Smithsonian Castle Cornerstone Survey Report

1.0 Introduction

Atkinson-Noland & Associates (ANA) was on site at the Smithsonian Castle in Washington, DC to conduct a nondestructive investigation of select masonry walls at the East Wing. The objective of the investigation was to locate, if possible, a metal time capsule(s) thought to be buried in one of the masonry walls of the building. The scope of the investigation was based on a document titled "SOW SIB cornerstone" provided by the Client on April 7, 2022, and correspondence between the Smithsonian Institution and ANA.

The nondestructive investigation utilized surface penetrating radar (SPR), a magnetic locator, and a fiber-optic videoscope to search for the metal time capsule. Torin McCue of ANA was on site on April 19th, 2022, for the investigation.

2.0 Surface Penetrating Radar Methodology

A Proceq broadband (400 to 6000 MHz) GP8000 radar antenna and a GSSI SIR-3000 radar unit with a 900 MHz antenna were used to conduct the surface penetrating radar scanning. The SPR method involves the transmission of high frequency electromagnetic radio (radar) pulses into the object of interest and measuring the time elapsed between transmission, reflection off a buried discontinuity, and reception back at the surface radar antenna. A pulse of radar energy is generated on a dipole-transmitting antenna that is placed on the surface of the wall. The resulting wave of electromagnetic energy propagates into the material and portions of it are reflected to the antenna at discontinuities. The discontinuities where reflections occur are created by changes in dielectric properties of the underlying material. Void spaces, metal presence, and any distinct change in material will generate significant radar reflections due to a change in radar wave velocity at the interface.

Two radar systems were used because the GSSI system with a 900 MHz antenna has a deeper scanning range but limited resolution, whereas the Proceq GP8000 system has limited range but higher resolution. The two used interchangeably allowed for full-depth scans through the approximately 46" thick masonry walls while also getting great resolution.

While on site, approximately one hundred and eighty (180) SPR scans were collected in both horizontal and vertical orientations, collected from interior and exterior sides of the wall. All interior scans were collected at the basement level for the full height of the wall at that level, typically spaced 6" on center. All exterior scans were collected at the first floor from exterior grade level up to approximately 7'-6" above grade, with scans typically spaced 6" to 12" on center. Figure 1 and Figure 2 show the scan areas overlaid on plan views of the basement and 1st floor levels. The background drawings are provided by others. Figure 3 shows a typical SPR scan being collected with the 900 MHz antenna at the northeast corner of the East Wing.

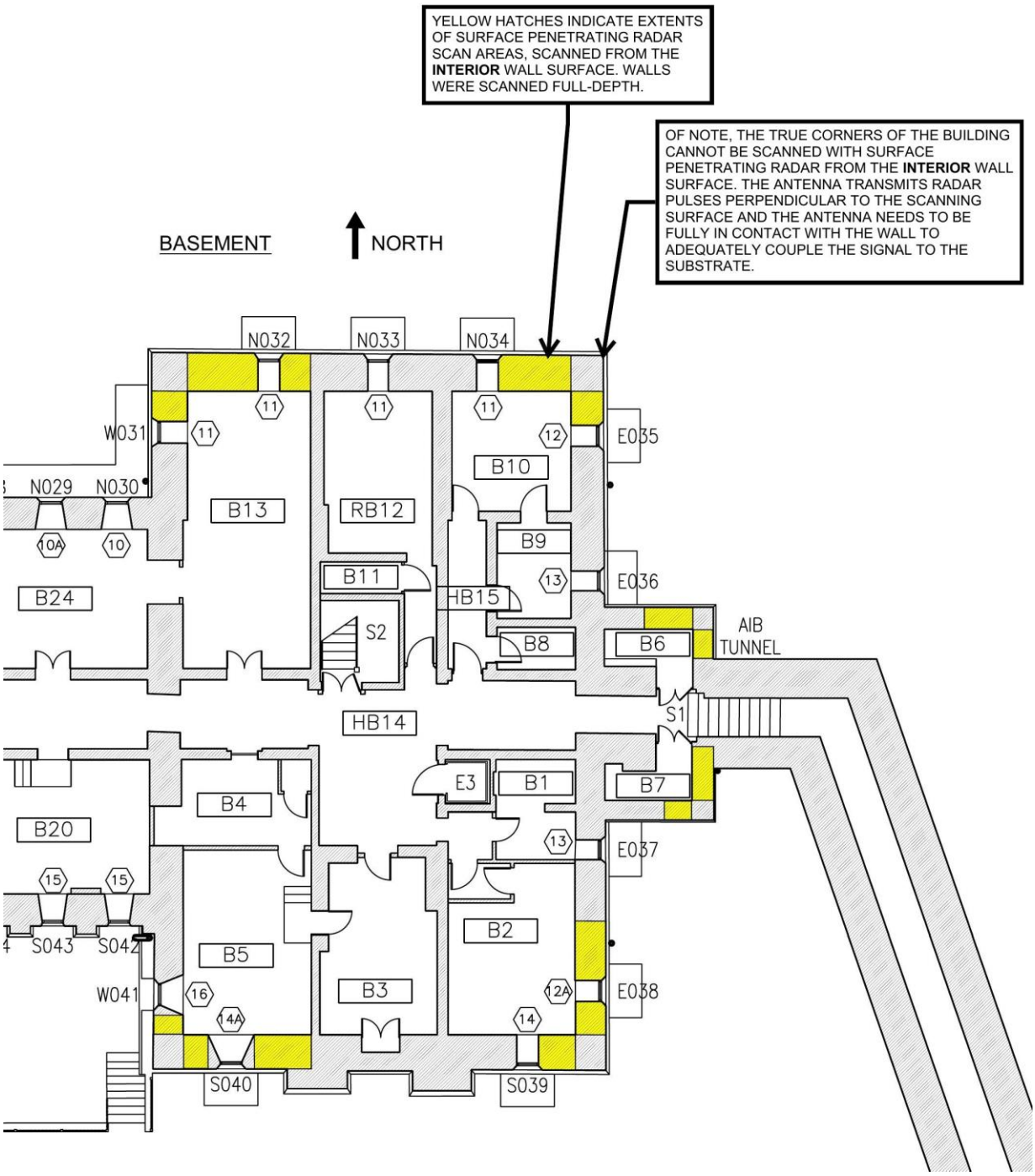

Figure 1. East Wing basement level: SPR scan locations are highlighted in yellow.

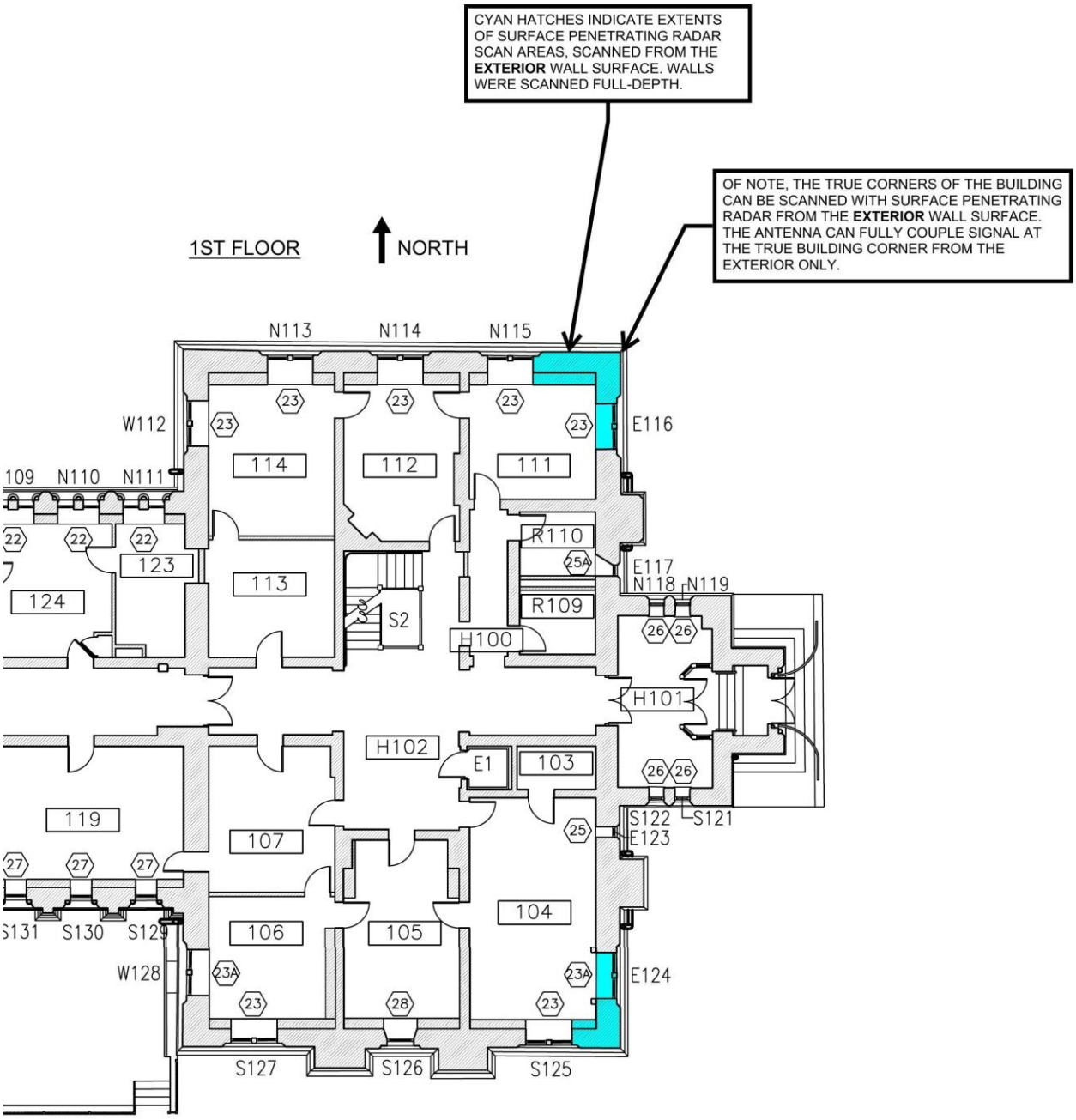

Figure 2. East Wing 1st floor level: SPR scan locations are highlighted in cyan.

Figure 3. Typical SPR scan collected with the 900 MHz antenna at the northeast corner of the East Wing.

The fixed frequency 900 MHz antenna was able to scan full depth through the walls and the back of the wall was typically very clear in the SPR trace. Figure 4 shows a typical 900 MHz radar scan with key features described via color-coded annotations. The back of wall is visible as a bright line at a depth of approximately 3.4 feet. The transition from façade faced sandstone units to the structural backup stone varies slightly but is typically at a depth of approximately 0.6 to 0.8 feet. Most scans were void of any anomalies near or around mid-depth into the wall where it seems likely for the time capsule to be located. Specific anomalies that were further investigated will be discussed in the videoscope section of this report and the summary at the end.

The broadband GP8000 antenna was better suited for scanning from the interior at the basement because of the higher resolution scans. Figure 5 shows a typical GP8000 radar scan with key features described via color-coded annotations. The back of the wall is not visible because it is out of range for this antenna. Some anomalies are present in this scan including a conduit, a hyperbola-shaped miscellaneous anomaly, and an internal void between stones which was further investigated with a videoscope. There is also a clear line at a depth of approximately 5" indicating the signal exiting the brick and plaster interior finish wall and entering a small air cavity. The interior finish wall comprised of one wythe of brick and plaster is set approximately 1" to 2" off of the structural stone, creating an air cavity.

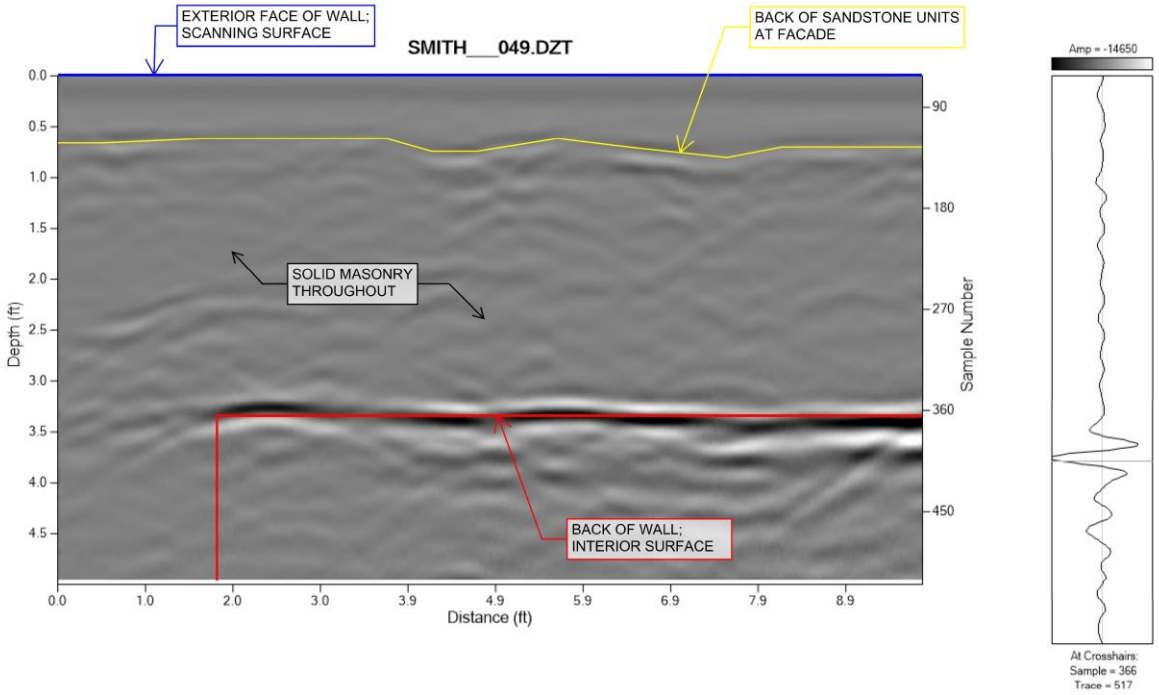

Figure 4. Typical radar scan with the 900 MHz antenna. This is collected from the exterior.

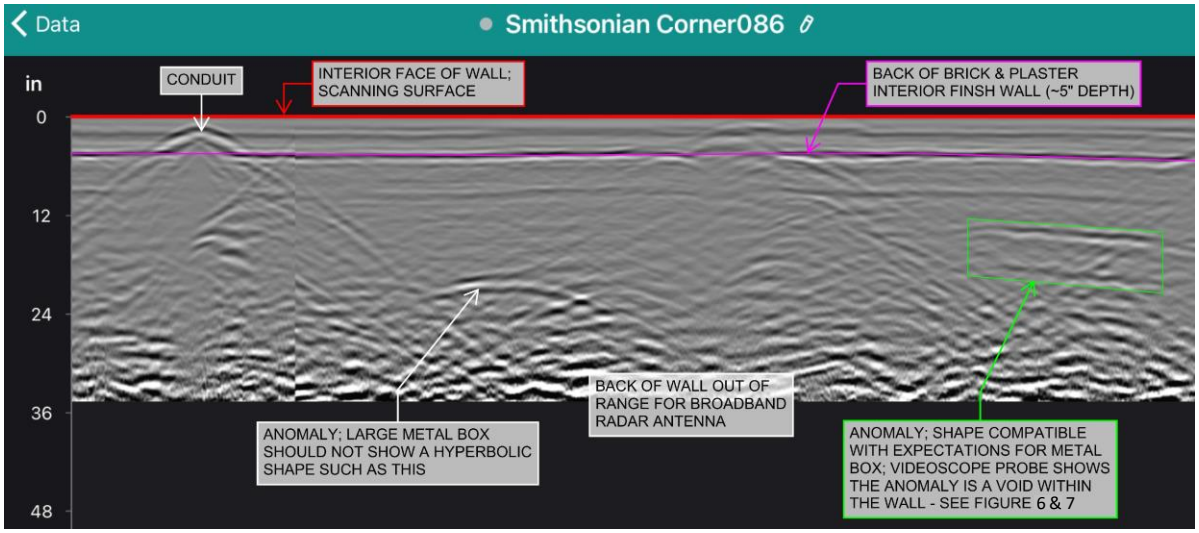

Figure 5. Typical radar scan with the broadband GP8000 antenna. This is collected from the interior.

3.0 Fiber-Optic Videoscope Investigations

While on site, four (4) small diameter (1/2") videoscope holes were drilled through the wall to intercept internal anomalies detected with SPR. Three of the four holes were drilled from the interior directly through the wall finish, and one was drilled from the exterior at a mortar joint. At each of the holes, a fiber-optic videoscope was inserted to view internal conditions of the wall and search for what caused an anomaly in the SPR scans.

Two holes were drilled from the interior at the north wall near the northeast corner of the East Wing. The two holes were drilled in approximately the same area because the first hole was blocked when a portion of the drill bit sheared off within the wall. The second was drilled approximately 18" into the wall. Beyond the interior finish wall comprised of brick and plaster, both holes revealed completely solid stone for the full depth of the two probes. The SPR device was calibrated to exclude anomalies of this nature from consideration when searching for the time capsule.

One hole was drilled from the exterior at the east wall near the northeast corner of the East Wing. The hole was drilled approximately 18" into the wall. The sandstone unit at the façade was determined to be approximately 8" thick and the remaining 10" of the hole was solid structural stone. The SPR device was calibrated to exclude anomalies of this nature from consideration when searching for the time capsule.

One hole was drilled from the interior at the east wall near the southeast corner of the East Wing. This was drilled at the most significant anomaly detected throughout the 180+ SPR scans. The anomaly is shown in Figure 5 above as highlighted by the green rectangle. The anomaly was at an appropriate depth into the wall (~14") where a time capsule could reside, and the shape and general dimensions were in line with expectations. The anomaly was approximately 24" wide by 12" tall when looking at the wall in elevation – also in line with expectations for a time capsule. The videoscope hole was drilled at the middle of the anomaly to a depth of approximately 14", when the drill jumped slightly. Drilling was stopped and the videoscope was inserted into the hole to reveal a significant void between stone units, void of mortar – not a time capsule. Looking up, down, left, and right, the void appears in line with the SPR signature as approximately 24" wide by 12" tall and approximately ½" thick. No other anomalies were deemed significant enough to drill into. Figure 6 and Figure 7 show videoscope images from within the internal void at a depth approximately 14" into the east wall.

Figure 6. Videoscope image looking up inside the internal void initially suspected of being a time capsule.

Figure 7. Videoscope image looking down inside the internal void initially suspected of being a time capsule.

4.0 Magnetic Locator Investigations

Two types of metal detectors were brought to the building to supplement SPR results, but neither ended up being used beyond initial trials. One was a Schonstedt Maggie magnetometer, and the other a Garrett Ace 150 metal detector. Both were picking up significant background noise from nearby conduit, and metal objects from desks and other furniture. There was too much miscellaneous metal nearby to isolate readings exclusive to internal wall metals.

5.0 Site Findings Summary

A combination of surface penetrating radar scanning supplemented by fiber-optic videoscope investigations were used to search for a metal time capsule within the stone masonry wall of the East Wing at the Smithsonian Castle. The investigation focused on selected areas thought to have a high likelihood of containing a time capsule, but results showed that no objects representative of a metal box are within the walls that were investigated. The SPR scans were clear and of adequate resolution and depth range to locate a metal box within the walls had it been in the scan area. The 900 MHz antenna used for the investigation could clearly receive back of the wall readings, meaning it is highly unlikely that a metal box is within the wall sections that were scanned over with the radar antenna.

Four significant anomalies were detected with SPR scans, and those locations were drilled into with small diameter holes that were used to insert a fiber-optic videoscope. Visual observation of the internal wall conditions showed that the anomalies represented either solid stone or internal voids between stone units, not a metal time capsule.

There are some limitations to the nondestructive approach utilized, with the most notable being the omission of true building corners when scanning from the interior at the basement. Because the radar antenna emits an electromagnetic wave in the form of a narrow conical projection, a portion of the building corners will be outside the reach of the radar pulse. This is unavoidable when scanning from the interior of any wall corner with non-zero thickness. Figure 8 visually demonstrates the issue.

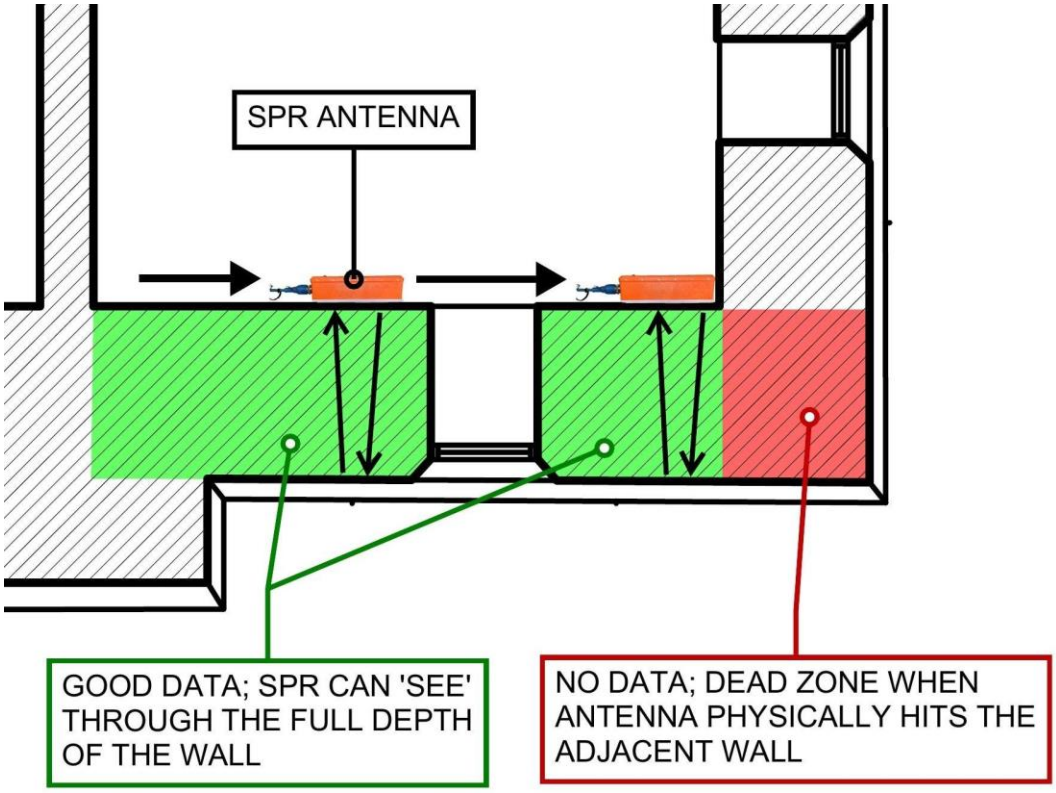

Figure 8. Representative illustration of the 'dead zone' at the corner when scanning from the interior.

The other limitation being that SPR scans were limited to wall areas above the basement floor slab. If the cornerstone and time capsule are part of the foundation wall and are placed below the level of the basement slab, the current approach would not find the time capsule. Instead, a portion of the floor would need to be removed similar to a test pit to provide access lower down the wall for SPR scanning. That could be achieved from the interior or the exterior, both requiring some level of excavation. Excavating at the exterior would also eliminate the limitations for the true building corner when scanning from the interior mentioned in the previous paragraph.

If the Smithsonian Institute still wants to locate the cornerstone and time capsule, ANA recommends another round of testing during the future renovations planned for the museum. The seemingly best course of action would be to excavate soil at the exterior side of the southeast and northeast corner of the East Wing as low as possible without compromising foundation components. If the cornerstone and time capsule is below grade, a follow up round of testing with similar methodologies could be more successful at locating the time capsule. Additionally, metal detecting techniques could be significantly more useful from the exterior due to the lack of nearby metals that are present at the interior.