ipaast-czo case study: Manor Farm, Yorkshire

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1. The Estate and the farmer / landowner:

About the place, including any interesting history, general background, and who is currently managing it.

Manor Farm, located near East Heslerton in Yorkshire, is managed by David Lumley and his immediate family. There is extensive archaeology located on the farm, which has been studied by the Landscape Research Centre (LRC), led by Dominic Powlesland. Detail on the archaeology of the region surrounding the farm, the Vale of Pickering, can be found at the home page of LRC.

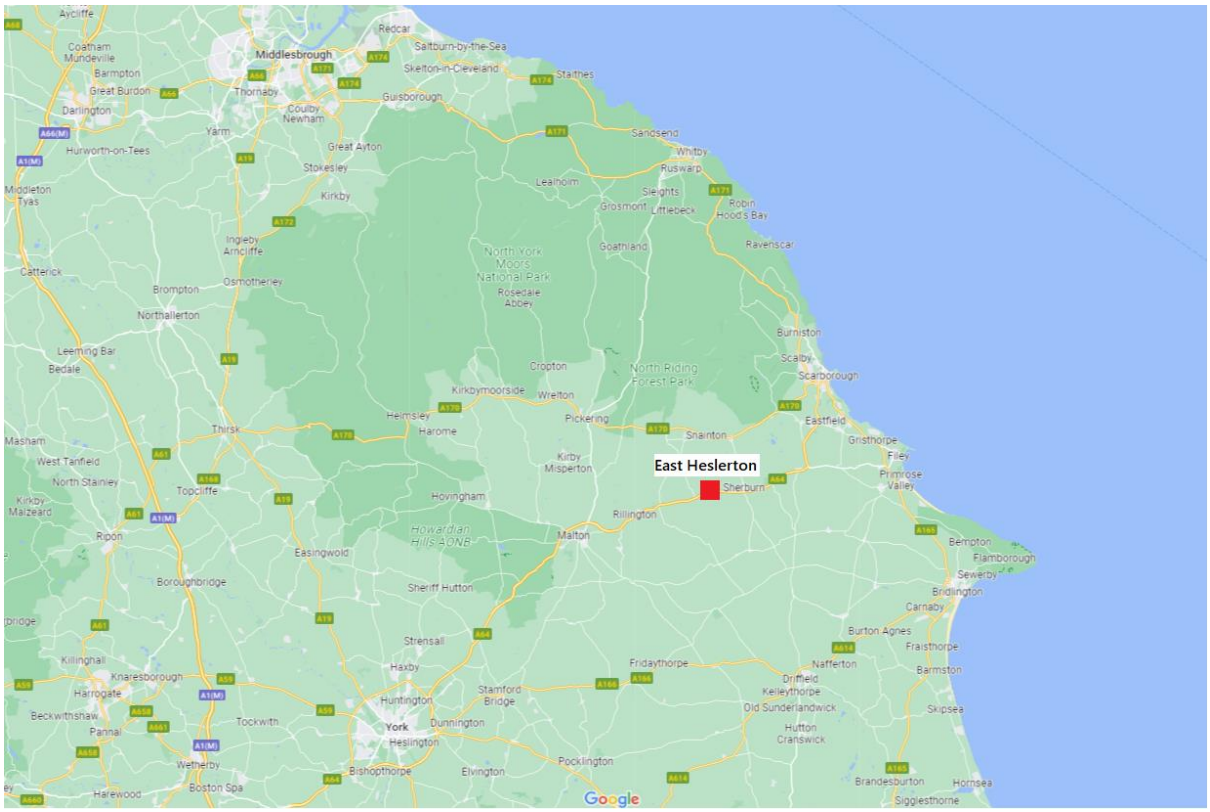

Figure 1 Location of Yorkshire case study area near East Heslerton, Yorkshire (adapted from Google maps)

2. Further land management stakeholders at Manor Farm:

Including archaeologists and heritage management agencies interested in the land, community groups, environment agencies, etc.

Natural England and Historic England are engaged in the management of the land at Manor Farm through their oversight of interventions that potentially impact its natural and cultural heritage (with certain fields falling within a designated site of special scientific interest (SSSI). Dominic Powlesland and the Landscape Research Centre are also actively involved in research and in informing land management decisions.

3. Current land use:

(For example farming practices, tourism, etc.)

Manor Farm is a commercial arable and livestock enterprise. While previously under arable rotations, today with much of the land used to graze sheep. Some areas are currently managed under Environmental Stewardship schemes or Heritage Conservation schemes. Archaeological aspects of the landscape are signed for tourists, but the site is not currently actively managed for tourism.

Figure 2 Current land use in the study area – pasture and arable fields (Photos: Rachel Opitz)

4. What we know about archaeology on the farm:

Any background on the significance of local archaeology, prior research etc.

Archaeological research on the farm has been carried out by Dominic Powlesland and the LRC for over 40 years. The case study included two fields studied by the LRC. The following are extracts taken from the LRC database documenting the site:

Site 070

"The southern field: Site 070 contains localised evidence of Anglo-Saxon settlement, possible prehistoric activity and fragmentary medieval cultivation. The preservation of the archaeological deposits have not been assessed, but it is likely that only those areas in the dry valleys are well preserved, as the depth of overburden sealing the features in these areas should be deeper than that on the chalk knolls.

Site 070 is a large field located at the foot of the Wolds, 360m south of the medieval and modern village of East Heslerton. The track running south to Manor Wold farm is located immediately to the east of the site. The north-east part of the site contains evidence for part of an Anglo-Saxon settlement extending into the fields to the north and east. There is also fragmentary evidence for medieval cultivation across the site, presumably associated with the settlement site to the north.

The field contains a steep chalk knoll in the south-east. To the north of this the ground falls away into a dry valley that turns and runs down the eastern edge of the site. It is under arable cultivation. Wire fencing and hedges define all four boundaries. Along the western, northern and southern boundaries these hedges have been cut back and replanted.

The soils on this site are complex, in the north-east corner they appear to consist largely of a sandy material. In the dry valley running across the site and on the rise in the west of the field is colluvium (hillwash). The steep chalk knoll in the south-east is characterised by large, angular chalk fragments, presumably dislodged when this part of the site is ploughed."

Site 120

"The northern field: Site 120 contains extensive evidence associated with the late Iron Age/Romano-British ladder settlement, and is therefore ranked highly for archaeological presence. The auger survey indicates that the although there are localised areas sealed by windblown sand, the shallow depth of overburden across the majority of the field means that the archaeological deposits are generally at risk from damage by cultivation.

Site 120 is a large field under arable cultivation to the west of Carr Lane. It incorporates the site of a sewerage farm. Archaeologically, it is characterised by the late Iron Age/Romano-British ladder settlement in the north of the field. It is bounded by hedges, with a fence around the sewerage farm. The predominant soil type is windblown sand, running into silty, organically enriched soils at the northern boundary."

Figure 3 Known archaeology of East Heslerton – documented earthworks visible in aerial photography, mostly relate to the medieval village with the rectangular bank of the manorial enclosure showing clearly. Copyright English Heritage – with permission granted to reproduce on the LRC website.

5. How precision agriculture is being used:

Past data collections, methods being used, if any – or ambitions to do this if it's not already happening.

Soil mapping using Frequency domain electromagnetic (FDEM) survey has previously been carried out at Manor Farm to inform the creation of management zones. This is the main precision agricultural technology in use to date.

6. Management Challenges:

What the main land management problems are, especially with an eye to improving sustainability.

Limiting the erosion of wind-blown sands and managing the pasture to maintain sward productivity in areas that contain buried archaeological layers constitute significant challenges for land management at the farm. At present, some areas are not productive and there is ingress of weeds and white clover. To attempt to mitigate soil erosion and maintain sward productivity, deeper or denser rooting varieties should be planted, an action also favourable under new environmental land management schemes, but there is a concern that doing so could potentially damage buried archaeological features. It is important to understand both the location and depth of burial of archaeological layers and the soil types present in detail to inform the planning of sward renewal and the selection of varietals and species which will meet both environmental and archaeological management needs, while improving sward productivity.

Figure 4 FDEM data collection in the field – similarities and differences: agricultural sensor set-up on the left (Photo: Rachel Opitz), archaeological prospection on the right (Photo Philippe De Smedt).

7. Sources of existing data:

Archival data or other existing data you were able to access, including previously collected precision agricultural data.

Data collected previously includes archaeological data available at http://landscaperesearchcentre.org/html/lrc_home_page.html and at https://lrc.cast.uark.edu/. These included the results of magnetometer (fluxgate gradiometer) surveys, locations of cropmarks identified in aerial photographs, the results of an augur survey which identified the depth of the soil and depth to peat or windblown sand across the sites and surrounding areas, surface topography maps, and the results of excavations in the local area.

8. New data collected for the case study:

The data you collected… in summary with a pointer to the data archive.

FDEM data were collected using a Dualem 21HS sensor, resulting in ECa and IP-MS data from a horizontal coplanar (HCP) coil pair at 0.5 (HCPH), 1 (HCP1) and 2 m (HCP2) transmitter-receiver separation and a perpendicular (PRP) coil pair at 0.6 (PRPH), 1.1 (PRP1) and 2.1 m (PRP2) separation. 10 locations for soil sampling were determined by conditioned Latin hypercube sampling and two control locations were added. Soil samples were collected using a Dutch auger and analyses using standard soil analyses, including granulometry, CaCO3, Phosphorus (P), organic matter content, and soil nutrient information. The case study data are archived at: http://doi.org/10.5281/zenodo.7741749.

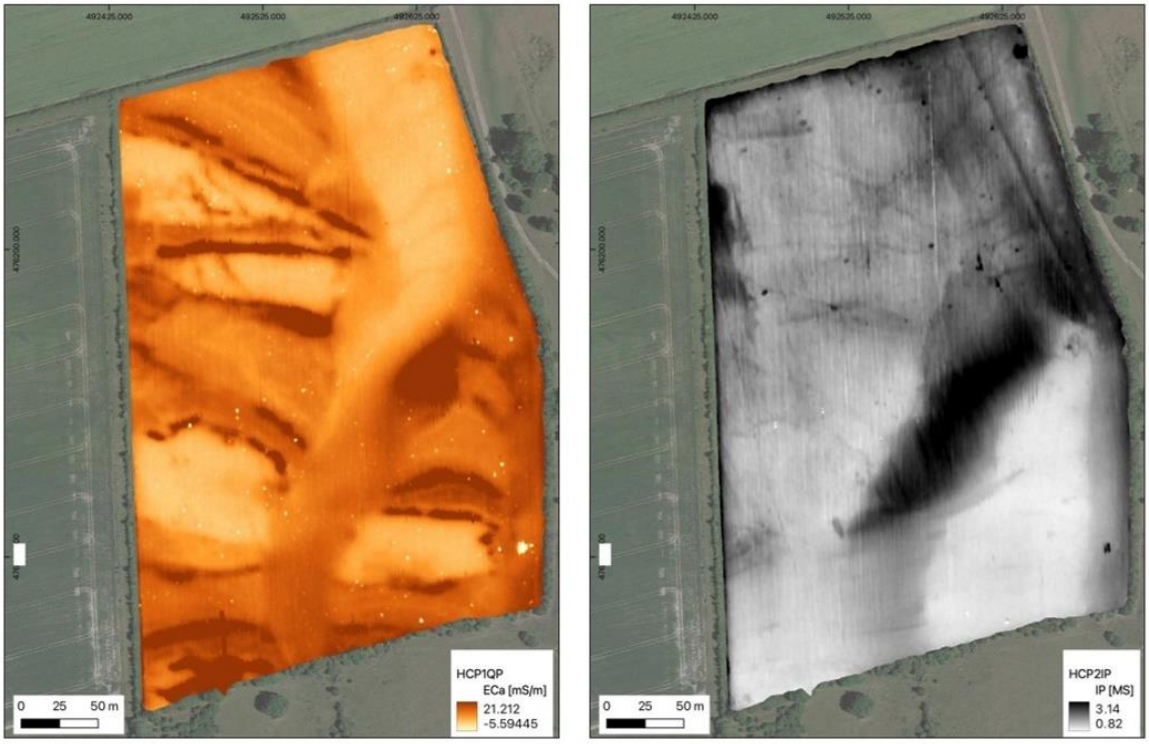

Figure 5 Preliminary results from the FDEM survey (high resolution archaeology dataset): electrical conductivity (left) and magnetic susceptibility (right) – Site O70 (Courtesy University of Ghent).

9. Insights from joint analysis and interpretation:

Interim results and anything you've learned from the data you've collected from both an archaeological and precision agricultural perspective.

Interim analysis of the survey, together with the background data, provided information on the overall preservation of features between 2006, when prior magnetic gradiometer surveys were executed, and 2023, giving useful insights into overall rates of erosion and impacts of recent land use. Many features are evidently preserved, as they are visible in both datasets, including those in areas which are vulnerable to erosion.

The combination of survey data and soil samples allows some preliminary conclusions to be drawn about the relationships between nutrient variations and the presence and character of subsurface archaeology. For example, at site 120, there is elevated P content corresponding to areas with elevated IP-MS which are interpreted as settlements, while lower P values concentrate themselves

in low IP-MS regions such as the floodplain. The results of detailed preliminary analysis are currently in preparation to be published in the *Journal of Archaeological Prospection*.

10. Soil Health and Heritage futures:

How the data you collected could be used for sustainable management. What further data would be needed.

The data collected, together with archaeological data assembled for the sites, could support the planning of management zones, based on improved local soil and subsoil maps. Further datasets which would support sustainable management include continuous monitoring of erosion (topographic change through repeat surveys). Gamma ray spectroscopy surveys could also potentially provide further insight into soil nutrient profiles which may be affecting sward health.