

**Archaeological investigation of the
Kaitemako Substation site,
Welcome Bay, Tauranga: final report**

**report to
The New Zealand Historic Places Trust
and
Transpower New Zealand Ltd**

Matthew Campbell and Glen Farley

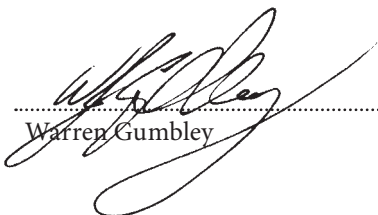
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Introduction

Transpower New Zealand Ltd are installing an electrical substation on land owned by them at Lot 1 DPS 63772 Kaitemako Road (the Kaitemako substation), which includes an access road across Lot 42 DPS 69258 and Lot 3 DPS 88961. A precautionary authority to modify, damage or destroy was applied for from the New Zealand Historic Places Trust under section 12 of the Historic Places Act 1993. Authority 2006/301 was issued for Lot 1 DPS 63772 and authority 2007/150 was issued for Lot 42 DPS 69258 and Lot 3 DPS 88961. The authorities required that suitable protocols for monitoring and mitigating the effects of earthworks on the archaeology be put in place. The results of the ensuing investigations are reported here.

Research Strategy

Because of the limited nature of archaeological monitoring of earthworks and the uncertainty of what might be uncovered, no detailed research strategy was required. The authority application contained the condition that “appropriate steps will be taken to investigate any archaeological features exposed by earthworks following standard archaeological protocols, depending on the nature of the exposed features.” In addition to this, the possibility of pre-European or historic period Maori garden soils being found was considered to be high, and it was proposed to investigate these both through excavation and microfossil analysis.

Methodology

An archaeological assessment of the property in was undertaken by Matthew Campbell of CFG Heritage in March 2006. This included assessing previous archaeological fieldwork and early survey plans, and undertaking a detailed inspection of the site. Two archaeological sites had previously been recorded on the property, recorded in the New Zealand Archaeological Association (NZAA) site file as U14/2011, a pit site, and U14/2016, a ditch. Both had been resurveyed in 2002 during the New Zealand Archaeological Association Site Upgrade Project. U14/2011 was judged to not be an archaeological site and U14/2016 was not relocated. An 1868 survey plan (ML 1121) showed “Native Cultivations” very close by the development area. The assessment concluded that the valleys to the south of the Tauranga Harbour have recently been shown to contain highly significant archaeological landscapes, and the Kaitemako valley has similar potential. In particular it was thought that gardened soils might be present.

All earthworks that involved removal of topsoil were monitored by an archaeologist. The main areas monitored were the building platforms of the two switchyards, the sediment pond and the access road off Wade Place. In addition, a number of ancillary works, such as temporary access ways, working platforms and cable trenches were also monitored. The plan called for screening vegetation to be planted on the property – the areas to be planted were closely inspected for archaeological features (none were visible on the current ground surface) but not monitored any further.

The first phase of the archaeological monitoring involved the removal of topsoil from three test trenches crossing the two building platforms in order to look for gardened soils in the trench profiles (Trenches 1–3, Figure 3 and Figure 4). The three trenches ran roughly north–south and ended several metres outside the limits of the building platforms. The topsoil varied in depth along the trenches, with the greatest depth in the low ground at around 300 mm, while the ridge top was shallow at just 100 mm. Once these trenches had been investigated a backhoe with weed bucket, loading out into a tractor and trailer unit, stripped the rest of the building platforms of topsoil.

A sediment pond was also stripped and excavated. This involved excavating a levelled area to the north west of the rest of the construction. This was excavated to a depth of around 2 m with bunds built up around the outside edges. The access road was stripped by motor scraper.

Any archaeological features observed during topsoil stripping were recorded and investigated by excavating and sampling by hand. Features were photographed and GPS points taken with a handheld GPS unit (Garmin etrex) generally accurate to ± 5 m.

Historical evidence

The historic plan, ML [Maori Land] 1121, referred to above is shown in Figure 1. The block totals 805 acres. In 1879 Judge Wilson seems to have ordered that a more accurate plan be drawn up, which locates the block with reference to the Hairini Trig and No. 2 survey station. It would, therefore, be possible to reconstruct the exact location of the block, but for current purposes it was georeferenced to the 1:50,000 topographical dataset by visual best fit, that is, by manual scaling and rotation in Adobe Illustrator (Figure 2). This plan shows the navigable extent of the Kaitemako Stream as well as a series of “Native Cultivations”, most of which lie outside Hone Macleod’s block. One of these cultivations was located at the current intersection of Kaitemako Road and Panorama Drive, about 600 m east of the Transpower property (these cultivations are shaded



Figure 1. Plan ML 1121 dated 1868, Plan of Hone Macleod's land at Tauranga.

green on Figure 2). While ML 1121 does not show any cultivations on the Transpower property, it does indicate the kind of uses to which the land was put in the mid-nineteenth century. Given the density of sites nearby and the evidence of gardening in similar situations in adjacent valleys it indicates that evidence of prehistoric occupation would be expected.

There are two annotations on this plan relating to its being produced in evidence in the Native (later Maori) Land Court. The first reads: "Produced in Court, J.A. Wilson, 29 [July] 1879." A search of the Tauranga, Opotiki, Matata and Maketu minute books for 1879 did not show any results that would match this; a search of the Knowledge Basket online index to the minute books did

not show that Judge Wilson sat on any cases in July 1879; a search for the date 29 July turned up no results for any land court sittings, though only the start date for cases can be searched. It is not clear what this annotation refers to. The second annotation reads: "Introduced before the Native Land Court at Tauranga this 30th day of May 1896, J.A. Wilson, Judge." In this case Hone Makarauri is applying for a charging order for surveys made on blocks Hairini 1, Hairini 1A and Hairini 1B, among others, as the surveys were made on behalf of others (Opotiki Minute Book 14: 167–170). While the minute books may often be informative regarding the history of particular land blocks, this is unfortunately not the case here and this line of research was not followed any further.

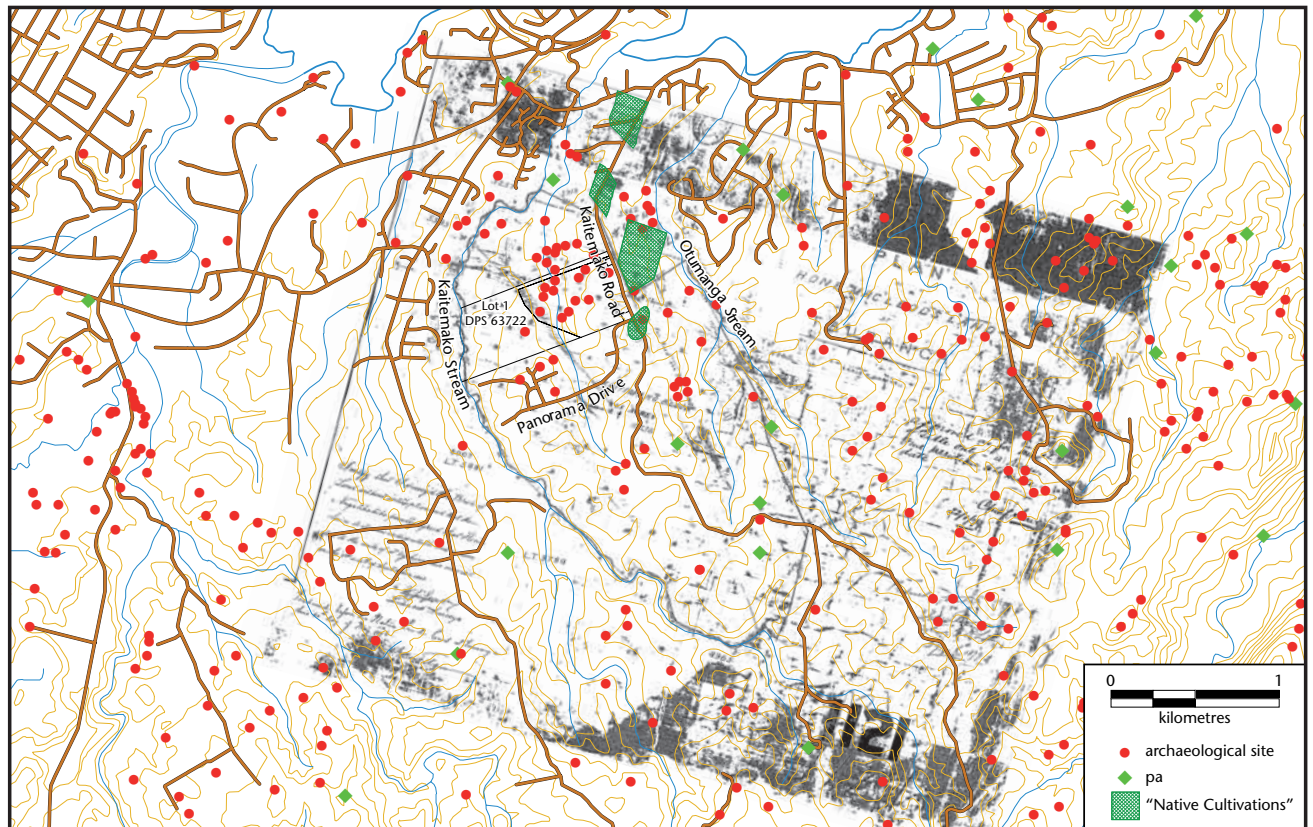


Figure 2. The Kaitemako Valley, showing the study area (Lot 1 DPS 63722) and georeferenced Plan ML 1121 dated 1868, Plan of Hone Macleod's Land at Tauranga. The "Native Cultivations" are highlighted in green.

Monitoring and investigation

Monitoring of the topsoil removal for the Kaitemako sub-station saw the identification of a number of pre-European features including a series of small damaged shell midden smears, an oven scoop, a posthole, and a cluster of rocks. Also observed in Trench 1 was a small area of modified topsoil in a small terrace which is assumed to be a gardened soil. Samples were taken from the latter for microfossil analysis.

The topsoil ranged in depth from 100–300 mm, but was generally 250 mm deep over most of the site. Beneath this was the mixed yellow tephra typically encountered around Tauranga. The underlying Rotoehu tephra was not encountered in any of the pre-European features.

There were a number of modern features, including more than 25 fence postholes, animal and/or rubbish burials and a deposit of clay, metal and tire rubber. Six modern pits were identified during the topsoil removal. Other formation processes were observed during the removal of topsoil. These are generally modern in origin and are likely to have had some impact on the archaeological features on the property. Numerous plough lines were noted criss-crossing the property at the interface of the topsoil and the

subsoil. Ploughing can damage archaeological deposits, particularly shallow midden deposits which tend to disintegrate to the point of complete destruction. This means that if small middens were once present in the upper soil layers, they will have been destroyed without trace – there is no way of knowing. Small areas of burning were also noted, presumably as a result of land clearance by fire; it is not clear if this activity is pre-European or modern. Several small circular depressions were noted. These were shallow 'scoops' of topsoil generally 50–70 mm deep and around 1500 mm in diameter, close to the eastern edge of the building platform. This area had a farm shed until recently, with a lot of modern farm debris still present. These depressions are considered to be the result of farming activities, possibly from cattle. An old metal water pipe crossed the paddock from the old shed, to the western side of the property.

A piece of ceramic from a power pylon was found at the base of the topsoil at the southern end of Trench 2. Given the number of power pylons across the property it is reasonable to expect that some modifications have been made to the landscape, outside of the erection of pylons, in the past. However, the pylons are on the hill tops which were not affected by the current earthworks. Even so, these high

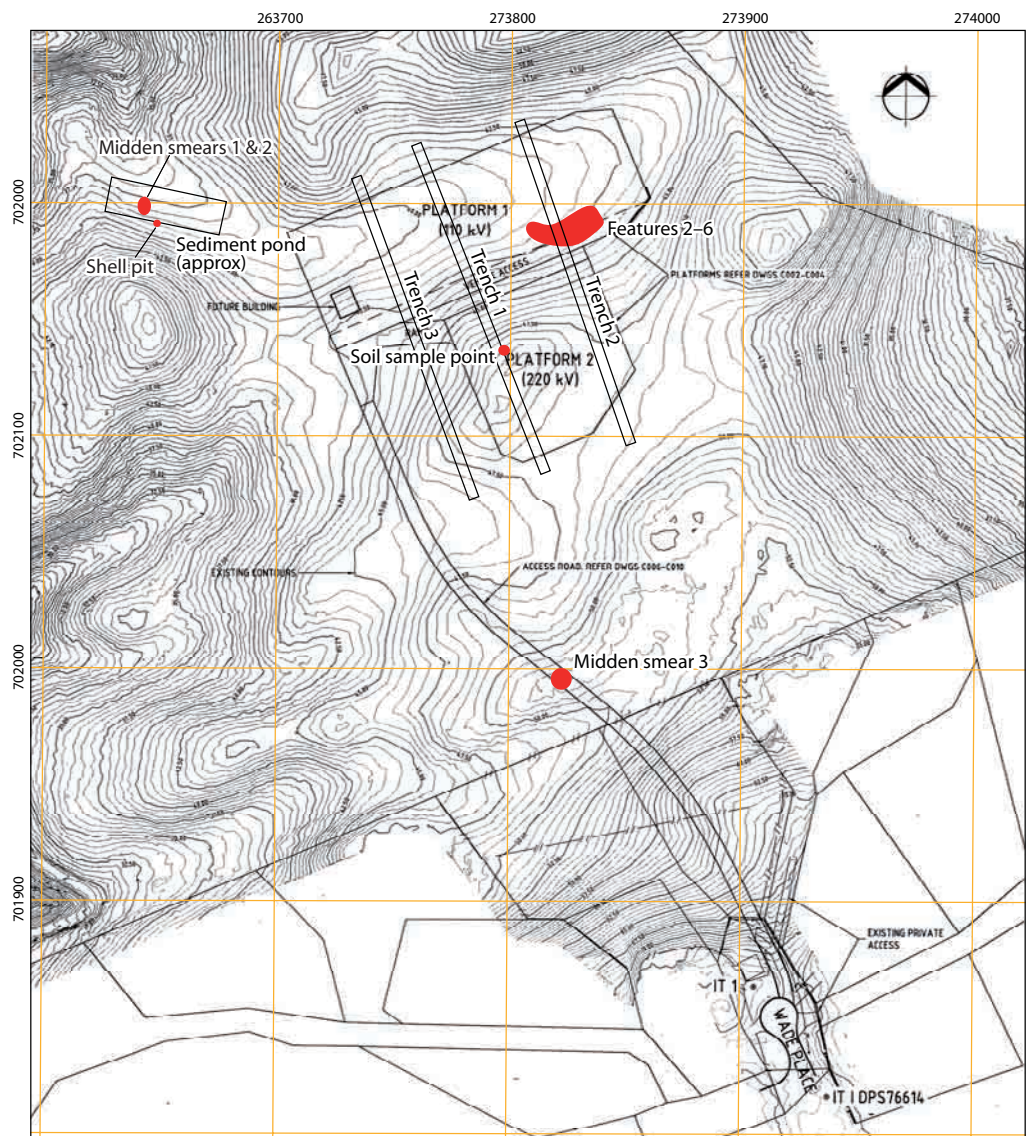


Figure 3. Location of test trenches and recorded features. Grid = 100 m. Contour interval = 0.5 m. Bay of Plenty circuit 1949. Base data supplied by Edison.



Figure 4. Panoramic view of the development area showing the three test trenches, left to right, Trench 2, Trench 1 and Trench 3. The arrow shows the approximate location of garden terrace (Figure 5).



Figure 5. Composite photograph of the lens of modified or garden soil in the profile of Trench 1.

points are the areas on the property most likely to contain pre-European archaeological features.

Midden

Midden smears 1 and 2 were located within the sediment pond. The scatters were thin and sporadic in their distribution. Excavation of this shell revealed that past cattle trampling had heavily fragmented the upper material. Whole clean shell was only identified in oddly shaped holes/tunnels that were probably remnant rabbit/rat burrows. Samples were collected from each but were not analysed.

Midden smear 3 was located at the southern end of the road formed by the motor scraper. The shell was very ephemeral, generally being one shell thick with damage by

both cattle and rabbit burrows. A sample was collected but was not analysed.

While excavating the sediment pond a lens of shell midden was noted in one section of the south wall (Figure 6). The shell was clean and generally whole with very little soil or charcoal present. It measured 600 mm wide x 200 mm deep in section when first observed. It appeared to be part of the fill of a pit of which only the edge had been exposed by the machine. A series of scrapes was made back into the wall with photos taken at each stage. The shells ended 500 mm into the wall. A sample was collected for analysis. There was another possible pit next to it measuring 400 mm wide by 1000 mm deep in section; this may have been the corner of a pit cut in section across the diagonal. Neither of the features were excavated further.



Figure 6. Lens of shell in the wall of the sediment pond. Scale = 1 m.

Features

Several features were found in close proximity in Trench 2 (Feature 1 was a modern rubbish pit). These were further exposed with the backhoe.

Feature 2 was a probable oven scoop on the west side of Trench 2, measuring 400 x 100 mm and 50 mm deep, containing shell, charcoal and burnt rock. It had been heavily damaged by cattle and rabbits.

Feature 3 was a shell smear continuing intermittently over an area measuring 3 x 2.5 m. The shell layer was very thin and heavily fragmented. Two further features were found at the base of the deposit; a rock deposit and a shallow oven scoop.

Feature 4 appeared to be a part of Feature 3, measuring 300 x 250 mm, but with rocks present.

Feature 5 was a square posthole filled with compacted small shell fragments, rock and charcoal, measuring 250 x 250 mm by 200 mm deep.

Feature 6 was a circular oven scoop containing shell, charcoal and burnt rock, 500 mm in diameter and with a maximum depth of 150 mm (Figure 7). A sample was taken for midden analysis.

Midden analysis

Each midden sample was air dried, weighed, wet sieved through a 2 mm mesh and redried. Three simple statistics can be calculated from the resultant measures

– dry weight/volume (g/l), dry sieved weight/volume (g/l) and loss through sieving (as a percentage) (Table 1). Raw shell counts as MNI (Minimum Numbers of Individuals) are given in Table 2 – MNIs for bivalves are calculated by halving the combined total of right and left valves, which were not differentiated during analysis. In Table 3 the same counts are given with sample sizes adjusted to 10 litre equivalents in order to allow for comparison between samples, and in Table 4 the weight of identified and unidentified shell is given also adjusted to 10 litre equivalents.

The midden is dominated by cockle (*Austrovenus stutchburyi*), pipi (*Paphies australis*) and large wedge shell (*Macomona liliana*). Cockle and pipi are generally the most common components of pre-European middens in New Zealand but wedge shell is not so common, certainly not around Tauranga. This is a more fragile shell than either cockle or pipi and most countable examples were quite broken; the original proportion of wedge shell may have been higher. Minor species included oval trough shell (*Cyclomacta ovata*), mud whelk (*Cominella* sp.), horn shell (*Zeacumantus lutulentus*) and cat's eye (*Turbo smaragdus*), which should be considered a bycatch. All these species live in estuarine environments, indicating that the occupants of Kaitemako gathered shellfish nearby in Welcome Bay. This contrasts with assemblages from Papamoa (Fredericksen, Barber and Best 1995; CFG Heritage report in preparation), for instance, that are typically dominated by tuatua



Figure 7. Feature 6 prior to excavation. Scale divisions = 200 mm.

(*Paphies subtrinagulata*) and ostrich foot (*Struthiolaria papulosa*) which are open sandy beach species, reflecting the Papamoa environment.

It is notable that the weight of shell in the sediment pond sample is higher (Table 4), though the count is lower (Table 3) than for Feature 6. The sediment pond has 0.46 shells per gram, while Feature 6 has 0.82. In other words, the least disturbed deposit actually has the lowest count when the matrix of soil and rock is discounted, while an oven scoop, where the shell is by nature highly disturbed both mechanically and by burning, has the highest – this is not what would initially be expected. It is most probable that the more disturbed a deposit is, the more the thinner margins of shells are destroyed through mechanical, chemical or biological processes, so that all that is left in the Feature 6 are the tough hinge parts, which are the parts that are counted.

Analyses of this kind are in their early stages, though it is 40 years since Wal Ambrose (1967) pointed out that

Context	Volume (l)	Dry weight (g)	Sieved weight (g)	dry wt/vol (g/l)	sieve wt/vol (g/l)	% loss (g)
Sediment pond	4	3200	829	800	200	74.1
Trench 2, F6	9	9030	1616	1003	111	82.1

Table 1. Volume and weight data for midden samples.

Context	Cockle (<i>Austrovenus stutchburyi</i>)	Pipi (<i>Paphies australis</i>)	Large wedge shell (<i>Macomona liliata</i>)	Miscellaneous bivalves	Miscellaneous gastropods	Total
Sediment pond	66	3	308	3	3	383
Trench 2, F6	975	322	32		43	1372

Table 2. Counts of shell by species.

we lacked understanding of the structure and formation of middens. The only comparable work is Betty Meehan's (1982) work in Arnhem Land in the Northern Territory of Australia, where she analysed how shell middens were deposited by modern Australian Aboriginals. The lessons from this research have not been incorporated into archaeology, and it is not yet clear how closely the Arnhem Land situation relates to New Zealand.

Gardened soils and microfossil analysis

In the profile of Trench 1, dug across the building platforms, a lens of modified soils was observed. This lens was roughly 2500 mm long and up to 200 mm deep, and lay beneath 100–150 mm of topsoil (Figure 5). The soil consisted of mixed topsoil and subsoil with a few fragmented shells, most probably pipi, mixed through and in the base. The total area of the soil was approximately 3 x 3 m and appeared to be the remnant of the back of an artificial terrace, since obscured and largely destroyed by ploughing.

Context	Cockle (<i>Austrovenus stutchburyi</i>)	Pipi (<i>Paphies australis</i>)	Large wedge shell (<i>Macomona liliata</i>)	Miscellaneous bivalves	Miscellaneous gastropods	Total
Sediment pond	165	8	770	8	8	959
Trench 2, F6	1083	358	36		48	1477

Table 3. Counts of shell by species, adjusted to 10 litre equivalents (rounded).

Context	Cockle	Pipi	Large wedge shell	Miscellaneous bivalves	Miscellaneous gastropods	Residue	Total
Sediment pond	200	43	595	10	5	1220	2073
Trench 2, F6	199	98	2		12	1484	1795

Table 4. Weights of shell by species in grams, adjusted to 10 litre equivalents.

This soil profile is typical of pre-European garden soils: the mixing of soils is incomplete as would be expected from working to soil with wooden tools; the shell may have been added as a mulch or may originate from nearby midden deposits. It was thought that these garden soils may be related to those shown in the general area on the 1868 plan ML 1121 (Figure 1) and two soil samples were collected from the soil profile for microfossil analysis (the full microfossil analysis report is attached as an appendix).

Environmental microfossil analysis relies on the identification of either pollens or phytoliths (particles of silica formed in flowers, stems, leaves and roots of many higher plants) that are specific to particular plants, enabling the reconstruction of the vegetation present in the environment. The third type of microfossil that is commonly analysed is starch grains. In this case we are looking for evidence of starchy crops such as kumara or taro (pre-European Maori introductions, though taro is unlikely in this situation), or European introductions such as white potato or sweet corn consistent with the general area being garden in or around 1868.

Starch residues consistent with the tuberous roots of kumara (*Ipomoea batatas*) were found highly concentrated in one of the samples, suggesting that the garden soil was used for cultivation or preparation of kumara. No evidence of European introduced crops was found – it is not possible to tell one way or another what period the garden evidence belongs to from the starch grain evidence, as kumara continues to be garden up to the present.

Fragments of microscopic charcoal were found in both samples, indicating human-induced burning. This is further supported by the presence of large numbers of bracken (*Pteridium esculentum*) spores, which is often one of the first plants to grow in a burnt landscape. Tree fern (*Cyathea* sp.) spores were also present in large numbers as were pollens of manuka/kanuka (*Leptospermum scoparium/Kunzea ericoides*), grasses, puha/dandelion (*Sonchus/Taraxacum*) and spores of hornworts (Anthocerotae), all indicate vegetation disturbance. Some exotic pine pollen was found in one of the samples, so the soils may be of European age consistent with garden in or around 1868, but there is also a possibility that they may also have been mixed down into the soil by a number of natural factors. Pine pollen was not found in the other sample. Phytoliths (silica granules) of nikau (*Rhopalostylis sapida*) rewarewa (*Knightsia excelsa*), beech (*Fuscopsora* sp.) and toetoe (*Cortaderia*) were also found. Phytoliths often survive better than pollens and so may be indicative of the vegetation present before it was burnt – nikau, rewarewa and toetoe are themselves indicative of second growth bush or forest edge, so the disturbance indicated by the pollen may be the second such episode.

Chronology

A single shell sample from the sediment pond midden was submitted to the University of Waikato Radiocarbon Dating Laboratory for analysis. The resulting date (Wk 22575) was 702 ± 25 BP (Conventional Radiocarbon Age) which calibrates to AD 1490–1690 at a 95% confidence interval. This date is similar to other dates obtained from sites in the valleys leading up from Tauranga Harbour, for instance at Oropi and Ohauti where dates are generally in the range of AD 1450 to 1650 (Campbell 2004a, 2004b, 2005; Campbell and Piahana 2003; Campbell and Harris 2007; Campbell and Hudson 2008; Furey 2004).

Discussion and conclusion

As far as we are aware this is the first reported archaeological investigation from Kaitemako. It involved only the monitoring of topsoil stripping and trenching over a fairly small area and only a few, mostly disturbed archaeological features were found. They certainly indicate use of the area by pre-European Maori but it is hard to say how intensively. The substation site was tucked into a hollow, whereas most evidence will probably be located on the nearby hill and ridgetops. Such evidence would consist mostly of kumara storage pits, for which dry or well drained soils are preferred, and middens. There was, for instance, a shell midden, measuring 20 x 20 m and up to 150 mm deep, spilling down from the top of the hill to the east of the substation site. Other sites recorded in the general vicinity (Figure 2) are all of this type: pits and/or terraces and/or middens. None are particularly large (though limited surface evidence may conceal substantial and complex inground evidence) though there are several pa further up Ohauti and Kaitemako Roads, which run along the ridges defining the Kaitemako Valley.

The Kaitemako substation investigations have given us our first clues as to the nature of pre-European occupation at Kaitemako. Like the other valleys feeding into Tauranga Harbour, occupation seems to have taken place between the mid 15th and mid 17th centuries. Although we have no current evidence of earlier occupations along the harbour, this is presumably where Kaitemako was settled from as populations grew and garden soils closer to the harbour became overworked. However, due to the limited scale of investigation it is not feasible to take this line of inquiry further at this stage. Future investigations at Kaitemako will build on and/or modify these conclusions.

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Field work has carried out at various times by Matthew Campbell, Glenn Farley, Jaden Harris and Noel Hill. Neil Bromley and Brent Stark from Transpower, and Darryl Yorke from Edison facilitated our work. Des Heke and Max Heke from Nagti He facilitated tangata whenua involvement.

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Plant microfossil analysis of samples from Kaitemako

Mark Horrocks, Microfossil Reserach

Methods

Pollen analysis

Pollen analysis includes pollen grains of seed plants and spores of ferns. It provides insight into past vegetation and environments, and in New Zealand allows the differentiation of sediments deposited in pre-human, Polynesian and European times (Hayward et al. 2004, Matthews et al. 2005). Pollen may also provide direct evidence of introduced Polynesian plants, namely bottle gourd (*Lagenaria siceraria*) and paper mulberry (*Broussonetia papyrifera*) (Horrocks 2004), and European crops such as maize (*Zea mays*) (Horrocks & Lawlor 2006).

Samples were prepared for pollen analysis by the standard acetylation and hydrofluoric acid method (Moore et al. 1991). At least 100 pollen grains and spores per sample were counted and slides were scanned for types not found during the counts. Fragments of microscopic charcoal are extracted along with pollen during preparation, providing evidence of fires.

Phytolith analysis

Phytoliths are particles of silica formed in inflorescences, stems, leaves and roots of many higher plants (Piperno 2006). Phytolith analysis compliments pollen analysis, especially regarding grasses (Poaceae); unlike grass pollen, grass phytoliths may be differentiated below the family level. Also, silica is often better preserved than pollen. Phytoliths (like pollen) may provide direct evidence of bottle gourd and paper mulberry (Horrocks 2004). Other types of biogenic silica, notably diatoms and sponge spicules, are extracted along with phytoliths during preparation. Diatoms are unicellular algae found in aquatic and sub-aquatic environments and have cell walls composed of silica. Sponges, exclusively aquatic, are multi-cellular animals with an internal skeleton often composed of siliceous spicules. Diatoms and sponges are found in both marine and freshwater environments.

Samples were prepared for phytolith analysis by density separation (Horrocks 2005). At least 100 phytoliths and other types of biogenic silica per slide were counted and slides were scanned for biogenic types not found during the count.

Analysis of starch and other residues

This analysis includes starch grains and other plant material such as xylem cells (Torrence & Barton 2006). Starch is the main substance of food storage for plants and is

mostly found in underground stems (e.g. tubers, corms), and roots and seeds. It may provide direct evidence of Polynesian starch crops, namely kumara (*Ipomoea batatas*), taro (*Colocasia esculenta*) and yams (*Dioscorea* spp.) (Horrocks & Barber 2005; Horrocks & Wozniak, in press), and European crops such as potato (*Solanum tuberosum*) (Horrocks & Best 2004). Starch is present in tubers etc. in very high concentrations of grains. Xylem is a complex vascular tissue through which most of the water and minerals of a plant is conducted, and is characterised by the presence of tracheary elements with distinctive thickenings.

Starch and other residues were prepared for analysis by density separation (Horrocks 2005). The samples were analysed for starch and other significant material, and presence/absence noted.

Results and interpretation

Pollen analysis

Fragments of microscopic charcoal were found in both samples, reflecting anthropogenic fires (Fig. 1). The samples are dominated by bracken (*Pteridium*) and *Cyathea* spores. Bracken, an invasive ground fern with widely dispersed spores, is often abundant in New Zealand pollen assemblages of the last millennium and is commonly associated with Polynesian deforestation which mostly occurred c. 800–600 years ago (McGlone 1983). The low proportion of pollen of tall trees coincident with charcoal and bracken spores indicates repeated firing of forest. Bracken fernland was a significant part of the regional Kaitemako vegetation at the time. *Cyathea* tree ferns typically colonise gullies in fernland. Pollen and spores of other taxa indicating vegetation disturbance, namely manuka/kanuka (*Leptospermum/Kunzea*), grasses, puha/dandelion (*Sonchus/Taraxacum*) and hornworts (Anthocerotae) are also present in the samples. Hornworts are inconspicuous plants that colonise freshly exposed soils. Notwithstanding the clear evidence of forest destruction, the high proportions of bracken and *Cyathea* spores is largely due to greater resistance of these types to degrading soil micro-organisms (Dimbleby 1985). Most of the pollen grains and spores are corroded, indicating aerobic conditions allowing decomposition of organic material. Exotic pollen, namely pine (*Pinus*), was found in sample 1, indicating that the particular deposit is of European age or that European and prehistoric deposits have been mixed by percolation, bioturbation or mechanical disturbance. As exotic pollen was not found in sample

2, that deposit may be of prehistoric age (assuming it is older than or lies below sample 1).

Spores consistent with truffle (hypogeous Ascomycotina) were found in sample 1 (Fig. 1). Most truffles grow in intimate association with host plant roots and produce the spore-bearing bodies in close proximity. This putative truffle spore type resembles those of the Australasian truffle genera *Labyrinthomyces*, *Dingleya* and *Reddellomyces* but is not identifiable to any known species (Trappe et al. 1992).

Phytolith analysis

Phytoliths provide further insight into the Kaitemako vegetation at the time. The samples are dominated by spherical nodular, spherical spinulose and spherical verrucose phytoliths (Fig. 2). The latter are common in rewarewa (*Knightia*) and *Fuscopsora* (beech spp. other than silver beech) (Kondo et al. 1994). Little is known yet about the types of plants that produce spherical nodular phytoliths. Spherical spinulose phytoliths occur in palms (Arecaceae) and bromeliads (Bromeliaceae) (Piperno 2006). New Zealand has no native bromeliads therefore in this case this phytolith type is from nikau (*Rhopalostylis*) palm, New Zealand's only representative of this family. Spherical smooth phytoliths are found in rata and pohutukawa (*Metrosideros*), beech, kamahi (*Weinmannia*), tawa (*Bielschmeidia*) and *Cyathea* tree ferns.

Bulliform phytoliths are exclusively from grasses, in New Zealand originating commonly from *Rhytidosperra*. Chionochloid phytoliths originate from the Arundinoideae sub-family of grasses; in this case probably mainly toetoe (*Cortaderia*). Festucoid phytoliths are found commonly in the Pooideae sub-family (e.g. *Poa*, *Festuca*); panicoid phytoliths are found in Panicoideae, some *Chionochloa*, *Cortaderia* and *Rhytidosperra*.

Elongate phytoliths generally do not possess any sub-family or tribal characteristics; they are present in grasses and other monocotyledons, ferns and some trees. The scarcity of fern phytoliths, which appears at odds with the pollen results (abundant fern spores), is not unusual because ferns are under-represented in New Zealand phytolith spectra.

Analysis of starch and other residues

Starch residues consistent with the tuberous roots of kumara were found highly concentrated in sample 1, suggesting that the sampled area was used for cultivation or preparation of this starch crop. Kumara is part of the small group of six introduced plant species being cultivated by Maori at the time of European contact in the late 18th century. Most of the many plant species (72) identified as being intentionally introduced to the Pacific by prehistoric people (Whistler 1991) are native to various regions within the area from southeast Asia to Papua New Guinea.

Kumara however, known elsewhere as sweet potato, originated in South America, its introduction to the Pacific a result of Polynesian contact (Hather & Kirch 1991).

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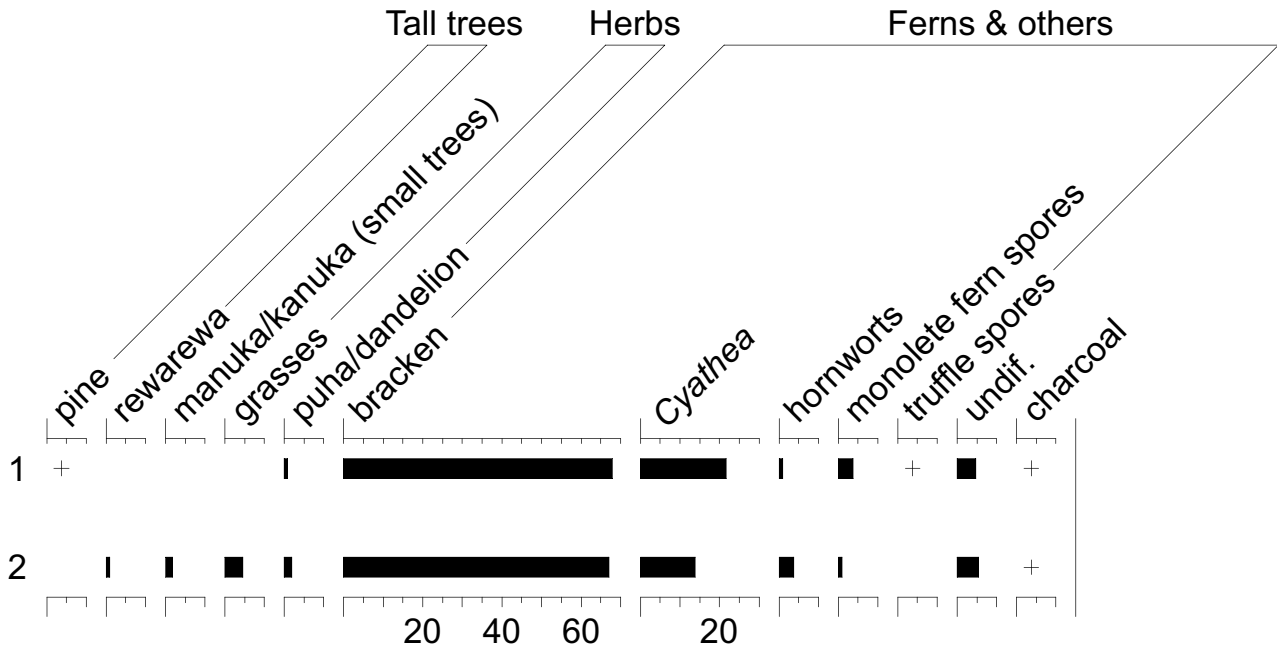


Figure 1. Percentage pollen diagram of samples from Kaitemako (+ found after count).

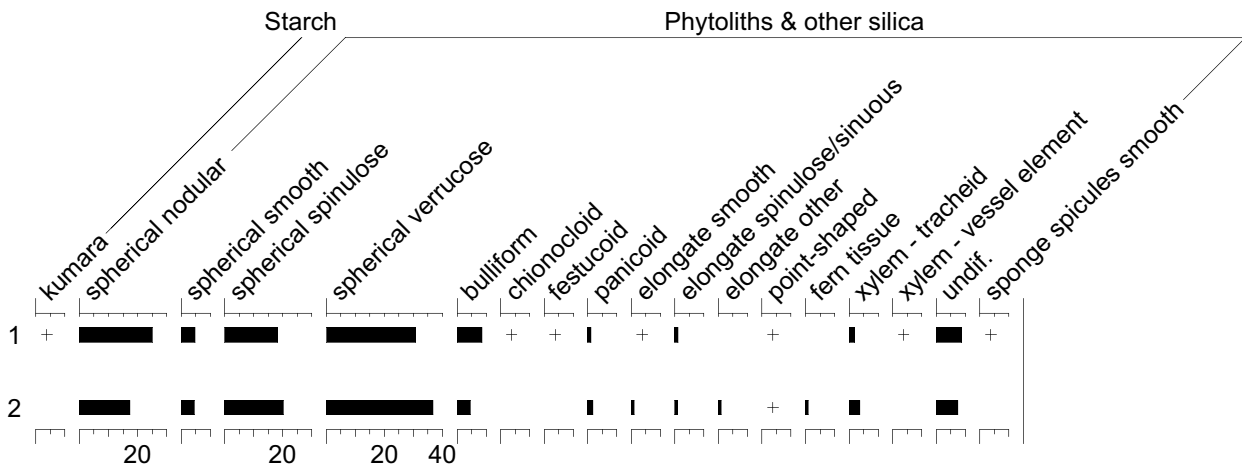


Figure 2. Starch and percentage phytolith diagram of samples from Kaitemako (+ found after count).

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Report on Radiocarbon Age Determination for Wk- 22575

Submitter	M Campbell
Submitter's Code	Kaitemako - from wall.
Site & Location	Kaitemako, Tauranga, New Zealand
Sample Material	Cockle
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 2 M dil. HCl for 200 seconds, rinsed and dried.

$\delta^{13}\text{C}$	0.6 ± 0.2	‰
D^{14}C	-83.7 ± 2.9	‰
$\text{F}^{14}\text{C}\%$	91.6 ± 0.3	$\%$
Result	$702 \pm 25 \text{ BP}$	

Comments

14/1/08

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- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
 - Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
 - The isotopic fractionation, $\delta^{13}\text{C}$, is expressed as ‰ wrt PDB.
 - $\text{F}^{14}\text{C}\%$ is also known as pMC (percent modern carbon).

Marine data from Hughen et al (2004);Delta_R -7±45;OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]

