Specialist report on the Stone Age occurrences documented for the proposed exploration camp on the farm Demaneng 546, near Kathu, Gamagara Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province

Compiled by Dr MM van der Ryst and S.U. Küsel

Commissioned by PGS Heritage

Report Date: August 2021

Declaration of independence

This report has been compiled by Maria van der Ryst and Siegwalt Küsel. We declare that as independent consultants we have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which the appointment was made other than fair remuneration for work performed in connection with the activity or application.

Note that a copy of the report will be lodged with SAHRA as stipulated by the NHRA (Act No. 25 of 1999), Section 38 (particularly subsection 4).

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Contents

List of acronyms

AIA	Archaeological Impact Assessment
ASAPA	Association of Southern African Professional Archaeologists
BAR	Basic Assessment Report
BIF	Banded Ironstone Formations
BP	Before Present
CFP	Change Find Procedure
ESA	Earlier Stone Age
HIA	Heritage Impact Assessment
LCTs	Large Cutting Tools
LSA	Later Stone Age
MSA	Middle Stone Age
NHRA	National Heritage Resources Act (No. 25 of 1999)
OES	Ostrich Eggshell
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
STPs	Shovel Test Pits
ToR	Terms of Reference
Ya	years ago

1 Executive summary

As a Stone Age specialist accredited with ASAPA, I assessed the Stone Age lithics that have been recorded as part of the Phase 1 Heritage Impact Assessment (HIA) for a proposed exploration camp on the farm Demaneng 546, near Kathu, in the Gamagara Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province. SAHRA (2007: 7) defines Heritage Impact Assessments (HIAs) as 'studies conducted by qualified heritage specialists that aim to identify heritage resources within a proposed development area, assess their significance, assess the impact of the development on the heritage resources and provide relevant mitigation measures to alleviate impacts to the heritage resources'.

The initial 2021 PGS Phase 1 HIA in situ recording of stone tools identified concentrations of MSA lithics at two localities, namely DEM-01 and DEM-02. These sites contained mainly low and some medium density surface occurrences of mostly MSA tool types. The highest density of lithics was recorded in an area that appears to have been previously disturbed, i.e. site DEM-01. The surface lithic scatters within the undisturbed area were recorded as site DEM-02. Several GPS points were taken at different locations/findspots on site with significant surface scatters with a higher density of stone tools. An overlay of all the archaeological and heritage sites identified during fieldwork over the proposed development footprint areas was made to assess the impact of the proposed development on these identified archaeological and heritage sites (see Chapter 9 PGS 2021).

PGS Heritage proactively decided that it was important to record some of the MSA localities. According to the *SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports* for sites that cannot or need not be saved from development but carry information of significance about the past, the archaeologist will recommend a Phase 2 Archaeological Mitigation (SAHRA 2007: 4). A great many Stone Age sites have been documented through predevelopment Heritage Impact Assessments (HIAs) and Archaeological Impact Assessments (AIAs). At a time when cultural research management was still a relatively new concept, Schiffer et al. (1977: 44) argued that 'management research can and must produce, and is producing, significant contributions to scientific archaeology'. The recording of Stone Age assemblages documented through impact assessments at a great variety of sites in the Northern Cape has added immeasurably to the data base on the Stone Age prehistory of the region.

PGS in their 2021 HIA report therefore recommended that some of the localities should be mitigated and documented in more detail. This would comprise in situ recording of selected lithic scatters to determine the varying densities, tool types and raw material use (see section 6). PGS Heritage subsequently commissioned a Stone Age specialist to undertake an assessment of the documented stone tools from the various identified localities and to make recommendations on the significance of the finds. The authorisation of a Section 35 Permit was not required since no lithics were removed from their contexts.

During the August 2021 visit to the identified MSA localities non-invasive in situ recording was carried out. In addition to conventional field survey, a grid documentation was used to obtain more data on lithic densities and the spatial distribution patterning. A one-metre grid square was used in two main areas where fairly high densities of stone artefacts were observed. A total of 30 1-metre grids were established for DEM-01 that is located in an area where the gravel deposits had been mined and screened to obtain material for road-building. For DEM-02, located on higher-lying undisturbed contexts, two grids of 20 x 20 metres were put out.

By plotting the counts of all lithic elements, relative density per square metre was established and rated on a scale of (<10), medium (10-20) and high (>20). The archaeologists recorded mostly low densities <10. The landscape setting of each locality was photographed and the lithics within each of the grids were photographed. The artefacts all exhibit a MSA signature.

The significance of the impact of the development during a pre-mitigation Medium Significance is supported by the post-mitigation Medium Significance based on the data collected during the 2021 non-invasive documentation and subsequent analyses. A fairly low-scale utilization of resources during the MSA is reflected by the relatively low numbers and densities of lithics, and the somewhat limited range of formal tool types recorded on the surface at localities DEM-01 and DEM-02. While the documentation reflected the distribution of artefacts on the surface, the recorded densities were unfortunately too low to allow any inferences on spatial patterning. The lithics were mostly present on calcrete, pebble and also on disturbed surfaces. No subsurface lithics were observed in the walls of the eroded gullies.

The authors of this report are confident that the lithic occurrences of the property under review were adequately documented and assessed during the Phase 1 HIA (PGS 2021) and the subsequent survey and documentation during August 2021 by the Stone Age specialist.

No further mitigation actions are required in view of the findings as set out under Section 6. A destruction permit is accordingly not required.

2 Introduction and Terms of Reference

PGS Heritage (Pty) Ltd (PGS) was appointed by EXM Advisory Services (Pty) Ltd (EXM) to undertake a Phase 1 Heritage Impact Assessment (HIA) for the proposed exploration camp on the farm Demaneng 546, near Kathu, in the Gamagara Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province (PGS 2021).

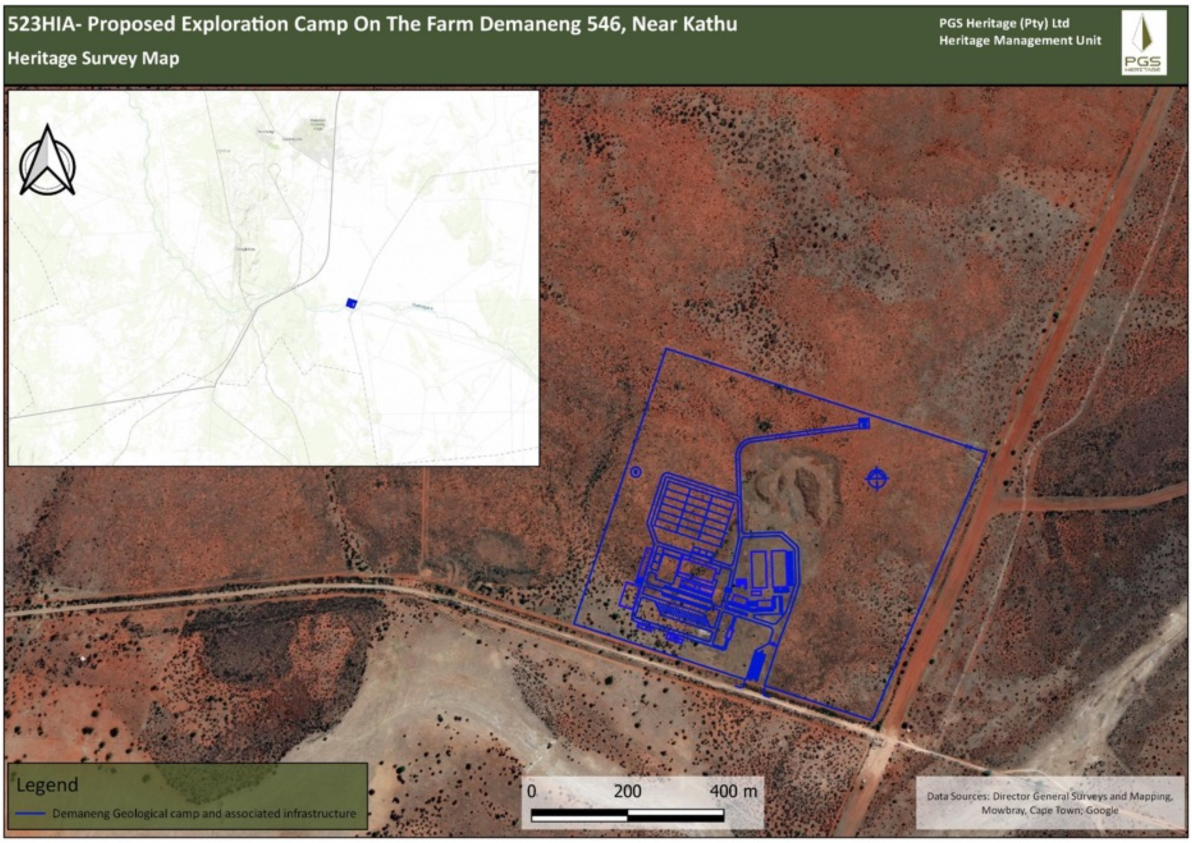

Figure 1. *Google Earth depiction of the study area boundaries and development footprints. The study area is located on the farm Demaneng 546, near the town of Kathu in the Northern Cape Province (PGS 2021: 13).*

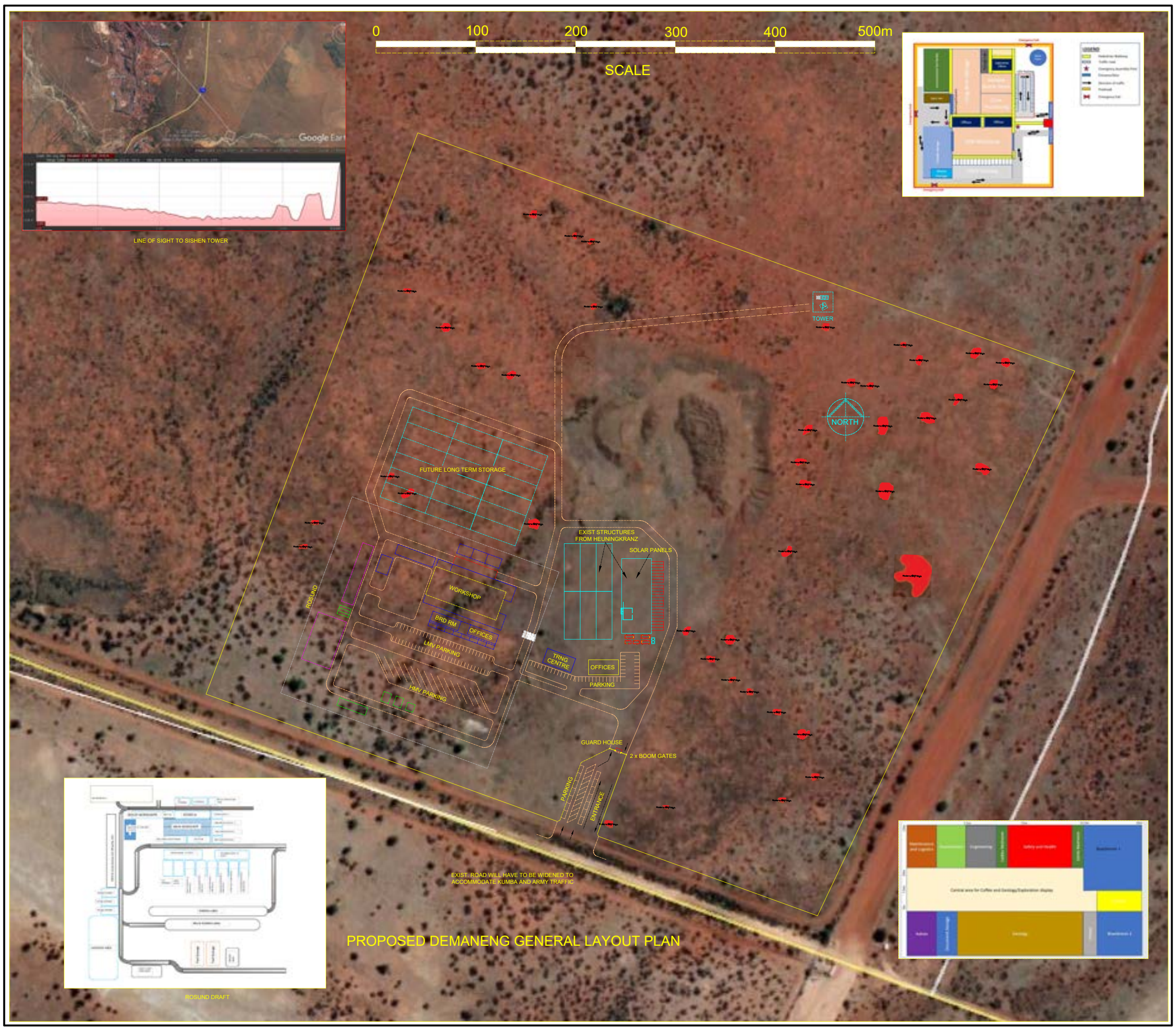

Figure 2. *Proposed development layout plan. This plan was provided by the client (PGS 2021: 45).*

The initial 2021 PGS Phase 1 HIA in situ recording of stone tools identified concentrations of MSA lithics at two localities, namely DEM-01 and DEM-02. These sites contained mainly low and some medium density surface occurrences of mostly MSA tool types. Five main criteria were considered in assigning significance (PGS 2021: 16-17). Both sites DEM-01 and DEM-02 were rated to be of medium significance. **On the basis of this specialist assessment the significance has been revised to Low or No significance.** The Impact Assessment and Mitigation measures were calculated (see PGS 2021: 70 Table 14 - Impact Assessment Table (pre-mitigation), and Table 15 - Impact Assessment Table (post-mitigation).

Mitigation measures proposed by PGS (2021) included the commissioning of a Stone Age specialist to provide specialist input on the two Stone Age assemblages documented during the Phase 1 HIA. The SAHRA APM Guidelines: Minimum Standards SAHRA (2007: 7) on mitigation measures assert that '[w]here it is not possible to retain the heritage resources in situ, and the heritage resources are not deemed significant, the loss of information can be reduced by recording and mitigation of the heritage resources through a process of excavation (or sampling) by a qualified specialist as a condition on the development in terms of section 38(4)d ….' This allows us to record a part of the history of the place as part of the national inventory. Assessment and mitigation in the early phase of the development may save the developer considerable delays and related costs'.

The two localities that were deemed of significance were reassessed on 10 to 11 August 2021 by Dr Maria van der Ryst assisted by Siegwalt Küsel. During the site visit the densities and typologies of the Stone Age lithics at the two sites were investigated. This report provides context on the various stone tool assemblages from the targeted sites based on the field data of two surveys and the techno-typological analyses.

3 Assessment methodology

Previous to and during the initial HIA conducted by PGS (2021) the heritage resources of the study area were investigated. These included a desktop study that provided an archaeological and historical overview of the study area and surroundings. The field survey focussed on an intensive walkthrough of the footprint area to identify and record all heritage resources. Scatters of mostly MSA surface lithics were observed and recorded. More dense concentrations of lithics were found at two localities that were named DEM-01 and DEM-02. A Stone Age heritage specialist was appointed to make an assessment as to the significance of the two sites.

During the subsequent specialist study the following methodology was applied:

Prior to the field work all maps of the survey area were mapped and plotted on Google Earth and high-resolution aerial imagery and converted to .gpx format. The data were transferred to the mobile App GPS HD (Motion X) to allow for georeferencing during the field survey via Ipad and Iphone. GPS coordinates were recorded with a Garmin e-Trex 30 (Datum WGS84).

Site data was captured by using open source app software (mobile data-gathering platform). The number of lithic elements within each demarcated area and their attributes at both DEM-01 and DEM-02 were captured on a mobile data base app (https://five.epicollect.net/). The typological classes and attributes that feature in the analyses of lithics from southern African Stone Age sites were drawn into the app. The collected data was immediately uploaded and linked to Excel. The data was subsequently downloaded to a server.

The site assessment methodology comprises the following:

- On site the existing sites DEM-01 and DEM-02 were marked with the use of a handheld GPS through the process of waypoint averaging.

- To obtain an understanding of the sites, the historical disturbances, and the distribution of stone tools a series of transects were walked across the broad area indicated as lithic-bearing by the PGS archaeologist (2021).

- To contextualize the observed lithics in the disturbed locality, these were compared with lithics in primary undisturbed areas.

- This consisted of random 1-square meter grid documentation in undisturbed areas. The investigation was limited to surface deposit documentation and excluded collection or excavation. For photographic purposes the position of some lithics were marked and numbered so that these could be replaced following documentation.

  Grid documentation is used to obtain more data on lithic densities, lithic typologies and spatial distribution patterning. By plotting the counts of all lithic elements, relative density per square metre can be established and rated on a scale of low (<10), medium (10-20) and high (>20). This is an expedient and non-invasive strategy that is particularly useful in the value assessment of lithic occurrences.

  In the HIA survey PGS (2021) used the density of the accumulated lithic assemblage at all the recorded surface MSA sites to assign significance. An assessment of significance that is based on defined parameters promotes the design of appropriate mitigation strategies with regard to intervention measures, sampling methods and a responsible budget. The assessment of value is fundamental for heritage projects as it aids planning and decision-making strategies (Mason 2002).

- Structured 1-square metre grid documentation was then applied at the previously identified sites DEM-01 and DEM-02 where higher densities of stone artefacts had been observed during the Phase 1 HIA (PGS 2021). During the specialist assessment conducted in August 2021 a grid with a total of 30 1-metre squares was established at DEM-01. By plotting the counts of all lithic elements, relative density per square metre was established and rated on a scale of (<10), medium (10-20) and high (>20).

- In addition, the existing screen dumps were extensively searched to determine whether these contained any lithics.

- Following the initial recording of 1-square meter grids and the subsequent low-density findings three 400 square metre areas were sampled (20 x 20m). This was done to record a regional representative lithic baseline.

- For the report a desktop study of existing literature on several Stone Age sites within the wider region was conducted for comparative purposes on the typologies and attributes of the lithics, and the preferential use of raw materials for the manufacture (Section 8).

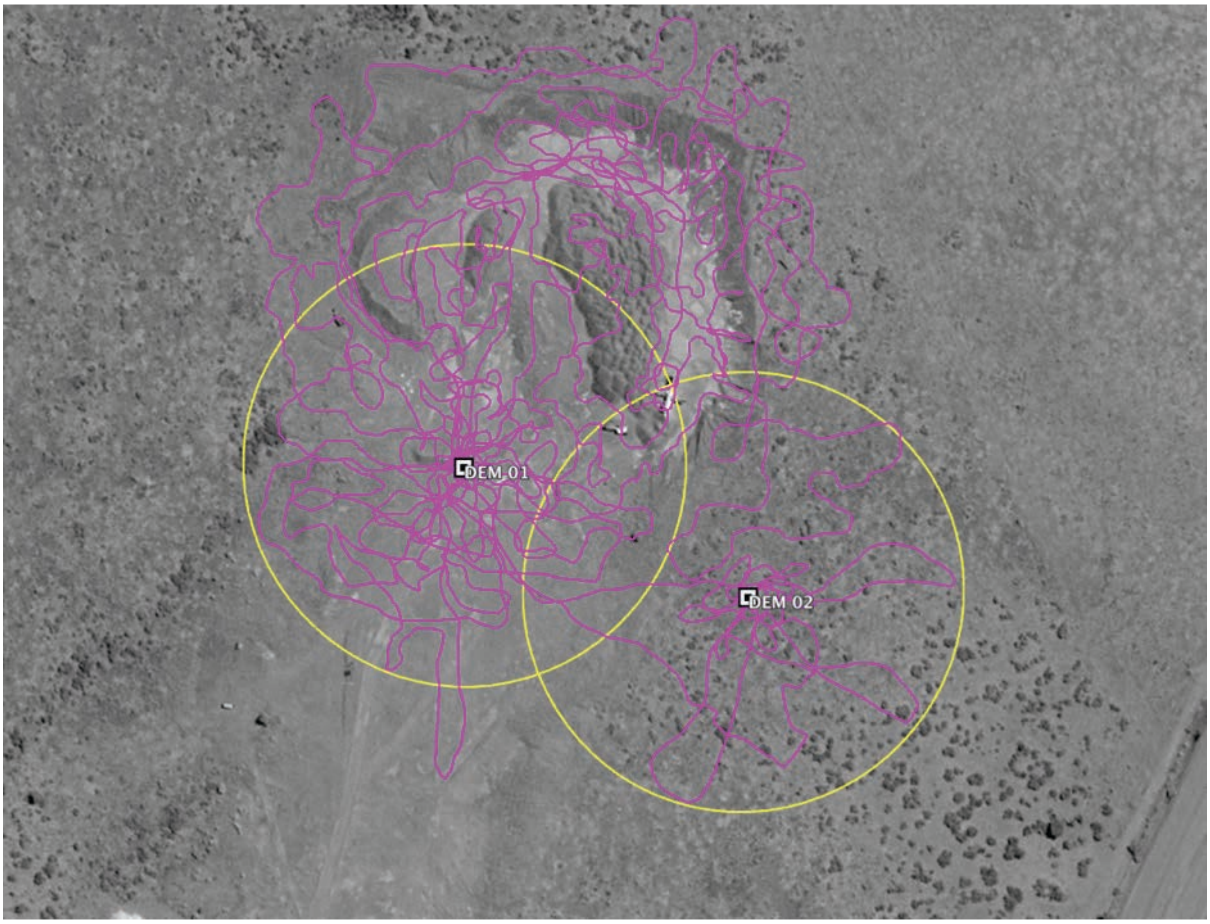

Figure 3. *Extent of tracks from this survey. The yellow circles are 200 m in diameter.*

4 The archaeology and historical settlement within the study area

4.1 The southern African archaeological sequence

Landscapes were humanly inhabited and experienced in the everyday life of the past. Based on iconic lithic tool types and occupation sequences the southern African Stone Age sequence can be divided into the following periods. Please refer to Annexure A for more detail on the Stone Age sequence.

TABLE 1 Broad outline of the southern African Stone Age sequence	
Period	**Approximate dates**
Earlier Stone Age (ESA)	more than 2 million years ago to >200 000 years ago
Middle Stone Age (MSA)	<300 000 years ago to >20 000 years
Later Stone Age (LSA) – Includes rock paintings and engravings	<40 000 years ago up to historical times in certain areas[1]

4.2 The PSG (2021) desktop study

PGS (2021: 27–37) provides a review on the various phases of settlement in the study area through a desktop study as presented in their report. AIAs, HIAs and academic publications on the prehistory and historical period generated a data base for the general area. These sources demonstrated a diverse cultural landscape with settlement and utilization of the local resources starting from the deep past over a period of time that spans millions of years up to recent times. It documents the earliest occupations of hominins, Stone Age settlement, migrations of African farmers and the later movement of white farmers into the region, mining, industrialization, urbanization, warfare and conflict.

See PGS (2021: 39–52) for an overview of the archaeological contexts of the study area and surroundings that includes a summary of pertinent archaeological and heritage assessments. Detail on the Stone Age occurrences recorded at the DEM-01 and DEM-02 localities are provided in the report by PGS (2021).

4.2.1 Relevant heritage resource that have a bearing on the archaeology of the Kathu sites and other Northern Cape heritage resources

[1] < = less than > = greater than

The region exhibits a continuous distribution of material culture deposited during many different episodes. Stone Age hunting and gathering groups traversed and utilized the resources of the area for millions of years. Occupation of the interior during the historic past has been well-documented by travellers, missionaries and researchers (Dunn 1880, 1931; Campbell 1815, 1822; Burchell 1967; Arbousset & Daumas 1968; Humphreys 1975; Humphreys & Thackeray 1983; Mitchell 2002). The Northern Cape is an arid region with limited sources of surface water It is therefore not surprising that the remains of archaeological events occur mostly in the vicinity of water and good sources of lithics that have been used to produce stone tools (see also Morris 2005, 2007, 2009, 2010, 2012; PGS 2010, 2012a; hell, 2006; Webley 2010; Webley & Halkett 2010; Webley et al. 2010; Van der Ryst & Küsel 2012; African Heritage Consultants 2013, 2018; Fourie, PGS 2013, 2015, 2020a, 2020b; Fourie et al. 2018; Smeyatsky 2019).

Palaeo- and current river systems, springs and pans and dominant geographical landscape features such as hills or shelters featured as important locales within any landscape. The Northern Cape contains very numerous small shallow pans, also known as dolines, of 100 to 200 m in diameter, and also larger pans. Areas around pans tend to display higher densities of lithics (van der Ryst & Küsel 2011, 2012; Webley 2010). Sensitive areas where heritage resources may be present would be in these environments, around low koppies and, importantly, also at outcrops of raw stone materials suitable for the production of stone tools. ESA, MSA and LSA lithics are commonly found in calcrete deposits around pans and springs (Webley 2010; Webley et al. 2010; Webley & Halkett 2010; Webley & Halkett 2014).

Heritage assessments commissioned by commercial mines within the broader ambit of South Africa's environmental and heritage legislative requirements have essentially driven archaeological research in the more remote areas of southern Africa. It is almost impossible to individually review the innumerable Archaeological Impact Assessments (AIAs) and Heritage Impact Assessments (HIAs) carried out in the Northern Cape. The data generated by the great many archaeological and heritage surveys previously conducted in the general region to record and mitigate heritage resources prior to development, in particular mining and currently the alternative energy installations, form the basis for a lithic assemblages within the Kathu region. Published research data, often emanating from such surveys, provide more detail on the settlement and utilization of the region. Regional approaches are, nevertheless, limited by immediate and practical spatial concerns such as the areal extent of the proposed impact by development and land use (Kantner 2007: 5/45).

The Stone Age of the region is of particular interest in view of the remarkable high lithic density of ESA assemblages and the wide representation of the MSA (Walker et al. 2013; Walker et al. 2014). The early occurrence of blade technology was recorded at Kathu Pan 1 in a Fauresmith assemblage at possibly >400 000 years ago. The Fauresmith is considered a transitional industry between the ESA and the MSA. Blades are a common component in the southern African MSA. Long and symmetrical blades were systematically removed using direct hard hammer percussion from blade cores that were carefully prepared through centripetal flaking (Wilkins & Chazan 2012). However, considerable variation is found in the southern African MSA assemblages, both across space and through time (Wadley 2015, 2016). This can to some extent be ascribed to the availability of suitable fine-grained rock types for tool manufacture.

5 Site context

The locality is situated within close proximity to the Gamagara River on a ridge of palaeo-river gravels offering a vantage point across the landscape. The Kathu landscape is marked by an overlay of ephemeral utilization of seasonal resources and intensively exploited viable lithic resources such as the Gamagara River, outcrops and lithic extraction quarries with abundant material, for example surfaces of fine-grained bedrock at Kathu Townlands and Bestwood (Chazan et al. 2012; Wilkins & Chazan 2012).

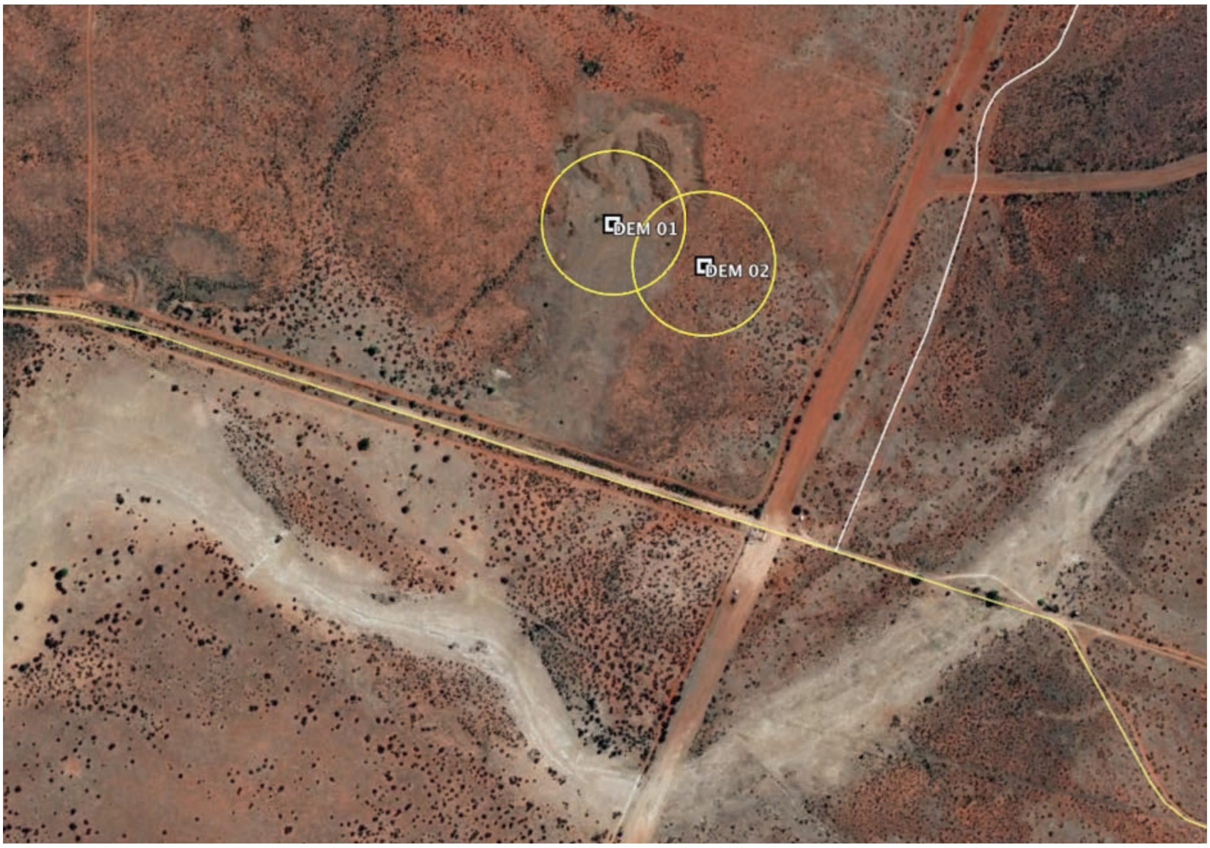

Figure 4. *The site localities DEM-01 and DEM-02 relative to the Gamagara River. The circles are 200 m in diameter.*

Figure 5. *General view across the site. Note the extent of mining around DEM-01, which is to the left.*

Figure 6. *The untransformed landscape to the north of the site. Note the presence of the gravel dumps to the right.*

5.1 2011 to 2017 mining activities at Demaneng

From the Google Earth imagery it is evident that the locality was mined from 2011 to 2017. The process included the excavation, screening, sorting and crushing of material for aggregates and engineered fill material such as G4 to G7 grades used in the construction of base layers. Throughout the site abundant evidence of these processes remain. See photographs below.

Figure 7. *Google image of 2006 prior to the mining activities.*

Figure 8. *Google image of 2011 at the commencement of mining.*

Figure 9. *Google image from 2017. Note the presence of the mobile screen and crushing plant on the right, excavator below the plant and a dump truck to the left. Also note the extent and depth of excavations.*

Figure 10. *Google image of the status quo in 2021.*

Figure 11. *Typical example of a tracked mobile crush and screen plant.*

Figure 12. *Remains of screens at dumps.*

Figure 13. *Screen fragment among graded material directly adjacent to DEM-01. Fragment 140 mm.*

Figure 14. *Calcrete bedrock exposed during mining activities. Note the absence of lithics.*

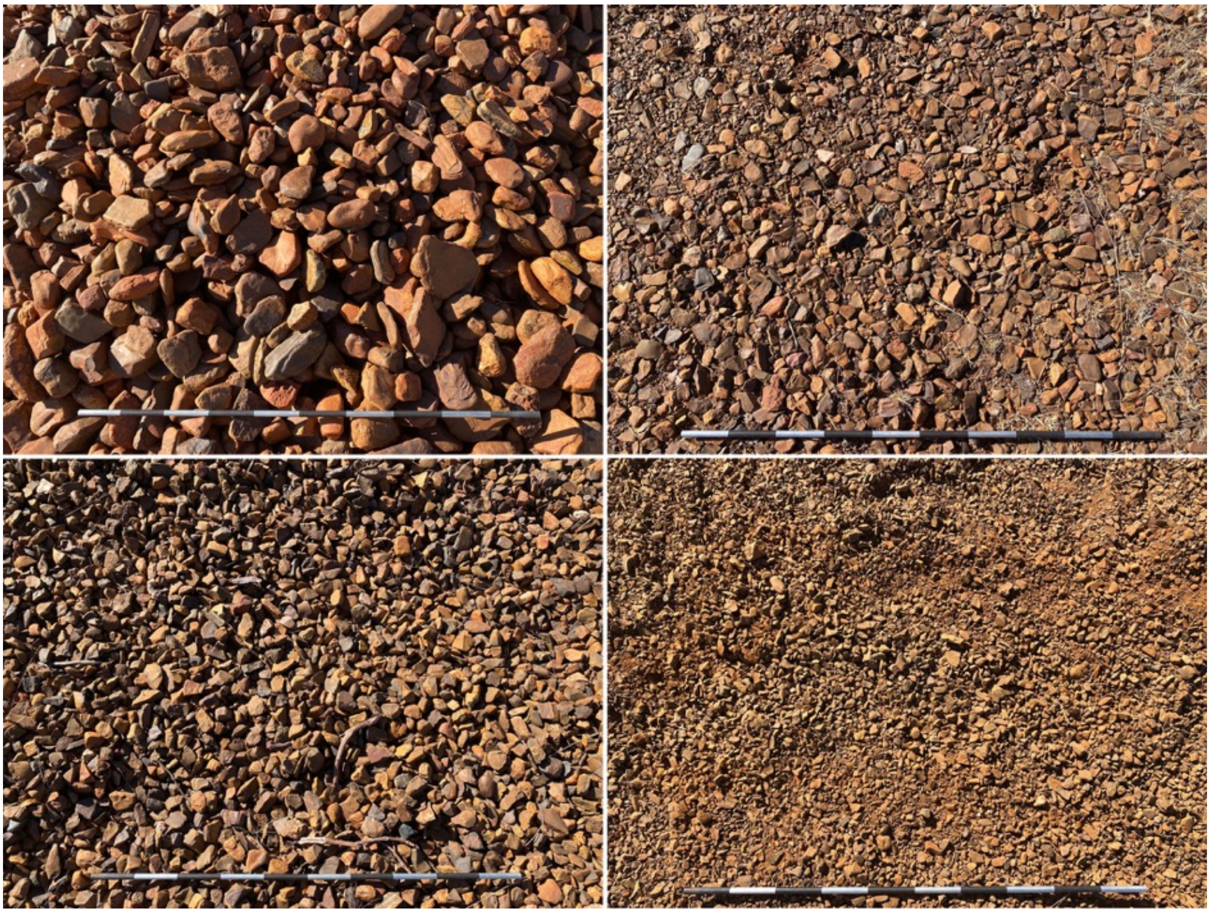

Figure 15. *Graded materials from mining across the site. Scale measure 100 mm intervals.*

Figure 16. *Example of the in situ soil profile. Note the absence of stone tools. Scale measure 100 mm intervals.*

6 Findings and the specialist assessment

The localities recorded during the HIA were assessed during the subsequent specialist assessment through an in-situ documentation of lithics and densities without collecting any archaeological material.

6.1 Contextual sampling

Following the pinpointing of localities DEM-01 and DEM-02, these two sites and the wider context were assessed by using a 1x1 m grid documentation to obtain a representative sample of the MSA lithics in the undisturbed area in the immediate proximity of the two previously identified localities (PGS 2021). This consisted of walking and then randomly placing a 1 x 1 m aluminium frame on the surface to record lithic density and typology. A total of 30 samples were taken, of these only ten squares (including DEM-01 and DEM-02) contained Stone Age lithics. The eight new localities with stone tools were assigned numbers DEM-03 to DEM-10.

Figure 17. *Example of 1 x 1 m grid at DEM-07. Note the MSA core.*

Figure 18. *Detailed map of 1x1 m recorded localities DEM-01 to DEM-10.*

Table 1	**DEM-01 to DEM-10**						
Square	**Coordinates**	**Tool type**	**CCS**	**Jasper**	**BIF**	**Quartzite**	**TOTAL**
DEM-01	S 27.83187; E 23.089621	Chunks, flakes, blades, scrapers, borers	5	3	10	1	19
DEM-02	S 27.83187; E 23.089621	Large scraper	1				1
DEM-03	S 27.830311; E 23.087369	Chunk, flake			2		2
DEM-04	S 27.830038; E 23.087369	Chunks	3				3
DEM-05	S 27.829715; E 23.088684	Core, blades	3				3
DEM-06	S 27.829988; E 23.089552	Broken flake	1				1
DEM-07	S 27.830647; E 23.089965	Core	1				1
DEM-08	S 27.831154; E 23.089868	Borer		1			1
DEM-09	S 27.831553; E 23.089811	Flakes	3				3
DEM-10	S 27.831733;	Large spokeshave			1		1

	E 23.089621						
TOTAL			17	4	13	1	35

The in-situ recording demonstrated that lithics occur at an average density of 3.5 elements per square meter across the study area. It was moreover clear that the nature of the lithics at DEM-01 is different and the density of stone material notably higher. The sample at DEM-01 is the only one taken in the area of high disturbance where the gravels were quarried and processed. If one discards the density recorded at DEM-01, then the average density of the undisturbed squares is significantly lower at 1.6 elements per square meter.

In lithic analysis a primary and important distinction is made between tools with little effort expended in their production (informal tools) and tools with more effort expended in their production (formal tools) (Andrefsky 1994, 2005). Formal tool types noted during the recording include cores, scrapers, borers and spokeshaves/notched scrapers. The presence of some cores suggest on-site tool production. Yellow and red jaspelite (common in the Banded Ironstone Formations (BIF)) or cryptocrystalline silicas (CCS) were evidently preferentially selected for toolmaking. Fine-grained CCS and BIF were the preferentially selected raw materials.

On the basis of the anomalies between the lithic assemblages from disturbed and undisturbed we decided to intensify the recording of lithic distribution, densities and typologies around DEM-01.

6.2 DEM-01 GPS Coordinates: S 27.831350; E 23.088319

DEM-01 is located within the area of high disturbance where material was mined for the purpose of manufacturing engineered filling and base materials. The process included screening, grading, crushing and reconstituting of material classes to produce a range of aggregates and base materials such as G4-7. Large spoil heaps of mined stone remain. DEM-01 is immediately adjacent to the spoil heaps. DEM-01 is clearly a surface depositional feature as no lithics are present in any of the existing soil profiles around the site. The site (PGS 2021: 55-58) occurs within a pavement of stone debris (Fig. 13). A one-metre grid square was used at DEM-01 where higher densities of stone artefacts had been observed during the Phase 1HIA (PGS 2021).

Based on our findings with the contextual sampling to gather more data from the immediate vicinity, the area around DEM-01 was further investigated. On the basis of a previous impacts to the locality and some more recent disturbance by vehicular traffic used in fencing off the proposed camp, a sampling area was selected in a relatively open but less disturbed context. A 20 m baseline was set out from DEM-01 located at S 27.831350; E 23.088319 in the south, to point DEM-01.20 located at S 27.831240; E 23.088380 in the north.

The area was sampled in 10 alternating one-metre squares starting with DEM-01.1 in the south to DEM-01.10 in the north. Samples were taken alternately east and west of the line. All lithic elements within each of the squares were recorded and classified.

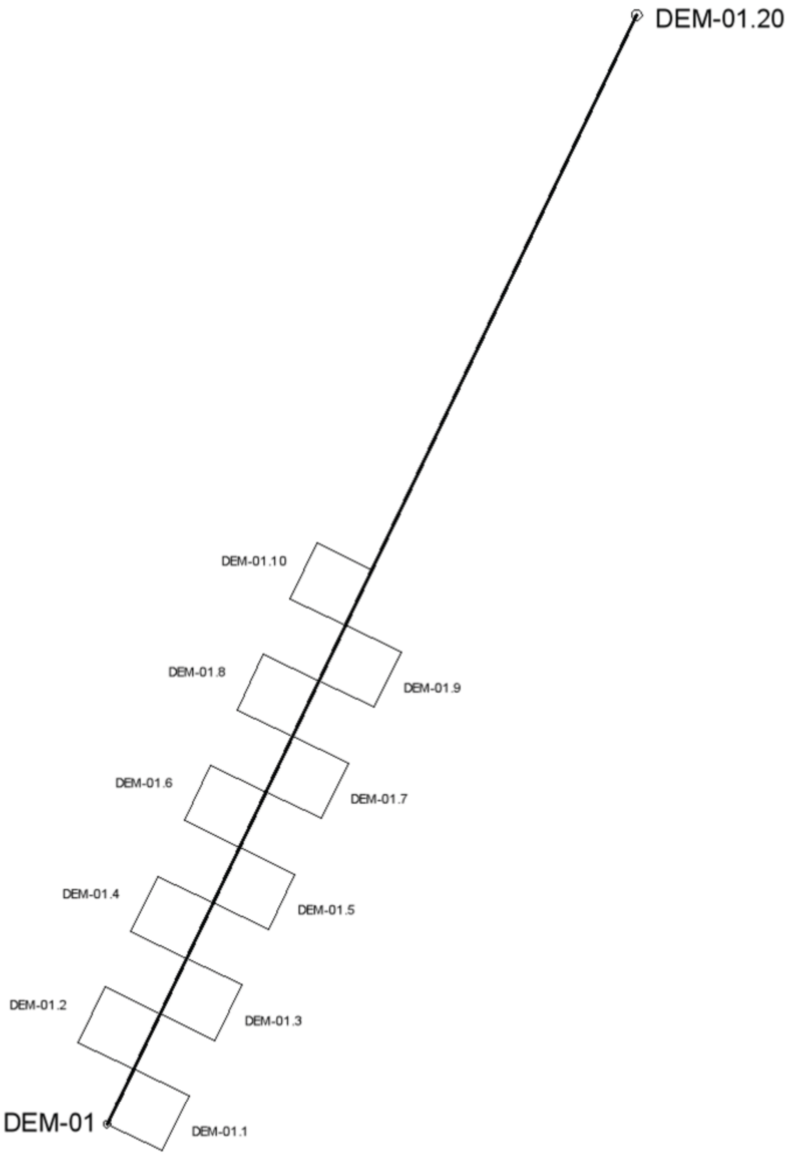

Figure 19. *Site plan of sampling at DEM-01.1-DEM-01.10.*

Figure 20. *Recording of 1x1 grids along the baseline from DEM-01.*

The distribution of archaeological material was found to be sparse. The post-depositional mining of river gravels had effectively destroyed the original higher-lying surface. The remaining artefacts occur among crushed material that produced indeterminate debitage but also what appears as pseudo artefacts with a lithic signature that is similar to an archaeological one.

TABLE 2 DEM-01.1 to DEM-01.10											
	DEM-01.1	**DEM-01.2**	**DEM-01.3**	**DEM-01.4**	**DEM-01.5**	**DEM-01.6**	**DEM-01.7**	**DEM-01.8**	**DEM-01.9**	**DEM-11.10**	**TOTAL**
DEBITAGE											
Chunks	2	4		5	5	2	2	1		5	**26**
CORES											
Irregular cores >30 mm					2	2				2	**6**
Bladelet core								1			**1**
FLAKES											
Cortical endstruck >30 mm					1		2				**3**
Endstruck >30 mm				1							**1**
Sidestruck >30 mm					1			3			**4**
Cortical endstruck <30 mm				1							**1**
Endstruck <30 mm	9	1		1				1	1		**13**
Sidestruck <30 mm		2	4			2	1	1	1	2	**13**
Cortical				2		1					**3**

BLADES											
Blade	4	1	1	2	2	1	1		5	1	**18**
Blade with utilization		1	1				1				**3**
SCRAPERS											
SMALL <20 mm											
Side	2				1						**3**
BORER <30 mm	2										**2**
TOTAL	**19**	**9**	**6**	**12**	**12**	**8**	**7**	**7**	**7**	**10**	**97**

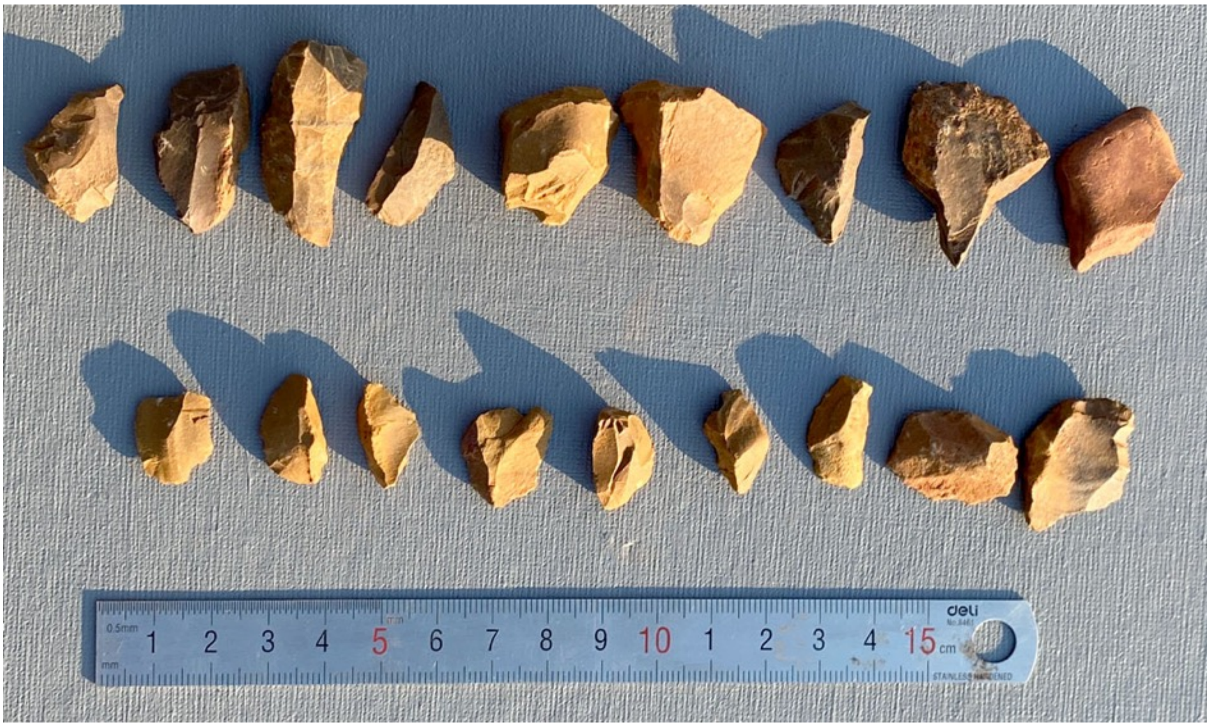

Figure 21. *DEM-01.1. Lithics similar to archaeological types. Note the evident size grading when compared to the following images. This clearly resulted from the 2011-2017 mining and screening of the gravels.*

Figure 22. *DEM-01.5. Lithics similar to archaeological types. Note the clear size grading that results from the 2011-2017 mining and screening of the gravels. Also compare the size of the lithic material between figures above and below.*

Figure 23. *DEM-01.8. Cores. Note the clear size grading that results from screening.*

During the recording and classification of the lithic typologies it became evident that the DEM-01 assemblage mostly lacks the distinctive attributes of MSA tool types. This prompted us to reconsider the formation of this relatively high-density surface deposition of lithic material. It was also apparent that the lithics are anomalous in that they all exhibit fresh breaks, with distinct sharp edges, a very low incidence of bulbs of percussion and there was also a notable absence of cores. In contrast to the toolstone material preference noted in the undisturbed higher-lying deposits that demonstrated an evident selection for jaspilites and BIFS, the material for the lithics at DEM-01 is unselective in terms of raw material and also quality (i.e. many lithics exhibit cross fractures derived from inherent flaws in the rocks). The lithics sampled from each square are size graded (similar in size) as a result of the mechanical screening process (Figs 21 to 23). Size class broadly correspond to standard aggregate and sub-base grades of 13, 22, 26, 37 and 53 mm respectively.

This suggested that the bulk of the lithics may reflect a pseudo non-cultural deposit. The main distinguishing attribute at the DEM-01 site is that the dorsal and ventral surfaces of the pseudo tools exhibit fresh scars without any patina, flakes exhibit sharp edges and there is a low incidence of bulbar scars. Various post-depositional taphonomic processes can account for geofacts or pseudo artefacts that are similar to those produced by humans. Borazzo (2016) cautions that both contextual and morphological approaches are important for our archaeological ability to distinguish between natural and cultural modifications. The assessment of the lithics at DEM-01 demonstrates that the context of the artefacts and the post-depositional taphonomic processes are important considerations in assigning some of the lithics as pseudo artefacts. Mechanical (impact and/or pressure) fragmentation of rocks produce the geofacts are difficult to distinguish from those with a cultural, human-made origin (Borazzo 2016).

During careful examination of the locality a number of clear examples of pseudo knapping as a result of repeated mechanical activities were noted (see illustration below).

Figure 24. *Example of mechanical fracture morphology attributes that mimic knapping from a block of stone.*

6.2.1 Significance:

From the assessment it is apparent that the bulk of the lithic elements associated with this site is associated with pseudo artefacts as a result of previous mining. The site is subsequently regarded as Generally Protected Grade 4D, with a Low to No Heritage value. The site can be destructed.

6.3 DEM-02 GPS Coordinates: S 27.831880; E 23.089631

In view of the findings from the contextual sampling and those at DEM-01, the higher-lying undisturbed part of the site was further walked to investigate and establish the nature of the stone tool distributions in an area with high archaeological integrity. DEM-02 was an area with no surface disturbance (PGS 2021: 59-62). Due to the low density of lithic scatters that we have recorded within this part, three additional grids of 20 x 20 meters were used to record the densities and typologies of the lithics in the immediate vicinity of DEM-02. While mere scatters with low densities were recorded, there was clearly more MSA tool types among the identified lithics.

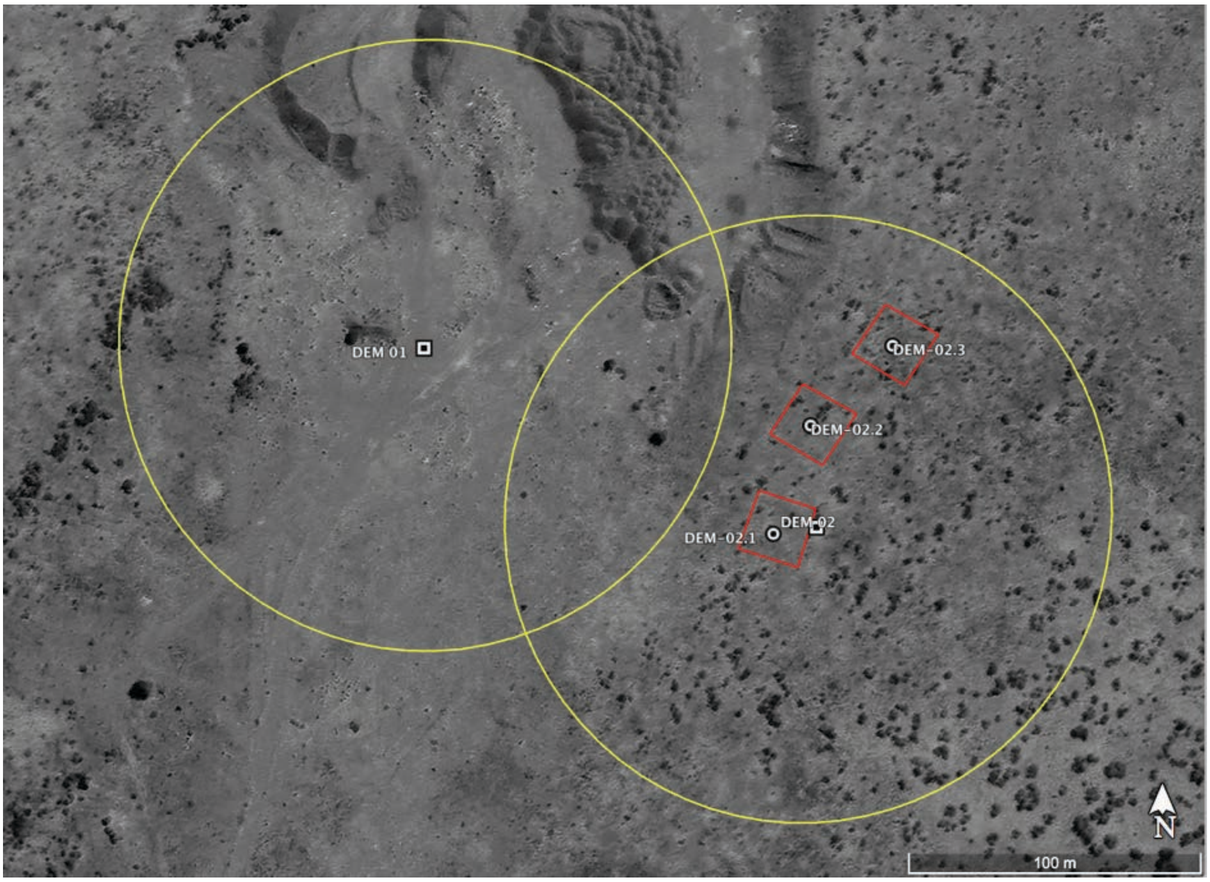

Figure 25. *Location of 20 x 20 grids.*

Most of the lithics at the various DEM-02 localities were informal. Typical MSA centripetal cores that were carefully prepared for the systematic removal of flaked blanks were recorded. The presence of blade cores and blades within this assemblage demonstrate laminar technologies prevalent during the various stages of the southern African MSA expressions. Formal tool types are various scraper forms. The several awl-scraper tools were produced on convergent flakes. In this part of the site BIF and fine-grained CCS were the preferentially selected raw materials. BIF nodules are abundant of which many are waterworn. Yellow and brown jaspelite were evidently selected for toolmaking. Numerous chunks of CCS nodules and BIF cobbles with less than three flake removals (to be classified as cores at least 3 flakes removals are required) were noted.

TABLE 3 DEM-02.1 – DEM-02.3 coordinates		
DEM-02.1	S 27.831777°	E 23.089436°
	S 27.831826°	E 23.089626°
	S 27.832000°	E 23.089567°
	S 27.831949°	E 23.089372°
DEM-02.2	S 27.831459°	E 23.089576°

	S 27.831548°	E 23.089754°
	S 27.831696°	E 23.089647°
	S 27.831609°	E 23.089474°
DEM-02.3	S 27.831227°	E 23.089847°
	S 27.831313°	E 23.090022°
	S 27.831463°	E 23.089915°
	S 27.831370°	E 23.089739°

TABLE 3 DEM-02.1 – DEM-02.3				
	DEM-02.1	**DEM-02.2**	**DEM-02.3**	**TOTAL**
DEBITAGE				
Chunks			5	**5**
CORES				
Irregular cores >30 mm	4	2	6	**12**
Radial core	1	0	3	**4**
Blade core	0	2	0	**2**
FLAKES				
Cortical endstruck >30 mm	20	0	0	**20**
Sidestruck >30 mm	15	0	0	**15**
Cortical endstruck <30 mm	1			**1**
BLADES				
Blade	1	0	4	**5**
Blade broken	2	0	0	**2**
SCRAPERS				
Large >30 mm				
side	0	1	2	**3**
Medium 20-30 mm				
Side	5	4	3	**12**
SMALL <20 mm				
Side	6	0	0	**6**
Spokeshave	0	3	1	**4**
Awl	8	1	0	**9**
TOTAL	**63**	**13**	**24**	**100**
Density per square meter	**0.15**	**0.03**	**0.06**	

Figure 26. *Selection of stone tools from DEM-02.1. Row 1 cores, 2 and 3 awls, 4 and 5 scraper, also three blades on the lower left.*

Figure 27. *DEM-02.2 selection: cores scrapers, spokeshaves and awl.*

Figure 28. *DEM-02.3 selection: cores, awls and scrapers.*

Since the data from the density mapping are statistically insignificant so that charts or graphs are not provided.

6.3.1 Significance:

From the assessment it is apparent that the lithic elements over the project area reflect an ephemeral MSA presence in the landscape. The low incidence of formal tool typologies and the low frequency or density of MSA material across the site means that the is regarded as Generally Protected Grade 4D, with a Low to No Heritage value. The site can be destructed.

7 Typology and classification of lithics

(Based on Deacon 1984a, 1984b; Lombard et al. 2012)

In the following section the typology and attributes of stone tool classes are discussed. A macroscopic techno-typological analysis was used to determine the attributes of the stone tools within each grid area. The typology of the DEM tool types was broadly based on Deacon 1984a, 1984b; Barham & Mitchell 2008; Lombard et al. 2012). Different classificatory systems are used in southern Africa to analyse lithics from the various chronological divisions of the Stone Age succession (Goodwin & Van Riet Lowe 1929; Clark 1969, 1988; Deacon 1984a, 1984b; Deacon & Deacon 1999; Thackeray 1992; Wadley 1993, 2005, 2015; Barham & Mitchell 2008; Lombard et al. 2012; Dusseldorp et al. 2013; Wadley n.d.). Each of the subdivisions is formed by a group of industries where the assemblages share attributes or common traditions (Deacon & Deacon 1999; Lombard et al. 2012).

Lithic technological analyses reflect human responses to environmental change since the characteristics of a representative lithic assemblage inform on the acquisition and transport of raw materials used for stone tools, and the reduction and discard behaviours that are subject to social and economic decisions (Wilkins et al. 2017). Iconic and characteristic lithic types and technological attributes are used to construct a typology for a particular assemblage. Typology is the science of classification whereby stones tools are arranged in orderly groups (Schick & Toth 1993: 96). Even lithic clusters with low densities can produce valuable data (Tainter 1979). Although areas that featured concentrations of artefacts were targeted for documentation, only low to medium stone tool densities were apparent at all the DEM localities that were mitigated through non-invasive documentation and analyses.

In the following section the various stone tool types recorded at DEM are discussed with reference to the production of particular tool types based on their morphology and likely function. Note that images of tool types photographed during the density surveys of the lithics at the DEM sites are provided in the section on the documentation (Section 6, Figs 21 to 23, 26 to 30).

7.1 Debitage

Two main products result when a suitable source of stone is struck with a stone hammer: the rock/stone from which fragments are struck, termed the core; and the fragments produced by the impact, namely the flakes or flaked blanks. The point of impact is the striking platform. Stones that have been flaked by humans exhibit a breakage pattern called conchoidal fracture. These are ripple marks on the inner surface that radiates in progressively larger arcs from the point of impact (Schick & Toth 1993). The side that shows the force of impact is the ventral surface. The first, or primary, flakes retain some cortex. The cortex of a core or flake is the weathered, outer surface of the rock. Depending on the type of core and also the technique that the tool maker uses, subsequent flakes retain cortex or partial cortex and/or dorsal scares on the dorsal surface.

Schick and Toth (1993: 118) define technique as the physical forces applied to the stones, whereas methods/strategies are generated in the mind of the tool maker. Both became more sophisticated over time, that is from the earliest tools produced by humans during the ESA, and the increased sophistication and complexity that mark the MSA. There is a radical and abrupt change in the archaeological record around 40 000 years ago (ya) at the onset of the LSA, with further refinement and an exponential range of tool types (Schick & Toth 1993).

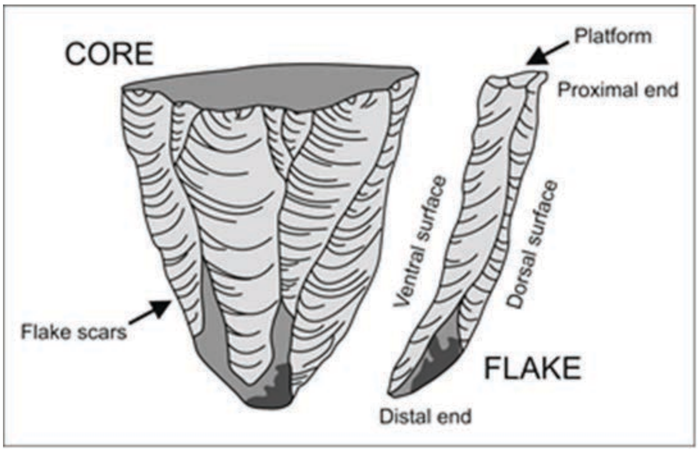

Figure 29. *Some basic terms used to describe the attributes of a core and flake (AGE2601/2018).*

Stone tool production is subtractive. Different stages of modification of raw materials yield debitage and flaked material. Shaping of the core produced discards in the form of small chips and unusable flakes. Debris from the production of flaked blanks, the reworking of primary blanks into tools and also the resharpening of tools during maintenance, generated waste and account for a large proportion of the lithics in any assemblage. Further shaping of flaked blanks to produce task-specific tools produced small flakes and chips of debitage that were usually discarded. The blank form can be retouched along one or more edges for the working part of a tool. The final tool forms shaped through formal retouch are classified as formal tool types.

The surface lithics at DEM-01 appeared to be in transformed contexts. There were also low levels of lithic elements such as chips, chunks and debris from stone tool manufacture since these are generally not well-presented at open-air localities. A surface assemblage is also not likely to retain the same quantities of discards since surface material is often reused by later populations. Fragments register behaviour as much as complete tools (Shott 2000). At the DEM-02 localities in particular some debitage from stone tool production suggests localised manufacture of at least some of the lithics.

7.2 Cores

Several cores were evident on the exposed surfaces of the DEM localities. Rock types selected for cores include yellow and brown jaspilite, and BIF. At least three negative flake removal scars are required to classify a block of material as a core (see Fig. 29). Pieces that exhibit only one or two negative flake scars are therefore classified as chunks and not cores. Prepared/centripetal/Levallois cores are diagnostic MSA core types. Through this technique a core is shaped by the systematic removal of flakes from a pebble or a chunk of rock in order to produce a final product of one flake/blade or multiple primary flakes. With the prepared technique cores were shaped through some preliminary flaking to produce pre-determined shaped blanks that were subsequently used to manufacture different tool types.

Figure 30. *Core from DEM-02.1.*

7.3 Flaked products

Flakes, bladelets and blades are the main products of any reduction process. Flaked blanks with a sharp cutting edge were frequently used without further modification of retouch. Variability in flake morphology results from raw material differences, functional requirements and use life (Andrefsky 2005). Blade manufacture with hard and with soft hammer percussion is mainly a characteristic of the MSA (Soriano et al. 2007). Long, narrow punch-struck blade flakes can occur in a range of sizes. Blades usually show signs of utilization and/or retouch but were also used as blanks to produce formal tools. Knives are blades that were shaped through retouch to produce a faceted cutting edge. MSA assemblages often contain relative high numbers of sidestruck flakes (and also sidestruck scrapers made on this flake category).

7.3.1 Blades

Flakes with parallel sides are termed flake blades. Several blade forms and broken blades, both cortical and non-cortical, form part of the DEM collections (Figs 26). Raw materials that featured in the manufacture of the lithics are mostly fine-grained yellow and brown jaspilite, and also BIF. Some of the blades exhibit utilization. The origins and significance of laminar technology are complex. Blade technology was invented in multiple places and times (Wilkins & Chazan 2012). Technological changes, including prepared core reduction strategies that delivered multiple flake and blade blanks from a core, are common elements in MSA assemblages (Wadley 2016). Blades were also used in the LSA, but to a lesser extent. These technological and behavioural shifts roughly correlate with the appearance of *Homo* species, and also increases in cranial capacity (Ruff et al. 1997; Rightmire 2001; Willoughby 2008; Wilkins & Chazan 2012).

7.4 Formal tools

Emblematic MSA tool types such as flakes with multifaceted striking platforms that result from prepared core types, convergent flakes, unifacial and bifacial points were not recorded at any of the DEM localities. A high frequency of formal tool types and production debris generally demonstrate production on site or that the tools have been used for subsistence-related tasks. The detached blanks are shaped through secondary retouch into specialized tool types required for particular tasks. Points and convergent flakes are typical MSA products of prepared Levallois, centripetal and radial cores. These core types delivered specific triangular or convergent flakes that served as blanks. The flaked blanks could be used without any further trimming, but also shaped into specialized tool types such as pressure-flaked unifacial or bifacial point. Whereas several radial or centripetal cores were recorded, no points or unretouched convergent flakes were found at any of the DEM localities.

7.4.1 Convergent morphologies

MSA convergent flakes are absent in the DEM assemblages. Convergent morphologies and point production are some of the most characteristic technologies of the southern African MSA. In a recent comparative study on point production in MIS 5 assemblages, Douze et al. (2020) argue that technological and use-wear patterns reflect regionally-specific features. Although varied, MSA points do conform to a morphological template of a convergent triangular shape where the lateral edges join in a distal tip (Mackay et al. 2010). This shape has various functional applications, with two long cutting edges and a sharp tip that can function in perforation. Convergent flakes were likely used for the scraper/awl combinations described in the following section.

7.4.2 Perforating tool types and scraper combinations

Several examples of tools with focus on the distal tip, also termed awls, were present at the DEM localities (Fig. 28). A pointed tip was frequently obtained through the removal of a burin spall on one edge and invasive retouch on the other. Perforators with a similar short projection from a MSA open-air assemblage in Botswana have been classified as a sub-class of awls (Robbins 1989). This tool type is task-specific and were presumably used for a variety of tasks. Common ethnographic applications for awls and borers include their use as piercers in the manufacture of skin clothing, leather hunting and gathering bags, reed matting and to make holes in ornamental objects of skin, wood, bone and shell.

7.4.3 Scrapers and scraper-awls

Scrapers are integral to Stone Age lithic assemblages worldwide and from virtually all prehistoric periods. Their function is, in the main, ascribed to hide working based on ethnography (Webley 1990; Deacon & Deacon 1999). In southern Africa endscrapers in particular are associated with scraping and processing skins (Stow 1910; Silberbauer 1981). These tool types usually have a convex edge formed by retouch and utilization. The retouch is generally at an angle of 30° to 90°. Often MSA scraper forms with a convex edge also exhibit a pointed, awl-like tip (Figs 27 and 28). During the lithic density documentation various scrapers were noted. CCS and BIF were used in their manufacture.

Several scraper made on CCS was found at DEM-02 (Figs 27 and 28). This tool type was likely used in the production of wooden hafts for composite tools, other wood- and bone working activities, and for the processing of skins, medicinal and plant foods. Bone and stone tools are used in the dehairing, fleshing and softening of hide working (Christidou & Legrand 2003; van der Ryst 2006). The Kua men of the Kalahari say that '[t]he work we most enjoy is the scraping of the skins' (Valiente-Noailles 1993: 59). Marshall (1976) observed that during hide-working the conversation of Ju/'hoansi men is all about the hunt, which is a topic they never tire of. There is much inter-site and intra-site variability in scraper morphology, and technological and functional variations are particularly evident in LSA assemblages (Guillemard & Porraz 2019).

8 Findings in relation to MSA sites within the region

In this section the data from the two surveys and the analyses of lithics from two areas are used to discuss the attributes of the lithics and to make some inferences and comparisons with several MSA sites within the region. The interpretation of any material record and the processes of deposition can be daunting (Shott 1998). To understand toolmaking and the ideas or intentions behind the final product, we have to consider variables such as the raw material that the toolmaker chose to work with, the complexity and extent of the deliberate shaping or retouch, and the morphology of the final product (Schick & Toth 1993, 2006).

The presence of a tool, or fragments, in an assemblage not only records use or collection for whatever reason but register behaviour (Shott 2000). Archaeologists do not reconstruct the past, which is gone. Instead, we infer its nature from the material record that we directly observe in the present (Shott 1998). In fact, the majority of archaeological materials comprise ephemeral scatters of stone tools and debris. It is often difficult to assign a value to ephemeral occupation sites or tools from eroded or deflated contexts recorded during an HIA or AIA such as the DEM localities. Primary sources of raw material generally occur as outcrops and have a fixed location in the Kathu landscape (Wilkins 2017). Nodules from river graves also provide a wide range of in particular CCS materials suitable for knapping. In the following section findings at several sites within the broader region are now taken in consideration to compare the range of MSA lithics, the densities and the preferred raw materials from the assemblages.

8.1 Wonderwerk Cave

One of the best-known sites in the region is the multicomponent Wonderwerk Cave in the eastern Kuruman Hills. The cave extends horizontally for 140 m and was formed by an ancient solution cavity in the dolomite formation (Beaumont 2004a). Excavations since the 1940s, which became more focussed as from 1976 to 1993, revealed a stratified series of deposits that accumulated up to a depth of about seven metres and are divided into nine Major Units (Beaumont & Vogel 2006). The lithic succession at Wonderwerk serves as a benchmark for the Stone Age sequence of the Northern Cape. It comprises an uppermost LSA sequence that contains Ceramic LSA, Wilton and Oakhurst (Humphreys & Thackeray 1983). Some of the cave deposit has been removed by guano diggers, which destroyed several important archaeological levels.

The MSA levels that were still intact yielded radially-prepared cores blades and unifacial MSA points. The Early MSA (EMSA) ca. 240 000–150 000 that lacks bifaces, is a flaked-based industry with minimum retouch (of which some flakes have a pointed distal end), the use of a centripetal prepared core technology and with few blades (Wilkins 2013; Chazan et al. 2020). Frequencies for the use of chert and ironstone are similar, with low numbers for quartz and dolomite. Chert, ironstone, and quartz are all available in the immediate vicinity of the cave. The ESA sequence contains the usual Large Cutting Tools (LCTs) and includes a transitional Fauresmith assemblage with blades and large scrapers (Beaumont 2004a; Chazan et al. 2008, Chazan & Horwitz 2009; Wilkins 2013; Chazan 2015, 2020; Horwitz, & Chazan 2015; Chazan et al. 2020).

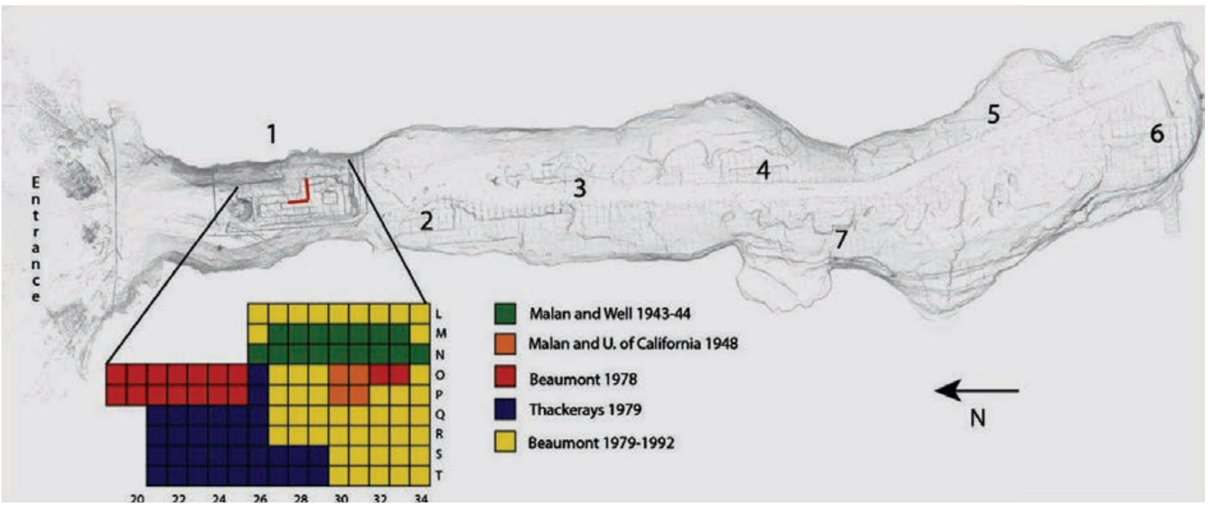

Figure 31. *Plan of Wonderwerk Cave with the seven excavation areas indicated. Detail shows the history of excavation (Horwitz & Chazan 2015: 598).*

8.2 Kathu Pan 1

The Kathu Complex is a protected national heritage site. Even though the sink holes have offered windows into the deposits around the Kathu Pan sites, and excavations and heritage assessments have offered clues to the deposits outside the sink holes, the overall extent of the Kathu Pan sites is still unknown (Walker et al. 2013; Walker et al. 2014). The thickness of the sand formation that can be up to several metres often masks underlying deposits. Kathu Pan (KP) is located about 4.5 km northwest of the town of Kathu. KP is situated between the Langeberg Hills ~30 km to the west, and the Kuruman Hills ~7 km to the east with the Gamagara River about 11 km west (Wilkins 2017). Kathu Pan is formed by a shallow depression with an internal drainage and a high water table. KP comprises a sequence of several ESA, and MSA sites with sparse LSA in the uppermost deposits. Raw materials within the immediate region around Kathu from primary sources (BIF), quartzite and CCS nodules of volcanic origin), and cobbles and nodules from nearby secondary sources (streams and river beds) provided raw material for the manufacture of lithics.

In early MSA and transitional assemblages, i.e. the interface between the ESA and MSA, there is an increased selection of fine-grained raw material compared to the ESA Acheulean assemblages. Raw material type frequencies at KP1 show that BIF was preferentially selected, followed by much lower use of CCS and with insignificant numbers of quartz (Wilkins 2017). As to tool types, large flaked blanks with an incipient blade production and infrequent retouch are present in the earlier KP1 Stratum 4a assemblage that is underlain by an ESA assemblage. Stratum 3 yielded tool types consistent with the MSA such as prepared cores, convergent flakes, points and a prominent blade component (Beaumont 1990, 2004b; Beaumont & Morris 1990; Walker et al. 2014; Beaumont & Vogel 2006; Porat et al. 2010; Wilkins & Chazan 2011; Chazan et al. 2012; Beaumont & Bednarik; Wilkins 2017).

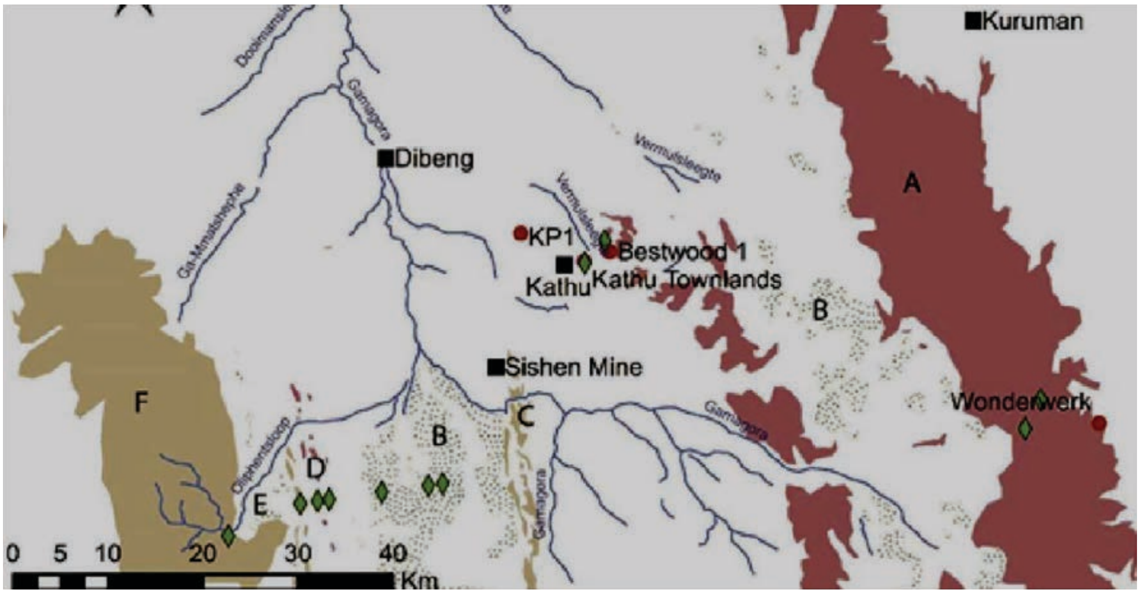

Figure 32. *KP1in relation to the primary sources of raw material in the region (from Wilkins 2017: 171). Banded ironstone; quartzite and CCS as stipples.*

8.3 Nooitgedacht 469 (Woon 469)

A Phase 2 mitigation undertaken at a demarcated surface area of locality SA02 on the farm Nooitgedacht 469 confirmed the presence of a transient LSA of low to medium significance, very low incidences of MSA tool types and ephemeral utilization during the ESA at locality SA02 (S27°43'13.7" E22°57'12.7). The survey indicated mostly low densities of lithic scatters. Of a total of 157 sampled squares the majority (55% n = 86) contained no lithics; 33% (n = 52) exhibited low densities of <10 lithics; 10% (n = 16) had medium densities of 10-20 lithics; and only 2% (n = 3) had more than 20 lithic elements (African Heritage Consultants 2013).

Figure 33. *Sampling at SA02 sing a 1-metre grid, and typical lithic distribution(African Heritage Consultants 2013: 16).*

8.4 Kolomela Postmasburg

The Kolomela assemblages are mostly concentrated around pan localities. Generally low densities of surface scatters of stone tools were recognised within the thin layer of calcrete capping. Pans on the periphery of the drainage lines contain higher densities of stone tools and knapping debris. The occurrence of ESA, MSA and LSA lithics within the pan areas attest to the presence of earlier as well as more recent earlier populations, spanning a period of utilisation over many hundred thousands of years. All pan localities exhibit evidence of the knapping of stone tools. This suggests groups camping nearby for a couple of days while exploiting the local resources. The lithics reflect relatively short visits over time by small groups of people.

Hunter-gatherers view land as an integral part of their identity. Each group has a defined territory with a collection of natural resources on which they depends for survival (Marshall 1976; Barnard 1992, 2004). Ownership implies access to the resources of this area, an inalienable right which is acquired by inheritance and utilization. The subsistence strategy inherent in the planning of hunting and gathering trips is to limit the duration and the distances to be covered. Primary territories would have included a permanent or semi–permanent waterhole (Smith 1999), such as the pans, springs and annual watercourses at Kolomela, along with other resources, in particularly plant foods.

An ephemeral ESA is represented by LCT's with the main component consisting of MSA and LSA cores, flakes, blades, bladelets, formal tool types and waste from stone tool knapping and other lithic reduction processes.

The Kolomela collection is not large enough for the MSA tools to be assigned to particularly phases within the MSA. The range of tool types, the diversity of raw materials used as well as the presence of formal tools types reflect various instances of site utilization over a very long period of time. As the lithics were surface finds it is probably that sub-surface assemblages may be present. A range of local-available raw materials was utilized in the production of the lithics. The collection is dominated by local cryptocrystalline silica rock types being fine-grained and eminently suitable for knapping. Jaspers, (yellow and also the brown form) and BIF are particularly abundant and used for the bulk of the lithics followed by CCS, quartz, and low percentages of other materials such as hornfels (Morris 2007; Van der Ryst & Küsel 2011, 2013). Local rock types were generally used at most Stone Age localities with low numbers of tools occasionally made on rocks imported to the region or manufactured at other localities and then carried to a camp site (Beaumont 2004a, 2004b).

Figure 34. *View of a pan sampled at Leeuwfontein for the Kolomela project (African Heritage Consultants 2011: 14).*

8.5 Heuningkrans Postmasburg

A heritage survey on the farms Heuningkrans 364 and Langverwacht 432 in the Postmasburg District. The most significant heritage resources with a rating of high sensitivity relate to the Stone Age. The LSA shelters in the Heuningkrans Valley in particular are of high significance. Also important are the mostly MSA lithic production localities with a predominant focus on the extensive outcrops of BIF that underlie large tracts of in particular Heuningkrans. There is an ephemeral ESA presence as evidenced by the low numbers of stone tool types of this period. These findings are deemed important in view of a lack of research data on the utilization of the vast number of open localities that document the utilization of local lithic resources within this landscape.

BIF was the preferential material used, followed by a range of CCS and in particular red and yellow jasper. There is such a proliferation of in particular BIF as a major source for stone tool production that it was clear from our observations that the prehistoric stone knappers were highly selective in their choice of fine-grained blocks of BIF to manufacture the lithics. Of course they were also opportunistic in randomly selecting suitable stone for immediate requirements such as at a killing site. The expedient production of lithics as and when required is a feature of prehistoric stone tool use. Stone tool densities accordingly vary from low (<5/square meter) to medium (>5-15/square meter). However, systematic sampling is required to determine actual densities within different areas (African Heritage Consultants 2011, 2018).

Figure 35. *ESA and MSA lithics at Heuningkrans (African Heritage Consultants 2013: 14).*

8.6 Mokala Hotazel

The Mokala Manganese project on the farm Gloria 266 required the realignment of the R380 road on the farm Kipling 271 (Morris 2007; Fourie, PGS Heritage 2013, 2015, 2020a, 2020b; van der Ryst 2020). Excavations and surface collections were undertaken in seven areas. All stages of lithic reduction are represented in the HMK1 and HMK1a collections. The presence of different core types, core trimming elements, cortical pieces, blanks, and retouched pieces such as various scraper forms, adzes, piercing tools and the debris generated by stone tool manufacture, reflect in situ knapping and utilization of the particular resources in this landscape in the past.

In general, both the HMK1 and HMK1a collections predominantly exhibit a MSA signature in the form of MSA core types, a prominent blade component, and convergent flakes. The HMK1 and HMK1a collections yielded several convergent flakes (with and without utilization/retouch), and also a few bifacial and unifacial points with invasive flaking on one or both faces. Convergent morphologies and point production are some of the most characteristic technologies of the southern African MSA. The high relative frequency of awl-like tools with a sharp-pointed distal tip is a distinctive element of the HMK1 and HMK1a collections. Radial or centripetal, and blade cores, several blade forms and broken blades, both cortical and non-cortical, form part of the HMK1 collections. A few of the lithics were weathered, to the extent that the utilization/retouch scars were smoothened, presenting as denticulated edges. These lithics suggest different periods of deposition or the reuse of earlier surface tools. A few lithics also show limestone encrustation. BIF was generally the preferred raw material for the excavated lithics, followed by lower numbers of quartzite and CCS, and much lower numbers of other stone materials.

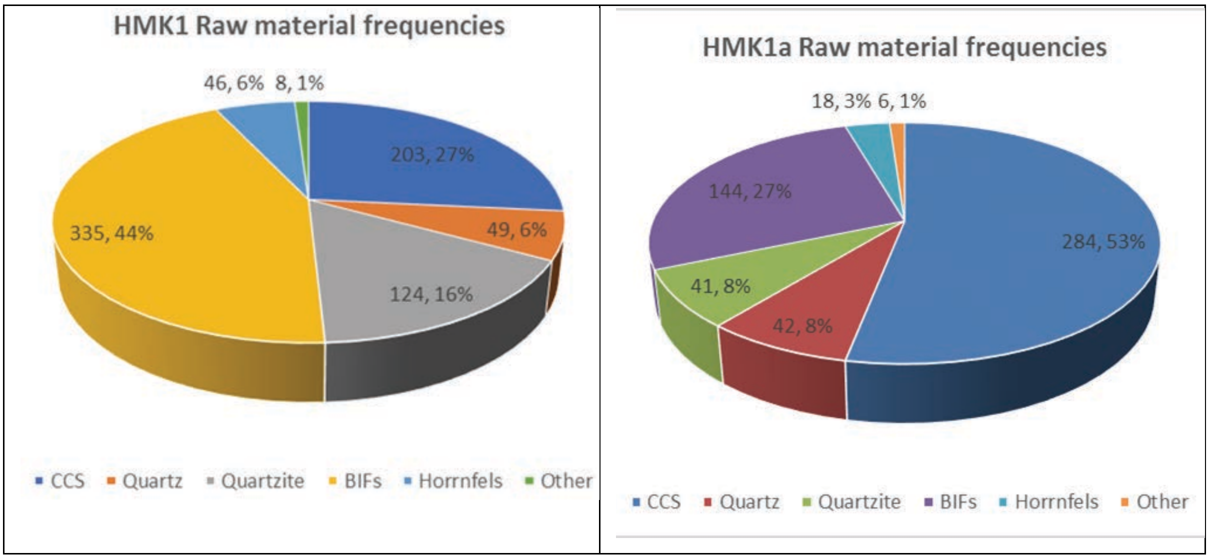

Figure 36. *Examples of raw material frequencies at Mokala (van der Ryst 2020: 28,33).*

8.7 The DEM lithic assemblage in relation to other MSA open-air localities

The typological classification uses terminology commonly applied to southern African MSA lithic analyses (Porraz et al. 2013). Tool industries are defined by the presence or absence of specific and iconic or emblematic tool types or classes, also known as the type specimen (Schick & Toth 1993). The most significant tool types observed during the survey and the in situ documentation of the lithics are blades with retouch and/or utilization, scrapers and also several awl types. The southern African MSA, which lasted almost half a million years from >250 000 to around 40/20 000 years ago (see Annexure A), is associated with early modern humans with complex cognition, novel behaviours and transformative technologies.

Surface stone artefacts from open-air localities such as the DEM sites are likely to be short-term remains of the activities of hunters and gatherers. Such localities can, however, offer some insights into the behaviour of hunters and gatherers, patterns of settlement, resource procurement, and land use (Tainter 1979; Zvelebil et al. 1992; Dietl et al. 2005; Hardaker 2011; Hallinan 2013). Landscapes are the geographical context in which prehistoric socio-economic systems functioned and were transformed by socioecological processes (Barton et al. 2004). Some archaeologists argue that the concept of a site should be replaced by one of an archaeological landscape. In the archaeology of hunter-gatherers we are dealing with only a small fraction of the complex patterns of mobility and landscape use. The impact of geogenic, biogenic and anthropogenic factors on site formation processes, as well as vertical and horizontal movements in the deposit, are essential to establish spatial integrity and sequential occupations (Henry et al. 2004; Barton & Riel-Salvatore 2014). The overlay of intermittent visits by nomadic groups from various archaeological periods over the long span of the South African Stone Age succession is, moreover, to be expected at an open-air locality such as at DEM. Open-air scatters or occupation levels often present as a deflated horizon where the soils have been leached resulting in a collection of lithics from separate visits or even Stone Age periods.

The assessment of site integrity at open-air sites is consequently complex. Open sites do not preserve all aspects of the innovations from this period. The DEM lithics were recorded on current surfaces underlain by river gravels or calcrete (Fig. 14). DEM-01 is located in and close to disturbed contexts. Whereas some of lithics may still lie on the original surfaces, others are clearly diffused or disturbed. Many post-depositional site processes can account for the accumulation of the lithics. It is most likely that the surface areas on which the lithics occur are remnants of formerly larger concentrations, sections of which were eroded away and exposed through soil loss. Hillslopes steeper than 4.5° are particularly vulnerable (Mararakanye & Sumner 2017).

MSA lithics were more common at DEM-02 on the undisturbed low ridge above the mining dump. The ridge could have featured as a vantage point from where game could be observed. The documentation of assemblages from different sections of the study area allows an investigation of density patterning and the techno-typological attributes of the documented lithics. The low densities of artefacts and knapping debris per square meter at the DEM localities suggest that the area was likely intermittently visited by MSA communities roaming the landscape to extract subsistence materials for food, with expedient knapping of suitable stone material to produce useable flakes and also some formal tool types required for specific activities. The removal of river gravels for processing into road-building material likely removed part of former surface sites.

The toolkits of mobile groups with low carrying capacity are generally multifunctional. Lithic studies support such multifunctional applications (Lombard et al. 2004; Andrefsky 2005). The functional attributes of a tool, such as several working edges, define use (and typology), and not always the overall morphology (Shott 1986; Andrefsky 2005; Macdonald & Wilkins 2010). Yet the functions of the various classes of artefacts within each period are often inferred by their morphology. Lithic tool names typically imply use for a specific task, for example a scraper or an awl/perforator. A term such as scraper refers to the morphological shape as well as to the function of the artefact. Such functional interpretations are indeed often correct, but the form of an artefact does not necessarily match its inferred function. Different shapes and sizes of tools, for instance scrapers, often result from use and the resharpening of implements rather than different mental templates. The most significant tool types observed during the survey and the in situ documentation of the lithics are, blades with retouch and/or utilization and also several awl types. Convergent morphologies and point production are some of the most characteristic technologies of the southern African MSA. A restricted range of formal tools that were intentionally shaped through retouch were also present. Several core types, unretouched primary flakes that retain cortex and secondary flaked blanks suggest activities such as the procuring and processing of foods, other subsistence-related activities and the manufacture of tools. The raw materials selected for the DEM lithic assemblages include fine-grained siliceous rocks (CCS), with a preferential selection of yellow and red jaspelite, and also BIF. All of these could be potentially procured from the immediate surroundings.

The comparatively low numbers of lithics from different classes of tool types that could be recorded at the DEM sites are, however, statistically insignificant. The MSA at the DEM localities is also deemed undiagnostic since the documented assemblages are too small to assign to a particular MSA lithic industry. Wadley (2016) suggests that more open sites in northern South Africa should be investigated to see how their assemblages compare with cave and rock shelter sites. Important MSA excavated sites from the general region were briefly reviewed in Section 8 of this report to provide a background and context for the lithics at the four DEM localities that were selected for mitigation. The MSA in southern Africa comprises various industries and regional expression. The oldest MSA sites seem to occur inland (Wadley 2015; de la Peña et al. 2019).

While the MSA lithics are associated with the Pleistocene, not enough lithics were recorded at the DEM localities during the two surveys to make an informed decision of a more precise age for the local MSA. A representative suite of lithics that contain iconic tool classes, and a satisfactory high level of site integrity are required to relatively date an assemblage. The dating of open-air sites is problematic because such localities represent a palimpsest of activities and visits over time, and diagnostic formal tool types that act as classic cultural markers may be absent or rare (Porraz et al. 2008; Porraz et al. 2015; Porraz et al. 2018).

The discussion above where a selection of MSA sites from the general region featured demonstrates that densities of stone tools at open-air sites are generally low to medium. Differences in the use of preferential toolstone likely reflects local availability of sources of fine-grained material. We have already discussed the increased selection for fine-grained raw material during the MSA throughout the region (see e.g. Kathu). Despite applying a multitude of recording strategies, the range of formal tool typologies is limited at this locality precluding a direct comparison with other known MSA localities. This may also reflect an ephemeral lithic presence as part of a broader landscape pattern of utilization despite the close proximity to the Gamagara River. No ESA lithics were recorded at DEM while ESA assemblages or tools were present at most of the above localities.

8.8 Pseudo artefacts

The lithic assemblage from the untransformed part of the site represents a low intensity MSA landscape utilization. In contrast, the lithics at the disturbed DEM-01 are geofacts or pseudo artefacts that are difficult to distinguish from a context that is undoubtedly cultural (Garvey & Mena 2016). It is only on the basis of a specialist assessment that an informed decision can be made on whether the assemblage is likely to have been created by human action (artefacts) or other causes (geofacts)

(Lubinski et al. 2014; Wišniewski et al. 2014). This introduces a taphonomic perspective in lithic assemblage analyses (Borazzo 2016).

Post-depositional taphonomic edge damage is a recognized feature at lithic assemblages resulting from mining and heavy earthmoving vehicles. Numerous instances of incidental damage to stone are known, including trampling by humans and/or animal traffic on an archaeological deposit. Heavy vehicular traffic at large-scale developments such as mining, solar parks and wind farms often move over sensitive artefact-bearing areas. The removal of surface vegetation and ground levelling with earthmoving machines can create pseudo lithics. Such flakes or flat pieces of stone present edge damage that can be easily mistaken for retouch or use-wear. Criteria such as toolstone attributes (raw material, angularity, size, patination) and diagnostic fracture morphology attributes (presence/absence and frequencies of identifiable dorsal and ventral surfaces, multiple dorsal flake scars, flake scar orientation, bulb of percussion) feature in geofact versus artefact distinction (Lubinski et al. 2014).

The following case studies from the local context illustrate the inherent difficulties in identifying pseudo artefacts.

Van der Walt & Bradfield (2018) documented the long-term effects of heavy-duty earth moving machinery on the formation of lithic debitage at open-air Stone Age sites. The authors use the sensitive Stone Age landscape of Kathu as a case study. At localities such as the Kathu Solar Park facility it is unavoidable that damage through contact with metal edges will result in incidental damage. They demonstrated that some of the lithic attributes and morphologies were superficially indistinguishable from knapping waste were produced during the experiment.

The authors emphasize that '[d]ifferentiating between causes of edge damage is one thing, but relatively little attention has been paid to understanding the extent to which industrial earth-moving machines may replicate an entire knapping debitáge assemblage, complete with formally-recognized debitáge categories' (van der Walt & Bradfield 2018: 5). (See van der Walt & Bradfield 2018: 6–9 for detail of the three experiments). They conclude that a well-trained archaeologist will be able to distinguish between machine-damaged cobbles and cores or ESA choppers tools. Incidental crushing (in particular step-crushing) and flake removals mirror some of the archaeological attributes. The degree and location of wear traces may be offer criteria to distinguish between geofacts from artefacts. (See Table 1 *Damage produced on the banded ironstone cobbles by the action of the* *hydraulic iron arm of a JCB excavator*; and Table 2 for *Technological and metric information provided by detached flakes*).

In the 1940s the Abbe Breuil had to confront the problem of pseudo artefacts in the glacial conglomerates at Nooitgedacht, Kimberley. In 1943 he had already identified quartzite pebbles trimmed by glacial action in ancient river terraces of the Vaal River close to Vereeniging. On a subsequent visit to Nooitgedacht, he picked up bruised and striated pebbles, of which he claimed that if the striations were not on the actual fractures, might pass as elementary stone flakes in the glacial deposits (Breuil 1945). The lithics illustrated conform in some instances to standard archaeological morphological features, including negative facets like flaking, re-trimming, striking platform, percussion bulb on the base, and deep notches on a concave cutting edge. All of these were produced by mechanical action including glacial. The pseudo-trimming was produced on Ventersdorp Diabase. In conclusion Breuil (1945: 398)noted that '[s]ince writing the above, Professor van Riet Lowe and I have recognised numerous pseudo-implements derived from Dwyka Conglomerates exposed near Bloemhof and Winsorton as well as on the Prime Minister's farm at Irene where scattered pebbles of quartz are all that now remain of the conglomerates that once extended over that area'.

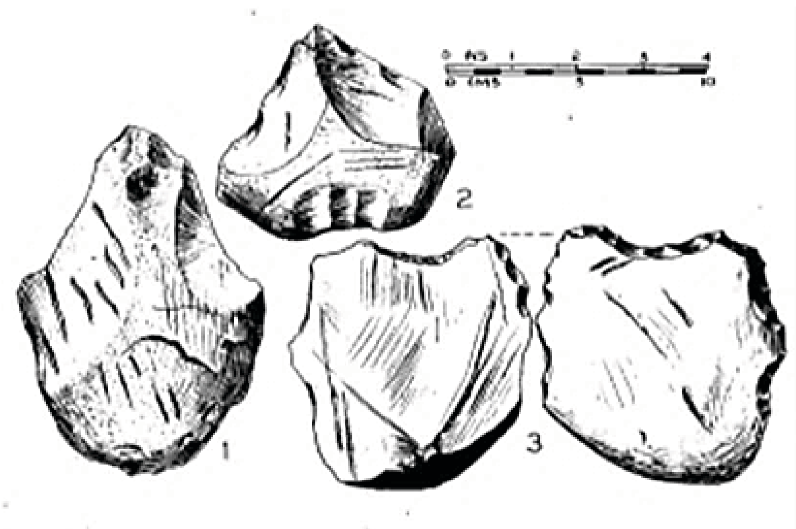

Figure 37. *1 Pseudo handaxe, 2 triangular flat pebble; 3 a flake struck of a pebble from Nooitgedacht (Breuil 1945: 399).*

Borazzo (2016) maintains that both contextual and morphological approaches are important to distinguish mimics from artefacts. The on-site assessment of the lithics at DEM-01 demonstrates that the context of the artefacts and the post-depositional taphonomic processes are important considerations in assigning some of the lithics as pseudo artefacts. Both contextual and morphological approaches are important for our archaeological ability to distinguish between natural and cultural modifications Borazzo (2016). Human retouch is defined as 'intentional modification of a stone tool edge by either pressure or percussing flaking technique. Modification by use is considered usewear as opposed to retouch' (Andrefsky 2005: 260).

The bulk of the lithic objects at the DEM-01 locality does not reflect such a cultural origin. The great many flakes and apparent tool types were produced by mechanical processes that involved mining, crushing and screening of river gravels. The heavy machines used in the various processes caused fragmentation on the stones. These morphological taphonomic effects produced pseudo artefacts. Mechanical (impact and/or pressure) fragmentation of rocks that produce geofacts are the most difficult to distinguish from those with a cultural, human-made origin (Borazzo 2016). It is therefore conceivable that non-cultural lithics and debitage can be inadvertently interpreted as tools.

The main distinguishing attribute for pseudo tools at the DEM-01 site is that the dorsal and ventral surfaces of the pseudo tools exhibit fresh flake scars without any patination and sharp edges or irregular notching/crushing. Bulbar scars, when present, are very small. There is also an absence of emblematic MSA tool types such as convergent flakes, unifacial and bifacial points at the DEM-01 locality. No flakes with the typical MSA core preparation attribute that presents as flakes with multifaceted striking platforms were recovered. It was also apparent during the documentation of the lithics at DEM-01 that there is evidently a pattern of different size grades of stone material (see Figs 21 to 23). Size grading of the crushed stone is also demonstrated in the gravel extraction and crushing areas (Fig. 15). There are, moreover, no stone tools apparent in the profiles of in situ river gravels (Fig. 16). Figure 13 shows a screen fragment among graded material directly adjacent to DEM-01. These factors further support the assignment of pseudo artefacts to lithics from the greater part of the disturbed area DEM-01.

It is well-documented that Stone Age lithics are associated with river gravels. The deposition of lithic artefacts in such contexts is complex with intermixing and reworking of artefacts and pebbles through flooding and other post-depositional modifications. The artefacts are generally in varied conditions through fluvial damage and other mechanisms that smoothed and rounded edges and ridges (Kuman et al 2020; Lotter 2020). While lithics at Canteen Kopje were often so modified through abrasion that they were barely recognisable as artefacts, others appeared fresh (McNabb & Beaumont 2011; Lotter 2020). Since the lithics were made on a range of raw materials with different hardness, the artefacts weather and erode at different rates (Gibbon et al. 2009; Lotter 2020).

In the investigation of the dumps at the DEM locality no artefacts could be found among the pebbles. The absence of Stone Age tools in the dumps further supports the interpretation that the bulk of the lithics at DEM-01 are geofacts. The Google view in Figure 9 shows the extent of the removal of the river gravels during the mining activities. The current surface around the dumps, and where site DEM-1 is located, was created by the extensive removal of the gravels. DEM-01 is accordingly situated on an artificial surface.

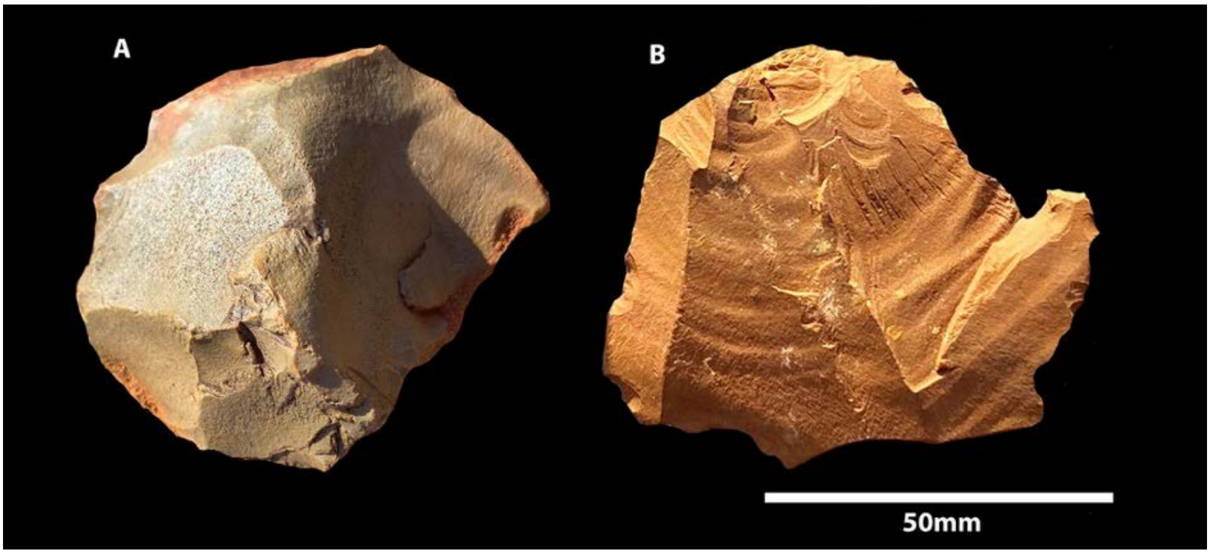

Figure 38. *Example of a MSA core (A) and a pseudo core (B) from the DEM sites. Note the difference in patination and the edge contrast between the two specimens. Also note the edge damage on B that mimics utilization.* ***Note that it is very difficult to identify pseudo artefacts in field without intense sampling and classification of lithic typologies.***

9 Dating the MSA

A secure chronology is essential for understanding the past. Dates proposed for the transitional period between the ESA and MSA are based on a series of dates obtained through various dating methods, palaeoclimatic inferences as well as lithic technologies and diagnostic tool types as artefactual markers of a particular period (Porat et al. 2010; Herries 2011; Walker et al. 2014). There is general consensus that MSA of southern Africa began around 300 000 ago in some regions. While the MSA is characterized by the absence of LCTs such as handaxes, an emphasis on prepared centripetal cores that delivered specific convergent/pointed flakes and a range of flake blades and the presence of convergent tool types such as points, its earliest expressions are still unclear (Soriano et al. 2007).

The MSA is best known for innovations and novel behaviour that appear in the archaeological record at various times after about 200 000 years (Wadley 2015). From around 200 000 there is clear evidence for anatomically modern *Homo sapiens* (McBrearty & Brooks 2000; Deacon & Wurz 2001; Willoughby 2008). The use of compound adhesives and pigments, projectile hunting, the hafting of lithics to handles and the retouch of lithic points are some of the technological innovations that are particular to the MSA. The MSA in southern Africa is therefore an important phase being marked by anatomically modern human development, complex cognition and the development of sophisticated technologies, and regional and cultural identities (Lombard et al. 2004; Porraz et al. 2013; Wadley 2013a; Chazan 2020). Cognitive complexity implies a capacity for abstract thought, innovative technologies, goal-directed actions, flexibility in problem-solving as well as planning over long distances or time (Wadley 2013a, 2015, 2016).

Radiocarbon dating is particularly used to estimate the age of materials that originated from living organisms. An age is estimated by measuring the amount of carbon-14 present in the sample and comparing this against an internationally used reference standard. Radiocarbon dating, while eminently suitable to date the LSA, cannot be used to date archaeological assemblages beyond 45 000 years ago (Mitchell 2008). Dendrochronology is the technique of dating events, environmental change, and archaeological timber by using the characteristic patterns of annual growth rings in timber and tree trunks (Dunuweera & Rajapakse 2018). Optically Stimulated Luminescence (OSL), Thermoluminescence (TL) and Electron-spin Resonance (ESR) are used for dating MSA archaeological materials and deposits in southern Africa (Feathers et al. 2020).

Biostratigraphy or faunal correlation is often used to date southern African sites and gives some indication of the approximate age of some of the associated assemblages. Archaeological and palaeoenvironmental data from Kathu Pan and Kathu Townlands were used to reconstruct changes over time in the prehistoric environment (Beaumont 2004b). Associated faunal remains with some of the Acheulean assemblages include *Elephas recki recki*. These animals disappeared at sites in East Africa such as at Olorgesailie, Kenya, at around 600 000/800 000 years ago (Beaumont 2004b: 51; McNabb et al. 2004).

The Marine Isotope timescale[2] is also now widely used in archaeology for the reconstruction of climate and to express relative dates of archaeological occurrences during the Quaternary period (Barham &

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[2] Marine Isotope Stages (MIS) are the chronological listing of alternating cold and warm periods of the global oxygen isotope record that reflects palaeoclimatic changes. The Holocene is the present geological epoch. The Holocene began approximately 10 000 years ago following on the Pleistocene, which is the first geological epoch of the Quaternary period. The current Holocene is therefore the second epoch of the Quaternary period. It is a warm period, known as Marine Isotope Stage 1 (MIS 1).

Mitchell 2008). Marine Isotope Stages (MIS) are the chronological listing of alternating cold and warm periods of the global oxygen isotope record that reflects palaeoclimatic changes. The marine isotope variations are numbered from the top down with warm interglacial stages having odd numbers and cold glacial stages even numbers. The Holocene is MIS 1. The global MIS record provides a framework to structure chronology. While some MSA sites date to MIS 6 (191-130 ka), most of the southern African MSA sites date from MIS 5 (130–71 ka) and up to MIS 3 (57–29 000 ka) (Stewart & Jones 2016).

10 Assessment methodology

10.1 Site significance

The two localities (**DEM-01 and DEM-02)** were investigated by a Stone Age specialist in August 2021. DEM-01 is located in a transformed area where river gravels were extracted and screened for road-building from around 2007 to 2011. The surface scatters in the unimpacted area was recorded as site **DEM-02**. Several GPS points were taken at different locations/findspots where surface scatters of MSA tool types were apparent.

Site significance classification standards prescribed by the South African Heritage Resources Agency (SAHRA) (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report for all sites identified (see Error! Reference source not found.). In terms of the Field Ratings, they assist the responsible heritage resources authority (Provincial or National) in the grading of identified heritage resources into national (Grade I), provincial (Grade II) or local (Grade III) categories. Field ratings are required under Chapter II Section 7(J) of the SAHRA Minimum Standards (2007).

The significance rating of a specific resource is based on information obtained through a review of available sources as well as its representativity or uniqueness within the specific cultural and natural landscape. This significance rating of an identified resource was also evaluated in terms of its contribution to aesthetic, historical, scientific and social values. In addition, the type of impact, the duration and extent of the impact, and the levels of change to the resource before mitigation was also taken into consideration.

The significance of heritage sites, for all sites identified by PGS in the HIA, was based on five main criteria:

- site integrity (i.e. primary vs. secondary context),
- amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
  - Low - <10/50m2
  - Medium - 10-50/50m2
  - High - >50/50m2
- uniqueness and
- potential to answer present research questions.

Table 4 Site significance			
FIELD RATING	**GRADE**	**SIGNIFICANCE**	**RECOMMENDED MITIGATION**
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High/Medium	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium	Recording before destruction
Generally Protected C (GP.C)	Grade 4D	Low	Destruction

10.2 Methodology for Impact Assessment

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance. The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;

- Probability; and
- Degree of certainty.

A combination of quantitative and qualitative methodology was used for each of the aforementioned assessment criteria to describe impacts.

A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria are given in **Table 1**Error! Reference source not found.**.**

Table 1 Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	**SIGNIFICANCE**	**EXTENT SCALE**	**TEMPORAL SCALE**
1	VERY LOW	Proposed site	Incidental
2	LOW	Study area	Short-term
3	MODERATE	Local	Medium/High-term
4	HIGH	Regional/Provincial	Long-term
5	VERY HIGH	Global/National	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

10.2.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1000 km2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is high, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common.

A more detailed description of the impact significance rating scale is given in **Table 2** below.

Table 2		Description of the significance rating scale
RATING		**DESCRIPTION**
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

10.2.2 Spatial scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Error! Reference source not found..

Table 7		Description of the significance rating scale
RATING		**DESCRIPTION**
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level).

3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study site	The impact will affect an area not exceeding the Eskom property.
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

10.2.3 Duration scale

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out below.

Table 8 Description of the temporal rating scale.		
RATING		**DESCRIPTION**
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium/High term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

10.2.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in Error! Reference source not found. below.

Table 9 Description of the degree of probability of an impact occurring	
RATING	**DESCRIPTION**
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It’s going to happen / has occurred

10.2.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard “degree of certainty” scale is used as discussed in Error! Reference source not found.. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 10	**Description of the degree of certainty rating scale**
RATING	**DESCRIPTION**
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

10.2.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

Impact Risk **= (<u>Significance + *Spatial* + Temporal) X Probability</u>**

$$\text{Impact Risk} = \frac{(\text{Significance} + \text{Spatial} + \text{Temporal})}{3} \times \frac{\text{Probability}}{5}$$

An example of how this rating scale is applied is shown in **Table 3**.

Table 3 - Example of Rating Scale

Impact	**Significance**	**Spatial Scale**	**Temporal Scale**	**Probability**	**Rating**
	LOW	Local	Medium/High-term	Could Happen	
Impact to air	2	3	3	3	1.6

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2.67. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2.67 is then multiplied by the probability rating (0.6) to give the final rating of 1,6.

The impact risk is classified according to five classes as described in the Error! Reference source not found. below.

Table 12	Impact Risk Classes	
RATING	**IMPACT CLASS**	**DESCRIPTION**
0.1 – 1.0	1	**Very Low**
1.1 – 2.0	2	**Low**
2.1 – 3.0	3	**Moderate**
3.1 – 4.0	4	**High**
4.1 – 5.0	5	**Very High**

Therefore, with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be considered to be a low impact.

11 Impact Assessment on Stone Age sites

Impact assessment pre-mitigation						
IMPACT	**IMPACT DIRECTION**	**SIGNIFICANCE**	**SPATIAL SCALE**	**TEMPORAL SCALE**	**PROBABILITY**	**RATING**
Impact on archaeological sites	Negative	MODERATE	Study Area	Long term	Very Likely	
	-	3	2	4	4	2.40

Impact post mitigation						
IMPACT	**IMPACT DIRECTION**	**SIGNIFICANCE**	**SPATIAL SCALE**	**TEMPORAL SCALE**	**PROBABILITY**	**RATING**
Impact on archaeological sites	Negative	LOW	Isolated site	Permanent	Impossible	
	-	3	2	5	1	0.53

12 Recommendations and mitigation measures

The significance of the impact of the development during a pre-mitigation Medium Significance is supported by the post-mitigation Medium Significance based on the data collected during the 2021 non-invasive documentation and subsequent analyses. A fairly low-scale utilization of resources during the MSA is reflected by the relatively low numbers and densities of lithics, and the limited range of formal tool types recorded on the surface at the DEM-01 and DEM-02 localities. While the 2021 surveys and documentation reflected the distribution of artefacts on the surface, the recorded densities were unfortunately too low to allow any inferences on spatial patterning. The lithics were mostly present on shallow soils that overlie pebble or calcrete surfaces (Fig. 14).

SAHRA (2007: 4) defines mitigation as '[t]he act or effort by a qualified heritage specialist appointed by a developer to lessen the impact of a development on heritage resources within or near the development footprint'. The authors of this report is confident that the lithic occurrences of the property under review were adequately documented and assessed during the 2019 PGS HIA and the subsequent survey, documentation, the analyses and in this report by the Stone Age specialist.

No further mitigation actions are required in view of the findings as set out under Section 6. A destruction permit is accordingly not required.

It is not expected that these localities will yield subsurface lithics, apart from lithic elements that deflated downwards. However, in the event that construction activities do reveal subsurface lithics, the Change Find Procedure (CFP) must be implemented and the heritage authorities informed.

13 Conclusion

The Phase 1 HIA findings of PGS (2021) for the proposed geological exploration camp on the farm Demaneng 546, near Kathu, identified two Stone Age localities DEM-01 and DEM-02. This specialist Stone Age assessment report was commissioned to obtain an expert and informed opinion on the nature and extent of these localities with the aim of refining the existing mitigation recommendations. Through a multi-modal non-invasive approach empirical data on lithic distribution and typology were gathered on the 10 and 11 August 2021. The specialist assessment included documentation of lithics in both the previously identified localities and the wider unimpacted context.

From the extensive investigation and recording of the lithics across the study area it became evident that the assemblage represents an ephemeral landscape utilization. Overall the assemblage exhibit relatively low frequencies of the diagnostic and distinctive characteristics that typifies the regional MSA. Subsequently the localities DEM-01 and DEM-02 are deemed to be of Low to No Significance and no further mitigation is required.

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15 Annexure A: The southern African chronological sequence

The following table provides an overview of the southern African chronological sequence, the main attributes associated with a particular period, and cultural groups associated with each of the periods.

The southern African chronological sequence		
Cultural period and approximate ages	**Cultural groups**	**Technological attributes and tool types**
Earlier Stone Age (ESA) >2 m—>200 000 ya[3]	Early hominins Australopithecines *Homo habilis* *Homo erectus* archaic *Homo sapiens*	Large cutting tools (LCTs), scrapers and flaked forms. Some use of flaked bone as tools.
Middle Stone Age (MSA) <300 000 —>20 000 ya	Archaic and fully modern *Homo sapiens*	A reduction in tool size. Blades, convergent points and awls made on prepared core types to produce uniform tool forms, also scrapers and other tool types. Flaked products were often further shaped through secondary retouch to produce a range of formal tool types. Decorative items, body ornaments and ochre use become apparent. Rare engravings and rock art.
Later Stone Age (LSA) <40/20 000 ya up to historical times	*Homo sapiens* San hunter-gatherers Khoekhoe herders	An extended range of microlithic tool types, often used as inserts for bow-and-arrow hunting. Characteristic tools include scrapers, borers, and arrow heads. Ostrich eggshell (OES) beads and flasks — sometimes decorated— are prolific. Trade/barter items include glass, iron and copper beads, and pigments. Leather working, basketry, bone implements and armatures for arrows are common. Bow-and-arrow hunting and snaring. San and herder ceramics. Domestic animals: sheep, goats, cattle and dogs. Rock art. Polished stone tools and grooved stones used to shape different bone implements.
Early Iron Age (EIA) c. AD 200—c. AD 900	Bantu-speaking African farming communities	Distinct pottery styles for the various pottery expressions, metal working, subsistence agriculture, domestic animals,

[3] Ya = years ago

		trade and barter. Upper and lower grinding stones.
Middle Iron Age c. AD 900—c. AD 1300	Bantu-speaking African farming communities	Distinct pottery for the various ethnic groups, metal working, subsistence agriculture, domestic animals, trade and barter.
Late Iron Age (LIA) c. AD 1300 – c. AD 1840 Stone-walled LIA sites: c. AD 1640—c. AD 1840	Bantu-speaking African farming groups and Europeans	Characteristic pottery traditions associated with each of the main divisions, metal working, subsistence agriculture, domestic animals, trade and barter. Upper and lower grinding stones and other stone implements. Farmer rock art. Stone-walled settlements.
Colonial Period c. 1650	Bantu-speaking African farming groups and Europeans	Historical structures, industrial metals, glass, porcelain and ceramics.
Historical Period c. 1850	Various African groups, groups of mixed origin and Europeans	Historical structures, industrial metals, glass, porcelain and ceramics.

The following section provides a synthesis of the cultural succession of settlements within the southern African archaeological context.

15.1.1 Stone Age

Archaeological traces in the form of mostly stone tools suggest a widespread presence for tool-producing Plio-Pleistocene hominins in southern Africa. The South African Stone Age sequence is chronologically divided into the Earlier Stone Age (ESA), the Middle Stone Age (MSA) and the Later Stone Age (LSA) based on the concept of techno- or industrial complexes. Each of the subdivisions is formed by a group of industries where the assemblages share attributes or common traditions (Deacon & Deacon 1999; Lombard et al. 2012).

The australopithecines were gradually displaced by *Homo habilis*, a genus that evolved into the more advanced *Homo ergaster/erectus* by 1.8 million years BP. The large stone cutting tools (LCTs) associated with these hominins form part of the Oldowan and Acheulean industries of the ESA. Most ESA localities with stone tools in South Africa are associated with the hominin species known as *Homo erectus*, and the more recent ESA assemblages with archaic *Homo sapiens* (Barham & Mitchell 2008).

By >250 000 years BP, the large cleavers and handaxes (large cutting tools or LCTs of the ESA were discontinued and replaced by a larger variety of smaller tools and weapons of diverse shapes and sizes and made by using different techniques. The MSA typologies following on the ESA represent greater specialization in the production of stone tools, in particular flake, blade and scraper tools and also in a more extended range of specialized, formal lithic tool types. These changes in technology mark the beginning of the MSA.

The MSA is known for typically prepared centripetal cores that delivered specific convergent/pointed flakes and a range of flake blades (Soriano et al. 2007). Flaked products often retain the characteristic faceted striking platform that derives from this technique (see Fig. 11). Several other core types were also used to produce blank forms. Many of these were shaped by secondary trimming to produce a range of formal tool types. This period is moreover characterized by regional lithic variability, evidence for symbolic signalling, polished bone tools, portable art and decorative items.

The main developments during the MSA are cognitive, cultural and physical modernity (Wadley 2013a, 2013b, 2015, 2016; Chazan 2020). The MSA, which lasted almost half a million years, is associated with early modern humans with complex cognition, novel behaviours and transformative technologies. During the MSA early humans still settled in the open near water sources but also in caves and shelter localities. The MSA marks the transition from the more archaic *Homo* species to anatomically modern humans, *Homo sapiens sapiens* (Jurmain et al. 2013).

It is now generally accepted that the MSA was fully replaced by a mostly microlithic LSA marked by a series of new technological developments and cultural innovations (Wadley 2013a, 2013b). The LSA is marked by a series of technological innovations, social transformations and also noticeable demographic changes (Mitchell 2002a). The transition from the MSA to the LSA is vague. Dates proposed for the transitional period range from around 60/40 000 – 20 000 years ago based on a series of dates obtained through diverse dating methods, palaeoclimatic inferences as well as lithic technologies and diagnostic tool types as artefactual markers of a particular period.

The major changes comprise the replacement of MSA lithic technologies by LSA microlithic stone-working traditions and more widespread signs of symbolic and ritual activity in the form of art and decorative items, specifically objects made for personal adornment, such as pendants and the ubiquitous ostrich (*Struthio camelus*) eggshell (OES) beads (Mitchell 2002a). During the LSA small (microlithic) tools, bone tools and weapon armatures and a range of decorative items as well as rock art were produced.

Hunter-gatherer societies (and the later San) relied to a large extent on bow-and-arrow hunting with poisoned tips, and also snaring. Veld foods and medicinal plants were gathered. Ceramics were used and/or produced by hunter-gatherers and Khoekhoe herders towards the terminal phases of the LSA over a period of around 2000 years. Many of these stone tools and other material cultural items were still manufactured and used when the first Europeans settled in southern Africa in the 17th century AD. Information recorded about the lifestyles of the Khoekhoe herders and the San (Bushmen) at the time of the arrival of Europeans provides some insight into the immediate past history of these indigenous people.

Evidence for Stone Age communities within the broader region comprises the complete sequence of the southern African Stone Age (Mason 1962).

15.1.2 Rock Art

Thousands of painted and engraved sites dating from the LSA have been documented throughout Southern Africa and many more are still being found every year. Paintings and engravings were also executed on loose slabs of stone and some were used as markers for storage pits and in burials. Rock art in the form of paintings, but in particularly the many and diverse categories of engravings on the highveld, is not well represented in the general region (Mason 1968, 1986; RARI Wits Database).

15.1.3 Settlement by African farmers

The migrations into southern Africa and the expansion of Early Iron Age (EIA) African farming societies are apparent from AD 400 onwards. Pioneer Sotho-Tswana and other ethnic groups settled in semi-permanent villages, cultivated a range of crops, raised livestock, made ceramic containers, mined ore and smelted metals and engaged in trade or barter. Our understanding of EIA sites relies heavily on ceramic assemblages as the most archaeologically visible remains of the EIA cultures (Küsel 2011).The Late Iron Age was accompanied by aggregations of large numbers of communities (Huffman 2007; Boeyens 2012) that were often marked by extensive stonewalled settlements, or enclosures demarcated with poles and brushwood.