A Geohydrologic Reconnaissance

of

North Fork Green River Area

King County, Washington

By

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PURPOSE OF THE INVESTIGATION

This study was initiated in December, 1971 in response to a letter of September 8, 1971 from the Office of Operations, Department of Ecology requesting the determination of "the interrelationship between the proposed withdrawal of ground waters (by the City of Tacoma) and the flow of the North Fork Green River into the Howard A. Hanson reservoir."

LOCATION AND TOPOGRAPHY

The area of interest (map in pocket) lies largely within T. 21 N., R. 8 and 9 E.W.M. in south central King County. The North Fork of the Green River heads in the foothills of the Cascades at an elevation of about 4400 feet and flows generally westward about seven miles, thence southward about two miles to its confluence with Green River at Howard A. Hanson reservoir (elevation 1100 feet).

GEOLOGY AND GROUND WATER

The North Fork flows for about seven miles of its nine-mile course in a narrow stream-cut valley underlain by Tertiary extrusive igneous rocks. These are relatively dense, lack permeability and porosity and, therefore, are unable to hold or conduct water except in minor amounts along fractures. Consequently, all river recharge throughout this portion is from precipitation and melting snow pack, and during late summer when the snow pack is gone, there is no leveling influence because of the absence of ground water inflow. Surface runoff is rapid and streamflow fluctuates directly with the precipitation.

Near the north quarter corner of section 15, T. 21 N., R. 8 E., the stream enters the southeast end of a comparatively broad U-shaped valley which is the product of glacial erosion. It is underlain by glacio-fluvial deposits which, in part, are extremely porous and permeable and readily hold and transmit water. The North Fork is in hydraulic continuity with this, the West Valley aquifer, and where the stream channel is above the water table, water is lost from the stream to the aquifer. Conversely, where the stream bed is below the top of the water table, the river is spring-fed.

The streamflow measurements made prior to the construction of the Howard A. Hanson dam (see Water Supply Bulletin No. 23) show the above relationship. A portion of these data which are pertinent to the problem are shown below in Table 1.

TABLE 1
STATIONS - FLOW IN CFS

DATE	A	B	C	D	E	E-A	A-C
9-11-42	13.2	10.4	5.96	37.8	40.9	27.7	7.24
10- 9-42	9.39	-	2.38	-	35.4	26.01	7.01
10-23-42	9.93	-	2.97	-	31.8	21.87	6.96
12-17-42	202.0	-	218.0	-	350.0	148.	-
3- 8-43	50.5	-	46.0	-	129.0	78.5	4.5
5- 6-43	99.9	-	86.8	-	192.0	92.1	13.1
7- 5-43	39.7	-	30.4	-	85.8	46.1	9.3
8- 6-43	20.4	-	12.1	-	55.3	34.9	8.3
9-22-43	11.9	-	4.79	-	36.1	24.2	7.11
9-12-45	10.7	-	0.0	-	36.6	25.9	10.7

Station A measurements are representative of stream flow prior to any appreciable loss; the one measurement at Station B shows some loss and Station C data indicate minimum streamflow and maximum loss to underflow. The measurements at Stations D and E show an increase in flow because of ground-water entry. The difference between the maximum flow in the river

upstream from the spring area (Station A - see Plate 1) and the maximum flow in the river below the spring area (Station E) represents ground-water inflow from the West Valley aquifer plus a minor amount of surface water which enters via a small tributary from the east immediately upstream from Station E. On the basis of this information, the recharge of the North Fork from the aquifer ranges from 20 to 30 cfs (cubic feet per second) during periods of low flow and from 50 to 90 cfs during periods of intermediate to peak flows.

The West Valley aquifer receives its recharge from precipitation falling within the eleven square mile (7,000 acres) drainage area. Recharge is also possible from underflow from the North Fork. However, during the period covered by Table 1, no net recharge occurred from this source. This is indicated by the downstream gain in flow (column E-A). As shown on the topographic map there is no surface drainage from the valley into the North Fork. The surface runoff sinks and becomes a part of the ground-water supply. The average annual rainfall is about 90 inches and the annual loss to evapotranspiration is about 24 inches. The remainder, five feet or 35,000 acre-feet, is available annually for aquifer recharge. If a constant discharge occurred from the aquifer into the lower North Fork drainage it would be about 50 cfs; this appears to be a reasonable estimate as indicated by stream measurement data given in Table 1 (column E-A).

A second source of ground-water underflow is surface water lost by the North Fork to the underlying sands and gravels. The approximate amount is the difference between columns A and C and averages 7 cfs. The data indicate two extremes: On December 17, 1942 the surface flow increased progressively downstream because of abundant surface water and a high water table at or

above stream level. Conversely on September 12, 1945 all of the water in the stream sank because of a low ground-water table.

CONCLUSIONS

The City of Tacoma's ground-water application is for the instantaneous withdrawal of 62,500 gallons per minute (139 cfs) and a total annual withdrawal of 30,244 acre-feet per year for municipal supply. Although it is not specifically mentioned in the application, the reports which accompany it indicate that the proposed withdrawal will be supplemental to existing rights and pumping will occur only during times of turbid flow in the Green River. As shown by Figure 3 dated April, 1970 (reduced copy enclosed), which is a part of a report submitted to the City of Tacoma by Robinson, Roberts, and Associates, turbid flow coincides with times of abundant precipitation which in turn results in maximum underflow and maximum surface flow in the North Fork. Assuming an underflow of 70 cfs during periods of high demand, nearly 70 additional cfs will be needed to satisfy the requested 139 cfs. This must come from ground water storage in the West Valley aquifer and/or from surface water of the North Fork Green River which generally is clear throughout the year.

The West Valley aquifer has an areal extent of about 2,000 acres. Assuming a sand and gravel reservoir of this extent and having a specific yield of 0.20 which is believed to be conservative for a reservoir of this type, 400 acre-feet per foot of drawdown is available. Figure 3 of the Robinson, Roberts, and Associates report referred to above shows times of turbidity in Green River from December 3, 1968 to April 13, 1970. During this interval, a maximum of 21 days of continuous pumping of 70 cfs or 140

acre-feet per day (April 8 - April 29) would have been required because of turbid waters in Green River. This would have required a withdrawal of 2,940 acre-feet from the aquifer or a total drawdown of about eight feet. The average duration of continuous turbidity was four days. Pumping during this interval would have resulted in a drawdown of about two to three feet. With proper placement of wells and installation of screens such that the aquifer storage is utilized to the maximum, the drawdowns mentioned above should be accomplished without difficulty. Further, in the event that the ground-water supply is inadequate, the surface waters of the North Fork generally are of excellent quality and could be used to satisfy needs during times of turbid flow in the Green River.