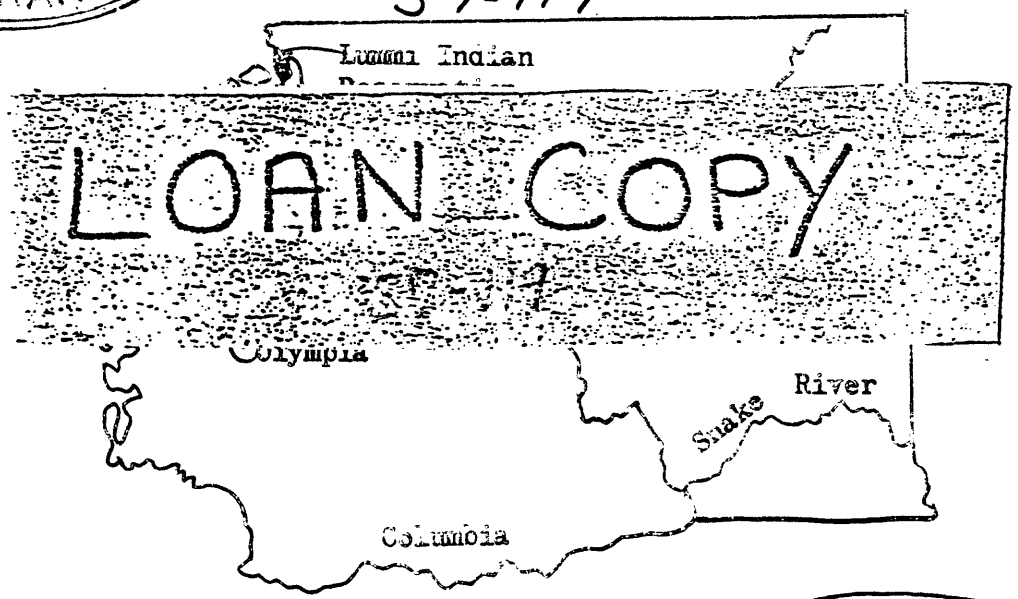
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GROUND WATER BRANCH

GROUND WATER IN THE LUMMI INDIAN RESERVATION, WHATCOM COUNTY, WASHINGTON

By

Robert L. Nasburn



Prepared in cooperation with the
Department of Health, Education, and Welfare,
Division of Indian Health

Open-file report. Not reviewed for conformance with stratigraphic nomenclature or editorial standards of the Geological Survey

April 1957

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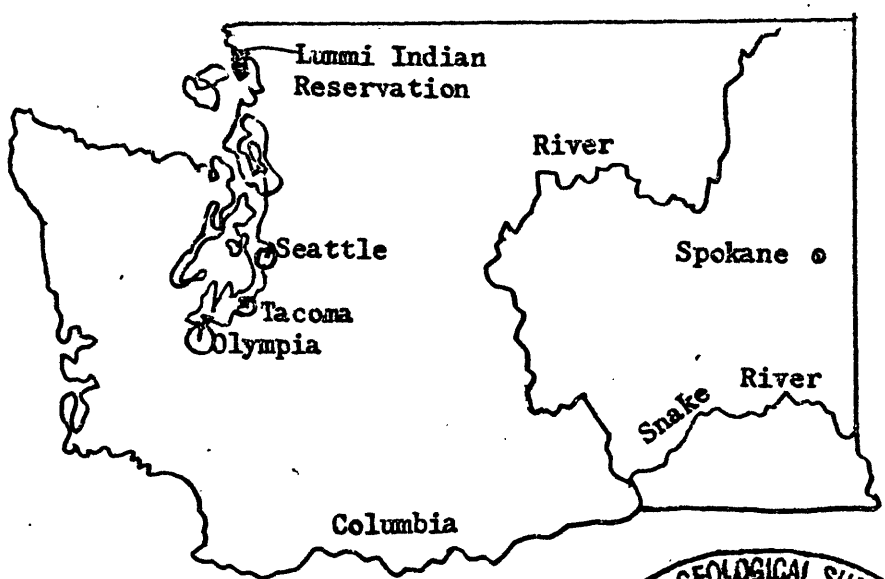

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GROUND WATER IN THE LUMMI INDIAN RESERVATION, WHATCOM COUNTY, WASHINGTON

By

Robert L. Washburn

INTRODUCTION

Present water supplies developed within the Lummi Indian Reservation are inadequate for the needs of the residents. Nearly all the Indians living on the reservation obtain water for domestic and stock use from springs or shallow dug wells. Supplies from many of the dug wells become inadequate or fail entirely during the late summer or early fall.

This hydrogeologic investigation was made to determine the availability of ground water from individual domestic wells within the limits of the Lummi Indian Reservation. It was made in response to a request by the Department of Health, Education, and Welfare, Division of Indian Health. Field work, including a well and spring inventory, measurement of wells, collection of water samples, test-hole augering, and geologic mapping, was done between March 28 and May 25, 1956. During the week of May 21-25, 19 test holes were bored on the Lummi Peninsula to obtain additional hydrologic and geologic information. The holes ranged in depth from 11 to 90 feet, and the total footage bored was 1,071 feet. A truck-mounted power auger was used.

The investigation was made under the direct supervision of M. J. Mundorff, formerly district geologist of the Ground Water Branch of the Geological Survey for the State of Washington.

The Lummi Indian Reservation, in northwestern Washington, is in the west-central part of Whatcom County, about 7 miles west of the city of Bellingham (fig. 1, also inset on pl. 1). The reservation lies within Tps. 37 and 38 N., Rs. 1 and 2 E., and includes the peninsula separating Bellingham Bay from Lummi Bay, a strip of adjoining mainland to the north, and a small island (know locally as Portage Island) just south of the peninsula (pl. 1). The investigation covered all the reservation except Portage Island.

The only communities within the reservation are Portage, Gooseberry Point, Fish Point, and Neptune Beach (pl. 1). These communities consist of small groups of privately owned non-Indian residences.

Most of the 70 to 80 Indian homes on the reservation are scattered along the east side of the peninsula between the Lummi School and the community of Portage, and on the west side of the lower delta of the Nooksack River. Outside the reservation a considerable number of Indians live in the town of Marietta, about 1½ miles east of Lummi School, and along the northeast side of the Nooksack River. The occupied Indian homes are shown on plate 1.

The area of this investigation consists of two uplands and a lowland. The southern margin of the upland region northwest of the Lummi River is known as the Mountain View upland. The upland that forms the peninsula is called the Lummi Peninsula upland by Newcomb, Sceva, and Stromme (1949).[1/] The lowland is a delta that lies between the two uplands and separates the peninsula from similar uplands to the east. About two-thirds of the reservation consists of upland regions. The maximum altitude of the Mountain View upland within the reservation is 230 feet; the maximum altitude of the peninsula is 150 feet. The altitude of the delta lowland does not exceed 12 to 15 feet.

1/ See p. 15 for list of references cited.

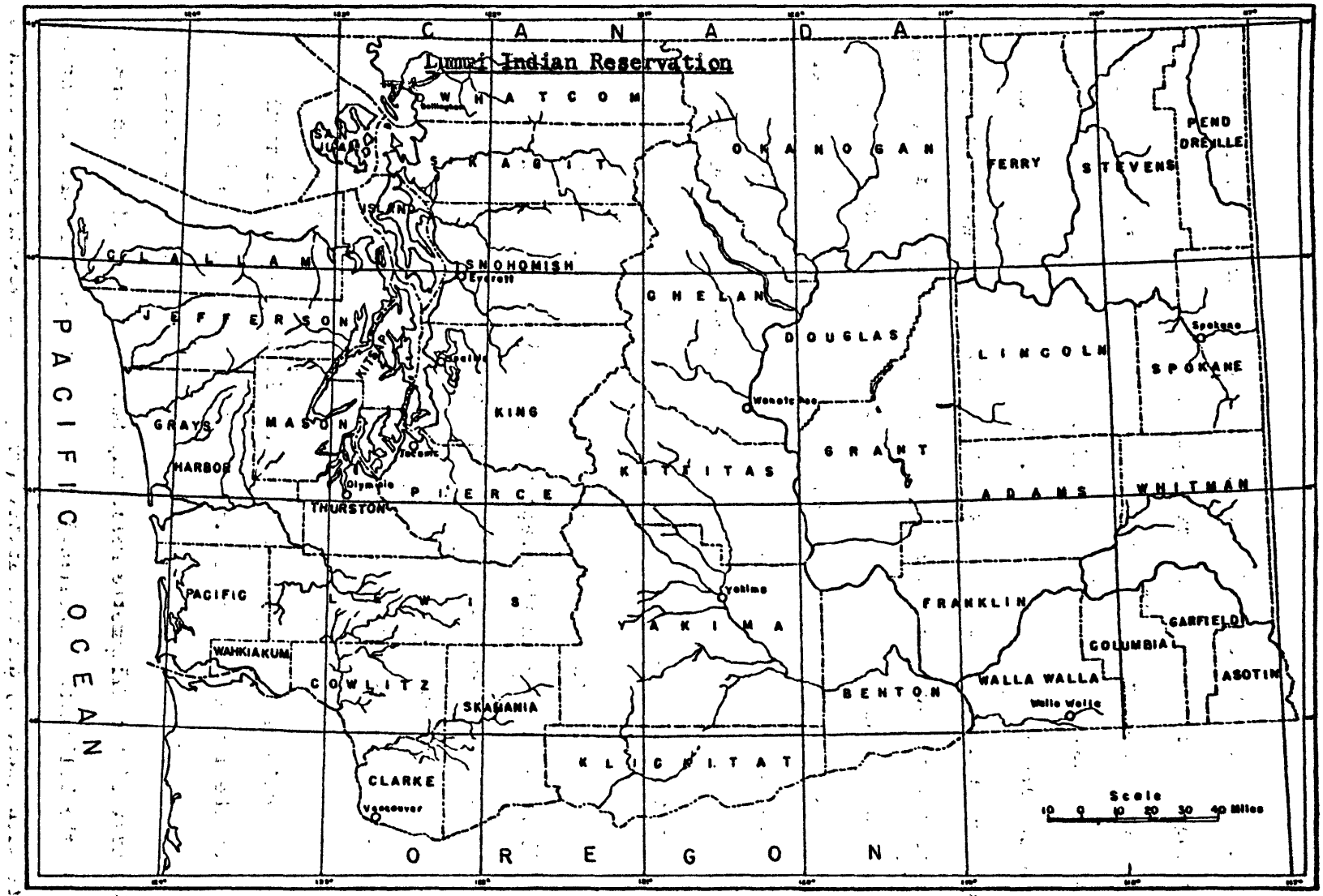

FIGURE 1.—Map of the State of Washington showing area covered by this investigation.

The uplands are drained by numerous short, intermittent streams that discharge into either Lummi or Bellingham Bay or into the delta lowland between the Mountain View upland and the Lummi Peninsula. The lowland itself is drained by the through-flowing Lummi and Nooksack Rivers.

Climatological data have been collected at two U. S. Weather Bureau stations near the reservation. A 41-year record of precipitation and a 37-year record of temperature are available for the Marietta station (about 1 mile east of the reservation, near Marietta). A 44-year record of precipitation and a 42-year record of temperature are available for the Bellingham station (about 4 miles east of the reservation, near Bellingham). The normal annual precipitation is 31.79 inches at the Marietta station and 33.96 inches at the Bellingham station. The highest monthly precipitation occurs in December, and the lowest in July or August. Average monthly temperatures at the Marietta station range from 37.4°F in January to 62.3° in July, and the yearly average is 49.0°.

Numbering System for Wells, Springs, and Test Borings

Well numbers used in this report are based on and show locations of wells according to the rectangular system for subdivision of public land, indicating township, range, section, and 40-acre tract within the section. For example, in the well number 38/1-7P1, the part preceding the hyphen indicates successively the township and range (T. 38 N., R. 1 E.) north and east of the Willamette base line and meridian. (Because all townships in Washington are north of the Willamette base line the letter "N", indicating north, is omitted; and because most of the State is east of the Willamette meridian the letter "E" is omitted for those ranges east of the Willamette meridian, but "W" is included when the range lies west of the Willamette meridian.) The first number following the hyphen indicates the section (sec. 7) and the letter (P) gives the 40-acre subdivision of the section as shown in the diagram. The last number (1) is the serial number of the

well in that particular 40-acre tract. Thus, the first well recorded in the SE¼SW¼ sec. 7, T. 38 N., R. 1 E., would have the number 38/1-7P1, and the second well would have the number 38/1-7P2.

Springs are numbered in the same manner, except that the letter (s) is added after the serial number. Thus, the first spring in the SE¼SW¼ sec. 7, T. 38 N., R. 1 E. would have the number 38/1-7P1s.

The test holes also have the same numbering system except that the letter (t) is added to the serial number.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Previous Investigations

No previous detailed ground-water studies have been made on the Lummi Indian Reservation. However, the report by Newcomb, Sceva, and Stromme (1949) describes briefly the geology and hydrology of the area. Also a geologic map of the reservation is included in a report published in 1907 by the Kansas Academy of Science.

Acknowledgments

Well and spring records were obtained from well owners, users, and drillers, whose assistance is sincerely appreciated. The cooperation of personnel of the Department of Health, Education, and Welfare, Division of Indian Health, and of the Engineering Geology Branch of the Geological Survey also is gratefully acknowledged.

GEOLOGIC SETTING

The geologic conditions within the reservation are discussed briefly in the following paragraphs, inasmuch as geology controls the occurrence and availability of ground water in an area.

The reservation is underlain by unconsolidated clay, sand, and gravel of Quaternary age. These materials were deposited as glacial outwash, glacial till, and flood-plain or delta deposits. The total thickness of these sediments is unknown, because no well in the area has penetrated them completely. They are exposed best at sea cliffs along the peninsula and mainland, and in exposures in shallow road cuts and small borrow pits in the uplands areas.

Recessional outwash deposits, (deposited during the retreat of a glacial front) consisting primarily of unconsolidated sand, or sand and gravel, mantle the uplands discontinuously. The recessional outwash ranges in thickness from about 2 to 30 feet. It occurs mainly along the east and west margins of the peninsula, in the interior of the peninsula, and on the uplands northwest of the peninsula.

Underlying the recessional outwash throughout most of the area is a stratum of fossiliferous blue-gray pebbly clay. At some exposures the clay is only 2 feet thick, but well 38/1-12K1, 0.2 mile west of Lummi School, reportedly penetrated 177 feet of this material (table 5). The clay contains well-preserved marine fossils, presumably of Pleistocene age. This deposit is described in adjoining areas in Canada by J. E. Armstrong and W. L. Brown (1954).

Unconsolidated sand and gravel, believed to be advance outwash (deposited during the advance of a glacier) of Pleistocene age, underlie the pebbly clay. The thickness of these sediments is unknown, as no well in the area has completely penetrated them.

The delta lowland is underlain by deltaic deposits of sand, silt, and clay of Recent age. Well 38/2-6B1 (table 5) reportedly penetrated deltaic deposits

to a depth of 535 feet without encountering the sediments of Tertiary age described by Newcomb, Sceva, and Stromme (1949, p. 14) as underlying the Quaternary deposits.

GROUND WATER

Ground water supplies the domestic and stock needs of the Indians within the reservation, except those living along the west bank of the Nooksack River. In that area, as well as in Marietta, water is supplied through the Bellingham water mains.

Within the reservation, about half the Indian population obtains water from individually owned wells and springs. The other Indian families that are dependent on ground water obtain it from the Lummi School well, number 38/2-7M1.

Nearly all the wells used by the Indians are dug, the depths ranging from 8 to 45 feet. A few Indians have drilled wells, which range in depth from 50 to 85 feet, but most of the drilled wells in the area appreciably deeper than 85 feet are in the non-Indian communities of Neptune Beach, Portage, Fish Point, and Gooseberry Point. The deepest well in use on the peninsula is 170 feet deep (well 38/2-19L2), and is on a privately owned tract of land near Fish Point.

The two main sources of ground water in the uplands are the recessional outwash sand or sand and gravel (herein called the upper aquifer) and the advance outwash sand and gravel (called the lower aquifer). Minor amounts of water also are obtained from the pebbly clay.

The upper aquifer, from which most of the dug wells obtain water, is not continuous throughout the area. Also, at many places where it does occur, expecially at higher elevations on the upland, it is either above the water table or too thin to yield appreciable quantities of water to wells. Most

of the wells tapping this upper aquifer are on a bench that extends from Fish Point northward for about 2½ miles. The bench, which ranges in elevation from 25 to 40 feet, is underlain by 20 to 30 feet of fine- to medium-grained sand. The Lummi School well (38/2-7M1) is one of the dug wells in this area.

In some areas of the interior of the peninsula, ground water in the upper aquifer forms a semiperched water body, because the underlying pebbly clay, which has a low permeability, retards appreciably the downward percolation of water to the main water table. In some places on the mainland also, ground water in the upper aquifer may be perched or semiperched above the main water table.

Nearly all the drilled wells and a few of the deeper dug wells obtain water from the lower aquifer, beneath the pebbly clay. Most of the wells that tap this aquifer are along the eastern margin of the peninsula (from Fish Point southward to the community of Portage), and in the vicinity of the two communities of Gooseberry Point and Neptune Beach. A few wells scattered throughout the rest of the area also obtain water from the lower aquifer. The areal extent of the lower aquifer is not definitely known.

In the delta defined as a lowland the main source of water is the deltaic sand and silt, the delta lowland aquifer. This aquifer, which is important as a source of domestic supply for residents in the lowland, yields small to moderate amounts of water at shallow depths.

There are numerous springs in the reservation, most of them along the eastern edge of the peninsula from the community of Fish Point northward to the vicinity of the Lummi School. These springs discharge from the base of the bench described previously, at the contact of the pebbly clay and the overlying sand of the upper aquifer, at elevations ranging from 15 to 25 feet. Only a few of the springs are now being utilized.

Yields of Wells and Springs

Yields ranging from a fraction of a gallon per minute to 130 gallons per minute (gpm) were reported for 11 wells in the reservation. Pump-test data and yield records indicate that wells tapping the lower aquifer in the uplands, and the sand in the delta, generally have much higher yields than wells in the upper aquifer of the uplands. Wells that derive their water solely from the pebbly clay generally yield 1 gpm or less. Well 38/2-6P1 had the highest reported yield. It is in the delta and obtains its water from sand. It is a dug well, 36 inches in diameter and 22 feet deep, and was pumped at the rate of 130 gpm for 4 hours with a resultant drawdown of 18 feet (table 1). Eight wells have reported yields of 5 gpm or more; of these, 6 are in the upland area and derive their water from the lower aquifer, and 2 are in the delta and tap the deltaic deposits. In general, wells in the area having well screens or perforated casings yield more water than wells that obtain water only through the open ends of solid casings.

An attempt was made to run aquifer tests on 2 wells and 3 test holes so that data for computing aquifer transmissibility could be obtained. However, because of mechanical difficulties and low, non-uniform yields, the tests were unsatisfactory. The fragmentary data obtained from the tests on three of the wells are tabulated as follows:

Well or test hole	Yield (gpm)	Drawdown (feet)	Duration of test (min)	Diameter of casing (inches)
38/1-26R1	12	7.31	34	36
38/2-19L4	1.6	—	39	30
38/2-26B1t	3 to 4	26	3	—

At least some part of the yield from 26R1 and 19L4 originated from storage within the well. The test on 26B1t was discontinued because the level dropped to the point of intake. On the basis of these details, it is believed that

the sustained yield of each of the three wells for which the yield was measured is less than 1 gpm. It is apparent that the aquifer transmissibility is quite low at each of the wells tested.

Recharge to Aquifers

The shallow water-bearing sand beds underlying the Lummi Indian Reservation are recharged chiefly by direct percolation of rainfall. In addition, the aquifers underlying the northern part of the reservation receive some recharge by lateral movement of water from hydraulically continuous zones to the north, beyond the reservation boundary.

Discharge

Discharge of ground water in the area occurs by evaporation and transpiration and from springs and wells. As the semiperched water table is close to the land surface, and there is a thick cover of vegetation over most of the reservation, considerable ground water is transpired by plants, and evaporated from swampy areas. Many springs issue at the base of the sea cliffs and may be seen at low tide. Most of these springs flow but a few gallons a mimute; however, it is believed that their aggregate discharge is large. There are relatively few wells in the area, and the individual yields from them are small. The total withdrawal from wells in the area is estimated to be about 25 acre-feet per year.

Water levels

During the late summer and early fall, water levels in many of the shallow wells decline and yields are insufficient for domestic use. In March and April 1956, water levels were measured in shallow dug wells. Of 22 wells ranging in depth from 7 to 22 feet, the levels in 14 were within 5 feet of the land surface. In none of the 22 was the level more than 13 feet below the land surface. Many well owners reported an annual water-level fluctuation of 5 to 10 feet. From December 1955 to May 1956, periodic measurements of water level were made at

well 38/2-7M1, at the Lummi School. The highest water level in this well was 9.6 feet below the land surface, on December 30, 1955, and the lowest was 13.4 feet, on May 25, 1956.

No observation wells have been measured regularly in the area; however, periodic water-level measurements from March 1953 to January 1957 in well 40/1-26J1, about $7\frac{1}{2}$ miles north of the area, indicate an annual fluctuation of about 5 feet. This observation well is 12.7 feet deep, and is in an area geologically and climatologically similar to the Lummi Indian Reservation. It obtains water from sand and has a reported yield of about 6 gpm.

All the drilled wells and the deeper dug wells in the area yield enough water for domestic and stock purposes throughout the year. The water from a few of the deeper drilled wells is highly saline, which limits its usefulness.

Quality of Water

During the investigation field determinations of hardness, chloride, and alkalinity were made on 15 samples of ground water from the Lummi Indian Reservation. The results of these tests are shown in table 3.

Hardness of water is its soap-consuming property and is dependent chiefly on the amount of calcium and magnesium ions in the water. Waters are classed as "soft" if the hardness, expressed as $CaCO_3$, ranges from zero to 60 ppm, as "moderately hard" if the hardness is 61 to 120 ppm, as "hard" if the hardness is between 121-200 ppm, and as "very hard" if the hardness is greater than 200 ppm.

Generally, the deeper wells in the area yield harder water than do the shallow wells. Hardness ranged from 40 ppm for water from well 38/1-26R1 (18.9 feet deep) to 206 ppm for well 37/1-2K1 (42 feet deep). The average hardness of the 15 samples was about 108 ppm.

Nearly all ground water contains some chloride, as chloride salts are readily soluble in water. Water containing not more than 250 ppm of chloride is considered suitable, so far as that constituent is concerned, for domestic purposes by the U. S. Public Health Service (1946). In 15 samples tested during April and May 1956, the chloride content ranged from 10 ppm in 39/1-34N1 (9.1 feet deep) to 136 ppm in 38/2-19L3 (11.9 feet deep). The average for the 15 samples was about 37 ppm. The deepest well from which a sample was collected and tested during the present investigation was 38/1-4D2, which is about 120 feet deep. However, a field test made on a sample collected from well 38/2-19L2 (170 feet deep) on July 26, 1948, showed a chloride content of 1,160 ppm. Three other drilled wells, all 150 feet or more in depth, also reportedly encountered saline water.

Temperatures of water in 7 wells were measured. They ranged from 43°F in well 38/2-19G1 to 49° in well 38/2-19L4. The average was 45.8° .

CONCLUSIONS

Three aquifers are being utilized on the Lummi Indian Reservation. These are (1) the recessional outwash (upper aquifer) overlying the pebbly clay, (2) the advance outwash (lower aquifer) underlying the clay, (3) the deltaic deposits (delta lowland aquifer). The upper aquifer and the delta lowland aquifer could be developed further by means of large-diameter dug wells or by driven wells, whereas drilled wells generally would be required to tap the lower aquifer.

On the basis of this study, it is believed that at least one of these aquifers can be exploited at most places on the reservation to furnish additional ground water. Most of the Indian dwellings are around the margins of the peninsula, on the edge of the upland or in the delta lowlands, where aquifers

can be developed at shallower depth and with less expense than in the center of the peninsula on higher elevations on the upland.

Many Indian dwellings are on the bench extending from a quarter of a mile north of Lummi School to about half a mile south of Fish Point. This bench appears to be favorable for the development of additional domestic ground-water supplies. The bench, which ranges in altitude from 25 to 40 feet, is underlain by 20 to 30 feet of fine- to medium-grained sand (pl. 2). The Lummi School well (38/2-7M1), from which many of the residents on the reservation obtain water, is on this bench. Test hole 38/2-7M1t (table 4), about 0.2 mile northwest of well 38/2-7M1, on this same bench, penetrated approximately 30 feet of sand before encountering pebbly clay. Three other test holes bored on the bench penetrated from 25 to 30 feet of sand before hitting pebbly clay. The sand along the bench is saturated below a depth of 5 to 20 feet, according to the time of the year and altitude of the well. Well 38/2-19L4, which was test pumped at 1.6 gpm, also is on this bench. As this well is not perforated or screened, it probably obtains all its water through the bottom of the casing. It should be noted that dug wells now being used on the bench ranged from about 9 to 18 feet in depth and reportedly yield inadequate water during dry seasons. Four test holes bored on the bench showed that the base of the sand ranged from 25 to 30 feet below the surface. It is believed that if the dug wells were deepened they would yield adequate water supplies throughout the year. Water supplies in this sand could be developed also by means of shallow drilled wells or possibly by means of a combination well consisting of a bored upper section and a driven well point below.

Springs discharging from the escarpment at the margin of the bench also are a potential source of supply. Properly developed, some springs may have perennial yields of 5 gpm or more.

In the area along the beach from Fish Point southwestward to Portage, sand and gravel of the lower aquifer are at comparatively shallow depths (pl. 2). The top of the sand and gravel aquifer generally is very close to sea level, so that, as most of the dwellings are at an altitude of 30 to 80 feet above sea level, wells ranging in depth from about 40 to 100 feet would be required. A number of wells have been drilled into this aquifer, especially in the vicinity of Portage, and have been uniformly successful in obtaining adequate water supplies. Deeper wells into this aquifer, however, yield salty water unsuitable for domestic use.

In the upland interior of the peninsula between Lummi School and Portage, only thin and discontinuous patches of recessional outwash are found. Some semiperched water occurs in these scattered patches, and in or near the top of the underlying pebbly clay. Supplies developed from these sources may fail during dry seasons. Dependable supplies probably could be obtained in the upland interior from the sand and gravel underlying the pebbly clay, but the water levels in this deeper aquifer would be about at sea level or a little above. The altitude of the upland ranges from 100 to 140 feet so that it would be necessary to drill wells 100 to 150 feet deep into these beds.

In the delta lowland of the Lummi River, north and northwest of Lummi School, ground water can be obtained from the deltaic deposits. Well 38/2-6B1 taps this aquifer and has the highest reported yield in the area. This well was reportedly pumped at 130 gpm for 4 hours with an 18-foot drawdown. The well is 22 feet deep and 36 inches in diameter. Some dug wells in the delta area are reported to go dry during the fall. These wells are probably too shallow, and if dug to a depth of a few feet below sea level should yield adequate water even during dry seasons. The deltaic deposits can be developed by means of shallow drilled wells and by driven wells utilizing screened well points.

A 535-foot well, 38/2-6B1, drilled in the delta area, had a reported flow of 7 gpm; however, the water was too salty for domestic use.

In the Neptune Beach area a number of drilled wells obtained adequate supplies of water at depths ranging from 24 to 143 feet. The depths required to develop adequate water depend to a considerable extent on the altitude of the land surface at the well site. Most of the wells are completed at depths of 20 to 30 feet below sea level. Test hole 38/1-8A1t, south of Neptune Beach, encountered water-bearing sand and gravel from about 1 foot above sea level to 69 feet below sea level. Immediately east of Neptune Beach, test holes 38/1-4B1t and 38/1-4J1t were bored to 41 and 50 feet below the land surface, respectively, without encountering satisfactory water-bearing materials. The land-surface altitude at these wells was 165 and 130 feet, respectively. Deeper wells drilled at these locations might encounter satisfactory aquifers. In this upland area some semiperched water is found and can be developed with or by means of dug wells. However, these supplies may not always be adequate during dry seasons.

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Table 1.--Records of representative wells in the
(Locations of wells

Type of well: Bd, bored; Dg, dug; Dr, drilled.

Depths and water levels: Measurements expressed in feet and decimal parts of feet were made by the Geological Survey; those in whole feet were reported by owner, tenant, or driller.

Type of pump: B, bucket; C, centrifugal; J, jet; N, none; P, piston (deep-well type); S, suction; Sb, submersible; T, turbine; HS, hand-operated suction.

Well number	Owner or tenant	Approximate altitude, feet above sea level	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of casing (feet)	Water-bearing	
							Depth to top (feet)	Thickness (feet)
T. 37 N., R. 1 E.								
2E1	Victor Jones	35	Dr	85	6	85	85	..
2G1	Peter Naverette	8	Dg	20	96±	0	..	..
2G2	F. W. Nolte	8	Dr	50	4	50	..	..
2G3	J. E. Francisco	15	Dr	60	6	60	50	..
2G4	. . . .do. . . .	8	Dr	100	6	..	..	..
2K1	Bob D. Bezona	10	Dr	42	6	42	..	..
2K2	. . . .do. . . .	15	Dr	55	6	55	..	..
2K3	--Yorkston	15	Dr	44	6-5	44	41	3

Lummi Indian Reservation, Whatcom County, Washington
shown on plate 1)

Use of water: D, domestic; Des, destroyed; Irr, irrigation; PS, public supply; S, stock; NU, not in use.

Remarks: Dd, drawdown; ft, foot or feet; gph, gallons per hour; gpm, gallons per minute; hr, hour(s); L, log; min, minute(s); temp, temperature in degrees Fahrenheit. Remarks on the adequacy and dependability of water supply, general quality of water, and materials penetrated are reported by owners, tenants, drillers, and others, except pump tests on wells 38/1-26R1 and 38/2-19L4 which were made by the U. S. Geological Survey, Ground Water Branch.

zone(s)	Water level		Type of pump and horsepower	Use of water	Remarks
Character of material	Feet below land-surface datum	Date			
Sand	40	1946	J, ½	D, S	Bottom 6 ft of well backfilled with gravel, some water at 40 ft. Supplies 3 homes and 30 head of cattle.
do	1.5	4-16-56	B	D	Well never goes dry.
Quicksand	4.2	4-16-56	J, ½	D	Water level fluctuates with tide. Well pumps fine sand.
Clay, hard, sandy	9	March 1953	do	D	Yields 1 gpm; L.
do	do	do	N	Des	Drilled almost entirely in hard blue clay. Inadequate supply.
Sand	5-10	Fall 1952	J, ½	D	Bottom few ft of well backfilled with gravel.
do do do	14.3	4-16-56	J, ½	D	Hard water.
Sand and gravel	do	do	J, ½	D	Yield 5 gpm; L.

Table 1.--Records of representative wells in the

Well no.	Owner or tenant	Altitude (feet)	Type of well	Depth of well (feet)	Diam. of well (inches)	Depth of casing (feet)	Water-bearing	
							Depth to top (feet)	Thickness (feet)
T. 37 N., R. 1 E.--Con.								
2K4	Lee Holcomb	10	Dr	49	6	49	38	11
2M1	Stan Solomon	30	Dr	55	6	55	55	..
2Q1	Zilpha Barber	8	Dr	39	4	39	30	9
2Q2	J. G. Barber	8	Dr	38	4	38	30	8
11C1	Dr. S. R. Boynton	10	Dr	139	6	139	128	11
T. 38 N., R. 1 E.								
1B1	Everett Matz	10	Dr	330	6	330	117	4
1N1	Dave Jefferson	15	Dr	280±	..	280	..	..
3J1	Lee Brothers	25	Dg	7.5	84?	..	..	..
4B1	James Adams	165	Dg	11.6	..	..	..	..
4D1	Pete Baker	95	Dr	117	6-4	117	102	13
4D2	--Steinmetz	90	Dr	115-120	4	..	..	..
4D3	Neptune Beach Water Assoc. Inc.	30	Dr	143	8	143	133	11
5A1	W. S. Hibbard	60	Dr	89	5	78	..	..
5H1	Harry Dawley	6	Dr	34	6	34	10	24
5H2	Allen O'Dell	6	Dr	24	6	24	..	..
5R1	John Finkbonner	10	Dg	11.7	36	72	..	..
11N1	U. S. Navy	8	Dr	150+	10	150	..	..
12M1	Herbert Johns	25	Dg	18	..	..	..	..
12J1	Francis Celestine	60	Dg	13½	36	13½	..	..
12K1	U. S. Navy	45	Dr	200	10	..	200	..

Lummi Indian Reservation, Whatcom County, Wash.--Con.

zone(s) Character of material	Water level: Feet below datum	Water level: Date	Pump Type H.P.	Use	Remarks
Sand, fine	..	..	..	D	Test pumped 10 gpm for 4 hr; L.
Sand	..	..	J, ½	D	Never pumped dry.
Silt, glacial	5-6	..	S	D	Adequate supply.
.. do ..	5-6	..	J, ½, ¾	D	Never pumped dry. Occasionally pumps fine sand; L.
Sand	8	1954	J, 1	D	Originally 39 ft, deepened in 1954 because well pumped sand; L.
.. do ..	..	..	N	NU	Inadequate supply; L.
..	..	..	N	Ds	"Hardpan" at 280 ft.
..	1.9	4-17-36	S	D	Supply not adequate for both stock and domestic use.
..	1.5	4-17-36	S, ½	D	
Gravel, fine	..	..	Sb	D	Yield 10 gpm; L.
..	..	..	P, ¾	D	Supplies 3 homes.
Sand, very fine	68	Jan., 1953	-, 1	PS	Dd 73 ft after 4 hr pumping 6± gpm; L.
..	60	3- 3-47	..	D	L.
Sand, fine	10	1951	S, ½	D	L.
.. do ..	..	..	..	D	Yield 10 gpm; L.
Sand(?)	6.7	4-17-56	S, ½	D	Supplies two homes. Water level recovers quickly.
Sand, medium	near surface	Spring 1952	N	NU	Abandoned due to saline water.
Clay, blue and sand	..	..	N	Ds	Small yield of saline water.
Sand	8.3	4-17-56	B	D	Well never goes dry; sand entire depth.
Sand, fine	36.9	6-24-52	..	..	Saline water; L.

Table 1.--Records of representative wells in the

Well no.	Owner or tenant	Altitude (feet)	Type of well	Depth of well (feet)	Diam. of well (inches)	Depth of casing	Water-bearing	
							Depth to top (feet)	Thickness (feet)
T. 38 N., R. 1 E.--Con.								
13C1	Francis Celestine	60	Dg	7	48	..	..	..
23B1	M. F. Harnden	6	Dg	8	36	8	7	1
23B2	. . . .do. . . .	35	Dg	36	48-6	0	..	..
24G1	Art Humphreys	120	Dg	15.5	42 by 60	5	..	..
25J1	Al Peters	35	Dg	11.9	72	0	..	..
25Q1	Jimmie Alexander	35	Dg	17.1	72	0	..	..
26R1	Art Pierre	115	Dg	18.9	36	19?	..	..
26R2	. . . .do. . . .	105	Dg	14	..	..	..	..
34K1	Gooseberry Point Water Assoc.	50	Dr	70	6	67	54	13
34Q1	Jones Family	6	Dr	185+	6	185+	..	..
35R1	Vic Johnson	35	Dg-Bd	29.9	30-8	34	25	7
36C1	Dora Solomon	35	Dg	12	72	0	..	..
36E1	Felix Solomon	40	Dg	16.5	96-60	0	..	..
36M1	Al Washington	30	Dr	54	6	54	54	..

Lummi Indian Reservation, Whatcom County, Wash.--Con.

zone(s) Character of material	Water level Feet below datum	Water level Date	Pump Type H.P.	Use	Remarks
Sand	3±	6-24-52	B	D	Low yield.
Sand and gravel	5	"	S. ½	D,S	Topsoil 0-2 ft; clay, blue, pebbly 2-36 ft.
Clay, pebbly	3.2	4-17-56	S.¼,½	NU	Dug 0-16 ft, augered 16-36 ft; L.
"	4.7	3-28-56	B	D	Originally 46 ft, backfilled to present depth. Gravelly clay from 0-16 ft. Dry gravel at 46 ft. Dry from June to Oct.
Clay, gravelly	3.2	4-17-56	N	NU	Originally 70 ft deep. Goes dry every summer. Temp 45; L.
"	1.7	4-16-56	B	D	Dug mostly in clay. Water level drops to 8-10 ft below LSD in summer and fall. Temp 47.
"	1.2	3-28-56	HS	NU	Dd 6.31 ft after 34 min pumping almost 12 gpm. Temp 47.
"	"	"	N	De	Dug in gravel, with a few layers of sand 1-2 ft thick. Supply was inadequate.
Sand	56	10-23-53	T. 3	PS	Dd 4 ft after more than 4 hr pumping 22 gpm. Supplies boat-house, cafe and 50 homes; L.
Gravel	"	"	N	De(?)	Abandoned due to inadequate supply.
Sand, black	22.9 3.5	7-26-48 3-28-56	S. ½	D	Originally dug 0-34 ft, augered 34-42 ft; L.
"	1-2	"	N	NU	Water is of poor quality; L.
Clay, pebbly	3.2	4-16-56	B	D	Goes dry in the summer. Water hard and saline; L.
Clay and sand	"	"	P	D	Originally drilled and cased to 120 ft but was "dry" at that depth. Yield 50 gph.

Table 1.--Records of representative wells in the

Well no.	Owner or tenant	Altitude (feet)	Type of well	Depth of well (feet)	Diam. of well (inches)	Depth of casing (feet)	Water-bearing	
T. 38 N., R. 2 E.								
6B1	Frank Imhoff	12	Dr	535	..	..	515	20
6F1	Percy Hood	10	Dg	22	36	22	18	4
7M1	Lummi School	40	Dg	18.0	54-9.2	18	..	..
18C1	Francis Jefferson	20	Dg	15	..	..	..	..
18D1	Matilda Jefferson	45	Dg	16.3	48	..	..	..
19G1	Pete Nelson	35	Dg	15	36	15	..	..
19G2	A. W. Baker	35	Dg	9.4	36	13.4	..	..
1/19L1	W. A. Connacher	30	Dg	17	24	17	5	12
2/19L2	N. P. Cruikshank	35	Dr	170	5	170	165	5
19L3	M. J. Holland	35	Dg	11.9	36	12	..	..
19L4	. . . do . . .	40	Dg	17.1	30	17	..	..
T. 39 N., R. 1 E.								
34N1	Lynn Blunt	195	Dg	9.1	36(?)	9.1	..	..

1/ Formerly G1
2/ Formerly G2

Lummi Indian Reservation, Whatcom County, Wash.--Concluded.

zone(s) Character of material	Water level Feet below datum	Water level Date	Pump, Type H. P.	Use	Remarks
Sand, fine	Flowing	8-9-46	..	S	Flows 7 gpm. Water saline.
Sand	2	July 1948	C, 7½	Irr	Dd 18 ft after 4 hr pumping 130 gpm; L.
.. do ..	11.5	3-27-56	J, 1	PS	Water level can be drawn down to the bottom of the well in 1-2 hr. Sand entire depth.
"Quicksand"	..	..	N		Destroyed because "quicksand" could not be kept out.
Sand	8.2	3-27-56	B	D	Has never been dry. Temp 43½.
Sand(?)	Near surface	..	BS	D	Temp 43.
..	5.4	3-27-56	S	D	Supply low in summer.
Sand	12.9	7-26-48	P, ½	D	
Gravel, sandy	38	1946	J, 1	D, S	No appreciable dd bailing 700 gph; L. /
Sand, fine	6.3	4-16-56	S, ½	D	L.
.. do ..	10.8	.. do. .	S, 1/6	D	Goes dry in summer and early fall. Dd 1.15 ft after 39 min pumping about 1.6 gpm. L. Temp 49.
Sand and gravel	3.1	4-17-56	P, ½	D, S	Area around well very sandy and gravelly. Temp 46.

/ Test made on 7/26/48 showed 1160 ppm of chloride.

Table 2.--Representative springs in the Lummi Indian Reservation, Whatcom County, Washington
(Location of springs shown on plate 1)

Spring number	Owner or tenant	Altitude above sea level	Water-bearing material	Occurrence	Use	Remarks
38/2-7M1s	Norman Bosler	30	Sand	Contact between pebbly clay and overlying sand	D	Seasonal fluctuation.
38/2-7M2s	Joe James	30	do.	do.	D	Occasionally goes dry during summer months.
38/2-7M3s	George James	30	do.	do.	D	Seasonal fluctuation, supplies 3 homes.
38/2-18L1s	Martha Williams	20	do.	do.	NU	Water appears cloudy, temp 46°F.
38/2-19B1s	Al Charles	35	do.	do.		Water leaves iron stain in sink, temp 46°F. Chloride 38 ppm.
38/2-19G1s	Ellen Charles	30	..	do.	D	Seasonal fluctuation, temp 46°F.

Table 3.--Analyses of ground water in the Lummi Indian Reservation
Analyses, in parts per million, by U. S. Geological Survey (April to June 1956)

Well number	Hardness as $CaCO_3$	Chloride (Cl)	Bicarbonate (HCO_3)	Depth of well (feet)	Aquifer
37/1-2K1	206	40	..	42	Sand
-2Q2	176	26	..	38	Silt
38/1-4B1	48	16	..	11.6	..
-4D2	162	18	..	115-120	Gravel, fine(?)
-5H1	118	14	37	34	Sand, fine
-5R1	54	26	..	11.7	Sand(?)
-25Q1	46	22	..	18.1	..
-26R1	40	16	61	18.9	..
-35R1	114	42	110	29.9	Gravel
38/2-7M1	58	16	55	18.0	Sand
-18D1	68	30	61	16.3	. .do. .
-19G1	104	26	116	15	Sand(?)
-19L3 1/	172	110	..	11.9	Sand, fine
-19L3 2/	172	136	116	11.9	. .do. .
39/1-34N1	78	10	..	9.1	Sand and gravel

1/ 4/16/56

2/ 5/24/56

Table 4.--Logs of test holes

38/1-10Jlt. About 10 ft east of gravel road, and about 200 ft southwest of house. Altitude 8+ ft.

Material	Thickness (feet)	Depth (feet)
Soil, dark.	3	3
Soil, brown, clayey . .	2	5
Sand, brown, medium to coarse, water.	5	10
Sand, gray, fine to medium, water.	25	35
Silt, gray, sandy, grading into silt, clayey, water	10	45
Clay, gray, silty, water	15	60

Water level - 5.89 ft below land-surface datum.

38/1-4Elt. About 50 ft south of James Adam's house, and a few feet south of barbed wire fence. Alt. 165+ ft.

Material	Thickness (feet)	Depth (feet)
Soil, brown gravelly. .	2	2
Clay, brown, sandy (wet), with gravel.	11	13
Clay, gray, sticky (wet), with pebbles	25	38
Gravel, fine to coarse (and clay?).	3	41

38/1-4Jlt. About 100 ft west of gravel road and 100 ft south of house. Altitude 130+ ft

Material	Thickness (feet)	Depth (feet)
Soil, brown, clayey. .	2	2
Clay, brown, with gravel	3	5
Clay, gray-brown, with gravel.	10	15
Clay, gray, stiff, with pebbles	30	45
Clay, gray, stiff, cohesive (wet), with pebbles	5	50

No water-bearing material from 0-45 ft

38/1-8Alt. About 10 ft east of road to Sandy Point, and 100 yd northwest of Lee Bros. farmhouse. Altitude 6+ ft.

Material	Thickness (feet)	Depth (feet)
Soil, dark, sandy. . . .	3	3
Gravel, fine-medium and medium sand (water at 6 ft)	9	12
(continued next column)		

38/1-8Alt. Con.

Material	Thickness (feet)	Depth (feet)
Sand, medium-coarse, and fine gravel, water. . .	3	15
Sand, gray, fine-coarse, water.	5	20
Sand, gray, medium, water	55	75

Water level-4.79 ft below land-surface datum.

38/1-13Jlt. About 40 ft south of gravel road, at top of hill. Altitude 140+ ft.

Material	Thickness (feet)	Depth (feet)
Soil, brown.	1	1
Clay, brown, with pebbles	19	20
Clay, gray, stiff, cohesive, with pebbles.	25	45

No water-bearing material encountered

38/1-14Alt. About 40 ft east of dirt road, in clearing. Altitude 30+ ft.

Material	Thickness (feet)	Depth (feet)
Soil, clayey.	1	1
Clay, gray-brown, stiff, cohesive, with pebbles. .	14	15
Clay, gray, cohesive, (wet), with pebbles.	5	20
Clay, gray, silty, cohesive (wet) with a few pebbles	15	35
Clay, gray, cohesive, with a few pebbles (wet) . .	35	70

38/1-24Glt. About 50 ft southwest of Art Humphreys. Altitude 120+ ft.

Material	Thickness (feet)	Depth (feet)
Soil, brown, clayey. . .	2	2
Clay, brown, with gravel	3	5
Clay, gray-brown, with gravel.	10	15
Sand, coarse and gravel, fine-medium.	12	27
Sand, gray, medium, and some fine gravel (wet) . . .	16	43
Gravel, fine-coarse and some gray-brown, medium sand	7	50

No good water-bearing material encountered.

38/2-18C1t. About 150 ft SSE of Francis Jefferson's house, about 10 ft north of wooded area. Altitude 35± ft.

Materials	Thickness (feet)	Depth (feet)
Soil, brown, sandy. . .	2	2
Sand, brown, medium . .	3	5
Sand, gray-brown, fine-medium, water below 8 ft	20	25
Sand, gray very fine, or clay, water.	5	30
Silt, gray, or clay, water.	10	40
Clay, gray (very wet) .	10	50

Water level=10.15 ft below land-surface datum.

38/2-18F1t. About 200 ft west of Lummi Shore Rd, and about 25 ft south of small new house. Altitude 20± ft.

Materials	Thickness (feet)	Depth (feet)
Soil, brown sandy. . .	3	3
Sand, brown, fine-medium, water below 10 ft . .	22	25
Sand, gray to brown, fine, and some clay with pebbles, water. . . .	5	30
Clay, gray, cohesive(wet) with pebbles.	20	50

38/2-18F2t. Located in bottom of sand pit, about 25 ft north of gravel road. Altitude 15±.

Materials	Thickness (feet)	Depth (feet)
Sand, brown, fine-medium	5	5
Sand, gray-brown, fine (moist).	1	6
Sand, gray-brown, very fine or silt, water. . .	1	7
Silt, gray-brown, clayey, water.	2	9
Sand, gray very fine, water.	1	10
Clay, gray-brown (wet) with fine gravel	1	11

38/2-18F1t. About 200 ft east of Indian Cemetery and about 20 ft north of narrow road into the cemetery. Altitude 15± ft.

Materials	Thickness (feet)	Depth (feet)
Soil, reddish-brown, sandy and gravelly (fill?). . . .	3	3
Clay, gray-brown.	3	6
Clay, gray, cohesive, with pebbles (wet below 12 ft)	9	15
Clay, gray, cohesive (wet) with a few pebbles.	45	60
Sand, gray, fine or silt (wet) (and clay?).	30	90

38/2-19G1t. About 50 ft south of Pete Nelson's house, just a few ft north of fence. Altitude 30± ft.

Materials	Thickness (feet)	Depth (feet)
Soil, brown, sandy.	2	2
Sand, brown, fine-medium (water below 4 ft). . . .	8	10
Sand, gray-brown, fine-medium, water.	10	20
Sand, gray, fine, and some gray clay, water	5	25
Clay, gray (wet) with fine-medium gravel and pieces of shell.	15	40

Water level=7.29 ft below land-surface.

38/2-19F1t. About 40 ft west of Lummi Shore Rd, and 100 yd ENE of house. Altitude 25± ft.

Materials	Thickness (feet)	Depth (feet)
Soil, brown, with gravel and cobbles.	2	2
Clay, brown, cohesive, gravel	6	8
Clay, dark gray, cohesive(wet) with pebbles.	17	25
Sand, gray, and some fine gravel (and clay?)	15	40
Sand, coarse and fine-coarse gravel with gravel becoming coarser with depth (and clay?)	15	55

Material below 25 ft was apparently water-bearing.

Table 4.--Logs of test holes--Concluded

38/1-25C1t. About 200 ft north of Cagey Rd. and about 50 ft northeast of barn. Altitude 115± ft.

Materials	Thickness (feet)	Depth (feet)
Soil, light brown, gravelly	2	2
Clay, gray-brown, pebbles	10	12
Sand, gray-brown, fine-medium (moist).	17	29
Gravel.	1	30
Sand and some pebbles. . .	29	59
Gravel, sandy.	4	63
Gravel, coarse.	--	--

No water-bearing material encountered below 29 ft.

38/1-25E1t. About 100 ft west of Lummi Shore Rd. Altitude 35± ft

Soil, reddish-brown, gravel	3	3
Clay, brown.	7	10
Clay, gray to brown, sticky, some fine gravel.	12	22
Clay, gray, and medium-coarse gravel.	11	33
Gravel.	2	35
Sand and gravel.	15	50

Material below 33 ft apparently water-bearing.

38/1-25Q1t. About 400 ft west and 100 ft north of the S 1/16 corner of the SE ¼, sec 25, (about 100 ft north of Smokehouse Rd). Alt. 120±

Soil, brown.	1	1
Clay, brown, few pebbles .	4	5
Clay, gray to brown, with fine gravel.	10	15
Sand, brown, fine-medium (moist below 20 ft) . . .	45	60
Gravel, fine-coarse. . . .	12	72
Sand.	3	75
Gravel, fine-medium . . .	10	85
Gravel, coarse.	1	86
Sand.	1	87
Gravel, coarse	1	88

Sand and gravel below 20 ft was moist, but not wet.

38/1-36B1t. Located in the southwest corner of the intersection of Smokehouse Rd and Lummi Shore Rd, about 50 ft south of Smokehouse Rd and 100 ft west of Lummi Shore Rd. Altitude 30± ft.

Materials	Thickness (feet)	Depth (feet)
Soil.	1	1
Clay, brown, few pebbles. .	4	5
Clay, gray to brown, pebbles (wet).	10	15
Clay, gray, cohesive, pebbles (wet).	12	27
Gravel, medium-coarse (and clay)?.	8	35
Gravel, fine-medium and sand	30	65

Material below 27 ft was apparently water-bearing.

Water level-4.32 ft below land-surface datum.

38/1-36E1t. About 200 ft west of Lummi Rd. in yard at side of house. Altitude 40± ft.

Soil, brown, gravelly. . .	2	2
Clay, gray-brown, gravel . .	8	10
Clay, gray, cohesive, pebbles and pieces of shell (wet) .	7	17
Clay, gray, cohesive (wet) .	10	27
Gravel (and clay)?.	1	28

Material below 27 ft was apparently water-bearing.

38/2-7M1t. About 75 ft west of blacktop road, in clearing between two houses. Altitude 35±ft.

Soil, brown, sandy.	2	2
Sand, gray to brown, fine to medium.	3	5
Sand, brown, medium, wet below 8 ft.	5	10
Sand, gray to brown, fine to medium, water below 12 ft .	7	17
Sand, gray, fine, or silt, water	13	30
Silt, gray, water, or (clay with pebbles.	10.	40
Clay, gray (very wet) pebbles	50	90

Water level-8.51 ft below land-surface datum.

37/1-2G3. J. E. Francisco. Altitude about 15 feet. Drilled by C. F. Livermore & Son, 1953.

Materials	Thickness (feet)	Depth (feet)
Topsoil	2	2
"Hardpan"	12	14
Clay, soft, blue	5	19
Clay, blue, sandy, hard	31	50
Clay, blue, sandy, hard, and coarse gravel	10	60

Casing: 6-inch, 0-60 ft; perf. 47-60 ft.

37/1-2K3. --Yorkston. Altitude about 15 ft. Drilled by C. F. Livermore & Son, 1953.

Topsoil	1	1
Clay, yellow-gray	15	16
Clay, blue	16	32
Clay, gravelly	9	41
Sand and gravel	3	44

Casing: 6-inch 0- 41½ ft, 5-inch 41½ to 44 ft; perf. 41½-44 ft.

37/1-2K4. Lee Holcomb. Altitude about 10 ft. Drilled by C. F. Livermore & Son, 1955.

Topsoil	1	1
"Hardpan"	14	15
Clay, blue	9	24
Clay, gravelly, hard	14	38
Sand, fine, water-bearing	11	49

Casing: 6-inch, 0-44 ft; screened from 44 to 49 ft.

37/1-2Q2. J. G. Barber. Altitude about 8 ft. Drilled by C. F. Livermore & Son, 1946.

Soil	1	1
Clay, blue, with boulders	24	25
Sand and clay, alternating layers	5	30
Silt, water-bearing	8	38

Casing: 4-inch to 38 ft.

37/1-11C1. Dr. S. R. Boynton. Altitude about 10 feet. Drilled by G. H. Bezona & Sons, 1954.

Materials	Thickness (feet)	Depth (feet)
Clay, yellow, and gravel	16	16
Clay, blue, and gravel	14	30
"Hardpan"	6	36
Sand, water-bearing	4	40
Clay, blue sticky	88	128
Sand, water-bearing	11	139

Casing: 6-inch, 0-139 ft, bottom 2 feet of well backfilled with gravel.

38/1-1B1. Everett Matz. Altitude about 10 feet. Drilled by Radke & Sons, 1946.

Topsoil	3	3
Sand, "iron water muck"	16	19
Clay, blue, sticky	98	117
Sand, small amount of water	4	121
Clay, blue	209	330

Casing: 6-inch, 0-330 ft.

38/1-4D1. Pete Baker. Altitude about 95 feet. Drilled by C.F. Livermore & Son, 1953.

Topsoil	2	2
Clay, blue, some pebbles	100	102
Gravel, pea; water-bearing	13	115
Sand, water-bearing	2	117

Casing: 6-4 inches 0- 117 ft; perf. 97-117 ft.

38/1-4D3. Neptune Beach Water Assoc., Inc. Altitude about 30 feet. Drilled by G. H. Bezona & Son, 1953.

Sand and gravel, alluvial	2	2
Clay, brown and gravel	15	17
Till, blue ("hardpan")	70	87
Gravel and sand, water-bearing, tested 3-4 gpm.	3	90
Till, blue ("hardpan")	43	133
Sand, very fine, water-bearing, tested 6 gpm.	11	144

Casing: 8-inch 0-137 ft; perf. 133-137 ft; .010 screen from 133-143 ft.

Table 5.--Logs of representative wells--Con.

38/1-5A1. W. S. Hibbard. Altitude about 60 feet. Drilled by C. F. Livermore & Son, 1947.

Materials	Thickness (feet)	Depth (feet)
Sand and gravel, brown	20	20
Clay, blue, sandy, some gravel	58	78
Boulders	3½	81½
Clay, blue, sandy, hard	7½	89

Casing: 5-inch 0-78 ft.

38/1-5H1. Harry Dawley. Altitude about 6 feet. Drilled by G. H. Bezona & Sons, 1951.

Sand	10	10
Sand, fine, water	24	34

Casing: 6-inch 0-29 ft, screened from 29-34 ft.

38/1-5N2. Allen O'Dell. Altitude about 6 feet. Drilled by G. H. Bezona & Sons, 1951(?)

Sand, fine	24	24
Clay	--	--

Casing, 6-inch to 24 feet; perforated

38/1-12K1. U. S. Navy. Altitude about 45 feet. Drilled by G. H. Bezona & Sons, 1952.

Sand, fine, water from 3-23 feet	23	23
Clay and silt, a few pebbles, low permeability	177	200
Sand, fine, brackish water	--	--

Casing: 10-inch.

38/1-23B1. M. F. Harnden. Altitude about 6 feet. Dug by owner.

Clay	6	6
"Hardpan"	1	7
Sand and gravel	1	8

Casing: 36-inch 0-8 ft.

38/1-23B2. M. F. Harnden. Altitude about 35 feet. Dug by owner.

Topsoil	2	2
Clay, blue, pebbly	34	36

No casing: 48-inch open hole to 16 ft., 6-inch open hole from 16-36 ft.

38/1-25J1. Al Peters. Altitude about 35 ft. Dug by owner.

Materials	Thickness (feet)	Depth (feet)
Topsoil	2	2
Clay and gravel	66	68
Clay	2	70

72-inch open hole to 70 ft.

38/1-34K1. Gooseberry Point Water Assoc. Altitude about 50 ft. Drilled by C. F. Livermore & Son, 1947.

Topsoil	2	2
Sand, dry, loose, and gravel	8	10
Clay, blue, hard	21	31
Sand, brown, fine, muddy	23	54
Sand "10% coarse", fine gray, water-bearing	13	67
Clay, blue, pieces of bark and wood on top of clay	3	70

Casing: 6-inch 0-61 ft; 5-inch 61-67 ft; perf. 61-67 ft.

38/1-34Q1. Jones family. Altitude about 6 ft. Drilled by G. H. Bezona, 1947.

Gravel ("poor water")	16	16
Clay, blue	169	185

Casing: 6-inch 0-185 ft.

38/1-35R1. Victor A. Johnson. Altitude about 35 ft.

Topsoil	1	1
Clay, hard, with gravel ("hardpan")	24	25
Sand, black, water-bearing	7	32
(Clay, hard, with gravel)?	12	44

Casing: 30-inch 0-34 ft.

38/1-36C1. Dora Solomon. Altitude about 35 ft.

Clay, blue, hard, with sand and pebbles	12	12

72-inch open hole to 12 ft.

38/1-36E1. Felix Solomon. Altitude about 40 ft. Dug well

Clay, with gravel	25	25

96-60-inch open hole to 25 ft.

38/2-6P1. Percy Hood. Altitude about 10 feet. Dug by Harold Zwicke, 1948.

Material	Thickness (feet)	Depth (feet)
Clay.	18	18
Sand, water-bearing . .	4	22

Casing: 36-inch 0-22 ft.

38/2-19L2. N. P. Cruikshank. Altitude about 35 feet. Drilled by Radke & Sons, 1946.

Sand, fine.	14	14
Clay, blue.	96	110
Sand, fine, saline water	--	--
Clay, blue.	--	147
Clay, gravelly, compact	18	165
Gravel, sandy, saline water.	5	170

Casing: 5-inch.

38/2-19L3. M. J. Holland. Altitude about 35 feet. Dug by N. P. Cruikshank.

Topsoil.	2	2
Sand, fine, water-bearing	10	12
Clay.	--	--

Casing: 36-inch 0-12 ft; perf. 9-12 ft.

38/2-19L4. M. J. Holland. Altitude about 40 feet. Dug by N. P. Cruikshank.

Topsoil.	2	2
Sand, fine, water-bearing	15	17
Clay.	--	--

Casing: 30-inch 0-17 ft.

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Department of the Interior, Geological Survey

PLATE I

LUMMI INDIAN RESERVATION, WASHINGTON

R. 1 E.

R. 2 E.

T. 38 N.

T. 37 N.

NEPTUNE BEACH

Sandy Point

LUMMI BAY

Lummi River

Nooksack River

Lummi School

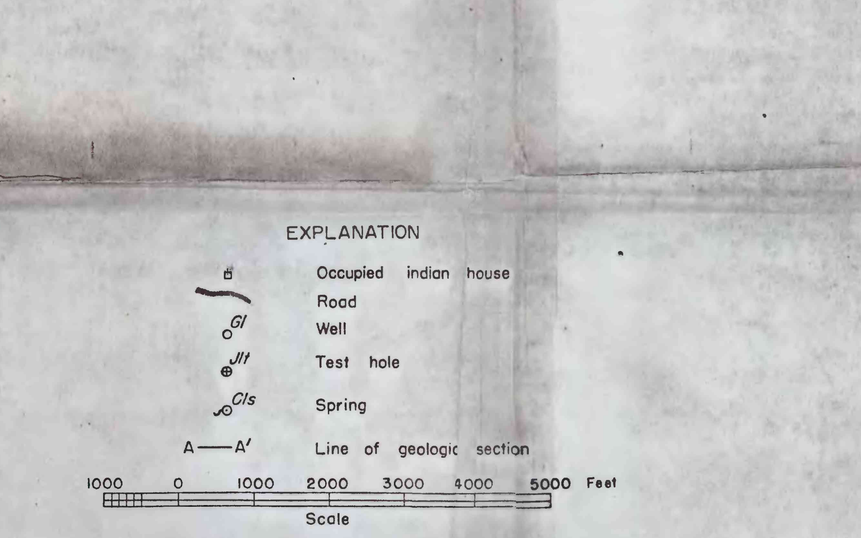
Fish Point

Gooseberry Point

PORTAGE ISLAND

Point Francis

BELLINGHAM BAY



EXPLANATION

- Occupied indian house
- Road
- Well
- Test hole
- Spring
- A—A' Line of geologic section

1000 0 1000 2000 3000 4000 5000 Feet

Scale

Contour intervals 20 and 50 feet

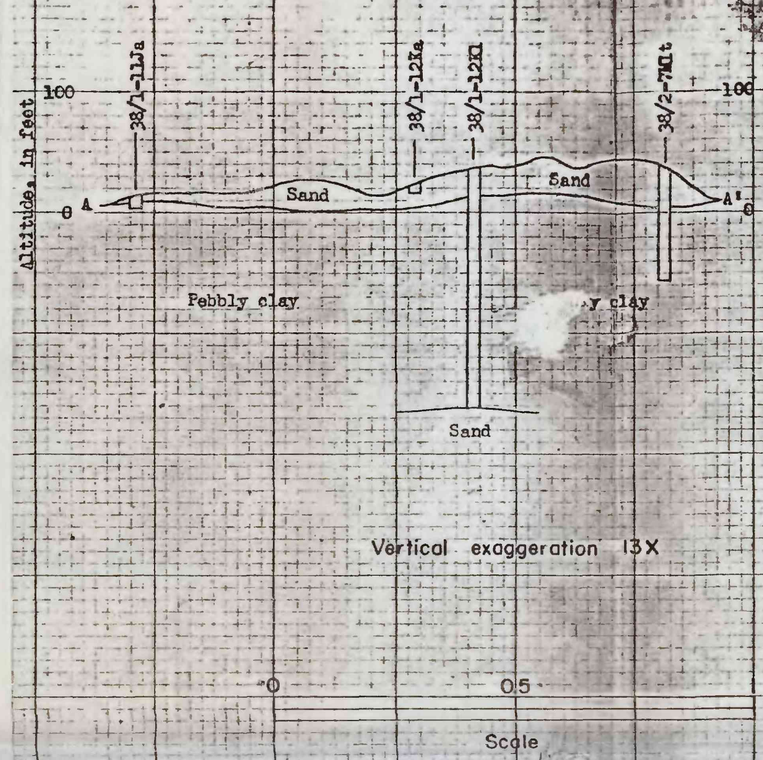
Plainimetric map courtesy of the Division of Indian Health, U.S. Public Health Service

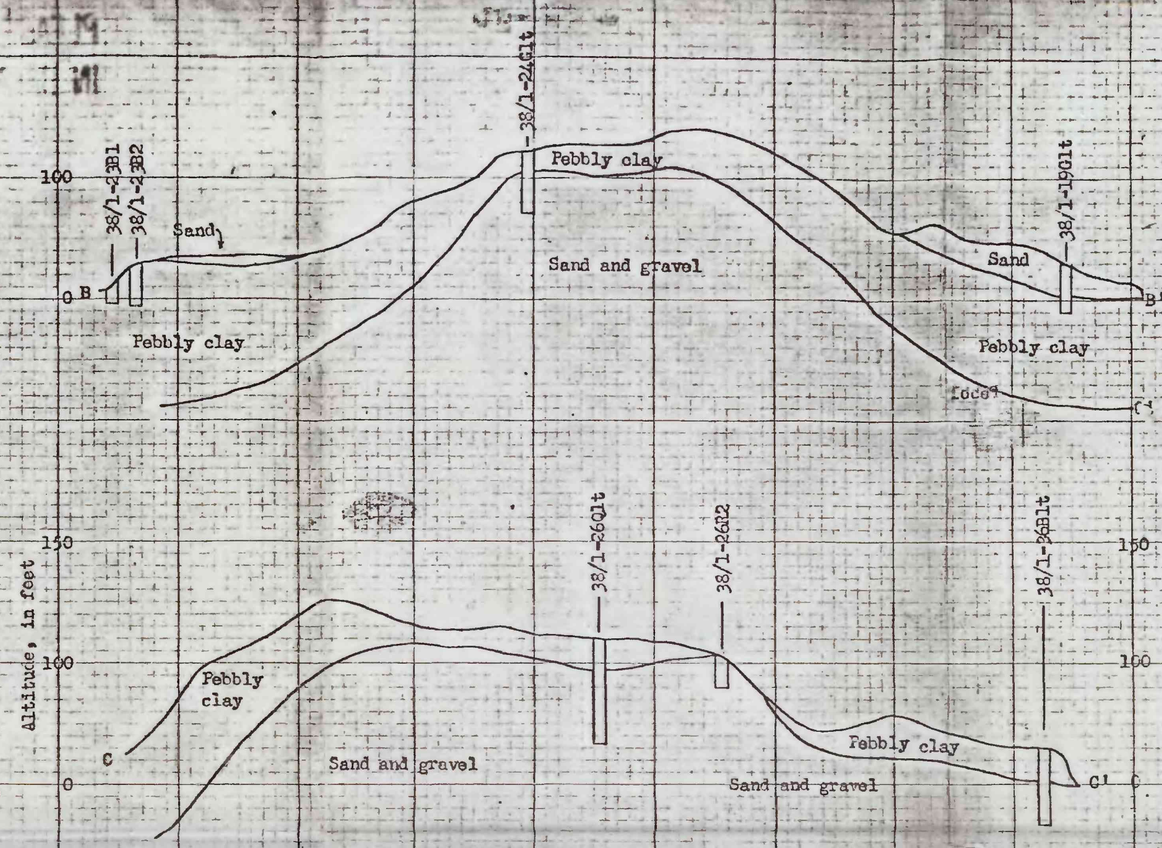
(Topographic contours from Anacortes and Blaine quadrangles)

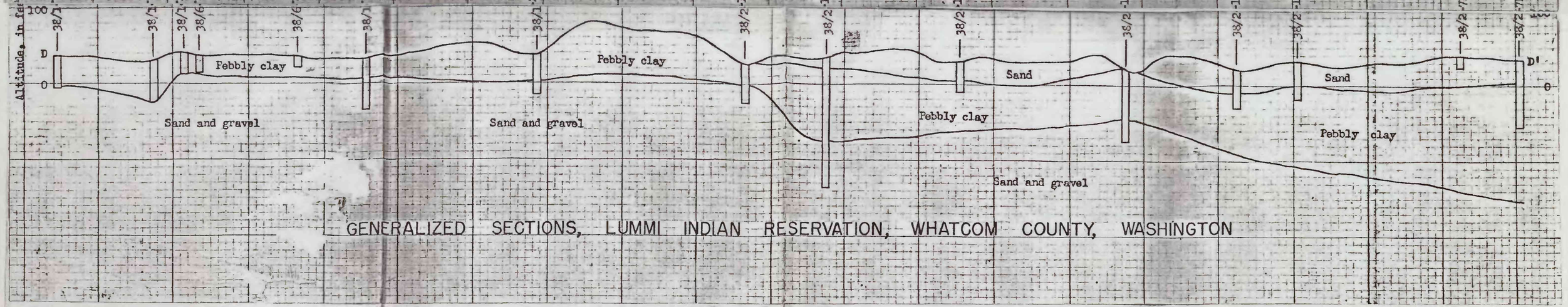
GEOLOGICAL SURVEY

PLATE 2

57-119







GENERALIZED SECTIONS, LUMMI INDIAN RESERVATION, WHATCOM COUNTY, WASHINGTON