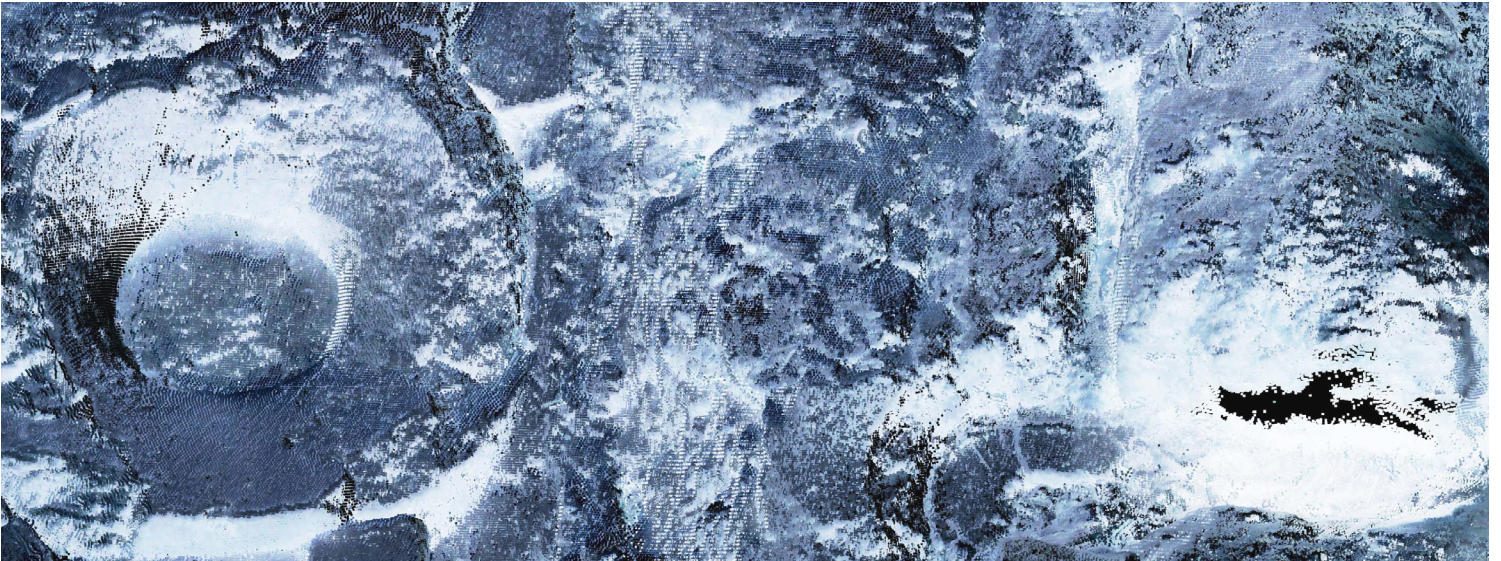# Blue Creek Archaeological Project: Documentation of Structures and Artifacts at Xno'ha and Tz'unun

2018 Report
### Ben Baaske and Robert Warden

2019

2018 Field Season
Team: Ben Baaske, Robert Warden, Lonnie Champagne, Thomas H. Guderjan, C. Colleen Hanratty, Justin Telepak, Joshua J. Kwoka, Alex Pastrana, Hollie Lincoln, Carlos Quiroz, Kevin Austin, Aubrey O'Toole, Thomas Ruhl, Jessie Leonard, Rianna Bowen

Blue Creek Archaeological Project: Documentation of Structures and Artifacts at Xno'ha and Tz'unun

Annual digital survey by the Center for Heritage Conservation at Texas A&M University with the Blue Creek Archaeological Project in northwestern Belize has been ongoing since 2008. This report discusses the breadth of "digital" artifacts generated during the 2018 season. The first six weeks of digital survey applied multi-image photogrammetry as a technique to produce daily, 3D-digital maps of excavations of architecture at Xno'ha and Tz'unun. 110 unique "maps" in the form of colorized point clouds were created: 69 maps at Xno'ha and 41 maps at Tz'unun. Structures and features excavated at both sites consisted of range structures, pyramidal mounds, chultuns, stelae, looter's trenches, and a mask. The final two weeks restricted most multi-image photogrammetry to recording smaller artifacts recovered from Xno'ha, Tz'unun, Nojol Nah, and Blue Creek, while also applying a new hand-held laser (the Artec Space Spider) technique to other artifacts. In addition to recording artifacts, the final two weeks of digital survey also laser scanned the final excavation phases of architecture at Xno'ha and Tz'unun. 10 architectural structures and features were laser scanned. While this report aims to present a catalogue of digital survey and 3D modeling, the report is also another iteration in experimenting with usable formats for accessibility by researchers and the public.

Site Plan | Xno'ha
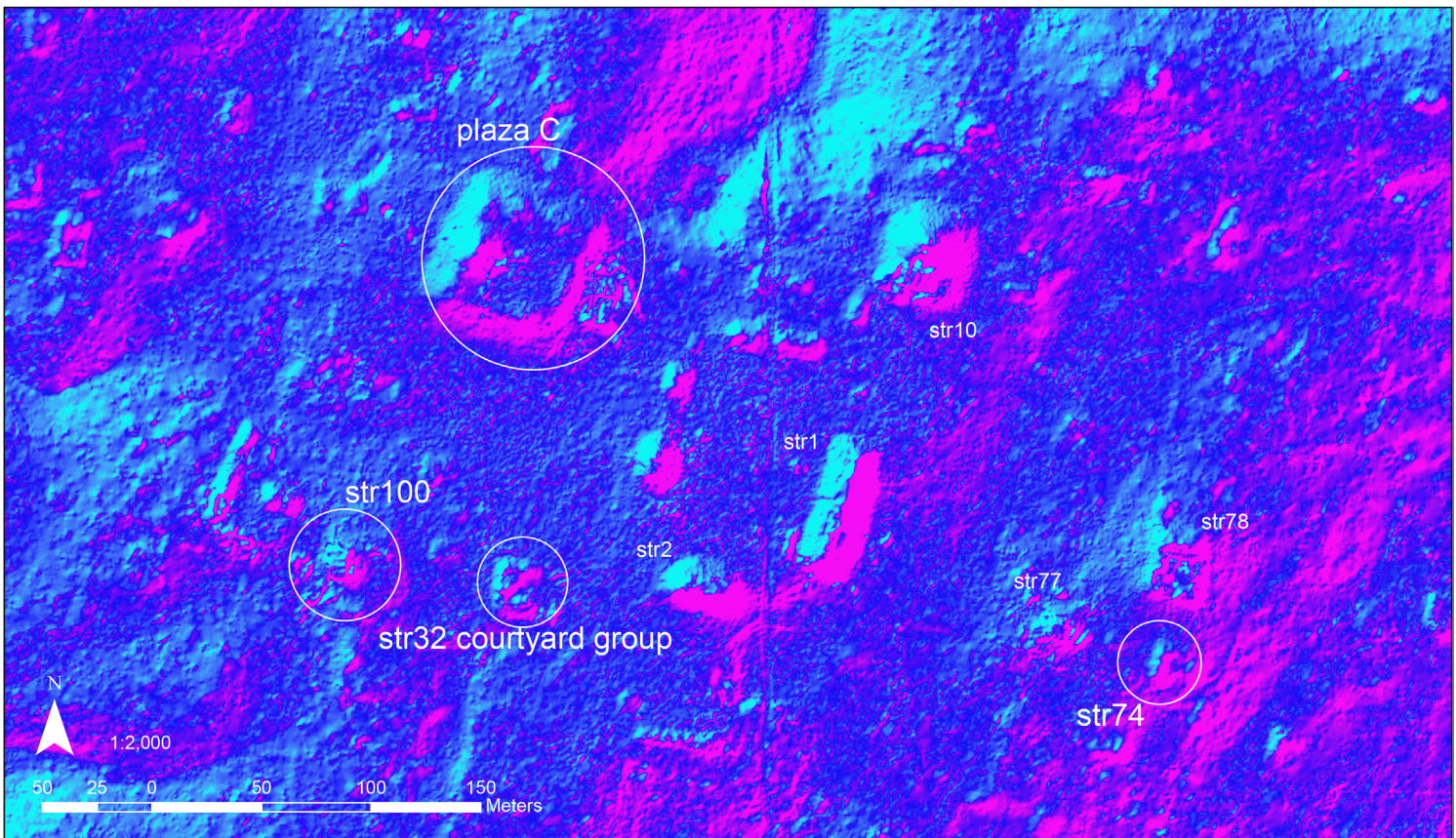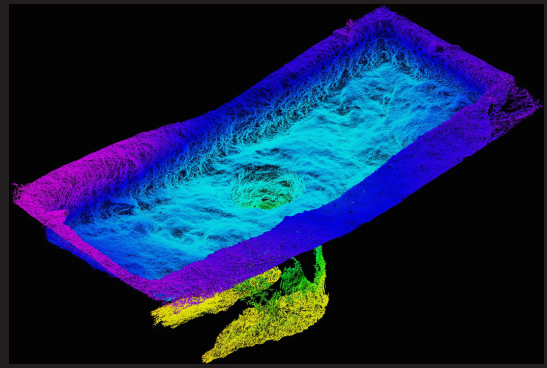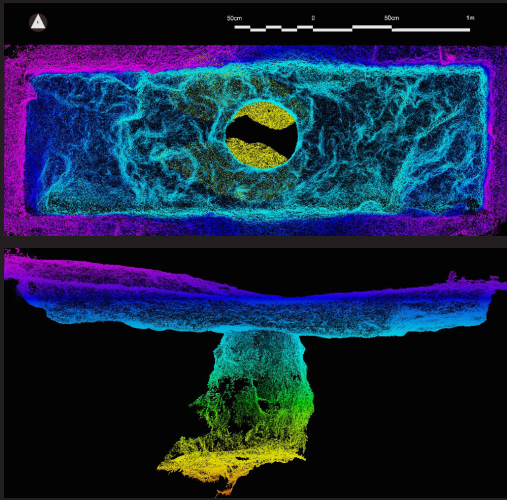
Sub-Op A | Chultun 18-01, Xno'ha
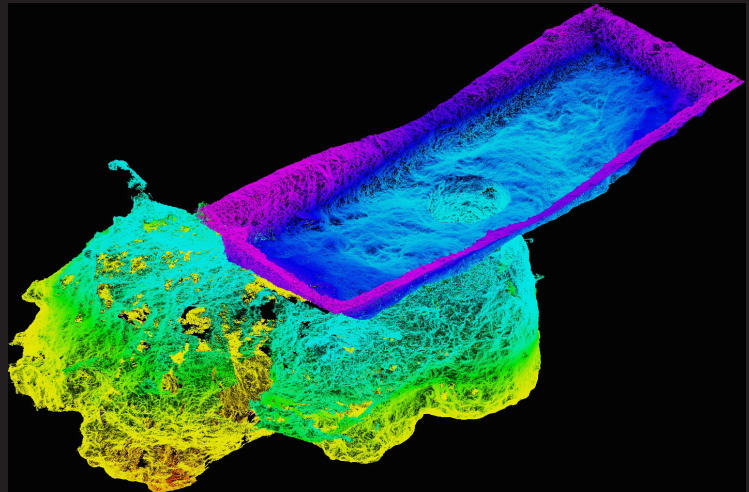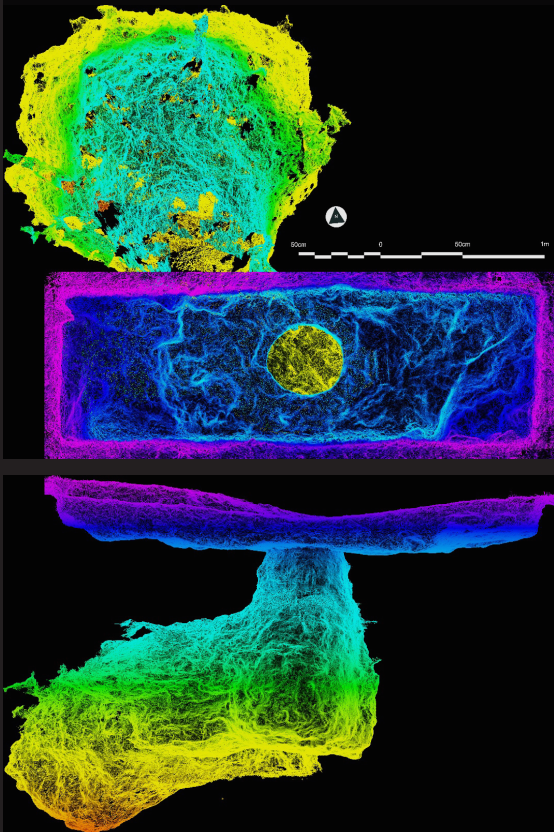
Sub-Op B, Lot 7 | Chultun 18-01, Xno'ha

Sub-Op J, Lot 93 + 94 | Structure 100
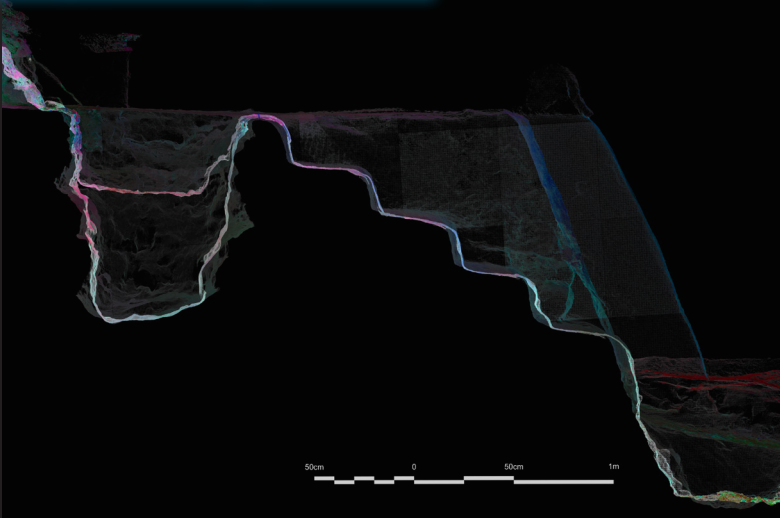
Sub-Op J, Lot 93-97 | Structure 100

Floor Plan | Structure 24

Southeast Isometric View | Structure 24

Longitudinal Section (looking North) | Structure 24

Northeast Isometric View | Structure 24

Site Plan | Structure 23 + 24, Plaza C, Xno'ha
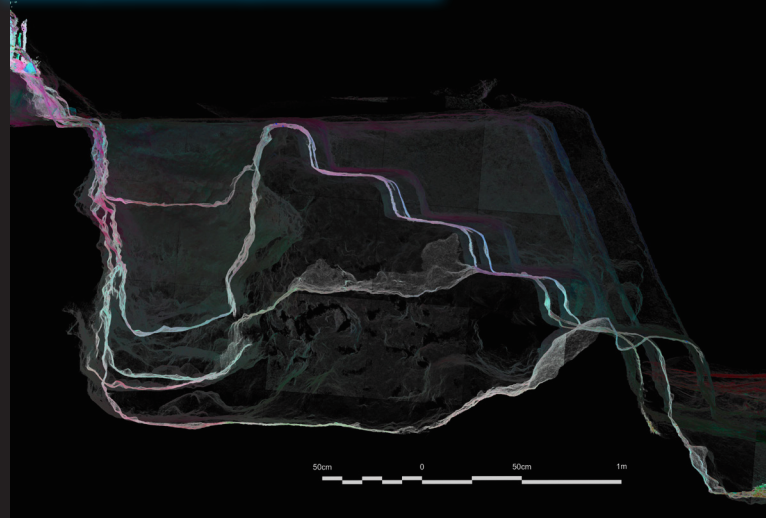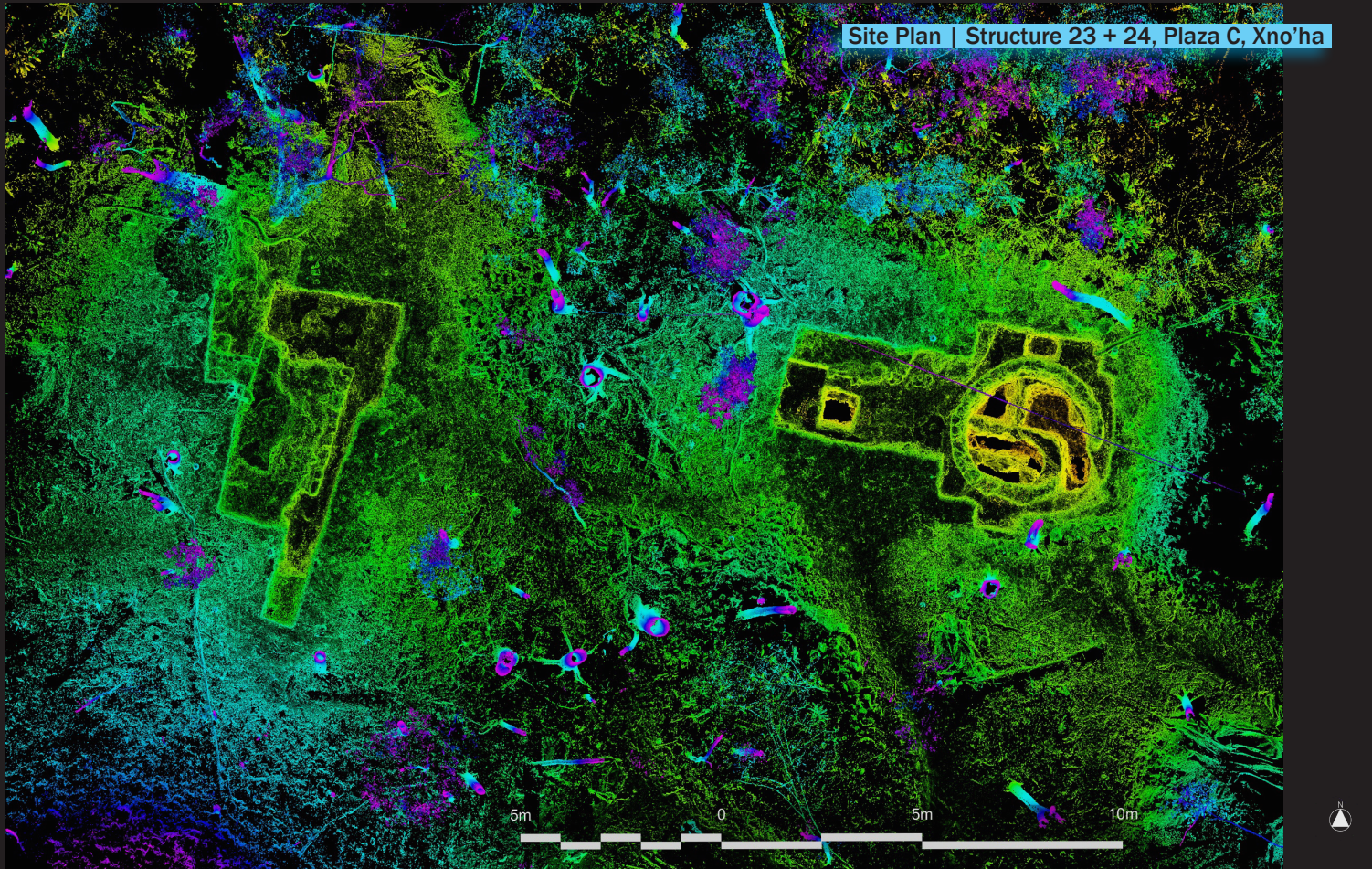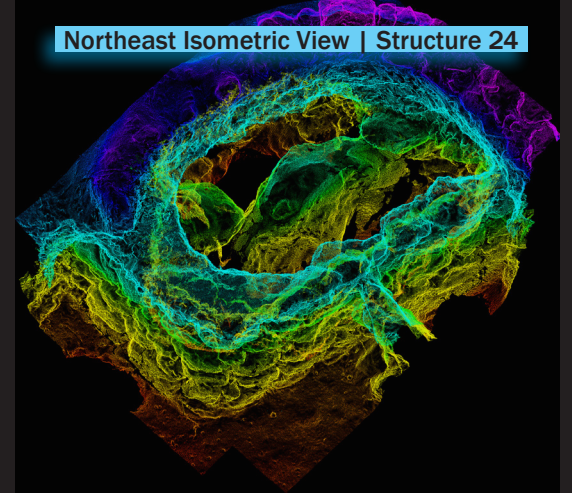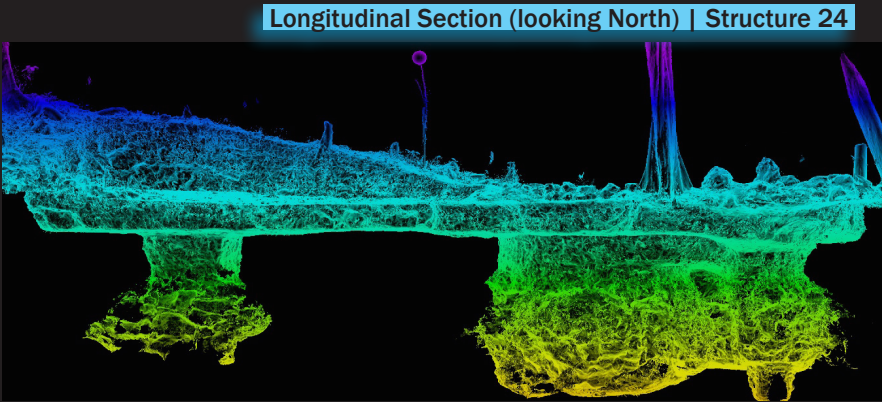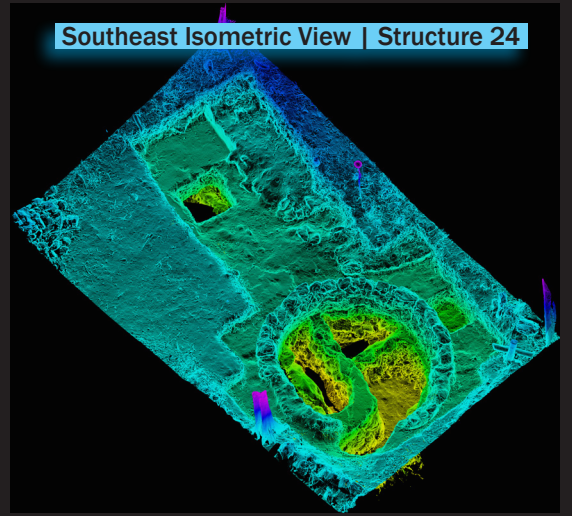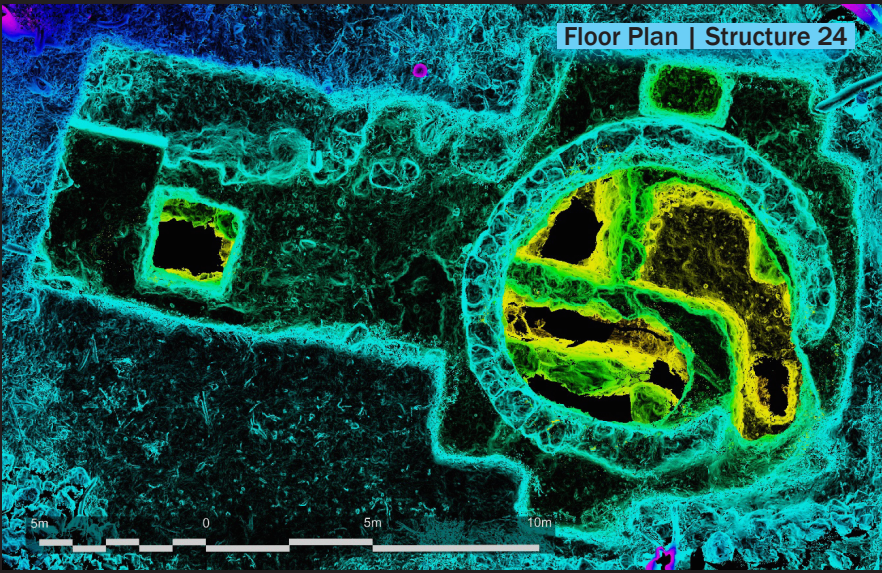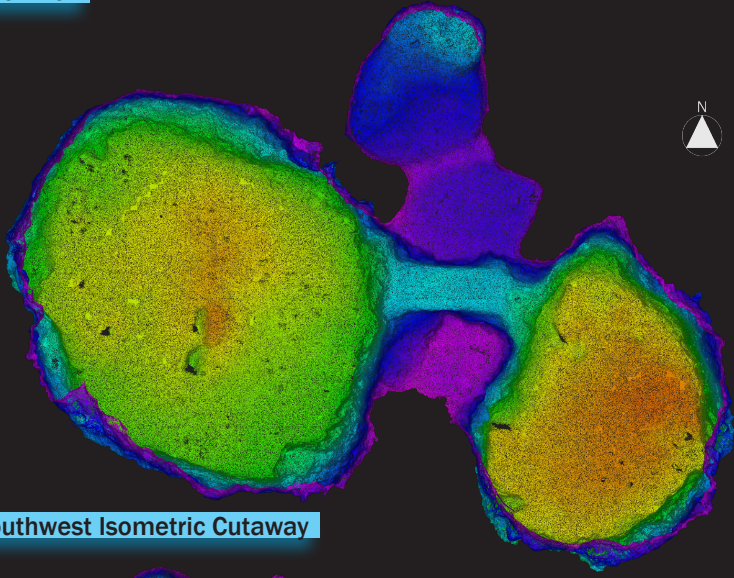
Floor Plan

Reflected Ceiling Plan
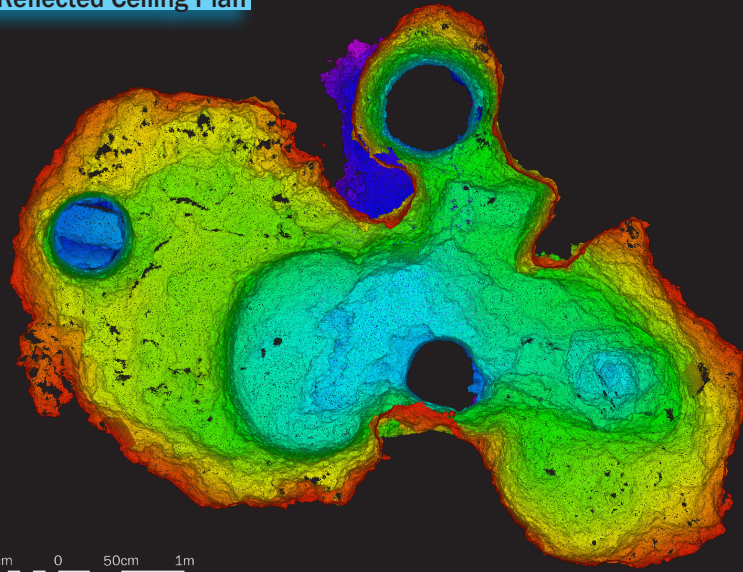
Southwest Isometric Cutaway

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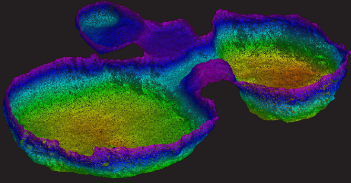
South Elevation "Section"

50cm   0   50cm   1m

10cm   0   10cm   20cm

0'-6"   0   0'-6"   1'-0"

10cm   0   10cm   20cm

0'-6"   0   0'-6"   1'-0"
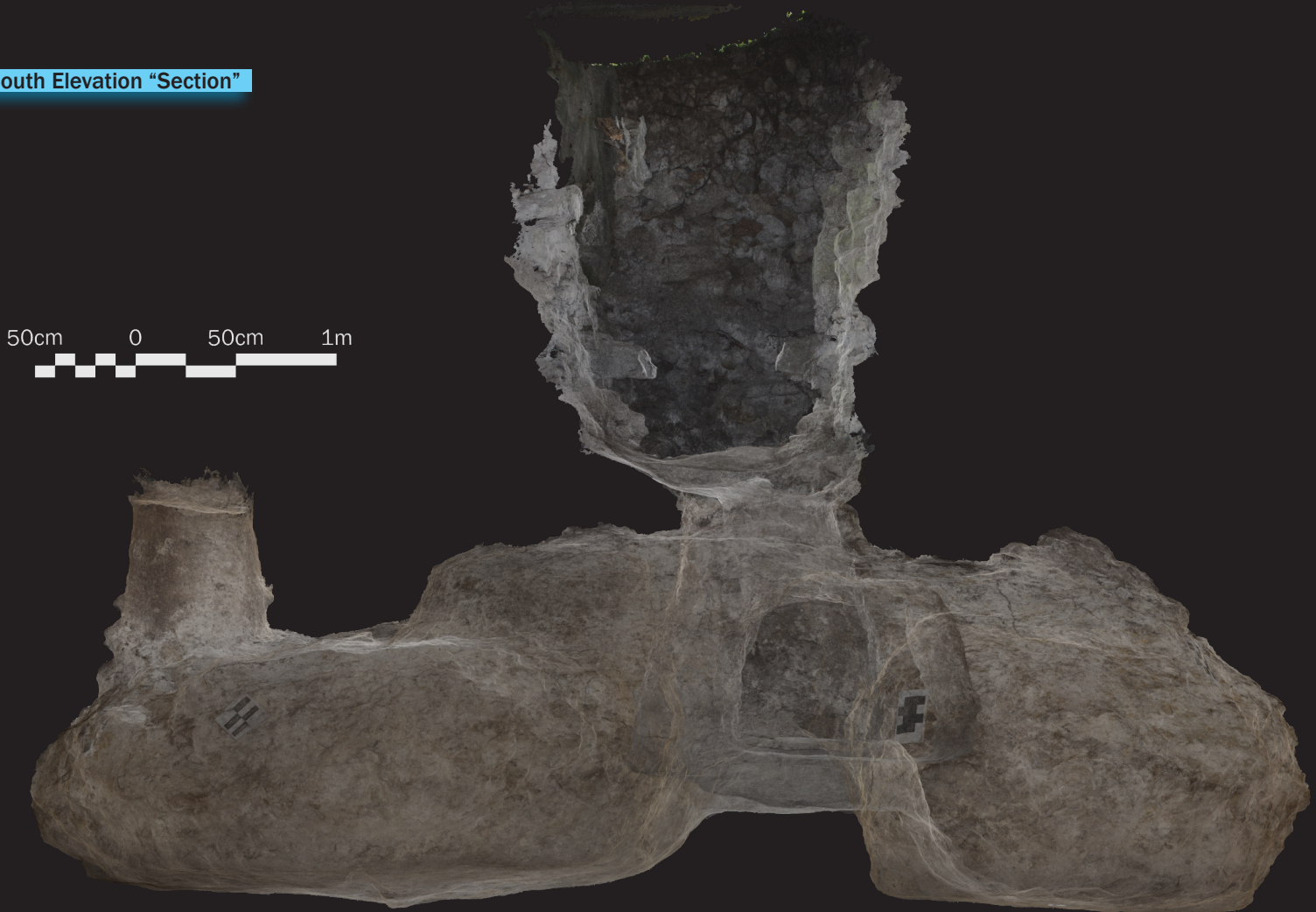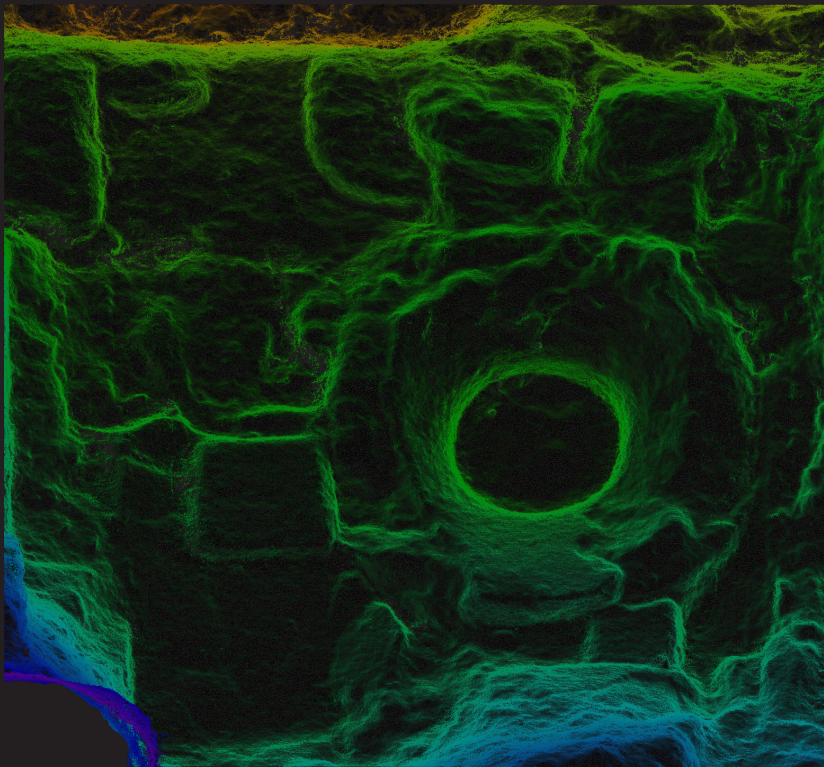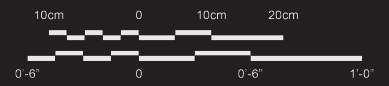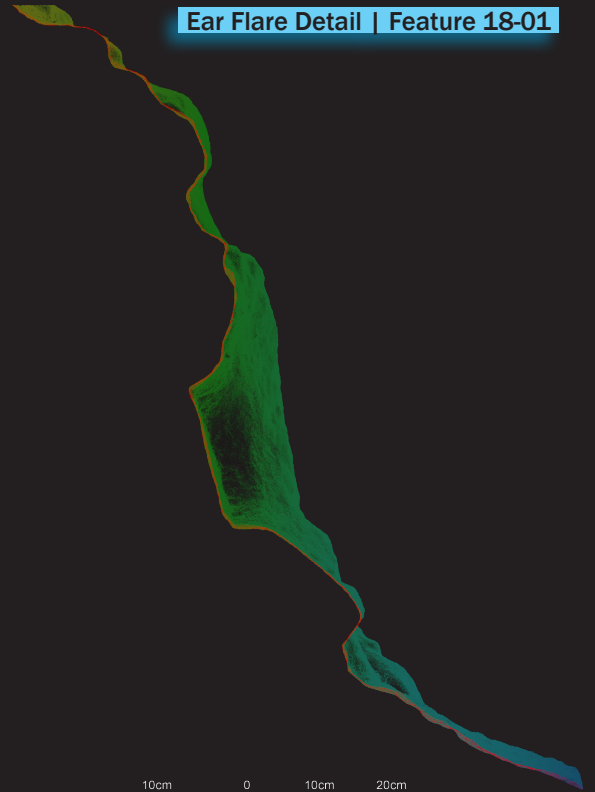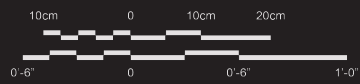
Floor Plan | Feature 18-01, Structure 22, Plaza C, Xno'ha

N

50cm   0   50cm   1m

2'-0"   0   2'-0"   4'-0"
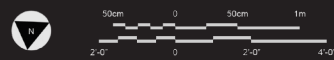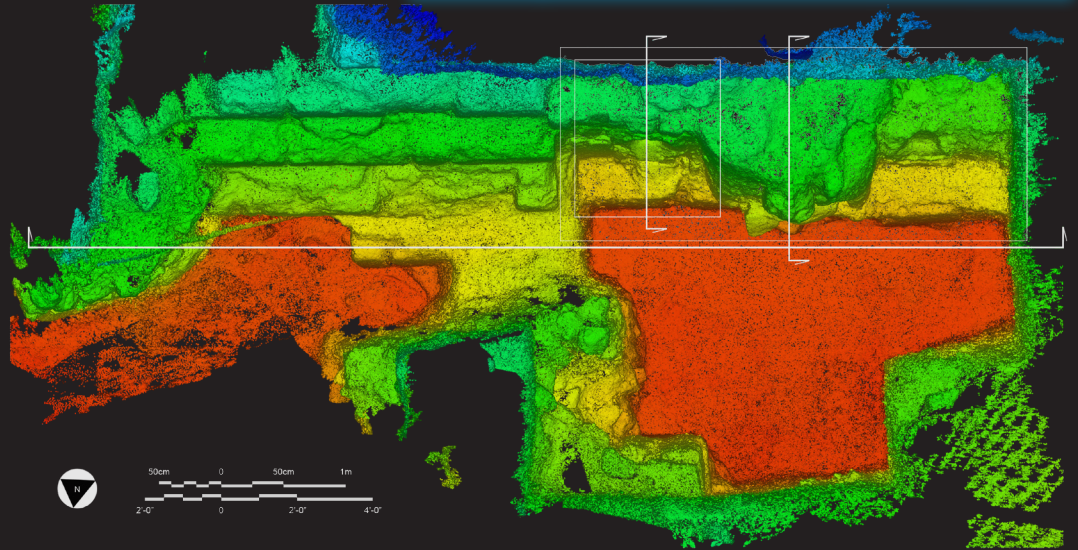
East Elevation | Feature 18-01, Structure 22, Plaza C, Xno'ha

50cm   0   50cm   1m

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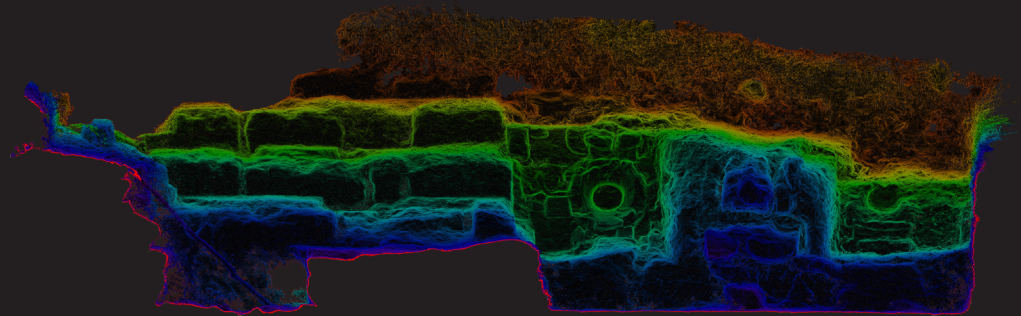
East Detail Elevation | Feature 18-01, Structure 22, Plaza C, Xno'ha

50cm   0   50cm   1m

2'-0"   0   2'-0"   4'-0"
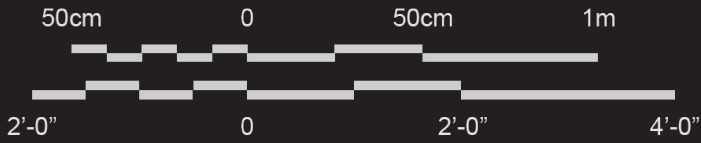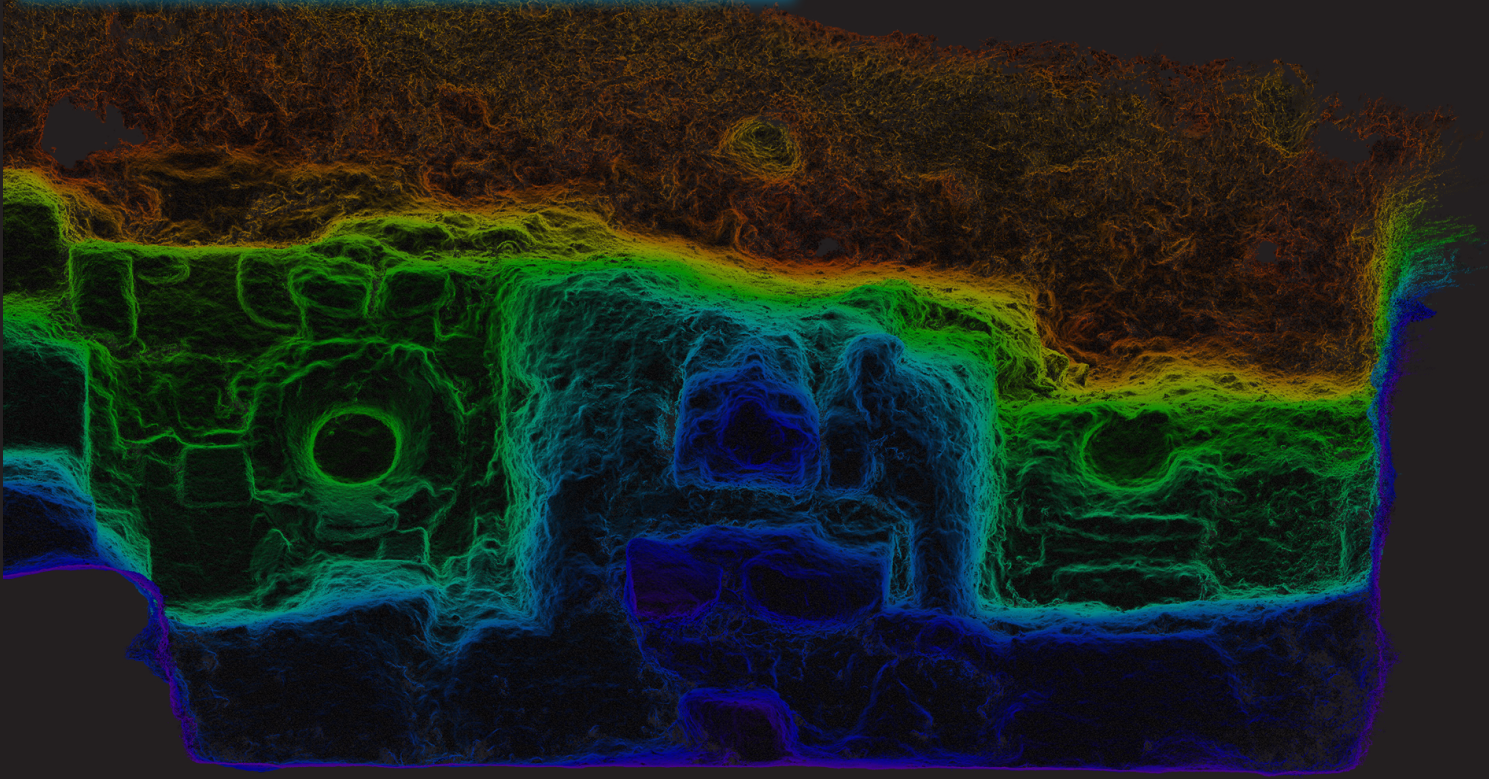
Site Plan | Structure 21, Tz'unun
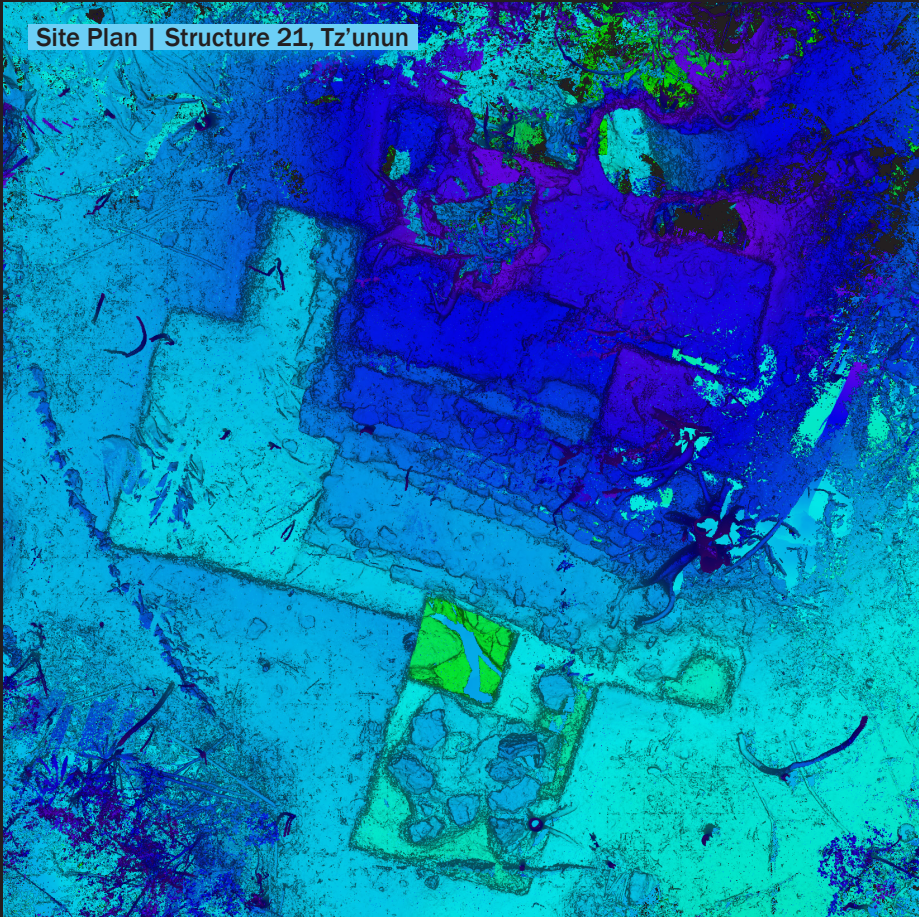
Southwest Isometric View | Structure 21, Tz'unun
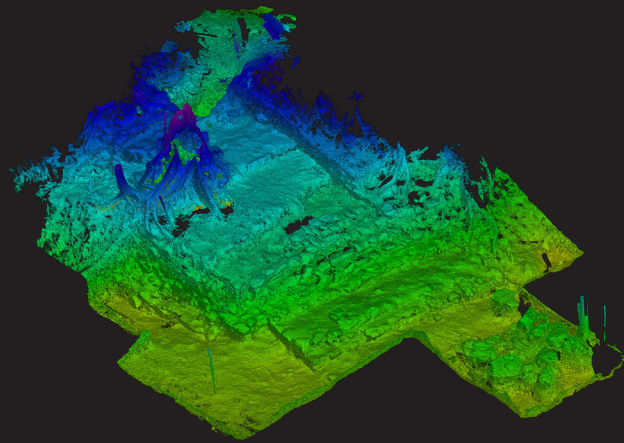
Southwest Perspective View | Structure 21, Tz'unun
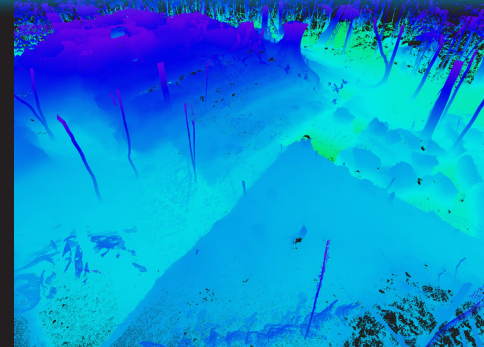
Site Plan | Structure 4+5, Tz'unun
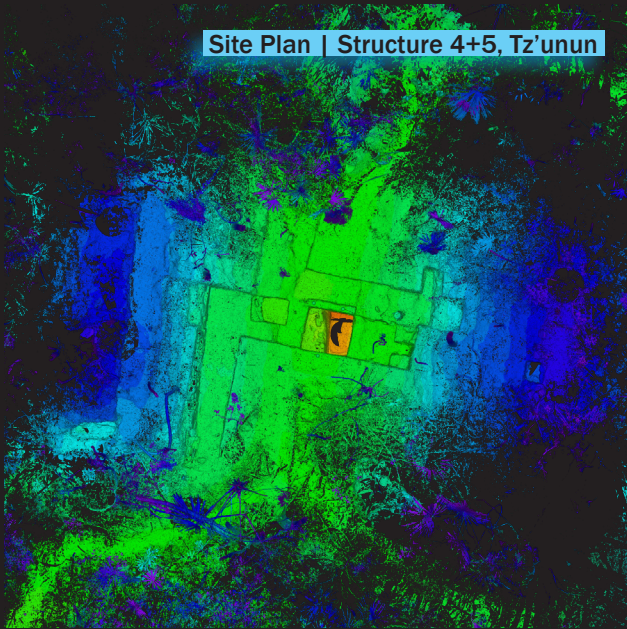
Southeast Perspective View | Structure 4+5, Tz'unun
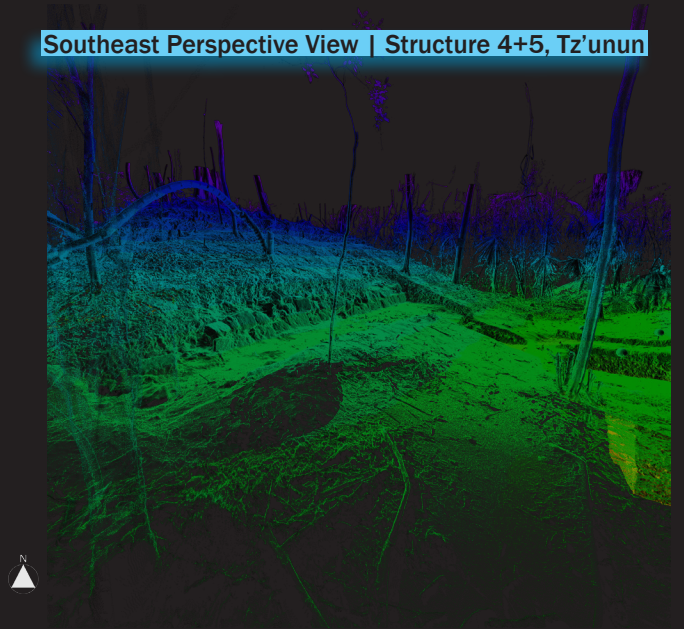
Site Plan | Structure 9, Tz'unun
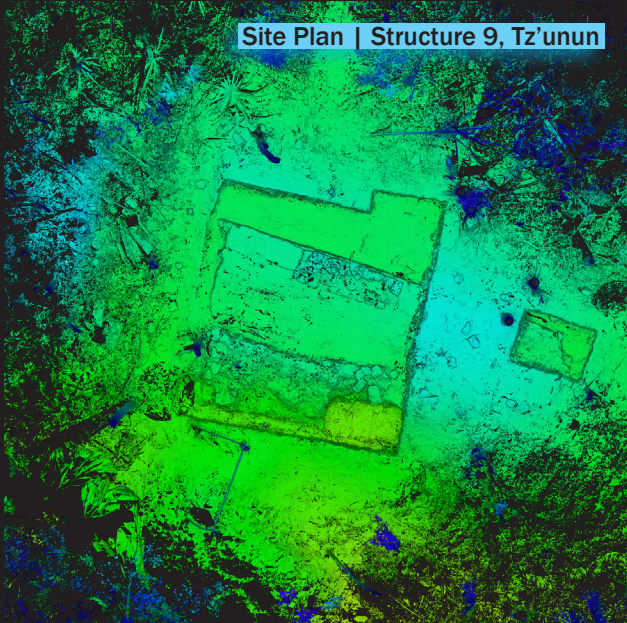
Southeast Isometric View | Structure 9, Tz'unun
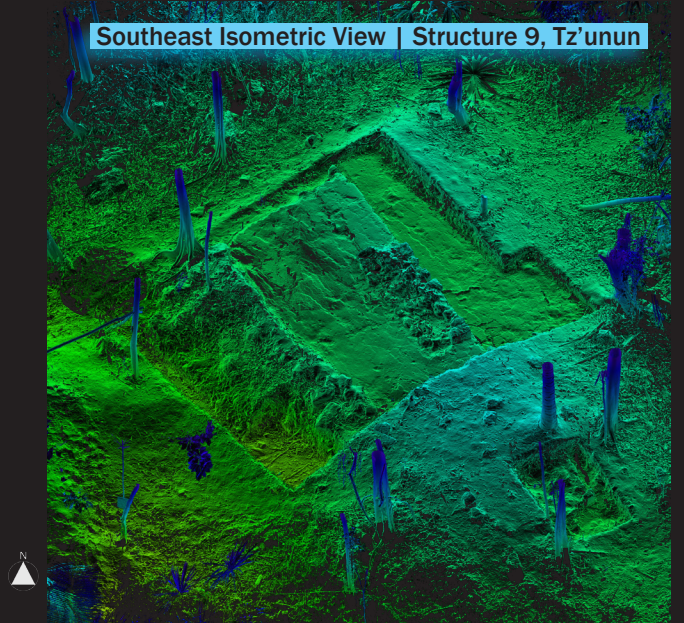
Site Plan | Structure 13, Tz'unun
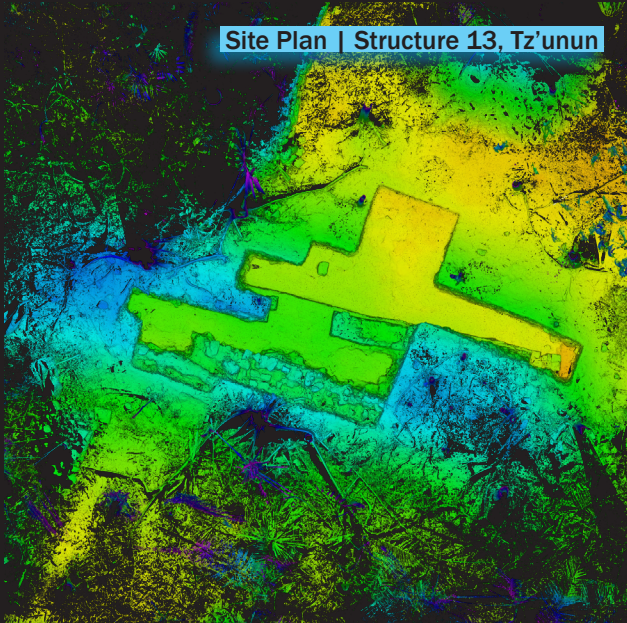
Northeast Isometric View | Structure 13, Tz'unun
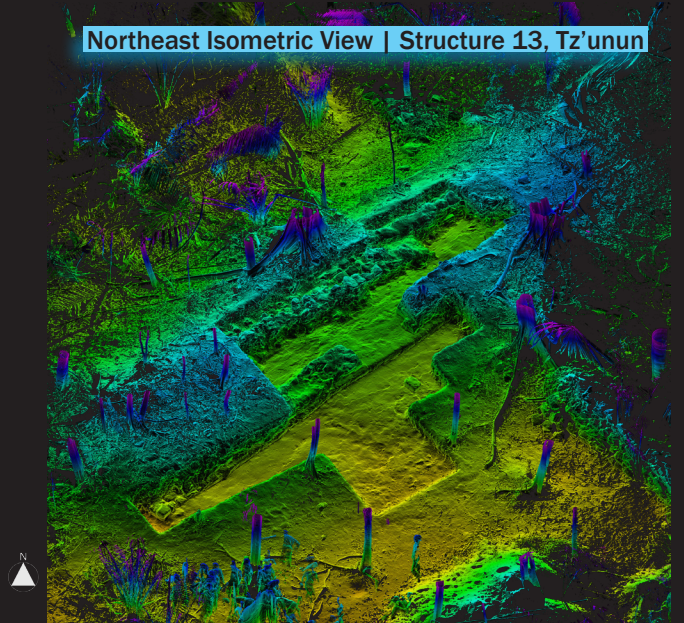
Appendix A (Field Notes)
Xno'ha
May 29, 2018
Captured baseline models using structure from motion (SfM) i.e. photogrammetry, at Structure 25 in Plaza C and Structure 100. This established what is termed "phase 1" for each structure. Structure 25 excavation broke new ground, while Structure 100 opened a new unit off an excavation that began in 2015. "Phase 2" of Structure 25 was captured at the end of the day. Structure naming at Plaza C was also reclassified: Structures 18, 19, and 22 maintain their designations from the 2017 field season, while what the Center for Heritage Conservation (CHC) termed Structure 25, is actually Structure 20, and Structures 25 and 24 are to be excavated this season (work continues at Structure 22) (Leonard 2018).
Phase 1 of Structure 25 sought to capture the baseline of Structure 24 as well, but registration was unsuccessful. This capture took 164 images, yielding an alignment of 79/164, with 167,559 tie points, a dense point cloud of 66,241,151 points (ultra high quality setting), and a 13,248,230 faced surface mesh. Phase 2 of Structure 25 captured 51 images, yielding an alignment of 51/51, with 56,265 tie points, a dense point cloud of 51,615,130 points (ultra high quality setting), and a 53,654 faced surface mesh. Phase 1 of Structure 100 captured 64 images, yielding an alignment of 58/64, with 55,331 tie points, a dense point cloud of 62,520,637 points (ultra high quality setting), and 53,548 faced surface mesh.
May 31, 2018
Documentation at the Structure 32 Courtyard Group focused on excavation of the north chamber of Chultun 16-02 i.e. chultun02 at Structure 32. The first layer consisted of sub-op J, lot 115, with the second layer being sub-op J, lot 116 (Austin 2018). J115 captured 149 images, yielding an alignment of 146/149, with 131,220 tie points, a dense point cloud of 12,805,151 points (medium quality setting), and a 2,561,030 faced surface mesh. J116 captured 93 images, yielding an alignment of 93/93, with 95,085 tie points, a dense point cloud of 38,842,124 (high quality setting), and a 7,768,399 faced surface mesh.
June 1, 2018
A third phase of photogrammetry (SfM?) was captured at Structure 25 in Plaza C. An inaugural phase of images was collected at Chultun 18-01 (located west of Structure 100), as well as at Structure 24 in Plaza C. A second phase of images were collected at Structure 100. Another layer of images was collected at Chultun02 at Structure 32. However, this layer did not fall at the end of J117, but near the end of the lot (named J117v). The lot has yet to be closed, and will be documented again once closed. It should be noted that the north arrow in Structure 25's third phase is approximate; Structure 100's second phase, Chultun 18-01's first, and Structure 24's first north arrows are less accurate the preceding approximation and should be primarily used for scaling; J117v in Chultun02 at Structure has accurate north arrow placement.
June 2, 2018
Documentation of excavations continued at Structures 24 and 25 in Plaza C, Structure 100, and Structure 32 Courtyard Group. This put Structure 25's excavation at four phases, Structure 24 at two, and Structure 100 at three.
Structure 32 Courtyard Group closed out sub-op J, lot 117, and thus captured images for processing of the end of that lot. The depth of the chamber from the opening's rim to the level of excavation is 120 centimeters. While J117 was closing out, work began on clearing out the surface directly below the central/south entry into the intersection space of the chultun. Remaining sub-op J, and designated lot 118, the lot is working on taking compressed sediment down 5-15 centimeters (mode thickness of 10 centimeters). Considerable ceramics were found here, along with a well-defined, level surface (toward the north chamber). This surface is currently unclear, but is likely to be either a plaster floor or smoothly sculpted from the natural feature. J119 in the north chamber is taking sediment down 20 centimeters from J117. This lot is pedestalling a large (~30 centimeters long) cut block on the northernmost side of the shaft, pulling considerable ceramics (as with the earlier lots J115-J117) from the eastern half of the chamber (Austin 2018).
June 4, 2018
Structure 24 and 25 at Plaza C continued with phase 3 and 5, respectively. These are in the process of getting their designations as lot numbered projects. Structure 24 currently has H38 (humic layer), H39 (10 centimeters down from plaza floor), and H42 (10 centimeters down from architecture). Structure 25 has similar designations with G37 (humic layer), G40 (10 centimeters down from plaza floor), and G41 (10 centimeters down from architecture) (Leonard 2018).
Structure 100 captured phase 4, and distinctions of lots will come later in the report.
Structure 32 Courtyard Group continued with J119v (the 'v' designates an intermediate capture within the lot; typically, lots are captured at their end). J119v captured the lot with the stone and ceramics still in place. J120v focused on the interstitial space between the three chambers of the chultun that also left ceramics and a stone matate in situ (Austin 2018). Then, lots J119 and J120 were captured together at the close of both respective lots and after ceramics and stones were pulled.
June 5, 2018
The processing that had been going for almost 6 days, for Tz'unun, failed. Other methods of breaking down the processing have been planned for. Processing is currently moving through smaller, more manageable projects (Structure 100, 24, 25, chultun 18-01, and str32 Courtyard Group) to catch up on project captures sitting in wait.
Phase 6 (G47) and phase 4 (H42) were captured at Structure 25 and Structure 24, respectively.
J121v at Structure 32 Courtyard Group captured an engraved ceramic, in this case, a matte finish ceramic. J121 was then capture after the ceramic was pulled, closing the lot. This lot also closes the north chamber of the chultun (Austin 2018).

K85 (center of structure, down to second platform) and I82 (dense fill along wall on the south end of the structure) were captured at Structure 100. Sub-op I focuses on the south end of Structure 100, but is likely to be on hold. There is little more information to be gained from the lot at this point in the field season. I80 consisted of the humic layer, I81 consisted of the base fill, while I82 dealt with the dense fill along the wall. Sub-op K is breaking through the center of the main platform of the structure to determine how many phases are present and what time periods they are associated with. K85 broke through the top layer of the platform before finding the level of the next phase ~20 centimeters below the top layer. K86 broke through this next phase and down to another construction phase (Lincoln 2018).

June 6, 2018

Phase 7 of Structure 25 was documented with G47end (a new naming system is needed for when these multiple, within lot, models are captured; 'v' and 'end' are not clear) and Structure continued with its 5th phase, H48 (end of lot by the end of the day) (Leonard 2018).

No new captures were taken at Structure 32 Courtyard Group in Chultun 16-02 i.e. chultun02. Focus has been on clearing out the western and eastern chambers for location of architectural features and bedrock. The western chamber is clear, but capture is holding until the eastern chamber is also cleared. Then, a full capture sequence will be done of Chultun 16-02: north, east, and west chambers. J122 deals with remains from the west chamber; J123 consists of the remains just above the floor in the west chamber; and J124 is the only open lot in the east chamber (Austin 2018).

K87 at Structure 100 was captured, continuing to chase the sloped platform wall down the currently invisible foundation phase (Lincoln 2018).

Chultun 18-01 finished with excavation and drawing. A final, comprehensive (not just the top unit and chultun opening) capture sequence was conducted on the chultun. The project end on sub-op and lot B7; the first capture of the feature was sub-op A (it will be assumed to be A1, should file renaming need to take place (Ruhl 2018).

June 7, 2018

Phase 8 and phase 6 of Structure 25 and 24, respectively (G47b and H48b, respectively) at Plaza C.

A mask with a well-preserved ear flare was found at Structure 22 at Plaza C. This was uncovered in the afternoon and a quick capture was taken for modeling. The model was processed and came out that day, but is not sufficient. A model will likely be created the next day. The mask is designated feature 18-01 for Structure 22, sub-op B, lot 45 (Quiroz and Pastrana 2018).

Structure 100 efforts have refocused from sub-op I to sub-op K, which is a potential burial (K88). In the afternoon, the sub-op was designated feature 18-01 for Structure 100. By the end of the day, the feature had been confirmed to be a burial and was designated burial 18-01 for Structure 100 (Lincoln 2018).

June 8, 2018

Phase 9 and phase 7 (G42-G47 and H38-H48) at Structure 25 and 24, respectively, were captured at the beginning of the day. Both north arrows are reliable. This was not the case for all early models and this was not indicated, but needs to be indicated on all models to ensure orientation accuracy. Next season, either a small laser scanner with reliable orientation and scaling needs to be used or PhotoScan Pro needs to be bought and targets need to be used for scaling. A method for orientation is also needed for the latter method using photogrammetry (SfM? Still need to check the difference between those two methods). A small drone could work, or finding some way to link targets to a coordinate system, which can integrate with GIS (geographic information science?) data. Can GPS data be linked to a camera in the same way that a drone has GPS information embedded in the images?

While at Plaza C for Structure 25 and 24, another round of captures for feature 18-01 at Structure 22 (B45b). This capture was more thoroughly conducted and the lighting was consistent and exceptionally good.

June 9, 2018

Final capture sequence for chultun02 i.e. chultun 16-02, at Structure 32 in the Structure 32 Courtyard Group. This capture included all three chambers: north, east, and west. Capture also contains the opening into the north chamber, the opening into the interstitial space between the chambers, as well as the capped opening in the west chamber. In addition to these openings, a few shots were taken to include the top surface context of the openings and the excavation trench. Using flash, and taking about 13 images every 3 minutes, the total capture procedure took about 2 hours. The 3 minute period to take 13 images is due to the decreased endurance in the camera's flash bulb. This is highly problematic as it is easy to lose track of where the last image in the sequence was taken.

Potential artifact models: matte ceramic, obsidian core, sf-biface from northern chamber of Chultun 16-02, jaguar head figurine.

June 11, 2018

Note: Structures 24 and 25 mentioned in preceding sections are now Structure 23 and 24; Structure 25 is the structure on the north end of the plaza that was excavated and documented in 2017 (Leonard 2018).

June 12, 2018

Documentation of Structures 23 and 24 continued at Plaza C with captures of H48d and G47f, respectively. The continued use of H48 and G47 for designating the model layers is due to this being the farthest depth and lot for the respective structures. A plan view overlay, showing the different lots existing simultaneously in each model will be needed. Additionally, this visual method could serve an excellent means to monitor and teach the evolution of archaeological excavation strategies. This method could even ease in handing off excavations between archaeologists.

Structure 100 continued work with J95 (trench behind the big stairs) and L89b (the unit adjacent to the small stone wall on the northern end of the structure) (Lincoln 2018). These capture sequences (as well as those in Plaza C) are now averaging around 100 images per model, which has become a manageable size for processing, yet still relatively high resolution. However, this still needs to be tested through comparison of exports images of the point clouds.

June 13, 2018

Structures 23 and 24 were documented and designated (in the modeling realm) H48e and G47g, respectively. Again, the illustration of these multiple lots existing in a single capture needs to be clear and diagnostic. However, it is still unclear how this will translate into the organization of the image and model files.

Structure 100 continued work on sub-op J with J96. This lot likely ended today and began J97. The sub-op is now breaking through the stairs in a unit that is roughly 1 meter wide (Lincoln 2018).

June 14, 2018
Documentation continued at Structures 23 and 24 in Plaza C with lots H48f and G47h, respectively (Quiroz and Pastrana 2018).

Lot J97 closed excavation at sub-op J, which cut through the staircase on the north end of the building (Lincoln 2018).

June 15, 2018
Operations closed at the end of the day for Structures 23 and 24 at Plaza C. Documentation continued with lots H48g (Structure 23) and I50 (Structure 24b); Structure 24 has since been split into two structures: 24a and 24b. Structure 24b is the structure that consists of a round wall structure. Structure 24a deteriorates about 2 meters away from Structure 24b, and largely consists of a wall, building floor, and plaza floor (Leonard 2018).

Operations at Structure 100 opened a new sub-op (M), which is penetrating the main platform between sub-ops K and J. Documentation continued with lot M101 (Lincoln 2018).

June 18, 2018
Documentation continued in Plaza C with Feature 18-01 at Structure 22. Lot B34 was documented at the beginning of the day and B52 was documented at the day's end. B52 consists of material 20-30 centimeters above the floor, while B34 is 20-30 centimeters above that layer; B33 is the sub-humic transition layer and B31 is the humic layer. There should now be a special deposit associated with this area (that is just east of the mask with the ear flare i.e. Feature 18-01), which is designated XO 18-02. The special deposit in Chultun 16-02 in Structure 32 of the Structure 32 Courtyard Group should be Special Deposit XO 18-01 (Quiroz and Pastrana 2018).

Despite a temporary hold on operations at Structure 100, documentation continued. The documentation closed out sub-op M, though the lot number is still needed. There is also another sub-op started between M and K, which might be designated sub-op N. This will be updated when that information is available.

June 20, 2018
Documentation continued with Feature 18-01 (mask) at Structure 22 with lots B52b and B52c. The method for organizing units and lots is akin to those used at Structures 23 and 24, where the humic layer and all subsequent layers within the same lot. B31 is the humic layer; B33 is the sub-humic transition layer; B34 is the upper construction layer of about 20-30 centimeters; and B52 is the lower construction layer of about 20-30 centimeters above architecture (in this case, the floor) (Quiroz and Pastrana 2018).

July 3, 2018
Operations have temporarily (maybe permanently) halted at Structure 100. The terminal lots are N102, M101, J98, K88, L90, I82, and H83. Sub-op L only consisted of lots 89 and 90 (Lincoln 2018). Capture was designated N102 and captured 654 images, and consisted of sub-ops N, M, J, K, I, and H (not L).

Documentation of Feature 18-01 (mask) at Structure 22 in Plaza C continued with another iteration of B52 with B52d of 229 images.

July 4, 2018
While Xno'ha was not documented this day, some information concerning the mask and the chultuns at Structure 32 Courtyard Group came to light. Feature 18-01 (mask) at Structure 22 is complete and will be documented tomorrow. Ceramics found in J124 (final lot) of Chultun 16-02 at Structure 32 (in the Structure 32 Courtyard Group) match with ceramics found in H104 and H105 (the last captured layer before closing the chultun is unmarked, but the preceding layer is H107) of Chultun 16-01 at Structure 33 (in the Structure 32 Courtyard Group). H104 and H105 should fall within the "boot" area of the chultun. This indicates that both of these chultuns (or at least these openings) were accessible simultaneously, and that the vessel was broken and distributed into two separate deposits (very likely deliberately). This finding and the number of partial ceramic vessels leads to asking whether there are more chultuns beneath the structures at Structure 32 Courtyard Group (Hanratty and Riggs 2018).

July 5, 2018
Feature 18-01 (mask) at Structure 22 in Plaza C is closed, and will be tarped for protection tomorrow (Quiroz and Pastrana 2018). This should keep the mask well-protected until the fourth session, where it can be documented using the new Arktek hand-held laser scanner.

July 10, 2018
Documentation resumed at Structure 24a and Structure 24b with lot I51. Lot I51 is about 20 centimeters below fill; lot I50 is the sub-humic transition layer; and lot I49 is the humic layer. Sub-op I is the designation for all new lots pertaining to Structure 24b (Leonard 2018).

July 12, 2018
Documentation continued with lot I51b of Structure 24a and Structure 24b, but the excavation only pertained to Structure 24b.

Tz'unun
May 30, 2018
The inaugural 3D documentation of Tz'unun aimed at three structures being cleared for excavation, as well as the newly cleared footpath for archaeologists at the site. Three checkerboard targets were placed at the first intersection of paths, with the first of two possible residential platforms to the north and the two large temples flanked by the ball court to the south. Distances were measured between target centers using a hand laser measure (these need to be measured again using a Total Data Station), and can become incorporated into both the SfM model and the laser scanning model (laser scanning will be done in the fourth session;

last two weeks of July).

Capture at the site consisted of a total of 2,342 images covering four sections of trails, and three individual structures. Processing of these images is in progress with about 5 days remaining as of 17:45 May 31, 2018. Image files were organized into the individual structures as well as three sections of the trails. If the initial alignment fails, or partially fails, alignments of these smaller chunks will be conducted.

June 14, 2018

Tz'unun currently has four operations underway: TZ 18-01 (Josh Kwoka at Structure 21; Stela 1 & 2), TZ 18-04 (Kevin Austin at Structures 4 and 5; currently the excavation is not formally either structure, but is focusing on the alley between the ballcourt platforms), TZ 18-06 (Aubrey O'Toole at Structure 9; next to Structure 1, which is the larger of the two temples east of the ballcourt), and a chultun being excavated near Structure 21 and the platform for the eastern portion of an E-Group (Thomas Ruhl). TZ 18-07 will be the residential platform near the smaller of the two temples near the ballcourt (Jessie Leonard) (Kwoka 2018).

Documentation began with Stela 1 & 2 with lot A1, near Structure 21. This also captured the adjacent face of Structure 21 as well as the looters trench on the northeast side of the structure.

The alley between the ballcourt's was documented as lot A1 for Structure 4. The unit measures roughly 2 meters north-south, and 3 meters east-west. (Austin 2018).

Documentation started (the baseline file came out, and is usable, but may be omitted) for Structure 9 with lot A1. The unit measures roughly 2 meters east-west, and 4 meters north-south. (O'Toole 2018).

June 16, 2018

Documentation of Stela 1 & 2 at Structure 21 continued with captures of lots A1b and A1c. Portions of these capture sequences are likely to get designated with another lot number as seems to be some kind of special deposit in front of the structure. (Kwoka 2018).

Documentation of Structure 4 and 5's alley continued with the lot designated A4. Here, A4 is the humic layer of the extension of the initial unit east toward the ballcourt platform. The extension moves the unit east 1 meter, making it 2 meters north-south, and 4 meters east-west. A1 is the humic layer of the initial 2 by 3 meters unit; A2 is collapse to ballast in that unit; and A3 is collapse to the floor. (Austin 2018)

Documentation of Structure 9 continued with lot A4. The exposed wall is in good condition (running east-west), and the floor near the wall is in good condition, but deteriorates moving north in the unit. A new unit has been marked out, almost centered on the north-south axis of the first unit. This unit runs 4 meters east-west and 2 meters north-south. (O'Toole 2018).

June 19, 2018

Documentation continued with Structures 9 and 4; lots B6 and A6 were captured, respectively. Structure 4 capture saw the end of A6 and the beginning of A7. A7 for Structure 4 extends the 2 meter by 4 meter unit another meter east, making the entire unit now a 2 meter north-south by 5 meter east-west unit. (Austin 2018).

Structure 9 capture saw B6 in progress. Structure 9 appears to have a well-preserved wall extending into its B sub-op, which is set 63 centimeters south of the north end of sub-op A. Sub-op B runs 2 meters north-south and 4 meters east-west. Current open lots for Structure 9 are A2, A4, B5, and B6, but sub-op A is currently not being worked on. (O'Toole 2018).

Considerable material was moved at Structure 21 and around Stela 1 & 2. Documentation continued in the mid-morning with lot A10a of Stela 1 & 2 at Structure 21, with end-of-day documentation of A10b. Field notes include descriptions and mappings of the lots currently open and past lots open at Structure 21. Currently, lots A5, A6, A7, A8, and A10 are open. Lots A1, A2, A3, and A4 have been closed. Special Deposit 18-01 for Structure 21 will span multiple lots, and has large amounts of materials coming from A6, A7, and A8. Today brought in 6 5-gallon buckets of material, primarily of ceramics. A stemmed biface and a leaf-cut (check name) biface were also found in a niche of A7 adjacent (and perhaps in) A6. A ceramic with possible depiction of architecture (temple steps) and a glyph associated the wind god was also found in lot A8, although, the boundaries of A7 will change to take on more of what is A8. Also, these depictions are currently speculation and need to be verified. The reading above is preliminary and not to be taken as publishable fact at this time. A hollowed out ceramic with what appears to be three eyes and a cylindrical foot to rest on was also found (likely in A6). The figure resembles the head of a turtle, more specifically a soft-shell turtle, but this is also speculative at this time. (Kwoka 2018).

June 20, 2018

Documentation continued at Structure 9 with lot B7, with lots B6, A4, and A2 all exposed (O'Toole 2018).

Documentation continued at the ballcourt with new expansion into Structure 5 (the western ballcourt platform), but the capture sequence included previous work toward Structure 4. For Structure 5, B10 is the humic layer; B11 is collapse; and B12 the layer above alley floor and the ballcourt bench. Lots A8 and A9 were excavated near Structure 4 (Austin 2018). The capture sequence including both structures is designated B12 for Structures 4 & 5.

June 21, 2018

Documentation continued at Structure 21, Stela 1 & 2 with lot B2. Many lots are present and open in the same model (Kwoka 2018). A diagrammatic map was drawn in the field notes and will be translated onto an export image of the corresponding point cloud / model.

Excavation at Structure 4 and the ballcourt alley between Structure 4 and Structure 5 shifted focus to Structure 5, although new units have been added to the area near Structure 4 as well. The most recent lot is C20, but lots in sub-ops A and B are still open. Sub-op A designations are as follows: A1 is humic, A2 is collapse, A3 is collapse to floor, A4 is humic, A5 is collapse (possible wall and fill), A6 is wet fill, A7 is humic, A8 is fill, A9 is fill, A13 is humic, and A14 is collapse to the top of the bench. Sub-op B designations are as follows: B10 is humic, B11 is collapse, B12 is collapse to floor and bench, B15 is humic, and B17 is collapse to floor and bench. Sub-op C designations are as follows: C16 is below the first floor, C18 is below the first floor (with soil change), C19 is below second floor, and C20 is below third floor (Austin 2018).

Documentation continued at Structure 9 with lot B9. Lots A2 and A4 are closed, but are in the model; lots B6, B7, B8, and B9 are open and in the unit to the west of sub-op A. Sub-op B is 4 meters east-west by 4.4 meters north-south and is shifted 60 centimeters south of the northern end of sub-op A (O'Toole 2018).

June 22, 2018

Documentation continued at Structure 21, Stela 1 & 2 with lot C2; this meaning that C2 is the newest sub-op and the newest lot number. Other lots are open in this model. Within this model are sub-op A with A5, A6, A7, A8, and A10 open; sub-op B has B3 open; sub-op C has lot C2 open; and sub-op D has lots D1 and D2 open (Kwoka 2018). A second capture of the cache at Structure 21, Stela 1 & 2 is designated as Cache B and not included in the C2 model since the zoom (focal length) is closer to 55 millimeters (the typical excavation-sized models are captured using close to 18 millimeter lens length).

Documentation began (and ended for this season) at Chultun 18-05 with lot B3 (subterranean) and lot A6 (above ground). This chultun will be opened back up to continue excavation in 2019 (Ruhl 2018). While the capture focused on the upper bedrock and chultun opening, some of the interior (partially excavated) chamber came out in the processing. This indicates the beginning morphology for the chambers. Right now, the chultun appears to have 3 chambers and resembles Chultun 16-02 at the Structure 32 Courtyard Group at Xno'ha. Resembles this chultun if Chultun 16-02 were filled with sediment, as Chultun 18-05 is.

July 4, 2018

Documentation continued at Structure 21 with the most recent sub-op and lot being F1. The special deposit was pulled on Saturday, June 23, 2018, and might be termed a midden (while retaining its special deposit status) (Hanratty 2018; Kwoka 2018). The reasoning for this change in designation from a sub-stela cache is unclear. Capture consisted of roughly 200 images.

Work began at Structure 13 with establishing a founding unit running 2 meters north-south and 3 meters east-west (Lincoln 2018). The sub-op and lot number will likely be A1 and has currently been designated as such in this report, but is subject to change. Capture consisted of 50 images.

Documentation of Structure 9 with the most recent sub-op and lot being E14 (O'Toole 2018). Capture consisted of 167 images.

July 6, 2018

Documentation continued at Structure 21 with capture of F2 (and other simultaneously open lots) (Kwoka 2018). Lighting was a challenge considering the overcast day and additional tarps hung over the units. In order to reduce the use of a camera flash, images were taken with a longer exposure and lower F-stop (1/13 second exposure time and f/10 F-stop). This kept the ISO speed to around 3200. Focal length was 18 millimeters.

Documentation continued at Structure 13 with lot A3. Lighting was considerably better than at Structure 21, with brighter skies and one light blue tarp. Camera settings were set back to the standard that has been used most of the season with 1/20 second exposure time; f/16 F-stop; 18 millimeter focal length; and ISO set to automatic.

July 9, 2018

Documentation continued at Structure 4 and Structure 5 (ballcourt) with lot C21. The operation is Tz'unun 18-04 (TZ 18-04). This capture is at the beginning of C21 and will continue to penetrate through the center unit. C21 begins on the 4th floor found in the unit, and will penetrate through that floor (Austin 2018).

Documentation continued at Structure 21 with lot A33. The operation is TZ 18-01 (Kwoka 2018).

Documentation continued at Structure 13 with lot A4. A lot map was added to the original field notes for the day (page 85). The operation is TZ 18-07 (Lincoln 2018).

Documentation closed the day continuing at Structure 9 with lot F16. The operation is likely TZ 18-06, but needs verified. Lot E15 consists of the (O'Toole 2018).

July 11, 2018

Documentation continued at Structure 4 and Structure 5 with the capture of C24. This capture was lost when an error occurred with the camera and micro sd card in an sd card adaptor. Documentation was not lost for Structure 4 & Structure 5 of lots C25 and C27. C24 contains the 6th floor; C25 contains floor the 7th floor; and C27 contains the 8th floor (Austin 2018).

Documentation continued at Structure 21, but the data was lost due to an error with the camera and micro sd card in an sd card adaptor.

Documentation continued at Structure 13 with lot A6 (Lincoln 2018).

Documentation continued at Structure 9 with lot F18, which extends out east from the main part of the excavation (O'Toole 2018).

July 13, 2018

Documentation continued at Structure 21 with lot J34. The lot on top of shrine within the possible room is G29. Multiple lots are open and within each model, but the naming of the model files pertains to the latest lot number (Kwoka 2018).

Structure 9 was closed today, so the final capture for the structure was taken. The documentation concluded with the same lot as July 11, 2018, with F18b. Sub-op F is the east unit (O'Toole 2018).

Documentation continued at Structure 13 with lot A6b. The lots have not changed since the documentation carried out on July 11, 2018 (Lincoln 2018).

3D Modelling Field School | Xno'ha & Tz'unun

Xno'ha

Laser Scanning

Laser scanning at Xno'ha consisted of work on Feature 18-01 (mask) at Structure 22 in Plaza C, Structure 74, the trail from Plaza A to Plaza C, Chultun 16-02 at Structure 32 in Structure 32 Courtyard Group, and Structure 23, Structure 24a, and Structure 24b (within the same laser scan project file) in Plaza C. At the close of the field school, most laser scan project files had been registered successfully (Feature 18-01, Structure 74, and Structure 23, Structure 24a, and Structure 24b), Chultun 16-02 did

not fully register (but will be in the immediate offseason), and the trail from Plaza A to Plaza C did not register (and will not be a priority to resolve in the immediate offseason).

Artifacts (Artec Structured Light Scanner & Photogrammetry)

Tz'unun

Laser Scanning

Laser scanning at Tz'unun consisted of work on Structure 9, Structure 21 (including Stela 1 & 2), Structure 4 and Structure Structure 5 (ballcourt), and Structure 13. At the close of the field school, most laser scan project files had been registered successfully (Structure 9, Structure 4 and Structure 5, and Structure 13), while Structure 21 is correctly registered with the exception of one scan position. Two solutions pertaining to correcting this issue are (1) attempt registration with target-based registration method versus the top-view and cloud-to-cloud method previously used and (2) simply remove the scan from the project (since it is on the unexcavated side of the structure and adds minimal data to the model).

Appendix B (Modeling Outputs)

PhotoScan

Xno'ha (69 models)

Chultun 16-02 / Structure 32 / Structure 32 Courtyard Group

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
J115	149	146/149	131,220	12,805,151	Medium	2,561,030	180531
J116	93	93/93	95,085	38,842,124	High	7,768,399	180531
J117v	97	90/97	116,709	48,525,382	High	9,704,977	180601
J117	96	96/96	184,185	39,157,470	High	7,831,493	180602
J120v	47	36/47	27,486	14,888,955	High	2,977,768	180604
J119a	96	96/96	104,949	38,662,074	High	7,732,414	180604
J119-J120	108	108/108	207,517	46,424,832	High	9,284,966	180604
J121a	75	72/75	79,781	33,107,472	High	6,621,494	180605
J121b	71	71/71	133,182	33,351,331	High	6,670,265	180605
J124a	136	122/136	129,871	55,227,713	High	11,045,542	180608
J124b-final	474	474/474	757,762	136,555,126	High		180609

Chultun 18-01

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
A	83	83/83	73,312	17,116,153	High	3,423,229	190222
B7	193	193/193	392,906	70,182,533	High		180606

Feature 18-01 / Structure 22 / Plaza C

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
B45	43	43/43	94,650	41,280,661	Ultra high	8,256,131	180607
B45b	157	157/157	113,764	52,665,848	High	10,533,160	180608
B34	125	125/125	179,523	29,381,357	High		180618
B52	65	65/65	110,411	29,171,875	High		180618
B52b	117	117/117	94,227	30,967,489	High		180620
B52c	246	246/146	207,516	36,686,258	High		180620
B52d	229	229/229	288,415	40,934,571	High		180703
B52e	174	174/174	213,935	37,768,033	High		180705

Structure 23 / Plaza C

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
H38	82	82/82	170,421	19,904,077	High		180601
H39	101	101/101	108,164	21,879,831	High		180602
H42a	98	98/98	107,766	19,023,148	High		180604
H42b	88	88/88	76,243	18,429,263	High		180605
H48a	107	107/107	111,929	20,153,567	High		180606
H48b	121	121/121	119,702	21,315,831	High		180607
H38-H48	109	109/109	129,137	25,792,014	High		180608
H48c	136	136/136	156,577	30,886,742	High		180611
H48d	91	91/91	117,381	27,974,104	High		180612
H48e	122	122/122	174,714	36,510,546	High		180613
H48f	160	160/160	378,776	41,438,507	High		180614
H48g	109	109/109	137,422	40,938,426	High		180615

Structure 24 / Plaza C

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
G37a	164	79/164	167,559	66,241,151	Ultra high	13,248,230	180529
G37b	51	51/51	56,265	51,615,130	Ultra high	10,323,026	180529
G40	148	148/148	87,343	7,215,779	Medium	1,443,154	180601
G41	120	120/120	110,664	19,803,375	High		180602
G47a	142	142/142	135,027	24,407,226	High		180604
G47b	152	152/152	115,355	24,828,192	High		180605
G47c	115	115/115	90,205	17,223,145	High		180606
G47d	106	106/106	111,681	19,150,513	High		180607
G42-G47	109	109/109	129,667	25,751,197	High		180608
G47e	87	87/87	108,752	19,799,669	High		180611
G47f	90	90/90	106,476	20,718,700	High		180612
G47g	140	140/140	152,090	29,266,497	High		180613
G47h	127	127/127	263,770	28,312,638	High		180614

Structure 24b / Plaza C

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
I50	49	49/49	47,539	24,813,826	High		180615
J56	119	119/119	114,660	28,767,346	High		180723

Structure 24a & Structure 24b / Plaza C

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
I51	174	174/174	331,353	39,089,546	High		180710
I51b	220	220/220	396,009	42,207,245	High		180712

Burial 18-01 / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
Burial 18-01	156	156/156	263,167	60,520,261	High		180607

Sub-Op I / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
I80	64	64/64	103,358	28,825,715	High	5,765,142	180529
I81	131	131/131	67,417	6,553,412	Medium	1,310,681	180601
I82	163	163/163	220,095	35,068,221	High	7,013,643	180602

Sub-Op H / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
H83v	164	164/164	127,226	33,006,216	High	6,601,242	180604
H83w	83	57/83	41,789	22,806,536	High		180605

Sub-Op K / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
K85	109	109/109*	75,111	31,933,541*	High		180605
K87	114	114/114	103,478	30,627,056	High		180606
K88	204	204/204	196,238	72,265,855	High		180607

Sub-Op J / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
J93	91	91/91	80,660	29,795,485	High		180608
J94	101	101/101	111,995	25,568,438	High		180611
J95	112	112/112	122,324	30,962,116	High		180612
J96	112	112/112	106,971	30,560,871	High		180613
J97	156	156/156	310,087	44,332,911	High		180614

Sub-Op L / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
L89a	31	31/31	41,134	9,675,951	High		180608
L89b	73	73/73	70,923	21,439,551	High		180612

Sub-Op M / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
M101	91	87/91	83,282	22,225,044	High		180615
M-N	113	113/113	120,001	26,880,462	High		180618

Sub-Op N / Structure 100

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
N102	654	654/654	1,294,121	44,176,039	Medium		180703

Tz'unun (41 models)
Site baseline

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
Site baselines	2,342						180531

Trails

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
Trail1	288	288/288	537,220	20,419,565	Medium		180531
Trail2	1,064						180531
Trail3	272	228/272	396,205	25,278,078	Medium		180531

Chultun 18-05

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
B3	99	99/99	116,318	42,654,489	High		180622

Structure 4 & Structure 5 (ballcourt)

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
A1 str4	34	31/34	25,062	63,309,021	Ultra high		180614
A4 str4	96	62/96	120,517	65,366,313	Ultra high		180616
A6 str4	91	91/91	53,346	20,408,600	High		180619
B12 str4 & str5	134	134/134	142,735	33,726,026	High		180620
C20 str4 & str5	130	130/130	154,769	33,027,866	High		180621
C21 str4 & str5	194	194/194	178,413	46,192,303	High		180709
C25 str4 & str5	82	82/82	89,285	20,168,480	High		180711
C27 str4 & str5	87	87/87	148,978	21,166,439	High		180711
D30 str4 & str5	260	260/260	481,921	74,171,375	High		180716

Structure 6

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
Baseline	133	133/133	269,852				180531

Structure 9

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
Baseline	98	65/98	93,240	21,319,723	High		180531
A1	37	37/37	48,438	15,449,564	High		180614
A4	108	108/108	222,792	31,658,119	High		180616
B6	116	116/116	216,371	35,562,702	High		180619
B7	170	170/170	182,164	42,602,416	High		180620
B9	182	181/182	198,336	48,163,292	High		180621
E14	167	167/167	211,709	55,384,129	High		180704
F16	197	197/197	224,850	51,830,652	High		180709
F18	171	169/171	339,161	48,186,584	High		180711
F18b	174	173/174	235,518	57,794,737	High		180713

Structure 13

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
A1	50	24/50	23,413	12,982,667	High		180704
A3	83	83/83	93,718	22,617,431	High		180706
A4	136	136/136	280,831	30,962,793	High		180709
A6	153	153/153	183,485	38,439,432	High		180711
A6b	174	174/174	194,770	42,107,256	High		180713

Structure 21

Feature	Images	Alignment	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
Str21a	213						180531
Str21b	274						180531
Str21	487	403/487	409,869				180531
A1 Stela 1+2	205	200/205	377,762	18,323,214	Medium	3,664,641	180614
A1b Stela 1+2	93	93/93	153,676	26,479,999	High		180616
A1c Stela 1+2	94	94/94	199,421	28,035,751	High		180616
A10a Stela 1+2	170	170/170	350,756	44,550,099	High		180619
A10b Stela 1+2	177	167/177	277,254	42,501,783	High		180619
B2 Stela 1+2	193	193/193	310,410	52,106,845	High		180621
Cache Stela 1+2	31	31/31	55,831	10,004,391	High	2,000,875	180621
C2 Stela 1+2	163	163/163	263,866	37,170,372	High		180622
Cache B Stela 1+2	31	31/31	33,938	9,530,249	High	1,906,037	180622
F1	199	199/199	402,693	54,403,644	High		180704
F2	169	169/169	422,327	60,681,963	High		180706
A33	216	216/216	259,445	62,890,764	High		180709
J34	340	325/340	400,175	1 06,718,605	High		180713

FARO Scene / Autodesk ReCap / E57 (from PhotoScan)

Xno'ha

Chultun 16-02 / Structure 32 / Structure 32 Courtyard Group

Feature	E57	Scene	Scene points	E57 update	ReCap	Image exports	Date
J115	Yes	Yes	12,725,816	Yes	Yes	5	181107
J124b-final	Yes	Yes	135,796,617	Yes	Yes	15	180623

Chultun 18-01

Feature	E57	Scene	Scene points	E57 update	ReCap	Image exports	Date
A	Yes	Yes	17,107,789	Yes	Yes	A bit	190222
B7	Yes	Yes	69,856,967	Yes	Yes	A bit	190222

Feature 18-01 / Structure 22 / Plaza C

Feature	E57	Scene	Scene points	E57 update	ReCap	Image exports	Date
B52e 90	Yes	Yes	37,633,396	Yes	Yes	Lots	180707
B52e 02	Yes	Yes	37,633,396	Yes	Yes	Also lots	180707

Burial 18-01 / Structure 100

Feature	E57	Scene	Scene points	E57 update	ReCap	Image exports	Date
Burial 18-01	Yes	Yes	60,487,094	Yes	Yes	17	180609

Sub-Op J / Structure 100

Feature	E57	Scene	Scene points	E57 update	ReCap	Image exports	Date
J93	Yes	Yes					190222
J94	Yes	Yes					190222
J95	Yes	Yes					190222
J96	Yes	Yes					190222
J97	Yes	Yes	(all) 53,208,627				190222

Tz'unun

Structure 4 & Structure 5 (ballcourt)

Feature	E57	Scene	Scene points	E57 update	ReCap	Image exports	Date
A4_str4	Yes	Yes	62,206,602	Yes	Yes		180619

Structure 21

Feature	E57	Scene	Scene points	E57 update	ReCap	Image exports	Date
Stela1+2	Yes	Yes	18,249,779	Yes	Yes		181015
B2 Stela 1+2	Yes	Yes	51,956,851	Yes	Yes		180707
J34	Yes	Yes	106,374,087	Yes	Yes		181016

FARO Scene / Autodesk ReCap / E57 (from Laser Scanning)

Xno'ha

Feature 18-01 / Structure 22 / Plaza C

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str22mask	11	Yes	119,536,380	5.0	Pts			180719

Structure 23, Structure 24a, & Structure 24b

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str23_24	28	Yes	268,962,951	4.2	Pts	Yes	Yes	180727

Chultun 16-02 / Structure 32 / Structure 32 Courtyard Group

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str32 chultun	11	Yes						180723

Structure 74

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str74	10	Yes	131,363,893	8.1	Pts	Yes		180719

Trails

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Plaza C	7	Yes						180723

Plaza C (2017)

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str18-19-22-25	43	Yes	722,419,499		E57	Yes		180708

Tz'unun

Structure 4 & Structure 5

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str4_5	20	Yes	311,178,345	4.6	Pts	Yes	4	180726

Structure 9

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str9	11	Yes	170,514,062	6.2	Pts	Yes	Yes	180720

Structure 13

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str13	15	Yes	223,862,436	4.2	Pts	Yes	Yes	180728

Structure 21

Feature	Scans	Scene	Scene points	Error (mm)	E57/pts	ReCap	Image exports	Date
Str21	23	Yes	342,622,430	4.9*	Pts	Yes	Yes	180725

Artifacts (Photogrammetry and Artec Structured Light Scanner)

Xno'ha

17-8333/18-8356 / Ceramics / XO 16-01
[17-8333/18-8356, XO 16-01, Str33, H104;105, Chultun 16-01, Austin, July 2017, Ceramics]

Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
18-8356 01	94	94/94	Success*	52,481	6,415,384	High		180730
18-8356 02	95	95/95	Success*	84,478				180801
18-8356 03								180801

Artec Structured Light Scanner

Trial	Scans	Success / Fail	Max Error Mean (mm)	Max-Max Error (scan)	Max Error (mm)	Min-Max Error (scan)	Min-Max Error (mm)	Date
01	4	Success*	0.2	2	0.3	3	0.1	180718

18-8357 / Brownware Plate Rim & Base / XO 16-01
[18-8357, XO 16-01, SD 18-01, Str32, J124, Chultun 16-02, Austin, May-June 2018, Brownware Plate Rim & Base]

Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
18-8357A 01	138	138/138	Success*	104,072	5,751,232	High	1,150,246	180730
18-8357B 01	220							180731
18-8357A 02	140	140/140	Success	102,050		High		180801

18-8348 / Re-fit / XO 16-01
[18-8348, XO 16-01, SD 18-01, Str32, J119, Chultun 16-02, Austin, June 2018, Re-fit]

Artec Structured Light Scanner

Trial	Scans	Success / Fail	Max Error Mean (mm)	Max-Max Error (scan)	Max Error (mm)	Min-Max Error (scan)	Min-Max Error (mm)	Date
01								180718

18-8359 / Biface / XO 16-03
[18-8359, XO 16-03, Str74, B20, Burial 18-02, Miller-Wolf/Quiroz, 7.6.2018, Biface]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	165							180724

Artec Structured Light Scanner

Trial	Scans	Success / Fail	Max Error Mean (mm)	Max-Max Error (scan)	Max Error (mm)	Min-Max Error (scan)	Min-Max Error (mm)	Date
01								180724

Tz'unun
18-8258 / Eccentric / TZ 18-01
[18-8258, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.20.2018, Eccentric]
Artec Structured Light Scanner

Trial	Scans	Success / Fail	Max Error Mean (mm)	Max-Max Error (scan)	Max Error (mm)	Min-Max Error (scan)	Min-Max Error (mm)	Date
01								180721

18-8259 / Biface #1 / TZ 18-01
[18-8259, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #1]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	276	276/276	Fail					180721
02	162	162/162	Success	65,421	5,651,346	High	1,130,268*	180724

18-8260 / Biface #2 / TZ 18-01
[18-8260, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #2]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	89	89/89	Success	43,245				180724

18-8261 / Biface #3 / TZ 18-01
[18-8261, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #3]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	107	107/107	Fail	53,278				180724

18-8262 / Biface #4 / TZ 18-01
[18-8262, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #4]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	81							180724

18-8263 / Biface #5 / TZ 18-01
[18-8263, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #5]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	82							180724

18-8264 / Biface #6 / TZ 18-01
[18-8264, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #6]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	61							

18-8265 / Biface #7 / TZ 18-01
[18-8265, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #7]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	66							

18-8266 / Biface #8 / TZ 18-01
[18-8266, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #8]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	46							

18-8267 / Biface #9 / TZ 18-01
[18-8267, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #9]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	64							

18-8268 / Biface #10 / TZ 18-01
[18-8268, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #10]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	49							

18-8269 / Biface #11 / TZ 18-01
[18-8269, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #11]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	54							180724

18-8270 / Biface #12 Eccentric / TZ 18-01
[18-8270, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #12 Eccentric]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	99							180724

18-8271 / Biface #13 / TZ 18-01
[18-8271, TZ 18-01, SD 18-01, Str21-Stela2, A7, Cache 18-01, Kwoka, 6.23.2018, Biface #13]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	81							180724

Structure 21 Cache Vessel / TZ 18-01
[TZ 18-01, Str21, Cache 18-02, Kwoka, 7.19.2018, Cache Vessel]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
Bottom 01	60	60/60	Success	82,584				180730
Top 01	55							180730
Bottom inside 01	70	70/70	Success	80,336	11,766,993	High		180730
Bottom full 01	122	122/122	Fail	177,447				180730

18-8353 / Sierra Red Bowl / TZ 18-05
[18-8353, TZ 18-05, A4, Chultun 18-01, Ruhl, 6.16.2018, Sierra Red Bowl]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	91	47/91	Fail					180721

Artec Structured Light Scanner

Trial	Scans	Success / Fail	Max Error Mean (mm)	Max-Max Error (scan)	Max Error (mm)	Min-Max Error (scan)	Min-Max Error (mm)	Date
01								180718

18-8236 / Ceramic / TZ 18-06
[18-8236, TZ 18-06, Str9, E15, O'Toole, 7.5.2018, Ceramic]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	95	95/95	Success	119,109	11,266,258	High	2,253,250	180727

Blue Creek
BC3304 / Large Eccentric Biface
[BC3304 N73, Cache 35, Large Eccentric Biface]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	112	71/112	Fail	32,779				180724
02	90	87/90	Fail	86,464				180724
03	206							

BC3318 / Large Eccentric Tridentate
[BC3318 N73, Cache 35, Large Eccentric Tridentate]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01								180724
02	169							180724

Nojol Nah
NN1025 / Black Sherd
[NN1025, Black Sherd]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	68	68/68	Fail	44,428				180727

NN602 / Shell Whistle
[NN602, Shell Whistle]
Photogrammetry

Trial	Images	Alignment	Success / Fail	Tie points	Dense point cloud	Dense point cloud quality	Surface mesh faces	Date
01	116							180726