Section 4 Summary

The primary focus of this 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 from urban development. The results of this study suggests that it is very difficult to determine the difference between signal reflections caused by significant discrete objects or reflections caused by historic disturbance, subsurface infrastructure (utilities, old foundations, etc.), and imported fill layers. However, it should be noted that Section 4 test excavations contained very few culturally significant discrete objects large enough to detect with the GPR equipment. As mentioned in the Interpretation and Results section, a buried stone and mortar wall was observed in T-119 and T-119A and a privy was located in T-202. Unfortunately the GPR was not able to clearly resolve these objects. The privy was beyond the range of clean signal return and the stone and mortar walls were only partially in range and located under a concrete slab. 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 development is needed to increase the reliability of GPR as a tool for discrete object detection in urban fill environments, particularly within the Section 3 and Section 4 project areas.

This study was able to demonstrate that GPR can be a useful tool to map subsurface stratigraphy. By comparing the GPR 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 was within 0.25 mbs of the reflected signal transition observed in the GPR profiles. This information can be important when looking for stratigraphic transitions that represent the boundary between fill layers and naturally deposited layers. The number of stratigraphic transitions observed in a GPR profile also provides analysis that 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 the GPR to determine stratigraphic transitions is limited to the depth of clean signal return. In the Section 4 project area many of the naturally deposited sediments were located below the depth of clean signal return (approximately 0.75 mbs–1.0mbs). It is for this reason that using GPR in the Section 4 project area to locate stratigraphic transitions as a way to determine the probability of encountering naturally deposited sediments had limited results.

The GPR was also tested for its ability to approximate subsurface sediment material in a non-invasive way. This study found that the GPR is capable of determining sediment material based on signal reflectivity and topography (signal texture). Analysis requires that the sediment layer is at least 0.25 m thick and within the range of clean signal return. Figures displaying representative signal textures are located in the Interpretation and Results section and in the Geographic Zone sections of the excavation by excavation results. Clear patterns in signal

texture were consistent in both Section 3 and Section 4 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 Section 4 project area, results were limited. This corroborates with 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 though they were rarely within the “visible” range of the GPR). Discrete objects were located with less than 50 percent accuracy in the Section 4 project area. The greatest potential use of GPR in this area is 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 mbs–1.0 mbs for Section 4). 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 Section 4 project area

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