CANADA – BRITISH COLUMBIA
OKANAGAN BASIN AGREEMENT

SUMMARY REPORT

OKANAGAN BASIN
GROUNDWATER REVIEW BOARD

1. Introduction - At the 14th meeting of the Okanagan Study Committee held in Penticton, B.C. on February 14 and 15, 1971, it was agreed that an overall review of the groundwater program, based on existing information, should be carried out jointly by the Federal and Provincial groundwater staff prior to the implementation of any further studies in this field. Exceptions to the above included the expenditures of $15,300 for instrumentation and testing of existing wells and a budget of $10,000 for evaluation of existing data.

The joint review was to commence in April 1971 and a report on the findings was to be completed for presentation to the Study Committee by May 31, 1971.

Dr. J. C. Foweraker was appointed to represent the province on the Groundwater Review Board; Mr. D. H. Lennox and Mr. E.C. Halstead were appointed to represent the federal government. The Review Board met in Victoria, B.C. on April 22. Also present at the meeting was Mr. E.G. LeBreton of the B.C. Groundwater Division who attended as an observer and to discuss and answer questions on the progress report he had prepared on the "Okanagan River Basin Hydrogeological Reconnaissance Studies (Tasks 38, 39 and 40)". This progress report and the Review Board terms of reference prepared by the Okanagan Basin Study Director were the basic documents on which this summary report is based; where the progress report did not directly provide some of the answers required in the terms of reference, supplementary data and calculations were utilized in order to obtain the missing information.

2. Terms of Reference - The terms of reference listed below are slightly modified from those originally prepared by the Study Director. The modified terms take into account a change in the scheduling of field work.

A. Available Data - All information obtained from the study of groundwater resources under the Agreement was made available to the Review Board. Instrumentation and testing of existing wells have, however, been delayed and will not take place until May and June. Consequently, these data could not be incorporated into the summary report. A final groundwater report will include these data and there may be some modification in the conclusions as a result, particularly since the new data will probably provide a more accurate assessment of the groundwater potential of the north end of the basin.

B. Objective - The overall objective of the review was to determine if groundwater represents a feasible alternative to diversion for the supply of an adequate quantity and quality of water to meet present and future demands for this resource in the Okanagan Basin.

C. Scope - The scope of the review was defined as follows:

(a) Define aquifers in the study area

i) capacity as a mining operation and/or in terms of annual recharge

ii) depth in relation to mean sea level.

(b) Define geographic sources and destinations of groundwater.

(c) Define quality of groundwater.

(d) Determine cost of groundwater at surface per acre foot per 100 feet of lift.

(e) Determine limits of accuracy.

(f) Estimate costs of further studies (i.e. surveys, seismic work, drill holes, instrumentation, pump tests, etc.) needed to narrow or improve the limits of accuracy.

3. Data Evaluation - The Groundwater Review Board is satisfied that the available data are valid and sufficient to provide a good first approximation to the groundwater potential in the basin. Expenditures to date have been justified since without them it would not have been possible to obtain the necessary understanding of the geological framework in which groundwater moves and is stored. It is on this understanding that the estimates of groundwater potential are based.

In this summary report, discussion is largely confined to or based on results obtained in the north end of the main Okanagan Valley and in the O'Keefe Valley. The bulk of the hydrogeological studies were carried out in these areas. Studies carried out in the sub-basins (Task 38) indicated that they make very little groundwater contribution to the main groundwater flow system and do not therefore merit further detailed consideration.

(a) Aquifers in the Study Area - Aquifers in the main valley and in the O'Keefe Valley all lie within the surficial deposits. The surficial deposits in the main valley range in thickness up to 1900 feet or more. They may be sub-divided into two distinct layers. The upper layer consists mainly of silt with local deposits of fine- to

medium-grained angular sands. The lower layer can be further sub-divided into sub-layers of till; silt, sand and clay; and sand and gravel.

i) Capacity - The available data permit an estimation of the groundwater available in the surficial deposits purely on the basis of a mining operation. The estimate is based on estimated volumes of various aquifer units in the upper and lower surficial layers. These units are described in the progress report. It is assumed that only 1 per cent* of the total estimated aquifer volume represents actual water recoverable by groundwater mining. This assumption takes into account (a) the estimated storage space (porosity) of the aquifer units and (b) the fact that all groundwater in storage will not be recoverable.

Estimated Yield from Groundwater Mining

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|---|---|
| Main Valley, North End | |
| Lower part, surficial deposits | 15,150 acre-ft. |
| Upper part, surficial deposits | 4,700 acre-ft. |
| O'Keefe Valley | 63,250 acre-ft. |
| | 83,100 acre-ft. |

Thus, for that part of the Okanagan Valley lying north of Okanagan Lake plus the O'Keefe Valley there is a total of approximately 80,000 acre-feet of groundwater in storage and recoverable by groundwater mining. Details of this and other calculations are available from the Groundwater Division, B.C. Department of Lands, Forests and Water Resources.

An estimate of capacity in terms of annual recharge is provided by the progress report. It is estimated there that the total groundwater flow down the main Okanagan Valley below the confluence with the O'Keefe Valley is about 12 cfs. This presumably can be equated to the instantaneous recharge to the groundwater system. Total annual groundwater recharge may then be estimated as about 9,000 acre-feet.

ii) Depth in Relation to Mean Sea Level - The upper surficial deposit layer lies everywhere above mean sea level. Its base is at about 100 feet above and its top at about 1,000 feet above mean sea level. Aquifer units in the lower surficial deposit layer have elevations that vary from place to place. Except for the lowest-lying unit, their bases can range both

* See addendum to the report (attached) for a more detailed statement on this.

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above and below mean sea level. The base of the lowest unit is found at depths ranging down to 600 feet below mean sea level. The O'Keefe Valley aquifer was found in a single test hole to lie in the depth interval between 1,025 and 1,375 feet above mean sea level.

(b) Geographic Sources and Destinations of Groundwater - Groundwater inflow into the Okanagan Valley is principally from the Salmon and Shuswap River Valleys. There is some underflow from tributary creeks and probably an appreciable component of recharge (about 5 cfs.) from precipitation. Groundwater in the valley moves south towards Okanagan Lake. Some of this flow is probably discharged directly into the lake while the balance passes beneath it. The relative amounts depend on such factors as the permeability of the lake bottom and the thickness of permeable deposits underlying it.

(c) Quality of Groundwater - Information obtained to this point indicates that the groundwater is of excellent quality. It is of the calcium-magnesium type with a total dissolved solids content commonly less than 500 ppm. There are no data, however, concerning water quality in the lower part of the surficial deposits. These data are to be obtained during the May - June instrumentation and testing program.

(d) Cost of Groundwater - The estimated capital costs for a hypothetical well drilled to 1,000 feet to pump 1,000 U.S. gpm are $27,200 made up of (a) well drilling and construction ($15,000), (b) pump ($7,200) and (c) well housing ($5,000). No provision has been made in this estimate to incorporate costs of bringing power to the site. These costs could vary considerably depending on site location. Power costs for pumping would be $0.85 per kilowatt-hour, giving an estimated operating cost for the hypothetical well of $2.45 per acre-foot per day.

(e) Limits of Accuracy - In general, the estimates for aquifer yield from mining, groundwater flow, recharge from precipitation, and groundwater costs are based in part on measurements and in part on assumptions. The assumptions involve such factors as regional aquifer continuity, aquifer porosity and permeability, per cent of precipitation recharged to the groundwater reservoir, etc. The real values of the numbers involved may turn out to be quite different from those values that have been assumed.

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It is believed that the areal extents and thicknesses of the aquifer units contained in the lower part of the surficial deposits are reasonably well defined, as are the lengths and widths of the main valley. Nevertheless, a factor-of-two error in estimating volumes of these units is certainly not out of the question. Similarly, although the O'Keefe Valley is believed on limited hydrogeological evidence to be continuous from the Salmon River to the main Okanagan Valley, the possible error in the corresponding volume estimate is probably of the same relative magnitude. The possible relative error in estimating the volume of the upper surficial deposits of the main valley is probably greater since the aquifer of interest has been identified with certainty only in the Maid Creek area. These possible errors suggest that the estimates of yield from mining and of groundwater flow should be regarded as being possibly in error by at least a factor of two. It is probably preferable at this time to consider them as order-of-magnitude estimates.

Similar considerations suggest that the estimate of recharge from precipitation should also be considered an order-of-magnitude estimate. In the case of the groundwater-cost estimate, however, the possible error in the estimate is probably much smaller. With drilling conditions generally as encountered in the exploratory program to this point, the actual capital cost might range 20% upwards or downwards from an average figure of $25,000. Allowing for difficult design or geological conditions, on the other hand, would mean setting aside up to $50,000 for the hypothetical 1,000-foot well.

(f) Estimated Costs of Further Studies - These will of course vary depending on different viewpoints concerning the urgency of hydrogeological investigations in certain selected areas of the basin. A minimum figure based on the review board discussions is about $100,000. About $75,000 of this would be spent in the southern end of the basin where hydrogeological knowledge is at present sketchy (seismic and gravity exploration - $30,000; one deep test hole - $20,000; salaries and expenses - $25,000). Another $10,000 would be required to drill shallow test holes for better definition of the hydrogeological system in the O'Keefe Valley and $15,000 would be utilized to fill in knowledge gaps for the Kelowna, Mission Creek and Coldstream Valleys. The order of priority for these studies is in the order listed.

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4. Conclusions - The significant conclusions of the Groundwater Review Board were as follows:

(a) The total groundwater ~~in storage~~ in the north end of the basin (north of Lake Okanagan) is of the order of ~~80,000~~ 85,000 acre-feet.
(b) The total annual recharge to the main valley groundwater system is of the order of 9,000 acre-feet.
(c) Volumes of groundwater equivalent to those obtainable through diversion are not available on a sustained basis. Groundwater is adequate to meet most local, municipal, irrigation and domestic demands.
(d) Capital costs for a typical 1,000-foot well to produce 1,000 U.S. gpm could range from $25,000 to $50,000. Power costs for the same well would run about $2.50 per acre-foot per day.
(e) Further hydrogeological studies could cost an estimated $100,000. In order of priority they are:

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| Southern Okanagan Valley | $75,000 |
| O'Keefe Valley | 10,000 |
| Various other sites | 15,000 |
| | $100,000 |

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