SKAGAFJÖRÐUR CHURCH AND SETTLEMENT SURVEY

Hegranesþing: Geophysical Prospection, Coring and Excavation Interim Report 2017

Brian N. Damiata
John M. Steinberg
Guðný Zoëga
Rita V. Shepard
John W. Schoenfelder
Douglas J. Bolender

Photo on front page – Brian Damiata using the CMD Mini at Hegranesþing.

Brian N. Damiata, John M. Steinberg, Guðný Zoëga, Rita V. Shepard, John W. Schoenfelder, and Douglas J. Bolender

Byggðasafn Skagfirðinga/Fiske Center for Archaeological Research, UMass Boston

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SKAGAFJÖRÐUR HERITAGE MUSEUM

The Skagafjörður Heritage Museum is a center for research on local history and cultural heritage in the Skagafjörður region, North Iceland. It is affiliated with the National Museum of Iceland and its main exhibition at the old turf farm of Glaumbær is one of the most visited national heritage tourist attractions. The Archaeological Department of the museum was established in 2003 and engages in contract and research driven archaeology both within and outside the region. The core long-term research programs center on fundamental issues surrounding the settlement and early medieval church history of Skagafjörður and the North-Atlantic region with a focus on developing methodological and theoretical approaches to the geography of early Christian cemeteries. The department is involved in multifaceted interdisciplinary collaboration with Icelandic and international institutions and specialists. Its research portfolio includes bioarchaeology, early metal production, settlement studies, as well as the methodological aspects of archaeological surveying.

FISKE CENTER FOR ARCHAEOLOGICAL RESEARCH

The Andrew Fiske Memorial Center for Archaeological Research at the University of Massachusetts Boston was established in 1999 through the generosity of the late Alice Fiske and her family as a living memorial to her late husband Andrew. As an international leader in interdisciplinary research, the Fiske Center promotes a vision of archaeology as a multi-faceted, theoretically rigorous field that integrates a variety of analytical perspectives into its studies of the cultural and biological dimensions of colonization, urbanization, and industrialization that have occurred over the past one thousand years in the Americas and the Atlantic World. As part of a public university, the Fiske Center maintains a program of local archaeology with a special emphasis on research that meets the needs of cities, towns, and Tribal Nations in New England and the greater Northeast. The Fiske Center also seeks to understand the local as part of a broader Atlantic World.

SKAGAFJÖRÐUR CHURCH AND SETTLEMENT SURVEY

The Skagafjörður Church and Settlement Survey (SCASS) seeks to determine if the settlement pattern of the 9th-century colonization of Iceland affected the development of the religious and economic institutions that dominated the 14th century. The research builds on the combined methods and results of two projects. One has focused on Viking Age settlement patterns. The other has been investigating the changing geography of early Christian cemeteries. Together, the research seeks to understand the connections between the Viking settlement hierarchy and the Christian consolidation.

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1.0 ABSTRACT

This report outlines the 2017 work at Hegranesþing that built upon previous work at this complex and important site. The geophysical results, using the CMD Mini-Explorer, give a more detailed picture of the site than the 2016 Explorer results. The geophysical results suggest that there are substantial remains and important deposits that are not visible on the surface. The coring suggests these substantial and continuous remains are consistent with permanent continuously occupied Viking Age and pre-AD 1300 farmsteads. The first of the two 1x1m excavations suggest that the northern area was occupied during the settlement period and abandoned well before the AD 1104 volcanic tephra fell and is not associated with the visible churchyard. The second excavation suggests that the southern area, near the visible churchyard, was occupied after the settlement period and abandoned before the AD 1300 tephra fell and this occupation is likely associated with the churchyard. The combined results suggest that there may be a third area primary occupied 1104-1300 northwest of the visible churchyard, but more work is necessary to confirm this third occupation.

2.0 ÚTDÁTTUR (ICELANDIC SUMMARY)

Hegranesþing

3.0 INTRODUCTION

Hegranesþing, a Viking and medieval assembly site (sometimes spelled Hegranesthing) is on the northern part of the island of Hegranes, in central Skagafjörður (Figure 1). The name of the island, and in turn the assembly site, is probably derived from the nickname of the supposed first settler of the region, Havardr hegri, translated into English as Havard the heron, (Pálsson and Edwards 1972:90). The Hegranesþing takes up part of the northern area of the farm of Garður, but its boundaries are unclear. Hegranesþing presents itself as a collection of booths, in the style typical of Icelandic assembly sites (Vésteinsson 2013; Vésteinsson, et al. 2004). Surrounding some of the southernmost booths is a tún boundary wall that encloses about 5550 m^2. A circular church wall intercepts the southeastern portion of the tún wall and encloses an additional 550 m^2. These walls appear to define the outer boundary of Hegranesþing, although many surface features, consistent with booths, can be identified well outside these walls.

The modern farm buildings of Garður are about 400 m to the south of the Hegranesþing's tún boundary wall. To the west of Hegranesþing is the delta of Austari-Héraðsvötn, that includes

Garðssandur & Flæðar. To the east is the farm of Keflavík, to the northeast is the farm of Utanverðunes, and to the north are the waters of Skagafjörður. The rivers that currently surround Hegranes, Austari-Héraðsvötn and Eystri Héraðsvötn are constantly shifting and Hegranes may have been connected to one side or another in the past, rather than being an island, as it is today (Zoëga 2015). Garður has been assigned number 444 based on its Jarðatal number (Johnsen 1847:277). The main farm area, where the modern buildings are located is place #1. Hegranesþing has been assigned place #2.

Figure 1. Air photo of Hegranes showing modern farm boundaries in yellow.

Figure 2. Kite photograph of Lower Keflavík with tun boundary wall from (Zoëga and Sigurðarson 2009) in yellow and defined Lower Keflavík area in black. The churchyard associated with the western farm mound (Keflavík 1) is also shown.

3.1 Geology and tephra

The geology of the region is characterized by Upper Tertiary basic and intermediate extrusive basalts (Feuillet, et al. 2012) overlain by morainic glacial till (Decaulne, et al. 2016). The area was deglaciated by 6100 yr cal.BP and then subject to uplift (Cossart, et al. 2014). Hegranes is probably a large rock drumlin, flyggberg, or rôche moutonnée formation (e.g., Neil 2002), with a long gradual south-side slope and a more sudden fall off on the north with many areas of plucked bedrock on that side of the island. The natural stratigraphy of the near surface of the region consists of a rapidly formed sediment and soil with intermixed tephra layers, along with gravel layers and lenses of glacial origin. The soil is a brown andosol that derives from aeolian sediments of volcanic origin, but is not the direct product of eruptions (Arnalds 2004, 2008; Arnalds, et al. 1995). The andosol is non-cohesive but has an extremely high water-retention capacity (Arnalds 2008).

The settlement and church survey relies heavily on tephra layers preserved in the soil. Skagafjörður has an early tephra sequence that allows for a fine-grained chronology of the changes in early settlement patterns (Larsen, et al. 2002). While tephra deposition can vary over small distances (Davies, et al. 2010) the basic tephra sequence is found throughout Skagafjörður and allows for a common dating system among farms and farmsteads (Þórarinsson 1977).

- Historic:
  - Hekla A.D. 1766. A black tephra usually found in turf or in the upper 10 cm of the soil sequence (Kirkbride and Dugmore 2006; Thórarinsson 1967).
  - Hekla A.D. 1300: A gray-blue to dark black tephra (Larsen 1984; Larsen, et al. 1999; Larsen, et al. 2002; Larsen, et al. 2001; Sveinbjarnardóttir 1992).
  - Hekla A.D. 1104 (H1). This white or yellowish-white tephra is the most consistent in Skagafjörður (Eiriksson, et al. 2000) and is readily identifiable in both natural and cultural stratigraphic sequences.

- Landnám sequence (LNS):

  - Vj~1000 tephra. A blue to bluish-black layer whose source has not been determined but is likely to be either from a Grímsvötn and/or Veiðivötn eruption dated to approximately A.D. 1000 (Sigurgeirsson 2001). The layer was first suggested in two undergraduate theses (Jónsson 2005; Ólafsson 1985) and it has been proposed that this layer may be found in other areas (Aldred and Sigurgeirsson 2005; Lárusdóttir, et al. 2012). Preliminary analysis of the composition of volcanic glass shards by scanning electron microprobe (SEM) has identified a mixture of shards from both volcanic sources.

  - The mid-10th century layer (~950). This blue-green layer that is sporadically found is currently an un-sourced and undated layer that lies between the LNL and Vj~1000. There are several potential candidates for this layer, including the large eruption of Eldgjá dated to A.D. 934 ±2 (Fei and Zhou 2006; Hammer, et al. 1980; Thordarson, et al. 2001) or perhaps a few years later (Oppenheimer, et al. 2018). It could also be an A.D. 933 ±6 green tephra layer identified in the Lake Mývatn area from Veiðivötn, termed V-Sv ~950 (Sigurgeirsson, et al. 2013). Preliminary analysis by SEM has identified shards primarily from the Grímsvötn source.

  - "Landnám" or "settlement" layer (LNL, LTL, also designated as 871). The layer is so-named for its association with the earliest settlements in Iceland (Dugmore and Newton 2012)) and is dated to A.D. 871 ±2, (Grönvold, et al. 1995), but could be dated to A.D. 877±4 (Schmid, et al. 2017; Zielinski, et al. 1997). The tephra originates from the Vatnaöldur fissure swarm associated with the Torfajökull and Bárðarbunga volcanos (Dugmore and Newton 2012; Larsen 1984). In general, this layer consists of two distinct tephras–an olive-green tephra overlying a white tephra. However, in Skagafjörður, only the green portion is present (cf. Hallsdóttir 1987). In many cases this layer and surrounding layers of the LNS are tightly spaced in a brown organic rich soil matrix associated with the environmental changes of colonization.

  - Black tephra below the LNL (K800). The earliest tephra in this sequence is a dark black layer probably from the Katla volcano, but is not well dated (Wastegard, et al. 2003). It is usually labeled K800 in profiles.

- Prehistoric:

- Hekla 3 (H3). A thick (generally 2-3 cm) white or whitish-yellow tephra dating to about 950 B.C. (Dugmore, et al. 1995).

- Hekla 4 (H4). A thick (generally 1-3 cm) white or yellowish-white tephra dating to about 2300 B.C. (Eiriksson, et al. 2000).

3.2 Farmstead stratigraphy

Chronological phasing of farmstead sizes primarily relies on two tephra layers: the white Hekla A.D. 1104 (H1) and the dark Hekla A.D. 1300. These layers are the most commonly found in cores and often the easiest to identify of the historical tephras. H1 is presented twice as often as Hekla A.D. 1300. Using these tephra layers to date cultural deposits allows for the chronological phasing of farmstead sizes and for farmstead sizes to be compared across contemporary temporal horizons. Their presence also allows for the identification of changes in the size of individual farmsteads. Other tephra layers are used to help identify the overall stratigraphic sequence in the soil cores and to associate specific layers with historical periods. Deposits categorized by these temporal phases are based on whether or not they contained "farmstead" material. The resulting chronology allows for the estimation of farmstead size for three primary periods:

- Pre-A.D. 1104
- A.D. 1104-1300
- Post-A.D. 1300

3.3 Farmstead deposits identified in coring

To determine the location and area of farmstead deposits, the results of cores were divided into three simple categories: "yes," "no," and "maybe" based on the presence of cultural material above or below specific tephra layers (Steinberg, et al. 2016). Small and infrequent anthropogenic inclusions in soils – such as ash, charcoal, and bone – are common near farmsteads and other activity areas. These are good indicators that an activity area or domestic site may be nearby but we do not count infrequent inclusions as contributing to the areal extent of the farmstead. Higher concentrations of anthropogenic inclusions, midden deposits, turf, and floors are included in farm mound deposits.

For the “Pre-A.D. 1104” period a “Yes” cores presented cultural deposits below the H1 (or an earlier) tephra. “Maybe” cores indicated early cultural deposits, as determined by depth or association with another tephra such as the 1766 or 1300 tephra, but without the presence of a clearly defined H1 tephra layer. The absence of the H1 in a context of a cultural deposit is mostly because it was not preserved or the core did not penetrate deeply enough to encounter it (i.e., refusal within more recent deposits). A “no” core resulted when no cultural layers were present in the core or where there was no cultural layer below the H1. Almost all “no” cores had the H1, or some other tephra that allowed for the assessment of this important negative evidence. The same logic was used for the “A.D. 1104-1300” and the “Post-A.D. 1300” farmstead distributions based on coring.

For the purposes of the coring survey, farmstead or farm mound deposits include:

- Turf deposits: any evidence for a turf structure, including collapsed or levelled turf, are considered evidence of farm buildings. The organic content and percentage of soil in turf deposits is variable. Sometimes tephra layers are present in turf, which can provide a terminus post quem (TPQ) date for the deposit. Dating turf deposits is not without difficulties. As a rule, a turf farmstead deposit containing a tephra layer is a positive farm mound location (yes) for the period(s) after the latest identified tephra. In the absence of in situ tephra, the rest of the deposit is characterized as a potential farm mound (maybe). For example, in a core with turf including what was identified as the H 1300 tephra as the only "farmstead deposit" would be coded as "Yes" for post-1300 but also "Maybe" for the pre-1104 and 1104-1300 phases because of the inherently uncertainty of a field identification of a single dark tephra.

- Low density cultural layers (LDC): defined by anthropogenic inclusions amounting to 10-50% of the soil matrix. These are assumed to result from indistinct and extensive depositional events that suggest regular activity typical of farmsteads or other farm production areas. Sometimes this deposit has a “mixed” character.

- Middens: defined by anthropogenic inclusions amounting to more than 50% of the soil matrix that suggest the regular deposition of household or production area waste. Middens are the result of distinct and intensive depositional events associated with purposeful disposal. In both LDC and Midden layers that are punctuated by tephra layers, for purposes of farm mound dating, the deposits are assumed to be continuous, occurring immediately before and after the date of the tephra deposition. For example, in a midden deposit with only H1 present, surrounded on either side by midden, both "Pre 1104, and "1104-1300" would be positive ("yes") while "Post-A.D. 1300" would be "maybe."

- Floor: characterized by dense, compacted, and/or greasy cultural layers indicative of floors, extramural activity areas, or areas of intense deposition of organic materials. Sometimes floors are distinct fine-grained black ash. These floor deposits are often thin but are very distinct.

For a farmstead to be defined, at least one core had to have some evidence of human burning or other unambiguous evidence of human occupation that would be distinct from an animal only outbuilding. A farmstead's perimeter for a given time period was determined by the results of the plotted cores taken around a farmstead site. The perimeter was plotted half way between a "yes" and "no" core, or on a "maybe" core between a "yes" and "no" core. The continuous area within the perimeter was calculated to produce the maximum possible area of a farmstead.

Most cores with farmstead deposits are clustered together allowing for the definition of a single contiguous farmstead area. However, isolated areas with multiple cores containing farmstead deposits that are some distance removed from the main farmstead area are often identified in the coring. A 30-meter, multiple core rule was applied to these areas to determine whether these islands should be included in the main farmstead boundary, generated an additional measured area of the same farmstead, or were ignored. First, islands were only identified based on multiple neighboring cores that had farmstead deposits. Single isolated cores with farmstead deposits were not considered islands. Second, islands had to have a midden deposit present in at least one of the cores. Isolated areas of turf or LCD, without nearby midden, floor, or distinct cultural deposits, were not defined as farmstead islands. If the islands had a sterile interstitial area that separated the island from the main farmstead area by less than 30 m, the main farmstead boundary was extended to include the island. Separate enclosing boundaries were generated for islands that had sterile interstitial areas of more than 30 m from the main farmstead area. The area of these isolated islands was then added to the area of the main farmstead. Isolated farmstead deposits beyond 100 meters from the main farmstead are counted as separate named farmstead areas.

3.4 Written sources

The Earliest mention of Hegranesþing is in The *Saga of Grettir the Strong* where it was described having booths separated from some of the more public areas:

> . . . [T]he Hegranes Assembly came around in the spring. A great gathering from all the districts that the assembly covered attended. They spent much of the spring engaged in both legal cases and festivities, because at that time there were many men in the districts who liked celebrating.
>
> [Grettir] arrived at the assembly as people were living the Law council on their way back to their booths…
>
> Some young men said that the weather was fine and pleasant and that it would do them good to arrange wrestling matches and entertainment. Everyone agreed that this was a good idea and went to sit down near their booths. . . (Scudder 1997:160)

Hegranesþing is also mentioned in the *Saga of Hacon* where the attempted swearing of an oath seems to be adjourned from Hegranesþing to a later date at the Althing (Þórðarson 1894).

Between 1271 and 1281 law books divide the Hólar bishopric into four assembly regions, specifically specifying Hegranesþing as one of them (Sigurðsson 2012). Hegranesþing is also mentioned in the *Lárentíus Saga* (Hafliðason 1890), a saga written down about 1530 and describing the events of AD 1301. Hegranes “moot” is described as the location where Berg the Wren thought he killed Krók-Álfur, a Norwegian official, who was presenting writs from the King of Norway to the assembled people. According to the story, Krók-Álfur was appointed to two quarters of Iceland and at both Oddeyri and Hegranes assemblies, the people accosted him.

> At Hegranesþing:” he was so scared that he hardly knew where to turn for refuge: the vagabond beggars whooping and hollering, smote their shields against him; he was only saved from slaughter at their hands by Lord Thórd from Mödruvellir and other lords having him covered by their shields. (Hafliðason 1890:27)

In 1374 Garður is listed in the Hólar land inventory as belonging to that bishopric (Pálsson 2010:39) but Hegranesþing is not specifically mentioned in that document. Along the same lines, medieval documents from about that time mention churches and chapels on nearby farms (including Ás, Keflavík and Utanverðunes), but not at Garður (Sigurðardóttir 2012:31). In 1713 Garður was worth 20 hundreds (Magnússon and Vídalín 1930:64) and no sub-farms are mentioned in the listing. However, there is a reference to an abandoned weaning fold (stekkur) with field walls around it. Magnússon and Vídalín (1930) suggest that it might have been a small subsidiary farm occupied by freed slaves (þrælagerði). Oddly enough, they are told that the site of the meeting place is lost, but that it might be north of "Garðar" (Friðriksson, et al. 2004:39). In the second decade of the 19th century, Finnur Magnússon mentions that ruins of the assembly site are visible on Hegranes but no specific location is given (Rafnsson 1983). According to the later Jarðatal, Garður was worth 20 hundreds (Johnsen 1847) and there is no mention of outbuildings or subfarms, let alone an assembly site.

3.5 Previous archaeological work

The earliest known scientific investigations at Hegranesþing is that of the philologist and cultural historian Kristian Kålund between 1872 and 1874 (Kålund 1892:78) who identifies the spot on Garður as being the assembly place. In 1886 Sigurður Vigfússon describes 48 different structures at Hegranesþing (Vigfússon 1892). Of those structures, he associates 17 with the weaning fold, the specific location as that of the Hegranesþing of Grettir the Strong, and with the place name Litli-Garður. In 1896 Daniel Bruun noted even more structures (Bruun 1897:226) and he produced a map in 1898 (Bruun 1899). In 1974, the National Museum investigated a booth impacted by road construction (Ólafsson and Snæsdóttir 1975). The stone-footed building did not have a floor and only a few stains of charcoal, burnt bones, and peat ash in the deposit. Six postholes filled with sand in the center of the building were identified.

In 2003 as part of the Assembly Project, a surface survey and two test excavations were conducted at the site of Hegranesþing (Friðriksson, et al. 2004). Excavation 1 revealed the presence of a supposed early Christian cemetery from about the time of deposition of the 1104 (H1) tephra layer. In particular, the visible circular enclosure wall of the cemetery was mostly from the time after the H1 tephra fell. In addition, the cultural layers identified were not associated with the cemetery but from a much later smaller farmstead, that was abandoned well before the 1766 tephra fell. Excavation 2, into a booth, revealed turf foundation walls constructed between 1104 and 1766, but closer to 1104. Although there were animal bones and bits of charcoal, no cultural layer was encountered.

In 2009, three test trenches were dug as part of the Skagafjörður Church Project. Excavation 1 of the prior Assembly project was expanded and deepened, revealing four graves. The two graves that had been identified in 2003 were fully excavated and the skeletons removed for further analysis. Another test trench was placed about 8 m to the south of test trench 1, just east of a presumed church ruin. The trench revealed the cut of a fifth grave (Zoëga 2009). While the two graves excavated were clearly dug through the 1104 tephra, two other burials were overlain by that tephra, suggesting that the cemetery was in use before and after the tephra layer fell. The third test trench confirmed that the cemetery's wall that is visible on the surface post-dates 1104 and most likely represents a 12th century enlargement of the cemetery. The cemetery had been landscaped and leveled with turf, both before and after the 1104 tephra fall, the later landscaping episode probably associated with the building of the cemetery wall. The cemetery remains are consistent with a large number of early Christian farmstead cemeteries that are found in the Skagafjörður region (Zoëga 2014, 2015). Thus, the functional, temporal, and spatial relationship between the cemetery and the assembly is unclear, but the cemetery is potentially associated with a nearby farmstead.

Figure 3. Bruun's 1898 map superimposed on landscape. Georeferencing is based on tún walls.

In 2013 and 2015, as part of this project, a series of geophysical surveys were conducted at Hegranesþing (Damiata, et al. 2016). The work in 2013 was a preliminary part of the SCASS project to investigate and analyze the use of geophysical methods to locate and image early Christian cemeteries in Iceland, while the work in 2015 was part of the basic SCASS work described in the front matter. This work indicated that the northern part of the cemetery at least was densely packed with burials. High ground conductivity readings in the center of the visible tún enclosure (478610E 581500N) suggests the possible presence of a long-term domestic occupation (Damiata, et al. 2016). The broad anomaly of elevated readings is qualitatively different from the well-defined smaller "booth" anomalies as seen in other parts of the site. In 2016, a geophysical and coring survey took place, and two distinct areas of habitation, before and after 1104 were defined (Steinberg, et al. 2017). This work is a follow up on this earlier work.

4.0 LAND SURVEYING AND ESTABLISHMENT OF GRIDS

All land-survey data were collected based on the ISN93 coordinate system. Core locations were determined in several ways. For only a few cores that were taken well away from ruins, the internal GPS receiver in the iPhones or iPads that were used to record the coring data was used. Within Lower Keflavík, most cores were collected on 10 x 10 m grid that were located with the Topcon GPT 9005A total station. Judgmentally placed cores were originally located with an iPad and then refined by either a Topcon Hiper SR DGPS or a Trimble Geo XH which was equipped with a Zepher antenna in order to improve upon the accuracy of the locational data.

The geophysical grid was initially established using a Topcon Hiper SR DGPS using the ISMAR differential station at Stoð ehf in Sauðárkrókur, which yields about 1 cm horizontal accuracy and 2 cm vertical accuracy. The original GPS points were re-measured with the Topcon GPT 9005A auto tracking pulse total station to ensure consistency across different total-station set ups. The corner points of the survey area and internal grids at intervals of 50 × 50 meters were flagged using the total station. Additional flags were laid out at intervals of 10 × 10 m using fiberglass measuring tapes that were stretched between the stations established by the DGPS. The eastern and western baselines of the entire grid were flagged at 1-m intervals using alternating colors. Additional lines of alternating flags running east to west were laid out 10 m apart to help guide the surveying.

5.0 GEOPHYSICAL SURVEY

The use of geophysical methods in support of archaeological investigations is widely established (e.g., Gaffney and Gater 2003; Linford 2006). For the 2017 study, frequency-domain electromagnetics (FDEM) was applied over substnatial portions of the assembly site. Summarized below are the geophysical methodologies that were used. Appendix A provides a general overview of FDEM operations.

5.1 Site Conditions and Geophysical Targets

The natural stratigraphy of the region consists of soil with intermixed tephra layers, along with gravel layers and lenses of glacial origin. At Hegranesþing, the ground surface is hummocky due to a combination of thufurs or frost heaves (e.g., Grab 2005) as well as the remnants of archaeological remains. A limited excavation within the cemetery proper yielded fill layers overlying a gravel deposit below which two well-preserved skeletons were revealed (Zoëga 2009).

There are several potential geophysical targets associated with the Viking Age archaeological remains at Hegranesþing. For this survey, the most important targets are usually found in a central farmstead. The most common include: longhouses, middens, barns, pit houses, outbuildings, and churches. Other features, that are not necessarily roofed buildings, include animal pens, seasonally occupied booths, and boundary walls - which can, less frequently, be identified using maps of geophysical readings. Geophysical techniques are most effective for predicting the location of buried archaeological structures and deposits without surface sign where the deposits are substantial and are of a single component. Furthermore, the archaeological remains must have physical properties that make them distinct from the surrounding environment. Finally, the geophysical techniques work best where the remains have a will-defined interface with an original surface. Generally, geophysical techniques are contraindicated when the remains are ephemeral, or in disturbed contexts, or part of a complex palimpsest-like deposit.

The two main targets for the geophysical survey are long houses and churchyards. Long houses are distinguishable by their geometry, with two slightly bowed 2 m thick turf walls that are between 4 and 8 m apart. Thus far, we have not identified a central fireplace or hearth with geophysical techniques, but these fire features are a key part of longhouse structures.

Other archaeological remains (e.g., booths, walls) are expected to consist of compacted turf blocks overlying a stone foundation. In some cases, the turf will be placed directly on the ground or on a prepared surface. From a geophysical perspective, measurable contrasts between stones and soil and between compacted turf and soil are anticipated (i.e., contrast in apparent ground conductivity and in-phase for FDEM).

In general, churchyards consist of a small central church that is surrounded by a cemetery, which is enclosed by a circular wall. The churches are often only 3 × 4 m in size and constructed of wood with stone foundation. The wall is typically between 15 to 30 m in diameter and composed of compacted turf overlying a stone foundation or gravel base. Graves may be found throughout the enclosed cemetery including under the church.

Graves can be a difficult geophysical target to detect but differential fill, breaks in soil stratigraphy, and the interfaces along the sides and bottom of grave shafts might be detectable (Bevan 1991; Conyers 2005, 2006; Doolittle and Bellantoni 2010; Jones 2008; King, et al. 1993). In some instances, the direct detection of skeletal remains is possible (Damiata, et al. 2013; Damiata, et al. 2017; Schultz 2008; Schultz and Martin 2011).

5.2 Frequency-Domain Electromagnetic Surveying

In 2013, an FDEM survey was conducted over a 50 × 50 m grid, which was primarily intended to investigate the churchyard. In 2015, an expanded reconnaissance survey was conducted over areas to the south, north and west of the churchyard—including most of the homefield. One objective of this work was to directly compare geophysical results (Damiata, et al. 2016) to the exposed archaeological remains (e.g., Figure 3). In 2016, a third FDEM survey was conducted, which covered a portion directly to the north of the expanded reconnaissance survey that was conducted in the previous year (Steinberg, et al. 2017). Here we report on the results of the forth FDEM survey undertaken in 2017 with the CMD Mini-Explorer.

5.2.1 Equipment and Field Procedures

The FDEM surveys were conducted using a GF Instruments' CMD Mini-Explorer (Figure 4). The CMD Mini, like the larger CMD explorer operates at 30 kHz over three separate dipole lengths. By increasing dipole length, a greater volume and depth of soil can be sensed. The CMD mini Explorer has a single TX located at one end of the unit and three separate RX located at dipole lengths of 0.32, 0.71 and 1.18 m which provide depths of interrogation of approximately 0.5, 1.0 and 1.8 m, respectively, relative to the level of the sensors (Bonsall, et al. 2013). For the 2017 CMD Mini survey, the unit was operated in the vertical dipole mode with the boom carried at foot level oriented parallel to the direction of the east-west transects that were walked unidirectinally from west to east along contiguous transects that were separated by 0.25 m. The sampling rate was set to 10 Hz (i.e., 10 samples per second), which yielded a spacing between measurements of ~0.06 m while walking at a normal pace. The surveying was guided by color-coded PVC flags that were placed every 10 meters along transects separated by 1 m. The survey took place over four days and no appreciable rain fell between surveys.

Both quadrature phase (bulk ground conductivity - C) and in-phase (related to bulk ground magnetic susceptibility - IP) components were recorded for each of the three dipole lengths (i.e., six simultaneous readings were recorded for each "measurement"). Maps and figures of FDEM readings are labeled with the component and dipole length. Thus, C1 and IP1 present quadrature phase and in-phase data from the shortest dipole length, and shallowest depth of interrogation while C3 and IP3 present quadrature phase and in-phase data from the longest dipole length, and greatest depth of interrogation.

Figure 4. Using the CMD Mini Explorer with the boom oriented parallel to the direction of transects.

5.2.2 Data Processing

The raw data were initially corrected to properly adjust for the starting and ending locations of each transect. As a check on quality control, the average spacing of measurements for each fiducial segment along a given transect (i.e., every 10 m) was calculated to ensure the spacing between measurements was approximately 0.07 m or less. The data were then processed using Oasis Montaj mapping software to produce color-contoured maps. The four days of survey were processed individually and three of them were later combined into a single dataset. The merging of these data sets required slight color adjustments to create single images with minimal mismatch at the seams. The CMD Mini-Explore data set over the visible circular churchyard was not combined, but still has a similar color range. The processed data were also archived into a database for future use.

5.2.3 Results

Figure 5 and Figure 6 present the composite results for apparent ground conductivity and in-phase component, respectively. The FDEM data provide detailed maps that reflect changes in both surficial topography and subsurface material properties. The results for C1 and IP1 provide the best correspondence to the partially visible remains, which include enclosure wall of the churchyard, boundary wall of the homefield, and booths within and outside of the homefield.

With respect to apparent ground conductivity and sensor 3 (Figure 5 left), archaeological features that have relatively pronounced topographic variations (e.g., tún wall) present themselves as a high-low-high (i.e., red-blue-red) responses. This is attributed to elevational variations of the RX and TX as the feature is approached and crossed over, and to a lesser extent to the distances to buried stone or bedrock. However, features with little or no topographic expression (e.g., many of the booths) have responses that are more influenced by buried rock and appear as mainly low apparent ground conductivity (i.e., blue). This is the case for some of the booths to the northeast in the vicinity of the earliest excavations at Hegranesþing. All of those excavations suggest that the structures and walls have a substantial stone component that is consistent with the limited archaeological work that has taken place (Friðriksson, et al. 2004; Ólafsson and Snæsdóttir 1975; Zoëga 2009). As often the case, several of the blue lines in C3 are associated with turf walls. For the CMD Mini-explorer surveys that were conducted, combined with the results of the coring at this site, the pink in the IP3 component is sometimes associated with dense and thick areas of peat ash, charcoal and floors. That being said, high IP 3 values are also associated with the presence of rocks (Damiata, et al. 2016).

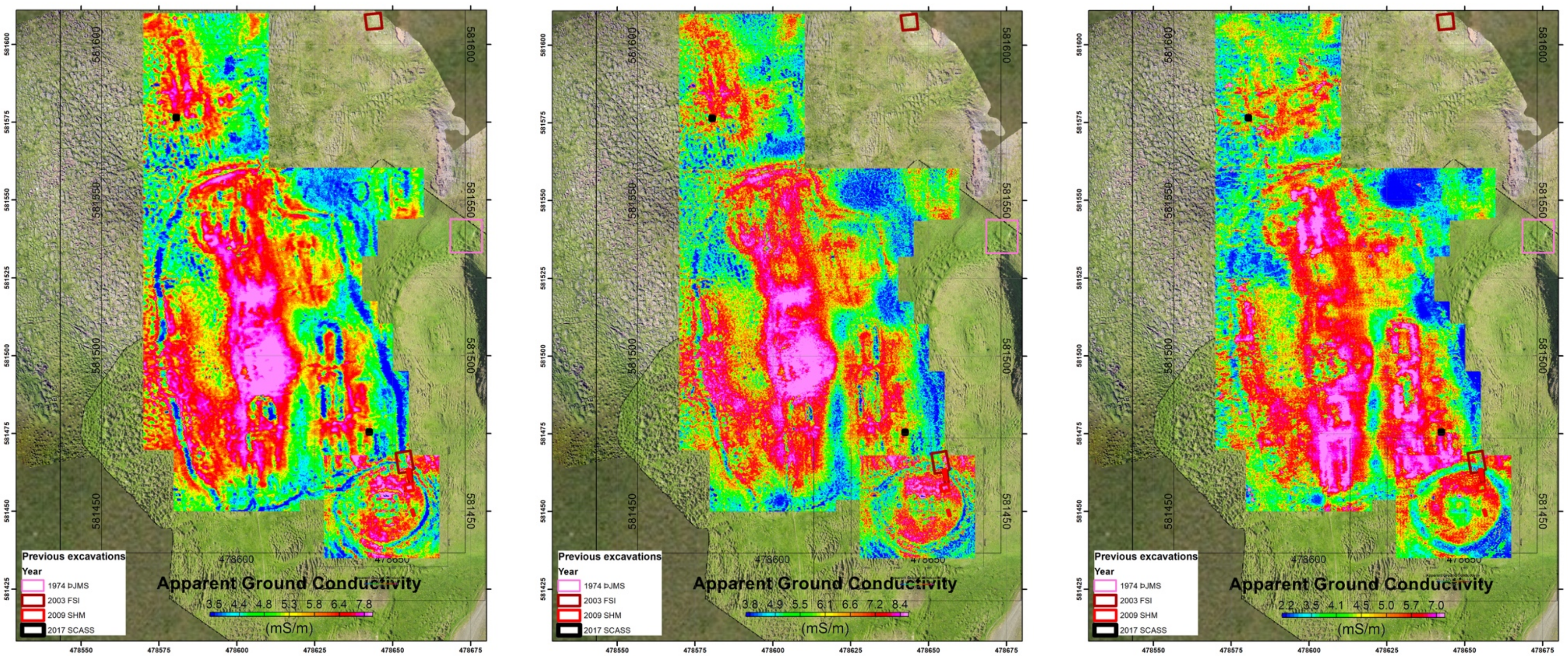

Figure 5. CMD Mini Apparent ground conductivity maps (mS/m) u. Left: C3 composite image. Middle: C2 composite image. Right: C1 composite image3.

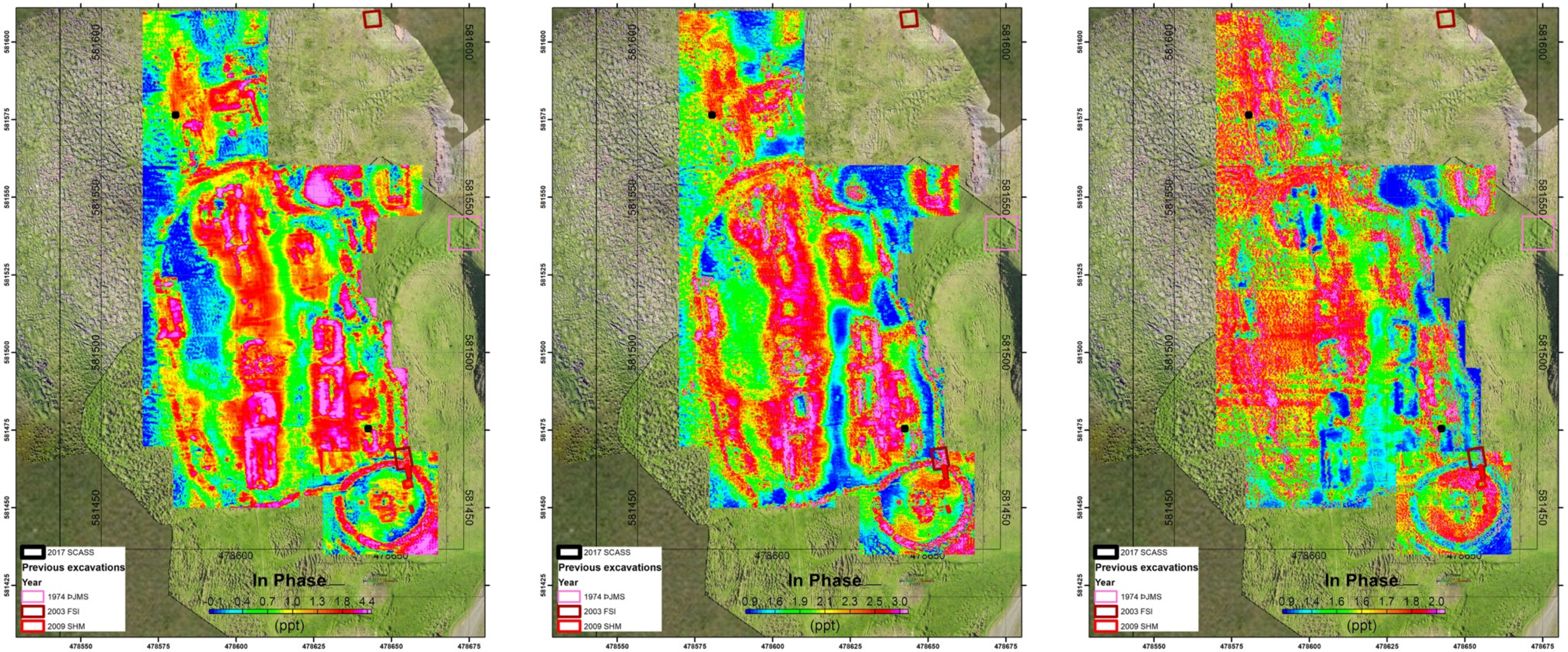

Figure 6. In-phase component maps (ppt). Left: IP3 composite image. Middle: IP2 composite image. Right: IP1 composite image.

6.0 CORING

174 cores were taken at Hegranesþing during the 2017 season. Those cores encountered 177 tephra layers (about 1.0 tephra layer per core) and 795 specific stratigraphic layers (about 4.6 layers per core). The 2017 cores taken in Hegranesþing bottom out at an average of 74.8 cm (SD=25.9) below the ground surface onto gravel (Table 1). For context, the overall average for cores for the SCASS survey is 62.6 cm (SD=94). Of these 174 cores, 32 did not have any cultural remains at all (Table 3). Fourteen cores had distinct floor deposits while 36 had district midden deposits, but, unusually, only one core (172779) had both floor and midden deposits. Almost 72.4% of the cores had turf deposits, and those turf layers had an average thickness of 37.7 cm.

Of these 174 new 2017 cores, there were 2 instances of the 1766 (both of which had the 1300 tephra) and 12 instances where the1300 tephra was presented. Conversely, 45 presented the H1 (25.9%) and 71 (40.8%) presented the H3/H4 tephra (Table 2). Eight cores encountered an in situ dark tephra from between the H1 and the time of settlement, four of them identified in the field as the "1000" layer, while four of the black layers were identified as the ~950 tephra. In no 2017 Hegranesþing core were two dark tephra from between the H1 and the time of settlement identified. Thirty-two of the 2017 cores indicated pre-1104 occupation, and only 2 indicated 1104-1300 occupation There were no 2017 cores that suggested a post 1300 occupation.

Many of the cores showed thick floor deposits (e.g., Figure 9, Figure 10, Figure 11, Figure 12, Figure 15, and Figure 16) substantial midden deposits (e.g., Figure 7, Figure 8, and Figure 14) and profiles consistent with burnt turf (e.g., Figure 10, Figure 13, and Figure 14). These specific deposits are entirely consistent with typical farmstead deposits seen elsewhere in Hegranes. Interestingly, there were no sequences of thin layers of ash, interspersed with aeolian deposits encountered in any of the cores, which is strange since clearly a substantial portion of the archaeology is entirely consistent with temporary booth structures seen at other assembly sites (Sanmark 2017; Vésteinsson 2013; Vésteinsson, et al. 2004). These thin alternating layers are clear in some of the Gásir deposits (Roberts 2006:13). While strange, this missing evidence of abandonment and reoccupation in the cores is consistent with the earlier excavations of temporary structures at Hegranesþing which suggest that trampled earthen floors are common (Friðriksson, et al. 2004; Ólafsson and Snæsdóttir 1975) and these deposits would probably not be identified in the standard JMC backsaver cores.

The deposits, when explored using coring transects (Figure 17, Figure 18, and Figure 19), appear to be substantial and consistent over 10's of meters, rather than associated with various and sundry refuse pits and pit-hearths associated with outdoor cooking seen at other seasonal sites such as Gásir (Harrison, et al. 2008; Roberts 2003, 2004, 2006; Vésteinsson 2008). That being said, it is possible that the deposits cored are not sheet middens and other continuous deposits but associated with a series of pits and specialized temporary industrial structures that appear to be continuous in cores, or that the pits are so numerous and so substantial that the deposits appear contentious. The general character of the cores does not suggest that an unusual number of pits were dug past the H3 tephra later and then filled with refuse. Of the 320 cores taken in 2016 and 2017 at Hegranesþing, 57 were considered to have midden deposits and 20 were interpreted as having floor deposits. Of the cores with midden 35% also had an intact H3 deposits below it (n=20), and 50% of the cores with floor had intact H3 deposits below them (n=10). The midden percentage at Hegranesþing is lower than the SCASS average of 41% of cores with midden that that have a preserved H3 below but the percentage of cores with floor and an intact H3 at Hegranesþing is higher than the 41% of total SCASS cores with floor and an intact H3. (Of the 7484 cores taken since 2013, 1142 cores had midden and 470 of those cores with midden had an intact H3 while 121 cores had floor and of those 50 cores presented both floor and an intact H3.) These numbers suggest that the midden and floor deposits at Hegranesþing are largely consistent with other farmstead deposits, in terms of being placed in pits or other environments where the subsoil is disturbed.

Figure 7. Core 172761 First 40 cm showing midden staring at 30 cm bgs

Figure 8. Core 172761 showing the second barrel 40-80 cm presenting midden down to 60 cm

Figure 9.Core 172812 with floor from 28 to 43 (3 cm into next barrel)

Figure 10.Core 172918 presenting burnt turf from 10-37 and dark ash layer (labeled floor) from 37 to the end of the 40 cm barrel

Figure 11.second barrel of 173051 showing a thin peat ash floor burnt turf from at 54.5 cm.

Figure 12.second barrel of core 173648 showing a thin black ash floor with potential 950 tephra layer just above it at 50 cm bgs.

Figure 13.core 73649 showing burnt turf from 20-45 (5 cm into next barrel)

Figure 14.core 173666 with thin midden from 34 to 36 with H1 underneath at 38 showing burnt turf from 20-45 (5 cm into next barrel)

Figure 15.core 173759 first barrel showing floor starting at 28 cm bgs and continues into the next core (Figure 16)

Figure 16. Second barrel of core 173759 showing floor that began at 28 (Figure 15) going down to 51 and another thin floor from 66 to 69.

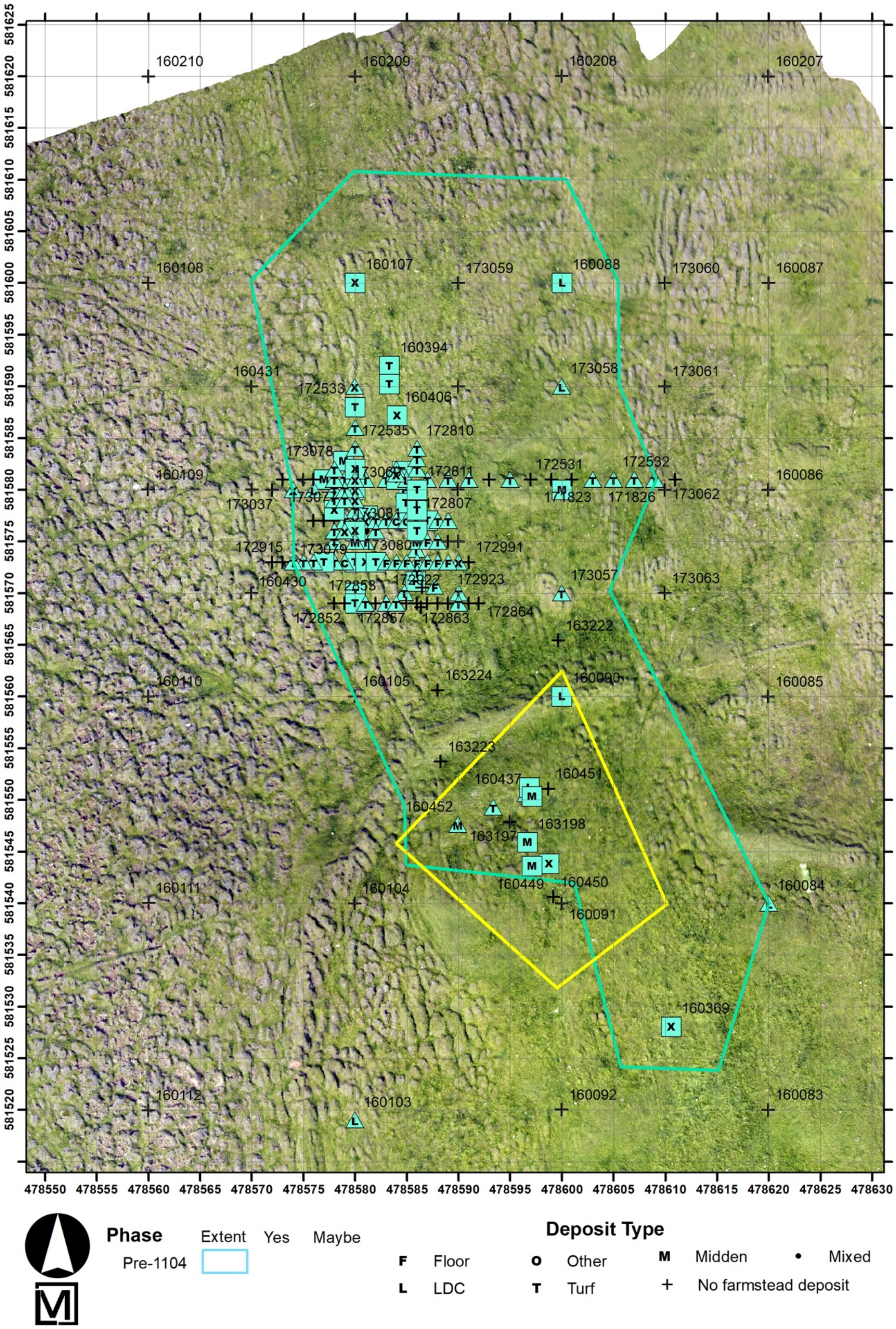

Figure 17. Northern pre-1104 farmstead area in blue, with coring results superimposed on orthophoto.

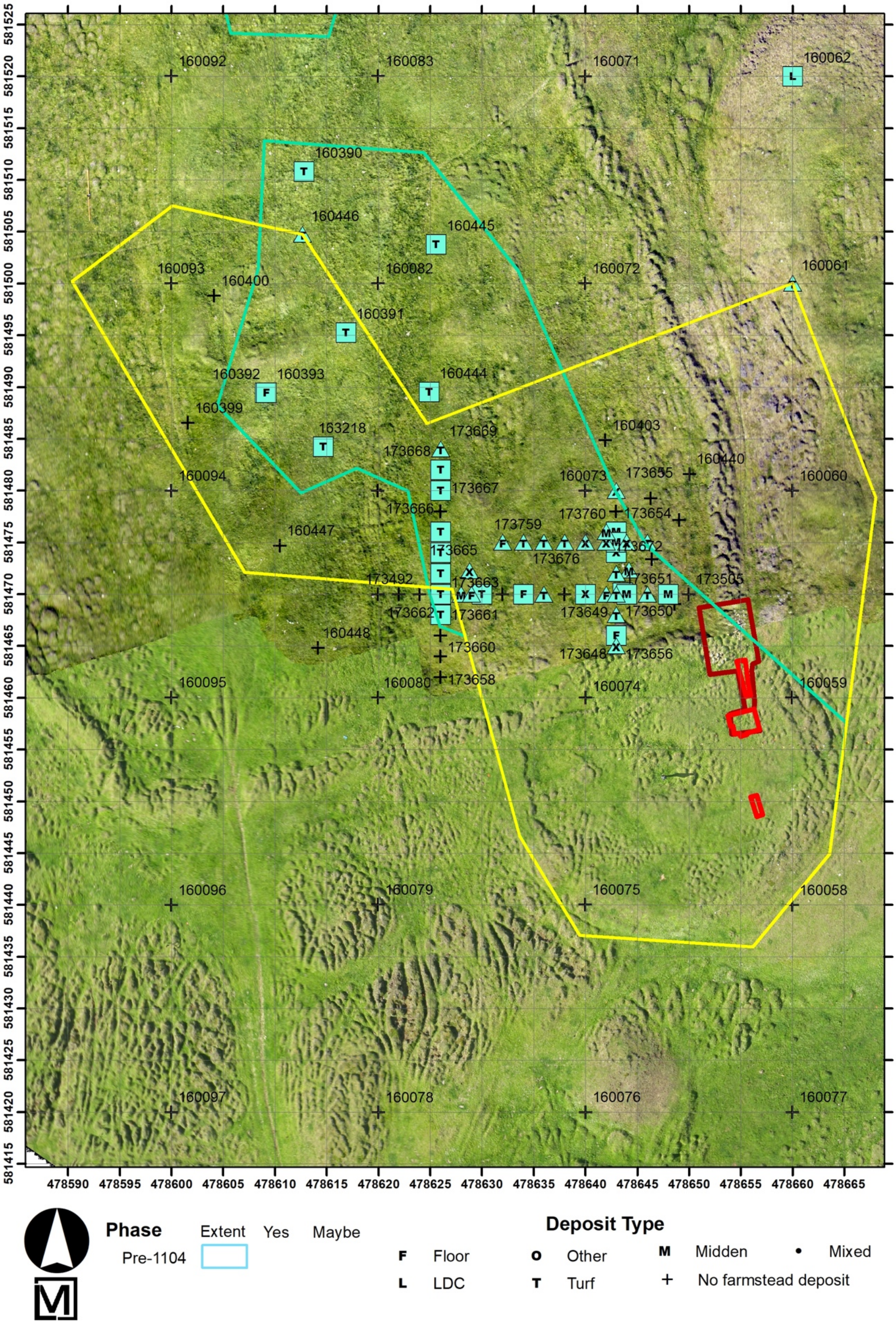

Figure 18. Southern pre-1104 farmstead area in blue, with coring results superimposed on orthophoto.

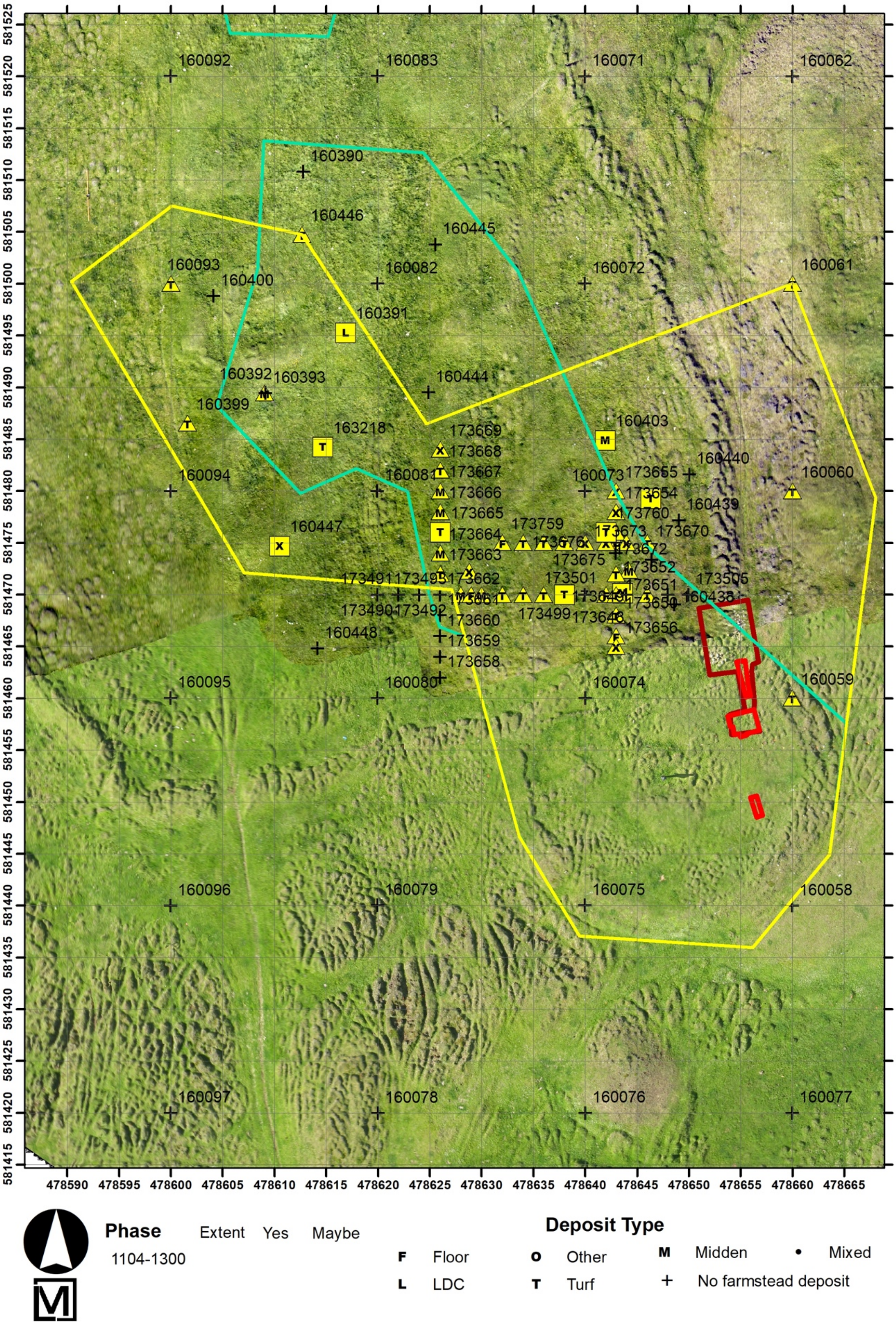

Figure 19. Southern 1104-1300 farmstead area in yellow, with coring results superimposed on orthophoto.

7.0 EXCAVATIONS

Two test pits were excavated at Hegranesþing during the 2017 field season. The idea was to place the excavations in middens that appeared to be associated with nearby structures, although the complex nature of the site makes the identification of structures difficult.

7.1 Test Pit 1

Test pit 1 (TP1) was placed based on a combination of visible surface remains, geophysical results, and coring. The coring in this northern area suggested a complex distribution of features with turf, midden, floor, and LDC with relatively clear edges defined by cores without any cultural material (Figure 20). The conductivity readings suggested two north-south parallel lines of turf (pink in Figure 21) while the IP readings suggested a broad smear of cultural activity with a substantial floor (pink in Figure 22). In order to attempt to avoid the internal parts of a poorly preserved, but perhaps very early structure, the pit was placed at the western edge of the potential smear of cultural material where tephra preservation seemed to be very good.

The sequence at TP1 (Figure 32) consisted of an aeolian deposit [101-102] over construction turf [103-108] that ended on a stone foundation [109] that was on top of a pink peat ash midden [110-114] that rested on a second lower deposit of turf [115-117] that rested on aeolian deposits (Figure 27). The actual sequence is only complicated by a turf wall and foundation (Figure 29). Context [101] was a standard root mat and aeolian soil with both the AD 1300 and 1104 tephras close together. The root mat rested on a typical sterile aeolian deposit [102] suggesting that the lower cultural deposits were abandoned well before the 1104 tephra fell. In sterile cores at Hegranesþing where both the 1104 and 1300 tephras were present, 18-15 cm separated the two tephra layers, but in this location, the separation was even less. Context [103] was primarily turf collapse which was on top of [104] which contained streaks of H3 mixed in. The turf was taken off in fairly fine layers so the turf deposits [104, 105, 106, and 107] are all similar and should be examined as a unit together, which might include the firmer [108] and the stone foundation of the turf wall [109], which was not excavated. Contexts [106 & 107] contained several pieces of metal (Table 4). The turf collapse bottomed out on a midden deposit (Figure 31). While [109] was not excavated, the sidewall below 109 made it clear that the wall was constructed on top of an early midden deposit. The first excavated midden deposit] [110] was taken as a thin slice because it bottomed out on a dark green tephra that was interpreted as the ~950. The rest of the excavated midden deposit was also taken in relatively thin slices that included [111, 112, 113, and 114]. The midden seemed to be composed primary of pink peat ash and contained a remarkable amount of well-preserved animal bones. Context [111] contained several pieces of worked bone, including pieces of a comb (Table 4). A second lower turf deposit, below the midden was also excavated in thin slices [115, 116 & 117] and was resting on a very thin aeolian deposit [118] which capped a distinct LNS. The LNS rested on another aeolian deposit [119] which was on another aeolian deposit [120] which contained a substantial but partially truncated in situ H3 tephra layer.

The sequence of TP1 suggests that the lower turf deposit may be collapse from a very early structure, so the main midden deposit in this sequence is later but potentially mostly before the ~950 tephra fell. The turf wall and stone foundation must have been constructed after ~950 and well before 1104. The sequence from this potentially very early farmstead does not show any signs of abandonment during its limited occupation. We assume that the midden profiled in TP1 is related to the substantial floor 4 m to the southeast (Figure 22). We suppose that the rest of a structure, with a long axis that runs north northwest, was disturbed by the construction of the tún wall. This farmstead may continue on the south southeast side of the tún wall, where it is overlain by a small distinct post 1104, pre 1300 occupation (Figure 38).

7.2 Test Pit 2

Test Pit 2 (TP2) was placed based on a combination of visible surface remains, geophysical results, and coring. Core 173657 presented a 12 cm thick midden with 10 cm of aeolian deposit between it and a 7 mm thick H1. The geophysics from this location suggested a structure with a south southeast running long access that apparently ended just a few meters north of the visible churchyard (Figure 24). The well-defined structures with probable stone walls to the west of TP2 (pink in Figure 25) are probably booths with almost perfect north-south orientations. While most of the deposits are pre-1104, there are some midden and turf deposits that are clearly 1104-1300 (Figure 26) in this area.

The sequence is straightforward, other than a post or stake hole [131] with a series of turf deposits that overlie an aeolian deposit mixed substantial bone inclusions (Figure 28)—

entirely consistent with seasonal feasting. Below a dark patchy charcoal midden is a patchy line LNS in an aeolian deposit that is on top of glacial gravel. The root mat [101 was on top of a patchy 1300 tephra layer (Figure 30) that was on top of a relatively sterile aeolian layer [121]. The next thee contexts [122, 123, & 123] Is a mixed turf, charcoal and bone deposit (Figure 35 & Figure 36) that rests on a patchy H1 that below a more sterile aeolian deposit [125]. While there are only patches if H1 visible in the sidewall, during excavation, the layer, while uneven, was clearly visible in several locations at the [125]-[126] interface.

The aeolian deposit and H1 is on top of the beginning a substantial midden. The top midden layer has more peat ash [126] and the next four midden layers [127, 128, 129, & 130] are mostly dark black with large mottled patches (Figure 34). Context [129] was a ridge of midden deposits, perhaps a single depositional event of ash, and does not appear in any of the side walls. Appearing just below the beginning of the midden [126] was a small stake hole [131] that extend through the four midden layers [127, 128, 129, & 130] filled with peat and charcoal midden and small unburnt wood deposits. The midden deposit was on top of a aeolian deposit with noticeable gravel [132] that contained a dark tephra interpreted in the field as the ~950 but could also be the 1000 tephra. Below this aeolian deposit was a glacial sand and gravel deposit [133].

On a methodological note, cores into the aeolian bone rich deposits of TP2 [122-124] missed their nature (e.g., cores 173760, 173653 in Table 3), completely. Those deposits were characterized as sterile aeolian deposits. This error suggests that many seasonal occupation deposits will not be identified in coring, at least with the JMC backsaver. Conversely, cores are an excellent tool for roughly characterizing substantial permanent, long-term farmstead occupations

This upper low density 1104-1300 midden [122-124] is consistent with both temporary occupations, such as the visible booths, or potentially with permanent but less intense and sporadic refuse disposal that takes place at the far edges of middens. Thus, it is critical to investigate other midden deposits to the east that are consistent with later (1104-1300 domestic occupations - Figure 37 & Figure 38). Test pit 2 suggests the pre-1104 midden [127, 128, 129, & 130] almost certainly associated with a domestic occupation immediately to the west of the test pit. Which, structure or structures, if any, visible on the CMD are associated with this midden is difficult to postulate. That being said, Test pit 2 is consistent with a domestic occupational sheet midden, and is in a typical location with regards to the visible churchyard and structures identified in the CMD readings, that the domestic occupation is associated with the church. The upper deposits, suggest either a distant edge or a seasonal occupation, consistent with later (post 1104) visible booths nearby, including in the churchyard itself.

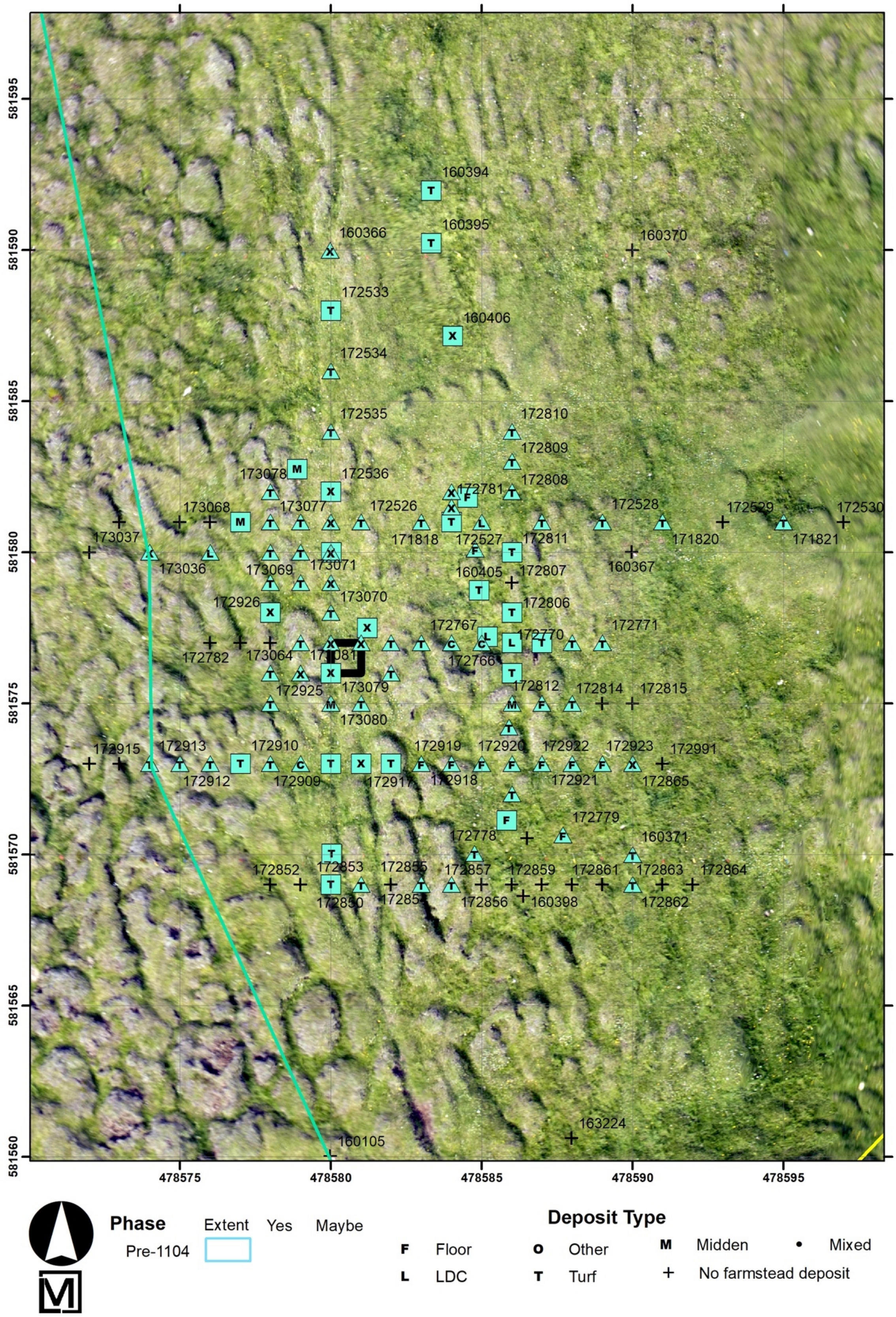

Figure 20. Location of test pit 1 with cores underlain by orthophoto

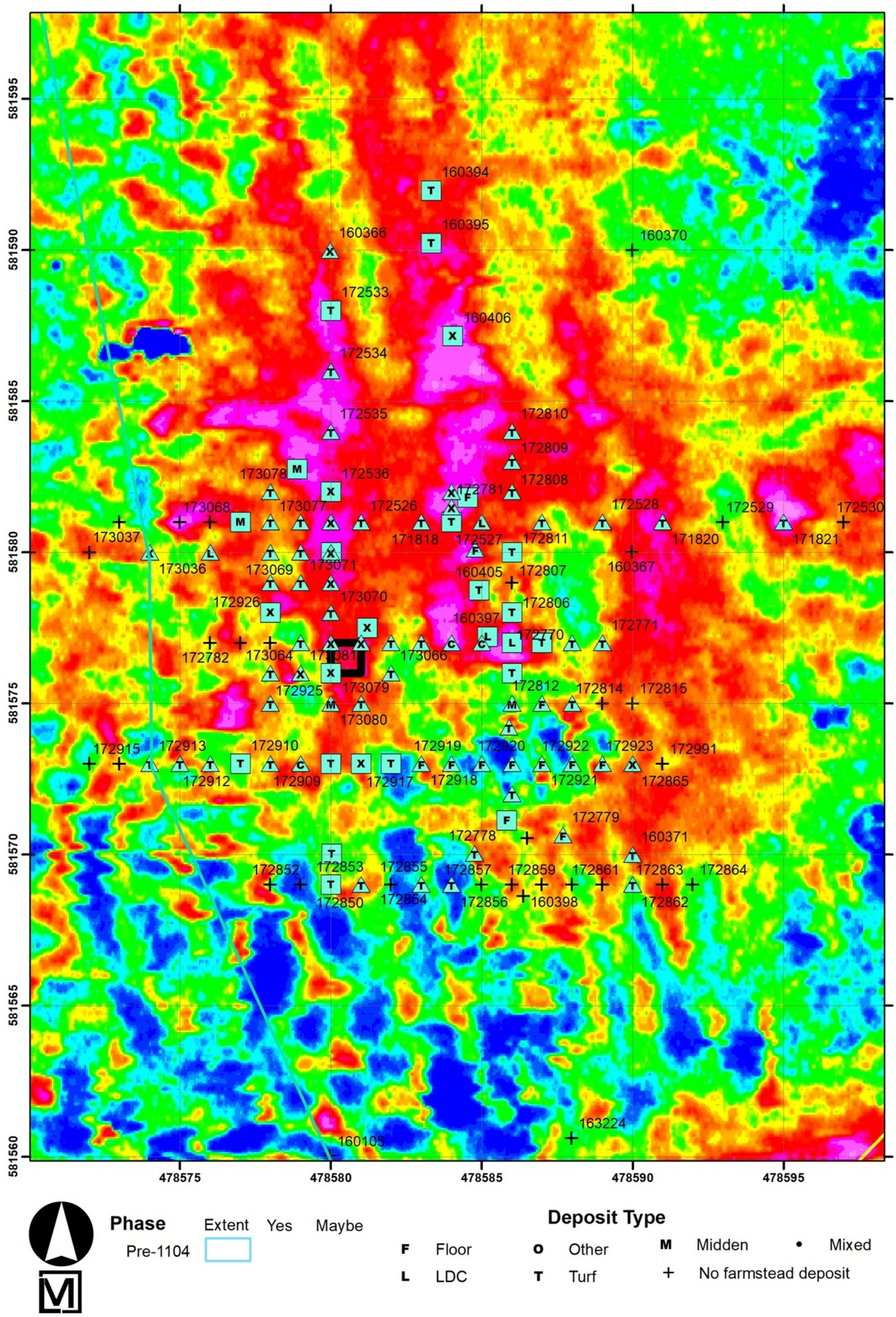

Figure 21. Location of test pit 1 with cores and CMD Mini Explorer C3 results (C3 color scale can be found in Figure 5 left).

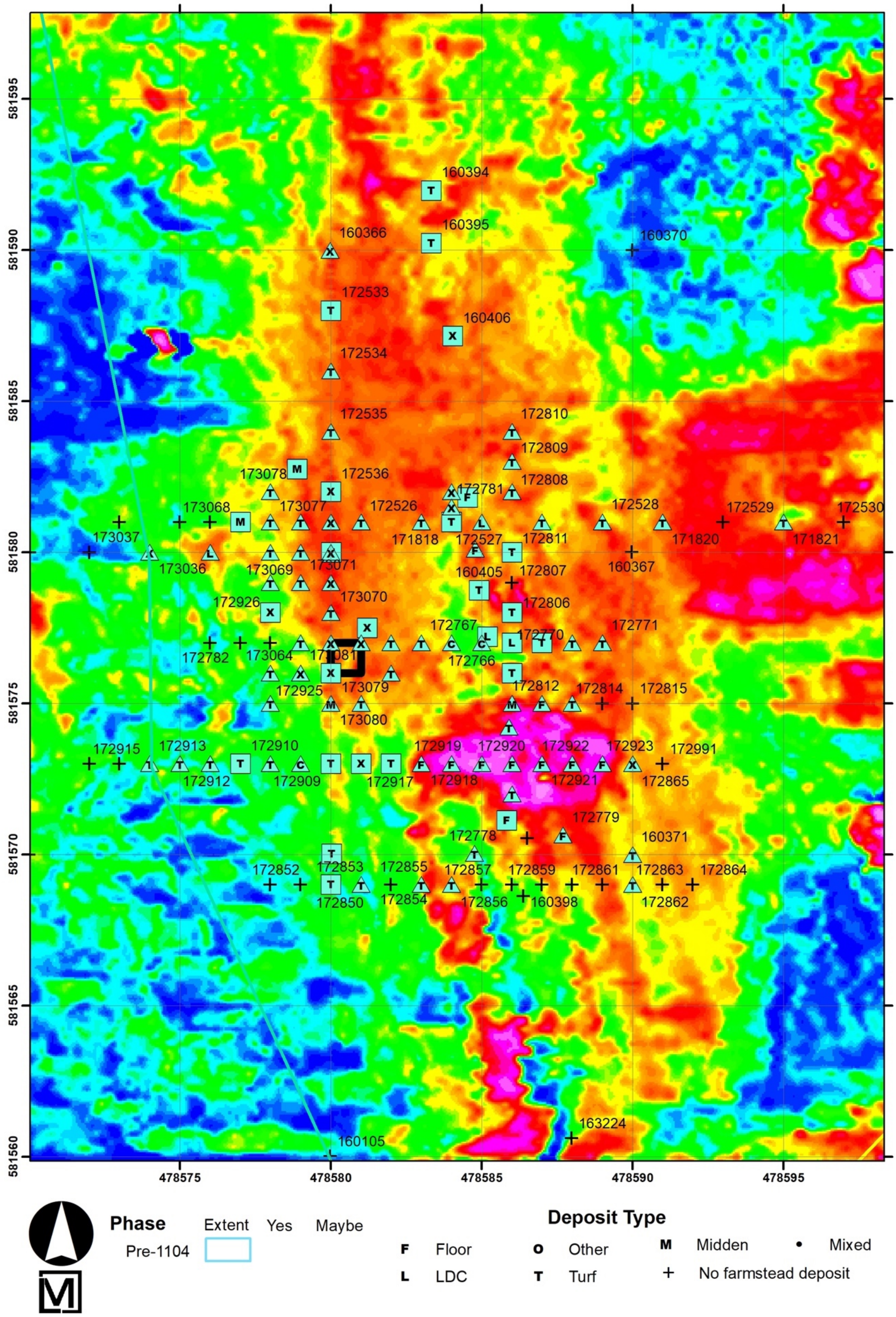

Figure 22. Location of test pit 1 with cores and CMD Mini Explorer IP3 results (IP3 color scale can be found in Figure 6 left).

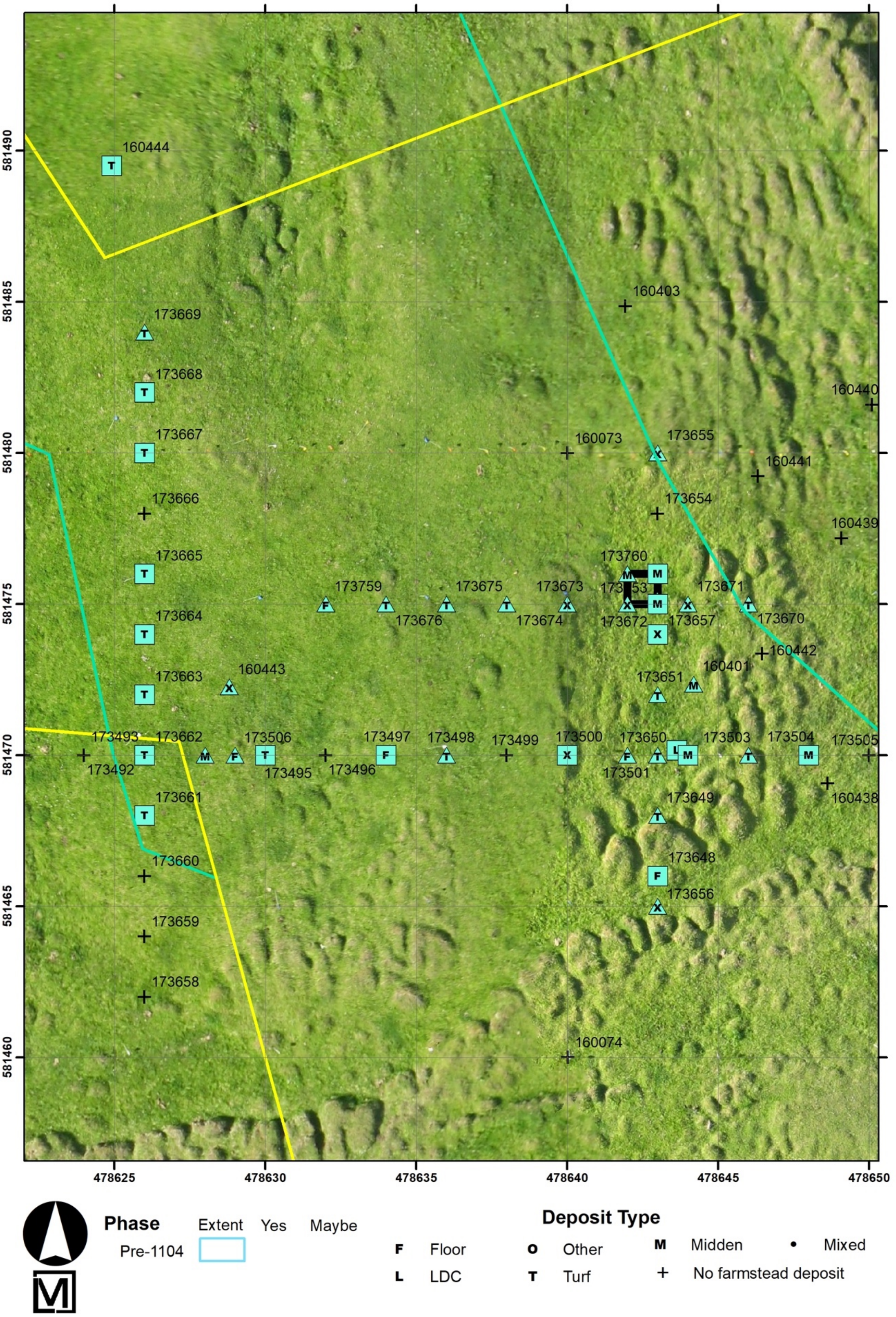

Figure 23. Location of test pit 2 with cores underlain by orthophoto

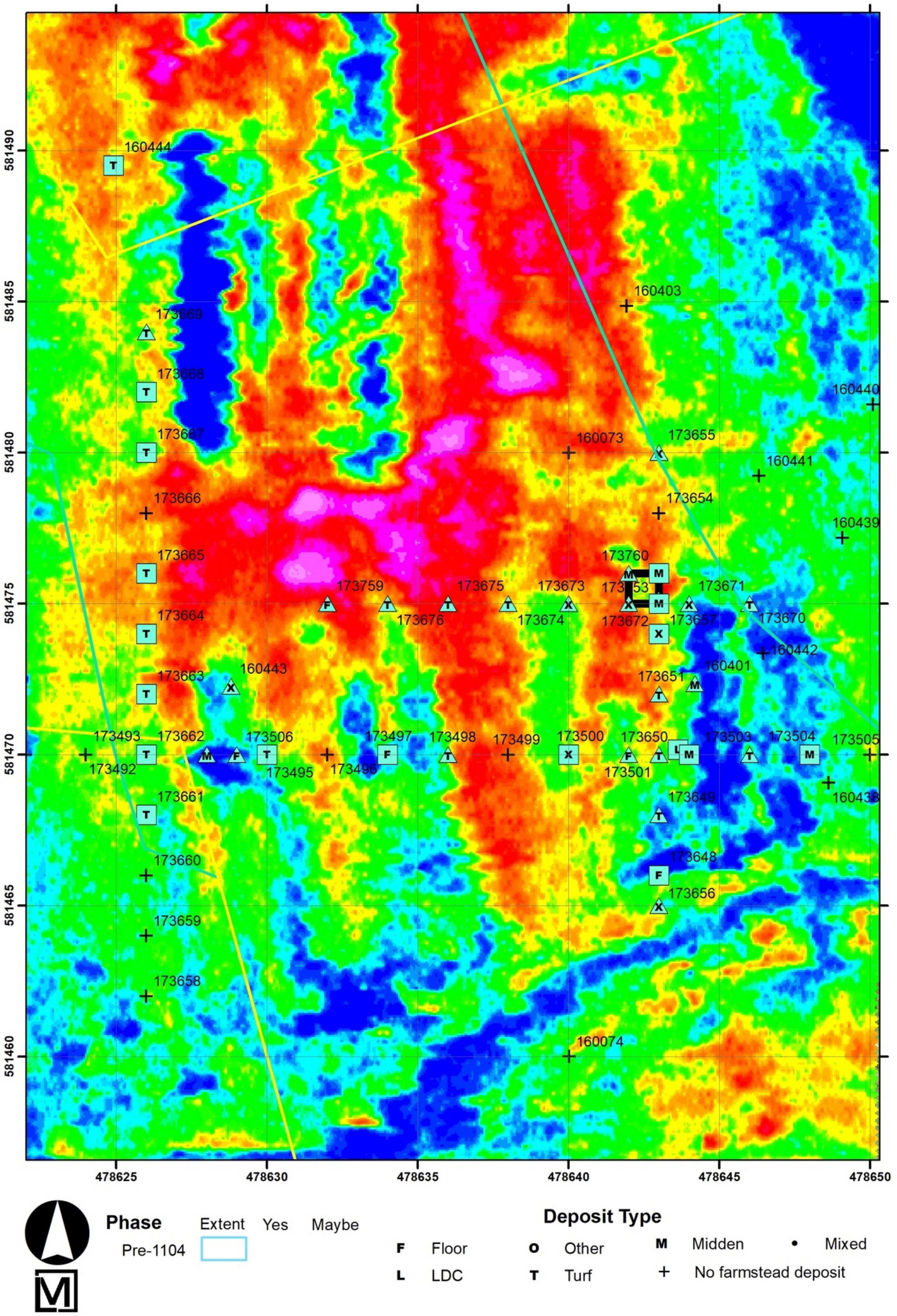

Figure 24. Location of test pit 2 with cores and CMD Mini Explorer C3 results (C3 color scale can be found in Figure 5 left).

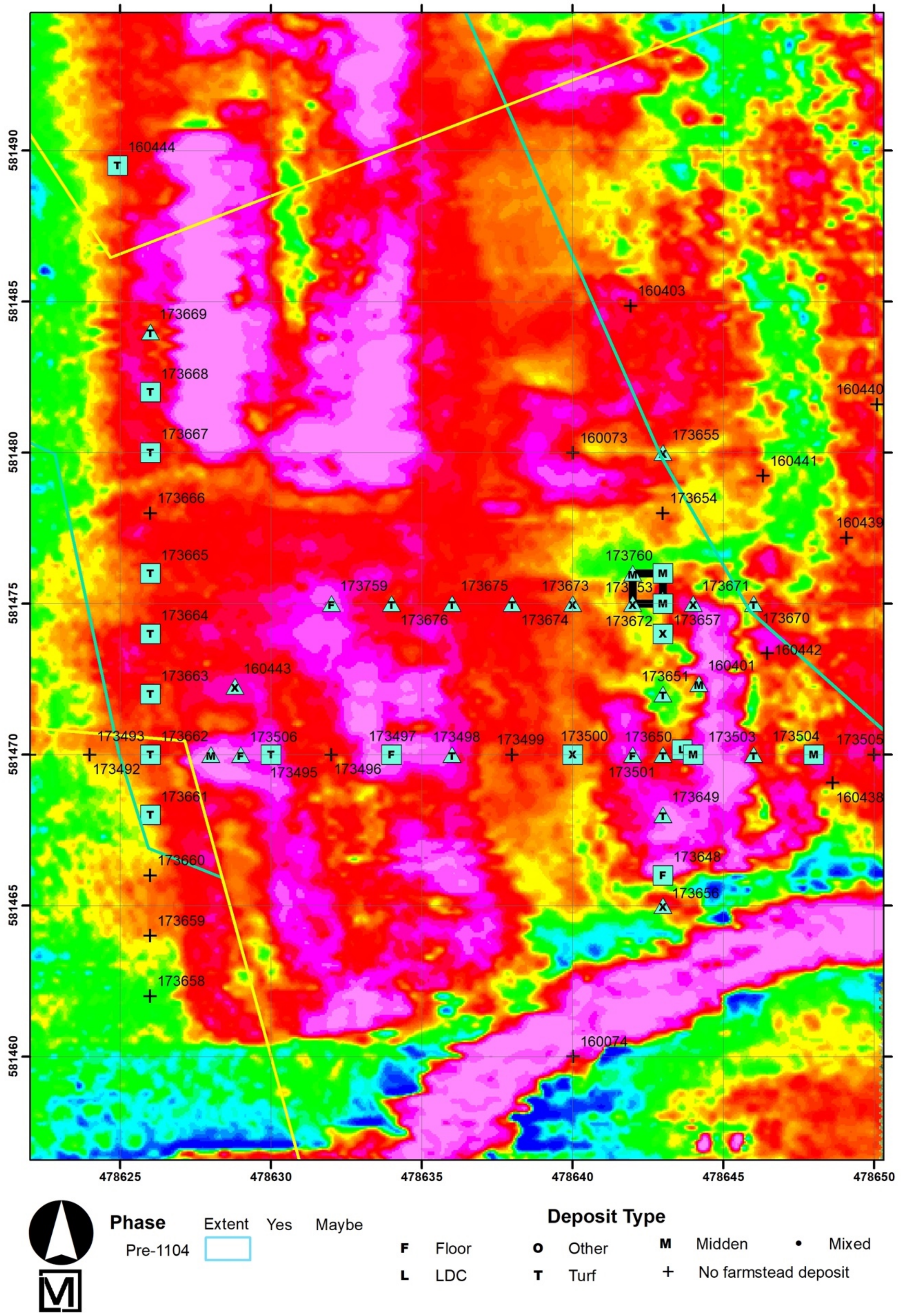

Figure 25. Location of test pit 2 with cores and CMD Mini Explorer IP1 results (IP3 color scale can be found in Figure 6 left).

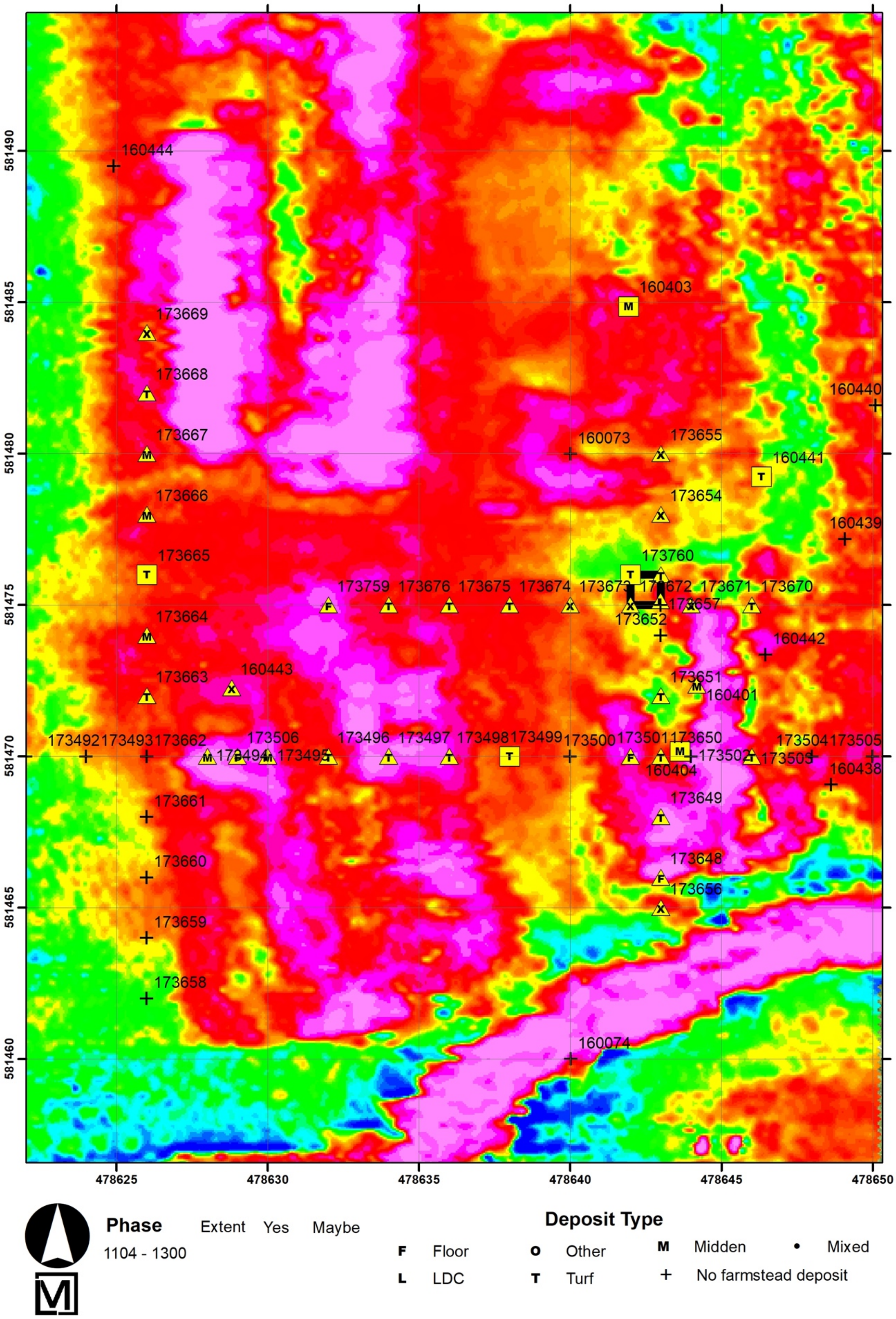

Figure 26. Location of test pit 2 with 1104-1300 cores and CMD Mini Explorer IP1 results (IP3 color scale can be found in Figure 6 left).

Garður/Hegranesþing - 444-1
TP 1

E: 478580.00
N: 581575.00
Z: 17.80

Context	Description
101	Root mat.
102	Compact mid brown aeolian under root mat.
103	Turf collapse; soft, mid yellowish-brown.
104	Soft, mottled turf; mid brown with 1104 and H3.
105	Soft, turf; mid yellowish-brown.
106	Mottled turf collapse getting firmer; mid yellowish-brown.
107	Firm turf collapse; mid yellowish-brown.
108	Firm, mottled turf collapse; mid orangish-brown.
109	Rocks in base of turf wall and surrounding turf.
110	Mottled peat ash midden; mid pinkish-brown.
111	Soft, light pinkish-brown midden.
112	Dense, mid pinkish-brown midden.
113	Soft, mid pinkish-brown midden.
114	Midden.
115	Soft, mid greyish-brown mixed turf.
116	Firm, dark brown.
117	Firm, brown mottled turf.
118	Thin, soft, brown aeolian deposit; ends on LNL.
119	Cryoturbated aeolian deposit; mid reddish-brown; some iron precipitates.
120	Aeolian with H3; mid reddish-brown; some iron throughout.

Tephra

- 1300?
- 1104
- 934
- 871

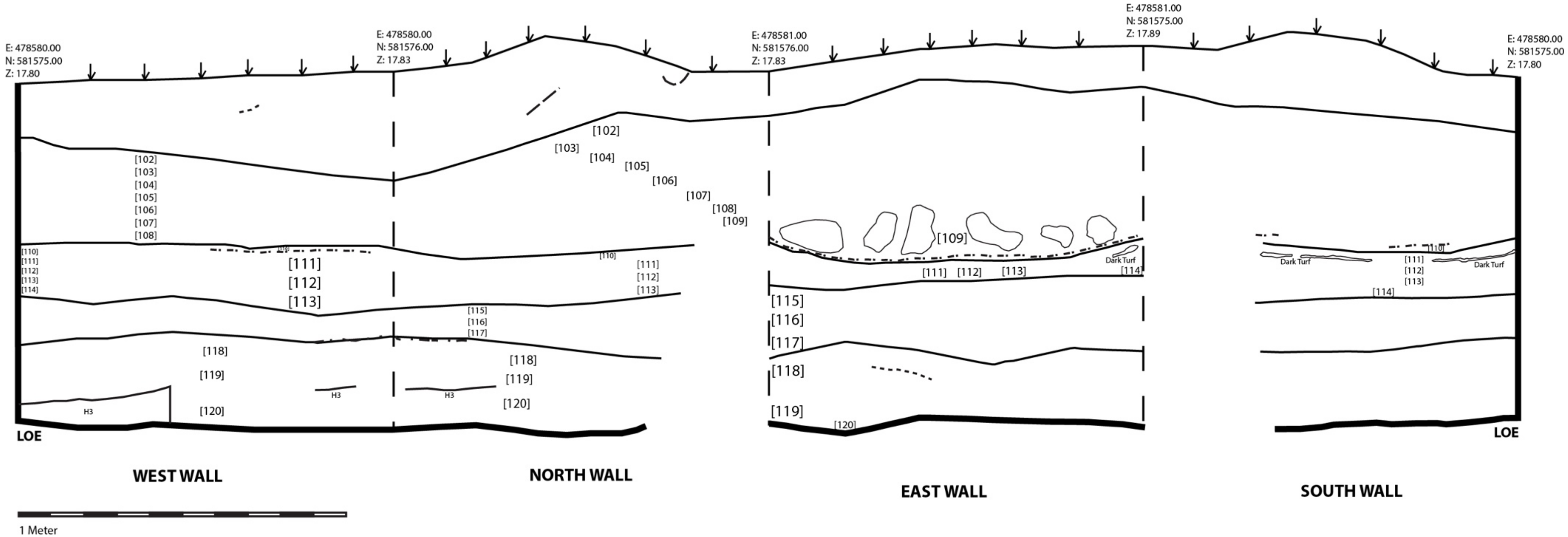

Figure 27. Drawn profiles of test pit 1.

Garður/Hegranesþing - 444-1

TP 2

E: 478642.00
N: 581475.00
Z: 17.61

Tephra

— — — — — — — — 1300
- - - - - - - - - - - - - 1104
·· -· -· -· -· -· -· -· 934/LNL?

Context	Description
101	Top Soil
121	Aeolian deposit
122	Turf with faint red (possible peat ash) north-south running stripes and gravel inclusions
123	Mixed turf with peat ash strips and burned bone and charcoal inclusions
124	Mixed turf with charcoal bone and gravel inclusions
125	Aeolian deposit with bone inclusions. Large stone/cobble located in center south half of unit
126	Brown aeolian and peat ash layer with bone, gravel, pebble, and cobble inclusions. Two large rocks in south of unit
127	Midden
128	Black ash midden with bone inclusions
130	Mottled pink, gray, white and black peat and wood ash with charcoal, diatom and bone (including butter bone) inclusions
131	Mottled colors in what could be a stake hole. Has wood and peat ash and charcoal inclusions
132	Yellowish-Brown aeolian deposit, with greenish glacial sand mixed in. Gravel, pebble, and cobble inclusions. Dark tephra, possibly 934 or LNL found in NE corner
133	Greenish-Brown glacial sand with gravel, pebble and cobble inclusions

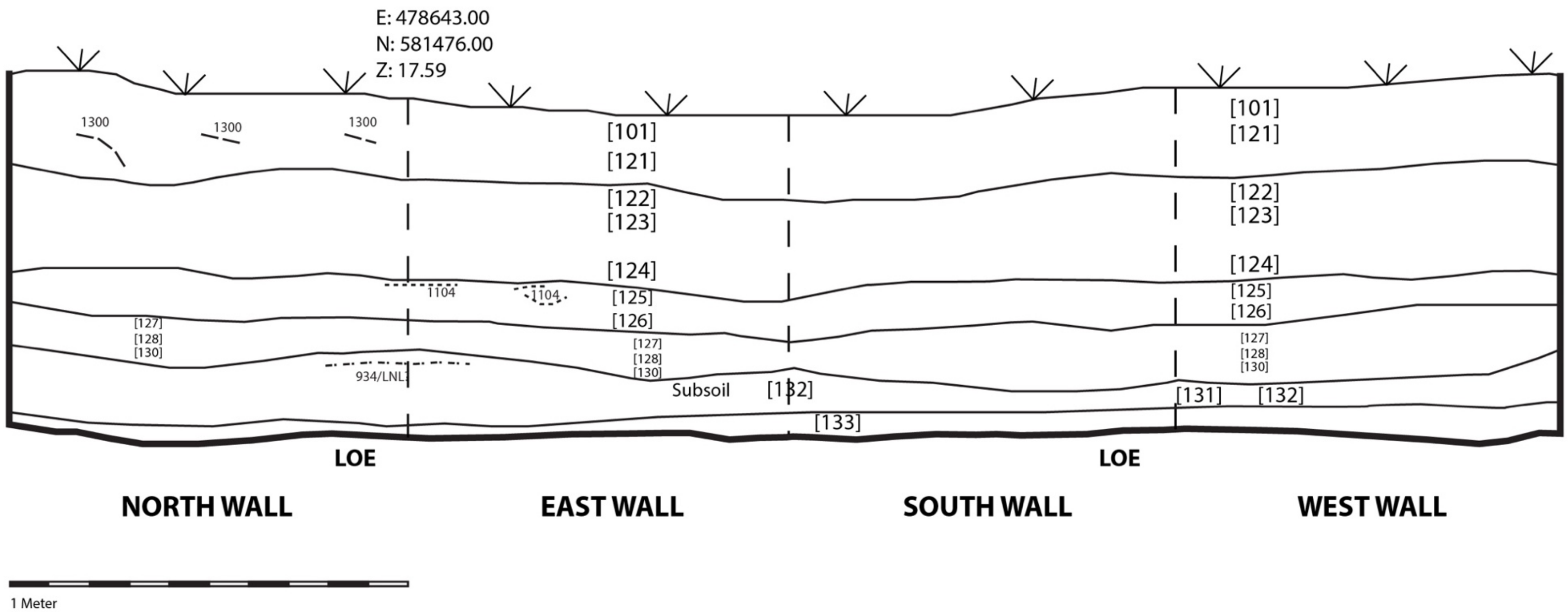

Figure 28. Drawn profiles of test pit 2.

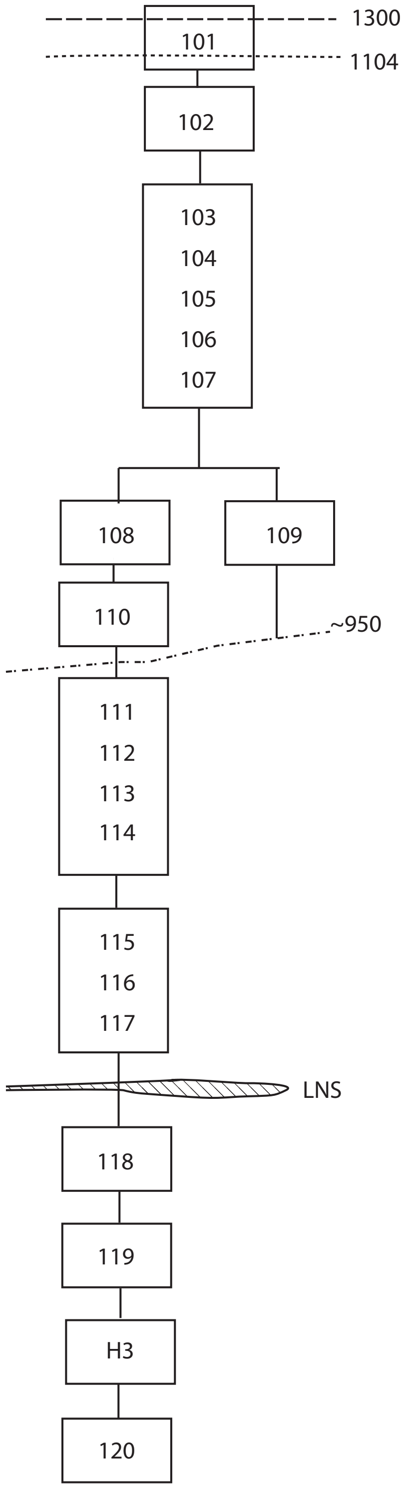

Figure 29. Harris matrix of test pit 1.

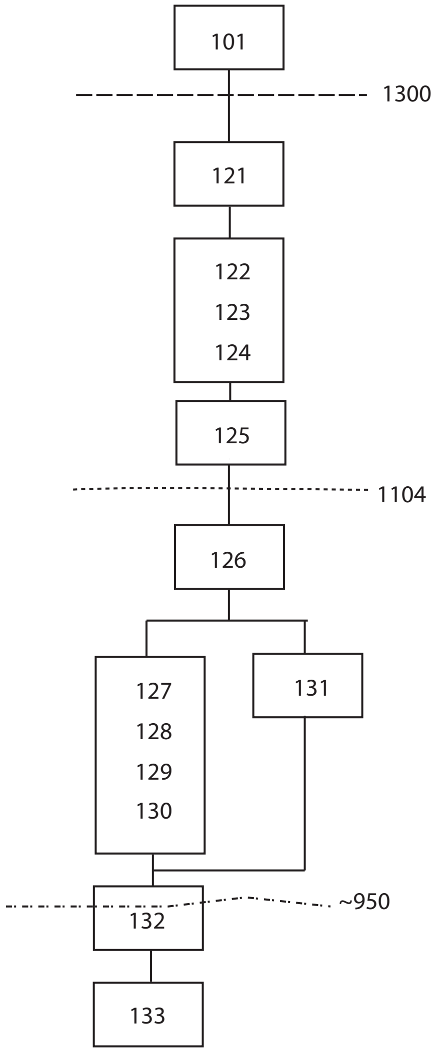

Figure 30. Harris Matrix of test pit 2.

Figure 31. Photo from the south of the excavation of TP 1, showing bottom of 108 and top of the probable wall [109]

Figure 32. plan photo of excavation of TP 1, showing bottom of [111] midden and top of the probable wall [109]

Figure 33. photo of west wall of the completed excavation of TP 1. A patch of H1 can be seen in the center, just above the leveling string (marked with white).

Figure 34. Photo from the south of the excavation of TP2, showing bottom of [128].

Figure 35. photo of east wall of the completed excavation of TP2. A patch of H1 can be seen in the northeast.

Figure 36. Photo of north wall of the completed excavation of TP2. A small patch of H1 can be seen in the northeast above the aeolian deposit mixed with bone [127-130].

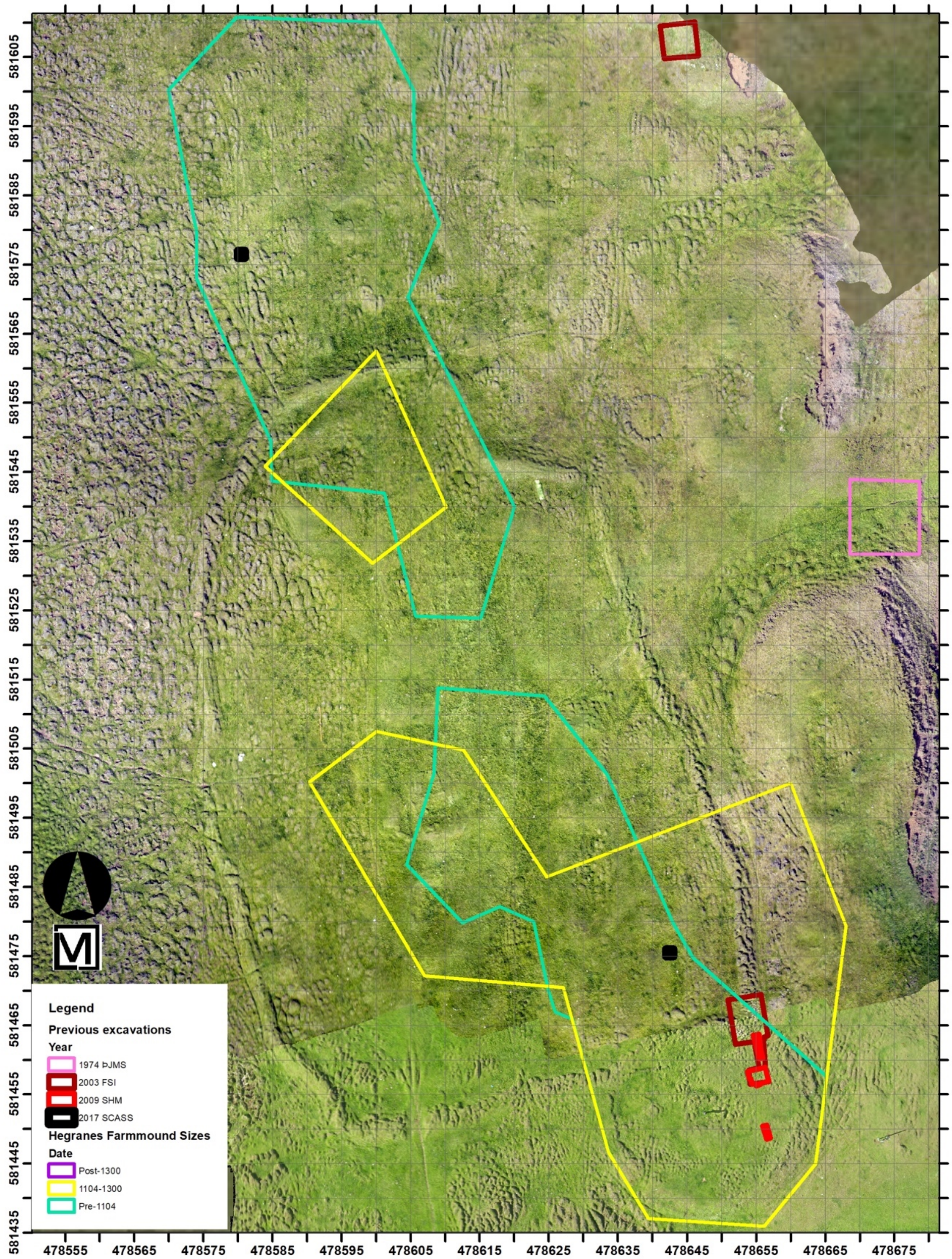

Figure 37. Farm mound areas with excavations superimposed on orthophoto.

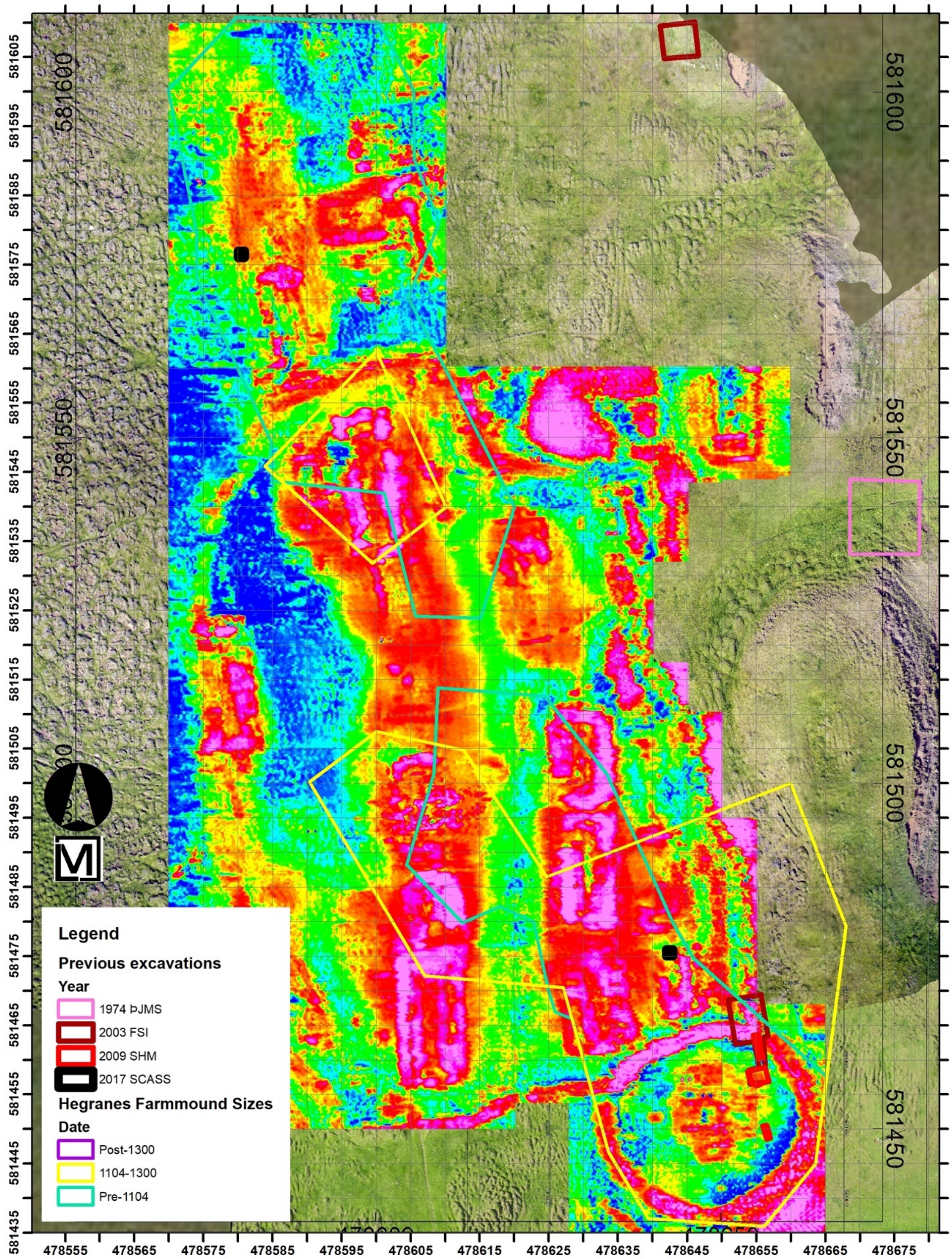

Figure 38. Farm mound areas with excavations superimposed on CMD Min-Explorer IP3 results.

CONCLUSIONS

Much of the archaeology at Hegranesþing is associated with an assembly place and its temporary nature, the upper cultural deposit in TP2 [122-124] is entirely consistent with temporary seasonal occupation. . The geophysics, coring and test pits suggest deep and potentially old deposits that seem to be best interpreted as typical farmstead deposits.

Thus, these farmsteads have been measured and dated based on the cores and test pits. The northern pre-1104 tephra (blue in Figure 39) is about 2,410 m^2 and is termed Hegranesþing 1 (Figure 39). The farmstead area of Hegranesþing 1extends south through the tún wall. Hegranesþing 1 is the earliest farmstead identified at the site and seems to be primary before ~950. Hegranesþing 2 (Figure 40), the southern farm mound is about 2080 m^2 and contains the churchyard. Even with the churchyard, Hegranesþing 2 is the smallest farmstead yet identified at the site. Hegranesþing 2 seems to primary occupied from ~950 to AD 1104. Hegranesþing 3 is the AD 1104-1300 farmstead and has not been investigated with a test pit. Hegranesþing 3 is broken into two areas (Figure 41) with a sum total of 3230 m^2. Hegranesþing 3 is probably also associated with the churchyard. There seem to be no substantial post 1300 permanent occupation at the site.

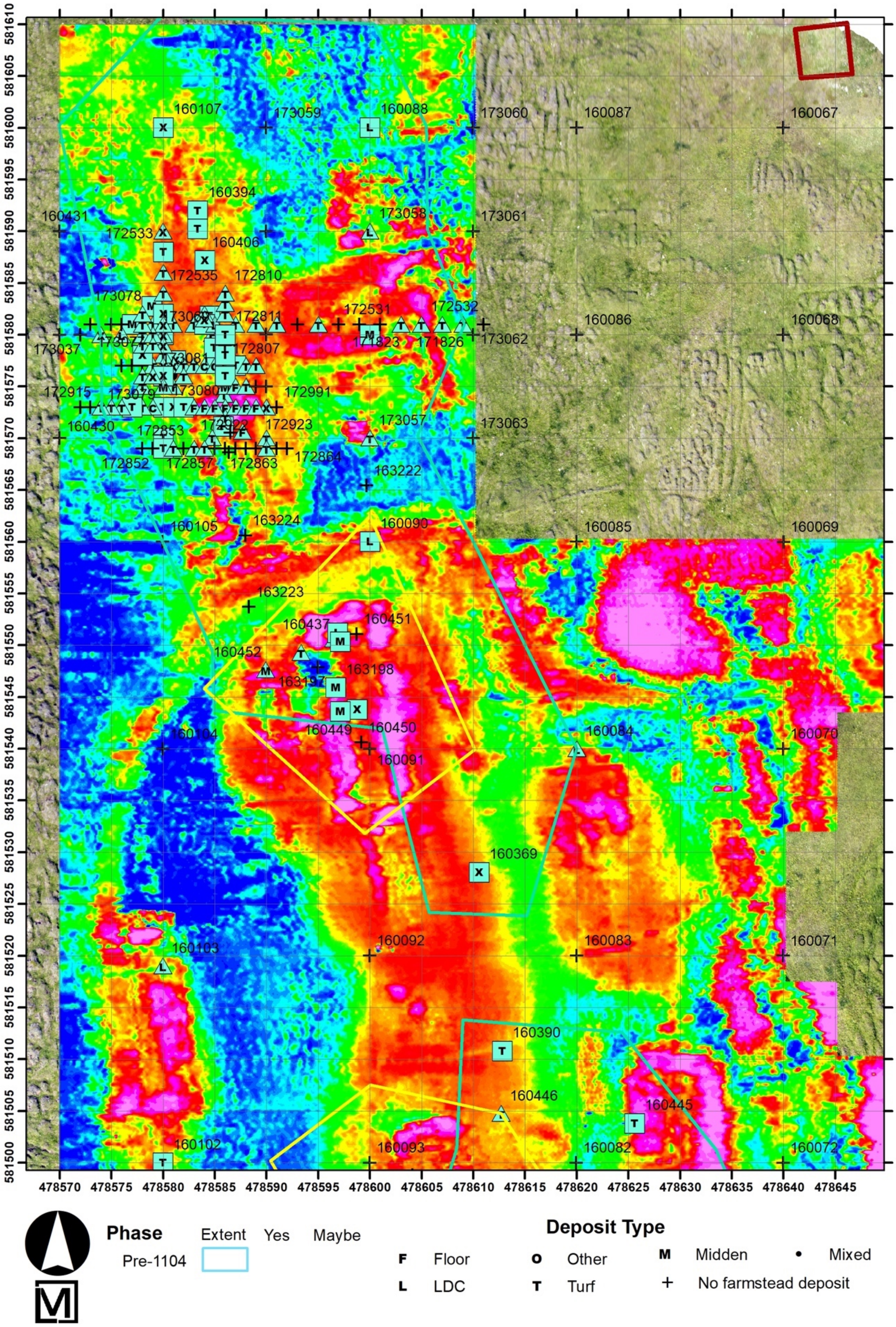

Figure 39. Northern pre-1104 Farmstead (Hegranesþing 1) area in blue with cores on CMD Min-Explorer IP3 results.

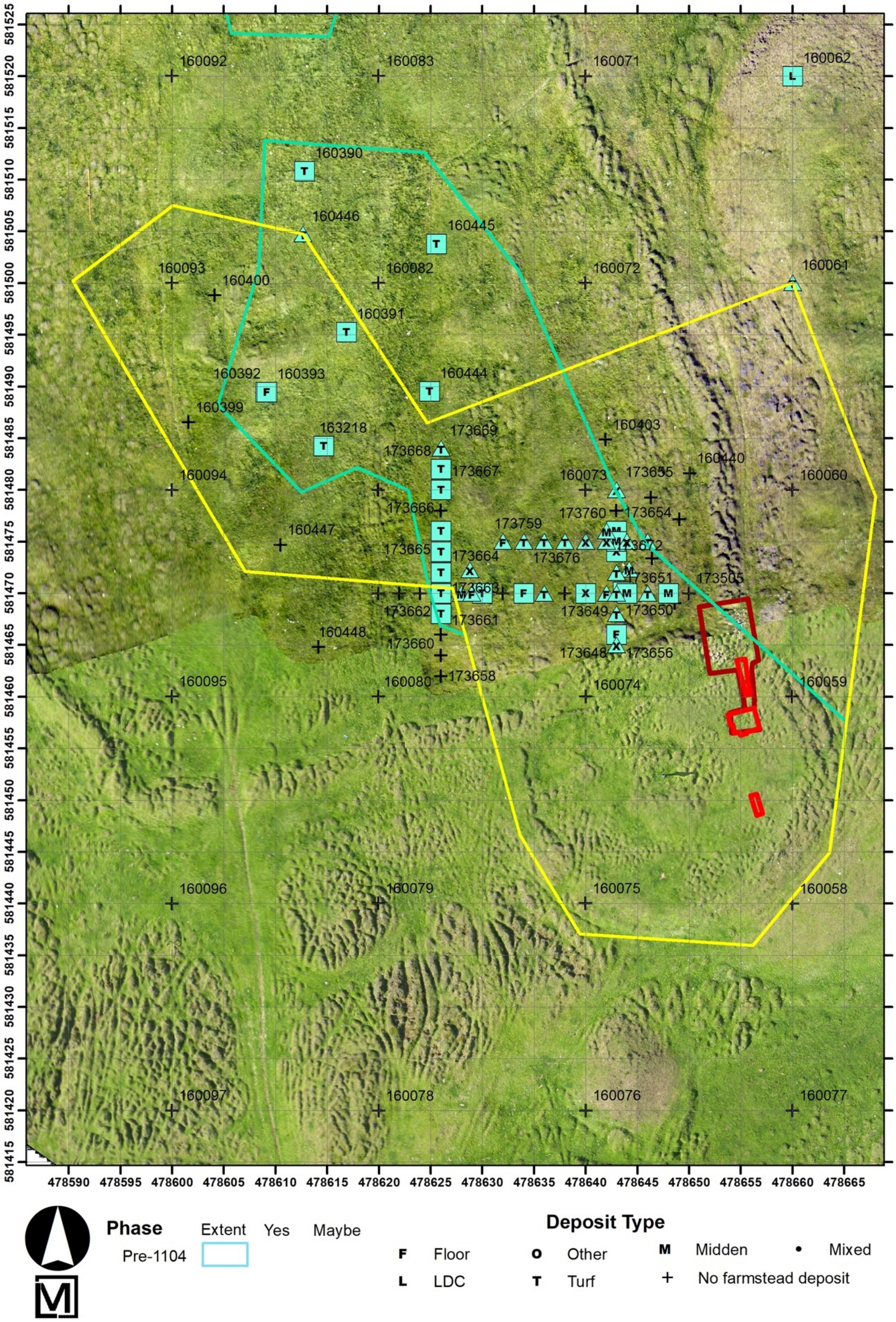

Figure 40. Southern pre-1104 Farmstead (Hegranesþing 2) mound area in blue with cores on orthophoto.’

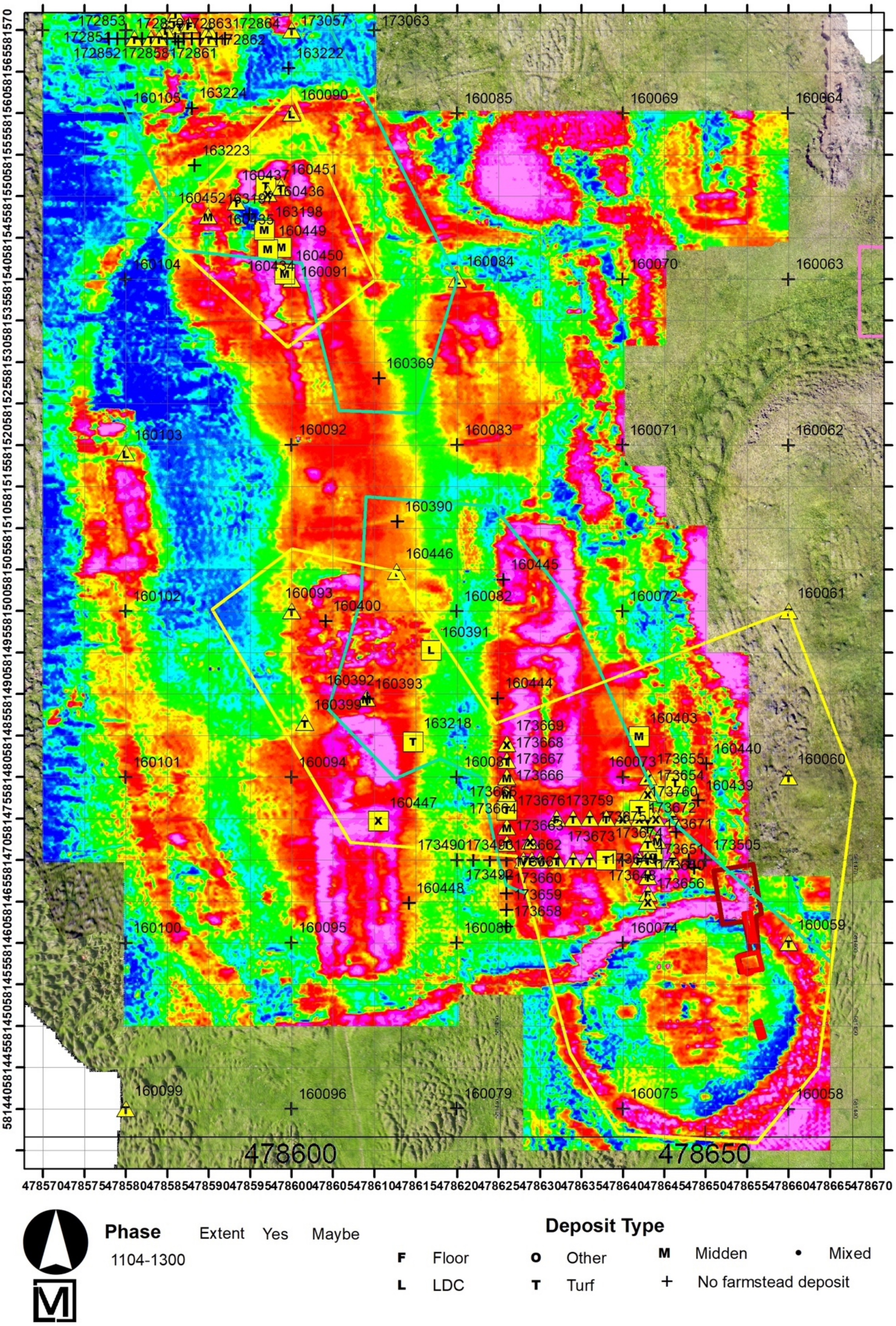

Figure 41. Southern 1104-1300 Farmstead (Hegranesþing 2) mound area in yellow on CMD Min-Explorer IP3 results.

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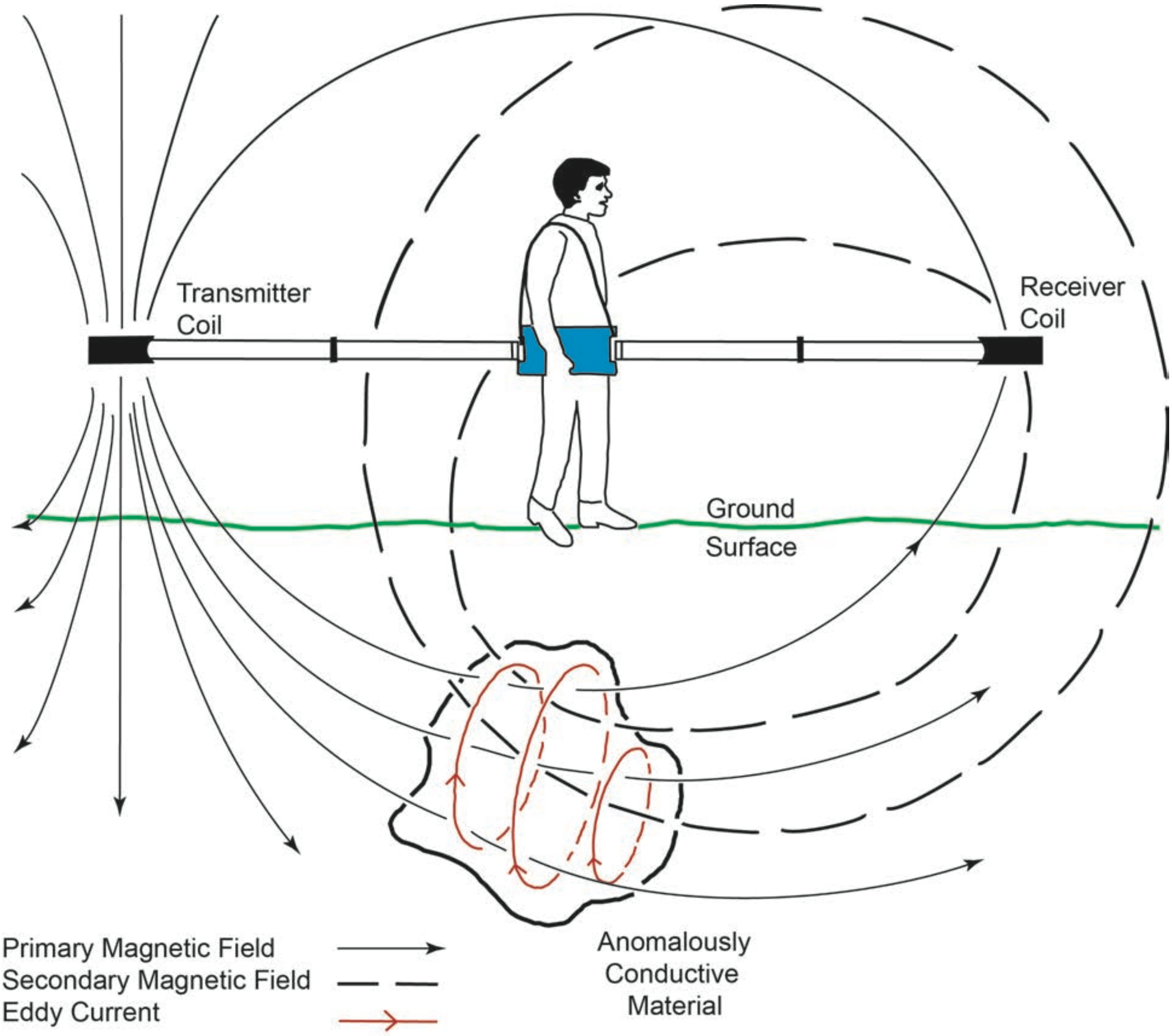
APPENDIX A – BASIC PRINCIPLES OF FREQUENCY-DOMAIN ELECTROMAGNETICS

The frequency-domain electromagnetic (FDEM) method is an active non-destructive geophysical method that is used to obtain shallow subsurface information. In the EM method, a time-varying magnetic field is generated by driving an alternating current through either a loop of wire or a straight wire that is grounded at both ends. Induced or eddy currents with flow within any conductive solid or fluid material that is present beneath the area of investigation. The eddy currents, in turn, generate their own magnetic fields such that at any point in space, the total magnetic field is the superposition of the primary field due to the source current and secondary fields due to the eddy currents, as schematically illustrated in Figure B1. By discriminating between primary and secondary fields, variations in the EM properties of the ground can be discerned.

EM instruments measure both out-of-phase (quadrature) and in-phase components of the induced magnetic fields. The former is a measure of the bulk apparent ground conductivity; the latter is related to magnetic susceptibility and is particularly sensitive to the presence of metallic objects. Bulk apparent ground conductivity reflects true conductivity when the subsurface is homogeneous and isotropic, which is rarely the case in practice. For heterogeneous conditions, it represents an integrated effect of the all the conductivity within the volume of ground being sensed. It does not, however, represent an average conductivity and in fact can be lower or higher than the lowest or highest subsurface conductivities, respectively. A lateral variation in the components is indicative of lateral changes in properties. The conductivity is particularly sensitive to fluid content and dissolved salts or ions. Accordingly, wet sands, clays and materials with high ion content generally have high bulk apparent ground conductivity; dry sands and crystalline rocks have low bulk apparent ground conductivity.

Ideally, EM surveys are conducted in archaeological investigations to find conductive targets in resistive environments such as middens and rammed-earthed walls. Although more subtle and difficult to detect, resistive targets such as buried stone walls and foundations can also be detected through EM surveying.



$$\sigma_a = \frac{2}{\pi f \mu l^2} \frac{H_s}{H_p}$$

(McNeill, 1980)

σ_a = Apparent Ground Conductivity (mS/m)
f = Frequency
μ = Magnetic Permeability of Free Space
l = Intercoil Spacing
H_s = Secondary Magnetic Field
H_p = Primary Magnetic Field

Figure A1. Schematic diagram illustrating the principles of FDEM.

APPENDIX B– 2017 CORING DATA

Table 1. Coring locations.

Core Number	End Depth	East	North
171815	65	478573	581581
171816	57	478575	581581
171817	110	478579	581581
171818	105	478583	581581
171819	40	478587	581581
171820	95	478591	581581
171821	95	478595	581581
171822	85	478599	581581
171823	57	478603	581581
171824	70	478607	581581
171825	64	478611	581581
171826	85	478609	581581
171827	115	478584	581581
171828	48		
172525	110	478577	581581
172526	115	478581	581581
172527	104	478585	581581
172528	75	478589	581581
172529	115	478593	581581
172530	115	478597	581581
172531	50	478601	581581
172532	50	478605	581581
172533	120	478580	581588
172534	120	478580	581586
172535	120	478580	581584
172536		478580	581582
172537		478580	581580
172538	130	478580	581578
172757	40	478586.512	581570.541
172758	80	478585.908	581574.208
172759	70	478586	581573
172760	80	478586	581572
172761	65	478586	581575
172762		478580	581577
172763	55	478581	581577
172764	98	478582	581577
172765	110	478583	581577
172766	102	478584	581577
172767	120	478585	581577
172768	102	478586	581577
172769	62	478587	581577
172770	95	478588	581577
172771	50	478589	581577
172778	59	478584.759	581570.035
172779	110	478587.697	581570.645
172780	80	478584	581582
172781	70	478584	581581.5
172782	62	478576	581577
172783	15	478577	581577

Core Number	End Depth	East	North
172784	68	478578	581577
172785	110	478579	581577
172805	64	478586	581576
172806	80	478586	581578
172807	47	478586	581579
172808	40	478586	581582
172809	94	478586	581583
172810	75	478586	581584
172811	68	478586	581580
172812	120	478587	581575
172813	120	478588	581575
172814	50	478589	581575
172815	110	478590	581575
172850	63	478580	581569
172851	90	478579	581569
172852	18	478578	581569
172853	61	478581	581569
172854	56	478582	581569
172855	36	478583	581569
172856	62	478584	581569
172857	63	478585	581569
172858	37	478586	581569
172859	54	478587	581569
172860	62	478588	581569
172861	25	478589	581569
172862	69	478590	581569
172863	67	478591	581569
172864		478592	581569
172865	120	478590	581573
172907	80	478580	581573
172908	78	478579	581573
172909	80	478578	581573
172910	80	478577	581573
172911	80	478576	581573
172912	80	478575	581573
172913	75	478574	581573
172914	78	478573	581573
172915	87	478572	581573
172916	80	478581	581573
172917	120	478582	581573
172918	78	478583	581573
172919		478584	581573
172920		478585	581573
172921	120	478587	581573
172922	73	478588	581573
172923	69	478589	581573
172924	80	478578	581575
172925	79	478578	581576
172926	75	478578	581578
172927	78	478578	581579
172991	64	478591	581573
173034	120	478578	581580
173035	60	478576	581580
173036	67	478574	581580
173037	68	478572	581580

Core Number	End Depth	East	North
173057	76	478600	581570
173058	52	478600	581590
173059	40	478590	581600
173060	45	478610	581600
173061	40	478610	581590
173062	85	478610	581580
173063	57	478610	581570
173064	66	478579	581576
173065	46	478581	581575
173066	120	478582	581576
173067	120	478580	581581
173068	65	478576	581581
173069	108	478579	581580
173070	110	478580	581579
173071	120	478579	581579
173077	110	478578	581581
173078	120	478578	581582
173079	81	478580	581576
173080	90	478580	581575
173081	83	478579	581576
173490	40	478620	581470
173491	45	478622	581470
173492	55	478624	581470
173493	70	478626	581470
173494	40	478628	581470
173495	83	478630	581470
173496	80	478632	581470
173497	90	478634	581470
173498	40	478636	581470
173499		478638	581470
173500	120	478640	581470
173501	74	478642	581470
173502	40	478644	581470
173503	52	478646	581470
173504	48	478648	581470
173505	28	478650	581470
173506	65	478629	581470
173627	68	478539.2852	581457.3939
173628	40	478530.8568	581459.4188
173648	65	478643	581466
173649	45	478643	581468
173650	45	478643	581470
173651	41	478643	581472
173652	53	478643	581474
173653	62	478643	581476
173654	71	478643	581478
173655	60	478643	581480
173656	71	478643	581465
173657	56	478643	581475
173658	52	478626	581462
173659	58	478626	581464
173660	56	478626	581466
173661	62	478626	581468
173662		478626	581470
173663	72	478626	581472

Core Number	End Depth	East	North
173664	67	478626	581474
173665	95	478626	581476
173666	60	478626	581478
173667	75	478626	581480
173668	65	478626	581482
173669	71	478626	581484
173670	60	478646	581475
173671	44	478644	581475
173672	73	478642	581475
173673	112	478640	581475
173674	91	478638	581475
173675	86	478636	581475
173676	43	478634	581475
173759	110	478632	581475
173760	70	478642	581476

Table 2. Tephra layers in cores

Core Number	Depth	Tephra	Description
171815	25	1300	
171815	50	H3	
171815	55	H4	
171816	46	H3	
171817	107	H3	
171818	92	H3	
171820	73	H3	
171822	59	H1	
171822	66	H3	
171827	29	H1	
171827	79	H3	
171828	18	H3	Appears to have been truncated at too
172525	30	H1	
172525	103	H3	
172525	105	H4	
172530	100	H3	
172530	105	H4	
172532	38	H3	
172532	40	H4	
172536	62	950	
172537	89	LNS	
172537	97	H3	
172538	105	H3	
172758	50	LNL	
172758	70	H3	
172758	75	H4	
172759	62	H3	
172760	57	H3	
172760	65	H4	
172764	88	LNS	
172767	81	H3	
172768	11	H1	
172768	51	H3	
172769	18	H1	Cryoturbated
172778	48	Katla 850	
172778	56	H3	
172782	26	LNL	
172784	28	LNL	
172785	80	H3	
172805	31	H1	
172806	22	H1	
172806	74	H3	
172807	6	H1	
172809	72	H3	
172811	21	H1	
172811	66	H3	
172813	93	H3	

Core Number	Depth	Tephra	Description
172813	104	H4	
172814	28	H1	
172815	58	LNS	
172815	70	H3	
172815	72	H4	
172850	20	H1	
172851	20	1300	
172851	32	H1	
172851	51	LNS	
172851	60	H3	
172853	49	1000	Possibly in turf
172856	60	H3	
172859	31	H1	
172860	60	H3	
172862	67	H3	
172863	31	H1	
172864	36	H1	
172864	62	LNL	
172864	78	H3	
172865	88	H3	
172907	16	H1	
172908	76	H3	
172910	12	H1	
172910	63	H3	
172910	70	H4	
172911	56	H3	
172911	60	H4	
172912	60	H3	
172912	65	H4	
172913	60	H3	
172913	64	H4	
172914	22	H1	
172914	40	LNS	
172914	41	H3	
172914	50	H4	
172915	15	H1	
172915	60	LNS	
172915	70	H3	
172915	75	H4	
172916	19	H1	
172917	25	H1	
172918	45	LNL	
172918	47	Katla 850	
172918	55	H3	
172918	61	H4	
172919	75	H3	
172919	80	H4	
172920	69	H3	
172920	73	H4	

Core Number	Depth	Tephra	Description
172921	99	H3	
172921	105	H4	
172923	66	H3	
172924	65	H3	
172924	75	H4	
172925	68	H3	
172926	35	H1	
172927	65	H3	
172991	63	H3	
173034	96	H3	
173036	41	1000	Little greenish gray
173036	47	H3	
173036	57	H4	
173037	42	H3	
173037	48	H4	
173057	58	H3	
173059	29	H3	
173060	27	H3	
173061	32	H3	
173063	17	1000	
173063	29	LNL	
173063	35	H3	
173064	64	H3	
173068	64	H3	
173069	96	H3	
173070	78	H3	
173071	105	H3	
173078	105	H3	
173079	31	H1	
173079	76	LNL	
173079	78	H3	
173080	80	H3	
173490	20	1300	
173490	32	H1	
173491	9	1766	
173491	18	1300	
173491	32	H1	
173492	30	H1	
173493	31.5	H1	
173495	39	H1	
173497	37	H1	
173497	73	H3	
173499	18	1300	
173499	70	H3	
173499	78	H4	
173500	21	H1	
173502	19	H1	
173503	56	1000	
173504	32.5	H1	

Core Number	Depth	Tephra	Description
173504	44	LNS	
173627	14.5	1766	
173627	39	1300	
173628	33.5	1300	
173648	50	950	
173652	15	1300	
173652	23	H1	
173653	35	H1	
173653	52	950	
173654	40	H1	
173654	41	LNS	
173654	42	H3	
173655	55	H3	
173657	34	H1	
173658	13	1300	
173659	28	H1	
173661	19	1300	
173661	27	H1	
173662	28	H1	
173663	33	H1	
173664	39	H1	
173664	66	H3	
173665	27	1300	
173665	46	H1	
173665	86	H3	
173666	38	H1	
173667	42	H1	
173668	38	H1	
173673	104	950	
173674	72	H3	
173675	77	H3	
173760	13	1300	

Table 3. Stratigraphic layers in cores.

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
171815	0	5	Root Mat		
171815	5	50	Aeolian Deposit		
171815	50	65	Subsoil		
171816	0	40	Aeolian Deposit		
171816	0	40	Aeolian Deposit		
171816	40	45	Iron Pan		
171816	45	57	Aeolian Deposit		
171816	57	57	Rock		
171817	0	4	Root Mat		
171817	4	18	Aeolian Deposit		
171817	18	107	Turf		LNL/LNS
171817	107	110	Aeolian Deposit		
171817	110	110	Rock		
171818	0	4	Root Mat		
171818	4	12	Aeolian Deposit		
171818	12	87	Turf		H3/H4
171818	87	105	Aeolian Deposit		
171819	0	5	Root Mat		
171819	5	12	Aeolian Deposit		
171819	12	40	Turf		
171819	40	40	Rock		
171820	0	5	Root Mat		
171820	5	70	Turf		unknown
171820	70	78	Aeolian Deposit		
171820	78	95	Subsoil		
171820	95	95	Rock		
171821	0	5	Root Mat		
171821	5	95	Turf		
171821	95	95	Rock		
171822	0	6	Root Mat		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
171822	6	59	Turf		
171822	59	85	Aeolian Deposit		
171822	85	85	Rock		
171823	0	8	Root Mat		
171823	8	42	Turf		
171823	42	57	Aeolian Deposit		
171823	57	57	Gravel		
171824	0	7	Root Mat		
171824	7	43	Turf		
171824	43	70	Subsoil		
171824	70	70	Gravel		
171825	0	7	Root Mat		
171825	7	64	Turf		H1
171825	64	64	Rock		
171826	0	7	Root Mat		
171826	7	70	Turf		
171826	70	85	Aeolian Deposit		
171827	0	6	Root Mat		
171827	6	35	Aeolian Deposit		
171827	35	79	Turf		
171827	79	102	Aeolian Deposit		
171827	102	104	Iron Pan		
171827	104	115	Aeolian Deposit		
171828	0	7	Root Mat		
171828	7	18	Aeolian Deposit		
171828	18	48	Aeolian Deposit		
171828	48	48	Gravel		
172525	0	5	Root Mat		
172525	5	40	Aeolian Deposit		
172525	40	50	Low Density		
172525	50	75	Midden		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172525	75	110	Aeolian Deposit		
172525	110	110	Rock		
172526	0	10	Root Mat		
172526	10	115	Turf		
172526	115	115	Iron Pan		
172527	0	10	Root Mat		
172527	10	30	Aeolian Deposit		
172527	30	35	Low Density		
172527	35	50	Aeolian Deposit		
172527	50	55	Gravel		
172527	55	60	Aeolian Deposit		
172527	60	63	Gravel		
172527	63	70	Aeolian Deposit		
172527	70	87	Cultural Layer		
172527	87	104	Subsoil		
172527	104	104	Gravel		
172528	0	10	Top Soil		
172528	10	75	Turf		LNL/LNS
172528	75	75	Iron Pan		
172529	0	8	Root Mat		
172529	8	65	Turf		H1
172529	65	115	Turf		LNL/LNS
172529	115	115	Iron Pan		
172530	0	10	Root Mat		
172530	10	72	Turf		H1
172530	72	115	Aeolian Deposit		
172530	115	115	Iron Pan		
172531	0	10	Top Soil		
172531	10	50	Turf		H1
172531	50	50	Rock		
172532	0	12	Top Soil		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172532	12	35	Turf		
172532	35	50	Aeolian Deposit		
172532	50	50	Rock		
172533	0	6	Root Mat		
172533	6	120	Turf		1000
172534	0	5	Root Mat		
172534	5	110	Turf		LNL/LNS
172534	110	115	Iron Pan		
172534	115	120	Turf		
172535	0	5	Root Mat		
172535	5	120	Turf		
172536	0	5	Root Mat		
172536	5	60	Turf		
172536	60	81	Midden		
172536	81	105	Turf		
172536	105	105	Iron Pan		
172537	0	6	Root Mat		
172537	6	62	Turf		
172537	62	70	Midden		
172537	70	120	Aeolian Deposit		
172538	0	5	Root Mat		
172538	5	91	Turf		
172538	91	95	Aeolian Deposit		
172538	95	97	Iron Pan		
172538	97	130	Aeolian Deposit		
172757	0	4	Root Mat		
172757	4	19	Aeolian Deposit		
172757	19	40	Turf		H1
172757	40	40	Rock		
172758	0	12	Root Mat		
172758	12	44	Turf		934

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172758	44	59	Aeolian Deposit		
172758	59	62	Iron Pan		
172758	62	72	Aeolian Deposit		
172758	72	80	Iron Pan		
172758	80	80	Iron Pan		
172759	0	8	Root Mat		
172759	8	47	Turf		
172759	47	55	Low Density		
172759	55	62	Floor		
172759	62	70	Aeolian Deposit		
172759	70	70	Iron Pan		
172760	0	8	Root Mat		
172760	8	20	Aeolian Deposit		
172760	20	30	Gravel		
172760	30	52	Turf		934
172760	52	57	Iron Pan		
172760	57	80	Aeolian Deposit		
172761	0	8	Root Mat		
172761	8	30	Aeolian Deposit		
172761	30	60	Midden		
172761	60	65	Aeolian Deposit		
172761	65	65	Iron Pan		
172762	0	12	Root Mat		
172762	12	44	Turf		
172762	44	48	Midden		
172762	48	48	Aeolian Deposit		
172763	0	6	Root Mat		
172763	6	48	Turf		LNL/LNS
172763	48	55	Midden		
172763	55	55	Rock		
172764	0	8	Root Mat		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172764	8	78	Turf		LNL/LNS
172764	78	98	Aeolian Deposit		
172764	98	98	Rock		
172765	0	9	Root Mat		
172765	9	80	Turf		LNL/LNS
172765	80	95	Aeolian Deposit		
172765	95	100	Iron Pan		
172765	100	110	Aeolian Deposit		
172766	0	7	Root Mat		
172766	7	35	Turf	Collapse?	
172766	35	36	Cultural Layer	Thin, soft	
172766	36	102	Aeolian Deposit		
172766	102	102	Iron Pan		
172767	0	9	Root Mat		
172767	9	42	Turf		
172767	42	45	Cultural Layer	Floorish lens of charcoal (4mm) on ldc	
172767	45	56	Turf		LNL/LNS
172767	56	120	Aeolian Deposit		
172768	0	8	Root Mat		
172768	8	30	Aeolian Deposit	Mottled, turfy, mixed aeolian and collapse?	
172768	30	32	Low Density		
172768	32	102	Aeolian Deposit		
172768	102	102	Gravel		
172769	0	7	Root Mat		
172769	7	30	Aeolian Deposit		
172769	30	51	Turf		
172769	51	62	Aeolian Deposit		
172769	62	62	Gravel		
172770	0	10	Root Mat		
172770	10	95	Turf		LNL/LNS
172770	95	95	Rock		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172771	0	8	Root Mat		
172771	8	50	Turf		LNL/LNS
172771	50	50	Rock		
172778	0	6	Root Mat		
172778	6	40	Turf		
172778	40	59	Aeolian Deposit		
172778	59	59	Iron Pan		
172779	0	7	Root Mat		
172779	7	20	Turf		
172779	20	30	Low Density		
172779	30	50	Turf		
172779	50	59	Midden		
172779	59	61	Floor		
172779	61	80	Aeolian Deposit		
172779	80	85	Iron Pan		
172779	85	110	Aeolian Deposit		
172779	110	110	Iron Pan		
172780	0	6	Root Mat		
172780	6	65	Turf		H3/H4
172780	65	66	Midden		
172780	66	80	Low Density		
172780	80	80	Iron Pan		
172781	0	6	Root Mat		
172781	6	49	Turf		
172781	49	50	Midden		
172781	50	70	Aeolian Deposit		
172781	70	70	Gravel		
172782	0	6	Root Mat		
172782	6	40	Aeolian Deposit		LNL/LNS
172782	40	62	Aeolian Deposit	Mottled,irony	
172782	62	62	Rock		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172783	0	5	Root Mat		
172783	5	15	Aeolian Deposit		
172783	15	15	Rock		
172784	0	10	Root Mat		
172784	10	68	Aeolian Deposit		
172784	68	68	Iron Pan		
172785	0	7	Root Mat		
172785	7	40	Aeolian Deposit		
172785	40	80	Turf	Black tephra, Katla?	unknown
172785	80	110	Aeolian Deposit		
172805	0	10	Root Mat		
172805	10	33	Aeolian Deposit		
172805	33	64	Turf		H3/H4
172805	64	64	Rock		
172806	0	2	Root Mat		
172806	12	29	Aeolian Deposit		
172806	29	60	Turf		
172806	60	80	Iron Pan		
172807	0	6	Root Mat		
172807	6	47	Aeolian Deposit		
172807	47	47	Rock		
172808	0	12	Root Mat		
172808	12	40	Turf		None
172808	40	40	Rock		
172809	0	6	Root Mat		
172809	6	72	Turf		
172809	72	94	Aeolian Deposit		
172810	0	10	Root Mat		
172810	10	49	Aeolian Deposit		
172810	49	75	Turf		
172810	75	75	Iron Pan		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172811	0	12	Root Mat		
172811	12	36	Aeolian Deposit		
172811	36	49	Turf		
172811	49	59	Aeolian Deposit		
172811	59	66	Iron Pan		
172811	66	68	Aeolian Deposit		
172812	0	12	Root Mat		
172812	12	28	Aeolian Deposit		
172812	28	43	Floor		
172812	43	110	Turf		
172812	110	120	Aeolian Deposit		
172813	0	12	Root Mat		
172813	12	30	Aeolian Deposit		
172813	30	92	Turf		
172813	92	115	Aeolian Deposit		
172813	115	120	Iron Pan		
172814	0	12	Root Mat		
172814	12	50	Aeolian Deposit		
172814	50	50	Rock		
172815	0	12	Root Mat		
172815	12	110	Aeolian Deposit		
172815	110	110	Gravel		
172850	0	5	Root Mat		
172850	5	28	Aeolian Deposit		
172850	28	63	Turf		LNL/LNS
172850	63	63	Rock		
172851	0	6	Root Mat		
172851	6	90	Aeolian Deposit	Mottled below 40	
172851	90	90	Rock		
172852	0	6	Root Mat		
172852	6	18	Aeolian Deposit		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172852	18	18	Rock		
172853	0	6	Root Mat		
172853	6	30	Aeolian Deposit		
172853	30	47	Turf		
172853	47	61	Aeolian Deposit		
172853	61	61	Rock		
172854	0	5	Root Mat		
172854	5	56	Aeolian Deposit	Turfy	
172854	56	56	Rock		
172855	0	5	Root Mat		
172855	5	10	Aeolian Deposit		
172855	10	20	Turf	Burnt	
172855	20	36	Aeolian Deposit		
172855	36	36	Rock		
172856	0	5	Root Mat		
172856	5	60	Turf		H3/H4
172856	60	62	Aeolian Deposit		
172856	62	62	Rock		
172857	0	6	Root Mat		
172857	6	14	Aeolian Deposit		
172857	14	63	Aeolian Deposit		
172857	63	63	Iron Pan		
172858	0	6	Root Mat		
172858	6	37	Aeolian Deposit		
172858	37	37	Rock		
172859	0	6	Root Mat		
172859	6	54	Aeolian Deposit	Sheep bone at 43	
172859	54	54	Rock		
172860	0	7	Root Mat		
172860	7	62	Aeolian Deposit		
172860	62	62	Rock		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172861	0	7	Root Mat		
172861	7	25	Aeolian Deposit		
172861	25	25	Rock		
172862	0	5	Root Mat		
172862	5	18	Aeolian Deposit		
172862	18	61	Turf		LNL/LNS
172862	61	69	Aeolian Deposit		
172862	69	69	Iron Pan		
172863	0	8	Root Mat		
172863	8	28	Aeolian Deposit	Turfy	
172863	28	67	Aeolian Deposit		
172863	67	67	Iron Pan		
172864	0	7	Root Mat		
172864	7	69	Aeolian Deposit		
172864	69	78	Iron Pan		
172865	0	6	Root Mat		
172865	6	35	Aeolian Deposit		
172865	35	67	Turf		LNL/LNS
172865	67	69	Midden	Thin lens of white sand like burnt bone in charcoal	
172865	69	120	Aeolian Deposit		
172907	0	10	Root Mat		
172907	10	42	Aeolian Deposit		
172907	42	65	Turf		LNL/LNS
172907	65	80	Aeolian Deposit		
172907	80	80	Rock		
172908	0	10	Root Mat		
172908	10	36	Aeolian Deposit		
172908	36	38	Cultural Layer		
172908	38	45	Aeolian Deposit		
172908	45	60	Turf		
172908	60	78	Aeolian Deposit		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172908	78	78	Gravel		
172909	0	10	Root Mat		
172909	10	40	Aeolian Deposit		
172909	40	61	Turf		934
172909	61	80	Aeolian Deposit		
172909	80	80	Gravel		
172910	0	12	Root Mat		
172910	12	63	Turf		
172910	63	80	Aeolian Deposit		
172910	80	80	Gravel		
172911	0	10	Root Mat		
172911	10	50	Turf		934
172911	50	53	Iron Pan		
172911	53	80	Aeolian Deposit		
172911	80	80	Gravel		
172912	0	15	Root Mat		
172912	15	30	Disturbed		
172912	30	55	Turf		
172912	55	59	Iron Pan		
172912	59	80	Aeolian Deposit		
172912	80	80	Gravel		
172913	0	10	Root Mat		
172913	10	37	Turf		934
172913	37	75	Aeolian Deposit		
172913	75	75	Gravel		
172914	0	10	Root Mat		
172914	10	78	Aeolian Deposit		
172914	78	78	Gravel		
172915	0	5	Root Mat		
172915	5	87	Aeolian Deposit		
172915	87	87	Gravel		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172916	0	12	Root Mat		
172916	12	47	Aeolian Deposit		
172916	47	55	Midden		
172916	55	80	Turf		934
172916	80	80	Iron Pan		
172917	0	10	Root Mat		
172917	10	45	Aeolian Deposit		
172917	45	120	Turf		934
172918	0	10	Root Mat		
172918	10	37	Turf	Burnt	
172918	37	42	Floor		
172918	42	43	Diatoms		
172918	43	71	Aeolian Deposit		
172918	71	72	Iron Pan		
172918	72	78	Aeolian Deposit		
172918	78	78	Gravel		
172919	0	10	Root Mat		
172919	10	40	Aeolian Deposit		
172919	40	63	Turf	Burnt	
172919	63	67	Floor		
172919	67	120	Aeolian Deposit		
172920	0	12	Root Mat		
172920	12	46	Turf	Burnt	
172920	46	49	Floor		
172920	49	120	Aeolian Deposit		
172921	0	10	Root Mat		
172921	10	27	Aeolian Deposit		
172921	27	46	Turf	Burnt	
172921	46	48	Floor		
172921	48	67	Low Density		
172921	67	120	Aeolian Deposit		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172922	0	12	Root Mat		
172922	12	20	Aeolian Deposit		
172922	20	51	Turf	Burnt	
172922	51	52	Floor		
172922	52	70	Disturbed		
172922	70	71	Iron Pan		
172922	71	73	Aeolian Deposit		
172922	73	73	Iron Pan		
172923	0	12	Root Mat		
172923	12	35	Turf	Burnt	
172923	35	36	Floor		
172923	36	60	Disturbed		
172923	60	69	Aeolian Deposit		
172923	69	69	Iron Pan		
172924	0	10	Root Mat		
172924	10	65	Turf		
172924	65	80	Aeolian Deposit		
172924	80	80	Gravel		
172925	0	10	Root Mat		
172925	10	30	Aeolian Deposit		
172925	30	68	Turf		
172925	68	79	Aeolian Deposit		
172925	79	79	Gravel		
172926	0	10	Root Mat		
172926	10	40	Aeolian Deposit		
172926	40	55	Turf		
172926	55	56	Midden		
172926	56	75	Aeolian Deposit		
172926	75	75	Iron Pan		
172927	0	10	Root Mat		
172927	10	65	Turf		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
172927	65	78	Aeolian Deposit		
172927	78	78	Iron Pan		
172991	0	5	Root Mat		
172991	5	64	Aeolian Deposit	Burnt bone at 51	
172991	64	64	Rock		
173034	0	3	Root Mat		
173034	3	90	Turf	1000 kind of green, could be LNL, but not as green as we'd	1000
173034	90	120	Aeolian Deposit		
173035	0	10	Root Mat		
173035	10	18	Aeolian Deposit		
173035	18	30	Turf	Burnt	H1
173035	30	46	Aeolian Deposit		
173035	46	48	Low Density		
173035	48	60	Aeolian Deposit		
173035	60	60	Rock		
173036	0	9	Root Mat		
173036	9	39	Turf		LNL/LNS
173036	39	40	Midden		
173036	40	67	Aeolian Deposit		
173036	67	67	Rock		
173037	0	5	Root Mat		
173037	5	68	Aeolian Deposit	Mottled	
173037	68	68	Gravel		
173057	0	5	Root Mat		
173057	5	48	Turf	Burnt	LNL/LNS
173057	48	76	Aeolian Deposit		
173057	76	76	Rock		
173058	0	7	Root Mat		
173058	7	29	Aeolian Deposit		
173058	29	31	Low Density		
173058	31	52	Aeolian Deposit		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173058	52	52	Rock		
173059	0	6	Root Mat		
173059	6	30	Aeolian Deposit		
173059	30	40	Subsoil		
173059	40	40	Rock		
173060	0	4	Root Mat		
173060	4	25	Aeolian Deposit		
173060	25	45	Subsoil		
173060	45	45	Rock		
173061	0	5	Root Mat		
173061	5	33	Aeolian Deposit	Turfy	
173061	33	40	Subsoil		
173061	40	40	Rock		
173062	0	2	Root Mat		
173062	2	85	Turf		H1
173062	85	85	Rock		
173063	0	6	Root Mat		
173063	6	40	Aeolian Deposit		
173063	40	57	Subsoil		
173063	57	57	Gravel		
173064	0	6	Root Mat		
173064	6	64	Turf	Tephra gray green thin line	unknown
173064	64	66	Aeolian Deposit		
173064	66	66	Rock		
173065	0	6	Root Mat		
173065	6	46	Turf		LNL/LNS
173065	46	46	Rock		
173066	0	4	Root Mat		
173066	4	120	Turf		LNL/LNS
173067	0	6	Root Mat		
173067	6	68	Turf		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173067	68	78	Midden		
173067	78	120	Aeolian Deposit	Mottled	
173068	0	65	Aeolian Deposit		
173068	65	65	Rock		
173069	0	5	Root Mat		
173069	5	90	Turf		LNL/LNS
173069	90	108	Aeolian Deposit		
173070	0	5	Root Mat		
173070	5	52	Turf	Collapsy	LNL/LNS
173070	52	55	Midden		
173070	55	76	Low Density	Turfy mix	
173070	76	110	Aeolian Deposit		
173071	0	5	Root Mat		
173071	5	81	Turf		LNL/LNS
173071	81	120	Aeolian Deposit		
173077	0	10	Root Mat		
173077	10	110	Turf		
173077	110	110	Iron Pan		
173078	0	10	Root Mat		
173078	10	105	Turf		
173078	105	120	Aeolian Deposit		
173079	0	12	Root Mat		
173079	12	35	Aeolian Deposit		
173079	35	52	Turf		
173079	52	65	Midden		
173079	65	70	Turf		
173079	70	81	Aeolian Deposit		
173079	81	81	Iron Pan		
173080	0	12	Root Mat		
173080	12	52	Aeolian Deposit		
173080	52	60	Midden		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173080	60	90	Aeolian Deposit		
173080	90	90	Iron Pan		
173081	0	12	Root Mat		
173081	12	47	Turf		
173081	47	56	Midden		
173081	56	83	Turf		LNL/LNS
173081	83	83	Iron Pan		
173490	0	5	Root Mat		
173490	5	42	Aeolian Deposit		
173490	42	42	Rock		
173491	0	5	Root Mat		
173491	5	45	Aeolian Deposit		
173491	45	45	Gravel		
173492	0	10	Root Mat		
173492	10	55	Aeolian Deposit		
173493	0	7	Root Mat		
173493	7	35	Aeolian Deposit		
173493	35	70	Turf		H3/H4
173493	70	70	Rock		
173494	0	6	Root Mat		
173494	6	28	Aeolian Deposit		
173494	28	34	Midden		
173494	34	40	Low Density		
173494	40	40	Rock		
173495	0	5	Root Mat		
173495	5	25	Aeolian Deposit		
173495	25	39	Midden		
173495	39	45	Aeolian Deposit		
173495	45	65	Turf		
173495	65	83	Aeolian Deposit		
173495	83	83	Rock		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173496	0	7	Root Mat		
173496	7	29	Aeolian Deposit		
173496	29	70	Turf		H1
173496	70	80	Subsoil		
173496	80	80	Gravel		
173497	0	6	Root Mat		
173497	6	25	Aeolian Deposit		
173497	25	35	Turf	Burnt	
173497	35	41	Floor		
173497	41	45	Aeolian Deposit		
173497	45	60	Turf		H3/H4
173497	60	73	Aeolian Deposit		
173497	73	90	Subsoil		
173498	0	8	Root Mat		
173498	8	25	Aeolian Deposit		
173498	25	40	Turf		
173499	0	5	Root Mat		
173499	5	22	Aeolian Deposit		
173499	22	68	Turf		H1
173499	68	81	Aeolian Deposit		
173499	81	97	Subsoil		
173500	0	10	Root Mat		
173500	10	40	Aeolian Deposit		
173500	40	75	Turf		
173500	65	66	Midden		
173500	66	68	Aeolian Deposit		
173500	68	70	Iron Pan		
173500	70	120	Aeolian Deposit		
173501	0	6	Root Mat		
173501	6	30	Aeolian Deposit		
173501	30	40	Turf	Burnt	

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173501	40	54	Turf		
173501	54	55	Floor		
173501	55	74	Aeolian Deposit		
173501	74	74	Gravel		
173502	0	10	Root Mat		
173502	10	29	Aeolian Deposit		
173502	29	31	Midden		
173502	31	40	Aeolian Deposit		
173503	0	9	Root Mat		
173503	9	20	Aeolian Deposit		
173503	20	35	Turf	Burnt	
173503	35	42	Turf		
173503	42	52	Aeolian Deposit		
173503	52	52	Rock		
173504	0	5	Root Mat		
173504	5	20	Aeolian Deposit		
173504	20	26	Midden		
173504	26	48	Aeolian Deposit		
173505	0	12	Root Mat		
173505	12	28	Aeolian Deposit		
173505	28	28	Rock		
173506	0	8	Root Mat		
173506	8	25	Aeolian Deposit		
173506	25	48	Turf	Burnt	
173506	48	53	Floor		
173506	53	65	Aeolian Deposit		
173506	65	65	Rock		
173627	0	9	Root Mat		
173627	9	68	Bog		
173627	68	68	Rock		
173628	0	8	Root Mat		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173628	8	40	Bog		
173648	0	6	Root Mat		
173648	6	20	Aeolian Deposit		
173648	20	37	Turf	Burnt	H3/H4
173648	37	44	Floor		
173648	44	50	Aeolian Deposit		
173648	50	51.5	Floor		
173648	51.5	65	Aeolian Deposit		
173648	65	65	Rock		
173649	0	5	Root Mat		
173649	5	20	Aeolian Deposit		
173649	20	45	Turf	Burnt	
173649	45	45	Rock		
173650	0	7	Root Mat		
173650	7	35	Aeolian Deposit		
173650	35	40	Turf		
173650	40	45	Aeolian Deposit		
173650	45	45	Rock		
173651	0	6	Root Mat		
173651	6	28	Aeolian Deposit		
173651	28	32	Turf		
173651	32	41	Aeolian Deposit		
173651	41	41	Rock		
173652	0	10	Root Mat		
173652	10	15	Aeolian Deposit		
173652	15	25	Aeolian Deposit		
173652	25	45	Turf		
173652	45	49	Aeolian Deposit		
173652	49	53	Midden		
173653	0	7	Root Mat		
173653	7	29	Aeolian Deposit		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173653	29	35	Turf		
173653	35	40	Aeolian Deposit		
173653	40	52	Midden	Dark	
173653	52	62	Aeolian Deposit		
173654	0	7	Root Mat		
173654	7	22	Aeolian Deposit		
173654	22	27	Low Density		
173654	27	35	Turf		
173654	35	53	Aeolian Deposit		
173654	53	71	Subsoil		
173654	71	71	Gravel		
173655	0	6	Root Mat		
173655	6	35	Aeolian Deposit		
173655	35	38	Turf		
173655	38	40	Midden		
173655	40	45	Low Density		
173655	45	60	Aeolian Deposit		
173656	0	8	Root Mat		
173656	8	19	Aeolian Deposit		
173656	19	26	Midden		
173656	26	35	Turf		
173656	35	45	Aeolian Deposit	Boggy	
173656	45	71	Aeolian Deposit		
173657	0	6	Root Mat		
173657	6	43	Aeolian Deposit		
173657	43	55	Midden		
173657	55	56	Aeolian Deposit		
173657	56	56	Rock		
173658	0	5	Root Mat		
173658	5	52	Aeolian Deposit		
173658	52	52	Rock		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173659	0	5	Root Mat		
173659	5	58	Aeolian Deposit		
173659	58	58	Rock		
173660	0	5	Root Mat		
173660	5	56	Aeolian Deposit		
173660	56	56	Rock		
173661	0	7	Root Mat		
173661	7	40	Aeolian Deposit		
173661	40	50	Turf		
173661	50	60	Aeolian Deposit		
173661	60	62	Subsoil		
173661	62	62	Rock		
173662	0	7	Root Mat		
173662	7	38	Aeolian Deposit		
173662	38	68	Turf		
173662	68	68	Rock		
173663	0	8	Root Mat		
173663	8	30	Aeolian Deposit		
173663	30	34	Turf		
173663	34	40	Aeolian Deposit		
173663	40	59	Turf		
173663	59	70	Aeolian Deposit		
173663	70	72	Subsoil		
173664	0	7	Root Mat		
173664	7	30	Aeolian Deposit		
173664	30	37	Midden		
173664	37	44	Aeolian Deposit		
173664	44	60	Turf		
173664	60	66	Aeolian Deposit		
173664	66	67	Subsoil		
173664	67	67	Rock		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173665	0	7	Root Mat		
173665	7	29	Aeolian Deposit		
173665	29	43	Turf		
173665	43	50	Aeolian Deposit		
173665	50	56	Turf		
173665	56	87	Aeolian Deposit		
173665	87	95	Subsoil		
173666	0	8	Root Mat		
173666	8	34	Aeolian Deposit		
173666	34	36	Midden		
173666	36	60	Aeolian Deposit		
173666	60	60	Rock		
173667	0	8	Root Mat		
173667	8	36	Aeolian Deposit		
173667	36	40	Midden		
173667	40	46	Aeolian Deposit		
173667	46	60	Turf		
173667	60	75	Aeolian Deposit		
173667	75	75	Rock		
173668	0	8	Root Mat		
173668	8	24	Aeolian Deposit		
173668	24	32	Turf		H1
173668	32	40	Aeolian Deposit		
173668	40	59	Turf		
173668	59	65	Aeolian Deposit		
173668	65	65	Rock		
173669	0	7	Root Mat		
173669	7	25	Aeolian Deposit		
173669	25	28	Midden		
173669	28	40	Turf		H1
173669	40	46	Aeolian Deposit		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173669	46	67	Turf		
173669	67	71	Aeolian Deposit		
173669	71	71	Rock		
173670	0	8	Root Mat		
173670	8	19	Aeolian Deposit		
173670	19	60	Turf	Burnt	
173670	60	60	Rock		
173671	0	6	Root Mat		
173671	6	23	Aeolian Deposit		
173671	23	31	Midden		
173671	31	37	Aeolian Deposit		
173671	37	44	Turf		
173671	44	44	Gravel		
173672	0	6	Root Mat		
173672	6	26	Aeolian Deposit		
173672	26	40	Turf	Burnt	
173672	40	47	Turf		
173672	47	65	Midden		
173672	65	73	Aeolian Deposit		
173673	0	5	Root Mat		
173673	5	34	Aeolian Deposit		
173673	34	94	Turf		934
173673	94	104	Midden		
173673	104	112	Aeolian Deposit		
173674	0	6	Root Mat		
173674	6	35	Aeolian Deposit		
173674	35	59	Turf		
173674	59	72	Aeolian Deposit		
173674	72	91	Subsoil		
173675	0	7	Root Mat		
173675	7	19	Aeolian Deposit		

Core Number	Top Depth	Bottom Depth	Category	Description	Tephra in Turf
173675	19	57	Turf		
173675	57	80	Aeolian Deposit		
173675	80	86	Subsoil		
173676	0	6	Root Mat		
173676	6	26	Aeolian Deposit		
173676	26	43	Turf		
173676	43	43	Rock		
173759	0	7	Root Mat		
173759	7	28	Aeolian Deposit		
173759	28	51	Floor		
173759	51	66	Turf		
173759	66	69	Floor		
173759	69	71	Aeolian Deposit		
173759	71	73	Floor		
173759	73	110	Aeolian Deposit		
173760	0	10	Root Mat		
173760	10	30	Aeolian Deposit		
173760	30	50	Turf		H1
173760	50	57	Aeolian Deposit		
173760	57	69	Midden		
173760	69	70	Aeolian Deposit		
173760	70	70	Rock		

Table 4. Finds list

Farm	Place	Artifact Number	DESCRIPTION	CONTEXT	ID	DATE
Garður	Hegranesþing	2017-12-1	Worked iron - nail?	106	RSS	08/02/2017
Garður	Hegranesþing	2017-12-2	4 metal pieces in screen, 1 by hand	106	KWS	08/02/2017
Garður	Hegranesþing	2017-12-3	Possible rivet	107	TLP	08/02/2017
Garður	Hegranesþing	2017-12-5	Fragment	111	GMC	08/03/2017
Garður	Hegranesþing	2017-12-6	Worked bone	111	TLP	08/03/2017
Garður	Hegranesþing	2017-12-7	Worked bone, similar to find 6 and possibly from the same object maybe a comb sheath	111	RSS	08/03/2017
Garður	Hegranesþing	2017-12-9	In screen - comb fragment in screen	112	RSS	08/03/2017
Garður	Hegranesþing	2017-12-11	In screen - comb fragment in screen	111	RSS	08/03/2017