Water Utilization

in the

White River Basin, Oregon

by

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Summary

1. White River, tributary to the Deschutes River at an altitude of 760 feet, has its principal source in the White River Glacier on the south slope of Mt. Hood at an altitude of 6,500 feet. It drains an area of 400 square miles in north central Oregon, the upper half of which is rough to rolling, and densely timbered with fir and pine, the lower half, a comparatively level plateau, mostly sage plain, but partly wooded, sloping gently to the east. The river is deeply entrenched in the plateau until it reaches Tygh Valley, a sort of cove extending up from the Deschutes River about six or seven miles to the confluence of White River and Tygh Creek. Tygh Creek and Clear Creek are the principal tributaries.

2. The climate of the White River basin is typical of eastern Oregon, semi-arid, with somewhat wide ranges in temperature, except for a small area around Mt. Hood, which has a more humid climate.

3. Factors affecting hydraulic structures in the basin are occasional extremes of cold weather necessitating some protection against ice, and a high percentage of glacial silt in White River flow which will cause severe scouring of turbines and will gather in conduits, forebays and other installations to a troublesome extent.

4. The mean annual run-off for White River near its mouth is 297,000 acre feet or 410 second-feet, as determined from the record at Tygh Valley from 1917 to 1943. Extremes for the period are a maximum of 13,300 second-feet on January 6, 1923, and a minimum of 10 second-feet (regulated flow) on August 9, 1931 and other dates. Discharge varies with the seasons, being heaviest during spring when the maximum run-off occurs from melting snow on Mt. Hood, and, in general, lowest during late summer and early fall. Many small diversions for irrigation above the gaging station, and some regulation at the power plant, obscure somewhat the minimum natural flow of the river. The minimum flow of record at a station maintained above all but minor diversions for irrigation from 1911 to 1918 (frag.) was 75 second-feet (Oct. 16-19, 1915).

5. No storage of material value is available in the White River basin. Some additional pondage for desilting purposes could probably be developed.

6. Power development in the White River basin will probably be subordinated to irrigation, and any material development of power may therefore not be feasible. If all flow were utilized for power it is roughly estimated that totals of 10,000, 13,000 and 32,000 horsepower could be developed for 100 percent, 90 percent and 50 percent of the time, respectively. After prospective diversions for irrigation the total potential power of the river will be reduced to an estimated 2,700 horsepower for 100 percent of the time, 4,000 horsepower for 90 percent of the time, and 20,000 horsepower for 50 percent of the time.

7. Present plans for the irrigation of lands in the White River basin contemplate diversion of all the low flow of summer at an altitude of 2,500 feet. This prospective diversion would make infeasible any power development below Keeps Mill.

8. If the present plans for irrigation are realized, power development in White River would probably be restricted to the area above Keeps Mill, or above an altitude of 2,500 feet. In this upper reach of river it is estimated that a total of 2,700 horsepower, 3,900 horsepower, and 10,000 horsepower could be developed for 100 percent, 90 percent and 50 percent of the time, respectively, without interference with irrigation.

9. Problems of silt control, prospective diversion for irrigation, and the general economics of development, suggest an alternative plan of power development whereby the winter flow of White River above an altitude of 4,200 feet would be diverted to Salmon River for storage in the proposed Salmon Meadows reservoir. The total annual diversion consistent with irrigation is estimated at 12,000 acre-feet, which would be available for over-all power regulation through 3,000 feet of head in Salmon and Sandy Rivers.

Summary of potential power in White River, Oregon, under present conditions of flow

Site or reach	Head Ft.	Flow in second-feet			Horsepower		
		100 percent of time Q100	90 percent of time Q90	50 percent of time Q50	100 percent of time Q100	90 percent of time Q90	50 percent of time Q50
Mt. Hood site	700	10	15	40	560	840	2,240
Iron Creek site	1,400	12	18	50	1,340	2,000	5,600
Keeps Mill site	260	40	50	125	830	1,040	2,600
Alt. 2500-1080	1,420	50	60	150	5,680	6,810	17,040
Alt. 1060-760	300	80	100	200	1,900	2,400	4,800
Total potential power*					10,000	13,000	32,000

*Assumes that basic periods of time are synchronized at all sites.

Summary of potential power in White River, Oregon, after prospective irrigation

Site or reach	Head Ft.	Flow in Second-Feet 100 percent of time Q100	90 percent of time Q 90	50 percent of time Q 50	Horsepower 100 percent of time Q100	90 percent of time Q 90	50 percent of time Q 50
Mt. Hood site (Not affected by irrigation)					560	840	2,240
Iron Creek site " " " "					1,340	2,000	5,600
Keeps Mill site " " " "					830	1,040	2,600
Alt. 2500-1080	1,420	Nil	Nil	70	Nil	Nil	8,000
Atl. 1060-760	300	Nil	10	100	Nil	240	2,400
Total potential power*					2,700	4,000	20,000

*Assumes that basic periods of time are synchronized at all sites.

Water Utilization in the White River, Oregon

Introduction

This report presents briefly the results of an investigation of the water and power resources of the White River made in 1943 primarily for the purpose of classification of lands adjacent to the stream that have been withdrawn for power purposes. About three days were spent by the writer in field examination of the river basin during August and September. A survey of the river from its confluence with the Deschutes River to the Mt. Hood Loop Highway is published by the Survey. Nearly all of this map was surveyed in 1932. The entire basin is shown on quadrangle sheets. A record of discharge is available for the period 1917-43 at a station near the mouth of the river, and several short records are available at points upstream and on tributary streams.

Geography, geology and physiography

White River drains an area of about 400 square miles in north central Oregon. Its source is the White River Galcier on the south slope of Mt. Hood, and it describes a wide, semi-circular course, flowing first in a general southeast direction, then east, then northeast to its confluence with the Deschutes River at an altitude of about 760 feet. In its upper reaches the river flows over a broad wash in which the main channel frequently changes its course (See photograph No. 1.) From source to mouth it has a total length of about 50 miles, and a total fall of about 6,000 feet, most of which, however, is concentrated in the upper reaches where the flow is small. Its principal tributaries are Tygh Creek and Clear Creek.

The headwaters region is densely timbered with fir and pine to an altitude of about 5,000 feet. A thinner covering of woodland extends down to a line roughly 10 miles back from the Deschutes River. The lower basin is open sage and juniper plain, partly under cultivation, and partly under irrigation. In the vicinity of its confluence with Tygh Creek, White River flows through a comparatively broad valley (See Dufur quadrangle map) where are situated some of the best lands in the basin. Except for this limited area the main valley of the river is a deep, rough canyon, wooded or timbered, and non-cultivable. (See photograph No. 2.)

The entire basin is within an area of comparatively recent lava flows, which are in general overlaid by a vulcanic ash and other wind blown material varying from a few inches to several feet in depth. Lava rock is so near the surface in much of the area as to make cultivation impracticable. It occurs also as outcrops or is exposed by erosion in drainage channels. A large part of the lower basin, however, has a relatively deep soil covering and could be irrigated. A part of the timbered or wooded area is sufficiently level for cultivation and has a fair depth of soil. If cleared and irrigated, it would make valuable farm land. Most of the basin is accessible by roads, a considerable mileage of which is paved. Maupin on the Deschutes River and Tygh Valley at the confluence of Tygh Creek are the principal trade centers. Wheat growing is the leading industry. Some general farming is carried on, and irrigation is practiced on a small scale.

Climate

The climate of the White River basin is typical of eastern Oregon, semi-arid, moderately warm in summer, moderately cold in winter. Precipitation is light over most of the area, but varies greatly with altitude. In the lower basin the mean annual precipitation is probably about the same as at Warm Springs on the Warm Springs Indian Reservation, which received an average annual precipitation of 10 inches during the 24-year period from 1903 to 1927. A small area in the White River basin above an altitude of 4,000 feet probably receives an annual precipitation not much less than Government Camp. Although the latter is on the west slope of the Cascades, a comparatively low divide intervenes. The average for Government Camp from 1896 to 1923 was 85 inches.

A rough index to precipitation throughout the basin can be had from forest cover, especially from its lower limits as shown on the Dufur quadrangle map. A station at Friend, Oregon, is located near the lower limits of forest cover on the northeast margin of the White River drainage area at an altitude of 2,400 feet. Its average annual precipitation for the period 1924-30 was 13.46 inches.

Temperature ranges for the lower White River basin are probably comparable to the ranges at Friend. On January 18, 1943, the station recorded a minimum for that month of -21 degrees. This month was somewhat colder than normal. The mean temperature for January, 1943, at Friend was 22 degrees.

A station at Government Camp on the west side of the Cascades divide at an altitude of 3,980 feet recorded a minimum on January 18, 1943, of -14 degrees. This station shows a mean January temperature of 30.3 degrees for a 45-year period. Although no weather station has been maintained at a comparable altitude in the White River basin, it seems probable that the low divide between the two basins above an altitude of 3,890 feet is not sufficient to cause any marked changes in climatological conditions above that altitude in the two basins. (See Mt. Hood quadrangle map.)

The growing season in the lower White River basin probably compares favorably with the growing season at Antelope, Oregon, a station in Wasco County, T. 7 S., R. 17 E., at altitude 2,630 feet, which, during the period from 1925 to 1930, shows a frost free season varying from 101 to 155 days, sufficiently long for the maturing of most agricultural crops in a region that has a high percentage of clear days.

Factors Affecting Hydraulic Structures

Somewhat wide temperature ranges in the White River basin would make necessary some precaution against freezing weather. Heavy silt loads in White River water during part of the year will cause a coating to gather on power installations, and will result in severe scouring of turbine blades. Much trouble with silt has been experienced at the Pacific Light and Power Company's plant below Tygh Valley, and replacements have involved heavy expense.

Water Supply

The following records of discharge for White River and its tributaries have been obtained by the Geological Survey, the State, and the Bureau of Reclamation:

Discharge records for White River and tributaries, Oregon.

Point	sec.	T. and R.	Period
White R. below Tygh Valley	sec. 8,	T. 4S., R.14E.	1917-43
" " above Gate Creek	" 35,	T. 4S., R.12E.	1925-33(frag.)
" " near Swim (Bul.No.8,p.237)	" 13,	T. 3S., R. 9E.	1928-30(frag.)
" " near Keeps Mill crossing	" 11,	T. 5S., R.10E.	1941-43
" " near Tygh Valley, above Tygh Cr.	" 10,	T.4 S., R.13E.	1912-17, and frag.1918,1911-12
Clear Creek near Wapinitia	" 11,	T. 5S., R. 9E.	1918, and frag. 1934-35
" " " " (Oak Grove Road)	" 8,	T. 5S., R.10E.	1917-18 (frl)
" " " Clear Lake	"		1942 (frl.)
Rock Creek near Wamic	" 14,	T. 4S., R.11E.	1936 (frl.)
Gate Creek near Wamic	" 33,	T. 4S., R.12E.	1917-18,'20-23, and '27 (frl.)
Hazel Hollow Cr. near Wamic	" 35,	T. 4S., R.11E.	1926-27 (frl.)
Tygh Creek below Jordan Creek	" 26,	T. 3S., R.12E.	1918 (frl.)
" " at Tygh Valley	" 4,	T. 4S., R.13E.	1911-13,'18(frl
Badger Creek near Tygh Valley	" 6,	T. 4S., R.13E.	1918 (frl.)
" " " mouth			1941-43

Except for the White River below Tygh Valley (1917-43) the available records of discharge are largely fragmentary, having been obtained in main by the State to show flow available during the irrigation season.

The discharge record for White River below Tygh Valley is summarized in the following table (Table 2).

Table 2

Run-off for White River below Tygh Valley in thousands of acre-feet (Sta. 3613)

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1917-18	8.9	9.7	91.6	66.4	46.0	30.3	36.5	33.0	18.6	12.0	10.1	9.5	373.0
1918-19	10.8	11.7	15.0	34.0	24.0	28.6	57.1	64.6	33.5	16.7	11.6	9.5	317.0
1919-20	10.1	30.4	23.7	46.0	30.7	21.1	37.6	42.2	20.6	10.9	7.6	9.6	290.0
1920-21	13.3	17.2	22.3	55.4	51.4	62.1	57.0	65.2	40.8	16.5	10.1	10.2	422.0
1921-22	11.2	37.0	73.8	21.5	17.7	29.1	43.6	91.0	57.4	18.4	10.3	9.6	419.0
1922-23	9.3	10.2	20.01	23.0	25.1	35.8	63.1	67.0	36.4	18.3	10.2	8.7	428.0
1923-24	10.0	11.3	17.2	20.7	44.6	24.4	26.5	26.1	11.7	8.4	6.4	6.0	213.0
1924-25	8.7	20.5	25.6	41.5	63.3	34.0	50.6	48.6	22.6	12.2	8.5	8.4	344.0
1925-26	6.8	8.7	18.0	15.8	38.9	33.3	24.0	15.2	8.4	7.4	6.2	7.4	190.0
1926-27	10.5	22.5	33.4	32.5	70.5	42.3	43.7	62.7	40.3	13.6	8.8	10.5	391.0
1927-28	15.8	34.5	34.2	38.9	24.3	60.3	47.1	46.4	17.6	10.7	8.4	7.6	346.0
1928-29	8.8	11.7	10.9	10.5	9.0	25.0	26.9	54.6	28.3	11.4	8.1	6.8	212.0
1929-30	6.8	7.0	15.4	9.4	41.2	28.7	31.8	19.1	12.1	7.8	6.7	6.3	192.0
1930-31	7.6	8.4	8.7	10.8	11.7	27.0	63.7	30.2	12.7	8.8	6.3	5.7	202.0
1931-32	7.6	11.0	12.0	20.5	21.2	57.9	55.9	65.8	31.7	12.2	8.7	7.2	312.0
1932-33	7.7	24.3	22.3	27.1	17.4	23.0	44.5	56.7	64.9	20.4	10.3	9.6	328.0
1933-34	11.0	15.3	74.7	78.7	29.4	38.4	24.6	12.4	8.5	7.6	6.2	5.9	312.8
1934-35	9.6	22.0	43.6	33.1	26.0	28.0	37.0	58.5	30.0	11.6	7.7	6.8	313.0
1935-36	7.3	8.5	9.4	35.0	16.6	33.0	63.0	59.0	25.0	10.8	7.8	7.3	282.0
1936-37	6.9	6.8	10.1	7.5	11.3	23.7	44.8	62.0	42.0	14.8	8.4	7.6	245.0
1937-38	8.0	20.9	40.0	51.0	32.6	56.2	58.8	54.8	24.6	10.8	7.8	6.8	372.0
1938-39	6.9	9.9	16.7	13.8	17.3	30.7	43.5	33.8	14.3	8.6	6.4	5.9	208.0
1939-40	6.8	6.7	11.3	11.9	35.6	42.7	35.9	20.2	7.8	6.0	5.1	5.4	195.0
1940-41	6.5	10.3	13.8	15.2	13.9	17.4	13.3	14.0	9.0	5.9	4.9	5.7	130.0
1941-42	6.3	11.9	25.2	15.6	28.0	19.2	26.7	23.4	15.8	11.0	7.1	5.5	196.0
1942-43	5.4	28.1	63.8	51.2	63.5	36.4	85.9	68.6	47.6	20.5	10.6	8.0	489.8
Mean	8.8	16.0	29.0	34.1	31.2	34.2	44.0	46.0	26.2	12.0	7.5	7.6	297.0

Note: Numerous small irrigation ditches take out above this station.

It will be noted from the preceding table (Table 2) that the heaviest run-off in the White River basin occurs during spring and early summer when melting snow contributes its maximum, and that the period of lowest run-off is from August to October, inclusive. Normally the river has a gradual increase in flow from September to May, with a slight recession in February, apparently the result of continued cold weather which reduces to a minimum the run-off from rains and melting snow. The 26-year record at Tygh Valley indicates a mean annual flow of 410 second-feet, a maximum of 13,300 second-feet (Jan. 6, 1923), and a minimum of 10 second-feet (August 9, 1931, and other dates.) Diversions for irrigation obscure the true minimum natural flow. Some regulation at the White River Falls power plant also affects the flow at the station. A station maintained above the confluence of Tygh Creek and above all but minor diversions from 1911 to 1918 (fragmentary) indicates an extreme low of 75 second-feet (Oct. 16-19, 1915).

Storage

There is no opportunity for feasible storage in the White River basin except for a small pondage that could possibly be developed by construction of a low dam at a site in sec. 33, T. 4 S., R. 10 E. This pondage would have no value for regulation, but might have some value as a desilting basin. Some additional storage could be developed above the existing power plant at White River Falls near the river's mouth, but it would impound water at so low an altitude as to be of little value for regulation, and backwater would inundate a relatively wide area of agricultural land for the volume of storage created. The site is consequently of little value except as it offers a means for some desilting.

Power and other uses of water

Although White River has appreciable possibilities as a power stream, its summer flow at an altitude of 2,500 feet may eventually be utilized entirely for irrigation. The Bureau of Reclamation is now studying the feasibility of irrigating an area near Wapinitia and Maupin from direct White River diversion. The Bureau has maintained a gaging station on the River near Keeps Mill for a period of two years, and it appears from the record of discharge that all the summer supply of water will be necessary to the project.

The Dufur quadrangle map indicates that around 50,000 acres on the right bank of White River are sufficiently flat to be irrigable from a diversion at an altitude of 2,500 feet. Much of this land, however, is too rocky or shallow for cultivation. The 1942 run-off at the station was only 66,550 acre-feet for the irrigation season, assuming this to be April through September. Assuming a duty of

water of 4 feet, this total run-off even though regulated, would supply only 16,600 acres. A considerably larger area is probably irrigable. I have been informed that lands now contemplated for irrigation from White River are mostly in direct Deschutes River drainage, and that little return seepage into White River may be expected from the proposed diversion.

It would appear, therefore, that the only opportunity for any material power development on White River would be in the area above Keeps Mill. Some flow will always remain in the lower reaches of White River, but, if all is diverted near Keeps Mill in summer the residual flow in the lower reaches of the river will not be sufficient to attract further power development, nor will it supply the existing plant of the Pacific Light and Power Company below Tygh Valley.

The following table (Table 3) makes a comparison of flow in White River at the two stations now in operation:

Table 3

Comparative run-off at stations on White River.

1941-2	At Keeps Mill crossing A. F.	Below Tygh Valley A. F.	Difference between stations (inflow) A. F.	Sec.-Ft.
Oct.	4,430	6,330	1,900	30
Nov.	6,770	11,940	5,170	87
Dec.	19,640	25,170	5,530	90
Jan.	- -	15,640	- -	--
Feb.	- -	28,040	- -	--
Mar.	11,900	19,240	7,340	119
Apr.	22,240	26,700	4,460	75
May	19,100	23,390	4,290	70
June	10,670	15,770	5,100	86
July	6,280	11,020	4,740	77
Aug.	4,610	7,160	2,550	41
Sept.	3,650	5,500	1,850	31

It will be noted from Table 3 that in September, 1942, the inflow below Keeps Mill road crossing was only 1,850 acre feet, or a mean flow of 31 second-feet. In October, 1941, the mean was only 30 second-feet. It will be noted also from Table 3 that a substantial inflow occurred throughout the remainder of the year, but that this would be of little value without regulation. Some storage could be developed by construction of a dam in the area just above the existing power plant, but this would probably not be feasible on account of the large area of valuable farm lands that would be

inundated by a relatively small volume of stored water, which would also be subject to a high percentage of evaporation loss due to its surface area-volume ratio. The conclusion seems inescapable that established power rights on the lower river cannot be reconciled to the present plans for irrigation, and that one or the other must be subordinated. It is perhaps a safe assumption that in the long run irrigation will prevail since it appears that the potential value of water for irrigation in the Wapinitia area is greater than its potential power value. I have included no plans for the future utilition of summer flow in the lower basin for power, but have suggested the remote possibility of some additional power development from winter flow only.

White River above Keeps Mill has appreciable potential power but the heavy load of silt carried by the stream during part of the year will create difficult problems of development. Unless some means is found to desilt the flow of the river before it is admitted to turbines, development may not be feasible.

Developed Power Sites

The only developed power site in the White River basin is located below Tygh Valley in sec. 7, T. 4 S., R. 14 E. It is owned by the Pacific Power and Light Co., and is described in Water-supply Paper 344, p. 121. Head is 149 feet, and installed capacity 3,600 horsepower. Silt control has been a major problem.

Undeveloped Power Sites

Mt. Hood Site ( ). The Mt. Hood quadrangle map (see Pl. Ib) indicates that it might be physically possible to divert the White River about 1.5 miles upstream from the Mt. Hood Loop Highway bridge. If diversion were feasible at an altitude of 4,900 feet the flow could be carried around that contour on the left bank to a penstock discharging into a powerhouse on Iron Creek at an latitude of 4,200 feet. The main valley floor of White River in this area is a broad wash which may not be suitable either for a power house site nor for a re-diversion. (See photograph No. 1.) The Iron Creek ravine may be more suitable for both purposes.

Heavy silt from the Mt. Hood glacial area will probably make this site infeasible. There is apparently no opportunity to construct a forebay of sufficient size to be a factor in desilting. If constructed, the project would require about two miles of buried conduit, perhaps 500 feet of tunnel, and 3,000 feet of penstock.

Flow is estimated from the summer record at the Mt. Hood Highway bridge (See Bul. No. 8, Oregon, p. 237, Sta. No. 3618) and a comparison with the long time record below Tygh Valley. It seems likely that a complete freeze-up of the Mt. Hood area in mid-winter will bring a complete cessation of all flow from rains, melting snow or ice, and that during certain periods only spring fed flow will remain in the river.

As a check on the possible flow in the upper reaches of White River, it will be noted that the long time record on Salmon River near Government Camp (1910-12, 1926-43) indicates a comparatively strong flow throughout winter. This station is located less than four miles from White River, and at an altitude of 3,446 feet. The reach of White River in the site here described, ranges from 4,200 to 4,900 feet, but is separated f. the Salmon River basin by only a low divide (See Mt. Hood quadrangle.) For a further discussion of flow in the upper White River see "Alternative plan of power development", page .

Potential power at Mt. Hood power site ( )

Head, 700 feet			70 percent efficiency		
Natural flow in second-feet			Horsepower		
100 percent of time Q100	90 percent of time Q90	50 percent of time Q50	100 percent of time Q100	90 percent of time Q90	50 percent of time Q50
10	15	40	560	840	2,240

Iron Creek power site ( ). A low diversion dam could probably be constructed on Iron Creek below the Mt. Hood Loop Highway crossing at about 4,200 feet, and below the power house of the Mt. Hood site above described (See Pl. Ib.) Any residual flow in the White River channel below the highway bridge could be carried to the diversion dam if feasible. The highway embankment would give some protection to the diversion canal or conduit, although I am informed that the highway bridge has itself been washed out on occasions. A canal or conduit leading from the diversion dam would carry the flow to a penstock discharging into a power house near mile 34, in sec. 31, T. 4 S., R. 10 E., at an altitude of 2,800 feet. A longer canal would recede from the river.

Potential power at Iron Creek power site ( )

Head, 1,400 feet — 70 percent efficiency

Natural flow in second-feet			Horsepower		
100 percent of time Q100	90 percent of time Q90	50 percent of time Q50	100 percent of time Q100	90 percent of time Q90	50 percent of time Q50
12	18	50	1,340	2,000	5,600

Keeps Mill power site ( ). The river survey indicates that some pondage could possibly be developed by construction of a low dam in sec. 33, T. 4 S., R. 10 E., (mile 32.5) at an altitude of 2,720 feet (See Pl. Ib.) This might be of sufficient volume to serve as a settling basin for the heavy silt load that is carried at periods. A dam 80 feet high at this site would back water to the tailrace of the next site upstream. Assuming outlet at an altitude of 2,760 feet and a conduit or canal leading to a penstock and power house in sec. 11, T. 5 S., R. 10 E., at altitude 2,500 feet, the site would have a gross head of 260 feet. Flow is estimated at somewhat less than the measured discharge at the Bureau of Reclamation station near Keeps Mill.

Potential power at Keeps Mill power site ( )

Head, 260 feet — 70 percent efficiency

Natural flow in second-feet			Horsepower		
100 percent of time Q100	90 percent of time Q90	50 percent of time Q50	100 percent of time Q100	90 percent of time Q90	50 percent of time Q50
40	50	125	830	1,040	2,600

Power sites below Keeps Mill crossing on White River

The 23-mile reach of White River from Keeps Mill to Tygh Valley has a total fall of 1,420 feet (from 2,500 to 1,080, altitude), an average of 62 feet per mile. Discharge records obtained by the Bureau of Reclamation near Keeps Mill for 1941-42 indicate a minimum flow of 58 second-feet. Since the entire low flow of summer is now being considered for irrigation use, no power development seems feasible in this reach. Winter flow will probably always be available for power development in this reach, but it would have little value. Assuming that the irrigation season will include the period from April to September, inclusive, and that it will demand a comparatively large water supply in April, it appears from the discharge record at Keeps Mill that the Q50 flow available for power would be about 70 second-feet.

The Q90 flow would be nil. The available power in this 23-mile reach after prospective diversions for irrigation is accordingly estimated at 8,000 horsepower for 50 percent of the time, and no power for 90 percent of the time.

For purely statistical purposes the potential power in this 23-mile reach may also be estimated on the assumption that there will be no diversion for irrigation. The total flow is estimated on the basis of the 1941-42 record at Keeps Mill road crossing at 50, 60, and 150 second-feet, respectively, for 100 percent, 90 percent, and 50 percent of the time. Corresponding capacity values are 5,680 horsepower, 6,810 horsepower and 17,040 horsepower.

The potential power in White River below Tygh Valley may also be estimated for purposes of general information, although development is remote, and probably will never be contemplated except as it involves a continuation of the existing plant. Assuming diversion below the mouth of Tygh Creek at an altitude of 1,060 feet (mile 4.6) and a conduit or canal to a power house on the Deschutes River at 760 feet, the site would have a gross head of 300 feet. Total natural flow is estimated from the record at Tygh Valley (below many small irrigation ditches) as 80,100, and 200 second-feet respectively for 100, 90, and 50 percent of the time. The corresponding capacities are 1,900 horsepower, 2,400 horsepower, and 4,800 horsepower, respectively.

Power development on the Deschutes River may affect the lower end of White River. Water-supply Paper No. 344 proposes a dam at Sherar Falls rising to an altitude of 780 feet. This would involve about 20 feet of head in White River.

Following is a tabulation of flow and power estimates for White River below Keeps Mill crossing before and after prospective diversions for irrigation:

Potential power in White River below Keeps Mill crossing, Oregon

Reach of river		Head	Natural flow in sec.-ft.			Horsepower		
Altitudes	Miles	Feet	100 percent of time Q100	90 percent of time Q90	50 percent of time Q50	100 percent of time Q100	90 percent of time Q90	50 percent of time Q50
2,500-1,080	23	1,420	50	60	150	5,680	6,810	17,040
do after Div. for irrigation			Nil	Nil	70	Nil	Nil	8,000
1,060-760	5	300	80	100	200	1,900	2,400	4,800
do after division for irrig.			Nil	10	100	Nil	240	2,400
Total potential power under existing conditions of flow						7,580	9,210	21,840
Total potential power after prospective diversions						Nil	240	10,400

Alternative plan of power development on White River ( )

In view of the remoteness of any further development of power on White River below the contemplated diversion for irrigation, and in view of the severe silt problem on White River for which there is little apparent remedy, an alternative plan for the partial development of its potential power is here suggested. This plan may have sufficient merit to justify further investigation.

Assuming the feasibility of a low diversion dam on White River at an altitude of 4,200 feet, the Mt. Hood quadrangle map shows that a comparatively short and inexpensive canal, conduit or tunnel, or combination of them, could be constructed in the area of Barlow Pass, now occupied by the Mt. Hood Loop Highway, which would divert White River flow into Salmon River drainage (see Pl. Ib.) Somewhat further upstream, or about one mile above the highway bridge over White River, a 3,000-foot tunnel might pierce the narrow divide between the two streams. The lower diversion through Barlow Pass would collect a slightly greater run-off, and would require no tunnel.

If storage is feasible on the Salmon River at the Salmon Meadows site, this diversion from White River could be utilized through about 2,000 feet of head on Salmon River, and possibly a total of 3,000 feet on Salmon and Sandy Rivers. The total available head would depend on the feasibility of power development on the Salmon and Sandy Rivers.

Storage of White River flow in the proposed Salmon Meadows reservoir would solve the silt problem, and would make possible its utilization for over-all power regulation. However, the total amount of water that could be diverted from White River under any circumstances would be small. Under present plans for irrigation in the White River basin, no diversion to Salmon River would be possible during the irrigation season. During the non-irrigation season, however, there is no prospective use for White River flow except in the small plant below Tygh Valley, and in sites to be developed on the Deschutes River. The White River plant utilizes only 149 feet of head. If irrigation plans are fully realized the future status of that plant is doubtful. As for other Deschutes River plants to be constructed, these would have little interest in the small diversion from White River that could be utilized through only about 600 feet of head on Deschutes River, which may also be without sufficient storage capacity in its lower reaches to fully utilize existing or prospective flow.

Assuming diversion of White River to Salmon River from October to March, the total amount of water that might be so diverted is estimated roughly from the record obtained by the Bureau of Reclamation near Keeps Mill, (see Table 3, p. 9) and comparison with the record on Salmon River near Government Camp, and with the fragmentary record on White River in sec. 13, T. 3 S., R. 9 E. The latter record is summarized as follows:

Monthly run-off in acre-feet of White River near Swim, Oregon*

Year	July	August	September
1928			1,490
1929		1,560	1,200
1930	1,360	1,300	946
Mean	1,360	1,430	1,212

The above record was obtained at an altitude of about 4,200 feet. A comparison with the record obtained on White River at about 2,500 feet (See Table 3, p. 9) shows that at the lower station July, August, and September were distinctly in the low flow period, the lowest of the record being September, 1942. However, a difference of 1,700 feet in altitude invalidates any direct comparison. It will be noted from the record on Salmon River near Government Camp (altitude 3,446 feet) that winter flow at that station was also in general stronger in winter than in summer. A monthly summary of the record for the period prior to 1936 is taken from State Bul. No. 9, p 323:

Monthly mean discharge of Salmon River near Government Camp for the periods 1910-12 and 1926-36

Month	Mean Sec.-ft.	Month	Mean Sec.-ft.
October	25.3	April	50.3
November	39.0	May	69.3
December	43.8	June	60.2
January	42.2	July	36.3
February	35.8	August	25.1
March	40.2	September	22.2
Totals	226.3		263.4

It will be noted that 46 percent of the total annual flow in this period occurred during the non-irrigation season, October to March. It will also be noted that the average September flow (22.2 second-feet) was only about 10 percent of the total flow from October to March. If it is assumed that September flow in White River at 4,200 feet altitude bears the same relation to the 6-month period, October to March, as occurs on Salmon River at 3,446 feet, a total run-off of 12,000 acre feet would appear available. The comparatively high run-off in White River during winter, as recorded at Keeps Mill station (altitude 2,500 feet) appears to support this estimate. Any estimate of flow at the higher altitudes on Mt. Hood must be made with caution, however, in view of the variable climatic conditions there prevailing.

* Oregon State Bul. No. 8, p. 237.

Assuming a total annual diversion from White River to Salmon River of 12,000 acre-feet, this would represent a continuous flow of 16 second-feet, which, if developed through a total head of 3,000 feet, would represent 3,800 continuous horsepower. If the diverted water were stored in the proposed Salmon Meadows reservoir, it could be used for over-all power regulation, and might therefore convert a much larger block of power from dump power to prime power. Following is a comparison of the potential power under the above plan with the potential power under the plan outlined for development within the White River basin above Keeps Mill.

Comparison of potential power in White River sites above Keeps Mill with power under the diversion plan

	Horsepower total for all sites	
	If developed on Salmon and Sandy Rivers	If developed on White River above Keeps Mill
For 100 percent of time	3,800	2,730
" 90 " " "	3,800	3,880
" 50 " " "	3,800	10,400

This comparison appears to favor the diversion plan, especially since this would solve the silt problem and would eliminate the cost of 15 miles or more of canal or conduit on White River. Except for a low diversion dam, and a short line of canal, conduit or tunnel, the development of the diverted flow would entail little or no expense in addition to that otherwise necessary to development on Salmon and Sandy Rivers. Moreover the 3,800 horsepower which could be developed by diversion to Salmon River, would be available for over-all power regulation, whereas no such use could be made of the power that might be developed from unregulated flow in White River.

The feasibility of this proposed diversion will depend entirely on the feasibility of storage in the Salmon Meadows reservoir site, and upon the degree of utilization that is made of the 3,000 feet of head available for power in the Salmon and Sandy Rivers.

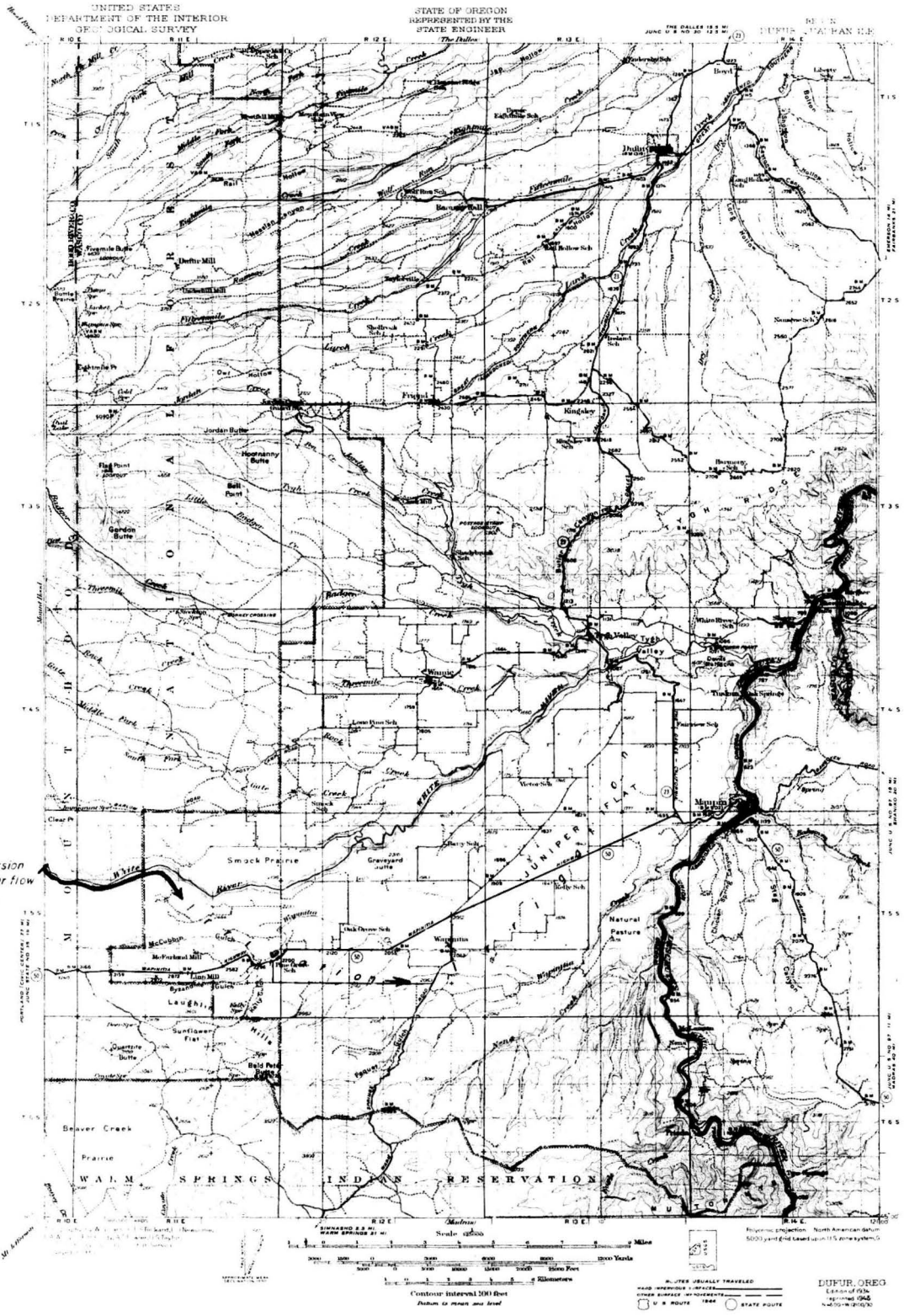
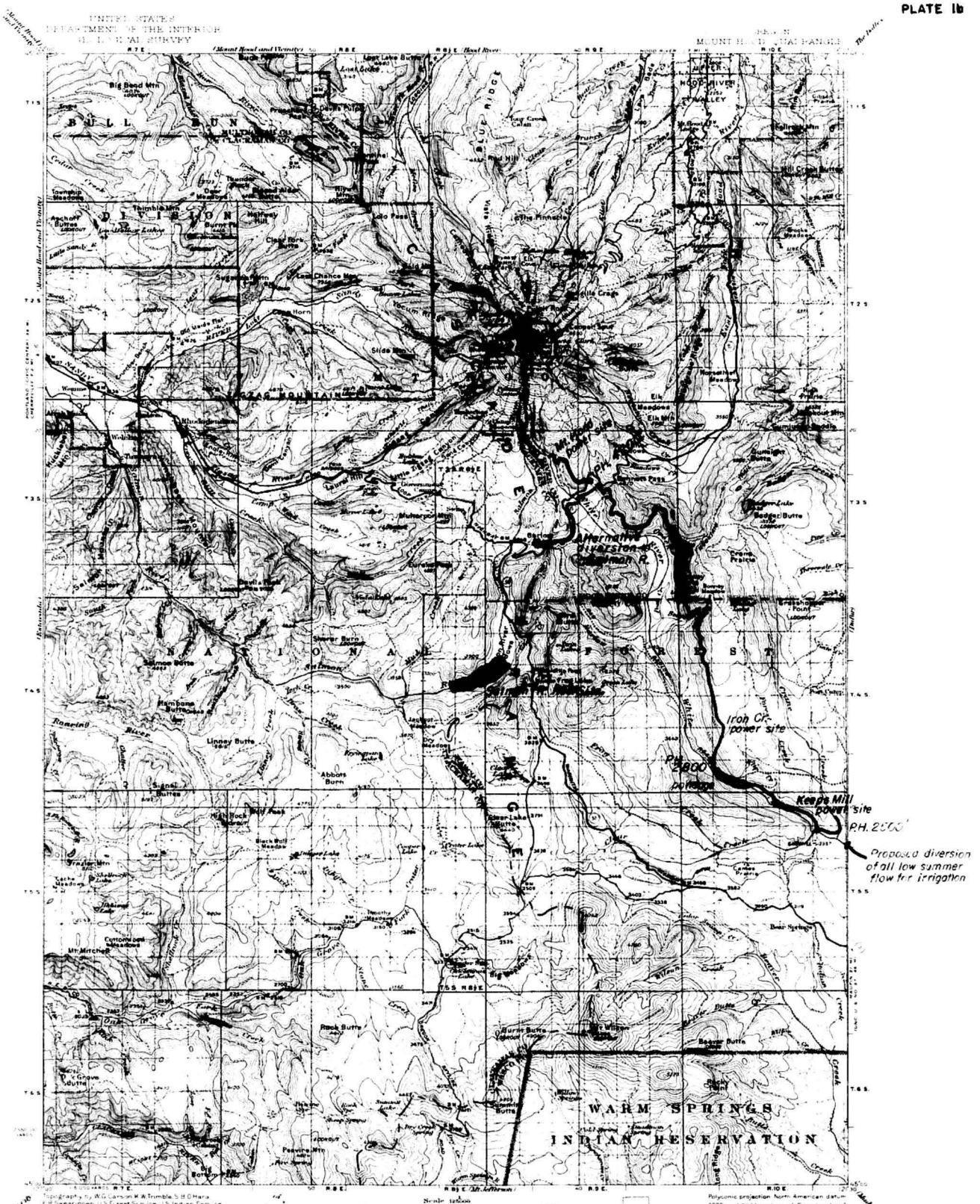

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
STATE OF OREGON
REPRESENTED BY THE
STATE ENGINEER
Proposed diversion of all low summer flow for irrigation
Smock Prairie
Graveyard Butte
Natural Pasture
Beaver Creek
Prairie
WARM SPRINGS INDIAN RESERVATION
Contour interval 200 feet
Datum is mean sea level
DUFUR, OREG.

PLATE 1b


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MOUNT HOOD, OREGON
BULL RUN
DIVISION
NATIONAL FOREST
WARM SPRINGS
INDIAN RESERVATION
Alternative diversion R.
Iron Cr. power site
P.H. 2800' power site
Keeps Mill power site
P.H. 2500'
Proposed diversion of all low summer flow for irrigation
Scale 1:62500
Contour interval 100 feet
Datum is mean sea level
MOUNT HOOD, OREG.
Edition of 1923