Geology and Ground Water Resources of Arlington Heights, Snohomish County, Washington

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A report on geology and ground-water resources of the Arlington Heights area in Snohomish County. Prepared by Paul A. Eddy, Office of Technical Services, Department of Ecology, Olympia, Washington, January 1971.

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INTRODUCTION

Purpose and Scope of Investigation

, This study was initiated on November 1970 in response to a letter received from the Principal Planner, North County Section of the Snohomish County Planning Department requesting information about present and future ground-water availability in the Arlington Heights area. Additional need for this information was shown when many of the individuals in the Arlington Heights area went on record opposing the granting of ground-water permits for several proposed subdivisions in the area.

The scope of this study was initially set to include several determinations which are:

1. Ascertain availability of ground water in the Arlington Heights area.
2. Determine the proper plan for future development and utilization of the ground water.
3. Possible pollution of surface water and ground water by septic tanks.

The study has consisted of a general geologic reconnaissance of the area, obtaining water levels of representative wells, pump testing the aquifer, obtaining information from various sources in the area and the interpretation of the various data.

Location and Extent of the Area

Arlington Heights area is designated to inlcude approximately 3000 acres within Township 31 North, Range 5 East, Sections 28, 29, 30, 31, 32, and 33. Also Sections 4, 5, 6, 8, and 9, Township 32 North, Range 5 East lying approximately 2 miles east of the city of Arlington in Snohomish County, Washington. (Figure 1.)

Arlington lies geographically near the northwest corner of the county and is readily accessible via Interstate 5. The Arlington Heights area is crossed east to west by a paved road and also has a network of graveled roads which afford good accessibility.

The area is generally bounded on the north by the North Fork Stillaguamish River. On the west by the South Fork Stillaguamish River. On the south and southeast by Jim Creek and on the northeast by Ebey Hill.

The base map (Figure 1) used in this report is taken from the Arlington East Quadrangle, 7.5 minute series put out by the U. S. Geological Survey, Topographic Branch. The contour on the map is 20 feet.

Acknowledgements and Previous Investigations

A report on the Ground-Water Resources of Snohomish County, Washington was published in 1952 which was a cooperative study between the Snohomish County PUD #1, the U. S. Geological Survey, and the Washington State Department of Conservation and Development, and was authored by R. C. Newcomb.

Additional information was obtained through well records and miscellaneous well data available from water-right applications made to the Water Resources Branch of the Department of Ecology. The remaining well information used in the preparation of this report was collected from the individual well owners, and their cooperation is gratefully acknowledged.

The writer wishes to express special thanks to Howard Lovering, Principal Planner, North County section of the Snohomish County Planning Department, Mr. Charles Mangum of the Snohomish County Health Department, and Mr. and Mrs. Somerville for information and assistance they provided throughout the period of study.

Topography and Drainage

The topography of the Arlington Heights area is an upland bench or terrace which drops off rather abruptly toward the North and South Forks Stillaguamish River and Jim Creek and abuts against Ebey Hill to the east. The surface of the terrace is approximately 200 feet above the city of Arlington. The terrace is relatively flat and featureless throughout the area except for the dropping off to the east and north to lower level terraces.

There are no prominent surface drainage features on the terrace indicating that local precipitation that is not lost to evapotranspiration percolates downward to the ground-water table.

GEOLOGY AND GEOLOGIC HISTORY OF THE AREA

The physiographic features and rock units of the Arlington Heights area represent the end product of a complex geologic process. For this report the rock units need only be divided into two groups. The important group is the one which includes the glacially derived sands and gravels of Pleistocene age. These are the most recent rocks deposited in the area, and various units of this group serve as the only important aquifers.

The units are outwash consisting largely of the deposits that accumulated during the late Vashon time in the impounded waters of the South Fork Stillaguamish River and the subsequent terrace deposits and valley drains that were formed by integrated streams flowing across the Stillaguamish sand member and on down the Marysville trough (Arlington gravel member and Marysville sand member).

The Stillaguamish sand member is an outwash deposit which accumulated to a thickness of about 200 feet at a time when the melting ice temporarily blocked the river at the north end of Getchell Hill and caused the Stillaguamish drainage to pass southward through a spillway now followed by the Pilchuck River. The deposits are largely fine sand and clay but contain much coarser material towards the top and especially around the margin opposite points of tributary-stream debouchment. In the Arlington Heights area the character of the material in the Stillaguamish sand member as interpreted from outcrops in the escarpments about Section 5 and 6 is as follows (from an altitude of 300 feet down):

	Altitude (Feet)
Sand, fine, uniform, loose-------------------	225 - 300
Silt, blue, massive--------------------------	195 - 225
Covered (sand?)------------------------------	155 - 195
Till of the Vashon glaciation---------------- (Newcomb 1952)	135 - 155

Since all wells on the Arlington Heights obtain water from the upper 50 feet, our concern is with the sand unit between 225 and 300 feet in altitude.

The second group will be referred to merely as bedrock. It includes numerous rock types --- sandstone, shale, conglomerate, andesite, basalt, and metamorphosed sedimentary and igneous rock. This group is unimportant as an aquifer since it is essentially impermeable and yields little or no ground water. (Figure 2.)

GROUND WATER

Occurrence and Present Availability of Ground Water

As indicated above, the principal aquifer underlying the Arlington Heights area is made up of glacially derived sand and gravel of Pleistocene age. The lateral extent of this aquifer (Stillaguamish sand member) has generally been delineated, but it has not been possible to complete a definitive quantitative analysis in the area since the configuration of the lower units of Stillaguamish sand member is not known.

The procedure for determining a reasonable minimum capacity of a water bearing zone (aquifer) is as follows: The depth of the aquifer penetrated for 18 wells was tabulated (Figure 3) with the average depth penetrated into the aquifer of 9.4 feet. The specific yield of an aquifer, which is the ratio of the volume of water a saturated rock unit will yield, by gravity, to the total volume of the saturated rock unit was assumed to be approximately 20% (Stallman 68). The surface area of the aquifer was approximately 2,100 acres. Utilizing the preceding figures, the available storage capacity of the Stillaguamish sand member (sand unit) in the Arlington Heights area is calculated to be a minimum of 3950 acre-feet.

It is noted that the 3950 acre-feet figure has been determined using the average depth of the aquifer penetrated by existing wells so in the setting of the bottom of the wells as the bottom of the aquifer is an assumption which obviously is not the case. Since none of the representative wells penetrate the entire thickness of the aquifer the above number of acre-feet is probably very conservative. The point is stressed in order to emphasize that the 3950 acre-feet is a safe figure for the minimum available storage capacity of the aquifer.

In order to understand the above number (3950 acre-feet) it is pointed out that a single dwelling with its own well uses approximately 1 (one) acre-foot per year. Since the precipitation in this area is approximately 45 inches per year this would indicate that 3950 homes could be supplied by this aquifer.

As an aid to understanding the above discussion, reference to the geologic map is recommended (Figure 2) where outcrops of rock other than Qvrs are shown to indicate the boundary of the aquifer. The light colored line indicates the bottom of the upper sand unit of the Stillaguamish sand member.

Ground Water Movement

The Arlington Heights terrace is recharged from precipitation on the terrace surface and by runoff from Ebey Mountain. The ground water moves radially from an apex near the eastern edge of the terrace and discharges to springs at the terrace escarpment. It appears that a decreasing permeability in the finer material that underlie the terrace toward its western edge may have considerable influence in maintaining the high level of the water table and the greater part of the Arlington Heights terrace. (Figure 4.)

Utilization of Ground Water Present and Future

The history of water use on the Arlington Heights terrace indicates that domestic supply is the primary use with minor amounts used for dairy operations and irrigation of grazing land. The only change in this usage is the diminishing use of water for dairy operation.

Several sub-divisions have been planned for this area. If they come into existence, a new use, community domestic supply will be present. The only concern about this type development is a large discharge from the aquifer from a point source. However, there seems to be adequate ground water available to properly constructed wells. The cone of depression should be quite shallow (based on a short term pump test in the area) and have little real influence on other wells in the area.

Pollution of Ground Water by Septic Tanks

A safe distance between a water source and the origins of contamination is dependent upon many local factors and its determination involves, among other things, an evaluation of:

1. Character and location of sources of contamination;
2. Permeability and structure of the water bearing formation;
3. Type of well and nature of construction;
4. Natural ground water gradient; and
5. The influence of well pumpage on the depression of the water table at the well.

Where possible, the evaluation of the ground water source should be above that of all surrounding sources of contamination. Recommended minimum distances between a water supply source and contamination source are as follows (soil porosity between sources not greater than that of sand, free of gravel):

Septic tank trench (outflow)	100 ft.	200 ft.
Barnyards	100 ft.	300 ft.

The first row of figures are based on the elevation of the contamination being the same as the water source and the second having the contamination above the water source. If the following recommended distances cannot be followed, the consultative services of the local health department should be used when soil conditions and distances for a shallow well cannot be followed (Dept. of Health Bulletin ES No. 4).

Possible Adverse Effects of Future Ground Water Appropriation

In accordance with Section 90.44.070 RCW, no permit shall be granted for the development or withdrawal of public ground water beyond the capacity of the underground bed or formation in a given basin, district, or locality to yield such water within a reasonable or feasible pumping lift in case of pumping developments, or within a reasonably or feasible reduction of pressure in the case of artesian developments. Additionally, all permits are granted subject to existing rights and this Department shall have the power to determine whether the granting of any such permit will injure or damage any vested or existing right or rights under prior permits and in addition to office records, require further evidence, proof, and testimony before granting or denying any such permits.

On the basis of available data, it appears that the sand unit of the Stillaguamish sand member is not overappropriated at the present time (under existing conditions) in periods of normal precipitation. During the period of study no evidence was found suggesting that the aquifer was being utilized beyond its capacity. Consequently, under existing conditions, it does not appear that granting of more ground-water permits in the Arlington Heights area would be a serious detriment to existing ground-water rights.

CONCLUSIONS AND RECOMMENDATIONS

The Arlington Heights area obtains the major portion of its ground water from the upper sand unit of the Stillaguamish sand member. The producing unit is composed of a fine, uniform, loose sand which is in direct contact with the land surface and has an areal extent of over 2100 acres and has well defined boundaries on all sides.

The specific yield of the aquifer has been estimated to be approximately 3950 acre-feet assuming the aquifer is fully recharged. The major use of water in this area is for household supplies with lesser amounts for dairy operation and irrigation.

The sand unit of the Stillaguamish sand member is not fully appropriated each year and that overdraft of the aquifer has not as yet occured.

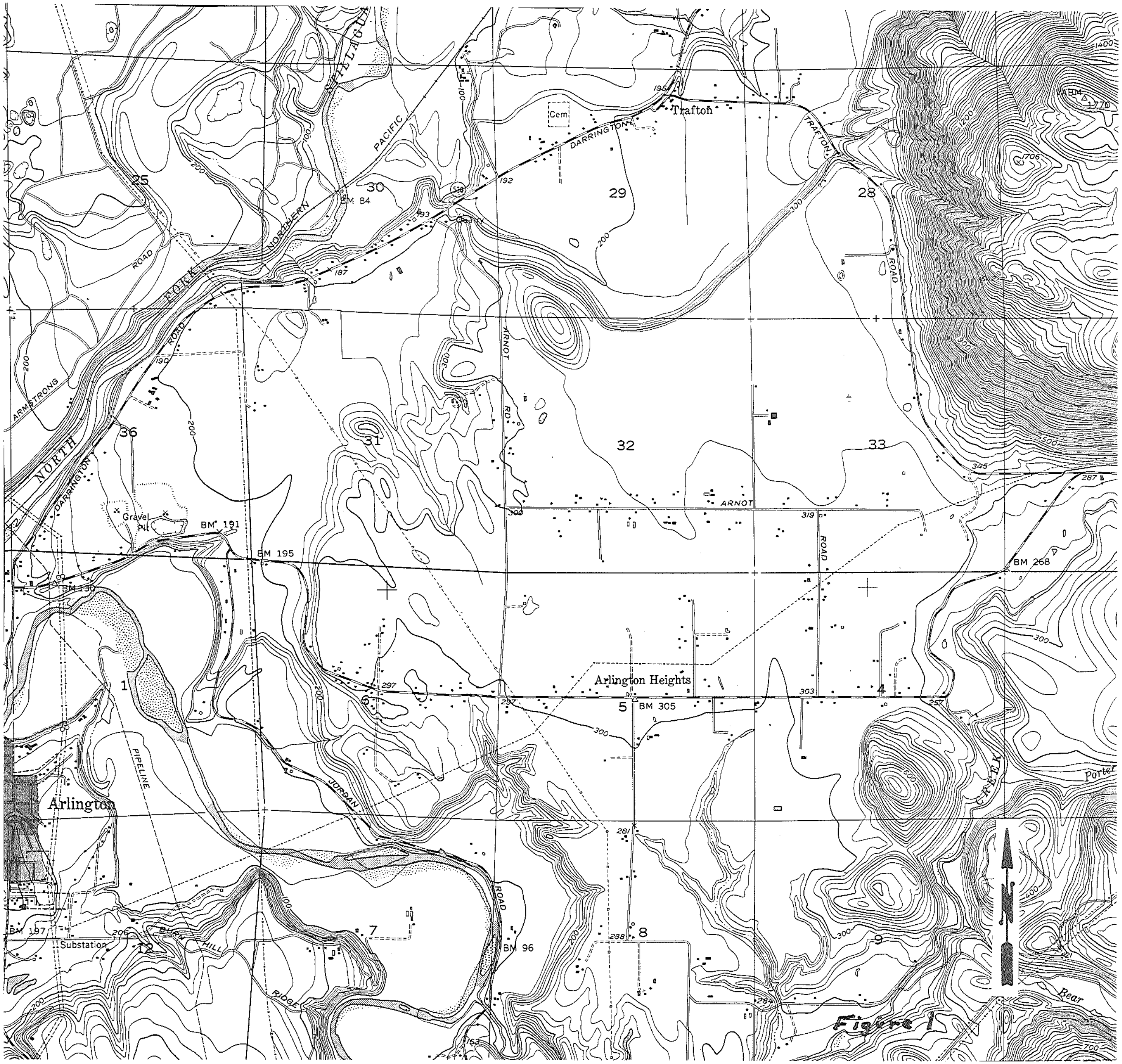
The future development and utilization of all waters in the Arlington Heights area are based on conditions as they were during the period of study. The Department of Ecology should continue to issue permits for the appropriation of ground water from the upper sand unit of the Stillaguamish sand member, but future applicants should be fully cognizant of the fact that they are only establishing rights to the use of their waters when they are available without adversely affecting existing rights.

Placement of future wells should be established as to minimize the possibility of local interference problems and the prevention of contamination reaching water sources.

APPENDIX

FIGURES 1-4

PAGES 8-12



Trafton
Cem
DARRINGTON
TRAFTON
PACIFIC
NORTHERN
NORTH
FORK
ROAD
ARMSTRONG
ARNOT
RD
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BM 84
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BM 195
BM 130
BM 268
BM 305
BM 197
BM 96
Gravel Pit
Arlington Heights
Arlington
PIPELINE
JORDAN
ROAD
Substation
BURN
HILL
RIDGE
CREEK
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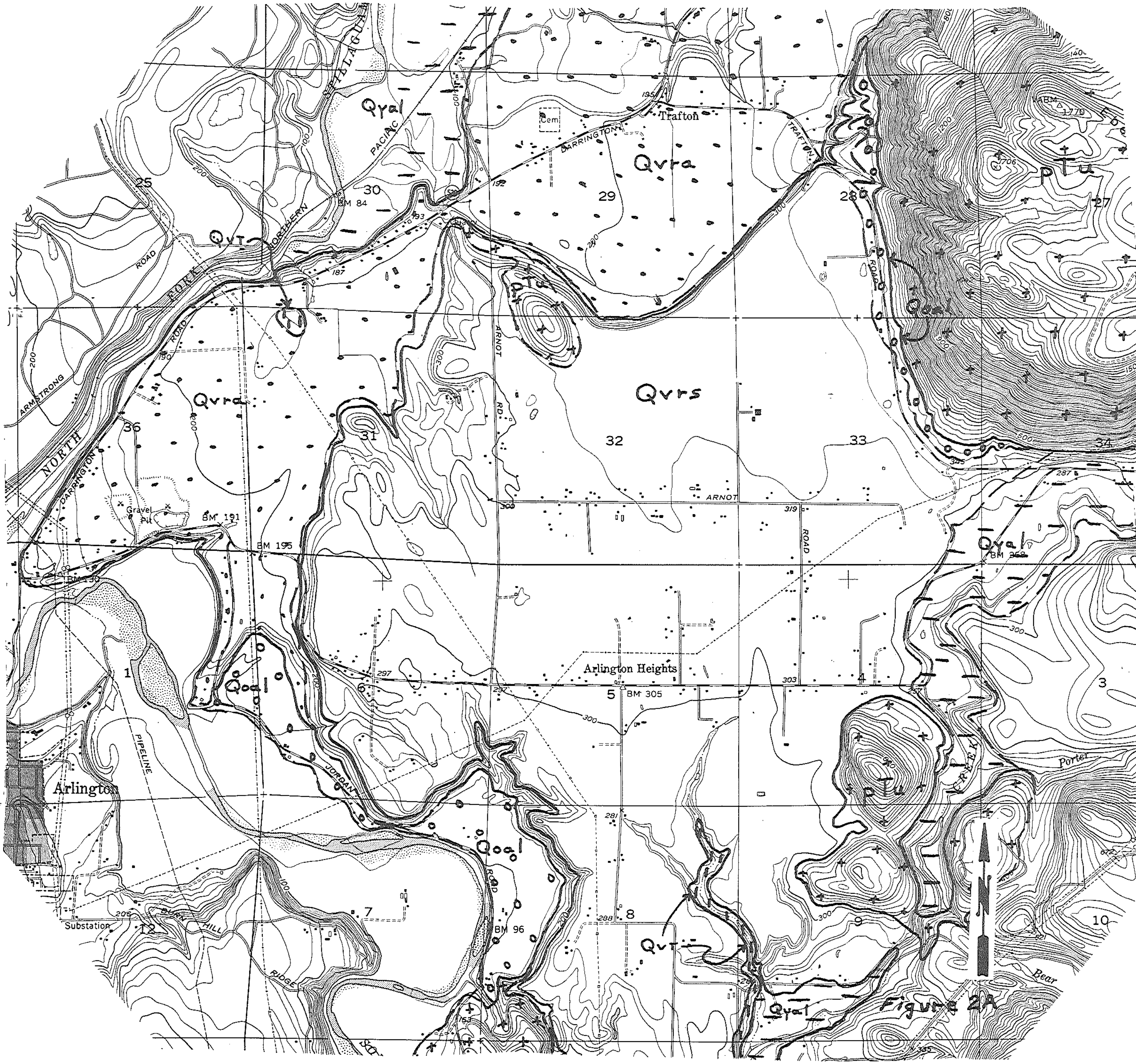
Figure 1


Qyal
Qvra
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Substation
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BM 195
BM 130
BM 305
BM 96
BM 368
BM 1779
NORTH FORK
NORTHERN PACIFIC
STILLAGUAMISH
ARMSTRONG ROAD
DARRINGTON ROAD
DARRINGTON
ARNOT RD
ARNOT ROAD
TRAFTON ROAD
PIPELINE
JORDAN ROAD
BURN HILL RIDGE
Porter CREEK
Bear
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Figure 2A

EXPLANATION

Unconsolidated or Semiconsolidated Deposits

Quaternary

Recent

Qyal

Younger Alluvium

Clay, silt, peat, sand, and gravel; some artifical fill included. Coarse-grained materials yield large quantities of ground water. Water commonly contains iron compounds and is brackish near Sound.

Qoal

Older Alluvium

Clay, silt, sand, and gravel; may include some late-glacial meltwater deposits. Coarse-grained material yields moderate quantities of water where below the local water table.

Pleistocene

Qvra

Arlington Gravel Member

Sand and gravel - relatively thin sheet on terrace cut in Stillaguamish sand member.

Qvrs

Stillaguamish Sand Member

Sand, silt, clay, and gravel valley fill 300± feet thick. Coarse elements yield moderate quantities of ground water.

Qvt

Till

Gray concretelike mixture, principally ground-moraine deposit, 20 to 150 feet thick. Essentially impervious, but the included sandy and gravelly streaks, as well as the disintegrated surface zone,

pTu

Metamorphic and Igneous Rocks, Undifferentiated

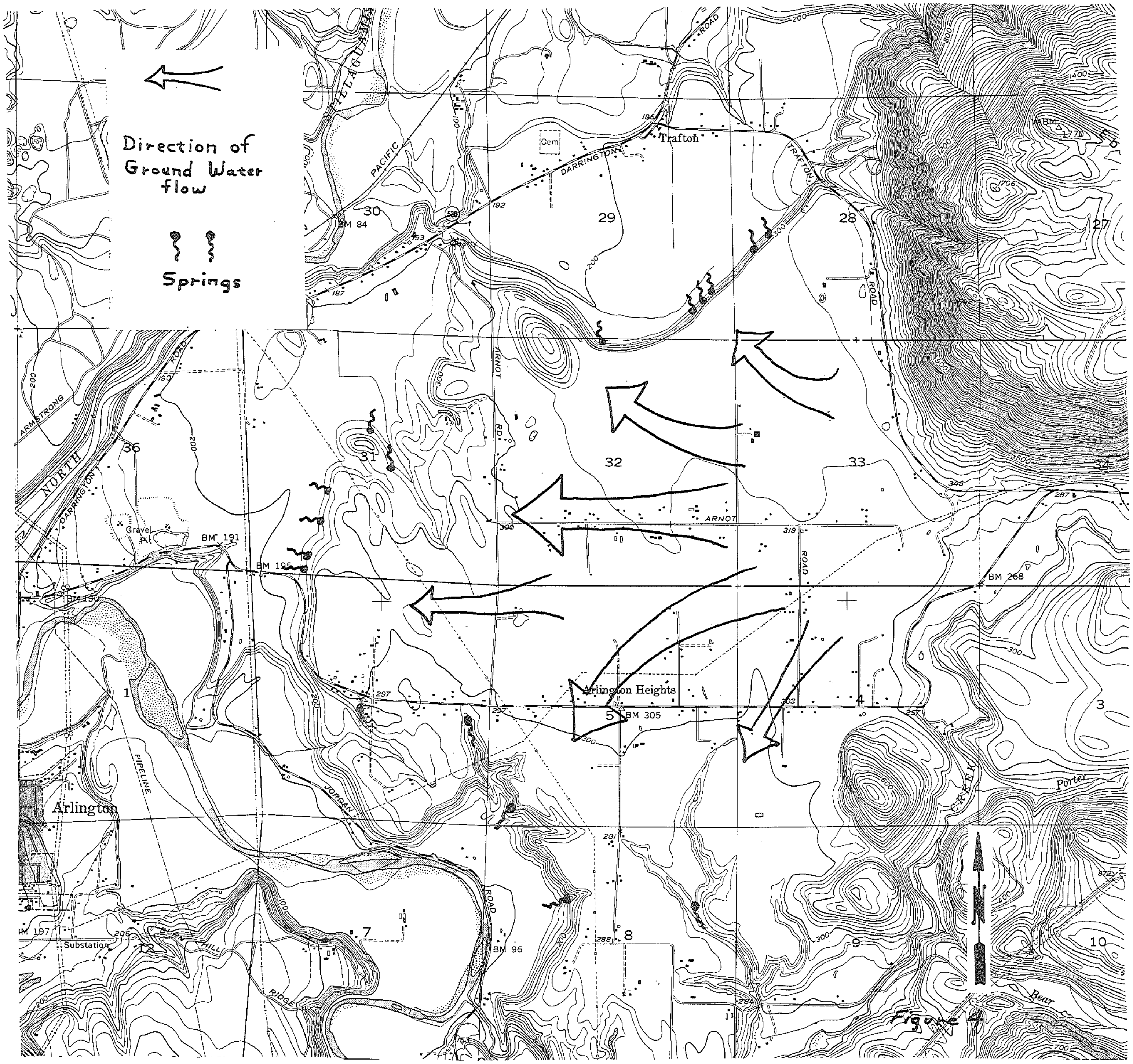
Metamorphosed sedimentary and igneous rocks, including Tertiary (?) volanic rocks except in the Bald Hills mass. Yield little or no ground water.

Figure 2b

REPRESENTATIVE WELLS

Name	Depth	Dia.	W/L Date
Adolfson, A.	13.8	48	10 (44)
Bauer, Joseph	31	36	9
Brown, E.J.	14	3	12 (44)
Carlson, H.F.	35	36	10 (53)
Cranmore, Neocia			
Darst, L.C.	64	36	28 (70)
DeVerna, Floyd	25	36	
Freeburg, E.	16		11± (44)
Groendyk, George	28	36	
Hamblim, Harold	25	1+	
Hughes, John	24	36	
Jackson, M.W.	18	1+	13+ (44)
Kroeze, Paul	25	36	
Lee, Peter			
Persson, Gerda	12	36	
Price, James	28	36	9+ (52)
	15	1+	
Rylie, Lewis	25	30	8 (70)
Terpstra, Duane	26	36	
Tillman, Don	18	36	12 (70)
	24	36	7 (70)
	13+	30	12 (70)

Figure 3


Direction of Ground Water flow
Springs
Trafton
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PACIFIC
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Figure 4