Section 2 AIS Research Design and Methods

This research design and methods discussion is taken from the SHPD-approved City Center AISP (Hammatt et al. 2011).

2.1 Research Design

The archaeological identification efforts described in the AISP are archaeological research activities, and as such are governed by a research design. A research design is essentially a plan that clearly identifies the following:

1) What is currently known about the research subject;
2) The research objective or objectives;
3) The research investigation steps and methods that will collect the needed information to fulfill the research objective; and,
4) How the results of the investigation will be interpreted and evaluated.

This research design was developed in consideration of what is currently known about the archaeological record in the vicinity of the City Center study area. It is also based on the specific engineering/construction requirements and preliminary engineering footprint of the City Center portion of the HHCTCP. Important considerations in the development of this research design are: 1) the City Center study area is completely developed and paved over; 2) there are unlikely to be surface indications of extant archaeological cultural resources; and relatedly, 3) all extant archaeological cultural resources are likely to be subsurface.

City Center of the HHCTCP is in an area of high archaeological sensitivity based on historic background research and the results of past archaeological investigations in the vicinity. As outlined in the Previous Archaeological Research Section (refer to Volume II), significant subsurface archaeological deposits, including human burials, are likely located within the City Center study area and may be affected by project construction. The background research presented in Volume II provides the historic/cultural information to make predictions regarding the types and locations of archaeological cultural resources that are likely within the study area. This background research, along with the detailed preliminary engineering information that delineates the actual project footprint, was used to develop the project’s research design, including methods and sampling strategy.

The overall objective of the archaeological cultural resource identification activities described in the City Center AISP (Hammatt et al. 2011) is to locate and document archaeological cultural resources that may be affected by the HHCTCP City Center construction. The City Center AIS was carried out as part of the HHCTCP’s compliance with State and Federal historic preservation requirements. It identified archaeological deposits, including human burials, within the HHCTCP Section 4 corridor. Once identified, these archaeological deposits were investigated and recorded in sufficient detail so that their significance could be assessed and the project’s potential effect on significant archaeological deposits could be evaluated. Based on this project effect evaluation, appropriate mitigation recommendations could be made.

This AIS focuses exclusively on archaeological cultural resources. The identification, documentation, and treatment decisions for traditional cultural properties (TCP) and historic

buildings and structures are not part of the current investigation. This AIS report for the HART uses available information currently generated as part of the city’s on-going TCP study for City Center (refer to Section 4).

The city is currently working with the SRI Foundation and Kumu Pono Associates to produce a comprehensive ethnographic and ethnohistoric investigation of the HHCTCP project corridor and its environs. These investigations, including historic research with Hawaiian language sources, place name and oral tradition research, and ethnographic interviews, will support and be incorporated into the project’s TCP study. To the extent possible, available information from these ongoing TCP studies were utilized to inform the interpretations and recommendations of the City Center AIS research.

AIS research methods investigations (described below in this section) were carried out to inform this research design. The proposed research strategy includes the following roughly sequential steps:

AISP Preparation:

1) Conduct environmental, cultural, historical, and archaeological background research.
2) Development of an archaeological predictive model/summary of past finds based on background research.
3) Carry out investigations to evaluate appropriateness of potential investigation methods, techniques, and sampling strategies.
4) Overlay the project’s preliminary engineering plans on the predictive model.
5) Develop a preliminary subsurface sampling strategy based on the overlay.
6) Consult with Native Hawaiian Organizations (NHOs), community members, project engineers, and the City regarding the proposed AIS methods and subsurface sampling strategy.
7) Modify sampling strategy based on consultation comments.
8) Prepare draft AISP for the SHPD and community review and comment.
9) Prepare final AISP for SHPD approval based on comments received.

AIS Fieldwork and Laboratory Work:

10) Implement field survey/sampling strategy.
11) Augment/modify sampling strategy as needed to provide required cultural resource documentation and to facilitate avoidance of identified cultural resources.
12) Process collected samples and conduct laboratory studies on selected materials as the AIS fieldwork continues.

AIS Report Preparation and Consultation:

13) Through the PA's consultation protocol regarding treatment of any *iwi kūpuna* (burials/human skeletal remains) identified during the AIS fieldwork (PA Stipulation III.B.4)—disseminate information to cultural descendants and interested parties to facilitate burial treatment decisions.

14) Incorporate the results of the ongoing TCP studies into the write-up and interpretation of the AIS-identified archaeological cultural resources.

15) Coordinate with Kumu Pono Associates, the SRI Foundation, and HART so that documentation from the on-going AIS investigation is available to be incorporated into the ongoing TCP and historic context and cultural landscape studies.

16) Consult with NHOs, community members, interested individuals, and the City regarding the AIS results, including cultural resource significance, project effect, and mitigation recommendations.

17) Prepare draft AIS report for SHPD and community review.

18) Prepare final AIS report based on review comments received.

19) Disseminate copies of the final AIS report to interested consulting parties, the City, and per the requirements of HAR 13-275-5(e)(3) (with copies submitted to SHPD, University of Hawai'i at Mānoa's Hamilton Library Pacific Collection, Bishop Museum Library, University of Hawai‘i Hilo Library, Maui Community College Library, and Kaua‘i Community College Library).

The AISP was submitted to the SHPD for review and approval prior to the commencement of the AIS investigation. The AISP was accepted by SHPD on October 25, 2011 (Log No. 2011.2379, Doc. No. 1110NN08).

2.2 Research Focus

The AISP described an archaeological inventory survey investigation. The purpose was to identify archaeological cultural resources in the project APE, then document them sufficiently so that their significance could be assessed and the project's effect on these cultural resources could be evaluated. Based on the background research conducted as part of the AISP, this AIS investigation had the potential to inform on a wide range of archaeological topics, several of which are briefly summarized below:

1) Settlement Transect—The proposed AIS investigation is an opportunity to identify and document archaeological resources within a narrow but continuous transect through O‘ahu's densely populated coastal south shore. The results of the AIS investigation will likely inform on differences in the distribution of pre-Contact human settlement and activity across this broad area. Change related to post-Contact Western acculturation may be apparent in the distribution of archaeological site and feature types.

2) Ground Penetrating Radar (GPR) Utility—In general, GPR's use in archaeological research has become fairly well established over the last decade. In Hawai‘i, the technology has been somewhat slower to be utilized. The AIS investigation will provide a means to evaluate the GPR method's strengths and weaknesses in terms of archaeological research, particularly in fully developed urban landscapes.

3) Pre-Contact Landforms and Shorelines—The coastal location of the City Center portion of the HHCTCP has been subjected to intensive modification throughout the post-Contact period. The AIS investigation will provide direct data on pre- and post-Contact change to the landforms and shorelines. Potential AIS data collection could include the pre-Contact cultural landscape of shoreline fishponds, *lo‘i* (irrigated pond fields), and house lots, and the expansion of post-Contact fill lands for residential and commercial usage.
4) Human-Induced Environmental Change—Research into diachronic human-induced environmental change within the City Center portion of the HHCTCP would be augmented by the results of such research methods as pollen analysis, wood taxa identification, and Carbon 14 analysis.
5) Burials—One of the primary foci of the proposed AIS investigation will be the identification of burials (*iwi kūpuna*). The AIS would inform on distribution, age (pre- vs. post-Contact), and burial practices over time. Additionally, the AIS research would allow for evaluation of remote sensing methods, such as GPR, specific to burial finds.

2.3 Environmental, Cultural, Historical, and Archaeological Background Research

Background research for the AISP and additional research for the preparation of the AIS report included: a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawai‘i at Mānoa, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the *Waihona ‘Aina* database (<www.waihona.com>). LCA and Royal Patent records for the land areas immediately along the City Center corridor were copied from *Waihona ‘Aina* and the Hawai‘i State Archives; these records are included in Appendices A through E in Vol. III of this report.

This research provided the environmental, cultural, historic, and archaeological background for the study area. The sources studied were used to formulate a predictive model regarding the expected types and locations of cultural resources in the project area.

As noted previously, HART is currently working with the SRI Foundation and Kumu Pono Associates to produce a comprehensive ethnographic and ethnohistoric investigation of the HHCTCP project corridor and its environs. The results of this research, including historic research with Hawaiian language sources, place name and oral tradition research, and ethnographic interviews, will be available to augment the cultural and historical background sections of the City Center AIS report. This additional contextual information will inform the interpretations, significance evaluations, and mitigation recommendations of the archaeological cultural resources that will be the subject of the City Center AIS report.

2.4 GPR Methods Investigation for the City Center AISP Preparation

In 2010, as part of the City Center AISP preparation, at the request of CSH, TAG Research by Sturm, Inc. conducted a GPR methods investigation within select areas of Honolulu to test this

remote sensing technology’s efficacy in the identification and mapping of subsurface cultural deposits, including human burials (see Sturm 2010). This investigation sought to evaluate which antenna frequencies (270 MHz, 400 MHz, or 900 MHz), data collection parameters, and data processing procedures would be the most effective for potentially identifying and mapping subsurface cultural deposits within an urban setting dominated by extensive subsurface modifications including backfilled excavations, utility lines, and land filling.

GPR surveys were conducted at six locations: the Alapa`i Transit Center/Joint Traffic Management Center (ATC/JTMC), St. Augustine By-the-Sea Church, a portion of Halekauwila Street, the proposed location of the Civic Center Station, and two discrete areas at the Kaka‘ako Fire Station (Figure 11). The GPR survey areas within the proposed location of the Civic Center Station and Halekauwila Street are both situated within the project corridor. The remaining four survey areas had been previously investigated via subsurface testing and/or archaeological monitoring by CSH (Pammer et al. 2009; Pfeiffer et al. 1993; Yucha et al. 2011). During these prior archaeological investigations, subsurface cultural deposits, including human burials, were identified within stratigraphic contexts that are similar to those that are anticipated to be present within the project corridor. Thus, the four survey areas located outside the project corridor were investigated in an attempt to model how subsurface cultural deposits, including human burials, are recorded via GPR and then apply these models to GPR data collected within the project corridor. The results would address the efficacy of using GPR to identify the presence of subsurface cultural deposits, including human burials, prior to subsurface testing.

The results of the GPR methods investigation were promising, although with some constrictions and limitations. TAG Research was able to confirm the locations of known human burials within all of the survey areas in which burials were previously recorded. Burial pits were represented in GPR depth profiles as ephemeral hyperbolic reflections. These hyperbolic reflections were associated with stratigraphic irregularities caused by burial pit excavation (i.e., burial shafts and associated backfill material) rather than by the burials themselves (Sturm 2010), which was likely due to a number of factors, including the sediment mineralogy and deterioration of the burial and/or casket, if one was present. The hyperbolic reflections corresponding to the known locations of previously recorded burials were the only GPR anomalies that could be confidently determined to be associated with human burials.

Other subsurface features that were able to be identified and mapped via GPR were fill deposits and utility lines. In general, both of these features were represented in GPR imagery (i.e., depth profiles and amplitude slice maps) as high amplitude reflections of large size. Anomalies associated with utility lines were linear and tended to be narrower than the large amorphous masses associated with fill deposits.

These results led to the determination that “the overall potential for using the GPR method to map archaeological features and burials in this urban Honolulu setting is considered very good up to about 1.5 meters in depth” (Sturm 2010:35). Of note, however, were several limitations, including the inadequate resolution of GPR readings below 1.5 meters and the fact that the association of subsurface anomalies with possible burials could only be accomplished with

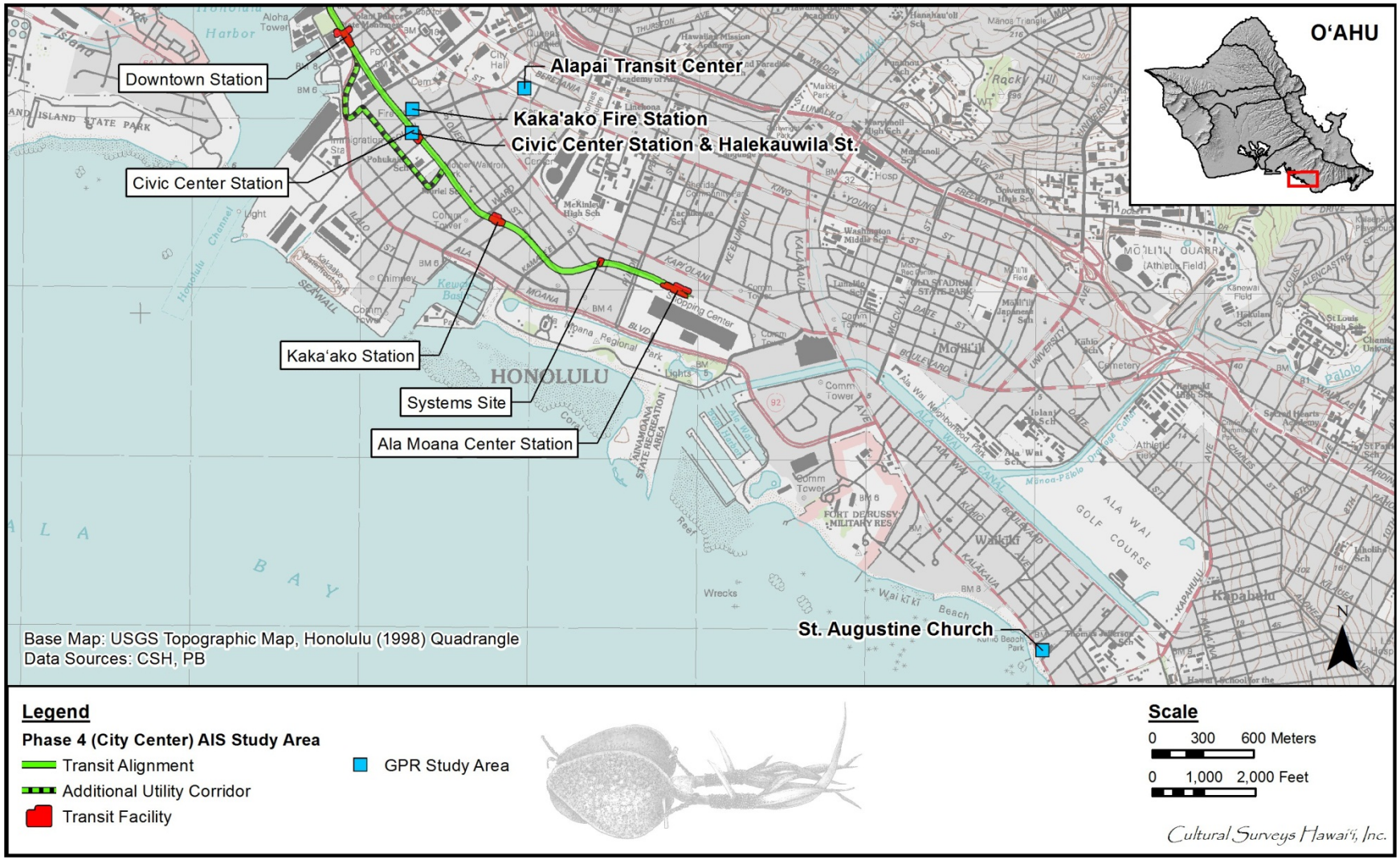

Figure 11. U.S.G.S. 7.5-Minute Series Topographic Map, Honolulu (1998) Quadrangle, showing the locations of GPR survey areas investigated as part of the AISP GPR Methods Investigation (reported in Hammatt et al. 2011)

confidence in areas where burials have already been confirmed to be present (i.e., through previous archaeological subsurface testing or historic land use research). One of the goals of this method’s investigation was to address the question of depth penetration and resolution in relation to various GPR antenna frequencies (270 MHz, 400 MHz, and 900 MHz). Based on the results of the GPR surveys, the 400 MHz antenna was determined to provide the best overall quality data, allowing high resolution mapping of target features of interest (including burials) to a depth of approximately 1 to 1.5 meters. While the 270 MHz antenna achieved the overall greatest depth at each location surveyed, it was unable to provide adequate resolution to target features of interest, including burials. Conversely, the 900 MHz antenna provided the best resolution of subsurface features but was limited to an average depth penetration of half a meter, which in a majority of Honolulu is a stratigraphic zone dominated by imported fill deposits.

Recommended data collection parameters for conducting future GPR surveys within the project corridor include conducting surveys within wider areas or blocks, as opposed to single narrow transects, using a transect spacing of 50 centimeters (cm) or less, and having a high number of scans per meter (e.g., 40). All of these factors will ensure the collection of high-resolution data and subsequent mapping of potential archaeological features of interest, which are typically small or subtle and could be easily missed by using wide transect spacing or coarser resolution collection (Sturm 2010:36).

Recommended GPR data post-processing involves the creation of GPR reflection profiles and amplitude slice maps for the analysis of collected data. Reflection profiles illustrate the shape, geometry, and depth of the radar reflections recorded during data collection. An analysis of these profiles can determine whether radar energy is reflecting from a flat stratigraphic layer (seen as a distinct horizontal band), from a discrete buried object (seen as a hyperbola), or from stratigraphic irregularities such as subsurface disturbances associated with utility installation or human interment (also seen as hyperbolas, but usually are more ephemeral and consist of clustered reflections).

Amplitude slice maps are a three-dimensional tool for viewing differences in radar reflection amplitudes across a given surface at various depths. Amplitude slice maps can be thought of as plan view maps or excavation level records that display GPR data at user-defined depth intervals. Reflected radar amplitudes are of interest because they measure the degree of physical and chemical differences in buried materials, which in turn can indicate the presence of stratigraphic interfaces, discrete buried objects (e.g., basalt boulders, utility lines, burial caskets, etc.), or stratigraphic irregularities (i.e., subsurface anomalies associated with burial pits, fire pits, buried irrigation ditches, etc.). Amplitude slice maps are important because they allow the visulization of radar reflections throughout the entire dataset collected at a survey area at a given depth. This gives size and shape to collected radar reflections, which can aid in the interpretation of identified subsurface anomalies.

Finally, while this GPR methods investigation was successful at mapping many features of interest, including several previously recorded burials, many of the feature interpretations were based on knowledge gained from previous archaeological investigations that involved extensive background research and subsurface testing. It is thus recommended that future GPR surveys be correlated with site-specific historic research and subsurface testing (i.e., excavation) wherever possible (Sturm 2010:29, 36).

2.5 Consultation

Following the project’s PA requirements (Stipulation III. B. and C.) and the AIS requirements of HAR 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 the City consulted frequently with the O‘ahu Island Burial Council (OIBC) and 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 (late 2012 and early 2013) CSH met twice monthly with SHPD to discuss the progress and results of the AIS investigations for City Center. During these 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 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, CSH presented updates of the City Center AIS investigation at several public meetings (November 8 and 27, 2012, and December 17, 2012, February 7, 2013, and March 11, 2013) arranged to consult with, and seek treatment preferences from, potential lineal or cultural descendants to the human skeletal remains identified in the City Center AIS. Section 5 describes consultation results.

2.6 Field Methods

In general, fieldwork included 100 percent pedestrian inspection of the study area; global positioning system (GPS) data collection; GPR survey; and subsurface testing. All areas selected for subsurface testing were surveyed with a Geophysical Survey Systems, Inc. SIR-3000 GPR unit equipped with a 400 MHz antenna. The subsurface testing program was backhoe-assisted. In general, linear trenches measuring approximately 3 m or 6 m (10 ft / 20 ft) long and 0.6 or 0.9 m (2 ft / 3 ft) wide were 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 were proposed, with the potential for additional testing to refine the boundaries of subsurface deposits. In total, 250 test excavations and seven test cores were completed by the end of the City Center (Section 4) AIS. Field results are variously described in this Volume I (pedestrian inspection, Section 4), Volume IVA-D (excavation summaries), and Volume VIA and B (GPR survey).

2.6.1 Personnel and Scheduling

City Center AIS fieldwork proceeded under the direction of CSH principal investigators Matt McDermott, M.A., and Hallett H. Hammatt, Ph.D. A field crew of eight to fourteen archaeologists, including two field directors, three osteologists, two GPS/GIS specialists, and two GPR specialists, completed the AIS investigation under the direction of the principal investigators.

2.6.2 Pedestrian Survey

Pedestrian inspection of the study area was completed at 100 percent coverage, including all areas of project related ground disturbance, which consisted of the different components of project related ground disturbance listed in Table 1. The pedestrian inspection was generally accomplished through systematic sweeps. As the study area is generally located in the median or shoulder of existing roadways, archaeologists traversed the medians and shoulders of the active thoroughfare.

2.6.3 GPR Survey

GPR use is specifically dictated in the HHCTCP PA and was requested by the overwhelming majority of Native Hawaiian cultural consultants (Native Hawaiian Organizations and indivituals) that gave input on the development of this AISP. The GPR focus evaluated the GPR effectiveness, and strove to make observations that could at least, and potentially improve GPR effectiveness through “ground truthing” (comparison of GPR results with actual excavation results).

All areas selected for subsurface testing were surveyed with GPR prior to excavation. GPR field data were post-processed and used to inform the subsurface testing results. The GPR survey was performed using a Geophysical Survey Systems, Inc. (GSSI) SIR-3000 system equipped with a 400 MHz antenna. This is a bistatic system in which electromagnetic energy in the radar frequency range is transmitted into the ground via a sending antenna. Radar energy is reflected off of the subsurface matrix and is then received by a paired antenna. Reflected energy is sampled and the travel time (in nanoseconds) of the reflected waves is recorded. Wave propagation speed varies depending on the nature of the subsurface medium. Any changes in density or electromagnetic properties within the stratigraphic column may cause observable variations in reflection intensity. Reflection features may include discrete objects, stratigraphic layering, or other subsurface anomalies.

The GPR survey was conducted in blocks centered on the subsurface testing area. The GPR survey results generated two-dimensional (2D) depth profiles in order to prospect for subsurface anomalies and stratigraphic interfaces prior to excavation, as these could correspond to isolated archaeological features or sediments that are more likely to contain cultural deposits. Following the completion of subsurface testing, the documented stratigraphy was referenced against the GPR profiles to establish if there were patterns in the GPR data that may be associated with stratigraphic interfaces, sediment types, and subsurface features (e.g., trash pits, or construction debris).

The GPR survey was also conducted to assess the ability of GPR in determining stratigraphy and locating cultural deposits in the study area (i.e., urban Honolulu). The effectiveness of GPR is highly dependent on local soil conditions. The high signal attenuation rate of many soil types restricts the depth of radar penetration and therefore limits the effectiveness of GPR surveys. The National Resource Conservation Service (NRCS) produced maps indicating the relative suitability of GPR applications throughout the U.S. based on U.S. Department of Agriculture (USDA) soil survey data. Figure 12 shows the study area on the NRCS GPR Suitability Map for

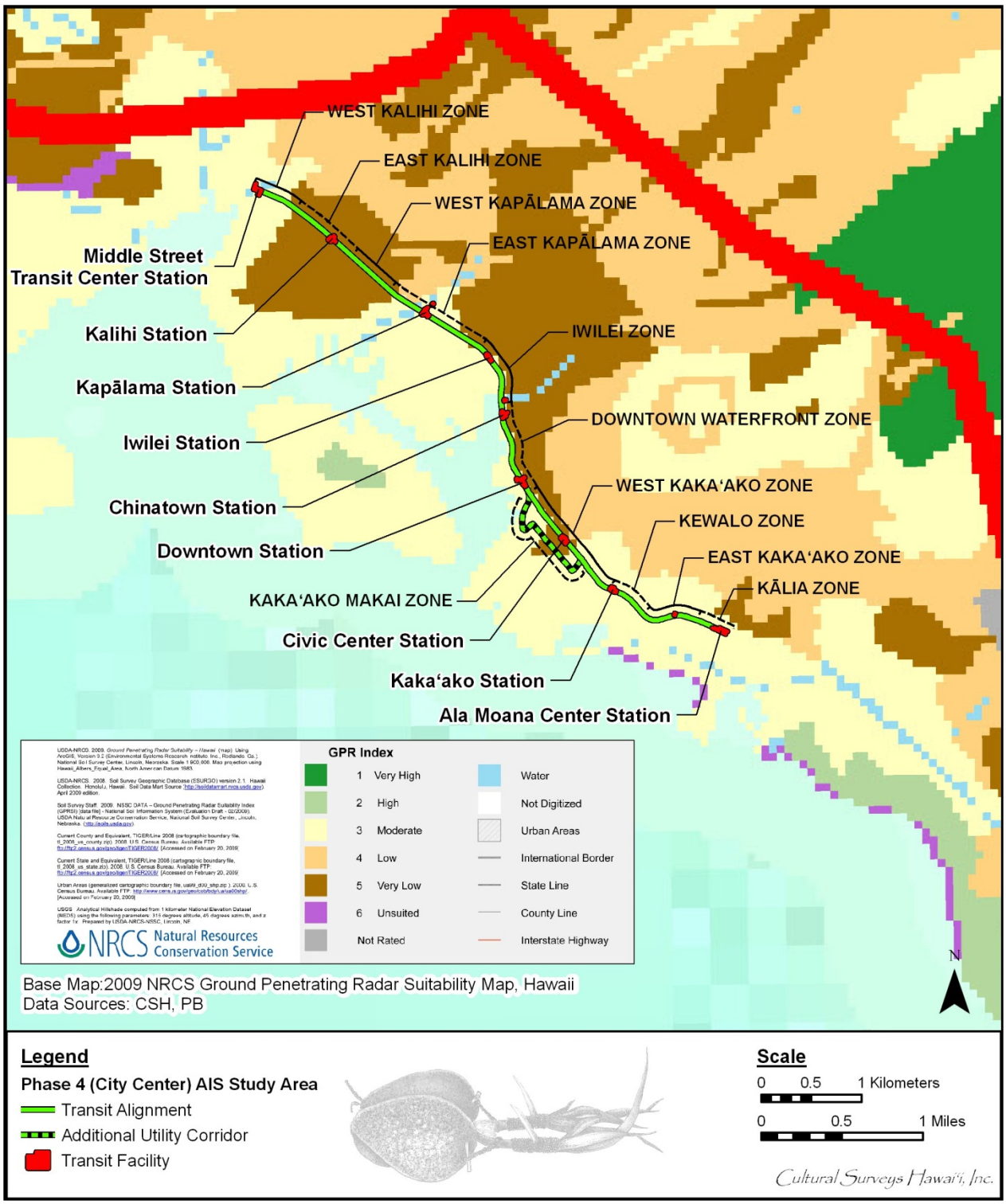

Figure 12. NRCS GPR Suitability Map for Hawai‘i showing the City Center AIS study area

Hawai‘i. The project area is shown to traverse lands in the moderate (“#3”) and very low (“#5”) suitability categories

2.6.4 Test Excavation Methods

The subsurface testing program was assisted by the use of backhoes and track excavators (Figure 13). The testing program included sampling portions of all areas of direct project-related ground disturbance, including the different components of project related ground disturbance listed in Table 1 (See Section 3, below, for more details). In general, linear trenches measuring approximately 3 m or 6 m (10 ft or 20 ft) in length and 0.6 or 0.9 m (2 ft or 3 ft) in width were excavated within the project footprint (based on preliminary engineering) at selected station locations, guideway column locations, and utility relocation areas. To the extent feasible, test trenches were excavated at the precise location of the proposed guideway column foundations, utility relocation areas, or station footprint, as currently shown on the project’s preliminary engineering plans; however, it is clear that considerable conflicts existed between the AIS testing locations and existing subsurface utilities. In cases where subsurface testing at the precise location of the proposed guideway column foundation/utility relocation area were exceedingly problematic due to existing subsurface utilities or other constraints, an alternate test area was selected, or the test excavation was slightly offset from the column foundation location. Excavations were made to depths of culturally sterile sediments, bedrock, or the water table.

The testing program also focused on characterizing the remnants of the project area’s buried natural land surface that predates the historic and modern fill layers. These remnants of the former land surface are more likely to be associated with significant cultural deposits. In general trenches were excavated to expose archaeological deposits and discrete features in profile in the backhoe trench sidewalls, where they could be photographed, drawn, inspected, and sampled. The excavation methods are typical for archaeological excavations in fully developed urban environments. They are felt to be a reasonable balance between archaeology’s inherent destructiveness and the need to fairly rapidly assess the potential for significant subsurface deposits over a wide geographic area. The exception to this are sand deposits that are more likely to contain human skeletal remains/burials, see discussion below. These sand deposits were excavated by hand (shovel and trowel).

CSH personnel closely monitored all backhoe excavation activity. Archaeologists watched as the backhoe excavated at a variable pace (with excavation speed reduced in sediments more likely to contain archaeological deposits), as well as inspected the sediment as it was removed from the ground and deposited into a backfill pile adjacent to the excavated trench. A standard backhoe with a 2-foot-wide bucket was used to excavate, at a minimum, portions of each trench. Working within safety constraints, and based on the type of sediments exposed, the archaeological crew members stopped mechanized excavation to enter the trench to clean off the trench sidewalls and base to inspect for cultural deposits.

The mechanized excavation extended through the fill layers to any underlying natural deposits (i.e., naturally-deposited sand layers, not imported land reclamation or construction fill layers). In non-sand deposits, mechanized excavation continued through these natural sediments until the water table or culturally sterile sediments were found. Where appropriate and feasible, archaeological features and/or deposits exposed in plan view during the mechanized excavation of the trench were documented in plan view and excavated by hand. The feasibility of this plan

Figure 13. Photograph of typical track excavator-assisted test excavation in progress (Test Excavation 227B at corner of Punchbowl and Pohukaina Steets).

view documentation and hand excavation was dictated by: 1) whether or not the feature/deposit was exposed in plan view in the trench profile; 2) the type of sediment the feature/deposit was in (for example sediments comprised of large amounts of rubble were not hand excavated); and 3) the size of the feature, for example massive trash pits were not hand excavated.

These limitations to hand excavation in non-sand deposits were applied particularly to the initial 232 test trenches that were planned as the initial sampling design. Where additional test trenches were excavated in the vicinity of a trench where cultural resources were documented, hand excavation was utilized to a greater extent to provide the best possible documentation of the cultural deposits in that area, and to better define the geographic extent of those cultural deposits.

Natural sand deposits are more likely to contain human skeletal remains and burials. When natural sand deposits were encountered, mechanized excavation was stopped and excavation continued by hand until culturally sterile sediments or the water table were reached. During hand excavation, the sand was carefully scraped off in thin layers in order to reduce disturbance to possible cultural deposits or human burials. During hand excavation through sand deposits, the backhoe assisted with the removal of already hand-excavated sediments from the trench. For example, if the archaeologists threw the hand-excavated sand into one corner of the trench, the backhoe removed this already excavated sand from the trench.

Each test excavation was documented with a scale section profile, photographs, and sediment descriptions, and located using a Trimble ProXH mapping-grade GPS unit (sub-foot accuracy). Sediment descriptions, using standard USDA soil description observations/terminology, included the following elements: Munsell color designations; texture; consistency; structure; plasticity; cementation; origin of sediments; descriptions of any inclusions, such as cultural material and/or roots; lower boundary distinctiveness and topography; and other general observations.

If human skeletal remains were encountered during subsurface testing, no further work took place in the vicinity of the find, including no screening of back dirt, no cleaning and/or excavation of the burial area, and no exploratory work of any kind, unless specifically requested by the SHPD. All human skeletal remains encountered during the AIS fieldwork were handled in compliance with HRS 6E-43 and HAR 13-300 and in consultation with the SHPD. A burial consultation protocol further refined the processes and protocols that were implemented once the identification of human skeletal remains was made.

2.6.5 Geotechnical Core Methods

The subsurface testing program was supplemented by excavation and documentation of seven geotechnical cores. These cores were drilled/extracted under archaeological supervision, with the archaeologist recording core depths, depths of stratigraphic boundaries, and collecting samples of distinct strata. Geotechnical cores were conducted to determine if A-horizons/culturally modified sediments, natural organic peaty sediments, and/or estuary sediments could be accurately identified through coring and if so, would coring would be a viable alternative to trenching in areas affected by safety issues. Through the coring, sediment samples were collected from immediately adjacent test excavations, and the results from the cores were compared to the results of the nearby test excavations. Coring results indicated that natural sediments and their contents could be identified, and that the coring program was an effective supplement to the more traditional test excavations.

A truck mounted coring rig was used. The coring process itself consisted of drilling through the initial 0 to 0.9 m of pavement, base course, and known fill strata with a 4-in (0.1 m) diameter drill bit. The depth of the fill layers were known based on the results of the immediately adjacent test excavations. No core sediment samples were collected from the initial 0 to 0.9 m below surface that were drilled through pavement and fill. Below the fill sediments, a 3.5-in (0.9 m) diameter split tube sampler was driven into the sediment by the repeated percussion of the drive weight. The split tube collected cores in 12 inch (0.30 m) thick “lifts.” These core samples were inspected by the archaeologists, their stratigraphic information was recorded, and the samples were collected. All cores extend beneath the water table, which was readily apparent in the core shafts. All sediment samples (the 0.3 m thick lifts) were photographed in the field with a scale. Sediments within each core lift were placed end to end to create a continuous core. Sediments were differentiated into individual strata based on color, texture, and content. Samples of each stratum was placed into plastic bags and labeled with the field information pertinent to each strata and coring sample.

2.6.6 Sampling

Sampling of subsurface cultural layers and/or A-horizons were carried out to characterize the cultural content of these layers. Sampling also helped to establish geographic boundaries for the layers and the general time frame of their deposition (prehistoric/traditional Hawaiian and/or historic and/or modern). The sampling was undertaken on both pit features associated within stratigraphic layer and sample areas taken from the portion of the stratigraphic layer that were not part of a particular cultural feature. The distinction between samples from pit features and samples from sample areas reflected the difference in cultural material content between sediment from specific events, such as the excavation and use of a pit, and the more general accumulation of sediment as part of a culturally enriched stratigraphic layer.

The samples from pit features and sample areas were excavated out of the sidewall or from the base of the excavation into 5 gallon buckets. The sediments then were screened through 1/8-inch wire mesh and all cultural materials was collected, bagged by provenience, and taken to the CSH laboratory. During the collection of cultural materials from the screen, careful attention was made to distinguish between water-rounded, bleached, natural marine, sedimentary shell, and the unbleached, un-rounded, often relatively freshly-broken shell derived from human activity. The volume of each screened sample was recorded so that comparisons could be made between samples.

Where appropriate, column sediment samples of discrete strata, or series of strata, were taken directly from the cleaned sidewall of the trench. Depending on the type of sediment sampled and the analytic purpose of the column samples collected, column samples were collected in 5, 10, or 20 cm depth intervals. For example, column samples from low energy alluvial sediments that may inform on environmental conditions and environmental change were collected at 5 cm intervals. These samples could be used for radiocarbon dating, pollen analysis, and micro charcoal particle quantification.

Where additional documentation of a particular sediment was desired, bulk sediment samples of 1 to 5 liters were collected from the cleaned sidewall of the trench for further analysis in the laboratory. These samples were used to better characterize a sediment and for further analysis, including wet screening through 1/16-inch mesh to better inspect the sediment’s contents. All

sediment sample collection locations from trench sidewalls were recorded on trench profiles, planviews or from the backhoe bucket (when necessary, due to safety protocol) and the sediment samples were labeled with provenience information.

Background research indicates the likelihood of encountering historic trash pits, privies, and other historic pit features in the AIS trenches. These types of historic features typically contain substantial numbers of individual artifacts, ranging from building materials, metal fragments, household refuse, and industrial refuse, including brick, stone, wood, glass, metal, ceramic, bone, and plastic. Documentation of these generally artifact-rich features focused on recording feature dimensions and locations so that their distribution could be considered in relation to historic land use of the study area and vicinity. Recordation also focused on collecting sufficient information to characterize age, duration of use, and function (e.g., residential versus commercial or industrial refuse disposal). The collection of historic artifacts was limited to diagnostic and/or interpretive items, or items that could not be readily identified in the field and thus required further analysis in the laboratory. Redundant diagnostic historic artifacts from the same feature were documented with written descriptions, but not collected. Generally, non-diagnostic glass, metal, wood, stone, plastic, and ceramic fragments were not collected. When new classes of artifacts or other archaeological material were found, then appropriate collections of these materials were made for laboratory analysis. This grab sampling method focused on recovering qualitative data for dating and interpretative purposes.

2.6.7 Photography

Photographs were taken of the general project area and in-progress work; recording on-the-job procedures, personnel, work conditions, and the area’s natural and/or built environment. Additionally, all subsurface features, cultural layers, profiles, and samples of artifacts were photographed. A photographic scale and north arrow, as appropriate, is included in each photograph. Human skeletal remains were not photographed.

2.6.8 Cultural Monitoring

During the cultural consultation with Native Hawaiian Organizations, individuals, and community members that were part of the preparation of the AISP, several cultural consultants (Native Hawaiian Organizations and individuals) recommended that the City have a program of Native Hawaiian cultural monitors to oversee the City Center AIS fieldwork. The City actively worked with the Native Hawaiian Community to develop an appropriate cultural monitoring program. CSH has a long history of working with cultural monitors and completed the City Center AIS fieldwork under the cultural monitoring program that was established and implemented by HART and the Native Hawaiian Community. The cultural monitoring program is described in the Consultation Section, Section 5 of this volume.

2.7 Laboratory Methods

Materials collected during AIS fieldwork were identified and catalogued at CSH’s laboratory facilities on O‘ahu. Analysis of collected materials was undertaken using standard archaeological laboratory techniques. Artifacts were washed, sorted, measured, weighed, described, photographed, and catalogued. In general, artifact analysis focused on establishing, to the greatest extent possible, material type, function, cultural affiliation, and/or age of manufacture. Diagnostic (dateable) attributes of artifacts were researched.

2.7.1 Traditional Hawaiian Artifacts

Traditional Hawaiian artifactual material was identified, and forms and functions determined using standard reference material (e.g., Barrera and Kirch 1973; Brigham 1974; Buck 2003; and Emory et al. 1968).

2.7.2 Historic Artifacts

Historic artifacts were identified using standard reference materials and resources available on the internet (e.g., Elliott and Gould 1988; Fike 1987; Kovel and Kovel 1986; Lehner 1988; Lindsey 2010; Lockhart 2004–2010; Millar 1988; Toulouse 1971; Whitten 2009; and Zumwalt 1980). Analyzed materials were tabulated into chart form and a master catalogue is presented within the AIS report. As noted above, the results of the historic artifact analysis were used to better characterize the age, function, and potentially the cultural affiliation of the associated archaeological deposits and/or features.

2.7.3 Bulk Sediment Samples

The AIS identified and characterized archaeological resources found. Detailed sample analyses and the results from processing bulk sediment samples, are established within the AIS laboratory methods. For example, identifying buried former agricultural sediments and/or wetland sediments that may hold important paleoenvironmental information. To provide additional information on the content of selected sediments, the collected bulk sediment samples (varying from 1 to 5 liters) were wet screened through 1/16-inch mesh. The remnants were dried and inspected for faunal, floral, and artifact remains. These results were included in the description of the sediment. (As multiple bulk sediment samples were collected from the same stratum or feature of a test trench, some redundant samples were not wet screened and analyzed if further investigation was not warranted.)

2.7.4 Vertebrate Material

Non-human skeletal material was identified to the lowest possible taxa at the CSH laboratory using an in-house comparative collection and reference texts (e.g., Olsen 1964; Schmid 1972; and Sisson 1953). Additionally, the Osteidhyes and mammalian reference collections of the Bernice Pauahi Bishop Museum were utilized. Secondary identifications of the vertebrate material were conducted by an outside expert in faunal analysis (Dr. Sara Collins, Lead Archaeologist from Pacific Consulting Services, Inc.).

2.7.5 Invertebrate Material

Invertebrate remains were identified to the lowest possible taxa, weighed, and analyzed. Common marine shells were identified and analyzed at the CSH laboratory using an in-house comparative collection and reference texts (e.g., Abbott and Dance 1990; Eisenberg 1981; Kay 1979; and Titcomb 1979). A sample of non-marine mollusks was sent to an outside expert (Dr. Carl C. Christensen) for identification and analysis; his report is included in Volume V.

2.7.6 Wood Taxa Identification

Appropriate charcoal samples were prepared, weighed, and submitted for species identification. Samples were sent to the International Archaeological Research Institute, Inc. (IARII) for taxa identification. The samples were viewed under magnification of a dissecting microscope and then compared with anatomical characteristics of known woods in the Pacific

Islands Wood Collection at the Department of Botany, University of Hawai‘i at Mānoa, as well as published descriptions. Taxa identification of wood samples provides useful information for interpreting the environmental and cultural history of the project area and helps determine a general time frame of land use. Analysis by IARII also identified short-lived plant species, which were used for radiocarbon dating. Following analysis, artifacts were returned to the CSH laboratory.

2.7.7 Radiocarbon Dating

Charcoal samples from short-lived plant species were submitted to Beta Analytic, Inc. of Miami, Florida, for radiocarbon dating analysis. The samples were analyzed using the Accelerator Mass Spectrometer method. The conventional radiocarbon age determined by Beta Analytic, Inc. was calibrated to calendar ages using the OxCal calibration program, Version 4.1, developed by the University of Oxford Radiocarbon Accelerator Unit and available as share-ware over the internet.

2.7.8 EDXRF Analysis

Energy-Dispersive X-Ray Fluorescence (EDXRF) analysis provides informative results on lithic sourcing. It is non-destructive and inexpensive. The information obtained helps characterize archaeological deposits and can help develop research questions for subsequent additional investigation and/or data recovery.

Samples were sent to Dr. Peter Mills at the X-Ray Fluorescence (XRF) Laboratory at the University of Hawai‘i at Hilo for EDXRF analysis. EDXRF analysis is an effective way to determine elemental composition of archaeological material, and in some instances the origin of the material can be determined. X-ray spectrometry emissions produce an energy spectrum that is observable as peaks of high and low concentrations of trace elements. These trace elements are measured as value ranges. These value ranges are compared to other known value sets and to a constant geological standard (BHVO-2) used as the control sample. Samples are analyzed non-destructively with an accuracy of less than 1 percent of relative error and comparable reproducibility (Shackley 2010). Following analysis, artifacts were returned to the CSH laboratory.

2.7.9 Pollen/Micro Charcoal Particle Analysis

Palynology is the branch of science concerned with the study of pollen, spores, phytoliths, and other palynomorphs. Palynomorphs are often preserved in sediment samples and, following physical and chemical extraction, can be identified using light microscopy. This information can potentially identify the types of plants that made up the local environment, or the local watershed, at the time the sediment was deposited. A large amount of palynological research has been conducted on O‘ahu to examine human impacts on native vegetation. Micro charcoal particle quantification will accompany the palynological work. The size and amount of these charcoal particles within a sediment sample can inform on the level of human activity in the vicinity at the time the sediment was deposited. CSH submitted samples to Paleo Research Institute, Inc. for pollen analysis/micro charcoal particle quantification to facilitate paleoenvironmental reconstruction. Samples for these analyses were selected from the collected bulk sediment and sediment column samples that were collected from AIS trenches.

2.8 AIS Report

2.8.1 Report Contents

The AIS report includes the following:

a. A project description (Vol. I, Section 1).

b. A section of a U.S. Geological Survey topographic map showing the study area boundaries and the location of all recorded cultural resources (Vol. I, Section 4).

c. Historical and archaeological background sections summarizing pre-Contact and post-Contact land use of the study area and its vicinity (Vol. II and III).

d. Descriptions of each geographic zone followed by the test excavation results, including selected photographs and scale drawings, and discussions of stratigraphy, contents, and context (Vol. IVA through IVD).

e. Discussion of the laboratory results, including a summary of the traditional Hawaiian and historic artifacts, energy-dispersive X-ray (EDXRF) analysis, faunal analysis, non-marine mollusks analysis, wood taxa identification, radio carbon dating, and pollen analysis (Vol. V).

f. Descriptions of all cultural resources, including selected photographs and scale drawings, and discussions of age, function, laboratory results, and significance (Vol. I, Section 4).

g. Discussion of the ground penetrating radar methods and results (Vol. VIA and VIB)

h. A section concerning cultural consultations (per the requirements of HAR §13-276-5[g] and HAR §13-275/284-8[a][2]) (Vol. I, Section 5).

i. A summary of cultural resource categories, integrity, and significance based upon the Hawai‘i and National Register evaluation criteria (Vol. I, Section 7).

j. A project effect recommendation (Vol. I, Section 8).

k. Treatment recommendations to mitigate the project’s potential effect on any cultural resources identified in the study area that are recommended eligible to the National/Hawai‘i Registers of Historic Places (Vol. I, Section 8).

2.8.2 Cultural Resource Numbers and Feature Designations

In consultation with the SHPD, CSH assigned SIHP numbers to archaeological cultural resources observed during the AIS. This included documenting previously unrecorded sites/features and assigning them new SIHP numbers as well as documenting additional features of previously existing cultural resources (to which an SIHP number has already been assigned).

Figures for this report were created using CSH’s GIS data base. In this database the last digits of all SIHP numbers are expressed in five digits rather than four. For example, SIHP #50-80-14-7425 in CSH’s GIS data based is expressed as “50-80-14-07425.” Accordingly, in the figures created for this document the last digits of all SIHP numbers consist of five, not four, digits. In text SIHP numbers are written with four last digits.

Different features were included within the same archaeological site based on several considerations, including: 1) general geographic proximity (features closer together are more likely to be included within the same site number than those farther apart); 2) similarity of features; and/or 3) interrelatedness of features (e.g., subsurface features of a continuous subsurface cultural layer). Horizontal boundaries of cultural resources were documented to the extent possible.

2.8.3 Cultural Resource Significance Assessments

To be considered eligible for listing on the Hawai‘i and/or National Register of Historic Places a cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following broad cultural/historic significance criteria: “A” reflects major trends or events in the history of the state or nation; “B” is associated with the lives of persons significant in our past; “C” is an excellent example of a site type/work of a master; “D” has yielded or may be likely to yield information important in prehistory or history; and “E” (Hawai‘i Register only) has traditional cultural significance to an ethnic group, which includes religious structures, traditional cultural properties, and/or burials. For this AIS investigation, cultural resource integrity and significance was assessed based on the guidance provided in National Register Bulletin # 15, “How to Apply the National Register Criteria for Evaluation.” Cultural resource integrity and significance assessments were developed in consultation with SHPD.

2.8.4 Review of Place Names, *Wahi Pana* (Storied Places), and Traditional Cultural Property Data During Archaeological Cultural Resource Interpretation and Significance Assessment

While City Center AIS investigation focused on the identification and assessment of archaeological cultural resources, it was important that the interpretation and significance assessments of these resources take into account information from available cultural studies. Particularly important was consideration of the project-related cultural investigations carried out in fulfillment of the project’s PA (Stipulation II “Traditional Cultural Properties”).

To fulfill these PA requirements, the City hired SRI Foundation and Kumu Pono Associates to produce comprehensive ethnographic and ethnohistoric investigations of the HHCTCP project corridor and its environs. These studies, including historic research with Hawaiian-language sources, place name and oral tradition research, and ethnographic interviews, supported and were incorporated into the project’s traditional cultural property (TCP) study (Hammatt et al. 2011:173).

In order to further inform this City Center AIS, CSH was supplied with a working draft of Kumu Pono Associates’ *He Mo‘olelo ‘Āina—Traditions and Storied Places in the District of Kona—Honolulu Region (Lands of Kalihi to Waikīkī), Island of O‘ahu: A Traditional Cultural Properties Study—Technical Report* (Maly and Maly January 28, 2013) along with the following three draft Appendices:

- Appendix A: *Historical Accounts of the Honolulu Region—A Hawaiian Community and Kingdom in Transition*,
- Appendix B: *The Māhele ‘Āina, Royal Patent Grants & Overview of Land Use and Tenure*, and
- Appendix C: *Boundary Commission Proceedings and Survey Records*.

The Maly and Maly (January 28, 2013) working draft is a large and rich compendium of data and the reader is referred directly to that study (as well as Volume II of the present study) for details regarding the cultural history of the entire HHCTCP route and the surrounding areas. The Maly and Maly (January 28, 2013) working draft was studied in the preparation of this AIS report and its results were compared with the AIS results. Although of limited direct applicability to the specific archaeological cultural resources observed in the City Center AIS study area, the results of the Maly and Maly (January 28, 2013) study were considered in the interpretation and significance assessment of the identified archaeological cultural resources.