STATE OF NEW YORK
CONSERVATION DEPARTMENT
WATER RESOURCES COMMISSION

GROUND-WATER RESOURCES IN THE VICINITY OF THE CROWN POINT FISH HATCHERY ESSEX COUNTY, NEW YORK

By

I. H. KANTROWITZ
U.S. GEOLOGICAL SURVEY

REPORT OF INVESTIGATION
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Prepared by
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

in cooperation with
NEW YORK STATE CONSERVATION DEPARTMENT

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INTRODUCTION

The Crown Point Fish Hatchery, one of several hatcheries operated by the New York State Conservation Department, is located in Crown Point Center, Essex County, on the eastern edge of the Adirondack Highlands and about 2 miles west of Lake Champlain. Figure 1 is a location map of the vicinity of the Hatchery. This report summarizes an investigation by the U.S. Geological Survey, in cooperation with the New York State Conservation Department, Division of Water Resources, to locate and evaluate sources of additional ground-water supply for the Hatchery. In order to expand the facilities at the Hatchery, an additional water supply of about 100 gpm (gallons per minute) to as much as 350 gpm is needed. In addition, the type of fish culture practiced requires a water temperature of about 7 to 13 degrees Celsius (centigrade) for optimum results.

The cooperation and assistance of the New York State Department of Transportation, Bureau of Soil Mechanics, the New York State Education Department, Museum and Science Service, and G. A. Connally of the State University of New York at New Paltz, during this study are gratefully acknowledged. Much of the preliminary field work was done by G. L. Giese and W. A. Hobba, Jr., U.S. Geological Survey, as part of a water-resources study of the Lake Champlain basin. The field work was supervised by R. C. Heath, former district chief of the Water Resources Division, U.S. Geological Survey. G. G. Parker, district chief, supervised the preparation of this report.

1/ Hydrologist, U.S. Geological Survey, Albany, N. Y.

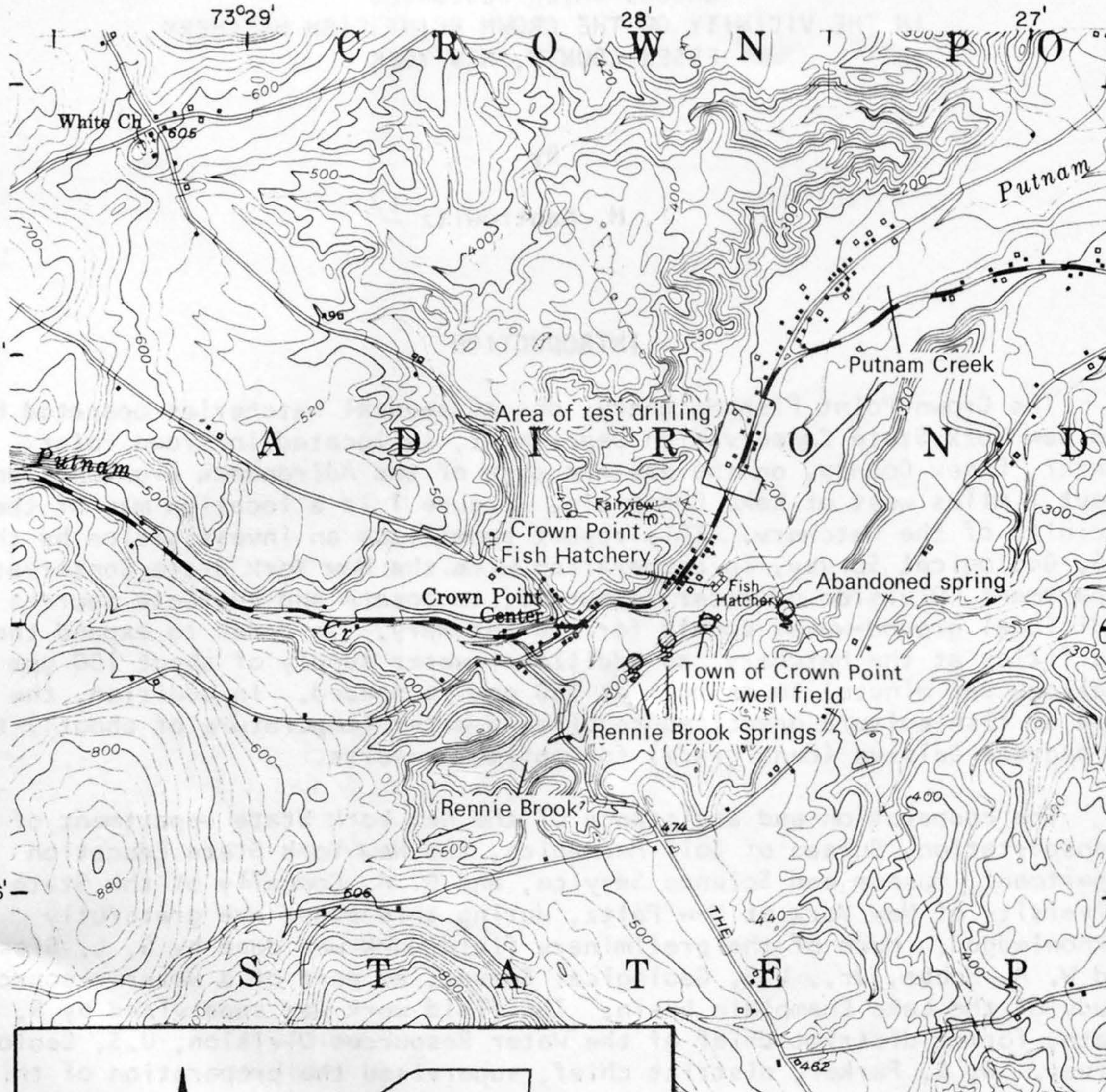

Figure 1.--Vicinity of the Crown Point Fish Hatchery.

EXISTING WATER SUPPLIES

Water presently used at the Crown Point Fish Hatchery is derived from four sources. These are: (1) overflow from the Town of Crown Point well field, (2) overflow from an abandoned spring formerly used by the town, (3) diversion from Putnam Creek, and (4) spring seepage from the Rennie Brook Springs. The locations of these sources are shown in figure 1. It is estimated that present water use at the Hatchery varies from about 150 to 350 gpm.

The amount of overflow from the present and former town supplies is subject to the manner of operation of the system and varies from 15 to 30 gpm. Putnam Creek, even at times of low flow, generally has a sufficient flow to satisfy the current and anticipated water needs of the Hatchery -- the minimum average flow during a consecutive 7-day period is estimated to be less than 1,700 gpm on the average of only once every 10 years (written communication, G. L. Giese, 1967). The temperature of the water from Putnam Creek, however, has a wide range of seasonal fluctuation and is frequently either too warm or too cold to be used.

The Rennie Brook Springs are the principal source of water for the Hatchery. The supply consists of seepage from several areas along the hillside south of Rennie Brook. The seepage is collected by a shallow drainage ditch which empties into a small open reservoir. From the reservoir the water flows by pipe into the Hatchery water-supply system. It is estimated that the average yield of the Rennie Brook Springs is about 140 gpm. The temperature of the water is about 7°C.

SOURCES OF ADDITIONAL WATER SUPPLY

Recent well records collected in the eastern half of the Adirondack Highlands indicated that the majority of wells drilled into crystalline bedrock yield about 10 gpm -- the maximum known yield is 35 gpm (written communication, W. A. Hobba, Jr., 1967). Therefore, in this investigation the bedrock was disregarded as a source of potential ground-water supply.

Unconsolidated deposits mantle much of the bedrock in the vicinity of the Hatchery. Figure 2 shows the nature and areal distribution of the principal deposits. The outwash and ice-contact deposits are the only deposits with sufficient permeability to be regarded as potential sources of ground water for the Hatchery. Development of a water supply in the outwash deposits would have required about 1.5 miles of pipeline to bring the water to the Hatchery. Conservation Department personnel felt that it was not economically feasible to pipe water more than about 0.5 mile. Therefore, the investigation was limited to the ice-contact deposits within a 0.5-mile radius of the Hatchery.

Rennie Brook Springs

The Rennie Brook Springs occur along the contact of the ice-contact deposits and the underlying bedrock southwest of the Hatchery. Bedrock is exposed, in places, along Rennie Brook and the drainage ditch but not in the hillside at the springheads. It seemed possible that a significant quantity of ground water could be moving beneath the drainage ditch and discharging into Rennie Brook. Seismic profiles run by the Bureau of Soil Mechanics, however, indicated that bedrock was within 4 feet of the bottom of the drainage ditch. Also, a series of streamflow measurements along Rennie Brook indicated that no ground water was reaching the stream in the reach adjacent to the springs. Test trenching in the area west of the spring seepage showed that the ice-contact deposits were thin and contained no water. It, therefore, appears unlikely that the yield of the Rennie Brook Springs can be increased.

Putnam Creek Valley

A seismic survey conducted by the Bureau of Soil Mechanics revealed a thick sequence of unconsolidated deposits in Putnam Creek valley northeast of the Hatchery. These deposits apparently fill a preglacial valley in the underlying bedrock surface. The axis of this valley is approximately coincident with the road north of the present stream channel. Streamflow measurements made in the summer of 1966 indicated that Putnam Creek loses a total of 800 gpm in the 2,500-foot reach downstream from the Hatchery. Also, water levels in test trenches dug in the alluvium adjacent to the stream were below the bottom of the stream channel. These data indicate that permeable material is present in the valley.

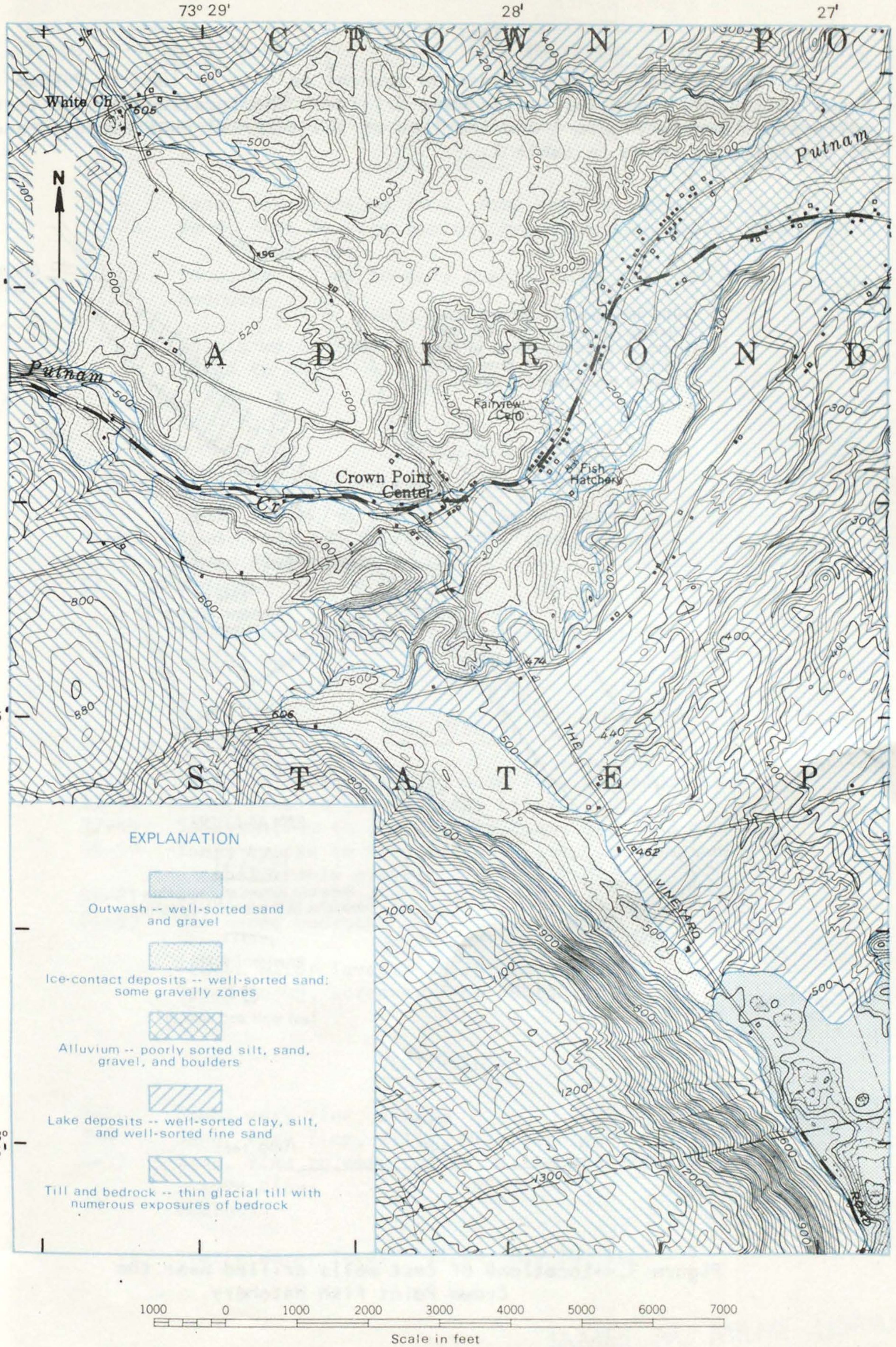

Figure 2.--Distribution of unconsolidated deposits in the vicinity of the Crown Point Fish Hatchery.

Test Drilling

Drilling options were obtained on several parcels of land in Putnam Creek valley and seven test wells were drilled. The locations of the test wells are shown in figure 3 and the logs of the material penetrated in each of the wells is shown in table 1.

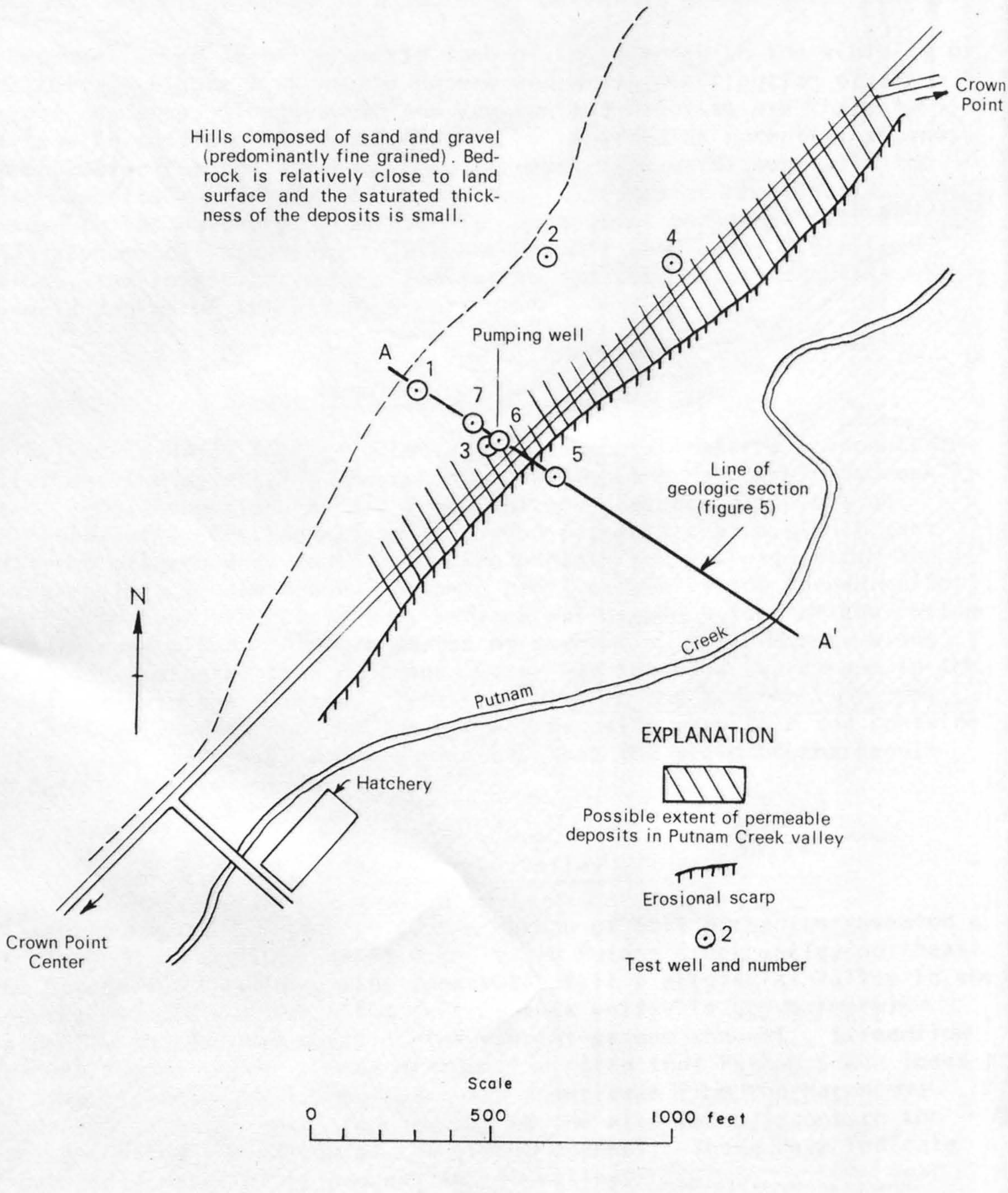

Figure 3.--Locations of test wells drilled near the Crown Point Fish Hatchery.

Table 1.--Logs of test wells drilled near the Crown Point Fish Hatchery

(All measurements, in feet below land surface)

TEST WELL 1

0-14	Sand, very fine to fine, some silt and clay
14-28	Sand, fine to very coarse, gravel and boulders, some silt and clay
28-65	Sand, very fine to very coarse, some silt and clay
65	Bedrock

Static water level: 42.91, May 24, 1967
Cased to 64

TEST WELL 2

0-8	Sand, very fine, silty
8-41	Sand, very fine to fine, silt and clay
41-45	Sand, fine to coarse, silty, some gravel
45-51	Sand, fine, silty
51	Bedrock

Static water level: 31.0, March 22, 1967
Casing pulled

TEST WELL 3

0-13	Sand, very fine, silty, some fine to medium sand
13-37	Sand, fine to very coarse, silty
37-44	Sand, medium to very coarse, some silt and gravel
44-59	Sand, coarse to very coarse, some fine sand and silt, considerable gravel
59-81	Sand, fine, silty
81-97	Weathered bedrock

Static water level: 29.25, May 24, 1967
Cased to 49, screened from 49 to 59

TEST WELL 4

0-2	Sand, very fine, silty
2-4	Sand, very fine, silty, with cobbles
4-39	Sand, fine to very coarse, silty and gravelly, some clay
39	Bedrock

Static water level: 21.64, May 24, 1967

Table 1.--Logs of test wells drilled near the Crown Point Fish Hatchery (Continued)

TEST WELL 5

0-47	Sand, fine to very coarse, gravelly, considerable silt, clay and boulders
47	Bedrock
	Static water level: 8.85, May 24, 1967

TEST WELL 6

0-12	Sand, very fine, some clay and silt
12-47	Sand, medium to coarse, some silt and gravel
47-59	Sand, medium to very coarse, gravelly
59-61	Sand, fine to medium
	Static water level: 30.11, May 24, 1967
	Cased to 48, screened from 48 to 58

TEST WELL 7

0-12	Sand, very fine, clayey and silty
12-42	Sand, fine to very coarse, silty and clayey, some boulders
42-47	Sand and gravel, some silt
47-55	Sand, fine to coarse, clayey and silty
	Static water level: 33.96, May 24, 1967
	Cased to 45

Based on streamflow measurements and ground-water levels it appears likely that any aquifer present in the valley would receive part of its recharge by seepage from Putnam Creek. Such stream infiltration might result in ground-water temperatures that at times would be unsatisfactory for use at the Hatchery. The effect of stream infiltration on ground-water temperature decreases with increasing distance from the stream. Therefore, test wells 1 and 2 were drilled as far from the stream as possible. These wells penetrated saturated deposits that were too fine grained and too thin to be considered for potential water supplies. Test well 3 was then drilled at a site 250 feet closer to the stream where the seismic data indicated that the unconsolidated deposits were thickest. This well penetrated a layer of water-bearing sand and gravel in which a well screen was installed from 49 to 59 feet below land surface. The well was test pumped for 3 hours but could not sustain a yield of 50 gpm. The low yield of the well was believed to be caused by incomplete development of the screened zone -- possibly caused by caving of the bore hole -- rather than a reflection of the water-bearing characteristics of the aquifer.

Test wells 4 and 5 were drilled to determine the extent of the aquifer. Both wells failed to penetrate favorable water-bearing material, indicating that the aquifer is not extensive throughout the valley. Because of difficulty of access and lack of permission to drill, it was not possible to further explore the extent of the aquifer.

In order to determine the perennial yield of the aquifer it was necessary to run a controlled aquifer test -- that is, to pump one well at a constant rate and observe the water-level decline (drawdown) in nearby wells. By means of such a test we are able to measure the ability of the aquifer to store and transmit water. Aquifer-test data also can be used to determine the location and nature of aquifer boundaries. Test well 6 was drilled 13 feet away from well 3 to serve as the pumping well. This well was finished with an 80-slot screen -- designed to pass sand grains smaller than 0.08 inch in diameter -- between 48 and 59 feet below land surface. Preliminary test pumping indicated that the well could sustain a yield of at least 50 gpm. Water temperature during the test and during all subsequent tests was 9° C. Test well 7 was drilled 85 feet away from well 6 to serve as an additional observation well during the aquifer test.

The aquifer test was conducted for an 8-hour period on May 24, 1967; budget and contract limitations precluded a longer test. Well 6 was pumped at a constant rate of 105 gpm during the 8-hour period and water levels were periodically measured in all the wells. Figure 4 shows the trend of the water levels in well 3 (the principal observation well) and well 6 (the pumping well) during and after the aquifer test.

Based on the data from the aquifer test and a preliminary 3-hour test on May 17, the coefficient of transmissibility of the aquifer is approximately 57,000 gallons per day per foot of aquifer width; the coefficient of storage is about 0.26. These data indicate a permeable water-table aquifer. The test data also indicate that an impermeable boundary exists approximately 50 feet from well 6. The test was not run long enough to determine the presence of additional impermeable boundaries or a recharge boundary (hydraulic connection with Putnam Creek).

Aquifer Yield

The perennial yield of the aquifer may be defined as the maximum rate of pumpage that can be sustained for a prolonged period of no recharge (assumed here to be 200 days) without exceeding the available drawdown in the aquifer; provided also that this discharge rate does not exceed the average rate of water replenishment (recharge) to the aquifer. Thus, there are two factors affecting aquifer yield: (1) the physical response of the aquifer to pumping, and (2) the maximum recharge available to the aquifer.

Response of the aquifer to pumping

Using the coefficients of transmissibility and storage it is possible to compute the maximum pumping rate that can be sustained for a period of 200 days without lowering the water level in the aquifer below the top of the well screen. Such computations must take into account the lowering of

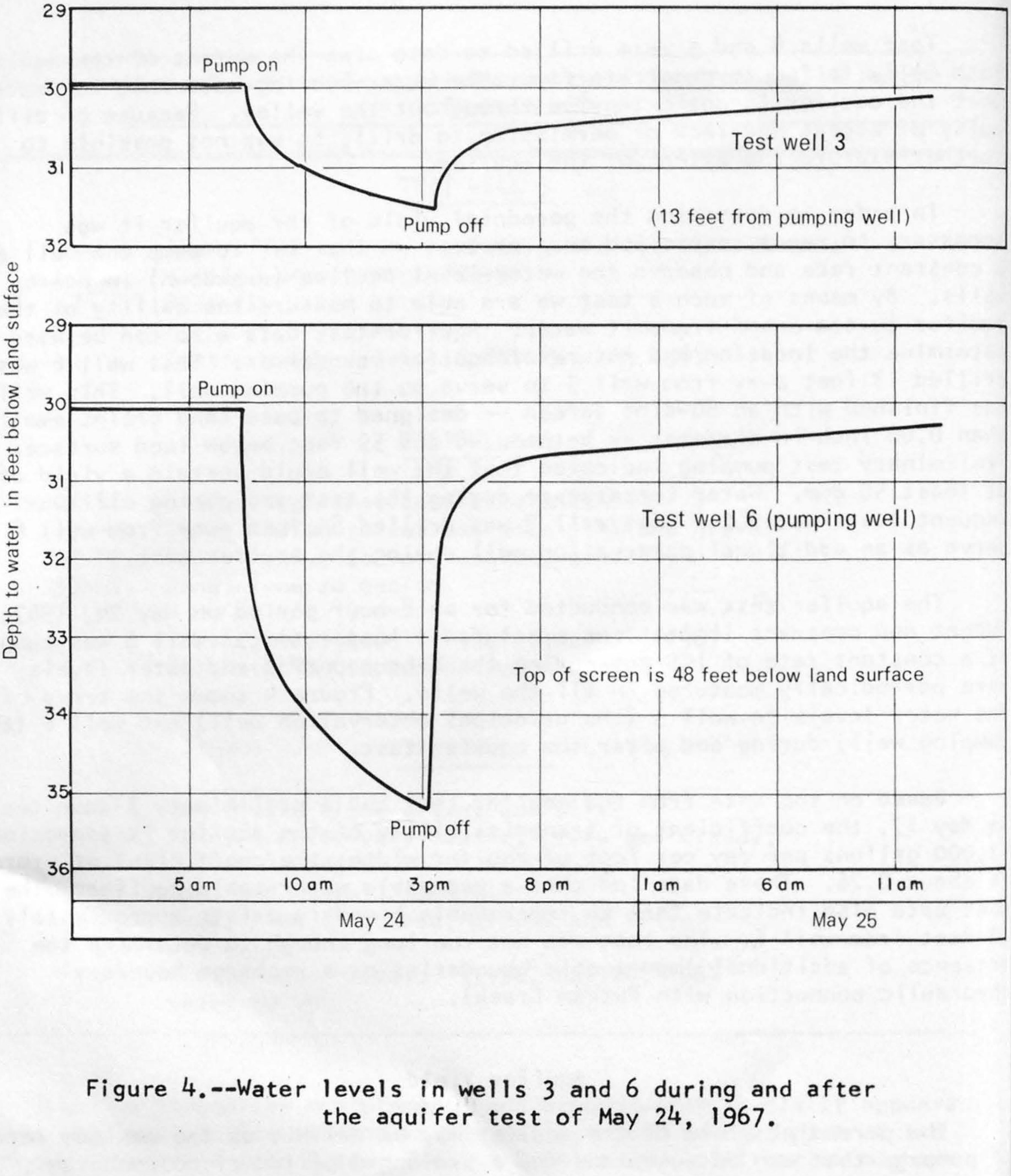

Figure 4.--Water levels in wells 3 and 6 during and after the aquifer test of May 24, 1967.

the water table around the pumping well as ground water is removed from storage, the head loss due to the friction of water moving through the well screen, the head loss due to the partial dewatering of the aquifer, a seasonal decline of the water table estimated to be 2 feet during a 200-day period of no recharge, and the effect of impermeable boundaries, recharge boundaries, or both.

Only one boundary -- an impermeable boundary at 50 feet -- was detected during the 8-hour aquifer test. Based on the geology of the deposits it is likely that a second impermeable boundary at about 100 feet would have been noted if the aquifer test were of a longer duration. The most likely configuration of the aquifer is shown in figure 5. The boundary at 50 feet is assumed to represent a thinning of the permeable beds in the direction of test well 7. The boundary at 100 feet is assumed to represent an

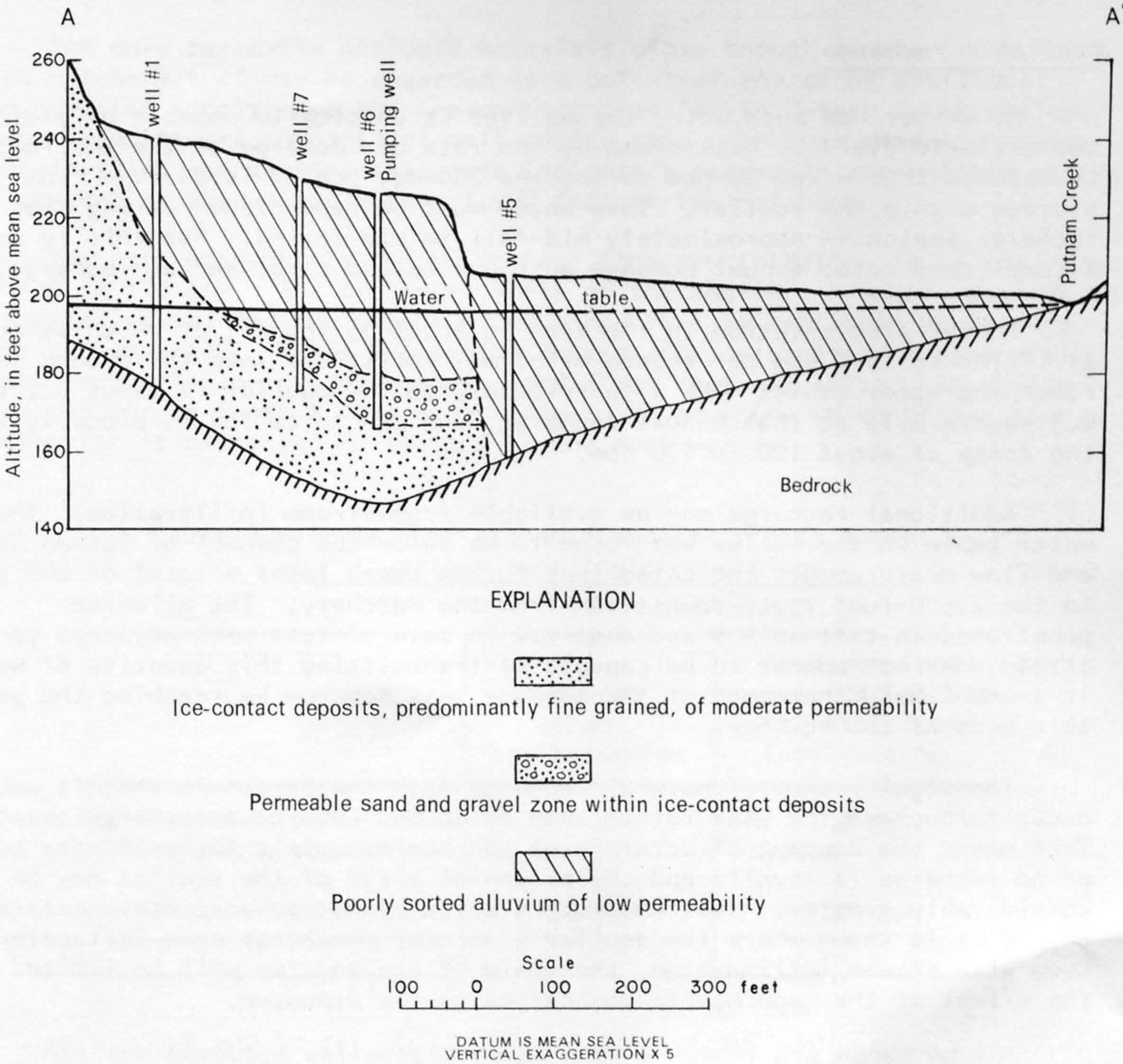

Figure 5.--Geologic section through wells 1, 7, 6, and 5.

erosional contact with the relatively impermeable alluvium penetrated in test well 5. It is possible that the aquifer is reasonably extensive in a northeast-southwest direction, as indicated in figure 3. Well 6, tapping such an aquifer, could be pumped at a rate of 50 gpm for 200 days before the pumping level drops to the top of the screen.

Under the less likely condition that only one impermeable boundary exists, the aquifer could yield a total of about 200 gpm for a 200-day period from 2 wells spaced 100 feet apart before the pumping levels would drop to the tops of the screens. This points out the effect of aquifer geometry on well yields and the need for a longer test to better define the limits of the aquifer.

Available recharge

No matter how much water the aquifer is physically capable of yielding, the ultimate yield is determined by the rate of recharge to the aquifer. It is assumed that water pumped during the 200-day period is derived from storage within the aquifer. This water must be replenished during the recharge season -- approximately mid-fall to mid-spring. For this to be accomplished total annual pumpage must not exceed total annual recharge.

Annual precipitation in the area is about 35 inches, of which as much as 17 inches (570 gpm per square mile) may infiltrate into the ground and reach the water table. The area tributary to the aquifer is about 0.2 to 0.3 square mile so that annual recharge from precipitation is probably in the range of about 100 to 170 gpm.

Additional recharge may be available from stream infiltration. The water table in the valley was found to be below the channel of Putnam Creek and flow measurements indicated that Putnam Creek loses a total of 800 gpm in the 2,500-foot reach downstream from the Hatchery. The alluvium penetrated in test well 5 and observed in several test pits adjacent to the stream does not appear to be capable of transmitting this quantity of water. It seems likely that much of the seepage must somehow be reaching the permeable beds of the aquifer.

The significance of natural recharge from the stream is that it would occur throughout the year rather than being confined to a recharge season. This means the concept of determining the maximum yield for a 200-day period of no recharge is invalid and the perennial yield of the aquifer may be considerably greater. Just how much greater cannot be adequately determined unless it is known where the aquifer's natural discharge area is located. Even with stream infiltration, the yield of the aquifer will be limited by the effect of the impermeable boundaries on the drawdown.

SUMMARY AND CONCLUSIONS

The only permeable geologic materials close enough to the Crown Point Fish Hatchery that may be regarded as a potential source of additional ground-water supply, are the ice-contact deposits in Putnam Creek valley. These deposits are composed of well sorted sand with some gravelly zones. Test-drilling and aquifer-test data indicate a permeable water-table aquifer is present in the valley within 1,500 feet of the Hatchery.

The rate of recharge to the aquifer from precipitation is in the range of 100 to 170 gpm. The perennial yield of the aquifer, however, depends on its areal extent and the amount of recharge that is available by seepage from Putnam Creek. Table 2 presents conservative estimates of perennial yield under the various hydrologic conditions that may exist. An aquifer test run for at least 4 days would help in determining which of the four possibilities presented in table 2 is the most valid.

Table 2.--Summary of probable aquifer yields under various hydrologic conditions

	Recharge from precipitation	Recharge from precipitation and natural-stream infiltration
Aquifer bordered by one impermeable boundary	100 gpm	200 gpm
Aquifer bordered by two impermeable boundaries	50 gpm	100 gpm

All the computed well-yield data in this report are based on the assumption that a well or wells tapping the aquifer would be pumped continuously. If pumpage were to be intermittent, higher rates would be possible.