**SPARC Project Short Report: Using Total Viewsheds to Evaluate Visibility in the Placement of Chacoan Monumental Architecture**

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*Summary of work:*

Architecture—particularly the massive, arguably monumental structures that archaeologists call great houses and great kivas—is central to archaeological interpretations of Chaco Canyon, New Mexico, and it is the spread of great houses across a large part of the northern Southwest that supports the idea of widespread participation in an ideology centered on the Canyon. As with monumental architecture in other archaeological contexts, visibility has long been of interest in the study of Chaco-style architecture (e.g., Hayes and Windes 1975; Van Dyke et al. 2016). This project addressed the question of whether the builders of Chacoan architecture across the northern Southwest intentionally placed these structures in locations that would have been highly visible to people living in and moving through the local area. "Total viewsheds," cumulative viewsheds intended to represent relative degrees of visibility of a complete landscape, are highly relevant to this type of research question (Llobera 2003; Llobera et al. 2010). The method has seen limited use, however, because of the very significant amount of computing time required.

Following consultation with SPARC personnel, this project developed a novel modified total viewshed methodology. Rather than using each raster cell center as a viewpoint, as in a traditional total viewshed, we used a grid of viewpoints spaced at 5-cell intervals to generate our visibility surfaces. For a small sample of study areas, comparisons between true total viewsheds and these modified total viewsheds were carried out by standardizing both as proportions of the total number of viewpoints used to generate them. These comparisons showed little or no meaningful difference between the two products, supporting the use of the much less computationally expensive modified methodology. In addition, one of the co-PIs (White) developed a customized program able to utilize the processing cores of an NVIDIA graphics processing unit, further reducing the time needed to run the analysis to a fraction of what would otherwise be required (e.g., if using legacy viewshed tools in ArcGIS). Location data for great houses and great kivas were taken from the Chaco Social Networks database (Peeples et al. 2016). A detailed description of project data sources and methodology can be found in the publication listed below.

*Project results*:

Modified total viewsheds were generated for 9km-radius study areas around 430 total sites, 269 sites recorded as great houses and 161 non-great house sites with recorded great kivas. The total viewshed rasters were then simplified into visibility deciles (e.g., the 10$^{th}$ decile contains the 10 percent of raster cells with the greatest visibility), allowing comparison of the distribution of sites within visibility deciles to the uniform distribution of the landscape background. Great house locations are

disproportionally likely to fall into higher visibility deciles, while great kivas are relatively evenly distributed among high, moderate, and low visibility locations. These patterns are largely consistent over time, although the preference for highly visible locations for great houses may have become more pronounced over time. These patterns suggest that builders of great houses frequently sought out highly visible building sites for structures, and that this was likely generally not true for great kivas. This is in keeping with the interpretation of great houses as intended to display both participation in a Chacoan ideology and the power of their builders and residents. It may imply in addition that great kivas were less bound up with this kind of display. These patterns also fit with the "affordances" of the architectural forms themselves—great kivas are generally much smaller and shorter than great houses, and therefore lend themselves less to visibility, regardless of location. Beyond this, the modified total viewshed approach taken here has broader implications for studies modeling visibility; even without the use of a custom program, wider viewpoint spacing substantially reduces computing time.

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*Publications*

Katherine A. Dungan, Devin White, Sylviane Déderix, Barbara Mills, and Kristin Safi
2018 A Total Viewshed Approach to Local Visibility in the Chaco World. *Antiquity* 92:905–921. https://doi.org/10.15184/aqy.2018.135

Katherine Dungan, Devin White, and Sylviane Déderix
2018 "Visibility and Chacoan Architecture." *Archaeology Southwest Magazine* 32(2-3):33–34.

*Conference Presentation*

Katherine Dungan, Sylviane Déderix, Barbara Mills, Kristin Safi, and Devin White
2017 "Local Visibility and Monumentality in the Chaco World: A Total Viewshed Approach." Presented at the 82nd Annual Meeting of the Society for American Archaeology, Vancouver, BC, as part of the session "Recent Analytical Contributions to Chacoan Archaeology."

*Works Cited*

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2003 Extending GIS-based visual analysis: The concept of visualscape. *International Journal of Geographical Information Science* 17(1): 25–48.

Llobera, M., D. Wheatley, J. Steele, S. Cox & O. Parchment
2010 Calculating the inherent visual structure of a landscape ('total viewshed') using high-throughput computing, in F. Niccolucci & S. Hermon (eds.) *Beyond the artefact: Digital interpretation of the past: Proceedings of CAA2004, Prato 13-17 April 2004*: 146–151. Budapest: Archaeolingua.

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