PREPARED IN COOPERATION WITH THE
U.S. ARMY CORPS OF ENGINEERS

AREAS OF GROUND-WATER FAVORABILITY

This hydrologic atlas represents a part of a comprehensive survey of the water and related land resources of the Connecticut River basin. The purpose of this report is to assess the ground-water potential of the basin and to delineate areas where that potential may be reckoned in terms of millions of gallons a day. Attention was confined to the unconsolidated formations because, with few exceptions, high-yield wells can be developed in the basin only from such formations. About 350 gpm (gallons per minute) per well or 0.5 mgd (million gallons per day) was considered a high yield for the purpose of this work.

The map shows areas of ground-water favorability based on potential yield. Area 1 shows the location of aquifers where large supplies of water (more than 0.5 mgd) can be developed from wells. Some of the aquifers represented in this area are ice-contact deposits—sandy to gravelly beds that were deposited by meltwater streams between valley walls and glacial ice occupying the axial portion of the valley. Other aquifers are valley-train deposits—coarse to fine sediments brought in by rapidly flowing streams after ice had completely melted out of the valley. Both ice-contact and valley-train deposits may be present in the same valley. In areas of subdued topography great thicknesses of the ice-contact deposits are saturated and yield large supplies of water to wells. The valley-train deposits in Area 1, which are generally in mountainous terrane, yield water readily because they are composed of coarse-grained material in the axial portion of the valleys.

Area 2 shows the location of aquifers, largely composed of ice-contact and valley-train deposits, where the potential yield per well generally is less than 0.5 mgd. In this area, ice-contact deposits lie high on the valley walls and may not yield water in large quantities because they do not extend much below the water table. Such high-lying deposits are characteristically present in valleys in mountainous terrane. The valley-train deposits in Area 2 are generally fine-grained and occur in broad open valleys, particularly in Massachusetts and Connecticut. In such areas ice lingered in the narrow, deepest part of the valley, and when it melted the space thus created was filled by deposits of less turbulent streams or by lake deposits. These fine-grained sediments are poor aquifers.

Area 3 shows the location of aquifers, composed largely of glacial till and bedrock, where the potential yield is very small. Development of ground-water supplies in this area is generally limited to stock and domestic usage.

The depth of the well and the depth to bedrock are shown in areas of unconsolidated formations where known and where such designations seem significant. Because the earlier drainage was unrelated to the modern drainage system, test drilling is necessary to determine the thickness of valley-fill deposits. South of Deerfield and west of Mount Toby in Massachusetts, the depth to bedrock is indicated as 529 and 398 feet below the surface, or 245 and 235 feet below sea level. These and other data show that the central lowland in Massachusetts and Connecticut was deeply channeled in preglacial time and that the drainage pattern then was quite different from the present one. Old channels of this type are important as potential aquifers in that some of them are filled in places with considerable thicknesses of coarse-grained, water-bearing material.

The thickness of the sandy to gravelly fill is important in that, the thicker the fill the more water there is in underground storage. Thus a wide, deep valley filled with unconsolidated sediments might easily contain enough water in storage to supply several high-yield wells during long periods of drought. The amount of stored water available is determined not only by the total volume of saturated sediments but by the amount of water that will drain from them when water levels are lowered by pumping, which is the specific yield. The specific yield may be as high as 25 percent of the total volume of the sediment.

The amount of water that can be developed depends also upon the amount of recharge to the aquifer. Recharge may be derived directly from streamflow. Where no streams or rivers flow through a valley, the recharge is essentially that derived from local precipitation. In a sand or gravel filled valley in Area 1, the recharge from precipitation is calculated to average about 1 mgd per square mile. Recharge that may be available to such sediments in a valley bottom by underflow from adjacent bedrock areas is believed to be much less. Where a narrow valley filled with highly permeable fill receives only local recharge, high-yield wells may be constructed but continuous pumping of several such wells there could not be sustained.

The volume of valley fill, and hence the volume of available stored water, is important in maintaining yields during periods of little or no recharge to an area. In some years recharge is very deficient and in other years it may be excessive. If only minimum storage were available, pumping at any time would be limited to the recharge that occurred in the preceding days or few weeks and, quite commonly, much less than the average recharge could be pumped. However, if ample storage were available, pumping at the average recharge rate could continue for many months. Wells would draw upon stored water in the periods of deficient rainfall and the loss of stored water in such a period would be made up subsequently in periods of high rainfall.

Where the favorable deposits that are indicated on the map lie in the valleys of large streams or rivers, or in abandoned glacial meltwater channels crossed by large streams, the amount of recharge available to the sediments is much greater than merely recharge from local precipitation. Heavy pumping adjacent to these watercourses may induce infiltration of water from the stream or river to the aquifer. The well water discharged may then be, in part, naturally filtered surface water. (In some places water from large lakes may be drawn into heavily pumped wells.) The total amount of water that can be developed from wells recharged by adjacent streams cannot be estimated with any degree of certainty without detailed local tests. Infiltration from streams is dependent upon several factors: the makeup of the valley-fill sediments, the degree of clogging of the riverbed sediments that may have taken place, and other conditions. There is also the largely economic question of how closely wells can be spaced without unduly influencing each other. However, it is belived that heavy pumpage in many places adjacent to a large perennial watercourse will induce recharge from that source, and that conditions are favorable for the development of large supplies of underground water. In some such areas along the lower courses of the large tributaries to the Connecticut River, and in some places along the Connecticut itself, it seems probable that large quantities of water could be developed from wells, perhaps as much as tens of millions of gallons a day.

Most of Area 1 is underlain by deposits laid down in the paths of meltwater streams during the waning stages of ice dissipation. Characteristically the deposits were formed by a long series of cut-and-fill actions and are notably erratic in their distribution. Hence, in any one of the valley-fill areas indicated as favorable on the map, a well may penetrate anything from fine sand or silt to clean coarse gravel. Where cut-and-fill action has been incomplete, till ("hardpan") may be present on one side of the valley at shallow depth and permeable water-bearing beds on the other side of the valley. Therefore, test drilling will be necessary in all the areas designated as favorable in order to determine the optimum thickness of section and the location of the coarsest sediments. In most instances test drilling should be done by the cable-tool method to assure that the complete section of unconsolidated sediments is explored and to obtain the accurate samples necessary for optimum production-well planning and construction.

Area 2 on the map indicates locations that are less favorable or are unfavorable for the development of ground-water supplies. In the Eastern Highlands of Connecticut and Massachusetts this pattern commonly delineates locations of very short-lived or subordinate meltwater channels in which the fill is shallow, narrow, and perhaps poorly sorted. In the Western Highlands of Connecticut and Massachusetts, narrow fringing terraces along some large streams are included although little is known of their thickness. Some of these deposits may extend to a great enough depth to be recharged from the adjacent river, in which case they could be developed as aquifers. Other deposits of this type may bottom out at shallow depth and be capable of yielding only very small quantities of water. Isolated patches of unconsolidated sediment in the Western Highlands are included in Area 2 where recharge potential is believed to be poor or are included in Area 1 where either storage or recharge potential is favorable.

In parts of the central Connecticut River Valley, Area 2 represents a cover of clays and silts that was deposited in a late glacial lake that extended from Middletown, Connecticut to North Stratford, Vermont. At the lake's highest stage, fine-grained sediments were deposited some miles up some of the major tributaries of the Connecticut River, the Passumpsic and White Rivers of Vermont being the most notable examples. However, drainage down and out of the Connecticut Valley had been established before the lake stage, and coarse deposits had been laid down in water courses between the lingering ice masses and the valley walls. Upon formation of the lake, these deposits were inundated by the lake waters and covered over with clays and silts that are exposed at the surface. In some places these hidden permeable deposits have yielded large quantities of water to wells even though the surficial sediments are impermeable (Wells River and Windsor, Vermont). It is most likely that there are other permeable deposits beneath the lake clays and silts that have not yet been discovered and that certain areas designated as unfavorable may be underlain by highly permeable deposits. In an area near Agawam and South Hadley, Massachusetts, (indicated by the line pattern) coarse-grained materials deposited by large meltwater rivers (deltas) are known to be present at depth. West of Amherst however permeable deposits tapped by wells beneath the cover of clay beds and at some distance from the submountainous highlands appear to be shoe-string sands.

Some localities in low-lying submountainous terrane, as in the area south of Quabbin Reservoir in Massachusetts, are unfavorable for ground-water development because they are underlain by fine sands. These sands are probably valley train deposits laid down by streams during a late stage of glaciation rather than lake deposits.

North of Nulhegan River in Vermont, east of Winchendon and Gardner in Massachusetts, and north of Burlington in Connecticut deposits generally consist of a widely distributed thin cover of glacio-fluvial sediments. In some instances these areas may have been crossed by streams that eroded definite channels and deposited coarse sediments from which moderate yields of water could be obtained by wells. However, unless such channels can be discovered, the areas should be regarded as unfavorable.

SELECTED REFERENCES

Baker, J. A., Lang, S. M., and Thomas, M. P., 1965, Geology and hydrology of the Hartford Research Center CANEL site, Middletown, Connecticut: U.S. Geol. Survey Bull. 1133-G, 42 p.

Cushman, Robert V., 1964, Ground water resources of north central Connecticut: U.S. Geol. Survey WSP 1752, 96 p.

Cushman, R. V., Baker, John A., and Meikle, R. L., 1964, Records and logs of selected wells and test borings and chemical analyses of water in north central Connecticut: Conn. Water Resources Bull. No. 4, 27 p.

LaSala, Jr., A. M., 1964, Geology and ground-water resources of the Bristol-Plainville-Southington area, Connecticut: U.S. Geol. Survey WSP 5178, 70 p.

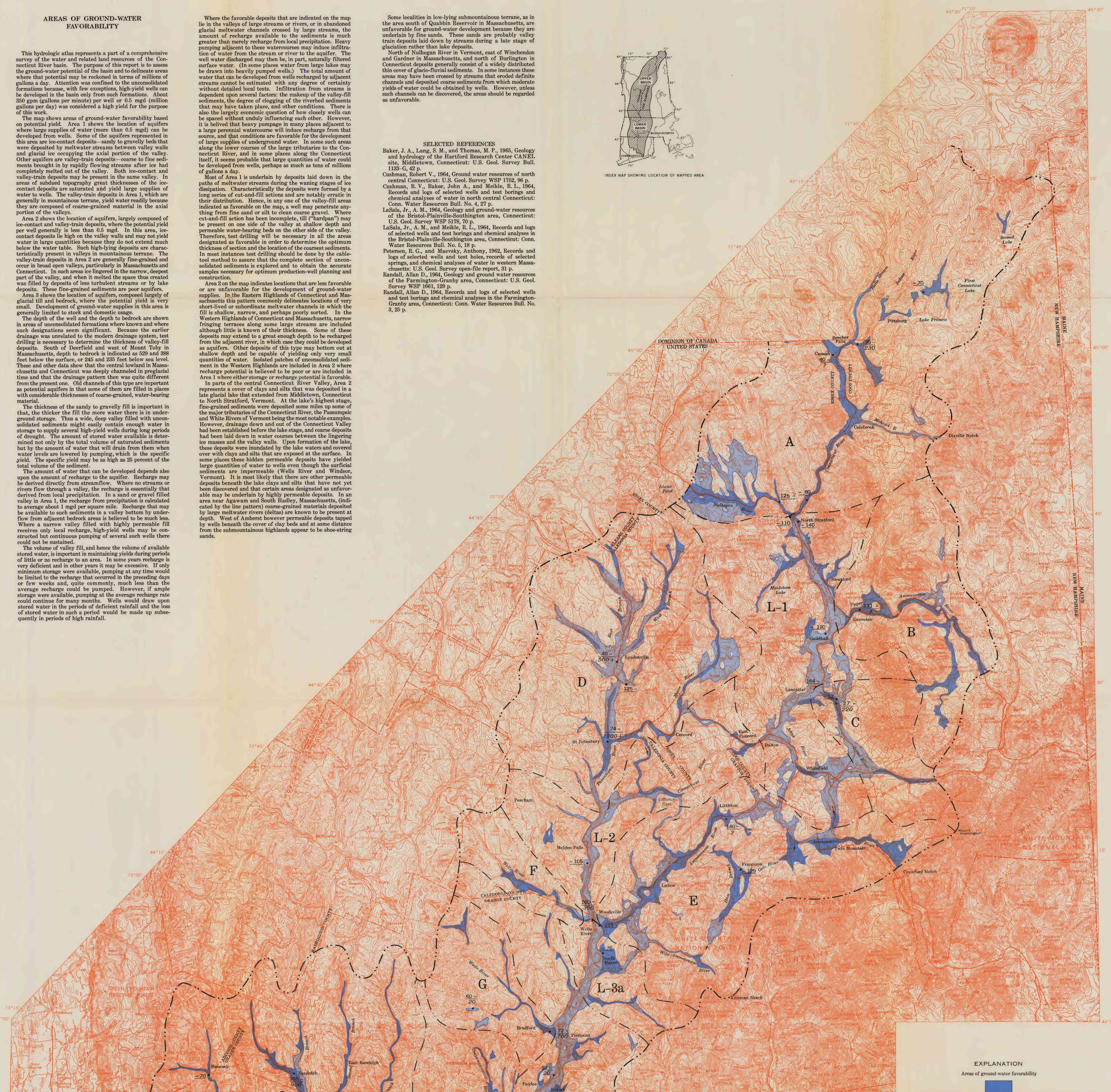
LaSala, Jr., A. M., and Meikle, R. L., 1964, Records and logs of selected wells and test borings and chemical analyses in the Bristol-Plainville-Southington area, Connecticut: Conn. Water Resources Bull. No. 5, 18 p.

Petersen, R. G., and Maevsky, Anthony, 1962, Records and logs of selected wells and test holes, records of selected springs, and chemical analyses of water in western Massachusetts: U.S. Geol. Survey open-file report, 31 p.

Randall, Allan D., 1964, Geology and ground water resources of the Farmington-Granby area, Connecticut: U.S. Geol. Survey WSP 1661, 129 p.

Randall, Allan D., 1964, Records and logs of selected wells and test borings and chemical analyses in the Farmington-Granby area, Connecticut: Conn. Water Resources Bull. No. 3, 25 p.

INDEX MAP SHOWING LOCATION OF MAPPED AREA



MAP OF THE UPPER BASIN

GROUND-WATER FAVORABILITY OF THE CONNECTICUT RIVER BASIN, NEW ENGLAND STATES

By
D. J. Cederstrom and Arthur L. Hodges, Jr.
1967

For sale by U.S. Geological Survey, price $1.25 per set