Kapiti Coast District Council

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Ecological Monitoring Plan - Waikanae River

Resource Consent WGN050024 [23848]

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Kapiti Coast District Council

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1 Introduction

This Ecological Monitoring Plan is in accordance with the requirements of Resource Consent WGN050024[23848] condition 8. This condition requires the preparation of a monitoring manual which shall include:

- Details of a monitoring programme to determine the impacts of the water abstraction on water quality, native fish species and trout, including:
  - Macroinvertebrate Community Index (MCI)
  - Native fish and trout surveys
- Monitoring methods, and frequency locations
- Frequency and method of reporting the monitoring information to the Greater Wellington Regional Council.

In addition to the requirements of the Resource Consent condition 8, the following aspects have also been included in this ecological monitoring plan.

- Greater Wellington Regional Council Periphyton monitoring data
- Assessment of river mouth for fish passage, and
- How the results from individual and accumulated surveys over time should be assimilated, presented, and analysed.

2 Aim

The aim of the ecological monitoring plan is to gather biological data from unaffected areas (sites upstream from the water intake plant) and impacted areas (downstream of the water intake plant) of the Waikanae River, and to quantify any differences between the sites. The null hypothesis is that there is no significant difference between measurements of any parameter between upstream and downstream sites.

2.1 Macroinvertebrate Sampling

The purpose of quantitative sampling of macroinvertebrates is to estimate densities (numbers per square metre) present at each sampling site. As macroinvertebrate densities are highly variable, both spatially and temporally, frequently in response to flow and substrate conditions they are a suitable indicator of the effect of water abstraction.

MCI is used to describe the general "health" of a stream based on abundance, taxonomic richness and pollution tolerance of the animals within the sample. MCI gives a numerical indication of stream health, which is useful for comparison between sites. The MCI values can theoretically range from 20 to 200. However, streams generally do not have an MCI of over 150. Streams with an MCI above 120 are believed to be of pristine conditions with very good water quality, and only streams that are extremely polluted will, have scores of less than 50. The MCI uses a system where each taxa are given a score between 1 and 10, where pollution intolerant families have higher scores than those that are pollution tolerant. The MCI is calculated using the following formula:

$$\text{MCI} = \left(\frac{SiteScore}{NumberofScoringTaxa} \right) \times 20$$

Table 1 Guidelines for Instream Health using MCI

Macroinvertebrate Community Index Score	Water Quality Habitat
>125	Good habitat quality
116 – 125	Good - moderate habitat quality
106 – 115	Moderate habitat quality
95 – 105	Moderate - poor habitat quality
<95	Poor habitat quality

Ephemeroptera/Plecoptera/Tricoptera (EPT) is a score of the abundance of Ephemeroptera, Plecoptera and Tricoptera aquatic macroinvertebrate taxa present. The EPT can be used as an indicator of water quality as these species are very pollution and sediment intolerant. A high EPT score will indicate good water quality. However, this can also be related to the stream substrate type. A low EPT score may indicate a sandy silt substrate rather than nutrient enriched conditions. An EPT of 0 - 3 indicates unsuitable substrate and/or pollution, 3 - 6 indicates an average healthy stream and 5 - 20 indicates

ideal habitat conditions. Used in association with MCI, an indication of the substrate influence can be assessed with a reasonable degree of certainty.

The method used takes into consideration the techniques specified in Stark *et al* (2001).

2.2 Native Fish and Trout Surveys

To assess density, population and community structure (i.e., recruitment and species diversity) comparison will be made with physical site parameters with known limits of survival. Assessment of the river mouth is to be correlated with recruitment data – i.e., poor recruitment may be a result of the mouth being closed at the time fish were entering freshwater for their upstream migration.

2.3 Periphyton

Greater Wellington Regional Council collects monthly water quality and periphyton data on the Waikanae River. The Periphyton data shall be obtained and incorporated in the results of this report. Periphyton data is important in the interpretation of other data collected. Periphyton is often related to temperature and flow; this data will be useful in the final conclusion of assessing impacts of water abstraction on the Waikanae River.

3 Methodology

3.1 Sample Sites

For quantitative analysis and comparisons between sites samples shall be taken from 5 sites as shown on Figure1.

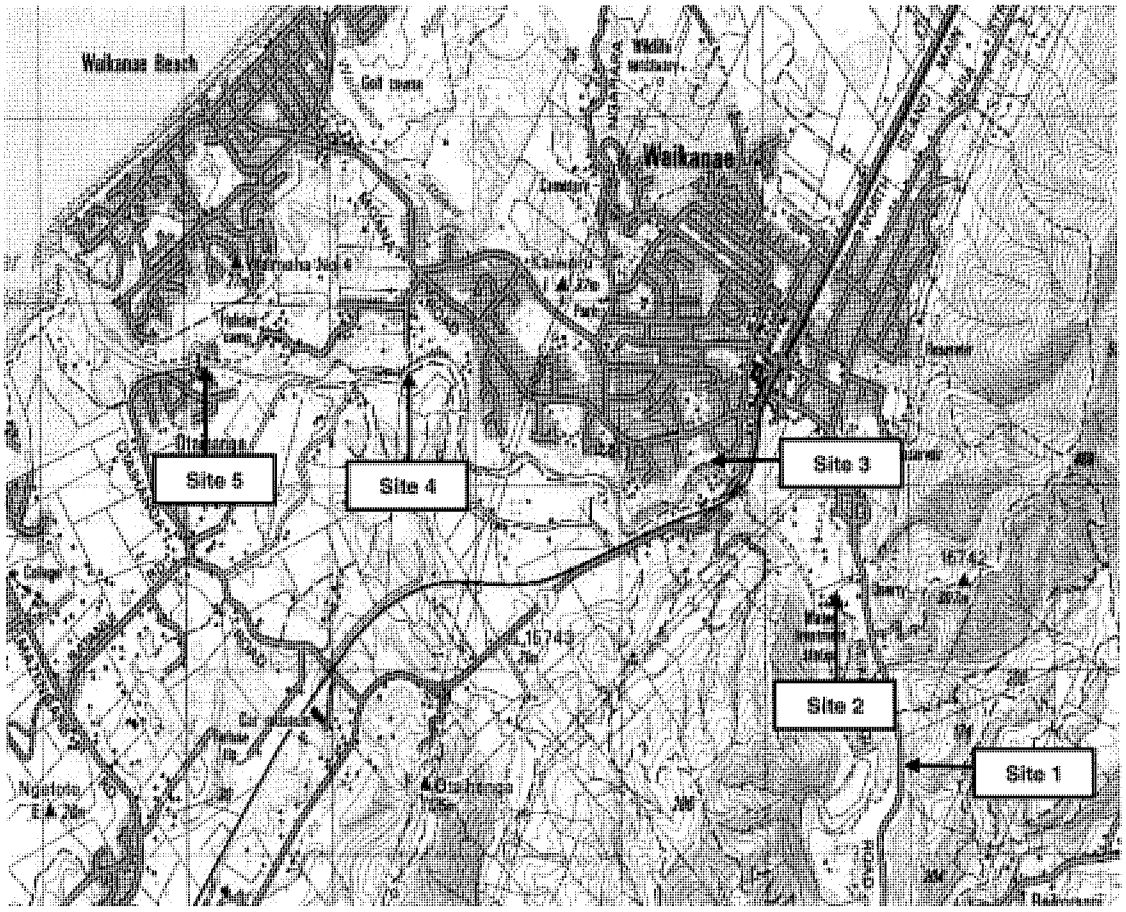

Figure 1 Waikanae River Sampling Sites

Sites 1 and 2 are upstream of the water intake site. Sites 3, 4, and 5 are below the intake and State Highway 1.

Included in the sampling shall be a visual documentation of the state of the river mouth at the time of sampling. The state of the river mouth is important for migratory fish species. It is not known if the river mouth condition under low flow conditions presents a barrier for fish migration. Documentation of the opening state of the mouth shall be completed at each sampling (i.e., at the time of MCI and fish sampling).

3.2 Site Description

Site record forms (likely to be obtainable from the Greater Wellington Regional Council) should be completed at each sample site.

Records of stream and surrounding catchment morphology, land-use, pool-riffle-run sequence, and wetted area should be made.

3.3 Macroinvertebrate Sampling

Collection of invertebrates from similar habitats up and downstream of the abstraction point shall be assessed. The MCI and other invertebrate assessment methods can be used to determine whether sensitive taxa are present in the abstraction impact reaches[1,2]. In conjunction with this assessment, density comparisons can be made of the invertebrate numbers at the different sites.

All sample collection and processing is to be undertaken in accordance with *Protocols for Sampling Macroinvertebrates in Wadeable Streams* (Stark *et al*, 2001). The Waikanae River is defined as a hard bottom stream, its substrate being dominated by particles of gravel size or greater (i.e., <50% of the bed is made up of sand/silt)[3]. Riffle habitats are common, reflecting a reasonable stream gradient. As such, *Protocol C3 – Hard-bottomed, quantitative* for sample collection, *Protocol P3 – Full count with subsampling option* and *Protocol QC3 – Quality control for full count with subsampling option* for sample processing should be used (refer Appendix 1).

The following equipment will be needed for sample collection:

- Waders or gumboots depending on depth of stream
- Surber sampler (0.5mm mesh)
- White tray or 10L bucket
- Sieve or sieve bucket (0.5mm mesh)
- Plastic sieve or sieve bucket (usually 500 to 1000ml volume)
- Preservative
- Sample container labels
- Waterproof marker pen and pencil
- Field notebook or field data record sheets

Four Surber samples (0.1m^2, 0.5 mm mesh) shall be collected at each of the five sites, and thus will provide estimates of MCI to a precision just over ± 10%.

Riffle habitat should be targeted for sampling in order to reduce the variability in the data when sites are compared (e.g. upstream/downstream, and comparison to reference) and to provide the greatest opportunity to detect pollution sensitive taxa.

The site location, sampling date, sampling time, and name of personnel undertaking sampling shall be recorded. A site photograph is useful and water quality or stream habitat measurements are essential for subsequent interpretation of biological data. At the very

[1] Stark, J. D. (1985). A macroinvertebrate community index of water quality for stony streams. *Water & Soil miscellaneous publication 87*: 53p.

[2] Stark, J. D. (1993). Performance of the Macroinvertebrate Community Index: effects on sampling method, sample replication, water depth, current velocity, and substratum on index values. *New Zealand Journal of Marine and Freshwater Research 27*: 463 – 478.

[3] Stark, J. D.; Boothroyd, I. K. G.; Harding, J. S.; Maxted, J. R.; Scarsbrook, M. R. (2001). Protocols for sampling macroinvertebrates in wadeable streams. *New Zealand Macroinvertebrate Working Group Report No. 1*. Prepared for the Ministry for the Environment. Sustainable Fund Project No. 5103. 57p.

least, assessments of substrate composition, riparian vegetation, stream width and depth, temperature, conductivity, dissolved oxygen, and periphyton community composition should be considered.

Samples are to be stored in alcohol and analysed by a suitably qualified laboratory or ecologist for MCI and QMCI.

3.4 Native Fish and Trout Surveys

Electric fishing is recommended as a means of quickly and effectively sampling at each of the five sites. The following methodology is generally in accordance with that described in Allibone (2000)[4].

The following procedure is recommended at all sites surveyed for data on population structure, fish density, and recruitment. It is highly likely that only relatively large impacts will be detected when monitoring these population parameters.

A. The objective of the fishing operation is to obtain a large sample of fish. Small streams may require longer sections than larger streams to obtain a fish sample of at least 30 or more fish. If the fish are sparse, fishing can be restricted to 100 m^2 of stream. Larger site areas provide better fish density estimates because small scale patchiness in fish distribution can bias samples from small areas.

B. Place stop nets at the top and bottom of the section.

C. Stream widths are measured at each end of the sample site and at number of places within the site and total area is determined by the addition of the area of each segment.

D. The site is divided into habitat sections (when possible) and each section is stop-netted before fishing. It is recommended that fishing commences in the upstream section and progresses down through the site. The uppermost stop net can be shifted following the fishing of the uppermost habitat section. Fishing the reach then requires only three stop nets. The bottom-most net remains in position throughout the fishing operation. The uppermost net is shifted downstream to bottom of the next habitat section to be fished after each section is completed.

E. Electric fishing operations should fish each habitat section at least twice and preferably three times. Two sweeps are sufficient if the second catch is less than 10% of the first sweep. If catches have not declined in the first three sweeps, continue fishing until the catch declines to less than 25% of the initial sweep's catch, to a maximum of five sweeps.

F. All fish captured are measured (to the nearest mm). Recorded in conjunction with these measurements should be information about which habitat section the fish came from, (i.e. riffle or pool).

If possible, obtaining Fish & Game data sets relevant to trout or whitebait population characteristics (i.e., recruitment, releases, biomass) would add depth to the investigation and analysis of results.

[4] Allibone, R. M. (2000). Assessment techniques for water abstraction impacts on non-migratory galaxiids of Otago streams. Pp. 5 – 23 in Allibone, R. M. (2000). Water abstraction impacts on non-migratory galaxiids of Otago streams. *Science for Conservation 147*, 45p.

4 Analysis

Plotting visual representations of all data collected will allow a preliminary assessment of the findings in relation to the null hypothesis (i.e. that all sites are equal). Plots will generally form the basis for further investigation and statistical testing of any trends and differences to determine if what is shown graphically is statistically significant.

The plotting of data should be followed up by an appropriate statistical test (i.e. analysis of variance or ANOVA) to determine the significance of any trend or difference.

4.1 Macroinvertebrate Analysis

Full counts provide the most precise estimate of the abundance of individual taxa in a sample. It is necessary when direct, statistical comparisons of abundance or calculation of metrics requiring numerical data are desired. For samples collected from a known area (quantitative sample), the density of organisms at a site can be estimated (i.e., number m^2) and accurate percentage community compositions can be determined. Assuming adequate replication, there are effectively no limitations on subsequent data analyses if all animals in samples are counted.

Box and whisker plots and scatter plots would be useful for highlighting inter-site differences or temporal trends. Percentage composition bar plots can effectively represent community structure by species and abundance.

4.2 Fish Analysis

Density estimates can be based on actual fish captured and on estimated fish numbers using the repeated runs fishing data according to the methods of Carle & Strubb (1978) and Zippin (1956)[5]. Comparison on densities caught among sites up and downstream from the intake may indicate chronic declines in population health. If density is significantly lower in downstream sites this could indicate an impact. Data used for comparisons should be for the same time of year. There is likely to be significant variation in fish density and biomass among different seasons.

The data can be graphed with plots comparing sites or variation through time. The same plots as described for macroinvertebrates would be useful here, as well as a histogram to represent fork length.

Fish collections measured in Autumn should contain a distinct cohort of juvenile fish usually between 30-50mm in length. These are the juvenile fish recruiting to the population. The absence of recruits at some sites may indicate reproductive limitations and/or the absence of spawning habitat. However, care must be taken when assessing recruitment data, as environmental and historical factors may be influencing recruitment, not the abstraction. Comparison of recruitment in the abstracted stream with that in unimpacted streams could distinguish the effects of the abstraction from natural variability. Comparisons with Fish &

[5] Allibone, R. M. (2000). Assessment techniques for water abstraction impacts on non-migratory galaxiids of Otago streams. Pp. 5 – 23 in Allibone, R. M. (2000). Water abstraction impacts on non-migratory galaxiids of Otago streams. *Science for Conservation 147*, 45p.

Game data sets may provide useful insights into the dynamics of recruitment in the Waikanae River.

Potential causative factors that could be assessed are temperature regime, dissolved oxygen levels, food availability, operating frequency of water abstraction, and sediment inputs. Temperature and DO can be compared between upstream and downstream sites and compared to environmental tolerances of species if known. Food availability, both the abundance of preferred prey items and overall prey abundance, can decline when instream conditions are harsh.

Fine sediment could also accumulate in low flow area below abstraction. If a lot of water is removed by the abstraction it is likely that the area immediately downstream has reduced sediment transportation ability leading to the accumulation of fine sediments. Fine sediment accumulation can reduce available habitat by clogging interstitial spaces, reducing cover for fish and invertebrates, and smothering spawning habitats. Initial assessment of sedimentation could be undertaken during MCI sampling along with substrate composition records. This anecdotal data can then be compared between upstream and downstream sites and over time or in relation to operation of extraction.

5 Timing, Frequency and Reporting

5.1 Timing

Monitoring of macroinvertebrates, native fish and trout is to be carried out during the autumn season to complement existing data collected during investigations completed in April 2003, and also Fish and Game trout surveys that have typically occurred during April.

Collection of data at this time is considered appropriate to ensure the potential impacts from summer low flows, or instream works conducted from October to April, can be assessed.

Monitoring shall be undertaken during low to mean flow conditions.

5.2 Frequency

The five sites shall be sampled biennially. The monitoring programme shall be reviewed after a six year period of data collection and analysis, and re-evaluated according to the results and trends.

From a purely ecological perspective, monitoring annually would be desirable. However, from a consent compliance perspective it is deemed that monitoring every second year meets the intent of the consent conditions.

5.3 Reporting

The results shall be analysed and summarised in report format and submitted to the Greater Wellington Regional Council. This report shall incorporate the results and analysis of the sampling and shall be submitted to the Regional Council no later than two months after the sampling has been carried out.

The monitoring results are to be interpreted in relation to other catchment variables and activities such as:

- recorded river flow data (to be obtained from Greater Wellington Regional Council) including any exceptional events such as floods or drought
- in-stream works
- abstraction data
- results of trout count surveys (to be obtained from Wellington Fish and Game Council)
- and any other factors likely to have had an influence on monitoring results

Appendix 1

Protocol C3 (MCI Methodology)

Protocol C3:
Hard-bottomed, Quantitative

Requirements:

1. Waders or sturdy boots
2. Surber sampler (area 0.1 m^2, 0.5 mm mesh)
3. Brush
4. White tray
5. Sieve or sieve bucket (0.5 mm mesh)
6. Plastic screw-top sample containers (600 ml volume)
7. Preservative
8. Labels and waterproof marker pen, or pencil

Protocol:

1. Ensure that the sampling net is clean.
2. Select a suitable sample reach and habitat (e.g., riffle). Sample beginning at the downstream end of the reach and proceeding across and upstream.
3. Place the sampler on the streambed ensuring a good fit around the perimeter. The sampler should be positioned so that the water current washes dislodged material into the net.
4. Brush material from the upper surface of all cobbles contained within the sample quadrat. Pick up each cobble and, holding it immediately in front of the net mouth, brush all sides of the cobble clean. Repeat for all of the larger substrate elements within the sampler quadrat. Place clean cobbles outside of the sampler quadrat. Disturb the finer substrate remaining within the quadrat to a depth of 5 – 10 cm. Beware of broken glass and other sharp objects.
5. Remove the sampler from the water, rinse the net several times to concentrate the sample in the bottom of the net (take care not to lose material during this process), and return to the stream bank. Remove and discard large substrate elements that may have entered the net, taking care to remove adhering invertebrates before disposal. Remove sample from collection net either by inverting net into a suitable container, or by removing container attached to end of collection net. Elutriation may also be required (i.e., repeated rinsing of sample to separate organic and inorganic fractions).
6. Let the sample settle for a few minutes and decant off excess water via the sieve. Return any macroinvertebrates that are washed out with the water to the sample container. (Tweezers may be useful here).
7. Add preservative. Aim for a preservative concentration in the sample container of 70 - 80% (i.e., allowing for the water already present). Be generous with preservative for samples containing plant material (leaves, sticks, macrophytes, moss or periphyton).
8. Place a sticky label on the side of the sample container and record the site code/name, date, and replicate number (if applicable) using a permanent marker. Write on the label when it is dry and do not rely on a label on the pottle lid! Place a waterproof label inside the container. Screw the lid on tightly.
9. Note the sample type (e.g., Surber 0.1 m^2), collector's name and preservative used on the field data sheet.

Protocol P3:
Full Count with Subsampling Option

Requirements:

1. Running water tap and sink
2. Endecott® sieves (0.5, 1.0, 2.0, & 4.0 mm)
3. Grided white trays
4. Petri dishes
5. 2 pairs of fine forceps (#4 or #5)
6. Binocular microscope
7. Identification keys & taxonomic references
8. 70% ethanol preservative
9. Glass vials and/or pottles
10. Labels and sharp pencil

Protocol:

1. Sieve and place the sample in grided sorting trays following Protocol P1.
2. Starting with the largest size fraction, work systematically across each tray removing all of the organisms in the sample. Normal eyesight should be precise enough to detect organisms > 1mm in total length. Do not use magnification.
3. Place the organisms of each taxon encountered into separate Petri dish to confirm identifications by microscopic examination (if necessary). Place sorted animals into vials or pottles containing 70% alcohol for storage and QC.
4. The minimum level of identification required is that specified in Appendix B. Do not include aerial adult insects, pupae, terrestrial invertebrates, empty snail shells, caddisfly cases or exuviae. . Examination of late pupae can, however, assist greatly with larval identifications.
5. Place a label in the vial or pottle noting the site code/name, date, sample type, and collector's name. Label multiple containers (e.g., "1 of 2, 2 of 2).
6. On completion of sample processing, there should be (1) labelled vials or pottles containing sorted organisms, and (2) the preserved sample residue in its original plastic pottle with the original label.

Subsampling Option:

(Note: Only very abundant taxa should be subsampled. Full counts should be made for all other taxa).

1. Subsampling of very abundant taxa (> 500 individuals) can save considerable time.
2. Count the number individuals of each very abundant taxon from a fixed fraction (between 10% and 50% recommended) of the sample grids for each sorting tray. Estimate the total abundance for that taxon by multiplying the number counted by between 10 (for 10% fraction) and 2 (for 50% fraction) according to the fraction of the sample that was counted.
3. Record the count estimate on the bench data sheet and note that the value is a subsampling estimate (e.g., 25% fraction).
4. Remove 10-20 representatives of each taxon subsampled and store in a separate vial or pottle from that containing the other sorted organisms.

Quality Control for Protocol P3

Protocol QC3:
Quality Control for Full Count with Subsampling Option

Protocol:

1. All samples received, processed and identified should be recorded in a "laboratory log". The fate of samples can then be verified in conjunction with a Chain–of- Custody form.
2. Ten percent of the sorted samples to be re-examined by another sorter. The second sorter must be familiar with sorting procedures and the full range of macroinvertebrate taxa from running waters in New Zealand and will be provided with the results from the first sorter.
3. **Taxonomic accuracy.** On average, the number of taxa that are identified as different taxa between the two taxonomists must be < 10% of the total taxa recorded from the sample. For example, a sample with 31 taxa passes QC when no more than 3 taxa are identified differently between the two taxonomists.
4. **Sorting accuracy.** On average, the total number of each taxon found in the remnant sample must be < 10% of total for each taxon counted during the first sort. If the QC sorter finds less than an average 10% more organisms than recorded in first sort then the sample passes QC requirements. If average > 10% more organisms are found then a further 10% of samples to be re-checked. If the criterion is still not met than all samples must be re-processed and resorted. If the correct taxonomic identification of an organism is disputed, then a specimen should be checked by an agreed expert.
5. Trainee sorters should have at least 50% of samples re-checked for QC, and can be considered competent sorters when < 10% of checked samples are returning < 10% more organisms and < 10% new taxa than first sort.
6. After a sample has been completely sorted all sieves, trays and equipment should be thoroughly cleaned and picked free of organisms and debris before the next sample is introduced.