GROUND-WATER AVAILABILITY IN THE WHITE RIVER JUNCTION AREA, VERMONT

BY

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A RURAL COMPREHENSIVE WATER AND SEWER PLAN FOR WINDSOR COUNTY, VERMONT

BY

VERMONT DEPARTMENT OF WATER RESOURCES

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1972

GROUND-WATER AVAILABILITY

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ERRATA

Page 3 Line 13 - "8-inch well" is NRW 36*.

Line 14 - "2½-inch wash-bore hole" is NRW 37.

Page 7 Line 11 - "auger borings" are NRA 6, NRW 33 to NRW 35, other borings not scheduled.

Line 14 - "8-inch test hole" is NRW 38.

Page 8 ---- Chemical analysis is for well NRW 36

Page 11 Line 2 - "auger borings" are NRA 1, NRA 2, and NRW 32.

Line 12 - "auger borings" are NRA 3 to NRA 5.

Third line from bottom - the "boring" cited is HFA 2.

Page 14 Line 7 - "wash boring" cited is HFA 22.

Fourth line from bottom - "auger borings" are HFW 92 to HFW 95.

Page 14 Second line from bottom - "8-inch test hole" is HFW 60.

Page 16 Last line - delete "is well"
insert "equals"

Page 17 ----- Chemical analysis is for well HFW 60.

Iron delete ".1"
insert ".01"

Manganese - delete ".5"
insert ".05"

Page 18 Line 1 - delete "above"

Line 3 - delete "would"
insert "may"

Line 13 - "auger boring" cited is HFA 9.

* Local well and boring numbers used by the U. S. Geological Survey

Page 18 Second line from bottom - "auger holes" are HLA 29 to HLA 33.

Page 21 Line 6 - "auger holes" are HLW 58 to HLW 60.

Line 8 - "8-inch test hole is HLW 57.

Page 23 Last Line - "auger boring" cited is HLA 24.

Page 24 ---- Chemical analysis is for well HLW 57.

Page 27 Insert "Lockwood, Kessler and Bartlett, Inc., 1971, Seismic refraction profiling White River Junction area, Vermont, 28 p.

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GROUND-WATER AVAILABILITY IN THE WHITE RIVER JUNCTION AREA, VERMONT

by

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INTRODUCTION

A study of the ground-water resources of the White River Junction area, Windsor County, Vermont, was begun in 1969 as part of a cooperative program between the Vermont Department of Water Resources and the U.S. Geological Survey. The purpose of the study was to provide technical appraisal of potential sources of water to meet the expanded needs of many towns in Windsor County, as pointed out by the Rural Comprehensive Water and Sewer Plan (Vermont Department of Water Resources, 1969). Funding was made available by the U.S. Department of Agriculture, Farmers Home Administration, for water-resources exploration, including the testing of the quantity and quality of the water in sand and gravel aquifers. The geology was mapped, and private and municipal water supplies were inventoried in 1969.

GEOLOGY

The White River Junction area lies wholly within the drainage basin of the Connecticut River. Major tributaries include the White and Ottauquechee Rivers and Lulls Brook. Much of the area is unsuitable for

development of large supplies of ground water because it is underlain by silt and clay or bedrock at shallow depth. However, saturated sand and gravel at several places in the valleys is more than 90 feet thick and has potential for the development of high-capacity wells. Uplands between the river valleys are underlain by bedrock that is covered by a wariable thickness of glacial till. Most wells finished in bedrock and till yield small amounts of water, and the uplands where this material is exposed, are generally unfavorable for the development of high-capacity wells. For this reason, exploration was limited to those segments of the valleys in which thick deposits of water-bearing sand and gravel are known to occur (Hodges, 1968).

EXPLORATION METHODS

Test work was carried out in three phases. The first was seismic refraction profiling at several locations to determine the shape, thickness, location, and type of materials below the surface of the land. The second phase was subsurface sampling with auger and wash borings to determine the permeability of the subsurface materials. Observation wells, 1½ inches in diameter, were installed in auger or wash-bore holes at four locations that were found to have potential for development as municipal water supplies. These small-diameter wells served as observation wells during the third phase of the program, during which an 8-inch well was constructed at each of the four locations and the aquifer tested. The four test wells, finished with wire-wrapped screen, were pumped until the pumped water was virtually sand-free, assuring good well efficiency during testing. After

the wells were developed, three of the wells were pumped for 48 hours, and drawdown and recovery were measured in the pumping well and at least one observation well.

TEST SITES AND AQUIFER TESTS

Test work was carried out at 11 sites (fig. 1) within the White River Junction area.

Site 1

Town of Norwich on the properties of A.B. Farrell and D.S. Loveland adjacent to the Connecticut River. This site is on the axis of an esker (Lyons, 1958) that extends several miles northeast on the Vermont side of the Connecticut River. South of the test site, the esker crosses the river to New Hampshire. The width of the esker was not determined by seismic profiling or test drilling, but it is estimated to be at least 500 feet wide. An 8-inch well penetrated the 136 feet of sand and gravel and stopped at that depth only because of drill-rig limitations. A 2½ inch wash-bore hole 100 feet north of the 8-inch well penetrated an additional 10 feet of sand and gravel before ending at 156 feet in glacial till. The static water level in both holes was about 50 feet below land surface. A recording gage installed temporarily on the 8-inch well indicated that water levels at the test site are affected by changes in stage of the Connecticut River, indicating hydraulic connection between the aquifer and the river. It is, then, reasonable to assume that continuous pumping from this site would induce infiltration from the river.

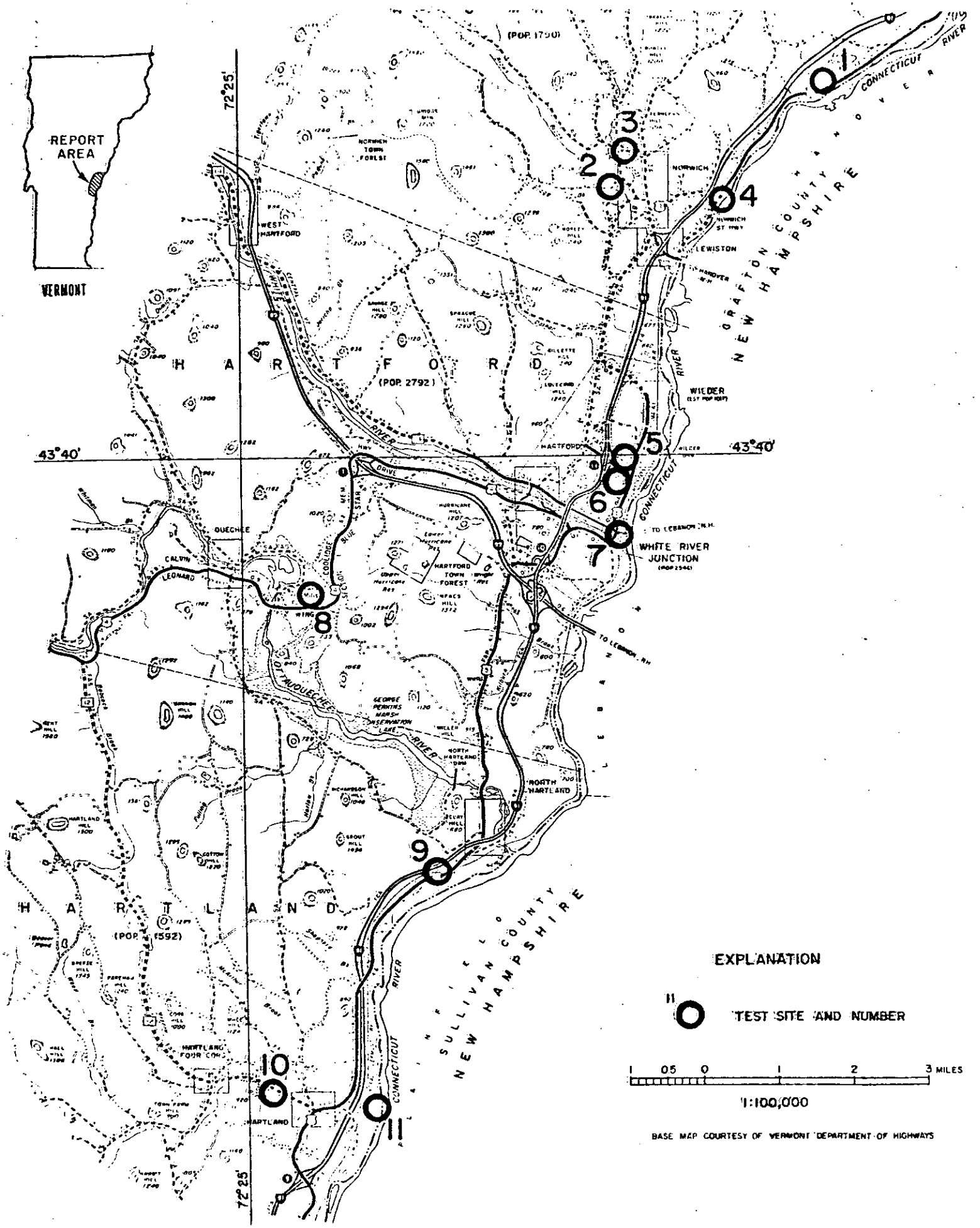

FIGURE 1 WHITE RIVER JUNCTION REPORT AREA AND TEST SITES

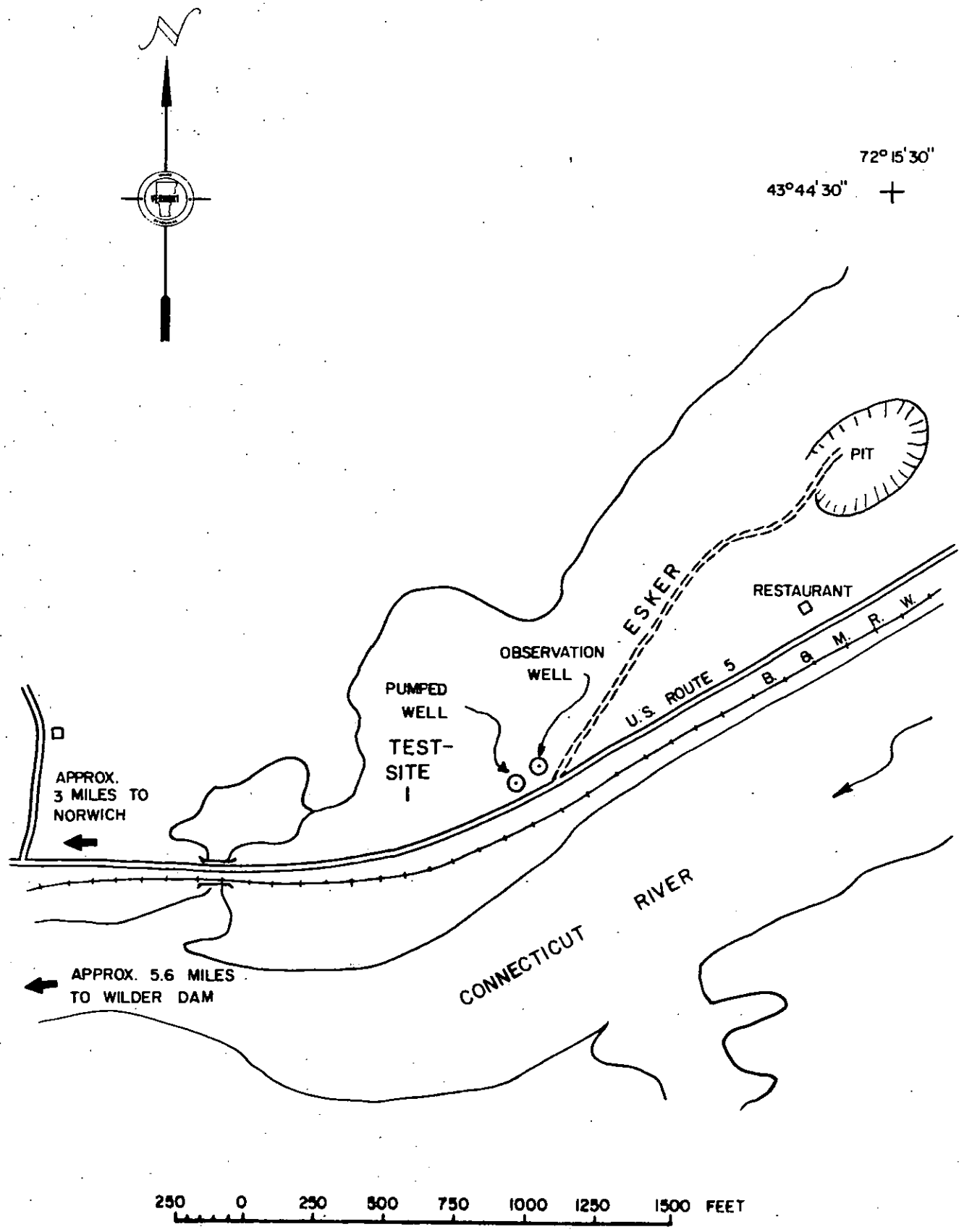

FIGURE 2 TEST-SITE 1

The pumping rate during aquifer testing was held constant at 614 gpm (gallons per minute) for 48 hours. During this time the water level in the pumping well declined from 53.0 feet to 62.5 feet below land surface, indicating a specific capacity of 64 gpm per foot of drawdown. Maximum drawdown in an observation well 100 feet north of the pumping well during testing was 0.67 foot.

Estimates of Available Water at Site 1

Water levels in the Connecticut River adjacent to the Norwich test site are affected by operations at the Wilder Power Station 5 miles downstream. Static level in the test well fluctuated as much as 0.35 foot as a result of water impoundment and subsequent release, making data from the pumping test difficult to analyze. However, some generalizations can be made from the test. Drawdown in both the pumping well and the observation well continued for 18 hours after the pump was started. After this length of time, ground water levels rose and fell in response to changes in the level of the Connecticut River. The saturated thickness of the aquifer at the test site is about 100 feet. A properly designed and constructed water well in this formation should produce about 3,000 gpm with 50 feet of drawdown, based on a specific capacity of 64 gpm per ft. Average discharge of the Connecticut River at the test site is about 4,900 cfs (cubic feet per second), and the minimum daily discharge of record is 162 cfs. If a production well at this site withdrew 3,000 gpm continuously and all recharge came from the Connecticit River, 0.13 percent of the average flow of the river and 4 percent of lowest flow of record would be diverted. Therefore,

the effects of a high-capacity well at this site on the Connecticut River would be negligible.

Analysis of a water sample taken during the pumping test is given in table 1. All chemical constituents were found to be well below limits recommended by the U.S. Public Health Service (1962) for a public water supply, and, therefore, the water should be usable without treatment other than chlorination.

Site 2

Norwich, near the confluence of Bragg Brook and Bloody Brook in a gravel pit owned by Truman Barrett.

Seven auger borings in the deltaic deposits of Bragg Brook penetrated from 19 to 65 feet of stratified material ranging in size from gravel to clay. Thickness of the deposits increased from west to east, as did the percentage of fine sand, silt, and clay. An 8-inch test hole screened in sand and gravel produced a maximum of 25 gpm with 19 feet of drawdown - a specific capacity of 1.3 gpm per ft. of drawdown. The test was discontinued after 2 hours of pumping because of the obviously low yield of the aquifer. Had the test been continued, specific capacity would probably have increased somewhat.

Site 3

Norwich seismic profile is perpendicular to Bloody Brook on property owned by the Norwich School District approximately 1,200 feet downstream from the mouth of the Charles Brown Brook. Seismic profiling indicated 55

Table 1.--Chemical analysis of water at site 1

Date: February 3, 1972 Previous pumping: 2 days

(All values, except pH, specific conductance, and temperature in milligrams per liter)

Calcium	38	Fluoride	0.1
Magnesium	3.3	Nitrate	.18
Sodium	2.1	Alkalinity as $CaCo_3$	93
Potassium	1.9	Dissolved solids, sum	129
Iron	0	Hardness, Ca and Mg	108
Manganese	0	Hardness, noncarbonate	15
Bicarbonate	144	Nitrate as N	.04
Carbonate	0	pH	8.0
Sulfate	18	Silica	7.0
Chloride	2.8	Specific conductance, mhos @ 25°c	222

Temperature, -- 6.0 °C

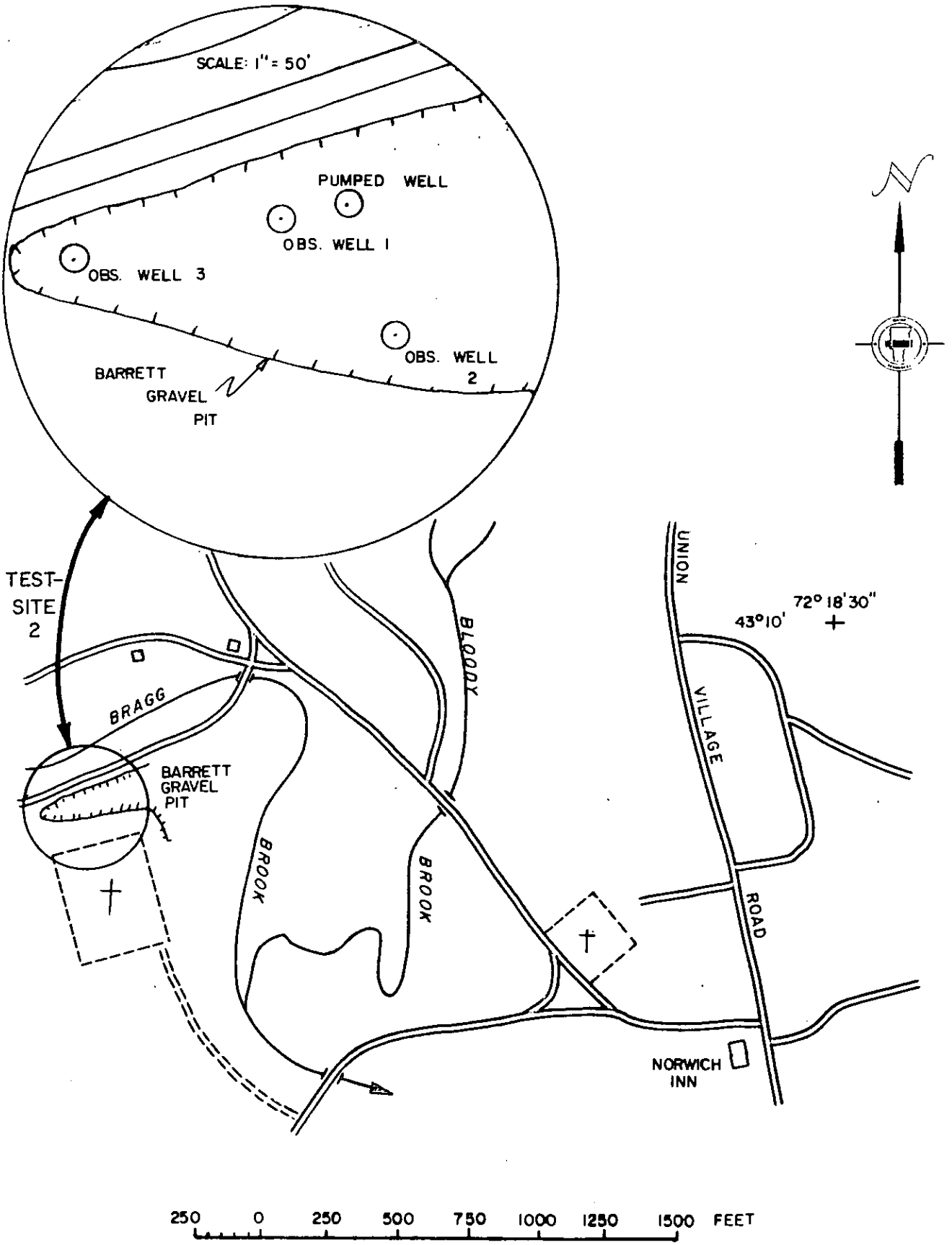

FIGURE 3 TEST-SITE 2

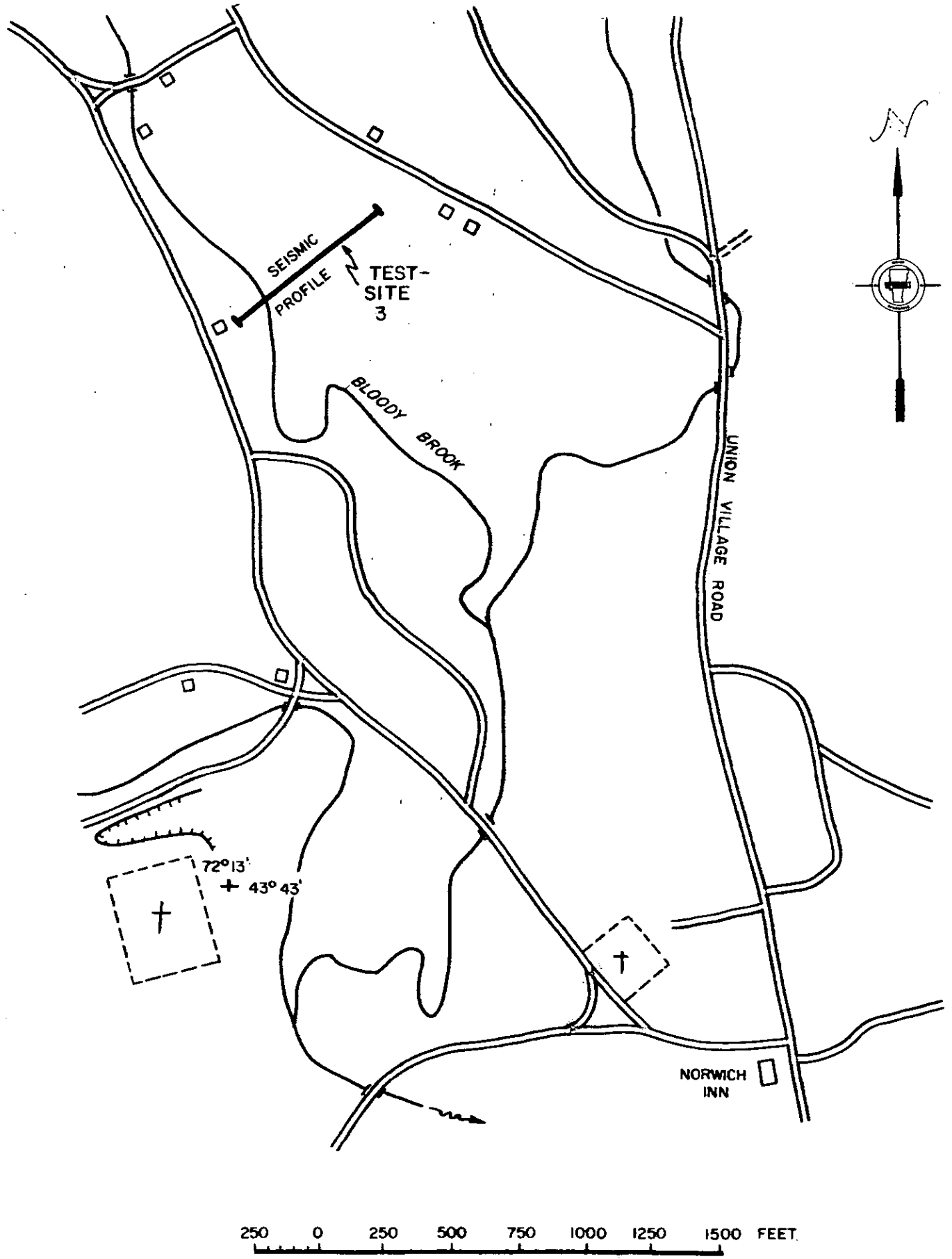

FIGURE 4 TEST-SITE 3

feet of stratified material overlying bedrock, and a water table 10 feet below land surface. Three auger borings on the line of the seismic profile penetrated 10 to 15 feet of coarse sand and gravel underlain by silt and clay. The shallow gravel may be a potential aquifer that can be developed by infiltration galleries or well points.

Site 4

Norwich seismic profile is perpendicular to the Connecticut River approximately 0.95 mile north of the Norwich, Vermont-Hanover, New Hampshire bridge over the Connecticut River on property owned by the Melendy Estate. An 840-foot-long seismic profile indicated from 30 to 110 feet of unconsolidated material overlying bedrock. The material thickens from west to east. Three auger borings along the seismic line showed minor thicknesses of gravel on the west end of the line, grading into silt and clay to the east. Most of the sand and gravel at this site is above the water table, and, therefore, this location is unsuitable for the development of high-capacity water wells.

Site 5

Hartford, in a sand pit owned by Hartford Oil Company, between U.S. Route 5 and Interstate 91, ½ mile south of Wilder, Vermont. A seismic profile outlined between 190 and 224 feet of unconsolidated material overlying the bedrock surface. A boring at this site several years ago penetrated 127 feet of silt and clay. Information derived from seismic velocities indicated no change in material below this level, and therefore, the site is

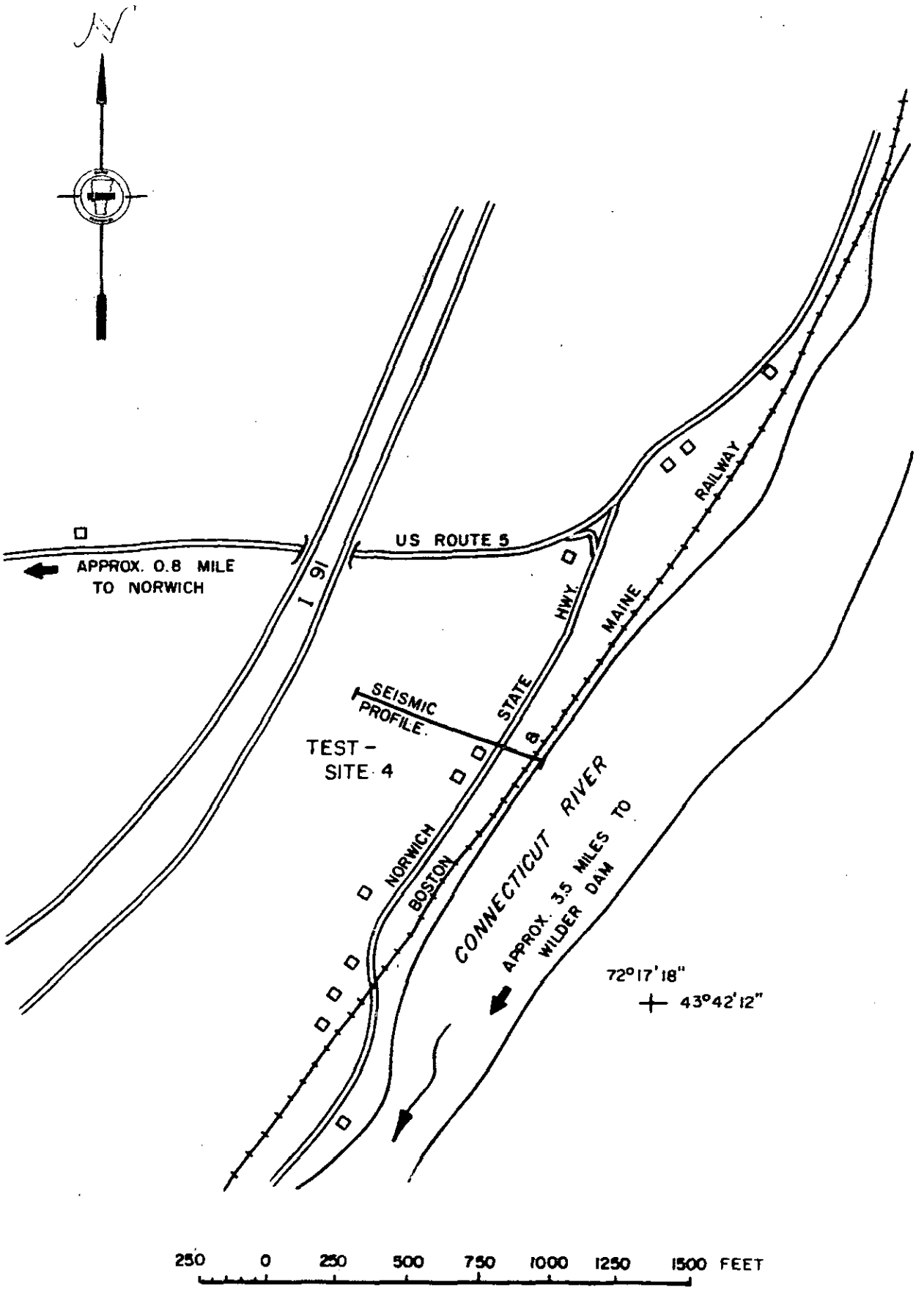

FIGURE 5 TEST – SITE 4

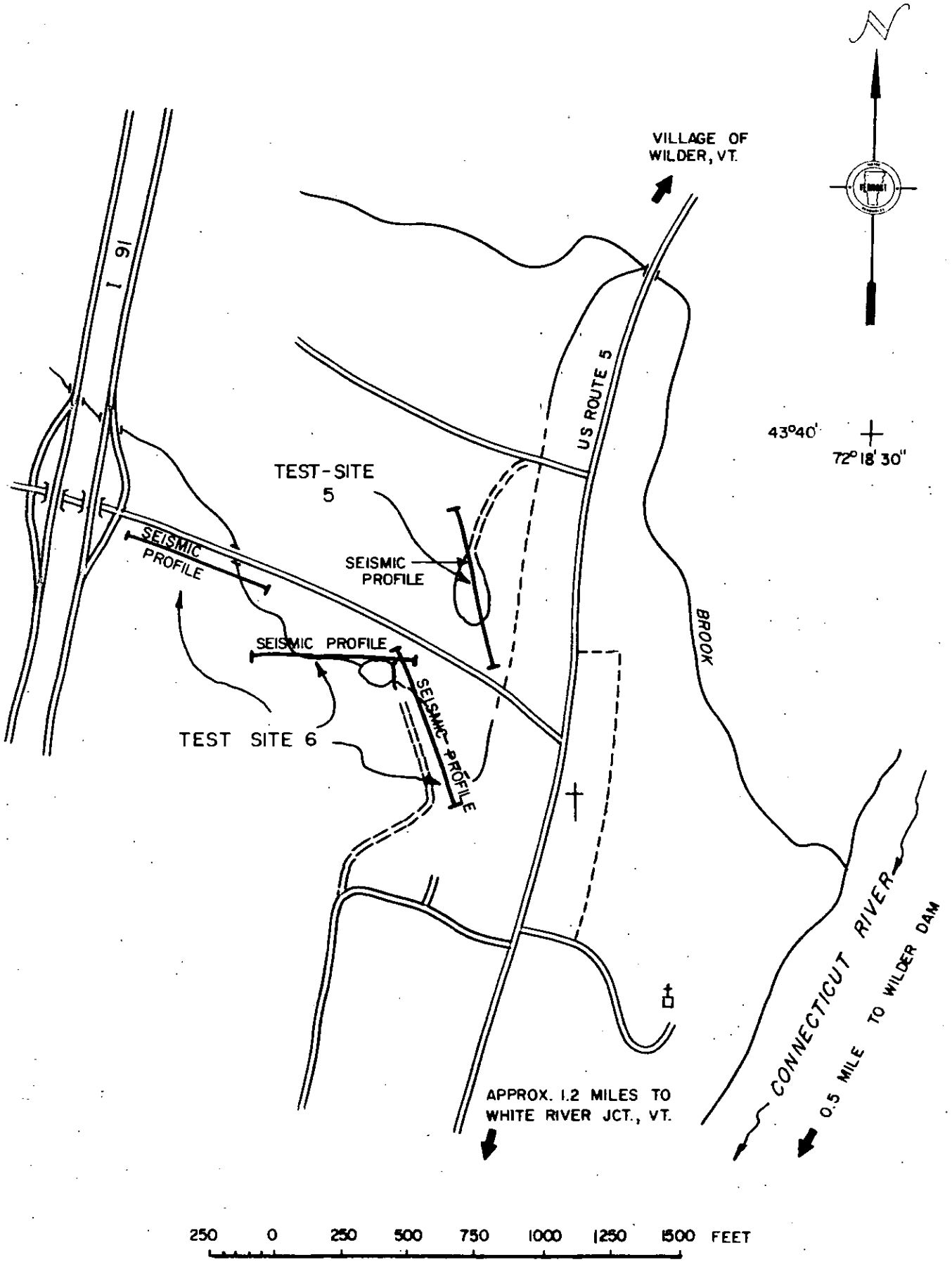

FIGURE 6 TEST-SITES 5 & 6

assumed to be unsuitable for development of water supplies from the stratified material above the bedrock surface.

Site 6

Hartford, along the south side of the connector road between Wilder, Vermont and Interstate 91 on property owned by Hartford Oil Company. Seismic profiling indicated that unconsolidated material overlying bedrock ranged from 18 to 168 feet in thickness. A single wash boring near the south end of the profile penetrated 114 feet of very fine sand and silt overlying glacial till. This area is unsuitable for development of water supplies from the stratified material above the bedrock surface.

Site 7

Hartford, at the mouth of the White River on property owned by the State of Vermont and the Town of Hartford. A seismic profile was made along the south side of the bed of the White River from the new U.S. Route 5 bridge to the center of the Connecticut River. This profile showed that the bedrock surface beneath the new U.S. Route 5 bridge dips to the east, reaching a maximum depth of 104 feet below mean low river level at a point 120 feet east of the former U.S. Route 5 bridge. From this point, the bedrock surface rises to the east and is exposed in the middle of the Connecticut River. Four auger borings on the north bank of the White River next to the Hartford Municipal Building ranged in depth from 65 to 73 feet below land surface to the top of the glacial till overlying bedrock. A 8-inch test hole offset about 70 feet west of the line of auger holes bottomed at 78 feet below land

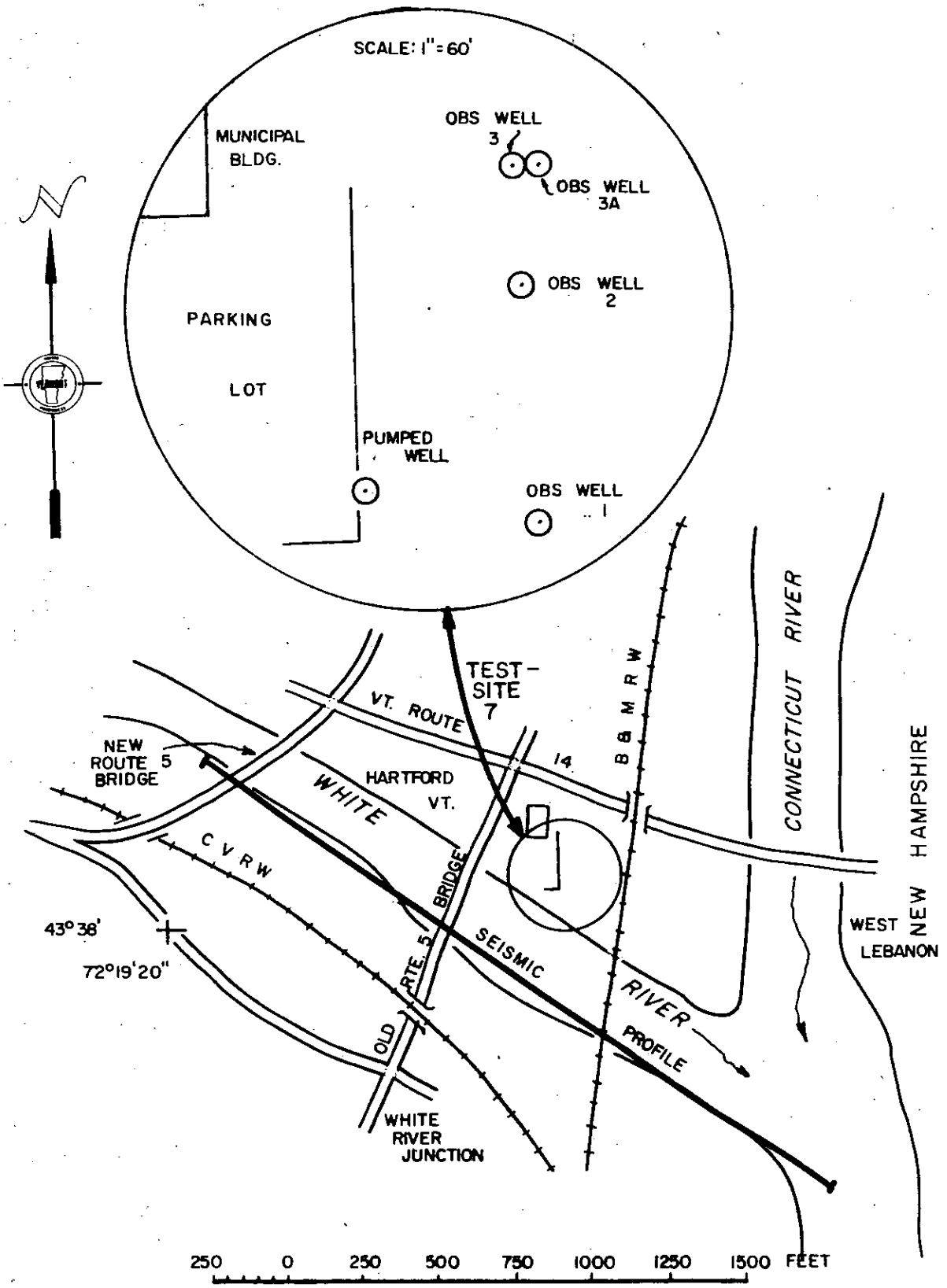

FIGURE 7 TEST-SITE 7

surface on bedrock or a boulder. This well was finished with 10 feet of screen set from 68 to 78 feet below land surface and, after development, produced 400 gpm with 23 feet of drawdown. Computations of aquifer characteristics from this pumping test were extremely difficult, as the water level in the aquifer changed in response to fluctuations in the level of both the Connecticut and the White Rivers. Impoundment and release of water on the Connecticut River at Wilder Dam produced changes in the level of the White River of 2 feet in 2 hours or less. Corrected data indicate that the pumping well had a specific capacity of 17 gpm per foot of drawdown.

Estimates of Available Water at Site 7

Fluctuations of aquifer water levels in response to changes in the level of the White and Connecticut Rivers indicate that recharge would be induced from the river by long-term pumping from the aquifer. The ability of the aquifer to transmit water, rather than the availability of recharge is the limiting factor at site 7. A well at this site that lowers the water level from a static level of 24 feet to a pumping level of 65 feet below land surface would yield 695 gpm, or about 1 mgd (million gallons per day) of water. The specific capacity of this well is low, probably due to a moderate percentage of silt and clay within the screened part of the aquifer. Test holes to the east of the pumping well penetrated considerably more clay than the final well. The aquifer may be thicker and more permeable west of the pumping well.

Analysis of a water sample taken during the pumping test is given in Table 2.

The water is of acceptable quality except for manganese, which is well

Table 2.--Chemical analysis of water at site 7

Date: December 10, 1971 Previous pumping: 2 days

(All values, except pH, specific conductance, and temperature in milligrams per liter)

Calcium	75	Fluoride	0.1
Magnesium	7.3	Nitrate	1.3
Sodium	14.0	Alkalinity as $CaCo_3$	162
Potassium	5.3	Dissolved solids, sum	280
Iron	.1	Hardness, Ca and Mg	217
Manganese	.5	Hardness, noncarbonate	55
Bicarbonate	198	Nitrate as N	.3
Carbonate	0	pH	7.9
Sulfate	32	Silica	7.7
Chloride	40	Specific conductance mhos @ 25°C	477

Temperature -- 9.0 °C

above the limit of 0.05 mg/l (milligram per liter) recommended by the U.S. Public Health Service (1962) for drinking water. Treatment of this water to remove manganese would be required to meet Public Health standards for a public water supply.

Site 8

Hartford, on land owned by the U.S. Corps of Engineers, extending from U.S. Route 4 to Deweys Mills near Quechee Gorge. A seismic profile 3,480 feet long and paralleling the north side of the old road north of U.S. Route 4 indicated depths to bedrock as much as 238 feet below land surface. This is about 80 feet below the bottom of Quechee Gorge to the west. Seismic velocities in the material overlying bedrock indicate that suitable aquifer material may underlie a point approximately 1,400 feet west of the intersection of the old road and U.S. Route 4; however, an auger boring made several years ago at the east end of the present seismic line penetrated 127 feet of silt and clay. The boring was not carried to refusal, so the seismic velocities may indicate sand and gravel underlying the silt and clay.

Site 9

Hartland, approximately 1 mile southwest of North Hartland village on property owned by Green Acres farm. Seismic profiling between Interstate 91 and the Central Vermont Railroad indicated a small buried channel, probably resulting from diversion of the Ottauquechee River to the west of Clay Hill during Pleistocene time. Five auger holes in the channel deposits penetrated silt and clay and only minor thicknesses of sand. This area is, therefore,

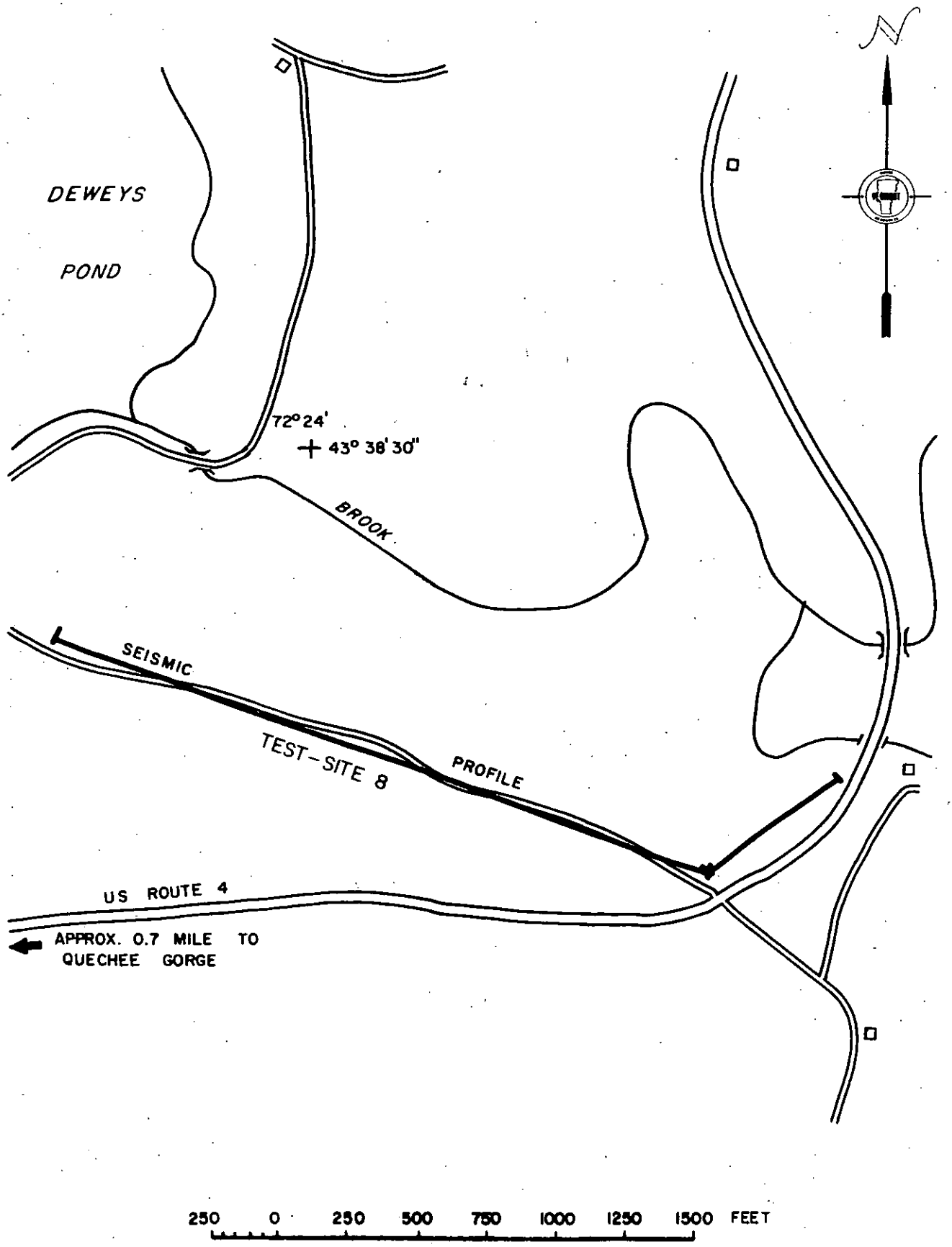

FIGURE 8 TEST-SITE 8

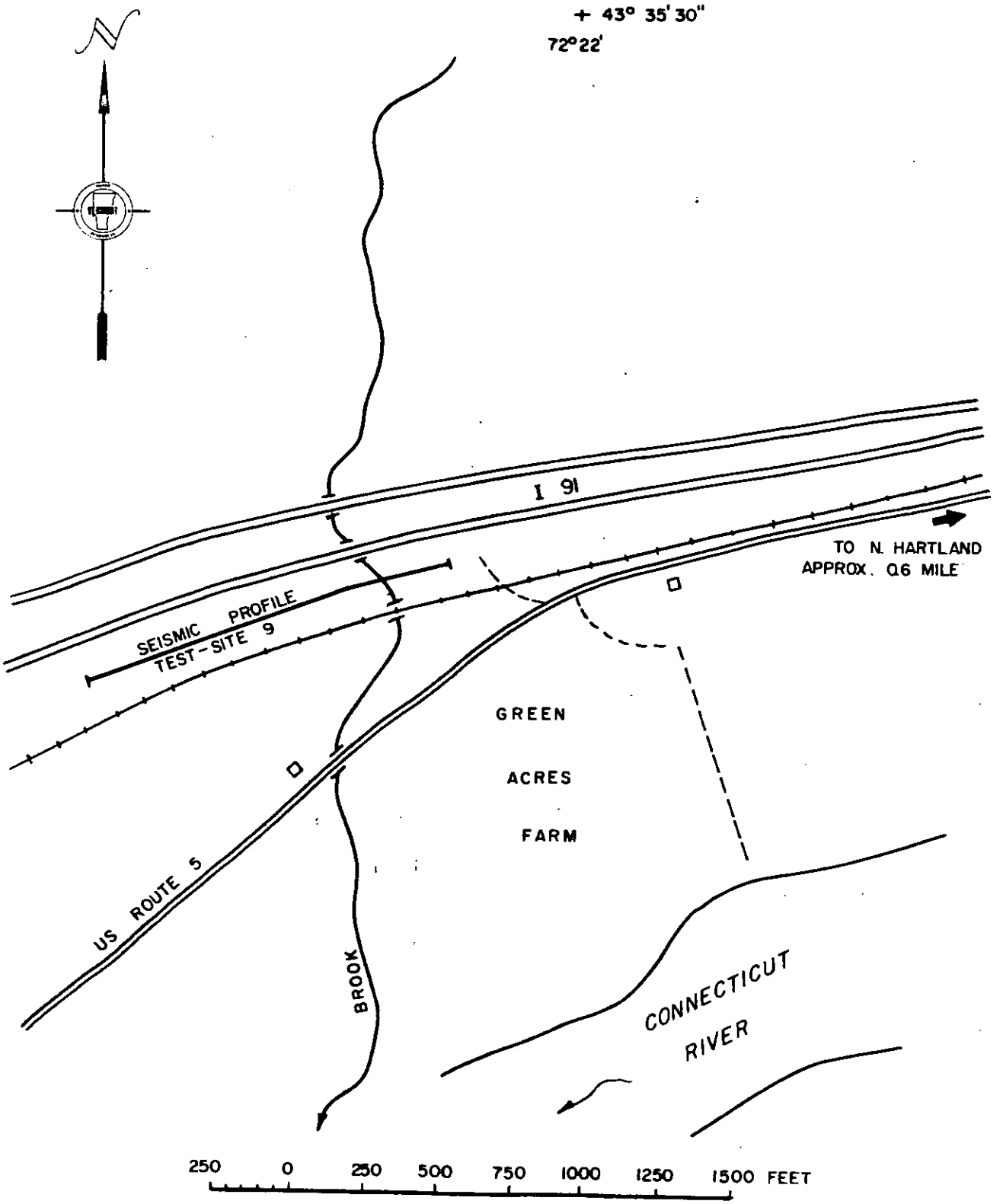

FIGURE 9 TEST-SITE 9

unsuitable for development of large supplies of ground water.

Site 10

Hartland, seismic profile is perpendicular to Vermont Route 12 on land owned by the Hartland Volunteer Fire Department. Seismic profiling from Vermont Route 12 to Lulls Brook indicated 90 to 100 feet of stratified material beneath the Hartland Fire Station. Three auger holes along the seismic line penetrated saturated sand and gravel and were finished as observation wells. An 8-inch test hole was screened between 59 and 69 feet below land surface and, after development, produced 463 gpm during a 48-hour pumping test. Static water level before the start of the test was 9 feet below land surface, and pumping level at the end of the test was 24 feet below land surface. The specific capacity is about 30 gpm per foot of drawdown. Analysis of the effects of pumping on the adjacent observation wells indicates that the aquifer has a transmissivity of about 2.0×10^4 feet squared per day.

Estimates of Available Water at Site 10

Lulls Brook drains approximately 20 square miles above the village of Hartland. It is estimated that half the average yearly precipitation on this area passes through the valley of the brook either as streamflow or underflow. On a yearly average, this volume of water is 19 mgd. Obviously, a large percentage of this flow occurs during relatively short periods of spring runoff and intense summer storms. During the remainder of the year, streamflow is considerabely reduced, with daily average flows reduced to perhaps

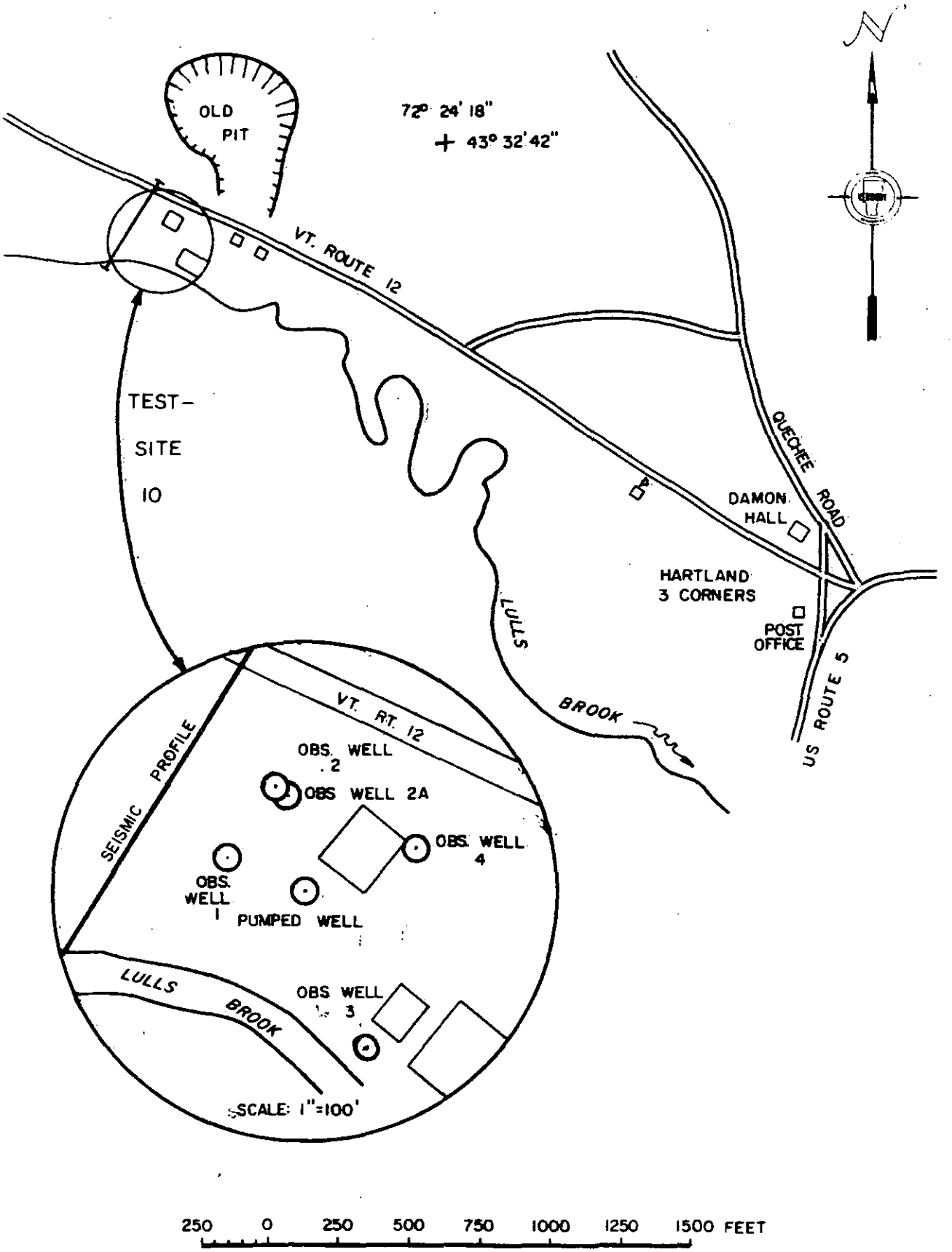

FIGURE 10 TEST-SITE 10

20 percent of the annual average during September and October of a normal year and reduced to as little as 10 percent during drought. The above flows are 3.8 mgd and 1.9 mgd, respectively. The Vermont Department of Water Resources recommends that low flows in streams be maintained at not less than 0.2 cfs per square mile of drainage area. This would be 4 cfs, or 2.6 mgd, in Lulls Brook at Hartland Village.

Based on the above assumptions, 1 mgd of water could be withdrawn from the gravel aquifer of the Lulls Brook valley without excessively depleting the flow of the brook during years of normal precipitation. During extended drought, however, continued withdrawal at this rate could be expected to affect the low flow of Lulls Brook seriously.

An analysis of water collected from the test well at site 10 is given in Table 3. All chemical constituents were found to be below limits recommended by the U.S. Public Health Service (1962) for a public water supply, and, therefore, water from this aquifer should be usable without treatment other than chlorination. Note that a permanent well for a public water supply could not be located at the site of the test well, as it was less than the distance away from two septic tanks required by the Vermont Department of Health.

Site 11

Hartland, adjacent to the Connecticut River on property owned by R. Summarsell. Seismic profiling, both parallel and perpendicular to the river, indicated a bedrock surface sloping to the southeast, with a maximum depth of about 70 feet below the riverbank. An auger boring in this area several

Table 3.--Chemical analysis of water at site 10

Date: November 4, 1971 Previous pumping: 2 days

(All values, except pH, specific conductance, and temperature in milligrams per liter)

Calcium	59	Fluoride	0
Magnesium	5	Nitrate	6.63
Sodium	6.3	Alkalinity as $CaCo_3$	139
Potassium	1.9	Dissolved solids, sum	200
Iron	0	Hardness, Ca and Mg	168
Manganese	0	Hardness, noncarbonate	29
Bicarbonate	169	Nitrate as N	1.5
Carbonate	0	pH	7.9
Sulfate	15	Silica	6
Chloride	17	Specific conductance mhos @ 25°C	355

Temperature -- 8.0 °C

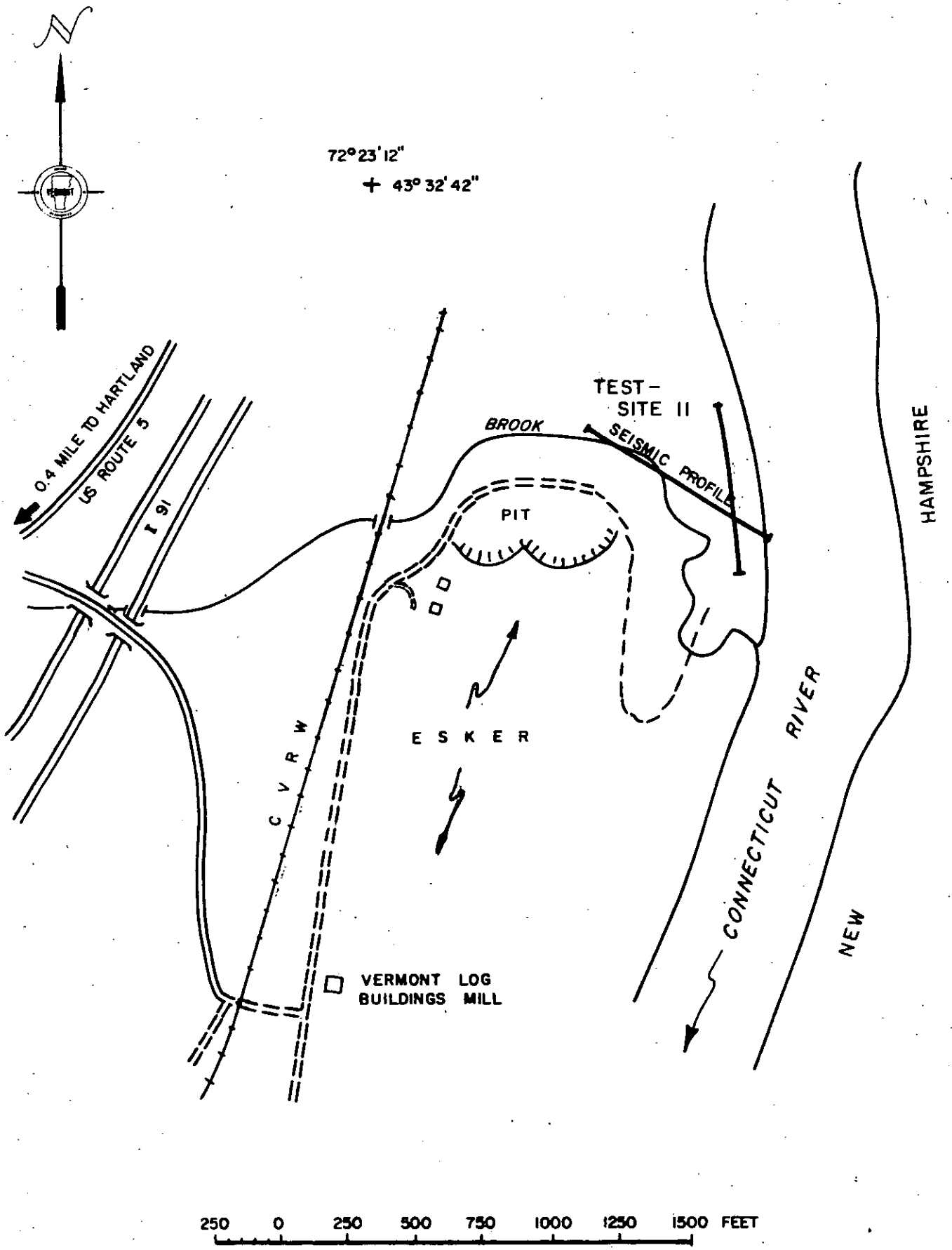

FIGURE 11 TEST-SITE 11

years ago penetrated 52 feet of sand and gravel, and the static water level was 13 feet below land surface, indicating a potential site for a high-capacity well.

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PLATE 1. OCCURRENCE OF WATER IN BEDROCK, WHITE RIVER JUNCTION AREA, VERMONT

BEDROCK GEOLOGY OF THE WHITE RIVER JUNCTION AREA

QUALITY OF WATER

GROUND WATER RESOURCES OF THE WHITE RIVER JUNCTION AREA, VERMONT

BY

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1976

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH STATE OF VERMONT
AGENCY OF ENVIRONMENTAL CONSERVATION, DEPARTMENT OF WATER RESOURCES

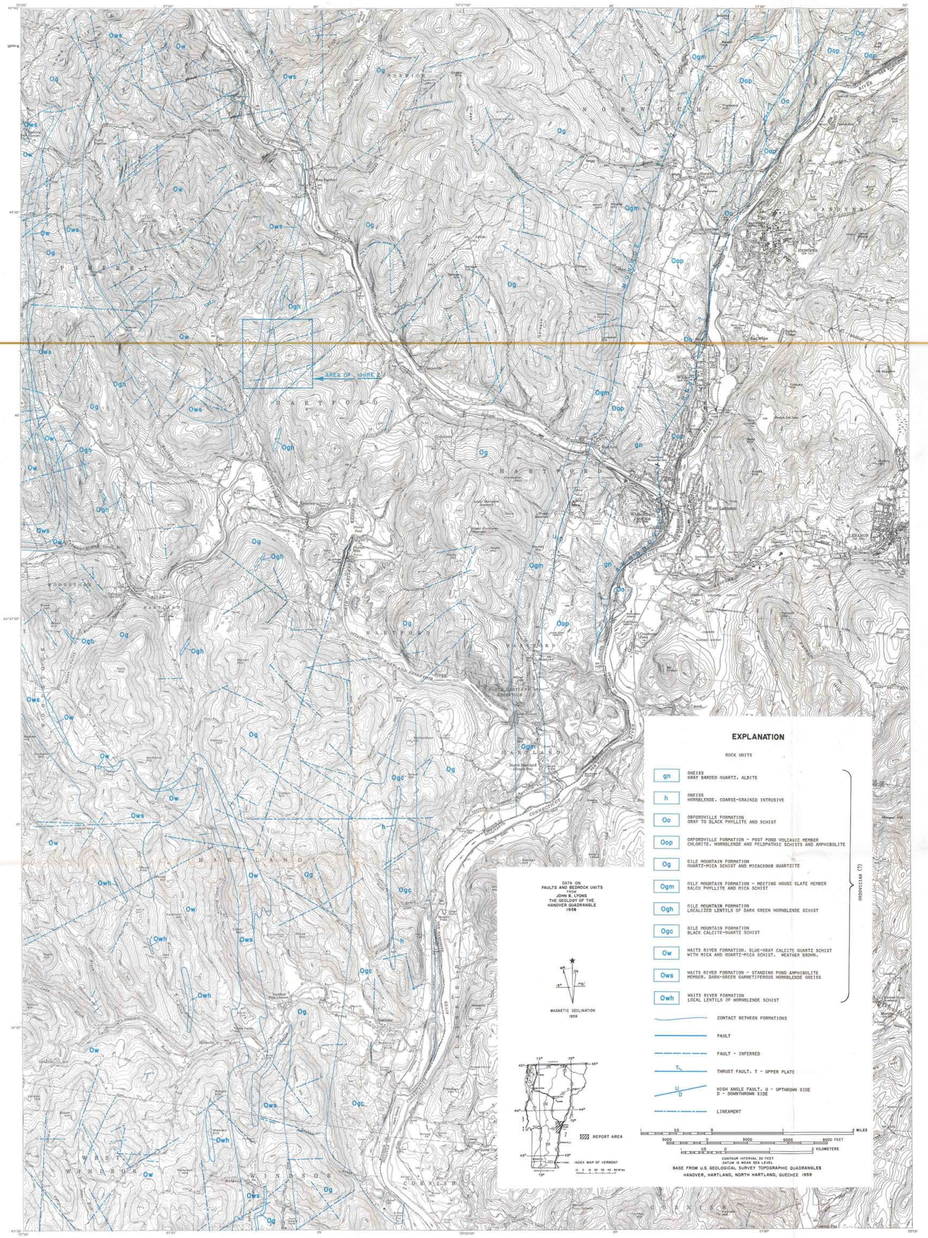

FIGURE 1. - - BEDROCK GEOLOGY OF THE WHITE RIVER JUNCTION AREA

BEDROCK AQUIFERS

Bedrock formations in the White River Junction area (fig. 1) consist primarily of Ordovician schist with some gneiss, amphibolite, and phyllite (Lyons, 1958). Structural competence and resistance to weathering vary because of lithologic differences, ultimately affecting well-yield characteristics.

The oldest bedrock unit, the Waits River Formation, occurs in the western part of the White River Junction area. It is composed of calcite-quartz schist, and some mica schist and mica-quartz schist. Two units of the Waits River Formation that have limited areal extent are made up of hornblende gneiss and hornblende schist.

The overlying Gile Mountain Formation has the greatest areal extent of all rock types in the project area. Quartz-mica schist and micaceous quartzite are the predominant rock types in this unit. Phyllite and mica schist of the Meeting House Slate Member, and calcite-quartz schist are less widespread.

The Orfordville Formation is the youngest bedrock formation in the White River Junction area. This unit underlies the Connecticut River Valley north of North Hartland and underlies an area less than 1.5 mi (2.4 km) wide in the project area. The Post Pond Volcanic Member, composed of chlorite schist, hornblende schist, amphibolite, and feldspathic schist is the most widespread rock type in this formation. The black phyllite has limited areal extent.

Primarily, bedrock structures (bedding, schistosity and faults) in the report area (Lyons, 1958) trend northerly in the southern part of the White River Junction area, and north-northeasterly in the northern part of the area. Bedding structures in the Waits River Formation have shallow angles of dip, whereas those of the remaining formations are considerably steeper.

Two major faults parallel the Connecticut River north of the Ottauquechee River. The Monroe Fault is the more westerly of the two, and is assumed to be nearly vertical. This fault separates the Gile Mountain Formation on the west from the Orfordville Formation on the east. The amount of displacement across this fault is unknown. The Ammonoosuc Fault, however, is assumed by Lyons to have several thousand feet of displacement. The fault plane is generally coincident with the west bank of the Connecticut River, and dips 35° - 45° W.

YIELD OF BEDROCK WELLS

A comparison of average and median yields and depths of selected wells (table 1) shows that while yields of wells in bedrock are low (about 4 to 10 gal/min or 0.3 to 0.6 l/s median), there are substantial variations between yields of different formations.

Shallow angles of dip in the Waits River Formation and fracturing associated with the Monroe and Ammonoosuc Faults in the Orfordville Formation may explain higher bedrock yields in these two formations than in the more steeply dipping and less fractured Gile Mountain Formation.

A comparison of median yield versus depth drilled shows that the Waits River Formation has the highest yield per foot drilled, followed by the Post Pond Volcanic Member of the Orfordville Formation. The Gile Mountain Formation and its calcite-quartz schist have the lowest yield per foot drilled.

TABLE 1. - - AVERAGE YIELD AND DEPTH OF SELECTED WELLS

TYPE OF WELL	NUMBER OF WELLS	MEDIAN YIELD G.P.M.	AVERAGE YIELD G.P.M.	MEDIAN DEPTH FEET	AVERAGE DEPTH FEET	MEDIAN YIELD/FOOT DRILLED
Wells in Bedrock						
Gneiss (gn)	0	--	--	--	--	--
Hornblende gneiss (h)	0	--	--	--	--	--
Orfordville Formation, Black phyllite (Oo)	3	*	*	*	*	*
Orfordville Formation, Post Pond Volcanic Member (Oop)	35	9.00	18.0	207.0	254.6	0.043
Gile Mountain Formation (Og)	80	5.00	8.9	248.5	283.3	.020
Gile Mountain Formation, Meeting House Slate Member (Ogm)	3	*	*	*	*	*
Gile Mountain Formation, Hornblende schist (Ogh)	0	--	--	--	--	--
Gile Mountain Formation, Calcite-quartz schist (Ogc)	24	3.75	5.2	194.5	217.0	.019
Waits River Formation (Ow)	23	10.00	17.1	203.0	256.3	.049
Waits River Formation, Standing Pond Amphibolite Member (Ows)	4	*	*	*	*	*
Waits River Formation, Hornblende schist (Owh)	0	--	--	--	--	--
Wells in Unconsolidated Material (Unc)	24	17.5	136.5	78.0	79.0	.224

* Number of wells insufficient to calculate meaningful average or median.

A recent study in Delaware (Woodruff, and others, 1972) shows that yields of rock wells are related to their position with respect to zones of rock fractures, termed "lineaments." In the Delaware study, lineaments were identified and subsequently drilled. Those wells drilled along the strike of the lineaments had yields substantially greater than the average yield of wells drilled in the same rock unit but offset from the lineaments.

Because identification of lineaments may provide information that could be used to locate sites for development of potentially high-yield rock wells, interpretation of topographic maps and aerial photos was used to map lineaments in the White River Junction area. Lineaments appear on maps and photos as straight lines or narrow zones of marked topographic or tonal change that in some places mark river or water conditions along the lineaments than on either side of the lineaments.

A small area in the Town of Hartford (figs. 1 and 2) was mapped in detail to estimate the relationship of lineaments to well yield. This area was selected for its shallow bedrock cover and six inventoried wells. All lineaments mapped were of limited width (less than 100 ft or 30 m) and appeared as straight lines. Because of the relatively narrow width of the lineaments and rough terrain, field identification was generally only possible with the assistance of aerial photographs.

Of the six wells located in the lineament study area, only one well (HFW 79) was located on an identifiable lineament. This well has a yield of 18 gal/min (1 l/s). The other five wells in the study area (wells HFW 74 to 78) were not located on any of the lineaments and had yields of only 1 to 5 gal/min (0.1 to 0.3 l/s), with a median and average yield of 1.5 and 2.2 gal/min (0.1 and 0.2 l/s), respectively. The Gile Mountain Formation, in which all six wells were drilled, has a median yield of 5 gal/min (0.3 l/s) and an average yield of 8.9 gal/min (0.6 l/s) to wells (table 1). The small amount of data suggests a correlation between higher yields of rock wells and their proximity to lineaments. These interpretations also suggest that major drainageways in the report area occupy broad lineament zones.

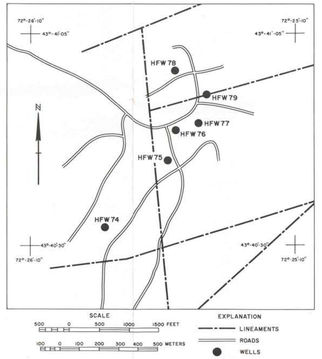

FIGURE 2. - - INVESTIGATION SITE OF BEDROCK WELL YIELDS

CONVERSION FACTORS

The following table may be used to convert English units to International System of Units (SI).

Multiply English units	By	To obtain SI units
inches (in)	25.4	millimetres (mm)
feet (ft)	.3048	metres (m)
gallons per minute (gal/min)	.06309	litres per second (l/s)
million gallons per day (Mgal/day)	3785	cubic metres per day (m^3/day)

QUALITY OF WATER

Nine analyses of ground water and two analyses of surface water were made by the Geological Survey during the study, and additional analyses of ground water were obtained from several sources. Numerous partial analyses of water from several streams in the area were made by the Vermont Department of Water Resources. These analyses are shown in tables 2 and 3, and the locations of the sampling points are shown on Plate 3.

Nineteen (42 percent) of the 45 partial or complete analyses (table 2) of water from wells contained one or more constituents that equalled or exceeded U.S. Public Health Service (1962) recommended maximum limits for drinking water supplies. Two of the five public water-supply wells for which water-quality analyses are available, have analyses in which the recommended limits are exceeded. Iron and manganese were most commonly responsible for exceeding the limits. Manganese equalled or exceeded the limits in 13 samples, iron in 4, nitrate in one, lead in one and zinc in one.

Surface waters in the White River Junction area were sampled in 17 locations to determine chemical composition. Analyses of these samples are shown in table 3. Surface waters show median pH of 8.0 and an average hardness of 58 mg/l (milligrams per litre) as $CaCO_3$. This compares with a median pH of 7.4 and hardness of 125 mg/l for ground-water samples. Surface water is generally more alkaline (pH greater than 7.0), therefore, than ground water. Water from the Connecticut River is slightly more acidic (pH less than 7.0) than its tributaries - the Ottauquechee and the White. No other regional trends are evident from these analyses.

HARDNESS

Hardness of water is a term applied to the soap-neutralizing power of water. Hardness is largely determined by the concentration of calcium and magnesium, and is expressed as the content of calcium carbonate ($CaCO_3$). The following ranges have been adopted by the U.S. Geological Survey to classify hardness:

Hardness as $CaCO_3$ (mg/l)	Descriptive Rating
0 - 60	Soft
61 - 120	Moderately Hard
121 - 180	Hard
181 or more	Very hard

While soft and moderately hard water can generally be used without treatment except for some industrial purposes, hard water frequently requires treatment (softening) for use in laundries, some industrial, and most domestic uses. Very hard water requires softening for most purposes to make the water usable and to prevent damage to water supply and water-using equipment.

Average hardness of all ground-water analyses in the White River Junction area was 125 mg/l, ranking the water as hard, and therefore commonly requiring treatment before use. Five of the analyses in table 2 show very hard water. Two of these analyses were from widely separated rock wells, and the remaining three analyses were from a test well (HFW 60) in unconsolidated deposits in the Town of Hartford.

IRON AND MANGANESE

Iron and manganese are minor constituents in water, but excessive concentrations, particularly of manganese, may have harmful effects on health (Yase, 1972). The U.S. Public Health Service Standards (1962) recommends a limit of 0.3 mg/l for iron and 0.05 mg/l for manganese in drinking water supplies. Although the average iron concentration in all analyses in table 2 was 0.13 mg/l, water from only four rock wells exceeded the recommended limit. The iron found in the water may be from many sources in the White River Junction area. Most of the bedrock formations in the report area contain iron-bearing minerals. Iron may also be derived from organic matter and from human and industrial waste.

Average manganese concentrations for all ground-water analyses was 0.14 mg/l--nearly three times the recommended limit. Seven of the 24 wells sampled showed excessive manganese. However, manganese is not a major part of the mineral composition of any of the rock types identified by Lyons (1958) in the White River Junction area. Therefore, the origin of this constituent is not clear. Water from the Town of Hartford municipal well at Wilder (HFW 2) consistently had excessive levels of manganese. This well and two others (HFW 60 and NSW 36) tapping unconsolidated sand and gravel aquifers are located adjacent to and are recharged by the Connecticut River. Although these wells are in similar geologic and hydrologic situations, well HFW 2 yields water with a large amount, well HFW 60, only a minor amount, and well NSW 36, no detectable amount of manganese. The lack of an obvious relationship between manganese concentration and aquifer type or recharge source suggests that only an in-depth local study could determine the factors contributing to the excessive manganese levels shown in table 2.

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Woodruff, K. D., Miller, J. D., Jordan, R. R., Spoljaric, N., and Pickett, T. E., 1972, Geology and ground water: University of Delaware, Newark, Delaware, 40 p.

Yase, Yoshiro, 1972, The pathogenesis of amyotropic lateral sclerosis: The Lancet, Aug. 12.

TABLE 2. - - CHEMICAL ANALYSES OF GROUND-WATER IN THE WHITE RIVER JUNCTION AREA

LOCAL WELL NUMBER	DATE OF SAMPLE	TEMPERATURE (C)	pH	TURBIDITY STD. UNITS	COLOR STD. UNITS	ALKALINITY AS $CaCO_3$ (MG/L)	HARDNESS AS $CaCO_3$ (MG/L)	IRON (Fe) (MG/L)	MANGANESE (Mn) (MG/L)	COPPER (Cu) (MG/L)	CALCIUM (Ca) (MG/L)	CHLORIDE (Cl) (MG/L)	SODIUM (Na) (MG/L)	NITRATE AS N (MG/L)	NITRITE AS N (MG/L)	FLUORIDE (F) (MG/L)	LEAD (Pb) (MG/L)	ZINC (Zn) (MG/L)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25° C)	SOURCE OF DATA 2/	TYPE OF AQUIFER 3/	ADDITIONAL DATA AVAILABLE 4/
U.S.P.H.S. STANDARDS 1/--		--	--	5*	15*	--	--	0.3*	0.05*	1.0*	--	250.*	--	10.0**	--	--	0.05**	5.0*	--	--	--	--
HARTFORD (HF)																						
W 1	03-19-70	--	6.9	0	0	0	0	0.05	0.00	0.1	--	15	42.	0.1	0.01	0.0	--	--	--	H	UNC	--
W 2	01-13-64	--	7.6	5	0	89	102	.00	.7	.0	--	3.9	3.4	.1	.00	.0	--	--	--	H	UNC	--
	02-11-66	--	--	0	0	67	100	.00	1.03	.0	--	7.0	--	.5	.00	.1	--	--	--	H	UNC	--
	07-07-67	--	7.4	0	0	96	134	.00	--	.0	--	6.0	3.4	.2	.01	.3	--	--	--	H	UNC	--
	05-17-70	--	7.4	0	0	78	106	.03	.51	.1	--	7.0	5.0	.1	.02	--	--	--	--	H	UNC	--
	03-29-71	--	7.3	0	0	72	118	.05	.85	.0	--	5.0	4.1	.0	.00	.1	.00	--	--	H	UNC	--
	10-19-71	--	7.7	0	15	108	2	.00	.93	7.	--	7.0	4.0	.3	.03	.1	.01	.0	--	H	UNC	7.7
W 60	12-08-71	9.1	7.7	--	--	182	251	.01	.08	--	87	44	16	.3	--	.1	--	--	541	USGS	UNC	C,Ph
	12-09-71	9.0	7.8	--	--	169	231	.01	.05	--	80	40	16	.4	--	.1	--	--	498	USGS	UNC	C,Ph
	12-10-71	9.0	7.9	--	--	162	217	.01	.05	--	75	40	14	.3	--	.1	--	--	477	USGS	UNC	C,Ph
W 90	06-25-73	--	7.4	0	0	80	114	.13	.01	.1	--	9.0	5.0	2.8	.00	7.4	--	.00	2.0	H	UNC	--
	06-26-73	--	7.0	0	0	98	121	trace	.0	.0	--	8.5	--	3.0	.01	.0	--	--	250	D&K	UNC	--
	06-26-73	--	7.4	0	0	84	118	.29	.03	.0	--	9.	5.0	2.7	.00	.0	.00	.0	--	H	UNC	--
	06-28-73	--	7.5	0	5	96	111	trace	.0	.0	--	8.5	--	3.8	.00	.1	--	--	250	D&K	R (Pa)	7.5
W 98	05-12-72	--	6.6	0	0	62	78	.05	.06	.1	--	14	5.0	.8	.00	--	.00	.1	--	H	R (Pa)	--
W 99	04-23-72	--	7.6	1	0	108	96	.13	.03	.0	--	1	6.0	.4	.00	--	.02	0.0	--	H	R (Pa)	--
W 100	10-21-71	--	6.5	1	0	94	9	.00	.00	.0	--	10	19	.0	.00	--	.00	.0	--	H	R (Pa)	--
W 101	10-21-71	--	6.5	1	0	90	2	.10	.00	.0	--	10	47	.0	.00	--	.00	.0	--	H	R (Pa)	--
W 102	10-21-71	--	7.5	0	0	74	74	.00	.00	.0	--	10	3.0	.7	.00	--	--	.2	--	H	R (Pa)	--
W 103	10-15-72	--	7.3	0	0	114	142	.05	.01	.0	--	4.0	4.0	.2	.00	--	.00	.0	--	H	R (Pa)	--
HARTLAND (HL)																						
W 2	09-15-65	--	7.1	5	0	--	--	.19	--	.0	--	10	6.1	.3	.00	.2	--	--	--	H	UNC	--
	09-16-65	--	7.1	5	0	82	104	.19	--	.0	--	9.5	6.1	.3	.00	.1	--	--	--	H	UNC	--
	09-15-66	--	6.9	5	0	70	82	.03	--	.1	--	11	7.8	.3	.00	.0	.00	--	--	H	UNC	--
	10-27-66	--	6.8	0	5	78	86	.04	--	.0	--	12	4.4	.3	.00	.1	.00	--	--	H	UNC	--
	10-25-71	--	7.2	0	0	104	140	.00	.21	.1	--	22	10.	5.6	.00	.0	.00	.1	--	H	UNC	--
W 38	02-18-65	--	8.0	20	10	--	119	1.62	--	--	85	30	31	--	--	.1	--	--	--	H	R (Oan)	--
W 54	03-26-71	--	7.0	2	5	146	180	.14	.04	.1	--	4.6	--	1.4	--	--	.11	13.	--	WR	UNC	--
W 56	05-05-65	--	8.1	20	5	--	111	.71	--	--	57	2.0	9.1	0.1	--	.1	--	--	--	H	R (Oe)	--
W 57	11-02-71	8.0	7.8	--	--	137	168	.30	--	--	59	14	5.3	1.5	--	.0	--	--	343	USGS	UNC	C,Ph
	11-03-71	8.0	7.9	0	--	159	170	.0	.0	--	60	16	5.8	1.5	--	.0	--	--	351	USGS	UNC	C,Ph
	11-04-71	8.0	7.9	--	--	159	168	.0	.0	--	59	17	8.5	1.5	--	.0	--	--	355	USGS	UNC	C,Ph
W 61	10-01-73	--	7.1	0	0	124	174	.15	.05	--	--	15	3.0	.2	.01	.0	.00	--	--	H	UNC	--
W 64	09-28-73	--	6.6	0	0	136	164	.72	.02	.1	--	7.0	3.0	.0	.00	--	.00	.1	--	H	R (Ow)	--
W 65	12----73	--	6.8	1	0	138	170	.07	.04	.0	--	10	5.0	.0	.00	--	.02	.0	--	H	R (Oa)	--
W 66	10-18-66	--	8.1	--	--	--	106	.23	--	--	--	--	--	.0	--	--	--	--	--	H	R (Ogc)	--
NORWICH (R)																						
W 22	02-27-74	--	6.6	0	0	198	206	.10	.01	.0	--	30	26	29	.03	--	.00	1.9	--	H	R (Oom)	--
W 36	02-01-72	6.0	8.0	--	--	88	105	.0	0.0	--	36	3.0	2.0	.0	--	--	--	--	212	USGS	UNC	C,Ph
	02-02-72	6.0	8.1	--	--	93	111	.0	0.0	--	39	2.5	2.1	.1	--	.0	--	--	223	USGS	UNC	C,Ph
	02-03-72	6.0	8.0	--	--	95	108	.0	0.0	--	38	2.8	2.1	.0	--	.1	--	--	222	USGS	UNC	C,Ph
W 39	08-15-73	--	7.2	1	0	110	142	.07	.01	.0	--	30.	13.	.0	.01	--	.02	.0	--	H	R (Oom)	--
W 40	12-11-72	--	7.2	0	0	114	118	.00	.00	.0	--	2.0	2.0	.5	.00	.0	.01	.1	--	H	R (Oom)	--
W 41	05-12-71	--	7.7	5	0	112	162	.10	.09	.0	--	1.0	5.0	.0	.00	.1	.00	--	--	H	R (Oom/Ho)	--
POMFRET (PO)																						
W 3	09-30-74	--	7.8	0	0	96	130	.00	.01	.0	--	1.0	2.0	.0	.00	--	.05	.0	--	H	R (Ow)	--
SHARON (SI)																						
W 8	09-19-72	--	7.3	1	0	146	176	.10	.04	.0	--	13	9.0	.0	.01	--	.02	.2	--	H	R (Ow)	--
W 9	05-17-72	--	7.1	0	0	122	183	.45	.40	.0	--	34	12	.0	.00	--	.01	.2	--	H	R (Ow)	--

1/ U.S. Public Health Service Standards (1962) drinking water standards limits of concentration: * recommended limit, ** maximum allowable
2/ Source of Data: H - Vermont Department of Health, D&K - DuBois & King, Inc., Randolph, Vermont, USGS - U. S. Geological Survey, WR - Vermont Department of Water Resources.
3/ Type of Aquifer: UNC - Unconsolidated Materials, R - Bedrock (letters in parentheses refer to bedrock formations - Plate 1, Figure 1. - - Bedrock Geology of the White River Junction area).
4/ Additional Data Available: C - Chemical, Ph - Physical (data on file at Vermont Field Office, U. S. Geological Survey)

TABLE 3. - - CHEMICAL ANALYSES OF SURFACE-WATER IN THE WHITE RIVER JUNCTION AREA

WATER	MAP NUMBER	DATE OF SAMPLE	TEMPERATURE (C)	pH	TURBIDITY STD. UNITS	ALKALINITY AS $CaCO_3$ (MG/L)	HARDNESS AS $CaCO_3$ (MG/L)	CHLORIDE (Cl) (MG/L)	DISSOLVED OXYGEN (MG/L)	TOTAL COLIFORM BACTERIA PER 100 MILLILITERS	SOURCE OF DATA	ADDITIONAL DATA AVAILABLE 2/
Connecticut River	1	7-30-70	24.5	--	--	--	--	--	6.4	4,000	A	R,C,Ph
Connecticut River	2	7-30-70	24.0	--	--	--	--	--	6.2	62,000	A	R,C,Ph
Connecticut River	3	7-30-70	25.0	--	--	--	--	--	5.7	30,000	A	R,C,Ph
Connecticut River	4	7-15-70	23.0	--	--	--	--	--	7.8	--	A	R,C,Ph
White River	5	7-22-64	25.2	8.0	5.5	--	--	7.0	8.3	10,000	A	R,C,Ph
White River	6	6-27-74	20.0	8.0	1.0	14	75	9.0	10.0	--	A	R,C,Ph
White River	7	7-22-64	25.8	8.0	5.5	--	--	8.0	8.1	500	A	R,C,Ph
White River	8	7-22-64	21.8	8.2	5.0	--	--	7.0	8.1	300	A	R,C,Ph
White River	9	7-22-64	25.0	--	5.5	--	--	--	8.3	--	A	C,Ph
Ottauquechee River	10	7-11-61	21.0	8.0	--	54	57	9.0	9.0	3,000	A	R,C,Ph
Ottauquechee River	11	7-11-61	21.5	8.1	--	56	--	--	8.6	--	A	C,Ph
Ottauquechee River	12	7-30-71	23.5	--	--	--	--	--	8.2	800	A	R,C,Ph
Ottauquechee River	13	6-27-74	20.0	7.6	2.6	11	63	8.0	9.0	--	A	C,Ph
Connecticut River	14	8-04-66	23.0	6.9	--	34	--	5.8	5.8	100	B	C
White River	15	8-11-66	24.0	7.3	--	42	--	10.0	7.0	2,400	B	B,C
Connecticut River	16	9-14-71	21.6	6.8	4.0	50	39	6.9	6.2	430	C	B,C,Pe,Ph,Rc
White River	17	9-16-71	19.5	--	1.0	--	--	--	--	--	C	C,Ph

1/ Source of Data: A - Vermont Department of Water Resources, B - Webster-Martin, Inc., C- U.S. Geological Survey.
2/ Additional Data Available: B - Bacteriological, C - Chemical, Pe - Pesticide, Ph - Physical, Rc - Radiochemical.

PLATE 2. OCCURRENCE OF WATER IN UNCONSOLIDATED DEPOSITS IN THE WHITE RIVER JUNCTION AREA, VERMONT

THICKNESS OF UNCONSOLIDATED DEPOSITS

GROUND-WATER AVAILABILITY IN UNCONSOLIDATED DEPOSITS

GROUND-WATER LEVELS

GROUND WATER RESOURCES OF THE WHITE RIVER JUNCTION AREA, VERMONT

BY
A. L. HODGES, JR., D. BUTTERFIELD, J. W. ASHLEY
1976

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH STATE OF VERMONT
AGENCY OF ENVIRONMENTAL CONSERVATION, DEPARTMENT OF WATER RESOURCES

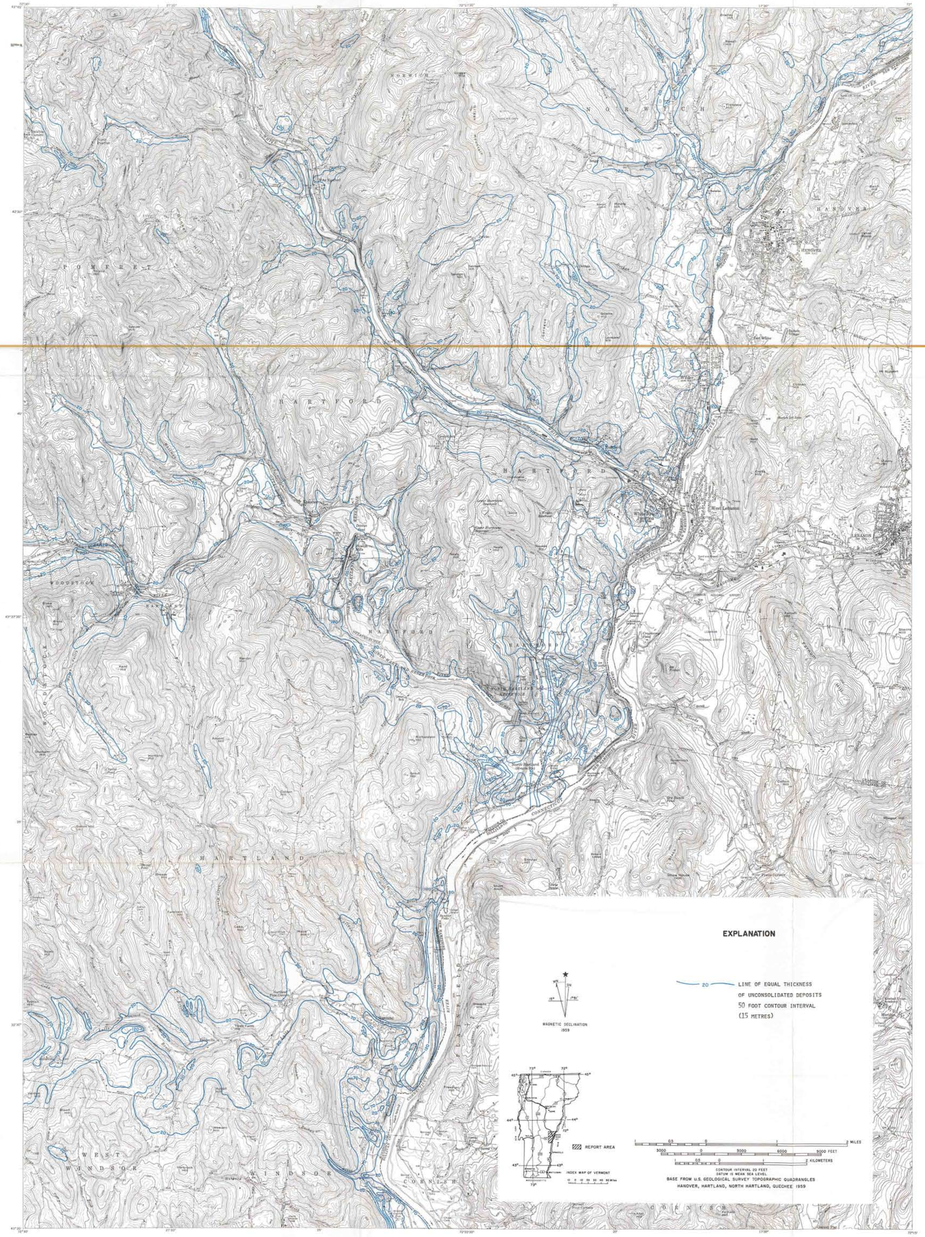

FIGURE 1. - - THICKNESS OF UNCONSOLIDATED DEPOSITS

THICKNESS OF UNCONSOLIDATED DEPOSITS

The thickness of the unconsolidated deposits overlying bedrock in the White River Junction area is illustrated in figure 1. The thickness of these deposits ranges from zero on the many bedrock outcrops to more than 275 ft (84 m) in Hartland (well HLW 12). Thickness and texture of these deposits is important for two reasons. First, they may affect the yield of bedrock wells. Thick deposits of clay or till may restrict recharge into bedrock fractures that are not part of a widespread fracture system, resulting in wells of low yield. Conversely, thick deposits of sand and gravel may act as storage reservoirs supplying underlying bedrock fractures, resulting in bedrock wells of high sustained yield. Second, the cost of constructing a bedrock well is in part determined by the length of casing used to seal off the unconsolidated deposits above the bedrock surface. Knowledge of the length of casing required for a proposed well aids in estimating the cost of the well.

SAND AND GRAVEL AQUIFERS

Deposits of sand and gravel have a higher permeability than any other subsurface materials in the White River Junction area. At places where these deposits contain water, are sufficiently thick, and are connected to a source of recharge, they are capable of yielding large quantities of water to properly constructed wells (Hodges, 1969). Beds of coarse gravel were deposited in the valleys of Lulls Brook, the Ottauquechee River, and the Connecticut River. Tests of an aquifer in Norwich show that the transmissivity is about 12,600 ft^2/d (1,200 m^2/d), and the sustained yield, assuming induced infiltration from the Connecticut River, is conservatively estimated at 4 M gal/day (million gallons per day, or about 15,000 m^3/d). A test well in an aquifer at Hartford had a specific capacity of 17 gal/min/ft (4 l/s/m) and it is estimated that a properly constructed well could produce 1 Mgal/d (3,800 m^3/d) for an indefinite period; infiltration would be induced from the White River or Connecticut River. An aquifer test at Hartland showed the transmissivity to be about 2,000 ft^2/d (190 m^2/d) and the sustained yield of the aquifer is estimated to be about 1 Mgal/d (3,800 m^3/d), assuming induced infiltration from Lulls Brook. Additional information on aquifer testing is given in the accompanying report (Hodges and Butterfield, 1972). Locations of the sand and gravel aquifers having sufficient water-saturated thickness to yield large quantities of water are shown on figure 2. Deposits of sand and gravel with sufficient saturated thickness to yield water for domestic, commercial, or light industrial use are shown on the same figure.

GROUND WATER IN FINE-GRAINED SEDIMENTS

Deposits of fine sand, silt, and clay cover much of the White River Junction area below an elevation of 600 ft (190 m). The most prominent areas include the Connecticut River valley, the Ottauquechee River valley, and Lulls Brook valley. These deposits (fig. 2) have low potential for ground-water development. Even where saturated, they yield water at a very low rate because of their low permeability. Occasional intercalated lenses of coarser grained materials may increase the yield of wells in these deposits.

GROUND WATER IN TILL

Two types of till have been described in the White River Junction area by Stewart and MacClintock (1969). Basal till is a compact gray mixture of material ranging in size from clay to boulders. It is often fissile, suggesting a subglacial origin. Ablation till is a loose mixture of brown sand, cobbles, and boulders containing minor amounts of silt and clay. Stewart and MacClintock ascribe the formation of this material to slow settling of supraglacial debris during ice wasting. Water velocities were assumed to be only fast enough to remove clay and silt while leaving the larger particles undisturbed. Thickness of the till varies from a few feet in the uplands to considerable thickness in the valley underlying the water-sorted sediments.

Most of the water taken from the till aquifer in the project area comes from large-diameter dug wells. Those wells penetrating basal till yield small quantities of water. Permeability of basal till is usually low because of the clay-silt component. If the well reaches the top of underlying bedrock, however, a thin layer of permeable, water-bearing till is commonly found at the till-bedrock interface.

Dug wells finished in ablation till may yield adequate quantities of water for domestic use. Because ablation till has a low percentage of clay and silt, a loost matrix structure, and intercalated lenses of sand, its permeability is higher than that of basal till.

Almost all dug wells supplying water from till are located on hillsides or hilltops above major stream valleys. Unless permeable zones in the till are directly connected to perennial streams, recharge is dependent upon local precipitation, and, during drought, yield may become inadequate to meet domestic demand.

RECHARGE AND DISCHARGE

Water movement into and out of the project area can be expressed by the following equation: $P = R + ET \pm \Delta S$ where P = precipitation, R = runoff, ET = evapotranspiration, and ΔS = change in storage. Precipitation measured at Hanover, New Hampshire, averages 35.8 in (910 mm) per year, and is slightly higher during summer than winter. Average yearly snowfall is 74.5 in (1890 mm) per year, with greater accumulations at higher elevations.

The 35.8 in (910 mm) of precipitation (average) each year leaves the area either as evapotranspiration or as runoff. Evapotranspiration returns the equivalent of about 15 in (380 mm) of this precipitation to the atmosphere each year through direct evaporation of surface water and snow and through transpiration of living organisms. Evapotranspiration is greatest during the spring and summer growing season. Ground-water levels decline during this period (fig. 3), as trees and plants remove water from the soil and release it to the atmosphere as water vapor. Killing frosts in September or October end the yearly growth cycle, and, as transpiration declines, ground-water levels begin to rise.

Approximately 21 in (530 mm) of precipitation per year leaves the area as runoff; runoff includes water that runs directly over the land surface and water that seeps into the ground, recharges aquifers, and moves to points of discharge in the streams. Ground-water discharge to streams forms a significant proportion of the total streamflow and sustains streamflow during drought and periods below freezing temperature.

When water in a stream is higher than the water table in adjacent permeable materials, stream water may move into these materials, raising the water table. Wells in an aquifer adjacent to a river commonly have high sustained yields because pumping lowers the water table and induces water to flow from the river into the ground.

Monthly measurements of water levels in two wells in the White River Junction area (fig. 3) reflect the continuous change of storage in the ground-water body. These wells are in unconfined aquifers and therefore respond rapidly to local recharge. Normally, water levels are highest in March or April, coinciding with melting of the snow pack and break-up of ice in the rivers, and lowest in September and October, at the end of the growing season. This sequence, however, can be modified substantially by excessive rainfall or prolonged drought.

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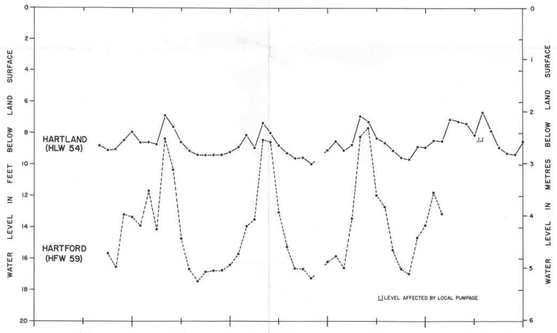
FIGURE 3. - - GROUND-WATER LEVELS IN THE WHITE RIVER JUNCTION AREA



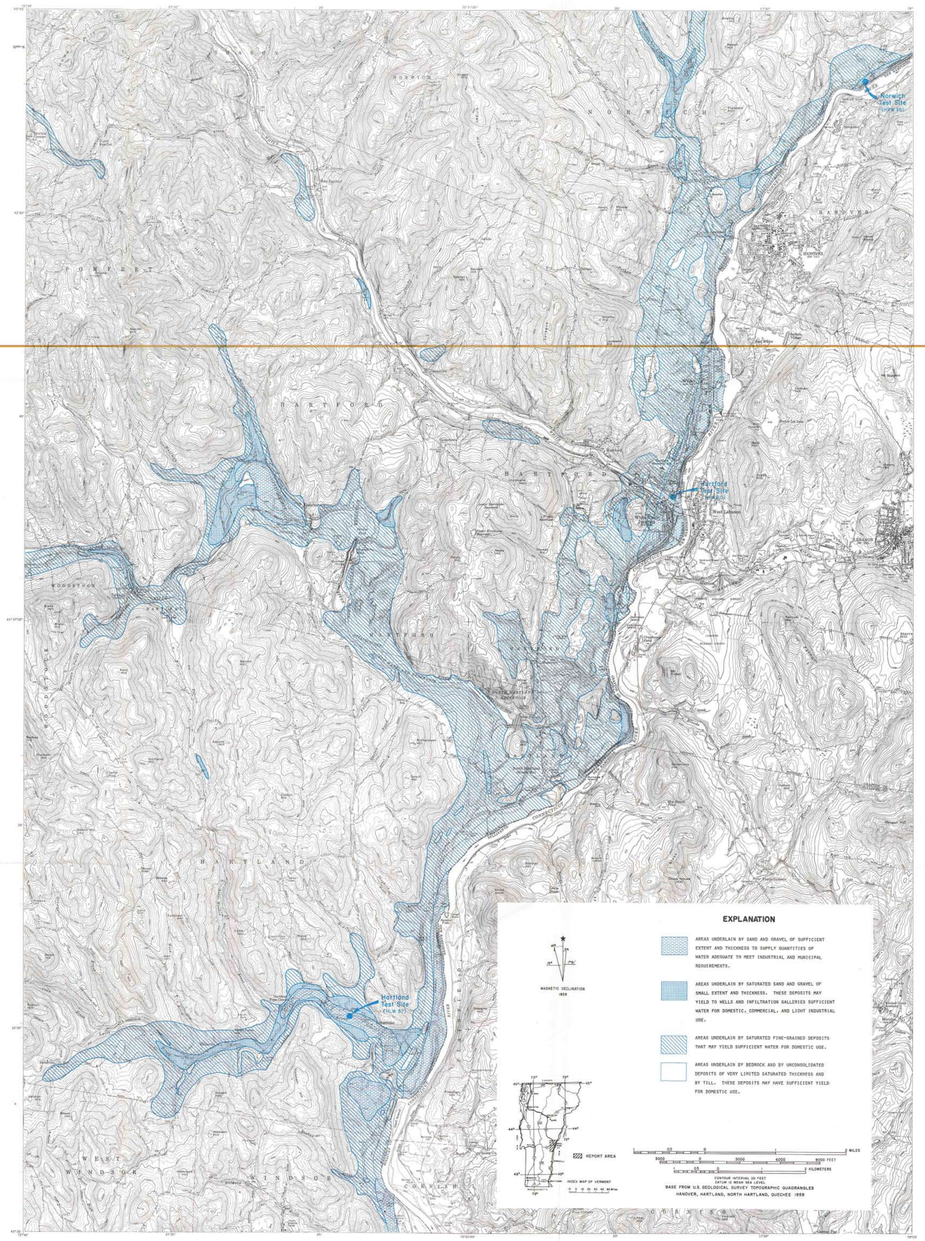


FIGURE 2. - - GROUND-WATER AVAILABILITY IN UNCONSOLIDATED DEPOSITS

PLATE 3. BASIC DATA FOR THE WHITE RIVER JUNCTION AREA, VERMONT

LOCATION OF DATA POINTS

TEST BORING INFORMATION

DESCRIPTION OF SELECTED WELLS

GROUND WATER RESOURCES OF THE WHITE RIVER JUNCTION AREA, VERMONT

BY
A. L. HODGES, JR., D. BUTTERFIELD, J. W. ASHLEY
1976

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH STATE OF VERMONT
AGENCY OF ENVIRONMENTAL CONSERVATION, DEPARTMENT OF WATER RESOURCES

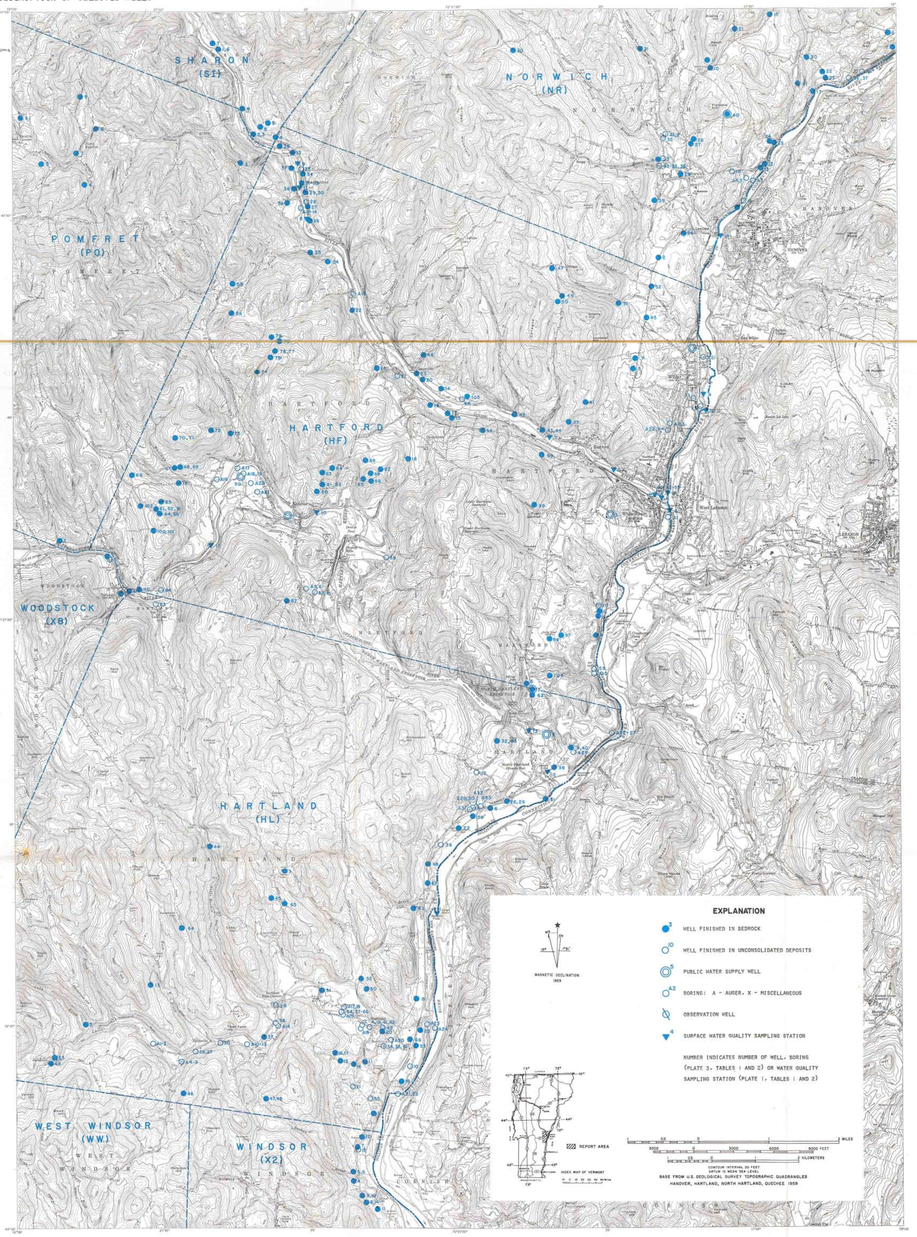


FIGURE 1. - - LOCATION OF DATA POINTS

TABLE 1. - - DESCRIPTION OF SELECTED WELLS, TEST WELLS, AND BORINGS

LOCAL WELL NUMBER: LETTER PREFIX INDICATES--a. U.S. GEOLOGICAL SURVEY AUGER BORING; b. DRIVEN BORING; e. REACHAY BORING; w. WELL ON TEST WELL; x. MISCELLANEOUS TEST BORING.

LATITUDE-LONGITUDE: NUMBER FOLLOWING DECIMAL POINT IS A SEQUENTIAL NUMBER FOR WELLS OR BORINGS IN A 1-SECOND GRID.

ALTITUDE OF LAND-SURFACE DATUM: ALTITUDES ARE EXPRESSED IN FEET ABOVE MEAN SEA LEVEL.

METHOD DRILLED: a. AIR-ROTARY; b. BORED OR AUGERED; c. CABLE TOOL; D. DUG; H. HYDRAULIC-ROTARY; J. JETTED; P. AIR-PERCUSSION; R. REVERSE-ROTARY; T. TRENCHED; W. DRIVEN; WJ. DRIVEN-JETTED.

WELL FINISH: C. POROUS CONCRETE; P. GRAVEL WALL WITH PERFORATED OR SLOTTED CASING; G. GRAVEL WALL WITH COMMERCIAL SCREEN; N. NONE; O. OPEN HOLE; S. SAND WALL WITH PERFORATED OR SLOTTED CASING; S. SCREEN; T. SAND POINT; W. WALLED OR SHORED. A. OPEN HOLE IN AQUIFER (GENERALLY CASED TO AQUIFER).

WELL DEPTH: DEPTH OF FINISHED WELL IN FEET BELOW LAND SURFACE.

USE: A. ABSEN; D. DRAINAGE; E. DESIRED HOLE; H. HEAT RESERVOIR; O. OBSERVATION; P. OIL OR GAS; R. RECHARGE; T. TEST; U. UNUSED; W. WATER WITHDRAWAL; X. WASTE DISPOSAL; Z. DESTROYED.

WATER-BEARING MATERIAL: PRINCIPAL WATER-BEARING ZONE.

ADDITION SYMBOL CHARACTERS:
1 VERY FINE GRAINED
2 FINE GRAINED
3 MEDIUM GRAINED
4 COARSE GRAINED
5 VERY COARSE GRAINED
6 CLAYEY
7 SILTY
8 SANDY
9 GRAVELLY
0 CAVERNOUS
A CONSOLIDATED
B BOULDERS
C CALCAREOUS
D DOLOMITIC
E CONCRETIONARY
F IRONSTAINED IN IRON CEMENTED
G GLAUCONITIC
H HARD
I INTERBEDDED
J JOINTED OR FRACTURED
K COLUMNAR
L LAMINATED OR BANDED
M MARLY
N NODULAR
O ORGANIC
P PEBBLES, SORTED
Q CHERTY OR SILICEOUS
R REDDED
S SHALY
T "SALT AND PEPPER"
U UNCONSOLIDATED
V VOLCANIC CENTER
W WELL CONSOLIDATED
X CROSS BEDDED
Y YELLOW OR BUFF
Z WEATHERED

LITHOLOGY (SECOND CHARACTER)
A ALLUVIUM
B BITUMINOUS ROCK;
BRECCIA(FIRST)
C CONGLOMERATE
D DOLOMITE
E EPIDOTE OR AMPHIBITE
F SHALE
G GRAVEL
I IGNEOUS, GRANULAR (SABBRO, GRANITE, ETC.)
J JASPER, CHERT, FLINT
K KLAGIF (BASALT, ETC.)
L LIMESTONE
M MARL, CLAY BALL, MUD
N METAMORPHIC, COARSE GRAINED (GNEISS, MARBLE, ETC.)
O METAMORPHIC, FINE GRAINED (SCHIST, SLATE)
P PEBBLES
S SILT OR LOESS
R SAND AND GRAVEL
T TILL
U UNCONSOLIDATED SEDIMENT
V VOLCANIC
W SILTSTONE
X SILTY SAND
Y CLAYEY SAND
Z SHALE

WATER LEVEL: LEVELS ARE GIVEN IN FEET BELOW LAND SURFACE; "+" INDICATES WATER LEVEL ABOVE LAND SURFACE; "F" INDICATES FLOWING WELL.

WATER USE: A. AIR CONDITIONING; B. BOTTLING; C. COMMERCIAL; D. DEWATERING; F. POWER GENERATION; F. FIRE PROTECTION; G. GARDEN; I. IRRIGATION; M. MEDICINAL; N. INDUSTRIAL; INCLUDING BOILERS; R. RECREATION; S. SCHOOL; SW. STOCK; T. INSTITUTIONAL; U. UNUSED; V. REFRIGERATION; W. RECHARGE; X. DESALINATION-PUBLIC SUPPLIES; Y. DESALINATION-OTHER SUPPLIES.

PUMPAGE/YIELD: IN GALLONS PER MINUTE (GPM/MIN).

PUMPAGE/DRAWDOWN: THE DIFFERENCE BETWEEN STATIC WATER LEVEL AND PUMPING LEVEL.

PUMPAGE/TIME: THE FOLLOWING CODES ARE USED FOR PUMPING PERIODS OF LESS THAN 1 HOUR: A. THROUGH 15 MINUTES; B. 16 TO 30 MINUTES; C. 31 TO 45 MINUTES; D. 46 TO 59 MINUTES.

LOG: D. DRILLER'S LOG; E. ELECTRIC LOG; G. GEOLOGIST'S LOG (*LOG AVAILABLE IN TABLE 2).

DQ: TYPE OF CHEMICAL ANALYSIS AVAILABLE IN TABLE 2. PLATE 1. C. COMPLETE; J. CONDUCTANCE AND CHLORIDE; K. CONDUCTANCE; L. CHLORIDE; M. MULTIPLE (INCLUDES ONE COMPLETE AND ONE OR MORE PARTIALS); P. PARTIAL.

LOCAL WELL NUMBER	LATITUDE-LONGITUDE	ALTITUDE OF LSD (FT)	OWNER OR USER	YEAR/METHOD DRILLED	DIAM-ETER (IN)	WELL DEPTH (FT)	WATER-BEARING MATERIAL	FEET TO BEARING ZONE	WATER-LEVEL (FT)	WATER USE	PUMPAGE YIELD/TIME (GPM/MIN)	DD	LOG
HARTFORD (HF)													
A 3	433944072195.3	365	US GEOL SURVEY	1969 D	4	79	--	--	--	U	--	DQ*	--
A 4	433944072193.4	430	US GEOL SURVEY	1969 D	4	107	--	--	--	U	--	DQ*	--
A 5	433950072193.5	430	US GEOL SURVEY	1969 D	4	107	--	--	--	U	--	DQ*	--
A 6	433950072191.6	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 7	433953072192.7	430	US GEOL SURVEY	1969 D	4	79	--	--	--	U	--	DQ*	--
A 8	433954072192.8	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 9	433954072191.9	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 10	433957072190.0	430	US GEOL SURVEY	1969 D	4	79	--	--	--	U	--	DQ*	--
A 11	433957072189.1	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 12	433957072188.2	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 13	433957072187.3	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 14	433957072186.4	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 15	433957072185.5	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 16	433957072184.6	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 17	433956072183.7	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 18	433956072182.8	430	US GEOL SURVEY	1969 D	4	80	--	--	--	U	--	DQ*	--
A 19	433956072181.9	430	PENNING HORSTS	1969 D	4	80	--	--	--	U	--	DQ*	--
A 20	433956072180.0	430	HARVEY JAMES H	1969 D	4	80	--	--	--	U	--	DQ*	--
A 21	433956072179.1	430	GILMAN ELLEN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 22	433956072178.2	430	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 23	433956072177.3	430	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 24	433956072176.4	430	STUDENS H	1969 D	4	80	--	--	--	U	--	DQ*	--
A 25	434000072175.5	430	ALDRICH ROBERT	1972 C	6	120	--	--	--	U	--	--	--
A 26	434000072174.6	430	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	--	--
A 27	434000072173.7	430	BRUNER EDWARD	1969 D	4	80	--	--	--	U	--	--	--
A 28	434000072172.8	430	LUCE ALBERT L	1967 P	6	544	10	--	50	--	--	--	--
A 29	434000072171.9	430	LUCE ALBERT L	1967 P	6	544	10	--	50	--	--	--	--
A 30	434000072170.0	430	LUCE ALBERT L	1966 C	6	80	--	--	--	--	--	--	--
A 31	434000072169.1	430	LUCE ALBERT L	1966 C	6	80	--	--	--	--	--	--	--
A 32	434000072168.2	430	PENNING HORSTS	1969 D	4	80	--	--	--	U	--	DQ*	--
A 33	434000072167.3	430	HARVEY JAMES H	1969 D	4	80	--	--	--	U	--	DQ*	--
A 34	434000072166.4	430	GILMAN ELLEN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 35	434000072165.5	430	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 36	434000072164.6	430	WEIDEL FRANK	1967 P	6	245	91	--	55	2-6F	30	--	D
A 37	434000072163.7	430	MIDWOOD GEORGE	1969 D	4	80	--	--	--	U	--	DQ*	--
A 38	434000072162.8	430	BURCH DONALD	--- D	4	12	--	--	--	U	--	--	--
A 39	434000072161.9	430	BURCH DONALD	--- D	4	12	--	--	--	U	--	--	--
A 40	434000072160.0	430	JOHNSON CARL	1966 D	4	80	--	--	--	U	--	DQ*	--
A 41	434000072159.1	430	METZIS ROBERT	1969 P	6	156	7	7	20	1-6	3	--	D
A 42	434000072158.2	430	FOGG NELSON	1969 P	6	73	12	0	5-6F	2	1	--	--
A 43	434000072157.3	430	CLIFFORD GARAGE	1967 P	6	73	12	0	5-6F	2	1	--	--
A 44	434000072156.4	430	CLIFFORD GARAGE	1966 P	6	73	12	0	5-6F	2	1	--	--
A 45	434000072155.5	430	CLIFFORD ERWIN	1966 P	6	220	5	--	5	2	--	--	--
A 46	434000072154.6	430	CARPENTER H	1967 P	6	215	6	15	--	10	11-6F	3	D
A 47	434000072153.7	430	KENYON RALPH J	1967 P	6	215	6	15	--	10	11-6F	3	D
A 48	434000072152.8	430	KENYON RALPH J	1967 P	6	215	6	15	--	10	11-6F	3	D
A 49	434000072151.9	430	KENYON WENDELL	1967 P	6	245	5	5	--	5	2	--	--
A 50	434000072150.0	430	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 51	434000072149.1	430	DRAKE HARMON	1969 D	4	80	--	--	--	U	--	DQ*	--
A 52	434000072148.2	430	NEIL DAVID	1965 D	4	50	30	--	30	--	--	--	--
A 53	434000072147.3	430	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 54	434000072146.4	430	JOHNSON CARL	1966 D	4	80	--	--	--	U	--	DQ*	--
A 55	434000072145.5	430	TAYLOR AND CARL	1966 D	4	211	9	37	--	--	--	--	--
A 56	434000072144.6	430	DIGRAZIGNANI M	1967 D	4	80	7	25	--	5	-67	C	D
A 57	434000072143.7	430	POTTERS MOTOR	1967 C	6	87	8	25	--	5	-67	C	D
A 58	434000072142.8	430	POTTERS MOTOR	1967 C	6	87	8	25	--	5	-67	C	D
A 59	434000072141.9	370	HAYNES LUCILLE	1969 D	4	80	--	--	--	U	5-6F	--	--
A 60	434139072195.5	550	BILLINGS DAIRY	1969 P	6	200	9	55	--	11	10-6E	5	--
A 61	434134072193.5	620	HEYSHONE EVERN	1967 P	6	263	9	122	--	7	5-6A	8	25
A 62	434134072191.5	630	ABBOTT ALBERT A	1969 P	6	263	9	122	--	7	5-6A	8	25
A 63	434134072189.5	640	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 64	434134072187.5	650	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 65	434134072185.5	660	DOW H HAYWARD	1968 P	6	80	10	--	--	--	--	--	--
A 66	434134072183.5	670	HAYNES LUCILLE	1969 D	4	80	--	--	--	U	--	DQ*	--
A 67	434134072181.5	680	MAZZA-MAS-TONY	1967 P	6	80	10	--	--	--	--	--	--
A 68	434134072179.5	690	MOURNS FRED	1967 P	6	80	10	--	--	--	--	--	--
A 69	434134072177.5	700	OLSON ELLA A	1967 P	6	80	10	--	--	--	--	--	--
A 70	434134072175.5	710	CARPENTER H	1967 P	6	200	9	15	--	5	2	--	--
A 71	434134072173.5	720	CARPENTER H	1967 P	6	200	9	15	--	5	2	--	--
A 72	434134072171.5	730	DRAKE HARMON	1969 D	4	80	--	--	--	U	--	DQ*	--
A 73	434134072169.5	740	NEIL DAVID	1965 D	4	50	30	--	30	--	--	--	--
A 74	434134072167.5	750	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 75	434134072165.5	760	JOHNSON CARL	1966 D	4	80	--	--	--	U	--	DQ*	--
A 76	434134072163.5	770	TAYLOR AND CARL	1966 D	4	211	9	37	--	--	--	--	--
A 77	434134072161.5	775	DIGRAZIGNANI M	1967 D	4	80	7	25	--	5	-67	C	D
A 78	434134072159.5	780	POTTERS MOTOR	1967 C	6	87	8	25	--	5	-67	C	D
A 79	434134072157.5	790	POTTERS MOTOR	1967 C	6	87	8	25	--	5	-67	C	D
A 80	434134072155.5	800	HAYNES LUCILLE	1969 D	4	80	--	--	--	U	5-6F	--	--
A 81	434134072153.5	810	BILLINGS DAIRY	1969 P	6	200	9	55	--	11	10-6E	5	--
A 82	434134072151.5	820	HEYSHONE EVERN	1967 P	6	263	9	122	--	7	5-6A	8	25
A 83	434134072149.5	830	ABBOTT ALBERT A	1969 P	6	263	9	122	--	7	5-6A	8	25
A 84	434134072147.5	840	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 85	434134072145.5	850	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 86	434134072143.5	860	DOW H HAYWARD	1968 P	6	80	10	--	--	--	--	--	--
A 87	434134072141.5	870	HAYNES LUCILLE	1969 D	4	80	--	--	--	U	--	DQ*	--
A 88	434134072139.5	880	MAZZA-MAS-TONY	1967 P	6	80	10	--	--	--	--	--	--
A 89	434134072137.5	890	MOURNS FRED	1967 P	6	80	10	--	--	--	--	--	--
A 90	434134072135.5	900	OLSON ELLA A	1967 P	6	80	10	--	--	--	--	--	--
A 91	434134072133.5	910	CARPENTER H	1967 P	6	200	9	15	--	5	2	--	--
A 92	434134072131.5	920	CARPENTER H	1967 P	6	200	9	15	--	5	2	--	--
A 93	434134072129.5	930	DRAKE HARMON	1969 D	4	80	--	--	--	U	--	DQ*	--
A 94	434134072127.5	940	NEIL DAVID	1965 D	4	50	30	--	30	--	--	--	--
A 95	434134072125.5	950	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 96	434134072123.5	960	JOHNSON CARL	1966 D	4	80	--	--	--	U	--	DQ*	--
A 97	434134072121.5	970	TAYLOR AND CARL	1966 D	4	211	9	37	--	--	--	--	--
A 98	434134072119.5	980	DIGRAZIGNANI M	1967 D	4	80	7	25	--	5	-67	C	D
A 99	434134072117.5	990	POTTERS MOTOR	1967 C	6	87	8	25	--	5	-67	C	D
A 100	434134072115.5	1000	POTTERS MOTOR	1967 C	6	87	8	25	--	5	-67	C	D
A 101	434134072113.5	1010	HAYNES LUCILLE	1969 D	4	80	--	--	--	U	5-6F	--	--
A 102	434134072111.5	1020	BILLINGS DAIRY	1969 P	6	200	9	55	--	11	10-6E	5	--
A 103	434134072109.5	1030	HEYSHONE EVERN	1967 P	6	263	9	122	--	7	5-6A	8	25
A 104	434134072107.5	1040	ABBOTT ALBERT A	1969 P	6	263	9	122	--	7	5-6A	8	25
A 105	434134072105.5	1050	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 106	434134072103.5	1060	HARTFORD TOWN	1969 D	4	80	--	--	--	U	--	DQ*	--
A 107	434134072101.5	1070	DOW H HAYWARD	1968 P	6	80	10	--	--	--	--	--	--
A 108	434134072099.5	1080	MAZZA-MAS-TONY	1967 P	6	80	10	--	--	--	--	--	--
A 109	434134072097.5	1090	MOURNS FRED	1967 P	6	80	10	--	--	--	--	--	--
A 110	434134072095.5	1100	OLSON ELLA A	1967 P	6	80	10	--	--	--	--	--	--
A 111	434134072093.5	1110	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 112	434134072091.5	1120	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 113	434134072089.5	1130	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 114	434134072087.5	1140	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 115	434134072085.5	1150	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 116	434134072083.5	1160	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 117	434134072081.5	1170	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 118	434134072079.5	1180	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 119	434134072077.5	1190	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 120	434134072075.5	1200	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 121	434134072073.5	1210	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 122	434134072071.5	1220	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 123	434134072069.5	1230	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 124	434134072067.5	1240	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 125	434134072065.5	1250	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 126	434134072063.5	1260	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 127	434134072061.5	1270	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 128	434134072059.5	1280	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 129	434134072057.5	1290	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 130	434134072055.5	1300	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 131	434134072053.5	1310	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 132	434134072051.5	1320	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 133	434134072049.5	1330	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 134	434134072047.5	1340	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 135	434134072045.5	1350	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 136	434134072043.5	1360	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 137	434134072041.5	1370	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 138	434134072039.5	1380	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 139	434134072037.5	1390	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 140	434134072035.5	1400	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 141	434134072033.5	1410	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 142	434134072031.5	1420	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 143	434134072029.5	1430	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 144	434134072027.5	1440	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 145	434134072025.5	1450	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 146	434134072023.5	1460	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 147	434134072021.5	1470	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 148	434134072019.5	1480	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 149	434134072017.5	1490	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 150	434134072015.5	1500	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 151	434134072013.5	1510	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 152	434134072011.5	1520	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 153	434134072009.5	1530	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 154	434134072007.5	1540	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 155	434134072005.5	1550	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 156	434134072003.5	1560	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 157	434134072001.5	1570	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 158	434134071999.5	1580	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 159	434134071997.5	1590	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 160	434134071995.5	1600	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 161	434134071993.5	1610	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 162	434134071991.5	1620	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 163	434134071989.5	1630	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 164	434134071987.5	1640	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 165	434134071985.5	1650	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 166	434134071983.5	1660	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 167	434134071981.5	1670	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 168	434134071979.5	1680	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 169	434134071977.5	1690	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 170	434134071975.5	1700	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 171	434134071973.5	1710	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 172	434134071971.5	1720	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 173	434134071969.5	1730	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 174	434134071967.5	1740	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 175	434134071965.5	1750	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 176	434134071963.5	1760	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 177	434134071961.5	1770	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15
A 178	434134071959.5	1780	QUECHEE LAKES	1973 P	6	135	4	5	--	1	1-7J	8	15