

APPENDIX 1

ANNUAL, EVAPORATION AND GROUNDWATER LEVEL MONITORING SITES

TABLE A1.1
RAINFALL MONITORING SITES

Site No.	Site Name	Grid Reference	Altitude	Record Length	Mean (Annual)	Minimum (Annual)	Maximum (Annual)
534701	Kaikohe JH Orr	P05:818-419	162 m	January 1922 June 1971	1612	1249 (1931)	2459 (1956)
534801	Kaikohe Aero	P06:849-385	170 m	July 1956 July 1978	1507	1217 (1973)	2054 (1962)
534802	Kaikohe Grasslands	P05:849-423	185 m	January 1973 December 1985	1594	1137 (1983)	1995 (1985)
534807	Kaikohe DSIR	P05:854-418	204 m	February 1986 October 1990	-	Min month 24 (Jan) 1988	Max month 859 (Oct) 1987
534803	Kaikohe MWD	P05:841-445	201 m	March 1979 November 1989	1500	-	1999 (1981)
534725	Kaikohe Woolshed	P05:831-406	160 m	April 1989 -> open	1162	1116 (1991)	-
534724	Kaikohe Borough (at Hill)	P05:821-431	240 m	January 1986 -> open	1596	1325 (1991)	2003 (1989)
534810	DSIR Grasslands	P05:849-423	185 m	January 1987 December 1991	1539	1255 (1991)	1962 (1989)
534722	Opahi Cocksfoot	P05:766-436	189 m	February 1969 -> open	1477	1147 (1982)	1977 (1971)

*** Tideda Ver 4.1 *** Water Resources Survey-Whangarei
 *** PCAL *** VER 1.8 30-04-86

Monthly totals 1986 to 1991 site 534810 at DSIR Grasslands

Rain mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Total
1986	?	?	?	?	136	71	185	189	129	69	52	115	947?
1987	73	30	107	123	46	55	182	85	156	146	192	198	1394
1988	22	85	292	28	254	89	243	168	172	92	140	190	1777
1989	342	46	52	53	77	241	153	385	266	197	91	58	1962
1990	91	43	104	100	149	105	168	258	75	107	91	15	1307
1991	48	62	87	106	27	136	183	228	176	96	55	52	1255
Min.	22	30	52	28	27	55	153	85	75	69	52	15	1255
Mean	115	53	128	82	115	116	186	219	162	118	104	105	1539
Max.	342	85	292	123	254	241	243	385	266	197	192	198	1962

The Min Mean and Max of Annual means are for complete years only.

End of process

TABLE A1.2

EVAPORATION MONITORING SITES

Site No.	Site Name	Grid Reference	Altitude	Record Length	(mm) Mean (Annual)	(mm) Minimum (Monthly)	(mm) Maximum (Monthly)
NZMS A53482	Kaikohe DSIR at Kaikohe	P05:856-418	204 m	April 1973 March 1984	1153	29 July 1973	206 January 1983
NZMS A531901	Kerikeri at MAF	P05:956687	79 m	October 1981 December 1989	1026	26 June 1983	198 January 1982 & 1983

TABLE A1.3 DETAILS FOR GROUNDWATER LEVEL MONITORING SITES

Site No. (TIDEA)	WELARC No.	Name	Map Reference	Depth (m)	GL (mamsl)	Length of Record	Type
5347001	3196	Rangihamama	P05:827-410	80.7	171.9	from 27/8/87	automatic
5437003	3199	Woolshed	P05:831-406	38.0	166.7	12/5/88	automatic
5347005	3199	Woolshed piezo	P05:831-406	15.0	166.6	16/5/88	manual
5347007	3198	SH12	P05:822-414	53.9	176.6	13/6/88	automatic
5347009	3198	SH12 piezo	P05:822-414	15.0	176.5	16/5/88	manual
5347011	3200	Roadside	P05:828-409	8.8	173.0	12/5/88	automatic
5347012	3197	Roadside piezo	P05:828-410	61.4	172.7	3/9/87	manual
5347013	3057	Kaikohe Hill (No. 4)	P05:820-432	86.2	260?	9/3/89	manual

APPENDIX 2**BORE LOCATIONS AND BORE LOG SUMMARIES**

Note: There are likely to be other bores in the area which were drilled prior to the mid 1970's and even some more recent which are not marked on these maps and for which the Council has no bore logs.

WELARC NO.: 3057 continued
 NAME: Kaikohe Hill No. 5

MAP REFERENCE: P05:820-432

Interval of Logging	Recovery (%) 75 80. 75	Nature of Core	Depth (m)	Legend	LITHOLOGY		SAMPLES FIELD TESTS							
					DESCRIPTION Name colour strength, grain, size (moisture) miscellaneous	Sample Type (Water Level)								
			7.5	X	SLIGHTLY SANDY SILTY CLAY- medium orange/brown, firm to stiff, moist, moderate plasticity (ASH). Becomes gradually grey/brown in colour with depth. Layers of medium red/brown C.W. vcs sand-medium gravel sized Basalt(TUFF). Occasional boulders of dark grey Basalt.									
				X	APROXIMATE CONTACT ONLY									
			15.7	V	TUFFACEOUS BASALT- orange red/brown to med. grey C.W. - M.W. vesicular Basalt cobbles and boulders set in matrix of orange/brown Ash. Minor scoriaceous Basalt. Large 7 boulder from 12.25 to 12.45 metres.									
			20.2	D	HIGHLY VESICULAR BASALT- dark grey(wet), turraceous, H.W-M.W. minor red/brown scoriaceous Basalt. Becoming harder (less weathered) with depth.									
				D	SCORIACEOUS BASALT- medium red/brown, highly vesicular, M.W.- H.W. Loss of air circulation - poor sample recovery. Contains layers of dark grey vesicular Basalt 200-500 mm thick. Circulation returns when drilling these layers. Moderately hard Basalt layer from 40.95 to 41 35 metres. Loose- having trouble re- entering hole at various levels below 20.2 metres and with bit blocking off due to fines flowing back into hole when air turned off for rod changes.									

205mm diameter Blade Bit

JOB NAME:

BOREHOLE No. 5

LOCATION:

FEATURE:

CLIENT:

GRID. REF.:

JOB No.:

COLLAR ALTITUDE:

DATUM:

SHEET 2 OF 2

Method of Boring	Recovery (%) 25. 30. 75.	Nature of Core	Depth (m)	Legend	LITHOLOGY		SAMPLES FIELD TESTS							
					DESCRIPTION Name, colour, strength, grain size (moldure) miscellaneous		Sample Type (Water Level)							
205 mm diameter Blade bit						SCORIACEOUS BASALT- medium red/brown as 20.2 to 50 .0 metres.								
			77.10											
			79.10			TUFFACEOUS OR SCORIACEOUS BASALT- red/brown and dark grey/green. Firm, light to moderately welded.								
			86.2			BASALT- dark grey/black (wet), moderately vesicular, probably minor jointing. Following description from large cobble recovered during air- lifting from 80.09 metres: vesicular, porphyritic, Feldspar phenocrysts completely altered to Serricite. Jointed, surfaces rough, clean or coated with light orange highly plastic clay. Some Limonite coatings on the inside of vesicles. Very hard from 84.5 metres - no joints								
						E. O. B. 86.2 metres								

55.9  15-06-88

WELARC NO.:

3195

MAP REFERENCE:

P05:831-426

NAME:

Town Bore (KBC No. 171)

Recovery (%) 25, 50, 75	Nature of Core	Depth (m)	Legend	LITHOLOGY		Sample Type (Water Level)	SAMPLES FIELD TESTS			
				DESCRIPTION Name, colour, strength, grain, size, (moisture) miscellaneous						
		2.5	x x x x	Weathered soil, red/brown, organic						
		10	v v v v	BASALT, highly weathered, brown staining on joint surfaces (Flow 1) soft zone becoming less weathered						65mm Class C PVC
		20	v v v v	BASALT, Grey, black mottles, white inclusions						
			x x x x	(Flow 2) Some red/brown SILT bands (Volcanic Ash)						
			⊗ ⊗ ⊗	BASALT AND SCORIA with some red/brown SILT (broken Basalt and Volcanic Ash)						Slotted, wrapped with filter cloth
		30	v v v v	BASALT, blue/grey						
		40	v v v v							
		50	v v v v							
			x x x x	CLAY						
			x x x x	SILTSTONE blue/grey, fractured appearance						Backfill
				END OF BORE 57.7 metres						

DATE STARTED: 5 December 1986
 DATE FINISHED: 6 December 1986
 DRILLER: T. Ormond, Brown Bros. Ltd.
 TYPE OF DRILLING RIG:
 INGERSOLL RAND TH 60
 LOGGED BY: G W ROBERTS

CARRIER & ASSOCIATES LTD.
 CONSULTING GEOLOGISTS
 P.O. BOX 15-483, AUCKLAND 7 — PHONE: 817-8818

SAMPLES/FIELD TESTS

WELARC NO.: 3196

MAP REFERENCE:

P05:827-411

NAME: Rangihamama (KBC No. 2)

Method of Boring	Recovery (%) 25, 50, 75	Nature of Core	Depth (m)	Legend	LITHOLOGY		Sample Type (Water Level)	SAMPLES FIELD TESTS			
					DESCRIPTION Name, colour, strength, grain size, (moisture) miscellaneous						
150mm DOWN HOLE HAMMER			0.7	x x x x	ORGANIC SILT - topsoil						
			1.7	v v v v	Basalt boulders in silts (very highly weathered Basalt)						
				v v v v	BASALT - Dark grey, staining on fractures (weathered Basalt)						
			8.4	v v v v	(broken and fractured with some SILT bands)						
				x x x x	SILT, clayey, red/brown (volcanic Ash and baked sediment layers)		10/12/86				
				x x x x			8.5				
			20.0	x x x x							
				v v v v	BASALT, blue/grey, some yellow/brown stains and inclusions						
				v v v v							
			38.0	v v v v							
150mm ROLLER BIT			41.5	x x x x	SILT, stiff, light grey and red/brown (baked sediment and volcanic ash)						
			42.5	v v v v	BASALT						
			43.0	v v v v	SILT, Brown/grey						
				v v v v	BASALT, blue/grey, fractured, stained red/brown on fractures. Some black mottling and staining						
				v v v v	Light yellow/brown inclusions (flow increases over depth range to total depth)						
150mm DOWN HOLE HAMMER			74.9	v v v v							
				x x x x	CLAY, silty, grey						
				x x x x							
					END OF BORE 80.7 metres						

TEMPORARY 150mm
DIAM. CASING DRIVEN
TO REFUSAL

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CONSULTING GEOLOGISTS
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SAMPLES/FIELD TESTS

JOB NAME:

LOCATION:

CLIENT:

JOB No.:

FEATURE: 75

GRID. REF.:

COLLAR ALTITUDE:

DATUM:

BOREHOLE No. 7

SHEET 2 OF 2

Method of Boring	Recovery (%) 25. 50. 75	Nature of Core	Depth (m)	Legend	LITHOLOGY		Sample Type (Water Level)	SAMPLES FIELD TESTS						
					DESCRIPTION Name, colour, strength, grain, size, (moisture) miscellaneous									
			53.6	----	CLAY - pale pink, stiff, highly plastic (C.W. MUDSTONE)									
				XXXX	VERY SANDY SILTSTONE - pale green, soft (can easily be crushed between fingers) - (H.W. SILTSTONE)									
					E.O.B 53.9 metres									

DATE STARTED: 29-03-88
 DATE FINISHED: 6-04-88
 DRILLER: K. STEVENS
 TYPE OF DRILLING RIG:

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 CONSULTING GEOLOGISTS

P.O. BOX 15-483, AUCKLAND 7 - PHONE: 817-8118

SAMPLES/FIELD TESTS

WELARC NO.: 3199

76

MAP REFERENCE:

P05:831-406

NAME:

Woolshed (KBC No. 8)

Method of Boring	Recovery (%) 25, 50, 75	PENETR. M/HOUR	Depth (m)	Legend	LITHOLOGY	Sample Type (Water Level)	SAMPLES FIELD TESTS			
					DESCRIPTION Name, colour, strength, grain size, (moisture) miscellaneous					
150mm Ø BLADE BIT			1.45	XXXX	ASH - Medium orange/brown, moist, silty, low plasticity					
		24		VVVV	BASALT/ TUFF - medium purple/grey, highly to completely weathered. Relict porphyritic texture still visible. limonite and MnO2 staining on joint faces. Moist below 3.0 metres, saturated below 4.0 metres Flow increasing generally between 6.3 and 15.0 metres Basalt present as large (cobble - sized) core - stones set in a matrix of much soft, highly plastic orange/brown and purple grey SILTY CLAY (ASH)	6.3	IN FLOW			
		60		VVVV						
		22		VVVV						
			16.4	VVVV	WEATHERED BASALT - as 1.45 to 16.4 metres pale grey in colour. (Saprolite)	15.4	IN FLOW			12.2 BENEONITE SEAL
			19.76	VVVV		19.0	IN FLOW			15.0 16.0 19.0
150mm Ø DOWN HOLE HAMMER		24	19.86	VVVV	OLIVENNE BASALT - dark blue/grey (wet). Fresh to slightly weathered, moderately vesicular. Limonite and manganese staining on inside of vesicles. Slight sericitisation of feldspar phenocrysts. Pale green euhedral Olivine phenocrysts common	24.16	IN FLOW			
			20.86	VVVV	WEATHERED BASALT - as 16.4 to 19.76 metres OLIVENNE BASALT - as 19.76 to 19.86 metres. Major jointed zone from 28.2 to 29.6 metres moderately vesicular Joint surfaces clean, rough, moderately wavy to planar					27.3
		1.6		VVVV		28.2	IN FLOW			
				33.3	XXXX	SILTSTONE - blue/grey, soft, highly weathered	33.3			
					E.O.B. 37.98 metres					

DATE STARTED: 7-04-88
 DATE FINISHED: 8-04-88
 DRILLER: K. STEVENS

CARRIER & ASSOCIATES LTD.

SAMPLES/FIELD TESTS

WELARC NO.: 3200

77

MAP REFERENCE:

P05:828-409

NAME:

Rangihamama Roadside (KBC No. 9)

Method of Drilling	Recovery (%) 25, 50, 75	Nature of Core	Depth (m)	Legend	LITHOLOGY	Sample Type (Water Level)	SAMPLES FIELD TESTS							
					DESCRIPTION Name, colour, strength, grain, size, (moisture) miscellaneous									
150mm Ø DOWN HOLE HAMMER				x x x	SANDY SILT - medium orange/brown, damp. Contains occasional small pebble sized fragments of H.W. dk grey BASALT with limonite and MnO2 staining in vesicules (ASH)									
				v v v	GRAVELLY SANDY SILT - medium grey/brown,damp. Composed of H.W. to M.W. BASALT cobbles and small boulders set in a matrix of much volcanic ASH									
				v v v	CLAYEY SILT - red/brown, firm, moist(VOLCANIC ASH) Contains bands of GRAVELLY SANDY SILT (TUFF) below 10.0 metres									
					E.O.B 12.0 metres									

DATE STARTED: 9-04-88
 DATE FINISHED: 9-04-88
 DRILLER: K. STEVENS
 TYPE OF DRILLING RIG:

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SAMPLES/FIELD TESTS

KAIKOHE HILL BORES - BORE LOGS
EX KAIKOHE BOROUGH COUNCIL

Drilled 1960's (GHK)

No. 1

0-6m	Volcanic Clay	RL of GL at bore(s) approximately 265 mamsl
6-9m	Rotten Scoria Rock	
9-17.4m	Scoria and Boulders	swl (1967) ~ 209m
17.4-28.4m	Rotten Scoria Rock	
28.4-33.5m	Scoria and Boulders	
33.5-64.3m	Rotten Scoria Rock	RL (base of unit) 200 mamsl
64.3-73.2m	Scoria Solid	
73.2-79.6m	Honeycomb Basalt	
79.6-80.8m	Solid Basalt	RL 184.2 mamsl

Bore cased to 57.6 m with 6" casing welded
 From 57.6 m to 64.3 m cement grouted hole watertight
 Open bore from 64.3m to 80.8 m.

No. 2

0-14.3m	Scoriacious Clay
14.3-82.9m	Scoriacious Vesicular Basalt
82.9-85.4m	Hard Basalt

Cased with 150 mm dia galvanized pipe to 65.9 m, the casing being drilled tight into a hard layer.

No. 3

0-22.3m	Brown Clay some small Basalt Boulders
22.3-77.7m	Red Brown Scoriacious Vesicular Basalt
77.7-80.8m	Hard Grey-Blue Basalt - some minor fractures

BORE LOG SUMMARIES

WELARC NO: 5582
MAP REFERENCE: P06:865371
LOCATION: Kaikohe, Mangakahia Road
DATE DRILLED: 29 May 1989
LOG: 0-6 Scoria
6-61 Basalt
61-65.5 Clay
65.5-67 Gravel Bed

DRILLER'S ESTIMATE OF PRODUCTION: 3 l/s
DEPTH TO STANDING WATER LEVEL (at drilled date):

3065
P06:872363
Tautoro, Kaikohe
27 September 1950
0-2.7 Soil
2.7-4.8 Hard Basalt
4.8-6.0 Scoria
6.0-8.2 Coarse Basalt
8.2-18.2 Hard Basalt

0.45 l/s
3 m

3061
P06:859355
Kaikohe, Picadilly Road
November 1977
0-5.0 Volcanic
5.0-16.7 Lava Flow

0.38 l/s

3062
P06:861355
Kaikohe, Picadilly Road
29 May 1989
0-11.2 Lava Flow

2.3 l/s
2.4 m

3029
P06:818388
Kaikohe, Te Iringa Marae
5 November 1976
0-3.0 Volcanic Soil
3.0-12.7 Hard Scoria
12.7-14.5 Brown Volcanic Clay
0.38 l/s
6.4 m

3039
P06:870355
Tautoro, Kaikohe
2 December 1977
0-1.2 Clay
1.2-6.4 Clay, Scoria
6.4-8.2 Scoria
8.2-10.9 Layered Bluestone
10.9-11.0 Shingle
11.0-11.7 Clay
11.7-15.3 Bluestone with some scoria
15.3-16.7 Hard Bluestone
16.7-18.6 Soft Bluestone
18.6-18.8 White Clay

0.44 l/s
6.4 m below
ground level
(mbgl)

3021
P06:814389
Kaikohe, Te Iringa
17 June 1980
0-2.1 Volcanic Soil
2.1-10.7 Weathered Basalt
10.7-15.2 Hard Basalt
15.2-22 Weathered Basalt

0.44 l/s
9.7 m (mbgl)

3159
 P05:823411
 Kaikohe, Taheke Road
 19 November 1984
 0-10 Basalt Bounders
 10-99 Three Basalt Flows with Ash between
 31/s
 9.3 m

3186
 P05:822415
 Kaikohe, Taheke Road
 2 June 1987
 0-9m Clay & Scoria
 9-19.5 Basalt
 19-5-32.3 Volcanic Ash
 32.3-43 Basalt
 43-46 Volcanic Ash
 0.75 l/s

3198
 P05:822414
 Kaikohe
 6 April 1988
 0-3 Volcanic Soil
 3-8 Weathered Basalt
 8-11 Ash & Scoria
 11-25 Basalt
 25-28 Ash/Tuff
 28-35 Basalt
 35-49 Olivine Basalt
 49-53 Clay
 53-54 Siltstone

3025
 P05:817409
 Kaikohe, Taheke Road
 0-6 Clay
 6-9 Scoria
 9-12 Scoria & Bluestone
 12-15 Bluestone
 15-17 Yellow Clay
 0.45 l/s
 7 m

3028
 P05:818401
 Kaikohe
 0-3 Boulders
 3-18 Yellow Clay
 18-19 Blue Silt
 19-22 Blue Shale No Water

3033
 P05:824414
 Kaikohe
 17 November 1977
 0-2 Volcanic Clay
 2-5 Clay Boulders & Scoria
 5-9 Scoria
 9-14 Bluestone
 0.3 l/s
 5.5 m

3048
 P05:823412
 Kaikohe
 23 November 1977
 0.2 Volcanic Clay
 2-8 Scoria
 8-10 Scoria with Bluestone Boulders
 10-12 Bluestone
 7.5 m (mbgl)

3022
 P06:854385
 Kaikohe Aerodrome
 5 March 1984
 0-15 Volcanic Clays & Ash
 15-20 Burnt Clay
 0.6 l/s
 7 m (mbgl)

3037	P05:826419	Kaikohe Sawmill	9 January 1966		
3038	P05:827422	Kaikohe	March 1977	Volcanic Soil	
			0-2	Basalt	
			2-22		0.21/s
3195	P05:831426	Kaikohe Town	5 December 1986	Volcanic Soil	
			0-2.5	Weathered Basalt	
			2.5-15	Basalt	
			15-22	Scoria	
			22-26	Basalt	
			26-51	Clay	
			51-53	Siltstone	
			53-58		5.9 m
3176	P05:809407	Kaikohe, Taheke Road	24 October 1985	Volcanic Soil	
			0-2.5	Weathered Basalt	
			2.5-16	Basalt	
			16-23	Volcanic Ash	
			23-26	Basalt	
			26-30	Sandstone	
			30-33	Mudstone	
			33-33.5		0.75 l/s
3040	P05:828417	Kaikohe	19 September 1980	Volcanic Soil	
			0-1.8	Weathered Basalt	
			1.8-2.4	Basalt	
			2.4-3.9	Clay	
			3.9-10.3	Scoria	
			10.3-13.6	Hard Scoria	
			13.6-21	Siltstone	
			21-25.6		1.3 l/s .48
3032	P05:822118		30 November 1983	Soil & Boulders	
			0-6	Basalt	
			6-24	Volcanic Ash	
			24-27	Basalt	
			27-50	Siltstone	
			50-51		3.2 l/s 6
3046	P05:835428	Kaikohe Town	24 November 1977	Clay	
			0-2	Bluestone	
			2-3	Soft Scoria	
			3-11	Bluestone	
			11-13		0.25 l/s 2.8 metres

3172
 P05:829435
 Kaikohe
 23 January 1986
 0-52 Basalt
 52-61 Volcanic Ash
 61-73 Scoria
 73-78 Basalt
 78-85 Volcanic Ash

1.91/s
 22 m

3031
 P05:822439
 Kaikohe
 0-4 Volcanic Clay
 4-8 Weathered Scoria
 8-13 Scoria
 13-28 Basalt

0.12 l/s
 13.7 m

3051
 P05:842438
 Kaikohe
 27 March 1974
 0-12 Volcanic Clays
 12-22 Basalt

16 m

3160
 P05:841446
 Kaikohe
 31 October 1989
 0-20m Weathered Basalt
 20-40m Basalt
 40-70m Basalt
 70-70 Siltstone

0.63 l/s
 5 m

3058
 P05:855451
 Kaikohe
 20 January 1984
 0-84 Volcanic Ash
 Basalt Flow
 Volcanic Ash

1.21/s
 5 m

3189
 P05:859448
 Kaikohe
 4 December 1987
 0-22m Clays
 22-32 Broken Basalts

8.31/s
 5 m

APPENDIX 3**GROUNDWATER RECHARGE & THROUGHFLOW ESTIMATION**

- 3.1 Infiltration - Soil Moisture Budget Estimate.
- 3.2 Pukekohe Example.
- 3.3 Groundwater Level Rises.
- 3.4 Groundwater Throughflow Estimation.

APPENDIX 3.1**INFILTRATION - SOIL MOISTURE BUDGET ESTIMATE**

Recharge of the basalt aquifer(s) at Kaikohe has been estimated using the method described in Fenemor (1985), a soil moisture budgeting model in which drainage from the base of the soil profile is computed. Kaikohe daily rainfall (site 534803), raised pan evaporation data from Kerikeri, and a soil water holding capacity of 100 mm were used in the model calculations. A surface runoff quickflow loss is included in the model to account for the proportion of rainfall that is quickly lost due to surface runoff and rapid subsurface flow to drains and streams during and immediately after rainfall events. The quickflow loss used in the Kaikohe simulations was calculated from rainfall and stream flow records for the Waipao Stream (Whatitiri catchment) west of Whangarei.

The recharge simulation was carried out for the years 1979 to 1985 inclusive. The mean annual rainfall for that period was 1564 mm and the mean annual recharge was computed to be 563 mm. The results of the simulation are summarised below.

TABLE 3.1**ESTIMATION OF GROUNDWATER RECHARGE**

From Soil Moisture Budgeting Model (Fenemor, 1985)

<u>Year</u>	<u>Rainfall (mm)</u>	<u>Estimated Recharge (mm)</u>
1979	2105	875
1980	1879	739
1981	2010	883
1982	1173	334
1983	1335	391
1984	1096	253
1985	1401	465
mean	1564	563
Quickflow loss:	rainfall (mm/day)	% runoff
	0-20	12
	20-80	24
	80+	40

APPENDIX 3.2

INFILTRATION AS A PROPORTION OF RAINFALL : RELATED STUDIES

Petch et al (1991) carried out a detailed 5 year study of the groundwater and surface water resources of a basalt catchment in the Pukekohe area. Their study produced a mean water balance, for the study period, of:

Rainfall	=	Evapotranspiration	+	Quickflow	+	Infiltration
1317 mm	=	728mm	+	291mm	+	298mm

For a rainfall of approximately 1570 mm per year (see Table 2.1), this equates to an infiltration rate of about 350 mm per year.

APPENDIX 3.3

GROUNDWATER LEVEL RISE

Groundwater level rises have been measured in several wells in the Kaikohe area for a number of winters (refer Figure A3.3) as summarised below:

Year	Rangihamama 5347001	Roadside 5347011	SH12 5347007	Woolshed 5347003
1988	2.94	3.58	2.67 m	3.90
1989	3.80	4.71	3.32	3.80
1990	3.10	4.01	2.94	3.85
1991	3.04	3.69	2.99	3.64
			mean	3.50

Storage Coefficient:

An aquifer's storage coefficient indicates the proportion of the aquifer from which water can be drained. For example, an aquifer with a storage coefficient of 0.01 will yield 10 litres for every cubic metre (1000 litres) of aquifer which is drained.

Pump test analyses (Thompson, 1987) yielded an average storage coefficient of 0.00065.

Groundwater modelling, reported in Roberts (1987) produced an estimate of 0.025. It is considered likely that Thompson's (1987) figures reflect localised conditions only, and that the higher figure of Roberts (1987) is a more realistic estimate.

These figures yield total resource estimates of 2.3 mm per year and 87.5 mm per year respectively.

APPENDIX 3.4**GROUNDWATER THROUGHFLOW ESTIMATION**

Groundwater throughflow analyses estimate groundwater flux through an equipotential surface. Two calculations have been carried out for the aquifer at its widest point south of Kaikohe (between the 180 m and 170 m piezometric contours), and at a narrower section closer to its southern extent, between the 120 m and 130 m piezometric contours (refer Figure 2.10).

Throughflow estimates are as follows:

	Q	=	TiW
where	Q	=	throughflow in m ³ per day
	T	=	transmissivity in m ² per day
	i	=	hydraulic gradient
and	W	=	equipotential line width in metres

	T	i	W	Q
Case 1 (north)	80	0.0087	3700	2575 (9.4 x 10 ⁵ m ³ per year)
Case 2(south)	80	0.04	2250	7200 (2.6 x 10 ⁶ m ³ per year)

Transmissivity has been measured by pump testing in the area of the northern flux estimation, so this estimate can be regarded as more reliable than the southern figure, for which no transmissivity data is available. The steep hydraulic gradient suggest transmissivity may be substantially lower than in the north (consistent with geological history) and hence throughflow lower than estimated.

APPENDIX 4

STREAM FLOW GAUGINGS - MAP OF SITES AND LIST OF GAUGING

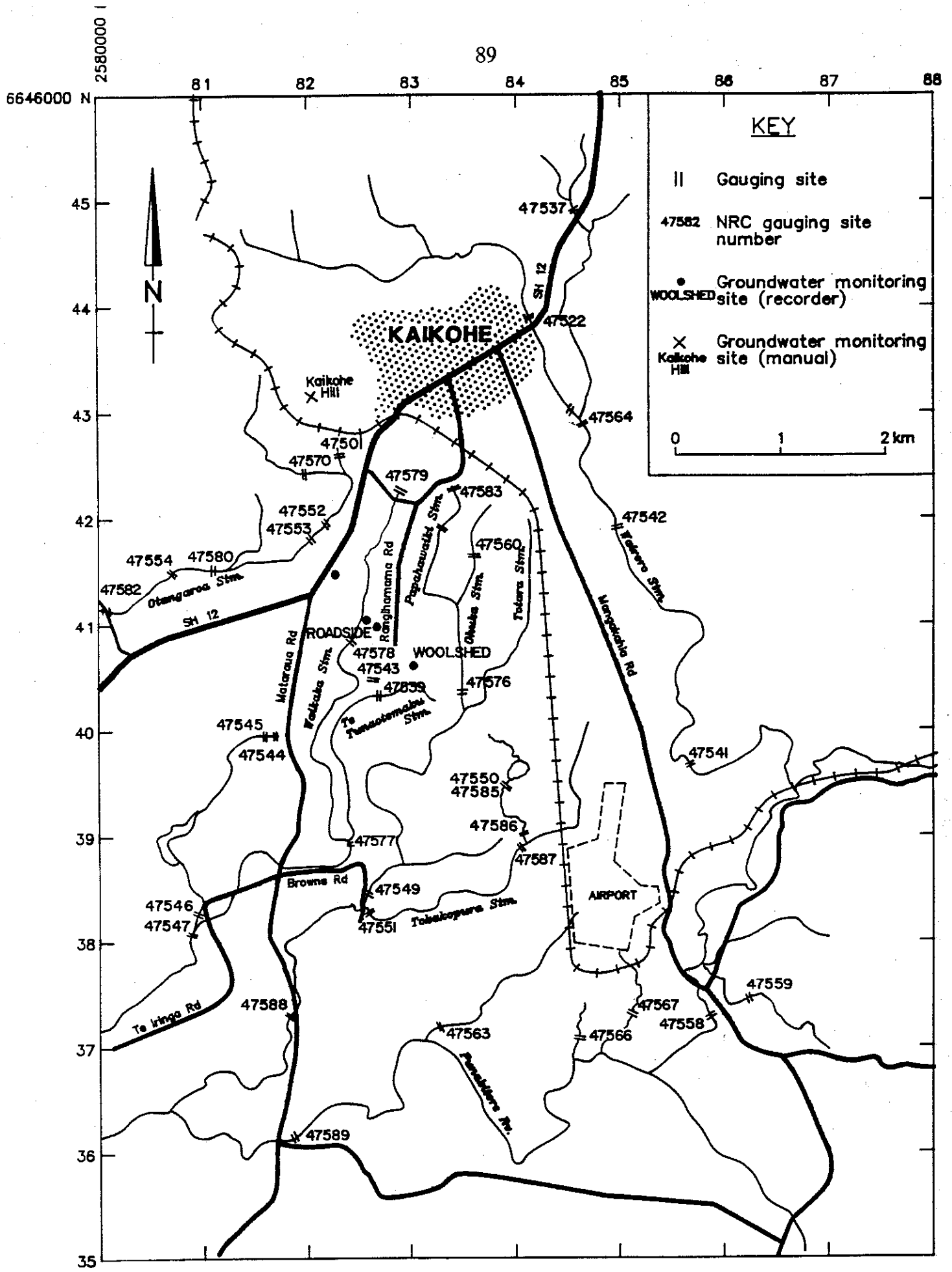


Figure A 4.1: Stream Flow Gauging Sites

TABLE A. **STREAM FLOW GAUGINGS**

SITE NO.	RIVER NAME	SITE NAME	MAP REF.	DATE	FLOW
47524	Mangamutu S	SH12	P05:841-439	731002	97.2
				731122	43.8
				740107	9.6
				740112	4.4
				851217	47.4
				860213	115.0
47522		College Grounds	N15:322-339 P05:844-430	740131	6.5
				861209	28.4
				861216	22.3
				870113	16.9
				870210	10.7
				870305	12.2
				890316	55.9
				890406	24.3
				890420	25.0
				47576	Ohuka S T
730807	24.9				
730904	22.7				
731003	19.1				
731122	12.1				
740107	4.4				
740212	2.2				
47560	Ohuka S	Rangihamama Rd Culvert	P05:835-415	730621	37.2
				730807	48.2
				730904	53.0
				731003	26.6
				731122	16.0
				740107	2.6
				740212	2.2
				880127	24.0
				880211	4.7
				900330	1.2
47577	Omaunu S T	Gerrards Dam overflow	N15:299-300 P06:822-395	801216	8.5
				811205	23.4
				811214	28.0
				820204	7.4
				820125	11.5
				850108	18.6
				850205	8.9
				850212	43.4
				880127	22.0
				880211	23.1
47578	Omaunu (Waikaka) S	Slyfields	N15:300-315 P05:822-408	811214	9.1
				820125	2.4
				820204	1.7
				820115	3.5
				830318	0.6
47579		unnamed (u/s of road)	N15:304-332 P05:828-424	730621	3.6
				730807	4.2
				730904	5.3
				731002	2.4
				731122	0.9
				740107	0.3
				740212	0.1
47547	Omaunu S	Te Iringa Rd	P06:808-381	730621	36.8
				730807	35.2
				730904	57.6
				731002	31.5
				731122	6.9
				740101	4.6
				740212	5.3
				851218	32.6
				860213	64.1
				890310	54.0
				890315	49.0
				890405	22.9
				890420	25.7
				900307	5.5

SITE NO.	RIVER NAME	SITE NAME	MAP REF.	DATE	FLOW
47547 cont				901213	15.9
				910108	3.2
				910122	1.2
				910207	8.9
				910226	2.8
				910314	1.4
				911126	26.8
				911220	10.6
				920115	10.8
47544	Omaunu S T	Guest Upper Spring	N15:293-307 P05:816-401	880128 880212 900307	0.4 3.0 0.0
47546		Above Confluence	P06:809-382	900307	1.2
47545		u/s spring Guest pump	N15:292-307 P05:814-401	880128 880212 890302 890310 900307	3.4 0.0 4.1 3.8 1.5
47570	Otangaroa S T	Rock Outcrop	N15:290-333 P05:819-424	730621 730807 730904 731002 731122 740107 740212 890302 890309 890315 920115 920330	12.6 12.3 18.5 6.1 1.5 0.8 0.8 3.5 2.7 2.7 0.2 0.3
47501		Squires Spring ?	N15:299-334 P05:822-425	730621 730807 730904 731002 731122 740107 740212	0.9 3.1 3.8 0.8 0.7 0.1 0.0
47552		u/s Johnsons Dam	P05:821-419	730621 730807 730904 731002 731122 740107 740212 890309 900306 900419 910212 910215 910226 910314 911223 920115 920320	31.5 224.2 35.2 13.3 3.0 1.4 0.0 5.2 1.9 3.0 1.1 0.5 1.1 1.3 0.3 2.3 1.4
47553		d/s Johnsons Dam	P05:819-418	770809 850108 850205 890302 890309 900306 900419 900419 910212 910215 910226 910314 911223 920115 920330	20.0 2.2 0.0 4.3 3.9 1.5 1.0 0.8 0.4 0.4 0.4 1.0 0.6 1.0 0.9
47554		Barneys Crossing	P05:804-413	820204	1.2

SITE NO.	RIVER NAME	SITE NAME	MAP REF.	DATE	FLOW
47554 cont				820115	5.6
				820125	2.6
				890302	16.2
				890309	14.1
				890315	12.4
				890405	6.0
				900315	1.9
				900329	2.9
				901213	3.3
				910108	1.3
				910122	2.2
				910212	0.5
				910215	0.3
				910226	0.6
				910314	1.1
				911126	9.4
				911223	2.9
				920115	3.3
47580		W.Dalton property	P05:809-415	830211	0.4
47582		Jordon Rd	P05:798-411	851217	24.4
				860613	45.2
47548	Papahawaiki S	Tauri Property	P05:832-418	880128	14.8
				880212	12.3
				890301	14.7
				890310	12.9
				900306	6.0
				900330	6.7
				900419	6.0
				910108	6.0
				910227	6.9
				910314	7.9
47583		Rangihama Rd	P05:832-423	880120	8.7
				880212	7.9
47543	Te Tunaotemaku S T	Windmill Spring	P05:824-405	880127	3.4
				880211	3.1
				890301	4.3
				890310	3.8
				900306	1.3
				900330	1.1
				910108	1.6
				910226	0.9
				910314	1.0
				911220	2.3
				920115	1.8
47584		Down from Woolshed	N15:304-310 P05:826-403	880127	4.9
				880211	4.8
				890301	5.4
47539	Te Tunaotemaku S	Rock Weir	P05:832-403	890301	4.2
				890310	2.0
				890315	1.9
				890420	1.2
				890530	1.5
				890530	1.3
				900306	0.9
				900330	1.2
				910108	0.9
				910226	0.7
				910314	0.9
				910215	0.7
				920128	1.2
47585	Tokakopura S T	New Dam Outfall	P06:841-395	890302	5.5
				890309	6.7
				900306	4.4
47550		Maori Affairs Dam	P06:841-395	811214	9.3
				820125	5.4
				820204	4.7
				820114	5.0
				840229	14.7
				890309	8.0

SITE NO.	RIVER NAME	SITE NAME	MAP REF.	DATE	FLOW
47550 cont				910109	3.2
				910227	1.2
				910313	0.6
47586		Edwards Rd. u/s of cross.	P06:841-390	890301	5.1
				890309	8.9
47587		Wooden Crossing	P06:841-389	811215	28.7
				820125	14.7
				820204	14.0
				820115	17.6
				881006	69.8
				890301	26.6
				890309	28.2
47551		Browns Rd L.H	P06:826-382	811215	69.9
				820114	35.5
				820125	21.9
				820204	12.9
				830318	8.5
				890302	47.3
				890309	49.3
				890315	43.4
				890405	29.6
				890420	30.4
				900307	15.8
				900329	18.7
				910108	11.4
				910215	8.6
				910227	6.6
				910314	5.9
				911126	32.6
911220	36.9				
920115	17.3				
47549		Browns Rd R.H	P06:825-384	811215	75.9
				820114	31.9
				820125	31.9
				820204	20.2
				830318	7.8
				890302	64.5
				890309	60.7
				890315	44.8
				890405	24.6
				900307	7.9
				900329	14.6
				901213	17.7
				910108	5.4
				910215	3.5
				910226	5.1
				910314	3.4
				911126	31.8
911220	36.9				
920115	12.4				
47588	Tokakopura S	Waimatenui Rd.	P06:818-373	830318	30.7
47556	Otaua S T	Renwick Rd (above confl)	P06:732-291	900307	14.4
47555	Otaua S	End Renwick Rd	P06:733-292	900306	82.2
47563	Korowhata S	H.Clarks	P06:832-372	900329	193.0
				910108	10.7
				910122	8.9
				910207	3.7
47565	Punakitere R T	Tautoro Spr.	P06:864-356	910107	27.1
				910313	20.5
47567		O'Connors 1st Culvert	P06:850-374	890405	5.9
				910109	1.2
				910227	1.9
				910313	1.9
				911220	1.5
47566		O'Connors 2nd Culvert	P06:846-372	890405	21.2
				910109	4.2
				910227	3.7

SITE NO.	RIVER NAME	SITE NAME	MAP REF.	DATE	FLOW
47556 cont				910313	3.9
				911220	0.9
47559	Punakitere R	Above Falls	P06:861-374	900329	178.0
				900419	117.4
				910107	69.1
				910226	54.3
				910313	47.7
				911223	71.1
47558		Opp Ngapipito Rd	P06:859-374	900329	408.2
				900419	247.5
				910107	152.4
				910226	84.5
				910313	93.4
				911126	434.8
				911223	174.5
				920207	139.7
47589		Piccadilly Rd	P06:818-361	838318	567.0
47575		Rest Area S.H.12	P06:735-376	830317	716.0
				920207	527.4
				920211	703.9
47537	Wairoro	S.H.12	P05:844-447	860401	69.4
				860423	52.4
				861209	47.0
				861216	38.5
				870113	48.3
				870305	26.1
				870507	59.2
				870514	46.8
				870519	108.0
				870528	39.9
				880128	57.2
				880212	70.7
				890301	106.0
				890309	96.6
				890316	111.0
				890406	60.2
				890420	61.8
				900213	89.2
				900227	39.6
				900306	21.8
				900330	56.4
				900419	40.8
				901214	53.0
				910107	25.7
				910122	30.2
				910207	33.8
				910212	25.8
				910226	16.2
				910313	14.7
				911126	46.3
				911220	26.6
				920115	42.8
				920128	31.6
				920207	18.7
47564		Northland College	P05:846-428	861209	69.7
				861216	64.4
				870113	102.0
				890316	199.0
				890406	98.4
				890420	86.9
				910107	52.6
				910227	29.7
				910313	26.7
47542		Cumbers Rd	P05:848-420	811214	382.0
				820115	130.0
				820125	106.0
				861209	99.2
				861216	78.0
				870113	104.0
				870305	40.0
				870507	157.0

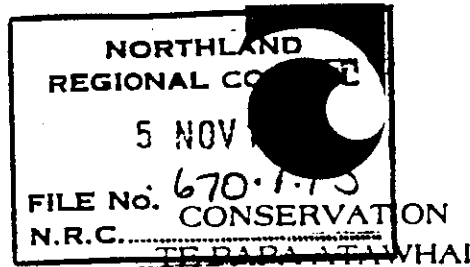
SITE NO.	RIVER NAME	SITE NAME	MAP REF.	DATE	FLOW
47542 cont				870528	112.0
				890316	250.0
				890406	107.2
				900306	48.6
				910313	29.4
				920115	83.6
47541		Quarry	P06:856-397	811215	417.0
				820115	151.0
				820126	117.0
				820205	93.0
				870210	70.5
				870305	77.8
				870507	205.0
				870528	169.0
				890406	129.0
				910107	61.9
				910227	59.7
				910313	45.2

APPENDIX 5**REPORTS ON ECOLOGICAL AND HABITAT VALUE OF STREAMS AND WETLANDS**

- 5.1 Summary of sites included in DOC "Sites of Special Biological Interest" data base.
- 5.2 Ecological Report on Kaikohe/Rangihamama Visit, 9/11/89. Prepared by Lisa Forester, Conservation Officer - Flora, Department of Conservation.
- 5.3 Freshwater Fisheries Assessment. By M R Poynter.

APPENDIX 5.1**SUMMARY OF SSBI, DOC 1992**

- (1) Hows Road Bush (3 separate remnants) - SSBI No. P05/H074
 Grid Reference : 837-406 (P)5 NZMS260
 20 ha site.
 Podocarp - hardwood 2° growth in small patches.
 Totara, rimu, miro, kauri, tree ferns, coprosma arborea.
- Ranking MOD - HIGH (4/11/87)
 (presence of Kauri Snail)
- (2) Mawhitu Dam - SSBI No. P06/H004
 Grid Reference : 820-397 (P06)
 1.5 ha site.
 Man-made freshwater dam. Rounded V shape, edges in Juncus articulata and
 herbs, pasture, pines and gums.
- Ranking - MODERATE (25/8/87)
- (3) Browns Road Swamp - SSBI No. P06/H005
 Grid Reference : 822-386 (P06)
- Narrow tongue of swamp 10 metres wide.
Phormium/Typha association. Slow moving meandering stream with fringe
 swamp. Heavily grazed around edges.
- Ranking - POTENTIAL (9/11/89)



NAME	Action	Info
Chairman		
Gen. Mgr.		
Mgr. Nat Res.		<input checked="" type="checkbox"/>
Maritime Mgr.		
Planning Mgr.		
Commercial Mgr.		
Corporate Mgr.		
Treasurer		
Secretary		

1 November 1990

OUR REF: FLO200

ECOLOGICAL REPORT ON KAIKOHE/RANGIHAMAMA CATCHMENT VISIT

9 NOVEMBER 1989

On 9 November 1989 Conservation Officer, Flora, Lisa Forester visited several sites in the Kaikohe/Rangihamama Catchments with Northland Regional Council representatives, D Kokich and M Poynter who were gathering data for the Northland Regional Council using water measurement and electric fishing techniques. Brief vegetation/wetland descriptions were completed for each area with a botanical species list. Time spent in each area allowed only cursory descriptions to be done.

Results

All of the areas visited were severely modified and cattle grazed with a very depauperate number of native plants present. The ecological value of such areas is limited under intense grazing regimes, although fencing of the wetlands and margins would create good potential habitats especially for wetland birds. The only area listed by the Wildlife Service as a Site of Special Wildlife Interest is the Browns Road swamp because it is likely to contain spotless and marsh crake (see appendix I) and the potential of this wetland would be increased by damming and fencing. However, Browns Road has been given the lowest ranking of "Potential" habitat.

A site which was not visited which could be of floristic interest is the Kahikatea stand at the head of site 1. Such lowland kahikatea stands now have a restricted distribution in Northland.

Listed below are descriptions and species lists for each area:-

SITE 1 - OHUKA STREAM

Description

This area is a long, open, grassy wetland with a stand of kahikatea forest at its head (not visited). The wetland is being grazed and is severely modified.

There is a small amount of raupo with a few wheki in the middle. A shining cuckoo was heard.

Species:-

Podocarps

Dacrycarpus dacrydioides kahikatea

Podocarpus totara totara

Dycotyledons

Alectryon excelsa totoki

Beilschmiedia tarairi taraire

Corynocarpus laevigatus karaka

Monocotyledons

Baumea articulata sedge

Carex virgata sedge

Isolepis prolifer sedge

Typha orientalis raupo

Ferns

Dicksonia squarrosa wheki

Adventives

Callitriche stagnalis starwort

Glyceria declinata floating sweetgrass

Polygonum spp. willow weed

SITE 2 - PAPAHAWAIKI STREAM BELOW HOUSE

Description

This area is an open grassy wetland with a few trees around the edge. The area is grazed.

Podocarps

Podocarpus totara totara

Docotyledons

Coprosma parviflora

swamp maire

Monocotyledons

Carex virgata

sedge

C. dissita

sedge

Cyperus sp.

umbrella sedge

Isolepis inundata

sedge

I. prolifer

sedge

Adventives

Holcus lanatus

Yorkshire fog

Juncus articulatus

jointed rush

Rorippa nasturtium - aquaticum

watercress

Polygonum sp.

willow weed

Ranunculus repens

creeping buttercup

SITE 3 - WAIKAKA STREAM AT END OF RACE

Description

This fairly open stream has some bush on the edges. Eucalypt species are present also on the edge of the stream. Grazed. Birds recorded include: pukeko, blackbirds, song-thrushes, sky-lark, Californian quail and Paradise duck.

Podocarps

Dacrycarpus dacrydioides

kahikatea

Podocarpus totara

totara

Dycotyledons

Metrosideros perforata

white rata

Vitex lucens

puriri

Weinmannia silvicola

towai

Monocotyledons

Carex sp.

sedge

Isolepis inundata

sedge

Ferns

<u>Blechnum</u> sp. 1	kiokio
<u>Cyatheamedullaris</u>	ponga
<u>Dicksonia squarrosa</u>	wheki
<u>Diplazium australe</u>	
<u>Pyrrosia eleagnifolia</u>	leatherleaf - fern

Adventives

<u>Arum italicum</u>	Italian Arum
<u>Anthroxanthum odoratum</u>	sweet vernal
<u>Berberis glaucocarpa</u>	barberry
<u>Callitriche stagnalis</u>	starwort
<u>Cirsium vulgare</u>	Scotch thistle
<u>Colocasia esculenta</u>	taro
<u>Eucalyptus</u> sp.	gum
<u>Juncus articulatus</u>	jointed rush
<u>J. effusus</u>	soft rush
<u>Lotus pedunculatus</u>	lotus
<u>Polygonum</u> sp.	willow weed
<u>Populus</u> sp	poplar
<u>Rorippa nasturtium - aquaticum</u>	watercress
<u>Rubus fruticosus</u>	blackberry
<u>Senecio bipinnatisectus</u>	Australian fireweed
<u>Solanum mauritianum</u>	woolly nightshade

SITE 4 - TE TUNAOATEMAKU STREAM BELOW CROSSING

Description

Very open wetland/stream with a small patch of bush. Grazed.

Podocarps

<u>Dycrycarpus dacrydioides</u>	kahikatea
<u>Dacrydium cupressinum</u>	rimu

Diclytyledons

Laurelia novae-zelandiae

pukatea

Myrsine australis

mapou

Syzygium maire

swamp maire

Weinmannia solvicola

towai

Ferns

Blechnum minus

swamp kiokio

Pyrrosia eleagnifolia

leatherleaf - fern

Adventives

Anthroxanthum odoratum

sweet vernal

Callitriche stagnalis

starwort

Colocasia esculenta

taro

Juncus articulatus

jointed rush

Plantago lanceolata

plantain

Polygonum sp.

willow weed

Rorippa nasturtium-aquaticum

water cress

SITE 5 - OTANGAROA STREAM AT ROCK SHELF

Description

An open stream near open swamp area grazed to edge of bank.

Dicotyledons

Myriophyllum ?triphyllum

milfoil

Monocotyledons

Eleocharis acuta

sedge

Isolepis prolifer

sedge

Sparganium subglobosum

sedge

Adventives

Anthroxanthum odoratum

sweet vernal

Callitriche stagnalis

starwort

Holcus lanatus

Yorkshire fog

Juncus articulatus

jointed rush

<u>Lotus pedunculatus</u>	lotus
<u>Polygonum ?decipiens</u>	willow weed
P. sp.	willow weed
<u>Ranunculus repens</u>	creeping buttercup
<u>R. trichophyllus</u>	water buttercup
<u>Ulex europeaus</u>	gorse

P. trichophyllus
(P. trichophyllus)

SITE 6 - OTANGAROA STREAM AT ROCK CROSSING

Description

Open stream with overhanging bank vegetation but no trees. Juncus articulatus is dominant with Isolepis prolifer occasional and Myriophyllum very occasional. Taro is locally abundant. Nesting Paradise shelducks were present.

Podocarps

<u>Podocarpus totara</u>	totara
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Dicotyledons

<u>Alectryon excelsa</u>	titoki
<u>Myriophyllum propinquum</u>	milfoil
<u>Potamogeton cheesmannii</u>	pondweed

Monocotyledons

<u>Carex maorica</u>	sedge
<u>Isolepis inundata</u> or <u>reticularis</u>	sedge
<u>I. prolifer</u>	sedge

Adventives

<u>Anthroxanthum odoratum</u>	sweet vernal
<u>Cirsium vulgare</u>	Scotch thistle
<u>Colocasia esculenta</u>	taro
<u>Glyceria declinata</u>	floating sweet grass
<u>Holcus lanatus</u>	Yorkshire fog
<u>Juncus articulatus</u>	jointed rush
<u>Mentha pulegium</u>	pennyroyal
<u>Myosotis laxa</u> ssp <u>caespitosa</u>	water forget-me-not
<u>Polygonum</u> sp.	willow weed

Ranunculus repens

creeping buttercup

Rumex sp.

dock

Trifolium sp.

clover

SITE 6a - OMAUNU STREAM

Description

Gravelly stream with overhanging vegetation and trees. Open, light covering of eucalypts with pines and occasional willow. Also very occasional taraire and tobacco weed over mamaku and occasional karaka and wheki. One planted kowhai. Grazed.

Dicotyledons

Beilschmiedia tarairi

taraire

Calystegia sepium

bindweed

Corynocarpus laevigatus

karaka

Geranium solanderi "Coarse hairs"

geranium

Sophora microphylla

kowhai

Monocotyledons

Carex ?dissita

C. germinata

C. virgata

Cordyline australis

Isolepis inundata

Isachne globosa

Juncus australis

J. pallidus

Oplismenus imbecillis

Ferns

Blechnum sp1 (= B. capense sensu Alan)

kiokio

Cyathea medullaris

mamaku

Dicksonia squarrosa

wheki

Diplazium australe

Deperia petersoni

<u>Histiopteris incisa</u>	waterfern
<u>Phymatosorus diversifolius</u>	hounds tongue
<u>Pteridium esculentum</u>	bracken
<u>Pyrrosia eleagnifolia</u>	leatherleaf fern
<u>Adventives</u>	
<u>Callitriche stagnalis</u>	starwort
<u>Cirsium vulgare</u>	Scotch thistle
<u>Conyza albida</u>	fleabane
<u>Crepis capillaris</u>	hawksbeard
<u>Colocasia esculenta</u>	taro
<u>Eucalyptus sp.</u>	eucalypt
<u>Holcus lanatus</u>	Yorkshire fog
<u>Hypochaeris radicata</u>	catsear
<u>Juncus effusus</u>	soft rush
<u>Lotus pedunculatus</u>	lotus
<u>Phytolacca octandra</u>	inkweed
<u>Pinus ?radiata</u>	pine
<u>Plantago major</u>	broad leaf plantain
<u>Polygonum sp.</u>	willow weed
<u>Rorippa nasturtium-aquaticum</u>	watercress
<u>Rumex sp.</u>	dock
<u>Salix sp.</u>	willow
<u>Senecio bipinnatisectus</u>	Australian fireweed

SITE 7 - TOKAKOPURA STREAM

No information.

SITE 8 - OMAUNU STREAM BELOW BROWNS ROAD

Description

Stream running along edge of 10m wide fertile wetland. Dense raupo cover with scattered flax and Juncus articulatus on edges. One or two kahikatea with manuka fringe. Cabbage tree, gorse/manuka shrubland above swamp on one side only. Area is registered Site of Special Wildlife Interest (Appendix I) listed at "Potential" habitat.

Heavily grazed and trampled.

Listed on the wildlife cards are Mynah, thrush, welcome swallow, Australasian harrier, fantail, skylark, blackbird, silvereye, pukeko with spotless crane and marsh crane probably present. The card also states that partial daming would increase area of swamp vegetation and continuity.

Podocarps

Dacrycarpus dacrydioides

Dicotyledons

Leptospermum scoparium

manuka

Monocotyledons

Carex virgata

sedge

Cordyline australis

cabbage tree

Eleocharis acuta

sedge

Isachne globosa

grass

Isolepis ?inundata

sedge

Ferns

Cyathea dealbata

ponga

Adventives

Callitriche stagnalis

starwort

Polygonum sp.

willoweed

Rorippa nasturtium-aquaticum

watercress

Rumex sp.

dock

Salix sp.

willow

Urex europeaus

gorse

SITE 9 - TOKAKOPURA STREAM AT MATARUA BRIDGE ROAD

Description

Flowing rocky stream in open pasture grazed to edges but with weedy margins and the occassional kahikatea, flax, mamaku, totara and soft rush.

Podocarps

Dacrycarpus dacrydioides

kahikatea

Podocarpus totara

totara

Monocotyledons

Carex virgata

Juncus pallidus

Ferns

Blechnum sp1 (= B. Capense sensu Alan)

kiokio

Pteridium esculentum

bracken

Adventives

Anthroxanthum odoratum

sweet vernal

Bromus sp.

broome

Cortaderia selloana

pampas

Crepis capillaris

hawkesbeard

Galium aparine

cleavers

Holcus lanatus

Yorkshire fog

Hypochaeris radicata

catsear

Juncus effusus

soft rush

Pennisetum clandestinum

kikuyu

Rorippa nasturtium-aquaticum

watercress

Rubus fruticosus

blackberry

Rumex sp.

dock

Senecio jacobea

ragwort

Sison amomum

stone parsley

Solanum mauritianum

wody nightshade

Tradescantia fluminensis

wandering jew

Ulex europeus

gorse

SITE 10 - OMAUNU STREAM AT TE IRINGA ROAD BRIDGE

Description

Fast flowing rocky stream with willow on the edge in places. Very open and modified with cattle grazing to edge.

Dicotyledons

Callitriche stagnalis

starwort

Potamogeton cheesmannii

pondweed

Monocotyledons

Isachne globosa

grass

Adventives

Bromus sp.

broome

Daucus carota

carrot weed

Galium aparine

cleavers

Juncus effusus

soft rush

Polygonum spp.

willowweed

Ranunculus repens

creeping buttercup

Rorippa nasturtium-aquaticum

watercress

Rubus fruticosus

blackberry

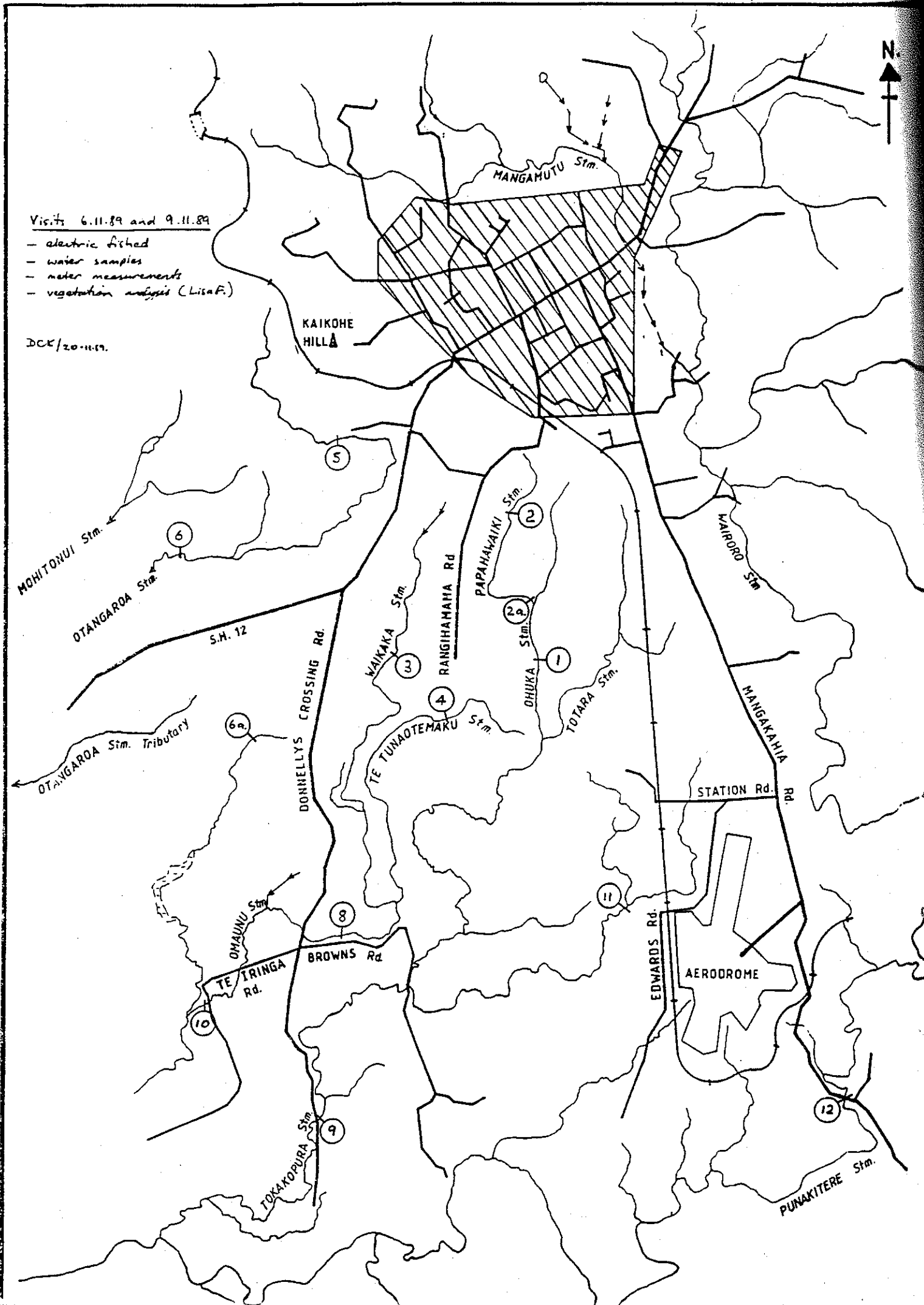
Sonchus oleraceus

sow thistle

SITE 11 - No information.

SITE 12 - No information.

FIGURE 1 : FISHERIES SURVEY SITES



KAIKOHE BOROUGH WATER SUPPLY
FRESHWATER FISHERIES ASSESSMENT

A Report Prepared For :

Northland Regional Council
Private Bag
WHANGAREI

By :

M R Roynter
Environmental Consultant
P O Box 7105
WHANGAREI

21 November 1989

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1.0	Introduction
2.0	Study Area
3.0	Results and Discussion
4.0	Conclusions

1.0 INTRODUCTION

An outcome of the Northland Regional Council's (NRC) consideration and decision in respect of water right application 4393 in which the Kaikohe Borough sought approval to take up to 2300 cubic metres of natural water per day from a bore in the catchment of the Tokakopura Stream was the following resolution :

"That the Northland Regional Council give immediate priority to a more complete water resource survey and preparation of a water management plan for the Kaikohe District groundwater resource and associated surface catchments."

Ref: Northland Regional Council Water and Soil Management Committee. Report of Standing Tribunal. Water Right Application No. 4393.

As part of this water resource survey, in November 1989, 12 stream sites to the south and southwest of Kaikohe Borough were surveyed and evaluated as to their freshwater fish fauna and more generally as to their ecological state.

2.0 STUDY AREA

Figure 1 provides a map of the study area and the survey sites.

3.0 RESULTS AND DISCUSSION

Appendix 1 provides a summary of the field survey results.

The streams inspected fall into one of several general types :

- (i) Small, slow flowing, emanating from spring fed wetlands, water generally clear although substrate silted, heavy macrophyte growth, pastoral edges (i.e. survey sites 2, 2a, 8 and 10).
- (ii) Small to medium stream, open pastoral with undercut banks and/or patchy overhanging vegetation (i.e. survey sites 4, 5, 6 and 11).
- (iii) Cascade and/or boulder run streams, well shaded and/or overhung by riparian vegetation and undercut banks (i.e. survey sites 3, 6a and 9).
- (iv) Large, open aspect and turbid (i.e. survey site 12).

There was little difference in the fish diversity in the different stream types. Only 3 native fish species were recorded in the entire survey. Short fin eel (Anguilla australis) was common although long fin eel (A. dieffenbachii) were also recorded. One common bully (Gobiomorphus cotidianus) was recorded in the Tokakopura Stream (Site 9).

In fact common bullies were notable by their absence as the habitat at most sites appeared generally suitable for this species. One may also have expected red fin bully (Gobiomorphus huttoni) at site 9 but this was not recorded.

Aquatic insects were less obvious than expected in the faster flowing streams as were native crayfish (Koura) at sites rich in macrophytes such as watercress (Nasturtium officinale).

Levels of dissolved oxygen above 85% saturation occurred at all but 1 site and thus were adequate to sustain native fishes. Site 2 showed a depressed oxygen level of 63.5% saturation. This site was swampy and rich in organic material, the decay of which was presumably exerting a demand on available oxygen. Oxygen levels probably decline quite markedly as water temperatures rise at the swampy sites. It is unlikely that eels are deterred from colonising such locations although other species might be.

pH ranged from 5.9 to 7.5. It was most acidic at site 5, the upper Otangaroa Stream station. Here the water was stained brown and its peaty appearance and pH probably reflected an elevated concentration of humic acids from upstream swamp sections. However at other sites pH was within the range normal for natural waters and as such would not be a significant factor influencing fish diversity or abundance.

There are quite substantial falls on the Punakitere River near Taheke. These falls restrict species such as smelt (Retropinna retropinna), inanga (Galaxias maculatus) and torrent fish (Cheimarrichthys fosteri) from inhabiting upstream sections of the Punakitere and its tributaries.

The general habitat structure of the subcatchments inspected is highly modified and downgraded from a native fish perspective. As such, the area is not suited to fish such as the various Kokopu species (Galaxias spp) which almost exclusively inhabit native forested side streams and tributaries in upper catchment areas.

It can be noted that the Punakitere Stream contains a self recruiting recreational rainbow trout (Oncorhynchus mykiss) fishery established by the Bay of Islands Acclimatisation Society. This fishery is quite well patronised by local anglers. The results of one angler's catch between 17 November 1988 and 29 April 1989 showed 14 wild fish caught at any average length and weight of 35.6cm and 0.61kg (1.4 pounds) respectively.

One regular Punakitere angler (B Birchall pers comm) reports that there are very few common bullies in the river and also that trout diet is mainly insects of terrestrial rather than aquatic origin. Mosquito fish (Gambusia affinis) and common goldfish (Carassius auratus) are two other exotic species also reported to be common in some Punakitere tributaries.

4.0

CONCLUSIONS

- (i) Fishery values of the tributaries to the Punakitere Stream are low. Short fin eel is the only species commonly present.
- (ii) There are no recreational fishery values in the tributaries or other values based on faunal or community rarity or commercial exploitation.
- (iii) General instream and ecological values associated with these streams are also low due to their generally small size and the modified nature of the catchment. There are however a number of wetlands, several of which have or should have been recorded as Sites of Special Wildlife Interest.
- (iv) Provided that a minimum flow of 40% of the 1 in 5 year design drought flow is maintained to protect general ecological values, allocation of water up to that amount will have no deleterious impact on aquatic life or fisheries.

Mark Poynter

22 November 1989

APPENDIX : SUMMARY OF SURVEY RESULTS AT 12 STREAM SITES

SITE NO.	NAME	FISH & OTHER FAUNA	TEMPERATURE °C	pH	DISSOLVED OXYGEN mg/l	% SATURATION	COMMENT
1	Ohuka Stream	Not sampled	17	6.4	8.4	87.5%	
2	Papahawaki Stream	Anguilla australis (short fin eel) Potamopyrgus antipodarum (snail) Lymnaea spp (snail) Sphaeridae spp (small bivalve)	16.5	6.1	6.2	63.5%	Pastoral, swampy, heavily silted, spring fed, dense macrophytes
2a	Papahawaki Stream (downstream)	A. australis	17	6.4	7.5	78%	Edge of raupo/kahikatea swamp, dense macrophytes, little other biota
3	Waikaka Stream	A. australis	17.5	6.5	9.6	101%	Rocky, good cover, little other biota
4	Te Tunaoemaku Stream	A. australis	17	6.5	8.6	90%	Pastoral, rocky bed, <u>Nasturtium</u> , no Koura
5	Otangaroa Stream	Not sampled	21	5.9	7.6	85.4%	Pastoral, downgraded, peaty coloured
6	Otangaroa Stream (downstream)	A. australis Paranephrops spp (Koura)	19.5	6.4	10.1	109.1%	Pastoral, bank vegetation
6a	Omaunu Stream	A. australis	15.5	6.3	8.5	85%	Well shaded, good cover
7	Tokakopura Stream	Not sampled (dry)	-	-	-	-	No instream values
8	Omaunu Stream	Not sampled	17	6.5	7.6	79%	Pastoral, edge of raupo swamp, eels probably

SITE NO.	NAME	FISH & OTHER FAUNA	TEMPERATURE °C	PH	DISSOLVED OXYGEN mg/l	% SATURATION	COMMENTS
9	Tokakopura Stream	A. australis A. diffebachii (long fin eel) Gobiomphus cotidianus (common bully) P. antipodarum (snail) Koura	17.5	7.5	9.9	104.2%	Fast flowing, cobbles and boulders, undercut banks, good habitat
10	Onaunu Stream	Gambusia affinis (mosquito fish) A. australis Koura	-	-	-	-	Pastoral, <u>Nasturtium</u> , <u>Callitriche</u> , eels abundant
11	Tokakopura Stream	Not sampled	17.9	6.8	8.0	85%	Pastoral, probably eels
12	Punakitere Stream	Not sampled	17.2	7.1	9.0	93%	Large stream, turbid and silted. Eels, rainbow trout reported

APPENDIX 6

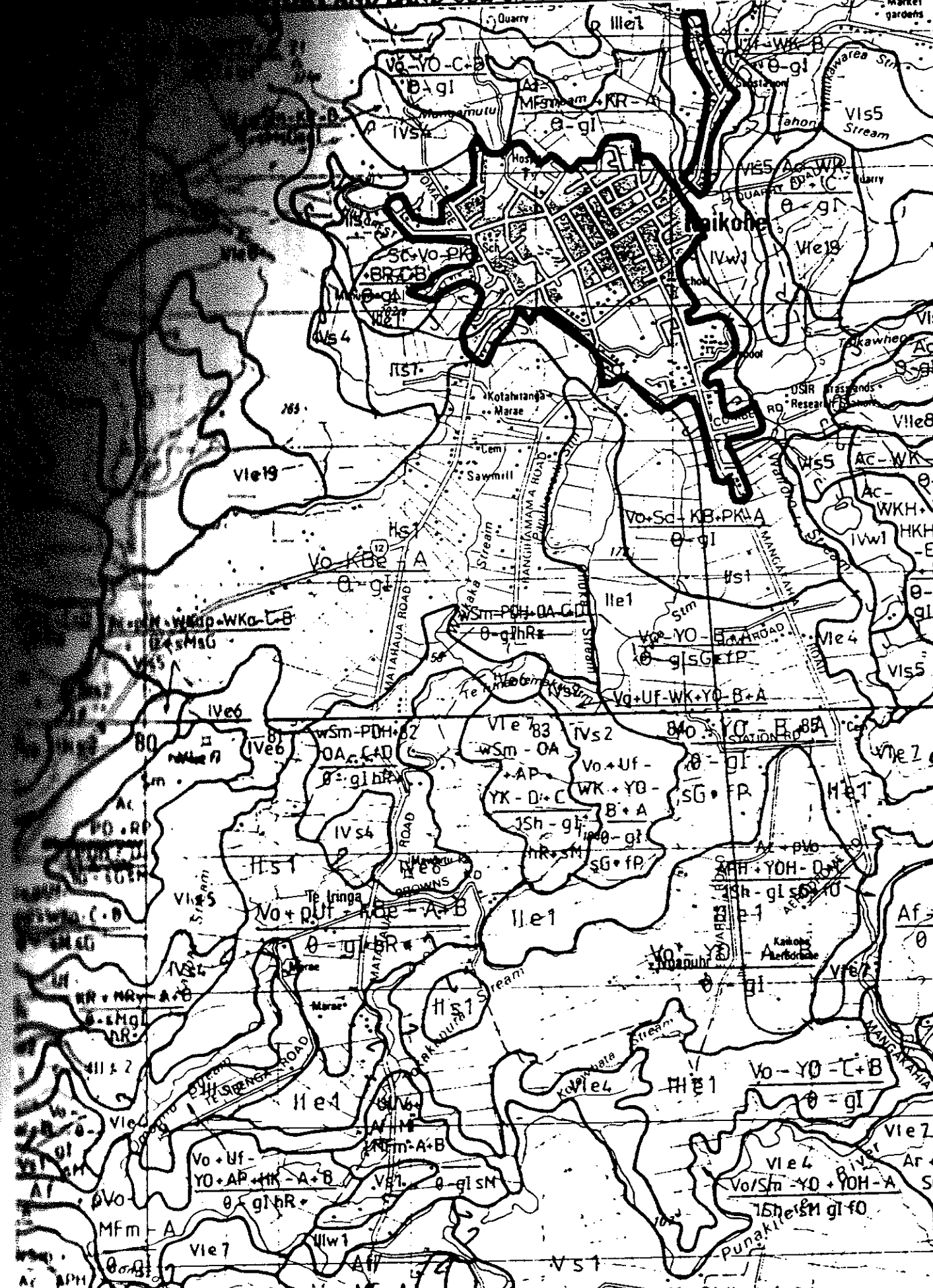
TABLE A61

LIST OF CURRENT, EXPIRED, AND SURRENDERED WATER RIGHTS IN THE KAIKORU AREA

No.	Name	Type	Map ref.	Catchment	Status	Quantity m ³ /day	Use
4790	FAR NORTH DC - KAIKORU TIP	DISCHARGE	P05:837-428	PAPAHAWAIKI STM	A	6	tip transfer/consent
2937	CLARK H A	DISCHARGE	N015:303-287	TOKAKOPURA S T	C	100	combined effluent
1659	THOM BH	SURFTAKE	P05:848-418	WAIKAKA STM	C	100	irrigation
4026	JOHNSONS PLANTS LTD	UNDERTAKE	P05:822-418	OTANGAROA STM T	C	45	irrigation
4732	SMITH WD	SURFTAKE	P06:824-391	TE-TUNOTEMAKU S	C	100	irrigation
2452	RANGIHAMA OMAPERU TRUST	DAM	P06:840-394	TOKAKOPURA STM T	C	50	irrigation
3875	JOHNSONS PLANTS LTD	UNDERTAKE	P05:822-411	TOKAKOPURA STM T	C	38	irrigation
2006	KAIRANGI ORCHARD	UNDERTAKE	P05:827-414	WAIKAKA STM T	C	1600	public water supply
1865	JOHNSON'S PLANTS LTD	UNDERTAKE	P05:826-432	MANGAMUTU STM	C		abbatoir effluent
4393	FAR NORTH DC - TOKAKOPURA STM - W/S	UNDERTAKE	P05:826-409	TOKAKOPURA STM	C		irrigation
4539	KAIKORU ABBATOIR CO	DISLAND	N015:310-290	TOKAKOPURA STM	C		irrigation
1882	COOPER BM	SURFTAKE	P05:838-453	WAIKAKA STM T	C	1800	cowshed effluent
2687	NORTHLAND COLLEGE BOARD	DISCHARGE	N015:328-340	WAIKAKA STM	C		public water supply
4109	FAR NORTH DC - WAIKAKA STM - W/S	SURFTAKE	P05:843-447	WAIKAKA STM	C		public water supply
3626	GERRARD PW	SURFTAKE	P05:819-401	WAIKAKA/OMAUU STM	C		public water supply
1862	FAR NORTH DC - OTANGAROA S PUB W/S	UNDERTAKE	P05:849-431	OTANGAROA STM	C	1100	irrigation
3672	GRASLANDS DIVISION DSIR	SURFTAKE	P05:833-452	WAIKAKA STM	C	20	irrigation
4046	FAR NORTH DC - WAIKAKA STM W/S	SURFTAKE	P05:823-407	WAIKAKA S	C	150	irrigation
4826	BERNORA PRODUCE LTD	SURFTAKE	P06:826-396	TOKAKOPURA STM T	C	90	irrigation
2939	MUNFORD N H & I J	SURFTAKE	P05:846-426	WAIKAKA STM	C	25	irrigation
3707	NORTHLAND COLLEGE BOARD OF TRUSTEES	SURFTAKE	P05:816-401	OMAUU STM	C	100	irrigation
2172	NORTHLAND COLLEGE BOARD OF TRUSTEES	SURFTAKE	P05:832-376	PUNAKITERE R	C		farm water
2451	ANTUNOVIC MI & JA	DAM	N015:296-326	OTANGAROA STM	C		irrigation
2782	JOHNSON'S PLANTS LTD	DAM	P05:842-390	TOKAKOPURA STM	C		abbatoir water
4540	KAIKORU ABBATOIR CO	DAM	P05:856-409	WAIKAKA STM	C		sewage
2417	FAR NORTH DC - WAIKAKA S, TREATY EF	DISCHARGE	P05:823-407	WAIKAKA STM	C		irrigation
3850	FAR NORTH DC - MANGAMUTU STEM T	DIVERT	N015:312-353	WAIKAKA STM	D		irrigation
4662	BERNORA PRODUCE LTD	SURFTAKE	P05:823-407	TOKAKOPURA STM	E		irrigation
3855	GARNER DM	UNDERTAKE	N015:293-271	OMAUU STM	E		irrigation
2601	RANGITATA FARM LTD	DISCHARGE	N015:298-520	OMAUU STM	E		irrigation
2707	JOHNSONS PLANTS LTD	UNDERTAKE	P06:845-371	PUNAKITERE R T	E		irrigation
1672	HYLAND LR	SURFTAKE	N015:324-264	PUNAKITERE R	E		irrigation
3691	HYLAND LR	SURFTAKE	N015:325-315	TOKAKOPURA S T	E		irrigation
3687	INESON K & H	UNDERTAKE	N015:288-315	OTANGAROA STM	E		irrigation
2007	JOHNSON NFS	UNDERTAKE	N015:289-335	WAIKAKA S SPRING	E		water supply
2923	MAHI KIA MOHIO TRUST	SURFTAKE	N015:284-313	OTANGAROA STM T	E		irrigation
2453	O'CONNOR MJ & CH	DAM	N015:330-280	PUNAKITERE R T	E		irrigation
1500	WRIGHT EWA & FM	SURFTAKE	N015:295-275	TOKAKOPURA STM	E		irrigation
2749	MACKIE AJ & SL	UNDERTAKE	N015:289-316	OTANGAROA STM	S		irrigation
2735	BROWN RW	SURFTAKE	N015:296-278	TOKAKOPURA STM	S		irrigation
2733	JENKINS RN	UNDERTAKE	N015:300-323	OMAUU STM	S		irrigation
3627	MARSHALL P E	SURFTAKE	N015:334-311	WAIKAKA STM	S		irrigation
1666	ROSELL AND ROWSELL LTD	UNDERTAKE	N015:303-327	WAIKAKA STM	S		timber mill
3832	HARFORD FAMILY ORCHARDS	SURFTAKE	N015:317-361	MANGAMUTU STM	S		irrigation
2922	MCGRATH J A	SURFTAKE	N015:303-333	OMAUU STM T	S		irrigation

NOTES: 1) 'SURFTAKE' - taking water from a stream. 'UNDERTAKE' - taking of groundwater. 2) A - application, C - current consent, D - application declined, E - an expired consent, S - a consent that has been surrendered.

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From: NZLRI Worksheets P05
 Kaikohe and P06 Mangakahia
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