A survey to investigate the presence or absence of *Didymosphenia geminata* in selected Southland rivers

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Prepared for

Biosecurity New Zealand

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Contents

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Executive Summary

1. The invasive alga *Didymosphenia geminata* is now abundant in the lower Waiau and Mararoa Rivers, Southland, both of which are popular fishing rivers. There is concern that it may have been transferred to neighbouring catchments, which also have important trout fisheries.

2. Sixty-two sites in the Upper Waiau, Von, Oreti, Aparima and Mataura Rivers were surveyed on 17-18 December 2004 to check for the presence of low levels of *D. geminata*.

3. The survey targeted river sites from which *D. geminata* would be most likely to spread into the river (i.e. fishing/recreational access points). The sampling method also targeted habitats most likely to be colonized by *D. geminata*.

4. Thirty-six drift-net samples provided information about algal drift between the sites. These samples were taken because, in rivers where it is present, *D. geminata* is known to form drifting fragments.

5. Approximately 550 sub-samples of stone scrapings and drift net samples were examined microscopically. No traces of *D. geminata* cells or stalks were found in any of the examined material.

6. A simple test using binomial (presence/absence) data was used to estimate the probability of finding *D. geminata* in the survey. Assuming independent sampling units (sites), random sampling, and uniform distribution of *D. geminata* with an expected occurrence in less than 5 of every 100 sampling units (if it was present in the rivers), a 62-site survey has a 95% probability of finding *D. geminata* in at least one sampling unit. For an expected occurrence of 2 in every 100 sampling units, the probability of finding *D. geminata* in the survey falls to 72%.

7. The survey failed to detect *D. geminata* at any of the 62 access sites surveyed in the Upper Waiau, Von, Oreti, Aparima and Mataura Rivers. The number of locations sampled allows us to be confident (at the 95% confidence level) that *D. geminata* is either absent from the areas sampled, or occurs at a very small number of locations (in this case, fewer than 5% of access points).

8. Because the sampling was specifically directed at sites and habitats most likely to pick up *D. geminata* these probabilities are likely to be conservative. This increases confidence that the negative result indicates absence of the species from the rivers.

1. Introduction

Didymosphenia geminata, a Northern Hemisphere invasive diatom (type of alga), has been declared by Biosecurity New Zealand to be an unwanted organism. The species is currently blooming in the Mararaoa and lower Waiau Rivers. A visual survey of other rivers in the Southland/Otago region on 25-26 November 2004 yielded no sightings of other proliferations of this diatom. However, given the massive occurrence of the species in the Mararoa/lower Waiau catchment, there is a strong possibility that *D. geminata* may already be present in nearby rivers, but in low quantities. It is important to determine whether this diatom has colonized adjacent catchments because this has implications for whether future confinement/control measures might be feasible.

The purpose of the survey described in this document was to detect *D. geminata*, if it was present, in selected Southland rivers. The rivers surveyed were the Upper Waiau, Von, Oreti, Aparima and Mataura Rivers, all of which are popular trout fisheries. Southland Fish & Game identified these rivers as particularly vulnerable to infestation by *D. geminata* for the following reasons:

- Their upper reaches are close to the Mararoa and lower Waiau Rivers;
- There are known, regular, movements of fishermen and other recreational users among these rivers and the Mararoa River, especially in the upper reaches;
- These rivers are all physically somewhat similar to the Mararoa and lower Waiau Rivers, and their upper reaches tend to experience long periods of low, stable flows that would favour the growth of *D. geminata*.

Absence of an algal species in a river can never be *absolutely* established because it is generally only possible to sample a small proportion of the places where the alga might grow. Therefore, to ensure that a negative survey result has a high chance of reflecting the absence of the species from the river, it is necessary to maximize the chance of finding the alga. This can be achieved by: (1) sampling many sites, (2) targeting the sampling at points where the alga is most likely to have been introduced, and (3) sampling the habitats that the alga is most likely to colonise first.

It is suspected that *D. geminata* was introduced into the Mararoa and lower Waiau Rivers by recreational river users (fishermen/kayakers/ etc.), although this can never be proven. Assuming this was the case, then spread to other catchments is likely to

occur by the same means. Therefore locations sampled in the present survey were generally places with public access, which are used regularly by fishermen, kayakers and other river users.

The survey was undertaken on 17 – 18 December 2004.

2. Methods

2.1. Field procedures

On each river, sampling was undertaken from upstream to downstream to eliminate any chance of the upstream transfer of *Didymosphenia*. A "sampling site" was defined as a river reach with stony substrate, approx. 20-40 m. long. All sites were fishing access points listed in the Southland Fish and Game fishing brochures (see www.fishandgame.org.nz/SITE_Default/SITE_your_region/SITE_Southland/Fishing/**access**.asp.) Up to 10 rocks were selected from each sampling reach in light of what has already been observed about the habitat preferences of *D. geminata* (Kilroy 2004):

- In moderate velocity waters (i.e., not in very still waters, not in very fast flowing waters), which are usually wadeable. The species may be present in backwaters of rivers (out of direct flow, but subject to constant water movement). In the early stages of colonization it is likely that *D. geminata* will not be in fast-flowing areas (> 1 m/s).

- In well-lit areas of the stream bed (but this did not preclude areas that are in shade for part of the day);

- On stable substrates: i.e. most likely to occur on substrate of cobble-size or larger (>150 mm diameter).

The sampling team was also instructed to look for rocks with very tiny, tightly adhering, light brownish bumps, but to include rocks with all types of algae.

Samples were taken by scraping and/or brushing the algae from the surface of the rocks, and then rinsing the resulting suspension of algae into labeled containers. From one to five (occasionally more) subsamples were taken at each site. Each sample therefore comprised the algae scraped from one or more rocks.

In addition to the stone samples, drift nets were deployed at over half of the sites sampled, for up to one hour. The contents of the drift net were rinsed into a separate

container. Drift nets were used because in the Mararoa and lower Waiau, floating fragments of *D. geminata* have been reported to be very obvious (B. Jarvie, Southland Fish & Game, pers. comm.) Thus drift was thought to be a useful way of collecting an integrated sample that might pick up any sources of *D. geminata* between the fishing access points.

Since at the time of sampling it was not known whether *D. geminata* was present or not, precautions were taken to prevent the transfer of live cells to other catchments. This involved cleaning all equipment and waders with a 10% bleach solution before moving upstream or into a different catchment.

2.2. Microscopic examination of samples

Samples were concentrated as necessary by pipetting off excess water. Aliquots of approx. 1 ml of the algal suspensions were transferred to the well of an inverted microscope and allowed to settle briefly. The samples were then scanned at magnifications of x100 to x200. At least three aliquots from each sample were examined in order to increase the chances of finding *D. geminata* in a sample, even if it was very rare.

Precautions were taken in the laboratory to prevent the transfer of live cells. All subsamples examined were rinsed back into the original sample or into a separate container. Excess water was pipetted into a separate container and was not washed into the drainage system. Following examination, all samples were transferred to a freezer (-20 ˚C).

2.3. Data analysis

This survey had two possible outcomes:

1. Cells or other traces of *D. geminata* would be detected in one or more samples. This result would imply that the species had already spread from the Mararoa / lower Waiau catchment.

2. No traces of *D. geminata* would be detected in any of the samples. This would imply *either* that the species was not present in the rivers at the time of sampling *or* that the sampling was not sufficiently rigorous to pick it up.

For the second outcome, the question to be answered would be: how confident can we be that the survey would have detected the species if it was present?

To estimate the probability of detecting a rare species during a survey, a binomial formula (i.e. based on presence/absence data) (McArdle 1990) was used to determine the probability that a rare species will be detected during a given sampling effort:

$$\alpha = 1 - (1\text{-}p)^N$$

where:

α = the probability that the species will be detected during a sampling of N units; and

p = the probability of the species occurring at a single site (an estimate of the rarity of the species).

The formula is based on the following assumptions:

- The sampling units are taken randomly from the habitat;
- p is constant over all the sampling units;
- Sampling units are independent of each other.

These assumptions are discussed in the context of the present survey in Sections 3.3 and 4 below.

3. Results

3.1. Sites and samples

Sixty-two sites were sampled, yielding 142 samples of algae scraped from the surfaces of river stones, and 36 drift net samples. Prior to the survey it was estimated from the Southland Fish & Game maps that there were approximately 130 fishing access points on all the rivers combined. However, high flows in the lower catchments of the Mataura, Oreti and Aparima Rivers eliminated about 50 potential sites. In addition, several sites in the upper catchments were difficult to locate, were very close together, or could not be reached successfully on foot. The short time-frame in which the survey was required dictated that the sampling had to be completed within just two days.

Figure 1 shows the locations of sites included in the survey. Site and sample details are listed in Appendix 1.

3.2. Microscope analysis

Approximately 550 sub-samples from the 62 sites were examined. No traces of *D. geminata* stalks or frustules were located in any sub-sample.

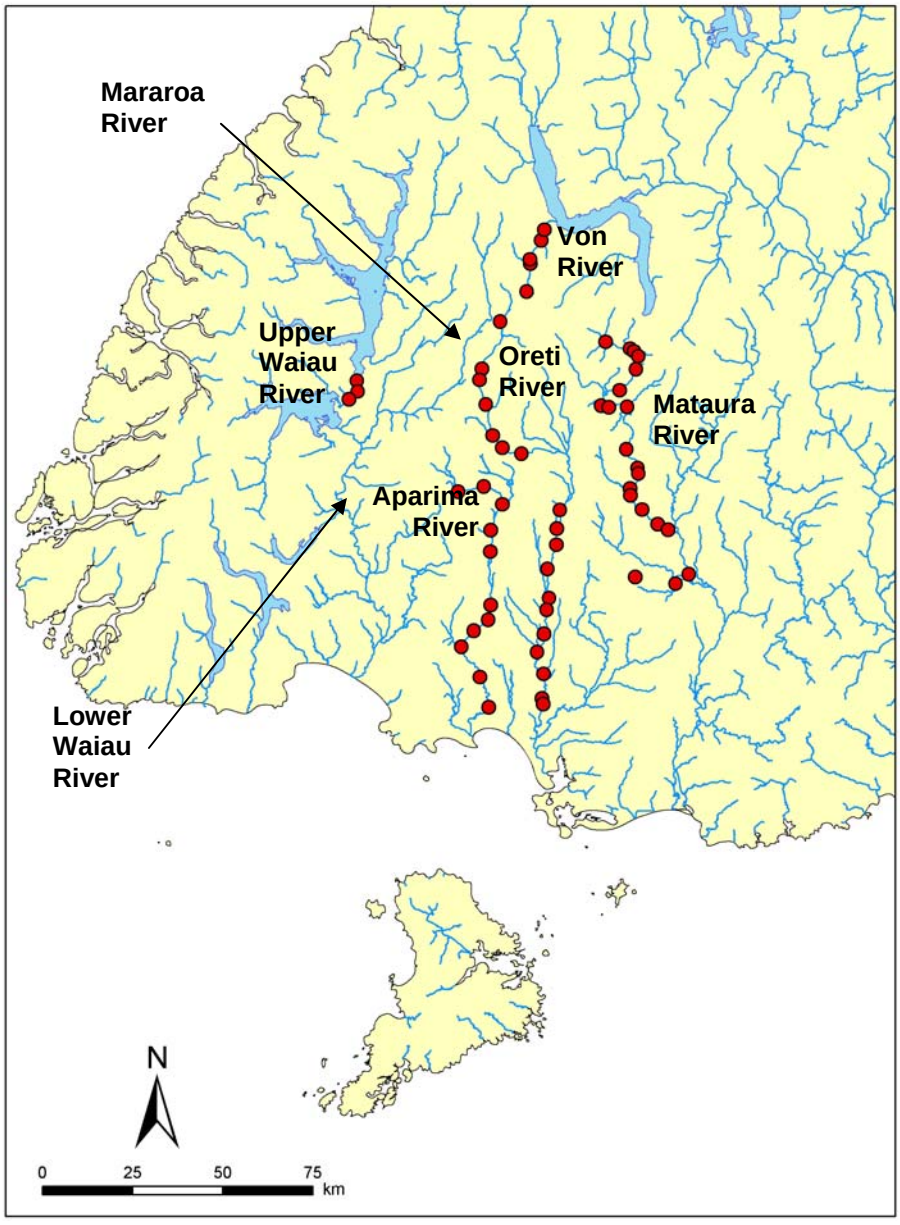

Figure 1. **Sites sampled on 17 – 18 December 2004 to check for the presence of *Didymosphenia geminata* in five Southland rivers.**

3.3. Probability analysis

For this survey, a sampling unit was taken to be a site. Multiple samples taken within each site minimize the chance of not finding *D. geminata* at any particular site, if it is present. However, the samples taken close together at a single site are not independent of one another. On the other hand sites were generally spaced several kilometers apart and were unlikely to be influencing each other.

Using the formula in Section 2.3, the probability of finding *D. geminata* in a survey (α) was calculated for values of rarity (p) ranging from 0 to 10%, for N = 62, 80, 100 and 200. A plot of p vs. α for each value of N (Fig. 2) shows the effect of increasing sampling sites (N) on the probability of detecting species of varying rarity. Thus the plot for N = 62 (dark blue curve) shows that if p = 5% (i.e. *D. geminata* would be expected to occur in 5 of every 100 sites examined, if it was present in the rivers sampled) then there was a >95% chance of detecting it at one site in the survey of 62 sites (blue intersects).

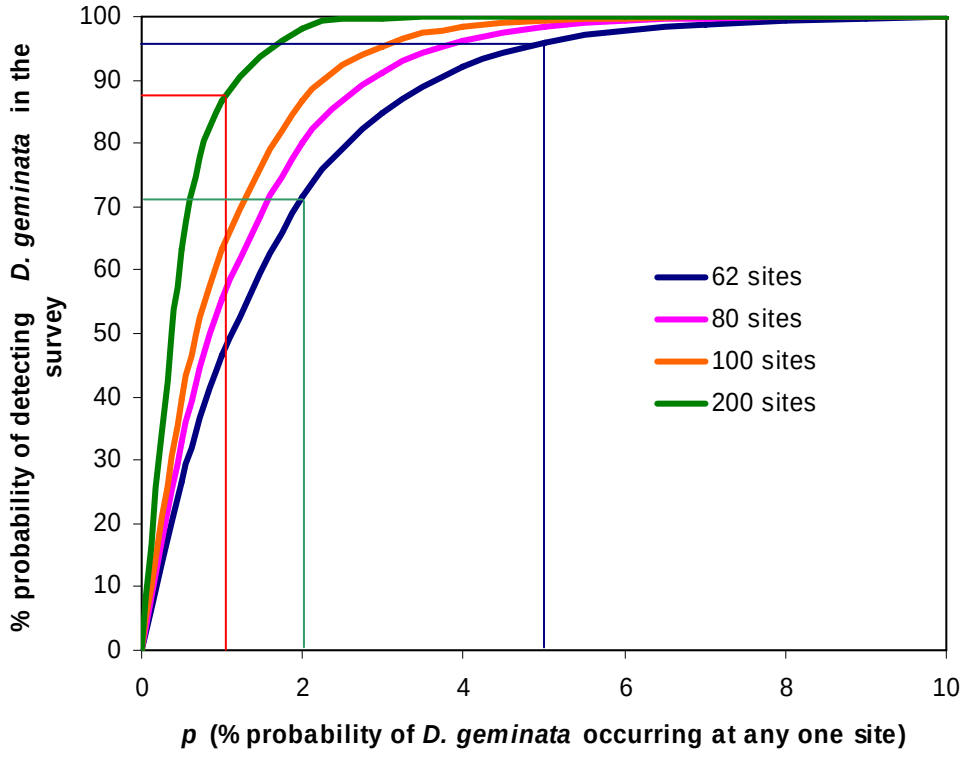

Figure 2. **Abundance of *D. geminata* (p, as %) at low levels plotted against the probability (α, as %) of finding the species at a single site during a survey of multiple sites. Curves are shown for surveys of 62, 80, 100 and 200 sites. See text for reference to the red, green and blue intersects.**

Assuming that *D. geminata* is much rarer than this, say if $p = 2\%$, then the chance of detecting it in a survey of 62 sites reduces to about 72% (green intersects).

4. Discussion

Figure 2 illustrates that no amount of sampling can definitively prove that a species is *not* present. When $p = 0$, then $\alpha = 0$, regardless of the number of sampling units. From the failure to find *D. geminata* at any of the 62 sites sampled, it can only be stated (95% confidence) that *if* the species *is* present in these rivers, then it is rare ($p < 5\%$; McArdle 1990).

However, the estimate of the probability of detection of *D. geminata* is conservative because the sampling units (sites) were locations with the greatest likelihood of infestation, and the samples were taken from habitat at those sites with the greatest likelihood of colonization by *D. geminata*. As mentioned in Section 1, sampling was deliberately targeted at accessible sites where *D. geminata* was most likely to have been introduced to the rivers. At these sites, microhabitats (stones) were selected that were most likely to have provided suitable habitat for colonization (see Section 2.3).

The results of the drift sample analyses further support the suggestion that the estimate of probability of detection of *D. geminata* is conservative. Almost all the drift samples contained diatoms as well as other types of algae. The taxa found included some that were not seen in the samples collected from rocks. While the 36 drift net samples cannot strictly be interpreted as additional sampling units, they do increase the effectiveness of the sampling at each site. In other words they increase confidence that if *D. geminata* was present in the area, it was not missed in the sampling procedure.

The only way to increase the *statistical* probability of detecting *D. geminata* at a much lower level than 5 sites in 100, would be to increase the number of sites sampled, remembering that sites must be independent from one another. The pink, orange, and green lines in Fig. 2 illustrate the effect of increasing the number of sampling sites to 200. For example, the red intersects show that by sampling 200 sites, there is an 88% chance of detecting *D. geminata* if it abundance is only 1% (occurring in only 1 of every 100 sites). At this level of sampling it is possible to have some confidence that the species is not in the area sampled.

In the present survey, with the time available and given the flow conditions in the rivers, the number of sites sampled was the best that could be achieved. Fig. 1 shows

that the coverage was good. Large gaps between sites indicate reaches that were not accessible on foot.

5. Conclusions

From the 62 sites sampled in the Upper Waiau, Von, Oreti, Aparima and Mataura Rivers on 17-18 December 2004 it can be stated that if *D. geminata* was present in the area at an average abundance of <5% (occurring in less than 5 of every 100 sites) then there was a 95% chance of finding it at one site. The fact that it was not found in any of the samples examined indicates that the species is rarer than this, possibly absent. The protocols used in the survey also suggest that this estimate of probability was conservative. In other words, there was the same or higher chance of finding *D. geminata* at a much lower abundance than 5%.

6. Acknowledgements

The sampling team put in a great effort to complete the survey in a very short time: Bill Jarvie, Stuart Sutherland (Southland Fish & Game), Michelle White, Randall Milne (Environment Southland), Brian Goodger (AgriQuality), Neil Blair (NIWA). Murray Smith (AgriQuality) did much of the pre-survey organization. Neil Blair ensured that all the samples were delivered to the laboratory as rapidly as possible. Karen Robinson is thanked for assistance with the microscope work, and for data entry. Graeme Inglis provided valuable advice on data analysis. Graeme Inglis, Barry Biggs and Mark Weatherhead are thanked for their constructive comments on earlier versions of this report, and Helen Hurren is thanked for generating the map at extremely short notice.

7. References

Kilroy, C. 2004: A new alien diatom, *Didymosphenia geminata* (Lyngbye) Schmidt: its biology, distribution, effects and potential risks for New Zealand fresh waters. NIWA Client Report CHC2004_128. For Environment Southland.

McArdle, B.H. 1990: When are rare species not there? *Oikos 57*: 276-277.

APPENDIX 1

List of samples taken from the Upper Waiau, Von, Oreti, Aparima and Mataura Rivers, 17-18 December 2004

DATE	NAME	RIVER	EASTING	NORTHING	SITE DESCRIPTION	SAMPLE_NO	SAMPLE_TYPE
18-Dec-04	B Jarvie	Upper Waiau			First bend on the left bank d/s of Lake Te Anau outlet.	UW1	rocks
18-Dec-04	B Jarvie	Upper Waiau			First bend on the left bank d/s of Lake Te Anau outlet.	UW2	rocks
18-Dec-04	B Jarvie	Upper Waiau			First bend on the left bank d/s of Lake Te Anau outlet.	UW3	drift
18-Dec-04	B Jarvie	Upper Waiau	2094686	5514787	Yerex Reach camp area	UW4	rocks
18-Dec-04	B Jarvie	Upper Waiau	2094686	5514787	Yerex Reach camp area	UW5	rocks
18-Dec-04	B Jarvie	Upper Waiau	2094686	5514787	Yerex Reach camp area	UW6	drift
18-Dec-04	B Jarvie	Upper Waiau	2094836	5511782	Queens Reach Midsection	UW7	rocks
18-Dec-04	B Jarvie	Upper Waiau	2094836	5511782	Queens Reach Midsection	UW8	rocks
18-Dec-04	B Jarvie	Upper Waiau	2094836	5511782	Queens Reach Midsection	UW9	drift
18-Dec-04	B Jarvie	Upper Waiau	2092392	5509698	Balloon Loop	UW10	rocks
18-Dec-04	B Jarvie	Upper Waiau	2092392	5509698	Balloon Loop	UW11	rocks
18-Dec-04	B Jarvie	Upper Waiau	2092392	5509698	Balloon Loop	UW12	drift
17-Dec-04	B Jarvie	Aparima	2122829	5484009		AP1	rocks
17-Dec-04	B Jarvie	Aparima	2122829	5484009		AP2	rocks
17-Dec-04	B Jarvie	Aparima	2122829	5484009		AP3	drift
17-Dec-04	B Jarvie	Aparima	2129981	5485482	Dunrobin Bridge	AP4	rocks
17-Dec-04	B Jarvie	Aparima	2129981	5485482	Dunrobin Bridge	AP5	rocks
17-Dec-04	B Jarvie	Aparima	2129981	5485482	Dunrobin Bridge	AP6	drift
17-Dec-04	B Jarvie	Aparima	2135012	5480419	d/s Wreys Bush Rd (~200m d/s)	AP7	rocks
17-Dec-04	B Jarvie	Aparima	2135012	5480419	d/s Wreys Bush Rd (~200m d/s)	AP8	rocks
17-Dec-04	B Jarvie	Aparima	2135012	5480419	d/s Wreys Bush Rd (~200m d/s)	AP9	drift
17-Dec-04	B Jarvie	Aparima	2131792	5473395	1km u/s Etal Creek confluence	AP10	rocks
17-Dec-04	B Jarvie	Aparima	2131792	5473395	1km u/s Etal Creek confluence	AP11	rocks
17-Dec-04	B Jarvie	Aparima	2131792	5473395	1km u/s Etal Creek confluence	AP12	drift
17-Dec-04	B Jarvie	Aparima	2131716	5467360	"opp Gowan Hill Rd, Intersection with Wreys Bush Rd"	AP13	rocks
17-Dec-04	B Jarvie	Aparima	2131716	5467360	"opp Gowan Hill Rd, Intersection with Wreys Bush Rd"	AP14	rocks
17-Dec-04	B Jarvie	Aparima	2131716	5467360	"opp Gowan Hill Rd, Intersection with Wreys Bush Rd"	AP15	drift
17-Dec-04	B Jarvie	Aparima	2131851	5452557	Wreys Bush Bridge	AP16	rocks
17-Dec-04	B Jarvie	Aparima	2131851	5452557	Wreys Bush Bridge	AP17	rocks
17-Dec-04	B Jarvie	Aparima	2131851	5452557	Wreys Bush Bridge	AP18	drift
17-Dec-04	B Jarvie	Aparima	2131168	5448441	"Shaws Trees Rd - West, off Bayswater Rd."	AP19	rocks
17-Dec-04	B Jarvie	Aparima	2131168	5448441	"Shaws Trees Rd - West, off Bayswater Rd."	AP20	rocks
17-Dec-04	B Jarvie	Aparima	2131168	5448441	"Shaws Trees Rd - West, off Bayswater Rd."	AP21	rocks
17-Dec-04	B Jarvie	Aparima	2131168	5448441	"Shaws Trees Rd - West, off Bayswater Rd."	AP22	drift
17-Dec-04	B Jarvie	Aparima	2127148	5445386	Access opp Gladfield Rd intersection with Bayswater Rd	AP23	rocks
17-Dec-04	B Jarvie	Aparima	2127148	5445386	Access opp Gladfield Rd intersection with Bayswater Rd	AP24	rocks
17-Dec-04	B Jarvie	Aparima	2127148	5445386	Access opp Gladfield Rd intersection with Bayswater Rd	AP25	drift
17-Dec-04	C Kilroy / N Blair	Aparima	2131850	5452567	Bayswater Bridge	AP1 a nb	rocks

17-Dec-04	C Kilroy / N Blair	Aparima	2131850	5452567	Bayswater Bridge	AP1 b nb	rocks
17-Dec-04	C Kilroy / N Blair	Aparima	2123680	5441059	Otautau Bridge	AP2 a nb	rocks
17-Dec-04	C Kilroy / N Blair	Aparima	2123680	5441059	Otautau Bridge	AP2 b nb	rocks
17-Dec-04	C Kilroy / N Blair	Aparima	2123680	5441059	Otautau Bridge	AP2 c nb	drift
17-Dec-04	C Kilroy / N Blair	Aparima	2128838	5432678	Fairfax Bridge	AP3 nb	rocks
17-Dec-04	C Kilroy / N Blair	Aparima	2131255	5424332	Thornberry 50m u/s of bridge	AP4 a nb	rocks
17-Dec-04	C Kilroy / N Blair	Aparima	2131255	5424332	Thornberry 50m u/s of bridge	AP4 b nb	rocks
17-Dec-04	S Sutherland	South Von	2141873	5539659	Bridge	Von 1a	rocks
17-Dec-04	S Sutherland	South Von	2141873	5539659	Bridge	Von 1b	rocks
17-Dec-04	S Sutherland	South Von	2141873	5539659	Bridge	Von 1 drift	drift
17-Dec-04	S Sutherland	South Von	2142827	5547316	u/s of North Von confluence 1km.	Von 2a	rocks
17-Dec-04	S Sutherland	South Von	2142827	5547316	u/s of North Von confluence 1km.	Von 2b	rocks
17-Dec-04	S Sutherland	South Von	2142827	5547316	u/s of North Von confluence 1km.	Von 2 drift	drift
17-Dec-04	S Sutherland	Von	2142679	5548541	500m below confluence of South and North Von	Von 3a	rocks
17-Dec-04	S Sutherland	Von	2142679	5548541	500m below confluence of South and North Von	Von 3b	rocks
17-Dec-04	S Sutherland	Von	2142679	5548541	500m below confluence of South and North Von	Von 3 drift	drift
17-Dec-04	S Sutherland	Von	2145865	5553903	d/s of old Nic Homestead	Von 4a	rocks
17-Dec-04	S Sutherland	Von	2145865	5553903	d/s of old Nic Homestead	Von 4b	rocks
17-Dec-04	S Sutherland	Von	2145865	5553903	d/s of old Nic Homestead	Von 4 drift	drift
17-Dec-04	S Sutherland	Von	2146696	5556798	bottom bridge	Von 5a	rocks
17-Dec-04	S Sutherland	Von	2146696	5556798	bottom bridge	Von 5b	rocks
17-Dec-04	S Sutherland	Oreti	2140388	5494624	Mossburn Bridge	Oreti 7a	rocks
17-Dec-04	S Sutherland	Oreti	2140388	5494624	Mossburn Bridge	Oreti 7b	rocks
17-Dec-04	S Sutherland	Oreti	2140388	5494624	Mossburn Bridge	Oreti 7 Drift	drift
17-Dec-04	S Sutherland	Oreti	2134485	5531253	Mt Nicholas Rd Bridge	Oreti 1a	rocks
17-Dec-04	S Sutherland	Oreti	2134485	5531253	Mt Nicholas Rd Bridge	Oreti 1b	rocks
17-Dec-04	S Sutherland	Oreti	2129392	5518143	"Oreti Rd end, slightly d/s"	Oreti 2a	rocks
17-Dec-04	S Sutherland	Oreti	2129392	5518143	"Oreti Rd end, slightly d/s"	Oreti 2b	rocks
17-Dec-04	S Sutherland	Oreti	2129392	5518143	"Oreti Rd end, slightly d/s"	Oreti 2 Drift	drift
17-Dec-04	S Sutherland	Oreti	2128696	5515111	Below Centre Hill managers House	oreti 3a	rocks
17-Dec-04	S Sutherland	Oreti	2128696	5515111	Below Centre Hill managers House	oreti 3b	rocks
17-Dec-04	S Sutherland	Oreti	2128696	5515111	Below Centre Hill managers House	oreti 3 drift	drift
17-Dec-04	S Sutherland	Oreti	2130452	5508279	Gravel Pits	oreti 4a	rocks
17-Dec-04	S Sutherland	Oreti	2130452	5508279	Gravel Pits	oreti 4b	rocks
17-Dec-04	S Sutherland	Oreti	2130452	5508279	Gravel Pits	oreti 4 drift	drift
17-Dec-04	S Sutherland	Oreti	2132321	5499622	Sobig Access	oreti 5a	rocks
17-Dec-04	S Sutherland	Oreti	2132321	5499622	Sobig Access	oreti 5b	rocks
17-Dec-04	S Sutherland	Oreti	2132321	5499622	Sobig Access	oreti 5 drift	drift
17-Dec-04	S Sutherland	Oreti	2134991	5496241	Christies Access	oreti 6a	rocks

17-Dec-04	S Sutherland	Oreti	2134991	5496241	Christies Access	oreti 6b	rocks
17-Dec-04	S Sutherland	Oreti	2134991	5496241	Christies Access	oreti 6 drift	drift
17-Dec-04	C Kilroy / N Blair	Oreti	2150138	5473809	Fishing Access	OR3 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2150138	5473809	Fishing Access	OR3 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2150138	5473809	Fishing Access	OR3 C	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2150009	5469216	Dipton u/s of bridge	OR4 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2150009	5469216	Dipton u/s of bridge	OR4 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2150009	5469216	Dipton u/s of bridge	OR4 C	drift
17-Dec-04	C Kilroy / N Blair	Oreti	2152008	5489155	Lumsden Bridge	OR1 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2152008	5489155	Lumsden Bridge	OR1 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2152008	5489155	Lumsden Bridge	OR1 C	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2152008	5489155	Lumsden Bridge	OR1 D	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2152008	5489155	Lumsden Bridge	OR1 E	drift
17-Dec-04	C Kilroy / N Blair	Oreti	2151101	5478902	First Anglers Access off road on true right	OR2 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2151101	5478902	First Anglers Access off road on true right	OR2 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2151101	5478902	First Anglers Access off road on true right	OR2 C	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2147601	5462609	Off Bridge - Benmore	OR5 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2147601	5462609	Off Bridge - Benmore	OR5 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2148093	5454435	McPhersons Farm. Access from Centre Bush / Catley Rd	OR6 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2148093	5454435	McPhersons Farm. Access from Centre Bush / Catley Rd	OR6 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2148093	5454435	McPhersons Farm. Access from Centre Bush / Catley Rd	OR6 C	drift
17-Dec-04	C Kilroy / N Blair	Oreti	2147336	5451266	Centre Bush Bridge u/s true left (?)	OR7 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2147336	5451266	Centre Bush Bridge u/s true left (?)	OR7 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146562	5444562	"Winton u/s from bridge, by gravel pit"	OR8 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146562	5444562	"Winton u/s from bridge, by gravel pit"	OR8 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146562	5444565	Just u/s of Winton Bridge	OR9 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2144768	5439625	d/s of Oreti School Rd	OR10 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2144768	5439625	d/s of Oreti School Rd	OR10 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2144768	5439625	d/s of Oreti School Rd	OR10 C	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2144768	5439625	d/s of Oreti School Rd	OR10 D	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2144768	5439625	d/s of Oreti School Rd	OR10 E	drift
17-Dec-04	C Kilroy / N Blair	Oreti	2146504	5433555	Lochiel Bridge	OR11 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146504	5433555	Lochiel Bridge	OR11 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146030	5426740	Viner Rd	OR12 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146373	5425133	Ryal Bush Transport Access	OR13 A	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146373	5425133	Ryal Bush Transport Access	OR13 B	rocks
17-Dec-04	C Kilroy / N Blair	Oreti	2146373	5425133	Ryal Bush Transport Access	OR13 C	drift
17-Dec-04	B Goodger	Mataura	2163737	5525594	"Cainard Rd, above Fairlight, ~400m up from bridge"	MAT1 A	rocks
17-Dec-04	B Goodger	Mataura	2163737	5525594	"Cainard Rd, above Fairlight, ~400m up from bridge"	MAT1 B	rocks

17-Dec-04	B Goodger	Mataura	2163737	5525594	"Cainard Rd, above Fairlight, ~400m up from bridge"	MAT1 C	drift
17-Dec-04	B Goodger	Mataura	2170576	5523769	Bridge at Fairlight homestead	MAT2 A	rocks
17-Dec-04	B Goodger	Mataura	2170576	5523769	Bridge at Fairlight homestead	MAT2 B	rocks
17-Dec-04	B Goodger	Mataura	2170576	5523769	Bridge at Fairlight homestead	MAT2 C	drift
17-Dec-04	B Goodger	Mataura	2171688	5522967	Just below Railway Station at Fairlight.	MAT3 A	rocks
17-Dec-04	B Goodger	Mataura	2171688	5522967	Just below Railway Station at Fairlight.	MAT3 B	rocks
17-Dec-04	B Goodger	Mataura	2172859	5521604	End of Brightwater Rd off SH96	MAT4 A	rocks
17-Dec-04	B Goodger	Mataura	2172859	5521604	End of Brightwater Rd off SH97	MAT4 B	rocks
17-Dec-04	B Goodger	Mataura	2172859	5521604	End of Brightwater Rd off SH98	MAT4 C	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 A	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 B	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 C	drift
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 D	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 E	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 F	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 G	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 H	rocks
17-Dec-04	B Goodger	Mataura	2172148	5518028	"Northcoat Rd, ~500m along Rd."	MAT5 I	rocks
17-Dec-04	B Goodger	Mataura	2167602	5512140	Bridge just north of Athol	MAT6 A	rocks
17-Dec-04	B Goodger	Mataura	2167602	5512140	Bridge just north of Athol	MAT6 B	rocks
17-Dec-04	B Goodger	Mataura	2162544	5507906	Nokomai Rd. First gate with 'foot access' on it	MAT7 A	rocks
17-Dec-04	B Goodger	Mataura	2162544	5507906	Nokomai Rd. First gate with 'foot access' on it	MAT7 B	rocks
17-Dec-04	B Goodger	Mataura	2162544	5507906	Nokomai Rd. First gate with 'foot access' on it	MAT7 C	rocks
17-Dec-04	B Goodger	Mataura	2164630	5507451	Nokomai Rd. First large bridge after fishermans huts	MAT8 A	rocks
17-Dec-04	B Goodger	Mataura	2164630	5507451	Nokomai Rd. First large bridge after fishermans huts	MAT8 B	rocks
17-Dec-04	B Goodger	Mataura	2164630	5507451	Nokomai Rd. First large bridge after fishermans huts	MAT8 C	rocks
17-Dec-04	B Goodger	Mataura	2164630	5507451	Nokomai Rd. First large bridge after fishermans huts	MAT8 D	rocks
17-Dec-04	B Goodger	Mataura	2169759	5507626	New Bridge d/s Nokomai rd. Last bridge giong into Nokomai Homestead	MAT9 A	rocks
17-Dec-04	B Goodger	Mataura	2169759	5507626	New Bridge d/s Nokomai rd. Last bridge giong into Nokomai Homestead	MAT9 B	rocks
17-Dec-04	B Goodger	Mataura	2169759	5507626	New Bridge d/s Nokomai rd. Last bridge giong into Nokomai Homestead	MAT9 C	drift
18-Dec-04	B Goodger	Mataura	2169483	5495844	300m past huts on Cattle Flat rd.	MAT10 A	rocks
18-Dec-04	B Goodger	Mataura	2169483	5495844	300m past huts on Cattle Flat rd.	MAT10 B	rocks
18-Dec-04	B Goodger	Mataura	2169483	5495844	300m past huts on Cattle Flat rd.	MAT10 C	rocks
18-Dec-04	B Goodger	Mataura	2172627	5490615	Cattle Flat Rd. d/s from Woolshed	MAT11 A	rocks
18-Dec-04	B Goodger	Mataura	2172627	5490615	Cattle Flat Rd. d/s from Woolshed	MAT11 B	rocks
18-Dec-04	B Goodger	Mataura	2172627	5490615	Cattle Flat Rd. d/s from Woolshed	MAT11 C	drift
18-Dec-04	B Goodger	Mataura	2172859	5489068	Cattle Flat Rd. Gateway 500m up from 961 rapid no.	MAT12 A	rocks
18-Dec-04	B Goodger	Mataura	2172859	5489068	Cattle Flat Rd. Gateway 500m up from 961 raphid no.	MAT12 B	rocks
18-Dec-04	B Goodger	Mataura	2170542	5484937	Opp huts just over Tomogalak Bridge	MAT13 A	rocks

18-Dec-04	B Goodger	Mataura	2170542	5484937	Opp huts just over Tomogalak Bridge	MAT13 B	rocks
18-Dec-04	B Goodger	Mataura	2170622	5482968	"Fishermans Access off Ardlussa/Cattle Flat RD, just past Rapid 170. No."	MAT14 A	rocks
18-Dec-04	B Goodger	Mataura	2170622	5482968	"Fishermans Access off Ardlussa/Cattle Flat RD, just past Rapid 170. No."	MAT14 B	rocks
18-Dec-04	B Goodger	Mataura	2170622	5482968	"Fishermans Access off Ardlussa/Cattle Flat RD, just past Rapid 170. No."	MAT14 C	drift
18-Dec-04	B Goodger	Mataura	2170622	5482968	"Fishermans Access off Ardlussa/Cattle Flat RD, just past Rapid 170. No."	MAT14 D	rocks
18-Dec-04	B Goodger	Mataura	2171983	5460292	"Keowns Bridge Rd, at bridge over Mataura"	MAT15 A	rocks
18-Dec-04	B Goodger	Mataura	2173871	5479044	Butler Rd off Riversdale Ardlussa Rd. Fishermans Access Rd.	MAT16 A	rocks
18-Dec-04	B Goodger	Mataura	2173871	5479044	Butler Rd off Riversdale Ardlussa Rd. Fishermans Access Rd.	MAT16 B	rocks
18-Dec-04	B Goodger	Mataura	2178204	5475025	"Off Riversdale Ardlussa Rd. Sharp bend at rapid 206, rd to river."	MAT17 A	rocks
18-Dec-04	B Goodger	Mataura	2178204	5475025	"Off Riversdale Ardlussa Rd. Sharp bend at rapid 206, rd to river."	MAT17 B	rocks
18-Dec-04	B Goodger	Mataura	2181107	5473427	Bridge at Riversdale Waikaia Rd.	MAT18 A	rocks
18-Dec-04	B Goodger	Mataura	2181107	5473427	Bridge at Riversdale Waikaia Rd.	MAT18 B	rocks
18-Dec-04	B Goodger	Mataura	2181107	5473427	Bridge at Riversdale Waikaia Rd.	MAT18 C	drift
17-Dec-04	R Milne	Mataura	2186856	5461112		MA1 A	rocks
17-Dec-04	R Milne	Mataura	2186856	5461112		MA1 B	rocks
17-Dec-04	R Milne	Mataura	2186856	5461112		MA1 C	rocks
17-Dec-04	R Milne	Mataura	2186856	5461112		MA1 D	drift
17-Dec-04	R Milne	Mataura	2183207	5458449		MA2 A	rocks
17-Dec-04	R Milne	Mataura	2183207	5458449		MA2 B	rocks
17-Dec-04	R Milne	Mataura	2183207	5458449		MA2 C	rocks
17-Dec-04	R Milne	Mataura	2183207	5458449		MA2 D	drift
17-Dec-04	R Milne	Mataura	2183207	5458449		MA2 E	rocks