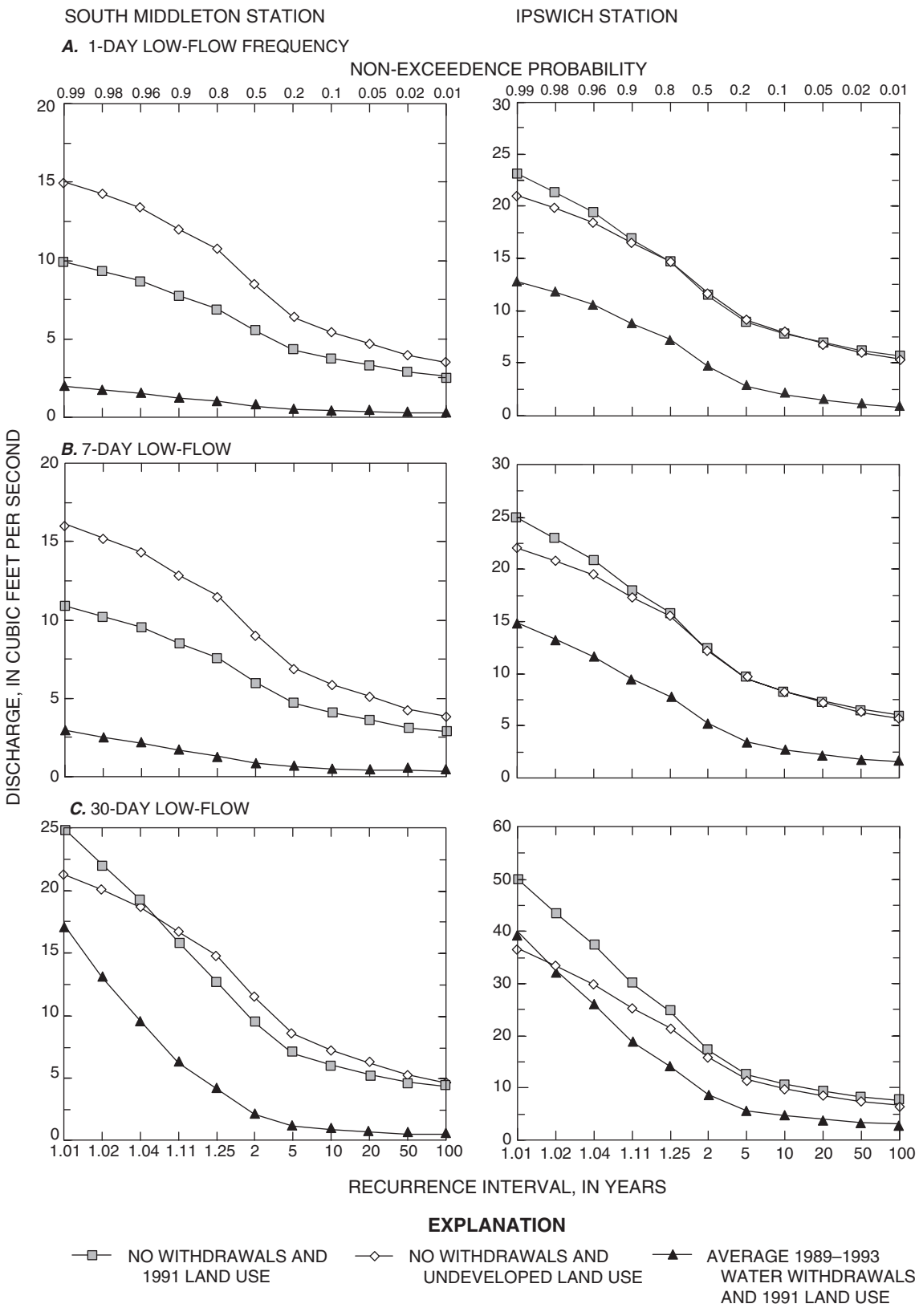

Figure 27. Log-Pearson Type III low-flow exceedence probabilities and recurrence intervals for (*A*) 1-day, (*B*) 7-day, and (*C*) 30-day annual minimum mean streamflows based on long-term (1961–95) simulations of average water withdrawals, no withdrawals with 1991 land-use conditions, and no withdrawals with undeveloped land-use conditions, for the Ipswich River at the South Middleton and Ipswich gaging stations, Mass.

greater lower zone evapotranspiration between forested and open land which offsets any gains in base flow.

Long-term simulations enabled the computation of low-flow-frequency probabilities by fitting annual series of low flows to the log-Pearson Type III distribution. Low-flow frequency probabilities were computed from annual series of minimum 1-day, 7-day, and 30-day mean flows for each of the long-term simulation scenarios using SWSTAT, a program designed to compute surface-water statistics (Lumb and others, 1994b). The low-flow frequency curves computed from the simulated daily discharges for each of the long-term scenarios are shown for each period of minimum flow in figure 27.

The 1-day low-flow probability curve indicates the minimum daily discharge that is likely to occur in the specified recurrence interval (bottom x-axis), which is the reciprocal of the probability of non-exceedence (top x-axis). For instance, streamflow at the South Middleton station for simulations with no water withdrawals and 1991 land use indicate that the minimum daily flow with a recurrence probability of 50 years is 2.9 ft^3/s. Flows might not fall below 2.9 ft^3/s in a given 50-year period or could fall below this level more than once in a 50-year period; over a long period of time, however, this minimum daily flow would be expected to occur, on average, once in 50 years if no water withdrawals were being made.

Minimum daily flows for simulations with no withdrawals with 1991 land-use conditions and no withdrawals with undeveloped land-use conditions were comparable. At the South Middleton station, flows ranged from 2.7 and 3.5 ft^3/s at the 100-year recurrence interval to 9.9 and 15 ft^3/s at about the 1-year recurrence interval for simulations with (1) no withdrawals with 1991 land-use conditions and (2) no withdrawals with undeveloped land-use conditions, respectively. At the Ipswich station, flows ranged from 5.8 and 5.5 ft^3/s at the 100-year recurrence interval to 23 and 21 ft^3/s at about the 1-year recurrence interval for simulations with (1) no withdrawals with 1991 land-use conditions and (2) no withdrawals with undeveloped land-use conditions, respectively. Simulations with no withdrawals with 1991 land-use conditions and those with undeveloped land-use conditions indicate that undeveloped land-use conditions resulted in increased discharge above South Middleton station, but slightly decreased discharge at the Ipswich station. This indicates that the imperviousness above the South Middleton station under the 1991 land-use condition was sufficient to inhibit infiltration and, thereby, decrease baseflow. This is underscored by the fact that under relatively less developed conditions at the Ipswich station, the undeveloped condition resulted in lower flow through evapotranspiration than the developed condition.

Minimum daily flows for simulations with average 1989–93 withdrawals were considerably less than the minimum daily flows for simulations with no withdrawals for either land-use condition. At the South Middleton station, flows with water withdrawals ranged from 0.32 ft^3/s at the 100-year recurrence interval to 2.0 ft^3/s at about the 1-year recurrence interval. At the Ipswich station, flows with water withdrawals ranged from 0.84 ft^3/s at the 100-year recurrence interval to 13 ft^3/s at about the 1-year recurrence interval.

The 7-day low-flow frequency represents the minimum flows over a continuous 7-day period. The 7-day low-flow probabilities are similar to, but slightly greater than, the 1-day low-flow probabilities. At the South Middleton station, flows ranged from 2.9 and 3.8 ft^3/s at the 100-year recurrence interval to 11 and 16 ft^3/s at about the 1-year recurrence interval for simulations with (1) no withdrawals with 1991 land use conditions, and (2) no withdrawals with undeveloped land conditions, respectively. At the Ipswich station, flows ranged from 6.0 and 5.7 ft^3/s at the 100-year recurrence interval to 25 and 22 ft^3/s at about the 1-year recurrence interval for simulations with (1) no withdrawals with 1991 land-use conditions and (2) no withdrawals with undeveloped land conditions, respectively. Minimum 7-day flows for simulations with water withdrawals ranged from 0.38 ft^3/s at the 100-year recurrence interval to 3.0 ft^3/s at about the 1-year recurrence interval at the South Middleton station, and from 1.5 ft^3/s at the 100-year recurrence interval to 15 ft^3/sec at about the 1-year recurrence interval at the Ipswich station.

The 7-day, 10-year, low-flow (7Q10), which represents the probable minimum flow over a 7-day period that will occur on average once in 10 years, is a widely used regulatory statistic. At the South Middleton station, the 7Q10 flows were 4.1 ft^3/s, 5.9 ft^3/s, and 0.54 ft^3/s for simulations with (1) no withdrawals with 1991 land-use conditions, (2) no withdrawals with undeveloped land-use conditions, and (3) average