



For Cotswold Archaeology

On Behalf Of Grand Union Housing

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#### Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 20ha area of land at Little Linford Lane, Newport Pagnell, Milton Keynes. A fluxgate gradiometer survey was successfully completed and has detected numerous anomalies of probable and possible archaeological origins. An area of potential multi-phase settlement activity has been identified towards the centre of a site, which expands on the detail of the sub-rectangular cropmarks previously identified in aerial photographs. To the south, a penannular feature, also previously identified as a cropmark, and a large rectangular enclosure have been detected as well. At the northern end, the survey area clips apparent rectilinear enclosures and ditches, which may reflect a continuation of settlement area previously identified through excavations to the east of the M1. In addition to these archaeological features, ridge and furrow ploughing is evident across the site, as well as the remnants of former field boundaries and a field barn. Potential quarrying activity has been identified as well, with discrete areas of mottled variations likely reflecting gravel extraction. The impact of modern activity is generally minimally.

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#### 1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by Cotswold Archaeology on behalf of Grand Union Housing to undertake a geophysical survey on a c.20ha area of land at Little Linford Lane, Newport Pagnell, Milton Keynes (SP 8531 4405).
- 1.2. The geophysical survey comprised hand pulled, cart-mounted fluxgate gradiometer survey.
- 1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).
- 1.4. The survey was conducted in-line with a Method Statement approved by Milton Keynes Council in advance of survey commencement.
- 1.5. The survey commenced on 22 May 2017 and was completed within four days.

# 2. Quality Assurance

- 2.1. Project management, survey work, data processing and report production have been carried out by qualified and professional geophysicists to standards exceeding the current best practice (CIfA, 2014; David et al., 2008, Schmidt et al., 2015).
- 2.2. Magnitude Surveys is a corporate member of ISAP (International Society of Archaeological Prospection).
- 2.3. Director Graeme Attwood is a Member of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, as well as the Secretary of GeoSIG, the CIfA Geophysics Special Interest Group. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Director Chrys Harris has a PhD in archaeological geophysics from the University of Bradford.
- 2.4. All MS managers have postgraduate qualifications in archaeological geophysics. All MS field staff have relevant archaeology or geophysics degrees and supervisors have at least three years' field experience.

# 3. Objectives

3.1. The geophysical survey aimed to assess the subsurface archaeological potential of the survey area.

# 4. Geographic Background

- 4.1. The site is located at the north-western fringe of Newport Pagnell, c. 5km north-east from the centre of Milton Keynes (Figure 1). Survey was undertaken across a single field that was situated off of Little Linford Lane and bounded by the M1 to the east, and the River Great Ouse to the north and west (Figure 2).
- 4.2. The underlying geology comprises limestone of the Blisworth Limestone Formation across the majority of a site. A band of Rutland Formation—argillaceous rocks with subordinate sandstone and limestone is recorded across the northern tip and a discrete area of mudstone from the Bliswroth Clay Formation is recorded towards the south-eastern end. Superficial deposits are variable across the site. Diamicton till (Oadby Member) is recorded in a band through the southern end; a band of glaciofluvial sand and gravel deposits are recorded extending into the centre of the site from the east; further sand and gravel (Felmersham Member) is recorded in a strip to the north of this, with a strip of clay and silt alluvium immediately to the north, towards the banks of the River Great Ouse (British Geological Survey, 2017).
- **4.3.** The soils consist of slightly acid loamy and clayey soils with impeded drainage through the centre of the site; a band of loamy and clayey foodplain soils is recorded through the northern tip and along the western end of site, following the path of the River Great Ouse; and finally, a band of lime-rich loamy and clayey soils with impeded drainage is recorded through the south-eastern corner (Soilscapes, 2017).

#### 4.4. Survey considerations:

Survey Area	Ground Conditions	Further notes:
1	Uncut pasture. Gentle undulations across the site.	Overgrown vegetation was present along the field's edges at the northern tip. Two discrete areas could not be surveyed at along the eastern edge of site, due to overgrown vegetation. A further area of overgrowth occurred at the southern end of site, near an area of scattered scrap that was bounded to the north by an embankment running east-west. The field was bounded by hedges to the east and north-west
		and a wire fence at the south-western edge.

# 5. Archaeological Background

- 5.1. The following section summarises the archaeological background of the site and its environs, derived from a desk-based assessment (DBA) produced by Cotswold Archaeology (Pratt, 2017). The site has been subject to previous archaeological investigations. A watching brief undertaken in 1982 recorded part of a former track depicted on historic maps. Trial trenching at the southern end of site in 2006 did not identify any archaeological finds or features. However, several cropmark features have been identified in aerial photographs of the site and will be discussed in more detail below.
- 5.2. Numerous cropmarks of potential prehistoric features have been identified along the River Great Ouse, the origin of which have been confirmed through archaeological investigations. Within the site itself, a c.30m wide possible ring ditch has been identified in aerial photographs, towards the southern part of site. In the field across the M1, a monument complex containing ring ditches, enclosures, and linear features was identified c.200m from site at Gayhurst Quarry. This was confirmed as a Bronze Age barrow cemetery, a Middle to Late Bronze Age boundary and field system, and an Iron Age Settlement by excavations undertaken in 1997 and 2000.
- 5.3. The Iron Age settlement c.200m east of site was defined by three sub-rectangular enclosures that contained pottery sherds, animal bone, and burnt cobbles. Further Iron Age activity has been identified to the south, north-east, and east of site, which demonstrate the situation of the site within a wider archaeological corridor along the River Great Ouse. Geophysical survey and trial trenching c.450m NNW of site revealed a complex series of intercutting features that demonstrated several phases of an enclosure boundary—potentially representing a farmstead. Farmsteads and field systems became more apparent throughout the wider landscape by the Late Iron Age. Two large rectangular cropmarks have been identified towards the centre of the site in aerial photographs. The configuration of these cropmarks suggests a potential Iron Age settlement enclosure with an attached stock enclosure, similar to the settlement recorded c.200m to the east of site. Evidence for continuity of settlement into the Roman period has been recorded c.350m south of site. Excavations identified features and finds dating to the Late Iron Age through to the late 4<sup>th</sup>-century AD.
- 5.4. Evidence for the continuation of settlement into the early medieval period is limited; however, excavations c.1km north-west of site recorded Saxon settlement activity, including a ditched trackway, buildings, and pits. The Domesday Survey records settlements in the surrounding landscape. The site itself was incorporated as part of the manor and parish of Newport Pagnell.
- 5.5. The configuration of the site and its surrounding landscape through the post-medieval and modern periods has been understood through a map regression. The 1795 Enclosure Map for Newport Pagnell records the site as divided into five fields, with a track running through the site on a sub N-S alignment. Groundworks undertaken in 1982 recorded the track as comprising a packed limestone surface c.2.6m wide. The Enclosure Map also records a quarry pit towards the south-eastern boundary of the site. The track and quarry pit are also recorded on the 1st Edition Ordnance Survey map of 1885. The OS map also depicts the site as sub-divided into nine fields. The removal of the site's internal subdivisions can be tracked through 20th century Ordnance Survey maps. During the 1970s, gravel extraction is recorded throughout the surrounding landscape.

# 6. Methodology

#### 6.1.Data Collection

- **6.1.1.** Geophysical prospection comprised the magnetic method as described in the following table.
- 6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

- 6.1.3. The magnetic data were collected using MS' bespoke hand-pulled cart system.
  - 6.1.3.1. MS' cart system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a Hemisphere S321 GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The Hemisphere S321 GNSS Smart Antenna is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.
  - 6.1.3.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.
  - 6.1.3.3. Rows of temporary sight markers were established in each survey area to guide the surveyor and ensure full coverage with the cart. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient data collection and processing.

#### 6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David et al., 2008: 11).

<u>Sensor Calibration</u> – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

<u>Zero Median Traverse</u> – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

<u>Projection to a Regular Grid</u> – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

<u>Interpolation to Square Pixels</u> – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

### **6.3**.Data Visualisation and Interpretation

- 6.3.1. This report presents the gradient of the sensors' total field data as greyscale images. Multiple greyscales images at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot, available in the digital archive. XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.
- 6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street mapping, satellite imagery, historic mapping, LiDAR data, and soil and geology mapping. Google Earth (2017) was consulted as well, to compare the results with recent land usages.



### 7. Results

# 7.1.Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports as well as reports of further work in order to constantly improve our knowledge and service.

#### 7.2.Discussion

- 7.2.1. The geophysical results are presented in consideration with historic maps (Figure 4).
- 7.2.2. The fluxgate gradiometer survey has responded well to the survey area's environment. Magnetic anomalies produced by natural variations in the soils and superficial geology have been detected across the site. The small, discrete responses scattered across the site are characteristic of superficial deposits. It is conceivable some of these responses have an anthropogenic origin; however, these would appear indistinguishable in the magnetic results from those responses produced by natural geology. Gravel extraction has been documented in portions of the site and the surrounding landscape. An undocumented quarry may occur in a rectilinear strip through the centre of the site, extending westwards from the old quarry. The impact of modern activity on the results is generally minimally. Broad, ferrous responses along the perimeter of the field reflect adjacent boundaries, while discrete ferrous responses across the site reflect scattered metallic debris.
- 7.2.3. Three distinct areas of archaeological activity have been detected in the southern, central, and northern parts of site. This has greatly expanded on the previous archaeological potential of the site understood through cropmark features identified in aerial photographs. In addition to the two sub-rectangular cropmarks towards the centre of the site, further enclosures have been detected, as well as possible roundhouses, ditches, pits, and possible industrial activity. An evident trackway feature encircling the enclosures to the north and east connects the settlement area with the surrounding landscape. The extent of the settlement encompasses an area roughly 2.4ha in size. To the south, the possible ring ditch feature identified in aerial photographs has been detected as a distinct penannular feature, as well as a previously unknown sub-rectangular enclosure. Evidence for settlement activity is less explicit in this area; the line of a potential pit alignment or post-holes has been identified towards the northern boundary of the enclosure. Finally, the northern tip of the site has clipped an apparent settlement area, which may represent a continuation of the Gayhurst Quarry Iron Age settlement to the east of the M1. Extensive ridge and furrow ploughing appears to truncate all areas of archaeological activity, as well as a former field

boundary that extends N-S through half of the site. The presence of ploughing through the archaeology has limited the confidence of certain features in-line with the trend, resulting in an "Undetermined" or "Archaeology Possible" classification.

### 7.3. Interpretation

#### 7.3.1. General Statements

- 7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.
- 7.3.1.2. **Undetermined** Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally not ferrous in nature.
- 7.3.1.3. **Ferrous (Discrete/Spread)** Discrete ferrous-like, dipolar anomalies are likely to be the result of modern metallic disturbance on or near the ground surface. A ferrous spread refers to a concentrated deposition of these discrete, dipolar anomalies. Broad dipolar ferrous responses from modern metallic features, such as fences, gates, neighbouring buildings and services, may mask any weaker underlying archaeological anomalies should they be present.

#### 7.3.2. Magnetic Results - Specific Anomalies

- 7.3.2.1. Archaeology (Enclosures) The magnetic results have confirmed the presence of the two sub-rectangular enclosures [1 & 2] identified towards the centre of the site in aerial photographs. The magnetic results expand on the detail of the cropmark interpretation, revealing three distinct contiguous sub-rectangular enclosures [1-3]. These enclosures are defined by broad linear ditch-like anomalies that exhibit a very strong magnetic fill. The largest enclosure [1] measures c.73m x c.75m. An apparent ditch terminal [1A] indicates an entrance into the enclosure; a weaker, more ephemeral linear response running parallel to the south may represent management of passage into the enclosure. Evidence for settlement activity within [1] is ambiguous. Towards the centre of the enclosure, two weak, semi-circular segments have been detected [1B] that measure c.26m at the widest. The specific origin of [1B] is not clear. A number of pit-like and other discrete anomalies have been detected within [1].
- 7.3.2.2. Archaeology (Enclosures) Evidence for settlement activity is clearer in the smaller enclosure [2], c.42m x c.52m in size, which abuts the north-west corner of [1]. Two circular anomalies [2A] towards the centre of [2] are indicative of potential roundhouse features. These features measure approximately 12m in diameter. Within the potential roundhouses are numerous small, discrete anomalies that may reflect postholes or pit-like features.

- 7.3.2.3. **Archaeology (Enclosures)** To the south and west of enclosures [2] and [1], respectively, is a third enclosure [3] that is much smaller in size. [3] measures c.30m x c.15m and may reflect a livestock enclosure or an ancillary function. A small entrance may be present along the enclosure's southern boundary.
- 7.3.2.4. Archaeology (Enclosures and Possible Industrial Activity) To the south and west of [3], a complex series of ditch-like and pit-like anomalies has been detected. These anomalies are concentrated within the extent between two parallel ditch-like features [4] running SW-NE. Four clear rectilinear enclosures can be discerned within this area. For clarity, only [5 & 6] are indicated as examples. [5] is defined by strong, ditch-like anomalies which form a sub-rectangular enclosure c.15m x c.14m in size. Two further possible enclosures abut [5] to the east and west. An alignment of discrete anomalies [5A] with a strong magnetic response are orientated in a line running parallel to the southern boundary of [5]. The magnitude of [5A] suggests the potential for an area of possible industrial activity.
- 7.3.2.5. Archaeology (Enclosures) The anomalies defining [6] are weaker and thinner in contrast to those of [5]. This could reflect a different type of usage for this feature or potentially indicate a feature of a different date; however relative phasing of fluxgate gradiometer data is difficult through the geophysical results alone. A series of weak, curvilinear anomalies extending through the enclosures may further indicate the potential for multi-phase activity; however, some of these responses also occur in-line with the direction of ploughing trends. Therefore, an archaeological origin is less confident, so an "Undetermined" classification has been ascribed.
- 7.3.2.6. Archaeology (Trackway) The northern boundary of [2] occurs in-line with an apparent trackway [6A]. [6A] is defined by parallel, linear ditch-like anomalies that extend E-W to the north of the enclosures [1 & 2], before changing directions to run NW-SE down to the east. The route of this trackway [6] connects the enclosures to the flood plain of the River Great Ouse. Elsewhere in the River Great Ouse corridor, similar trackway features have been identified which connect the Iron Age settlement to the river (see Pratt, 2017). A further trackway [6B] may be present extending to the east from the south-eastern corner of [1], with an apparent ovate enclosure extending from it. Another trackway [6C] may extend northward from the north-eastern corner of [2].
- 7.3.2.7. **Archaeology (Ring Ditch)** In addition to the sub-rectangular enclosures, the magnetic results have confirmed the presence of the possible ring ditch cropmark feature identified in aerial photographs. Towards the southern part of the site, a penannular feature [7] is defined by a strong ditch-like anomaly, which measures c.29m across. Enhanced superficial geology in this area makes it difficult to confidently identify specific internal features within this feature.

- 7.3.2.8. Archaeology (Enclosure) Approximately 20m south of the possible ring ditch, a sub-rectangular enclosure [8] is defined by a series of strong-ditch like anomalies. [8] measures c.61m x c.41-51m, which is smaller than the largest enclosure to the north [1], but considerably larger than largest enclosure at Gayhurst Quarry to the north-east of site (see Pratt, 2017). Unlike the enclosures to the north [e.g. 2, 3, 6], evidence for internal settlement activity is less clear. A series of small, discrete circular anomalies form an apparent linear E-W alignment [8A]. This could represent pit or post-hole alignment, but given the orientation in-line directly with a former field boundary and ploughing, the interpretation of this is less certain. It is unclear whether the gaps at the western end of [8] represent potential entrances or are a result of subsequent ploughing.
- 7.3.2.9. Archaeology (Enclosures/Ditches?) At the northern tip of site, a series of strong rectilinear and linear ditch-like anomalies have been detected. The most intelligible features are [9], a c. 12m square enclosure, and a strong, ditch-like anomaly [10], which may bound a larger sub-rectangular enclosure [10A]. These features form similar configurations and are on similar alignments to the excavated Bronze Age and Iron Age settlement area excavated at Gayhurst Quarry, to the east of the M1 (see Pratt, 2017). It is therefore highly likely that the anomalies detected at the northern end of site form a continuation of this settlement area. Ridge and furrow ploughing through this area makes it difficult to confidently discern any discrete or internal features within the enclosures and ditches; however, a zone of potential archaeological activity has been indicated as a "Spread" due to the enhancement of these anomalies over the surrounding area.
- 7.3.2.10. Agricultural The line of the former field boundary extending N-S through the site have been detected as a linear band of mixed material [11]. This has been indicated as "Agricultural (Spread)". The density and ferrous content of this material increases over the location of the former field barn [12], which likely reflects the presence of rubble from the structure's demolition.

Elsewhere in the site, former field boundaries have been detected as weak, linear anomalies [13]. This reflects the difference in fill material between [11] and [13] and could indicate [13] gradually refilled with material, instead of an intentional deposition at the boundaries of [11].

7.3.2.11. **Ridge and Furrow** – Several alignments of broad, widely spaced parallel linear and curvilinear anomalies have been detected across the site, which are characteristic of ridge and furrow ploughing. Through the central and southern parts of sites, the trends appear to extend through the former field boundaries and historic trackway; this could indicate a relative older date for the ploughing. The differences in the clarity of response to the west and east of the boundary may be a result of subsequent different land use.

- 7.3.2.12. Natural and Possible Quarrying Mottled areas of variation classified as "Natural (Spread)" are typical of variations in the superficial geology and natural soils (see Section 4.3). A concentration of such deposits occurs in the vicinity of the former quarry pit recorded on historic maps (Figure 4). Extending to the west from the quarry pit is a demarcated rectilinear area [14] that exhibits magnetic enhancement from the surrounding material. The northern and southern boundaries of [14] occur in-line with the ploughing regime, but exhibit a much stranger magnetic contrast than the surrounding ploughing responses. It is possible [14] reflects material extraction with this area; the limits of [14] roughly correlate with an area marked as possible historic quarrying activity identified through LiDAR in the DBA (see Pratt, 2017).
- 7.3.2.13. Undetermined (Spread) A similar area of variation to [14] has been detected towards the north-eastern end of site [15], which also occurs with depression visible in LiDAR (see Pratt, 2017); however, the limits of [15] are much less clearly delineated than those of the possible quarry and appear to extend through former field boundaries recorded on historic mapping (Figure 4). The extent of [15] also correlates with a discolour of the grasses, visible in recent satellite imagery (Google Earth, 2017). It is considered more likely that [15] also reflects the extraction of material or similar processes. Weak, linear responses [e.g. 15A] have been detected abutting the south-western edge of the variation.
- 7.3.2.14. **Modern, Undetermined, and Ferrous** Anomalies towards the southern end of site are likely associated with the groundworks undertaken previously for the stud farm (see Pratt, 2017) and the scrap material noted at the time of survey (see Section 4.4). Two parallel linear anomalies [16] demarcate an area of differential use at the ends of the embankment (see Google Earth, 2017).
- 7.3.2.15. **Undetermined** Anomalies have been classified as "Undetermined" where a specific origin of response is ambiguous. Those detected in the vicinity of archaeological activity are considered more likely to have greater archaeological potential.

### 8. Conclusions

- 8.1. A fluxgate gradiometer survey has successfully been undertaken across the site. The survey has detected a range of different types of anthropogenic responses, including archaeological activity, agricultural activity, modern activity, and possible quarrying activity. Natural responses have been identified as well and reflect variations within the superficial geology and natural soil.
- 8.2. Archaeological activity has been detected in the southern, central, and northern parts of the site towards the River Great Ouse. The configuration of the features identified are similar to other sites excavated in the surrounding landscape, which helps to frame the geophysical results within the wider River Great Ouse archaeological corridor.
- 8.3. Agricultural activity has been detected in the form of ploughing, former field boundaries, and the remains of a former field barn. The ploughing regime appears to extend through former field boundaries recorded in historic maps, which suggests a potential older origin for these features.
- **8.4.** Adjacent fences and boundaries have produced broad, ferrous responses in some areas; although the impact of modern activity on the site is generally minimally. Modern activity is most evident at the southern end of site, in the area of previous groundworks and refuse scatter (see Section 4.4).
- 8.5. Possible quarrying activity has been identified by a rectilinear strip extending through the centre of the site from a former gravel pit recorded on historic mapping.
- 8.6. Anomalies have been classified as "Undetermined" where a specific origin is ambiguous through the geophysical results and no correlating evidence supports a more confident interpretation. Many of these anomalies are considered to reflect anthropogenic processes resulting from a combination of agricultural, modern, and archaeological activity. A defined rectilinear area of mottled variation along the eastern boundary of the site may reflect a combination of natural processes and quarrying activity.

# 9. Archiving

- 9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and ungeoreferenced images, XY traces and a copy of the final report.
- 9.2. MS contributes all reports to the ADS Grey Literature Library subject to any time embargo dictated by the client.
- 9.3. Whenever possible, MS has a policy of making data available to view in easy to use forms on its website. This can benefit the client by making all of their reports available in a single repository, while also being a useful resource for research. Should a client wish to impose a time embargo on the availability of data, this can be achieved in discussion with MS.

# 10. Copyright

10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

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