# YIELD AND QUALITY OF GROUND WATER FROM STRATIFIED-DRIFT AQUIFERS, TAUNTON RIVER BASIN, MASSACHUSETTS: EXECUTIVE SUMMARY

*By* Wayne W. Lapham and Julio C. Olimpio

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# CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may prefer to use metric (International System) units rather than the inch-pound units used in this report, values may be converted by using the following factors.

| Multiply inch-pound unit | By | To obtain metric unit |
|---|---|---|
| | **Length** | |
| inch (in.) | 25.4 | millimeter (mm) |
| foot (ft) | 0.3048 | meter (m) |
| mile (mi) | 1.609 | kilometer (km) |
| | **Area** | |
| square mile (mi$^2$) | 2.590 | square kilometer (km$^2$) |
| | **Flow** | |
| cubic foot per second (ft$^3$/s) | 0.02832 | cubic meter per second (m$^3$/s) |
| cubic foot per second per square mile [(ft$^3$/s)/mi$^2$] | 0.01093 | cubic meter per second per square kilometer [(m$^3$/s)/km$^2$] |
| | **Hydraulic conductivity** | |
| foot per day (ft/d) | 0.3048 | meter per day (m/d) |
| | **Transmissivity** | |
| square foot per day (ft$^2$/d) | 0.09290 | square meter per day (m$^2$/d) |

**Temperature**

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows: °C = 5/9 (°F-32).

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level of 1929."

# Yield and Quality of Ground Water from Stratified-Drift Aquifers, Taunton River Basin, Massachusetts:

## EXECUTIVE SUMMARY

*By* Wayne W. Lapham and Julio C. Olimpio

## INTRODUCTION

Water shortages are a chronic problem in parts of the Taunton River basin and are caused by a combination of factors. One factor is that ground-water resources are limited, particularly in the northern half of the basin where glacial stratified-drift aquifers, which are the only sources used for public-water supply, are thin, small, and discontinuous. A second factor is drought or at least unusually dry conditions, which have occurred several times in the last 25 years and have caused water levels in aquifers to decline; this results in mandatory reductions in pumping rates. A third factor is that overall water use in the basin has increased during the past several decades. Finally, perhaps the most important factor is conjunctive water use in the basin. Withdrawal of water from surface-water and ground-water municipal-supply sources that are hydraulically connected affects the amount of yield from each source, and the yield available from similar water supplies elsewhere in the basin.

Water use in this part of the Boston metropolitan area is likely to increase during the next decade. Therefore, water shortages are predicted to become more widespread and to occur more frequently. The Massachusetts Division of Water Resources projects that about 50 percent of the cities and towns within and on the perimeter of the basin may have water-supply deficits by 1990, if water-management projects are not pursued throughout the 1980's.

In a recent report, Lapham (1988) presents a thorough technical discussion of the (1) hydrogeologic characteristics of the Taunton River basin, with focus on the northern half of the basin; (2) estimation of aquifer yields from 26 selected stratified-drift aquifers; (3) assessment of the potential yield of aquifers to support new development; and (4) description of the quality of ground water in the basin. The Taunton River basin study was done cooperatively by the U.S. Geological Survey and the Massachusetts Department of Environmental Management, Division of Water Resources, and is one of several studies under Chapter 800 Massachusetts legislation, which enables quantitative assessments of regional ground-water resources in the State.

This report summarizes the results of the Taunton River basin hydrogeologic study and provides a nontechnical description of the hydrologic and geologic characteristics of the basin, a discussion of the yields of the stratified-drift aquifers as determined from model simulation, and a discussion of the ground-water quality in the basin.

## PHYSICAL SETTING AND HYDROGEOLOGY OF THE BASIN

The Taunton River basin covers 530 mi$^2$ (square miles) of Bristol, Norfolk, and Plymouth Counties in southeastern Massachusetts. All or parts of the cities of Attleboro, Brockton, Fall River, New Bedford, and Taunton, and 36 towns are in the basin (fig. 1). The basin is drained by the Matfield, Town, and Taunton Rivers.

Tributary streams include the Canoe, Nemasket, Wading, Threemile, and Winnetuxet Rivers. Surface-water drainage is generally southward toward Mount Hope Bay, a part of Narragansett Bay at Fall River.

Stratified-drift deposits cover about 62 percent of the basin. These deposits are primarily ice-contact, outwash, and lake-bottom sediments, which were deposited in preglacial bedrock valleys and in water-filled depressions in the till and bedrock surface during retreat of the last glacier. The sediments are composed of sand, gravel, cobbles, silt, and clay. The drift ranges in thickness from zero to about 200 ft (feet) in some of the deep preglacial bedrock valleys. The thickest deposits are lake-bottom deposits composed of fine sand interbedded with silt and clay. Stratified-drift deposits are more abundant in the central and southern parts of the basin than in the northern part of the basin. In the northern one-third of the basin, stratified drift fills narrow, north-south trending valleys, which are bordered by till and bedrock uplands.

Yields of wells in the fine-grained stratified-drift deposits are usually no more than a few gallons per minute (gal/min) whereas yields of wells in the coarse-grained stratified drift may exceed 300 gal/min. The coarse-grained parts of the stratified-drift deposits form the major aquifers in the basin. In the northern part of the basin, these aquifers are long, narrow, and thin, and have saturated thicknesses that range from about 20 ft to somewhat more than 100 ft. The widths of the stratified-drift aquifers generally range from 0.1 to 1.5 mi (miles), and their lengths generally range from 1 to 5 mi.

Twenty-six stratified-drift aquifers in the northern half of the basin were studied in detail (fig. 2). These aquifers were selected because current and projected 1990 water-supply deficits are greatest in the northern half of the basin, affecting 14 of 19 municipalities. In contrast, only one of nine municipalities in the southern half of the basin is projected to have a deficit (Richard Thibedeau, Massachusetts Division of Water Resources, written

commun.,1984). The 26 aquifers also were selected because the use of ground water as the sole source of supply is greatest in the northern half of the basin. Fifteen of 19 municipalities in the northern half of the basin use ground water as compared to 4 of 9 municipalities in the southern half of the basin.

The 26 stratified-drift aquifers were identified as areas of stratified drift that have a transmissivity equal to or greater than 1,337 ft$^2$/d (square feet per day), which is equivalent to 10,000 gallons per day per foot. The aquifers underlie or are near major rivers or tributaries. The aquifers are composed mostly of layers of sand and gravel but include some interbedded layers of silt and clay. John R. Williams (U.S. Geological Survey, written commun., 1982) determined that the hydraulic conductivity of fine-to-coarse gravel ranges from about 150 to 500 ft/d (feet per day), mixed sand and gravel averages about 200 ft/d, and fine-to-coarse sand ranges from about 25 to 150 ft/d. The transmissivity of the stratified drift is equal to the product of its hydraulic conductivity and saturated thickness. Therefore, equal transmissivities at different locations in an aquifer may be the result of thin deposits of high-conductivity drift or thick deposits of low-conductivity drift. Transmissivity exceeds 4,000 ft$^2$/d in small areas in nearly all 26 aquifers. In a few areas, where the stratified drift is thick or has a high hydraulic conductivity, transmissivity exceeds 10,000 ft$^2$/d.

## AQUIFER YIELDS

### Estimates from Model Simulations

During severe drought, ground-water discharge from aquifers to streams is reduced or ceases, streamflow is at a minimum, and only small amounts of surface water are stored in wetlands and ponds. Consequently, water pumped from most aquifers in New England during severe drought is derived largely from storage in the aquifers. During normal climatic conditions, water pumped from an aquifer is derived from storage, intercepted ground-water discharge, and induced infiltration of surface water. To account for drought and normal conditions, two sets of aquifer-yield estimates were made for each of the 26 stratified-drift aquifers using simple ground-water flow models. "Short-term" aquifer yields during drought conditions were determined by considering only water from storage and are expressed as single values for several selected pumping periods. "Long-term" aquifer yields during normal

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Figure 1.--Physical setting of the study area.

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NAMES AND LOCATIONS OF AQUIFERS:

A. AQUIFER NORTH OF LAKE MIRIMICHI
B. CARVER POND-SOUTH BROOK AQUIFER
C. HAWTHORNE BROOK AQUIFER
D. HODGES BROOK AQUIFER
E. LITTLE CEDAR SWAMP AQUIFER
F. LOWER CANOE RIVER AQUIFER
G. LOWER MATFIELD-TAUNTON RIVER AQUIFER
H. LOWER QUESET BROOK AQUIFER
I. LOWER SHUMATUSCACANT RIVER AQUIFER
J. LOWER WEST MEADOW BROOK AQUIFER
K. MEADOW BROOK AQUIFER
L. MIDDLE CANOE RIVER AQUIFER

M. MIDDLE RUMFORD RIVER AQUIFER
N. MIDDLE WADING RIVER AQUIFER
O. MULBERRY BROOK AQUIFER
P. PINE SWAMP BROOK AQUIFER
Q. SALISBURY PLAIN RIVER AQUIFER
R. SALISBURY PLAIN RIVER AQUIFER AT BROCKTON
S. SATUCKET RIVER AQUIFER
T. TROUT BROOK AQUIFER
U. UPPER CANOE RIVER AQUIFER
V. UPPER HOCKOMOCK RIVER AQUIFER
W. UPPER QUESET BROOK AQUIFER
X. UPPER RUMFORD RIVER AQUIFER
Y. UPPER SHUMATUSCACANT RIVER AQUIFER
Z. UPPER WADING RIVER AQUIFER

EXPLANATION

Stratified-drift aquifer

Water body

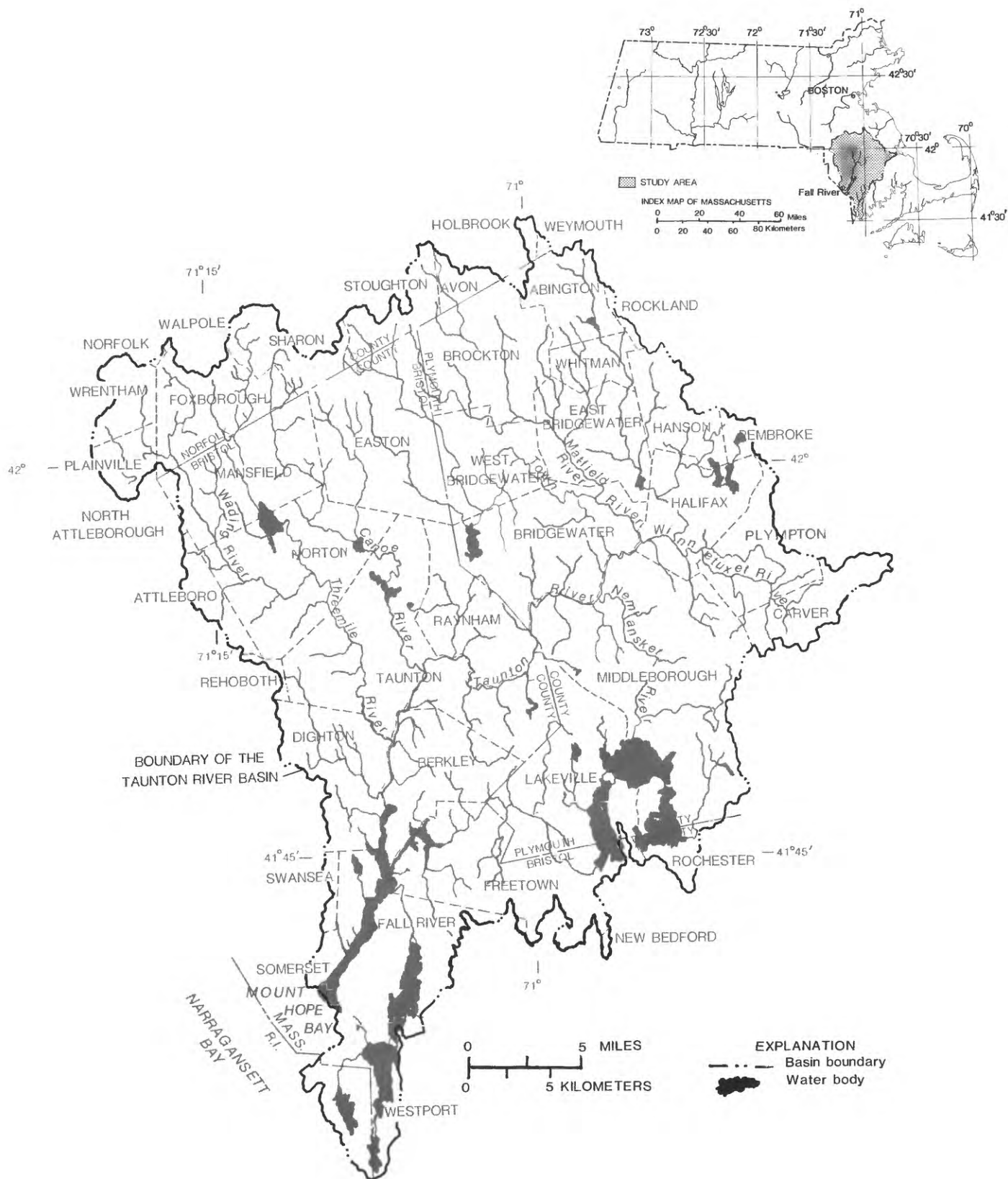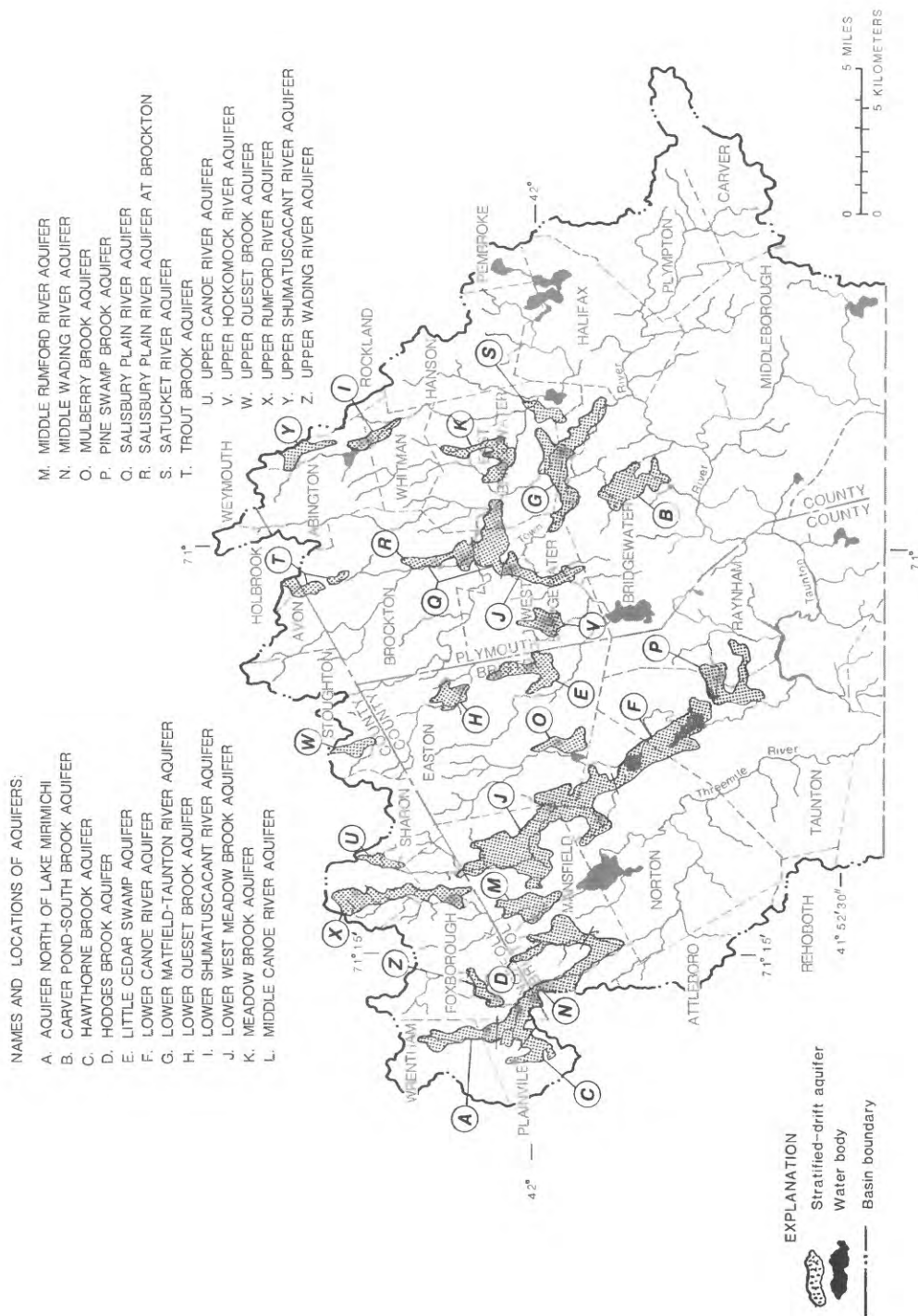Basin boundary

Figure 2.--Names and locations of the 26 stratified-drift aquifers, Taunton River basin, Massachusetts.

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climatic conditions were determined by considering water available from storage, intercepted ground-water discharge, and induced infiltration, and are expressed in terms of exceedance values for available streamflow.

On the basis of estimates of the short-term yields of the 26 aquifers (table 1), yields for a 30-day pumping period range from 2.6 to 15.0 ft³/s (cubic feet per second) (1 ft³/s = 0.646 Mgal/d (million gallons per day)). Fourteen of the 26 aquifers have yields less than 5 ft³/s, 7 have yields that range from 5 to 10 ft³/s, and five have yields between 10 ft³/s and 15 ft³/s. For a 180-day pumping period, short-term yields of the 26 aquifers range from 1.6 to 10.5 ft³/s. Nineteen of the 26 aquifers have yields less than 5 ft³/s, six have yields that range from 5 to 10 ft³/s, and one has a yield of 10.5 ft³/s. The estimates of yields from aquifer storage are applicable during severe drought. Because water is derived primarily from storage during severe drought, steady-state conditions may not be achieved, and continued pumping may cause continued water-level declines.

On the basis of the aquifer-yield data in table 1, one might conclude that large amounts of water are available in the 26 stratified-drift aquifers. However, rates given in table 1 are short-term yields. Potential long-term yields may be less than these short-term yields and are not constant over time, because streamflow, which varies seasonally, is an important source of water contributing to long-term yield. Therefore, the long-term yield estimate of each aquifer depends partly on the amount of streamflow that is to be maintained in the streams flowing over each aquifer. Estimated yields of the 26 aquifers available 90 percent of the time when streamflow of the major stream that drains each aquifer equals or exceeds the 99.5-percent duration of flow are presented in table 2. The aquifer yield, and, for comparison purposes, the 1983 pumping rate for each aquifer are presented in the table.

Estimates of the long-term yield of the 26 aquifers (table 2) indicate that the yields of the two most productive aquifers equal or exceed 11.9 and 11.3 ft³/s 90 percent of the time, respectively, if minimum stream discharge is maintained at 99.5-percent flow duration. Eighteen of the 26 aquifers were pumped for public-water supply during 1983. Further analysis of the yield characteristics of these 18 aquifers indicates that the 1983 pumping rate of each of these 18 aquifers can be sustained at least 70 percent of the time.

## Appraisal of Yield Estimates

The yields of aquifers estimated in this study are based on all available information about the geometry and hydraulic properties of the aquifers. The yield estimates are the results of model simulations assuming conditions that existed prior to any aquifer development and that represent the entire area of the aquifer. Actual yields may differ from the estimated yields because of specific limitations in well-field design or well performance. For example, a location where yield of an aquifer is greatest may not be suitable for development because the quality of the water is unacceptable, or it may be physically or economically more feasible to locate a well field elsewhere. In addition, well efficiency is less than 100 percent, although efficiency was assumed to be 100 percent for the estimates of aquifer yields. Also, 100 percent of the ground-water discharge from the aquifer is not captured by pumping; rather, only a fraction of the ground-water discharge may be captured by wells.

Estimates of aquifer yields listed in table 2 were based on the assumption that water is derived only from three sources--intercepted ground-water discharge, induced infiltration, and storage. However, other sources of water can increase actual yields, and these sources may be important in some areas of the basin. Four additional sources of water are: (1) ground-water discharge from the aquifer across sub-basin boundaries as underflow, which could be captured by pumping prior to discharging; (2) water conserved by lowering the water table, which reduces evapotranspiration of ground water; (3) return flow from wastewater discharge; and (4) water available from storage during conditions when streamflow is not available for induced infiltration.

Underflow was not considered as a source of water for the yield estimates because the hydrogeologic characteristics of the northern half of the Taunton River basin are such that rates of underflow from adjacent subbasins probably are small compared to rates available from the three sources considered in this study. Water conserved by reduction of evapotranspiration and water captured as return flows from wastewater discharge may be important, but these sources were not added to the yield estimates because the extensive collection and analysis of the data required for such calculations were beyond the scope of this study. Nevertheless, future determinations of aquifer yields in small, highly developed areas might benefit from inclusion of that information. Water derived from storage during

Table 1.--*Aquifer yields only from storage from the 26 aquifers*

| Aquifer system and aquifer name | Aquifer yield, in cubic feet per second[1], for indicated pumping period, in days | | | |
|---|---|---|---|---|
| | Pumping period | | | |
| | 30 | 60 | 180 | 365 |
| Canoe River aquifer system | | | | |
| Upper Canoe River | 3.4 | 2.7 | 1.6 | 1.0 |
| Middle Canoe River | 10.1 | 9.2 | 7.2 | 5.7 |
| Mulberry Brook | 3.8 | 3.2 | 2.2 | 1.6 |
| Lower Canoe River | 15.0 | 13.7 | 10.5 | 8.3 |
| Hockomock River aquifer system | | | | |
| Upper Queset Brook | 3.4 | 2.8 | 1.8 | 1.2 |
| Lower Queset Brook | 3.9 | 3.3 | 2.2 | 1.5 |
| Upper Hocomock River | 4.6 | 4.1 | 3.0 | 2.2 |
| Rumford River aquifer system | | | | |
| Upper Rumford River | 5.7 | 5.0 | 3.5 | 2.6 |
| Middle Rumford River | 3.7 | 3.1 | 2.0 | 1.4 |
| Salisbury River aquifer system | | | | |
| Trout Brook | 7.1 | 5.6 | 3.4 | 2.2 |
| Salisbury Plain River in Brockton | 3.7 | 3.4 | 2.7 | 2.2 |
| Salisbury Plain River | 9.8 | 8.8 | 6.6 | 5.1 |
| Satucket River aquifer system | | | | |
| Upper Shumatuscacant River | 3.4 | 2.8 | 1.8 | 1.8 |
| Lower Shumatuscacant River | 4.6 | 3.6 | 2.3 | 1.5 |
| Satucket River | 3.0 | 2.7 | 2.1 | 1.7 |
| Wading River aquifer system | | | | |
| Upper Wading River | 3.6 | 2.7 | 1.6 | 1.1 |
| Aquifer north of Lake Mirimichi | 5.3 | 4.3 | 2.9 | 2.0 |
| Hawthorne Brook | 2.8 | 2.5 | 1.8 | 1.3 |
| Middle Wading River | 11.2 | 9.2 | 6.1 | 4.3 |
| Hodges Brook | 3.5 | 2.9 | 2.0 | 1.5 |
| Other aquifers | | | | |
| Carver Pond-South Brook | 10.7 | 9.4 | 6.9 | 5.3 |
| Little Cedar Swamp | 5.8 | 5.2 | 4.1 | 3.2 |
| Lower Matfield-Taunton River | 13.4 | 12.1 | 8.8 | 6.7 |
| Lower West Meadow Brook | 2.6 | 2.4 | 1.9 | 1.5 |
| Meadow Brook | 5.4 | 4.8 | 3.4 | 2.6 |
| Pine Swamp Brook | 9.0 | 8.0 | 6.0 | 4.6 |

[1] 1 ft$^3$/s = 0.646 Mgal/d.

Table 2.- *Aquifer yields available 90 percent of the time if minimum streamflow is maintained at 99.5-percent flow duration*

[All aquifer yields and pumping rates are given in cubic feet per second; the number to the left of the slash is the rate with no development of upstream aquifers; the number following the slash is the rate with full development of upstream aquifers]

| Aquifer system and aquifer name | Aquifer yield[1] | 1983 pumping rate[2] |
|---|---|---|
| Canoe River aquifer system | | |
| Upper Canoe River | 0.3 | 0.3 |
| Middle Canoe River | 2.8/2.4 | 3.9 |
| Mulberry Brook | 1.5 | .0 |
| Lower Canoe River | 11.3/6.0 | 1.9 |
| | | |
| Hockomock River aquifer system | | |
| Upper Queset Brook | .2 | 1.9 |
| Lower Queset Brook | .8/.6 | 1.1 |
| Upper Hockomock River | 3.2 | .5 |
| | | |
| Rumford River aquifer system | | |
| Upper Rumford River | .9 | 2.8 |
| Middle Rumford River | 2.6/1.4 | .0 |
| | | |
| Salisbury River aquifer system | | |
| Trout Brook | .4 | .6 |
| Salisbury Plain River | | |
| in Brockton | 1.8/1.2 | .2 |
| Salisbury Plain River | 3.2 | .8 |
| | | |
| Satucket River aquifer system | | |
| Upper Shumatuscacant River | .3 | .0 |
| Lower Shumatuscacant River | .5/.2 | .6 |
| Satucket River | 2.6 | .0 |
| | | |
| Wading River aquifer system | | |
| Upper Wading River | .4 | .2 |
| Aquifer north of Lake Mirimichi | .9 | .7 |
| Hawthorne Brook | .6 | .7 |
| Middle Wading River | 3.2/1.1 | 1.9 |
| Hodges Brook | .5 | .0 |
| | | |
| Other aquifers | | |
| Carver Pond-South Brook | .4 | .5 |
| Little Cedar Swamp | .8 | .0 |
| Lower Matfield-Taunton River | 11.9 | .8 |
| Lower West Meadow Brook | 2.5 | .0 |
| Meadow Brook | 1.0 | .0 |
| Pine Swamp Brook | .1 | .4 |

[1] Aquifer yield equaled or exceeded 90 percent of the time.
[2] Richard Thibedeau, Massachusetts Division of Water Resources, written commun., 1983.

pumping when no stream discharge is available for infiltration was not considered in the study because the areal extent and thickness of the 26 aquifers are small. Therefore, the additional water derived from storage probably would be small.

Four management options were selected to illustrate how estimates of aquifer yield could vary depending on maintained minimum streamflows. The four management options were: 1) aquifer yields available 70 percent of the time if minimum streamflow is maintained at the 99.5-percent flow duration; (2) aquifer yields available 70 percent of the time if minimum streamflow is maintained at the 95-percent flow duration; (3) aquifer yields available 90 percent of the time if minimum streamflow is maintained at the 99.5-percent flow duration; and (4) aquifer yields available 90 percent of the time if minimum streamflow is maintained at the 95-percent flow duration. Comparison of the estimated yields of the aquifers with the 1983 pumping rates indicates that the yields of most aquifers equal or exceed the 1983 pumping rates, under all selected flow conditions. However, several aquifers were pumped in 1983 at rates that exceed the estimated yields available under the two most restrictive management options (options 3 and 4 above). Therefore, under the two most restrictive management options, some percentage of the time these aquifers cannot yield water to wells at the 1983 pumping rate unless stream discharge decreases below the minimum flow conditions assumed for those two management options.

The aquifer yield estimates in tables 1 and 2 may be useful in (1) assessing the potential of an aquifer to sustain current and future withdrawals during normal and drought conditions, (2) planning and managing the regional development of the water resources for all uses in the basin, and (3) assessing the need for and effects of interbasin and intrabasin transfer of water.

## QUALITY OF GROUND WATER

Selected physical properties and concentrations of major chemical constituents in ground water from the stratified-drift aquifers at 80 sampling sites were used to characterize general water quality in aquifers throughout the basin. Results of the analyses are listed in table 3.

The pH of the ground water ranged from 5.4 to 7.0. At half of the sampling sites, pH was less than 6.0, and at 90 percent of the sites, pH was less than 6.5. As a result, this water is considered acidic and is capable of corroding pipes and plumbing fixtures.

Hardness of the ground water ranged from 9 to 97 mg/L (milligrams per liter as $CaCO_3$). At 86 percent of the sites, hardness was less than or equal to 60 mg/L, which classifies the ground water at these sites as soft (Durfor and Becker, 1964). No concentrations of sulfate or chloride that exceeded Massachusetts limits recommended for drinking water were found in the ground water (Massachusetts Department of Environmental Quality Engineering, 1982). However, concentrations of sodium in 19 samples exceeded the limit of 20 mg/L recommended by Massachusetts for drinking water for those individuals on a sodium-restricted diet (Massachusetts Department of Environmental Quality Engineering, 1982).

Natural elevated concentrations of iron and manganese in water in the stratified-drift aquifers are present locally in the basin. Natural concentrations of these two metals commonly exceed the limits of 0.3 mg/L for iron and 0.05 mg/L for manganese recommended for drinking water (U.S. Environmental Protection Agency, 1980). Twelve of the 80 samples analyzed for iron and 37 of the 80 samples analyzed for manganese had concentrations that exceeded the recommended limits.

Fifty-one analyses of selected trace metals in ground-water samples (arsenic, barium, cadmium, chromium, copper, cyanide, lead, mercury, selenium, silver, zinc, and nickel) from stratified-drift aquifers throughout the basin were used to characterize trace metal concentrations in the ground water. Of the 10 constituents sampled that have U.S. Environmental Protection Agency limits recommended for drinking water, only the lead concentration in water at one site ((60 $\mu$g/L) (micrograms per liter)) exceeded the recommended limit of 50 $\mu$g/L.

Analyses of selected organic compounds in water in the stratified-drift aquifers at 74 locations revealed that 13 of the samples contained one or more of the following compounds: chloroform; carbon tetrachloride; 1,1 dichloroethane; 1,2 trans-dichloroethylene; tetrachloroethylene; toluene; 1,1,1 trichloroethane; and trichloroethylene.

The U.S. Environmental Protection Agency has set maximum contaminant levels (MCLs) for community water systems for eight synthetic organic compounds (U.S. Environmental Protection Agency, 1985). These eight compounds and their MCLs are: trichloroethylene, 5 $\mu$g/L; carbon tetrachloride, 5 $\mu$g/L; vinyl chloride, 1 $\mu$g/L; 1,2-dichloroethane, 5 $\mu$g/L; benzene, 5 $\mu$g/L; 1,1-dichloroethylene, 7 $\mu$g/L; 1,1,1-trichloroethane, 200 $\mu$g/L; and p-dichlorobenzene, 750 $\mu$g/L. As noted above, three of these com-

Table 3.--*Statistical summary of selected chemical constituent data in ground water in stratified-drift aquifers*

[Data are in milligrams per liter except as indicated; dashes indicate not applicable]

| Constituents and properties | Number of analyses | Concentration | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Recom- mended limit[1] | Minimum value | Mean | Maximum value | Values in 50 percent of analyses are less than those shown | Values in 90 percent of analyses are less than those shown | Number of samples exceeding recom- mended limit |
| pH (units) | 79 | -- | 5.4 | -- | 7.0 | 6.0 | 6.5 | -- |
| Alkalinity (as CaCO₃) | 80 | -- | 4.0 | 16.5 | 41.0 | 14.5 | 27.0 | -- |
| Hardness (Ca + Mg as CaCO₃) | 77 | [2]-- | 9.0 | 37.3 | 97.0 | 34.5 | 69.2 | 0 |
| Calcium | 80 | -- | 1.6 | 10.0 | 25.0 | 9.1 | 17.0 | -- |
| Magnesium | 80 | -- | .9 | 3.1 | 21.0 | 2.3 | 5.9 | -- |
| Sodium | 80 | [3]20 | 2.0 | 15.7 | 54.0 | 11.3 | 30.0 | 19 |
| Potassium | 80 | -- | .3 | 1.4 | 8.6 | 1.0 | 2.3 | -- |
| Iron | 80 | .3 | .0 | .6 | 19.0 | .02 | .57 | 12 |
| Manganese | 80 | .05 | .0 | .2 | 2.1 | .02 | .62 | 37 |
| Sulfate | 80 | 250 | 2.0 | 16.7 | 44.0 | 14.9 | 33.0 | 0 |
| Chloride | 80 | 250 | 4.0 | 23.6 | 87.0 | 18.5 | 55.0 | 0 |
| Nitrate (as N) | 80 | 10 | .0 | 1.4 | 16.0 | .82 | 2.7 | 2 |
| Specific conductance (microsie- mens per centimeter at 25 °C) | 80 | -- | 38.0 | 161 | 410 | 142 | 280 | -- |

[1] Recommended limits for drinking water, U.S. Environmental Protection Agency (1975; 1977;1980).

[2] Soft water is commonly considered to have hardness concentrations between 0 and 60 mg/L (Durfor and Becker, 1964).

[3] Recommended limit for drinking water for those individuals on sodium-restricted diets (MDEQE, 1982).

pounds were detected. Trichloroethylene was detected in five samples. The concentration of trichloroethylene in one of these five samples exceeded the limit of 5 μg/L. A concentration of carbon tetrachloride of 0.8 μg/L was detected in one sample, which is below the MCL of 5 μg/L. Concentrations of 1,1,1 trichloroethane were detected in 10 samples, but none exceeded the MCL for that compound.

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