Province of British Columbia
Ministry of Environment
WATER INVESTIGATIONS BRANCH

MEMORANDUM

To: Mr. A.P. Kohut
Sr. Geological Engineer
Groundwater Section
Hydrology Division

Date: November 20, 1979

File: 92/F

Re: Proposed Vancouver Island Fish Hatchery - Groundwater Supply (Fanny Bay to Campbell River).

INTRODUCTION

At the request of the Fish and Wildlife Branch, a study of the groundwater potential along the east coast of Vancouver Island from Nanoose Bay to Campbell River was undertaken. Due to the large area under investigation, the study was divided into two separate studies. The first study involved a preliminary groundwater investigation of the area between Nanoose Bay and Fanny Bay. A report on this investigation was completed in October, 1979 (filed under NTS 92/F). The second study involved a preliminary groundwater investigation of the area between Fanny Bay and Campbell River. The following report is the result of this second study which includes an office review of available groundwater data such as geological maps, aerial photographs, well records and previous groundwater reports, as well as the results of a field investigation of selected areas.

Figure 1 shows the selected areas in which the groundwater geology, groundwater potential and recommendations for further groundwater exploration or development are discussed in detail. These specific areas were chosen largely on their proximity to surface water supplies which may be available to supplement the potential groundwater source(s) in order to meet water requirements of approximately 30 cfs, as suggested by the Fish and Wildlife Branch for fish rearing.

AREA 1 - TSABLE RIVER

Surficial Geology

Based upon the surficial geology of the area, as mapped by J. Fyles (1960), Figure 2 has been prepared to show the principal areas of sand and gravel deposits that may contain potential groundwater for development. Area A is a delta which is underlain by an unknown thickness of sands and gravels and possibly silt or clay. Area B is underlain by terraced fluvial deposits consisting of sands and gravels and possibly silt or clay. The Tsable River for most of its course flows over bedrock and/or till. During a recent site investigation, it was noted that in some areas, the river had incised about 100 feet into soft, friable shale containing sandstone stringers. It was also noticed that the sand and gravel overburden averaged 25 feet in thickness.

. 2

ark

Well Log Data

There are very few wells that have been dug or drilled in this area. The log of a well located at the ferry terminal at Buckley Bay shows that bedrock was encountered at 56 feet and that the overlying surficial sediments were dry. Another drilled well (abandoned), located next to the highway and the gravel pit just north of the mouth of Tsable River, apparently penetrated bouldery gravel to an estimated depth of 90 feet and produced good quality water. Several low yielding springs occur along the coast, just south of Base Flat (see Figure 2).

Analysis and Recommendations

Based upon limited subsurface data and surficial geology, area A appears to contain a potentially substantial groundwater reserve. Further groundwater exploration by way of drilling and pump testing is suggested. A tentative drill site is located as shown in Figure 2.

Based upon a site investigation and a study of the aerial photographs of the area, the deltaic fluvial sand and gravel deposits (area B) which flank the areas north and south of Tsable River are shallow and appear to be dry. Further groundwater exploration in this area is not recommended.

AREA 2 - TRENT RIVER AND CUMBERLAND AREA

Surficial Geology

Based upon the surficial geology as mapped by J. Fyles (1960), the areas of permeable sand and gravel deposits that may contain potential groundwater for development, have been outlined in Figure 3. Area A is underlain by deltaic sands and gravels of unknown thickness. At the E and N railway bridge crossing, there are bedrock shales exposed along the banks of the river. Upstream of the railway bridge, Trent River is flanked on the south-east side by thin marine deposits and on the north-west side by fluvial sands and gravels which overlie bedrock at depths of between 20 to 30 feet below ground level. Till was also found exposed above the bedrock in the river valley.

Well Log Data

There is a very limited amount of well log data presently available for this area. Shallow dug wells in the delta area (A) have reported yields up to 20 gpm. Drilled wells in the vicinity of area B have estimated yields of up to 40 gpm. Data from one drilled well indicates that the depth to bedrock in the area is less than 30 feet.

Analysis and Recommendations

The deltaic area (A) is of moderate extent and of unknown thickness. Bedrock exposures at the railway bridge crossing suggests that the deltaic deposits may not be thick. Further exploration by way of test drilling would be needed to obtain more data. Based upon the groundwater development potential in other such deltas (such as Rosewall Creek), the possibility

. 3

of encountering a moderately yielding aquifer in the Trent River delta is good. It is recommended that a test hole be drilled between the railway bridge crossing and the highway crossing, next to the Trent River.

In area B, the presence of bedrock along the valley walls of the Trent River and bedrock exposures to the north-west, suggests that the overlying fluvial deposits are not thick. From a site investigation along the valley, the thickness of the surficial sediments was found to be less than 30 feet. No seepages could be seen along the contact between the surficial sediments and the bedrock to suggest that the surficial sediments are water-bearing. In light of the available data at this time, no further groundwater exploration is recommended for this area.

AREA 3 - CRUICKSHANK RIVER AND SOUTH END OF COMOX LAKE

A site investigation of the above areas (see Figure 4) was made recently to ascertain the types of surficial sediments in the areas. The Cruickshank River has incised into the bedrock and flows into Comox Lake where it has formed a small delta. This delta consists of cobbles, gravels and sands which appear to be very permeable. The groundwater potential in this type of deposit appears to be excellent. Further exploration by way of test drilling in the delta would be needed to ascertain the potential.

Where the Puntledge River enters Comox Lake (southern end of Comox Lake), the area appears to be underlain by deltaic and fluvial deposits consisting in cobbles, and silty sand. The area is swampy, which may indicate the presence of clay or peat. Further groundwater exploration in this area is not recommended at this time.

AREA 4 - PUNTLEDGE RIVER - BROWNS RIVER

Surficial Geology

Based upon the surficial geology as mapped by J. Fyles (1960), the potentially good water-bearing sand and gravel areas are as outlined in Figure 5. Essentially, four specific areas have been identified. Area A is underlain by floodplain sands and gravels and possibly silt and clay. Area B is essentially underlain by terraced deltaic deposits containing sand and gravel which is commonly underlain by silt and clay. Browns River has incised into the bedrock for most of its course. Exposures along the sides of the valley indicate that the surficial deposits of sand, gravel and till overlie bedrock. The thickness of the surficial sediments appear to be generally less than 30 feet. The deposits in area C and flanking the Puntledge River are similar to those of area B. For most of its course, Puntledge River flows over bedrock. Similar to the Browns River, surficial sediments (generally less than 30 feet thick) overlie bedrock, along the banks of the Puntledge River. Area D is underlain by an extensive glacio-fluvial sand and gravel deposit, which exhibits terraced, pitted terrace and esker features. North-east of the deposit, Fyles has mapped a landslide feature. In this area, the glacio-fluvial gravel, sand and

. 4

s[illegible] are underlain by clay. At the eastern end of the deposit, there are several large sand and gravel pits which are presently being mined.

Well Log Data

There is a general lack of well log data for the entire area. The available data shows that the majority of known wells are shallow dug wells of low yields.

At the base of the glacio-fluvial deposit (eastern end of area D) there are several springs, one of which is reported to be flowing at 200 gpm.

Analysis and Recommendations

Area A: The thickness of the floodplain deposit north-east of Courtenay River is not known at this time and hence it is difficult to ascertain the potential groundwater in this deposit. During a recent field investigation, it was noted that the area did not appear very well-drained. This undrained feature implies that the area is underlain by silty or clayey sediments. Alternatively, it may imply that the general water table is close to the surface. In any case, further groundwater exploration is required to assess the subsurface conditions. A test hole anywhere in the area is recommended.

Areas B & C: In a recent site investigation, it was noted that the terraced deltaic deposits along the banks of the Browns River and Puntledge River were less than 30 feet in thickness. No visible signs of springs could be seen in either area to suggest that the surficial materials may be water-bearing. On the basis of the available data, further exploration in these areas is not recommended.

Area D: The presence of springs, located to the east of the glacio-fluvial deposit, implies that there is a groundwater flow system probably originating from Comox Lake. The highly permeable nature of the surficial sediments and the presence of many lakes (whose surface may represent the local water table in the area) and the spring discharges at the base of the terraced deposits suggests that there is a substantial amount of groundwater in reserve. Further exploration by way of test drilling and pump testing is recommended, to ascertain the subsurface nature of the surficial sediments and the aquifer parameters. A test hole located along the Comox Lake is suggested.

AREA 5 - TSOLUM RIVER

Surficial Geology

According to Fyles(1960), the only area that is underlain by permeable sand and gravel deposits in the Tsolum River area is the floodplain deposits of the river from Dove Creek to Puntledge River. North-east and south-west of the river, a thin marine-veneer deposit overlies till. Upstream of Dove Creek, Tsolum River flows mostly over bedrock.

. 5

Well Log Data

There are many shallow dug wells in the area between Dove Creek and Puntledge River. Most of these wells are reported to have encountered lenses of sand and gravel within the marine-veneer or till; which generally yield up to 5 gpm. Several drilled wells in the area have penetrated the till and encountered water-bearing sand and gravel zones to depths of 220 feet. Of significance are three wells, located in Figure 6 which have reported yields of between 150 and 300 gpm.

There are also many springs in the area (see Figure 6) occurring between the marine-veneer deposits and underlying till. The flows from these springs are low, but sufficient for domestic purposes.

Analysis and Recommendations

The available subsurface data for the Tsolum River area indicates that the area is generally underlain by till. Proven yields of up to 300 gpm from sand and gravel sub-till zones indicate that at least a moderate groundwater potential aquifer exists in the area. The thickness of the floodplain sand and gravel deposit along the Tsolum River is not known at this time. Further exploration by way of test drilling through this deposit would be required to ascertain the thickness of permeable water-bearing sands and gravels. A test hole at the confluence of the Tsolum River and Puntledge River is recommended.

AREA 6 - OYSTER RIVER

Surficial Geology

Based on the surficial geology as mapped by J. Fyles (1959), the areas of sand and gravel deposits that may contain substantial amounts of groundwater are outlined as shown in Figure 7. Area A is underlain by deltaic sands and gravels of unknown thickness. Area B is underlain by fluvial sands and gravels and till. Upstream and downstream of this area, the Oyster River flows over bedrock. Area C is underlain by terraced fluvial and floodplain deposits consisting mainly of gravel, sand, silt and till. Along its course within this area, Oyster River flows over bedrock. Surficial deposits of cobbles, gravel, and sand are exposed along the banks, and are generally less than 20 feet thick.

Well Log Data

In area A, most of the shallow dug wells have low yields. According to the well logs, it was reported that the water in some of these dug wells contained high amounts of dissolved iron and/or sulfur. At the UBC experimental farm, a shallow dug well was constructed in permeable sand and gravel and presently yields an estimated 50 gpm. Near the old bridge across Oyster River, a 42-inch diameter well was dug to a depth of 16 feet and encountered water at less than 7 feet below ground level. The coarse sand and gravel aquifer was pump tested and found to have a potential yield to the well of 300 gpm, with very little drawdown.

. 6

Some drilled wells in area A have also been successful in obtaining moderate to high yields. A well at the UBC experimental farm, drilled in 1968, near the Oyster River, is reported to have encountered sand and gravel to a depth of 40 feet(?) and was pump tested at a rate of 700 gpm.

The Regional District of Comox-Strathcona have drilled several good yielding shallow wells in the vicinity of the highway bridge crossing and the Provincial park area. No details are presently available except that one of the wells was reported to have a capacity of 375 gpm.

In area B, one drilled well located on the south side of the Oyster River penetrated till to a depth of 100 feet and then encountered sand and gravel to a depth of 107 feet (see Well #4, Figure 7). A pump test of this zone was made, but only 4 gpm was the reported yield.

No well log data is available for area C.

Analysis and Recommendations

The permeable nature of the water-bearing deltaic deposits (area A) and the fact that there is a proven potential of up to 700 gpm from wells located close to the Oyster River indicates that there is a substantial amount of groundwater in the area. Further groundwater exploration and development by way of test drilling and pumping tests is recommended. A tentative test site is located in the area between the two highway bridges at Oyster River (well site #3, Figure 7).

Data concerning the 107-foot drilled well in area B indicates that there is a sub-till aquifer in the area, but apparently of low yielding capacity. Based upon this subsurface data and the surficial geology, it appears that there may be low to moderate groundwater potential from sub-till aquifer(s) in this area. Further exploration by way of test drilling would be required to prove up the potential. Due to the low potential, further exploration in this area is not recommended at this time.

Similar to the Tsable River and Trent River, Oyster River upstream of area B flows across bedrock. The surficial deposits above the bedrock are thin and do not appear to be water-bearing. Further groundwater exploration in this area is not recommended at this time.

AREA 7 - WILLOW PT. CREEK (SWANSKY CR.)

Surficial Geology

According to the surficial geology as mapped by J. Fyles (1959), Willow Pt. Creek is underlain by sandy, stoney and gravelly marine-veneer deposits which overlie ground moraine deposits (till) containing lenses of gravel, sand and silt. North of the airport (see Figure 8) there is a terraced glacio-fluvial sand and gravel deposit which overlies clay or silt. According

t[illegible] study of the aerial photographs of the area, this creek drains extensive marsh lands, which may be local groundwater discharge areas. Bedrock is exposed near the mouth of the creek (along the coast) and a short distance upstream (see Figure 8).

Well Log Data

The majority of wells on record are shallow low yielding dug wells constructed in sand and gravel lenses within till or marine deposits. The drilled well data for this area indicates that clay and/or till to depths of less than 100 feet overlies bedrock. One well, constructed at the airport (Figure 8), encountered water-bearing sand between 49 feet and 67 feet below ground. It was pump tested at 20 gpm.

Analysis and Recommendations

According to the surficial geology of the area, it appears that the marshy lands are underlain by marine silt and clay. The source of recharge to these marshes, other than precipitation, is not definitely known at this time, but may be partly from Quinsam River. In any case, this recharge does not appear to be substantial. Based upon available subsurface data and the surficial geology, the groundwater potential in the Willow Pt. Creek area does not appear to be good. Further groundwater exploration in the area is not recommended at this time.

AREA 8 - CAMPBELL RIVER, QUINSAM RIVER AREA

Surficial Geology

Based upon the surficial geology as mapped by Fyles (1959) and McCammon (1977), the areas of permeable sand and gravel deposits have been outlined in Figure 9. Area A is underlain by recent deltaic sands and gravels which overlie marine silty clay and/or till. Area B is underlain by recent fluvial sand and gravel deposits. Area C is underlain by fluvial sand and gravel deposits which have formed an irregular delta. In this area, bedrock is exposed on both sides of Campbell River. Area D is a sand and gravel delta, formed from glacial outwash. There is a prominent scarp-front facing east that is more than 100 feet high. Gravel foreset beds are overlain by horizontal gravel topsets which form the flat terraced surface of this delta.

Well Log Data

The available well log records indicate that most of the existing wells in the Campbell River and Quinsam River areas are shallow dug wells with low yields. The dissolved iron content in the water in some of these wells is reported to be high (i.e., greater than 3 mg/L). The well logs of several drilled wells (one located north and one south of the Campbell River) indicate that the region around Campbell River and Quinsam River are underlain by a thick (greater than 300 feet) clay and/or till deposit

which contain lenses of sand and gravel at depth. Initial pumping test results indicate low yields from these aquifers.

Analysis and Recommendations

Area A is principally underlain by deltaic sands and gravels and possibly clay and silt. The thickness of the deposit is not known at this time. Shallow wells constructed in this deposit have encountered groundwater at depths of less than 10 feet below ground and have reported only low yields, to date. Further exploration by way of test drilling in the delta is needed to ascertain the thickness of the water-bearing zone(s) and the nature of the subsurface sediments.

Area B, located at the confluence of Quinsam River and Campbell River, is underlain by fluvial sand and gravel of unknown thickness. Near the southern end of the outlined area, there was a well drilled recently to a depth of more than 300 feet, which encountered mostly till, containing some thin sand and gravel zones. Based upon the available subsurface data, it does not appear that the fluvial sand and gravel deposit is of any great extent or thickness. Further test drilling would be required to ascertain the subsurface conditions in this area. A test hole could be located in the provincial campground just west of Quinsam River.

Area C is predominantly underlain by fluvial sand and gravel which overlies bedrock in some areas and clay in the northern portion of the area. A well drilled to a depth of more than 300 feet and located immediately north of the irregular delta, encountered mostly clay. There is no subsurface data for the area just south of John Hart Lake, except that the surficial geology shows it is underlain by gravel and sand. Flintoff Creek appears to originate in this deposit and may be spring-fed. A test hole is recommended in this area to ascertain the thickness and nature of the subsurface sediments in this area.

The large glacio-fluvial delta (area D) east of McIvor Lake contains the largest gravel reserves in the Campbell River area. The gravels are presently being mined at various locations within this delta. At the base of the eastern scarp, there are many springs discharging towards the Quinsam River. The large flows from these springs indicate that there is a large groundwater flow under the delta, most likely originating from McIvor Lake. Further groundwater exploration and development by way of test drilling and pumping tests is recommended. Test holes could be located along McIvor Lake or at the base of the scarp (eastern end of the delta).

SUMMARY

There are many areas between Campbell River and Fanny Bay that may contain substantial amounts of groundwater in reserves. Those areas that appear to have the best potential for further groundwater development to meet the groundwater requirements for a proposed fish hatchery are as follows (in order of priority):

1. Oyster River delta (Area A, Figure 7)
2. McIvor Lake delta (Area D, Figure 9)
3. Tsable River delta (Area A, Figure 2)
4. Confluence of Tsolum and Puntledge Rivers (Figure 6)
5. Comox Lake glacio-fluvial area (Area D, Figure 5)
6. Cruickshank River delta (Figure 4)
7. Trent River delta (Area A, Figure 3)
8. Courtenay floodplain (Area A, Figure 5)

REFERENCES

Fyles, J.G. (1959). Surficial Geology - Oyster River, B.C. Map 49-1959. Geological Survey of Canada.

(1960). Surficial Geology - Courtenay, B.C. Map 32-1960. Geological Survey of Canada.

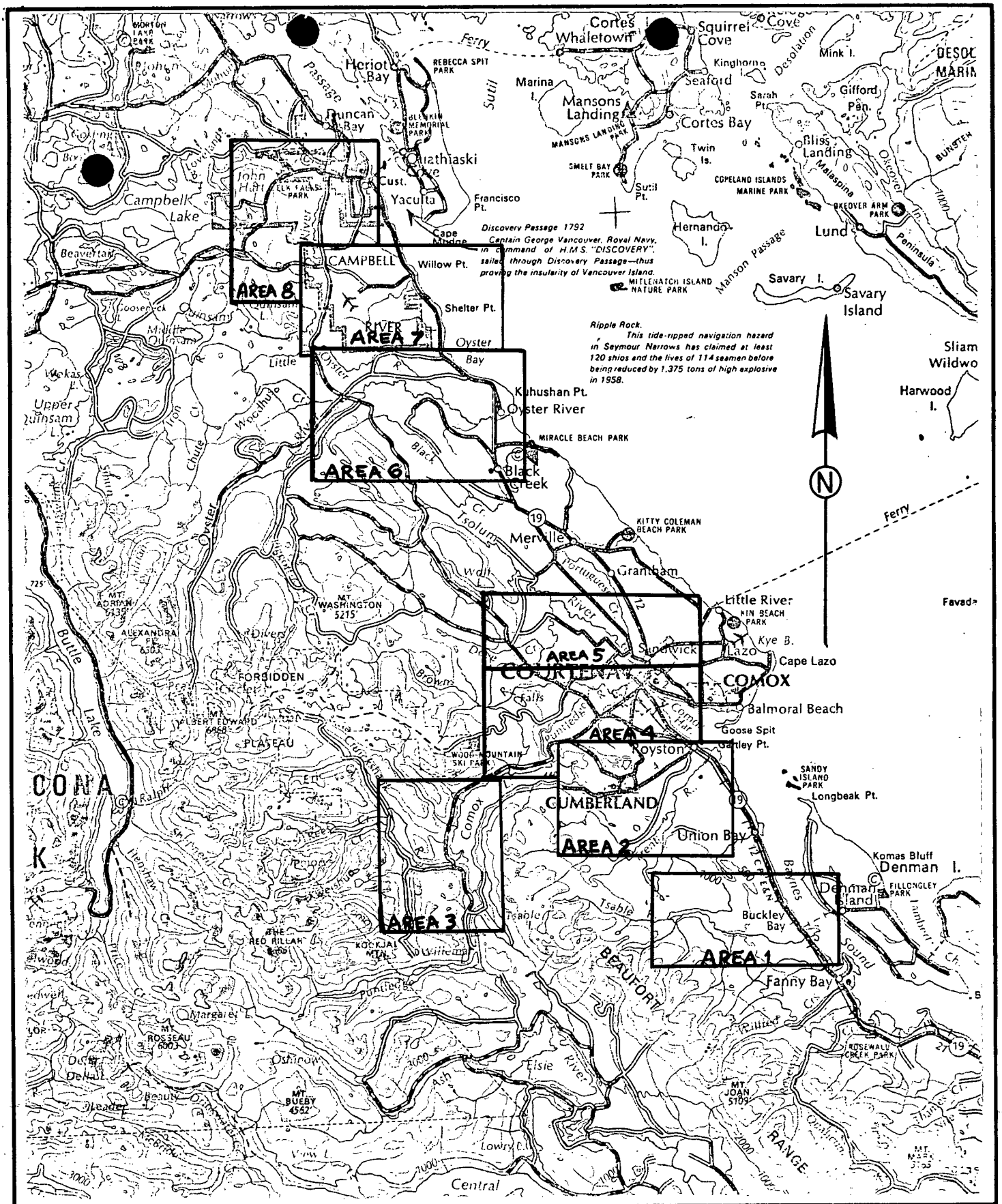
McCammon, J.W. (1977). Surficial Geology and Sand and Gravel Deposits of Sunshine Coast, Powell River, and Campbell River Areas. Bulletin 65. Ministry of Mines and Petroleum Resources. Province of British Columbia.

Marc Zubel.

Marc Zubel
Geological Engineer
Groundwater Section
Hydrology Division
Water Investigations Branch

MZ/hw

Attachs.



Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

PROPOSED VANCOUVER ISLAND FISH HATCHERY GROUNDWATER SUPPLY INVESTIGATION

SCALE: VERT. N/A HOR. 1 inch = 6 miles	DATE NOV. 1979	M. Zubel ENGINEER FILE No. 92 F DWG. No. FIG. 1

bcil 6660 wrs

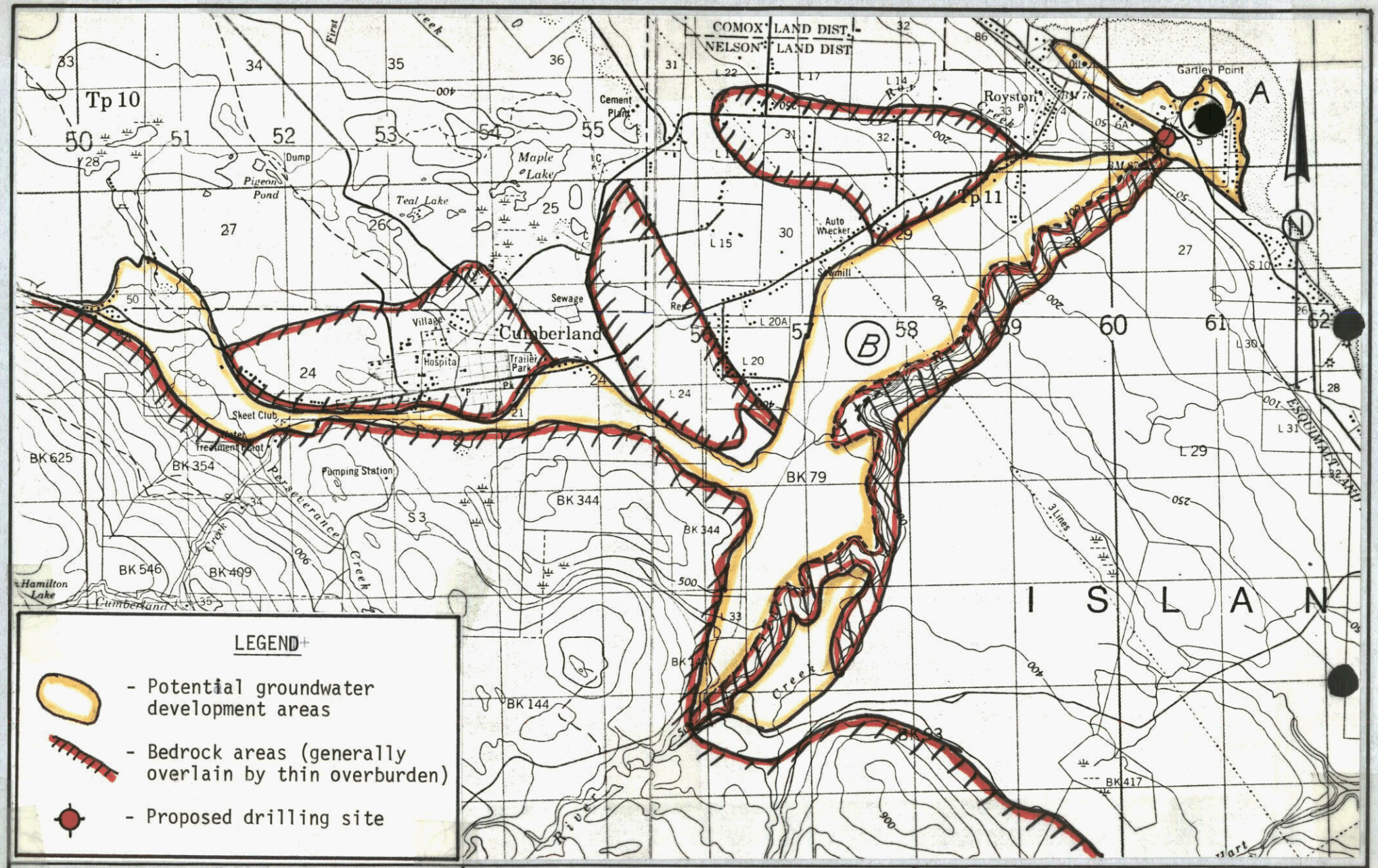
Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 1

TSABLE RIVER

SCALE: VERT. N/A	DATE NOV. 1979
HOR. 1:50,000	
M. Zubel ENGINEER	
FILE No. 92 F	DWG. No. FIG. 2

bcil 6661 wrs



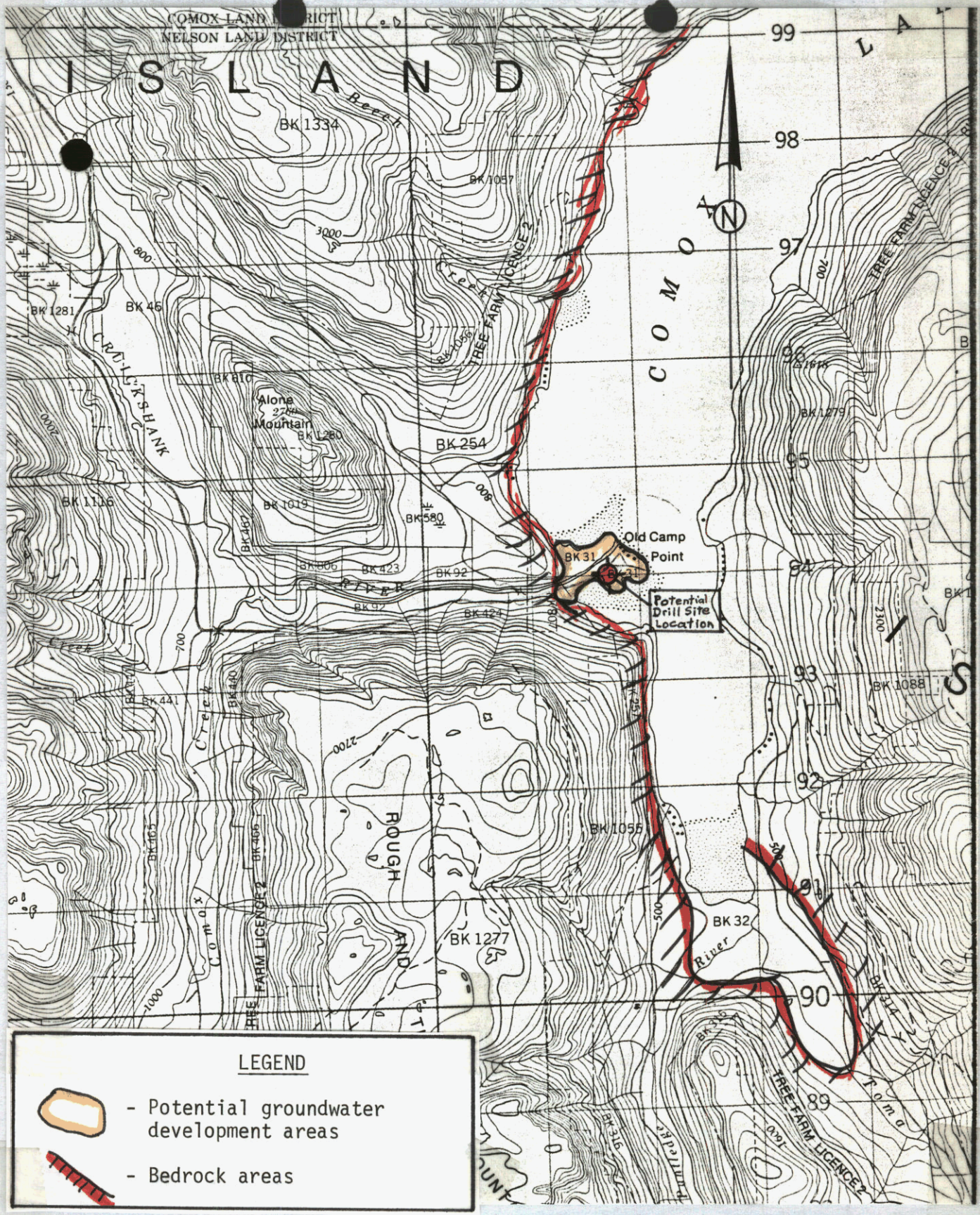
Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 2

TRENT RIVER AND CUMBERLAND AREA

SCALE: VERT.	N/A
HOR.	1:50,000
DATE	NOV. 1979
ENGINEER	M. Zubel
FILE No.	92 F
DWG. No.	FIG. 3

bcil 6661 wrs



Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 3

CRUICKSHANK RIVER AND
SOUTH END OF COMOX LAKE

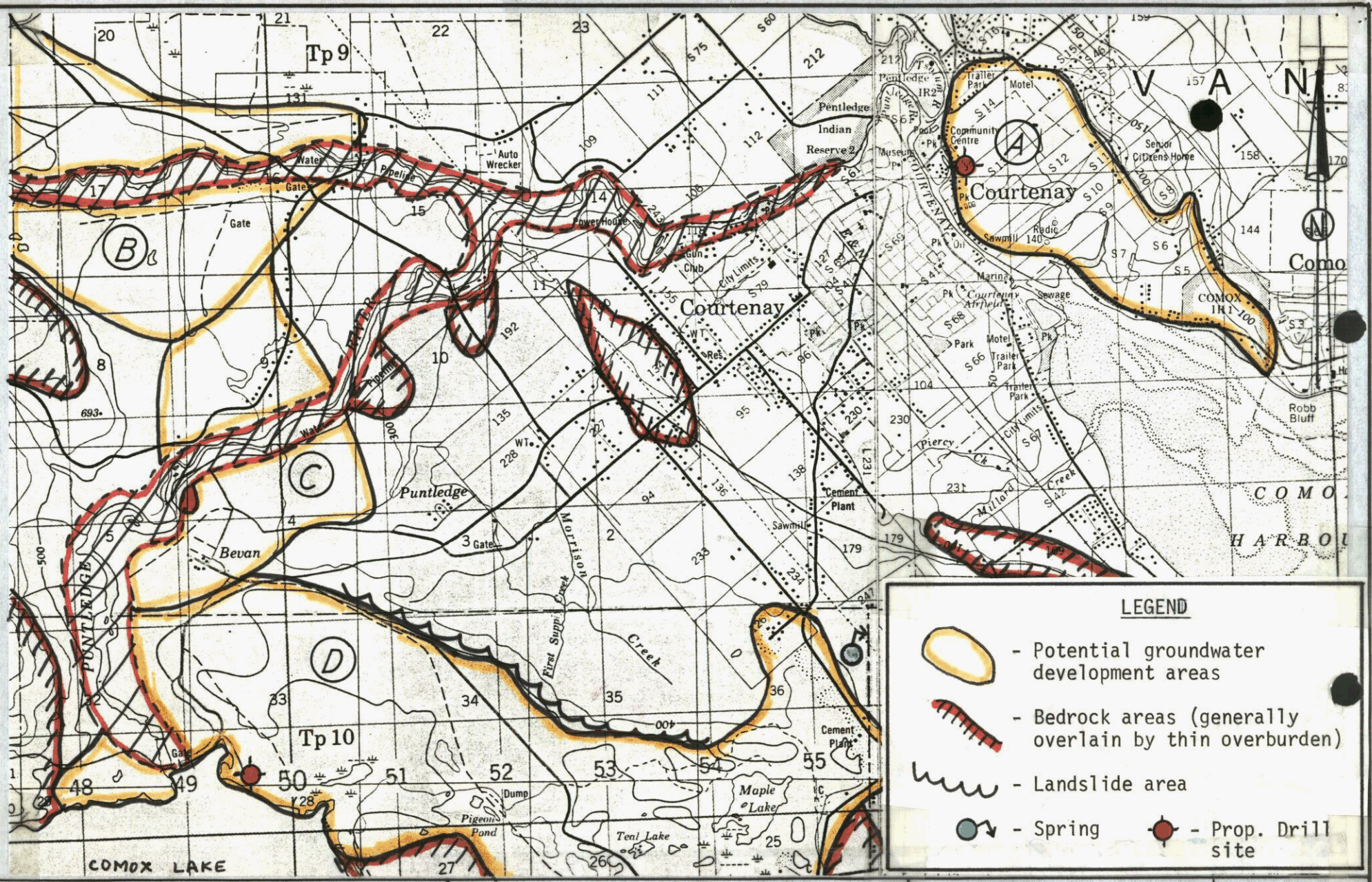
SCALE: VERT. N/A
HOR. 1:50,000

DATE NOV. 1979

M. Zubel ENGINEER

FILE No. 92 F DWG. No. FIG. 4

bcil 6660 wrs



Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 4

PUNTLEDGE RIVER, BROWNS RIVER AND COURTENAY AREA

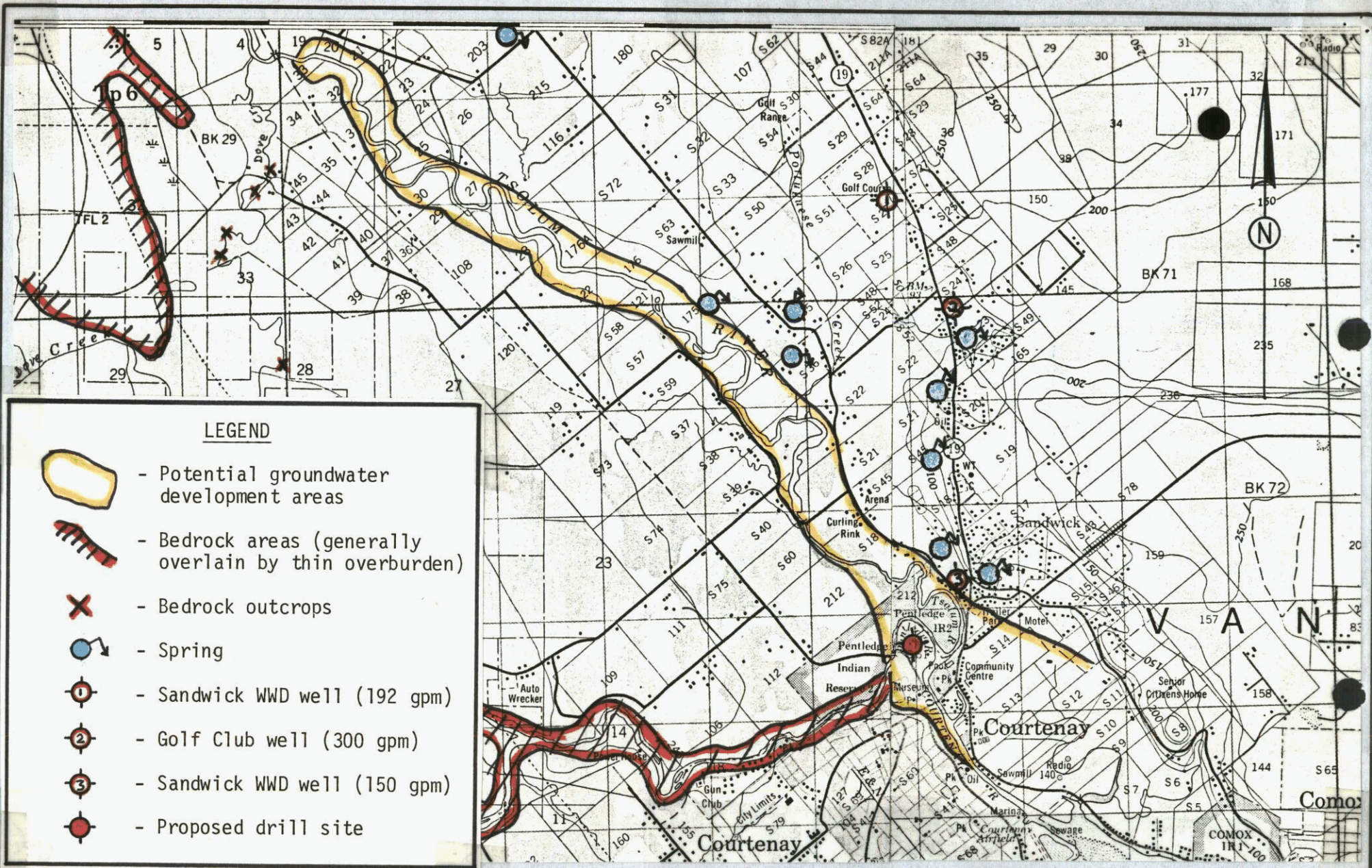
SCALE: VERT. N/A
HOR. 1:50,000

DATE NOV. 1979

M. Zubel ENGINEER

FILE No. 92 F DWG. No. FIG. 5

bcil 6661 wrs



Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 5

TSOLUM RIVER

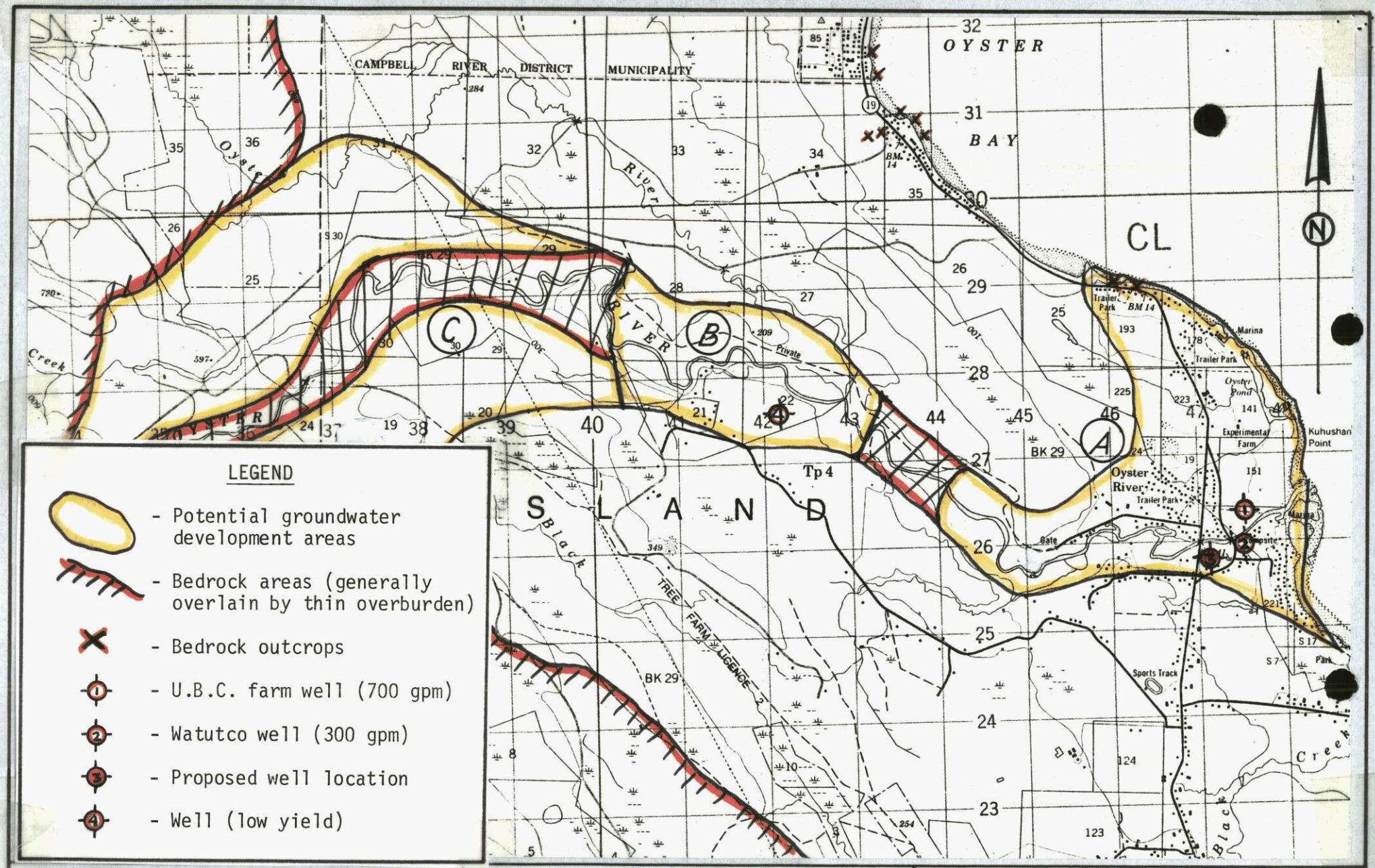
SCALE: VERT. N/A
HOR. 1:50,000

DATE NOV. 1979

M. Zubel ENGINEER

FILE No. 92 F DWG. No. FIG. 6

bcil 6661 wrs



Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 6

OYSTER RIVER

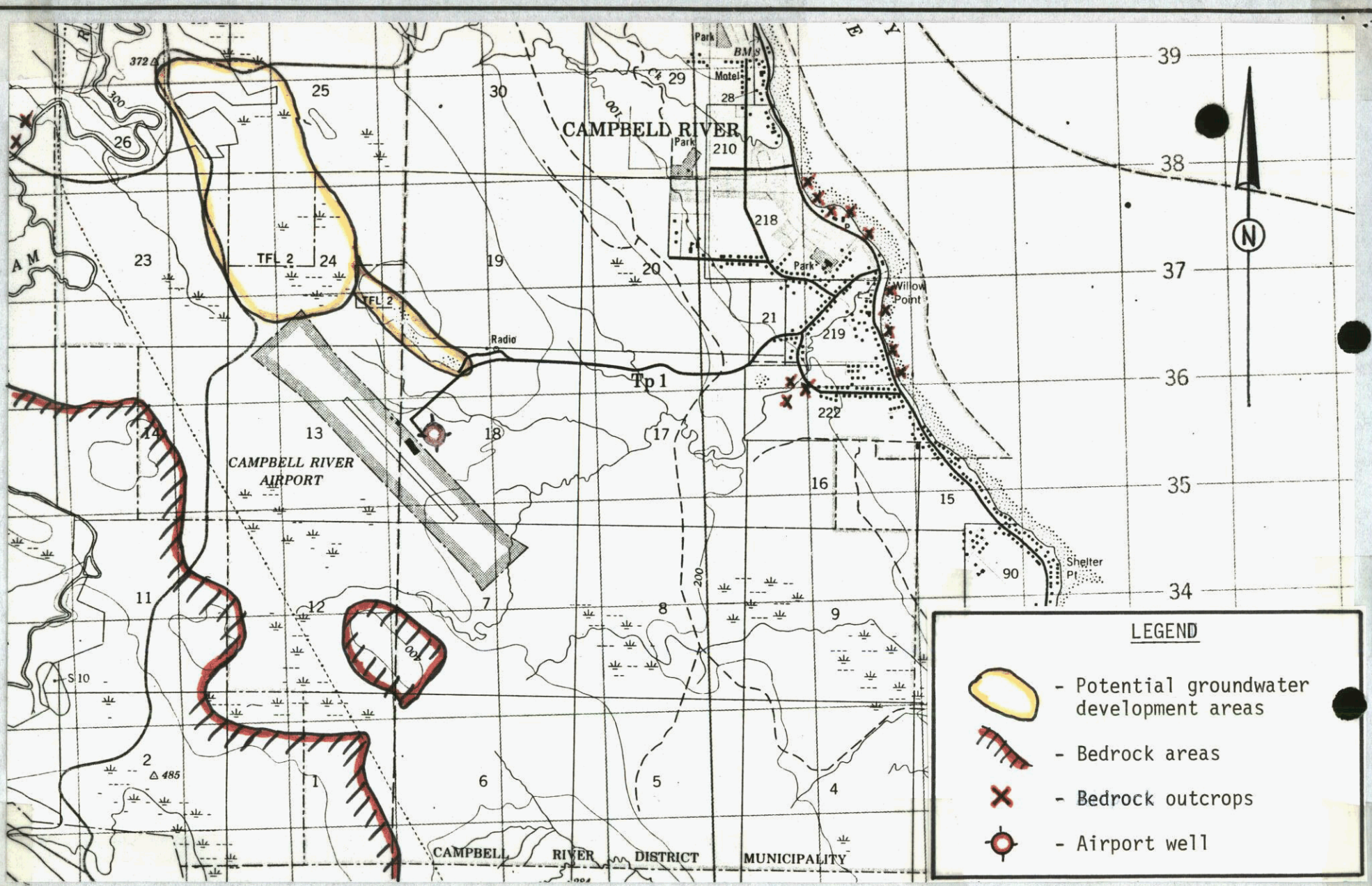
SCALE: VERT. N/A
HOR. 1:50,000

DATE
NOV. 1979

M. Zubel
ENGINEER

FILE No. 92 F
DWG. No. FIG. 7

bcil 6661 wrs



Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 7

WILLOW PT. CREEK

SCALE: VERT. N/A
HOR. 1:50,000

DATE: NOV. 1979

M. Zubel — ENGINEER

FILE No. 92 F DWG. No. FIG. 8

bcil 6661 wrs

Province of British Columbia
Ministry of the Environment
ENVIRONMENTAL AND ENGINEERING SERVICE
WATER INVESTIGATIONS BRANCH

AREA 8

CAMPBELL RIVER AND QUINSAM RIVER AREA

SCALE: VERT. N/A
HOR. 1:50,000

DATE NOV. 1979

M. Zubel ENGINEER

FILE No. 92 F DWG. No. FIG. 9

bcil 6660 wrs