Afetna Point, Saipan

Archaeological Investigations of a Latte Period Village and Historic Context in the Commonwealth of the Northern Mariana Islands

Boyd Dixon, Cherie Walth,
Kathy Mowrer and Danny Welch

with contributions by

Isla Nelson and Robert Jones

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Cover: Afetna Point to Agingan Point, Tinian in the background

Contents

List of Figures

List of Tables

Preface

This book is based on research conducted by Cardno GS between 2014 and 2017 during archaeological inventory survey and data recovery excavations at Parcel 004-I-52 in San Antonio, Saipan, in the Commonwealth of Northern Mariana Islands (CNMI). Preliminary results have been presented at the 2nd and 3rd Annual Marianas History Conferences held in Saipan and are available to the public via www.Guampedia.com. Rosanna Barcinas is especially thanked for coordination and inspiration to make these events and their contributions a reality.

The authors would like to acknowledge the following individuals and their institutions on Saipan for their continued support. At N15 Architects, Andrew Ashburn, Chris Fryling, and Catherine Shai maintained an open door policy with staff archaeologists. At Honest Profit International Ltd. (HPIL), Peter Che was instrumental in keeping staff archaeologists in the loop with Win Win Way's project manager Elaine Kwok and their construction scheduling. They ensured access to Hofschneider Engineering and project biologist and permit facilitator John Gourley.

The CNMI Historic Preservation Office (HPO) with Mertie Kani and her staff archaeologists coordinated their permitting requirements with project staff and the Japanese Consulate in a changing economic climate and Typhoon Soudelor. HPO staff archaeologists Erik Lash, Jennings Bunn, and Jim Pruitt helped guide the data recovery and laboratory analyses at critical junctures, and HPO review board members Dr. Hiro Kurashina and Don Farrell and especially Dr. Mike Carson, offered advice when sorely needed. Former San Antonio resident Robert Hunter at the Department of Community and Cultural Affairs (DCCA), welcomed staff archaeologists on more than one occasion and shared the CNMI Museum's guidelines plus childhood stories of the property.

John Scott of AMPROUXO graciously gave field staff an unexploded ordnance safety brief. Win Win Way safety officer Ponce Raza helped establish almost daily contact with the CNMI police department for removal of World War II era combat ordnance. Spontaneous encounters with Scott Russell of the CNMI Humanities Council also provided focus and context to almost daily surprises in the field, as did conversations with colleague Dr. Mike Dega at Scientific Consulting Services, Lon Bulgrin of Naval Facilities Engineering Command Marianas, the late Carmen Sanchez, and Sam McPheters.

SWCA staff osteologist, Kathy Mowrer, shared the challenges of fieldwork and always reported with a smile for everyone. Cherie Walth of SWCA crafted an excellent burial report out of hours of sand and sweat and sun. Dr. Mark Horrocks of Microfossil Research Ltd conducted microfossil identification from five subsistence features containing charcoal radiocarbon dated by Beta Analytic. Judy Amesbury of Micronesian Archaeological Research Services helped identify midden shell and tools, and Darlene Moore discussed the complexity of late Pre-Latte ceramics from the perspective of Chalan Piao. Dr. Jolie Liston discussed aspects of feasting in relation to cooking features at the site. Joe Garido and Joe Quinata also discussed alternative uses of dogas shells in earth oven cooking and traditional Chamorro place names, while Moneka de Oro discussed use of stone tools in traditional herbal medicine.

Cardno GS staff included project manager Todd McCurdy in Honolulu and Terry Rudolph in Boise, Guam archaeologists Rick Schaefer, Jacy Moore, and Brent Coffman, plus Saipan archaeologist John Castro. Boise based Cardno GS archaeologists Isla Nelson and Robert Jones shouldered much of the manuscript generation, while Dr. Danny Welch calibrated radiocarbon dates and integrated microfossil results and ground stone tools into the text. The opinions presented herein do not reflect those of Cardno GS, its subconsultants, the CNMI HPO, or HPIL and the senior author is responsible for all errors in reporting and interpretation.

The Procedures for the Treatment of Human Remains adopted by the CNMI in 1999 were followed during data recovery excavation, analysis, and reporting. Only selected photographs from analysis are included in this book as per HPO consultation. No photographs of excavated remains in the field are presented. Human remains were not removed from the island and are temporarily curated at the CNMI Museum of Culture and History pending reburial consultation with the Chamorro community, the HPO and DCCA, and HPIL.

This book is dedicated to the people of San Antonio, past and present, who have endured yet another disaster from Typhoon Yutu to become even more resilient.

Chapter 1

Introduction to Afetna Point on Saipan

1.1. Afetna Point Then and Now

When Spanish Captain General Ferdinand Magellan (Portuguese born Fernando de Magallanes) first anchored off the island of Guam in 1521, the inhabitants of the small Latte Period village at Afetna Point on the southwest coast of Saipan (Figure 1.1-1) some 218 kilometers (km) or 135 miles (mi) north were likely unaware. News from their Chamorro cousins to the south soon reached their shores probably along with iron nails, glass beads, and other objects of trade from the rather rude visitors.

Subsequent shipwrecks during the Manila Galleon trade period between the Philippines and Acapulco in Mexico (1565-1815) and the eventual arrival of Spanish missionaries and their military in 1668 would change that splendid isolation. Archaeological investigations of the Afetna Point village yielded traditional Latte Period burials, cooking features, ceramics, stone and shell tools, datable charcoal, and microfossils from food remains and fuel dating from the 1400s before Magellan's arrival to the early 1700s a century or more later, as well as Pre-Latte Period remains perhaps dating to A.D. 500-1000 or earlier. Examination of deeper excavations suggests the property may not have been habitable when sea levels were higher prior to 500 B.C. and at the arrival of the first Austronesian settlers a millenium or two earlier circa 1500 B.C. as indicated at other landward sites nearby.

No direct evidence of foreign Contact before Spanish occupation of the Mariana Islands in 1668 and the forced abandonment of Chamorros from Saipan during *La Reduccion* circa 1730 was encountered at the site, after which time the island remained virtually empty until the arrival of Carolinian and Chamorro settlers from Guam nearly a century later circa 1815. Spanish resettlement until 1898 (the Spanish-American War), the German occupation from 1898-1914 World War One (WWI), and the Japanese sugarcane period from 1914-1944 World War Two (WWII) left few traces on property which was located at some distance from the few population centers on the island to the north. However, the construction of a concrete Japanese ammunition magazine just before the war brought home the reality of global conflict to the native and immigrant residents, even if it was not obviously defended. Strongpoints were established at Agingan Point just to the south and measured targets were flagged in the lagoon for use during the American invasion.

On June 15, 1944, the location was called Yellow Beach 2 by the U.S. Marines and Army infantry braving Japanese artillery to establish a beachhead before capturing As Lito airfield (today Isely Field International Airport) the following day. The beachhead then served as a resupply landing for the next week or two as U.S. Marines and Army Infantry took the battle east and north to slowly clear the island of enemy strongpoints, and removed battle weary and wounded to off-shore medical treatment. An inventory survey in 2014 recorded post-war U.S. Coast Guard Loran Station buildings and antenna support structures, and a modern boxing rink and fruit stand built upon post-WWII era structural remains. Excavation in 2015 yielded subsurface remains of the late prehistoric village around a deep sand mine from the 1980s. Archaeological lab work conducted during 2017 yielded a complex record of this long history, from Pre-Latte artifacts and Latte Period features and burials to WWII Japanese war casualties, American combat weapons and discarded field gear, unexploded ordnance, and post-war disturbances.

Figure 1. Location of Saipan in the Northern Mariana Islands

Afetna Point has long been an idyllic landscape punctuated by episodes of intense struggle on a global scale for Saipan over centuries if not millennia, perhaps beginning nearby circa 1500 B.C. with initial settlement of the archipelago. Today regional competition for Asian tourism and American military investment makes Saipan and its neighbors once again a nexus of geopolitical struggle, but its prehistory has deep roots that tie the Mariana Islands and its modern culture to ancestral island SE Asia. Afetna Point contributes to this story and leaves the visitor captivated by its beauty today as it did in the past.

This book presents the results of the first half of this story, that of the late prehistoric or Latte Period village at the site and its historic context. Remains of the equally prolific WWII invasion beach site will have to await another telling.

1.2. Afetna Point Archaeological Project

The Afetna Point Archaeological Survey and Data Recovery Project was conducted by Cardno GS for Honest Profit Limited International (HPIL) of Hong Kong, People's Republic of China, in support of a proposed resort development at Parcel 004-I-052 in San Antonio, Saipan (Figure 1), Commonwealth of the Northern Mariana Islands (CNMI). The CNMI Historic Preservation Office (HPO) identified the project area as having a high potential for encountering significant archaeological and historical resources. Previous investigations reported subsurface archaeological deposits on the property, it is located on a National Historic Landmark WWII American invasion beach, and supported a USCG Long Range Navigation (LORAN) Station used from 1944 to 1978.

Figure 2. Project Location on Saipan

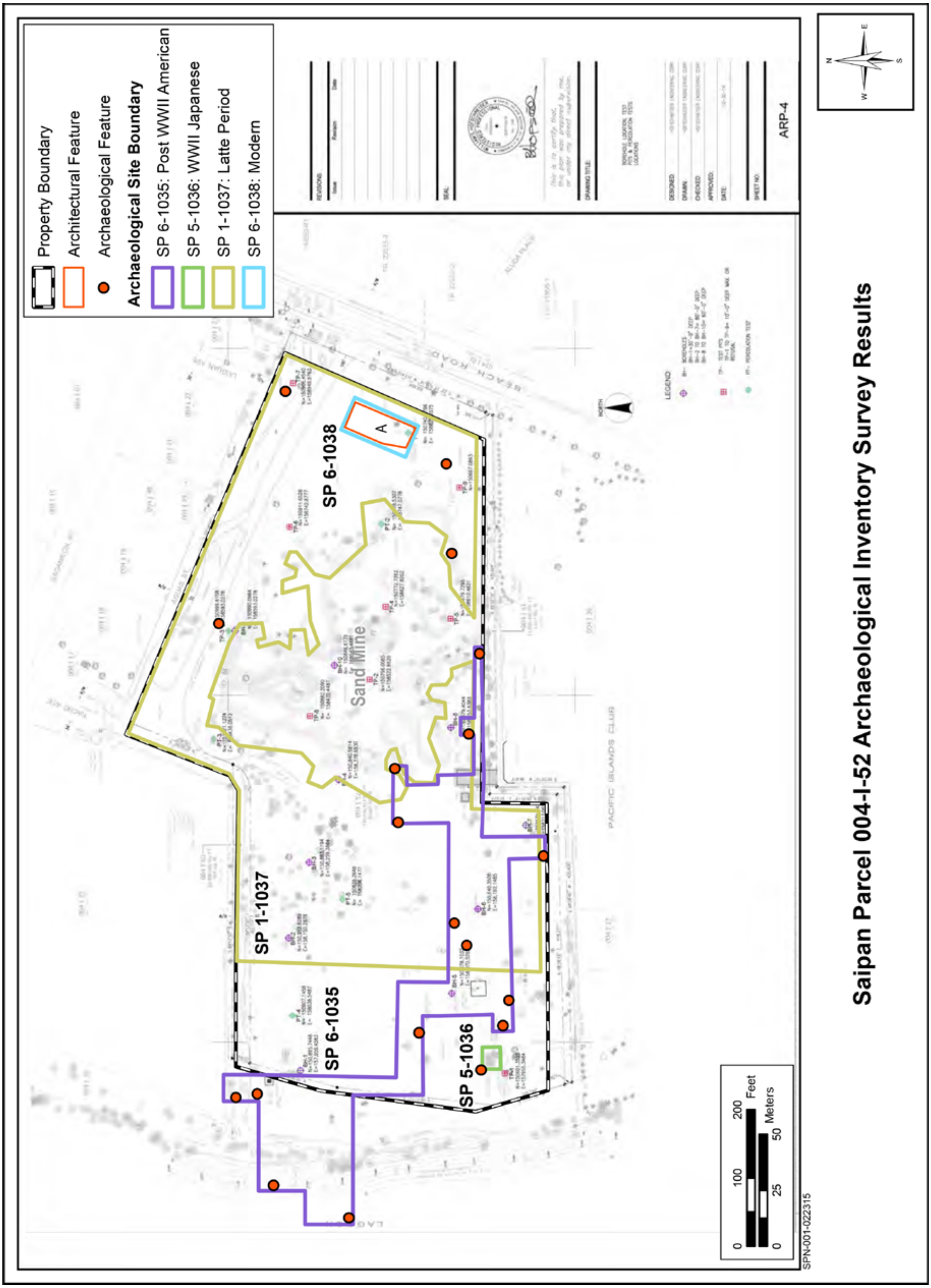

Figure 3. Archaeological Inventory Survey Results

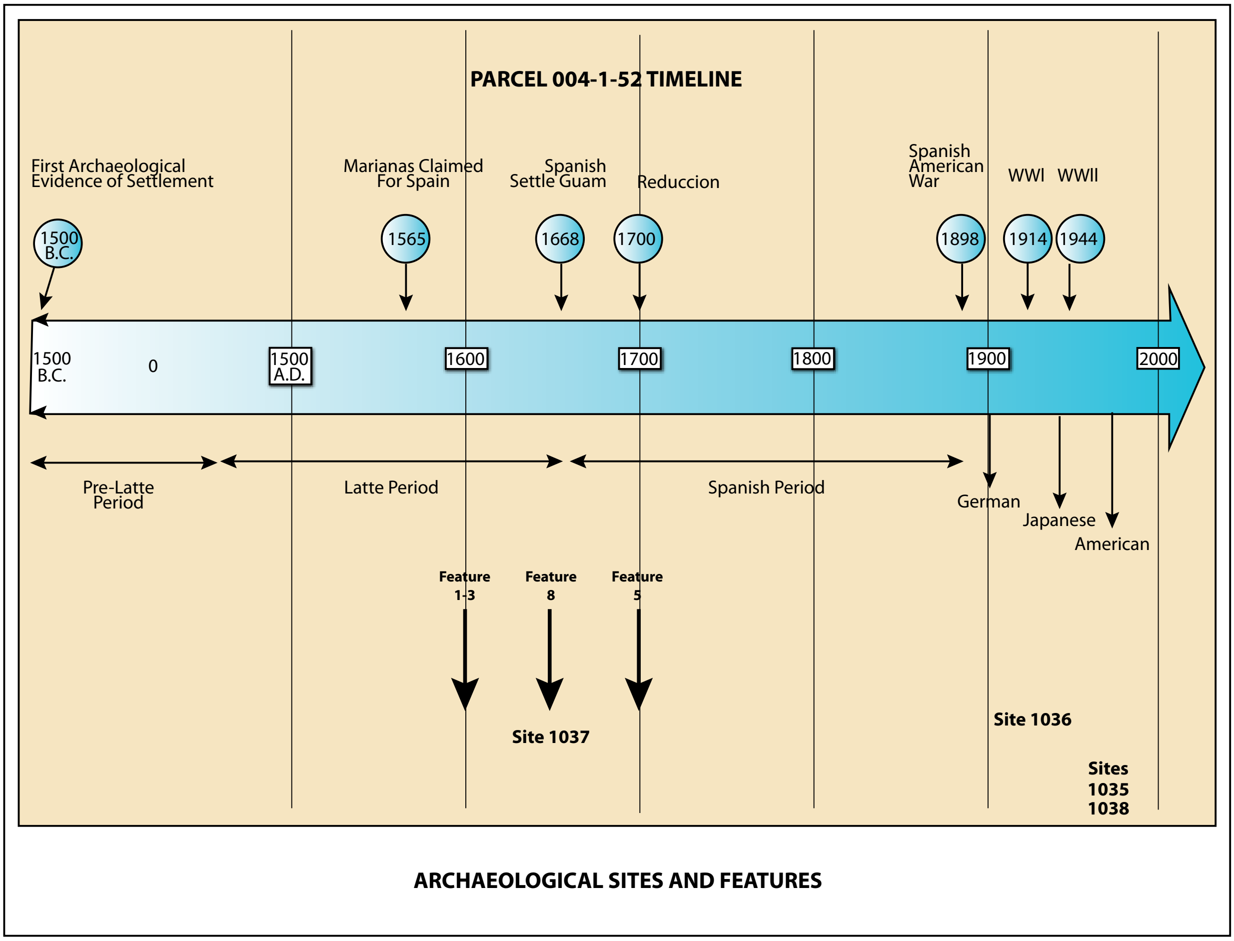

Figure 4. Timeline for Parcel 004-1-52, San Antonio, Saipan

The proposed resort development measured approximately 40,827 square meters (439,458 square feet), or 4.09 hectares (10.1 acres). It is situated immediately north of the Pacific Islands Club, bounded to the east by Beach Road (Figure 2), to the west by the Lagunan Garapan and Philippine Sea coast at Unai Afetna, and to the north by residential neighborhoods and San Antonio Middle School. In 1987, a sand mining project removed an unknown number of prehistoric human remains from the east half of the parcel, in an area measuring approximately 0.91 hectares (2.25 acres).

In 2015, Cardno GS completed an Archaeological Inventory Survey report of the project area that included National Register of Historic Places (NRHP) significance evaluations at four surface sites (Figures 3 and 4) with recommendations for their treatment (Dixon and McCurdy 2015a). The four archaeological sites were assigned permanent numbers by the CNMI HPO: SP 11037 is a subsurface cultural horizon with prehistoric remains; SP 5-1036 is a WWII Japanese ammunition magazine; SP 6-1035 is the remains of the WWII and Cold War USCG LORAN station; and SP 6-1038 is a modern concrete pad for a boxing rink and then a fruit stand formerly on the west side of Beach Road, with a WWII buried structural component.

The overall strategy employed during 2015 data recovery fieldwork and 2017 labwork, after consultation with CNMI HPO (Dixon and McCurdy 2015b and 2015c), consisted of implementing three phases of investigation. This strategy involved a combination of mechanical excavation conforming to the project engineering design including large scale vegetation clearing, global positional system (GPS) recording of all significant artifacts and features including burials, and manual excavations targeting features found to have intact remains for radiocarbon dating and microfossil analyses.

All activities outlined in this project complied with pertinent sections of the National Historic Preservation Act (NHPA) and associated 36 Code of Federal Regulations Part 800, as well as with CNMI Public Law 3-39 and in accordance with 55-10-725 *Standards for Excavation Permits. The Content, Format, and Submission Standards for Final Reports of Archaeological Projects in the CNMI*. When human remains were encountered the *Procedures for the Treatment of Human Remains* adopted by the CNMI in 1999 were followed.

All excavations, testing, and reporting relating to cultural resources in the form of archaeological sites, features, structures, artifacts, and human remains were carried out under the supervision of Cardno GS senior archaeologist Boyd Dixon, Ph.D. meeting the professional qualifications found in the Secretary of Interior Professional Qualification Standards, 48 Federal Register 44716.

Chapter 2

Environmental Context of Afetna Point

2.1. Physical Environment

2.1.1 Geology

The southern portion of Saipan, including the development parcel and the village of San Antonio, has broad, level lowlands formed of limestone terraces and accretional beach sand deposits with fault ridges that rise from Agingan Point toward the slopes of Mount Tapotchau at the center of the island (Young 1989) behind Lake Susupe and its surrounding marsh. The western coastal plain ranges from 100 meters (328.1 feet) wide near Puntan Agingan to 1 kilometer (0.62 mile) wide behind Lake Susupe, with extensive beaches protected by a shallow fringing reef that ends approximately 1 kilometer (0.62 mile) south of Afetna Point and the proposed project area.

2.1.2 Soils

The project area is located within Shioya loamy sand, 0 to 3 percent slopes. This type of soil is very deep, excessively drained, and is located on coastal strands. It was formed in water-deposited coral sand in areas that are typically long, narrow, and parallel to the shoreline. The surface layer is typically a very dark gray loamy sand and is approximately 19 centimeters (7.5 inches) thick. Below this layer is a very pale brown sand that extends to a depth of approximately 160 centimeters (63 inches) below surface. Cemented sand, coral rubble, or porous bedrock is situated below the sand at more than 150 centimeters (59.1 inches) below the surface. This soil has a rapid permeability, the water capacity is low, the runoff is slow, and there is a slight hazard of water erosion. Shioya loamy sand is best suited for urban development and not for farming or grazing (Young 1989).

2.1.3. Precipitation

The climate of Saipan is warm and humid throughout the year when daytime temperatures usually climb to about 30 degrees Celsius (86 degrees Fahrenheit) with a relative humidity level of about 70 percent. Nighttime temperatures fall to about 20 degrees Celsius (68 degrees Fahrenheit) with a relative humidity of about 90 percent. The mean average temperature is about 27 degrees Celsius (80.6 degrees Fahrenheit). Saipan rainfall has a monsoonal pattern, averaging 230 centimeters (90.6 inches) annually. It is highest during the months between July and November when it averages about 24 to 34 centimeters (9.4 to 13.4 inches) per month. Rainfall averages about 8 to 10 centimeters (3.1 to 3.9 inches) per month between December and June (Young 1989). West to northwest moving storm systems and typhoons bring heavy showers and occasional torrential downpours. During the survey and data recovery field seasons from December 2014 to July 2015, it was apparent that southwestern Saipan lies in a partial rainshadow from Mount Tapachau during prevailing trade winds, such that clouds and rain form in the afternoons to the north but less regularly drift over the coastal plain toward Agingan Point and Tinian.

2.1.4. Vegetation

The mixed secondary forest in the project area was characterized by project biologist John Gourley as intermittent high cover of lebbeck trees (*Albizia* sp.; *kalaskas* in Chamorro [hereafter referred to as lebbeck trees]) combined with *tangantangan* (*Leucaena leucocephala [hereafter referred to as tangantangan]*). Stands of ironwoods (*Casuarina equisetifolia; gagu* in Chamorro [hereafter referred to as ironwoods]) line the shoreline areas immediately beyond the western boundary. A few coconut palms (*Cocos nucifera; niyok* in Chamorro [hereafter referred to as coconut palms]), Indian mulberry (*Morinda citrifolia; noni* in Chamorro [hereafter referred to as Indian mulberry]), and papaya (*Carica papaya*) also Iay within the project area. The mosaic of open field habitat consisted of typical weeds, grasses, ferns, and vines. At the bottom of the sand mining areas, within the eastern half of the project area, were stands of giant or elephant ear taro (*Alocasia macrorrhizos; piga* in Chamorro [hereafter referred to as giant ear taro]). The majority of the vegetation appeared to be secondary or tertiary growth that encroached into the site following abandonment of the historic and modern use of the area by the U.S. Coast Guard and more recent sand-mining activity in the late 1980s.

Chapter 3

Research Design and Methods Employed

3.1. Research Objectives

Where not disturbed by the modern sand borrowing activities, previous archaeological investigations (Graves 1987) and those to the south in the Pacific Islands Club property (McGovern-Wilson 1989), strongly suggested that Latte Period burials and habitation features were present in the middle of the proposed development property to a depth of at least 1 meter (3.3 feet). Specialized methods were used to evaluate these possible horizons and their remains, and they are identified below.

- Radiocarbon dating of sealed contexts was paired with the identification of wood charcoal submitted for C14 assay to determine the chronological sequence of occupation at the property; and
- Pollen, phytolith, and starch residue analysis of soils from sealed contexts was used to determine the range of subsistence activities and plant or animal use by former occupants.

Given current understanding of Pre-Latte Period site formation processes on Saipan (Butler and DeFant 1994; Carson 2008, 2014), including cemented sandstone deposits at depths greater than 1.5 meters (4.9 feet) in some locations (i.e. Carson and Peterson 2011, 2012), deeper excavations were needed to demonstrate that evidence of earlier Pre-Latte occupation prior to A.D. 1000 was not present in the eastern edge of the property. In addition to the methods above, the following techniques were used to assess Pre-Latte Period contexts:

- Cross-sections of the property were compiled using mapped profiles from linear excavations in a roughly north to south and east to west orientation to reconstruct the formation of the site during and before the cultural horizons encountered in data recovery excavations.

In the western portion of the property adjacent to the modern coast, Latte Period Chamorro human remains, disturbances from Japanese agriculture, evidence of WWII combat with unmarked burials or UXO, and USCG LORAN Station modifications were expected. Evidence of more recent natural events such as typhoons was expected. Determination of time period and ethnicity for human burials encountered during data recovery excavations were enabled by contextual information (associated artifacts and archival information) by completing these methods:

- Osteological analyses were undertaken of all human remains to determine minimum number of individuals, age, gender, and paleopathology.

3.2. Research Questions

Pre-Latte and Latte Period archaeological remains on the proposed development property and in the vicinity, stood in contrast to the somewhat limited archival evidence of early Spanish Contact occupation and land use on the southwestern corner of Saipan. Research issues that could be realistically addressed by the data recovery investigation of the property were therefore determined to some degree by sealed contexts found with materials for possible analysis exposed during the archaeological inventory survey (Dixon and McCurdy 2015a), and included addressing the following questions for each time period after a brief introduction. Research objectives and questions relating to the sparse early historic record and far more prolific WWII and post-war periods are addressed in the larger technical report (Dixon and McCurdy 2015b and c) and in future publications.

3.2.1 Pre-Latte Period Site

The project area appeared to be situated near the hypothetical late Pre-Latte Period shoreline, which was projected to lie just east of Beach Road near the 10 meter (32.8 foot) topographic contour (McGovern-Wilson 1989). Late to Transitional Pre-Latte ceramics were found west of Beach Road in contexts sometimes mixed with Latte Period remains (Graves 1987).

Research Question 1: Could the pro-graded late Pre-Latte Period shoreline and back dune aquatic environments be identified by sealed cultural deposits within the project area, and if so what could their analysis say about land use and marine exploitation prior to A.D. 1000?

3.2.2 Latte Period Site

Much stronger evidence existed for Latte Period occupation on the proposed property and in the vicinity in the form of a dark organic cultural horizon located not far beneath the present surface at site SP 1-1037. There were human burials, cooking features, and artifacts suggesting a range of domestic activities as might be expected of a small village or extended family residential area. What was often missing from this reconstruction was evidence of actual *latte* sets or traditional house remains generally associated with such sites at the time of Spanish Contact and earlier (Russell 1998).

Research Question 2: Could Latte Period habitation structures and use areas in SP 1-1037 be identified from patterned subsurface features or near more ephemeral structures and could middens be identified and dated in their vicinity?

Research Question 3: Could Latte Period burials, often found beneath and around these types of habitation structures, be identified in SP 1-1037 and examined to reconstruct the demographics and health of the local community after A.D. 1000?

3.3. Methods

3.3.1. Field Methods

The technical approach to data recovery fieldwork, as approved in the Work Plan (Dixon and McCurdy 2015b) and presented in the End of Fieldwork letter report (Dixon and McCurdy 2015c), consisted of three phases: 1) archaeological monitoring of security fenceline construction, 2) monitoring of vegetation grubbing and clearing, and 3) data recovery during mechanical excavation, supplemented by manual excavations and sampling of exposed prehistoric features and cultural strata. At the beginning of mechanical excavation, Win Win Way construction engineers provided archaeologists with a rough map of four proposed pre-construction phases (Figure 5) for deployment of pile drivers and heavy equipment. Hoffschneider Engineering surveyors also staked basic building footprints to facilitate excavation placement according to their priorities. These four areas were used to identify features in the field and separate those of similar function found in other parts of the construction site. Phase 1 construction comprised the north and south hotel blocks, swimming pools, and villas in the western half of the property. Phase 2 construction encompassed the access road located near the Middle School, and Phase 3 construction included the access road to the front gate along Beach Road near the northeast corner of the property. Phase 4 construction comprised the southeastern boundary of the property from the former USCG buildings to Beach Road.

3.3.2. Data Recovery Excavation

The data recovery investigation was conducted in a controlled fashion within linear excavations oriented parallel to each other with adjacent corridors for safe machine placement and transit, varying from 2

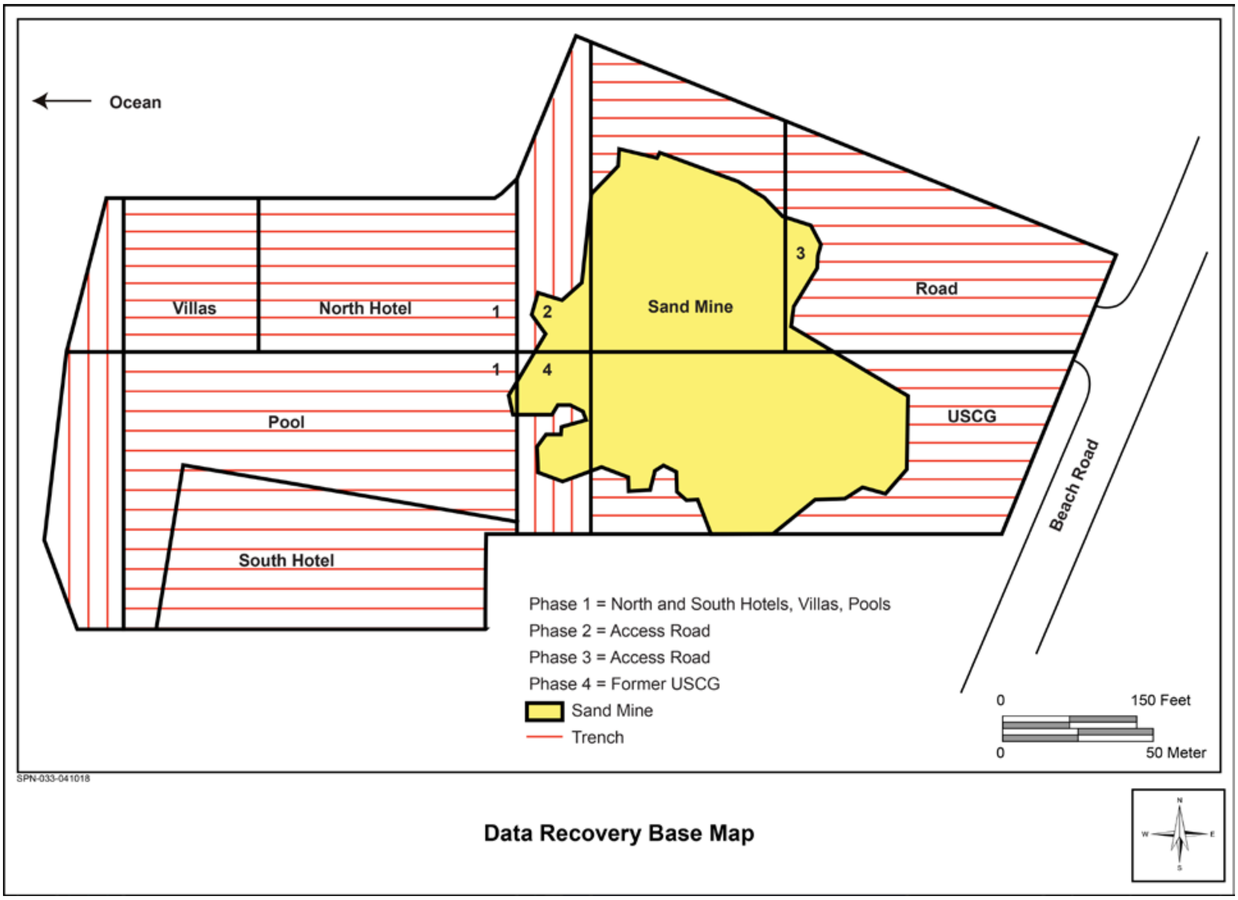

Figure 5. Schematic of Construction Phases Across the Project Area

to 5 meters in width. Configurations and orientations of these excavations varied given the constraints imposed by heavy equipment staging during data recovery and the necessity to backfill open excavations daily for safety purposes. A welded metal plate covered the teeth of the 1-meter (3.3-foot) and 1.5meter (4.9-foot) wide excavator buckets to avoid damage to sensitive cultural deposits. One archaeologist was assigned to closely monitor each earthmoving machine while another archaeologist inspected the back dirt for cultural remains, both stopping the machine to record any features or signficant artifacts exposed or suspected. Cultural features such as prehistoric *dogas* ovens and hearth complexes were exposed in their greatest expanse to be mapped, and then assigned a unique feature number and prefix denoting the area of the site, as defined by project engineers (i.e. North Hotel Feature 1), before manual recording and excavation. Typically Test Pits (TPs) were excavated within these features, measuring from 20 by 20 centimeters (7.9 by 7.9 inches) to 1 by 1 m (39.3 by 39.3 inches), to extract sealed C14 and microfossil soil samples plus a representative sample of artifacts and shell midden if present.

Depths of mechanical excavation varied depending on safe proximity to underground utilities or UXO and depth of cultural deposits. The investigation began by carefully exposing the previously identified prehistoric cultural horizon and features rarely deeper than 30 centimeters (11.8 inches) below the disturbed ground surface, especially on the west half of the property subject to heavy WWII bombardment, mechanized invasion, and subsequent resupply activities. Specific attention was given to record any significant WWII material or historic features observed above or within the known cultural horizon. Excavation then continued until at least 50 centimeters (19.7 inches) of undisturbed sterile sand or the water table was exposed below the cultural horizon.

While depth of excavation generally totaled at least 1 meter (3.3 feet) deep in the western half of the property, depths sometimes exceeded 2 meters (6.6 feet) where WWII combat remains were buried after the invasion or where prehistoric *dogas* marine shell ovens were encountered. Depth of excavation in the eastern half of the property was commonly 1.5 meters (4.9 feet) due to one or more layers of crushed limestone paving and sand mine overburden. No prehistoric cultural remains were encountered below 1.2 meters (3.9 feet) deep in the east although trenching sometimes exceeded 2 meters (6.6 feet) where WWII combat remains were buried. The water table was encountered at the base of the sand mine, roughly 3 meters (9.8 feet) or less with prolonged rainfall, with no deeper cultural horizons observed during archaeological monitoring of geophysical testing in the survey phase of investigation or data recovery (Dixon and McCurdy 2015a). This water table proved to be the approximate sea level after comparison of mechanical excavations conducted before data recovery.

A sample of in situ diagnostic artifacts, including the majority of prehistoric subsistence remains (stone and shell tools and diagnostic pottery) and WWII combat remains (military equipment and supplies), were collected to characterize the deposits and features encountered during excavtion. Samples of intact prehistoric cooking and refuse disposal features were recorded *in situ* and collected by hand for further analysis such as pollen or phytolith identification, radiocarbon dating, and organic residue on charred ceramics. Artifacts and samples to be submitted for special analysis were temporarily housed in an on-site container and then curated at the CNMI Museum of History and Culture after analysis. All human remains were mapped/recorded in situ by GPS and photography or sketch mapping before manual excavation and removal for analysis, depending on the degree of disturbance and disarticulation.

When significant cultural deposits were found in manual excavation units, profiles of exposed features and representative stratigraphy were drawn and photographed. Scaled illustrations and textual descriptions were also prepared. Photographs included a vertical or horizontal scale and a photo log was compiled with the date, photographer, direction of view, and subject of the image. Profiles or plan views showed the stratigraphic layers and horizontal positions of diagnostic artifacts, intact features, and samples removed for analysis. The stratigraphy matched the geotechnical excavations previously conducted during the pedestrian survey (Dixon and McCurdy 2015a); therefore, profiles were photographed but not drawn of the excavations that did not have significant cultural deposits. In cases where features below 1 meter (3.3 feet) in depth were encountered in loose shifting sands, with heavy equipment passing dangerously close, profiles were drawn but excavation faces were not thoroughly cleaned before final photography. Attempts to do otherwise were quickly discontinued for crew safety after profile collapse was noted.

Soils were described using standard archaeological nomenclatures including the Munsell color. Subsurface features, artifacts, test units, and human remains were mapped by a survey-grade (sub-meter accuracy) Trimble XE GPS, with a unique reference number. Pertinent information was recorded in the GPS data dictionary and in field notebooks or standard forms. GPS data were compiled in Universal Transverse Mercator Zone 55 North, using the World Geodetic Survey 1984 datum to conform to existing GIS data currently used by the CNMI HPO.

3.3.3 Laboratory Methods

Artifacts and midden deposits were washed and separated by material category. All resulting categories were quantified, described, and photographed where appropriate to characterize the assemblages. Field catalog artifact, bag and box numbers, and provenience information were maintained for each separated material group in clearly labeled bags. Appendix A includes the results of the artifact inventory and identification, including samples retrieved for specialized analyses and then curated for future research.

3.3.3.1. Artifact Analysis

3.3.3.1.1 Ceramics

In the laboratory, diagnostic pottery sherds were sorted by size and condition. The recorded information for the analyzed sherds included data regarding the following attributes: vessel part, rim type, rim orientation, surface treatment, temper inclusions, rim and wall thickness, and weight.

Sherds were identified according to their vessel part, such as wall, base, or rim. Rims were identified according to two of the major rim forms originally developed by Spoehr (1957): Type A and Type B. The lips of Pre-Latte Type A rims have the same thickness or are thinner than the vessel wall and frequently close to vertical. The lips of the Latte Period Type B rims are wider than the vessel wall and frequently inverted. While both unthickened (Type A) and thickened (Type B) rim types occur through time in the Northern Marianas, Type A rims were nearly replaced by Type B rims by the beginning of the Latte Period. Information about rim orientation employed categories described by Sant and Lebetski (1988), as incurving or vertical. Rim orientation is identified in Figure 6.

Estimated diameter of the vessel orifice (opening) was determined by placing the rim on a graph of concentric rings separated by distances of 5 millimeters (0.2 inches). In this collection, only a few rims were large enough to provide an estimate of orifice diameter.

A sherd was classified as a base if it was thick and curved, tho early vessel types were frequently quite thin. Many thick (13 to 17 millimeters [0.51 to 0.67 inch]) sherds that probably derived from the lower portions of the globular Latte Period pots were not classified as base sherds because they lacked curvature. Figure 7 illustrates vessel forms commonly found in the Northern Mariana Islands.

Exterior surface treatment was determined by inspecting each diagnostic sherd and classifying it according to one of the categories previously established for the Northern Marianas. Sherds were coded as plain if some attempt had been made to achieve a smooth surface, rough plain if the thickness of the sherd varied and the surface was irregular, boldly combed when a regular pattern of grooves and ridges was noted, faintly combed when the grooves and ridges were very shallow, randomly grooved when the grooves and ridges overlapped, and wiped/brushed when short (at least 1 centimeter [0.39 inch] long) irregular drag channels were observed. Sherds were coded as punctate if the surface had often circular indentations. Latte Period vessels on Saipan were characteristically plain with little surface treatment, unlike contemporaneous vessels on Guam with a greater degree of surface treatment.

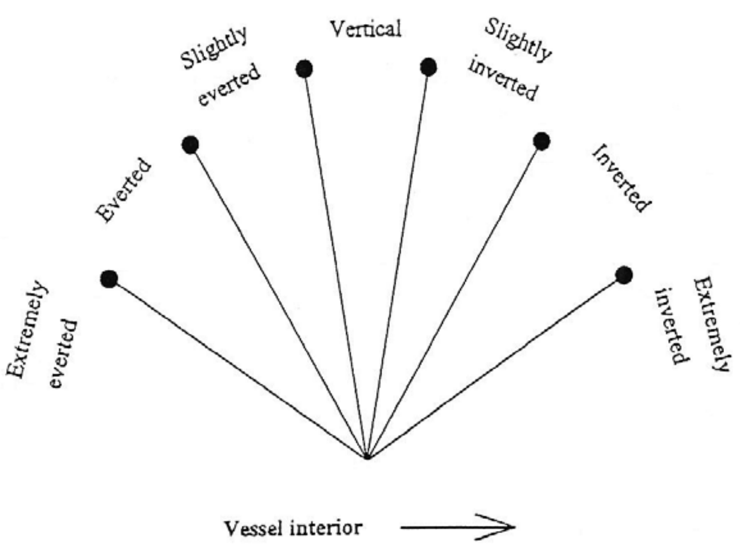

Figure 6. Clock Used to Measure Rim Orientation

The analysis of temper was accomplished by observing a freshly broken section of a sherd with a 10x lens. When green, black, gray, and occasional white inclusions were noted, the sherd was classified

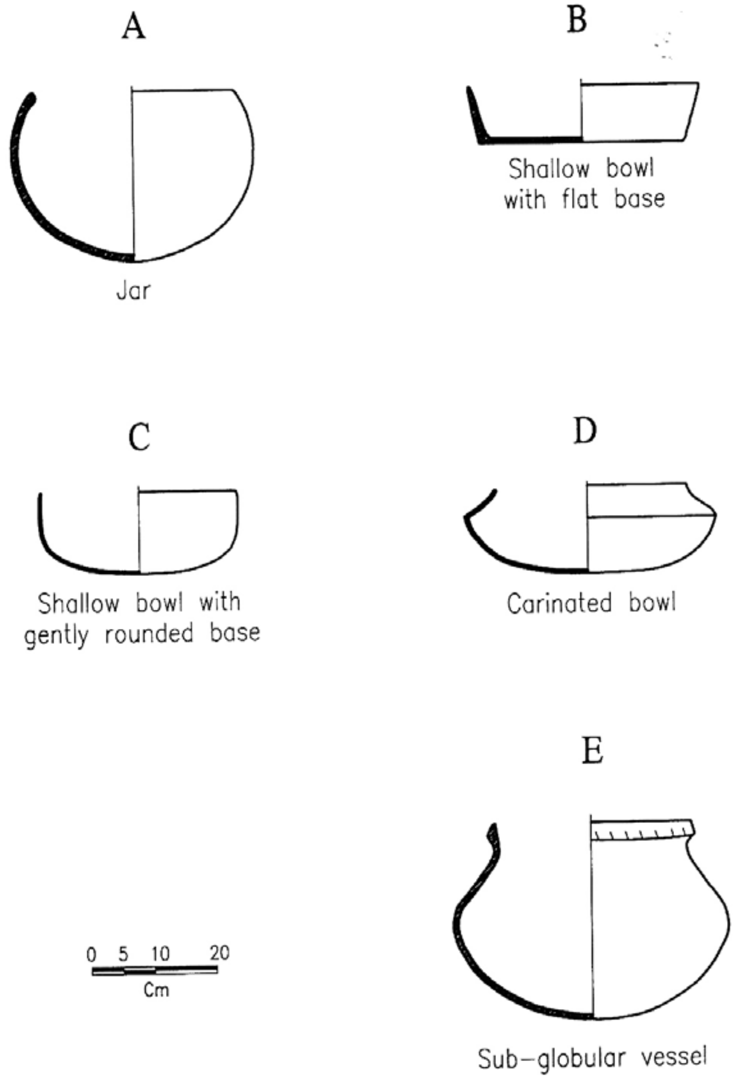

Figure 7. Ceramic Vessel Forms in the Mariana Islands

as volcanic sand temper or calcareous. In addition to volcanic or calcareous inclusions, some sherds also contained small bits of quartz. On Saipan Pre-Latte ceramics are more likely to have calacreous sands than later Latte Period vessels.

Information about thickness was obtained by measuring each sherd with calipers. Thickness values to the nearest millimeter were recorded. Because the range of Type B rim thickness increased over time during the Latte Period, rim thickness indicated something about the relative age of the site, and the shapes of the pots used.

3.3.3.1.2. Stone Artifacts

Stone artifacts were described in terms of material type and form. Measureable attributes included length, width, thickness, weight, and alterations to the traditional artifact surface. Attempts were made to assess artifact functions based on knowledge of other sites in the region and breakage patterns. Non-metric observations were included as appropriate in the description.

Functional classes of stone artifacts cross-cut some tool types and activities: fabricators (used for artifact manufacture and repair), procurement (used in capture or collection of food), weapons (used as projectiles or in hunting), processing (used in food preparation or consumption), ornaments (used to be worn or buried with the dead), containers (used to prepare food or medicine), and sources of raw materials (Craib 1998). Few remains of in situ stone debitage were noted although most finished tools had evidence of use wear and in some cases were retouched for continued use.

3.3.3.1.3 Shell Artifacts

Marine shell artifacts recovered during data recovery included *Tridacna* adzes, gouges, and chisels and unused possible preforms. Their ubiquity suggests manufacture and use by most households. *Spondylus* beads found with several burials were considered a hallmark of Latte Period bodily ornamentation (Amesbury and Walth 2016). One *Codakia punctata* shell bivalve, with wear around its interior, suggested use as a grater.

3.3.3.1.4 Historic Artifacts

Post-Contact remains such as ceramic fragments were examined and assigned to a ceramic type such as porcelain, stoneware, and ironstone, but are not addressed explicitly in this volume. An attempt was made to identify the fragment as to form, place of origin, manufacturing date, and decorative patterns and style. An occasional sherd of Japanese porcelain was observed during surface survey (Dixon and McCurdy 2015a), but none were recovered *in situ* during data recovery. It therefore appears unlikely there was a historic or pre-war period habitation on the property, while the few Japanese soy sauce and beer bottles could have been deposited during military preparations for war.

Prior to 1915 and continuing to 1944, Japanese merchants traded with the Northern Marianas, including Saipan and other islands in Micronesia (Peattie 1988). Pre-WWII stores on Saipan sold Japanese dishware and other goods, and it is likely that pre-WWII Japanese residents of Saipan brought their own supply of domestic dishware and other household goods from Japan.

Ceramics made in America and Europe could have arrived via visiting ships during the 18th and 19th centuries, or when the U.S. took over administration of Guam in 1898 while Germany occupied Saipan and the Northern Mariana Islands. After that date, it is likely that the few German military administrators and the families accompanying the government officials and troops brought dishware obtained from Europe with them. Historic artifacts were described in terms of their material type, form, function, and volume where appropriate. Measureable attributes included length, width, thickness, weight, and alterations to the traditional artifact surface. Glass bottles, sometimes included maker's marks, date, or place of manufacture. Noted bottle characteristics included base diameter, seams, closure, and embossed designs. References for bottles on Saipan included websites such as www.antique-bottles.net.

3.3.3.1.5 Faunal Analysis

Faunal remains and marine shellfish food remains were identified to family or genus whenever possible, with the assistance of Judy Amesbury of Micronesian Archaeological Research Services on Guam. Vertebrate animal bones were identified as major categories of fish, bird, reptile, mammal, and to their anatomical component. These remains were also identified by the project osteologist as a native species or historically introduced and invasive species.

Human Bone Analysis

The human skeletal remains were analyzed in two phases (Walth and Mowrer 2018) and at two different locations on Saipan. Approximately 34 of the 93 burials and isolated occurrences were analyzed at the laboratory facility in Garapan, June 1-July 5, 2015. The remaining 59 burials were analyzed at laboratory facilities in Chalan Kanoa, February 1-19, 2017. The remains were gently wiped clean of dirt using a dampened paper towel. In the laboratory, each skeleton was arranged anatomically on a table. Select elements were reconstructed when possible to maximize the data collection. Masking tape was used in the reconstruction. The tape was removed when analysis was complete and the skeletal elements were prepared for repatriation. Loose teeth were replaced in their sockets within the dental arc to aid in identification. All dentition, reasonably complete crania, dental remains, and pathologies were photographed.

Each burial was assigned a unique number in the field. However, many of the burials included the remains of more than one individual. When elements were present from more than one individual, a unique burial designation was given to the additional individuals by adding a letter following the burial number (e.g., Burial 25a, Burial 25b). These designations were given only when the remains consisted of more than a few fragments of bone, and were assigned in the laboratory, not in the field. There had to be a reasonable expectation that the additional elements were from the same individual, such as an articulated portion of an individual or several elements from a subadult, or that they represented a reasonable portion of the dentition.

The skeletal and dental data recorded were in accordance with standard osteological texts (Bass 1987; Bramblett and Steele 1988; Brothwell 1981; Buikstra and Ubelaker 1994; Johnston and Zimmer 1989; Scheuer and Black 2000; White and Folkens 2005). Data collection forms were tailored after the forms in Standards for Data Collection from Human Skeletal Remains (Buikstra and Ubelaker 1994), which provide convenient numerical codes for data entry. All data recorded on the burials and isolated occurrences were entered into a Microsoft Access database.

All available skeletal information was used in this analysis to assess age of the individual at death and sex of the adult individuals. Growth and maturation of the dental and skeletal elements provide reasonably accurate age estimates for subadults. Subadult age estimates were based on the calcification and eruption of the teeth (Bass 1987; Brothwell 1981; Johnston and Zimmer 1989), the degree of fusion of the epiphyses, and the lengths of long bones (Johnston and Zimmer 1989; Scheuer and Black 2000). Age estimates for adults are less precise than those for subadults, and an age range was indicated based on available morphological data. Adult age estimates were based on documented changes on the face of the pubic symphysis and the auricular surface of the ilium as presented by various researchers, such as Todd (1921a, 1921b), Katz and Suchey (1986), Suchey and Katz (1986), Lovejoy et al. (1985), Meindl and Lovejoy (1989), and Bedford et al. (1989). Additional criteria used to estimate adult age included assessing the degenerative changes, cranial suture closure, and dental attrition.

Adults and older adolescents were examined for morphological characteristics that would aid in estimating the individual's sex. Characteristics for estimating sex on the pelvis include the greater sciatic notch breadth, subpubic angle, ventral arc, and breadth of the pubic ramus. Cranial characteristics include the shape of the eye orbit; the size of the mastoid, glabella, and nuchal crest; and chin shape. Sex-specific metric measurements for select long bones were generated from the Naton Beach Site, Guam (Walth 2016), and the Latte period (Chamorro) measurements were used to aid in estimation of sex. Additionally, size and robusticity of the postcranial elements were recorded for the assessment of age and sex.

Cranial and postcranial measurements were recorded using the guidelines in Standards for Data Collection from Human Skeletal Remains (Buikstra and Ubelaker 1994), with additional data collected on the crania following Howells (1973) and on the calcaneus and talus following Steele (1976). Measurements were taken on the left element for sided elements, substituting the right side when the left was absent or fragmentary. Instruments used included a standard osteometric board; mandibulometer; spreading, coordinate, and digital calipers; and metal tape. Dental metric data were collected following Moorees (1957), Mayhall (1992), and Buikstra and Ubelaker (1994). Dental nonmetric data were collected using the method developed by Turner (Turner et al. 1991), the Arizona State University dental anthropology system that uses a set of dental casts for aiding in the recordation of a suite of traits. Calculation of stature for this study follows formulae developed by Houghton et al. (1975) based on Polynesians from New Zealand.

Nonmetric traits were recorded on skeletal elements following guidelines in Standards for Data Collection from Human Skeletal Remains (Buikstra and Ubelaker 1994), supplemented with descriptions in Brothwell (1981). Skeletal and dental pathologies and anomalies were recorded, including but not limited to dental caries, abscesses, periodontal disease, antemortem tooth loss, and cultural modifications. Evidence of trauma, infectious diseases (such as yaws and periostitis), and degenerative changes were described. Several standard references were used as an aid in determining the specific pathology (Aufderheide and Rodriguez-Martin 1998; Barnes 1994; Mann and Hunt 2005; Ortner and Putschar 1981; Scheuer and Black

2000). Muscular skeletal markers were recorded according to the information from Mariotti et al. (2007) and Steen (2003). The location and degree of expression of occipital superstructures were recorded according to protocols described in Heathcote et al. (1996).

One small barbed human bone spear point fragment was also found in a disturbed burial context.

Specialized Analysis

The general research questions outlined above were addressed by bringing various analytical methods to bear for data generation and comparison. Some of these, such as radiocarbon dating, are standard techniques, while others, such as residue or pollen and phytolith analysis, have been less frequently applied to Northern Marianas archaeology.

3.3.3.1.6. Radiocarbon Dating

As discussed above, efforts were made to obtain reliable radiocarbon determinations for each substantial feature. This required dating short-lived wood charcoal or plant parts that were obtained from primary contexts where available, primarily earth oven deposits and hearth features. Dates were further refined using Bayesian calibration models (Bayliss and Bronk Ramsey 2004). Dates from subsurface contexts provided terminal dates (dates after which) estimates that allowed a degree of temporal confidence.

Five charcoal samples were submitted for radiocarbon dating (BetaAnalytic Inc.) using the Accelerator Mass Spectrometry method, four from feature matrixes and one from a charred Latte Period pottery sherd in another feature context. Where organic sediments were submitted for radiocarbon analysis, BetaAnalytic provided high resolution photographs of the sorted carbonized materials prior to dating, for the principal investigator to select only fragments of charred coconut shells.

3.3.3.1.7 Microfossil Analysis

Five samples, four from earth ovens and hearth complexes and one from a charred Latte Period pottery sherd in similar feature context, were analyzed for plant microfossils by Microfossil Research Ltd. (Horrocks 2017) to provide a record of past vegetation, environments, and human activity. The samples of soil and charred sediment were analyzed for pollen, phytoliths, and starches.

3.3.3.1.8 Pollen Analysis

Pollen analysis included identification and quantification of pollen grains of seed plants and spores of ferns and other plants. Pollen analysis provided insight into past vegetation and environments, and in the Pacific region can provide evidence for Pre-Contact Period Mirconesian crops. These crops include taro (*Colocasia esculenta*; *sunen agaga´* in Chamorro [hereafter referred to as taro]); banana (*Musa spp; chotada* in Chamorro [hereafter referred to as banana]); and lesser yam (*Dioscorea esculenta*; *nika* or *gado'* in Chamorro [hereafter referred to as lesser yams]). Post-Contact Period crops in the Mariana Islands include sweet potato (*Ipomoea batatas)* (Horrocks et al. 2012, 2014; Kahn et al. 2014). Tree crops used before and after Contact included coconut; breadfruit (*Artocarpus* spp.; *dokdok* in Chamorro [hereafter referred to as breadfruit]); and screwpine (*Pandanus* tectorius; *kafu in Chamorro* [hereafter referred to as screwpine]). Where present, European-introduced pollen types allowed the differentiation of Pre-Contact and historic or modern deposits.

The samples were prepared for pollen analysis by the standard acetylation method (Moore et al. 1991). For this type of analysis, at least 150 pollen grains and spores were typically counted for each sample and slides were scanned for types not found during the counts. However, in some samples pollen and spores were sparse and resulted in a lower count for one sample and insufficient pollen for meaningful counting in three other samples. Slides of these three were still scanned, and occasional pollen types noted.

3.3.3.1.9 Phytolith Analysis

Phytoliths were particles of silica formed in inflorescences, stems, leaves, and roots of many plants (Piperno 2006). Phytolith analysis may provide direct evidence of Pacific crops such as banana (Horrocks et al. 2012, 2014, 2015; Kahn et al. 2014). Other types of microscopic biosilicates, notably diatoms, radiolarians, and sponge spicules were extracted along with phytoliths during preparation. Diatoms were unicellular algae and had cell walls composed of silica; radiolarians were a type of amoeboid protozoa with siliceous skeletons; and sponges were multi-cellular animals with skeletons often composed of siliceous spicules. Diatoms were found in aquatic and sub-aquatic environments; radiolarians and sponges were exclusively aquatic. Diatoms and sponges were found in both marine and freshwater environments; radiolarians were exclusively of marine origin.

The samples were prepared for phytolith analysis by density separation (Horrocks 2005). For this type of analysis, at least 150 phytoliths were typically counted for each sample and slides were scanned for types not found during the counts. Slides of the remaining samples were scanned and occasional phytolith types noted.

3.3.3.1.10 Starch and Other Plant Materials

This analysis included starch grains and other plant material such as calcium oxalate crystals and tracheary cells. Starch was the main substance of food storage for plants and mostly found in high concentrations of microscopic grains in underground stems (e.g., tubers, corms), roots, and seeds. Amyloplasts synthesized and stored these starch grains. The calcium oxalate crystals were needle-shaped raphides that occurred in groups called druses, and were found in both the above- and underground parts of many plant taxa. Tracheary tissue comprised elongated cells through which most of the water and minerals of a plant were transported. Starch analysis provided evidence of Pacific starch crops, such as aroids (e.g., taro and close relatives), and lesser yams (Loy et al. 1992; Horrocks et al. 2012, 2014, 2015; Kahn et al. 2014), and later sweet potatoes. Starch and other remains were prepared for analysis by density separation and presence/absence noted (Horrocks 2005).

A recent advance in the starch analysis method was the use of Fourier Transform InfraRed spectroscopy. Typically, starch identification was often uncertain due to loss of distinguishing features; however, this method could positively identify degraded starch collected from archaeological deposits (Horrocks et al. 2012, 2014; Kahn et al. 2014). Starch and other remains were prepared for this type of analysis using density separation and noting presence/absence (Horrocks 2005). Microscopic fragments of charcoal were also extracted during preparation to identify evidence of fires.

3.4 Previous Archaeological Investigations near Afetna Point

Archaeological investigations in the southwest corner of Saipan indicated that over the past century the coastline has changed dramatically since Pre-Latte Period times, when the first settlers arrived in the Mariana Islands around 1500 B.C. Excavations in the vicinity of San Antonio and Chalan Piao by the Bishop Museum during the early 1920s (Hornbostel 1924-1925; Thompson 1932) targeted the remains of *latte* sets, pairs of limestone columns and capstones supporting A-frame structures (Figure 8). By A.D. 1000 villages dotted the coastline from Unai Achugao in the north to Unai Afetna in the south with far fewer inland. Numerous burials found beneath and around these former houses show that generations of Chamorros lived and thrived, fishing the rich lagoon, farming the hillside slopes, and trading with their cousins on other islands ranging from Guam to Maug on a regular basis. Remains of barbed human bone spear points and stone or clay sling stones showed that relations were not always peaceful, as populations grew and infringed on each other's shrinking territories. Many of these village sites, such as Agingan to the south of Afetna Point, underwent extensive disturbance during the sugarcane and copra plantation period of the Japanese Administration between 1919 and 1944 (Bowers 1950; Spoehr 1954), the American invasion in June 1944 (Denfeld 1997, 2002), subsequent military development of Kobler Airfield, and construction of the LORAN Station.

Later investigations after the war and the development of radiocarbon dating found that up to 1 meter (3.3 feet) beneath the disturbed surface of Chalan Piao, east of Beach Road (Spoehr 1957; Thompson 1977; Russell 1984), the former coastline around 1500 B.C. was far inland. This shoreline encompassed what is today the vast marsh extending between San Antonio and Chalan Kanoa (Moore et al. 1992), when Lake Susupe was an arm of the ocean and sea levels were roughly 1.8 meters (5.9 feet) higher than today. During the Pre-Latte Period, inhabitants lived in houses built on wooden pilings (Carson 2008; Clark et al. 2010) or on cobble and sand flooring such as found near the House of Taga on Tinian (Carson 2014). The inhabitants decorated their dead with shell ornaments such as bracelets, beads, or pendants, and manufactured attractive redware ceramics, some with elaborate designs in-filled with lime. As sea levels gradually receded to modern levels by A.D. 500, a sand spit accumulated at the southern end of the lagoon in what is now San Antonio (Thompson 1977) filling in the shallow waters from the former shoreline to the east and over time eventually sealing in what had become a mangrove marsh from the north.

As the new coastline stabilized, populations began to move closer to the ocean where they remained up to the time of Spanish arrival. By then the populations were erecting *latte* stones to support A-framed structures to house their families and protect their sailing canoes or *proas*. In 1978, the remains of a PreLatte Period burial ground were encountered during earthworks in San Antonio village (Russell 1984) and a mass secondary burial of Latte Period individuals was encountered during Beach Road expansion. Excavation of test pits in advance of the redevelopment of the Surf Hotel (now the Pacific Islands Club) on the south end of the Reception Building encountered numerous Latte Period burials near those previously encountered by Fleming in 1978 at a depth of 1 meter (3.3 feet). Subsequent monitoring to the north, near the two guest wings, encountered shell middens and seven more burials in shallower deposits (PriceWilliams 1987).

Additional development of the Surf Hotel immediately to the north, required the excavation and archaeological monitoring of a series of backhoe trenches at the former USCG LORAN Station and Army Reserve Property. Latte Period burials near Beach Road and cultural sediments to the west were exposed no deeper than 1 meter (3.3 feet) below surface. Subsequent excavation of seven test pits in the same project area (Graves 1987) encountered Late to Transitional Pre-Latte ceramics and midden remains in the upper 50 centimeters (19.7 inches) of Test Pit 1. A dark soil horizon with a rock concentration and sparse cultural material from 50 to 100 centimeters (19.7 to 39.4 inches) below surface was also present. Test pits to the east encountered disturbed fill layers near the surface and loosely compacted midden soil to 90 centimeters (35.4 inches) below surface. Test Pits 5 and 6, located to the west towards the shore, encountered sparse Pre-Latte ceramics and darkened soil layers to 70 centimeters (27.6 inches) below surface. Test Pits 7 and 8, closest to the beach, found only Latte Period remains. Construction did not proceed on this property, although it was subsequently subject to sand mining until stopped by the CNMI HPO when more burials were encountered in the mid-1980s. Unfortunately, the map showing the precise locations of Graves' test trenches was not located.

To the south at the Afetna Site (Figure 9), data recovery excavations at the present Pacific Islands Club (former Surf Hotel) were required in the vicinity of the deep foundations for two swimming pools and

Table 1. Cultural Sequence for Afetna Site (Adapted from McGovern-Wilson 1989:26)

TPs	***Layer***	***Period***	***Description***
1	I	Historic	WWII military gear, shell discs, sling stones
2-4	II	Latte Period	Boulder alignment, burial, pounders, flakes
5-7	III	Mixed	Possible posthole, storm tossed sands
8-10	IV	Middle (or Pre-Latte)	Red slipped pottery, fishbone, hearths
11-12	V	Mixed	Storm tossed sands
13-14	VI	Early Period	Hearths, burned stones and shell
15-29	VII	Sterile base	Storm tossed sands, intrusive hearth

boat pond, situated between the two guest wings and the reception building, and the associated utility trenches (McGovern-Wilson 1989). Twenty-nine TPs were dug to a depth of up to 1.5 meters (4.9 feet) (Figure 10). The TPs encountered Latte Period burials and refuse as well as deeper compacted dark sand sediments with Pre-Latte pottery and Strombus shells. Beneath this stratum was interpreted as sterile beach sand. An expanded areal excavation measuring 5 by 10 meters (16.4 to 32.8 feet) was then opened adjacent to the TPs and excavated in 10 centimeter (3.9 inch) levels or spits, resulting in the following cultural sequence (Table 1).

Figure 8. Kalabera Cave Latte sets

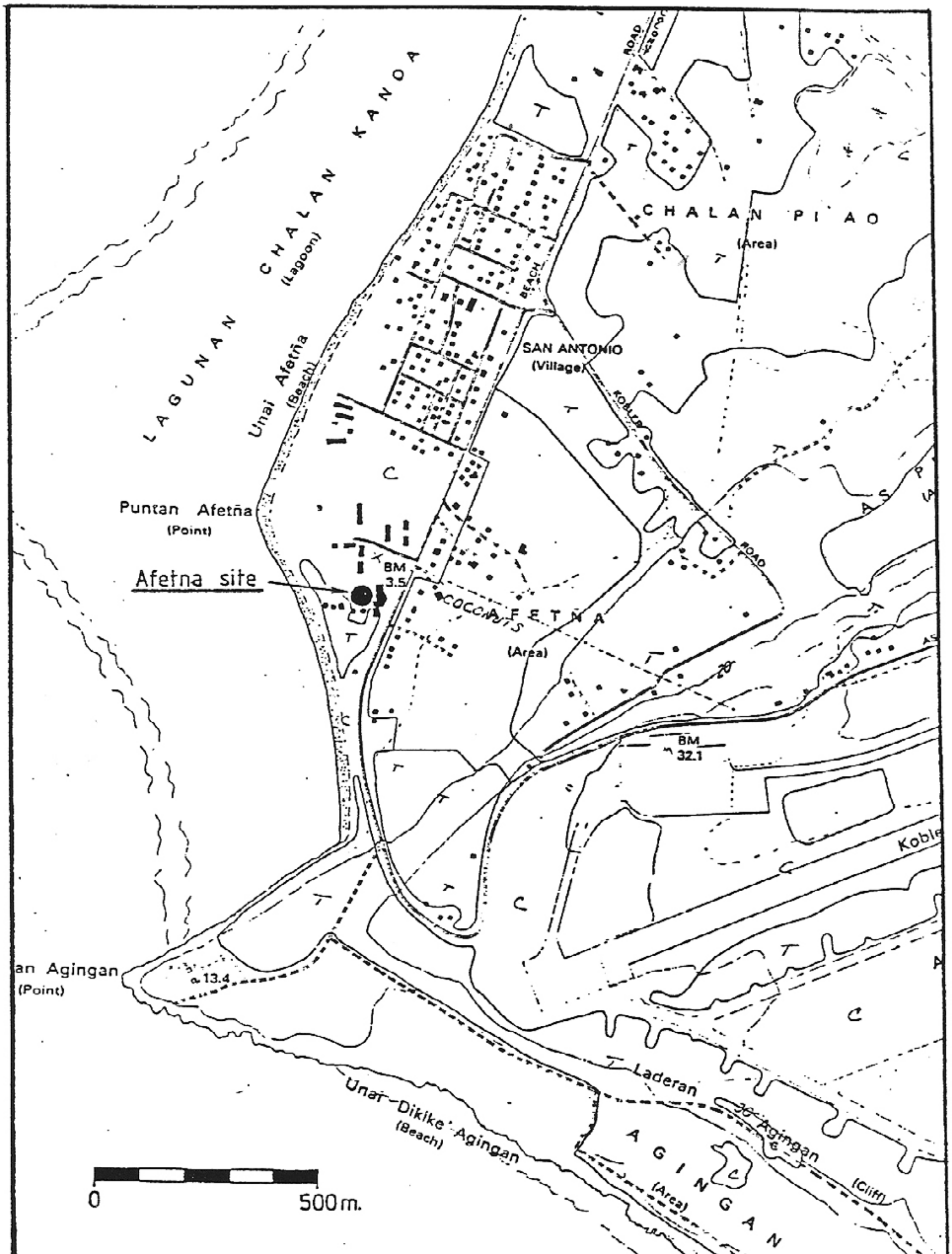

Figure 9. Map of San Antonio Village Showing the Afetna Archaeological Site

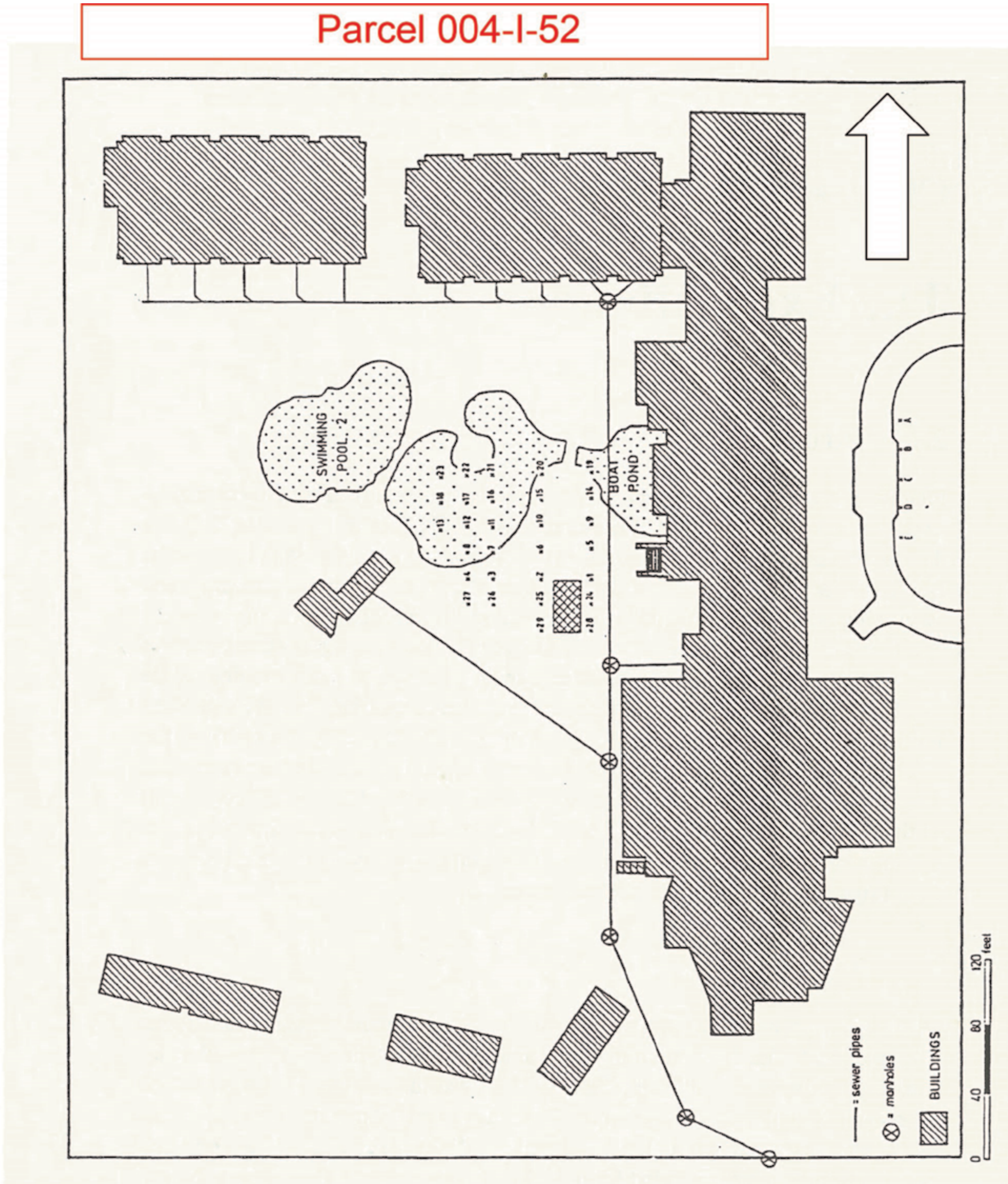

Figure 10. TP Locations at Surf Hotel

Excavations in the area of the two swimming pools and boat pond plus associated utility trenches encountered 34 bone scatters and burials (Figure 11). One was a Japanese combat victim with military gear, the others likely dated to the Latte Period judging from the presence of red-stained teeth or missing leg bones in some interments and seven human bone spear points in another. Radiocarbon dating of sealed deposits yielded three Late PreLatte Period assignations; Layer II at A.D. 650, Layer IV

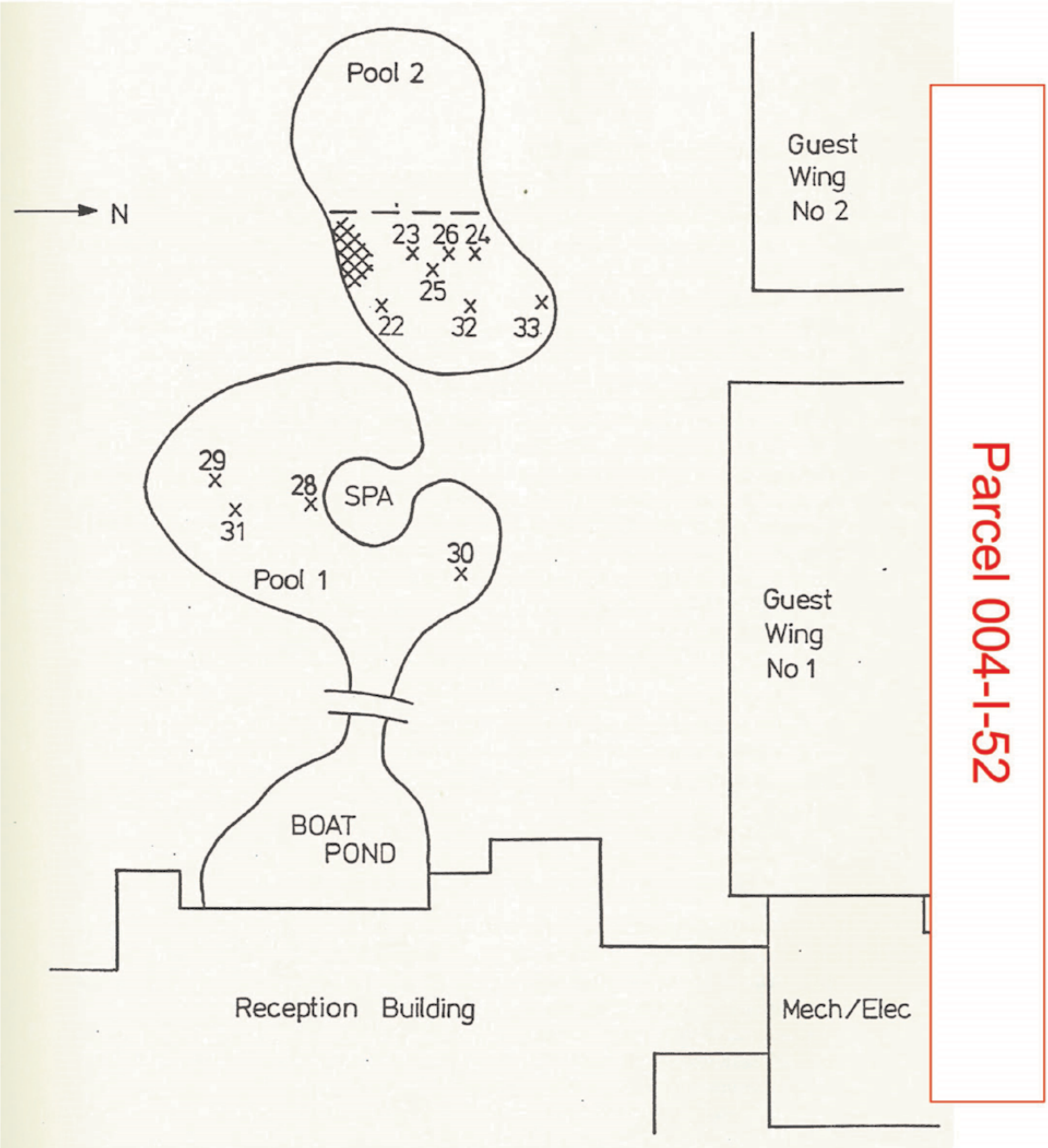

Figure 11. Burial Locations at the Surf Hotel

at A.D. 565, and Layer VI at A.D. 400. These dates suggest that the former Surf Hotel is situated at the seaward edge of the Late Pre-Latte beach dune enclosing the Susupe marsh. It is possible that earlier Pre-Latte remains could lie inland of Beach Road to the east.

Subsequent excavation of 11 backhoe trenches at the Building 'F' site in the Pacific Islands Club (Leap et al. 1991) encountered Latte Period cultural deposits. Some of these deposits were truncated by construction and others buried up to 1.45 meters (4.76 feet) in recent debris from the demolished Cold Warera USCG LORAN Station. No in situ burials were encountered and few earlier materials were found.

At the Saipan Resort Hotel, located roughly 0.8 kilometers (0.5 miles) north of the development property in San Antonio, surface survey and excavation of 47 backhoe trenches encountered disturbed remains of Latte Period occupation and burials with pit features and midden soil (Rader and Haun 1989). These Latte Period remains were overlying what was interpreted as sterile beach sand no deeper than 170 centimeters (66.9 inches) below surface.

On February 4, 1985, the WWII landing beaches on the west coast of Saipan were listed in the NRHP and designated a National Historic Landmark (NHL). The NHL encompasses 552.80 hectares (1,365.99 acres) of land and water and is described as 'The waters between the coral reefs and the land, including Lagunan Chalan Kanoa and Lagunan Garapan' (Thompson 1984). The NHL was designated based on the history of the area and the integrity of the landing beaches; no archaeological fieldwork was conducted at that time (Burns and Krivor 2015:30). Twenty years later, the CNMI HPO conducted a survey of a probable pre-WWII Japanese farmstead at the Tudela Site in As Perdido (Bulgrin 2005). This site was located on the next terrace above Beach Road and it was determined that subsurface investigations should occur due to the surface remains of a WWII American battlefield. Collection and identification of the remains indicated the farmstead was defended by the 25th Marines during the first day of the invasion with .30 and .50 caliber machine guns. There was little evidence of Japanese defenders or American mortars, artillery shells, or bombs. Other areas overlooking Asilito Field were more heavily contested.

In 2010, an archaeological pedestrian survey was conducted of the western shoreline of Saipan identifying three clusters of WWII defensive remains, largely Japanese (Katz 2015). Cluster 1 was situated along Yellow Beaches 1 and 3 including Parcel 004-I-52, between Agingan Point and Susupe Point, and was part of the Landing Beaches NHL. 'Cluster 1 is the largest cluster and contains the most features, the vast majority of which are 'miscellaneous.' The building features are either metal or concrete structures, none of which are intact. In addition to the buildings, a possible concealed defensive position, similar to Feature 86 found near Pau Pau Beach [a spider hole complex], was identified' (Katz 2015:90). The Japanese munitions magazine at Site SP 5-1036 was not recorded during this survey and was presumably obscured by vegetation and backdirt from nearby clearing.

Building upon that information, an underwater remote sensing survey of the NHL covered the west coast of Saipan from Puntan Makpe south to Agingan Point, as well as 200 meters (656.2 feet) outside the existing reef line (McKinnon and Carrell 2015). One goal was to enhance the potential of an underwater cultural heritage trail for public and visitor education and recreation (McKinnon and Carrell 2015). Diving on all major magnetic anomalies in navigable portions of Tanapag and Garapan Lagoons recorded minor objects such as anchors and modern debris, as well as shipwrecks, amphibious tractors, tanks, and WWII discarded metallic refuse. Diving was not conducted within the Chalan Kanoa lagoon to the south including settings seaward of Parcel 004-I-52. However, debris from the invasion of Yellow Beaches 1 to 3 remains unrecorded archaeologically as does offshore UXO.

In 2014, Cardno GS conducted an archaeological inventory survey of Parcel 004-I-52 including monitoring of geotechnical excavations for N15 Architects, in support of CNMI Department of Environmental Quality permitting to conduct clearing and grubbing for the proposed HPIL hotel construction (Dixon and McCurdy 2015a). Four archaeological sites were identified within the survey area and assigned permanent numbers by the CNMI HPO. Site SP 6-1035 were the remains of the USCG LORAN Station postdating WWII (USCG 1946), SP 5-1036 was a WWII Japanese munitions magazine, SP 1-1037 consisted of four subsurface cultural horizons with prehistoric remains, and SP 6-1038 was a modern concrete pad for a boxing rink and then later a fruit stand, which was formerly on the west side of Beach Road (Dixon and McCurdy 2015a).

CNMI HPO review of the survey report determined that sites SP 6-1035 and SP 6-1038 were not considered eligible to the NRHP. No further archaeological work was therefore recommended at sites SP 6-1035 and SP 6-1038. However, the CNMI HPO recommended mechanical subsurface exposure of the concrete drain at SP 6-1035 Feature D to confirm with which time period it was associated. Site SP 5-1036 was considered eligible to the NRHP under criteria A and D and site SP 1-1037 was considered eligible to the NRHP under criterion D. Data recovery investigations were recommended at site SP 5-1036 around and inside the Japanese magazine to ensure no burials or significant WWII artifacts remained. Data recovery of the entire property was recommended to record the subsurface extent of prehistoric site SP 6-1037 and possible human remains disturbed by WWII, the post-war USCG LORAN Station, and the 1980s sand mining.

Chapter 4

Latte Period Village: Historic Context

4.1 Prehistoric Background

The main Mariana Islands were initially settled by at least 1500 years B.C. (Carson 2014) according to radiocarbon dated archaeological data on Guam, Tinian, and Saipan (Table 2). Some paleoenvironmental evidence suggests initial settlement of Guam and the CNMI by as much as 900 years earlier (Athens and Ward 1998; Athens et al. 2004); however, this has not been corroborated by archaeological data. Far from the Marianas being an accidental discovery, it appears many of the islands of SE Asia including Sulawesi and Indonesia were being populated at roughly the same time in what has been termed a 'swarm' of maritime exploration (Peterson 2009), perhaps coinciding with a global high sea stand between 5,000 and 3,500 years (Before Present) B.P. An early voyage from that region via Palau and Yap to the Mariana Islands is entirely feasible, although equally early dated sites in Palau and Yap have yet to be excavated at a comparable scale to Guam, Tinian, and Saipan.

The second theory is that Austronesian people originally inhabiting Taiwan circa 3000 B.C. eventually sailed to the Mariana Islands after first settling in the northern or central Philippines circa 2000 B.C. The reliability of sailing directly from the Philippines to the Marianas during much of the year has been brought into question due to prevailing trade winds (Winter et al. 2012), although such skills were also well developed by Nusantao 'Seasian' peoples inhabiting island SE Asia in roughly the same Late Neolithic time frame (Miksic and Yian Goh 2017). This second theory is based on coastal archaeological settlement patterns and Pre-Latte ceramic stylistic similarities with decorated and red-slipped assemblages from northern Luzon (Carson 2014). Noticeably absent in early Pre-Latte sites are pigs, dogs, and chickens commonly found in contemporaneous Philippine sites and it should be cautioned that '...the early period Marianas pottery resembles [only] a sub-set of the more diverse Nagsabaran pottery' (Hung et al. 2011:915).

Conversation with ceramic specialist Darlene Moore who has examined assemblages from both culture areas indicates that neither surface treatment nor paste and temper are identical (Dixon personal communication, 2012). It seems likely early maritime settlers were able to transfer their knowledge of ceramic production to local clays within a relatively brief time frame. One theory does not exclude the other possibility of course, and both places of origin may have contributed to later Latte Period development as well.

4.2 Pre-Latte Period

Near the southwest coast of Saipan at Chalan Piao (Amesbury et al. 1996), radiocarbon dates from charcoal samples and marine shell associated with Marianas Red pottery and incised sherds confirm early Pre-Latte Period occupation of the island between 1720 and 1325 years B.C. (Figure 12). These sites are situated 1 to 2 meters (3.3 to 6.6 feet) above the present day sea level but at the edge of the mid-Holocene high stand (Dickinson 2000; Peterson and Carson 2009), in close proximity to marine resources and forest products the earliest settlers would have recognized. Changes in sea level also affected settlement options at San Antonio (Moore et al. 1992; Spoehr 1957) and in Achugao (Butler 1994, 1995), which at one time were shallow embayments. Sediment coring at inland Lake Susupe, located at one end of a large marsh approximately 2 kilometers (1.24 miles) north of Chalan Piao, produced evidence supporting a circa 3500 year B.P. date for the early settlement of Saipan (Athens and Ward 2005; Athens et al. 2004), although earlier human activity is suggested.

Table 2. Saipan Chronology

Major Period	Event/Activity	Date	Note
Pre-Contact Era	1500 B.C. – A.D. 1521		
	Settlement	By 1500 B.C.	First human transformation of the Saipan landscape, settlement, and agriculture
	Pre-Latte Period	1500 B.C.-A.D.1000	Coastal settlements based on marine resources, taro, and coconut; perishable structures
	Early	1500-900 B.C.	
	Middle	900-400 B.C.	
	Late	400 B.C.-A.D. 400	Initial movement into interior areas
	Transitional	A.D. 400-1000	Agricultural intensification
	Latte Period	A.D. 1000-1668	Island-wide settlement; communities with latte stone structures
	Early Latte	A.D. 1000-1300	Beginning of latte construction and probable introduction of rice
	Middle Latte	A.D. 1300-1521	Elaboration of latte structures
	Late Latte / Contact Period	A.D. 1521-1668	Continuity of traditional Chamorro life with infrequent Spanish contact
Spanish Era	1521-1898		
	Spanish discovery of Guam	1521	
	Nuestra Senora de Concepcion wrecks off Aguigan Point	1638	
	Spanish settlement of Saipan	1668	
	Father Medina and two Philippino lay brothers killed on Saipan	1670	
	Chamorro revolt on Saipan	1684	
	Chamorros from Gani brought to Saipan	1698	
	Churches at Anaguan and Fatiguan destroyed by typhoon	1705	
	Chamorros removed from Saipan, island depopulated	1722-1730	Traditional site occupation is truncated
	Carolinian families first visit Saipan	1805	
	Carolinian Chief Aghurubw settles at Arabawal/Garapan	1815	
	Carolinian families authorized to remain on Saipan	1818	
	New group of Carolinians allowed to settle on Saipan	1843	
	Chamorros begin to resettle on Saipan	1865-1869	
	Spanish deportados temporarily housed on Saipan	1875	
German Era	1898-1914		
	Spanish-American war, acquisition of Guam by the United States; acquisition of the Northern Mariana Islands by Germany	1898-1899	
	German administration; Garapan becomes capital of NMI	1899-1914	

Major Period	Event/Activity	Date	Note
Japanese Colonial Era	1914-1939		
	World War I, Japan occupies the formerly German-held islands of Micronesia	1914-1919	Mariana Islands settlement is an expression of Japan's Nanshin Seisaku or Southern Advance Policy
	League of Nations creates the Micronesia Mandate, governed by Japan	1919	
	Nan'yo Kohatsu Kaisha (NKK) established on Saipan, introducing successful sugarcane commerce	1922-1926	
	NKK leases properties on Saipan for sugarcane cultivation and refinery in Chalan Kanoa	1926	
	Garapan becomes capital of 'Japan in the Tropics'	1926-1944	Transformation of Saipan landscape, most of the island is converted to sugarcane cultivation; private land leased
Japanese Military Era	1939-1944		
	Japanese Naval Air Facilities established (facilities of the 1st Air Fleet as of February 1944)	1939-1944	Change to Saipan landscape as various agricultural areas are converted to air bases and defenses without compensation
	Japanese forces construct defenses and places of war refuge	1941-1944	
Battle of Saipan	June 1944		
	U.S. amphibious assault (first day)		
	Japanese defenses hard fought; Banzai charges at Tanapag critical juncture in the battle		
	Prisoner of War camp established at Susupe		
	U.S. cemetery established at Hopwood		
U.S. WWII Era	August 1944 - September 1945		
	U.S. military facilities (airfields, camps, defenses) established across the island		Airfields at Aslito, Koblerville, Kagman, and Marpi
Early Post-War Era	1946-1953		
	Japanese and Korean soldiers and civilians repatriated from Saipan	1946	POW camp at Susupe abandoned
	Chamorros and Carolinians in camp at Chalana Kanoa liberated	July 4, 1946	NKK structures become base of new community
	Trust Territory of the Pacific Islands declared	April 2, 1947	Capital on Guam
	U.S. Naval Technical Training Unit established to train Nationalist Chinese forces on Saipan	1952-1962	Saipan reverts to U.S. Navy control until it becomes capital of Trust Territory
Source: Farrell 1994, 2011.			

Moore (2002) subdivides the Pre-Latte Period into four phases based on pottery styles: Early (1500-900 B.C.), Middle (900-400 B.C.), Late (400 B.C. to A.D. 400), and Transitional (A.D. 400-1000). Early Pre-Latte Phase sites are usually found in coastal calcareous sand deposits and typically contain redware pottery sherds (a small percentage with lime-filled stamping or incising) and implements of bone and shell including shell bracelet rings and beads of Conus and Trochus or Cyprea, associated with marine

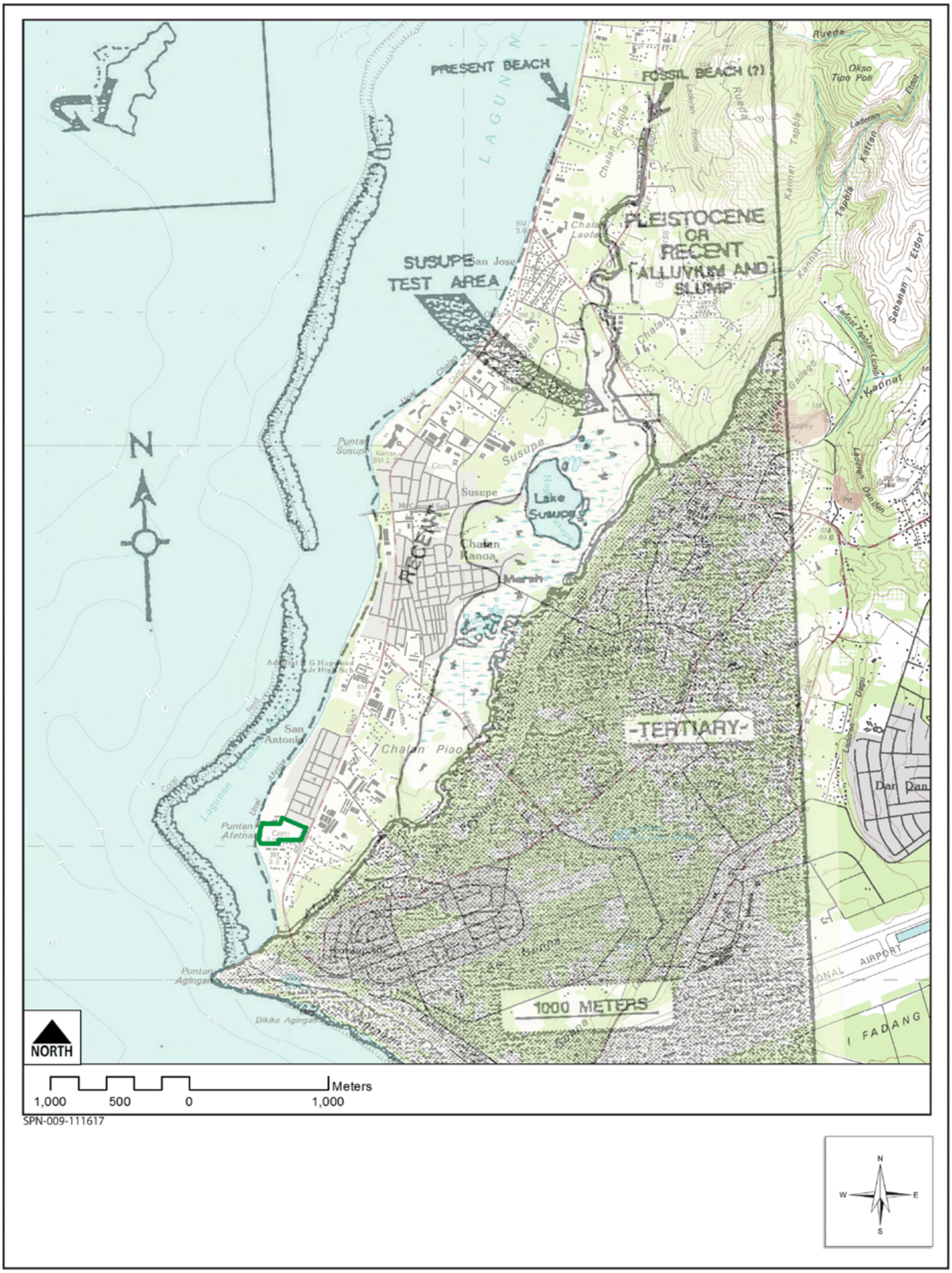

Figure 12. Early Pre-Latte Coastline

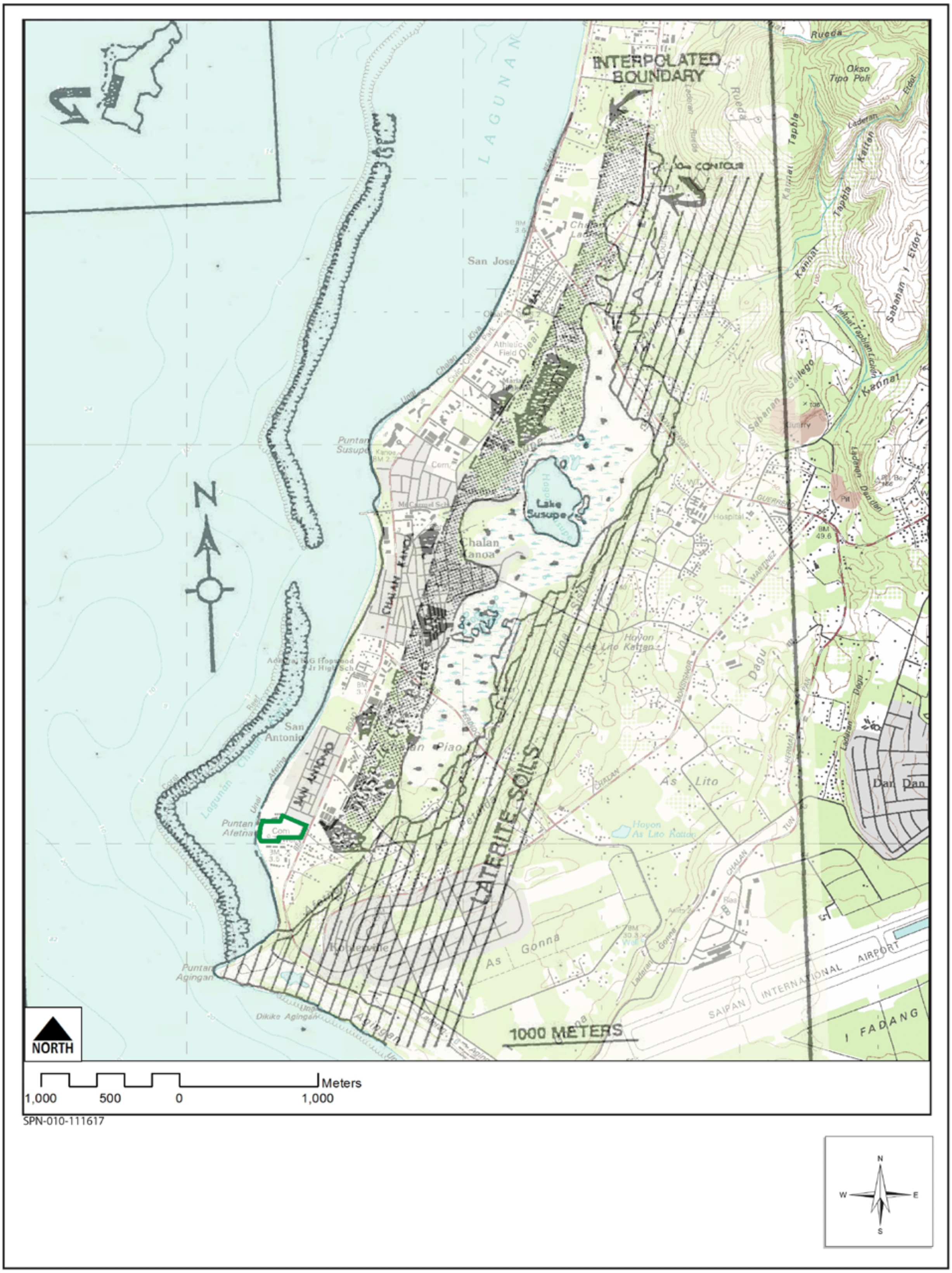

Figure 13. Late Pre-Latte Coastline

midden or food remains consisting mainly of bivalve shells (Amesbury et al. 1996). Middle Pre-Latte Phase deposits are thicker and evidenced by a few midden scatters, hearths, and occasional postholes (Carson 2008; Clark et al. 2010; Marck 1978), plus rock shelters perhaps used before the Latte Period.

The Late Pre-Latte Phase is characterized by the presence of large, thick-walled, shallow pan-like ceramic vessels (Moore and Hunter-Anderson 1999), although decreasing numbers of decorated bowls and jars are still present with the in-filling of lime disappearing over time. Transitional Phase deposits contain a continuation of large flat-bottomed pans, but they decline in frequency as pots with rounded bases and slightly incurved rims become more common (Hunter-Anderson and Butler 1995). Late Pre-Latte cooking technology and ceramic manufacturing may have begun adapting to the introduction of new foods such as rice (Butler 1990), while vessel decoration techniques may have been changing with the social messages of group identity they were imparting over time. Late Pre-Latte settlement by A.D. 1000 had moved seaward near present day Beach Road following the prograding shoreline and changing lagoonal resources (Figure 13).

4.3 Latte Period

Latte Period settlement in Saipan (A.D. 1000-1521) appears to have been oriented toward the lengthy lagoon along the west coast, from Agingan Point to San Roque, and to a lesser extent sheltered reefs off the south coast and around Laulau Bay, with less evidence recorded of sites in the immediate project area (Figure 14). This is perhaps a result of expanded copra plantations during German and Japanese occupation that may have disturbed or removed latte stone remains. Latte Period site complexes at Agingan on the southwest coast (Hornbostel 1924-1925; Russell and Fleming 1986; Thompson 1932), and its neighbor Obyan Beach to the east (Tomonari-Tuggle 1990) indicate the presence of Pre-Contact villages on Saipan and a preference for coastal locations with access to fresh water seeps at low tide.

Subsurface deposits from Oleai to Garapan (DeFant 1993; Hasebe 1928; Hornbostel 1924-1925; Shun and Moore 1989) bordering the lagoon reflect former coastal activity areas and burial sites, as do remains at Achugao (Swift and Athens 1990; Swift et al. 1991), Chalan Galaide (Graves and Moore 1986), Chalan Pupula (Craib 1999), Garapan (Allen 2002; Allen and Prasad 2002; Butler and DeFant 1994; Wickler 1990), and Afetna (McGovern-Wilson 1988). In fact, Farrell (1994) estimated that Saipan's population had probably reached 15,000 by the time of the earliest Spanish contacts with the island in the 16th century. An accurate population estimate from latte sets alone is fraught with complications given the destruction of the area during the 20th century (Thompson 1940).

Marine resources continued to provide the primary source of protein during this period. Shell middens contain increased quantities of gastropods and fewer bivalves. The difference in shellfish types found in middens appears to relate to relative changes in sea levels, which caused a loss in mangrove forests supporting bivalve habitat (Amesbury 1999), and siltation gradually intensified from deforestation and agriculture. The presence of lusong or boulder mortars near many latte sets (Dixon et al. 2006) suggests an increase in the consumption of rice in the Marianas (Butler 1990). Rock-filled ovens are assumed to have been used to bake tubers such as taro or yams (Bulgrin 2006), or forest products such as breadfruit.

In 1602, Spanish clergy on Rota noted individual plots worked by Chamorro farmers well inland from coastal communities (Driver 1983). The ubiquitous Latte Period pottery scatter in these settings may well be the archaeological signature of this agricultural landscape on Saipan (Bulgrin 2009). A gradual increase in Latte Period ceramic vessel size and presumed storage or cooking capacity also suggests few shortfalls in tropical forest or domestic food supply (Dixon et al. 2011) in the waning years of prehistory.

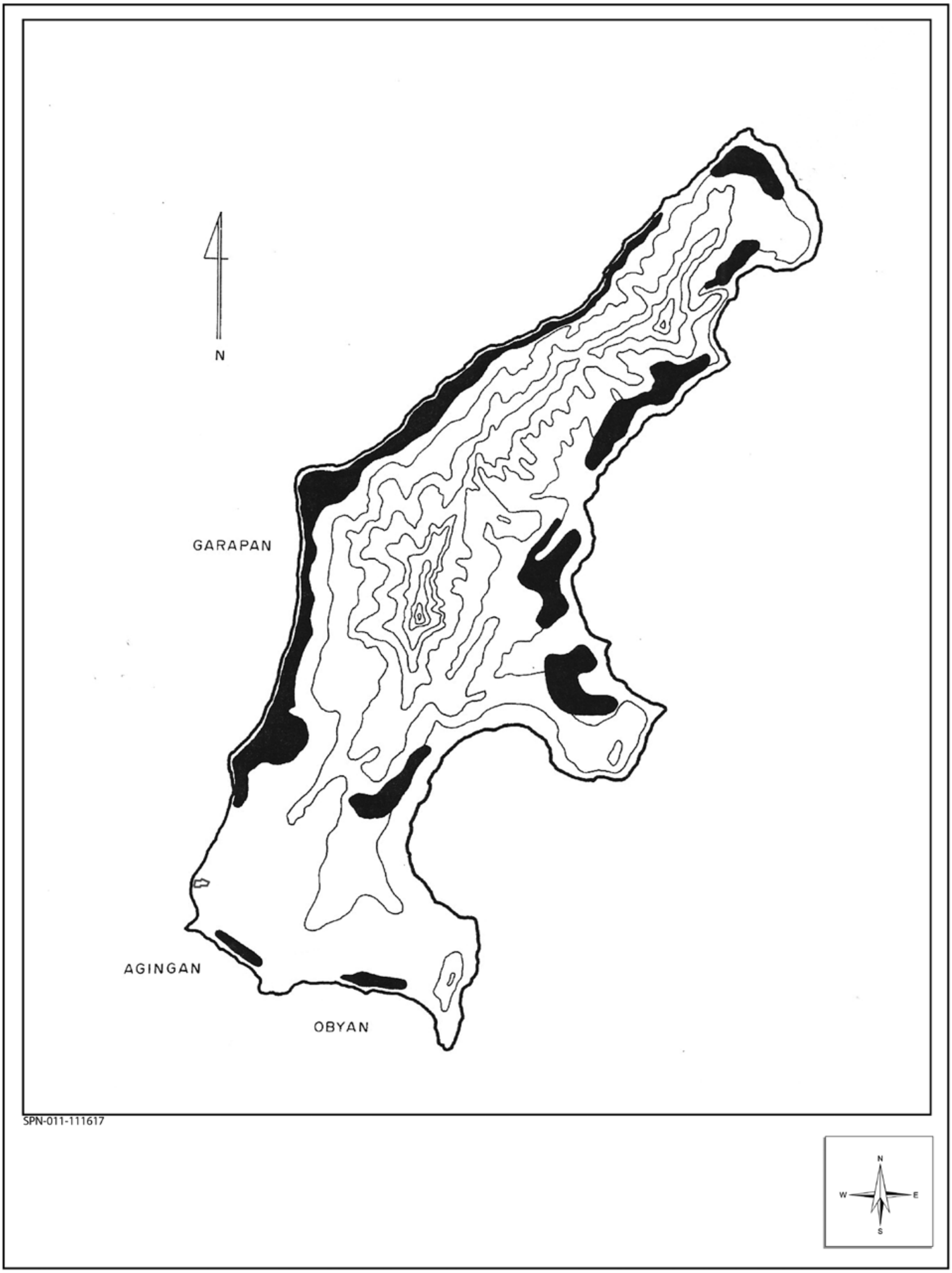

Figure 14. Latte Period Settlement Areas

It is precisely this time period at the end of the Latte Period and the cusp of Spanish Colonialism after Magellan's arrival in 1521 that is termed 'Early Modern' by Southeast Asian historians, inclusive of the Manila Galleon trade from 1565 to 1815 (Giraldez 2015). 'In distinguishing this period, world historians most commonly cite the expansion of international commerce and maritime trade, a rise in population, a more intensified use of land, the diffusion of new technologies, the growth of regional centers, the rise of urban commercial centers, the rise of urban commercial classes, religious revival and missionary movements, and a more pronounced incidence of peasant unrest' (Andaya and Andaya 2015:8).

All of these attributes, in nascent form, could be applied to the Northern Mariana Islands of Saipan, Tinian, and Rota after the arrival of the first Jesuit missionaries in 1668. Spurious accusations of Moorish slaving abduction of Chamorro inhabitants notwithstanding (Seijas 2014:65), Guam was the seasonal nexus of Spanish trans-Pacific shipping during the early galleon trade between Acapulco and Manila, however brief and bellicose the initial encounters with the native population. In contrast, Saipan remained the center of Latte Period tradition and resistance until the *La Reduccion* policy finally forced the island to be abandoned in the late 1720s, after failed attempts at Spanish colonization and indoctrination.

4.4. Historic Background

4.4.1. Contact Period

The Contact Period is the interval between Magellan's landing in 1521 and the first Spanish settlement in the CNMI after 1668, in what is otherwise known as the Early Modern Period in SE Asia (Andaya and Andaya 2015; Miksic and Yian Goh 2017). *Latte* stone structures continued to be built (Driver 1993), but Spanish-introduced materials were also found at a few sites dating to this period as Manila Galleons began to visit the region annually (Giraldez 2015; Seijas 2014). These materials included iron (Quimby 2011), glass beads, and fragments of Asian or European ceramics traded to the islanders by visiting sailors. Breadfruit, coconuts, yams, and taro were traded to passing vessels during this time period, as were bananas, sugarcane, rice, and fish caught both inshore and offshore. Chamorros were noted for their proa, a uniquely fast outrigger canoe, and their superlative skills at handling these vessels even in rough conditions (Barratt 2003).

After a mutiny, followed by the wreck of *Nuestra Senora de la Concepcion* in 1638 off Agingan Point (Giraldez 2015), 'some Islanders also offered gold neck chains and ivory figurines salvaged from the wrecks, causing observers to marvel that the islanders valued iron more than gold' (Quimby 2011:11). Beginning in 1989, more than '1,300 pieces of 22.5 carat gold jewelry, including a variety of chains, rings, buttons, plates, and other decorative gold items set with diamonds, rubies, sapphires, and emeralds' were recovered from *Nuestra Senora de la Concepcion* (Mathers et al. 1990:529). However, only a single silver coin (one Real) was among the recovered items (Moore 2013). At Obyan the top of a copper object was found in a buried context, suggesting a Post-Contact ending date to Latte Period occupations at both sites (Spoehr 1957). Chinese sailor Choco was also shipwrecked on Saipan in 1648 where he settled with a Chamorro wife (Hezel 1989), presumably he was familiar with metal working to some degree.

In 1684, after quelling several native revolts on Guam, Sergeant Major Jose de Quiroga y Losada went to Saipan to salvage the shipwreck *Nuestra Senora de la Concepcion*. He met with strong resistance and proceeded to burn native villages and crops using cannon and firearms; this did not cease until the natives sued for peace. This reprieve allowed the construction of a fort and church, probably near the wreck site at Agingan Point where over 10 cannons were recovered (Farrell 2011). After a general revolt against Spaniards, Quiroga defended his fort from several advances with a small contingent of soldiers and then slipped away in canoes to reinforce the garrison on Guam. In 1695, when Quiroga returned to end Chamorro resistance, two churches were established, Immaculate Conception at Anaguan to minister to the survivors of the revolts on Tinian and St. Joseph on Fatiguan to minister to the survivors from the northern islands campaign (Russell 1998). Beginning in 1722, the dwindling native village population on Saipan was resettled on Guam for the next century, although it is not beyond possibility that small groups of mobile Chamorros continued to occupy pockets of northern Saipan and the NMI or Gani.

4.4.2. Spanish Administration

Sometime between 1815 and 1820, after severe storms devastated the Caroline Islands (Spennemann 1984), refugees from Elato and Satawal began arriving in Guam as they likely did periodically in prehistory (Barratt 1988). These Carolinians were resettled to Saipan where they established the village of Garapan from which they assisted in rounding up and salting feral cattle from Tinian for sale to Guam (Driver and Brunal-Perry 1993), while providing interisland transportation to the *alcalde* of Saipan after 1835. Chamorros from Guam were then enticed to move to Saipan in the 1860s with offers of farmland, and in 1889 another group of Carolinians from the island of Namonuito left Tinian when the cattle venture collapsed and established the village of Tanapag. Remains of 19th century Carolinian burials have been exposed at Guma Capuchino in south Garapan with imported grave goods including beads of glass and ceramic, plus shell beads perhaps of local manufacture (Jones and Tomonari-Tuggle 1994).

While the Carolinians proved themselves an asset to the Marianas economy, the arrival on Saipan of deported Spanish and Filipino political prisoners during the 1870s became a serious impediment to local self-sufficiency (Madrid 2006) where they often led a life of destitution. Such deportations eventually ceased and most of the remaining prisoners were repatriated, after which a period of relative political calm prevailed in Spain's all but forgotten colonies.

The siesta was broken with the arrival of the American cruiser U.S.S. *Charleston* in 1898 to take Spanish government officials prisoner to Manila at the onset of the Spanish-American War (Farrell 1994). In May of 1899 Colonel Eugenio Blanco arrived with soldiers from the Philippine province of Pampangan to establish an interim government on Saipan until June 30th when Germany purchased the Northern Mariana Islands (except Guam which remained in American hands) and the rest of colonial Spanish Micronesia. The price was set at the equivalent of 4.2 million dollars in February of 1899 after a Japanese counter offer (Spennemann 2007), and the Paris peace treaty was signed in December of 1898 while Spain retained the right to use Saipan as a coaling station.

4.4.3. German Administration

On November 17, 1899, Captain Georg Fritz became the first administrator of the Imperial German District Office at the end of the Spanish-American War (Farrell 1994) and soon offered free passage and land to Carolinians and Chamorros from Guam to resettle in Saipan where their children were taught in German schools and German Capuchin Catholic churches (Spennemann 1999, 2007). Attempts to lure German farmers to the new colony with a similar offer met with far less favorable responses. Fritz (1989) reported that in 1902, 891 Chamorros, 524 Carolinians, and 42 foreigners resided in the capital of Garapan and 76 Chamorros, 97 Carolinians, and 1 foreigner in the port of Tanapag. Rota was briefly a duty station with a coconut plantation and 490 residents, while Tinian remained a cattle ranch with 95 residents.

Germany's primary interest in the Northern Mariana Islands was the development of a cash-based export economy of copra production (dried coconut used for oil and livestock feed). Coconut trees were planted on Saipan, Rota, Tinian, and Aguijan as part of the Tinian Gesellschaft and on the smaller islands to the north in two other lease areas, one to a Japanese firm beyond Agrihan. Japanese trading firm Nanyo Boki Kaisha also shipped copra to Yokohama with 16 to 30 vessels a year, while the German ship Germania only resupplied the island three times a year (Farrell 1994). Spanish-era grazing rights to large undeveloped tracts of land were revoked and lease holders were granted smaller plots to farm, the remainder being deemed public land suitable for the planting of coconuts or homesteading. Taxes were collected by local mayors, roads were constructed with community labor, a postal service was established, schools and a hospital were opened, harbors were improved at Garapan and Tanapag, and an imposing administration building with replica *latte* stone pillars was built in Garapan behind Mount Carmel cathedral (Farrell 1994).

After a poor response to European agricultural settlement offers and the devastation of young coconut plantations by two typhoons in the Marianas and in the Western and Central Caroline Islands in 1905 and 1907 (Spennemann 2004), several hundred Carolinian residents were resettled to Saipan at Oleai village south of Garapan and then to Pagan. After destructive typhoons returned to Saipan and Rota in 1911, 1913, and 1914, the German administration eventually became convinced that their economic gamble to establish a viable colony in the Northern Mariana Islands had failed (Fritz 1989). German authority over the islands ended in October 1914, when the Japanese battleship Katori seized control of Saipan, along with other German possessions in Micronesia.

4.4.4. Japanese Administration

During World War I, Saipan was placed under military jurisdiction by Japan; German nationals were expelled because Japan and Great Britain were allies. The Supreme Council of the League of Nations awarded the mandate over German Micronesia to Japan in May 1919 at the close of the war, with an agreement not to fortify any of the islands. The Nan'yo-cho or South Seas Bureau replaced the Japanese naval administration in 1922 and authority was later transferred to the Ministry of Overseas Affairs (Farrell 1994). After scientific studies of the island, two unsuccessful attempts were made to initiate agricultural industries on Saipan, until permission was granted to Haruji Matsue to grow sugarcane with the NKK or South Seas Development Company.

In 1922, the company began importing laborers and cleared land for sugarcane fields, organized factories, constructed Shinto shrines, and built railroads to the first sugar mill near Lake Susupe. Chalan Kanoa, where the NKK workers lived near the mill, quickly grew into a major town with a distillery to use molasses from the sugar mill, a warehouse, railway sheds, a dock, administrative offices, and company housing. The capital, Garapan, soon boasted schools, a jail (Allen 2006), hospital, leisure club for employees, recreational facilities, retail stores, power plant, radio station, and regular mail service to Japan (Peattie 1988). Islanders were served by Catholic priests brought from Japan and a convent was established for nuns. In 1937, the civilian population was 46,708 with only 4,145 of those being Chamorro or Carolinian; most of the population was Japanese, Okinawan, or Korean (Bowers 1950), many involved in small farming and sugarcane plantation employment.

In anticipation of the impending war, as Japan withdrew from the League of Nations in 1934, Aslito Airfield was completed by NKK laborers the following year ostensibly to serve a new air route by Great Japan Airways. Ships leaving with women and children of employees began returning to Japan, while 16,000 civilians and 2,000 Japanese prisoners from Yokohama were increasingly conscripted for military construction. This included new runways in Makpe, Kagman, and Chalan Kanoa, bunkers for artillery overlooking the expected invasion beaches such as Unai Obyan (Tomonari-Tuggle 1990), and networks of tunnels, rock shelters, and caves for defense and refuge near Laulau (Haun and Henry 1993; Mazurek et al. 1991; Olmo 1992a and 1992b; Tomonari-Tuggle 1990). On December 8, 1941, a squadron of Japanese aircraft left Asilito Airfield and the Puntan Flores seaplane base and bombed military targets around

Apra Harbor on Guam, initiating the conflict with the U.S. with similar raids across the Pacific. Asilito Airfield was made operational with a 1,188.7-meter (3,900-foot) runway, a hospital, administration building, oxygen plant, power plant, shop areas, taxiways, fuel and ammunition storage, and hangars plus anti-aircraft artillery positions – many of which are still visible today.

Operation Forager air raids of military targets on Saipan began in February 1944 as a U.S. Navy carrier task force with over 800 ships sailed for the Mariana Islands. Native islanders, Japanese NKK employees, and laborers from Korea and Okinawa were forced to work on repairs to facilities at night (Petty 2002), which were bombed by day (Denfeld 1997; Peattie 1988). The influx of Japanese troops also brought housing pressures to the island as combined army and navy strength grew to almost 30,000 defenders under Lieutenant Generals Obata Hideyoshi and Saito Yoshitsugu, far more than estimated by the U.S. intelligence based on reconnaissance flights.

Systematic air and naval bombardment of Saipan began on June 11, 1944, and landing along the west coast began on the morning of June 15 as the 2nd and 4th Marine Divisions under the command of Lieutenant General Holland Smith were soon pinned down to the beaches by aggressive pre-sighted Japanese artillery not neutralized during the shelling. Concentrated fire from two fixed Japanese batteries and 'spider holes' on Agingan Point facing the present property's beachfront from the south was very effective in pinning down the Marines, until neutralized by ten tanks from Company A (Bulgrin 2005). They were reinforced over Yellow Beaches 1 through 3 by the 27th Army Infantry Division the following day and then by successive waves of artillery, medical, administrative, and communications support of the battle for Asilito airfield and Naftun Point. This occurred under the command of Major General Ralph Smith, until he was relieved of duty on June 24 by Lieutenant General Holland Smith during the struggle for Mount Tapochao.

Meanwhile the 25th Marines crossed the island from Yellow Beaches 1 through 3 at Afetna Point to the Kagman Peninsula and began pushing defenders to the north (Bulgrin 2005), while the 165th Army Infantry captured Asilito Airfield becoming operational for American support aircraft by June 22nd (Rottman 2004). Fighting in the streets of Garapan and Tanapag was intense in spite of previous shelling and the struggle to gain command of the high ground on Mount Tapochao was not completed until June 25. Saipan was declared secure on July 9, 1944, although forces under the command of Captain Sakae Oba remained hidden in the jungles around Mount Tapachau until deciding that information about the war's end from the Susupe internment camp was correct and he surrendered his command with 50 men on December 1, 1945 (Jones 1986).

An approximate 3,400 American soldiers and 29,500 Japanese military plus an undetermined number of Japanese civilians, since the process of separating the dead on the battlefield was complicated by rains and the mutilation of combat, were killed in action or died of their wounds (Adams et al. 1996; Prasad and Williams 2001; Tomonari-Tuggle et al. 2007). Civilians who survived helped in the burial process and were then interned in Camp Susupe to the south, one camp for Japanese, one for Koreans, and another for Chamorro and Carolinians. 'Regrettably, the ravages of the battle rage on in the memories of the families of the 933 native men, women, and children that died in a conflict not of their making' (Cabrera 2015:24).

4.4.5. American Administration

By late 1944, Saipan was transformed into the first operational B-29 base in the Pacific (Farrell 1994). Isely Field, the present International Airport and former Asilito Airfield, soon saw the arrival of General Curtis LeMay to organize high level bombing of selected Japanese military targets. However, there were still bombing raids on the airfield by Japanese Betty Bombers based in Iwo Jima. Japanese East Field at

Kagman and Marpi Point Air Base, were also renovated to support American P-47 fighter support, which employed napalm for the first time during the Tinian invasion. Kobler Field, close to Isley Field, was built near Agingan Point to support B-29s bombers (Craib 1991) and was critical for supplying American Prisoner of War camps in Japan at war's end.

After the declaration that Saipan was secured, civilian Japanese, Okinawans, Chamorros, Carolinians, and Koreans were interned in Camp Susupe or on Tinian where they awaited repatriation to the homelands or were released. The immediate crisis was the medical care needed for the wounded, sick, and starving men, women, and children. By the spring of 1946, nearly 10,000 Japanese and 1,300 Korean nationals were repatriated except for a few that were married to local islanders (Denfeld 1997). Over 2,300 Chamorro and 800 Carolinians were released in Saipan and were in high demand for government wage labor as the U.S. war effort grew and continued to do so until the 1950s and the Korean War (Bowers 1950; Spoehr 1954).

Construction of the USCG LORAN Station on Saipan began in November 1944, and was built alongside the same site of the modern Pacific Island Club (i.e., the former Surf Hotel) (Dietz 2018). The LORAN Station was first built with six Quonset huts and smaller support structures near the antennas. The transmitting station was paired with other USCG LORAN Stations on Orote Point and Cocos Island on Guam. The transmitting station on Saipan was used at the same time as the Central Intelligence Agency training of Taiwan Chinese nationalists to fight the communists in mainland China (Denfield in Mazurek et al. 1991) in the 1950s, when it was rebuilt with three concrete structures, signal power building, barracks, and a mess hall. The Agency continued training Taiwanese Nationalists (Mazurek et al. 1991) until 1962. The towers suffered damage during Typhoon Jean in 1968 and the facility was rehabbed in 1969. It was manned by the USCG until decommissioned in January 1978.

After the establishment of the Trust Territory of the Pacific Islands by the United Nations, the U.S. continued administration of Saipan under the jurisdiction of the Navy until 1951, when the Northern Mariana Islands were transferred to the Department of the Interior. The following year, Saipan became the headquarters of the U.S. Naval Technical Training Unit and jurisdiction was returned to the Navy. In 1962, Saipan became provisional capital of the Micronesia Trust Territory (Farrell 1994). On February 15, 1975, Saipan voted to adopt the CNMI covenant with a provision that a portion of Tanapag Harbor and Isley Field be jointly used by the U.S. military and CNMI. In 1978, the U.S. President and Congress approved the covenant and new constitution and in 1986, the President granted American citizenship to CNMI residents.

Chapter 5

Latte Period Results

5.1 Data Recovery Excavation

Data recovery excavation occurred between May 27 and July 5, 2015 with three archaeologists and one osteologist to manually excavate all intact human remains and in situ features (Figure 15). A welded metal plate covered the teeth of the 1-meter (3.3-foot) wide backhoe bucket and 1.5-meter (4.9-foot) wide excavator bucket during the excavation. Manual and mechanical excavation were conducted at approximate 10-centimeter (3.9-inch) levels. Work stopped upon command from the archaeologist to expose wider expanses above possible features. Further examination was done by hand with a trowel and shovel before recording. Such techniques were not optimal, but crew safety in close proximity to moving machinery and UXO was a constant concern. Feature profiles below 1 meter (3.3 feet) in depth were not always meticulously cleaned for photography, due to the collapse of loose sands with passing heavy machinery creating an unacceptable risk to crew safety.

As discussed above, excavation exposed at least 1 meter (3.3 feet) of depth below surface in the west and 1.5 meters (4.9 feet) in the east. Generally, 50 centimeters (19.7 inches) of sterile beach sand was present beneath the dark brown organic sand cultural horizon and intrusive USCG pipes and wires. Individual artifacts and UXO from the WWII invasion were sometimes intruding into sterile sand at or below 50 centimeters (19.7 inches) below surface. This indicated that the prehistoric cultural horizon was seriously disturbed on June 15, 1944, and then again during clean up after the battle when foxholes and trenches were buried.

Most human remains encountered during excvavation showed sign of prior breakage and disarticulation, often found associated with the construction of USCG LORAN Station antennas with their concrete supports, communication wires, and utility pipelines. Depth of excavation also ranged down to 2 meters (6.6 feet) below surface when post-U.S. invasion dumps of WWII combat materials, such as UXO, were encountered, and when intact prehistoric *dogas* ovens were exposed.

Excavation yielded Tridacna shell gouges, Tridacna shell adzes, Spondylus beads, coral nutting stones, basalt mortars, basalt pounders, basalt grinders, coral sling stones, limestone sling stones, basalt sling stones, basalt adzes, basalt manos, basalt sinker weights, basalt pestles, basalt balls, basalt anvil, ground basalt fragments, and ceramics.

5.1.1. Features and their Contexts

Ten archaeological and architectural features were exposed and investigated during data recovery excavations (Table 3; Figure 16). These features are identified by their proposed construction location in the property or previously assigned CNMI HPO site number (Dixon and McCurdy 2015b). The stratigraphic contexts in which these features were found are first presented for the property in general, followed by the individual features according to their time periods, earliest to most recent. Previously assigned feature letters from the inventory survey were retained during data recovery, but newly discovered features were assigned numbers associated with the construction area to facilitate communication with engineers coordinating heavy machinery with changing archaeological needs.

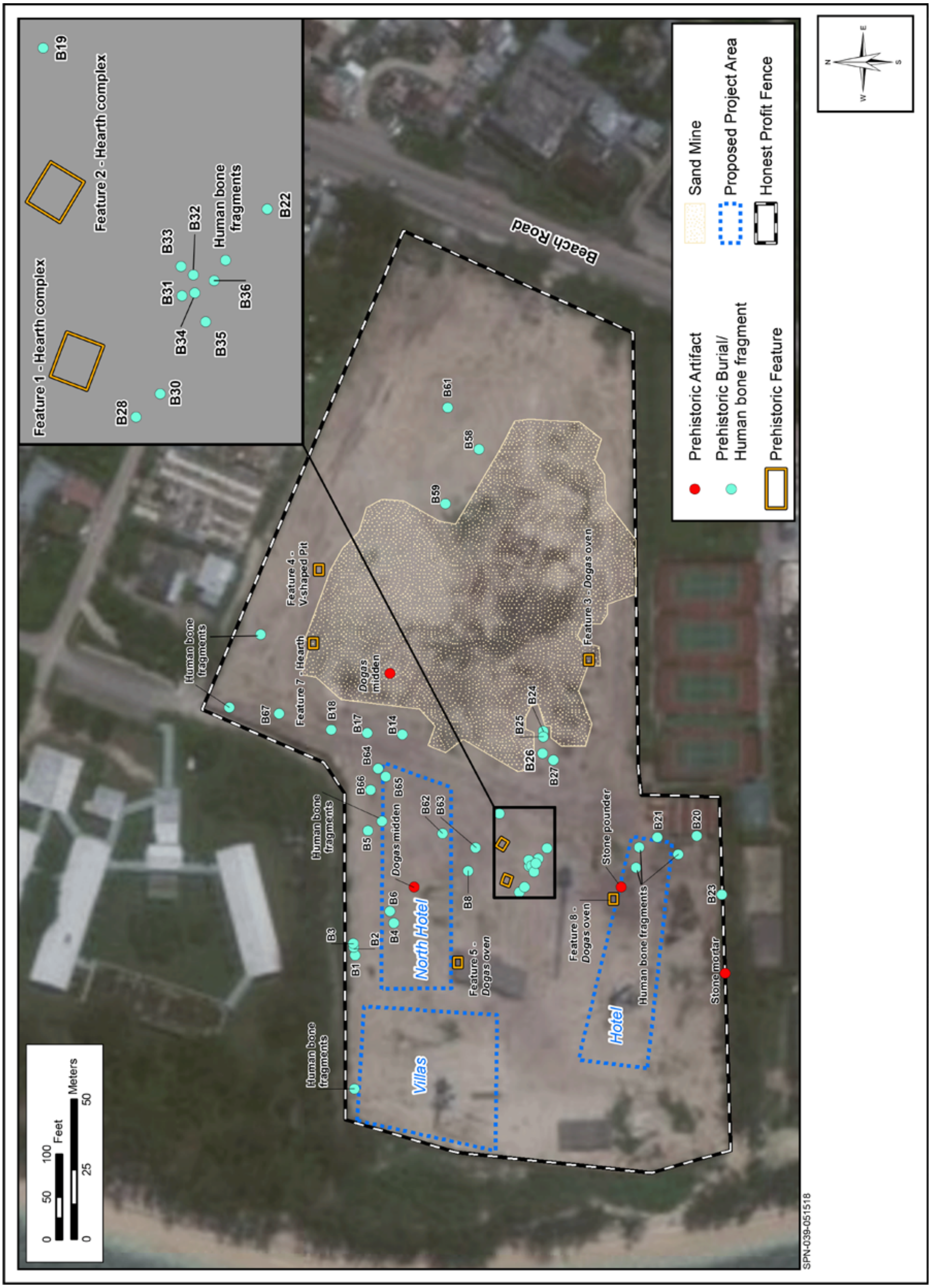

Figure 15. Subsurface Prehistoric Remains Recorded during Data Recovery

Table 3. Archaeological Features Recorded during Excavation of the Property

Site Number	Feature Number and Area	Feature Type	Feature Period	Feature Size	Feature Content
SP 1-1037	Feature 1/ North Hotel	FCR hearth complex	Latte Period	5 x 4 meters (16.4 x 13.1 feet) by 0.2 meters (0.66 feet) deep	FCR, pottery
	Feature 2/ North Hotel	FCR hearth complex	Latte Period	3 x 2 meters (9.8 x 6.6 feet) by 0.2 meters (0.66 feet) deep	FCR, pottery
	Feature 3/ USCG LORAN Station	*Dogas* oven	Latte Period	5 meters (16.4 feet) diameters by 0.3 meters (0.98 feet) deep	*Dogas* shell, pottery
	Feature 4/ Road	Pits and buried horizons	Latte Period and earlier strata	0.5 meters (1.6 feet) diameter by 0.4 meters (1.3 feet) deep and 0.75 meters (2.46 feet) deep	FCR, pottery
	Feature 5/ Pool	*Dogas* oven	Latte Period	6 meters (19.7 feet) diameter by 2 meters (6.6 feet) deep	*Dogas* shell, pottery
	Feature 7/ Road	FCR hearth	Latte Period	0.8 meters (2.6 feet) diameter by 0.15 meters (0.49 feet) deep	FCR, pottery
	Feature 8/ South Hotel	*Dogas* oven	Latte Period	8 meters (26.2 feet) diameter by 2 meters (6.6 feet) deep	*Dogas* shell, pottery
SP 5-1036	Feature A	Ammunition Magazine	Japanese WWII	8 x 8 meters (26.2 x 26.2 feet) polygon by 1.5 meters (4.9 feet) deep within cobble fill	Metal, glass, bottles
SP 6-1035	Feature D	USCG LORAN Station cesspool	Post-WWII	3 x 8 meters (9.8 x 26.2 feet) octagon by 2 meters (6.6 feet) deep within cobble leach field	Liquid waste
SP 6-1038	Feature A	Fruit stand and boxing pad	Modern	20 x 12 meters (65.6 x 39.4 feet) rectangle by 0.2 meters (0.66 feet) deep on top of gravel fill	Crushed concrete and metal sign below

5.1.2. Stratigraphic Context

Before presenting detailed feature descriptions based upon excavation and field analysis, the overall stratigraphic context of the property is presented below. This context is a schematic modification of Feature D in site Saipan (SP) 1-1037 that typifies stratigraphy above the former sand mine near the southeast corner of the previous inventory survey area (Dixon and McCurdy 2015a). Severe disturbance to almost 1 meter (3.3 feet) below surface was normal in this area.

Stratum I, the modern to historic horizon, was not uniformly distributed across the property. Crushed limestone road gravels from 1944 to 1978 and backdirt from the 1987 sand mine were mostly present in the eastern half, so are referred to as Strata Ia, Ib, Ic, etc. In some areas near the middle of the property it appeared that Stratum II was removed and then reintroduced as fill over WWII-era foxholes and refuse pits or later utility trenches and antenna wires, so was technically Stratum I in feature profiles. In other areas, primarily in the far western half of the property, it appeared there was no Stratum I present.

Stratum II, the prehistoric cultural horizon, was a relatively compact very dark grayish brown (10YR 3/2) sand with *dogas* marine shells and Latte Period pottery and tools. This horizon measured 20 to 30 centimeters (7.9 to 11.8 inches) thick. It generally had a wavy lower boundary that implied gradual and not sudden buildup. Stratum II sometimes covered small basin-shaped earlier features or later intrusions into the sand below from the WWIIera. This incipient topsoil formerly supported secondary

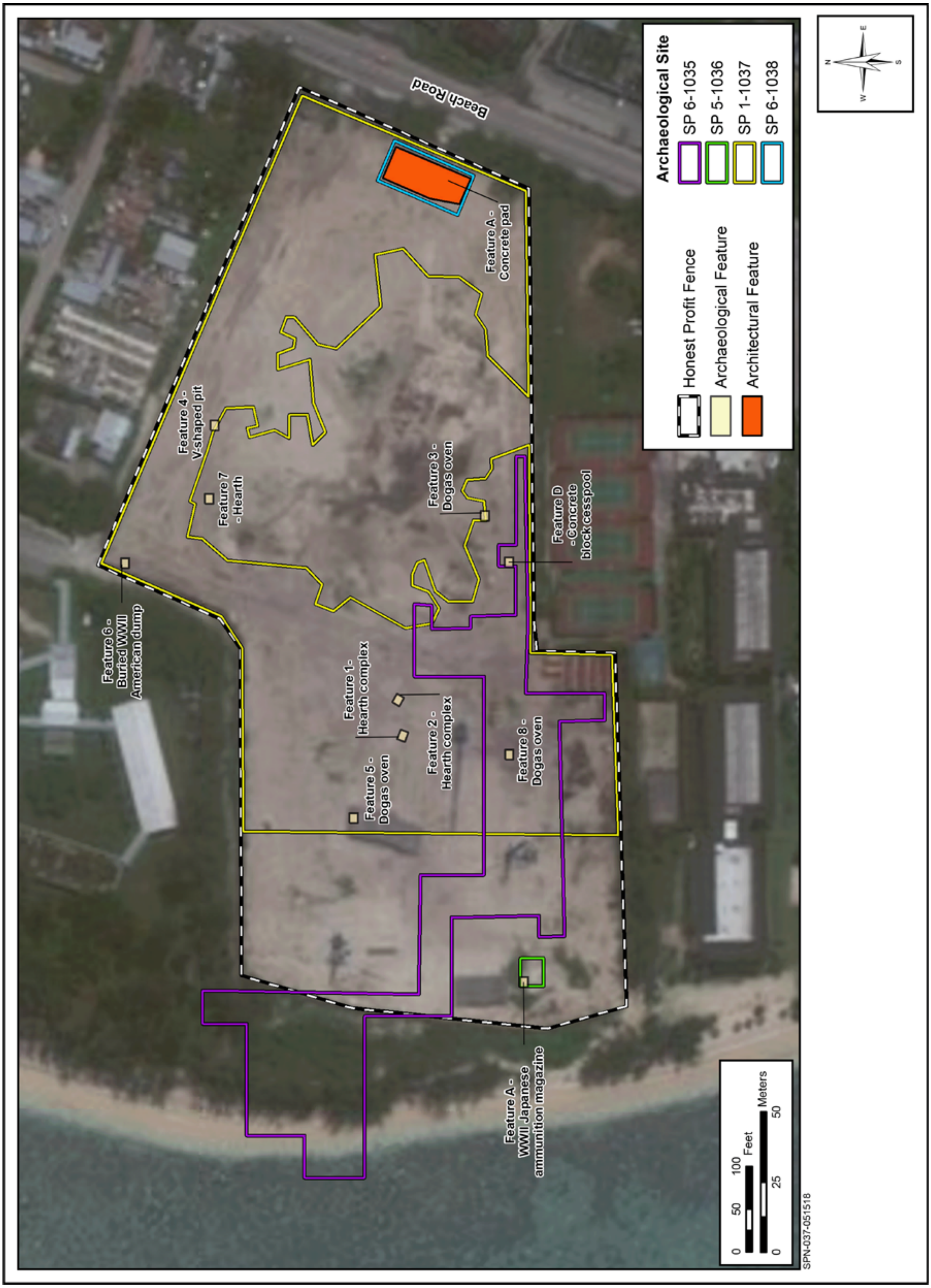

Figure 16. Location of Archaeological Sites and Features

regrowth of tropical vegetation at the time of grubbing and presumably in prehistory, as well as historic coconut plantations before WWII. This stratum was not as dark or as uniform along the western edge of the property overlooking the shoreline. Little evidence of prehistoric remains was encountered and cultural remains were sparse immediately inside the Beach Road fenceline.

Stratum III, a white (10YR 8/1) loose sand, sometimes contained lenses of gray (7.5YR 5/1 to 7/1) sand and occasional artifacts and *dogas* shells near the center of the property. This area presumably represents Late PreLatte activities but not major habitation. These lenses were not present to the east or west as tested by deeper excavations during survey and data recovery. The locus of earliest occupation of the property appears to lie perpendicular to the former sand mine, on a roughly north to south axis, which was largely removed in 1987.

Stratum IV, a white (10YR 8/1) sterile loose sand, was generally found across the entire site, above the water table encountered at or near 3 meters (9.8 feet) below surface depending on rainfall. These sands appear to be those targeted by the 1987 sand mine when other horizons above were removed. Where darker bands of Stratum III were not present, sands weathered to the same hue within minutes of being exposed to the sun and elements.

While the depths below surface were approximate, depending on disturbance depths, the overall stratigraphy was as follows:

- Stratum I = 0 to 30 centimeters (0 to 11.8 inches) below surface, loose backfills from sand mining over road gravels from USCG LORAN Station.
- Stratum II = 30 to 60 centimeters (11.8 to 23.6 inches) below surface, compact very dark grayish brown (10YR 3/2) organic cultural horizon, sometimes with features beneath in grayish brown (10YR 5/2) sand.
- Stratum III = 60 to 100 centimeters (23.6 to 39.4 inches) below surface, loose white (10YR 8/1) sand sometimes with cultural lenses in gray (7.5YR 5/1 to 7/1) sand grading into the stratum below.
- Stratum IV = 100 to 150 centimeters (39.4 to 59.1 inches) below surface, loose white (10YR 8/1) sterile sand below except when cultural intrusions come from above.

5.1.3. Site SP 1-1037

A total of eight features were recorded at Site SP 1-1037 (Figure 17). Features believed to be prehistoric in time period are presented first; however, the tops of many features were likely truncated by WWII combat and follow-on cleanup and later construction of the USCG LORAN Station and associated buried infrastructure. All the features identified during data recovery pertain to the Latte Period from approximately A.D. 1000 until the settlement of Spanish in the 1670s (Russell 1998), as denoted by their site prefix ‘SP 1’. Please note that the term ‘prehistoric’ used here in no way infers that native Chamorro people did not retain their own history before and after the arrival of Ferdinand Magellan in 1521.

5.1.3.1. Feature 1

Feature 1 a hearth complex, situated within the North Hotel footprint (see Figure 15), represents what is likely a primary type of communal or repeated cooking area within the aforementioned domestic activity zone, presumably situated on the seaward or downwind side of the Latte Period community’s habitations. Unlike the deeply buried *dogas* cooking ovens nearby, this feature was a roughly rectangular area of fire-cracked coral rocks and clusters of burned Latte Period Type B rimmed pottery. This feature was located within a black (10YR 2/1) to very dark grayish brown (10YR 3/2) compact sand. At least four dense clusters of FCR in a white (10YR 8/1) ash, each roughly 50 centimeters (19.7 inches) in diameter, were noted within the darker matrix. Together, the feature and its contents, measured approximately 5.5 meters (18 feet) in length north to south by 4 meters (13.1 feet) in width east to west and only 10 to

Figure 17. Site SP 1-1037 with Features

Figure 18. Site SP 1-1037, Feature 1, Plan View and Profile Photo

20 centimeters (3.9 to 7.9 inches) deep. The matrix had a wavy lower boundary above sterile loose white (10YR 8/1) Stratum III sand; although the top was truncated.

This hearth complex is interpreted as a cooking area requiring the heating of large Latte Period vessels and their contents on small low fires, although another interpretation is offered in addressing the Research Questions below. It is presumed that the hearth complex was cleaned out and local resident families introduced new stones repeatedly either during communal events or over time. Larger burned rock middens have been found near Latte Period habitation sites on Rota (Bulgrin 2006) and have been interpreted as accumulated near outdoor kitchens. The roughly rectangular shape of this feature suggests it may have been roofed (Figure 18 and 19) as do two possible post holes found near the northeast and southeast corners beneath the midden floor.

5.1.3.1.1 Feature 1 Test Pit 1

Feature 1 TP1 measured 20 by 20 centimeters (7.9 by 7.9 inches) in size and was placed within the east edge of Feature 1, to investigate the relationship of surface and subsurface artifact density, and to extract a measured sample of charred material for radiocarbon dating and microfossil identification and analysis. Feature 1 TP1 was excavated to a maximum depth of 10 centimeters (3.9 inches) below surface and contained one distinct soil horizon (Stratum II), situated above Stratum III with relatively sterile white sands below (Table 4). Burned Latte Period ceramics (1 rim and 39 body sherds) were recovered

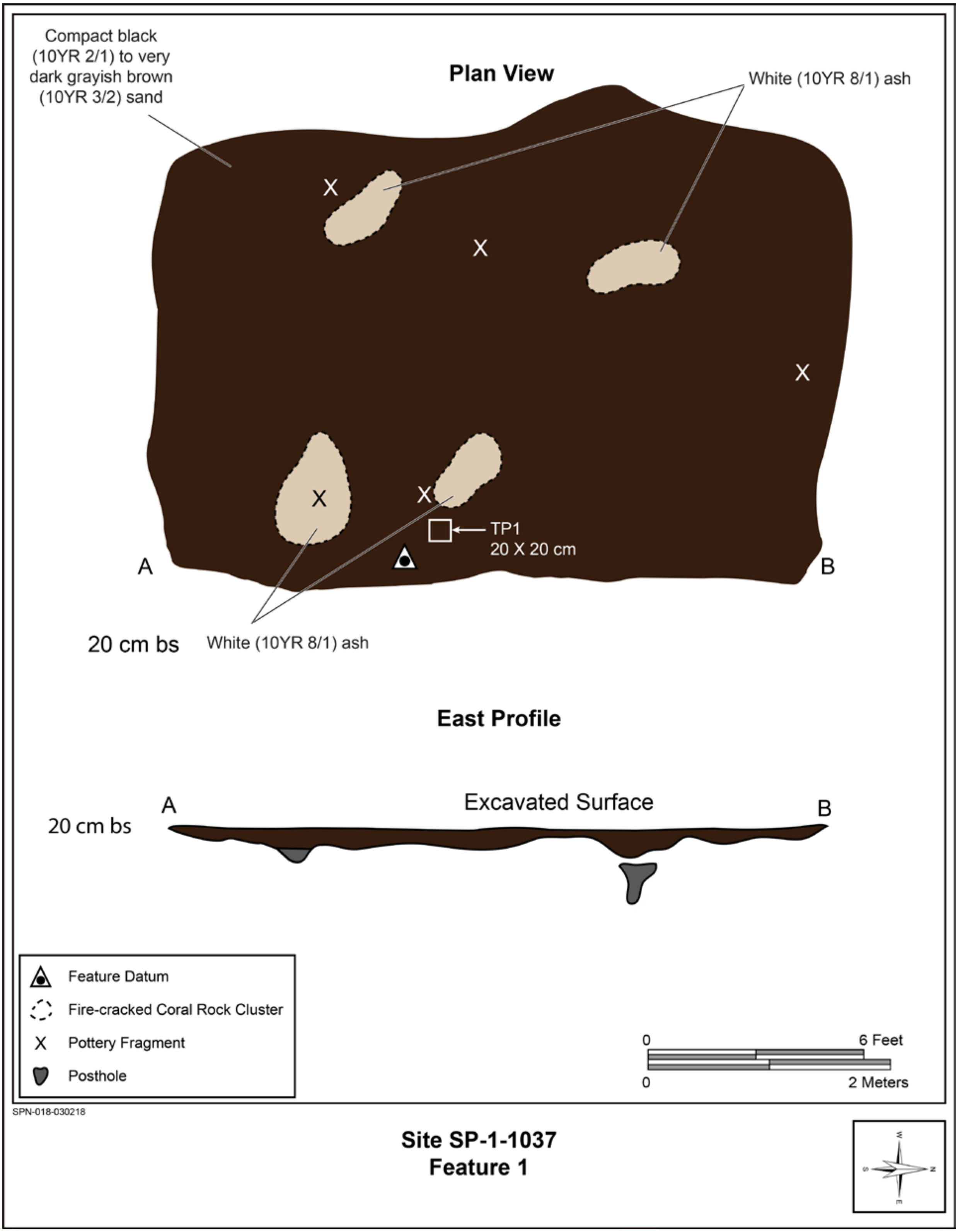

Figure 19. Site SP 1-1037, Feature 1, Plan View and Profile View to west

Table 4. Stratigraphic Summary of Feature 1 TP1 at

Stratum	Depth (centimeters/inches below surface)	Soil Description	Contents
II	10-20/3.9-7.9	Black (10YR 2/1) compact sand with wavy boundary below	Burned coral rocks, ash pockets, 1 Latte Period rim sherd and 39 Latte Period body sherds

during manual excavation and one each submitted to BetaAnalytic Inc. and Microfossil Research Ltd. for analysis. The remaining artifacts weighed 1,589 grams (56.05 ounces) and were unwashed for curation and future research.

Based on Bayesian sequence models for initial site use, Accelerator Mass Spectrometry (AMS) radiocarbon dating of charred material adhering to the exterior surface of the sherd from Feature 1 TP1 (Beta 458316) yielded a calibration of Cal A.D. 1483-1646 with the highest probability at a 95.4 percent confidence level (2 sigma). This calibrated date and its charred remains places the use of this feature in the final two centuries of the Latte Period when European castaways only sporadically visited Saipan when the Manila Galleon wrecked off shore and before the first arrival of Jesuit priests in 1668. The charred material on the matching sherd was identified by Microfossil Research as coconut and fern pollen, with grass and palm phytoliths, and marine sponge silica. These remains were presumed to be fuel used to generate the fire(s) of the Feature 1 hearth complex and not food residue from its cooked ingredients.

5.1.3.2 Feature 2

Feature 2, situated within the North Hotel footprint, is a smaller hearth complex located approximately 25 meters (82 feet) northeast of Feature 1. This feature was a roughly rectangular to oval area of firecracked coral rocks and clusters of burned Latte Period Type B rimmed pottery. The feature was composed of a black (10YR 2/1) compact organic sand midden beneath very dark grayish brown (10YR 3/2) sand (Stratum II). At least two dense clusters of FCR in a white (10YR 8/1) ash, each roughly 50 centimeters (19.7 inches) in diameter, were noted within the darker matrix. Together the feature and its contents measured approximately 3 meters (9.8 feet) in length north to south, 2 meters (6.6 feet) in width east to west, and only 20 centimeters (7.9 inches) deep. The matrix had a wavy lower boundary above sterile loose white (10YR 8/1) Stratum III sand and the top was truncated.

This hearth complex has been interpreted as a smaller cooking area or outdoor kitchen requiring the heating of large Latte Period vessels and their contents on small low fires, although another interpretation is offered in addressing the Research Questions below. The roughly oval shape of this feature suggests it may not have been roofed (Figures 20 and 21). Its smaller size presumably indicated a shorter term of use or by a smaller family group.

5.1.3.2.1. Feature 2 Test Pit 1

Feature 2 TP1 measured 20 by 20 centimeters (7.9 by 7.9 inches) in size and was placed within the eastern extension of Feature 2, to investigate the relationship of surface and subsurface artifact density, and to extract a measured sample of charred soil for radiocarbon dating and microfossil identification and analysis. Feature 2 TP1 was excavated to a maximum depth of 10 centimeters (3.9 inches) below surface and contained one distinct soil horizon (Stratum II), situated above Stratum III with relatively sterile white

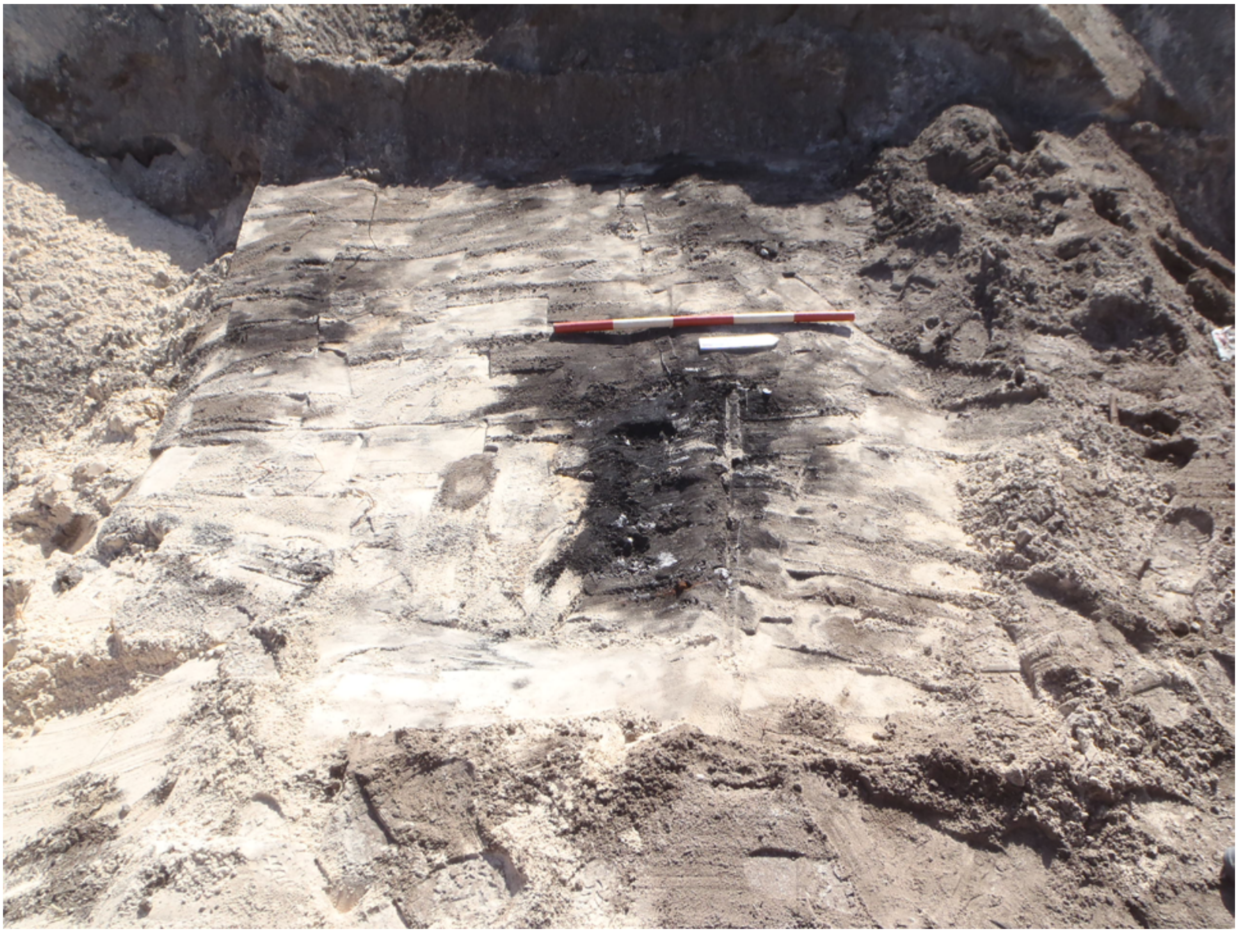

Figure 20. Site SP 1-1037, Feature 2, Plan View to the West, Profile below on the Left

Table 5. Stratigraphic Summary of Feature 2 TP1

Stratum	*Depth (centimeters/inches below surface)*	*Soil Description*	*Contents*
II	10-20/3.9-7.9	Black (10YR 2/1) compact sand with wavy boundary below	Burned coral rocks, ash pockets, Latte Period pottery

sands below (Table 5). Stratum II consisted of black (10YR 2/1) compact sand with a wavy boundary and contained burned coral rocks, ash pockets, and Latte Period pottery. Charred organic sediment recovered during manual excavation of the unit was submitted to BetaAnalytic Inc. and Microfossil Research Ltd. for analysis and the remaining soil weighed less than 399.7 grams (14.1 ounces).

Based on Bayesian sequence models for initial site use, AMS radiocarbon dating of charred organic sediment from Feature 2 TP1 (Beta 458314) yielded a date of Cal A.D. 1450-1530 with the highest probability at a 95.4 percent confidence level (2 sigma). The calibrated date places the use of this feature in the final century of the Latte Period. The charred material in the soil was identified by Microfossil Research as coconut and fern pollen, with grass and palm phytoliths, and starch rapides from aroid corms and leaves. These remains were presumed to be fuel used to generate the fire(s) of the Feature 2 hearth complex, and perhaps residue from its cooked ingredients.

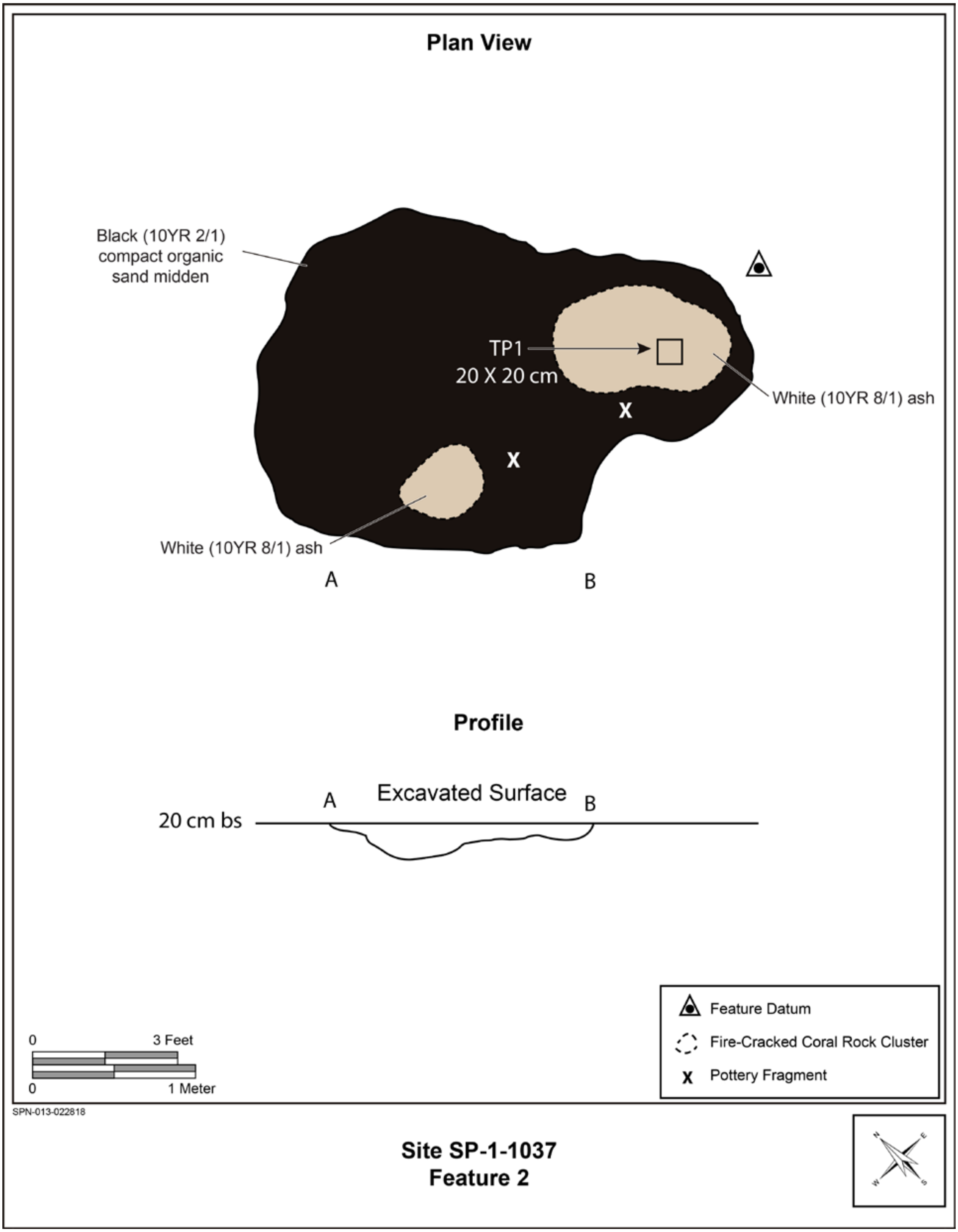

Figure 21. Site SP 1-1037, Feature 2, Plan View and Profile to the Northeast

5.1.3.3. Feature 3

Feature 3, situated east of the former USCG facility, was a roughly circular small *dogas* oven approximately 2 meters (6.6 feet) in diameter and at least 40 centimeters (15.7 inches) deep. These measurements were taken where mechanical excavation truncated the feature in a road cut into the former sand mine (Figures 22 and 23). Prior USCG road construction had exposed the discarded midden from the oven to at least a 5-meter (16.4foot) diameter area on the surface. Five shovel tests excavated beyond Feature 3 (Figure 24) were negative for cultural materials (Table 6). This feature, located on the south edge of the former sand mine, is much smaller and more shallow than the *dogas* ovens to the west (Features 5 and 8). Feature 3 may represent a single family or short-term cooking area. If situated on the seaward or downwind side of the Latte Period community's habitations, then the actual living area was destroyed by the sand mine.

The lowest cultural Stratum, IID, at the bottom of the oven feature, was a concave layer of very dark brown (10YR 2/2) fire-darkened sand 10 centimeters (3.9 inches) thick above and within sterile loose white (10YR 8/1) Stratum III sand. To the east and stratigraphically above Stratum IID was another 10 centimeter (3.9 inch) thick very dark grayish brown (10YR 3/2) oven feature Stratum IIC. This stratum had calcified *dogas* shells present that appeared not to have been totally removed for consumption. Stratum IIB, a layer of gray (7.5YR 5/1) ash, lies above the oven and the entire excavation unit was capped by a 15 centimeter (5.9 inch) thick layer of very dark brown (10YR 2/2) Stratum IIA mixed with *dogas* shells and pottery. This uppermost layer, Stratum I, was white (10YR 8/1) crushed coral road base fill. Feature fill was present below Stratum I, covering an area no more than 5 meters (16.4 feet) in diameter based on the negative results of five surrounding shovel test pits measuring 30 centimeters by 30 centimeters (11.8 inches by 11.8 inches) below surface.

Table 6. Stratigraphic Summary of Shovel Test Pits at Feature 3

Shovel Test Pit Number	***Layer***	***Depth (centimeters/inches below surface)***	***Soil Description***	***Contents***
1	I-III	0-30/11.8	Stratum I white (10YR 8/1) crushed coral road base with wavy boundary; slight traces of Stratum II very dark brown (10YR 2/2) sand below; over Stratum III white (10YR 8/1) sterile sand	Sparse *dogas* shells, no artifacts
2	I-III	0-30/11.8	Stratum I white (10YR 8/1) crushed coral road base with wavy boundary; slight traces of Stratum II very dark brown (10YR 2/2) sand below; over Stratum III white (10YR 8/1) sterile sand	Sparse *dogas* shells, no artifacts
3	I-III	0-30/11.8	Stratum I white (10YR 8/1) crushed coral road base with wavy boundary; slight traces of Stratum II very dark brown (10YR 2/2) sand below; over Stratum III white (10YR 8/1) sterile sand	Sparse *dogas* shells, no artifacts
4	I-III	0-30/11.8	Stratum I white (10YR 8/1) crushed coral road base with wavy boundary; slight traces of Stratum II very dark brown (10YR 2/2) sand below; over Stratum III white (10YR 8/1) sterile sand	Sparse *dogas* shells, no artifacts
5	I-III	0-30/11.8	Stratum I white (10YR 8/1) crushed coral road base with wavy boundary; slight traces of Stratum II very dark brown (10YR 2/2) sand below; over Stratum III white (10YR 8/1) sterile sand	Sparse *dogas* shells, no artifacts

Figure 22. Site SP 1-1037, Feature 3, Profile of TP1, View to the South

5.1.3.3.1. Feature 3 Test Pit 1

Feature 3 TP1 measured 100 by 100 centimeters (39.4 by 39.4 inches) in size and was placed within the northern extension of Feature 3, to investigate the relationship of surface and subsurface artifact density, and to extract a measured sample of charred soil for radiocarbon dating and microfossil identification and analysis. All matrices were screened through 0.364 centimeter (0.25 inch) wire mesh and all shell with a few pottery sherds were recovered for analysis (see Figures 22 and 23). Feature 3 TP1 was excavated to a maximum depth of 60 centimeters (23.6 inches) below surface and contained one distinct soil horizon (Stratum IIA) situated above two distinct oven basins (Stratum IIB/C and IID) with Stratum III, sterile white sands below (Table 7). Charred organic sediment recovered during manual excavation of the unit was submitted to BetaAnalytic Inc. and Microfossil Research Ltd. for analysis and the remaining soil weighed 3,859 grams (136.1 ounces).

Based on Bayesian sequence models for initial site use, AMS radiocarbon dating of charred organic sediment from Feature 3 TP1 (Beta 458312) yielded a date of Cal A.D. 1450-1530 with the highest probability at a 95.4 percent confidence level (2 sigma). The calibrated date places the use of this feature in the final century of the Latte Period. The charred material in the soil was identified by Microfossil

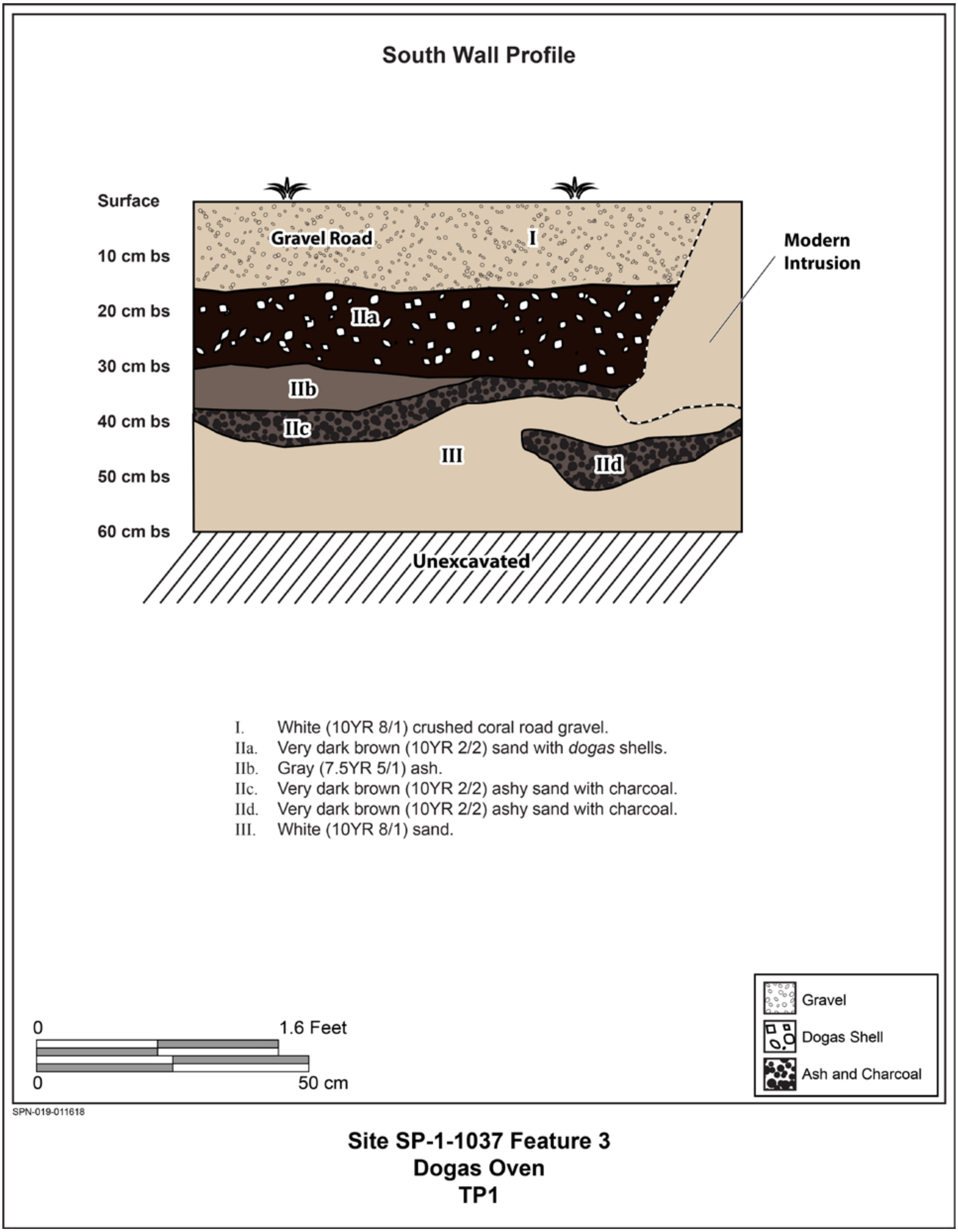

Figure 23. Site SP 1-1037, Feature 3, TP1 Profile, South Wall

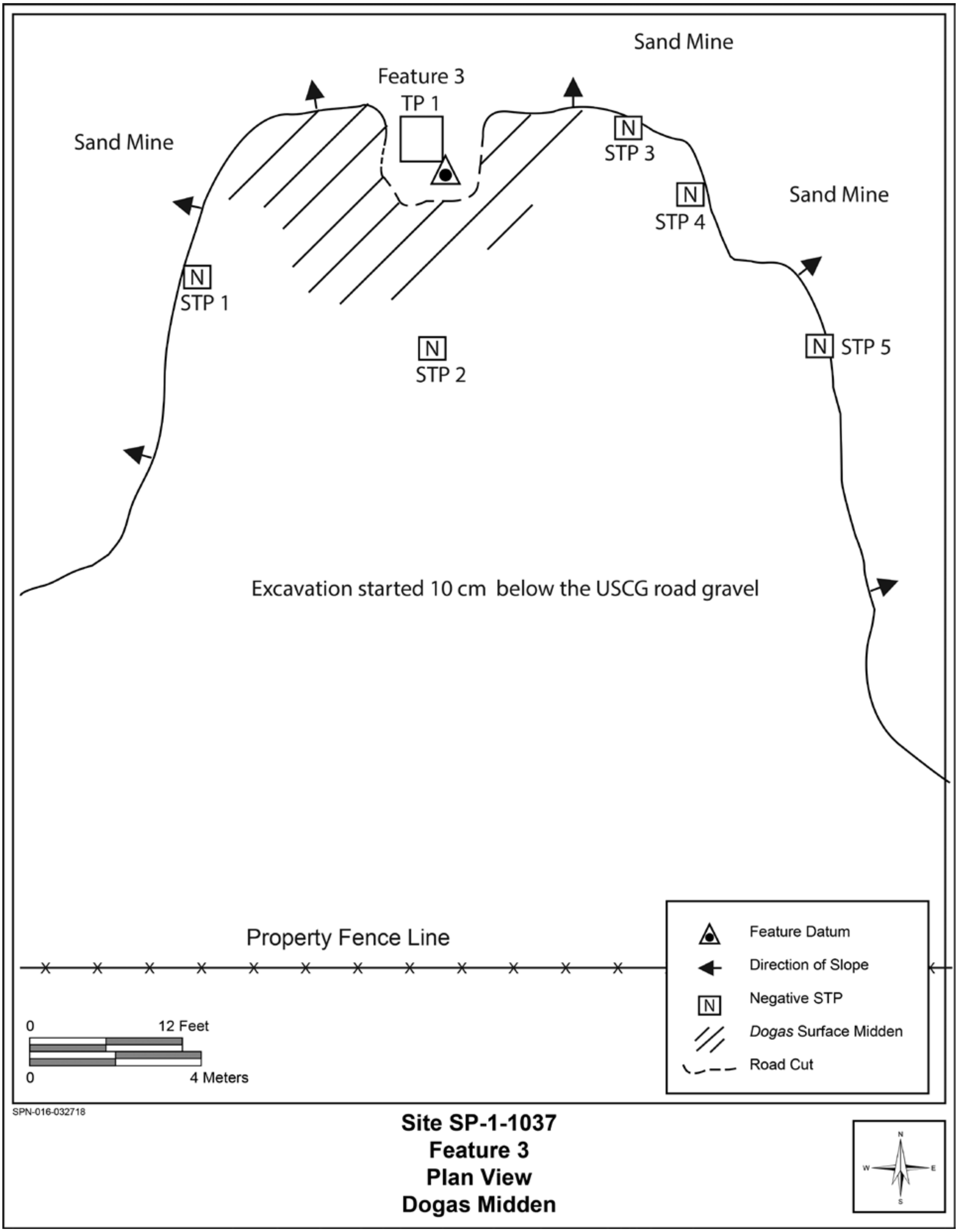

Figure 24. Site SP 1-1037, Feature 3, TP1 Plan View and Negative Shovel Test Pits

Table 7. Stratigraphic Summary of Feature 3 TP1

Stratum	***Depth (centimeters/inches below surface)***	***Soil Description***	***Contents***
I	0-15/0-5.9	White (10YR 8/1) crushed coral road gravel with wavy boundary below	None
IIa	15-30/5.9-11.8	Very dark brown (10YR 2/2) sand with wavy boundary below	Dense *dogas* shells, sparse Latte Period ceramics
IIb	30-40/11.8-15.7	Gray (7.5YR 5/1) ash	None
IIc	40-45/15.7-17.7	Very dark brown (10YR 2/2) ashy sand oven basin	None
IId	45-50/17.7-19.7	Very dark brown (10YR 2/2) ashy sand oven basin	None
III	50-60/19.7-23.6	White (10YR 8/1) sand	None

Research as non-coconut palm and Indian Mulberry pollen with grass phytoliths and starch rapides from aroid corms and leaves. These remains were presumed to be fuel used to generate the fire(s) of the Feature 3 *dogas* oven and perhaps residue from its cooked ingredients.

Figure 25. Site SP 1-1037, Feature 4, Profile with Complex Stratigraphy Below

5.1.3.4. Feature 4

Feature 4, situated beneath former Aguas Street, was a roughly V-shaped pit within the base of the 10 centimeter (3.9 inch) thick Stratum II cultural horizon (Figure 25). This feature was exposed by trenching through the road gravel of Stratum I, located next to a shallower and smaller pit with burned coral rocks to the south (Figure 26). The 30 centimeter (11.8 inch) deep V-shaped pit matrix was a very dark gray (7.5YR 3/1) sand with occasional *dogas* shells and a wavy lower boundary, but no evidence of burning in situ. Immediately below the feature was Stratum III, a 40 centimeter (15.7 inch) thick light gray (7.5YR 7/1) sand. Stratum III was homogenous in matrix, with a fairly abrupt lower boundary. This suggests relatively rapid deposition perhaps during one or more storm surge events before the Latte Period occupation above. Stratum IIIA below Stratum III was 10 centimeter (3.9 inch) thick gray (7.5YR 6/1) sand with occasional *dogas* shells and a wavy boundary below implying some temporal stability. This is likely toward the end of the Pre-Latte Period to judge from occasional Type A rim sherds and undecorated redware found in the backdirt. Stratum IIIB was a 10 centimeter (3.9 inch) thick pinkish gray (7.5YR 7/2) sand with darker mottling and wavy boundary below, likely another storm surge event. Stratum IIIC below was a gray (7.5YR 5/1) sand with mottling and occasional *dogas* shells. This stratum gradually faded into sterile loose white (10YR 8/1) sand (Stratum IV) at the bottom of the trench approximately 100 centimeters (39.4 inches) below surface.

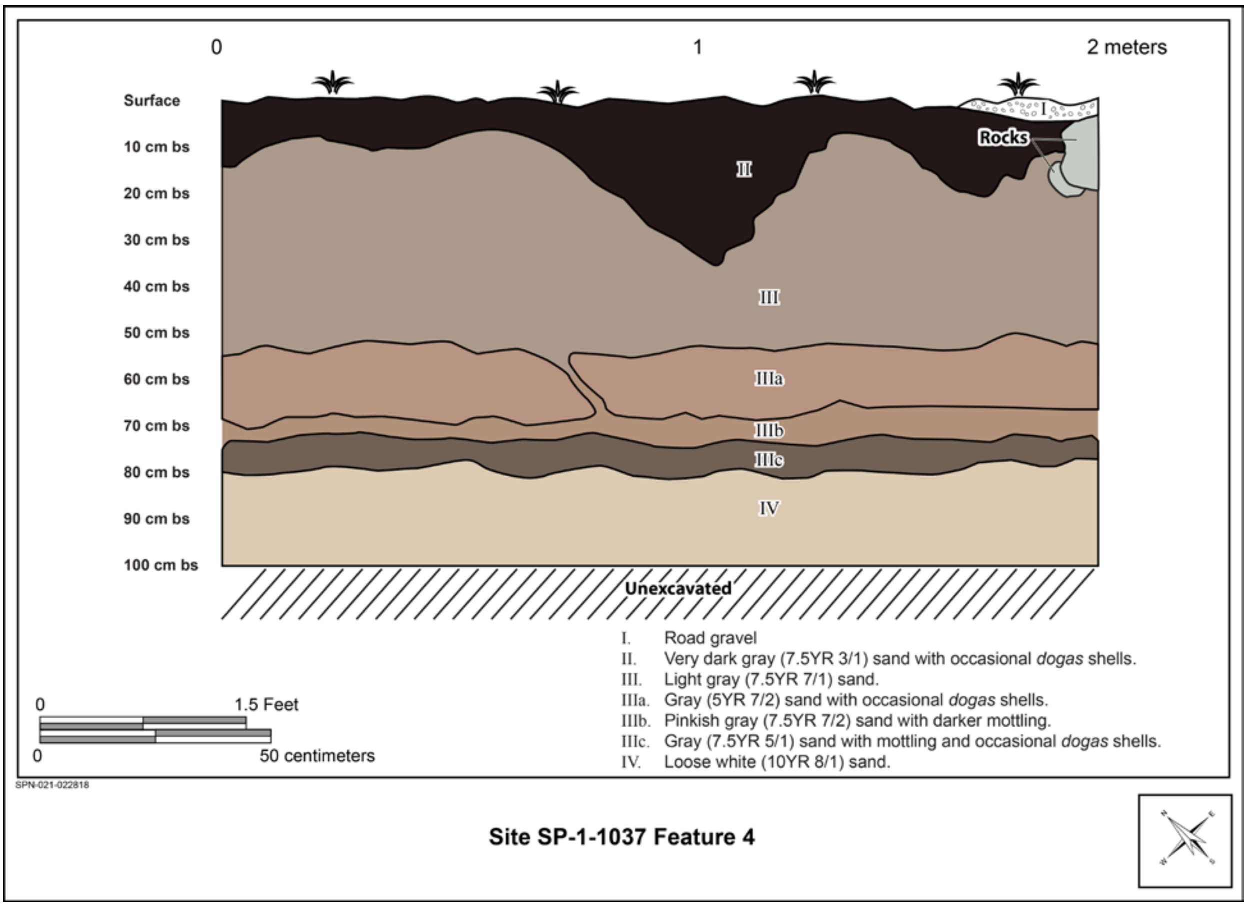

Figure 26. Site SP 1-1037, Feature 4, Profile of the North Wall

5.1.3.5. Feature 5

Feature 5 was situated within the swimming pool area between the two hotel footprints. The feature was a roughly circular shaped *dogas* oven approximately 6 meters (16.7 feet) in diameter and at least 2 meters (6.6 feet) deep, where mechanical excavation and profile cleaning ceased due to safety concerns (Figure 27). The side walls consisted of loose sand and ash with shell lenses but were unsafe to document due to collapsing trench walls. USCG road construction and then grading and grubbing had exposed the discarded midden from the oven to a much larger area on the surface. This feature, located on the west edge of the former sand mine, is much larger and deeper than the small *dogas* oven to the east (Feature 3). Feature 5 may represent a communal or long-term cooking area. If this oven was situated on the seaward or downwind side of the Latte Period community's habitation, then the actual living area was partially destroyed by the sand mine.

The lowest stratum of the oven feature was a 40 centimeter (15.7 inch) thick basin of black (10YR 2/1) compact organic sandy ash (Stratum II). It was impossible to determine the exact boundary with the sterile loose white (10YR 8/1) Stratum III/IV sand below because the side wall was extremely unstable. Immediately above, on the southern side of the feature, was a 20 centimeter (7.9 inch) thick lens of calcified *dogas* shells, which appeared not to have been totally removed for consumption. The entire cooking feature was then capped by Stratum II, a 60 centimeter (23.6 inch) thick layer of dark grayish brown (10YR 4/2) ashy sand mixed with *dogas* shells. It is presumed to be the remains of oven clean out and *dogas* consumption in situ. This layer is capped by Stratum I, another 60 centimeter (23.6 inch) very dark grayish brown (10YR 3/2), mixed by WWII-era disturbances and antenna grounding wire.

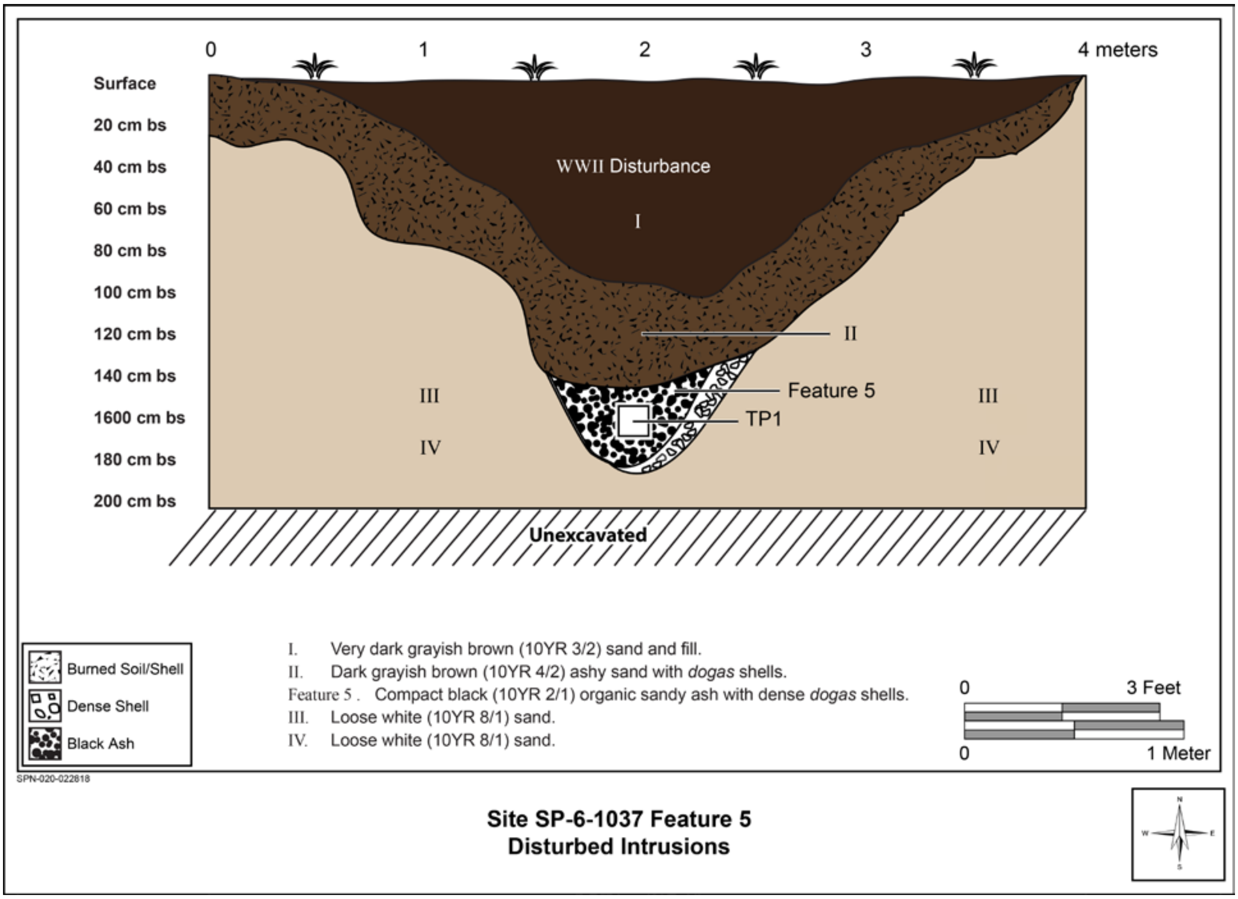

Figure 27. Site SP 1-1037, Feature 5, Profile of East Wall

Table 8. Stratigraphic Summary of Feature 5 TP1

Stratum	***Depth (centimeters/inches below surface)***	***Soil Description***	***Contents***
II	150-170/59.1-66.9	Black (10YR 2/1) compact organic sandy ash	*Dogas* shells

5.1.3.5.1. Feature 5 Test Pit 1

Feature 5 TP1 measured 20 by 20 centimeters (7.9 by 7.9 inches) in size and was placed within the lowest layer of charred soil in Stratum II, approximately 1.5 meters (4.9 feet) below surface (Table 8), to investigate the relationship of surface and subsurface artifact density, and to extract a measured sample of charred soil for radiocarbon dating and microfossil identification and analysis. Charred organic sediment recovered during manual excavation was submitted to BetaAnalytic Inc. and Microfossil Research Ltd. for analysis and the remaining soil weighed 96.1 ounces (2,724 grams).

Based on Bayesian sequence models for initial site use, AMS radiocarbon dating of charred organic sediment from Feature 5 TP1 (Beta 458313) yielded a date of Cal A.D. 1669-1780 with the highest probability at a 95.4 percent confidence level (2 sigma). The earliest intercept of this calibrated date places the use of this feature after the first arrival of Jesuit priests to Saipan in 1668 and presumably before the final removal of Chamorro inhabitants by Spanish military at the end of La Reduccion, approximately in 1721. The charred material in the soil was identified by Microfossil Research as grass and palm phytoliths with marine sponge silica and taro starch. These remains were presumed to be fuel used to generate the fire(s) of the Feature 5 *dogas* oven and perhaps residue from its cooked ingredients.

5.1.3.6. Feature 7

Feature 7 was situated on the south side of Aguas Street near the edge of the sand mine. The feature consisted of a small cooking hearth that was located beneath gravel fill (Stratum I) and the cultural horizon (Stratum II) approximately 50 centimeters (19.7 inches) below road surface (Figure 28). This feature was a roughly circular area of fire-cracked coral and small stones measuring just under 1 meter (3.3 feet) in diameter and only 10 centimeters (3.9 inches) deep (Figure 29). The hearth was mixed with occasional *dogas* shells and black (10YR 2/1) ashy sand above white (10YR 8/1) sands (Stratum III). It is assumed this represents a onetime cooking event, perhaps similar to many more such features accumulated within the hearth complexes of North Hotel Features 1 and 2 described above. A test pit was not excavated within this feature due to near surface disturbances.

5.1.3.7. Feature 8

Feature 8, situated within the South Hotel footprint, was a roughly circular shaped *dogas* shell oven approximately 8 meters (26.2 feet) in diameter and at least 2 meters (6.6 feet) deep. Mechanical excavation ceased due to safety concerns regarding the side walls, which consisted of loose sand and ash with shell lenses unsafe to profile. USCG road construction and then grading and grubbing had exposed the discarded midden from the oven to a much larger area on the surface. This feature, located on the west edge of the former sand mine, is much larger and deeper than the *dogas* oven to the east (Feature 3). This may represent a communal or longterm cooking area similar to Feature 5. If this feature was situated on the seaward or downwind side of the Latte Period community's habitations, then the actual living area was partially destroyed by the sand mine.

Figure 28. Site SP 1-1037, Feature 7, Plan View to the South

The lowest stratum at the bottom of the oven feature was a 30-centimeter (11.8-inch) thick concave layer of gray (7.5YR 6/1) fire-darkened sand (Stratum IIC). Stratum IIC covered at least two large and flat coral cobbles horizontally bedded above the sterile loose white (10YR 8/1) sand (Stratum III). This implies their use as heating elements for the first cooking event was at least 2 meters (6.6 feet) below the surface (Figure 30). No longer present was the oxidized firewood used to heat the rocks before introducing the wrapped food for underground cooking. A 10 centimeter (3.9 inch) thick lens of very dark grayish brown (10YR 3/2) ash (Stratum IIB) was located above the deepest burned sand. This perhaps represents a second cooking event covered by another 10 centimeter (3.9 inch) thick layer of fire-darkened sand.

Immediately overlying those three strata was a 20 centimeter (7.9 inch) thick lens of calcified *dogas* shells (Figure 31), which appear not to have been removed for consumption. The entire cooking feature was then capped by a 40 centimeter (15.7 inch) thick layer of very dark brown (10YR 2/2) organic ashy sand (Stratum IIA). This layer was mixed with *dogas* shells and is presumed to be the remains of oven clean-out and *dogas* consumption in situ. This was in turn capped by another 40 centimeters (15.7 inches) of grayish brown (10YR 5/2) soil (Stratum I) mixed by WWIIera disturbances and thus spread far beyond the limits of the cooking feature itself.

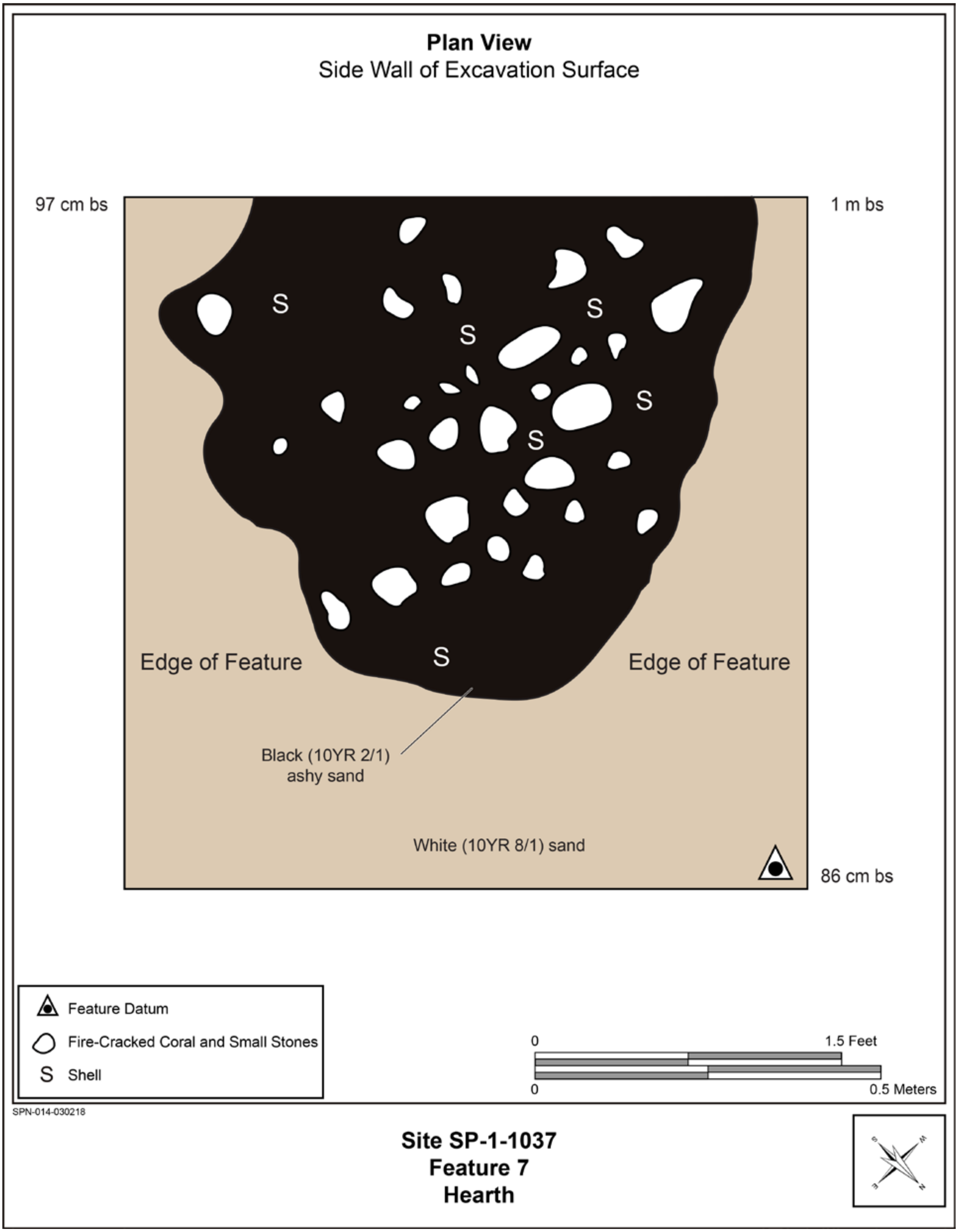

Figure 29. Site SP 1-1037, Feature 7, Plan View of Hearth

5.1.3.7.1. Feature 8 Test Pit 1

Feature 8 TP1 measured 20 by 20 centimeters (7.9 by 7.9 inches) in size and was placed within the highest layer of intact charred soil in the northwest corner of Stratum IIA (Table 9). The TP was located here to investigate the relationship of surface and subsurface artifact density and to extract a measured sample of charred soil for radiocarbon dating and microfossil identification and analysis. Charred organic sediment recovered during manual excavation of the unit was submitted to BetaAnalytic Inc. and Microfossil Research Ltd. for analysis and the remaining soil weighed 4,994 grams (176.2 ounces).

Based on Bayesian sequence models for initial site use, AMS radiocarbon dating of charred organic sediment from Feature 8 TP1 (Beta 458315) yielded a date of Cal AD 1513-1601 with the highest probability at a 95.4 percent confidence level (2 sigma). This calibrated date places the use of this feature in the final two centuries of the Latte Period. The charred material in the soil was identified by Microfossil Research as grass and palm phytoliths with starch rapides from artiod corms and leaves. These remains were presumed to be fuel used to generate the fire(s) of the Feature 8 *dogas* oven and perhaps residue from its cooked ingredients.

Table 9. Stratigraphic Summary of Feature 8 TP1

Stratum	***Depth (centimeters/inches below surface)***	***Soil Description***	***Contents***
IIA	0-20/0-7.9	Very dark brown (10YR 2/2) organic ashy sand	*Dogas* shells

Figure 30. Site SP 1-1037, Feature 8 Profile, View to the Northeast

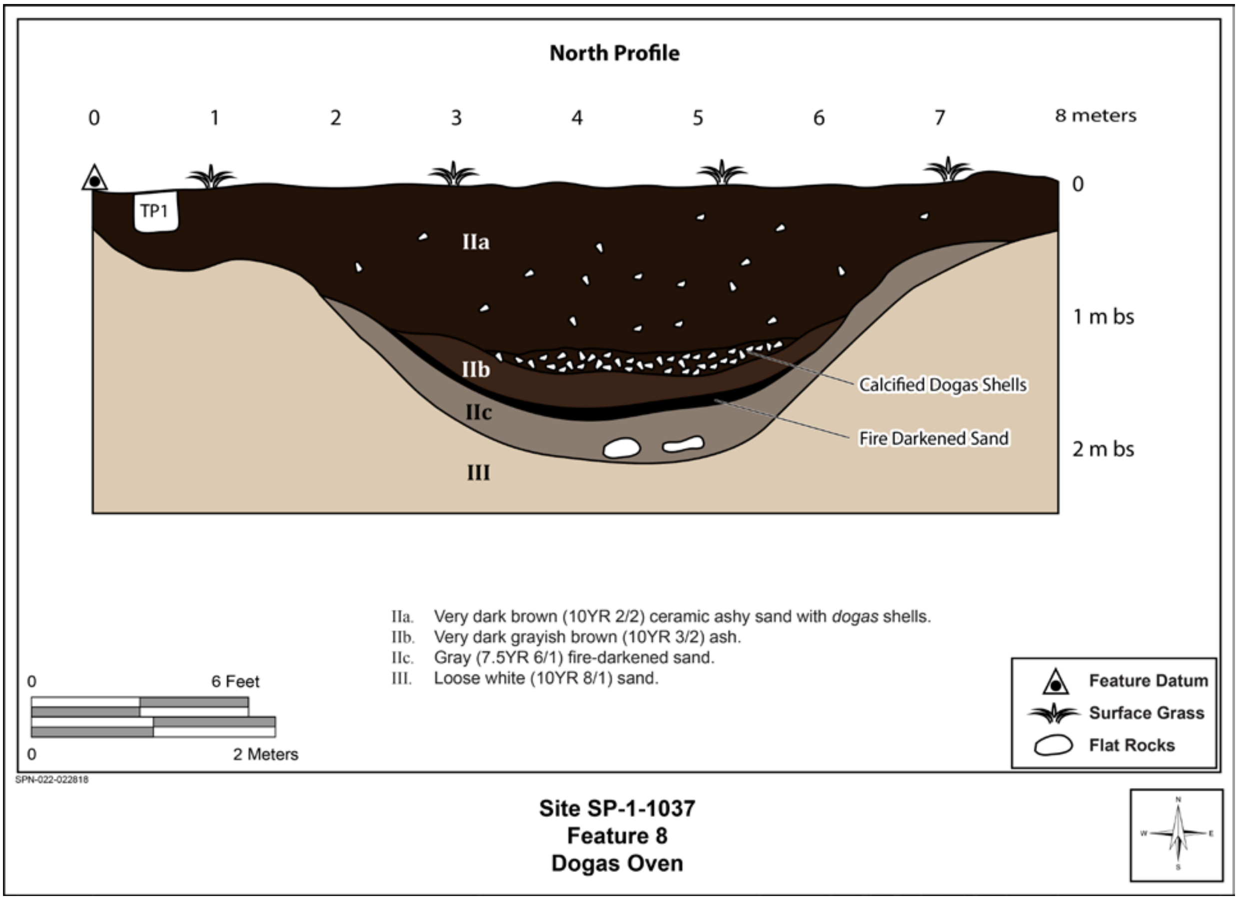

Figure 31. Site SP 1-1037, Feature 8, Profile of North Wall

5.1.4 Artifacts

Prehistoric artifacts at Site SP 1-1037 reflected a broad spectrum of domestic activities, including cooking (ceramics), forest clearing (stone adzes), wood working (shell chisels and adzes), food preparation (stone pounders and grinders), herbal medicine preparation (stone mortars and pestles), abraders (pitted coral), ornamentation (shell beads), and hunting or fighting (limestone sling stones and human bone spear points).

5.1.4.1. Groundstone Artifacts

Groundstone artifacts at Site SP 1-1037 (Table 10) were 'whole or fragmentary implements whose shape has been produced mainly by pecking and grinding, as opposed to chipping' (Hunter-Anderson 1994). Raw materials used for stone tool manufacture included basalt or andesite (not differentiated geochemically in this report), coral, and limestone. Chert artifacts were not encountered. These groundstone tools displayed a wide variety of forms and functions suggesting relatively easy access to raw materials presumably within a half day walk to the sources, or via exchange of blanks and finished tools with people living in the Saipan uplands. In spite of the absence of basalt or volcanic stone outcrops on the coastal plain and southern terraces, it appears this interaction was frequent given the quantity of groundstone tools on property. Perhaps Site SP 1-1037 even functioned as an intermediary in exchange with inhabitants across the water on Tinian who lacked tool quality basalt and volcanic stone raw materials.

Adzes

Basalt and andesitic stone adzes at Site SP 1-1037 appeared likely to reflect forest clearing for agriculture as well as tree felling and shaping activities for house construction and canoe production. They ranged in shape from flat/rectangular to trapezoidal to oval and most had considerable use wear on one or more edges. Their limited number on site suggested they were not tools of daily use for every household. Their used condition may suggest they were re-sharpened or re-hafted and curated at home for future use by skilled wood working artisans at the work site.

Discrete variables used to characterize stone adzes in Micronesia (Craib 1998:147) included manufacturing stage (blank, peform, finished), condition (whole or broken), material (basalt or andesite), X-section (circular, rectangular, lenticular, oval, quadrangular, plano-convex), edge shape (straight, wide-curve, U-curve), and poll shape (squared, rounded, pointed). Variability in stone tool form is the combined result of three primary factors: 1) functional requirements, 2) tool use life, and 3) raw material differences (Andrefsky 2005:160).

Morphological attributes associated with use wear and re-working observed on stone adzes followed terminology outlined by Andrefsky (2005:87) to compare relative levels of repair and reuse between artifacts. The attributes used to determine intensity of use and re-use on site included flake characteristics of step fractures (often the result of heavy impact) and feathered flake terminations (the result of more controlled stone flaking strategies).

Artifact Number 55.001, found during data recovery in the Phase 1 area, was a complete, finished stone adze possibly made of basalt (Figure 32). The adze was rectangular in plan and roughly lenticular to rectangular in cross section. The adze exhibited smooth grinding on both sides of the tool, front and back. Evidence of use wear in the form of step fractures about the cutting edge was present and altered the original shape, yet remaining portions suggest a wide-curve bevel shape and squared to sub-rounded poll for hafting. Flake scars with stepped terminations present along the tool margin, post grinding, suggested that the tool was reshaped to accommodate a new haft during its use life. The adze measured 155.21 millimeters (5.1 inches) long by 75.18 millimeters (3 inches) wide by 25 millimeters (1 inch) thick and weighed 454 grams (16 ounces).

Figure 32. Artifact Number 55.001, Basalt Adze, Ground Flat and Sharpened

Figure 33. Artifact Number 139.001, Basalt Adze, Oval Shape with Use Wear on Bevele

Table 10. Basalt Artifacts Collected from Site SP 1-1037

Artifact Number	*Phase of Investigation*	*Construction Area (Stratum II [30-60 centimeters below surface])*	*Object*	*Alteration*	*Length (millimeters/ inches)*	*Width (millimeters/ inches)*	*Thickness (millimeters/ inches)*	*Weight (grams/ ounces)*
13.001	Fenceline	FP10	Pounder	Battered ends	74/2.9	34/1.3	48/1.9	224.9/7.9
17.001	Fenceline	Road surface west of USCG building	Adze preform	Roughly chipped	138/5.4	44/1.7	34/1.3	680/24
21.001	Fenceline	Road surface west of USCG building	Adze preform	Roughly chipped	141/5.6	59/2.3	42/1.7	454/16
25.001	Grubbing	Phase 1 South Hotel surface	Grinding stone fragment		60/2.4	50/2	46/1.8	144.8/5.1
37.001	Data Recovery	Phase 1 South Hotel trenching	Grinding basin fragment		195/7.7	175/6.9	120/4.7	5,443/192
38.001	Data Recovery	Phase I South Hotel trenching	Pounder fragment	Battered end/ smooth surface	53.52/2.11	41.75/1.64	25.32/0.10	84.5/3
39.001	Data Recovery	Phase 1 South Hotel trenching	Pounder	Two sided	105.52/4.15	74.15/2.92	52.08/2.05	454/16
40.001	Data Recovery	Phase 1 South Hotel trenching	Pounder	Battered end/ smooth surface	85.87/3.38	63.29/2.49	23.15/0.91	201.8/7.1
46.001	Data Recovery	Phase 1 South Hotel trenching	Grinding Stone fragment		210.05/8.27	98.6/3.9	82.94/3.27	2,722/96
49.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone		58.58/2.31	35.32/1.39	30.57/1.20	69.1/2.4
50.001	Data Recovery	Phase 1 North Hotel trenching	Pounder fragment	Battered end/ smooth surfaces	60.05/2.36	79.26/3.12	63.19/2.49	1,816/64.1
51.001	Data Recovery	Phase 1 North Hotel trenching	Pounder	Battered end/ smooth surface	160.21/6.31	88.54/3.49	74.31/2.93	1,814/64
52.001	Data Recovery	Phase 1 North Hotel trenching	Pounder fragment	Smooth surface and edge, FAR	96.86/3.81	66.07/2.6	64.44/2.54	454/16
53.001	Data Recovery	Phase 1 North Hotel trenching	Pounder fragment	Smooth surface	93.52/3.68	68.78/2.71	45.48/1.79	484/17.1
55.001	Data Recovery	Phase 1 North Hotel trenching	Adze	Shaped edges	155.21/6.11	75.18/2.96	20.95/0.82	454/16

Artifact Number	***Phase of Investigation***	***Construction Area (Stratum II [30-60 centimeters below surface])***	***Object***	***Alteration***	***Length (millimeters/ inches)***	***Width (millimeters/ inches)***	***Thickness (millimeters/ inches)***	***Weight (grams/ ounces)***
58.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone		66.10/2.6	34.33/1.35	30.34/1.19	79.7/2.8
59.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone		57.66/2.27	33.82/1.33	29.74/1.17	74.75/2.64
134.001	Data Recovery	Phase 1 North Hotel trenching	Pounder fragment	Battered end	84/3.3	57/2.2		454/16
139.001	Data Recovery	Phase 1 North Hotel trenching	Adze	Polished and chipped end	150/5.9	80/3.1	33/1.3	153.4/5.4
140.001	Data Recovery	Phase 1 North Hotel trenching	Polishing stone	One polished surface	80/3.1	35/1.4	35/1.4	142.6/5
160.001	Data Recovery	Phase 1 North Hotel trenching	Grinding stone	One ground surface	150/5.9	110/4.3	70/2.8	1,905/67.2
161.001	Data Recovery	Phase 1 South Hotel trenching	Grinding basin fragment	Hole 2 centimeters (0.9 inches) deep by 6 centimeters (2.4 inches) wide	100/3.9	90/3.5	60/2.4	1,451/51.2
161.002	Data Recovery	Phase 1 South Hotel trenching	Grinding basin fragment	Hole 2 centimeters (0.9 inches deep by 6 centimeters (2.4 inches) wide	125/4.9	125/4.9	45/1.8	454/16
163.001	Data Recovery	Phase 1 trenching west of USCG building	Grinding stone	One ground surface	110/4.3	100/3.9	80/3.1	680/24
164.001	Data Recovery	Phase 1 trenching west USCG building	Pounder	One ground end	150/5.9	50/2	70/2.8	1,816/64.1
165.001	Data Recovery	Phase 1 trenching west of USCG building	Polishing stone	Two ground surfaces	90/3.5	75/3	55/2.2	680/24
166.001	Data Recovery	Phase 1 swimming pool trenching	Pounder	One ground end	90/3.5	50/2	90/3.5	1,362/48
167.001	Data Recovery	Phase 1 North Hotel trenching near Burial 65	Grinding stone	Two ground surfaces	105/4.1	70/2.8	40/1.6	681/24

Artifact Number	*Phase of Investigation*	*Construction Area (Stratum II [30-60 centimeters below surface])*	*Object*	*Alteration*	*Length (millimeters/ inches)*	*Width (millimeters/ inches)*	*Thickness (millimeters/ inches)*	*Weight (grams/ ounces)*
168.001	Data Recovery	Phase 1 North Hotel trenching	Grinding stone	One ground surface	120/4.7	60/2.4	50/2	544.8/19.2
169.001	Data Recovery	Phase 1 North Hotel trenching near Burial 62	Adze fragment	Broken	70/2.8	60/2.4	20/0.8	99.6/3.5
169.002	Data Recovery	Phase 1 North Hotel trenching near Burial 62	Adze fragment	Broken	75/3	45/1.8	15/0.6	71.2/2.5
170.001	Data Recovery	Phase 1 trenching west of USCG building	Pestle	Two ground surfaces	100/3.9	45/1.8	30/1.2	270.4/9.5
171.003	Data Recovery	Phase 2 north access road trenching	Pounder	One ground end	120/4.7	70/2.8	70/2.8	908/32
171.002	Data Recovery	Phase 2 north access road trenching	Grinding stone	Six ground surfaces	65/2.6	50/2	47/1.9	306.1/10.8
172.001	Data Recovery	Phase 2 north access road trenching	Pounder	One ground end	120/4.7	80/3.1	70/2.8	817.2/28.8
173.001	Data Recovery	Phase 1 pool area trenching	Stone sphere	Grooved edge	35/1.4	35/1.4	32/1.3	61.7/2.2
174.001	Data Recovery	Phase 2 north access road trenching	Grinding stone	Three ground surfaces	80/3.1	66/2.6	52/2	379.4/13.4
175.001	Data Recovery	Phase 2 south access road trenching	Grinding stone	Two ground surfaces, two pits	90/3.5	70/2.8	70/2.8	379.4/13.4
176.001	Data Recovery	Phase 2 south access road trenching	Stone sphere	Round and rolls	53/2.1	53/2.1	53/2.1	195.3/6.9
177.001	Data Recovery	Phase 4 southeast corner trench trenching	Stone anvil	Flaked on three edges	130/5.1	90/3.5	39/1.5	908/32

Artifact Number 139.001, found during data recovery in the Phase 1 North Hotel trench, was a complete finished stone adze, possibly made of basalt (Figure 33). The adze was rectangular in plan and oval in cross section. The bevel exhibited a wide-curved cutting surface and was ground smooth on one side of the tool. Poll shape was rounded where it would have abutted the wooden adze handle. Use wear or chipping around the beveled and ground cutting edge was evident in the form of minor step fractures likely caused by heavy impact during use. Flake scars along the tool margins as the result of reshaping and reuse were not present. The adze measured 80 millimeters (3.1 inches) long by 33 millimeters (1.3 inches) wide by 33 millimeters (1.3 inches) thick and weighed 153.4 grams (5.4 ounces).

Figure 34. Artifact Number 21.001 (left) and Artifact Number 17.001 (right) Basalt Adze

Artifact Number 17.001, found on the surface west of the USCG facility next to Artifact Number 21.001, during fence line monitoring, was a complete adze preform possibly made of basalt (Figure 34). The adze blank was trapezoidal in plan, oval in cross section, and was roughly polished on one side of the preform. A beveled working edge had been roughly established and exhibited a squared to sub-rounded shape. Slight use wear or chipping around the beveled and ground cutting edge was evident in the form of pecking. The adze preform measured 138 millimeters (5.4 inches) long by 44 millimeters (1.7 inches) wide by 34 millimeters (1.3 inches) thick and weighed 680 grams (24 ounces).

Artifact Number 21.001, found on the surface west of the USCG building next to Artifact Number 17.001 during fence line monitoring, was a complete adze preform possibly made of basalt (see Figure 34). The adze preform was trapezoidal in plan, oval in cross section, and has been roughly ground on one side of the tool. A beveled working edge had been roughly established by small flake removal and rough grinding. Slight use wear or chipping around the beveled and ground cutting edge was evident in the form of pecking. The adze preform measured 141 millimeters (5.6 inches) long by 59 millimeters (2.3 inches) wide by 42 millimeters (1.7 inches) thick and weighed 454 grams (16 ounces).

Pounders

Pounders are hand tools ‘for crushing by downward force in a regular up and down motion that involves separation of the tool and the material being crushed each time the tool is lifted prior to the next downward blow. These tools are struck against a flat or concave nether stone or slab of wood’ (Hunter-Anderson 1994:5.48).

Basalt stone pounders at Site SP 1-1037 appeared to reflect food processing activities for agricultural (taro and yams) and/or forest subsistence items such as breadfruit, cycad nuts, and screwpine nuts. They ranged from roughly tear drop to oval or conical shaped cobbles obviously selected for use with two hands in mind, and small irregular shaped cobbles best used by one hand. Most of the pounders had evidence of use wear on one or more surfaces. Their large number on site and numerous fragments suggested they were a daily component used to support the diet of every household, as might be expected by expedient domestic use and communal cooking as a shared activity between nearby families.

Artifact Number 39.001, found during excavation of the South Hotel in the Phase 1 area, was a complete pounder possibly made of basalt (Figure 35). The pounder was roughly conical in plan and circular in cross section with slightly polished surface. The artifact exhibited a single ground pounding end with use wear evidence of pecking made by successive strikes against a stone mortar. The tool measured 105.52 millimeters (4.2 inches) long by 74.15 millimeters (2.9 inches) wide by 52.08 millimeters (2.1 inches) thick and weighed 454 grams (16 ounces).

Figure 35. Artifact Number 39.001, Basalt Pounder, Tear Drop Shaped Cobble with Use Wear

Artifact Number 46.001, found during excavation of the South Hotel in the Phase 1 area, was a complete pounder possibly made of basalt (Figure 36). The pounder was roughly oval in plan and elliptical in cross section, with slightly polished surface and a single ground pounding end. Evidence of use wear was present as slight pecking on the end of the tool as the result of successive impacts during use. The tool measured 210.05 millimeters (8.3 inches) long by 98.6 millimeters (3.9 inches) wide by 82.94 millimeters (3.3 inches) thick and weighed 2,722 grams (96 ounces).

Artifact Number 13.001, found during excavation of the South Hotel in the Phase 1 area, was a pounder fragment possibly made of basalt (Figure 37). The pounder was roughly rectangular in plan, elliptical in cross section, with a slightly polished surface, and a single ground pounding end. The tool showed considerable use wear in the form of pecking on both ends of the artifact, which likely formed through successive impacts during use. The tool measured 74 millimeters (2.9 inches) long by 34 millimeters (1.3 inches) wide by 48 millimeters (1.9 inches) thick and weighed 224.9 grams (7.9 ounces).

Figure 36. Artifact Number 46.001, Basalt Pounder, Oval Shaped Cobble with Use Wear

Artifact Number 166.001, found during excavation of the Phase 1 swimming pool area, was a broken pounder possibly made of basalt (Figure 38). The pounder fragment was roughly conical in plan and cross section, with a polished surface, and two ground pounding ends. Evidence of use wear was present on the remnant working end in the form of pecking, which likely formed as the result of successive striking during use. The tool measured 90 millimeters (3.5 inches) long by 50 millimeters (2 inches) wide by 70 millimeters (2.8 inches) thick and weighed 1,362 grams (48 ounces).

Figure 37. Artifact Number 13.001, Basalt Pounder, Rectangular Shaped Cobble

Figure 38. Artifact Number 166.001, Basalt Pounder, Conical Shaped Cobble with Use Wear

Figure 39. Artifact Number 164.001, Basalt Pounder, Oval Shaped Cobble with Use Wear

Figure 40. Artifact Number 171.001, Basalt Grinder, Oval Shaped Cobble with Use Wear

Artifact Number 164.001, found during excavation of the USCG area, was a broken pounder possibly made of basalt (Figure 39). The pounder fragment was roughly oval in plan and cross section, with a polished surface, and one ground pounding end. Evidence of use wear was present on the pounding end in the form of pecking caused by repeated impacts during use. The tool measured 150 millimeters (5.9 inches) long by 50 millimeters (2 inches) wide by 70 millimeters (2.8 inches) thick and weighed 1,816 grams (64 ounces).

Grinders

Basalt stone grinders collected at Site SP 1-1037 also appeared to reflect food processing activities for agricultural products (taro and yams) and/or forest resources including breadfruit, screwpine nuts, and cycad nuts. They ranged from roughly tear drop to oval shaped cobbles obviously selected for use with two hands in mind, and small irregular shaped cobbles best used by one hand. Most stone grinders had evidence of use wear on one or more surfaces. Use wear evidence was often on a ground end of the tool, including parallel striations caused by back and forth movement upon the working surface. Pecking from successive striking, a trait more often found on pounders, is minimal on most grinders, although some tools obviously served both purposes. Their moderate number on site and numerous fragments suggested they were a daily component to processing the diet of every household, as might be expected by cooking as a shared activity between nearby families.

Artifact Number 171.001, found during excavation of the Phase 2 road, was a broken grinder possibly made of basalt (Figure 40). The grinder fragment was roughly rectangular in plan and cross section, with polished surfaces, and one grinding end. Use wear was present as slight parallel striations, which likely formed as the result of back and forth movement during use. The tool measured 120 millimeters (4.7 inches) long by 70 millimeters (2.8 inches) wide by 70 millimeters (2.8 inches) thick and weighed 908 grams (32 ounces).

Figure 41. Artifact Number 175.001, Basalt Grinder, Oval Shaped Cobble with Use Wear

Artifact Number 175.001, found during excavation of the Phase 2 north access road, was a broken grinder possibly made of basalt (Figure 41). The grinder fragment was roughly oval in plan and cross section, with a polished surface including a small pecked pit on two sides. Use wear was present on one grinding end with considerable pecking while small striations were present along the flat surfaces. The combination of striations and pecking suggested that this was a multi-functional tool for both grinding and pounding. The tool measured 90 millimeters (3.5 inches) long by 70 millimeters (2.8 inches) wide by 52 millimeters (2 inches) thick and weighed 379.4 grams (13.4 ounces).

Artifact Number 167.001, found during excavation of the Phase 1 area near Burial 65, was a complete grinder possibly made of basalt (Figure 42). The grinder was roughly oval in plan and cross section, with polished surface and two grinding ends. Use wear was present on the tool ends as small parallel striations and pecking, likely formed by back and forth motion and repetitive striking. The tool measured 105 millimeters long by 70 millimeters (2.8 inches) wide by 40 millimeters (1.6 inches) thick and weighed 681 grams (24 ounces).

Figure 42. Artifact Number 167.001, Basalt Grinder, Oval Shaped Cobble with Use Wear

Spheres/Ovoids

Stone implements exhibiting sphere/ovoid and disc forms have been identified elsewhere in the Marianas ‘in an attempt to differentiate them from tools used to work chert’ (Hunter-Anderson 1994:5.61). Basalt stone spheres collected on property ranged from completely round shaped small cobbles perhaps made to roll across a flat surface, to a similar shaped object with a ground depression around its mid-section that might also serve to roll in one direction. The use of small stone balls in gaming is described enthnographically for other island communities across Oceania, including competitive rolling of small shaped stone balls downslope in Hawaii (Fornander and Thrum 1920:214). While some stone spheres could have served both purposes, the latter object could also have been used as a net sinker weight. Their small number on site suggested they were not a daily component of every household, as might be expected by gaming objects for shared activities between nearby families.

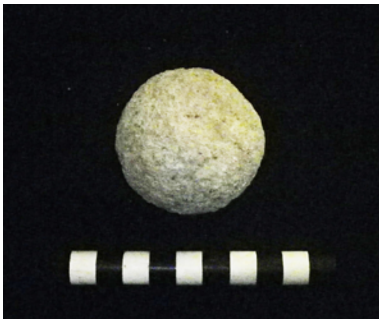

Figure 43. Artifact Number 176.001, Stone Sphere

Artifact Number 176.001, found during excavation of the Phase 2 south access road, was a complete small stone sphere possibly made of basalt (Figure 43). The sphere was round in plan and cross section with a slightly polished surface. Evidence of use wear was present in the form of pecking across the surface of the tool suggesting that the tool was struck repeatedly on all faces. The object measured 53 millimeters (2.1 inches) in diameter and weighed 195.3 grams (6.9 ounces).

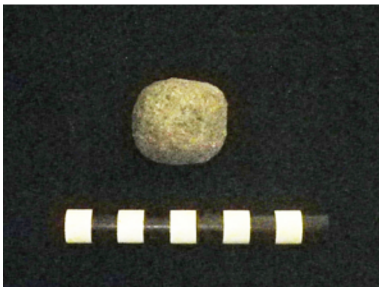

Figure 44. Artifact Number 173.001, Stone Sphere with Band around the Center

Artifact Number 173.001, found during excavation of the Phase 1 pool area, was a complete small stone sphere possibly made of basalt (Figure 44). The sphere was round in plan and cross section, with a slightly polished surface, and a slight groove worn around its mid-section. The central groove may have been created to accept cordage as seen with fishing net weights. The object measured 35 millimeters (1.4 inches) in diameter and weighed 61.7 grams (2.2 ounces).

Anvil

Anvils have been described elsewhere as 'a relatively large stone with a flat surface upon which some battering is evident... [reflecting] the prevalence of the bi-polar flaking technique...' in the Marianas (Hunter-Anderson 1994:5.66). The basalt anvil collected at Site SP 1-1037 was smaller than described above, but appeared to have been a naturally flat cobble easily held in one hand or on the lap or ground, with chipping around its three sides, giving the impression of being used for reducing local chert flakes or perhaps *Tridacna* shell blanks into usable tools for further manufacturing. The limited number of anvils present on site and paucity of chert flakes recovered from activity areas suggested that these anvils served a purpose other than chert flake production. Also, the low frequency of abundance on site indicated they were not a daily component to processing tools or food for every household.

Figure 45. Artifact Number 177.001, Basalt Anvil with Chipping around Edges

Artifact Number 177.001, found during excavation of the Phase 4 southeast corner trench, was a small stone anvil possibly made of basalt. The anvil was roughly triangular in shape, with a flat unmodified surface, and chipping along all three sides (Figure 45). Typical use wear in the form of pitting from bipolar flaking (Vergès and Ollé 2011:1019) was not present on the anvil surface and suggested use other than chert flake production. The anvil measured 130 millimeters (5.1 inches) long by 90 millimeters wide by 39 millimeters thick and weighed 908 grams (32 ounces).

Figure 46. Artifact Number 161.001, Basalt Mortar, Circular Shaped Ground Cobble

Mortars and Basins

Portable mortars and grinding slabs or basins 'are nether stones used with pestles, pounders, and manos to crush resistant materials in relatively small quantities at a time. Portable mortars are those thought small enough to have been moved from site to site over the course of their use-life, unlike the embedded mortars [*lusongs*] which, because of the size and weight, are assumed to have been more or less permanently emplaced as site furniture elements' (Hunter-Anderson 1994:5.53). Basalt mortars and grinding basins at Site SP 1-1037 appeared to reflect plant grinding activities perhaps associated with medicinal herbs used in healing practices. They ranged in shape from circular to oval to somewhat irregular and all had one central depression for grinding activities. Their limited number on site suggested they were not a daily component to every household, as might be expected of their use by native healers or *siruhanu*.

Figure 47. Artifact Number 161.002, Basalt Mortar, Irregular Shaped Ground Cobble

Artifact Number 161.001, found during excavation of the South Hotel in the Phase 1 area, was a mortar possibly made of basalt. The mortar was roughly circular in plan, concave in cross section, with rounded sides 20 millimeters (0.8 inches) wide. A single ground circular depression 70 millimeters (2.8 inches) in diameter and 20 millimeters (0.8 inches) deep in the center was also present on the mortar (Figure 46). The tool measured 100 millimeters (3.9 inches) long by 90 millimeters (3.5 inches) wide by 60 millimeters (2.4 inches) thick and weighed 1,451 grams (51.2 ounces).

Artifact Number 161.002, found during excavation of the South Hotel in the Phase 1 area, was a mortar possibly made of basalt. The mortar was roughly circular in plan, concave in cross section, with rounded sides 20 millimeters (0.8 inches) wide, and a single ground circular depression. This depression measured 80 millimeters (3.1 inches) in diameter and 25 millimeters (1 inch) deep in the center (Figure 47). The tool measured 125 millimeters (4.9 inches) long by 125 millimeters (4.9 inches) wide by 45 millimeters (1.8 inches) thick and weighed 454 grams (16 ounces).

Figure 48. Artifact Number 37.001, Basalt Mortar, Circular Shaped Ground Cobble

Artifact Number 37.001, found during excavation of the South Hotel in the Phase 1 area, was a mortar fragment possibly made of basalt. The mortar fragment was roughly circular in plan, concave in cross section, with rounded sides 50 millimeters (2 inches) wide, and a single ground circular depression was present. This circular depression measured 150 millimeters (5.9 inches) in diameter and 55 millimeters (2.2 inches) deep in the center (Figure 48). The tool measured 195 millimeters (7.7 inches) long by 175 millimeters (6.9 inches) wide by 120 millimeters (4.7 inches) thick and weighed 5,443 grams (192 ounces).

Polishing Stones

Polishing stones at Site SP 1-1037 appear to reflect the final stages of finishing softer materials for use, perhaps screwpine or other leaves on a wooden surface for woven products, or grinding within shallow basins perhaps with water or oil added to a fine finish. Small smooth stones recovered within domestic settings have been also interpreted as burnishing stones for polishing the surfaces of ceramic vessels as a surface treatment (O'Reilly 1997:135). Polishing stones recovered during fieldwork were oval to irregular shaped cobbles obviously selected with their particular use in mind given their small size, and had evidence of polishing or internal use wear. Their few number on site suggests they were not a daily component of every household.

Figure 49. Artifact Number 140.001, Basalt Polishing Stone, Oval Shaped Cobble

Artifact Number 140.001, found during excavation in the Phase 1 area, was a polishing stone possibly made of basalt. The polishing stone was roughly oval in plan, convex in cross section, with a single polished surface. The polished surface was located on the flat side and measured 30 millimeters wide (1.2 inches) and 30 millimeters (1.2 inches) long (Figure 49). The tool measured 55 millimeters (2.2 inches) long by 35 millimeters (1.4 inches) wide by 35 millimeters (1.4 inches) thick and weighed 142.6 grams (5.0 ounces).

Table 11. Coral Artifacts Recovered at Site SP 1-1037

Artifact Number	*Phase of Investigation*	*Construction Area (Stratum II [30-60 centimeters below surface])*	*Object*	*Length (millimeters/ inches)*	*Width (millimeters/ inches)*	*Thickness (millimeters/ inches)*	*Weight (grams/ ounces)*
19.001	Fenceline	Road surface west of USCG building	Abrader 2 sided	94/3.7	74/2.9	24/0.9	199.2/7
116.001	Data Recovery	Phase 1 pool trenching near Burial 33	Bead	5/2	5/0.2	4/0.2	14.6/0.5
132.001	Data Recovery	Phase 1 pool trenching	Pestle	150/5.9	52/2	45/1.8	454/16
162.001	Data Recovery	Phase 1 trenching west of USCG building	Abrader	100/3.9	80/3.1	50/2	454/16
171.002	Data Recovery	Phase 2 access road trenching	Abrader	120/4.7	100/3.9	40/1.6	454/16

5.1.4.2. Coral Artifacts

Coral was present in the lagoon and more distant reef, and in eroded cobbles along the beach, being used for abraders or pestles (Table 11) and more readily as heating materials for burned rock hearths and *dogas* shell ovens. Some specimens of fossilized coral also were noted, perhaps imbedded in reef rock or imported from limestone outcrops from nearby Puntan Agingan. Finger coral (*Acropora cervicornis*) could also be used for drill bits, although none were positively identified in the field.

Abraders

Abraders were tools 'that were grasped in the hand and rubbed against a surface (e.g., stone, wood, clay) in order to smooth, polish and shape them, and to pulverize small-grained materials such as gritty pigments or pottery temper' (Hunter-Anderson 1994:5.57). Coral abraders at Site SP 1-1037 appear to reflect grinding activities perhaps associated with the polishing of wooden surfaces and household implements (tool handles) or those of bone (spears). Some contained shallow depressions on one or more sides and may have been used for cracking small nuts (e.g., dry betel nuts), if not crafted as hand grips for their use as abraders. Others were larger and had relatively flat surfaces to facilitate grinding. The few number on site suggests they were not a daily component to every household, as might be expected if their use was by skilled artisans. Some appeared to have a groove around the mid-section to be reused as sinker weights.

Artifact Number 19.001, found during fenceline construction along the road to the USCG building, was an abrader made of waterworn coral. The abrader was roughly oval in plan and cross section, with rounded edges, and two ground oval depressions in the center of both sides (Figure 50). The oval depressions measured 25 millimeters (0.9 inch) in diameter and 5 millimeters (0.2 inches) deep in the center of both sides. A slight groove around the mid-section suggests the abrader may have been reused as a net sinker weight. The tool measured 94 millimeters (3.7 inches) long by 74 millimeters (2.9 inches) wide by 24 millimeters (0.9 inches) thick and weighed 199.2 grams (7.0 ounces).

Figure 50. Artifact Number 19.001, Pitted Coral Abrader, Oval Shaped with Depressions

Pestle

Coral pestles at Site SP 1-1037 appear to reflect grinding activities perhaps associated with the volcanic stone mortars also found in similar contexts. They contained use wear in the form of pitting on two ends from grinding and pounding within a small vessel of similar proportions. The few number on site suggests they were not a daily component to every household, as might be expected of their use by native healers or *siruhanu*.

Artifact Number 132.001, found during excavation in the Phase 1 area, was a pestle made of waterworn coral cobble. The pestle was roughly rectangular in plan and cross section, with rounded edges, and pitting use wear on both ends. The smaller end was more intensely ground than the butt end (Figure 51). The tool fragment measured 150 millimeters (5.9 inches) long by 52 millimeters (2.0 inches) wide by 45 millimeters (1.8 inches) thick and weighed 454 grams (16 ounces).

Figure 51. Artifact Number 132.001, Coral Pestle, Rectangular Shaped with Use Wear

Bead

Only one fossilized coral bead was collected and was associated with Burial 31. The bead was polished and drilled from both sides for suspension from cordage. Its provenience with a human burial also containing a drilled perforation to the cranium suggests its uniqueness, not an ornament of common distribution.

Figure 52. Artifact Number 116.001, Fossilized Coral Bead, Polished and Drilled

Artifact Number 116.001 (reburied), found during excavation of Burial 31 in the Phase 3 area, was a bead made of a small fossilized coral cobble. The bead was roughly circular in plan, and oval in cross section, with rounded edges, and two drilled perforations. These perforations measured 5 millimeters (0.2 inches) in diameter and 5 millimeters (0.2 inches) deep on both sides with a hollow cavity only 1 millimeter (0.04 inch) in the center (Figure 52). The bead measured 14 millimeters (0.6 inches) in diameter and 4 millimeters (0.2 inches) thick and weighed 14.6 grams (0.5 ounces).

5.1.4.3 Limestone Sling Stones

Sling stones 'represent considerable effort in manufacture, at least those of hard volcanic stone, limestone or clay' (Hunter-Anderson 1994:5.66). The bipointed ovoid shape was apparently favored for its aerodynamic shape, although others were chipped and abraded into more diamond or egg shapes. 'The marked proliferation of slingstones during the Latte Phase is usually and reasonably interpreted as signaling the advent of warfare in the Marianas' (York and York 2011:20), although they could have been used to hunt fruit bats or seasonal waterfowl. The majority were hand sized weighing 40 to 80 grams (1.4 to 2.8 ounces), although a few were the size of American footballs and exceeded 1 kilogram (35.3 ounces), thought to be ceremonial or used as canoe breakers (Hunter-Anderson 1994:5.69).

Table 12. Limestone Artifacts Recovered from Site SP 1-1037

Artifact Number	*Phase of Investigation*	*Construction Area (Stratum II [30-60 centimeters below surface])*	*Object*	*Length (millimeters/ inches)*	*Width (millimeters/ inches)*	*Weight (grams/ ounces)*
11.001	Fenceline	FP11	Sling stone fragment	58/2.3	31/1.2	78.1/2.8
38.002	Data Recovery	Phase 1 North Hotel trenching	Sling stone	67/2.6	38/1.5	103.9/3.7
43.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone	59.55/2.3	30.62/1.2	27.6/0.9
45.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone	63.33/2.5	42.42/1.7	37.60/1.3
45.002	Data Recovery	Phase 1 North Hotel trenching	Sling stone fragment	<63.33/2.5	<42.42/1.7	<37.60/1.3
47.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone	60.41/2.4	36.64/1.4	79.4/2.8
49.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone	58.58/2.3	35.32/1.4	69.1/2.4
54.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone	67.49/2.7	38.30/1.5	69.1/2.4
137.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone	60/2.4	28/1.1	56.3/2
138.001	Data Recovery	Phase 1 North Hotel trenching	Sling stone	72/2.8	27/1.1	91.8/3.2

Exposed limestone was present in the coastal cliffs and bedrock outcrops of Agingan Point not far to the south, and small cobbles were presumably available on the beach below for use as sling stones (Table 12). Their ubiquity at Site SP 1-1037 suggests they were part of most household weaponry or hunting tool kits, if not later serving as net sinker weights. Some sling stones retained shapes associated with early stages of manufacture, with little evidence of grinding or polishing and were likely preforms or met the minimal required shape for functional use. Others found in fragmented condition could have been discarded upon manufacturing breakage or may have broken as the result of impact with hard materials. Most sling stones were not found in situ, but rather eroded out of backdirt during excavation or after an evening rain.

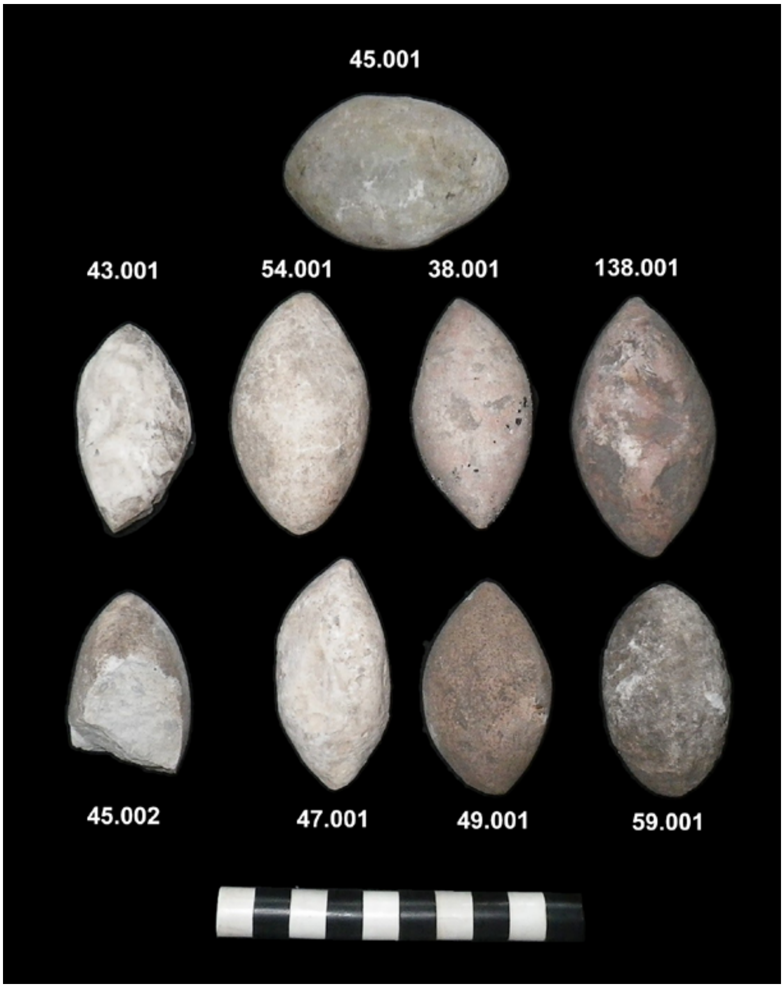

Figure 53. Limestone and Basalt Sling Stones, Uniform to Irregular Shaped

Sling stones found during excavation in the Phase 1 area were made of limestone. The sling stones were elliptical in plan and cross section, with two pointed ends, occasionally fragmented perhaps from a previous impact. The weapons measured between 58 and 72 millimeters (2.3 and 2.8 inches) long, between 28 and 42 millimeters (1.1 and 1.7 inches) thick at their mid-section (Figure 53) and weighed between 27 and 103 grams (0.9 and 3.6 ounces). Density of the limestone sources varied considerably, so not all artifacts were likely to have been quarried from the same outcrop or beach material.

Patterning of Lithic Artifacts at Parcel 004-1-52

The organization of stone tool technology on a particular site, that is the suite of tools created and employed, was the product of an interrelationship among individuals, their location, task requirements, and the availability of lithic raw materials (Rickless and Cox 1993:445). Since stone tool traditions interact with other cultural subsystems such as exchange and food production, tool efficiency and material access may have fluctuated over time in response to constraints imposed by other variables. In the case of additions or shifts in the lithic tool kit, patterning in production strategies would likely be archaeologically visible due to the durable nature of stone tool manufacturing debris. The relationship between tool types and manufacturing debris within the site area offered the ability to observe which tools were widely used, and those with a more restricted or specialized use. Patterning present in availability of tool stone, either raw materials or finished groundstone tools, also offered insight into potential exchange or distribution networks which supplied local communities.

A total of 55 stone artifacts were recovered from Parcel 004-1-52 (Table 13). Patterning in the relative proportions of stone tools indicated that pounders were the most prevalent stone tools used on site (total combined = 26 percent). Sling stones of both basalt and limestone were second in abundance (21 percent), while basalt grinding stones were third in relative abundance (16 percent). Finished stone adzes accounted for 7 percent of the total assemblage. The assemblage shows a skew toward stone tools associated with the processing of subsistence items (pounders, grinding basins, grinding stones) which together account for 49 percent of the total assemblage. As opposed to sites consisting of expedient and informal stone flakes associated with intermittent resource procurement (Eckert and Welch 2013), the emphasis on formal tools including grinding stones and pounders suggests a focus on domestic food preparation activities, as may be present in areas with standing structures for coastal habitation.

The paucity of flake tools, those implements removed from a stone core for short-term use and discard, indicates that access to raw materials did not occur frequently. Rather, tools were brought to the site in finished or nearly finished form for extended use, re-shaping and eventual breakage and discard. The presence of finished tools coincident with a lack of flakes indicates that individuals acquired finished tools and brought them on the site rather than procuring raw stone and finishing tools on site. This dynamic points to the fact that inhabitants on site were connected to exchange networks for distribution of finished tools, among other goods. The pattern of primarily finished formal tools within the assemblage aligns well with known behaviors associated with the relationship between abundance and quality of raw material and the types of tools present (Andrefsky 2005:159).

Table 13. Frequency and Relative Percent of Stone Tools from Parcel 004-1-52

Tool Type	***Count***	***Percent of Assemblage (%)***
Adze preform	3	5
Finished adze	4	7
Pounder- basalt	13	23
Pounder-coral	2	3
Grinding stone- basalt	9	16
Grinding basin- basalt	3	5
Stone anvil	1	2
Stone sphere	2	3
Sling stone	12	21
Abrader- coral	4	7
Bead- coral	1	2
Pestle- coral	1	2

Table 14. Marine Shell Artifacts Recovered from Site SP 1-1037

Artifact Number	***Phase of Investigation***	***Area***	***Object***	***Material Type***	***Alteration***	***Length (millimeters/ inches)***	***Width (millimeters/ inches)***	***Thickness (millimeters/ inches)***	***Weight (grams/ ounces)***
14.001	Fenceline	FP2	*Tridacna* fragment	Fossilized	Broken	117/4.6	57/2.2	29/1.1	215.9/7.6
18.001	Fenceline	FP12	Modified bivalve shell	*Codakia punctata*	Modified edges	70/2.8	59/2.3	14/0.6	39.3/1.3
26.001	Grubbing	Phase 2 access road surface	Gouge fragment	*Tridacna*	Broken	76/3	50/2	9/0.4	59.9/2.1
28.001	Grubbing	Phase 1 North Hotel surface	Gouge fragment	*Tridacna*	Broken	62/2.4	54/2.1	7/0.3	44.7/1.6
42.001	Data Recovery	Phase 1 North Hotel trenching	Gouge fragment	*Tridacna*	Modified edges	78.24/3.1	43.26/1.7	8.28/0.3	62.6/2.2
44.001	Data Recovery	Phase I North Hotel trenching	Gouge	*Tridacna*	Modified edges	43.26/1.7	20.05/0.8	9.62/0.4	15.8/0.6
121.001	Data Recovery	Phase 1 pool trenching near Burial 33	Bead (n=1)	*Spondylus*	Drilled ventral side	19/0.7	19/0.7	5/0.2	2/0.07
128.001	Data Recovery	Phase 1 pool trenching near Burial 33	Beads (n=3)	*Spondylus*	Drilled ventral side	19-21/ 0.7-0.8	19-21/ 0.7-0.8	5/0.2	2-2.4/ 0.07-0.08
129.001	Data Recovery	Phase 1 pool trenching near Burial 36	Beads (n=9)	*Spondylus*	Drilled ventral side	14-22/ 0.6-0.9	14-22/ 0.6-0.9	5/0.2	1.9-2.8/ 0.07-0.1
136.001	Data Recovery	Phase 1 pool trenching	Adze fragment	*Tridacna*	Sharpened end	53/2.1	33/1.3	NA	29.2/1
148.001	Data Recovery	Phase 1 pool trenching	Adze	*Tridacna*	Modified edges	60/2.4	42/1.7	14/0.6	58.7/2.1
149.001	Data Recovery	Phase 1 pool trenching	Adze fragment	*Tridacna*	Missing cutting edge	77/3	42/1.7	11/0.4	59.6/2.1
149.002	Data Recovery	Phase 1 pool trenching	Adze fragment	*Tridacna*	Missing butt	52/2	31/1.2	10/0.4	28.9/1
150.001	Data Recovery	Phase 1 pool trenching	Adze fragment	*Tridacna*	Missing butt	56/2.2	36/1.4	13/0.5	45.2/1.6
183.001	Data Recovery	Phase 4 trenching near USCG Feature 3, TP1, 010 centimeters below surface	Marine shells	*Dogas* shells	Pollen, phytolith	NA	NA	NA	3,362/ 118.6

In this case, abundance is low (no local basalt sources) and quality is high (tool-quality basalt). The recovered assemblage conforms well to the modeled relationship that maintains that individuals or groups will typically place an emphasis on formal tools to maximize the use-life of implements that required investment of time and resources to obtain. The prevalence of reshaping and heavy use wear on adzes and basalt pounders to maximize tool life correlates well with known behaviors present in areas where access to quality stone is rare (Andrefsky 2005:158) and illustrates a coastal communities' technological response to scarce basalt raw materials.

5.1.4.4. Marine Shell Artifacts

Marine shell artifacts comprise a substantial group of traditional tool types in the project area assemblage (Table 14), including *Tridacna* adzes, gouges, and chisels and their preforms, as well as *Spondylus* beads found with several prehistoric burials. Unused *Tridacna* shell bivalves found in primary *dogas* shell midden contexts suggest their use as a food source, as do *Turbo operculums*. Their ubiquity suggests manufacture and use by most households. *Codakia punctata* shell bivalves with wear around their interior also suggest use as graters.

Adzes

Tridacna shell adzes and gouges at Site SP 1-1037 appeared likely to reflect activities involving finer aspects of house construction and canoe production, given their small size and material, at least in comparison to larger basalt adzes. They ranged in shape from rectangular to trapezoidal or oval and were elliptical or oval in cross-section, with pointed or oval poll ends where they were hafted. Discrete variables used to characterize shell adzes in Micronesia (Craib 1998:147) included manufacturing stage (blank, preform, finished), condition (whole or broken), material (*Tridacna*), X-section (elliptical, oval), edge shape (straight, wide-curve, U-curve), and poll shape (oval, pointed).

Artifact Number 42.001, found during excavation in the Phase 1 area, was a *Tridacna* shell adze. The adze was oval in plan, concave in cross section, with a cutting edge that appeared to have been re-sharpened, and the pole end pointed (Figure 54). The tool measured 77 millimeters (3.0 inches) long by 42 millimeters (1.7 inches) wide by 11 millimeters (0.4 inches) thick at its mid-section and weighed 59.6 grams (2.1 ounces).

Figure 54. Artifact Numbers 42.001 and 149.001 (left to right), Tridacna Shell Adzes, Oval

Figure 55. Artifact Numbers 149.002 and 44.001 (left to right), Chisels

Artifact Number 149.001, found during excavation in the Phase 1 area, was a *Tridacna* shell adze fragment. The adze fragment was oval in plan, concave in cross section, with a broken and missing cutting edge, and the pole end squared off (Figure 54). The tool measured 52 millimeters (1.9 inches) long by 31 millimeters (1.2 inches) wide by 13 millimeters (0.5 inches) thick at its mid-section and weighed 45.2 grams (1.6 ounces).

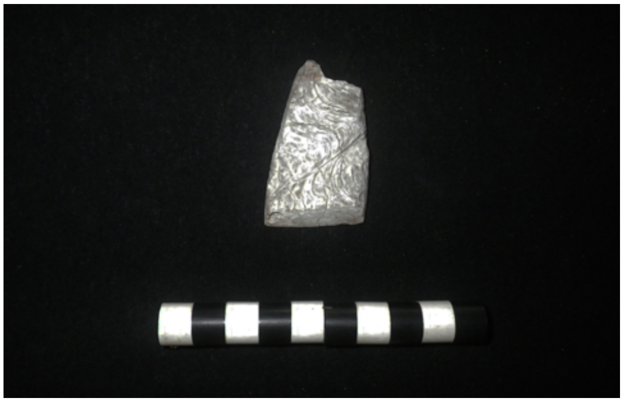

Figure 56. Artifact Number 150.001, Tridacna Shell Adze, Rectangular Shape Dorsal

Artifact Number 149.002, found during excavation in the Phase 1 area, was a *Tridacna* shell chisel or gouge. The chisel was roughly rectangular in plan, concave in cross section, with a broken pole end, and a sharpened and tapered cutting edge (Figure 55). The tool measured 76 millimeters (3 inches) long by 50 millimeters (1.9 inches) wide by 9 millimeters (0.4 inches) thick at its mid-section and weighed 59.9 grams (2.1 ounces).

Figure 57. Artifact Number 18.001, Codakia punctata Shell Grater, Interior with Possible wear

Artifact Number 44.001, found during excavation in the Phase 1 area, was a *Tridacna* shell chisel or gouge. The chisel was roughly rectangular in plan, concave in cross section, with a broken pole end, and a sharpened and tapered cutting edge (Figure 55). The tool measured 62 millimeters (2.4 inches) long by 54 millimeters (2.1 inches) wide by 7 millimeters (0.3 inches) thick at its mid-section and weighed 44.7 grams (1.6 ounces).

Artifact Number 150.001, found during excavation in the Phase 1 area, was a *Tridacna* shell adze fragment. The adze fragment was rectangular in plan, concave in cross section, with a broken pole end, and intact beveled cutting edge (Figure 56). The tool measured 56 millimeters (2.2 inches) long by 36 millimeters (1.4 inches) wide by 13 millimeters (0.5 inches) thick at its mid-section and weighed 45.2 grams (1.6 ounces).

Grater

According to Judy Amesbury of Micronesian Archaeological Research Services, who identified Artifact Number 18.001 from the photograph, the bivalve *Codakia punctata* (Family Lucinidae) was not commonly used on Saipan in Pre-Latte times when *Anadara* scrapers or graters were more common. In those artifacts, the edges were usually more worn smooth around the inner edges (Amesbury, personal communication 2017).

Artifact Number 18.001 suffered from post-depositional fractures during mechanical excavation of fence postholes. It likely represented a Latte Period artifact from a species collected in the lagoon after post-A.D. 1000 seaward progradation (Amesbury et al. 1996; Amesbury 2007). It was perhaps used to peel or grate raw or baked tubors such as yams or tree fruit such as breadfruit. The artifact measured 70 millimeters (2.8 inches) long by 59 millimeters (2.3 inches) wide by 14 millimeters (0.6 inches) thick (Figure 57) and weighed 39.3 grams (1.4 ounces).

Beads

'Shell beads possibly exhibit a temporal pattern of occurrence in the Marianas, Conus beads being produced earlier than, and mostly replaced by, *Spondylus* beads. The Pre-Latte deposit at Chalan Piao lacked *Spondylus* beads... while *Spondylus* beads predominated in the Transitional, Latte, and early Historic Period contexts' (Hunter-Anderson 1994:7.5). Most beads appear to have been drilled from the ventral or inside of the bivalve blank, leaving the dorsal side with orange coloring exposed, in some cases appearing to have been lightly incised in geometric patterns to enhance their appeal. Three sets of *Spondylus* beads were encountered in three burials, likely of Latte Period origin given their prevalence in late prehistory in the Mariana Islands (Amesbury and Walth 2016).

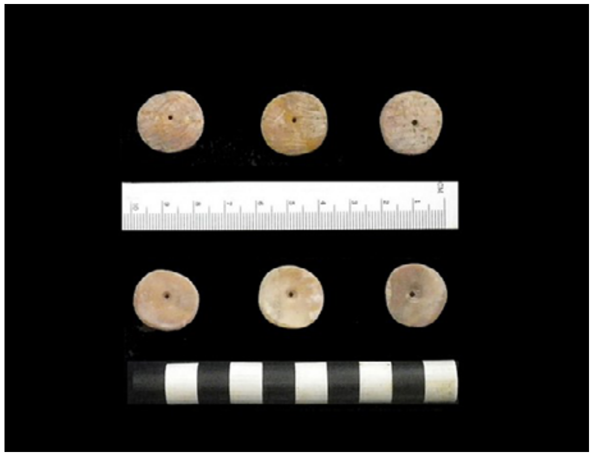

Figure 58. Artifact Number 128.001, Three Spondylus Shell Beads, Drilled and Polished

Artifact Number 128.001 (reburied with burial) consisted of three Spondylus shell beads from a single Latte Period burial. Each bead measured between 19 and 21 millimeters (0.7 and 0.8 inches) in diameter by 5 millimeters (0.2 inches) thick and weighed between 2 and 2.4 grams (0.07 and 0.08 ounces). All three were drilled from the ventral or interior side of the shell blank leaving a perforation 2 millimeters (0.08 inches) wide to be strung (Figure 58). The orange exterior may have been incised in geometric patterns perhaps parallel to natural striations of the shell before polishing.

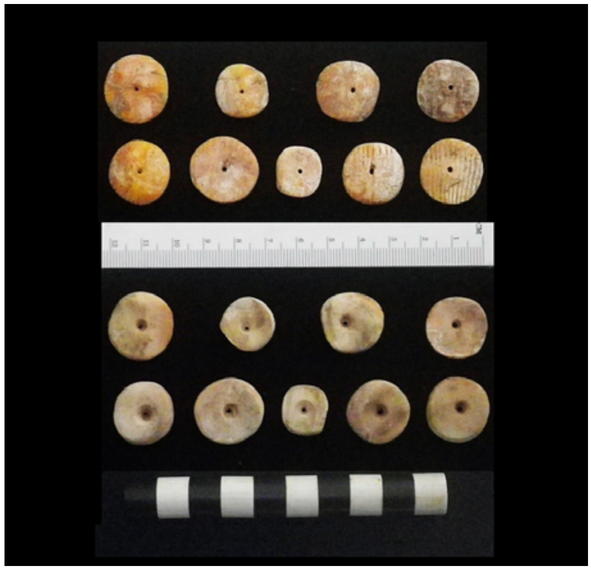

Figure 59. Artifact Number 129.001, Nine Spondylus Shell Beads, Drilled and Polished

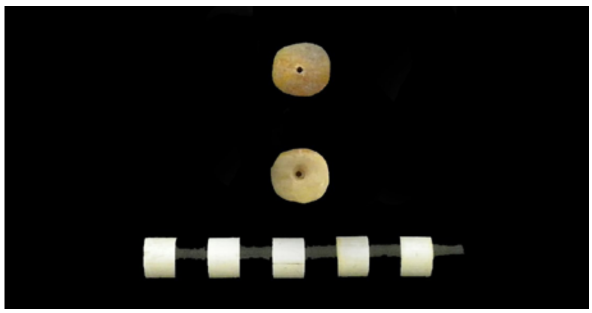

Figure 60. Artifact Number 121.001, Spondylus Shell Bead, Drilled and Polished, Exterior

Artifact Number 129.001 (reburied with burial) consisted of nine *Spondylus* shell beads from a single Latte Period burial. Each bead measured between 14 and 22 millimeters (0.6 and 0.9 inches) in diameter by 5 millimeters (0.2 inches) thick and weighed between 1.9 and 2.8 grams (0.07 and 0.1 ounces). All nine were drilled from the ventral or interior side of the shell blank leaving a perforation 2 millimeters (0.08 inches) wide to be strung (Figure 59). The orange exterior may have been incised in geometric patterns perhaps parallel to the natural striations of the shell before polishing.

Artifact Number 121.001 (reburied with burial) inlcuded one Spondylus shell bead from a single Latte Period burial. The bead measured 19 millimeters (0.7 inches) in diameter by 5 millimeters (0.2 inches) thick and weighed 2 grams (0.07 ounces). It was drilled from the ventral or interior side of the shell blank leaving a perforation 2 millimeters (0.08 inches) wide to be strung (Figure 60). The orange exterior may have been incised in geometric patterns perhaps parallel to the natural striations of the shell before polishing.

Marine Shell Midden

Marine shell midden was recovered within Feature 3 TP1 while screening Level 1, 0 to 10 centimeters (0 to 3.9 inches) below surface. This feature was within Stratum II at the small earth oven Feature 3. Feature 3 is located at the east edge of the former sand mine in the USCG area. It was dominated by over 99 percent small *dogas* shells (Figure 61 [F through J]). The total weight after extraction of Latte Period sherds was 3,362 grams (118.6 ounces) for the 10-centimeter (3.9-inch) thick excavated level. The species, as identified by Judy Amesbury of Micronesian Archaeological Research Services and pictured in Figure 5.1-63, included the following: A – unidentified gastropod; B through D – Family Cerithiidae; E – Family Cypraidae, all cowries used to be the genus Cypraea but now they have been divided into numerous genera (Amesbury, personal communication 2017); F through J – *Strombus gibberulus gibbosus* now renamed *Gibberulus gibberulus gibbosus* (Amesbury, personal communication 2017); and K through O – *Fragum fragum* of the family Cardiidae.

According to Ms. Amesbury, the area of Parcel 004I52 is probably too late in time to have much *Anadara antiquata.* This species adapted to live in mangrove marshes, which are more characteristic of the Pre-Latte Period in the Chalan Piao area circa 3500-2000 years B.P. (Amesbury et al. 1996; Amesbury 2007). Instead, inshore habitat change related to seaward progradation would have increased strand areas useful for terrestrial planting and collecting during the Latte Period after A.D. 1000. This would have resulted in a shift of focus toward collecting marine shells such as *dogas* from coral reefs and sandy lagoon sediments off shore. The other species in the photograph, however small their percentage of Stratum II at Feature 3 TP1, were likely recovered in concert with the vast majority of *dogas* due to their shared habitat, and inadvertently cooked for consumption.

Figure 61. Marine Shell Midden (Artifact Number 183.001), Representative Shells

The majority of *dogas* shells do not appear to have been opened for extraction of their meat (as possibly with G and H in Figure 61), It is possible they were instead prepared within ceramic vessels for consumption in a seafood chowder or gumbo, perhaps at the nearby hearth complex Features 1 and 2. According to early postWWII accounts on the west coast of Guam, 'Shellfish were collected from the beach and waters of Tumon Bay. People would rake the sand at the waters edge and collect many bivalves...and dogas. These small shellfish were cooked and eaten as a soup, usually with barbequed breadfruit' (Bulgrin and Bulgrin 2009:3). It is also possible the baked *dogas* shells were pulverized into *afok*, the slaked lime used to mix with pupulu leaves to chew betel nut to this day, or just deposited on top of vegetable foods with associated sands to facilitate steaming (personal communication, Joe Garrido 2018). The effects of betel nut including the darkening of the teeth were found in many adult Latte Period burials in Parcel 004I52. The vast quantity of *dogas* shells exposed on the disturbed surface of the site, after grading and grubbing, suggest their consumption was primarily during family or community feasting events in larger ovens at Features 5 and 8, which dated near the end of the Latte Period.

5.1.4.5. Bone Artifacts

One distal fragment of a barbed human bone spear point was encountered with Burial 1. Upon analysis, the spear point was found near the remains of a young child near two partially intact adults. Whether it was originally buried as an offering or was imbedded within one of the burials was impossible to determine in the mixed deposits located near the USGS communications building and its underground utilities.

Artifact Number 75.001 (reburied with burial) was a fragment of a probable human bone spear point from a single Latte Period burial. The polished spear point measured 30 millimeters (1.2 inches) long by 12 millimeters (0.5 inches) wide by 3 millimeters (0.1 inches) thick and weighed 0.6 grams (0.02 ounces). The artifact had three parallel sets of barbs along both sides, presumably very near the end or tip of the weapon (Figure 62). The context was disturbed, but its proximity to an adolescent male suggests it was buried with its intended person.

5.1.4.6. Ceramics

Of the ceramic assemblage recovered during data recovery at Site SP 1-1037 (Table 15), several Type A straight rimmed bowl and necked jar sherds were noted across the middle of the site near Road Feature 4. This indicates a limited late Pre-Latte Period use of the former back dune setting prior to A.D. 1000. Little surface treatment was noted on the sherds except for red slipping sometimes inside and out, while tempering agents include calcareous sands and quartz. The absence of features in that setting suggests early habitation remained east of Beach Road, but the limited presence of *dogas* shells indicated some collection and subsistence activities. Late Pre-Latte Period small bowls and high-necked jar forms predominated the collected ceramic assemblage perhaps due to its scarcity. Also called the Transitional Pre-Latte Period in the literature after circa 1600 B.P. to differentiate from earlier Intermediate Pre-Latte flat-bottomed bowls. These ceramics had 'slightly thickened, incurving rims, thinner walls, and rounder bases. Surface treatment varied more during this time. Most vessels have a plain finish, but polished, burnished, and striated surfaces also occur' (Moore and Hunter-Anderson 1996:495).

Figure 62. Artifact Number 75.001, Human Bone Spear Point

Table 15. Ceramics from Data Recovery Excavations at Site SP 1-1037

Artifact Number	***Phase of Investigation***	***Area***	***Sherd Type***	***Alternation***	***Period***	***Rim***	***Length (millimeters/ inches)***	***Width (millimeters/ inches)***	***Rim (millimeters/ inches)***	***Wall millimeters/ inches)***	***Temper***	***Weight (grams/ ounces)***
8.001	Fenceline	FP2	Body		Latte	N/A	65/2.56	40/1.57	N/A	18/0.71	CST/QST	59.4/2.1
9.001	Fenceline	FP8	Body		Latte	N/A	41/1.61	34/1.33	N/A	17/0.67	VST	59.4/2.1
9.002	Fenceline	FP8	Body		Latte	N/A	32/1.26	29/1.14	N/A	12/0.47	VST	13.5/0.48
9.003	Fenceline	FP8	Body		Latte	N/A	31/1.22	24/0.94	N/A	9/0.35	VST	8.6/0.30
10.001	Fenceline	FP5	Type B rim		Latte	Inverted	66/2.60	40/1.57	18/0.71	19/0.75	VST	68.7/2.42
10.002	Fenceline	FP3	Body		Latte	N/A	57/2.24	27/1.06	N/A	14/0.55	VST	32/1.13
10.003	Fenceline	FP4	Body		Latte	N/A	64/2.52	42/1.65	N/A	12/0.47	VST	30.3/1.07
10.004	Fenceline	FP6	Body		Latte	N/A	46/1.81	33/1.30	N/A	14/0.55	VST	31.5/1.11
12.001	Fenceline	Percolator Test 7; 70 centimeters below surface	Body		Latte	N/A	33/1.30	30/1.18	N/A	12/0.47	CST	15.2/0.54
13.002	Fenceline	FP9	Body	Brushed	Latte	N/A	27/1.06	25/0.98	N/A	16/0.63	VST/QST	9/0.32
15.001	Fenceline	FP7	Body		Latte	N/A	40/1.57	40/1.57	N/A	16/0.63	VST	27.9/0.98
15.002	Fenceline	FP7	Body		Latte	N/A	45/1.77	32/1.26	N/A	23/0.91	VST	43.8/1.55
20.001	Fenceline	FP14	Type B rim		Latte	Inverted	59/2.32	32/1.26	19/0.74	14/0.55	VST	32.7/1.15
22.001	Fenceline	NFM 12 (new)	Type B rim		Latte	Inverted	74/2.91	54/2.13	22/0.87	10/0.39	CST	72.3/2.55
57.001	Data Recovery	Phase 1 North Hotel trenching	Type B rim		Latte	Inverted	45.66/1.8	45.46/1.79	N/A	9.58/0.377	VST	Unknown
57.002	Data Recovery	Phase 1 North Hotel trenching	37 body		Latte	N/A	N/A	N/A	N/A	N/A	VST	376/ 13.26
130.001	Data Recovery	Phase 1 North Hotel trenching Feature 1, TP1	40 body	Unwashed residue	Latte	N/A	N/A	N/A	N/A	N/A	V/C/QST	>400/ >14.11
131.001	Data Recovery	Phase 1 North Hotel trenching near sand mine	Body	Red slip	Pre-Latte	N/A	87/3.43	47/1.85	N/A	9/0.35	QST/CST	48.7/1.72

Artifact Number	***Phase of Investigation***	***Area***	***Sherd Type***	***Alternation***	***Period***	***Rim***	***Length (millimeters/ inches)***	***Width (millimeters/ inches)***	***Rim (millimeters/ inches)***	***Wall millimeters/ inches)***	***Temper***	***Weight (grams/ ounces)***
133.001	Data Recovery	Phase 1 North Hotel trenching, Feature 1	Type B rim		Latte	Inverted	56/2.20	49/1.9	19/0.75	14/0.55	V/C/QST	Unknown
133.002	Data Recovery	Phase 1 North Hotel trenching, Feature 1	Type B rim		Latte	Inverted	100/3.94	75/2.95	22/0.87	19/0.75	V/C/QST	Unknown
135.001	Data Recovery	Phase 1 North Hotel trenching	Type B rim	Globular jar shape	Latte	Inverted	142/5.59	116/4.57	17/0.67	9/0.35	V/C/QST	209.1/ 7.38
151.001	Data Recovery	Phase 1 North Hotel trenching; South side of access road	Body	Red slip	Pre-Latte	N/A	54/2.13	32/1.26	N/A	11/0.43	QST/VST	22.8/0.80
151.002	Data Recovery	Phase 1 North Hotel trenching; South side of access road	Body	Red slip interior, ridge	Pre-Latte	N/A	81/3.19	51/2.01	N/A	12/0.47	QST/VST	61.1/2.16
151.003	Data Recovery	Phase 1 North Hotel trenching; South side of access road	Type A rim	Red slip	Pre-Latte	Straight	29/1.14	27/1.06	7/0.28	9/0.35	CST	8.6/0.30
152.001	Data Recovery	Phase 3 trenching South side of access road	Type A rim	Red slip interior	Pre-Latte	Inverted	64/2.52	50/1.97	10/0.39	12/0.47	QST/CST	61.1/2.16
152.002	Data Recovery	Phase 3 trenching Southside of access road	Type A rim	Red slip	Pre-Latte	Straight	49/1.93	39/1.54	8/0.31	9/0.35	QST/CST	21.2/0.75
152.003	Data Recovery	Phase 3 trenching South side of access road	Type A rim	Red slip flat	Pre-Latte	Straight	49/1.93	38/1.50	7/0.28	7/0.28	QST/CST	16.5/0.58

Artifact Number	Phase of Investigation	Area	Sherd Type	Alternation	Period	Rim	Length (millimeters/ inches)	Width (millimeters/ inches)	Rim (millimeters/ inches)	Wall millimeters/ inches)	Temper	Weight (grams/ ounces)
153.001	Data Recovery	Phase 4 SE corner trenching	Type B rim	Red slip	Pre-Latte	Straight	98/3.86	71/2.80	14/0.55	15/0.59	CST	146/5.15
154.001	Data Recovery	Phase 1 near Burial 16	Type A rim	Jar	Pre-Latte	Everted	114/4.49	69/2.72	8/0.31	13/0.51	QST/CST	128.2/ 4.52
155.001	Data Recovery	Phase 1 near North Hotel trenching near Burial 17	Type A rim	Red slip	Pre-Latte	Straight	30/1.18	29/1.14	7/0.28	5/0.20	QST/CST	5.8/0.20
155.002	Data Recovery	Phase 1 North Hotel trenching near Burial 17	Type A rim	Red slip	Pre-Latte	Straight	19/0.75	13/0.51	8/0.31	9/0.35	CST	5.8/0.20
156.001	Data Recovery	Phase 2 trenching North side of access road	Base	Flat jar base	Pre-Latte	N/A	104/4.09	76/2.99	N/A	N/A	CST	62.7/2.21
157.001	Data Recovery	Phase 2 trenching South side of access road	Type A rim	Red slip interior	Pre-Latte	Straight	49/1.93	40/1.57	4/0.16	10/0.39	QST/VST	21.4/0.75
178.001	Data Recovery	Phase 1 North Hotel trenching; Feature 1, TP1	Type B rim	N/A	Latte	Inverted	Unknown	Unknown	Unknown	Unknown	VST/CST/ QST	Unknown
178.002	Data Recovery	Phase 1 North Hotel trenching; Feature 1, TP1	39 body	N/A	Latte	N/A	N/A	N/A	N/A	N/A	VST/CST/ QST	1,589/ 56.05
180.001	Data Recovery	Phase 2 trenching Feature 4, Level 1	4 body	N/A	Latte	N/A	N/A	N/A	N/A	N/A	VST/CST	58.2/2.05
181.001	Data Recovery	Phase 2 trenching Feature 4, Level 2	Type B rim	N/A	Latte	Inverted	55/2.17	50/1.97	15/0.59	11/0.43	VST/CST	65.2/2.30

Note: *Two body sherds submitted for radiocarbon dating and microfossil analyses, the remainder unwashed and analyzed for curation.
N/A = not applicable; NFM = north fence monitoring; CST = calcareous sand temper; QST = quartzite sand temper; VST = volcanic sand temper.

A few general observations are pertinent to understanding the context of the majority of ceramics observed and collected in Stratum II and to a lesser extent Stratum III of Site SP 1-1037. This can be summarized by parallel observations in the Mangeggon Hills sites of southern Guam, albeit from a very different geographical context. 'Subsurface concentrations [of pottery] were associated with earth-oven pit fill [or hearth complex features], [and] other areas of dark soil containing charcoal and fire-altered rock. The subsurface patterning that occurred...suggests that discarded sherds were incorporated into cooking features as the features were being used, after they were abandoned, or both. Regarding temporal changes in the pottery industry during the time that the...sites formed, early Type A forms do not entirely disappear from the archaeological record late in time, but they are gradually replaced by the Type B form which then becomes the most common form during the Latte Period' (Hunter-Anderson 1994:3.67).

Figure 63. Three Late Pre-Latte Period Sherds, Plain Carinated Body Sherd (Artifact Number 151.002) (top), Red-Slipped Body Sherd (Artifact Number 151.001) (bottom left), and Type A Rim (Artifact Number 151.003) (lower right)

Three Late Pre-Latte Period sherds (Figure 63) were recovered during Phase 1 at the edge of the south side road. The Type A rim sherd (Artifact Number 151.003) (see lower right) measured 29 millimeters (1.14 inches) long by 27 millimeters (1.06 inches) wide by 9 millimeters (0.35 inches) thick and weighed 8.6 grams (0.30 ounces). This Type A rim sherd appeared to be from a small, straight walled bowl with calcareous sand temper. The red slipped body sherd (Artifact Number 151.001) (see lower left) measured 54 millimeters (2.13 inches) long by 32 millimeters (1.26 inches) wide by 11 millimeters (0.43 inches) thick and weighed 22.8 grams (0.80 ounces). This body sherd appeared to be from a small bowl with quartz and volcanic sand temper. The carinated body sherd (Artifact Number 151.002) (see upper center) measured 81 millimeters (3.19 inches) long by 51 millimeters (2.01 inches) wide by 12 millimeters (0.47 inches) thick and weighed 61.1 grams (2.16 ounces). This sherd appeared to be from a medium sized jar with quartz and volcanic sand temper, red slipped interior with plain exterior.

Bag Number 152 consists of three Late Pre-Latte Period sherds (Figure 64) recovered during Phase 3 at the south access road. The Type A rim sherd (Artifact Number 152.003) (see lower right) measured 49 millimeters (1.93 inches) long by 38 millimeters (1.50 inches) wide by 7 millimeters (0.28 inches) thick and weighed 16.5 grams (0.58 ounces). This Type A rim sherd appeared to be from a small, straight walled bowl with calcareous sand temper and red slipped interior. The second Type A rim sherd (Artifact Number 152.002) (see lower left) measured 49 millimeters (1.93 inches) long by 39 millimeters (1.54 inches) wide by 9 millimeters (0.35 inches) thick and weighed 21.2 grams (0.75 ounces). This sherd appeared to be from a small bowl with quartz and calcareous sand temper. The third Type A rim sherd (Artifact Number 152.001) (see upper center) measured 64 millimeters (2.52 inches) long by 50 millimeters (1.97 inches) wide by 12 millimeters (0.47 inches) thick and weighed 61.1 grams (2.16 ounces). This sherd appeared to be from a medium sized bowl with quartz and calcareous sand temper. The rim sherd had a red slipped interior with plain exterior.

Artifact Number 154.001 was a Late Pre-Latte Period rim sherd recovered during Phase 3 at the south access road. The Type A rim measured 114 millimeters (4.49 inches) long by 69 millimeters (2.72 inches)

Figure 64. Three Type A Late Pre-Latte Period Rim Sherds, Artifact Number 152.001 (upper center); Artifact Number 152.002 (lower left); Artifact Number 152.003 (lower right)

Figure 65. Artifact Number 154.001, Type A Late Pre-Latte Period Jar Sherd, Exterior

wide by 13 millimeters (0.51 inches) thick and weighed 128.2 grams (4.52 ounces). This rim sherd appeared to be from a medium sized straight walled jar neck with quartz and calcareous sand temper and is unslipped (Figure 65).

Artifact Number 155.001 was a Late Pre-Latte Period rim sherd recovered during Phase 1 near Burial 17. The Type A rim measured 30 millimeters (1.18 inches) long by 29 millimeters (1.14 inches) wide by 5 millimeters (0.20 inches) thick (Figure 66) and weighed 5.8 grams (0.20 ounces). This rim sherd appeared to be from a small red slipped bowl with quartz and calcareous sand temper.

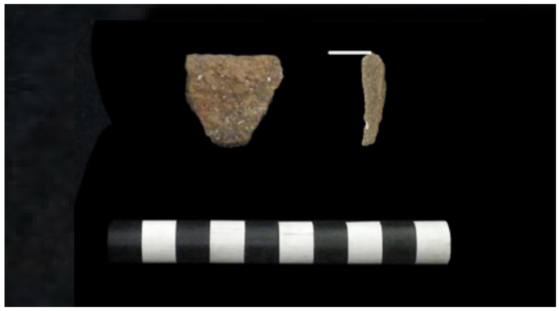

Figure 66. Artifact Number 155.001, Type A Late Pre-Latte Period Bowl Sherd, Exterior

Artifact Number 157.001 was a Late Pre-Latte Period rim sherd recovered during Phase 2 at the south access road. The Type A rim measured 49 millimeters (1.93 inches) long by 40 millimeters (1.57 inches) wide by 10 millimeters (0.39 inches) thick (Figure 67) and weighed 21.4 grams (0.75 ounces). This rim sherd appeared to be from a medium sized, straight walled jar neck with quartz and volcanic sand temper, with a red slipped interior, and unslipped exterior.

Figure 67. Artifact Number 157.001, Type A Late Pre-Latte Period Jar Sherd, Exterior

Artifact Number 135.001 was a Latte Period rim sherd recovered duringPhase 1. The Type B rim measured 142 millimeters (5.59 inches) long by 116 millimeters (4.57 inches) wide by 9 millimeters (0.35 inches) thick (Figure 68) and weighed 209.1 grams (7.38 ounces). The rim sherd appeared to be from a medium sized outwardly curving jar with quartz, volcanic sand, and calcareous sand temper and was unslipped.

Figure 68. Artifact Number 135.001, Type B Latte Period Rim Sherd Exterior, With Outward Curving Neck

Figure 69. Artifact Number 153.001, Type B Latte Period Rim Jar Sherd Exterior

Artifact Number 153.001 was a Latte Period rim sherd recovered during Phase 4. The Type B rim measured 98 millimeters (3.86 inches) long by 71 millimeters (2.80 inches) wide by 15 millimeters (0.59 inches) thick (Figure 69) and weighed 146 grams (5.15 ounces). The rim sherd appeared to be from a medium sized inwardly curving jar with calcareous sand temper and a red slipped exterior.

Bag Number 133 consisted of two Latte Period rim sherds from the same vessel (Figure 70) recovered during Phase 4. The upper Type B rim (Artifact Number 133.01) measured 56 millimeters (2.20 inches) long by 49 millimeters (1.93 inches) wide by 14 millimeters (0.55 inches) thick (see Figure 4.3-89). The lower Type B rim (Artifact Number 133.02) measured 100 millimeters (3.94 inches) long by 75 millimeters (2.95 inches) wide by 19 millimeters (0.75 inches) thick (see Figure 4.3-89). Together they weighed 908 grams (32.03 ounces) and appeared to be from a medium sized, inwardly curving jar with quartz and volcanic sand temper, and was unslipped.

Figure 70. Two Type B Latte Period Jar Sherds, Exterior Rims, Artifact Number 133.001 (top), Artifact Number 133.002 (bottom)

5.1.5. Faunal Bone Remains

During grubbing and data recovery within the project area, numerous feral dogs, cats, and rats were sighted by archaeologists and machine operators, as were hermit crabs in a variety of shelters (from land snail shells to baby food bottles) and occasional coconut crabs. Faunal remains collected from subsurface contexts were invariably shallow (10 centimeters [3.9 inches] below surface) and from disturbed, not sealed deposits. Since no land mammal other than the fruit bat or *fanihi* was native to the Northern Mariana Islands prior to European contact in 1521, animals introduced by Spanish or Philippine immigrants during the 17th and 18th centuries included pigs, cattle, water buffalo, dogs, deer, and rats, plus chickens and other domestic fowl. Japanese immigrants in the early 20th century introduced the large land snail presumably from Okinawa and probably other domestic livestock of Asian varieties.

Not surprisingly, the faunal assemblage identified by the project osteologist below (as listed in Table 16) reflects Post-Contact fauna still present on Saipan today. These are therefore not at all associated with the Latte and PreLatte remains encountered during archaeological investigation of the property, unless further research were to suggest otherwise. Where present, butcher marks with metal tools also indicate the bones' modern origins, likely discarded as food refuse and redistributed by dogs, cats, and rats. No evidence of Contact-Period faunal remains was encountered in primary contexts with Latte Period burials or subsistence features. Pigs, dogs, and chickens are not known to have been transported to the Northern Marianas by early Chamorro settlers.

Table 16. Faunal Bone Remains from Site SP 1-1037

Artifact Number	Phase of Investigation	Construction Area (Stratum II [30-60 centimeters below surface])	Object	Material Type	Alteration	Weight (grams/ ounces)
30.001	Grubbing	Phase 1 North Hotel Trenching	2 vertebra, 4 ribs	Mammal	Dog?	39.7/1.40
31.001	Grubbing	Phase 1 North Hotel Trenching	1 long bone	Bird	Chicken?	1.8/0.06
32.001	Grubbing	Phase 1 North Hotel Trenching	2 ribs	Mammal	Dog?	8.2/0.29
33.001	Grubbing	Phase 1 North Hotel Trenching	2 long bones, 1 cut	Mammal	Dog/pig	40.7/1.44
34.001	Grubbing	Phase 1 North Hotel Trenching	1 long bone	Mammal	Dog?	8.5/0.30
36.001	Grubbing	Phase 3 Access Road Trenching	1 tarsal	Mammal	Pig/cow?	25.8/0.91
60.001	Data Recovery	Phase 1 North Hotel Trenching	1 tibia	Mammal	Pig?	35.1/1.24
61.001	Data Recovery	Phase 2 Access Road Trenching	1 cranial fragment	Mammal	Water buffalo cranium? Cuts	51.2/1.81
62.001	Data Recovery	Phase 2 Access Road Trenching	1 long bone distal end	Mammal	unfused distal end,	8.9/0.31
63.001	Data Recovery	Phase 2 Access Road Trenching	1 femur, prox. end	Mammal	Pig? unfused, prox. end	22.9/0.81
64.001	Data Recovery	Phase 2 Access Road Trenching	1 right scapula	Mammal	Dog/pig? Assoc. with Bag 65	14.2/0.50
65.001	Data Recovery	Phase 2 Access Road Trenching	left scapula, clavicle, rib frag5	Mammal	Dog/pig? Assoc. with Bag 64	29.4/1.04
66.001	Data Recovery	Phase 2 Access Road Trenching	left femur, tibia, tibia epiphysis	Mammal	Pig	52.5/1.85
67.001	Data Recovery	Phase 1 North Hotel Trenching	vertebra neural arch	Mammal	Pig/dog?	3.4/0.12
68.001	Data Recovery	Phase1 North Hotel Trenching	1 long bone	Mammal	Dog?	24.7/0.87
217.001	Data Recovery	Phase 2 Access Road Trenching	Isolated HR 9	Animal	1 animal	Unknown
218.001	Data Recovery	Phase 2 Access Road Trenching	Isolated HR 10	Animal	Cut marks	Unknown

5.2. Radiocarbon Dating

5.2.1. Research Questions and Interpretive Models

Radiocarbon results from subsurface earth oven cooking and features at site SP 1-1037 offered data to inform aspects of the second main research question: 2a) can Latte Period habitation structures and use areas at site SP 1-1037 be identified from patterned subsurface features or ephemeral structures and 2b) Can middens be identified and dated in the vicinity. While excavation did not encounter direct evidence of *latte* stone habitation support features (*haligi* and/or *tasa*), a large (50 to 70 meter [164 to 229.7 feet] wide) subsurface area of earth oven cooking and eating with associated food remains provided datable organic materials from discrete cooking settings. Manually-cleaned earth oven profiles and excavated test pits with associated organic sediments recovered in situ allowed for analyses and discussion of initial site occupation and changes evident over time in the morphology and function of on-site cooking basins.

The relationships between calibrated calendrical date ranges typically offered significant information regarding whether a site saw sustained habitation over a long duration or short periods of intermittent site visitation. A model of sequential or punctuated land use would be supported by the presence of appreciable gaps in the radiocarbon record and would indicate multiple discrete periods of resource procurement and cooking over time. Alternatively, partially-overlapping age ranges would indicate that cooking events took place fairly rapidly over time, as may be expected in the case of attached residential habitation rather than sporadic site visitation.

A final goal of this analysis asked whether site function changed over time, i.e., did residents or visitors to the site target different resources over time or were similar species targeted consistently between periods of landscape use. Cooking areas or refuse middens with mutually-exclusive suites of dietary remains and sequential date ranges would support a pattern of shifting target species over time, while consistency in dietary remains would support similar food production over time.

5.2.2. Materials and Analytical Methods

Manual excavation within the cooking features collected a total of five soil specimens for radiocarbon age determination and microfossil identification. BetaAnalytic undertook the process of radiocarbon assay for each specimen and all tested materials fulfilled the required weight and organic material content for confident radiocarbon age attribution. All reported radiocarbon dates came from materials collected in situ with a clean metal trowel during controlled excavation. The samples were placed into labeled tinfoil containers to control for factors of cross-contamination.

Samples were sent to BetaAnalytic for AMS assay. Conventional radiocarbon ages, corrected for isotopic fractionation, were recalibrated using Oxcal Version 4.2.4. Calibrated radiocarbon calendar dates were then subjected to statistical tests of agreement to illustrate chronological patterning as it related to roughly contemporaneous (within a single habitation span) versus a record of several cooking events separated by centuries. Coeval dates were signaled in this test by an agreement percentage that exceeded the combination index ($A_{comb} > A_n$ = coeval; $A_{comb} < A_n$ = sequential). This method allowed for intra- and inter-site comparison of chronologic placement. Calibrated radiocarbon age ranges were reported as cal. A.D. and were evaluated at the two-sigma (95 percent) confidence level in cases of a single radiocarbon curve intercept. One sigma results (68.2 percent confidence level) were examined in cases where two sigma results failed to provide refined age ranges. Calibrated radiocarbon age ranges that included multiple intercepts with the atmospheric carbon calibration curve were discussed in terms of age range and associated probability distribution. Further, a Bayesian sequence analysis was employed to reduce the uncertainty (error) value for the earliest likely earth oven cooking events at site SP 1-1037. As the result

Table 17. Radiocarbon Results from Site SP 1-1037

Radiocarbon Sample ID	Unit	Context	Sample Material	Depth (centimeters/ inches below surface)	Conventional Radiocarbon Age B.P.	2 Sigma (95.4 %) Calibrated Date (A.D.) and Period
C14-1 (Beta - 458312)	Feature 3 TP1	Small Oven	Organic sediment	10/3.9	360 ± 30	1450-1530 (47.7%) 1540-1635 (47.7%)
C14-2 (Beta - 458313)	Feature 5 TP1	Big Oven	Organic sediment	150/59	140 ± 30	1669-1780 (43.1%) 1798-1891 (36.8%) 1909-1945 (15.5%)
C14-3 (Beta - 458314)	Feature 2 TP1	Hearth Complex	Charred material	10/3.9	360 ± 30	1450-1530 (47.7%) 1540-1635 (47.7%)
C14-4 (Beta - 458315)	Feature 8 TP1	Big Oven	Organic sediment	10/3.9	280 ± 30	1498-1504 (0.8%) 1513-1601 (54.3%) 1616-1666 (38.2%) 1784-1795 (2.1%)
C14-5 (Beta - 458316)	Feature 1 TP1	Hearth Complex	Charred material	10/3.9	320 ± 30	1483-1646 (95.4%)

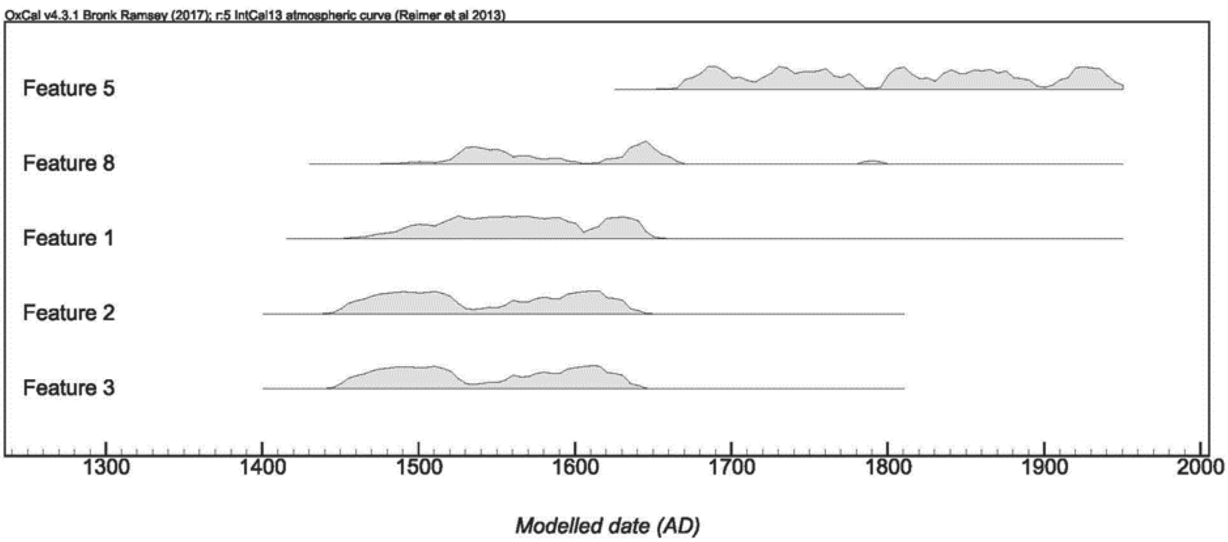

Figure 71. Multi-plot of Calibrated Age Range Determinations from Site SP 1-1037

of systematic collection methods, the reported dates all came from discrete areas of cooking activity and reflected the actual event date ranges for documented features rather than ambiguous dates for portions of soil. As the dates provided (Table 17 and Figure 71) described the timing of actual activity events, a discussion of the timing of initial and subsequent land use and the diachronic change toward larger, likely communal, cooking events within the subject area is given below.

5.2.3. Radiocarbon Results

5.2.3.1. Feature 1

Feature 1 consisted of a hearth complex, including burned cooking stones, charcoal, and food refuse. Specimen C14 -5 (Beta-458316), recovered from Feature 1, contained charred material adhered to a Latte Period ceramic sherd. The charred material provided sufficient weight for dating and was recovered in situ at a depth of 10 centimeters (3.9 inches) below surface within the discrete cooking area. The sample offered a single calibrated age range determination at the 95 percent probability level of Cal AD 1483-1646.

5.2.3.2. Feature 2

Feature 2 consisted of a hearth complex, including burned cooking stones, charcoal, and food refuse. Specimen C14-3 (Beta-458314), recovered from one burned Latte Period body sherd within Feature 2, contained charred material sufficient for dating and was recovered in situ at a depth of 10 centimeters (3.9 inches) below surface within the discrete cooking area. The sample provided two calibrated age range determinations at the 95 percent probability level of Cal AD 1450-1530 (47.7 percent) and equally-weighted Cal AD 1540-1635 (47.7 percent).

5.2.3.3. Feature 3

Feature 3 consisted of a small earth oven, including burned cooking stones, charcoal, and *dogas* shellfish food remains. Specimen C14-1 (Beta-458312), recovered from Feature 3, contained charred material sufficient for dating and was recovered *in situ* at a depth of 10 centimeters (3.9 inches) below surface within the discrete cooking area. The sample provided two calibrated age range determinations at the 95 percent probability level of Cal A.D. 1450-1530 (47.7 percent) and equally weighted Cal AD 1540-1635 (47.7 percent). Similarity in calibrated calendar dates between Feature 2 and Feature 3 come from identical conventional radiocarbon ages of 360 ± 30 BP.

5.2.3.4. Feature 5

Feature 5 consisted of a large earth oven, including burned cooking stones, charcoal, and *dogas* shellfish food remains. Specimen C14-2 (Beta-458313), recovered from Feature 5, contained charred material sufficient for dating and was recovered in situ at a depth of 150 centimeters (59.1 inches) below surface within the discrete cooking area. The sample provided three calibrated age range determinations at the 95 percent probability level of Cal A.D. 1669-1780 (43.1 percent), Cal A.D. 1798-1891 (36.8 percent) and Cal A.D. 1909-1945 (15.5 percent). The likeliest date for use of Feature 5 lies between Cal A.D. 1669-1780.

5.2.3.5. Feature 8

Feature 8 consisted of a large earth oven, including burned cooking stones, charcoal, and *dogas* shellfish food remains. Specimen C14-2 (Beta-458313), recovered from Feature 8, contained charred material sufficient for dating and was recovered in situ at a depth of 10 centimeters (3.9 inches) below surface within the discrete cooking area. The sample provided three calibrated age range determinations at the 95 percent probability level of Cal A.D. 1498-1504 (0.8 percent), Cal A.D. 1513-1601 (54.3 percent), Cal A.D. 1616-1666 (38.2 percent), and Cal A.D. 1784-1795 (2.1 percent). The likeliest date for use of Feature 8 lies between Cal A.D. 1513-1601.

5.2.3.6. Statistical Analyses of SP 1-1037 Radiocarbon Results

Features 1, 2, and 3 exhibited overlapping date ranges at the 95 percent confidence level and showed that all three cooking features were likely created between either Cal A.D. 1471- 1528 (40.0 percent) or Cal A.D. 15541634 (55.4 percent), with Cal A.D. 1554-1634 exhibiting a slightly higher probability for overall timeframe of use (X2-Test: df=2 T=1.091 [5 percent 5.991] agreement, n=3 Acomb=98.0 percent [An= 40.0 Percent]). A Bayesian sequence analysis of these three early dates suggested that initial use of site SP 1-1037 took place between Cal A.D. 1416-1517, offering support for initial use of the site by circa A.D. 1500 (1σ, 49.3 percent model agreement=103.4). Conclusions regarding the start date of site use at

SP 1-1037 relied on one sigma confidence level, as the 95 percent confidence level failed to provide a sufficiently restricted age range for initial use.

5.2.3.7. Discussion of Radiocarbon results

The modeled date ranges given by both statistical analyses showed that small-scale cooking events had likely begun within the site area by circa A.D. 1500, if not slightly earlier. This earliest period of site use continued until A.D. 1600 or a few decades thereafter. The latest cooking event observed at site SP 1-1037 likely took place between Cal A.D. 1669-1780. Overall, the results show two main episodes of use at site SP 1-1037 with an initial sustained period of earth oven cooking beginning circa 1500 and ending before the 1630s. After the initial habitual use of site SP 1-1037, available data suggested a residential hiatus of 50-100 years was followed by later cooking activity between Cal A.D. 1669-1780. While the complete data set indicated a sequential pattern of site use overall, Features 1, 2, 3, and 8 illustrated relative continuity and represented sustained earth oven cooking during the Latte Period.

This study also sought radiocarbon data to determine whether site function changed over time and if shifts in cooking strategies were archaeologically visible. Patterning in earth oven type and size within the sample, specifically a shift toward larger cooking basin sizes over time, did suggest that large *dogas* shellfish cooking events were an aspect of later site use. The earliest large *dogas* shellfish oven within the sample (Feature 8) provided a likely date range of Cal A.D. 1513-1601. As Feature 8 failed to show significant association (overlap) with the clustered dates of Feature 1, 2, and 3 (circa A.D. 1500-1550), the more likely date range for Feature 8 and large-scale shellfish cooking, is nearer to A.D. 1600 or shortly thereafter. The shift in earth oven size may reflect later feasting events by a small residential community or a scaled response to increased local population density. Microfossil remains recovered within each dated feature are discussed below as they related to continuity and change in subsistence practices.

5.3. Microfossil Remains

In the coastal San Antonio area, the absence of reliable fresh water sources (not withstanding low-tide seeps) did not appear to preclude extended occupations and probable household gardening during the Latte Period. Instead, this scarcity may have encouraged the excavation of shallow wells and regular visits to moist inland soil basins such as the base of the escarpment in the lower Chalan Piao marsh, probably by more than one family or clan as seasonal subsistence needs arose in coastal villages. Recent examination of the relationship between the few small inland *latte* sets on the northern Guam plateau and natural resource catchment areas (Dixon and Schaefer 2014) suggests each coastal village may have maintained one or more inland sites, often situated near recognizable boundaries between group territories. Pockets of moist arable soil similar to farming and forest collection sites postulated on inland Tinian (Dixon et al. 2011) would have been prime assets for inhabitants of San Antonio and southern coastal Saipan. Such planting areas and small residential sites may have functioned as nodes in a larger subsistence strategy involving farming and tree cropping from multiple camps and activity areas, supporting coastal villages and their respective clans.

According to these models extrapolated to southern Saipan, inland residency involved exploitation of locally farmed agricultural products (taro, yams, and bananas) and forest resources (breadfruit, screwpine, cycads, and wood for construction), when seasonally available. The products were then processed inland for transport to the nearest coastal village, with the inhabitants eventually returning inland with marine food supplies (fish and shellfish) and finished tools (pottery and adzes). Besides daily subsistence needs in the coastal village, feasting events and seasonal droughts must have necessitated almost weekly commutes between coastal and inland settings, a routine easily recognized in the relationship of *lanchos* to Spanish-era villages (Russell 1998). This pattern of utilizing inland plateaus as a resource reservoir of forest products and arable soil by coastal communities may have considerable time depth in the San Antonio area, given the proximity of many Pre-Latte Period settlements to the north near Chalan Piao marsh and Lake Susupe. This may also be conceived as a risk minimization strategy, perhaps developed in response to climatic unpredictability between 1350 and 1800 C.E. (Nunn 2000; Nunn et al. 2007). Microfossil evidence of such a strategy was expected from soils sampled in Features 1, 2, 3, 5, and 8, although the results tell a somewhat different story.

5.3.1. Microfossil Results

There is considerable circumstantial evidence of what subsistence activities may have been undertaken locally during the Latte Period at the San Antonio village. *Tridacna* shell adzes and their fragments, all of a size better suited for wood working tasks than actual primary forest reduction, were encountered within the Stratum II cultural horizon. Intact and broken basalt adzes, pounders, grinders, and several mortars found during excavation also suggest that surrounding forested hillslopes were actively being harvested by the time the *latte* sets were erected. Food processing tools such as mortars and pestles are presumed to have been used where taro, lesser yams, and breadfruit were baked in roasting pits or earth ovens, and food then consumed on the site or transported back to inland subsistence camps and field residences. Polishing and grinding tools may have been used to soften screwpine leaves before plaiting into baskets, mats, and sails, as well as to process clays and tempers for pottery production.

Microfossil remains from plants exploited in Features 1 through 3, 5, and 8 were analyzed in the same contexts as five radiocarbon samples by Microfossil Research Ltd. (Horrocks 2017). These samples were all radiocarbon dated to the late Latte Period/early Spanish Contact Period occupation of southern Saipan. Rather than a plethora of domestic food remains, analysis revealed the dominance of pollen such as coconuts, other palms, and ferns (Figure 72) and phytoliths such as grasses and palms (Figure 73), all from fuel species in the two hearth complexes Features 1 and 2 and the three *dogas* ovens Features 3, 5, and 8. This fuel was to be expected given the probable construction materials of shallow cooking Features 1 and 2 and nearby *dogas* ovens, but food remains were also expected as a byproduct of cooking features being opened and rebuilt for repeated use over time. In another study of microfossil remains from a site near Lake Susupe (Horrocks et al. 2015), coconut and screwpine pollen were identified as probable constituents of the surrounding native forest. Possible food remains there on the other hand, were identified from *Discorea* phytoliths, not identified in the San Antonio village site.

Unexpectedly, no microfossil food remains were encountered in the hearth complexes, but pollen from Indian Mulberry, sponge spicule silica, taro starch, and other rapides were encountered in the deeper *dogas* oven Features 5 and 8. This occurrence appears to suggest that *dogas* ovens were also used to warm or bake wrapped plant foods for consumption with the *dogas* shells, or cut up into the soup or seafood gumbo in which they were boiled and eaten afterward. With the benefit of hindsight, it now appears more realistic to interpret hearth complex Features 1 and 2 as possible ceramic brush kilns, given the presence of fuel and the clusters of burned coral rocks, pockets of white ash, and

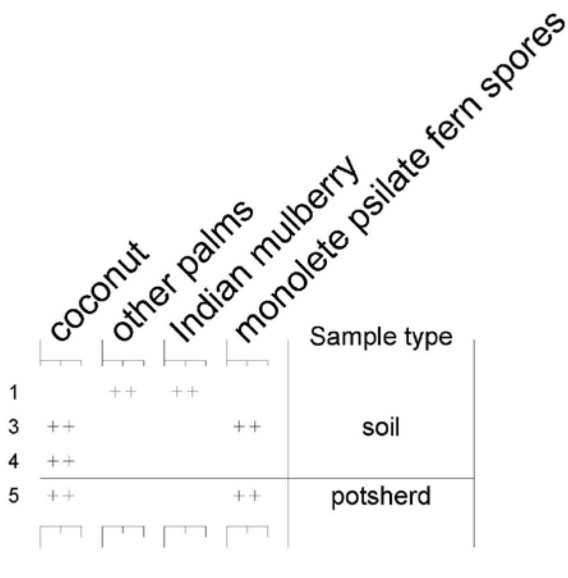

Figure 72. Pollen Diagram from Site SP 1-1037 (++=small amount)

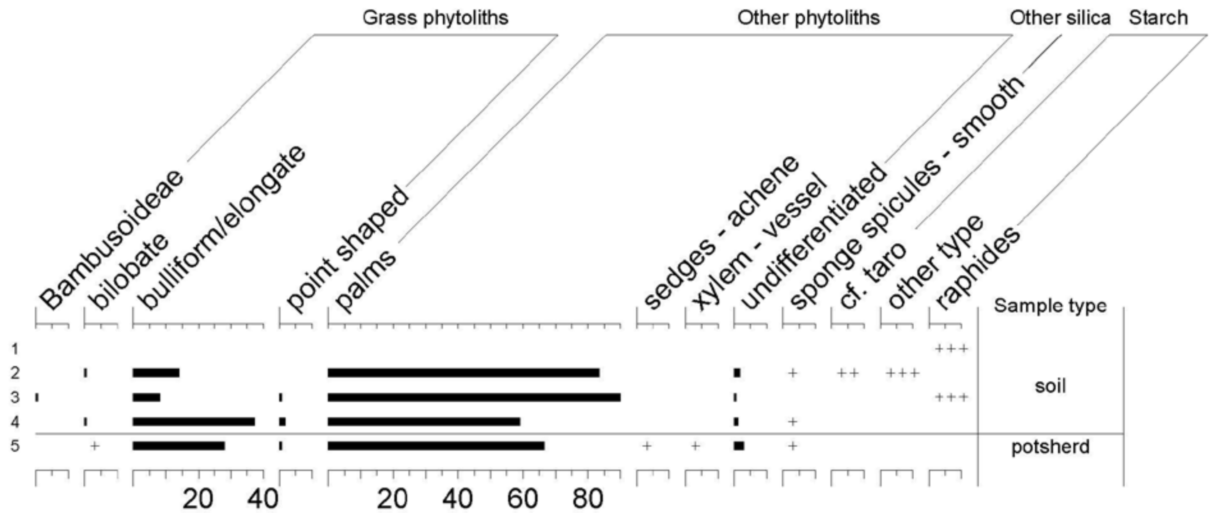

Figure 73. Phytolith and Starch Diagram from Site SP1-1037, Saipan
(+ = found after count, ++ = small amount, +++ = large amount)

scatters of poorly fired Latte pottery in the shallow burned soils. If they were also used to cook foods for local consumption, the evidence remains to be encountered. In fact, the one burned pottery sherd from Feature 1 was noted by Microfossil Research, not to contain burned residue on the interior, but rather to have burned fuel remains adhered to the exterior surface. Poor preservation in alternating wet/dry salty conditions of the sandy coastal villages may also be a likely factor for explaining the lack of perishable organic remains in these features.

Chapter 6

Osteological Analysis

6.1 Introduction

This chapter presents the osteological analysis of the human remains recovered from this project (Walth and Mowrer 2018). The human remains could not be directly dated, but radiocarbon dates from cooking features and middens found on both sides of the Burial 31–45 cluster area date toward the end of the Latte period, from the late A.D. 1400s to the early 1700s. The individuals at this site lived and died in the area between the Latte and post-Contact periods. In the chapters above the methods used were detailed. This chapter includes this introduction, followed by assemblage characteristics, paleodemography, morphology of the cranium and mandible, morphology of the postcranial remains, dental morphology, dental pathologies, skeletal pathologies, mortuary analysis, and conclusions. The far fewer WWII Japanese remains will not be covered here.

6.1.1 Previous Osteological Investigations in Saipan

Human skeletal remains have been collected and studied since the 1920s in Saipan. The Hornbostel-Thompson collection represents skeletal remains from Guam, Saipan, and Tinian. These remains, now housed in the Guam Museum, have been the basis of a variety of studies (Brace et al. 1990; Brace and Hunt 1990; Dodo 1986; Hanihara 1986, 1992; Ishida and Dodo 1993; Pietrusewsky 1976). In Saipan, information about prehistoric inhabitants is located primarily in unpublished burial reports generated from cultural resources management mitigation. These reports are often difficult to procure and though limited in focus, they contain most of the details, discussions, conclusions, and raw data regarding prehistoric skeletal remains from Saipan. Archaeological investigations began on Saipan in the early 1900s, with work in Afetna and Chalan Piao to the north, and Agingan to the south (Hornbostel 1924; Spohr 1957; Thompson 1971). It was not until the late 1970s when Thompson (1977) surveyed and preformed test excavations in San Antonio and members of the Northern Marianas Archaeology Society recovered a mass burial area exposed during earthworks in the San Antonio village (Russell 1984) that archaeological research in the southwestern portion of Saipan began in earnest. These projects indicated that parts of the southwest corner of Saipan had been occupied since the early period of the island's prehistory.

As research and excavations increased throughout the 1980s, numerous important reports were produced. Pietrusewsky and Batista (1980) and Pietrusewsky (1986) analyzed the human remains recovered from five sites on Saipan, including one site in San Antonio. Pietrusewsky and Batista (1980) analyzed the remains from two of those sites, Saipan Latte House (Grotto) and the Marianas High School site. The remains from Hafa Dai Beach, San Antonio site, and Tanapag were too fragmented to provide meaningful analysis. Pietrusewsky and Batista (1980) and Pietrusewsky (1986) were able to determine that these populations were relatively healthy with some evidence of trauma, exhibited betel-nut staining and dental modification on the teeth, and that the skeletal elements from the San Antonio population were particularly robust and tall in stature. McGovern-Wilson (1989) analyzed the remains of 41 prehistoric burials from the Afetna site for the Surf Hotel in San Antonio, just south of the current project. McGovern-Wilson findings were similar to Pietrusewsky and Batista (1980) and Pietrusewsky (1986); the population was relatively healthy, exhibited betel-nut staining and dental modification on the teeth, and the one male where stature could be estimated, was taller and more robust when compared with other Mariana Island populations. Hanson (1989) recovered the fragmentary remains of nine burials during construction in Garapan to the north and also found little evidence of disease, no caries, extreme tooth wear (possibly from use of teeth as tools), and that stature fell into the tall range. In 1996, Hunter-Anderson et al. (1996) excavated 32 prehistoric burials from the Saipan Judiciary Center in Susupe, and found little evidence of disease, caries, or trauma. A published volume of the *American Journal of Physical Anthropology* (Vol. 104) was dedicated to Marianas research (Ambrose et al. 1997; Douglas et al. 1997; Hanihara 1997; Hanson and Butler 1997; Hanson and Pietrusewsky 1997). Publications in several other peer-reviewed journals have focused on the colonization of the Marianas and biological relatedness of the ancient Chamorro (Hanihara 1992; Hung et al. 2011; Pietrusewsky 1990a, 2006, 2008; Vilar et al. 2012).

6.2 Assemblage characteristics

6.2.1 Preservation

The human burials at Parcel 004-1-52 were overall in fair condition. The site and some burials were disturbed by prehistoric activity. In the pre-Contact period, it was common to bury an individual under or near a structure where other individuals had previously been interred, thus disturbing the earlier burials with the new interment. Disturbance also occurred in the historic and recent times. The project area is on a National Historic Landmark WWII American invasion beach, with a WWII Japanese ammunition magazine, a U.S. Coast Guard Loran facility used from 1944 to 1978, and the remnants of a modern concrete pad for a boxing rink and food stand. Burials have also been disturbed by the construction of nearby roads, road repairs, and the installation of various utilities. For example, Burial 36 was discovered under the copper wiring associated with construction of the U.S. Coast Guard Loran facility (Figure 74). The disturbance from prehistoric through recent times resulted in burials being displaced, disarticulated, and isolated from their original context.

Figure 74. Copper tubing over the remains of Burial 36, with Burials 37 and 38 to left

The human bone varied in condition and most were fragmented to some degree, with old and new breaks observed. A few exhibited damage from root action and gnawing from rodents and small mammals.Of the 93 field and laboratory numbered burials, 24 were in good condition (25.8 percent), 60 in fair condition (64.5 percent), 6 in poor condition (6.4 percent), 2 in variable condition, which is fair to poor (2.2 percent) and 1 (1.1 percent) was in very poor condition. Assessment of condition was determined by examination of the condition of the cortex (weathering, cracking, root, and insect damage).

Completeness is an estimate of the skeletal elements present for any

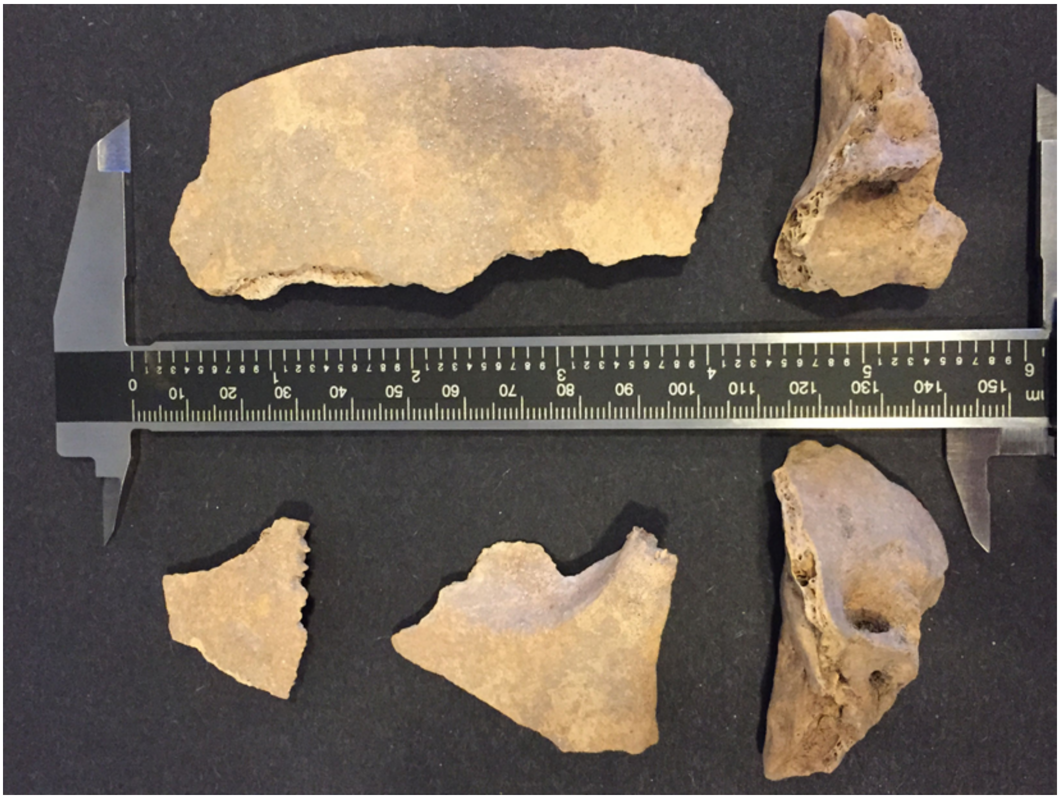

Figure 75. Example of a burial represented by less than 25 percent of skeletal elements

Figure 76. Example of a burial represented by approximately 80 percent of the skeletal elements

individual burial. In the lab, the analyst placed the elements in anatomical position and estimated the overall percent of the individual represented by the skeletal elements. The majority, 36 burials (38.7 percent of the sample), were 26 to 50 percent represented, 30 burials (32.3 percent) were 51 to 75 percent represented, 19 (20.4 percent) were 1 to 25 percent represented, and 8 (11.6 percent) were relatively complete, 76 to 100 percent represented. Figure 75 shows Burial 3 with less than 25 percent of the skeletal elements present for this individual. Figure 76 shows Burial 37, a burial approximately 80 percent complete represented by all but the lower legs, one foot, and most of the elements are nearly complete except for the lower half of the femora.

6.2.2 Calculations of Minimum Number of Individuals

The skeletal assemblage recovered from Parcel 004-1-52 ranged from complete, articulated, formal burials to isolated human bone that consisted of a bone, or bone fragment. In the field, primary inhumations and isolated remains were assigned a field burial number, but many of the primary inhumations included the remains of one or more individuals. If the additional remains represented another individual (for example, an additional sided element), or exhibited skeletal morphology or preservation differences, then the second (or third, fourth, etc.) individual was assigned a laboratory burial number by adding a letter to the field burial number, such as 7a, and 7b. In addition to primary inhumations, four isolated human remains were recovered. The isolated bone was listed by number of fragments, element, side, and, when possible, age and sex, and were recorded on a separate data sheet, referred to as isolated human bone. Calculation of minimum number of individuals (MNI) was determined by finding the most numerous sided element. All human remains were considered and divided by affiliation (Latte or Japanese WWII) and by age and sex (for adults). Teeth generally survive well but are often lost naturally through attrition and wear. Therefore, isolated teeth that could not be assigned to a burial or isolated remains were excluded from these calculations because they are not definitive evidence of death. Teeth are also small in relative size and not often recovered during monitoring of heavy equipment moving the sandy matrix.

The remains were assigned to Latte or Japanese WWII temporal affiliation based on preservation, burial goods, the affiliation of the burial that they were interred near, or on physical characteristics. For example, two of the Japanese WWII burials exhibited extensive dental work—bridgework and crowns—which would most likely not be found on the prehistoric Latte population. Japanese burials also had burial items that were war-related and preservation characteristics of those individuals was different from the Latte remains. The Japanese remains were in a better state of preservation than the Latte remains. The most numerous sided element for the Latte group was the femur. The field-numbered Latte burials totaled 60 and, based on the count of femoral elements, the isolated remains added four individuals, for 64 field-identified burials. The field-numbered Japanese WWII soldier burials totaled four. The additional Latte individuals identified in the laboratory was 25 for a Latte total of 89, and no additional Japanese WWII skeletal remains were identified in the laboratory. The final MNI for the skeletal assemblage at Parcel 004-1-52 is 93 (89 Latte and four Japanese).

6.3. Paleodemography

Paleodemography is a field of study that focuses on demographic characteristics of prehistoric populations, and in this case one that is derived from an archaeological investigation. Accuracy of the age and sex estimates is an important factor and a potential source of bias in the sample (Milner et al. 2008). The demographic profile of an archaeological sample can be affected by factors such as differential preservation, selective burial practices, and inadequate sampling. The current site was not excavated by any scientific sampling strategy. Burials that were identified during monitoring were excavated and in the process, additional burials were discovered and exhumed. The demographic profiles from the age and sex distributions, when paired with data on pathological changes to the skeleton and dentition, can provide some indication of the health and longevity of past populations.

6.3.1 Age and Sex Distribution

The age distribution is presented in Table 18 and graphically represented in Figure 77. The overall distribution of subadults (<20 years) to adults (20+ years) is 16 to 73, or 82 percent of the sample are adults. Therefore, 18 percent of the sample represents subadults, which compares favorably to other Latte period samples from Guam and the CNMI (Douglas and Ikehara 1992; Graves 1987; McGovern-Wilson 1989; Pietrusewsky and Batista 1980; Pietrusewsky et al. 2003; Rader and Haun 1989; Trembly and Tucker 1999; Walth 2016). There are a large number of adults where the age could only be categorized as 20+ years (33.7 percent, n=30). The next largest cohort is the middle adult category (35–49.9 years of age) at 25.8 percent (n=23), followed by the young adult category with 21.3 percent (n=19). These three groups are the majority of the sample (80.9 percent, n=72). Adolescents are 6.7 percent (n=6) of the sample, followed by infants with 4.5 percent (n=4), young child with 3.4 percent (n=3), child with 2.3 percent (n=2), and older child with 1.1 percent (n=1) of the population. One older individual (50+ years of age-at-death; 1.1 percent) was also identified.

Sex distribution for the adolescents and adults are presented in Table 19. The table includes only the field and laboratory burials, which total 79 individuals. The table does not include any of the child categories or the infant category as sex cannot be determined for individuals this young. The female and possible female were added together as were the male and possible male to get the totals for females and males.

Table 18. Age Distribution for Parcel 004-1-52

Age Category	*Age Range*	*MNI*	*Percent*
Fetal-Infant	−2 months–1.9 years	4	4.5
Young Child	2.0–4.9 years	3	3.4
Child	5.0–9.9 years	2	2.3
Older Child	10.0–14.9 years	1	1.1
Adolescent	15.0–19.9 years	6	6.7
Young Adult	20.0–34.9 years	19	21.3
Middle Adult	35.0–49.9 years	23	25.8
Older Adult	50+ years	1	1.1
Adult	20+ years	30	33.7
Total		89	100%

Table 19. Sex and Age Distribution of Adolescents and Adults for Parcel 004-1-52, San Antonio

Age	*Female*	*Ind*	*Male*	*Total*
Adolescent	2	4	0	**6**
Young Adult	9	5	5	**19**
Middle Adult	12	5	6	**23**
Older Adult	0	0	1	**1**
Adult	2	25	3	**30**
Total	25	39	15	**79**
Percent	**31.6%**	**49.4%**	**19.0%**	**100%**

Ind = Indeterminate

Females outnumber males (25 to 15 or 1.67:1) with 1.67 females to every one male. Sex could not be estimated for 39 individuals (49.4 percent of the sample). As a percent females and males, more females (44 percent, n=11) than males (33 percent, n=5) died by young adult age (20–35 years) and one male lived into the older adult age group (50+ years of age). The increased risk of childbearing likely represents a hazard for the females. Male hazards resulting in death could include warfare, accidents, or other cultural activities.

6.3.2 Abridged Life Table

The abridged life table for the Parcel 004-1-52 burials is presented in Table 20 (sexes combined). The adult individuals with no specific age estimate were distributed proportionately among the age ranges. The life table includes parameters such as the actual number of observed deaths (Dx), survivorship rate (lx), mortality rate (qx), age-specific death rate (mx), and life expectancy (ex). The reliability of the demographic reconstruction presented in the life table is dependent on the assumptions that the age and sex estimates are representative of the population. The burial sample has individuals in age categories from infancy to older adult (estimated in this group as 50+ years of age at death). Overall life expectancy (mean age at death) is 30.2 years. Mortality risk is highest in the 35–39.9 group. That is followed in descending order by the 20 to 24.9 age group, the 25 to 29.9 and 40 to 44.9 age groups, the 35 to 39.9 age group, and the 45 to 49.9 age group. Mortality for children (under 15 years) is highest for children ages 0 to 0.9 months, and 2 to 4.9 years, followed by children 5 to 9.9, and lowest for the 1 to 2.9 and 10 to 14.9 age groups. The survivorship curve data (life table column lx) are presented for the complete assemblage in Figure 8.5.

The dependency ratio estimates the number of dependents supported by each worker in the population. The ratio is calculated as the number of individuals that are under the age of 15 and over the age of 50 (Dx 0–14.9+Dx50+/Dx15.0–49.9) divided by the number of individuals between the ages of 15 and 50 (Howell 1982). The dependency ratio for the burial assemblage is .16 or 16 dependents for every 100 workers. Workers have to work harder when there are more dependents than workers. Estimation of

Table 20. Life Table for Parcel 004-1-52, San Antonio

x	*nx*	*Dx*	*dx*	*lx*	*qx*	*Lx*	*mx*	*Tx*	*ex*
0–0.9	1	3	3.37	100.0	0.03	98.3	0.03	3,015.2	30.2
1–1.9	1	1	1.12	96.6	0.01	96.1	0.01	2,916.9	30.2
2–4.9	3	3	3.37	95.5	0.04	281.5	0.01	2,820.8	29.5
5–9.9	5	2	2.25	92.1	0.02	455.1	0.00	2,539.3	27.6
10–14.9	5	1	1.12	89.9	0.01	446.6	0.00	2,084.3	23.2
15–19.9	5	6	6.74	88.8	0.08	427.0	0.02	1,637.6	18.4
20–24.9	5	15	16.85	82.0	0.21	368.0	0.05	1,210.7	14.8
25–29.9	5	14	15.73	65.2	0.24	286.5	0.05	842.7	12.9
30–34.9	5	3	3.37	49.4	0.07	238.8	0.01	556.2	11.3
35–39.9	5	17	19.10	46.1	0.41	182.6	0.10	317.4	6.9
40–44.9	5	14	15.73	27.0	0.58	95.5	0.16	134.8	5.0
45–49.9	**5**	**8**	**8.99**	**11.2**	**0.80**	**33.7**	**0.27**	**39.3**	3.5
>50	**5**	**2**	**2.25**	**2.2**	**1.00**	**5.6**	**0.40**	**5.6**	0.0
Total		89							

x = age interval; nx = number of years in the interval; Dx = number of individuals dying; dx = percent of individuals per interval; lx = survivorship; qx = probability of dying during the interval; Lx = total number of years lived by all individuals in the interval; mx = death rate for age interval; Tx = number of years remaining in lifetimes of all entering the interval; ex = average life of individuals entering the interval.

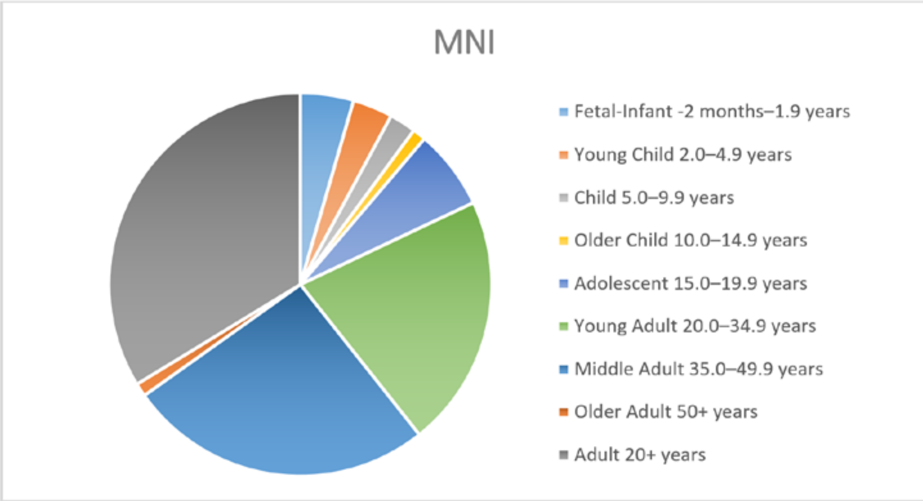

Figure 77. Chart of age distribution for Parcel 004-1-52, San Antonio

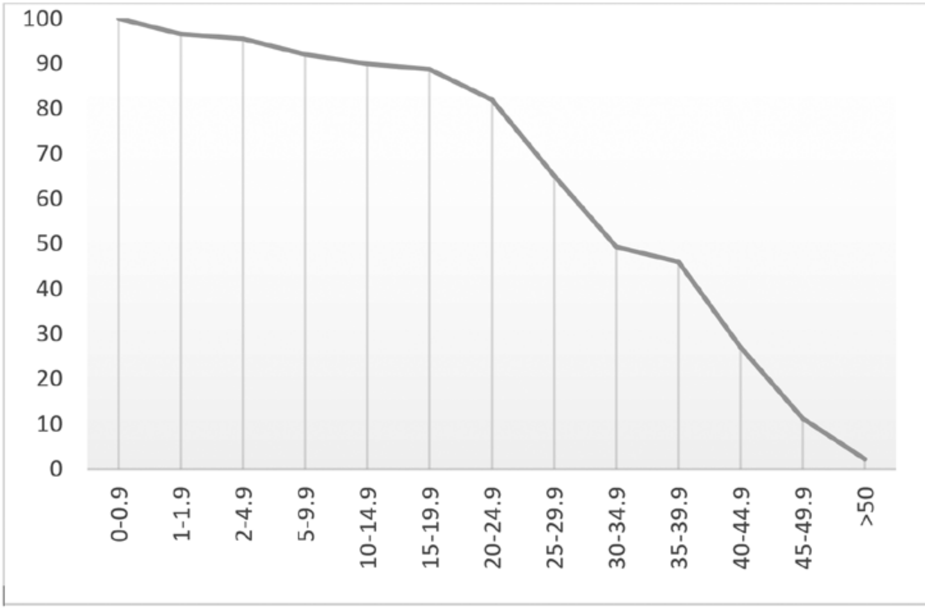

Figure 78. Survivorship curve for all the Parcel 004-1-52 burials

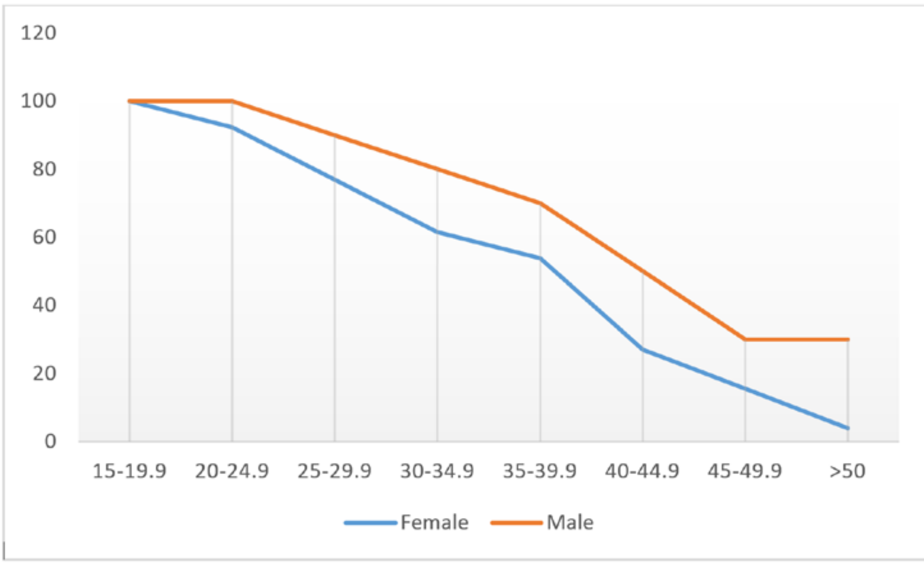

Figure 79. Survivorship curve for the males and females in the Parcel 004-1-52 project area

fertility in a population is similar to the dependency ratio and is calculated in a similar manner with one change. Fertility (birth rate) is calculated using the number of deaths over the age of 30 divided by the number of deaths over the age of 5 (Buikstra et al. 1986). For the current assemblage it is 0.54 (44/82).

The survivorship curve data (life table column lx) are presented for the complete assemblage in Figures 78 and 79, and displays the number of individuals alive from the beginning of the first interval, 100 percent of the individuals are alive, and the curve displays the decline of the population to the last age interval. The line declines relatively slowly at first, a result of the generally low mortality of the young individuals. There is a steep drop in the line reflecting the large number of individuals that died in the age range between 20 and 34.9. The line then levels off slightly with another steep drop to the age of 50+.

6.4 Morphology of the cranium and mandible

Cranial measurements include lengths, breadths, heights, and distances between specified points, and of individual bones of the cranium and the mandible. Cranial remains were fragmented and reconstruction was able to be completed on only a few burials to provide cranial metric data. The mandible is a thicker-walled and more durable element than other cranial elements, but still only a few were available for analysis. Subadult remains were scarce and the bones of children are thinner and more easily damaged. No cranial remains from the subadults were complete enough for analysis.

Cranial characteristics offer a means to study the genetic affinities between different populations; for example Ishida and Dodo's (1997) study of nonmetric cranial variation of people from the Marianas, and the craniometric studies of the Marianas and various Pacific groups by Pietrusewsky (1990a) and Pietrusewsky et al. (2003). Researchers generally agree that nonmetric and craniometric data indicate genetic relatedness (Pietrusewsky 2012; Saunders and Rainey 2008).

6.4.1 Cranial and Mandibular Metric Data

For the current study, cranial measurements and mandibular measurements were recorded (Table 21 and Table 22). Traits were scored on the left and right sides when appropriate, but often only one side or the other was complete enough to record the trait. The craniometric data are presented for females and males. None of the individuals of indeterminate sex were complete enough to record craniometric data. Table 23 presents the cranial and mandibular indices for the males and females. There was only one male with a cranium complete enough to obtain measurements. There were two females that provided cranial metric data.

The indices (see Table 23) were calculated using the means determined and listed in the data tables above. The cranial index is a ratio of the breadth of the skull to its length. The male cranial shape is nearly oval and is in the mesocranic range (75 to 80) and the females fall in the dolichocranic(narrow or long-headed) category (<75). The ratios for cranial height in respect to length or breadth indicate a relatively high cranial shape. The height to breadth ratio is in the tapeinocranic range (<92) for the male and the females. The cranial module provides a measure of the overall size of the cranium using the length, breadth, and height measurements. There are two female and one male skull complete enough to calculate this index: female mean (141.91) and male mean (203.33). These data can be used to attain an estimate of cranial capacity using the Lee-Pearson formulae (Gohiya et al. 2010:1212; Manjunath 2002; Olivier 1969:135); the cranial capacity for the two females averages 1,319 cc. The cranial capacity of the one male is 2,111 cc. The fronto-parietal index expresses the relationship of the breadth of the frontal and the maximum breadth of the vault. The females are in the broad (eurymetopic) range, with an average of 81.79, and no index for the male could be calculated. The nasal structures did not survive well and there is only one female that was able to be measured. The nasal index for this individual indicates a broad nasal

Table 21. Cranial Metric Data for Males and Females

Measurement ***n***	***Females***			***Males***	
	Mean	***SD***	***n***	***Mean***	***SD***
Maximum cranial length (1)(GOL)	1	178.1		1	200
Maximum cranial breadth (2)(XCB)	2	120.44	10.41	1	150
Bizygomatic breadth (3)(ZYB)	1	129.17		1	139
Basion-bregma height (4)(BBH)	1	127.18		1	160
Cranial base length (5)(BNL)	1	122.81		1	125
Basion-prosthion length (6)(BPL)	0			1	131.00
Maxillo-alveolar breadth (7)(MAB)	1	39.22		1	72.83
Maxillo-alveolar length (8)(MAL)	1	54.97		1	57
Biauricular breadth (9)(AUB)	2	111.51	3.46	1	127.62
Nasal height (13)(NLH)	1	52.64		0	
Nasal breadth (14)(NLB)	1	27.27		1	27.43
Orbital height (15)(OBH)	2	39.79	0.57	1	36.86
Orbital breadth (16)(OBB)	2	40.86	1.92	1	41.20
Biorbital breadth (17)(EKB)	2	97.64	10.08	1	100.88
Interorbital breadth (18)(DKB)	2	23.97	6.59	1	24.31
Min frontal breadth (WFB)	1	97.54		1	104.01
Upper facial breadth (FMB)	2	101.13	1.04	1	98.93
Minimum frontal breadth (11)	2	98.51	1.37	1	104.01
Upper facial breadth (12)(FMB)	0			1	98.93
Foramen magnum breadth (23)(FOB)	1	29.81		1	30.26
Foramen magnum length (FOL)	1	40.14		1	38.9
Mastoid length (24)(MDH)	1	27.97		1	26.41
Frontal chord (19)(FRC)	1	109.92		1	115.85
Parietal chord (20)(PAC)	1	110.47		1	123.29
Occipital chord (21)(OCC)	1	95.31		1	94.86

All measurements in millimeters (mm). Measurements listed with numbers are referring to *Standards* (Buikstra and Ubelaker 1994); measurements with capitalized letters are referring to Howells (1973).
n = number; SD = standard deviation.

Table 22. Mandibular Metric Data for Males and Females

Measurement ***n***	***Females***			***Males***	
	Mean	***SD***	***n***	***Mean***	***SD***
Chin height (25)	1	27.65		1	40.22
Body height (26)	1	32.24		1	30.36
Body breadth (27)	1	15.64		1	14.06
Bigonial width (28)	1	85.68		1	83.54
Bicondylar breadth (29)	0			1	129.15
Minimum ramus breadth (30)	1	42.08		1	37.50
Maximum ramus breadth (31)	1	51.58		1	44.50
Maximum ramus height (32)	1	66.93		1	64.00
Mandibular length (33)	1	89.66		1	89.67

All measurements in millimeters (mm). Measurements listed with numbers are referring to *Standards* (Buikstra and Ubelaker 1994);n = number; SD = standard deviation.

Table 23. Cranial and Mandibular Indices for Males and Females

Index	*Females*	*Males*
	Mean	*Mean*
Cranial		
Cranial index	67.62	75.00
Cranial module	141.91	203.33
Length-height index	71.41	80.00
Height-breadth index	105.60	106.67
Mean basion-height index	85.20	58.18
Fronto-parietal index	81.79	
Nasal index	51.80	
Orbital index	97.38	89.47
Maxillo-alveolar index	71.35	127.77
Mandible		
Robusticity index	48.51	46.31
Mandibular index		69.43
Gonio-condylar index		64.68
Ramus index	77.07	69.53

Cranial index = maximum cranial breadth × 100/maximum cranial length.
Cranial module = length+breadth+height/3.
Length-height index = basion-bregma height × 100/max length.
Breadth-height index = basion-bregma height × 100/max breadth.
Mean basion height index = basion-bregma height × 100/(cranial length+breadth/2).
Fronto-parietal index = minimum frontal breadth × 100/max cranial breadth.
Nasal index = nasal breadth × 100/nasal height.
Orbital index = orbital height × 100/orbital breadth.
Maxillo-alveolar index = maxilla-alveolar breadth × 100/maxilla-alveolar length.
Mandible robusticity index = mandibular body breadth × 100/body height.
Mandibular index = mandibular length × 100/bicondylar breadth.
Gonio-condylar index= bigonial width × 100/bicondylar breadth.
Ramus index=maximum ramus breadth × 100/maximum ramus height.

index for the female (51.80). The orbital index expresses the relationship of the height to breadth of the eye opening. The one male and two females had orbits that are broader than high, with an index of 97.38 for the females and 89.47 for the male.

The mandibular index expresses the ratio of the length to breadth of the mandible. The individuals in this assemblage have generally short and broad mandibles. The ramus index reflects the relative breadth to length of the ramus. Females index averages 77.07 and are broader than the male at 69.53. Mandibular robusticity index, which is measured at the nutrient foramen, reflects the robusticity of the mandibular body. The male (46.31) was less robust than the females (48.51).

In summary, the males have a nearly oval cranial shape and females are long and narrow. Males and females have high cranial vaults relative to length

Figure 80. Cranium of Burial 28, male, front view (on left); cranium of Isolated Find 1, female

and breadth. The frontals are slightly broader in females. One female has a broad nasal index and both males and females have orbits that are nearly equal in height and breadth. The individuals have short and broad mandibles, with the females having a higher ramus and a more robust body than the males. Figure 80 shows the best preserved crania and mandibles from the assemblage. Burial 28 is a male cranium and a female cranium is shown from Isolated Find 1.

6.4.2 Cranial and Mandibular Nonmetric Data

Variation in expression of 33 nonmetric traits was scored in the cranial assemblage and is presented in Table 24. Left and right sides were combined in the table. For ossicles in cranial sutures, the asterionic was present in 15.4 percent, apical bone was present in 11.1 percent, and the epepteric, coronal, bregmatic, sagittal, and lambdoid were all absent. Supraorbital notch was noted as present in 83.9 percent and supraorbital foramen was present 43.2 percent with one (male) having multiple foramen present. There was variability in the zygo-facial foramen with the greatest score being a single foramen, large or small at 61.3 percent. Tympanic dehiscence was observed in 50 percent of the individuals. Auditory exostosis was present in 11.1 percent and mylohyoid bridge was absent in 94.8 percent of all individuals. Ishida and Dodo (1997:402 Table 2a) have trait percentage for Guam collected from the Hornbostel Collection for tympanic dehiscence (50 percent), supraorbital foramen (33.5 percent), and ossicles at lambda (15.4 percent). Compared to the assemblage of the current study, there is a similar occurrence of tympanic dehiscence, a slightly greater percentage of supraorbital foramen in the current assemblage, and a lower percentage of ossicles at lambda in the Hornbostel Collection. The current assemblage has a sample size that is too small to make meaningful comparisons between males and females. Any differences noted may be a result of the small sample size.

Table 24. Cranial and Mandibular Nonmetric Traits for Adult Females, Males, and Individuals of Indeterminate Sex

Trait/Variation	***Females (N*)***		***Males (N*)***		***Indeterminate (N*)***		***Total* (N)***	
	n	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Metopic Suture	**6**		**5**		**2**		**13**	
Absent	6	100	5	100.0	2	100	13	100
Partial	0	0	0	0	0	0	0	0
Complete	0	0	0	0	0	0	0	0
Supraorbital Notch	**17**		**10**		**4**		**31**	
Absent	3	17.7	1	10.0	1	25.0	5	16.1
Present	14	82.3	9	90.0	3	75.0	26	83.9
Supraorbital Foramen	**17**		**15**		**5**		**37**	
Absent	8	47.1	8	53.3	4	80.0	20	54.1
Present	9	52.9	6	40.0	1	20.0	16	43.2
Multiple	0	0	1	6.7	0	0	1	2.7
Infraorbital Suture	**9**		**9**		**3**		**21**	
Absent	2	22.2	5	55.6	2	66.7	9	42.9
Partial	1	11.1	3	33.3	1	33.3	5	23.8
Complete	6	66.7	1	11.1	0	0	7	33.3
Infraorbital Foramen	**12**		**9**		**4**		**25**	
Absent	10	83.33	6	66.7	1	25.0	17	68.0
Single	2	16.67	3	33.3	1	25.0	6	24.0
Double	0	0	0	0	2	50.0	2	8.0

Trait/Variation	*Females (N*)*		*Males (N*)*		*Indeterminate (N*)*		*Total* (N)*	
	n	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Zygo-facial Foramen	**18**		**9**		**2**		**31**	
Absent	5	27.8	3	33.3	0	0	8	25.8
Single (large or small)	11	61.1	6	66.7	2	0	19	61.3
Double (large or small)	1	5.6	0	0	0	0	1	3.2
More than two	1	5.6	0	0	0	0	1	3.2
Parietal Foramen	**10**		**8**		**7**		**25**	
Absent	5	50.0	5	62.5	3	33.33	13	52.0
Present, Parietal	5	50.0	3	37.5	4	66.67	12	48.0
Condylar Canal	**4**		**2**		**6**		**12**	
Patent	3	75.0	1	50.0	2	33.3	6	50.0
Not Patent	1	25.0	1	50.0	4	66.7	6	50.0
Divided Hypoglossal Canal	**4**		**2**		**6**		**12**	
Absent	3	75.0	2	100	5	83.3	10	83.3
Partial	0	0	0	0	0	0	0	0
Complete	1	25.0	0	0	1	16.7	2	16.7
Sagital Sulcus Flexure	**6**		**5**		**4**		**15**	
Right	0	0	2	40.0	2	50.0	4	26.7
Left	1	16.67	2	40.0	2	50.0	5	33.3
Bifurcated	5	83.33	1	20.0	0	0	6	40.0
Foramen Ovale Incomplete	**0**		**2**		**2**		**4**	
Absent	0	0	2	100	2	100	4	100
Partial	0	0	0	0	0	0	0	0
No Definition of Foramen	0	0	0	0	0	0	0	0
Tympanic Dihiscence	**9**		**9**		**4**		**22**	
Absent	3	33.33	6	66.7	2	50.0	11	50.0
Foramen only	4	44.45	0	0	2	50.0	6	27.3
Full defect	2	22.22	3	33.3	0	0	5	22.7
Auditory Exostosis	**11**		**8**		**8**		**27**	
Absent	9	81.81	8	100	7	87.5	24	88.9
Present	2	18.19	0	0	1	12.5	3	11.1
Epipteric Bone	**8**		**8**		**4**		**20**	
Absent	8	100	8	100	4	100	20	100
Present	0	0	0	0	0	0	0	0
Coronal Ossicle	**11**		**6**		**7**		**24**	
Absent	11	100	6	100	7	100	24	100
Present	0	0	0	0	0	0	0	0
Bregmatic Bone	**7**		**2**		**2**		**11**	
Absent	7	100	2	100	2	100	11	100
Present	0	0	0	0	0	0	0	0
Sagittal Ossicle	**9**		**2**		**2**		**13**	
Absent	9	100	2	0	2	100	13	100
Present	0	0	0	0	0	0	0	0

Trait/Variation	Females (N*)		Males (N*)		Indeterminate (N*)		Total* (N)	
	n	%	n	%	n	%	n	%
Apical Bone	**9**		**5**		**4**		**18**	
Absent	7	77.78	5	100	4	100	16	88.9
Present	2	22.22	0	0	0	0	2	11.1
Lambdoid Ossicle	**14**		**8**		**5**		**27**	
Absent	14	100	8	100	5	100	27	100
Present	0	0	0	0	0	0	0	0
Asteronic Bone	**5**		**6**		**2**		**13**	
Absent	5	100	4	66.7	2	100	11	84.6
Present	0	0	2	33.3	0	0	2	15.4
Occipitomastoid Ossicle	**5**		**6**		**4**		**15**	
Absent	5	100	6	100	4	100	15	100
Present	0	0	0	0	0	0	0	0
Parietal Notch Bone	**6**		**4**		**4**		**14**	
Absent	6	100	4	100	4	100	14	100
Present	0	0	0	0	0	0	0	0
Inca Bone	**7**		**4**		**2**		**13**	
Absent	7	100	4	100	2	100	13	100
Present	0	0	0	0	0	0	0	0
Mastoid Foramen Location	**4**		**6**		**3**		**13**	
Absent	2	50.0	4	66.7	1	33.3	7	53.8
Temporal	1	25.0	2	33.3	0	0	3	23.1
Sutural	0	0	0	0	0	0	0	0
Occipital	1	25.0	0	0	2	0	1	7.7
Sutural & Temporal	0	0	0	0	0	66.7	0	6.5
Mastoid Foramen Number	**4**		**6**		**4**		**14**	
Absent	2	50.0	4	66.7	1	25.0	7	50.0
Single	2	50.0	2	33.3	1	25.0	5	35.7
Double	0	0	0	0	1	25.0	1	7.1
>2	0	0	0	0	1	25.0	1	7.1
Mental Foramen	**21**		**13**		**6**		**40**	
Absent	0	0	0	0	0	0	0	0
Single	20	95.24	12	92.3	6	100	38	95.0
Double	1	4.76	1	7.7	0	0	2	5.0
>2	0	0	0	0	0	0	0	0
Mandibular Torus	**21**		**13**		**8**		**42**	
Absent	7	33.33	4	30.8	0	0	11	26.2
Trace	5	34.81	6	46.2	3	37.5	14	33.3
Moderate	9	42.86	3	23.0	5	62.5	17	40.5
Mylohyoid Bridge Location	**18**		**11**		**9**		**38**	
Absent	16	88.89	11	100	9	100	36	94.8
Near Foramen	1	5.56	0	0	0	0	1	2.6
Center of Groove	1	5.56	0	0	0	0	1	2.6

Trait/Variation	*Females (N*)*		*Males (N*)*		*Indeterminate (N*)*		*Total* (N)*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Mylohyoid Bridge Degree	**18**		**11**		**9**		**38**	
Absent	16	88.89	11	100	9	100	36	94.7
Partial	2	11.11	0	0	0	0	2	5.3
Complete	0	0	0	0	0	0	0	0

* Left and rights combined

6.5 Morphology of the postcranial remains

The postcranial measurements include length of long bones, breadth across the ends of long bones, diameters and circumference at midshaft or at specific morphological markers along the shaft, and specified lengths and widths of foot elements. Metric data provide information on size and robusticity. Humans are a sexually dimorphic species and metric data can help in the estimation of sex of individuals. Stature of the individual can be estimated using lengths of long bones, and was calculated using formulae from Houghton et al. (1975) based on Polynesians. Length of long bones in juveniles offers a means of estimating age. Measurements were taken on the left side unless that side was unavailable for measurements, in which case the right side was substituted.

Postcranial nonmetric traits include characteristics such as facet forms, presence of foramen in particular locations, and extensions of articular facets. Nonmetric traits are less influenced by age and sex than metric measurements and have the advantage of being able to be scored on fragmentary and poorly preserved remains. Some postcranial nonmetric traits, as with cranial nonmetric traits, offer a means to study the genetic affinities between different populations (Saunders and Rainey 2008). For the current study, 20 postcranial nonmetric traits were examined in the adult remains. Traits were scored on the left and right sides when available, but often only one side was complete enough to record the trait.

6.5.1 Postcranial Metric Data for Adults

The mean, standard deviation, and range of measurements for 40 postcranial measurements for the males and females are presented in Table 25. The human remains for this assemblage were poorly preserved and only six females and seven males had postcranial elements that were complete enough to obtain some measurements. There were a few measurements that indicated the sexual dimorphism between males and females that is expected. The maximum length of the clavicle, epicondylar breadth of the humerus, vertical diameter of the humeral head, anterio-posterior diameter of the ulna, and minimum width of the calcaneus. However, caution must be advised when the sample size is this small. Therefore, calculating sex using the metric data was not applied to the indeterminate sex individuals.

Indices were calculated where all the necessary measurements were available. Because sample size was so very small, only five indices could be calculated. Table 26 presents the female and male postcranial indices. The flattening of the humeral shaft is reflected in the humeral diaphyseal index. The individuals in this collection have a generally rounder rather than flatter shaft with indices of 89.2 for females and 82.9 for males. The relative forearm to upper arm length is depicted in the radio-humeral index. The male index is 79.3 and the female mean is 72.4; both reflect a shorter forearm to upper arm length. The platymeric index is a measurement of the flattening of the femur shaft, and is measured below the trochanter (subtrochanteric). The females and males have a round to oval cross-section

Table 25. Postcranial Metric Data for Females Males, and Indeterminate Sex

Element Measurement	***Females***				***Males***			
Clavicle	***n***	***Mean***	***STD***	***Range***	***n***	***Mean***	***STD***	***Range***
Max Lgth	1	135			3	145.6	6.6	138–149.7
AP Dia	2	12.3	1.0	11.5–13.0	4	13.1	1.9	11.4–15.8
SI Dia	2	10.0	1.4	9.0–11.0	4	13.9	0.4	13.3–14.3
Humerus	n	Mean	STD	Range	n	Mean	STD	Range
Max Lgth	1	311			1	299		
Epicondylar Brdth	3	57.0	5.1	53.4–62.9	1	65.0		
Vert Dia Head	2	38.3	2.1	36.8–39.7	2	51.2	3.4	48.8–53.6
Midshaft Max Dia	2	22.1	1.6	21.0–23.2	2	25.0	1.9	23.7–26.3
Midshaft Min Dia	2	18.3	3.3	16.0–20.7	2	20.7	1.2	19.9–21.6
Least Circumference	0				0			
Radius	n	Mean	STD	Range	n	Mean	STD	Range
Max Lgth	1	225			1	237		
Midshaft AP Dia	4	14.7	2.5	11.5–15.0	2	16.0	0.1	15.9–16.1
Midshaft ML Dia	4	12.6	2.5	10.2–15.4	2	13.8	1.2	12.9–14.6
Max Dia Head	0				0			
Neck Circumference	0				0			
Ulna	n	Mean	STD	Range	n	Mean	STD	Range
Max Lgth	1	248			1	251		
AP Dia	4	13.7	1.4	11.8–15.2	2	17.4	0.7	16.8–17.9
ML Dia	4	14.3	3.1	10.9–18.2	2	14.0	2.8	12.0–15.91
Physiological Lgth	0				1	248		
Min Circumference	3	33.7	2.5	31.0–36.0	1	30.0		
Femur	n	Mean	STD	Range	n	Mean	STD	Range
Max Lgth	0							
Bicondylar Lgth	0							
Epicondylar Brdth	1	72.1						
Max Head Dia	1	41.2			4	44.2	3.7	40.1–48.7
Subtrochanteric AP	3	29.7	0.3	29.5–30.0	2	36.6	8.3	30.8–42.5
Subtrochanteric ML	4	28.4	4.0	24.3–33.8	1	25.0		
Midshaft AP Dia	4	27.6	2.3	25.3–30.5	2	27.8	1.1	27.1–28.6
Midshaft ML Dia	4	27.5	1.9	25.8–30.1	2	25.0	0.5	24.6–25.3
Midshaft Circumference	3	79.7	6.8	72–85	2	82.0	5.7	78–86
Tibia	n	Mean	STD	Range	n	Mean	STD	Range
Max Lgth	1	320			1	353		
Brdth Prox Epi	2	53.2	17.5	40.8–65.5	1	45.0		
Brdth Dist Epi	2	39.8	6.5	35.1–44.4	2	41.6	10.8	33.9–49.2
Max Dia @ NF	4	33.5	5.8	24.8–37.2	1	25.4		
ML Dia @ NF	3	27.2	1.3	25.6–28.0	0			

Element Measurement	***Females***				***Males***			
Circumference @ NF	2	92.5	0.7	92–93	1	93		
Fibula	n	Mean	STD	Range	n	Mean	STD	Range
Max Lgth	0				1	351		
Min Dia	2	16.2	2.6	14.4–18.0	1	18.6		
Calcaneus	N	Mean	STD	Range	n	Mean	STD	Range
Max Lgth	3	72.5	2.3	70.4–75.0	2	80.3	0.5	79.9–80.6
Min W	3	38.4	0.8	37.4–38.4	2	47.0	4.2	44–50
Talus	**N**	**Mean**	**STD**	**Range**	**N**	**Mean**	**STD**	**Range**
Max Lgth	1	47.1			0			
Max W	1	40.5			0			

Note: All measurements in mm and include adolescent measurements.
AP = anterior-posterior; BRDTH = breadth; DF= Discriminate Function (Steele 1976); Dia = diameter; Epi = ephicondylar; Lgth = length; Max = maximum; Min = minimum; ML = medial-lateral; NF = nutrient foramen; SI = superior-inferior; STD = standard deviation; W = width.

Table 26. Postcranial Indices for Females and Males

Indices	***Females***	***Males***
Humeral diaphyseal	89.2	82.9
Radio-humeral	72.4	79.3
Playtmeric	104.6	123.18*
Pilastric	100.1	111.4
Platycnemic	81.1	0

Index was calculated using means because of small sample size.
Humeral diaphyseal = minimum diameter at midshaft × 100/maximum diameter at midshaft
Radio-humeral Index = maximum length of radius × 100/ maximum length of humerus
Playtmeric = femur subtrochanteric anterior-posterior diameter × 100/subtrochanteric mediolateral diameter
Pilastric = femur anterior-posterior diameter at midshaft × 100/mediolateral diameter at midshaft
Platycnemic = tibia mediolateral diameter at nutrient foramen × 100/maximum diameter nutrient foramen
* This index calculation was completed using Burial 48 because there was only one subtrochanteric mediolateral diameter, and that individual was very gracile. Using the mean of the anterior-posterior and this one mediolateral measurements produced an index that was not representative.

with the female index of 104.6 (near a 1 to 1) and the males with 123.18 (greater anterior-posterior than medio-lateral). Pilastric index is calculated from the femur midshaft measurements and reflect the amount of pilastic development (development of the linea aspera). Females have less development (more gracile) at 100.1 and males are a bit more robust with an index of 111.4. Flattening of the tibia is reflected in the platycnemic index. As with the femur, this reflects the flattening of the shaft and is measured at the nutrient foramen. The index for the males could not be calculated. The female index reflects a flatter shaft with a score of 81.1.

6.5.2 Estimated Stature for Adults

Stature was calculated for two females and three males following the calculation of stature developed by Houghton et al. (1975) based on Polynesians from New Zealand. Table 27 presents the list of the elements that were used in the stature calculations for each burial. The stature estimation for the females was based on a humerus and tibia for Burial 16 and on the radius and ulna for Burial 25. Burial 28, male, was based on one element and that was a humerus. Burial 42, female, was also based on one element and that was the tibia. A radius and ulna were available for Burial 36, male. Table 27 also summarizes the data for the males and females. The male stature ranges from 1,682.83 to 1,706.76 mm (5′6″ to 5′7″) and the female range was 1,580.86 to 1,658.02 mm (5′2″ to 5′5″). Females are approximately 9.6 percent shorter than their male counterparts. This is slightly greater than the 7 percent difference found by Houghton et al. (1975).

Table 27. Stature Estimates for Males and Females from Parcel 004-1-52, San Antonio

Burial No.	***Sex***	***Element(s)***	***Side***	***Stature in mm***	***Stature in inches***	***Mean Inches***	***Stature in feet, inches***
16	Female	Humerus	L	1,658.02	65.28	63.76	5′ 3¾″
		Tibia	R	1,580.86	62.24		
25	Female	Radius	L	1,609.0	63.35	63.52	5′ 3½″
		Ulna	L	1,617.61	63.69		
42	Female	Tibia	L	1,706.76	67.20	67.20	5′ 7¼″
28	Male	Humerus	L	1,685.82	66.37	66.37	5′ 6½″
36	Male	Radius	R	1,690.86	66.57	66.39	5′ 6½″
		Ulna	R	1,682.83	66.21		

Table 28. Postcranial Metric Data for Infants and Children

Burial No.	***Age***	***Description of Measurement***	***Measurement (mm)***
35	1.4–2.8 years	L ilium length	64.46
		L femur maximum length	165.22
		L tibia maximum length	138.35
		L fibula maximum length	135.92
35	fetus–40 weeks	L radius maximum length	48.29
		L ulna maximum length	53.94

Two juvenile individuals had elements sufficiently intact to measure: one fetus/infant and one young child. The remaining infants and children did not have elements complete enough to measure. Individuals who were classified as adolescent are included in the adult metric data set. Each individual is listed in Table 28 with the age estimate, element, and measurement in mm.

6.5.3 Postcranial Nonmetric Data

Nonmetric variation was scored for 20 traits listed in Table 29. For the vertebral traits, these individuals showed no bridging on the atlas (0/19), no retroarticular bridge (0/4), no vertebral shifts either cranial or caudal (0/8) are present, the facet form for the atlas is normal (0/10), and accessory transverse foramen are absent (0/12).

Glenoid fossa extension (13/13), and circumflex sulcus (13/8) was absent. The accessory acromial facet was absent (normal) in 9 of 13 individuals and present in the other 4 (4/13). The suprascapular notch was present in two individuals (2/16). The septal aperture of the humerus can be expressed as a pinhole or a true perforation. In the present assemblage, 4.5 percent (1/22) were recorded as a true perforation and 4.5 percent as a pinhole (1/22) with the other 91 percent (20/22) as absent. The supratrochlear spur is absent (normal) in all of the sample (18/18). The ulna notch form includes 90.5 percent (19/21) as the hourglass (normal) expression and 9.5 percent are two facets (divided) (2/21).

Allen's fossa was present in one instance (1/6 or 16.7 percent), exostosis in the trochanteric fossa (0/5), third trochanter (0/8), and Poirier's facet are all absent in these individuals. In the patellae, there was one vastas notches noted (1/16). No distal tibia were complete enough to score for squatting facet. Squatting facet on the talus was nearly evenly split with 6/11 (54.5 percent) absent and 5/11 (45.5 percent) as present. The talar facet form on the calcaneus had two with an expression of two facets and the other 10 had one facet (normal).

Table 29. Nonmetric Postcranial Traits for Males, Females, and Adults of Indeterminate Sex

Trait/Variation	***Females (N)***		***Males (N)***		***Sex Ind (N)***		***Total‡ (N)***	
	n	***%***	***n***	***%***	***N***	***%***	***N***	***%***
Vertebrae								
Atlas Bridging*	3L/3R		2L/2R		2L/3R		19	
Left Absent (normal)	3	100	2	100	2	100	19	100
Left Complete	0	0	0	0	0	0		
Right Absent (normal)	3	100	2	100	1	33.3		
Right Complete	0	0	0	0	2	66.7		
Atlas Facet Form	2L/2R		2L/2R		1L/1R		10	
Left Absent (normal)	2	100	2	100	1	100	10	100
Left Double	0	0	0	0	0	0		
Right Absent (normal)	2	100	2	100	1	100		
Right Double	0	0	0	0	0	0		
Retroarticular Bridge	2		1		1		4	
Absent (normal)	2	100	1	100	1	100	4	100
Present	0	0	0	0	0	0	0	0
Accessory Transverse Foramen†	3L/3R		3L/3R		0		12	
Absent (normal)	6	100	6	100	0	0	12	100
Partial	0	0	0	0	0	0	0	0
Vertebral Shift	5		2		1		8	
No Shift	5	100	2	100	1	100	8	100
Cranial	0	0	0	0	0	0	0	0
Caudal	0	0	0	0	0	0	0	0
Scapula								
Suprascapular Notch/Foramen	3L/3R		1L/1R		3L/3R		16	
Absent	6	100	2	100	3	66.7	14	87.5
Notch	0	0	0	0	2	33.3	2	12.5
Foramen	0	0	0	0	0	0	0	0
Accessory Acromial Facet	2L/2R		2L/1R		3L/3R		13	
Absent (normal)	4	100	0	0	5	83.3	9	64.3
Present	0	0	3	100	1	16.7	4	28.6
Glenoid Fossa Extension	2L/2R		2L/1R		3L/3R		13	
Absent (normal)	4	100	3	100	6	100	13	100
Present	0	0	0	0	0	0	0	0
Circumflex Sulcus	1L/0R		2L/2R		2L/1R		8	
Absent (normal)	1	100	4	100	3	100	8	100
Present	0	0	0	0	0	0	0	0
Humerus								
Septal Aperture	6L/4R		3L/2R		4L/3R		22	
Left Absent (normal)	5	83.3	3	100	3	75	20	91.0
Left Pinhole	1	16.7	0	0	0	0	1	4.5
Left True	0	0	0	0	1	25	1	4.5

Trait/Variation	*Females (N)*		*Males (N)*		*Sex Ind (N)*		*Total[‡] (N)*	
	n	*%*	*n*	*%*	*N*	*%*	*N*	*%*
Right Absent (normal)	4	100	2	100	3	100		
Right Pinhole	0	0	0	0	0	0		
Right True	0	0	0	0	0	0		
Supratrochlear Spur	4L/5R		2L/2R		3L/2R		18	
Left Absent (normal)	4	100	2	100	3	100	18	100
Left Present	0		0	0	0	0	0	0
Right Absent (normal)	5	100	2	100	2	100		
Right Present	0	0	0	0	0	0		
Ulna Trochlear Notch Form	6L/4R		1L/2R		4L/4R		21	
Left Absent (normal)	6	100	1	100	3	75	19	90.5
Left Two Facets	0	0	0	0	1	25	2	9.5
Right Absent (normal)	4	100	2	100	3	75		
Right Two Facets	0	0	0	0	1	25		
Femur								
Allen's Fossa	2L/0R		0L/1R		2L/1R		6	
Left Absent (normal)	2	100	0	0	2	66.7	5	83.3
Left Present	0	0	0	0	1	33.3	1	16.7
Right Absent (normal)	0	100	1	100	2	100		
Right Present	0	0	0	0	0	0		
Poirier's Facet	1L/1R		0L/1R		2L/2R		7	
Left Absent (normal)	1	100	0	0	2	100	7	100
Left Present	0	0	0	0	0	0	0	0
Right Absent (normal)	1	100	1	100	2	100		
Right Present	0	0	0	0	0	0		
Third Trochanter	3L/3R		0L/1R		2L/1R		10	
Left Absent (normal)	3	100	0	0	2	100	10	100
Left Present	0	0	0	0	0	0	0	0
Right Absent (normal)	3	100	1	100	1	100		
Right Present	0	0	0	0	0	0		
Exostosis	1L/0R		0L/2R		2L/1R		6	
Left Absent (normal)	1	100	0	0	2	100	6	100
Left Present	0	0	0	0	0	0	0	0
Right Absent (normal)	0	0	2	100	1	100		
Right Present	0	0	0	0	0	0		
Patella Vastus Notch	7L/2R		1L/1R		3L/2R		16	
Left Absent (normal)	7	100	1	100	3	100	15	93.8
Left Present	0	0	0	0	0	0	1	6.2
Left Bipartite	0	0	0	0	0	0		
Right Absent (normal)	2	100	0	0	2	100		
Right Present	0	0	1	100	0	0		
Right Bipartite	0	0	0	0	0	0		

Trait/Variation	*Females (N)*		*Males (N)*		*Sex Ind (N)*		*Total‡ (N)*	
	n	*%*	*n*	*%*	*N*	*%*	*N*	*%*
Tibia Squatting Facet	0L/0R		0L/0R		0L/0R		0	
Left Absent (normal)								
Left Present								
Right Absent (normal)								
Right Present								
Talus Squatting Facet	2L/2R		3L/2R		1L/1R		11	
Left Absent (normal)	2	0	1	33.3	0	0	6	54.5
Left Present	0	0	2	67.7	1	100	5	45.5
Right Absent (normal)	2	100	1	50	0	0		
Right Present	0	0	1	50	1	100		
Calcaneus Talar Facet	3L/3R		2L/2R		1L/1R		12	
Left One (normal)	3	100	1	50	1	100	10	83.3
Left Two	0		1	50	0	0	2	16.7
Left Joined (hour-glass)	0		0	0	0	0	0	0
Right One (normal)	3	100	1	50	1	100		
Right Two	0		1	50	0	0		
Right Joined (hour-glass)	0		0	0	0	0		

* Lateral and Posterior combined
† C3–C7 combined
‡ Males/females/Ind and left/right combined

6.6 Dental Morphology and Pathologies

In Saipan, poor bone preservation from differential exposure to wet and dry environments and harsh limestone-based soil matrices are the norm, leaving skeletal remains brittle and fragmented as is the case in general in the Mariana's islands (Hanson and Butler 1997). Teeth are often the best-preserved portion of human skeletal remains, which makes them ideal specimens for study. Researchers have examined teeth to better understand genetic relatedness and health in Mariana's ancient population (Brace et al. 1990; Hanihara 1990; Heathcote 1994; Leigh 1930; Parr 2012; Turner 1990a, 1990b, 1992). This section describes the dental metric and nonmetric data recorded for the assemblage.

6.6.1 Dental Metric Data

Two standardized measurements were taken on each available tooth using Mitutoyo Digital calipers following *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994). The mesiodistal diameter (MD), or the length of the crown, was obtained by measuring the greatest distance between the mesial and distal portion of the tooth, as expected in proper anatomical position. The buccolingual diameter (BL), or the width of the crown, was obtained by measuring the width of the tooth, perpendicular to the mesiodistal plane, following the long axis of the tooth. All measurements were taken to the closest 0.01 mm and were not taken in teeth with extreme amounts of wear. The mesiodistal and buccolingual diameters were multiplied to attain the cross-sectional area (CX) of each tooth class, following Brace (1979, 1980). The left tooth was measured unless that tooth was not available, then the right was substituted. Tooth summaries (TS) were calculated following Brace (1979). The tooth summary is the sum of the upper and lower mean cross-sectional areas of each tooth category. This number allows for a comparison of mean tooth size between groups and represents an approximation of the total occlusal area of the population. The TS was calculated for males, females, individuals of indeterminate sex, and for the assemblage as a whole.

The measurable assemblage is composed of 306 teeth. There are more teeth from the females (n = 122) than males (n = 92), and 92 teeth are from individuals indeterminate to sex. Table 30 presents the mean, standard deviation, and range for the measurements MD, BL, and CX for the females, males, and individuals of indeterminate sex. The overall tooth summary for the assemblage is large, at 1,391.79 mm^2. Unexpectedly the tooth summary for the male dentition is the smaller (TS = 1,237.22 mm^2) than the female dentition, which is (TS = 1,470.79 mm^2). In males, the largest tooth is the mandibular first molar, with a cross-sectional area of 134.34 mm^2. The mandibular first molar is also the largest tooth in females with a cross-sectional area of 124.73 mm^2. Figure 81 to Figure 84 represent typical male and female dentitions.

Table 30. Dental Measurements on Permanent Dentition by Sex

Tooth	***Meas.***	***Female***				***Male***				***Indeterminate Sex***			
		N	***Mean***	***STD***	***Range***	***N***	***Mean***	***STD***	***Range***	***N***	***Mean***	***STD***	***Range***
Max M3	MD	7	9.77	1.76	7.2–11.68	5	11.27	0.84	10.06–12.12	3	10.04	0.95	9.37–11.10
	BL		10.61	1.76	7.18–11.84		10.50	1.23	9.62–10.59		11.25	2.53	8.60–13.64
	CX		105.15	29.11	51.70–137.00		117.68	8.01	106.62–126.76		111.70	19.17	95.46–132.85
Max M2	MD	8	11.18	0.85	10.16–12.82	5	9.25	0.62	8.38–10.11	9	10.74	0.91	9.74–11.50
	BL		11.07	1.16	8.67–11.66		11.00	1.35	8.94–11.59		11.59	1.38	8.89–13.64
	CX		123.17	9.43	113.49–130.87		101.16	6.61	90.38–106.05		124.28	16.89	95.57–156.18
Max M1	MD	8	10.71	0.76	9.31–11.36	7	11.12	0.70	10.05–11.97	9	11.15	1.08	9.84–13.45
	BL		11.14	0.97	9.87–12.35		11.86	0.67	10.76–12.58		11.52	1.17	9.36–13.08
	CX		117.55	16.01	93.94–138.94		131.91	11.01	120–50–151.77		128.57	18.48	101.55–164.63
Max PM2	MD	11	7.48	1.06	6.05–10.5	7	7.76	1.00	6.79–8.21	9	7.81	1.50	6.25–10.55
	BL		9.24	1.27	6.7–10.53		9.88	0.76	9.15–10.54		8.90	1.68	6.54–11.31
	CX		73.35	15.00	64.63–75.46		76.30	7.16	66.63–85.47		69.94	20.69	40.88–112.99
Max PM1	MD	11	7.39	1.26	5.42–9.58	8	7.78	0.86	6.96–9.62	6	7.17	0.84	6.21–8.43
	BL		9.20	1.13	7.27–10.42		9.93	0.82	9.34–11.40		8.28	1.66	6.37–10.67
	CX		67.25	9.89	48.45–80.55		77.07	9.58	65.85–93.94		59.76	15.59	39.56–71.43
Max C	MD	8	7.33	1.28	6.02–9.20	6	8.12	0.43	7.47–8.51	7	8.18	0.60	7.07–9.05
	BL	7	7.57	0.97	6.58–8.69		6.93	1.30	4.35–7.97		7.18	1.35	5.68–8.76
	CX	7	56.34	16.38	39.61–76.73		56.64	12.31	5.47–9.83		58.56	10.70	51.23–72.97

Tooth	Meas.	Female				Male				Indeterminate Sex			
		N	***Mean***	***STD***	***Range***	***N***	***Mean***	***STD***	***Range***	***N***	***Mean***	***STD***	***Range***
Max I2	MD	8	6.76	0.76	5.89–7.49	6	7.22	0.65	6.02–7.90	6	6.68	0.36	6.19–7.08
	BL		5.01	1.19	3.6–6.91		4.52	0.58	3.59–4.91		4.38	0.67	3.91–5.47
	CX		33.85	8.63	22.28–49.52		32.80	6.06	5.03–9.16		29.30	4.75	22.28–34.68
Max I1	MD	5	6.7	0.81	5.87–7.48	2	5.57	0.44	5.26–5.88	4	7.67	1.04	6.59–8.87
	BL		5.59	1.41	4.59–6.91		3.55	0.22	3.39–3.70		4.48	0.46	3.87–4.89
	CX		38.33	5.26	33.11–51.69		19.70	0.33	19.46–19.93		34.09	3.51	31.43–38.94
Man I1	MD	3	7.13	2.41	5.26–8.83	2	5.57	0.44	5.26–5.28	2	4.52	0.86	3.91–5.13
	BL		4.61	0.23	3.98–4.77		6.47	0.36	3.37–3.39		5.43	0.92	4.78–6.08
	CX		33.12	12.73	20.93–42.12		19.70	0.33	19.46–19.93		24.15	0.53	23.77–24.52
Man I2	MD	8	6.79	1.30	4.86–8.42	4	6.05	1.43	4.28–7.79	1	6.3		6.3
	BL	9	5.79	2.13	3.45–9.89		5.42	1.60	3.85–7.14		4.82		4.82
	CX	8	34.15	7.74	22.66–45.56		32.47	12.04	23.14–49.93		30.37		30.37
Man C	MD	8	6.98	0.47	6.25–8.20	5	7.21	0.86	5.79–8.06	3	6.97	0.26	6.77–7.27
	BL	8	6.99	1.83	4.61–9.18		5.82	1.45	3.97–7.78		6.55	0.86	5.67–7.39
	CX	7	47.63	12.36	32.54–63.07		42.04	12.93	28.74–62.71		45.67	6.48	38.39–50.70
Man PM1	MD	7	7.57	0.53	6.91–8.38	7	7.28	1.01	5.24–8.17	5	7.10	0.54	6.33–7.75
	BL		8.46	1.23	6.84–10.3		7.44	1.39	4.57–8.51		8.04	0.66	7.39–8.84
	CX		64.17	11.09	50.41–78.80		53.93	12.22	37.34–69.12		57.31	8.65	46.78–66.88
Man PM2	MD	8	7.71	1.44	5.94–10.27	6	7.57	0.73	6.14–8.06	7	7.48	0.65	6.36–8.35
	BL		7.86	0.80	6.48–8.73		8.38	1.04	6.50–9.42		8.30	1.03	7.28–9.75
	CX		60.65	12.23	38.49–75.79		63.55	10.87	49.27–71.71		62.26	10.99	51.44–81.41
Man M1	MD	8	11.42	0.43	11.05–12.3	7	12.07	0.86	10.89–13.04	9	12.43	0.38	11.99–13.12
	BL		10.93	0.79	10.39–12.39		11.12	0.71	10.02–11.58		10.93	0.67	9.60–11.74
	CX		124.73	9.21	117.44–133.23		134.34	14.28	117.03–154.76		135.95	12.02	125.23–154.03

Tooth	Meas.	Female				Male				Indeterminate Sex			
		N	Mean	STD	Range	N	Mean	STD	Range	N	Mean	STD	Range
Man M2	MD		11.01	0.43	10.33–11.92		11.46	1.06	10.40–13.20		11.60	0.93	10.42–12.65
	BL	9	10.42	0.69	9.23–11.48	5	11.02	0.67	10.37–12.04	8	11.03	0.60	9.88–11.85
	CX		114.57	6.43	101.23–127.20		126.33	13.77	125.22–149.29		128.12	13.94	104.93–149.90
Man M3	MD		9.85	1.02	8.57–11.03		11.20	0.81	10.06–11.34		10.77	0.83	9.70–11.51
	BL	6	11.01	1.36	8.64–12.98	5	10.52	1.23	99.9–12.06	4	10.54	0.28	10.25–10.85
	CX		107.72	9.61	75.17–118.68		117.12	7.54	106.62–133.56		113.63	11.37	100.59–124.88

Meas. = Measurement; STD = Standard Deviation; Max = Maxilla; Man = Mandible; MD = Mesiodistal; BL = Buccolingual; MD and BL in mm; CX = Cross-section (CX=MD*BL and is in mm^2)

Figure 81. Burial 59, female, typical maxillary dentition

Figure 82. Burial 8, female, partial mandibular dentition

6.6.2 Dental Nonmetric Data

Dental morphological trait analysis has been used on various populations around the world and at various magnitudes or levels of differentiation from global, regional, to local. There are several advantages to dental trait analysis: 1) teeth are durable and are typically the best-preserved portion of skeletal assemblages in the Marianas and elsewhere; 2) dental morphological traits possess a high genetic component; 3) except for attrition and caries, they do not change shape once formed; 4) they are less affected by the environment than bone; 5) they can be studied in both living and extinct populations; and 6) dental trait analysis does not require expensive equipment and can be done by one researcher to help minimize time and expense.

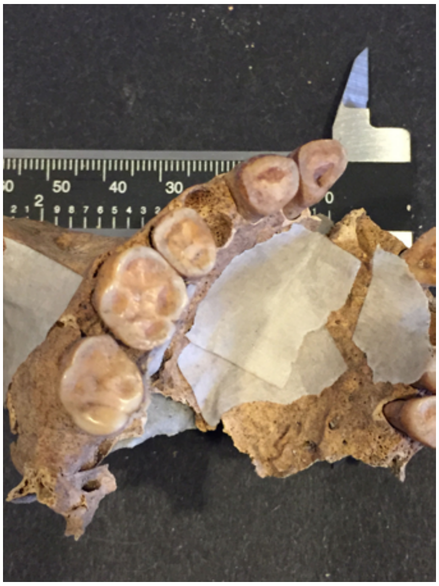

Figure 83. Burial 36, male, partial maxillary dentition

Figure 84. Burial 9, male, partial mandibular dentition

The current study used the ASU DAS, which offers a means of standardizing the recording of dental traits (Turner et al. 1991). The frequency of occurrence of each trait variation is calculated by determining the number of teeth, which display presence of the trait divided by the total number of teeth scorable for that trait. The breakpoints used here (the threshold of expression at which a trait is considered to be present) is based on each trait's morphological threshold (Haeussler et al. 1988) and follows standards used by other researcher's (Turner 1987, 1990a). The tooth chosen to represent the presence of a trait is dependent on the goals of the study. A trait like Carabelli's can occur on more than one member of a class of teeth. Usually only one tooth in the class is used to represent the occurrence of the trait in an individual. To facilitate use by future researchers, the suite of traits recorded for all teeth is presented in Table 31.

Teeth are normally similar, if not identical on the two sides, exhibiting a high degree of symmetry, but random size and shape differences between antimeric teeth (fluctuating asymmetry) does occur. In recording dental traits, both antimeres were scored, and the antimere exhibiting the greatest expression of the trait was used to represent the individual (individual count method). The reasoning behind this method is that the tooth exhibiting the greatest expression best represents the underlying genetic potential for that trait (Turner 1985).

Table 31. Dental Nonmetric Traits by Sex

Trait/Tooth	***Breakpoint / Total Range***	***Female***		***Males***		***Sex Indeterminate***		***Total***	
		%	***n/N***	***%***	***n/N***	***%***	***n/N***	***%***	***n/N***
Maxillary Traits									
Winging I1	1/1–4	0	0/5	100	1/4	0	0/4	7.7	1/13
Labial Curve I1	2–4/0–4	0	0/4	0	0/4	16.7	1/6	7.1	1/14
Shoveling I1	2–6/0–6	33.3	2/5	0	0/4	20	1/5	21.4	3/14
Shoveling I1	3–6/0–6	33.3	2/5	0	0/4	0	0/5	14.3	2/14
Shoveling I2	3–7/0–7	33.3	1/3	20	1/5	25	2/8	25	4/16
Dbl Shovel I1	2–6/0–6	20	1/5	50	2/4	20	1/5	28.6	4/14

Trait/Tooth	***Breakpoint / Total Range***	***Female***		***Males***		***Sex Indeterminate***		***Total***	
		%	***n/N***	***%***	***n/N***	***%***	***n/N***	***%***	***n/N***
Dbl Shovel I2	2–6/0–6	33.3	1/3	40	2/5	25	2/8	31.3	5/16
Interruption Groove I1	1–4/0–4	0	0/5	0	0/4	20	1/5	7.1	1/14
Interruption Groove I2	1–4/0–4	0	0/3	20	1/5	0	0/8	6.3	1/16
Tuberculum I1	2–6/0–6	20	1/5	50	2/4	0	0/5	21.4	3/14
Tuberculum I2	2–6/0–6	33.3	1/3	40	2/5	28.6	2/7	33.3	5/15
Tuberculum C	2–6/0–6	25	1/4	20	1/5	11.1	1/9	16.7	3/18
Mesial Ridge C	1–3/0–3	0	0/6	0	0/5	0	0/8	0	0/19
DAR C	2–5/0–5	20	0/5	20	1/5	0	0/7	5.9	1/17
Accessory Cusps P1	1/0–1	0	0/3	0	0/5	0	0/9	0	0/17
Accessory Cusps P2	1/0–1	0	0/3	0	0/5	0	0/11	0	0/19
Metacone M1	3–5/0–5	66.7	4/6	50	3/6	10	1/10	36.4	8/22
Metacone M2	3–5/0–5	40	2/5	0	0/6	10	1/10	14.3	3/21
Metacone M3	3–5/0–5	40	2/5	50	2/4	0	0/5	28.6	4/14
Hypocone M1	2–5/0–5	33.3	2/6	0	0/6	10	1/10	13.6	3/22
Hypocone M2	1–5/0–5	100	5/5	33.3	2/6	0	0/8	36.8	7/19
Hypocone M3	1–5/0–5	80	4/5	0	0/4	20	1/5	35.7	5/14
Metaconule M1	1–5/0–5	33.3	2/6	33.33	2/6	20	2/10	27.3	6/22
Metaconule M1	2–5/0–5	16.7	1/6	16.7	1/6	20	2/10	18.2	4/22
Metaconule M2	1–5/0–5	80	4/5	0	0/6	25	2/8	31.6	6/19
Metaconule M3	1–5/0–5	40	2/5	0	0/4	20	1/5	21.4	3/14
Carabelli’s M1	2–7/0–7	0	0/5	16.7	1/6	10	1/10	9.5	2/21
Carabelli’s M1	3–7/0–7	0	0/5	16.7	1/6	10	1/10	9.5	2/21
Carabelli’s M2	2–7/0–7	0	0/4	16.7	1/6	12.5	1/8	11.1	2/18
Carabelli’s M3	2–5/0–7	25	1/4	0	0/4	0	0/5	7.7	1/13
Parastyle M1	1–5/0–5	0	0/5	16.7	1/6	0	0/6	5.9	1/17
Parastyle M2	1–5/0–5	0	0/5	0	0/6	12.5	1/8	5.3	1/19
Parastyle M3	1–5/0–5	0	0/6	0	0/5	11.1	1/9	5	1/20
Enamel Extension M1	1–3/0–3	0	0/6	0	0/6	0	0/10	0	0/22
Enamel Extension M2	1–3/0–3	0	0/5	0	0/6	0	0/8	0	0/19
Enamel Extension M3	1–3/0–3	0	0/5	0	0/4	0	0/7	0	0/16
Root # P1	1/1–2	66.6	2/3	100	4/4	33.3	2/6	57.1	8/14
Peg Shaped I2	2/0–2	0	0/3	0	0/5	0	0/8	0	0/16
Peg-Reduced I2	1–2/0–2	0	0/3	0	0/5	0	0/8	0	0/16
Peg Shaped M3	2/0–2	0	0/5	20	1/5	0	0/5	0	0/15
Peg-Reduced M3	1–2/0–2	0	0/5	20	1/5	20	1/5	13.3	2/15
Congenital Abs UM3	1/0–1	0	0/5	20	1/5	0	0/5	6.7	1/15
Mandibular Traits									
Shoveling I1	2–3/0–3	0	0/3	50	2/4	100	1/1	37.5	3/8
Shoveling I2	2–3/0–3	0	0/6	25	1/4	50	1/4	14.3	2/14
DAR C	2–5/0–5	0	0/5	25	1/4	0	0/4	7.7	1/13
Cusp # P1	2–9/0–9	0	0/6	0	0/5	0	0/6	0	0/17
Cusp # P2	2–9/0–9	0	0/6	0	0/4	0	0/7	0	0/17

Trait/Tooth	Breakpoint / Total Range	Female		Males		Sex Indeterminate		Total	
		%	n/N	%	n/N	%	n/N	%	n/N
Tome's Root P1	2–5/0–5	0	0/3	0	0/5	0	0/5	0	0/13
Groove Pattern M1	Y/Y,X,+	77.8	7/9	20	1/5	62.5	5/8	59.1	13/22
Groove Pattern M2	Y/ X,+Y	40	4/10	20	1/5	12.5	1/8	26.1	6/23
Groove Pattern M3	Y/,Y,X,+	37.5	3/8	50	2/4	33.3	2/6	38.9	7/18
Cusp # M1	6/4–6	0	0/9	0	0/5	0	0/9	0	0/23
Cusp # M2	4/4–6	50	5/10	40	2/5	62.5	5/8	52.2	12/23
Cusp # M2	5–6/4–6	50	5/10	60	3/5	25	2/8	43.5	10/23
Cusp # M3	4/4–6	42.9	3/7	75	3/4	83.3	5/6	64.7	11/17
Deflect. Wrinkle M1	2–3/0–3	25	2/8	0	0/4	14.3	1/7	15.8	3/19
Deflect. Wrinkle M2	2–3/0–3	11.1	1/9	25	1/4	0	0/6	10.5	2/19
Deflect. Wrinkle M3	2–3/0–3	0	0/6	0	0/3	20	1/5	7.1	1/14
Trigonid Crest M1	1/0–1	0	0/9	0	0/5	0	0/9	0	0/23
Trigonid Crest M2	1/0–1	0	0/10	0	0/5	0	0/8	0	0/23
Trigonid Crest M3	1/0–1	0	0/7	0	0/4	0	0/6	0	0/17
Protostylid M1	1–7/0–7	25	2/8	20	1/5	11.1	1/9	18.2	4/22
Protostylid M2	1–7/0–7	28.6	2/10	0	0/5	12.5	1/8	13.0	3/23
Protostylid M3	1–7/0–7	28.6	2/7	25	1/4	0	0/6	17.6	3/17
Cusp 5 M1	3–5/0–5	44.4	4/9	40	2/5	33.3	3/9	39.1	9/23
Cusp 5 M2	3–5/0–5	20	2/10	40	2/5	0	0/8	17.4	4/23
Cusp 5 M3	3–5/0–5	14.3	1/7	25	1/4	0	0/6	11.8	2/17
Cusp 6 M1	2–5/0–5	11.1	1/9	40	2/5	22.2	2/9	21.7	5/23
Cusp 6 M2	2–5/0–5	30	3/10	20	1/5	25	2/8	26.1	6/23
Cusp 6 M3	2–5/0–5	14.3	1/7	25	1/4	20	1/5	18.8	3/16
Cusp 7 M1	1–4/0–4	11.1	1/9	0	0/4	11.1	1/9	9.1	2/22
Cusp 7 M1	2–4/0–4	11.1	1/9	0	0/4	11.1	1/9	9.1	2/22
Cusp 7 M2	1–4/0–4	0	0/10	0	0/5	0	0/8	0	0/23
Cusp 7 M3	1–4/0–4	14.3	1/7	0	0/4	0	0/6	5.9	1/17
Root # M1	3/1–3	0	0/4	0	0/3	20	1/5	8.3	1/12
Root # M2	1/1–3	0	0/5	0	0/2	0	0/3	0	0/10
Root # M3	1/1–3	0	0/4	0	0/1	0	0/4	0	0/9
Congenital Abs LM3	1/0–1	30	3/10	25	1/4	42.9	3/7	33.3	7/21

Dbl = Double; DAR = Distal Accessory Ridge; n = number present; N = number scored
Table has key trait/tooth combination and breakpoints. Breakpoint is the equivalent score where the trait is considered present. For example, shoveling has a potential of scores 0 to 6, and is considered present if the score is 2 to 6 (0 and 1 being absent for that trait).

6.6.3 Permanent Dentition

The current study recorded the following characteristics and pathologies on the dentition: attrition (wear on the teeth); occurrences of caries; linear enamel hypoplasia (LEH); abscesses; antemortem tooth loss; and calculus. The current sample from Parcel 004-1-52, San Antonio, Saipan, included 42 individuals that had some or all of their teeth. Of those 42 individuals, there are 17 females (40.5 percent), 16 individuals of indeterminate sex (38.1 percent) and 9 males (21.4 percent). The females had 185 teeth that were present (32.8 percent), the males had 175 teeth (31.0 percent), and individuals of indeterminate sex had 204 teeth (36.2 percent) for a total tooth count of 564. For the individuals of indeterminate sex, tooth count includes the permanent dentition from children. The deciduous dentition will be discussed below in this chapter.

Figure 85. Burial 28, male, view of LEH on incisors

6.6.4 Linear Enamel Hypoplasias

Enamel hypoplasias are deficiencies in tooth enamel that appear as horizontal linear grooves or pits, and are the result of a disruption in enamel formation (Goodman and Armelagos 1985). These defects are a permanent record of developmental disturbances due to growth-disruptive stressors. Although the exact cause is unknown, they reflect nonspecific physiological disruption that occurred during childhood as the tooth was developing. Enamel hypoplasias have been associated with factors such as fever, malnutrition, infection, trauma, and hereditary anomalies; thus, they are considered an indicator of a general stress event (Goodman and Rose 1991).

Only two individuals had teeth that exhibited LEH. Burial 28, male age 20–24, exhibited a clear line on 10 teeth. This included four uppers (left and right, first incisors and first molars) and six lower teeth (left and right, first and second incisors and first molars) (Figure 85). This disruption occurred between the ages of 2.5 to 3.5 years of age. Burial 10, male age 35–39, exhibited a clear line on one upper first incisor. This disruption appears to have occurred between the ages of 2.5 and 3.5 years of age. Considering only two individuals out of the 42 that had teeth, suggests a low frequency of occurrence. It is likely that most of the individuals in this assemblage did not experience severe stressors as children and they were healthy through the childhood years.

6.6.5 Carious Lesions

Carious lesions are the result of bacteria in the mouth, which causes enamel demineralization (Larsen 1983). The frequency of carious lesions is highly influenced by diet, and is associated primarily with foods that are rich in sugars and carbohydrates (Larsen 1983). Carious lesions were analyzed in individuals with erupted permanent dentition, which included the first molars in several of the children. Carious lesions were found in eight individuals with teeth present (18.6 percent) of the Parcel 004-1-52 individuals.

By individual, carious lesions were found in three females (3/43, 7.0 percent), three males (3/43, 7.0 percent), and two individuals of indeterminate sex (2/43, 4.7 percent) (Table 32). In terms of tooth count, the three females had four carious teeth, the seven males had six teeth with caries, and the individuals of indeterminate sex had two teeth with caries (Table 33). In general, there is a low percent of caries in this population. Further, carious lesions were typically seen on the occlusal surface, with few originating at the interproximal or the cervico-enamel junction. See Figure 86 for examples of carious lesions observed on the occlusal surface.

Table 32. Individual Occurrence of Carious Lesions by Sex

	Female		*Male*		*Indeterminate Sex*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Present	3	17.6	3	33.3	2	11.8	8	19.0
Absent	14	82.4	6	66.6	14	88.2	34	81.0
Total	17	40.5	9	21.4	16	38.1	42	100

Table 33. Tooth Count of Carious Lesions by Sex

	Female		*Male*		*Indeterminate Sex*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Present	4	2.2	6	3.4	2	1.0	12	2.1
Absent	181	97.8	169	96.6	202	99.0	552	97.9
Total	185	32.8	175	31.0	204	36.2	564	100

Looking at which teeth had carious lesions shows that it was relatively evenly split with upper molar 2 and lower canine having three carious lesions. There were two caries on the lower molar 1, 2, and 3. Upper dentition had three carious teeth and the remaining nine teeth were all on the lower dentition.

Figure 86. Burial 11, female, view of lower right molar 2 with large caries

6.6.6 Abscesses

The progression of dental caries is an important factor in the cause of dental abscesses. The progression of the carious lesions result in the introduction of bacteria in the pulp canal. 'Bacterial invasion produces rapid necrosis of the canal vasculature and soft tissues, extending the process to the root apex and surrounding trabecular bone, producing a periapical abscess' (Aufderheide and Rodríguez-Martín 1998:403). The abscess frequently penetrates the thin alveolar cortex, and it is typically seen in prehistoric populations as a penetrating hole (lytic response) with various stages of healing. Periodontal abscesses may occur in localized areas along with periodontal disease, but the infection is outside the pulp cavity. 'Abscess of the alveolar bone without evidence of caries involvement of the pulp cavity would be suggestive of periodontal abscess' (Ortner and Putschar 1985:442–443).

None of the individuals exhibited periapical abscesses that are characterized by a penetrating hole. There were several individuals that exhibited local alveolar resorption indicative of periodontal disease and these may be indicative of periodontal abscesses (see periodontal discussion below).

6.6.7 Antemortem Tooth Loss

Antemortem tooth loss can result from one or more factors. Severe attrition can result in carious lesions or abscesses with subsequent tooth loss. Carious lesions can lead to abscesses and periodontal disease, resulting in the loss of the tooth. Antemortem tooth loss can also be the result of purposeful extraction for

Table 33. Individual Count of Antemortem Tooth Loss by Sex

	a/O	%
Females	6/17	35.3
Males	3/9	33.3
Indeterminate	5/16	31.3
Total	12/42	28.6

a = affected; O = observed

Table 34. Individual Count of Antemortem Tooth Loss by Age

	a/O	%
Adolescence	0/5	0.0
Young Adult	2/12	16.7
Middle Adult	7/15	46.7
Older Adult	1/1	100
Adult	4/9	44.4
Total	12/42	28.6

a = affected, O = observed

various reasons. Betel-nut chewing is suspected as a predictor for periodontal disease and subsequent antemortem tooth loss (Aufderheide and Rodríguez-Martín 1998:402).

Antemortem tooth loss based on individual count by sex and age is presented in Table 33 and Table 34. There are 12 out of 39 (30.8 percent) individuals that lost one or more teeth prior to death. The rate of caries is low (18.6 percent) and thus the rate of tooth loss is higher than expected. Females had a higher rate of tooth loss than males (35.3 percent versus 33.3 percent). Tooth loss by age is generally consistent with expectations with the highest frequency for the older and middle adults followed by adults (20+ years), then young adults, and with no tooth loss for adolescents.

The data for antemortem loss by tooth are presented in Table 35 for this assemblage. Overall a greater number of lower teeth were lost antemortem than upper teeth (uppers: 8/296, 2.7 percent and lowers: 46/322, 14.3 percent). Molars are the tooth lost most. Females lost more teeth than the males and indeterminate sex individuals combined. There were three females of middle adult age that had lost all or nearly all of their teeth before death. This could be related to sex-specific tasks or food resources, but there is no evidence of either of these factors. The other possible reason for the difference by sex is the small sample size.

Table 35. Antemortem Tooth Loss by Tooth for the Parcel 004-1-52 Site Assemblage

Tooth	Female		Male		Sex Ind		Tooth	Female		Male		Sex Ind	
	a/O	%	a/O	%	a/O	%		a/O	%	a/O	%	a/O	%
ULM3	0/4	0.0	0/4	0.0	1/4	25.0	LLM3	1/7	14.3	1/5	20.0	1/5	20.0
ULM2	0/5	0.0	0/6	0.0	1/5	20.0	LLM2	1/9	11.1	1/8	12.5	1/7	14.3
ULM1	0/6	0.0	0/8	0.0	0/6	0.0	LLM1	2/13	15.4	1/7	14.3	1/9	11.1
ULPM2	0/4	0.0	0/7	0.0	0/8	0.0	LLPM2	1/8	12.5	2/10	20.0	0/7	0.0
ULPM1	0/5	0.0	0/6	0.0	0/7	0.0	LLPM1	2/9	22.2	2/7	28.6	0/8	0.0
ULC	0/5	0.0	0/6	0.0	0/8	0.0	LLC	2/13	15.4	0/4	0.0	0/6	0.0
ULI2	0/4	0.0	0/5	0.0	0/4	0.0	LLI2	1/11	9.1	0/5	0.0	0/4	0.0
ULI1	0/7	0.0	0/3	0.0	0/9	0.0	LLI1	0/4	0.0	0/3	0.0	1/3	33.3
URI1	0/3	0.0	0/5	0.0	1/6	16.7	LRI1	2/4	50.0	0/4	0.0	0/1	0.0
URI2	0/4	0.0	0/6	0.0	1/9	11.1	LRI2	2/8	25.0	1/5	20.0	0/3	0.0
URC	0/7	0.0	0/8	0.0	0/8	0.0	LRC	3/7	42.9	1/8	12.5	0/6	0.0
URPM1	0/8	0.0	0/8	0.0	1/9	11.1	LRPM1	3/7	42.9	0/7	0.0	0/6	0.0
URPM2	0/8	0.0	0/7	0.0	0/10	0.0	LRPM2	3/6	50.0	0/6	0.0	0/9	0.0
URM1	1/8	12.5	1/7	14.3	0/9	0.0	LRM1	3/7	42.9	1/8	12.5	0/10	0.0
URM2	0/6	0.0	0/5	0.0	0/8	0.0	LRM2	3/9	33.3	1/6	16.7	0/10	0.0
URM3	0/4	0.0	0/3	0.0	1/4	25.0	LRM3	2/7	28.6	0/4	0.0	0/6	0.0
Total	1/88	1.1	1/94	1.1	6/114	5.3	Total	31/129	24.0	11/93	11.8	4/100	4.0

a = affected; O = observed; Sex Ind = indeterminate sex

6.6.8 Calculus

Calcified plaque (called calculus) is commonly observed in prehistoric human remains. As teeth wear, gaps are opened up to the gingival tissues of the interdental spaces. Food becomes lodged in these spaces, and with chronic retention, bacterial growth occurs. Bacteria invade the tissues and begin to calcify to form calculus. This is the single most important factor in the development of periodontal disease (Aufderheide and Rodríguez-Martín 1998).

Table 36 presents the individual count for the occurrence of calculus by sex. The individual was counted present for calculus if one or more teeth had calculus present. The overall rate is moderate in this group with 35.7 percent (15/42) having at least one tooth with at least slight amounts of calculus. The occurrence of calculus is very similar for females and males as well as individuals of indeterminate sex.

Table 36. Individual Count of Calculus by Sex

	a/O	%
Females	5/12	41.6
Males	4/9	44.4
Indeterminate	6/16	37.5
Total	15/42	35.7

a = affected; O = observed

Table 37. Individual Count of Calculus by Age

	a/O	%
Adolescent	0/5	0.0
Young Adult	5/12	41.7
Middle Adult	4/15	26.7
Older Adult	1/1	100.0
Adult	6/9	66.7
Total	**16/42**	**38.1**

a = affected, O = observed

The individual count for the occurrence of calculus by age is presented in Table 37. As with Table 36, the individual is counted present for calculus if one or more teeth is observed with calculus. As expected,

Table 38. Calculus by Tooth for the Parcel 004-1-52 Site Assemblage

Tooth	***Female***		***Male***		***Sex Ind***		***Tooth***	***Female***		***Male***		***Sex Ind***	
	a/O	***%***	***a/O***	***%***	***a/O***	***%***		***a/O***	***%***	***a/O***	***%***	***a/O***	***%***
ULM3	1/4	25.0	1/4	25.0	1/3	33.3	LLM3	2/6	33.3	2/4	50.0	3/4	75.0
ULM2	3/5	60.0	3/6	50.0	1/4	25.0	LLM2	3/8	37.5	2/5	40.0	3/6	50.0
ULM1	3/6	50.0	3/8	12.5	1/6	16.7	LLM1	2/11	18.2	2/7	28.6	4/8	50.0
ULPM2	2/4	50.0	4/7	57.1	2/8	25.0	LLPM2	3/7	42.9	3/6	50.0	3/7	42.9
ULPM1	2/5	40.0	3/6	50.0	3/7	42.9	LLPM1	3/7	42.9	3/7	42.9	4/8	50.0
ULC	2/5	40.0	3/6	50.0	3/8	37.5	LLC	2/11	18.2	3/4	75.0	3/6	50.0
ULI2	2/4	50.0	3/5	60.0	3/4	75.0	LLI2	1/10	10.0	3/4	75.0	3/4	75.0
ULI1	2/7	28.6	1/3	33.3	2/9	22.2	LLI1	1/4	25.0	2/3	66.7	1/2	50.0
URI1	1/3	33.3	2/5	40.0	2/5	40.0	LRI1	0/2	0.0	2/3	66.7	1/1	100.0
URI2	2/4	50.0	3/6	50.0	3/8	37.5	LRI2	1/6	16.7	2/5	40.0	3/3	100.0
URC	3/7	42.9	4/8	50.0	3/8	37.5	LRC	0/4	0.0	2/4	50.0	3/6	50.0
URPM1	4/8	50.0	4/8	50.0	4/8	50.0	LRPM1	1/4	25.0	2/5	20.0	3/6	50.0
URPM2	5/8	62.5	3/7	42.9	4/10	40.0	LRPM2	1/3	33.3	4/8	50.0	3/9	33.3
URM1	3/8	37.5	3/6	50.0	4/9	44.4	LRM1	1/4	25.0	2/6	33.3	3/10	30.0
URM2	3/6	50.0	2/5	40.0	4/8	50.0	LRM2	2/6	33.3	3/7	42.9	3/10	30.0
URM3	2/4	50.0	1/3	33.3	1/3	33.3	LRM3	2/5	40.0	1/4	25.0	3/6	50.0
TOTAL	40/87	46.0	43/93	46.2	41/108	38.0	**TOTAL**	25/98	25.5	38/82	46.3	46/96	47.9

a = affected; O = observed; Sex Ind = indeterminate sex the adolescents do not have any calculus. Somewhat unexpected is the lower number of middle versus young adults that have calculus. This is likely a result of the higher number of middle adults that had antemortem tooth loss. These individuals likely had calculus but had lost those teeth.

Calculus was scored by tooth and by the degree of build-up; degree of build-up scores were slight, moderate, and severe. Presence/absence by tooth is presented in Table 38. Calculus was fairly evenly distributed between uppers and lowers and anterior and posterior teeth. Looking at the degree of calculus that was scored indicates that the majority (171/233, 73.4 percent) had moderate calculus present. Followed by a few with slight calculus (52/233, 22.3 percent) and with very few that had severe calculus (10/233, 4.3 percent). The remaining teeth (331 teeth) had no calculus present.

6.6.9 Periodontal Disease

Periodontal disease is commonly found in archaeological collections. Localized forms of periodontal disease correlate strongly with attrition and caries (Aufderheide and Rodríguez-Martín 1998). Calculus is the single most important factor in the development of periodontal disease (Aufderheide and Rodríguez-Martín 1998). In archaeological specimens, periodontal disease is manifested by the local or general alveolar resorption. If there is alveolar resorption but little or no evidence of caries or tooth loss, then a diagnosis of periodontal disease is appropriate (Ortner and Putschar 1985:443). As a simplified method of estimating the number of individuals that may have had local or general periodontal disease in the current investigation, the data on the presence of calculus are used as a proxy indicator.

As described in the above sections, the individuals in this assemblage have a low occurrence of caries (19.0 percent) and antemortem tooth loss was moderate with 28.6 percent. The number of individuals with some degree of calculus is a moderate amount (35.7 percent). The amount of alveolar resorption varied from slight to severe (Figures 87 to 89).

Figure 87. Burial 28, male, with slight alveolar recession on maxilla and mandible

Figure 88. Burial 8, female, with moderate alveolar recession on mandible

Figure 89. Burial 37a, female, with severe alveolar recession on mandible

However, the severe examples, such as seen on Burial 37a (see Figure 89), is primarily a result of antemortem tooth loss and not periodontal disease. Burial 8 (see Figure 88), mandible, exhibits a rolled rim characteristic of periodontal disease. There were 20 individuals with mandible or maxilla that were intact enough to assess the alveolar recession. Of these, four were slight, 10 were moderate, and six were severe. But as stated above, the severe examples are all related to tooth loss. Alveolar recession was found on nine females, seven males, and four individuals of indeterminate sex. Ages represented included two adolescents, two adults (20+), five young adults, 10 middle adults, and one older adult.

6.6.10 Dental Attrition

Dental attrition is normal wear from mastication and not a pathological condition. However, moderate to severe wear can lead to pathologies such as caries, abscesses, and antemortem tooth loss. Loss of the enamel surface of the tooth as a result of functional or cultural tooth uses reflects the lifelong history of the teeth. Dental attrition is scored in the permanent teeth of the assemblage on a scale reflecting no wear (1), enamel wear (2–3), dentine exposure (4–5), secondary dentine exposure (pulp) (6–7), and wear to the root (8). Attrition was not scored on damaged teeth.

To determine if there was patterning to the tooth wear, attrition for lefts versus rights was examined. No difference by side was noted as unusual, and sides were combined. Attrition for uppers versus lowers showed slight differences. For both males and females, there was slightly greater attrition on lower dentition than for uppers. As discussed above, there were a number of teeth lost antemortem, and it is

Table 39. Attrition by Tooth and Sex

Tooth	*Degree*	*Females*		*Males*		*Ind Sex*		*Total*	
		a/O	*%*	*a/O*	*%*	*a/O*	*%*	*a/O*	*%*
Molars	1	3/60	5.0	3/65	4.6	12/70	17.1	**18/195**	**9.2**
	2–3	12/60	20.0	6/65	9.2	7/70	10.0	**25/195**	**12.8**
	4–5	31/60	52.7	42/65	64.6	37/70	52.9	**110/195**	**56.4**
	6–7	12/60	20.0	10/65	15.4	7/70	10.0	**29/195**	**14.9**
	8	2/60	3.3	5/65	7.7	9/70	12.9	**16/195**	**8.2**
Premolars	1	0/44	0.0	0/51	0.0	3/52	5.8	**3/147**	**2.0**
	2–3	10/44	22.7	13/51	25.5	13/52	25.0	**36/147**	**24.5**
	4–5	14/44	31.8	28/51	54.9	25/52	48.1	**67/147**	**45.6**
	6–7	10/44	22.7	10/51	19.6	12/52	23.1	**32/147**	**21.8**
	8	0/44	0.0	0/51	0.0	0/52	0.0	**0/147**	**0.0**
Canines	1	0/24	0.0	0/22	0.0	1/24	4.2	**1/70**	**1.4**
	2–3	4/24	16.7	5/22	22.7	2/24	8.3	**11/70**	**15.7**
	4–5	14/24	58.3	12/22	54.5	13/24	54.2	**39/70**	**55.7**
	6–7	6/24	25.0	5/22	22.7	7/24	29.2	**18/70**	**25.7**
	8	0/24	0.0	0/22	0.0	1/24	4.2	**1/70**	**1.4**
Incisors	1	5/34	14.7	1/34	2.9	2/26	7.7	**8/94**	**8.5**
	2–3	6/34	17.6	8/34	23.5	6/26	23.1	**20/94**	**21.3**
	4–5	18/34	52.9	21/34	61.8	16/26	61.5	**55/94**	**58.5**
	6–7	7/34	20.6	2/34	5.9	2/26	7.7	**11/94**	**11.7**
	8	1/34	2.9	1/34	2.9	0/26	0.0	**2/94**	**2.1**

a = affected, O = observed; Ind = indeterminate not clear if these teeth had been severely worn prior to being lost. The loss of the teeth may have more to do with caries, abscesses, and periodontal disease than with severe attrition.

Combining lefts and rights, and uppers and lowers, Table 39 summarizes tooth attrition by tooth type and sex. The males and females have a similar degree of wear for all teeth. Several teeth were worn to the root; otherwise, most teeth have moderate (pulp exposure) attrition. In general, there is similar wear on the posterior teeth and anterior teeth.

6.6.11 Betel Nut Staining

The habitual use of the areca nut (*Areca catechu*) is common throughout Southeast Asia and the Western Pacific (Strickland 2002). In the Mariana Islands, the areca nut is usually combined with the betel leaf (*Piper betle*) and slaked lime (CaCO3) (Hanson and Butler 1997). This combination of ingredients is commonly lumped into the general category 'betel nut.' Betel nut chewing results in a light to dark brown staining in the maxillary and mandibular dentition (Hanson and Butler 1997). The practice of purposefully painting (staining or blackening) teeth has been documented in Asia, Micronesia, and Melanesia (Zumbroich 2011). It is possible that the staining on the teeth in this assemblage is a combination of the practice of chewing betel nut and of purposefully painting the teeth. The darkest stained and more uniformly stained teeth are anterior and on the labial surface (outer surface). Betel nut staining was found in almost all of the adult teeth for this group. Children appear to not chew or have their teeth painted and this may be part of a rite of passage at some point near young adulthood. Once a person became an adult, all seemed to practice this cultural modification. Both males and females had stained teeth.

6.6.12 Deciduous Dentition

The deciduous dentition was scored for caries, abscesses, and calculus. There were 22 juveniles in the sample with only seven children that had some or all of their deciduous teeth. No incidences of caries or abscesses were observed in the deciduous teeth of these children. Burial 27, an older child 8 to 10 years old, had slight calculus on the lower second, deciduous, molars. None of the deciduous teeth exhibited LEH on their deciduous dentition.

6.7 Skeletal Pathologies

The categories of pathologies recorded for human remains from this project include trauma, infectious diseases, congenital, and degenerative, as well as some of unknown etiology; each is described below. Table 40 below briefly summarizes the burials from this project and the skeletal pathologies noted. The pathologies observed are those that have been noted in other burial assemblages on Saipan and the Marianas. There are 28 individuals that exhibit some pathology or unusual trait. This is the Chamorro population and does not include the Japanese remains. The assemblage had 89 Chamorro individuals and this represents 31.5 percent of the individuals recovered. By far the most common pathology is osteoarthritis including degenerative joint disease (DJD) on the appendicular elements and vertebral osteoarthritis on the axial elements. The expression on the axial elements (vertebra) is noted in the table below as Vertebral Osteoarthritis (Vertebral OA) to easier count the individuals who have this pathology on axial or appendicular elements. There are 10 individuals that have some degree of DJD, four with Vertebral OA, and six with both for a total of 20 individuals. Two individuals have Schmorl's nodes, two have possible blunt force trauma on cranial elements, and two (counted above in DJD) possibly had a traumatic injury that resulted in DJD. There are two possible cases of treponemotosis (yaws), and three individuals with unknown infectious lesions. There is one conoid joint, three individuals with squatting facets, one with Pacchionian pits, one rhomboid fossae, two Steida's process, one with a fused middle and distal foot phalange, and two with enthesophytes at the Achilles tendon. Each of these are discussed further below.

Table 40. Skeletal Pathologies Summarized by Burial

Burial No.	*Age*	*Sex*	*Pathology Short Name*	*Description: Summary*
4	20+	Male	DJD	The left patella exhibits Stage 1 lipping along the edges of the lateral and medial facets. There is slight porosity with pitting and a small area of remodeling (area is 6.11 mm in diameter) on the medial aspect.
6	20+	Ind	DJD	Stage 1 lipping on the olecranon process along the trochlea notch of the left ulna.
7	35–40	Female	Vertebral OA	Stage 2, lipping on two of the mid-to-lower thoracic vertebrae on both the superior and inferior surfaces.
7a	30–50	Male	Other	Squatting facet on L talus. Steida's process on left talus.
9	40–44	Male	DJD and Vertebral OA	The 1st left and right proximal foot phalanges exhibited DJD, Stage 1 lipping, on the proximal articular surface. Stage 2, moderate lipping exhibited on the lower lumbar vertebrae on the inferior surface of the centrum.
10	35–39	Male	DJD and Vertebral OA	Both calcanei and tali exhibit DJD Stage 1, lipping on their corresponding articular surfaces. Stage 1, lipping on the proximal epiphysis of the olecranon notch and the margins of the trochlear notch of the left ulna. DJD, Stage 1, lipping on the radial tuberosity of the left radius. C-7 and T-1 exhibit DJD, Stage 1, slight to moderate lipping on the inferior aspect of the centra.
16	45–50	Female	DJD and Vertebral OA and Other	Pacchionian pits on the inner table of the left and right parietal. One intermediate phalanx and two distal foot phalanges exhibit DJD, Stage 1, lipping on the proximal articular surface. Lytic reaction on the articular surface on the right patella. DJD, Stage 1 exhibited on T1-9, posterior and superior surfaces.
18	20+	Ind	Congenital	Fused middle and distal foot phalange.
19	20+	Ind	DJD	Stage 1 DJD, lipping on the medial and lateral articular surfaces of the left and right talus.
23	20–35	Ind	Other	Squatting facet on the left and right talus. Rhomboid fossa on the left clavicle.
25	24–30	Female	Infectious	Possible treponematosis or infection of unknown etiology on the frontal.
28	20–24	Male	DJD and Other	Stage 2 lipping on the talus articular surface of both calcaneus. Enthesophytes at Achilles tendon and calcaneal spur. Squatting facets on both tali. Steida's process on the right talus.
30	30–50	Ind	Trauma and DJD and Vertebral OA	Atlas exhibits bony growth on the left side. Schmorl's nodes on superior aspect of T8-12. Stage 1 lipping along the glenoid fossa and acromion of the right scapula.
33	20+	Ind	DJD	Stage 2, extensive raised lipping, along the edges of the glenoid fossa of the left scapula especially along the lateral edge.
36	30–40	Male	Trauma and DJD and Vertebral OA and Other	Possible blunt force trauma on frontal. Possibly trauma related DJD on right 1st metacarpal and trapezium. Stage 2&3 lipping on thoracic and lumbar centrum. Stage 2 lipping on right ulna. Stage 2 lipping on right radius. Two rib bodies are fused possibly from trauma, or unknown etiology. Right acetabulum exhibits remodeling, possibly from trauma.
40a	13–16	Ind	Infectious	Possible treponemal infection or periosteal reaction exhibited on the left and right tibia at the anterior crest in the form of bowed shins.

Burial No.	*Age*	*Sex*	*Pathology Short Name*	*Description: Summary*
44	35–45	Male	Trauma	Possible traumatic injury on left frontal.
46	40–44	Female	DJD	Stage 1, slight lipping, on the distal articular surface of the left distal humerus along the margins of the trochlea and proximal articular surface of the left ulna. Both patellae exhibit DJD Stage 1, lipping on the posterior aspect, especially along the margin of the medial articular surfaces.
50	30–35	Male	Vertebral OA	Stage 1, lipping on the superior and inferior articular surfaces on the lumbar and lower thoracic vertebrae. Stage 2-3 on the lower thoracic and lumbar vertebrae. Severe lipping is also exhibited on the lower rib vertebral articular surfaces.
51	20+	Ind	Trauma or DJD and Other	Lytic reaction on the left 5th metatarsal, on the 1st metatarsal, and on three distal phalanges. Possibly DJD as a result of trauma. Enthesophytes on both calcanei at the Achilles tendon.
52	35–39	Female	Vertebral OA and Other	Stage 1, on the superior aspect of the centrum of the first lumbar vertebrae and eleventh and twelfth thoracic vertebrae. Pathology of unknown etiology. There is an extensive active periosteal reaction and remodeling of the right ulna, with an accompanying lytic reaction, that has affected the proximal end and superior aspect of the olecranon.
53	20–35	Ind	Other	Completely headed periosteal reaction on the fibula at the interosseous crest due to trauma or a localized pathology of unknown etiology.
59	20–24	Female	Trauma	Schmorl's nodes on the inferior and superior aspect of the lower thoracic and upper lumbar vertebrae.
60	35–45	Female	DJD and Vertebral OA and Infectious	Stage 1, slight lipping on the left and right distal tibiae and fibulae epiphyses along the margins of the articular surfaces. Possible infectious disease involving the ribs. Stage 1 slight lipping is exhibited on the centrum and superior articular surfaces of the lower thoracic and lumbar vertebrae.
63	20+	Ind	DJD and Other	The supracondylar ridge on the distal humerus fragments exhibits slight lipping. A possible conoid joint is on the left clavicle.
64	35–50	Ind	Vertebral OA	Stage 3, extreme lipping on the superior and inferior lumbar centrum.
65	20+	Ind	DJD	Small lytic reaction on the left radius head.
Isolate 4	20+	Ind	DJD	Stage 1 slight lipping on the muscle attachments on the palmar aspect of the right 4th metacarpal.

6.7.1 Trauma

Trauma and possible trauma were observed in five individuals. Trauma in cranial elements was noted in two individuals and these lesions may be blunt-force trauma resulting in a depression fracture. Burial 36, male 30-40 years of age, exhibits a periosteal reaction near the center of the frontal approximately 8–10 cm anterior of bregma that may be the result of blunt-force trauma. The lesion is well healed, exhibiting remodeling at the fracture location. The depression is linear, measuring approximately 12.00 × 3.97 mm. This individual also has DJD that may be a result of trauma in the right first metacarpal and trapezium, and well as fragments of two ribs fused together that may also be a result of trauma. Burial 44, male 35–45 years of age, exhibits a small circular lesion that has been obscured by a postmortem break. The circular portion of the lesion exhibits a small amount of remodeling but it is difficult to say how large the affected area was because of the newer break. The lesion may be a result of blunt-force trauma; the remodeling suggests the individual survived the trauma for a period of time.

Schmorl's nodes is included in the list with the trauma. The pathogenesis of Schmorl's nodes is thought to result from chronic stress from a variety of activities leading to herniation and destruction of the disk. This is traumatic in origin and is therefore included here. Schmorl's nodes were observed in two individuals. Burial 30, indeterminate sex 35–50 years of age, has Schmorl's nodes present on the superior aspect of thoracic (T) vertebra numbers 8–12. This individual also has bony growth on the left side of the atlas that could be a result of some traumatic event. Burial 59, female 20–24 years of age, has Schmorl's nodes on the inferior and superior aspect of the lower thoracic and upper lumbar vertebrae. This individual is very young to have this pathology, which suggests some severe traumatic event that must have occurred.

The last individual is Burial 51, indeterminate sex 20+ years of age, exhibiting an active lytic/periosteal reaction on the proximal epiphysis of the left 5th metatarsal. There is also a lytic reaction on the proximal end of the first metatarsal. The lytic reaction appears to have affected the medial aspect of the bone. Three distal foot phalanges exhibit remodeling on the proximal articular surface. All of these affected foot elements suggests some type of healed injury, the result of trauma to the foot.

6.7.2 Treponematosis (Yaws)

Treponemal infections include syphilis, bejel, and yaws. The *Treponema pallidum* bacterium has adapted to different environments, and in hot, humid climates like Saipan, yaws is the most common treponemal infection found. Yaws has been found to be endemic in the prehistoric populations in the Mariana Islands and is primarily a disease of childhood (Buckley and Tayles 2003; Steinbock 1976). The tibia, fibula, and femur are the elements most commonly affected. Other elements affected are the clavicle, humerus, radius, ulna, hands, and feet (Buckley and Tayles 2003; Ortner and Putschar 1985; Steinbock 1976). Differential diagnoses are tuberculosis, leprosy, and rheumatoid arthritis. Skeletal changes consistent with yaws include changes in the bone morphology, and a bowing of the diaphysis of an element can occur. Tibias often exhibit the saber-shin shape (boomerang leg), a typical characteristic resulting from treponemal infection. Periosteal bone growth on the cortical surface of a skeletal element (periostitis) is the initial stage of yaws. These early lesions of yaws can heal completely without leaving observable bone changes. Cortical thickening and narrowing of the medullary canal occurs in more advanced cases of the disease. Late-stage yaws can be quite destructive and can have severe gummatous periostitis and osteomyelitis (Ortner and Putschar 1985), as well as caries sicca on the skull.

Two individuals are suspected of having yaws. In Burial 40a, a subadult (13–16 years of age) of indeterminate sex, the left and right tibia exhibit bowed shins. True bowing is associated with subadult treponematosis. Subadult treponematosis usually begins before 15 years of age and usually involves other skeletal elements, particularly other long bones and the hands (Aufderheide and Rodriquez-Martin 2003:155–157; Ortner 2003:274–275). Burial 40a is estimated to be between 13 and 16 years of age and fits the common age for treponematosis to form and result in the bowed shins. Alternatively, the bowed shins could be pseudo-bowing, the result of a periosteal reactive bone formation on the medial and anterior surfaces of the tibia. Pseudo-bowing tends to be associated with changes occurring in adults. None of the other bones of this individual exhibited evidence of treponematosis, however very few bones were recovered with this individual and a definitive diagnosis is not possible. The other individual is Burial 25, female age 24–30. The frontal exhibits multifocal lesions consistent with a granulomatous destructive condition. The lesions consist of depressed foci with stellate lines radiating from the central focus of destruction that resulted in a bumpy outer table. The inner table was not affected. The affected area extends from the coronal suture to glabella, and is primarily on the right side of the frontal. There is no involvement of the inner table and the lesions are limited to the outer table, also indicative of possible treponematosis (Ortner 2003). It should be noted that none of the other skeletal elements recovered with this individual exhibited evidence of treponematosis. Yaws is one possible diagnosis for this pathology, but it may be the result of unknown etiology.

6.7.3 Osteoarthritis

This disorder is a chronic and progressive pathology that is the result of the direct contact of bone joint surfaces. The bone-on-bone movement results in the growth of new bone, which is easily identified in archaeological specimens. This disorder is generally visible in individuals that are 40 years and older. Secondary causes of osteoarthritis include trauma, infection, metabolic disorders, and occupation-related stress (Aufderheide and Rodríguez-Martín 1998). For this report, the discussion of osteoarthritis has been separated into vertebral osteoarthritis (vertebral OA) and DJD, which was observed on appendicular elements. For this report, vertebral OA includes osteophytosis (osteophytic growth on the centra) and osteoarthritic changes on the articular facets.

6.7.4 Vertebral Osteoarthritis

There are 10 burials that had some expression of vertebral OA. Burial 30 was discussed above with bony growth on the atlas that may have been from trauma. Burial 10 had slight (Stage 1) bony growth on the seventh cervical and first thoracic. The other eight individuals have slight to severe OA on the middle to lower thoracic and lumbar vertebrae. All individuals were 30 years of age or older and most of the expression was bony spicules growing from the centra. Of the 10 individuals, there were four females, four males, and two individuals of indeterminate sex. This is a disease that did not favor one sex over the other. Both likely lead active lives that resulted in the expression of this pathology.

6.7.5 Degenerative Joint Disease

There were 16 individuals that had DJD of one or more elements. Table 41 below summarizes the burial, sex, age, and elements that had some DJD. The elements listed represent general areas of the body and not necessarily the specific element, such a knee instead of patella, ankle for calcaneus or talus, etc. These individuals were 20 years of age or older and include three females, six males, and seven of indeterminate sex. The general area of the body with the most DJD is the elbow, followed by the knee, foot and ankle, hand and shoulder, and last one hip. Motions with the arm resulting in stress at the elbow appear to result in the most DJD. This is closely followed by activities that stress the ankle and foot.

Table 41. Burials with DJD, Parcel 004-1-52

Burial	*Sex*	*Age*	*Element(s)*
4	Male	20+	Knee
6	Ind	20+	Elbow
9	Male	40–44	Foot
10	Male	35–39	Ankle and elbow
16	Female	45–50	Foot and knee
19	Ind	20+	Ankle
28	Male	20–24	Ankle
30	Ind	30–50	Shoulder
33	Ind	20+	Shoulder
36	Male	30–40	Hand, elbow, and hip
46	Female	40–44	Elbow and knee
51	Ind	20+	Foot
60	Female	35–45	Knee
63	Ind	20+	Elbow
65	Ind	20+	Elbow
Isolate 4	Ind	20+	Hand

6.7.6 Pathologies of Unknown Etiology and Other Conditions

This section covers an array of pathological conditions that include Pacchionian pits, squatting facets, abnormalities such as Steida's process, conoid joint, and fused foot phalanges. Most of these occur on one or only a few individuals. The last section discusses occipital superstructures on the skull.

6.7.7 Pacchionian Pits

Lacunae laterales are usually large depressions that occur post-bregma and have smooth borders. Pacchionian pits are small and often clustered, have sharp margins, and can occur on the parietals and frontal. Lacunae laterales house arachnoid granulations, and Pacchionian pits are caused by the erosion of arachnoid granulations. Arachnoid granulations filter cerebrospinal fluid. The pits and depressions increase in size and number with increasing age. The underlying reason for the erosion of the inner cranial vault by the arachnoid granulations is not known (Mann and Hunt 2005). Burial 16 a female age 45–50 that has Pacchionian pits on the inner table of the left and right parietal.

6.7.8 Squatting Facets

The talus is an especially common location to observe squatting facets. The squatting facets appear as an oval-shaped extension on the superior surface of the bone and often are also observed on the distal tibia. In the current collection, the distal tibia did not survive well and squatting facets were only observed on the talus. Squatting facets are a result of the hyperdorsiflexion attributed to prolonged activity in a squatting position that strains the foot. Squatting facets on the metarsals have been recorded on remains from Guam and are likely the result of hyperflexion of the metatarsal-phalangeal joint. One theory is that this occurs during the scaling of coconut palms (Hanson 1988). Other possibilities would be any activity that requires the toes to be flexed, perhaps in a squatting or kneeling position.

There were three burials observed with squatting facets. Burial 7a, male 30–50 years of age, had a squatting facet on the left talus. This talus also had a Steida's process, which is discussed below. Burial 23, an individual of indeterminate sex age 20–35, had squatting facets on the left and right tali. Burial 28 is a male age 20–24 that had squatting facets on both tali. This individual also had enthesophytes at the Achilles tendon, a calcaneal spur, and DJD on the articular surface of the calcaneus and tali. There is also a Steida's process on the tali. All of this suggests vigorous activity involving the feet, especially given this person's young age.

6.7.9 Unknown Etiology

Burial 63, an individual of indeterminate sex age 20+, has a facet that is a possible conoid joint. This occurs on the left clavicle at the attachment for the deltoid. This is a normal variant of the clavicle that is described by Scheuer and Black (2000:260) as follows:

> In the case of a diarthrodial articulation, a triangular bony outgrowth arises from the inferior surface of the clavicle, which meets a similar-shaped outgrowth from the upper surface of the coracoid.... This condition can cause some pain and limitation of movement in the shoulder joint, as well as numbness or tingling in the upper limb due to neurovascular involvement.

The Steida's process is an elongated tubercle, which is considered to be an anatomical variant and when separated from the body of the talus is referred to as an os trigonum. Steida's process is caused when the secondary ossification center fuses with the rest of the talus and usually occurs between 7 and 13 years of age (Mann and Hunt 2005). There are two burials that exhibit this anomaly, Burial 7a (male 30–50 years) and Burial 28 (male 20–24 years).

A fused middle and distal foot phalange was recorded for Burial 18, an individual of indeterminate sex 20+ years old. Enthesophytes at the Achilles tendon were recorded for Burials 28 (male 20–24) and Burial 51 (indeterminate sex age 20+). Burial 52, female age 35–39, had a pathology of unknown etiology. There is an extensive active periosteal reaction and remodeling of the right ulna, with an accompanying lytic reaction, that has affected the proximal end and superior aspect of the olecranon. The affected area exhibits porosity and remodeling with large pits, the posterior aspect also exhibits porosity and large pits and lipping along the margins of the posterior articular surface. The trochlear notch exhibits lipping along the margins of the articular surface. The radius and distal humerus are missing so it cannot be determined if other elements were affected. Burial 53, an individual of indeterminate sex age 20–35, has a completely healed periosteal reaction on the fibula at the interosseous crest due to trauma or a localized pathology of unknown etiology.

6.7.10 Occipital Superstructures

A protocol for scoring occipital superstructures was proposed by Heathcote et al. (1996) and was followed in the current study. These scores are taken at three sites: the tubercle on the occipital torus (TOT), the retromastoid process (PR), and the posterior supramastoid tubercle (TSP). Marked expressions of the superstructures at these locations are phenomena that appear to be related to populations only in Oceania. One theory for the marked expression in the Marianas' populations and in the Latte peoples specifically involves strenuous activities involved in stoneworking (cutting, dressing, moving, and erecting the megaliths) (Heathcote et al. 1996). However, in a more recent examination of the occipital superstructures, Heathcote et al. (2014) suggest that this interpretation may be simplistic and that more factors may be at work resulting in the expression of these traits. The appearance of the superstructures suggests that occipital superstructure development is essentially fibrocartilaginous at enthesis sites, and activity may be a proximate cause in genetically predisposed individuals (Heathcote et al. 2014:1019).

Four burials were recorded as having the TOT present and moderately to marked expression of this trait. See Appendix A for photographs of this trait. The burials with this trait include Burial 30 (indeterminate sex 35–50 years of age), Burial 33 (indeterminate sex 20+ years old), Burial 44 (male 35–45 years of age), and Burial 65 (indeterminate sex 20+ years old).

6.8 Mortuary Analysis

The work associated with the archaeological investigation for Parcel 004-1-52 in the village of San Antonio project area included the discovery and excavation of the human remains. The human remains were prehistoric Chamorro and WWII, probably Japanese, individuals and this mortuary analysis will examine the Chamorro individuals only. This chapter will examine the patterns of the burials in terms of location within the site and with information on age, sex, orientation, placement, and grave goods for each burial. Location of the burials in the project area is shown in Figure 90. The burial information is summarized in Table 42.

A cluster analysis was performed to identify spatial units using a k-means algorithm in the ArcGIS program. The k-means algorithm is set to minimize the average squared distance between points in the same 'cluster.' This was run to show how the data clustered using two to 15 groups. These plots were examined and the optimum number of groups was selected, which for this assemblage was eight. Using that set number of groups, the program was then run 10 times. The patterns produced would vary in each of the 10 sets, with some groups remaining fairly constant in each run. This program is a heuristic tool and does not have 'one' correct result. Further, the program puts all points into a cluster, creating some spatially large groups. We arrived at the end result by looking at which burials routinely clustered together, and then removing some of the points (burials) that were too distant to be meaningful. The clusters are referred to as analysis areas (AAs). There are a number of burials that were isolated and randomly scattered across the area of investigation. Given the amount of previous disturbances, both prehistorically and more recently, it is no wonder that there would be isolated burials.

Table 42. List of Burials including Age, Sex, Orientation, Placement, Position, and Grave Items

Burial No.	***Estimated Age (years)***	***Estimated Sex***	***Orientation****	***Placement***	***Position***	***Facing***	***Burial Goods***	***Analysis Area***
42	Adolescent (12–20)	Female	southeast	extended	supine	N/A	none	1
46	Middle Adult (40-44)	Female	northeast	extended	supine	N/A	none	1
47	Middle Adult (35–39)	Female	N/A	N/A	N/A	N/A	none	1
52	Middle Adult (35–39)	Female	N/A	extended	supine	N/A	none	1
54	Young Adult (17–24)	Female	N/A	N/A	N/A	N/A	none	1
49	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	1
51	Adult	Indeterminate	N/A	extended	supine	N/A	none	1
53	Young Adult (20–35)	Indeterminate	N/A	N/A	N/A	N/A	none	1
55	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	1
56	Young Adult (20–25)	Indeterminate	N/A	extended	N/A	N/A	none	1
48	Young Adult (25–39)	Male	southwest	extended	supine	N/A	none	1
50	Young Adult (30–35)	Male	northeast	N/A	right side	north-west	none	1
3	Young Adult (20–35)	Female	N/A	N/A	N/A	N/A	none	2
2	Child (3–5)	Indeterminate	N/A	N/A	N/A	N/A	none	2
1	Young Adult (17–25)	Male	N/A	N/A	N/A	N/A	none	2
6	Adult	Indeterminate	N/A	N/a	N/A	N/A	none	3
4	Adult	Male	N/A	N/A	N/A	N/A	spear point	3
9	Middle Adult (35–50)	Male	N/A	N/A	N/A	N/A	none	3
59	Young Adult (20–24)	Female	northeast	extended	supine	west	none	4
60	Middle Adult (35–45)	Female	northeast	extended	supine	N/A	none	4
58	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	4
61	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	4
24	Middle Adult (35–39)	Female	N/A	N/A	N/A	N/A	none	5
25	Young Adult (20–30)	Female	N/A	N/A	N/A	N/A	none	5
26	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	5
27	Child (8–10)	Indeterminate	N/A	N/A	N/A	N/A	none	5
29	Young Adult (30–35)	Female	N/A	N/A	N/A	N/A	none	6
31	Young Adult (24–30)	Female	N/A	N/A	N/A	N/A	none	6
37	Middle Adult (35–50)	Female	west	semi-flexed	supine	up	none	6

Burial No.	***Estimated Age (years)***	***Estimated Sex***	***Orientation****	***Placement***	***Position***	***Facing***	***Burial Goods***	***Analysis Area***
38	Adolescent (18–22)	Female	west	extended	supine	up	none	6
22	Young Adult (17–25)	Indeterminate	N/A	N/A	N/A	N/A	none	6
30	Middle Adult (30–50)	Indeterminate	N/A	N/A	N/A	N/A	none	6
33	Adult	Indeterminate	east	extended	supine	east	none	6
34	Child (3–6)	Indeterminate	N/A	N/A	N/A	up	none	6
35	Infant (<2)	Indeterminate	N/A	N/A	N/A	N/A	none	6
39	Adolescent (12–20)	Indeterminate	N/A	N/A	N/A	N/A	none	6
40	Adult	Indeterminate	south	extended	supine	N/A	none	6
41	Adolescent (12–18)	Indeterminate	southeast	extended	supine	N/A	none	6
45	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	6
28	Young Adult (20–24)	Male	north	extended	supine	south	none	6
32	Old Adult (50+)	Male	east	extended	supine	south	none	6
36	Middle Adult (30–40)	Male	east	extended	supine	west	*Spondylus* bead	6
44	Middle Adult (35–45)	Male	N/A	N/A	N/A	N/A	coral bead	6
8	Middle Adult (34–39)	Female	east	extended	supine	N/A	none	7
11	Middle Adult (35–50)	Female	N/A	N/A	N/A	N/A	none	7
16	Middle Adult (45–50)	Female	N/A	N/A	N/A	N/A	none	7
14	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	7
19	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	7
10	Middle Adult (35–39)	Male	north	extended	supine	up	none	7
7	Middle Adult (35–40)	Female	N/A	N/A	N/A	N/A	none	8
12	Middle Adult (40–50)	Female	N/A	N/A	N/A	N/A	none	8
5	Young Adult (18–25)	Indeterminate	N/A	N/A	N/A	N/A	none	8
17	Middle Adult (35–40)	Indeterminate	N/A	N/A	N/A	N/A	none	8
18	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	8
62	Child (2–6)	Indeterminate	N/A	N/A	N/A	N/A	none	8
63	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	8
64	Middle Adult (30–40)	Indeterminate	N/A	N/A	N/A	N/A	none	8
65	Adult	Indeterminate	N/A	N/A	N/A	N/A	none	8

* Orientation indicates the position of the head relative to the post-cranial elements and is oriented along the spine.

Table 43. Density of Burials within Each Analysis Area

Analysis Area	*Size (m²)*	*No. of Burials*	*Density (burials/ meter)*
1	260	12	0.05
2	36	3	0.08
3	68	3	0.04
4	595	4	0.01
5	102	4	0.04
6	356	17	0.05
7	1,018	6	0.01
8	875	9	0.01
Total		58	

Note: The number of burials includes the main field-numbered burial only and not all the comingled individuals.

Table 43 presents the size (m²) of each cluster, number of burials, and density of burials in each cluster. The largest cluster is AA 6 at 1,018 m² and the smallest is AA 2 at 36 m². The densest AA is also AA 2 with 0.08 burials per m². AAs 1, 3, 5, and 6 are very similar in density with 0.04 and 0.05 burials per m². The clustering of burials is similar to patterns observed in the Latte period, which have been considered by researchers to represent burial beneath and around *latte* sets (Butler 1988; Davis et al. 1992; Ray 1981; Reinman 1977; Ryan 2010; Ryan et al. 1999; Spoehr 1957; Stodder et al. 2016; Thompson 1971; Yawata 1961). Currently, there is no archaeological indication of *latte* sets in the area excavated during this project. Figure 6.18 to Figure 6.22 show each AA and the burials with sex, orientation, and position indicated when known.

Table 44. Subadult to Adult Frequency within Each Burial Cluster Area

Analysis Area	*Subadult*		*Adult*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*
1	1	8.3	11	91.7	**12**	**20.7**
2	1	33.3	2	66.7	**3**	**5.2**
3	0	0.0	3	100	**3**	**5.2**
4	0	0.0	4	100	**4**	**6.9**
5	1	25.0	3	75.0	**4**	**6.9**
6	5	29.4	12	70.6	**17**	**29.3**
7	0	0.0	6	100	**6**	**10.3**
8	1	11.1	8	88.9	**9**	**15.5**
Total	**9**	**15.5**	**49**	**84.5**	**58**	**100**

The following two tables examine the frequency of individuals by age and sex (Table 44 and Table 45). Subadults were present in AAs 1, 2, 5, 6, and 8. The presence of both adults and subadults as well as males and females supports the idea that most of these clusters represent family or kinship units.

Table 45. Frequency of Females, Males, and Indeterminate Sex for Each Analysis Area, Parcel 004-1-52, San Antonio

Analysis Area	*Female*		*Male*		*Ind*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
1	5	41.7	2	16.6	5	41.7	**12**	**20.7**
2	1	33.3	1	33.3	1	33.3	**3**	**5.2**
3	0	0.0	2	66.7	1	33.3	**3**	**5.2**
4	2	50.0	0	0.0	2	50.0	**4**	**6.9**
5	2	50.0	0	0.0	2	50.0	**4**	**6.9**
6	4	23.5	4	23.5	9	52.9	**17**	**29.3**
7	3	50.0	1	16.7	2	33.3	**6**	**10.3**
8	2	22.2	0	0.0	7	77.8	**9**	**15.5**
Total	**19**	**32.8**	**10**	**17.2**	**29**	**50.0**	**58**	**100**

Ind = Indeterminate sex which includes juveniles.

The frequencies of females and males in each burial cluster area are shown in Table 45. Most of the AAs have both females and males, but there are four that have only males or females, although these groups do have a number of individuals of indeterminate sex. It is possible that some of the clusters are single-sex residence units. Both sexes and all age groups are represented. Carr (1995) noted that location of the burial within the cemetery reflects horizontal social position (group affiliation), primarily the deceased kin group. Kinship

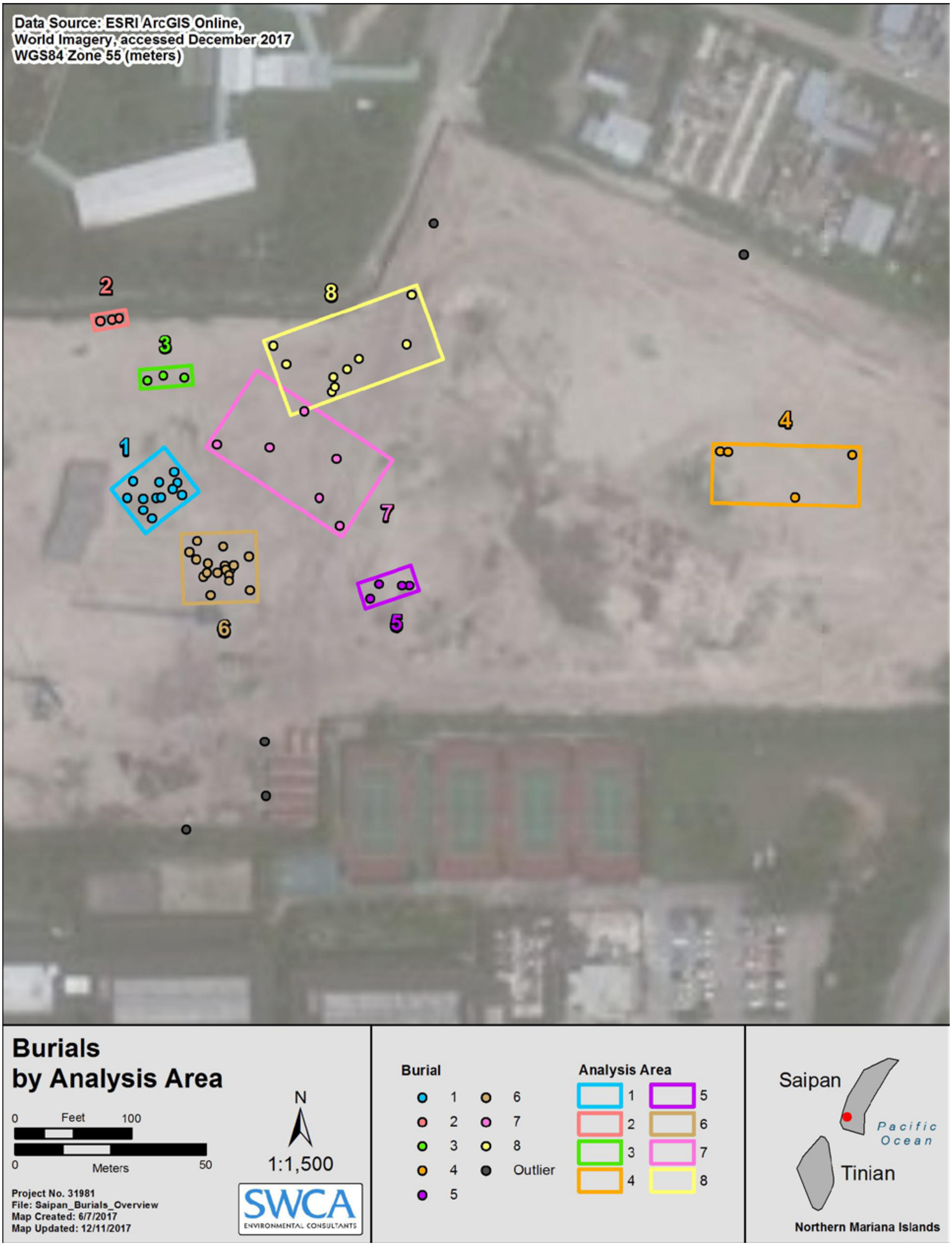

Figure 90. Location of the burials recovered in the project area

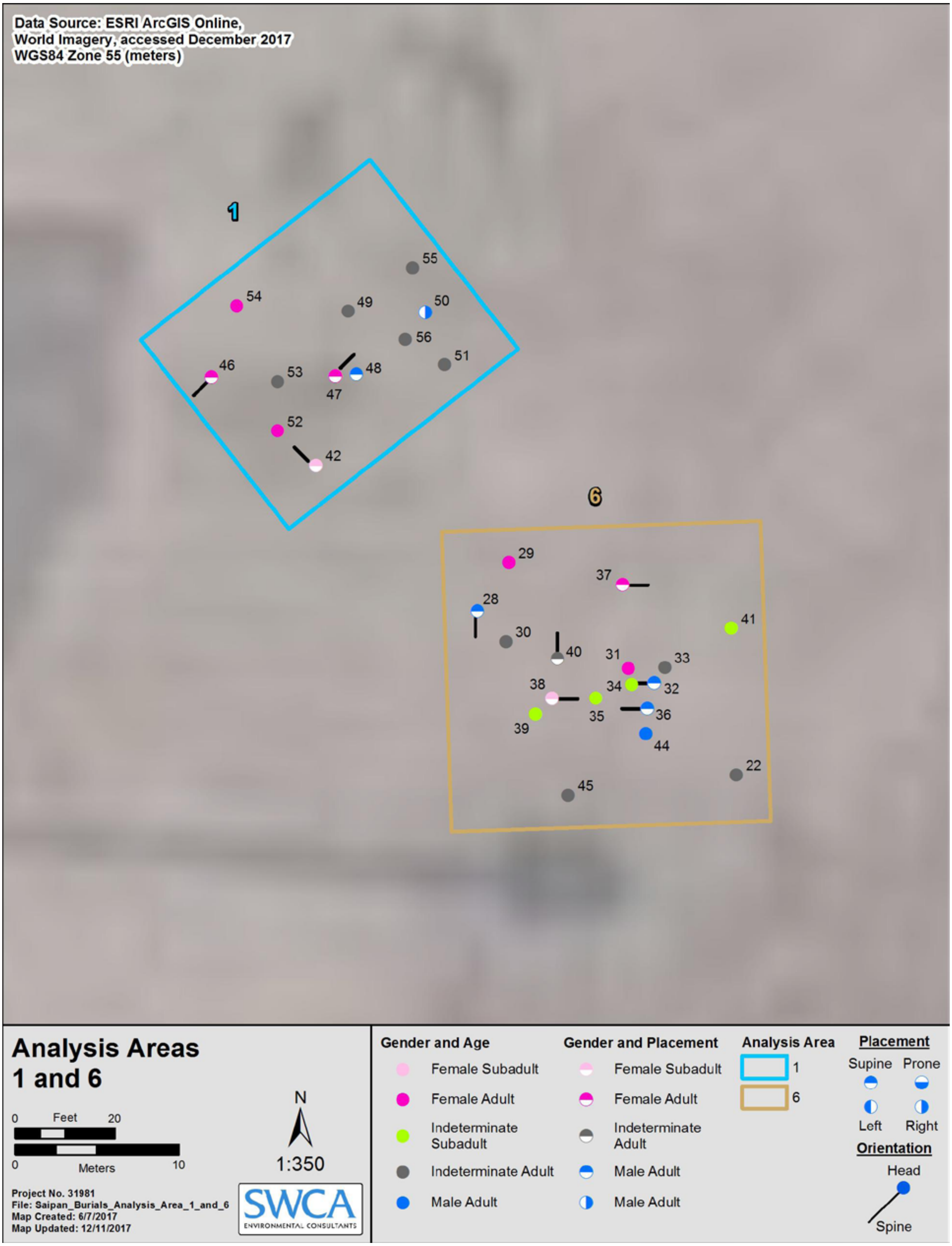

Figure 91. Burials in analysis areas 1 and 6

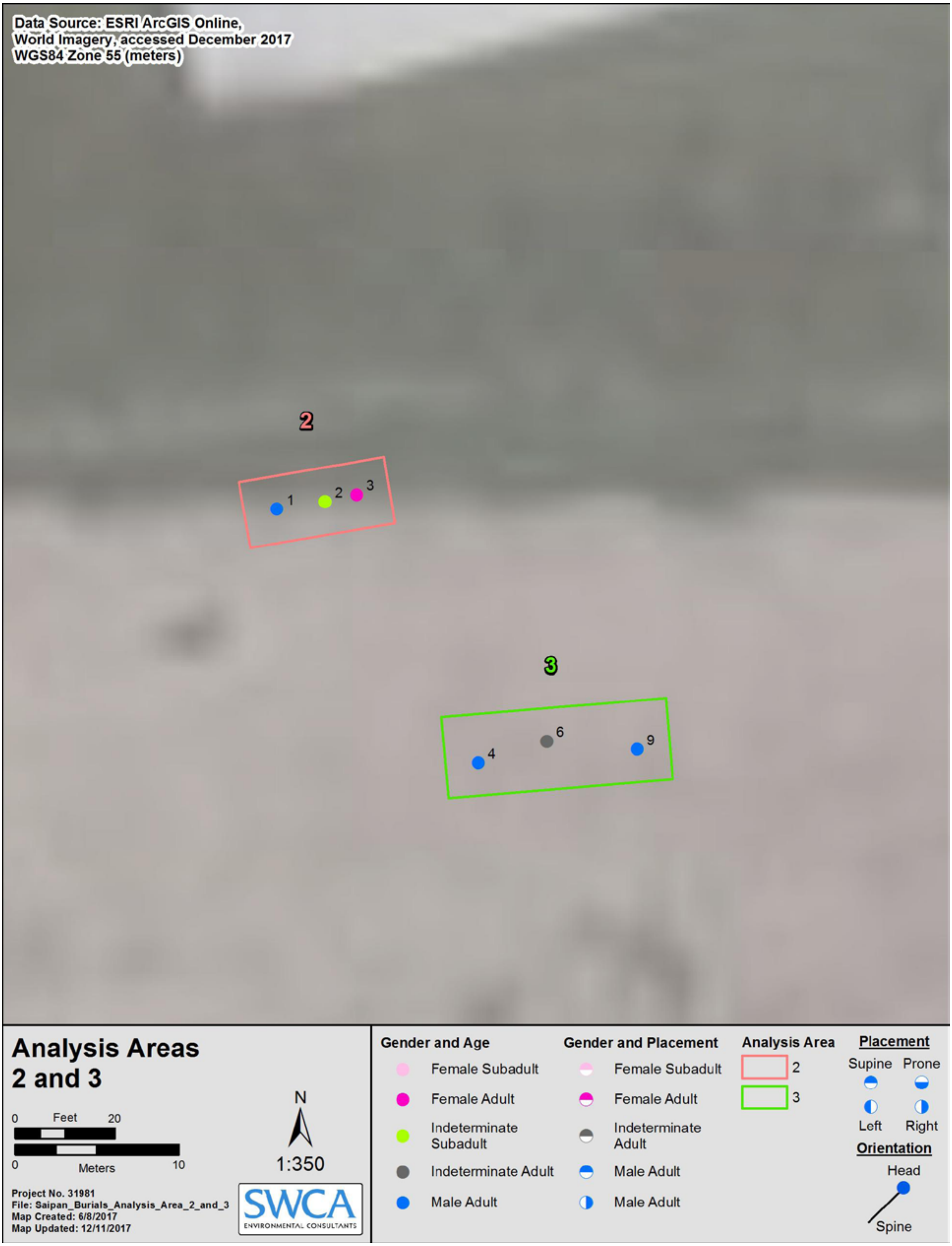

Figure 92. Burials in analysis areas 2 and 3

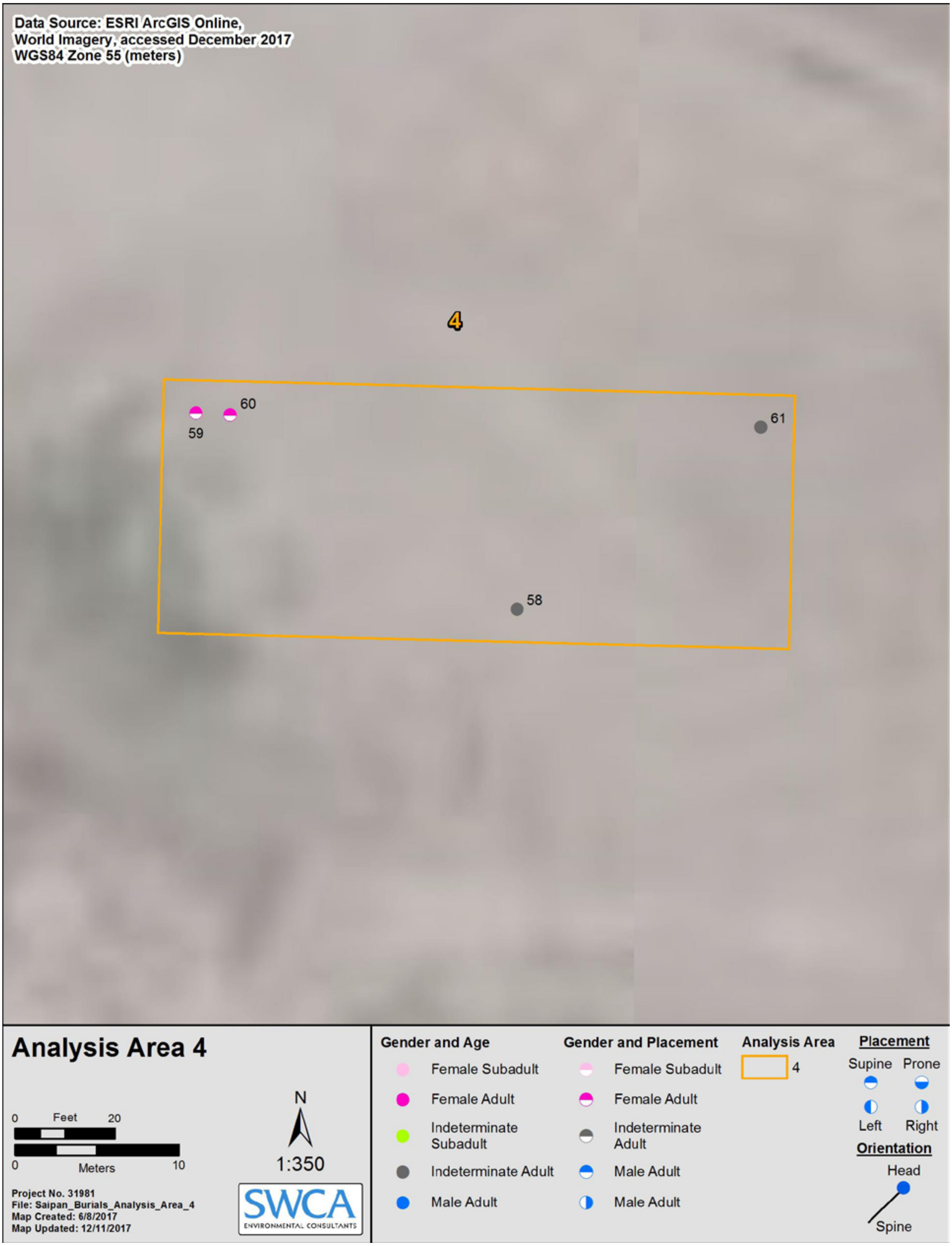

Figure 93. Burials in analysis area 4

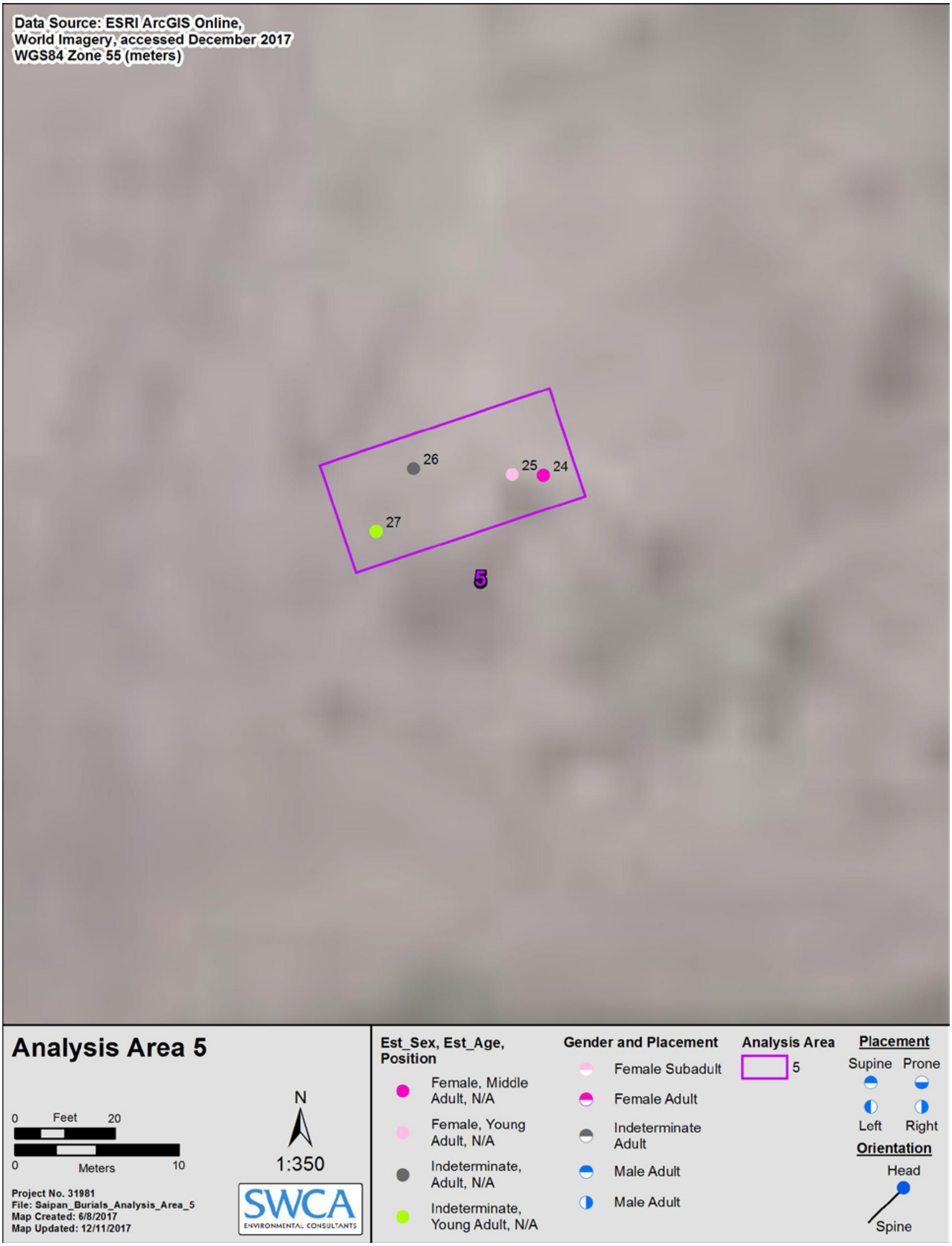

Figure 94. Burials in analysis area 5

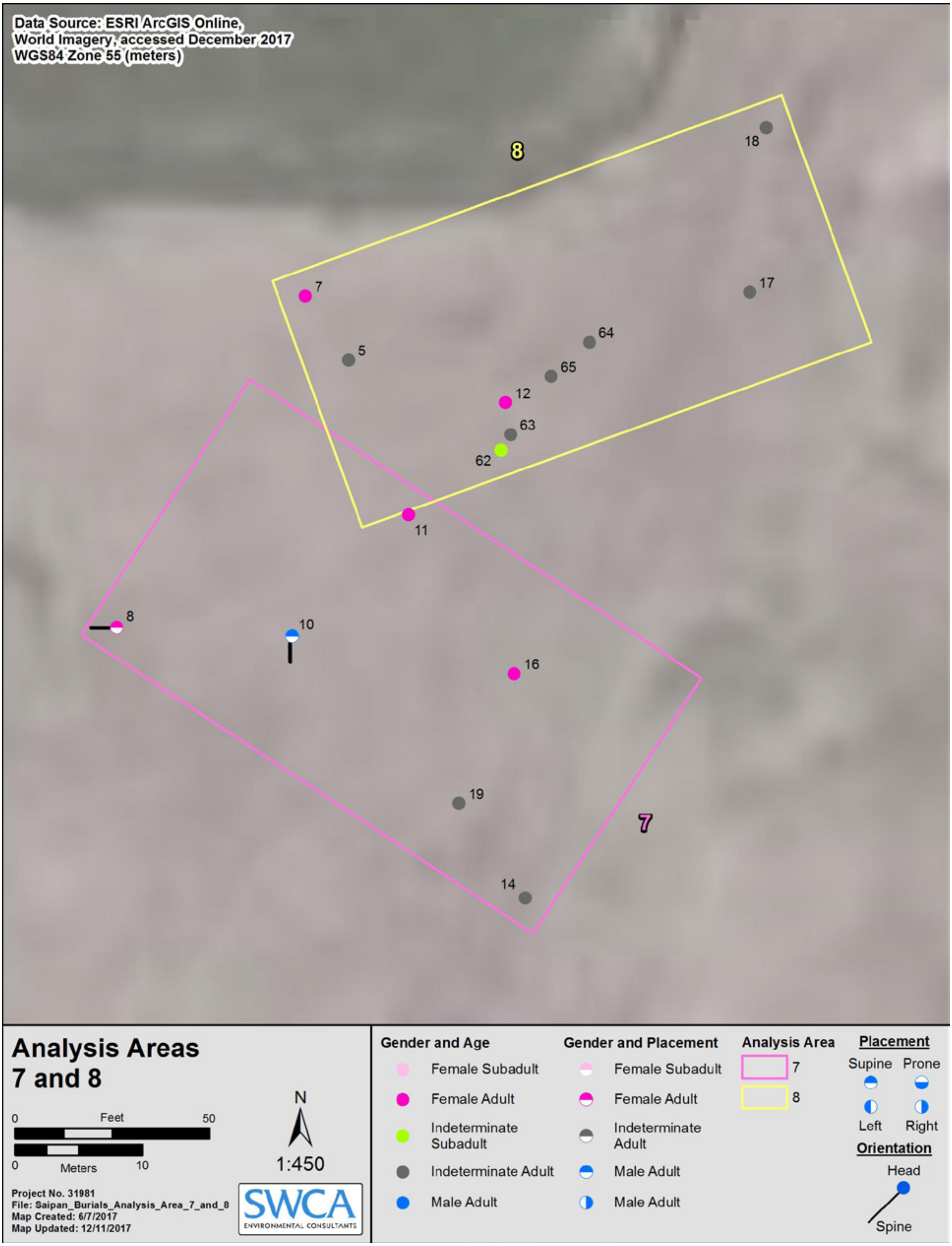

Figure 95. Burials in analysis areas 7 and 8

may be the primary factor for association within the burial clusters within the site in this study. The clustering of burials reflects a bounded area for interring the dead and is one way to symbolize the inclusiveness of a social group (especially lineage).

6.8.1 Burial Orientation

The orientation of the burials is presented below in Table 46 and in Figure 91 to Figure 95 (above). These data include the main field-numbered burials. It does not include the commingled remains because no orientation could be collected for these individuals. They were not recognized in the field as separate individuals; they were identified in the lab. The orientation is along the spine and indicates the direction toward the head. The above figures (see Figures 91–95) are keyed to indicate orientation, with the circle representing the head and the line representing the spine. When there is no line, the orientation could not be taken in the field. This occurred with fragmentary and incomplete burials with insufficient data to determine orientation. The shore is to the west; and more burials have their feet towards the beach than to any other direction. This is adding the burials that have their head to the northeast, southeast, and east (10/16, 62.5 percent). Field information indicates a variability in the orientation of the body of the body with burials also oriented to the north, south, southwest, and west. When the orientation is correlated with sex, there the two males oriented to the north, two to the east, and one each to the northeast and southwest. The orientation of the females indicates two towards the west, three to the northeast, and one each oriented to southeast and east.

Table 46. Orientation for Burials from Parcel 004-1-52, San Antonio

Direction	***Female***	***Male***	***Ind Sex***	***Total (N)***	***%***
North		2		**2**	**12.5**
Northeast	3	1		**4**	**25.0**
Southeast	1		1	**2**	**12.5**
Southwest		1		**1**	**6.25**
South			1	**1**	**6.25**
West	2			**2**	**12.5**
East	1	2	1	**4**	**25.0**
Total	**7**	**6**	**3**	**16**	**100**

Ind Sex = Sex Indeterminate.

Table 47. Summary of Burial Placement for Parcel 004-1-52, San Antonio

	Right Side	***Supine***
	N	***N***
Female		
Extended		6
Semi-flexed		1
Male		
Extended	1	5
Indeterminate Sex		
Extended		3
Total	1	15

6.8.2 Burial Position and Placement

Burial position describes the body in terms of extended, semi-flexed, or flexed, which is based on the appendicular elements placed in a straight alignment or with flexure of the elbow, knee, or hip and the degree of that flexure. Placement of the body describes whether the body was placed on the back (supine), front (prone), left side, or right side. The positions of the burials were mostly found to be supine and extended position, but with one in a semi-flexed and one on its right side. Burial placement is shown in Table 47.

6.8.3 Grave Goods

Only three males had an item that was likely a grave good. The males were Burial 4, an adult with a bone spear point fragment in AA 3. Burial 36, a middle adult male, had one *Spondylus* bead, and Burial 44, a middle adult male, had a coral bead; both are in AA 6. In AA 6, Burials 33 to 37 were closely clustered and three *Spondylus* beads were found. The beads were loose in the fill and it is not clear with which burial they were originally associated. A cautionary note on the grave goods should be kept in mind. The site area has been disturbed by human and natural causes from prehistoric to modern times. The disturbances could have resulted in some artifacts that were not intentionally placed being introduced into the area of a burial. Similarly, items that may have been placed with a burial might have been subsequently moved or removed during disturbance events. Artifacts considered grave goods were in the immediate area or close proximity to a burial. Other artifacts that are more likely to be part of the general cultural deposit were not considered as grave items. These items would be introduced when the pit for the deceased was dug and backfilled, and the artifacts in the deposit would have ended up near the burial.

6.8.4 Discussion

In general terms, mortuary analysis is an examination of the patterns of the burials that may indicate the actions, behaviors, rituals, symbols, and ideology of a specific community or culture. The difficulties lie in finding meaningful ways to connect the actions, behaviors, rituals, symbols, and ideology with the material remains. There are no easy generalizations that can be drawn upon and any connection would need to be specific to the culture being studied. Different theoretical approaches have been described and applied, such using the data to generalize underlying social complexity, inherited status, and overall social organization. One of the underlying assumptions in this approach is that the burial adequately represents the funeral ritual and social organization. The obvious problem with this assumption is that the archaeological remains do not preserve the entire rite of passage. What we are left with is the portion of that ritual that is tangible and has survived through time.

Previous excavations in the Marianas reveal that during prehistoric and early historic times, burial beneath or adjacent to *latte* sets was common (Butler 1988; Davis et al. 1992; Ray 1981; Reinman 1977; Ryan 2010; Ryan et al. 1999; Spoehr 1957; Stodder et al. 2016; Thompson 1971; Yawata 1961). The location of burials has provided indirect evidence for the presence of *latte* sets or pole and thatch structures (Bath 1986). Previous research has hypothesized that prehistoric Chamorro villages included structures for ordinary households, high-status households, and men's houses (Davis et al. 1992; Graves 1986, 1991; Hunter-Anderson and Butler 1991; Reinman 1977; Walth 2016). Some dwellings consisted of pole and thatch structures raised on wooden posts, and possibly higher-status structures raised on limestone pillars (*latte* sets). Researchers have found that Chamorro burials in and around *latte* sets tend to orient perpendicular to the long axis of a structure when buried beneath, and parallel when buried outside of a structure (Bath 1986:33; Butler 1988; Graves 1986:146; Ray 1981; Reinman 1977; Ryan 2010; Ryan et al. 1999; Thompson 1971; Yawata 1961).

In terms of understanding burial practices based on mortuary patterns, Carr (1995) found that local grave location and formal demarcation of the cemetery most frequently indicated the horizontal social position of the deceased, including his/her lineal descent group. The variable, 'horizontal social position' pertains to sodalities, kinship groups, or residence groups, and could then inform us of potential social groups for the current investigation. The eight clusters of burials found during the current investigation suggest that these clusters may be organized as kinship and residence groups (as defined by Carr). A cautionary note pertaining to analyses of this nature is that the span of time represented covers a relatively large span of years and this compression in a single cultural layer may create unintended patterning.

Carr (1995) used the human relations area files (HRAF) to understand the social organization and philosophical-religious, physical, and circumstantial factors that affect mortuary practices. Some key findings from his research are that mortuary practices are determined by a complex mix of factors.

Mortuary practices that reflected social organization included cemetery internal organization, the overall energy expended on mortuary activities, and disposition of the body, the number of socially recognized burial types, the number of persons per grave, and the type of grave 'furniture' (i.e., grave goods; Carr 1995:190). Horizontal social position, primarily the kin or residential group, is indicated by where the burial is located within the cemetery. Vertical social organization is reflected by variables that include type of grave furniture (grave goods). Variables that reflect philosophical-religious ideas more than social organization include body position, body orientation, and the spatial arrangement of furniture in the grave. Orientation reflects a society's belief about the afterlife, universal orders, and the soul's journey to the afterlife (Carr 1995:157).

Social organization is reflected by several factors, including the type of grave furniture (Carr 1995). If this is true for the individuals buried in Parcel 004-1-52 in the village of San Antonio, then vertical social positioning may be reflected in the type of grave items. Only three individuals from the current project had grave items, all were males and each had only one item. The low number of grave items suggests any inference of vertical social position may not be adequately represented by the presence/absence or type of grave items. Since only males had grave items, this may suggest that a higher vertical social position may be bestowed upon males (patrilineal).

Applying Carr's findings to the current investigation, the orientation of the placement of each burial is somewhat variable, but overall, most have their feet pointed generally towards the beach. Further, there is a similarity in the body position (extended and supine). This may indicate that there may be a one unifying philosophical-religious or worldview as represented by the commonality in the orientation, placement, and position of the burials. In terms of social positioning, the organization of the burials around a dwelling reflects the horizontal social position and is primarily kin based. Four of the AAs have only one sex, but they do also include individuals where sex could not be estimated. AAs 3, 4, 5, and 8 may be residence groups, whereas AAs 1, 2, 6, and 7 may represent family kin groups.

One of the research questions asks about identifying possible latte structures in the project area. The location of burial clusters provides a proxy for locations of *latte* sets. The cluster analysis was completed to offer a means of determining which burials cluster together to help answer this research question. To further tease out this answer requires looking at the size of the AA units defined from the cluster analysis and compare that with known information on *latte* structures. Bath (1986:33–34) proposed four criteria for estimating the number and location of dwellings within a site. This was based on information from Guam, however the underlying assumptions would be comparable to Saipan. Those four criteria are:

1. The long axis of structures....will be oriented somewhere between due north and due east, with the most likely orientation between N 50°E and N 68°E. This assumption is extended to pole-and-thatch houses.
2. House length will vary between 10 and 12 meters, width between 2.9 and 3.6 meters, and distance between stones or posts between 2.5 and 3.5 meters.
3. The short axis will be at right angles to the long axis.
4. A concentration of burials with a consistent orientation provides evidence of a prior house structure oriented perpendicular to the burial orientation. (Bath 1986:33–34)

Given the above postulated length and width of a *latte* dwelling, the overall size would fall between 29 and 43.2 m^2. No size was specified for pole-and-thatch structures, but it is assumed that they would not be any larger and could be smaller. Information on the size of the AA units from this site were presented above in Table 8.27. AA units 2 and 3 fall within the postulated size for a *latte* structure. AA 5 is about twice the size, and the remaining AAs go up in size from there. However, it is possible that the larger size is a result of one or more factors. Burials are also interred outside of the *latte* structure, and this would increase the overall size greatly. This would make AA units 1, 4, and 6 in the likely realm for a *latte* structure depending on the distance outside of the footprint of the structure that burials were interred. This still leaves AA 7 and 8 being exceptionally large. These two AAs also have a very low density of burials. Another possibility is that is that a *latte* structure may have been constructed, removed, and a new structure placed in a similar area but outside of the original footprint. Looking at size, burial density, age, and sex of the burials, it is likely that AAs 1, 2, 3, 4, 5, and 6 do represent *latte* or some other residential habitation structure.

6.9 Conclusions

6.9.1 Summary

The human burials at Parcel 004-1-52 were overall in fair condition. The site and some burials had been disturbed by prehistoric activity. In the pre-Contact period, it was common to bury an individual under or near a structure where other individuals had previously been interred, thus disturbing the earlier burials with the new interment. Disturbance also occurred in historic and recent times. The project area is on a National Historic Landmark WWII American invasion beach, with a WWII Japanese ammunition magazine, a U.S. Coast Guard Loran facility used from 1944 to 1978, and the remnants of a modern concrete pad for a boxing rink and food stand. Burials had also been disturbed by the construction of nearby roads, road repairs, and the installation of various utilities.

All human remains were considered (field- and laboratory-numbered burials, comingled remains, and isolated remains) in the calculation of MNI; age and sex were also taken into consideration. The human remains included individuals that were Chamorro and a few from WWII, probably Japanese soldiers. To calculate MNI, the remains were first separated by cultural affiliation. A MNI of four Japanese was identified. The MNI for the Chamorro remains totaled 89, with 60 field-numbered burials plus 29 individuals identified in the lab.

Analyses of dental patterns in the teeth of Southeast Asians, Northern Asians, Polynesians, Micronesians, and Australians have been completed over the last few decades (see work reported in Turner 1987, 1990a, 1990b; and Scott and Turner 1997). Two major dental divisions have been identified and independently confirmed by other research such as evidence from cranial metrics (Pietrusewsky 1990a, 1990b, 2005). The two dental groups are referred to as Sinodonty and Sundadonty (Turner 1990a). Sinodonts are represented by major populations in China, Mongolia, Japan, Korea, Northeast Asia, and North and South America. The name Sundadonts was coined from the Sunda Shelf, a geological feature that is now submerged but once connected much of Southeast Asia with the archipelago of islands in the region. Sundadonts include populations on mainland and insular Southeast Asia as well as Polynesians and Micronesians. The two groups are identified by a difference in the expression of a suite of dental traits in these various populations. Turner (1990a) found that the following eight traits were key in the dichotomization between these two groups: 1) shoveling UI1; 2) double shoveling UI1; 3) one-rooted UP1; 4) enamel extension UM1; 5) reduced, peg, or absence UM3; 6) deflection wrinkle LM1; 7) three-rooted LM1; and 8) four-cusped LM2.

The current study used the ASU DAS for recording dental nonmetric traits. This system offers a means of standardizing the recording of dental traits (Turner et al. 1991). The data from the current study were compared with the frequency of occurrence for the two main ancestral groups (Sinodonts and Sundadonts). Table 48 displays the mean and standard deviation of the Sundadonts and Sinodonts, which reflects the frequency of occurrence in the represented populations (see Turner 1990a:Tables 1–9). The data from the current investigation show the frequency of occurrence for this group. The comparison with the Sundadont and Sinodont data indicates that the individuals from this site are more closely

Table 48. Comparison of Parcel 004-1-52 with Key Traits of Sundadonts and Sinodonts

	Current Site	***Sundadont****		***Sinodont****	
	%	***Mean***	***SD***	***Mean***	***SD***
Shoveling UI1	21.4	**30.8**	15.8	71.1	11.5
Double shovel UI1	28.6	**22.7**	18.2	55.8	21.9
One-rooted UP1	57.1	**70.6**	11.8	78.8	11.4
Enamel extension UM1	**0.0**	26.4	16.5	50.1	9.5
P-R-CA† UM3	10.0	**16.3**	10.0	32.4	10.3
Deflection wrinkle LM1	15.8	**25.5**	18.3	44.1	19.7
Three-rooted LM1	3.8	**8.8**	5.8	24.7	7.7
Four-cusped LM2	52.2	**30.7**	14.1	15.5	6.9

* From Turner (1990a:Table 9).
† Peg, Reduced, Congenital Absence (P-R-CA) was combined to determine this frequency; note that **bold text** indicates the group to which the individuals from Parcel 004-1-52 are closest.
SD = standard deviation.

related to the Sundadonts. The table below does show one trait that has a different frequency than that of either group: the incidence of enamel extension on upper M1. This may reflect a genetic signature of a different group, possibly those of the Carolinians or those of Spanish or Philippine descent. However, it may also reflect the small sample size. More studies would need to be completed to confirm the difference.

Culturally induced dental modifications observed in the Parcel 004-1-52 individuals include betel nut staining. Betel nut staining may have included both incidental staining, from the cultural practice of chewing the areca nut, and from intentionally stained (painted) teeth. Betel nut staining was found in almost all of the adult teeth for this group. Children appear to not chew or have their teeth painted and this may be part of a rite of passage at some point near young adulthood. Once a person became an adult, all seemed to practice this cultural modification. Both males and females had stained teeth.

6.9.2 How do the individuals recovered compare to remains recovered from other sites?

Sites with burials recovered and analysis completed that have comparable data are presented in Table 49. The sites used for comparison include Hunter-Anderson et al. (1996) reporting from Susupe, Saipan, that had an MNI of 32 individuals, Pietrusewsky and Batista (1980) report from four sites on Tinian and Saipan with MNI counts of 6, 5, 2, and 33 individuals, Hanson (1989) reports from the Duty Free site on Saipan with an MNI of 8, Pietrusewsky and Douglas (1989) report on 34 individuals from Oleai, Saipan, and Walth (2017) reports from the Agana Bridge site on Guam.

The Saipan Judiciary Center site (Hunter-Anderson et al. 1996) recovered human remains from eight areas. These areas with clustered burials was described as relating to the location of residences and likely associated with *latte* structures. In total, there were 32 individuals recovered from this site. There were infants to older adults and a mix of males, females, and individuals indeterminate to sex, however, the report does not provide summary information as to the age and sex of each burial or a summary of the remains by age and sex. For this report, we summarized from the scant information available to create the data for the age and sex distribution used in Table 8.39 below.

Pietrusewsky and Batista (1980) reported on four sites with human remains, three on Saipan and one on Tinian. Tinian House had a MNI of four individuals and includes one with yaws. Marianas High School had an MNI of five, Grotto site had an MNI of two, and San Antonio site had an MNI of 33. San Antonio site had a burial pit with skulls stacked on top of each other, which is atypical, but is similar to what Pietrusewsky and Douglas (1989) reported in the Oleai site.

The skeletal remains from the Duty Free site (Hanson 1989) included eight individuals—two females, six males, and one child of approximately 2 years of age. The adults were 40 years or older and there was little pathological evidence of significant disease in any of the individuals.

The remains from the Oleai site included 34 individuals. However, 14 of these were represented by skulls and/or mandibles only, which is very atypical (Pietrusewsky and Douglas 1989). Further, adults outnumber subadults greatly and males outnumbered females almost 2 to 1. Features of the cranial and postcranial remains otherwise compared favorably to other Chamorro remains.

The Agana Bridge site is also known as San Antonio Village (Walth 2017) on the island of Guam. This site was included because it has comparable data and includes many individuals from the late Latte period to Contact. There is an MNI of 94 individuals recovered from this site. The individuals recovered from this site were generally healthy, active people. There was evidence of yaws but otherwise there was little significant disease.

Table 50 gives the data on Parcel 004-1-52 and the comparative sites. The small sample sizes for most of the comparable sites may explain the variability in the ratios of subadults to adults and males to females. The ratio of subadult to adult is also greatly influenced by preservation. The smaller, more fragile, subadult elements are often poorly preserved in comparison to the more robust adult elements. The samples from Tinian House and Oleai have unusual ratios of males to females. Removing those from consideration, then the Judiciary Center and Duty Free sites have more males, and all the others have a greater number of females. Life expectancy was not calculated for any of the sites except for Parcel 004-1-52 and Agana Bridge. These two sites compare well in the life expectancy of the individuals recovered.

Information on the stature of males and females is presented in Table 51. In general, all individuals are very comparable. The tallest individual was a male from the San Antonio site followed by one from

Table 49. Comparative Assemblages from Saipan and Guam

Title	***Short Name***	***Author(s)***	***Date***	***MNI***	***Affiliation***
Archaeological Monitoring and Hand Excavations in Eight Burial Areas at the Saipan Judiciary Center, Susupe, Saipan	Judiciary Center	Hunter-Anderson et al.	1996	32	Latte
Human skeletal and Dental Remains from Four Sites on Tinian and Saipan, Commonwealth of the Northern Mariana Islands	Tinian House Marianas High School Grotto San Antonio	Pietrusewsky and Batista	1980	6 5 2 33	Latte
The Skeletal Biology of Prehistoric Human Mortuary Remains from the Duty Free Site, Garapan Village, Saipan	Duty Free	Hanson	1989	9	Latte
Human Remains from Oleai, Saipan	Oleai	Pietrusewsky and Douglas	1989	34	Latte
Final report: Archaeological Investigation for the Agana Bridge #1 and Route 1/Route 8 Intersection Improvements Project (GU-NH-0001 (14)), Hagatna, Guam. Volume II: Osteological Analysis	Agana Bridge	Walth	2017	94	Latte (Early to Late)

Table 50. Age, Sex Profiles, and Life Expectancy for Comparative Assemblages and Parcel 004-1-52

Site	***Subadult to Adult Ratio***		***Male to Female Ratio***	***Life Expectancy***
Judiciary Center	10/16	1:1.6	1.5:1	N/A
Tinian House	2/4	1:2	0:4	N/A
Marianas High School	2/3	1:1.5	1:2	N/A
Grotto	0/2	0:2	1:1	N/A
San Antonio	1/32	1:32	1:1	N/A
Duty Free	1/7	1:7	3:1	N/A
Oleai	5/29	1:5.8	1.9:1	N/A
Agana Bridge	24/65	1:2.7	1.2:1	26.6
Parcel 004-1-52	16/73	1:4.6	1:1.7	30.2

Table 51. Stature Calculations for Parcel 004-1-52 and Comparative Assemblages

Site	***Male Stature***		***Female Stature***	
	Range in cm	***Range in feet/inches***	***Range in cm***	***Range in feet/inches***
Judiciary Center	173.8	5′8″	158.3	5′2″
Tinian House			163.5–163.8	5′4″
San Antonio	170–193	5′7″–6′4″	150–173	4′11″–5′8″
Duty Free	174	5′8″		
Oleai	65.6–69.1	5′5″–5′9″	59.4–64.5	4′11″–5′4″
Agana Bridge	170–179.7	5′7″–5″11″	156.1–162.2	5″1–5′4″
Parcel 004-1-52	168.3–170.7	5′6″–5′7″	158.1–165.8	5′2″–5′5″

Agana Bridge site, and the shortest was from Oleai. The other males generally fall with the range of 5′7″ to 5′9″. The tallest female was also from San Antonio and San Antonio and Oleai both had the shortest females. In general, the females range from 5′1″ to 5′5″. Parcel 004-1-52 fits well within the range for males and females.

For the data on tooth summaries, there are only four assemblages that calculated this metric (Table 51). The San Antonio Village individuals have some of the largest teeth overall, but Parcel 004-1-52 females have unusually large teeth. Oleai individuals have very small teeth. Parcel 004-1-52 males have smaller teeth than the females which is not common, but otherwise fall within the upper range of tooth summary size.

The recordation of LEH was reported by tooth and not by individual for all but the Agana Bridge and Parcel 004-1-52 assemblages. For these two assemblages, the females did not have LEH observed. Male individuals did have LEH and Parcel 004-1-52 had considerably more males with LEH than the Agana Bridge assemblage (Table 52).

Table 51. Tooth Summary Data for Parcel 004-1-52 and Comparative Assemblages

Study Sample	***Male***	***Female***	***Total Sample***
San Antonio			1,427
Oleai	1,085	1,011	1,071
Agana Bridge	1,397.4	1,283.8	1,314.9
Parcel 004-1-52	1,237.2	1,470.8	1,391.8

Table 52. Linear Enamel Hypoplasia in Parcel 004-1-52 and Comparative Assemblages

Study Sample	***Male***	***Female***
Agana Bridge	0.2%	0.0%
Parcel 004-1-52	13.3%	0.0%

The remains from Judiciary Center included pathological conditions of osteoarthritis, periostitis, osteomyelitis, and cribra orbitalia. Caries were present but in low numbers and periodontal disease was present. Many of the teeth were stained from betel-nut chewing. LEH was not observed on the deciduous dentition but was on the permanent dentition. The LEH is 38.9 percent for all teeth, which is quite high. The results were not reported by individual, only for all teeth, and was not reported by sex. Thus this site is not included in Table 6.42 above. This suggests some stress but not in the early childhood years, but certainly in the later developmental years.

The pathologies present in the individuals from Tinian House include treponemal infection (yaws), but because of poor preservation, no other pathologies were noted on the skeletal remains. Tinian House had teeth stained from betel-nut chewing. There were caries, abscesses, and periodontal disease present in these individuals.

The pathologies noted in the Marianas High School include some osteoarthritis. Because of poor preservation, no other pathologies were noted. Grotto had two individuals recovered and osteoarthritis was present in both.

San Antonio site included mostly skulls and mandibles, and the dental pathologies included antemortem tooth loss, caries, abscesses, and periodontal disease. The dentition for adults did have betel-nut staining on the teeth. For the skeletal remains, the preservation was poor and no pathologies were noted.

The Duty Free site had poor preservation, thus there is little information on the pathological condition of these individuals. The ends of long bones and vertebrae did not survive well so even osteoarthritis was not observed. There was no traumatic injury on any of the elements present.

The remains from Oleai recorded typical pathological conditions, which included osteoarthritis, trauma, treponemal infection (yaws), hyperostosis, and cribra orbitalia. Dental pathologies included tooth loss (antemortem), caries, and LEH. The LEH is reported by tooth and not by individual and is therefore not included in Table 8.42 above. Betel-nut staining was present on most teeth, with females having a greater number stained than the males.

The Agana Bridge burial assemblage noted trauma, treponemal infection, cribra orbitalia, and osteoarthritis. The dental pathologies included caries, LEH, abscesses, antemortem tooth loss, and calculus. Betel-nut staining was observed on the adult dentitions.

All of the above are conditions typically observed in archaeological specimens from the Mariana Islands. Parcel 004-1-52 is no exception. The individuals in Parcel 004-1-52 assemblage were generally healthy, active people. There is possible evidence of yaws, which is known to be endemic for the pre-Contact population. Anemia, represented by cribra orbitalia, was absent for this group. There is also a low frequency of LEH. The absence of cribra and low frequency of LEH would suggest that childhood stress was not frequent or severe enough to impact the overall health of the individual. The occurrence of osteoarthritis, although commonly found, is generally within expectations for adults over 30 that are very active. The amount of physical stress was likely low. The people were active, but the activity was not overly strenuous. This suggests good overall health and nutrition for this group.

Chapter 7

Discussion of Research Questions

The following discussion of research questions posed in Chapter 3 presents interpretations of features, artifacts, and data analyses described above by Prehistoric Period divided into the Pre-Latte (1500 B.C. to A.D. 800) and Latte Periods (A.D. 800 to 1668).

7.1 Pre-Latte Period

Very little in situ evidence of the early Pre-Latte settlement of Saipan circa 1500 B.C. was expected on the property given reconstructions of the former coastline when sea levels were approximately 1.8 meter (5.9 feet) higher than today (Carson 2008).There was not any evidence expected of subsequent occupation until after the coastline stabilized circa 500 B.C. if not much later (Butler 1994; Dickinson 2000).

> *Research Question 1: Could the prograded Pre-Latte Period shoreline and backdune aquatic environments be identified by sealed cultural deposits within the project area and if so, what could their analysis say about land use and marine exploitation prior to A.D. 1000?*

The late Pre-Latte Period high ground for some time before A.D. 1000 appears to have been situated just east of the Middle School parking lot and on a north to south orientation across the middle of the property, as the stratigraphic column of Road Feature 4 suggests. Two thin stratigraphic layers were noted between 50 and 100 centimeters (19.7 and 39.4 inches) below surface, containing only sparse cultural remains and a few *dogas* shells but no features. This probably indicated the high ground was briefly occupied more than once in between periodic storm surges as the Stratum III beach sands accumulated and later Latte Period occupants then created the Stratum II cultural horizon on top. East to west trenching along Aguas Street indicated that this early landform with occasional Type A rim sherds and undecorated redware was only about 30 meters (98.4 feet) wide. Unfortunately Aguas Street lay astride the 1987 sand mine, which appeared to have targeted the Stratum IV sands below for extraction. Also representative of this same high ground before A.D. 1000 was the profile of Feature D recorded directly south of the sand mine during the survey phase of investigation (Dixon and McCurdy 2015b). Dark lenses were found beneath the Latte Period Stratum II, which suggested short-term or non-intensive late Pre-Latte Period activities.

The water table was encountered at the base of the sand mine, roughly 3 meters (9.8 feet) below surface or less with prolonged rainfall. No deeper cultural horizons were observed during geophysical testing in the survey phase of investigation (Dixon and McCurdy 2015b) or data recovery. The early to middle Pre-Latte coastline was therefore hypothesized to have been situated east of Beach Road (Moore et al. 1992), first behind and then around the shrinking Lake Susupe marsh in the vicinity of Chalan Piao before 100 B.C. (Amesbury et al. 1996; Athens and Ward 2005; Athens et al. 2004). The late Pre-Latte coastline in San Antonio would only have been located midway through the property circa A.D. 500, as sea level dropped and the lagoon formed in front. Little in situ evidence of late Pre-Latte marine shell consumption was noted to measure subsistence changes over time (Amesbury 2007), but *dogas* shells did appear in much lower quantities below Road Feature 4. This suggests that their habitat was restricted before the Latte Period. It has been noted that falling sea levels would have killed large areas of the PreLatte reef, which when covered in shallow sands, would later create a favorable habitat for *Strombus* (Amesbury 1999).

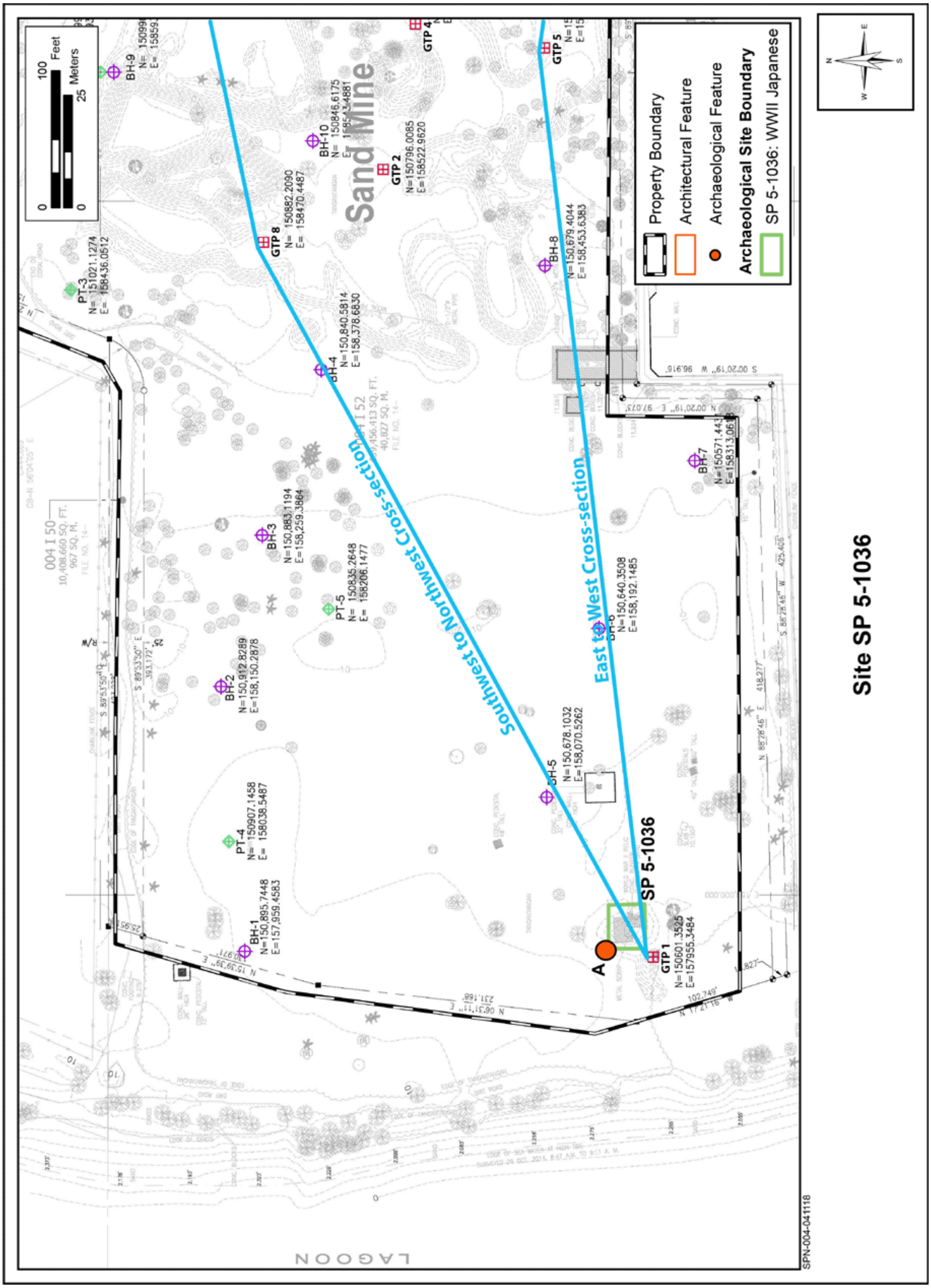

Figure 96. Schematic Cross-Sections of GTP Locations across the Western End of Parcel

A reconstruction of the depositional sequence across the Parcel 004-I-52 landscape was enabled by compiling three stratigraphic cross-sections (Figures 96 and 97). Each transect portrays profiles of geotechnical test pits (GTP) excavated during the survey phase of investigation (Dixon and McCurdy 2015a) at their absolute elevation as recorded by Hofschneider & Associates. The transect containing GTP 3, 4, and 9 oriented from north to southeast (Figure 98) roughly paralleled the late Pre-Latte Period high ground before A.D. 1,000 and GTP 3 was situated at the highest elevation across the site at approximately 3.7 meters (12 feet) above sea level. Unfortunately, GTP 3 was truncated after encountering human remains in the Stratum II cultural horizon during the survey phase of investigation. The presence of Layer III sands at the top of GTP 4 in the bottom of the sand mine was assumed to be the result of redeposition by erosion after abandonment of the mine in 1987, and was not an intact stratigraphic sequence.

Earlier strata were not apparent until Feature 4 was exposed. GTP 4 revealed that the water table in the bottom of the sand mine was near sea level. The water table at GTP 9, located to the south, was at the interface between modern Stratum I and Latte Period Stratum II, probably near the existing grade of Beach Road before construction of the USCG LORAN Station began in 1944.

The subsequent Latte Period high ground, circa A.D. 1416-1669, appeared to be seaward of the sand mine based on the majority of burials and cooking features encountered during data recovery. Although a few probable earlier Latte Period human remains were encountered around the north and south edges of the mine judging from their depth below Stratum II, a few were found even further west near the Middle School fence. This depositional sequence was best portrayed in the west to east transect of GTP 1 through GTP 9 (Figure 99) and the southwest to northeast transect consisting of GTP 1 through GTP 7 (Figure 100). Both transects demonstrated the complete absence of modern Stratum I and Latte Period Stratum II at GTP 1 in the vicinity of the Japanese munitions magazine. This was confirmed by monitored mechanical excavations along the western fence line. GTP 5 and GTP 8 were situated at the bottom of the sand mine near the water table, while GTP 7 and GTP 9 were at the interface between modern Stratum I and Latte Period Stratum II before construction of the USCG LORAN Station began in 1944. The presence of Layer IIa/b and III at the top of GTP 8 in the bottom of the sand mine was assumed to be the result of redeposition by erosion after abandonment of the mine in 1987, and was not an intact stratigraphic sequence.

7.2 Latte Period

After A.D. 800-1000 and into the final centuries of sustained European contact before *La Reduccion* in the early 1700s, it would appear likely the receding project area coastline was attractive to Latte Period inhabitants. Although such archaeological evidence was not recorded in the 1920s by Hans Hornbostel perhaps this was due to dense coconut plantings undertaken during the German and Japanese Periods.

> *Research Question 2: Could Latte Period habitation structures and use areas in SP 1-1037 be identified from patterned subsurface features or near more ephemeral structures and could middens be identified and dated in their vicinity?*

While no evidence of *latte* habitation support architectural features (e.g., *haligi* or *tasa*) was encountered, an almost continuous zone used for food preparation, cooking, eating, and discard that measured at least 50 to 75 meters (164.0 to 246.1 feet) wide is presumed to have been situated on the seaward or downwind side of the Latte Period community's habitations, as noted elsewhere in the CNMI (Dixon et al. 2006; Russell and Fleming 1986). Virtually the entire width of the property on the west edge of the former sand mine contained a layer of disturbed organic midden soil with shellfood remains, tools of marine shell (Figure 101) and basalt (Figure 102), sling stones, and Latte Period pottery (Figure 103) with

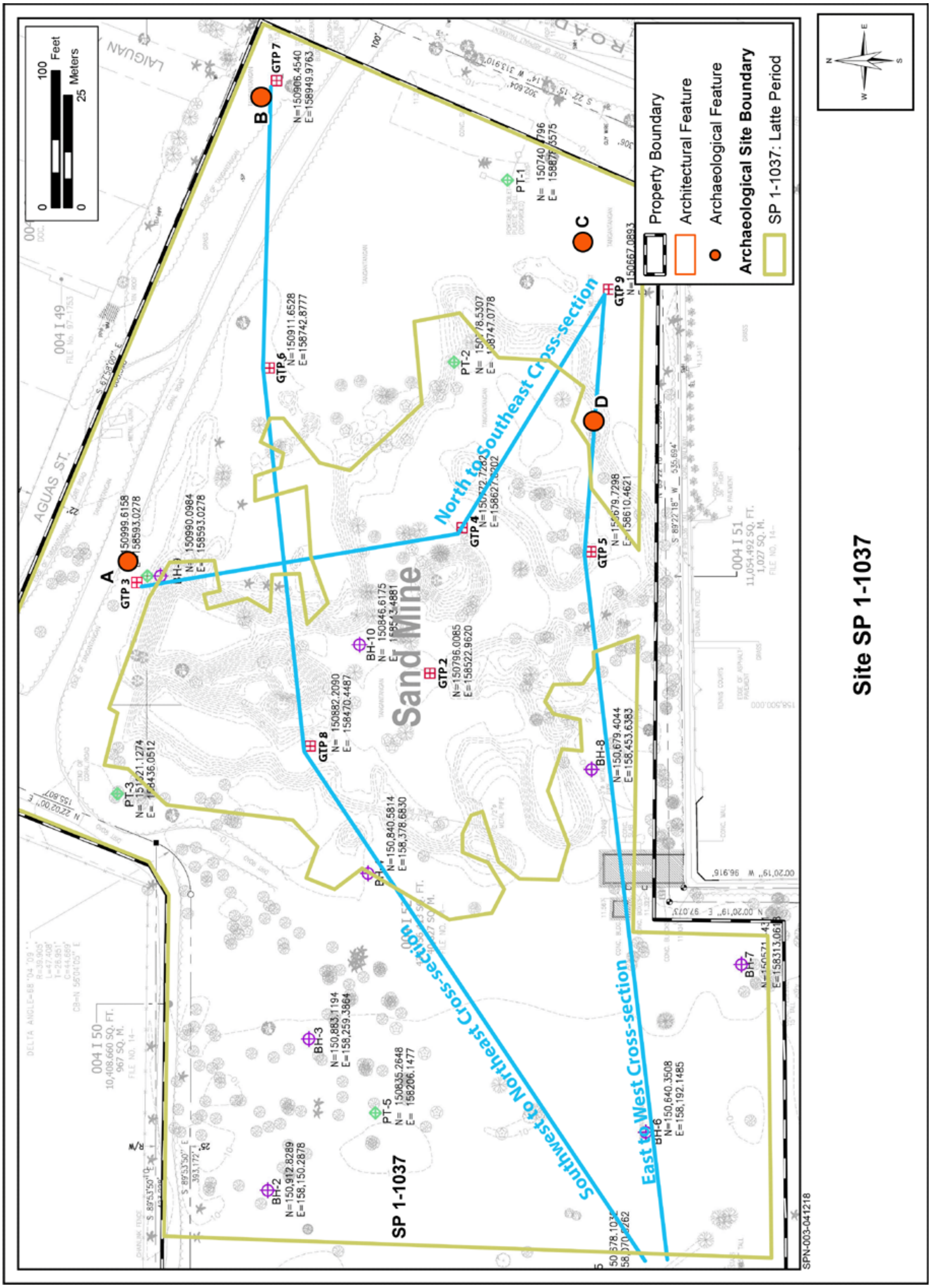

Figure 97. Schematic Cross-Sections of GTP Locations Across the Eastern End of Parcel

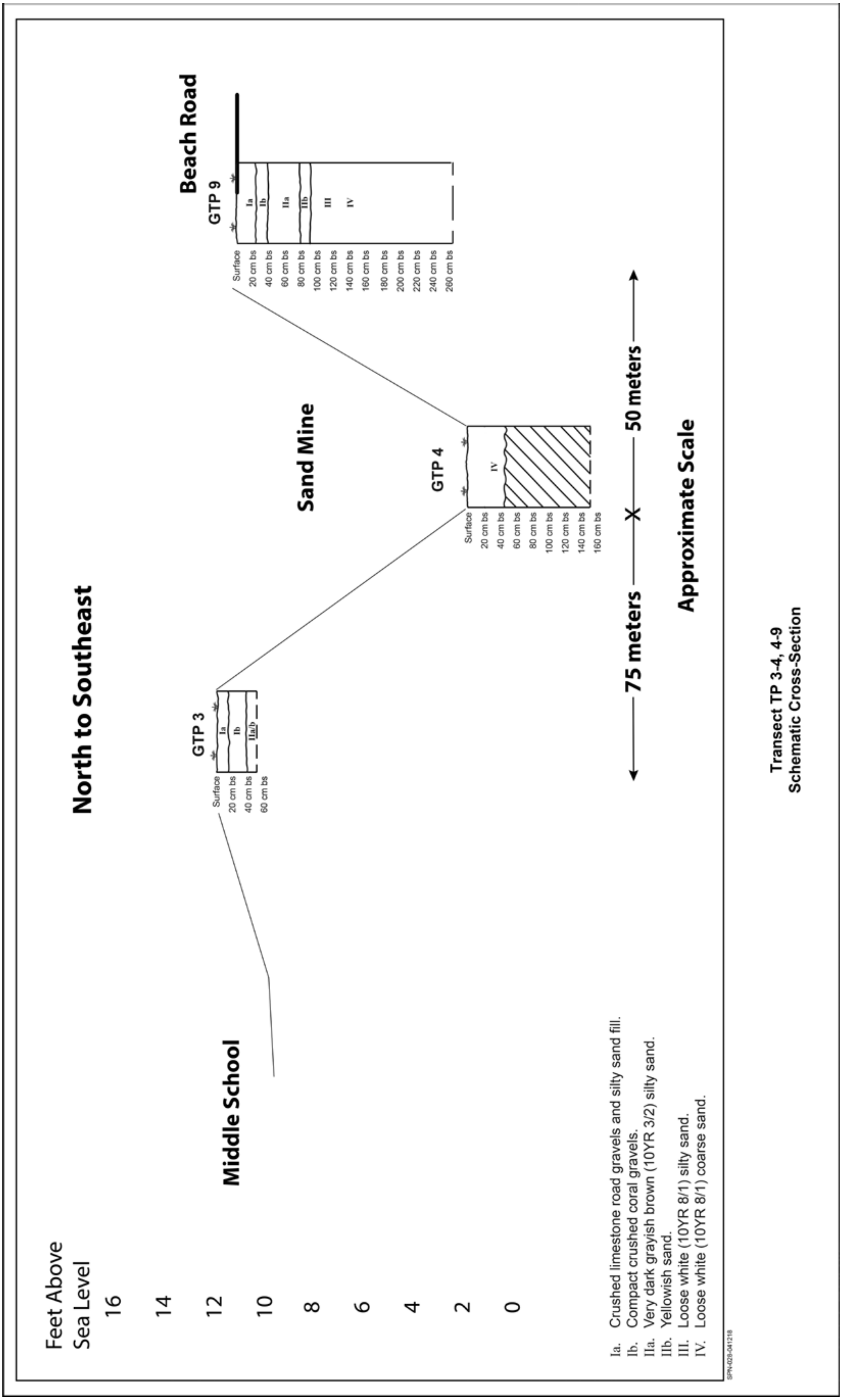

Figure 98. North to Southeast Cross-Section with GTP 3, GTP 4, and GTP 9 Soil Profiles

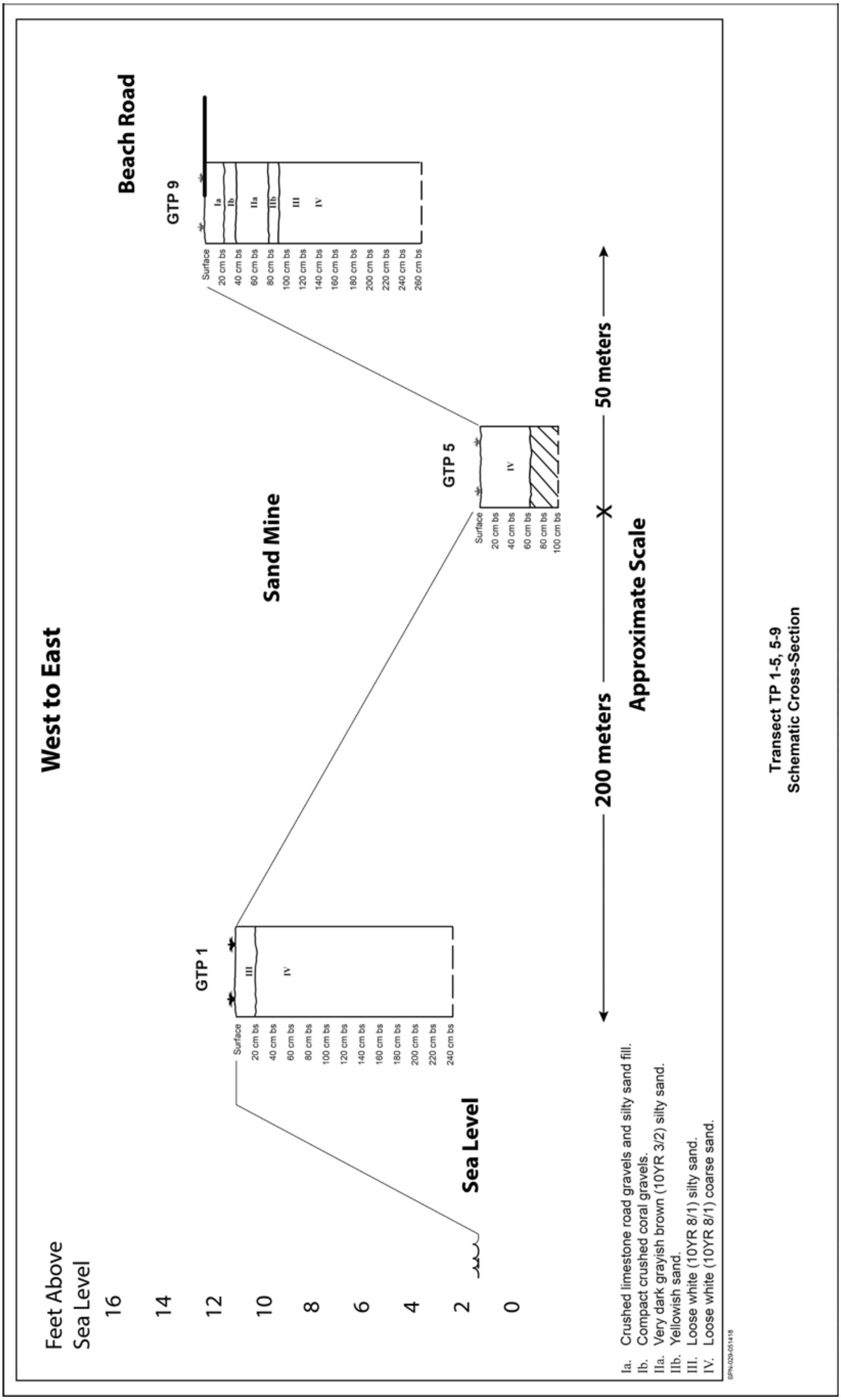

Figure 99. West to East Cross-Section with GTP 1, GTP 5, and GTP 9 Soil Profiles

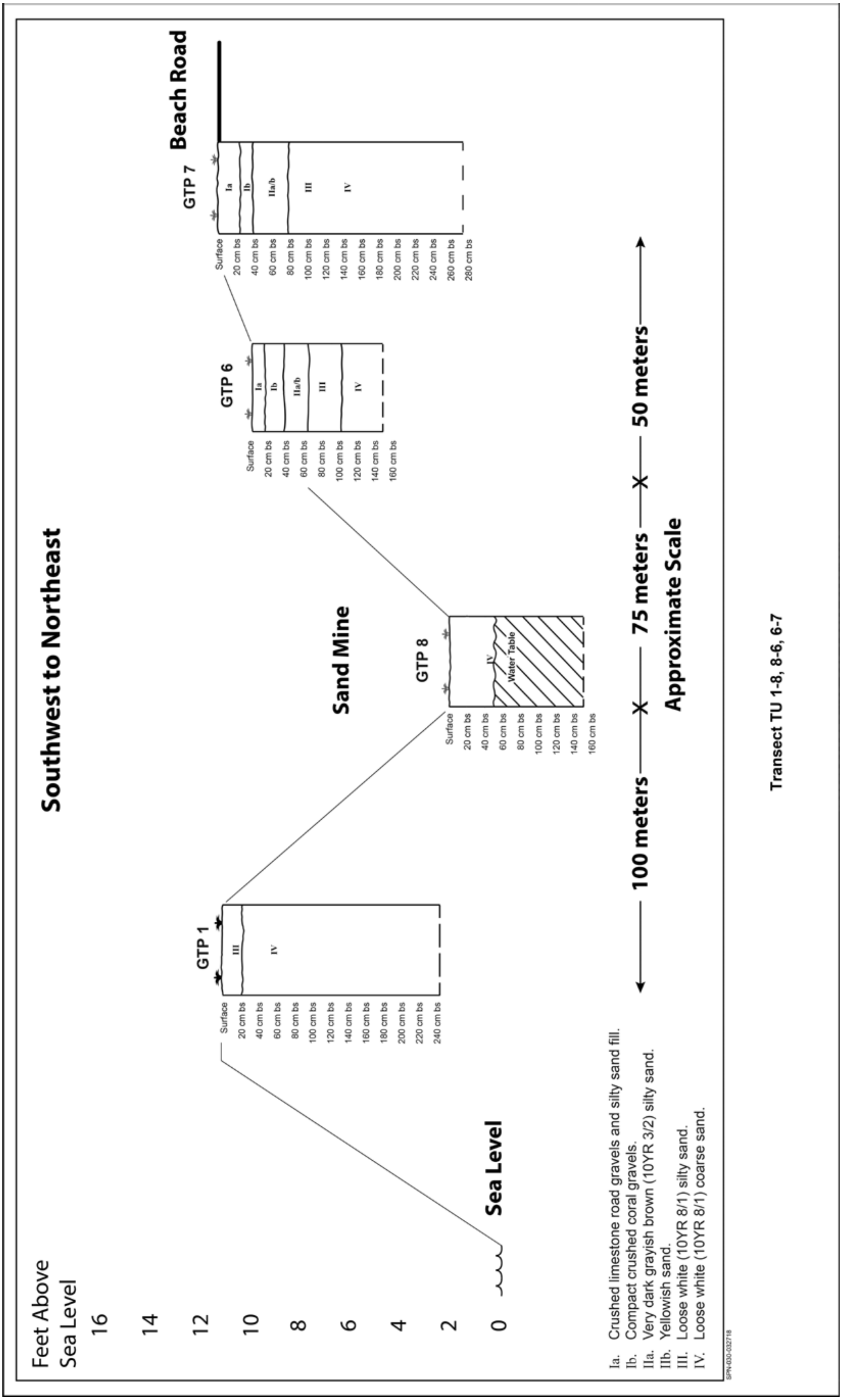

Figure 100. Southwest to Northeast Cross-Section with GTP 1, GTP 8, GTP 6, and GTP 7

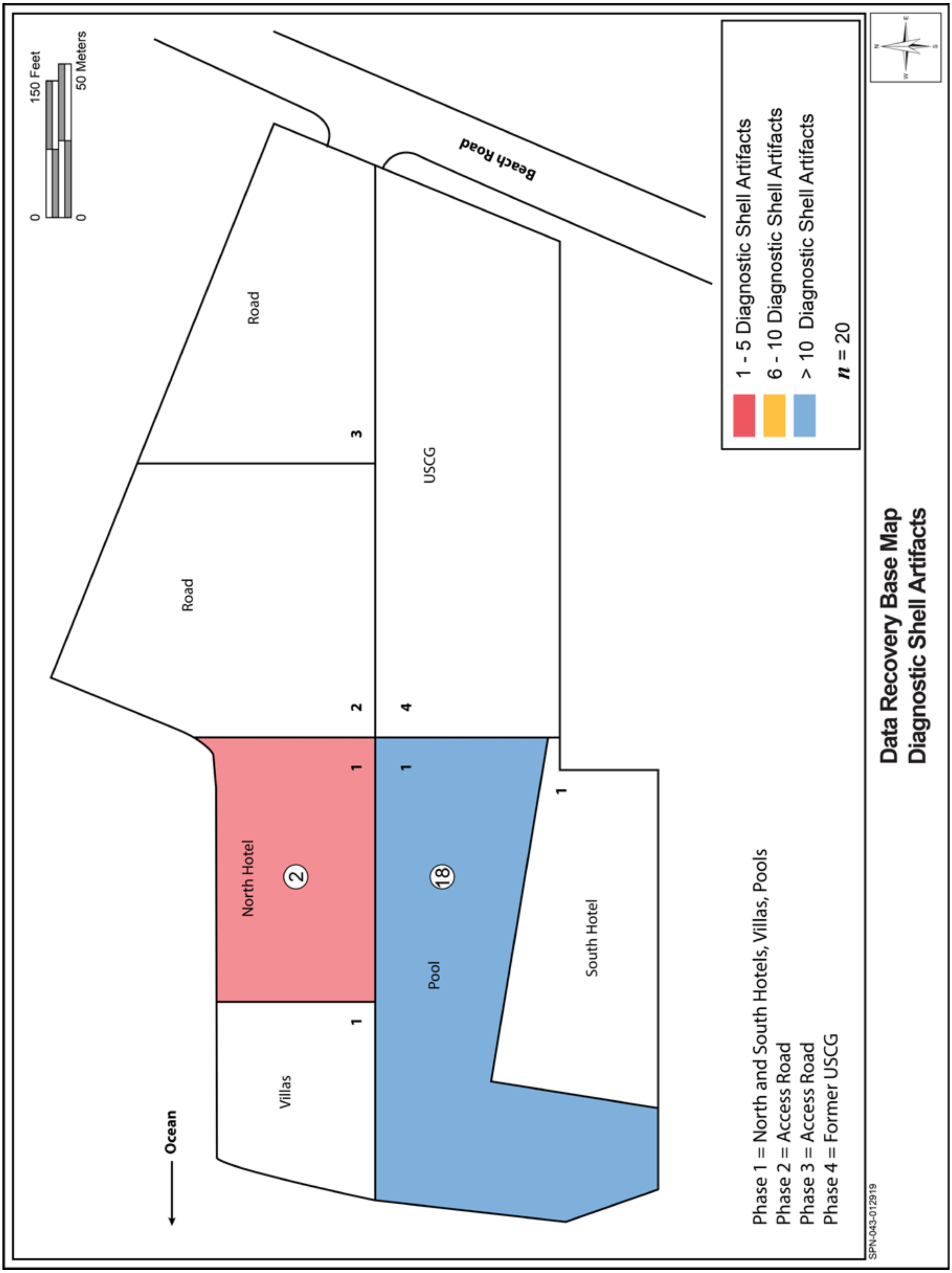

Figure 101. Diagnostic Shell Artifacts

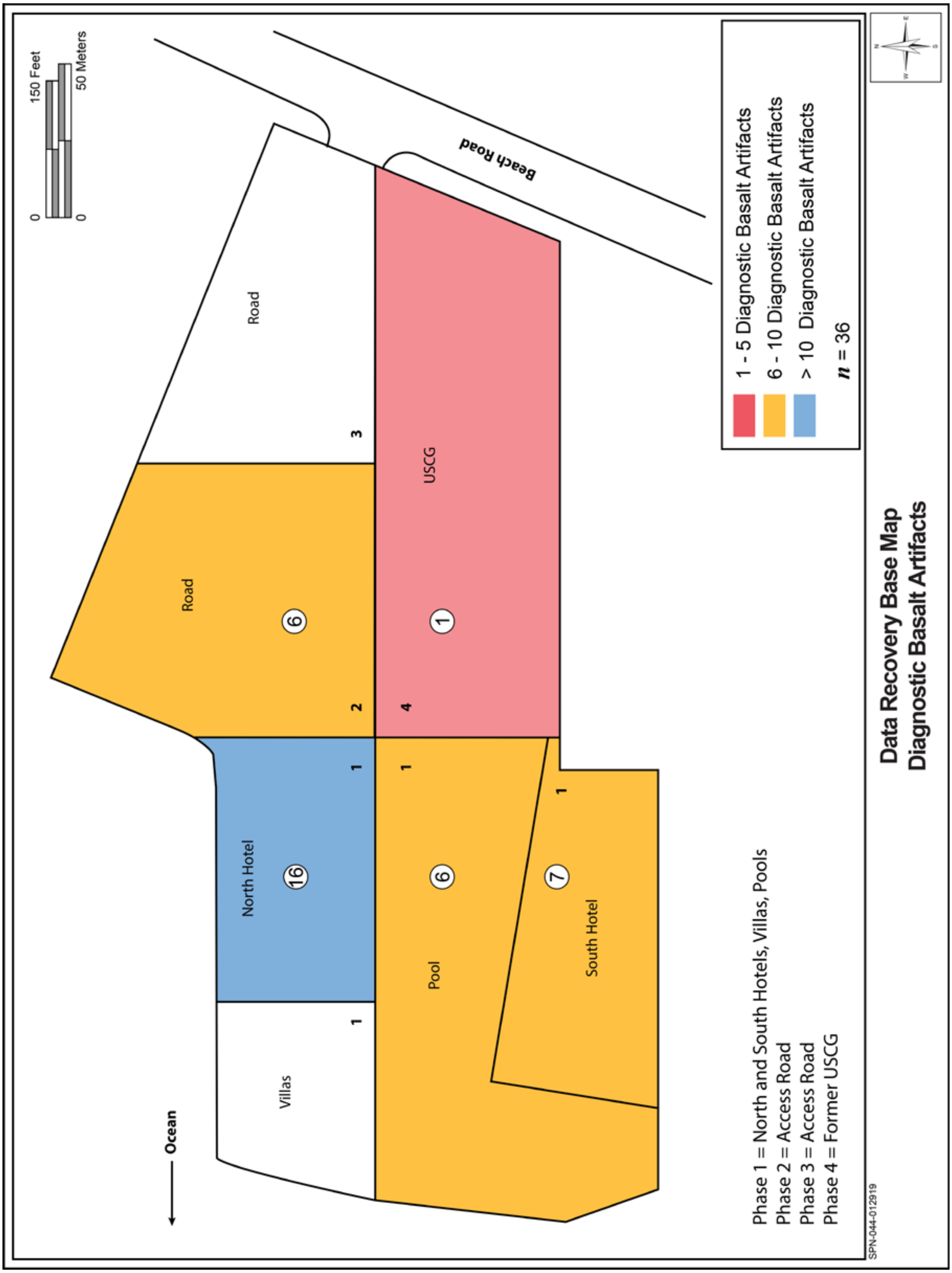

Figure 102. Diagnostic Basalt Artifacts

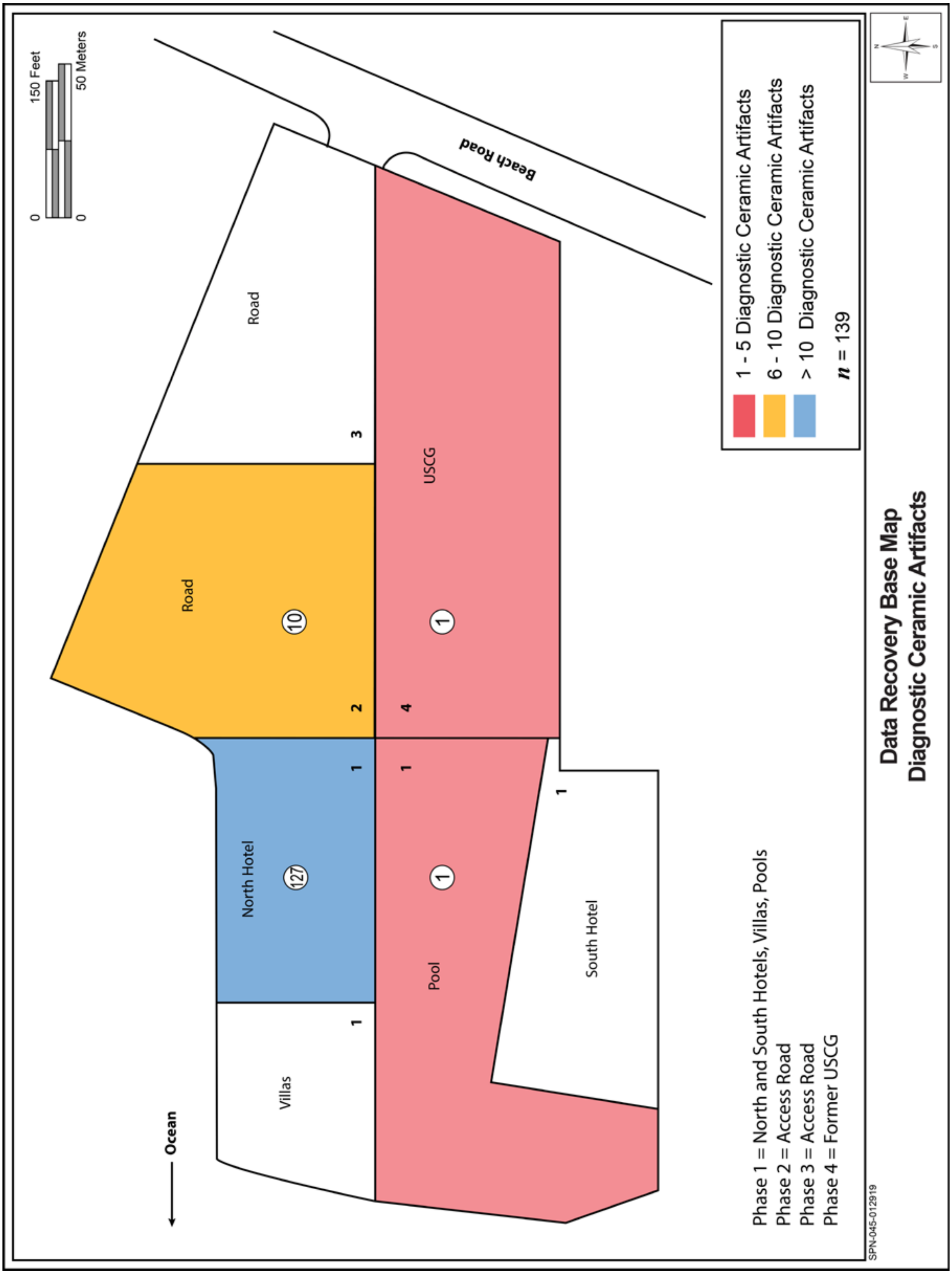

Figure 103. Diagnostic Ceramic Artifacts

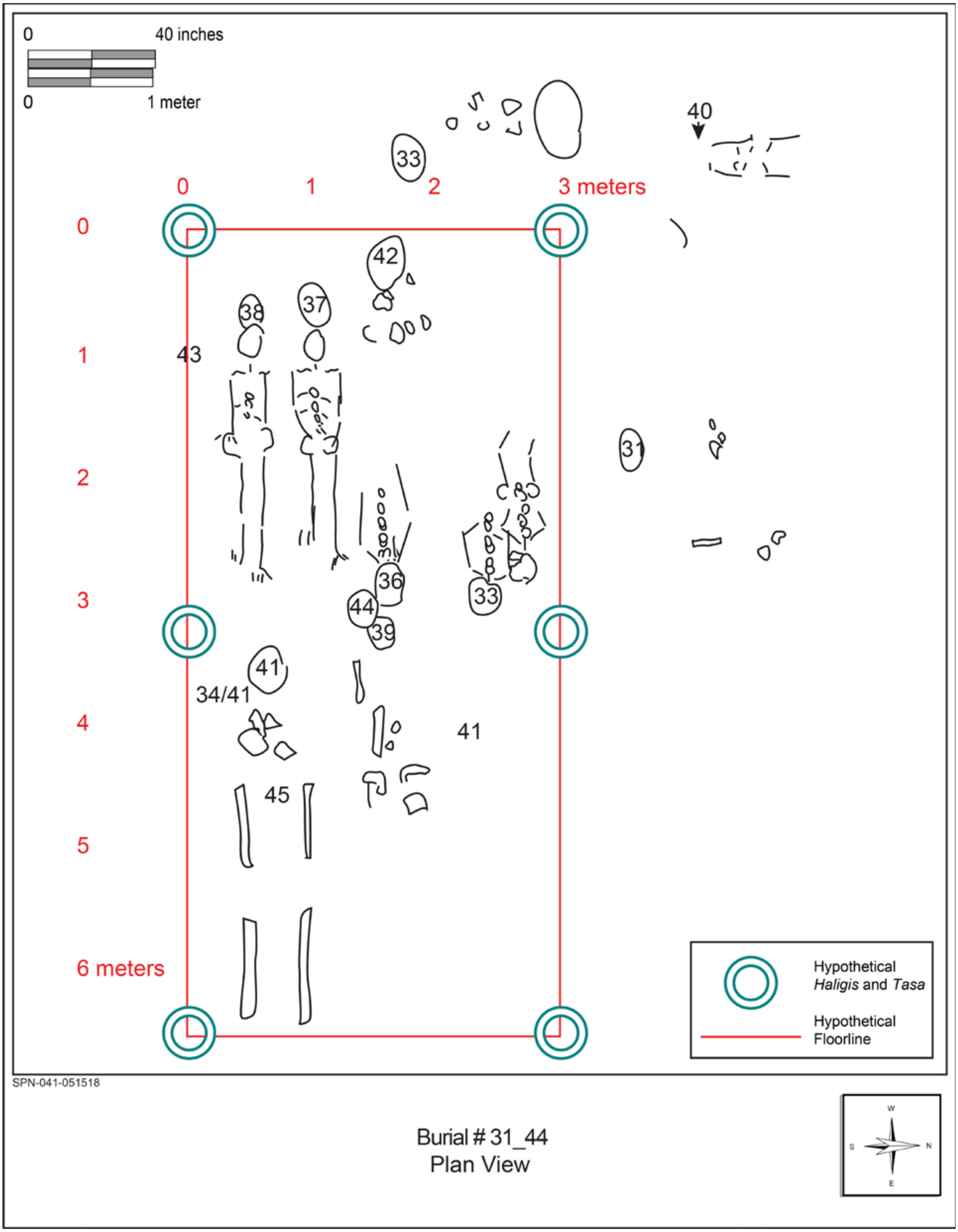

Figure 104. Hypothetical Latte Structure in Correlation with Burials 31 through 44

Type B rims (Stratum II) (Butler 1990; Moore and Hunter-Anderson 1999; Russell 1998). While specific family cooking and eating areas may have been spatially and temporally discrete events over centuries (Bulgrin 2009; Dixon et al. 2011), food preparation on such a large scale with 2 meter (6.6 feet) deep *dogas* ovens and large hearth complexes suggests both communal marine shell collection and periodic feasting involving multiple households (Dietler and Hayden 2001). Interestingly, the deepest *dogas* oven (Feature 5) contained sediments radiocarbon dated between A.D. 1669 and 1780, decades later than the smaller *dogas* oven (Feature 3) and two hearth complexes (Features 1 and 2) that dated A.D. 1450-1646, and the other deep *dogas* oven (Feature 8) that dated A.D. 1513-1601. This chronological sequence, based on Bayesian sequence models for initial site use (Cal A.D. 1416-1517), implies more intense food production at the end of the Latte Period and presumed highest population density, before the site and island were forcibly abandoned during *La Reduccion* circa A.D. 1721.

If so, the other deep *dogas* oven (Feature 8) dated A.D. 1513-1601 suggests resident families at Afetna Point, and perhaps in much of what is now San Antonio, were increasingly bound together by kinship obligations to participate in communal gathering events and periodic feasting (today referred to as *fiestas*) as found in other matrilineal societies across Micronesia (Rainbird 2004). An example of such resource collection, after demographic recovery from WWII in Tumon Beach on Guam, was noted where 'People would rake the sand at the waters edge and collect bivalves... and *dogas*... [that] were cooked and eaten as a soup, usually with barbequed breadfruit' (Bulgrin and Bulgrin 2009). Rebuilding of family residences after devastating typhoons would certainly have called for communal labor (c.f. Spennemann 2004), as it still does today. Family births and deaths would also have been unifying events, as burial customs described below appear to imply. Hypothetical reconstruction of these Latte Period family residences was further complicated by considerable disturbances from pre-war plantations, WWII, and post-war construction of the USCG LORAN Station. The charred material in the soil of the hearth complexes and *dogas* ovens was identified by Microfossil Research as grass and palm phytoliths, with marine sponge silica, and taro starch or rapides of other aroid corms and leaves. These remains were presumed to be fuel used to generate the fires of the cooking features, and perhaps residue from its cooked ingredients.

Notwithstanding these challenges to plant and food preservation, Burials 31 through 44 were found to be relatively intact during excavation and appeared to be a discrete cluster of 12 individuals within a rectangular area roughly 3 meters (9.8 feet) wide north to south by 6.5 meters (21.3 feet) long east to west. Given the approximate distance of 3 meters (9.8 feet) between and across pairs of *haligi* in most average sized *latte* sets (Morgan 1988), this cluster would appear to fit a 3-pair Latte habitation structure quite well (Figure 104). Excavations also yielded at least three stratigraphic sets of burials: an elder male in deepest position (Burial 38a), two adults immediately above (Burials 37 and 38) and three to the east at their feet (Burials 34, 41, and 45), plus four possible subadults to the north (Burials 32, 33, 36, and 42). Also present were craniums apparently not associated anatomically with these individuals (Burials 35 and 44), although some movement during secondary interment or removal of burial components is possible. It is tempting to interpret this particular cluster as a nuclear family of three generations, especially given the near absence of teeth and healing in the eldest *manamko* Burial 38a's mandible who lived to 60 years old or more, presumably cared for by his family to a venerable old age. A smaller cluster of Burials 46 through 48, within a possible 4 *haligi*/2-pair *latte* set not far away (Figure 105), suggest a possible kinship-related household of another nuclear family, without the earlier *manamko* or later grandchildren.

Unfortunately none of the remaining burials recorded on the property are as discretely clustered as Burials 31 through 44. Many appear to have been buried in pairs, denoting familial ties if not the close

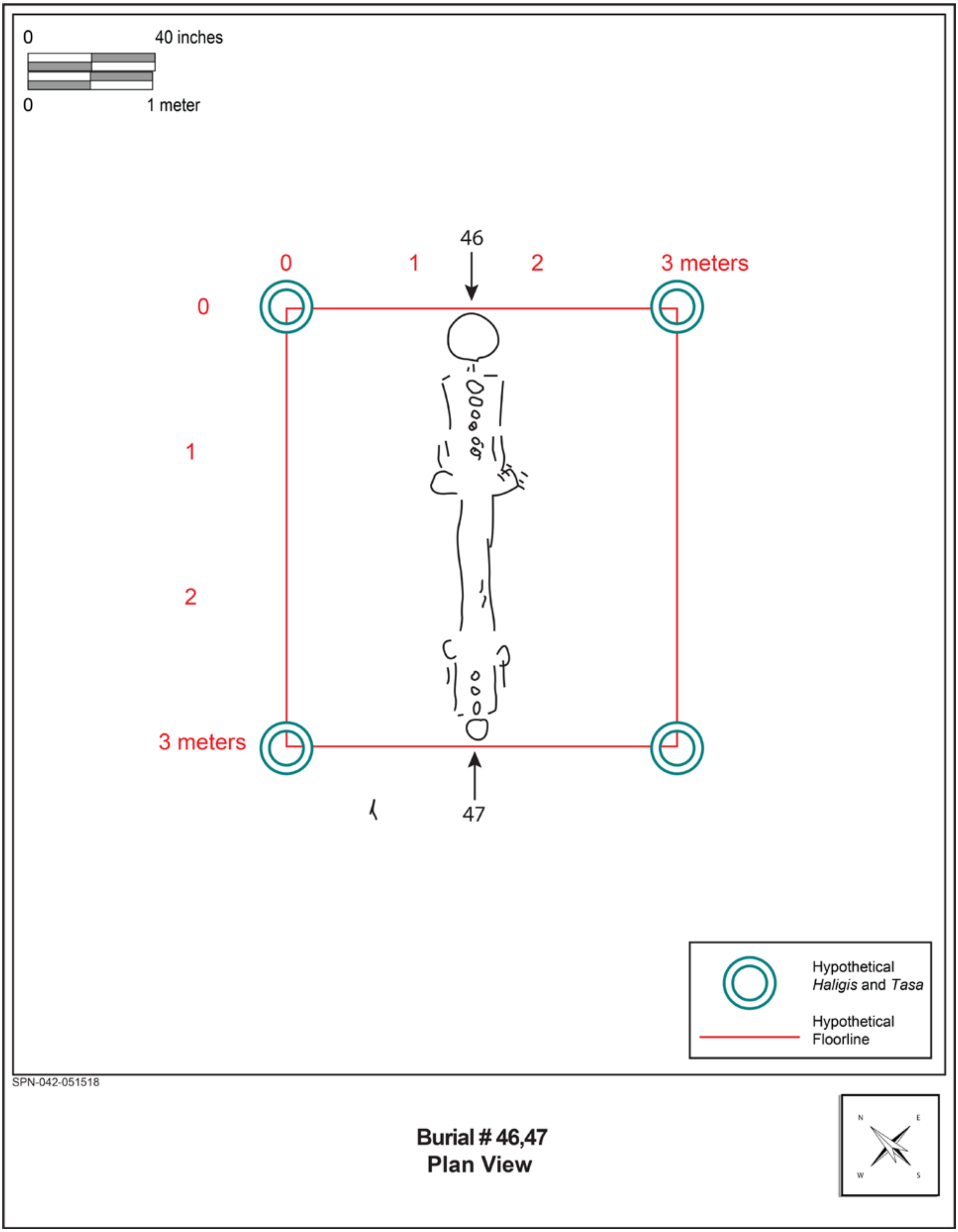

Figure 105. Hypothetical Latte Structure in Correlation with Burials 46 and 47

timing of their deaths. Worthy of note is that this possible *latte* set house at Burials 31 through 44 is oriented on its long axis east to west, perpendicular to and not parallel to the coast as is depicted in most larger coastal villages in the Mariana Islands (Graves 1986; Morgan 1988). Its orientation and small size relative to many larger village structures, even if it is the largest or at least longest occupied house in Site SP 1-1037 (discounting what may have been present in the 1980s sand mine), may imply that the Puntan Afetna community grew in a more organic manner, rather than being a more symmetrical planned community as perhaps was the case in Garapan. Radiocarbon dates from cooking features and middens found on both sides of Burials 31 through 44, within the property boundary, also cluster toward the end of the Latte Period from the late 1400s to the late 1600s. The local community may have not had the residential longevity of neighbors to the north or east. Isolated burials and pairs may have reflected shorter term family habitations toward the late 1600s, especially those found seaward of Burials 31 through 44 and its surrounding intensive activity zone, in shallow sands.

Another alterative activity, perhaps represented by the two hearth complexes Features 1 and 2, could be the production of pottery, likely undertaken at the family level but redistributed through each community as need and gifting required. While such features have rarely been recognized as such in the Northern Marianas, reconstructions of bonfire kiln stacks in the Caribbean appear to have similar elements – a stone base in a shallow basin on which the vessels lie above and below fuel of wood and then grass or leaves as cover (Figure 106). After repeated combustion events, each with removal of fired vessels, one might presumably have a feature consisting of a large spread of burned soils and residual fuel materials such as palm leaves, plus burned rock clusters with ash. 'Most potters allowed their wares to cool before pulling them from the dying fire to prevent undue cracking through rapid heat loss' (Krause 2016:59), but occasional broken pottery sherds might result from unsuccessfully fired vessels. A thatched roof set in shallow postholes might keep the rain from ruining each firing.

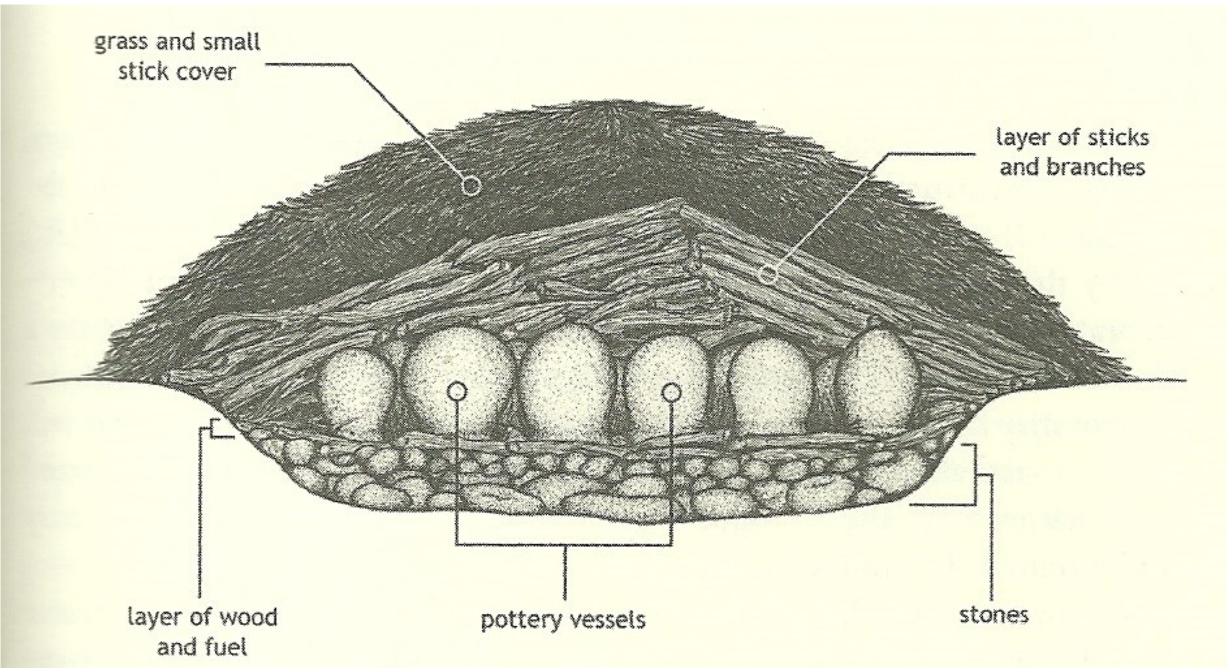

Figure 106. Hypothetical Latte Period Bonfire Pottery Kiln

Research Question 3: Could Latte Period burials often found beneath and around these types of habitation structures be identified in SP 1-1037 and examined to reconstruct the demographics and health of the local community after A.D. 1000?

7.2.1 Does the patterning of Latte burials suggest locations of domestic residences (latte structures)?

Previous excavations in the Marianas reveal that during prehistoric and early historic times, burial beneath or adjacent to *latte* sets was common (Butler 1988; Davis et al. 1992; Ray 1981; Reinman 1977; Ryan 2010; Ryan et al. 1999; Spoehr 1957; Stodder et al. 2016; Thompson 1971; Yawata 1961). The location of burials has provided indirect evidence for the presence of *latte* sets or pole-and-thatch structures (Bath 1986). Previous research has hypothesized that prehistoric Chamorro villages included structures for ordinary households, high-status households, and men's houses (Davis et al. 1992; Graves 1986, 1991; Hunter-Anderson and Butler 1991; Reinman 1977; Walth 2016). Some dwellings consisted of pole-and-thatch structures raised on wooden posts, and possibly higher-status structures raised on limestone pillars (*latte* sets). Researchers have found that Chamorro burials in and around *latte* sets tend to orient perpendicular to the long axis of a structure when buried beneath and parallel when buried outside of a structure (Bath 1986:33; Butler 1988; Graves 1986:146; Ray 1981; Reinman 1977; Ryan 2010; Ryan et al. 1999; Thompson 1971; Yawata 1961).

To address the research question regarding identifying possible latte structures in the project area: the location of burial clusters provides a proxy for locations of *latte* sets. The cluster analysis was completed to offer a means of determining what burials cluster together to help answer this research question. To further tease out this answer requires looking at the size of the AA units (clusters) defined from the cluster analysis and compare that with known information on *latte* structures. Bath (1986:33–34) proposed four criteria for estimating the number and location of dwellings within a site. This was based on information from Guam, however the underlying assumptions would be comparable to Saipan. Those four criteria are:

1. The long axis of structures....will be oriented somewhere between due north and due east, with the most likely orientation between N 50°E and N 68°E. This assumption is extended to pole-and-thatch houses.
2. House length will vary between 10 and 12 meters, width between 2.9 and 3.6 meters, and distance between stones or posts between 2.5 and 3.5 meters.
3. The short axis will be at right angles to the long axis.
4. A concentration of burials with a consistent orientation provides evidence of a prior house structure oriented perpendicular to the burial orientation. (Bath 1986:33–34)

Given the above postulated length and width of a *latte* dwelling, the overall size would fall between 29 and 43.2 m^2. No size was specified for pole-and-thatch structures, but it is assumed that they would not be any larger and could be smaller. Information on the size of the AA units from this site was presented above in Table 8.27. AA units 2 and 3 fall within the postulated size for a *latte* structure. AA 5 is about twice the size, and the remaining AAs go up in size from there. However, it is possible that the larger size is a result of one or more factors. Burials are also interred outside of the *latte* structure, and this would increase the overall size greatly. This would make AA units 1, 4, and 6 in the likely realm for a *latte* structure, depending on the distance outside of the footprint of the structure that burials were interred. This still leaves AA 7 and 8 being exceptionally large. These two AAs also have a very low density of burials. Another possibility is that a *latte* structure may have been constructed, removed, and a new structure placed in a similar area but outside of the original footprint. Looking at size, burial density, age, and sex of the burials, it is likely that AAs 1, 2, 3, 4, 5, and 6 do represent *latte* or some other residential habitation structure.

7.2.2 What are the demographics of the burial population recovered?

Paleodemography is a field of study that focuses on demographic characteristics of prehistoric populations, and in this case one that is derived from an archaeological investigation. The current site was not excavated by any scientific sampling strategy. Burials that were identified during monitoring were excavated and in the process, additional burials were discovered and exhumed. Thus a note of caution should be given that the demographics of this excavated population may not necessarily represent the living population that it was a part of. Paleodemographics examine the age and sex profile of the population sample.

The overall distribution of subadults (<20 years) to adults (20+ years) is 16 to 73, or 82 percent of the sample are adults. Therefore, 18 percent of the sample represents subadults, which compares favorably to other Latte period samples from Guam and the CNMI (Douglas and Ikehara 1992; Graves 1987; McGovern-Wilson 1989; Pietrusewsky and Batista 1980; Pietrusewsky et al. 2003; Rader and Haun 1989; Trembly and Tucker 1999; Walth 2016). There are a large number of adults where the age could only be categorized as 20+ years (33.7 percent, n=30). The next largest cohort is the middle adult category (35–49.9 years of age) at 25.8 percent (n=23), followed by the young adult category with 21.3 percent (n=19). These three groups are the majority of the sample (80.9 percent, n=72). Adolescents are 6.8 percent (n=6) of the sample, followed by infants with 4.5 percent (n=4), young child with 3.4 percent (n=3), child with 2.3 percent (n=2), and older child with 1.1 percent (n=1) of the population. One older individual (50+ years of age at death) was identified. The assemblage does have individuals in all age groups from birth to old age.

For the information on the distribution of sex, the analysis only considers individuals that are adolescent or older because sex of children cannot be reliably obtained unless DNA analysis is completed. For the demographic profile for this group, those individuals that were identified as 'female possible' were added to the females, and likewise 'male possible' individuals were added to the males. Females outnumber males (25 to 15 or 1.67:1) with 1.67 females to every one male. Sex could not be estimated for 39 individuals (49.4 percent of the sample). As a percent females and males, more females (44 percent, n=11) than males (33 percent, n=5) died by young adult age (20–35 years) and one male lived into the older adult age group (50+ years of age). The increased risk of childbearing likely represents a hazard for the females. Male hazards resulting in death could include warfare, accidents, or other cultural activities.

An abridged life table was completed to estimate the life expectancy for the group. For this life table, sexes are combined, and individuals with no specific age estimate were distributed proportionately among the age ranges. The burial sample has individuals in age categories from infancy to older adult (estimated in this group as 50+ years of age at death). Overall life expectancy (mean age at death) is 30.2 years. Mortality risk is highest in the 35–39.9 group. That is followed in descending order by the 20 to 24.9 age group, the 25 to 29.9 and 40 to 44.9 age groups, the 35 to 39.9 age group, and the 45 to 49.9 age group. Mortality for children (under 15 years) is highest for children ages 0 to 0.9 months, and 2 to 4.9, followed by children 5 to 9.9, and lowest for the 1 to 2.9 and 10 to 14.9 age groups. Survivorship data for just the males and females were also calculated. This includes adolescent through older adults. The adults that were indeterminate to sex were not included. Adolescent females had a life expectancy of 19 years and adolescent males had a life expectancy of 25 years.

7.2.3 What is the general health of this population?

There are 28 individuals that exhibit some pathology or unusual trait. By far the most common pathology is osteoarthritis including degenerative joint disease (DJD) on the appendicular elements and vertebral osteoarthritis on the axial elements. There are 10 individuals that have some degree of DJD, four with Vertebral OA, and six with both for a total of 20 individuals. Two individuals have Schmorl's nodes, two have possible blunt-force trauma on cranial elements, and two possibly had a traumatic injury that resulted in DJD. There are two possible cases of treponemotosis (yaws), and three individuals with unknown infectious lesions. There is one conoid joint, three individuals with squatting facets, one with Pacchionian pits, one rhomboid fossae, two Steida's process, one with a fused middle and distal foot phalange, and two with enthesophytes at the Achilles tendon. Osteoarthritis indicates that these were active individuals that may have participated in physically stressful activities, but it is a typical ailment that progresses with age. In general, these individuals were relatively healthy. The fact that few had LEH and none were observed with cribra orbitalia, suggests that they did not have excessive stress during the developing childhood years. Yaws is endemic in the populations of the Mariana Islands and it is not uncommon to have some individuals with this disease.

Chapter 8

Larger Research Implications

8.1 Latte Period Comparisons

As a result of the *3rd Annual Marianas History Conference* in Saipan (www.Guampedia.com), tentative comparisons are enabled between the Afetna Point site in San Antonio (Dixon 2017) and the Anaguan site in Garapan (Dega et al. 2017), with a linear distance of roughly 9.7 kilometers (6.0 miles) between the two Latte Period villages. Although both sites were roughly contemporaneous, it is proposed that their clan composition and the traditions handed down in both villages may have reflected somewhat distinct ecological adaptations and unique family histories, perhaps resulting in the following patterns noted below.

- Both developments covered an approximate area of 4 hectares (10 acres), although the Afetna Point site included a less than 0.81 hectare (2 acre) portion removed during 1980s sand mining, with an unknown number of burials extracted.
- Both sites were occupied during the Latte Period, although use of the Garapan site was much earlier as radiocarbon dated between at least A.D. 1220-1645 (before sustained Contact), while the Afetna Point site use was radiocarbon dated between at least A.D. 1426-1780 (more likely circa 1730 after *La Reduccion*).
- The Garapan site yielded 416 burials in 2017 and 261 in the 1990s totaling 677, while the Afetna Point site yielded 93 total, minus those removed in the sand mining and by Graves in the 1980s. The earliest Latte Period component of the Afetna Point site may thus have been partially removed in the sand mine, but the site was likely occupied later in time as well.
- The Garapan site had three spatially distinct burial complexes roughly paralleling the coast and perhaps representing three time periods or lineage clusters, while Afetna Point burials had no extensive complexes on such a large scale nor any observable orientation or patterning.
- Burials at the Garapan site included several with dental incision and one child within a ceramic vessel, while no such evidence was noted at Afetna Point site.
- Both sites had a relatively healthy population with evidence of betel nut dental staining, but no major health problems or introduced pathogens.
- The Garapan site contained fire hearths and postholes with dense midden, while the Afetna Point site contained deep *dogas* ovens and multiple hearth complexes with dense midden, but few postholes evident.
- Both sites had the full range of Latte Period stone and shell tools or beads, although the Garapan site had more basalt flakes, cores, and sling stones, than noted at the Afetna Point site.
- Both sites had the full range of Latte Period ceramic vessel forms, although the Garapan site had more decorative surface treatment styles than noted at the Afetna Point site.
- Both sites had evidence of the range of domestic food crops and forest products expected during the Latte Period, in Garapan identified from biomolecular research and in Afetna Point from microfossil remains.

To summarize these comparisons, the Garapan site appears to have been occupied earlier in the Latte Period, but perhaps abandoned or moved after the arrival of the Spanish missionaries circa 1668. The Afetna Point site began two centuries later but continued to be occupied up until *La Reduccion* circa 1730, perhaps due to its greater distance from Colonial acculturation. The Garapan site had a larger population density and more clustered settlement pattern, while the Afetna Point site had a smaller population and more dispersed settlement pattern, perhaps reflecting different clan residency rules and interclan marriage restrictions between opposing ends of the island and lagoon. The higher number of sling stones at the Garapan site may also have had social implications in this regard.

Both sites had ample cooking remains, but those at the Afetna Point site suggest communal ovens and hearth complexes, while at the Garapan site cooking may have been relegated to within site clusters, again perhaps a reflection of clan residency and foodways. Both sites also had the full range of stone and marine shell tools or beads, but the Garapan site appeared to contain more evidence of stone tool manufacture while the Afetna Point site had more evidence of stone tool maintenance and repair. Garapan was situated much closer to sources of volcanic stone in the uplands, while Afetna Point was situated at the extreme southwestern corner of the island on a limestone plateau, and not far (on a calm day) from the island of Tinian. Both sites appeared to be sustained by terrestrial farming, hunting, and forest collection, as well as marine resource collection and fishing, although Garapan was far closer to limestone forest resources while Afetna Point was closer to marsh edge settings.

Differences between contemporaneous Latte Period village 'personalities' on Saipan and in the Marianas have not always been recognized as such archaeologically, especially as the changing pace of development over the past few decades has tended to splinter observations by property and region of each island. The early Spanish record however, is replete with references to bellicose differences being unresolved between the villages of Sanhalom and Makpo on Tinian in 1669, shifting allegiances to the Spanish between villages on Guam in 1684, and continued resistance to *La Reduccion* in Saipan and Gani into the 1720s (Farrell 2011). Landuse and clan organization appear to have been matrilineal and residency tended toward matrilocal prior to contact, as the 'missionaries noted that Chamorros did not marry relatives' and 'the women were the heads of households' (Russell 1998:149-150). It could be expected then that differences in house structures, craft production, foodways, burials, and even language might well have been preserved at individual villages over generations as part of community group identity (Ross 1997, 1998), at least until the demise of interisland voyaging in the early Spanish period (Hage and Mark 2002).

Chapter 9

References Cited by Major Topics

9.1 Archaeological and Historical References

Adams, J., C. Denfeld, and M. Tomonari-Tuggle

1996 Test Excavation of a World War II Japanese Mass Grave at Achugao, Saipan, Commonwealth of the Northern Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.

Allen, J.

2006 The Old Japanese Jail: Archaeological Survey and Testing at Site SP-5-0020, Garapan, Saipan, Commonwealth of the Northern Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.

Amesbury, J.

1999 Changes in Species Composition of Archaeological Marine Shell Assemblages in Guam. *Micronesica* 31(2):347-366.

2007 Mollusk Collecting and Environmental Change during the Prehistoric Period in the Mariana Islands. *Coral Reefs* 26(4):947–958.

Amesbury, J., D. Moore, and R .Hunter-Anderson

1996 Cultural Adaptations and Late Holocene Sea Level Change in the Marianas: Recent Excavations at Chalan Piao, Saipan, Micronesia. *Indo-Pacific Prehistory Association Bulletin* 15:53-69.

Amesbury, J.R. and C.K. Walth

2016 Who Wears the Beads? 2,000 Years of Ornaments from an Archaeological Site on Guam. A booklet prepared by Micronesian Archaeological Research Services, Guam

Andaya B.W. and L.Y. Andaya

2015 A History of Early Modern Southeast Asia, 1400–1830. *Asian Affairs*, 47(1), pp. 170–171.

Andrefsky, W. Jr.

2005 Lithics Macrosopic Approaches to Analysis. Cambridge University Press. New York.

Athens, S., M. Dega, and J. Ward

2004 Austronesian Colonization of the Mariana Islands: The Paleoenvironmental Evidence. *Indo-Pacific Prehistory Association Bulletin* (Taipei Papers, Volume 2) 24:21-30.

Athens, S. and J. Ward

1998 Paleoenvironment and Prehistoric Landscape Change: A Sediment Core Record from Lake Hagoi, Tinian, CNMI. Prepared for Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaiʻi. International Archaeological Research Institute, Inc., Honolulu.

2005 Holocene Paleoenvironment of Saipan: Analysis of a Core from Lake Susupe. Micronesian Archaeological Survey Report Number 35, Saipan.

Aufderheide, A.C., and C. Rodriguez-Martin

1998 *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge University Press, Cambridge, United Kingdom.

Barnes, E.

1994 *Developmental Defects of the Axial Skeleton in Paleopathology*. University Press of Colorado, Niwot.

Barratt, G.

1988 *Carolinean Contacts with the Islands of the Marianas: The European Record.* Micronesian Archaeology Survey Report Series Number 25. CNMI Division of Historic Preservation, Saipan.

2003 *The Chamorros of the Mariana Islands Early European Records, 1521-1721.* Occasional Historic Papers Series No. 10. CNMI Division of Historic Preservation, Saipan.

Bass, W.M.
1987 *Human Osteology: A Laboratory and Field Manual.* 3rd ed. Missouri Archaeological Society, Columbia.
Bayliss, A. and C. Bronk Ramsey
2004 Pragmatic Bayesians: A Decade of Integrating Radiocarbon Dates into Chronological
Models. In *Tools for Constructing Chronologies: Tools for Crossing Disciplinary Boundaries*, edited by C.E. Buck and A.R. Millard, pp. 25-41. Springer, London.
Bedford, M.E., K. Russell, and C.O. Lovejoy
1989 The Utility of the Auricular Surface Aging Technique. Poster presented at the 58th Annual Meeting of the American Association of Physical Anthropologists, San Diego, California.
Bowers, N.
1950 *Problems of Resettlement on Saipan, Tinian, and Rota, Mariana Islands.* Coordinated Investigation of Micronesian Anthropology Report, No. 31. Pacific Science Research Board and National Research Council, Ann Arbor, Michigan.
Bramblett, C.A., and D. Gentry Steele
1988 *The Anatomy and Biology of the Human Skeleton.* 7th ed. Texas A&M University Press, College Station, Texas.
Brothwell, D.R.
1981 *Digging Up Bones: The Excavation, Treatment, and Study of Human Skeletal Remains.* 3rd
Edition. Ithaca, New York: Cornell University Press.
Bulgrin, L.
2005 The Tudela Site: Fire and Steel Over Saipan, 15 June 1944. *Journal of Combat Archaeology* 1(1):117.
2006 'Fina`okso Antigo' Prehistoric Soil Mounds in the Interior of Rota. *Micronesian Journal of the Humanities and Social Sciences* 5(1/2):31-41.
2009 Beyond Latte Stones: Modeling the Latte Period. *Pacific Island Archaeology in the 21st Century: Relevance and Engagement.* Palau.
Bulgrin, L., and M. Bulgrin
2009 'There Was Nothing Wrong with Tumon': A Description of Post-World War II Tumon. In M. Carson and J. Peterson (Editors), Archaeological Research at the New Charterhouse Condominiums Project, Location of Former Tropicana Hotel, Tumon, Guam. Prepared for Architects Laguana and Christobel. Manuscript on file with MARC, University of Guam, Mangilao.
Buikstra, J.E., and D.H. Ubelaker
1994 *Standards for Data Collection from Human Skeletal Remains.* Arkansas Archaeological Survey
Research Series No. 44.
Burns, J.M., and M.C. Krivor
2015 Archaeological Survey of WWII Landing Beaches on the West Coast of Saipan. In J. McKinnon and T. Carrell (Eds.), *Underwater Archaeology of a Pacific Battlefield: The WWII Battle of Saipan.* New York: Springer.
Butler, B.
1990 Pots as Tools: The Marianas Case. *Micronesica* 2:33-46.
1994 Early Prehistoric Settlement in the Mariana Islands: New Evidence from Saipan. *Man and Culture in Oceania* 10:15-38.
1995 Archaeological Investigations in the Achugao and Matansa Areas of Saipan, Mariana Islands. Micronesian Archaeological Survey Report No. 30. Division of Historic Preservation, Department of Community and Cultural Affairs, Saipan, MP.
Butler, B., and D. DeFant
1994 Archaeological Survey on the Leeward Coast of Saipan: Garapan to Oleai. Micronesian Archaeological Survey Report No. 27. The Micronesian Archaeological Survey, Division of Historic Preservation, Department of Community and Cultural Affairs, Saipan.
Cabrera, G.
2015 An historical overview of the battle for Saipan. In J. McKinnon and T. Carrell (Eds.), *Underwater Archaeology of a Pacific Battlefield: The WWII Battle of Saipan.* New York: Springer.

Carson, M.
2008 Refining Earliest Settlement in Remote Oceania: Renewed Archaeological Investigation at Unai Bapot, Saipan. *The Journal of Island and Coastal Archaeology* 3:115-139.
2014 *First Settlement of Remote Oceania Earliest Sites in the Mariana Islands*. Springer, New York.
Carson, M., and J. Peterson
2011 Calcrete Formation and Implications for Buried Archaeological Deposits in the Mariana Islands, Western Pacific, *Geoarchaeology* 26(4):501-513.
2012 Radiocarbon Dating of Agal Bioclasts in Beach Sites of Guam. *The Journal of Island and Coastal Archaeology* 7(1):64-75.
Clark, G., F. Petchey, O. Winter, M. Carson, and P. O'Day
2010 New Radiocarbon dates from the Bapot-1 Site in Saipan and Neolithic Dispersal by Stratified Diffusion. *Journal of Pacific Archaeology* 1(1):21-35.
Craib, J.
1991 Archaeological Investigations in Support of the MTC Cable Project, Guam and the Commonwealth of the Northern Mariana Islands. Prepared by ERC Environmental and Energy Services Co., Inc., Honolulu, Hawaii.
1998 Archaeological Surveys of Military Lease Lands on Tinian for the Partial Mitigation of Adverse Effects in Conjunction with the FY93 Tandem Thrust Training Exercise. Prepared for the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i. Ogden Environmental and Energy Services Co., Inc. Honolulu, Hawaii.
1999 Archaeological Investigations at Tanapag Village and the Former Quartermaster Station, Chalan Pupula, Saipan, Commonwealth of the Northern Mariana Islands. Prepared by Ogden Environmental and Energy Services Co., Inc., Honolulu, Hawaii.
DeFant, D.
1993 Phase I Archaeological Inventory Survey of the Saipan Eastern Bay Golf Course Project Area, Commonwealth of the Northern Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
Dega, M., D. Perzinski, and J. Ferrugia
2017 Draft The *Latte* Village of Garapan: Archaeological Data Recovery, Saipan, Commonwealth of the Northern Mariana Islands. Prepared by Scientific Consultant Services for Imperial Pacific International, LLC. December.
Denfeld, C.
1997 *Hold the Marianas: The Japanese Defense of the Mariana Islands*. White Mane Publishing Company, Inc., New York.
2002 *Japanese World War II Fortifications and Other Military Structures in the Central Pacific*.
N.M.I. Division of Historic Preservation, Saipan.
Dickinson, W.
2000 Hydro-Isostatic and Tectonic Influences on Emergent Holocene Paleoshorelines in the Mariana Islands, Western Pacific Ocean. *Journal of Coastal Research* 16(3):735-746.
Dietler, M., and B. Hayden
2001 Digesting the Feast—Good to Eat, Good to Drink, Good to Think: An Introduction, in *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*. Washington, D.C., pp. 120.
Dietz, B.
2018 Loran Station History. Available on-line: http://www.loran-history.info/.
Dixon, B.
2017 *Archaeological Data Recovery of Parcel 004-1-52, San Antonio, Saipan*. Paper presented at the 3rd Annual Marianas History Conference.
Dixon, B., S. Athens, D. Welch, J. Ward, T. Mangieri, and T. Reith
1999 Archaeological Inventory Survey of the Sasa Valley and Tenjo Vista Fuel Tank Farms, Piti District, Territory of Guam, Mariana Islands. Prepared for Naval Facilities Engineering Command, Pacific

Division, Pearl Harbor, Hawai`i by International Archaeological Research Institute, Inc., Honolulu, Hawai`i. September.
Dixon, B., D. Welch, T. Dye, and T. Mangieri
2000 Phase II Archaeological Survey of the Military Lease Area (Former VOA Areas B and C), Island of Tinian, Commonwealth of the Northern Mariana Islands.
Dixon, B., H. Bartow, J. Coil, W. Dickinson, G. Murakami, and J. Ward
2011 Recognizing Inland Expansion of Latte Period Agriculture from Multi-disciplinary Data on Tinian, Commonwealth of the Northern Mariana Islands. *Journal of Island & Coastal Archaeology* 6(3):375-397.
Dixon, B., and R. Schaefer
2014 Reconstructing Cultural Landscapes for the Latte Period Settlement of Ritidian: A Hypothetical Model for Northern Guam. In Guam's Hidden Gem: Archaeological and Historical Studies at Ritidian, Guam. British Archaeological Reports, Edited by Mike Carson, BAR International Series 2663:64-72.
Dixon, B., T. Mangieri, E. McDowell, K. Paraso, and T. Reith
2006 Latte Period Domestic Household Activities and Disposal Patterns on the Micronesian Island of Tinian, CNMI. *Micronesica* 39(1):55-71.
Dixon, B., and T. McCurdy
2015a Final Archaeological Inventory Survey Report in Support of Proposed Development at Parcel 004-I-52, San Antonio, Saipan, Commonwealth of the Northern Mariana Islands. Prepared for N15 Architects. 27 February.
2015b Work Plan for Archaeological Data Recovery of Parcel 004-I-52, San Antonia, Saipan, Commonwealth of the Northern Mariana Islands. Prepared for N15 Architects, Sapian MP. February.
2015c End-of-Fieldwork Summary Letter for Archaeological Data Recovery Investigation at Parcel 004-1-52, San Antonia, Saipan, CNMI. 19 July.
Driver, M.
1983 Fray Juan Pobre De Zamora and His Account of the Mariana Islands. *Journal of Pacific History* 18:198216.
1993 *Fray Juan Pobre in the Marianas 1602*. MARC Miscellaneous Series No. 8, University of Guam.
Driver, M., and O. Brunal-Perry (editors)
1993 *Carolinians in the Marianas in the 1800s*. MARC, University of Guam.
Farrell, D.
1994 *Saipan*. Micronesian Productions, Commonwealth of the Northern Mariana Islands, Saipan.
2011 *History of the Mariana Islands to Partition*. Public School System, Commonwealth of the Northern Mariana Islands, Saipan.
Fritz, G.
1989 *The Chamorro: A History and Ethnography of the Marianas*. CNMI Division of Historic Preservation, Saipan.
Giraldez, A.
2015 *The Age of Trade: The Manila Galleons and the Dawn of the Global Economy*. Rowman and Littlefield, Maryland.
Graves, M.
1986 Organization and Differentiation within Late Prehistoric Ranked Social Units, Mariana Islands, Western Pacific. *Journal of Field Archaeology* 13(2):139–154.
1987 *A Preliminary Archaeological Assessment of the Surf Hotel Extension Project, San Antonio, Island of Saipan.* Prepared for the Division of Historic Preservation, CNMI, Saipan.
Graves, M., and D. Moore
1986 An Inland Latte Period Site at Chalan Galaide, Saipan: Archaeological Survey and Test Excavations of Prehistoric and Historic Components. Prepared for the Division of Historic Preservation, CNMI, Saipan.
Griffin, A., T. McCurdy, B. Dixon, and R. Jones
2015 Final V3 Identification and Evaluation of Traditional Cultural Properties on the Island of Tinian, Commonwealth of the Northern Mariana Islands. Prepared for Department of the Navy. March.

Hage, P., and J. Marck

2002 Proto-Micronesian Kin Terms, Descent Groups, and Interisland Voyaging. *Oceanic Linguistics* 41(1):159-170.

Hanson, D.

1990 *The Skeletal Biology of Prehistoric Human Mortuary Remains from the Duty Free Site, Garapan Village, Saipan.* Report prepared for Duty Free Shopper, Ltd. and the Division of Historic Preservation, Department of Community and Cultural Affairs, Commonwealth of the Northern Mariana Islands, Saipan.

Hasebe, K.

1928 Ruins and Relics in the Islands of Saipan and Tinian. *Zinruigaku Zassi* 43(88):243-274.

Haun, A., and J. Henry

1993 Archaeological Inventory Survey Phase II – Data Collection Shimizu Golf Course Development Area Historic Context: Japanese World War II Defense of Saipan Circa 1930-1944 Island of Saipan Commonwealth of the Northern Mariana Islands. Prepared by Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawaii.

Heathcote, G., K. Bansil, and V. Sava

1996 A Protocol for Scoring Three Posterior Cranial Superstructures Which Reach Remarkable Size in Ancient Mariana Islanders. *Micronesica* 29:281-298.

Heathcote, G.M., T.G. Bromage, V.J. Sava, D.B. Hanson, and B.E. Anderson

2014 Enigmatic Cranial Superstructures Among Chamorro Ancestors From the Mariana Islands: Gross Anatomy and Microanatomy. *The Anatomical Record* 297:1009-1021.

Hezel, F.

1989 *From Conquest to Colonization: Spain in the Mariana Islands 1690 to 1740.* Division of Historic Preservation, Saipan.

Hornbostel, H.G.

1924-25 Unpublished notes from the Bernice P. Bishop Museum, Honolulu. Microfilm on file, Micronesian Area Research Center, University of Guam, Mangilao.

Horrocks, M.

2005 A Combined Procedure for Recovering Phytoliths and Starch Residues from Soils, Sedimentary Deposits and Similar Materials. *Journal of Archaeological Science* 32:1169-1175.

2017 Plant Microfossil Analysis of Archaeological Samples from Site SP1-1307, Saipan, Mariana Islands. *Microfossil Research*, Auckland, NZ.

Horrocks, M., W.T. Baisden, M.K. Nieuwoudt, J. Flenley, D. Feek, N.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, 185-204.

Horrocks, M., J. Peterson, and M.T. Carson

2015 Pollen, Starch, and Biosilicate Analysis of Archaeological Deposits on Guam and Saipan, Mariana Islands, Northwest Pacific: Evidence for Chamorro Subsistence Crops and Marine Resources. *Journal of Island and Coastal Archaeology* 10:97-110.

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.

Houghton, P., B.F. Leach, and D.G. Sutton

1975 The estimation of stature of prehistoric Polynesians in New Zealand. Journal of the Polynesian Society 84:325-336.

Howells, W.W.

1973 *Cranial Variation in Man: A Study by Multivariate Analysis of Patterns of Difference among Recent Human Populations*. Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University, Volume 67. Harvard University, Cambridge, Massachusetts.

Hung, S., M. Carson, P. Bellwood, F. Campos, P. Piper, E. Dizon, M. Bolunia, M. Oxenham, and Z. Chi
2011 The First Settlement of Remote Oceania: the Philippines to the Marianas. *Antiquity* 85:909-926.
Hunter-Anderson, R.
1994 Archaeology in Manenggon Hills, Yona, Guam Volume III Results of Analyses. Prepared for MDI Guam Corporation, Yona, Guam by Micronesian Archaeological Research Services, GMF, Guam. March.
Hunter-Andersen, R., and B. Butler
1995 *An Overview of Northern Marianas Prehistory*. Micronesian Archaeological Survey Report No. 31. Commonwealth of the Northern Mariana Islands, Division of Historic Preservation, Saipan.
Johnston, F.E., and L.O. Zimmer
1989 Assessment of Growth and Age in the Immature Skeleton. In *Reconstruction of Life from the Skeleton,* edited by Mehmet Y. İşcan and Kenneth A. R. Kennedy, pp. 23–40. Alan R. Liss, Inc., New York, New York.
Jones, D.
1986 *Oba The Last Samurai Saipan 1944-1945.* Presidio Press, Novato, CA.
Jones, B., and M. Tomonari-Tuggle
1994 *Archaeological Data Recovery at the Guma Capuchino and South Garapan Sites Garapan Village, Saipan.* Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
Kahn, J.G., T.M. Rieth, P.V. Kirch, J. S. Athens, and G. Murakami
2014 Re-Dating of the Kuliʻouʻou Rockshelter, Oʻahu Hawaiʻi: Location of the First Radiocarbon Date from the Pacific Islands. *Journal of the Polynesian Society* 123:67-90.
Katz, C.R.
2015 Between Land and Sea: Surveying the Shoreline. In J. McKinnon and T. Carrell (Eds.), *Underwater archaeology of a Pacific battlefield: The WWII Battle of Saipan.* New York: Springer.
Katz, D., and J. M. Suchey
1986 Age Determination of the Male Os Pubis. *American Journal of Physical Anthropology* 69:427–435.
Krause, R.A.
2016 *A Universal Theory of Pottery Production: Irving Rouse, Attributes, Modes, and Ethnography*. Caribbean Archaeology and Ethnohistory. University Alabama Press.
Leap, L., R. Brown, and A. Haun
1991 Archaeological Inventory Survey Pacific Islands Club Building 'F' Site, Afetna, Island of Saipan, Commonwealth of the Northern Mariana Islands. Prepared by Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawaii.
Lovejoy C.O., R.S. Meindl, T.R. Pryzbeck, and R.P. Mensforth
1985 Chronological Metamorphosis of the Auricular Surface of the Ilium: A New Method for the Determination of Adult Skeletal Age at Death. American Journal Physical Anthropology 68:15-28.
Loy, T.H., M Spriggs, and S. Wickler
1992 Direct Evidence for Human Use of Plants 28,000 Years Ago: Starch Residues on Stone Artefacts from the Northern Solomon Islands. *Antiquity* 66, 898–912.
Madrid, C.
2006 *Beyond Distances Governance, Politics and Deportation in the Mariana Islands from 1870-1877.* .
Mann, R.W., and D.R. Hunt
2005 *Photographic Regional Atlas of Bone Disease, A Guide to Pathologic and Normal Variation in the Human Skeleton*. Charles C. Thomas, Springfield, Illinois.
Marck, J.
1978 *Interim Report of the 1977 Laulau Excavations*. Report on file, CNMI Division of Historic Preservation, Saipan.

Mariotti, V., F. Facchini, and M. G. Belcastro
2007 The Study of Entheses: Proposal of a Standardised Scoring Method for Twenty-Three Entheses of the Postcranial Skeleton. *Collegium Antropologicum* 31(1):291–313.
Mathers, W., H. Parker III, and K. Copus
1990 Archaeological Report, The Recovery of the Manila Galleon, Neustra Señora De La Concepción. Prepared for the Government of the Commonwealth of the Northern Mariana Islands. Prepared by Pacific Sea Resources, Sutton, Vermont.
Mayhall, J.
1992 Techniques for the Study of Dental Morphology. In *Skeletal Biology of Past Peoples: Research Methods,* edited by S. R. Saunders and M. A. Katzenberg, pp. 59–78. Wiley-Liss, New York, New York.
Mazurek, C., M. Kasko, and C. Denfield
1991 *Interim Summary Report: Phase I Archaeological Inventory Survey of the Proposed Kagman Golf Course Project Area Saipan, Commonwealth of the Northern Mariana Islands*. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
McGovern-Wilson, R.
1988 Afetna: The Prehistory of South West Saipan. Prepared for the Division of Historic Preservation, CNMI, Saipan.
McKinnon, J., and T. Carrell (eds.), *Underwater archaeology of a Pacific battlefield: The WWII Battle of Saipan.* New York: Springer.
Meindl, R.S., and C.O. Lovejoy
1989 Age Changes in the Pelvis: Implications for Paleodemography. In *Age Markers in the Human Skeleton*, edited by M. Y. Īşcan, pp. 137–168. Charles C Thomas, Springfield, Illinois.
Miksic, J.N., and G. Yian Goh
2017 *Ancient Southeast Asia*. Routledge, New York. NY.
Moore, D.
2002 *Guam's Prehistoric Pottery and Its Chronological Sequence*. With contributions by William R. Dickinson, Hector Neff, Michael D. Glascock, Thomas H. Loy, and Alison Crowther. Prepared for International Archaeological Research Institute, Inc., Honolulu, and the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i. Micronesian Archaeological Research Services, Guam.
2013 *Where is the Gold? Silver and Copper Coins from Two of Guam's Historic Sites*. Unpublished Typescript in the Files of Micronesian Archaeological Research Services, Mangilao.
Moore, D.R., and R. Hunter-Anderson
1996 Pots and Pans in the Intermediate Pre-Latte (2500-1600BP), Mariana Islands, Micronesia. Paper presented at the Vanuatu National Museum--Australian National University--ORSTOM conference: 'The Western Pacific, 5000-2000 BP: Colonisations and Transformations,' Port Vila, Vanuatu, July 31-August 6.
1999 Pots and Pans in the Intermediate Pre-Latte (2500-1600 BP), Mariana Islands, Micronesia. In *The Pacific from 5000 to 2000 BP, Colonisation and Transformations*, edited by Jean- Christophe Galipaud and Ian Lilley, pp. 487-503. Institut de Recherche pour le Développement, Colloques et Séminaires, Paris.
Moore, P.D., J.A. Webb, and M.E. Collinson
1991 *Pollen Analysis*, 2nd Edition. Blackwell Scientific, London.
Moore, D., R. Hunter-Anderson, J. Amesbury, and E. Wells
1992 *Archaeology at Chalan Piao, Saipan.* Prepared for CNMI Division of Historic Preservation, Saipan. Micronesian Archaeological Research Services, Guam.
Moorees, C.F.A.
1957 *The Aleut Dentition: A Correlative Study of Dental Characteristics in an Eskimoid People*. Harvard University Press, Cambridge, Massachusetts.

Morgan, W.
1988 *Prehistoric Architecture in Micronesia*. Austin, Texas: University of Texas Press.
Olmo, R.
1992a Phase I Archaeological Inventory Survey, Shimizu Laulau Resort Project Area Saipan, Commonwealth of the Northern Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
1992b Phase I Archaeological Inventory Survey, Kanaya Property Laulau Bay, Saipan. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
O'Reilly, D.
1997 Analytical results in *The Excavation of Nong Nor. A Prehistoric Site in Central Thailand* (ed. C.F.W. Higham and R. Thosarat). Published by the Anthropology Department, University of Otago.
Ortner, D.J.
2003 *Identification of Pathological Conditions in Human Skeletal Remains*. 2nd ed. Academic Press, San Diego, California.
Ortner, D.J. and W.G.J. Putschar
1981 *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Contributions to Anthropology, No. 28. Smithsonian Institution Press, Washington, D.C.
Oxenham, M.F., H. Matsumura, A. Drake, and A. Forthcoming
2012 Trauma and infectious disease in Northern Japan: Okhotsk and Jomon. In: Pechenkina K, Oxenham MF, editors. Bioarchaeology of East Asia: movement, contact, health. Gainesville, FL: University Press of Florida.
Peattie, M.
1988 *Nanyo The Rise and Fall of the Japanese in Micronesia 1885-1945*. University of Hawai`i Press, Honolulu.
Peterson, J.
2009 *The Austronesian Moment. College for Indigenous Studies' International Symposium on Indigenous Peoples' Education and Policy*. Unpublished typescript in the files of Richard F. Taitano, Micronesian Area Research Center, University of Guam, Mangilao.
Peterson, J., and M. Carson
2009 Mid- to Late Holocene Climate Change and Shoreline Evolution in Tumon Bay, Guam. Manuscript on File, Micronesian Area Research Center. Mangilao, Guam: University of Guam.
Petty, B.
2002 *Saipan Oral Histories of the Pacific War*. McFarland & Company, Inc., London.
Piperno, D.R.
2006 *Phytoliths: A Comprehensive Guide for Archaeologists and Paleoecologists*. Altamira Press, Lanham.
Prasad, U., and S. Williams
2001 *Archaeological Monitoring and Sampling During PCB Clean-Up at Tanapag Saipan, Commonwealth of the Northern Mariana Islands.* Prepared by Ogden Environmental and Energy Services Co., Inc., Honolulu, Hawaii.
Price-Williams, D.
1987 *Preliminary Report on Retrieval and Monitoring of Archaeological Materials from the Construction Areas.* Prepared for the Division of Historic Preservation, CNMI, Saipan.
Quimby, F.
2011 The *Hierro* Commerce: Culture Contact, Appropriation and Colonial Entanglement. *The Journal of Pacific History* 46(1)1-26.
Rader, B., and A. Haun
1989 Surface and Subsurface Archaeological Reconnaissance Survey Saipan Resort Hotel, San Antonio., Island of Saipan, Commonwealth of the Northern Mariana Islands. Prepared by Paul. H. Rosendahl, Ph.D., Inc., Hilo, Hawaii.

Rainbird, P.
2004 Prehistory in the Northwest Tropical Pacific: the Caroline, Mariana, and Marshall Islands. *Journal of World Prehistory* 8(3):293-349.
Ross, M.
1997 Social Networks and Kinds of Speech-Community Event. In R. Blench and M. Spriggs, *Archaeology and Language I Theoretical and Methodological* Orientations, pp. 209-261, One World Archaeology, London.
1998 Sequencing and Dating Linguistic Events in Oceania: The Linguistics/Archaeology Interface. In R. Blench and M. Spriggs, *Archaeology and Language II Theoretical and Methodological* Orientations, pp. 141-173, One World Archaeology, London.
Russell, S.
1984 Report on the Excavation of a Mass Burial at Afetna, Saipan Island, Commonwealth of the Northern Mariana Islands. Prepared for the Division of Historic Preservation, CNMI, Saipan.
1998 Tiempon I Manmofo`ona: Ancient Chamorro Culture and History of the Northern Mariana Islands. Micronesian Archaeological Survey Report 32, Saipan: CNMI Division of Historic Preservation.
Russell, S., and M. Fleming
1986 Archaeology in the Northern Mariana Islands: An Overview. *Journal of the Polynesian Society* 95:115-126.
Sant, M., and N. Lebetski
1988 Ceramics. In *Archaeological Investigations on the North Coast of Rota, Mariana Islands*. Micronesian Archaeological Survey Report 23, edited by Brian Butler, pp. 179-253. Center for Archaeological Investigations, Carbondale, Illinois: Southern Illinois University.
Santos, R.S.
2009 Oral Interview of Carmen Dela Cruz Farrell in Final V3 Identification and Evaluation of Traditional Cultural Properties on the Island of Tinian, Commonwealth of the Northern Mariana Islands. Prepared for the Naval Facilities Engineering Command Pacific by Griffin et al. 2015.
Scheuer, L., and S. Black
2000 *Developmental Juvenile Osteology*. Academic Press, San Diego, California.
Seijas, T.
2014 *Asian Slaves in Colonial Mexico: From Chinos to Indians*. Cambridge Latin American Studies.
Shun, K., and D. Moore
1989 Archaeological Reconnaissance Survey and Testing of the Proposed Flood Control Project, Garapan, Saipan, Commonwealth of the Northern Marianas Islands. Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, Hawai'i.
Spoehr, A.
1957 Marianas Prehistory: Archaeological Survey and Excavations on Saipan, Tinian, and Rota.
Fieldiana: Anthropology 48. Field Museum of Natural History, Chicago.
Steele, D. G.
1976 The Estimation of Sex on the Basis of the Talus and Calcaneus. *American Journal of Physical Anthropology* 45(3):581–588.
Steen, S.
2003 The Interpretation of Musculoskeletal Stress Marker Data from Four Different Alaskan Eskimo Populations. Ph.D. dissertation, University of Alberta, Edmonton, Canada.
Suchey, J., and D. Katz
1986 Skeletal Age Standards Derived from an Extensive Multiracial Sample of Modern Americans. Paper presented at the 55th annual meeting of the American Association of Physical Anthropologists, Albuquerque, New Mexico.
Swift, M., and S. Athens
1990 Archaeological Subsurface Investigations at the Achugao Resort – Part Two Project Area, Achugao, Saipan, Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii

Swift, M., S. Wickler, and S. Athens
1991 Archaeological Subsurface Investigations of the Gentle Breeze, Inc. Project Area, Achugao, Saipan. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
Thompson, D.
1977 Archaeological Survey and Test Excavation Along the Leeward Coast of Saipan, Mariana Islands, Part I: A Summary of Methods and Procedures. University of Iowa, Iowa City.
Thompson, E.
1984 National Historic Landmark Form for Landing Beaches, Aslito/Isley Field, and Marpi Point, Saipan Island. 1 July.
Thompson, L.M.
1932 *Archaeology in the Mariana Islands*. Bernice Pauahi Bishop Museum Bulletin 100.
1940 The Function of the Latte in the Marianas. *Journal of the Polynesian Society 49:447-465.*
Todd, T.W.
1921a Age Changes in the Pubic Bone. I: The Male White Pubis. *American Journal of Physical Anthropology* 3:285–334.
1921b Age Changes in the Pubic Bone. III: The Pubis of the White Female. IV: The Pubis of the Female White-Negro Hybrid. *American Journal of Physical Anthropology* 4:1–70.
Tomonari-Tuggle, M.
1990 Preliminary Assessment of Cultural Resources, Obyan, Saipan, Commonwealth of the Northern Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
Tomonari-Tuggle, M., D. Tuggle, J. Allen, D. Welch, and M. Carson
2007 *Final Report Archaeological Assessment Study in Support of the Strategic Forward basing Initiative, Guam and the Commonwealth of the Northern Mariana Islands.* Prepared by International Archaeological Research Institute, Inc., Honolulu, for the Department of the Navy Naval Facilities Engineering Command, Pacific, Pearl Harbor, Hawai`i.
Turner, C.G. II, C.R. Nichol, and G.R. Scott
1991 Scoring Procedures for Key Morphological Traits of the Permanent Dentition: The Arizona State University Dental Anthropology System. In *Advances in Dental Anthropology*, edited by M. A. Kelley and C. S. Larsen, pp. 13–31. John Wiley and Sons, Inc., New York, New York.
U.S. Coast Guard
1946 The Coast Guard at War LORAN IV, Volume II. Coast Guard Construction Detachments in the Pacific Theatre. Prepared in the Historical Section Public Information Division U.S. Coast Guard Headquarters. 1 August.
Walth, C.
2016 *Archaeological Investigations at the Naton Beach Site, Tumon Bay, Guam*. Cultural Resources Report No. 13-504. SWCA Environmental Consultants, Albuquerque, New Mexico, and Guam.
White, T., and P. Folkens
2005 *The Human Bone Manual*. Elsevier Academic Press, Burlington, Massachusetts.
Wickler, S.
1990 Archaeological Testing of the C.U.C. Underground Power Cable Right-of-Way Garapan Saipan, Commonwealth of the Northern Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
Winter, O., G. Clark, A. Anderson, and A. Lindahl
2012 Austronesian Sailing to the Northern Marianas, a Comment on Hung et al. (2011). *Antiquity* 86: 898-914.
Young, F.J.
1989 Soil Survey of the Islands of Rota, Aguijan, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands. U.S. Department of Agriculture, Soil Conservation Service, U.S. Government Printing Office, Washington, D.C.

9.2 Osteological References

Ambrose, S. H., Butler, B. M., Hanson, D. B., Hunter-Anderson, R. L. and Krueger, H. W.
1997 Stable isotopic analysis of human diet in the Marianas Archipelago, Western Pacific. *American Journal of Physical Anthropology* 104:343–361.
Aufderheide, A. C., and C. Rodriguez-Martin
1998 *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge University Press, Cambridge, United Kingdom.
Barnes, Ethne
1994 *Developmental Defects of the Axial Skeleton in Paleopathology*. University Press of Colorado, Niwot.
Bass, William M.
1987 *Human Osteology: A Laboratory and Field Manual.* 3rd ed. Missouri Archaeological Society, Columbia.
Bath, J. E.
1986 *The San Vitores Road Project, Part 1: Final Report*. Pacific Studies Institute. Prepared for Maeda Pacific Corporation and Construction Company, Ltd., Tamuning, Guam.
Bedford, M. E., K. Russell, and C. O. Lovejoy
1989 The Utility of the Auricular Surface Aging Technique. Poster presented at the 58th Annual Meeting of the American Association of Physical Anthropologists, San Diego, California.
Brace, C. L.
1979 Krapina, 'Classic' Neanderthals, and the Evolution of the European Face. *Journal of Human Evolution* 8:527–550.
1980 Australian Tooth-size Clines and the Death of a Stereotype. *Current Anthropology* 21:141–164.
Brace, C. L, M. L. Brace, Y. Dodo, K. D. Hunt, W. R. Leonard, L. Yongyi, S. Sangvichien, S. Xiang-Qing, and Z. Zhenbiao
1990 Micronesians, Asians, Thais and Relations: A Craniofacial and Odontometric Perspective. *Micronesia Supplement* 2:323–348.
Brace, C. L., and K. D. Hunt
1990 A nonracial craniofacial perspective on human variation A(ustralia) to Z(uni). *American Journal of Physical Anthropology* 82:341–360.
Bramblett, Claud A., and D. Gentry Steele
1988 *The Anatomy and Biology of the Human Skeleton*. 7th ed. Texas A&M University Press, College Station, Texas.
Brothwell, D. R.
1981 *Digging Up Bones*. 3rd ed. Cornell University Press, Ithaca, New York.
Buckley, H. R., and N. Tayles
2003 Skeletal Pathology in a Prehistoric Pacific Island Sample: Issues in Lesion Recording, Quantification, and Interpretation. *American Journal of Physical Anthropology* 122:303–324.
Buikstra, J. E., L. W. Konigsberg, and J. Bullington
1986 Fertility and the Development of Agriculture in the Prehistoric Midwest. *American Antiquity* 51(3):528–546.
Buikstra, Jane E., and Douglas H. Ubelaker (editors)
1994 *Standards for Data Collection from Human Skeletal Remains*. Arkansas Archeological Survey Research Series, No. 44, Fayetteville, Arkansas.
Butler, B. M.
1988 *Archaeological Investigations on the North Coast of Rota, Mariana Islands*. Micronesian Archaeological Survey, Report No. 23.
Carr, C.
1995 Mortuary Practices: Their Social, Philosophical-Religious, Circumstantial, and Physical Determinants. *Journal of Archaeological Method and Theory* 2(2):105–200.

Davis, B. D., M. J. Tomonari-Tuggle, S. Wickler, and C. K. Favreau

1992 *Archaeological investigations at the Leo Palace Hotel Site, Naton Beach, Tumon Bay*. Vol. I: *Archaeological Data Recovery, Burial Recovery, and Monitoring*. Prepared for Sumitomo Construction Company, Tamuning, Guam. International Archaeological Research Institute, Inc., Honolulu, Hawaii.

Dodo, Y.

1986 Nonmetric cranial variants of the Micronesians from Guam. In K. Hanihara (ed.): *Anthropological Studies on the Origin of Pacific Populations, with Special Reference to the Micronesians – A Preliminary Report*, edited by K. Hanihara, pp. 56–65. Grant-in-Aid for Overseas Scientific Surveys, Ministry of Education, Japan.

Douglas, M. T., and R. M. Ikehara

1992 *Archaeological Investigations at the Leo Palace Hotel Site, Naton Beach, Tumon Bay, Guam.* Vol. II: *Osteological Study of Prehistoric Chamorro Skeletal Remains*. International Archaeological Research Institute, Inc., Honolulu, Hawaii.

Douglas, M. T., M. Pietrusewsky, and R. M. Ikehara-Quebral

1997 Skeletal Biology of Apurguan: A Precontact Chamorro Site on Guam. *American Journal of Physical Anthropology* 104:291–313.

Gohiya, V. K., S. Shrivatava, and S. Gohiya

2010 Estimation of Cranial Capacity in 20-25 Year Old Population of Madhya Pradesh, a State of India. *International Journal of Morphology* 28(4):1211–1214.

Goodman, A. H., and G. J. Armelagos

1985 Factors Affecting the Distribution of Enamel Hypoplasias within the Human Permanent Dentition. *American Journal of Physical Anthropology* 68:479–493.

Goodman, A. H., and J. C. Rose

1991 Dental Enamel Hypoplasias as Indicators of Nutritional Status. In *Advances in Dental Anthropology*, edited by M. A. Kelley and C. S. Larsen, pp. 279–293. Wiley-Liss, New York, New York.

Graves, M. W.

1986 Organization and Differentiation Within Late Prehistoric Ranked Social Units, Mariana Islands, Western Pacific. *Journal of Field Archaeology* 13:139–154.

1987 A Preliminary Archaeological of the Surf Hotel Extension Project. Report G-2. Paul H. Rosendahl, Ph.D. Inc., Hilo, Hawaii.

1991 Architectural and Mortuary Diversity in Late Prehistoric Settlements at Tumon Bay, Guam. *Micronesica* 24(2):169–194.

Haeussler, A. M., C. G. Turner, and J. D. Irish

1988 Concordance of American and Soviet Methods in Dental Anthropology. *American Journal of Physical Anthropology* 75(218).

Hanihara, T.

1986 Dentition of Guam Skeletal Remains. In *Anthropological Studies on the Origin of Pacific Populations, with Special Reference to the Micronesians: a Preliminary Report*, No. 59041021, pp. 5–14. Grant-in-Aid for Overseas Scientific Surveys, Ministry of Education, Science and Culture, Japan.

1990 Dental Anthropological Evidence of Affinities among the Oceania and Pan-Pacific Populations: The Basic Populations in East Asia, II. *Journal of the Anthropological Society of Nippon* 98:233–246.

1992 Biological Relationships among Southeast Asians, Jomonese, and the Pacific Populations as Viewed from Dental Character: The Basic Populations in East Asia, X. *Journal of Anthropological Society, Nippon* 100:53–67.

1997 Craniofacial affinities of Mariana Islanders and Circum-Pacific peoples. *American Journal of Physical Anthropology* 104:271–290.

Hanson, D. B.

1988 Prehistoric Mortuary Practices and Human Biology. In *Archaeological Investigations on the North Coast of Rota, Mariana Islands*, edited by B. M. Butler, pp. 375–435. Micronesian Archaeological Survey Report

No. 23. Center for Archaeological Investigations Occasional Paper No. 8. Southern Illinois University, Carbondale.
1989 *The Skeletal Biology of Prehistoric Human Mortuary Remains from the Duty Free Site, Garapan Village, Saipan*. Bioengineering Department, Forsyth Dental Center, Boston, Massachusetts.
Hanson, D. B., and B. M. Butler
1997 A Biocultural Perspective on Marianas Prehistory: Recent Trends in Bioarchaeological Research. *American Journal of Physical Anthropology* 104:271–290.
Hanson, D. B., and C. C. Gordon
1989 Mortuary Practices and Social Complexity in Micronesia: Problems and Prospects of an Emerging Archaeological Database. *Man and Culture in Oceania* 5:37–66.
Hanson, D. B., and M. Pietrusewsky
1997 Bioarchaeological Research in the Mariana Islands of the Western Pacific: An Overview. *American Journal of Physical Anthropology* 104:267–269.
Heathcote, G.
1994 Osteology and Odontology of Fragmentary Human Skeletal Remains Recovered from Sites 10, M204, NP4, and 266, Miyama (Manenggon) Hills, Guam. Unpublished report prepared for Micronesian Archaeological Research Services, Guam.
Heathcote, Gary, K. Bansil, and Vince Sava
1996 A Protocol for Scoring Three Posterior Cranial Superstructures Which Reach Remarkable Size in Ancient Mariana Islanders. *Micronesica* 29:281–298.
Heathcote, G. M., T. G. Bromage, V. J. Sava, D. B. Hanson, and B. E. Anderson
2014 Enigmatic Cranial Superstructures Among Chamorro Ancestors From the Mariana Islands: Gross Anatomy and Microanatomy. *The Anatomical Record* 297:1009–1021.
Hornbostel, Hans G.
1924 Unpublished notes from the Bernice P. Bishop Museum, Honolulu. Microfilm on file, Micronesian Area Research Center, University of Guam, Mangilao.
Houghton, P., B. F. Leach, and D. G. Sutton
1975 The Estimation of Stature of Prehistoric Polynesians in New Zealand. *Journal of the Polynesian Society* 84(3):325–336.
Howell, N.
1982 Village Composition Implied by a Paleodemographic Life Table: The Libben Site. *American Journal of Physical Anthropology* 59:263–269.
Howells, W. W.
1973 *Cranial Variation in Man: A Study by Multivariate Analysis of Patterns of Difference among Recent Human Populations*. Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University, Volume 67. Harvard University, Cambridge, Massachusetts.
Hung, H., M. T. Carson, P. Bellwood, F. Z. Campos, P. J. Piper, E. Dizon, M. J. L. A. Dizon, M. Oxenham, and Z. Chi
2011 The first Settlement of Remote Oceania: The Philippines to the Marianas. *Antiquity* 85:909–926.
Hunter-Anderson, Rosalind L., Judith Amesbury, and Darlene R. Moore
1996 *Archaeological Monitoring and Hand Excavations in Eight Burial Areas at the Saipan Judiciary Center, Susupe, Saipan*. Micronesian Archaeological Services, Guam.
Hunter-Anderson, R. L., and B. M. Butler
1991 *An Overview of Northern Marianas Prehistory.* Prepared for Division of Historic Preservation, Commonwealth of the Northern Mariana Islands, Saipan. Guam.
Ishida, H., and Y. Dodo
1993 Nonmetric Cranial Variation and the Populational Affinities of the Pacific Peoples. *American Journal of Physical Anthropology* 90:49–57.
1997 Cranial Variation in Prehistoric Human Skeletal Remains from the Marianas. *American Journal of Physical Anthropology* 104:399–410.

Johnston, Francis E., and Louise O. Zimmer
1989 Assessment of Growth and Age in the Immature Skeleton. In *Reconstruction of Life from the Skeleton*, edited by Mehmet Y. İşcan and Kenneth A. R. Kennedy, pp. 23–40. Alan R. Liss, Inc., New York, New York.
Katz, D., and J. M. Suchey
1986 Age Determination of the Male Os Pubis. *American Journal of Physical Anthropology* 69:427–435.
Larsen, C. S.
1983 Behavioral Implications of Temporal Change in Cariogenesis. *Journal Archaeological Science* 10:1–8.
Leigh, R. W.
1930 Dental morphology and pathology of prehistoric Guam. *Journal of Dental Research* 10:451–479.
Lovejoy, C. O., R. S. Meindl, T. R. Pryzbeck, and R. P. Mensforth
1985 Chronological Metamorphosis of the Auricular Surface of the Ilium: A New Method for the Determination of Age at Death. *American Journal of Physical Anthropology* 68:15–28.
Manjunath, K. Y.
2002 Estimation of Cranial Volume-An Overview of Methodologies. *Journal of Anatomical Society of India* 51(1):85–91.
Mann, R. W., and D. R. Hunt
2005 *Photographic Regional Atlas of Bone Disease, A Guide to Pathologic and Normal Variation in the Human Skeleton*. Charles C. Thomas, Springfield, Illinois.
Mariotti, V., F. Facchini, and M. G. Belcastro
2007 The Study of Entheses: Proposal of a Standardised Scoring Method for Twenty-Three Entheses of the Postcranial Skeleton. *Collegium Antropologicum* 31(1):291–313.
Mayhall, J.
1992 Techniques for the Study of Dental Morphology. In *Skeletal Biology of Past Peoples: Research Methods*, edited by S. R. Saunders and M. A. Katzenberg, pp. 59–78. Wiley-Liss, New York, New York.
McGovern-Wilson, Rick
1989 *Afetna: The Prehistory of South West Saipan*. Anthropology Department, University of Otago, Dunedin, New Zealand.
Meindl, R. S., and C. O. Lovejoy
1989 Age Changes in the Pelvis: Implications for Paleodemography. In *Age Markers in the Human Skeleton*, edited by M. Y. Īşcan, pp. 137–168. Charles C Thomas, Springfield, Illinois.
Milner, G. R., J. W. Wood, and J. L. Boldsen
2008 Advances in Paleodemography. In *Biological Anthropology of the Human Skeleton*, 2nd ed., edited by M. A. Katzenberg and S. R. Saunders, pp. 561–591. John Wiley & Sons, Inc.
Moorees, C. F. A.
1957 *The Aleut Dentition: A Correlative Study of Dental Characteristics in an Eskimoid People*. Harvard University Press, Cambridge, Massachusetts.
Morita, S., K. Hattori, N. Miyazaki, and M. Tanaka
1971 The Appearance of Primary Ossification Centres in the Japanese Foot Phalanges in the Later Half of Fetal Life. *Tokyo Jikeikai Medical Journal* 86:711–717.
Olivier, G.
1969 *Practical Anthropology.* Charles C. Thomas, Springfield, Illinois.
Ortner, Donald J.
2003 *Identification of Pathological Conditions in Human Skeletal Remains*. 2nd ed. Academic Press, San Diego, California.
Ortner, D. J., and W. G. J. Putschar
1981 *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Contributions to Anthropology, No. 28. Smithsonian Institution Press, Washington, D.C.
1985 *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Contributions to Anthropology, No. 28. Smithsonian Institution Press, Washington, D.C.

Parr, N. M.
2012 A Diachronic Assessment of Health and Disease from the Adult Dentition of the Naton Beach Burial Complex in Tumon Bay, Guam. Ph.D. dissertation, University of Florida, Gainesville.
Pietrusewsky, M.
1976 *Prehistoric Human Skeletal Remains from Papua New Guinea and the Marquesas*. Asian and Pacific Archaeology Series No. 7. Social Sciences and Linguistic Institute, University of Hawai'i, Honolulu.
1986 A Study of Human Remains from Three Sites in the Northern Mariana Islands. Unpublished report to the Historic Preservation Office, Saipan, Commonwealth of the Northern Mariana Islands.
1990a Craniometric Variation in Micronesia and the Pacific: A Multivariate Study. *Micronesica* (Supplement) 2:373–402.
1990b Craniofacial Variation in Australian and Pacific Populations. *American Journal of Physical Anthropology* 82:319–340.
2005 The Physical Anthropology of the Pacific, East Asia, and Southeast Asia: A Multivariate Craniometric Analysis. In *The Peopling of East Asia: Putting Together Archaeology, Linguistics, and Genetics*, edited by L. Sagart L., R. Blench, and A. Sanchez-Mazas, pp. 203–231. Routledge Curzon, London, England.
2006 A Multivariate Craniometric Study of the Prehistoric and Modern Inhabitants of Southeast Asia, East Asian and Surrounding Regions: A Human Kaleidoscope? In *Bioarchaeology of Southeast Asia*, edited by M. Oxenham and N. Tayles, pp. 59–90. Cambridge University Press.
2008 Craniometric Variation in Southeast Asia and Neighboring Regions: A Multivariate Analysis of Cranial Measurements. *Human Evolution* 23:49–86.
2012 Biological Distance. In *Encyclopedia of Global Archaeology*, edited by C. Smith. Springer Verlag, Berlin and Heidelberg, Germany.
Pietrusewsky, M., and C. Batista
1980 Human Skeletal and Dental Remains from Four Sites on Tinian and Saipan, Commonwealth of the Northern Mariana Islands. Unpublished report to the Northern Marianas Archaeological Society, Saipan, Commonwealth of the Northern Mariana Islands. Department of Anthropology, University of Hawaii-Manoa, Honolulu.
Pietrusewsky, M., and M. T. Douglas
1989 *Human Remains from Oleai, Saipan, Commonwealth of the Northern Mariana Islands*. Department of Anthropology, University of Hawaii-Manoa, Honolulu.
2003 *Archaeological Investigations at Apotguan, Guam: Agana Beach Condominium Site. Volume 3: An Osteological Investigation and a Comparison with Other Marianas Series*. Draft Report. International Archaeological Research Institute, Inc., Honolulu, Hawaii.
Rader, Bert, and Alan Haun
1989 *Surface and Subsurface Archaeological Reconnaissance Survey Saipan Resort Hotel*. Report No. 479-012589. Paul H. Rosendahl, Ph.D. Inc., Hilo, Hawaii.
Ray, Erwin R.
1981 The Material Culture of Prehistoric Tarague Beach, Guam. Master's thesis, Arizona State University, Tempe.
Reinman, F. R.
1977 *An Archaeological Survey and Preliminary Test Excavations on the Island of Guam, Mariana Islands, 1965-1966*. Miscellaneous Publication No. 1. Micronesian Area Research Center, University of Guam, Mangilao.
Rottman, G.
2004 *Saipan & Tinian 1944 Piercing the Japanese Empire*. Oxford: Osprey Publishing.
Russell, Scott
1984 *Report on the Excavation of a Mass Human Burial in Afetna, Saipan Island, Commonwealth of the Northern Marianas*. Prepared for Historic Preservation Office, Saipan, Commonwealth of the Northern Mariana Islands.

1999 *Tiempon Aleman: A Look Back at German Rule of the Northern Mariana Islands 1899- 1914*. Saipan: CNMI Division of Historic Preservation.

Ryan, E. M.

2010 Chamorro Health and Illness at a Prehistoric Coastal Habitation Site in Tumon Bay, Guam. Unpublished Ph.D. dissertation, Australian National University, Canberra.

Ryan, E. M., B. J. Dilli, and A. E. Haun

1999 *Tumon Bay Hyatt Hotel Archaeological Data Recovery, Tumon, Tamuning Municipality, Territory of Guam*. PHRI Report No. 797-090999. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawaii.

Saunders, S. R., and D. L. Rainey

2008 Nonmetric Trait Variation in the Skeleton: Abnormalities, Anomalies, and Atavisms. In *Biological Anthropology of the Human Skeleton*, 2nd ed., edited by M. A. Katzenberg and S. R. Saunders, pp. 533–559. John Wiley & Sons, Inc.

Scheuer, L., and S. Black

2000 *Developmental Juvenile Osteology*. Academic Press, San Diego, California.

Scott, G. R., and C. G. Turner II

1997 *The Anthropology of Modern Human Teeth: Dental Morphology and Its Variation in Recent Human Populations*. Cambridge University Press, Cambridge.

Spennemann, D.H.R.

1999 Aurora Australis – The German Period in the Mariana Islands 1899-1914. Occasional Historical Papers Series No. 5, Division of Historic Preservation, Commonwealth of the Northern Marianas Islands, Saipan.

2004 Typhoons in Micronesia. A History of Tropical Cyclones and Their Effects Until 1914. Division of Historic Preservation, Saipan.

2007 The Edge of Empire The German Colonial Period in the Northern Mariana Islands. Heritage Futures, Albury, Australia.

Spoehr, A.

1954 *Saipan The Ethnology of a War-Devastated Island*. Chicago Natural History Museum in Fieldiana, Anthropology, Volume 41, Chicago.

1957 *Marianas Prehistory Archaeological Survey and Excavations on Saipan, Tinian and Rota*. Fieldiana: Anthropology Vol. 48. Chicago Natural History Museum, Chicago, Illinois.

Steele, D. G.

1976 The Estimation of Sex on the Basis of the Talus and Calcaneus. *American Journal of Physical Anthropology* 45(3):581–588.

Steen, S.

2003 The Interpretation of Musculoskeletal Stress Marker Data from Four Different Alaskan Eskimo Populations. Ph.D. dissertation, University of Alberta, Edmonton, Canada.

Steinbock, R. T.

1976 Treponema Infection: Syphilis, Bejel, and Yaws. In *Paleopathological Diagnosis and Interpretation: Bone Diseases in Ancient Human Populations,* Chapter IV, pp. 87–169. Charles C. Thomas, Springfield, Illinois.

Stodder, A. L. W., E. M. Ryan, R. L. Hunter-Anderson, M. T. Douglas, and R. Ikehara-Quebral

2016 Under the Latte: Osteobiography and Social Context of a Burial Assemblage at Tumon Bay, Guam. In *The Routledge Handbook of Bioarchaeology in Southeast Asian and the Pacific*, edited by M. F. Oxenham and H. R. Buckley, pp. 527–568. Routledge, New York, New York.

Strickland, S. S.

2002 Anthropological Perspectives on Use of the Areca Nut. *Addiction Biology* 7:85–97.

Suchey, J., and D. Katz

1986 Skeletal Age Standards Derived from an Extensive Multiracial Sample of Modern Americans. Paper presented at the 55th annual meeting of the American Association of Physical Anthropologists, Albuquerque, New Mexico.

Thompson, D.
1977 Archaeological Survey and Test Excavation along the Leeward Coast of Saipan, Mariana Islands. Unpublished manuscript on file with the CNMI Historic Preservation Office, Saipan.
Thompson, L. M.
1971 *Archaeology of the Marianas Islands.* Reprinted. Kraus Reprint Co. Originally published 1932, Bernice P. Bishop Museum Bulletin 100, Bishop Museum, Honolulu, Hawai'i.
Todd, T. W.
1921a Age Changes in the Pubic Bone. I: The Male White Pubis. *American Journal of Physical Anthropology* 3:285–334.
1921b Age Changes in the Pubic Bone. III: The Pubis of the White Female. IV: The Pubis of the Female White-Negro Hybrid. *American Journal of Physical Anthropology* 4:1–70.
Tomonari-Tuggle, M.
1990 Preliminary Assessment of Cultural Resources, Obyan, Saipan, Commonwealth of the Northern Mariana Islands. Prepared by International Archaeological Research Institute, Inc., Honolulu, Hawaii.
Tomonari-Tuggle, M., D. Tuggle, J. Allen, D. Welch, and M. Carson
2007 *Final Report Archaeological Assessment Study in Support of the Strategic Forward basing Initiative, Guam and the Commonwealth of the Northern Mariana Islands.* Prepared by International Archaeological Research Institute, Inc., Honolulu, for the Department of the Navy Naval Facilities Engineering Command, Pacific, Pearl Harbor, Hawai`i.
Trembly, D., and C. Tucker
1999 Human Skeletal and Dental Remains from the Tumon Bay Hyatt Hotel Site, Tumon, Tamuning Municipality, Territory of Guam. PHRI, Paul H. Rosendahl, Inc., Hilo, Hawaii.
Turner II, C. G.
1985 Expression Count: A Method for Calculating Morphological Dental Trait Frequencies by Using Adjustable Weighting Coefficients. *American Journal of Physical Anthropology* 68:263–268.
1987 Late Pleistocene and Holocene Population History of East Asia Based on Dental Variation. *American Journal of Physical Anthropology* 73:305–321.
1990a Major Features of Sundadonty and Sinodonty, including Suggestions about East Asian Microevolution, Population History, and Late Pleistocene Relationships with Australian Aboriginals. *American Journal of Physical Anthropology* 82:295–317.
1990b Origin and Affinity of the People of Guam: A Dental Anthropological Assessment. *Micronesica Supplement* 2:403–416.
1992 The Dental Bridge Between Australia and Asia: Following Macintosh into the East Asian Hearth of Humanity. *Perspectives in Human Biology* 2:120–127.
Turner, Christy G. II, Christian R. Nichol, and G. Richard Scott
1991 Scoring Procedures for Key Morphological Traits of the Permanent Dentition: The Arizona State University Dental Anthropology System. In *Advances in Dental Anthropology*, edited by M. A. Kelley and C. S. Larsen, pp. 13–31. John Wiley and Sons, Inc., New York, New York.
Vilar, M. G., C. W. Chan, D. R. Santos, D. Lynch, R. Spathis, R. M. Garruto, and J. K. Lum
2012 The Origins and Genetic Distinctiveness of the Chamorros of the Marianas Islands: An mt DNA Perspective. *American Journal of Human Biology* 25(1):116–122.
Walth, Cherie
2010 *Archaeological Recovery of Human Remains from South Santa Cruz Street, Agat Village, Guam.* SWCA Environmental Consultants, Guam.
2016 *Archaeological Investigations at the Naton Beach Site, Tumon Bay, Guam.* Cultural Resources Report No. 13-504. SWCA Environmental Consultants, Albuquerque, New Mexico, and Guam.
2017 *Osteological Analysis for the Agana Bridge #1 and Route 1/Route 8 Intersection Improvements Project (GU-NH-001(14)), Hagatna, Guam*. SWCA Environmental Consultants, Albuquerque, New Mexico, and Guam.

Walth, Cherie, and Kathy Mowrer

2018 *Osteological Analysis of Human Remains Recovered from Parcel 004-1-52, San Antonio, Saipan, Commonwealth of the Northern Mariana Islands*. SWCA Project No. 31981, Albuquerque

White, T., and P. Folkens

2005 *The Human Bone Manual.* Elsevier Academic Press, Burlington, Massachusetts.

Yawata, I.

1961 Rice Cultivation of the Ancient Mariana Islands. In *Plants and the Migrations of Pacific Peoples,* edited by Jacques Barrau. Bishop Museum Press, Honolulu, Hawaii.

Zumbroich, T. J.

2011 To Strengthen the Teeth and Harden the Gums – Teeth Blackening as Medical Practice in Asia, Micronesia, and Melanesia. *Ethnobotany Research and Applications* 9:97–113.