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DEPARTMENT OF LANDS AND FORESTS

WATER RIGHTS BRANCH

SURFICIAL GEOLOGY AND GROUNDWATER RESOURCES OF PARTS OF THE SAANICH PENINSULA

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SYNOPSIS

The surficial geology of the Saanich peninsula north of Mt. Douglas is discussed, the distribution of various surficial deposits being shown on the accompanying map. Areas where rock is at surface or where it is covered only by a thin veneer are not included. Important aquifers consist of Pre-Vashon sand and gravel present in a number of places. These usually occur as terrace like deposits against ridges of rock. Significant zones of this sand and gravel are described individually and rough estimates are made of possible yields of water. These estimates indicate that significant amounts of water might be obtained. Development of these aquifers would probably affect present water users, most of whom are using overflow from the aquifers. More data should be collected on geology and aquifer performance to enable a more complete evaluation of possible water supply to be made. Artificial recharge should be considered if further investigation shows that natural recharge is insufficient.

Introduction

The data from which this report and map are composed are a compilation of data gathered by Hugh Nasmith in 1951 and by the writer in August 1961. The well records are almost all Nasmith's the surface mapping is entirely by the writer.

A field trip with Mr. E. C. Halstead and Dr. J.E. Armstrong of the Geological Survey of Canada near Nanaimo in July was very helpful in giving the writer some background information on Pleistocene geology of Vancouver Island. Half a day was spent on the Saanich Peninsula with Mr. Halstead in August in visiting several of the better sections in gravel pits and at Cowichan Head.

Nasmith's data were all plotted on a 1 in. = 1000 ft. contoured base map before the surface mapping was started. This area is covered by G.S.C. Memoir 36, Geology of Victoria and Saanich Map Areas by C.H. Clapp, 1913. This report and maps were very helpful.

Water occurs in Pleistocene and recent unconsolidated sediments and also in fractures in bedrock. This report is concerned only with the groundwater possibilities in the Pleistocene and recent deposits.

It is evident from the map that the mapping does not cover the whole Saanich Peninsula and that most of the field work was done in areas most heavily populated and where Pleistocene deposits have an appreciable thickness.

Geology

Pleistocene glacial and interglacial sediments overly a very irregular bedrock surface with a relief of over 1000 ft. In this area where the bedrock surface is above about 400 ft. it has little or at best an intermittent cover of overburden, mostly till. Rock outcrops also in numerous areas down to sea level.

At least 4 periods of glaciation are known in the Puget sound area and also in the Fraser Valley. In the Saanich area there is evidence of at least 3 and in two places possibly a fourth. It is not possible to correlate the glacial episodes of this area with those of the Fraser Valley, Puget Sound or the Nanaimo area with certainty although some evidence for correlation is presented below. The stratigraphic section in the Fraser Valley taken from the work of Armstrong, Brown, and Halstead is given below in much simplified form with possible correlation with members observed on the Saanich peninsula.

The best correlation is between the Vashon till in both areas. This is the most widespread till and it overlies topography formed on older deposits during the post Quadra erosional intervals. The other correlations are rather uncertain.

In his work Clapp considers only 2 glacial episodes the Seymour and the Vashon. He did not distinguish stony clay, deposited from floating ice, as a separate sediment type. In his stratigraphic section Clapp puts all the marine clay below the Cordova sand and gravels whereas the present work indicates that there are at least 3 marine stony clays, the one above the Vashon till being by far the most widespread.

The till of the Seymour glaciation was not seen in this area although an old till is mentioned by Clapp in his report on Victoria. This however could be either the Semiamu till or the Seymour till.

The lowest part of the section seen is exposed along the shore bluffs near Cowichan Head. Here a blue-grey stony silty clay with numerous shells and shell fragments occurs from about 10 ft above sea level to below low water level. This material is typical marine drift and its presence

PLEISTOCENE STRATIGRAPHIC SECTION, FRASER VALLEY WITH POSSIBLE CORRELATION, SAANICH PENINSULA

FRASER VALLEY		SAANICH PENINSULA
Name	Type of deposits	Type of deposits
Sumas (glacial deposits related to valley glaciation)	till, marine and non-marine sediments	till-like material above buried soil Mt. Tolmie till overlying Vashon stony clay - Sidney Airport?
Vashon (deposits of last ice sheet glaciation)	recessional outwash, stony clay, till, advance outwash	recessional outwash (Colwood), stony clay, till, advance outwash
Erosion interval - - - - - -	- - - - - - - - - - - - - - - - - - - -	Erosion Interval - - - - - - - - - - - - - - - - - - thick sand and gravel (called Cordova by Clapp)
Semiamu (glacial deposits)	till and glacio-lacustrine deposits	stony clay and till
Erosion interval - - - - - -	- -	- -
Quadra (intertill, probably interglacial sediments)	marine and non-marine sediments	marine silt.
Seymour (deposits related to glaciation)	till stony clay	stony clay, till?

implies an older till which, if it occurs at this locality, is below sea level.

Abruptly overlying this is about 30 ft of bedded compact sandy silt which is brown when wet and a light blue-grey when dry. On bedding planes it has a shiny appearance when dry apparently due to the presence of micas or other platey minerals. In one place on the bedding planes to this silt shows remarkable sinusoidal lines which are believed to be tracks of marine animals indicating a marine origin. From its position in the section this is correlated with the Quadra sediments of the mainland, possibly an equivalent of the Nicomekl silt.

Disconfommably overlying the silt is a very bouldery unsorted bed up to 6 ft thick which is missing in many places or may be represented only by a thin bed of boulders. This is believed to be a till and is tentatively correlated with the Semiamu till of the Fraser Delta. Overlying the till is blue-grey stony silty clay with shells up to about 25 ft thick. The shells are most plentiful in the upper part of this bed. This is believed to be the marine drift associated with the Semiamu till.

Over the stony clay is bedded sand and gravel up to about 40 ft thick in this locality. This material shows cross bedding, festoon bedding, channelling etc. This material is quite obviously non-marine in origin so the change from a marine stony clay to non-marine sand and gravel must represent a considerably time interval probably the post-Semiamu erosional interval. This sand and gravel horizon is believed to be the one which reaches such great thickness (over 100 ft) in the gravel pits at Cordova Bay and Keatings Cross Road.

The sand and gravel is overlain by compact sandy till up to about 25 ft thick. This till is very widespread and underlies much of the Saanich Peninsula. It seldom contains large boulders and seldom has much clay. It is conformable to present topography and may be seen to truncate bedding of underlying gravels in a number of places, indicating an erosion interval between the underlying gravels and the till. In a few places the contact with the underlying gravel is almost gradational; in these localities up to about 10 ft of diry unsorted advance outwash is thought to be present. This gradation is believed to be more apparent than real and may be due to the great similarity of the overlying sandy till and outwash (?), and underlying sandy gravel from which the till was, no doubt, derived. This till has been correlated with the Vashon (Surrey) till of the mainland because of its widespread distribution, because it conforms to present topography, and because it is the uppermost widespread till.

The till is overlain by up to 10 ft of stony clay. This stony clay differs from the stony clays already described in that it has a brown (oxidized) colour in contrast to the blue-grey of the others, it shows a very dark brown to black stain on fractures and in it the shells have been almost completely leached out leaving only casts in contrast with the fresh shells of the other stony clays. This extends to an elevation of about 250 ft in this area.

The stony clay is in some places overlain by a veneer up to about 3 ft thick of gravel believed to represent a beach developed by the sea as the land was uplifted following Vashon glaciation. A number of well defined beach terraces have been developed especially southwest of Sidney. These may show up to 15 ft of beach sand at the edge of the terraces. These terraces are only poorly developed south of the Sidney area.

In the gravel pit at Mt. Tolmie, which is located in a tail of a crag-and-tail like form, thin sandy Vashon till overlies intricately bedded sand and gravel as desdribed above. The till has a thin minutely bedded grey sandy silt layer at the top overlain by up to 6 ft of sand and gravel upon which is developed about 1 ft of dark soil. This is in two places overlain by an unsorted sandy till-like material up to about 6 ft thick

on which present soil is developed. This till-like material is uncompacted in comparison to the Vashon till.

This buried soil must represent post-Vashon time interval after which some agency deposited the till-like material overlying it. This could represent the time between Vashon and Sumas glaciations. However, all evidence is against a widespread Sumas Glaciation in this area and it is difficult to see how a small hill-like Mt. Tolmie could have carried a local ice cap.

In a well exposed road cut on Mills Cross Road, north of the Pat Bay Airport, material which is almost certainly a sandy till overlies a brown stony clay believed to be the upper stony clay. This occurs at the top of a small drumlin-like hill and could be explained as having been deposited by floating ice which became grounded on the small hill already covered with stony clay or as a mass of till dropped from floating ice. On the other hand it may be evidence of post Vashon glaciation although a source for such a glacier in this area is not apparent.

A problem arises in this area which does not occur in the Fraser Valley or on the east coast of Vancouver Island further north. This concerns the origin of the thick gravel beds (Cordova) below the Vashon till. In areas near high mountains one may propose a normal sedimentary origin during pre-Vashon time. Here however, the very thick section of coarse gravel occurs, as in the pits near Keating Cross Road, near the height of land with the only possible sources are many miles away across deep marine basins, much too far away to act as a source of this material. Unless we are to call on such ridiculous conveniences as late Pleistocene offshore mountain ranges the only source would seem to be thick ice. If ice was the source it could be Vashon advance outwash. It is difficult to see how it could be Semiamu recessional outwash as the stony clay associated with the Semiamu till implies that the land was below sea level and the ice was wasting away while floating in the sea. It is possible that a late Semiamu advance from Vancouver Island could, after uplift had commenced, have served as a source for this material. This is in some ways more likely than a Vashon advance outwash because the Vashon till truncates these deposits implying erosion between the times of deposition of the gravel and the till which would hardly be the case with advance outwash and till of the same glacial episode. In any case if the writer's interpretation of the section at Cowichan Head is correct this sand and gravel, called Cordova by Clapp, cannot be correlated with the Quadra sediments of the mainland and the east coast of Vancouver Island.

An examination of air photos shows a number of rather distinct glacial land forms most of which fit in fairly well with the surficial geology. A number of drumlins occur; these are formed of Vashon till and are, in some cases, buried by the upper stony clay so that they are not as distinct as one might expect. Several patches of irregular pattern are believed to be pitted outwash also buried by stony clay. The puzzling features are the large, long, north-south trending ridges occurring in several places. Several are probably crag-and-tail features but others have a core of pre-Vashon sediments with Vashon till deposited over the top and sides. The alignment and shape implies that they were moulded by moving ice but it is not clear why such pronounced ridges were formed. These ridges form the best aquifers of this area.

A sinuous ridge followed by the West Saanich Road from Keating Cross Road to Wallace Drive is believed to be an Esker buried by stony clay. Well records show this ridge has a gravel core tending to confirm this interpretation.

Groundwater

From the above description and discussion it is apparent that there are several possible aquifers in this area. The most important high

yield aquifer is the pre-Vashon Cordova sand and gravel which is thick enough and permeable and porous enough to yield large amounts of water. The floor of this aquifer is usually unknown but may be rock or any of the underlying stony clays. It may be confined above by the upper stony clay to give artesion conditions in some places.

The Vashon till in spite of being quite compact is an important low yield aquifer in which many domestic wells are located. At first impression this material does not appear to be permeable but water may be seen flowing through it at McHattie's gravel pit on Keating Cross Road and several wells which are known with certainty to be in this material yield small amounts of water. This fact is important not so much as far as its role as an aquifer is concerned but in permitting recharge of the underlying gravels or in transmitting water slowly over rock and under the upper stony clay which blankets much of the area below about 250 ft elevation. If this widespread till were impermeable recharge of the important gravel aquifers would be very limited indeed.

Areas blanketed by the upper stony clay probably do not allow recharge of underlying material unless the clay is thin and soil development penetrates it completely. This may be the case where it is less than 3 feet in thickness. It is, incidentally, quite a bit thinner on slopes and at higher elevations than in broad flat valleys where well records indicate that it may be over 40 ft thick.

In some places marine beach erosion during uplift may have removed the stony clay from the more exposed locations and in some cases has removed the Vashon till also especially where it is thin. Such conditions probably prevail at lower elevations south and west of Sidney.

The beach gravel which is present in some areas is also helpful in retaining precipitation to allow recharge and may serve as an unimportant aquifer in areas where it is faily thick. This gravel probably does not exceed 5 ft in thickness except in very limited areas.

Groundwater is not being used except for individual domestic supplies to any great extent on the Saanich Peninsula. The only large users are McIntyre and Harding Gravel Pit at Cordova Bay, Butler Bros. Gravel Pit at Keating Cross Road, Saanich Municipality (intermittent), town of Sidney, Brentwood Water Works District, and a few farmers who use the water for irrigation. Stewart's well, owned by the R.C.A.F. is also in this aquifer but is not in use at the present time. In the case of the gravel pits most of the water is recharged in the pit during the dry months.

In most cases these developments have utilized known springs or use wells located adjacent to known springs. During the war the R.C.A.F. drilled 50 ft holes for water in this area in an effort to obtain a supply for the air station at Sidney. Only two of these holes were successful one being Stewart's well which is drilled at a known spring, the other near existing wells located near Sidney. It is difficult to see how 50 holes could be drilled in this area without a better success ratio but some were drilled in areas of stony clay where rock is known to be at shallow depth and these had only slight chance of success; several others were for foundation tests. The most productive areas have been along the flanks of the long ridges which, in most cases, are marked by spring lines. Here if the stony clay is present local artesian conditions often prevail. When wells are drilled or dug well down into the aquifer especially where gravel beds or lenses are encountered the yield may be very high. A number of farmers are irrigating at a rate probably about 30 gpm from 3 ft diameter dug wells penetrating the water table about 4 ft and are able to pump for days at a time with less than 2 ft drawdown. In such a situation a properly developed wells penetrating well below the water table should be capable of a very large yield.

The present use of groundwater in the good aquifers is mostly

utilization of the overflow and in a number of places part of the water is going to waste. In general, any water from the aquifers which gets above the upper stony clay has little if any chance to get back to an aquifer and thus goes to waste. This situation occurs along the west side of the valley between Cordova Bay and Saanichton and at the head of Hagan Creek. In both places water from the gravel aquifers is discharged by springs and runs over the top of the upper stony clay to waste except for the part used by local farmers for irrigation.

The map with this report shows by colours the material exposed on surface and by shading the probable presence of the pre-Vashon (Cordova) sand and gravel below surface where it is believed to have a reasonable thickness. The Cordova sand and gravel is shown because it is the most important aquifer in this area. Notes indicate areas where well records or other information indicate that rock is fairly close to surface. Glacial land forms such as drumlines, kames, and pitted outwash are also indicated by notes. These land forms have been plotted from air photographs.

The aquifers may be considered individually.

(a) Cordova Bay aquifer. This aquifer extends approximately from the north side of Mt. Douglas to Saanichton and perhaps beyond. This ridge is actually a terrace like feature against rock on the west side. Intermittent outcrops along the east side of Elk Lake, along the east side of Bear Hill and well records further north show that the thick sand and gravel of this aquifer is on the east side of a rock ridge. The McIntyre and Harding gravel pit and several other smaller pits in this area show that there is about 80 ft of gravel over a thick (about 50 ft) sandy section which probably overlies pre-Vashon stony clay or till. The gravel which is horizontally bedded, with much small scale cross bedding, is overlain unconformably by a blanket of Vashon sandy till which probably averages about 15 ft in thickness. In some places , particularly along the steep slopw facing Cordova Bay, this till is absent probably having been removed by marine erosion. Stony clay is absent over most of this area. As stated previously the writer believes that the Vashon till does not impede recharge to any great extent when it is covered by soild and vegetation. The recharge is entirely from rainfall. There has been much speculation in the past about whether part of the recharge may be from Elk Lake. Mapping shows a ridge of rock outcropping east of Elk Lake along most of its length and the writer believes that this ridge of rock is probably continuous although buried along the entire east side of the lake. Data on the slope of the water table here during the dry time would also help to clear up uncertainty on this point.

With such a long narrow aquifer any attempt at estimating the possible yield of groundwater should be made on a per unit length basis. We may assume that recharge is only from rain falling directly on the aquifer which is probably a conservative assumption especially at the south end where higher areas like Bear Hill may feed this aquifer with runoff from the rock surface. For purposes of making a rough guess the average known width of the aquifer is probably about 2500 ft. Assuming that recharge is 30% of a rainfall of 2½ ft per year a recharge of about 75×10^6 gallons per year/1000 ft of length is obtained. The total length of this aquifer is about 35,000 ft. Most of the water being charged into this aquifer is now running to waste from springs along the foot of the slope from Cordova Bay to Saanichton. There is virtually no information available on the water level in this aquifer. The only place where any information is available on water levels is near the spring line where the water table is nearly constant. To gain any idea of the potential of this aquifer observation well data are needed some distance west of the spring line.

(b) Keating aquifer. This is a thick terrace like deposit of gravel and underlying sand as at Cordova Bay around a buried rock hill located south and to a lesser extent north of Keating Cross Road between Oldfield Road and West Saanich Road. An excellent exposure of the gravel may be

seen in the Butler Bros. Gravel Pit. The gravel is almost entirely covered by a blanket of till and to the north also by stony clay over till. Artesian conditions exist where the gravel passes under the clay at the west end of Keating Cross Road and may extend eastward where no information is available.

The main users of water from this aquifer are Butler Bros. Gravel Pit and Brentwood Waterworks District. During the period between about January and June, Butler Bros. let the water used to wash gravel go to waste. During the summer and fall the water is recharged in the pit. From January to June the pit, according to Mr. Butler, uses 80,000 gallons per day (1 shift). If we assume 100 days operation this is 8×10^6 gallons. Some water is removed during the time of recirculation by removal of wet gravel, mixed concrete, evaporation etc. According the Mr. Butler the use in the wet season has little effect on the water level, but heavy pumping by Brentwood lowers the level in the pit during the fall. Brentwood uses a maximum of about 75,000 gallons per day during the summer. An inspection of the area late in August by the writer showed water flowing from springs north of Keating Cross Road.

Total yearly use is probably in the order of 25×10^6 gallons. If we attempt to estimate yield using assumptions like those used in the discussion of the Cordova Bay aquifer and an area of recharge of 2000 ft x 4000 ft a yield of about 35×10^6 gallons per year is obtained.

(c) Sand and Gravel at the head of Hagan Creek. Another significant aquifer is located around the head of Hagan Creek west of Saanichton. This is considered to be distinct from the Cordova Bay aquifer which runs this far north as there is evidence of a buried rock ridge running north in this area separating the sand on the Saanichton side from that on the head of Hagan Creek. Overflow from this aquifer is the main source of Hagan Creek during the summer and fall. The sand is blanketed with till and in the Hagan Creek valley, also with stony clay. Artesian conditions occur where the clay covers the sand. The only use of the water in this aquifer is by a few farmers who irrigate from wells and by the R.C.A.F. who owns Stewart's well, an artesion well at the head of Hagan Creek. This well is connected to the Elk Lake pipeline. Overflow from this aquifer forms Hagan Creek and is used by farmers having water licences on this source. It is reported that any extensive pumping at Stewart's well causes a drop in Hagan Creek.

The extent of this aquifer and the area involved in recharging it are not well defined by available data. Sources of recharge are rainfall and drainage from part of the large clay flat east of Brentwood which runs over sand and gravel in the small intermittent creek running into Hagan Creek. It may also receive water from the east slope of Mt. Newton. Making the former assumptions and including no water from Mt. Newton and only a small area of the clay flats to the south a possible yield of about 85×10^6 gallons/year is obtained. The overflow of Stewart's well and Hagan Creek at the well in September was estimated by the writer at about 150 gpm which would, without allowing for increased flow during the rainy season, come to about 75×10^6 gpy. Thus the calculated yield appears to be quite conservative.

It might be possible to increase the recharge of this aquifer south of Stewart's well by improving recharge conditions of the portion of Hagan Creek between Wallace Drive and Stewart's well as this valley is apparently a pre-Vashon valley and is partly blanketed by till. This would cut down on the flow during the rainy season and could possibly increase the flow during the dry season if the water were not used by wells.

(d) Sidney aquifer. This aquifer is located southeast of Sidney along the slope below, and northward from, the Dominion Experimental Farm. Here the conditions are similar to those described for the other aquifers except that marine erosion, which has produced a number of distinct terraces in this area, has apparently removed the stony clay, till, and probably also much of the sand in certain areas. The total thickness of the sand aquifer is estimated to be less than in the areas described above but no data are available on this. Certainly the sand pinches out rapidly eastward toward the shore and northward toward the airport.

The main users of this aquifer are the town of Sidney which owns several wells and a spring, and a number of small farmers who use water for irrigation. The experimental farm uses Elk Lake water for irrigation which may contribute a small amount to recharge of this aquifer. As with the other aquifers this one also overflows at a number of springs along the foot of the slope. Recharge is almost certainly from the northeast slope of Mt. Newton which has a dense cover of bush. The Sidney system is not completely metered but the portion pumped from the wells near the highway is over 30×10^6 gpy. The spring which is believed to be above the upper limit of the sand and is therefore not receiving water from the aquifer probably contributes an equal amount to the Sidney water supply.

(e) Sand north of Airport. An interesting potential aquifer is the sand showing in the gravel pit north of the Airport. This sand was drilled for the R.C.A.F. by Mr. Godwin of Sidney who reports that it is 60 ft thick and was saturated for most of this thickness. The extent of the sand as shown on the map, is estimated from information supplied by Mr. Godwin who drilled a number of other holes in that area.

This aquifer is of particular interest because the Patricia Bay - Deep Cove area to the northwest is relatively densely populated and is very short of water having to rely on a number of small capacity wells drilled in clay, till, and rock. This aquifer would seem to be the nearest one to the area mentioned above. Using the former assumptions for recharge this aquifer is estimated to have a yield of about 35×10^6 gpy. If we assume a saturated thickness of 30 ft and 20% porousity this sand area would hold about 300×10^6 gallons. If further investigation indicates insufficient natural recharge this would seem to be a suitable location for an artificial recharge scheme using winter runoff from the airport area, Mt. Newton, the Gloake Hill area to the north, or overflow from the Sidney water system.

Conditions here appear to be favourable for a geophysical investigation. For the Gish-Rooney resistivity method, 2 and 3 layer situations would be presented, 2 layers when considering the sand and underlying material (probably rock) or for clay and thick sand and 3 layers when clay, sand, and underlying material are considered all together. By this means the extent and thickness of the sand and the extent of the overlying clay might be determined.

(f) Cowichan Head aquifer. The ridge along the east shore running from the East Saanich Indian Reserve to Cowichan Head is a potential aquifer although data on this area are rather sparse. As mentioned in the section on geology, the complete section is present in this area and it includes at least one sand and gravel horizon capable of serving as an aquifer. This gravel as exposed on Cowichan head is fairly high above sea level and much of the potential recharge area is covered with a blanket of stony clay which is quite impervious and would, therefore, impede recharge. In August when this area was mapped there was virtually no water flowing out of the gravel horizon along the beach near Cowichan Head. It is possible but rather unlikely that the dip of the impervious beds under the gravel is away from the shore and that discharge is not toward the sea. From meager data on this area it is quite porbable that recharge is small and that the sand and gravel is topographically high, is highly permeable, and drains rapidly to waste. A few well records show that wells in this area are not very productive.

(g) Northwest Elk Lake aquifer. Another aquifer, probably of limited extent, exists along the northern part of the west shore of Elk Lake and is probably one of the main sources of Elk Lake during the dry months. Water from this aquifer is being used by Mr. Oldfield for irrigation near the corner of Oldfield and Brookleigh Roads. Here a bulldozer trench exposes gravel at the foot of a slope. A large flow of water from this trench flows into a pond from which part of the water is pumped for irrigation, the rest running eventually to Elk Lake. Near this location large springs along the old railway grade run into Elk Lake. Mapping and a few well records indicate that this aquifer does not extend any distance to the south

where a thin layer of till covers a rock ridge. It is not apparent where this aquifer is being recharged.

(h) Brentwood esker. The ridge, believed to be a buried esker, under West Saanich Road east of Brentwood serves as a limited aquifer for domestic wells in that area. As recharge is limited by the overlying clay the yield of this source is very limited.

(i) Miscellaneous small aquifers. In addition to the aquifers described above, the valley of Tod Creek which runs northward to Brentwood has numerous local aquifers some of which supply appreciable quantities of ground water. The valley seems to be blanketed with stony clay probably up to about 225 ft elevation which is overlain by peat in some of the valley flats. This situation produces artesian conditions in parts of the valley. The underlying material, however, is probably mostly till having limited permeability, so that these wells are not very productive.

The only source of ground water in rock which may have some importance in the area covered by this investigation is the old quarry along Tod Creek about 3/4 mile southeast of Brentwood. This old limestone quarry about 100 ft wide and several hundred feet long is reported to be about 80 ft deep. It is full of clear water which is being used by a number of houses owned by Butchart's Gardens and the B. C. Cement Co. The Brentwood Water Works District has recently applied for a licence on this source also.

At the beginning of September the water stood about 3 ft below high-water mark. The quarry is well situated for recharge from the bush-covered hill to the east. A number of springs exist just to the south where old machinery foundations and a small clay pit have cut into the stony clay which blankets the valley so recharge may occur in part beneath the clay from the hill to the west. The limestone may be more permeable, due to solution channels, than the volcanic rocks of this area and may channel groundwater from fractures in other rock types into the quarry area. In any case this quarry could be tested for yield by standard pump test procedures.

Conclusions

Important sources of groundwater are present on the Saanich Peninsula in a number of separate aquifers which are in all cases composed of pre-Vashon sands and gravels. Conditions for natural recharge seem favourable. Data available are insufficient to evaluate these aquifers but preliminary estimates indicate that they are capable of yielding important quantities of water. Use of groundwater in this area is very limited, most of the local supplies used, being overflow from the aquifers. Future development of several of these aquifers will affect this overflow.

Recommendations

The above discussion, particularly the attempted evaluation of the various aquifers, is obviously based on very meagre data. Every effort should be made to obtain data on aquifer yield and performance and to assemble more geologic information as this becomes available. Arrangements have been made with Mr. Godwin of Sidney to obtain logs and estimates of yield for about 700 wells which he has drilled in this area, most of these being on the Saanich Peninsula. Many of these are in rock but in these cases his records show the type and thickness of the overburden, which information certainly will add to the data assembled in this report. In each well log Mr. Godwin has made an estimate of probable yield by a simple bailing test. This should give further information on aquifer performance.

If and when the capacity of the Elk Lake water supply is reached a more detailed inventory of ground water resources should be made, together with an economic study of the use of ground water versus the import of surface water to this area to supplement the Elk Lake supply. The feasibility of artificial recharge projects should also be considered at that

time.

Further data should be assembled on the aquifer on Mills Cross Road north of the airport to evaluate its usefulness as a source of water in the Pat Bay - Deep Cove area. Artificial recharge should be considered here.

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EL/pd

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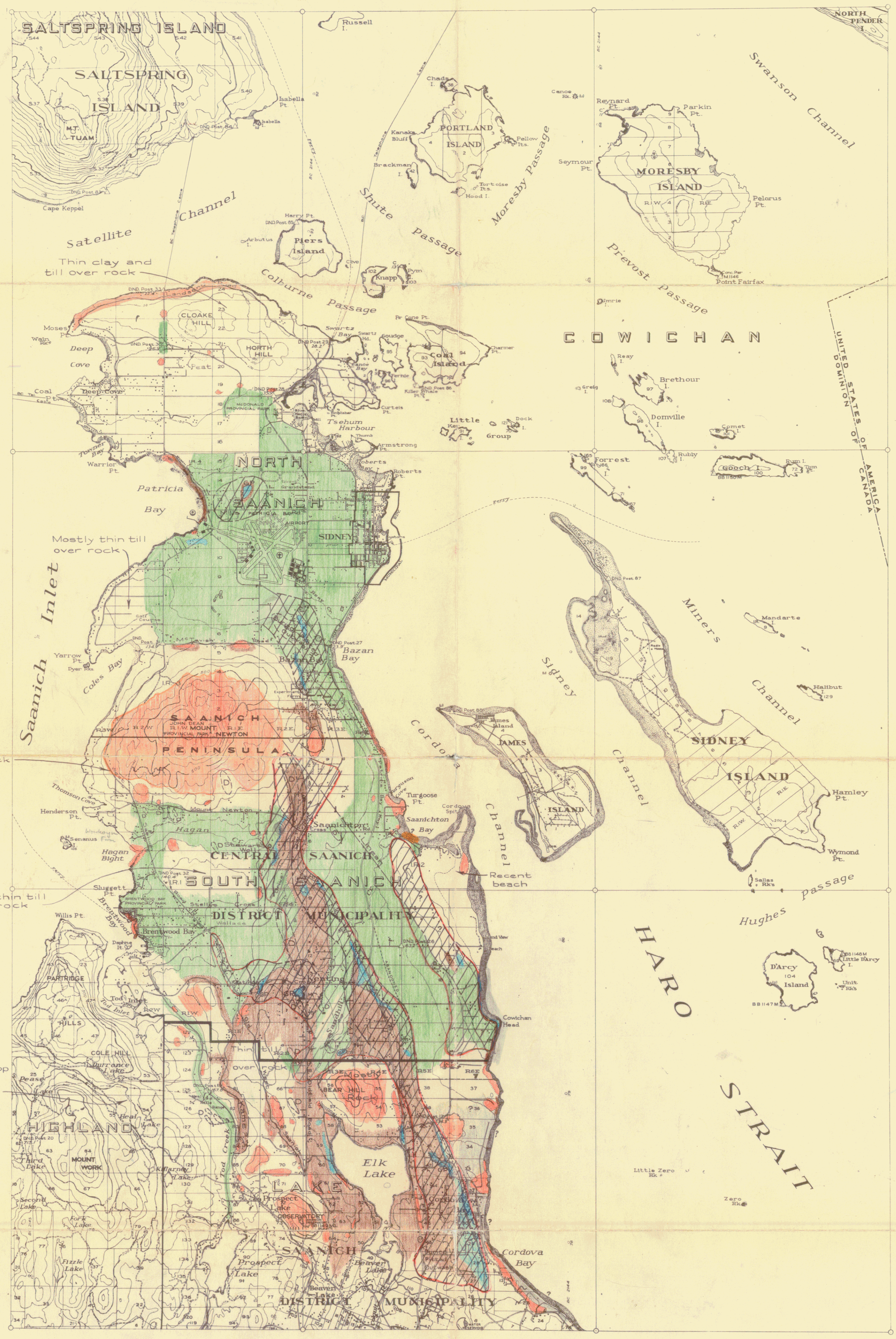

LEGEND

GP GRAVEL PIT

D DRUMLIN

VASHON
- SILTY, STONY CLAY, BROWN
- SANDY TILL

PRE-VASHON
- SAND AND GRAVEL
- SILTY, STONY CLAY, GREY WITH SHELLS
- TILL

ROCK AT OR NEAR SURFACE

ESTIMATED EXTENT OF AQUIFERS

BRITISH COLUMBIA DEPARTMENT OF LANDS AND FORESTS WATER RIGHTS BRANCH
GROUNDWATER INVESTIGATION
TO ACCOMPANY REPORT ON SURFICIAL GEOLOGY AND GROUND-WATER RESOURCES OF SAANICH PENINSULA
SCALE 1:50,000 DATE SEPT. 1961
GEOLOGICAL ENG.
FILE NO. DRAWING NO. 4385 Revised Dec 62