

DEVELOPMENT OF A SPATIALLY ENABLED ARCHAEOLOGICAL DATABASE APPLICATION

ABSTRACT

This paper describes the development of a proprietary database application used to facilitate the management and analysis of archaeological data for the SCAPE Project. The application had to meet several criteria: manage large amounts of data; accommodate the spatial and temporal attributes of the data; interface with external statistical and spatial analysis applications; and accommodate the different taxonomic classifications used by archaeologists. The result is a flexible and extensible application that includes a simple utility for exporting the attributes and corrected UTM positions of artifacts to a delimited text file that can be easily imported into a GIS.

BACKGROUND

SCAPE (Study of Cultural Adaptation in the Prairie Ecozone) is a interdisciplinary, collaborative research initiative that is investigating four ecologically diverse and archaeologically complex localities across the Canadian Prairie Ecozone; these include the Cypress Hills, Alberta; the Greater Forks locality, Saskatchewan (roughly defined as the area surrounding the confluence of the North and South Saskatchewan Rivers); the Glacial Lake Hind Basin, Manitoba; and the Tiger Hills, Manitoba. Archaeological investigations and paleoenvironmental reconstructions in these areas are focusing on five time slices at 500, 1500, 3000, 6000 and 9000 BP. The objectives of SCAPE are to better understand how aboriginal groups living on the Northern Plains used and modified these landscapes and how they perceived and reacted to changing environmental conditions throughout the Holocene.

A diverse suite of investigative techniques are being used to reconstruct the ancient physical and cultural environments at the site, local, and regional scales in each of these study areas. Geomatics technologies, specifically geographic information systems (GIS), remote sensing (RS), and the global positioning system (GPS), are being used extensively for mapping, modeling, and managing both archaeological and geoarchaeological data. In addition, given the geographic scope of the project, number of active archeological sites under investigation, and volume of cultural material anticipated, it was decided that a relational database application designed around a standard taxonomy and providing a set of tools for managing archaeological data would be developed and adopted by SCAPE project members. The resulting application, called ArchWizard, is a Microsoft Access front-end that is available free of charge. The source code is also provided so that users can edit and modify the application to suite their needs.

ARCHWIZARD

The concept behind ArchWizard was derived from the Macadam program developed by Dr. Terence Gibson for Macintosh computers. ArchWizard was designed primarily as a cataloging system that allows rapid, precise, and accurate classification of artifacts while minimizing the potential for cataloguer error. ArchWizard was designed to meet several specific criteria: manage large amounts of recovered data; accommodate the temporal and spatial nature of the data; incorporate graphics and mapping capabilities; accept additional modules for analysis; be easily modified and adapted; reflect the differing regions under study; and accommodate the needs of the primary researchers. The program consists of a dashboard (**Fig. 1**) that provides the user with a series of related forms for creating new site databases, cataloging artifacts, searching the database, creating reports, exporting saved lists, and editing the taxonomic classification.

Arch Wizard

Current Site: DiLv-29-Ex
Hokanson

Exports Maintenance Taxonomy About
Site Artifacts Search Reports Saved Lists

Edit

Jump to: DiLv-29-E

New Site / Survey

Site Number	Site Name				
DiLv-29-Ex	Hokanson				
Site Datum	Zone	Easting	Northing	Elevation	
UTM coord	14	00461026.00	05473005.00	0	
Arch coord	West	500	South	500	
Artifact Count	Unit	Datum			
12321		<input type="radio"/> NW <input checked="" type="radio"/> NE <input type="radio"/> SW <input type="radio"/> SE			
Municipal	Storage				
Strathcona	Brandon University				
Collection	Highest Catalogue Number				
Excavation Units	12323				
Notes					
Begin adding artifacts at # 12255 - these are empty					
Quarter	Section	Township	Range	Meridian	
NW	23	5	16	west prime	
Default	<input type="radio"/> BD <input checked="" type="radio"/> BS	UTM Rot.	0.00	recalc	
		Dec.			

Figure 1: The ArchWizard dashboard showing items under the Site menu.

Site Information

Once a new site database is created, the Site form (**Fig. 1**) is used to enter site information including name, Borden number, archaeological coordinates of the site datum, the corresponding UTM coordinates of the site datum (including elevation), angle of rotation between archaeological and UTM grid, legal description, storage location of artifacts, and also displays the number of records in the database after artifact information has been entered.

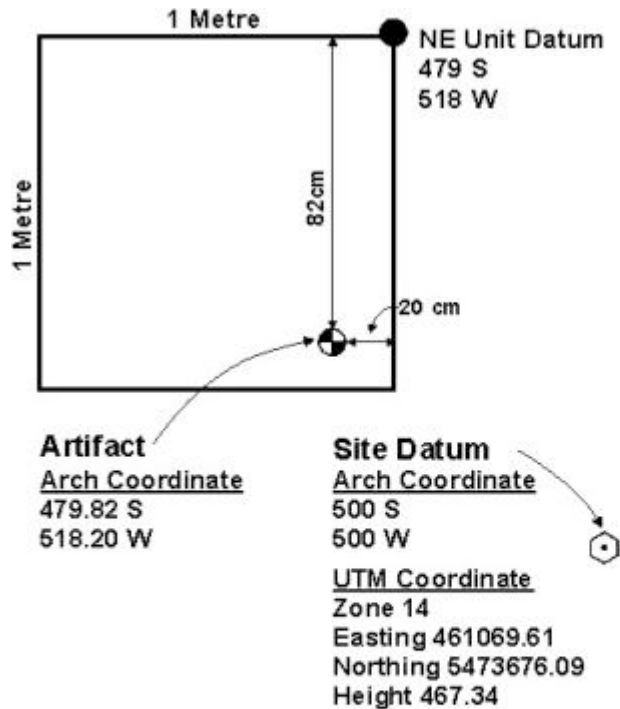
Artifact Information

Individual artifacts are catalogued under the Artifact form (**Fig. 2**). Each record consists of two subsets of information: metadata (e.g. location, depth, collection date, cataloging date) and taxonomic data. Information common to all records within a site are copied over from the Site form (e.g. Borden number), while other data (e.g. unit number, level, field and cat #, and entry date) are copied over from the previous record for the convenience of the user, but can be edited as required.

Artifact																																																																															
Cat #	Borden	Unit	S	W	Level	Depth	BD / BS		UTM Northing																																																																						
1525	DiLv-29-Ex	2	00000538.70	00000517.99	6	26.50	<input type="radio"/> BD	<input checked="" type="radio"/> BS	05472966.30																																																																						
EntryDate	CollectionDate	Count	Weight	Orientation	Quad			UTM Easting																																																																							
17-Dec-01	17-Jul-01	1	0		<input type="radio"/> NW	<input type="radio"/> SW	<input type="radio"/> N/A	00461008.01																																																																							
					<input checked="" type="radio"/> NE	<input type="radio"/> SE																																																																									
Unit Surface Elevation					0 (relative to Site Datum)		Field Cat #		Paleosol:																																																																						
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Note CS: triangular																																																																															
Artifact Traits																																																																															
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Figure 2: The ArchWizard dashboard showing items under the Artifact form.

The archeological grid coordinates of the site datum, corresponding UTM coordinates, and angle of rotation between the archeological and UTM grid entered on the Site form (**Fig.1**), and artifact provenience entered for each record on the Artifact form (**Fig. 2**) are used to calculate and store the UTM coordinates (including elevation asl) of each artifact as it is entered into the database (**Fig. 3**).



$$\begin{aligned} \text{Artifact UTM N} &= (\text{Site N/S Datum} - \text{Artifact N/S}) + \text{Site UTM N} \\ &= (500 - 479.82) + 5473676.09 \\ &= 5473696.27 \end{aligned}$$

$$\begin{aligned} \text{Artifact UTM E} &= (\text{Site E/W Datum} - \text{Artifact E/W}) + \text{Site UTM E} \\ &= (500 - 518.20) + 461069.61 \\ &= 461051.41 \end{aligned}$$

Figure 3: Worked example of artifact UTM location assuming provenience measured from a NE unit datum and no angle of rotation between archaeological and UTM grids.

Taxonomy

The program taxonomy is a compilation of the taxonomic terms used by SCAPE project archaeologists. The taxonomy reflects the terminology used by these researchers for materials from the Northern Plains and was designed to provide uniform recording and reporting terminology for the project. A *Taxonomy Flowchart (Fig. 4)* that shows the relationship between each level of the taxonomic hierarchy has been prepared and serves as a guide for cataloguers who wish to visualize the next menu of traits when entering artifact records.

Faunal Classification - Ungulate

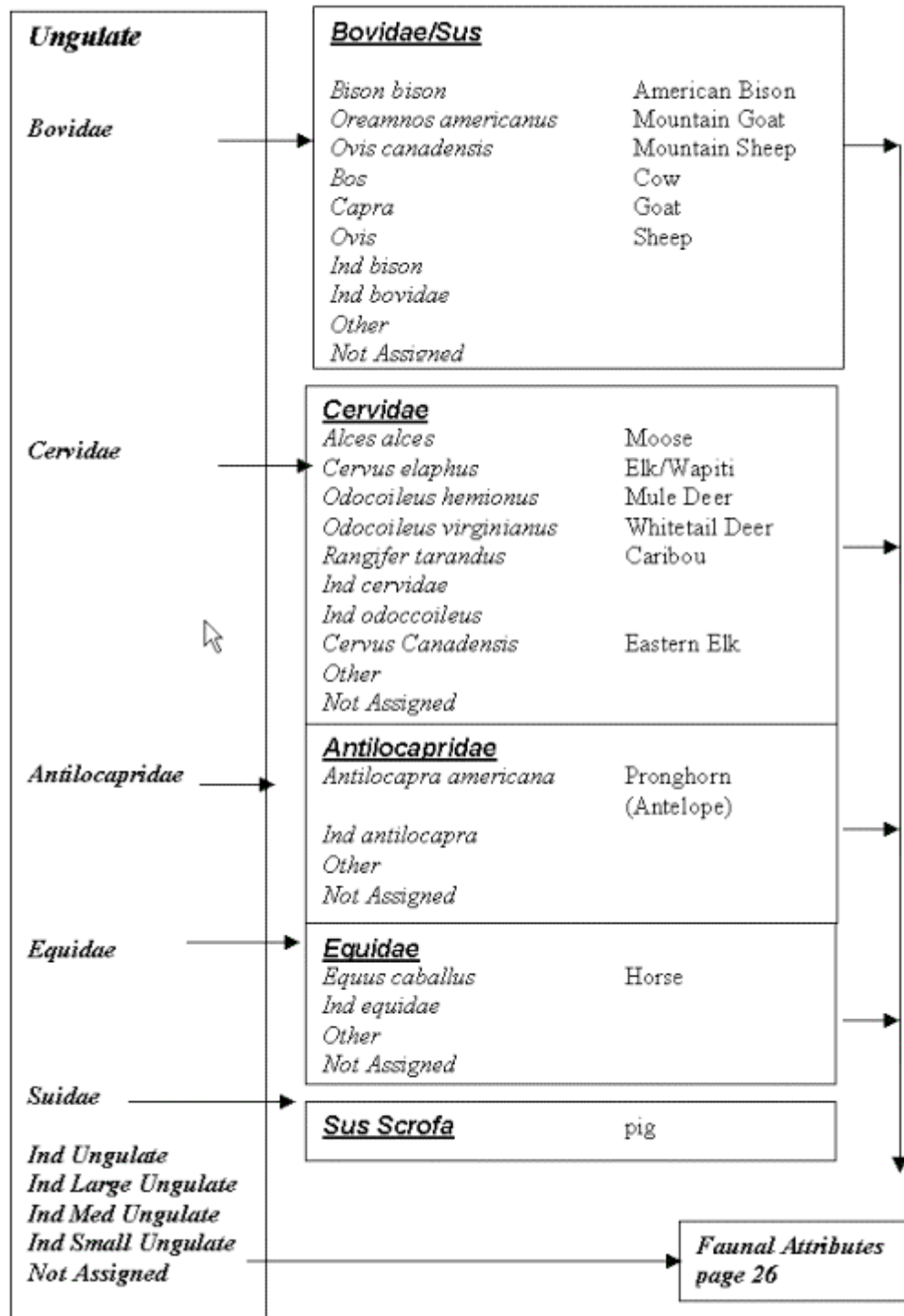


Figure 4: Example of a page from the *Taxonomy Flowchart* showing the taxonomic hierarchy of ungulates available in ArchWizard for SCAPE researchers. This taxonomy can be edited to suite the needs of the user.

The artifact taxonomic data is entered through a process of “drilling down” through the taxonomic hierarchy. This taxonomy, shared by all databases in the SCAPE project, is what enables meaningful comparisons between sites and across study areas. Non-SCAPE users are free to use the existing taxonomy or create their own. The structure of the taxonomy allows for the concept of repeating groups (i.e. one or more of these traits or trait groups), backing out of incorrect choices, and indeterminate selections (i.e. unknown). A running traits list provides the user with a means of keeping track of where they are in the hierarchy.

Saved Lists and Export Sets

ArchWizard also provides a rudimentary set of analytical tools that make use of the twin concepts of Saved Lists and Export Sets. The ArchWizard Search form (**Fig. 5**) enables users to select subsets of the data based on either metadata (e.g. select all the artifacts at this depth) or taxonomic characteristics (e.g. select all ungulate remains) using simple drop-down lists and Boolean operators. These subsets, known as Saved Lists, can be used for generating reports, exporting selected data into other packages for further analysis (e.g. ArcView, Excel), or to select a subset of records for display in the Artifacts screen.

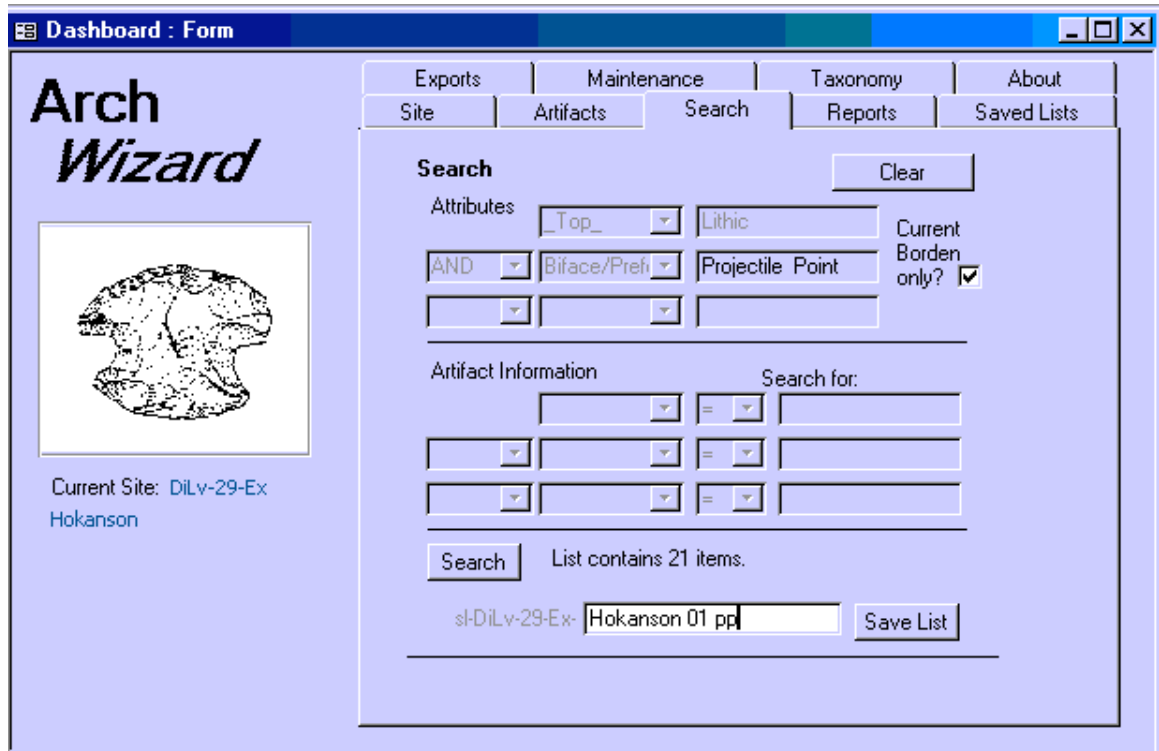


Figure 5: The ArchWizard dashboard showing items under the Search form. In this case all bifacial projectile points are being selected from all the records entered for the Hokanson site and this search stored as a Saved List.

The Export function also enables the user to define an Export Set (**Fig. 6**), which consists of a subset of artifact fields (metadata or taxonomic attributes) to be exported. Because the same taxonomy is used throughout the SCAPE project, a researcher can create an Export Set to filter out only the interesting fields from all site databases across all study areas. A similar utility for applying common searches across sites, called Saved Search Criteria, is in development.

Microsoft Excel limits you to a maximum of 255 columns. You can use this form to choose which Artifact and/or Taxonomic fields you would like to be able to import into Microsoft Excel.

Artifact Fields

- RecordID
- Catalogue Number
- Quad
- Borden
- Unit
- Y
- X
- UTM
- Level
- Depth

Double-click on the fields from the Artifact Fields list and the Taxonomic Fields list that you would like added to the Export Set.

Add All Artifact Fields

Number of fields chosen: 22

Taxonomic Fields

- _Top_ - Faunal
- _Top_ - Historic
- _Top_ - Lithic
- _Top_ - No artifacts
- _Top_ - Pottery
- _Top_ - Sample
- Accipitridae - Accipiter cooperii
- Accipitridae - Accipiter gentilis
- Accipitridae - Accipiter striatus
- Accipitridae - Aquila chrysaetos
- Accipitridae - Buteo jamaicensis

Chosen Fields

- 22 pUTM Northing
- 21 UTM Northing
- 20 pUTM Easting
- 19 UTM Easting
- 18 Unit Surface Elevation
- 17 Field Cat
- 16 Orientation
- 15 Weight
- 14 Count
- 13 CollectionDate
- 12 EntryDate
- 11 BD_BS
- 10 Depth
- 9 Level
- 8 UTM
- 7 Y
- 6 X
- 5 Unit
- 4 Borden
- 3 Quad
- 2 Catalogue Number
- 1 RecordID

Clear Remove Selected

es-DiLv-3- Save Set

Figure 6: The Export Set form can be used to select specific artifact fields (attributes) to be included in the Export dataset.

Reports

The user can also prepare a variety of standard reports, most notably the Item Report, Compact Report, and Card Report. The Item Report provides all the information from the Artifact screen for a single record. The Compact Report shows much the same information but does so for a selection of records. Finally, the Card report can be used to print artifact catalogue cards on standard cardstock or labels (**Fig. 7**). Since the source code is provided, anyone can build new reports to suit their specific needs.

Wapiti Sakihtaw		DiLw-12	
DiLw-12	-176		
South =	559.5	West =	385
		Depth =	50
			BS
Lv =	0	CU =	0
Count =	2	Grams =	0
			0-0-176
Ceramic	Smooth		
Vessel area	Decoration		
Rim	Incised		
Temper	Paste		
Fine grit	Laminated		
Rim forms	Classification		
Braced/Wedge	Not assigned		
Surface finish			
TP18-559/385-19		?? Q;	TP;BN;LM;JP;cynomys?

Figure 7: Example of a Card Report used to print catalogue cards on card stock or labels.

ARCHPIC

ArchPic is an image-cataloguing system accompanying ArchWizard that provides a tool for easily classifying and searching digital images (**Fig. 8**). Images are not stored within the database itself, instead the path and filename for each image is stored, allowing the user to create whatever directory hierarchy for the images they like. A thumbnail of the image appears on the image-cataloguing screen. One of the optional fields stored for each image is the corresponding ArchWizard artifact catalogue number. This provides the ability to access the image for a particular artifact and vice versa, as well as link this information to spatial features in a GIS.

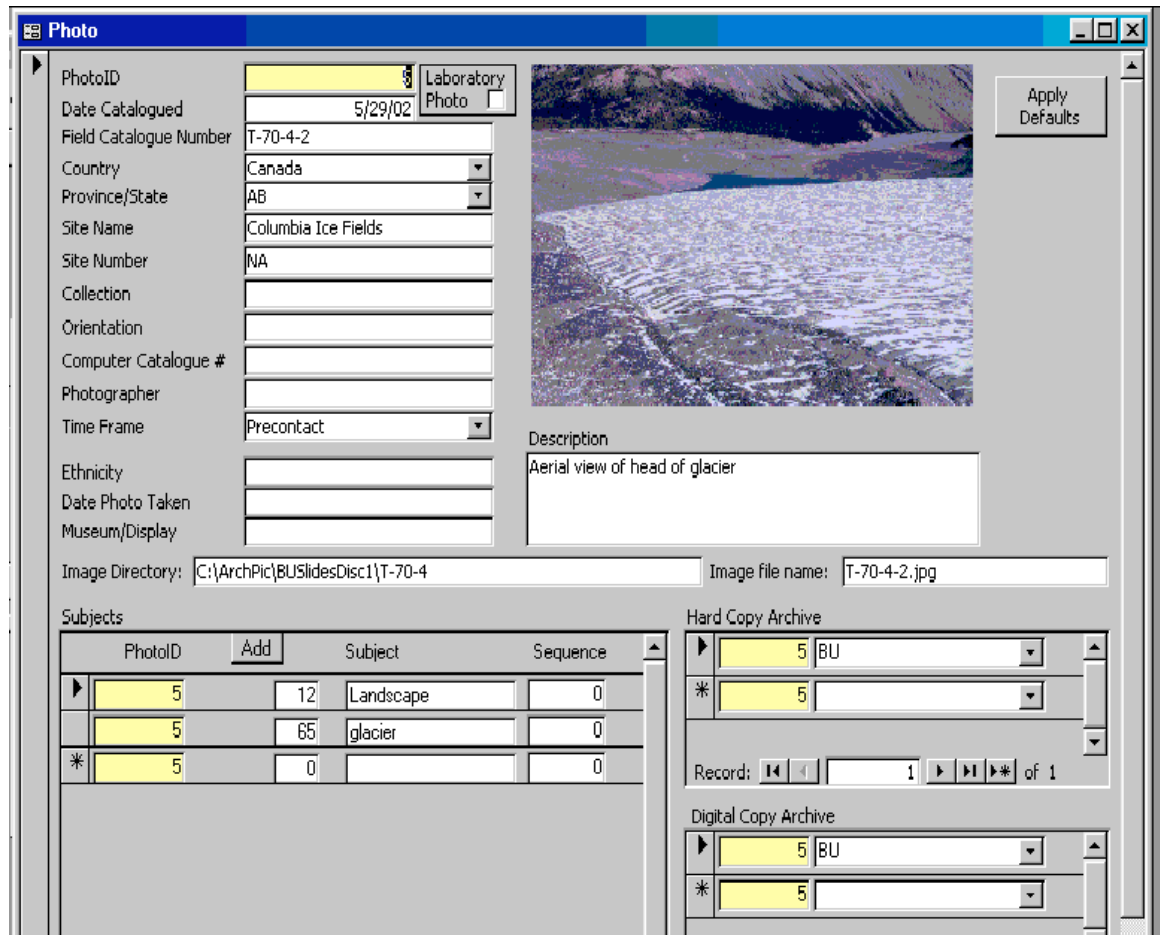


Figure 8: The ARCHPIC image cataloging menu showing image metadata and thumbnail.

LINKING ARCHWIZARD TO ARCVIEW GIS

The Export function enables the user to select a Saved List and Export set to create a delimited text file that can be easily imported into a GIS. Since the location of each record in ArchWizard is determined with reference to an established coordinate system, not only can the location of artifacts within a site be mapped relative to one another (**Fig 9.**), these data can also be displayed or mapped with reference to other existing geospatial databases (e.g. soils, surficial geology, hydrology, topography, and digital orthophotography) and proprietary data derived from the paleoenvironmental reconstructions currently under development (**Fig. 10**).



Figure 9: Map layout showing distribution of faunal remains at the Hokanson site.

This enables archaeological investigations at the site level to be easily integrated with geoarchaeological investigations at the local and regional scales. For example, in the Cypress Hills of Alberta, archaeological investigations at the Stampede site (DjOn-26), local stratigraphic and sedimentological analyses, and regional geomorphic investigations have enabled SCAPE researchers to establish that the site was occupied only after a slump block impounded Elkwater Lake and that early occupants of the site were located

on the distal end of an alluvial fan in a nearshore wetland environment approximately 50 m from the lake.

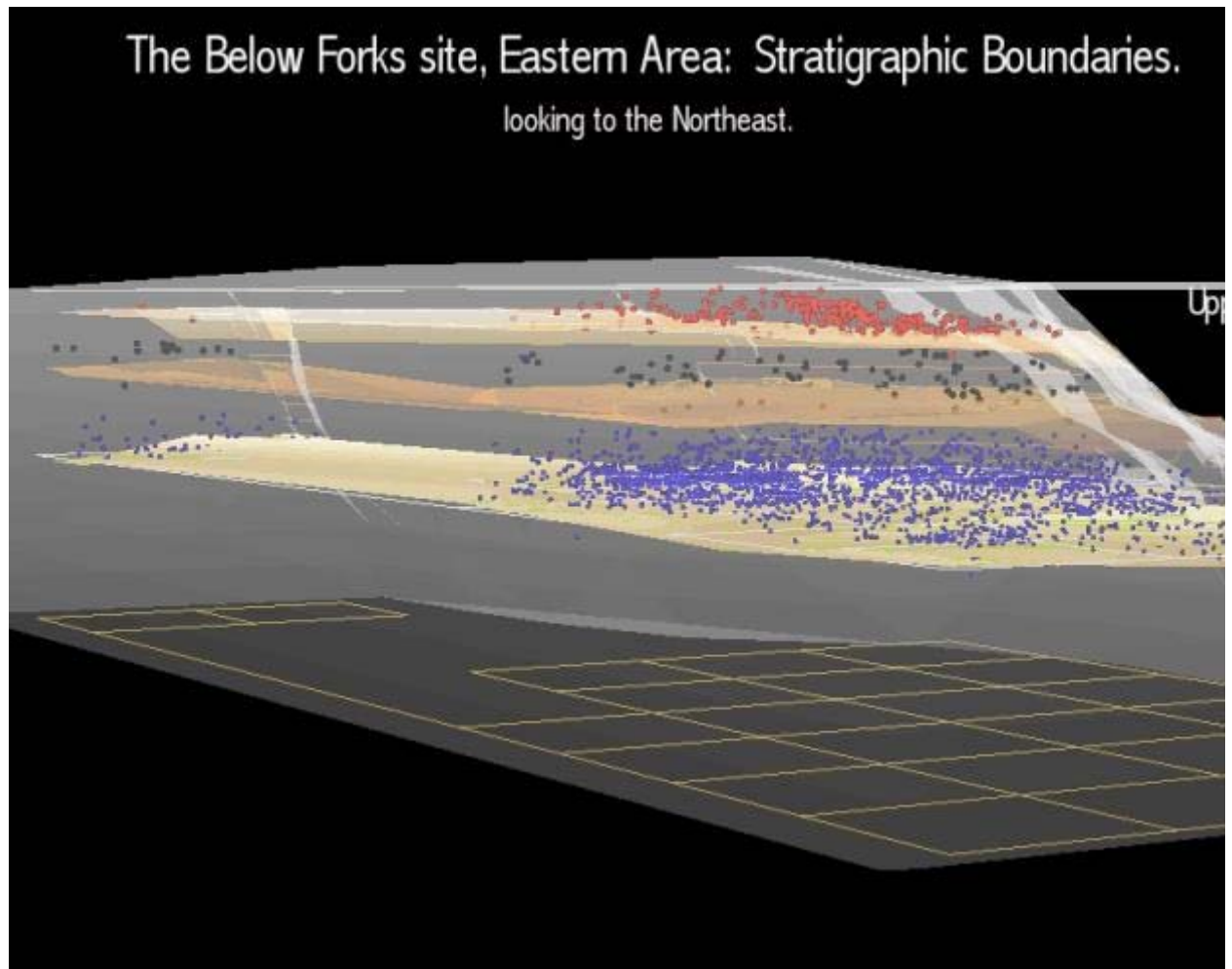


Figure 10: Perspective view of a cutbank on the Saskatchewan showing the distribution of artifacts in relation to three stratigraphic markers.

CONCLUSIONS

ArchWizard was developed primarily as an archaeological cataloging system that would facilitate rapid, precise, and accurate classification of artifacts, minimize cataloguer error, and provide a standard taxonomic classification for SCAPE project member. While ArchWizard in itself provides no mapping or spatial analysis functionality, it was designed with the needs of GIS users in mind. The ability to transform the location of artifacts recorded with reference to a local archaeological grid to a common absolute coordinate system provides a means of easily integrating site-

specific archaeological data with existing or proprietary geospatial databases at the local and regional scales, facilitating the degree of interdisciplinary collaboration between archaeologists and geoscientists. Further development will focus on the complete integration of ArchWizard and ArchPic into the ArcGIS geospatial data model so that a truly seamless spatially enabled archaeological cataloging system is available.

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For more information about the SCAPE project and for a free copy of ArchWizard or ArchPic

please visit the SCAPE website at <http://scape.brandonu.ca/>.