

## Executive Summary, Research Readiness Level Assessment, and Technology Transfer

### Statewide Geographic Information System (GIS) as a Predictive Tool for locating Deeply Buried Archeological Deposits in Nebraska - Phase I, Phase II and Phase III

#### Research Benefits

This research is poised to assemble the complete geomorphological data for Nebraska in such a way that it can be effectively used for NDOT and FHWA compliance with environmental regulations. The FHWA and NDOT are required under Section 106 of the National Historic Preservation Act and other laws/regulations to identify historic properties that might be impacted by highway construction. Historic properties can occur in the form of deeply buried prehistoric archeological sites dating between 1,000 and 12,000 years ago. Important deeply buried sites are preserved most often in stream valley terrace complexes, valley margins, and alluvial fans and rarely occur in uplands above or overlooking stream valleys.

#### Phase I Objectives

The proposed project will develop a GIS-based data repository of all Nebraska (and relevant immediately adjacent portions of surrounding states) geoarchaeological information including: published and unpublished reports or portions of reports, bibliographies, stratigraphic profiles, radiocarbon ages, maps, notes, and photographs (Figures 2-5). These data will be linked to specific LSAs in specific stream valleys and drainage basins. The GIS will allow us to visualize the data in the form of maps and diagrams and reveal temporal and spatial patterns of landscape evolution in drainage basins. Moreover, the GIS will allow users to look at the data in a way that is quickly understood and easily shared.

#### Phase II Objectives

The proposed project will add to the existing Phase I GIS-based data repository of all Nebraska geo-archeological information including: published and unpublished reports or portions of reports, bibliographies, stratigraphic profiles, radiocarbon ages, maps, notes, and photographs. These data will be linked to specific LSAs in specific stream valleys and drainage basins. The GIS will allow us to visualize the data in the form of maps and diagrams and reveal temporal and spatial patterns of landscape evolution in drainage basins. The complete statewide data set also will be organized in such a way to use a GIS prediction tool to evaluate in general terms if the landscape has high, moderate or low potential to contain buried archeology and in specific settings such as floodplain, terrace, or fan.

#### Background

Traditional methods used to discover archeological sites include pedestrian surface surveys and relatively shallow hand-dug shovel or soil core testing. While these methods are appropriate for locating surface and near-surface sites on ridges, hilltops, and on the surface of valley floors, they do not adequately identify archeological remains buried in stream valleys (alluvial terraces, floodplains, fans and valley margin walls). Phase I created a GIS-based prediction tool to better estimate where deeply buried, and difficult to identify, archeological sites are likely to occur. The project serves to assist NDOT environmental planners and cultural resource consultants with an enhanced method to identify and avoid significant cultural properties during the transportation planning process (Layzell and Mandel 2018 and Layzell et al. 2018). Several large areas of Nebraska were not covered because available data were simply too limited. These areas include the following major drainage basins: Niobrara, White, central segments of the Platte, South Platte, and portions of the Loup (including the vast Sand Hills region drained by the North Loup, South Loup, Middle Loup, Dismal and Calamus rivers as well as numerous lakes). Improved data sets are now available for those drainages, and we propose phase II in this research project to extend the coverage to the entire state. To ensure state-wide coverage, the present proposal also includes field work to collect new data for select drainage basins. The phase III of this project will examine multiple localities along some of these streams to fill in the major data gap in our existing Phase I and Phase II buried sites prediction tool. While new data will always be added and the model improved, the current proposal seeks to complete acquisition of baseline data for all drainages in the entire state. Upon completion, if awarded, the project will allow to prediction tool to be operational for all of Nebraska.

#### Phase I Conclusion

This project is designed to assist cultural resource specialists involved in Nebraska Department of Transportation (NDOT) and the Federal Highway Administration (FHWA) project planning and development. The goal was to develop Geographic Information System (GIS) data layers that spatially delineate different landform-sediment assemblages (LSAs) and depict the associated geologic potential for buried cultural deposits in select watersheds in Nebraska. The *Nebraska Buried Sites GIS* resource will allow planners and cultural resource specialists to determine whether future project areas are likely to be free of deeply buried sites or whether subsurface exploration is necessary. In sum, the fundamental issue of scale in soil survey mapping is that the actual soils associated with a given map unit may not necessarily be those indicated on the map, even in the best-case scenario where a map unit represents a consociation. We view this project as a beginning and the current product as fluid. Several large areas of Nebraska are not covered because available data was simply too limited. These areas include the following major drainage basins: Niobrara, White, central segments of the Platte, South Platte, and portions of the Loup (including the vast Sand Hills region drained by the North Loup, South Loup, Middle Loup, Dismal and Calamus rivers as well as numerous lakes).

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### Phase III Objectives

The proposed project will add to the existing Phase I and Phase II GIS-based data repository of all Nebraska geoarchaeological information including: published and unpublished reports or portions of reports, bibliographies, stratigraphic profiles, etc. This data will be linked to specific LSAs in specific stream valleys and drainage basins and in some lakeshore setting in the Sandhills. The GIS will be housed at and maintained by the HN State Archeology Office. However, it will be available to transportation planners at NDOT and FHWA and also to consultants either through remote site updates or on-line. After the conclusion of the proposed project, the GIS and associated data repository will be continually updated as new information becomes available. Therefore, as time passes and data gaps are filled, the predictive capability and planning utility of the program will increase. Because the high, medium, and low site potential assignments noted above are based on correlations between known archeological site locations and a number of environmental variables, the utility of the project will improve as new archeological and environmental data become available.

### Interested in finding out more?

Phase I Final Report Available:  
[HERE](#)

Phase II Final Report Available:  
[HERE](#)

Phase III Final Report Available:  
[HERE](#)

### Principal Investigator

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### NDOT Lead TAC Members

**Stacy Stupka**, Highway Environmental

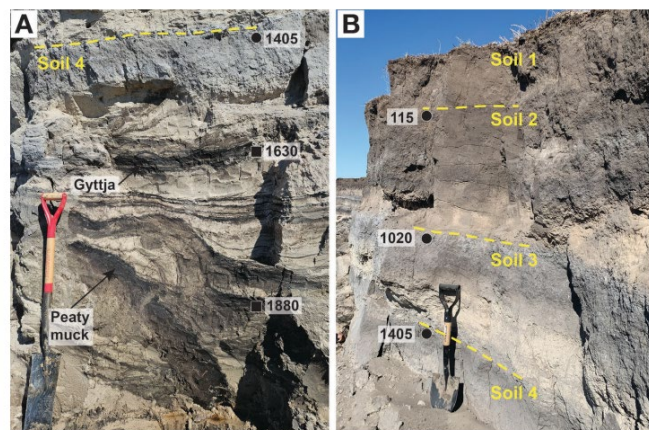
Biologist III

### Phase II Conclusion

This project developed a GIS to assist with the identification of deeply buried archeological sites in alluvial settings across Nebraska except for the Sandhills region. Soil survey data, previous geoarchaeological investigations, landform position, and other information was used to rank the potential of any stream valley setting as low, low-moderate, moderate-high, or high potential to contain buried soils (paleosols). While the presence of buried soils does not necessarily translate to presence of buried archeological sites, the potential for such sites is far greater in paleosols. The GIS can be used by NDOT and other agencies with statutory historic preservation obligations, to identify tracts on proposed construction projects that might require deep mechanical testing (backhoe or coring) in search of buried archeological properties.

### Phase III Conclusion

This project developed a GIS to assist with the identification of deeply buried cultural deposits in alluvial settings across the Sandhills region of Nebraska. Soil survey data, previous geoarchaeological investigations, landform position, and other information was used to rank the potential of any stream valley setting as low, low-moderate, moderate-high, or high potential to contain buried cultural deposits. While the presence of buried soils does not necessarily translate to presence of buried archeological sites, the potential for such sites is far greater in buried soils. This project has shown that specific soil series are associated with particular LSAs throughout Nebraska as well as different members of the DeForest Formation in eastern and central Nebraska. Therefore, the developed GIS data layers, together with the associated detailed repository of geoarchaeological information, can be used as a helpful screening tool to determine whether certain areas are likely to be free of deeply buried cultural deposits or whether subsurface exploration is necessary. Because soil survey data are generalized, they should only be used to establish first approximations of buried-site potential. Detailed field investigations are necessary to confirm and elaborate on those approximations and to establish more appropriate spatial and temporal scales



Photograph of the profile described at the Miles Locality in the North Loup River valley. (A) lower part of the profile, (B) upper part of the profile.

Picture from Phase III [final report](#)

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### Technology Transfers:

#### Phase I:

Principal Investigator did not have any technology transfer for this research project.

#### Phase II:

##### Transportation Research Board (TRB) papers and Publications

- Layzell, A.L., Mandel, R.D., 2019. Using soil survey data as a predictive tool for locating deeply buried archaeological deposits in stream valleys of the Midwest, USA. *Geoarchaeology* 34(1), 80–99. [doi.org/10.1002/gea.21707](https://doi.org/10.1002/gea.21707)

##### Webinars/Presentations

- Ziska, C., Johnson, N.L., Layzell, A.L., 2019. The Nebraska Buried Sites GIS in Practice: Initial Results and Next Steps. 77th Plains Anthropological Conference, Bloomington, IN. Oct. 16-19.
- Layzell, A.L., Mandel, R.D., Ziska, C., Bozell, R., 2016. Developing a Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archaeological Deposits in Nebraska. 74th Plains Anthropological Conference, Lincoln, NE

##### Journal Papers Submitted for Review and In Progress Journal Papers and Theses

- *Geoarchaeology* (ANTH 517), University of Kansas, Department of Anthropology, February 2022.
- *Geoarchaeology* (ANTH 517), University of Kansas, Department of Anthropology, February 2020.

#### Phase II:

Principal Investigator did not have any technology transfer for this research project.

### Phase I NDOT Recommendations Based Off Research Project – 2018

Several large areas of Nebraska are not covered because available data was simply too limited. These areas include the following major drainage basins: Niobrara, White, central segments of the Platte, South Platte, and portions of the Loup (including the vast Sand Hills region drained by the North Loup, South Loup, Middle Loup, Dismal and Calamus rivers as well as numerous lakes). If funding remains available, continued data gathering in these drainages is recommended. The research, also recommend that select portions of basins that are covered in this project are in need of expanded fieldwork to collect additional radiocarbon dates and systematic soil profiles from deep exposures, cores, and backhoe trenches. As more data is amassed and incorporated into the GIS, the more reliable its predictive potential becomes.

- *As provided by Rob Bozell, P.I.*

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### Phase II NDOT Recommendations Based Off Research Project – 2021

The results of a state-wide assessment of deep subsurface archeological and geoaerchaeological data provided significant benefit to the NDOT environmental compliance program. The study added to the existing Phase I GIS-based data repository of all Nebraska geoaerchaeological information including: published and unpublished reports or portions of reports, bibliographies, stratigraphic profiles, radiocarbon ages, maps, notes, and photographs. The effort created a GIS-based prediction tool to better estimate where deeply buried, and difficult to identify, archeological sites are likely to occur particularly along stream and river floodplains, terraces, and alluvial fans. The data acquired from this research allowed the development of field strategies (such as close stream bank examination or mechanical testing) during the early identification phase of projects to identify and ideally avoid impacts to deeply buried archeological deposits. The Department is continuing the effort to update the deep subsurface archeological and geoaerchaeological information with a third and final phase of the project focusing on the Nebraska Sandhills, a region that encompasses much of central and western Nebraska PHASE III-The Sandhills Region starting July 2022.

- *As provided by Stacy Stupka, Lead TAC Member*

### Phase III NDOT Recommendations Based Off of Research Project – 2025

Research results have been continuously used in standard practice since the first phase of the research. The GIS can be used by NDOT and other agencies with statutory historic preservation obligations, to identify tracts on proposed construction projects that might require deep mechanical testing (backhoe or coring) in search of buried archeological properties. Archeologists already use this as a tool to determine if there is potential for buried sites by determining the risk of there being buried soils, which has resulted in fewer unidentified or unexpected discoveries during projects. This has saved time that would have been spent analyzing and having consultants for the unidentified soils. With this model NDOT has improve their project delivery prior construction. It is important to note that the model is not perfect, with there still being unexpected deposits; however, the model has been about 95% effective thus far. Furthermore, this is a dynamic model, meaning the model receives more data as more projects are completed, which should result in even greater accuracy.

- *As provided by Stacy Stupka, Lead TAC Member*

### Research Readiness Level (RRL) Assessment

#### Level 5: Standard Practice

Research adopted; no evaluation required.

Phase II – Level 3: Development/Field-Leve I- Completed and Implemented

**RRL 5**

**This brief summarizes Project SPR-P1(16) M048, SPR-P1(16) M100, and SPR-FY22(011):**

**“Systematic Approach to Identifying Deeply Buried Archeological Deposits: Phase I”**

**“A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: Phase II”**

**“A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: Phase III-The Sandhills Region”**

**Nebraska Department of Transportation Research Program**