PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF MASSACHUSETTS
WATER RESOURCES COMMISSION
AND BERKSHIRE COUNTY

GEOLOGY AND GROUND WATER

MAP SHOWING GENERALIZED EXTENT OF STRATIFIED SURFICIAL DEPOSITS AND AREAS MOST FAVORABLE FOR THE DEVELOPMENT OF GROUND-WATER SUPPLIES

GEOLOGY AND GROUND WATER

The geologic units included in this report are separated into two broad categories; they are: (1) surficial deposits, and (2) bedrock. The surficial deposits, excluding swamps and Recent alluvium, are glacial in origin. The bedrock is largely paleomarine and igneous in origin.

The surficial deposits (surficial geologic and ground-water-availability map) are composed of rock particles ranging in size from clay to boulders. They are classified, according to mode of deposition, as stratified deposits (glaciofluvial and glaciolacustrine) and nonstratified (till) deposits.

Bedrock in the basin consists of sandstone, limestone, and dolomite; and marble, quartzite, schist, and gneiss (bedrock geologic map). These rocks have been deformed by tilting, folding, and faulting to such a degree during various periods of geologic history that their overall formation attitudes can be determined only by detailed geologic mapping. The deformational processes have caused parting along joints and fractures which now constitute the major water-bearing openings in the rocks.

HYDROLOGY

In order to evaluate an aquifer for a possible large-scale water supply, it is necessary to determine its hydraulic characteristics. These may be found by field pumping tests. Data collected from these tests are used to compute transmissibility (T) and storage coefficient (S) values that, in turn, may be used to predict practical aquifer performance.

A pumping test was made in the aquifer underlying the valley of Town Brook in Lanesborough, about half a mile northeast of Pontoosuc Lake. Figure 1 is an arithmetic graph of the drawdown and recovery curves of the water levels in the observation wells during the test. The rise in the trend measurements made in observation wells 2 and 5 the night before the start of the test was due to a torrential rainfall that ended that evening.

Values for T and S were determined from the data gained from the pumping test. An average T value of 65,000 gpd per ft and an S value of 0.0004 were used to compute theoretical curves for the relation of drawdown to distance for a constant well discharge of 500 gpm (figure 2).

In practical application, the curves may be used to predict well interference. That is, should another well be placed in the same aquifer 2,600 ft away from a well pumping 500 gpm, the drawdown in the one well caused by pumping in the other would be about 1.8 ft after one day, 3.8 ft after 10 days, and 5.8 ft after 100 days of pumping in the interfering well. Because the drawdowns caused by interference are additive, this means that if the drawdown in one well caused by its own pumping was 10 ft, then the total drawdown in that well would be about 15.8 ft, due to the interference caused by continuously pumping the well which is 2,600 ft away for 100 days. Similarly, the drawdown at the midpoint (1,300 ft) of the above two wells after both were pumped at 500 gpm continuously for 100 days would be about 14 ft (2 times 7 ft, on the graph).

Boundary conditions were not considered in the predicted drawdown graph shown in figure 2; both recharge and discharge boundaries may be expected if pumping is continued for long periods.

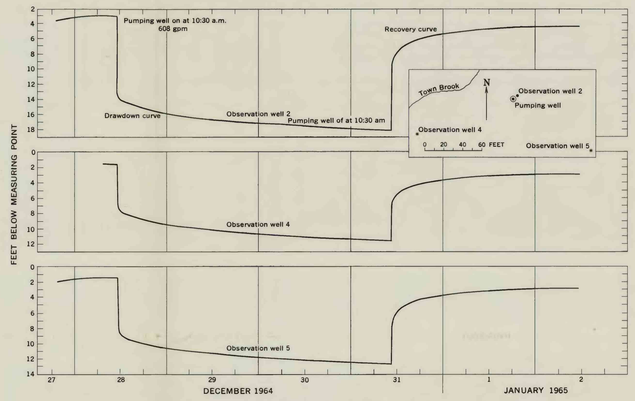


FIGURE 1.—*Hydrographs showing water levels in wells 2, 4, and 5 during Lanesborough pumping test*

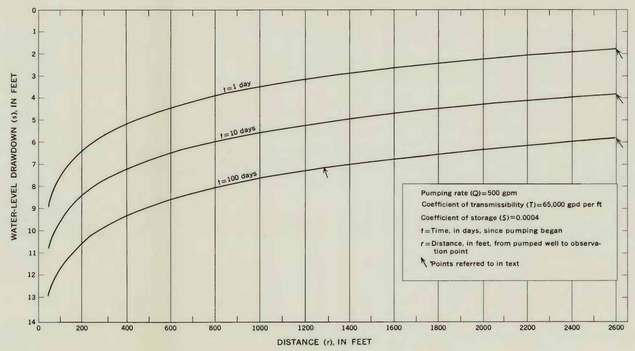


FIGURE 2.—*Drawdown versus distance graph in the aquifer underlying the Town Brook Valley at Lanesborough*

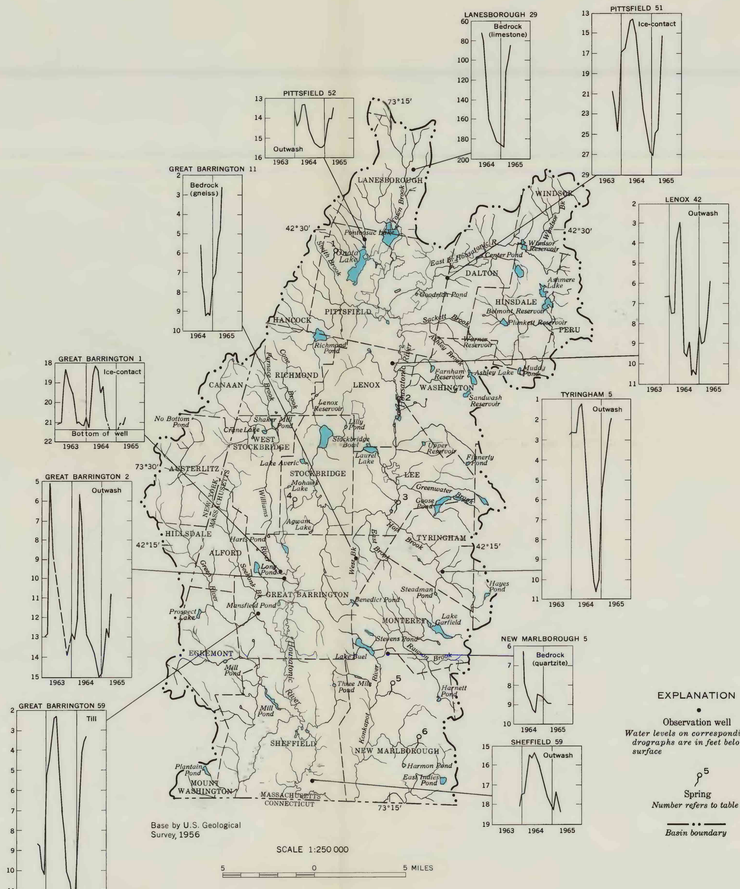
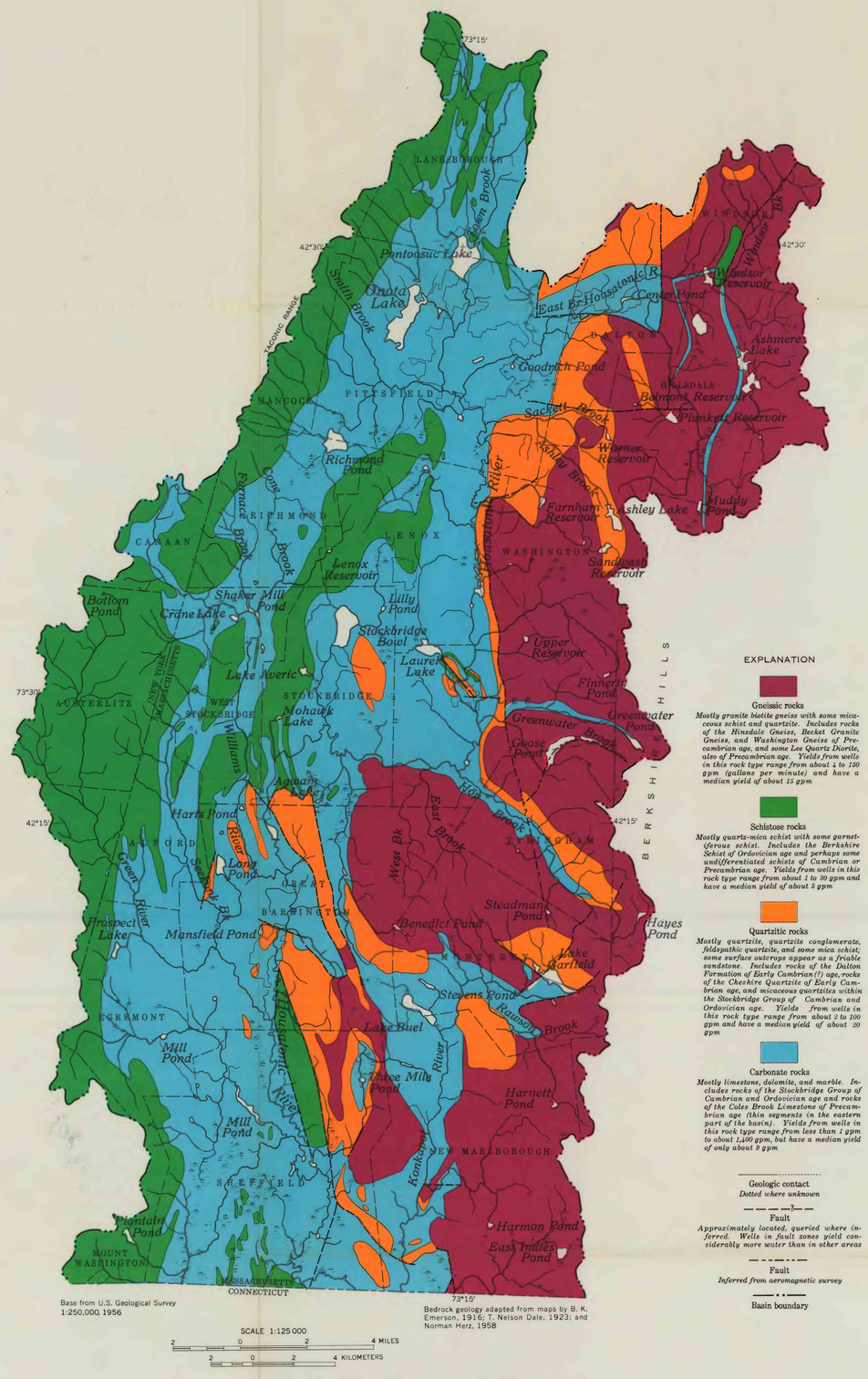


FIGURE 3.—*Map showing locations and hydrographs of observation wells and locations of springs*



MAP SHOWING GENERALIZED BEDROCK GEOLOGY

AVAILABILITY OF GROUND WATER

Although the total amount of water stored in natural subsurface reservoirs is many times greater than that stored in both natural and man-made surface reservoirs, only 1.2 percent of all the water supplied by municipalities in the basin comes from wells.

SURFICIAL DEPOSITS

In addition to showing the extent of stratified surficial deposits, the surficial geologic and ground-water-availability map shows the general areas most favorable for finding ground water. A larger scale, more detailed ground-water-favorability map of the area is available in a report by Norvitch (1966).

Numerous test holes and test pumpings sometimes are required to find places where the surficial stratified deposits are well sorted and coarse enough to yield sufficient volumes of water for municipal and industrial supplies. Because of the variability of grain sizes in these deposits, sufficient testing is imperative. Insufficient testing might easily cause a suitable aquifer to be disregarded as a source for supply.

A summary appraisal of water-bearing properties of the valley fill deposits (mostly glaciofluvial and glaciolacustrine) in the basin, indicates that sediment grains in the tributary valleys generally are coarser than sediment grains in the trunk stream (Housatonic River) valley. The coarseness of the grains in a few areas, particularly south of Woods Pond in Lee, are exceptions to this appraisal.

The valley of the Williams River, beginning at Shaker Mill Pond in West Stockbridge is largely filled with silt and clay, a poor water-yielding combination.

The valley of the Green River, beginning at North Egremont and ending somewhere east of the Great Barrington airport, is filled with poorly to well-sorted sand and gravel composed largely of schistose grains. The schist tends to break down into small platy fragments and very fine grains which pack between the coarser grains, thereby reducing the permeability of the deposit. However, well-sorted coarse zones do occur making this a likely place to test drill for ground water. The deposit thins rapidly near the sides of the valley, so the center part near the stream may be the best place to drill.

The valley deposits of Secum and Daniels Brooks, north of Onota Lake also contain large percentages of schistose and platy grains which may be tightly packed. However, an auger boring near Old Ore Bed Road in Lanesborough penetrated about 60 feet of sand and gravel before being stopped by difficult drilling, and a gravel face in the ice-contact deposit just north of Hancock Road in Pittsfield shows some well-sorted coarse gravel zones. If these zones continue in the subsurface, below the water table, they might yield large volumes of water to wells. Base-flow measurements also favor both of these places for ground-water exploration.

The valley of Town Brook in Lanesborough contains at least 150 feet of stratified deposits in places. The Town of Lanesborough has two producing wells in these sediments.

The valley deposits of Unkamet Brook north of Coltsville contain at least 98 feet of stratified sediments in places. A well, 52 feet deep, in the northern part of this valley, reportedly supplies half a million gallons of water a day. An auger hole drilled in these sediments near the basin boundary indicated alternating layers of fine and coarse grains, with the fine grains predominating. A gravel-packed well here may be made to connect all the coarse layers in any one section, thereby obtaining a large water yield from the layered sediments.

The East Branch of the Housatonic River and Waconah Falls Brook join in Dalton in a broad flat valley. The ice-contact deposits in the northwest part of the valley are fine sand to coarse gravel, composed largely of quartzitic and schistose grains. Wells completed in the sand and gravel supply sufficient amounts of water to operate a large aggregate washing plant here. An auger test hole at the Department of Public Works garage on Orchard Street in Dalton penetrated about 115 feet of sediment before reaching refusal; the test hole log shows about 70 feet of very fine sand over alternating layers of fine sand and coarse sand below the water table, which was about 13 feet below land surface. Where Waconah Falls Brook flows out of the hills onto the broad flat there is an area geologically suitable for deposition of coarser sediments than predominate in the remainder of the eastern part of the valley. The bedrock rises close to the land surface and crops out west of Center Pond and along the banks of the river, therefore, seismic profiles in conjunction with test drilling might save time and money when exploring for ground water in this valley.

Information is lacking on the depth and texture of the valley fill deposits of the East Branch Housatonic River south of Hinsdale town proper. The ice-contact deposits near the basin boundary on the south are sorted and stratified. If these deposits continue in the subsurface, large quantities of water would be available to wells.

The extensive ice-contact deposit along the eastern border of Pittsfield is extremely variable in composition; however, silt and fine sand seem to predominate in the subsurface. Auger holes drilled in the northern part near Barton Brook encountered some coarse layers at depth but their water-bearing potential was not determined. There may be local places where large volumes of water may be available to properly developed wells.

The ice-contact deposit just south of Woods Pond in the Town of Lee is also variable in composition; however, two drilled wells near the pond each supply more than a million gallons of water a day. Many test holes were required to select these sites. Like most of the stratified deposits in the basin, coarse sand and gravel layers here may grade laterally and vertically into finer sediments in very short distances, thus reducing the water-bearing potential. This is an extensive deposit, however, and the central part of it has not been fully explored for water. The southern end of this deposit appears to be mostly fine sand in the subsurface.

The valley of Green Water Brook in East Lee, although narrow, may be a good source of ground water. An auger hole drilled in the flat valley bottom east of the Massachusetts Turnpike overpass on Highway 20 penetrated 64 feet of sand and gravel before having to stop because of hard drilling. Base-flow measurements also are favorable in this area.

Auger holes were drilled in the Tyringham Valley near the confluence of Hop Brook and the Housatonic River, near Breakneck Road, and near the Tyringham-Monterey Road. The sediments were fine and not suitable to supply water to high-capacity drilled wells.

Some of the largest sand and gravel deposits in the basin occur just east and northeast of Monument Mountain in Great Barrington and Stockbridge. They are sorted and stratified and contain large percentages of carbonate rock. Little is known as to the depth of these deposits below the water table. If they continue in the subsurface, they should provide large volumes of water to wells.

Little is known about the texture and depths of the sediments in the Konkapot River Valley. Massachusetts Department of Public Works bridge borings show alternating layers of sand and gravel to depths of 29 feet. The ice-contact deposit just east of Hartsville is located geologically in a favorable place for deposition of coarse sand and gravel. Base-flow measurements also show this valley to be favorable for ground-water exploration.

Sediments in the trunk stream valley are composed largely of silt and sand. Auger holes drilled in Pittsfield penetrated remarkably uniform silt and fine sand to a depth of 122 feet. An auger hole drilled near the river at Stockbridge penetrated gray silt until stopped at a depth of 112 feet. Near the river in Great Barrington and Sheffield, the fine sediments were also found to predominate. The sediments will not supply usable quantities of water to drilled wells. However, the subsurface texture of the valley fill deposits (here) is unknown. Locally, it may be possible to encounter sediments coarse enough to supply usable quantities of water to drilled wells. For instance, a well providing water for the Town of Sheffield penetrated 242 feet of silt and fine sand before being completed in 8 feet of coarse sand. The well yields 150 gpm.

WATER-LEVEL FLUCTUATIONS

Ground-water levels are not stable; they display short-term, seasonal, and long-term fluctuations. Short-term fluctuations are of little significance to the water user unless they are caused by pumping, in which case, he should be aware of the effects of pumping as explained previously. Seasonal fluctuations are important because they may influence the depth a pump is set, or they may even influence the depth a well is completed, especially a shallow dug well. Seasonal fluctuations are caused by changes in rates of ground-water recharge and discharge during the year. Long-term fluctuations are due to temperature and precipitation cycles that occur over a number of years. This study was made during a prolonged drought period and many of the water levels recorded herein might be considered as record lows.

Figure 3 shows the yearly highs and lows that occurred in 11 observation wells measured during this study. The maximum water-level fluctuation during this period, in any one aquifer, was 13.89 feet, with the exception of 113.95 feet in Lanesborough 29 (see figure 3). The fluctuations in this well should not be considered normal water-level fluctuations in a bedrock aquifer; however, they present a possible extreme for this area.

All high water levels in the spring of 1965 were lower than their former levels in the spring of 1964. This condition was caused by below normal winter and early spring precipitation. During periods of normal precipitation water levels in aquifers will peak at about the same level every spring.

All the hydrographs on figure 3 show nearly the same trend. Water levels generally reach a peak in the early spring due to recharge from melting snow and frost, before vegetation begins to flourish. They begin to decline in the late spring due to an increase in evapotranspiration, and they continue to decline until the late fall when evapotranspiration essentially ceases. At this time they either level out or begin a gradual climb, depending on local and climatic conditions, until spring recharge again takes effect to complete the cycle.

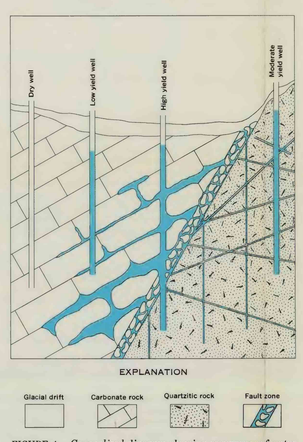


FIGURE 4.—*Generalized diagram showing occurrence of water in bedrock adjacent to a fault zone*

BEDROCK AQUIFERS

The areal extent and ground-water yields of the four major types of bedrock in the basin are shown on the bedrock geologic map. They all contain ground water in secondary openings, such as fractures, joints, and solution cavities, within the rock formations. The volume and rate at which they will yield water to wells is dependent upon the size and interconnection of these openings.

Figure 4 shows the occurrence of ground water in bedrock and why some wells produce and others do not. The figure also shows the significance of a fault adjacent to carbonate rock. The crushed rock zone along the fault provides an easy access for percolating ground water to move into secondary openings in the rock and cause larger solution openings. It is not possible to predict the location of buried solution complexes in carbonate rock, however, likely places would be near faults and geologic contacts.

SPRINGS

Springs are a water source to many individual homes and some towns in the basin. They largely occur on the flanks of bedrock hills, generally near the base. During years of normal precipitation they are a perennial water source; however, because of the prolonged drought (beginning 1961) some springs barely flowed or ceased to flow during the summer and fall of 1964, for the first time in memory.

Springs rise where ground water, under hydrostatic pressure, in the bedrock aquifers makes its way through fissures or solution openings in the rocks, either laterally or upward, to the land surface. Springs also can flow from unconsolidated deposits. This occurs generally where an impervious layer (clay, for example) impedes the downward percolation of ground water and carries it laterally to where it flows out of the ground from the side or bottom of a hill.

The volume of spring flow is dependent upon the head in its aquifer source. The flow is at a maximum in the spring (season) when water levels are high, and at a minimum in late summer when water levels are low. Table 1 shows the variance in seasonal flow for six selected springs in the basin. They are located on figure 3. Again, because of the drought, these may represent all time record low flows. As the data show, in some places the difference between the fall and spring (season) flows are appreciable.

TABLE 1.—*Selected spring flows for fall (1964) and spring (1965)*

Location		Date	Flow (gpm)	Temp. (°F)
No.	Town			
1	Pittsfield	11-13-64	39.9	—
		5- 5-65	552	44.5
2	Lee	11-13-64	15.0	46
		5- 5-65	34.5	45
3	do.	11-13-64	9.87	47
		5- 4-65	31.0	46.5
4	Stockbridge	11-13-64	6.3	48
		5- 5-65	6.7	47
5	New Marlborough	11-12-64	1.4	49
		5- 4-65	32.2	46
6	do.	11-12-64	1.2	46
		5- 4-65	3.6	47

HYDROLOGY AND WATER RESOURCES OF THE HOUSATONIC RIVER BASIN, MASSACHUSETTS

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