1. Description of the project and its significance

The *Crow Canyon Digital Archaeology Tools and Access* (*CC-DATA*) project will modernize Crow Canyon Archaeological Center's research database to enable diverse forms of access for **researchers, descendent communities, and the broader public**. The project focuses on integrating legacy archaeological datasets recorded over the last 33 years with "born-digital" data such as drone maps, 3D laser scans, and digital photographs. This modern database will be deeply geospatial, and will enable connections to external collections databases.

Building upon such a database, the *CC-DATA* project will develop digital humanities products such as richly-interactive data exploration tools and multivocal archaeology portals that blend Western and indigenous perspectives about the past. Crow Canyon has been a leader in completing archaeological research with the assistance of the public—**this effort will invite the public to join in the co-creation of archaeological knowledge that is interdisciplinary, multicultural, and relevant in the 21st century.**

CC-DATA has long-term benefits for humanities research, education, and public programming:

Research. Researchers in archaeology and other fields in the social and humanistic sciences will be able to access Crow Canyon's research archive both directly and using statistical software and web-based research portals. Researchers will be able to publish **reproducible research** products that fully connect Crow Canyon data to their research interpretations.

Education. Educators will be able to use Crow Canyon's data portals to teach their students about ancient Pueblo culture and archaeology—and also **basic data literacy**. Using standards-aligned lesson plans from Crow Canyon, educators will connect social knowledge to humanities data. Lessons—and the data portals themselves—will be tailored to the needs and interests of specific communities, including those of descendent communities, enabling **cultural preservation and revitalization** through access to archaeological knowledge of the past.

Public programming. Members of the public, and especially of the local Montezuma County, Colorado community, descendent communities, and visitors to Mesa Verde National Park, will be able to access Crow Canyon's research database through intuitive, often map-based search tools, enhancing their understanding of the rich cultural history right in their backyards. Cultural-archaeological resources are nonrenewable and disappearing every day, and enhancing public engagement with archaeological data will **build public support for historic preservation**.

Other data-holders. Other archaeological data holders—including universities, museums, and private firms—will be able to **use Crow Canyon's data infrastructure as a model** for making their own data accessible to researchers and the public. Curators of the physical materials from Crow Canyon's excavations will be able to connect metadata about their collections with particular excavation contexts. Crow Canyon will be able to access digital representations (photographs, 3D scans) of objects, enhancing its web portals through rich data linking.

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3. Narrative

Significance

To call the century and a half of accumulated information in American archaeology "big data" would be somewhat disingenuous—analyzing archaeological data doesn't often require a super-computer (as textual or genomic analysis might) or advanced computational algorithms (though they are sometimes handy; see Bocinsky et al. 2016). But while archaeological data are not "big" in the sense of computational requirements, they do present unique challenges (Clark 2015). Principal among these are non-standardized data formats; metadata standards tailored to particular geographic regions or material types (e.g., ceramics, animal bones); and the distributed nature of data holdings themselves (Kintigh et al. 2015). For over 150 years, anthropological archaeology has adhered to a model of decentralized data collection, storage, and dissemination—a process that began with academic (including museum) archaeologists running independent field projects (and often archiving their own physical collections), and accelerating with the explosion of cultural resource management (CRM) activities since the 1970s. Archaeological data, if in a digital format at all, are most likely to be stored at individual institutions, and often by individual researchers. The data may not be "big," but the tasks of organizing, integrating, and analysing those data are massive.

Until recently, the state of these multifarious archaeological data hadn't been perceived as particularly problematic—indeed, archaeologists have often viewed "their data" as proprietary (even when collected using public funds) and careers have been built upon publishing repeatedly on findings from these individual datasets. Instead of prompting a collective effort to synthesize archaeological knowledge, the abundance of data has provoked many archaeologists to focus even more closely on local regions or particular materials (Kintigh et al. 2015:2). Furthermore, although efforts to increase public engagement in archaeology have been ongoing since the late 1960s, public access to archaeological *data* has remained woefully inadequate. Public engagement with archaeology remains primarily materials-based—the domain of museums and other curators of physical collections.

During the last five years, however, archaeologists have increased research efforts to synthesize archaeological data in order to meet several "grand challenges" for archaeology (Kintigh et al. 2014a, b). This has led to the acknowledgement of a growing crisis in archaeological data management—an embarrassment of riches. This crisis is being met by several initiatives:

> **Recognition.** Efforts to enhance and centralize the archiving of archaeological data. Initiatives like the Digital Archaeological Record (tDAR)[1] and the Archaeological Data Service (ADS)[2] are community-driven investments that are ingesting archaeological data in standard formats, and are curating these data for posterity.

[1] http://www.tdar.org/
[2] http://archaeologydataservice.ac.uk/

Integration. Efforts to map disparate, domain- and regionally-specific archaeological data to shared data ontologies. These facilitate regional and even continental reanalysis of archaeological data, and are prompting concerns about (and innovations addressing) comparability of data quality and sampling.

Aggregation. Efforts to ingest site-level data in the United States, currently held primarily by the states themselves, into federated meta-repositories. Essential metadata elements—including site location, description, and cultural affiliation—are being harmonized and standardized across state boundaries. Projects such as the Digital Index of North American Archaeology (DINAA)[3] are federally funded and enjoy broad support from the archaeological community.

These initiatives are fundamental for ensuring the protection and stewardship of cultural resources and data in the US, and for enhancing archaeological research capacity. What they do *not* do, however, is enhance or facilitate *access* to archaeological data for researchers, policymakers, and the interested public. Barriers to access are many, but include:

- Lack of knowledge of archaeological data categories and the processes of archaeological investigation as a humanistic social science
- Data are presented in archives and formats that require expert (and esoteric) knowledge
- Data are divorced from interpretation, and interpretation from data
- Broad data illiteracy among the public, and even among academic researchers.

It is essential to overcome these barriers in order to meet the goal of broadening access to archaeological knowledge—and, indeed, knowledge in all fields of the humanities and social sciences. Broadening access to archaeological data would result in the following outcomes, among others:

- Invite and enable co-creation (Bollwerk, Connolly, and McDavid, 2015) of archaeological knowledge between professional archaeologists, descendent communities, and the broader public
- Invite and enable data-driven, discovery-based learning about human pasts
- Enhance data and information literacy through informal exploration of archaeological data.

These goals will require a concerted effort from the archaeological community in coming years. However, potential exists—indeed, necessity mandates—for individual data holding institutions to lead the way in broadening access to their data. By doing so, these institutions would provide models for others data holders to emulate. **Here, we propose a project to preserve humanities (archaeological) data and enhance the accessibility of those data to professional archaeologists, descendent communities, and the broader public.** Specifically, this project

[3] http://ux.opencontext.org/

would build foundational infrastructure necessary to bring 33 years worth of archaeological data gathered by the Crow Canyon Archaeological Center to these constituencies.

The Crow Canyon Archaeological Center's mission is to advance and share knowledge of the human experience through archaeological research, education programs, and partnerships with American Indians. Our vision is to expand the sphere in which we operate geographically and intellectually and show how knowledge gained through archaeology can enhance our understanding and appreciation for all humanity and promote a better world.

Archaeologists at Crow Canyon work collaboratively with American Indian partners to protect and preserve cultural resources, to develop and deliver educational programming based on our research, and to make significant contributions to understanding the human past and the broader human experience.

Crow Canyon is a 501(c)(3) non-profit located in the Four Corners region of the southwestern US, which contains the densest concentration of archaeological sites recorded anywhere in America. This archaeological region is one of the world's most important for understanding the human past. But perhaps more important is the connection between ancestral Pueblo archaeological sites and the Pueblo Indians who continue to live in the area. Today Pueblo people live in 21 Indian nations in northern New Mexico, Arizona, and El Paso, Texas. They maintain their languages, their religions, and a strong connection to their past. Their continuing association with this area provides an essential link with their ancestors, and Crow Canyon provides a means by which they preserve this connection.

Crow Canyon has been a leader in public engagement in archaeology since its founding in 1983. Through on-campus educational programs and cultural explorations across the southwestern US and around the world, Crow Canyon reaches over 2,000 program participants per year—and countless more through publications, web resources, and presentations for the public.[4] Critical to Crow Canyon's mission is that we invite the public to *engage* with archaeology through experiential learning—participants join Crow Canyon archaeologists in the field and lab, where they assist in excavating ancient communities and analyzing artifacts from those excavations. Participants leave Crow Canyon with an acute understanding of how archaeological knowledge is generated, how to respectfully visit archaeological sites so as to preserve them for future generations, and with an understanding that Pueblo descendent communities are still here in the Southwest.

These are each important outcomes of visiting Crow Canyon. But if our goal is to invite the public to participate in the whole process of archaeology—to join us as we walk along inferential pathways into the human past—some critical components are missing. Participants join in data collection (excavation and laboratory analysis), but not in the exploration and analysis of data generated by their labors, or the process of inference, discovery, and recursive project design that motivates archaeological research. Data analysis and knowledge inference form the bridge that takes us from the particular site contexts to information relevant to human societies today.

[4] Find out more about our programs and resources for educators at http://www.crowcanyon.org/.

Furthermore, focus on only the data collection phase of archaeological research undermines a central message of Crow Canyon's programs: that "it's not what you find, it's what you find out," in the words of David Hurst Thomas, a curator at the American Museum of Natural History in New York. Crow Canyon has been a leader in completing archaeological research with the assistance of the public—**this effort will invite the public to join in the co-creation of archaeological knowledge that is interdisciplinary, multicultural, and relevant in the 21st century.**

Crow Canyon data holdings are immense—a testament to the huge amount of work it has accomplished over the last 33 years, and conveying why these data have so much value for producing archaeological knowledge. Crow Canyon's database is almost unique among archaeological holdings: three decades of data collected using consistent and research-driven methods. Crow Canyon staff identify the database as Crow Canyon's most important asset. Crow Canyon's data holdings include (as of July 2016):

- Information from 449 different archaeological sites
- 382 sites with some form of excavation data or laboratory analysis data conducted by Crow Canyon
- 394 MB of tabular data, including over 1 million records in 375 different tables
- 152 GB of archived photographs, representing 21,789 photographs
- 1,524,772 recorded and analyzed pottery fragments in 199,254 data records
- 21,050 provenience designations, or distinct stratigraphic contexts
- 122,866 faunal records
- 83,826 chipped stone records
- Over 1,600 automated queries for running forms for data input and that export data to web interfaces

The Crow Canyon research database is similar to research archives at universities and cultural resource management firms: it contains long-term data collected under relatively consistent methods. But it also shares negative qualities. These databases were not designed to facilitate broad access, especially of the sort enabled by today's web visualization and data access tools. Until recently, the Crow Canyon research database was stored as several shared Microsoft Access 2003 MDB files on a central fileserver at Crow Canyon, and to date is only accessible through an outdated, static web interface.

The *Crow Canyon Digital Archaeology Tools and Access* (*CC-DATA*) project is designed to modernize Crow Canyon's research database to enable a diversity of forms of access, for researchers and the public alike (see ***History, scope, and duration***). The project focuses on integrating legacy datasets recorded using traditional archaeological field methods with "born-digital" data such as unmanned aerial vehicle (drone) mapping, laser scanning, digital photographs, and various remotely-sensed datasets. We also seek to build a database that is deeply geospatial, acknowledging that *all* archaeological data are connected to spatial contexts. The modern database that we envision (see ***Methodology and standards***) will enable connections to other external research databases through an application programming interface

(API) for dataset integration and aggregation by the research community and other archaeological data holders.

Building upon such a database, we will develop digital humanities products such as richly-interactive data exploration tools and multivocal humanities portals. For example, one portal to an excavation could be an online, 3D site tour, where users can not only find out what materials were uncovered during Crow Canyon excavations, but receive a rich, multicultural experience as archaeologists and native scholars from descendent communities interpret what ancient spaces and artifacts might have been used for. Tools such as those we propose here will serve as the foundation for 21st century, experiential, informal humanities education.[5]

We anticipate long-term benefits to research, education, and public programming in archaeology (and the broader humanities) will emerge from the *CC-DATA* project. Specifically, we envision use by the following communities:

> **Research.** Researchers in archaeology and other fields in the social and humanistic sciences will be able to access Crow Canyon's research holdings in a variety of ways, from direct programmatic access through a set of APIs, to access through the *R* statistical programming language (built using the APIs), to web-based research portals. Domain specialists will quickly and easily locate the data pertinent to their research questions and integrate those data with non-Crow Canyon data holdings. Researchers will be able to publish *reproducible research* products that fully connect Crow Canyon data to their research interpretations. Researchers will be able to access archived data in perpetuity in *the Digital Archaeological Record (tDAR)*.
>
> **Education.** Educators across the United States and around the world will be able to use Crow Canyon's data portals to teach their students about ancient Pueblo culture and archaeology—and also to teach basic data literacy. Using standards-aligned curricula and lesson plans from Crow Canyon (developed as part of subsequent projects), educators will connect social knowledge to humanities data.[6] School groups who participate in Crow Canyon's on-campus programs will be able to continue the process of archaeological inference after they return home, and track in real-time the progress of ongoing Crow Canyon excavations. Lessons—and the data portals themselves—will be tailored to the needs and interests of specific communities. For example, a classroom at Jemez Pueblo might be presented with culturally-appropriate information (e.g., appropriate to the age or gender of particular students), enabling cultural preservation and revitalization through access to archaeological knowledge of the past, and prompting the transmission of cultural knowledge from elders to students.

[5] For a similar, yet non-spatial example of such multivocal interpretations of an archaeological research project, visit http://veparchaeology.org/.
[6] These would be archived and accessible through resources such as NEH's EDSITEment web portal: http://edsitement.neh.gov/.

Public programming. Members of the public, and especially of the local Montezuma County, Colorado community and descendent Pueblo, Diné, and Ute communities, will be able to access Crow Canyon's research database through intuitive, often map-based search tools, enhancing their understanding of the rich cultural history right in their backyards. Visitors to Mesa Verde National Park, Canyons of the Ancients National Monument, and other regional cultural sites will be able to "dig deeper" into archaeological data about the past, and to connect lessons learned from the past to contemporary and future social challenges. Cultural-archaeological resources are nonrenewable and disappearing every day, so the preservation of what remains is essential and up to archaeologists. Enhancing public engagement with archaeological data will build public support for historic preservation.

Other data-holders. Finally, other archaeological data holders—including universities, museums, and CRM firms—will be able to use Crow Canyon's data infrastructure as a model for making their own data accessible to researchers and the public. Data holders will access Crow Canyon's detailed data dictionary for describing its data structure, and will emulate its access tools using code freely-available in Crow Canyon's open source code repository. Curators of the physical materials from Crow Canyon's excavations—currently at the Anasazi Heritage Center (AHC), a Bureau of Land Management curation facility and museum in Dolores, Colorado—will be able to use the research database API to connect metadata about their collections with particular excavation contexts (provenience). Crow Canyon, in turn, will be able to access digital representations (photographs, 3D scans) of objects held at the AHC, enhancing web portals through rich data linking.[7]

History, Scope, and Duration

The Crow Canyon Archaeological Center research database was first developed in the late 1980s when then-president Sandy Thompson organized a multi-day meeting to discuss how to upgrade Crow Canyon's computing capacity. Among those he invited were Art Rohr and Lynn Udick, who had been the computer specialists on the Dolores Archaeological Program, at that time the largest and most computationally sophisticated archaeological project in the United States. Art and Lynn designed the first network architecture for Crow Canyon and the implemented the first relational database in Advanced Revelation, a DOS-based relational database management system. By the late 1990s, Crow Canyon had committed to electronic publication of it site reports, and to expand the research database. Art and Lynn began working with Melita Romasco (the lab director at the time) and the lab and field archaeologists to design an MS Access 1997 database to replace the Advanced Revelation database. Under the

[7] Bridget Ambler, curator at the AHC, has recently described ongoing initiatives at the museum to broaden digital access to its collections and enable linking between collections data and the CCAC research database (personal communication, 2016).

leadership of Scott Ortman, who replaced Melita as the lab director in 2000, the database was updated to MS Access 2003, as it remained until early 2016. The design, development, and publication of the Access research database was partially supported by a State Historical Fund grant from the Colorado Historical Society.

The *CC-DATA* project was initiated in 2014 to modernize the Crow Canyon research database and make Crow Canyon data holdings more accessible to researchers, descendent communities, and the general public. For several years, a geospatial database (geographic information system, or "GIS") had been developed in parallel to the Crow Canyon research database. Researchers at Crow Canyon recognized the benefits of integrating the research database with the GIS, which necessitated moving to an extensible object-relational database management system with GIS capabilities. After considering several candidate database systems, we settled on the open source PostgreSQL as offering the best balance of flexibility, extendability, support, and cost.

The *CC-DATA* project has three primary phases:

> **Phase 1: Back-end conversion to PostgreSQL.** Convert from MS Access 2003 to PostgreSQL. **Connect extant front-ends** (data entry, web-access) to the PostgreSQL database. Troubleshoot and correct any errors in translation—particularly, field constraints are treated differently in MS Access versus PostgreSQL. Establish **GitHub project repository** for complete project documentation, version control, and open-source dissemination of all project results. *Phase 1 completed in May 2016.*
>
> **Phase 2: Middle-ware and internal front-ends. Simplify table and relational structure** in the research database, archiving non-related custom datasets created by researchers over the years. Integrate GIS capabilities into the PostgreSQL database using the **PostGIS** expansion module for PostgreSQL. Complete a **data-dictionary** describing the contents, format, and structure of the database. Implement **middleware** to enable secure remote access to tabular and geospatial data, including a **RESTful API** and **mapserver**. Develop new, **web-based internal front-end for data-entry**, using the RESTful API. Regularly clone the database into an **innovation sandbox** for rapid prototyping. Subset the database by archaeological project, and **archive each project** with the Digital Archaeological Record (tDAR). **Document all activities** for reproducibility by other data-holding institutions. *Phase 2 ongoing.*
>
> **Phase 3: Front-ends for research and education.** Using the innovation sandbox, work with educators, archaeologists, and Native American cultural specialists to develop **innovative web front-ends** to Crow Canyon's research database. Connect the Crow Canyon research database to **federated repositories and clearinghouses**, such as DataONE[8] and the SKOPE project.[9] Create **domain-specific front-ends** for research (e.g., to botanical, zooarchaeological, or geospatial data). Explore and develop the use of **story**

[8] Data Observation Network for Earth: https://www.dataone.org/.
[9] Synthesizing Knowledge of Past Environments: http://www.envirecon.org/.

maps[10] for dynamic, data-drive presentations and multi-vocal educational products. Develop **GIS curricula** for use by Crow Canyon and others using open-source tools including Quantum GIS (QGIS)[11] and GRASS GIS.[12]

To date, Phase 1 of the project is complete, and portions of Phase 2 are ongoing. Funding from the *CC-DATA* project has thus far been entirely internal. **Here, we are seeking two years of funding for the *CC-DATA* project to complete Phase 2 and begin Phase 3.** We will seek subsequent funding to support most Phase 3 activities.

Methodology and Standards

The *CC-DATA* project will be dedicated to using open source software at all phases of project development. We will also thoroughly document all steps of development so that other data-holding institutions may readily implement similar data access products.

Data cleaning (Bocinsky; Research Database Designer/Manager). As with most long-lived, institutional databases, the Crow Canyon research database has accrued several orphaned (non-relational) data tables over the years, and many data *views* (virtual tables) that are no longer used. We will analyze database schema to identify orphaned tables and esoteric views and archive them in a legacy clone of the research database. Essential, relational tables will be maintained as part of the core research database. Current data fields will be assessed as to whether additional field constraints may be added to enhance data consistency.

GIS integration/data entry/cleaning (Coffey; Research Database Designer/Manager). All geospatial data associating legacy tabular data to spatial provenience will be included in the Crow Canyon research database using the PostGIS[13] extension to PostgreSQL; this enables 3D geographic objects (e.g., points, lines, polygons, and surfaces) and allows locational queries to be run in PostgreSQL. All Crow Canyon site maps for legacy projects are currently being geo-rectified in a commercial GIS (ESRI's ArcGIS) and stored in a file geodatabase. These spatial data will be imported into the PostgreSQL research database, and all workflows for future conversions will transition to QGIS and other open source tools. Where possible, geospatial data will be checked for accuracy by overlaying site-maps on high resolution orthoimagery available from the USGS[14] or georectified drone imagery collected by Crow Canyon (Ullah 2015). SQL scripts will be written to convert legacy tabular spatial data to geospatial objects—for example, point locations of particular artifacts with coordinates in a project-specific local reference system. Geospatial constraints will be heavily utilised; for example, point locations should fall within the spatial boundaries of provenience designations. Raster datasets such as remotely

[10] E.g., using StoryMapJS (https://storymap.knightlab.com/) or similar open source tools.
[11] http://www.qgis.org/
[12] https://grass.osgeo.org/
[13] http://postgis.net/
[14] http://nationalmap.gov/ortho.html

sensed data from ground-penetrating radar or soil resistivity will also be entered into the research database. All geospatial datasets will be stored in native PostGIS data formats, and will be transformed to a common spatial reference system.

Data dictionary and metadata (Bocinsky; Research Database Designer/Manager). We will construct a data dictionary and metadata for all tables and geospatial objects. Documentation of the research database will adhere to the Archaeology Data Service/Digital Antiquity Guides to Good Practice.[15] We will record metadata at a number of levels (database, table, and field) to ensure that they can be preserved and reused reliably. We will generate a master entity-relationship diagram describing all relationships between tables in the database. Metadata for tables of geospatial objects will adhere to the International Standards Organization (ISO) 191xx series of metadata standards,[16] as recommended by the Federal Geographic Data Committee.

Application Programming Interface (Bocinsky; Research Database Designer/Manager). A basic RESTful API will be generated using the open source PostgREST software and standalone web server.[17] RESTful APIs allow for server-side data requests using standard HTTP verbs (GET, POST, PUT, DELETE, etc.) that web browsers use to retrieve web pages. PostgREST generates a set of commands using familiar SQL syntax with common filtering operators, and has built-in authentication using JSON Web Tokens and server-side database roles. This means that the RESTful HTTP access can inherit the user roles and groups defined in the PostgreSQL research database, greatly enhancing and simplifying security.

Web-based front-end for data entry (Bocinsky; Research Database Designer/Manager). The RESTful API will be utilized and tested with the development of a web-based front-end for data entry, for use by Crow Canyon staff and volunteers. We will use the node.js web application framework and a Create/Read/Update/Delete (CRUD) extension for the PostgREST API—possibly the Ext.js CRUD.[18] The internal front-end will act as a template for future web-based data-entry front-ends, such as for entering data digitally while in the field.

R access using API (Bocinsky). We will develop a software package for the *R* statistical environment[19] that provides access to the Crow Canyon research database via the API. Researchers are increasingly using *R* as the statistical framework of choice for research in the social science and humanities. A Crow Canyon *R* package would facilitate ingesting data from the research database into *R*, and performing basic data manipulations. This software package will be developed directly in GitHub, and will be released on GitHub, the Comprehensive *R*

[15] http://guides.archaeologydataservice.ac.uk/g2gp/Main
[16] http://www.fgdc.gov/metadata/iso-standards
[17] http://postgrest.com/
[18] https://github.com/timwis/ext-postgrest-crud
[19] https://www.r-project.org/

Archive Network (CRAN),[20] and ROpenSci.[21] Bocinsky has extensive experience developing data access tools for *R*,[22] and will lead development of the Crow Canyon *R* package.

GeoServer (Coffey; Research Database Designer/Manager). Geospatial data require a different set of tools than a standard RESTful API in order that they may be queried spatially, using map-based tools. We will use the open source GeoServer[23] Java-based software server for map creation and data sharing. GeoServer is an Open Geospatial Consortium (OGC) compliant implementation of a number of open standards such as Web Feature Service (WFS), Web Map Service (WMS), and Web Coverage Service (WCS). These, in turn, will provide native, server-side geospatial querying capability to users of various GIS front-ends, including QGIS and ESRI ArcGIS. This capability will also facilitate the creation of web mapping tools during Phase 3 of the *CC-DATA* project.

Archiving with tDAR (Bocinsky). Given that Crow Canyon Archaeological Center has excavated some of the largest and most important sites in the Pueblo Southwest, it is essential that Crow Canyon data persist in archival form. The database will be divided into its constituent legacy projects and archived with the Digital Archaeological Record (tDAR).[24] Sub-databases will be back-converted to MS Access format (required by tDAR), or another format should tDAR change its policies to include open source data formats (such as SQLite file databases).

Innovation Sandbox. The entire research database will be regularly cloned into an "innovation sandbox," available on Crow Canyon's internal network and enabling rapid prototyping of innovative data access tools during Phase 3 of the *CC-DATA* project, all while protecting the integrity of Crow Canyon's research data. When a tool is ready for deployment, it will be able to access the research database directly.

Sensitive data. Archaeological data presents unique challenges for digital data holders. In particular, archaeological site locations and details about human remains, funerary objects, and ritual features are culturally sensitive information.[25] Archaeologists and other cultural resource managers are expected to adhere to a set of ethical standards when using or distributing such information. In accordance with Crow Canyon's policy with regard to the treatment of human remains, funerary objects, and related data, we will restrict access to information about human remains found during excavation. Although drawings of human skeletal remains may be included on maps, the results of human remains analysis and photographs showing human remains will not be available on-line. As per current policy, professional researchers should contact Crow Canyon's Director of the Research Institute, in writing, to request access to human remains data.[26] Site locations will not be presented in tabular data and will be obscured in map

[20] https://cran.r-project.org/
[21] https://ropensci.org/
[22] See, for example, the *FedData* package: https://github.com/bocinsky/FedData
[23] http://geoserver.org/
[24] https://www.tdar.org/
[25] http://www.saa.org/AbouttheSociety/PrinciplesofArchaeologicalEthics/tabid/203/Default.aspx
[26] A copy of Crow Canyon's human remains policy is available in The Crow Canyon Archaeological Center Field Manual: http://www.crowcanyon.org/ResearchReports/FieldManual/FM_Titlepage.asp.

data available to the general public. Credentialed users will be able to access site locations and un-obscured data.

Intellectual Property. Crow Canyon is committed to providing open access to archaeological knowledge. All data will be published under the Creative Commons Attribution License (CC-By 4.0),[27] which stipulates that others are free to copy, distribute, and adapt the data so long as they attribute the work to Crow Canyon (i.e., provide proper citation). All software created during the *CC-DATA* project will be licensed under the MIT license,[28] which allows users to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the software so long as the license is preserved noting Crow Canyon's copyright; it also notes that software is provided without warranty and that Crow Canyon cannot be held liable for damages that might occur from use of the software.

GitHub and continuous integration. All software will be developed using the Git version control system,[29] and will be made available through GitHub at Crow Canyon's organization page.[30] Code will be developed in public repositories. All projects will implement continuous integration and testing using Travis CI;[31] the *R* package will adhere to Hadley Wickham's best practices for writing *R* packages.[32]

Hardware and network infrastructure. Server hardware and network infrastructure will be managed by Crow Canyon's department of information technology; physical infrastructure is not part of this proposal. Crow Canyon operates a local-area wired and wireless network with an over 50 Mbps Internet connection. Our server capacity includes a Dell PowerEdge R620 server with 96 GB of memory and 5.5 TB of storage running Windows 2012 R2 Datacenter Hyper-V server with eight Windows 2012 R2 Datacenter virtual servers, one Windows 2008 R2 Enterprise Exchange virtual server, and one Ubuntu 14.04 LTS Linux virtual server. We also have a HP Proliant ML350 G6 server with 24 GB of memory and 2 TB of storage running a Windows 2008 R2 Enterprise Hyper-V server with two Windows 2012 R2 Datacenter virtual servers. The research database is backed up nightly to network attached storage.

[27] https://creativecommons.org/licenses/by/4.0/
[28] https://opensource.org/licenses/MIT
[29] https://git-scm.com/
[30] https://github.com/crowcanyon
[31] https://travis-ci.org/
[32] http://r-pkgs.had.co.nz/

Sustainability of Project Outcomes and Digital Content

Crow Canyon is dedicated to sustained access to both its data holdings and the software and other tools it produces as part of the *CC-DATA* project. As described in ***Methodology and standards***, our commitment to using public repositories, open source tools, and permissive use licenses maximize the likelihood that the tools and data we produce will be used, refined, and enhanced by others. Furthermore, the Crow Canyon research database is designed with widely-used standards (PostgreSQL, PostGIS, RESTful APIs) with proven scalability from small projects to industry-scale databases. Data archival with tDAR will ensure the long-term availability of Crow Canyon's research data. Internally, Crow Canyon is committed to retaining the Research Database Designer/Manager position beyond the duration of this project (see Appendix D: Letter of commitment — Crow Canyon Archaeological Center). Crow Canyon's backup policies guarantee the short-term preservation and versioning of the research database.

Dissemination

Dissemination of data availability, methods, and tools is crucial to ensuring that the *CC-DATA* project maximizes its benefits to the research and descendent communities, as well as to the broader public. The *CC-DATA* project description, status, and milestones will be disseminated through a **project website** connected to Crow Canyon's main website, and will include a blog for project updates and links to all software and data products. In year 2, Bocinsky will submit an **article to *Advances in Archaeological Practice***, a journal of the Society for American Archaeology, discussing challenges of data preservation and access given our archaeology's distributed data model, and describing the innovations in co-created archaeological knowledge enabled by data frameworks such as the one proposed here. Bocinsky, Coffey, and other Crow Canyon staff will present Crow Canyon data access tools at **regional and national professional conferences** at the end of years 1 and 2, including the Colorado Council of Professional Archaeologists, the Southwest Symposium, and the Society for American Archaeology annual meetings. Crow Canyon maintains an active **social media** presence on **Facebook**[33] and **Twitter**,[34] and will spread awareness of project activities on those platforms and through press releases. Finally, software development in a **public repository on GitHub** and the use of **open source licensing** on all data and software products invites collaboration and dissemination of all project products.

[33] https://www.facebook.com/crowcanyonarchaeologicalcenter/
[34] https://twitter.com/crow_canyon

Work Plan

Project timespan is May 2017 – April 2019. RD: Database Designer/Manager. **Products and outcomes appear in bold.** Social media outreach will occur throughout the project duration.

Mar 2017	Award notification; begin search for Database Designer/Manager
Apr 2017	Receive award documents; **design project website (Bocinsky)**
May 2017	Hire Research Database Designer/Manager; begin project
May – Jul 2017	Data cleaning; begin preparing data dictionary (Bocinsky, RD)
May – Nov 2017	GIS integration/data entry/cleaning; geospatial metadata (Coffey, RD)
Aug 2017	**Archive legacy projects in tDAR (Bocinsky)**
Aug 2017	**Establish innovation sandbox**
Nov 2017 – Apr 2018	Finalize data dictionary; develop API (Bocinsky, RD)
Jan 2018	**Presentation at Southwest Symposium**
Apr 2018	**Release data dictionary and API**
Apr 2018	**Presentation at Society for American Archaeology annual conference**
Apr – Oct 2018	Develop web-based front-end for data-entry (RD)
Apr – Oct 2018	Develop *R* package for data access (Bocinsky)
Oct 2018	**Release *R* package for data access**
Oct – Dec 2018	Develop GeoServer services; test internally (Coffey, RD)
Oct 2018 – Apr 2019	Test and finalize web-based front-end for data-entry (Bocinsky, RD)
Jan 2019	**Submit article to *Advances in Archaeological Practice***
Jan 2019	**Release GeoServer services**
Mar 2019	**Presentation at Colorado Council of Professional Archaeologists**
Apr 2019	**Presentation at Society for American Archaeology annual conference**
Apr 2019	**Release web-based front-end for data-entry**
Apr 2019	**Archive ongoing project in tDAR (Bocinsky)**
Apr 2019	**Complete and submit final report**

Staff

Project staff. The project staff will be the core team to complete all products and outcomes, and includes the Project Director (Bocinsky), Co-Project Director (Coffey), and a new position: Research Database Manager/Designer. (2-page résumés are included in the appendices for the project staff.)

Kyle Bocinsky (Project Director) is the **Director of Sponsored Projects** at the Research Institute at Crow Canyon and **Adjunct Assistant Professor** in the Department of Anthropology at the Washington State University. He holds a PhD in Anthropology from Washington State University, focusing on data-driven computational analyses of human-environment interactions in the ancestral Pueblo Southwest. Bocinsky has extensive experience in building cyberinfrastructure in support of archaeology, and is the author of several packages for the *R* statistical language, including *FedData* for downloading and processing data from several federated data sources and *PaleoCAR* for high-resolution paleoclimate reconstruction from tree-rings. Bocinsky will serve as the Project Director, and will oversee all database, middleware, and front-end development. Additionally, he will be responsible for developing the *R* software package, and submitting Crow Canyon data to tDAR. In each year of the two-year grant, Bocinsky will spend 40% of his time on this project.

Grant Coffey (Co-Project Director) is the **GIS Archaeologist** at Crow Canyon Archaeological Center. He holds an MA in Anthropology from Northern Arizona University. Coffey oversees all GIS work at Crow Canyon. For this project, Coffey will be responsible for working with the Research Database Manager/Designer on GIS integration, data entry, cleaning; will develop the GeoServer services for the database; and develop workflows for entering born-digital geospatial data in the future. In each year of the two-year grant, Coffey will spend 40% of his time on this project.

Crow Canyon will hire a full-time, permanent **Research Database Designer/Manager** for the duration of the project, funded by the NEH. This person will report to the Project Director, and will be involved in all aspects of the project. In each year of the two-year grant, the Research Database Designer/Manager will spend 100% of her time on this project. A job description is included in the Appendices. As noted above, Crow Canyon commits to retaining the Research Database Designer/Manager position beyond the duration of this project (see Appendix D: Letter of commitment — Crow Canyon Archaeological Center). A desktop computer supporting the Research Database Designer/Manager's activities is requested in the *Supplies & Materials* section of the project budget.

Supervisory team. The supervisory team consists of Crow Canyon staff members who are most familiar with the design and use of the research database. The project staff and supervisory team will meet in person for two hours every two weeks (2.5% time) to discuss project progress and advise on products and outcomes. Additionally, the Director of Archaeology (Ryan) will be consulted on the research database for an additional hour per week. (2-page résumés are included in the appendices for the supervisory team.)

> **Susan C. Ryan** is the **Director of Archaeology** at Crow Canyon. She holds a PhD in Anthropology from the University of Arizona. In each year of the two-year grant, Ryan will spend 5% of her time on this project.
>
> **Josephine (Jamie) Merewether** is the **Collections Manager** at Crow Canyon. She holds an MA in Anthropology from the University of Alabama. In each year of the two-year grant, Merewether will spend 2.5% of her time on this project.
>
> **Kari L. Schleher** is the **Laboratory Manager** at Crow Canyon and **Adjunct Assistant Professor** in the Department of Anthropology at the University of New Mexico. She holds a PhD in Anthropology from the University of New Mexico. In each year of the two-year grant, Schleher will spend 2.5% of her time on this project.
>
> **Shanna Diederichs** is a **Supervisory Archaeologist** at Crow Canyon. She holds an MA in Anthropology from Northern Arizona University. In each year of the two-year grant, Diederichs will spend 2.5% of her time on this project.
>
> **Caitlin Sommer** is a **Supervisory Archaeologist** at Crow Canyon. She holds an MA in Anthropology from the University of Colorado Boulder. In each year of the two-year grant, Sommer will spend 2.5% of her time on this project.
>
> **Mike Awe** is the **Director of Information Technology** at Crow Canyon. He holds a Bachelor's of Business Administration from Loyola University of Chicago. In each year of the two-year grant, Awe will spend 2.5% of his time on this project.

Project advisory board. The project advisory board consists of Crow Canyon research associates who have intimate knowledge of the research database—many of them generated data within it. They will be updated on the project progress quarterly throughout the duration of the project via conference call, and will be on call to answer data-specific questions throughout the project duration. (2-page résumés are not included for the project advisory board.)

> **Karen R. Adams, PhD** — *Research Institute, Crow Canyon Archaeological Center*
> **Jonathan C. Driver, PhD** — *Archaeology, Simon Fraser University*
> **Donna M. Glowacki, PhD** — *Anthropology, University of Notre Dame*
> **William D. Lipe, PhD** — *Anthropology, Washington State University*
> **Scott D. Ortman, PhD** — *Anthropology, University of Colorado, Boulder*
> **Mark D. Varien, PhD** — *Research Institute, Crow Canyon Archaeological Center*

4. History of grants

This project has not received any prior or current grant support.

5. Project Deliverables

The *Crow Canyon Digital Archaeology Tools and Access (CC-DATA)* project aims to enhance the functionality, extendibility, and access to the Crow Canyon Archaeological Center's archaeological research database. Crow Canyon's data holdings include (as of July 2016):

- Information from 449 different archaeological sites
- 382 sites with some form of excavation data or laboratory analysis data conducted by Crow Canyon
- 394 MB of tabular data, including over 1 million records in 375 different tables
- 152 GB of archived photographs, representing 21,789 photographs
- 1,524,772 recorded and analyzed pottery fragments in 199,254 data records
- 21,050 provenience designations, or distinct stratigraphic contexts
- 122,866 faunal records
- 83,826 chipped stone records
- Over 1,600 automated queries for running forms for data input and that export data to web interfaces

Project deliverables include the following (delivery month in parentheses):

- Start project website and blog (April 2017)
- Eight legacy projects archived in the Digital Archaeological Record (August 2017)
- Establish innovation sandbox (August 2017)
- Project status presentation at the 2018 Southwest Symposium (January 2018)
- Data dictionary and database metadata (April 2018)
- Application Programming Interface (API) to the research database (April 2018)
- Project status presentation at Society for American Archaeology meetings (April 2018)
- *R* package for access to the research database (October 2018)
- GeoServer service access point to the research database (January 2019)
- Article submission to *Advances in Archaeological Practice* (January 2019)
- Project presentation at Colorado Council of Professional Archaeologists (March 2019)
- Release web-based front-end for data entry (April 2019)
- Project presentation at Society for American Archaeology meetings (April 2019)
- Archive ongoing project in the Digital Archaeological Record (April 2019)
- Complete and submit final report (April 2019)

6. List of Participants

Participants in **bold** are part of the project staff or supervisory team, and their 2-page résumés are included in the appendices. Other participants are part of the project advisory board—2-page résumés are not included for the project advisory board members.

Adams, Karen R. — *Research Institute, Crow Canyon Archaeological Center*
Awe, Mike — *Information Technology, Crow Canyon Archaeological Center*
Bocinsky, R. Kyle — *Research Institute, Crow Canyon Archaeological Center*
Coffey, Grant — *Archaeology, Crow Canyon Archaeological Center*
Diederichs, Shanna — *Archaeology, Crow Canyon Archaeological Center*
Driver, Jonathan C. — *Archaeology, Simon Fraser University*
Glowacki, Donna M. — *Anthropology, University of Notre Dame*
Lipe, William D. — *Anthropology, Washington State University*
Merewether, Jamie — *Archaeology, Crow Canyon Archaeological Center*
Ortman, Scott D. — *Anthropology, University of Colorado, Boulder*
Ryan, Susan C. — *Archaeology, Crow Canyon Archaeological Center*
Schleher, Kari L. — *Archaeology, Crow Canyon Archaeological Center*
Sommer, Caitlin — *Archaeology, Crow Canyon Archaeological Center*
Varien, Mark D. — *Research Institute, Crow Canyon Archaeological Center*

8. Appendices

Appendix A: References Cited

Bocinsky, R. Kyle, Johnathan Rush, Keith W. Kintigh, and Timothy A. Kohler
2016 Exploration and exploitation in the macrohistory of the pre-Hispanic Pueblo Southwest. *Science Advances* 2:e1501532.

Bollwerk, Elizabeth, Robert Connolly, and Carol McDavid
2015 Co-creation and public archaeology. *Advances in Archaeological Practice* 3(3):178–187.

Clarke, Mary
2015 The Digital Dilemma: Preservation and the digital archaeological record. *Advances in Archaeological Practice* 3(4):313–330.

Kintigh, Keith W., Jeffrey H. Altschul, Mary C. Beaudry, Robert D. Drennan, Ann P. Kinzig, Timothy A. Kohler, W. Fredrick Limp, Herbert D.G. Maschner, William K. Michener, Timothy R. Pauketat, Peter N. Peregrine, Jeremy A. Sabloff, Tony J. Wilkinson, Henry T. Wright, and Melinda A. Zeder
2014a Grand challenges for archaeology. *Proceedings of the National Academy of Sciences* 111(3):879–880.
2014b Grand challenges for archaeology. *American Antiquity* 79(1):5–24.

Kintigh, Keith W., Jeffrey H. Altschul, Ann P. Kinzig, W. Fredrick Limp, William K. Michener, Jeremy A. Sabloff, Edward J. Hackett, Timothy A. Kohler, Bertram Ludäscher, and Clifford A. Lynch
2015 Cultural dynamics, deep time, and data: Planning cyberinfrastructure investments for archaeology. *Advances in Archaeological Practice*, 3(1):1–15.

Ullah, Isaac
2015 Integrating older survey data into modern research paradigms: Identifying and correcting spatial error in "legacy" datasets. *Advances in Archaeological Practice* 3(4):331–350.

Appendix B: Staff Résumés

DR. R. KYLE BOCINSKY (Project Director)

Director of Sponsored Projects, Crow Canyon Archaeological Center
23390 Road K, Cortez, CO 81321
Tel: +1 970 564 4384; Email: kbocinsky@crowcanyon.org

PROFESSIONAL PREPARATION

University of Notre Dame	Notre Dame, IN	Anthropology	B.A., 2008
Washington State University	Pullman, WA	Anthropology	M.A., 2011
Washington State University	Pullman, WA	Anthropology	Ph.D., 2014

APPOINTMENTS

1/2016 – present	Adjunct Assistant Professor, Dept. of Anthropology, Washington State University, Pullman, WA, USA
11/2015 – present	Director of Sponsored Projects, Crow Canyon Archaeological Center, Cortez, CO, USA
2015	Post-doctoral researcher, Dept. of Anthropology, Washington State University, Pullman, WA, USA
8/2011 – 5/2014	Fellow, NSF Graduate Research Fellowship Program, Dept. of Anthropology, Washington State University, Pullman, WA, USA
8/2009 – 5/2011	Trainee, IGERT Program in Evolutionary Modeling, Dept. of Anthropology, Washington State University, Pullman, WA, USA
1/2012 – 12/2014	Instructor, Dept. of Anthropology, Washington State University, Pullman, WA, USA
8/2008 – 5/2009	Research Assistant, Dept. of Anthropology, Washington State University, Pullman, WA, USA

RELATED PRODUCTS

In press	A 5500 year model of changing crop niches on the Tibetan Plateau. *Current Anthropology*. (Co-author with Jade d'Alpoim Guedes and Sturt Manning).
2016	Exploration and exploitation in the macrohistory of the pre-Hispanic Pueblo Southwest. *Science Advances*, 2:e1501532. (Lead-author with Johnathan Rush, Keith W. Kintigh, and Timothy A. Kohler).
2016	The social consequences of climate change in the Central Mesa Verde region. *American Antiquity*, 81(1):74–96. (Co-author with Dylan M. Schwindt, Scott G. Ortman, Donna M. Glowacki, Mark D. Varien, and Timothy A. Kohler).
2015	The impact of climate on the spread of rice to North-eastern China: A new look at the data from Shandong Province. *PLoS ONE*, 30 June 2015. DOI: 10.1371/journal.pone.0130430. (Co-author with Jade d'Alpoim Guedes and Guiyun Jin).
2014	A 2000-year reconstruction of the rain-fed maize agricultural niche in the US

Southwest. *Nature Communications*, 5:5618. DOI: 10.1038/ncomms6618. (Lead-author with Timothy A. Kohler).

OTHER SIGNIFICANT PRODUCTS

2016 Great houses, shrines, and high places: Intervisibility in the Chacoan World. *American Antiquity*, 81(2):205–230. (Co-author with Ruth M. Van Dyke, Tucker Robinson, and Thomas C. Windes).

2015 Comment on "Agriculture facilitated permanent human occupation of the Tibetan Plateau after 3600 BP". *Science*, 348(6237):872–872. (Co-author with Jade d'Alpoim Guedes and Ethan E. Butler).

2015 *FedData: Functions to Automate Downloading Geospatial Data Available from Several Federated Data Sources*. http://CRAN.R-project.org/package=FedData. R package version 2.1.

2015 *PaleoCAR: Paleoclimate Reconstruction from Tree Rings using Correlation Adjusted corRelation*. https://github.com/bocinsky/PaleoCAR/archive/2.0.tar.gz. R package version 2.0.

2014 Extrinsic site defensibility and landscape-based archaeological inference: An example from the Northwest Coast. *Journal of Anthropological Archaeology*, 35:164–176.

SYNERGISTIC ACTIVITIES

- Graduate researcher, the Village Ecodynamics Project II (NSF DEB-0816400), August 2008–December 2014.
- Research collaborator, the Long-Term Vulnerability and Transformation Project (NSF BCS-1113991), October 2014–present.
- Postdoctoral researcher, NSF "Building Community and Capacity for Data-Intensive Research in the Social, Behavioral, and Economic Sciences and in Education and Human Resources" grant entitled "Collaborative Research: Designing SKOPE: Synthesized Knowledge of Past Environments," (BCC-1439591), September 2014–present.

GRANT D. COFFEY (Co-Project Director)
GIS Archaeologist, Crow Canyon Archaeological Center
23390 Road K, Cortez, CO 81321
Tel: +1 970 564 4370; Email: gcoffey@crowcanyon.org

PROFESSIONAL PREPARATION

Northern Arizona University	Flagstaff, AZ	Anthropology	M.A., 2004
Fort Lewis College	Durango, CO	Anthropology	B.A., 2001
Fort Lewis College	Durango, CO	Agricultural Science	A.A., 2001

APPOINTMENTS

1/2015 – present	GIS Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
1/2008 – 1/2015	Supervisory Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
4/2005 – 1/2008	Field and Laboratory Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
2/2005 – 4/2005	Archaeological Mapping Specialist, Western Mapping, Inc., Tucson, AZ, USA
9/2004 – 11/2004	Survey Crew Chief, Woods Canyon Archaeological Consultants, Cortez, CO, USA
6/2004 – 9/2004	Staff Archaeologist, Glen Canyon National Recreation Area, Page, AZ, USA
8/2003 – 5/2004	Field Coordinator, Anthropology Laboratories, Northern Arizona University, Flagstaff, AZ, USA

RELATED PRODUCTS

2015 Universal Scaling: Evidence from Village-Level Societies. Paper for inclusion in the volume "*Scaling and Complexity in Human Organizations"*, edited by Luis Bettencourt, Jose Lobo, and Geoffrey West. Princeton Primers in Complexity, Princeton University Press. In press, co-author.

2015 Creating Symmetry: The Cultural Landscape in the Sand Canyon Locality, Southwestern Colorado. Accepted by *Kiva,* in press.

2015 The Harlan Great Kiva Site: Civic Architecture and Community Persistence in the Goodman Point Area of Southwestern Colorado. *Kiva* 79 (4): 380–404.

2014 Residential versus civic use in the Pueblo II-II period: A case study from the Harlan Great Kiva site in the Goodman Point area of southwestern Colorado. *Journal of Field Archaeology* 39 (2): 115–123.

2010 Landscape and Social Scale at Goodman Point, Hovenweep National Monument, Southwestern Colorado. *Kiva* 76 (1): 55–82.

2010 Heartland of Early Pueblos: The Central Mesa Verde. In *Crucible of Pueblos: The Early Pueblo Period in the Northern Southwest* edited by Richard H. Wilshusen, Gregson Schachner, and James R. Allison. Costen Institute of Archaeology Press. Co-author.

2006 Reevaluating Regional Migration in the Northern San Juan during the Late Pueblo I Period: A Reconnaissance Survey of the East Dove Creek Area. *Kiva* 72 (1): 57–72.

RELEVANT SKILLS

- Graphics Software: Adobe Illustrator, Adobe Photoshop, Trimble Sketchup
- Quantitative Analysis: SPSS, Access
- Geographic Information Systems: Certified in the ESRI suite of GIS software (ArcMap, ArcScene, ArcCatalog), quantitative geospatial analysis of data

DR. SUSAN C. RYAN (Supervisory Team)
Director of Archaeology, Crow Canyon Archaeological Center
23390 Road K, Cortez, CO 81321
Tel: +1 970 564 4381; Email: sryan@crowcanyon.org

PROFESSIONAL PREPARATION

Illinois State University	Normal, IL	Anthropology	B.S., 1996
New Mexico State University	Las Cruces, NM	Anthropology	M.A., 1998
University of Arizona	Tucson, AZ	Anthropology	Ph.D., 2013

APPOINTMENTS

2013 – present	Director of Archaeology, Crow Canyon Archaeological Center, Cortez, CO, USA
2013	Instructor of Record, Dept. of Anthropology, Adams State University, Alamosa, CO, USA
2009 – 2010	Teaching Assistant, School of Anthropology, University of Arizona, Tucson, AZ, USA
2008	Research Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
2001 – 2013	Project Director, Albert Porter Pueblo research project, Crow Canyon Archaeological Center, Cortez, CO, USA
1998	Assistant Project Director, Shields Pueblo research project, Crow Canyon Archaeological Center, Cortez, CO, USA
1998	Teaching Assistant, Dept. of Anthropology, New Mexico State University, Las Cruces, NM, USA
1998	Assistant Crew Chief, Henry Wertheim Site, New Mexico State University, Las Cruces, NM, USA
1997 – 1998	Field School Director, Jackrabbit Ruin, New Mexico State University, Las Cruces, NM, USA
1995	Archaeological Technician, Illinois Transportation Archaeology Research Program, Champaign, IL, USA

RELATED PRODUCTS

In press	Integration and Disintegration: The Role of Kiva Architecture in Community Formation during the Pueblo II and Pueblo III Periods in the Prehispanic U.S. Southwest. In *Coming Together: Comparative Approaches to Population Aggregation and Early Urbanization*. SUNY Press, Buffalo (expected 2017).
2016	A Spatial Analysis of Civic-Ceremonial Architecture in the Central Mesa Verde Region of the United States. *Journal of Anthropological Archaeology*. (Co-author with Grant D. Coffey).
2015	*The Archaeology of Shields Pueblo: Excavations at a Mesa Top Community Center*. Crow Canyon Archaeological Center, Cortez. (Editor).

2015 *The Archaeology of Albert Porter Pueblo: Excavations at a Great House Community Center*. Crow Canyon Archaeological Center, Cortez. (Editor).

2010 The occupational history of Albert Porter Pueblo during the AD 1130–1180 drought. *Kiva*, 75(3):303–325.

2009 The Rise of Central Structure Communities Among the Central Mesa Verde & Kayenta Anasazi. *The Artifact*, 47.

2008 Constructing Community and Transforming Identity at Albert Porter Pueblo. In *The Social Construction of Communities: Studies of Agency, Structure, and Identity in the Southwestern U.S.* M. Varien and J. Potter (Editors). Altamira Press, Plymouth, United Kingdom. Pp. 69–86.

2008 Population Dynamics among Salmon's Northern Neighbors in the Central Mesa Verde Region. In *Chaco's Northern Prodigies: Salmon, Aztec, and the Ascendancy of the Middle San Juan Region After A.D. 1100.* Paul F. Reed (Editor). University of Utah Press, Salt Lake City. Pp. 352–365. (Co-author with Mark D. Varien, Scott G. Ortman, and Kristin A. Kuckelman).

OTHER SIGNIFICANT PRODUCTS

2011 The Potential of Osteometric Data for Comprehensive Studies of Turkey (*Meleagris gallopavo*) Husbandry in the American Southwest. *Kiva*, 78(1):61–78. (Co-author with Shaw Badenhorst, Robin Lyle, Jamie Merewether, and Jonathan C. Driver).

2010 The Impact of Long-Term Residential Occupation of Community Centers on Local Plant and Animal Resources. In *Leaving Mesa Verde: Peril and Change in the Thirteenth-Century Southwest.* T. Kohler, M. Varien, and A. Wright (Editor). University of Arizona Press, Tucson. Pp. 156–179. (Co-author with Andrew I. Duff and Karen R. Adams).

2008 Native Americans and the Environment: Perspectives on the Ecological Indian, edited by M. Harkin and D. Lewis. Book Review in the J*ournal of American Ethnic History*, 27(2).

SYNERGISTIC ACTIVITIES

- Nine reports written on archaeological and ethnographic research from 1996-2011.
- Over twenty-five presentations delivered at professional meetings, archaeological interest groups, and to the general public.
- Approximately $822,000 received in grant awards as PI and Co-PI from 2013-present.
- Member of the Society for American Archaeology, Register of Professional Archaeologists, and the Arizona Archaeological and Historical Society.

JOSEPHINE (JAMIE) MEREWETHER (Supervisory Team)

Collections Manager, Crow Canyon Archaeological Center
23390 Road K, Cortez, CO 81321
Tel: +1 970 564 4391; Email: jmerewether@crowcanyon.org

PROFESSIONAL PREPARATION

University of Colorado	Boulder, CO	Anthropology	B.A., 1979
University of Alabama	Tuscaloosa, AL	Anthropology	M.A., 1984

APPOINTMENTS

12/1997 – present	Collections Manager, Crow Canyon Archaeological Center, Cortez, CO, USA
2/2009 – 3/2009	Field Archaeologist, Abajo Archaeology, Bluff, UT, USA
4/1992 – 12/1997	Field Lab Director and Field Office Manager, Soil Systems Inc, Cortez, CO, USA
3/1992 – 4/1992	Field Archaeologist, Division of Conservation Archaeology, Naschitti, NM, USA
1/1998 – 2/1992	Field Archaeologist, Lab Archaeologist, Crew Chief, Soil Systems Inc, Phoenix, AZ, USA
9/1987 – 12/1987	Field Archaeologist, San Juan College, Farmington, NM, USA
7/1987 – 8/1987	Field Archaeologist, Office of Contract Archaeology, University of New Mexico, Albuquerque, NM, USA
4/1986 – 6/1987	Field Archaeologist, Soil Systems Inc, Phoenix, AZ, USA
5/1984 – 6/1986	Field Archaeologist/Lab Technician, WCRM, SW Wyoming and Boulder, CO, USA
10/1984 – 5/1984	Graduate Teaching Assistant, Department of Anthropology, University of Alabama, Tuscaloosa, AL, USA
9/1981 – 11/1981	Field Archaeologist, UNDAR, West Bayfield, ND, USA
5/1980 – 8/1981	Field Archaeologist, Archaeological Services, Laramie, WY, USA

RELATED PRODUCTS

2015 Ritual Drinks in the Pre-hispanic US Southwest and Mexican Northwest. *Proceedings of the National Academy of Sciences* 112.37: 11436-11442. (Coauthored with Patricia L. Crown and others).

2013 The potential of osteometric data for comprehensive studies of turkey (Meleagris gallopavo) husbandry in the American Southwest. *Kiva* 78(1):61-77. (Coauthored with Shawn Badenhorst, Robin Lyle, and Susan Ryan).

2005 The Crow Canyon Archaeological Center Laboratory Manual, Crow Canyon Archaeological Center, Cortez, CO. (Co-authored with Scott G. Ortman and others).

1994 Chronology in *The Pueblo Grande Project*, Vol 2: 157-254. (Co-authored with David

Abbott and Douglass R. Mitchell).

OTHER SIGNIFICANT PRODUCTS

2011 Evaluating Chaco Influences in the San Juan Basin Using Material Culture during the Pre-A.D. 1150 and Post-Chaco Periods. Paper presented at the SAA conference in Sacramento, CA. (Co-authored with Fumi Arakawa and Chris Nicholson).

2008 Turkey (*Melleagris gallapavo*) Husbandry and Osteometric Traits in the Central Mesa Verde Region of the American Southwest A.D. 1100 – 1280. Poster presented at the SAA conference in Vancouver, BC. (Co-authored with Robin Lyle and Shawn Badenhorst).

2007 Snapshot of a Chaco-era Pueblo in Southwestern Colorado: Examining the Relationship Between a Great House and it's Community. Paper presented at the SAA conference in Austin, TX. (Co-authored with Erin Baxter and Jonathan Till).

2005 An Analysis of Late PII Ancestral Pueblo Basket Impressed Pottery. Paper presented at the SAA conference in Salt Lake City, UT. (Co-authored with Scott Ortman).

1983 Multivariate Analysis of the Archaeological Maize Collections: A Method and a Peruvian Example. Paper presented at the SAA conference. (Co-authored with C. Gyllenhaal-Davis, J. Callahan, and C.E. Smith, Jr.).

DR. KARI L. SCHLEHER (Supervisory Team)
Laboratory Manager, Crow Canyon Archaeological Center
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PROFESSIONAL PREPARATION

University of Arizona	Tucson, AZ	Anthropology	B.A., 1998
University of New Mexico	Albuquerque, NM	Anthropology	M.A., 2010
University of New Mexico	Albuquerque, NM	Anthropology	Ph.D., 2014

APPOINTMENTS

01/2014 – present	Laboratory Manager, Crow Canyon Archaeological Center, Cortez, CO, USA
10/2011 – 1/2014	Laboratory Analysis Manager, Crow Canyon Archaeological Center, Cortez, CO, USA
8/2010 – present	Adjunct Assistant Professor, Dept. of Anthropology, University of New Mexico, Albuquerque, NM, USA
8/2009 – 9/2010	Ceramics Analyst, Southwest Archaeological Consultants, Santa Fe, NM, USA
8/2005 – 5/2010	Pictorial Collections Fellow, Center for Southwest Research, University of New Mexico, Albuquerque, NM, USA
2/2005 – 6/2005	Petrographic Ceramic Analyst, Criterion Environmental Consulting, Albuquerque, NM, USA
6/2004 – 8/2004	Archival Intern, Wheelwright Museum of the American Indian, Santa Fe, NM, USA
8/2003 – 5/2004	Curatorial Assistant, Maxwell Museum of Anthropology, University of New Mexico, Albuquerque, NM, USA
8/2002 – 12/2003	Teaching Assistant, Dept. of Anthropology, University of New Mexico, Albuquerque, NM, USA
6/2001 – 8/2002	Archaeology Technician, National Park Service, Santa Fe, NM, USA
8/2000 – 12/2001	Ceramic Analyst, San Marcos Pueblo Archaeological Project, University of New Mexico, Albuquerque, NM, USA
5/1999 – 8/1999	Field Research Intern, Crow Canyon Archaeological Center, Cortez, CO, USA
1/1998 – 8/1998	Research Assistant, Desert Archaeology, Inc., Tucson, AZ, USA

RELATED PRODUCTS

2015 Communities of Identity, Communities of Practice: Understanding Santa Fe Black-on-white Pottery in the Española Basin of New Mexico. *Journal of Archaeological Science.* 63: 1-12. (Co-author with Suzanne L. Eckert and William D. James).

2012 Glazed Over: Composition of Northern Rio Grande Glaze Ware Paints from San Marcos Pueblo. In *Potters and Communities of Practice: Glaze Paint and Polychrome Pottery in the American Southwest, AD 1250 to 1700.* Edited by Linda Cordell and Judith Habicht-Mauche. Anthropological Papers of the University of Arizona, Number 75, pg. 97-106. The University of Arizona Press, Tucson, AZ. (Co-author with Deborah L. Huntley and Cynthia L. Herhahn).

2012 Analytic and experimental approaches to understanding Rio Grande glaze paint technology as an artistic process. In *Potters and Communities of Practice: Glaze Paint and Polychrome Pottery in the American Southwest, AD 1250 to 1700.* Edited by Linda Cordell and Judith Habicht-Mauche. Anthropological Papers of the University of Arizona, Number 75, pg. 107-116. The University of Arizona Press, Tucson, AZ. (Co-author with Eric Blinman, Tom Dickerson, Cynthia L. Herhahn, and Ibrahim Gundiler).

2012 On-ramps to the Glazeware Interstate: Ceramic Trade at Pottery Mound and Montaño Bridge. In *Potters and Communities of Practice: Glaze Paint and Polychrome Pottery in the American Southwest, AD 1250 to 1700.* Edited by Linda Cordell and Judith Habicht-Mauche. Anthropological Papers of the University of Arizona, Number 75, pg. 65-74. The University of Arizona Press, Tucson, AZ. (Co-author with Franklin Hayward),

2005 Petrographic Analysis of Glaze-Painted Ceramics. In *Across the Caja del Rio Plateau III: Hunters and Farmers in the Northern Rio Grande.* Edited by Peggy A. Gerow and Patrick Hogan. Office of Contract Archaeology, University of New Mexico. pp. 153-165.

OTHER SIGNIFICANT PRODUCTS

2017 *Change and Stability: The archaeology and history of Pueblo San Marcos, New Mexico*. The University of New Mexico Press, Albuquerque, NM. Co-editor with Ann F. Ramenofsky (In Press)

2017 Learning and Production: The Northern Rio Grande Glaze Ware Community of Practice at San Marcos Pueblo during the Protohistoric Period. In *Change and Stability: The archaeology and history of Pueblo San Marcos, New Mexico*. The University of New Mexico Press, Albuquerque, NM. (In Press)

2017 Introducing San Marcos: A Protohistoric Town in North Central New Mexico. In *Change and Stability: The archaeology and history of Pueblo San Marcos, New Mexico*. The University of New Mexico Press, Albuquerque, NM. (Co-authored with Ann F. Ramenofsky, In Press).

2017 Situating San Marcos: Space, Time, and Tradition. In *Change and Stability: The archaeology and history of Pueblo San Marcos, New Mexico*. The University of New Mexico Press, Albuquerque, NM. (Co-authored with Ann F. Ramenofsky and Ariane O. Pinson, In Press).

2017 Artifacts at San Marcos Pueblo. In *Change and Stability: The archaeology and history of Pueblo San Marcos, New Mexico*. The University of New Mexico Press, Albuquerque, NM. (Co-authored with Ann F. Ramenofsky, Dorothy Larson, and

Jennifer Boyd Dyer, In Press).

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PROFESSIONAL PREPARATION

University of Colorado	Boulder, CO	Anthropology	B.A., 1995
Northern Arizona University	Flagstaff, AZ	Anthropology	M.A., 2016

APPOINTMENTS

1/2011 – present	Supervisory Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
9/2014 – 6/2015	Crew Chief, Northern Arizona Anthropology Laboratory, Flagstaff, AZ, USA
1/2011 – 2/2011	Architectural Illustrator, Dept. of Fine Arts, New York University, New York, NY, USA
1/2012 – 2/2012	Architectural Illustrator, Dept. of Fine Arts, New York University, New York, NY, USA
8/2007 – 1/2010	Staff Archaeologist, Aztec Ruins National Monument, Aztec, NM, USA
4/2005 – 8/2007	Alcove Site Assessment Field Director, Mesa Verde National Park, CO, USA
3/2007 – 5/2007	Archive Research Contractor, Crow Canyon Archaeological Center, Cortez, CO, USA
2/2006 – 3/2006	Digital Illustration Contractor, Manti-La Sal National Forest, Price, UT, USA
3/2004 – 4/2005	Lab Manager, SWCA Environmental Consultants, Durango, CO, USA
5/2003 – 9/2003	Field and Laboratory Archaeologist, Lake Clark National Park, Port Alsworth, AK, USA
4/2001 – 5/2003	Field Director, Bircher, Pony, and Long Mesa Post-fire Assessment, Mesa Verde National Park, CO, USA
5/1999 – 4/2001	Archaeologist, Woods Canyon Archaeological Consultants, Inc., Cortez, CO, USA
5/1995 – 5/1999	Archaeologist, Alpine Archaeological Consultants, Inc., Montrose, CO, USA

RELATED PRODUCTS

2016 *Demographic and Social Dimensions of the Neolithic Revolution in Southwest Colorado*. *Kiva*. (Co-authored with Scott Ortman, Caitlin Sommer, Kari Schleher, Jerry Fetterman, and Marcus Espinosa)

2016 Transformation in Technologies: A Look at Basketmaker III Archaeology in Southwestern Colorado. In *Archaeological Remote Sensing: Applications in North America*, University of Alabama Press.

2013 Archaeological Geophysical Surveys reveal the Basketmaker III Populations at the Dillard Site. *International Society for Archaeological Prospection* 35.

2013 *The Basketmaker Communities Project Annual Report, 2012 Field Season*. Submitted to Colorado Office of Historic Preservation, Denver, CO.

2012 New Clues to Early Pueblo Communities. *Popular Archaeology*, December 2011.

2012 *The Basketmaker Communities Project Annual Report, 2011 Field Season.* Submitted to Colorado Office of Historic Preservation, Denver, CO.

2010 Heartland of the Early Pueblos: The Central Mesa Verde. In *Crucible of the Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by Richard H. Wilshusen, Gregson Schachner, and James Allison. University of Arizona Press, Tucson, AZ.

2007 *Cultural Resource Inventory of the 2005 Long Mesa Fire in Mesa Verde National Park, Colorado*. Mesa Verde National Park, CO.

2007 *The 2005 and 2006 Annual Condition Assessment Report on Backcountry Alcove Sites in Mesa Verde National Park, Colorado.* Mesa Verde National Park, CO.

2004 *Burned Area Emergency Rehabilitation of Cultural Resources of the Bircher and Pony Fires, Mesa Verde, Colorado.* Mesa Verde National Park, CO.

2003 *Cultural Resource Inventory of 6,200 acres affected by the Bircher Fire, Mesa Verde, Colorado.* Mesa Verde National Park, CO.

2003 Four chapters in *The Mid-America Pipeline Company/Williams Rocky Mountain Expansion Loop Pipeline Archaeological Data Recovery Project, Northwestern New Mexico, Western Colorado, and Eastern Utah.* Woods Canyon Archaeological Consultants, Inc., Cortez, CO.

1997 *Cultural Resource Survey of the Proposed Palisade Watershed Pipeline, Grand Junction, Colorado*. Alpine Archaeological Consultants, Inc., Montrose, CO.

ADDITIONAL TRAINING

- Managing Cultural Resources in the National Park Service (80 hour Course) through DOI Learn, November 2010.
- Section 106 and NEPA certification, August 2010.
- ASMIS 3.0 and 4.0 workshop, Sante Fe, March 2009.
- Creation, utilization, and management of databases in Access 2002, 40 hour course. San Juan Basin Technical School. October 2002. Extensive experience in Access up to Microsoft Office 2013.
- Photogrammetry using Agisoft Photoscan. 80 hour workshop and field documentation of three sites.
- Cy-Ark 3-d Laser Scanning training. 40-hour course on the technical use of 3-d architectural scanning/mapping under the direction of Texas Tech University.

CAITLIN SOMMER (Supervisory Team)
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PROFESSIONAL PREPARATION

Connecticut College	New London, CT	Anthropology	B.A., 2006
University of Colorado Boulder	Boulder, CO	Anthropology	M.A., 2013

APPOINTMENTS

1/2014 – present	Supervisory Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
8/2012 – 12/2014	Field Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
4/2011 – 8/2012	Seasonal Archaeologist, Crow Canyon Archaeological Center, Cortez, CO, USA
5/2010 – 7/2010	Field Intern, Crow Canyon Archaeological Center, Cortez, CO, USA
5/2007 – 8/2008	Field Director, Hartgen Archeological Associates, Inc., Rensselaer, NY, USA
5/2006 – 5/2007	Field Technician, Hartgen Archeological Associates, Inc., Rensselaer, NY, USA

RELATED PRODUCTS

In press	*Demographic and Social Dimensions of the Neolithic Revolution in Southwest Colorado*. *Kiva*. (Co-authored with Scott Ortman, Shanna Diederichs, Kari Schleher, Jerry Fetterman, and Marcus Espinosa)
2015	*The Basketmaker Communities Project Annual Report, 2015 Field Season*. Submitted to Colorado Office of Historic Preservation, Denver, CO.
2014	*The Basketmaker Communities Project Annual Report, 2014 Field Season*. Submitted to Colorado Office of Historic Preservation, Denver, CO.
2013	*The Basketmaker Communities Project Annual Report, 2013 Field Season*. Submitted to Colorado Office of Historic Preservation, Denver, CO.
2013	*Animacy, Symbolism, and Feathers from Mantle's Cave, Colorado*. Unpublished MA thesis, University of Colorado Boulder, Boulder, CO.

MICHAEL AWE (Supervisory Team)
Director of Information Technology, Crow Canyon Archaeological Center
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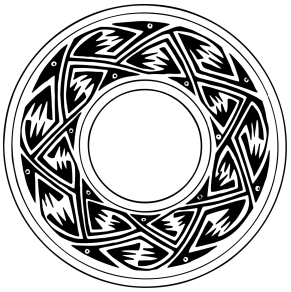
PROFESSIONAL PREPARATION

Loyola University of Chicago	Chicago, IL	Business	B.B.A., 1989

APPOINTMENTS

10/2014 – present	Director of Information Technology, Crow Canyon Archaeological Center, Cortez, CO, USA
4/2013 -- 5/2014	Director of Information Technology, San Juan Board of Cooperative Educational Services, Durango, CO, USA
9/2011 – 4/2013	Business Analyst, Fort Lewis College, Durango, CO, USA
8/1998 – 8/2011	Senior Implementation Consultant, Lawson Software Implementation Projects, GlobalStar Consulting, LLC., Austin, TX, USA
4/1995 – 8/1998	Director of Information Technology, Rocky Mountain Chocolate Factory, Durango, CO, USA
7/1989 – 4/1995	Director of Information Technology, Purgatory Resort, Durango Ski Corporation, Durango, CO, USA

Appendix C: Draft Research Database Designer/Manager Job Description



Crow Canyon Archaeological Center Job Description

Position Title: Research Database Designer/Manager
Status: Exempt
Employment Category: Full Time
Reports to: Director of the Research Institute
Approved: 7/16 – KB

Position Summary:

The Research Database Designer/Manager is responsible for the development of database middleware (APIs, map servers) and web-based front-ends for the Crow Canyon archaeological research database, and their subsequent management and support. The incumbent will join an established project—funded by the National Endowment for the Humanities—to modernize the Crow Canyon research database and make Crow Canyon data holdings more accessible to researchers, descendent communities, and the general public. They will be an integral part of Crow Canyon's research mission, and will be a part of the Research Institute at Crow Canyon.

Education and Experience:

A bachelor's degree in computer science, object-relational database management systems (PostgreSQL or similar), or a related field (such as computational social science) is required; a master's degree is preferred. Experience with geographic information systems (GIS) is required. Experience designing web-based front-ends for data entry and visualization is strongly preferred. Familiarity with and dedication to open source software is preferred; in particular, PostgreSQL, PostGIS, PostgREST, GeoServer, Quantum GIS (QGIS), server-side runtime environments such as node.js, and web frameworks such as Bootstrap. Familiarity with the *R* statistical language is strongly preferred, as is familiarity with current software development tools for version control, continuous integration, and testing. Experience with or interest in archaeological data is strongly preferred.

Essential Duties and Responsibilities:

To perform this job successfully, an individual must be able to perform each essential duty satisfactorily. The requirements listed below are representative of the knowledge, skill, and/or ability required. Reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions.

- Work with Crow Canyon staff to review data entered into the research database, identify issues to resolve, and implement actions as needed in order to maintain the integrity and security of Crow Canyon research data
- Work with the GIS Archaeologist and other Crow Canyon staff to integrate geospatial data into the research database

- Develop routines to check geospatial data for accuracy and apply geospatial data constraints
- Assist in composing a data dictionary for the research database that adheres to industry and Federal metadata and documentation standards
- Assist in building an Application Programming Interface (API) for the research database
- Assist in the design, construction, and implementation of a web-based front-end for data entry (with create/read/update/delete capabilities); work closely with archaeology staff in the design, implementation, and testing phases
- Provide database and GIS support as needed by the archaeology staff
- Assist the GIS Archaeologist in implementing a GeoServer Java-based software server for map creation and data sharing
- Design advanced database queries, custom reports, templates, and forms
- Effectively identify and clarify users' needs to generate expected database output
- Coordinate and document policies, protocols, and procedures with all database users
- Identify database issues, support software upgrades, evaluate additional modules, and work with the users to manage database related issues
- Maintain database security to reflect the organization's ethical specifications and the industry's best practices
- Evaluate new technologies and protocols to determine potential benefits, and implement them into the database system
- Implement changes as needed to include, but not limited to, database software options, data entry, analysis, and presentation methods
- Support technology as needed for data collection

Knowledge, Skills, and Abilities:

- Excellent organizational and interpersonal communication skills
- Ability to work both independently and as a part of a team
- Ability to develop the skills and talents of staff members
- Ability to rapidly learn new technologies and skills
- Adaptability and flexibility
- Ability to work accurately, with attention to detail
- Demonstrated proficiency in database design and management
- Project management skills
- Ability to translate between end users needs and database output

Note: This is a general description of the kinds of duties and responsibilities that are performed by employees who have this title. It shall in no way be construed as an all-inclusive determination of the specific duties and responsibilities of any particular position. It is not intended in any way to limit the right of any supervisor to assign, direct, and control the work of employees under his or her supervision.

Appendix D: Letter of Commitment — Crow Canyon Archaeological Center

CROW CANYON
ARCHAEOLOGICAL CENTER
Discover the Past, Share the Adventure

July 14, 2016

Nadina Gardner, Unit Director
Humanities Collections and Reference Resources
Division of Preservation and Access
National Endowment for the Humanities
400 Seventh Street, SW
Washington, DC 20506

Dear Ms. Gardner

I am writing to confirm the Crow Canyon Archaeological Center's appreciation of your review and consideration of our proposed project, *CC-DATA: Crow Canyon Digital Archaeology Tools and Access*. Additionally, we confirm our commitment to retaining the Research Database Designer/Manager position beyond the duration of this project as an integral function of the Crow Canyon Archaeological Center.

If you have questions, please do not hesitate to contact me.

Sincerely,

Deborah J. Gangloff
President and CEO

Advancing knowledge of the human experience through archaeological research, education programs, and collaboration with American Indians

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