



T. J.C. Foweraker, Head
Groundwater Section
Hydrology Division
Water Investigations Branch

Date: July 27, 1979

File: 92 B/14

Re: Groundwater and Surface Water Problems,
North Pender Island

As requested I have briefly reviewed the status of groundwater and surface water studies completed and presently being undertaken by our Branch on North Pender Island. Information on these studies has been obtained from C.H. Coulson, Head of the Surface Water Section, R.N. Nordin and B.J. Kangasniemi of the Environmental Studies Division and from files of the Groundwater Section. Mr. R. Pollard of the Community Water Supply Division was also contacted regarding analyses carried out by the Water Rights Branch on water supply and sewerage systems on Pender Island. Background information on proposed island by-laws etc., was obtained from T. Roberts of the Islands Trust. This memorandum summarizes this information and provides some recommendations on possible future groundwater and surface water studies which might be considered for the island.

Previous Work and Background Information

Previous studies on Pender Island for the most part have centered on specific problem areas which have been outlined below. Location of these areas are shown in the accompanying map of the island.

A. Magic, Buck and Roe Lakes

- March 11, 1977 - Marc Holmes, Chairman of the Islands Trust in a letter to Mr. Nielsen, Minister of Environment requested that the Ministry "undertake the necessary studies to determine the exact nature and extent of the problems facing the lakes".
- preliminary examination of algae and water lily problems by the E.S.D. according to Holmes was based on incomplete data and he felt, "it would be desirable if thenecessary additional work could be done to provide a complete analysis of present conditions of both Buck and Magic Lakes to assess any potential danger to the lakes which might result from further residential development".
- April 6, 1977 - J. Wiens, Pedologist with E.S.D. reported to R.J. Buchanan on the situation at Magic and Buck Lake and recommended that further studies should focus on answering specific questions on the lakes and undertaking, "selected, limited observations/analysis to gain a somewhat better understanding of

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the situation and support intuitive (common sense?) suggestions:

- eg., - map and identify weeds
- identify kind and extent of algae
- water chemistry
- temperature and oxygen profile
- sediment depths and nature"

April 18, 1977 - J.A. Nielson, advised Mr. Holmes that "our present commitments and resources do not allow significant efforts to be directed to the Buck and Magic Lakes area at this time. As time permits, however, my staff will continue to be available to consult and advise on this matter."

May 30, 1977 - At the request of Mr. Brady, a review of groundwater potential in the Magic Lake area was completed by A. Kothut and E. Tradewell of the Groundwater Section. This office review indicated that "from the geology and limited available storage of the bedrock that large quantities of groundwater are not readily available in the watersheds occupied by Buck and Magic Lakes. Estimates are that from 25 to 80 Igpm might be developed on a continuous basis from wells under optimum conditions ... several wells would probably have to be drilled to prove up this potential ... it does not appear groundwater would be sufficient to supply the entire community and at best could only augment the present surface source... possibly 10 percent of the total anticipated requirements."

- a remote possibility mentioned for improving water quality from Magic Lake, "would be to pump from the lake and recharge a shallow gravel deposit in the area ... a detailed field investigation by a geologist would have to be undertaken ... and some test drilling would be required to prove up the feasibility".

March 16, 1978 - W. Obedkoff of the Surface Water Section reported to H. Coulson on the hydrology of Pender (Magic), Buck and Roe Lakes. This report supplied mean monthly inflow estimates to the above lakes for a mean runoff year and a 10-year return period drought year. H. Coulson (pers. comm. July 1979) indicates additional data is now available in the area and these estimates could be refined if necessary.

- April 7, 1978 - Mr. T. Pollard of the Community Water Supply Division completed a comprehensive report entitled, "Review of Water and Sanitary Sewer Systems at Magic Lake Estates, Pender Island". The report outlines several recommendations regarding water supply and sanitary sewage disposal (see Appendix I attached).
- Present Situation - Mr. Pollard's report (pers. comm. R.A. Pollard) was forwarded to the Ministry of Municipal Affairs and Islands Trust and subsequently has been referred to the Capital Regional District.

 - One of Mr. Pollard's recommendations on water supply was to "request the E.S.D. Ministry of Environment, to carry out studies as required with the objective of establishing the existing biological condition of Roe Lake and forecasting its suitability as a drinking water source, vis-a-vis Buck and Pender Lakes".
 - Water quality sampling has been carried out by the E.S.D. during the last 8 to 9 months on Roe Lake (pers. comm. R. Nordin) to determine the suitability for water supply and the results are disappointing as the lake is highly productive, with colour, algae and anaerobic bottom conditions being problems. Mr. Pollard advises there is sufficient quantity of water in Roe Lake but it would require "polishing" treatment for supply.
 - E.S.D. are also currently monitoring Magic Lake for eutrophication and have been during the past year on a continuous basis. Other studies on Magic Lake by E.S.D. (pers. comm. B. Kanganeimi) include visiting the lake on an irregular basis undertaking observations on aquatic vertebrates and mapping areas of eurasian milfoil.
 - According to T. Pollard, the Magic Lake Estates Water Utility is presently operating in receiver-ship.

B. Wallace Point Area (Pender Utilities Ltd. and Neptune Estates Ltd.)

Residents of the Wallace Point area are experiencing water supply problems with the water system, owned by Pender Utilities Ltd. The water system for the 66-lot subdivision is supplied by 7 low capacity bedrock wells and demand requirements are estimated at 2l Igpm (pers. comm. F. Humphrey, Community Water Supply Division).

- August 29, 1978 - Marc Holmes, Chairman of Islands Trust in a letter to Mr. Brady requested staff assistance, "to assist the people of the area in their efforts to locate additional well sites". Part of the concerns for obtaining new well sites was the fact that adjoining property belonging to Neptune Estates Ltd., was under consideration by the Islands Trust under a minimum 10-acre subdivision plan. Residents of the Wallace Point area hoped that potential well sites, right of ways, etc., could be identified and set aside on the Neptune Estates parcel, so that access to these sites would be possible should additional water be required on Wallace Point (pers. comm. D. Morris, 1978).
- September 13, 1978 - H. Curtis, Minister of Municipal Affairs in a letter to Mr. Brady, reaffirmed the concerns in this area and requested particular attention to the Wallace Point problem.
- September 20-22, 1978 - Mr. Brady replied to Mr. Holmes and Mr. Curtis respectively noting that the water system involved was a water utility, administered by the Water Rights Branch under the Water Utilities Act and that the matter has been referred to the Comptroller of Water Rights. Mr. Brady advised further that groundwater studies being undertaken on the Gulf Islands, "are mainly regional in scope and not orientated to site specific studies of individual water systems. The Groundwater Section also has only limited staff and available funding to carry out its existing functions and present commitments and is therefore unable to provide the site specific assistance you have requested."
- September 26, 1978 - In a letter to Mr. Holmes, Mr. Brady further recommended that, "once the water requirements of the subdivision and economic limits of seach are ascertained and following a preliminary hydro-geological assessment of the area, suitable well sites could be selected for test drilling to prove up the desired quantities... we also believe that it would be inadvisable to set aside tracts of land for future groundwater development without ascertaining by drilling and testing if significant groundwater supplies can be extracted from these areas".

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Mr. Brady further pointed out, "consideration might also be given at some future date to undertaking an overall groundwater resource evaluation by a competent hydrogeologist, on the whole area between Magic Lakes Estates and Wallace Point. We believe this study may become necessary in view of possible future subdivision planning for this area, and in view of the groundwater supply shortages we know exist in other areas of the Gulf Islands".

- January 6, 1979 - In a letter to Dr. Foweraker, Mrs. Beatrice A. Lane, Secretary of the Trincomali Property Owner's Association (Wallace Point) expressed concern over the water system and requested a geologist visit the area.
- March 15, 1979 - Dr. Foweraker forwarded copies of our correspondence with the Islands Trust to the TPOA and advised, "unfortunately due to staff limitations and current responsibilities, we are unable to undertake any site specific studies in your area at this time".
- April 5, 1979 - In a memorandum to the Comptroller of Water Rights, F.J. Humphrey of the Community Water Supply Division outlined that a plan for 40, 10-acre lots had been registered by Neptune Estates with the Ministry of Highways for the area adjacent to and west of Wallace Point. No requirements for a community water system were made because of the size of the lots, and the developer was in the process of drilling a well on each lot. Concerned about well interference and the existing situation on Magic Lake and Wallace Point, Mr. Humphrey suggested advising the Islands Trust of these concerns and requesting the Groundwater Section to review the situation.
- May 17, 1979 Dr. Foweraker in a memorandum to Mr. Brady regarding the drilling plans of Neptune Estates advised, "we do not see that this would cause any serious effects on the available drawdown or the yield of the existing production wells of Pender Utilities Ltd. However, we do not know what the effects would be on the utility wells if the demand for water on those

10-acre lots was increased for, say agricultural or for greenhouse purposes." Dr. Foweraker further advised, "we think it would be important for the Islands Trust, Pender Utilities Ltd., and for members of the Trincomali Property Owner's Association to understand that additional wells required to supplement existing supplies (when additional lots are developed within the boundaries of the utility) may have to be sited on land outside the boundaries of the utility. It may be difficult to obtain easements for drilling and sites for well construction once the adjacent lots of Neptune Estates are sold and subsequently developed."

Present Situation - F. Humphrey (pers. comm.) has advised that the owner of Pender Utilities wants to be relieved of the utility unless funds are released for the system. Not all of the utility wells are on line due to pump drive problems. Residents of the area have requested the Capital Regional District to take over the water system, as a special designated area and staff of the C.R.D. are currently reviewing the matter.

C. Port Washington - Hope Bay Area

March 17, 1976 - Hilary Brown, Chairman of the Islands Trust in a letter to Mr. Brady requested to know, "how much further development the groundwater reserves of the northern parts of the island can sustain without degrading the resource or causing existing of future users to drill deeper and deeper wells."

June 30, 1976 - A report completed by G. Harris of the Groundwater Section entitled, "Preliminary Groundwater Investigation of North Pender Island," was forwarded along with a covering memorandum by A. Kohut to the Islands Trust by Mr. Brady in response to the March 17 request. This report indicated from the preliminary model analysis that groundwater withdrawal rates in the Port Washington area and the Hope Bay area appear to be exceeding the natural annual recharge and groundwater mining may be occurring in these areas. It was recommended that observation wells should be established to verify this situation before any future development is planned in the watersheds. Other watersheds in the northern portion of the island showed potential for additional groundwater development.

- July 23, 1976 - In a letter to Mr. Brady, Hilary Brown advised that the Trust had set aside \$2500 for the establishment of an observation well or for carrying out other recommendations (field inventory work) of the June 30 report.
- August 16, 1976 - In a letter to Hilary Brown, Mr. Brady clarified some aspects of the June 30 report pointing out that the figures showing additional groundwater potential should be used with reservation in planning development and a phased approach in conjunction with groundwater monitoring should be considered.
- September 7, 1976 - Mr. Brady advised Hilary Brown that the Groundwater Section would proceed with the construction of two monitor wells in the Port Washington area.
- November 29, 1976 - Following a telephone request with regards to a proposed Land Use Contract, ^{Frank} D. Morris, of the Islands Trust, the Groundwater Section prepared "Preliminary Comments on General Procedures To Be Considered in the Development of Groundwater Supplies Within the Gulf Islands" (see Appendix II attached). This document was forwarded to Marc Holmes of the Islands Trust by Mr. Brady. Mr. Brady pointed out that "the role of the W.I.B. in this matter is solely to provide technical advice on the capability and the preservation of the groundwater resource".
- March 29, 1977 - Drilling of two observation wells in the Port Washington area was completed. The Islands Trust contributed \$3,700 to the final cost and W.I.B. contributed \$1,800. One well was completed adjacent to the coast to monitor the influence of the sea water intrusion under groundwater pumping and the other was sited further inland to monitor water level fluctuations in the recharge area. No analysis has been carried out as yet on the water level data obtained to date due to other staff priorities. One of the wells at the coast shows a potential yield up to 30 Igpm and being perhaps the largest capacity well drilled on the island; the owners of the property are anxious to obtain use of the well. The site agreement with the owner's of the property expires in January 1982.

Possibilities of Future Involvement of Groundwater and Surface Water Sections

Listed below are examples of the type of studies which could be undertaken by the Hydrology Division on the island. Input from the Surface Water Section was obtained from H. Coulson.

1. If required the Groundwater Section could undertake an overview of groundwater conditions on Pender Island similar to studies recently completed on Saltspring Island and Gabriola Island. The previous report on Pender Island, June 1976, encompassed only portions of the northern half of the island. Preliminary studies however are presently being carried out on other Gulf Islands (Hornby, Saturna) and it would be several months (12-18) before an analysis of Pender would be completed. These analyses would probably not produce any positive solutions to problems but would serve to expand groundwater knowledge in the other areas outlining where further potential exists. We do not have a firm understanding of demand versus potential relationships at this time.
2. Investigations could be initiated on examining the feasibility of recharging shallow overburden materials with water from Magic Lake to improve water quality through natural treatment.
3. Test drilling could be undertaken in specific areas to prove up groundwater and prospects for developing production wells.
4. Studies could be carried out on examining the role of major faults on the groundwater regime of Pender Island. Preliminary analysis of fault zones on Gabriola Island for example indicate these linear zones may not be significant recharge areas for groundwater but act as barriers to groundwater flow. They nevertheless do affect the groundwater flow systems.
5. Surface water studies could be undertaken in specific watersheds on the island where there may be storage potential.
6. With regards to logging, D. Reksten of the Surface Water Section suggests, "timber removal in itself may benefit surface water supply temporarily (until vegetation returns to original state) as a result of reduced evapotranspiration; removal of shade, increasing evaporation partly counterbalances this. If harvesting activities result in reduced infiltration by compacting ground surface (e.g., roads, skid trails) recharge to groundwater aquifers could be reduced. Some increase in sedimentation is likely during harvesting activities but impact may be temporary." With regards to groundwater recharge, the upper portions of watersheds are important and these should be protected from uncontrolled development which could cause water quality problems (inappropriate siting of waste disposal sites for example) or disruption of the natural recharge processes through removal of vegetation, soil cover, etc. These latter processes, however, are not adequately understood at this time and the effects of

Logging on the recharge mechanism needs further study. The Islands Trust has applied for jurisdiction to control logging in designated areas of Pender Island (pers. comm. T. Roberts). It might be advisable to have an adequate understanding of the hydrological characteristics of these designated areas and the probable affects development could have prior to restricting logging.



A.P. Kohut
Senior Geological Engineer
Groundwater Section

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RECOMMENDATIONS RE. WATER SUPPLY

1. Any legal options which may be exercised to prevent the use of Buck and Pender Lakes for recreational purposes, while they continue to be used as drinking water sources, should be investigated and implemented wherever possible. In the meantime appeal to riparian lot owners to do everything possible to prevent contamination of the lakes by sewage or other deleterious substances.
2. Appeal to landowners within the watersheds of Buck and Pender Lakes to restrict their land clearing and to use chemical garden fertilizers sparingly.
3. Discharge to a holding tank the wastewater from the softener at the Magic Lake water treatment plant and dump this waste in the sea. Discontinue softening temporarily if and when there is no need to remove hardness or iron, by by-passing the softeners, but first obtain approval from the Public Health Inspector.
4. A gradual decline in the quality of water in Buck and Pender Lakes may be anticipated, with Pender the more problematical. If water quality becomes unacceptable, consult the Environmental Engineering Division of the Ministry of Health for advice on further treatment. Make no changes in treatment plant without Health approval.
5. If and when Pender Lake raw water quality becomes intolerable for domestic use, or treatment of the water (or the Lake) required to correct the problem will be expensive, consider substituting Roe Lake as a source for Pender Lake. If Roe

Lake were used, as a source of domestic water instead of Pender Lake, 2 and 3 above would not apply to the Pender Lake watershed.

6. Request the Environmental Studies Division, Ministry of the Environment, to carry out studies as required with the objective of establishing the existing biological condition of Roe Lake and forecasting its suitability as a drinking water source, vis-a-vis Buck and Pender Lakes. If Roe Lake is considered to be superior in the long term, the study should include recommendations on its management.
7. Request a reserve under Section 45 of the Water Act be placed on the unrecorded water of Roe Lake.
8. Remedy the deficiencies noted under "Water System Deficiencies". Especially check with the supplier on the selection of the Buck Lake pumps to prevent damage to the motors. Not all items in the check list need immediate attention, however.
9. Eventually install water meters on all service connections. Metering not only will conserve water but reduce the load on sewage treatment plant.

Labour	\$1,080
Repairs	100
Power	256
Chlorine and sundries	70
Professional consulting, monitoring and inspection	65
Property taxes	<u>80</u>
Total monthly Operation & Maintenance	\$1,651, or \$5.16 per lot per month.

The water Rights Branch has not estimated the future cost of operation and maintenance of these sewer systems.

RECOMMENDATIONS RE. SANITARY SEWAGE SYSTEMS

In the chapter "Existing sanitary sewage systems" the principal parts of the five sewer systems serving Magic Lake Estates are described. Where deficiencies are evident these have been noted and recommendations made for their remedy. The chapter "Capital Cost of Sewer System Improvements" provides a check list of these deficiencies.

Parts of the collection system which are admitting infiltration should be checked and, where needed, tops should be raised to flush with the road surface level. Tops of other manholes should be raised above the surrounding ground. To improve watertightness of manholes, item 26.5 "Watertightness" of P.C.B. "Guidelines for Assessing Sewerage Works" should be followed, namely "Watertight manhole covers are to be used where the manhole tops may be flooded by street runoff or high water. Manholes of brick or cement block should be waterproofed on the exterior with plaster coating supplemented

by a bituminous waterproof coating where groundwater conditions are unfavorable.

It must be emphasized that, where sewers have been noted to be undersized, this conclusion is based on calculated peak domestic flows plus allowable infiltration. Further, 100% occupancy of tributary lots has been assumed. Provided that infiltration can be successfully prevented, the actual peak flow in sewers may be somewhat less than predicted, especially if all lots are never occupied simultaneously. In any event, it will probably be many years before most of the lots in the sewered areas are hooked-up, judging by the slow pace of settlement in Magic Lake Estates to date. It follows that implementation of some of the recommendations in this report for increasing the capacity of sewerage, pumping facilities and treatment plant may be deferred. Flows in the sewer systems (especially in those parts calculated to be undersized) should be periodically observed to establish when the recommended modifications will actually be required.

PRELIMINARY
CONCERNS ON GENERAL PROCEDURES TO BE
CONSIDERED IN THE DEVELOPMENT
OF GROUNDWATER SUPPLIES WITHIN THE
CHIFF ISLANDS

The following notes are preliminary only and represent some initial thoughts that could be considered by those responsible for the future application and development of groundwater supplies in the Chiff Islands on lots of two or three acres or less. Before any firm proposals can be made however there should be considerable discussion and agreement with leading groundwater consultants in this Province and with Ministry of Health Officials responsible for approval of septic tank and disposal field design and location.

We believe a water supply proposal should indicate the source of supply and whether it will be surface or groundwater.

If groundwater is to be used, then will the supply be based on individual wells located on individual lots or will only one or two community wells be constructed to service a community water system to the subdivision, i.e., will the subdivision water supply operate as a Water Utility. A water supply proposal should clearly indicate the demand requirements for the individual lots and for the subdivision as a whole, also the anticipated supply to be available when developed.

We strongly favour a community well or wells to service a subdivision. Such a well or wells should be tested during the dry summer months for 72 hours and rated as being capable of supplying the required volume of potable water. It may be that more than one well is required to supply the proposed demand. Guidelines for water supply and well testing are obtainable from the Water Rights Branch, Community Water Supply Division. Besides test well drilling and well evaluations based on recognized test procedures, it is also very important to adequately evaluate the hydrogeology and hydrochemistry of the area. If these proven engineering procedures are followed it is then possible to "size" the proposed development to the groundwater that is known to be available.

If the community test well results indicate insufficient supply is available then serious consideration can be given to the alternatives of supplying the subdivision water requirement on the basis of individual wells for each lot. There are however two serious drawbacks to the latter suggestion. Each well may be

individually tested and shown to have an adequate supply, however the combined effect of all the wells pumping may lead to interference and a lowering of the subdivision water table leading to "groundwater mining" problems. Also the number of septic tanks and disposal fields in close proximity to the wells may collectively cause a deterioration of the groundwater quality with time.

Should it be a requirement that the proving up of a groundwater supply be a prerequisite to subdivision approval then the need for pre-testing and evaluation ahead of time is obvious. It is however difficult to assess by presently accepted well test procedures the continued long term adequacy of a groundwater supply (both quantity and quality), based on many small domestic wells operating independently within the subdivision. One suggestion is for a developer to construct two or more observation wells, and to commence a continuing program of well monitoring for both water level fluctuations and for water quality, together with adequate metering of groundwater consumption. However, this monitoring program will be more practical and effective if only one or two community wells are the basis of water supply rather than a great number of individual domestic wells. In the latter case if the subdivision development is approved in phases, there would be adequate time between each phase for assessment of the monitoring data and performance of the wells. In other words this phased development would allow adequate time to assess the impact of the development on the groundwater resource and its ability to supply the concentration of required groundwater without "mining" or endangering the water quality.

Therefore if proving up a groundwater supply is required prior to subdivision approval then we recommend a competent groundwater consultant should be retained by a developer to draw up a realistic proposal for a groundwater supply exploration and development program which will meet the practical objectives of the development proposal. Such a program should include field investigations, test well drilling, well testing and an engineering report. The groundwater consultant must ascertain that adequate potable groundwater exists before subdivision takes place and that long term groundwater supplies are indeed available to supply the areas long term demand, without well interference problems, salt water intrusion, decreases in well yield, excessive lowering of water table with increasing demand etc.

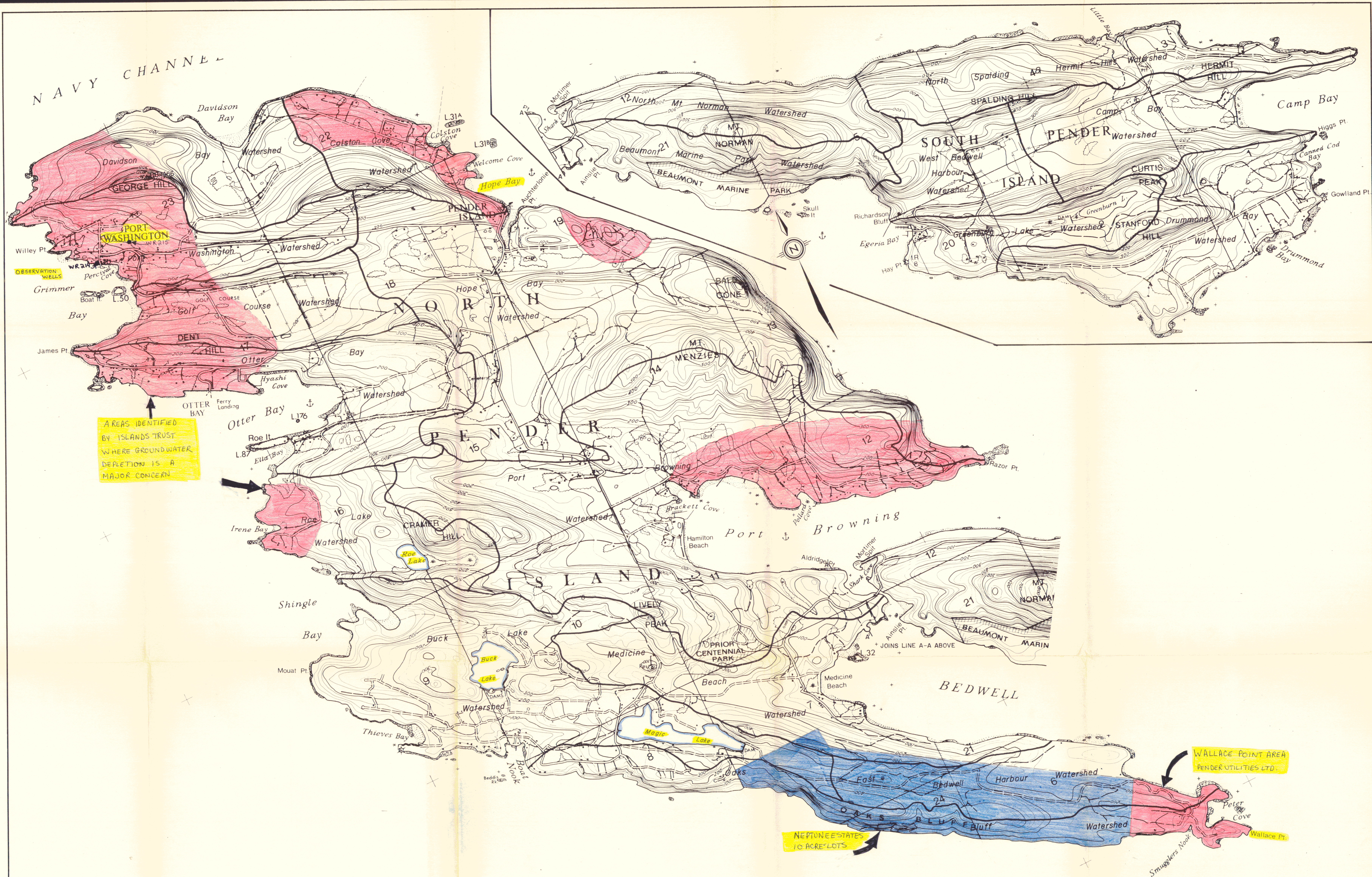
There should also be a close liason between the Public Health Official responsible for the approval of the sewage and disposal field design and the groundwater engineer responsible for the

water supply well sites so that both designs are compatible
w/ long term aims for preservation of groundwater quantity
and quality within the subdivision.

J. C. Poweraker

J. C. Poweraker, Head
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Ministry of the Environment

JCP/dmc



AREAS IDENTIFIED BY ISLANDS TRUST WHERE GROUNDWATER DEPLETION IS A MAJOR CONCERN

WALLACE-POINT AREA PENDER UTILITIES LTD.

NEPTUNE ESTATES 10 ACRE LOTS

Photogrammetric Mapping was carried out by the Survey & Mapping Branch, Lands Service, this sheet being the mapping as on Sheet M 234 Drawing No. M 234.

LEGEND		BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH GROUNDWATER DIVISION	
—	WATERSHED BOUNDARIES	DATE	FILE No. 0239013
		DESIGNED	
		DRAWN W. McInnes	SCALE 1 inch = 1000 feet Contours - 25 feet
		TRACED	DWG. No. FIGURE 5
		CHECKED	SHEET OF
		DATE	
		ENGINEER	APPROVED DIV. CHIEF

**NORTH & SOUTH PENDER ISLAND
WATERSHED MAP**