

McElmo Flume LIDAR Scanning Project Report

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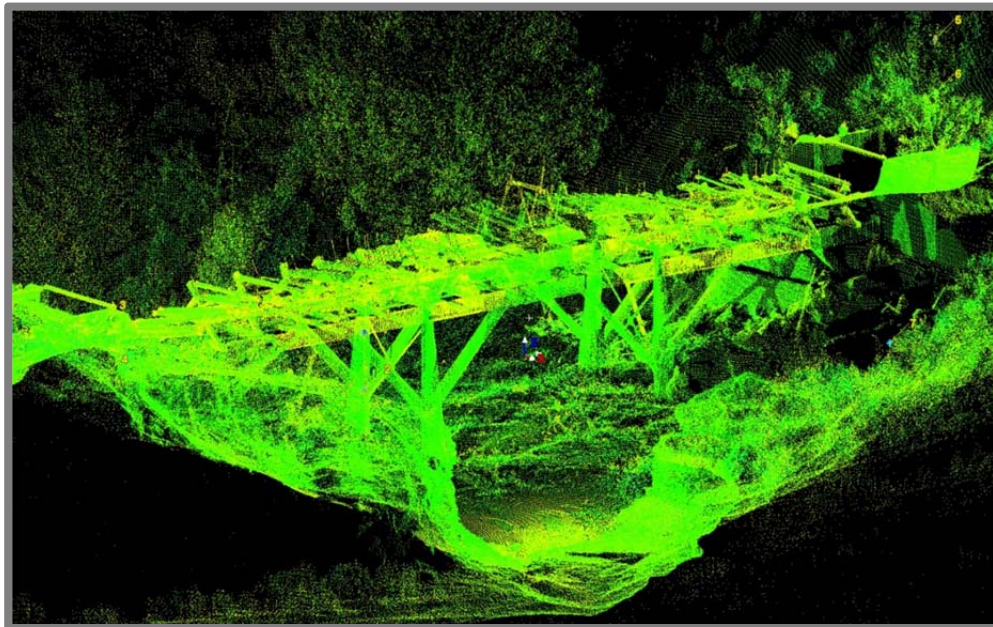
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- ❖ General Site Procedures
- ❖ Procedures and Scanning Effort Details
- ❖ Site Photos and Working Screen Shots
- ❖ Field Notes

General Site Procedures

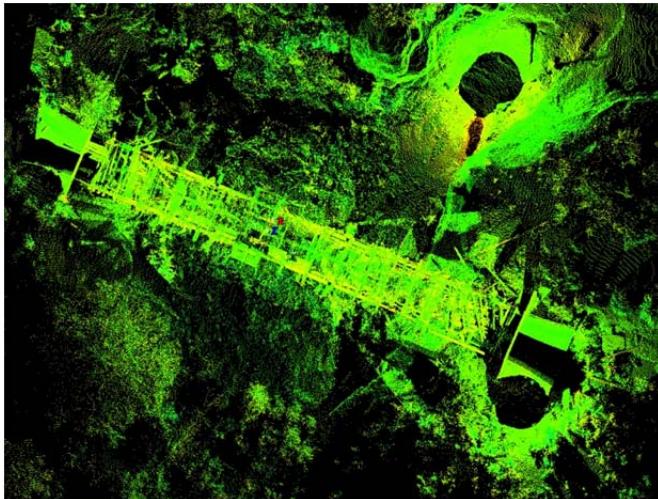
Onsite Description of Technical Processes:

Using LiDAR to digitally scan a site and/or structure is different for every project. Depending on the desired outcomes and deliverables expected the strategies involved can vary widely. For the most part though, the equipment we bring is similar. Besides the Leica made Scan Station 2, we use a PC laptop to control the scanner, a standard Ethernet cable to connect the two, a number of HDS targets on tripods, two large batteries to power the scanner, a tribrach, Nodal Ninja, Digital SLR camera, and a separate, heavy tripod that supports the 40 pound, fully robotic scanner. We also bring a gas-powered generator with us to most sites, as they tend to be remote. The generator powers the laptop and charges the batteries used for the scanner.



HDS target at McElmo Flume

Once a thorough site inspection has been completed so that scan locations and target locations have been identified the scanner is set up in its first location. These scan locations are determined based on efficient data collection and wide coverage of the site and or structure that is being documented. Once the scanner is ready it is connected to the PC laptop via the Ethernet cable. We use a software program called Cyclone (made by Leica) to connect the scanner to the laptop. After the appropriate settings are established the scanner can now be controlled by the laptop. The scanner is equipped with a digital camera (low quality) inside and has the capability of taking a nearly 360-degree image from the perspective of the scanner. This allows us to see what the scanner sees from the laptop. We can now see what the scanner sees and can begin to select what to scan through this digital image provided to us through the Cyclone software interface.



Aerial view of scan data at McElmo Flume

Once we can see this preview image the scanning can begin. Depending on how much and at what point densities we are scanning a scan can take anytime between 15 minutes and several hours to complete. The scanning itself is not the only thing going on at each scan location. Within each scan we are also acquiring HDS (High Definition Surveying) targets. These are very precise points in space that allow us to tell the scanner where it was in space in relationship to the other scan locations. This is important for post-processing efforts once data collection is complete. The process telling the computer where each scan location was in relation to the other scan locations is called registration. This is when we tie all the scans together to create a completed 3D model.

Once scanning and target acquisition is completed we use the Digital SLR camera to collect better image information than the scanner can. We take the time to collect HDR (High Dynamic Range) photography at each location. HDR allows us to capture high quality images that give us more information than standard photography. We also collect RAW images for greatest quality and color range. We collect a 365-degree sphere of images that we later stitch together and texture map onto the point cloud data for a more photo-realistic 3D model.

Once scanning and HDR photograph is complete at each location the process of moving to the next location must be completed. During the process of moving all the equipment related to the scanning process it is critical to make sure that they stay out of the way of the scans. We often are shifting around the generator, battery boxes, scanner boxes, etc. to ensure we are only capturing the site and its structures. As we move equipment around we are also being very cautious not to shift targets. These HDS targets are so accurate that even an accidental touch can shift the target out of position giving you errors in the post-processing effort. The target locations are also very specific so they can be seen from multiple scan locations. At each location the scanner is disconnected, powered down and moved with care.



Scanner and equipment at McElmo Flume

Procedures and Scanning Effort Details for McElmo Flume

On Site Process:

The University of Colorado Denver scanned McElmo Flume and surrounding context using a Leica Scan Station 2 Scanner on Monday, August 6th 2012. Two CoPR employees, Julia Ausloos and Mike Nulty, arrived at the McElmo Flume site by 6:30 am and began scanning at the first location by 7:00 am. In total, seven different scan locations were acquired on site, and of those locations three consisted of 360 degree scans to acquire surrounding context of the flume. The remaining four scans consisted of detailed window scans of the flume and other important features. In addition to scanning, seven panoramic images were also captured at each location to be used for photo texturing during post processing. Seven HDS targets were used throughout the site as control points that would later tie all seven scan locations together. Five to seven targets were acquired at each location. The final scan was started at 3:00 pm and by 4:30 the CoPR employees were packed up and leaving the site. On average the 360 degree scan locations took about an hour and a half, while the other four window scan locations took about 45 minutes. (please see field notes for a more detailed scan schedule)

Initial Post-Processing:

On Monday, August 13th post processing of the McElmo Flume began. The seven panoramic images were processed and eventually applied to each scan location making the data look more photo realistic. All seven scan locations were registered together using only target registration with a Mean Absolute Error (MAE) of only .001 m. By Tuesday, August 14th all the data collected in the field was processed and ready to be used for creation of the site plan. In all 49 point clouds were created equaling 226,861,928 points total in the entire model.

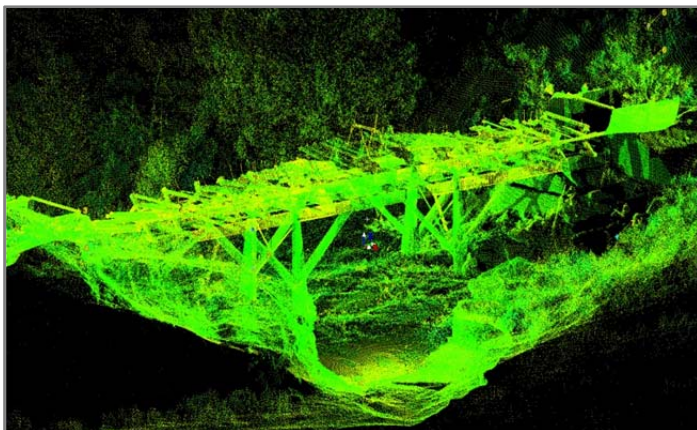
Deliverable Processing:

Leica's Cloudworx software was used to bring the scan data two-dimensionally into AutoCAD. The scan data was then traced in AutoCAD to create a scaled and accurate drawing of the flume and surrounding context. This drawings was then placed on a USGS topographic map and Bing aerial photograph. A final scaled orthogonal site plan was created combining all the information from the three sources: point cloud data, topographic map, and aerial photograph. In addition to the scaled orthogonal site plan, a smaller scale detailed drawing of the flume was provided, and four scan shots of the point cloud data.

Site Photos and Working Screen Shots

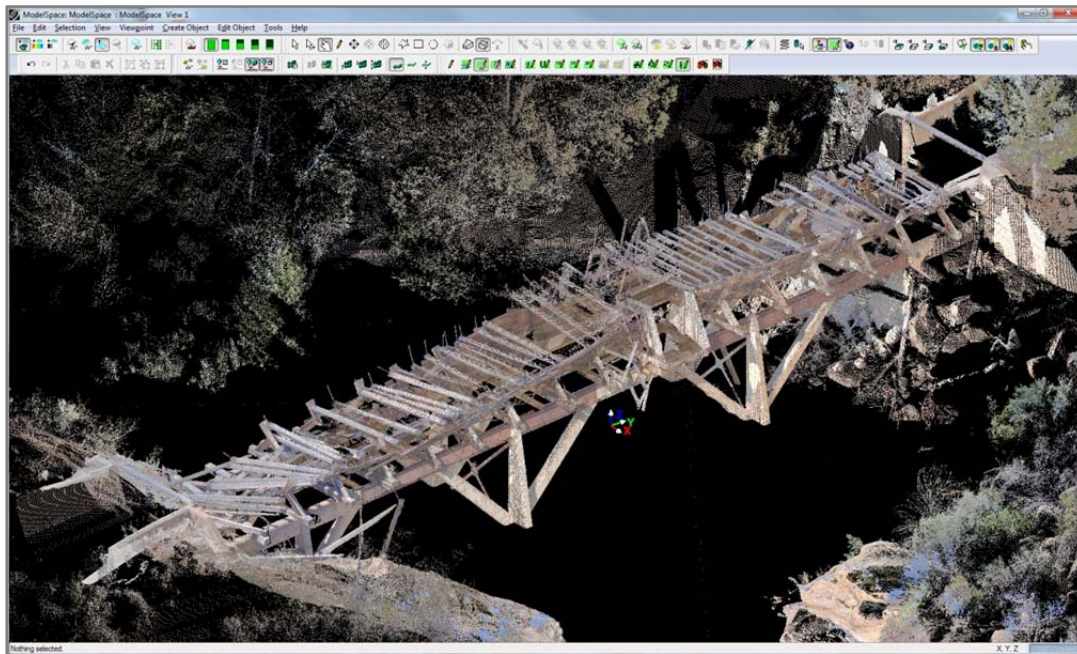


McElmo Flume being scanned by Leica Scan Station 2

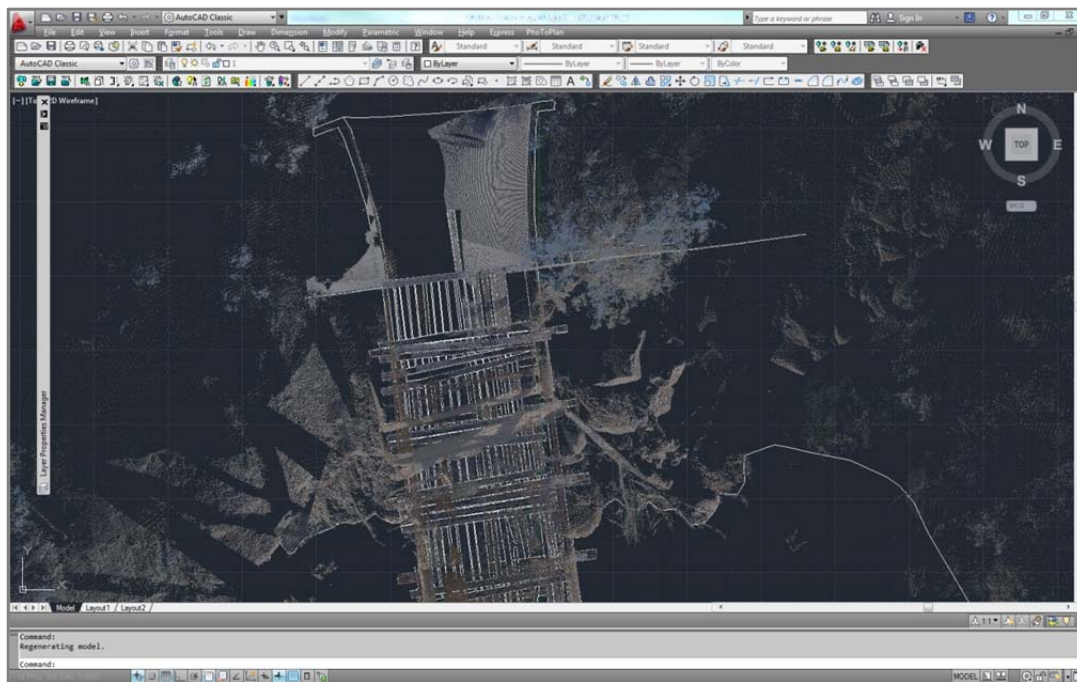


Scan data before and after photo texturing





Creek bed floor removed for ease of tracing flume

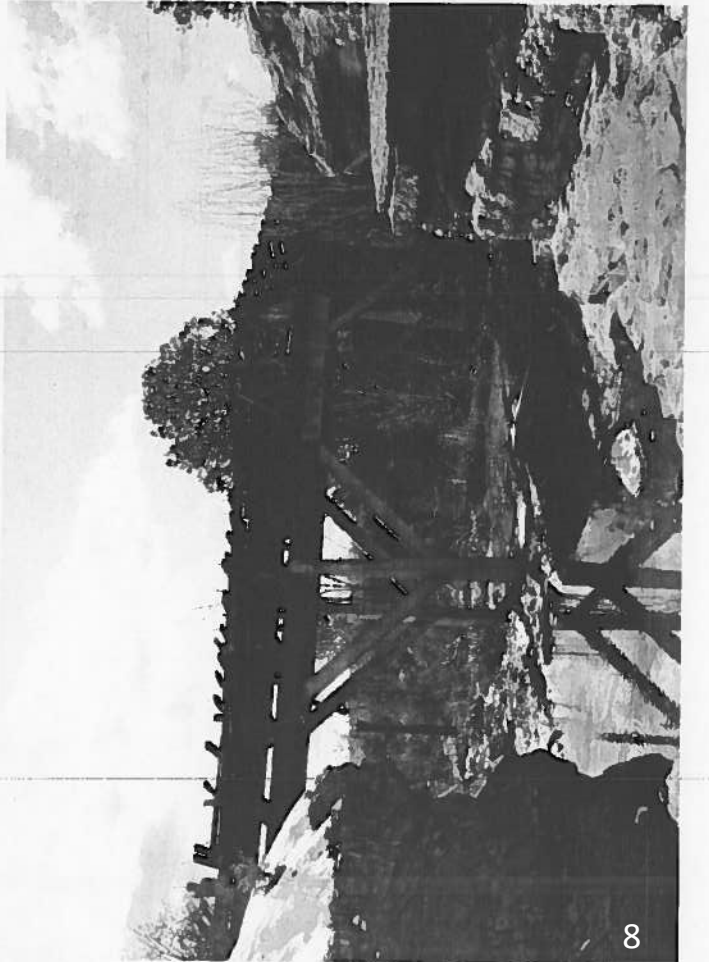
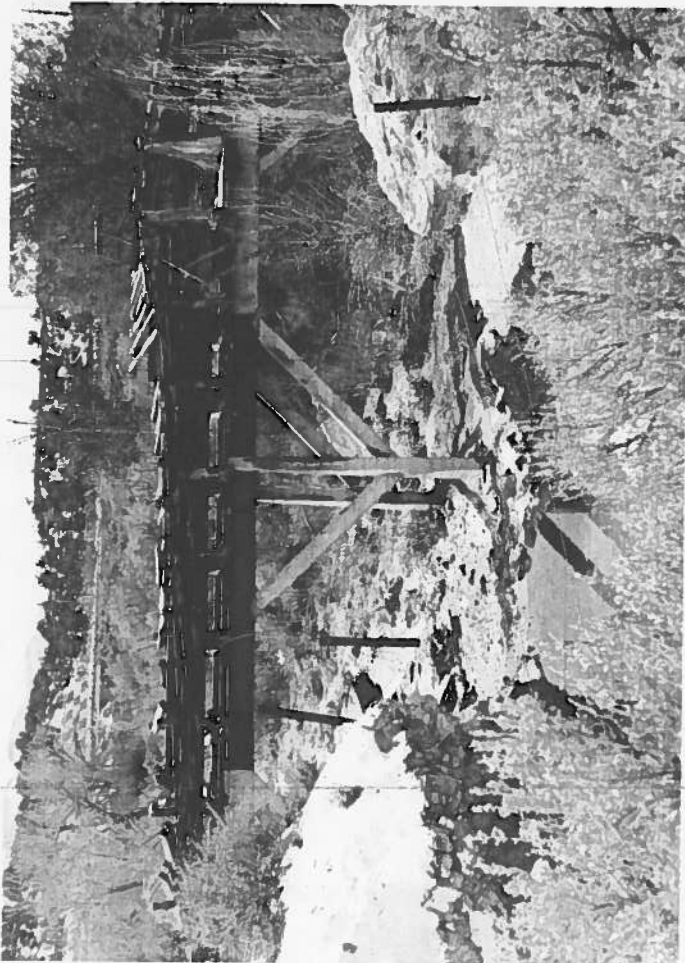
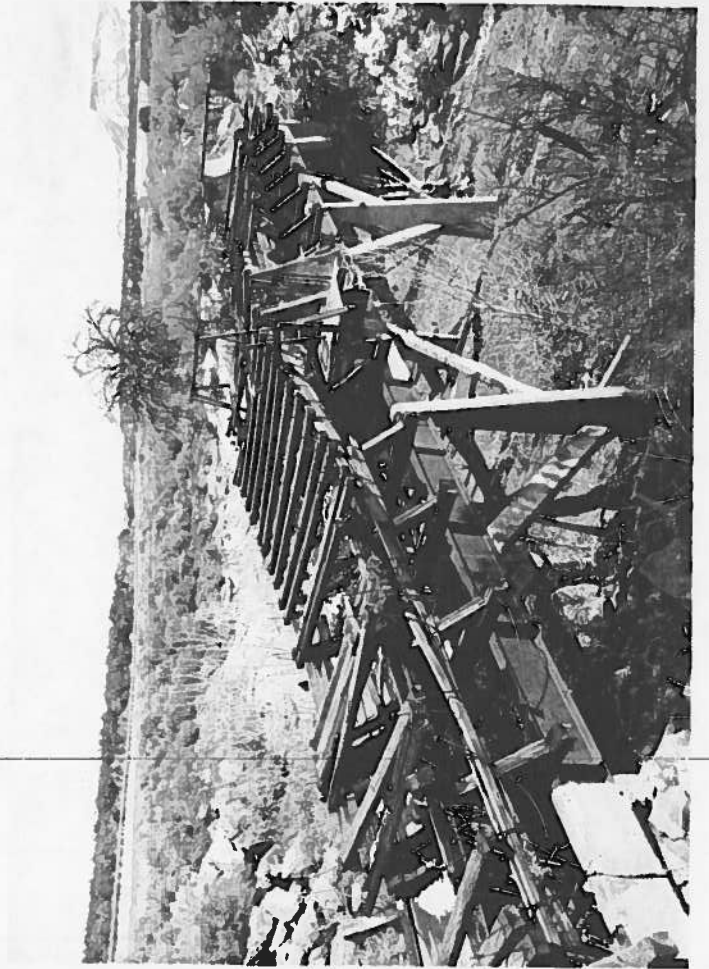


Flume being traced in AutCAD using Cloudworx pugin

McElmo Flume Site in context to the town of Cortez, Colorado



McElmo Flume Site Images
(Prior to Laser Scan)



McElmo Flume: Scan Schedule

6-Aug-12

Sunrise: 6:04 AM

Sunset: 8:07 PM

		Est time: scans, aq trgts, panos	Actual: time of day	Actual: length of time
Leave Hotel:	6:00 AM			
Arrive/Scope Site/Setup:	6:30 AM	1 hr 30 min		
Scan Station 01 (SS01)	7:00 AM	1 hr 30 min	7:00	
15 min				
Scan Station 02 (SS02)	8:30 AM	1 hr	8:30	1 hr
15 min				
Scan Station 03 (SS03)	9:45 AM	1.5 hr	10:00	1.5 hr
15 min				
Scan Station 04 (SS04)	11:45 AM	45 min	11:30	45 min
15 min				
Scan Station 05 (SS05)	12:30 PM	45 hr	12:30	45 min
15 min				
Scan Station 06 (SS06)	1:30 PM	1 hr 15 min	1:30	1 hr 15 min
15 min				
Scan Station 07 (SS07)	3:00 PM	1 hr	3:00	
Clean up:	4:00 PM			
Leave Site:	5:00 PM			

Sunny 80-90°



The University of Colorado Denver, College of Architecture and Planning, Center of Preservation Research

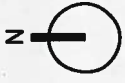
Digital Documentation Field Record

PROJECT NAME: McElmo Flume
 DATE: 8-6-12

Station:	Comments / Notes:	Pano Folder Name:	Scanner ID:	Scanner Height (m):	Scan Resolution (Xmm @ Xm):	Target IDs:	Target Types:	Target Heights (m):	Total Station or GPS Station:	GPS Height:
7am. SS 01	360° - 33 min. Window - 18 min.	MCE01			5mm @ 80m 5mm @ 40m	1, 2, 5, 6, 7				
SS 02	300° - 34 min Window - 20 min	MCE02			5mm @ 80m 5mm @ 30m	1, 2, 3, 4, 5, 6, 7		target 1 Not accurate target 2 Not accurate	7 Fine 5 scans	
SS 03	Window - 12 min Window - 9 min Window - 4 min	MCE03			6mm @ 10m 6mm @ 10m 5mm @ 4m	1, 2, 3, 4, 5, 7				
SS 04	Window - 20 min Window - 4 min	MCE04			5mm @ 14m 5mm @ 10m	2, 3, 4, 5, 7				
X 05	Window - 15 min	MCE05			5mm @ 30m	1, 2, 3, 5, 6, 7				
SS 06	360° - 30 min Window - 20 min	MCE06			5cm @ 80m 5mm @ 30m	1, 2, 3, 4, 5, 6, 7		Accidentally added extra target named 'X'	7 Fine Power Scanned Signs + Line	
SS 07	Window - 20 min	MCE07			5mm @ 30m	1, 2, 3, 4, 5, 6, 7				
SS 08										

McElmo Flume Site Aerial

8-6-12 SCAN LOCATIONS



Highway 160

