The Tale of Two Villages

New Perspective on the Historic Palestinian Landscape

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Abstract

A surface reconnaissance survey of several archaeological sites in greater Megiddo spanning the late Roman through Ottoman-Mandate periods was undertaken during June and July 2019 using LiDAR imagery with the intent of determining what features displayed by the LiDAR (Light Detection and Ranging) technology imagery could be verified on the ground. Specifically, the investigation sought to understand how LiDAR imagery could display sub-surface structures and certain surface features in two Palestinian villages previously identified in the vicinity of Tel Megiddo. The results of the field research of these case studies illustrate how the near-surface structures that once supported various buildings can be readily identified through the visualization that LiDAR provides.

Keywords

Ottoman Palestine; Mandate Palestine; historic landscapes; remote sensing; Palestine agriculture; historic demography; LiDAR imagery.

The dominant urban centers of the western Levant, the result of habitation for many millennia, often garner scholarly attention that overshadows the places and events of smaller sites within their immediate area of influence. Such is the case of Tel Megiddo, occupied from the Neolithic through Persian periods (6000 BCE – 400 BCE),[1] and later sites in its immediate vicinity. The tel's strategic location along a major trade route between the eastern Mediterranean coast and Jezreel valley (Marj ibn 'Amr) is well documented through archaeological and historic documentary sources (figure 1). The importance of the location was notably recognized by the Romans in the early centuries of the current era during their occupation of "Syria Palaestina" from 105–337 CE.[2]

The individual case studies discussed in this article use a type of remote sensing technology known as LiDAR (Light Detection and Ranging). While everyone has seen remote sensing data like satellite images available from Bing and Google, there are other types of images which can be created from wavelengths that are not visible to the human eye. Infrared images show heat patterns, while other imagery can reveal the amount of moisture on the landscape. LiDAR, a form of airborne laser scanning, uses a wavelength invisible to the human eye, but can penetrate vegetation to reveal surface features as if the ground was bare. In certain conditions, it is possible to see below the soil surface and view structures and features that only excavation would reveal. For this reason, LiDAR has revolutionized archaeological survey in many parts of the world. In Cambodia, for example, until recently most archaeologists believed the medieval area of Angkor Thom (which includes the Angkor Wat temple and surrounding monuments) occupied only 9 km^{2}. LiDAR has revealed a 35 km^2 area of the city and temple sites.[3] In Central America, the lowland Maya region has been subject to archaeological survey for over 125 years. The focus for many decades was on the ceremonial centers, with survey of the areas surrounding the centers only undertaken in detail during the past fifty years. A recent study in the Guatemalan Maya Biosphere Reserve identified 61,480 structures within 2,144 km^2, suggesting that the Late Classic period (650 CE to 800 CE) in the central lowlands had a population of 7 million to 11 million inhabitants.[4] In the dramatic case of the site of Caracol in Belize, LiDAR mapped 208 km^2 (80 square miles) defining the full extent of the site, whereas twenty-five years of research had only mapped 13 percent of the site.[5]

Field research in greater Megiddo during the summer of 2019 focused on investigating previously known historic sites from the Roman, Byzantine, and late Ottoman/Mandate eras with the use of LiDAR. Only a few of the sites located within the vicinity of Tel Megiddo have structures that are still evident on the surface. Since vegetation and soil can affect how LiDAR images present surface and subsurface features, the initial baseline fieldwork reported here sought to validate how observable terrain might be evident compared to subsurface features evident in the LiDAR imagery. This report summarizes some of the findings from this recent investigation.

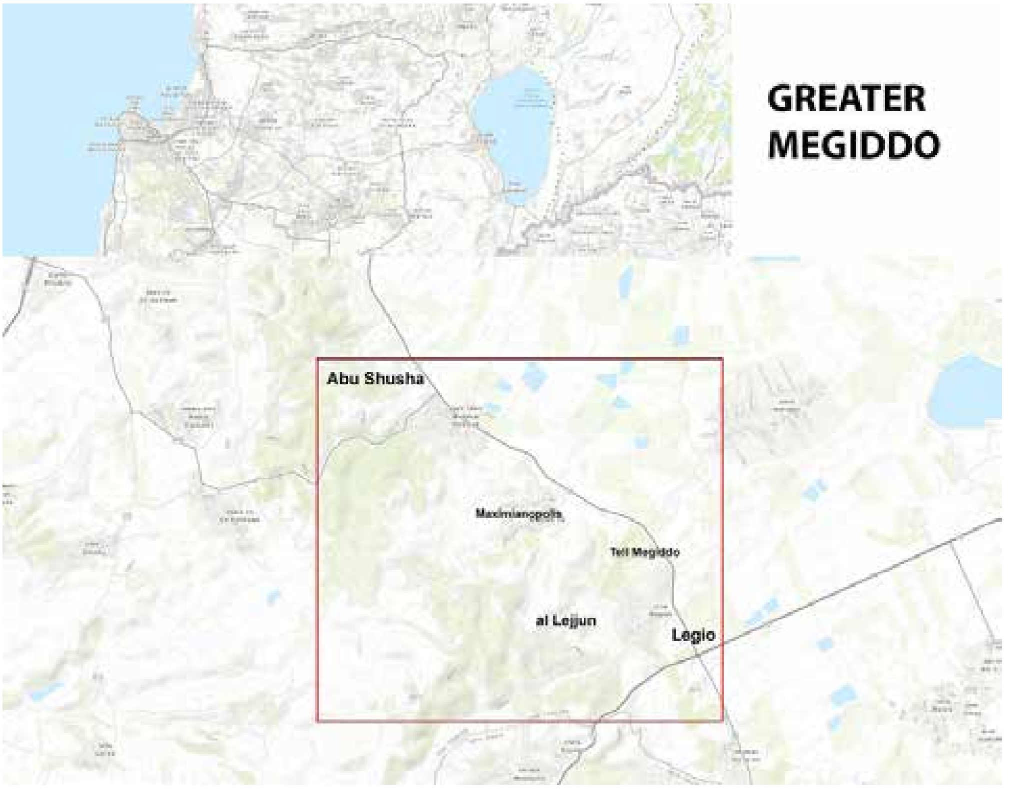

Figure 1. Sites of greater Megiddo. Source: J. Howry from Arcgis.com.

The Camp of the Sixth Roman Legion

The map of the area (figure 1) generally locates various archaeological sites which directly or indirectly were the result of Roman occupation and the nearby trade routes. Legio was the camp of the Roman Legio VI Ferrata (Sixth "Iron" Legion) which occupied the site from 192 CE to 316 CE.[6] For the current study, this location serves as the anchor for the surrounding sites occupied in the early centuries of the first millennia of the current era. The rectangular shape of the traditional Roman camp is clearly evident from the LiDAR image (figure 2). Today's sloping hillside masks the multiple buildings and streets which once defined this site of 5,000 legionnaires.

Excavations over several field seasons during the past decade have revealed the complex structure of the camp. Although many Roman camps followed a rectangular design with specific structures, Legio descends twenty-five meters down the hillside in a series of terraces crisscrossed with streets that separated the many buildings (officers' quarters, barracks) of the camp.

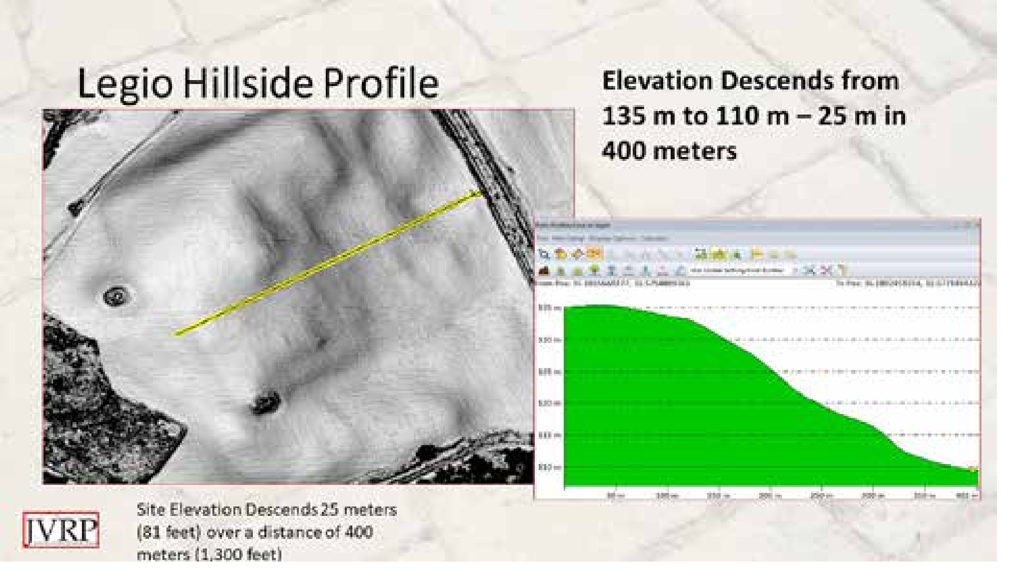

Figure 2. Legio's LiDAR Image and Terrain Profile, Jezreel Valley Regional Project. Source: J. Howry.

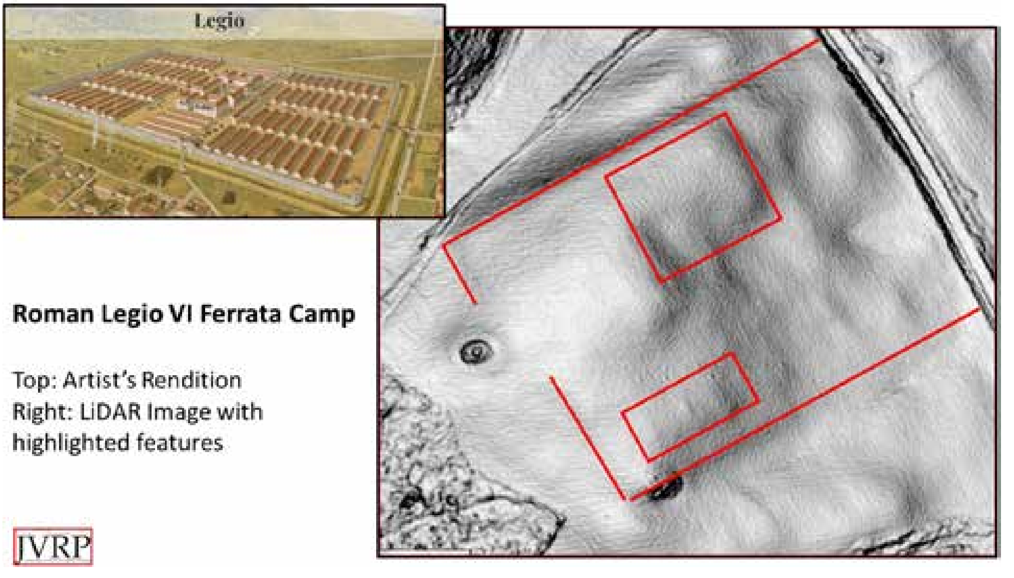

Figure 3. Roman Legio VI Camp and highlighted structures. Source: Jezreel Valley Regional Project and J. Howry.

An artist's early sketch of Legio (figure 3, left image) shows a typical rectilinear plan common to many Roman legion camps. However, the LiDAR image (figure 3, right image) presents a much more complex layout, with multiple levels separating sections of the camp. Some of the different sections located on separate levels are highlighted by red lines, as well as the perimeter ramparts which were constructed around the camp. Recent excavations have confirmed the presence of streets at multiple levels under which are sewage lines that served the buildings above. The traditional rectilinear plan of many Roman camps is clearly contrasted with the sloping camp of the Sixth Legion as exceptionally well delineated in the LiDAR imagery.

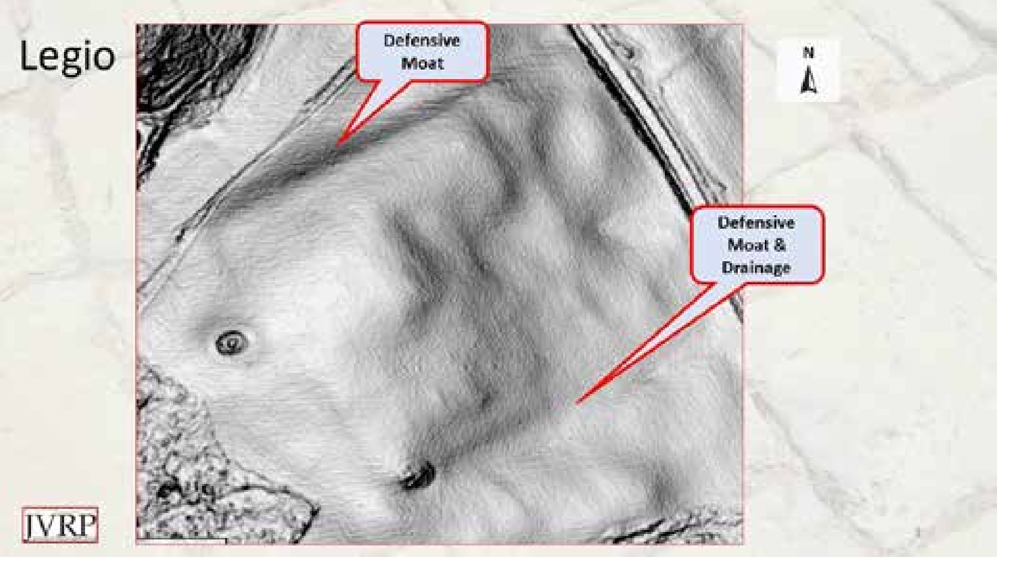

Figure 4. Legio's Defensive Moat and Drainage, Jezreel Valley Regional Project. Source: J. Howry.

A careful examination of the LiDAR image (figure 4) reveals the defensive moats that bordered the camp, but also the drainage ditch paralleling the southeast boundary of the camp. Excavations during the previous field seasons and in 2019 disclosed several drainage lines which flowed in a southeasterly direction, suggesting that at least some of the camp's sewage may have flowed through the defensive moat which paralleled the camp.

Overview of Two Villages and Their Roman Heritage

Roman legion camps (*castra*) required a substantial number of workers for logistical support and general labor. Some soldiers had families who lived outside of the camp. As a result, villages where workers and families lived became associated with individual Roman camps. Al-Lajjun was an example of just such a village whose very name in Arabic comes from the Latin "legio" (legion).[7] A Roman camp typically contained defined building types and architecture and therefore required specific construction materials and techniques. Several seasons of excavations at Legio during the past decade as part of the Jezreel Valley Regional Project (JVRP)[8] have provided many examples of the types of materials used in the construction of the camp. Among those materials most evident are ceramic roof tiles of the buildings which are found throughout the camp. Production of these tiles required the construction and operation of a nearby manufacturing facility. This was just one of the building trades which took place in al-Lajjun, most likely along the year-round stream known as Nahal Qeni, which provided the water for the large-scale production of roof tiles.

The village of al-Lajjun was historically located in the Mandate era Jenin district (Ottoman era Sanjuk of Acre and Roman *Palestina Prima*) as was the nearby village of Abu Shusha. Both can be traced back to at least the late Roman era (second century CE), although Tel Shusha, located on the easternmost hill overlooking the Jezreel valley (Marj ibn 'Amr), may date back to the Bronze age.[9]

To the west of Legio, the village of al-Lajjun became established with the arrival of the Sixth Legion about 192 CE. Historic sources indicate that there were three localities which comprised the village in recent centuries that corresponded to certain families or clans: al-Lajjun West (al-Lajjun al-Gharbiyya) located on a basalt mound flanked by fields to the east and south, a second south focus located along the Nahal Qeni, and a third area located north across the fields in elevated terrain which became the Roman city of Maximianopolis,[10] today the area occupied by Kibbutz Megiddo.

Abu Shusha was a second village located less than six kilometers northwest of Legio on ridges overlooking the Jezreel valley (Marj ibn 'Amr) to the east.[11] The length of occupancy of Tel Abu Shusha is not certain, as it is one of the few tels in the area which has never been excavated. Documentary sources indicate that it was occupied during the late Roman era when the Legio camp was operating. Recent research affirms that the village was known as Gaba Hippeon,[12] and possibly founded by retired members of Herod's household cavalry.

These two villages were examined in terms of their LiDAR imagery to present different types of features, some of which are not visible by terrestrial survey. These case studies detail specific patterns of occupation while providing examples of how LiDAR can inform our understanding of the historic landscape. In this way, LiDAR can provide valuable insights that can guide more detailed terrestrial surveys with subsurface testing, as well as define major subsurface features not revealed without extensive soil removal through archaeological investigation.

Village of al-Lajjun

Early in the author's research of imagery in the general vicinity of Legio, the Google Earth imagery, and particularly that from 2010, suggested there were extensive boundary walls constructed throughout a portion of the settlement and within the fields (see figure 5, left). This area became the focus of LiDAR analysis with the intent of determining whether these features could be observed on the ground.

A 1946 map of al-Ljjun prepared by the British Mandate administration clearly delineates a good number of structures on the mound. As the aerial photograph (1945) shows, most of the remaining portion of the mound is covered with thick vegetation making surface observation extremely limited. However, the regularity of the pattern seen in the LiDAR image supports the premise that the house sites that formerly occupied the mound were clearly bounded by low stone walls in a regular pattern. By contrast, on the more level fields where dark, rectilinear patterns appear in the LiDAR (2012), there were no walls to be observed at ground level! A second visit to the fields in the early morning, when the angle of sunlight was low, provided the first insight into what were previously walls. Instead of low walls, the dark rectilinear pattern results from the dense scattering of white limestone and basalt rock fragments that were previously field walls. Decades of cultivation using tractor drawn plows and disc equipment has created the scattering of the stone that was previously the various stone field walls. The dense pattern of fragmented stone could be confirmed using a high-resolution GPS instrument and matched with the dark rectilinear pattern in the LiDAR imagery (see figure 5, lower right).

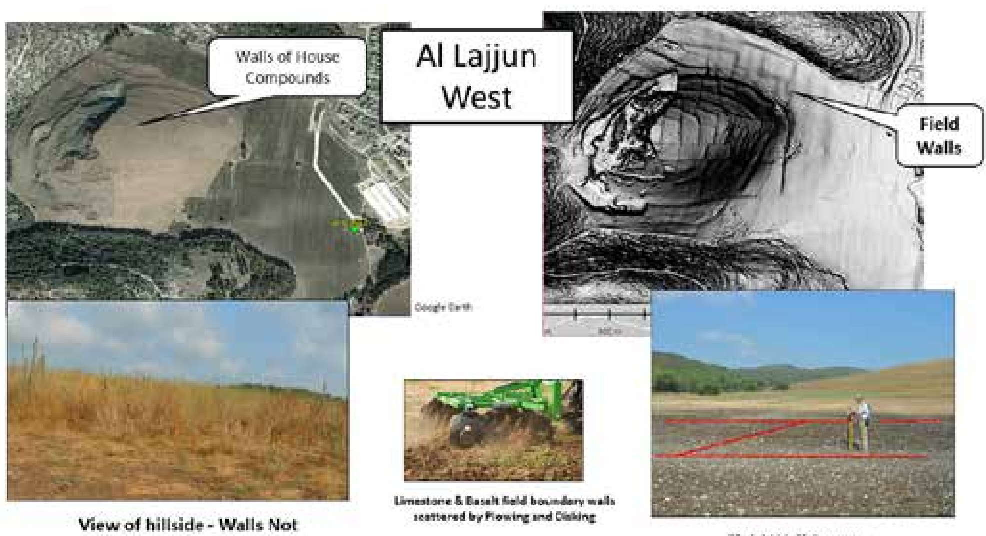

Figure 5. Al-Lajjun West (al-Lajjun al-Gharbiyya), household and field walls. Source: J. Howry.

The important insight provided by this portion of the survey is that although the physical evidence of the village's structures is very limited from terrestrial survey, the general pattern of the house sites as well as the pattern of cultivated fields is made evident from the LiDAR imagery when it is filtered for ground level features. If ground conditions were different and a higher resolution LiDAR were available, some of the more salient features of the village structures would be evident. In the next section, a second village site is examined where more distinctive residential features were evident and their specific attributes in similar LiDAR imagery were revealed.

Village of Abu Shusha

Approximately five kilometers north of Tel Megiddo is the much smaller Tel Abu Shusha, whose eastern slope faces the Jezreel valley (Marj ibn 'Amr). The historic village of Abu Shusha is principally located on the west side of the tel and extends southwest across the ridge and along a parallel ridge to the north. The village buildings and structures occupied the upper elevations of the two ridges that are separated by a stream (figure 6).

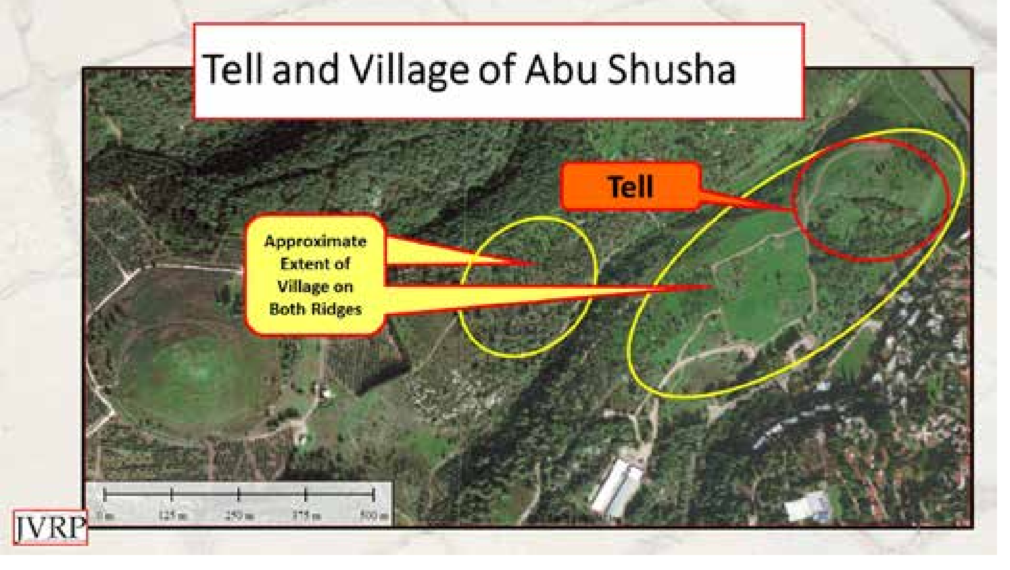

Figure 6. Satellite image displaying the topography of the tel and village of Abu Shusha. Source: Bing image with annotation by J. Howry.

The village was selected for study in part because some of the foundations of previous buildings and structures are still evident from terrestrial survey. In addition, the much earlier occupied area of the tel is primarily on the east facing slope, overlooking the Jezreel valley (Marj ibn ‘Amr). Together these landscapes provide a diversity of features which could be interpreted by the LiDAR.

Figure 7. Terraces of Abu Shusha. Source: J. Howry.

Terrace structures at Tel Abu Shusha, or possibly those of the later village, are clearly apparent on the northeasterly slopes in the LiDAR panel to the right. The terrestrial survey of existing conditions in 2019 confirmed these terraces, although dense vegetation precluded observing any ground features except at the highest points on the tel where ashlar blocks were observed, as well as a single Ottoman (or earlier) era semi-subterranean arched structure used for storage. Surface indications suggest that the platforms may have Ottoman and Mandate era use by the village, as well as by the much earlier occupants of the tel. The top-most platform is triangular, with successively lower platforms descending the eastern slope of the ridge. Some of these platform structures may be remnants of village construction that are evident in the aerial imagery from the UK Royal Air Force (RAF) from 1945.

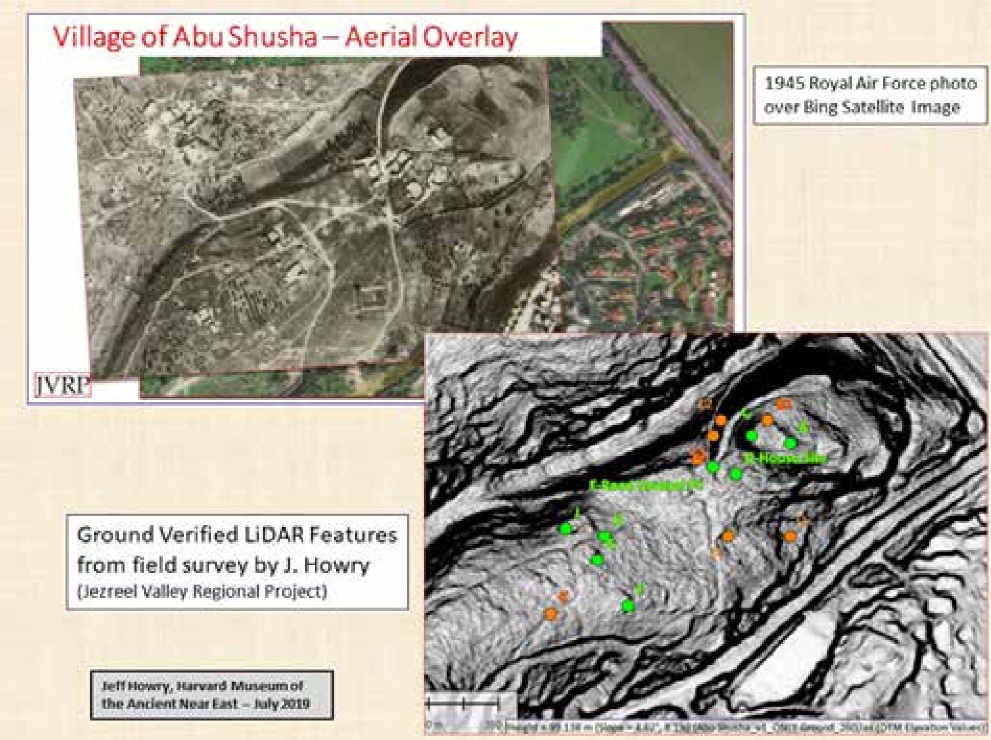

Figure 8. 1945 the UK Royal Air Force (RAF) aerial image overlay on satellite image and bare ground LiDAR image. Source: Aerial Photography Archive, Department of Geography, Hebrew University of Jerusalem; Bing; and author.

A limited terrestrial survey confirmed that building foundations shown in the 1945 image were well represented in the LiDAR imagery. In addition to house sites, smaller residential features such as cisterns and household boundary walls evident in the aerial image could also be found through terrestrial survey using the LiDAR image as a guide.

Future Research Directions

The case studies in this article highlight the significantly different conditions in which LiDAR imagery can provide essential data on the context and structure of archaeological sites which span millennia of occupation. At al-Lajjun it was possible to highlight field patterns, many of which were physically destroyed in the past half century. At Abu Shusha, the multi-terraced character of some of the highest terrain became clear. Future analysis will include a detailed comparison of the LiDAR with the aerial imagery from 1945, and the surface artifacts found from Tel Abu Shusha during an intensive archaeological survey by the JVRP in 2017. It is expected that the subsequent analysis of the results of the archaeological survey will evaluate how the surface collection combined with the LiDAR can enable interpretation of the near-surface features. It is hoped that this analysis will produce insights into the value that LiDAR provides for interpreting historic landscapes.

One further character of LiDAR is that it provides a very precise geospatial location of points that can be assigned to features identifiable in historic aerial imagery, such as road intersections and buildings. With the availability of 1945 aerial photographs, it is possible to place these images on top of the digital elevation model (DEM) created by the LiDAR to produce a 3D model of Abu Shusha and its structures as they existed at that time. Georeferencing the image in this way allows the user to reference the features that existed than and even today. An example of such an image is found below.

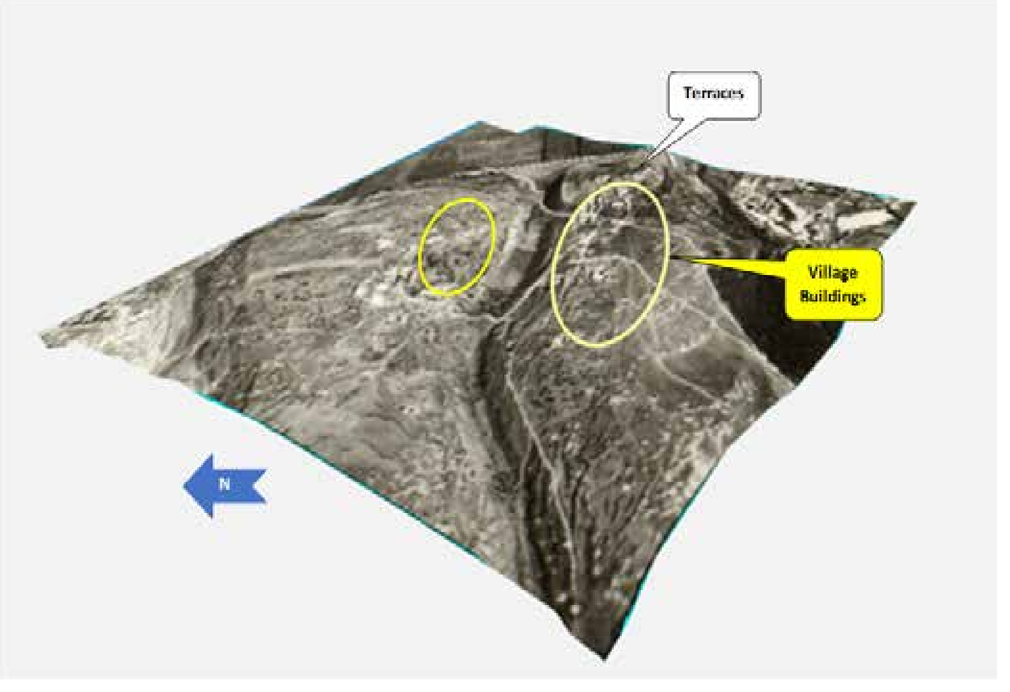

Figure 9. View of Abu Shusha (1945) from the East toward the Jezreel Valley. Source: J. Howry.

This type of image georeferencing and DEM modeling can be used to create virtual landscapes of many villages in historic landscapes where the terrain has not been substantially altered by development or agriculture.

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Endnotes

1 Jessie Pincus, Timothy S. DeSmet, Yotam Tepper, and Matthew Adams, "Ground-penetrating Radar and Electromagnetic Archaeogeophysical Investigations at the Roman Legionary Camp at Legio, Israel," *Archaeological Prospection* 20, no. 3 July–September 2013): 175–88, online at onlinelibrary.wiley.com/doi/10.1002/arp.1455 (accessed 16 May 2020).

2 Pincus, et al., "Ground-penetrating Radar."

3 "Uncovering Archaeological Landscapes at Angkor using LiDAR," *Proceedings of the National Academy of Sciences* 110, 31 (30 July 2013): 12595–12600 (see n. 2), online at doi:10.1073/pnas.1306539110 (accessed 16 May 2020).

4 Marcello A. Canuto et al., "Ancient Lowland Maya Complexity as Revealed by Airborne Laser scanning of Northern Guatemala," *Science* 361, no. 6409 (28 September 2018), online at science.sciencemag.org/content/361/6409/eaau0137/tab-article-info (accessed 16 May 2020).

5 Arlen F. Chase, Diane Z. Chase, and John F. Weishampe, "Lasers in the Jungle," *Archaeology* 63, no. 4 (July/August 2010), online at archive.archaeology.org/1007/etc/caracol.html (accessed 17 May 2020).

6 Jesse Pincus, et al., "Ground-penetrating Radar."

7 Tepper, Yotam, "Lajjun – Legio in Israel: Results of a survey in and around the military camp area," Proceedings of the 28th International Congress of Roman Frontier Studies, Amman, Jordan, vol. 1 (September 2000), ed. Philip Freeman, Julian Bennett, Zbigniew T. Fiema and Birgitta Hoffmann, (Basingstoke, UK: Basingtoke Press, 2002), 234. The late Ottoman and Mandate era Palestinian village of al-Lajjun was depopulated and destroyed in the 1948 war, and its land confiscated. The main center of al Lejjun, formerly the Roman city of Maximianopolis, has become Kibbutz Megiddo whose members currently cultivate most portions of the village. See Walid Khalidi, ed., *All That Remains* (Washington DC: Institute for Palestine Studies, 1992), 334–37.

8 The JVRP (Jezreel Valley Regional Project) is an ongoing initiative of the Albright Institute for Archaeological Research, Jerusalem. Dr. Mathew Adams, Director of the AIAR, supervises the JVRP, which provided the logistical support for the field research as part of the Legio 2019 field season.

9 See "Tel Shush" (Tal Abu Shusha) in Wikipedia, online at (wikipedia.org) bit.ly/2Y3YsKv (accessed 17 May 2020). Also see Ayala Sussmann, "Mishmar HaEmek–32," Archaeological Survey of Israel (2013), online at bit.ly/2UOJlTl (accessed 17 May 2020).

10 "Legio/Caporcotani/Maximianopolis," *Pleiades*, online at pleiades.stoa.org/places/678266 (accessed 17 May 2020).

11 The Palestinian village of Abu Shusha was depopulated and destroyed in April 1948, along with several nearby villages, following military confrontation in the 1948 war due to their strategic location leading to the Jezreel Valley (Marj ibn 'Amr). See Khalidi, *All That Remains*, 142–43.

12 Azriel Siegelmann, "The Identification of Gaba Hippeon," *Palestine Exploration Quarterly* 116, no. 2 (July–December 1984): 89–93, online at (tandfonline.com) bit.ly/2N4Bkp3 (accessed 17 May 2020).