Skagafjörður Church and Settlement Survey

Lower Keflavík: Geophysical Prospection and Coring Interim Report 2012-2016

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Photo on front page – Core from Lower Keflavík showing floor deposit.

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The Keflavík geophysical and coring survey is part of a larger survey of Hegranes. General permits for the survey of Hegranes and associated excavations were granted by The Cultural Heritage Agency of Iceland (MÍ201506-0056, MÍ201506-0058, & MÍ201506-0059. The work was supported by the US National Science Foundation (PLR # 1242829, 1345066, 1417772 & 1523025) in a joint project of the Skagafjörður Heritage Museum and UMass Boston. The Icelandic Archaeology Fund also supplied significant support for the project. We are grateful to the Skagafjörður Commune for their ongoing and invaluable support. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the individuals and institutions who support this work. Products or instruments mentioned should not be construed as an endorsement.

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 INTRODUCTION

Keflavík is one of the most northern farms on Hegranes. "Keflavík" means driftwood bay. The name of the island 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; Zoëga and Bolender 2016; Zoëga, et al. 2015). To the north of Keflavík are the waters of Skagafjörður, with the northerneastern border a beach (probably the actual keflavík), and the rest of the northern border of the farm are sea cliffs. To the northwest is the farm of Utanverdunes and to the southeast is Helluland. The farm south of Keflavík is Garður (Figure 1). The central part of the farm's fields is in a 300 m wide north-south running valley that drains to the north. Today the farm buildings are on high on a ridge on the east side of the valley, but the main farmmound, barn, and other activity areas are directly opposite, on the west side ridge. The eastern part of the main farmmound contains a Viking Age and medieval churchyard and is currently being investigated (Zoëga and Bolender 2016; Zoëga, et al. 2015). The results presented here cover the investigation the area in the center of Keflavík's fields, between the modern houses and the main farmmound, termed Lower Keflavík. The defining feature of Lower Keflavík is a visible tun wall that runs for about 200 m (Figure 2). For coring purposes, the area defined as Lower Keflavík is about 14,950 m^2 (starting at N 581790 and going 115 m north to E581905 and starting at 477290 and going 130 m east to 477420. This area, either defined by the tun wall, or the strict dimensions above, does not appear to be associated either with the main, farmmound or the medieval churchyard.

Keflavík first appears in the historical record in 1374 as a property belonging to the bishop's see at Hólar. A medieval cartulary dating to 1394 recounts that a priest was paid for his service at Keflavík, which suggests that there might have been a chapel (Sigurðardóttir 2012). The existence of an early Christian cemetery at Keflavík was confirmed in 2013 and is currently under investigation (Zoëga and Bolender 2016; Zoëga, et al. 2015). This 2013 church was abandoned long before the 1394 mention, hinting that this site may be complex and potentially other churches. In 1713 the farm was worth 20 hundreds (Magnússon and Vídalín 1930:64) and the same again 130 years later (Johnsen 1847:277) and neither land survey source mentions a church. Magnússon and Vídalín (1930) do mention other potential farms at Keflavík: Vík, Grønagerði or Grottakot, Þrægerði, Litla-Keflavík, and an unnamed old farm. Thw western border of Lower Keflavík is about 40 m from the cemetery excavations, which are at the eastern base of the main farmmound and it is unclear if the Lower Keflavík area is associated with any of the places mentioned by Magnússon and Vídalín (Zoëga and Sigurðarson 2009). Recient work on the outlying farmssteads at Keflavík (Catlin and Steinberg 2016; Catlin, et al. 2017) suggest that most of these mentioned farms are not associated with the Lower Keflavík area.

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

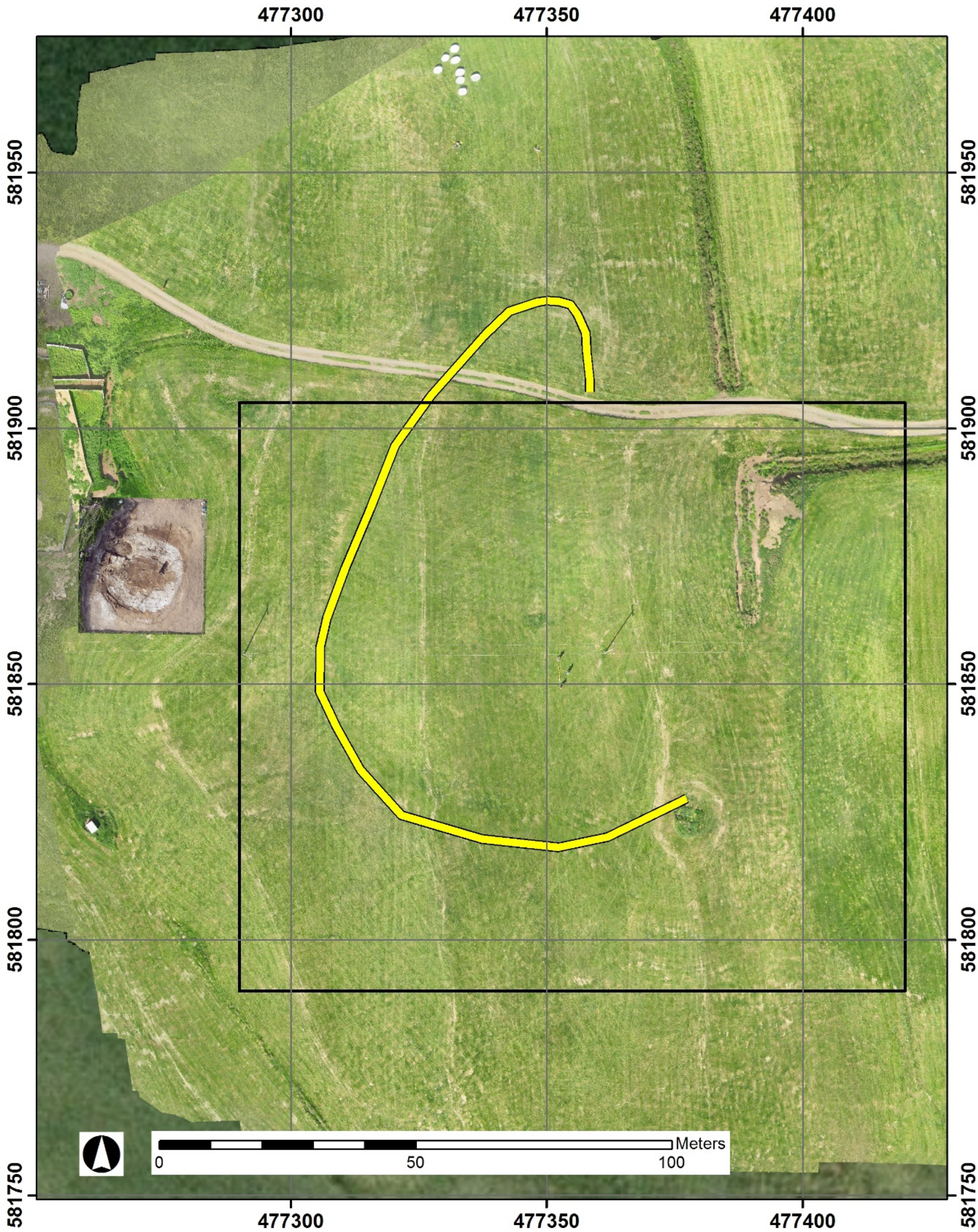

Figure 2. Kite photograph of Lower Keflavík with tun boundary wall in yellow and defined area in black. The churchyard associated with the western farmmound is also shown.

1.1 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.
  - 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; Thórarinsson 1967) 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 (Boygle 1999; Ólafsson 1985; Sigurgeirsson 1998; Wastegard, et al. 2003). 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 is lies between the LNL and Vj~1000. There are several potential candidates for this layer, including the large A.D. 934 ±2 eruption of Eldgjá. (Fei and Zhou 2006; Hammer, et al. 1980; Thordarson, et al. 2001) or 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; Zielinski, et al. 1997, [A.D. 877 ±4]). 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 are tightly spaced in a brown organic rich soil matric 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).

1.2 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

1.3 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. These deposits are often thin but are very distinct.

A farmstead's perimeter for a given time period was determined by the results of the plotted cores taken around a 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.

1.4 Previous archaeological work

In 2008 the visible surface features within the tun wall of Lower Keflavík were mapped and tested as part of the Skagafjörður Church Project (Figure 3). The main goal of this work was to identify churchyards, therefore special attention was given to circular surface features. Two distinct circular features were identified along with an indistinct circular slump. Additionally an east-west long feature, consistent with a turf structure, was also identified. Trench 2008-1 showed only ephemeral signs of turf. Trench 2008-2 makes clear that, at least that part of the defining tun wall was constructed before the 1104 tephra fell (Figure 4). Trench 2008-3 identified a substantial turf deposit mixed with midden under a well-preserved H1 (Zoëga and Sigurðarson 2009:22). Trench 2008-4 had clear domestic deposits, characterized by peat ash, charcoal and animal bones, again, below a well-defined H1. Trench 2008-5 had substantial peat ash and wood ash deposits (Figure 5), along with degraded turf, suggesting a smithy or some sort of iron working deposit.

Some previous geophysics has already been reported on (Bolender, et al. 2013) but will be reanalyzed here in light of the intensive and extensive coring at Lower Keflavík. Trench 2015-6 is part of Ramona Steel's Master's thesis work, and will not be reported on here, but the stratigraphy and dating observed in trench 2008-2 is entirely consistent with 2015-6 (Figure 4).

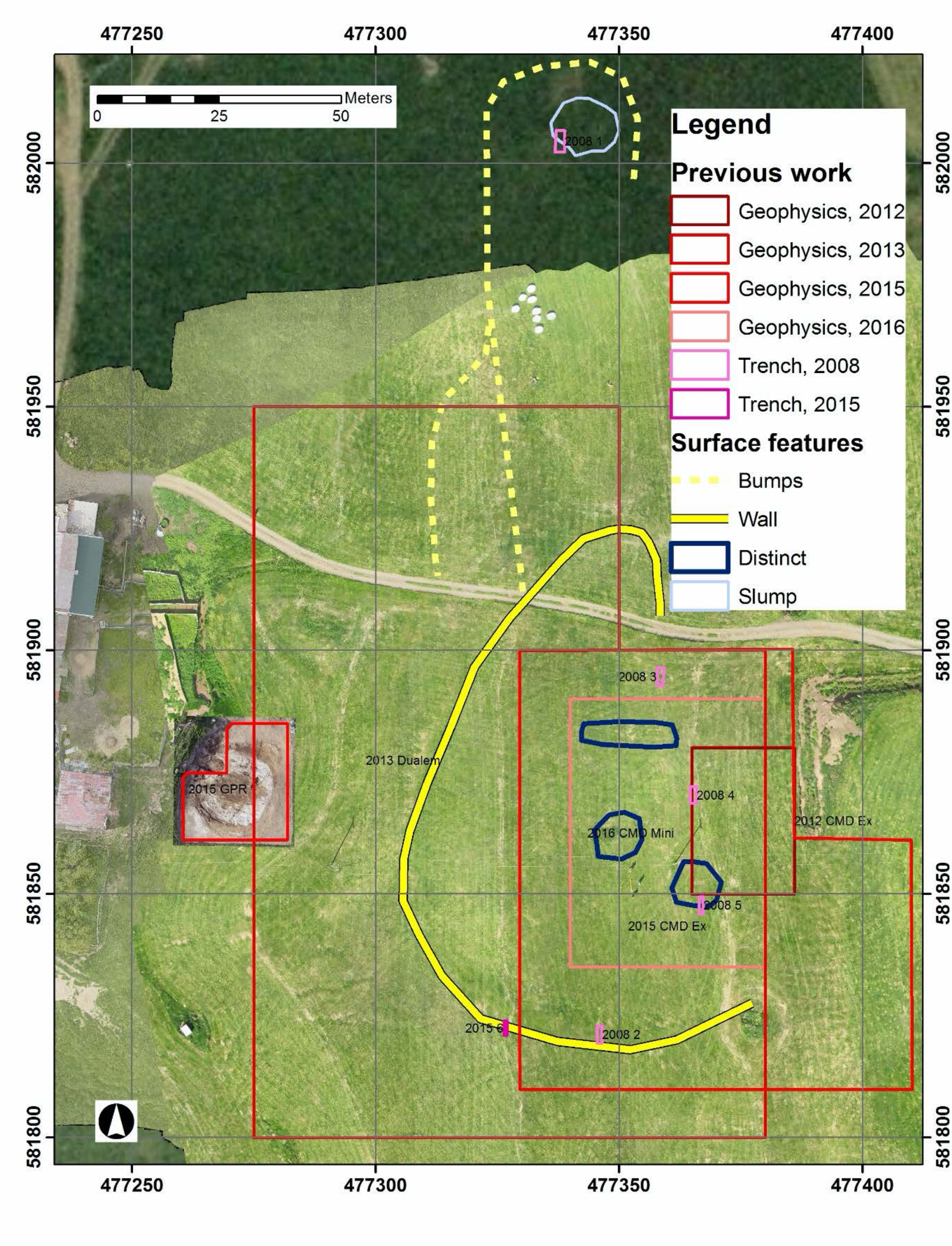

Figure 3. Location and areas of archaeological work and distinct surface features at Lower Keflavík

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Figure 4. West sidewall of trench 2008-2 showing H1 on top of turf wall.

Figure 5. North sidewall of trench 2008-5 peat ash and wood ash deposits.

2.0 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 the center of Lower Keflavík, the internal GPS receiver in the iPhones or iPads that were used to record the coring data was used. Many of these cores were taken in 2015. Within Lower Keflavík, most cores were collected on rough 10 x 10 m grid spacing that were located by pacing. Judgmentally placed cores were originally located with an iPad and then 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 2016 cores transect lines were placed using the geophysical grid.

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.

3.0 GEOPHYSICAL METHODOLOGIES

The use of geophysical methods in support of archaeological investigations is widely established (e.g., Gaffney and Gater 2003; Linford 2006). For the 2016 study, frequency-domain electromagnetics (FDEM) was applied over northern portions of the assembly site. Summarized below are the geophysical methodologies that were used. Appendix A provides a general overview of FDEM operations.

3.1 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 Lower Keflavík, the ground surface is relatively smooth but there are a few thufurs or frost heaves (e.g., Grab 2005), as well as the ephemeral remnants of archaeological remains, do create some topographical relief.

There are several potential geophysical targets associated with the Viking Age archaeological remains at Lower Keflavík. 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 buildings, include animal pens and boundary walls, that 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, measureable 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).

3.2 Frequency-Domain Electromagnetic Surveying

There were several overlapping geophysical surveys at Lower Keflavík conducted over multiple years. In 2012, an FDEM survey using the CMD Explorer was conducted over a 20 × 30 m grid, which was primarily intended to test the unit (Figure 3). In 2013, an expanded reconnaissance survey was conducted over a 150-x200 m grid using the DuelEM to test the efficacy of that instrument. One objective of this early work was to directly compare geophysical to the exposed archaeological remains, especially the visible tún wall. In 2015, a third FDEM survey was conducted, this again with the CMD Explorer. Finally, in 2016, a fourth survey was conducted using the CMD Mini. This last survey proved to be the most efficacious.

3.2.1 Equipment and Field Procedures

The FDEM surveys were conducted using a host of multi-sensor conductivity meters: GF Instruments' CMD Explorer (Figure 6), a Dualem-21 (Figure 7) and a CMD-MiniExplorer (Figure 8). Unlike traditional EM meters that have a single transmitter and receiver coil, the multi-sensor instruments have multiple receiver coils at different lengths from the transmitter coil (i.e., dipole lengths) thus sensing different volumes (and total depths from the ground surface) of the subsurface. One of the major advantages of these systems is that the different readings from the same location can be compared and filtered to isolate anomalies (cf. Saey, et al. 2009; Simpson, et al. 2009). Thus, maps of archaeological features that produce subtle changes in moisture content can be produced more easily. Multi-sensor instruments have significant advantages over single sensors as they can potentially distinguish the depth of features causing anomalies. Having an approximate depth of specific anomalies can greatly aid in interpretation (Bonsall, et al. 2013). 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. 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").

The CMD Explorer operates at 30 kHz over three separate dipole lengths (i.e., a single transmitter [TX] located at one end of the unit and three separate receivers [RX] located at varying distances along the boom). By increasing dipole length, a greater volume and depth of soil can be sensed. When operated in the vertical dipole mode, the dipole lengths of 1.48, 2.82 and 4.49 m provide depths of interrogation of approximately 2.2, 4.2 and 6.7 m (i.e., ~1.5X the dipole length), respectively, relative to the level of the sensors. For the 2013 CMD Explorer survey it was operated in the vertical dipole mode with the boom carried at hip level oriented perpendicularly to the direction of the east-west transects that were walked from east to west along contiguous transects that were separated by 0.5 m. For the 2015 CMD Explorer survey, the unit was operated in the vertical dipole mode with the boom carried at hip level oriented parallel to the direction of the east-west transects that were walked from east to west along contiguous transects that were separated by 0.5 m. In both cases 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. Note that surveying was guided by color-coded PVC flags that were placed every 10 meters along transects separated by 1 m. The true location of a measurement was determined by fiducial markers that were placed into the data stream by the operator and assuming linear interpolation between markers.

The DualEM-21 has four dipole lengths (1.0 m, 1.1 m, 2.0 m and 2.1 m) with receivers oriented both horizontally (1.0 m and 2.0 m) and vertically (1.1 m and 2.1 m) relative to a horizontally oriented transmitter coil (i.e., horizontally coplanar and perpendicular geometries). The instrument was mounted on sled and dragged parallel to survey transects bi-directionally. Transects were 1 m apat. The DualEM collects data at a fixed rate of time, and therefore during survey a given fiducially must be reached exactly in the allotted time. In most cases we used 1 m/sec and collected data approximately at 0.01 m intervals.

CMD Mini, like the larger CMD explorer operates at 30 kHz over three separate dipole lengths with 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. For the 2016 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 from east to west along contiguous transects that were separated by 0.5 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. Again, surveying was guided by color-coded PVC flags that were placed every 10 meters along transects separated by 1 m.

Figure 6. Using the CMD Explorer at Hegranesthing in 2015 before the church excavation.

Figure 7. Electromagnetic surveying with the DualEM-21 (pictured at Stóra-Seyla). Damiata, keeps track of the distance, while Steinberg right, pulls unit at an even pace along the ground surface.

Figure 8. Using the CMD Mini at Keflavík in 2015 before the church excavation.

3.2.2 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 for the CMD, 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 processed data were also archived into a database for future use.

3.2.3 Results

The 2012 CMD Explorer results at Lower Keflavík were covered a small area and showed little structure to the data (Figure 9 and Figure 10). Operating the unit perpendicular to the transect does not yield high resolution of contrasts on archaeological scales.

The 2013 DualEM results were mixed. The horizontal C, especially sensor 1 (Figure 11) seems to be very sensitive to surface metal. The C horizontal sensor 2 , vertical C sensor 1 and vertical C sensor 2 (Figure 12) all show little structure to the data, while all of the IP data shows substantial structure, especially the tún walls (Figure 13 and Figure 14). Most importantly, in light of the CMD mini, discussed below, horizontal C sensor 1 & 2 & vertical IP sensor 2 both suggest important structure to the data that was not identified until the 2016 results of the CMD mini survey. Conversely, the tún walls do not present well in the C components, and where they do appear, they are slightly higher (more conductive) then the surrounding environment. In the IP, the tún walls present as high anomalies surrounded by low ip regions, This pattern would suggest that the tún walls at Lower Keflavík do not contain rocks, in contrast to the visible tún walls at neighboring Hegranesþing (Damiata, et al. 2016) from about the same time period.

The 2015 CMD Explorer C readings suggest almost no structure (Figure 15) while the IP readings suggest substantial structure (Figure 18). Unfortunately, other than the visible tún wall, we have not been able to associate the patterns seen in the IP data with specific archaeological components. Again, as discussed below, CMD Mini and coring data suggests that all of the CMD Explorer readings are deep and may be picking up variations in the ubiquitous gravel layer that generally begins about 55 cm bgs.

The 2016 CMD Mini C readings do not exhibit any discernable archaeological structure (Figure 17) and the central area generally appears as a low. While IP 1 and 2 show little interpretable structure, IP 3 shows obvious structure (Figure 18). In the IP3 two quasi-parallel low anomalies can be seen in the center of the survey area, running about 30 m north-south separated by about 8 m east-west. Separating these two low linear anomalies is a distinct high. This anomaly geometry is consistent with a longhouse. To complete the picture, running out east at N 581865 is a break in the eastern low conductivity anomaly, consistent with an entrance to the longhouse. To the north, running east-west at the N 581862 line is a low conductive anomaly, which may be another wall.

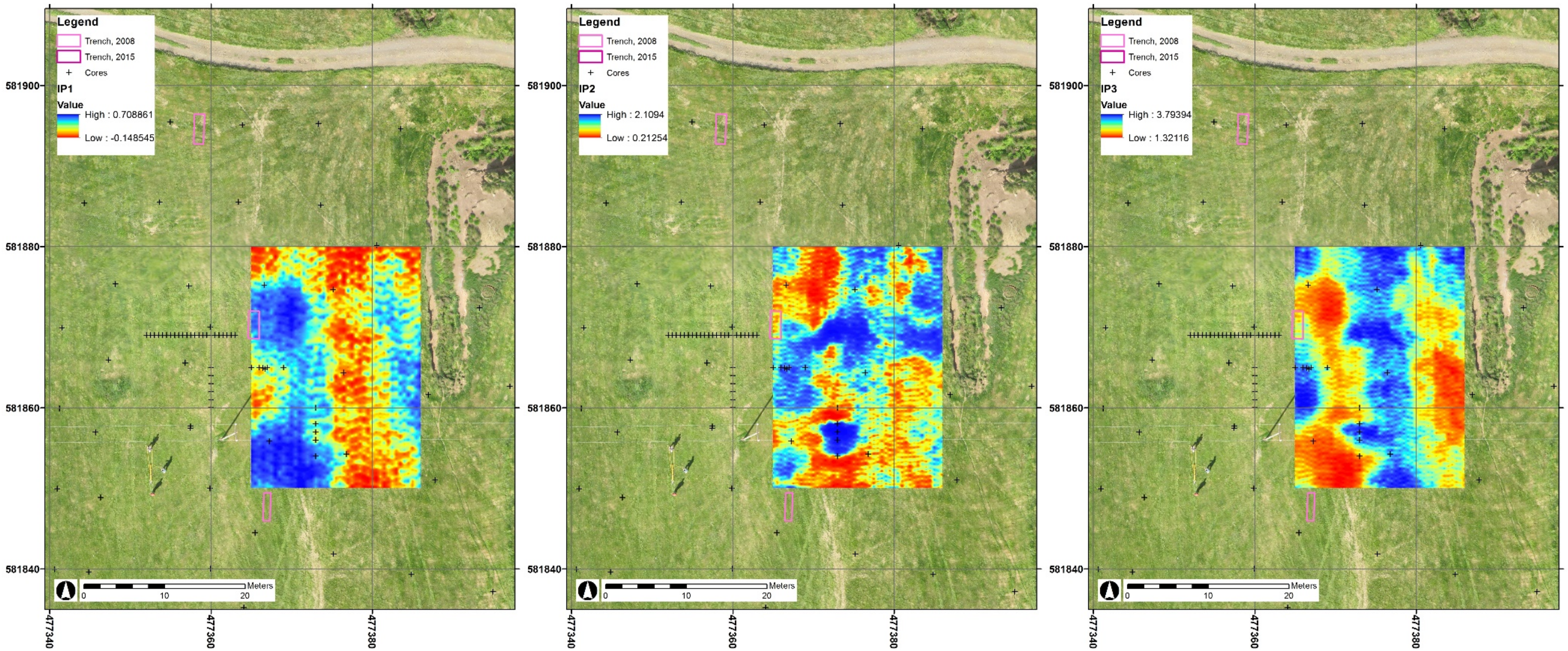


Figure 9. Apparent ground conductivity maps (mS/m) from CMD Explorer in 2013. Left: C3 image. Middle: C2 image. Right: C1 image. Note the three operators of the DualEM to the left of the survey area.

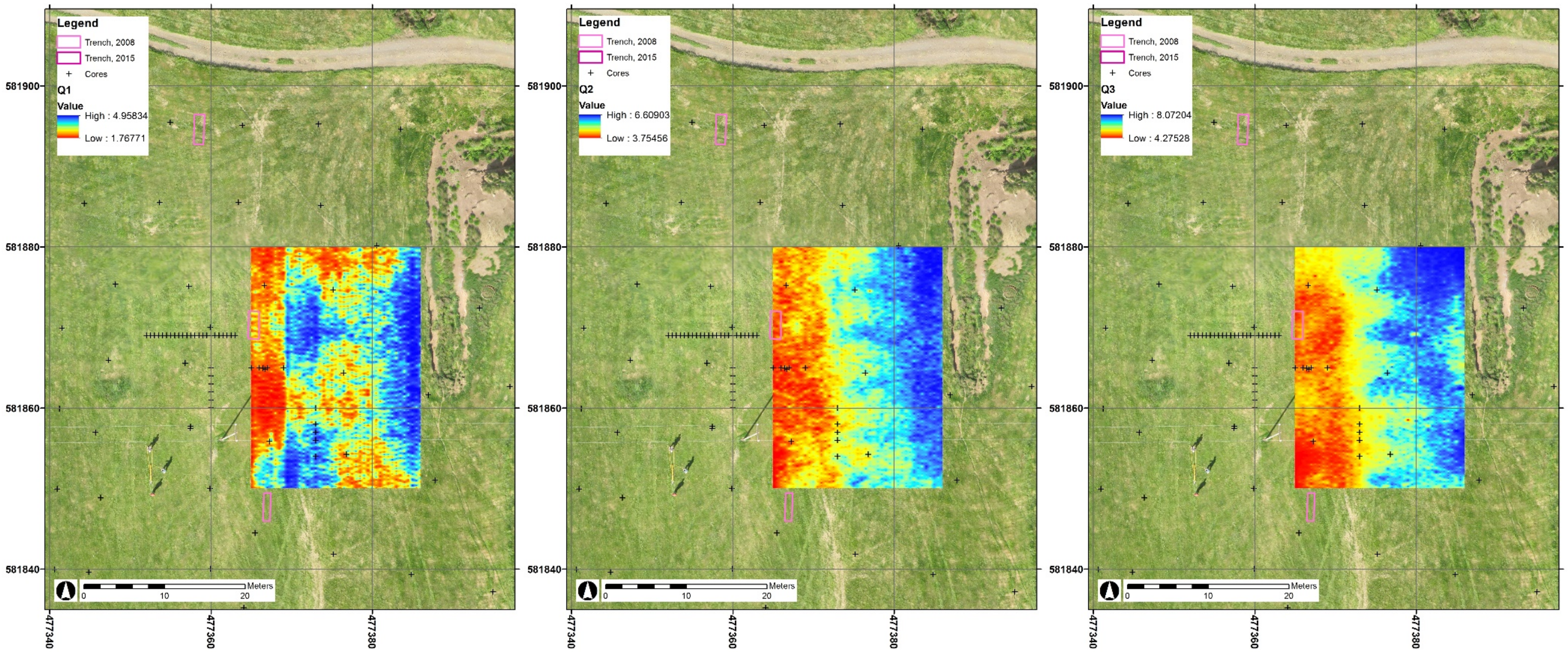


Figure 10. In-phase component maps (ppt) from CMD Explorer in 2013. Left: IP3 image. Middle: IP2 image. Right: IP1 image.

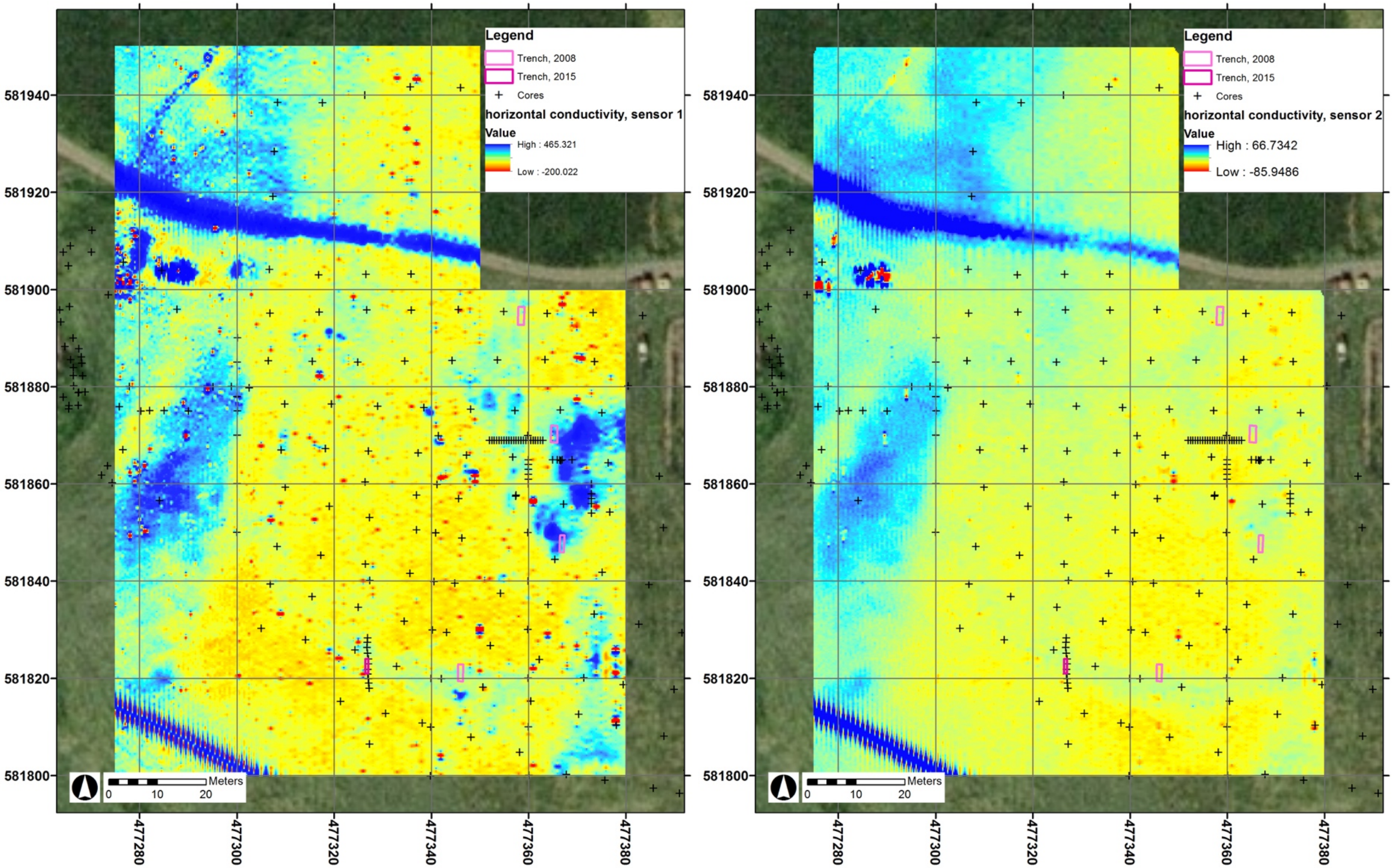


Figure 11. Horizontal bulk ground conductivity maps (mS/m). Left: Horizontal sensor 1 Right: Horizontal sensor 2.

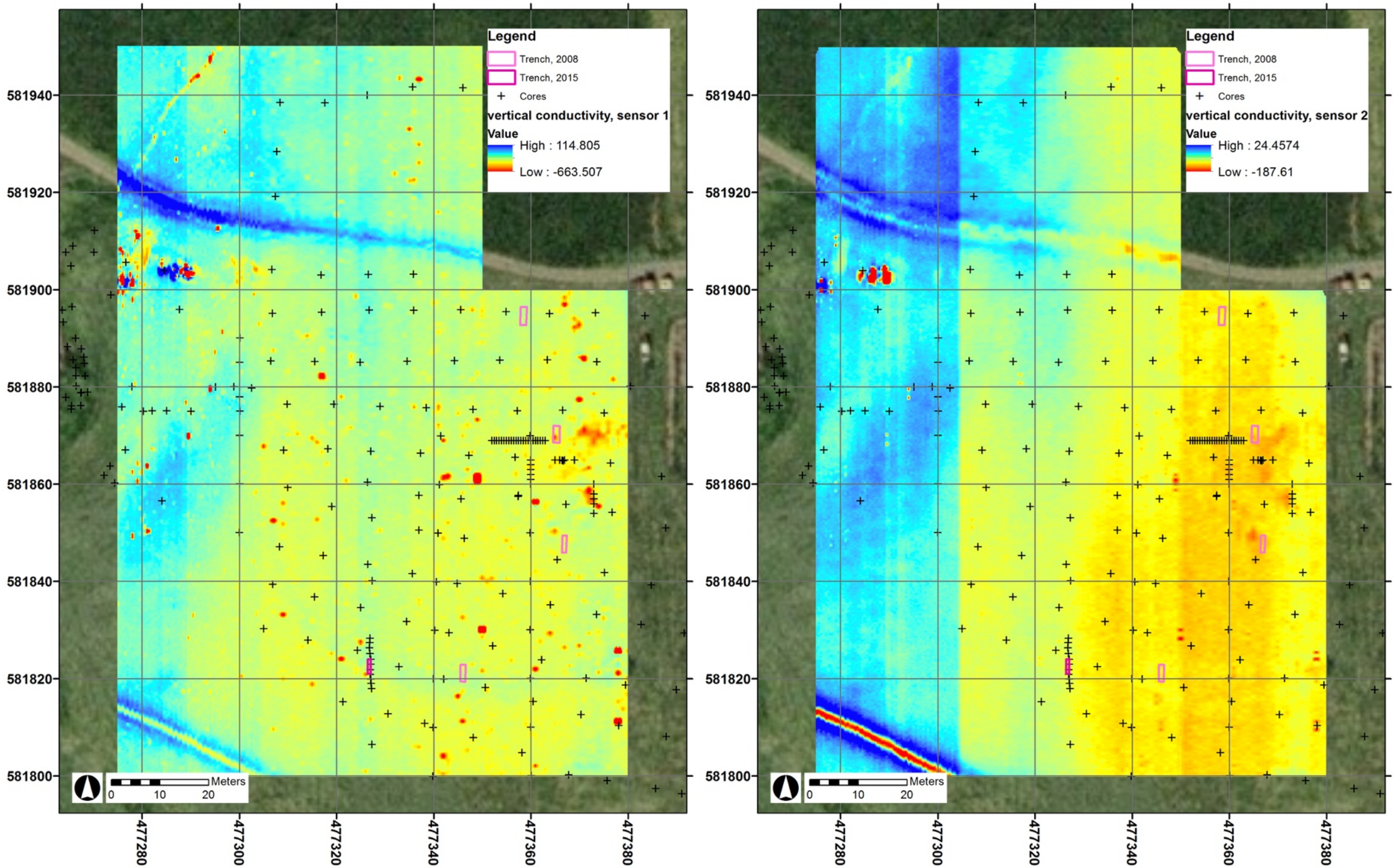
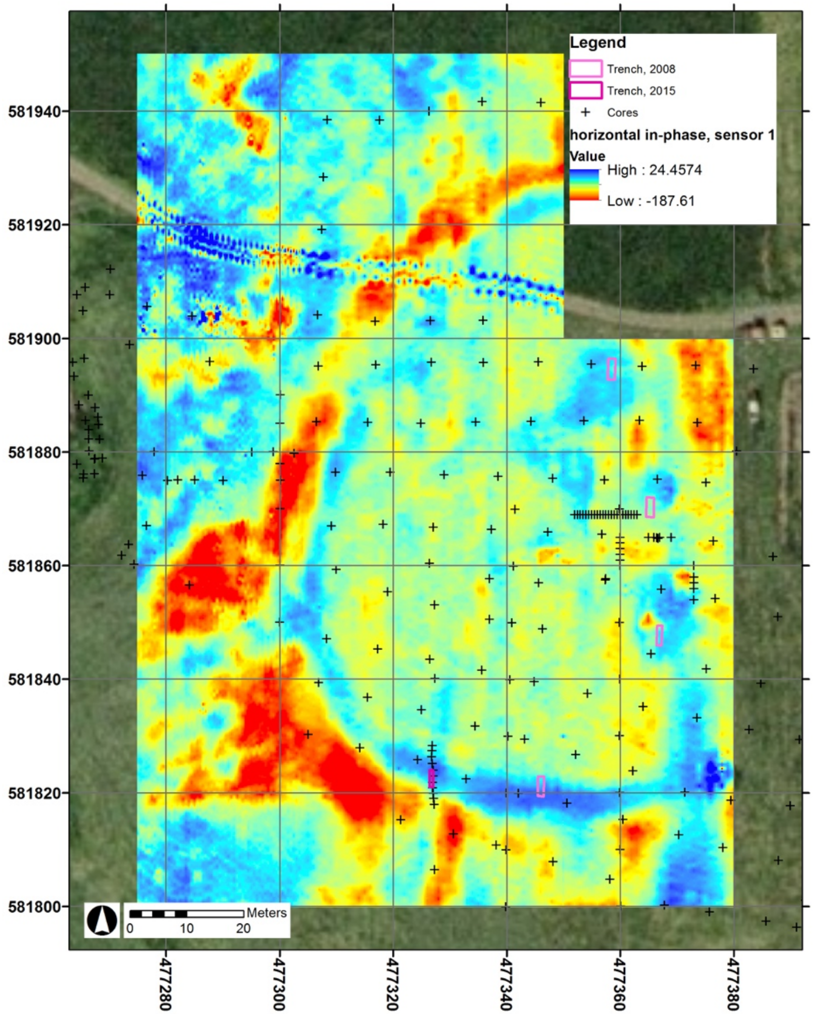


Figure 12. Vertical bulk ground conductivity maps (mS/m). Left: Vertical sensor 1 Right: Vertical sensor 2.



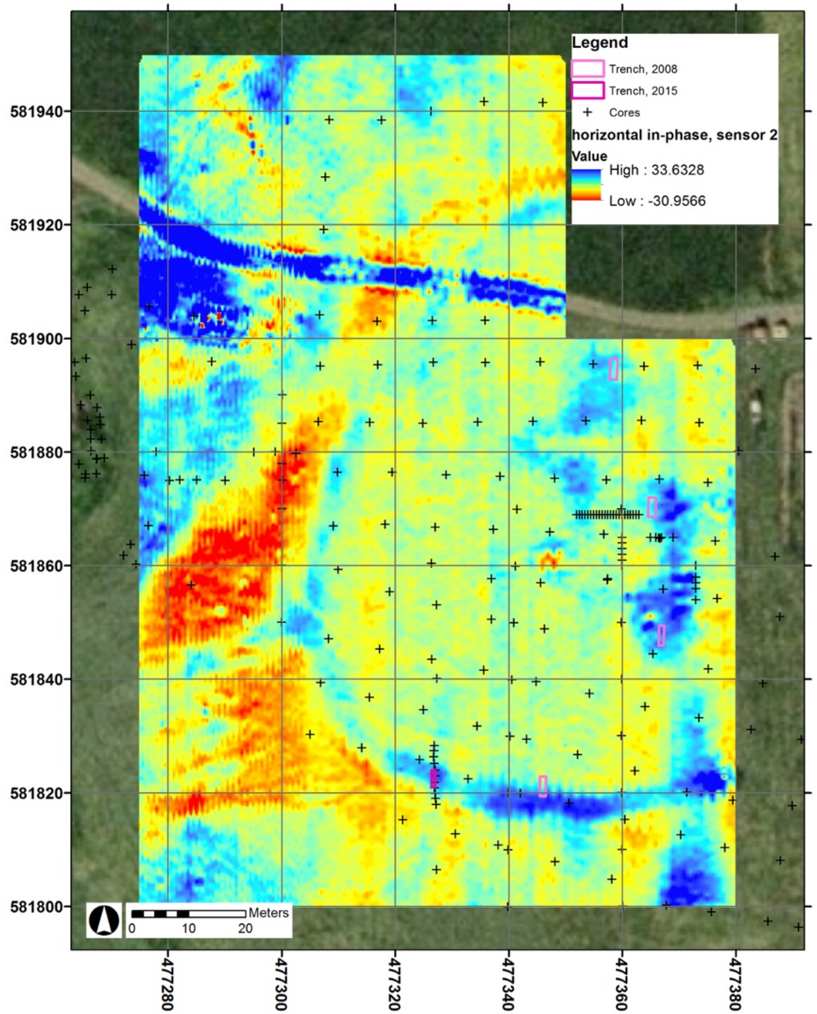


Figure 13. Horizontal IP maps (ppt). Left: Horizontal sensor 1 Right: Horizontal sensor 2.

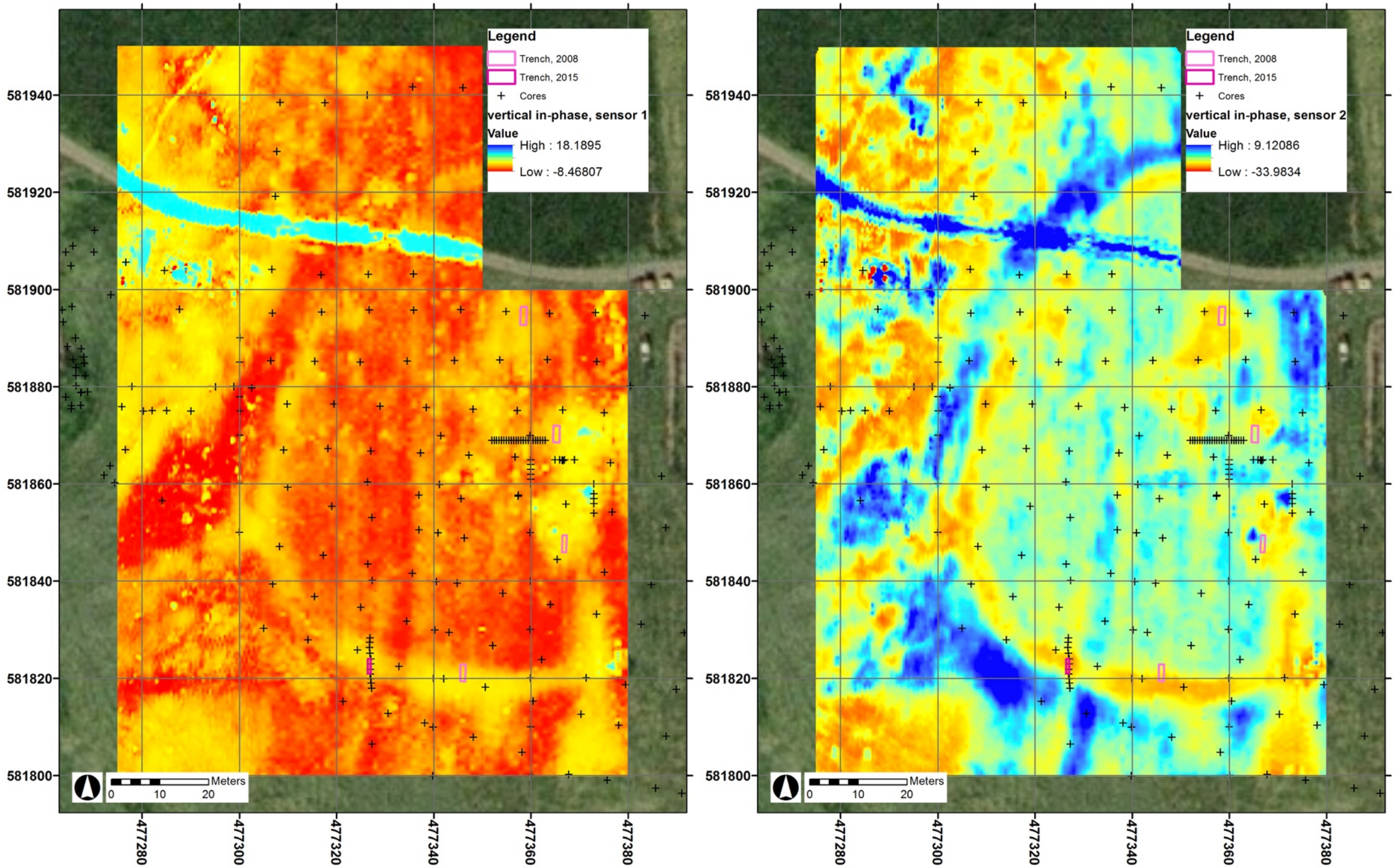


Figure 14. Vertical IP maps (ppt). Left: Vertical sensor 1 Right: Vertical sensor 2.

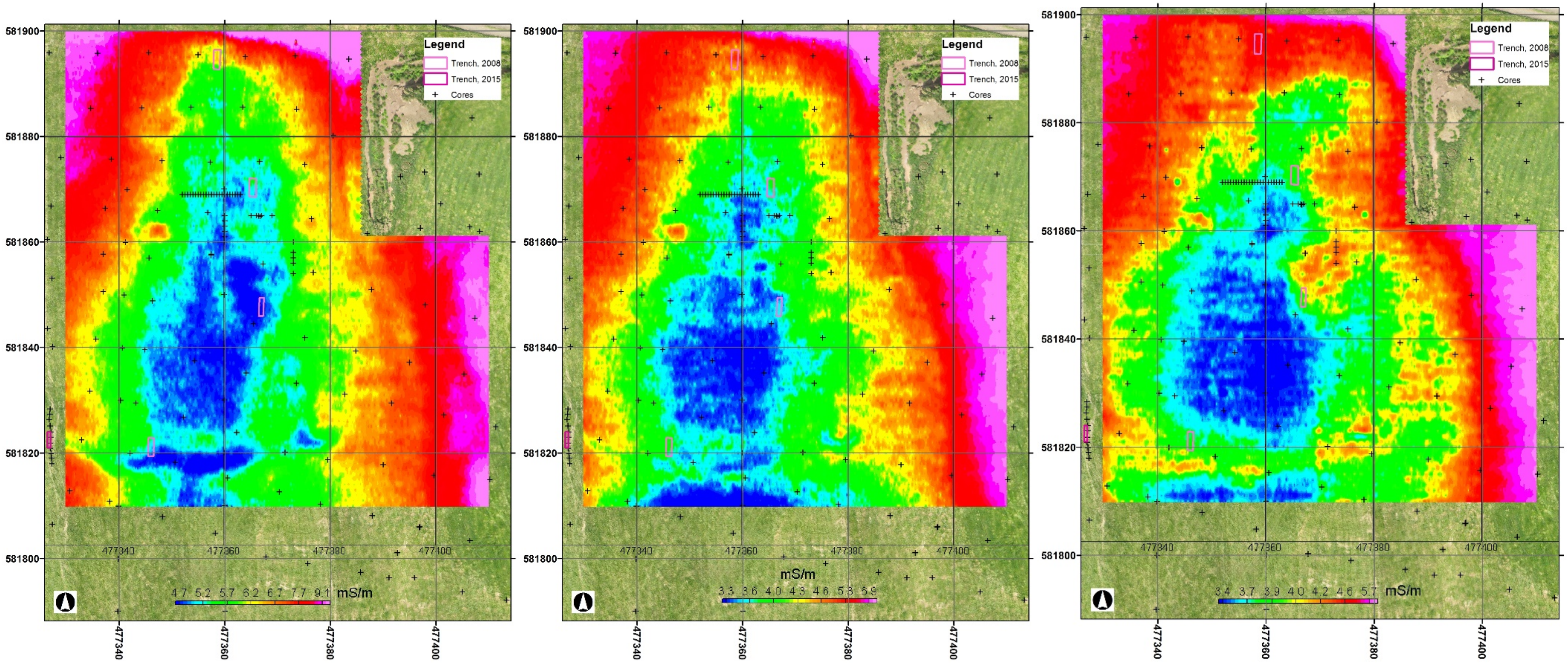


Figure 15. Apparent ground conductivity maps (mS/m) from CMD Explorer in 2015. Left: C3 image. Middle: C2 image. Right: C1 image.

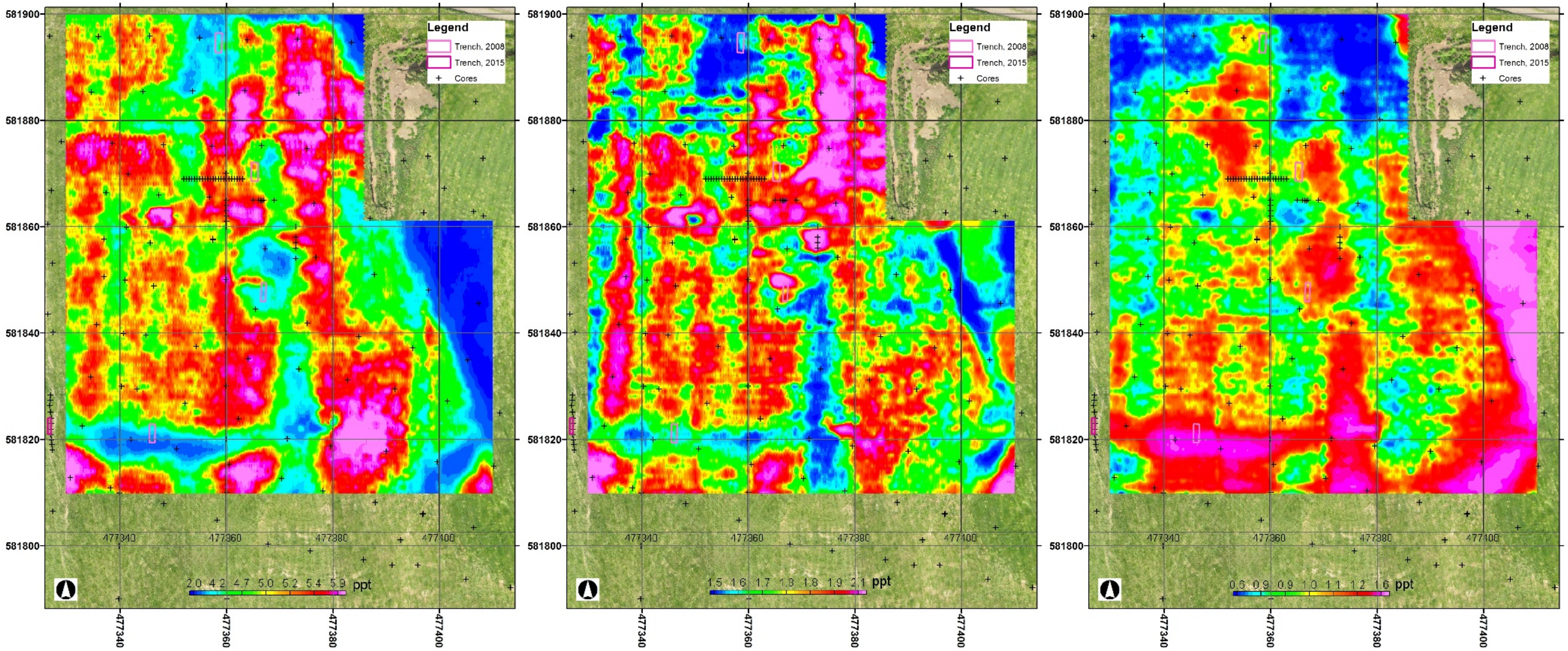


Figure 16. In-phase component maps (ppt) from CMD Explorer in 2015. Left: IP3 image. Middle: IP2 image. Right: IP1 image.

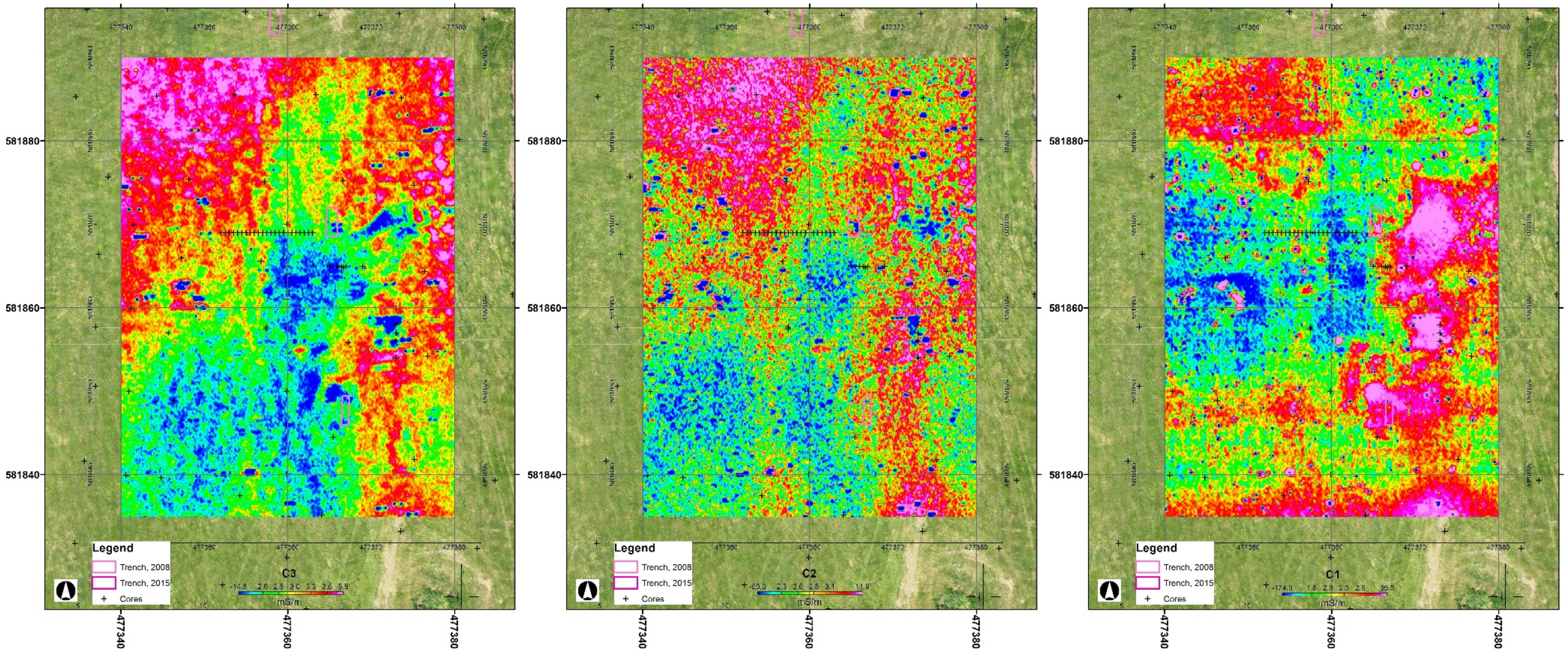


Figure 17. Apparent ground conductivity maps (mS/m) from CMD Mini in 2016. Left: C3 image. Middle: C2 image. Right: C1 image.

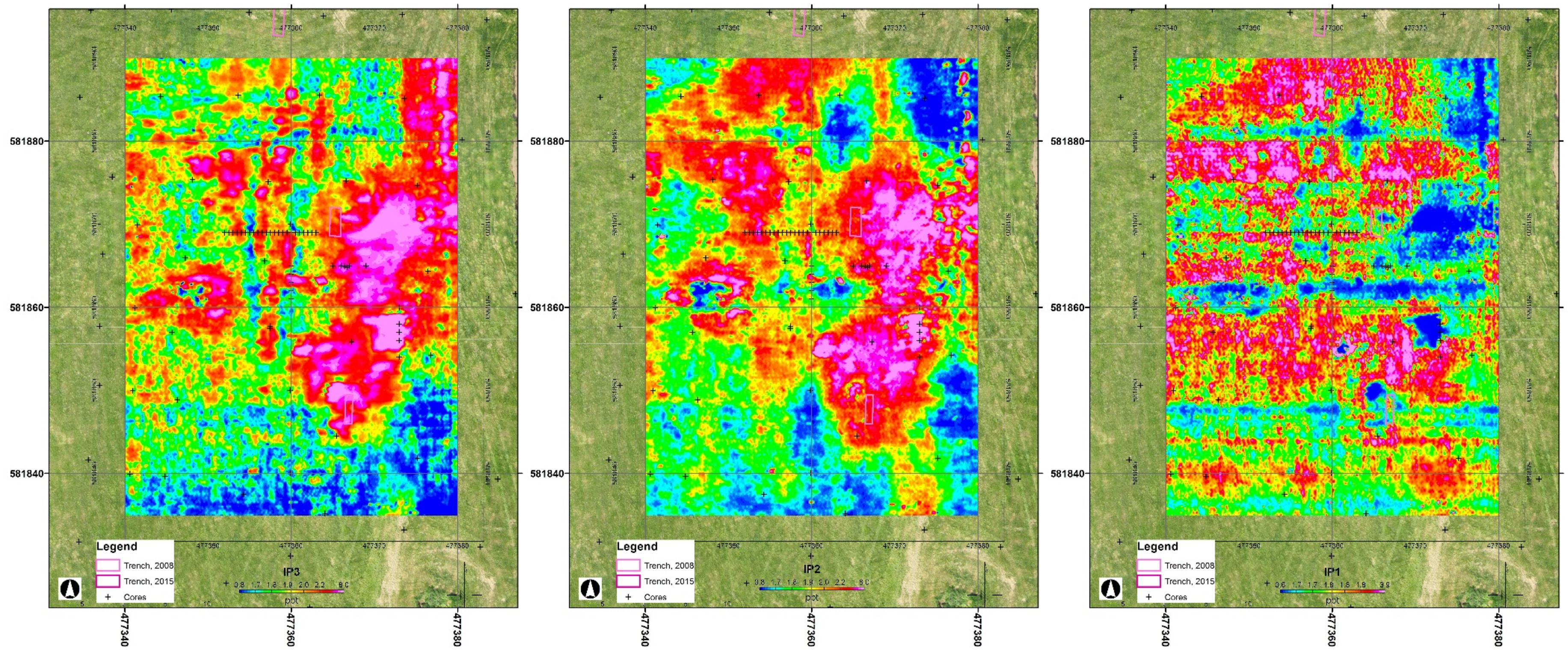


Figure 18. In-phase component maps (ppt) from CMD Mini in 2016. Left: IP3 image. Middle: IP2 image. Right: IP1 image.

4.0 CORING

At Lower Keflavík, 207 cores were taken during the 2013, 2015, and 2016 field seasons. There were 66 cores that revealed turf deposits. At seven coring locations, all concentrated in the same area, distinct floor deposits were encountered. Overall, 125 cores contained some sort of cultural deposit (60%) while 82 had none. Many of the cores taken in 2015 (164) were taken on a 10 × 10 m grid (79%) as part of the broad coring survey of the farm. while the rest were judgmentally placed based on previous coring, geophysical results or surface topography.

As for tephra layers, 4 cores encountered an in situ 1766 tephra (less than 2%), which is normally very difficult to identify in cores (e.g., of the 8962 cores taken in Skagafjörður by the SCASS and SCAS teams, about 641 (7%) contained this tephra). Along the same lines, 19 cores encountered the 1300 tephra (9%). exactly the average that are presented in Skagafjörður as a whole). In situ H1 tephra layer was the most common identified. It appeared in 90 different cores (43%), while H3/H4 was in 104. Four cores encountered an in situ dark tephra from between the H1 and the time of settlement, all of them identified in the field as the "1000" layer. Six cores revealed a distinct LTL and 17 others the LNS, which appeared as a dark distinct mixed layer.

The cores taken in Lower Keflavík bottom out at an average of 56.1 cm (SD=16.9) below the ground surface onto gravel. The overall average for cores for the SCASS survey is 62.6 cm (SD=94) suggesting that Lower Keflavík is a consistent, but shallow deposit, relative to other areas, especially given its substantial cultural activity. In fact, the 125 cores that contained cultural material averaged only a few cm deeper than the area as a whole (avg 58.1, SD 18.3), while for the whole SCASS survey, the average core with cultural material is almost 17 cm deeper than those without (Avg =79.3 cm, SD=38.9).

Based on the 2016 CMD mini, results, especially IP3 (Figure 18 left) a series of cores were judgmentally placed in order to test the hypothesis that the low conductivity anomalies outlined a structure with an eastern entrance (Figure 19). The first sequence was across the potential structure, with 50 cm spacing, located so that, moving from west to east, starting at core 163909 and ending at 163931, the cores would encounter extramural deposits, turf wall, floor, turf wall, and finally extramural deposits. The second sequence was placed across a potential entrance, starting at core 163932 and going through 163937, designed to encounter turf wall, floor, and turf wall moving from south to north. Both of these sequences were confirmed.

Across the potential house, cores 163909 and 163910 had LCD, while 163911 and 163912 had LDC and midden. Core 163914 had obvious turf deposits which continued to Core 163915. Core 163916 (Figure 21) and core 163917 (Figure 21have think floor which, with a few exceptions continue though core 163924 (Figure 23) which has a lighter, thinner floor. Core 163923 which has only LCD deposits (but floor deposits on either side) would have been unremarkable, except that it has a clear in situ H1 over the cultural deposit perhaps indicating that the whole deposit is pre 1104. Cores 163925 (Figure 25), 163926, and 163927 all have turf deposits that cross cut the potential east wall. Continuing east, Cores 163928- through 163931 have mostly LCD, and midden deposits, with some turf, suggesting an extramural deposit.

Moving north, along the east edge of the probable structure, and across a potential entrance, with 1 m spacing, core 163932 had distinct turf deposits. Cores 163933 and 163934 had turf and LCD deposits. The most substantial floor at 17 cm thick and 30 cm bgs was core 163935 (Figure 26). Turf deposits completed the northern part with cores 163936 and 163937 back into a potential wall.

The results of both of these sequences suggest that, in this relatively flat field in Lower Keflavík, (Figure 27) there is a distinct and well preserved structure. Across the center of the structure, the cores created a LCD-turf-floor-turf-LCD pattern. The relationship of this probable structure to the tún wall and other features, including the visible bumps nearby (Figure 3), is still unclear. While the structure is clearly before AD 1104, it is not yet possible to refine the establishment or abandonment date any further.

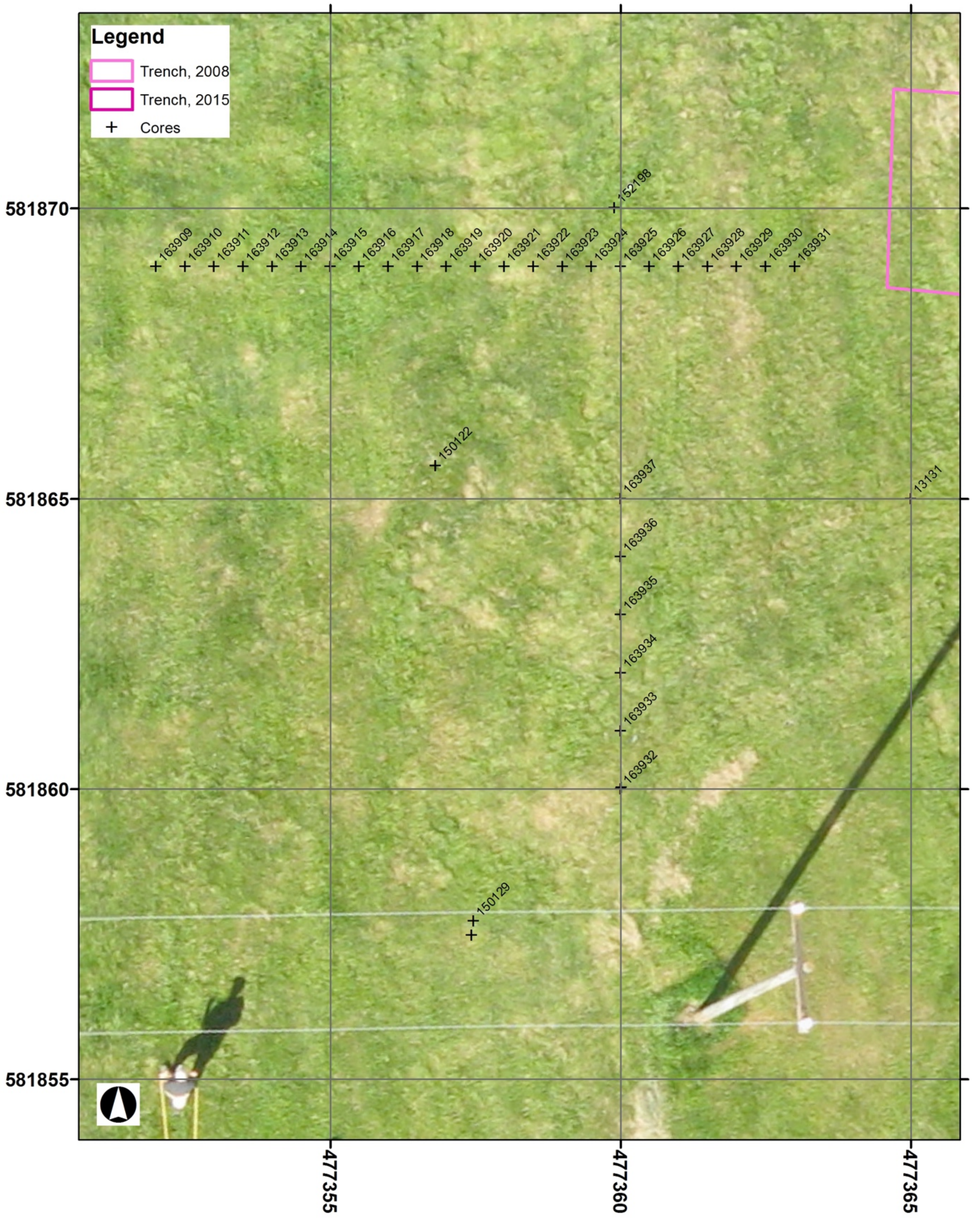


Figure 19. Core sequences at Lower Keflavík

Figure 20. Core 163916 showing floor from 22-30 cm bgs.

Figure 21. Core 163917 showing floor from 26-34 cm bgs. Below the floor was 11 cm of LDC, 12 cm of aeolian depost, which bottomed out on gravel at 57 cm bgs.

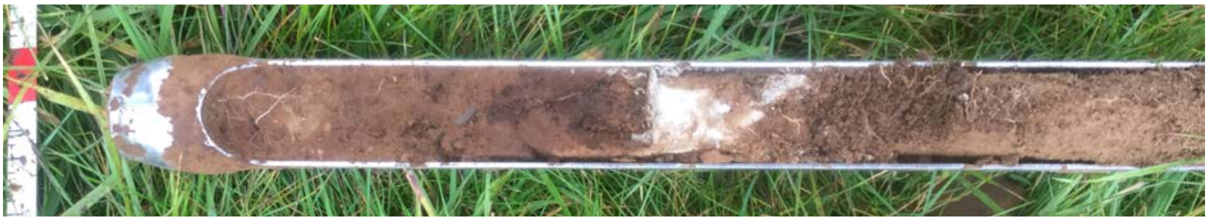


Figure 22. Core 163923 showing LDC from 27-45 cm bgs, clearly under an in situ H1 at 20 cm bgs. Below the LDC was 3 cm of aeolian deposit, which bottomed out on gravel at 48 cm bgs.

Figure 23. Core 163924 showing floor from 28-31 cm bgs. Below the floor was 24 cm of aeolian deposits, which had an in situ H3 at 39 cm bgs. The aeolian deposit bottomed out on gravel at 55 cm bgs.

Figure 24. Core 163925 showing Turf from 20-39 cm bgs, under an ephemeral in situ H1 at 16 cm bgs. Below the turf was 5 cm of aeolian deposit, which bottomed out on gravel at 44 cm bgs.

Figure 25. Core 163927 showing Turf from 20-37 cm bgs, under an ephemeral in situ H1 (visable in the center of the core at the top) at 16 cm bgs. Below the turf was 4 cm of aeolian deposit (which contained in situ H3/H4)), which bottomed out on gravel at 41 cm bgs.

Figure 26. Core 163935 showing floor from 30-47 cm bgs (which continued into the next core barrel). Above the floor was an 8 cm LDC deposit with an in situ H1 at 21 cm bgs. The floor rested on gravel at 47 cm bgs.

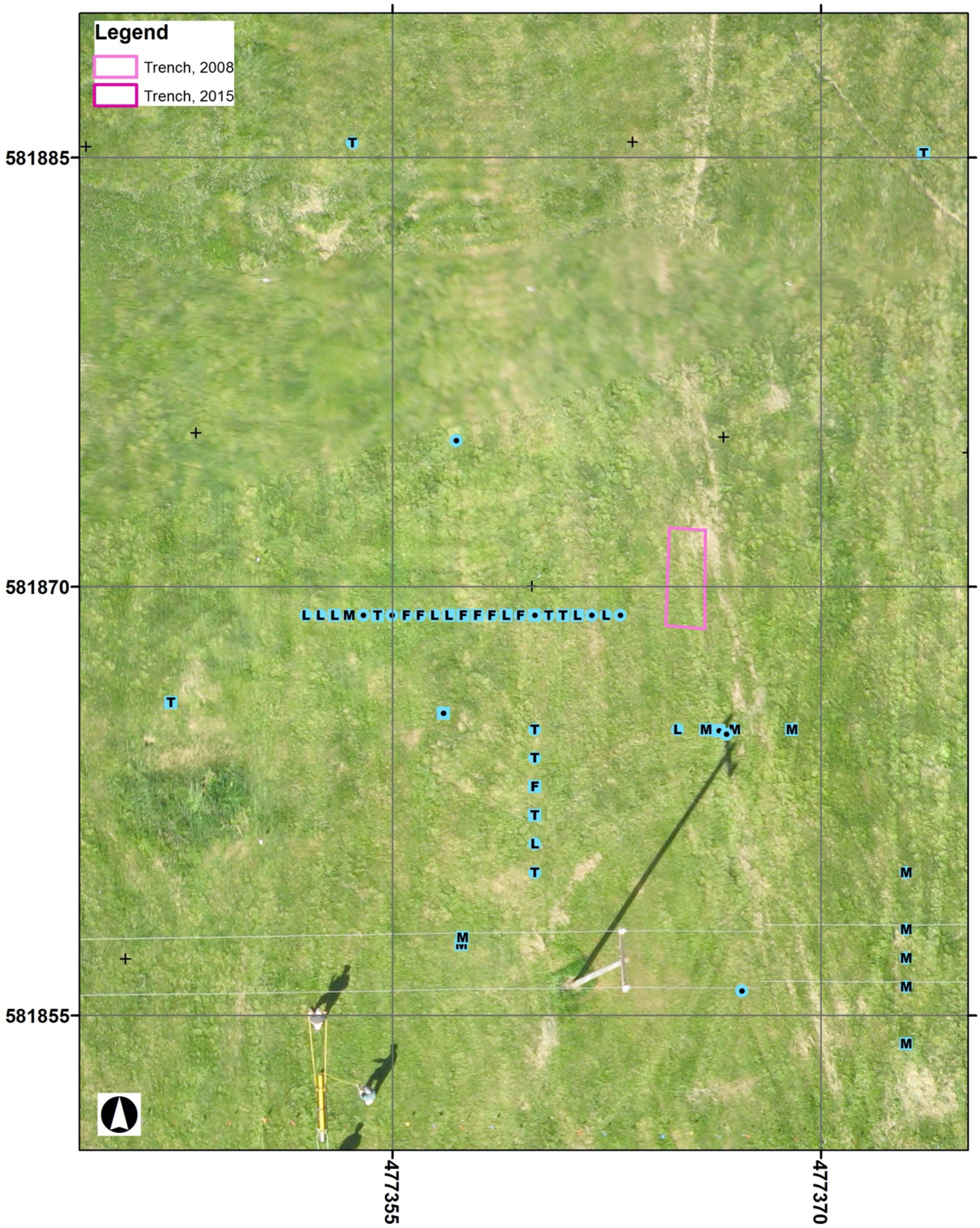


Figure 27. distribution of pre-1104 material in cores, on kite photo. For symbol key see Figure 31

5.0 SUMMARY AND CONCLUSIONS

Geophysical surveys were conducted at Lower Keflavík in 2012, 2013, 2015, and 2016 and cores were taken in 2014, 2015 and 2016. By combining the cores and geophysical results it is possible to get a distinct picture of the main structure. This structure defined by the contrast of the low IP (blue) readings and the high IP pink readings can be outlined to form a structure consistent with a 25 m long, 8 m wide north-south running longhouse (Figure 28). There may also be a structure with its long axes running east-west north of the potential longhouse. The longhouse has a distinct entrance facing east, in the southcentral part of the long house. Generially high IP readings are assocated with midden depoists, of which there are several, again also to the east.

Using the outline from the IP3 CMD mini readings, specific sensors from the DualEM may have picked up this ephemeral structure. Most interesting, the Horizontal C 1 sensor seems to have picked up the probable floor deposit (Figure 29) while the Vertical IP sensor 2 (Figure 30) seems to have outlined some parts of the floor and more specifically the potential east entrance. This is remarkable, since the DualEM survey was conducted north-south, bi-directionally. Both the DualEM and CMD Mini readings, along with the cores, suggest that the midden may be to the east of the probable longhouse.

The discovery of this potential structure does not seem to have changed the overall area (top right in Figure 31) of the mass of deposits that defined the mound area of Lower Keflavík (Bolender, et al. 2013). While there are post 1104 deposits in the area (bottom two images in Figure 31), there is no evidence that those much spottier deposits are associated with the potential pre-1104 structure outlined here.

The nature of these results, suggest that, although there is a substantial natural gravel deposit underlying all of Lower Keflavík, the structure outlined here contains almost no stone deposits. The underlying gravel is probably responsible for much of the contrasts seen in the deeper readings, such as those from the CMD Explorer. If the potential structure does not contain stones, the CMD Mini was able to bring out a very subtle contrast associated with this all-turf structure.

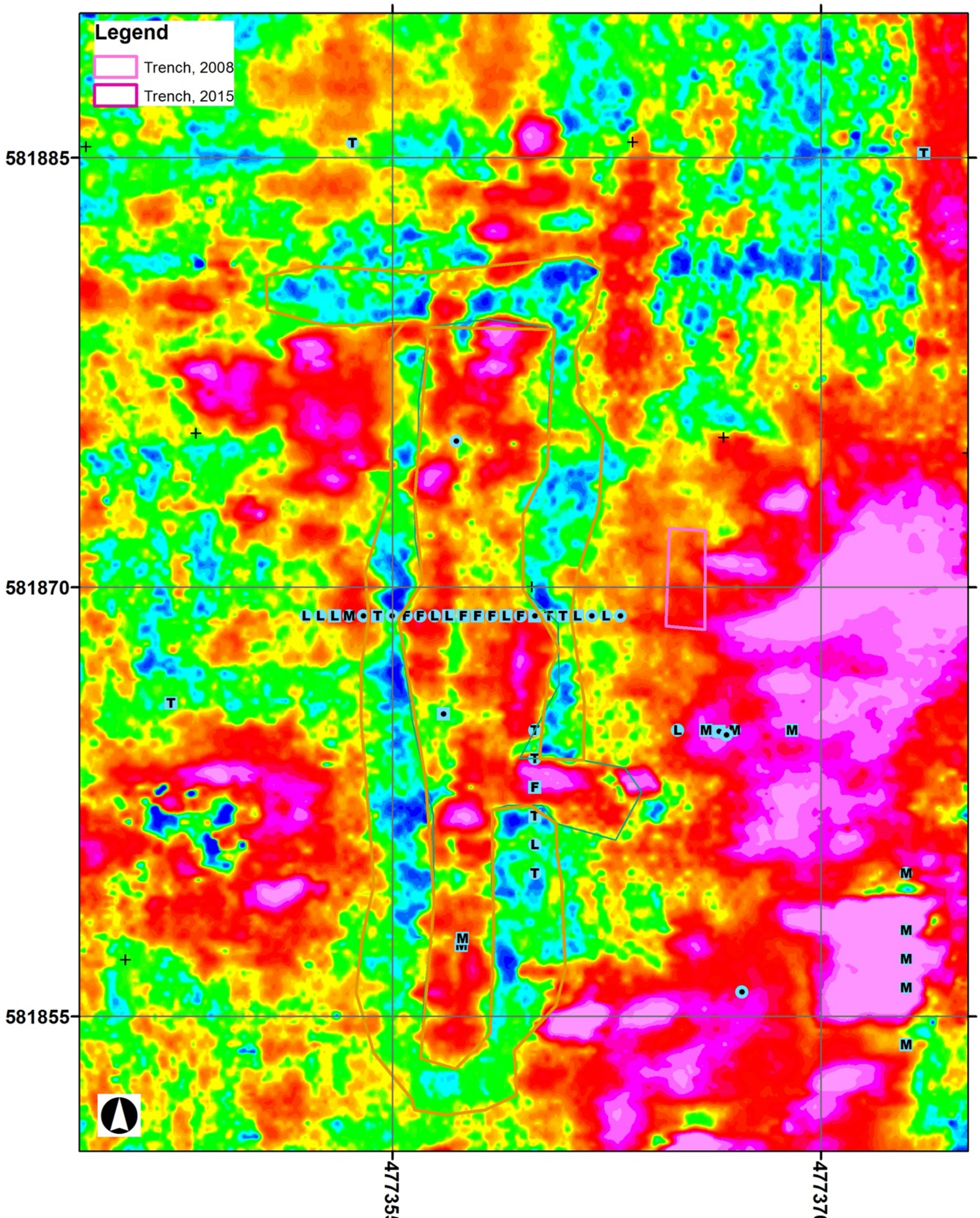


Figure 28. 2016 CMD Explorer IP3 with pre-1104 coring results test trenches, and potential outline of structure.

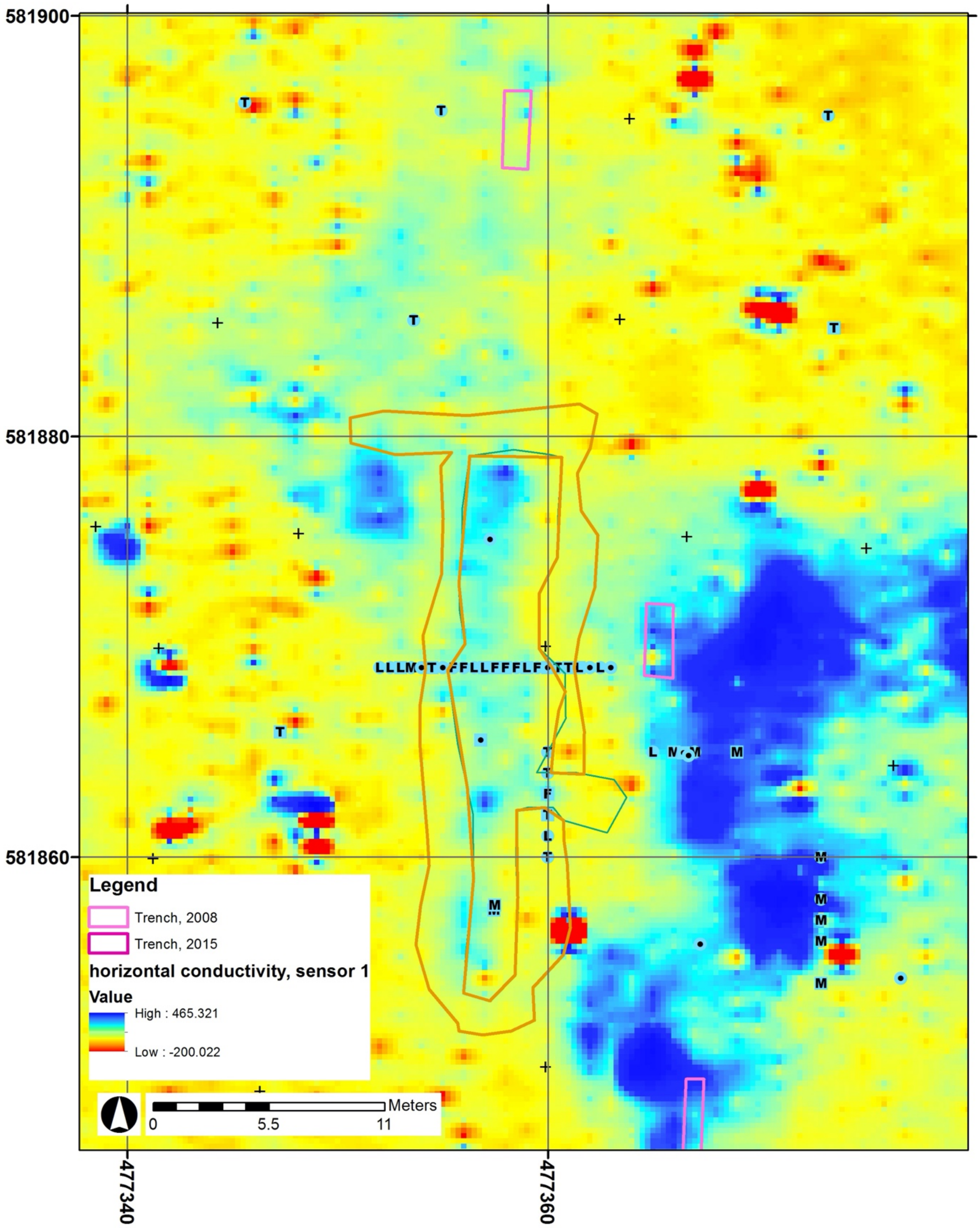


Figure 29. Horizontal C sensor 1 with Pre-1104 coring results, test trenches, and potential outline of structure.

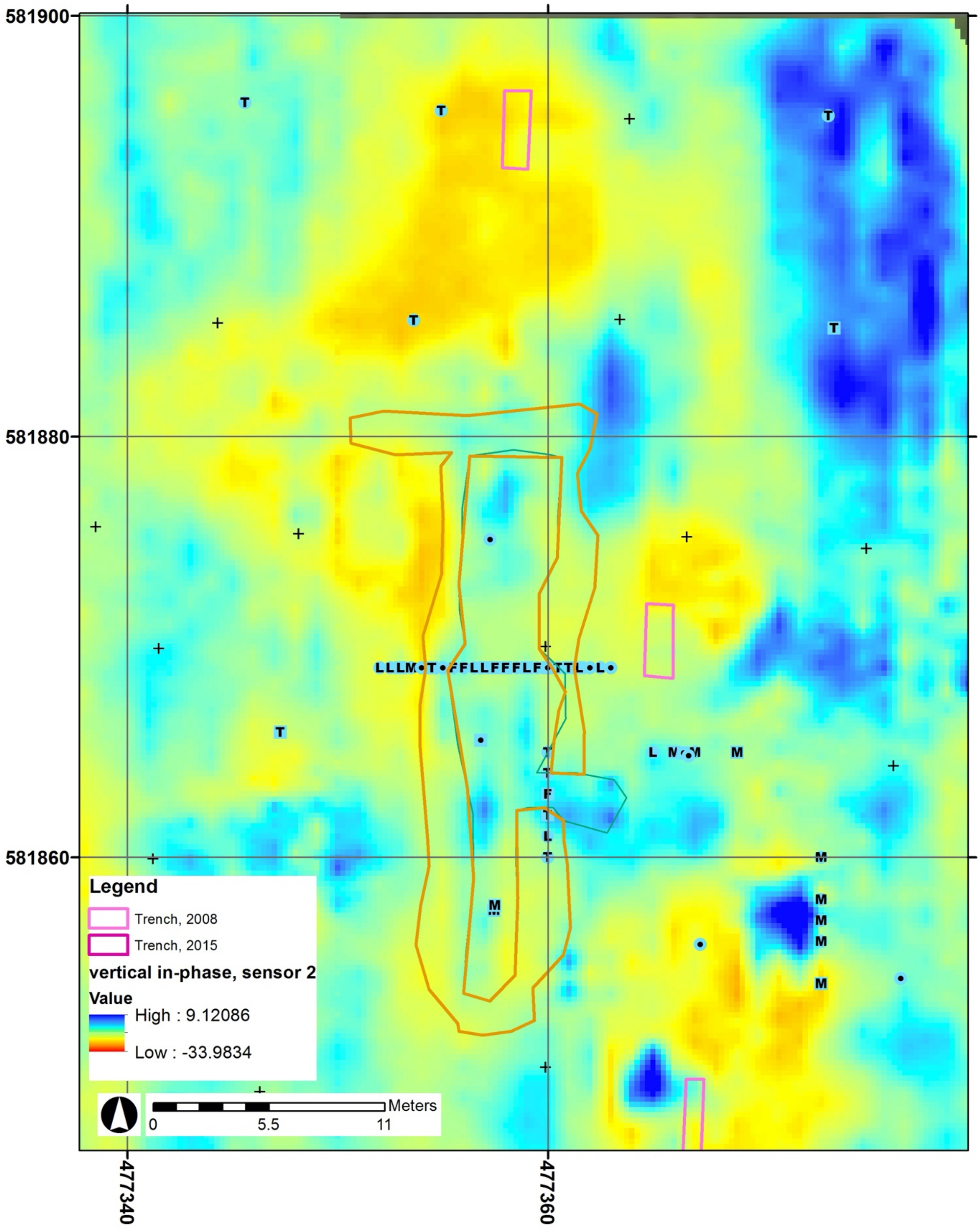


Figure 30. Vertical IP sensor 2 with Pre-1104 coring results, test trenches, and potential outline of structure.

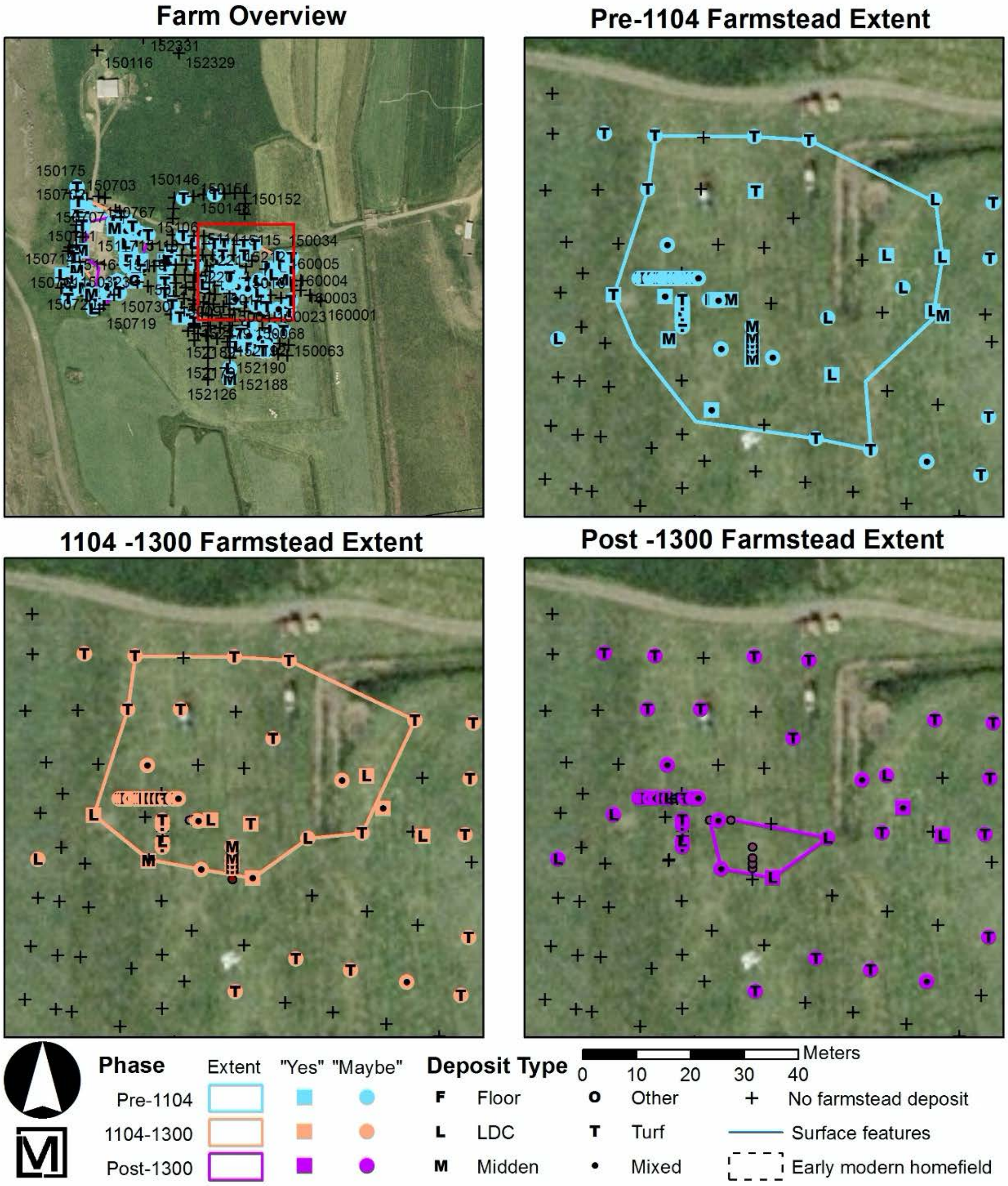


Figure 31. Farm mound sizes for different time periods based on coring at Lower Keflavík.

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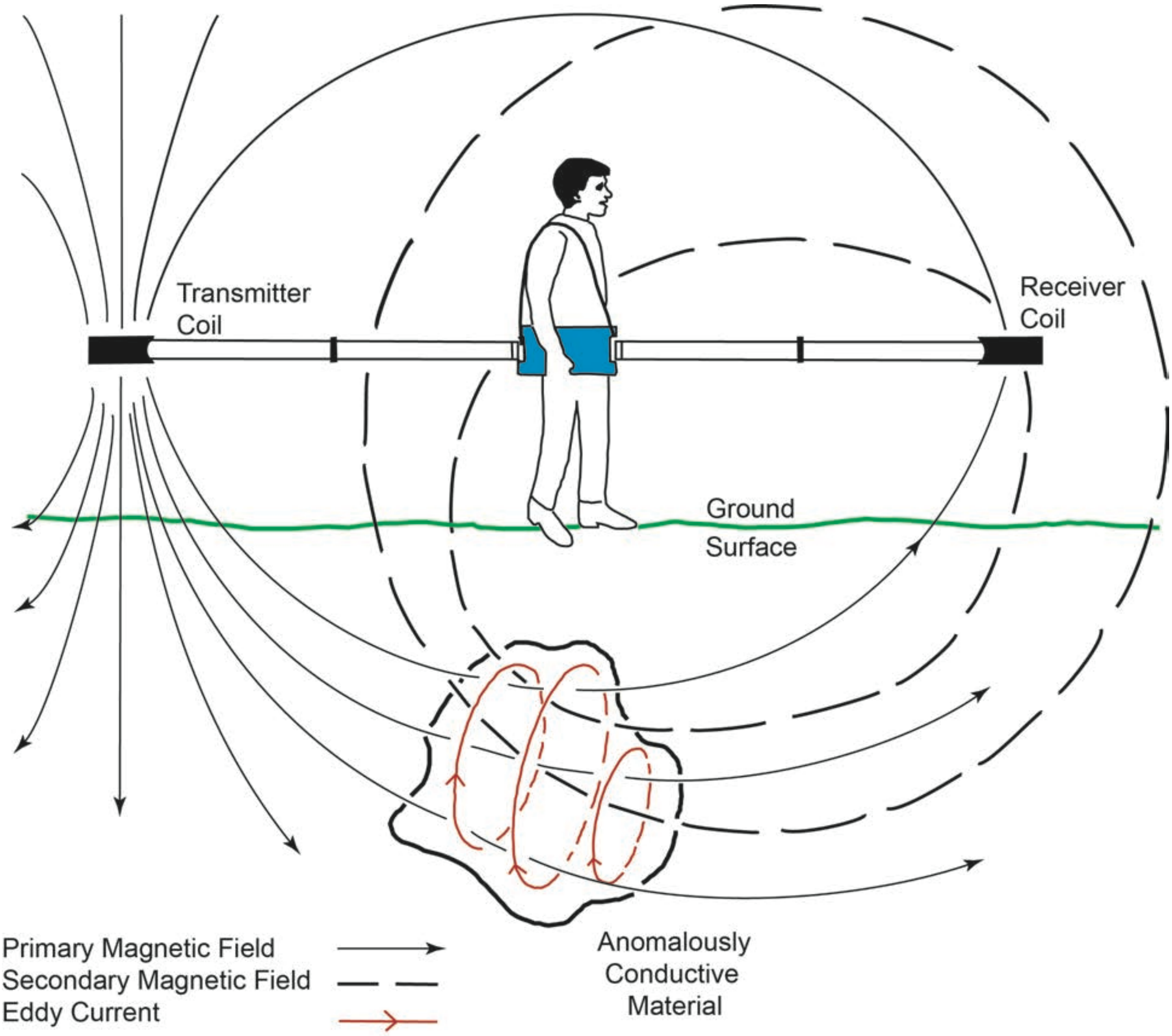
APPENDIX A – BASIC PRINCIPLES OF FREQUENCY-DOMAIN ELECTROMAGNETICS

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 – CORING DATA

Table 1. Coring locations

Core Number	End Depth	ISNet East	ISNet North
13131	60	477365	581865
13132	60	477366	581865
13133	70	477367	581865
13134	70	477369	581865
13135	90	477373	581854
13136	80	477373	581856
13137	80	477373	581857
13138	70	477373	581858
13139	65	477373	581860
15000	50	477391.626	581829.427
15100	100	477383.541	581894.645
15101	40	477373.355	581895.248
15001	60	477382.752	581831.145
15102	44	477363.888	581895.108
15002	63	477373.573	581833.212
15103	56	477354.937	581895.494
15003	54	477364.078	581835.177
15104	55	477345.598	581895.869
15104	55	477345.598	581895.869
15105	39	477335.934	581895.756
15105	39	477335.934	581895.756
15004	59	477354.278	581837.49
15200	80	477300.103	581890.067
15201	80	477300.071	581880.012
15202	40	477300.054	581870.048
15203	45	477300.032	581860.058
15005	60	477344.843	581839.617
15106	58	477326.756	581895.846
15006	52	477335.611	581841.623
15204	55	477300.003	581850.053
15107	56	477316.925	581895.351
15007	52	477326.459	581843.555
15205	80	477295.093	581880.011
15108	53	477306.814	581895.162
15206	55	477300.034	581885.053
15008	52	477317.262	581845.307
15207	45	477300.098	581875.052
15109	33	477306.492	581885.347
15009	63	477308.288	581847.16
15208	40	477302.523	581879.794
15110	59	477315.553	581885.25
15209	65	477298.879	581880.08
15010	59	477309.986	581859.378
15210	46	477300.062	581878.001
15111	40	477324.898	581885.058

Core Number	End Depth	ISNet East	ISNet North
15211	55	477375.157	581874.68
15011	57	477319.053	581855.423
15112	56	477334.592	581885.311
15212	70	477366.605	581875.226
15012	42.2	477327.279	581853.118
15113	44	477344.289	581885.39
15013	50	477336.963	581850.59
15213	68	477357.254	581875.11
15114	72	477353.627	581885.533
15014	46	477346.304	581848.853
15214	70	477348.137	581875.374
15115	42	477363.419	581885.56
15215	57	477338.482	581875.704
15216	40	477329.005	581876.016
15217	57	477319.459	581876.459
15218	75	477309.846	581876.456
15016	51	477365.459	581844.499
15219	58	477309.098	581866.991
15220	40	477318.243	581867.312
15221	40	477327.077	581866.782
150018	40	477375.198	581841.836
150120	45	477337.337	581866.393
150121	55	477347.271	581865.944
150019	50	477384.848	581839.328
150122	61	477356.814	581865.569
150020	40	477394.989	581837.18
150123	63	477366.462	581864.951
150021	104	477405.374	581834.955
150124	57	477366.708	581864.827
150022	110	477415.41	581832.508
150125	45	477376.447	581864.352
150023	42	477416.897	581843.229
150024	105	477407.395	581845.587
150126	43	477376.799	581854.241
150025	62	477397.978	581848.081
150026	55	477387.801	581851.023
150127	67	477367.257	581855.853
150027	63	477386.978	581861.617
150028	74	477397.086	581862.647
150029	100	477406.433	581862.876
150128	59	477357.433	581857.479
150030	104	477416.172	581862.265
150129	60	477357.469	581857.723
150130	56	477345.673	581856.972
150032	72	477417.112	581872.737
150131	40	477336.967	581857.708
150033	91	477417.724	581882.989
150034	104	477406.859	581883.511

Core Number	End Depth	ISNet East	ISNet North
150035	25	477408.208	581872.835
150132	49	477326.413	581860.425
150036	110	477397.891	581873.246
150133	56	477373.62	581885.166
150037	50	477401.521	581827.207
150134	66	477306.697	581904.166
150038	92	477411.354	581824.947
150039	46	477410.258	581814.984
150040	40	477399.62	581815.757
150135	45	477316.84	581903.034
150041	37	477390.026	581817.751
150042	56	477379.568	581818.715
150043	68	477371.415	581820.109
150044	45	477362.255	581823.889
150136	50	477326.556	581903.173
150045	57	477352.195	581826.763
150137	52	477335.871	581903.195
150046	91	477350.649	581818.222
150047	50	477343.158	581829.476
150138	50	477380.562	581880.174
150314	80	477290.039	581875.02
150048	53	477334.466	581831.76
150049	58	477324.986	581834.659
150139	42	477315.496	581836.846
150140	43	477306.852	581839.422
150050	40	477305.016	581830.303
150051	52	477314.155	581827.949
150052	68	477324.299	581825.879
150053	53	477332.873	581822.486
150054	80	477342.094	581819.95
150055	46	477360.522	581815.312
150056	54	477370.356	581812.64
150057	61	477378.122	581810.35
150058	55	477387.945	581808.128
150059	80	477396.852	581805.922
150060	69	477396.957	581806.038
150061	38	477406.472	581803.411
150062	67	477414.907	581801.953
150063	33	477413.412	581792.165
150064	36	477405.025	581793.682
150065	58	477395.948	581796.361
150153	58	477385.755	581797.409
150066	61	477392.741	581801.099
150067	42	477391.14	581796.348
150068	67	477375.764	581799.043
150069	69	477367.824	581800.269
150070	43	477358.235	581804.823
150071	40	477338.176	581810.829

Core Number	End Depth	ISNet East	ISNet North
150072	37	477348.19	581807.891
150073	40	477321.343	581815.301
150074	13	477330.636	581812.806
152180	42	477339.848	581799.983
152181	40	477339.903	581809.957
152182	73	477339.974	581820.006
152183	40	477340.26	581829.967
152184	40	477340.605	581839.93
152185	40	477340.928	581849.953
152186	40	477341.211	581859.935
152187	50	477341.497	581869.934
152190	39	477360.073	581790.045
152191	40	477360.094	581800.065
152192	50	477360.019	581810.043
152193	59	477359.945	581820.056
152194	39	477359.913	581830.066
152195	40	477359.934	581840.022
152196	40	477359.883	581850.015
152197	50	477360.012	581860.026
152198	40	477359.894	581870.014
152567	50	477327.357	581840.141
152568	50	477326.911	581828.361
152569	45	477326.864	581827.409
152570	40	477326.769	581826.375
152571	63	477326.905	581825.176
152572	60	477327.056	581824.022
152573	74	477327.052	581822.993
152574	64	477326.969	581821.834
152575	65	477326.96	581820.9
152576	45	477327.098	581819.937
152577	45	477327.16	581819.066
152578	40	477327.26	581817.994
152579	50	477327.322	581806.484
160000	100	477393.3214	581872.3973
160004	104	477417.3657	581857.2105
160005	70	477408.3256	581862.0169
160006	100	477400.9375	581867.2221
163909	51	477352	581869
163910	45	477352.5	581869
163911	50	477353	581869
163912	51	477353.5	581869
163913	55	477354	581869
163914	75	477354.5	581869
163915	50	477355	581869
163916	47	477355.5	581869
163917	57	477356	581869
163918	40	477356.5	581869
163919	50	477357	581869

Core Number	End Depth	ISNet East	ISNet North
163920	43	477357.5	581869
163921	51	477358	581869
163922	45	477358.5	581869
163923	48	477359	581869
163924	55	477359.5	581869
163925	44	477360	581869
163926	47	477360.5	581869
163927	41	477361	581869
163928	55	477361.5	581869
163929	50	477362	581869
163930	50	477362.5	581869
163931	48	477363	581869
163932	48	477360	581860
163933	50	477360	581861
163934	47	477360	581862
163935	47	477360	581863
163936	43	477360	581864
163937	44	477360	581865

Table 2. Tephra layers in cores

Core Number	Depth	Tephra Layer	Description
13131	37	LNS	
13131	45	H3	
13132	23	H1	
13133	50	H3	
13133	55	H4	
13134	25	H1	
13134	47	LNS	
13134	60	H3	
13135	20	H1	
13136			
13136	60	H3	
13136	65	H4	
13137	30	LNL	
13137	50	H3	
13137	55	H4	
13138	50	H3	
13138	60	H4	
13139	55	H3	
15000	45	H3	possible
15001	27	H3	
15001	31	H4	
15002	26	H1	disturbed
15002	31	LNL	
15002	31	LNS	
15002	33	H3	

Core Number	Depth	Tephra Layer	Description
15003	30	H1	
15004	26	H1	
15005	23	H1	
15005	28	H3	cryotubated
15006	24	H3	
15007	25	LNS	
15007	27	LNL	
15007	30	H3	
15008	28	H3	
15009	26	H1	
15009	40	LNS	
15009	43	H3	
15010	40	LNL	
15011	25	H3	
15011	28	H4	
15013	23	H1	
15014	23	H1	
15014	36	H3	
15016	20	H1	possible
15016	46	1000	possible
15101	34	H3	
15102	20	H1	
15102	31	H3	
15103	49	H3	
15104	26	H3	diffuse
15104			
15104	67	H3	
15104			
15105			
15105			
15106	27	H3	mixed with ad
15107	23	LNS	
15107	28	H3	
15108	32.5	H1	
15108	35	unknown	black
15109	28.5	H1	
15110	27	H1	speck
15110	37	H3	
15111	22	H1	
15112	18	H1	
15112	29	H3	
15113	24.5	LNL	
15113	24.5	LNS	
15113	35	H3	
15200	13	H1	
15200	68	H3	
15201	20	H1	
15201	30	LNS	

Core Number	Depth	Tephra Layer	Description
15201	55	H3	
15202	29	H1	
15202	32	1000	
15202	32	1000	
15203	8	1766	
15203	19	1300	
15203	25	H1	
15205	22	1300	
15205	35	H1	
15206	28	LNS	
15206	38	H3	
15207		LNS	
15207	22	1300	
15207	25	H1	
15207	30	1000	
15208	33	H1	
15209	7	1766	
15209	22	H1	
15209	37	LNS	
15210	5	1766	
15210	20	1300	
15211	28	H1	
15211	31	H3	
15212	25	H1	diffuse
15212	26	LNS	
15212	55	H3	
15214	28	H1	
15214	32	H3	
15215	3	1766	possible
15215	35	H3	
15217	33	H3	
15218	43	H1	
15218	44	LNS	
15218	50	H3	
15219	22	H1	
15219	35	H3	
15220	26	H3	
150022	8	1300	
150022	31	H3	
150024	29	H3	
150025	27	H3	
150026			
150026	22	H1	ephemereal
150026	32	H3	
150026	35	H4	
150027	37	H3	
150027	42	H4	
150028	22	H1	

Core Number	Depth	Tephra Layer	Description
150028	45	H3	
150028	61	H4	
150029	29	H1	
150029	34	LNL	
150029	42	H3	
150029	51	H4	
150030	21	H1	
150030	28	LNS	
150030	42	unknown	light grey
150030	48	H3	
150032			
150032	25	H3	
150033	48	H3	
150034	21	H1	possible
150034	42	H3	
150034	58	H4	
150035	24	H1	
150035	31	H3	
150035	43	H4	
150036	9	1300	
150036	21	H1	weak
150036	24	H1	weak
150036	25	H1	strong
150036	49	H3	
150036	81	H4	
150037	30	unknown	white
150037	34	unknown	white
150038	34	unknown	yellow/white
150038	39	H3	
150039	14	unknown	
150040	22	H3	
150040	30	H4	
150042	17	H1	
150042	23	H1	
150042	36	H3	
150044	27	H3	
150046	44.5	1300	
150046	61	LNS	
150046	74	H3	
150046	87	H4	
150047	30	H3	
150048	32	H3	
150049	21.5	H1	
150049	30	H3	
150049	35	H4	
150050	22	H1	
150051	23	H1	
150052	58	H3	

Core Number	Depth	Tephra Layer	Description
150053	25	H3	
150053	30	H4	
150054	22	H1	
150054	30	H3	
150054	51	H4	
150055	19.5	H1	
150056	34	H3	
150056	40	H4	
150057	40	H3	fades at 44mm
150059	53	H3	
150059	60	H4	
150060	46	H3	
150060	55	H4	
150061	31	H1	
150063	17	H3	
150064	22.5	H1	thufurized?
150065	44	H3	
150065	51	H4	
150066	38	H3	
150068	27.5	1300	
150068	50	unknown	
150069	34	1300	
150069	43	H1	LDC above and below.
150070	22	H1	
150071	21	H1	
150072	18	H1	disturbed tephra layer
150120	31	H3	
150121	19	1300	
150121	24	H1	
150121	35	H3	
150122			
150122	20	H1	speck
150123	19	1300	
150123	40	unknown	black
150125	18	1300	
150125	23.5	H1	in turf
150126	26	1300	
150127	62	unknown	black
150128	23.5	1300	speck
150128	27	H1	thufurized
150128	33	unknown	dark black with green sparklies
150129	26	H1	
150129	34	unknown	dark black with green sparklies
150130	30.5	1300	
150130	35	H3	
150131	29	H3	
150131	33	H4	

Core Number	Depth	Tephra Layer	Description
150132	27	H3	
150132	30	H4	
150133	17	H1	
150134	29	1300	
150134	40	H3	
150134	43	H4	mixed
150136	21	H1	speck
150136	34	H3	
150137	18	H1	
150137	28	H3	
150137	42	H4	
150138	37	H1	questionable
150139	30	H3	
150139	33.5	H4	
150314	31	H1	
150314	38	1000	
150314	65	H3	
150314	80	H4	
152180	16	H1	
152182	55	H3	
152183	21	H1	
152183	27	H3	
152183	30	H4	
152184	26	H1	
152184	35	H3	
152185	19	H1	
152185	28	H3	
152185	33	H4	
152186	22	H1	
152187	33	H3	
152187	36	H4	
152191	17.5	H1	
152191	30	H3	
152191	32	H4	
152192	18	H1	
152192	33.5	LNS	
152193	19	H1	
152193	48	H3	
152193	51	H4	
152194	18	H1	
152194	28	H3	
152195	18.5	H1	
152195	28	H3	
152195	32	H4	
152196	22	H1	
152196	34	H3	
152197	20	H1	
152197	41	H3	

Core Number	Depth	Tephra Layer	Description
152197	42	H4	
152198	27	H3	
152198	32	H4	
152568	25	H1	
152569	23	H1	
152570	22	H1	
152570	33	H3	
152570	37	H4	
152571	23	1300	
152571	48	H3	
152573	50	H3	
152575	22	H1	
152577	23	H1	
152579	18	H1	
152579	30	H3	
160000	55	H1	Boggy
160000	95	H3	
160004	12	1300	
160004	28	LNS	No tephra, questionable
160004	44	H3	
160005	12	H1	
160005	31	H3	
160006	29	1300	
160006	49	H3	
160006	58	H4	
163911	22	H1	
163914	15	H1	
163914	65	H3	
163919	25	H1	
163920	38	H1	
163921	28	H1	
163923	20	H1	
163924	39	H3	
163925	15	H1	
163927	16	H1	
163927	39	H3	
163928	24	H1	
163933	38	H3	
163934	19	H1	
163935	21	H1	
163937	40	H3	

Table 3. Stratigraphic layers in cores.

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
13131	0	20	Top Soil		
13131	20	35	Low Density Cultural		
13131	35	60	Aeolian Deposit		
13131	60	60	Gravel		
13132	0	20	Top Soil		
13132	20	30	Low Density Cultural		
13132	30	45	Midden		
13132	45	60	Aeolian Deposit		
13132	60	60	Gravel		
13133	0	20	Top Soil		
13133	20	40	Low Density Cultural		
13133	40	45	Midden		
13133	45	70	Aeolian Deposit		
13133	70	70	Gravel		
13134	0	20	Top Soil		
13134	20	30	Low Density Cultural		
13134	30	45	Midden		
13134	45	70	Aeolian Deposit		
13134	70	70	Gravel		
13135	0	20	Top Soil		
13135	20	57	Midden		
13135	57	65	Low Density Cultural		
13135	65	90	Aeolian Deposit		
13135	90	90	Gravel		
13136	0	20	Top Soil		
13136	20	55	Midden		
13136	55	80	Aeolian Deposit		
13136	80	80	Gravel		
13137	0	20	Top Soil		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
13137	20	30	Midden		
13137	30	80	Aeolian Deposit		
13137	80	80	Gravel		
13138	0	20	Top Soil		
13138	20	28	Low Density Cultural		
13138	28	35	Midden		
13138	35	70	Low Density Cultural		
13138	70	70	Gravel		
13139	0	20	Top Soil		
13139	20	30	Low Density Cultural		
13139	30	35	Midden		
13139	35	45	Low Density Cultural		
13139	45	65	Aeolian Deposit		
13139	65	65	Gravel		
15000	0	45	Aeolian Deposit		
15000	45	50	Aeolian Deposit	River	
15001	0	6	Root Mat		
15001	6	37	Aeolian Deposit		
15001	37	39	Gley		
15001	39	60	Other	River	
15002	0	5	Root Mat		
15002	5	16	Aeolian Deposit		
15002	16	25	Turf		
15002	25	63	Aeolian Deposit		
15003	0	8	Root Mat		
15003	8	53	Aeolian Deposit		
15003	53	54	Gravel		
15004	0	7	Root Mat		
15004	7	49	Aeolian Deposit		
15004	49	50	Gravel		
15004	50	59	Sand		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15005	0	15	Root Mat		
15005	15	43	Aeolian Deposit		
15005	43	60	Aeolian Deposit		
15006	0	7	Root Mat		
15006	7	18	Aeolian Deposit		
15006	18	50	Aeolian Deposit		
15006	50	52	Sand		
15007	0	14	Root Mat		
15007	14	22	Disturbed		
15007	22	52	Aeolian Deposit		
15008	0	13	Root Mat		
15008	13	22	Disturbed		
15008	22	40	Aeolian Deposit		
15008	40	45	Aeolian Deposit		
15008	45	52	Sand		
15009	0	16	Root Mat		
15009	16	25	Disturbed		
15009	25	63	Aeolian Deposit		
15009	63	63	Rock		
15010	0	16	Root Mat		
15010	16	20	Disturbed		
15010	20	59	Aeolian Deposit		
15010	55	59	Aeolian Deposit	Sandy	
15011	0	11	Top Soil		
15011	11	18	Disturbed		
15011	18	47	Aeolian Deposit		
15011	47	54	Aeolian Deposit		
15011	54	57	Aeolian Deposit	Sandy	
15011	57	57	Rock		
15012	0	12	Top Soil		
15012	12	21	Disturbed		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15012	21	35	Aeolian Deposit		
15012	35	42.2	Aeolian Deposit		
15012	42.2	42.2	Gravel		
15013	0	14	Root Mat		
15013	14	21	Disturbed		
15013	21	43	Aeolian Deposit		
15013	43	50	Aeolian Deposit		
15013	50	50	Gravel		
15014	0	10	Root Mat		
15014	10	41.5	Aeolian Deposit		
15014	41.5	46	Aeolian Deposit		
15016		17	Disturbed		
15016	0	10	Root Mat		
15016	17	29.5	Aeolian Deposit		
15016	29.5	31	Turf		
15016	31	34	Aeolian Deposit		
15016	34	35	Midden		
15016	35	40	Low Density Cultural		
15016	40	43	Midden		
15016	43	49	Aeolian Deposit		
15016	49	51	Low Density Cultural		
15100	0	6	Root Mat		
15100	6	31	Disturbed		
15100	31	59	Turf		H1
15100	59	72	Clay		
15100	100	100	Rock		
15101	0	15	Root Mat		
15101	15	22	Turf		
15101	22	34	Aeolian Deposit		
15101	35	40	Subsoil	Subsoil (Sterile/Natural)	
15101	40	40	Rock		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15102	0	14	Root Mat		
15102	14	38	Aeolian Deposit		
15102	38	44	Subsoil		
15103	0	19	Root Mat		
15103	19	31	Aeolian Deposit		
15103	31	44	Turf	Irony	H3/H4
15103	44	49	Aeolian Deposit		
15103	52.5	56	Subsoil		
15103	56	56	Rock		
15104	0	11	Root Mat		
15104					
15104	0	10	Root Mat		
15104					
15104	10	80	Aeolian Deposit		
15104					
15104	11	23	Disturbed		
15104					
15104	23	26	Turf		
15104					
15104	26	34	Aeolian Deposit		
15104					
15104	34	40	Subsoil		
15104					
15104	40	55	Subsoil		
15104					
15104	55	55	Rock		
15104					
15105	0	21	Root Mat		
15105					
15105	21	28	Disturbed		
15105					

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15105	28	33	Aeolian Deposit		
15105					
15105	33	39	Subsoil		
15105					
15105	39	39	Rock		
15105					
15106	0	13	Root Mat		
15106	13	20	Disturbed		
15106	20	27	Low Density Cultural		
15106	27	35	Aeolian Deposit		
15106	35	58	Subsoil		
15106	58	58	Rock		
15107	0	12	Root Mat		
15107	12	18	Disturbed		
15107	18	31	Aeolian Deposit		
15107	31	56	Subsoil		
15107	56	56	Rock		
15108	0	15	Root Mat		
15108	15	22	Disturbed		
15108	22	53	Aeolian Deposit		
15108	53	53	Rock		
15109	0	19	Root Mat		
15109	19	30	Aeolian Deposit		
15109	30	33	Turf		
15110	0	15	Root Mat		
15110	15	25	Disturbed		
15110	25	44	Aeolian Deposit		
15110	44	59	Subsoil		
15110	59	59	Rock		
15111	0	19	Root Mat		
15111	19	30	Aeolian Deposit		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15111	30	40	Subsoil		
15112	0	11	Root Mat		
15112	11	21	Disturbed		
15112	21	34	Aeolian Deposit		
15112	34	56	Subsoil		
15112	56	56	Rock		
15113	0	14	Root Mat		
15113	14	18	Disturbed		
15113	18	35	Aeolian Deposit		
15113	35	44	Subsoil		
15114	0	13	Root Mat		
15114	13	49	Turf		LNL/LNS
15114	49	72	Subsoil		
15114	72	72	Rock		
15115	0	14	Root Mat		
15115	14	20	Disturbed		
15115	20	33	Turf		H1
15115	33	42	Subsoil		
15115	42	42	Rock		
15200	0	10	Root Mat		
15200	10	80	Aeolian Deposit		
15201	0	10	Root Mat		
15201	10	20	Disturbed		
15201	20	29	Aeolian Deposit		
15201	29	32	Aeolian Deposit	Soil	
15201	32	40	Low Density Cultural		
15201	40	70	Aeolian Deposit		
15201	70	80	Gravel		
15202	0	15	Root Mat		
15202	15	38	Aeolian Deposit		
15202	38	40	Gravel		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15203	0	15	Root Mat		
15203	15	35	Aeolian Deposit		
15203	35	38	Turf		
15203	38	45	Gravel		
15204	0	20	Root Mat		
15204	20	40	Aeolian Deposit	reworked tephra	
15204	40	45	Turf		
15204	45	50	Aeolian Deposit		
15204	50	55	Gravel		
15205	0	15	Root Mat		
15205	15	75	Aeolian Deposit	Irony	
15205	75	80	Gravel		
15206	0	12	Root Mat		
15206	12	55	Aeolian Deposit		
15206	55	55	Gravel		
15207	0	15	Root Mat		
15207	15	36	Aeolian Deposit		
15207	36	43	Turf		
15207	43	45	Gravel		
15208	0	15	Root Mat		
15208	15	33	Aeolian Deposit		
15208	33	38	Turf		
15208	38	40	Aeolian Deposit		
15209	0	15	Root Mat		
15209	15	60	Aeolian Deposit		
15209	60	65	Gravel		
15210	0	15	Root Mat		
15210	15	22	Plow Zone		
15210	22	45	Aeolian Deposit		
15210	46	46	Gravel		
15211	0	12	Root Mat		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15211	12	50	Aeolian Deposit		
15211	50	55	Sand		
15212	0	12	Root Mat		
15212	12	67	Aeolian Deposit		
15212	67	70	Gravel		
15213	0	11	Root Mat		
15213	11	30	Aeolian Deposit		
15213	30	45	Low Density Cultural		
15213	45	54	Turf		unknown
15213	54	68	Midden		
15214	0	15	Root Mat		
15214	15	37	Aeolian Deposit		
15214	37	50	Sand	River	
15214	50	60	Aeolian Deposit		
15214	60	70	Gravel		
15215	0	16	Root Mat		
15215	16	57	Aeolian Deposit		
15216	0	15	Root Mat		
15216	15	20	Aeolian Deposit		
15216	20	30	Turf		
15216	30	40	Aeolian Deposit		
15217	0	15	Root Mat		
15217	15	47	Aeolian Deposit		
15217	47	57	Gravel		
15218	0	15	Root Mat		
15218	15	35	Turf		
15218	35	65	Aeolian Deposit		
15218	65	75	Gravel		
15219	0	14	Root Mat		
15219	14	53	Aeolian Deposit		
15219	53	58	Gravel		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
15220	0	12	Root Mat		
15220	12	40	Aeolian Deposit		
15221	0	15	Root Mat		
15221	15	40	Aeolian Deposit		
150018	0	14	Root Mat		
150018	14	29	Disturbed		
150018	29	35	Aeolian Deposit		
150018	35	40	Aeolian Deposit		
150019	0	9	Root Mat		
150019	9	18	Disturbed		
150019	18	28	Turf		
150019	28	38	Turf		
150019	38	49	Aeolian Deposit		
150019	49	50	Aeolian Deposit	Sandy	
150020	0	15	Root Mat		
150020	15	22	Turf		
150020	22	32.5	Turf		unknown
150020	32.5	40	Disturbed		
150020	40	40	Rock		
150021	0	7	Root Mat		
150021	7	21	Disturbed		
150021	21	25	Low Density Cultural		
150021	25	80	Turf		
150021	80	104	Gley		
150022	0	6	Root Mat		
150022	6	14	Disturbed		
150022	14	40	Turf		H3/H4
150022	40	100	Bog		
150022	100	110	Gley		
150023	0	6	Root Mat		
150023	6	40	Turf		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150023	40	42	Gravel		
150024	0	7	Root Mat		
150024	7	19	Aeolian Deposit		
150024	19	105	Bog		
150025	0	7	Root Mat		
150025	7	16	Disturbed		
150025	16	22	Aeolian Deposit		
150025	22	50	Bog		
150025	50	62	Gley		
150025	62	62	Gravel		
150026	0	7	Root Mat		
150026	7	14	Disturbed		
150026	14	22	Aeolian Deposit		
150026	22	30	Low Density Cultural		
150026	30	55	Aeolian Deposit		
150026	55	55	Gravel		
150027	0	4	Root Mat		
150027	0	16	Aeolian Deposit		
150027	16	23	Aeolian Deposit		
150027	23	32	Low Density Cultural		
150027	32	43	Aeolian Deposit		
150027	43	58	Aeolian Deposit	Mottled	
150027	58	63	Gravel		
150028	0	6	Root Mat		
150028	6	22	Turf		
150028	22	30	Aeolian Deposit		
150028	30	74	Bog		
150029	0	6	Root Mat		
150029	6	19	Disturbed		
150029	19	29	Aeolian Deposit		
150029	29	32	Low Density Cultural		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150029	32	100	Bog		
150030	0	6	Root Mat		
150030	6	19	Turf		H1
150030	19	42	Aeolian Deposit		
150030	42	104	Bog		
150030	104	104	Gravel		
150032	0	8	Root Mat		
150032	8	22	Turf		
150032	22	67	Bog		
150032	54	58	Sand		
150032	58	72	Bog		
150033	0	6	Root Mat		
150033	6	18	Disturbed		
150033	18	28	Turf		
150033	28	91	Bog		
150034	0	5	Root Mat		
150034	5	23	Turf		H1
150034	23	38	Low Density Cultural		
150034	38	104	Bog		
150035	0	7	Root Mat		
150035	7	19	Disturbed		
150035	19	25	Low Density Cultural		
150035	25	27	Iron Pan		
150035	27	34	Aeolian Deposit		
150035	34	100	Bog		
150036	0	5	Root Mat		
150036	5	9	Disturbed		
150036	9	20	Aeolian Deposit		
150036	20	36	Low Density Cultural		
150036	36	110	Bog		
150037	0	7	Root Mat		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150037	7	21	Disturbed		
150037	21	45	Bog		
150037	45	50	Gravel		
150038	0	8	Root Mat		
150038	8	24	Disturbed		
150038	24	92	Bog		
150039	0	8	Root Mat		
150039	8	30	Turf		
150039	30	46	Bog		
150039	46	46	Gravel		
150040	0	7	Root Mat		
150040	7	14	Low Density Cultural		
150040	14	22	Aeolian Deposit		
150040	24	40	Bog		
150040	40	40	Rock		
150041	0	12	Root Mat		
150041	12	17	Disturbed		
150041	17	37	Aeolian Deposit		
150041	37	37	Rock		
150042	0	9	Root Mat		
150042	9	17	Aeolian Deposit		
150042	17	28	Low Density Cultural		
150042	28	40	Aeolian Deposit		
150042	40	56	Aeolian Deposit		
150043	0	10	Root Mat		
150043	10	26	Disturbed		
150043	26	41	Aeolian Deposit		
150043	41	68	Aeolian Deposit		
150043	68	68	Rock		
150044	0	15	Root Mat		
150044	15	23	Disturbed		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150044	23	45	Aeolian Deposit		
150044	45	45	Rock		
150045	0	12	Root Mat		
150045	12	22	Disturbed		
150045	22	57	Aeolian Deposit		
150045	57	57	Rock		
150046	0	19	Root Mat		
150046	19	23	Disturbed		
150046	23	91	Aeolian Deposit		
150047	0	15	Root Mat		
150047	15	19	Disturbed		
150047	19	50	Aeolian Deposit		
150047	50	50	Rock		
150048	0	15	Root Mat		
150048	15	53	Aeolian Deposit		
150049	0	15	Root Mat		
150049	15	25	Disturbed		
150049	25	36	Aeolian Deposit		
150049	36	58	Subsoil		
150049	58	58	Rock		
150050	0	12	Root Mat		
150050	12	22	Disturbed		
150050	22	40	Aeolian Deposit		
150050	40	40	Rock		
150051	0	10	Root Mat		
150051	10	23	Disturbed		
150051	23	27	Turf		
150051	27	52	Aeolian Deposit		
150051	52	52	Rock		
150052	0	15	Root Mat		
150052	15	23	Disturbed		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150052	23	53	Aeolian Deposit		
150052	53	58	Turf		
150052	58	68	Aeolian Deposit		
150053	0	14	Root Mat		
150053	14	25	Disturbed		
150053	25	53	Aeolian Deposit		
150054	0	10	Root Mat		
150054	10	22	Disturbed		
150054	22	80	Aeolian Deposit		
150055	0	14	Root Mat		
150055	14	19.5	Disturbed		
150055	19.5	46	Aeolian Deposit		
150055	46	46	Rock		
150056	0	14	Root Mat		
150056	14	25	Turf		
150056	25	54	Aeolian Deposit		
150056	54	54	Rock		
150057	0	12	Root Mat		
150057	12	16	Disturbed		
150057	16	28	Turf		unknown
150057	28	40	Low Density Cultural		
150057	40	61	Aeolian Deposit		
150058	0	9	Root Mat		
150058	9	14.5	Disturbed		
150058	14.5	18	Turf		
150058	18	34	Low Density Cultural		
150058	34	36	Iron Pan		
150058	36	55	Aeolian Deposit		
150059	0	8	Root Mat		
150059	8	33	Turf		H3/H4
150059	33	71	Bog		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150059	71	75	Aeolian Deposit		
150059	75	80	Gravel		
150060	0	7	Root Mat		
150060	7	29	Turf		
150060	29	34	Aeolian Deposit		
150060	34	36	Midden		
150060	36	38	Aeolian Deposit		
150060	38	69	Bog		
150061	0	10	Root Mat		
150061	10	26	Turf		
150061	26	38	Bog		
150061	38	38	Rock		
150062	0	9	Root Mat		
150062	9	67	Bog		
150062	67	67	Rock		
150063	0	8	Root Mat		
150063	8	13	Disturbed		
150063	13	31	Bog		
150063	31	33	Aeolian Deposit		
150063	33	33	Rock		
150064	0	12	Root Mat		
150064	12	17	Disturbed		
150064	17	36	Aeolian Deposit	Mottled	
150064	36	36	Rock		
150065	0	16	Root Mat		
150065	16	24	Disturbed		
150065	24	36	Aeolian Deposit	Mottled	
150065	36	37	Low Density Cultural		
150065	37	39	Aeolian Deposit	Mottled	
150065	39	41	Midden		
150065	41	58	Bog		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150066	0	13	Root Mat		
150066	13	17	Low Density Cultural		
150066	17	25	Aeolian Deposit		
150066	25	33	Aeolian Deposit	Mottled	
150066	33	61	Bog	Mottled	
150066	61	61	Rock		
150067	0	10	Root Mat		
150067	10	16	Disturbed		
150067	16	25	Aeolian Deposit	Mottled	
150067	25	31	Turf		
150067	31	39	Aeolian Deposit		
150067	39	42	Bog		
150068	0	13	Root Mat		
150068	13	15	Disturbed		
150068	15	27.5	Aeolian Deposit		
150068	27.5	40	Turf		
150068	40	67	Aeolian Deposit		
150069	0	11.5	Root Mat		
150069	11.5	19	Disturbed		
150069	19	26	Turf		
150069	26	37	Aeolian Deposit		
150069	37	57	Low Density Cultural		
150069	57	69	Aeolian Deposit		
150070	0	11	Root Mat		
150070	11	15	Disturbed		
150070	15	43	Aeolian Deposit		
150070	43	43	Rock		
150071	0	18.5	Root Mat		
150071	18.5	40	Aeolian Deposit		
150071	40	40	Rock		
150072	0	16	Root Mat		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150072	16	27	Disturbed		
150072	27	37	Aeolian Deposit		
150072	37	37	Rock		
150073	0	11	Root Mat		
150073	11	20	Disturbed		
150073	20	40	Aeolian Deposit		
150073	40	40	Rock		
150074	0	12	Root Mat		
150074	0	13	Aeolian Deposit		
150074	12	21	Disturbed		
150074	13	13	Rock		
150074	21	35	Aeolian Deposit		
150074	35	35	Rock		
150120	0	12	Root Mat		
150120	12	20	Disturbed		
150120	20	45	Aeolian Deposit		
150120	45	45	Rock		
150121	0	13	Root Mat		
150121	13	17	Disturbed		
150121	17	25	Low Density Cultural		
150121	25	28	Turf		
150121	28	40	Aeolian Deposit		
150121	40	55	Subsoil		
150121	54	55	Gravel		
150122	0	10	Root Mat		
150122	10	21	Disturbed		
150122	21	32	Turf		
150122	32	40	Low Density Cultural		
150122	40	61	Turf		H1
150123	0	13	Root Mat		
150123	13	20	Disturbed		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150123	20	26	Low Density Cultural		
150123	26	40	Midden		
150123	40	52	Turf		
150123	52	58	Subsoil		
150123	58	63	Gravel		
150124	0	14	Root Mat		
150124	14	20	Disturbed		
150124	20	27	Low Density Cultural		
150124	27	35	Midden		
150124	35	54	Turf		
150124	54		Subsoil		
150124	54	57	Gravel		
150125	0	12	Root Mat		
150125	12	22	Disturbed		
150125	22	35	Turf		
150125	35	45	Subsoil		
150126	0	13	Root Mat		
150126	13	21	Disturbed		
150126	21	30	Low Density Cultural		
150126	30	36	Turf		
150126	36	43	Subsoil		
150127	0	12	Root Mat		
150127	12	18	Disturbed		
150127	18	44	Turf		H1
150127	44	49	Aeolian Deposit		
150127	49	53	Midden		
150127	53	67	Low Density Cultural		
150128	0	21	Root Mat		
150128	21	28	Aeolian Deposit		
150128	28	31	Low Density Cultural		
150128	31	33	Aeolian Deposit		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150128	37	52	Midden		
150128	52	59	Aeolian Deposit		
150128	59	59	Rock		
150129	0	20	Root Mat		
150129	20	24	Disturbed		
150129	24	38	Aeolian Deposit		
150129	38	47	Midden		
150129	47	58	Aeolian Deposit		
150129	58	60	Gravel		
150130	0	14	Root Mat		
150130	14	35	Aeolian Deposit		
150130	35	52	Subsoil		
150130	52	56	Gravel		
150131	0	15	Root Mat		
150131	15	19	Aeolian Deposit		
150131	19	26	Low Density Cultural		
150131	26	40	Aeolian Deposit		
150132	0	13	Root Mat		
150132	13	20	Disturbed		
150132	20	49	Aeolian Deposit		
150132	49	49	Rock		
150133	0	16	Root Mat		
150133	16	21	Disturbed		
150133	21	29	Turf		
150133	29	35	Aeolian Deposit	Subsoil (Sterile/Natural)	
150133	35	56	Aeolian Deposit	Subsoil (Sterile/Natural)	
150133	56	56	Rock		
150134	0	12	Root Mat		
150134	12	24	Disturbed		
150134	24	64	Aeolian Deposit		
150134	64	66	Gravel		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150135	0	14	Root Mat		
150135	14	32	Turf		H1 1300
150135	32	45	Aeolian Deposit		
150135	45	45	Rock		
150136	0	10	Root Mat		
150136	10	19	Disturbed		
150136	19	50	Aeolian Deposit		
150136	50	50	Rock		
150137	0	5	Root Mat		
150137	5	17	Disturbed		
150137	17	52	Aeolian Deposit		
150137	52	52	Rock		
150138	0	15	Root Mat		
150138	15	20	Disturbed		
150138	20	33	Turf		1300
150138	33	40	Aeolian Deposit	Mottled	
150138	40	50	Aeolian Deposit		
150138	50	50	Rock		
150139	0	12	Root Mat		
150139	12	20	Disturbed		
150139	20	42	Aeolian Deposit		
150139	42	42	Rock		
150140	0	14	Root Mat		
150140	12	18	Disturbed		
150140	18	29	Turf		H1
150140	29	43	Aeolian Deposit		
150140	43	43	Rock		
150153	0	12	Root Mat		
150153	12	18	Disturbed		
150153	18	31.5	Aeolian Deposit		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
150153	31.5	34	Midden		
150153	34	44	Aeolian Deposit	Subsoil (Sterile/Natural)	
150153	44	58	Gravel		
150314	0	20	Plow Zone		
150314	20	80	Aeolian Deposit		
152180	0	10	Root Mat		
152180	10	15	Disturbed		
152180	15	32	Aeolian Deposit		
152180	32	42	Subsoil		
152180	42	42	Rock		
152181	0	11	Root Mat		
152181	11	19	Disturbed		
152181	19	40	Aeolian Deposit		
152182	0	17	Root Mat		
152182	17	20	Disturbed		
152182	20	59	Aeolian Deposit		
152182	59	73	Subsoil		
152182	73	73	Rock		
152183	0	7	Root Mat		
152183	7	19	Disturbed		
152183	19	35	Aeolian Deposit		
152183	35	40	Subsoil		
152184	0	15	Root Mat		
152184	15	26	Disturbed		
152184	26	35	Aeolian Deposit		
152184	35	40	Subsoil		
152185	0	17	Root Mat		
152185	17	19	Disturbed		
152185	19	36	Aeolian Deposit		
152185	36	40	Subsoil		
152186	0	14	Root Mat		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
152186	14	26	Disturbed		
152186	26	40	Aeolian Deposit		
152186	40	40	Rock		
152187	0	17	Root Mat		
152187	17	39	Aeolian Deposit		
152187	39	50	Subsoil		
152187	50	50	Rock		
152190	0	14	Root Mat		
152190	14	33	Disturbed		
152190	33	39	Aeolian Deposit		
152190	39	39	Rock		
152191	0	15	Root Mat		
152191	15	33	Aeolian Deposit		
152191	33	40	Subsoil		
152192	0	11	Root Mat		
152192	11	18	Disturbed		
152192	18	38	Aeolian Deposit		
152192	38	50	Subsoil		
152192	50	50	Rock		
152193	0	14	Root Mat		
152193	14	22	Disturbed		
152193	22	55	Aeolian Deposit		
152193	55	59	Subsoil		
152193	59	59	Rock		
152194	0	16	Root Mat		
152194	16	22	Disturbed		
152194	22	29	Aeolian Deposit		
152194	29	39	Subsoil		
152194	39	39	Rock		
152195	0	16	Root Mat		
152195	16	19	Disturbed		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
152195	19	38	Aeolian Deposit		
152195	38	40	Subsoil		
152196	0	12	Root Mat		
152196	12	20	Disturbed		
152196	20	36	Aeolian Deposit		
152196	36	40	Subsoil		
152197	0	13	Root Mat		
152197	13	18	Disturbed		
152197	18	50	Aeolian Deposit		
152197	50	50	Rock		
152198	0	9	Root Mat		
152198	9	17	Disturbed		
152198	17	35	Aeolian Deposit		
152198	35	40	Subsoil		
152567	0	19	Root Mat		
152567	19	22	Disturbed		
152567	22	33	Aeolian Deposit		
152567	33	50	Subsoil		
152567	50	50	Rock		
152568	0	14	Root Mat		
152568	14	20	Disturbed		
152568	20	32	Aeolian Deposit		
152568	32	50	Subsoil		
152568	50	50	Rock		
152569	0	16	Root Mat		
152569	16	23	Disturbed		
152569	23	40	Aeolian Deposit		
152569	40	45	Subsoil		
152569	45	45	Rock		
152570	0	15	Root Mat		
152570	15	22	Disturbed		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
152570	22	39	Aeolian Deposit		
152570	39	40	Subsoil		
152570	40	40	Rock		
152571	0	14	Root Mat		
152571	14	23	Disturbed		
152571	23	51	Aeolian Deposit		
152571	51	63	Subsoil		
152571	63	63	Rock		
152572	0	10	Root Mat		
152572	10	24	Disturbed		
152572	24	39	Turf		LNL/LNS H3/H4
152572	39	50	Aeolian Deposit		
152572	50	60	Subsoil		
152572	60	60	Rock		
152573	0	9	Root Mat		
152573	9	14	Disturbed		
152573	14	52	Turf		LNL/LNS H3/H4
152573	52	55	Aeolian Deposit		
152573	55	74	Subsoil		
152573	74	74	Rock		
152574	0	15	Root Mat		
152574	15	22	Disturbed		
152574	25	49	Aeolian Deposit		
152574	49	64	Subsoil		
152574	64	64	Rock		
152575	0	16	Root Mat		
152575	16	25	Disturbed		
152575	25	40	Aeolian Deposit		
152575	40	65	Subsoil		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
152575	65	65	Rock		
152576	0	10	Root Mat		
152576	10	22	Disturbed		
152576	22	45	Aeolian Deposit		
152576	45	45	Rock		
152577	0	7	Root Mat		
152577	7	23	Disturbed		
152577	23	45	Aeolian Deposit		
152577	45	45	Rock		
152578	0	7	Root Mat		
152578	7	21	Disturbed		
152578	21	40	Aeolian Deposit		
152578	40	40	Rock		
152579	0	11	Root Mat		
152579	11	18	Disturbed		
152579	18	32	Aeolian Deposit		
152579	32	50	Subsoil		
152579	50	50	Rock		
160000	0	10	Root Mat		
160000	10	25	Turf		
160000	25	34	Low Density Cultural		
160000	34	35	Midden		
160000	35	100	Bog		
160004	0	10	Root Mat	Boggy	
160004	10	28	Aeolian Deposit	Mottled	
160004	28	55	Bog	Striated	
160004	55	88	Bog	Mottled	
160004	88	100	Gley	Irony	
160004	100	104	Gravel	Irony	
160005	0	8	Root Mat		
160005	8	13	Low Density Cultural	Mottled	

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
160005	13	13.5	Midden		
160005	13.5	30	Low Density Cultural	Striated	
160005	30	70	Bog	Rooty	
160006	0	12	Root Mat		
160006	12	20	Turf		
160006	20	35	Low Density Cultural		
160006	35	100	Bog	Striated	
163909	0	8	Root Mat		
163909	8	19	Disturbed		
163909	19	28	Aeolian Deposit		
163909	28	50	Low Density Cultural		
163909	50	51	Aeolian Deposit		
163909	51	51	Rock		
163910	0	10	Root Mat		
163910	10	25	Disturbed		
163910	25	45	Low Density Cultural		
163910	45	45	Gravel		
163911	0	12	Root Mat		
163911	12	21	Disturbed		
163911	21	45	Low Density Cultural		
163911	45	50	Midden		
163911	50	50	Gravel		
163912	0	12	Root Mat		
163912	12	20	Disturbed		
163912	20	45	Low Density Cultural		
163912	45	50	Midden		
163912	50	51	Aeolian Deposit		
163912	51	51	Gravel		
163913	0	10	Root Mat		
163913	10	22	Disturbed		
163913	22	39	Low Density Cultural		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
163913	39	45	Turf		
163913	45	55	Aeolian Deposit		
163913	55	55	Gravel		
163914	0	12	Root Mat		
163914	12	22	Disturbed		
163914	22	53	Turf		
163914	53	75	Aeolian Deposit		
163914	75	75	Gravel		
163915	0	9	Root Mat		
163915	9	20	Disturbed		
163915	20	40	Low Density Cultural		
163915	40	45	Turf		LNL/LNS
163915	45	50	Aeolian Deposit		
163915	50	50	Gravel		
163916	0	12	Root Mat		
163916	12	22	Disturbed		
163916	22	30	Floor		
163916	30	40	Low Density Cultural		
163916	40	42	Floor		
163916	42	45	Low Density Cultural		
163916	45	47	Aeolian Deposit		
163916	47	47	Gravel		
163917	0	12	Root Mat		
163917	12	26	Disturbed		
163917	26	34	Floor		
163917	34	45	Low Density Cultural		
163917	45	57	Aeolian Deposit		
163917	57	57	Gravel		
163918	0	15	Root Mat		
163918	15	25	Disturbed		
163918	25	31	Low Density Cultural		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
163918	31	34	Midden		
163918	34	40	Low Density Cultural		
163918	40	40	Gravel		
163919	0	15	Root Mat		
163919	15	25	Disturbed		
163919	25	45	Low Density Cultural		
163919	45	50	Gravel		
163920	0	15	Root Mat		
163920	15	25	Disturbed		
163920	25	39	Low Density Cultural		
163920	39	40	Floor		
163920	40	43	Low Density Cultural		
163920	43	43	Gravel		
163921	0	15	Root Mat		
163921	15	28	Disturbed		
163921	28	37	Low Density Cultural		
163921	37	39	Floor		
163921	39	48	Low Density Cultural		
163921	48	51	Aeolian Deposit		
163921	51	51	Gravel		
163922	0	13	Root Mat		
163922	13	25	Disturbed		
163922	25	37	Low Density Cultural		
163922	37	39	Floor		
163922	39	45	Aeolian Deposit		
163922	45	45	Gravel		
163923	0	15	Root Mat		
163923	15	20	Disturbed		
163923	20	27	Aeolian Deposit		
163923	27	45	Low Density Cultural		
163923	45	48	Aeolian Deposit		

Core Number	top depth	bottom depth	Category	Description	Tephra in Turf
163923	48	48	Gravel		