Section 6 Summary and Interpretation

6.1 HHCTCP Background and Historic Preservation Regulatory Context

The Honolulu High-capacity Transit Corridor Project (HHCTCP) extends approximately 23 miles (37.0 km) from Kapolei in the west to the Ala Moana Center in the east. The purpose of the transit system is to provide high-capacity rapid transit in the highly congested east-west transportation corridor along O‘ahu’s South Shore via a fixed guideway rail transit system. The project will be funded by the Federal Transit Administration (FTA) and the Honolulu Authority for Rapid Transportation (HART) of the City and County of Honolulu (City). In addition to the guideway, the project will require construction of transit stations and ancillary support facilities. Project construction will also require relocation of existing utility lines within the corridor that conflict with the proposed project design. Minimally, land disturbing activities will include grading of facility locations and excavations for guideway column foundations, subsurface utility relocation and installation, and station and ancillary facility foundation construction. Utility relocation and roadway widening will make up the greatest project-related disturbance.

The HHCTCP is divided into 4 construction sections. From west to east these are as follows: Section 1, West-O‘ahu/Farrington Highway, extending from East Kapolei to approximately Leeward Community College; Section 2, Kamehameha Highway, extending from Leeward Community College to Aloha Stadium; Section 3, Airport, extending from Aloha Stadium to approximately the Middle Street Interchange; and, Section 4, City Center, extending from Middle Street to Ala Moana Center. The focus of this AIS investigation is City Center (Section (refer to Figure 1).

Due to federal funding (and use of federal U.S. Navy lands in Construction Section 3) the HHCTCP is a federal undertaking. With HART funding and the use of State of Hawai‘i and municipal lands, the HHCTCP is also a state project. Accordingly, the HHCTCP’s historic preservation review must comply with both federal (Section 106 of the National Historic Preservation Act) and Hawai‘i State (HRS Chapter 6E-8 and HAR Chapter 13-275) historic preservation review legislation. Accordingly, this AIS investigation was carried out to comply with both. AIS preparation carefully followed the HHCTCP Programmatic Agreement (PA), Final—January 2011.

Subsequent to the SHPD-approval of the City Center AISP (Hammatt et al. 2011), consideration was given to a possible alternate site (Alternate A) for the Kaka‘ako Transit Station located approximately 50 m northeast (*mauka*) of the Kaka‘ako Transit Station location addressed in the City Center AISP. This possible alternate station site, and associated minor changes to the immediately adjacent guideway alignment, was addressed in an Addendum AISP (Hammatt et al. 2013). The Addendum AISP was accepted in the SHPD Section 106 review letter of March 1, 2013 (Log No. 2013.1958, Doc. No. 1302SL28).

6.2 The City Center Archaeological Inventory Survey Plan

Following Stipulation III of the PA, this AIS investigation for City Center was carried out following an archaeological inventory survey plan (AISP) that was reviewed and approved by the State Historic Preservation Division (SHPD) on October 25, 2011 (Log No. 2011.2379, Doc No. 1110NN08). The AISP was prepared in compliance with the requirements of HAR Chapter 13-275-5(c), the Hawai‘i State rules governing AISPs. The AIS was specifically designed to focus on the identification of archaeological cultural resources because other project- related studies have been completed or are currently underway to address other types of cultural resources, such as traditional cultural properties and historic buildings and structures.

The preparation of the City Center AISP (Hammatt et al. 2011) involved thorough background research to compile a detailed predictive model of archaeologically sensitive areas within the City Center AIS study area. The study area is identified as an area of high archaeological sensitivity based on historic and cultural background research and the results of past archaeological research in the vicinity. The City Center archaeological predictive model was overlain on the project's preliminary engineering plans to develop a sampling strategy to test various components of the HHCTCP construction—primarily utility relocations, fixed-guideway support columns, and station touch-down footprints. An initial sampling strategy of 232 test excavations was described in the AISP, with clear guidelines for consultation with the SHPD and HART to expand the testing in areas where archaeological cultural resources were identified or suspected based on initial testing results.

Subsequently consideration was given to an alternate site (Alternate A) for the Kaka‘ako Station located approximately 50 m northeast (*mauka*) of the Kaka‘ako Station location addressed in the Hammatt et al. (2011) AISP for City Center. This alternate station site, and associated minor changes to the immediately adjacent guideway alignment, were addressed in an Addendum AISP (Hammatt et al. 2013). The Addendum AISP was accepted in the SHPD Section 106 review letter of March 1, 2013 (Log No. 2013.1958, Doc. No. 1302SL28).

6.3 City Center AIS Fieldwork

The City Center AISP fieldwork effort was summarized as follows (from Hammatt et al. 2011:iii):

A. CSH principal investigators Matt McDermott, M.A. and Hallett H. Hammatt, Ph.D. will direct the City Center AIS.

B. An anticipated field crew of eight to fourteen archaeologists, two field directors, two GPS/GIS specialists, and two GPR specialists will complete the AIS investigation under the direction of the principal investigators. Detailed sample analysis will be provided by International Archaeological Research Institute, Inc., (wood/charcoal speciation), PaleoResearch, Inc., (pollen speciation), and Beta Analytic, Inc., (radiocarbon dating).

C. Six to ten months are estimated to complete AIS fieldwork.

D. Fieldwork will include 100 percent pedestrian inspection of the study area; global positioning system (GPS) data collection; ground penetrating radar (GPR) survey; and subsurface testing. All areas selected for subsurface testing will be surveyed with a Geophysical Survey Systems,

Inc., SIR-3000 GPR unit equipped with a 400 MHz antenna. The planned subsurface testing program will be backhoe-assisted. In general, linear trenches measuring approximately 3 m or 6 m (10 ft or 20 ft) long and 0.6 or 0.9 m (2 ft or 3 ft) wide will be excavated within the project footprint (based on preliminary engineering) at selected station locations, guideway column locations, and utility relocation areas. Two hundred and thirty two (232) test excavations are proposed, with provisions for additional testing to refine the boundaries and further investigate subsurface archaeological deposits. This additional testing will be designed in consultation with project engineers to seek ways for project construction to avoid significant archaeological cultural resources.

The subsurface testing sampling strategy was developed giving consideration to sediment types; natural geographic features, such as streams and ponds; background research, including information from historic maps and Land Commission Award (LCA) documents; the results of previous archaeological studies in the vicinity; the results of consultation with the Native Hawaiian community; an assessment of the impact of prior land development; and a consideration of safety concerns for actually carrying out the archaeological work.

E. The greatest factors limiting the AIS survey effort include 1) the survey area's large (5.6 ha or 13.87 acres), dispersed (6.9 km or 4.3 miles) area; 2) the survey area's highly developed and highly active setting (in-use city streets, sidewalks, and buildings); and 3) the dense, complex array of existing subsurface utilities in the survey area.

F. Test excavations will be the primary means of identifying and documenting archaeological cultural resources.

G. AIS documentation of observed archaeological cultural resources will include stratigraphic profiles and plan views, available cultural resource boundary information based on additional testing, sample collection and analysis, written descriptions, photographs, and artifact analysis.

H. All identified archaeological historic properties will be documented and located with a Trimble ProXH mapping-grade GPS unit (sub-foot accuracy).

This AISP summary above (A-H) is largely accurate of the actual City Center fieldwork effort. The following four points describe the actual City Center AIS fieldwork effort, where additional clarification or correction is needed in relation to the summary above:

1. Pedestrian inspection of the City Center AIS study area was carried out at three separate times: 1) in May 2011 to support the preparation of the City Center AISP (Hammatt et al. 2011); 2) in November 2011 when the City Center AIS fieldwork began; and 3) in February 2013 when the AIS subsurface testing program was complete.

2. A GPR survey was carried out at all test excavation locations prior to testing, and the results were compared to the actual excavation results to evaluate the GPR method.

3. Two hundred fifty (250) machine-assisted test excavations (232 original, 9 abandoned, and 27 added test excavations) were documented as part of the City Center AIS (8% more than the 232 test excavations specified as the initial sampling strategy in the City Center AISP). As outlined in the City Center AISP, consultation among CSH, PB, and the SHPD was effective in determining

areas for additional subsurface testing in areas where initial testing results indicated additional investigation was appropriate.

4. Not mentioned in the AISP summary above were geotechnical cores. In consultation with the SHPD, seven geotechnical cores were carried out under archaeological supervision to investigate specific stratigraphic layer distributions and boundaries. These geotechnical cores, carried out at the Chinatown Station (SIHP #50-80-14-7427) and in the vicinity of Test Excavation 124 (SIHP #50-80-14-2963), provided additional stratigraphic information in instances where built environment constraints made additional backhoe testing problematic.

5. Fieldwork was carried out intermittently between November 2011 and February 2013. Fieldwork required approximately 6,300 person-hours or 785 person-days to complete.

6. During AISP preparation, and following the HHCTCP final PA, a "*Consultation Protocol for Iwi Kūpuna Discovery During the Archaeological Inventory Survey for the City Center (Construction Phase 4)*" (Hammatt 2011) (reviewed and approved by FTA, per the PA requirements) was developed to facilitate consultation regarding the treatment of identified human skeletal remains. Seven City Center AIS test excavations, located within four archaeological cultural resources (SIHP #50-80-14-7427, #50-80-14-5820, #50-80-14-7429, and #50-80-14-2918), documented human skeletal remains. These ranged from previously disturbed single bones within imported fill deposits to complete, previously undisturbed flexed individuals in Jaucas sand deposits. In all cases, the documentation, consultation, and treatment of the remains followed the City Center AISP (Hammatt et al. 2011) and the "*Consultation Protocol for Iwi Kūpuna Discovery*" (Hammatt 2011). This included immediate notification and consultation with the O‘ahu Island Burial Council (OIBC) Kona representatives, the SHPD, and project engineers. Consultation regarding ethnicity, treatment decision jurisdiction (the SHPD or the OIBC), and the applicability of Hawai‘i State Burial Laws (HRS Chapter 6E-43 and HAR Chapter 13-300) is currently underway between the SHPD and the HART. Consultation with potential and recognized cultural descendants of the remains is on-going and will likely culminate in a City Center burial treatment plan (per HAR Chapter 13-300).

6.4 Division of the City Center AIS Study Area into Geographic Zones

For organization and results presentation, as well as to provide a suitable context to interpret the results of test excavations and the significance of identified archaeological cultural resources, the 6.9 km of the City Center AIS study area were divided into 11 geographic zones. The boundaries of the 11 geographic zones were based on background research and fieldwork results. Areas with similar stratigraphy and geomorphology, and, where feasible, areas within traditional Hawaiian *ahupua‘a* were grouped together.

6.5 Identified Archaeological Cultural Resources

Eighteen (18) archaeological cultural resources were identified within, or immediately adjacent to, the City Center AIS study area. Twelve of these resources were previously identified and documented, and some have already had their Hawai‘i and/or National Register-eligibility determined. Where this eligibility has not yet been determined for these previously identified cultural resources, eligibility recommendations are given based on available information. The

remaining six cultural resources were newly identified and documented during the City Center AIS and their Hawai‘i and National Register-eligibility is presented here as a recommendation. All 18 archaeological cultural resources have been assigned Hawai‘i State Inventory of Historic Properties (SIHP) numbers, all with the prefix 50-80-14. They are listed below roughly from west to east. The bold SIHP #s are newly identified as part of the City Center AIS, and the associated test excavations are listed.

SIHP #-**7425** is a buried single *imu* (earth oven) feature, recommended eligible to both the Hawai‘i and National Registers under Criterion D identified in Test Excavation 20 (T-020).

SIHP #-**7426** as identified consists of buried agricultural sediments, recommended eligible to both the Hawai‘i and National Registers under Criterion D identified in T-054–082, and T-085.

SIHP #-5368 as identified consists of buried remnants of the Kūwili Fishpond, previously determined eligible to both the Hawai‘i and National Registers under Criterion D identified in T-088, 091, 092, 093, and 094.

SIHP #-5966 as identified consists of buried remnants of the Kawa Fishpond, previously determined eligible to both the Hawai‘i and National Registers under Criterion D; T-095 within the fishpond boundaries (but no fishpond sediments were observed).

SIHP #-**7427** as identified consists of buried historic building foundations/walls and the underlying culturally enriched sediments, as well as one human talus bone from overlying fill deposits, recommended eligible to both the Hawai‘i and National Registers under Criterion D; T-096-101.

SIHP #-**7428** as identified consists of a buried culturally-enriched sand A-horizon and historic warehouse foundation, recommended eligible to both the Hawai‘i and National Registers under Criterion D; T-119, 119A, 120, 120A, and 120B.

SIHP #-2963 as identified consists of buried pond sediments containing historic artifacts and buried culturally enriched sand A-horizon (in the current City Center AIS study area). The designated site also includes seven human burials as described in the adjacent Makai Parking Garage monitoring report (Clark 1987), recommended eligible to the Hawai‘i Register under Criterion D and E and eligible to the National Register under Criterion D. This historic property was identified in T-122, 123, and 124.

SIHP #-7124, as identified consists of buried historic building remnants, previously determined eligible to the Hawai‘i Register under Criterion A and D and recommended eligible to the National Register under Criterion D. This historic property was identified in T-132.

SIHP #-7189 as identified consists of a buried fill layer containing burnt historic refuse, previously determined eligible to the Hawai‘i Register under Criterion A and D, and recommended eligible to the National Register under Criterion D. This historic property was identified in T-130, 132,134, 138, 140, 231A, 232, and 232A.

SIHP #-7190, is identified as buried salt pan remnants, previously determined eligible to the Hawai‘i Register under Criterion A and D, and recommended eligible to the National Register under Criterion D. This historic property was identified in T-229 and T-230.

SIHP #-7197, is a buried late pre-Contact/early post-Contact cultural layer previously determined eligible to the Hawai‘i Register under Criterion A and D and recommended eligible to the National Register under Criterion D. This cultural layer was not observed in the current AIS fieldwork, but this historic property is potentially affected by project construction due to its close proximity.

SIHP #-5820 includes burials/human skeletal remains and a buried culturally-enriched sand A-horizon, recommended as eligible to the Hawai‘i Register under Criterion D and E and eligible to the National Register under Criterion D. This historic property was identified in T-141, 142, 145, 146A, 150, 151, and 151A.

SIHP #-**7429**, a light buried culturally enriched sand A-horizon, includes a human cranial fragment and is recommended eligible to both the Hawai‘i and National Register under Criterion D. This historic property was identified in T-167, 168, 168A, 168B, 169, 170, and 170A.

SIHP #-6856 identifies buried remnants of Kolowalu Fishpond previously determined eligible to the Hawai‘i Register under Criterion D and recommended eligible to the National Register under Criterion D. This historic property was identified in T-181–185.

SIHP #-6636 identifies buried remnants of Kewalo wetland sediments, previously determined eligible to the Hawai‘i Register under Criterion A and D, and recommended eligible to the National Register under Criterion D. This historic property was identified in T-186–193, 195, 196, 198–200, 202, 202A, 203, 205, 207, 208, 210–212, 214, 219, and 220

SIHP #-**7430** is a buried historic privy remnant, recommended eligible to both the Hawai‘i and National Registers under Criterion D. This historic property was identified in T-202.

SIHP #-7193 designates a buried historic refuse-enriched fill deposit, previously determined ineligible to the Hawai‘i Register, and recommended ineligible to the National Register. This historic property was identified in T-214.

SIHP #-2918 designates a buried culturally enriched sand A-horizon with human skeletal remains/burials and also includes historic railway tracks\. This site is recommended eligible to the Hawai‘i Register under Criterion D and E and eligible to the National Register under Criterion D. This historic property was identified in T-226A, B, C, and D, 227 and 227A

Although Test Excavation 95 was excavated within the footprint of SIHP #50-80-14-5966, Kawa Fishpond, actual pond sediments or structural remains were not observed during the City Center AIS fieldwork, only fill sediments related to the pond’s infilling. Because the City Center construction will extend through Kawa Fishpond, there is potential for the project to affect this archaeological cultural resource. Accordingly, discussion and evaluation of significance, project effect, and project mitigation related to #50-80-14-5966 are included in this City Center AIS report.

Although SIHP #50-80-14-7197 was not observed in the City Center AIS, it was previously identified and documented (Pammer et al. 2011) in close proximity to the City Center APE (the Civic Center Station), and the geographic extent of SIHP #50-80-14-7197 is only generally understood, it is possible portions of SIHP #50-80-14-7197 will be affected by the construction of City Center. Accordingly, discussion and evaluation of significance, project effect, and project mitigation related to SIHP #50-80-14-7197 are included in this City Center AIS report.

6.5.1 Archaeological Cultural Resource Function

Of the 18 archaeological cultural resources identified within, or immediately adjacent to, the City Center study area, 16 cultural resources were documented during test excavations. Two were not identified but were close enough to warrant consideration of potential project effect (Kawa Fishpond, SIHP #50-80-14-7197 and a buried, culturally enriched, sand A-horizon, SIHP #50-80-14-5966). The cultural resources consisted of a wide range of function types including agriculture, aquaculture, burial, commerce, cooking, habitation, land reclamation/refuse disposal, salt production, toilet, transportation, and natural wetland. Many of the cultural resources encompass multiple functions. Habitation, ascribed to eight cultural resources, constituted the largest percentage (44%), while aquaculture (22%), burial (16%), commerce (11%), and land reclamation/refuse disposal (11%) were also moderately represented. A breakdown of function type, the percentage of function type found within the study area, and their locations are provided in Table 44. Figure 281 through Figure 284 depict the locations of the cultural resources color-coded by function.

Table 44. Cultural Resources Categorized by Function

Function	Number of Cultural Resources	Percentage of Total	SIHP #50-80-14-	Geographic Zone
Agriculture	1	5	7426	West Kapālama, East Kapālama
Aquaculture	4	22	5368, 5966, 2963, 6856	Iwilei, West Kaka‘ako, East Kaka‘ako
Burial	3	16	2963, 5820, 2918	West Kaka‘ako, Kaka‘ako Makai
Commerce	2	11	7427, 7428	Downtown Waterfront, West Kaka‘ako
Cooking	1	5	7425	West Kalihi
Habitation Pre- or post-Contact	8	44	7427, 7428, 2963, 7124, 7197, 5820, 7429, 2918	Downtown Waterfront, West Kaka‘ako, Kewalo, Kaka‘ako Makai
Land reclamation / refuse disposal	2	11	7189, 7193	West Kaka‘ako, Kaka‘ako Makai, Kālia
Salt production	1	5	7190	Kaka‘ako Makai
Toilet	1	5	7430	Kālia
Transportation	1	5	2918	Kaka‘ako Makai
Wetland	1	5	6636	East Kaka‘ako, Kālia

Habitation sites were located within contiguous geographic zones along the Honolulu/ Kaka‘ako coastline, from Downtown Waterfront through Kaka‘ako Makai and West Kaka‘ako to Kewalo. The habitation sites consisted of both pre- and post-Contact traditional-type habitation,

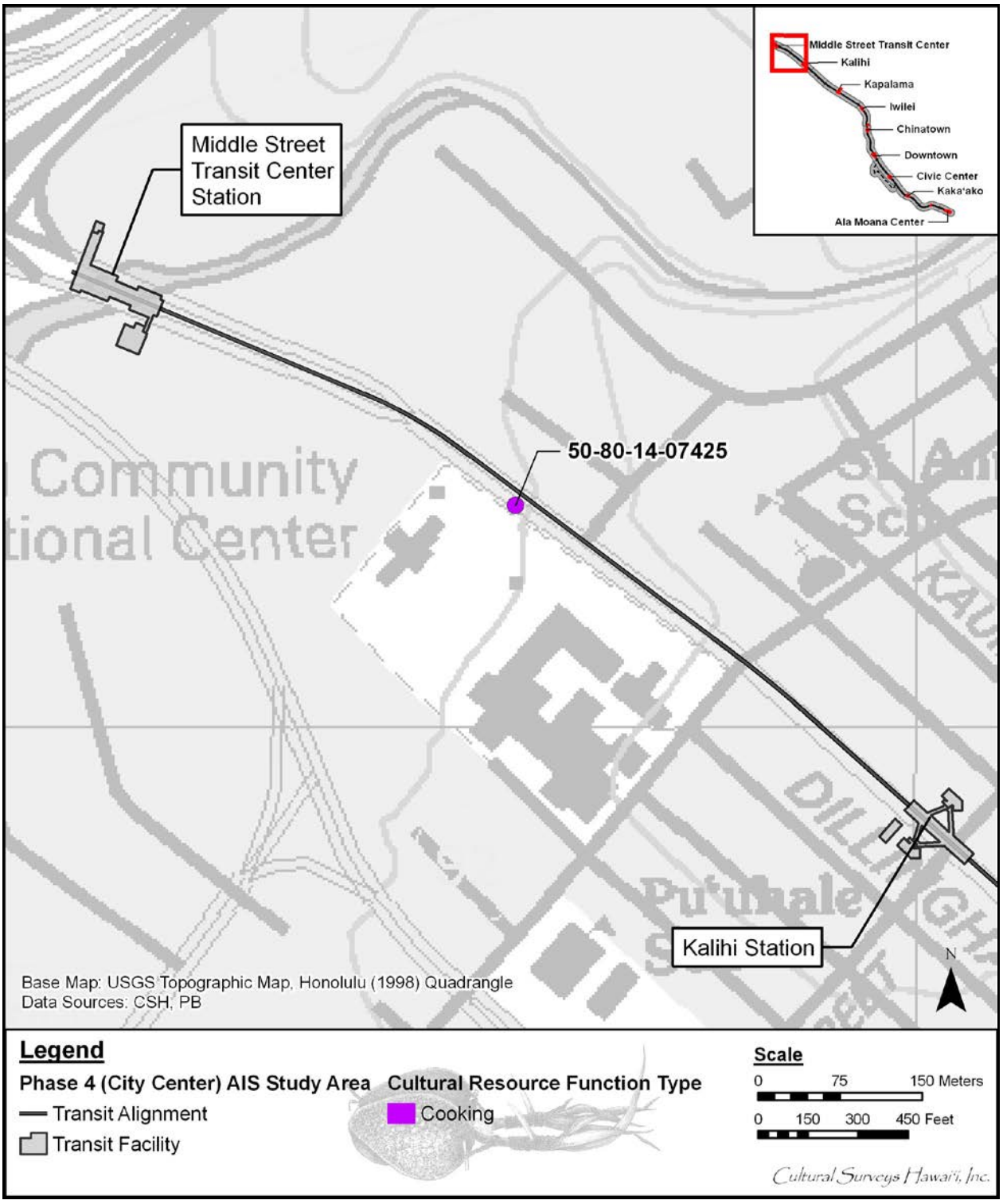


Figure 281. Locations of cultural resources at the west end of the City Center AIS corridor color-coded by function (base map: 1998 U.S. Geological Survey topographic map, Honolulu Quadrangle)

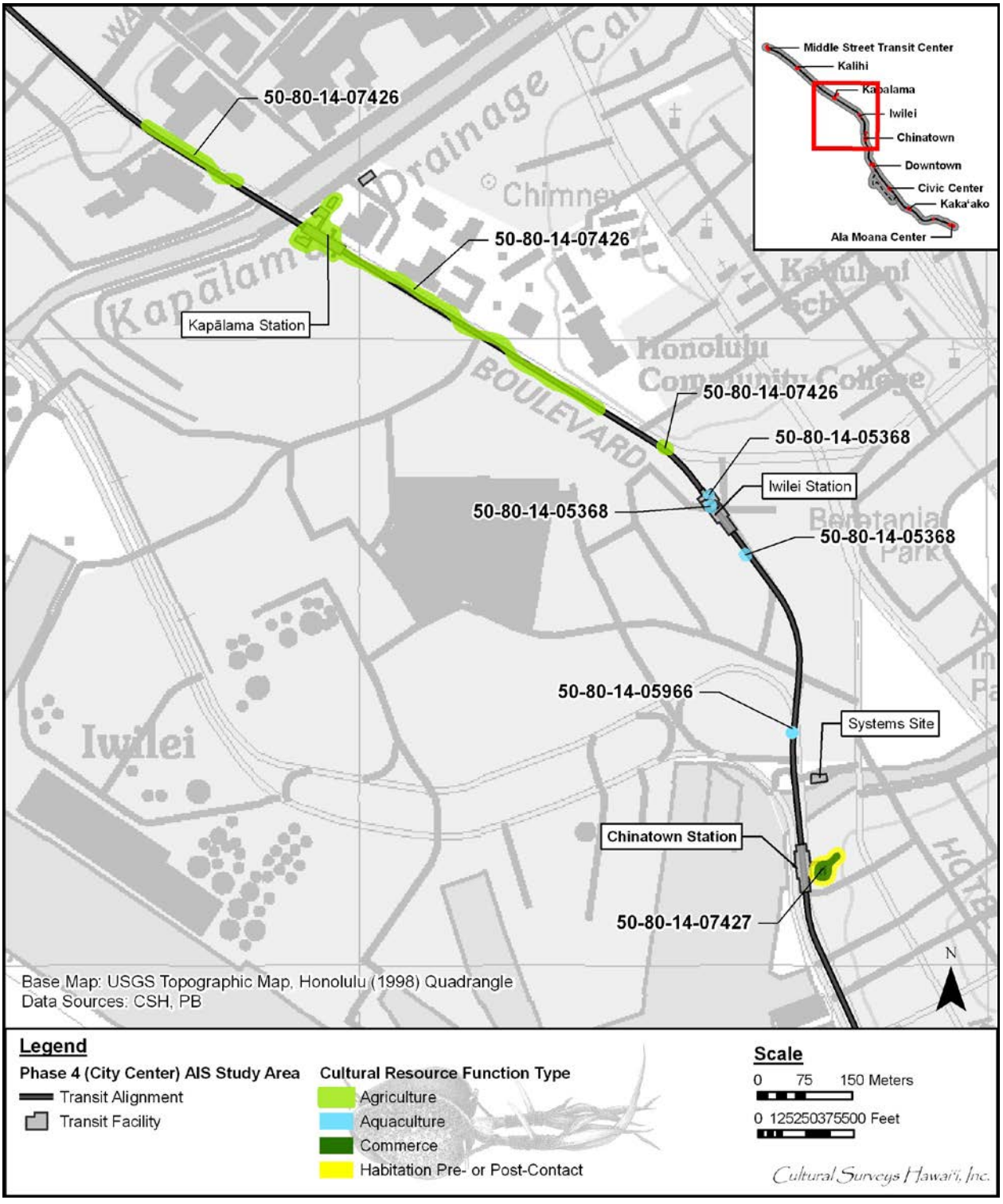


Figure 282. Locations of cultural resources in the center of the City Center AIS corridor color-coded by function (base map: 1998 U.S. Geological Survey topographic map, Honolulu Quadrangle)

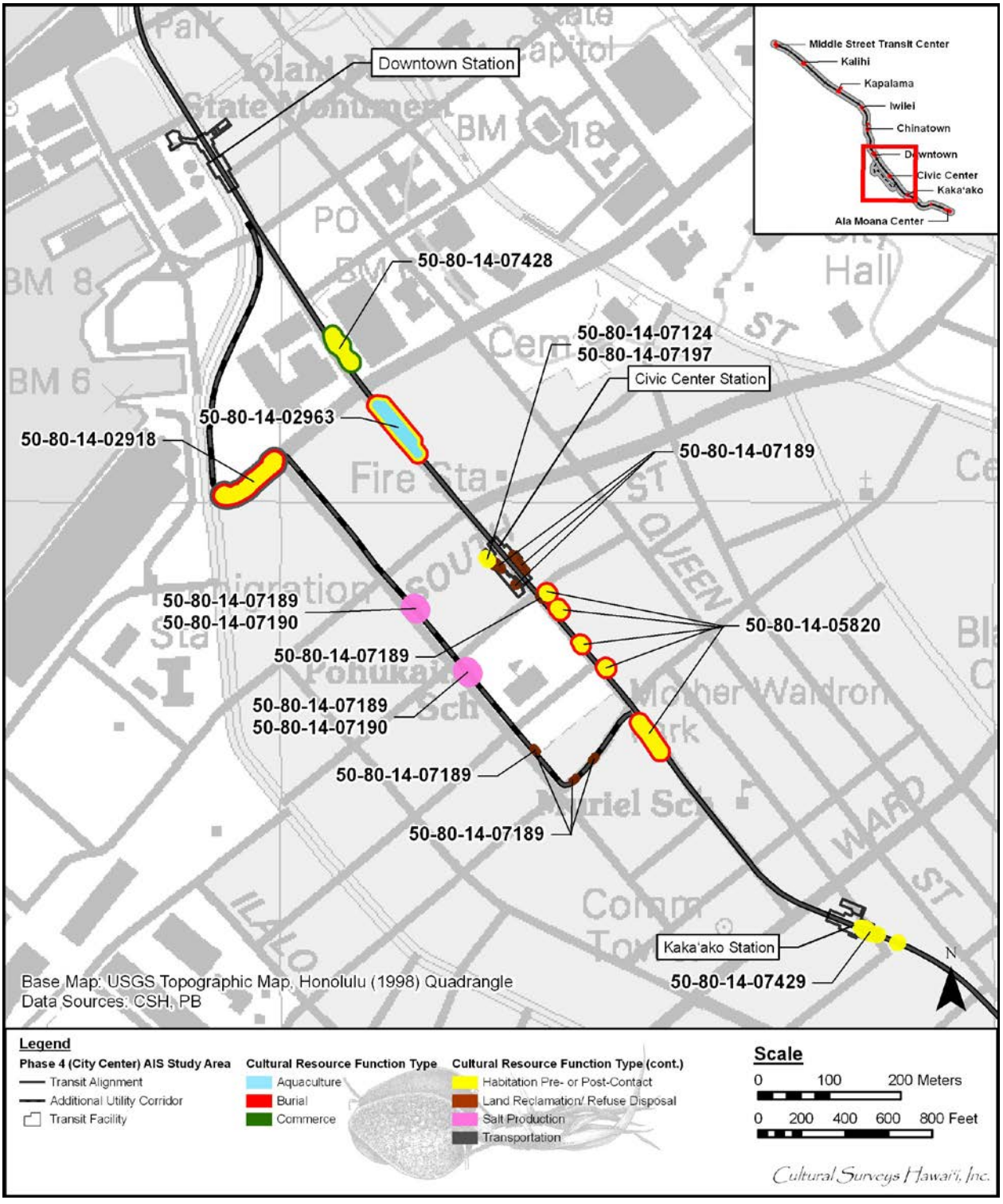


Figure 283. Locations of cultural resources in the center of the City Center AIS corridor color-coded by function (base map: 1998 U.S.Geological Survey topographic map, Honolulu Quadrangle)

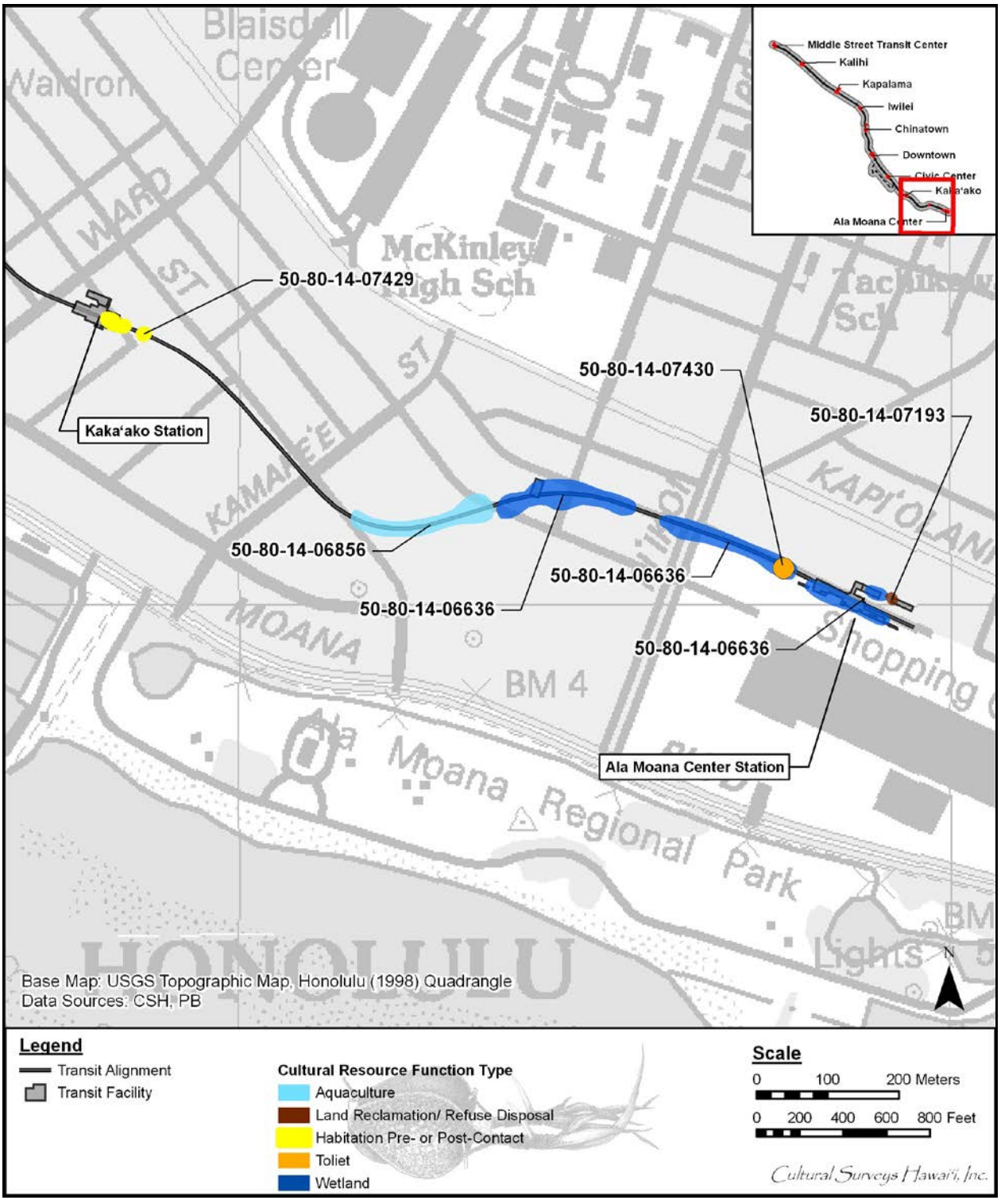


Figure 284. Locations of cultural resources at the east end of the City Center AIS corridor color-coded by function (base map: 1998 U.S.Geological Survey topographic map, Honolulu Quadrangle)

represented by a buried, culturally-enriched A-horizon with associated pit features, and historic-era buildings, represented by building remnants within fill. The majority of cultural resources with a habitation function consisted in form and composition of traditional-type habitation: an area of culturally-enriched former ground surface (buried A-horizon) with pit features containing midden (**Error! Not a valid bookmark self-reference.**).

Table 45. Habitation Sites as Determined by Form and Contents

SIHP #50-80-14-	Form	Contents
7427	Buried cultural layer (potentially re-worked)	Midden
7428	Buried A-horizon with pit features	Midden
2963	Buried A-horizon with pit features	Midden
7197	Buried A-horizon with pit feature	Midden
7124	Fill deposit likely related to building demolition	Building remnants, household goods, and faunal remains
5820	Buried A-horizon with pit features	Midden
7429	Buried A-horizon with pit features	Midden
2918	Buried A-horizon with pit features	Midden; posthole

Aquaculture sites consisted of both marine fishponds (SIHP #s-5368 and -5966) and inland fishponds (SIHP #s-2963 and -6856). The marine fishponds (Kūwili and Kawa) were located along the shoreline of Iwilei. The inland fishponds (Kolowalu and unnamed ponds) were located within the West and East Kaka‘ako Geographic Zones. The aquaculture cultural resources were characterized by dark clay-based sediments, abundant fresh- and brackish-water snails and organic material. The composition of these sediments is consistent with aquaculture activity.

Burial sites documented during test excavations consisted of two intact burials at the base of Jaucas sand deposits, one with a faint burial pit outline and one without a visible pit outline (SIHP #s -5820 and -2918), and one incomplete, previously disturbed burial within a pit feature that likely originated from the A-horizon (SIHP #-2918). Seven additional human burials (SIHP #-2963), including four within defined pit features, were documented during previous archaeological investigations (Clark et al. 1987) outside the City Center AIS study area. The documented burials were all located within the Kaka‘ako area (the West Kaka‘ako and Kaka‘ako Makai Geographic Zones). The pit feature form of two of the burials and the stratigraphic context are consistent with traditional Native Hawaiian-style burial practices.

Cultural resources representing a commercial function consisted of subsurface historic-era building foundation remnants (SIHP #s-7427 and -2963). These building foundations were located within the Downtown Waterfront (Chinatown) area and within the West Kaka‘ako Geographic Zone. The building foundations consisted of concrete slabs, stone and mortar walls and foundations, and brick walls. According to historic maps, these cultural resources likely consisted of commercial storage warehouses (such as a City Mill warehouse and a rice mill storage facility).

Cultural resources representing land reclamation and/or refuse disposal functions were located in the Kaka‘ako Makai and Kālia Geographic Zones (SIHP #s-7189 and -7193). The cultural resource is characterized by a black burnt layer containing abundant historic debris. It is typically deposited over natural wetland deposits. The composition of the cultural resource, as well as its location over wetland deposits, are consistent with historic land reclamation activity in the wetland areas of Kaka‘ako and Kālia.

One cultural resource representing cooking activity was documented in West Kalihi (SIHP #-7425). The cultural resource consisted of a sub-surface *imu* pit feature. The feature was bowl-shaped and contained fire-affected basalt cobbles and abundant charcoal. The form and composition of this feature are consistent with a cooking function.

Agriculture sites consisted of a contiguous area of wetland sediments on either side of Kapālama and Niuhelewai Streams (SIHP #-7426). The cultural resource is characterized by dark alluvial sediment containing decomposing organics, marine shell, and fresh- and brackish water snails. The composition of this sediment is consistent with taro and/or rice cultivation.

One cultural resource representing salt production was documented in the Kaka‘ako Makai Geographic Zone (SIHP #-7190). The cultural resource is characterized by two potential man-made sand berms and gray clay with thick lenses of peat. The form and composition of these sub-surface deposits are consistent with a salt-making field.

One cultural resource representing a toilet function was documented in the Kālia Geographic Zone (SIHP #-7430). The toilet consisted of a rectangular wooden structure, composed of wood planks and posts, containing deposits of historic refuse. The form and composition of the structure are consistent with a historic-era privy.

One cultural resource representing a transportation function was documented in the Kaka‘ako Makai Geographic Zone (SIHP #-2918). The form of the site was linear and comprised of a wood beam, a metal rail, and red bricks. The form and composition of the site are consistent with railway or streetcar infrastructure.

One cultural resource consisted of natural wetlands extending from the East Kaka‘ako Geographic Zone through the Kālia Geographic Zone (SIHP #-6636). The cultural resource is characterized by a variety of wetland sediments containing charcoal, marine invertebrates, fresh- and brackish water snails, and a high organic content. Although no modifications of this cultural resource were observed within the City Center study area, previous archaeological investigations have documented some modifications, including a sand berm and modified pond.

6.6 Laboratory Results

6.6.1 Summary of Traditional Hawaiian Artifacts

Test excavations within the City Center AIS study area produced a total of 62 traditional Hawaiian artifacts. The traditional Hawaiian artifacts consisted of a range of artifact types and function, including: volcanic glass debitage, basalt debitage and possible adze fragments, fishing tools, a basalt game stone, a sling stone weapon, an eating implement, and a dog tooth ornament. The majority of the traditional Hawaiian artifacts consisted of volcanic glass debitage (72.58%) with the remaining artifacts consisting of basalt flakes (11.29%) and miscellaneous artifacts

(16.13%). Of interest were a bone artifact interpreted as a net mender tool (*kī‘o‘e*), a sling stone (*‘alā o ka ma‘a*), and a drilled dog tooth ornament (*kūpe‘e niho ‘īlio*).

6.6.2 Energy-Dispersive X-ray Fluorescence Analysis

Energy-Dispersive X-ray Fluorescence (EDXRF) analysis was carried out on traditional Hawaiian stone artifacts to establish geochemical “fingerprints” for comparative purposes. The volcanic glass samples submitted for analysis appear to fall into two geochemical groups, each with very similar elemental fingerprints. Thus, almost certainly, the samples falling into each of the two groups came from two discrete geological sources. One group of volcanic glass samples appears quite similar to volcanic glass known from a Waiāhole, O‘ahu quarry. This Waiāhole-like volcanic glass is quite wide-spread with identifications from almost one end of the City Center corridor to the other.

In contrast, the identifications of a second grouping of volcanic glass all occur within a 2 km stretch southeast from the mouth of Nu‘uanu Stream. Two contrary hypotheses are suggested. The more limited distribution of Group 2 volcanic glass could relate to a more localized source, perhaps in the neighboring leeward south Ko‘olau volcanic range, with limited distribution. Variously, given that this immediate area may have been more likely to have been involved in interisland interchange than most areas of the archipelago, the likelihood of volcanic glass from another island might be greater in this area than in most other foci of traditional Hawaiian settlement. For example, it seems probable that the Maui and Hawai‘i Island forces involved in the conquest of O‘ahu and the establishment of the center of Kamehameha’s kingdom in what is now downtown Honolulu in the 1795 to 1810 timeframe would have transported volcanic glass from their home islands to this immediate area of O‘ahu. The expansion of a data base of geochemical “fingerprints” of stone tools may well shine light on questions such as the origin and history of the Group 2 volcanic glass.

6.6.3 Summary of Historic Artifacts

A total of 1,283 historic artifacts/artifact fragments was collected, consisting of 380 ceramic vessels/ceramic vessel fragments, 477 glass bottles/bottle fragments, and 426 miscellaneous items.

There were mainly two types of historic deposits for the test excavations in the HHCTCP project. In the West and East Kalihi and Iwilei Geographic Zones, fill layers had bottles dating exclusively from the 1930s to 1940s. This is probably an indication of the late development of these areas in the expansion of the urban area of Honolulu. In the Downtown, West and East Kaka‘ako, and Kaka‘ako Makai Geographic Zones, test excavations documented mainly fill layers with trash from the late nineteenth century to the early twentieth century. Bottles typically dated from the 1870s to the 1920s, within the mold-blown period. There was only one definitely free-blown bottle (pre-1850 period) with a pontil, but it was probably made in a European factory, which were much slower to abandon the older manufacturing techniques than American and Canadian companies. In these Downtown and Kaka‘ako deposits, there also usually were no machine-blown bottles (post-1920s). The lag between the manufacturing time of the bottles and their discard may be from 5 to 10 years.

The ceramics dates in these test excavations mirrored the bottle results. While some of the more expensive European-made ceramics had early manufacturing dates, these types of wares may have been passed down through generations, and may have a long deposition lag between the manufacturing date, through the purchase and use date, until they were finally discarded. This is probably not as true for the inexpensive mass-produced Chinese painted wares and Japanese transfer-prints, which were easily broken and may have had a short deposition lag, possibly around 10 years from the time of manufacture to the time of discard. Most of the trash probably represents domestic refuse. In the Downtown Geographic Zone, there were a lot of spirits (ale, whiskey, beer) bottles, possibly from nearby hotels or bars. Some of the European ceramics were made of a durable earthenware, called Ironstone, that was also mainly purchased for hotels and restaurants. Thus, some of the trash from this area is most likely from commercial establishments rather than family residences.

In the Iwilei Geographic Zone, near the former OR&L railroad terminal building, several rail spikes, probably part of the old railroad tracks, were recovered. In the Kewalo Geographic Zone, a part of a railroad track and a spike were found. In this case, the rail may be part of the Honolulu streetcar system that operated from 1898 to 1933. Much of the construction debris (nails, bricks, milled wood, etc.) is probably also the result of some commercial enterprise, as the Honolulu area, especially before the 1900 Chinatown fire, was a mixture of commercial and residential buildings. Before, and especially after, the fire, industries and residences began to move into the Kaka‘ako area to the east. To develop this area, people were encouraged to take their trash and fill in former ponds and swamps. Large sections of Kaka‘ako were also used for open-air trash burning. In the Kālia Geographic Zone, some test excavations have only post-1920s material, indicating the late commercial development of this area. There are also test excavations with the same type of 1870s to 1920s artifacts as the Kaka‘ako area, either from deposition of nearby domestic refuse, from open-air burning, or the use of trash to fill in this former low-lying wetland area.

6.6.4 Faunal Analysis

Faunal analysis was conducted on material that was collected in two ways: 1) through screening of bulk sediment samples in the laboratory and 2) through hand collection in the field. Faunal analysis revealed that the bulk sediment samples were largely comprised of invertebrate midden, while the hand collected faunal material was largely comprised of terrestrial vertebrates.

The faunal assemblage from bulk sediment samples identified areas of previous wetlands or shallow marine environments and areas of cultural activity, as evidenced by distinct midden signatures. Terrestrial and marine midden consistent with traditional Hawaiian consumption was documented in those areas that contained buried A-horizons and Jaucas sand.

The hand-collected, largely terrestrial faunal assemblage provided evidence primarily of post-Contact food scrap deposition, represented by a large percentage of cow and other large species. No traditional Hawaiian terrestrial food scrap deposition was identified.

Identified vertebrates included horse, cow, pig, sheep/goat, dog, cat, bird, chicken, duck, rat, sea turtle, shark, and a variety of bony fish. Identified invertebrates included crustaceans, sea urchins, and a variety of mollusks. The density and nature of the faunal remains supported the identification of areas of more intense habitation.

6.6.5 Analysis of Non-marine Mollusks

Dr. Carl C. Christensen prepared an "Analysis of Nonmarine Mollusks from Selected Sites for the City Center Section AIS" that identified twelve species of non-marine mollusks. The fact that some of these species are native, some are understood to be Polynesian introductions, and some are post-Contact introductions offers potential insights into land use history. Different environmental constraints for these species allow for a reconstruction of former environmental conditions. All 11 samples from the eight test excavation locations sampled have aquatic snails that indicate a fresh- or brackish-water environment. All samples, except the sample from T-131, also contained *M. tuberculata*, which requires permanent water. The presence of this species indicates permanent water in all other locations sampled.

6.6.6 Wood Taxa Analysis

This project included an extensive effort at charcoal taxa analysis carried out by Gail Murakami of the International Archaeological Research Institute, Inc. This analysis served two purposes: 1) to aid in the selection of charcoal samples for radiocarbon dating; and 2) to inform regarding the plant species present to aid in a reconstruction of the environment during pre-Contact times. A surprisingly large number of taxa were identified, which aided in a reconstruction of the environment in late pre-Contact and early post-Contact times.

6.6.7 Radiocarbon Dating

Twenty-eight charcoal samples of identified, short-lived, native Hawaiian plant species, *kukui (Aleurites moluccana)* nut shell, and coconut (*niu, Cocos nucifera*) shell were sent to Beta Analytic, Inc., of Miami, Florida for carbon dating. Carbon samples from contexts including post-Contact artifacts or typically post-Contact wood (conifer and temperate hard wood) were excluded from selection for dating. Hence, there was a deliberate bias in sample selection for what were believed to be pre-Contact deposits.

Of the 28 samples, 20 (71 percent) yielded carbon dates with 2-sigma date ranges extending into the twentieth century. These 20 "late" dates typically span the past three centuries with stronger probabilities for nineteenth and twentieth century calendar ages. This very large percentage of "late" dates is suggested to reflect the extraordinary growth of the greater Honolulu area in the early post-Contact period particularly following the conquest of O‘ahu by Kamehameha I in 1795 and his encouragement of Honolulu as a center of commerce.

Six samples had exclusively pre-Contact dates that clustered relatively tightly in the AD 1440 to 1660 time period. It was somewhat surprising that no earlier dates were acquired. A lack of earlier dates may be due to the fact that the present City Center AIS study missed areas of earlier settlement by virtue of being too seaward. Much of the present alignment was actually off-shore of this Downtown Honolulu area of particular interest for relatively early settlement.

6.6.8 Pollen Analysis

Results of pollen analysis were prepared in a report, "*Pollen Analysis of Samples from the Honolulu High-Capacity Transit Corridor Project, Honolulu, Hawai‘i*" by Linda Scott Cummings with assistance from R. A. Varney, of PaleoResearch Institute, Golden, Colorado. The pollen analysis report indicated that the former environment along the City Center AIS

corridor was primarily one of sedges and grasses representing marshy land and grass lands. Indigenous, Polynesian-introduced, and Western-introduced (post-Contact) pollen species were identified. Many of the pollen samples clearly indicate post-Contact environmental change as evidenced by the presence of pollen from exotic species. Samples indicated that several plant varieties were formerly cultivated, including taro, rice, cotton, and sugar cane. Rice and taro agriculture were shown to be far more widespread than cotton and sugar cane cultivation.

6.7 AISP Research Focus

As described in Section 2.2 of this volume, the City Center AISP outlined five research foci for which, based on extensive AISP background research, the City Center AIS could be expected to provide significant additional information. The five research foci deal with settlement along the City Center AIS corridor, GPR utility, pre-Contact landforms and shorelines, human-induced environmental change, and burials. The results of research on each of these foci are described in detail, below.

6.7.1 Settlement Transect

The linear, dispersed nature of the City Center guideway alignment increased the informational value of the AIS study in that it provided a long cross-section transect through the majority of the most archaeologically sensitive portion of O‘ahu’s south shore. This cross-section traversed four *ahupua‘a,* Kalihi, Kapālama, Honolulu, and Waikīkī, and passed through distinct environmental and cultural settings. An evaluation of the archaeological cultural resource types and distributions within the 11 City Center AIS geographic zones provides a synthesis of pre- and post-Contact settlement and land use.

The western portion of the West Kalihi Geographic Zone is characterized by thick fill deposits over natural estuary alluvium. These estuary sediments contain a mix of terrestrial gravels, silts, and sands, with marine shell and some charcoal and historic artifacts—the charcoal and artifacts represent activity in the immediate watershed, which would have been extensive from pre-Contact times into the modern era. The area has been greatly disturbed and altered by historic and modern development, particularly by the introduction of massive fill deposits.

The eastern portion of the West Kalihi Geographic Zone has similar thick fill deposits, but these cap a distinct layer of terrestrial alluvium, which in turn overlies the Kalihi Stream estuary sediments near the water table. Preserved within this deep terrestrial alluvium layer were the remains of a single *imu* (earth oven) feature (SIHP #50-80-14-7425). This pre-Contact feature (radiocarbon dated to the fifteenth or sixteenth century) is a remnant of the undoubtedly relatively intensive use of this resource rich (estuary combined with alluvial deposits used for agriculture) area. It is interesting that additional preserved remains of traditional Hawaiian activity were not found in this area. This lack of additional preserved remains may be the result of disturbance related to the construction and subsequent expansion and redevelopment of Kamehameha Highway/Dillingham Boulevard.

Further east, the East Kalihi and West Kapālama Geographic Zones are located on the raised Pleistocene coral shelf related to the 7.5 m Waimanalo stand of the sea (McDonald et al. 1983). The stratigraphy observed consists of roadway-related fill over naturally deposited alluvium over the shallow (often 0.5 to 1.0 mbs) coral shelf. No archaeological cultural resources were

observed in these two geographic zones. The alluvial deposits would have been suited for dry-land agriculture, although rainfall probably was a limiting factor. Because of the higher elevation of the coral shelf, irrigated agriculture was probably not feasible. The lack of observed archaeological cultural resources may be due to the construction and subsequent expansion of Dillingham Boulevard (in the 1930s).

At Waiakamilo Road, the West Kapālama Geographic Zone ends and the HHCTCP corridor drops down off the coral shelf into the East Kapālama Geographic Zone. These low-lying alluvial lands were well-watered by both Niuhelewai and Kapālama Streams. Historic research clearly indicates that these areas were productive wetland agricultural lands, first for taro and later for rice. These agricultural wetland deposits were designated SIHP #50-80-14-7426 and were undoubtedly developed in the pre-Contact period, with continued use into the twentieth century. It is not surprising that, aside from these wetland sediments, no other archaeological cultural resources were observed. The environment was not well suited for habitation, burial interment, commerce, or other activities given the high water table.

The Iwilei Geographic Zone is within the footprint of the former Kūwili and Kawa Fishponds (SIHP #50-80-14-5368 and #50-80-14-5966, respectively). Constructed in the pre-Contact period, the fishponds were used into the latter part of the nineteenth century. These former off-shore areas were filled as part of land reclamation in the late nineteenth century as land values immediately adjacent to Honolulu increased. These types of fishponds are relatively common along this stretch of O‘ahu’s south shore. They are a conspicuous example of resource procurement intensification to support larger populations and/or an elite ruling class.

The Downtown Waterfront Geographic Zone extends east from Nu‘uanu Stream to Richards Street. Much of the zone consists of former off-shore areas that were filled/reclaimed in the latter half of the nineteenth century as part of the development of Honolulu Harbor. The stratigraphy observed in the zone consisted of thick fill layers over marine sediments at the northern and southern ends, with fill over Pleistocene limestone in the central portion. This area was the site of the early development of the Village of Kou into the Port of Honolulu, and the zone passes through or immediately adjacent to sites important in the development of Honolulu, such as the family compound of Francisco Marin (advisor to Kamehameha the I), the Kamehameha I royal residential compound at Pākākā, and the Honolulu Fort (1816–1857). No archaeological cultural resources were observed in this geographic zone, despite several test excavations within the footprint of the former Honolulu Fort and in the vicinity of the Kamehameha compound at Pākākā. Test excavation results in this geographic zone indicate that the HHCTCP alignment is largely *makai* of the more extensive archaeological remains that have been documented *mauka* of Nimitz Highway/Ala Moana Boulevard.

At the intersection of Richards Street and Ala Moana Boulevard the HHCTCP alignment leaves the Honolulu Waterfront and extends across the area that is today known as Kaka‘ako. The remaining five geographic zones to the east of Richards Street, including West Kaka‘ako, East Kaka‘ako, Kaka‘ako Makai, Kewalo, and Kālia, are all located in fairly similar geologic and cultural settings. They are all part of the coastal Honolulu Plain, which is stratified with late-Pleistocene coral reef substrate overlaid with calcareous marine sand or terrigenous sediments and stream-fed alluvial deposits (Armstrong 1983:36). Before its infilling as a part of land reclamation in the late nineteenth and early twentieth centuries, the relatively low-lying area was

a mosaic of natural Jaucas sand berms, often forming swales, open water ponds, and marshy areas. Native Hawaiians used the area for salt making, aquaculture, wetland agriculture, habitation, and burial interment, and many of these uses continued into the late nineteenth and early twentieth centuries, at least in some areas. AIS results from the five geographic zones east of Richards Street documented markedly more intensive archaeological deposition than was observed in the six geographic zones to the west.

Within the West Kaka‘ako, Kaka‘ako Makai, and Kewalo Geographic Zones, buried sand A-horizons with remnants of pre- and post-Contact land use, including habitation, commerce, and burial interment were well represented (SIHP #s 50-80-14-7428, 50-80-14-2963, 50-80-14-7197, 50-80-14-5820, 50-80-14-7429, and 50-80-14-2918). Commonly known as “subsurface cultural deposits,” these buried, culturally enriched A-horizons are the former land surface that predates the massive fill deposits that were brought into Kaka‘ako in the late nineteenth and early twentieth centuries. Along the shoreline of the western portion of the West Kaka‘ako Zone, salt pan remnants (SIHP #50-80-14-7190) were documented. Background research indicates that these salt pans were utilized in both pre- and post-Contact times for salt production.

These pre- and early post-Contact land surfaces remained in use until these areas were developed and buried during the urbanization of Honolulu. A trash layer (SIHP #50-80-14-7189) documented in the West Kaka‘ako and Kaka‘ako Makai Zones may have acted as fill material during development/land reclamation activities. This trash layer was found overlying portions of the salt pan remnants listed above (SIHP #50-80-14-7190). Buried building remnants (SIHP #50-80-14-7124) were also documented overlying the salt pan remnants.

The East Kaka‘ako and Kālia Geographic Zones are characterized by thick fill deposits over natural pond and wetland sediments. The western portion of the East Kaka‘ako Zone is within the footprint of the former Kolowalu Fishpond (SIHP #50-80-14-6856). Kolowalu Fishpond may have been constructed during the pre-Contact period, though its use continued into historic times. According to historic documents and maps, Kolowalu Fishpond was filled in the early part of the twentieth century during land reclamation activities. Due to its location inland, the pond was likely freshwater, or partially brackish. As with Kūwili and Kawa Fishponds, Kolowalu Fishpond is an example of resource procurement intensification to support larger populations and/or an elite ruling class.

The eastern portion of the East Kaka‘ako Zone and the majority of the Kālia Zone are characterized by thick fill deposits over natural wetland sediments (SIHP #50-80-14-6636). Historic research clearly indicates that these areas were productive wetland agricultural lands, first for taro and later for rice. These agricultural wetland deposits were undoubtedly developed in the pre-Contact period, with continued use into the early twentieth century, at which time they were drained and filled during land reclamation activities. A trash layer (SIHP #50-80-14-7193) documented at the east end of the Kālia Zone may have acted as fill material during these land reclamation activities (conversely, it could simply represent a trash disposal area). A mid- to late-nineteenth century privy (SIHP #50-80-14-7430) was documented at the east end of the Kālia Zone intruding into the natural wetland sediment (SIHP #50-80-14-6636). This demonstrates the beginnings of historic-era (Western) use and habitation in the natural wetland environment.

6.7.2 Ground Penetrating Radar

The primary focus of the GPR survey was to test the efficacy of GPR analysis within the context of urban Honolulu archaeology. Part of this study was designed to determine the ability of GPR technology to locate discrete objects in areas containing multiple fill events that are heavily disturbed by urban development. The results of this study suggest that it is very difficult to determine the difference between signal reflections caused by significant discrete objects and reflections caused by historic disturbance, subsurface infrastructure (utilities, old foundations, etc.), and imported fill layers. A statistical study was conducted using utilities to determine the accuracy of locating discrete objects in the range of clean signal return and it was found that less than half of the objects were detected in the GPR results. Location of discrete objects has traditionally been the role of GPR analysis within the context of modern archaeology. While GPR technology has been shown to be effective in other depositional environments, the results of this study suggest that further refinement is needed to increase the reliability of GPR as a tool for discrete object detection in urban fill environments.

This study was able to demonstrate that GPR can be a useful tool to map subsurface stratigraphy. By comparing the GPR results to the test excavation profiles, it was statistically shown that GPR data can accurately display stratigraphic transitions even in areas that are disturbed with multiple fill events. The results of the statistical study showed that 82 percent of the "ground-truthed" stratigraphic transitions that were in the range of clean signal return were within 0.25 m of the reflected signal transition observed in the GPR profiles. This information can be important when looking for stratigraphic transitions that represent boundaries between fill layers and naturally deposited layers. The number of stratigraphic transitions observed in a GPR profile also can be used to determine the probability of encountering naturally deposited sediments. For instance, a high number of stratigraphic transitions observed in the data may suggest an environment with multiple fill events, decreasing the odds of encountering naturally deposited sediments. The ability of GPR to determine stratigraphic transitions is limited to the depth of clean signal return. In the City Center AIS study area, many of the naturally deposited sediments were located below the depth of clean signal return (approximately 0.75 to 1.0 mbs). It is for this reason that using GPR in the City Center AIS study area to locate stratigraphic transitions as a way of determining the probability of encountering naturally deposited sediments had limited results.

GPR was also tested for its ability to approximate subsurface sediment material in a non-invasive way. This study found that GPR is capable of determining sediment material based on signal reflectivity and topography (signal texture). Clear patterns in signal texture were consistent in both HHCTCP Construction Section 3 and Section 4 GPR surveys, suggesting that the results can be applied to other urban project areas with similar depositional environments. Utilizing GPR signal texture analysis, coupled with soil maps and data collected from previous archaeological projects conducted in the vicinity, the probability of encountering naturally deposited sediments can be determined. This analysis could greatly enhance the general understanding of the area and provide a targeted approach to future test unit placement.

Finally, determining the effectiveness of GPR to locate human burials was a focus of this study. Burials can be considered discrete objects with stratigraphic and sediment transitions associated with burial pit features. Three potentially fully articulated human burials were

encountered during the entirety of the City Center AIS (T-142, T-226C, and T-227A). The apparently fully articulated burial located in T-142, and the much smaller infant burial in T-227A, were discovered in naturally deposited Jaucas sand with a slight pit feature associated with the burial. An articulated human pelvis was also discovered in T-226C and may represent an *in situ* burial located in a disturbed former A-horizon associated with a lower layer of Jaucas sand. The burials in T-226C and T-227A were both located deeper than the range of clean signal return and could not be clearly resolved during processing. No distinct hyperbolic reflection could be directly linked to the location of any of the burials. Hyperbolic responses to burials tend to be ephemeral, which is problematic to locate in Jaucas sand that generally exhibits high reflectivity and undulating signal topography. No stratigraphic transition or changes in signal texture representing sediment materials were observed in the GPR analysis for any of the burials that indicated the associated pit features found during excavation. Burials are subjected to the same limitations in terms of deciphering signal reflections in a highly disturbed urban context. Depth of signal penetration is also a large limiting factor in the City Center AIS study area, as most human burials are located beyond (deeper than) the range of clean signal return (0.75 to 1.0 mbs).

Overall, this study suggests that GPR technology has potential for use in Hawaiian urban archaeology but due to the limited depth of clean signal return and the highly disturbed nature of the City Center AIS study area, results were limited. This corroborates the USDA GPR suitability rating of low to very low for this area. No cultural deposits or archaeological features were clearly observed in the results, although they were rarely within the “visible” range of the GPR. Discrete objects were located with less than 50 percent accuracy in the Section 4 study area. The greatest potential use of GPR in this area is in determining the location of naturally deposited sediments and using this analysis to access the probability of encountering culture within these deposits. Again, this capability is limited to the depth of clean signal return (0.75 to 1.0 mbs for the City Center section). Further research should be conducted utilizing a lower frequency GPR antenna to gain increased depth of penetration. Some signal resolution will be lost for use in locating discrete objects, but stratigraphic transition and sediment material analysis could be conducted at greater depths where most of the transitions from fill to naturally deposited sediments occur in the City Center AIS study area.

6.7.3 Pre-Contact and Pre-Fill/Land Reclamation Landforms

The modern configuration of the coastline and coastal areas of O‘ahu’s south shore, including the vast majority of the City Center AIS study area, is primarily the result of the following.

1) The extent and topography of late Pleistocene calcareous reef and lithified dune deposits that had been undergoing both sub-aerial accretion and erosion during various Pleistocene sea stands (Grigg 1998)

2) Rising sea level following the end of the Pleistocene (see McDonald et al. 1983 and Stearns 1978)

3) The mid- to late Holocene c. 1.5–2.0 m high-stand of the sea (see summary in Dye and Athens 2000:18–19)

4) Prehistoric and historic human landscape modification

5) Historic and modern dredging and fill deposition

At the end of the Pleistocene, between approximately 20,000 and 5-6,000 years ago, water previously locked in glacial ice returned to the world's oceans and sea level rose over 100 m to approximately its current level. In the vicinity of the City Center AIS study area, rising sea levels flooded the previously dry, earlier Pleistocene coral reef and dune deposits, which had formed hundreds of thousands of years previously when sea level was comparable to modern levels. In the mid-Holocene, when sea level reached approximately modern levels, the now coastal regions became depositional environments, where for tens of thousands of years previously, during the lower sea levels, they had been erosional environments. This resulted in the deposition of both terrigenous and marine sediments, leading to the accumulation of thick deposits of soft/loose sediments along the current coastlines in areas that had formerly been valleys, drainage ways, and exposed limestone (former reef) plains (Geolabs Hawai‘i, Inc. 1993:9).

More recently, between 4,500 and 2,000 years ago, a high stand of the sea occurred, ca. 1.5 to 2.0 m above present sea level, which has been well documented for the Northern Main Hawaiian Islands (Kaua‘i and O‘ahu) (see Athens and Ward 1991; Fletcher and Jones 1996; Grossman et al. 1998; Grossman and Fletcher 1998; Harney et al. 2000; Stearns 1978). During this high stand, there appears to have been an increase in coral reef production and the production of detrital reef sediments. Littoral environments appear to have been augmented substantially by the deposition of marine sediments. "What this means is that the great shoreline sand berms must have developed around the islands at this time because this was when calcareous sand was being produced and delivered to the shorelines in large quantities" (Dye and Athens 2000:19). The subsequent drop in sea level to its present level, by at least 2,000 years ago, most likely created a slightly erosional regime that may have removed sediments deposited during the preceding period of deposition (Dye and Athens 2000:19). However, the net gain in sediments would have been substantial, largely creating the coastal environment that was first inhabited by early Hawaiians.

It is this change from an erosional environment to a depositional environment that created much of the City Center AIS study area's natural (pre-fill) land surface. Equally important was the mid-Holocene high-stand of the sea, which produced increased sediment budgets for deposition in areas like the Kalihi and Nu‘uanu Stream estuaries and the Kaka‘ako, Kewalo, and Kālia areas. It was these combined forces that resulted in the estuaries and "mosaic landscape" of open water ponds, marshy wetlands, and higher Jaucas sand swales that were first used by Native Hawaiians, with continued land use into the late nineteenth and early twentieth centuries when fill deposits permanently capped the natural surfaces. These historic and modern fill deposits have largely capped and preserved the pre-fill natural land surface.

In order to better evaluate the pre-Contact landforms and their distribution throughout the AIS study area, histograms and maps were created to illustrate the observed patterns. The landform analysis histograms show natural sediment distribution (and depth of fill) within the City Center AIS study area. Each histogram presents geologic and landform data collected during the City Center AIS. Figure 285 presents data from excavations T-001 to T-115, covering Zone 1 (West Kalihi) through Zone 6 (Downtown Waterfront). Figure 286 presents data from excavations T-116 to T-222, covering Zone 7 (West Kaka‘ako) through 10 (Kālia).

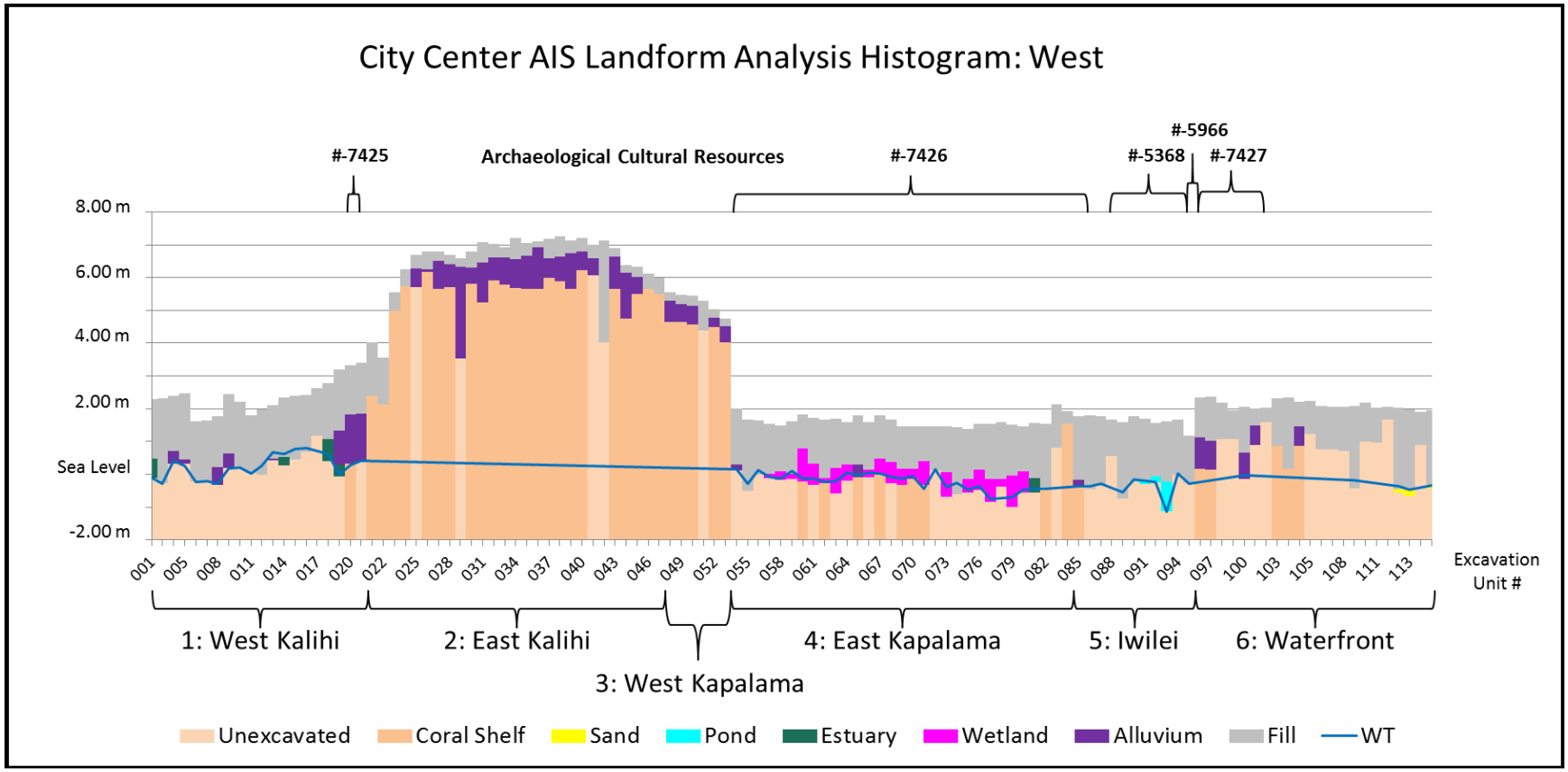


Figure 285. The subsurface natural geomorphology and overlying fill layers of the western portion of the City Center AIS study area; locations of archaeological cultural resources are also depicted

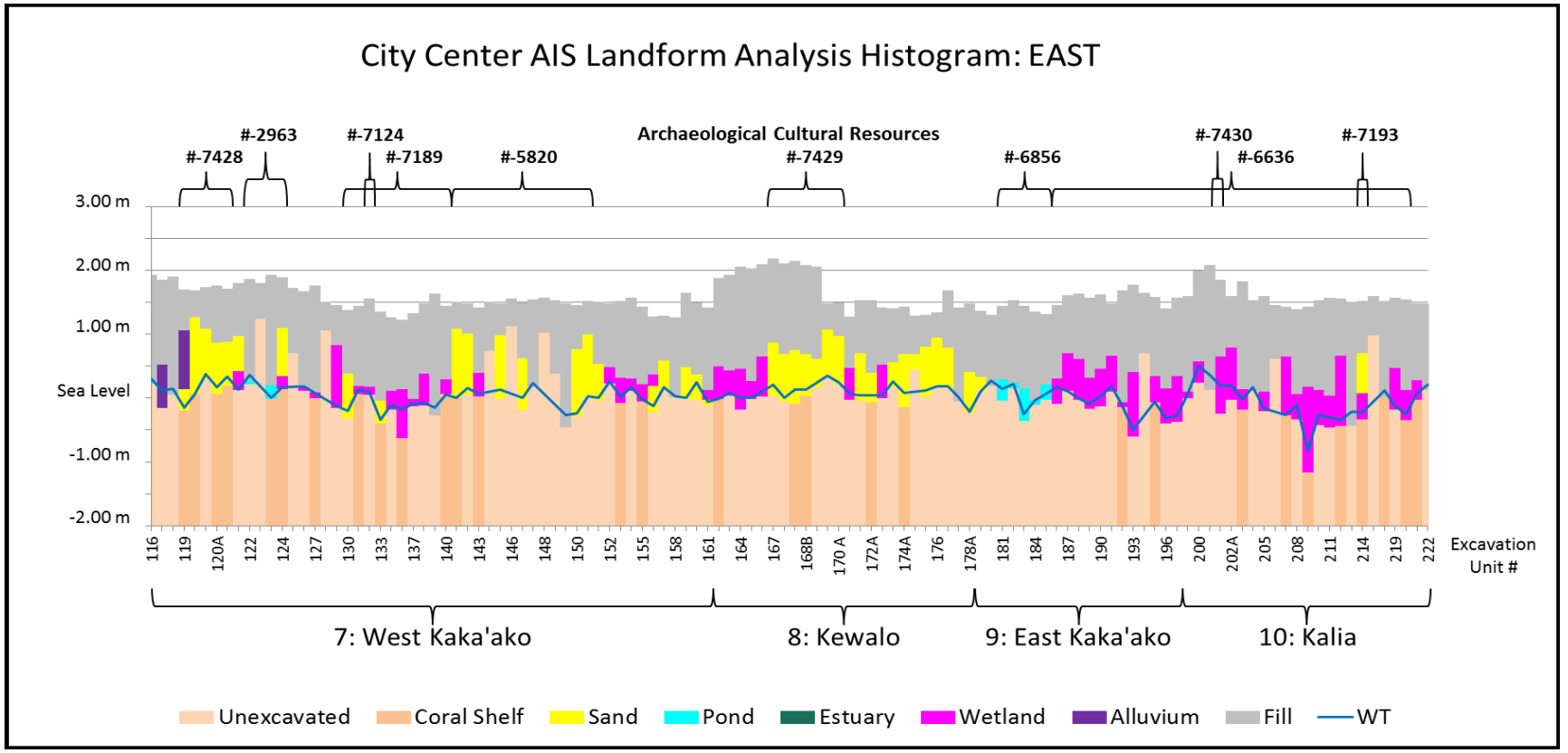


Figure 286. The subsurface natural geomorphology and overlying fill layers of the eastern portion of the City Center AIS study area; locations of archaeological cultural resources are also depicted

The histograms present a stratigraphic cross-section of the City Center corridor. Each column represents one test excavation. The stratigraphy of each trench is color coded, and has been simplified to clearly show the boundary between modern fill and the remaining natural land surfaces. The data is arranged according to excavation unit number (T-001 to T-115 for the western portion of the City Center AIS study area, and T-116 to T-222 for the eastern portion).

In general, excavations were numbered from northwest to southeast, so the histogram approximates a northwest-southeast stratigraphic cross-section. However, numbering became more complex at station locations. Presenting the data in ordinal form simplifies unit identification; however, this means the histograms show only relatively, not absolutely, spatially adjacent units. Additionally, the histograms do not show linear distance along the City Center corridor. Subsequent units may be 10 m or 100 m apart. Spatial distribution trends for the different landform types can be seen for the western half of the study area on Figure 287, Figure 288, and Figure 289, which show the distribution of these pre-fill landforms on an aerial photograph and two historic maps. Spatial distribution trends for the different landform types can be seen for the eastern half of the study area on Figure 290, Figure 291, and Figure 292, which show the distribution of these pre-fill landforms on two aerial photographs and an 1884 map of the area by S. E. Bishop.

Each histogram has three layers: modern/historic fill, natural land surfaces, and unexcavated deposits. Reasons that some deposits remain unexcavated vary (see Section 4.2 for discussion). All data was corrected for elevation, thus all stratigraphic layers are shown in correct relative position to each other. The height of each column represents elevation above mean sea level as recorded by project surveyors. The top of the grey (fill) layer represents the modern surface of Honolulu.

Excavation stratigraphy was simplified for landform analysis. All deposits were coded with one of six designations: Fill, Sand, Pond, Estuary, Wetland, or Alluvium. Excavations often encountered complex deposits, and often fit in multiple categories. The natural stratigraphy of each unit was examined and assigned a code that best approximated the overall depositional environment. Historic context and in-field assessment were given the most weight in assigning a designation. Multiple natural surface designations were assigned only when there was a significant and clear transition between depositional events.

All excavations contained modern/historic fill. In 28.7% of the excavations (72 out of 250 instances) fill was the only type of deposit encountered. Deposits from modern/historic land reclamation, construction and grading actives were all classified as fill, regardless of type or material source. This designation encompasses a wide variety of deposits, including concrete and asphalt surfaces, layers of grading coral, dredged fill, trash dumps and redeposited land surfaces.

Natural land surfaces were encountered in 71.3% of the excavations (179 out of 250 instances). The distribution of natural land surfaces encountered during the AIS is displayed in four pie charts (two each for the eastern and western portions of the City Center AIS study area) (Figure 293, Figure 294, Figure 295, and Figure 296). These charts show frequency based on presence/absence criteria; if an excavation encountered a natural surface it was scored as present. The thickness of deposits was not considered. Units were counted twice if two natural land surfaces were assigned based on field observations.

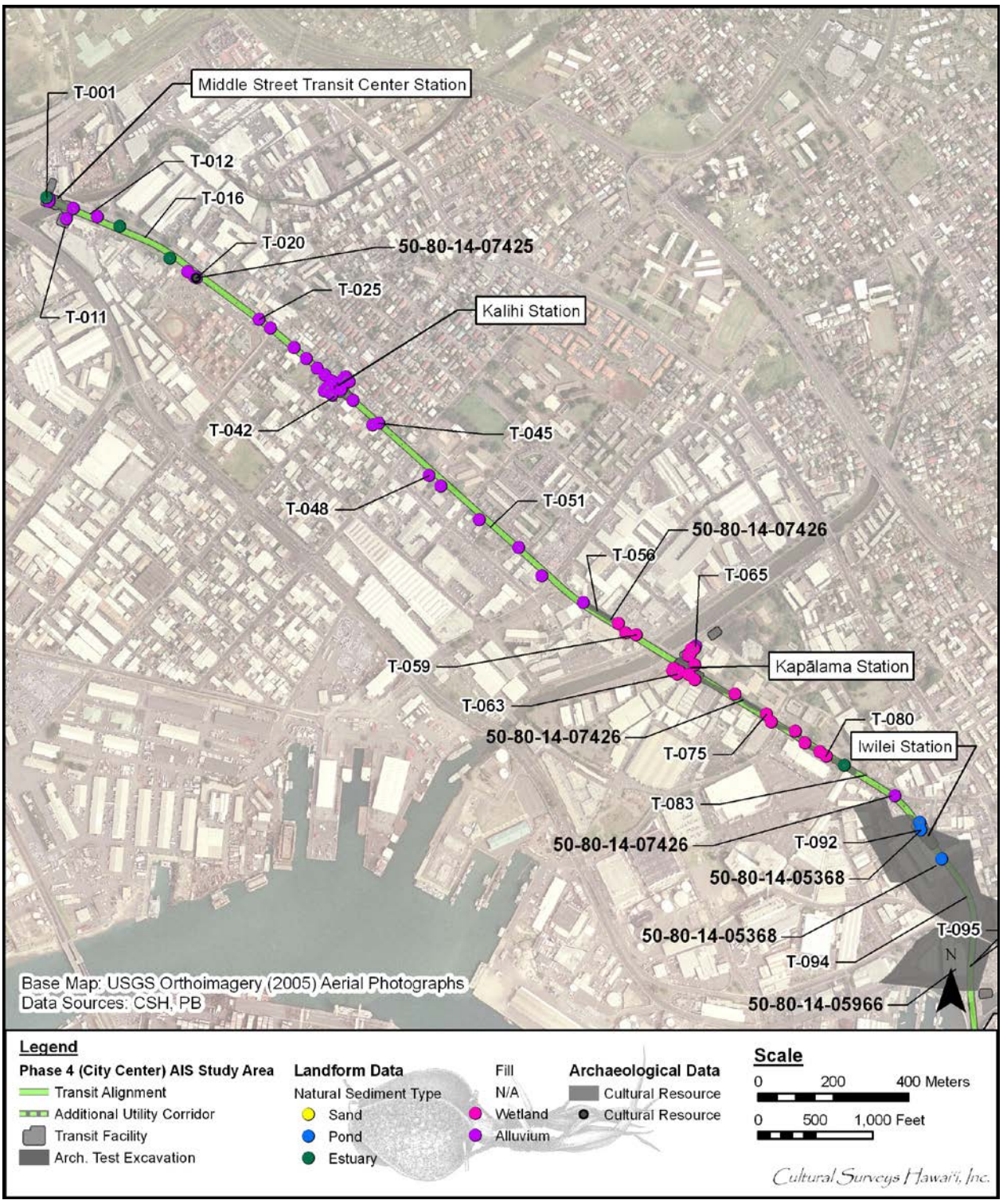


Figure 287. Aerial photograph showing the distribution of natural sediments beneath fill layers in the test excavations in the western portion of the City Center AIS (source: 2005 U.S.G.S. orthoimagery)

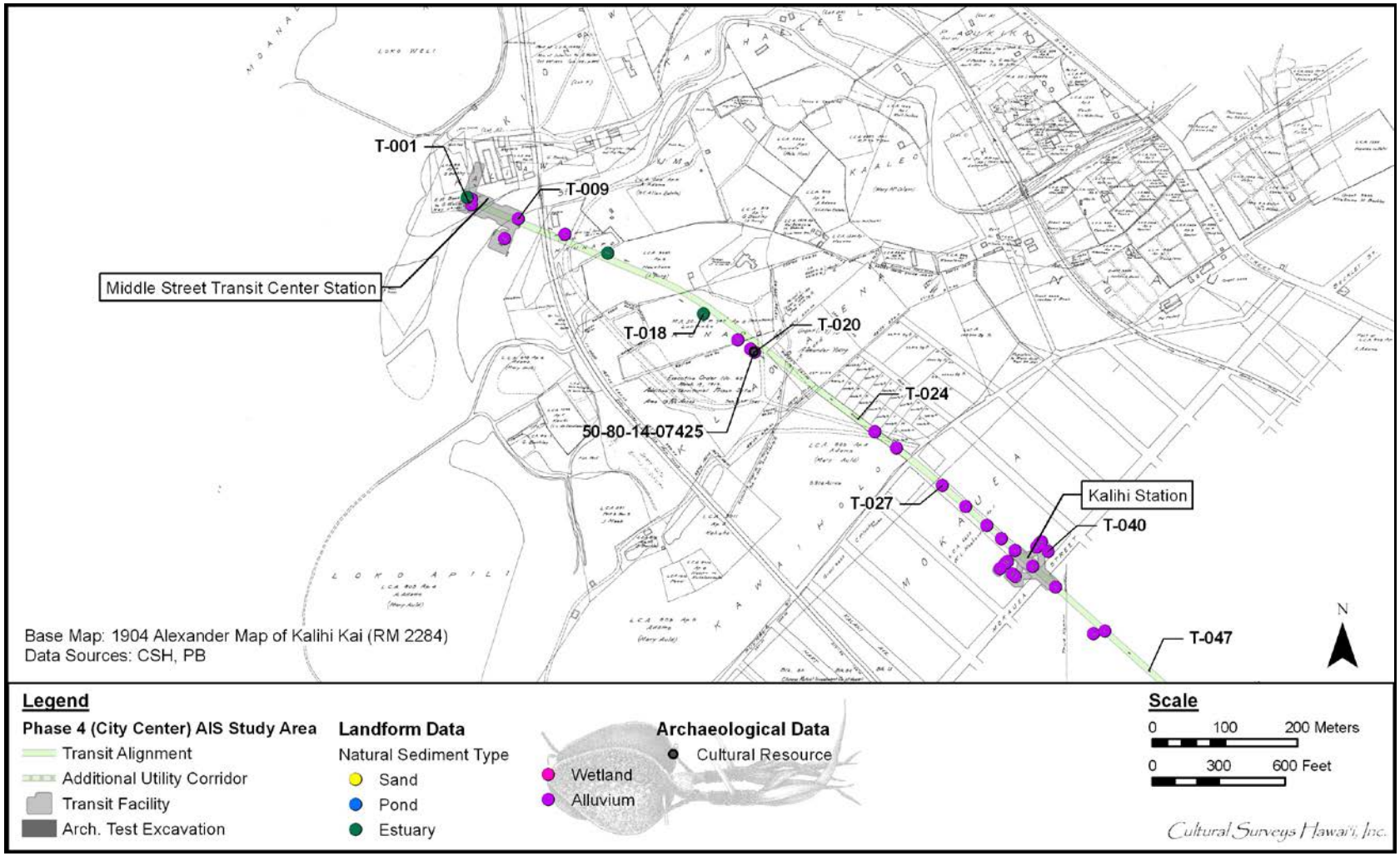


Figure 288. Portion of the 1904 Alexander Map of Kalihi Kai showing the distribution of the different natural landform types observed beneath fill layers in the City Center AIS test excavations in the vicinity of the Middle Street Transit Center Station and Kalihi Station

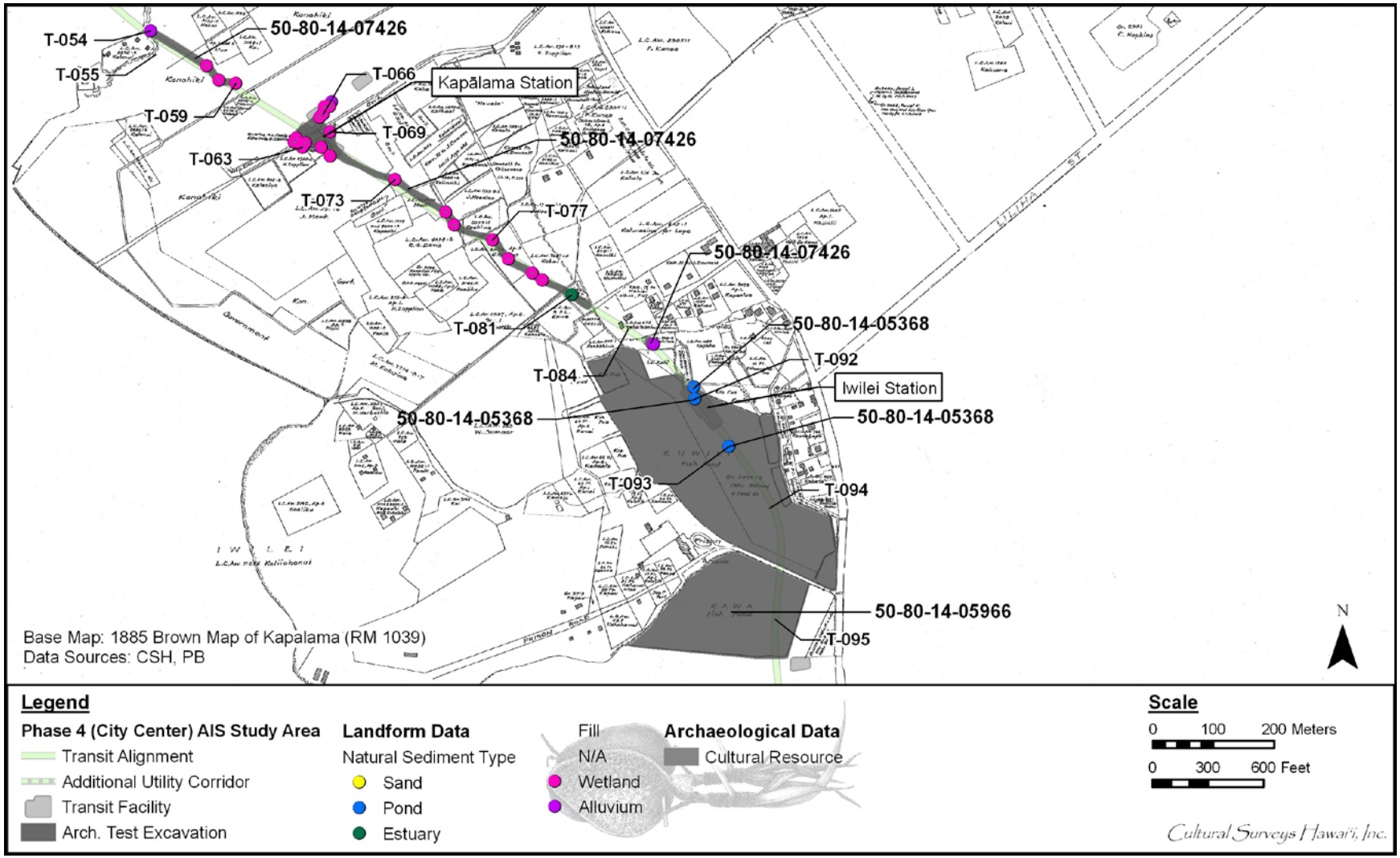


Figure 289. Portion of the 1885 Brown Map of Kapālama showing the distribution of the different natural landform types observed beneath fill layers in the City Center AIS test excavations in the vicinity of the Kapālama and Iwilei Station

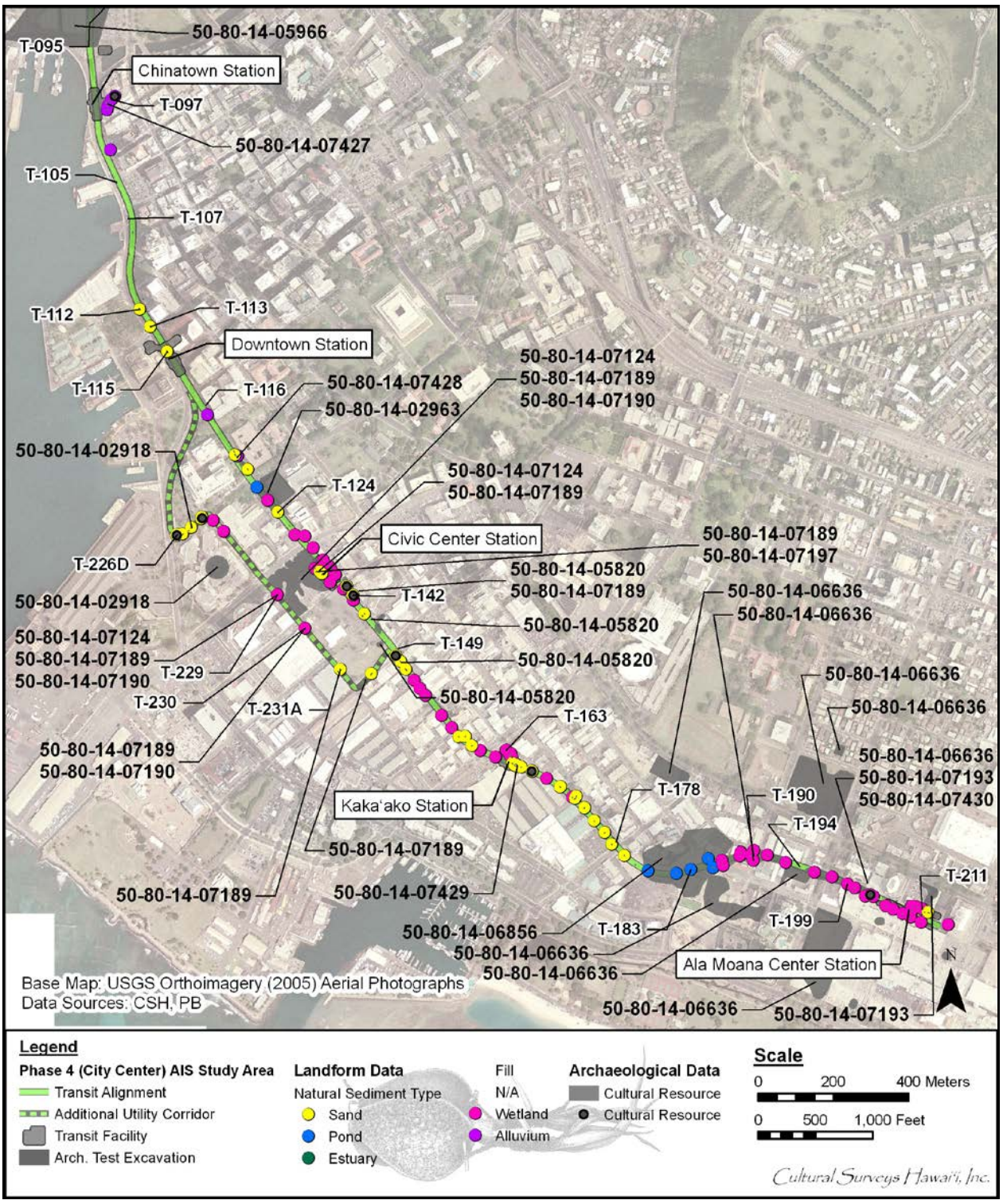


Figure 290. Aerial photograph showing the distribution of Jaucas Sand (Sand), wetlands, and pond sediments observed beneath fill layers in the Downtown and Kaka‘ako areas within City Center AIS test excavations (source: 2005 U.S.G.S. orthoimagery)

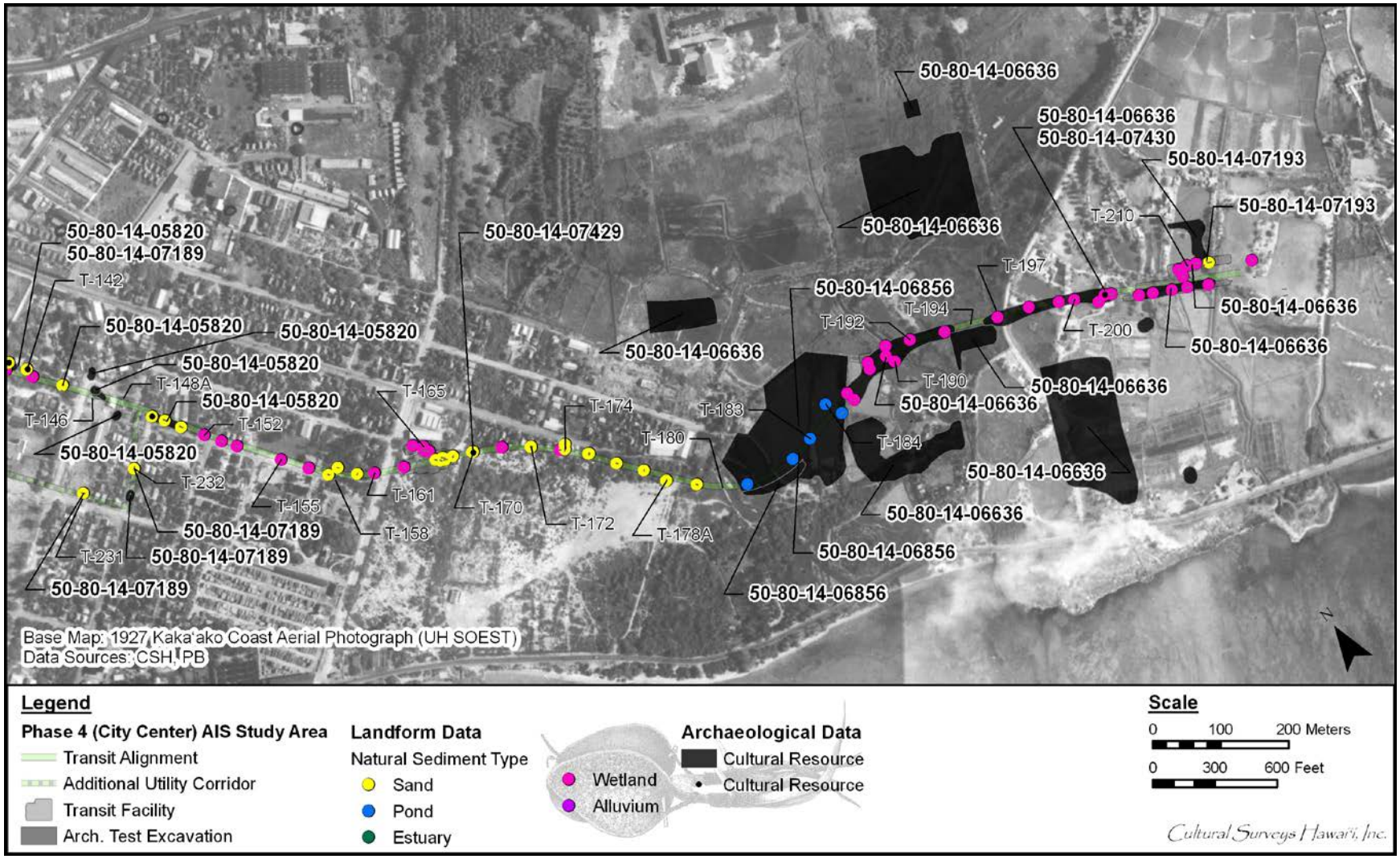


Figure 291. 1927 Kaka‘ako Coast aerial photograph (source: U.H. SOEST) showing the distribution of Jaucas sand (Sand), wetlands, and pond sediments observed beneath fill layers in the Kaka‘ako area within City Center AIS test excavations

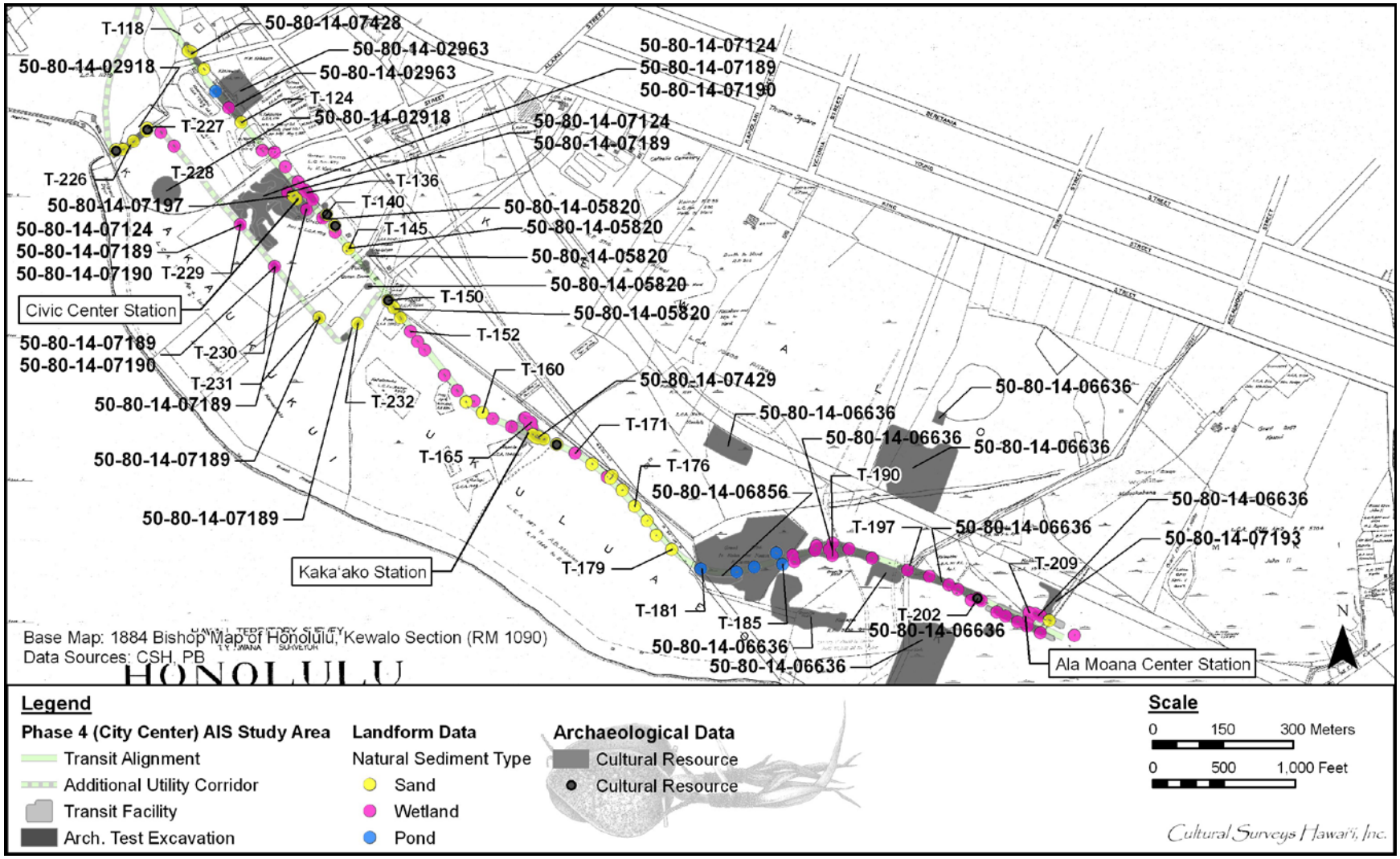


Figure 292. Portion of an 1884 map of Honolulu by S. E. Bishop, showing the distribution of Jaucas Sand (Sand), wetlands, and pond sediments observed beneath fill layers in the Kaka‘ako area within City Center AIS test excavations

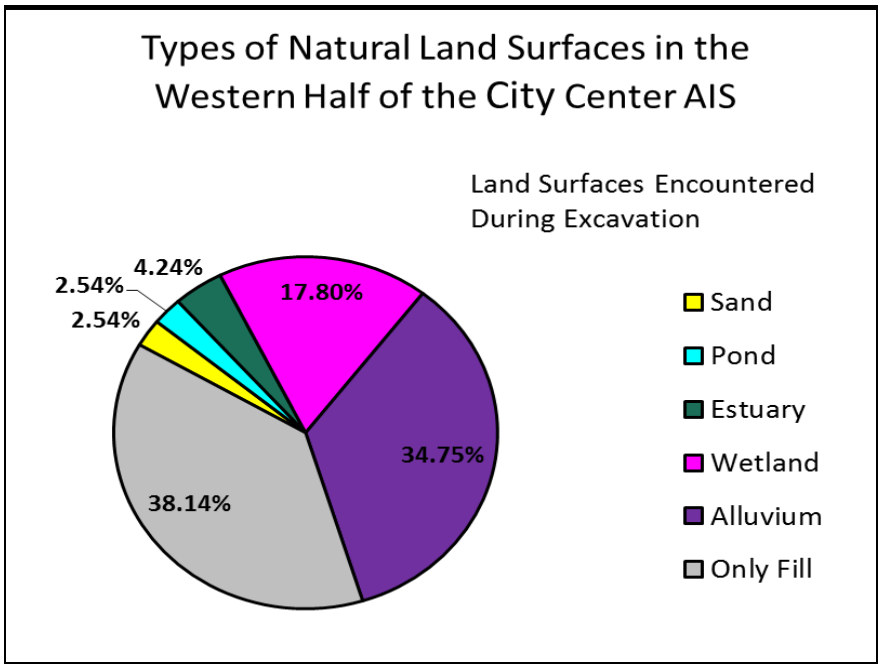


Figure 293. Percent distribution of each type of landform encountered in the western portion of the study area including those with only modern/historic fill deposits (Test Excavations 1 to 115)

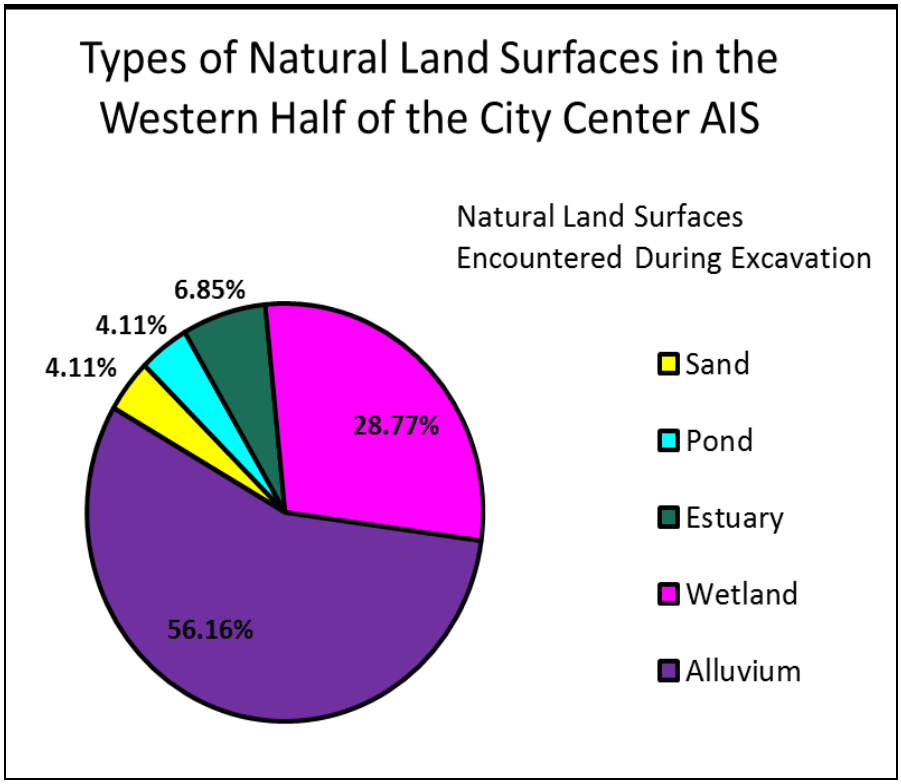


Figure 294. Percent distribution of each type of natural landform encountered in the western portion of the study area beneath layers of historic/modern fill (Test Excavations 1 to 115)

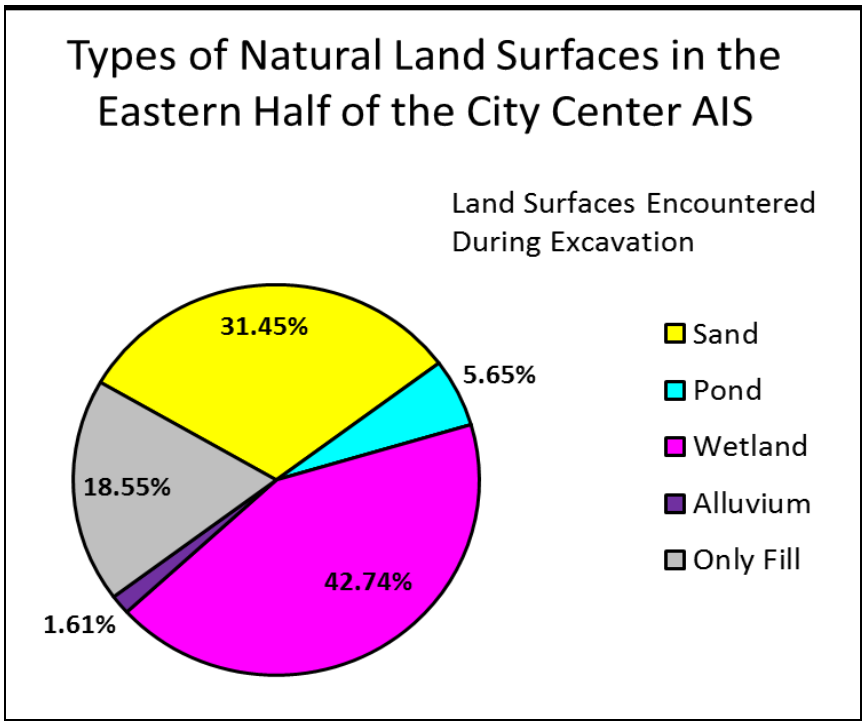


Figure 295. Percent distribution of each type of landform encountered in the eastern portion of the study area (Test Excavations 116 to 222—not including Kaka‘ako Makai T-226 to T-232A), including those with only modern fill deposits

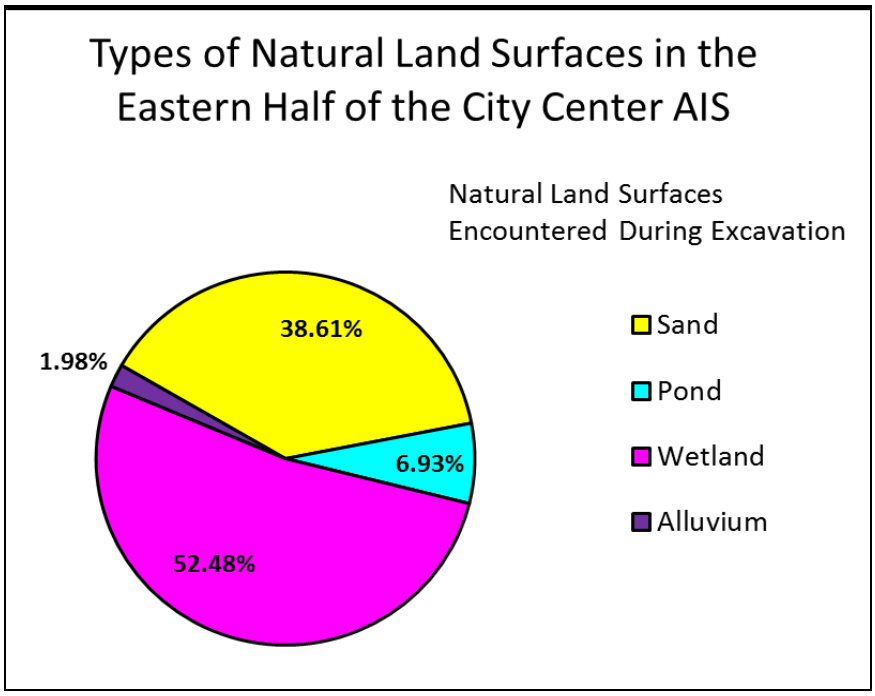


Figure 296. Percent distribution of each type of natural landform encountered in the eastern portion of the study area beneath the overlying modern/historic fill (Test Excavations 116 to 222—not including Kaka‘ako Makai T-226 to T-232A)

Sand designates a predominance of Jaucas sand, a loamy sand surface, or primarily sandy deposits within the excavation. These deposits typically vary in color from yellow or very light brown to very dark brown. This category does not include silty sand marine deposits that fall under the wetland designation. It also does not include the excavated portions of degrading coral shelf, often described as sandy in the field.

There are three designations for variations of wetland deposits: estuary, pond, and wetland. All three types of deposits were fairly similar, and existed on a continuum. The designations serve to differentiate between known wetland environments, such as the Kalihi Stream estuary and the historic fishponds. In general, the pond and wetland categories were quite similar and could clearly bend one into the other. Often the pond sediments were composed of finer grained silts and clays overlying marine sands and clays. The similar wetland sediments were comprised of silty, clayey and sandy sediments that had considerable organic content (including peaty layers of organics). Often both the wetland and pond sediments included abundant freshwater and brackish water snail shells. The estuary sediments were more distinct in that they had higher energy alluvial deposits, such as gravels, and fairly abundant marine shell and coral fragments. Field crews had access to historic maps and aerial photographs, so this information on the locations of historic ponds and wetlands was used in the field during the interpretation of the test excavation sediments.

Alluvium encompasses all non-marine deposits of eroded soil. Specifically it refers to ‘Ewa Silty Clay Loam (EmA) encountered predominantly in the West Kalihi, East Kalihi and West Kapālama Geographic Zones. ‘Ewa Silty Clay Loam soils are described as:

> …well-drained soils in basins and on alluvial fans… [that] developed in alluvium derived from basic igneous rock... These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of finger grass, kiawe, koa haole, klu, and uhaloa [Foote et al. 1972:29].

Coral shelf or solid rock was encountered in 33% of the excavations (83 of out 250 instances). This designation also includes basalt bedrock and coarse deposits of degrading coral reef. Some 67% of the units did not reach coral shelf or bedrock. In these instances the area beneath the last excavated strata is simply coded as unexcavated.

The water table is demarcated by a jagged blue line. It shows the elevation where each excavation initially encountered ground water. Not all excavations reached the water table; where there is no data, the trend line continues to next available data point. The water table level fluctuates and depends on numerous factors, including tide, porosity of the surrounding matrix, surface water drainage, and surface development.

6.7.3.1 Western City Center (Geographic Zones 1-6: West Kalihi, East Kalihi, West Kapālama, East Kapālama, Iwilei, and Downtown Waterfront, Test Excavations 1 to 115)

In the western portion of the City Center AIS study area, alternating estuary/wetland environments and alluvial/raised Pleistocene reef areas are prevalent. Natural land forms documented in test excavations in the western portion of the study area can be broken down into five categories: 1) sand; 2) pond; 3) wetlands; 4) alluvium; and 5) estuary. Natural sand surfaces are comprised of Jaucas sands. Ponds are in some aspects similar to wetlands and are comprised of dark-colored silty sediments containing organics and snails. Wetlands are comprised of various silty, clay, and sandy sediments with considerable peat (and other organics) content and

abundant fresh- and brackish water snails. The majority of these deposits are part of the Kapālama/Niuhelewai terrigenous floodplain. Alluvium refers to the thin deposits of ‘Ewa silty clay loam encountered in the East Kalihi/West Kapālama area. These sediments rest on top of a Pleistocene coral shelf, part of the 7.5 m Waimānalo stand of the sea. Estuary sediments were encountered in the Kalihi Stream drainage as well as Iwilei, and consisted of terrigenous gravels and silty clays mixed with tidal zone marine shells. Figure 295 and Figure 296 show the percentage breakdown of landforms in the western half of the study area.

6.7.3.2 Eastern City Center (Zones 7-11: West Kaka‘ako, Kewalo, East Kaka‘ako, Kālia and Kaka‘ako Makai, Test Excavations 117 to 232A)

In the eastern portion on the study area, a mosaic of landform types is present: generally a lagoonal/wetland environment behind a prograding beach berm, with both fresh- and brackish-water and pockets of higher elevation sand deposits. Native Hawaiians used Kaka’ako prehistorically for resource procurement, agriculture, burial interment, at least limited habitation, and as a transportation route. This Native Hawaiian use of the area would have resulted in changes to Kaka‘ako’s landform. By early historic times, the *mauka* portions of Kaka‘ako had become a dusty plain interspersed with freshwater courses fed by springs and *mauka* streams. Kaka‘ako’s Makai (Figure 297) portions were dotted with salt making areas, marshes, fishponds, and taro fields.

Natural landforms documented in test excavations in the eastern portion of the study area can be broken down into three categories: 1) wetlands; 2) ponds; and 3) sand. Wetlands are comprised of various silty, clay, and sandy sediments with considerable peat (and other organics) content and abundant fresh- and brackish-water snails. Sandy and clay marine sediments containing shell midden are also considered part of the wetlands. Ponds are in some aspects similar to wetlands and are comprised of dark-colored silty sediments containing organics and snails. Natural sand surfaces are comprised of Jaucas sands. In Zone 11 (*Kaka‘ako Makai*) only sand and wetland deposits were encountered. Figure 293 and Figure 294 show the percentage breakdown of landforms in the eastern half of the study area.

The AIS test excavation results provide a relatively detailed cross-section of sediment types above bedrock or above the water table (the limits of the AIS investigation) for the City Center AIS study area. Through this cross-section, it is possible to evaluate the distribution and roughly quantify the percentages of the different types of buried natural land surfaces and the overlying fill layers. The pre-Contact landforms, or at least the pre-nineteenth century fill deposit landforms, are shown in cross-section. The graphic presentation of natural sediment types encountered in the test excavations informs the discussion of archaeological cultural resource distribution. There are clear correlations between landform type and the types of archaeological cultural resources observed. For example, as would be expected, the higher sand deposits in Kaka‘ako have the habitation and burials/human skeletal remains. The low-lying Kapālama areas have the wetland agricultural sediments.

The geography and landforms of modern Honolulu are the result of extensive land reclamation fill events, which are clearly visible in the cross-sections. These results provide a rough means to quantify and predict the depth of fill deposits along the City Center AIS study area. Clearly the pre and post-Contact settlement patterns documented during the City Center AIS are correlated with the natural land surfaces observed in the City Center test excavations.

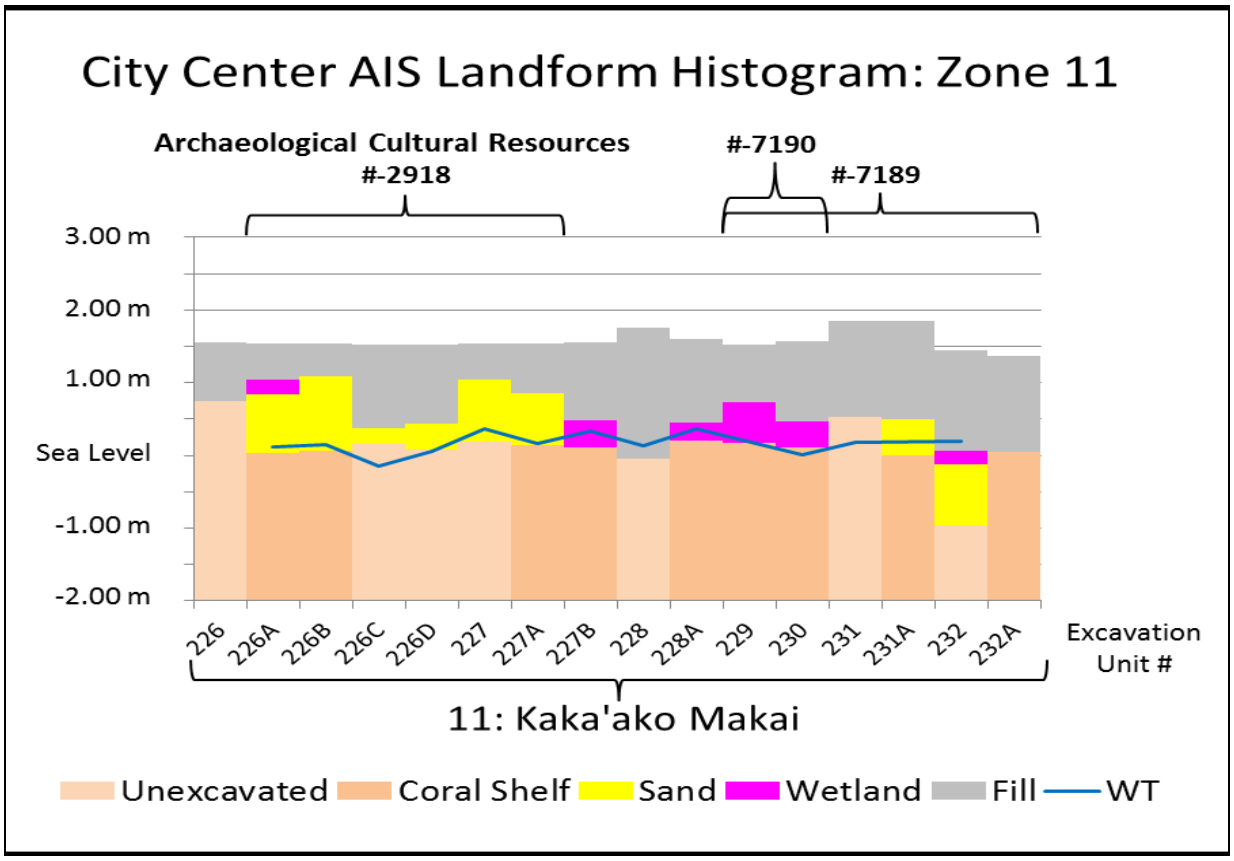


Figure 297. Additional Landform Histogram for *Kaka‘ako Makai* (Zone 11) which runs parallel to a portion of the eastern City Center AIS Study Area; this section (Test Excavations 226-232A) continues the mosaic pattern observed throughout the eastern half of the study area

6.7.4 Human-Induced Environmental Change

The focus of the present inquiry is a reconstruction of the flora in the vicinity of the City Center AIS corridor from the late pre-Contact period up through the period of intensive rice cultivation (circa 1900) for which this study has developed significant data in the form of the direct taxa identification through charcoal and pollen analysis. The environment in the late pre-Contact period had already been massively changed from that prior to human arrival, but would be radically and rapidly changed further by Western-induced changes following contact. This analysis seeks to elucidate the immediate environment of the City Center section from pre-Contact times through this period of rapid change.

6.7.4.1 Time Depth for the Consideration of Environmental Change

The 28 charcoal samples submitted in the course of the City Center AIS produced relatively late radiocarbon dates. Twenty dates typically span the past three centuries. The predominance of calendar ages extending into the nineteenth and twentieth century are an indication of intestive historic land use in the AIS study area. Only six carbon samples produced exclusively pre-Contact date ranges which clustered relatively tightly in the AD 1440–1660 period. The oldest date range recovered was AD 1440–1640. Thus, data developed in this City Center AIS is believed to reflect the environment of the western Kona District of O‘ahu from late pre-Contact times up into the twentieth century.

International Archaeological Research Institute, Inc. (IARII) carried out two studies (Athens and Ward 1994, 1997) in close proximity to the City Center corridor that report details of environmental changes pre-dating Polynesian arrival, and the reader is referred to these studies for a discussion of longer term change extending back before the common era.

Interpretation of datable pollen results has long supported the conclusion that radical change to the environment occurred fairly early in the course of Hawaiian colonization of the archipelago. For example, an IARII Fort Shafter Flats paleoenvironmental and archaeological investigation was confident that:

> …one conclusion is firm: the picture of a lowland *Pritchardia* (*loulu*) forest with a high diversity of dryland to mesic forest types offers a new level of understanding of the pre-Contact natural lowland vegetation, very different from the vegetation seen today or even during the period represented by Pollen Zone A around A.D. 768–997. (Wickler et al. 1991:51)

IARII reports that the oldest Pollen Zones in the Fort Shafter flats, testing indicated that *Pritchardia* remained quite constant accounting for 25% to 28% of the pollen, but by the AD 768-997 sample it dropped to 2% (Wickler et al. 1991:49-50). Data such as this has supported the conclusion that prior to AD 1200, the Hawaiian environment had been very much modified by direct human activity and secondary impacts (from introduced rats, pigs, dogs, and extensive deliberate burning and accidental impacts of range fires).

When Cuddihy and Stone published their *Alteration of Native Hawaiian Vegetation: Effects of Humans, Their Activities, and Introductions*, they emphasized the general point that “[b]y the time of Captain James Cook’s arrival in the Hawaiian Islands in 1778, the original vegetation of the lowlands had been greatly altered by more than 1,000 years of Hawaiian occupation” (1990:103). They emphasized that “Agricultural practices of the Hawaiians were the major cause

of environmental change in the Islands" citing the clearing of the original dry and mesic vegetation over large tracts of the lower leeward slopes for irrigated taro and dryland field systems. They also cite the use of fire, use of thatching grasses, firewood gathering, and removal of timber for construction purposes as significant factors in the degradation of natural vegetation.

While radical transformation to the native ecosystem clearly occurred in pre-Contact times, the rapid damage to lowland forests following western contact is well documented in a general sense. There were many factors contributing to the loss of these lowland forests, such as the western desire for forest resources such as sandalwood, *pulu* ("wool on the base of tree-fern leaf stalks," from Pukui and Elbert 1984:327), and cordage from such forest plants as *olonā* (*Touchardia latifolia*). By one estimate, it took 6,000 sandalwood trees to fill the hold of just one ship (Cuddihy and Stone 1990:38). A potentially greater ancillary impact "was the use of fire to detect sandalwood by the fragrant smoke produced when the tree burned" (Cuddihy and Stone 1990:39). The need of western ships for firewood may have been generally underestimated. As Cuddihy and Stone (1990:38) point out, this demand for firewood would have been particularly pronounced "near leeward ports." By 1810, Honolulu would have been a premier leeward port and the demand for firewood may well have been fierce, especially coupled with the domestic demands of the growing urban center. The rapid population growth of goats, sheep, cattle, and horses in the greater Honolulu area would have further decimated native shrubs and trees in the vicinity.

6.7.4.2 Methodological Considerations Regarding Species Represented in Charcoal as Representative of Immediate Biota

The following analysis explores the implications of charcoal species identified for environmental reconstruction as if the species present in charcoal were an indicator of the immediate environment. The general premise is that typically people will not carry wood to burn as fuel very far. Hence the concept is that typically the species indicated in charcoal taxa analysis grew within a kilometer or so of where the wood was burned. This may not always be so due to a variety of factors, including the following.

- There is reason to believe that Polynesian occupation (and associated introductions of rats, dogs, pigs, and the use of fire) transformed pristine climax forests into shrub land and grass land. As wood to burn became less available, it may have been transported for significantly greater distances (even transported by canoe). If all the wood native to the dry lowlands had been used up, wood may have been transported down from significantly wetter environs where it was still available.
- Wood that grew in the uplands, or even on distant continents, could be transported long distances by streams and sea (as drift wood).
- It is certainly possible that sources of wood from a much earlier time could have been covered and preserved by natural processes (hurricanes, tsunamis), that this wood supply would have been utilized as fire wood as much as centuries later, and that this "old wood" would not be indicative of the environment at the time of burning.
- It is certainly possible that wood gathered for the purposes of construction or for tool manufacture at a significant distance would be later utilized as firewood. For example a pre-Contact Hawaiian may have travelled many kilometers to acquire straight, long *‘ōhi‘a lehua* timber for a house post and after the passage of time and natural decay, the post would be used as firewood.

Taxa identified in charcoal samples are summarized in Table 46, below, by test excavation. Columns arrange the data into three general types of plants: “Native Trees,” “Polynesian Cultigens,” and “Exotic Wood.”

For the purposes of this analysis we have lumped *kukui* (wood) in with “Native Trees,” for although it is understood as a Polynesian introduction, it quickly naturalizes and is understood as part of the native ecosystem in which Hawaiians lived (the vast majority of *kukui* was never “planted”).

Under “Polynesian Cultigens” are four Polynesian introductions that were typically planted: *niu* or coconut (wood), *ipu* or *Lagenaria* sp. gourd, *kī* or ti, and *‘ulu* or breadfruit.

“Exotic Wood” includes two types of identifications: “Conifer” and “Temperate hardwood.” Samples with “Conifer” or “Temperate hardwood” indicated as present were discounted on the grounds that these are exotic woods and most likely post-Contact (resulting from the mass importation of lumber). It should be noted however, that driftwood from the Pacific northwest has always been common and such “fuel” at the coast would almost certainly have been burned by pre-Contact Hawaiians.

Kukui and *niu* “nutshells” and *hala* “fruit keys” were regarded as particularly likely to be transported over long distances and hence not necessarily indicative of local environmental factors (other than indicating Polynesian activity). In contrast, *kukui* “wood” and *niu* “wood” were thought to be indicators of the likely growth of these trees in the vicinity.

The identifications of *Syzygium* sp. was not addressed in this analysis as the source could be a Polynesian introduction *(‘ōhi‘a ‘ai,* mountain apple) or a post-Contact exotic introduction (roseapple, Java plum). The same with *Senna* sp. that may have originated in native *kolomona* or may have been post-Contact introductions.

A standard dichotomy was followed between “tree” and “shrub” (supplied by Gail Murakami), and these are regarded as normative and appropriate. This results, however, in something of an artificial dichotomy with declaring “shrubs” to include such species as *‘a‘ali‘i* (*Dodonaea viscosa*), which can grow to 8 m (Wagner et al. 1990:1227), and *pūkiawe* “sometimes tree-like… stems to 5 m long” (Wagner et al. 1990:590).

6.7.4.3 Pre-Contact Environmental Change

Given that the vast majority of dated archaeological features have date ranges into modern times and that the oldest date range does not pre-date AD 1440, nothing can be said with certainty regarding environmental change in pre-Contact times based on this AIS data. There is, however, a suggestion of biota change from the oldest charcoal samples to the later taxa assemblages that may merit consideration in future studies.

The exclusively pre-Contact dated charcoal (believed to most likely date from the sixteenth and early seventeenth centuries) included taxa found in more contemporary proveniences, such as *‘ōhi‘a lehua* and coconut, but also included the only identifications of *hō‘awa* (identified twice in older charcoal) and *pūkiawe.* It may be the case that *hō‘awa* and *pūkiawe* were less common in the lowlands in late pre-Contact times than previously. It may also be notable that *lama* is found in 4 out of 6 (66%) of the solidly pre-Contact charcoal assemblages, but in only 2 of the 19 later charcoal assemblages. The suggestion is that *hō‘awa, pūkiawe,* and *lama* became scarcer before other species.

Table 46. Taxa identified in the City Center AIS Charcoal Analysis

Test Excavation #	Native Tree Indicated	Polynesian Cultigen Present	Exotic Wood Present	Comments
20, Feature A (2.35–2.50 mbs, Stratum II)	*Lama, Hō‘awa*	-	-	AD 1440–1630
20A (2.30–2.34 mbs, Str. II)	*Pūkiawe*	-	-	AD 1470–1650
75 (1.68–1.95 mbs, Str. IIb)	*Naio, ‘Ōhi‘a lehua*	-	Conifer	
78	*‘Ōhi‘a lehua*	*Niu* (wood)	Conifer	
119A (0.80–0.93 mbs, Str. IIa)	*‘Ōhi‘a lehua, Kukui** (nutshell)	-	-	AD 1670–post 1950
119A (1.25–1.50 mbs, Str. IIa/IIb)	*Kōpiko, ‘Ōhi‘a lehua, Kukui* (nutshell)	*Ipu*		AD 1680–post-1950
120 (Feat. C, 1.12–1.26 mbs)	*Kukui* (nutshell), *Hau, Loulu, Pilo, ‘Ahakea*	*Ipu*		AD 1670–post-1950
120 (Feat. D, 1.10–1.18 mbs)	*Kukui* (nutshell), *‘Ōhi‘a lehua, Hau, Pilo*			Modern
120 (Feat. F, 1.04–1.07 mbs)	*Kukui* (nutshell)			AD 1680–post-1950
120A (Sample 6, 1.10–1.18 mbs, Str. II)	*Kōpiko, ‘Ōhi‘a lehua, Hao, Kukui* (nutshell), *Pilo, Lama*	*Ulu*		AD 1670–post-1950
120A (Feat. 1, 1.28–1.36 mbs)	*Kōpiko, Hau, Pilo*			AD 1660–post-1950
120A (Feat. 2, 1.25–1.32 mbs)	*Kukui, Lama, Kōpiko*			AD 1660–post-1950
120A (Feat. 4, 1.28–1.32 mbs)	*‘Ōhi‘a lehua, Kukui* (wood)	*Ulu*		AD 1660–post-1950
124 (Feat. 1, 1.38–1.44 mbs)		*Kī, Niu* (nutshell)		Modern
124 (Feat. 2, 1.18–1.25 mbs, Str. IIa)	*Hau, Lama*			AD 1670–post-1950
124 (Feat. 5, 1.40–1.63 mbs, Str. IIb	*Lama, Kukui* (wood)			AD 1520–1660
124 (Feature 11, 1.20–1.32 mbs)	*Lama, Hō‘awa*			AD 1450–1640
141 (Feature 6, 0.75–0.95 mbs, Stratum IIa)	*Kukui* (wood)			

Test Excavation #	Native Tree Indicated	Polynesian Cultigen Present	Exotic Wood Present	Comments
142 (Feat. 6, 0.55–0.70 mbs, Stratum IIa)	*Kukui* (nutshell and wood), *Kōpiko*	*Niu* (nutshell)		AD 1520–1950
145(Feat. 1, 0.81–0.95 mbs, Str. IIa)	*Lama*			AD 1470–1650
145 (Feat. 2, 0.95–1.10 mbs, Str. IIb)	*Kukui* (nutshell)			
146A (Feat. 2, 0.75–0.90 mbs)	*Kukui* (nutshell and wood), *Hau*	*Niu*		AD 1640–post-1950
146A (Feat. 3, 0.83–0.94 mbs)	*Kukui* (nutshell), *‘Ōhi‘a lehua, Hau*			AD 1640–post-1950
146A (Feat. 4, 0.85–0.95 mbs)	*‘Ōhi‘a lehua*	*Niu*		AD 1500–1660
146A (Feat. 5, 0.81–0.92 mbs)	*Kukui* (wood), *Pilo*			AD 1650–post-1950
150 (Feat. 2, 0.70–0.75 mbs)	*Kukui* (nutshell)			Modern
150 (Feat. 3, 0.90–1.30 mbs)	*Kukui* (nutshell)			AD 1640–post-1950
151 (Feat. 6, 0.86–1.08 mbs)	*Kukui* (nutshell)			AD 1490–1650
167 (Feat. 3, 1.45–1.48 mbs)			Conifer	
168B (Feat. 1, 1.60–1.65 mbs)	*‘Ōhi‘a lehua*		Conifer	
189	*Hao, Kukui* (wood)		Temperate hardwood	
226A (0.60–0.97 mbs, Str. IIa)	*Lama, Kukui* (nutshell), *Hau, Naio, ‘Ōhi‘a lehua*	*Niu* (nutshell)	Conifer, Temperate hardwood	
226A (Feat. 1, 0.98–1.03 mbs, Str. IIa)	*Kōpiko, ‘Ōhi‘a lehua, Hau, Kukui* (nutshell), *Hala* (fruit key)	*Ipu*	Temperate hardwood	
226A (Feat. 2, 0.82–0.88 mbs, Str. IIa)	*Kukui* (nutshell), *‘Ōhi‘a lehua, Hau*	*Niu* (nutshell), *Ulu*	Conifer	
226A (Feat. 3, 0.87–1.02 mbs, Str. IIa)	*Kōpiko, Kukui* (nutshell), *‘Ōhi‘a lehua, Lama*	*Kī, Ulu, Ipu*	Temperate hardwood	

Test Excavation #	Native Tree Indicated	Polynesian Cultigen Present	Exotic Wood Present	Comments
226B (Feat. 1, 0.81–0.87 mbs)	*‘Ōhi‘a lehua*, *Kukui* (wood and nutshell), *Pilo*	*Ulu*		
226B (Feat. 2, 0.80–0.90 mbs)	*Kukui* (nutshell)			
226B (Feat. 3, 0.82–0.93 mbs)	*Hau, ‘Ōhi‘a lehua*, *Kukui* (nutshell and wood)	*Niu* (nutshell), *Kī*		
226B (Feat. 4, 0.80–0.95 mbs, Str. II)		*Niu* (nutshell)		
226B (Feat. 5, 0.76–0.90 mbs, Str. II)	*Kukui* (nutshell), *Lama*	*Niu* (nutshell), *Kī*		
226B (Feat. 6, 0.76–0.85 mbs, Str. II)	-	-	-	-
226B (Feat. 7, 0.75–0.87 mbs, Str. II)	*‘Ōhi‘a lehua*			
226B (Feat. 8, 0.78–0.94 mbs, Str. II)	*Kukui* (nutshell)	*Niu* (nutshell)		
227A (Feat. 2, 1.08–1.31 mbs, Str. IIa)	*Kōpiko, Lama*			AD 1650–post-1950

*Although *Kukui* is understood as a Polynesian introduction, it was not treated as a Polynesian Cultigen but rather as a “Native Tree” as it readily naturalizes

6.7.4.4 The Environment in the Timeframe of Western Contact

Charcoal selected for carbon dating was preferentially selected to be from what appeared to be likely proveniences for pre-Contact dates. Charcoal from proveniences with post-Contact artifacts or indications were not selected for taxa analysis. Because the vast majority of the carbon dates span the past three centuries with stronger probabilities for nineteenth and twentieth century calendar ages it is believed that the environment represented by the charcoal typically falls relatively close to the time of Western contact. For the lay person, a surprisingly wide variety of species is represented in the charcoal as summarized in Table 47 and described in detail in Section 1.7.4.8, Description of Plant Species indicated as Common in the City Center Corridor, below. The explanation may largely lie in the conclusion (promulgated by the botanist J. F. Rock) that lowland leeward forests were “the richest of all Hawaiian forests in terms of numbers of tree species and unique plants, but today they have been reduced to mere remnants over much of their original range” (Cuddihy and Stone 1990:13).

A generalization regarding this assemblage would be to note the general absence of large diameter, long-lived species such as *Acacia koa* (*koa*), *Pritchardia* (*loulu*), and *Erythrina sandwicensis* (*wiliwili).* It appears that any climax forest of such species in the vicinity was long gone by the time period indicated, with more shrub-like species predominating. The one

Table 47. Charcoal Taxa Identified

Taxon	Common/Hawaiian Name	Origin/Habitat
Aleurites moluccana	*Kukui*	Polynesian Introduction/Tree
Artocarpus altilis	*Ulu*	Polynesian Introduction/Tree
Bobea sp.	*‘Ahakea*	Native/Tree
Chamaesyce sp.	*Akoko*	Native/Shrub
Chenopodium oahuense	*‘Āheahea, ‘āweoweo*	Native/Shrub
Cocos nucifera	*Niu, coconut*	Polynesian Introduction/Tree
Coprosma sp.	*Pilo*	Native/Shrub-Tree
Cordyline terminalis	*Kī,* ti	Polynesian Introduction/Shrub
Diospyros sandwicensis	*Lama*	Native/Tree
Dodonaea viscosa	*‘A‘ali‘i*	Native/Shrub
Hibiscus tiliaceus	*Hau*	Native/Shrub-Tree
Lagenaria siceraria	*Ipu*	Polynesian Introduction/Vine
Metrosideros polymorpha	*‘Ōhi‘a lehua*	Native/Tree
Myoporum sandwicensis	*Naio*	Native/Tree
Osteomeles anthyllidifolia	*‘Ulei*	Native/Shrub
Pittosporum sp.	*Hō‘awa*	Native/Tree
Poaceae	Grass	
Pritchardia sp.	*Loulu*	Native/Tree
Psychotria sp.	*Kōpiko*	Native/Tree
Pteridophyta	Fern	
Rauvolfia sandwicensis	*Hao*	Native/Shrub-Tree
Senna sp.	*Kolomona*	Native and Historic Introductions
Sida fallax	*‘Ilima*	Native/Shrub
Styphelia tameiameaie	*Pūkiawe*	Native/Shrub
Syzygium sp.	Mountain apple, roseapple, Java plum, *‘ōhi‘a ai*	Native and Historic Introductions/Tree
Wikstroemia sp.	*‘Ākia*	Native/Shrub

exception among native species is *‘ōhi‘a lehua* that shows up a number of times in the charcoal record. Notably *‘ōhi‘a* can be quite shrub-like.

It was surprising how abundant *kukui* (wood) was in the charcoal record, appearing in charcoal from eight test excavations. This suggests that *kukui* was one of the most common tree species in the vicinity in late pre-Contact times.

A surprisingly large number of identifications of cultigens (not including coconut shell) were made (identifications in 13 test units). These identifications of cultigens were particularly common in the Kaka‘ako area (see Figure 298). This supports the view that Hawaiians at western contact were living in a botanical environment that was to a remarkable extent of their own making.

6.7.4.5 Cultigens in the Pollen Record

Identified Polynesian cultigens included *Cocos nucifera* (*niu* or coconut, in T-014, T-080, T-122, T-181, and T-184), *Cordyline* sp. (*kī* or ti, in T-093), and *Colocasia* sp. (taro or *kalo*, in T-041, T-080, and T-093).

There was only one spore of *Saccharum* sp. (sugar cane, *kō*) identified in T-067 near the Kapālama Drainage Canal. It is unclear whether this represents traditional Hawaiian cultivation or later commercial cultivation.

Morinda pollen representing *noni* was noted from T-093 and is indicated in Cummings and Varney (2013) Figure 2 as also present in T-067.

It appears from Cummings and Varney (2013) Figure 1 that a very small quantity of *Artocarpus* (breadfruit or *‘ulu*) was identified from T-207.

The Cummings and Varney (2013:13) report notes that in two of the three instances of the documentation of taro pollen, there are indications that this represents post-Contact taro cultivation. In the case of T-041, the *Colocasia* pollen was accompanied by *Leucaena* (*koa-haole*), *Prosopis* (*kiawe*), and *Oryza*-type pollen. In the case of the T-080, the presence of *Commelina* and *Oryza*-type pollen indicated post-Contact cultivation. Only in T-092 was there no alien pollen observed with the taro pollen, suggesting pre-Contact taro cultivation.

The seeming complete absence of *kukui* (*Aleurites moluccana*) from the pollen record in the Cummings and Varney (2013) report is difficult to understand as *kukui* would be expected to have been ubiquitous in the valleys upwind and was remarkably common among the charcoal species identifications.

With the exception of coconut palms (presence suggested in the pollen from five test excavations), the pollen record suggests a notable lack of traditional Hawaiian agriculture. This is understood to at least in part reflect the generally low rainfall of the City Center corridor (the Aloha Tower rain gauge, for example, averages 9.3 inches (210 mm) of annual rainfall (source: Pacific Disaster Center).

6.7.4.6 Characterization of the Native Landscape

As noted above, Cyperaceae appears to be the largest pollen contributor with Poaceae a strong second in abundance. The environment indicated throughout the pollen record is one of sedges and grasses representing marshy land and grasslands. The next most abundant component is the

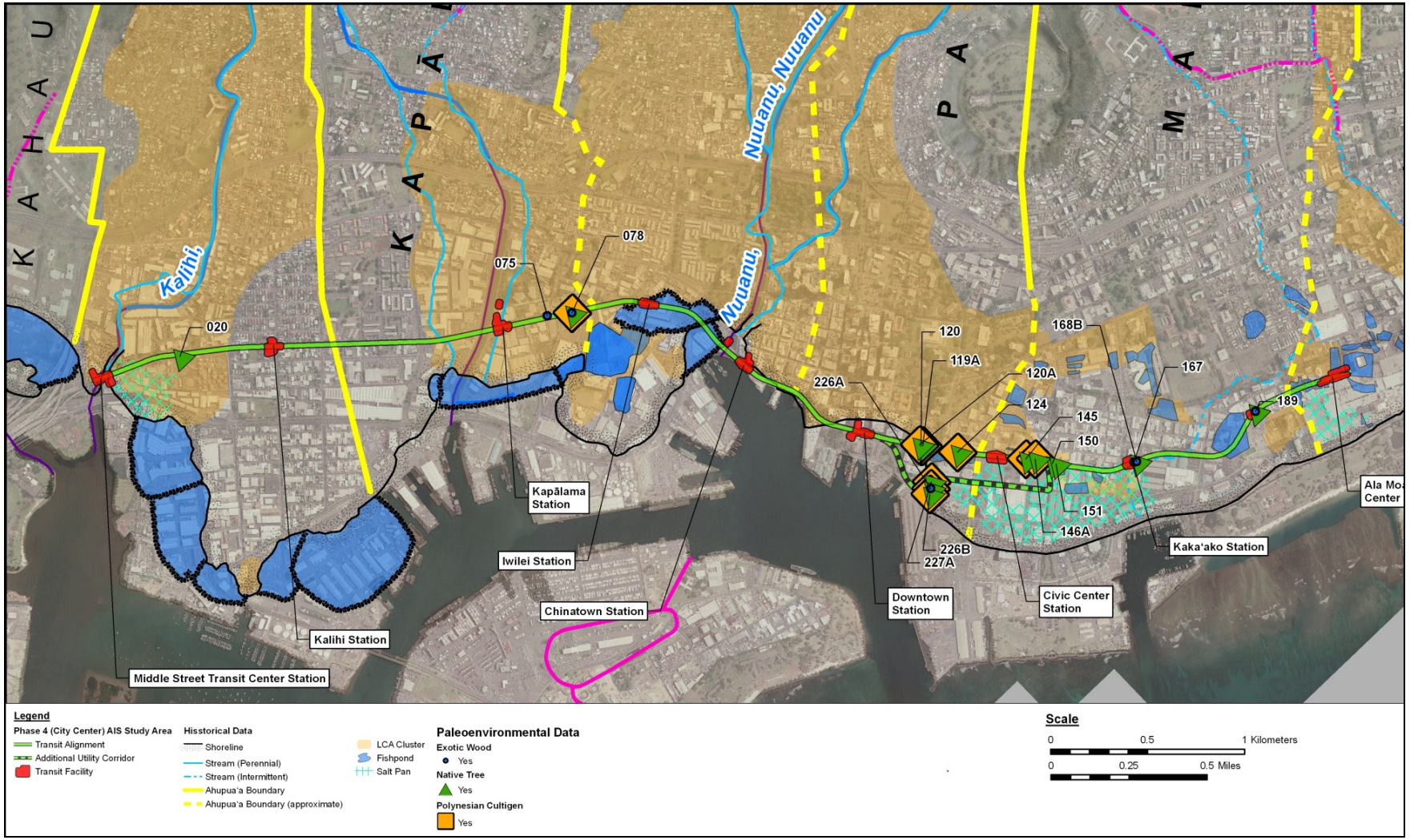


Figure 298. Map of the City Center project area and vicinity showing the locations of identifications of native trees, Polynesian cultigens, and exotic wood from the charcoal taxa analysis

“cheno-am,” understood to be produced by a variety of dry land species such as *Chenopodium oahuense* (*‘aweoweo* or goosefoot) and *Amaranthus* sp. Wagner et al. (1990:536) insightfully describes *Chenopodium* species as “subshrubs,” which captures their herbaceous, “rarely woody,” and weedy nature. Cuddihy and Stone (199012) characterize such a landscape as dry leeward lowland grasslands and shrub lands. They posit that dominant grass species might have included *pili* (*Heteropogon contortus*), *kākonakona* (*Panicum torridum*), and *‘emoloa* (*Eragrostis variabilis*), and that a common sedge might have been *Fimbristylis cymosa* (*mau‘u*) that Wagner et al. (1990:1405) describe as “common on sandy beaches, and in shallow sand or soil on and among rocks and cracks.” Cuddihy and Stone (1990:12) note that such extensive lowland grasslands “were probably largely the result of the Hawaiian practice of burning.” Clearly pre- and post-Contact agriculture and post-Contact grazing were also factors in the creation and maintenance of grass lands.

While this data alone suggests that the landscape was a somewhat monotonous plain of grasses, sedges, and weedy cheno-am subshrubs, a complete picture must acknowledge that a significant species diversity is in fact represented. Cuddihy and Stone (1990:12) posit that “native shrubs that are dominants in these communities” included *‘a‘ali‘i* (*Dodonaea viscosa*), *‘ākia* (*Wikstromia* sp.), *‘aweoweo* (*Chenopodium oahuensis*), *ko‘oko‘olau* (*Bidens menziesii*), *pūkiawe* (*Styphelia tameiameiae*), *alahe‘e* (*Canthium odoratum*), low-growing *‘ōhi‘a* (*Metrosideros polymorpha*), and possibly also *‘akoko* (*Chamaesyce* sp.), *nehe* (*Lipochaeta* sp.), *kulu‘i* (*Nototrichium sandwicense*), and *‘ohai* (*Sebania tomentosa*). This posited list of dominants actually has fairly minimal overlap with the pollen taxa identified in the City Center AIS (compare species mentioned above with the charcoal taxa listed in Table 47). This suggests that the shrubs and trees of this grassland may have been more diversified than previously understood.

6.7.4.7 Post-Contact Cultigens

The only post-Contact cultigens identified in the pollen record were rice and *Vigna* pollen (cf. *Vigna sinensis*, cow pea, or “yard-long beans”) from T-067 located at Honolulu Community College suggesting use of this area for growing these introduced beans used in Chinese cooking.

Rice was surprisingly common in the pollen record (identified in eight test excavations) suggesting that rice cultivation may have been extensive in the vicinity. Coulter (1937:21) documents that in 1892 there were many hundreds of acres under rice cultivation in Kalihi, the vicinity of Kewalo, Pālama, and Waikīkī.

6.7.4.8 Description of Plant Species indicated as Common in the City Center Corridor

‘A‘ali‘i

Hawaiian Name(s): *‘a‘ali‘i, ‘a‘ali‘i kū makani, ‘a‘ali‘i kū ma kua, kumakani*

Scientific Name: *Dodonaea viscose*

Vernacular Name: None

Family: Sapindaceae

Status: Indigenous

Description: Shrub/tree

Habitat: Found on open sites, ridges, lava, low pastures, shrublands, dry to mesic and wet forest, and subalpine shrubland, 3-2,347 m on all main islands except Kaho‘olawe (Wagner et al. 1990).

Medicines: In a treatment termed *holoina*, *‘a‘ali‘i* leaves are mixed with *ala‘a* bark (*Pouteria sandwicensis*) and *puakala ku kula* root (*Argemone glauca*) then ground and strained. The liquid is heated in a steam bath, which is followed with a purge of ground *pilikai* fruit (*Stictocardia tiliifolia*) to treat skin rash (‘*ohune* or *mane‘o*) (Chun 1994).

Non-Medicinal Uses: Wood is hard, heavy, durable; sometimes used for house posts and spears; many uses for fruits, such as a medicine, dye, and in *lei*, flowers also used in *lei* (Abbott 1992; Krauss 1993; Little and Skolmen 1989; Malo 1951). Pioneer species (Lamb 1981); made into “bait sticks,” these were shaped and then charred in the fire (Krauss 1993).

‘Ahakea

Hawaiian Name(s): *‘ahakea*, *‘ahakea lau li‘i* (*B. brevipes*), *‘akupa* (*B. brevipes*), *‘ahakea lau nui* (*B. elatior*)

Scientific Name: *Bobea* (4 species)

Vernacular Name: None

Family: Rubiaceae

Status: Endemic

Description: Trees, all four species up to 10 m tall, wood is a dull orange-brown and becomes dark gold when rubbed with *kukui* oil.

Habitat *B. brevipes* in mesic to wet forests from 250–1280 m (Kaua‘i and O‘ahu); *B. elatior* in mesic valleys to mesic to wet forests 250–100 m (Kaua‘i, Moloka‘i, Maui, Hawai‘i); *B. sandwicensis* in dry to mesic forest and open lava flows 100–1220 m (O‘ahu, Moloka‘i, Lana‘i, Maui); *B. timoniodes* dry to mesic forest 250–580 m on Maui and Hawai‘i (Wagner et al. 1990).

Medicines: In a treatment for abscesses *‘ahakea* bark is ground with *puakala ku kula* root bark (*Argemone glauca*), *‘ohi‘a ‘ai* bark (*Syzygium malaccense*), and *‘auko‘i* (*Senna occidentalis*) and then placed in a *mai‘a* (banana, *Musa* spp.) and used as a poultice (Chun 1994).

Non-Medicinal Uses: Yellow wood used for canoes; most favored for gunwales (Krauss 1993), *poi* pounding boards, canoe paddles (Malo 1951), and door and doorframes (Krauss 1993).

‘Aheahea/‘Aweoweo

Hawaiian Name(s): *‘āheahea, ‘ahea, ‘āhewahewa, alaweo, alaweo huna* (Ni‘ihau), *‘āweoweo, kāha‘iha‘i*

Scientific Name: *Chenopodium oahuense*

Vernacular Name: None

Family: Chenopodiaceae

Status: Endemic

Description: Lightly scented shrubs, sometimes tree-like.

Habitat: Occurring as a common or occasional element of dry habitats, ranging from 0–2,520 m from coastal zones to dry forest and subalpine shrubland (Wagner et al. 1990) on most main islands and some NWHI.

Medicines: This plant is used to treat *‘ea* (thrush, etc.) and *pa‘ao‘ao* (ailments). The leaf buds are used to treat children; the bark is ingested sometimes with *niu* (coconut, *Cocos nucifera*), *kukui* (*Aleurites moluccana*), *lipoa* (*Dictyopteris* spp.), or *poi* as a cosmetic for children. For *‘ea*, *‘aweoweo* is ground together with *uluhe* (*wawae ‘iole kuahiwi*, cf. *Huperzia* spp. or *Lycopodium* spp.), *‘ala‘ula* (*wawae ‘iole kahakai*, cf. *Codium edule*), *‘ilima* (*Sida fallax*), and marine shells, then mixed with water and fed to children in *poi* or possibly *‘uala* (sweet potato, *Ipomoea batatas*) (Chun 1994).

Non-Medicinal Uses: Leaves cooked and eaten as greens (Hillebrande 1888; Malo 1951). Part of composite fishhooks (Kamakau 1976; Krauss 1993). “The *kahuna* ho‘omanamana called this plant *‘iloe holokula*, because it was used everywhere to induce death…[also used] with the *‘ākia lau nui* (*Wikstroemia*) and some bitter plants as firewood in the fireplaces used to send prayers” but also positive medicinal qualities (Chun 1994). The wood of the *‘aheahea* is not true wood, but secondary growth (Lamb 1981).

‘ākia

Hawaiian Name: *‘ākia, kauhi, ‘ākia manolo*

Scientific Name: *Wikstroemia uva-ursi*

Vernacular Name: None

Family: Thymelaeacae

Status: Endemic

Description: Shrubs/small trees; height of 1–3 ft, spreads laterally up to 10 ft

Habitat: This endemic plant can easily be seen in numerous landscapes throughout Honolulu and the rest of the state. This plant, along with *naupaka* (*Scaevola sericea*), *pohinahina* (*Vitex rotundifolia*), and *pualoalo* (*Hibiscus arnottianus*) are among the most used native plants in Hawaiian landscapes today. Although, in the wild it is not common at all, found only in dry, open, often disturbed, lowland or coastal habitats on Kaua‘i, O‘ahu, Moloka‘i, and Maui where it is also reported as far inland as ‘Iao Valley.

Medicines: The sap—together with *niu* flesh (coconut, *Cocos nucifera*) and *kō kea* (white sugarcane, *Saccharum officinarum*)—is ingested with *‘uala* (sweet potato, *Ipomoea batatas*) as a purgative. The leaves and leaf buds are mixed with the bark of *‘ohi‘a ‘ai* (*Syzygium malaccense*) and *‘uhaloa* root (*Waltheria indica*), flesh of *niu*, *kō ‘aina kea* (sugarcane variety, *Saccharum officinarum*). Pounded, water added, strained, and the liquid ingested for *wai‘opua pa‘a* and *nae kulou* (Chun 1994).

Non-Medicinal Uses: Wood used as *‘auamo* (carrying sticks), leaves, branches and berries, beaten and used to stupify fish (Lamb 1981; Degener 1930); fruits as *lei* (Abbott 1992; Krauss 1993); cordage made from bast fibers, with bark removed (Abbott 1992; Rock 1913). Extremely poisonous, for suicide or execution, also used for binding (Degener 1930).

‘Akoko

Hawaiian Name: *‘akoko, koko, ekoko kōkōmālei, ‘akokoko*

Scientific Name: *Chamaesyce degeneri*

Vernacular Name: Spurge

Family: Euphorbiaceae

Status: Endemic

Description: Shrubs and annual herbs

Habitat: Habitats vary, but most are found in dry to mesic vegetation (Wagner et al. 1990)

Medicines: Leaf buds fed to children or to lactating mothers to treat ‘*ea* and *pa‘ao‘ao*. To insure or augment mothers’ milk, ‘*akoko* sap with *kalo* leaves (taro, *Colocasia esculenta*), ingested in *poi*. For the ailment ‘*ala‘ala hamani*, sap is mixed with powdered ‘*ahu‘awa* stem as an ointment. Treatment for *kohepopo* and *wai‘opua hinanawe* (womens’ weakness, debilitation) combines ‘*akoko* leaf buds, ‘*ohi‘a ‘ai* bark, mature *noni* fruit (*Morinda citrifolia*), *kō kea* (white sugarcane, *Saccharum officinarum*), ‘*ala‘ala wainui pehu* (*Peperomia* spp.), and *pia* (*Tacca leontopetaloides*) (Chun 1994).

Non-Medicinal Uses: *C. celastroides* (as *C. lorifolia*) noted as “much used as firewood” by Hillebrand 1888; sap used in paint (Krauss 1993); leaves and sap medicinal (Chun 1994).

Hala

Hawaiian Name: *hala*, *pū hala*, *lauhala*

Scientific Name: *Pandanus tectorius*

Vernacular Name: Screw pine

Family: Pandanaceae

Status: Endemic

Description: Small trees up to 10 m tall supported at base by several thick, rigid roots exposed above soil. Four types of *hala* based on color of fruit: common *hala* is yellow, *hala ‘ula* is orange, *hala lihilihi ‘ula* is red fading to yellow, and *hala pia* is small and pale yellow.

Habitat: Commonly occurs in mesic coastal sites and into low elevation slopes of mesic valleys further inland 0–610 m (Wagner et al. 1990).

Medicines: The *hala* fruit is made part of a treatment for ‘*ea* and *pa‘ao‘ao*. The aerial roots are used in medications for childbirth and a skin disorder. They are combined with *pohepohe* (*Hydrocotyle verticillata*), *kohekohe* (*Eleocharis* spp.), *hala* leaf buds, *‘ala‘ala wai nui pehu* (*Peperomia* spp.), *‘ihi makole* (*Oxalis corniculata*), *naio* leaf buds, fruit, and leaves (*Myoporum sandwicense*), *niu* (coconut, *Cocos nucifera*), *kukui* flowers (*Aleurites moluccana*), *noni* fruits (*Morinda citrifolia*), and *kō* (*Saccharum officinarum*). For childbirth, a treatment includes *‘uhaloa* root (*Waltheria indica*), *noni* fruits, *hala* leaf buds and aerial roots, *‘ahu‘awa* leaf buds (*Cyperus javanicus*), *kō kea*, and *‘alaea* clay. For chest pains and *kohepopo* a drink of *hala* aerial roots, *pa‘ihi* (*Nasturtium sarmentosum*), *‘uhaloa*, *pōpolo* root bark (*Solanum americanum*), *‘ala‘ala wai nui pehu* stems (*Peperomia*), *‘ohi‘a lehua* bark (*Metrosideros* spp.), *noni* fruit, and *kō kea*) (Chun 1994).

Non-Medicinal Use: Leaves are prepared and woven into mats, pillows, and thatch (Abbott 1992). Seeds and fruit are edible (Abbott 1992), and roots may be used as cordage fiber (Summers 1990). For some *‘uli‘uli* (hula rattles), the handles were made of *lauhala*. Phalanges (fruit parts or “keys”) used in *lei* and when dried, as brushes for painting *kapa* (Abbott 1992).

Hao

Hawaiian Name: *Hao*

Scientific Name: *Rauvolfia* sandwicensis

Vernacular Name: None

Family: Apocynaceae

Status: Endemic

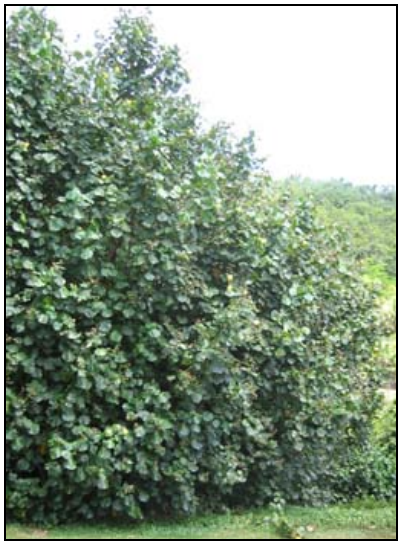
Description: Small shrub to tree

Habitat: *R. sandwicensis* is most commonly found on ridges, slopes, gulches of mesic forest between 100–500 m; occasionally in low, open dry areas (Wagner et al. 1990)

Medicines: The root contains small amounts of reserpine, used to treat high blood pressure and mental illness, but different related species from Africa and India are the ones commercially harvested.

Non-Medicine Uses: Little and Skomen (1989) state that the wood was “not used by the Hawaiians for fuel because the smoke was thought to be poisonous, nor for charcoal because it burned completely to ashes. It was however, considered a good wood for construction.” Yet Malo states: “…*hao* and others…are ‘no doubt’ used for fuel” (Malo 1951). *Hao* often found at *heiau*, thought by some to have religious significance (Lamb 1981).

Hau



Hawaiian Name: *Hau, hau ka‘eka‘e*

Scientific Name: *Hibiscus tiliaceus*

Vernacular Name: *None*

Family: *Malvaceae*

Status: Introduced

Description: Shrubs, to small trees

Habitat: Commonly occurring along coasts, streams, and other wet areas to 300 m on most main islands and some NWHI (Wagner et al. 1990)

Medicines: The flower buds and sap used as laxative and for *‘ea* and *pa‘ao‘ao*. That may be followed with an enema made from *noni* fruit (*Morinda citrifolia*). Sap from the bark was scraped and mixed with sap from the *kikawaio* fern (*Christella cyatheoides*) and *‘uwi‘uwi* (cf. *Conyza* spp.), with root bark from *‘uhaloa* (*Waltheria indica*) and *pōpolo* (*Solanum americanum*) for chest congestion. The leaf buds were chewed/swallowed for dry throat. The inner bark (with sap) was soaked and drunk for labor pains and rubbed on stomach (Chun 1994). Sap used as an internal lubricant as a mild laxative and to facilitate the passage of a fetus through the birth canal (Abbott 1992).

Non-Medicine Use: *Hau*’s bast fibers can be used for cordage, its light wood for the spars of outriggers and floats for fishnets (Handy et al. 1972), also used in firemaking with the harder wood of the Perrottetia (*olomea*). The *hau* “log” (‘*aunaki*) was slightly hollowed and the pointed stick (‘*aulima*) of *olomea* was rubbed in it to start fires. Branches also used in *‘ohai* sport known from Kaua‘i, where oiled, burning branches were tossed from cliffs (Degener 1930); bark for sandals (Krauss 1993); used on *hula* altars (*kuahu*) (Emerson 1909). Cordage used to sew *kapa* sheets together or tie sandals, also for *kapa* design sticks (*lapa*), slingshots, string of a bow, branches set along shorelines to indicate *kapu* fishing zones, kite frames and adz handles (Lucas 1982).

Hō‘awa

Hawaiian Name: *hō‘awa, hā‘awa, papahekili* (*P. glabrum*), *a‘awa* (*P. hosmeri*), *‘a‘awa hua, hō‘awa lau nui* (*P. kauaiense*)

Scientific Name: *Pittosporum* (11 species)

Vernacular Name: *None*

Family: Pittosporaceae

Status: Endemic

Description: Leaves 4–10” long and 1–2.5” wide, fruits 2–3” long, and 2-4 valved.

Habitat: Habitats vary greatly within and by species; many restricted to single islands (Wagner et al. 1990).

Medicines: For a swollen neck *(‘a‘i palaha*) or other similar illnesses, the inner flesh of the *hō‘awa* fruit is mixed with dried *kukui* nuts (*Aleurites moluccana*), leaves and root of *kupukupu hohonu* (cf. *Nephrolepis* spp.), and leaves, root, and bark of *‘ilie‘e* (*Plumbago zeylandica*) added to ‘*okolehao* (distilled from *ki, Cordyline fruticosa*) (Chun 1994).

Non-Medicinal Uses: Wood was “‘no doubt’ good for fuel” (Malo 1951). Sometimes used as gunwales (canoe part) (Krauss 1993); fruits as medicines (Neal 1965). Used by certain *kahuna* for “evil and troublesome work” (Chun 1994).

‘Ilima

Hawaiian Name: *‘ilima, apiki, ‘ilima lei, kapuaokanakamaimai. ‘ilima ku kala, ‘ilima makana‘a*

Scientific Name: *Sida fallax*

Vernacular Name: None

Family: *Malvaceae*

Status: Endemic

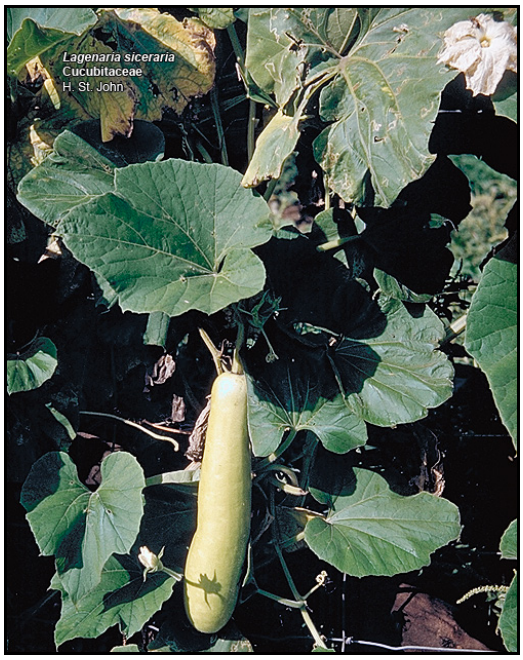
Description: Shrubs, 0.2–1.5 m.

Habitat: Common along coasts in rocky or sandy habitats, also in low open dry forest to mixed mesic forests, rare in low wet forest between 0–1,980 m (Wagner et al. 1990).

Medicines: There are numerous different types of *‘ilima* that have different Hawaiian names. In one publication (Chun 1994) they are listed separately. For *‘ilima lei*, he notes that the buds are fed to very young babies. To treat *pu‘ao ha‘ule* (and maybe *pu‘ao pelu*), the flowers of *‘ilima lei* are combined with leaf buds and flowers of the *pōpolo* (*Solanum americanum*), and dried *niu* fruit (coconut, *Cocos nucifera*). For the treatment of *‘ea and pa‘ao‘ao*, the root bark of the *‘ilima lei* is used with the flowers and leaf buds of *‘uhaloa* (*Waltheria indica*), flowers leaf buds, and stems of *‘ala‘ala wai nui pehu* (*Peperomia* spp.), flowers, leaf buds, and leaves of *pōpolo* (*Solanum americanum*), *noni* fruit (*Morinda citrifolia*), and *kō kea* (white sugarcane, *Saccharum officinarum*). For *nae* and *hano nae* the leaf buds, flowers and root bark if the *‘ilima lei* are mixed with the root bark of the *pukamole* (*Lythrum maritimum*), and *kō honua‘ula* (red-brown sugarcane, *Saccharum officinarum*) (Chun 1994).

Non-Medicinal Uses: Often said that the flowers were used in *lei* that were for the *ali‘i* (Degener 1930). Pukui notes that this is not strictly true (Handy et al. 1972); stems used in house frames, and lashed together to encircle taro-planting mounds in swampland; vines as rough basketry and floor covering under sleeping mats (Handy et al. 1972); used on *hula* altars (*kuahu*) (Emerson 1909).

Ipu



Hawaiian Name: *ipu, ipu nui, hue, pōhue, ipu ‘awa‘awa*

Scientific Name: *Lagenaria siceraria*

Vernacular Name: Bottle gourd

Family: Cucurbitaceae

Status: Polynesian introduction (not naturalized)

Description: Climbing vine

Habitat: Annual, that thrives only under cultivation. It grows best in dry areas with some type of support so the fruit won‘t spoil (Lucas 1982).

Medicines: For treatment of *hehena a moe‘ole a ka po*, young leaves are ingested in conjunction with dried *niu* (coconut, *Cocos nucifera*) and *‘uala* (sweet potato, *Ipomoea batatas*). For illnesses such as *papaku*, *hoaka*, and *wai‘opua* the flesh of the *ipu* is combined with *noni* fruit (*Morinda citrifolia*) and water and delivered as an enema. For *pu‘ao pelu* and maybe *ha‘ule*, the treatment combines *ipu* fruit flesh with leaf buds, leaves, and stems of the *kukaepuaa* (*Digitaria setigera*) (Chun 1994).

Non-Medicinal Uses: The hardened fruit is made into a variety of containers, for water, food, dyes, etc. (Krauss 1993). Also used for musical instruments, such as the bases of *‘uli‘uli* (*hula* rattles), knee drums, *‘ulili, pa ipu* or *ipu heke* (a percussion instrument made by joining two *ipu*, one atop the other) (Abbott 1992; Krauss 1993). The *ipu* was also used to chase away sharks (Lucas 1982:39); fisherman carried their lines and hooks in gourds and taken on sea voyages so if the canoe overturned the gourds would float and could be retrieved (Kamehameha Schools 1994).

Kī

Hawaiian Name: *kī*

Scientific Name: *Cordyline fruticosa*

Vernacular Name: ti

Family: Asparagaceae

Status: Polynisian introduction

Description: Shrubs, 2–3.5 m, green thin leaves 40–80 cm long

Habitat Found in cultivated and mesic valleys and mesic forest 5–610 m (Wagner et al. 1990)

Medicines: *Kī* has many medicinal uses. For treatment of *i‘aku o ka ihu* (nasal growth), *kī* flowers are combined with rhizomes (underground stems) of *‘ōolena* (*Cucurma longa*), *‘awapuhi kuahiwi* (*Zingiber zerumbet*), and *‘awapuhi lei* (Hedychium coronarium), as well as powdered *‘iliahi* (*Santalum* spp.) and *naio* (*Myoporum sandwicense*). For *hano* (ho) *maka‘u i ke kanaka*, *kī* flowers are added to pith of the *‘ama‘uma‘u* fern (*Sadleria cyatheoides*) and *‘ōkaha* (birdsnest fern, *Asplenium nidus*), and taken internally with *poi* and other foods. Treatment for shortness of breath/asthma (*nae*, *nae‘oiku*, *nae hokale ‘ano ohaohao*), *kī* flowers and leaf buds are mixed with *‘uhaloa* root bark (*Waltheria indica*), *‘ala‘ala wai nui pehu* (*Peperomia* spp.), *noni* fruit (*Morinda citrifolia*), *‘uala huamoa* (sweet potato, *Ipomoea batatas*), possibly *pu* (squash, Cucurbita spp.), and *kō kea* (white sugarcane, *Saccharum officinarum*).

Non-Medicinal Uses: Many uses, including leaves as food wrappers in *imu* and for footwear; the sweet roots baked as a “treat or famine food;” in historic period distilled into an alcoholic beverage, *‘okolehao* (Handy et al. 1972). The earliest account of *kī* use come from the late eighteenth century (Cpt. Portlock 1789), who says that sweet potatoes, taro, sugarcane, yams, and “tee” were “met in great abundance.” Abbott suggests that the term “famine food” for *kī* may be inappropriate, and says perhaps it was more commonly consumed (Abbot 1992). Commonly cooked and eaten in many other island groups, such as New Zealand, Samoa, Society Islands (Pollock 1992). It is of note that Portlock made beer from the boiled roots for curing scurvy, it is possible that this was a forerunner of *‘okolehau*, which is distilled in iron pots, hence the name “ironbottom.”

Kolomona

Hawaiian Name: *kolomona, kalamona, heuhiuhi, uhiuhi*

Scientific Name: *Senna gaudichaudii*

Vernacular Name: None

Family: Fabaceae

Status: Endemic

Description: Shrubs 0.5–4 m

Habitat The native *Kolomona* occurs primarily on leeward sides on talus slopes, lava flows, or rocky sites in coastal shrubland, dry to mesic forest 5–920 m on most main islands (Wagner et al. 1990).

Medicines: No known uses for *Kolomona*.

Non-Medicinal Uses: Flowers used in *lei* (McDonald 1989).

Kōpiko

Hawaiian Name: *kōpiko, kōpiko ula* (*P. hawaiiensis*), *‘ōpiko* (*P. hawaiiensis*, *P. mauiensis*), *kōpiko kea* (*P. kaduana*)

Scientific Name: *Senna gaudichaudii*

Vernacular Name: None

Family: Rubiaceae

Status: Endemic

Description: Trees/shrubs

Habitat: *P. fauriei* windswept summits (450–) 520–860 m (O‘ahu), *P. grandiflora* mesic to wet forest 1040–1230 m (Kaua‘i), *P. greenwelliae* mesic to wet forest 610–1280 m (Kaua‘i), *P. hathewayi* mesic to dry forest 360–940 m (O‘ahu), *P. hawaiiensis* wet forest (occasionally dry to mesic forest) (50–) 150–1590 m (Hawai‘i, Moloka‘i, Maui), *P. hexandra* mesic to wet forest 360–1250 m (Kaua‘i, O‘ahu), *P. hobdyi* mesic forest 600–610 m (Kaua‘i), *P. kaduana* mesic valleys, mesic and wet forests (15–) 180–1220 m (most main islands), *P. mariniana* mesic to wet forest (60–) 180–1220 m (most main islands), *P. mauiensis* mesic to wet forest 215–1,470 m (most main islands), *P. wawrae* mesic forest 120–850 m (Kaua‘i) (Wagner et al. 1990).

Medicines: No known traditional medicinal uses.

Non-Medicinal Uses: Wood used for *kua kukukapa* (*kapa* anvil) and for fuel (Malo 1951).

Kukui

Hawaiian Name: *kukui, kuikui*

Scientific Name: *Aleurites moluccana*

Vernacular Name: Candlenut, tung tree

Family: Euphorbiaceae

Status: Polynesian introduction

Description: Trees, to 25 m tall, silvery-gray powder on leaves.

Habitat: Common in mesic valleys especially between 0–700 m on most main islands (Wagner et al. 1990).

Medicines: For *‘ea* and *paa‘ao‘ao* the flowers and endosperm (nut) of the *kukui* are combined with *‘ala‘alawainui pehu* stems (*Peperomia* spp.), *‘ohi‘a ‘ai* bark (*Syzygium malaccense*), *‘aka‘akai ‘oliana* (?onion, *Allium cepa*) bulb, *noni* fruit (*Morinda citrifolia*), *kō kea* (white sugarcane, *Saccharum officinarum*), and possibly *kikania* (*Desmodium sandwicense*). Ingedients are mashed and strained, and liquid ingested. For infected sores, including *puho ‘a‘ai*, the green flesh of the *kukui* fruit is cooked in *kī* leaves (ti, *Cordyline fruticosa*) and combined with *‘ulu* sap (*Artocarpus altilis*), powdered *‘ahu‘awa* (*Cyperus javanicus*), and powdered *lama* (*Diospyros* spp.); the mixture is applied as a salve. For *pu‘ao pehu* the “shell” (endocarp) is burned and the smoke is used from inside an *ipu*. To build strength after an illness the endocarps (nut meat) are ground, along with cooked *kalo* (taro, *Colocasia esculenta*), the flesh of *kikawaioa* (fern, *Christella cyatheoides*), these are eaten with fish and *‘uala poi* (sweet potato, *Ipomoea batatas*) with a *ko‘oko‘olau* infusion.

Non-Medicinal Uses: The light-weight wood can be used for canoes (Abbott 1992; Malo 1951); the bark for dye and fruits and oil for light (Hillebrande 1888); “nuts” (oily endosperm) placed inside bamboo as torch (*kali kukui*) or oil burned in lamps (Abbott 1992), fish floats from wood (Degener 1930), oil for fishing, polishing; soot collected on smooth, clean pebbles under which *kukui* nuts had been burned for tattooing (Abbott 1992; Handy et al. 1972), dye also from the fleshy part of the green part of fruit also for tattooing (not as good), the “meat” of the seed (endosperm) used for *hula* altars (Pukui 1942); “nuts” for *lei* (Krauss 1993); wood for house timbers (Handy et al. 1972).

Lama

Hawaiian Name: *lama*, *ēlama*

Scientific Name: *Diospyros* (2 species)

Vernacular Name: Persimmon, ebony

Family: Ebenaceae

Status: Endemic

Description: Tree 7–13 m tall, leaves thick, leathery and dull

Habitat: *D. sandwicensis*: dry to mesic to wet forest, 5–1,220 m, *D. hillbrandii* 15–-760 m, diverse mesic forest (Wagner et al. 1990).

Medicines: *Lama* is not a primary medicinal plant, but can be found as a secondary ingredient in many remedies. For cuts, boils, abscesses, bruises, and cold sores powdered *lama* is mixed with crushed *‘ahu‘awa* (*Cyperus javanicus*) (Chun 1994). In the cleansing of *puho* and *kaupo* the bark of *‘ahakea* (*Bobea* spp.), *‘āla‘a* (*Pouteria sandwicensis*), and *‘auko‘i* stalk (*Senna occidentalis*) are used, and then *‘ulu* sap (*Artocarpus altilis*) with powdered *‘ahu‘awa* and *lama* are placed on the affected area (Chun 1994). For “burns on the rear end” and *puho puhi ka‘oka‘o lama* ashes are combined with *kawa‘u* (*Ilex anomala*?) and *‘ahu‘awa* as a salve (Chun 1994). For infected sores, including *puho ‘a‘ai*, the green flesh of the *kukui* fruit is cooked in *kī* leaves (ti, *Cordyline fruticosa*) and combined with *‘ulu* sap, powdered *‘ahu‘awa*, and powdered *lama*; the mixture is applied as a salve (Chun 1994).

Non-Medicinal Uses: Hard wood used for god images, house posts, and house fences (Malo 1951), fences of mapele or *unu o Lono* (type of *heiau*) (Malo 1951); fruits eaten (Hillebrande 1888; Krauss 1993). *Lama* is a sacred plant, and an un-carved block of wood placed on *hula* altar (*kuahu*) wrapped in yellow *kapa* (usually *wauke*, *Broussonetia papyrifera*, scented with *‘ōolena*, *Cucurma longa*) to represent Laka (Mitchell 1982); sticks in fish traps (Krauss 1993:41), name means “light,” and connotes “enlightenment” (Pukui and Elbert 1986).

Loulu

Hawaiian Name: *loulu, loulu hiwa* (*P. martii*)

Scientific Name: *Pritchardia* (22 species)

Vernacular Name: Native fan palm

Family: Arecaceae

Status: Endemic

Description: Palms, up to 30 m

Habitat: Most common in mesic to wet forest up to 1220 m. All highly restricted in distribution: *P. affinis, P. beccariana, P. schattaurei* (Hawai‘i); *P. arecina, P. forbesiana, P. glabrata* (Maui); *P. aylmer-robinsonii* (Ni‘ihau); *P. hardyi, P. minor, P napaliensis, P. viscosa, P. waialealeana* (Kaua‘i); *P. hillebrandii, P. lowreyana, P. munroi* (Moloka‘i); *P. kaalae, P. lanigera, P. martii* (O‘ahu); *P. remota* (Nihoa) (Wagner et al. 1990).

Medicines: *Loulu* is used to treat *‘ea* and *pa‘ao‘ao* in children and adults. The leaf bud and inner flesh are combined with *niu* (coconut, *Cocos nucifera*), *kō kea* (white sugarcane, *Saccharum officinarum*), *‘ōhi‘a* bark (*Metrosideros* spp.) and *‘ala‘alawainui pehu* (*Peperomia* spp). All of the items are pounded into a liquid form and drunk three times a day (Chun 1994).

Non-Medicinal Uses: *Loulu* palm were erected to signify a temporary, special “*heiau loulu*,” where gods of fishing were seasonally propitiated (Abbott 1992).

Naio

Hawaiian Name: *naio*, *naeo*, *naieo*

Scientific Name: *Myoporum sandwicense*

Vernacular Name: False sandalwood, bastard sandalwood, and *Naio*

Family: Scrophulariaceae

Status: Indigenous

Description: Shrub/small 1–15 m tall

Habitat: *M. sandwicensis* occurs in a number of different habitats from strand vegetation, to dry forest, lava flows, mesic to wet forest, and in subalpine forest 0–2,380 m (Wagner et al. 1990).

Medicines: To treat *nae kulou* and *waiopua paa*, or stubborn case of asthma, *‘ākia manalo* leaves (*Wikstroemia* spp.), *naio* leaf buds and leaves, the bark of *ohi‘a ai* (*Syzygium malaccense*) and *hi‘aloa* (*‘uhaloa*, *Waltheria indica*) tap roots, dried *niu* (coconut, *Cocos nucifera*), and *kō aina kea* (sugarcane, *Saccharum officinarum*) are pounded into a mash and the mixture is strained with *ahu‘awa* (*Cyperus javanicus*). The liquid is drunk cold for five days, twice a day. (Chun 1994). For the illness *ma‘i hemo keiki o na wahine hanau nui i ke keiki* (child birth of women who have had many children), *hala* aerial roots (*Pandanus tectorius*), *niu*, *kohekohe* (*Eleocharis* spp.), *hala* leaf buds, *ala‘alawainui pehu* stems (*Peperomia* spp.), *‘ihi makole* (*Oxalis* spp.), and *naio* leaf buds, fruit and leaves, *kukui* flowers (*Aleurites moluccana*), *noni* fruits (*Morinda citrifolia*), and *kō kea* (white sugarcane, *Saccharum officinarum*) are pounded into a mash and strained with *‘ahu‘awa*. The liquid mixture is heated. Once cool, the medicine is taken two times a day, once in the morning and again in the evening (Chun 1994).

Non-Medicinal Uses: Wood has odor similar to sandalwood (Degener 1930). Used for house posts (Degener 1930; Krauss 1993). Burns well and long, used for torches (Lamb 1981). Wood used for fish net gauge (*haha ka ‘upena*) (Krauss 1993).

Niu

Hawaiian Name: *Niu, ololani*

Scientific Name: *Cocos nucifera*

Vernacular Name: Coconut

Family: Arecaceae

Status: Polynesian introduction

Description: Trunk up to 30 m tall, leaves up to 6 m long

Habitat: Widely cultivated and occasionally naturalized, especially along sandy coasts (Wagner et al. 1990).

Medicines: *Niu* flesh, oil, leaf buds, and water were used in numerous medicines. These include formulations for *lepo pa‘a* (constipation), *‘ea* (thrush), *pa‘ao‘ao*, and the “illness related to *lolo*;” in addition, the leaf bud is made into a topical medicine for *‘eha moku kukonukonu* and *‘eha ‘ulia wale* (Chun 1998).

Non-Medicinal Uses: *Niu* (coconut) has many uses. The trunks used to make house posts, small canoes, hula drums, or food containers (Handy et al. 1972). Leaves (*launiu*) used for baskets, thatch, and for fans, known as some of the finest in Polynesia (Abbott 1993; Summers 1990). Leaf sheaths used as food or fish-bait wrappers (Handy et al. 1972). Husk fibers also used for cordage to make nets or lashing, known as *‘aha* (Summers 1990); the cordage could be coarse or fine. The cordage can be made into supports for *‘umeke* (bowls) or other round-based objects. Shell of fruit was used for eating utensils, such as spoons, bowls, plates, as well as *‘awa* cups and strainers for *‘awa*. *Niu* shells also served for storage containers, lids, and knee drums or *puniu* (Krauss 1993; Handy et al. 1972); the fibers are made into a drum beater. A musical instrument, the *hokiokio*, can also be made from coconut shell. Small mortars and bull roarers (*oeoe*) are also made from the *niu* shell (Krauss 1993). *Niu* water used as a drink, and flesh eaten raw or with *poi* (Handy et al. 1972). Some of the most familiar preparations of *niu* were not developed by ancient Hawaiians.

‘ōhi‘a ‘ai

Hawaiian Name: *‘ōhi‘a ‘ai, ‘ōhi‘a, ‘ōhi‘a ‘ai ke‘oke‘o, ‘ōhi‘a hākea, ‘ōhi‘a kea, ‘ōhi‘a leo, ‘ōhi‘a ‘ula*

Scientific Name: *Syzygium malaccense*

Vernacular Name: Mountain apple, Malay apple

Family: Myrtaceae

Status: Polynesian introduction

Description: Tree, to 20 m tall

Habitat: Occurring most commonly in mesic valleys at low elevations at mesic to wet sites between 200–310 (–550) m (Wagner et al. 1990).

Medicines: The bark is pounded with salt and strained through a *niu* leaf sheath (coconut, *Cocos nucifera*) for a topical medicine for open and deep cuts. For *‘ea* (thrush) and *pa‘ao‘ao*, the bark, leaves, and leaf buds are combined with *kukui* flowers (*Aleurites moluccana*), flowers, leaf buds, and leaves of the *hinahina ku kahakai* (*Heliotropium anomalum* var. *argenteum*), *‘aka‘akai ‘oliana* bulbs (*Allium cepa*), leaves, leaf buds and flowers of the *‘uhaloa* (*Waltheria indica*), and *kō honua‘ula* (red sugarcane, *Saccharum officinarum*). The mixture is strained through the *‘ahu‘awa* (*Cyperus javanicus*) and drunk. Foods suitable to consume while using this medicine are fish, *lu‘au*, *kukui*, *‘uala* (sweet potato, *Ipomoea batatas*), and fresh *poi*. For *hauna o ka waha* (bad breath) and *waha pala* (coated mouth), the bark is combined with *moa holokula* (cf. *Psilotum nudum*) and *kō kea* (white sugarcane) (Chun 1994). The bark chewed for a sore throat. Leaves were crushed and ingested for bronchitis (Abbott 1992).

Non-Medicinal Uses: Fruit eaten (Lucas 1982; Malo 1951). Used at *hula* altars (*kuahu*) (Emerson 1909). Dyes made from inner bark of trunk and root (brown) as well as the fruit skin (red) (Krauss 1993). Wood for posts, house rafters, and enclosures for *heiau* (Wagner et al. 1990), as well as being used for carved idols (Rock 1913).

‘ōhi‘a lehua

Hawaiian Name: *‘ōhi‘a lehua*, *lehua*, *‘ōhi‘a*

Scientific Name: *Metrosideros* (2 species)

Vernacular Name: None

Family: Myrtaceae

Status: Endemic

Description: Shrub/tree, to 100 ft

Habitat: *M. polymorpha* (the more common species) is found in a wide variety of habitats (early successional species on lava, shrublands, mesic to wet forest) between 0–2,200 m on most main islands; *M. macropus* on O‘ahu only (Wagner et al. 1990)

Medicines: The flower of the "*‘ōhi‘a a-pane*" is used as a medicine for childbirth. Also the young leaf buds are used to treat *muhe‘e kea* (paleness) in babies (Chun 1998).

Non-Medicinal Uses: Wood for images (*ki‘i*), posts and rafters, fences for temples, firewood, canoes (Malo 1951), construction of *luakini heiau* (Malo 1951), flowers and young leaf buds for *lei* (Abbott 1992); bowls (but difficult to work, see Abbott 1992). Placed on *hula* altars for *Kuka‘ohi‘a Laka* (Abbott 1992). Musical instruments (Krauss 1993).

Pilo

Hawaiian Name: *pilo, hupilo, maiapilo, pua pilo, koi* (*C. kauensis*), *olena* (*C. waimeae*)

Scientific Name: *Coprosma* (12 species)

Vernacular Name: None

Family: Rubiaceae

Status: Endemic

Description: Shrub to small trees

Habitat: *C. cymosa* in mesic forest, 500–1000 m (Hawai‘i); *C. elliptica* bogs and wet forest (Kaua‘i); *C. foliosa* mesic to wet forest between 300–1830 m (Kaua‘i, O‘ahu, Moloka‘, Lāna‘i, Maui); *C. kauensis* wet to mesic forest 600–1330 m (Kaua‘i); *C. longifolia* mesic to wet forest 360–1200 m (O‘ahu); *C. menziesii* mesic forest 270–1220 m (Hawai‘i); *C. montana* supalpine shrubland and woodland, mesic forest 1830–3050 m (Maui, Hawai‘i); *C. ochraecea*, wet habitats, occ. mesic forest, 790–2290 m (most main islands); *C. pubens* wet to mesic forest 360–1900 m (Maui, Hawai‘i, Moloka‘i, Lāni‘i); *C. rhynchocarpa* mesic to wet forest, subalpine shrubland 490–2260 m (Hawai‘i); *C. ternata* mesic to wet forest 760–1400 m (Moloka‘i); *C. waimeae* mesic forest 580–1070 m (Kaua‘i) (Wagner et al. 1990).

Medicines: The berries of the *pilo* are used as a laxative (Degener 1930).

Non-Medicinal Uses: Wood variable from hard to soft between species (Little and Skolmen 1989).

Pūkiawe

Hawaiian Name: *pūkiawe*, *a‘ali‘i mahu*, *kānehoa*, *kāwa‘u* (Lāna‘i, Maui), *maiele*, *maieli*, *puakiawe*, *puakeawe*, *pūpūkiawe*

Scientific Name: *Leptecophylla tameiameiae*

Vernacular Name: None

Family: Ericaceae

Status: Indigenous

Description: Shrubs

Habitat: Scattered to very common in mesic forest to open areas, low elevation to montane wet forest, to alpine shrublands and bogs rarely windward coastal sites 15–3230 m (Wagner et al. 1990).

Medicines: Leaves of the *pūkiawe* or *‘a‘ali‘i mahu* are ground with salt, mixed with water, and inhaled through the nose to treat congestion (*holopani upe nui*) (Chun 1994).

Non-Medicinal Uses: The fruit often used in *lei* (Abbott 1992); when *‘ali‘i* wished to mingle with commoners (with no harm to them or himself), would be smudged with smoke from *pūkiawe* while *kahuna* chanted for “dispensation” (Degener 1930), “this is the plant that a person would burn to sanctify the *kapu* of the chiefs” (Malo 1951); wood used for cremating bodies of outlaws (Little and Skolmen 1989); wood for *kua kuku* (*kapa* anvil) (Krauss 1993).

Uhihi

Hawaiian Name: *uhiuhi*, *kāwa‘u* (Maui), *kea* (Maui)

Scientific Name: *Caesalpinia kavaiensis*

Vernacular Name: None

Family: Fabaceae

Status: Endemic; endangered

Description: Shrubs or tree, 4–10 m tall

Habitat: Now rare in mesic or dry forest at Waimea Canyon, Kaua‘i; central leeward Wai‘anae Mountains, O‘ahu; *Hualalai*, *Hawai‘i* (Wagner et al. 1990).

Medicines: To purify the blood, combine and mash young leaves and leaf buds and bark of *uhiuhi*, along with the inner bark of *hāpu‘u* (*Cibotium* spp.), *okolehao* (usually of *ki*, *Cordyline fruticosa*), *‘ulu* bark (*Artocarpus altilis*), *‘uhaloa* tap roots (*Waltheria indica*), and sections of *kō kea* (white sugarcane, *Saccharum officinarum*). Strain mixture through *‘ahu‘awa* (*Cyperus javanicus*) and drink three times a day (Chun 1994).

Non-Medicinal Uses: Extremely hard wood used to make weapons (Abbott 1992), *‘o‘o* or digging stick (Krauss 1993), house posts (Kamakau 1976; Krauss 1993), *kapa* beaters (Kamakau 1976: Krauss 1993), *la‘au kahi wauke* or a board for scraping *wauke* to make *kapa* (Krauss 1993); sled runners (for *holoa*) (Culliney and Koebele 1999). Also for fish hooks (Kamakau 1976; Krauss 1993); octopus or fish spears (Kamakau 1976; Krauss 1993).

‘ūlei

Hawaiian Name: *‘ūlei, u‘ulei, eluehe* (Moloka‘i)

Scientific Name: *Osteomeles anthyllidifolia*

Vernacular Name: None

Family: Rosaceae

Status: Indigenous

Description: Shrubs; glossy green leaves with white fragrant blossoms and round fruit.

Habitat Occurring in a wide variety of habitats including dry open shrubland, dry to mesic forest, disturbed sites, lava fields; between 2–2,320 m on most main islands (Wagner et al. 1990).

Medicines: To treat *‘ea* and *pa‘ao‘ao*, the leaf buds and seeds, *‘ūlei*, are eaten until the illnesses are gone. To treat open cuts or injuries, the *‘ūlei* bark , leaves, and salt are pounded into a mass and applied to the cut (*kahi ‘eha*) (Chun 1994).

Non-Medicinal Uses: Mature, hard wood used for *‘o‘o* (digging sticks) (Krauss 1993), musical instrument; *ukeke*, musical bow (Krauss 1993); short spears, including octopus spears (Kamakau 1976) and *ihe pahee* (javelin) (Malo 1951); younger, flexible branches for fish net loops (Malo 1951); fruits as famine or casual food, lavender dye and *lei* (Krauss 1993).

‘ulu

Hawaiian Name: *‘ulu*

Scientific Name: *Artocarpus altilis*

Vernacular Name: Breadfruit

Family: Moraceae

Status: Polynesian introduction (not naturalized)

Description: Trees, grow up to 30 ft with diameter up to 4 ft

Habitat: *A. altilis* is not considered naturalized but is cultivated in hot, moist areas (Lucas 1982; Wagner et al. 1990).

Medicines: To treat *koko‘ino* (bad blood), one can combine the bark of *‘ulu* with that of *‘ahakea* (*Bobea* spp.), *‘ohi‘a* (*Metrosideros* spp.), *‘uhaloa* (*Waltheria indica*), *‘auko‘i* (*Senna occidentalis*), and *kō kea* (white sugarcane, *Saccharum officinarum*) along with the flowers and leaves of *ko‘oko‘olau* (*Bidens* spp.); these items are mixed into a liquid form and to be taken three times daily (Chun 1994). *‘Ulu*, especially the sap, is used as a secondary ingredient in numerous other remedies.

Non-Medicinal Uses: Large fruit eaten and made into *poi* (Abbott 1992; Malo 1951); sweet dish made from *ulu* and coconut (*niu*) cream (Krauss 1993). It is said that the original *ulu maika* was disk cut from immature breadfruit (Krauss 1993). The lightweight wood used for drums (*pahu*) (Abbott 1992), surfboards (*papa he‘enalu*) (Krauss 1993); house doors and canoes (Kamakau 1976; Malo 1951). Trunks used to make *poi* boards (*papa ku‘i ‘ai*) (Krauss 1993). Inner bark fibers for a low-grade *kapa* (Abbott 1992; Malo 1951). A yellow-brown dye is made from male flowers (Krauss 1993); sap for birdlime and leaves as sandpaper (Handy et al 1972); used on *hula* altars (*kuahu*) (Emerson 1909). Sap as gum from stem chewed by children, and also used as glue to join gourds to make *ipu heke* (Handy et al. 1972).

6.7.5 Human Skeletal Remains

6.7.5.1 City Center Human Skeletal Remains Synthesis

Seven test excavations during the current AIS yielded human skeletal remains (T-096, T-141, T-142, T-150, T-170, T-226C, and T-227A) located within four archaeological cultural resources. From west to east:

T-096	SIHP #50-80-14-7427
T-141, T-142, and T-150	SIHP #50-80-14-5820
T-170	SIHP #50-80-14-7429
T-226C and T-227A	SIHP #50-80-14-2918

The remains ranged from isolated single elements and fragments to complete in situ burials. The following paragraphs describe each set of human skeletal remains, with a brief synthesis of the burials given at the end. As the number of human skeletal remains identified during the current AIS was relatively minimal, the general analysis of the burials is limited. Additionally, once skeletal remains were conclusively identified as human, no further analysis was permitted, which leads to a dearth of information on the remains themselves and burial practices in general.

T-096 contained an isolated human talus (ankle bone) from a disturbed context within fill material. In additional to the talus, the fill material also contained faunal bones, rusted metal, slag, ceramic shards, bottle glass fragments, and charred material. The talus appears to be from an adult or older adolescent individual. Due to the paucity of remains, neither sex nor ancestry was determinable. The talus could be from a previously disturbed Native Hawaiian or historic-era burial. It is not uncommon in Hawai‘i to find isolated remains in disturbed contexts within fill material. It has been documented in the *Hawaiian Gazette* (January 1896:5; February 1896:4) that Chinese compatriots living in Chinatown (in the vicinity of T-096) disinterred their countrymen’s remains for shipment back to China. Once the remains were disinterred, they would scrape remaining tissue from the bones and bundle them in satchels. It is not improbable that some remains could become “lost” during this process. The talus is considered part of SIHP #50-80-14-7427, designated during the current AIS to refer to the talus; buried, culturally enriched sediments; and historic structural remnants.

T-141 contained several isolated human skeletal remains from a disturbed context within a buried, culturally enriched, sandy A-horizon and a contemporaneous pit feature, as well as within a modern/historic pit feature that cut through the former A-horizon. The remains consisted of several elements from both infant and adult individuals. Based on the presence of adult and infant remains as well as duplication of adult elements, the minimum number of individuals represented within this assemblage is three. Due to the paucity and fragmentary nature of the remains, neither sex nor ancestry was determinable; however, based on the stratigraphic context of the remains and associated cultural material, the remains are more likely to be Native Hawaiian than Western. Cultural material found in association with the remains within the buried A-horizon and associated features included: an in situ horse burial, a stone sinker, faunal skeletal fragments, a sea urchin spine, a minimal amount of assorted marine shell, and a minimal amount of charcoal. The human skeletal remains and buried A-horizon from T-141 have been incorporated into SIHP #50-80-14-5820, originally designated by Winieski and Hammatt 2000a

to document human skeletal remains and a buried, culturally enriched, sand A-horizon within Kaka‘ako Improvement District 3.

T-142 contained in situ human skeletal remains, believed to represent a complete burial. The remains were located within natural Jaucas sand beneath a buried, culturally enriched, sandy A-horizon. Based on the observable remains and the size of the burial pit, the burial was flexed or partially flexed. The size and morphology of the remains suggests an adult or older adolescent individual. Neither sex nor ancestry was determinable; however, based on burial context (location and position of the burial and associated cultural material), the burial is likely Native Hawaiian. Cultural material found in association with the remains within the buried A-horizon and associated features included: burnt and un-burnt faunal skeletal remains, charcoal, a minimal amount of marine shell, a possible game stone, and a shell fishhook. The human skeletal remains and buried A-horizon from T-142 have been incorporated into SIHP #50-80-14-5820, originally designated by Winieski and Hammatt (2000) to document human skeletal remains and a buried, culturally enriched, sand A-horizon within Kaka‘ako Improvement District 3. Additionally, During processing of a bulk sediment sample from the culturally-enriched buried sand A-Horizon at T-142, two small fragments of human spongy bone and a human mandibular incisor were found.

T-150 contained an isolated portion of a posterior, proximal, human tibia that may have been used in tool manufacture (possibly for a fishhook). Kirch provides the following summary of the use of human long bones to make fishhooks:

> The largest one-piece and two-piece hooks were made from human long bones, prized not only for their size and strength, but also because it was believed that the *mana* of the deceased would render the hook particularly efficacious. The practice of making hooks from human bones was also used to humiliate enemies defeated in war, and chiefs went to considerable lengths to camouflage their burial places so that their bones would not fall into the hands of would be fishhook-makers! The use of human bone for fishhooks seems to have greatly increased in the late prehistoric period, and was relatively uncommon earlier in Hawaiian prehistory. (Kirch 1985:204)

The tibia portion was located in a pit feature that extended down from a buried, culturally enriched, sandy A-horizon. The size of the tibia portion suggests an adult or older adolescent individual. Due to the paucity and fragmentary nature of the remains, neither sex nor ancestry was determinable; however, based on burial context (location and associated cultural material) and the nature of the bone (being worked), the tibia portion is more likely Native Hawaiian than Western. Cultural material found in association with the remains within the buried A-horizon and associated features included: a possible adze or sharpening stone fragment, volcanic glass debitage, fire-cracked rock, marine shell midden, fish bone, and charcoal. The tibia portion and buried A-horizon from T-150 have been incorporated into SIHP #50-80-14-5820, originally designated by Winieski and Hammatt (2000) to document human skeletal remains and a buried, culturally enriched, sand A-horizon within Kaka‘ako Improvement District 3.

T-170 contained an isolated cranial fragment located within a buried, sandy A-horizon. Due to the paucity and fragmentary nature of the remains, age, sex, and ancestry were not determinable; however, based on burial context (location) the cranial portion is more likely Native Hawaiian

than Western. The cranial portion is considered part of SIHP #50-80-14-7429, designated during the current AIS to refer to the cranial fragment and a buried, culturally enriched, sand A-horizon.

T-226C contained an articulated human pelvis located within a pit feature extending down from a buried, sand A-horizon. The burial had been previously disturbed; the pelvis had no articulating legs, and it was unclear if the upper body was present as the burial extended into the trench sidewall (once the determination of human was made, the burial was not explored further). The size and morphology of the remains suggests an adult or older adolescent individual. Neither sex nor ancestry was determinable; however, based on burial context (location), the burial is more likely Native Hawaiian than Western. Cultural material found in association with the remains within the buried A-horizon included a bone pick, volcanic glass debitage, charcoal, and a minimal amount of marine shell and fish bone. This burial was incorporated into SIHP #50-80-14-2918, originally designated by Yent 1985 to document a buried, culturally enriched, sand A-horizon containing human skeletal remains, as well as historic railroad tracks located within the former Honolulu Ironworks site.

T-227A contained human infant skeletal remains, believed to represent a complete and in situ burial. The remains were located within natural Jaucas sand, underneath a buried, sandy A-horizon. The age-at-death of the infant was determined to be between birth and three years. Neither sex nor ancestry was determinable; however, based on burial context (location), the burial is more likely Native Hawaiian than Western. Cultural material found in association with the remains within the buried A-horizon included: volcanic glass debitage, fire-cracked rock, charcoal, shell midden, fish bone, faunal skeletal remains, a basalt fragment, and a brick fragment. This burial was incorporated into SIHP #50-80-14-2918, originally designated by Yent 1985 to document a buried, culturally enriched, sand A-horizon containing human skeletal remains, as well as historic railroad tracks, located at the former Honolulu Ironworks site.

Six of the instances of human skeletal remains documented during the current AIS were located in a relatively small area of Kaka‘ako, between Punchbowl and Kamake‘e Streets. The seventh instance of human skeletal remains (from T-096) was located in the Downtown Honolulu (Chinatown Station) area. The remains in this instance consisted of a single element from a disturbed context in fill material (i.e., not an in situ burial) and are the only instance where there is no evidence to suggest that it is of Native Hawaiian origin. Within the City Center portion of the HHCTCP, human skeletal remains were not found west of River Street or east of Kamake‘e Street.

As mentioned above, the talus from T-096 is believed to be the only instance of human remains found during the current AIS where there is no evidence to suggest that it is of Native Hawaiian origin. The talus was found in a disturbed context in fill material containing historic rubbish. The origin of the talus (Native Hawaiian vs. Western) is undetermined. The other six instances of human skeletal remains do bear evidence to indicate that they are more likely Native Hawaiian in origin (although this is not definitive in all cases). This is based on burial context (location within a sandy pre-Contact/early post-Contact cultural layer or within natural Jaucas sand, flexed/partially flexed position, associated cultural material [although lacking grave goods], and no evidence of coffins) and, in one instance, the nature of the skeletal remains (being worked for possible fishhook manufacture).

Among the seven instances of human skeletal remains, three sets of remains were believed to represent primary, in situ burials. The remains from T-142 definitely represent a complete, in situ burial, while the remains from T-227A are very likely to be a complete, in situ burial (although this is not conclusive), and the remains from T-226A are not complete, but are articulated, suggesting that they represent an in situ burial. A fourth instance of human skeletal remains, the remains from T-170, consist of a single, isolated bone, but further excavation could reveal that additional remains exist nearby. The remaining three instances of remains represent isolated and previously disturbed remains, although all three cases are diverse. In one instance (T-141) several remains were found in a previously disturbed context dispersed throughout a former cultural layer and its associated features, while in another instance (T-150) the human bone had been taken from its original interment location and modified as a potential tool and was located within a discrete feature of a former cultural layer, and in the last instance (T-096) the human bone had been disturbed from its original interment location and deposited within historic fill material.

The seven cases of human skeletal remains documented during the current AIS and described above reflect typical instances of human remains documented in the Kaka‘ako region, and Hawai‘i in general. Traditional Hawaiian burials were typically (although not always) interred in unmarked locations in sandy sediments, in a flexed or semi-flexed position, close to the former traditional Hawaiian land surface with accompanying cultural material, and lacked grave goods and coffins. In highly urbanized areas, such as the greater Honolulu area, thick fill layers would be present above the former traditional Hawaiian land surface and burials, both of which may have been impacted and disturbed by development.

6.7.5.2 Broad Context Human Skeletal Remains Distribution Discussion

Graphics were created to plot human skeletal remains documented during the current City Center AIS as well as during previous archaeological studies within the vicinity of the City Center project corridor. Both sets of human skeletal remains were plotted on several figures with regards to burial type (traditional Hawaiian, Western, or undetermined), burial condition (in situ, previously disturbed, or isolated remains), and geographic location. In the following figures “Archaeological Data” refers to the results of the current City Center AIS investigation. The “Prev. Arch. Data” refers to the previously recorded discoveries of human skeletal remains near the City Center AIS study area. Specific information for each of these “Prev. Arch. Data” human skeletal remains discoveries is summarized in Section 5.5 of Volume II, “Predictive Model for Human Skeletal Remains.”

It is clear from looking at Figure 299 and Figure 300 that the majority of human skeletal remains were originally located in the eastern half of the City Center project corridor, east of Nu‘uanu Stream and the Chinatown district of downtown Honolulu, with very few human skeletal remains documented west of Nu‘uanu Stream (only four instances from previous studies). Within the eastern half of the City Center corridor, human skeletal remains are clustered in the center of Kaka‘ako, at the eastern end of Kaka‘ako, and to a lesser extent in the Chinatown District of downtown Honolulu. Human skeletal remains plotted on a 1927 aerial photograph of the Kaka‘ako Coast (Figure 301) show that many burials were located on the edges of ponds/wetlands, where raised sand berms acted as boundaries. It is not surprising that the

majority of documented burials are located within the greater Kaka‘ako region; the land surface in large portions of this area was formerly sand, which was a preferred burial matrix.

In most cases, human skeletal remains documented during the current City Center AIS were located very near human skeletal remains identified during previous archaeological studies. Only human skeletal remains from T-170 of the City Center AIS (SIHP #50-80-14-7429) were not located in the vicinity of other previously identified human skeletal remains (see Figure 300). This may be due to a lack of previous archaeological studies conducted in the area, which potentially would have located additional human skeletal remains, or possibly the fact that the remains from T-170 are isolated and could have been transported from their original interment location.

Figure 303 and Figure 304 show that both traditional Hawaiian and Western burials/human skeletal remains have been documented in the same vicinity. There are no discrete geographical areas along the City Center project corridor where only one type of burial is found. There are, however, some discrete groupings based on burial type, although these groupings are located adjacent to one another.

Figure 305 and Figure 306 show that in many cases in situ burials have been located near previously disturbed burials. This indicates that previous disturbance, largely due to construction activities/ development, did not necessarily disturb all human skeletal remains in the general area or even within a discrete grouping. The fact that in situ burials have been found at all in the highly urbanized areas along the City Center project corridor, particularly within the greater Kaka‘ako area, shows that development and construction activities have not disturbed or obliterated all earlier burials that once existed along the southern coast of O‘ahu. Oftentimes, burials are found mere inches from former construction undertakings. Interestingly, instances of isolated remains are not found only near previously disturbed remains, but are often located near in situ burials or by themselves; one would expect disturbed isolated remains to be found in close proximity to their original interment location with the rest of the burial, in most cases.

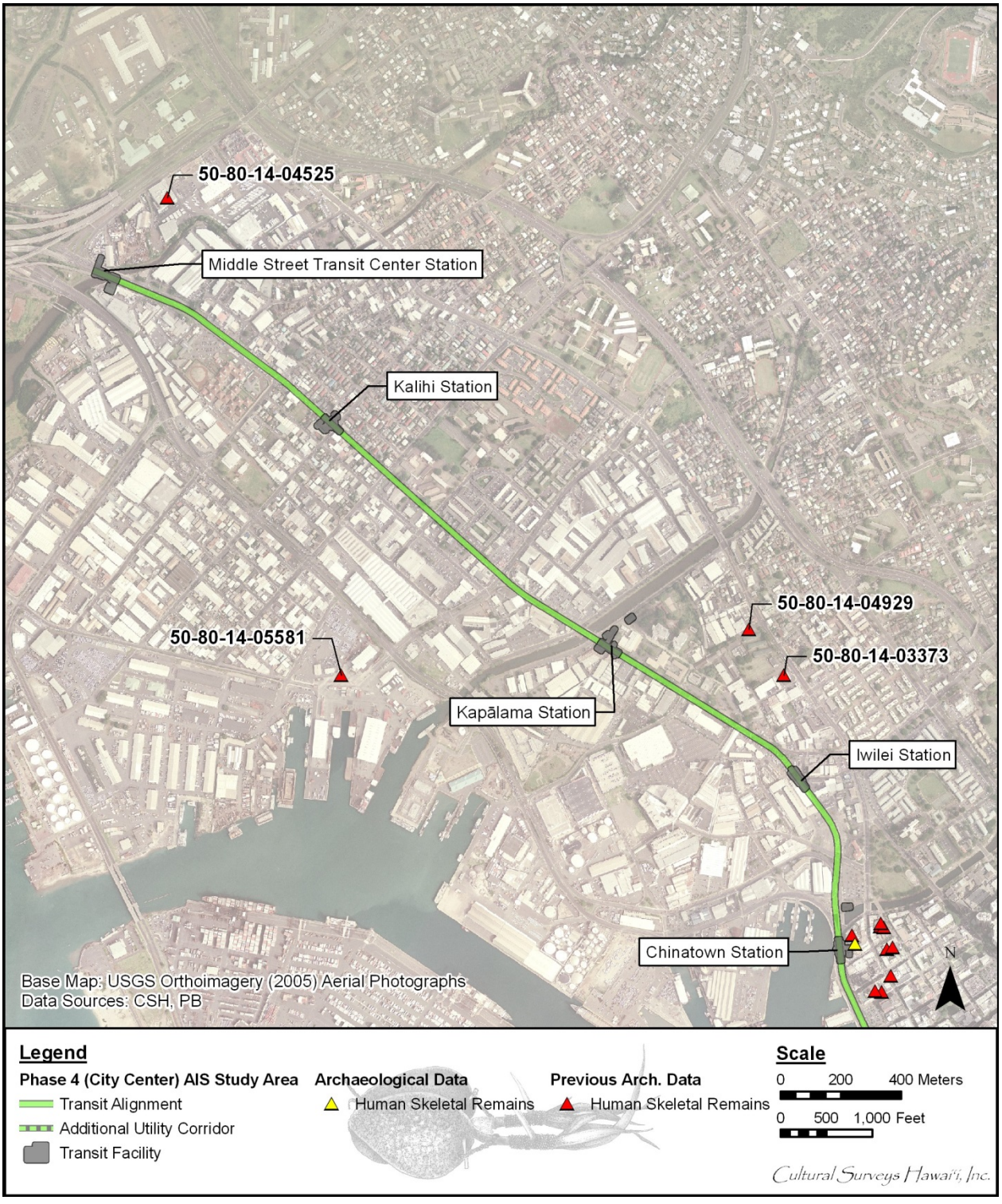


Figure 299. Human skeletal remains documented in the western half of the City Center corridor (base map: U.S.G.S. orthoimagery 2005)

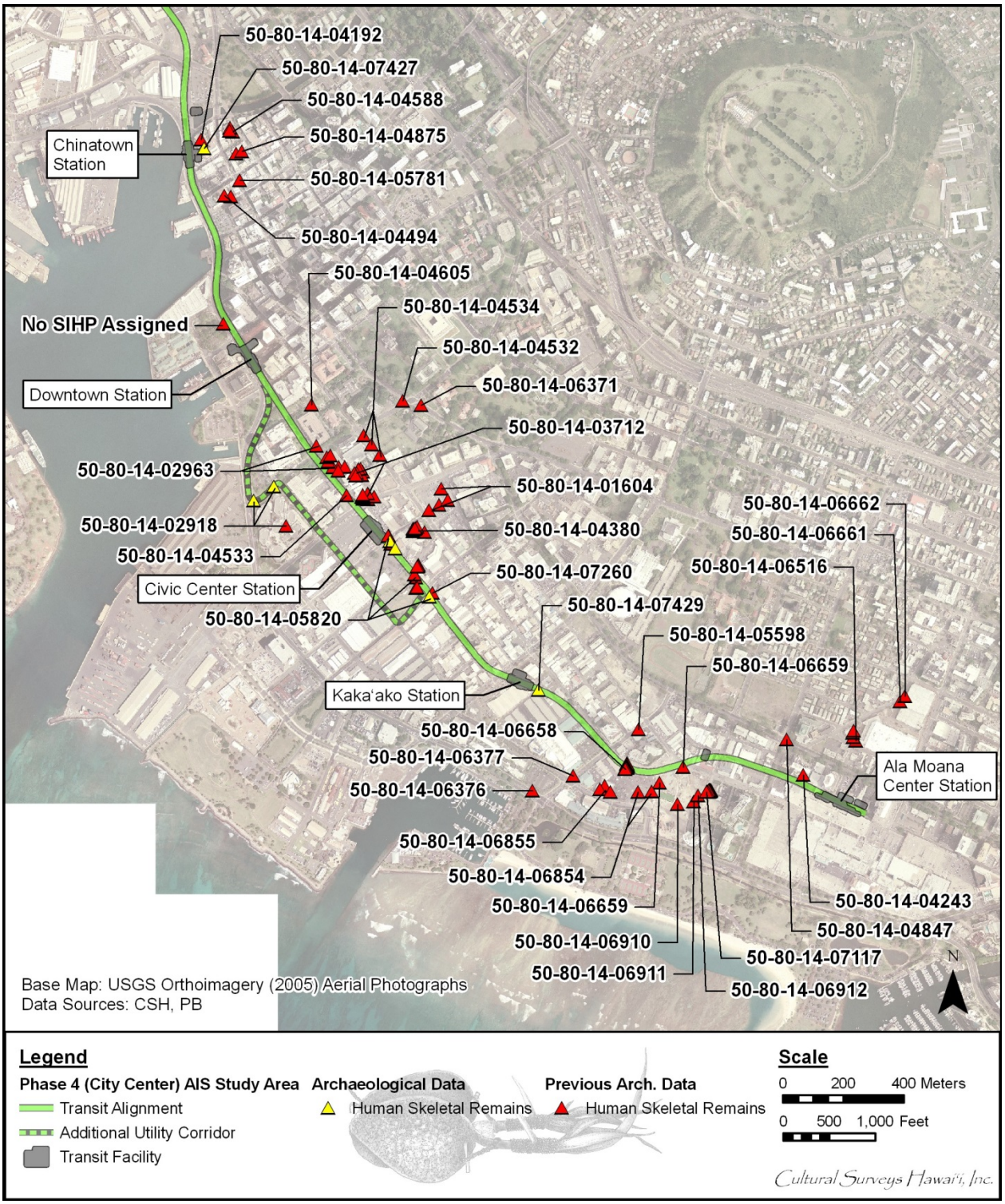


Figure 300. Human skeletal remains documented in the eastern half of the City Center corridor (base map: U.S.G.S. orthoimagery 2005)

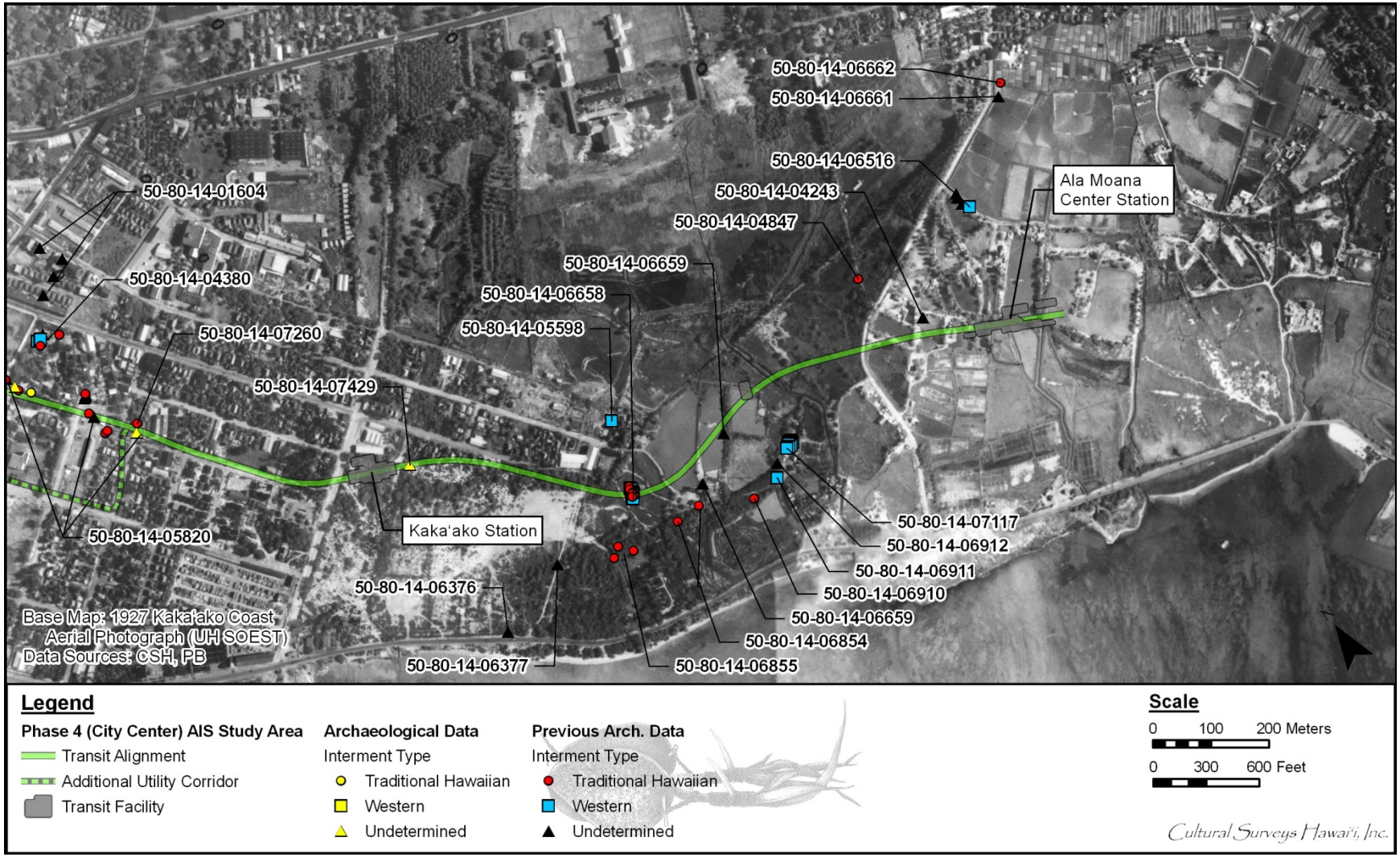


Figure 301. 1927 aerial photograph of the Kaka‘ako Coast showing locations of human skeletal remains in the eastern portion of the City Center corridor (source: U.H. SOEST)

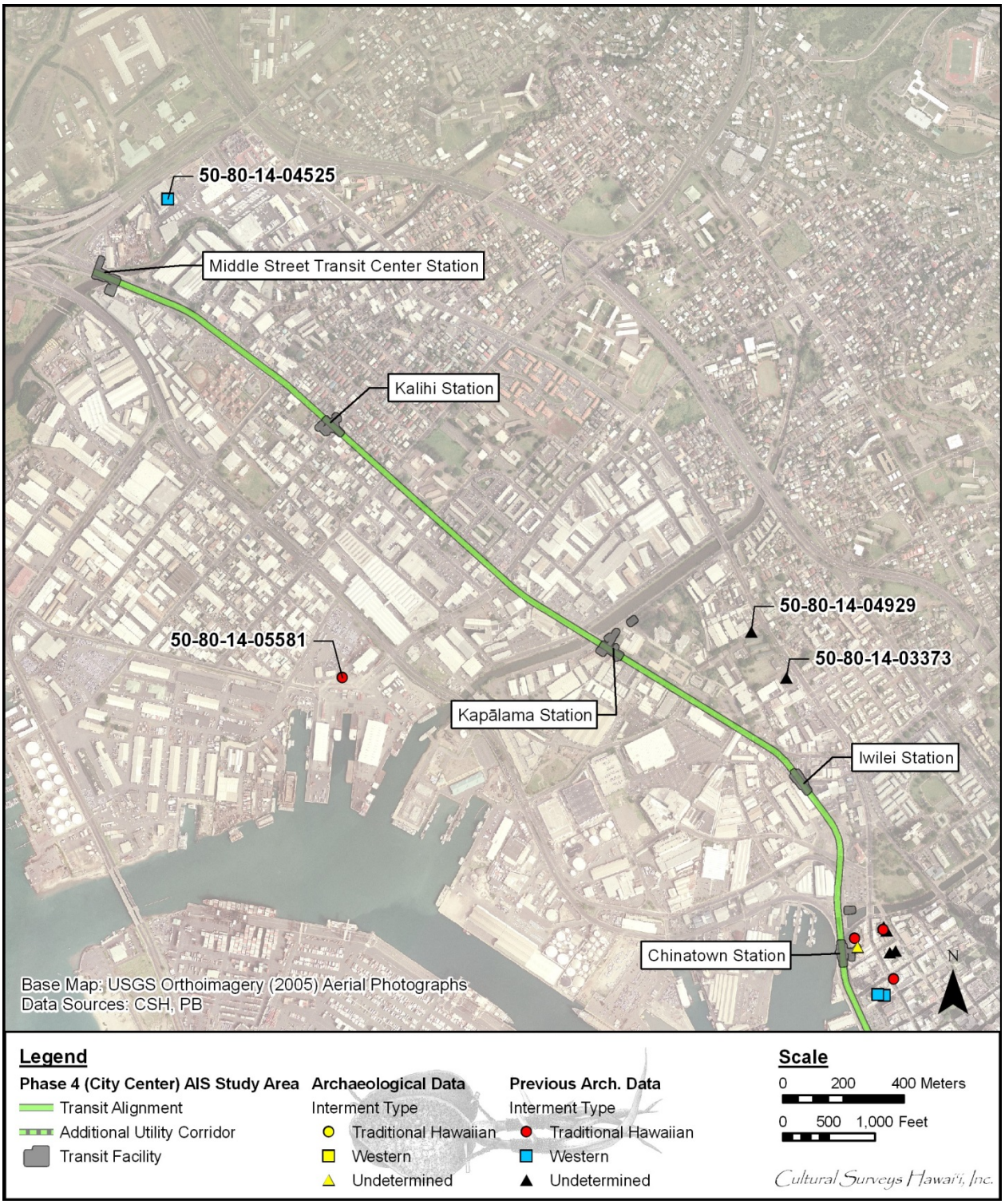


Figure 302. Human skeletal remains documented in the western half of the City Center corridor by interment type (base map: U.S.G.S. orthoimagery 2005)

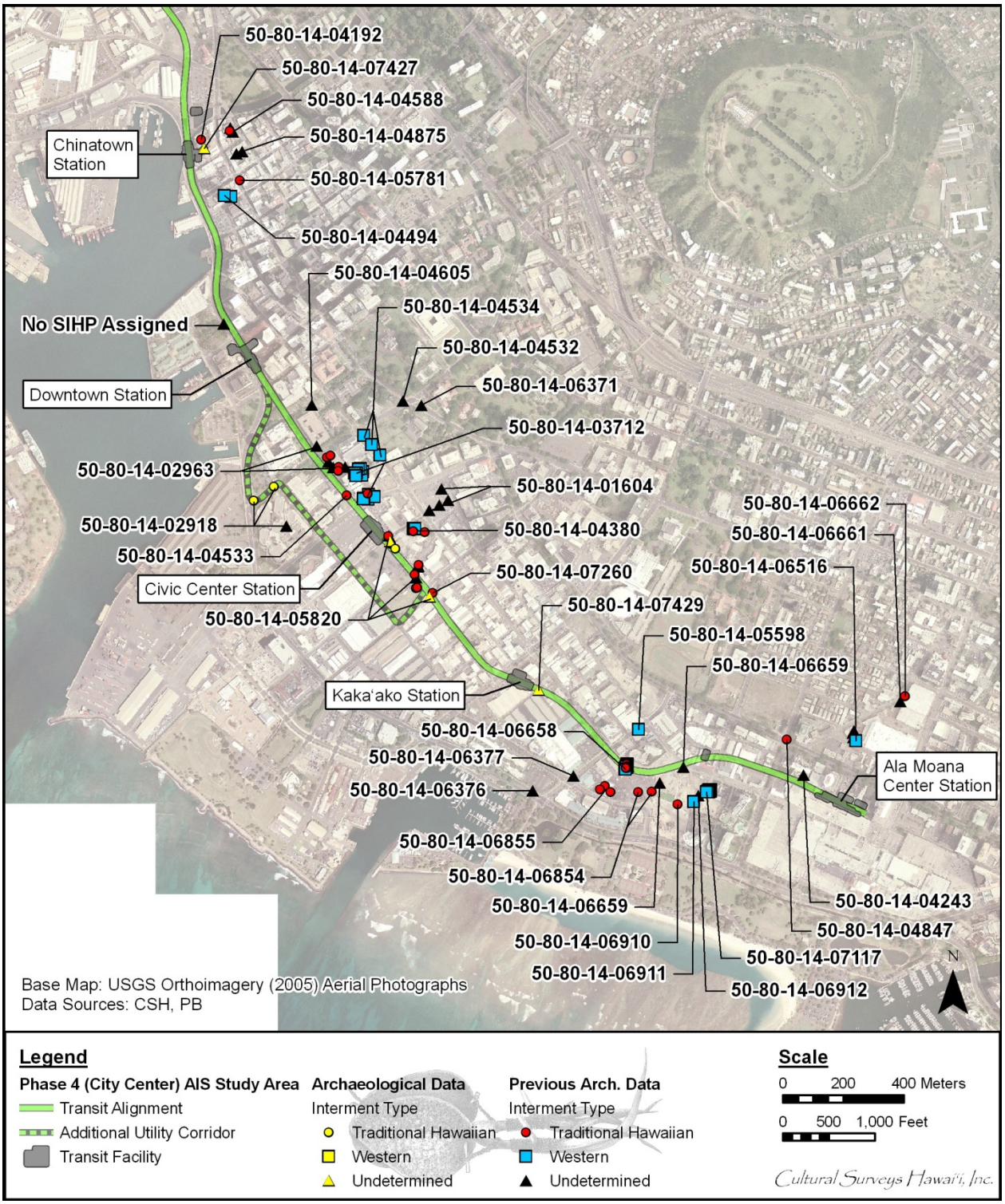


Figure 303. Human skeletal remains documented in the eastern half of the City Center corridor by interment type (base map: U.S.G.S. orthoimagery 2005)

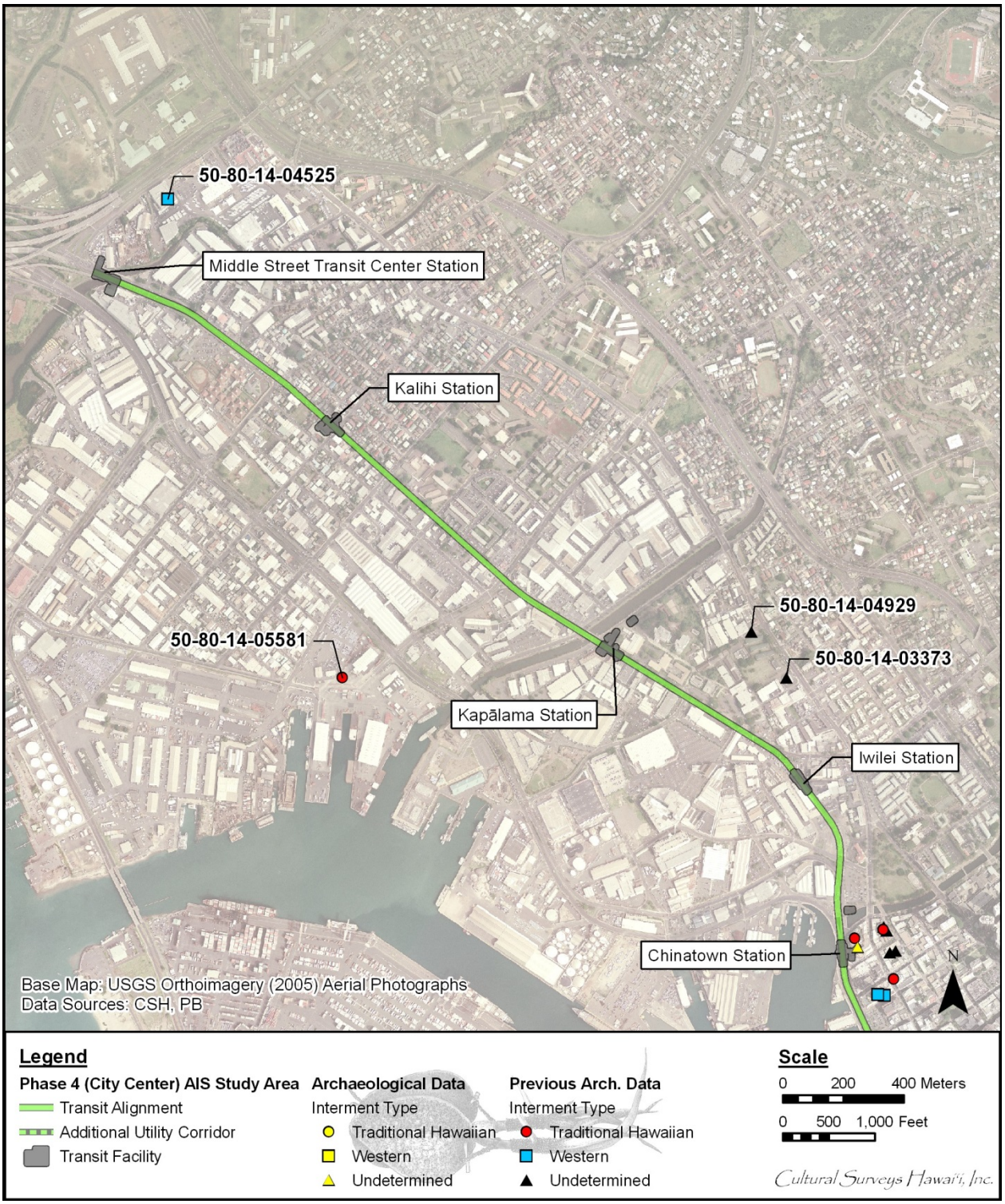


Figure 304. Human skeletal remains documented in the western half of the City Center corridor by interment type (base map: U.S.G.S. orthoimagery 2005)

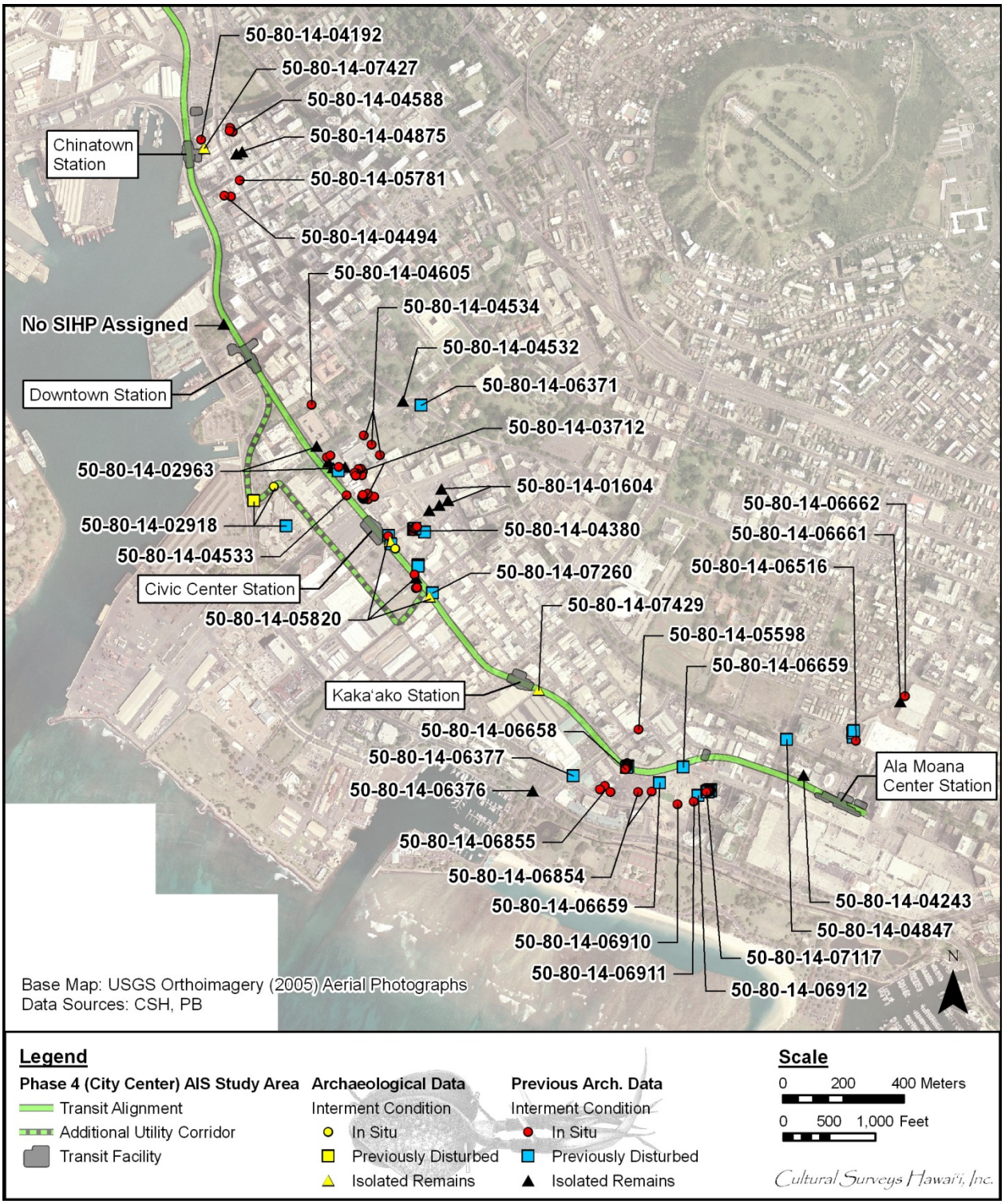


Figure 305. Human skeletal remains documented in the eastern half of the City Center corridor by burial condition (base map: U.S.G.S. orthoimagery 2005)

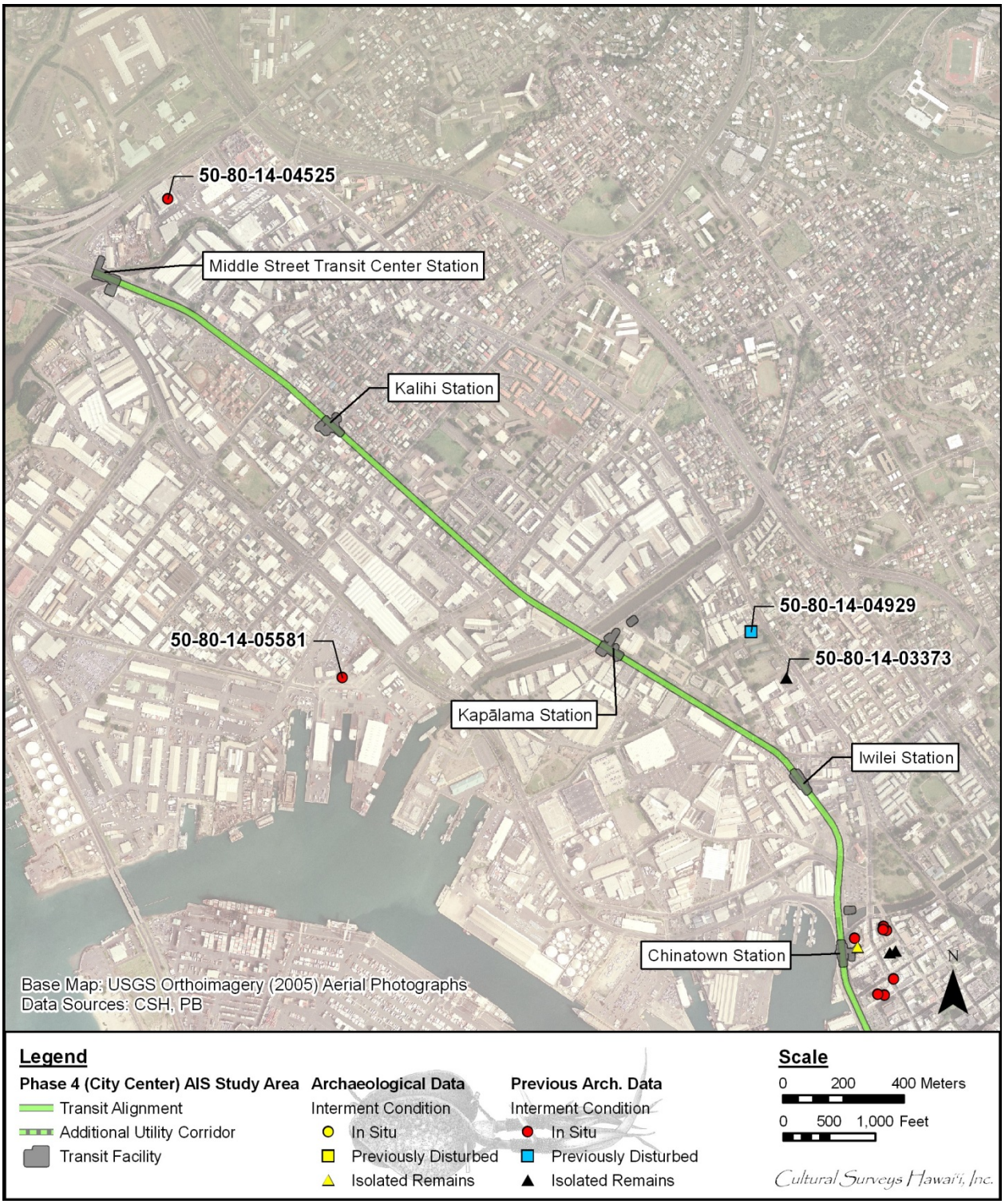


Figure 306. Human skeletal remains documented in the western half of the City Center corridor by burial condition (base map: U.S.G.S. orthoimagery 2005)

6.8 Cultural Consultation Effort

Following the project's PA requirements (Stipulation III.B and III.C) and the AIS requirements of HAR Chapter 13-276, cultural consultation was an important component of this AIS preparation. During the City Center AIS fieldwork, and subsequently during the preparation of this AIS report (throughout late 2012 and early 2013), CSH and HART consulted frequently with the OIBC and the SHPD regarding the progress and results of the AIS investigation. Presentations to the OIBC at their monthly August, September, October, November, and December 2012, and January and February 2013 meetings included updates on the City Center AIS results and the status of AIS report preparation. During this same time period (later 2012 and early 2013), CSH met twice monthly with the SHPD to discuss the progress and results of the AIS investigations for the City Center.

Feedback from the SHPD was an important factor guiding modifications of the AIS investigation and project design: for example, the reconfiguration of the rail design in the area of Test Excavations 141 and 142 in order to avoid impacting *iwi kūpuna* finds and the sand deposits in the *mauka* portion of Halekauwila Street, and also the decision, made on-site by the SHPD during excavations of T-226C, to excavate an adjacent Test Excavation 226D to provide an alternative utility relocation corridor.

During these SHPD discussions in early 2013, and in follow up emails, the significance of identified archaeological cultural resources was discussed, along with project effect and mitigation measure recommendations for the City Center AIS report. On February 20, 2013, CSH and the HART met with the Office of Hawaiian Affairs (OHA) and updated their archaeological and cultural staff on the City Center AIS results. During this OHA consultation meeting, CSH staff described the archaeological cultural resources documented, along with their significance and proposed mitigation measures.

Additionally, public outreach was a vital component of the AIS consultation effort. Neighborhood meetings providing project updates and the opportunity for comment and questions were held in five neighborhoods in May 2012. Weekly consultation updates on excavation results and finds were provided on the project's website, via e-blast, and via direct mailings, and consultation with concerned individuals was conducted via phone, email, and meetings. Updates of the City Center AIS investigation and *iwi kūpuna* finds were provided at several public meetings (November 8 and 27, 20012 and December 17, 2012). In addition, burial treatment consultation was initiated within a public forum on February 7, 2013 and March 11, 2013 in order to consult with, and seek treatment preferences from, potential lineal or cultural descendants to the human skeletal remains identified in the City Center AIS. The consultation effort also included the implementation of a Cultural Monitoring Program, begun on October 16, 2012, in which cultural monitors worked on site with project archaeologists.

The applicable information provided by cultural consultants was used in the interpretation and consideration of significance for identified archaeological cultural resources, as well as in recommendations of project effect and mitigation.

6.9 Completion of AIS Objectives

The City Center AIS was successfully carried out, and its primary objectives are documented in this AIS report. The AIS documentation identified archaeological cultural resources in the City Center archaeological APE. They were documented sufficiently to evaluate their Hawai‘i and National Register eligibility, to determine project effect, and to make specific mitigation recommendations to alleviate the project’s potential adverse effect on Hawai‘i and National Register-eligible archaeological cultural resources. The discussions of significance, project effect and mitigation follow in the next sections.