The distinction in terminology for mounds and heaps, and for walls and rows, may be unnecessary at the level of site recording, unless it is clear to the site recorder that a stone mound contains earth and has a structured form. It is important, however, to be explicit in how the individual terms are used.

Use of stone and earth mounds has not been part of the historically recorded Maori gardening practices in New Zealand. There are, however, several references from the inland Bay of Islands of garden areas being cleared of stones, which were then formed into heaps (Wilkes 1845: 372; Best 1976: 127). The earth and stone mounds are distinctly different from the low earthen mounds (called puke) associated with kumara.

The presence of single postholes in mounds at Wiri (Coates 1992) and in one mound in the Cross Site at Palliser Bay (Leach 1984: 42) lends credence, in at least some instances, to the interpretation of mounds as garden features and not just piles of stone. The posthole possibly represents a post or stake support for the gourd vine. The function of stone mounds was first suggested by Sullivan (1974), to account for the large numbers of structured mounds on flat land, where their appearance could not otherwise be accounted for. Without further elaboration, Sullivan interpreted these as gourd gardens, although there was acknowledgement that this explanation was not convincing.

Stone mounds are most commonly associated with stony soils on volcanic fields, and can be present in large numbers. In the garden systems of Auckland, very high densities of mounds have been recorded within small areas at Wiri Railway site (R11/1188) and at Harris Rd (R11/1301) in East Tamaki. It has been estimated that there may originally have been up to 10 000 stone mounds in the c. 280 ha of field remains at Wiri in South Auckland (Sullivan 1974: 128). Similarly, at Pouerua in the inland Bay of Islands, concentrations of mounds have been identified (Fig. 7). For example, clusters of mounds as close as 400 mm apart were recorded at P05/681. Heaps of larger stones were also recorded at this site. There was also a high density of mounds at the Washpool Cross Site in Palliser Bay, leading B.F. Leach (1979: 120) to comment that there was very little space between them.
At the Wiri Railway site, 8 of the 14 mounds excavated had earthen cores of friable loam (Coates 1992). One of these mounds (measuring 2.5 m × 2.2 m × 0.4 m) was estimated to contain 640 L of soil and 800–900 rocks. Two of the excavated mounds had shell fragments incorporated into their earthen core, but there was no shell in the surrounding soil. No evidence was found of gardening between and around the mounds.

After experimental work relating to soil temperature, soil moisture and chemical analysis of the soil, Coates (1992) concluded that there were strong grounds for interpreting mounds with inner soil cores as deliberately constructed garden features within which crops were grown. Soil in the mounds was found to be consistently warmer than the surrounding flat land. However, when there was a substantial drop in air temperature, all soil temperatures, regardless of location, also dropped rapidly, perhaps limiting the perceived advantage of using these structures in more marginal areas where rapid temperature changes are more likely to occur (Coates 1992: 59).

There may have been good reasons for growing plants in elevated stone structures, especially in Marlborough, where the climate was marginal for gardening. Temperatures would have been higher within the mounds and cold air would have drained down and away from the plants, reducing the likelihood of frost damage (McFadgen 1980b). However, they are not a common feature in gardens in more climatically marginal areas. In Marlborough, mounds are only reported from the Cattleyards Flat and Robin Hood Bay sites, and they are not abundant in Wairarapa sites either. While there are concentrations of small stones at Clarence...
River, the excavation of one revealed a heap containing no soil (Trotter 1977). The excavated mound at the Cross Site in the Makotukutuku Valley, Palliser Bay, had a high soil content amongst the rocks, which was interpreted as a growing medium that would have provided a deeper soil profile than the thin underlying soils (Leach, H.M. 1979b: 242).

As to which crops might have been grown in these soil-filled mounds, again only inferences are possible. Archaeologists in New Zealand have favoured gourd (Leach 1984). Use of high-resolution investigative techniques to look for pollen, phytoliths and starch grains in soil could potentially help answer this question. Traces of gourd pollen have been found in soil samples from a small mound at Pouerua, inland Bay of Islands, suggesting that gourd plants may have been grown on or near the mound (Horrocks et al. 2000). Kumara starch grains and xylem cells have also been detected in the same mound at Pouerua, and also at a mound at Puketona, the adjacent volcanic stone field to the east of Pouerua (Horrocks 2004). In each case, the mound was a similar form to that described above from Wiri, having an outside curbing of large stones and an inner core of earth. However, pine (*Pinus radiata*) pollen was also found at all levels within the Pouerua mound, which raises questions about the ease with which pollen grains can infiltrate and contaminate layers. However, the presence of pine pollen may also indicate that the mound was constructed in historic times. Further controlled work is necessary to understand why pollen from both pine and gourd, and kumara in traces, was present. The two most likely explanations are that either the soil profile was contaminated through infiltration, or older garden soils were redeposited in a more recent (historic) feature.

5.1.5 **Stone facing**

Stone facing may retain the front edge of artificial terraces. Such features are particularly common on islands, and are often associated with stone heaps. Terraces with stone facings may have been used for residential purposes, and some do have evidence of houses and midden; however, many are large, with rows, alignments or heaps placed on them, and are likely to have been used for gardens. No excavations have been carried out on these features on the islands. These sites are confined to the upper part of the North Island and northern offshore islands (Table 1).

5.2 **Ditches and Trenches**

Ditches and trenches occur in various situations and probably had more than one function, according to local and regional conditions. They can be divided into two broad types according to location and arrangement (Fig. 8). Although these features are referred to as ‘ditches’, ‘channels’, ‘drains’ and ‘trenches’ in the literature, the terminology does not imply a particular function. It is unlikely that the linear, parallel depressions on slopes were intended to conduit water to, or away from, garden areas. Instead, they probably functioned in a similar way to fences, or to parallel stone rows, and partitioned gardens into individual plots, although a drainage function cannot be ruled out. In contrast, the ditches in swamp areas of Northland may have channelled water away from gardens and controlled the flow of water from sources such as springs. For consistency, and
in keeping with terminology used for boundary divisions in the Wairarapa, in the following discussion the term ‘trench’ is used in relation to those features present on slopes and on flat land. ‘Ditch’ is used in relation to those features in swamps and on poorly drained land.

Within the NZAA site records, there are references to large and wide ditches in swamps, which could have been canoe portages, or for trapping eels, fish and ducks (e.g. those at Bulls in the Manawatu, and at Wairau in Marlborough). Other smaller connecting ditch systems are most likely related to gardening, and comprise many interconnecting channels on wet or poorly drained land. They are confined to Northland (Barber 1982, 1989a,b, 2001).

Other evidence takes the form of shallow, parallel trenches on slopes. These are more widespread, although the majority of the recorded sites are also in Northland. They occur on slopes varying from gentle to steep, on terraces and flats at the base of slopes, and in river valleys. These features are generally considered to demarcate garden plots (Nicholls 1965). Although Peters (1975: 178) agreed with this interpretation, he suggested that in some cases they may also have channelled surface water away from the garden area, and he cautioned that “…each field system must be looked at and interpreted in relation to the pattern it forms and its physical location’. Peters queried whether the term ditch was appropriate, and suggested that the linear features at Moturua Island, Bay of
Islands, were the result of soil being scooped up to form a raised ridge. However, there is no evidence for this archaeologically. Cross-slope trenches linking to the main down-slope linear trenches also occur at some sites, but these are not common, and in some instances have been interpreted as relating to more recent (historic) gardening activities.

These ditch-and-trench features are often difficult to see and they may be severely under-represented in the records: because they are shallow (usually less than 500 mm deep) and narrow, they are vulnerable to erosion and infilling, and on flat land are destroyed by ploughing and intensive European land-use practices. Often they are only visible when seen from a distance in particular light conditions, and under close-cropped pasture grass. Walton (1982b) has queried whether the implied association of these features with Maori gardening may be misleading, as plough lines can leave similar evidence. Although this explanation has merit in highlighting that surface evidence may have other origins, especially when on gently rolling or flat ground, the majority of the recorded features of this type are on steep slopes or poorly drained ground that has never been ploughed. The fact that these linear features have a very narrow geographical distribution reinforces that they are largely Maori in origin. Ploughing lands are more likely to have made a significant negative contribution to the survival of the Maori horticultural evidence rather than added to the quantity of sites recorded.

Barber (1982, 1989b) used the term ‘ditch’ and identified several types in Northland. His classification system also recognised features made by gum diggers, plough lines and recent land drainage. Eel weirs, duck traps and canoe portages were also incorporated. Four classes of site associated with Maori horticulture, and separated by the steepness of the land, were recognised:

- Steep-slope ditches associated with gardening
- Ditches on gentle slopes associated with gardening
- Boundary divisions on dry and level ground
- Wetland ditches and canals associated with cultivation

Examples of each of these types are present in the site records. Barber (1982, 1989b) assumed that the first two categories were multi-functional, serving as garden plot boundaries and to channel water. The third category acted as boundary divisions only, and the fourth was for drainage or reticulation ditches only. The separation of the first two categories may be arbitrary and unnecessary, as there is considerable overlap in possible function, as will be seen from the following discussion.

5.2.1 Steep-slope trenches

Steep-slope trenches, which are generally parallel (Fig. 9) or occasionally converge, occur on slopes with a gradient of over 15°, and on clay and clay loam soils. Barber (1989b: 28, 30) suggested that gardening on hillslopes had certain advantages, including being elevated above cold air in valley bottoms and having better drainage. However, in coastal parts of Northland, where this site type predominantly occurs, air temperature is unlikely to have been a major consideration affecting the development of slope gardens. Barber also argued that these slope trenches may have been constructed to manage erosion, by channelling slope run-off in areas subject to heavy downpours. A similar view is held for evidence in the Oruru Valley, Northland (Johnson 1986).
Well-known examples of slope trenches in Northland include those on steeper slopes at Tupou Bay on the east coast (Nicholls 1965; Jones 1994: 100–101), Marsden Cross and Rangihoua in the Bay of Islands (Spencer 1983; Jones 1994: 70), and Limestone Island in Whangarei Harbour (Q07/530).

Two systems of slope trenches have been investigated on Moturua Island. During excavations on Paeroa Pa in 1964–65, Groube (1966) uncovered trenches on the south-facing slope below the pa. This site (Q05/44) was in Hahangarua Bay. During further excavations at the same site in 1968, two modified soils containing shell and shingle from the beach were reported (Peters 1975). Trench-like features were cut into the later modified soil on an estimated 20° slope. The four trenches illustrated were 12 m, 9 m and 6–7 m apart. Two of them converged part way down the slope to form one trench. These features are not described in any detail and illustrated stratigraphic sections are not at a sufficiently large scale to establish whether the trenches were associated with the modified soil or post-dated it. If they post-date it, as suggested by Peters (1975), then they are unlikely to be horticultural in origin, as the modified soil was covered by modern topsoil rather than further garden-related deposits. Charcoal from the upper modified soil was radiocarbon dated to 510 ± 70 BP (ANU 543; Peters 1975), with a 95% probability that it was laid down before AD 1630. A similar result for the layer was obtained by Groube (1966; see Appendix 2). If the trenches were later than the soil, then the soil date gives a lower-end
range for indication of age. If contemporary, the soil and the ditches could have been in use any time from the late 13th century to the early 17th century. More recent investigations have been carried out in the adjacent Opunga Bay at site Q05/46 (Johnson 1997). This was the location of Peters’ (1975: 176–177) other investigation on the ‘flat area behind the beach’, where a modified soil was revealed. Johnson estimated that the soil covered c. 0.7 ha, extending from the lower hillslope and across the beach flat. Nine parallel trenches were detected on the slope south-west of the beach flat. The widths of the features varied from 0.53 m to 0.90 m, and depths from 0.30 m to 0.78 m. Distances between trenches were generally 16–17 m, although two trenches were 9 m apart. One trench extended for about 40 m downslope. None appeared to continue onto the coastal flat at the base of the slope. An age estimate on pipi (*Paphies australis*) shell within the soil indicates that it was constructed in the 16th–17th centuries (Johnson 1997: 35). See Appendix 2 for radiocarbon results.

5.2.2 Trenches on gentle slopes

Trenches occurring on gently sloping or well-drained flat land are on clay loam, silt loam and alluvial soils. These trenches differ from those on steeper slopes in that they often have transverse trenches that break the land up into rectangular or square plots. At some sites, systems with connecting trenches may be adjacent to an area of parallel steep-slope trenches and, in fact, may be a continuation of these, as at Tupou Bay (Nicholls 1965). This suggests that the separation of trenches into two categories based on slope does not match the continuous relationship observed archaeologically. Other examples on flat ground include those in the Oruru Valley (Johnson 1986), Waipoua Valley on river terraces associated with stone heaps and stone-faced terraces (O06/169), Q05/119 on Urupukapuka Island, and many others in northern coastal areas (Barber 1982). Some of these sites are in association with peach and fig trees, or with ditch-and-bank enclosures (e.g. O04/284), indicating that they are historic in age.

Within this category, several different functions or overlapping functions are implied from the surface evidence. These include diversion of surface water away from gardens, and reticulation of water to flatter areas for specific crop requirements. This latter interpretation implies that taro (the only moisture-tolerant cultigen) was grown on the flat, and kumara on the slopes; however, this may be a simplistic explanation. Examples of water diversion include systems with cross-ditches on the upper slope.

Archdeacon Walsh (1902: 15) provides further explanation of the function of these shallow trenches: ‘In the case of clay lands, especially those on the river-flats, drainage was necessary, and, where possible, surface channels were made before the winter rains set in, as a prolonged exposure to water not only retarded the spring operations, but had the effect of “souring” the soil and making the work of cultivation more difficult. On the old cultivations the cleaning-out of these drains was the first thing to be attended to as the planting-time approached’. He was referring to the growing of kumara, and reporting historic practices, but there is field evidence recorded, tentatively identified as historic, to which this function might apply.

Trenches on flat land generally have well-defined origins (or exits) at either stream banks or scarps above beaches, progressing upslope to finish at irregular
distances. This pattern was also observed with the stone rows at Palliser Bay, leading H.M. Leach (1979a: 155) to conclude that gardening started on the flat and extended for uneven distances up the slope in each strip.

5.2.3 Trench boundary divisions

Although water or erosion control may be one reason for the presence of trenches on some sloping sites, in other places on gentle slopes or flat land, such as on sandy loam flats behind beaches or on volcanic soils, drainage was not an issue. At Pouerua, there are examples of slope trenches joining longer trenches in valley floors, and parallel trenches up to 300 m long that cross knolls and ridges in the lava flow (Fig. 10). Short, transverse trenches occur in the space between the long trenches (Phillips 1980). Given the free-draining nature of the volcanic

Figure 10. Aerial photograph of shallow trenches as boundary divisions, Pouerua, Northland. Deep ash mantles the landscape on the eastern side of the volcanic cone. In the absence of stone, the trenches outline the garden plots. Photo: Anthropology Department, University of Auckland.
soils at Pouerua, and the fact that these trenches cross over knolls, they are unlikely to have had a drainage or water-channelling function. Rather, they can be interpreted as garden boundaries, perhaps doubling as footpaths around the edges of gardens.

Profiles through stone rows at North Pararaki in Palliser Bay revealed trenches underneath rows and may have been the initial boundary marker lines constructed prior to the more permanent stone rows (Leach, H.M. 1979a: 159). Parallel lines of trenches also occur at Pukaroro Maori Reserve and at Okoropunga on the Wairarapa coast; however, these are not like the Palliser Bay examples, which seem to be related to the rows themselves. At Panau on Banks Peninsula, a complex of parallel lines on a north-facing slope consists of low linear ridges in association with stone rows. Profiles through several of these indicated that they were not well-defined, and the features could be interpreted as being low earthen ridges or slight linear depressions (Jacomb 2000: 98). The southernmost recorded instance of the parallel down-slope raised linear ridge site is at Flea Bay on Banks Peninsula.

5.2.4 Wetland ditches

Wetland ditches in poorly drained or water-logged soils (Fig. 11) were first described in the 1920s, and were attributed to the drainage of swamps by Maori for horticulture (Wilson 1921, 1922). A similar system was described for the Kaipara Flats (Harding 1928). A large area of interconnecting ditches covering 125 ha has been recorded at Awanui near Kaitaia (Barber 1989a), and in the Oruru Valley (Johnson 1986). A similar system exists at Lake Tangonge, also near Kaitaia.

Barber (1983) mapped the large ditch complex (N03/638 and 639) at Motutangi near Houhora, which covered over 47 ha. Parallel lineal ditches and shorter cross-ditches enclose plots of land. The land is not flat, but the slope gradient is generally below 15°. The surviving part of N03/639 covers more than 7.7 ha, with a cumulative ditch length of over 6 km. Ditches were up to 500 mm deep and less than 500 mm in width. Soil excavated during ditch construction was heaped onto adjacent plots; this may be evidence of raised beds (Barber 1983), or may merely reflect the need to dispose of spoil efficiently and with the least effort. Radiocarbon dating of peat from above the bases of two ditches at Motutangi indicates that they were no longer in use by the mid-17th century at the latest (Barber 1989b: 39–40). Although drainage of water was the most likely function of the ditches, Barber (1983: 123) proposed that because the plots were concentrated in the wettest area of the swamp, the intention was also to redistribute water from natural springs through the ditch system and to irrigate the soil. After eliminating kumara, due to its intolerance of excessive moisture, and using traditional history from the area, Barber (1983) concluded that taro was the plant most likely to have been grown there. However, taro is not known to have been grown in wetland conditions in historic times and none of the early observers referred to the use of irrigated ditch systems. In New Zealand, taro was only ever observed growing in dryland situations throughout Northland and further south to Poverty Bay, although wetland taro cultivation was widely practised in Polynesia.