Potential Ground-water Resources of the upper John Day River Valley, Grant County, Oregon

by

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In the last 15 to 20 years, the growth of the five towns in the John Day River valley above Picture Gorge and increasing needs for hay and pasturage have greatly stimulated interest in obtaining water from wells. Up until about 1950, water from streams, springs, and shallow wells in stream gravels was sufficient for local needs. In 19.7 John Day drilled its first well at the City Hall, which sufficed until 1952. In October 1952, the City of John Day drilled the first well in the valley that was located by a ground-water geologist. This well and a companion well drilled in 1963 provide John Day with plenty of good water. A group of wells drilled west of Mount Vernon in 1962 and 1963 by John Cawrse showed that water is obtainable from sources in quantities needed for irrigation in that part of the valley. Surface water has not usually been sufficient or dependable enough for summer irrigation; only surface storage of flood waters or greater development of ground water can mitigate such deficiencies. Bench lands which comprise the largest potentially irrigable areas in the valley would not be served by dams along the main stream, and no good, large reservoir sites are available for storage that would serve them. Determination of the potential availability of ground-water now has become a necessary step in planning for the most efficient use of land and water in the upper John Day River valley.

The largest area of potentially irrigable land, for crops or pasture, is the extensive alluvial fans that spread out northward from the base of the Strawberry Range (see Figs. 1 and 13 of the * pamphlet, the geologic setting of the John Day Country). The surface area of the fans between Dean Creek (near the Oliver Ranch), Prairie City, and Blue Mountain Hot Springs totals about 50 square miles. This is shown by the symbol Tr in the ruled and cross hatched area of the accompanying map (Fig. 1). The valley bottom lands shown by the symbol Qa are not included in the 50 sq. mi. figure. Probably between 5 and 10 sq. mi. of the fan surface (bench land) is being irrigated from streams, leaving 40-45 sq. mi. of unimproved pasture land. Although the fan surface is only about two miles wide from head to foot (south to north) between Dean and Indian Creeks, from Indian Creek eastward it averages about 4-1/2 miles wide. A strip two miles wide along the lower edge of the fan, where the soil in general is best and water is most likely to be available at reasonable depth, aggregates about 25 sq. mi. or 16,000 acres. The principal target area for possible new irrigation therefore, comprises 12,000 to 15,000 acres. Availability of ground water at reasonable cost would be a major factor in improving this acreage.

*Pamphlet titled: "The Geologic Setting of the John Day Country, Grant County, Oregon," may be obtained from: USGS/Western Distribution Branch, Box 25286, Denver, CO 80225

The Prairie City Basin

Prairie City is situated near the center of a semicircular topographic basin that forms the easternmost segment of the John Day River valley east of Picture Gorge (see Fig. 1 of John Day Country leaflet). The northern and eastern slopes of the basin are formed by volcanic rocks that dip generally southward and westward in an arcuate pattern. The southern half of the basin is formed by the alluvial fans that slope northward from the base of the Strawberry Range. The straight southern boundary of the basin is determined by a complex system of faults, the John Day fault being the principal one, along which the Strawberry Range was raised a mile or more (see Fig. 14 of John Day Country leaflet). The arcuate course of the John Day River follows the intersection of the northward sloping alluvial fans and the southward and westward sloping lava flows that form the north half of the basin. The western end of the basin is near Dean Creek and the old Oliver Ranch (see Fig. 1), where the river valley proper is cut into volcanic rocks on both sides.

The rocks of the Prairie City basin, especially as regards ground/water, fall into two categories: (1) the volcanic and older rocks, and (2) younger gravels. Downwarping of the volcanic rocks around the north and east sides of the basin is shown by the slopes of the lava flows. West of Dixie Creek the volcanic rocks (Tcr) range from basalt flows to pumiceous beds, and contain some interbedded gravels. The two operating John Day City wells are in these rocks. From Dads Creek (2 miles east of Prairie City) southeastward the volcanic rocks consist mostly of thick massive platy andesite flows (Ts) which are believed to be relatively poor sources of ground water.

The gravels (Tr in Fig. 1) that are the most promising source of ground water and that also underlie the bench lands to be irrigated are less well known than the volcanic rocks. The surface forms of the present fans are believed to be related to glaciation in the Strawberry Range, but gravels of at least three ages can be distinguished. The oldest gravels are very coarse boundary deposits (shown as Trb in Fig. 1) that are as much as 650 feet thick between Reynolds and Deardorff Creeks and seem to go below the valley bottom. Gravels of intermediate age form the prominent benches that stand 250-300 feet above and north of the valley near Prairie City, and occur in scattered patches (Tr) northeast of the river from there nearly to Blue Mountain Hot Springs. All these gravels slope southward or westward and must have been deposited when the John Day River was south of its present course. The lower contacts of these gravels on lavas either side of Dixie Creek slope southward about 300 feet per mile (See Figs. 1 and 2) where they come down to valley level. They appear, therefore to continue on down under the present river valley. Such a relation is supported by presence of 148 feet of gravel in a well in Section 11, in Prairie City, and by geological evidence farther west in the John Day River valley. The tuff member (Trt) of the Rattlesnake Formation north of the John Day fault has been dropped about 250 ft. by movement on the fault two miles east of John Day. Between Mount Vernon and Picture Gorge, the base of the Rattlesnake Formation is believed to have been dislocated at least 1,000 feet, and in places it may be 600-800 feet below the present valley level. The gravels in the vicinity of Prairie City, accordingly, are believed to extend below present river level, and may constitute an important aquifer.

The uniform northward surface slopes of the major fans south of the river indicate that the youngest gravels have not been disturbed. As the fans were built up by debris eroded from the Strawberry Range, especially during periods of glaciation, the John Day River was pushed northward to its present course. In some places, as at Halls Hill east of Bear Creek and near the Oliver Ranch, the river was forced to cross the ends of spur ridges from the north. We cannot tell definitely from surface evidence where the old channel was, except that it probably was at least half a mile farther south in the vicinity of Halls Hill and lay south of the Oliver Ranch. The old channel is likely to contain good water-bearing gravels or sands and could be found by drilling. In Figure 2 the old valley bottom is projected from available data as about three-quarters of a mile farther south of Prairie City than the present river and about 250 feet lower, but this is only an "educated guess".

Groundwater Potential of the Prairie City Basin

Without more data from wells, the groundwater potential of the Prairie City basin can only be postulated from experience in similar situations elsewhere. Records of 6 wells present a mixed picture. Two wells drilled on the valley floor in Sec. 35, T. 13 S., R. 34 E., near the mouth of Deardorff Creek, went to depths of 157 and 260 feet, respectively, apparently in gravels of the Rattlesnake formation; the shallower one yielded 35 gallons per minute (gpm). A well in Sec. 11, in or south of Prairie City, ended in gravel at 146 feet and yielded 24 gpm; another well reportedly near Halls Hill found gravel to a depth of 200 feet and yielded 30 gpm. The well drilled by Prairie City in Section 2 to a depth of 526 feet indicates that the Clarno Formation (see Fig. 1) is unfavorable for water. The most promising well was drilled near the center of Sect. 27, T. 13 S., R. 32 E., about a mile southeast of the Oliver Ranch; a preliminary test indicated a yield of several hundred gpm from gravel under 150 feet of hard pan.

Three wells drilled near Birch Creek, about 5 miles west of Mount Vernon, are believed to indicate the possibilities of the Prairie City basin, even though they are 25-30 miles down valley. There, also, gravels of the Rattlesnake Formation lying on basalts have been displaced below the valley level (see Fig. 1 of John Day Country leaflet). A well drilled to a depth of 1,210 feet yielded 1,200 gpm with a drawdown of 130 feet, and two others drilled to depths of 230 and 245 feet yielded 520 and 540 gpm, respectively. The shallower wells may get some water from river gravels, but the water in the deep well must come from gravels in the Rattlesnake Formation or from basalts below about 340 feet.

The Rattlesnake Formation gravels form a thin veneer on underlying volcanic rocks. (See Figs. 2 and 3). They are, however, a few to several hundred feet thick in the lower parts of the fans, thick enough to offer possibilities for one or more good water-bearing beds. Poorly permeable hard-pan layers may be expected to seal off the lower gravels and water in the gravel would be under artesian pressure. Gravels below river level and not sealed off from river water should be saturated up to river level; wells on the bench some distance from the river, such as Well C in figure 2, would intercept water moving toward the river from the head of the fans.

The volcanic rocks below the gravels would be saturated, and favorable zones could produce good wells. These rocks are believed to be cut by many faults and fractures along which water could move to permeable gravels or breccia zones between flows. Along the northern fringe of the fans, the water in lavas is likely to be under artesian pressure (see Fig. 2).

Recommendations

Complete appraisal of the ground-water resources of the Prairie City basin would probably take 3 or 4 years; a less thorough investigation might take less than 2 years. In any event, appraisal of the resources logically would precede development. An efficient program should, therefore, provide for successive stages, each of which is adjusted to results of preceding steps. Obviously, there is no point in planning works for recharging before the presence of aquifers that are worth or need artificial recharge has been demonstrated.

If development of ground water is deemed to be a desirable alternative to other plans, or part of a broad water-resource plan, the Grant County Planning Commission could request that the Oregon District Office, Water Resources Division, Geological Survey, prepare a proposal for an investigation. As was brought out at the meeting of the Planning Commission on December 14, 1971, most ground-water studies by the Geological Survey require cooperative funding. Local as well as State commitments for funding are likely to be needed if an appraisal study is contemplated.

The real reason for appraising the ground-water resources of the upper John Day River valley, namely, the benefits that would result from more water, is beyond the scope of this memorandum. The first question to be answered is how much the local economy might profit from full development of land that would be suitable for irrigation by well water. The potential benefits would limit the overall magnitude of a project and the location of suitable areas would largely control its direction. A request for a ground-water investigation, therefore, should be based on a well-documented account of possible contributions to the local economy.

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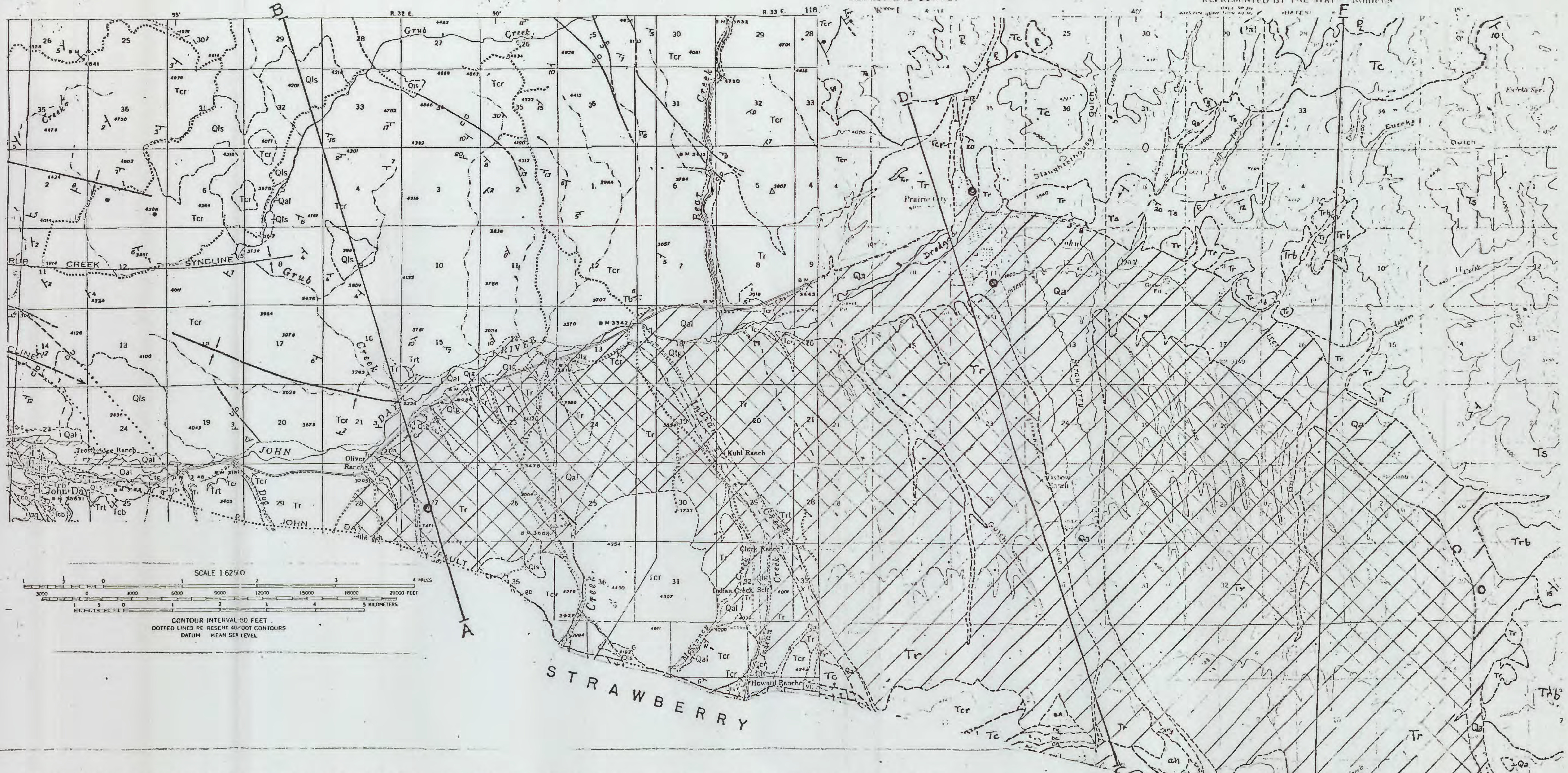

Fig. 1. Geologic map of parts of the John Day and Prairie City quadrangles, Grant County, Oregon, showing area believed to be most favorable for development of ground water (diagonal ruling). Areas probably most favorable for new irrigation from wells are indicated by cross-hatching. The map area east of a north-south line through the Oliver Ranch covers most of the Prairie City basin (see text).

PLEASE REPLACE IN POCKET
IN BACK OF BOUND VOLUME

EXPLANATION

(Applies only to rocks north of the Strawberry Range)

Quaternary

Qa

Alluvium
Mainly valley fill consisting of silt, sand, and gravel.
Source of water in shallow wells only.

Tertiary

Trt | Trb

Rattlesnake Formation
Poorly sorted bouldery to clayey deposits forming extensive pediments south of the John Day River and irregular smaller benches north of it
Trb, deposits containing numerous boulders two feet or more in size, mostly higher than the Rattlesnake Formation proper
Trt, Rhyolite tuff member. Exposed in vicinity of John Day and just east of Grub Creek.
This formation is the most promising source of groundwater in the John Day River valley east of Canyon Creek.

Tcr, Ts

Columbia River Group-Strawberry Volcanics
Flows of basaltic to rhyolitic composition interbedded with mudflow breccia, bedded volcanic ash, and some conglomerate.
Source of water in all three John Day City wells, and may contain highly productive zones elsewhere

Tc

Clarno Formation
Mostly andesite flows and breccias north and east of Prairie City.
Not promising as source of groundwater because of impermeability in this area

Contact
Dashed where approximately located

Fault
Dashed where approximately located, dotted where concealed. Bar and ball on downthrown side

25
Strike and dip of beds or lava flows

Well
Approximately located.

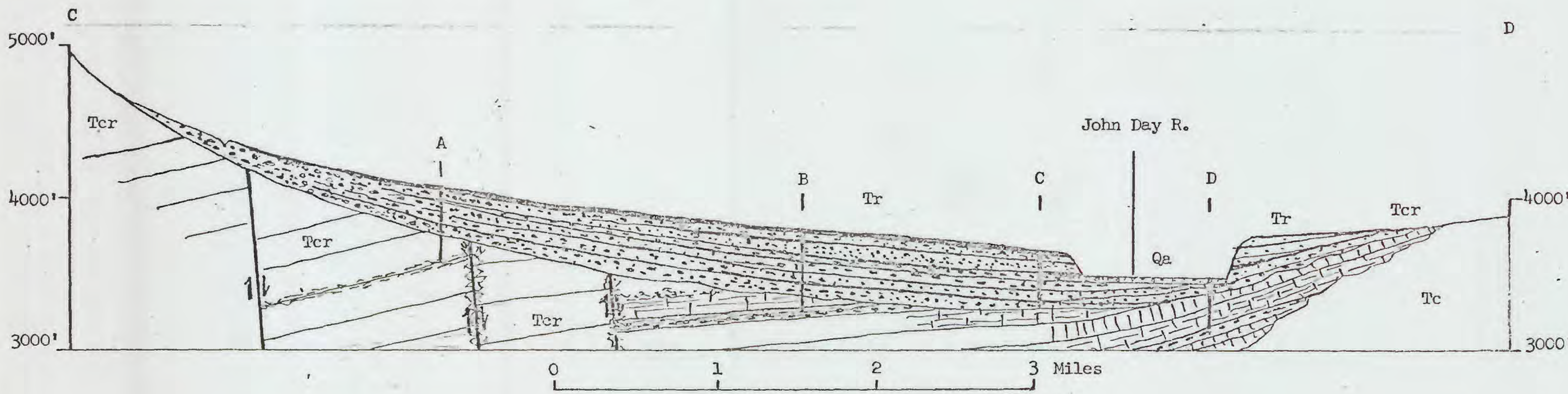

Fig. 2. Diagrammatic section across the John Day River Valley along line C-D, west of Prairie City and Strawberry Creek, showing geologic structure and possible sources of ground water. Heavy lines in Rattlesnake Formation (Tr) indicate ~~im~~ poorly permeable clayey (hard pan) layers between sand and gravel beds that may contain water. Wells A and B might get water from several gravel beds and permeable breccia zones or gravels between lava flows. Well C might get artesian flow from a gravel bed sealed off by overlying hard pan. Well D is shown getting might obtain artesian flow from a bed between lava flows, as the two John Day City wells do. The vertical scale is 5 times the horizontal.

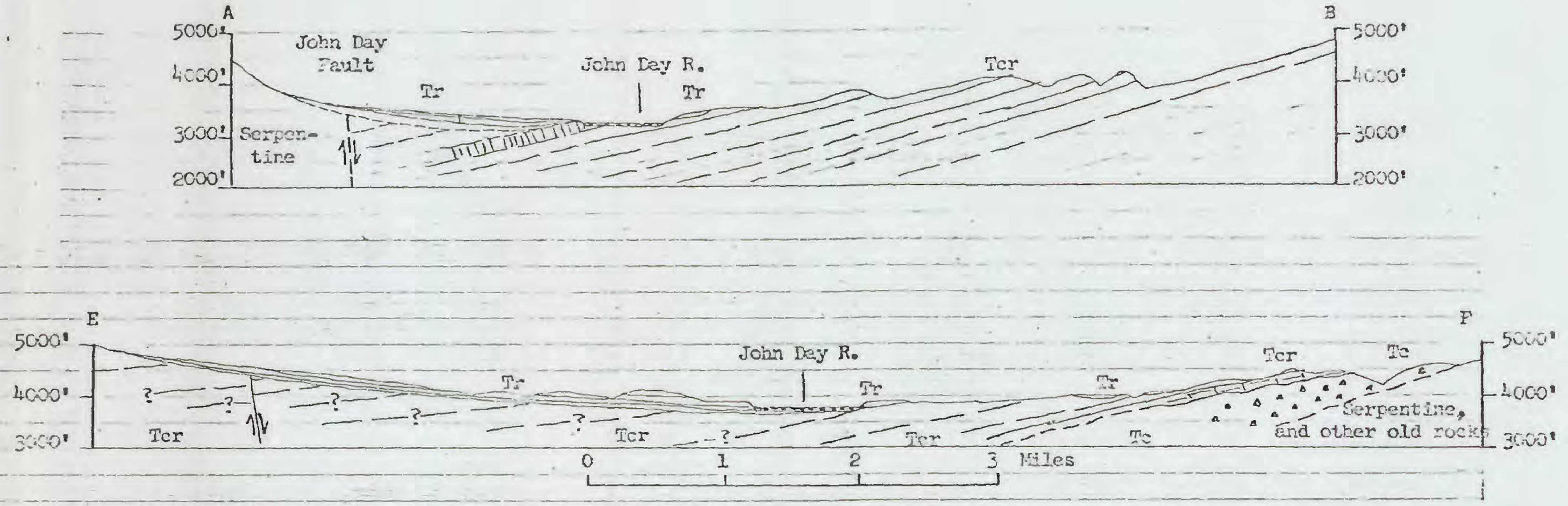

Fig. 3. Geologic sections across the John Day River Valley east of Dean and Grub Creeks (above) and east of Winegar Gulch and Jeff Davis Creek (below). For locations of sections and explanation see accompanying map. Vertical scale is twice the horizontal.