Next Generation Very Large Array Memo #129

Transitioning to Rev F: Site Development Considerations

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Abstract

The current configuration for the ngVLA is Rev D. Rev D was highly aligned to available infrastructure, which would reduce the cost of building sites. Rev E was proposed to provide improved scientific value but was purely mathematical (Walker, 2022b) and did not closely follow infrastructure corridors. The evolution from Rev D to Rev E has been discussed extensively in previous memos (Carilli, 2022; Carilli et al., 2022; Walker, 2022a; Walker, 2022b). Efforts are underway to release Rev F as part of the preliminary design technical baseline. This baseline change was prompted by an effort to improve array performance over what was established in Rev D. The Rev F configuration is also optimized to reduce infrastructure costs and retain scientific value.

1 Introduction

The Next Generation Very Large Array (ngVLA) will span multiple US states, Mexico, and two oceans. Substantial infrastructure will be required to support this vast undertaking. Roads, power, and fiber are necessary to construct and connect the various array systems. Sites will also need to have access sufficient for construction vehicles and delivery of components. The cost of infrastructure for such a large project can be significant so any change that reduces cost while preserving performance is worthy of exploration. Array configuration has a direct correlation with cost of construction and also has a significant affect on scientific performance. The final (constructed) ngVLA configuration will need to be optimized to reflect the best scientific returns and most efficient infrastructure plan.

2 Rev D

Rev D was an early spiral configuration (Walker, 2018) designed to follow infrastructure corridors such as highways and right of ways (ROWs) which reduced building costs and encouraged use of existing utility corridors. Using existing ROWs reduces new ground disturbance in areas not previously disturbed and decreases the amount of new ROWs that have to be procured. Rev D sites were selected to avoid RFI, flooding, landslides, seismic activity, and wildfires (Carilli et al., 2021). Issues with the scientific performance of the Rev D configuration were identified (Carilli et al., 2022; Walker, 2022b) and several options, one of which would become Rev E, were proposed (Walker, 2022b).

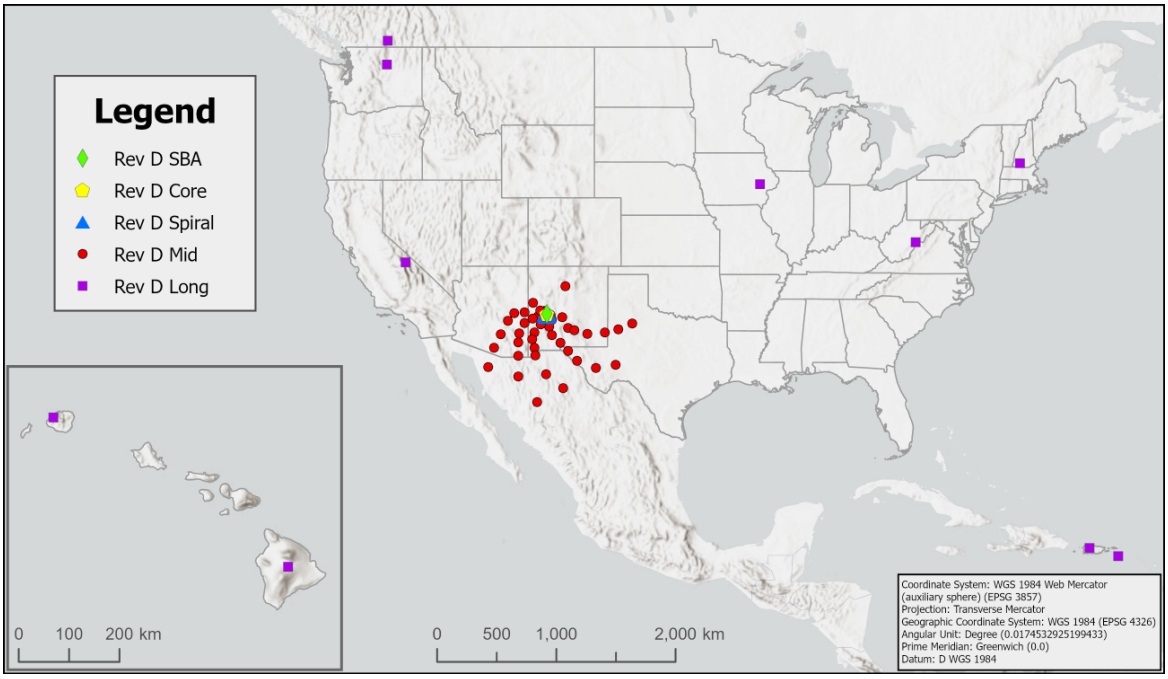

Figure 1: Overview of Rev D site locations.

3 Rev E

Rev E explored a mathematical spiral layout to improve scientific results and was found to produce better coverage than Rev D (Walker, 2022b). The sites were then subjected to an extensive review based on criteria defined by Science, Engineering, and Site Development (Price, 2024b). These criteria and the subsequent analysis are detailed in ngVLA memo 124 (Price, 2024a). Several alternate sites were selected to be explored further if the preferred site is not suitable for construction. Upon completion of Rev E site analysis, it was noted by Engineering that several sites were found to be a significant distance from power, fiber, and road access. The net changes would lead to a significant construction cost increase. Moving the sites to improve infrastructure access would have resulted in sites being too close together or too far outside the acceptable dither range, thus compromising their scientific value. To remedy this, modifications to Rev E were explored that would improve infrastructure access while adhering to scientific requirements. These changes became Rev F.

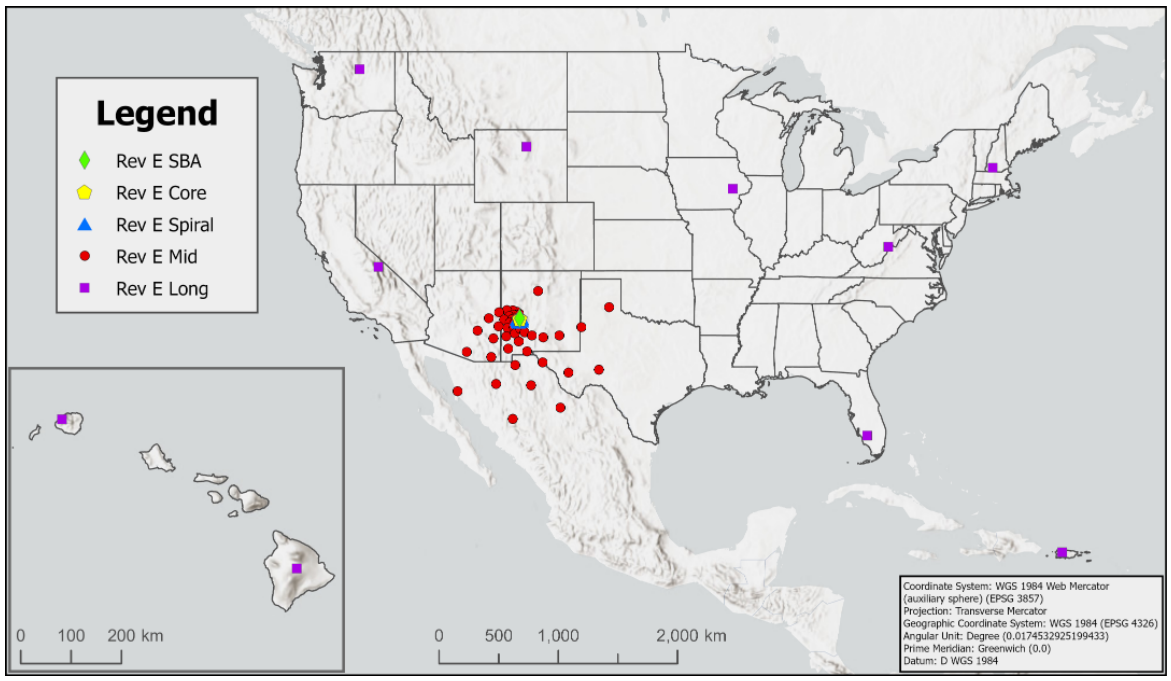

Figure 2: Overview of Rev E site locations.

4 Rev F

Rev F provides both better UV coverage than Rev D (similar imaging to Rev E (Papazyan1, A.A., and Ricci, L., 2024)) and improved infrastructure access over Rev E. A detailed analysis of Rev F sites was conducted that included all criteria used to analyze Rev E sites as discussed in Price, 2024. Sites were also vetted using suggestions on general distances of avoidance to mitigate RFI (Rob Selina, email communication). The additional avoidance distance criteria for RFI are:

Wind farms, substations, and high voltage lines: 6 km
Oil extraction operations/pumps and isolated residential areas: 1 km
Line of sight cell towers: 20 km
Line of sight microwave towers: directional, 2 km

The above criteria were provided as general guidance during site analysis. Topographic shielding can mitigate RFI concerns so it was used whenever possible to locate sites closer to infrastructure while shielding from potential RFI impacts. While exploring RFI impacts it was also noted that the most prominent sources of RFI in the future could arise from orbital RFI sources such as satellites (Selina R. and De Pree C., 2023). While we can somewhat control ground source RFI with careful site placement, avoiding site placement near large population centers and areas likely to see development is the only method currently available to site selection to reduce orbital RFI.

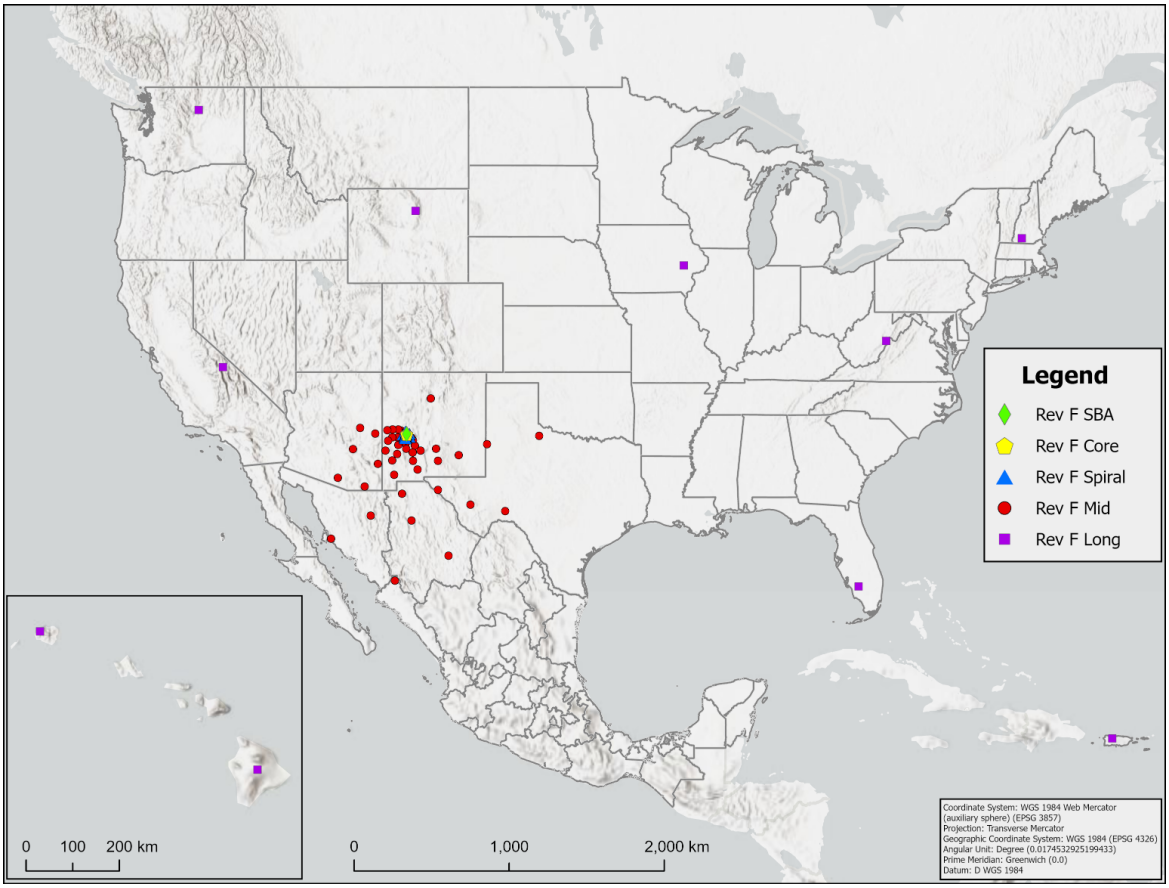

Figure 3: Overview of Rev F site locations.

5 References

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