

Mu'tariḍ Community Mall: more insights into the development of the hydraulic, agricultural, and funerary landscapes of al-'Ayn (UAE)

PETER SHEEHAN, NOUR AL MARZOOQI, MOHAMMED KHALIFA & MALAK AL AJOU

Summary

Excavations carried out in 2023 for a major commercial construction project along the north-western edge of Mu'tariḍ Oasis produced important new evidence for the origins and development of the hydraulic, agricultural, and funerary landscapes of al-'Ayn.

The multi-period palimpsest presented by the site includes at least one monumental Umm an-Nār (2600–2000 BC) tomb, located nearly 10 km to the south of the nearest known parallels at Hili. The Bronze Age funerary landscape to which this tomb belongs is overlain by an extensive and complex Iron Age (1300–300 BC) field system, with a network of channels feeding coherent groups of tree pits and plots and providing further evidence of the scale, extent, and diversity of Iron Age agriculture in al-'Ayn. Deep sections provided by 4 m+ excavations for underground car parks immediately to the north and west of the preserved archaeological landscape have shown the relationship between the natural geomorphology of the site and the Iron Age hydraulic and agricultural systems.

The Iron Age agricultural landscape here is preserved beneath 1–2 m-deep deposits of wind-blown sand overlain by late Islamic earthen structures that were in turn abandoned and then buried by the formation of aeolian dunes. These structures include several walls forming part of a field system around the western edge of Mu'tariḍ Oasis, as well as more fragmentary remains of a fortified house or defensive tower and a well-preserved mosque.

Subsequent agreement between the developer and DCT (Department of Culture and Tourism) Abu Dhabi to preserve parts of these three key elements *in situ* within a 3000 m² area of the plot provides a significant opportunity for future presentation of the site and increased public engagement with ongoing archaeological investigations by DCT Abu Dhabi into the development of the oasis landscape of al-'Ayn.

Keywords: al-'Ayn, oasis landscape, archaeological monitoring, Iron Age agriculture, Umm an-Nār tombs

Introduction — recent insights into the development of the oasis landscape of Al Ain

Since 2010 the Historic Environment Department of DCT Abu Dhabi has been engaged on an ongoing landscape archaeology project focused on understanding the formation processes at work in the origins and development of the oasis landscape of al-'Ayn (Power & Sheehan 2012). Over the past five years the overall aims of this project have been greatly accelerated by archaeological monitoring and detailed documentation of several large-scale construction and infrastructure projects, each of which has presented a distinct range of opportunities and challenges and thrown new light on different aspects — hydraulic, agricultural, and funerary — of the landscape of al-'Ayn. These projects

have increasingly come to function as archaeological evaluations of different areas of the city, and they are helping to define research questions, inform further fieldwork, and aid in the cultural resource management of the historic environment.

This paper will focus on the most recent of these projects, archaeological monitoring during 2023 of excavations for the Mu'tariḍ Community Mall (hereafter, MCM) (Fig. 1). Approaching the archaeology of the oasis landscape is a dynamic process of iterative recontextualization, in which understanding of the whole is informed by reference to the individual parts and the individual parts by reference to the whole. The paper will thus begin with a brief recap of the major new insights gained between 2019 and 2023. The basis of the outline chronology proposed here is a comparison of the

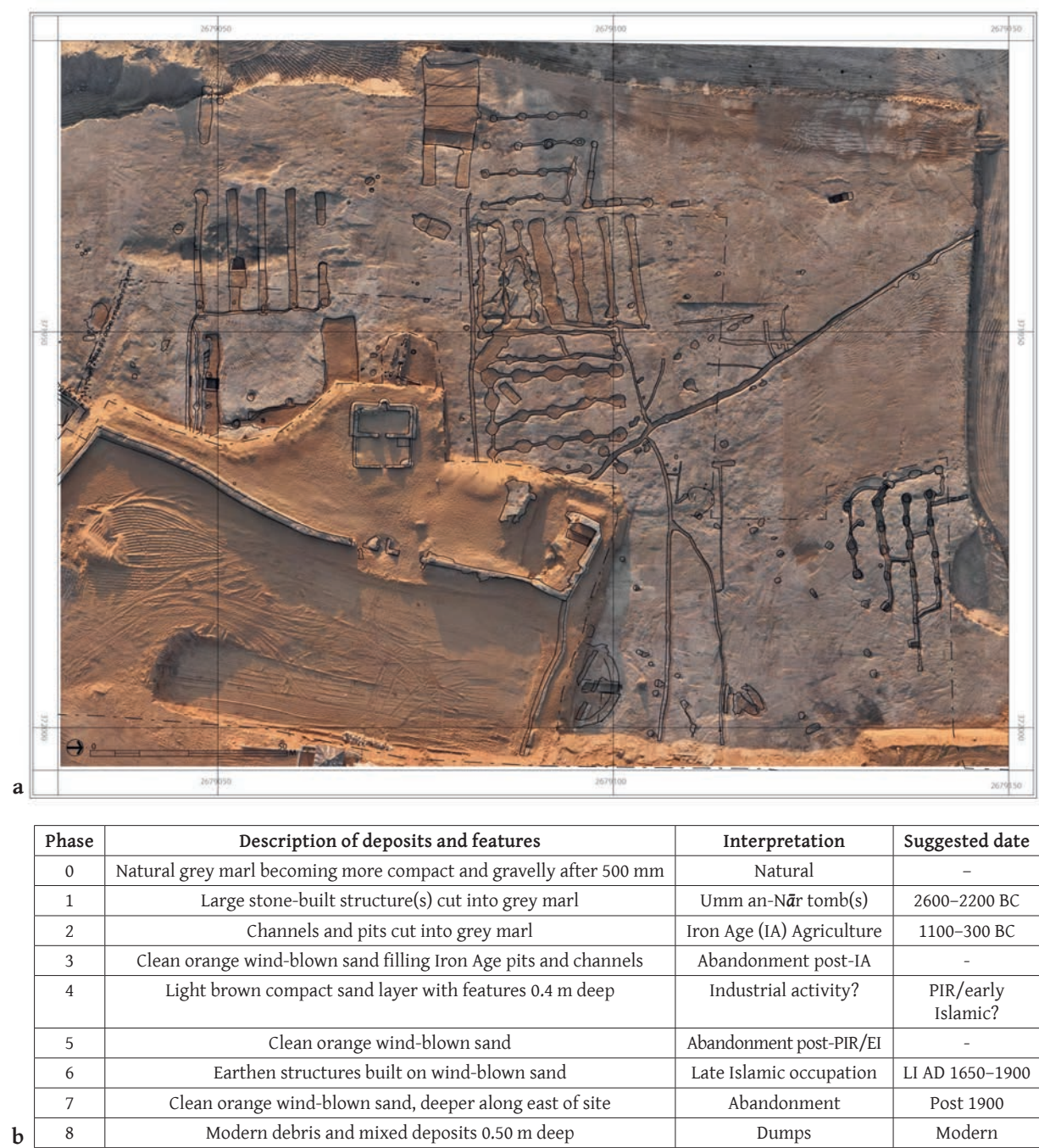


FIGURE 1. a. A CAD survey overlaid on a UAV image of the MCM site during excavation in 2023, highlighting the three key elements of this multi-period landscape, with late Islamic earthen structures defining the edge of the largely unexcavated orange sand deposits along the east of the site, and beyond this and at a lower level the network of channels and tree pits forming the Iron Age field system. The partially explored Umm an-Nār tomb is at the bottom centre of the image; **b.** a table showing the sequence of main deposits and activities on the MCM site.

diagnostic pottery from the site with published Bronze Age, Iron Age, and late Islamic ceramic assemblages from other sites in al-'Ayn and the region, along with two ^{14}C dates taken from key contexts (Magee 1996; Benoist 2000; Power, Benoist & Sheehan 2019; Power 2015; Cleuziou, Méry & Vogt 2011).

Archaeological work at Al Ain Museum (hereafter, AAM), initially from 2019 to 2020 and resuming from 2023 to 2024, has produced a wealth of new information on various aspects of the ancient landscape. Deep excavation over the half-hectare area of the proposed museum basement provided evidence for the sedimentary dynamics of the site and revealed approximately 200 deeply cut features. These included the shafts (*thuqb*) of several shallow Iron Age *aflāj* (sing. *falaj*) (utilizing a shallow water table with an irregular or seasonal flow) crossing the site from east to west, as well as at least one south–north *dawudi*-type *falaj* tapping a stable and perennial water source in the form of a deep aquifer. We have suggested that the introduction of this type of 'true' *falaj* was associated with the creation of the first sunken *bustan*-type oases towards the end of the Iron Age or in the late pre-Islamic (PIR) period. Both at AAM and elsewhere in al-'Ayn there is evidence that the early Islamic period (AD 700–1100) saw repairs to this type of *falaj* carried out with the red bricks typically associated with this period in the region. New evidence from AAM for the funerary landscape of al-'Ayn was provided first by the discovery of an elite stone PIR tomb in 2019 and subsequently in 2023 by the discovery of a number of individual graves dating to the same period (Sheehan et al. 2022; in press).

From 2020 onwards, archaeological monitoring of a major ongoing project by Al Ain Municipality to install storm water lines in the old *shaabiyāt* housing areas of the city has so far yielded evidence of around sixty separate *aflāj* of various depths and alignments in more than 150 different locations (Sheehan et al. 2024). This work has provided important new insights into the chronology of the different *falaj* types and the dynamics of their creation, use, and ultimate abandonment. It has also presented the opportunity to explore and record in plan substantial areas of Iron Age field systems watered by some of these *aflāj*. Monitoring of excavations for new storm water lines in the Kuwaitat area of al-'Ayn town centre in 2022 produced evidence for the ancient funerary landscape in the form of more than twenty

individual graves with well-preserved grave-goods at the eastern edge of a PIR cemetery (Sheehan et al. 2023a).

In 2021 archaeological monitoring of the Oman Border Fence project (hereafter, OBF) provided a series of deep sections through the ancient landscape totalling 11.5 km in length. Here the sedimentary sequence included deep deposits of compact sand overlying two distinct phases of an extensive Iron Age agricultural landscape. The first of these extends for at least 1 km from south to north and is characterized by a regular layout of deep intersecting channels with shallower rills branching off to water neat rows of individual, mostly square, tree pits. These pits have been provisionally dated to the Iron Age based on the associated ceramic assemblage from their fills, their stratigraphic position sealed beneath the overlying sand deposits, and the general absence of later intrusive material. A second and less extensive phase of Iron Age agricultural activity is marked by surviving 'islands' of the earlier arrangement of tree pits and channels that have been cut by deeper and roughly rectangular basins. The project also produced important evidence for the inter-relation between the agricultural and funerary aspects of a multi-period inherited landscape, including a large 25 m+ long stone-built Late Bronze Age collective tomb incorporating Umm an-Nār ashlar, which was then reused in the Iron Age when it seems to have formed the focal point of an extensive cemetery at the southern limit of the Iron Age agricultural landscape described above (Sheehan et al. 2023a).

Mutaredh Community Mall (MCM) – background and progress of the works

The MCM site occupies a 25000 m² plot at the north-west corner of Mu'tarīḍ Oasis. It thus lies approximately midway between two main seasonal water courses, Wāḍi al-'Ayn and Wāḍi al-Jīmī, both originating in the foothills of the Hajar mountains and flowing broadly east to west at a distance of c.4 km apart. Mu'tarīḍ Oasis is part of the southern group of al-'Ayn oases (the others are al-'Ayn and Muwajjī) and covers an area of c.24 ha. Like the rest of the al-'Ayn group, in its present form it is an artificially watered sunken basin supporting intensive palm cultivation within numerous individually owned

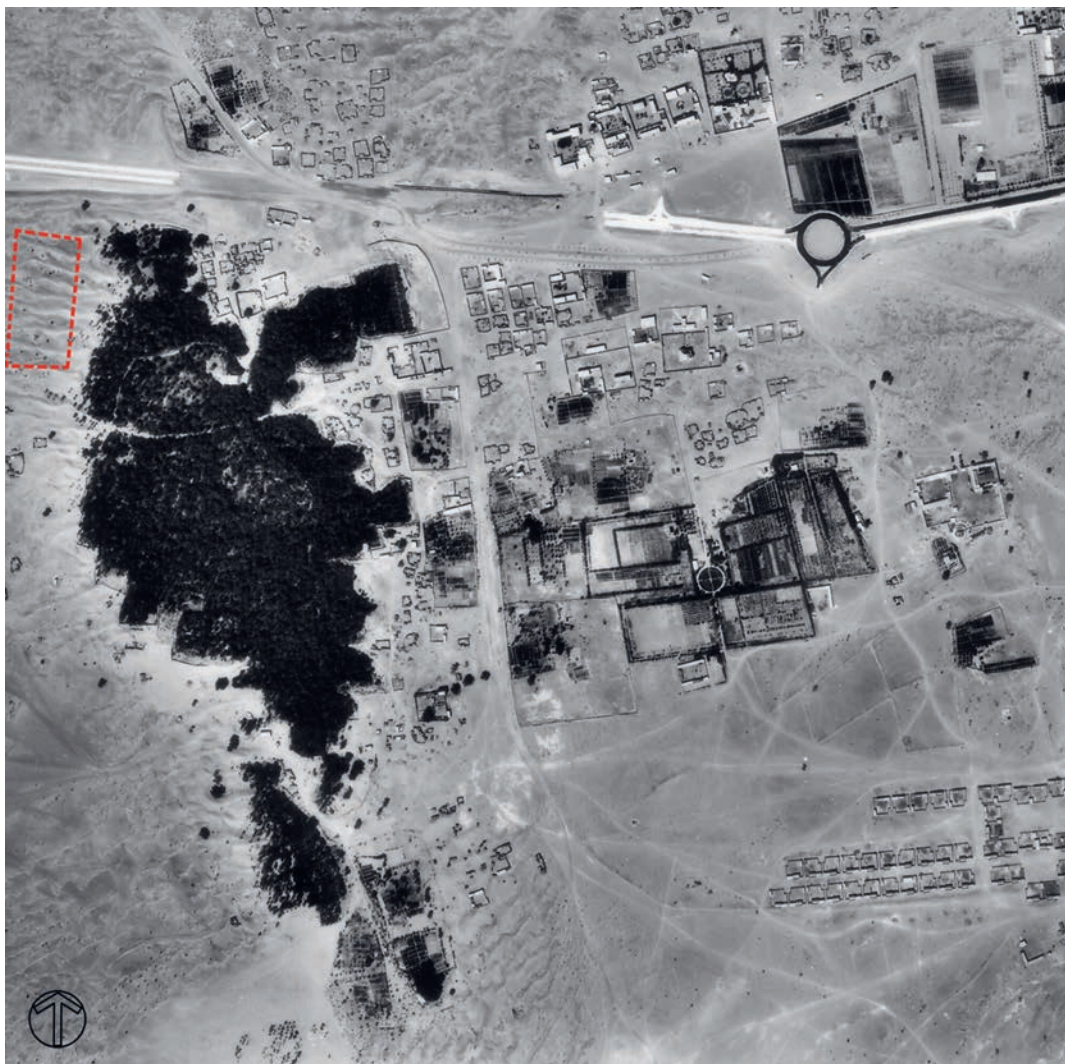


FIGURE 2. A 1968 RAF aerial photo of Muṭarīḍ Oasis, with the location of the MCM site highlighted, showing the extensive area of wind-blown sand dunes along the western edge of the oasis.

plots. Archaeological information for the Muṭarīḍ area is limited, with the nearest investigated sites being the Shaikh Khalifa Grand Mosque site 1 km to the north-east, investigated by DCT between 1999 and 2001 and again from 2011 to 2014 (al-Tikriti et al. 2015), and Qaşr Al Muwaijī, 1.4 km to the west, excavated between 2009 and 2011 (Power & Sheehan 2011a). Some limited archaeological investigations have also taken place at several of the historic earthen buildings dating from the late Islamic period that are found at various points

around the edge of the oasis (Al Tawalebah & Al Haj 2018).

Oral histories indicate that the area was formerly known as *hayy al-nudood*, a reference to the high mounds or dunes that lay along the western edge of the oasis. A 1968 RAF aerial photo of Muṭarīḍ Oasis shows the site at that time still covered by these deep aeolian sand dunes (Fig. 2), while a desktop review of satellite imagery for the plot over the past twenty years indicates various episodes of planting and material storage, culminating

in November 2022 with the clearance of trees from the eastern edge of the site ahead as part of the preparations for the MCM project. The site lies within the buffer zone of the Mu'tariḍ Oasis component of the UNESCO World Heritage Site, and the design of the building in relation to its oasis setting was carefully developed in coordination with urban planners and architects from DCT Abu Dhabi and Al Ain Municipality to enhance the World Heritage Site and minimize the visual impact of the development on the views of the oasis.

Planning for mitigation of the archaeological impact of the proposed underground car park had been less comprehensively developed, but monitoring of initial test trenches by the contractor along the northern and western edges of the site in December 2022 revealed a sequence of mixed modern deposits of loose sand and mixed debris over clean orange wind-blown sand, with the depth of the latter substantially greater towards the eastern edge of the site. These loose surface sand deposits in turn overlie a narrow band of more compact grey silty natural conglomerate of the type previously noted in the sedimentary sequence from the AAM and OBF projects. The very loose surface deposits found across the site made archaeological monitoring of test trenches and supervision during subsequent machine excavation a challenging process.

The late Islamic landscape — fields and buildings along the western limits of Mu'tariḍ Oasis

Mass excavation for the MCM building began in January 2023, proceeding from east to west across the site. Removal of the deep deposits of orange wind-blown sand along the eastern edge of the site very quickly revealed an intact archaeological sequence represented initially by several surviving earthen structures. These included substantial boundary walls, apparently forming the limit of a field system around the western edge of Mu'tariḍ Oasis, as well as the partial remains of a fortified house or defensive tower and a small but well-preserved mosque, very similar in size and form to the mosque from the Shaikh Khalifa Grand Mosque site, dated there to the early Islamic period (al-Tikriti et al. 2015).

At the MCM site, however, the mosque and the other earthen structures belong to the late Islamic (AD 1650–1950) oasis landscape. The earthen walls, with remains of a gateway through them leading to the mosque beyond, seem to mark the limit of fields around the oasis similar to those shown in historic archive photographs of various al-'Ayn oases. A late Islamic date for these structures is also suggested by associated ceramic finds, the shallow footings of the structures on wind-blown sand, and the similarity of materials and method of construction between these buildings and others preserved around the edge of the historic Mu'tariḍ Oasis, in particular the house of Shaikh Ahmed Bin Surūr, some 500 m away at the south-west corner of the oasis, that was similarly buried in wind-blown sand until it was excavated by DCT Abu Dhabi in 2005. The substantial preservation of earthen buildings in both these areas is an indicator of how rapidly these deep aeolian sand deposits can form. Like the other earthen buildings, the mosque was built over deep deposits of clean wind-blown sand that overlie ephemeral features, perhaps representing an intermediate PIR/early Islamic occupation, that is in turn separated from the underlying Iron Age agricultural landscape by further wind-blown sand deposits. Excavation was initially suspended over the c.3000 m² defined by these earthen buildings (Area 3 in Fig. 3). Following discussions between the developer and the DCT team they were subsequently included, together with other key elements of the multi-period landscape discussed below, within the area of the site to be preserved *in situ* for further investigation and presentation (see Fig. 10).

The Iron Age hydraulic and agricultural landscape

To the west and north of Area 3, archaeological monitoring and cleaning following the machine clearance of deep overlying sand deposits continued, revealing the second major element in this cultural landscape, a complex system of Iron Age irrigation channels watering arrays of tree pits and basins cut into the natural subsoil and covering an area of more than 4000 m² (Fig. 4).

The initial division of these agricultural features into Areas 1 and 2 was based on a difference in the ceramic

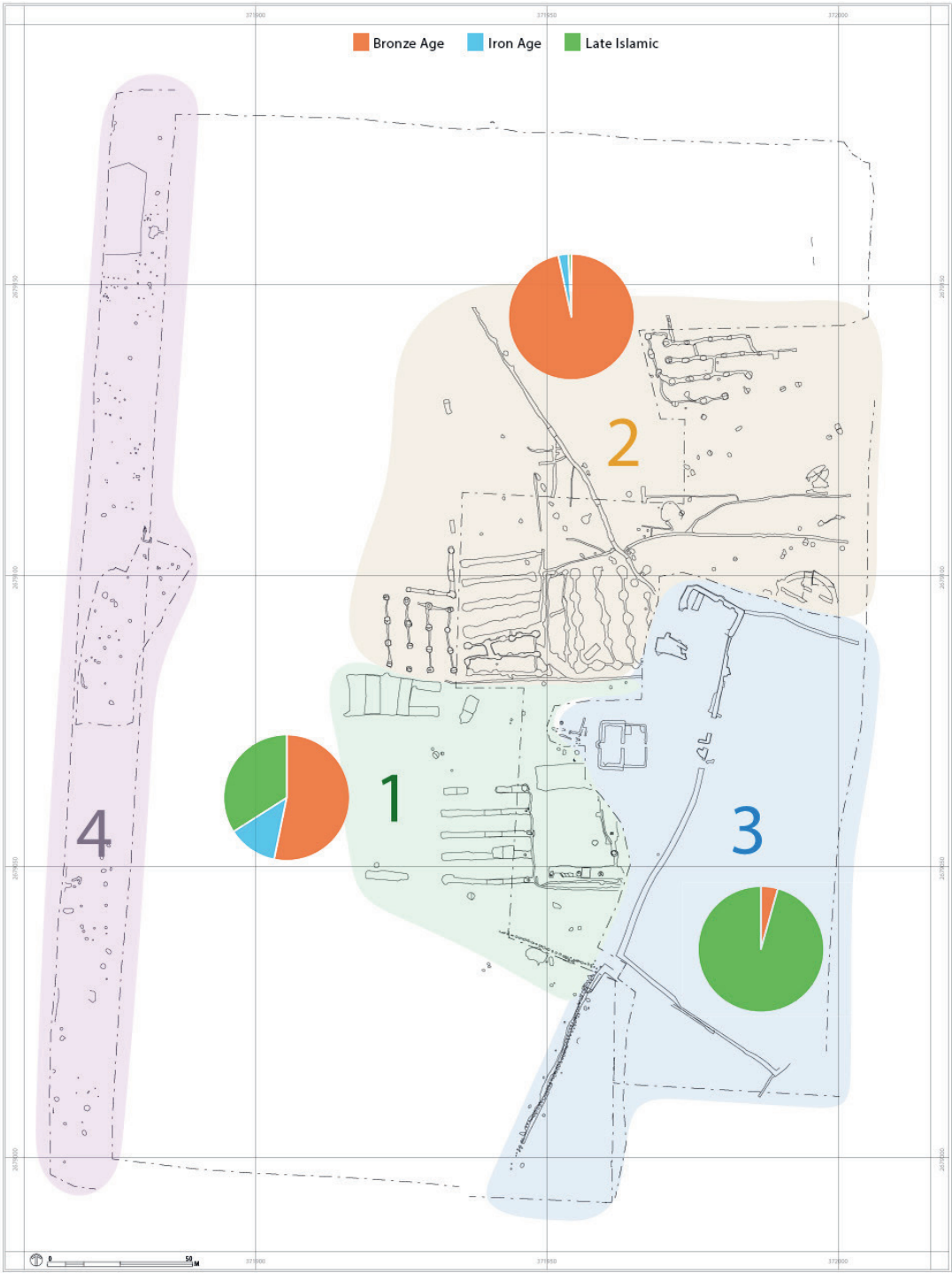


FIGURE 3. A plan of the site showing the different excavation areas 1-4, with preliminary pie charts indicating the proportions of the different ceramic assemblages found in Areas 1-3.



FIGURE 4. *Progress of the works in Area 2, with a detail of the arrangement of Iron Age channels and tree pits revealed during the monitoring of machine excavation. The pits and channels in the foreground were later seen to form part of Plot I, discussed below.*

finds assemblage, with greater quantities of late Islamic wares in Area 1 contrasting with almost exclusively Bronze and Iron Age material in Area 2 (see Fig. 3). The differences in the finds from each area may be due to the uneven topography and variable depth of the sand dunes on which the overlying late Islamic occupation took place. Preliminary quantification indicates that the ceramic assemblage from the MCM site is dominated by Bronze Age wares (up to 90% of the ceramic assemblage from the site), with much of this assemblage having been redeposited either during previous destruction episodes or during the tree removal and machine excavation for the MCM project. The division into Areas 1 and 2 also initially reflected a different morphology of cut features (parallel rows of tree pits in Area 2 versus long rectangular vegetable beds in Area 1), but the subsequent identification of rectangular beds in both areas and the similar east-west orientation of all these cut features (quite distinct from that of the overlying late Islamic field walls) strongly suggests they form different but complementary units of the same agricultural system.

Machine excavation and construction traffic over the soft sand deposits overlying the Iron Age pits and beds generally truncated at least the upper 200 mm of these features, with the depth of truncation increasing as excavation continued towards the west and north. The continuation of similar cut features to those recorded in plan was noted in both the north and north-east sections at the edge of the site. Notwithstanding the increased truncation towards the west, the impression that Areas 1 and 2 lie close to the original western limit of this agricultural system is supported by the absence of similar channels and tree pits during subsequent excavation of Area 4 (see Fig. 3). This westward extension of the additional project footprint was intended partially to compensate the developer for the loss of Area 3. The soft sand deposits overlying the natural soil in Area 4 were carefully excavated under archaeological supervision, and no truncation of the interface with underlying features and deposits took place.

Within the Iron Age agricultural system recorded in Areas 1 and 2 we were able to identify not just the arrangement of the main irrigation channels, but also at

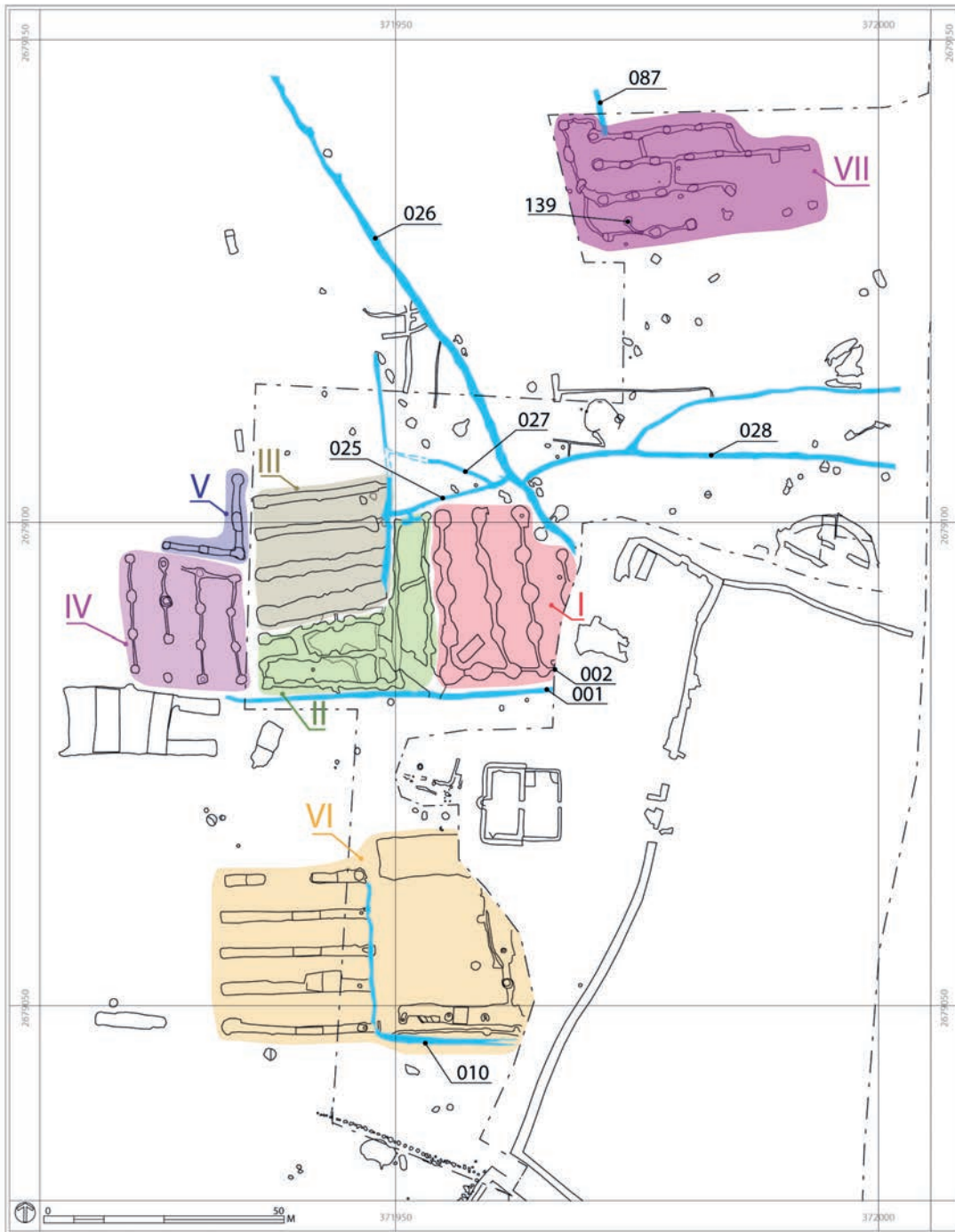


FIGURE 5. Plan of the site showing (numbered) the main and subsidiary channels and other features mentioned in the text, as well as garden 'plots' (numbered here I–VII) that were watered in sequence based on the size and shape of the pit or bed and the plants being grown in it.

least seven separate and distinct gardens or plots (Plots I–VII), with each of these watered by secondary channels in a sequence clearly related to the speed and direction of flow and the volume of water provided to each plot, that in turn was based on the size and shape of the tree pits or beds and the type of plant being grown. Both the general scope and the individual details of this complex agricultural system as well as the regular arrangement of a primary channel with subsidiary channels feeding separate plots, evidence of root balls in the tree pits, and broken pottery used to regulate the water flow, find close parallels in the Iron Age cultivation area (ICNA, Irrigation Channel Network Area) excavated by the Spanish team since 2009 at Al Madam 2 (AM2), located in the central plain of the Emirate of Sharjah (Fernandez & Del Cerro 2024).

The main channels and the agricultural plots

The principal water supply to the agricultural areas was provided by a substantial V-shaped linear channel (LNR 026), c.0.8 m wide and up to 1.2 m deep that was traced in plan for more than 60 m from where it emerges from below the unexcavated north-east corner of Area 3 and continues towards the north-west. North of this point it was not recorded in plan due to the truncation of the archaeological deposits, but the distinctive shape of this channel was recorded in the south-facing section of the site, confirming that it continues beyond the MCM plot. It is worth remarking that the orientation of this main channel is very similar to at least three of the *aflāj* recorded at the Shaikh Khalifa Grand Mosque site (al-Tikriti et al. 2015).

Excavation of the fill of the main channel to its sloping base confirmed the direction of flow and indicates it was partially fed by a subsidiary channel (LNR 028) flowing from east to west that was perhaps intended to recuperate surplus flow from irrigated areas to the east (a similar deep channel collecting surplus water from irrigated areas was also recorded at the OBF). From this main channel a secondary one (LNR 025) branches off to the west to water Plots II and III. Another subsidiary channel (LNR 001) running from east to west supplies Plots IV and V and possibly marks a division between a mixed group (I–V) of five similarly sized plots (each c.200 m², total

1000 m²) and the mainly long and rectangular beds and basins found in the single larger plot VI (c.1000 m²) to the south, which are watered by another subsidiary east–west channel (LNR 010) emerging from beneath Area 3.

Plot I covers a roughly rectangular area of c.200 m² and contains a coherent group of eighteen tree pits, each presenting as ovoid or circular cuts between 1.4 and 2 m in diameter, linked by 300 mm-wide channels and arranged in three roughly north–south parallel rows, with a fourth row to the east only partially revealed at the edge of excavation (Figs 4 & 5). Excavation of one of these rows showed that these channels and the bases of each tree pit gradually step down from south to north. This row is watered by a channel (LNR 002) that enters one of the tree pits at the south-east corner of the plot. The deeper level of this incoming channel compared with a shallower outflow channel in the north of the same tree pit shows the direction of flow and indicates that the tree pits were watered in sequence, with the water filling each pit and then overflowing to the next. The size of these pits, their square profile at a lower level, and the small holes dug at the bottom of each pit for drainage into the underlying gravel all find parallels with similar Iron Age tree pits from the OBF and Falaj Al Mazmi (south of Hili Oasis, hereafter FAM) and suggests these were for substantial trees, perhaps palms (Sheehan et al. 2023a; 2023b; 2024)

Plot II is a similar size (c.185 m²) but forms an L-shaped plot with eighteen noticeably smaller pits indicating the cultivation of smaller plants or bushes arranged in both north–south and east–west rows. The plot was watered via a T-shaped junction from a subsidiary channel (LNR 025), and this junction is marked, as noted in several other locations, by stones and potsherds used to temporarily dam these inlet channels and thus allow water to flow on to the neighbouring Plot III. This is another roughly square plot of c.200 m² consisting of four east–west rectangular beds each about 12 m long and 1 m wide, with a preserved depth of 0.6 m. One of these beds showed evidence of its inflow channel having been temporarily blocked with potsherds, while regular arrangements of darker patches within the sandy fill indicated possible plant locations.

Plot IV was more truncated than those further to the east but covers an area of c.170 m² and consists of sixteen medium-sized and roughly square tree pits arranged in

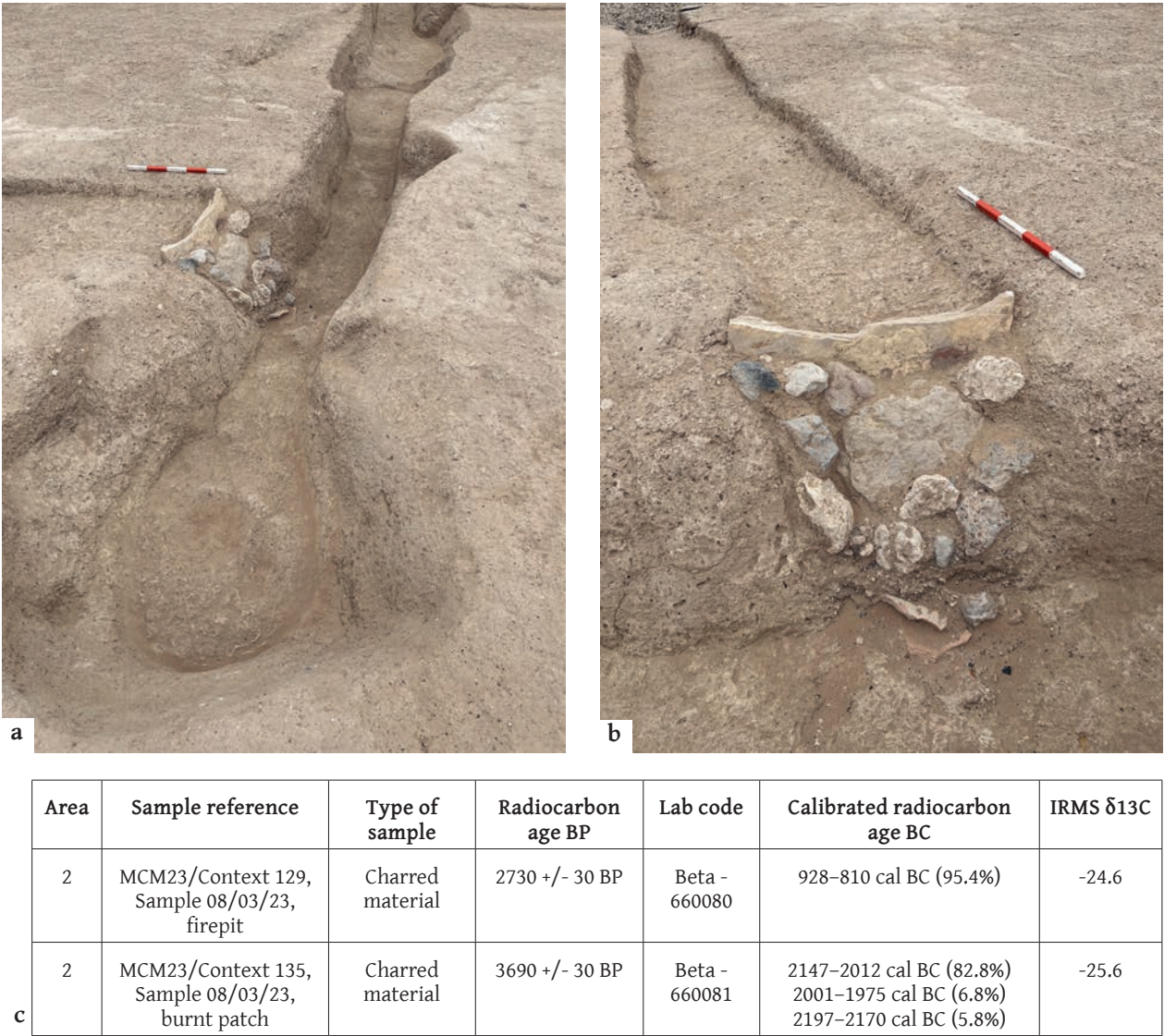


FIGURE 6. **a.** An array of tree pits in Plot VII supplied by channel (LNR 087); **b.** detail showing the final blocking of the channel with stones and potsherds. The Iron Age II sherds used provide a terminus post quem for the end of the field system and a poignant reminder of the farmer who never returned; **c.** a table of radiocarbon dates from MCM.

four parallel north–south rows. Plant locations are again marked by looser sand at the centre of the fill and/or a central depression for drainage in the base of the pit. Plot V was even more heavily truncated but appears to have had a similar arrangement, possibly watered by a continuation of the channel (LNR 027) branching off from the subsidiary channel (LNR 025).

South of this group of five roughly 200 m² plots, Plot VI covers a bigger overall area of c.1000 m², and contains a group of long and narrow east–west vegetable beds like those of Plot III, here watered by another east–west channel (LNR 010). In this area there are also several substantially deeper sunken basins that have been cut down through the underlying gravel layers, with



FIGURE 7. View looking east during initial investigation of the Umm an-Nār tomb, showing the deep deposits of wind-blown sand overlying the robbed tomb on which the late Islamic field walls and other structures were built.

individual tree pits linked by channels cut into the floor of the basin. These deeper basins may represent a second phase of more concentrated Iron Age activity, or they may simply have been intended to maximize the benefits of subsurface flows within the deeper gravel deposits (perhaps representing a former wadi course?) in this part of the site.

Plot VII lies towards the more truncated north-east corner of the excavated area, c.30 m north of the group of Plots I–V. Although the arrangement of twenty-four individual tree pits arranged in four parallel east-west rows shares the same general orientation, it may represent a separate farm or group of plots. In any case this plot appears to have been supplied with water by a channel from the north (LNR 087) that preserves another human touch with its final and rather poignant blocking of the channel still *in situ* (Fig. 6). This is composed of stone slabs mixed with large sherds of broken Iron Age II ceramics and provides a *terminus post quem* for the abandonment of this plot. The lower undisturbed fill of the channels and tree pits excavated in Plot VII produced similar Iron Age II ceramics. The tree pits here are similar in size to Plot II, with excavated examples showing a square profile at the lower level.

The southernmost row of tree pits in Plot VII is linked by a short channel to an oval cut (CUT 129) filled with burnt stones, a distinctive type of feature that was noted previously, also in an Iron Age agricultural context, at the OBF. Radiocarbon dating of charred material from this MCM pit provided a date of 928–810 cal BC (2 sigma), consistent with an Iron Age II dating.

A Bronze Age funerary landscape

Excavation along the eastern edge of the site immediately north of Area 3 revealed a large circular cut feature filled with stone fragments, which on closer inspection and excavation of a small test trench was revealed to be a monumental Umm an-Nār tomb (Fig. 7). The initial test trench produced fragments of soft-stone vessels and relatively large quantities (220 sherds — or nearly 14% — of a total Bronze Age assemblage of 1360) of Bronze Age decorated, fine and miniature wares, all types often found in burial contexts (Cleuziou, Méry & Vogt 2011). Human bone, burnt and otherwise, was also present in significant quantities, but in the absence of a bio-archaeologist on the team, excavation was discontinued and the tomb covered and backfilled. The southern half

of the tomb extends under the deep wind-blown sand deposits in Area 3 and so remains unexcavated, but it is clearly a large circular stone structure c.11 m in (external) diameter, with an outer wall c.1 m thick laid in a trench cut into the underlying natural soil. The remains of three east–west walls can be seen to divide the internal space into four separate compartments. Only the lowest courses of stone blocks forming the exterior circuit of the tomb survive, as the tomb was dismantled and heavily robbed out down to the contemporary ground level in antiquity, presumably for its building stone but perhaps initially also for the grave-goods it may have contained. The date of this destruction remains unclear but is likely to account for the extensive spread of Bronze Age ceramics throughout Areas 1 and 2. The presence of a late Islamic field wall built on the deep sand deposits overlying the robbed tomb suggests the robbing pre-dates the most recent phase of activity on the site. Finds of burnt bone and grave-goods, probably derived from an upper level of the tomb during its destruction, appear similar to those recovered during excavation by the French Archaeological Mission in the early 1980s of what appears to be its closest parallel in both form and presumed date, Hili North Tomb A, currently located in the grounds of Hili Fun City c.10 km to the north (Cleuziou, Méry & Vogt 2011).

The presence of burnt bone and funerary objects inside the tomb may be linked to relatively frequent patches of burning found in Area 2, some of which clearly pre-date and are cut by the Iron Age channels. Similar features, identified as fireplaces forming part of an occupational layer and associated with a largely intact Wadi Suq jar, were found at the Shaikh Khalifa Grand Mosque site (al-Tikriti et al. 2015). At MCM, radiocarbon dating of charred material (context 135) taken from a patch of burning that had later been cut by a channel linking tree pits in Plot I provided results consistent with an Umm an-Nār date.

Conclusions

The discovery of a monumental Umm an-Nār tomb on the western edge of Mu‘tariḍ Oasis invites a major re-evaluation of evidence for the Bronze Age landscape of al-‘Ayn, and its southern part in particular, that will include a review of the evidence from the nearby Shaikh Khalifa Grand Mosque site, reused Umm an-Nār ashlar

from the OBF, and isolated discoveries at other locations in the town centre. More evidence will be provided when excavation of the MCM Umm an-Nār tomb resumes, as well as by future investigations of the rising ground to the east of the site which appears to be a mound on which Mu‘tariḍ Oasis is set. The nature of the Umm an-Nār tomb (and perhaps others within a wider cemetery around it) and its possible continuation as a sacral and/or territorial marker in the later Iron Age agricultural landscape analogous with the situation recorded at the OBF, is another possible avenue of future research.

The next stage of fieldwork on the site will also have the opportunity to explore, under more controlled excavation conditions, the loose sand deposits within Area 3 where the complete archaeological sequence from the Bronze Age to the late Islamic period remains intact. The decision to preserve Area 3 *in situ* has already provided the opportunity for a ground penetrating radar (GPR) and magnetometry survey of the site by a team from the Earth Science Department of Khalifa University (Fig. 8). This has allowed us to compare the geophysical data from this survey with visible results in adjacent already excavated areas, and initial 3D results from this geophysical survey have indicated both the likely continuation of the Iron Age agricultural features and the possible presence of further stone structures similar to the Umm an-Nār tomb beneath the sands of Area 3 (Santos-Assunção et al. 2024).

The very large (c.4000 m²) area of agricultural landscape revealed at Mu‘tariḍ also represents another major step forward in understanding both the nature and extent of the area under cultivation in al-‘Ayn during the Iron Age. These new insights into the scale and techniques of agriculture and water management in an arid environment are important not only for our understanding of the development of the oasis landscape of al-‘Ayn, but also for the wider context of agriculture in south-east Arabia both past and present (Córdoba 2016; Charbonnier et al. 2017; Purdue et al. 2019). The different plot sizes, the position and shape of the various types of tree pits and beds, and the arrangement of channels all point to the diversity of plants being grown within a drought-resistant regime focused on the careful control and maximizing of the available water resources. It also underlines the point that Iron Age agriculture was clearly about more than growing palm trees. Further specialist analysis of the



FIGURE 8. The team from the Earth Science Department of Khalifa University carrying out ground penetrating radar (GPR) survey in Area 3. The survey indicated the likely presence of more stone tombs in this area.

extensive soil samples taken from the site, together with archaeobotanical data recovered during the processing of these samples, will help to further define our view of the practice of agriculture and its place within the rhythms of daily life.

The scale, morphology, and orientation of the agricultural features at Muṭariḍ all find close parallels with the extensive Iron Age agricultural landscape, covering an area of at least 100 ha and consisting of more than one phase, that has been recorded at various locations (OBF, FAM, the Bayt Bin‘Āti in Qaṭṭāra) around the northern group of al-‘Ayn oases (Hilī, Qaṭṭāra, Jīmī) (Sheehan et al. 2023b; Power & Sheehan 2011b). For the southern group (Muwaij‘ī, Muṭariḍ, al-‘Ayn), the recent evidence from MCM, AAM, and the central areas of Murabba and Kuwaitat (Sheehan et al. 2022; 2024), supplemented by previous observations from the Shaikh Khalifa Grand Mosque (al-Tikriti et al. 2015) and Muwaij‘ī (Power & Sheehan 2011a), all add to the growing picture of a similarly extensive but still largely unexplored Iron Age field system, watered from shallow surface sources and wadis flowing westwards across the modern border with Oman. The next steps will be to attempt a synthesis of the archaeological evidence from all these sites with

geoarchaeological and archaeobotanical data, which we hope will provide a fuller understanding of the agricultural base upon which Iron Age ‘civilization’ in al-‘Ayn and the wider region was founded.

At MCM the focus of activities for DCT Abu Dhabi has now shifted to the ongoing management of the site and future presentation of a core area containing three major elements — the late Islamic earthen buildings, a representative area of Iron Age agriculture, and the Umm an-Nār tomb. Pending a resumption of archaeological investigations and future interpretation measures, this has so far involved careful reburial and the construction of conservation shelters. Areas of Iron Age agriculture beyond this core will be preserved *in situ* beneath the building by locating the piled foundations in such a way as to avoid these features (Fig. 10). Planning for the future presentation of the site will also begin to focus on how it can be protected against the elements and integrated within its setting between the new building and Muṭariḍ Oasis, an approach that has already been successfully employed in recent years with other areas of the ancient landscape presented in the Archaeological Basement at Qattara Arts Centre and in the new archaeological galleries at Al Ain Museum.

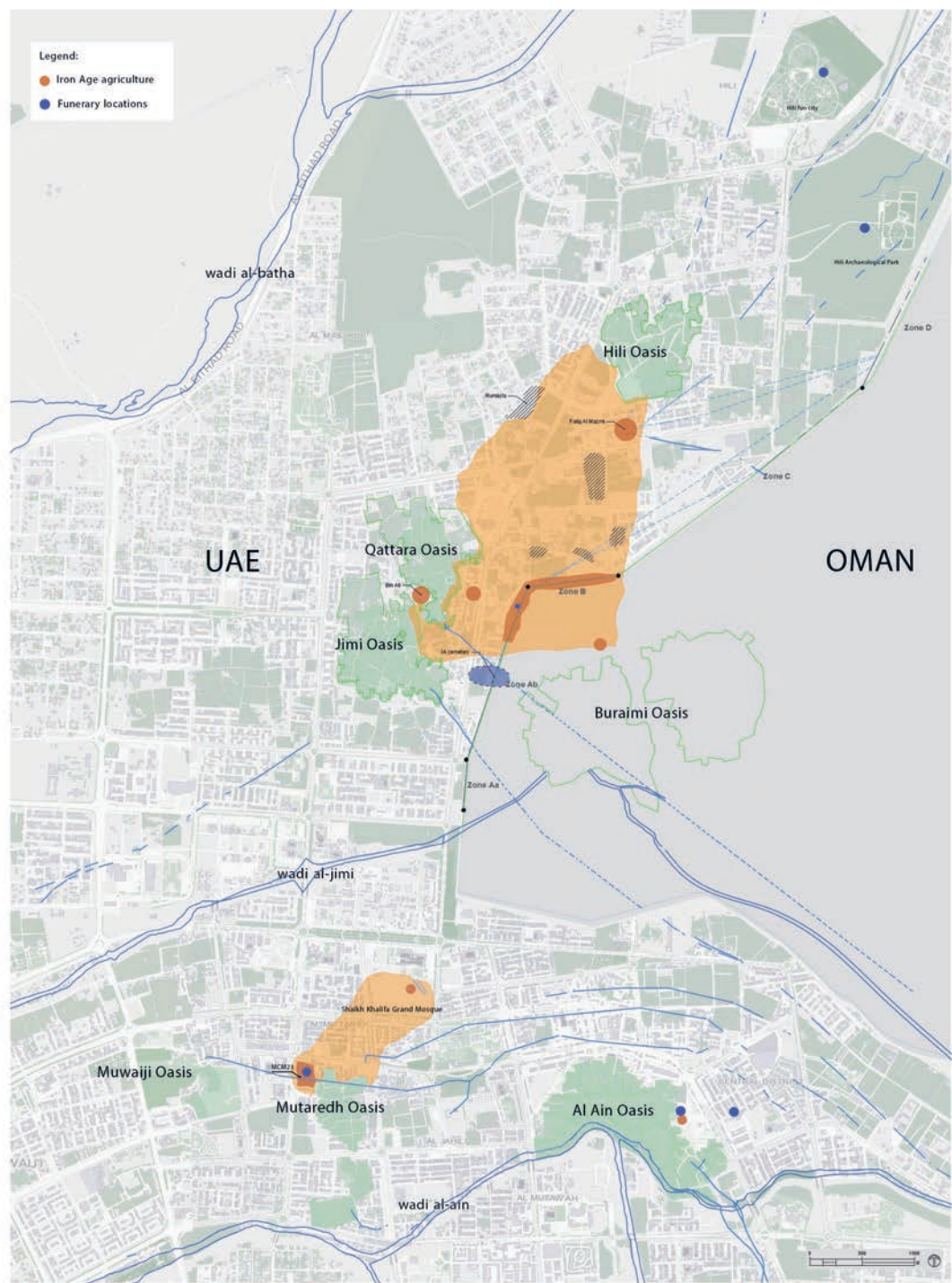


FIGURE 9. A plan of al-‘Ayn showing the extent of Iron Age field systems based on recent archaeological observations, with recorded locations of aflāj and known locations of the funerary landscape, as well as previously identified locations of Iron Age settlement (hatched).

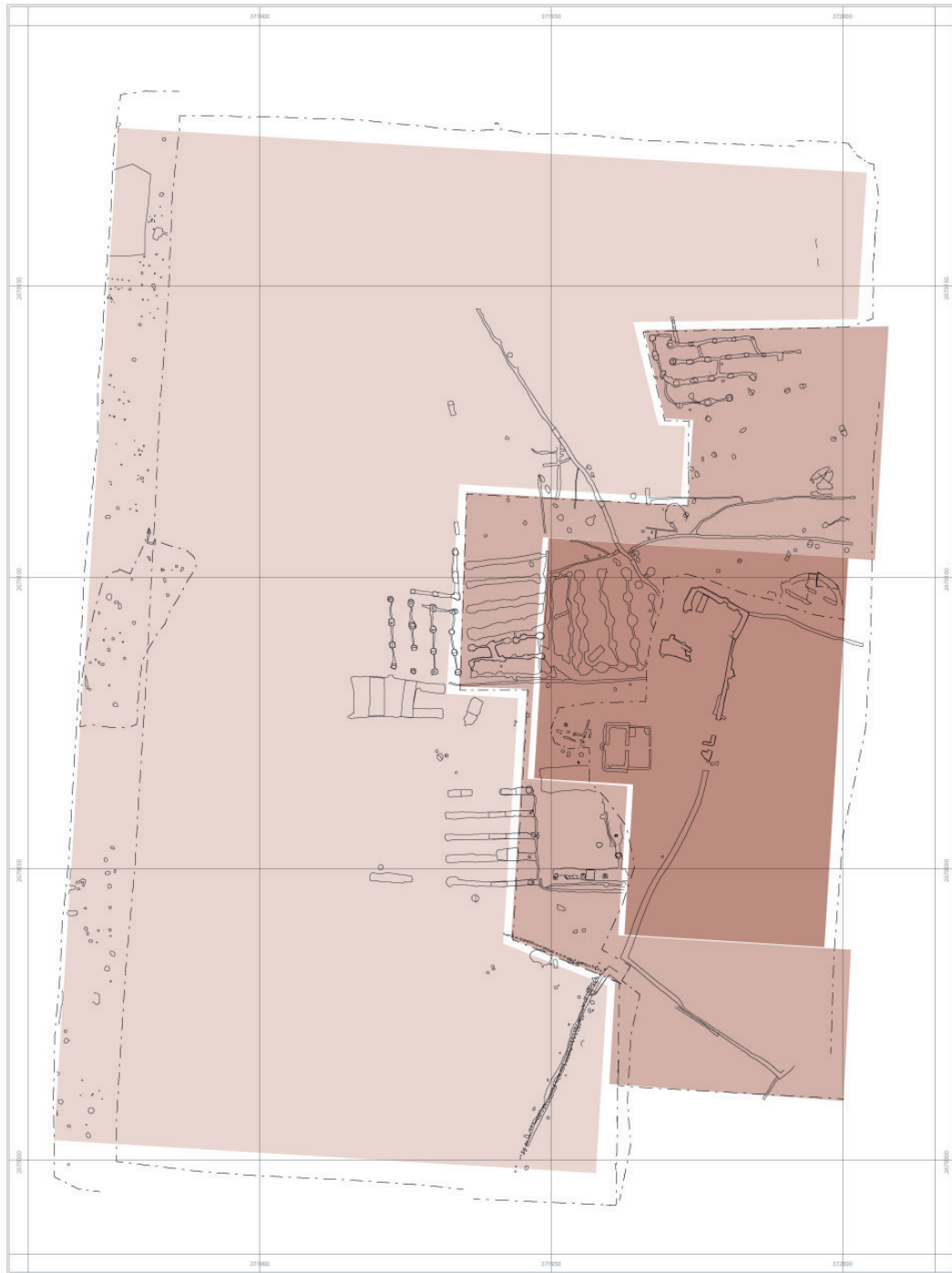


FIGURE 10. A plan of the MCM site showing (from dark to light): areas of the archaeological site preserved for further investigation and presentation; parts to be preserved in situ beneath the building; parts to be preserved by record only.

Acknowledgements

We would like to thank the MCM developer, Nayel Al Shamsi, Chairman of Nael General Contracting LLC, his representative Tamer Gabr, and the project consultants Arak Engineering for their continuous support and assistance during the project and for their forbearance with delays and major changes to the scope and schedule of a major construction project.

From the DCT side the major archaeological results from this site have once more demonstrated the value of the development control procedures implemented by the Historic Environment Department to protect the historic environment in all its aspects. We are grateful for the unstinting support and assistance from all our colleagues in the Department.

Our thanks also to Diana Francis, Sonia Santos-Assunção, and their team from the Earth Science Department at Khalifa University, and to Geotech3D and Al Mayedy Production & Aerial Shot.

References

- Benoist A. 2000. La céramique de l'Age du Fer en péninsule d'Oman. Thèse de doctorat, Université de Paris I, Panthéon-Sorbonne. [Unpublished.]
- Benoist A., Degli Esposti M., Charbonnier J. & Power T.C. 2021. al-Madam and the Archaeology of the Falaj in South East Arabia. Pages 165–182 in A.J.D. Monedeor, C.C. Linares, F.J.V. Ruiz de Toledo & F.L.B. Gallardo (eds), *Nomina in aqua scripta. Homenaje a Joaquín María Córdoba Zoilo*. Madrid: Universidad Autónoma de Madrid.
- Charbonnier J., Purdue L., Calastrenc C., Régagnon E., Sagory T. & Benoist A. 2017. Ancient agricultural landscapes in Southeast Arabia: Approach and first results of an archaeological, geo-archaeological, and spatial study of the Masāfi Palm Grove, Emirate of Fujairah. Pages 45–65 in W.Y. al-Tikriti & P.A. Yule (eds), *Proceedings of Water and Life in Arabia conference 14th–16th December, 2014*. Abu Dhabi: Abu Dhabi Tourism and Culture Authority.
- Cleuziou S., Méry S. & Vogt B. 2011. *Protohistoire de l'oasis d'al-Aïn. Travaux de la Mission archéologique française à Abou Dhabi (Émirats arabes unis): Les sépultures de l'âge du Bronze*. (British Archaeological Reports, International Series 2227). Oxford: Archaeopress.
- Córdoba J.M. 2013. New perspectives about Iron Age and the oasis culture in the Oman peninsula. Two conclusive seasons at al Madam (Sharjah, UAE). *Isimu* 16: 139–152. Available at <https://revistas.uam.es/isimu/article/view/3181/3376>
- Fernandez C. & Del Cerro C. 2024. Cultures, technologies and environment on the Oman peninsula: Recent discoveries and some hypotheses about the falaj system in Al Madam, Sharjah, UAE. Pages 271–292 in Zayed National Museum (ed.), *Advances in UAE archaeology. Proceedings of Abu Dhabi's Archaeology Conference 2022*. Abu Dhabi: Department of Culture and Tourism.
- Magee P. 1996. The chronology of the south-east Arabian Iron Age. *Arabian Archaeology and Epigraphy* 7/2: 240–252.
- Power T. 2015. A first ceramic chronology for the late Islamic Arabian Gulf. *Journal of Islamic Archaeology* 2/1: 1–33.
- Power T.C. & Sheehan P.D. 2011a. The Qaşr al-Muwaijī: *Diwān* of the Āl Nahayyān in the al-ʿAin/Buraimi Oasis. *Liwa: Journal of the National Center for Documentation & Research (Abu Dhabi)* 3/5: 26–41.
- Power T.C. & Sheehan P.D. 2011b. The Bayt Bin ʿĀti in Qaṭṭāra oasis: A prehistoric industrial site and the formation of the oasis landscape of al-ʿAyn (UAE). *Proceedings of the Seminar for Arabian Studies* 41: 267–282.
- Power T.C. & Sheehan P.D. 2012. The origin and development of the oasis landscape of al-ʿAyn (UAE). *Proceedings of the Seminar for Arabian Studies* 42: 291–308.
- Power T., Benoist A. & Sheehan P. 2019. An Iron Age ceramic sequence from the Bayt Bin Ati, al-Ain, UAE. *Arabian Archaeology and Epigraphy* 30: 75–102.
- Purdue L., Charbonnier J., Régagnon E., Calastrenc C., Sagory T., Virmoux C. ... Benoist A. 2019. Geoarchaeology of Holocene oasis formation, hydro-agricultural management and climate change in Masafi, southeast Arabia (UAE). *Quaternary Research* 92/1: 109–132.
- Santos-Assunção S., Ali M., Ali M.Y., Francis D., Sheehan P. ... Iqbal M.A. 2024. Identification of subsurface

- archaeology at Mutaredh, United Arab Emirates, using ground penetrating radar. *Frontiers of Earth Science* 12: 1450518.
- Sheehan P.D., Power T.C., Karacic S. & Costa S. 2022. Al Ain Museum: An ancient landscape beneath the carpark. *Proceedings of the Seminar for Arabian Studies* 51: 353–369.
- Sheehan P.D., Khalifa M., Al Ajou M. & Al Marzooqi N. 2023a. Secrets of the *shaabiyat*: Recent developments in the archaeology of the (urban) oasis landscape of Al Ain. Pages 293–306 in Zayed National Museum (ed.), *Advances in UAE Archaeology. Proceedings of Abu Dhabi's Archaeology Conference 2022*. Abu Dhabi: Department of Culture and Tourism.
- Sheehan P.D., Khalifa M., Al Ajou M., Al Marzooqi N., Van Bellegem M., Ferreira A. ... David-Cuny H. 2023b. The Oman Border Fence Project 2021: A journey through the hydraulic, agricultural, and funerary landscapes of al-ʿAyn. *Proceedings of the Seminar for Arabian Studies* 52: 323–337.
- Sheehan P.D., Khalifa M., Al Ajou M., Al Marzooqi N., Al Merri J. & Power T.C. 2024. *Aflāj* discoveries in al-ʿAyn — exploring and documenting the network of shafts and tunnels recently revealed below the streets of the modern city. *Proceedings of the Seminar for Arabian Studies* 53: 262–277.
- Sheehan P.D., Al Marzooqi N.N., Khalifa M. & Al Ajou M. (in press). Beyond the carpark: Further insights into the development of the oasis landscape from the new Al Ain Museum. *Proceedings of the DCT Archaeology Conference December 2023*.
- Al-Tawalebah D. & Al Haj A.A. 2018. The residence of Ibn Suroor Al Dhahri in Al Mutaredh Oasis in Al Ain. *Liwa: Journal of the National Center for Documentation & Research (Abu Dhabi)* 19: 33–52. [In Arabic.]
- Al-Tikriti W., Al Neyadi M., Tawalbeh D., Al Nuaimi A.R., Al Kaabi A. & Omar W. 2015. Filling a blank: New excavations at an early Islamic site at Oud Al Toba/Mutaredh in al-ʿAyn, UAE. *Proceedings of the Seminar for Arabian Studies* 45: 371–384.

Authors' addresses

Peter Sheehan, DCT Abu Dhabi, Historic Environment Department, Abu Dhabi Department of Culture and Tourism, Al Ain, Abu Dhabi, UAE.

e-mail peter.sheehan@dctabudhabi.ae

Nour Al Marzooqi, DCT Abu Dhabi, Historic Environment Department, Abu Dhabi Department of Culture and Tourism, Al Ain, Abu Dhabi, UAE.

e-mail NMarzooqi@dctabudhabi.ae

Mohammed Khalifa, DCT Abu Dhabi, Historic Environment Department, Abu Dhabi Department of Culture and Tourism, Al Ain, Abu Dhabi, UAE.

e-mail mohamed.khalifa@dctabudhabi.ae

Malak Al Ajou, DCT Abu Dhabi, Historic Environment Department, Abu Dhabi Department of Culture and Tourism, Al Ain, Abu Dhabi, UAE.

e-mail MAjou@dctabudhabi.ae