No. ______

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 101

WATER SUPPLY THE QUEEN ELIZABETH II OBSERVATORY, MT. KOBAU, BRITISH COLUMBIA

BY

E. C. HALSTEAD

OTTAWA

1965

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E.C. Halstead, Geological Survey Branch, DMTS

The following report was prepared at the request of the Department of Public Works and is an assessment of the potential water supply on Mt. Kobau chosen as the site for the Queen Elizabeth Observatory.

This high isolated site is most suitable for a large telescope. The water requirements are perhaps in the order of 2,000 gallons a day to supply an assigned staff of 35 to 40 members. If a sufficient supply is available facilities could be provided for tourists as well as some used for irrigating the immediate grounds.

The following report was prepared after a visit to the Dominion Astrophysical Observatory and the Water Investigations Branch, Provincial Department of Lands, Forests and Water Resources, Victoria. The site is not accessible during the winter except by snow-shoe traverse, therefore, a field trip has been arranged with Dr. G. Odgers, for April or May 1965.

Location

Mt. Kobau is that mountain in the Similkameen District of British Columbia, bounded on the east by Okanagan River valley and on the west by Similkameen River valley (Map #1). Its peak is at an elevation of more than 6,000 feet above mean sea level and is at a point 8 miles north of the International Boundary. The west side of Mt. Kobau rises steeply from 1,500 feet at the floor of Keremeos valley to attain elevations of more than 6,000 feet at the top, whereas the east side has a more gentle slope into which several intermittent creeks have cut headward forming steepsided valleys.

Geology

The area was geologically mapped by Dr. H.S. Bostock, 1929 and 1930 and published as GSC map 341A, Keremeos, Similkameen District, British Columbia (Map #2). Mt. Kobau is underlain by the Kobau group of metamorphosed stratified rocks including thin bedded quartzites, fine-grained, siliceous, mica schists and sheared greenstones. Granitic-type rocks intrude the Kobau group. These rocks provide for little or no storage or movement of groundwater except in joints or fracture zones. A thin mantle of till-like material, left after the retreat and wasting of the Cordilleran ice-sheet, provides a soil that supports a vegetative cover of sagebrush.

Climate, Precipitation and Runoff

Records of temperature, precipitation and sunshine are available for thirty year periods at Keremeos and Oliver. These data provide for classification of the valleys adjacent to Mt. Kobau as semi-arid with annual precipitation less than 10 inches. It is generally agreed that on Mt. Kobau, precipitation would be greater than in the adjacent valleys. Mr. H. Hunter, Chief, Snow Surveys, Hydrology Division, Dept. of Lands, Forests and Water Resources, Victoria has provided a derived relationship explaining annual precipitation as a function of elevation and latitude in British Columbia. The equation is applied here, but no attempt will be made to explain correlation coefficients, dependent or independent variables. The relationship is expressed as follows:

$$y_1 = 0.46\,x_1 + 4.29\,x_2 - 206.03$$

where,

y_1 = annual precipitation (total rainfall plus snowmelt)

x_1 = elevation (at Kobau assume 6,000 ft.)

x_2 = latitude (at Kobau 49°7')

then,

$$y_1 = 0.46\,(60.0) \quad + \quad 4.29\,(49.1) \quad - \quad 206.03$$

$$y_1 = 32.21 \text{ inches}$$

It is assumed that precipitation, heavist during winter months is mostly in the form of snow which melts during April, May and June causing maximum runoff at that time. No hydrometric survey data are available for those creeks draining Mt. Kobau but discharge measurements were made on a 23 square mile drainage basin on the west slope of Baldy Mountain approximately 18 miles east of Mt. Kobau, at the same latitude and elevation (Map #3). These measurements were made during the period 1941 to 1949 and are fairly continuous over the 1941 to 1946 period and indicate a 5 year average discharge of 9.5 sec. ft. representing a depth of 5.8 inches on the drainage area. For our purposes let us assume that at Mt. Kobau runoff will be equal to 6 inches.

Expressing the water balance as, (Fig. 1).

Recharge	=	Discharge
Total precipitation	=	runoff + evaporation + evapotranspiration
		+ storage (groundwater and surface)
32 inches	=	6 + E + Et + S
26 inches	=	E + Et + S

The only figure available for **E** and **Et** in the area indicates that the annual evaporation from free water surfaces at Summerland latitude 49°30', altitude 1,600 is 25.14 inches for period May to September (32 yr. record). At Mt. Kobau evaporation and evapotranspiration losses are probably in the same order. Storage as groundwater would be manifest as discharge to the creeks during time of minimum flow but the creeks are dry during part of the year hence groundwater storage is temporary, following snowmelt and for our purposes it is nil. Meltwater collected in bedrock depressions provides surface storage on the mountain top. Near the observatory site a lake provides irrigation water for an orchard at lower elevations on the east slope of Mt. Kobau. It is anticipated that this ponded water will provide sufficient supplies. The drainage area of the lake is in the order of 54 acres as determined from a recently prepared map of the site at a scale of 1 inch to 500 feet with 20 foot contours (Fig. 2). Recharge to the area is in the order of 32 inches per year or approximately 723,600 imperial gallons per acre. All this is assumed lost excepting where runoff at a rate of 6 inches or approximately 135,000 imperial gallons per acre is collected in depressions rather than lost to creeks. Therefore annual runoff to the lake averages 7,290,000 imperial gallons.

In considering the use of the surface water one has to take into account the thickness of the ice during the winter months and losses to evaporation during the summer. Evaporation losses can be reduced by the addition of a suitable film on the lake surface. The thickness of the ice would have to be determined prior to the breakup in the spring.

A chemical analysis of the ponded surface water is attached. The water is of good quality and much in contrast to that ponded in saline lakes at lower elevations on the mountain side. This is further supporting evidence of greater precipitation at the higher altitudes.

Conclusions

1. Although no records are available, it is believed that total precipitation at the proposed site will be in the order of 32 inches annually.

2. Runoff, evaporation, and evapotranspiration account for almost complete loss of the total annual precipitation.

3. Ponded surface runoff is a source of good quality water and its use is recommended.

4. Field evidence (spring discharge, fracture pattern of the rock, type of vegetation) may indicate a greater groundwater potential than the author has assumed in evaluation of the general water balance. If so, groundwater supplies may be available to augment surface supplies.

5. It is recommended that some observations be made at the site for a period of a year or more so that the potential water supply can be more accurately assessed.

6. Instrumentation would be directed toward receiving data as follows:

a) depth of snow cover

b) ice thickness of lake

c) discharge of Testalinda Creek; by installation of a gauging station by Water Resources Branch, Dept. of Northern Affairs and National Resources

d) temperature and precipitation as rainfall

e) evaporation rate; installation of a standard evaporation tank as used by Dept. of Agriculture in their evaporation measurements at research branch stations

f) changes in lake level

g) discharge of springs

7. Upon completion of the access road most of these observations can be easily made. In the meantime members of the observatory staff who already frequent the site can be responsible for measuring the depth of snow cover and thickness of the ice so that the recording can be established as early as possible.

COPY

DEPARTMENT OF NATIONAL HEALTH AND WELFARE
PUBLIC HEALTH ENGINEERING DIVISION

CHEMICAL ANALYSIS OF WATER

LOCATION: D.P.W., M & T.S. Project Okanagan Catchment Reservoir

DATE SAMPLED: -

IDENTIFYING MARKS: Mt. Kobau

SAMPLED BY: -

SUBMITTED BY: S. Copp

DATE RECEIVED IN LAB.: June 29/64

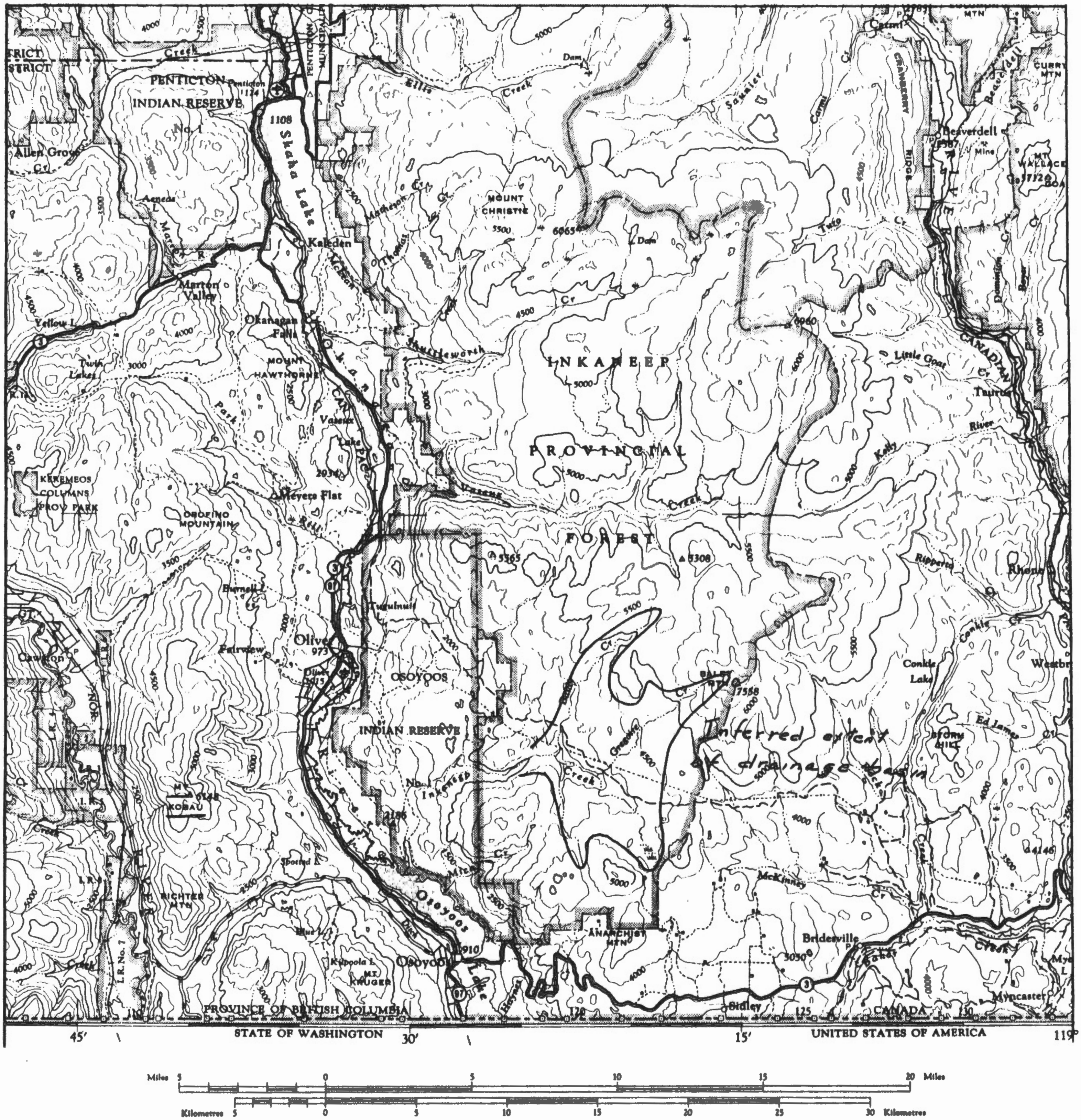
IONS, ETC., IN PARTS PER MILLION		IONS, ETC., IN PARTS PER MILLION	
pH Value	7.8	Calcium (Ca)	24.6
Hardness (Versene) as $CaCO_3$	64.0	Magnesium (Mg)	0.6
Alkalinities—Phenolphthalein as $CaCO_3$	nil	Sodium (Na)-Calculated	1.4
Total as $CaCO_3$	60.0	Bicarbonate as CO_3	36.0
Iron (Fe) (Total)	less 0.05	Carbonate (CO_3)	nil
Manganese (Mn) (Total)	nil	Sulphate (SO_4)	6.6
Color (Units)	20.0	Chloride (Cl)	1.0
Turbidity (Units)	1.7	Nitrate (NO_3)	0.4
Nitrate Nitrogen (N)	0.10	Fluoride (F)	0.03
Nitrite Nitrogen (N)	nil	Silica (SiO_2)	5.9
Free Ammonia Nitrogen (N)	0.08	R_2O_3 (Alumina, Iron Oxide, etc.)	
Albuminoid Nitrogen (N)	0.16	Loss on ignition (1 hour @ 600° C.)	
		Total Dissolved Solids—Calculated	
		Total Dissolved Solids—Determined	95.0

REMARKS: Report to R. Bickford

DATE: June 30, 1964

CHEMIST: R. Holowaty, Chemist

W.S. 37
VT3749—10.60


PENTICTON INDIAN RESERVE No. 1
Penticton
Skaha Lake
Kaleden
Allen Grove
Marron Valley
Yellow L.
Twin Lakes
Okanagan Falls
MOUNT HAWTHORNE
Vaseux Lake
MOUNT CHRISTIE
Ellis Creek
Shuttleworth
INKANEEP
PROVINCIAL
FOREST
Vaseux Creek
KEREMEOS COLUMNS PROV PARK
OROFINO MOUNTAIN
Meyers Flat
Park
Burnell L.
Tugulnuit
Oliver
Fairview
Cawston
OSOYOOS
INDIAN RESERVE
No. 1
Inkaneep
Osoyoos Lake
Osoyoos
MT KOBAU
RICHTER MTN
Spotted L.
Blue L.
Kilpoola L.
MT KRUGER
ANARCHIST MTN
Bridesville
Sidley
Rock Creek
McKinney
Conkle Lake
Little Goat Cr.
Kelly River
Rhone
Westbridge
Beaverdell
Carmi
Beaverdell
Tuzo Cr.
CURRY MTN
MT WALLACE
STONY HILL
Ed James Cr.
Myncaster
BALDY MTN
7558
Inferred extent of drainage basin
PROVINCE OF BRITISH COLUMBIA
CANADA
STATE OF WASHINGTON
UNITED STATES OF AMERICA
45′
30′
15′
119°
Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 5 10 15 20 25 30 Kilometres

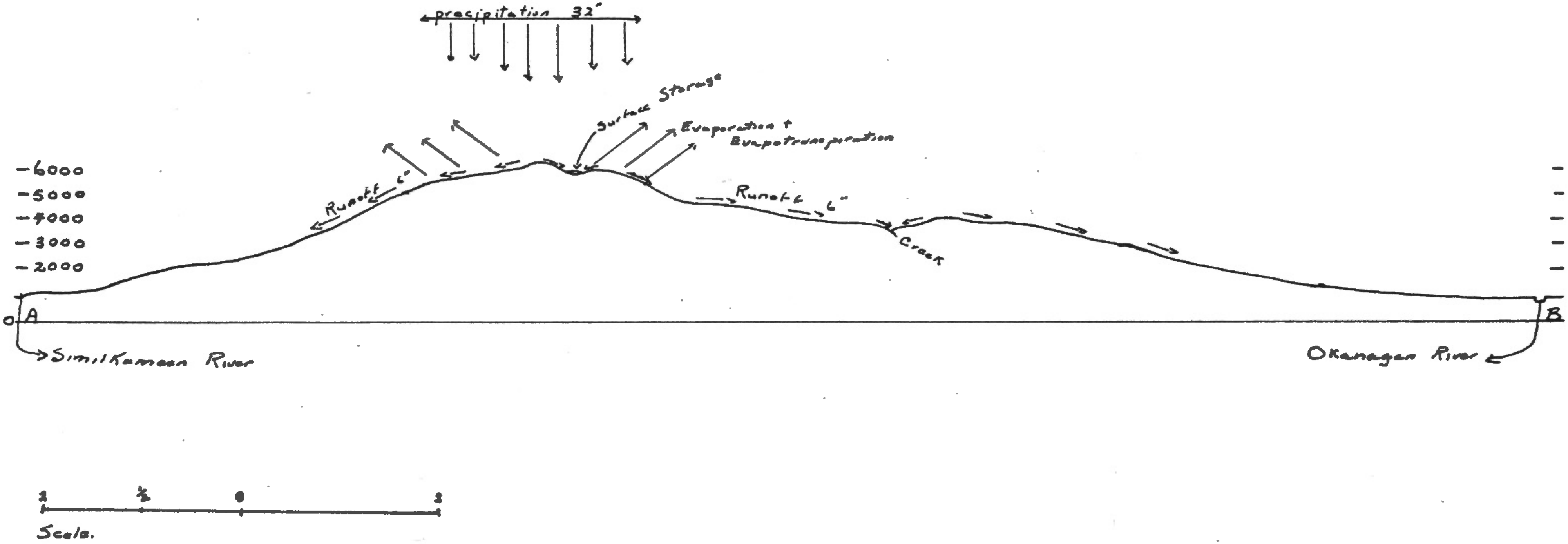
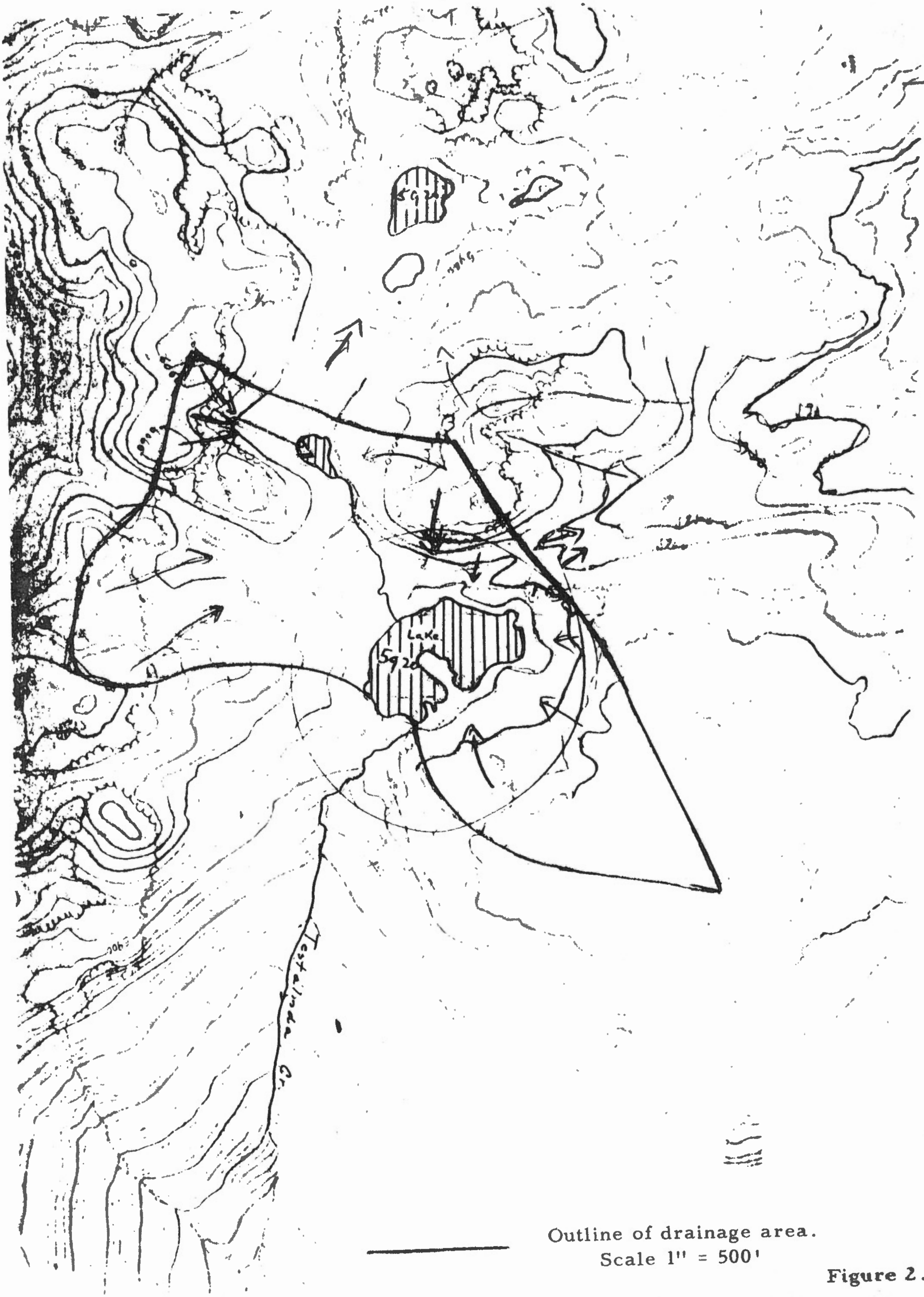


Fig. 1

Recharge - Discharge Relation, Mt. Kobau.

E.C. Halstead



Outline of drainage area.
Scale 1" = 500'

Figure 2.