QUEENSTOWN

GEOHYDROLOGICAL

INVESTIGATION

M.A.C. VANDOOLAEGHE

1980

PART I

A. GEOLOGY

B. BOREHOLE SURVEY

C. LEVELLING

****

CONTENTS

A. GEOLOGY

B. Borehole Survey

List of figures

List of tables

List of enclosures

List of appendices

A. GEOLOGY.

1. General:

The geology of the Queenstown investigation area is for practical reasons drawn on two maps;the northern half of the area on enclosure 1 (map one),the southern part on enclosure 2 (map 2).Stripped of the drift component,map one – again split in two parts for practical reasons – reduces to a dolerite occurrence map (enclosures 3a and 3b). The lack of extensive unconsolidated deposits made the compilation of a similar bedrock map of the southern area superfluous.

The base of map one was provided by 1:50000 provisional geological maps obtained from the Geological Survey (3126DD Queenstown,3126DC Lehmansdrif,3126DB Vaalbank and 3126DA Sterkstroom).Apart from the highlands,dolerite mapping ~~on these maps~~ proved to be ~~pretty~~ fairly inaccurate.As a result the project team was on a dolerite search for a long period,aided by compass,aerial photographs (bad quality!) and especially magnetometers.In the end results of the geo-electrical survey and exploratory drilling work also contributed to a large extent to the compilation of the geological map.

No such problems were encountered with the construction of map two,which is an enlarged image of part of the 1:250000 3226 King William's Town geological map.The brief description below of the sedimentary rock sequence in the survey region is largely drawn upon the explanatory notes of the latter map.

At an early stage of the investigation interim borehole survey reports and a reconnaissance geological survey indicated towards an association of groundwater occurrence with dolerite intrusions.From then onwards,the accent fell on surface dolerite mapping and geophysical exploration of dolerite intrusions.

2. Beaufort Group sediments:

The Beaufort Group is represented in the survey area by the Katberg Sandstone and Burgersdorp Formations.These formations make up the Tarkastad Subgroup and are of Triassic age.It can be mentioned that there is a stratigraphic dispute here,the question being if the lower few hundred metres of the Burgersdorp should be considered as a distal northern facies of the Katberg.

The older Katberg Formation consists of pale reddish-grey pebble-bearing fine to medium-grained sandstone and up to 30% greyish-red and greenish-grey mudstone.The mudstones are generally massive.Horizontal lamination and trough cross-bedding characterise the sandstones.

The boundary between Katberg Sandstone and Burgersdorp is arbitrary,and is taken as a plane below which sandstone is more abundant than mudstone.This horizon is difficult to locate because of the transitional nature of the contact. Exploration boreholes sunk 100 m down from the top of the

Katberg (as indicated on the 1:250000 geological map), did not reveal any lithological change from the overlying Burgersdorp (enclosure 4).

According to the explanatory notes the Burgersdorp Formation consists of light greenish-grey, olive-grey, or brownish-grey fine-grained sandstone (± 30%) and greyish-red with subordinate greenish-grey mudstone (± 70%). The total thickness is 950 m. (± 150 m). However, our observations resulted in a thickness of 730 m (enclosure 4). The top of the Burgersdorp was taken on the bottom of the first coarse-grained sandstone layer on Mount Shepstone. The mudstone-sandstone ratio is another point of dispute. A ratio of 4 to 1 was calculated when mapping poorly-exposed rock sequences (Stoffelsberg, Wildskutsberg South), while detailed mapping of a freshly-exposed sequence (Madeira Hill) gave a 3:2 ratio (see diagram on enclosure 4).

Sandstones and mudstone occur as alternating units a few metres (sandstone) to a few tens of metres (mudstone) thick, generally forming fining-upwards cycles. Sandstones are generally, mudstones invariably massive in appearance. The presence of channels and other sedimentological features point towards a fluviatile environment for the deposition of the Tarkastad sediments. The alternating sequences of channel fill sands and vertical accretion floodplain muds of the Burgersdorp were deposited by low sinuosity streams.

The sediments of the area are characterised by gentle (1^{0} to 3^{o}) northward dips.The sandstones are generally jointed but the density,spacing and openings of the joints are less pronounced than in the sandstones of the Beaufort West region.The main joint trend averages around north-north-west.Where a secondary joint direction is present,it is generally normal to the main trend.

3. Molteno Formation:

This distinctive unit outcrops on the higher slopes of Hangklip,Mount Shepstone and Mount Steep,and because it obviously did not play a role in the investigation, further comments are withheld.

4. Dolerite intrusions:

The sedimentary rocks have been intruded by numerous dykes,sills and inclined sheets of Jurassic-age dolerite. The striking feature is the presence of ring-shaped dolerite outcrops,which can rightly be termed the hallmark of the Katberg and Burgersdorp formations.Meyboom and Wallace (1978) have treated the occurrence and origin of these ring-shaped intrusions in the Eastern Cape Province.Field evidence for their investigations was obviously confined to the higher-lying,completely exposed dolerites in the area.The authors favour Bradley's theory of the interaction of lithostatic pressures and magma pressures to explain the formation of undulating sheets.

Bradley theorised that there would be a compensation surface in the crust where magma pressure would equal lithostatic pressure and that unless some form of fracture connected the magma chamber with the surface, a magma could not intrude above this compensation surface. New evidence on lower level dolerites provided by the present investigation is agrees consistent with Bradley's theory as applied by Meyboom and Wallace.In the present context we can however not go deeper into this matter and therefore refer to the publication itself.

Two dolerite levels can be perceived on the geological maps:

a. the undulating sheet observed and studied by Meyboom and Wallace,and characterized by a number of well-formed,ring-shaped saucers (Bongolo,Imvani, Bulhoek etc.) and remnants of dome parts (Hangklip, Mount Shepstone and Andriesberg).
The long axis of the ring-shaped outcrops have a general northerly to north-north-westerly trend. The diameters of these rings vary between 10 and 18 km.The inward dips usually range from 10°-35°, but higher and lower angles are not uncommon.

b. an irregular sheet system intruded about a plane topographically at valley level.The position of this sheet complex,of which the global thickness is considerably smaller than that of the high-level sheet,is not all too clear.

At first sight an interconnection with the high-level sheet seems a probability since in plane view both interlink in quite a few places.In this case we would deal with an intricate system of off-shoots which on itself often behaves in a undulating fashion.It is however improbable that all sheet intrusions in the area would have resulted from one magma rising at the same time.

A second possibility makes the system part of a separate low-level undulating sheet similar to the Cathcart ring-shaped feature.Evidence for such thesis is difficult to come by due to the fragmented pattern of outcrop.This low-level system would thus be younger than the high-level undulating sheet;this fact offers a way to substantiate the thesis.A continuously decreasing magma pressure combined with a highly irregular lithostatic pressure surface - a result of the earlier high-level intrusions which were subsequently dissected by erosion - could have resulted in a lower-level,wider and highly irregular sheet with low centroclinal dips.An additional feature is the enclosure of subsaucers and subdomes within the structure,as can be observed on the central part of the Lehmansdrif map.
A detailed petrographic study may be the only way to find the answer to this dolerite problem.

To enable a better study of the sheet intrusives, a few regional cross-sections were drawn up (fig.1).

QUEENSTOWN: GEOLOGICAL CROSS-SECTIONS through investigation area.

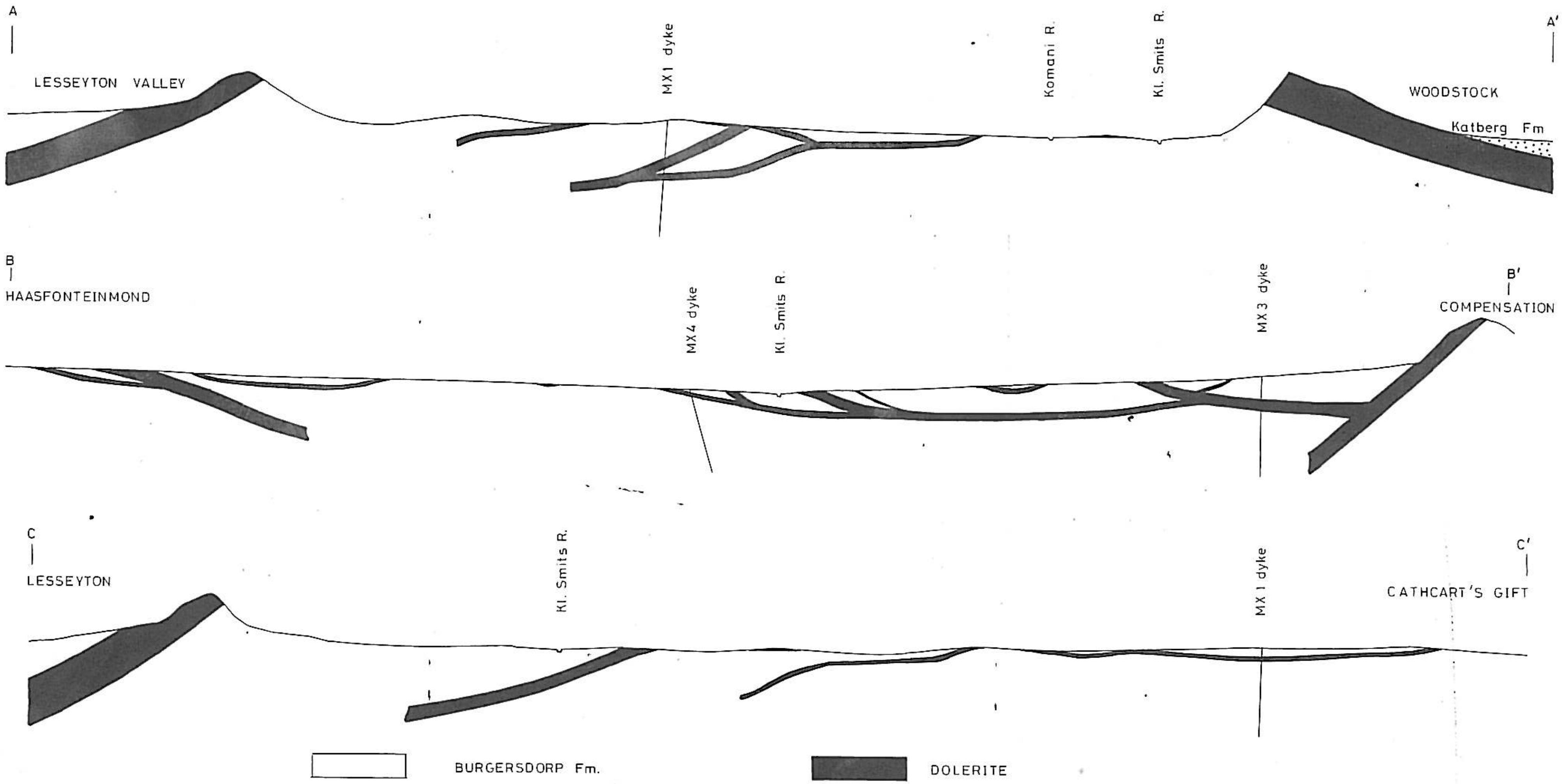

Fig. 1

Dolerite dykes of variable length, width and attitude are found in the investigation area. Short and thin (less than 5 m wide) dykes are abundant in the Tylden sector. Generally the Katberg Sandstone displays a markedly high concentration of dykes which probably has to do with the sandy (jointed?) nature of the deposits. The same feature was observed in the Middelburg (C.P.) district. Elsewhere dyke density is fairly normal, yet the intrusions are definitely longer. Two superlong dykes cross the survey area before continuing easterly into Transkei.

The overwhelming trend of these intrusions is nevertheless northerly, consistent with the general joint pattern. A few promising dykes were selected for groundwater exploration and were given code names (see drift maps - enclosures 1 and 2).

It is not claimed that the dyke contingent on the maps is complete, especially in the upper Klaas Smits and Lesseyton river valley areas. For instance, no work was done on the possible northern extensions of the MX2 and MX3 dykes, nor on some interesting dykes at Sherwood, Dell and Rooikraal farms.

It need no underlining that dolerite dykes are younger and of finer grain than sheet intrusions, at least at first sight.

5. Superficial deposits:

5.1. Alluvial deposits:

The Swart Kei river and tributaries are apparently in a more or less stagnant phase after a prolonged period of erosive action,whereof the local alluvial pockets are testimony.The greatest thickness was drilled at Doornhoek (21 m),but as in many other locations (Roodekrantz,Turvey's Post, Sherwood Forest)the deposit is clayey and largely unsaturated.

An exceptional yield was struck at the pebbly bottom of a local alluvial valley at Waterloo:22 m^3/h at 15 m.A lesser yield was intercepted at Plaattafelberg.In summary,the only alluvial deposits of geohydrological significance occur in the narrow strip along the course of the Klaas Smits river from Waterloo to Hopefield.

Important alluvial deposits allegedly occur up the Klaas Smits river valley, north of Flinksfontein, where farmers reported strong wells tapping alluvial reservoirs.We were in no position to verify this unless a groundwater project were initiated in the Sterkstroom district.

In the Swart Kei - Klipplaatriver confluence area alluvial deposits only occur on the Ciskei-to-be westbank.

5.2. Other superficial deposits:

Sheetwash has covered large areas with a thin colluvial layer,which generally borders the valleys and merges indistinguishably with the alluvial sediments.

Pediment and alluvial fans surround respectively the higher and lower slopes of koppies and mountains. Such accumulations are important on the slopes of Wildskutsberg, Hangklip, Mount Shepstone and the Mount Steep range.

Thin impure limestone(calcrete) deposits were observed on many farmlands; Roodekrantz-A, Hopefield, Rooikraal, Mierekraal, Stompstertfontein,...).

Topsoil, where present, is generally fine sandy.

6. Importance of the geological formations to the geohydrology of the investigation area:

A dolerite dyke is an important feature, if not the greatest asset, of the groundwater system in the region, and this for the following reasons:

- fractures induced by the rising magma into the hostrock were subsequently opened up by stress relaxation and weathering, and now form fractured aquifers;
- the dolerite body itself is often fractured;
- dolerite dykes are generally reliable to yield good water supplies;
- dolerite dykes are fairly easy to trace, either directly or indirectly, i.e. geophysically;
- through their weathered and jointed top zone dykes often present excellent ways of recharge

either in stream floors or on soil-free surface.

The importance of low-level dolerite sheets lies in the following points:

- certain parts are associated with groundwater occurrence;or in other words,certain parts of the sheets are fractured aquifers.Depending on well-specified conditions they host a single fracture or a network of horizontal or subhorizontal fractures,however always of limited dimensions;
- undulating low-level sheet aquifers yield high immediate supplies during a short period;
- pinpointing the aquifers is now an established but not yet widely practised art;
- exposed in river channels or generally when broken and jointed,parts of these sheets could be channels of recharge;
- together high and low-level sheets largely determined the geomorphology and perhaps the hydrological regime of the area.Gradient and direction of groundwater flow is clearly to a large degree shaped by their position and nature;
- low-level sheets divide the first grade compartments into smaller units.

The high-level sheets are likely to lack water-bearing properties,except for those parts of the centroclinal walls which dip less than 10° and are intersected by a major drainage system. However, the saucer parts of the undulating sheet are important groundwater compartments. The generally steep and high saucer walls are excellent zones of recharge, directly or via pediment and alluvial fans.

Beaufort Group sedimentary rock, although representing the overwhelming volume of potential reservoir rock, cannot be considered an excellent source of groundwater exploitation. Effective porosity of massive, unaltered mudstone and sandstone is virtually zero. Permeability and storage capacity are near inexistent. Moreover, fracturing is sporadic and of low intensity due to the thinness and lenticular nature of the sandstones. Fractured aquifers in sediments always occur in close association with dolerite intrusions.

The occurrence of groundwater in the Katberg Sandstone may be somewhat more favourable.

Sandstones are possible channels of recharge in the same way as dykes and low-level sheets.

Alluvial deposits as production aquifers will never attain fame in the Queenstown vicinity. Deposits are pocket-like, on average only up to 5% saturated (at present waterlevel conditions), and of clayey to fine sandy lithological composition.

Under high waterlevel conditions the alluvium can however provide a large volume of storage,which may in turn advantage the recharge of possible interconnected fractured aquifers.

Because of the nature and thickness of the unsaturated zone underlying colluvium and soil,instantaneous infiltration has never been considered an important process in these parts of the country.

* * *
* *
*

B. BOREHOLE SURVEY.

1. General:

A comprehensive survey of water points was carried out from February to December 1979,only interrupted by a break from mid-July to the end of September.Using the immediate Queenstown vicinity as starting point,the survey was continuously and progressively expanded in all directions,except the east,and ultimately covered a surface of 1558 km^2.In the process,priority was given to the farmlands in the valleys.

Hundred and twenty-one cadastral farms,or double this number of individual farms were called upon during the survey.A total of 1386 private boreholes were visited and code-marked.Waterlevel measurements were taken where possible.Survey routine further included the following actions:

- selective watersampling,for hydro-chemical analysis,
- conductivity measurements,
- pH determinations (only cover the northern half of the investigation area),
- annotation of the type of equipment,
- levelling of borehole references where waterlevel measurements were taken,

- inquiries with the owners about:
    - strength and used capacity of wells,
    - depths of wells and waterinterceptions,
    - location and flow of springs,
    - location and capacity of earth dams,
    - use of both surface water and groundwater,
    - agricultural data:size of irrigated lands, type of crop,...
    - geo/hydrogeological information.

The great number of private boreholes in Queenstown Township have not been inventoried.

The complete inventory list is presented as Appendix 1 (one).~~Notice the scarcity of information on many properties,which seems largely due to ignorance on the part of the owners.~~

The positions of the waterpoints have been plotted on enclosure 5.For practical reasons the enclosure is presented in nine subenclosures.A reference to map codes is to be found on enclosure 5a,which is a separate borehole location map for the agricultural plot area west of Queenstown.The remaining subenclosures coincide with the 1:50000 topographic maps:

EN5b	3126DA Sterkstroom
EN5c	3126DB Vaalbank
EN5d	3126DC Lehmansdrif
EN5e	3126DD Queenstown
EN5f	3127CC Bolotwa

EN5g	3226BA Poplar Grove
EN5h	3226BB Whittlesea
EN5i	3227AA Tylden

Positioning on the maps is understandably not very accurate.Co-ordinates (Appendix 1)should therefore rather be used to re-locate the waterpoints in the field.

2. Comment on the different aspects of the survey:

2.1.Farm data:

From information gathered with farmers the total surface under irrigation is calculated as 5330 ha, and is a minimum figure.Half of the total is intermittently cultivated,predominantly after sufficient early summer rains.

Lucern is the main crop (80%) followed by wheat,maize,oats and mixed vegetables.Dairy farming is common in the region,although sheep and cattle raising are important.Because of fodder requirements dairy farmers possess the major share of irrigation land,which they tend to cultivate throughout the year.The other farmers commonly keep to flood irrigation and seasonal dry land cultivation.

Boreholes,springs,rivers and dams are sources of irrigation water.Generally springs and dams are important in the mountaneous zones,especially in the ring-shaped valleys (Bongolo,Bulhoek),where run-off and springwater are collected in earthdams before application.Wells are rarely used.

Along the Swart Kei river below the confluence with the Klipplaatriver,riverwater -either directly pumped or diverted into furrows - is the sole source for irrigation.A low but permanent flow released at the Waterdown Dam for this purpose is the reason.

Farmers along the Komani river valley south of Queenstown have a special source of irrigation water.Queenstown Municipality supplies them with all treated sew age water as compensation for the loss of surface water caused by the Bongolo dam upstream the Komani river.The quantities involved are unknown but surely amount to a few million cubic metres per annum.

Along the Klaas Smits river the situation is rather complicated.Because irrigation practices are so complex even a broad estimate of annual water consumption for agricultural purposes is very difficult if not all together impossible.Some owners dare not supply an estimate or cannot give their general irrigation pattern.Furthermore,no information was sought beyond the boundaries of the present investigation area.All this together with other geohydrological restrictions will prevent even a broad attempt to calculate a water balance of the Klaas Smits catchment.

In summary, irrigation practices, especially in the Klaas Smits river valley, very much depend on the following factors:

- the availability of water from one or from a combination of the following sources:
  - <u>river</u>: run-off, spill-over weir water and water flowing from springs below weirs or from transverse dolerite bodies cutting the river are pumped directly, into furrows or into storage dams. This happens during winter months or during years with or above average rainfall. The only farmers profiting anytime from this and the next source are those along the upper reaches of the valley.

  - <u>weirs</u>: a large number of weirs - 9 between Doornhoek in the north and Thornlands in the south - collect direct river run-off and some springflow. Intrinsic and delivery capacity varies with time and place, the lower weirs drying up first. A weir at Quaggasfontein on the Heuningklipspruit supplies irrigation water to farmlands south-east (Smitskraal, Turvey's Post and Primgra~~c~~dia).

- springs: are responsible for the residual riverflow between weirs and river pumping stages. With a couple of exceptions springwater is elsewhere insufficient for irrigation purposes.
- dams: are small and either collect direct run-off or figure as temporary storage for river water and spring~~water~~flow. A relatively large dam is situated at Sherwood Forest. It is a reservoir for water diverted from the Swart Kei river.
- boreholes: are either back-ups or alternative sources; but become important with decline of precipitation especially in the lower Klaas Smits river valley.

- the crop requirements which amongst others depend on:
  - type of soil,
  - crop rotation,
  - general management,
  - climate.

- financial restraints: The cost of energy has caused a reduction in the total surface under irrigation especially inareas away from the valleys.The use of wells is limited to the absolute minimum and there is a tendency to pump strong wells only (30 m^3/h +).

2.2. Borehole data - geohydrological information:

- the diameter of existing boreholes does not exceed 210 mm,the most common size (88%) being 150 mm.
- the mean depth of the boreholes surveyed is 47 m (number of samples= 126).The shallower wells are usually situated in the valleys.
- type of equipment on the boreholes:

windpumps (all sizes) ;	740
turbines,centrifugal + small monopumps ;	280
open boreholes ;	164
submersible pumps and large monopumps ;	144
obsolete,unidentified pumps,boreholes drilled and equipped after survey	58

The fact that no boreholes are equipped with large turbines (intake wider than 100 mm) is an indication of the limited capacity of the boreholes in the Queenstown vicinity. Very few centrifugal pumps were encountered, a hint as to the average depth of the waterlevel.This type of pump is usually installed in a dug pit in the riverfloor and thus essentially pumps riverwater.Submersible pumps are popular in the agricultural plot area.

- the strength of private wells is an interesting point of discussion.The majority of maximum yields and/or capacities supplied by owners is highly doubtful;the reasons being:
  - an inaccurate and often wrong method of well testing.Boreholes are usually pumped at high discharge rates for a very short period.In case of fractured aquifers this is an undesirable procedure since the behaviour of these aquifers can change significantly with time.
  - some owners have only a faint idea of the quantity of water a certain pump delivers.
  - an exaggeration of the strength of wells on transfer of farm property.

- The strongest boreholes are associated with dolerite bodies in the valleys.Examples are to be found at Latham,Peninsula,Primgradia and Hopefield in case of sheet association, Thornlands,Cloetedale and Dell contain dyke associations.Strong waterinterceptions are reported from various locations in Queenstown Township and are linked with dolerite occurrences.Boreholes yielding in excess of 18 m^3/h have been plotted on the geological maps (enclosures 1 and 2) to show the dolerite/ yield relationship.A few strong wells were recorded away from dolerite occurrence;either their yields were grossly overestimated or the wells are situated in alluvial deposits of favourable lithological composition and higher than average saturated thickness (Bedford,Carelsrust,Sherwood Forest).

Boreholes equipped with windpumps are usually weak.Many strong wells are disused,a sign of changed farming priorities.

- windpump water is mainly used for stock watering,domestic and gardening purposes.Small scale irrigation does occur in the area of small holdings west of Queenstown.

- information on depth and yield of single waterinterceptions is scarce but table 1 gives nevertheless an idea of the yield/strike depth relationship.High supply interceptions are encountered down to 60 m,which is in agreement with the findings of the exploration drilling programme.

- geological logs were seldom obtained, but those received gave an early indication of the importance of dolerite intrusions. Since most boreholes were drilled by private contractor, the files of the Queenstown Boring Inspectorate did not provide much borehole data and geohydrological information.

Details on levelling and waterquality control will be discussed in the appropriate chapters.

Table 1: Number and yield distribution of waterinterceptions per depth interval for private boreholes.

Depth of strike (m)	number of strikes per yield range (m^3/h)							total number of strikes
	5	5-10	10-15	15-20	20-25	25-30	30	
10	2	8	3	3	1	1	2	20
10-20	26	17	8	2	3	1	2	59
20-30	55	25	5	2	2	4	6	99
30-40	23	12	6	5	2	1	5	54
40-50	21	10	-	5	2	3	5	46
50-60	4	1	3	1	1	-	1	11
60-70	11	3	1	-	-	-	-	15
70	8	1	-	-	-	-	-	9
Totals	150	77	26	18	11	10	21	313

3. Particular case: municipal water supply:

Queenstown municipality derives its watersupply from two sources, the Water Affairs built and controlled Waterdown Dam south of Whittlesea and the Bongolo Dam east of town. Consumption figures obtained from the Town Engineer's Office are somewhat confusing. Figures for monthly filtered water consumption often exceed the figures for raw water consumption. The discrepancy is apparently caused by unsatisfactory operation of the discharge meter under low-flow conditions.

Water from Waterdown gravitates via a 450 mm steel pipeline into the Berry reservoir on the eastern outskirts of town. The Bongolo situation is similar. To accomodate the increasing water demand largely from non-white residential areas, a second reservoir on the southern municipal boundary will soon come in operation. Table 2 gives the municipal water consumption for the period 1974–1979.

(10^6 m^3)

Table 2 :

year	Waredown Dam	Bongolo Dam	Total*
1974	0,547	2,367	2,914
1975	1,556	1,783	3,640
1976	0,462	2,959	3,586
1977	1,404	2,208	4,012
1978	1,795	2,208	4,259
1979	2,429	2,016	4,445

*Total does not always match the sums of both dam abstractions due to inaccurate metering.

A sudden increase in water consumption occurred with the connection of iZibeleni (Transkei) on the Queenstown line (mid-1974).Since then the total water use has steadily increased,which reflects largely the augmenting supply to non-white residential areas.

Bongolo is the main water source during normal and wet seasons or years (1974-1978),Waterdown Dam becomes important during runs of dry years.Monthly and annual municipal water consumptions are also depicted on figure 2.

* * *

* *

*

C. LEVELLING.

A handsome number of borehole collars were given heights above mean sea level, enabling the construction of a network of absolute waterlevels in the investigation area. Six hundred and thirteen (613) private wells and ninety-two (92) new exploration and observation boreholes - a total of 705 - were linked to the Trigonometric Survey network.

Routine practice was to lay out lines of bench marks along the main and secondary roads in the survey area (first grade lines). The waterpoints were subsequently levelled in from the nearest bench mark (second grade lines). Accuracy is 10 mm, except for the last points on the second grade lines.

Collar elevations and absolute waterlevels (year 1979) of existing boreholes are filed as Appendix II. Absolute waterlevels are replaced by co-ordinate positions in the case of the new departemental boreholes.

* * *

* *

*

APPENDIX II : Collar elevations - absolute waterlevels.

Private boreholes --- Borehole survey

Borehole N°	Collar elevation (m)a.m.s.l.	A.W.L.(79) (m)a.m.s.l.	A.W.L.(80) (m)a.m.s.l.
AA 1	1097,003	1060,033	
6	1106,198	1068,068	
7	1114,905	1067,005	
AE 2	1204,007	1184,605	
6	1203,054	1170,131	
7	1192,295	1169,447	
9	1154,062	1150,525	
10	1180,254	1166,287	
12	1192,065	1176,588	
14	1192,844	1162,641	
16	1175,055	1161,119	
AR 1	1060,660	1037,580	
7	1073,363	1048,683	
11	1071,914	1031,884	1030,294
14	1067,707	1037,377	
15	1067,546	1038,091	
16	1066,320	1034,137	
18	1074,510	1026,890	
BEF1	1117,972	1117,990	
3	1104,926	1101,554	
4	1121,677	1118,349	
8	1142,725	1131,863	
9	1095,345	1092,448	
BD 5	1120,745	1114,695	
6	1132,637	1112,667	1112,147
BI 1	1347,226	1337,058	

Borehole N°	Collar elevation	A.W.L.(79)	A.W.L.(80)
BK 1	1069,558	1057,418	
2	1069,448	1057,660	
3	1070,290	1058,290	
4	1075,290	1063,718	
6	1110,199	1105,579	
7	1115,283	1108,698	1105,409
8	1119,826	1116,936	1116,026
11	1088,048	1074,448	
12	1115,143	1107,993	1107,132
13	1157,451	1142,731	
14	1157,296	1142,516	1140,016
15	1141,946	1123,376	1132,831
16	1136,994	1118,971	1116,110
17	1116,750		
18	1168,600	1161,225	
19	1166,488	1159,692	
20	1172,281	1159,241	
BLE 1	1090,381	1057,708	
2	1102,927	1079,309	
3	1059,829	1050,139	
4	989,837	984,134	
5	1010,693	1000,261	
6	1008,185	995,153	
BN 4	1148,721	1140,271	
6	1153,758	1144,568	
7	1169,756	1164,781	
9	1170,005	1163,788	
12	1175,288	1170,078	
13	1175,818	1171,191	
15	1178,083	1163,528	
16	1176,928	1166,998	
BOS 1	1057,406	1038,373	
3	1101,625	1098,065	
4	1035,045	1029,415	
7	990,708	985,446	
8	1035,740	1029,865	1029,829

Borehole N°	Collar elevation	A.W.L.(79)	A.W.L.(80)
BR 2	1300,593	1294,287	
3	1301,063	1293,934	
5	1289,188	1280,322	
10	1305,538	1296,387	
11	1299,598	1291,557	
12	1298,869	1291,543	
14	1299,192	1291,554	
15	1303,730		
BZ 2	1075,913	1048,913	
3	1071,178	1046,357	
5	1068,234	1037,160	
6	1072,377	1049,941	
9	1032,156	1027,808	1027,881
10	1027,146	1014,216	1013,124
11	1021,463	1010,311	1005,743
13	1044,182	1019,642	
14	1081,892	1059,855	
15	1089,054	1044,786	
18	1087,289	1044,677	
19	1086,521	1061,827	
CE 2	1179,854	1169,885	
3	1179,481	1170,604	
4	1172,213	1163,365	
5	1197,472	1183,963	
6	1177,318	1158,488	
7	1181,365	1174,275	
9	1157,178	1154,267	
10	1151,120	1144,732	
CHT 2	1060,750	1041,053	
3	1042,037	1029,117	
5	1048,363	1006,846	
CLE 1	941,822	933,947	
2	942,421	934,491	
3	1000,107	985,059	
4	1012,899	989,589	
8	964,546	934,706	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
CP 1	1138,423	1136,335	
2	1138,270	1136,073	
3	1135,943	1132,540	
4	1134,921	1132,459	
7	1161,600	1135,836	
CST 1	1033,045	1022,730	
6	1032,847	1022,717	
7	1038,426	1024,853	
8	1050,830	1026,093	
9	1070,603	1050,498	
12	1089,748	1069,848	
13	1092,375	1069,851	
CT 1	1113,599	1099,710	
5	1113,861	1101,803	1100,423
6	1118,268	1116,890	
11	1107,745		
14	1107,753		
DE 1	1070,775	1053,541	
6	1076,893	1064,893	
DGS10	984,928	978,655	
DK 1	1067,781	1049,356	1048,741
3	1065,363	1048,926	
5	1064,507	1047,522	1047,225
EK 1	1059,787	1041,392	- -
2	1059,174	1041,475	1039,812
3	1063,999	1046,989	1044,104
5	1051,967	1040,057	
8	1074,781	1048,816	1043,125
EN 1	1174,615	1145,308	
3	1176,756	1184,523	
5	1144,710	1137,345	
ESX 3	1112,033	1082,861	
5	1122,966	1103,251	
6	1044,943	1038,453	
8	1057,232	1049,652	

Borehole Nº	Col. elevation	A.W.L.(79)	A.W.L.(80)
ESX 9	1066,142	1062,739	
11	1075,996	1063,505	
12	1088,436	1067,230	
15	1078,447	1068,184	
18	1082,911	1069,016	
FEF 2	1149,990	1142,379	
5	1182,982	1166,205	
6	1151,117	1145,437	
9	1140,712	1127,727	
12	1139,432	1125,597	
13	1140,153	1125,600	- -
14	1146,778	1125,546	
15	1147,604	1127,146	
16	1162,136	1127,886	
GE 3	1150,138	1141,693	
5	1158,205	1142,050	1141,797
6	1174,373	1157,589	
GN 1	1184,862	1158,058	
3	1202,504	1199,488	
4	1166,650	1130,910	
5	1194,769	1164,832	
6	1146,604	1135,704	
9	1251,430	1235,837	
GSG 1	1216,999	1179,143	
2	1179,688	1162,676	- -
4	1210,477	1198,740	
5	1171,385	1168,920	
7	1156,072	1137,162	
HDH 4	1204,062	1184,115	
6	1178,145	1158,215	
10	1206,733	1180,678	
11	1234,105	1223,958	
19	1155,542	1152,402	
HD 2	1214,806	1201,948	
3	1206,985	1202,202	
4	1265,406	1251,055	

Borehole N°	Col. elevation	A.W.L.(79)	A.W.L.(80)
HD 5	1221,714	1185,497	
6	1181,328	1168,630	
7	1213,047	1186,580	
8	1197,380	1185,787	
HEL 1	1054,708		
4	1046,062	1034,562	
HL 1	1129,535	1114,535	1110,955
3	1129,516	1118,520	
4	1129,494	1118,872	1118,256
5	1129,750	1116,258	1118,597
9	1222,975	1204,770	- -
10	1163,428	1137,093	1135,928
13	1135,045	1127,495	1126,815
14	1135,609	1129,080	1128,091
16	1152,066	1138,034	1135,928
17	1163,682	1150,336	1143,700
18	1150,177	1134,122	1131,757
19	1134,279	1127,401	
21	1132,480	1127,649	
HN 1	1140,123	1131,558	
2	1139,752	1134,933	1132,290
3	1151,396	1135,824	1133,931
4	1152,995	1146,995	1145,280
8	1158,340	1150,825	
15	1153,540	1149,395	
17	1155,400	1149,428	- -
18	1157,291	1149,690	
22	1168,609	1152,693	
23	1149,826	1134,823	1136,416
24	1159,796	1123,793	
IMI 1	1034,168	1007,846	
2	1060,919	1040,664	
3	1060,909	1041,894	
4	1050,095	1038,708	
5	1096,073	1083,383	
8	1023,841	1015,296	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
IXH 1	909,139	899,498	
2	909,040	899,572	
3	923,094	888,314	
JED 1	977,548	940,882	
2	935,284	925,454	
5'	956,770	933,780	
KP 1	1169,371	1158,056	1154,545
2	1182,401	1159,068	
5	1159,156	1149,381	
6	1166,214	1157,069	
7	1165,948	1160,428	
8	1173,302	1166,632	
9	1200,839	1189,795	1181,639
10	1193,693	1179,255	1178,983
11	1192,533	1180,158	1179,669
15	1215,623	1199,469	
16	1230,590	1209,065	1201,168
19	1204,524	1190,634	1190,076
LD 2	1091,477	1072,677	
3	1089,650	1072,937	
4	1091,034	1073,674	
5	1088,703	1078,228	1077,832
6	1087,971	1077,771	
8	1119,628	1096,738	
9	1150,311	1104,976	
10	1087,900	1078,755	
11	1091,145	1076,250	
12	1089,419	1078,304	
15	1108,068	1089,958	
16	1113,223	1089,888	
18	1122,232	1074,902	
LE 3	1149,985	1139,917	
LM 1	1061,180	1036,986	
4	1052,698	1040,063	
13	1040,941	1028,509	
14	1035,451	1027,391	
15	1035,451	1035,451	1034,439

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
LN 3	1117,142	1083,530	
6	1216,627	1205,822	
8	1118,994	1107,203	
12	1177,068	1142,536	
13	1135,420	1105,811	
LT 3'	1134,196	1122,146	
4	1137,300	1122,970	1121,700
6	1161,470	1130,170	1133,465
8	1194,119	1187,397	1184,664
9	1201,423	1186,163	1186,027
LYE 2	1119,961	1114,746	
3	1110,082		
MAT 1	983,745	980,988	
MD 3	1079,641	1038,754	
5	1082,472	1028,522	
7	1084,943	1034,065	
9	1088,117	1034,617	
12	1091,427	1059,333	
13	1091,526	1059,629	
17	1075,263	1031,773	
21	1069,233	1046,516	
24	1065,231	1048,606	
28	1062,894	1049,202	
29	1063,084	1049,444	
30	1060,988	1047,094	
32	1061,596	1050,248	
36	1046,818	1042,415	
42	1047,051	1044,041	
44	1057,184	1053,142	
43	1056,919	1053,326	
45	1058,504	1038,103	
49	1057,230	1046,888	
50	1055,843	1049,273	
51	1053,762	1050,402	
53	1055,146	1049,477	
54	1057,883	1047,199	
55	1058,182	1049,473	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
MD 56	1056,777	1047,705	
57	1055,277	1050,247	
60	1049,109	1039,419	
61	1048,368	1042,693	
62	1046,646	1034,987	
63	1047,264	1039,195	
64	1046,314	1036,290	
67	1050,800	1045,683	
70	1056,548	1035,102	1030,263
73	1044,130	1034,130	
74	1042,948	1037,966	
77	1070,926	1051,641	
79	1056,037	1043,715	
80	1072,939	1046,974	
81	1066,315	1047,970	1039,690
82	1048,008	1035,479	1035,038
85	1046,117	1029,075	
86	1046,656	1025,576	
87	1046,836	1032,074	
88	1054,211	1040,731	1032,901
91	1051,586	1022,401	
92	1052,155	1022,240	1028,468
93	1054,160	1037,478	
101	1047,726	1038,328	
102	1045,498	1039,882	
104	1049,819	1036,411	1037,574
105	1053,996	1043,537	
108	1066,069	1041,990	
109	1061,572	1041,010	
111	1067,702	1047,305	
113	1067,470	1041,679	
ML 1	1180,060	1163,819	1163,505
3	1280,723	1241,991	
MLN 1	995,567	984,581	
2	995,440	984,042	
3	1020,441	1007,096	
MNG 1	969,530	950,407	
2	986,970	964,666	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
MT 2	1297,071	1287,721	
3	1317,187	1288,451	
NC 3	1265,878	1252,718	
5	1257,960	1243,268	
7	1257,869	1242,135	
8	1252,563	1240,921	
11	1255,887	1252,145	
13	1265,674	1253,382	
14	1259,408	1249,252	
15	1260,722	1242,387	
16	1263,016	1252,273	
NH 1	1252,753	1241,682	
2	1255,117	1248,575	
6	1244,583	1227,143	
8	1245,102	1238,362	
14	1243,670	1233,698	
NN 2	1190,565	1186,555	1185,951
4	1186,008	1176,341	1173,867
6	1185,003	1166,843	1163,413
7	1183,987	1166,682	
8	1152,947	1134,562	1133,194
9	1137,083	1131,714	1130,223
10	1132,181	1127,977	1127,025
11	1166,641	1152,291	1124,565
12.	1135,967	1128,715	1127,005
NP 2	1144,088	1107,986	1112,752
4	1148,108	1109,928	1109,803
7	1118,835		1104,470
8	1140,262	1123,062	
10	1153,942	1129,597	1129,515
NT 5	1116,709	1107,859	
7	1159,858	1154,323	
8	1130,199	1121,609	1118,764
10	1128,911	1122,564	1122,199

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
PSK5	1185,803	1171,815	
6	1220,998	1193,581	
7	1155,140	1134,210	
8	1196,683	1169,581	
9	1128,989		
14	1115,319	1097,969	
15	1115,040	1097,953	
16	1114,727	1097,996	
17	1114,419	1097,970	
PT 1	1241,934	1216,557	
2	1242,916	1212,449	
3	1225,686	1202,149	
5	1195,850	1178,422	
QE 7	1139,210	1101,330	
10	1109,990	1090,031	
11	1110,424	1091,083	
3	1097,086	1083,766	
4	1084,122	1076,622	
5	1092,473	1078,606	
QK 1	1119,311	1108,551	
2	1109,362	1109,390	
QN 1	1170,670	1162,058	1163,284
2	1170,952	1160,937	
RD 2	1204,007	1197,647	
3	1217,042	1193,162	
RDN 2	1113,107	1104,419	1101,683
3	1112,108	1111,730	
4	1116,796		
RK 2	1051,503	1045,604	
3	1064,594	1052,533	
9	1084,946	1053,588	
9a	1070,607	1052,187	
11	1107,249	1064,749	
14	1130,477	1107,712	
15	1120,469	1089,389	
17	1069,127	1051,025	
18	1064,025	1051,125	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
PA 2	1055,227	1048,172	1041,057
4	1045,487	1045,217	
6	1054,362	1052,362	
7	1039,589	1034,005	
8	1033,818	1030,058	
14	1050,478	1047,428	
PD 2	1147,466	1138,403	
5	1149,363	1138,543	1132,923
8	1165,725	1150,696	1150,203
9	1147,532	1139,083	1133,254
PE 1	1234,451	1195,776	
2	1215,710	1196,247	
3	1249,415	1225,457	
7	1217,621		
8	1232,505	1212,815	
PEA1	940,906	910,168	
2	993,158	972,391	
3	972,676	936,816	
4	931,968	922,065	
PG 3	1133,977	1129,449	1129,187
4	1146,227	1135,512	1133,457
PK 1	1031,970	1025,970	
3	1042,211	1038,416	
8	1034,445	1029,800	1029,023
9	1048,505	1041,285	1039,255
PRT3	918,559	911,369	
5	983,786	975,195	
6	1002,136	970,845	
7	1004,482	981,539	
8	977,110	966,329	
9	976,750	966,525	
10	988,471	977,027	
PSK1	1090,611	1078,464	
2	1141,890	1110,000	
4	1138,767	1132,260	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
QE17	1101,723	1063,918	
RL 1	1253,151	1239,795	
2	1239,508	1199,356	1207,582
3	1187,063	1172,048	1174,577
6	1200,081	1189,927	
8	1196,438	1180,971	1172,385
10	1259,810	1241,475	1244,790
RN 1	1068,093	1052,368	
3	1067,509	1052,454	1050,669
4	1067,489	1052,009	
6	1064,461	1050,596	
7	1047,898	1040,684	
8	1065,758	1051,288	
14	1072,680	1055,950	
15	1073,590	1057,585	
16	1071,892	1056,407	1057,297
18	1074,909	1058,054	
19	1074,124	1062,612	
20	1076,722	1058,257	
22	1081,573	1065,383	
23	1064,907	1043,447	
24	1071,766	1053,606	
26	1058,087	1043,862	
28	1056,945	1043,775	1046,805
29	1062,943	1043,633	
31	1058,588	1040,518	
32	1060,359	1039,858	
35	1088,338	1046,948	
RTT 1	985,998	979,818	
3	1006,673	999,286	
6	1046,726	1029,058	
RZ 1	1067,745	1053,159	
2	1061,166	1052,001	1050,866
5	1043,444	1034,369	
6	1041,825	1036,157	

Borehole Nº	col.elevation	A.W.L.(79)	A.W.L.(80)
RZ 7	1043,123	1039,068	1038,398
8	1044,647	1040,154	
9	1044,107	1040,381	1039,237
10	1066,902	1053,463	
11	1085,287	1056,246	
12	1048,510	1044,450	
14	1051,399	1043,419	
SDF 2	1038,756	1032,612	
3	1036,424	1032,950	
4	1040,392	1036,274	
7	1038,426	1021,196	- -
8	1100,060	1077,570	
SHL 2	983,093	946,758	
SL 1	1166,044	1156,174	1155,539
3	1148,869	1139,589	1139,889
4	1155,459	1139,137	
SN 2	1410,540	1405,302	
5	1372,405	1362,987	
6	1384,810	1381,033	
8	1440,047	1422,944	
9	1435,583	1423,099	
SS 1	1171,787	1149,436	
2	1187,866		
3	1171,803	1161,780	1159,003
4	1162,446	1156,455	- -
7	1172,834	1158,144	1155,724
8	1182,776	1162,391	1159,626
ST 1	1116,709	1107,099	
4	1144,313		
5	1140,815	1123,280	
7	1138,770	1123,345	1122,600
8	1173,426	1148,944	1148,432
THL 1	1078,343	1039,023	
2	1002,507	997,725	995,692
3	1001,526	982,076	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
WS 4	985,459	982,377	
5	995,085	982,893	
8	1006,863	982,835	
9	988,797	981,719	
10	1013,510	984,975	
11	1061,842	1032,557	
12	1079,354		
14	1017,316	1005,766	
TK 1	1352,243	1273,397	
2	1243,761	1226,006	
4	1374,164	1348,786	
5	1380,386	1343,520	
TLE 1	1003,938	997,745	
2	1003,926	1001,406	
6	1027,771	1012,581	
7	1047,296	1023,451	
TT 2	1147,002	1137,300	
5	1169,745	1148,493	
7	1153,659	1139,559	1138,879
8	1144,872	1137,534	1136,592
VKL 7	954,893	947,100	
WE 7	1069,218	1040,718	
8	1076,589	1042,227	
10	1078,899	1035,864	1029,577
16	1077,704	1042,514	
17	1079,003	1042,523	
WEN 2	1145,402	1131,455	
4	1097,921	1074,896	
6	1089,250	1076,099	
WEY 1	1021,693	1010,615	
2	1035,481	1011,697	
5	1017,926		
6	1016,344	980,836	
8	1013,588	993,577	
9	1011,727	1002,515	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
WH 2	1109,290	1058,686	
4	1102,799	1054,319	
5	1134,192	1101,027	
6	1148,457	1117,707	
7	1112,500	1061,490	
12	1088,831	1059,044	1057,311
13	1088,966	1059,026	
14	1088,420	1056,862	
17	1093,835	1055,625	
18	1093,992	1042,655	
22	1082,257	1034,496	
23	1118,312	1069,357	
24	1091,906	1054,603	
25	1092,519	1044,209	
26	1091,757	1061,379	
27	1090,641	1054,537	
28	1087,411	1043,708	
29	1087,323	1044,156	
30	1087,199	1044,470	
31	1087,021	1046,525	
32	1084,415	1044,297	
33	1080,983	1054,479	
34	1078,305	1047,238	1051,995
35	1090,895	1054,313	
36	1085,257	1039,341	1036,252
39	1083,585	1037,814	
40	1084,233	1036,378	
41	1085,920	1035,772	
43	1083,552	1036,090	
46	1081,665	1038,715	
47	1080,510	1038,840	
49	1079,388	1038,896	1031,291
50	1078,627	1038,598	
51	1079,404	1038,479	
58	1077,295	1039,006	
59	1076,554	1042,936	
61	1076,327	1040,142	
62	1077,781	1039,840	

Borehole Nº	Col.elevation	A.W.L.(79)	A.W.L.(80)
WH63	1076,995	1040,643	
65	1079,743	1041,558	
67	1079,635	1039,615	
69	1075,075	1029,703	
70	1072,288	1032,382	
71	1071,888	1031,228	
72	1070,438	1014,097	1034,838
73	1080,273	1034,436	
WKY 1	1008,076	996,466	
2	1004,085	990,757	
WL 1	1221,092	1201,947	
2	1148,974	1141,233	1138,619
3	1165,871	1160,646	1158,796
6	1162,831	1160,056	1157,888
7	1186,731	1159,473	1160,878
WLN 1	926,571	917,094	
3	903,847	895,589	
4	918,132	909,780	
5	925,009	919,893	
6	928,708	919,063	
WN 2	1143,200		
4	1154,973	1139,547	1137,240
5	1181,013	1160,753	1159,077
6	1139,359		
WT 2	1078,023	1057,080	
ZD 1	1164,219	1156,829	
2	1168,599	1158,254	1158,037
3	1168,768	1159,362	
4	1168,751	1158,980	
5	1168,318	1159,249	
9	1203,302	1186,702	
10	1204,595	1186,744	
11	1224,454	1181,144	
12	1171,623	1163,568	1163,343
15	1176,422	1126,926	1165,742
16	1173,896	1165,534	

* * * * *

Appendix II : Collar elevations.

Exploration and observation boreholes.

DW-number	Geological Nº	Co-ordinates	Collar elevation (m) a.m.s.l.
134001/3	31628	31 56 47/26 47 46	1056,883
134002/1	31629	31 56 26/26 47 52	1043,933
134003/9	31630	31 57 03/26 46 51	1073,325
134004/7	31631	31 57 12/26 48 16	1046,101
134005/5	31632	31 56 37/26 48 45	1054,745
134006/3	31633	31 56 37/26 48 45	1054,430
134007/1	31634	31 57 05/26 49 25	1044,100
134008/9	31635	31 58 04/26 50 40	1041,481
134009/7	31636	31 57 25/26 49 52	1042,418
134010/5	31637	31 55 46/26 49 40	1050,143
134011/0	31638	31 57 08/26 49 45	1038,449
134012/8	31639	32 02 36/26 49 13	1022,020
134013/6	31640	32 02 50/26 49 22	1028,201
134014/4	31641	32 02 45/26 49 11	1031,541
134015/2	31642	32 02 45/26 49 11	1030,699
134016/0	31643	32 02 46/26 49 10	1032,832
134017/8	31644	32 02 48/26 49 14	1034,871
134018/6	31645	31 55 21/26 39 07	1134,646
134019/4	31646	31 54 53/26 38 26	1131,120
134020/9	31647	31 54 53/26 38 26	1130,994
134021/7	31648	31 54 53/26 38 26	1131,078
134022/5	31649	31 55 03/26 38 24	1131,507
134023/3	32000	31 53 34/26 35 41	1139,445
134024/1	32001	31 53 33/26 35 34	1140,526
134025/9	32002	31 53 34/26 35 41	1137,482
134026/7	32003	31 53 34/26 35 41	1140,199
134027/5	32004	31 52 32/26 34 51	1143,790
134028/3	32005	31 53 34/26 35 41	1140,582
134029/1	32006	31 47 42/26 35 24	1192,516
134030/6	32007	31 54 52/26 42 15	1107,753

DW-number	G-number	Co-ordinates	Collar elevation
135021/2	32008	31 54 46/26 50 56	1060,421
135022/0	32009	32 06 41/26 49 50	1015,122
135023/8	32010	32 06 41/26 49 50	1014,275
135024/6	32011	32 05 34/26 51 07	1032,125
135025/4	32012	32 06 02/26 50 47	1021,485
135026/2	32013	32 04 32/26 50 36	1012,218
135027/0	32014	31 56 06/26 48 08	1045,318
135028/8	32015	31 52 59/26 55 03	1103,950
135029/6	32016	31 55 05/26 51 43	
135030/1	32017	31 54 28/26 50 50	1048,975
135031/6	32018	31 54 03/26 50 53	1058,483
134031/4	31940	31 54 56/26 46 50	1052,835
134032/2	31941	31 54 40/26 47 15	1064,937
134033/0	31942	31 54 56/26 46 30	1074,292
134034/8	31943	31 57 02/26 47 27	1060,433
134035/6	31944	31 57 20/26 49 57	1042,453
134041/1	31945	31 57 25/26 49 52	1042,310
134042/9	31946	31 57 24/26 '49 51	1042,204
134043/7	31947	31 54 09/26 40 54	1125,483
134044/5	31948	31 54 37/26 40 16	1112,087
134045/3	31949	31 54 08/26 38 24	1140,189
134046/1	31950	3155 06 /26 39 42	1123,411
134047/9	31951	31 55 20/26 39 08	1133,569
134048/7	31952	31 56 09/26 34 36	1188,583
134049/5	31953	31 53 34/26 35 49	1138,770
134050/0	31954	31 53 35/26 35 49	1141,524
134051/8	31955	31 53 34/26 35 49	1138,876
134052/6	31956	31 53 06/26 35 53	1150,106
134053/4	31957	31 52 48/26 35 31	1138,689
134054/2	31958	31 52 09/26 36 08	1151,706
134055/0	31959	31 52 47/26 35 39	1143,685
135001/8	31960	31 52 48/26 35 32	1141,324
135002/6	31961	31 55 13/26 39 08	1130,961
135003/4	31962	31 57 06/26 47 56	1048,798
135004/2	31963	32 04 32/26 50 36	1012,534

DW-number	G-number	CO-ordinates	Collar elevation
135005/0	31964	32 04 30/26 50 36	1012,352
135006/8	31965	32 04 32/26 50 34	1010,932
135007/6	31966	32 04 32/26 50 36	1013,528
135008/4	31967	32 06 32/26 51 04	1029,054
135009/2	31968	32 06 32/26 51 06	1031,286
135019/9	31969	31 55 20/26 39 07	1134,856
135020/4	31970	31 54 09/26 38 25	1139,704
134072/0	31971	31 54 09/26 35 48	1143,970
134073/8	31972	32 06 01/26 50 47	1019,856
134074/6	31973	32 06 02/26 50 47	1019,996
134075/4	31974	32 06 00/26 50 47	1018,157
135061/0	31975	31 57 03/26 48 02	1048,069
134056/8	31981	31 56 05/26 48 34	1052,438
134057/6	31982	31 56 10/26 48 04	1052,005
134058/4	31983	31 56 15/26 48 04	1045,794
134059/2	31984	31 54 54/26 47 02	1060,028
134060/7	31985	31 54 54/26 42 53	1124,485
134061/5	31986	31 53 51/26 44 44	1082,410
134062/3	31987	31 53 16/26 36 25	1145,622
134063/1	31988	31 53 20/26 36 25	1146,923
134064/9	31989	31 53 21/26 36 25	1146,017
134065/7	31990	31 54 08/26 38 24	1140,268
134066/5	31991	31 54 06/26 38 24	1141,678
134067/3	31992	31 54 08/26 38 19	1139,961
134068/1	31993	32 05 12/26 50 38	1015,976
134069/9	31994	32 05 48/26 49 16	1022,922
134070/4	31995	32 05 44/26 49 15	1022,700
135010/7	31996	31 53 34/26 35 42	1138,283

* * * *

* * *

* *

*

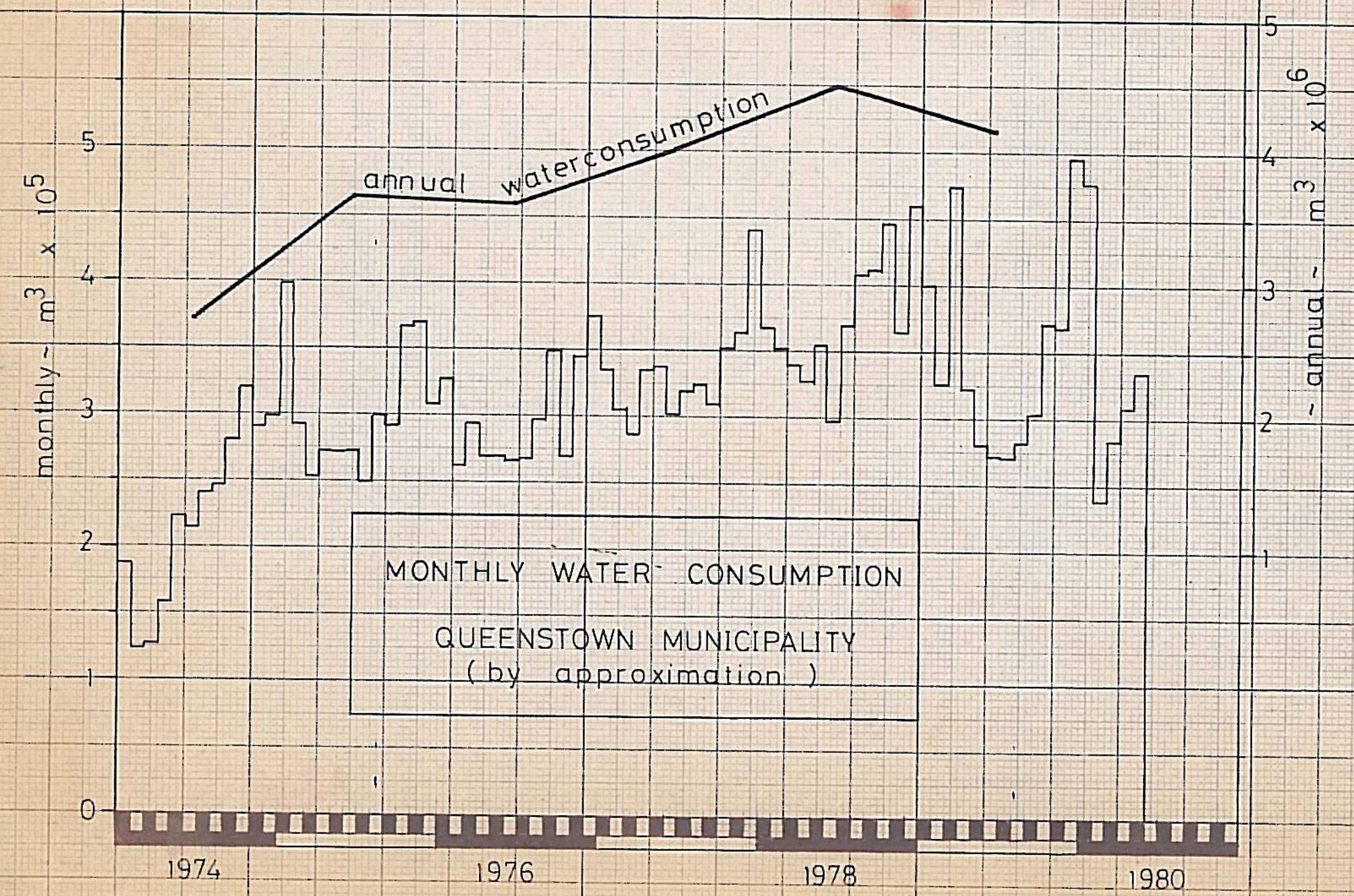
MONTHLY WATER CONSUMPTION
QUEENSTOWN MUNICIPALITY
(by approximation)
annual waterconsumption
monthly ~ m3 x 105
~ annual ~ m3 x 106
0
1
2
3
4
5
1974
1976
1978
1980

FIG. 2