***Current Research in Ohio Archaeology 2024***
*www.ohioarchaeology.org*

# Identifying and Mapping the *Chaine Operatoire*: ASC's Phase III Investigations of a Cobble Chert Quarry/Workshop site, Brown County, Ohio

Kevin R. Schwarz, ASC Group, Inc.

## Abstract

This current research article involves controlled surface collection and analysis of a cobble chert quarry/workshop site in Brown County. The Yates site, 33BR154, is one of 29 sites associated with the expansion of the Brown County Landfill, near Georgetown in southwest Ohio. The Yates site is a habitation site and a low-intensity prehistoric quarry where Native Americans exploited glacial chert cobbles, which consisted of Bisher or Brassfield cherts. This study undertook a *chaine operatoire* analysis and spatial statistical analysis designed to understand the lithic tool production strategies at play at this site. It was shown through these analyses that technological choices were enacted that resulted in the production of bifacial tools, but also expediently produced flake tools. The study provides a window on the complexities of prehistoric decision-making and agency within a technical productive system.

## Keywords

Chert quarry, lithic workshop, Bisher chert, Brassfield chert, *chaine operatoire*, spatial statistics, Local Indicator of Spatial Association, LISA, trend surface, technological choice, agency theory, gearing up.

## Introduction

Recently, ASC Group, Inc. (ASC) completed a multi-season Phase III investigation of an 11-acre multicomponent prehistoric site near Georgetown, along White Oak Creek in Brown County, Ohio. The Yates site (33BR154) combines elements of Late Archaic and Late Woodland camp sites with a small-scale, low-intensity quarry/workshop for cobble cherts (Schwarz et al 2020). The below study sketches one portion of the approach used in the Phase III data recovery report, which had a goal of understanding both the habitation and quarry/workshop components of the site. Here, I focus on trying to understand how technological choice is manifested in the lithic materials recovered from the site. The approach combines a spatial statistical analysis of quarry-related materials and a *chaine operatoire* analysis. It is planned that another study will address the site's habitation components.

It appears that the quarry and workshop activities were most intensive in the Early Archaic (10,000 BC-5800 BC) and Late Archaic (3500 BC-800 BC) periods and most likely usage tailed off during the Woodland period (800 BC-AD 900). The site is characterized as an exploitation locale for glacial cobble cherts and usage appears to be of low-intensity and almost certainly was episodic. Working of cobble cherts is poorly studied in regional prehistory, with just scattered references from Ohio and surrounding states, most of which deal with use of cherts from stream bed settings rather than those directly from glacial deposits (e.g., Ariens 2003; Cantin 2008:34; Kagelmacher 2001:6; Ray and Ray 2022; cf. Stelle and Duggan 2016). This *Current Research* paper seeks to rectify this deficiency. The information presented here advances our knowledge of low-intensity lithic raw material exploitation in Ohio's prehistory, particularly lithic materials obtained from glacial sources. The study also aids in modeling relationships between extractive and habitation activities.

Why is the study of technological choice important? This study provides a window on how decisions were made in a prehistoric technical system and informs the archaeologist about toolmaking strategies that existed within that system. In this case, the *chaine operatoire* analysis illustrates how the divergent lithic reduction sequences were worked out during actual production activities. The analysis thus allows archaeologists to model how prehistoric peoples' choices factored into the technological strategies they enacted to create stone tools. The technological strategies adopted by ancient peoples created greater variation in the lithic production systems than is sometimes recognized by archaeologists (Dobres 2000:174). This realization means that archaeological studies can integrate how agency, the ability to act independently within a technical productive system, resulted in the variable archaeological patterning encountered at this site and others (Diez-Martin et al. 2021; Dobres 2000; Cobb 2000; Lohse 2011).

## Methods

Two analytical techniques were utilized: 1) mapping and spatial statistical analysis of quarry and workshop-related materials; and 2) the development of *chaine operatoire* diagrams for the divergent lithic reduction sequences. Use of these analytical techniques help the archaeologist identify the technological choices that were made during the creation of two different kinds of lithic tools and how the use of those tools played out across space within the site. The two kinds of tools studied are curated bifacial tools and expedient flake tools.

Primary field data analyzed in this study are Phase II controlled surface collection results and Phase III surface survey data. Finds from the latter phase of work were piece plotted. Excavation data are supplemental and provide temporal and functional data on site usage.

The Yates site (33BR154) is just one of 29 prehistoric sites discovered and documented during Phase I and Phase II surveys of 361 acres at the Brown County Landfill. Most of this paper focuses on the Yates site and what can be understood from the intensive investigations conducted there. The discussion broadens though. The temporal patterning is better studied at a larger spatial scale, which in this case is the entire landfill expansion sample. Additionally, a local artifact collector, Duane Yates, shared his collection with ASC and allowed his artifacts to be photographically documented. These collector-recovered artifacts are included in the analysis and are vital for building a database for this site and region.

First, I focus on mapping the evidence of chert exploitation. Phase II-III surface surveys mapped cobbles, intermediate products, such as cores, and the end products, i.e., various stone tools, and by-products, such as debitage. The detailed proveniencing of artifacts allowed for use of a spatial statistical technique, the Local Indicator of Spatial Association (LISA) (Anselin 1995; Schwarz and Mount 2005). This technique enables the archaeologist to determine where decortication of chert cobbles was occurring. This information consequently figures in the reconstruction of the sequenced operations relating to lithic reduction in different portions of the site.

A second focus derives from *chaine operatoire* analyses conducted previously in the Phase III data recovery study (Schwarz et al. 2020). A composite *chaine operatoire*, or operator chain (Grace 2006; Sellet 1993), is used to explore how chert cobbles were reduced. The operator chain (a flow chart) provides a worked-out sequences of steps involved in the lithic reduction, which can involve branching as technological choices are made.

As the result of the application of these methods, two divergent trajectories were identified. The first reduction trajectory is the bifacial reduction continuum. The second reduction trajectory shows how expedient tools are often created as co-products incident to the better developed and well-known bifacial tradition (Pecora 2014; Cobb 2000). This second focus is important because, although the bifacial reduction trajectory is well studied in Ohio archaeology and elsewhere in the regional prehistory of the Midwest, little attention has been paid to expedient production in quarries (cf. Cobb 2000).

## Exploitation of Cobble Cherts from Upland Swales

As the result of the Phase II controlled surface collection, ASC delineated concentrations of local chert cobbles and related artifacts, which were primary decortication debitage, hammerstones, checked cobbles, and cores (Figure 1: A-C). Two kinds of local chert were encountered. The first is a light-colored cobble chert found within glacial till, which is Silurian Bisher or possibly Brassfield chert (termed Bisher-Brassfield here[1]). The cobbles were most likely derived from more northerly bedrock sources in Highland County (Stout and Schoenlaub 1945) and were deposited in this location by the Illinoian glacier. The second kind of chert encountered is a gray Ordovician chert that occurs in bedrock and cobble exposures in the Ohio Valley (Murphy 2006). It is less common at the Yates site.

Three clusters of prehistoric artifacts were delineated during the Phase II controlled surface collection in 2006 (Clusters 1-3). These clusters of artifacts were later subsumed in the Phase III analysis and so are not shown in the illustrations below.

During the Phase III work, these Bisher-Brassfield artifacts were found to be arranged in five subclusters (1A, 1B, 2E, 2F, and 3B) in and around swales within a larger set of clusters of site materials (Table 1). A hand axe/chopper (Figure 1: D) was found as well, although it was made from the Ordovician chert. Four other subclusters are associated with habitation activities and are described in Schwarz et al. (2020). Finds included projectile points (Figure 2) and various bifaces including drill and scrapers. Phase III excavations in the swales largely amplified an understanding of the surface patterning and provided additional details on the lithic exploitation system. The amount of artifact data available with relatively fine-grained spatial resolution allowed for a spatial statistical analysis to be carried out, with informative results.

Both surface and excavation data sources aided in the creation of the *chaine operatoire* as a description of the how initial processing of bifacial and expedient tools was carried out.

## Spatial Statistical Analysis

This analysis looked at the presence or absence of cortex on debitage from the Phase II-III surface survey data. The purpose of this analysis is to identify where decortication of cobbles was taking place at the Yates site. The reason decortication of cobbles is targeted by the analysis is that decortication is the first step in processing the chert cobble for making of intermediate products or tools, and decortication is readily detectable in the archaeological record. The Local Indicator of Spatial Association (LISA) was utilized. LISA is a localized expression of Moran's I, an indicator of spatial autocorrelation (Anselin 1995; Schwarz and Mount 2005). The raw data are depicted as red circles in the location in which debitage was found. The presence of cortex on the debitage is coded as "P" on the map, while absence of cortex is coded as "A" (Figure 3). The localized indicator is output for the grid and the data are kriged, which allows for the fitting of a trend surface that indicates the level of association across space. This visualization displays the spatial trend inherent in the data. The statistical software package, PASSaGE 2.0, was utilized to conduct the LISA analysis (Rosenberg and Anderson 2011).

The L Moran coefficient has values between -1 and 1. Values around 0 generally indicate no spatial association. Positive values indicate clustering (spatial aggregation of like specimens– in this case, debitage with cortex). Negative values indicate dispersion. In practice, LMoran values can exceed 1 and higher values mean there is a more intensive association in that region. The spatial trend surface is shown in gray (marked as LMoran Coefficient on Figure 4). Three large clusters are visible at the Yates site. The clusters correspond to some of the lithic exploitation subclusters identified above. The lithic exploitation subclusters mapped above were based on visually evident clusters of Bisher-Brassfield chert, the location of the swales, and the presence of hammerstone, cores, and checked cobbles. Hammerstones are tools that could have been used to reduce cortex-covered cobbles, while cores are objective pieces which were reduced from cobbles and could be used as sources of material for making tools. Subcluster 1A and 1B are contained by the trend surface indicated in the northern portion of the site between N4660–N4840. Subcluster 2E is mostly contained by the trend surface present in N4500 and N4580, but there is one important caveat (Figure 3). The trend surface actually extends farther into the center of the site in the east-west dimension than does Subcluster 2E. This suggests that more decortication was taking place in the center of the site than was recognized by the visual analysis presented above. Also, Subcluster 3B corresponds well with the southernmost trend surface between N4325–N4380 (Figures 3 and 4). However, Subcluster 2F did not correspond to any portion of the trend surface (Figures 3 and 4). It is less dense than the other clusters, perhaps accounting for the discrepancy. Of the five visually evident lithic exploitation subclusters, the LISA analysis detected four of them, an 80 percent success rate.

## Chaine Operatoire Analysis

The composite *chaine operatoire* analysis identifies the lithic reduction trajectory from the presence of a checked cobble through to the production of a core, and then through the most commonly studied reduction trajectory for regional prehistory, that of bifacial reduction in the context of a curated assemblage (e.g., Odell 1996; Pecora 2014) (Figure 5). The goal in such a sequence is the production of a biface, which may be a projectile point, knife, or other bifacial tool. Bifacial tools then are used and will need to be resharpened and repaired as damage, wear, and other attrition occur to the tool during use. This attrition may result in the abandonment of the original use of the tool and recycling or re-use as in, for example, a hafted endscraper.

The bifacial reduction continuum is conceptualized through Schiffer's (1995) model of lithic technological systems, which posits four stages of toolmaking and use. These are: I. Raw material procurement; II. Tool production; III. Tool use; and IV. Tool recycling and discard.

**Table 1. Lithic materials in chert exploitation subclusters.**

| Subcluster | Cobbles | Quarry/Work-shop Tools | Intermediate Products (cores) | Products (bifacial tools) | Co-Products (expedient tools) | Cortical Debitage |
|---|---|---|---|---|---|---|
| 1A | 2 checked cobbles | | | 1 biface | 1 flake drill | Small, dense concentration |
| 1B | 1 checked cobble | | 1 core and 1 core fragment | | 1 cortical sidescraper | Medium, dense concentration |
| 2E | 2 checked cobbles | 2 hammerstones, 1 chert hand axe | 2 cores | 2 biface fragments | | Moderately-sized and moderately dense concentration of Bisher-Brassfield and scatter of other chert debitage from ridge above |
| 2F | | 1 hammerstone and 1 combination hammerstone and bi-pitted stone | 1 core | | 1 retouched flake | Large, sparse scatter |
| 3B | 1 checked cobble | | | Hafted endscraper made from Chesser Notched point* | 1 retouched flake | Small, dense concentration |

*Subcluster 3B is near a Late Woodland/Late Prehistoric habitation area.

This bifacial trajectory is well understood and is generally conceived of as operating in a context of scarcity of tool stone (Odell 1996:58-61). However, in the context of a region with abundant cobble cherts, the scarcity of lithic raw materials was not necessarily an operative constraint and other kinds of patterning emerge.

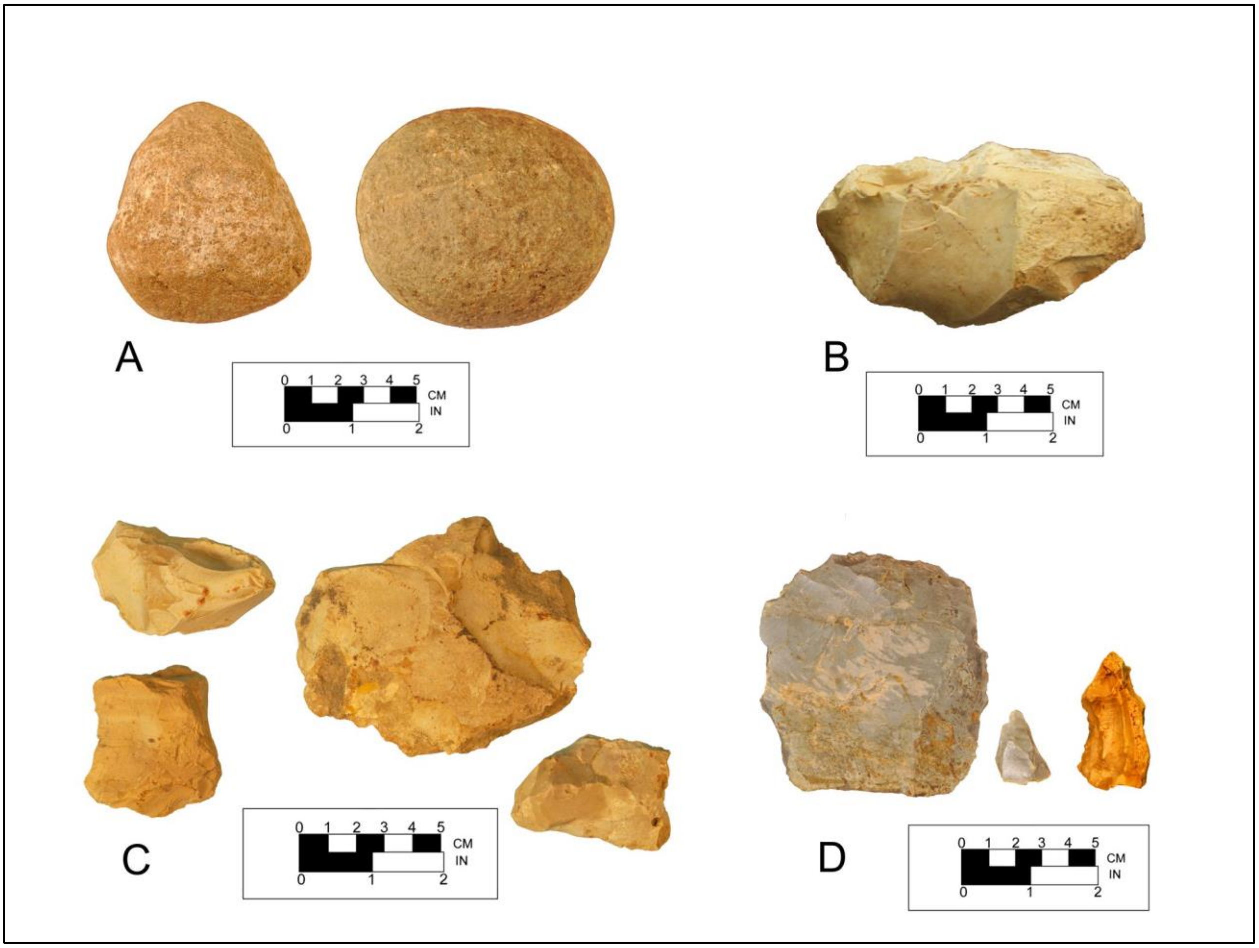


**Figure 1. Tools and products of lithic exploitation of chert cobbles: A, hammerstones; B, Bisher-Brassfield checked cobble; C, Bisher-Brassfield cores and core fragments; D, (l-r) gray Ordovician chert hand axe; Bisher-Brassfield flake drill; Bisher-Brassfield cortical side-scraper.**

The evidence from the Yates site, as identified in the upper portion of Figure 5, is that certain tools, such as scrapers and drills, were made expediently in and around the swales at the site. They were generally made from early-stage reduction flakes, such as decortication flakes, and had a few sharpening flakes removed. There is little evidence of forming or finishing, such that they can be difficult to recognize as tools upon initial inspection. However, both macroscopic and microwear analysis of Bisher-Brassfield chert artifacts recovered in and around these swales, identify that expedient tools were produced from flakes (Walter Gagliano 2020)[2].

Figure 6 is a more conceptual *chaine operatoire* diagram which shows how a search and testing routine for utilizing chert cobbles in the swales of the Yates site could have operated. This diagram engages with I. Raw material procurement; and II. Tool production, conceptualized in the technological system of Schiffer (1995), but only models, III. Tool use, in the striking of hammerstone blows to test and reduce chert cobbles. It shows how cobbles might have been found and tested and some accepted and others rejected. Checked cobbles[3] found at the Yates site, which were not fully reduced, may be evidence for rejection. The *chaine operatoire* diagram

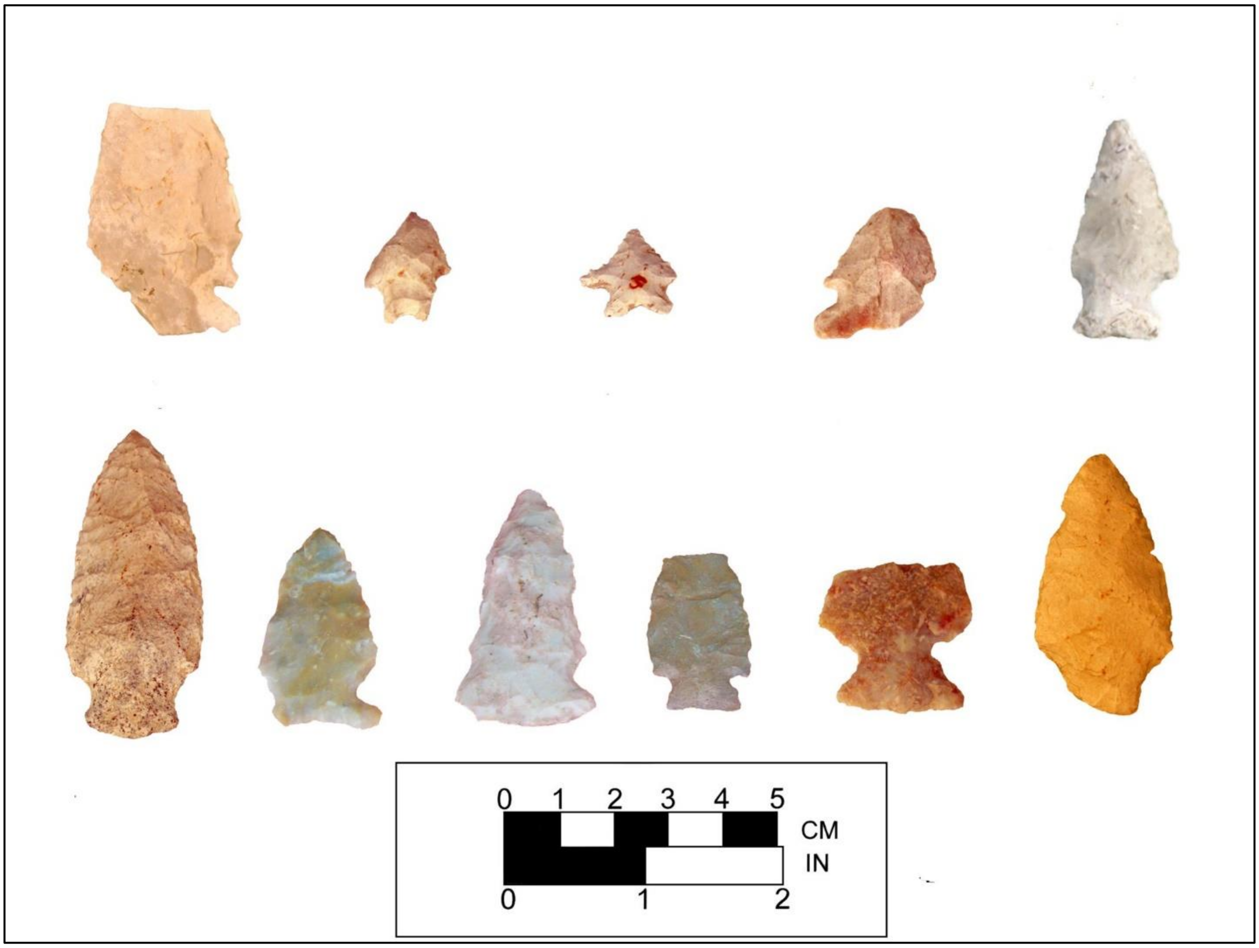


**Figure 2. Sample of projectile points from the Yates site (33BR154) and another nearby site.**

**Top row (l-r): Kirk Corner Notched projectile point, 33BR154; Kanawha Stemmed, Yates collection; Lecroy, Yates Collection; St. Albans Side Notched, Yates Collection; 33BR154; Middle Archaic-Late Archaic Matanzas Side Notched, 33BR144.**

**Bottom row (l-r): Benton Stemmed, Yates Collection; Brewerton Eared Notched, 33BR154; Lamoka, Yates Collection; Bottleneck, Yates Collection; Motley, Yates Collection, Late Archaic-Early Woodland Stemmed (Cogswell), 33BR154.**

then illustrates how the raw material and expedient tools were moved round the site with blue arrows representing transport junctures[4] and red arrows representing by-products. The co-products, expedient scrapers, and two varieties as shown, were two possible outputs of the tool production episode. But the bifacial trajectory was another possible output of the tool production episode, the details of which are shown in Figure 5.

The information is interesting because it mirrors evidence discovered by Cobb (2000) of the production of expedient tools at the better developed and well-known Mill Creek chert quarry in Southern Illinois. It also recalls an experimental study that detail energetic advantages

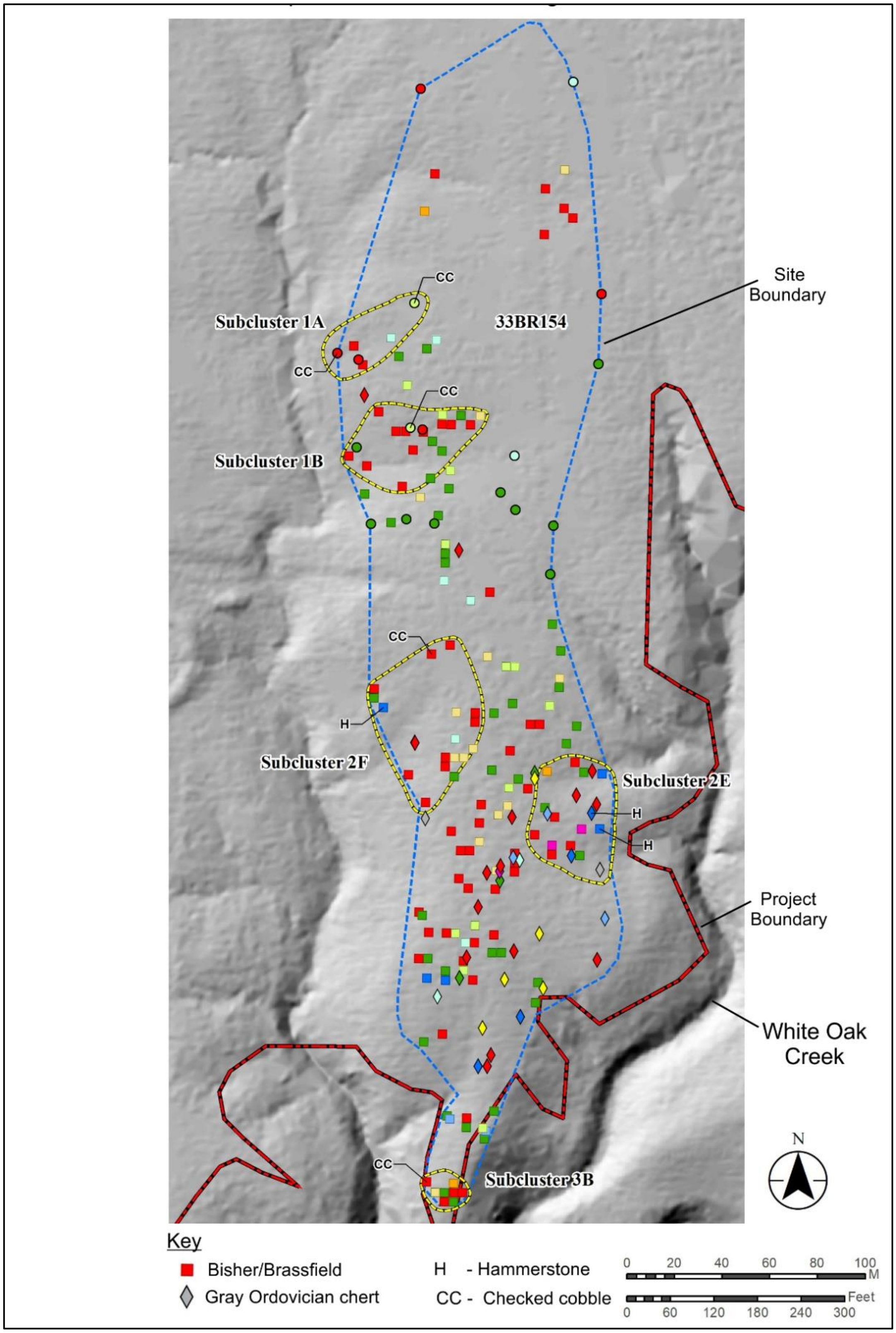


**Figure 3. LiDAR map showing surface survey results and chert exploitation subclusters along swales.**

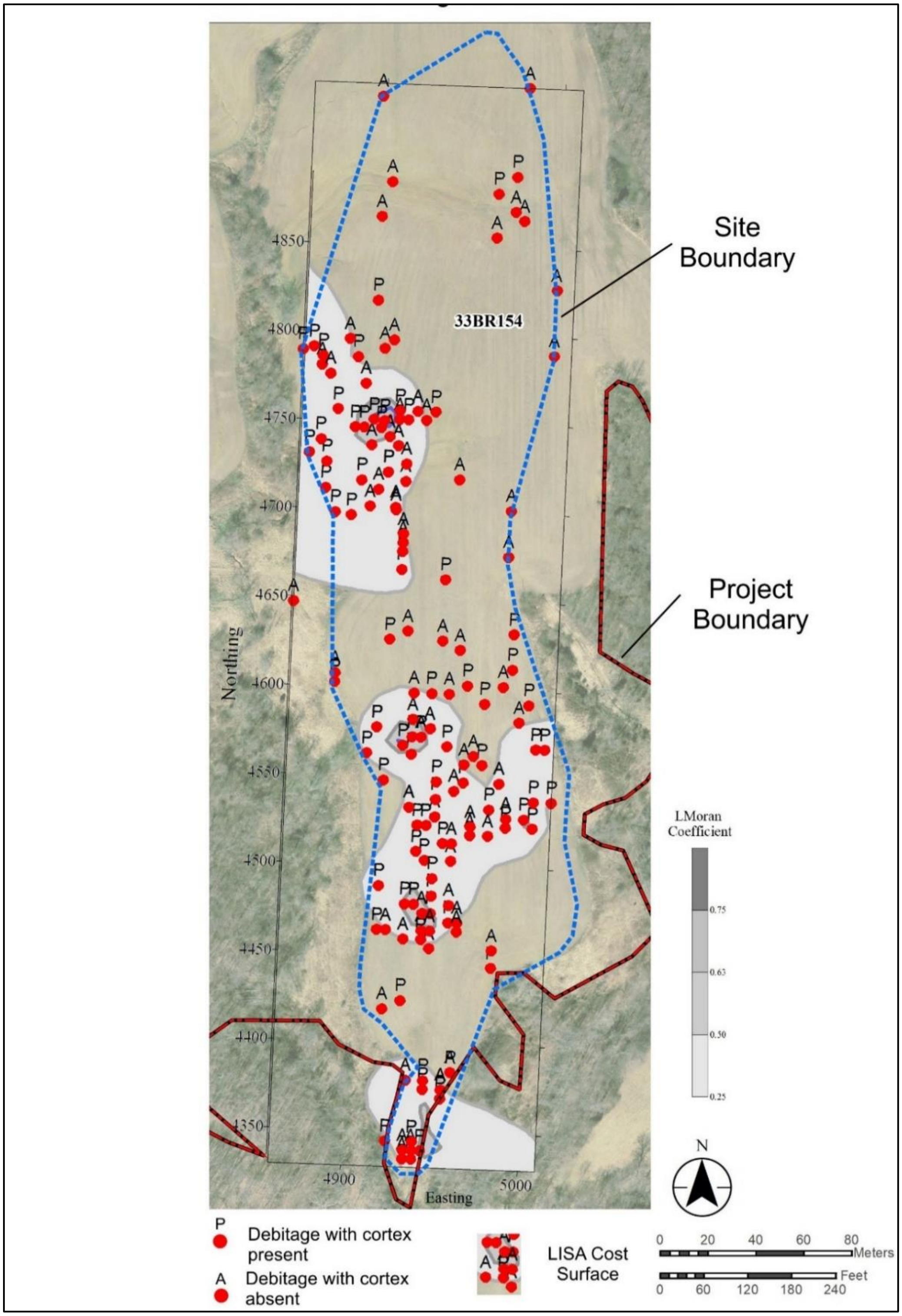


**Figure 4. Local Indicator of Spatial Association (LISA) map for cortical and non-cortical debitage at the Yates site.**

inherent in certain flake tool technologies, over those of curated hafted bifaces (Clarkson et al. 2015). The study of Clarkson et al. (2015) found that hafted end scraper production was much less energetically efficient than using unmodified or modified flakes in scraping activities, although certain kinds of tasks were best done with a hafted endscraper, due to the leverage it afforded. What I suggest is that these flake tools were quickly and efficiently made for tasks at hand and not intended to be curated or transported long distances nor where they used for the most difficult tasks where leverage was required. They can be conceived of as co-products, made quickly, used, and then discarded during lithic production and other generalized subsistence work. They are present in the assemblage incidental to the better developed bifacial lithic production system.

These tools were found in and around the swales with checked cobbles, cores, and decortication debitage, and the evidence does not indicate that expedient tools were moved to other places on-site. Rather, during or after bifacial reduction, early-stage blanks were transported, as identified by transport junctures (Figure 5, blue arrows). Transport junctures are an important concept, because the moving of chert objective pieces such as cobbles, cores, or unfinished tools, has profound patterning effects on where lithic debris ends up being deposited (Pecora 2002). In the case of the Yates site, this patterning suggests a distinctive means of working chert at or near the source locale, with expedient production, use, and discard in such locations, which are the swales on the edges of the site. This expedient production pattern is contrasted with a more drawn out and spatially extended set of work tasks and activity areas for bifacial production.

A more detailed working out of how, at least based on evidence available, the technological system functioned is presented in Figure 6, both in terms of curated bifacial reduction and expedient flake technologies.

The inventory of projectile points from the Brown County Landfill bears out this picture in terms of use of local and regional chert types. And projectile point data provide information on the use of the cobble cherts through time (Table 2). A slight majority of these projectile points are derived from Bisher-Brassfield chert. Other tools, often exhausted points, were from regionally important chert sources, such as Vanport, Upper Mercer, and Paoli. And, in a couple cases, a hafted endscraper and drill were made from these points. What is the explanation for the presence of these exhausted specimens at a small lithic quarry and workshop site? The most likely explanation is “gearing up”, a term used by Binford (1979:256) to describe the pattern, observed elsewhere, of hunters and gatherers disposing of old tools at quarry sites, prior to making new tools and thus effectively retooling their subsistence tool kits. Indeed, Lepper et al. (2001) note that discarded Bisher projectile points were found at a Flint Ridge quarry and workshop site in Licking County, Ohio, about 150 miles away from the Yates site. Stafford (2021:41) states that Early Archaic foragers disposed of Wyandotte tools near the location of a quarry of Muldraugh chert, where a series of workshop sites occupy a terrace of the Ohio River in southern Indiana. This pattern suggests that there was back and forth movement of tools, and probably people, as tools were made, used, and discarded at strategic locations on the landscape, often where the foraging party decided to retool. These two examples indicate the wide procurement circuits that hunters and gatherers must have utilized to obtain and maintain their tool kits.

The majority of identifiable projectile points date to two time periods: the Early Archaic ($n$ = 13) and the Late Archaic ($n$ = 12), with additional terminal Late Archaic ($n$ = 2) and transitional Late Archaic-Early Woodland points ($n$ = 2). Only a smattering of Woodland period points were recovered from these sites.

**Table 2. Projectile point types from the Brown County Landfill project area.**

| **Temporal period** | **Date Range*** | **Brown Co. Landfill Ct** | **Types present** |
|---|---|---|---|
| Paleoindian | 13,500 BC-10,000 BC | None | |
| Early Archaic | 10,000 BC-5800 BC | 13 | Lost Lake, Thebes, Kessell Side Notched, Kirk Corner Notched, Pine Tree Corner Notched, St. Albans Side Notched, LeCroy, and Kanawha Stemmed |
| Middle Archaic | 6000 BC-5000 BC | 1 | Stanly |
| Middle Archaic-Late Archaic | 3700 BC-3000 BC | 2 | Matanzas Side Notched |
| Late Archaic | 3500 BC-2000 BC | 12 | Karnak Stemmed, Lamoka, Brewerton Eared Notched, Benton Stemmed, Brewerton Side Notched, Bottle Neck, and Motley |
| terminal Late Archaic | 1600 BC-800 BC | 2 | Merom Expanded Stemmed and Trimble Side Notched |
| Late Archaic-Early Woodland | 3500 BC-500 BC | 2 | Late Archaic-Early Woodland Stemmed (Cogswell) and Saratoga Parallel Stemmed |
| Early Woodland | 1300 BC-AD 200 | 2 | Meadowood and Robbins |
| terminal Middle Woodland | AD 400-AD 600 | 1 | Baker’s Creek |
| Late Woodland | AD 400-AD 800 | 1 | Chesser |
| **Total** | | **36** | |
| **Note**: *Date ranges derived from Justice's (1987) assignments for individual projectile point types. | | | |

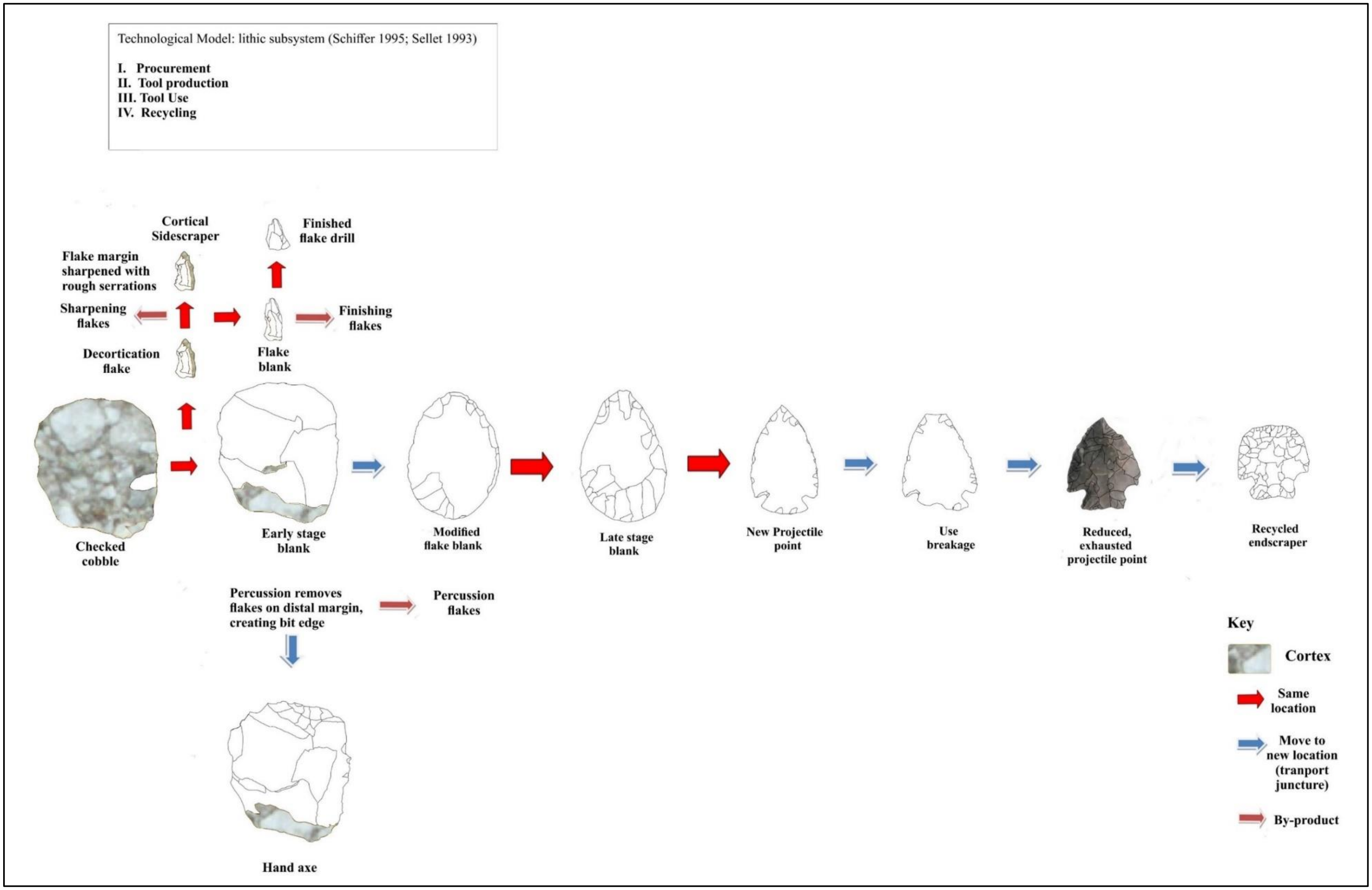


**Figure 5. Model of Divergent Lithic Reduction Sequences at the Yates Site, 33BR154. Bifacial reduction continuum is modeled after Pecora (2014). Expedient flake tools and hand axe are modeled in Schwarz et al. (2020).**

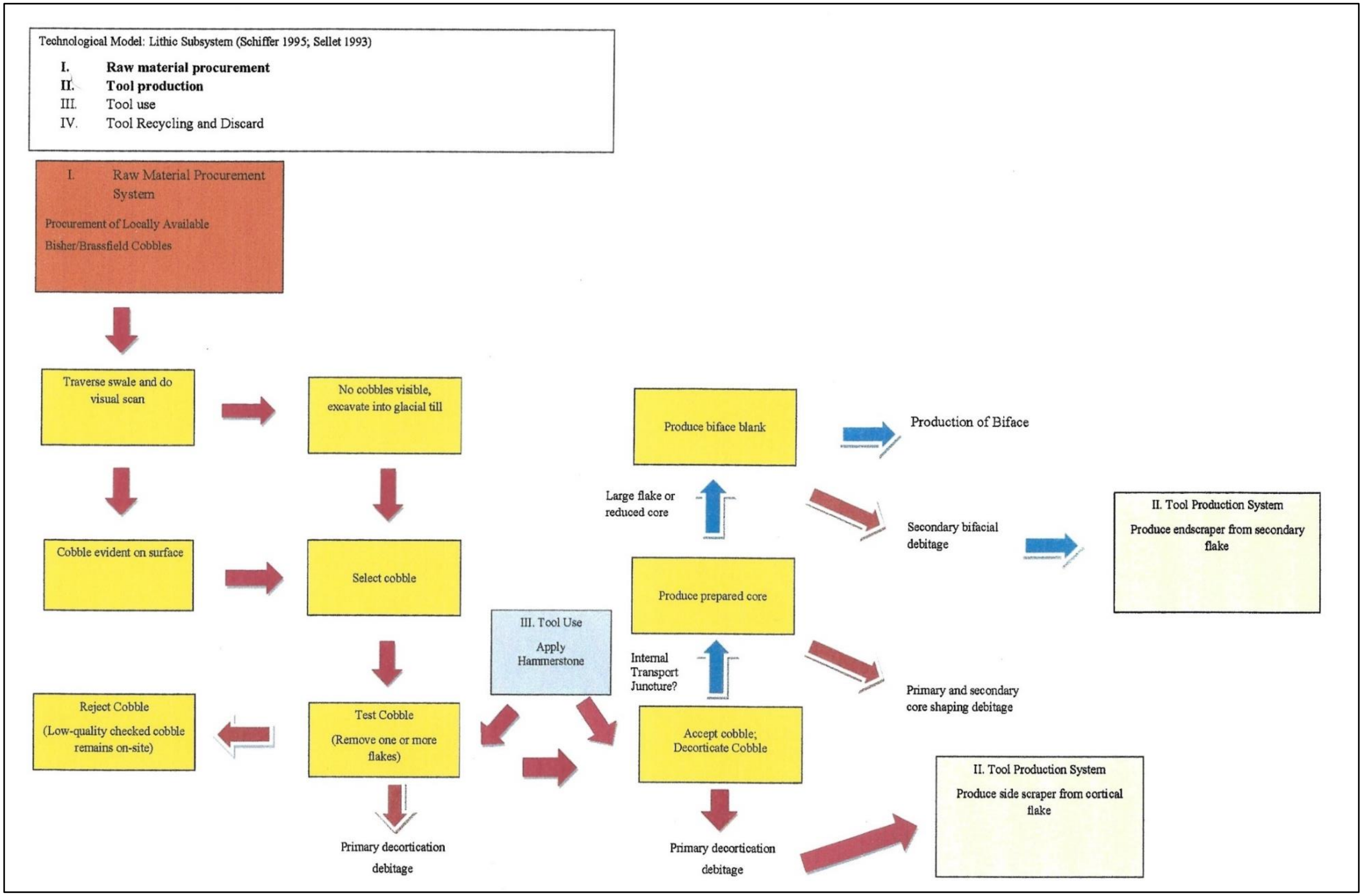


**Figure 6. Chaine operatoire diagram showing sequences for exploitation of lithic cobbles in swales (Schwarz et al. 2020).**

## Discussion and Conclusion

The Phase III investigation of the Yates site (33BR154) focused on one of twenty-nine prehistoric sites documented at the Brown County Landfill, near Georgetown, in Brown County, Ohio (Schwarz et al. 2020). The fieldwork was able to identify a lithic quarry and workshop, which derives from a source of glacial cobbles near White Oak Creek. The chert is believed to be glacially transported Bisher or Brassfield cherts. Such secondary sources have been known to occur in Ohio's glacial landscapes but seldom have been studied (Kagelmacher 2001:4-7). The Phase III data recovery report advances our knowledge of low-intensity lithic raw material exploitation in Ohio's prehistory and aids in modeling relationships between extractive and habitation activities (Schwarz et al. 2020). The projectile point inventory from the Brown County Landfill indicates that usage of this landscape was most common in the Early Archaic period and Late Archaic period and use tailed off during the Woodland period.

Attempts to disentangle the habitation and quarry and workshop components of the Yates site led to the mapping of visually apparent subclusters and spatial statistical analysis of quarry and workshop-related materials. Also, this research resulted in the development of *chaine operatoire* analyses to describe divergent lithic reduction sequences. The detailed mapping of artifacts recovered from the site illustrates the presence of five lithic exploitation areas within swales. These are locations where chert cobbles were extracted, tested, and decorticated. In some cases, evidence has emerged of the creation of expedient tools from decortication flakes, and my analysis termed these tools as "co-products," which were incidentally created during quarry and workshop operations. This kind of lithic reduction activity diverges from the bifacial reduction trajectories that characterize most studies of Ohio's prehistoric stone tool making (Pecora 2014).

Spatial statistical analysis, utilizing the LISA, inferred that comparisons of four of five of the visually-evident lithic exploitation subclusters were identifiable statistically by comparing cortical versus non-cortical flake distributions (Anselin 1995; Schwarz and Mount 2005). This mapping aided the creation of a *chaine operatoire* that specified where activity areas involving testing and decortication were taking place. Consequently, it was possible to puzzle out how the sequenced operations related to lithic reduction played out across the landscape.

The *chaine operatoire* provides detail on two divergent reduction sequences that can be identified at the site. While the curated bifacial lithic technology is well understood (Pecora 2014) and is shown in the *chaine operatoire* diagram, an expedient tool production chain is shown also to have existed and was pursued within the lithic exploitation subclusters. Tools such as flake drills and cortical sidescrapers could be quickly made from decortication flakes and deployed as needed for daily tasks. Likely, such tools were not transported or curated in the same way bifacial tools were.

This evidence of creation of expedient tools alongside the curated bifacial technology has been shown to be present at other quarry and workshop sites, such as the Mill Creek quarry complex, in Southern Illinois (Cobb 2000), but to my knowledge, this study is novel for secondary lithic source locales of southern Ohio. Expedient tools have another importance. The making of expedient stools introduced a degree of flexibility and speed into the lithic toolmaking system (Clarkson et al. 2015).

In the Phase III data recovery report, evidence of these divergent reduction sequences at the same site are modeled in terms of subsistence strategies such as "gearing up" and efficiencies of flake versus hafted scraper technologies (Binford 1979; Clarkson et al. 2015). But also, these divergences are described in terms of recognizing learning, technological choice, and agency in the archaeological record (Cobb 2000; Diez-Martin et al. 2021; Dobres 2000; Lohse 2011; Schwarz et al 2020). Lithic tool making activities resulted in a number of divergent technological choices, so a number of different outcomes within any technical system are possible and are visible in the archaeological record. Multiple bushy *chaine operatoire*, or sequences of steps, identify the divergences of possible outcomes, implying choice is present in the reduction trajectories adopted in prehistory. When these sequences are studied in detail a window can be provided on the complexities of prehistoric decision-making and agency within a technical productive system (Dobres 2000:174). Studies of lithic technology can allow for inferences regarding the diverse strategies employed to wrest resources from the natural environment. As Lohse (2011) and Dobres (2000) make clear, greater agency and variation must be sought out and recognized in these reduction sequence studies, in order to provide for more complete explanations of human behavior and the diversity of economic and technological strategies enacted through time.

## Acknowledgments

Mr. Duane Yates of Rumpke, Inc. kindly showed ASC his collection of stone tools and allowed them to be photographed for inclusion in this study. I would like to acknowledge his assistance. This *Current Research* Paper benefited from the help of several archaeologists. Jeremy Thornburgh and Tina Hartman Davis prepared Figure 3 and the artifact photographs and assisted with Figure 4. Chuck Mustain and Thomas Stetar were field directors for the Phase III archaeological investigation of the Yates site, and Chuck was field director of the Phase II controlled surface survey which produced most of the data described here. Kevin Gibbs and Dawn Walter Gagliano analyzed the artifacts. Dawn also conducted the microwear analysis of lithics referenced in the paper. Eric Olson organized a poster session for the 2021 Spring meeting of the Ohio Archaeological Council at which an early draft of this study was presented as a poster.

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[1] Vickery (1996) places the entire central portion of Brown County and western portion of Highland County in a Bisher exploitation zone, although he does not specify where bedrock or glacial Bisher cherts could be found. Kagelmacher (2001) and Stout and Schoenlaub (1945) record that Bisher chert outcrops in Liberty Township, Highland County, Ohio, which is 33 miles north of the project area. Bedrock cherts were presumably mobilized from this locale, or nearby. The chert likely was reworked, transported, and redeposited at 33BR154 by the Illinoian glacier. Brassfield chert also occurs in Highland County, but macroscopically the specimens collected from the Brown County landfill property are more similar to Bisher, and it is considered more likely to be Bisher, but the assignment is not certain.

The raw material can be described as a white to light yellowish brown (5Y 8/1 to 2.5Y 6/4) dull chert with impurities being very pale brown (10YR 8/4) and often speckly. Thin gray (10YR 5/1) bands are occasionally present. Small crystalline vugs are also sometimes visible, most which are eroded. Fossil inclusions are fairly common and include brachiopods (Moore et al. 1952:Figure 3-16H) filled with drusy quartz and a fossil hash (Kagelmacher 2001:41). This hash is believed to consist of echinoderm fossils. Crinoid fragments are present too. Most chert specimens are dull, i.e., having very little luster. But occasionally a slight luster is visible. Cortical rinds of up to 3 mm are present and cortex is often speckled with the pale brown (10YR 8/4) impurities. Flaking characteristics are good.

[2] The microwear analysis determined that 5 of 13, or 38.5 percent of tested macroscopically unretouched flakes, had microwear evidence of utilization, with one flake having polish indicative of scraping action and three flakes having microscopic edge damage (Walter Gagliano 2020). Four of these flakes were Bisher-Brassfield and one flake was Vanport (Flint Ridge) chert. Four of five, or 80.0 percent, of Bisher-Brassfield flakes tested showed microscopic evidence of utilization.

[3] Checked cobbles are defined as natural chert cobbles from which one or a few flakes were removed, presumably to assess raw material quality.

[4] A transport juncture is defined as a point in the reduction sequence when the lithic objective piece (i.e., a core, blank, etc.) is moved to a new location, at which time reduction continues, following Pecora (2002).