# Preliminary Report on Oil-Shale Resources of Piceance Creek Basin Northwestern Colorado

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# PRELIMINARY REPORT ON OIL-SHALE RESOURCES OF PICEANCE CREEK BASIN, NORTHWESTERN COLORADO

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ABSTRACT

Oil shale in the Green River formation of Eocene age underlies an area of about 1,400 square miles in that part of the Piceance Creek basin in Rio Blanco and Garfield Counties, Colo., that lies between the Colorado River to the south and the White River to the north.

Preliminary estimates of tonnage and oil content of the oil shale include indicated and inferred potential reserves which may be combined as follows: (1) part of the richest oil-shale zone (the Mahogany zone) yielding an average of 45 gallons of oil per ton and ranging from 5 to 31 feet in thickness contains a total of more than 7 billion tons of shale and 7.5 billion barrels of oil, (2) shale zones yielding an average of 30 gallons of oil per ton and ranging from 15 to 180 feet in thickness contain about 137.5 billion tons of shale and about 98.8 billion barrels of oil, (3) shale zones yielding an average of 25 gallons of oil per ton and ranging from 15 to 780 feet in thickness contain about 325 billion tons of shale and about 194 billion barrels of oil, (4) shale zones yielding an average of 15 gallons of oil per ton and ranging from 15 to 2,200 feet in thickness contain about 2,686 billion tons of oil shale, with an oil content of 959 billion barrels. The estimates reflect the total size and oil content of the deposits, and no allowance is made for losses that would be incurred in mining and processing of the oil shale.

## INTRODUCTION

The part of the Piceance Creek basin described in this report covers an area of about 1,400 square miles in northwestern Colorado, almost entirely in Rio Blanco and Garfield Counties. The area is bounded by the Colorado River on the south (fig. 30), the White River on the north, Douglas Creek and the East Fork of Salt Wash on the west, and Government and Sheep Creeks on the east. The oil shales are found in the lacustrine Green River formation of middle Eocene age, which attains a maximum thickness of about 3,500 feet. Underlying the Green River formation are variegated shales and lenticular sandstones of the Wasatch formation of Paleocene and early Eocene age. The Wasatch formation is about 5,500 feet thick in General Petroleum Corp. gas well 84–15–G, sec. 15, T. 2 S., R. 96 W., on the Piceance



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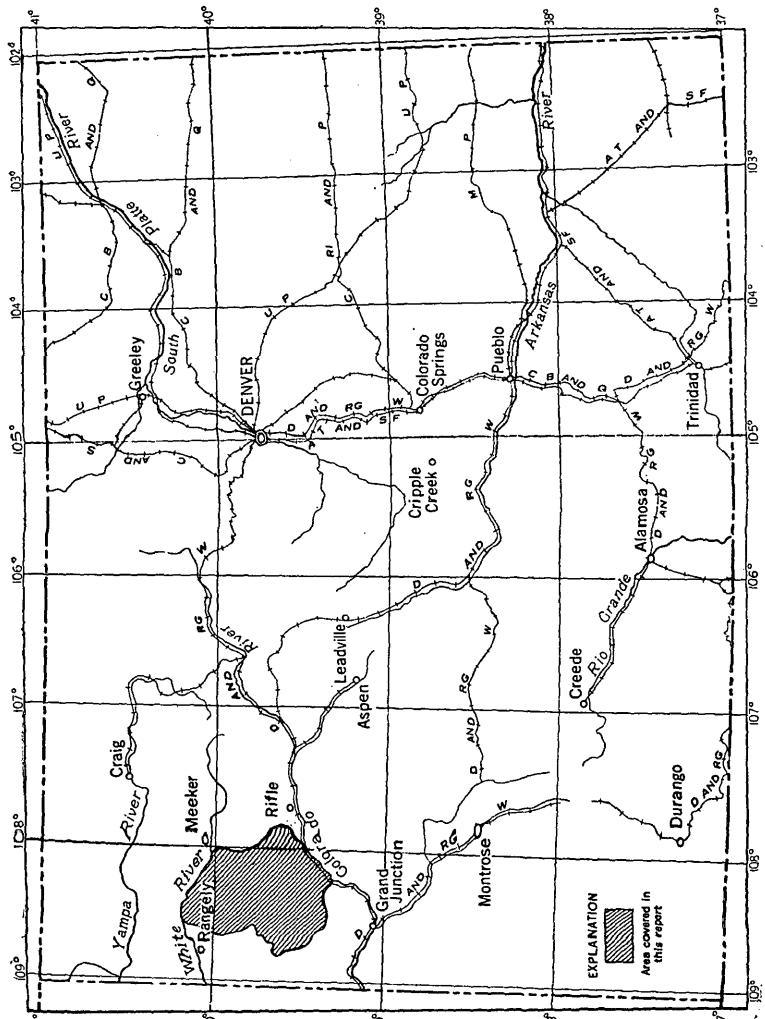


FIGURE 30.—Index map showing location of part of the Piceance Creek basin in northwestern Colorado.

Creek dome in the east-central part of the basin. Underlying the Wasatch formation is the Mesaverde formation of Late Cretaceous age.

That part of the area which is underlain by the Green River formation is a high plateau rising about 4,400 feet above the valley of the Colorado River near Rifle and attaining an altitude of 9,400 feet. The whitish and light-blue cliffs of the resistant oil shale are in sharp contrast to the low-relief badlands topography of the Wasatch formation bordering the plateau.

The Piceance Creek basin is a structural basin which coincides approximately with the original basin of deposition of the Late Cretaceous and early Tertiary sediments. Steep westerly dips on the eastern margin reflect the sharp monoclinal flexure of the Grand Hogback, whereas the gently east-dipping Green River strata on the western margin form the eastern flank of the Douglas Creek anticline. Thinning of formations toward the margins indicates that it was formerly a basin of deposition. The Wasatch formation, which attains its maximum known thickness of 5,500 feet on the Piceance Creek dome in T. 2 S., R. 96 W., thins to 375 feet about 25 miles to the northwest. Westward thinning also occurs in the underlying Mesaverde and Mancos formations.

The Green River formation, as described by Bradley (1931), consists of four members which are, in ascending order, Douglas Creek, Garden Gulch, Parachute Creek, and Evacuation Creek. The richer shales which may ultimately be of economic interest are mostly confined to the Parachute Creek member, which in turn is divided into the upper and lower oil-shale zones. These rich oil-shale zones are extremely resistant to weathering and form sheer cliffs or steep slopes. They are separated by a thin sequence of lean oil shale that weathers to a gentle slope or recess. In the lower part of the upper oil-shale zone is the Mahogany ledge, a unit that contains the principal oil-shale beds in the sequence. Everywhere that the ledge crops out it forms a sheer cliff delimited above and below by lean shales that form slopes. The subsurface counterpart of the Mahogany ledge is referred to in this report as the Mahogany zone. The ledge, or zone, is about 110 feet thick at the axis of the basin and thins toward the margins. Undoubtedly the first segment of the oil-shale sequence to be worked commercially will include part or all of the Mahogany zone. The U. S. Bureau of Mines experimented in mining a 78-foot section of shale in the Mahogany zone at their mine just west of Rifle.

The richest oil-shale bed within the Mahogany ledge, or zone, is called the Mahogany bed, which is used as a stratigraphic reference bed.

Interest in development of oil shale in northwestern Colorado began about 1916, and activity has continued, with varying degrees of inten-

sity, until the present. Private companies, the U. S. Bureau of Mines, and the U. S. Geological Survey have assayed core from 43 core holes and 32 surface sections, and the Bureau of Mines has assayed rotary cuttings from 13 wells of the General Petroleum Corp. This information, together with 16 incompletely sampled surface sections made by Dean E. Winchester, of the Geological Survey, between 1916 and 1921 (Winchester, 1917, 1923), and the estimated oil content of 36 surface sections measured by field parties of the Survey since 1945, were used in the calculation of the oil-shale resources.

Descriptions of the geology and oil-shale resources of several areas within the Piceance Creek basin have been published recently (Duncan and Denson, 1950; Duncan and Belser, 1950; Waldron, Donnell, and Wright, 1951; Donnell, Cashion, and Brown, 1953).

W. B. Cashion, Jr., William M. Zilbersher, J. H. Brown, Jr., M. G. Wolman, W. C. Gibson, and K. E. Englund have assisted the writer at different times since June 1949.

The following companies, Government agencies, and individuals furnished much of the information upon which the tonnage and oil content of the shale were calculated: U. S. Bureau of Mines, Union Oil Co. of California, Standard Oil Co. of California, Sun Oil Co., Cities Service Oil Co., Phillips Petroleum Co., Pure Oil Co., Continental Oil Co., Gulf Oil Corp., General Petroleum Corp., Weber Oil Co., Denver Research Institute, Charles Prien, John Savage, W. O. Pray, J. T. Juhan, and Tell Ertl.

## CRITERIA USED IN MAKING ESTIMATES OF TONNAGE AND OIL CONTENT OF OIL SHALE

To compute the tonnage and oil content of the oil shale, the oil-shale sequence was divided into several units on the basis of average oil yield, and reserves were computed separately for shale yielding respectively 15, 25, 30, and 45 gallons per ton. A minimum thickness of 5 feet was used for shale averaging 45 gallons per ton; a minimum thickness of 15 feet was used for the other grades.

The minimum thicknesses and grades of oil shale used in this report in part correspond approximately to the minimum thicknesses and grades of oil shale exploited on a sustained basis in other parts of the world. In Estonia, for example, oil shales (Kukersite) in beds ranging from about 5 to 8 feet in thickness and yielding from 45 to 55 gallons of oil per ton have been mined and processed for oil since about 1921 (Lutz, 1938; Guthrie and Klosky, 1951). Oil shales yielding as little as 15 gallons of oil per ton have been mined on large scale and processed in other places, such as in Sweden (Cadman, 1948; Guthrie and Klosky, 1951).

There has thus far been no large-scale commercial development of oil shale in this country; therefore it is not possible to predict with assurance what average grade will eventually prove most suitable, or what the minimum minable thickness will be. Results of research in processing oil shale by the U. S. Bureau of Mines at a pilot plant near Rifle indicate an optimum grade ranging between 25 and 33 gallons of oil per ton, and the underground mining methods developed by the Bureau require a minimum thickness of 25 feet of shale equal to the minimum operating room required by the equipment used. Continued advancements in the technology of mining and processing oil shale may alter these limits, consequently a wider range in grade and thickness was used in this report. Moreover, no attempt is made to predict what proportion of the oil will be lost in mining and processing of the oil shale, and no allowance is made for such losses in the estimates of tonnage and oil content of the shale.

## METHODS USED IN COMPUTING ESTIMATES OF TONNAGE AND OIL CONTENT OF OIL SHALE

For each locality where there was information on the oil content of the shale sequence, the data were studied to determine the maximum thicknesses of shale in continuous sequence that have an average assay value of 15, 25, 30, and 45 gallons per ton, respectively. Thickness data so obtained were then used to construct a series of thickness maps (pl. 14, *A–D*) from which the average thickness of each grade of oil shale was estimated for each township. The volume of oil shale of given grade in each township was then computed and converted to tonnage by using the estimated specific gravity of the shale.

The basic information on oil content generally consists of individual assays of a series of samples taken in vertical sequence; the samples may vary considerably both in thickness of strata represented and in oil content. Specific gravity determinations are not made in routine assays, but it has been established that lean oil shale is denser than rich oil shale (Belser, 1951, p. 5). In combining the assay data on a series of individual samples to determine the average assay value of the total thickness, the values of the individual samples were weighted according to the thickness of strata represented but were not weighted according to specific gravity. Where assays of samples of varying richness are combined, failure to weight the sample data according to specific gravity results in a slightly higher-than-actual average assay value. However, this source of error is generally small, particularly where the range in assay value is not large, which is generally true in practice. As other uncontrolled or unappraisable factors involved in the reserve estimates represent greater theoretical sources of error, and as actual specific gravity

determinations on the individual samples were not made, weighting of the sample data according to estimated density was considered unwarranted for this inventory. Although various assay methods were used to determine the oil content of the shale, most of the samples were analyzed by the modified Fischer assay method, as described by Stanfield, Frost, McAuley, and Smith (1951), who indicate that the yields and characteristics of the products by this method may not be comparable to those obtained under different retorting conditions or derived from commercial size units. The relative oil yields and data on products obtained from some larger experimental retorts are described by Guthrie (1955).

Estimates of tonnage and oil content of the oil shale have been broken down into two categories, indicated and inferred, that are intended to show the relative reliability of the estimates. Tonnage and oil content in the indicated category are considered more accurate than the inferred category. In most places, areas that have analyses of cores spaced less than 6 miles apart contain indicated potential reserves. A few areas where these cores are spaced more than 6 miles apart—but where the general increase or decrease in organic content is indicated to be uniform by many nearby cores—are also regarded as areas of indicated potential reserves. Reserves within approximately 2 miles of an isolated analyzed set of samples are regarded as indicated. If there are several sets of analyzed data roughly in line, then lines 2 miles from this alinement form the outer limits of indicated reserves. Reserves within 2 miles of a well with analyzed rotary cuttings, or within 2 miles of a group of wells whose rotary cuttings have been analyzed, are considered indicated for shale averaging 15 gallons of oil per ton. Rotary-cutting sample intervals are generally 10, 20, or 25 feet and are considered too great for even the moderate reliability desired to classify indicated reserves of 25- and 30-gallon shale and are considered inadequate for estimating potential reserves of the thin shale unit containing 45 gallons per ton.

Surface sections are exposed to weathering and in the weathering process may lose as much as 50 percent of their oil content (Winchester, 1917, p. 162–163, pl. 14). Also, lean oil shale breaks much more easily than rich oil shale, and, unless great care is taken to cut a uniform channel through the sequence, a representative sample will not be obtained. Hence, data obtained through surface sampling are not generally used in this report to delineate areas of indicated reserves. In places, however, where the oil shale showed little effect of weathering and a representative sample was obtained, the analytical data were used in the computation of indicated reserves.

An experienced investigator can estimate with moderate accuracy the oil content of oil shales from their physical characteristics. Esti-

mates tend to be conservative, and they have not been used in the calculation of indicated reserves; however, they were used in estimating the oil content of areas containing inferred reserves.

## SUMMARY OF POTENTIAL RESERVES

The following estimates of tonnage and oil content of the oil-shale deposits include the total amounts of oil shale in place and total potential oil yield, assuming that all the oil could be extracted from the deposit. Recoverable oil from the deposits will doubtlessly be much less than the total potential yield of the deposits because of losses in mining and processing and other unappraised cutoff limits of grade, depth, or distance from outcrop of a selected shale unit that may be exploited in the future. No attempt is made in this report to estimate the amount of oil recoverable from the deposits.

Estimated tonnage and oil content of shale in that part of the Mahogany zone that contains an average of 45 gallons of oil per ton in a continuous sequence 5 feet or more thick are shown in table 1. Distribution and thickness of the part of the unit for which estimates were made are shown on plate 14, *A*. Approximately 261 square miles of the area are underlain by indicated reserves of about 6,360 million tons of such shale with an oil content of about 6,800 million barrels. In addition, about 27 square miles of the area contain inferred reserves of 655 million tons of oil shale with an oil content of about 700 million barrels.

Estimates of tonnage and oil content of the 45-gallon shale are made only for the southern half of the area (pl. 14, *A*), where numerous analyses of both cores and surface samples indicate fairly well the thickness of oil shale averaging 45 gallons of oil per ton. Except for 3 core holes in the southern part of T. 3 S., R. 99 W., and 2 in T. 1 S., R. 100 W., there are no oil-shale samples north of the northern boundary of T. 4 S., that supply a basis for estimating the thickness of shale that yields an average of 45 gallons of oil per ton. Analysis of cuttings from one well in the Piceance Creek gasfield suggests the presence of 45-gallon shale: General Petroleum Corp. well 5–31–G, sec. 31, T. 1 S., R. 96 W., yielded one 10-foot sample in the Mahogany zone that assayed 43.9 gallons of oil per ton.

The thickest known sequence of 45-gallon shale (31 feet) in the area was obtained from the U. S. Bureau of Mines core hole E, sec. 2, T. 5 S., R. 95 W.

Estimates of tonnage and oil content of that part of the Mahogany zone and adjacent beds that yields an average of 30 gallons of oil per ton in a continuous sequence 15 feet or more thick are shown in table 2; the thickness and distribution of the unit are shown on plate 14, *B*. The unit includes the 45-gallon oil shale shown in table 1. An area

TABLE 1.—*Estimated tonnage and oil content of oil shale in part of the Mahogany zone that yields an average of 45 gallons of oil per ton in a continuous sequence 5 feet or more thick*

[Estimates include the total tonnage and oil content of the deposit, but they do not indicate the amounts recoverable]

| Township and range | Acreage | Average thickness of oil shale (feet) | Average tonnage per acre of oil shale (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| **Indicated Potential Reserves** | | | | | | |
| T. 4 S., R. 94 W. | 2,570 | 15 | 40.2 | 43.0 | 103 | 111 |
| T. 4 S., R. 95 W. | 9,310 | 26 | 69.6 | 74.5 | 648 | 694 |
| T. 4 S., R. 99 W. | 10,068 | 6 | 16.1 | 17.2 | 162 | 173 |
| T. 5 S., R. 94 W. | 17,100 | 15 | 40.2 | 43.0 | 687 | 735 |
| T. 5 S., R. 95 W. | 19,410 | 20 | 53.6 | 57.4 | 1,040 | 1,114 |
| T. 5 S., R. 96 W. | 18,350 | 15 | 40.2 | 43.0 | 738 | 789 |
| T. 5 S., R. 97 W. | 19,225 | 10 | 26.8 | 28.7 | 515 | 552 |
| T. 5 S., R. 98 W. | 9,930 | 10 | 26.8 | 28.7 | 266 | 285 |
| T. 5 S., R. 99 W. | 2,200 | 6 | 16.1 | 17.2 | 35 | 38 |
| T. 6 S., R. 94 W. | 647 | 11 | 29.5 | 31.6 | 19 | 20 |
| T. 6 S., R. 95 W. | 10,820 | 15 | 40.2 | 43.0 | 435 | 465 |
| T. 6 S., R. 96 W. | 8,790 | 18 | 48.2 | 51.6 | 424 | 454 |
| T. 6 S., R. 97 W. | 17,190 | 17 | 45.6 | 48.8 | 784 | 839 |
| T. 6 S., R. 98 W. | 6,730 | 9 | 24.1 | 25.8 | 162 | 174 |
| T. 6 S., R. 99 W. | 2,820 | 6 | 16.1 | 17.2 | 45 | 49 |
| T. 6 S., R. 100 W. | 59 | 5 | 13.4 | 14.3 | .8 | .8 |
| T. 7 S., R. 96 W. | 2,080 | 9 | 24.1 | 25.8 | 50 | 54 |
| T. 7 S., R. 97 W. | 6,590 | 10 | 26.8 | 28.7 | 177 | 189 |
| T. 7 S., R. 98 W. | 1,030 | 9 | 24.1 | 25.8 | 25 | 27 |
| T. 7 S., R. 99 W. | 2,070 | 8 | 21.4 | 22.9 | 44 | 47 |
| T. 7 S., R. 100 W. | 119 | 5 | 13.4 | 14.3 | 1.6 | 1.7 |
| Total | 167,108 | | | | 6,361.4 | 6,811.5 |
| **Inferred Potential Reserves** | | | | | | |
| T. 4 S., R. 94 W. | 2,290 | 10 | 26.8 | 28.7 | 61 | 66 |
| T. 4 S., R. 95 W. | 13,050 | 16 | 42.9 | 45.9 | 560 | 599 |
| T. 7 S., R. 98 W. | 830 | 7 | 18.8 | 20.1 | 16 | 17 |
| T. 7 S., R. 99 W. | 981 | 7 | 18.8 | 20.1 | 18 | 20 |
| Total | 17,151 | | | | 655 | 702 |

TABLE 2.—*Estimated tonnage and oil content of oil shale in and adjacent to the Mahogany zone that yields an average of 30 gallons of oil per ton in continuous sequence 15 feet or more thick*

[Estimates include the total tonnage and oil content of the deposit, but they do not indicate the amounts recoverable]

| Township and range | Acreage | Average of oil shale thickness (feet) | Average tonnage per acre of oil shale (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| **Indicated Potential Reserves** | | | | | | |
| T. 1 S., R. 96 W. | 2,212 | 30 | 88.8 | 63.4 | 196 | 140 |
| T. 1 S., R. 99 W. | 3,162 | 52 | 153.9 | 109.9 | 487 | 348 |
| T. 1 S., R. 100 W. | 7,264 | 35 | 103.6 | 74.0 | 753 | 538 |
| T. 2 S., R. 99 W. | 5,926 | 43 | 127.3 | 90.9 | 754 | 539 |
| T. 2 S., R. 100 W. | 12,192 | 35 | 103 6 | 74.0 | 1,263 | 902 |
| T. 3 S., R. 98 W. | 4,570 | 75 | 222.0 | 158.6 | 1,015 | 725 |
| T. 3 S., R. 99 W. | 20,070 | 51 | 151.0 | 107.8 | 3,031 | 2,165 |
| T. 3 S., R. 100 W. | 2,800 | 36 | 106.6 | 76.1 | 298 | 213 |
| T. 4 S., R. 94 W. | 2,750 | 60 | 177.6 | 126.9 | 488 | 349 |
| T. 4 S., R. 95 W. | 7,330 | 100 | 296.0 | 211.4 | 2,170 | 1,550 |
| T. 4 S., R. 96 W. | 5,215 | 88 | 260.5 | 186.1 | 1,359 | 971 |
| T. 4 S., R. 97 W. | 4,550 | 82 | 242.7 | 173.4 | 1,104 | 789 |
| T. 4 S., R. 98 W. | 11,392 | 65 | 192.4 | 137.4 | 2,192 | 1,566 |
| T. 4 S., R. 99 W. | 22,592 | 44 | 130.2 | 93.0 | 2,941 | 2,101 |
| T. 4 S., R. 100 W. | 1,796 | 29 | 85.8 | 61.3 | 154 | 110 |
| T. 5 S., R. 94 W. | 17,187 | 60 | 177.6 | 126.9 | 3,052 | 2,180 |
| T. 5 S., R. 95 W. | 19,410 | 90 | 266.4 | 190.3 | 5,171 | 3,694 |
| T. 5 S., R. 96 W. | 18,350 | 85 | 251.6 | 179.7 | 4,617 | 3,298 |
| T. 5 S., R. 97 W. | 21,600 | 67 | 198.3 | 141.7 | 4,283 | 3,059 |
| T. 5 S., R. 98 W. | 16,810 | 48 | 142.1 | 101.5 | 2,389 | 1,707 |
| T. 5 S., R. 99 W. | 13,000 | 40 | 118.4 | 84.6 | 1,539 | 1,099 |
| T. 6 S., R. 94 W. | 647 | 55 | 162.8 | 116.3 | 105 | 75 |
| T. 6 S., R. 95 W. | 10,820 | 78 | 230.9 | 164.9 | 2,498 | 1,784 |
| T. 6 S., R. 96 W. | 8,790 | 85 | 251.6 | 179.7 | 2,212 | 1,580 |
| T. 6 S., R. 97 W. | 17,190 | 75 | 222.0 | 158.6 | 3,816 | 2,726 |
| T. 6 S., R. 98 W. | 8,650 | 55 | 162.8 | 116.3 | 1,408 | 1,006 |
| T. 6 S., R. 99 W. | 5,460 | 40 | 118.4 | 84.6 | 646 | 461 |
| T. 6 S., R. 100 W. | 2,055 | 18 | 53.3 | 38.1 | 110 | 79 |
| T. 7 S., R. 96 W. | 2,080 | 47 | 139.1 | 99.3 | 289 | 207 |
| T. 7 S., R. 97 W. | 6,590 | 47 | 139.1 | 99.3 | 917 | 655 |
| T. 7 S., R. 98 W. | 1,030 | 35 | 103.6 | 74.0 | 107 | 77 |
| T. 7 S., R. 99 W. | 2,070 | 32 | 94.7 | 67.6 | 196 | 140 |
| T. 7 S., R. 100 W. | 209 | 17 | 50.3 | 35.9 | 11 | 8 |
| **Total** | 285,769 | ---- | ---- | ---- | 51,571 | 36,841 |

TABLE 2.—*Estimated tonnage and oil content of oil shale in and adjacent to the Mahogany zone that yields an average of 30 gallons of oil per ton in continuous sequence 15 feet or more thick*—Continued

| Township and range | Acreage | Average of oil shale thickness (feet) | Average tonnage per acre of oil shale (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| **Inferred Potential Reserves** | | | | | | |
| T. 2 N., R. 97 W. | 446 | 20 | 59.2 | 42.3 | 26 | 19 |
| T. 2 N., R. 98 W. | 8,582 | 25 | 74.0 | 52.9 | 635 | 454 |
| T. 2 N., R. 99 W. | 3,578 | 21 | 62.2 | 44.4 | 223 | 159 |
| T 1 N., R. 96 W. | 3,424 | 25 | 74.0 | 52.9 | 253 | 181 |
| T. 1 N., R. 97 W. | 18,112 | 45 | 133.2 | 95.1 | 2,413 | 1,724 |
| T. 1 N., R. 98 W. | 22,920 | 64 | 189.4 | 135.3 | 4,341 | 3,101 |
| T. 1 N., R. 99 W. | 20,288 | 36 | 106.6 | 76.1 | 2,163 | 1,545 |
| T. 1 N., R. 100 W. | 445 | 17 | 50.3 | 35.9 | 22 | 16 |
| T. 1 S., R. 95 W. | 565 | 17 | 50.3 | 35.9 | 28 | 20 |
| T. 1 S., R. 96 W. | 20,384 | 90 | 266.4 | 190.3 | 5,430 | 3,879 |
| T. 1 S., R. 97 W. | 28,320 | 79 | 233.8 | 167.0 | 6,621 | 4,729 |
| T. 1 S., R. 98 W. | 24,860 | 69 | 204.2 | 145.9 | 5,076 | 3,626 |
| T. 1 S., R. 99 W. | 22,038 | 56 | 165.8 | 118.4 | 3,654 | 2,610 |
| T. 1 S., R. 100 W. | 2,246 | 25 | 74.0 | 52.9 | 166 | 119 |
| T. 2 S., R. 95 W. | 7,050 | 25 | 74.0 | 52.9 | 522 | 373 |
| T. 2 S., R. 96 W. | 23,400 | 35 | 103.6 | 74.0 | 2,424 | 1,731 |
| T. 2 S., R. 97 W. | 23,925 | 72 | 213.1 | 152.2 | 5,098 | 3,641 |
| T. 2 S., R. 98 W. | 23,450 | 61 | 180.6 | 129.0 | 4,235 | 3,025 |
| T. 2 S., R. 99 W. | 17,783 | 50 | 148.0 | 105.7 | 2,632 | 1,880 |
| T. 3 S., R. 94 W. | 579 | 22 | 65.1 | 46.5 | 38 | 27 |
| T. 3 S., R. 95 W. | 18,420 | 32 | 94.7 | 67.7 | 1,744 | 1,246 |
| T. 3 S., R. 96 W. | 23,477 | 51 | 151.0 | 107.9 | 3,545 | 2,532 |
| T. 3 S., R. 97 W. | 24,210 | 74 | 219.0 | 156.4 | 5,302 | 3,787 |
| T. 3 S., R. 98 W. | 19,264 | 72 | 213.1 | 152.2 | 4,105 | 2,932 |
| T. 3 S., R. 99 W. | 1,594 | 54 | 159.8 | 114.1 | 255 | 182 |
| T. 4 S., R. 94 W. | 5,020 | 40 | 118.4 | 84.6 | 594 | 424 |
| T. 4 S., R. 95 W. | 15,290 | 80 | 236.8 | 169.1 | 3,621 | 2,587 |
| T. 4 S., R. 96 W. | 17,025 | 77 | 227.9 | 162.8 | 3,880 | 2,771 |
| T. 4 S., R. 97 W. | 18,750 | 78 | 230.9 | 164.9 | 4,329 | 3,092 |
| T. 4 S., R. 98 W. | 11,840 | 75 | 222.0 | 158.6 | 2,628 | 1,877 |
| T. 4 S., R. 99 W. | 208 | 23 | 68.1 | 48.7 | 14 | 10 |
| T. 4 S., R. 100 W. | 3,033 | 19 | 56.2 | 40.1 | 170 | 121 |
| T. 5 S., R. 99 W. | 3,110 | 20 | 59.2 | 42.3 | 184 | 131 |
| T. 5 S., R. 100 W. | 223 | 16 | 47.4 | 33.9 | 11 | 8 |
| T. 7 S., R. 98 W. | 830 | 25 | 74.0 | 52.9 | 61 | 43 |
| T. 7 S., R. 99 W. | 1,460 | 20 | 59.2 | 42.3 | 86 | 61 |
| Total | 436,149 | | | | 76,529 | 54,663 |

of approximately 447 square miles contains indicated reserves of about 52,000 million tons of shale with a potential yield of about 37,000 million barrels of oil. In addition, approximately 683 square miles contain inferred reserves of about 76,000 million tons of shale with a potential yield of about 54,000 million barrels of oil.

General Petroleum Corp. well 22–3–G, in sec. 3, T. 2 S., R. 96 W., contains 130 feet of shale in a continuous sequence that will yield an average of 30 gallons of oil per ton.

Other oil-shale zones yielding 30 gallons of oil per ton, not shown on the thickness maps, occur below the Mahogany zone. They range from 340 to 1,520 feet below the top of the Mahogany bed and are known only in the northeastern part of the basin in the vicinity of the Piceance Creek gasfield, where limited information is available from analyses of well cuttings. These zones combined cover an estimated area of 91 square miles and contain inferred reserves of about 9,500 million tons of shale with a potential yield of about 6,800 million barrels of oil. The maximum known thickness of 30-gallon shale is 180 feet; it is in a zone 830 feet below the Mahogany zone in General Petroleum Corp. well 5–31–G, located in sec. 31, T. 1 S., R. 96 W.

Total indicated and inferred reserves of about 137,500 million tons of 30-gallon-per-ton shale with a minimum thickness of 15 feet are present in the area. These reserves have a potential oil yield of 97,800 million barrels.

Estimated tonnage and oil content of that part of the Mahogany zone and adjacent beds that yield an average of 25 gallons of oil per ton in a continuous sequence 15 feet or more thick are shown in table 3; the distribution and thickness of the unit are shown on plate 14, *C*. The unit includes the 30-gallon shale shown in table 2. Indicated reserves of about 93,000 million tons of shale that contain about 55,000 million barrels of oil underlie an area of 452 square miles. Inferred reserves totaling about 167,000 million tons of shale that contain about 100,000 million barrels of oil underlie an additional 751 square miles. The thickest sequence of 25-gallon shale in the unit is found in General Petroleum Corp. well 5–31–G, in sec. 31, T. 1 S., R. 96 W., where it attains a thickness of 220 feet.

There are several zones that are not shown on the thickness maps, in the oil-shale sequence below the Mahogany zone, that contain an average of 25 gallons of oil per ton in a continuous sequence 15 feet or more thick. These zones are known only from assays of rotary cuttings in the vicinity of the Piceance Creek dome. As far as is known, they underlie about 180 square miles and contain inferred reserves of about 65,000 million tons of oil shale with an oil content of about 39,000 million of barrels. The thickest known sequence of 25-gallon shale is in General Petroleum Corp. well 5–31–G, in sec.

TABLE 3.—*Estimated tonnage and oil content of oil shale in and adjacent to the Mahogany zone that yields an average of 25 gallons of oil per ton in a continuous sequence 15 feet or more thick*

[Estimates include the total tonnage and oil content of the deposit, but they do not indicate the amounts recoverable]

| Township and range | Acreage | Average thickness of oil shale (feet) | Average tonnage per acre of oil shale (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| **Indicated Potential Reserves** | | | | | | |
| T. 1 N., R. 96 W. | 134 | 17 | 52.2 | 31.1 | 7 | 4 |
| T. 1 S., R. 95 W. | 104 | 18 | 55.3 | 32.9 | 6 | 3 |
| T. 1 S., R. 96 W. | 3,495 | 30 | 92.1 | 54.8 | 322 | 192 |
| T. 1 S., R. 99 W. | 3,162 | 101 | 310.1 | 184.6 | 980 | 583 |
| T. 1 S., R. 100 W. | 7,264 | 65 | 199.6 | 118.8 | 1,450 | 863 |
| T. 2 S., R. 99 W. | 5,926 | 90 | 276.3 | 164.5 | 1,637 | 974 |
| T. 2 S., R. 100 W. | 12,192 | 70 | 214.9 | 127.9 | 2,620 | 1,559 |
| T. 3 S., R. 98 W. | 4,570 | 130 | 399.1 | 237.5 | 1,824 | 1,086 |
| T. 3 S., R. 99 W. | 20,070 | 98 | 300.8 | 179.0 | 6,037 | 3,593 |
| T. 3 S., R. 100 W. | 2,800 | 65 | 199.6 | 118.8 | 559 | 333 |
| T. 4 S., R. 94 W. | 3,020 | 80 | 245.6 | 146.2 | 742 | 442 |
| T. 4 S., R. 95 W. | 7,330 | 150 | 460.5 | 274.1 | 3,375 | 2,009 |
| T. 4 S., R. 96 W. | 5,215 | 140 | 429.8 | 255.8 | 2,241 | 1,334 |
| T. 4 S., R. 97 W. | 4,550 | 145 | 445.2 | 265.0 | 2,026 | 1,206 |
| T. 4 S., R. 98 W. | 11,392 | 95 | 291.7 | 173.6 | 3,323 | 1,978 |
| T. 4 S., R. 99 W. | 22,592 | 85 | 261.0 | 155.3 | 5,897 | 3,510 |
| T. 4 S., R. 100 W. | 1,796 | 45 | 138.1 | 82.2 | 248 | 148 |
| T. 5 S., R. 94 W. | 18,131 | 90 | 276.3 | 164.5 | 5,010 | 2,982 |
| T. 5 S., R. 95 W. | 19,410 | 150 | 460.5 | 274.1 | 8,938 | 5,320 |
| T. 5 S., R. 96 W. | 18,350 | 140 | 429.8 | 255.8 | 7,887 | 4,694 |
| T. 5 S., R. 97 W. | 21,600 | 120 | 368.4 | 219.3 | 7,957 | 4,736 |
| T. 5 S., R. 98 W. | 16,810 | 100 | 307.0 | 182.7 | 5,161 | 3,072 |
| T. 5 S., R. 99 W. | 13,000 | 70 | 214.9 | 127.9 | 2,794 | 1,663 |
| T. 6 S., R. 94 W. | 647 | 80 | 245.6 | 146.2 | 159 | 95 |
| T. 6 S., R. 95 W. | 10,820 | 120 | 368.4 | 219.3 | 3,986 | 2,372 |
| T. 6 S., R. 96 W. | 8,790 | 135 | 414.5 | 246.7 | 3,643 | 2,168 |
| T. 6 S., R. 97 W. | 17,190 | 130 | 399.1 | 237.5 | 6,861 | 4,084 |
| T. 6 S., R. 98 W. | 8,650 | 95 | 291.7 | 173.6 | 2,523 | 1,502 |
| T. 6 S., R. 99 W. | 5,460 | 75 | 230.3 | 137.1 | 1,257 | 748 |
| T. 6 S., R. 100 W. | 2,560 | 30 | 92.1 | 54.8 | 236 | 141 |
| T. 7 S., R. 96 W. | 2,080 | 80 | 245.6 | 146.2 | 511 | 304 |
| T. 7 S., R. 97 W. | 6,590 | 90 | 276.3 | 164.5 | 1,821 | 1,084 |
| T. 7 S., R. 98 W. | 1,030 | 85 | 261.0 | 155.3 | 269 | 160 |
| T. 7 S., R. 99 W. | 2,070 | 75 | 230.3 | 137.1 | 477 | 284 |
| T. 7 S., R. 100 W. | 538 | 25 | 76.8 | 45.7 | 41 | 25 |
| Total | 289,338 | | | | 92,825 | 55,251 |

TABLE 3.—*Estimated tonnage and oil content of oil shale in and adjacent to the Mahogany zone that yields an average of 25 gallons of oil per ton in a continuous sequence of 15 feet or more thick*—Continued

| Township and range | Acreage | Average thickness of oil shale (feet) | Average tonnage per acre of oil shale (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| **Inferred Potential Reserves** | | | | | | |
| T 2 N., R. 97 W. | 1,488 | 30 | 92.1 | 54.8 | 137 | 81 |
| T. 2 N., R. 98 W. | 13,152 | 60 | 184.2 | 109.6 | 2,423 | 1,442 |
| T. 2 N., R. 99 W. | 6,272 | 40 | 122.8 | 73.1 | 770 | 458 |
| T 1 N., R. 96 W. | 4,448 | 40 | 122.8 | 73.1 | 546 | 325 |
| T. 1 N., R. 97 W. | 19,872 | 70 | 214.9 | 127.9 | 4,270 | 2,541 |
| T. 1 N., R. 98 W. | 22,920 | 162 | 497.3 | 296.0 | 11,398 | 6,784 |
| T. 1 N., R. 99 W. | 22,756 | 85 | 261.0 | 155.3 | 5,939 | 3,535 |
| T. 1 N., R. 100 W. | 1,440 | 30 | 122.8 | 73.1 | 177 | 105 |
| T. 1 S., R. 95 W. | 2,080 | 25 | 76.8 | 45.7 | 16 | 9 |
| T. 1 S., R. 96 W. | 20,384 | 120 | 368.4 | 219.3 | 7,509 | 4,469 |
| T. 1 S., R 97 W. | 28,320 | 195 | 598.7 | 356.3 | 16,955 | 10,092 |
| T. 1 S., R. 98 W. | 24,860 | 165 | 506.6 | 301.5 | 12,594 | 7,496 |
| T. 1 S., R. 99 W. | 22,038 | 118 | 371.5 | 221.1 | 8,187 | 4,873 |
| T. 1 S., R. 100 W. | 2,246 | 38 | 107.5 | 64.0 | 241 | 143 |
| T. 2 S., R. 95 W. | 12,480 | 35 | 107.5 | 64.0 | 1,342 | 799 |
| T. 2 S., R. 96 W. | 23,400 | 90 | 276.3 | 164.5 | 6,465 | 3,848 |
| T. 2 S., R. 97 W. | 23,925 | 145 | 445.2 | 265.0 | 10,651 | 6,339 |
| T. 2 S., R. 98 W. | 23,450 | 140 | 429.8 | 255.8 | 10,079 | 5,999 |
| T. 2 S., R. 99 W. | 17,783 | 112 | 334.6 | 199.2 | 5,950 | 3,541 |
| T. 3 S., R. 95 W. | 19,100 | 50 | 153.5 | 91.4 | 2,932 | 1,745 |
| T. 3 S., R. 96 W. | 23,477 | 125 | 383.8 | 228.4 | 9,011 | 5,363 |
| T. 3 S., R. 97 W. | 24,210 | 145 | 445.2 | 265.0 | 10,778 | 6,415 |
| T. 3 S., R. 98 W. | 19,264 | 125 | 383.8 | 228.4 | 7,394 | 4,401 |
| T. 3 S., R. 99 W. | 1,594 | 112 | 343.8 | 204.6 | 548 | 326 |
| T. 4 S., R. 94 W. | 3,935 | 45 | 138.2 | 82.3 | 544 | 324 |
| T. 4 S., R. 95 W. | 15,290 | 142 | 435.9 | 259.5 | 6,665 | 3,967 |
| T. 4 S., R. 96 W. | 17,025 | 140 | 429.8 | 255.9 | 7,317 | 4,355 |
| T. 4 S., R. 97 W. | 18,750 | 150 | 460.5 | 274.1 | 8,634 | 5,139 |
| T. 4 S., R. 98 W. | 11,840 | 122 | 374.5 | 222.9 | 4,434 | 2,639 |
| T. 4 S., R. 99 W. | 208 | 32 | 98.2 | 58.5 | 20 | 12 |
| T. 4 S., R 100 W. | 11,072 | 27 | 82.9 | 49.4 | 918 | 546 |
| T. 5 S., R. 99 W. | 3,110 | 37 | 113.6 | 67.7 | 353 | 210 |
| T. 5 S., R. 100 W. | 9,050 | 25 | 76.8 | 45.7 | 695 | 414 |
| T. 6 S., R. 100 W. | 4,025 | 20 | 61.4 | 36.6 | 247 | 147 |
| T. 7 S., R. 98 W. | 830 | 60 | 184.2 | 109.7 | 153 | 91 |
| T. 7 S., R. 99 W. | 1,995 | 40 | 122.8 | 73.1 | 245 | 146 |
| T. 7 S., R. 100 W. | 1,999 | 20 | 61.4 | 36.6 | 123 | 73 |
| T. 8 S., R. 99 W. | 865 | 20 | 61.4 | 36.6 | 53 | 32 |
| Total | 480,953 | | | | 166,713 | 99,233 |

TABLE 4.—*Estimated tonnage and oil content of oil shale that yields an average of 15 gallons of oil per ton in continuous sequence 15 feet or more thick*

[Estimates include the total tonnage and oil content of the deposit, but they do not indicate the amounts recoverable]

| Township and range | Acreage | Average thickness of oil shale (feet) | Average tonnage of oil shale per acre (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| **Indicated Potential Reserves** | | | | | | |
| T. 2 N., R. 98 W. | 535 | 1,575 | 5,181.8 | 1,850.4 | 2,772 | 990 |
| T. 1 N., R. 96 W. | 1,250 | 100 | 329.0 | 117.5 | 411 | 147 |
| T. 1 N., R. 98 W. | 7,104 | 2,000 | 6,580.0 | 2,349.7 | 46,744 | 16,693 |
| T. 1 N., R. 99 W. | 148 | 1,725 | 5,675.3 | 2,026.6 | 840 | 300 |
| T. 1 S., R. 95 W. | 294 | 175 | 575.8 | 205.6 | 169 | 60 |
| | 965 | 60 | 197.8 | 70.6 | 191 | 68 |
| T. 1 S., R. 96 W. | 3,860 | 300 | 986.8 | 352.4 | 3,809 | 1,361 |
| | 7,430 | 1,700 | 5,593.0 | 1,997.3 | 41,556 | 14,840 |
| T. 1 S., R. 97 W. | 2,825 | 2,150 | 7,073.5 | 2,525.9 | 19,983 | 7,136 |
| T. 2 S., R. 95 W. | 16,450 | 300 | 987.0 | 352.5 | 16,236 | 5,798 |
| T. 2 S., R. 96 W. | 20,400 | 1,950 | 6,415.5 | 2,291.0 | 130,876 | 46,736 |
| T. 2 S., R. 97 W. | 1,325 | 2,050 | 6,744.5 | 2,408.5 | 8,936 | 3,191 |
| T. 2 S., R. 99 W. | 768 | 550 | 1,809.5 | 646.2 | 1,390 | 496 |
| T. 2 S., R. 100 W. | 8,584 | 275 | 904.8 | 323.1 | 7,767 | 2,774 |
| T. 3 S., R. 94 W. | 580 | 50 | 164.5 | 58.7 | 95 | 34 |
| T. 3 S., R. 95 W. | 8,455 | 450 | 1,480.5 | 528.7 | 12,518 | 4,470 |
| | 864 | 150 | 493.5 | 176.2 | 426 | 152 |
| T. 3 S., R. 96 W. | 1,427 | 1,500 | 4,935.0 | 1,762.3 | 7,042 | 2,515 |
| T. 3 S., R. 99 W. | 10,825 | 700 | 2,303.0 | 822.4 | 24,930 | 8,903 |
| T. 3 S., R. 100 W. | 3,170 | 350 | 1,151.5 | 411.2 | 3,650 | 1,303 |
| T. 4 S., R. 94 W. | 7,100 | 180 | 592.3 | 211.5 | 4,205 | 1,502 |
| T. 4 S., R. 95 W. | 7,330 | 720 | 2,368.8 | 845.9 | 17,362 | 6,200 |
| T. 4 S., R. 96 W. | 5,215 | 1,150 | 3,783.5 | 1,351.1 | 19,731 | 7,046 |
| T. 4 S., R. 97 W. | 2,465 | 1,300 | 4,277.1 | 1,527.3 | 10,543 | 3,765 |
| T. 4 S., R. 98 W. | 3,950 | 850 | 2,796.5 | 998.6 | 11,046 | 3,945 |
| T. 4 S., R. 99 W. | 21,914 | 650 | 2,138.5 | 763.7 | 46,863 | 16,735 |
| T. 4 S., R. 100 W. | 1,952 | 450 | 1,480.5 | 528.7 | 2,890 | 1,032 |
| T. 5 S., R. 94 W. | 18,265 | 400 | 1,316.0 | 469.9 | 24,037 | 8,584 |
| T. 5 S., R. 95 W. | 20,950 | 760 | 2,500.4 | 892.9 | 52,383 | 18,706 |
| T. 5 S., R. 96 W. | 20,610 | 930 | 3,059.7 | 1,092.6 | 63,060 | 22,519 |
| T. 5 S., R. 97 W. | 21,610 | 910 | 2,993.9 | 1,069.1 | 64,698 | 23,104 |
| T. 5 S., R. 98 W. | 19,450 | 650 | 2,138.5 | 763.7 | 41,594 | 14,853 |
| T. 5 S., R. 99 W. | 13,568 | 475 | 1,562.8 | 558.1 | 21,204 | 7,572 |
| T. 6 S., R. 94 W. | 684 | 450 | 1,481.0 | 528.9 | 1,013 | 362 |
| T. 6 S., R. 95 W. | 10,320 | 560 | 1,842.4 | 657.9 | 19,014 | 6,790 |
| T. 6 S., R. 96 W. | 9,850 | 625 | 2,056.2 | 734.3 | 20,254 | 7,233 |
| T. 6 S., R. 97 W. | 14,790 | 630 | 2,072.7 | 740.2 | 30,655 | 10,947 |
| T. 6 S., R. 98 W. | 11,990 | 525 | 1,727.3 | 616.8 | 20,710 | 7,395 |
| T. 6 S., R. 99 W. | 7,780 | 400 | 1,316.0 | 469.9 | 10,238 | 3,656 |
| T. 6 S., R. 100 W. | 2,945 | 250 | 822.5 | 293.7 | 2,423 | 865 |
| T. 7 S., R. 98 W. | 970 | 400 | 1,316.0 | 469.9 | 1,277 | 456 |
| T. 7 S., R. 99 W. | 2,100 | 325 | 1,069.0 | 381.7 | 2,245 | 802 |
| T. 7 S., R. 100 W. | 717 | 175 | 576.0 | 205.7 | 413 | 147 |
| Total | 323,784 | | | | 818,200 | 292,183 |

TABLE 4.—*Estimated tonnage and oil content of oil shale that yields an average of 15 gallons of oil per ton in continuous sequence 15 feet or more thick*—Con.

| Township and range | Acreage | Average thickness of oil shale (feet) | Average tonnage of oil shale per acre (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| **Inferred Potential Reserves** | | | | | | |
| T. 2 N., R. 97 W. | 2,445 | 200 | 658.0 | 235.0 | 1.609 | 575 |
| T. 2 N., R. 98 W. | 14,272 | 675 | 2,220.8 | 793.0 | 31,695 | 11,318 |
| T. 2 N., R. 99 W. | 10,570 | 200 | 658.0 | 235.0 | 6,955 | 2,484 |
| T. 2 N., R. 100 W. | 211 | 20 | 65.8 | 23.5 | 14 | 5 |
| T. 1 N., R. 96 W. | 9,410 | 150 | 493.5 | 176.2 | 4,644 | 1,658 |
| T. 1 N., R. 97 W. | 20,950 | 900 | 2,961.0 | 1,057.4 | 62.033 | 22,152 |
| T. 1 N., R. 98 W. | 16.256 | 2,025 | 6.662.3 | 2,379.1 | 108,302 | 38,675 |
| T. 1 N., R. 99 W. | 23,002 | 950 | 3,125.5 | 1,116.1 | 71,893 | 25,673 |
| T. 1 N., R. 100 W. | 4,320 | 225 | 740.3 | 264.4 | 3,198 | 1,142 |
| T. 1 S., R. 95 W. | 8,090 | 80 | 263.2 | 94.0 | 2 129 | 760 |
| T. 1 S., R. 96 W. | 13,350 | 1,000 | 3,290.0 | 1,174.9 | 43,922 | 15,685 |
| T. 1 S., R. 97 W. | 25,495 | 2,050 | 6,744.5 | 2,408.5 | 171,951 | 61,404 |
| T. 1 S., R. 98 W. | 24,860 | 1,975 | 6,498.7 | 2.320.7 | 161,558 | 57,692 |
| T. 1 S., R. 99 W. | 25,200 | 1,150 | 3,783.5 | 1,351.1 | 95,344 | 34,047 |
| T. 1 S., R. 100 W. | 17,700 | 225 | 740.3 | 264.4 | 13,103 | 4,679 |
| T. 2 S., R. 95 W. | 3,485 | 50 | 164.4 | 58.7 | 573 | 205 |
| T. 2 S., R. 96 W. | 3,355 | 1,850 | 6,086.4 | 2,173.5 | 20,420 | 7,292 |
| T. 2 S., R. 97 W. | 22,600 | 1,775 | 5,839.8 | 2.085.4 | 131,979 | 47,130 |
| T. 2 S., R. 98 W. | 23,450 | 1,575 | 5,181.7 | 1,850.4 | 121,511 | 43,391 |
| T. 2 S., R. 99 W. | 22,232 | 1,050 | 3,454.5 | 1,233.6 | 76,800 | 27,425 |
| T. 2 S., R. 100 W. | 4,516 | 250 | 822.5 | 293.7 | 3,714 | 1,326 |
| T. 3 S., R. 94 W. | 160 | 20 | 65.8 | 23.5 | 11 | 4 |
| T. 3 S., R. 95 W. | 14,000 | 600 | 1.974.0 | 704.9 | 27,636 | 9,869 |
| T. 3 S., R. 96 W. | 22,050 | 1,600 | 5,264.0 | 1,879.8 | 116,071 | 41,449 |
| T. 3 S., R. 97 W. | 24,210 | 1,500 | 4,935.0 | 1,762.3 | 119,476 | 42,665 |
| T. 3 S., R. 98 W. | 23,550 | 1,250 | 4,112.5 | 1,468.6 | 96,849 | 34,585 |
| T. 3 S., R. 99 W. | 11,428 | 975 | 3,208.7 | 1,145.9 | 36,669 | 13,094 |
| T. 4 S., R. 94 W. | 3,600 | 150 | 493.5 | 176.3 | 1,777 | 635 |
| T. 4 S., R. 95 W. | 15,290 | 700 | 2,303.0 | 822.4 | 35.213 | 12,575 |
| T. 4 S., R. 96 W. | 17,025 | 1,200 | 3,948.0 | 1,409.9 | 67,215 | 24,002 |
| T. 4 S., R. 97 W. | 20,750 | 1,250 | 4,112.5 | 1,468.6 | 85,334 | 30,473 |
| T. 4 S., R. 98 W. | 18,510 | 1,000 | 3,290.0 | 1,174.9 | 60,898 | 21,747 |
| T. 4 S., R. 99 W. | 256 | 450 | 1,480.5 | 528.7 | 379 | 135 |
| T. 4 S., R. 100 W. | 12,898 | 350 | 1,151.5 | 411.2 | 14,852 | 5,304 |
| T. 5 S., R. 97 W. | 1,190 | 975 | 3,207.6 | 1,145.5 | 3.817 | 1,363 |
| T. 5 S., R. 98 W. | 743 | 850 | 2,796.8 | 998.8 | 2,078 | 742 |
| T. 5 S., R. 99 W. | 5,527 | 350 | 1,151.5 | 411.2 | 6,364 | 2,273 |
| T. 5 S., R. 100 W. | 18,410 | 200 | 658.0 | 235.0 | 12.114 | 4,326 |
| T. 6 S., R. 95 W. | 1,010 | 575 | 1,892.1 | 675.7 | 1,911 | 683 |
| T. 6 S., R. 96 W. | 1,804 | 590 | 1,941.2 | 693.3 | 3,502 | 1,251 |

TABLE 4.—*Estimated tonnage and oil content of oil shale that yields an average of 15 gallons of oil per ton in continuous sequence 15 feet or more thick*—Con.

| Township and range | Acreage | Average thickness of oil shale (feet) | Average tonnage of oil shale per acre (thousands of tons) | Average oil yield per acre (thousands of barrels) | Tonnage of oil shale (millions of tons) | Potential oil yield (millions of barrels) |
|---|---|---|---|---|---|---|
| T. 6 S., R. 97 W. | 5,100 | 510 | 1,677.8 | 599.2 | 8,557 | 3,056 |
| T. 6 S., R. 100 W. | 7,580 | 150 | 493.5 | 176.3 | 3,741 | 1,336 |
| T. 6 S., R. 101 W. | 4,710 | 85 | 279.7 | 99.9 | 1,317 | 471 |
| T. 7 S., R. 96 W. | 4,140 | 425 | 1,398.3 | 499.4 | 5,789 | 2,067 |
| T. 7 S., R. 97 W. | 9,550 | 425 | 1,398.3 | 499.4 | 13,354 | 4,769 |
| T. 7 S., R. 98 W. | 2,320 | 325 | 1,069.4 | 381.9 | 2,481 | 886 |
| T. 7 S., R. 99 W. | 3,070 | 200 | 658.0 | 235.0 | 2,020 | 721 |
| T. 7 S., R. 100 W. | 9,000 | 100 | 329.0 | 117.5 | 2,961 | 1,057 |
| T. 7 S., R. 101 W. | 2,175 | 55 | 181.1 | 64.7 | 394 | 141 |
| T. 8 S., R. 99 W. | 2,250 | 150 | 493.5 | 176.3 | 1,110 | 396 |
| T. 8 S., R. 100 W. | 1,120 | 90 | 296.1 | 105.8 | 332 | 119 |
| Total | 559,195 | | | | 1,867,569 | 666,911 |

31, T. 1 S., R. 96 W., where it is 780 feet thick and lies 500 feet below the Mahogany bed.

Indicated and inferred reserves of 25-gallon-per-ton shale total about 325,000 million tons with an oil content of 194,000 million barrels.

Estimates of tonnage and oil content of that part of the Green River formation that yields an average of 15 gallons of oil per ton in a continuous sequence 15 feet or more thick are shown in table 4. The distribution and thickness of 15-gallon shale are shown on plate 14, *D*. This unit includes the oil shales of all units previously discussed. Approximately 506 square miles of the area contain indicated reserves of about 818,000 million tons of oil shale with an oil content of 292,000 million barrels. An additional area of approximately 874 square miles contains inferred reserves of about 1,868,000 million tons of oil shale with an oil content of 667,000 million barrels. Analyzed rotary samples from General Petroleum Corp. well 5–31–G, sec. 31, T. 1 S., R. 96 W., just 10 miles west of the eastern 15-foot cutoff line (pl. 14, *D*), indicate the presence of an oil-shale sequence 2,200 feet thick that will yield an average of more than 15 gallons of oil per ton.

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