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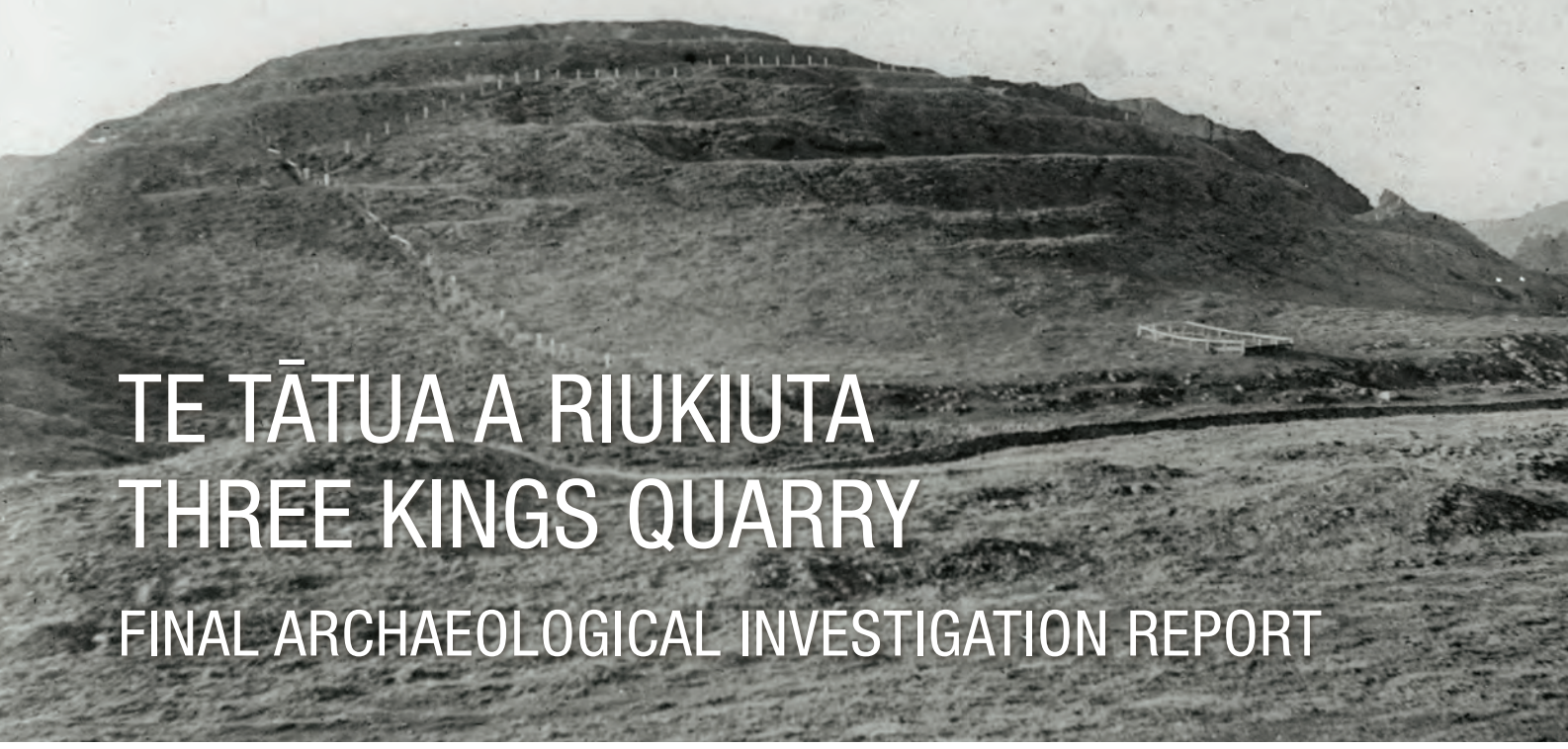

TE TĀTUA A RIUKIUTA
THREE KINGS QUARRY

FINAL ARCHAEOLOGICAL INVESTIGATION REPORT

By Simon Bickler
Aaron Apfel
Ellen Cameron
With contributions by Jaime Grant, Patricia Pillay, Leah Harding, Dr Rod Wallace, Dr Mark Horrocks

Report prepared for
Fletcher Living Ltd
August 2023

Fletcher Living

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TE TĀTUA A RIUKIUTA THREE KINGS QUARRY: FINAL ARCHAEOLOGICAL INVESTIGATION REPORT

Prepared in accordance with HNZPT Authority Nos.
2021/277, 2021/752 and 2022/072

For Fletcher Residential Ltd

August 2023

Fig. 74—*Sites of Old Terraced Hill Forts. Auckland Isthmus.* (See p. 289.)

Cl. Boscawen, Photo

By
Simon H. Bickler, PhD
Aaron Apfel, MA (Hons)
Ellen Cameron, MSc

With contributions by Jaime Grant, Patricia Pillay, Leah Harding, Dr Rod Wallace and Dr Mark Horrocks

Clough & ASSOCIATES LTD

321 Forest Hill Rd,
Waiatarua, Auckland 0612
Telephone: (09) 8141946
Mobile 0274 850 059
www.clough.co.nz

EXECUTIVE SUMMARY

Fletcher Residential Ltd is carrying out a residential development at 995 Mount Eden Road and adjacent properties, Three Kings, Auckland. This development encompasses the existing Three Kings Quarry and surrounding land. A rising main infrastructure project was also undertaken by Fletcher Residential Ltd, extending from Mount Eden Road along Kingsway and St Andrews Road, connecting to the main watermain on Mount Albert Road. During these developments, several archaeological sites were discovered. Four midden sites, that were recorded as R11/3282, R11/3332, R11/3337 and R11/3429, were exposed in proximity to the former quarry area. These middens provided valuable insights into the former Māori settlements on the lower slopes of the eastern of the three cone pā that once made up Te Tātua a Riukiuta.

R11/3282, located near Mount Eden Road, consisted of two areas referred to as the Front Midden and Back Midden. Radiocarbon dating of the Back Midden indicated occupation in the late 15th century AD and a later densely packed midden layer with fishbone suggested occupation in the 16th century. The Front Midden contained firescoops and was contemporary with the later material in the Back Midden.

R11/3332, situated southwest of R11/3282, showed evidence of previous disturbance, with only small patches of intact shell midden visible. A single date suggested occupation in the 16th century, in line with the use of volcanic soils around Te Tātua a Riukiuta maunga during that era.

R11/3337, near Mount Eden Road and Kingsway, was a long section cut from the lower slopes of the maunga, with deposits almost 1m thick. It displayed multiple archaeological contexts, including shell midden, a firescoop, and a hangi. Radiocarbon dates revealed two distinct phases of occupation, with the bulk of the midden dating from 1600-1620 AD, being intersected later by a mid-17th century stone-filled hangi.

This site also underwent microfossil analysis, shedding light on the plant material present in the area and used by its inhabitants. Large-scale landscape disturbance was evident, with Māori-introduced cultigens such as kūmara, taro, and ti pore (cabbage tree) identified. Charcoal analysis indicated the presence of various trees, including puriri, pohutukawa, and matai, as well as ferns and shrubs like bracken, hebe, coprosma, manuka, and akeake. Pohutukawa, used for the hangi feature, was likely chosen for its suitability as firewood and its availability.

R11/3429 was discovered during the rising main works along St Andrews Road. Despite being heavily disturbed by past utility works, suitable samples for radiocarbon dating were recovered and indicated occupation from the 16th to the first half of the 17th century AD.

All four middens were dominated by cockle, with a few other muddy or muddy and/or sandy environment shellfish species represented. These and the fish species identified from site R11/3282 would have been sourced from the inner Manukau Harbour c.2km to the south.

In addition to the middens, a historic artefact dump was uncovered in St Andrews Road, containing artefacts from the 19th and 20th centuries, and therefore dating to the 20th century.

A 20th century water supply building/pumphouse in the southeastern corner of the project area, while unrelated to Te Tātua a Riukiuta, held some historical significance and was documented before demolition.

These archaeological findings provide a window into the history and cultural heritage of the Three Kings area, offering glimpses of past settlements, land use, and plant materials used by its inhabitants over several centuries.

Authority No.	2021/277, 2021/752 and 2022/072
Authority holder	Fletcher Residential Ltd
NZAA site no(s)	R11/3282, R11/3337, R11/3332, R11/3429
Address of works	995 Mount Eden Road and other properties listed in Table 1-1
Local Authority	Auckland Council
Iwi/hapū	Ngāti Whatua Ōrākei, Te Ākitai Waiohua and Ngāti Tamaoho
Sec 45 approved person	Ellen Cameron
Feature types	Middens, firescoops/hangi
Dates of fieldwork	Authority no. 2021/277: 31 July 2020; 6 August 2020; 1 April 2021; 26 May 2021; 27 May 2021; 2 June 2021; 3 June 2021 Authority no. 2021/752: 8 April 2021; 23 July 2021; 28 July 2021 Authority no. 2022/072: Between 3 July 2022 and 17 November 2022
Archaeological Management Plan and research strategy reference	Cameron, E. 2020b. Archaeological Management Plan: Three Kings Quarry, Auckland – Proposed Residential Development. Prepared by Clough & Associates for Fletcher Living Ltd. Cameron, E. May 2021b. Archaeological Management Plan: Three Kings Quarry, Auckland – Proposed Residential Development (Grahame Breed Drive Berm Upgrade and Service Crossing). Prepared by Clough & Associates for Fletcher Living Ltd. Cameron, E. June 2021c. Archaeological Management Plan: Three Kings Quarry, Auckland – Proposed Wastewater Rising Main. Prepared by Clough & Associates for Fletcher Living Ltd.
Title and author of assessment report	Cameron, E. 2020a. Three Kings Quarry, Auckland – Proposed Residential Development: Archaeological Assessment. Clough & Associates report prepared for Fletcher Living Ltd. Cameron, E. 2021a. Addendum to Three Kings Quarry, Auckland – Proposed Residential Development: Archaeological Assessment August 2020. Clough & Associates report prepared for Fletcher Living Ltd. Bickler, S.H. and E. Cameron, 2021. Three Kings Quarry, Auckland – Wastewater Pump Station Rising Main Route: Archaeological Assessment. Clough & Associates report prepared for Fletcher Living Ltd.

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1 INTRODUCTION

1.1 Project Background

Fletcher Residential Ltd is carrying out a residential development at Three Kings, Auckland. The development area includes the existing Three Kings Quarry and some surrounding land (Figure 1-1). Information including the legal description of the properties included in the development is provided in Table 1-1 and locations are shown in Figure 1-2. The majority of the development area had been impacted by previous earthworks in the form of extensive quarrying.

Two archaeological assessments were undertaken for the project (Cameron 2020a and 2021a). Two areas were identified as not having been affected by previous quarrying impacts. These two areas were the grounds of a water supply building in the southeast corner of the development and the land bordering Mount Eden Road along the eastern boundary of the development in Lot 98 DP 517457 (Figure 1-1). The road reserve associated with Grahame Breed Drive was not originally assessed, but subsequent scheduled work resulted in additional assessment of that area.

Later, work for a rising main for the development was consented, which extended from Mount Eden Road along Kingsway and St Andrews Road before connecting to the main watermain on Mount Albert Road. This was subject to a third assessment (Bickler and Cameron 2021).

1.2 Authority Assessments

An archaeological assessment was commissioned in 2020 by Fletcher Residential Ltd to establish whether the development was likely to impact on archaeological values (Cameron 2020a). This was initiated after shell was encountered during geotechnical investigation of the area surrounding the water supply building. The site was recorded as R11/3282. An Authority was applied for and subsequently granted for works to continue in this area (no. 2021/277).

A second authority was applied for works near Grahame Breed Drive at the southern end of the property (no. 2021/752). This area was substantially modified by the road, but the midden associated with R11/3282 uncovered near the water supply building increased the possibility of archaeology being found.

A third authority for the Rising Main earthworks was applied for (no. 2022/072). Although the likelihood of significant archaeology was considered to be low, a midden had been recorded on one of the neighbouring properties and older stone walls were also common along the suburban street.

The resulting three Authorities and the assessments they were based are as follows:

- HNZPT Authority No. 2021/277 – Cameron (2020a).
- HNZPT Authority No. 2021/752 – Cameron (2021a).
- HNZPT Authority No. 2022/072 – Bickler and Cameron (2021).

This report is prepared in fulfilment of the conditions of these Authorities and the associated management plans (Cameron 2020b, 2021b and 2021c).

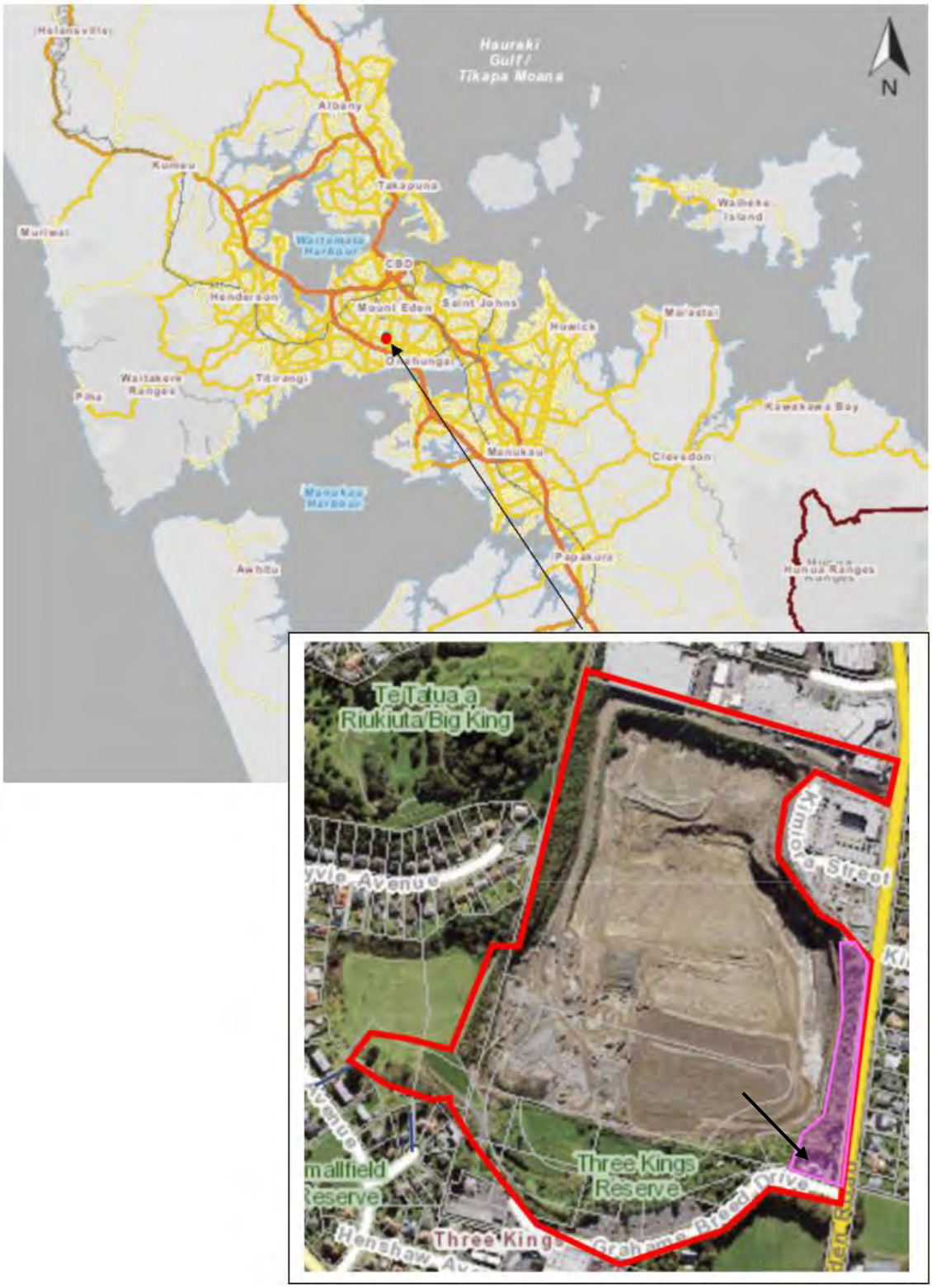


Figure 1-1. Main map showing the location of the development in the Greater Auckland area and inset showing the extent of works of the development outlined in red, with the area around the water supply building (black arrow) and land bordering Mount Eden Road outlined and shaded in purple (source: Auckland Council GeoMaps)

Table 1-1. Addresses, legal descriptions, area and ownership of the development properties

Address	Legal Description	Area (HA)	Ownership
995 Mount Eden Road	Lot 98 DP 517457	11.44	Fletcher Residential Ltd
Grahame Breed Drive	Lot 1 DPS 514701	.14	Auckland Council
Grahame Breed Drive	Lot 2 DP 517457	2.30	Auckland Council
Grahame Breed Drive	Lot 3 DP 514701	.11	Fletcher Residential Ltd
Barrister Avenue	Lot 5 DP 514701	.30	Fletcher Residential Ltd
Barrister Avenue	Lot 6 DP 514701	.23	Fletcher Residential Ltd
Barrister Avenue	Lot 7 DP 514701	.13	Fletcher Residential Ltd
Barrister Avenue	Lot 8 DP 514701	.013	Fletcher Residential Ltd
Barrister Avenue	Lot 9 DP 514701	.07	Fletcher Residential Ltd
Barrister Avenue	Lot 10 DP 514701	.29	Fletcher Residential Ltd
Barrister Avenue	Lot 11 DP 514701	.16	Fletcher Residential Ltd
Barrister Avenue	Lot 12 DP 514701	.23	Fletcher Residential Ltd
Barrister Avenue	Lot 13 DP 514701	.09	Fletcher Residential Ltd
Barrister Avenue	Lot 14 DP 514701	.20	Fletcher Residential Ltd
Barrister Avenue	Lot 15 DP 514701	.0009	Fletcher Residential Ltd
25 Fyvie Avenue	Lot 18 DP 514701	1.21	Auckland Council
Grahame Breed Drive	Lot 19 DP 514701	.11	Auckland Council
Grahame Breed Drive	Lot 20 DP 514701	.39	Auckland Council
Grahame Breed Drive	Lot 21 DP 514701	.50	Auckland Council
Grahame Breed Drive	Lot 22 DP 514701	.02	Auckland Council
Grahame Breed Drive	Lot 23 DP 514701	.51	Auckland Council
Grahame Breed Drive	Lot 24 DP 514701	.03	Auckland Council
Grahame Breed Drive	Lot 25 DP 514701	.16	Auckland Council
Grahame Breed Drive	Lot 26 DP 517701	.17	Auckland Council
Grahame Breed Drive	Lot 27 DP 514701	.0014	Auckland Council
Grahame Breed Drive	Lot 30 DP 514701	.07	Auckland Council
10A Henshaw Avenue	PT Allot 85B Sec 10	.25	Mount Roskill Borough Council

Rising Main

Address	Legal Description	Area (HA)	Ownership
995 Mount Eden Road	Lot 98 DP 517457	11.44	Fletcher Residential Ltd
Road Reserve	Mount Eden Road Kingsway St Andrews Road Mount Albert Road	Various	Auckland Council

Figure 1-2. Property details of the development area for the Three Kings residential development (source: Woods)

1.3 Methodology

Archaeological monitoring of works was carried out in the areas identified in the archaeological management plans and all archaeological remains encountered were investigated, recorded and sampled in accordance with the Authority conditions.

The archaeological sites found during the project consisted of four middens (see Table 1-2, which also lists the analyses undertaken for each site). In addition to the midden sites, three lava caves (tomo) were exposed and checked to ensure they did not contain any archaeological material, with their locations recorded. This was undertaken both as part of the HNZPT monitoring and for Auckland Council. A rubbish dump of early 20th century artefacts with some possible 19th century material was uncovered during trenching along St Andrews Road. This was noted but no detailed analysis was undertaken.

Table 1-2. HNZPT Authorities and sites recorded during the project, with the activities and analyses that were carried out for each site

Authority	Sites	Activities Undertaken	Midden	C14 Dating	Charcoal	Palynology	Faunal Analysis
2021/277	R11/3282	Midden Excavation	Y	Y	Y	N	N
	R11/3337	Midden Excavation, Tomo 2 Recording	Y	Y	Y	Y	Y
2021/752	R11/3332	Midden Excavation, Tomo 1 Recording, Tomo 3 Recording	Y	Partial	Y	N	N
2022/072	R11/3429	Monitoring of Trenching, Midden Excavation, Recording of 20th Century Rubbish Dump	Y	Y	Y	N	N
N/A	N/A	Building Photography, Demolition Photography	N/A	N/A	N/A	N/A	N/A

Recording of the water supply building (pumphouse) located at 1029 Mount Eden was also undertaken, along with a record of its demolition. This structure was of post-1900 construction and not covered by the archaeological authorities. However, it was of some historical interest and a photographic record was made for both HNZPT and the Auckland Council Heritage Unit.

The sites and features recorded during the project are shown in Figure 1-3, with the Authority areas indicated.

The summary background information for this report is from Cameron (2020a) and Bickler and Cameron (2021). More comprehensive information on the history of Te Tātua a Riukiuta/Three Kings is provided by Pishief and Adam (2015) and sources referenced there.

Analysis was undertaken by various specialists as well as the report authors. Charcoal analysis was undertaken by Rod Wallace for all the midden sites. Faunal analysis was undertaken by Patricia Pillay for site R11/3282 and palynological analysis was undertaken by Mark Horrocks for site R11/3337. Samples for radiocarbon dating for all of the sites except R11/3332 were processed by the Waikato University Radiocarbon Dating Laboratory.

The reports for the three authorities have been combined as their association with Te Tātua a Riukiuta/Three Kings maunga suggested that a more integrated approach was warranted.

Figure 1-3. View of project area, HNZPT Authority areas, sites and other features recorded in the project area with the rising main indicated by the orange line (source: Googlemaps)

1.4 Tikanga Statement

Cultural consultation was carried out between Fletchers Residential Ltd and mana whenua prior to the archaeological monitoring, with Ngāti Whātua Ōrākei, Te Ākitai Waiohua and Ngāti Tamaoho engaging in the discussions. It was agreed that comprehensive sampling for radiocarbon dates and other environmental information should be carried out to provide information on past occupation and usage over time of the area around Big King, the only surviving peak of Te Tātua a Riukiuta/Three Kings. As well, it was agreed that the excavated shell midden material would be redeposited within the overall development area (for the quarry sites) and left in situ at the rising main site where possible.

The archaeological management plans accompanying the authority applications for this project (Cameron 2020b, 2021b and 2021c) acknowledged Māori cultural values in addition to archaeological values and included protocols relating to the discovery of kōiwi tangata and taonga.

1.5 Acknowledgements

We would like to thank Jeff Lee (Te Ākitai Waiohua) and Nick Hawke (Ngāti Whātua Ōrākei) for their ongoing cultural support throughout the works.

We would also like to thank the team from Hicks Bros for their cooperation and flexibility during the works, especially Rob, Angus, Melanie and Billy.

2 BACKGROUND

2.1 Historical Background

2.1.1 Māori Settlement

Situated between the Waitematā and Manukau harbours, the Auckland isthmus was known to Māori as Tāmaki-makau-rau, often translated as 'the land desired by many' or 'the land of a hundred lovers' (Stone 2001: 81). Its sheltered harbours, wide-ranging fishing and shell fishing grounds, rich volcanic soils, easy waka (canoe) access, and portage routes made the area a highly desirable location for settlement.

Māori occupation of the isthmus can be traced back over centuries and is evidenced by the numerous archaeological sites (middens, pits, terraces, and pā) and associated place names throughout the region (Figure 2-1). Several different iwi and hapu groups claim affiliation with the Auckland area, whose tribal territories commonly changed in response to warfare, migration or intermarriage.

Early settlements were established near shorelines and major rivers and were occupied either long-term, seasonally, or temporarily, according to the availability of food resources (see e.g, Bunbury et al. 2022). Satellite fishing and gardening camps were usually set up away from long-term settlements during the summer months and food would be preserved and then taken back to the kāinga (village) for use during the winter.

Around 1500 AD Māori began to construct defensive settlements known as pā, which were sited on strategic areas such as headlands and volcanic cones, surrounded by ditches and palisades. The appearance of pā throughout Tāmaki-makau-rau indicated increased competition for the area's resources, a growing population, and ultimately, warfare.

The volcanic cones at Te Tātua a Riukiuta (Three Kings) contained pā sites and there would have been extensive gardening and settlements in their vicinity. The features were still distinct in the early 20th century (Figure 2-2, Figure 2-3). They include both agricultural and habitation terraces. Defensive structures were probably also still visible at that time. As well, lava caves containing burials have also been identified in the surrounding area in the past (e.g. NZAA Site Records R11/66, R11/136).

More extensive history of the Three Kings area is provided in Pishief and Adam (2015). The report outlines the oral traditions associated with the settlement of Tāmaki Makaurau and the report notes that the name Te Tātua o Riukiuta relates to Riukiuta, a navigator associated with the Tainui waka who settled in Tāmaki Makaurau in traditional accounts (Pishief and Adams 2015:25).

As well, the map of Māori place names in Figure 2-1 provides information on the surrounding landscape features, many of which are named. These include wetland areas (Wai Poharu located to the southeast of Te Tātua o Riukiuta and Wai o Raka located to the west), which would have provided habitats for native plants, birds and fish and would have been used for resource collection for food, weaving materials such as raupo and harakeke and traditional medicines and dyes (Landcare Research 2017; Simmons 1987).

Te Tātua a Riukiuta is also located approximately 2.5km to the north of the Mangere Inlet of the Manukau Harbour, which is the closest location for access to coastal resources. It is noted that the map in Figure 2-1 shows the name Te Puhea. The full name of this cove is Te Puheatanga o Te Ata, which translates to 'The blowing in of Te Ata, as a place where the waka of Te Ata, an ancestress of Ngāti Te Ata was blown ashore in high winds (Patterson n.d.; Simmons 1987).

The name Te Rorea a kehu is also recorded for the creek leading into the cove, which could have been a possible access route to the coast from Te Tātua a Riukiuta.

Figure 2-1. Māori place names around the Waitematā Harbour and central Tāmaki-makau-rau with Te Tātua a Riukiuta indicated by the red arrow, wetlands indicated by black arrows and Te Puhea indicated by the blue arrow (source: Kelly and Surridge 1990, Auckland Libraries Map 9250)

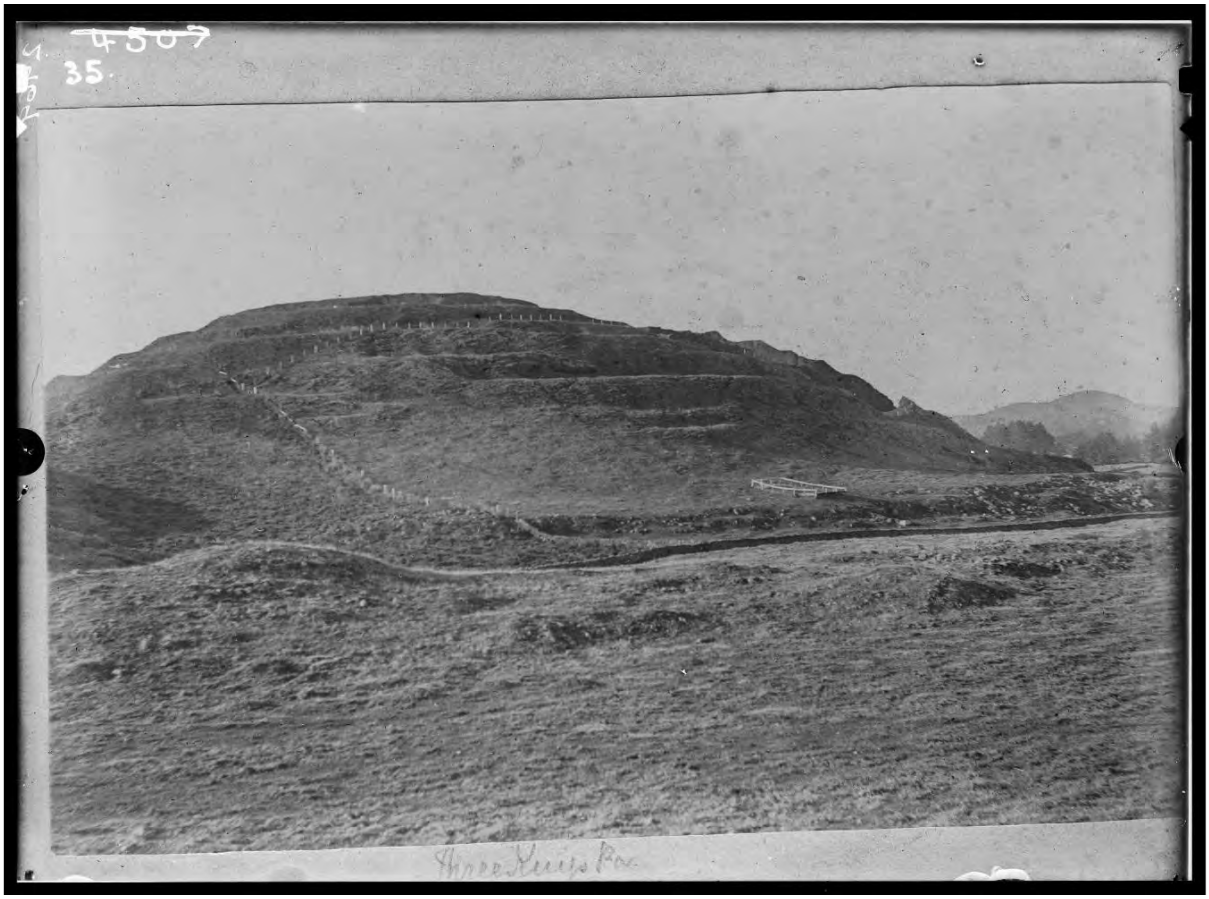


Figure 2-2. Te Tātua a Riukiuta c.1904-1906, looking approximately NNE (photograph by J. Macdonald, Te Papa Collections No. 35/4507)

Fig. 74—*Sites of Old Terraced Hill Forts. Auckland Isthmus.* (See p. 289.)

Cl. Boscawen, Photo

Figure 2-3. J.H. Boscawen photograph of Te Tātua a Riukiuta/Three Kings (Best 1927: figure 74)

2.1.2 European Settlement

European settlement at Three Kings in the 19th century was mainly associated with farming and quarrying and with education, as the Wesleyan Mission established the Wesleyan Native Institute at Three Kings in 1848/49. The training institute, which was located on the property bounding the development area to the west, included a school and a farm which operated through to 1869 and then again from 1876 to 1922, when they were relocated to Paerata, near Pukekohe (Pishief and Adam 2015: 58-59).

As can be seen in the photograph from the 1860s in Figure 2-4, before quarrying the Three Kings consisted of cleared land with terraces and stone walls visible on the hillsides. The three main allotments that cover most of the modern quarry area (and development area) are Allotments 82, 83 and 84. These allotments were sold by George Wardell in 1865. Wardell owned several properties, a number of which were sold by auction along with his Three Kings property, the latter being described as follows in the 15 August 1865 edition of the *Daily Southern Cross* newspaper:

> 'Farm at the Three Kings, 4 miles from Auckland, containing 60 acres, fenced, subdivided into paddocks, good House, Outbuildings, Stockyard, &c., being lots 82, 83 and 84, adjoining the properties of Thos. Russell, Esq., Alfred Buckland, Esq., and Wesleyan Mission Estate.'

Quarrying at Three Kings occurred during the 19th century but was carried out on a much larger scale from the 1920s when Winstone Ltd bought the land (Winstone Aggregates Website). The early quarrying was above the level of the surrounding land but eventually went deeper to form the large depressions that exist today.

Figure 2-4. Photograph dated from the 1860s entitled 'Looking west from the vicinity of Three Kings Road before the Three Kings were quarried for scoria' (source: Auckland Libraries Heritage Collections 4-891)

2.1.3 Quarrying and Development at Three Kings from the 1880s

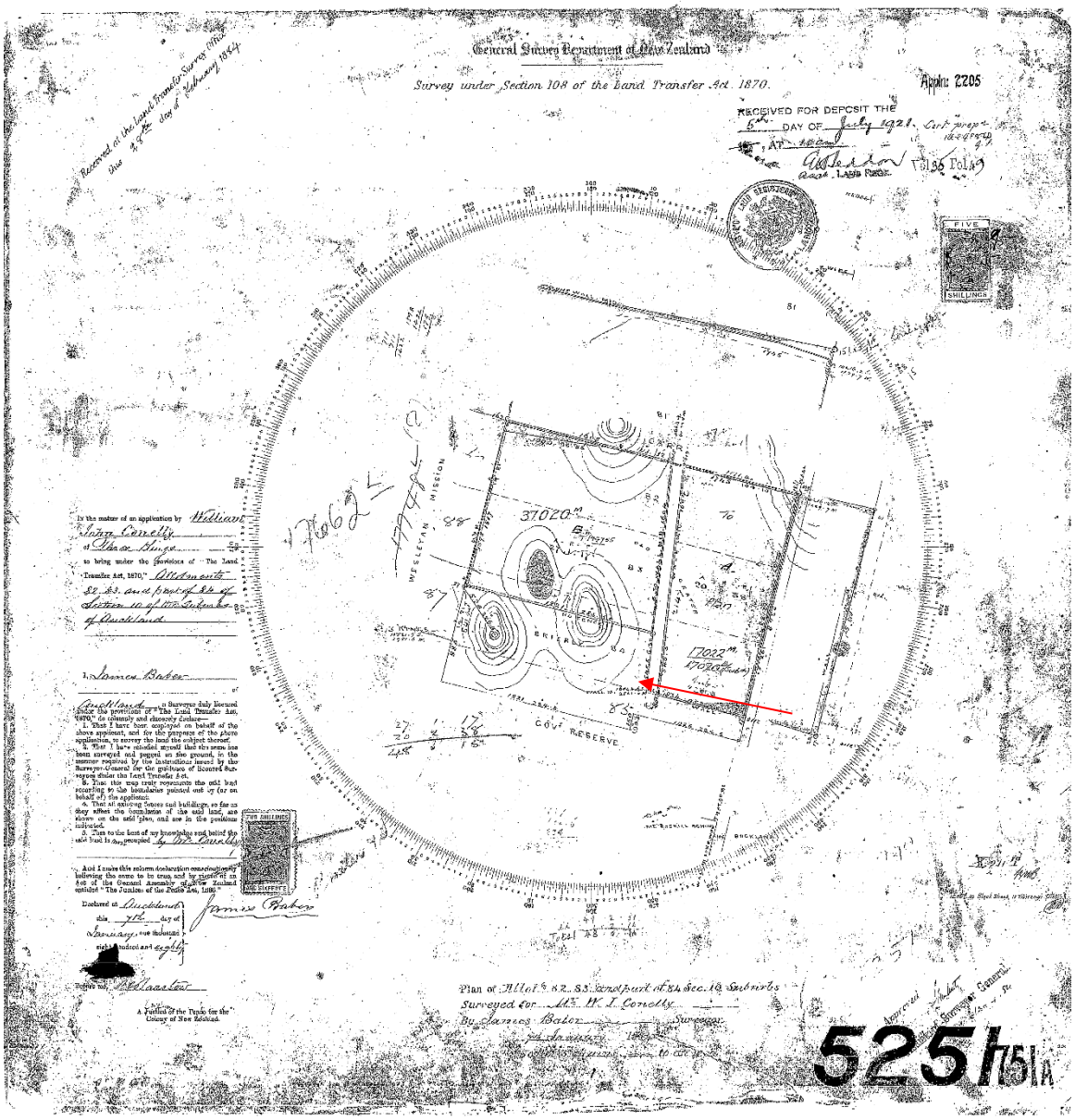
A review of early maps and plans was undertaken to gain information on past land use and ownership in the development area. The earliest survey plan containing Allotments 82, 83 and 84 found during research for the assessment (Cameron 2020a) dates from 1884 and is shown in Figure 2-5. It was prepared for a Mr W.J. Conelly, who was a dairy farmer but also earned his livelihood through quarrying scoria at h is Three Kings property. His scoria quarry was in use

the 1890s, as it is mentioned in a newspaper article that reported on the death of his son from an accident at the family scoria pit (*New Zealand Herald* 10 March 1894). The plan in Figure 2-5 also has a stamp 'received for deposit' dated 5 July 1921. W.J. Conelly had passed away by this time, as a notice in the *Auckland Star* newspaper dated 6 February 1920 displayed a tender notice issued by the executors of the will of the late W.J. Conelly, 'for a lease to the sole right to quarry in the pit at Three Kings, known as Conelly's Pit, for one year'. Conelly's land at Three Kings was eventually bought by Winstone Ltd and much more intensive quarrying took place, as can be seen in the survey plan from 1979 in Figure 2-6 which describes Allotments 82, 83 and 84 as 'mostly in quarry'.

Another early plan of the area dating from 1885 (Figure 2-7) shows the property to the south of Conelly's, namely Allotment 85. The plan shows the subdivision of this allotment for government reserves, with the allotment divided into Lot 85A (Metal Reserve), Lot 85B (Recreation Reserve) and Lot 85C (Pound and Offices). These were the first reserves to be permanently gazetted in the area, although the usage was not necessarily as described on the plan, as it was determined in 1928 that the Mt Roskill Road Board was quarrying within the Recreation Reserve for use in their roading projects (Pishief and Adam: 101, 105-106). This can be seen, as the 'new quarry' in the 1928 plan in Figure 2-8. The general area containing the water supply building has a rectangular feature in the plan in Figure 2-8, but with no description provided. It also shows the presence of a stone wall along Three Kings Road (now renamed Mount Eden Road). A slightly later plan, from 1930, in Figure 2-9 does not show the presence of a building in the area where the water supply building is located; however, it does indicate the presence of an old stone wall on the boundary of the metal reserve and Allotment 84.

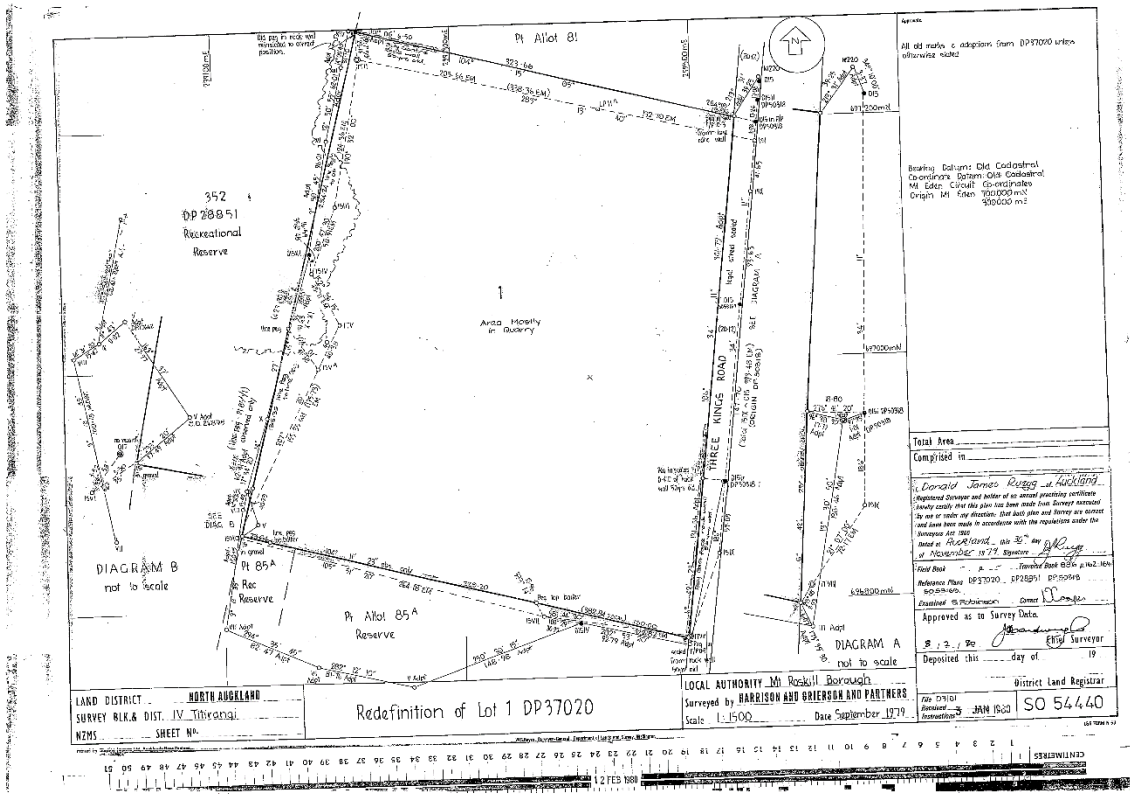
The water supply building was originally constructed as a house, most likely during the 1930s, based on the lack of a building on plans from 1930 and earlier and the presence of a building on an aerial photograph from 1940, as seen in Figure 2-10. The building was later mostly demolished in the 1990s and rebuilt to house a pump to supply water to the Three Kings Reservoir.

It never became functional, however, as once the Waikato Water Pipeline was completed it was no longer needed. Figure 2-10 also includes aerial photographs from 1959 and 2015/16 in which the building can be seen. Apart from differences in vegetation and installation of sealed surfaces around the building, no other major impacts to the area around the water supply building are visible in the aerial photographs. This is also the case for the strip of land along Mount Eden Road which marks the eastern boundary of the development area, and shows the presence of mature trees in the 2015/16 aerial photographs. For the remainder of the development area, the impacts from extensive quarrying are visible in all of the aerial photographs.



Land Information New Zealand, Custom Software Limited, Date Scanned 2002, Last modified February 2002, Plan is probably current as at 27/06/2019

Figure 2-5. AK DP 5251 I dated 1884 showing Allotments 82, 83 and 84 with 'Govt Reserve' to the south and approximate location of the water supply building indicated by arrow (source: Quickmap)



Land Information New Zealand, Custom Software Limited, Date Scanned 2002, Last modified February 2002, Plan is probably current as at 27/06/2019

Figure 2-6. AK SO 54440 dated 1979 showing the main part of the development area described as 'Mostly in Quarry' (source: Quickmap)

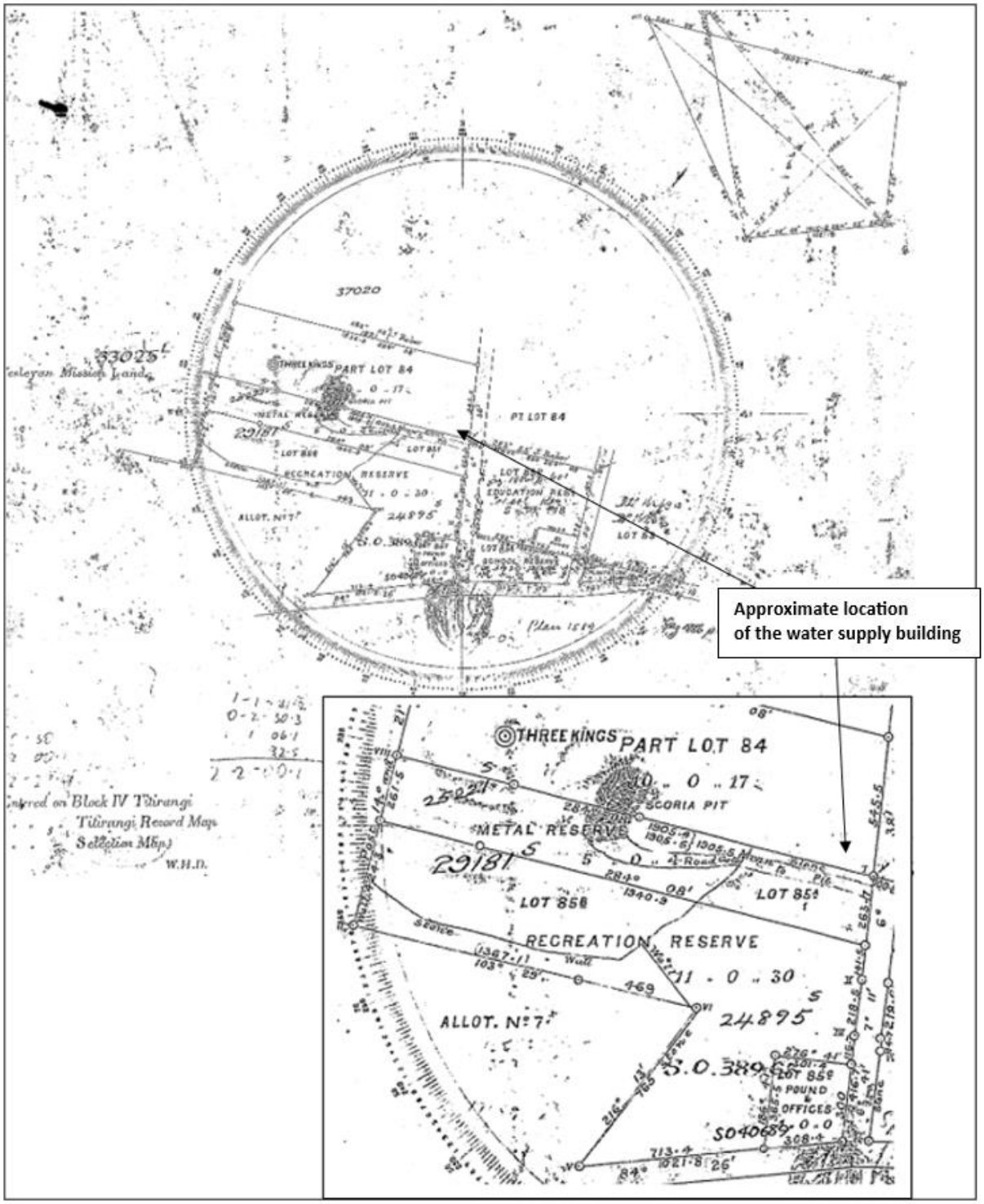


Figure 2-7. AK SO 3930 I dated 1885 showing the Government Reserves in the southern part of the development area along the northern side of what is now Grahame Breed Drive (source: Quickmap)

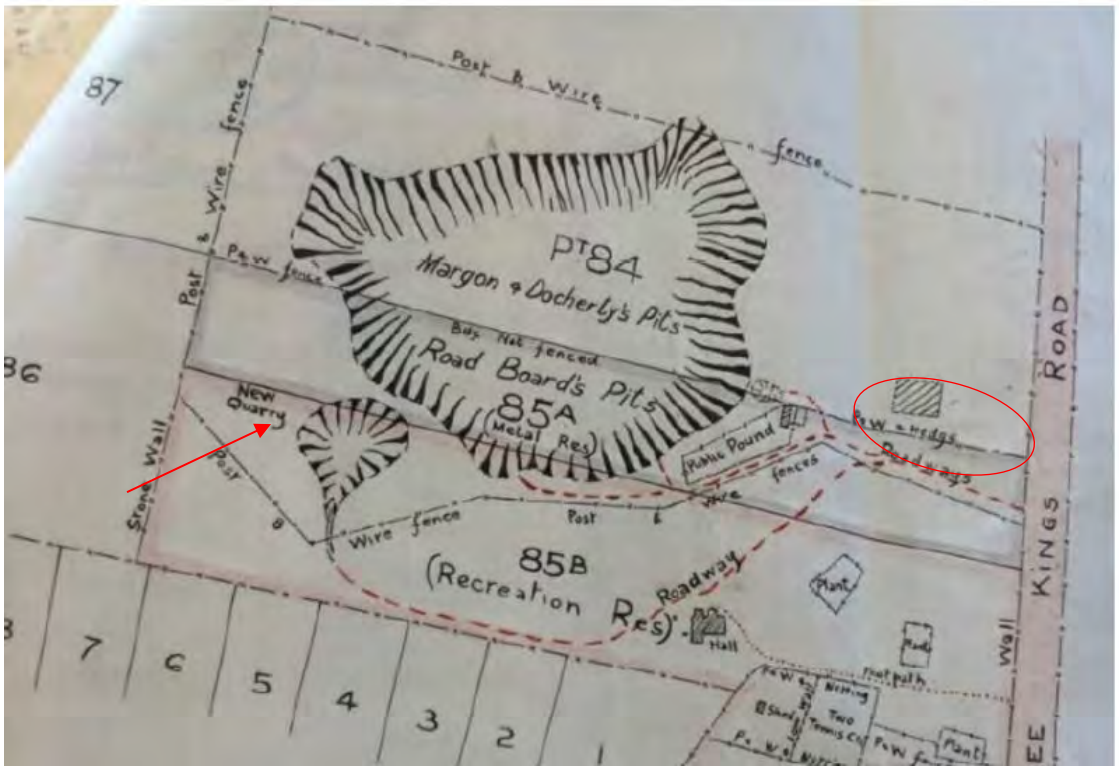


Figure 2-8. 1927/28 Sketch plan of the metal and recreation reserves with a new quarry (arrow) in the recreation reserve and the approximate location of the water supply building circled in red (reproduced from Pishief and Adam: 107 from original source – 'Reserves-volcanic cones, 1914-1974', BADY A1645 1109, Box 565, Ref. (e), No. 8/5/106, Pt. 1, National Archives, Auckland)

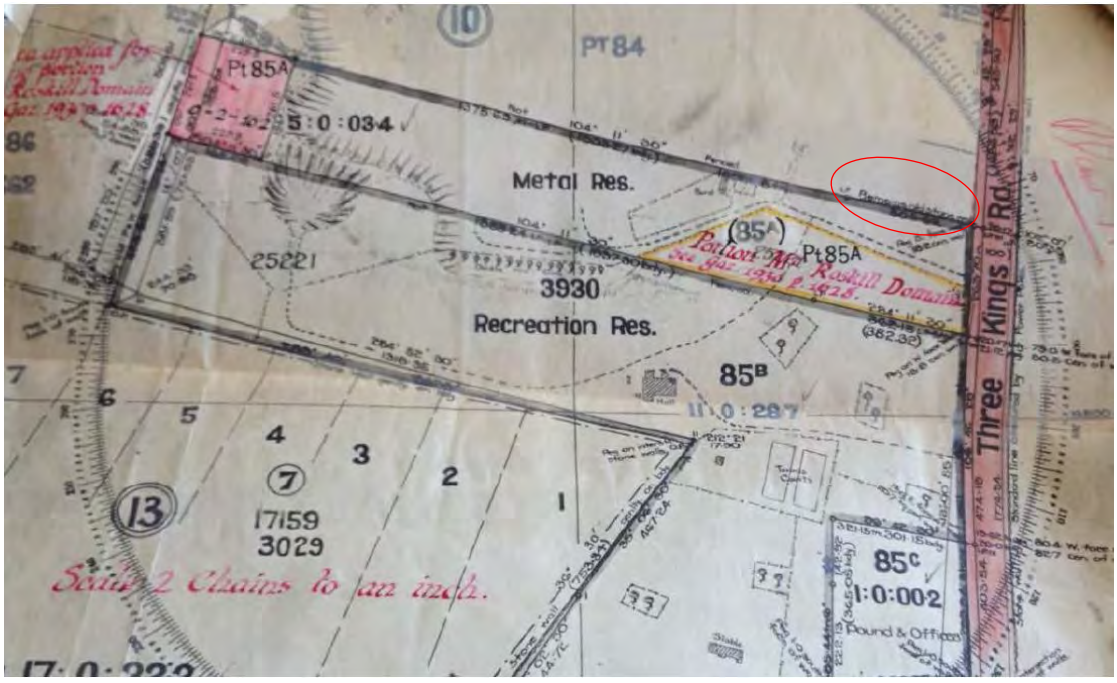


Figure 2-9. 1930 plan of the metal and recreation reserves with annotation of 'old stone wall' circled in red (reproduced from Pishief and Adam: 108 from original source – NZ Gazetter1930, page 1628. 'Reserves volcanic cones, 1914-1974', BADY A1645 1109, Box 565, Ref. (e), No. 8/5/106, Pt. 1, National Archives, Auckland)

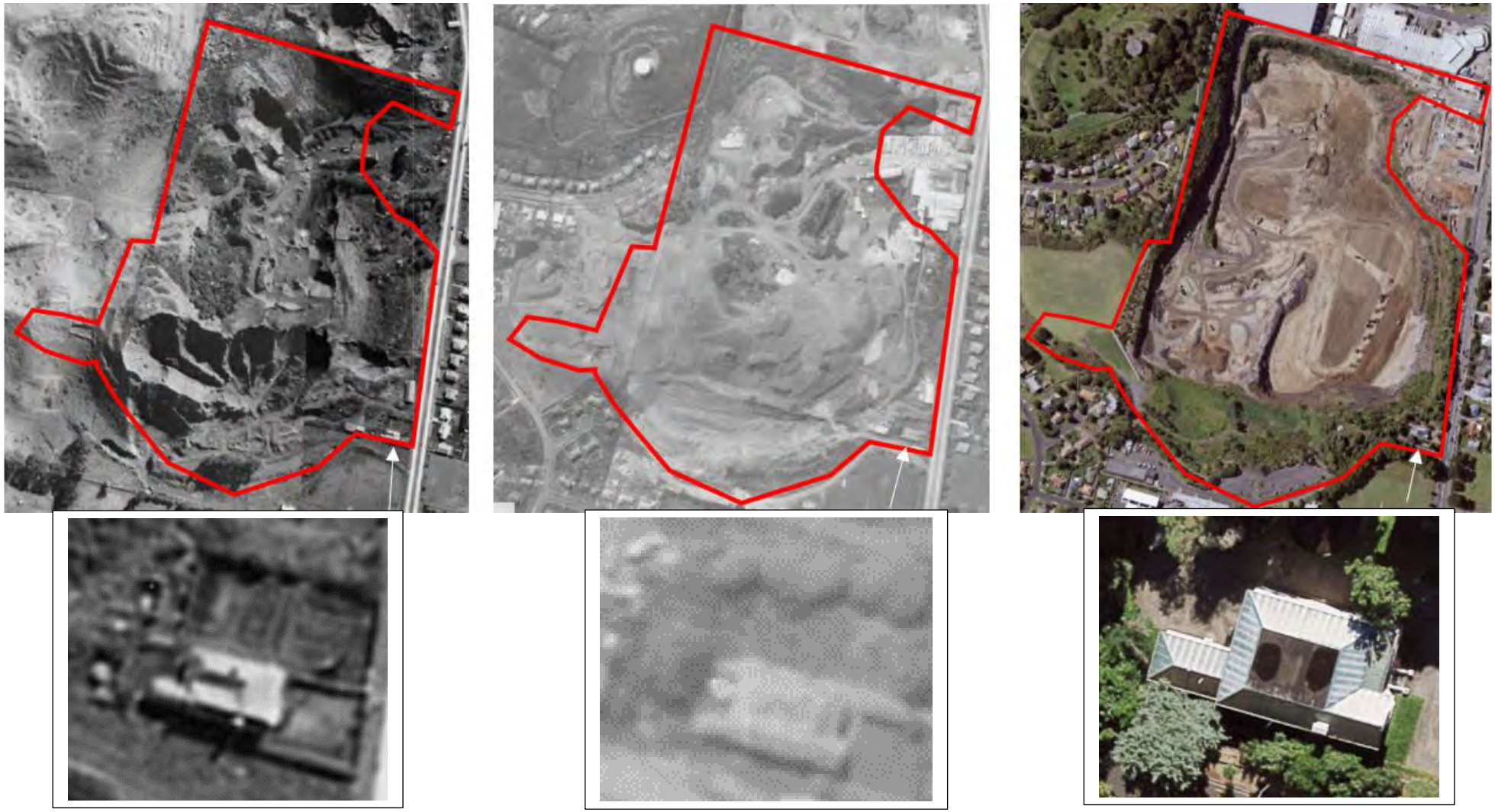


Figure 2-10. Aerial photographs, from left to right, dated 1940, 1959 and 2015/16 showing the approximate outline of the development area with the water supply building in lower inset (source: Auckland Council GeoMaps)

2.2 Archaeological Background

2.2.1 Archaeological Landscape

The development area is situated within the Auckland Volcanic Field at Te Tātua a Riukiuta/Three Kings, which was an active volcano c.28,500 years ago. Three or four main volcanic cones were present before quarrying destroyed all but one of them (Big King). The development area also lies between two other volcanic cones, Puketapapa/Mount Roskill c.1600m to the southwest and Maungakiekie/ One Tree Hill c.1900m to the east. All three of these volcanic cones contain pā. As well, the land surrounding the pā would have contained extensive settlements and garden areas in the past, creating a broad settlement landscape.

2.2.2 Recorded Archaeological Sites

No archaeological sites had previously been recorded in the residential development area, but a small number of archaeological sites associated with Māori settlement had been recorded in the surrounding area, which are discussed below to provide a general background. A brief summary description is also provided in Table 2-1 and the locations of the sites discussed are shown in Figure 2-11. It should be noted that the number of recorded sites does not necessarily reflect the actual number of sites that would have existed in the past, but rather the fact that much of the development in these areas took place long before mechanisms for the investigation and recording of archaeological sites were implemented and many sites would have been destroyed by past development without ever having been recorded.

Archaeological sites recorded in the vicinity include the pā at Big King (R11/18). Although there have been numerous past disturbances at Big King, including the installation of a water tank on the summit, archaeological features that have been able to be identified included terraces, pits, and shell midden in a 1981 walkover for the survey of a water pipeline (Grace and Kunin 1981). Other sites in the vicinity include a lava cave with burials (R11/66) located approximately 500m to the northwest of the development area. A burial (R11/2452) was also found c.300m to the northeast, where the complete skeleton of an adult female was found in a small cavern/crevice in a rocky volcanic outcrop in a residential garden. A chert flake was also found with the remains. Approximately 220m to the northeast of the development a shell midden site (R11/531) was identified during excavation works for a garage. Another burial (R11/136) was also reported c.350m to the east of the development, but no information was included on the site record. The final recorded site in the vicinity is located c.220m to the east of the southeast corner of the development. This site (R11/677) was a reported shell midden and an obsidian flake identified in a residential garden. It was reported in 1979, but no additional information on the site was provided in the NZAA site record.

2.2.3 Other Recorded Historic Heritage Places

In addition to the recorded archaeological sites, the Auckland Council Heritage Inventory (CHI) includes eight historic structures, three reported historic sites and one historic botanical site in the vicinity of the residential development area and rising main alignment (locations are shown in Figure 2-11 and a summary description is included in Table 2-1). These are all associated with European settlement in the 19th century and into the 20th century.

Figure 2-11. Aerial plan showing the locations of archaeological sites (within c. 500m) and other historic heritage places (within c. 400m) in the vicinity of the residential development area which is outlined in red (source: Auckland Council GeoMaps)

Table 2-1. Summary of recorded archaeological sites within c.500m of the development area, and other historic heritage places recorded on the CHI and scheduled in the Auckland Unitary Plan (AUP)

NZAA Ref	CHI No./ AUP	Site Type	Description	NZTM Easting	NZTM Northing
R11/18	11695	Pā	Te Tātua a Riukiuta/ Three Kings volcanic cone pa	1756477	5914301
R11/66	11490	Burial/ Cemetery	Lava cave with burials – found in the 1930s	1756213	5914894
R11/136	11498	Burial/ Cemetery	Reported but no information on site record	1756915	5914490
R11/531	5981	Midden/ Oven	Shell midden found during excavation for a garage	1757003	5914
R11/677	5986	Midden/ Oven	Reported shell midden and obsidian flake	1756941	5914009
R11/2452	17618 UPID 058	Burial/ Cemetery	Adult female skeleton found in a crevice of a rocky outcrop	1756909	5914591
--------	3145 1891/Cat B	Historic Structure	Former pump house – repurposed for community use	1756535	5913907
--------	14032 1737/Cat B	Historic Structure	Ranfurly Veteran's Home	1756733	5913675
--------	19400	Reported Historic Site	Waterscape Plaque – presented by the Rotary Club	1756498	5913903

NZAA Ref	CHI No./ AUP	Site Type	Description	NZTM Easting	NZTM Northing
--------	19401	Reported Historic Site	Plaque – commemorating the volcanic cones destroyed by quarrying	1756529	5913766
--------	19402	Reported Historic Site	Plaque – marking the location of the original Mount Roskill Road Board established in 1883	1756926	5913774
--------	19450	Historic Structure 2546/ Cat B	Former Mount Roskill Fire Station built in 1927	1756112	5913823
--------	19751	Historic Structure 2588/Cat B	Former Mount Roskill Municipal Building – opened in 1957	1756619	5913807
--------	19963 2597/Cat B	Historic Structure	Memorial cairn at the original Wesley Training College – dated 1941	1755966	5914256
--------	19965	Historic Structure 2594/ Cat B	Former 'Preston House' built in 1908	1756238	5913795
--------	19967	Historic Structure 2593/ Cat B	Three Kings Congregational Church built in 1907	1756449	5913723
---------	20112	Historic Structure	Dry stone basalt wall along old reserve boundary	1756291	5913987
--------	19813	Historic Botanical Site	Japanese Cherry Trees lining Bingley Avenue	1757133	5914357

3 PHYSICAL ENVIRONMENT

3.1 Topography, Vegetation and Land use

Much of the residential development area is situated in the existing quarry or formerly quarried areas. The latter are in the south of the development area and were used by the Council as tip sites in the past. More recently these areas have had vegetation growth over much of the area and a car park constructed.

The water supply building and its immediate surrounds are in the southeast corner of the development area and up until recently this area contained some mature trees. The narrow strip of land bordering Mount Eden Road along the eastern boundary of the development was also not affected by quarrying works and contained mature trees that have been recently removed. The majority of the area containing the rising main alignment is situated in the existing road reserve from Mount Eden Road through Kingsway, St Andrews Road and then into Mount Albert Road (shown in Figure 1-3 and Figure 3-1).

Figure 3-1. Aerial photograph with contours showing the southern and eastern parts of the residential development area (outlined in red) with the water supply building indicated by the arrow and area along Mount Eden Road that was not affected by past quarrying works outlined and shaded in purple (source: Auckland Council GeoMaps)

3.2 Geology and Geomorphology

The Auckland Volcanic Field is a dominant feature of the local landscape. The field was first mapped and studied by Ferdinand von Hochstetter in the 1850s and a map produced by Hochstetter in 1859 shows volcanoes identified at that time, which include Three Kings (Figure 3-2). There are around 50 volcanoes identified within the field, although continuing research suggests that this number may need to be increased (Hayward et al. 2011: 11). The volcanoes are relatively small on a global scale, and it has been noted that all of the eruptions from the field would only be equal to that of the 1980 eruption of Mount St Helens in the United States (Smith and Allen 1993). The field has been active over the past 250,000 years with the most recent eruptions having occurred at Rangitoto approximately 600 years ago (Lindsey et al. 2011: 380).

The nature of the Auckland Volcanic Field is different from others within New Zealand, with its source being a 'hot spot' or 'plume' located about 100km beneath the city. An eruption occurs when the molten rock reaches a certain percentage and rises to the surface. These volcanoes do not contain a crustal magma reservoir, which means that there is no associated geothermal activity as is seen in the central part of the North Island (ibid.).

The formation of the scoria cones, of which the Three Kings volcano is an example, occurs when gas-charged magma erupts at the surface and builds a cone/s of coarse tephra as it cools. As the lava flows from the vent it may cause a collapse of the cone, creating a breached cone. Associated tephra deposits in general are situated to the northeast and east of the volcanoes in the Auckland Field due to the presence of westerly prevailing winds (Smith and Allen 1993). A map showing the distribution of the Auckland volcanoes and the content and extent of deposits is shown in Figure 3-3.

Three Kings was the Auckland Volcanic Field's most complex volcano and is believed to have erupted around 28,500 years ago (Pishief and Adam 2015:9). In the early stages of the volcano's activity rising magma interacted with ground water to create an explosive eruption that would have thrown superheated steam along with rocks and ash high into the air. The falling ash accumulated in layers around the vents, creating a tuff ring, and once the ground water was used up during the eruption, the vents would have spewed lava which turned to scoria rock as it cooled (Hayward 2017:2). Three large scoria cones were formed (East, South and West/Big King) with smaller ones also likely forming around smaller vents. Extensive quarrying has destroyed all but one of the cones with only Big King remaining. As well, a lava lake was formed which flowed through a breach in the northern part of the tuff ring towards Western Springs (Hayward 2017: 3).

It has been noted that some of the volcanoes of the Auckland Volcanic Field have associated lava caves (tubes). Thirty-two of the volcanoes are known to have extruded lava and 14 had been identified as producing lava caves by 1994, as shown in the map in Figure 3-4. More recent studies have noted that most of the volcanoes with lava flows produced normal lava tubes which are normally found 1-2m below the surface and that 250 cave entrances have been identified in Auckland (Crossley 2016). It is also relevant that unidentified caves are still being discovered and that they are often encountered during construction works (ibid.). Finally, it is important to note that although lava caves are natural heritage features, they were used in the past by Māori, an example being for burials, and they can have archaeological value as a result.

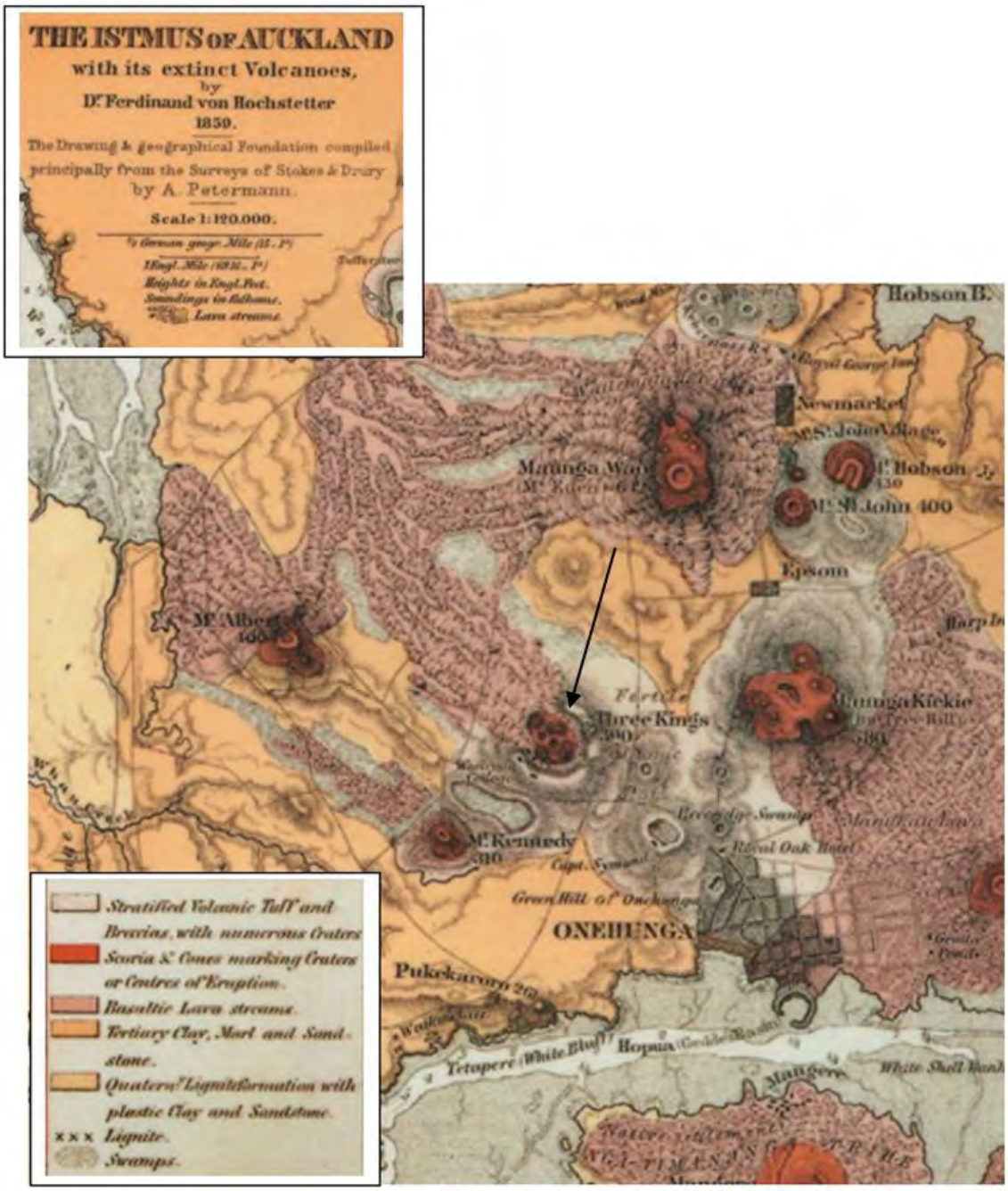


Figure 3-2. Detail showing Three Kings (indicated by arrow) and surrounding area taken from Hochstetter's 1859 map of the Auckland Volcanoes – note: Mt. Kennedy has been renamed Mount Roskill (source: Auckland Libraries Heritage Collections, NZ Map 5694b)

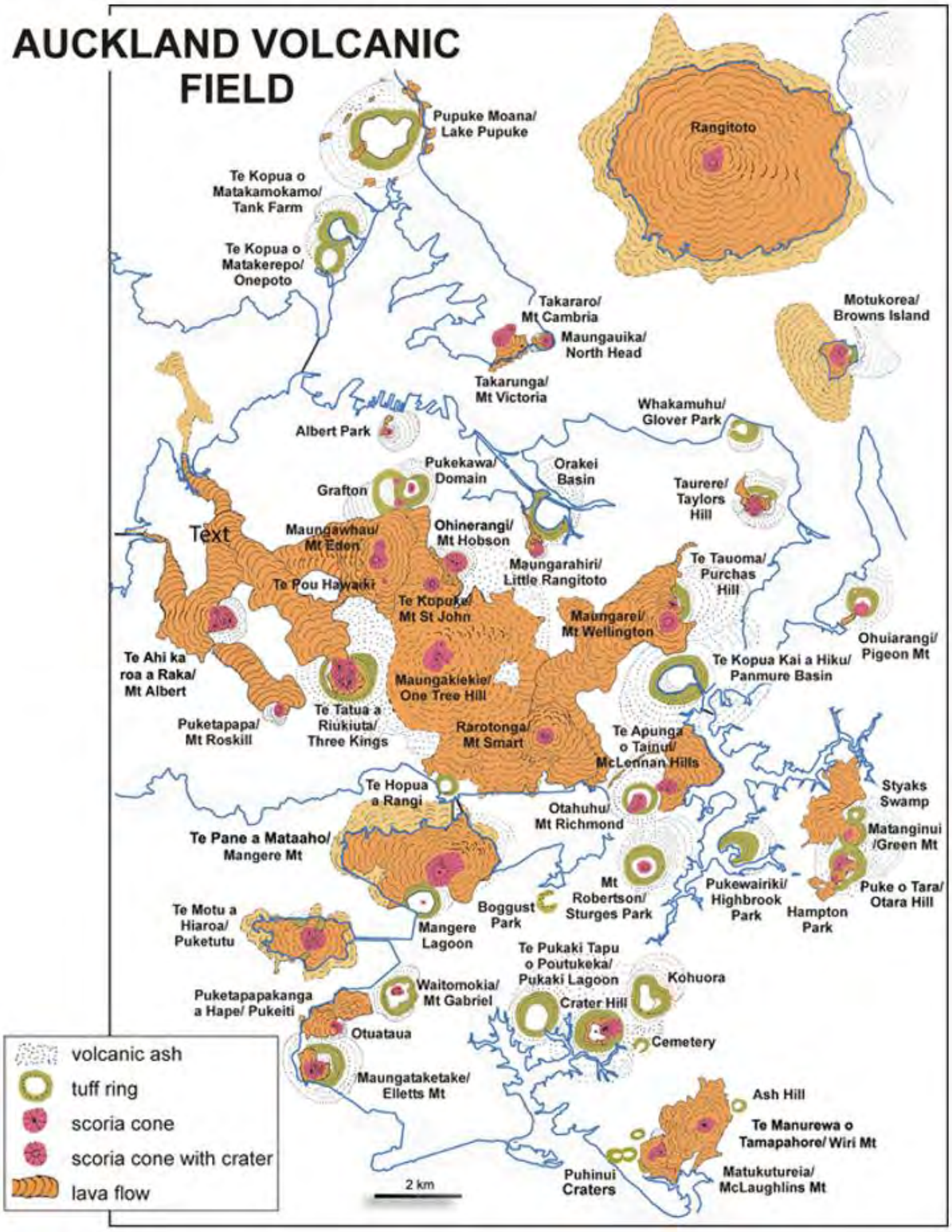


Figure 3-3. Map of the distribution of volcanic centres in Auckland in the Auckland Volcanic Field, with Three Kings indicated by the arrow (source: Hayward 2019; from Crossley 2016 and from Hayward 2011, updated from Kermode 1994)

Figure 3-4. Auckland Volcanic Field showing the locations (numbered) of the lava caves with their associated lava fields and source volcanoes. Other lava tubes with lengths greater than 20m are also shown. Three Kings indicated by the arrow (source: taken from Kermode 1994: 18)

4 R11/3282 INVESTIGATION RESULTS (AUTHORITY NO. 2021/277)

4.1 Site Identification

A preliminary site visit to the former water supply building grounds was undertaken on 31 July 2020 after the exposure of shell deposits during the excavation of geotechnical test pits. The building was in the central part of the area and a small shed was located just behind its northeast corner. The ground in front and along the northern side of the building was sealed, with the edges of the property having exposed soil from recent vegetation removal. Disturbance from previous utility installation (electricity and drainage) were noted. Five test pits (c.3m x 1.5m) had been dug for the geotechnical tests and shell had been identified in three, which were labelled as A, B and C. The locations of the three test pits containing shell are shown in Figure 4-1. At the time of the preliminary site visit, test pits A and B had been left open, but the three other test pits had been backfilled.

Test Pit A was located near Mount Eden Road at coordinates NZTM coordinates 1756684 5913992 +-3m. The test pit measured approximately 1m x 3m and was c.1.2m in depth. The stratigraphy showed a modern topsoil over a reddish clay fill layer over a dark brown silt. The southwest corner of the test pit contained an approximately 10-15cm thick layer of shell, consisting mostly of cockle in a dark brown to blackened soil with evidence of fire cracked rocks. There was no evidence of charcoal in the exposed material (photograph in Figure 4-2).

Test Pit B was located to the north of the water supply building at NZTM coordinates 1756671 5913992 +-3m. The ground had previously been covered by a concrete slab with a water tank on top. The concrete had been removed exposing a thin gravelly layer (most likely fill that was deposited when the concrete slab was set) visible along the edges of the test pit. A natural reddish-brown silty clay was visible underneath the gravel. In the northwest corner of the test pit a shell layer in a dark brown soil matrix was visible c.10cm below the surface. From observation at the top of the test pit (the depth of the pit at c.1.5-1.7m did not allow entry for safety reasons) it appeared that the soil containing the shells may have been cut into the natural clay, although the relationship between these soils could not be established for certain from observation alone. The shell appeared to be mostly cockle (photograph in Figure 4-3).

Test Pit C was located near the front of the water supply building at NZTM coordinates 1756671 5913992 +-3m. The test pit measured approximately 1m x 3m but its depth could not be discerned as it had been backfilled. However, a small section at the northeast corner where a small amount of very fragmented shell was visible had been left exposed. The shell was located under a plastic sheet moisture barrier and next to the front steps of the building. There was no in situ shell layer visible, presumably as a result of previous disturbance from building construction (photograph in Figure 4-4).

The shell deposits in Test Pits A and B were identified as in situ shell midden while the shell fragments observed in Test Pit C were in soil disturbed by the construction of the water supply building and the nature of any in situ deposit at this location could not be determined.

A field survey was subsequently undertaken on 6 August 2020 to inspect the grounds of the water supply building in case any further evidence of midden was identifiable and to record some stone walls (see Appendix D). Areas where trees and shrubs had been removed contained exposed soil and these areas were inspected, but no evidence of shell or any other archaeological remains was able to be identified. Based on the past usage of the site surface shell deposits were not expected and it was considered that if any additional archaeological

remains were present they would only be exposed after the removal of the sealed surfaces and stripping back of the upper soil, including modern fill layers.

Figure 4-1. Aerial plan showing the locations of geotechnical Test Pits A, B and C in relation to the water supply building (source: aerial Auckland Council GeoMaps)

Figure 4-2. Left photograph showing the exposed shell layer in the southwest corner of Test Pit A with detail of the exposed shell in right-hand photograph (both looking south)

Figure 4-3. Photograph showing the exposed shell in the northwest corner of Test Pit B (looking northwest)

Figure 4-4. Photograph showing the shell fragments in the west-facing profile of Test Pit C with the location of front steps of the water supply building labelled

4.2 Excavation and Recording

Following demolition of the water supply building along Mount Eden Road, which occurred in January–February 2021 (see Appendix D), the midden deposits identified earlier were examined during preparatory earthworks for the new building foundations.

Excavation was undertaken on 1 April 2021 with a digger clearing the overburden above the exposed features, followed by hand excavation. Features were drawn, photographed, sectioned and sampled for analysis. The site record form was updated following excavation.

The area had been heavily damaged by the 20th century works. An extensive set of pipes throughout the property was observed by the engineers which had heavily modified the ground to significant depth. There was also up to 1m of overburden found in some areas of the property.

The two areas of midden were investigated by Simon Bickler and Ellen Cameron. The work was assisted by the contractors from Hicks, who surveyed the midden. The middens were identified as the 'Back Midden', which was the more western of the two and the 'Front Midden' to the east near Mount Eden Road.

The features uncovered were all relatively small (Table 4-1).

Table 4-1. Features found in R11/3282

R11/3282	Feature	Description
Back Midden	Feature B1	A deposit of shell observed in section.
Front Midden	Feature F1	50-70cm diameter firescoop at southern end of midden. Up to 20cm deep. Predominantly made up of cockle and some burnt basalt hangi stones.
	Feature F2	Area at the northern end of the midden patch. Dense and fragmented midden sitting on cluster of small to medium size basalt blocks.
	Feature F3	Shallow 70-80cm diameter firescoop in the middle of the midden patch.

4.2.1 Back (West) Midden

The 'Back Midden' to the west, was significantly impacted by works in the area and contained a lot of basalt blocks. It was around 50cm across and contained dense patches of cockle and charcoal.

The stratigraphy on the east-facing side of the trench (Figure 4-5) showed the remains of a concrete pad over a compressed soil/gravel base course with additional gravel and other basalt and scoria material having been dumped into a cut. That cut had truncated the midden at its southern extent.

Two layers of midden were observed but the lower material was highly disturbed at the southern end and may have been re-deposited material from the original midden.

In the northwest of the trench (Figure 4-6) the midden, below infilling layers of scoria and other material, appeared to be more intact. A dense cockle layer around 18cm thick and narrowing down to the north was visible and sat above some charcoal-stained basalt blocks probably used as hangi stones.

The concrete was removed along with the overburden around the midden, but the midden did not extend more than 30cm beyond the exposed area to the west.

The northern section was cleared and cut back but could not be completely exposed as a live water pipe was present nearby. Cleaning down in that area exposed a mixed shell and basalt section (Figure 4-7). This did suggest that material had been moved around here by modern activities. However, a small collection of fishbone was trapped between two of the blocks and recovered for analysis.

Figure 4-5. East-facing section of Back Midden showing cockle midden and basalt blocks

Figure 4-6. East-facing section at northwest corner after cleaning

Figure 4-7. South-facing section of midden after cleaning showing location of fishbone

4.2.2 Front (East) Midden

The midden closest to Mount Eden Road had been exposed in section and was buried under almost 1m of material visible in the small trench (Figure 4-8). The stratigraphy here suggested that most of that material was relatively modern with layers of mixed basalt rock, scoria and soil with some concrete visible. Most likely the area in front of the water supply building had been levelled out a few times. Other nearby activities, such as the digging of a large hole to the south for a water tank and trenches for several pipes, were discovered during earthworks.

The material over the exposed midden section was stripped with the digger. The work was quite difficult and Rob, the driver, was careful to work side to side as well as back and forth (Figure 4-9). The small basalt blocks found throughout the overburden meant that the digger could rip up the exposed surface, potentially damaging any features. However, this methodology meant that it was possible to minimise those effects and the material over the midden was removed by the digger quite successfully as a result.

Under the overburden a patch of around 2m x 1m of cockle shell with some scallop and oyster was exposed (Figure 4-10, Figure 4-11).

The western side had been truncated by the digging of a relatively modern pipe into the nearby tank removal area (Figure 4-12, Figure 4-13).

Figure 4-8. View of Front Midden in section prior to excavation

Figure 4-9. Photograph showing the excavation of top of Front Midden, looking south

Excavation of the midden area suggested that probably at least three intercutting firescoops/hangi made up this rake-out of midden. Feature 1 consisted of a shallow, roughly circular firescoop around 50-70cm in diameter truncated partially by the pipeline trench. A cluster of irregular basalt blocks were found in the inner 50cm with a few other blocks more scattered around (Figure 4-14, Figure 4-15). Some of the blocks appeared to have been fire damaged. The scoop was sectioned and was only 15-20cm deep. Scallop and cockle were found with the dense charcoal.

A larger 10cm deep scoop, Feature 3, was found to the north, possibly having cut into the northern edge of Feature 1. The contents were like those of Feature 1, with scallop and possible oyster shell also identified. The scoop was probably around 70-80cm in diameter (Figure 4-14).

Feature 2 was defined by the cluster of rocks, around 40cm deep and spread around an area approximately 60cm in diameter (Figure 4-16). At the northwest corner, the base seemed to be made of a large basalt block that had been observed in the original trench section. Below, the rocks appeared to be mostly above a small cavity, suggesting the rocks had been placed to fill the small void and the shell had been cooked over the top.

Overall, the midden appeared to come from a roughly contemporary set of shell cooking and rake-out events using readily available basalt blocks as hangi stones for the cooking.

Samples were collected for midden analysis and dating. Other patches of midden were present in the vicinity but appeared to be pockets of material that had resulted from dispersal during the modern water pipe and building foundations work.

Figure 4-10. View looking south showing the basalt blocks at the base of the Front Midden and its extent

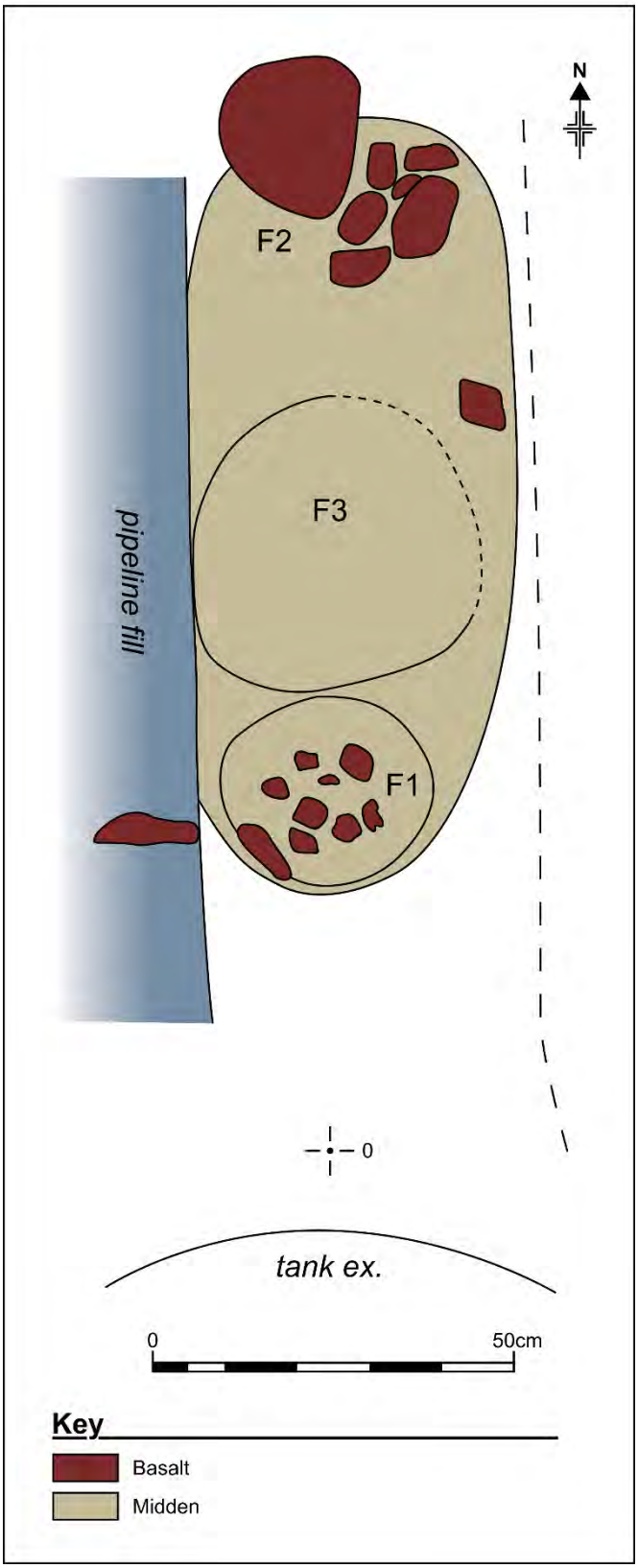


Figure 4-11. Plan of excavated features of Front Midden

Figure 4-12. Truncation of the midden by pipe trench

Figure 4-13. Looking at side of former tank location NNE of Front Midden (top arrow) and pipe visible in section (bottom arrow)

Figure 4-14. Plan of Features 1 and 3 (north to the right)

Figure 4-15. West-facing section through Feature 1

Figure 4-16. Area of Feature 2 showing basalt blocks

5 R11/3337 Investigation Results (Authority No. 2021/277)

5.1 Site Identification

The project archaeologists were notified about the discovery of a potential shell midden on 26 May 2021. The site was visited by Simon Bickler on 27 May 2021. A handheld GPS was used to record the location of the site, this being at NZTM coordinates 1756707, 5914195 +-3m (Figure 5-1).

The site was located on a small spit of remaining original ground surface on the edge of the quarry and above Mount Eden Road.

The feature appeared to be the remains of a cooking area and midden around 40-50cm below the original ground surface. The feature extended 5-6m along the spit on the eastern side with about 3-4m of cockle midden visible in section. Scallop and charcoal were also visible. There also appeared to be a cut into the midden at the northern end with charcoal-stained soil and basalt rocks likely to be a hangi. The remains were determined as being likely less than 1m below ground surface as no evidence of the feature was observable on the western side of the spit. Vegetation and the height of the feature above the quarry terrace below made it difficult to visually inspect the entire length of the midden (Figure 5-2 to Figure 5-5).

It was noted that the remnant archaeological feature was unstable and likely to disappear if left as discovered. The midden was in the area covered by the archaeological Authority for the residential development and could be investigated and recorded without further delay.

Figure 5-1. Aerial plan showing location of midden R11/3337 (aerial source: Google Maps)

Figure 5-2. Location of midden R11/3337 facing Mount Eden Road, looking west

Figure 5-3. West-facing section of area of midden R11/3337

Figure 5-4. Photograph taken looking west at the midden section

Figure 5-5. Photograph looking north at the spit showing location of the midden (R11/3337)

5.2 Excavation and Recording

Prior to excavation and recording, a site blessing for excavation was undertaken by Nick Hawke from Ngāti Whātua Ōrākei with the contractors from Hicks.

The midden section was extremely fragile with material crumbling easily. The exposed midden section was cleaned, photographed, and drawn (Figure 5-6). It consisted of a stretch of remnant midden around 10m long but less than 1m wide with the western edge having been quarried away in the past. The midden deposits were up to 50cm in thickness.

The midden layers were recorded and are described in Table 5-1 and Figure 5-7. The site contained a shallow firescoop near the middle of the section (1009) with layers of raked-out shell midden, scoria rock and soil over the top (1005, 1008, 1006, 1007).

These layers were cut at the northern end by what appeared to be a scoria-filled hangi pit (1004) with charcoal and loosely compacted soil (Figure 5-8 to Figure 5-10). This had also cut layers of scoria rock and soil (1001, 1002) at the northern end. These layers did not appear to contain any cultural material (Figure 5-11 to Figure 5-12).

The midden and hangi layers were sampled (Figure 5-13).

Jaime Grant monitored the removal of midden following the excavation on 3 July 2021.

Figure 5-6. View looking west at the midden section after cleaning

Table 5-1. Description of layer contexts of R11/3337 section

Context	Description
1000	Topsoil layer, vegetation and root disturbance. Dark brown loose loamy soil, medium sized scoria inclusions
1001	Medium/large sized scoria rock layer, moderately loose compaction
1002	Brown/grey silty loam, moderately loose. Occasional small sized scoria rock inclusions, minor root disturbance
1003	Natural clay, moderate compaction, occasional scoria rock inclusions
1004	Possible oven feature, small/medium scoria rock inclusions. Dark brown charcoal stain soil, minor root disturbance at base but signifcant disturbance near the surface, charcoal inclusions, moderately loose compaction
1005	Scoria rock/rake-out feature, small/medium scoria rocks, minor crushed shell inclusions, moderately loose compaction
1006	Compact shell layer, majority cockle, medium/light brown silty soil, charcoal and small scoria rock inclusions
1007	Mostly large scoria rocks, moderately dense
1008	Semi-crushed shell layer, medium light brown soil, charcoal and small scoria inclusions, root disturbed
1009	Base of scoop. Light brown soil, moderately compact, possible charcoal inclusions

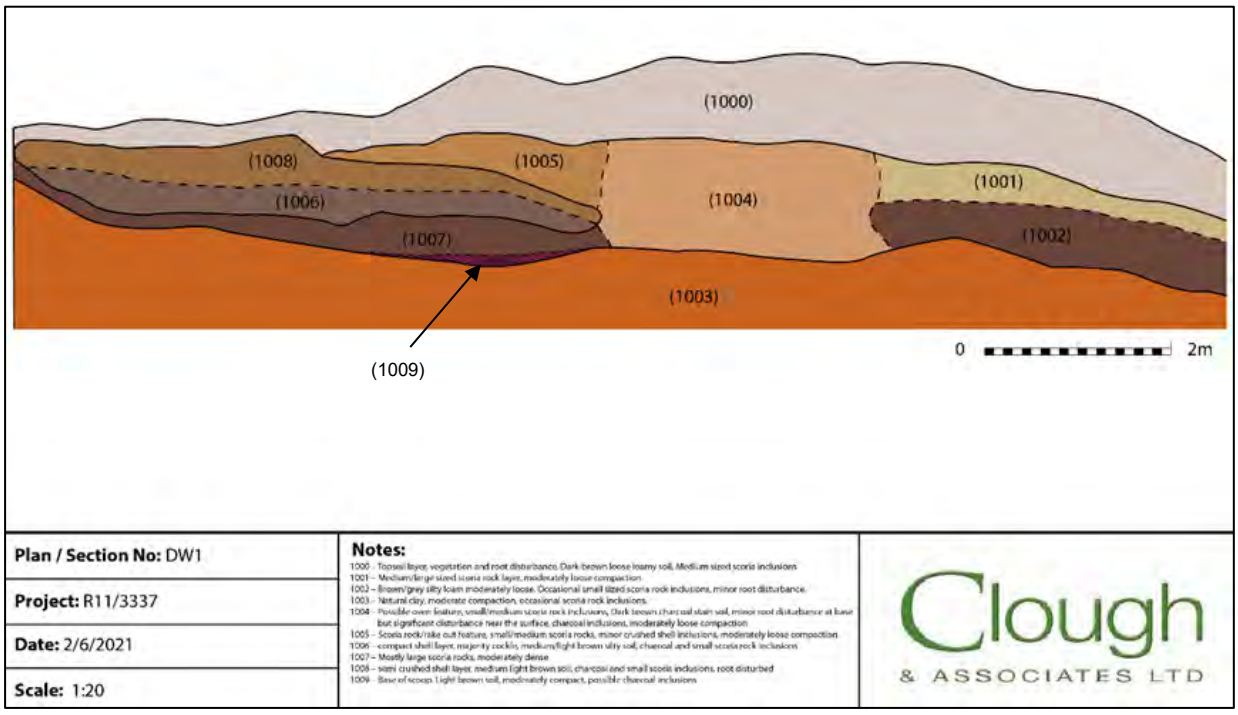


Figure 5-7. East-facing section drawing of R11/3337

Figure 5-8. View of southern end of midden section, looking west

Figure 5-9. View of south end of midden section with hangi on right, looking west

Figure 5-10. View of middle of the midden section showing hangi, looking west

Figure 5-11. Northern end of hangi in section, looking west

Figure 5-12. Northern end of midden section, looking west

Figure 5-13. Sampling of midden, looking west-northwest

6 R11/3332 Investigation Results (Authority No. 2021/752)

6.1 Site Identification

A site visit was undertaken on 8 April 2021 to inspect a shell midden deposit encountered during cut works for service trenches along the north-western side of Grahame Breed Drive (location shown in Figure 6-1), which was recorded as R11/3332. The area containing the shell showed evidence of previous disturbance and only small patches of intact shell midden were visible (marked as 1, 2 and 3 in Figure 6-2 with detailed photographs in Figure 6-3). The shell deposit ran parallel to Grahame Breed Dive in a northeast/southwest orientation. The south-western end (marked 1 and 2 in Figure 6-2) was noted to contain the thickest (c.30cm) deposit that was observed during the site visit. This area was adjacent to a large basalt boulder, and it was considered likely that the presence of the boulder had provided some protection from damage from previous impacts. As can also be seen in Figure 6-2 and Figure 6-3, a third remnant of midden (labelled 3) was present at the north-eastern end. The profile between 2 and 3 was examined and although this area was not cleaned extensively to avoid further damage, fragmentary shell was visible in the soil matrix, and it was considered likely that the area between deposits 1 and 3 represented the length of the remains of the surviving midden (c.2.5m). The midden remains observed contained predominantly cockle in a dark brown silt soil; there was a mixture of whole and fragmented shell and blackened patches of soil were also observed, especially at the base of the midden. In general, this would indicate that the overall extent of the site had been severely impacted from past activities and that only remnants of archaeological material have survived.

The extent of the shell midden was fenced off and covered with plastic sheeting pending an Authority application, as this area was not covered under Authority 2021/277.

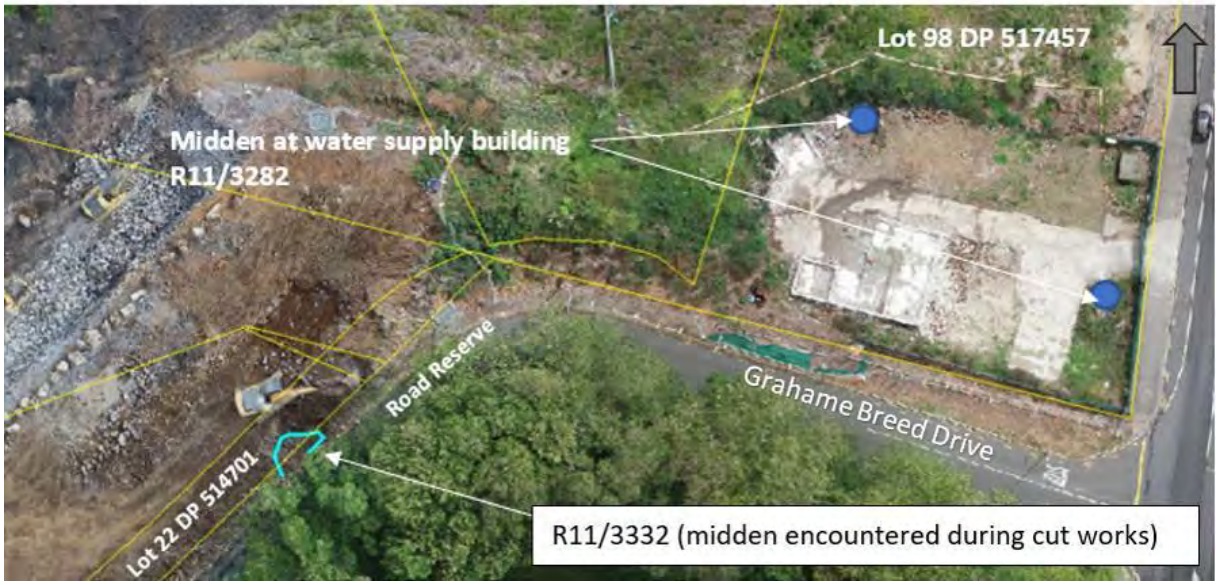


Figure 6-1. Aerial plan showing the location of midden R11/3332 in relation to the previously recorded midden R11/3282 (source: Cameron 2021a)

Figure 6-2. Photograph showing the exposed midden (R11/3332) with Grahame Breed Drive in the background, looking southeast

Figure 6-3. Left photograph showing midden deposit (3) and right photograph showing midden deposits (1) and (2)

6.2 Excavation and Recording

Following approval of the new Authority, on 23 July 2021 the site was revisited by Simon Bickler and Aaron Apfel and earthworks were undertaken along the road, exposing the midden more completely.

The midden section was cleaned, photographed, and sketched (Figure 6-4 to Figure 6-6). The midden was sampled in two areas, these being the east and west ends of the feature as these areas contained relatively intact deposits (Figure 6-5). An excavator was used to clear the area behind the section and see whether it extended further but nothing was observed (Figure 6-7).

The site was probably redeposited or highly disturbed midden from the area under Grahame Breed Drive.

Samples were taken for identification and dating but detailed analysis was not considered warranted as the material was highly mixed with modern debris.

Figure 6-4. View looking west at the midden R11/3332 section after cleaning

Figure 6-5. Clumps of shell midden at western end of trench (location of samples taken)

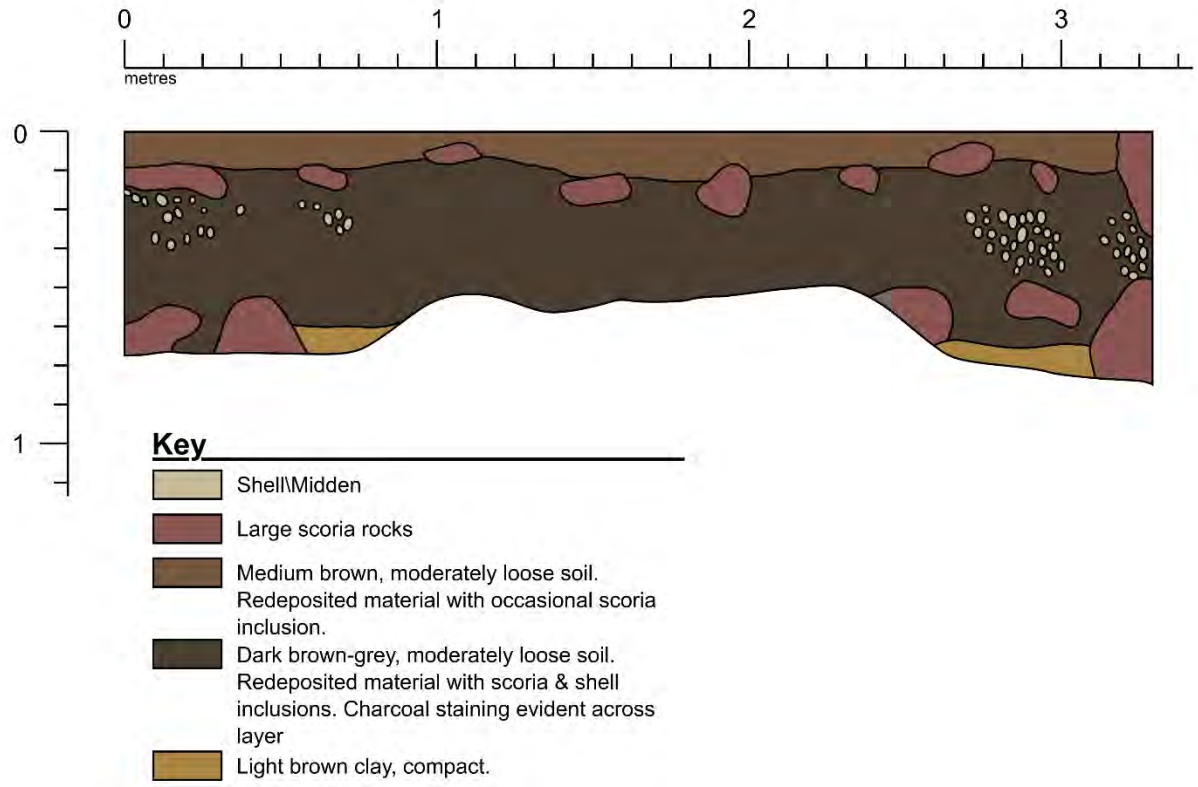


Figure 6-6. North-facing section of midden R11/3332

Figure 6-7. Area of midden following work

7 MONITORING OF TOMO

Three tomo/lava caves were exposed by the earthworks (see Figure 7-1 for locations). These were inspected in case they contained any archaeological remains.

7.1 Tomo 1, near Grahame Breed Drive

A site visit was undertaken by Ellen Cameron and Simon Bickler on 21 August 2020 to inspect a lava cave that had been encountered during fill removal works in a formerly quarried area that had also been used as a council dump site. Handheld GPS coordinates were taken for the location of the cave at NZTM coordinates 1756404 5913967 +-3m and the location is shown in the aerial plan in Figure 7-2.

For safety reasons the cave could not be entered and was observed from the opening that had been created by the excavator during the fill removal works. From what could be seen at the opening, the cave appeared to be approximately 1.5m deep and 3m wide. The length could not be determined from the visual inspection as it continued past the field of vision from the opening vantage point. It is not known if the cave had a surface opening prior to the one made during the works.

There was no evidence of any archaeological remains associated with the cave, although because of the restricted access, the entire length of the cave could not be inspected, and the presence or absence of archaeological material could not be confirmed.

7.2 Tomo 2, along Mount Eden Road

The project archaeologists were notified about a tomo uncovered in the quarry next to Mount Eden Road on 19 January 2021 (Figure 7-1, Figure 7-3). This was located at NZTM coordinates 1756706 5914168 +-3m. The tomo was found after a truck broke the top surface when working across the area. The feature was investigated to see if it contained any archaeological remains or kōiwi tangata/human remains.

The tomo entrance was 1.7m by 1.2m wide, sloping at an angle downwards towards the north to a length just under 5m and ~1.8m below the current ground surface (Figure 7-4 to Figure 7-6). The tomo appeared to have no other entrances and there was no indication it was ever open to people in the past.

No archaeological features, artefacts or human remains were observed in the cave.

Figure 7-1. Aerial plan showing the location of Tomos 1, 2 and 3 (source: Google Maps)

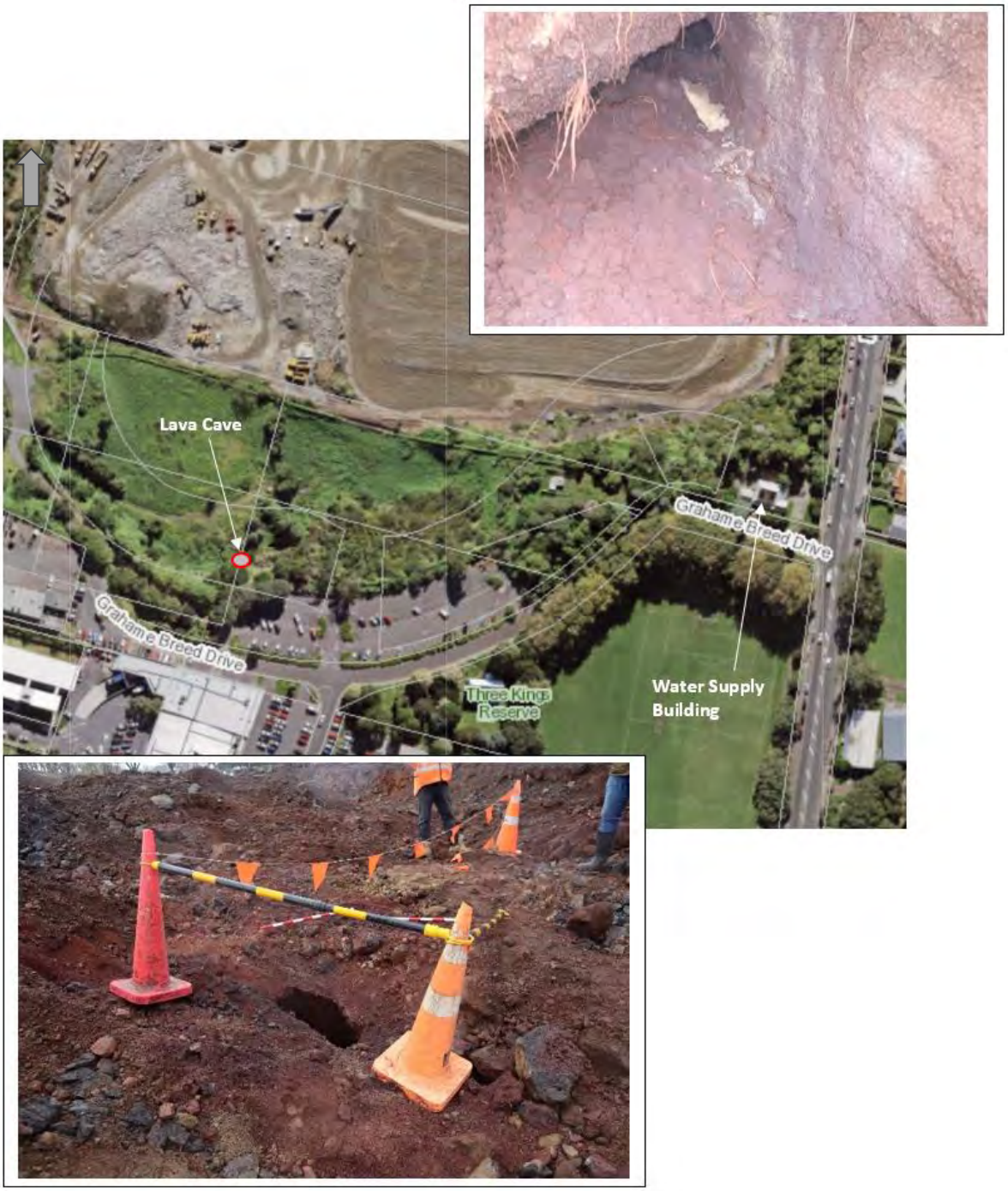


Figure 7-2. Aerial photograph showing the location of Tomo 1 (looking northeast) with lower photograph showing the opening and upper photograph taken looking into the opening (aerial source: Auckland Council GeoMaps)

Figure 7-3. Entrance to Tomo 2 looking east towards Mount Eden Road

Figure 7-4. View looking into Tomo 2

Figure 7-5. Looking at the bottom of Tomo 2

Figure 7-6. 3D model of Tomo 2 following clearing of the top

7.3 Tomo 3, near Water Supply Building

The project archaeologists were notified about another tomo uncovered in the quarry next to Grahame Breed Drive on 24 May 2021 (Figure 7-1, Figure 7-7). This was located at NZTM coordinates 1756646 5914014 NZTM +- 3m. The location was to the rear of the water supply building.

The site was visited by Simon Bickler along with Caitlin Slabbert from Auckland Council on 25 May 2021. The tomo was found during a removal of lava flow. The ground above the tomo was unstable and the loose material was removed for health and safety reasons. The feature was investigated to see if any archaeological remains or kōiwi tangata/human remains were inside, although access was limited.

The removal of the tomo was monitored by Simon Bickler on 2 June 2021. The tomo entrance was 4m by 1.5m high, although to the south there was also a small cavity. It also continued east for an unknown distance. However, internal collapse made it difficult to accurately measure. It appeared to be between 2.5m and 3m deep; however, it could have been more depending on the level of collapse. It was over 3m below the original ground surface (Figure 7-8 to Figure 7-10). The tomo appeared to have no other entrances and there was no indication it was ever open to people in the past. Some relatively modern concrete (possibly water) features were observed above the tomo (Figure 7-11).

No archaeological features, artefacts or human remains were observed.

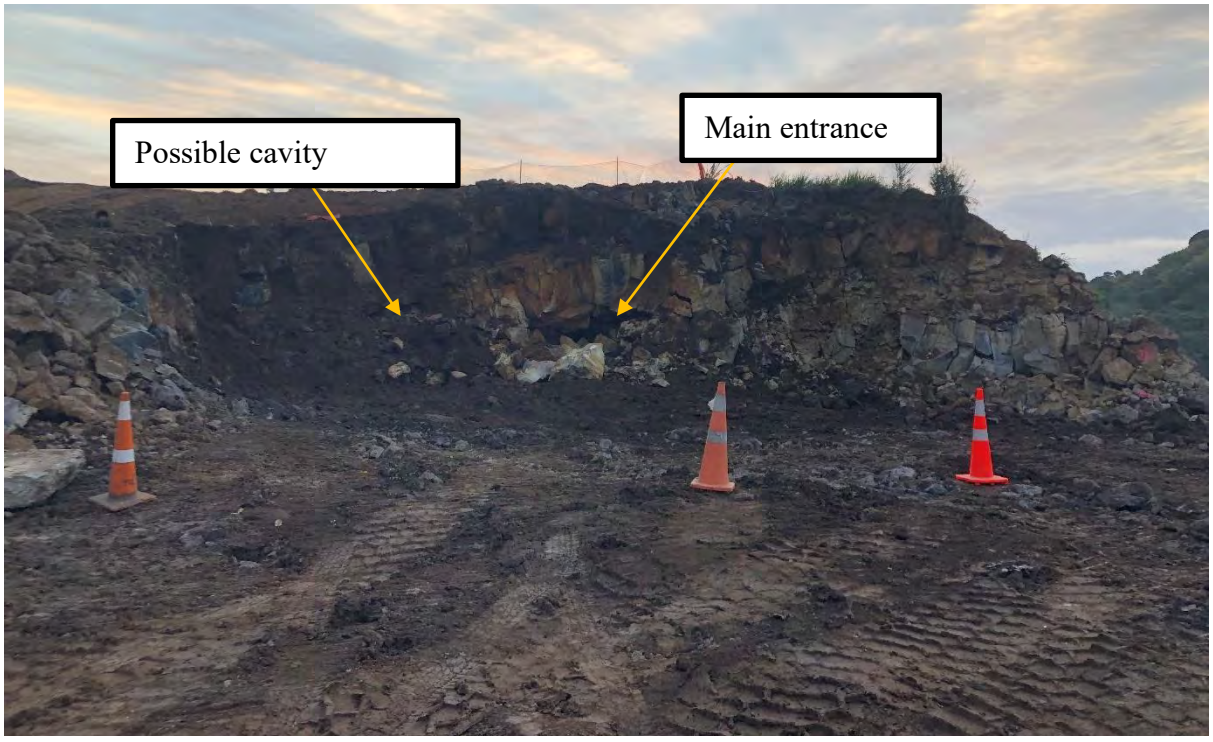


Figure 7-7. Entrance to Tomo 3 looking approximately west (photo courtesy Hamish Boult)

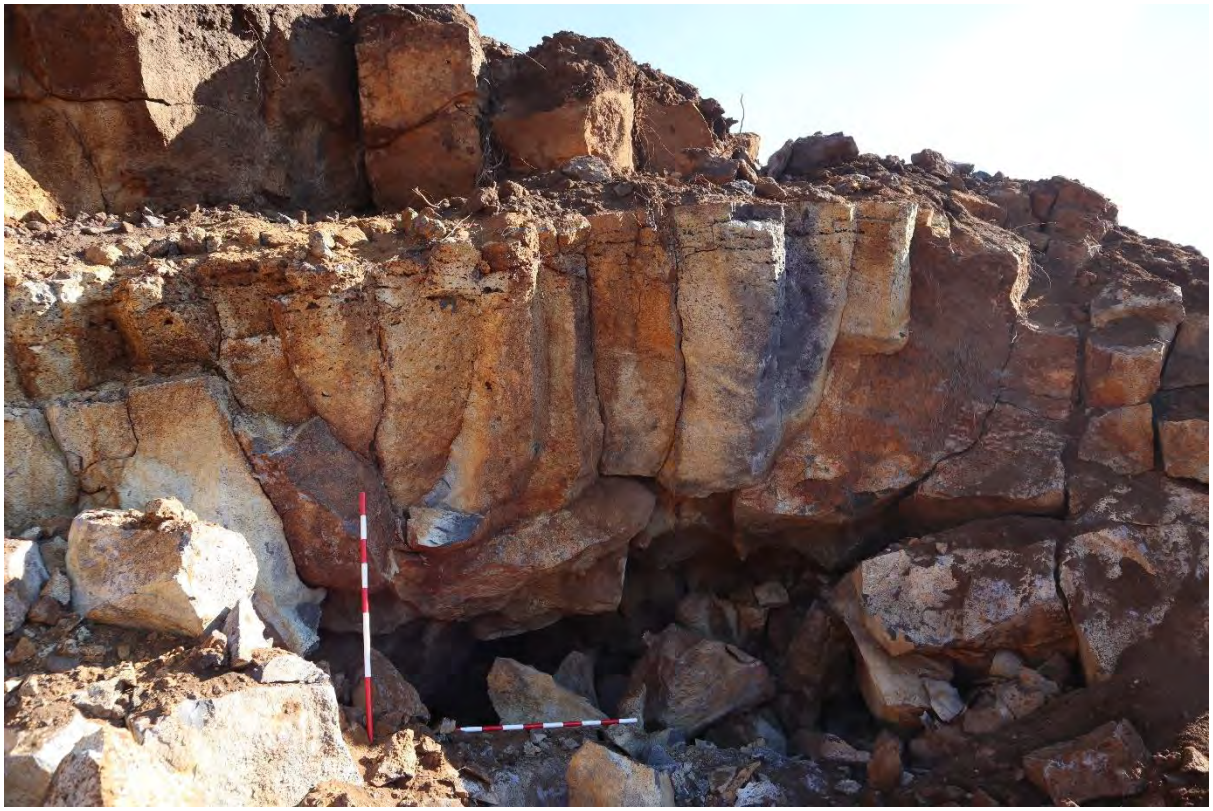


Figure 7-8. View looking at the main entrance to Tomo 3

Figure 7-9. Looking at the bottom of Tomo 3

Figure 7-10. View looking at the main Tomo 3 entrance during collapse

Figure 7-11. Concrete water pipe features on top of Tomo 3

8 RISING MAIN (AUTHORITY NO. 2022/072)

8.1 Introduction

The residential development required a wastewater rising main upgrade to be connected from the development area in the Three Kings Quarry at Mount Eden Road, along Kingsway, down St Andrews Road and onto Mount Albert Road to connect into services at the edge of the St Andrews Reserve (Figure 8-1). Most of the works were within the road reserves with the rising main mostly located under the footpaths and in the berm with crossings across the various roads at several points.

No archaeological sites had previously been recorded on the route, but a small number of archaeological sites associated with Māori settlement had been recorded in the surrounding area, including R11/3337 near the northern end of the route within the development area (see section 5). A second site, R11/677, was a reported shell midden and an obsidian flake identified in a residential garden at 254 St Andrews Road. It was reported in 1979, but a follow-up for Auckland Council in 2009 could not confirm that this site was still extant. It is noted that the Auckland Council CHI location is in front of 268 St Andrews Road which makes the ArchSite location more accurate (Figure 8-1).

The offices of the Mount Roskill Road Board (CHI:19402) which were built in 1903 and removed in the 1970s, were formerly located in St Andrews Reserve along Mount Albert Road (Figure 8-1). The site is generally post-1900 and falls outside the pre-1900 definition of an archaeological site but is still of heritage interest to Auckland Council. Given that the activities associated with the Reserve do pre-date 1900, such as the removal of scoria, it was considered possible that some archaeological artefacts and features might be found. Table 8-1 summarises the previously recorded heritage sites in proximity to the rising main alignment.

Table 8-1. Summary of previously recorded archaeological sites and historic heritage places on or near the route of the rising main

NZAA Ref	CHI No.	Site Type	Description	NZTM Easting	NZTM Northing
R11/677	5986	Midden	Shell midden in garden	1756941	5914009
R11/3337	-	Midden	Shell midden	1756708	5914195
-	19402	Plaque (for heritage buildings)	1974 Plaque for the Mt Roskill Road Board Offices	1756926	5913774

As the route of the rising main was predominantly in road reserves which did not allow subsurface assessment, an Authority was applied for as a precaution in view of the proximity of recorded midden sites.

Monitoring of the rising main works was undertaken only sporadically as it was considered there was only low potential for archaeology to be exposed by the trenching required for the project. However, material was identified in two areas around St Andrews Road and excavated as required under the Authority. Archaeological monitoring along Kingsway and the northern part of St Andrews Road did not identify any archaeological remains.

The two areas of archaeological remains were midden deposits recorded as R11/3429 and a dump of historic period artefacts, which are described below.

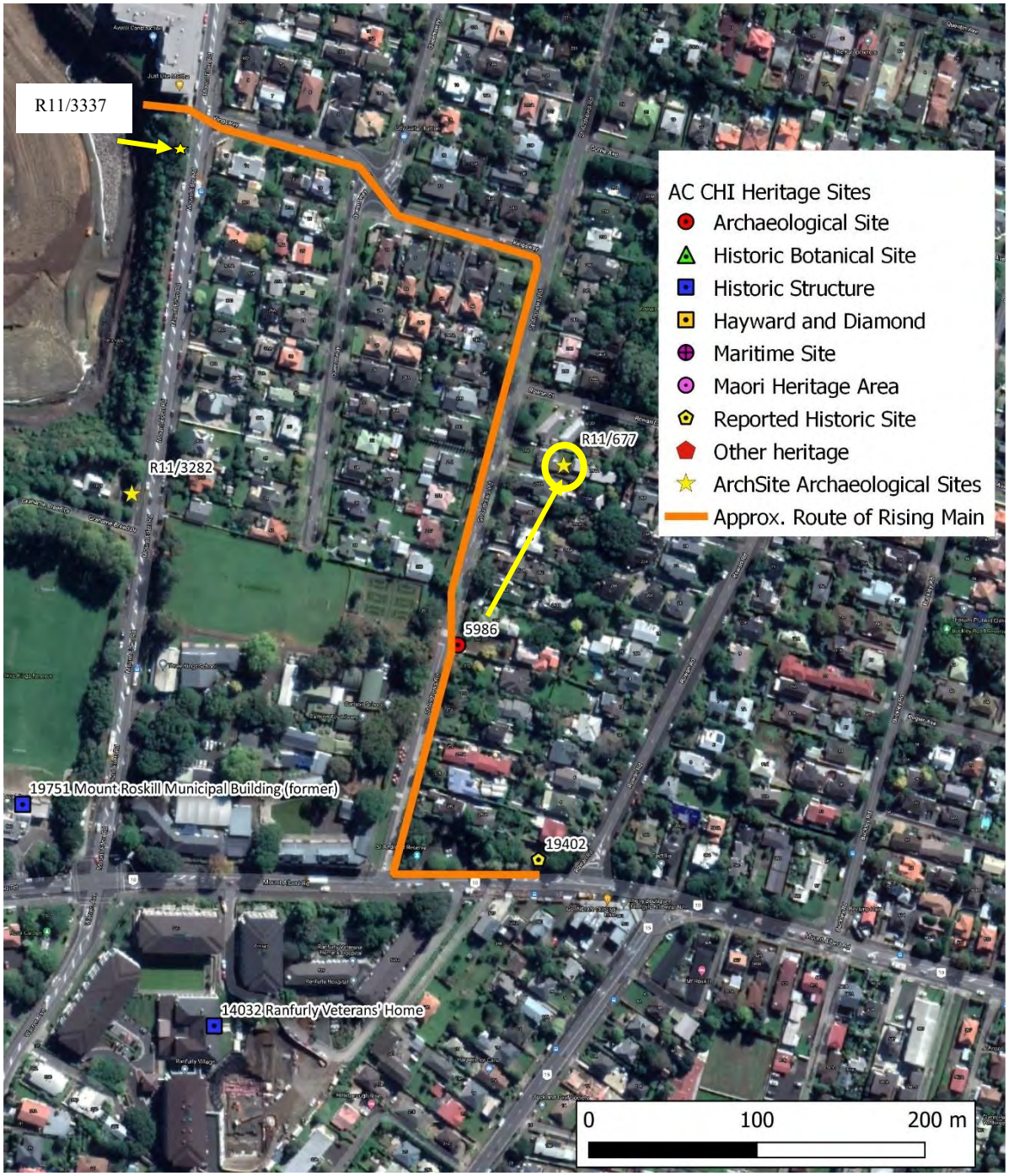


Figure 8-1. Route of the rising main, with nearby recorded archaeological and other historic heritage sites (source: Auckland Council CHI and NZAA ArchSite)

8.2 R11/3429 Investigation

Shell midden was identified by workers on 16 September 2022 during trenching. Two areas of shell were exposed in St Andrews Road near the intersection with Rowan Court (Figure 8-2). The areas were sealed after exposure prior to archaeological inspection. The location of the material was GPS recorded as NZTM E1756920 N5914061 for the main deposit and E1756921 N5914076 for a smaller scatter slightly to the north of the main deposit (Figure 8-2).

The more concentrated main exposure was at the Rowan Court excavation next to Chorus trenching and appeared to be around 1.5m long (N-S) and around 50cm wide within the trench (Figure 8-3). The material consisted of a mixture of fragmented and whole shell including cockle, pipi, scallop and oyster shell with one possible bird bone also recovered (Figure 8-2 to Figure 8-6). A sample was taken from the more concentrated area, but the material was highly mixed with a large amount of scoria and other debris (Figure 8-6).

A second scatter was observed in the middle of St Andrews Road c.30-50cm below the road surface (Figure 8-7). The shell was highly fragmented and very dispersed but extended approximate 1m E-W (Figure 8-8). However, the material was not considered sufficiently intact to sample and no further works were required in that area.

Monitoring of the removal of the remaining shell/soil around the main concentration was undertaken in the afternoon. Sections were recorded during the removal of trench fill (Figure 8-9). More concentrated and intact material was identified in the sections towards the south of the trench, including some charcoal (Figure 8-10, Figure 8-11). The feature did not appear to extend much further south in the current open trench. Sampling of the sections suggested that the shell did not extend very far into the trench wall. Samples for midden analysis and radiocarbon dating were taken.

The site was recorded in ArchSite as R11/3429. It may relate to site R11/677 at 254 St Andrews Road that was recorded in 1979, with its record updated in 2011.

Figure 8-2. Location of midden exposures – a scatter in St Andrews Road and a more concentrated exposure on the corner of St Andrews Road and Rowan Court

Figure 8-3. View of trench with main exposure of shell midden

Figure 8-4. Eastern side of trench showing midden on base

Figure 8-5. Main exposure of shell in trench

Figure 8-6. Test pit in shell midden looking down in main area

Figure 8-7. Thin layer of shell 30cm below road level

Figure 8-8. Close-up of scatter shell layer in road 40-50cm below road level

Figure 8-9. Removal of trench fill following original excavation

Figure 8-10. Southern end of west section showing main area of concentrated shell under utilities

Figure 8-11. Southern end of eastern section showing concentration of shell sampled (arrowed)

8.3 272-274 St Andrews Road Investigation

8.3.1 First Trench Area

Further south from R11/3429, more archaeological material was identified during trenching on 31 October 2022. A small dump of artefacts was identified in front of the main drive at 274 St Andrews Road (Figure 8-12), at NZTM E1756920 N5914061.

The small dump of artefacts was located at 1.1m-1.3m below the ground surface in a works trench (Figure 8-13, Figure 8-14) and extended into the western baulk. Artefacts included a white ware jug fragment, some decorated china cup fragments, a broken top of a brown beer bottle, and metal container remnants (Figure 8-15). The artefacts were likely to be of 20th century origin. The finds were noted but not recorded as archaeological site.

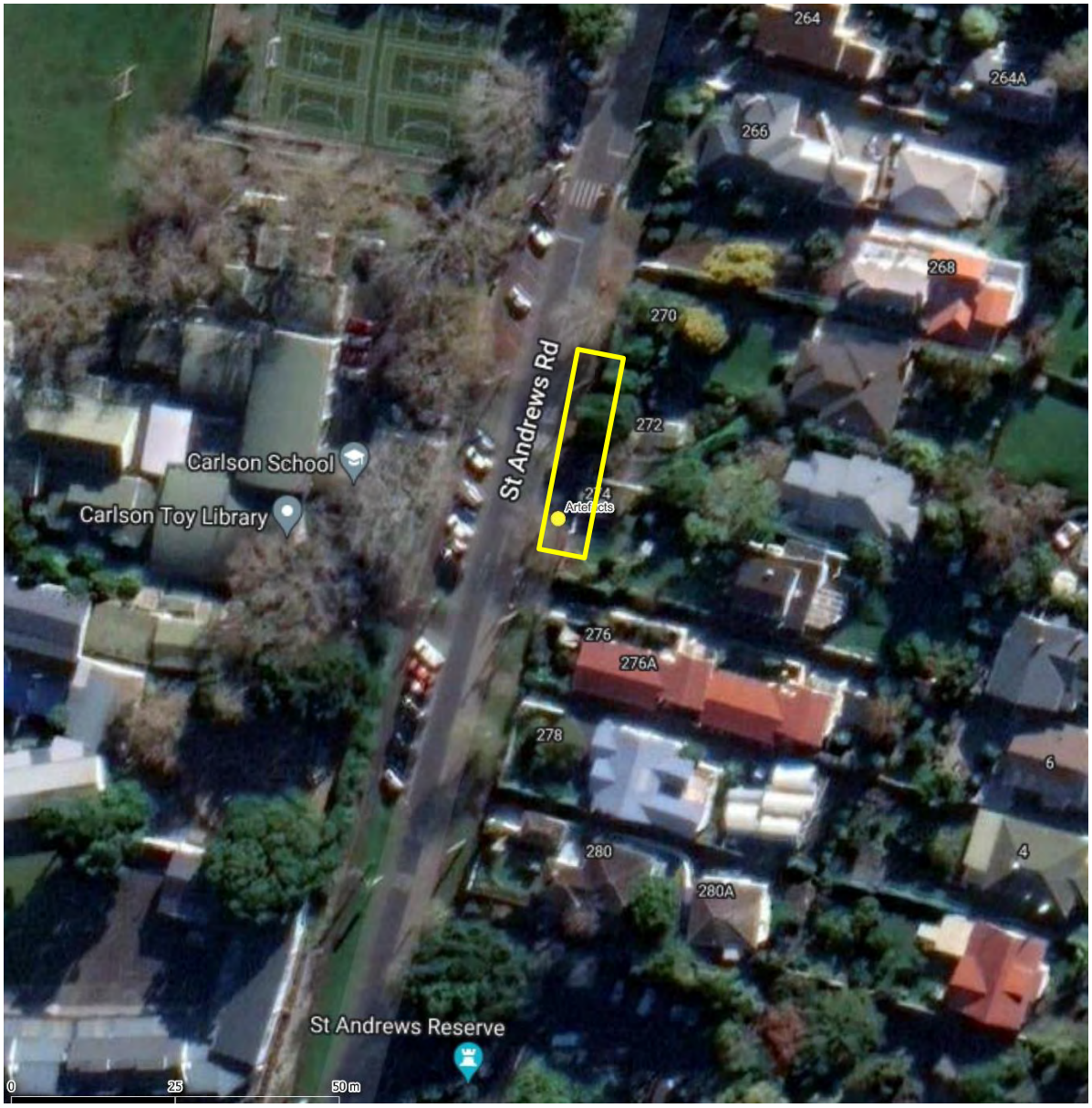


Figure 8-12. Location of artefacts found in trench

Figure 8-13. View of trench where dump was located (at base of 1m scale bar in trench)

Figure 8-14. West section of trench showing artefacts from dump at 1.1m depth

Figure 8-15. Selection of artefacts (scale interval 10cm)

8.3.2 Second Trench Area

Subsequent trenching slightly to the north of the previous trench section, in the pavement in front of 272-274 St Andrews Road resulted in more possible artefacts being uncovered on 17 November 2022 (Figure 8-16). The archaeologists were notified that a large amount of old domestic waste material had been uncovered during trenching and a site inspection was carried out on the same day.

Figure 8-16. Aerial showing approximate trench location in red (aerial source: Auckland Council GeoMaps)

Upon arrival it was found that the trench had been covered with metal plates and small amount of material had been put aside, including glass, ceramic and ferrous artefacts. Most of the material appeared to be turn of the century (c.1900) and early 1900s in origin; however, some of the material appeared to be pre-1900. One of the interesting pieces was what appeared to be an old clothing wringer (Figure 8-17 and Figure 8-18).

The trench was then inspected for intact/in situ deposits, which revealed the following stratigraphy:

- Layer 1: 10-15cm of a light grey silty gravel, moderately compact
- Layer 2: 5-8cm of a light brown/orange silty soil, moderately loose. Minor root disturbance.
- Layer 3: 25-30cm of a mid-brown/grey silty soil with significant gravel inclusions, moderately compact. Significant root disturbance.

- Layer 4: 1m+ (to base of trench) of a medium-dark brown moderately loose silty soil with numerous deposits of domestic waste existing at varied depths within the layer (Figure 8-19 to Figure 8-22). Significant root disturbance within first 40cm of this layer.

The stratigraphic profile seen within this trench showed significant disturbance and modified layers, varying considerably along the trench. The deposits of domestic waste containing material dating from the late 1800s to early 1900s were typically 1.2-1.5m beneath the surface and continued to a depth below the level required for this excavation.

The material identified within these deposits included glass, ceramic, ferrous material, shell and bone – the shell being rock oyster and cockle, and the bone being sheep and cow. Some deposits of mainly highly crushed shell (cockle) were identified (see Figure 8-22).

All of the deposits contained predominantly early 20th century material, indicating deposition post-1900. However, a sample including the earliest material, considered likely to have been manufactured pre-1900 or around the turn of the century, was taken. This material is shown in Figure 8-23 and described in Table 8-2.

These artefacts included black beer bottles, a hair tonic bottle (Figure 8-24) and other small medicine bottles, a Udolpho Wolfe aromatic schnapps bottle (Figure 8-25), two essence of coffee and chicory bottles, one being from 'Garland Auckland' and the other J.R. Love and Co. Ltd (which became a limited company in 1907[1], so this bottle is presumably of early 20th century origin (Figure 8-26), horseshoe, tin, and various ceramics including possibly Asiatic Pheasant and a decorative green tile with a castle motif stamped 'England' at the back.

The material discovered within the trench was predominantly of early 20th century manufacture but was mixed with some earlier items. It was therefore deposited in the 20th century.

[1] https://adb.anu.edu.au/biography/love-james-robinson-4042

Figure 8-17. Artefacts recovered by the contractors in the second area of trenching, set aside from the previous day (scale interval 20cm)

Figure 8-18. Close-up of clothing wringer (possibly late 1800s-early 1900s?) (scale interval 20cm)

Figure 8-19. Trench excavation in progress, facing southeast

Figure 8-20. East-facing profile of trench. Scale interval 20cm

Figure 8-21. Stratigraphic profile of east side of north end of trench with deposit of waste material at base continuing for an unknown depth. Scale interval 20cm. Facing east/southeast

Figure 8-22. Stratigraphic profile of south end of trench with crushed shell deposit near base (at 40cm mark on scalebar). This deposit also contained some ferrous/glass/ceramic material. Scale interval 20cm. Facing east/southeast

Figure 8-23. Assemblage of artefacts sampled from trench

Figure 8-24. 'Harlene for the Hair' tonic bottle

Figure 8-25. Udolpho Wolfe's aromatic schnapps bottle, Schiedam

Figure 8-26. Essence of coffee and chicory bottle, J.R. Love & Co. Limited, Victor[ia]

Table 8-2. Artefacts recovered from trench outside 272 and 274 St Andrews Road

Artefact Material	Artefact Type	Artefact Description	Est. Manufacture Date
Glass	Black Beer Bottle	Whole bottle, no marks	Late 1800s
Glass	Black Beer Bottle	Base, no marks	Late 1800s
Glass	Black Beer Bottle	Neck, no marks	Late 1800s
Glass	Green Schnapps Bottle	Udolpho Wolfe's Aromatic Schnapps, Schiedam	1859 - late 1800s
Glass	Hair Tonic Bottle	'Harlene for the Hair'	c.1890s
Glass	Ess. Coffee & Chicory	Whole, Ess Coffee & Chicory, J.R. Love & Co. Limited, Victor[ia]	c. 1907+
Glass	Ess. Coffee & Chicory	Essence Coffee And Chicory …Garland Auckland - fragments	c. 1922+
Glass	Blue Glass	Fragment	1800s-1900s
Glass	Mason Jar	Base, Ben Schloss Manufactor Patents Applied For S. F. Cal.	c.1910
Glass	Medicine Bottle	Whole, cork bottle unmarked	Early 1900s
Glass	Medicine Bottle	Whole, cork bottle unmarked	Early 1900s
Glass	Medicine Bottle	Whole, cork bottle unmarked	Early 1900s
Glass	Milk bottle?	Base, unmarked	Early 1900s
Glass	Vaseline Bottle	Vaseline, Cheeseborough New York	Early-Mid 1900s
Ferrous	Horseshoe	Regular shape with caulking/calk at tip	1800s-1900s
Ferrous	Tin	Small tin, possibly tobacco	1800s-1900s
Ceramic	Tile	Green tile with floral design around border, castle motif at centre – fragments	1800s-1900s?
Ceramic	Serving Plate	Large white serving plate with blue transfer floral design - fragments	Early 1900s
Ceramic	Serving Plate	Large white serving plate with blue transfer floral design – fragment	Early 1900s
Ceramic	Plate	White plate with blue floral transfer design, possible Asiatic Pheasant – fragments	1862-1900s
Ceramic	Vase	Large white vase, blue floral transfer design – fragment	Early 1900s
Ceramic	Bowl	White bowl with Alfred Meakin England mark at base – fragment	1907-1914
Ceramic	Lid	Ceramic lid with blue transfer design – fragment	Early 1900s
Ceramic	Vase	Light brown/orange vase – fragment	Early 1900s
Ceramic	Teacup	White teacup with linear gold gilding design – handle fragment	Early 1900s
Ceramic	Teacup	White teacup handle with blue transfer and gold gilding design - fragment	Early 1900s
Ceramic	Bowl	White bowl with gold gilding and ribbed design	Early 1900s

(References used for identification: Bickler et al. 2005, 2007; Shakles et al. 2019; Godden 1964)

8.3.3 Follow-up Monitoring

Monitoring of pipeline and infrastructure works north of previously excavated midden site R11/3337 (Figure 8-27) was undertaken periodically in August to December 2022 to ensure no further midden was encountered.

The area had been benched for a nearby showroom and modified for new utilities under Authority 2021/277. Some scattered shell had been observed during initial work but was identified as remnants from the archaeological excavation.

No new intact archaeological remains were identified (Figure 8-28 to Figure 8-32).

Figure 8-27. Location of midden R11/3337 (excavated) and area of site inspection

Figure 8-28. View of inspection zone

Figure 8-29. Follow-up visit

Figure 8-30. Pipe trench

Figure 8-31. View of trench with pipe and area for extension of trench

Figure 8-32. Pipe trench towards quarry showing basalt blocks from trench

9 MIDDEN ANALYSIS

9.1 Methodology

Ten litre or in some cases 2.5 litre samples were taken from the four midden sites and analysed by Jaime Grant (R11/3282) and Aaron Apfel (R11/3332, R11/3337 and R11/3429). Fishbone analysis was undertaken by Patricia Pillay (site R11/3282).

Sample analysis included charcoal flotation for species identification and radiocarbon dating.

The samples were then wet sieved with a 4mm, then a 2mm and then a 1mm sieve, with the charcoal and any fishbone floated and separated during this process. The separated components were air dried, sorted by hand into their main components (defined as):

- Soil: fine sediment removed from the samples during sieving; includes clay, silt, and sand-sized particles.
- Unidentifiable shell: often highly fragmented but including largely complete shells with no hinge present.
- Identifiable shell: whole shells and shell fragments with an intact hinge.
- Rock: fragments of rock, burnt stone, pebbles, and sandstone.
- Charcoal: pieces of charcoal.
- Bone: bone fragments, specifically fish.
- Artefacts: objects created by human agency.

The identifiable shell portion was set aside for further analysis. The identifiable shells were sorted and analysed by taxon. Preferred habitat was also noted for further analysis, with each species assigned to one of the following environmental niches:

- Muddy Shore
- Muddy and/or Sandy Shore
- Sandy Shore
- Rocky Shore
- Sandy, Rocky or Muddy Shore
- Other/Unknown.

A list of all the taxa identified in the analyses is presented in Table 9-1.

Table 9-1. List of identified taxa by common and scientific names and preferred habitat

Common Name	Scientific Name	Preferred Habitat
Cat's Eye	*Turbo smaragdus*	Rocky environment
Cockle	*Austrovenus stutchburyi*	Muddy environment
Hornshell	*Zeacumantus lutulentus*	Muddy environment
Rock Oyster	*Saccostrea cucullata*	Rocky environment
Mudsnail	*Amphibola crenata*	Muddy environment
Mussel	*Perna canaliculus*	Rocky environment
Large Trough Shell	*Spisula discors*	Muddy and/or sandy environment

Common Name	Scientific Name	Preferred Habitat
Scallop	*Pecten novaezelandiae*	Muddy and/or sandy environment
Pipi	*Paphies australis*	Muddy and/or sandy environment
Gastropod sp.		Other / Unknown
Whelk sp.		Muddy environment
Operculum		Other / Unknown
Tuatua	*Paphies subtriangulata*	Muddy or Sandy Environment
Pipi	*Paphies australis*	Muddy and/or sandy shore
Wedge Shell	*Macomona liliana*	Muddy or Sandy Environment
Limpet		Rocky environment

The analysis of each taxon examined six aspects: the Minimum Number of Individuals (MNI), MNI percentage, the Number of Identified Specimens (NISP), NISP percentage, weight (in grams) and weight percentage.

NISP is calculated by counting the total number of identifiable shells for each species. For bivalves to be counted an umbo was the minimum requirement. For gastropods whole or nearly whole terminal spires or a complete anterior canal were counted.

MNI is calculated for bivalves by separating the left and right hinges and using the larger number. For gastropods the MNI is the largest number counted of the two methods for identifying individuals and NISP is the sum of the two.

Total weight for each species was calculated to the nearest gram.

The analyses included the calculation of fragmentation ratios to assess the level of fragmentation of the deposit. The reasoning for this follows the argument that greater quantities of broken shells indicate greater levels of damage to the deposit. Therefore, greater quantities of intact shells would indicate a deposit in 'good/whole' condition. Interpretation of this ratio needs to take into account various taphonomic factors influencing the site, such as the level of plough damage, cattle trampling or vehicle movements across the site, or even environmental factors such as chemical weathering. To calculate the ratio, all identifiable shells were separated into whole shell and fragmented shell with a hinge. The MNI of each portion was calculated and the fragmented portion was divided by the whole portion. This creates a ratio of broken shells to whole shells, with a higher number indicating more broken shells.[2]

Shell dimensions were also measured when a sufficient sample was present. Shell dimension is a variable that can reveal changes in the levels of predation over time. A dense occupation over a considerable period of time could result in extensive harvesting of a particular species and would thereby reduce the size of the individuals available to little more than juveniles. Conversely a targeted harvest conducted by individuals moving quickly across the landscape may select simply the largest available shellfish. The size ranges for cockle (the only species present in sufficient quantities) are as follows: juvenile (up to 10mm), pre-adult (10-20mm),

[2] Based on the current data collected for cockle fragmentation ratios in the Auckland region the results can be split into six groups: very low = 0-1.5, low = 1.51-2.5, moderate = 2.51-4.5, high = 4.51-10, very high = 10.01-16, and extreme = 16.01+. These groups are roughly organized according to percentiles, with approximately 20% of the total numbers of samples assigned to each group, except for the last two which are around 10% each.

young adults (18-25mm), adults (>25mm), with sexual maturity 18-20mm (www.gopi.org.nz). The size of pipi at maturity has been estimated at 40mm (Hooker and Creese 1995).

9.2 R11/3282 Midden Analysis

9.2.1 Sample Analysis

Ten litre samples were taken from both midden areas of R11/3282. Samples were removed from the baulk of the Back Midden as a general bulk sample. An additional smaller sample from the area containing bone was also taken from that vicinity to include charcoal and shell for possible dating.

Two 10-litre samples were also taken from the Front Midden. One was from firescoop Feature 1 from the western excavated section and the other from a small trench just above the rocks associated with firescoop Feature 2.

Five samples were analysed:

- Back Midden Sample 1 Bag 1 (BMS1B1).
- Back Midden Sample 2 Bag 1 (BMS2B1).
- Back Midden Sample 2 small bag (BMS2SB).
- Front Midden Sample 1 Feature 1 (FMS1F1).
- Front Midden Sample 2 Feature 2 (FMS2F2).

The weight of each component for the samples is presented in Table 9-2 , with the proportions represented graphically in Figure 9-1 and Figure 9-2. This measure shows that overall in the samples taken identified shell was the largest component of the total weight excluding soil. The second largest component was unidentified shell. The percentages of both varied between samples. Charcoal was recovered from all of the samples but in varying amounts, ranging from 14 grams to 3 grams in total. No artefacts were recovered. Several of the samples contained fishbone; BMS2SB contained the most with 31 grams.

Table 9-2. Component breakdown of each sample (measured in grams), R11/3282

	BMS1B1	BMS2B1	BMS2SB	FMS1F1	FMS2F2
Soil	3265	1200	44	5742	4212
Unidentified Shell	1576	224	59	1732	2456
Identified Shell	2155	468	124	1298	2041
Rocks	1416	158	88	450	88
Charcoal	14	11	5	4	3
Artefacts	0	0	0	0	0
Bone	3	10	31	0	2
Total	8429	2071	351	9226	8802

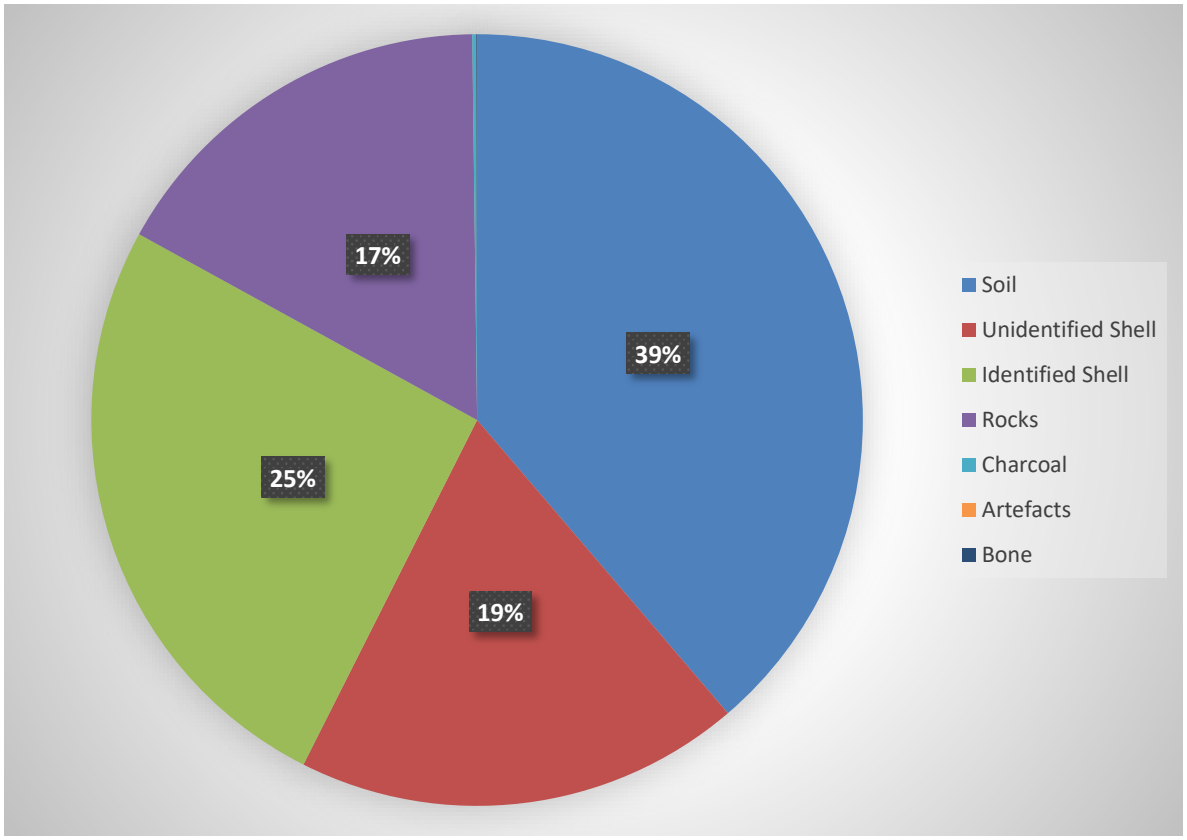


Figure 9-1. Overall composition for all samples taken from R11/3282

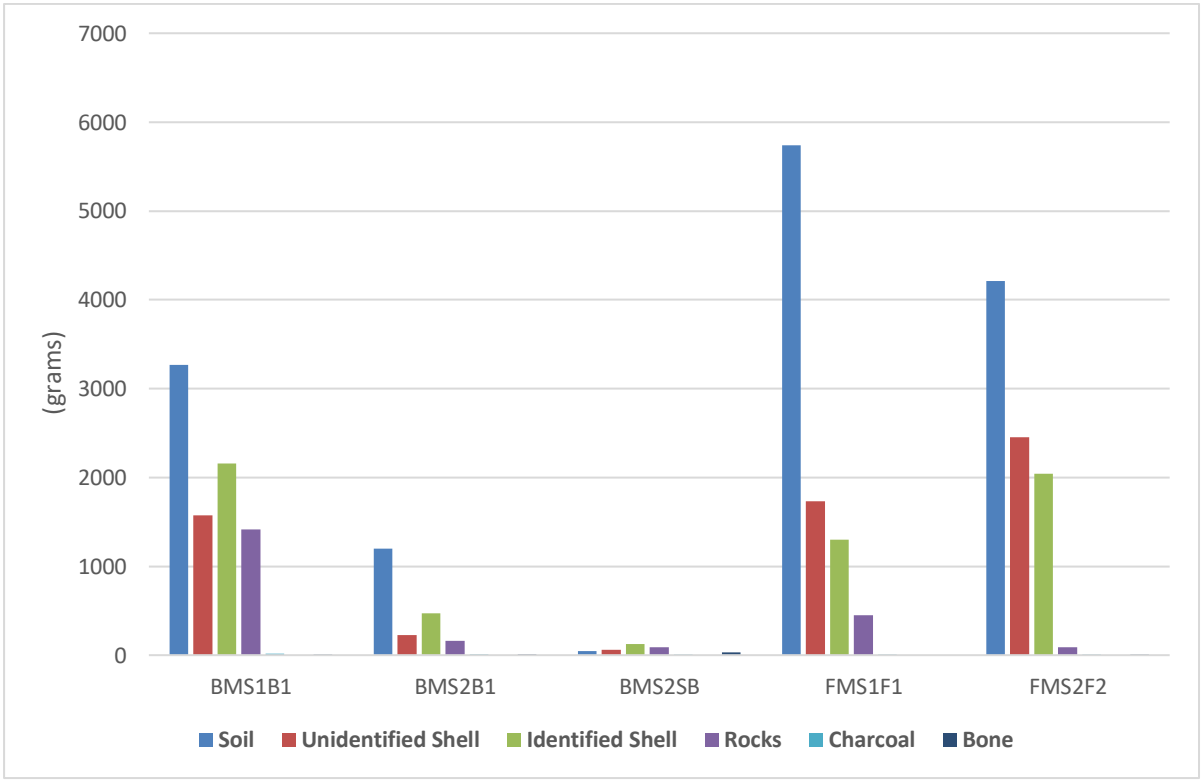


Figure 9-2. Composition of individual samples from R11/3282

9.2.2 Taxon Analysis

The taxon analysis for each of the samples is presented in Table 9-3 to Table 9-7.

Table 9-3. NISP, MNI number and percentage, and weight by taxa for BMS1B1, R11/3282

Taxon	NISP	NISP %	MNI #	MNI %	Wt. G.	Wt. G. %
Cockle	2831	99.1	1515	98.2	2015	97.2
Tuatua	14	0.5	14	0.9	10	0.5
Oyster	2	0.1	2	0.1	12	0.6
Scallop	1	0.0	1	0.1	8	0.4
Gastropod	6	0.2	6	0.4	18	0.9
Pipi	4	0.3	4	0.3	11	0.5
Total	2858	100.1	1542	100.0	2074	100.0

Table 9-4. NISP, MNI number and percentage, and weight by taxa for BMS2B1, R11/3282

Taxon	NISP	NISP %	MNI #	MNI %	Wt. G.	Wt. G. %
Cockle	661	99.1	331	98.2	460	98.3
Tuatua	6	0.9	6	10.7	8	1.7
Total	667	100.0	337	108.9	468	100.0

Table 9-5. NISP, MNI number and percentage, and weight by taxa for BMS2SB, R11/3282

Taxon	NISP	NISP %	MNI #	MNI %	Wt. G.	Wt. G. %
Cockle	169	94.9	331	97.4	460	96.0
Tuatua	5	2.8	5	1.5	8	1.7
Pipi	4	1.2	4	1.2	11	2.3
Total	178	98.9	340	100.0	479	100.0

Table 9-6. NISP, MNI number and percentage, and weight by taxa for FMS1F1, R11/3282

Taxon	NISP	NISP %	MNI #	MNI %	Wt. G.	Wt. G. %
Cockle	2831	100.0	1515	100.0	2015	100.0
Total	2831	100.0	1515	100.0	2015	100.0

Table 9-7. NISP, MNI number and percentage, and weight by taxa for FMS2F2, R11/3282

Taxon	NISP	NISP %	MNI #	MNI %	Wt. G.	Wt. G. %
Cockle	804	95.1	456	91.8	1999	98.3
Tuatua	5	0.6	5	1.0	6	0.3
Gastropod	36	7.2	36	7.2	28	1.4
Total	845	103.0	497	100.0	2033	100.0

Cockles made up the largest proportions (both NISP and MNI) of shellfish species for all the analysed assemblages, varying from 95% to 100% within the samples. A system of 'types' was previously developed for understanding middens dominated by cockle and pipi (Farley 2011:55 and Farley et al. 2015:104). This system was based on the variability of cockle and pipi proportions within the samples, which divided samples into five types:

- Type 1 is characterised by cockle comprising greater than 70% of the MNI.
- Type 2 is characterised by pipi comprising greater than 70% of the MNI.

- Type 3 is characterised by cockle comprising between 50% and 70% of the MNI.
- Type 4 is characterised by pipi comprising between 50% and 70% of the MNI.
- Type 5 is characterised by no single species comprising more than 50% of the MNI.

Types 1 and 2 indicate a very strong selection for a certain shellfish species, while Types 3 and 4 indicate a more mixed preference. Type 5 indicates a strong mixed selection.

Under this definition the samples all indicate a Type 1 midden deposit.

Other species were noted to be present through the samples, but these were never counted in great quantities. These were predominantly various gastropod species (including Hornshells and various whelks) and other bivalves. Such a clear domination of cockle in the samples is in part a reflection of the ease of access to this species and the volume present in the local environment in the Onehunga Bay.

9.2.3 Habitat Analysis

The environmental niche associated with each species was presented in Table 9-1. The MNI of all species in each niche was then summed to provide the total MNI for each niche. The relative proportions for these niches are presented in Table 9-8 and Figure 9-3. These show that the primary environment for these samples was a muddy environment, due to the dominance of cockle, with the second most prevalent being a muddy and/or sandy environment.

Given the location of the study area, it is hardly surprising that the inhabitants were consuming local food resources from the Manukau Harbour. Rocky and sandy shore environments are also located in the wider area and would have been utilised.

Table 9-8. Environmental niche of each sample from R11/3282

	BMS1B1	**BMS2B1**	**BMS2SB**	**FMS1F1**	**FMS2F2**
Muddy Environment	99	98.2	97.4	100	91.8
Rocky Environment	0.1	0	0	0	0
Muddy and/or Sandy Environment	18.1	1.8	6.2	0	12.2
Other/Unknown	0.4	0	0	0	7.2

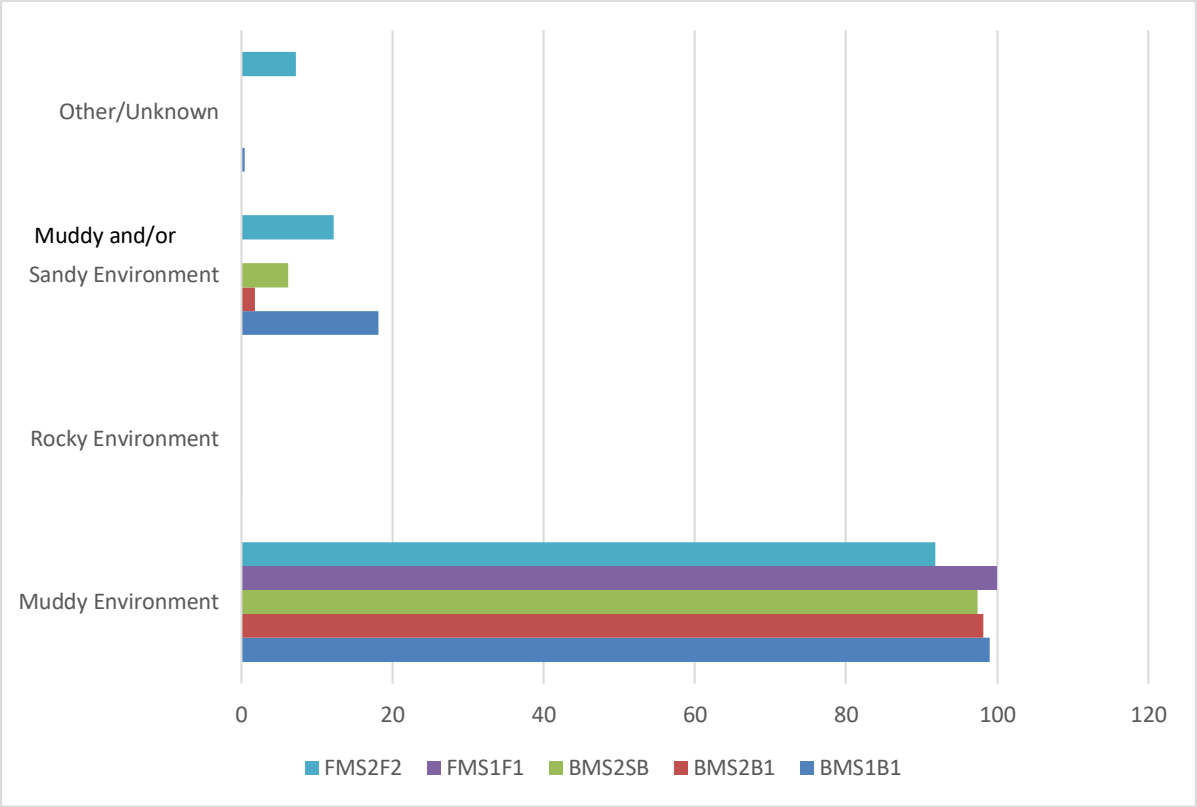


Figure 9-3. Environmental niches for shellfish species within samples from R11/3282

9.2.4 Fragmentation Ratio

Only cockle was calculated, as other species lacked sufficient numbers. The MNI numbers of each sample and the fragmentation ratio for cockle are presented in Table 9-9. The analysed samples returned results ranging from 0.36 to 0.91. These ratios would fall into the very low fragmentation group. The high level of preservation of the sample may in part be due to the midden being undisturbed or protected by the topsoil that had been covering it. It can also be a sign that the midden is a more recent one, which could explain the high level of preservation, but the radiocarbon dating results (section 11.1) indicate that was not the case.

Table 9-9. Fragmentation ratio of each sample from R11/3282

	BMS1B1	BMS2B1	BMS2SB	FMS1F1	FMS2F2
<50% MNI #	110	27	304	206	456
>50% MNI #	225	70	851	309	501
Ratio	0.49	0.39	0.36	0.67	0.91

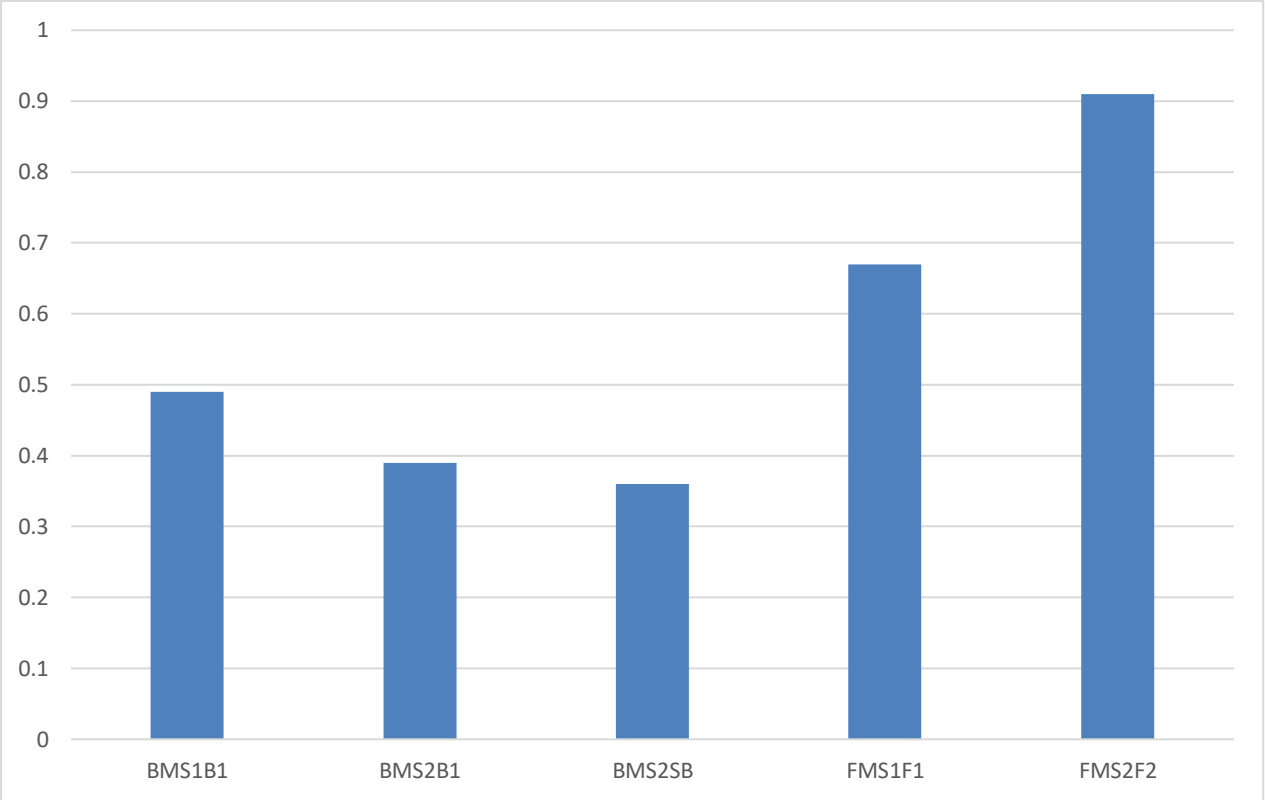


Figure 9-4. Fragmentation ratio of samples from R11/3282

9.2.5 Shell Dimensions

A total of 200 cockle shells were measured. Descriptive statistics for maximum dimensions are presented in Table 9-10 and Figure 9-5. The results suggest the targeting of largely mature cockle, with the mean size varying from 18 to 25mm. Some variation was observed between the samples in both the Back and Front Middens, suggesting different collection times for the samples. However, there is insufficient evidence to determine what these differences represent.

Table 9-10. Descriptive statistics for maximum dimensions from R11/3282 samples, in mm

	BMS1B1	BMS2B1	BMS2SB	FMS1F1	FMS2F2
Max	40	35	41	31	40
Min	11	11	9	11	12
Mean	25	24	18	18	24
Standard Deviation	5.7	6	5	5	7
Median	26	26	18	17	26

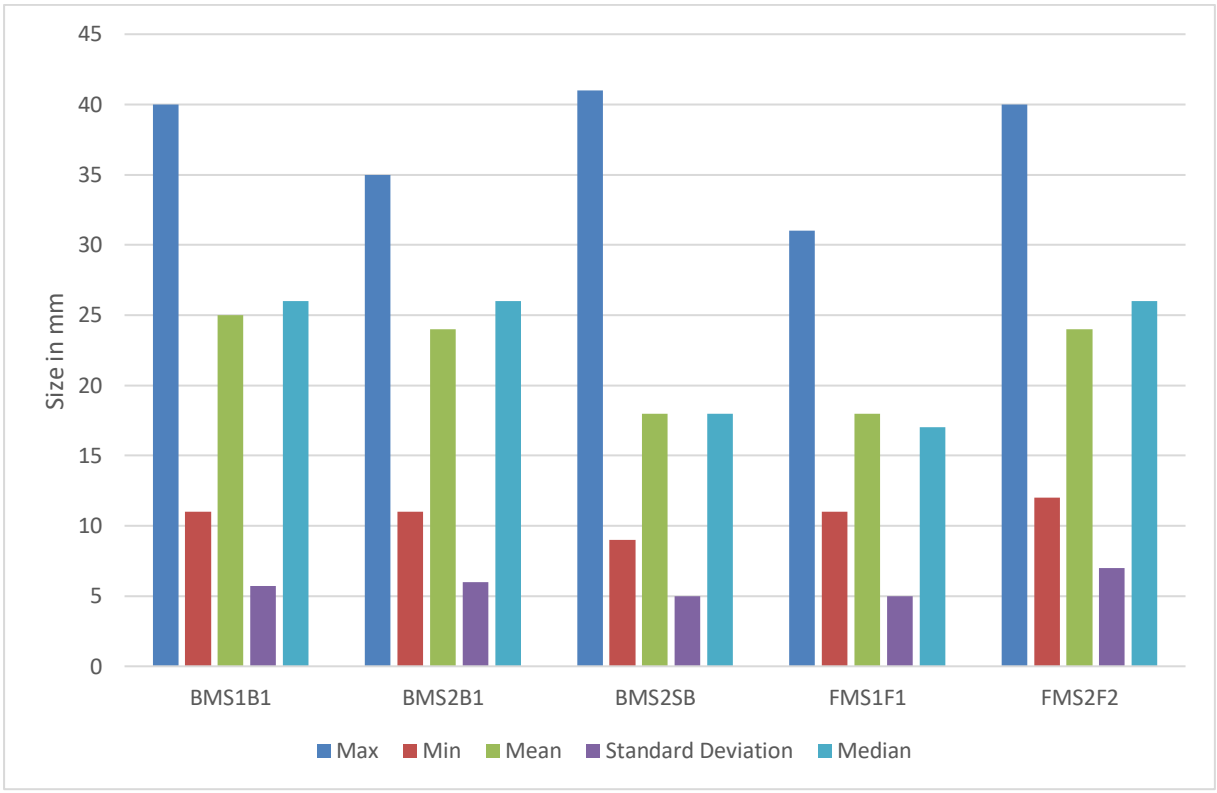


Figure 9-5. Descriptive statistics for cockle dimensions from R11/3282, in mm

9.2.6 Faunal Analysis R11/3282

This report on the fishbone from R11/3282 by Patricial Pillay aims to investigate the distribution of taxa, inform on possible subsistence economy strategies from species present in archaeological contexts, and aid in palaeoecological reconstruction.

9.2.6.1 Methods

Vertebrate material was sorted to element and side where possible and identified to the lowest taxonomic unit. Fishbone was determined using the author's reference material, the University of Auckland Anthropology Department reference collection, and relevant literature (Campbell 2016; Campbell et al. 2021). Fishbones were identified on a wider range of elements beyond the methodology outlined by Leach (1986), which focuses on the five paired mouthparts (dentary, premaxilla, maxilla, articular, and quadrates). Other diagnostic cranial elements and vertebrae were identified based on Campbell's (2016) and Nims and colleagues' (2020) recommendations.

Following identification, the material was quantified using zooarchaeological standard protocols (Grayson 1984; Reitz and Wing 2008) and re-bagged according to provenance, species, element, and side (if applicable). Quantified data was re-entered into an Excel spreadsheet along with MNE (Minimum Number of Elements), values, and weight. MNE values were then used to calculate MNI (Minimum Number of Individuals). Finally, scientific and common names for all identified taxa are provided.

9.2.6.2 Results

Fish are the second most frequent faunal class found in Aotearoa archaeological shell bearing deposits (Campbell 2016). Fish form a crucial component of pre-European Māori diets (Leach

2006: 235; Campbell 2016). Fish taxa distribution in the assemblage is fairly typical of fishbone analyses in North Island (Te-Ika-a-Māui) archaeological contexts, particularly around Tāmaki Makaurau (Auckland).

Fishbones from general bulk collection of the BMS2B1 sample contained unidentifiable fragments (Table 9-11). Four bony fish and one cartilaginous fish species were identified from the R11/3282 assemblages (Table 9-12 to Table 9-14). Like many North Island assemblages, tāmure (snapper, *Chrysophrys auratus*) was the most dominant in body part representation and is often preserved in archaeological shell-bearing deposits (midden) due to its robust bone structure (Figure 9-6).

At least one tāmure was present in the BMS2B1 sample (Table 9-12) and at least two individuals from BMS2SB (Table 9-14). At least one tarakihi (*Nemadactylus macropterus*) and one trevally (araara, *Pseudocaranx dentex*) were also identified from the vertebrae (Table 9-12). At least one flatfish species identified as sand flounder (pātiki, *Rhombosolea plebia*) was determined from dentary and ultimate vertebra elements (Figure 9-7, Table 9-12).

At least one specimen was identified to the Triakidae family and quite likely a school shark species (kapetā, tupere, makohuarau, c.f. *Galeorhinus galeus*) from FMS2F2 (Figure 9-8, Table 9-13). Sharking is notably recognised in the Tāmaki region and is widely documented (Campbell et al. 2021).

Figure 9-6. *Chrysophrys auratus* right maxilla (medial view)

Figure 9-7. *Rhombosolea plebia* left dentary (lateral view)

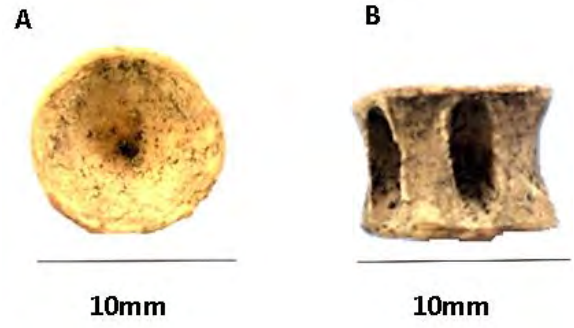


Figure 9-8. C.f. *Galeorhinus galeus* vertebra: (A) view of centrum, (B) View showing distinctive cartilage foramina

Table 9-11. Fishbone analysis for BMS2B1 general collection sample

Species	NISP	MNE	MNI	Weight (g)
Unidentified Fragments				
	3			0.1
Misc. spines	1			0.6

Table 9-12. Faunal analysis for BMS2B1 sample

Class	Species	NISP	MNE	MNI	Weight (g)
Fish	*Chrysophrys auratus* (Tāmure/Snapper)			1	
	Post temporal	1	1		
	Teeth	2			
	Nemadactylus macropterus (Tarakihi)			1	
	Vertebra caudal	1	1		
	Vertebra	1	1		
	Rhombosolea plebia (Sand flounder)			2	
	Dentary	2	2		
	Ultimate vertebra	1	1		
	Pseudocaranx dentex (Trevally)			1	
	Caudal Vertebra	1	1		
	Unidentified				
	Premaxilla	1	1		
	Misc. Spines	4			
	Fishbone fragments	23			
	Vertebra	4			
	Total	**41**	**8**	**5**	**1.6**
Shell	Fragment		1		<0.1

Table 9-13. Fishbone analysis for the FMS2F2 sample

Species	NISP	MNE	MNI	Weight (g)
c.f. *Galeorhinus galeus* (School Shark)			**1**	
Vertebra	**1**	**1**		**0.3**

Table 9-14. Faunal analysis for BMS2SB sample

Class	Species	NISP	MNE	MNI	Weight(g)
Fish	*Chrysophrys auratus* (Tāmure/Snapper)			2	
	Maxilla	1	1		
	Premaxilla	1	1		
	Dentary	3	2		
	Articular	1	1		
	Hyomandibula	2	2		
	Ceratohyal + Epihyal	1	1		
	Post temporal	1	1		
	Abdominal vertebra	1	1		
	Teeth	16			
	Unidentified				
	Misc spines				
	Vertebra	5			
	Hyomandibula	1	1		
	Fragments	123			
	Total	**154**	**11**	**2**	**10.9**
Shell					
	Fragment	2			<0.1

9.2.6.3 Discussion

Fishing does not appear to be a major activity based on the total fishbone (NISP=200) recovered and limited number of taxa identified. However, taphonomic processes have affected the site and movement of material from the contemporary activity is noted for the Back Midden material. The preservation of fishbone depends on the nature of preservation, excavation and recovery methods, and identification protocols. The low number of fish taxa recovered may have resulted from various taphonomic processes, such as acidic soils and modern activity. However, the number of recovered taxa and diversity confirm fish were brought to the area. Fish with smaller bones are also subject to higher fragmentation rates and taphonomic processes. This is not to detract from the importance of tāmure in archaeological contexts but to highlight that smaller-boned fish species may have a more significant role than the quantified results suggest (Campbell 2016). The species identified above – both bony and cartilaginous taxa – are open water fish. They can be caught in inshore waters, potentially by shore fishing, netting, spearing, or combining these techniques (Paul 2000: 87, 97, 141; Campbell 2016; Vogel 2020). These individuals were likely caught from the beach with the possibility of being netted. While flatfish are known to have been caught by spearing, the small sand flounder species identified were likely caught by nets in shallow waters or harbours off the open water (Paulin et al. 2001:239-240; Campbell 2019).

9.3 R11/3332 Midden Analysis

9.3.1 Sample Analysis

Two 10 litre samples were taken from the disturbed midden area of R11/3332. Due to the disturbed nature of the midden deposit, the charcoal was floated and collected separately but not used for species identification and radiocarbon dating. Two distinct deposits were identified, on the east and west sides of the trench.

Two samples were analysed:

- R11/3332 Sample Bag 1, eastern end of trench (SB1).
- R11/3332 Sample Bag 2, western end of trench (SB2).

The weight of each component for the samples is presented in Table 9-15**,** with the proportions represented graphically in Figure 9-9**.** This measure shows that out of the samples taken unidentified shell was the largest component of the total weight. The second largest component (excluding soil) was identified shell,. Charcoal was recovered from these samples. No artefacts were recovered. Both samples contained a small amount of fishbone. The fishbone included several cranial, rib and fin fragments, as well as a quadrate and tail spine fragments. However, the fish species represented by this small amount of bone could not be identified.

Table 9-15. Component breakdown of each sample (measured in grams) from R11/3332

	R11/3332 SB1	**R11/3332 SB2**
Soil	1176	1022
Unidentified Shell	1310	1233
Identified Shell	543	519
Rock	423	381
Charcoal	9	6
Bone	<1	<1
Artefacts	0	0
Total	3461	3161

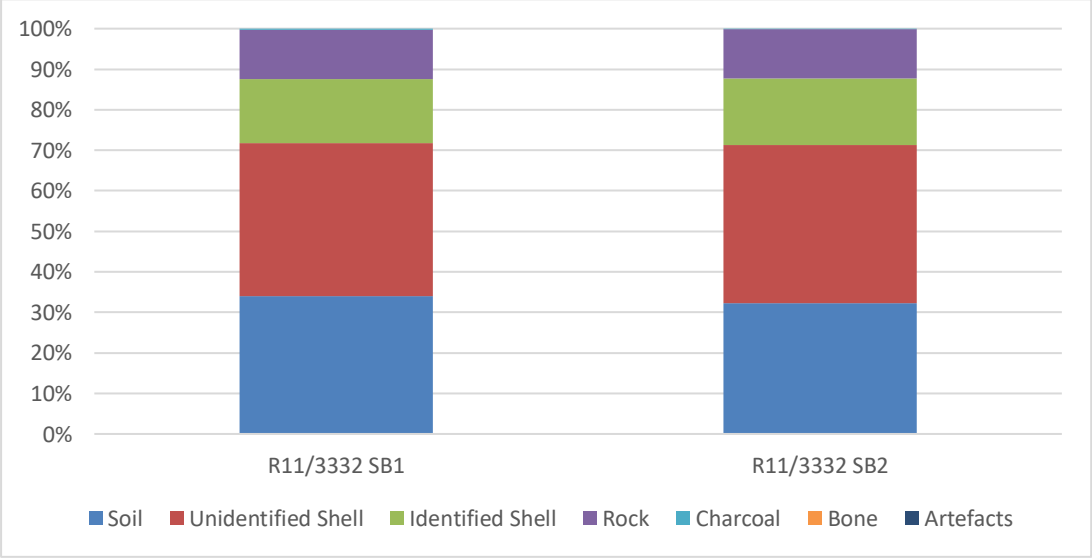


Figure 9-9. Showing the composition of each sample from R11/3332

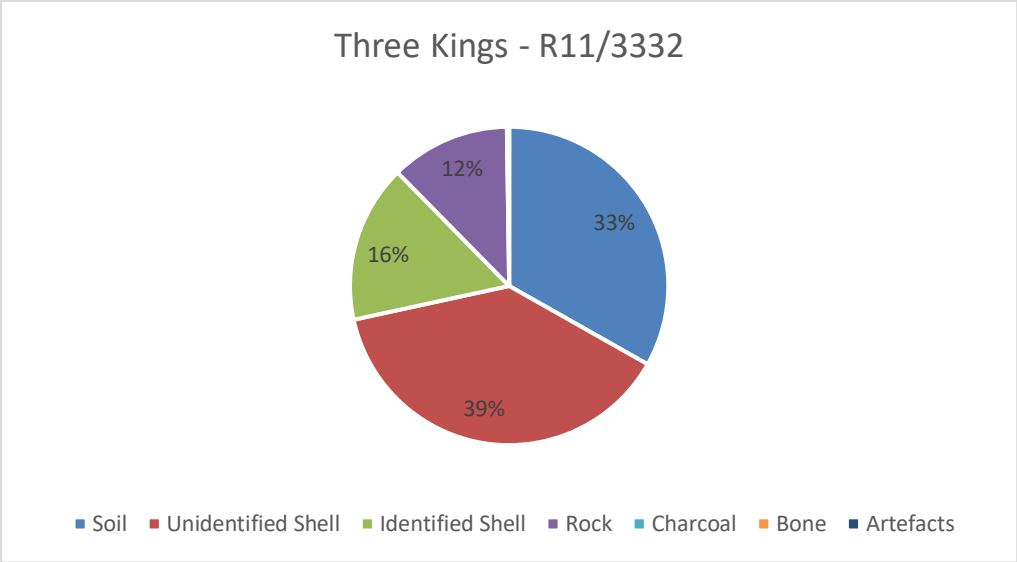


Figure 9-10. Composition of both samples from R11/3332 combined

9.3.2 Taxon Analysis

The taxon analysis for each of the samples is presented in Table 9-16 and Table 9-17.

Table 9-16. NISP, MNI number and percentage, and weight by taxa for R11/3332 SB1

Taxon		NISP	MNI #	MNI %	Wt. G.
Cat's Eye Shell	*Turbo smaragdus*	4	4	0.75	6
Cockle	*Austrovenus stutchburyi*	1017	506	95.11	533
Hornshell	*Zeacumantus lutulentus*	1	1	0.19	<1
Mudsnail	*Amphibola crenata*	1	1	0.19	<1
Mussel	*Perna canaliculus*	1	1	0.19	2
Pipi	*Paphies australis*	22	12	2.26	16
Tuatua	*Paphies subtriangulata*	2	1	0.19	3
Scallop	*Pecten novaezelandiae*	1	1	0.19	5
Gastropod sp.		1	1	0.19	<1
Whelk sp.		4	4	0.75	3
Total		1054	532	100	568

Table 9-17. NISP, MNI number and percentage, and weight by taxa for R11/3332 SB2

Taxon		NISP	MNI #	MNI %	Wt. G.
Cat's Eye Shell	*Turbo smaragdus*	5	5	0.99	8
Cockle	*Austrovenus stutchburyi*	922	482	95.26	463
Mudsnail	*Amphibola crenata*	1	1	0.2	<1
Mussel	*Perna canaliculus*	1	1	0.2	2
Pipi	*Paphies australis*	20	10	1.98	12
Tuatua	*Paphies subtriangulata*	1	1	0.2	2
Scallop	*Pecten novaezelandiae*	1	1	0.2	3
Gastropod sp.		1	1	0.2	<1
Whelk sp.		3	3	0.59	3
Operculum		1	1	0.2	<1
Total		956	506	100	493

Cockle made up the largest proportions (both NISP and MNI) of shellfish species for both analysed samples. Under the system of 'types' developed for understanding middens dominated by cockle and pipi (Farley 2011:55 and Farley et al. 2015:104) (see section 9.2.2), the samples are both Type 1, indicating a very strong selection for one particular shellfish species.

Other species were noted to be present through the samples, but these were never counted in great quantities. These were predominantly various gastropod species (including cat's eye, hornshell, operculum, mudsnail and various whelks) and other bivalves (including pipi, tuatua, mussel and scallops).

9.3.3 Habitat Analysis

The environmental niche associated with each species was presented in Table 9-1. The MNI of all species in each niche was then summed to provide the total MNI for each niche. The relative proportions for these niches are presented in Table 9-18 and Figure 9-11, showing that the primary environment for these samples is a muddy environment, followed by a muddy and/or sandy environment.

Table 9-18. Environmental niche of each sample from R11/3332

Habitat	R11/3332 SB1	R11/3332 SB2
Muddy Environment	95.49	96.05
Muddy and/or Sandy Environment	2.64	2.38
Rocky Environment	0.94	1.19
Other/Unknown	0	0.4

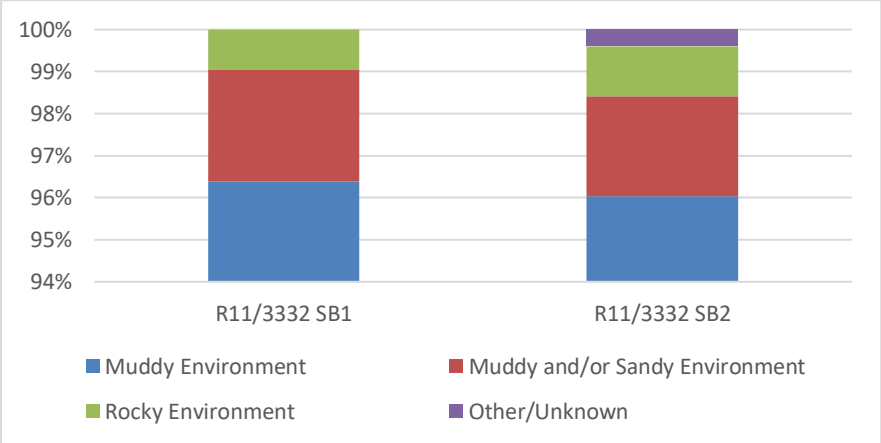


Figure 9-11. Visual representation of environments represented in each sample from R11/3332

9.3.4 Fragmentation Ratio

The MNI numbers of each sample and the fragmentation ratio for cockle are presented in Table 9-19. The analysed samples returned results ranging from 0.48 to 0.53. These ratios would fall into the very low fragmentation group. It is important to note that these ratios are determined by the number of surviving identifiable hinges. As shown in Table 9-15, unidentifiable shell made up most of both samples (by weight). Thus, the shell midden as a whole was still significantly fragmented.

Table 9-19. Fragmentation ratio of both samples from R11/3332

Sample	<50% MNI #	>50% MNI #	Ratio
R11/3332 SB1	181	341	0.53
R11/3332 SB2	151	315	0.48

9.3.5 Shell Dimensions

A sample of complete cockle was measured for both samples. A total of 200 shells were measured.

Descriptive statistics for maximum dimensions are presented in Table 9-20. Histograms displaying cockle measurements for both samples are presented in Figure 9-12 and Figure 9-13.

The results suggest that there is no significant difference between the two samples, which were obtained from deposits on the eastern (R11/3332 SB1) and western (R11/3332 SB2) ends of the trench. This supports the suggestion that the midden was redeposited or highly disturbed from works relating to Grahame Breed Drive.

The shells show a range of sizes, with mature and relatively immature examples suggestive of a largely opportunistic gathering strategy in relatively healthy shell beds.

Table 9-20. Description statistics for maximum cockle dimensions from R11/3332, in mm

Sample	Count	Mean	Median	Standard Deviation	Max.	Min.
R11/3332 SB1	100	20.6	20.0	4.2	34.1	13.9
R11/3332 SB2	100	20.5	19.7	4.2	33.2	12.7

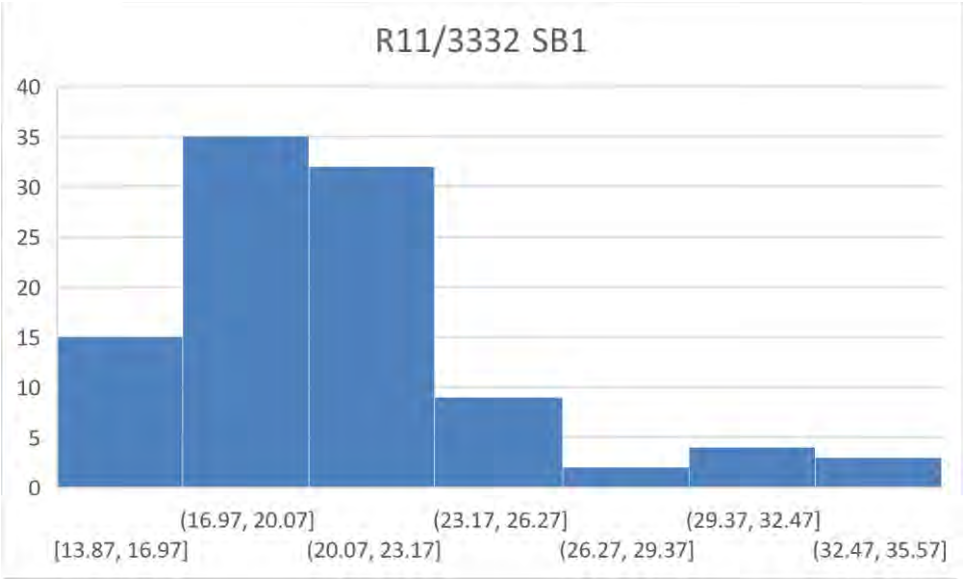


Figure 9-12. Histogram displaying cockle measurements in mm for R11/3332 SB1; y-axis = frequency

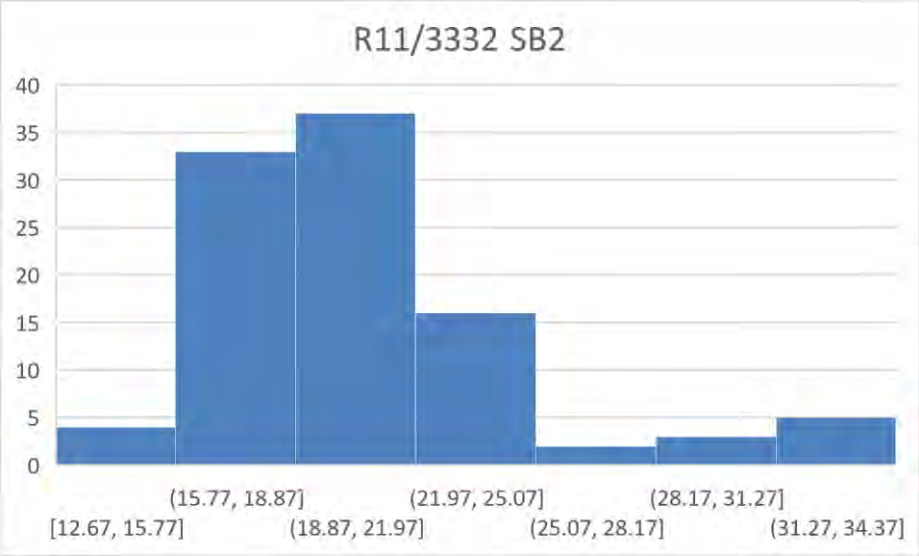


Figure 9-13. Histogram displaying cockle measurements in mm for R11/3332 SB2; y-axis = frequency

9.4 R11/3337 Midden Analysis

9.4.1 Sample Analysis

A total of four samples were collected from midden site R11/3337, with two 2.5 litre bags obtained for each sample given the limited material in section.

The four samples analysed were:

- R11/3337 – 1004
- R11/3337 – 1006
- R11/3337 – 1008
- R11/3337 – 1009.

The weight of each component for the samples is presented in Table 9-21**,** with the proportions represented graphically in Figure 9-14**.** This measure shows that out of the samples taken identified shell was the largest component of the total weight (excluding soil and rock). The second largest component was unidentified shell. Charcoal was recovered from these samples. No artefacts were recovered. Figure 9-15 is a chart displaying the site composition of all samples combined.

Table 9-21. Component breakdown of each sample from R11/3337 (measured in grams)

	R11/3337 1004	**R11/3337 1006**	**R11/3337 1008**	**R11/3337 1009**
Soil	3860	2067	2375	2759
Unidentified Shell	16	1281	709	23
Identified Shell	6	1840	899	39
Rock	1282	2200	2757	3812
Charcoal	4	40	15	<1
Bone	<1	<1	<1	<1
Artefacts	0	0	0	0
Total	5168	7428	6755	6633

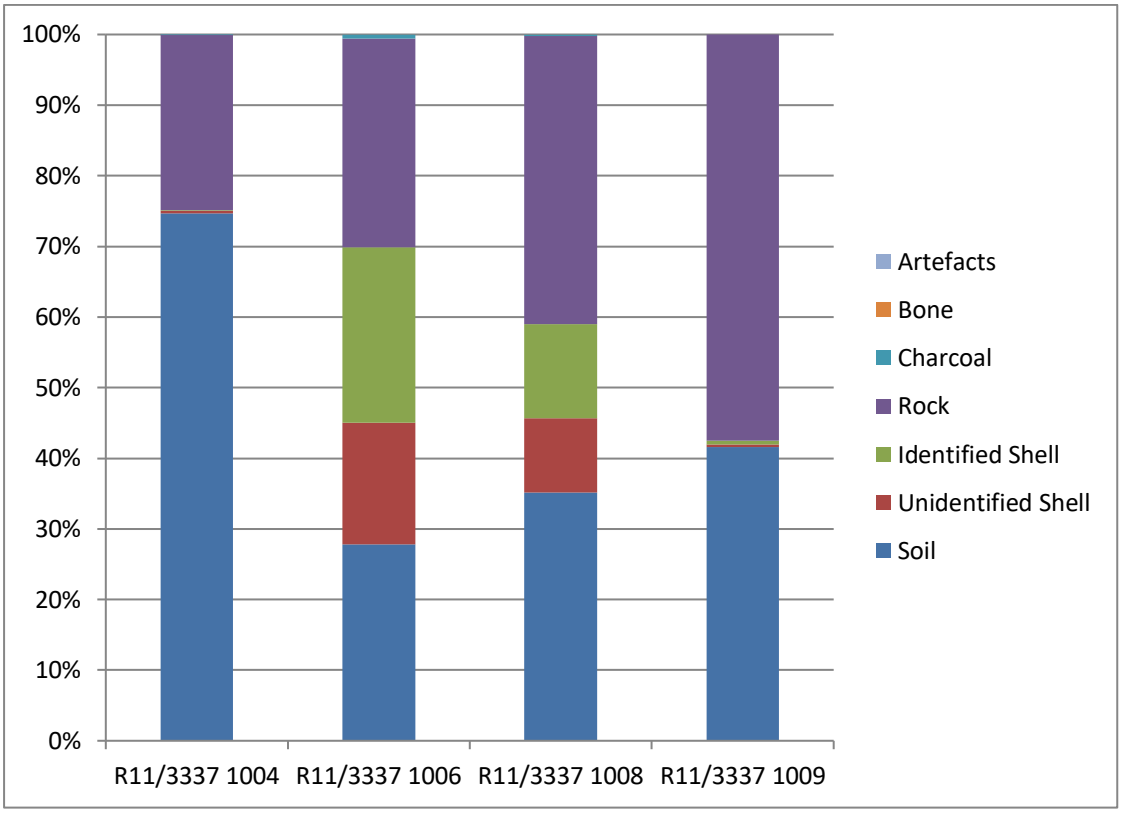


Figure 9-14. Showing the composition of each sample taken from R11/3337

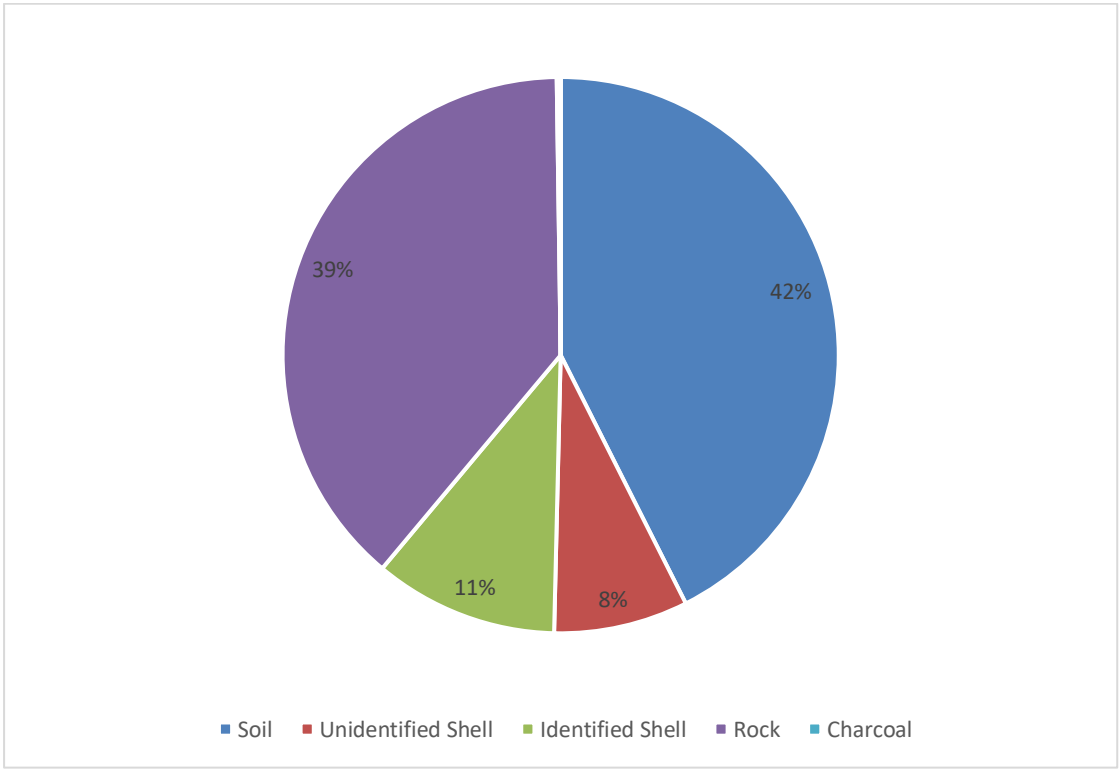


Figure 9-15. Site composition of all samples from R11/3337 combined

9.4.2 Taxon Analysis

The taxon analysis for each of the samples is presented in Table 9-22 to Table 9-25.

Table 9-22. NISP, MNI number and percentage, and weight by taxa for R11/3337 1004

Taxon		NISP	MNI #	MNI %	Wt. G.
Cockle	*Austrovenus stutchburyi*	15	11	91.67	6
Pipi	*Paphies australis*	1	1	8.33	<1
Total		16	12	100.00	6

Table 9-23. NISP, MNI number and percentage, and weight by taxa for R11/3337 1006

Taxon		NISP	MNI #	MNI %	Wt. G.
Cat's Eye Shell	*Turbo smaragdus*	20	20	1.56	6
Cockle	*Austrovenus stutchburyi*	4406	1135	88.74	1705
Hornshell	*Zeacumantus lutulentus*	6	6	0.47	<1
Mudsnail	*Amphibola crenata*	6	6	0.47	4
Trough Shell	*Spisula discors*	28	16	1.25	18
Pipi	*Paphies australis*	82	43	3.36	28
Scallop	*Pecten novaezelandiae*	1	1	0.08	40
Rock Oyster	*Saccostrea cucullata*	1	1	0.08	11
Wedge Shell	*Macomona liliana*	61	32	2.5	20
Gastropod sp.		5	5	0.39	<1
Limpet		3	3	0.23	<1
Whelk sp.		10	10	0.78	6
Operculum		1	1	0.08	<1
Total		4630	1279	100.00	1838

Table 9-24. NISP, MNI number and percentage, and weight by taxa for R11/3337 1008

Taxon		NISP	MNI #	MNI %	Wt. G.
Cat's Eye Shell	*Turbo smaragdus*	9	9	1.2	<1
Cockle	*Austrovenus stutchburyi*	2133	646	86.59	836
Hornshell	*Zeacumantus lutulentus*	3	3	0.4	<1
Mudsnail	*Amphibola crenata*	9	9	1.2	5
Trough Shell	*Spisula discors*	45	23	3.08	26
Pipi	*Paphies australis*	16	9	1.2	7
Scallop	*Pecten novaezelandiae*	1	1	0.13	<1
Rock Oyster	*Saccostrea cucullata*	1	1	0.13	4
Wedge Shell	*Macomona liliana*	58	30	4.02	15
Gastropod sp.		12	12	1.6	3
Whelk sp.		3	3	0.4	<1
Total		2290	746	100.00	896

Table 9-25. NISP, MNI number and percentage, and weight by taxa for R11/3337 1009

Taxon		NISP	MNI #	MNI %	Wt. G.
Cockle	*Austrovenus stutchburyi*	79	23	82.14	28
Mudsnail	*Amphibola crenata*	2	2	7.14	10
Trough Shell	*Spisula discors*	1	1	3.57	<1
Wedge Shell	*Macomona liliana*	2	2	7.14	<1
Total		84	28	100.00	38

Cockles made up the largest proportions (both NISP and MNI) of shellfish species for all analysed samples. Under the system of 'types' developed for understanding middens dominated by cockle and pipi (Farley 2011:55 and Farley et al. 2015:104) (see section 9.2.2), the samples are all Type 1, indicating a very strong selection for one particular shellfish species.

Other species were noted to be present through the samples, but these were never counted in great quantities. These were predominantly various gastropod species (including cat's eye, hornshell, operculum, mudsnail and various whelks) and other bivalves (including pipi, trough shell, wedge shell, rock oyster and scallops).

9.4.3 Habitat Analysis

The environmental niche associated with each species was presented in Table 9-26. The MNI of all species in each niche was then summed to provide the total MNI for each niche. The relative proportions for these niches are presented in Table 9-26 and Figure 9-16, showing that the primary environment for these samples is a muddy environment, followed by a muddy and/or sandy environment.

Table 9-26. Showing the environmental niche of each sample from R11/3337

Habitat	**R11/3337 1004**	**R11/3337 1006**	**R11/3337 1008**	**R11/3337 1009**
Muddy Environment	91.67	90.46	88.59	89.28
Muddy and/or Sandy Environment	8.33	7.19	8.43	10.71
Rocky Environment	0	1.87	1.33	0
Other/Unknown	0	0.47	1.6	0

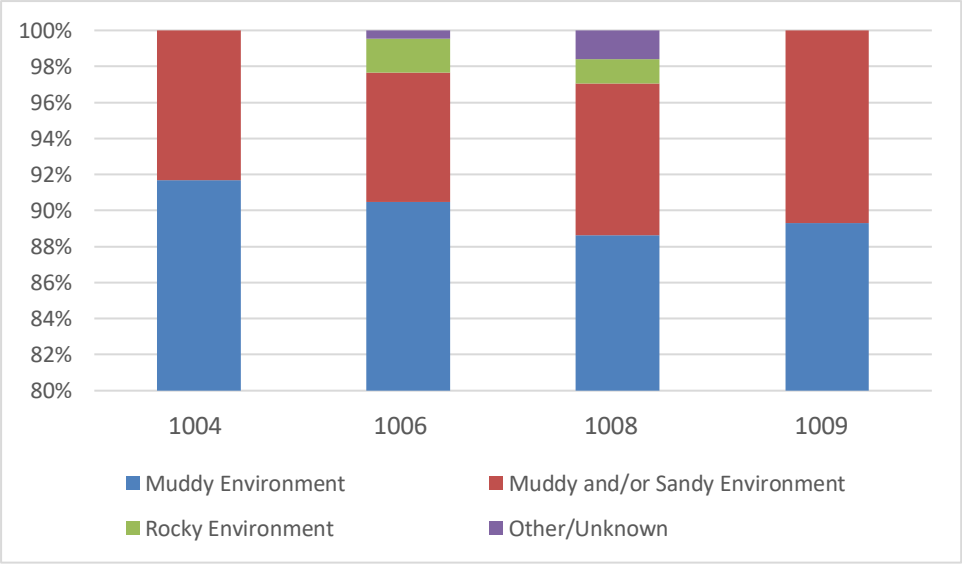


Figure 9-16. Visual representation of environments represented in each sample from R11/3337

9.4.4 Fragmentation Ratio

The MNI numbers of each sample and the fragmentation ratio for cockle are presented in Table 9-27. The analysed samples returned results ranging from 1.01 to 1.37. These ratios would fall into the very low fragmentation group. It is important to note that these ratios are determined by the number of surviving identifiable hinges.

Table 9-27. Fragmentation ratio of both samples from R11/3337

Sample	<50% MNI #	>50% MNI #	Ratio
R11/3337 1004	8	7	1.143
R11/3337 1006	2221	2185	1.016
R11/3337 1008	1233	900	1.37
R11/3337 1009	43	36	1.194

9.4.5 Shell Dimensions

A total of 200 shells were measured, 100 each from samples 1006 and 1008. Descriptive statistics for maximum dimensions are presented in Table 9-28. Histograms displaying cockle measurements for both samples are presented in Figure 9-17 and Figure 9-18.

The results of this analysis suggest that there are some differences in average cockle size between the two samples. The cockle shells ranged from 13-33mm in 1006 and 5-34mm in 1008, suggesting an opportunistic selection of shells from the shell beds. Sample 1008 contained a reasonable proportion of very juvenile examples, probably indicative of spring harvesting.

Table 9-28. Description statistics for maximum cockle dimensions from R11/3337 samples, in mm

Sample	Count	Mean	Median	Standard Deviation	Max.	Min.
R11/3337 1006	100	22.4	21.9	4.5	33.0	12.9
R11/3337 1008	100	21.1	20.6	5.5	34.1	5.1

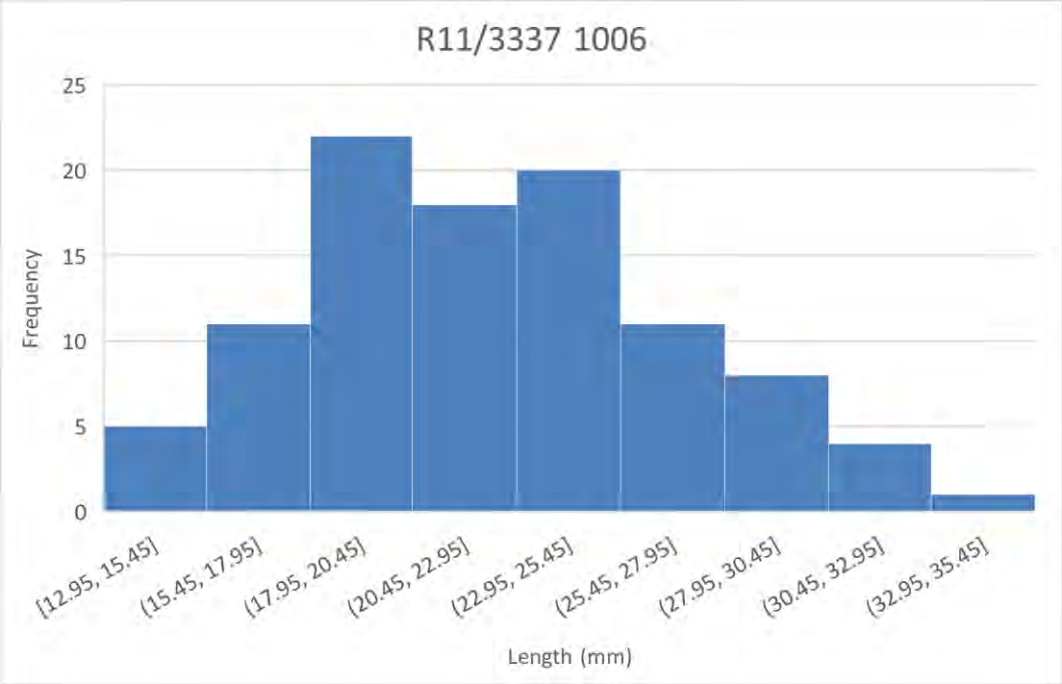


Figure 9-17. Histogram displaying cockle measurements for R11/3337 1006 using a bin width of 2.5mm

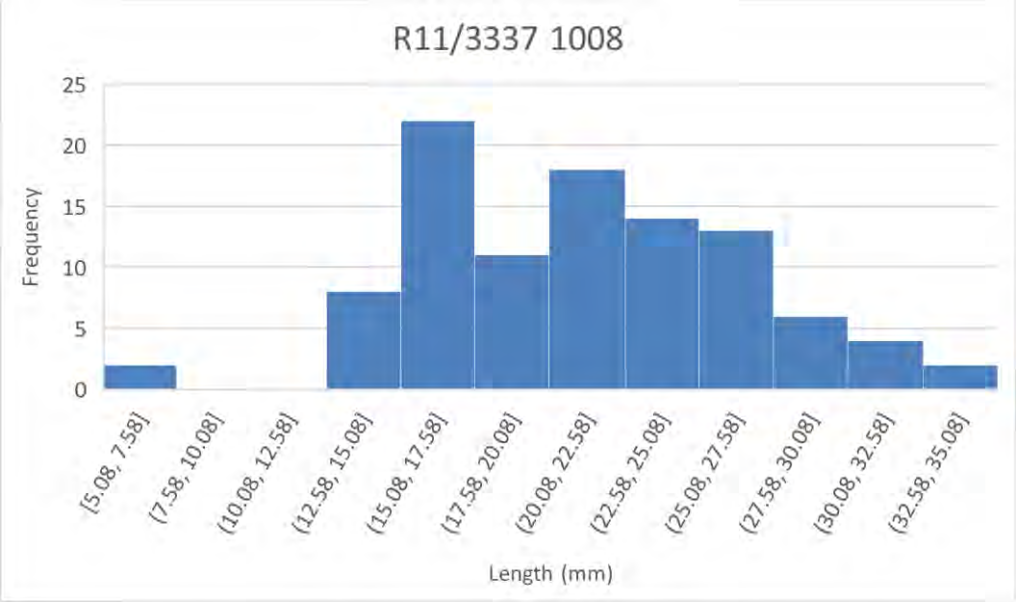


Figure 9-18. Histogram displaying cockle measurements for R11/3337 1008 using a bin width of 2.5mm

9.5 Rising Main R11/3429 Midden Analysis

9.5.1 Sample Analysis

The site comprised a midden discovered during utilities trenching down St Andrews Road under the road and berm. Three samples were taken from the disturbed midden area of R11/3429, sampled and labelled separately as the East, West and Central portions of the trench containing the midden.

The three samples analysed were labelled:

- R11/3429 W
- R11/3429 C
- R11/3429 E.

The weight of each component for the samples is presented in Table 9-29**,** with the proportions represented graphically in Figure 9-19 and Figure 9-20**.** This measure shows that out of the samples taken unidentified shell was the largest component of the total weight (excluding rock), except for sample R11/3429 C, where the largest component was identified shell. No artefacts were recovered from these samples. All samples contained a small amount of fishbone. The fishbone included several cranial, rib and fin fragments, as well as numerous fish scales. However, the fish species represented by this small amount of bone were not identifiable. All samples also contained a small amount of mammal and bird bone fragments. Sample R11/3429 C contained a dog molar, indicating dog was present within the assemblage.

Table 9-29. Component breakdown of each sample from R11/3429 (measured in grams)

	R11/3429 W	**R11/3429 C**	**R11/3429 E**
Unidentified Shell	1093	465	927
Identified Shell	612	496	813
Rock	1471	256	189
Bone	<1	<1	<1
Artefacts	0	0	0
Total	3176	1217	1929

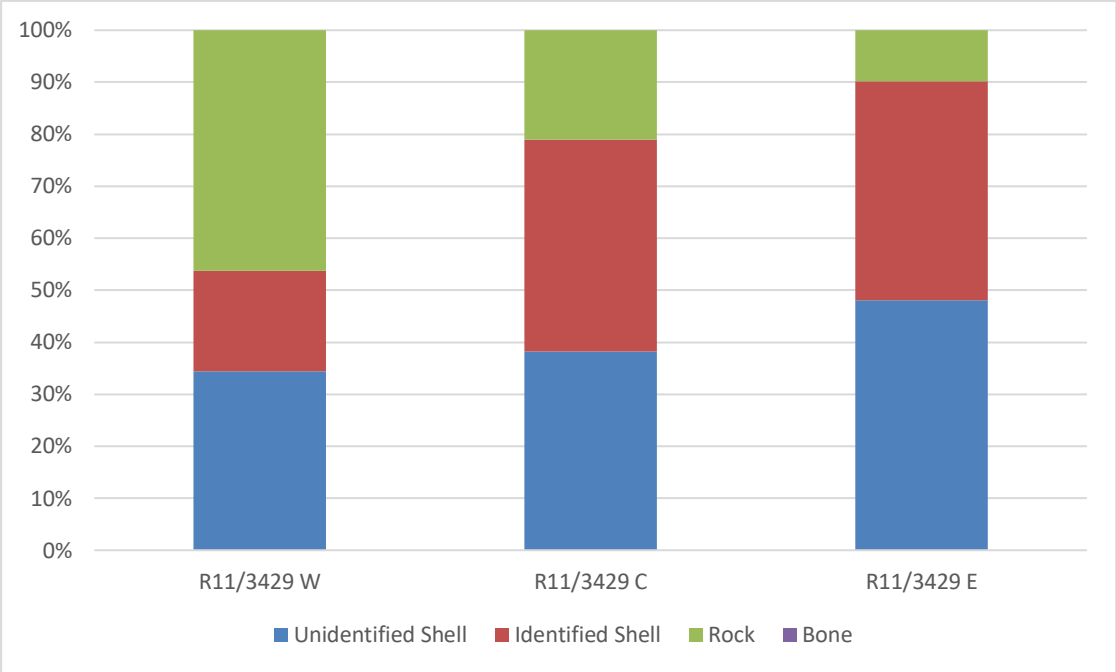


Figure 9-19. The composition of each sample taken from R11/3429

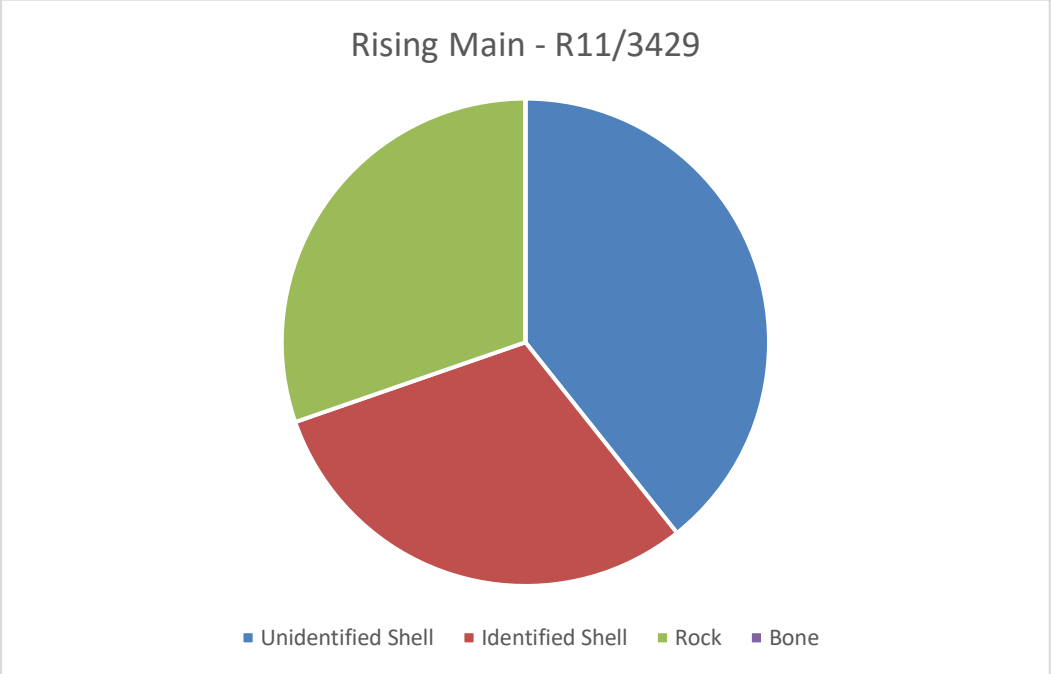


Figure 9-20. Site composition of all samples from R11/3429 combined

9.5.2 Taxon Analysis

The taxon analysis for each of the samples is presented in Table 9-30–Table 9-32.

Table 9-30. NISP, MNI number and percentage, and weight by taxa for R11/3429 W

Taxon		NISP	MNI #	MNI %	Wt. G.
Cat's Eye Shell	*Turbo smaragdus*	7	7	0.92	<1
Cockle	*Austrovenus stutchburyi*	1860	692	91.05	546
Hornshell	*Zeacumantus lutulentus*	6	6	0.79	<1
Mudsnail	*Amphibola crenata*	2	2	0.26	<1
Large Trough Shell	*Spisula discors*	1	1	0.13	<1
Pipi	*Paphies australis*	42	23	3.02	17
Rock Oyster	*Saccostrea cucullata*	3	3	0.39	26
Scallop	*Pecten novaezelandiae*	1	1	0.13	7
Gastropod Sp.		10	10	1.32	3
Whelk Sp.		12	12	1.58	8
Operculum		6	6	0.79	<1
Total		1950	763	100.00	607

Table 9-31. NISP, MNI number and percentage, and weight by taxa for R11/3429 C

Taxon		NISP	MNI #	MNI %	Wt. G.
Large Trough Shell	*Spisula discors*	29	16	2.19	17
Cockle	*Austrovenus stutchburyi*	1059	692	94.66	546
Rock Oyster	*Saccostrea cucullata*	1	1	0.14	4
Mudsnail	*Amphibola crenata*	3	3	0.41	<1
Pipi	*Paphies australis*	4	2	0.27	2
Gastropod Sp.		5	5	0.68	<1
Whelk Sp.		4	12	1.64	<1
Total		1105	731	100.00	569

Table 9-32. NISP, MNI number and percentage, and weight by taxa for R11/3429 E

Taxon		NISP	MNI #	MNI %	Wt. G.
Cockle	*Austrovenus stutchburyi*	2053	700	92.84	776
Hornshell	*Zeacumantus lutulentus*	3	3	0.4	<1
Mudsnail	*Amphibola crenata*	3	2	0.27	<1
Large Trough Shell	*Spisula discors*	26	17	2.25	9
Pipi	*Paphies australis*	14	9	1.2	3
Rock Oyster	*Saccostrea cucullata*	6	3	0.4	20
Gastropod Sp.		2	2	0.27	<1
Whelk Sp.		1	1	0.13	<1
Operculum		2	6	0.8	<1
Total		2110	743	100.00	808

Cockle made up the largest proportions (both NISP and MNI) of shellfish species for all analysed samples. Under the system of 'types' developed for understanding middens dominated by cockle and pipi (Farley 2011:55 and Farley et al. 2015:104) (see section 9.2.2), the samples are all Type 1, indicating a very strong selection for one particular shellfish species.

Other species were noted to be present through the samples, but these were never counted in great quantities. These were predominantly various gastropod species (including cat's eye,

hornshell, operculum, mudsnail and various whelks) and other bivalves (including pipi, large trough shell, rock oyster and scallops).

9.5.3 Habitat Analysis

The environmental niche associated with each species was presented in Table 9-1. The MNI of all species in each niche was then summed to provide the total MNI for each niche. The relative proportions for these niches are presented in Table 9-33 and Figure 9-21, showing that the primary environment for these samples is a muddy environment, followed by a muddy and/or sandy environment.

Table 9-33. Showing the environmental niche of each sample from R11/3429

	R11/3429 W	R11/3429 C	R11/3429 E
Muddy Environment	93.68	96.71	93.64
Muddy and/or Sandy Environment	3.28	2.46	3.45
Rocky Environment	0.92	0.14	0.4
Other/Unknown	2.11	0.68	1.07

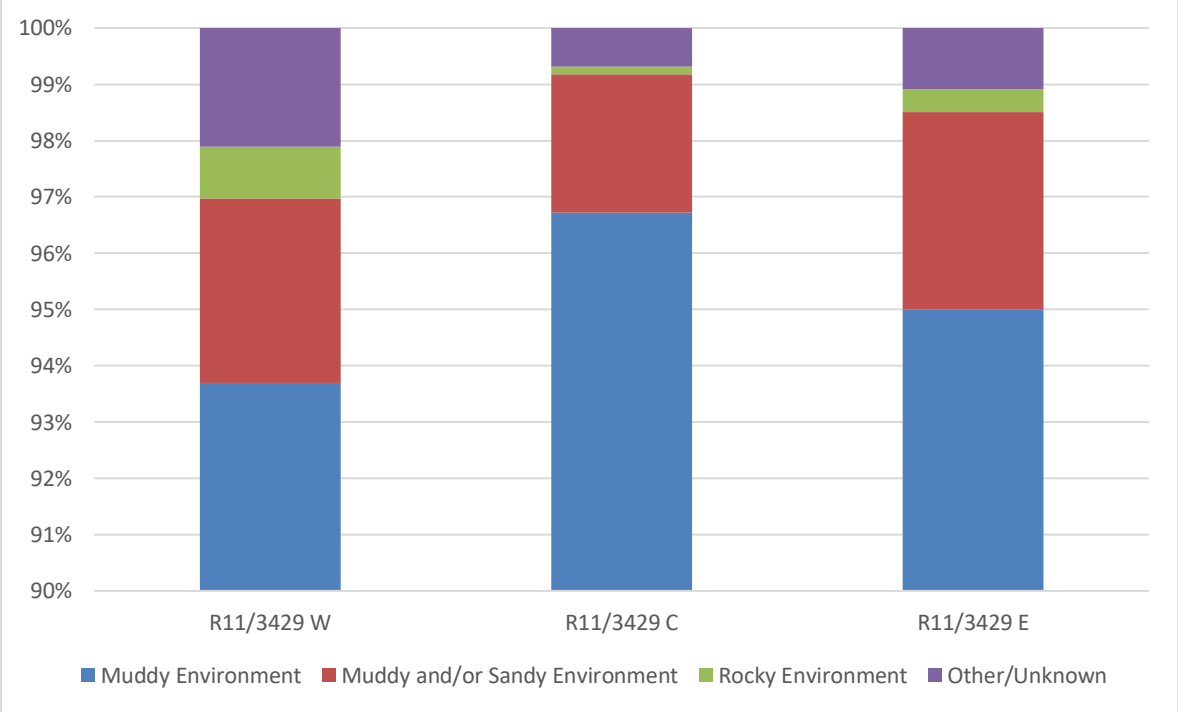


Figure 9-21. Visual representation of environments represented in each sample from R11/3429

9.5.4 Fragmentation Ratio

The MNI numbers of each sample and the fragmentation ratio for cockle are presented in Table 9-34. The analysed samples returned results ranging from 1.4 to 2.53. These ratios would fall into the low, but not very low fragmentation group. It is important to note that these ratios are determined by the number of surviving identifiable hinges. As shown in Table 9-15, with the exception of sample R11/3429 C, unidentifiable shell made up the majority of the samples (by weight), indicating that the shell midden as a whole was significantly fragmented.

Table 9-34. Fragmentation ratio of samples from R11/3429

Sample	<50% MNI #	>50% MNI #	Ratio
R11/3429 W	692	274	2.53
R11/3429 C	314	225	1.4
R11/3429 E	700	347	2.02

9.5.5 Shell Dimensions

A sample of complete cockle was measured for all samples, 100 shells for each sample, totalling 300 shells across the samples.

Descriptive statistics for maximum dimensions are presented in Table 9-35. Histograms displaying cockle measurements for all three samples are presented in Figure 9-22 to Figure 9-24. The cockle in the samples ranged from around 11mm to 37mm with means of c.21/22mm, indicating that mature shellfish were predominantly targeted.

Table 9-35. Description statistics for maximum cockle dimension in samples from R11/3429, in mm

Sample	Count	Mean	Median	Standard Deviation	Max	Min
R11/3429 W	100	21.0	20.1	4.8	36.4	11.4
R11/3429 C	100	22.6	21.8	4.5	34.2	13.6
R11/3429 E	100	22.1	20.3	5.0	36.8	14.2

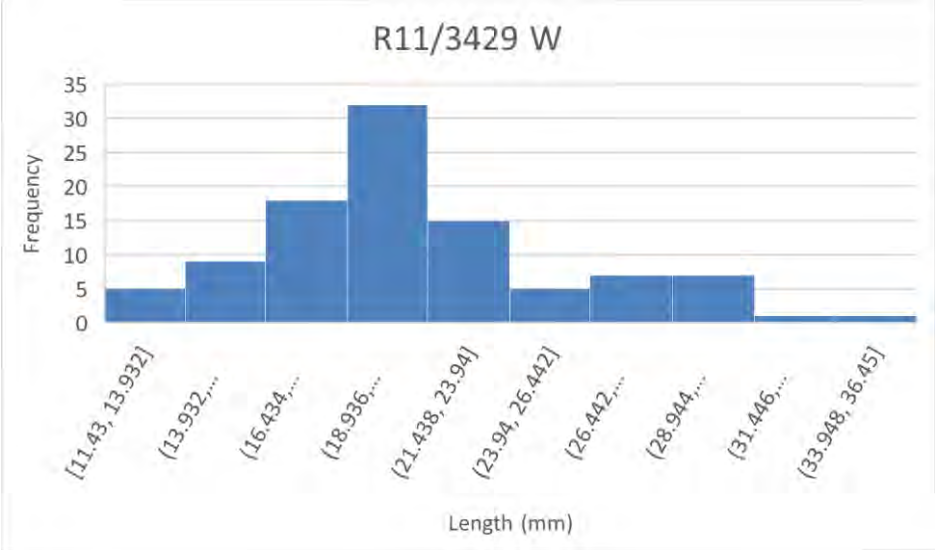


Figure 9-22. Histogram displaying cockle measurements for R11/3429 W

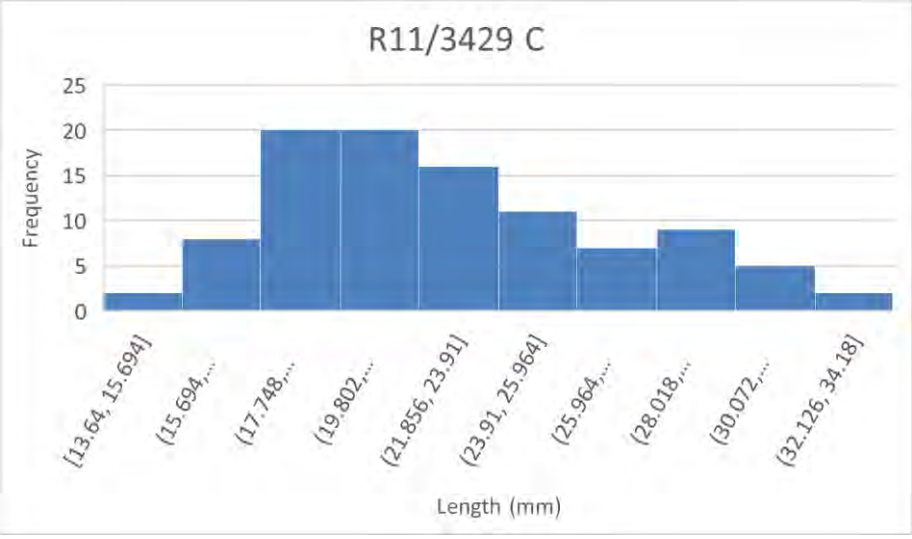


Figure 9-23. Histogram displaying cockle measurements for R11/3429 C

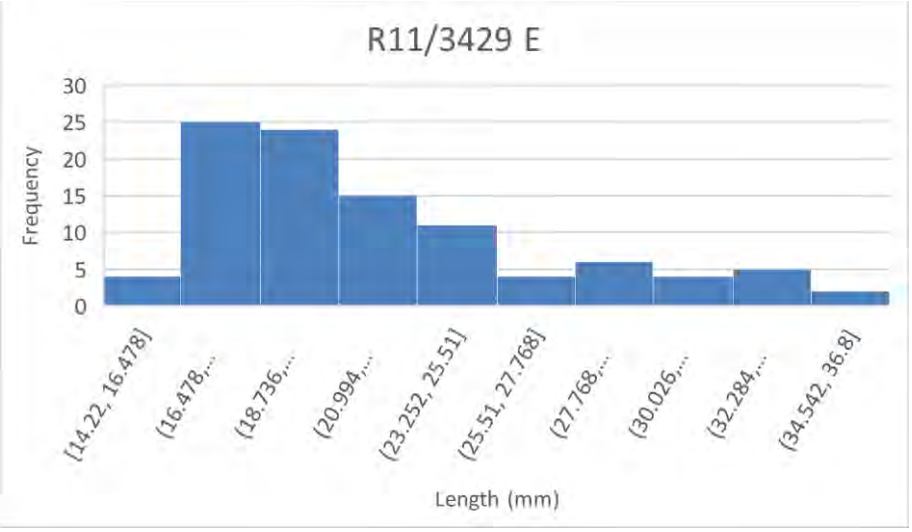


Figure 9-24. Histogram displaying cockle measurements for R11/3429 E

9.6 Midden Summary

The midden samples from all four sites showed a clear preference for cockle, which made up over 90% of the majority of the samples. Only two samples, both from R11/3337, contained a smaller proportion, with c.89% in sample 1006 and c.87% in sample 1008. Such a clear domination of cockle in the samples is in part a reflection of the ease of access to this species and the volume present in the local muddy shore environment in the inner Manukau Harbour to the south. Additional factors such as taste preference may also contribute, but these are harder to quantify. Other shellfish species were present within the samples, including pipi, tuatua, scallop and various gastropods, but these were never present in large numbers, and the majority of other shellfish species also came from muddy or muddy and/or sandy environments.

Given the location of the study area, within easy access of a muddy estuarine environment, it is hardly surprising that the inhabitants of Te Tātua a Riukiuta were consuming local food resources. Rocky and sandy shore environments are also located in the wider area and would have been utilised. A point of interest is how these different environmental niches were made use of and how this may have changed over time.

Cockle shell dimensions indicated that mature individuals were the primary target, though a small proportion of juveniles were also collected, typical of bulk harvesting of shellfish.

The fishbone sample from R11/3282 was not large, but it confirmed that snapper, terakihi, trevally, sand flounder and school shark were brought to the site. All are open water fish species, which could have been caught in inshore waters. The fragile nature of fishbone and its susceptibility to taphonomic and other post-depositional processes mean that the small amount present in the samples is unlikely to be an accurate reflection of its dietary importance to the people who lived on and around Te Tātua a Riukiuta.

10 ENVIRONMENTAL ANALYSIS

10.1 Charcoal Analysis

Charcoal samples from all the sites except R11/3332, which did not contain suitable material, were submitted to Dr Rod Wallace for species identification and extraction of material suitable for radiocarbon dating (Table 10-1 to Table 10-3). The results are discussed below.

10.1.1 R11/3282

Five samples from R11/3282 were submitted for identification (Table 10-1). Back Midden Sample 1 was obtained from the upper component of the midden in section, and Sample 2 from the lower level, with the B1 sub-sample relating to hand-selected material during excavation. The Front Midden samples were from the two fire scoops.

Table 10-1. Charcoal identification from R11/3282 samples

R11/3282		
Back Midden – Sample 1		
Hebe	3	C14 dating subsample
Puriri	11	
Matai	2	
Back Midden – Sample 2		
Hebe	3	C14 dating subsample
Coprosma	1	
Puriri	7	
Rimu	2	
Back Midden – Sample 2 B1		
Hebe	3	C14 dating subsample
Coprosma	1	
Mahoe	1	
Puriri	5	
Kauri	2	
Front Midden – Sample 1 F1		
Hebe	6	C14 dating subsample
Porokaiwhiri	2	
Puriri	2	
Front Midden – Sample 2 F2		
Hebe	4	C14 dating subsample
Tutu	1	
Puriri	1	
Pohutukawa	1	
Kauri	2	

The charcoal was an odd mixture of hebe dominated shrubs + puriri with a range of conifers such as rimu, matai and kauri. This probably indicates a cleared bracken and shrub cover with persistent puriri plus some access to a patch of forest locally with remnant conifer taxa occurring.

The small number of examples makes distinguishing between the middens difficult. Radiocarbon dating (see below) suggested the Front Midden was largely contemporary with upper layer of the Back Midden.

10.1.2 R11/3337

Three samples from site R11/3337 were submitted for species identification. These were from samples 1004, 1006 and 1008. The results are presented in Table 10-2.

Table 10-2. Charcoal identification from R11/3337 samples

Three Kings – R11/3337 1004		
Puriri	2	
Pohutukawa	8	
Matai	1	
Three Kings – R11/3337 1006		
Bracken	4	
Hebe twigs	5	C14 dating sample
Coprosma	1	
Manuka	3	
Pohutukawa	3	
Puriri	4	
Three Kings – R11/3337 1008		
Hebe twigs	4	C14 dating sample
Akeake	3	
Pohutukawa	9	
Puriri	5	

The results indicate the presence of various tree species in the vicinity of the site, including puriri, pohutukawa and matai. Several ferns and shrub species were also present in the samples, including bracken, hebe, coprosma, manuka and akeake.

The presence of these shrubs and ferns within the charcoal assemblage in the two midden contexts 1006 and 1008 may have been the result of vegetation clearance. It may also be reflective of the plant material chosen to cook shellfish or heat up the shell so that the hinges could be opened. The fact that these shrubs and ferns were not present within context 1004, which contains only tree charcoal (puriri, pohutukawa and matai), supports the identification of this context as an oven feature, where large pieces of wood were preferentially selected for burning. Pohutukawa dominates the charcoal assemblage of this feature, which may reflect either availability or preferential selection.

10.1.3 R11/3429

Three samples collected from the midden exposed in trench works in St Andrews Road were submitted for species identification, from the East, West and Central portions of the trench. The results are presented in Table 10-3.

Table 10-3. Charcoal analysis of samples from R11/3429

Three Kings – R11/3429 C		
Hebe twig 1-2 mm dia.	1	C14 dating sample
Hebe	3	C14 dating sample
Pittosporum	1	
Puriri	2	
Pohutukawa	2	
Matai	2	
Exotic sp. Acacia?	1	
Exotic sp.?	1	
Three Kings – R11/3429 E		
Hebe twigs	6	C14 dating sample
Puriri	1	
Kanuka	3	
Three Kings – R11/3429 W		
Hebe twigs	2	C14 dating sample
Pohutukawa/Kanuka	5	

Material from the centre (C) of the deposit did appear to contain modern charcoal. Given the nearby trenching from utilities the likelihood of disturbance was high. Overall, the earlier components of the samples were broadly similar to the shrub and tree species identified in the sites near the quarry.

The hebe sample from the East section was chosen for radiocarbon dating as it seemed less likely to have been impacted by the previous earthworks.

10.2 Microfossil Analysis, R11/3337

10.2.1 Introduction

Three samples from site R11/3337 was provided to Dr Mark Horrocks for plant microfossil analysis. These were from contexts 1004 (hangi), 1008 (rake-out) and 1009 (firescoop). They were analysed for pollen, phytoliths and starch to provide a record of past vegetation, environments, and human activity.

Detailed methods of analysis are described in Appendix C, with the results from Dr Horrocks' report presented below.

10.2.2 Results and Discussion

10.2.2.1 Pollen and spores

The samples contained microscopic fragments of charcoal, reflecting fire activity by people in the area. Pollen and spores were very sparse in sample 1008, with an insufficient amount present for meaningful counting. The pollen and spore assemblages of the other two samples were variably dominated by spores of bracken (*Pteridium esculentum*) fern, ferns with monolete spores, and hornworts (*Anthocerotopsida*) (Figure 10-1). Pollen of puha/dandelion (*Sonchus/Taraxacum*) type also featured.

These spore types, coincident with the charcoal and negligible pollen of forest tree taxa, reflect a majorly disturbed landscape in part cleared of forest by people (Figure 10-1). Bracken is an invasive, indigenous ground fern with widely dispersed spores, common in New Zealand pollen spectra since human settlement and almost always associated with large-scale, repeated burning of forest by early Māori, and subsequently Europeans. It can form tall, dense stands over extensive areas. Monolete spores, bean-shaped and difficult to differentiate, are produced by many of New Zealand's numerous native species of ground ferns and often reflect forest disturbance. Hornworts are small inconspicuous plants that commonly colonise freshly disturbed and exposed soils (Wilmshurst et al. 1999). Puha is native to New Zealand while dandelion is European introduced; both are invasive herbaceous plants following vegetation disturbance and pollen of the two can be difficult to differentiate.

Pollen of a Māori introduced cultigen was also identified, namely ti pore (*Cordyline fruticosa*, Pacific Island cabbage tree), found in sample 1009 (Figure 10-1). This species is not to be confused with New Zealand's several endemic Cordyline species.

10.2.2.2 Phytoliths and other biosilicates

The sample assemblages were variable, dominated by tree/shrub and fern phytoliths, with some grass (*Poaceae*) phytoliths (Figure 10-2). The tree/shrub phytoliths comprised mostly nikau (*Rhopalostylis*) palm and spherical nodular types, with the latter originating from twigs and wood. Nikau phytolith type is from the fronds. This species is one of the few taxa that can be identified to species level in the New Zealand phytolith flora (Kondo et al. 1994). In the North Island, nikau is found in coastal and adjacent lowlands, and in abundance only near coasts, often persisting after forest clearance (MacPhail and McQueen 1983). Given the large amounts of bracken spores in the samples, the fern phytoliths in this case are likely mostly from this species, which along with the grass phytoliths supports the pollen evidence for large scale landscape disturbance (Figure 10-1).

The large amounts of tree/shrub phytoliths in the samples could seem at odds with the very low tree pollen representation at the site (Figure 10-1 and Figure 10-2). This apparent anomaly can be explained by differential preservation and human activity. Some of these phytoliths could reflect the pre-settlement forest; being non-organic, phytoliths can accumulate in substrates for much longer than pollen and spores due to their generally greater resistance to decay. In addition, these phytoliths could partly reflect the use of nikau fronds and wood as fuel for fire activities.

Other biosilicates found in the midden comprised fragments of sponge spicules (Figure 10-2). These remains reflect the use of aquatic resources at the site.

10.2.2.3 Starch and other plant material

Two types of starch were identified in this study. One type, found in samples 1004 and 1008, comprised numerous degraded starch grains consistent with the tuberous root of cf. kūmara (*Ipomoea batatas*) (Figure 10-2). Fragments of xylem cells (tracheary tissue) consistent with the root of this species were also found. The other type of starch, noted in sample 1009, comprised a very small number of fragments of degraded masses of starch grains consistent with the corm of cf. taro (*Colocasia esculenta*). Starch grain decay involves progressive loss of visibility in cross-polarised light, discoloration, expansion, distortion, and disintegration (Horrocks and Weisler 2006; Horrocks et al. 2007).

10.2.2.4 Māori agriculture

Kūmara, taro, and ti pore, the Māori introduced starch cultigens identified in this study, are part of the small group of six introduced species cultivated by Māori at the time of European contact in the late 18th century. Almost all the numerous plant species (70+) identified as introduced to Polynesia by early people are native to various regions within the broad area from Africa to Melanesia (Whistler 2009). The native range of taro is Southeast Asia. The native range of ti pore is probably the broad area between the Himalayas and northern Australia. Kūmara, also known as sweet potato, is one of the few exceptions. This species originated in South America, its introduction to the Pacific a result of Polynesian contact (Hather and Kirch 1991).

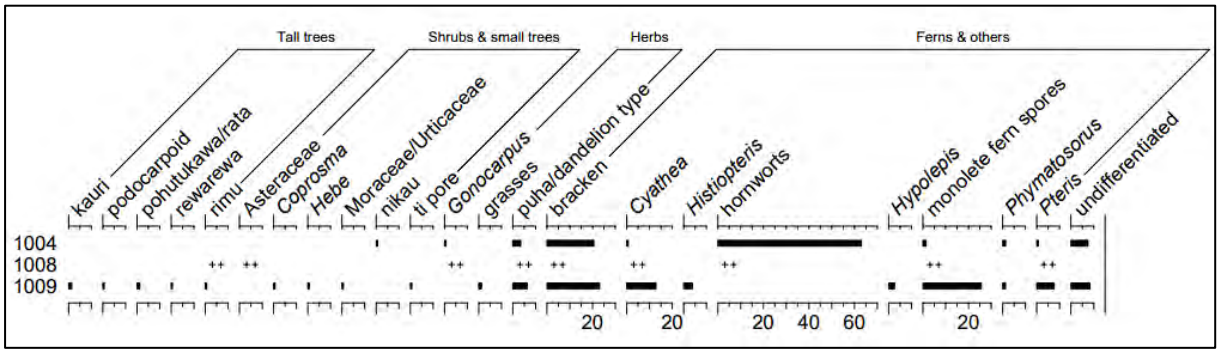


Figure 10-1. Pollen percentage diagram from R11/3337, Three Kings Quarry, Auckland (++ = present)

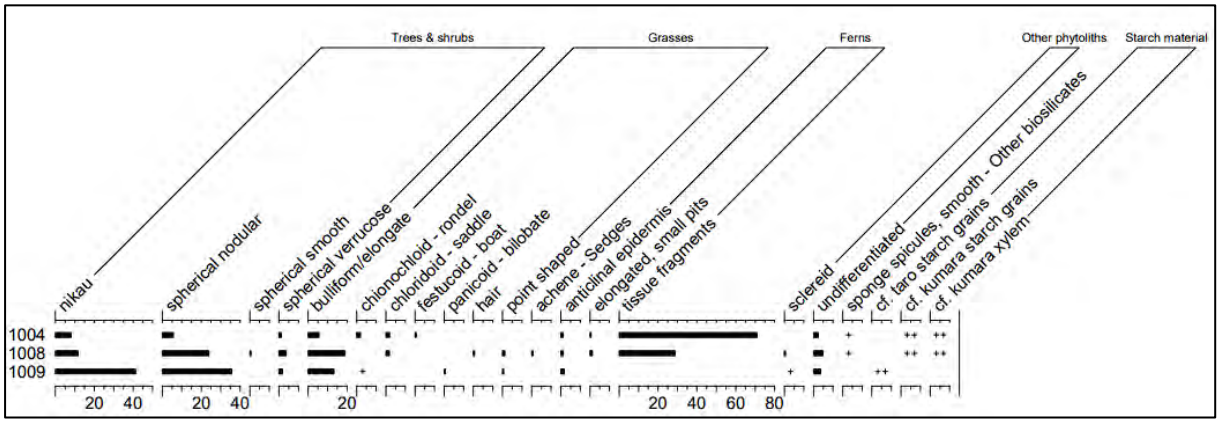


Figure 10-2. Phytolith percentage and starch diagram from R11/3337, Three Kings Quarry, Auckland (++ = present)

11 RADIOCARBON DATING

11.1 R11/3282

Four dates were obtained from the R11/3282 middens (Table 11-1, see Appendix B). Two were from the Front Midden (FM) and represented two firescoops, F1 and F2. The two charcoal samples suggested that the middens were from the 16th century AD and were sufficiently close to indicate that the features were probably contemporary.

The two samples from the Back Midden (BM) were also interesting (Table 11-1). The upper sample was possibly marginally older than the samples from the Front Midden but also from the 16th century AD. The lower sample was earlier. Bayesian analysis of the stratigraphic sequence of the dates suggested that while it was possible that the lower sample of midden may have overlapped with the other dates from R11/3282, it was more likely from the late 15th to early 16th centuries AD (Figure 11-1).

Table 11-1. Radiocarbon dates from R11/3282 showing standard calibrated age ranges (ShCal20)

Sample	Feature/Site	Material	CRA BP	-1σ	1σ	-2σ	2σ
Wk54393	R11/3282-FM-F1	Charcoal - Hebe	356 ± 24	1500AD	1630AD	1490AD	1650AD
Wk54394	R11/3282-FM-F2	Charcoal - Hebe	345 ± 24	1500AD	1640AD	1500AD	1650AD
Wk54395	R11/3282-BM-S1	Charcoal - Hebe	374 ± 24	1490AD	1630AD	1460AD	1640AD
Wk54396	R11/3282-BM-S2	Charcoal - Hebe	404 ± 27	1460AD	1620AD	1450AD	1630AD

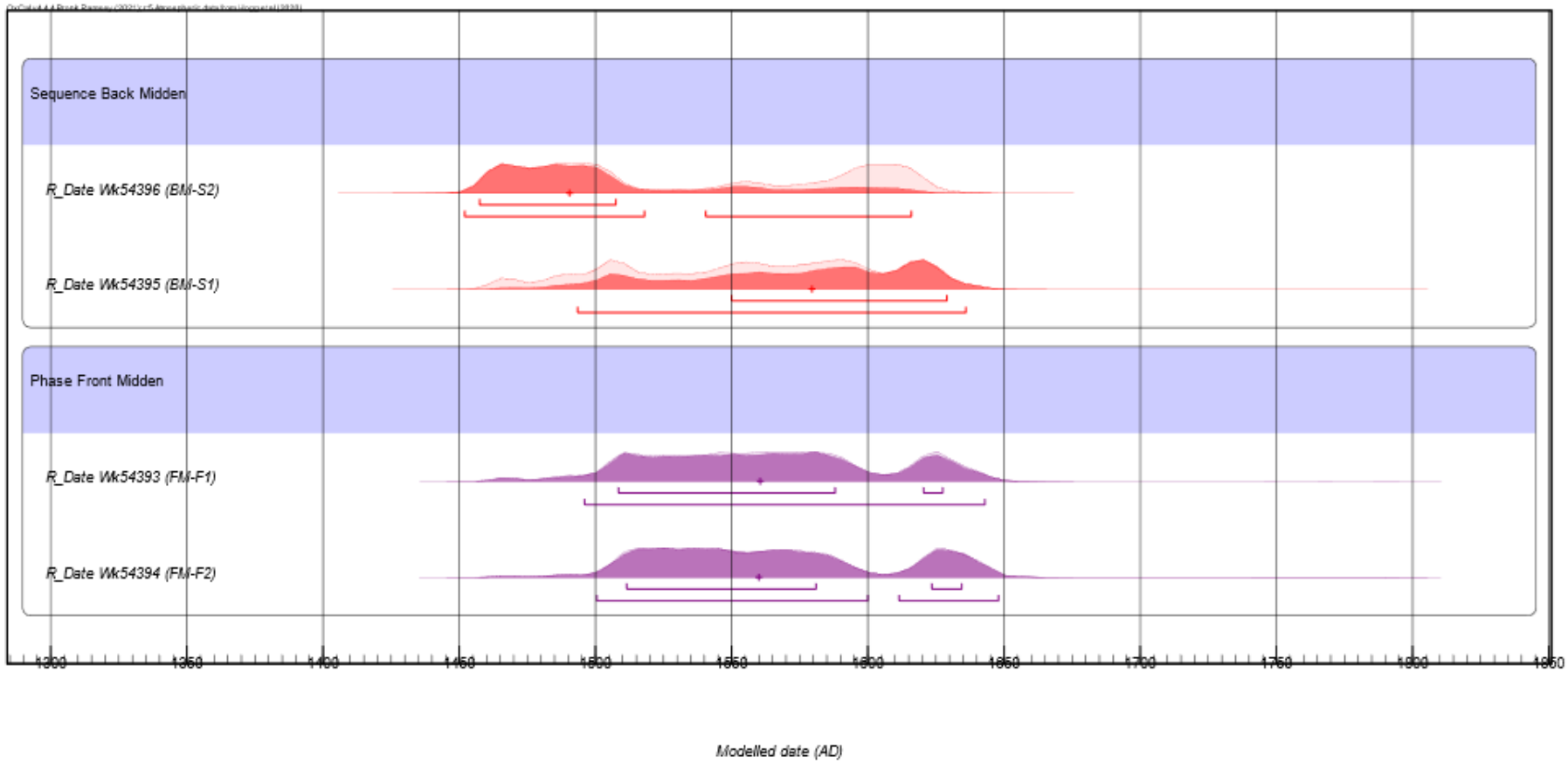


Figure 11-1. Bayesian calibration of the radiocarbon dates from R11/3282

11.2 R11/3332

A single cockle sample from R11/3332 was dated. The midden was heavily disturbed and so additional samples did not seem warranted. The result (see Appendix B) suggested that the midden dated to the 16th century AD (Table 11-2, Figure 11-2) although towards the latter half was more probable. There is little more that can be said about the date by itself, but the result did fit with the results from the rest of the project, discussed further below.

Table 11-2. Radiocarbon date from R11/3332

Sample	Feature/Site	Material	CRA BP	-1σ	1σ	-2σ	2σ
Wk54441	R11/3332	Marine shell - Cockle	768 ± 21	1500AD	1650AD	1430AD	1710AD

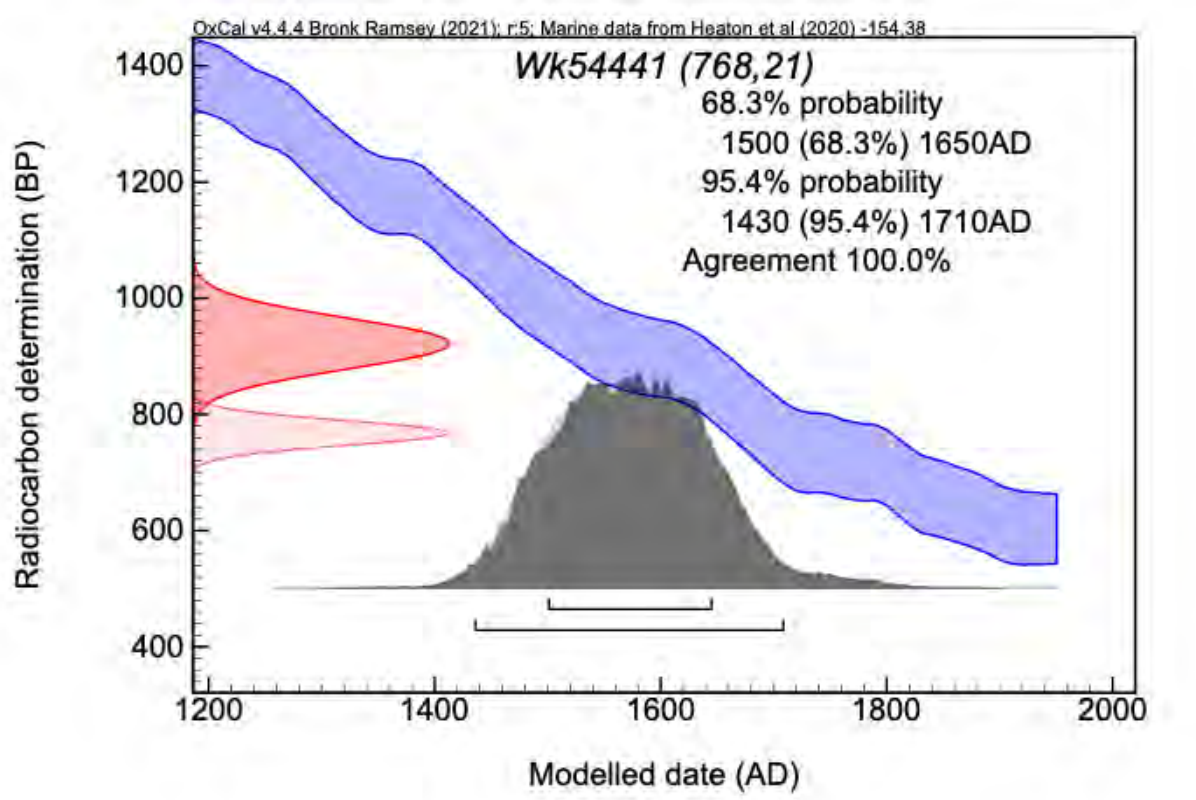


Figure 11-2. Calibrated radiocarbon date from R11/3332

11.3 R11/3337

The four radiocarbon dates from site R11/3337 were considered the best of the samples collected during the project, given the detailed sequence. However, suitable charcoal was not obtained from some of the samples, which was disappointing, but cockle shell proved useful in building the Bayesian calibration model and more precisely dating the occupation. The laboratory results (Appendix B) are summarised in Table 11-3, Table 11-4 and Figure 11-3, and indicated that the site was probably in use around 1450 AD to 1750 AD.

However, the samples from layers 1006, 1008, and 1009 form a series of firescoop events with sequences of shell rake-out that was then cut by the hangi, 1004, that was filled with rock. Indeed, the date from 1004 was much later than the other dates obtained and confirmed the stratigraphic sequence. Bayesian analysis suggested that the earlier use of the area was probably around 1600-1620 AD with the hangi probably dating to the mid-17th century AD.

Table 11-3. Radiocarbon dates from R11/3337 showing standard calibrated age ranges (ShCal20 and Marine20)

Sample	Feature/Site	Material	CRA BP	-1σ	1σ	-2σ	2σ
Wk56008	R11/3337 (1004)	Marine shell: Cockle	666 ± 15	1560AD	1750AD	1500AD	1840AD
Wk56009	R11/3337 (1006)	Charcoal: Hebe	416 ± 16	1450AD	1610AD	1450AD	1620AD
Wk56010	R11/3337 (1008)	Charcoal: Hebe	414 ± 17	1460AD	1611AD	1454AD	1620AD
Wk56011	R11/3337 (1009)	Marine shell: Cockle	695 ± 14	1530AD	1700AD	1480AD	1810AD

Table 11-4. Recalibration of radiocarbon dates from R11/3337 using Bayesian analysis of the sequence

Sample	Feature/Site	Material	CRA BP	-1σ	1σ	-2σ	2σ
Wk56008	R11/3337 (1004)	Marine shell: Cockle	666 ± 15	1615AD	1736AD	1605AD	1820AD
Wk56009	R11/3337 (1006)	Charcoal: Hebe	416 ± 16	1590AD	1615AD	1460AD	1620AD
Wk56010	R11/3337 (1008)	Charcoal: Hebe	414 ± 17	1600AD	1620AD	1485AD	1625AD
Wk56011	R11/3337 (1009)	Marine shell: Cockle	695 ± 14	1530AD	1605AD	1455AD	1610AD

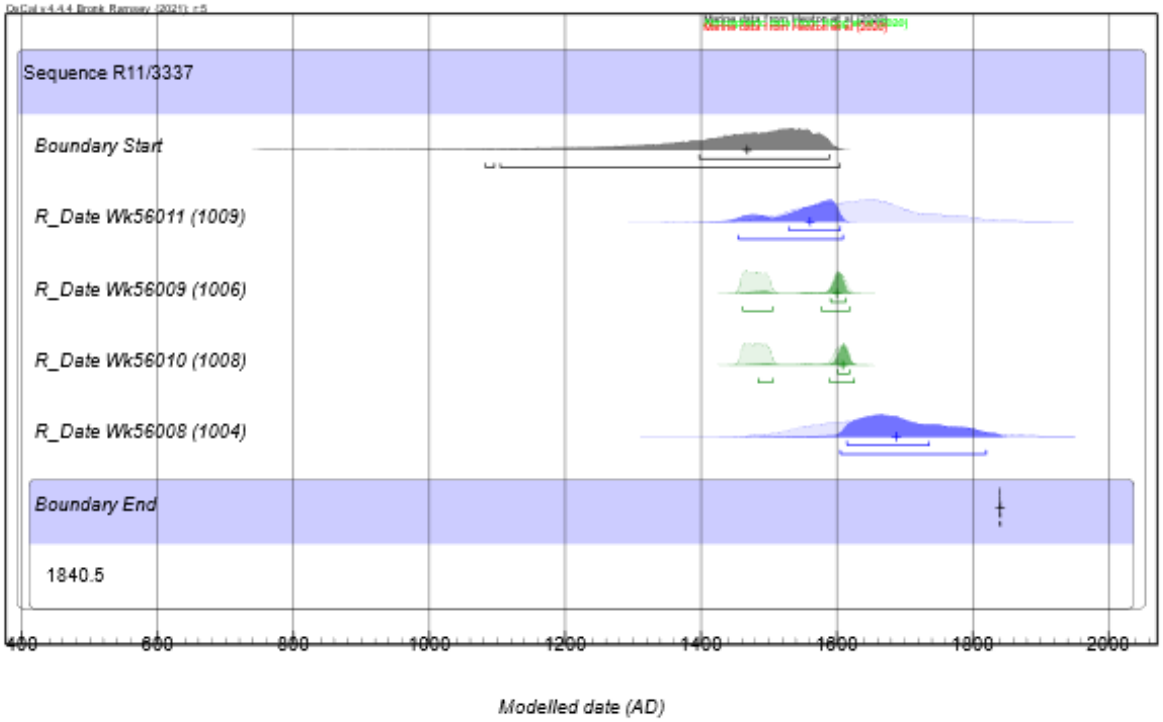


Figure 11-3. Bayesian calibration of the radiocarbon dates from R11/3337

11.4 R11/3429

The date from R11/3429 was an unexpected bonus. The site was not discovered as a part of the Three Kings Quarry project but was discovered nearby during the adjacent Three Kings Rising Mains project for Fletcher Residential Ltd in September 2022. The site comprises a midden exposed during utilities trenching down St Andrews Road under the road and berm.

The result (Table 11-5, Figure 11-4) was younger than the other dates from the project but not dramatically so, and still during the 16th and first half of the 17th centuries AD. There were certainly later intrusions from material dug from previous infrastructure works but the result still confirmed the site as a pre-colonial midden, indicative of the widespread use of the lower slopes of Te Tātua a Riukiuta maunga.

Table 11-5. Radiocarbon date from R11/3429

Sample	Feature/Site	Material	CRA BP	-1σ	1σ	-2σ	2σ
Wk55373	R11/3429-East Section	Charcoal Hebe twigs	317 ± 24	1510AD	1660AD	1500AD	1660AD

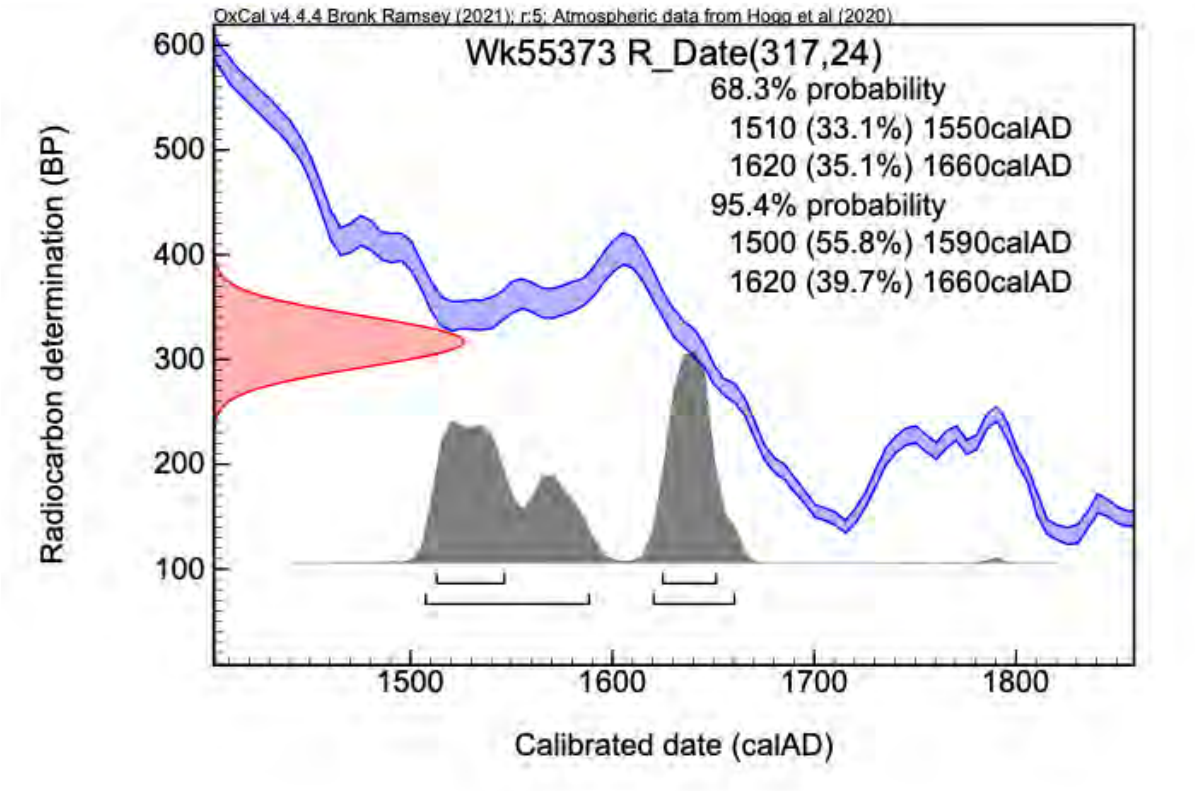


Figure 11-4. Calibrated radiocarbon date from R11/3429

11.5 Summary of Radiocarbon Dates

A total of 10 dates were obtained from the work associated with the Three Kings Quarry development (Figure 11-5 and Figure 11-6). Nine were from middens at three different locations around the boundary of the quarry and one was nearby in St Andrews Road, found during the work for the Rising Main.

The two dates from R11/3332 and R11/3489 were from disturbed midden near roads but the results were consistent with the 16th century use of the good volcanic soils around Te Tātua a Riukiuta maunga. The sites represented kai moana being brought up from the Onehunga catchment for small encampments or supporting the local gardening on the outer slopes of the volcanic zones.

The dates from R11/3282 and R11/3337 provided better sequences. R11/3282 consisted of two areas, the Front Midden characterised by a small number of firescoops and raked-out midden and the 'Back Midden, which had been damaged but provided a datable section. The Front Midden still was relatively small and both dates suggested that it was a single occupation from the 16th century AD, probably not much larger than R11/3332 and R11/3429. The Back Midden did appear to contain an earlier occupation layer from the late 15th century as well as a densely packed midden with fishbone from the 16th century AD.

R11/3337 only existed as a long section cut from the lower slopes of the maunga. It was almost 1m thick and there were two distinct phases represented. The bulk of the build-up of the midden appeared to date from 1600 to 1620 AD, the lowest elements probably occurring rapidly. This was later cut by a stone-filled hangi dating to the mid-17th century AD and probably indicative of much denser occupation at this part of the maunga than observed from the remnant midden excavated elsewhere.

Overall, however, the dates from the project did represent the first dates associated with Te Tātua a Riukiuta and are a significant contribution to understanding the settlement of the area. Comparing the dates from other nearby maunga (Figure 11-7), the dates from the current project overlapped with many of the dates obtained from those investigations but with a few earlier dates. This probably relates to the midden samples coming from the fringes of the Te Tātua a Riukiuta rather than closer to the main peak occupations where many of the dates from the other maunga were obtained.

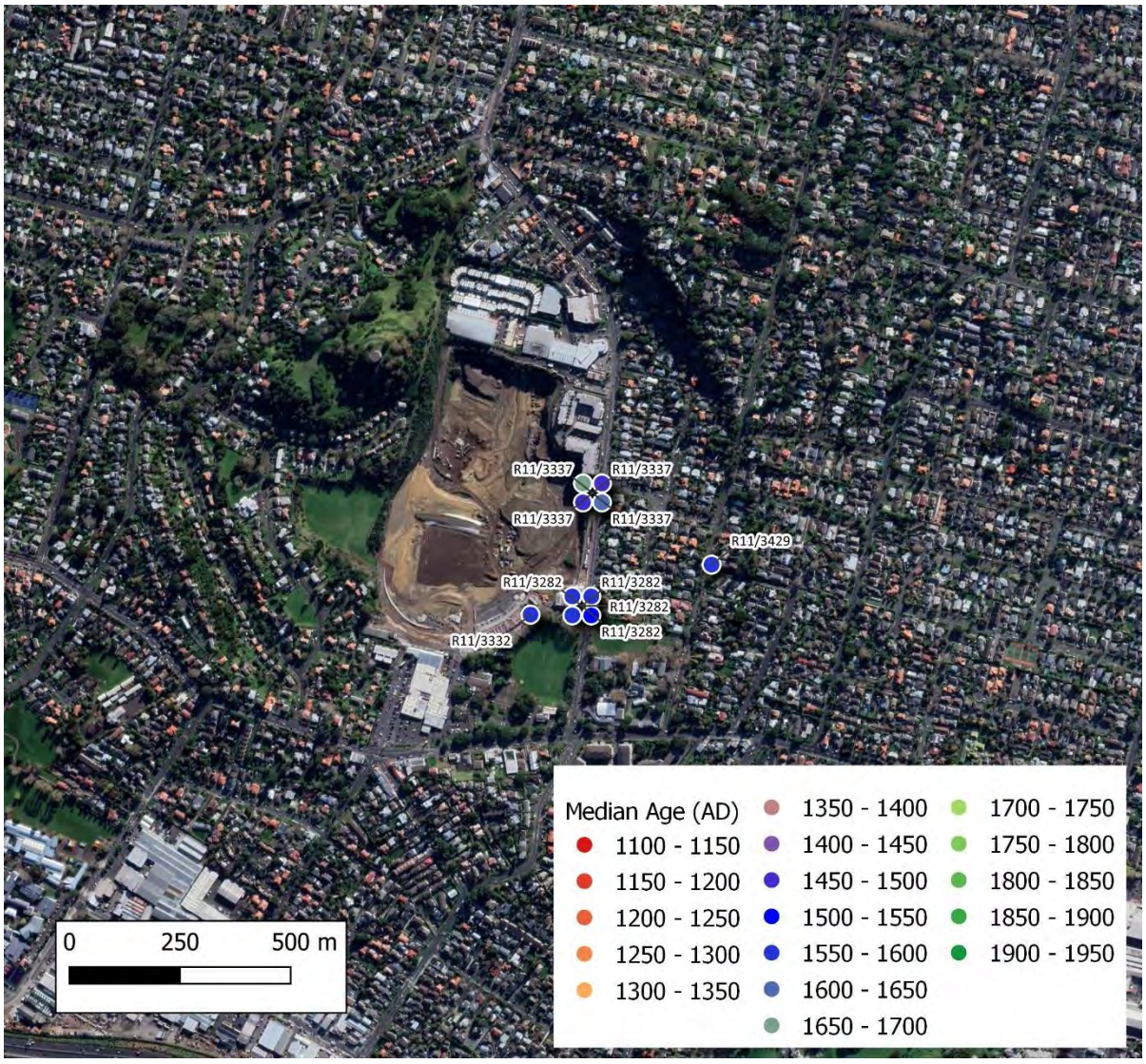


Figure 11-5. Location of radiocarbon dates from the Three Kings Project

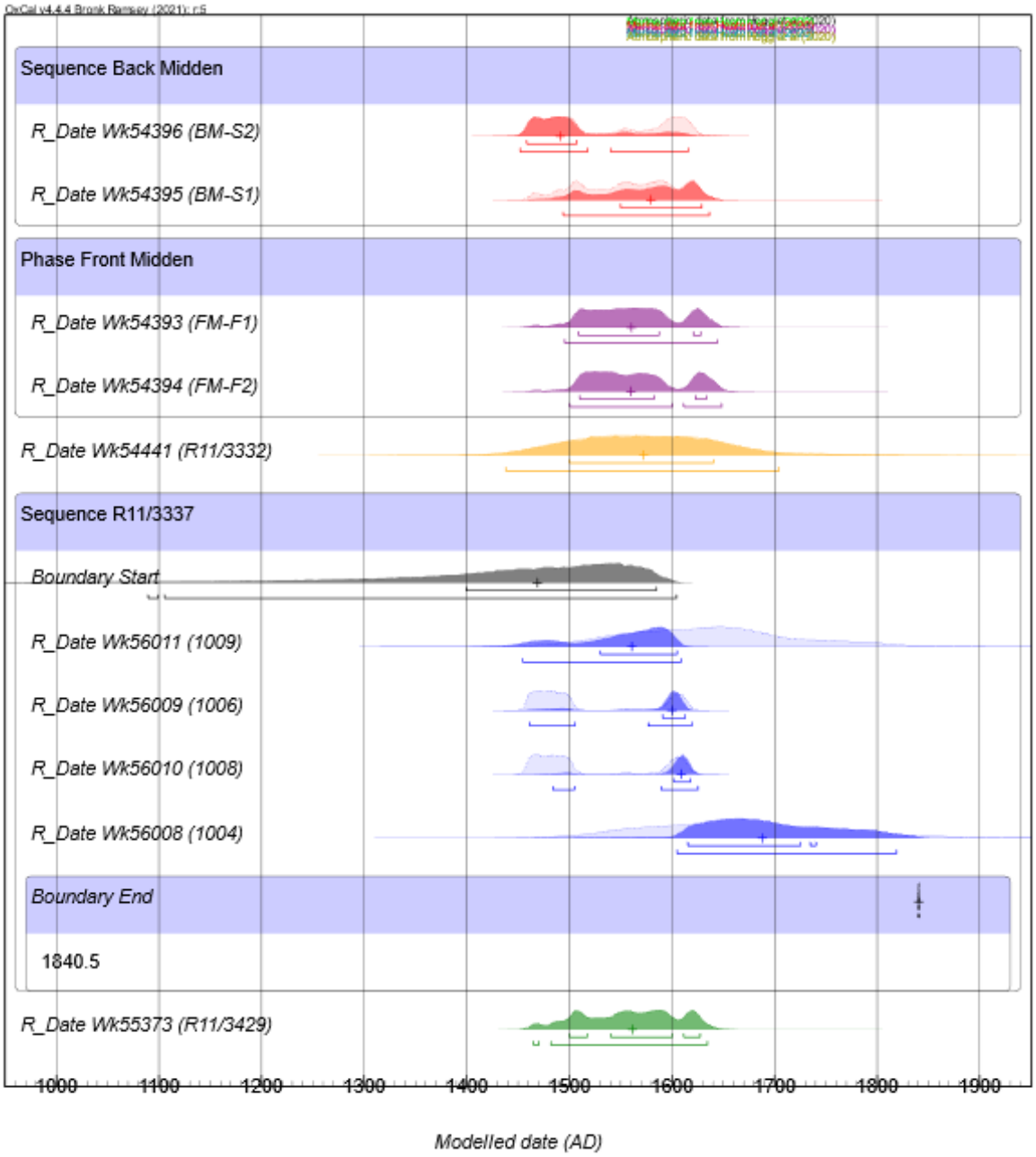


Figure 11-6. Calibrated radiocarbon dates from the Three Kings Project

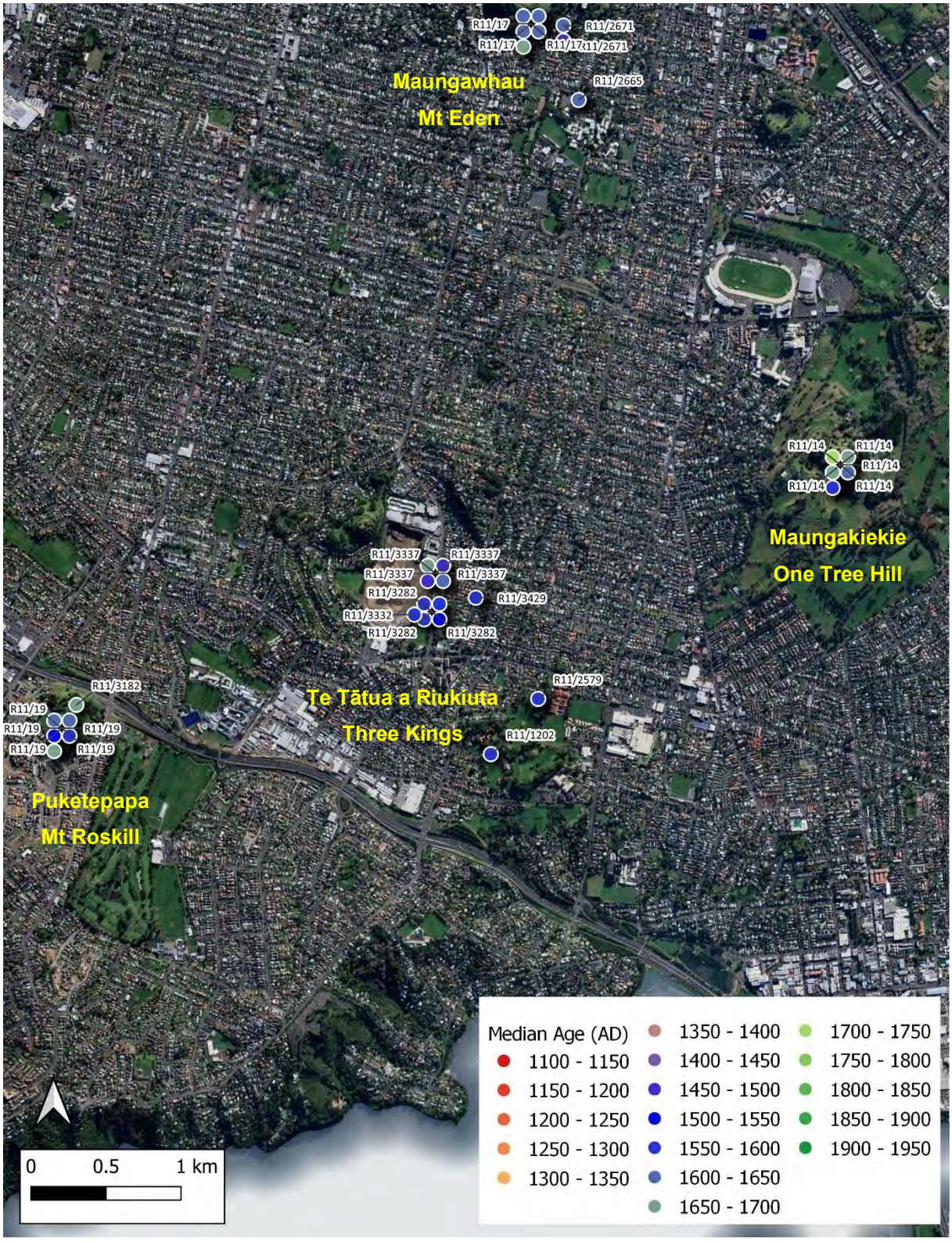


Figure 11-7. Comparison with radiocarbon dates from nearby maunga

12 DISCUSSION AND CONCLUSIONS

12.1 Summary of Results

Works relating to a residential development at the former Three Kings Quarry exposed three midden sites relating to Māori settlement at Te Tātua a Riukiuta (R11/18). Te Tātua a Riukiuta comprised a group of three volcanic cones which contained pā, two of which have been destroyed by quarrying (Figure 12-1). The three sites, R11/3282, R11/3332 and R11/3337, were located on the edges of the former quarry area and represent a few surviving remnants relating to settlement on the lower slopes of what was the eastern of the three cone pā. Subsequently, during the installation of a rising main along St Andrews Road, c.230m to the east of the quarry, a fourth midden was exposed (R11/3429).

Site R11/3282 was located adjacent to Mount Eden Road within a property that contained a c.1930s house that had been converted for water supply purposes in the 1990s. The site consisted of two areas, referred to as the Front Midden and the Back Midden. The Front Midden was relatively small, and two radiocarbon dates obtained for this part of the site suggested that it represented a single occupation in the 16th century AD. Two dates obtained from the Back Midden indicated an earlier occupation in the late 15th century and a later densely packed midden layer with fishbone indicating occupation in the 16th century AD. The Front Midden appeared more intact and likely formed as a set of contemporary firescoops for cooking shellfish followed by rake-out events. The readily available basalt blocks were used as hangi stones for the cooking. The extensive modifications to the water supply property are likely to have destroyed any other features associated with the midden, and no other archaeological features relating to habitation or gardening were exposed by the works in this area.

Site R11/3332 was located c.95m to the west-southwest of R11/3282 (Figure 12-1), on the north-western side of Grahame Breed Drive. The area containing the shell midden showed evidence of previous disturbance and only small patches of intact shell midden were visible. A single date was obtained from the site, indicating occupation in the 16th century.

Site R11/3337 was located close to Mount Eden Road near its intersection with Kingsway (Figure 12-1), on some of the only unmodified ground within the quarry. It was present as a long section cut from the lower slopes of the maunga, with deposits almost 1m thick. The site contained multiple archaeological contexts including shell midden, a firescoop and a hangi. These contexts and the dates obtained show a multi-phase occupation and use of the site, with two distinct phases represented. The four radiocarbon dates obtained from R11/3337 were considered the best of the samples collected during the project, given the detailed stratigraphic sequence. The bulk of the build-up of the midden appeared to date from 1600 to 1620 AD, the lowest elements probably being deposited over a relatively short period. These deposits were later cut by a stone-filled hangi dating to the mid-17th century AD. The stratigraphy was probably indicative of much denser occupation at this part of the maunga than was observed from the remnant midden excavated elsewhere.

Additionally, due to the preservation of the archaeological material and context, site R11/3337 was chosen for microfossil analysis, which provided a glimpse into the plant material used by the site's inhabitants. The plant microfossil analysis provides evidence of large-scale landscape disturbance by people and of the Māori introduced cultigens cf. kūmara, cf. taro, and ti pore (cabbage tree). The kūmara microfossils were found in large amounts while the taro evidence was relatively minor.

Figure 12-1. Archaeological sites and other historic heritage items identified during the project

The charcoal identified from R11/3337 provided information on the surrounding landscape. Various trees would have present within the vicinity of the site, including puriri, pohutukawa and matai, while several fern and shrub species were also present including bracken, hebe, coprosma, manuka and akeake. The presence of these shrubs, ferns and trees within certain features indicates preferential selection of the plant material used. Most notably, pohutukawa

was chosen for the hangi feature (1004), either as a preferred firewood or because of its availability – and probably both.

The charcoal samples from R11/3282 were largely similar to those from R11/3337 but with other species such as kauri, tutu and porokaiwhiri also identified, and no bracken.

Site R11/3429 was discovered during the rising main works along St Andrews Road (Figure 12-1). The midden was noted as being heavily disturbed by past utility works. However, the midden analysis yielded significant results. A single radiocarbon date was obtained from a relatively intact part of the midden which was younger than the other dates from the project, but not dramatically so, indicating a period from the 16th to the first half of the 17th century AD. As with the other sites, R11/3429 also contained mixed shrub and tree species but also small numbers of more modern European species such as acacia. This was most probably due to contamination from damage to the midden during earthworks in the road berm in the 20th century.

In addition to the midden sites, a historic artefact dump was exposed in St Andrews Road during trenching for the rising main, containing both 19th and 20th century artefacts and therefore dating to the 20th century. The artefacts were sampled, and a brief record made (see section 8.3).

The 20th century water supply building/pumphouse in the southeastern corner of the project area, while not relevant to Te Tātua a Riukiuta (Figure 12-1), was of some historical interest and was therefore recorded prior to and during its demolition (see Appendix D).

12.2 Discussion

The investigation of the four midden sites has revealed significant information relating to Te Tātua a Riukiuta, despite their limited extent and variable condition. Destruction of the eastern and western volcanic cone pā that made up Te Tātua a Riukiuta, and the lack archaeological investigations on the only surviving cone pā (Big King), mean that the only detailed archaeological information regarding the three pā and their occupants derives from the investigations carried out at the Three Kings Quarry and along the route of the rising main.

All four sites (R11/3282, R11/3332, R11/3337 and R11/3429) were midden sites containing intact shell midden deposits, with firescoop/hangi features at R11/3282 and R11/3337. However, R11/3332 and R11/3429 contained mostly disturbed sections. Information on the date of occupation was recovered from all four sites, and environmental information from three, in addition to information on the shellfish and fish that were brought to the sites for consumption.

The shellfish present in all four sites were predominantly obtained from muddy environments, which is consistent with the environments seen within the nearby bays of the Manukau Harbour to the south. The nearest shellfish beds would have been located at least 2km to the south of Te Tātua a Riukiuta and would have been transported to the maunga by foot and probably part-way by waka.

Cockle dominated the samples obtained from all four sites. The average (mean) sizes of cockle were consistent across all four sites, this being generally around 20-22mm, with some samples from R11/3282 containing some of the largest cockle found, at an average (mean) of 25mm. These averages indicate the targeting of largely mature shellfish and are consistent with cockle sizes seen at other archaeological sites in the broader region from this general period (see e.g., Bickler et al. 2013, 2020; Farley et al. 2015). Multiple variables impact cockle size seen within

archaeological assemblages, including environmental factors such as temperature and human intensification of marine resources.

One difference seen between the shell midden assemblages across the four sites was the range of other species present. R11/3282 contained a small number of other bivalves including rock oyster, scallop, tuatua, pipi and some unidentifiable gastropods. R11/3332 similarly contained other bivalves including those mentioned above (except for rock oyster), as well as mussel and various identifiable gastropods including cat's eye, hornshell, mudsnail and whelk. R11/3337 also contained all of the above bivalves and gastropods (except for tuatua), but also contained a comparatively high number of pipi, wedge shell and trough shell, and a small amount of limpet. Similarly, R11/3429 contained the above species (except for tuatua, wedge shell and limpet), and included a comparatively high number of pipi. Overall, the assemblages of R11/3282 and R11/3332 are similar. The differences seen in the shellfish assemblages, primarily the notable number of pipi, wedge shell and trough shell seen in R11/3337 and pipi seen in R11/3429, may be indicative of preferential selection of shellfish species. However, availability relating to changing seasonality and habitat locations may be an important factor.

All three intact sites contained a small amount of fishbone, but R11/3282 contained the only fishbone suitable for identification and analysis. This does not necessarily imply that fish as a resource played a relatively small role in the diet of the sites' occupants. Post-depositional processes, including taphonomic processes, have a large effect on the preservation of fishbone within an assemblage and it is therefore difficult to accurately determine the extent to which fishing and fish were a part of the pre-European lifestyle and diet within the Three Kings area during the 16th century based on the analysis of these middens. However, it is probable that it was significant and also likely that some of the fish caught was being consumed closer to where it was caught. Species that were identified consisted of snapper, tarakihi, flounder, trevally and a small shark fragment, which were probably all caught in the inner Manukau Harbour.

R11/3429 also contained some bird and mammal (including dog) bone, but samples from the site were small and these may have been modern.

The charcoal and pollen results obtained from the project indicate that the area around the maunga had probably been mostly cleared of bush, probably as a result of burning and gardening practices. Evidence of kūmara gardening was found and, given the quality of the volcanic soils, this is not surprising. Nikau was prominent in the palynological data and was a useful plant with leaves traditionally used for thatching, cooking food and being woven into baskets. The berries and flowers were also edible.

The microfossil analysis shows that plant cultivation including both dry land kūmara and wetland crops such as taro played a crucial role in the diet of the pre-European people within the Three Kings area, with a preference for kūmara cultivation. The results from R11/3337 contribute to a growing corpus of data for the Auckland Isthmus (e.g., Horrocks et al. in press), providing an important contribution to regional studies of landscape change in Aotearoa (cf. Horrocks et al. 2023).

Bracken remains a constant, indicative of both landscape disturbance and as a food source (see Leach et al. 2023 for a recent comprehensive review; Jones et al. 2021). Bracken clearance provided organic material to enhance kūmara gardens and a root crop to manage transition and fallow periods (Bickler et al. 2021; Damon and Bickler 2017). Wetland plants were both cultivated and probably collected near to the settlement. These were then supplemented by the food gathering associated with the extensive kai moana seafood remains sourced nearby at Onehunga. The charcoal data was more mixed, suggesting that larger trees were still probably present in stands in the area and indicating a managed mosaic of vegetation around the maunga.

The radiocarbon dates are a significant contribution to our understanding of the settlement of the area in the 16th and 17th centuries AD. Comparing the dates from other nearby maunga such as Maungawhau (e.g., Foster 2012), Puketepapa (e.g., Bickler and Farley 2010) and Maungakiekie (e.g., Phear 2011), the dates from the current project overlap with many of the dates obtained from those investigations, although there are more early dates at Te Tātua a Riukiuta. This may relate to the samples coming from the fringes of the Te Tātua a Riukiuta rather than closer to the main occupations from which many of the dates from the other maunga were sourced. Occupation at the peaks was often intensive with evidence of terracing for both whare and large numbers of rua (storage pits) and the defensive palisades and ditches. Down the slopes, small whare and more mixed cooking areas were located within the extensive cultivations in the rich volcanic soils. The dates from the wider Tāmaki Makaurau region reflect the intensification of inland agricultural zones following the period of earliest settlement around the coast (see e.g., Bunbury et al. 2022).

12.3 Conclusions

The Three Kings Quarry residential development project has had limited impacts on archaeological remains because of major historic changes to the maunga during the 20th century, which have destroyed the bulk of the archaeological evidence. Despite this, investigation of the middens at the periphery of the quarry and along nearby streets demonstrated the value of archaeological monitoring during the project.

The midden sites indicate that shellfish constituted a crucial part of the lifestyle and diets of the sites' Māori inhabitants, with fishing and plant cultivation also playing an important role in their lives. Additionally, charcoal and microfossil analyses have provided some insight regarding the flora present within the broader area in the past and how it was utilised. However, it is important to note that post-depositional processes, including taphonomic processes, have a direct impact on what survives within the archaeological record. It is difficult to discern the full extent to which shellfish, fish and plant resources were comparatively utilised in the past.

These sites represent the surviving archaeological remains on what would have been the eastern and southernmost boundaries of the Te Tātua a Riukiuta maunga, R11/18. From a temporal and spatial perspective, these results therefore offer a glimpse of the complex archaeology of Te Tātua a Riukiuta and into the pre-European Māori way of life within the Three Kings area, and have made an important contribution to the archaeology and history of the region.

REFERENCES

Best, E. 1927. *The Pa Maori.* Wellington: Whitcombe and Tombs.

Bickler, S.H., B. Baquié, R. Clough, T. Mace, D. Prince, M. Plowman and M. Turner. 2005. Excavations at Britomart, Auckland (R11/1379). *Clough & Associates Monograph Series* No. 1. Report for Auckland City Council.

Bickler, S.H. and E. Cameron. 2021. Three Kings Quarry, Auckland – Wastewater Pump Station Rising Main Route: Archaeological Assessment. Clough & Associates report prepared for Fletcher Living Ltd.

Bickler, S., R. Clough, B. Baquié and B. Pick. 2013. McLaughlins Quarry, Wiri: Final Report on Archaeological Investigations (Site R11/47) in Fulfilment of NZHPT Authority No. 2007/351. *Clough & Associates Monograph* 12. Report prepared for McLaughlins Quarry Trust.

Bickler, S., and G. Farley. 2010. Puketapapa/Mt Roskill Cycleway, Auckland (Site R11/19): Archaeological Monitoring Report in Fulfilment of NZHPT Authority No. 2008/280. Clough & Associates report prepared for Auckland City Council.

Bickler, S.H., G. Farley, R. Clough, T. Mace, M. Turner, D. Bonica, K. Hill and J. Low. 2007. Middle Class Spread: Excavations at Wynyard St, Auckland. *Clough & Associates Monograph Series* No. 2. Report for University of Auckland.

Bickler, S.H., J. Low, B. Larsen, B. Jones, C. Mailhot, L. Dawson and R. Clough. 2021. Archaeology at Weiti Bay, Auckland: Final Excavation Report. *Clough & Associates Monograph Series* No 22.

Bunbury, M., F. Petchey and S.H. Bickler. 2022. A new chronology for the settlement of Aotearoa (New Zealand) by Māori and the role of the Little Ice Age in demographic developments. *PNAS* 119: e2207609119.

Cameron, E. 2020a. Three Kings Quarry, Auckland – Proposed Residential Development: Archaeological Assessment. Clough & Associates report prepared for Fletcher Living Ltd.

Cameron, E. 2020b. Archaeological Management Plan: Three Kings Quarry, Auckland – Proposed Residential Development. Prepared by Clough & Associates for Fletcher Living Ltd.

Cameron, E. 2021a. Addendum to Three Kings Quarry, Auckland – Proposed Residential Development: Archaeological Assessment August 2020. Clough & Associates report prepared for Fletcher Living Ltd.

Cameron, E. May 2021b. Archaeological Management Plan: Three Kings Quarry, Auckland – Proposed Residential Development (Grahame Breed Drive Berm Upgrade and Service Crossing). Prepared by Clough & Associates for Fletcher Living Ltd.

Cameron, E. June 2021c. Archaeological Management Plan: Three Kings Quarry, Auckland- Proposed Wastewater Rising Main. Prepared by Clough & Associates for Fletcher Living Ltd.

Campbell, M. 2016. Body part representation and the extended analysis of New Zealand fishbone. *Archaeology in Oceania* 51:18–30. https://doi.org/10.1002/arco.5079.

Campbell, M., B. Hudson, J. Craig, L. Furey, K. Greig, A. McAlister, B. Marshall, F. Petchey, T. Russell, D. Trilford and R. Wallace. 2019. The Long Bay Restaurant Site, R10/1374: Volume 1, The Archaeology (HNZPTA Authorities 2015/19 and 2016/81) 1. CFG Heritage report.

Campbell, M., L. Shepherd, M. Kellett and R. Brassey. 2021. A highly fragrant comestible: the cartilaginous fish (Chondrichthyes) in pre-European Māori New Zealand. *Archaeology in Oceania* 0:1–15. https://doi.org/10.1002/arco.5248

Crossley, P. 2016. Lava caves in Suburban Auckland New Zealand. Article produced for the New Zealand Speleological Society.

Crossley, P. 2016. Lava caves in suburban Auckland New Zealand. Article produced for the New Zealand Speleological Society.

Damon, F.H., and S.H. Bickler. 2017. Stone and Water to Soils and Starch: Horticultural Transformation during the Holocene Settlement of the Pacific. AAA Meetings, Washington DC.

Farley, G. 2011. Archaeology of the Southern Link of the Orewa West Walkway/Cycleway: Final Report. Prepared in Fulfilment of NZHPT Authority No. 2010/113. Clough & Associates report prepared for Auckland Council.

Farley, G., Z. Burnett, J. Low, J. Mills, A. McAlister and R. Wallace. 2015. Archaeological Investigations at Timberly Road, Mangere: Final Report. In Fulfilment of NZHPT Authority No. 2014/573. *Clough & Associates Monograph* 16. Prepared for Harrison Grierson Ltd and Auckland International Airport Ltd.

Foster R. 2012. Maungawhau–Mount Eden Domain Watercare Reservoirs Upgrade. Archaeological. Monitoring report (NZHPT Authority 2010/357), Addendum. Russell Foster and Associates report.

Godden, G. A., 1964. *Encyclopaedia of British Pottery and Porcelain Marks*. London: Barrie and Jenkins.

Grace, C. and G. Kunin. 1981. Survey of water Pipeline of Big King Mountain at Three Kings (N42/10).

Grayson, D. 1984. *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Faunas*. Orlando: Academic Press.

Handley, S.J., A. Swales, M. Horrocks, M. Gibbs, M. Carter, R. Ovenden and J. Stead. 2020. Historic and contemporary anthropogenic effects on granulometry and species composition detected from sediment cores and death assemblages, Nelson Bays, Aotearoa-New Zealand. *Continental Shelf Research*, doi: 10.1016/j.csr.2020.104147.

Hather, J., and P.V. Kirch. 1991. Prehistoric sweet potato (*Ipomoea batatas*) from Mangaia Island, central Polynesia. *Antiquity* 65: 887-893.

Hayward, B. 2017. Assessment of Geological Heritage Values and Extent of 'Volcanic Remnants' within the Three Kings Precinct Plan. Geomarine Research Report prepared for the Environment Court.

Hayward, B. 2019. *Volcanoes of Auckland: A Field Guide*. Auckland University Press.

Hayward, B.W., H.R. Grenfell, K. Nicholson, R. Parker, J. Wilmshurst, M. Horrocks, A., Swales and. A.T. Sabaa. 2004. Foraminiferal record of human impact on intertidal estuarine environments in New Zealand's largest city. *Marine Micropalaeontology* 53: 37-66.

Hayward, B., J. Kenny and H. Grenfell. 2011. More volcanoes recognised in Auckland Volcanic Field. *Geoscience Society of New Zealand Newsletter*, November 201,1: 11-16.

Hooker, S.H., and R.G. Creese. 1995. The reproductive biology of pipi, Paphies australis (Gmelin 1790) (Bivalvia: *Mesodesmatidae*). I. Temporal patterns of the reproductive cycle. *Journal of Shellfish Research*, 14(1): 7–15.

Horrocks, M. 2004. Polynesian plant subsistence in prehistoric New Zealand: A summary of the microfossil evidence. *New Zealand Journal of Botany* 42: 321-334.

Horrocks, M. 2020. Recovering plant microfossils from archaeological and other paleoenvironmental deposits: A practical guide developed from Pacific Region experience. *Asian Perspectives* 59: 186-208.

Horrocks, M., W.T. Baisden, J. Flenley, D. Feek, L. González Nualart, S. Haoa-Cardinali and T. Edmunds Gorman. 2012. Fossil plant remains at Rano Raraku, Easter Island's statue quarry: Evidence for past elevated lake level and ancient Polynesian agriculture. *Journal of Paleolimnology* 48: 767-783.

Horrocks, M., W.T. Baisden, J. Flenley, D. Feek, S. Haoa-Cardinali, L. González Nualart and T. Edmunds Gorman. 2017. Pollen, phytolith and starch analyses of dryland soils from Easter Island show widespread vegetation clearance and Polynesian-introduced crops. *Palynology*, 41: 339-350.

Horrocks, M., W.T. Baisden, J. Flenley, D. Feek, C.M. Love, S. Haoa-Cardinali, L. González Nualart and T. Edmunds Gorman. 2016. Pollen, phytolith and starch analyses of dryland soils from Easter Island show widespread vegetation clearance and Polynesian-introduced crops. *Palynology* 41: 339-350.

Horrocks, M., W.T. Baisden, M.K. Nieuwoudt, J. Flenley, D. Feek, L. González Nualart, S. Haoa-Cardinali and T. Edmunds Gorman. 2012. Microfossils of Polynesian cultigens in lake sediment cores from Rano Kau, Easter Island. *Journal of Paleolimnology*, 47: 105-284.

Horrocks, M., and I. Barber. 2005. Microfossils of introduced starch cultigens from an early wetland ditch in New Zealand. *Archaeology in Oceania* 40: 106-114.

Horrocks, M., S.H. Bickler, W. Gumbley and B. Jones. 2023. Plant microfossil and 14C analysis of archaeological features at Coromandel Peninsula, New Zealand: Evidence for regional use of introduced and indigenous plants. *Journal of Pacific Archaeology* 13(2):1-19.

Horrocks, M., A. Brown, J. Brown and B. Presswell. In press. A plant and parasite record of a midden on Auckland Isthmus, New Zealand, reveals large scale landscape disturbance, Māori introduced cultigens, and helminthiasis. *Asian Perspectives*.

Horrocks, M., M. Campbell and W. Gumbley. 2007. A short note on starch and xylem of Ipomoea batatas (sweet potato) in archaeological deposits from northern New Zealand. *Journal of Archaeological Science*, 34: 1441-1448.

Horrocks, M., M.K. Nieuwoudt, R. Kinaston, H. Buckley and S. Bedford. 2014. Microfossil and Fourier Transform InfraRed analyses of Lapita and post-Lapita human dental calculus from Vanuatu, Southwest Pacific. *Journal of the Royal Society of New Zealand*, 44: 17-33.

Horrocks, M., I.W.G. Smith, S.L. Nichol and R. Wallace. 2008. Sediment, soil and plant microfossil analysis of Maori gardens at Anaura Bay, eastern North Island, New Zealand: Comparison with descriptions made in 1769 by Captain Cook's expedition. *Journal of Archaeological Science*, 35: 2446-2464.

Horrocks, M., and M.I. Weisler. 2006. A short note on starch and xylem of Colocasia esculenta (taro) in archaeological deposits from Pitcairn Island, southeast Polynesia. *Journal of Archaeological Science*, 33: 1189-1193.

Jones, B., S. Bickler, B. Larsen, K. Roth, D. Gaylard and R. Clough. June 2021. Final Report of Archaeological Investigations: Stage 2B, 4 and 5 Earthworks, 720 Purangi Road, Cooks Beach (Puakaki), Coromandel. In Fulfilment of HNZPT Authority 2020-230. *Clough & Associates Monograph* No. 23. Prepared for Longreach Developments Ltd.

Kahn, J.G., M. Horrocks and M.K. Nieuwoudt. 2014. Agriculture, domestic production, and site function: Micro-fossil analyses and late prehistoric landscapes of the Society Islands. *Economic Botany*, 68: 246-263.

Kelly, J. and J. Surridge. 1990. Map of the Tamaki Isthmus with Maori Place Names Redrawn from Tamaki Makau-Rau by Leslie Kelly. Department of Geography, Auckland University.

Kermode, L. 1994. New Zealand lava caves worth preserving for their geologic and geomorphic features (Memorial Volume to the late Professor Teruhiko Sameshima). *Geoscience Reports of Shizuoka University* 20 pp. 15-24.

Kondo, R., C. Childs and I. Atkinson. 1994. *Opal Phytoliths of New Zealand*. Lincoln: Manaaki Whenua Press.

Landcare Research. 2017. Te Reo O Te Repo - The Voice of the Wetland: Connections, Understandings and Learnings for the Restoration of our Wetlands. Edited by Yvonne Taura, Cherie Van Schravendijk- Goodman and Beverley Clarkson.

Leach, B.F. 1986. A method for analysis of Pacific Island fishbone assemblages and an associated database management system. *Journal of Archaeological Science* 13(2): 147-159.

Leach, B.F. 2006. *Fishing in pre-European New Zealand*. New Zealand Journal of Archaeology Special Publication. Wellington: New Zealand Archaeological Association.

Leach, F., J. Davidson, M. Burtenshaw, G. Harris, T. Tomlin and P. Davis. 2023. The New Zealand bracken fern rhizome, Pteridium esculentum (G.Forst): a toxic food plant of pre-European Māori. *Archaeology in Oceania*. https://doi.org/10.1002/arco.5285.

Lindsey J.M., G.S. Leonard, E. Smid and B.W. Hayward. 2011. Age of the Auckland Volcanic Field: a review of existing data. *New Zealand Journal of Geology and Geophysics* Vol 54, No. 4: 379-401

Macphail, M.K., and D.R. McQueen. 1983. The value of New Zealand pollen and spores as indicators of Cenozoic vegetation and climates. *Tuatara*, 26: 37-59.

McGlone, M.S., M.J. Salinger and N.T. Moar. 1993. Paleovegetation studies of New Zealand's climate since the Last Glacial Maximum. In H.E. Wright et al. (eds.), *Global Climates since the Last Glacial Maximum*, pp. 294-317. Minneapolis: University of Minnesota Press.

Moore, P.D., J.A. Webb and M.E. Collinson. 1991. *Pollen Analysis* (2nd edn). London: Blackwell Scientific.

Nims, R., D. Filimoehala, M.S. Allen and V.L. Butler. 2020. When less is more: Element selection as sampling strategy in zooarchaeology. *Journal of Archaeological Science* 121. https://doi.org/10.1016/j.jas.2020.105205.

Patterson, M. ND. Ngati Whatua o Orakei Heritage Report for State Highway 20: Transit Manukau Harbour Crossing. Ngati Whatua Orakei Corporate Ltd Report.

Paul, L. 2000. *New Zealand Fishes. Identification, Natural History and Fisheries*. Revised Edition. Auckland: Reed Books.

Paulin, C., A. Stewart, C. Roberts and P. McMillan. 2001. *New Zealand Fish. A Complete Guide*. Wellington: Te Papa Press.

Pearsall, D.M. 2015. *Paleoethnobotany: A handbook of procedures*, 3rd edn. Walnut Creek: Left Coast Press.

Phear, S. 2011. Removal of Part of a Historic Stone Wall, Olive Grove Drive, Cornwall Park: Final Archaeological Monitoring Report. Prepared in Fulfilment of NZHPT Authority No. 2010/372. Clough & Associates report for the Cornwall Park Trust Board.

Piperno, D.R. 2006. *Phytoliths: A Comprehensive Guide for Archaeologists and Paleoecologists*. Lanham: Altamira Press.

Pishief, E. and J. Adam. 2015. Te Tatua a Riukiuta – Three Kings Heritage Study 2105. Report prepared for the Puketapapa Local Board (Auckland Council).

Prebble, M., A.J. Anderson, P. Augustinus, J. Emmitt, S.J. Fallon, L.L. Furey, S.J. Holdaway, A. Jorgensen, T.N. Ladefoged, P.J. Matthews, J.-Y. Meyer, R. Phillipps, R. Wallace and N. Porch. 2019. Early tropical crop production in marginal subtropical and temperate Polynesia. *PNAS* 116, 8824-8833.

Reitz, E.J., and E.S. Wing. 2008. *Zooarchaeology* (2nd edn). Cambridge, UK: Cambridge University Press.

Shakles, R., S. Bickler, J. Low, S. Yoffe and R. Clough. 2019. Archaeological Investigation of Land Adjacent to the Stone Store, 19 Princes Street, Onehunga: Sites R11/2466 and R11/2580.

Clough & Associates Monograph No. 21. Report prepared in Accordance with HNZPT Authority Nos. 2011/207 & 2012/409 for Stone Store Properties Ltd.

Simmons, D. 1987. *Maori Auckland including the Maori Place Names of Auckland collected by George Graham*. Auckland: Gordon Ell the Bush Press.

Smith, I.E.M. and S.R. Allen. 1993. Volcanic Hazards at the Auckland Volcanic Field. *Volcanic Hazards Information Series* 5. Wellington: Ministry of Civil Defence.

Stone, R. 2001. *From Tamaki-makau-rau to Auckland*. Auckland: Auckland University Press.

Vogel, Y. 2020. Faunal Remains from the Tirimoana Place Subdivision, Whanganui. Prepared for Nick Mainwaring, WSP Ltd.

Whistler, W.A. 2009. *Plants of the Canoe People: An Ethnobotanical Voyage through Polynesia*. National Tropical Botanical Garden, Lawai, Kaua'i.

Wilmshurst, J.M., D.E. Eden and P.C. Froggatt. 1999. Late Holocene forest disturbance in Gisborne, New Zealand: A comparison of terrestrial and marine pollen records. *New Zealand Journal of Botany*, 37: 523-540.

Internet Sources:

Winstone Aggregates Website accessed at: http://www.threekingsquarry.co.nz/consenting-sites/three-kings quarry/history/

Newspaper Articles accessed at https://paperspast.natlib.govt.nz/newspapers/
Auckland Star Volume LI Issue 32, 6 February 1920
New Zealand Herald Volume XXXI Issue 9455, 10 March 1894.
Daily Southern Cross Volume XXI, Issue 2519, 15 August 1865.

APPENDIX A – UPDATED NZAA SITE RECORD FORMS

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE
archaeological site recording scheme

Site Record Form

NZAA SITE NUMBER: R11/3282

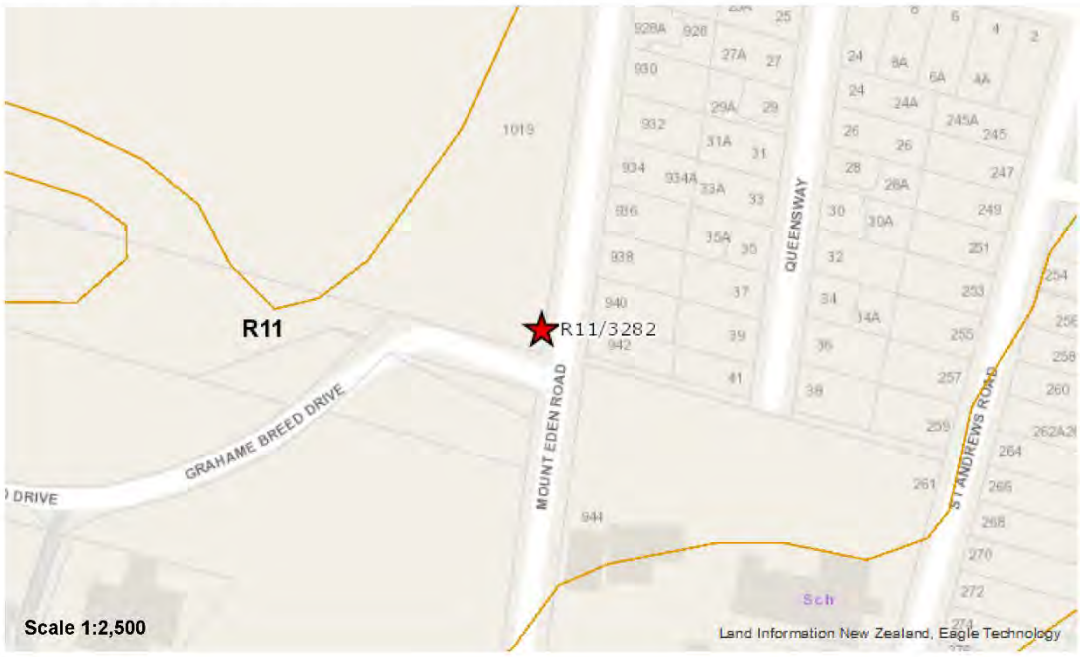
SITE TYPE: Midden/Oven

SITE NAME(s):

DATE RECORDED:

SITE COORDINATES (NZTM) Easting: 1756684 **Northing:** 5913992 **Source:** Handheld GPS

IMPERIAL SITE NUMBER: **METRIC SITE NUMBER:** R11/3282



Finding aids to the location of the site

The site is located in the grounds of an old water supply building at the corner of Mount Eden Road and Grahame Breed Drive Auckland. The location is adjacent to the Three Kings Quarry

Brief description

Shell midden

Recorded features

Midden

Other sites associated with this site

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD HISTORY	NZAA SITE NUMBER: R11/3282

Site description

Updated 05/04/2021 (Field visit), submitted by simonbickler , visited 01/04/2021 by Bickler, Simon
Grid reference (E1756684 / N5913992)

The two areas of midden were investigated on 1/4/2021. The "Back" midden to the west, was significantly impacted by works the area and contained alot of basalt blocks. It was around 50cm in diameter and with dense patches of cockle and charcoal.
The midden closest to the road was stripped and consisted of an patch of around 2m x 1m cockle shell with some scallop and oyster observed. The western side had been truncated by digging of a relatively modern pipe into the nearby tank area. 3 possible intercutting firescoops/hangi were identified during excavation (under HNZPT Authority). Samples collected for midden analysis and dating. Some other patches of midden possible but the area has been very highly damaged by all the water pipe work and other foundations etc.

Updated 24/08/2020 (Field visit), submitted by ellencameron , visited 31/07/2020 by Cameron, Ellen
Grid reference (E1756684 / N5913992)

Two in-situ shell midden deposits and some disturbed shell fragments were exposed during the excavation of geotech test pits for ground testing ahead of development.

Details from site visit below:
Test Pit A was located at coordinates E1756684 N5913992 +-3m. The test pit measured approximately 1 x 3 m and was c. 1.2 m in depth. The stratigraphy showed a modern topsoil over a reddish clay fill layer over a dark brown silt. The southwest corner of the test pit contained a layer of shell (approximately 10-15 cm thick), consisting of mostly cockle in a dark brown to blackened soil with evidence of fire cracked rocks. There was no evidence of charcoal in the exposed material.

Test Pit B was located along the front of the water supply building at coordinates E1756671 N5913992 +-3m. The test pit measured approximately 1 X 3m, depth could not be discerned as it had been back filled. However, a small section at the northeast corner where a small amount of very fragmented shell was visible had been left exposed. The shell was located under a plastic sheet moisture barrier and next to the front steps of the building. There was no in-situ shell layer visible, presumably as a result of previous disturbance from building construction.

Test Pit C was located to the north of the water supply building at coordinates E1756671 N5913992 +-3m. The ground had previously been covered by a concrete slab with a water tank on top. The concrete had been removed exposing a thin gravelly silt layer visible along the edges of the test pit. A natural reddish-brown silty clay was visible underneath the gravelly silt. In the northwest corner of the test pit a dark brown silt with a shell layer was present c.10 cm below the surface. From observation at the top of the test pit (the depth of the pit at c.1.5 m did not allow entry) it appeared that the soil containing the shells may have been cut into the natural clay, although the relationship between these soils could not be established for certain. As well, the shells appeared to be mostly cockle - although closer inspection would be required to confirm this .

Condition of the site

Updated 05/04/2021 (Field visit), submitted by simonbickler , visited 01/04/2021 by Bickler, Simon

Now mostly destroyed and will be completely destroyed when earthworks finalised for the new building in the area..

Updated 24/08/2020 (Field visit), submitted by ellencameron , visited 31/07/2020 by Cameron, Ellen

The excavation for the geotech test pits was halted upon discovery - but some of the midden layer was damaged in each case.

Statement of condition

Updated: 28/10/2020 - Fair - Some intact features, but others may be unclear or damaged

Current land use:

Updated: 28/10/2020 - Industrial/ commercial

Threats:

Updated: 28/10/2020 - Subdivision

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE
archaeological site recording scheme

Summary Site Record

NZAA SITE NUMBER: R11/3332

SITE TYPE: Midden/Oven

SITE NAME(s):

Record last updated: 23/08/2021

SITE COORDINATES (NZTM) Easting: 1756591 **Northing:** 5913978 **Source:** Handheld GPS

IMPERIAL SITE NUMBER: **METRIC SITE NUMBER:** R11/3332

Finding aids to the location of the site

Located on the northeastern side of Grahame Breed Drive

Brief description of the site

Shell midden

Condition of the site when last visited

Destroyed Destroyed following excavation and earthworks for subdivision

This report contains a summary of the information about this site held in ArchSite.

For a complete Site Record Form containing all the recorded information, please contact the ArchSite Coordinator.

For further information please contact:

ArchSite Coordinator, PO Box 6337, DUNEDIN

admin@archsite.org.nz

Printed by: simonbickler 03/04/2023

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE
archaeological site recording scheme

Summary Site Record

NZAA SITE NUMBER: R11/3337

SITE TYPE: Midden/Oven

SITE NAME(s):

Record last updated: 26/07/2021

SITE COORDINATES (NZTM) Easting: 1756707 **Northing:** 5914195 **Source:** Handheld GPS

IMPERIAL SITE NUMBER: **METRIC SITE NUMBER:** R11/3337

Finding aids to the location of the site

In remnant quarry on Mt Eden Road, opposite 16 Kingsway

Brief description of the site

Shell midden and oven

Condition of the site when last visited

Poor

This report contains a summary of the information about this site held in ArchSite.

For a complete Site Record Form containing all the recorded information, please contact the ArchSite Coordinator.

For further information please contact:

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admin@archsite.org.nz

Printed by: simonbickler 03/04/2023

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE
archaeological site recording scheme

Summary Site Record

NZAA SITE NUMBER: R11/3429

SITE TYPE: Midden/Oven

SITE NAME(s):

Record last updated: 18/09/2022

SITE COORDINATES (NZTM) Easting: 1756920 **Northing:** 5914061 **Source:** Handheld GPS

IMPERIAL SITE NUMBER: **METRIC SITE NUMBER:** R11/3429

Finding aids to the location of the site

Under road and berm at the corner of Rowan Court and St Andrews Rd, Three Kings.

Brief description of the site

Condition of the site when last visited

Below surface

This report contains a summary of the information about this site held in ArchSite.

For a complete Site Record Form containing all the recorded information, please contact the ArchSite Coordinator.

For further information please contact:

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Printed by: simonbickler 18/09/2022

APPENDIX B – RADIOCARBON DATES

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Thursday, 28 April 2022

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 54393

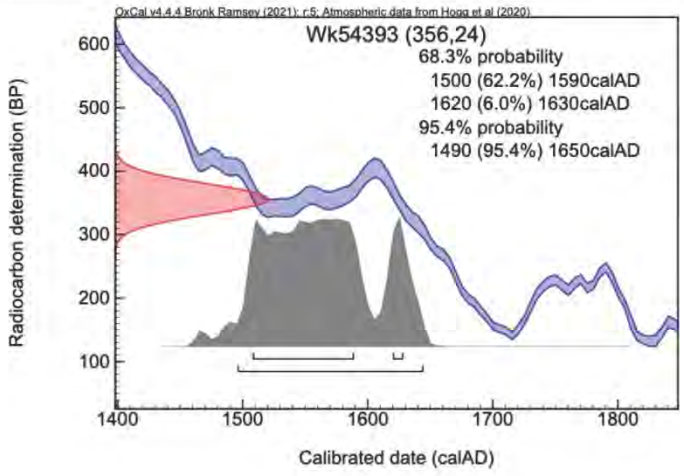
Submitter	S Bickler
Submitter's Code	R11/3282-FM-F1
Site & Location	R11/3282, New Zealand
Sample Material	Charcoal - Hebe
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-43.3 ±	2.9 ‰
$F^{14}C\%$	95.7 ±	0.3 %
Result	**356 ± 24 BP**	

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
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Thursday, 28 April 2022

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 54394

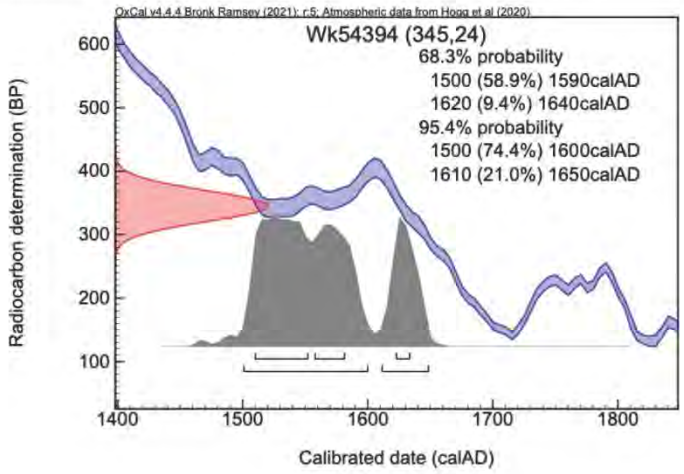
Submitter	S Bickler
Submitter's Code	R11/3282-FM-F2
Site & Location	R11/3282, New Zealand
Sample Material	Charcoal - Hebe
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-42.0 ±	2.8 ‰
$F^{14}C$%	95.8 ±	0.3 %
Result	**345 ± 24 BP**	

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



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- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C$% is also known as *Percent Modern Carbon (pMC)*.

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Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Thursday, 28 April 2022

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 54395

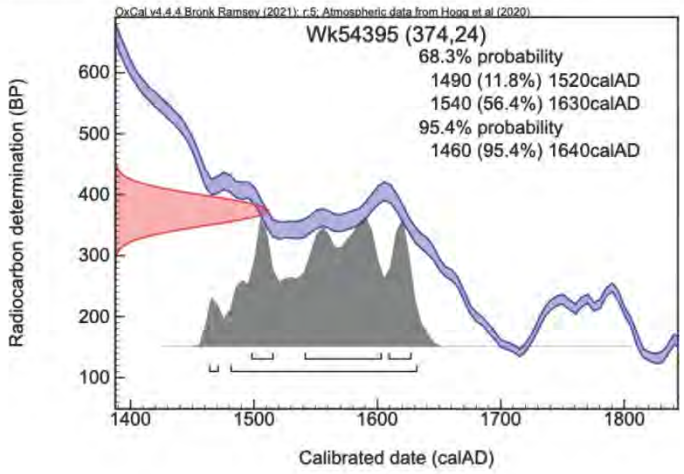
Submitter	S Bickler
Submitter's Code	R11/3282-BM-S1
Site & Location	R11/3282, New Zealand
Sample Material	Charcoal - Hebe
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-45.5 ± 2.8 ‰
$F^{14}C$%	95.5 ± 0.3 %
Result	**374 ± 24 BP**

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C$% is also known as *Percent Modern Carbon (pMC)*.

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WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Thursday, 28 April 2022

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 54396

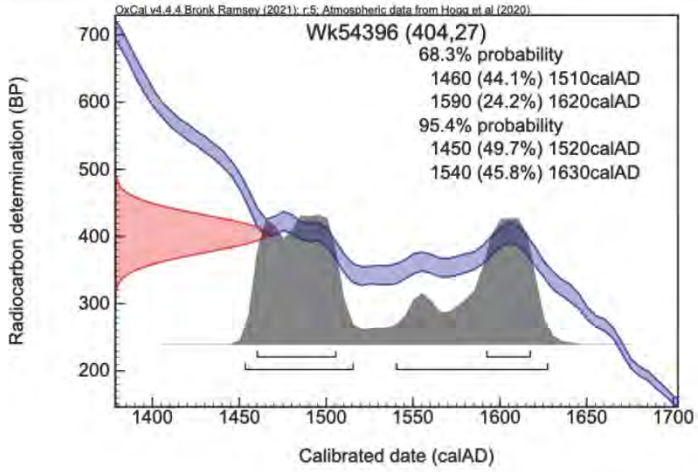
Submitter	S Bickler
Submitter's Code	R11/3282-BM-S2
Site & Location	R11/3282, New Zealand
Sample Material	Charcoal - Hebe
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-49.0 ±	3.2 ‰
$F^{14}C\%$	95.1 ±	0.3 %
Result	**404 ± 27 BP**	

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



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- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

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Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
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Thursday, 2 June 2022

Radiocarbon Dating Laboratory

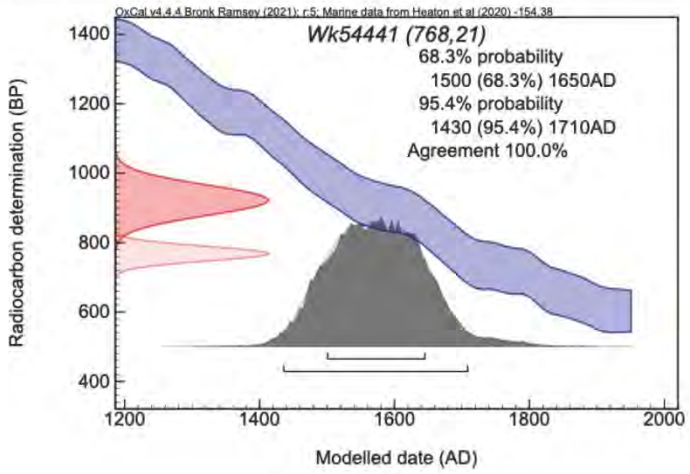
Report on Radiocarbon Age Determination for Wk- 54441

Submitter	S Bickler
Submitter's Code	R11/3332
Site & Location	R11/3332, New Zealand
Sample Material	Marine shell - Cockle
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 0.1N HCl, rinsed and dried.

$\delta^{13}C$	0.4	±	0.3 ‰	(CRDS)
$D^{14}C$	-91.1	±	2.4 ‰	
$F^{14}C\%$	90.9	±	0.2 %	
Result	**768 ± 21 BP**			

(AMS measurement)

Comments



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- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

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WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Tuesday, 10 January 2023

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 55373

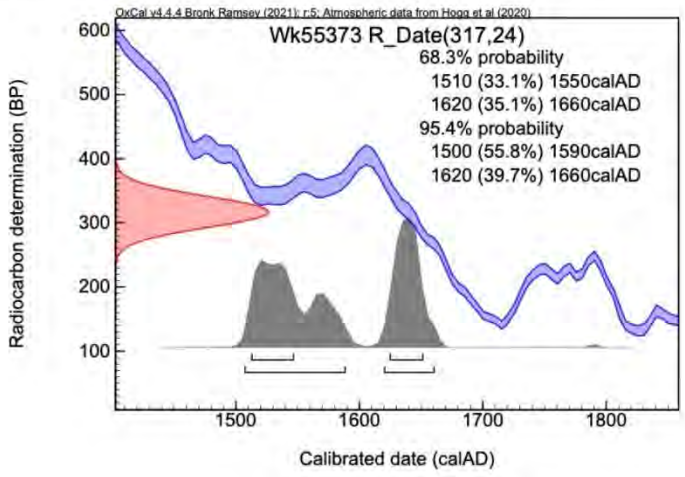
Submitter	S Bickler
Submitter's Code	R11/3429-East Section
Site & Location	R11/3429, New Zealand
Sample Material	Charcoal Hebe twigs
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-38.6 ± 2.8 ‰
$F^{14}C\%$	96.1 ± 0.3 %
Result	**317 ± 24 BP**

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



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- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Friday, 24 February 2023

Radiocarbon Dating Laboratory

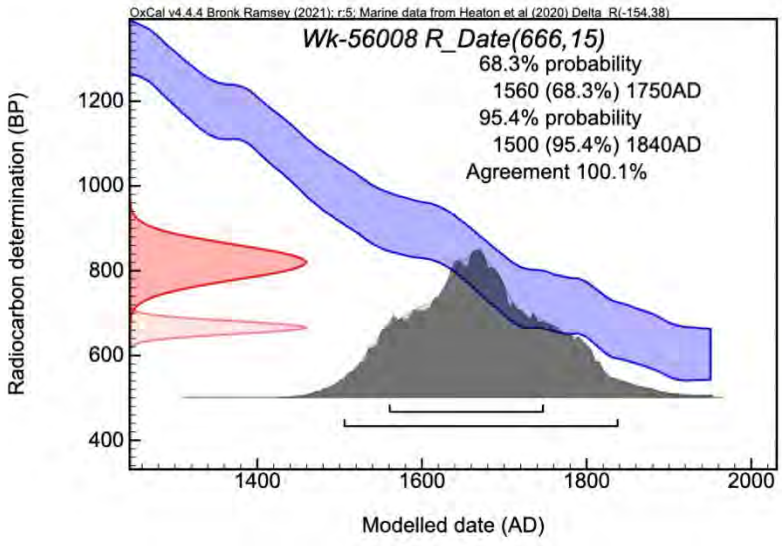
Report on Radiocarbon Age Determination for Wk- 56008

Submitter	A Apfel
Submitter's Code	1004
Site & Location	R11/3337 Three Kings Quarry, New Zealand
Sample Material	Marine shell: Cockle
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 0.1N HCl, rinsed and dried.

$\delta^{13}C$	3.6	±	0.6 ‰	(CRDS)
$D^{14}C$	-79.6	±	1.7 ‰	
$F^{14}C\%$	92.0	±	0.2 %	
Result	**666 ± 15 BP**			

(AMS measurement)

Comments



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- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Friday, 24 February 2023

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 56009

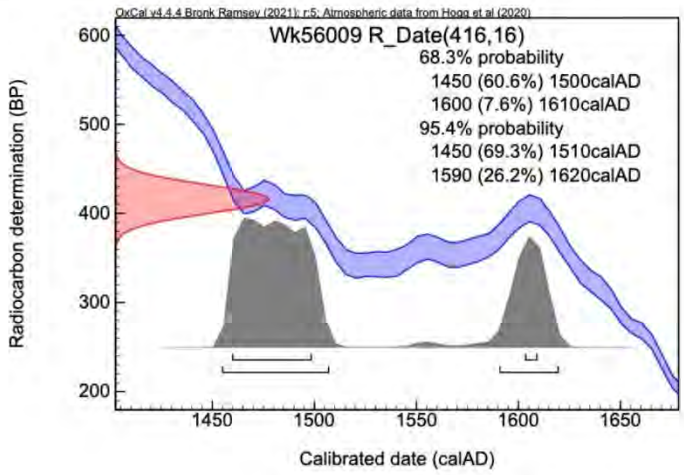
Submitter	A Apfel
Submitter's Code	1006
Site & Location	R11/3337 Three Kings Quarry, New Zealand
Sample Material	Charcoal: Hebe
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-50.5 ± 1.9 ‰
$F^{14}C\%$	94.9 ± 0.2 %
Result	**416 ± 16 BP**

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



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- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

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Private Bag 3105
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New Zealand.
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Friday, 24 February 2023

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 56010

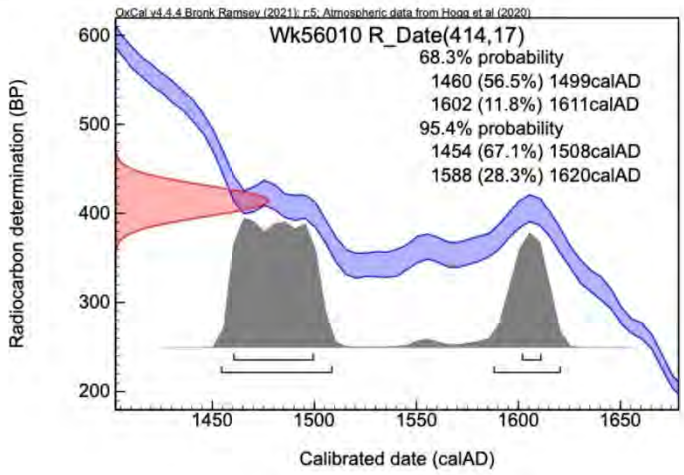
Submitter	A Apfel
Submitter's Code	1008
Site & Location	R11/3337 Three Kings Quarry, New Zealand
Sample Material	Charcoal: Hebe
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-50.2 ±	2.1 ‰
$F^{14}C\%$	95.0 ±	0.2 %
Result	**414 ± 17 BP**	

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



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- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

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Friday, 24 February 2023

Radiocarbon Dating Laboratory

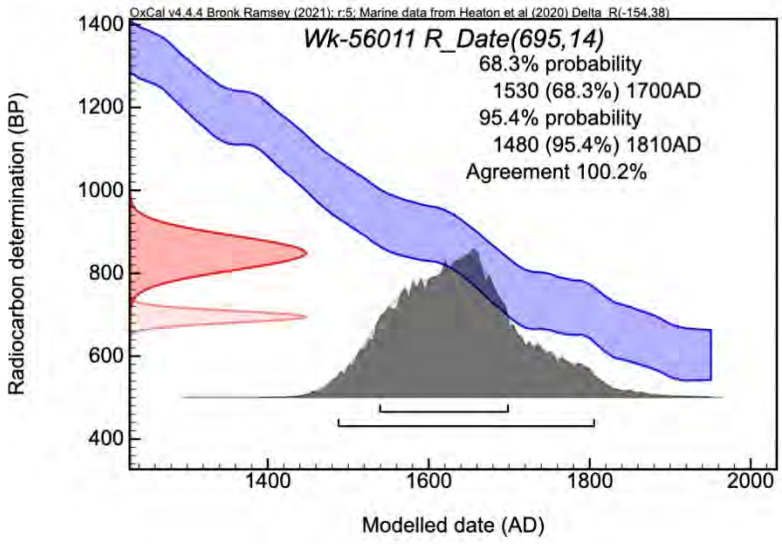
Report on Radiocarbon Age Determination for Wk- 56011

Submitter	A Apfel
Submitter's Code	1009
Site & Location	R11/3337 Three Kings Quarry, New Zealand
Sample Material	Marine shell: Hebe
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 0.1N HCl, rinsed and dried.

$\delta^{13}C$	2.0 ±	0.6 ‰	(CRDS)
$D^{14}C$	-82.9 ±	1.6 ‰	
$F^{14}C\%$	91.7 ±	0.2 %	
Result	**695 ± 14 BP**		

(AMS measurement)

Comments



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

APPENDIX C – PLANT MICROFOSSIL REPORT

Microfossil Research

Dr Mark Horrocks
Microfossil Research Ltd
31 Mont Le Grand Rd,
Mt Eden, Auckland 1024, New Zealand

Mob: 64 - 21 - 178 0957
info@microfossilresearch.com
www.microfossilresearch.com

5 August 2022

Plant microfossil analysis of archaeological samples from R11/3337, Three Kings Quarry, Auckland

Summary

The plant microfossils provide evidence of large-scale landscape disturbance by people and for the Māori introduced cultigens cf. kumara, cf. taro, and ti pore. The kūmara microfossils were found in large amounts while the taro evidence was relatively minor.

Methods

Three samples (1004, 1008, and 1009) were analysed for pollen, phytoliths, and starch to provide a record of past vegetation, environments, and human activity. Detailed methods of analysis are described in the Appendix.

Results and discussion

Pollen and spores

The samples contained microscopic fragments of charcoal, reflecting fire activity by people in the area. Pollen and spores were very sparse in sample 1008, with insufficient present for meaningful counting. The pollen and spore assemblages of the other two samples were variably dominated by spores of bracken (*Pteridium esculentum*) fern, ferns with monolete spores, and hornworts (Anthocerotopsida) (Fig. 1). Pollen of puha/dandelion (*Sonchus/Taraxacum*) type also featured.

These spore types, coincident with the charcoal and negligible pollen of forest tree taxa, reflect a majorly disturbed landscape in part cleared of forest by people (Fig. 1). Bracken is an invasive, indigenous ground fern with widely dispersed spores, common in New Zealand pollen spectra since human settlement and almost always associated with large-scale, repeated burning of forest by early Māori, and subsequently

Europeans. It can form tall, dense stands over extensive areas. Monolete spores, bean-shaped and difficult to differentiate, are produced by many of New Zealand's numerous native species of ground ferns and often reflect forest disturbance. Hornworts are small inconspicuous plants that commonly colonise freshly disturbed and exposed soils (Wilmshurst et al. 1999). Puha is native to New Zealand while dandelion is European introduced; both are invasive herbaceous plants following vegetation disturbance and pollen of the two can be difficult to differentiate.

Pollen of a Māori introduced cultigen was also identified, namely ti pore (*Cordyline fruticosa*, Pacific Island cabbage tree), found in sample 1009 (Fig. 1). This species is not to be confused with New Zealand's several endemic *Cordyline* species.

Phytoliths and other biosilicates

The sample assemblages were variable dominated by tree/shrub and fern phytoliths, with some grass (Poaceae) phytoliths (Fig. 2). The tree/shrub phytoliths comprised mostly nikau (*Rhopalostylis*) palm and spherical nodular types, with the latter originating from twigs and wood. Nikau phytolith type is from the fronds. This species is one of the few taxa that can be identified to species level in the New Zealand phytolith flora (Kondo et al. 1994). In the North Island, nikau is found in coastal and adjacent lowlands, and in abundance only near coasts, often persisting after forest clearance (Macphail and McQueen 1983). Given the large amounts of bracken spores in the samples, the fern phytoliths in this case are likely mostly from this species, which along with the grass phytoliths supports the pollen evidence for large scale landscape disturbance (Fig. 1).

The large amounts of tree/shrub phytoliths in the samples could seem at odds with the very low tree pollen representation at the site (Fig. 1, 2). This apparent anomaly can be explained by differential preservation and human activity. Some of these phytoliths could reflect the pre-settlement forest; being non-organic, phytoliths can accumulate in substrates for much longer than pollen and spores due to their generally greater resistance to decay. In addition, these phytoliths could partly reflect the use of nikau fronds and wood as fuel for fire activities.

Other biosilicates found in the midden comprised fragments of sponge spicules (Fig. 2). These remains reflect the use of aquatic resources at the site.

Starch and other plant material

Two types of starch were identified in this study. One type, found in samples 1004 and 1008, comprised numerous degraded starch grains consistent with the tuberous root of cf. kūmara (*Ipomoea batatas*) (Fig. 2). Fragments of xylem cells (tracheary tissue) consistent with the root of this species were also found. The other type of starch, noted in sample 1009, comprised a very small amount of fragments of degraded masses of starch grains consistent with the corm of cf. taro (*Colocasia esculenta*). Starch grain decay involves progressive loss of visibility in cross-polarised light, discoloration, expansion, distortion, and disintegration (Horrocks and Weisler 2006, Horrocks et al. 2007).

Maori agriculture

Kūmara, taro, and ti pore, the Māori introduced starch cultigens identified in this study, are part of the small group of six introduced species cultivated by Māori at the time of European contact in the late 18th century. Almost all the numerous plant species (70+) identified as introduced to Polynesia by early people are native to various regions within the broad area from Africa to Melanesia (Whistler 2009). The native range of taro is Southeast Asia. The native range of ti pore is probably the broad area between the Himalayas and northern Australia. Kūmara, also known as sweet potato, is one of the few exceptions. This species originated in South America, its introduction to the Pacific a result of Polynesian contact (Hather and Kirch 1991).

References

Handley, S.J., Swales, A., Horrocks, M., Gibbs, M., Carter, M., Ovenden, R., Stead, J. 2020. Historic and contemporary anthropogenic effects on granulometry and species composition detected from sediment cores and death assemblages, Nelson Bays, Aotearoa-New Zealand. *Continental Shelf Research*, doi: 10.1016/j.csr.2020.104147.

Hather, J., Kirch, P.V. 1991. Prehistoric sweet potato (*Ipomoea batatas*) from Mangaia Island, central Polynesia. *Antiquity* 65, 887-893.

Hayward, B.W., Grenfell, H.R., Nicholson, K., Parker, R., Wilmshurst, J., Horrocks, M., Swales, A., Sabaa, A.T. 2004. Foraminiferal record of human impact on intertidal estuarine environments in New Zealand's largest city. *Marine Micropalaeontology* 53, 37-66.

Horrocks, M. 2004. Polynesian plant subsistence in prehistoric New Zealand: A summary of the microfossil evidence. *New Zealand Journal of Botany* 42, 321-334.

Horrocks, M. 2020. Recovering plant microfossils from archaeological and other paleoenvironmental deposits: A practical guide developed from Pacific Region experience. *Asian Perspectives* 59, 186-208.

Horrocks, M., Baisden, W.T., Flenley, J., Feek, D., González Nualart, L., Haoa-Cardinali, S., Edmunds Gorman, T. 2012a. Fossil plant remains at Rano Raraku, Easter Island's statue quarry: Evidence for past elevated lake level and ancient Polynesian agriculture. *Journal of Paleolimnology* 48, 767-783.

Horrocks, M., Baisden, W.T., Flenley, J., Feek, D., Haoa-Cardinali, S., González Nualart, L., Edmunds Gorman, T. 2017. Pollen, phytolith and starch analyses of dryland soils from Easter Island show widespread vegetation clearance and Polynesian-introduced crops. *Palynology* 41, 339-350.

Horrocks, M., Baisden, W.T., Flenley, J., Feek, D., Love, C.M., Haoa-Cardinali, S., González Nualart, L., Edmunds Gorman, T. 2016. Pollen, phytolith and starch analyses of dryland soils from Easter Island show widespread vegetation clearance and Polynesian-introduced crops. *Palynology* 41, 339-350.

Horrocks, M., Baisden, W.T., Nieuwoudt, M.K., Flenley, J., Feek, D., González Nualart, L., Haoa-Cardinali, S., Edmunds Gorman, T. 2012b. Microfossils of Polynesian cultigens in lake sediment cores from Rano Kau, Easter Island. *Journal of Paleolimnology* 47, 105-284.

Horrocks, M., Barber, I. 2005. Microfossils of introduced starch cultigens from an early wetland ditch in New Zealand. *Archaeology in Oceania* 40, 106-114.

Horrocks, M., Brown, A., Brown J., Presswell, B. In press. A plant and parasite record of a midden on Auckland Isthmus, New Zealand, reveals large scale landscape disturbance, Māori introduced cultigens, and helminthiasis. *Asian Perspectives*.

Horrocks, M., Campbell, M., Gumbley, W. 2007. A short note on starch and xylem of *Ipomoea batatas* (sweet potato) in archaeological deposits from northern New Zealand. *Journal of Archaeological Science* 34, 1441-1448.

Horrocks, M., Nieuwoudt, M.K., Kinaston, R., Buckley, H., Bedford, S. 2014. Microfossil and Fourier Transform InfraRed analyses of Lapita and post-Lapita human dental calculus from Vanuatu, Southwest Pacific. *Journal of the Royal Society of New Zealand* 44, 17-33.

Horrocks, M., Smith, I.W.G., Nichol, S.L., Wallace, R. 2008. Sediment, soil and plant microfossil analysis of Maori gardens at Anaura Bay, eastern North Island, New Zealand: Comparison with descriptions made in 1769 by Captain Cook's expedition. *Journal of Archaeological Science* 35, 2446-2464.

Horrocks, M., Weisler, M.I. 2006. A short note on starch and xylem of *Colocasia esculenta* (taro) in archaeological deposits from Pitcairn Island, southeast Polynesia. *Journal of Archaeological Science* 33, 1189-1193.

Kahn, J.G., Horrocks, M., Nieuwoudt, M.K. 2014. Agriculture, domestic production, and site function: Micro-fossil analyses and late prehistoric landscapes of the Society Islands. *Economic Botany* 68, 246-263.

Kondo, R., Childs, C., Atkinson, I. 1994. *Opal phytoliths of New Zealand*. Manaaki Whenua Press, Lincoln.

Macphail, M.K., McQueen, D.R. 1983. The value of New Zealand pollen and spores as indicators of Cenozoic vegetation and climates. *Tuatara* 26, 37-59.

McGlone, M.S., Salinger, M.J., Moar, N.T. 1993. Paleovegetation studies of New Zealand's climate since the Last Glacial Maximum. In: Wright et al. (eds.) *Global climates since the Last Glacial Maximum*. University of Minnesota Press,

Minneapolis, pp. 294-317.
Moore, P.D., Webb, J.A., Collinson, M.E. 1991. *Pollen analysis, 2nd edn.* Blackwell Scientific, London.
Pearsall, D.M. 2015. *Paleoethnobotany: A handbook of procedures, 3rd edn.* Left Coast Press, Walnut Creek.
Piperno, D.R. 2006. *Phytoliths: A comprehensive guide for archaeologists and paleoecologists.* Altamira Press, Lanham.
Prebble, M., Anderson, A.J., Augustinus, P., Emmitt, J., Fallon, S.J., Furey, L.L., Holdaway, S.J., Jorgensen, A., Ladefoged, T.N., Matthews, P.J., Meyer, J-Y., Phillipps, R., Wallace, R., Porch, N. 2019. Early tropical crop production in marginal subtropical and temperate Polynesia. *PNAS* 116, 8824-8833.
Whistler, W.A. 2009. *Plants of the Canoe People: An ethnobotanical voyage through Polynesia.* National Tropical Botanical Garden, Lawai, Kaua'i.
Wilmshurst, J.M., Eden, D.E., Froggatt, P.C. 1999. Late Holocene forest disturbance in Gisborne, New Zealand: A comparison of terrestrial and marine pollen records. *New Zealand Journal of Botany* 37, 523-540.

Appendix

Plant microfossil methods

Pollen analysis

Pollen analysis includes pollen grains of seed plants and spores of ferns and other plants. It provides insight into past vegetation and environments, and in New Zealand allows the differentiation of sediments deposited in pre-settlement, early Māori, and European times (McGlone et al. 1993, Hayward et al. 2004). Pollen can also provide evidence from archaeological sites of Māori introduced plants, for example bottle gourd, paper mulberry, and taro, and European introduced crops such as maize (Horrocks 2004; Horrocks et al. 2008, in press; Prebble et al. 2019). As well as at archaeological sites, taro pollen has also been identified in an offshore marine sediment core (Handley et al. 2020).

The samples were prepared for pollen analysis by the standard acetolysis method (Moore et al. 1991, Horrocks 2020). For samples 1004 and 1009, at least 145 pollen grains and spores were counted and the slides were scanned for types not found during the counts. Sample 1008 had insufficient pollen and spores for meaningful counting. The slide for that sample was still scanned, and the occasional pollen and spore type noted.

Microscopic fragments of charcoal were also extracted during pollen preparation, providing evidence of fire. Starch and other plant remains can sometimes be found in pollen preparations.

Phytolith analysis

Phytoliths are particles of silica formed in inflorescences, stems, leaves, and roots of many plant species (Piperno 2006). Phytolith analysis compliments pollen analysis and, like pollen, can provide evidence for Māori introduced bottle gourd and paper mulberry (Horrocks 2004). Other types of microscopic biosilicates, notably diatoms, radiolarians, and sponge spicules, are extracted along with phytoliths during preparation. Diatoms are unicellular algae and have cell walls composed of silica; radiolarians are a type of amoeboid protozoa with siliceous skeletons; sponges are multi-cellular animals with skeletons often composed of siliceous spicules. Diatoms are found in aquatic and sub-

aquatic environments; radiolarians and sponges are exclusively aquatic. Diatoms and sponges are found in both marine and freshwater environments; radiolarians are exclusively of marine origin.

The samples were prepared for phytolith analysis by density separation (Piperno 2006, Horrocks 2020). At least 150 phytoliths were counted for each sample and the slides were scanned for types not found during the counts.

Analysis of starch and other plant material

This analysis includes starch grains and other plant material such as calcium oxalate crystals and xylem (Pearsall 2015). Starch is the main substance of food storage for plants and is mostly found in high concentrations of microscopic grains in underground stems (e.g., tubers and corms), roots, and seeds. The grains are synthesised and stored in amyloplasts; sub-cellular units specialised for this function. Calcium oxalate crystals, comprising raphides which are needle-like and druses which are compound, are found in both the aerial and underground parts of many plant taxa. Xylem is a vascular tissue comprising elongated cells through which most of the water and minerals of a plant are conducted. Starch analysis can provide evidence from archaeological sites for Māori introduced starch crops, such as kūmara, taro and yam, and European introduced crops such as potato (Horrocks and Barber 2005, Horrocks and Weisler 2006, Horrocks et al. 2007, 2008). As well as at archaeological sites, kūmara and taro starch and associated material have also been identified in an offshore marine sediment core (Handley et al. 2020).

Advances in this method include the use of Fourier Transform InfraRed spectroscopy to positively identify degraded starch, often uncertain due to loss of distinguishing features, and the discovery of non-starch taro microfossil types, namely shoot epidermal tissue and phenolic inclusions from the skin of the corm (Horrocks and Barber 2005, Horrocks et al. 2012a, 2012b, 2014, 2016, 2017, Kahn et al. 2014).

Starch and other remains were prepared for analysis by density separation and presence/absence noted (Pearsall 2015, Horrocks 2020). These remains can sometimes be found in pollen preparations despite the harsh chemicals used in that procedure.

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APPENDIX D – WATER SUPPLY BUILDING RECORDING

Introduction

This section presents the recording of the old water supply building near the Three Kings Quarry at 1029 Mount Eden Road. The building was originally a house, probably constructed during the 1930s, and was converted into a water supply building in the 1990s. The building plans for the conversion held by Auckland Council are provided in Figure 1 to Figure 5 (no clearer copies could be obtained). The building was of limited heritage value and had been significantly altered during the late 20th and 21st centuries. It has now been demolished as a part of the housing development at the Three Kings Quarry.

Recording prior to demolition was undertaken on 6 August 2020 with demolition recorded on 20-26 January 2021.

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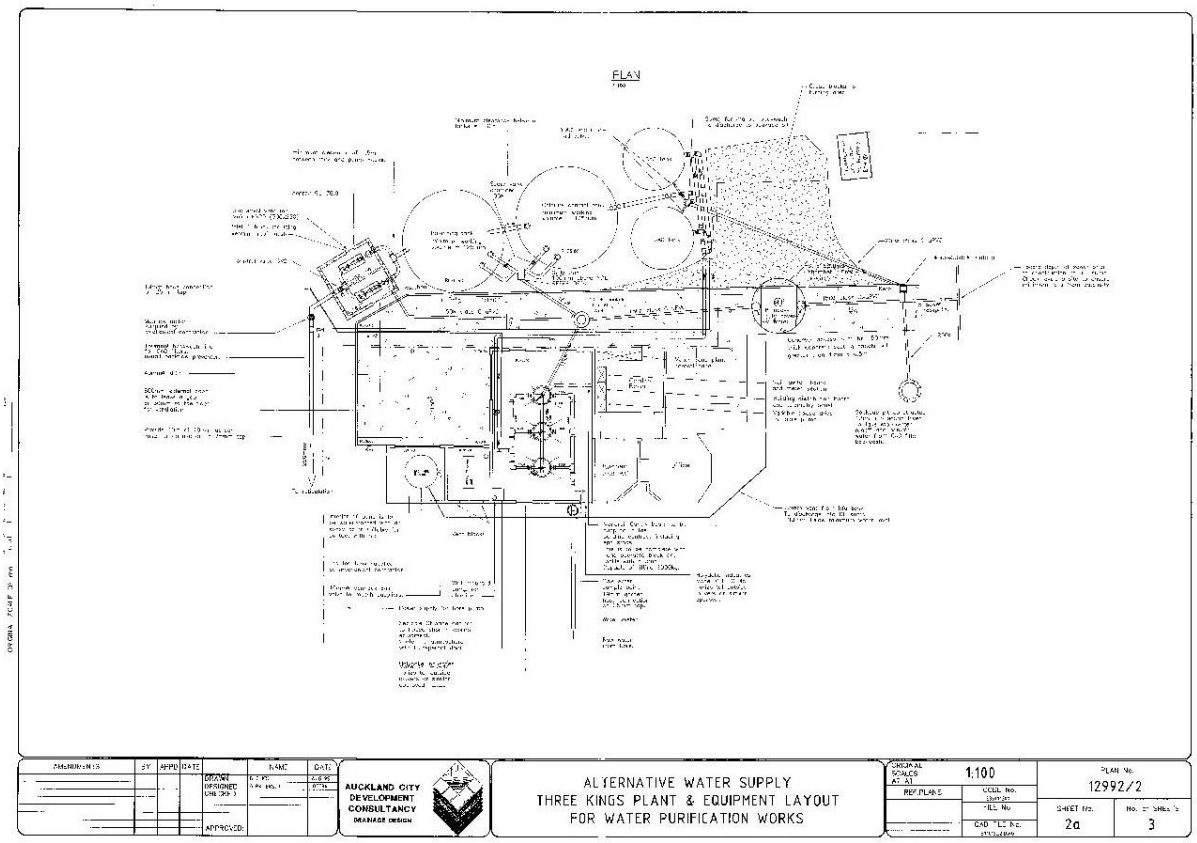

Figure 1. Plan of the water supply building

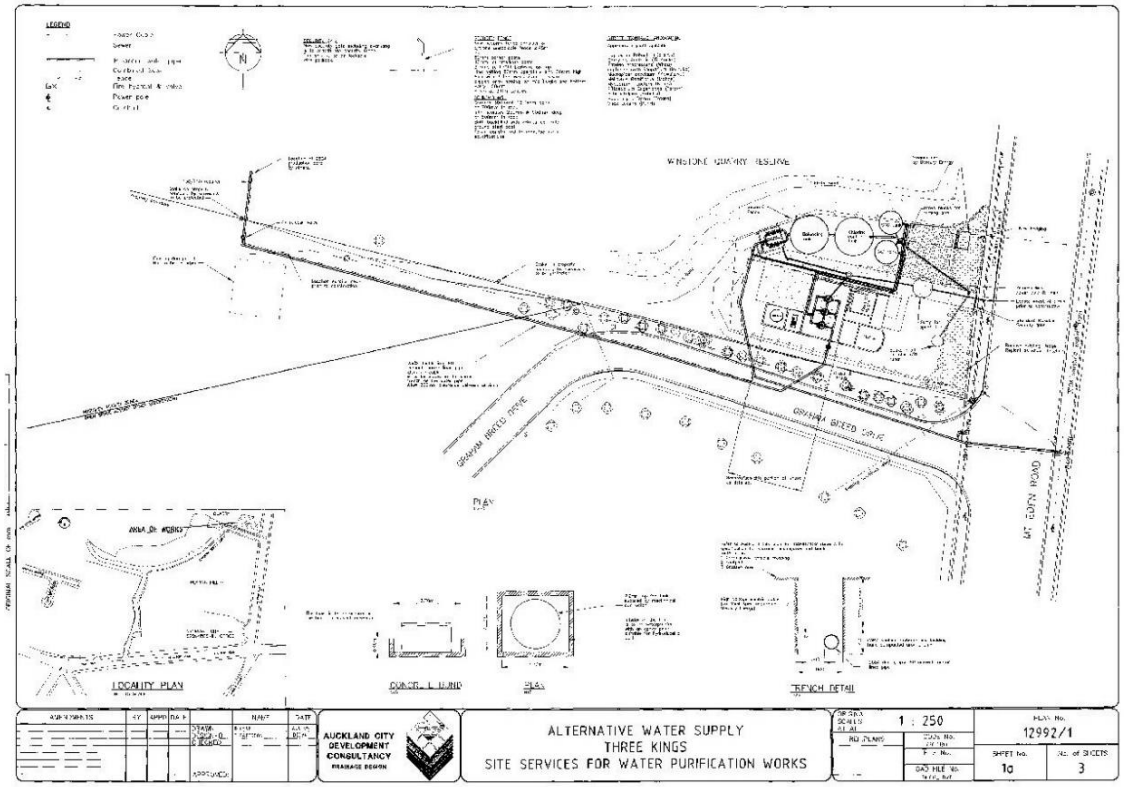

Figure 2. Overview of property during development of the water purification works

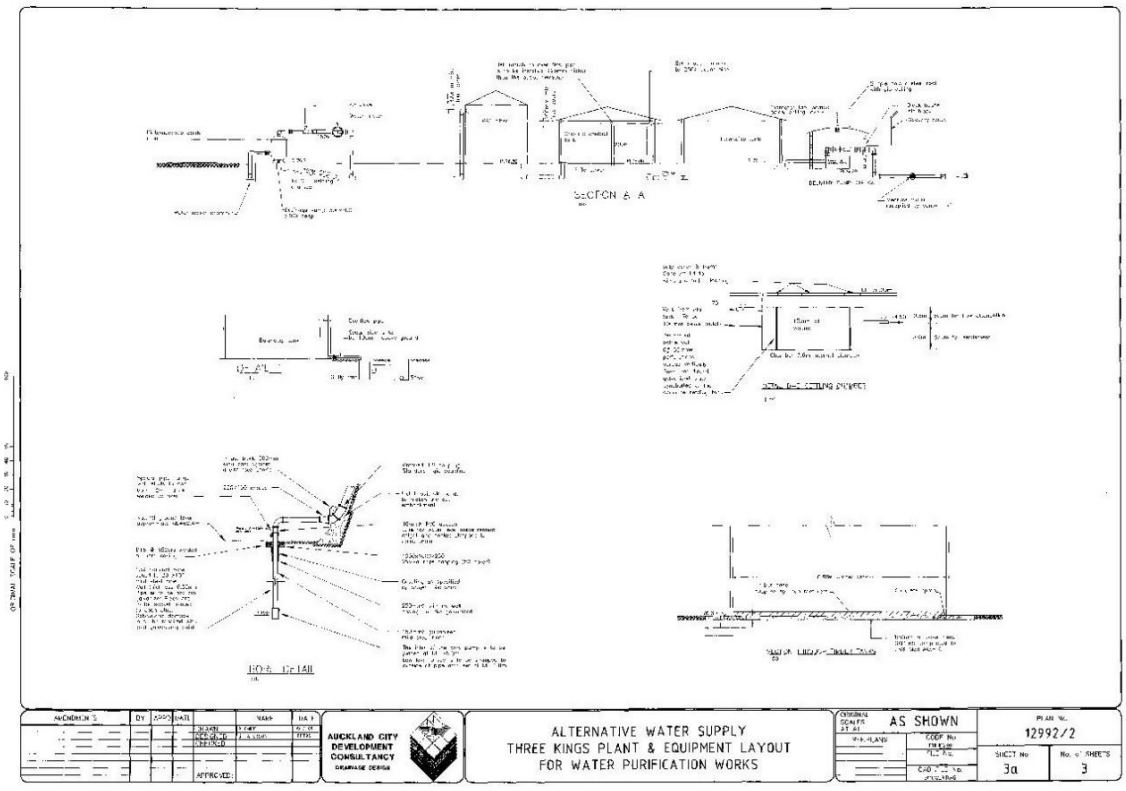

Figure 3. Sections through the building showing the water purification works

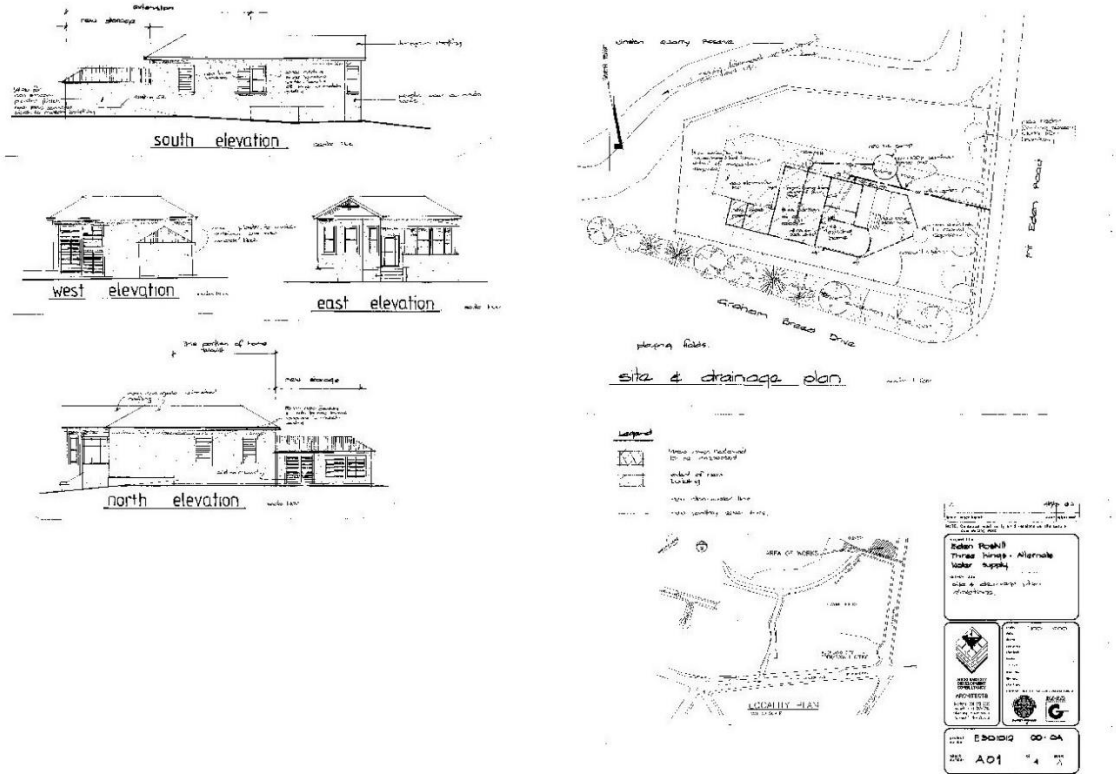

Figure 4. Elevations of the water supply building

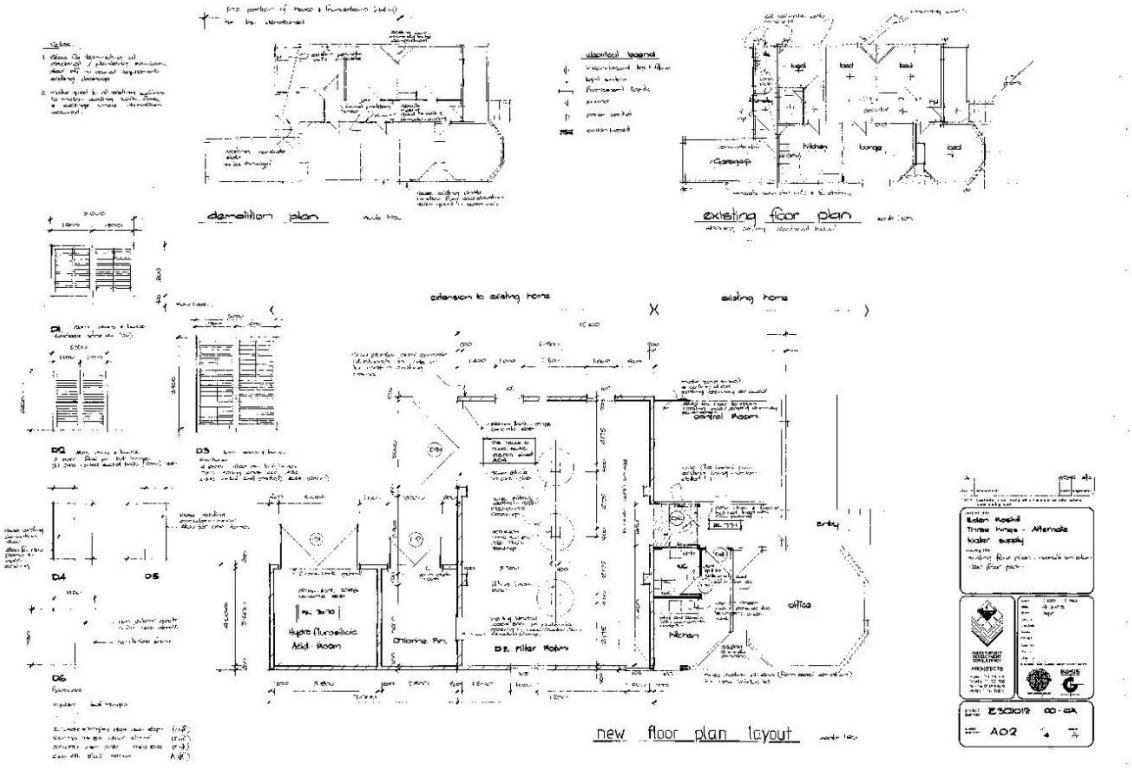

Figure 5. Floor plan of the original office building with new floor plan following development of the water supply building

Pre-Demolition Photographic Record

Exterior

The front (eastern) part of the original house appeared to be unmodified. It was a single bay house, with a bay window and gable roof (on the southern side) and a small semi-enclosed veranda with an entrance door and a double sash window (Figure 6). It had standard sheet metal roofing (Figure 7). A small bullnose roofing component covered the veranda. Moulded concrete steps led up the veranda with two low square pillars at the front.

While the overall shape of the building was designed to mimic the typical weatherboard housing of the area, the building was made from concrete which was plastered and painted. Some wooden elements had been added around the bay window and concrete square-tooth moulded elements were apparent above the main bay windows and running above the front of the veranda (Figure 8 and Figure 9).

The door was one of the better features of the building, but it was interesting to note that the frame was only present on the top and right-hand sides, with no frame on the left-hand side abutting the wall of the main room. Inside, the framing went all around the door, suggesting that the exterior frame may have been changed with additional plasterwork along the exterior wall of the main bay room, and an additional thickness of concrete/plaster was evident on this side of the bay (Figure 1). The panels around the door were a major feature, with shell-patterned coloured glass, although the glass panel in the door itself was plain frosted glass (Figure 10 and Figure 11).

The foundations of the building were visible when works to shut off the water exposed them on the northern side of the building. Figure 12 shows how the concrete foundations were built straight onto the basalt sub-surface. Drilling to allow the various pipe works would have been required.

The back (western part) of the original building had been modified and adapted for water supply purposes. Towards the back of the building on the northern side, openings had been created with two long and high ventilation portals for the pump area (Figure 7, Figure 13). Similar roller doors were found at the back (western end) of the building and along the northern side of the western extension, which was accessible only from the outside and used for storage (Figure 13).

Photography along the southern side of the building was limited by the closeness of the boundary and the trees (Figure 14). However, apart from two large, vented windows for the pumphouse at the back, a sash window in the older part of the building, and a small access opening to the underfloor of the building beneath the front room, the wall was plastered. Subsequent tree clearance (prior to demolition) allowed for better photographs of this side of the building (Figure 15) and the chimney (Figure 16).

A brief inspection under the building showed concrete foundation piles and miscellaneous debris (Figure 7 – Figure 19).

Other exterior elements included a small outbuilding associated with the pump machinery (Figure 20) and a stone wall in good condition along the Mount Eden Road frontage (Figure 21). Both elements were probably added after the original building was constructed.

Figure 6. Front (eastern) side of the building facing towards Mount Eden Road

Figure 7. View of NE corner of building showing original front and pumphouse extension to the rear

Figure 8. Decoration above bay window

Figure 9. Moulded elements in veranda roof

Figure 10. Original front door of house

Figure 11. Inside view of front door

Figure 12. View of foundations on northern side of building

Figure 13. Back of building showing roller doors behind pump house and eastern extension

Figure 14. Southern side of building looking east (left) and west (right)

Figure 15. View of southern side of building following tree clearance

Figure 16. Photograph of the chimney

Figure 17. Access to underfloor beneath main room of building

Figure 18. View of concrete foundations, flooring and debris beneath the building

Figure 19. Photograph taken under the building showing concrete piles and floor joists

Figure 20. Small outbuilding to the NW of the main building related to water supply

Figure 21. View of stone wall along Mount Eden Road and building, from opposite side of the road

Interior

There was little original interior fabric inside the building. The hallway (Figure 22) had been cut off at the western end during the pump machinery installation but some of the wooden tongue and groove flooring was present and continued into the main front room with the bay window, which had served as an office when converted in the 1990s.

In the main front room, modern gib board had been used and simple cabinetry had been added to the room relatively recently (Figure 23 and Figure 24). In parts where the wall had been damaged, it was possible to see some of the original wood framing and concrete block work (Figure 25 and Figure 26).

Following removal of the flooring in January 2021, the joists and bearers were exposed (Figure 27) and were in relatively standard form. They were tied into the concrete foundation.

Behind the main room, another room (square in plan) had been modified to include a modern bathroom and kitchenette (Figure 28–Figure 30).

Access to the northern room was delayed initially as the room was locked as machinery was still in use. However, by September 2020, access became possible, and the room was accessed. It was rectangular in plan. At the eastern end of the room was the double sash window and at the western end was exposed concrete blockwork (Figure 31–Figure 34).

The flooring was plywood and relatively modern, probably because of work required to add the control hardware for the pumphouse operation (Figure 31–Figure 34). The bearers and joists were exposed in January 2021 (Figure 34) and many appeared to have been replaced in relatively recently times with some original components re-used.

Double doors led down to the pump room which had been added to the back of the house. The floor was concrete with drainage and the pump and machinery was still visible and in working condition. Drainage to cope with overflows had been carefully set into the floor and piles for some other machinery were also visible (Figure 35–Figure 39).

A map showing the properties ‘that may receive water from the Three Kings water supply, as defined by pressure zone’ was also found (Figure 40).

One minor architectural feature was noted – the bases of some of the concrete columns inside the building were elegantly fluted at the base (Figure 41).

It was not possible to access the western exterior extension.

Figure 22. Hallway looking west towards pump room

Figure 23. View of bay window in main (south) room

Figure 24. Back of main room showing cabinetry

Figure 25. View of interior wood frame and concrete at back of main room (west)

Figure 26. Floor joists and bearers exposed in main room

Figure 27. View into back room from hallway

Figure 28. Kitchenette in back room

Figure 29. Bathroom in back room

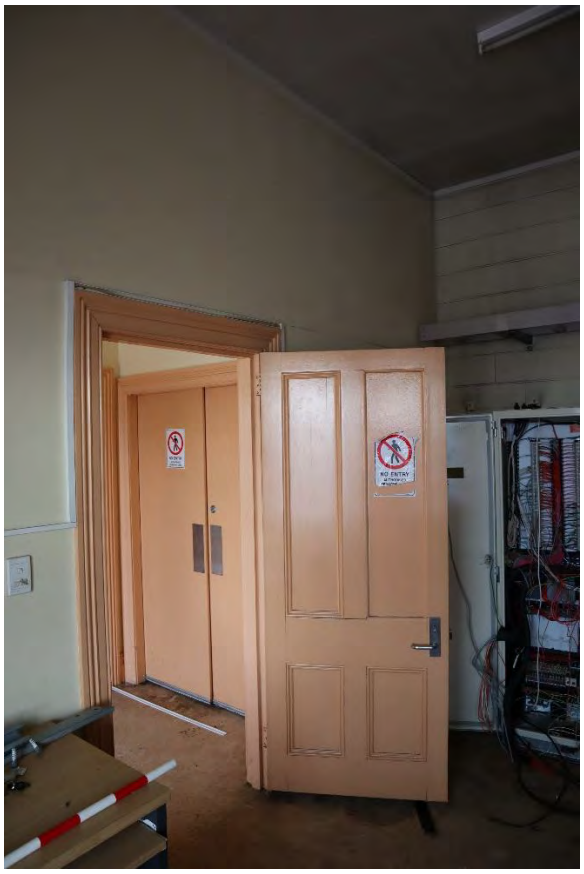

Figure 30. Looking at door towards hall from the north room, with doors to pumproom beyond

Figure 31. East wall in north room

Figure 32. Back (west) wall of north room

Figure 33. North wall of north room

Figure 34. Exposed bearers and joists in north room with plywood flooring

Figure 35. View of pumproom looking across to NW corner

Figure 36. View of pumproom looking to the south

Figure 37. View of interior (eastern) wall of pump room)

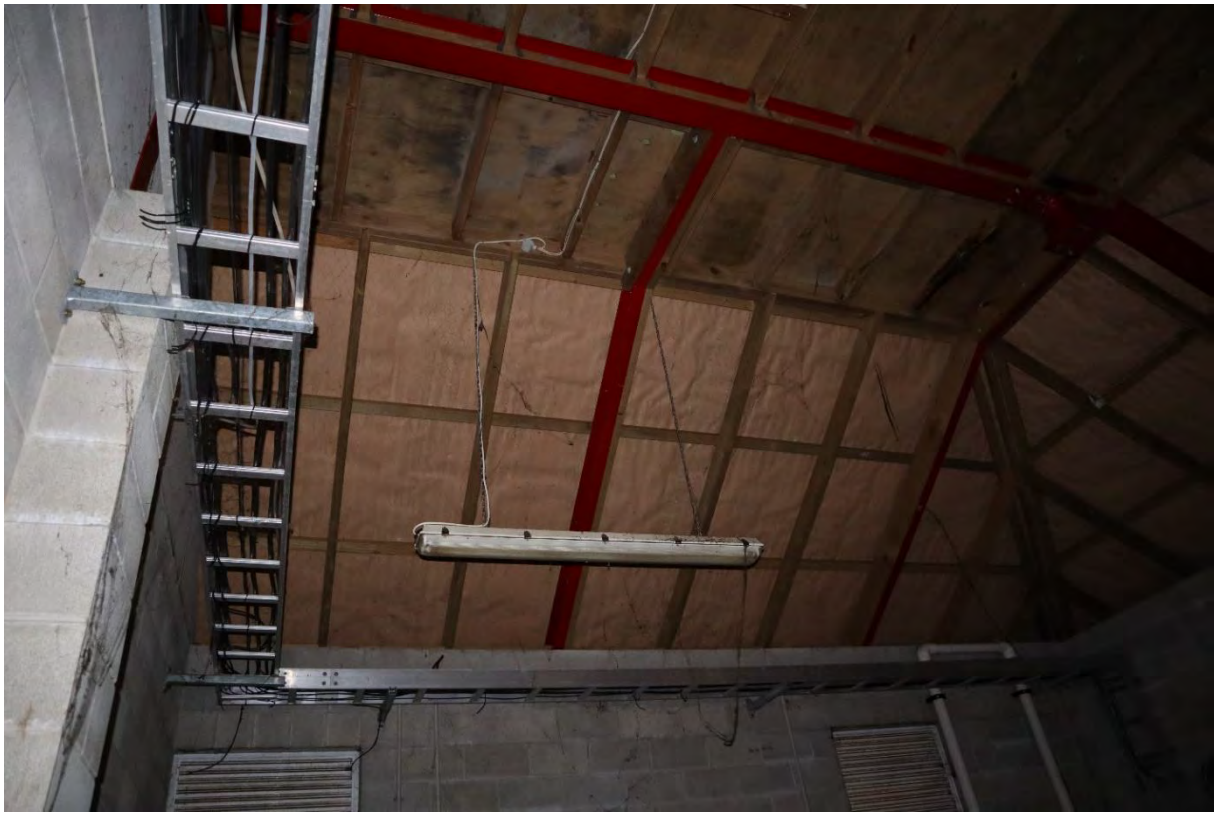

Figure 38. View of ceiling in pump room

Figure 39. View of drain and old piles running towards the south (scale is 20cm)

Figure 40. Old sign showing map of area

Figure 41. Moulded concrete fluted base on pillar

Demolition Photographic Recording

Area around the Main Building

Recording of the dry stone retaining walls around the building both during the initial assessment (Cameron 2020a) and following site clearance works showed that basalt blocks had been used to the south of the building along Grahame Breed Drive and along the eastern part of the northern boundary of the water supply grounds extending onto Mount Eden Road (Figure 42). On the south side (Figure 43, Figure 44) the building was over 1m below the level of the road. Along the northern boundary remnant dry stone basalt walls were also visible, but a large bund had been built over them to separate the pumphouse from the quarry (Figure 45, Figure 46). At the northeast corner of the water supply building grounds, this section joined to what appeared to be a collapsed wall section along Mount Eden Road running to the north (Figure 47). The length of wall could only be confirmed for approximately 20m. The much more intact and well-built stone wall along the front of the property has already been noted (Figure 21).

Demolition of the exterior pump house structures was carried out in September 2020. The concrete block building to the northwest of the main pumphouse building was broken up (Figure 48–Figure 50), showing the straightforward construction used and the various utilities. No detailed notes were taken of the building, which was of post-1990 construction.

Figure 42. Aerial photograph showing the water supply building grounds with areas containing dry stone wall sections outlined in red (source: Auckland Council GeoMaps)

Figure 43. Photographs showing dry stone wall remains along the southern boundary of the water supply building grounds along Grahame Breed Drive (looking south-southwest), during the 2020 assessment

Figure 44. Exposed basalt retaining along the southern side of the property

Figure 45. Exposed retaining on northern side of the property

Figure 46. Left photograph showing the section of wall along the northern boundary of the water supply grounds after tree removal (looking east) and right photograph showing the possible dry stone wall section in the northeast corner (looking northeast), taken during initial site assessment

Figure 47. Photograph looking north along Mount Eden Road with possible collapsed dry stone wall remains in the foreground, taken during the initial site assessment

Figure 48. Demolition of the NW pump building showing roof removal (looking east)

Figure 49. Looking down at the exterior building being demolished

Figure 50. Concrete block exterior structure during demolition

Demolition of the Main Water Supply Building

Demolition began from the rear, tearing down the small attached rear addition (Figure 51). Demolition then moved towards the main room of the pump house, starting first with the roof on the northern side (Figure 52). Following the roof, the northern wall was demolished, followed by the northern portion of the front of the original part of the building, tearing down the front veranda/porch (Figure 53). Demolition then moved to the southern (front) portion of the building, leaving the southern wall and chimney in place and revealing what the concrete chimney looked like from below the roof (Figure 54–Figure 56).

Shortly afterwards the excavator moved towards the centre of the building and demolished the entire eastern half of the structure (Figure 56). Work then began on the remaining original front southern wall.

Several decorative timber elements were recovered from the original front facing portion of the building (Figure 57–Figure 59). Removal of these small decorative pieces was difficult and most of them were broken in the process of removal. Other pieces from the front of the building were photographed and recorded including various pieces of timber, such as a section of gable (Figure 60). The saw marks on many of these timber pieces appeared to be modern circular-saw marks (Figure 61). A sash window weight and section of window flashing was also recorded (Figure 62).

The chimney was then demolished and subsequently the remainder of the original (front facing) portion of the building (Figure 63 and Figure 64). The chimney was constructed out of ceramic flues fixed within poured concrete. Some of this poured concrete was made to be ornate and decorative such as the upper portion of the chimney (see Figure 63, top). The final portions of the building to be removed were the walls of the northwest corner of the pump house room (Figure 65).

The removal of the demolition rubble/building material revealed the concrete base beneath both the original front facing portion of the house and the modified rear portion (Figure 66). Some mid-late 20th century waste was found below the floorboards of the front facing portion of the building during demolition (Figure 67).

No archaeological deposits were unearthed during demolition. The removal of the rubble and demolition material took several days due to the lack of space and transport time.

Figure 51. Initial demolition working at the rear (western side) of the building. Facing south

Figure 52. Demolition beginning from the northeastern part of the main building (pump house room). Facing southwest

Figure 53. Demolition of the northwestern portion of the structure. Facing southeast

Figure 54. Demolition of the front facing portion of the structure beginning with the veranda and adjoining wall. Facing south

Figure 55. Demolition of the eastern portion of the building. Facing south

Figure 56. Demolition taking out the southeast portion of the structure (front facing portion). Note concrete chimney left standing, showing what it looked like from below the roof. Facing southwest

Figure 57. Decorative fretwork from the front of the structure. Scale interval 20cm

Figure 58. Decorative finial from the front of the structure. Scale interval 20cm

Figure 59. Decorative veranda post from front of the structure. Scale interval 20cm

Figure 60. Section of timber gable from the front of the house. Scale interval 20cm

Figure 61. Section of gable plank with circle-sawn cut marks. Scale interval 20cm

Figure 62. Top: sash window weight. Bottom: Section of window frame. Scale interval 20cm

Figure 63. Sections of chimney showing ceramic flues encased in concrete. Scale interval 20cm

Figure 64. Demolition of the original (front facing/eastern) portion of the building complete. Facing southwest

Figure 65. Demolition near completion. Only the southwest corner of the pump house left. Facing south

Figure 66. Demolition complete and material removed revealing concrete base. Note the pumphouse area is raised, with different concrete. Facing south

Figure 67. Modern domestic waste found beneath floorboards on the east/southeast side of the structure. Scale interval 20cm