, site 4 gaging station	Connetquot River, site 1 Veterans Highway	Swan River, site 5 gaging station
			November 18, 1966		
1	11.2	10.4	11.4	10.4	10.0
2	11.2	10.3	11.4	10.3	--
3	11.1	10.2	11.3	10.1	10.0
4	11.1	10.2	11.3	10.1	--
5	11.1	10.1	11.3	9.9	10.0
6	11.0	10.1	11.2	9.9	--
7	11.0	10.1	11.2	9.8	10.0
8	11.0	10.2	11.2	9.7	--
9	11.0	10.3	11.2	9.6	10.0
10	11.1	10.6	11.3	9.4	--
11	11.1	10.9	11.4	9.6	10.0
12	11.3	11.1	11.5	10.0	--
13	11.7	11.4	11.6	10.6	10.1
14	12.2	11.3	11.9	11.1	--
15	12.8	11.2	12.1	11.6	10.4
16	12.9	11.2	12.3	11.7	--
17	12.8	11.2	12.4	11.7	10.7
18	12.8	11.1	12.5	11.8	--
19	12.7	11.1	12.5	11.8	10.8
20	12.5	11.1	12.5	11.7	--
21	12.4	11.1	12.4	11.6	10.8
22	12.3	11.0	12.4	11.4	--
23	12.2	10.9	12.2	11.2	10.8
24	12.1	10.8	12.1	11.1	--
			November 19, 1966		
1	11.9	10.8	11.9	11.1	10.3
2	11.7	10.6	11.8	10.8	--
3	11.4	10.4	11.5	10.6	10.0
4	11.0	10.1	11.4	10.3	--
5	10.8	10.2	11.2	10.0	9.9
6	10.4	10.1	10.8	9.8	--
7	10.1	9.8	10.4	9.5	9.7
8	9.8	9.6	10.3	9.3	--
9	9.4	9.4	10.1	9.0	9.2
10	9.4	9.7	10.0	8.9	--
11	9.4	9.8	9.9	9.1	8.6
12	9.6	9.9	9.9	9.4	--
13	9.9	10.1	10.1	10.0	8.3
14	10.1	10.3	10.2	10.0	--
15	10.3	10.1	10.3	10.0	8.1
16	10.3	9.7	10.3	9.7	--
17	10.2	9.3	10.2	9.4	7.8
18	10.1	9.1	9.8	9.2	--
19	9.7	8.9	9.4	9.2	7.8
20	9.1	8.8	9.2	9.0	--
21	8.6	8.5	8.7	8.9	7.5
20	8.1	8.2	8.3	8.6	--
23	7.8	8.0	8.2	8.3	7.2
24	7.5	7.8	7.6	8.1	--
			November 20, 1966		
1	7.3	7.5	7.5	7.8	6.9
2	7.1	7.5	7.4	7.3	--
3	6.9	7.3	7.1	6.9	6.4
4	6.8	7.3	6.9	6.7	--
5	6.7	7.3	6.8	6.4	6.1
6	6.4	7.2	6.8	6.3	--
7	6.3	7.2	6.7	6.3	5.6
8	6.2	7.3	6.6	6.1	--
9	6.2	7.6	6.6	6.0	5.3
10	6.3	8.1	6.7	5.9	--
11	6.7	8.6	7.2	6.0	5.0
12	7.3	9.1	8.1	6.1	--
13	8.2	9.3	8.4	6.7	5.3
14	9.2	9.3	8.9	7.8	--
15	9.6	9.1	9.0	8.3	5.8
16	9.8	8.9	9.2	8.4	--
17	9.8	8.6	9.2	8.3	6.1
18	9.7	8.3	9.0	8.1	--
19	9.2	8.1	8.8	7.9	6.1
20	8.8	8.0	8.6	7.5	--
21	8.4	7.8	8.3	7.2	5.8
22	8.1	7.7	7.9	7.0	--
23	7.5	7.4	7.5	6.8	5.6
24	7.3	7.3	7.2	6.7	--

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, November 15–21, 1966—Continued

Hour	East Meadow Brook, site 4 gaging station	Sampawams Creek, site 4 gaging station	Champlin Creek, site 4 gaging station	Connetquot River, site 1 Veterans Highway	Swan River, site 5 gaging station
November 21, 1966					
1	6.9	7.2	6.9	6.4	5.3
2	6.7	7.2	6.7	6.0	-------------
3	6.6	7.1	6.4	5.8	5.0
4	6.4	6.9	6.1	5.6	-------------
5	6.3	6.8	6.1	5.3	5.0
6	6.1	6.7	6.0	5.1	-------------
7	6.1	6.7	6.0	4.9	4.7
8	5.9	6.7	5.8	4.7	-------------
9	5.8	6.8	5.8	4.9	4.4
10	5.8	7.2	6.0	5.0	-------------
11	6.2	7.8	6.7	6.4	4.4
12	6.9	8.3	8.3	6.9	-------------
November 21, 1966—Continued					
13	7.8	8.7	8.6	7.2	5.0
14	8.3	9.0	9.2	7.5	-------------
15	8.6	8.9	9.3	7.2	5.3
16	8.7	8.7	9.4	6.8	-------------
17	8.6	8.4	9.4	6.4	5.6
18	8.4	8.2	9.0	6.1	-------------
19	8.1	7.9	8.4	5.8	5.6
20	7.6	7.7	8.1	5.6	-------------
21	6.9	7.5	7.8	5.3	5.6
22	6.2	7.3	7.3	5.0	-------------
23	5.8	7.2	7.2	4.5	5.3
24	5.4	7.1	6.9	4.2	-------------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, January 25–31, 1967

Hour	East Meadow Brook, site 4 gaging station	Sampawams Creek, site 4 gaging station	Champlin Creek		Connetquot River			Swan River	
			Site 3 Islip Boulevard	Site 4 gaging station	Site 1 Veterans Highway	Site 3	Site 5 "at bridge"	Site 3 Sunrise Highway	Site 5 gaging station
January 25, 1967									
1	9.3	10.7	10.6	11.0	10.0	10.3	9.8	10.8	10.6
2	9.3	10.6	10.6	10.8	10.0	10.2	9.7	10.8	----------------
3	9.2	10.6	10.6	10.6	10.0	10.2	9.5	10.8	10.4
4	9.1	10.6	10.3	10.6	10.0	10.2	9.4	10.8	----------------
5	9.0	10.4	10.3	10.6	10.0	10.2	9.3	10.8	10.4
6	9.0	10.3	10.3	10.6	10.0	10.2	9.2	10.8	----------------
7	8.9	10.1	10.3	10.4	10.0	10.2	9.0	10.8	10.1
8	8.9	10.0	10.0	10.3	10.0	10.1	8.8	10.7	----------------
9	9.0	9.8	10.0	10.1	9.9	10.0	8.7	10.6	10.0
10	9.0	9.4	10.0	10.1	9.9	10.0	8.6	10.6	----------------
11	9.1	9.8	10.6	10.1	10.3	10.8	9.2	10.7	10.0
12	9.6	10.0	10.8	10.3	10.8	11.1	9.7	10.8	----------------
13	9.7	10.3	11.2	10.6	11.4	12.2	10.6	11.0	10.3
14	10.3	11.1	11.1	10.8	11.9	12.4	11.0	11.4	----------------
15	10.9	11.8	11.0	11.1	12.2	12.5	11.4	11.9	10.6
16	11.3	11.9	10.8	11.4	12.2	12.5	11.4	12.2	----------------
17	11.3	11.8	10.7	11.4	12.2	12.4	11.4	12.2	10.6
18	11.3	11.8	10.6	11.4	11.9	12.2	11.4	12.1	----------------
19	11.3	11.7	10.4	11.4	11.7	11.7	11.1	11.8	10.6
20	11.1	11.6	10.3	11.4	11.2	11.4	10.7	11.6	----------------
21	11.1	11.6	10.0	11.4	10.9	10.9	10.4	11.3	10.6
22	10.9	11.3	9.9	11.1	10.7	10.8	10.2	11.2	----------------
23	10.7	11.1	9.9	10.8	10.6	10.6	10.0	11.1	10.6
24	10.3	10.8	9.8	10.6	10.3	10.5	9.7	10.9	----------------
January 26, 1967									
1	10.0	10.3	9.8	10.3	10.2	10.3	9.6	10.8	10.4
2	9.8	10.0	9.7	10.0	9.9	9.9	9.2	10.7	----------------
3	9.4	9.8	9.7	9.7	9.6	9.6	8.9	10.5	10.2
4	9.2	9.6	9.7	9.6	9.3	9.3	8.6	10.2	----------------
5	9.1	9.4	9.7	9.4	9.2	8.9	8.2	10.1	10.1
6	8.8	9.3	9.7	9.3	8.9	8.7	7.9	9.9	----------------
7	8.6	9.2	9.7	9.2	8.6	8.6	7.7	9.9	10.0
8	8.9	9.2	9.7	9.1	8.3	8.5	7.6	10.0	----------------
9	8.2	9.2	9.7	9.1	8.3	8.5	7.4	10.0	9.9
10	8.1	9.2	9.7	9.1	8.3	8.5	7.4	10.0	----------------
11	8.2	9.3	9.9	9.2	8.7	8.9	7.6	10.1	9.9
12	8.2	9.3	10.1	9.4	9.2	9.4	8.1	10.5	----------------
13	8.7	10.0	10.6	10.1	10.3	9.9	9.2	11.0	10.3
14	9.6	10.8	10.8	10.6	11.4	10.3	10.0	11.7	----------------
15	10.1	11.4	11.1	11.1	11.9	11.9	10.7	12.2	10.6
16	10.7	11.4	11.0	11.4	12.2	11.9	11.1	12.4	----------------
17	10.8	11.4	10.8	11.4	11.8	11.7	11.1	12.5	10.6
18	10.8	11.4	10.4	11.4	11.1	11.3	11.0	12.2	----------------
19	10.8	11.4	10.3	11.4	10.8	10.9	10.9	11.9	10.4
20	10.8	11.3	10.1	11.4	10.6	10.6	10.6	11.4	----------------
21	10.7	11.1	9.9	11.4	9.7	10.0	10.3	11.1	10.3
22	10.6	10.8	9.7	11.1	9.3	9.6	9.6	10.6	----------------
23	10.2	10.6	9.6	10.8	8.9	9.2	9.2	10.3	10.1
24	9.9	10.1	9.6	10.3	8.3	8.5	8.6	10.0	----------------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, January 25–31, 1967—Continued

Hour	East Meadow Brook, site 4 gaging station	Sampawams Creek, site 4 gaging station	Champlin Creek: Site 3 Islip Boulevard	Champlin Creek: Site 4 gaging station	Connetquot River: Site 1 Veterans Highway	Connetquot River: Site 3	Connetquot River: Site 5 "at bridge"	Swan River: Site 3 Sunrise Highway	Swan River: Site 5 gaging station
					January 27, 1967				
1	9.3	9.7	9.6	10.1	7.8	8.3	8.2	9.4	9.7
2	8.9	9.6	9.4	9.6	7.6	8.3	8.1	9.1	
3	8.7	9.2	9.3	9.4	7.4	8.3	7.8	9.3	9.4
4	8.4	9.1	9.2	9.4	7.3	8.3	7.8	9.2	
5	8.2	8.9	9.1	9.3	7.3	8.3	7.8	9.1	9.2
6	8.1	8.8	8.9	9.2	7.2	8.2	7.8	8.9	
7	7.9	8.7	8.8	9.1	7.2	8.2	7.8	8.9	8.3
8	7.9	8.6	8.7	9.1	7.2	8.2	7.8	8.9	
9	7.9	8.5	8.7	9.0	7.2	8.2	7.7	8.9	7.8
10	7.9	8.4	8.7	9.0	7.2	8.1	7.7	8.9	
11	7.9	8.3	8.7	9.0	7.2	8.1	7.7	8.8	7.8
12	7.9	8.3	8.6	9.0	7.2	8.1	7.7	8.8	
13	7.9	8.2	8.6	9.0	7.2	8.0	7.7	8.7	7.5
14	7.9	8.2	8.6	9.0	7.2	7.9	7.7	8.7	
15	7.9	8.1	8.6	9.0	7.2	7.9	7.7	8.7	7.2
16	7.9	8.0	8.6	9.0	7.2	7.8	7.7	8.4	
17	7.8	8.0	8.6	8.9	6.9	7.7	7.6	8.3	6.7
18	7.8	8.0	8.5	8.6	6.9	7.5	7.5	8.3	
19	7.7	8.0	8.5	8.4	6.7	7.4	7.4	8.2	6.7
20	7.4	8.0	8.5	8.2	6.5	7.4	7.4	8.0	
21	7.3	8.0	8.5	7.9	6.5	7.4	7.3	7.7	6.7
22	7.1	8.0	8.5	7.8	6.5	7.4	7.3	7.7	
23	6.9	8.0	8.5	7.8	6.4	7.4	7.3	7.7	6.7
24	6.9	8.0	8.5	7.8	6.4	7.4	7.3	7.7	
					January 28, 1967				
1	6.8	8.0	8.5	7.8	6.4	7.4	7.3	7.8	6.7
2	6.8	8.0	8.5	7.8	6.4	7.4	7.3	7.8	
3	6.8	8.0	8.5	7.8	6.4	7.6	7.3	7.8	6.6
4	6.8	8.0	8.5	7.8	6.5	7.6	7.3	7.8	
5	6.7	8.0	8.5	7.8	6.5	7.6	7.3	7.8	6.4
6	6.7	8.0	8.5	7.8	6.5	7.6	7.4	7.8	
7	6.6	8.0	8.5	7.8	6.6	7.6	7.4	7.8	6.4
8	6.4	7.8	8.5	7.8	6.6	7.6	7.4	7.8	
9	6.3	7.8	8.5	7.8	6.5	7.6	7.4	7.8	6.1
10	6.3	7.8	8.5	7.8	6.4	7.6	7.3	7.8	
11	6.4	7.8	8.6	7.8	6.4	7.7	7.3	7.8	6.1
12	7.2	7.8	9.0	7.8	6.4	7.7	7.3	7.9	
13	7.7	7.8	9.3	7.8	6.5	8.0	7.5	8.0	6.4
14	7.9	7.8	9.4	7.8	6.9	8.3	7.6	8.3	
15	8.1	7.8	9.4	7.8	6.9	8.4	7.7	8.3	6.4
16	8.2	7.8	9.4	7.8	6.9	8.3	7.7	8.3	
17	8.2	7.8	9.2	7.8	6.7	8.2	7.4	8.3	5.8
18	8.0	7.8	8.9	7.8	6.3	7.7	7.1	8.3	
19	7.4	7.7	8.6	7.8	5.8	6.9	6.6	8.0	5.6
20	7.1	7.4	8.4	7.8	5.4	6.8	6.2	7.8	
21	6.7	7.4	8.4	7.5	5.1	6.6	5.9	7.7	5.3
22	6.2	7.3	8.4	7.2	5.0	6.4	5.8	7.6	
23	6.0	7.1	8.4	7.2	4.8	6.4	5.8	7.5	4.7
24	5.8	6.9	8.4	6.9	4.8	6.4	5.7	7.5	
					January 29, 1967				
1	5.7	6.8	8.3	6.9	4.5	6.1	5.6	7.4	4.7
2	5.6	6.7	8.2	6.7	4.4	6.0	5.4	7.4	
3	5.4	6.6	8.2	6.6	4.4	6.0	5.3	7.3	4.4
4	5.1	6.6	8.1	6.4	4.4	5.9	5.2	7.2	
5	5.0	6.4	8.1	6.4	4.3	5.8	5.2	7.2	4.2
6	5.0	6.4	8.1	6.4	4.3	5.8	5.2	7.2	
7	4.9	6.3	8.1	6.3	4.2	5.8	5.2	7.0	3.9
8	4.9	6.2	8.1	6.3	4.2	5.8	5.2	7.0	
9	4.9	6.1	8.1	6.3	4.2	5.8	5.2	7.0	3.6
10	4.9	6.1	8.1	6.2	4.2	5.8	5.2	7.1	
11	5.0	6.2	8.1	6.2	4.4	6.4	5.3	7.1	3.6
12	5.3	6.4	8.4	6.3	4.7	6.9	5.6	7.1	
13	5.7	6.7	8.9	6.4	5.3	7.5	5.7	7.2	4.2
14	6.1	6.9	9.0	6.7	5.7	7.4	5.8	7.3	
15	6.3	7.1	9.0	6.8	6.0	7.2	5.8	7.3	4.2
16	6.4	7.2	9.0	6.9	5.8	6.9	5.6	7.4	
17	6.4	7.2	8.2	6.9	5.1	5.8	5.4	7.4	3.6
18	6.3	7.1	7.8	6.9	4.4	5.3	4.8	7.5	
19	5.7	7.0	7.5	6.9	3.9	4.9	4.4	6.9	3.6
20	5.0	6.9	7.5	6.7	3.7	4.8	4.1	6.5	
21	4.4	6.8	7.4	6.4	3.4	4.7	3.9	6.4	3.3
22	4.1	6.7	7.3	5.8	3.3	4.5	3.7	6.4	
23	3.9	6.0	7.3	5.7	3.2	4.3	3.6	6.3	2.8
24	3.7	5.8	7.2	5.6	3.1	4.2	3.4	6.3	

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, January 25–31, 1967—Continued

Hour	East Meadow Brook, site 4 gaging station	Sampawams Creek, site 4 gaging station	Champlin Creek		Connetquot River			Swan River	
			Site 3 Islip Boulevard	Site 4 gaging station	Site 1 Veterans Highway	Site 3	Site 5 "at bridge"	Site 3 Sunrise Highway	Site 5 gaging station
					January 30, 1967				
1	3.4	5.6	7.1	5.3	2.8	3.9	3.3	6.2	2.2
2	3.1	5.6	7.1	5.1	2.7	3.8	3.3	6.2	------
3	3.0	5.3	7.1	5.1	2.7	3.8	3.3	6.2	1.9
4	2.9	5.3	7.1	5.1	2.6	3.7	3.3	6.2	------
5	2.8	5.3	7.1	5.1	2.6	3.7	3.3	6.2	1.4
6	2.8	5.3	7.1	5.1	2.6	3.6	3.3	6.2	------
7	2.7	5.2	7.1	5.1	2.6	3.4	3.3	6.2	1.1
8	2.6	5.1	7.1	5.1	2.5	3.3	3.3	6.2	------
9	2.6	5.0	7.1	5.1	2.5	3.3	3.3	6.2	.6
10	2.8	5.0	7.1	5.1	2.5	3.6	3.7	6.2	------
11	3.3	5.1	7.8	5.2	2.9	4.8	4.4	6.2	1.4
12	4.2	5.2	8.8	5.3	3.7	6.0	5.3	6.4	------
13	4.8	5.3	9.3	5.9	5.0	6.9	5.8	6.8	2.2
14	5.5	5.7	9.6	6.1	6.4	7.3	6.4	7.4	------
15	6.1	6.4	9.7	6.5	6.7	7.3	6.9	7.8	2.8
16	6.3	6.7	9.6	6.5	6.7	6.8	6.9	8.1	------
17	6.3	6.4	8.9	6.5	6.1	6.1	6.8	8.1	2.8
18	5.9	6.2	8.3	6.5	5.3	5.6	6.4	7.9	------
19	5.4	6.1	8.0	6.5	4.9	5.0	5.8	7.8	2.2
20	4.7	6.0	7.8	6.5	4.2	4.6	5.7	7.4	------
21	4.2	5.6	7.7	6.5	4.1	4.4	5.4	7.1	1.7
22	3.7	5.4	7.6	6.4	3.9	4.3	5.1	7.1	------
23	3.4	5.3	7.6	6.3	3.8	4.2	4.8	6.9	2.5
24	3.2	5.0	7.5	6.1	3.6	4.0	4.6	6.9	------
					January 31, 1967				
1	3.1	4.7	7.5	6.6	3.5	3.9	4.4	6.9	1.4
2	2.9	4.4	7.5	5.9	3.6	3.7	4.1	6.8	------
3	2.8	4.2	7.3	5.8	3.5	3.6	3.8	6.8	1.9
4	2.7	3.9	7.3	5.8	3.5	3.4	3.6	6.7	------
5	2.6	3.9	7.2	5.7	3.4	3.3	3.4	6.7	1.1
6	2.4	3.6	7.2	5.7	3.4	3.3	3.3	6.6	------
7	2.3	3.3	7.2	5.6	3.1	3.2	3.1	6.5	1.1
8	2.2	3.3	7.1	5.6	3.1	3.2	3.1	6.4	------
9	2.1	3.3	7.1	5.4	3.1	3.3	3.1	6.4	1.4
10	2.1	3.3	7.1	5.4	3.2	3.6	3.2	6.6	------
11	2.5	3.6	7.8	5.4	3.6	4.6	3.8	7.2	1.9
12	3.3	4.4	8.9	6.0	4.4	5.9	4.7	7.5	------
13	4.3	5.6	9.7	6.5	5.6	6.9	5.8	7.8	2.8
14	5.2	6.7	10.0	6.9	6.7	7.5	6.7	8.1	------
15	5.7	6.9	10.0	7.2	7.2	7.5	7.5	8.3	3.3
16	6.0	6.9	9.9	7.6	7.1	7.4	7.7	8.6	------
17	6.3	6.7	9.7	7.8	6.9	6.9	7.7	8.6	3.9
18	6.3	6.7	9.0	7.8	6.3	6.4	7.6	8.4	------
19	6.2	6.6	8.9	7.8	6.2	6.1	7.3	8.3	3.9
20	5.9	6.5	8.8	7.8	6.1	6.0	7.1	8.1	------
21	5.7	6.4	8.8	7.8	5.8	6.0	6.8	8.1	4.2
22	5.4	6.4	8.8	7.8	5.8	5.9	6.6	7.8	------
23	5.3	6.4	8.6	7.8	5.7	5.6	6.3	7.8	4.2
24	5.0	6.4	8.4	7.8	5.4	5.4	6.1	7.8	------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, April 19–25, 1967

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4 gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4 gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5 "at bridge"	Site 3, Sunrise Highway	Site 5 gaging station
April 19, 1967													
1	8.9	9.6	10.0	10.0	9.4	10.7	11.1	10.3	8.1	9.4	9.4	10.0	10.6
2	8.9	9.4	9.9	9.9	9.2	10.7	11.0	10.1	7.9	9.2	9.4	10.0	---
3	8.9	9.3	9.9	9.8	9.0	10.6	10.8	10.0	7.9	9.2	9.4	10.0	10.3
4	8.9	9.2	9.9	9.7	8.9	10.6	10.8	9.9	7.8	9.1	9.4	10.0	---
5	8.8	9.1	9.9	9.7	8.9	10.6	10.8	9.9	7.8	9.1	9.4	10.0	10.0
6	8.7	9.0	9.9	9.6	8.9	10.3	10.4	9.6	7.8	8.9	9.4	10.0	---
7	8.6	8.9	9.9	9.6	8.9	10.3	10.3	9.4	7.8	8.9	9.4	10.0	10.0
8	8.6	8.9	9.9	9.6	8.9	10.4	10.3	9.4	7.8	8.9	9.4	10.0	---
9	8.6	8.9	9.9	9.6	9.4	10.4	10.3	9.4	7.8	8.9	9.4	10.0	9.4
10	8.6	8.9	10.0	9.6	10.0	10.6	10.4	9.4	7.8	8.9	9.4	10.0	---
11	8.7	9.1	10.4	9.6	10.6	10.9	10.7	9.4	8.3	9.2	9.7	10.3	9.4
12	9.2	9.5	10.7	9.8	11.1	11.1	11.1	9.6	8.9	10.0	10.0	10.8	---
13	9.7	10.4	11.1	10.2	11.4	11.5	11.6	9.8	10.0	10.8	10.6	11.4	9.8
14	10.6	10.9	11.2	10.6	11.7	11.6	11.9	10.0	11.9	11.7	11.1	11.7	---
15	10.8	11.2	11.2	10.9	12.2	11.6	12.0	10.2	11.9	11.7	11.7	11.7	10.0
16	10.9	11.4	11.2	11.2	12.2	11.6	12.0	10.2	12.2	11.7	11.7	11.4	---
17	10.8	11.4	11.1	11.1	11.9	11.6	12.0	10.2	12.2	11.4	11.7	11.1	10.3
18	10.5	11.4	11.0	11.1	11.7	11.4	11.9	10.2	11.7	11.1	11.4	10.8	---
19	9.9	11.1	10.8	11.1	11.4	11.1	11.8	10.1	10.8	10.6	11.4	10.6	10.0
20	9.7	11.0	10.6	11.0	11.1	10.8	11.7	10.0	10.0	10.0	11.1	10.1	---
21	9.2	10.6	10.3	11.0	10.6	10.6	11.1	9.9	9.4	9.6	11.1	9.7	9.7
22	8.9	10.2	10.1	10.8	10.0	10.4	10.8	9.7	8.9	9.2	10.3	9.4	---
23	8.7	9.9	10.1	10.8	9.4	10.3	10.6	9.4	8.4	8.9	10.0	9.3	9.4
24	8.6	9.7	10.1	10.6	9.2	10.0	10.3	9.3	8.1	8.6	9.7	9.2	---
April 20, 1967													
1	8.3	9.7	10.1	10.4	8.9	9.8	10.0	9.7	8.0	8.3	9.4	9.2	8.9
2	8.3	9.4	10.1	10.3	8.8	9.7	9.7	8.9	8.0	8.1	9.2	9.1	---
3	8.3	9.2	10.0	10.0	8.6	9.6	9.6	8.8	7.7	7.9	8.9	9.0	8.3
4	8.3	9.0	10.0	9.9	8.5	9.6	9.5	8.7	7.3	7.8	8.8	8.9	---
5	8.2	9.0	10.0	9.8	8.4	9.4	9.4	8.7	7.3	7.8	8.7	8.9	8.2
6	8.3	8.7	10.0	9.7	8.3	9.4	9.3	8.6	7.3	7.8	8.6	8.9	---
7	8.3	8.6	10.0	9.7	8.3	9.4	9.3	8.6	7.2	7.8	8.4	8.9	8.2
8	8.3	8.6	10.0	9.7	8.3	9.6	9.3	8.6	7.2	7.8	8.4	8.9	---
9	8.6	8.7	10.1	10.3	8.9	10.3	10.3	8.6	7.5	8.1	8.9	9.2	8.9
10	9.7	9.0	10.2	10.8	11.7	11.7	11.4	9.2	8.1	8.9	9.2	10.0	---
11	11.4	10.3	10.7	11.4	13.9	12.8	12.8	10.3	9.4	11.1	10.6	11.9	10.0
12	12.8	11.7	11.6	12.2	15.6	13.9	14.4	11.1	11.4	13.3	12.2	13.3	---
13	13.9	13.4	12.1	13.1	17.2	15.0	15.3	11.9	13.6	15.6	13.9	14.4	11.4
14	14.9	14.6	12.6	13.9	19.4	15.3	16.1	12.5	16.1	16.1	15.6	15.0	---
15	15.3	15.9	12.8	14.2	20.0	15.3	16.7	13.1	17.8	16.1	16.1	15.3	12.2
16	15.6	16.2	12.9	14.3	19.4	15.0	16.9	13.5	18.1	15.6	16.7	15.0	---
17	15.6	16.3	12.9	14.3	18.9	14.2	16.7	13.6	16.1	14.7	16.7	14.4	12.8
18	14.7	16.3	12.7	14.2	18.3	13.3	16.4	13.6	14.4	14.2	16.1	13.3	---
19	13.7	16.1	12.2	14.2	16.9	12.5	15.6	13.5	12.8	13.3	15.6	12.2	12.5
20	12.0	15.6	11.9	14.1	15.6	11.9	14.7	13.4	11.7	12.5	14.7	11.4	---
21	10.7	14.7	11.6	13.8	14.2	11.1	13.9	13.3	10.6	11.4	13.3	10.8	12.2
22	10.1	13.6	11.4	13.1	13.1	10.8	12.8	13.1	10.0	10.6	11.9	10.3	---
23	9.9	13.2	11.3	12.8	12.2	10.6	12.2	12.9	9.2	10.0	11.1	9.7	11.7
24	9.6	12.4	11.1	12.5	11.7	10.3	11.7	12.8	8.6	9.4	10.6	9.4	---
April 21, 1967													
1	9.1	11.7	11.1	12.2	11.1	10.3	11.2	12.8	8.3	8.9	10.0	9.2	11.7
2	9.1	11.2	10.9	12.0	10.8	10.2	10.9	12.5	8.2	8.6	9.6	9.0	---
3	9.0	10.7	10.8	11.9	10.3	10.0	10.7	12.2	7.9	8.5	9.2	8.9	11.3
4	8.9	10.6	10.7	11.7	10.0	9.8	10.3	12.1	7.7	8.3	9.1	8.8	---
5	8.7	10.3	10.7	11.6	9.7	9.8	10.0	11.9	7.3	8.2	8.9	8.7	11.1
6	8.7	10.1	10.6	11.4	9.6	9.8	10.0	11.9	7.3	8.1	8.8	8.7	---
7	8.7	10.0	10.5	11.4	9.4	9.7	10.0	11.8	7.3	8.0	8.7	8.9	11.1
8	8.8	10.0	10.5	11.4	9.4	9.8	10.0	11.7	7.3	8.0	8.7	8.9	---
9	10.0	10.0	10.5	11.4	9.7	10.0	10.6	11.7	8.1	8.6	8.9	9.2	11.3
10	10.8	10.6	10.7	11.7	10.8	10.6	11.7	11.8	9.2	10.0	9.4	9.4	---
11	12.0	11.6	12.0	12.1	13.9	11.7	12.8	12.2	11.1	12.2	11.1	11.1	11.7
12	12.9	13.1	12.6	12.8	15.3	12.5	13.9	12.8	12.8	13.9	12.5	12.5	---
13	14.0	14.4	12.9	13.4	16.7	13.3	14.7	13.4	14.2	15.3	13.9	13.3	11.9
14	14.3	15.0	12.9	13.9	18.3	14.0	15.4	13.9	15.6	15.6	15.0	14.2	---
15	14.4	15.6	13.1	14.3	18.9	14.2	15.8	14.1	16.1	15.6	15.6	14.3	12.2
16	14.4	15.7	13.1	14.3	18.9	14.2	15.8	14.2	15.6	15.0	15.6	14.3	---
17	13.6	15.7	12.9	14.2	18.6	13.9	15.4	14.2	14.4	13.9	15.0	13.6	12.5
18	12.5	15.6	12.7	14.1	17.8	13.3	14.9	14.2	12.2	12.8	14.4	12.8	---
19	11.9	15.0	12.2	14.0	16.9	12.8	14.4	14.2	11.1	12.2	14.2	11.7	12.5
20	11.3	14.4	12.1	13.8	16.1	12.2	13.4	14.2	10.6	11.7	13.9	11.4	---
21	10.8	13.6	11.9	13.7	15.0	11.9	13.1	14.2	10.0	11.1	13.3	10.8	12.4
22	10.8	12.9	11.8	13.4	14.2	11.4	12.7	14.2	9.9	10.6	12.5	10.6	---
23	10.7	12.8	11.7	13.3	13.6	11.4	12.5	13.8	9.7	9.9	11.4	10.4	12.3
24	10.7	12.5	11.6	13.1	13.5	11.3	11.9	13.8	9.6	9.7	11.1	10.4	---

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, April 19–25, 1967—Continued

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4 gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4 gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5 "at bridge"	Site 3, Sunrise Highway	Site 5 gaging station
April 22, 1967													
1	10.6	12.2	11.6	12.9	13.4	11.2	11.9	13.8	9.6	9.7	10.9	10.4	12.4
2	10.6	12.2	11.6	12.7	13.3	11.2	11.9	13.6	9.4	9.7	10.8	10.3	----------
3	10.6	12.0	11.6	12.4	13.2	11.2	11.8	13.6	9.3	9.7	10.8	10.3	12.4
4	10.6	11.9	11.6	12.4	13.1	11.1	11.7	13.6	9.3	9.7	10.8	10.3	----------
5	10.6	11.9	11.6	12.3	13.1	11.1	11.7	13.6	9.3	9.7	10.7	10.3	12.5
6	10.6	11.8	11.6	12.3	13.1	11.1	11.6	13.5	9.3	9.7	10.6	10.3	----------
7	10.6	11.8	11.6	12.2	13.1	11.1	11.6	13.4	9.3	9.7	10.4	10.3	12.2
8	10.6	11.7	11.6	12.2	13.1	11.1	11.5	13.4	9.3	9.7	10.4	10.3	----------
9	10.6	11.7	11.6	12.3	13.1	11.1	11.5	13.4	9.6	9.7	10.4	10.3	11.9
10	10.9	11.7	11.6	12.3	13.1	11.2	11.5	13.3	10.3	10.0	10.6	10.4	----------
11	12.1	11.9	11.8	12.4	13.6	11.3	11.5	13.3	11.1	10.3	10.8	11.1	11.9
12	13.2	13.1	12.1	12.7	13.9	11.3	11.9	13.3	11.7	11.1	11.1	11.9	----------
13	14.4	13.9	12.6	12.9	14.4	11.4	12.5	13.3	12.8	12.2	11.7	12.2	12.5
14	15.0	14.7	12.7	13.3	14.7	11.7	12.8	13.3	13.6	13.1	12.2	12.4	----------
15	15.4	15.3	12.8	13.6	15.0	11.7	13.2	13.3	14.2	13.9	13.1	12.4	13.1
16	15.6	15.8	12.9	14.0	15.6	12.0	13.6	13.3	14.7	13.9	13.6	12.5	----------
17	15.6	16.3	13.0	14.2	16.4	12.0	13.8	13.4	14.7	13.9	13.9	12.6	12.8
18	15.3	16.4	13.0	14.3	16.4	11.9	14.2	13.4	14.4	13.6	13.9	12.6	----------
19	14.4	16.4	12.9	14.2	15.8	11.9	14.2	13.4	13.6	13.3	13.6	12.2	12.8
20	13.3	16.3	12.8	14.1	15.3	11.7	13.9	13.4	12.2	12.2	13.3	11.7	----------
21	12.5	15.8	12.5	14.1	14.7	11.4	13.6	13.3	11.1	11.7	12.9	11.1	12.7
22	11.9	15.0	12.5	14.0	14.2	11.1	13.2	13.3	10.6	11.1	12.2	10.9	----------
23	11.7	14.4	12.3	13.9	13.6	10.8	12.8	13.2	10.1	10.6	11.8	10.7	12.4
24	11.3	13.9	12.2	13.7	13.1	10.7	12.3	13.2	9.9	10.3	11.4	10.6	----------
April 23, 1967													
1	11.3	13.3	12.2	13.4	12.2	10.6	11.7	13.1	9.9	10.0	11.1	10.6	12.2
2	11.1	12.8	12.1	13.2	11.7	10.1	11.3	12.8	9.6	9.7	10.7	10.3	----------
3	10.4	12.2	11.9	12.8	11.1	9.9	11.0	12.4	9.0	9.4	10.3	10.0	11.9
4	10.0	11.7	11.7	12.6	10.6	9.7	10.7	12.2	8.6	8.9	10.0	9.6	----------
5	9.7	11.1	11.4	12.3	10.2	9.4	10.3	11.9	8.3	8.6	9.7	9.3	11.4
6	9.4	10.6	11.3	12.1	10.0	9.2	10.1	11.9	8.1	8.3	9.3	9.1	----------
7	9.2	10.4	11.2	11.9	9.7	9.2	10.1	11.7	7.9	8.1	9.2	9.1	11.1
8	9.2	10.4	11.2	11.9	9.7	9.3	10.2	11.7	7.8	8.1	9.1	9.1	----------
9	9.3	10.4	11.2	11.9	10.3	9.4	10.3	11.7	8.1	8.3	9.2	9.1	11.4
10	10.0	10.8	11.7	11.9	12.2	11.1	11.9	11.7	8.9	9.4	9.4	9.4	----------
11	11.4	11.7	12.2	12.2	14.4	12.8	13.1	11.7	10.0	11.1	10.3	10.6	11.9
12	12.8	12.8	12.8	12.9	16.7	13.9	14.2	12.1	11.9	13.3	11.9	12.5	----------
13	13.8	14.2	13.2	13.6	17.5	14.3	15.0	12.4	13.6	15.0	13.3	13.6	12.5
14	14.2	14.7	13.3	14.2	17.5	14.6	15.4	12.6	14.7	15.6	15.0	14.4	----------
15	14.3	15.0	13.3	14.8	17.6	14.6	15.8	12.9	15.6	15.8	16.1	15.0	12.5
16	14.3	15.1	13.3	14.9	17.4	14.6	15.9	13.1	15.8	15.6	16.4	15.3	----------
17	14.3	15.3	13.3	14.8	16.7	13.9	15.2	13.1	13.9	13.6	15.6	14.4	13.1
18	13.9	15.3	13.2	14.7	15.3	13.3	14.4	13.1	12.8	12.9	14.4	13.3	----------
19	13.3	15.0	12.8	14.5	14.2	12.1	13.3	13.0	11.7	12.2	13.3	11.9	13.1
20	12.2	13.9	12.5	13.9	13.1	11.4	12.5	12.9	11.1	11.7	12.2	11.1	----------
21	11.4	13.1	12.2	13.6	12.2	10.8	11.9	12.9	10.3	10.6	11.7	10.2	12.8
22	10.7	12.2	11.9	13.1	11.1	9.7	11.4	12.8	10.0	10.0	11.1	9.8	----------
23	10.3	11.7	11.8	12.8	10.3	9.4	10.8	12.8	8.9	8.9	10.6	9.2	12.5
24	10.0	11.1	11.7	12.4	9.7	8.9	10.3	12.7	8.3	8.3	10.0	8.9	----------
April 24, 1967													
1	9.5	11.1	11.6	11.7	8.9	8.9	9.7	12.7	7.5	7.8	9.0	8.3	12.3
2	9.3	10.8	11.4	11.5	8.1	8.3	9.2	12.5	7.2	7.2	8.6	8.1	----------
3	9.2	10.6	11.4	11.3	7.7	8.3	8.9	12.2	6.9	7.1	8.2	8.1	11.9
4	9.2	10.3	11.5	11.1	7.7	8.3	8.6	12.0	6.9	7.1	7.8	8.1	----------
5	9.1	10.3	11.6	10.9	7.7	8.3	8.3	11.8	6.9	7.1	7.6	8.1	11.9
6	9.1	10.3	11.6	10.7	7.7	8.3	8.3	11.6	7.0	7.1	7.6	8.2	----------
7	9.1	10.3	11.6	10.4	7.7	8.3	8.3	11.4	7.1	7.1	7.6	8.3	11.4
8	9.1	10.3	11.5	10.3	7.8	8.3	8.3	11.2	7.1	7.2	7.7	8.3	----------
9	9.1	10.3	11.4	10.2	7.8	8.3	8.3	10.9	7.2	7.2	7.8	8.3	10.3
10	9.1	10.1	11.4	10.1	7.8	8.3	8.3	10.7	7.3	7.3	7.9	8.3	----------
11	9.1	10.0	11.3	10.0	7.7	8.2	8.1	10.4	7.3	7.3	7.9	8.3	9.2
12	8.7	10.0	11.3	9.7	7.7	8.1	7.8	9.7	7.1	7.3	7.9	8.1	----------
13	7.9	9.7	11.4	9.6	7.7	7.9	7.6	9.2	7.1	7.3	7.8	8.1	8.6
14	7.3	9.7	11.4	9.6	7.7	7.9	7.6	9.1	7.1	7.3	7.8	8.1	----------
15	7.0	9.8	11.7	9.6	7.8	7.9	7.6	9.1	7.1	7.4	7.9	8.1	9.2
16	6.9	9.9	11.8	9.7	8.3	8.1	7.7	9.1	7.2	7.5	7.9	8.3	----------
17	7.0	9.9	11.9	9.7	8.9	8.1	7.8	9.1	7.9	7.9	8.1	8.5	9.2
18	7.1	9.9	11.7	9.7	9.2	8.2	7.9	9.1	8.2	8.3	8.3	8.8	----------
19	7.1	9.9	11.7	9.7	9.2	8.2	7.9	9.1	8.2	8.3	8.4	8.9	8.9
20	7.1	9.8	11.4	9.7	9.2	8.2	7.9	9.1	8.1	8.3	8.4	8.9	----------
21	7.2	9.7	11.2	9.6	9.2	8.2	7.9	9.1	7.9	8.3	8.4	8.8	8.6
22	7.3	9.6	11.0	9.6	9.1	8.1	7.9	9.0	7.7	8.1	8.4	8.7	----------
23	7.3	9.4	10.9	9.5	8.9	8.1	7.8	9.0	7.5	7.9	8.3	8.6	8.6
24	7.3	9.2	10.8	9.3	8.8	8.1	7.8	9.0	7.3	7.8	8.3	8.4	----------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, April 19–25, 1967—Continued

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4 gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4 gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5 "at bridge"	Site 3, Sunrise Highway	Site 5 gaging station
							April 25, 1967						
1	7.3	8.9	10.8	9.3	8.6	8.1	8.0	9.2	7.2	7.8	8.3	8.3	8.1
2	7.4	8.9	10.7	9.1	8.5	8.0	8.0	8.9	7.2	7.7	8.2	8.3	----------
3	7.4	8.8	10.6	9.1	8.4	8.0	8.0	8.6	7.2	7.4	8.1	8.2	7.8
4	7.4	8.7	10.6	8.9	8.3	8.0	7.9	8.6	6.8	7.3	8.1	8.1	----------
5	7.4	8.4	10.4	8.9	8.2	7.9	7.8	8.4	6.7	6.9	8.0	8.0	7.5
6	7.4	7.8	10.4	8.7	7.9	7.8	7.8	8.3	6.6	6.9	7.9	8.0	----------
7	7.4	7.8	10.3	8.6	7.8	7.8	7.8	8.3	6.6	6.9	7.8	8.0	7.8
8	7.4	7.9	10.3	8.6	7.9	7.9	7.8	8.3	6.7	6.9	7.7	8.0	----------
9	7.8	8.3	10.5	8.6	8.3	8.0	8.2	8.3	7.2	7.2	7.7	8.3	8.3
10	9.4	9.7	10.7	8.6	12.2	8.9	9.4	8.3	8.9	8.9	9.4	9.2	----------
11	10.6	11.1	11.3	9.4	15.0	10.6	11.1	8.8	11.7	11.1	10.6	10.8	9.4
12	11.7	12.8	12.2	10.3	17.2	11.9	12.8	9.6	13.9	13.3	12.5	12.2	----------
13	12.8	14.2	12.5	11.4	19.4	13.6	13.9	10.6	16.1	15.3	13.9	13.3	10.3
14	13.3	15.0	12.8	12.2	19.4	14.0	15.3	11.7	16.7	15.6	15.3	14.2	----------
15	13.9	15.3	12.9	13.1	19.3	14.2	15.8	12.8	16.9	15.6	15.7	14.3	11.4
16	13.9	15.3	12.9	13.3	19.3	14.2	16.1	13.3	15.6	14.4	15.6	14.2	----------
17	13.6	15.2	12.8	13.2	18.3	13.6	15.6	13.9	12.8	13.6	15.3	13.6	11.9
18	12.8	15.0	12.3	13.1	16.1	13.3	15.0	13.9	11.7	12.8	14.4	12.2	----------
19	11.1	14.4	12.1	12.9	15.0	12.8	13.6	13.9	10.3	11.7	13.3	11.1	11.7
20	10.3	13.6	11.7	12.5	13.3	11.7	12.2	13.6	9.4	10.8	12.2	10.3	----------
21	9.4	12.5	11.6	11.8	12.8	11.1	11.4	13.3	8.6	10.0	11.7	9.4	11.7
22	8.9	11.9	11.3	11.4	11.4	10.7	10.6	13.2	8.3	8.9	11.4	8.9	----------
23	8.6	11.1	11.1	10.8	10.6	10.0	10.0	12.8	7.8	8.3	10.3	8.6	11.4
24	8.4	10.6	11.0	10.6	9.7	9.4	9.4	12.2	7.2	7.8	9.7	8.3	----------

Hourly stream-temperature data in degrees Celsius, at continuous recording stations, June 7–13, 1967

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4, gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4, gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5, "at bridge"	Site 3, Sunrise Highway	Site 5, gaging station
							June 7, 1967						
1	12.9	17.2	16.2	18.9	18.3	13.6	16.0	21.7	11.9	13.0	13.6	11.9	19.4
2	12.7	16.9	16.1	18.3	18.1	13.3	15.6	21.4	11.7	12.8	13.1	11.8	----------
3	12.4	16.3	15.9	18.1	17.8	13.2	14.9	21.1	11.4	12.5	12.9	11.8	19.2
4	12.3	16.1	15.8	17.8	17.5	13.1	14.4	21.1	11.1	12.2	12.7	11.7	----------
5	12.2	15.9	15.7	17.6	17.3	13.0	14.1	20.8	11.1	12.0	12.4	11.6	18.9
6	12.2	15.8	15.7	17.3	17.2	12.9	14.1	20.6	10.9	11.8	12.2	11.6	----------
7	12.2	15.8	15.7	17.1	17.2	12.9	14.1	20.6	10.9	11.8	12.1	11.6	18.9
8	12.5	15.8	15.7	16.9	17.2	12.9	14.1	20.3	11.4	11.8	12.2	11.7	----------
9	13.3	16.4	15.8	16.9	17.2	13.3	14.7	20.3	13.9	12.5	12.7	12.2	18.9
10	15.0	17.5	16.1	17.8	17.2	14.4	15.6	20.3	15.0	13.9	14.4	13.9	----------
11	16.4	19.2	17.5	19.2	18.9	15.3	16.7	20.6	16.4	15.6	15.6	15.0	19.4
12	17.5	20.6	18.3	20.3	20.0	16.4	17.5	20.8	17.5	17.5	17.5	15.8	----------
13	18.3	21.4	19.2	21.1	21.1	16.9	18.3	21.1	18.3	18.3	18.1	16.1	19.8
14	18.8	21.9	19.6	22.2	21.9	17.2	18.9	21.7	18.6	18.9	18.9	16.1	----------
15	19.0	22.2	19.6	22.8	22.2	17.3	19.3	22.2	18.3	19.2	19.4	16.1	20.6
16	19.0	22.5	19.6	23.2	22.2	17.2	19.7	22.5	17.8	19.1	19.4	16.0	----------
17	18.6	22.4	19.2	22.6	22.1	16.9	19.8	22.8	16.7	18.4	19.3	15.6	21.1
18	17.8	21.9	18.7	22.9	21.8	16.4	19.8	23.1	15.6	17.6	19.0	14.7	----------
19	16.7	21.3	18.1	22.7	21.4	15.8	19.4	23.1	14.7	16.4	18.3	14.0	21.1
20	15.6	20.8	17.5	22.2	21.1	15.3	19.3	22.9	14.3	15.8	17.5	13.6	----------
21	14.7	20.0	16.9	21.4	20.3	14.7	18.5	22.8	13.6	15.0	16.4	13.0	20.6
22	14.2	19.2	16.7	20.8	19.7	14.4	17.8	22.5	13.2	14.2	15.6	12.8	----------
23	13.9	18.6	16.5	20.0	19.4	14.2	16.8	22.2	13.0	13.9	14.7	12.4	20.3
24	13.6	17.8	16.3	19.7	19.2	13.9	16.4	21.9	12.8	13.6	14.2	12.2	----------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, June 7–13, 1967—Continued

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4 gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4 gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5, "at bridge"	Site 3, Sunrise Highway	Site 5, gaging station
						June 8, 1967							
1	13.7	17.2	16.1	19.4	18.6	13.9	16.1	21.9	12.5	13.3	13.9	12.2	20.0
2	13.3	17.1	15.9	18.9	18.3	13.8	15.6	21.7	12.2	13.1	13.6	12.1	----------
3	13.2	16.8	15.8	18.3	18.1	13.6	15.3	21.7	12.2	13.1	13.2	12.0	19.7
4	13.1	16.6	15.8	18.1	17.8	13.4	15.1	21.4	12.1	12.9	13.0	11.9	----------
5	13.0	16.3	15.8	17.8	17.8	13.4	14.9	21.2	11.9	12.8	12.8	11.9	19.2
6	12.9	16.3	15.7	17.5	17.8	13.3	14.8	20.8	11.9	12.7	12.8	11.9	----------
7	12.9	16.3	15.6	17.3	17.8	13.3	14.7	20.7	12.0	12.7	12.8	11.9	18.9
8	13.1	16.3	15.7	17.2	17.8	13.3	14.7	20.6	12.8	12.7	12.8	12.2	----------
9	13.6	16.9	15.8	17.3	17.9	13.5	14.7	20.6	13.9	13.2	13.1	13.3	18.8
10	14.7	18.1	16.1	17.6	18.3	14.2	15.3	20.6	15.3	14.4	13.6	14.4	----------
11	16.7	19.4	17.2	18.6	19.7	15.0	16.4	20.8	16.9	16.1	15.0	15.3	19.4
12	17.8	20.3	17.9	20.0	21.4	15.8	17.8	21.9	18.1	17.5	16.4	15.8	----------
13	18.9	21.7	18.3	21.4	22.2	16.7	18.3	22.2	18.6	18.3	17.8	16.2	19.7
14	19.7	22.2	19.0	22.5	22.7	16.9	18.9	22.5	18.6	19.2	18.9	16.2	----------
15	19.9	22.7	19.2	23.6	22.8	17.2	19.4	22.8	18.4	19.2	19.2	16.1	20.6
16	20.0	22.8	19.2	23.9	22.8	17.2	19.7	23.1	17.8	19.1	19.4	15.8	----------
17	19.9	22.8	18.7	23.8	22.7	17.0	19.9	23.3	16.9	18.6	19.4	15.3	21.1
18	19.3	22.6	18.3	23.4	22.3	16.9	19.9	23.4	15.8	17.5	19.2	14.4	----------
19	18.1	21.7	17.6	22.8	21.9	16.1	19.7	23.4	14.9	16.7	18.6	14.2	20.6
20	16.7	21.1	17.1	22.6	21.1	15.7	19.1	23.4	14.3	15.6	17.5	13.6	----------
21	15.6	20.0	16.7	21.7	20.6	15.0	18.6	23.3	13.7	14.9	16.4	13.0	20.3
22	14.7	18.9	16.4	21.1	20.0	14.7	17.8	23.1	13.3	14.2	15.6	12.8	----------
23	14.2	18.3	16.3	20.6	19.7	14.4	17.1	22.9	13.1	13.9	15.0	12.5	20.0
24	13.9	17.8	16.1	20.0	19.4	14.2	16.7	22.8	12.9	13.6	14.2	12.3	----------
						June 9, 1967							
1	13.6	17.8	15.9	19.4	19.2	14.1	16.2	22.8	12.7	13.5	13.9	12.3	20.0
2	13.3	17.5	15.8	19.2	18.9	13.9	16.0	22.5	12.6	13.2	13.7	12.2	----------
3	13.1	17.1	15.7	18.9	18.6	13.7	15.6	22.2	12.2	13.1	13.3	12.1	19.4
4	13.0	16.9	15.6	18.2	18.3	13.7	15.3	21.9	12.2	12.9	13.2	12.1	----------
5	12.9	16.7	15.6	17.9	18.3	13.5	15.1	21.7	12.2	12.8	13.0	12.0	19.4
6	12.9	16.6	15.6	17.7	18.2	13.5	14.8	21.6	12.2	12.8	12.9	12.0	----------
7	12.9	16.5	15.6	17.5	18.2	13.4	14.6	21.3	12.2	12.8	12.9	12.0	19.4
8	12.9	16.5	15.6	17.4	18.2	13.4	14.6	21.0	12.8	12.8	12.9	12.2	----------
9	13.8	16.9	15.6	17.8	18.2	13.6	14.6	20.9	14.7	13.6	13.6	12.8	18.9
10	15.3	17.8	15.8	18.3	18.3	14.2	15.3	21.0	15.8	15.3	14.7	13.9	----------
11	16.9	18.9	16.7	19.4	19.7	15.3	16.4	21.4	17.2	17.2	15.8	15.0	19.4
12	17.8	20.0	18.1	20.6	21.1	16.0	17.7	21.8	18.3	18.9	16.9	16.1	----------
13	19.2	21.1	18.9	21.4	21.7	16.6	18.3	22.2	18.6	19.3	18.1	16.4	20.3
14	20.1	22.2	19.2	22.2	22.2	16.9	18.9	22.5	18.6	19.4	18.9	16.4	----------
15	20.3	22.8	19.3	22.8	22.4	17.2	19.4	22.8	18.3	19.4	19.2	16.3	21.1
16	20.6	23.1	19.1	22.8	22.5	17.2	19.7	23.1	17.8	19.0	19.2	16.1	----------
17	20.4	23.0	18.7	23.2	22.6	16.9	20.0	23.3	16.7	18.1	19.2	15.6	21.7
18	19.7	22.5	18.1	23.1	22.5	16.6	20.0	23.5	15.6	17.2	18.9	14.9	----------
19	18.3	22.1	17.8	22.7	22.2	16.1	20.0	23.6	15.0	16.4	18.6	14.3	21.4
20	17.2	21.2	17.2	22.5	21.9	15.6	19.4	23.5	14.3	15.6	17.5	13.9	----------
21	16.1	20.7	16.7	22.2	20.8	15.0	18.6	23.3	13.8	15.0	16.4	13.3	21.1
22	15.3	19.7	16.3	21.1	20.0	14.6	17.7	23.1	13.3	14.4	15.6	13.1	----------
23	14.8	18.9	16.1	20.3	19.7	14.3	16.9	23.1	13.2	14.3	15.1	12.8	20.6
24	13.7	18.4	15.9	19.7	19.4	14.2	16.4	22.9	12.9	14.0	14.4	12.6	----------
						June 10, 1967							
1	13.9	18.0	15.8	19.4	19.2	14.2	16.1	22.8	12.8	13.8	14.2	12.5	20.3
2	13.6	17.5	15.7	18.9	18.9	13.9	15.7	22.5	12.7	13.6	13.9	12.4	----------
3	13.5	17.2	15.5	18.4	18.7	13.7	15.4	21.9	12.5	13.3	13.6	12.2	20.0
4	13.4	17.1	15.4	18.2	18.6	13.7	15.2	21.7	12.3	13.3	13.3	12.2	----------
5	13.3	16.9	15.4	18.1	18.4	13.6	15.0	21.5	12.3	13.2	13.2	12.2	19.7
6	13.3	16.9	15.4	17.8	18.3	13.6	14.8	21.2	12.3	13.2	13.1	12.2	----------
7	13.3	16.8	15.4	17.6	18.3	13.6	14.7	20.8	12.3	13.2	13.1	12.2	19.2
8	13.3	16.8	15.4	17.5	18.3	13.6	14.7	20.7	12.6	13.3	13.1	12.2	----------
9	13.5	16.9	15.5	17.6	18.3	13.9	14.7	20.7	13.3	13.9	13.6	13.3	19.2
10	14.7	17.5	15.7	17.8	18.3	14.4	15.3	20.7	14.7	14.7	14.4	13.9	----------
11	15.8	18.6	16.3	18.6	18.6	15.3	16.1	20.8	16.7	16.7	15.3	14.7	19.7
12	17.2	20.3	17.2	20.0	19.7	16.1	17.3	21.3	17.8	17.8	16.7	15.6	----------
13	18.6	21.7	18.1	21.1	20.8	16.7	18.1	21.7	18.3	18.1	18.3	15.8	20.8
14	19.4	22.5	18.9	21.7	21.7	16.9	18.6	22.2	18.9	19.0	18.9	15.9	----------
15	19.8	22.8	19.1	22.5	22.2	17.1	19.3	23.1	18.6	19.0	19.3	15.9	21.7
16	19.9	23.1	19.1	22.8	22.5	17.1	19.4	23.1	18.3	18.9	19.3	15.8	----------
17	19.9	23.1	18.6	23.1	23.1	16.9	19.7	23.1	17.5	18.1	19.2	15.3	21.9
18	19.4	23.1	18.5	23.0	23.1	16.4	19.7	23.2	16.7	17.2	18.9	14.7	----------
19	18.9	22.8	18.3	22.5	22.7	16.0	19.4	23.2	15.8	16.9	18.3	14.4	21.7
20	17.8	22.2	17.9	21.9	22.7	15.3	19.0	23.2	15.0	15.8	17.8	14.0	----------
21	16.7	21.7	17.5	21.6	22.0	15.0	18.6	23.1	14.4	15.3	16.7	13.6	21.4
22	15.7	20.7	17.2	21.2	21.7	14.7	17.8	22.9	13.9	14.7	15.8	13.2	----------
23	15.3	20.0	16.9	21.0	21.1	14.4	17.2	22.8	13.6	14.4	15.3	12.9	21.1
24	14.7	19.4	16.8	20.6	20.6	14.2	16.7	22.7	13.3	14.2	14.7	12.7	----------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, June 7–13, 1967—Continued

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4 gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4 gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5 "at bridge"	Site 3, Sunrise Highway	Site 5 gaging stat'on
June 11, 1967													
1	14.7	19.2	16.7	20.3	19.7	14.1	16.1	22.6	13.0	13.9	14.4	12.6	21.1
2	14.3	18.8	16.6	20.0	19.4	13.9	15.8	22.5	12.8	13.6	13.9	12.5	------------
3	14.1	18.4	16.6	19.6	19.2	13.9	15.4	22.2	12.7	13.3	13.6	12.3	20.8
4	13.9	18.2	16.4	19.4	19.0	13.8	15.2	22.1	12.5	13.2	13.4	12.2	------------
5	13.6	18.0	16.3	19.2	18.9	13.7	15.0	22.0	12.4	13.2	13.3	12.1	20.6
6	13.6	17.8	16.3	18.9	18.8	13.6	14.9	21.9	12.2	13.2	13.1	12.0	------------
7	13.6	17.8	16.2	18.8	18.8	13.6	14.7	21.9	12.2	13.2	13.0	12.0	20.3
8	13.6	17.8	16.2	18.7	18.8	13.7	14.6	21.9	12.6	13.3	13.0	12.2	------------
9	13.7	17.8	16.3	18.7	18.8	13.9	14.7	21.8	13.3	13.9	13.3	12.8	20.0
10	14.7	18.6	16.5	19.3	18.8	14.4	15.3	21.9	15.0	14.7	13.9	13.9	------------
11	16.4	19.7	17.5	20.0	19.4	15.3	16.2	22.0	16.7	16.1	15.0	14.4	20.0
12	17.7	21.1	18.3	21.3	20.6	16.1	17.3	22.2	17.5	17.1	16.7	15.6	------------
13	19.2	22.2	19.2	21.9	21.9	16.7	17.9	22.5	18.3	17.6	17.8	16.1	21.1
14	20.0	22.8	19.4	22.8	22.5	17.1	18.6	22.9	18.9	17.9	18.3	16.1	------------
15	20.7	23.6	19.5	23.3	23.1	17.1	19.2	23.1	18.6	18.0	18.9	16.1	21.9
16	21.0	23.9	19.5	23.9	23.2	17.1	19.6	23.6	18.1	17.9	18.9	15.8	------------
17	21.1	23.9	19.2	23.9	23.2	16.9	19.7	23.7	17.5	17.8	18.9	15.6	22.2
18	20.8	23.5	18.7	23.5	23.2	16.7	19.7	23.7	16.7	17.2	18.6	15.1	------------
19	20.3	23.1	18.4	23.5	22.8	16.1	19.4	23.7	15.6	16.4	18.3	14.6	21.9
20	19.4	22.8	18.1	22.8	22.7	15.6	19.2	23.7	14.9	15.8	17.8	13.9	------------
21	18.3	21.9	17.6	22.5	22.1	15.1	18.9	23.6	14.4	15.1	16.9	13.6	21.7
22	16.9	21 1	17.1	22.2	21.7	14.9	17.9	23.5	13.9	14.7	16.1	13.2	------------
23	16.1	20.3	16.8	21.7	21.1	14.8	17.4	23.2	13.6	14.4	15.3	13.0	21.1
24	15.6	19.4	16.5	21.1	20.6	14.6	17.0	23.1	13.3	14.1	14.7	12.8	------------
June 12, 1967													
1	15.0	19.0	16.4	20.8	20.3	14.6	16.7	22.8	13.2	14.0	14.4	12.8	20.8
2	14.4	18.6	16.3	20.4	20.0	14.3	16.4	22.7	13.1	13.9	13.9	12.7	------------
3	14.3	18.3	16.2	19.7	19.7	14.2	15.7	22.4	12.9	13.7	13.8	12.4	20.6
4	14.1	18.0	16.1	19.4	19.3	14.0	15.7	22.2	12.7	13.6	13.7	12.2	------------
5	13.8	17.8	16.0	19.2	19.2	13.9	15.6	22.0	12.4	13.4	13.4	12.2	20.0
6	13.7	17.6	15.9	18.9	19.0	13.9	15.3	21.8	12.4	13.3	13.1	12.2	------------
7	13.7	17.6	15.8	18.7	19.0	13.8	15.2	21.7	12.4	13.3	12.8	12.2	19.7
8	13.7	17.6	15.8	18.6	19.0	13.8	15.2	21.5	12.8	13.3	12.8	12.2	------------
9	13.9	17.8	15.9	18.7	19.1	13.9	15.2	21.5	14.4	13.9	13.3	13.1	19.7
10	15.8	18.7	16.3	19.4	19.1	14.4	15.6	21.5	15.6	16.1	14.4	14.2	------------
11	17.2	20.0	17.2	20.3	19.7	15.3	16.1	21.6	16.7	17.5	15.3	15.0	20.0
12	19.2	21.7	18.1	21.4	21.4	16.1	17.8	22.2	18.1	18.2	16.9	15.6	------------
13	20.3	23.1	19.2	22.5	22.2	16.7	18.3	22.8	18.9	18.6	18.6	16.1	21.1
14	21.7	23.6	19.6	23.3	23.1	17.2	19.2	23.1	19.2	18.7	18.9	16.4	------------
15	22.5	24.3	19.7	24.2	23.3	17.5	19.7	23.6	18.9	18.7	19.4	16.4	21.7
16	22.8	24.3	19.7	24.4	23.9	17.5	20.3	23.9	18.3	18.6	19.4	16.1	------------
17	22.8	24.3	19.3	24.6	23.9	17.3	20.4	24.2	17.8	18.3	19.4	15.8	22.5
18	22.3	23.9	18.6	24.6	23.9	17.1	20.4	24.2	16.7	17.8	19.2	15.6	------------
19	21.9	23.6	18.3	24.0	23.6	16.7	20.1	24.2	15.8	17.1	18.9	14.9	22.5
20	20.6	23.3	17.7	23.4	23.5	16.1	19.7	24.2	15.3	16.4	17.8	14.2	------------
21	19.2	23.8	17.2	23.3	22.8	15.8	19.4	24.2	14.7	15.8	17.2	13.8	22.2
22	17.8	21.9	16.6	22.8	22.2	15.0	18.3	24.1	14.2	15.0	16.4	13.3	------------
23	16.8	21.4	16.3	22.2	21.7	14.7	17.5	23.9	13.7	14.4	15.6	12.9	22.2
24	16.1	20.8	16.1	21.7	21.4	14.6	17.1	23.6	13.4	14.2	15.0	12.8	------------
June 13, 1967													
1	15.6	20.0	15.7	21.4	21.1	14.4	16.7	23.6	13.1	14.0	14.4	12.8	22.2
2	15.1	19.4	15.6	20.9	20.8	14.3	16.1	23.6	12.9	13.9	14.0	12.6	------------
3	14.9	19.2	15.5	20.6	20.6	14.2	15.8	23.2	12.8	13.7	13.7	12.4	21.9
4	14.7	18.8	15.1	20.3	20.3	14.1	15.6	23.1	12.8	13.6	13.4	12.3	------------
5	14.6	18.3	15.0	20.0	20.2	13.9	15.4	23.0	12.8	13.6	13.3	12.3	21.7
6	14.6	17.9	15.0	19.7	20.0	13.9	15.2	23.0	12.8	13.5	13.2	12.2	------------
7	14.6	17.5	15.0	19.6	19.7	13.9	15.1	22.7	12.8	13.5	13.2	12.2	21.4
8	14.6	17.5	15.0	19.4	19.6	13.9	15.0	22.5	12.8	13.5	13.2	12.2	------------
9	14.6	17.5	15.0	19.3	19.5	13.9	14.5	22.2	12.9	13.5	13.2	12.2	21.1
10	14.7	17.5	15.0	19.3	19.5	13.9	14.9	22.2	13.8	13.6	13.2	12.2	------------
11	15.3	19.2	15.6	19.7	19.5	14.4	15.3	22.2	15.6	14.4	13.9	12.8	21.1
12	16.4	20.8	16.7	21.0	20.0	15.3	16.4	22.8	16.4	15.6	15.0	13.6	------------
13	17.2	21.6	17.5	21.9	20.6	16.1	17.2	23.1	16.7	16.5	16.1	13.9	21.4
14	18.9	22.2	18.1	22.5	21.1	16.2	17.8	23.3	16.9	16.6	16.4	13.8	------------
15	20.0	22.4	18.1	22.8	21.4	16.1	18.3	23.3	16.4	16.5	16.7	13.6	21.1
16	20.6	22.4	18.1	22.8	21.7	16.1	18.3	23.3	16.1	16.4	16.7	13.2	------------
17	20.6	22.4	17.5	22.7	21.9	15.8	18.3	23.3	15.6	15.9	16.5	13.1	20.0
18	20.0	22.3	17.5	21.9	22.2	15.4	18.3	23.1	15.0	15.4	16.3	12.8	------------
19	19.4	21.4	16.9	21.4	21.7	15.0	17.9	22.9	14.2	15.0	16.1	12.8	19.4
20	18.3	20.9	16.9	21.3	21.4	14.7	17.4	22.5	13.8	14.4	15.3	12.5	------------
21	17.2	20.0	16.7	20.8	20.8	14.2	16.9	22.4	13.3	14.1	14.8	12.5	18.3
22	16.1	19.4	16.1	20.3	20.6	13.9	16.7	22.2	12.8	13.8	14.2	12.3	------------
23	15.6	18.9	15.6	20.0	20.3	13.9	15.6	21.9	12.5	13.5	13.8	12.1	18.1
24	15.0	18.4	15.3	19.7	20.0	13.7	15.4	21.7	12.2	13.3	13.4	11.9	------------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, August 24–30, 1967

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4, gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4, gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5 "at bridge"	Site 3, Sunrise Highway	Site 5, gaging station
August 24, 1967													
1	15.3	17.2	17.0	16.1	20.6	13.6	14.4	19.4	12.8	13.1	12.8	12.8	17.8
2	15.0	16.9	17.0	15.8	20.3	13.3	14.2	19.2	12.8	13.1	12.5	12.8	----------
3	14.8	16.7	17.0	15.6	20.0	13.3	14.2	19.2	12.5	12.8	12.5	12.5	17.5
4	14.7	16.6	16.9	15.6	19.7	13.3	13.9	18.9	12.5	12.8	12.2	12.5	----------
5	14.7	16.6	16.9	15.3	19.7	13.3	13.9	18.9	12.5	12.5	12.2	12.5	17.2
6	14.7	16.4	16.8	15.3	19.4	13.2	13.6	18.6	12.5	12.5	12.2	12.0	----------
7	14.7	16.4	16.7	15.3	19.4	13.2	13.3	18.6	12.2	12.5	11.9	12.0	16.9
8	14.8	16.4	16.7	15.3	19.4	13.2	13.2	18.6	12.2	12.5	11.9	12.0	----------
9	14.9	16.5	16.7	15.4	19.7	13.3	13.2	18.6	12.5	12.5	12.2	12.0	16.9
10	15.0	16.6	16.7	15.6	20.0	13.3	13.3	18.6	12.8	12.8	12.5	12.0	----------
11	15.1	16.8	16.8	15.8	20.3	13.6	13.6	18.9	13.1	12.8	12.8	12.5	17.2
12	15.3	17.1	16.8	15.8	20.6	13.6	13.9	18.9	13.3	13.1	13.1	12.5	----------
13	15.4	17.2	16.9	16.1	20.8	13.9	14.2	18.9	13.3	13.1	13.3	12.8	17.2
14	15.5	17.3	16.9	16.2	21.1	13.9	14.4	19.2	13.3	13.1	13.6	12.8	----------
15	15.5	17.4	17.0	16.4	21.2	13.9	14.7	19.2	13.1	13.1	13.9	12.8	17.5
16	15.5	17.4	17.0	16.4	21.1	13.9	14.7	19.2	13.1	13.3	13.9	12.8	----------
17	15.5	17.4	17.0	16.1	21.1	13.6	14.7	19.2	13.1	13.3	13.6	12.8	17.7
18	15.5	17.3	17.0	16.1	20.8	13.6	14.7	19.2	13.1	13.3	13.6	12.8	----------
19	15.5	17.2	17.1	16.1	20.8	13.6	14.4	18.9	12.8	13.1	13.6	12.8	17.2
20	15.5	17.2	17.1	16.1	20.6	13.6	14.4	18.9	12.8	13.1	13.3	12.8	----------
21	15.5	17.1	17.1	15.8	20.6	13.3	14.4	18.9	12.8	13.1	13.3	12.5	17.1
22	15.5	17.1	17.1	15.8	20.3	13.3	14.4	18.9	12.8	13.1	13.1	12.5	----------
23	15.4	16.7	17.1	15.8	20.3	13.3	14.4	18.9	12.8	13.1	13.1	12.5	16.8
24	15.4	16.6	17.1	15.8	20.0	13.3	14.2	18.6	12.8	13.1	12.8	12.5	----------
August 25, 1967													
1	15.4	16.6	17.1	15.8	19.7	13.3	14.2	18.6	12.8	13.1	12.8	12.5	16.4
2	15.4	16.6	17.1	15.8	19.4	13.3	14.2	18.6	12.8	13.1	12.8	12.5	----------
3	15.5	16.5	17.0	15.8	19.2	13.3	14.2	18.6	12.8	13.1	12.8	12.5	16.1
4	15.9	16.4	17.0	15.8	18.9	13.6	14.2	18.3	12.8	13.1	12.8	12.5	----------
5	16.2	16.4	17.0	15.6	18.3	14.2	14.4	18.1	13.1	13.1	12.5	12.5	15.9
6	16.5	16.4	17.1	15.6	18.1	15.0	14.6	17.8	13.1	13.3	12.5	12.5	----------
7	16.8	16.6	17.8	15.6	17.8	15.8	15.8	17.5	13.1	13.3	12.5	12.5	16.1
8	16.8	16.8	18.3	15.6	17.8	16.4	15.8	17.2	13.3	13.3	12.5	12.5	----------
9	17.1	16.8	18.9	15.6	17.8	16.4	15.8	17.2	13.3	13.3	12.8	12.8	16.1
10	17.2	16.9	19.4	15.6	17.8	16.4	15.8	17.2	13.3	13.3	12.8	12.8	----------
11	17.6	17.0	20.0	15.8	17.8	16.4	15.8	17.2	13.3	13.3	12.8	12.8	15.7
12	17.8	17.1	20.0	15.8	17.8	16.4	15.8	17.2	13.6	13.3	12.8	12.8	----------
13	18.1	17.1	19.7	16.1	18.1	16.4	16.1	17.2	13.6	13.3	12.8	13.1	15.8
14	18.1	17.2	19.6	16.1	18.1	16.4	16.1	17.2	13.6	13.3	12.8	13.1	----------
15	18.4	17.2	19.4	16.4	18.1	16.4	16.4	17.2	13.6	13.3	12.8	13.1	15.9
16	18.6	17.3	19.3	16.4	18.3	16.4	16.4	17.2	13.6	13.3	12.8	13.3	----------
17	18.8	17.3	19.2	16.4	18.3	16.4	16.7	17.2	13.6	13.3	12.8	13.3	16.1
18	18.8	17.3	19.1	16.4	18.6	16.4	16.7	17.2	13.6	13.3	12.8	13.3	----------
19	18.9	17.2	19.0	16.4	18.6	16.4	16.7	17.2	13.6	13.3	13.1	13.1	16.2
20	18.9	17.2	18.9	16.6	18.6	16.1	16.7	17.2	13.6	13.3	13.1	13.1	----------
21	19.2	17.1	18.8	16.6	18.6	15.8	16.7	17.2	13.6	13.3	13.1	13.1	16.3
22	19.7	17.1	18.8	16.6	18.9	15.7	16.6	17.2	13.6	13.3	13.1	12.8	----------
23	19.8	17.2	18.8	16.6	18.9	15.6	16.6	17.2	13.6	13.3	13.1	12.8	16.1
24	19.9	17.3	18.7	16.6	19.2	15.4	16.4	17.2	13.6	13.3	13.1	12.8	----------
August 26, 1967													
1	19.9	17.3	18.6	16.6	19.2	15.2	16.2	17.2	13.6	13.3	13.1	12.7	16.1
2	19.9	17.7	18.6	16.7	19.2	15.0	16.1	17.2	13.6	13.3	13.1	12.7	----------
3	19.9	17.9	18.6	16.9	19.2	14.9	15.9	17.2	13.6	13.3	13.1	12.6	16.1
4	19.9	17.9	18.7	16.9	19.2	14.7	15.8	17.2	13.6	12.8	12.8	12.5	----------
5	19.8	18.0	18.7	16.9	19.2	14.6	15.8	17.2	13.6	12.8	12.8	12.4	16.0
6	19.8	18.4	18.7	16.9	19.2	14.5	15.7	17.2	13.5	12.8	12.8	12.4	----------
7	19.7	18.6	18.7	16.9	19.2	14.5	15.7	17.2	13.4	12.8	12.8	12.4	15.9
8	19.6	18.7	18.6	16.9	19.2	14.5	15.7	17.2	13.3	12.8	12.8	12.4	----------
9	19.6	18.9	18.6	16.9	19.2	14.5	15.7	17.3	13.3	12.8	13.1	12.4	16.1
10	19.6	18.9	18.6	16.9	19.4	14.5	15.7	17.7	13.3	12.8	13.1	12.4	----------
11	19.6	18.9	18.6	16.9	19.4	14.4	15.7	17.8	13.3	12.8	13.1	12.4	15.9
12	19.6	18.9	18.6	16.9	19.7	14.4	15.7	17.9	13.3	12.8	13.1	12.4	----------
13	20.0	18.9	18.6	17.2	19.8	14.4	15.8	17.9	13.3	12.8	13.3	12.4	15.8
14	20.6	18.9	18.4	17.2	19.9	16.1	15.8	17.8	13.3	12.8	13.3	12.5	16.9
15	21.1	18.9	18.4	17.2	19.9	17.0	15.8	17.5	13.6	13.3	13.6	14.7	16.4
16	21.3	19.1	18.6	17.2	21.0	17.2	16.2	17.2	13.9	13.3	13.6	15.6	----------
17	21.4	19.2	18.7	17.2	21.0	17.1	16.4	17.2	14.2	13.5	13.6	15.4	15.8
18	21.4	19.3	18.8	17.2	20.9	17.0	16.5	17.3	14.2	13.5	13.7	15.2	----------
19	21.3	19.4	18.9	17.5	20.6	16.9	16.5	17.3	14.2	13.5	13.7	14.8	15.8
20	21.2	19.5	19.1	17.5	20.3	16.8	16.4	17.5	14.2	13.5	13.7	14.3	----------
21	21.1	19.6	19.2	17.5	20.1	16.7	16.4	17.7	14.2	13.5	13.7	13.9	15.9
22	20.8	19.6	19.2	17.5	20.0	16.6	16.4	17.7	14.2	13.3	13.7	13.6	----------
23	20.7	19.6	19.2	17.5	19.9	16.4	16.4	17.7	13.9	13.3	13.7	13.4	16.1
24	20.6	19.6	19.2	17.5	19.8	16.2	16.4	17.7	13.9	13.1	13.6	13.2	----------

Hourly stream-temperature data, in degrees Celsius, at continous recording stations August 24–30, 1969—Continued

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4 gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4 gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5 "at bridge"	Site 3, Sunrise Highway	Site 5 gaging station
	August 27, 1967												
1	20.1	19.6	19.2	17.5	19.7	16.0	16.3	17.8	13.9	13.2	13.6	13.0	16.7
2	19.9	19.6	19.2	17.5	19.7	15.9	16.3	17.8	13.9	13.2	13.6	12.9	----------
3	19.7	19.5	19.2	17.5	19.7	15.7	16.3	17.8	13.9	13.2	13.6	12.9	16.7
4	19.6	19.5	19.2	17.6	19.7	15.6	16.2	17.8	13.9	13.2	13.6	12.9	----------
5	19.9	19.5	19.1	17.6	19.7	15.6	16.1	17.8	13.6	13.2	13.6	13.1	17.8
6	20.1	19.4	19.0	17.8	19.7	15.6	16.1	17.8	13.6	13.2	13.6	14.4	----------
7	20.7	19.4	19.0	17.8	21.1	15.6	16.2	17.8	13.6	13.2	13.6	14.7	16.8
8	20.8	19.3	19.1	17.8	21.2	15.7	16.2	17.8	13.6	13.2	13.6	14.7	----------
9	20.9	19.2	19.1	17.9	21.1	17.3	16.2	17.8	13.6	13.3	13.7	14.6	17.2
10	21.1	19.2	19.1	17.9	21.0	17.4	16.3	17.8	13.6	13.3	13.8	14.4	----------
11	21.3	19.3	19.2	18.3	20.7	17.4	16.7	17.9	13.9	13.6	14.0	14.3	17.5
12	21.3	19.8	19.4	18.9	20.7	17.4	16.9	18.3	14.2	13.9	14.2	14.2	----------
13	21.3	20.4	19.6	19.2	20.7	17.4	17.2	18.7	14.4	14.2	14.4	14.2	17.7
14	21.2	21.1	19.6	19.6	20.7	17.1	17.5	19.0	14.4	14.2	14.7	14.1	----------
15	21.1	21.2	19.7	19.7	20.7	16.9	17.5	19.4	14.7	14.2	14.8	14.1	18.1
16	21.0	21.3	20.0	19.8	20.6	16.7	17.2	19.7	14.7	14.2	15.1	14.0	----------
17	20.8	21.3	20.0	19.8	20.6	16.4	17.2	19.9	14.7	14.1	15.1	13.9	18.2
18	20.7	21.3	20.0	19.8	20.6	16.2	16.9	20.0	14.7	14.0	15.0	13.7	----------
19	20.7	21.3	20.1	19.8	20.6	15.9	16.9	20.0	14.7	13.9	15.0	14.2	18.3
20	20.7	21.2	20.1	19.8	20.4	15.7	16.8	20.1	14.4	13.9	15.0	14.1	----------
21	21.0	21.1	20.2	19.8	20.3	15.6	16.7	20.1	14.4	13.9	15.0	14.1	18.4
22	21.3	20.9	20.2	19.8	20.3	15.6	16.7	20.1	14.4	13.8	14.8	14.0	----------
23	21.4	20.7	20.3	19.8	20.3	15.5	16.5	20.0	14.2	13.8	14.7	13.9	18.9
24	21.4	20.6	20.2	19.8	20.3	15.4	16.4	20.0	14.2	13.7	14.4	13.7	----------
	August 28, 1967												
1	21.5	20.6	20.1	19.7	20.3	15.3	16.4	20.0	14.2	13.7	14.4	13.1	18.9
2	21.4	20.6	20.1	19.7	20.3	15.3	16.3	20.0	14.2	13.6	14.3	13.1	----------
3	21.3	20.6	20.1	19.6	20.3	15.3	16.3	20.0	14.2	13.6	14.3	13.0	18.9
4	21.1	20.6	20.2	19.3	20.2	15.3	16.1	19.9	13.9	13.6	14.2	12.9	----------
5	20.6	20.6	20.2	19.2	20.2	15.3	16.1	19.9	13.9	13.6	14.2	12.8	18.9
6	20.2	20.6	20.3	19.1	20.2	15.2	16.1	19.8	13.9	13.6	14.2	12.8	----------
7	20.0	20.6	20.3	18.9	20.2	15.2	16.1	19.8	13.9	13.4	14.1	12.8	18.9
8	19.9	20.6	20.3	18.9	20.3	15.2	16.1	19.7	13.9	13.4	14.1	12.8	----------
9	19.9	20.6	20.3	18.9	20.4	15.2	16.1	19.6	13.9	13.4	13.9	12.8	18.9
10	20.0	20.6	20.3	19.0	20.5	15.2	16.1	19.6	13.9	13.4	13.9	13.2	----------
11	20.1	21.1	20.6	19.4	21.1	15.4	16.4	19.7	14.2	13.9	14.2	13.9	19.3
12	20.3	21.7	21.1	20.0	21.7	15.6	16.7	20.0	14.7	14.7	14.4	14.7	----------
13	20.4	22.3	21.1	20.6	21.9	15.9	17.5	20.8	15.3	15.8	15.6	15.3	20.0
14	20.7	22.3	21.2	20.8	22.3	16.1	18.3	21.7	15.6	16.1	16.1	15.4	----------
15	20.8	22.3	21.2	21.2	22.5	16.1	18.6	22.2	15.8	16.2	16.9	15.5	20.6
16	20.9	22.2	21.1	21.4	22.5	16.0	18.6	22.2	15.8	16.2	17.2	15.3	----------
17	20.7	22.2	21.1	21.4	22.3	16.0	18.4	22.2	15.6	16.1	17.2	15.0	21.1
18	20.2	22.1	20.8	21.2	22.0	15.9	18.1	22.2	15.6	15.6	16.9	14.7	----------
19	20.0	21.6	20.8	21.0	21.8	15.9	17.5	21.9	15.3	15.3	16.6	14.2	21.1
20	19.4	21.1	20.8	20.5	21.4	15.8	17.1	21.9	15.0	14.4	15.8	13.9	----------
21	19.6	20.8	20.6	20.3	20.9	15.6	16.7	21.9	14.7	14.1	15.3	13.3	20.6
22	18.8	20.6	20.6	19.8	20.7	15.3	16.4	21.7	14.4	13.7	14.7	13.3	----------
23	18.6	20.3	20.4	19.6	20.5	15.1	16.1	21.7	14.2	13.4	14.2	13.1	20.4
24	18.4	20.0	20.3	19.4	20.4	15.0	16.0	21.7	13.9	13.0	13.7	12.8	----------
	August 29, 1967												
1	18.4	19.9	20.6	19.7	20.3	14.8	15.7	21.4	13.6	12.8	13.3	12.5	20.0
2	18.3	19.7	20.4	18.9	20.2	14.7	15.6	21.1	13.3	12.6	13.1	12.4	----------
3	18.2	19.6	20.3	18.6	19.9	14.6	15.4	21.0	13.1	12.5	12.9	12.4	19.9
4	18.1	19.3	20.1	18.5	19.7	14.6	15.2	20.8	12.8	12.5	12.7	12.3	----------
5	17.9	19.2	20.0	18.2	19.6	14.4	15.1	20.6	12.8	12.3	12.5	12.2	19.7
6	17.8	18.9	19.8	18.1	19.5	14.3	15.0	20.3	12.5	12.2	12.3	12.2	----------
7	17.8	18.9	19.7	17.8	19.5	14.3	15.0	20.0	12.2	12.1	12.2	12.2	19.4
8	17.8	18.9	19.7	17.8	19.4	14.3	15.0	20.0	12.2	12.1	12.2	12.2	----------
9	17.8	18.9	19.6	17.8	19.4	14.3	15.0	20.0	12.2	12.2	12.2	12.4	19.4
10	18.1	19.1	19.7	17.9	19.4	14.4	15.1	20.1	12.5	12.6	12.3	12.8	----------
11	18.4	19.6	19.9	18.6	20.0	14.8	15.6	20.6	12.8	13.1	12.8	13.3	20.3
12	18.7	20.3	20.3	19.2	20.8	15.1	16.1	21.4	13.3	14.2	14.2	13.9	----------
13	18.9	21.2	20.6	19.7	21.2	15.4	16.7	21.7	14.2	15.1	15.0	14.4	20.6
14	18.9	21.7	21.1	19.7	21.7	15.6	17.5	21.7	14.4	15.5	16.4	14.7	----------
15	18.9	22.1	21.4	19.9	21.8	15.6	17.8	21.8	15.0	15.6	16.7	14.7	20.6
16	18.8	22.2	21.5	20.0	21.8	15.6	17.8	21.8	15.0	15.5	16.9	14.7	----------
17	18.7	22.2	21.5	20.0	21.8	15.6	17.5	21.9	14.4	15.3	16.9	14.6	20.6
18	18.4	22.2	21.3	20.0	21.6	15.6	17.2	22.0	14.2	14.9	16.7	14.3	----------
19	18.1	22.0	21.1	19.9	21.5	15.5	16.9	22.0	13.9	14.7	16.4	14.1	20.3
20	17.8	21.8	20.9	19.6	21.3	15.4	16.7	22.0	13.9	14.4	15.6	13.8	----------
21	17.6	21.3	20.7	19.3	20.9	15.3	16.5	21.9	13.6	13.6	14.9	13.4	20.3
22	17.3	20.8	20.6	19.2	20.7	15.1	16.4	21.8	13.3	13.3	14.3	13.2	----------
23	17.2	20.3	20.4	18.9	20.5	14.9	16.2	21.7	13.1	13.1	13.8	13.1	20.0
24	17.1	20.0	20.3	18.6	20.3	14.9	16.1	21.5	12.8	13.1	13.6	12.9	----------

Hourly stream-temperature data, in degrees Celsius, at continuous recording stations, August 24–30, 1967—Continued

Hour	East Meadow Brook			Sampawams Creek	Champlin Creek				Connetquot River			Swan River	
	Site 1, Jerusalem Avenue	Site 4, gaging station	Site 5E, Sunrise Highway	Site 4 gaging station	Site 1, Spur Drive North	Site 3, Islip Boulevard	Site 4 gaging station	Site 5, Montauk Highway	Site 1, Veterans Highway	Site 3	Site 5 "at bridge"	Site 3, Sunrise Highway	Site 5 gaging station
							August 30, 1967						
1	16.9	19.8	20.3	18.4	20.1	14.8	15.7	21.4	12.8	12.7	13.1	12.6	19.7
2	16.8	19.7	20.2	18.2	19.9	14.7	15.4	21.1	12.5	12.5	12.8	12.4	----------
3	16.8	19.6	20.0	17.9	19.8	14.7	15.3	20.8	12.2	12.3	12.5	12.4	19.4
4	16.7	19.4	20.0	17.7	19.7	14.6	15.2	20.8	12.2	12.2	12.3	12.3	----------
5	16.7	19.2	19.9	17.4	19.6	14.6	15.0	20.6	11.9	12.1	12.2	12.3	19.4
6	16.7	19.1	19.7	17.1	19.4	14.4	14.9	20.3	11.9	12.0	12.2	12.2	----------
7	16.7	18.9	19.7	16.9	19.3	14.4	14.9	20.0	11.9	11.9	12.1	12.2	19.2
8	16.7	18.9	19.7	16.9	19.3	14.4	14.9	20.0	11.9	11.9	12.1	12.2	----------
9	16.7	19.2	19.7	16.9	19.3	14.4	14.9	20.0	11.9	11.9	12.1	12.5	19.2
10	16.8	19.4	19.8	17.2	19.8	14.7	15.3	20.1	12.2	12.1	12.3	13.1	----------
11	17.2	20.0	20.0	17.8	20.6	15.0	15.8	20.8	13.3	13.6	13.3	13.6	19.4
12	17.6	20.8	20.3	18.6	21.4	15.8	17.2	21.7	14.4	14.7	14.4	14.3	----------
13	17.9	21.9	20.6	19.4	21.9	16.1	17.5	22.2	15.0	15.8	15.8	15.0	20.0
14	18.2	22.8	20.8	20.0	22.2	16.4	17.8	22.2	15.6	16.6	16.7	15.3	----------
15	18.4	23.1	21.0	20.4	22.6	16.7	17.8	22.5	15.6	16.7	16.9	15.3	20.6
16	18.4	23.1	21.1	20.6	22.8	16.7	17.8	22.5	15.6	16.6	17.3	15.3	----------
17	18.4	23.0	21.1	20.7	22.8	16.6	17.5	22.5	15.3	16.5	17.3	15.2	20.6
18	18.3	22.9	21.0	20.7	22.6	16.4	17.2	22.2	15.3	16.1	16.9	14.9	----------
19	18.1	22.6	20.9	20.4	22.2	16.4	17.1	22.2	15.0	16.0	16.4	14.4	20.6
20	17.8	22.2	20.9	20.2	21.9	16.1	17.0	22.2	15.0	15.3	15.8	14.2	----------
21	17.5	21.7	20.8	19.8	21.5	16.0	16.9	21.9	14.9	14.8	15.3	13.8	20.6
22	17.4	21.4	20.7	19.7	21.2	15.8	16.8	21.9	14.4	14.5	14.7	13.6	----------
23	17.3	21.1	20.7	19.6	20.9	15.7	16.7	21.9	14.2	14.2	14.4	13.4	20.3
24	17.2	20.8	20.6	19.4	20.8	15.6	16.4	21.7	13.9	13.9	14.2	13.3	----------

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