
PERMIAN QUARTERLY

Permian Basin Programmatic Agreement Quarterly Newsletter

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This aerial photograph depicts dashed lines that outline two projects processed under the Permian Basin Programmatic Agreement (PA). A red polygon lying partly within the lower dashed line represents the location of a prehistoric archeological site. These PA projects were included in an archeological survey to evaluate the effect of the PA on archeological resources within the PA area. Read more about the evaluation of the PA inside this newsletter.

Introduction to the Permian Basin Programmatic Agreement (PA)

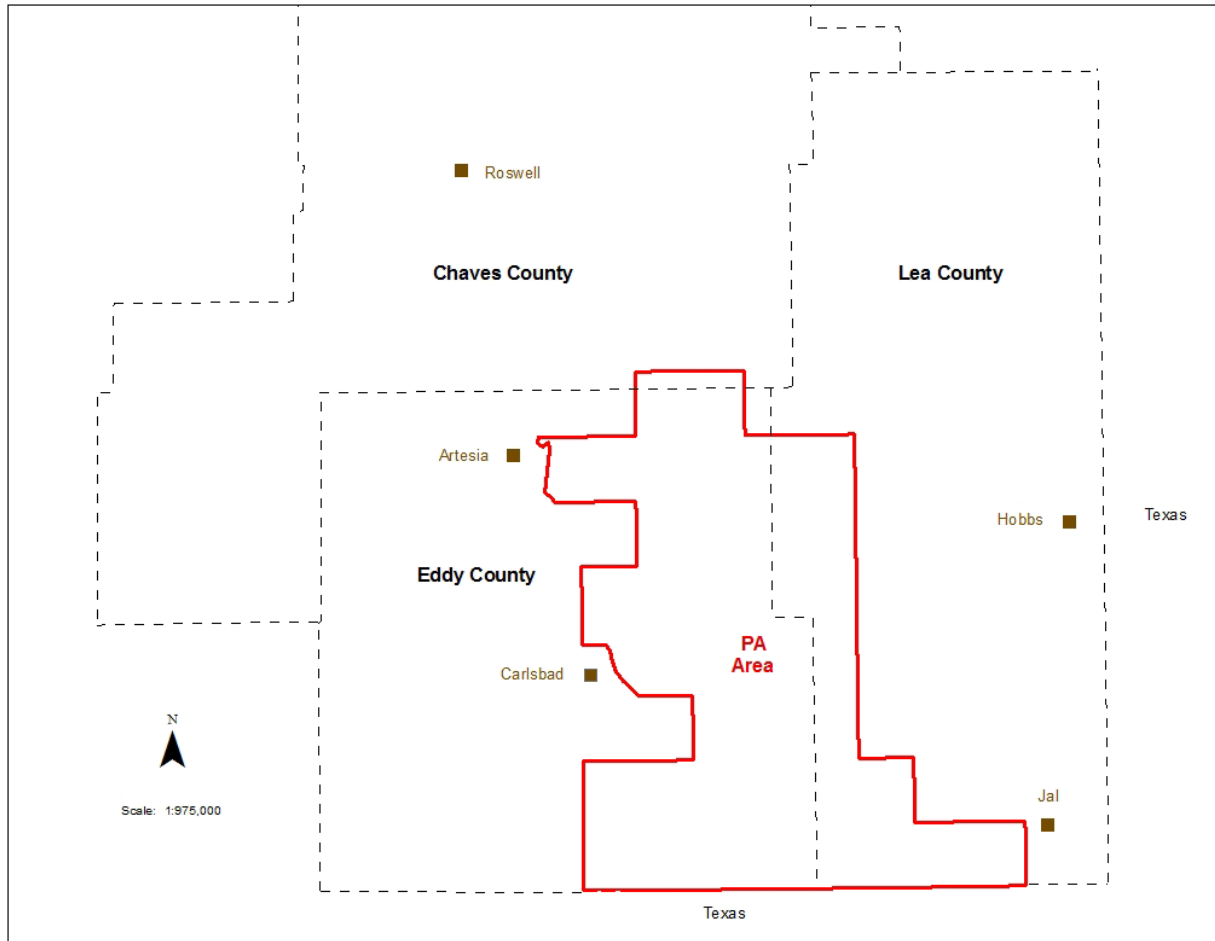


Figure 1. Map showing the Permian Basin PA Area.

The Permian Basin Programmatic Agreement (PA) is an alternate form of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, that is offered to the oil and gas industry, potash mining companies, and for other industrial projects located in southeastern New Mexico. The PA can be used for federal projects located on Bureau of Land Management (BLM) land or BLM sponsored projects located on private property. Originally begun as a Memorandum of Agreement (MOA), it was extended for a period of three years in April 2013 as a Programmatic Agreement (PA) and the PA was further extended for a period of 10 years beginning in May 2016. The PA area is located partially in Chaves, Eddy, and Lea counties. Proponents of projects within the PA area may contribute to a dedicated archeological research fund in lieu of contracting for project specific archeological surveys, provided their proposed projects avoid recorded archeological sites. This dedicated fund is used to study the archeology and history of southeastern New Mexico.

Current PA News

Research Update

Each issue of the *Permian Quarterly* newsletter has an introductory page that briefly describes the Permian Basin Programmatic Agreement (PA) as an alternate form of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and notes that project proponents may contribute to a dedicated research fund in lieu of contracting for project specific archeological surveys, provided their proposed projects avoid recorded archeological sites. People knowledgeable about archeology and preservation agree that avoiding recorded sites is the proper thing to do, but always ask, “What about unrecorded sites that may be within a project area? What happens to them?” A recently completed report entitled, *Evaluation of the Effect of the Permian Basin Programmatic Agreement on the Archeological Record within the Permian Basin PA Area: Field Survey and Document Review of 164 Projects*, by Tim B. Graves, Myles R. Miller, and Katherine Jones provides a partial answer to that question.

This report describes the results of the field examination of a 10 per cent stratified sample of 1,658 PA projects that were completed between May 1, 2013 and June 30, 2016. May is the month that the PA went into effect. This is the first detailed examination of the operation of the PA on the archeology of the PA area. Prior to this Carlsbad Field Office (CFO) staff archeologists made case-specific field checks of selected PA projects and they attempted to check a sample of PA projects each year. These efforts resulted in the identification of two instances where PA projects encroached upon unrecorded sites, and these projects were mitigated by modifying the projects and by CFO archaeologists doing limited data recovery and monitoring of construction; however, these checks on the operation of the PA were not consistent due to fluctuating staff size and workload.

Altogether 15 archeological sites and 104 Isolated Manifestations (IM) were found in the 10 per cent sample. Four of the sites were recommended as not eligible for listing on the National Register of Historic Places (NRHP), which is the standard used to determine if a site will be managed for preservation. Thus 11 sites are considered to be eligible or undetermined for listing on the NRHP and these sites will be managed for preservation by the CFO.

Isolated Manifestations include a location with fewer than 10 artifacts, or a single feature that cannot be dated. IMs must be truly isolated and not related to other nearby sites or IMs. The information recorded about IMs is considered to be sufficient documentation and they are not further managed by the CFO. Interpreting the significance of finding the 15 sites requires background knowledge of oil and gas operations and the BLM review of these operations within the CFO.

Brief Outline of the Oil and Gas Exploration Process in the CFO

The PA is primarily designed to process oil and gas projects although some potash and other industrial-type projects may qualify. Common oil and gas projects processed under the PA include well pads, tank batteries, fracking ponds, pumping stations, roads, pipelines, electric lines, and seismic exploration projects. How these projects are completed involves the BLM at every step when the projects are located on BLM managed land or require a BLM permit.

The CFO includes the western portion of the Permian Basin, a geological region of subsurface Permian age rocks containing proven oil and gas reserves. The first well drilled within the CFO was in 1924, albeit on New Mexico State Trust Land. Drilling has continued in a “boom and bust” fashion since that time. In modern days, a seismic survey precedes drilling. Commonly a grid of receivers is spread across the landscape to record shock waves produced by Seismic Vibrator Trucks, large vehicles equipped with movable metal plates on the bottom to strike the ground. For example, a recent seismic survey was 10 x 14 miles (16.0 x 22.5 kilometers) in extent, with cells measuring 725 x 890 feet (221 x 271 meters). In places, there are three or more grids superimposed (but not necessarily aligned) on each other as rock formations at different depths are examined. Each of the lines composing the grid undergoes an archaeological survey resulting in a consistent examination of evenly spaced corridors across a relatively large area of the landscape.

Oil and gas exploration companies bid on BLM leases and the successful bidders can submit an Application for Permit to Drill (APD) for a well location within the lease. The APD shows the location of the surface drill hole and the location of the bottom hole, among other types of information. The APD is subject to review by BLM specialists for its impact on endangered species of wildlife or plants, cave and karst concerns, archaeology, and a number of other topics. The well location may be changed as a result of this review to minimize any adverse impacts. Other kinds of projects typically follow on the APD location. Roads are built to access a well pad for drilling and production, electric lines supply power, and pipelines and flow lines carry oil and gas away from a well. Wells drilled vertically to oil and gas deposits are distributed across the landscape according to the subsurface location most favorable to penetrate the deposits. These wells may be clustered in one area but be spread apart in another. Horizontally drilled wells are typically evenly spaced and lined up along a section line. Multiple wells may be drilled from one pad and the associated infrastructure is likewise consolidated in the vicinity of the wells. Each activity has a permit attached to it, and it undergoes review by the BLM

Brief History of the Permian Basin PA

More than 5,500 projects have been reviewed in the CFO during the last 5 years, and equally large numbers of oil and gas projects have been processed in the past. The intensity of this development provided one reason for development of the PA, whose purpose is “...to implement a creative, directed program to resolve adverse effects and, in particular, the cumulative and indirect effects of full-field oil and gas development and other industrial-related development undertakings in southeastern New Mexico and result in better decisions affecting the management of historic properties in the Permian Basin.” These twin goals reflect the impetus for establishing the PA: (1) frustration on the part of industry that payment for identifying and protecting archaeological resources seemingly had no end and no good result and (2) frustration on the part of archaeologists that although the site inventory kept expanding, understanding of the past was stalled essentially at the level that H.P. Mera had described in his pioneering 1938 southeastern New Mexico survey report.

The key to the PA comes from the recognition that a portion of the CFO which has the most oil and gas development also has sufficient archaeological survey coverage and site location information to allow for a different approach to Section 106 compliance. Using an accumulated 30 years of seismic surveys and project specific surveys as a guide, the PA area was constructed using USGS 7.5-Minute quadrangle maps. These maps bound the portions of the CFO managed lands that have a minimum threshold of 20

percent survey coverage that is equally distributed across each map. In practice, a larger percentage of survey coverage is present on all current PA maps, ranging up to 37 percent. PA proponents proposed that instead of paying for another redundant survey, if recorded sites were avoided, an amount equal to the cost of the survey would be deposited into a fund that could be used for archaeological research.

This proposal was not made lightly, and it was not popular with all archaeologists or government regulators. Two studies provided background and justification for the decision. The PA grew out of the 2005 PUMP III (Preferred Upstream Management Practices) report that examined the way oil and gas projects were processed by the BLM, and it was field tested in New Mexico through a complete survey of land within the Pierce Canyon USGS 7.5-Minute Quadrangle. The Pump III report showed that after 10 percent of a quadrangle map had been surveyed knowledge of the distribution of sites and site composition, based upon surface exposure of artifacts and features, stabilized. Adding more site records did not appreciably add to our knowledge. In order to advance our knowledge of the archaeology of southeastern New Mexico, research beyond the survey level was needed. The Pierce Canyon results showed that existing survey coverage of 28 percent of the ground surface had identified 85 percent of all sites and 100 percent of the larger sites. The PA was instituted with the knowledge that by promoting research in an existing inventory of over 12,700 sites, there could be possible loss of, or damage to, unrecorded sites that may be impacted by a PA project.

The PA Process

The PA may be used to process oil and gas projects located within the PA area, provided they are located on BLM managed land or if they are BLM approved projects located on private property. The PA cannot be used for projects located on New Mexico State Land Office (SLO) property or on property belonging to other state agencies or subdivisions of the state. The PA cannot be used for interstate projects, such as highways or interstate pipelines and it cannot be used for large-scale projects, such as electric lines of 115 kilovolts or larger or for pipelines or other linear corridors larger than 100 feet wide. If human remains are discovered during work on a PA-approved project, then all work must stop in the vicinity of the human remains and the BLM must be notified at once.

Use of the PA by industry is strictly voluntary and applicants may use the PA for one project but not for another. There is no time limit for a company to use the PA and no fee for signing up. PA participants must design their projects to avoid all recorded sites listed on, eligible for, or presently undetermined for listing on the National Register of Historic Places (NRHP) by 100 feet, unless there are circumstances approved by a CFO archaeological reviewer. The CFO provides site location information to companies that sign up to use the program. This consists of a shapefile of polygons showing the locations of sites eligible or undetermined for listing on the NHRP but with no other attributes attached. This site location information is necessary for project planning and it is currently updated four times a year.

The applicant submits information about the project, with a contribution determined by a cost formula (adjusted annually for inflation) as well as a geographic information systems (GIS) shapefile. A CFO archaeologist reviews this information and if there are no problems the project is approved.

In practice, there can be informal consultation between project proponents and CFO staff archaeologists, especially when companies first begin to use the PA. Some companies use the PA for all projects that will qualify while other companies have never submitted a project for PA processing, and still others use

the PA for one project but not for another. Since this is a voluntary use program the CFO has made information about the PA available to applicants, but there has never been an effort to actively solicit companies to use it.

There are quirks in using the PA that mostly involve land ownership. The PA area includes BLM surface managed land, but there are checkerboard localities that include New Mexico SLO and private property. Since PA projects cannot be approved on SLO land, applicants for pipeline projects that cross from BLM to SLO land have to arrange for archaeological surveys of the state property. The same is true for well pads that are located on SLO property but that have BLM minerals. Since use of the PA is voluntary, there are still archaeological surveys being completed within the PA area for projects that are eligible but not submitted for PA review by the proponents.



Figure 2. Overview of LA 176300 looking north. This site was monitored during construction of the well pad that is in the upper left corner of the photograph.

The PA Evaluation and the Report Conclusions

The study examined 167 PA projects in total. Three of these were located on SLO property and were not approved by CFO archeologists. These erroneous submissions are still maintained in the files and are part of the PA record. They are included in this study because they were selected by the routine that identified the projects to be examined. Ultimately, these three projects were surveyed for cultural resources. The

remaining 164 projects included the full range of common project types including well pads (103 each), electric lines (19 each), pipelines of various kinds (31 each), followed by tank batteries (groups of temporary oil storage tanks), access roads, potash core drilling pads, and the reclamation of a saltwater spill and a well pad, that totaled 11 additional projects. Thirty of the 164 projects were in areas that had previously been surveyed, leaving 134 projects requiring additional fieldwork. Oil and gas projects are typically defined on the ground by wooden stakes, but these are temporary markers and the projects that were examined could be as much as three years old with the stakes being long gone. The surveyors relied on GPS units containing downloaded shapefiles of the location and size of each of the projects. Use of instruments with submeter accuracy kept the surveyors on track. Some of the wells had operating pump jacks, but others had not been drilled and were still open patches of desert landscape. The survey included all open land contained in each PA project reviewed, even if it consisted of fragments adjacent to already built oil and gas infrastructure.

As noted above 15 sites were found in the cumulative total of 1430.6 acres of land that was surveyed. The documented sites include 11 newly recorded sites and 4 sites that had been recorded during earlier surveys and they range in age from prehistoric through historic. The historic period sites include a single episode trash dump and a former residential site, that is now destroyed, but contains some remnants of vertical posts that supported a light-weight structure. Glass, ceramic, porcelain, metal, brick, tile, and rubber artifacts are found at the site.

The prehistoric sites include four lithic scatters, ranging in size from 547 to 13,129 square meters, and containing from 20 to over 2,500 lithic artifacts consisting primarily of cores and waste flakes. The remaining prehistoric sites contain a variety of lithic artifacts and six of them also have associated ceramic sherds of El Paso and Jornada brownwares. All of the sites have at least one charcoal stain from a hearth or roasting pit, that can potentially provide charred material for a radiocarbon date and possibly the identification of the plants that were burned in the feature.

The Perceived Problem of Previously Recorded Sites

Finding four previously recorded and eligible sites in the survey parcels needs further explanation, because projects that might affect recorded archaeological sites that are eligible or undetermined for listing on the NRHP are not permitted to be processed under the PA, so the presence of four previously recorded sites is a concern.

Of the four previously recorded sites, one had been previously determined not eligible, so a saltwater disposal line that crossed it was able to be processed under the PA. The site's NRHP eligibility changed as a result of the finding of a charcoal-stained feature in the current PA evaluation survey, which was completed after the project had been approved. Charcoal-stained features can potentially be dated using the radiocarbon method and they are considered eligible.

Two other sites were plotted in the CFO GIS more than 100 feet from the well pads they were associated with, so they were avoided and the projects were eligible for processing under the PA; however, it was discovered that there are conflicting locations between the CFO and the New Mexico centralized Archeological Records Management System (ARMS) plotting of these two sites. The current survey discovered that the ARMS GIS plots for these sites are accurate and that they are within the area of potential effect (APE) of the two well pads. The BLM location of one site has archaeological features and

artifacts because one of the features was dated in an earlier PA project. It is currently unknown if the CFO location of the other site has archaeological artifacts or features, or if it is an error, since it is more than 100 feet from the project boundary and it was not examined in the current survey.

The fourth previously recorded site, LA 176300, is partially located within the APE of Project 14-5468 a well pad and access road. Part of this site was known to be within the APE at the time of the review, but the reviewing archaeologist in consultation with the project proponent determined that it would not be affected. A stipulation that an archaeologist should monitor construction of the well pad to ensure that the site was not affected was attached to the approval. The site was thus protected during the PA review. This project is depicted on the cover of this newsletter.

At first glance these four sites within approved PA projects appear to show the PA review process is not working correctly, but upon closer examination it can be seen that the review process is functioning as designed. In two cases errors in GIS site locations resulted in potential effects to two sites and in another case the eligibility of the site was changed due to the discovery of a new feature that potentially can be radiocarbon dated. The fourth site was recognized as being partly within the APE of the project at the time of its review and it was monitored for protection while the project was under construction.

In order to identify when site locations in the BLM and ARMS GIS have different plotted locations the review process now includes checking ARMS. This should eliminate approval of PA projects where the ARMS location will potentially be affected and subsequent field-checking of the different site locations will straighten out the records.

The Operation of the PA and Site Loss or Damage

The report notes that the operation of the PA has resulted in very little impact to the archeological resources of the PA area.

Upon finding that 15 sites were discovered in a 10 percent sample of project parcels that were considered very low probability areas for sites and thus were released as part of the PBPA review procedure, the first thought naturally is that the program has resulted in adverse effects and site loss; however, a more detailed review of the findings reveals that, while some adverse effects and loss might have occurred, the overall rates are negligible (Graves, et al 2018:131).

In order to reach this conclusion the report looked at developed survey parcels, data on survey areas, sites, and the discovery rates for sites.

Developed Survey Parcels

Seventy-one (53 percent) of the 134 survey parcels had been developed to some degree, whether by grading for a well pad, grading and construction of a well, or construction of linear pipelines or various infrastructure supports such as electric or water lines. The amount of ground disturbance ranged from 10 percent to 100 percent, while some survey parcels also had pre-existing impacts from earlier episodes of road, pipeline, or well pad blading and occasionally other disturbances. Stains or artifact scatters or other evidence indicating the presence of a dense, significant site were not seen in any of the disturbed areas, with one exception. A hearth stain and artifacts were found in one previously impacted location, a bladed linear corridor. The report also notes:

It is possible that a small number of small sites measuring less than the size of an average well pad might have been destroyed by construction, and any evidence of that destruction was subsequently obscured by the construction of an elevated caliche pad over the spot; however, based on the survey experience with 134 project parcels and the site locations observed during those surveys, it is concluded that the number of possibly destroyed or obscured sites was very low and do not appreciably change the results of the survey and the sample extrapolations discussed in this chapter (Graves, et al 2018:132).

Survey Area Data and Sites

The report discusses approaches to estimating the impact of the operation of the PA from relatively crude direct comparisons to considerations of site size, the amount of site area disturbed, and the site's NRHP eligibility. Two eligible sites were slightly impacted, meaning that less than 5% of their surface area had been disturbed by a project. The same was true of one site that is recommended as not eligible. Only five of the 15 sites were in parcels that had been developed. Once the permit is expired for the undeveloped parcels they will go through the BLM review system again and the presence of sites there can be noted and they will revert to the standard Section 106 review. The results of this portion of the evaluation is summed up in the table from the report presented below:

Table 5.2. Quantitative and qualitative summary of survey results and impacts (based on data presented in Table 5.1)

164 project parcels comprising a 10% stratified random sample of 1,658 PBPA projects

15 sites and 134 IMs recorded in 14 project parcels

9 sites eligible for inclusion in the NRHP; 6 sites ineligible or of undetermined status

Project parcels with sites were found in 8 of the 28 USGS quadrangles of the PBPA

Survey and Site Areas

1,430 acres (ac) surveyed

Total acreage of all sites = 11.40 ac; 6.40 ac of sites were located within parcels

Total acreage of eligible sites = 4.79 ac; 1.92 ac of eligible sites were located within parcels

The 1.92 ac of eligible site area within the parcels represents 0.13% of the 1,430 ac surveyed

Impacts

10 of the 15 project parcels had not been developed as of February 2018

5 parcels were developed. Impact area within the parcels averaged less than 50% of the permitted area of the parcel

Of the 9 eligible sites, 8 were not impacted and 1 was slightly impacted (one site had been impacted by an earlier road construction not associated with the project parcel)

Of the 6 ineligible or undetermined sites, 5 were not impacted and 1 site was slightly impacted.

Less than 0.05 ac of eligible site area was impacted (Graves et al 2018:136-137).



Figure 3. Overview of LA 190144 looking north. This was a previously unrecorded site discovered during the survey.

Site Discovery Rates as a Factor in Site Locations

The 15 sites are distributed among eight of the 28 quadrangle maps within the PA area. An examination of the quadrangle maps containing sites using a series of bivariate scatterplots examined the relationship between survey intensity and site discovery. This analysis showed a negative correlation between site discovery rates and both the number of acres surveyed or the number of project parcels surveyed. The opposite is usually expected in archeological survey where more acres surveyed usually results in more sites recorded. The question arises, what might account for this discrepancy? The report notes the following:

It must be kept in mind that the current survey was not designed or intended as a standard discovery and inventory survey. Instead, the survey focused on a sample of parcels that had previously undergone archaeological review and, through those reviews, were determined to have low to very low likelihood of sites being present. In other words, from the very beginning the survey sample was skewed towards locations that had very low probabilities of sites being present.

The fact that the project parcels represent a sample of previously reviewed locations that were determined to have low site probabilities is critical to understanding the survey results. The determinations of whether specific projects were located in low to very low probability areas is based on pre-existing knowledge of the area gained through reviews of known site locations and distributions. That prior or pre-existing knowledge of site locations and locational probabilities – and the thoroughness, detail, and extent of such knowledge – is largely dependent on the number of surveys and amount of survey coverage in an area or quadrangle and, in turn, the number of surveys and amount of coverage of an area is dependent on how many oil and gas developments took place in the location or quadrangle.

In other words, a greater degree of oil and gas development in a quadrangle led to greater numbers of archaeological surveys that provided a more thorough and extensive knowledge base of site locations and distributions; therefore, it makes sense that the less archaeological knowledge of an area, the greater the chance for error in the assessment of low probability areas, and this appears to be what underlies the patterns displayed in Figure 5.5. In fact, if we do take into account the total amount of oil and gas development in each quadrangle, the same trend appears (Figure 5.6). Again, in most cases no sites were found and thus zero percent of the survey parcels in most quadrangles had a site (and supporting the fact that the overall PBPA review process was relatively sound). For those quadrangles where sites were discovered, again it is seen that higher error rates (expressed as quadrangles with higher proportions of survey parcels with sites) are correlated with quadrangles that have smaller oil and gas development acreage values and, by extension, less extensive archaeological knowledge (Graves et al 2018:139-140).

This report highlighted problems and perceived problems in the operation of the Permian Basin PA. Eligible sites were found within the area of potential effect of some PA projects, but none of the sites were damaged enough to cause them to lose any of the qualities that made them eligible for listing in the first place. However, this result was largely a matter of luck and changes should be made to reduce these occurrences. Although operation of the PA will not avoid 100 percent of unrecorded sites in the PA area of the field office, the report recommends that the PA program should be able to reach a 95 percent probability that a parcel under review will not have a site present, provided two changes are made to the operation of the program. One change is to add additional review of proposed projects and the other is to increase the survey coverage in the PA area.

Adding additional review of proposed PA projects has already been instituted. Historically there was a backlog of site forms waiting for entry into the GIS systems used by the State of New Mexico and thus the CFO GIS was seen as more accurate and became by default the system that was used. That backlog no longer exists and the New Mexico GIS can be used as a check on site location information. Human error has been and will continue to be responsible for incorrectly plotted site locations, but this double-check can identify some of those instances.

The PA program has focused on research using the existing site inventory with an orientation toward answering regional archaeological research questions. This is in response to years of having only nominal archaeological research in southeastern New Mexico and within the BLM-CFO specifically. Future PA projects will still answer archaeological research questions, but as this evaluation report shows, it is also

time to focus on the PA process and integrate it into the larger research goals. By determining the portions of the field office that are currently being developed for oil and gas wells it will be possible to supplement existing surveys with others that will help answer archeological site location research questions, instead of just responding to industry survey needs. This will reduce the possibility of having unrecorded sites being location within PA project boundaries.

This article is a greatly abbreviated version of the report. Readers interested in greater detail or those who wish to further investigate any of the report's topics should consult the complete document.

References Cited

Graves, Tim B., Myles R. Miller, and Katherine Jones

- 2018 Evaluation of the Effect of the Permian Basin Programmatic Agreement on the Archaeological Record within the Permian Basin PA Area: Field Survey and Document Review of 164 Projects. Versar, Inc., El Paso, Texas.

Other News from the Permian Basin

New Book on the Jornada Mogollon is Available

A new book entitled, *Late Prehistoric Hunter-Gatherers and Farmers of the Jornada Mogollon*, edited by Thomas R. Rocek and Nancy A. Kenmotsu is available from the University Press of Colorado. The Jornada Mogollon is an archeological region, first proposed in 1948, to encompass portions of southern New Mexico and West Texas in the United States and part of northern Chihuahua state in Mexico.

The Jornada Mogollon includes the modern cities and towns of Las Cruces, Alamogordo, and Tularosa in New Mexico, El Paso and Van Horn in Texas, and Ciudad Juarez and Villa Ahumada in Chihuahua. In 1965 an eastern extension of the Jornada Mogollon was proposed for additional portions of New Mexico and Texas to include Roswell, Carsbad, and Hobbs in New Mexico and Pecos, Midland/Odessa in Texas. The boundaries of the Jornada Mogollon and the eastern extension are tentative and subject to change as more is learned about this region. Similarities in projectile points and pottery types are noted in sites within this large area, as are the types of sites found.

The editors summarize the Jornada Mogollon and the book's contribution to understanding the region in these words:

The net result is that in many ways, the Jornada Mogollon with its eastern extension is both the largest and arguably the most "peripheral" of the divisions of the major archaeological areas of the Southwest. The Jornada is often regarded as marginal with limited relevance to the Southwest in general and to the Mogollon in particular. It is frequently viewed as a monotonous extension that is of minimal research interest compared to the dynamic Mogollon core area in the mountains of western New Mexico and eastern Arizona (Lekson et al. 2004). This volume is intended to counter this imbalance both in the attention and understanding afforded the region. The large data sets that have been, and continue to be, collected from across the Jornada illustrate that cultural processes demonstrated in other regions of the Southwest – changes in subsistence, technology, mobility, and land tenure, among others – align with the developmental

trends in the Jornada. Specifically, contributors to the volume use their data to highlight three major topics: The Jornada's environmental and cultural diversity; the region's developmental trends that parallel those elsewhere in the Southwest; and, issues of broad anthropological interest (Rocek and Kenmotsu 2018:7)

The book is divided into four parts with the following chapters:

Part I: Diversity and Change in the Jornada Mogollon

1. Diversity and Change in a "Marginal" Region and Environment, by Thomas R. Rocek and Nancy A. Kenmotsu.
2. Jornada Huts and Houses: Implications of Formative Architectural Diversity in the Jornada, by Thomas R. Rocek

Part II: Farming the Jornada Lowlands

3. Measuring Diversity: Land Use and Settlement Intensity in the Western Jornada before and after AD 1000, by Myles R. Miller and Nancy A. Kenmotsu
4. Evaluating Plant Utilization and Subsistence Economies in the Western Jornada: Current Trends and Perspectives, by Peter C. Condon and Javier Vasquez
5. Farming Dependence in Southern New Mexico: Earlier Than We Thought, by Jim A. Railey and Christopher A. Turnbow

Part III: Mobility within and Beyond the Lowlands

6. Deciphering Prehistoric Trails and Unraveling Social Networks in the Tularosa and Hueco Basins, by Myles R. Miller, Tim Graves, Moira Ernst, and Matt Swanson
7. The Dunlap-Salazar Site Lithic Sources and Highland Pithouse-Period Mobility in the Jornada, by Shaun M. Lynch and Thomas R. Rocek
8. What's for Supper? The Contents of a Complete Vessel Found in Southeast New Mexico, by Douglas H.M. Boggess, Chad L. Yost, David V. Hill, Linda Scott Cummings, and Mary Malainey
9. The Circulation of Prehistoric Ceramics in the Eastern Extension of the Jornada Mogollon, by David V. Hill

Part IV: Finding the Borders of Jornada Lifeways

10. Jornada Connections; Viewing the Jornada from La Junta de los Rios, by Nancy A. Kenmotsu
11. The Jornada Mogollon South of the Rio Bravo by Rafael Cruz Antillon, Timothy D. Maxwell and A. C. MacWilliams.
12. Plant-Baking Facilities and Social Complexity: A Perspective from the Western Jornada and Southeastern New Mexico, by Myles R. Miller and John Montgomery
13. Jornada's Other Half: Radiocarbon Dates, Climate Change, and Long-Term Trends in Far Southeastern New Mexico, by Jim A. Railey
14. Some Potential Ethnic Entities within the Jornada Mogollon Region, by Regge N. Wiseman

This volume will be useful to those interested in Southwestern Archeology and also for those interested in the archeology of the Southern Plains. The eastern extension of the Jornada Mogollon encompasses the boundaries of the Carlsbad Field Office and the PA Area, which is the focus of research supported by the Permian Basin Programmatic Agreement. (Editor's note: Tom Rocek is a member of the Permian Basin PA Workgroup and Chris Turnbow is a former member. Myles Miller, Peter Condon, and Jim Railey are archeological contractors who have completed Permian Basin PA projects).

References Cited

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2004 "Pueblo IV in the Chihuahuan Desert." In *The Protohistoric Pueblo World, A.D. 1275-1600*, ed. E. Charles Adams and Andrew I. Duiff, 53-61. University of Arizona Press, Tucson.

Rocek, Thomas R. and Nancy A. Kenmotsu, Editors

2018 *Late Prehistoric Hunter-Gatherers and Farmers of the Jornada Mogollon*. University Press of Colorado, Louisville.

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