New research proposal to Western National Parks Association (WNPA)

The information supplied should be limited to the space provided and submitted on these forms.
A proposal received in any other format will be returned. Additional attachments are not permitted.

Title of project:	Park(s) in which research is to be conducted:
New advancements in digital imaging can improve our knowledge of resources within the Great House at Casa Grande Ruins National Monument	Casa Grande Ruins National Monument
Name, address, and phone number of principal investigator, (PI)(s): Neil Dixon 25 Alton St. Arlington, MA 02474 (617) 206-0976	Payee information - individual name and address or Institution's name and address required: Casa Grande Ruins National Monument 1100 W. Ruins Dr. Coolidge, AZ 85128
Is this a multiyear project? YES **NO** Total amount requested: $7,290 This year: $7,290 If multiyear project, estimated amount: N/A 2nd year $_____ 3rd year $ _____	Desired start date: January 1, 2018 Note: Not prior to October 1st
Project duration: 12 months Project final completion date: January 1, 2019 (see research guidelines)	
Name(s) of research participant(s) who will acquire advanced degree(s) as a result of working on this project, if any: Katharine Williams, graduate student at the University of New Mexico	Product(s) of research (articles, theses, maps, checklists, etc.) in addition to final report to WNPA (see research guidelines): Reflectance Transformation Imaging (RTI) photography of the Casa Grande Great House; publications in the Vanishing Treasures Annual Report and InsideNPS; a presentation for park staff, volunteers, and the public; a short demo on RTI photography for interested park staff and special guests; a new panel or exhibit in the Visitor Center museum; a pamphlet or brochure for volunteers and visitors.

Abstract to be provided by PI(s). Do not exceed the half-page space provided below.

The Great House at Casa Grande Ruins National Monument is the last structure of its kind. It has attracted curious visitors and researchers for hundreds of years. Despite the publications of several in-depth studies on the Great House over the past century, a new photographic technique has the potential to provide park staff, researchers, tribal and other partners, and the public with new information about the Ancestral Sonoran Desert People who constructed this building.

The removal of bird excrement in a small test session inside Stack C of the Casa Grande has exposed what appear to be further decorations around a known plasterglyph spiral. We assume that there are more such plasterglyphs, but they are hard to discern because of years of accumulated bird excrement, the plasterglyhs' low-reliefs and heights above floor level, and the poor light conditions inside the Great House. After a more extensive cleaning conducted by an archeology graduate student in targeted locations in Stacks A and C, we will employ RTI (reflectance transformation imaging) photography to study the areas around known plasterglyphs, as well as other promising wall areas, in an exploratory search for further, currently-unknown wall decorations, and to more definitively learn about the age of three known plasterglyphs. The high-resolution photography that is generated by this project can also be used to monitor for fine condition changes over time in this centuries old building.

This project will generate a hands-on, and unmatched, preservation opportunity for a graduate student, and will be used to produce several interpretive materials such as a presentation, a poster, an article, and, hopefully, multimedia material for new Visitor Center museum exhibits. Park staff, volunteers, tribal and other partners, and the general public all stand to benefit.

(1) JUSTIFICATION (to be provided by submitting park): This section should specify the following: 1) Are NPS-appropriated funds available for the project (Yes/No)? 2) Where does this project rank in the submitting park's research priorities for all funding sources? 3) Was this proposal solicited by the park? If not, why is this project important to the park? 4) How will this research enrich visitors' understanding of the park? 5) What are the implications for resource management?

1. There are unfortunately no NPS-appropriated funds available for this project. Should this grant be funded, however, in-kind services will be provided by NPS staff, at CAGR, to facilitate the preservation and research process.

2. There are currently no ranked projects at CAGR that are equivalent to this project, but preservation of the Great House is a top priority.

3. CAGR solicited this project because of our interest in preserving and learning more about the Great House, and in generating new interpretive materials.

4. This proposed research will provide new qualitative data for better understanding the Great House and the Hohokam archeological culture. With new photography in hand, park staff hope to develop a number of interpretive materials to help visitors gain new insight into the structure and the culture. These include a publication in a journal, a poster presentation; a presentation for park staff, volunteers, and the public; a short demo on RTI photography for park staff; a special exhibit or panel in the new Visitor Center museum exhibits; and, in the meantime, a pamphlet or brochure for interpretive staff, volunteers, and visitors.

5. Information resulting from this project will aid in resource management because it will help pinpoint successful preservation techniques and also underline the exploratory and research-oriented aspects of RTI photography. The cleaning and photographic treatments we employ here, if successful, in the longer-term could be expanded to include the rest of the Great House's rooms, and would likely be of interest to other parks facing similar situations, in which prehistoric resources' interpretive values are hidden because of integrated pest management (IPM) issues. The RTI photographic product is very high-resolution and can also be used to monitor for small changes in the condition of walls and plaster over time.

(2) CONCISE STATEMENT OF RESEARCH OBJECTIVES, DESIGN, AND METHODOLOGY. This section should include the facilities and sites to be used. Note: Limit this section to the two pages provided.

Research Objectives

The nature of all exposed surfaces in the environment is to erode. The surfaces of the "Great House" at Casa Grande Ruins National Monument (CAGR) have the added protection of a roof structure; however, this protection also creates an added disadvantage by establishing a habitat for various bird populations. The plaster surfaces of the Casa Grande are therefore exposed to the added risk of damage from acidic bird droppings. Because of this, we propose improved documentation for the three known plasterglyphs within the Great House, none of which have been extensively documented. The glyphs are located above the first level and are, therefore, difficult to study in detail because of their height above the floor surface.

We believe that new advances in digital imaging techniques can both better document the physical condition of these plaster decorations, as well as help identify possible new elements in the areas surrounding them. This documentation will, furthermore, digitally preserve these decorations by helping mitigate, as it were, their ongoing animal damage.

The technique we propose employing is called Reflectance Transformation Imaging (RTI) and shall be described in the Methods section. The resulting image file from the use of RTI is a static image that has a variable light source, which is universally adjustable, by the viewer, from overhead to any-side raking light. The resultant files can be enhanced to bring unnoticed surface details into view -- details that are often not visible on location due to poor lighting and subtle surface variation. These enhanced images will provide the park with detailed data that will serve to demonstrate the current conditions of the plasterglyphs, aid in their research potential through the non-static lighting of RTI files, and create new and possibly interactive interpretive displays for visitors to CAGR.

Research Design and Methods

To begin, a brief explanation of RTI photography and its importance is needed. Hewlett Packard Labs developed a method of mapping multiple light positions onto a computer-generated image on the pixel level. This was called Polynomial Texture Mapping or PTM. This facilitated the ability to view an image and adjust the lighting angle in a dedicated viewer. Advancements in this technology lead to a reflectance transformation function that could use the pixel level light position data and enhance the surface structure of the image by adjusting contrast (Malzbender et al. 2001). This allows subtle surface information to be enhanced, providing details that can't be seen in field environments with the naked eye and, furthermore, providing details about different engraving periods by focusing on superposition (Mudge et al. 2006).

The first step in obtaining high resolution and detailed images of the three plasterglyphs in the Great House is to clean the areas around each, to eliminate bird droppings and fouling. This will be accomplished through the assistance of an experienced graduate student from the University of New Mexico, Katharine Williams. Scaffolding shall be employed to facilitate the cleaning and subsequent documentation of each glyph. Katharine will also instruct park staff in her conservation methods so that further gentle cleaning of the Great House walls can continue after she departs.

Upon completion of cleaning we will employ a 36-megapixel camera to capture 40 -70 detailed images with various light positions to create the RTI photography. These images will be gathered using an electronic flash unit operated by an assistant from the National Park Service (NPS).

(2) CONCISE STATEMENT OF RESEARCH OBJECTIVES, DESIGN, AND METHODOLOGY (Cont'd):

Once the images are captured, on site processing will be conducted to ensure the daily transfer of still images and completed RTI images are provided to the park for immediate use. This process will be repeated for each plasterglyph and their surrounding wall areas until completed, in 3-4 days, with remaining time used for final processing. The final images will be immediately available for the staff of CAGR to review and archive. A demonstration of the technique of RTI production and instruction in the use of the files and custom viewer will finalize the site work.

In conclusion, the improved textural detail and definition provided by RTI photography -- based upon its image enhancement capabilities and ability to vary the light falling across the captured surface -- *will* lead to an improved understanding of the plasterglyphs within the Great House at CAGR. An added benefit will be the availability of this data to researchers without their needing to access the Great House, thereby eliminating, or decreasing, the risk of damage to the structure.

References

Malzbender, T., Gelb, D., Wolters, H., 2001. Polynomial Texture Maps. In SIGGRAPH '01: Proceedings of the 28th annual conference on Computer graphics and interactive techniques (New York, NY, USA, 2001), ACM Press, pp. 519–528.

Mudge, M, Malzbender, T, Schroer, C, and Lum, M., 2006. New Reflection Transformation Imaging Methods for Rock Art and Multiple-Viewpoint Display. In M. Ioannides, D. Arnold, F. Niccolucci, (Eds.) Proceedings of the 7th International Symposium on Virtual Reality, Archaeology and Cultural Heritage (VAST2006), Eurographics Association, pg 195-200, 2006.

(3) CONCISE STATEMENT OF HOW YOUR RESEARCH CAN ENHANCE THE INTERPRETIVE MISSION OF THE PARK. Also include one paragraph describing the plan for an interpretation-related product of the research. Use this page only.

The Great House at Casa Grande Ruins is the most architecturally complex achievement of the Hohokam archeological culture. Archeological research and historic accounts suggest there may once have been 12 such Great Houses in the Phoenix Basin, but today CAGR's Great House is the only one that remains standing and available for public visitation. Despite its status as the centerpiece of this park, there is much that remains mysterious about the Great House. In the course of this two-staged project, we hope to further the preservation of this 700-year-old structure, and then document selected pieces of walls using a novel and sensitive photographic technique.

The interior of the Great House was closed to visitors in the 1970s because of concerns about the building's structural integrity. Visitors today can still look into the Great House from two doorways, but there is no visibility into Stack C, the center room of the Great House, where plaster preservation is greatest and where at least two spiral "plasterglyph" or "mortar glyph" decorations are located (There is also a recently-discovered anthropomorph plasterglyph in Stack A, the northern room of the building.) This is exciting because wall or mural art in the Hohokam world is extremely rare -- only three instances of it have ever been documented, all of which were also at CAGR. While there was a fair amount of publicity around the so-called "maze" (or spiral plasterglyph) in the Casa Grande during the 1920s, there is today no interpretation of this aspect of the Great House in the park's Visitor Center. Recent thought on these decorations is sparse, but revolves around the question of whether these spirals are truly prehistoric or simply historic replicas of a symbol that is found throughout the Southwest (there is a similar image at Montezuma Castle National Monument). A recent pilot study conducted by University of New Mexico researchers in removing bird excrement from the walls of the Casa Grande allowed them close access to one plasterglyph after a fresh cleaning. Because it looked like original plaster wash was overlaying the carving, they suggested that the decoration was, indeed, prehistoric.

The park's basic interpretive mission is interpreting the Great House and, by extension the Hohokam archeological culture, to visitors. Any action we can take to better preserve this structure aids in meeting the National Park Service mission by helping ensure its survival so future generations of visitors will still be able to appreciate the ingenuity of this desert culture. The walls of the Great House are covered in bird excrement from resident pigeons, starlings, and Great Horned Owls. Bird excrement is acidic and damages the red-pink plaster that is still nicely-preserved in Stack C. It also obscures underlying decorations and clues about the building's construction. The fresh slate provided by cleaning will offer an excellent background for photographic documentation. This new imagery, in turn, will give us a sensitive look at low-relief designs and help us better understand these three known plasterglyphs, and whether there might be otherw, which are yet to be discovered.

With all this in mind, we hope to develop a number of interpretive and academic products from this preservation and documentation project. Deliverables will include a) the photographic data and imagery, themselves, and b) instruction on manipulating and analyzing this photographic data, as well as, advice on developing it into an interactive multimedia tool for interpretation purposes. We also hope to c) circulate brief articles in pertinent National Park Service publications – the Vanishing Treasures Annual Report – and online – InsideNPS, an NPS employee portal. There are future plans to completely redesign the Visitor Center museum exhibits in 2020. Conceptually, information gathered through this project could provide the basis for new interpretive exhibits. These exhibits could come in the form of a panel highlighting the Great House's wall art and other instances of wall art found at the park or, ideally, feature a multimedia exhibit with a flatscreen TV or touch table that would allow visitors to explore the inside of the Great House remotely and safely, without the possibility of damaging it. RTI photography could play an excellent interpretive role in this medium because of its naturally dynamic aspect. In the meantime, we will create d) a temporary exhibit in the form of a poster outlining the use of this photographic technique in documenting prehistoric imagery and what our results suggest about the park's plasterglyphs and other wall art. Park staff will also create e) a booklet or pamphlet with information about the project and its findings for use by interpretive staff and volunteers to incorporate into their interpretive tours and programs of Compound A for the public. In terms of general education, the PI will f) provide a short demo on RTI photography for interested park staff and, g) park staff that help facilitate the project will present a talk in the Visitor Center theater to park staff, volunteers, and the public during our busy season, perhaps as part of the park's annual Speaker Series. In addition, park staff can invite the research and cultural resource departments, Tribal Historic Preservation Offices, museums, and other programs from CAGR's traditionally associated tribal groups, including researchers whom we have collaborated with from the nearby Gila River Indian Community, to hear the talk and view the RTI demo.

In sum, there is potential for both park visitors and distant researchers to gain new knowledge about the Great House, prehistoric architectural design, and the use of RTI photography in learning about and documenting low-relief or hard-to-see imagery. It will also provide a rare hands-on opportunity for an archeology graduate student to perform preservation work on an amazing resource and further her progress in her degree program.

(4) QUALIFICATIONS OF THE PI(S) CONDUCTING THE RESEARCH. Use this page only. List only those qualifications directly related to this grant request. Include a list of other WNPA-funded research conducted by this PI.

Neil Dixon has a B.A. in Anthropology from Eckerd College. He began his career in cultural resource management (CRM) as a field technician conducting archaeological surveys across the eastern United States. After working in the field and in archaeological conservation labs, he started a business specializing in photography for the CRM profession. He has gone on to work with preservationists, conservators, and archaeologists conducting field documentation and image preparation for 13 years. His specialties include Reflectance Transformation Imaging (RTI), rectified photography, photogrammetry, high-resolution rectified image compositing, large format film photography, color critical image capture, and aerial photography.

Among the many projects completed by Mr. Dixon are the rectified composite images of the interior and exterior wall structures of CAGR under contract by University of New Mexico through the Colorado Plateau Cooperative Ecosystems Studies Unit. He has also completed RTI imaging of plaster incising and decorations in Montezuma Castle National Monument and at Bare Ladder Ruin in Natural Bridges National Monument. His most recent project has been continuing RTI documentation of Mayan graffiti at the archaeological site of Xunantunich in Belize with the University of Texas-San Antonio.

Budget for New Research Proposal

Project title and submitting park:

New advances in digital imaging can improve our knowledge of resources within the Great House at Casa Grande Ruins National Monument

Personnel

PRINCIPAL INVESTIGATOR(S)	Funds requested from WNPA	Cash or in-kind contribution (Please specify which type and source.)
1. Neil Dixon	$3,500	$0
2.		
3.		

OTHER PERSONNEL (Specify number in brackets. Specify duties to be performed to earn funds on next page.)	Funds requested from WNPA	Cash or in-kind contribution (Please specify which type and source.)
1. Katharine Williams, doctoral student	$800	$400
2. NPS Staff (Conservation Assistant)	$0	$900
3. NPS Staff (Photographic Assistant)	$0	$900
4. NPS Staff (Compliance and Safety)	$0	$900
5.		
TOTAL PERSONNEL COSTS	$4,300	$3,100

EQUIPMENT COSTS (List item and dollar amounts for those items costing more than $100 each on next page.)

$0 $3,600

TRAVEL AND SUBSISTENCE (Itemize on next page.) $2,890 $1,080

OTHER COSTS

1 Supplies and material	$100	$0
2 Consulting services		
3 Computer services		
4 Subcontracts (Itemize on next page.)		
TOTAL PERSONNEL COSTS	$100	$0

TOTAL PERSONNEL COSTS (If multiyear project, summarize estimated subsequent year(s) budget(s) on next page.)

$7,290 $7,780

COSTS (Cont'd). Note: Be sure to explain here the duties that will be performed by any funded individual.

Please see the attached spreadsheet.

Personnel

Neil Dixon, PI
-6 days of work on site, including capture, processing, production, instruction, and RTI demo for staff and guests
-1 day of travel
7 days x $500 per day = $3,500

Katharine Williams, Project Assistant
-3 days of work on site, performing conservation and training NPS staff
-2 days data processing and reporting
-1 day of travel
6 days x $200 per day = $1,200 ($400 of which is covered by ongoing CESU agreement)

Other personnel
-NPS Staff (Conservation Assistant, helping with cleaning of Great House): 3 days x $300 per day = $900 (match)
-NPS Staff (Photographic Assistant): 3 days x $300 per day = $900 (match)
-NPS Staff (Compliance and Safety, NEPA/NHPA compliance and consultation, safety plan, etc.):
3 days x $300 per day = $900 (match)

Equipment Costs

-RTI photographic equipment (camera, lights, custom tripod…): $3,000 (match)
-scaffolding (rental if necessary), generator (for photographic lighting), and safety equipment (PPE): $600 (match)

Travel and Subsistence

PI travel
-airfare from Boston to Phoenix, return-trip: $800
-airfare baggage charge (photographic equipment): 2 bags x $132.5 each = $265
-lodging: 7 nights x $120 per night = $840
-car rental: 7 days x $100 per day = $700 (includes fuel, and transportation of Project Assistant to site)
-M&IE: 7 days x $30 per day = $210

Project Assistant travel
-airfare from Albuquerque to Phoenix, return-trip: $500 (match coordinated with ongoing CESU agreement)
-airfare baggage charge: 2 bags x $25 each = $50 (match coordinated with ongoing CESU agreement)
-lodging: 4 nights x $120 per night = $480 (match – stay at CAGR residence)
-M&IE: 5 days x $25 per day = $125 ($50 covered by ongoing CESU agreement)

Other Costs
-report production: $100

A special note for researchers and the park superintendent

WNPA is the funder of this grant on behalf of NPS, and WNPA monitors progress, administers the payment schedule, and determines successful completion or default.

All other decisions regarding the conduct of this research grant (e.g., park access, laws, safety, protocols, etc.) and uses of the research, data, and its products (e.g., release of information, publication, intellectual property, etc.) rest in the hands of NPS and are the responsibility of NPS Researchers and NPS should clarify any questions or assumptions before accepting the grant.

Due to several factors, ALL WNPA grants are for ONE YEAR ONLY (1 year only); however, we welcome and will carefully consider applications for second or third years following a successful first year.

Best wishes and hopes for a successful project. Thank you from WNPA.

I have read and agree to abide by the research guidelines in effect at the time of this application.

Signature of Principal Investigator(s) — Date: 8/28/2017

Signature of Park Superintendent — Date: 8/29/2017

Signature of Chief of Interpretation — Date: 8/29/17

For WNPA Use Only

WNPA Research Committee Review: Action and Date

Amount Granted

Item	Unit/Days	Cost	WNPA	Match	Description/Notes
Fees					
Principal Investigator	7	$500	$3,500	$0	6 days on site, 1 day travel
Project Assistant (doctoral student)	6	$200	$800	$400	3 days on site, 2 days report production, 1 day travel
subtotal			**$4,300**	**$400**	
Principal Investigator Travel					
Airfare BOS-PHX	1	$800	$800	$0	R/T
Airfare baggage	2	$133	$265	$0	
Lodging	7	$120	$840	$0	
M&IE	7	$30	$210	$0	
Car Rental	7	$100	$700	$0	includes fuel; will transport project assistant to/from site
subtotal			***$2,815***	***$0***	
Project Assistant Travel					
Airfare ABQ-PHX	1	$500	$0	$500	travel match; travel coordinated with CESU project at Casa Grande
Airfare baggage	2	$25	$0	$50	travel match; travel coordinated with CESU project at Casa Grande
Lodging	4	$120	$0	$480	4 nights; match (stay at CAGR residence)
M&IE	5	$25	$75	$50	travel match coordinated with CESU project at Casa Grande
subtotal			***$75***	***$1,080***	
Supplies/Equipment					
Photography	lump	$3,000	$0	$3,000	camera, lights, custom tripod…
Report Production	lump	$100	$100	$0	
subtotal			***$100***	***$3,000***	
NPS					
NPS Staff (Conservation Assistant)	3	$300	$0	$900	3 days on site in training and conducting conservation activities with Project Assistant; includes salary and benefits
NPS Staff (Photographic Assistant)	3	$300	$0	$900	3 days on site assisting photographer; includes salary and benefits
NPS Staff (compliance and safety)	3	$300	$0	$900	NEPA and NHPA compliance and consultation for treatment; preparation of safety plan; includes salary and benefits
Scaffolding, generator, safety equipmnt	1	$600	$0	$600	scaffolding rental (including assembly and disassembly); generator for photographic lighting; ladders for photography; PPE for each participant
subtotal			***$0***	***$3,300***	
TOTAL			**$7,290**	**$7,780**	