Norfolk Boreas Offshore Wind Farm

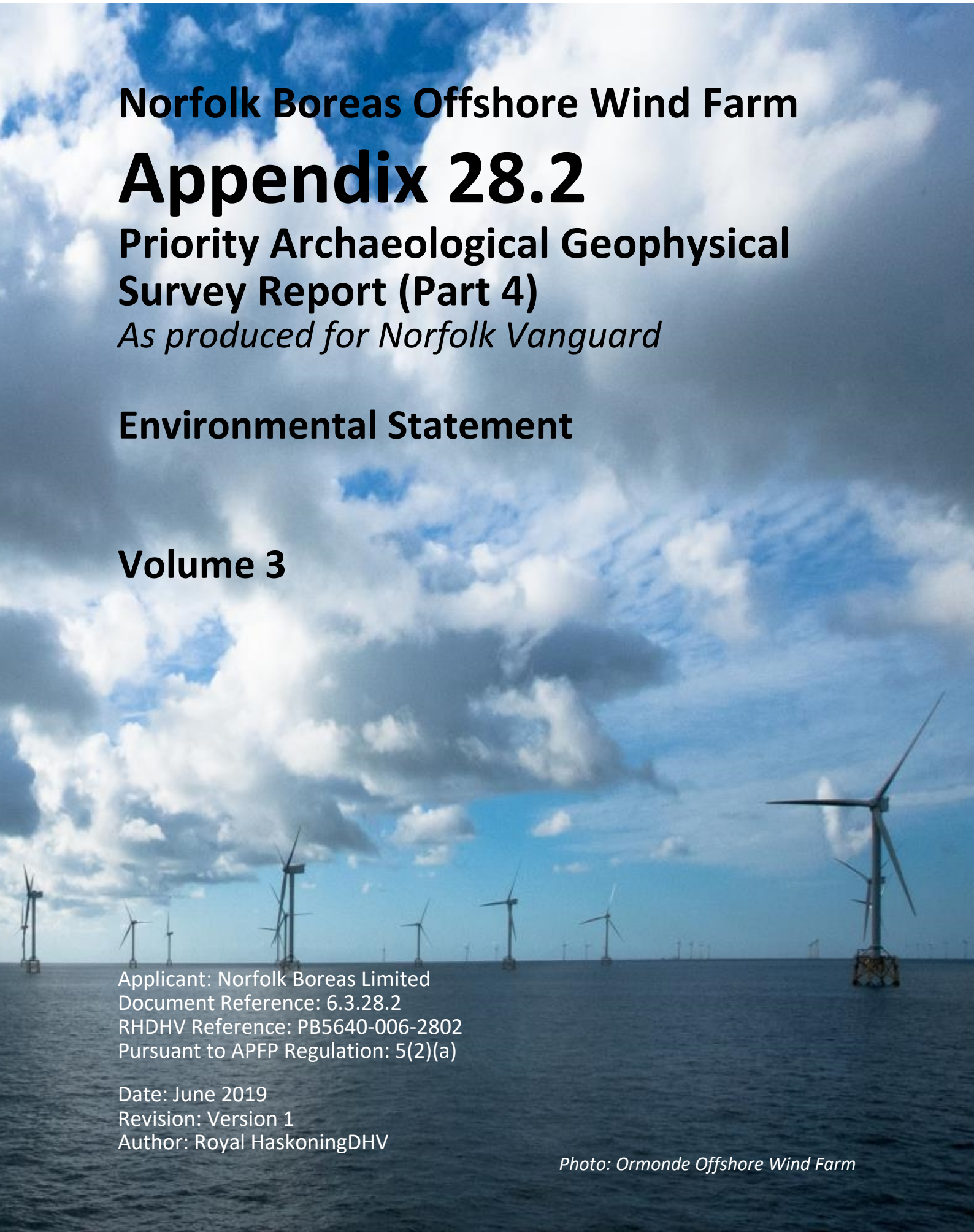
Appendix 28.2

Priority Archaeological Geophysical Survey Report (Part 4)

As produced for Norfolk Vanguard

Environmental Statement

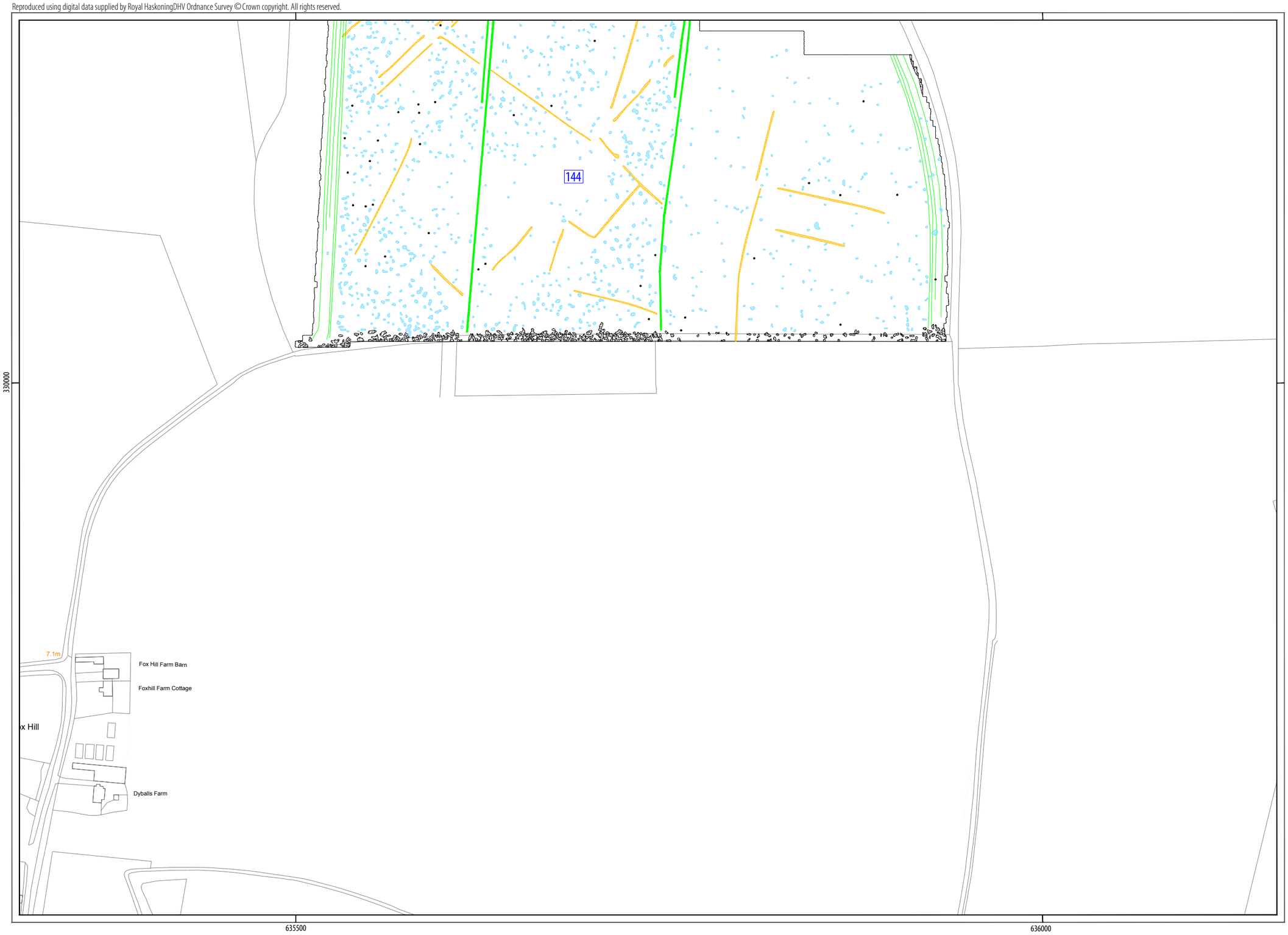
Volume 3



Applicant: Norfolk Boreas Limited
Document Reference: 6.3.28.2
RHDHV Reference: PB5640-006-2802
Pursuant to APFP Regulation: 5(2)(a)

Date: June 2019
Revision: Version 1
Author: Royal HaskoningDHV

Photo: Ormonde Offshore Wind Farm



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?

0 50m
1:2,500 @ A3

PROJECT NVOW17
Priority Archaeological Geophysical Survey
(Terrestrial Archaeology)
Norfolk Vanguard Offshore Wind Farm

CLIENT Royal HaskoningDHV

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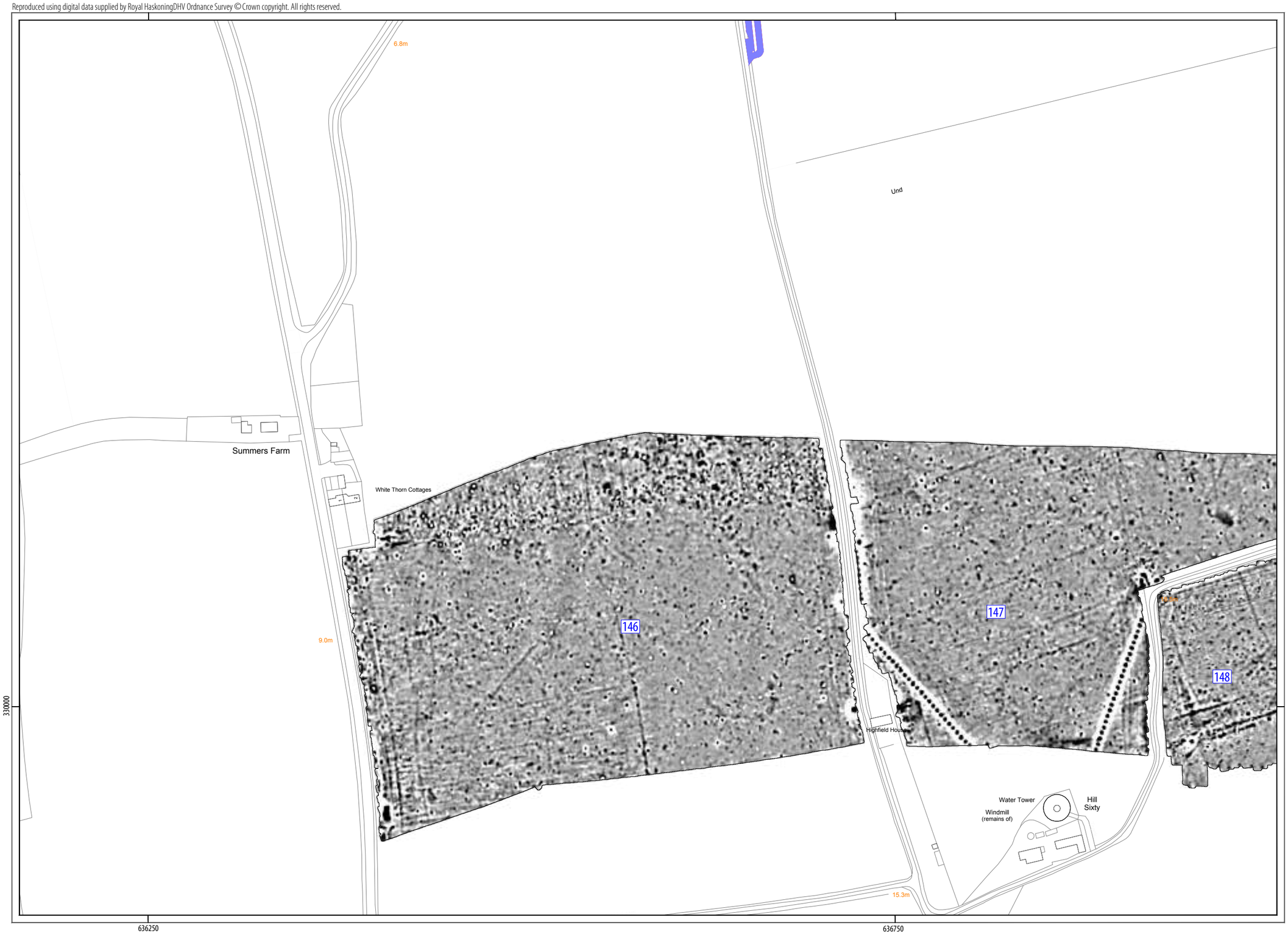
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 178 Interpretation of magnetometer data; PAGSA 144-145



norfolk vanguard red line boundary
access route

nT
-1.0 2.0

0 50m
1:2,500 @ A3

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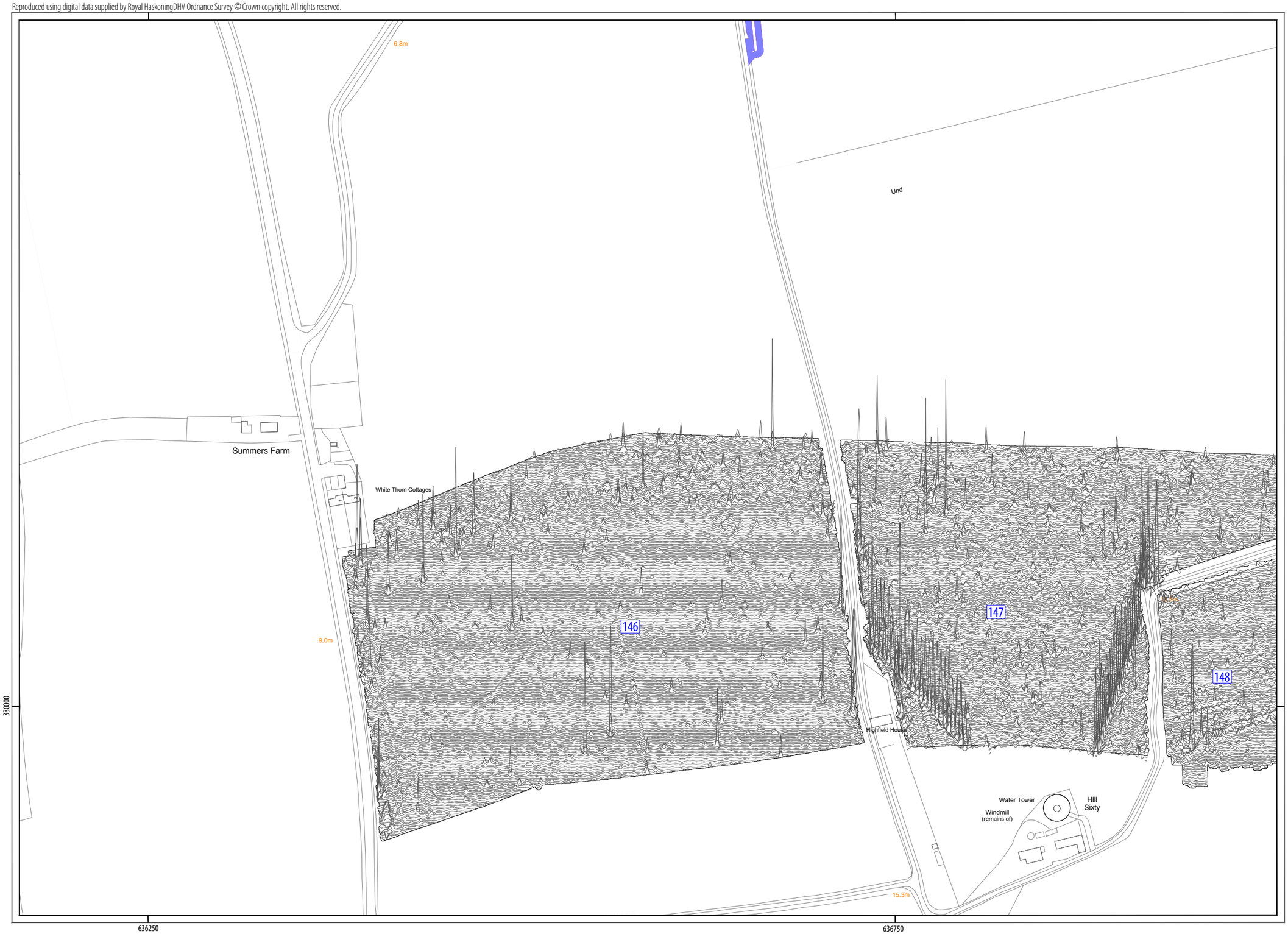
ILLUS 179 Processed greyscale magnetometer data; PAGSA 146-148



norfolk vanguard red line boundary
access route

50.0nT/cm

0 50m
1:2,500 @ A3

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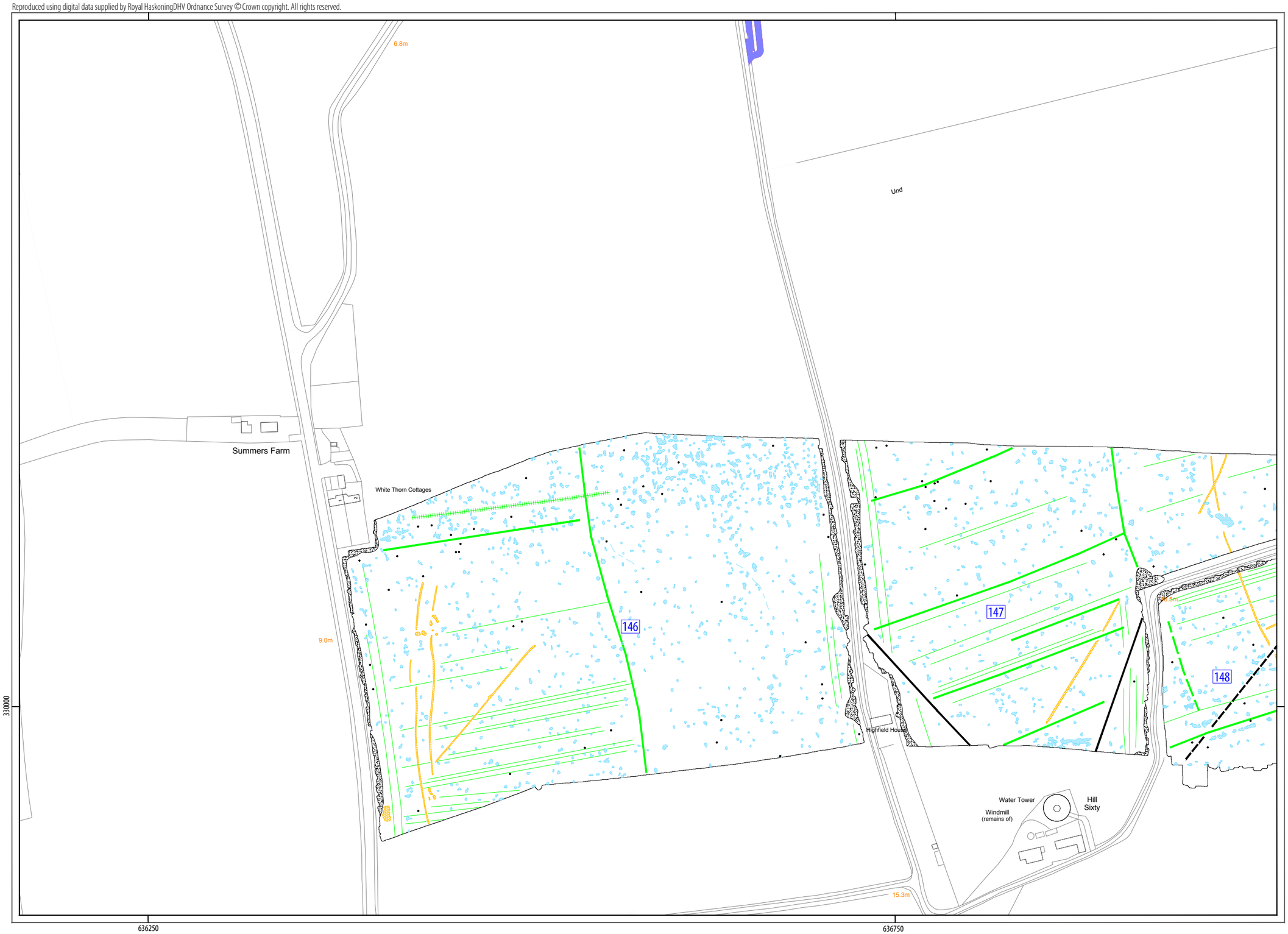
ILLUS 180 XY trace plot of minimally processed of magnetometer data; PAGSA 146-148



- norfolk vanguard red line boundary
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	service pipe
linear trend	drain
linear trend	agricultural
linear	former field boundary?
linear	former field boundary
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?

0 50m
1:2,500 @ A3

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ILLUS 181 Interpretation of magnetometer data; PAGSA 146-148

norfolk vanguard red line boundary
access route

nT
-1.0 2.0

0 50m
1:2,500 @ A3

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ILLUS 182 Processed greyscale magnetometer data; PAGSA 148-151 & 156-158

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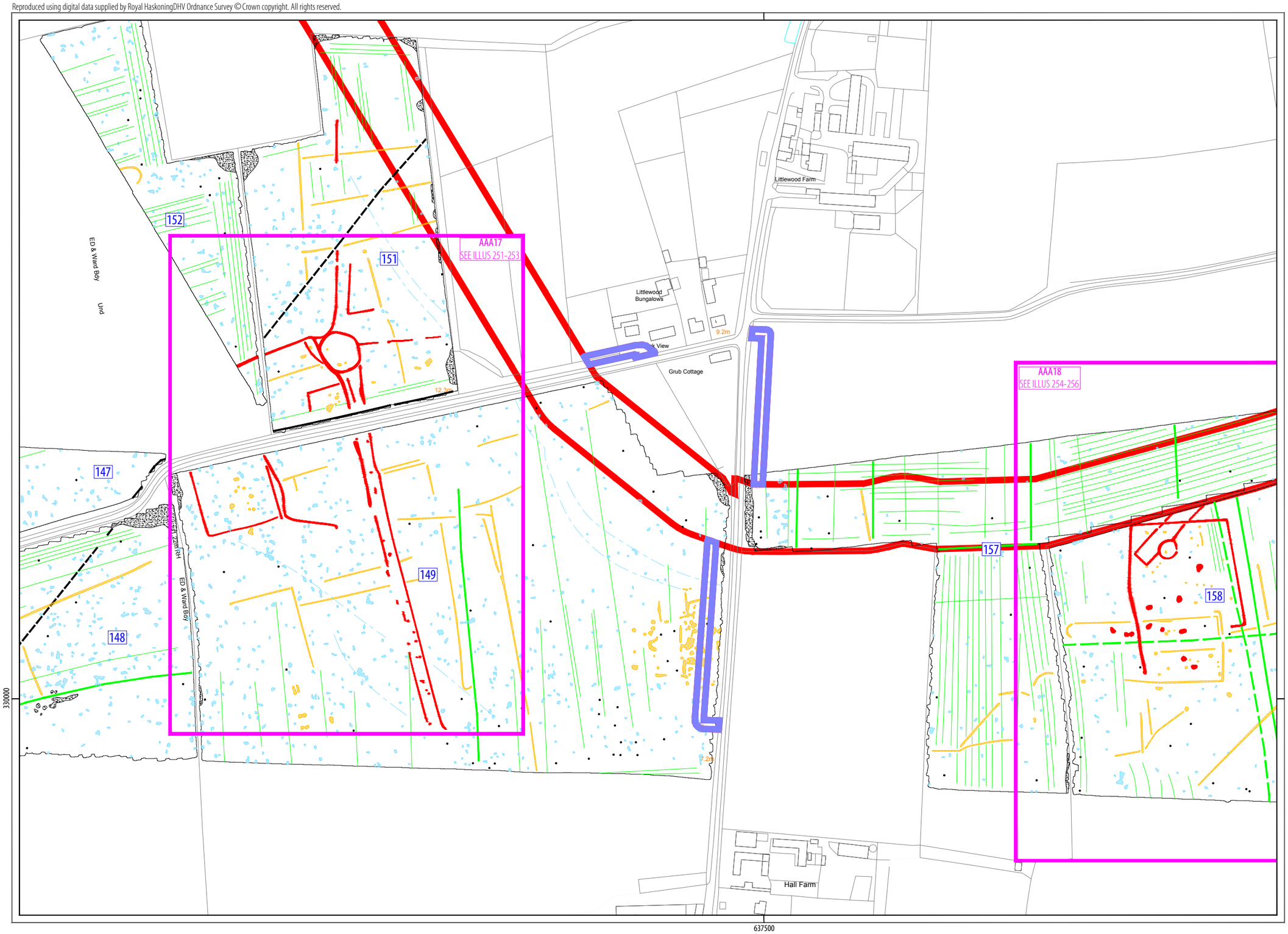
ILLUS 183 XY trace plot of minimally processed of magnetometer data; PAGSA 148-151 & 156-158



- norfolk vanguard red line boundary
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	service pipe
linear trend	agricultural
linear	former field boundary?
linear	former field boundary
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 50m
1:2,500 @ A3

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ILLUS 184 Interpretation of magnetometer data; PAGSA 148-151 & 156-158

norfolk vanguard red line boundary

nT
-1.0 2.0

0 50m
1:2,500 @ A3

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ILLUS 185 Processed greyscale magnetometer data; PAGSA 153-155

norfolk vanguard red line boundary

50.0nT/cm

0 50m

1:2,500 @ A3

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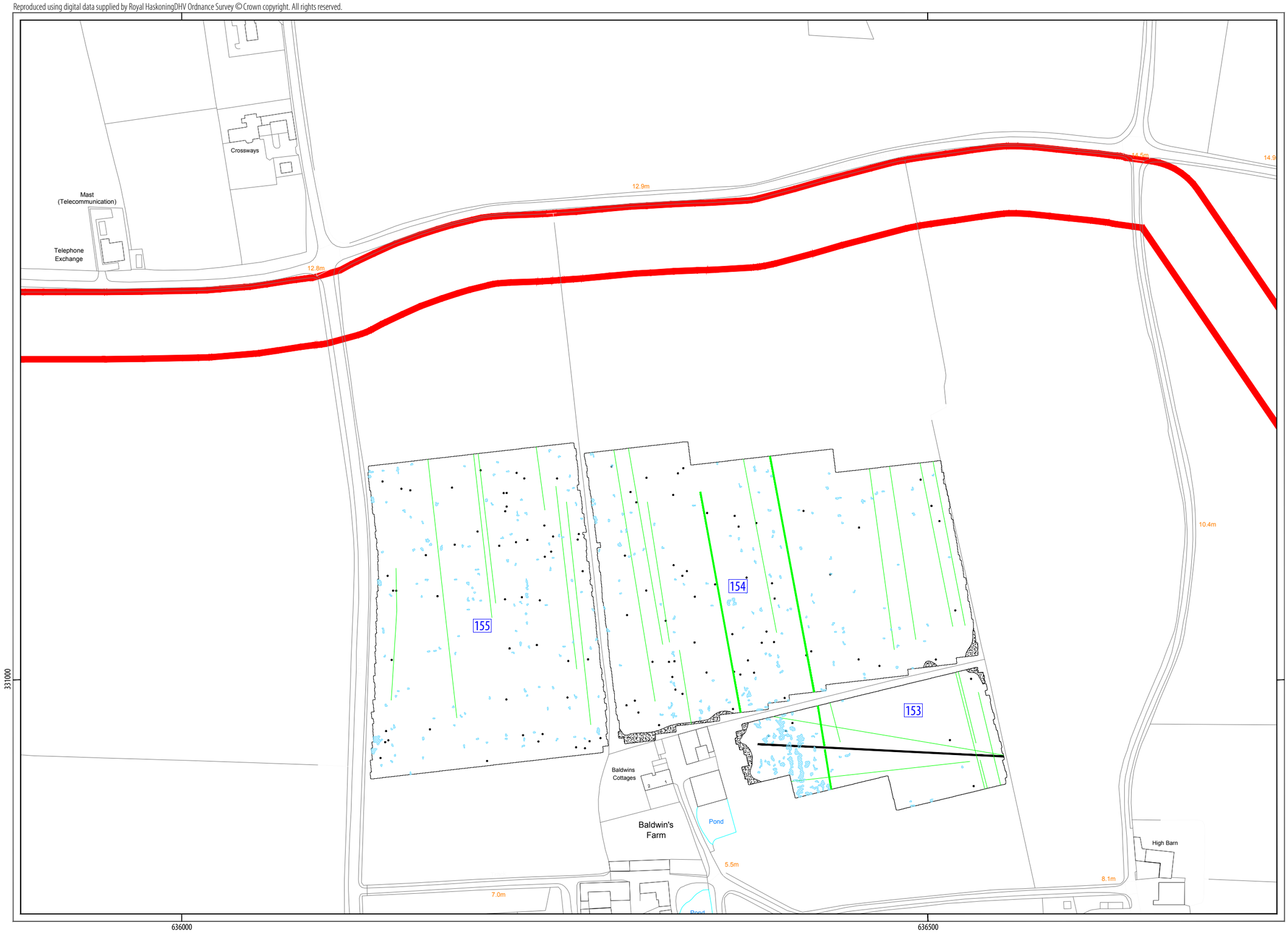
ILLUS 186 XY trace plot of minimally processed of magnetometer data; PAGSA 153-155



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	agricultural
linear	former field boundary
linear trend	geology
magnetic enhancement	geology

0 50m
1:2,500 @ A3

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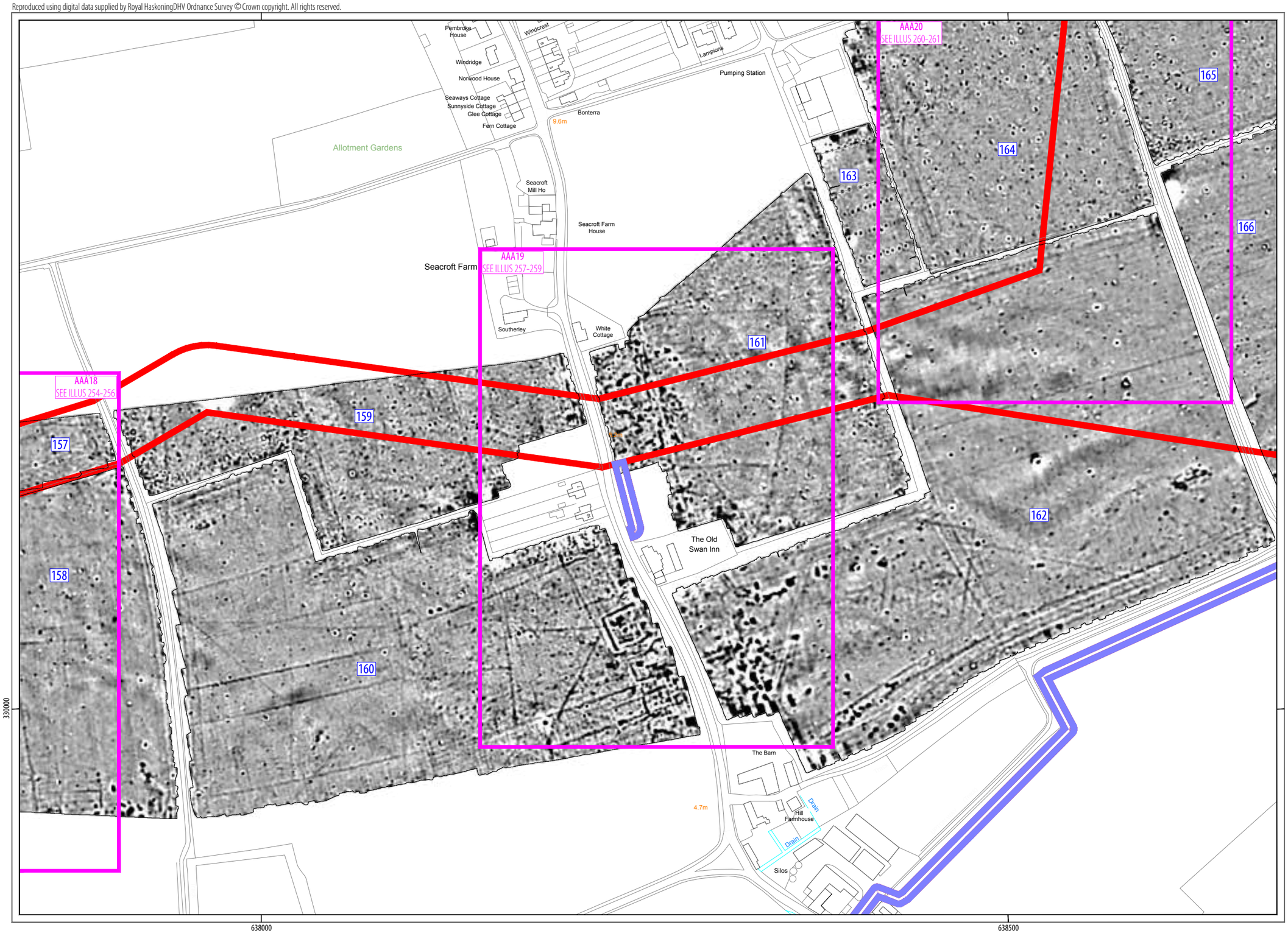
ILLUS 187 Interpretation of magnetometer data; PAGSA 153-155



norfolk vanguard red line boundary
access route

nT
-1.0 2.0

0 50m
1:2,500 @ A3

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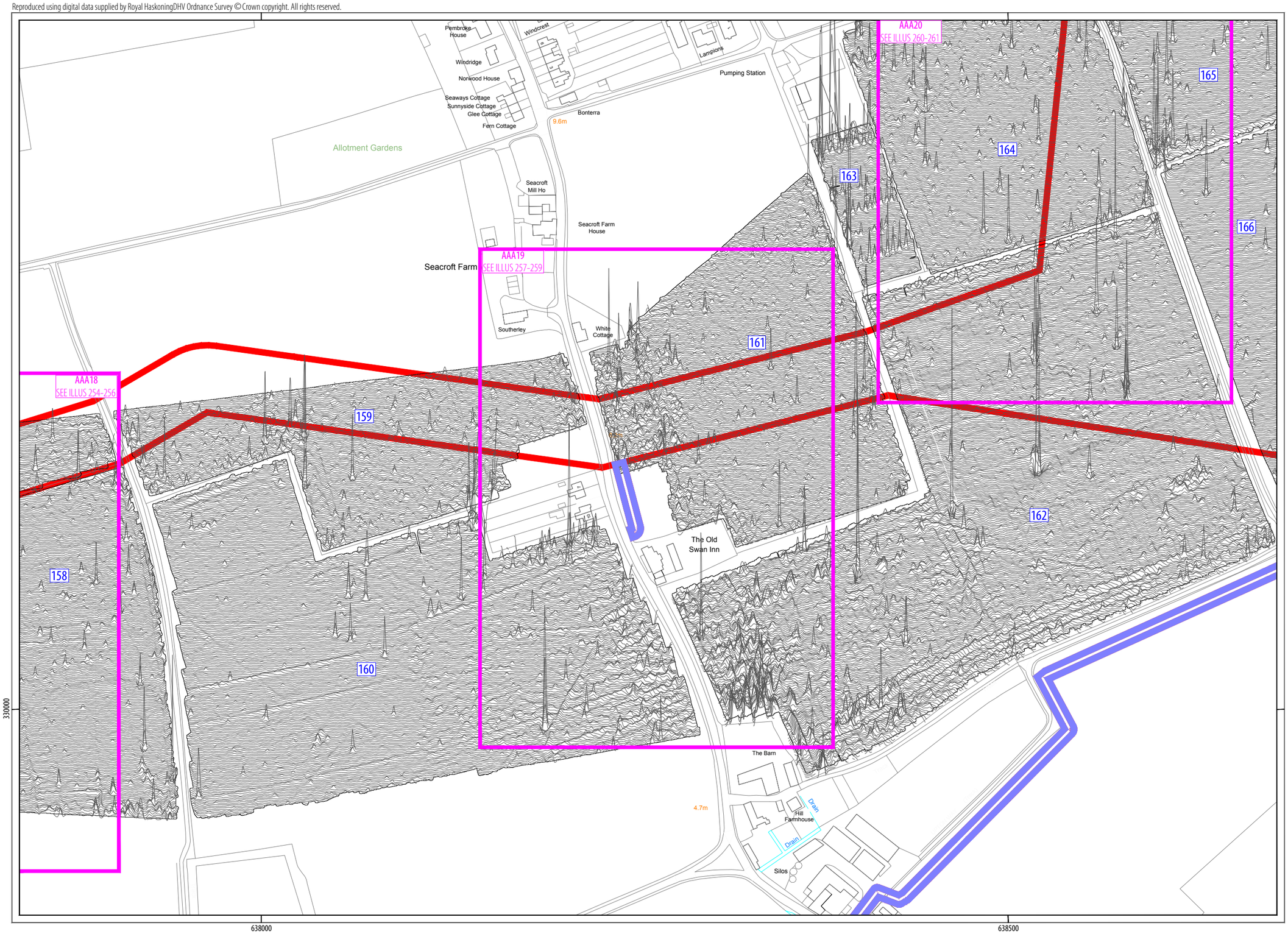
ILLUS 188 Processed greyscale magnetometer data; PAGSA 158-166



norfolk vanguard red line boundary

access route

50.0nT/cm

0 50m

1:2,500 @ A3

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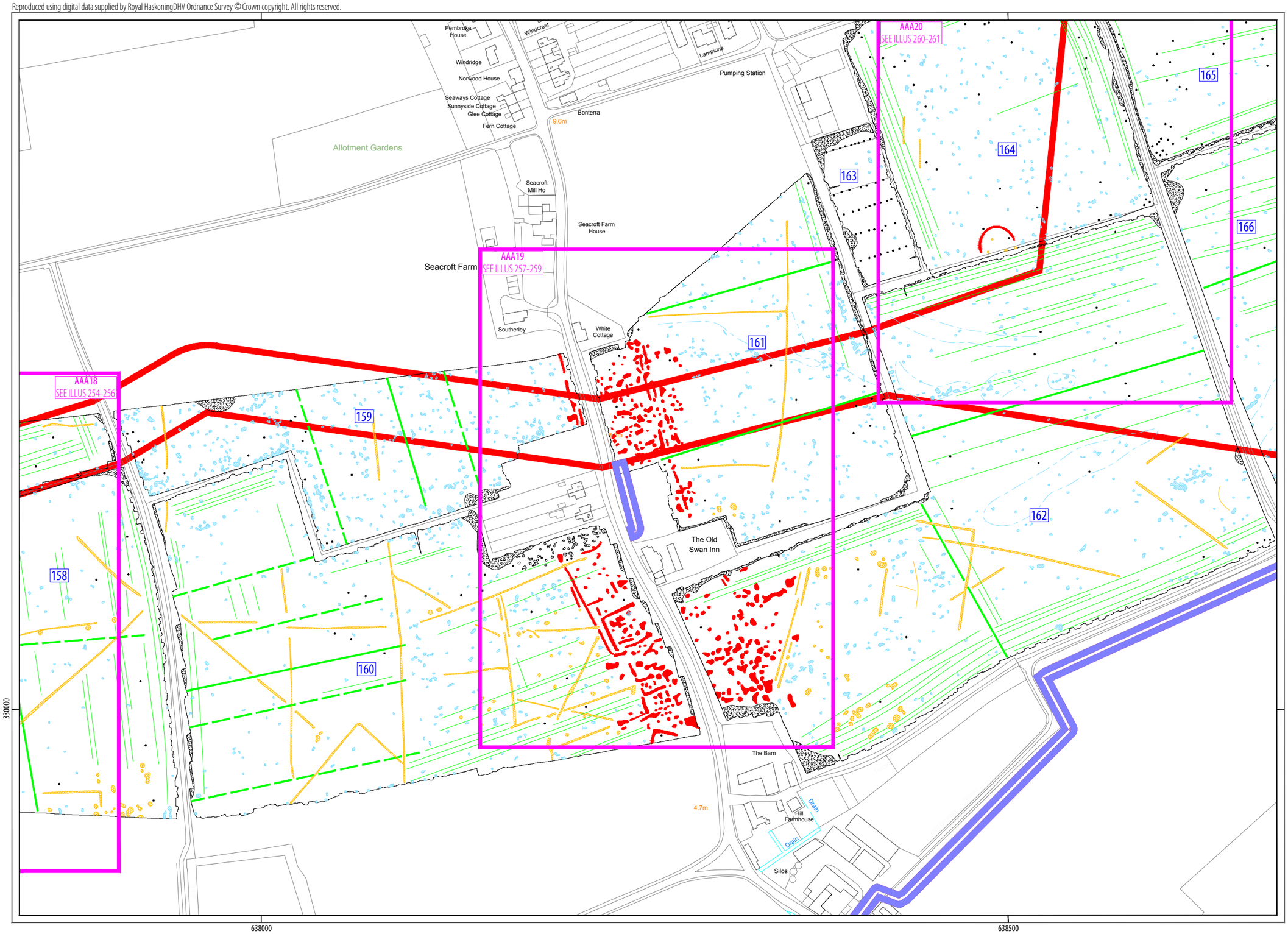
ILLUS 189 XY trace plot of minimally processed of magnetometer data; PAGSA 158-166



norfolk vanguard red line boundary
access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary?
linear	former field boundary
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 50m
1:2,500 @ A3

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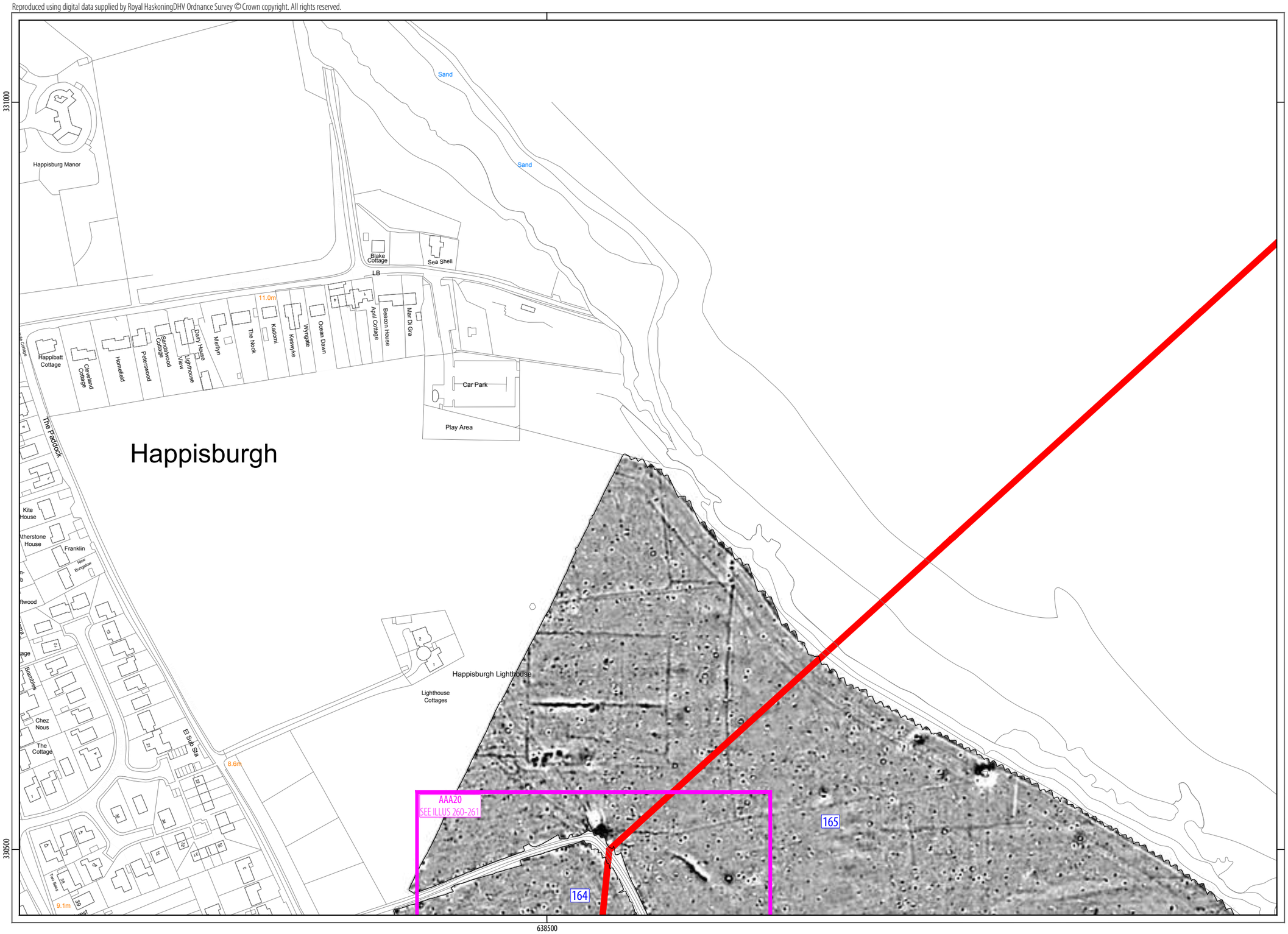
ILLUS 190 Interpretation of magnetometer data; PAGSA 158-166



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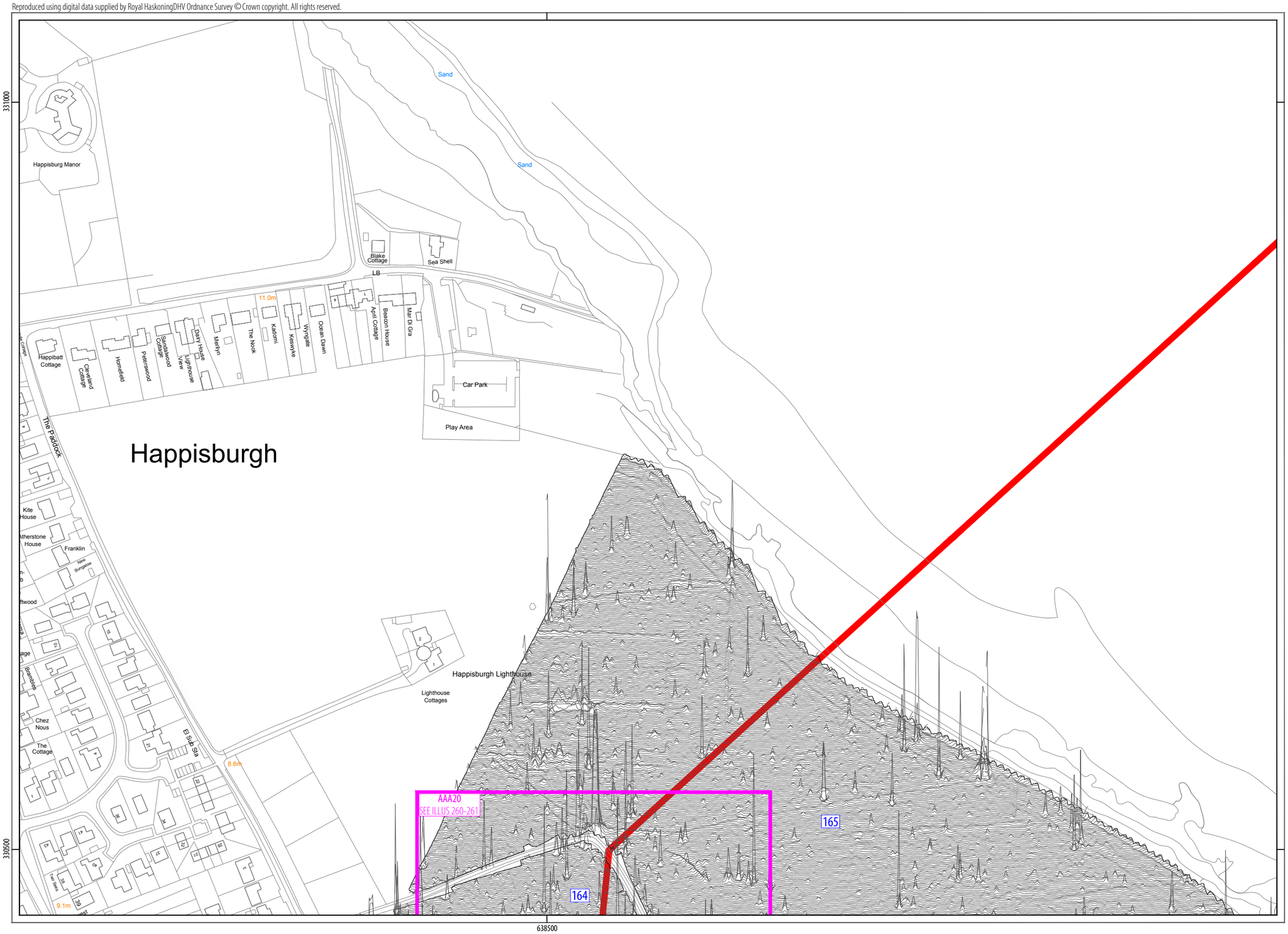
ILLUS 191 Processed greyscale magnetometer data; PAGSA 164-165



norfolk vanguard red line boundary

50.0nT/cm

0 50m

1:2,500 @ A3

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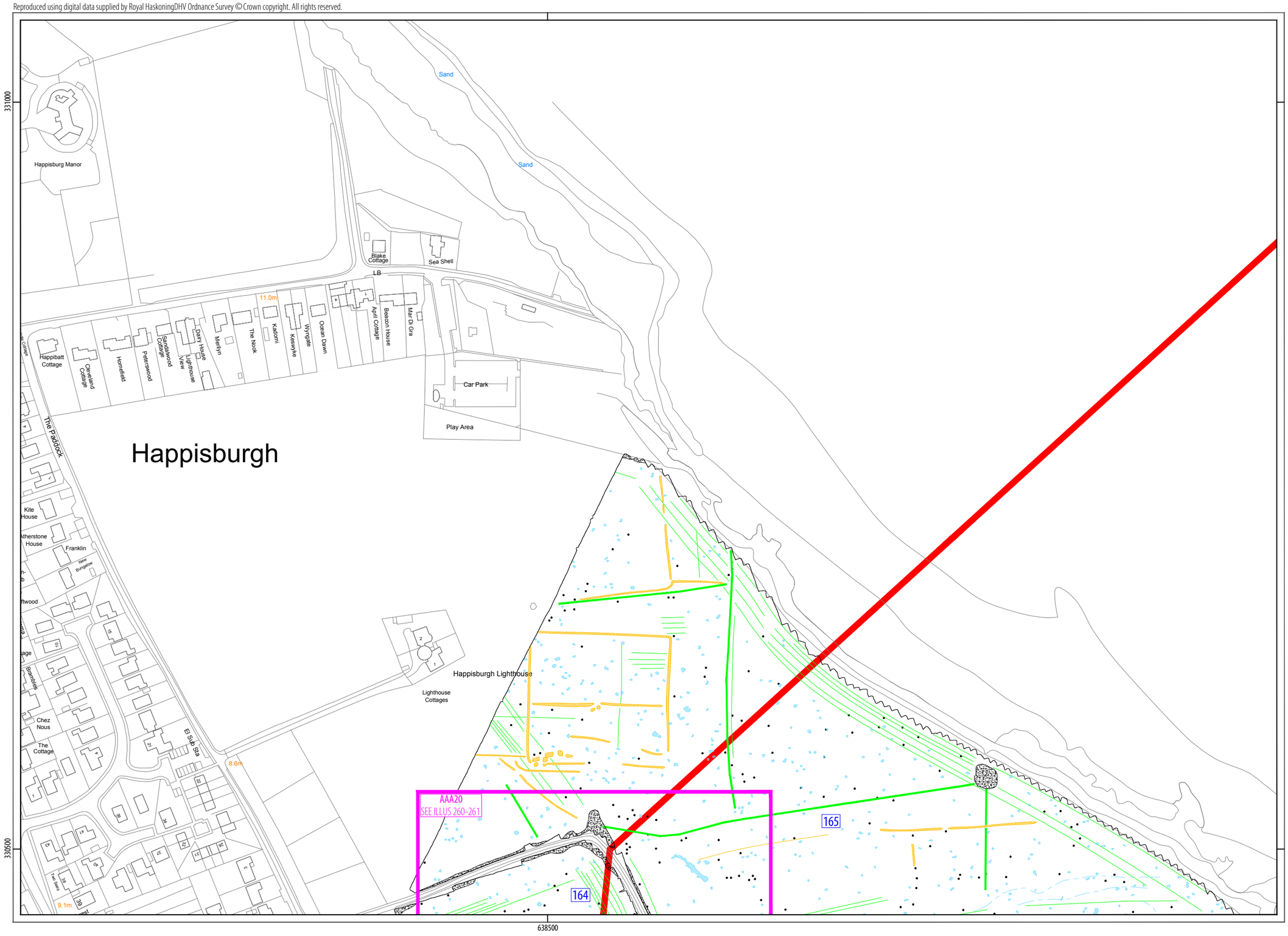
ILLUS 192 XY trace plot of minimally processed of magnetometer data; PAGSA 164-165



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?

0 50m
1:2,500 @ A3

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ILLUS 193 Interpretation of magnetometer data; PAGSA 164-165

norfolk vanguard red line boundary

access route

nT

-1.0 2.0

0 50m

1:2,500 @ A3

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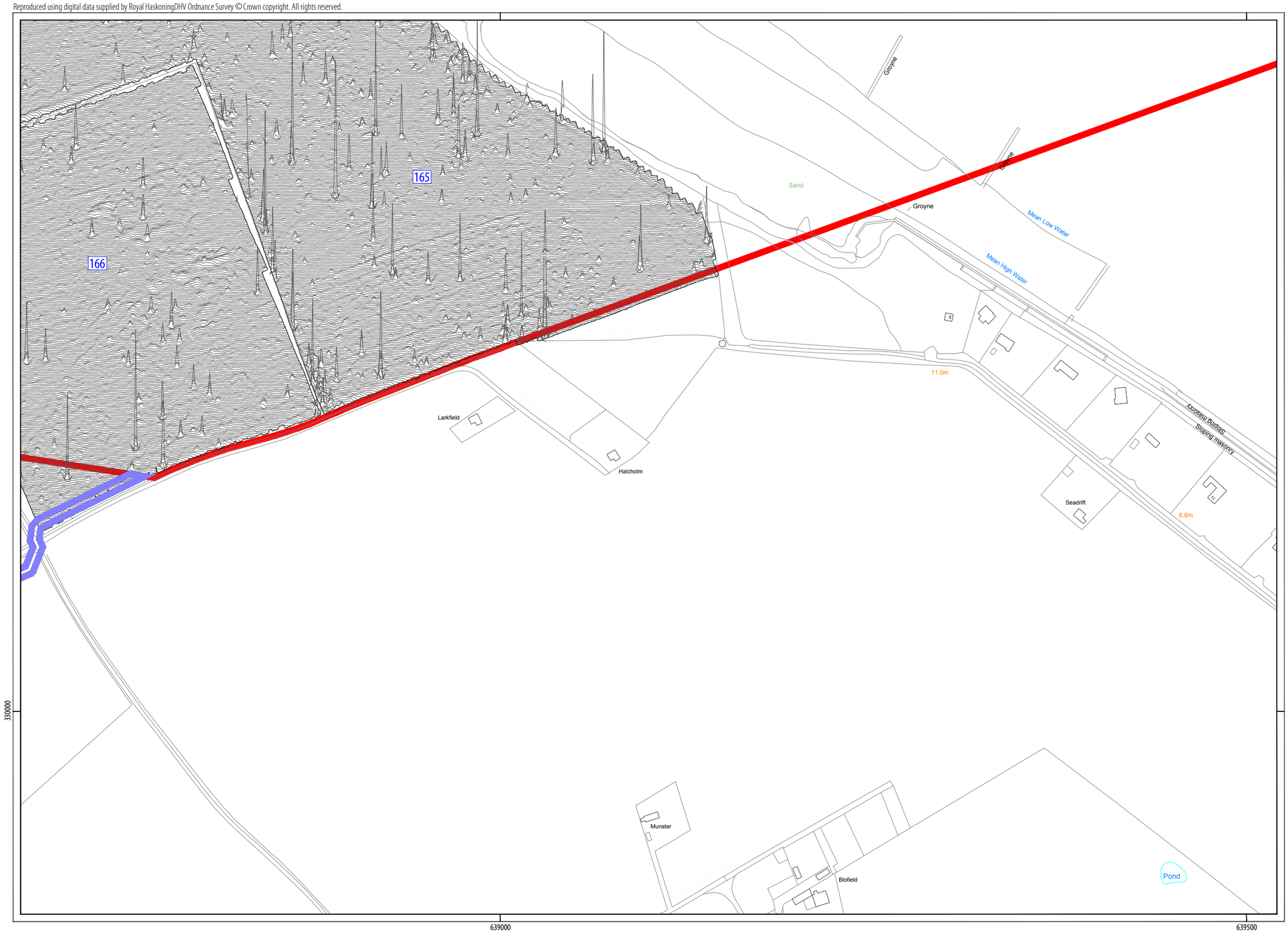
ILLUS 194 Processed greyscale magnetometer data; PAGSA 165-166



norfolk vanguard red line boundary

access route

50.0nT/cm

0 50m

1:2,500 @ A3

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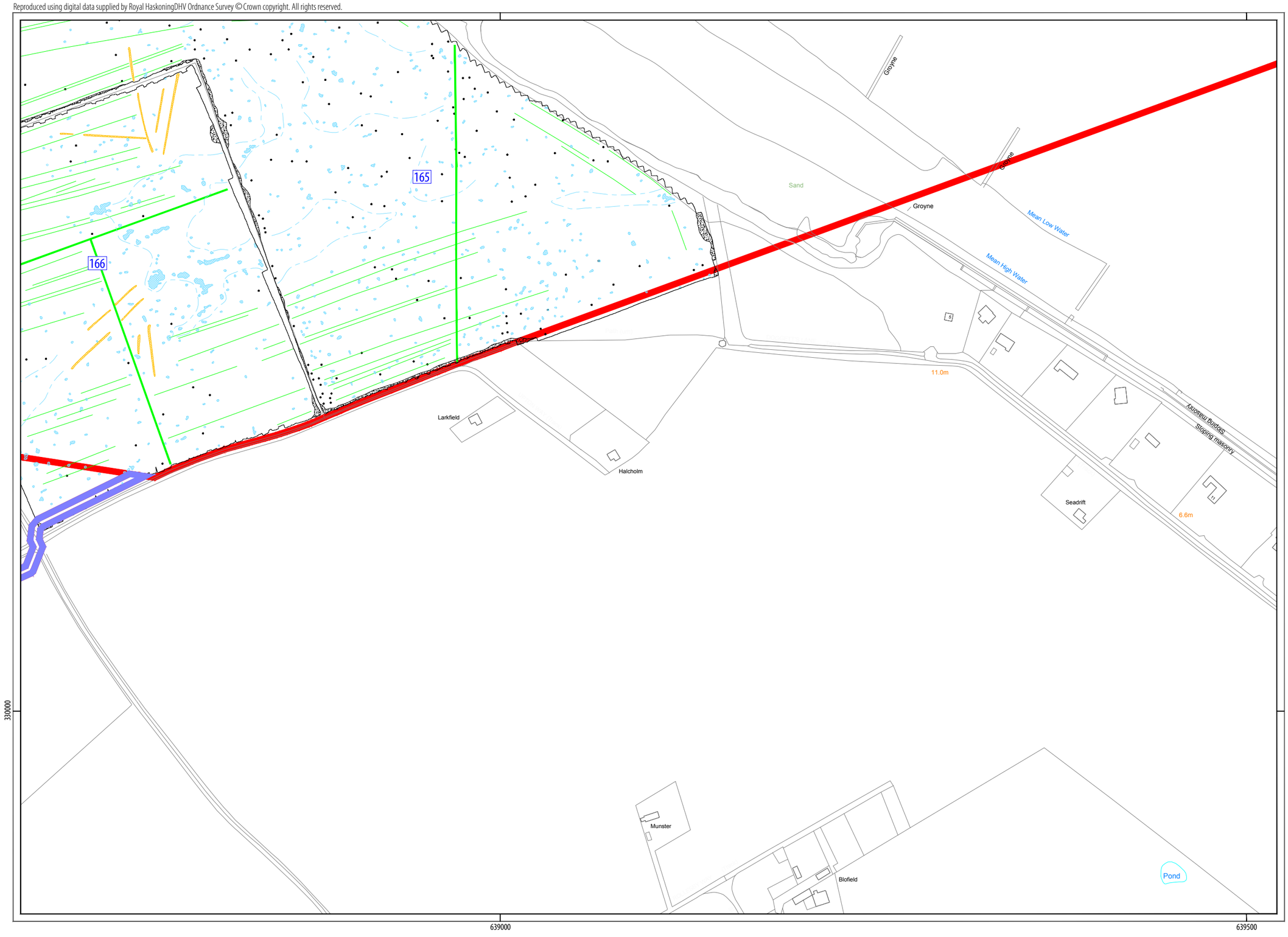
ILLUS 195 XY trace plot of minimally processed of magnetometer data; PAGSA 165-166



- norfolk vanguard red line boundary
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?

0 50m
1:2,500 @ A3

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ILLUS 196 Interpretation of magnetometer data; PAGSA 165-166

318800
318700
318600
605100
605200
605300
39a
Pond

-1.0 nT 2.0

0 25m
1:1,000 @ A3

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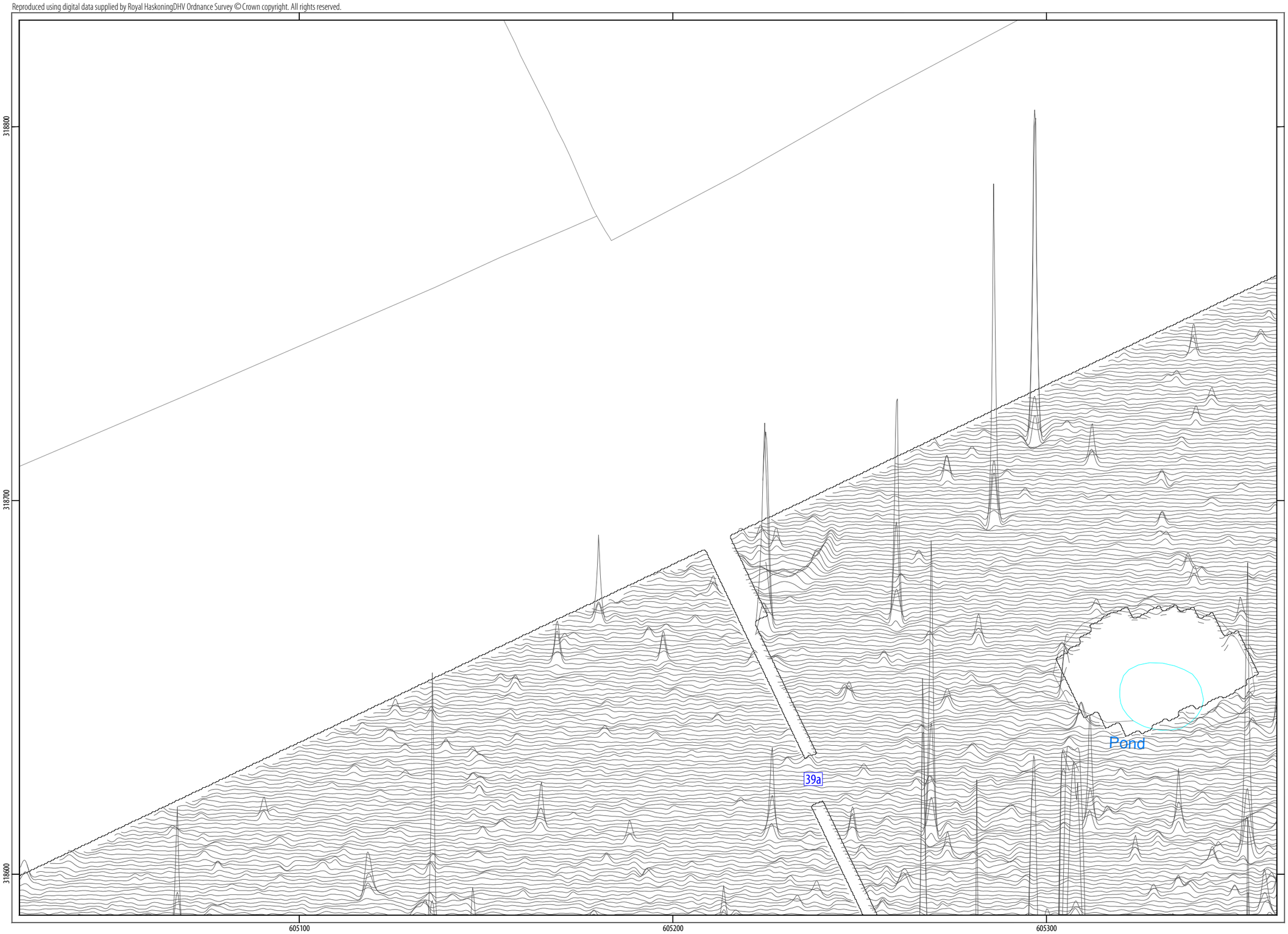
ILLUS 197 Processed greyscale magnetometer data; AAA1



20.0nT/cm

0 25m

1:1,000 @ A3

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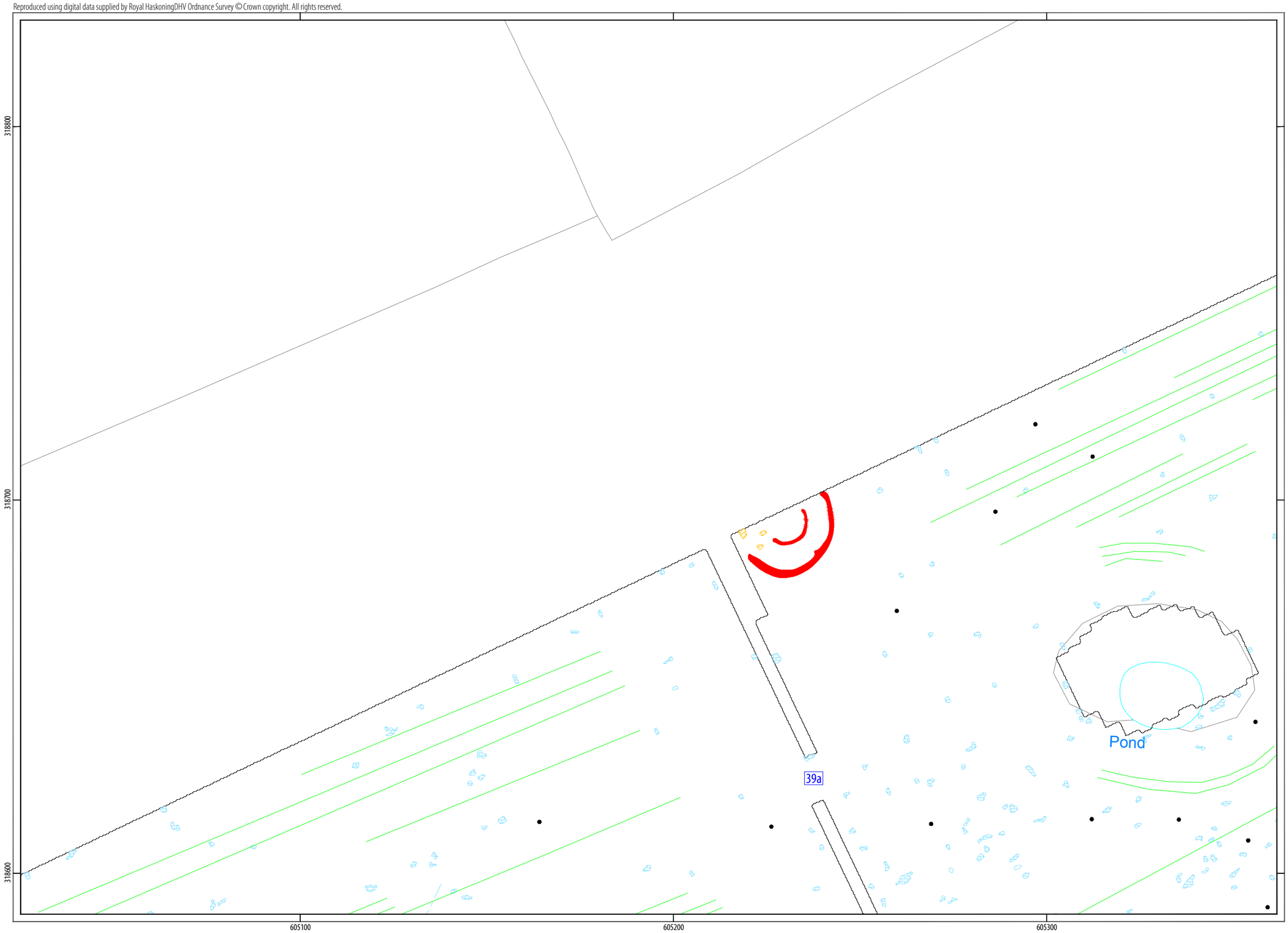
ILLUS 198 XY trace plot of minimally processed magnetometer data; AAA1



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
linear trend	agricultural
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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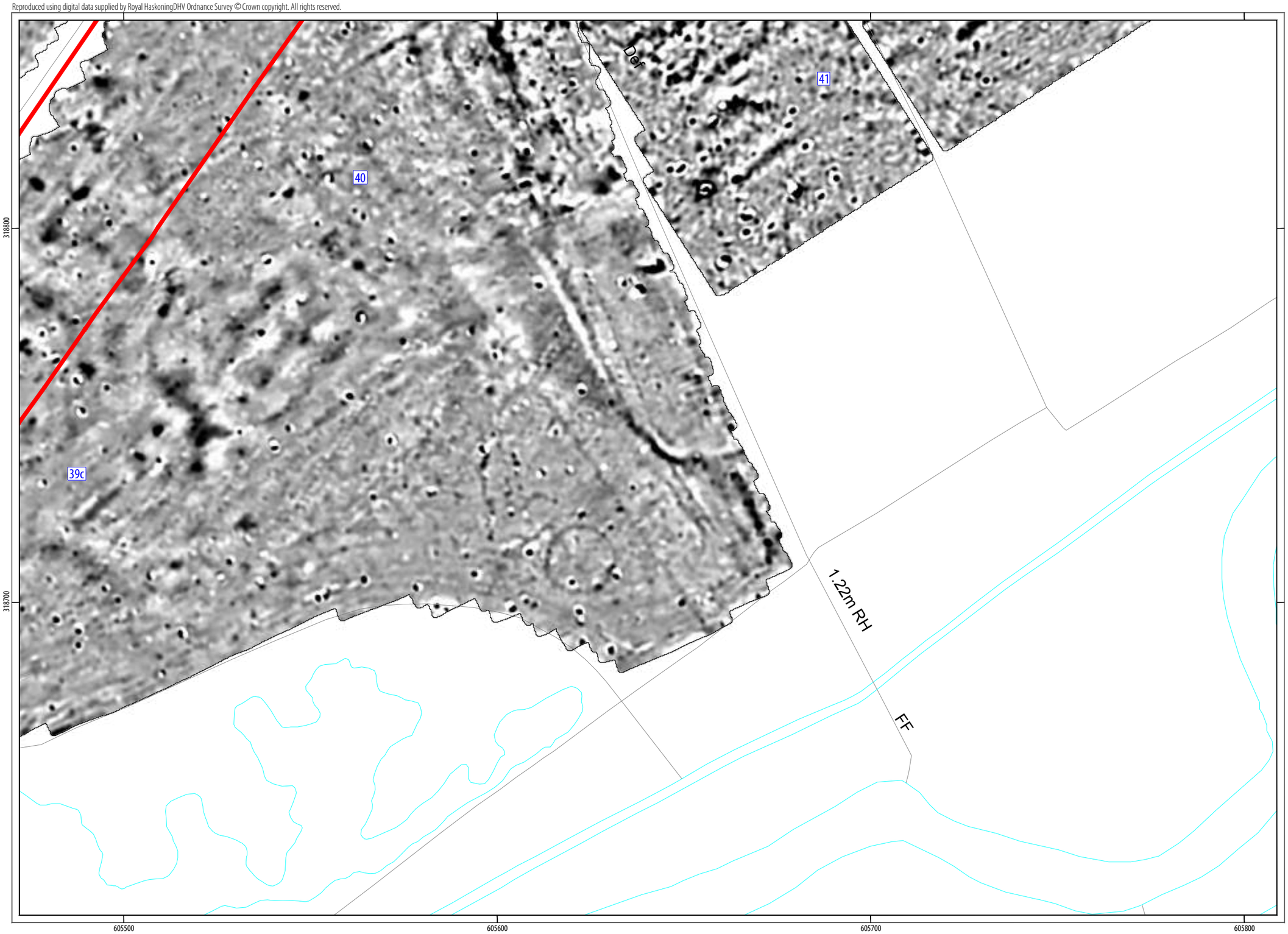
ILLUS 199 Interpretation of magnetometer data; AAA1



norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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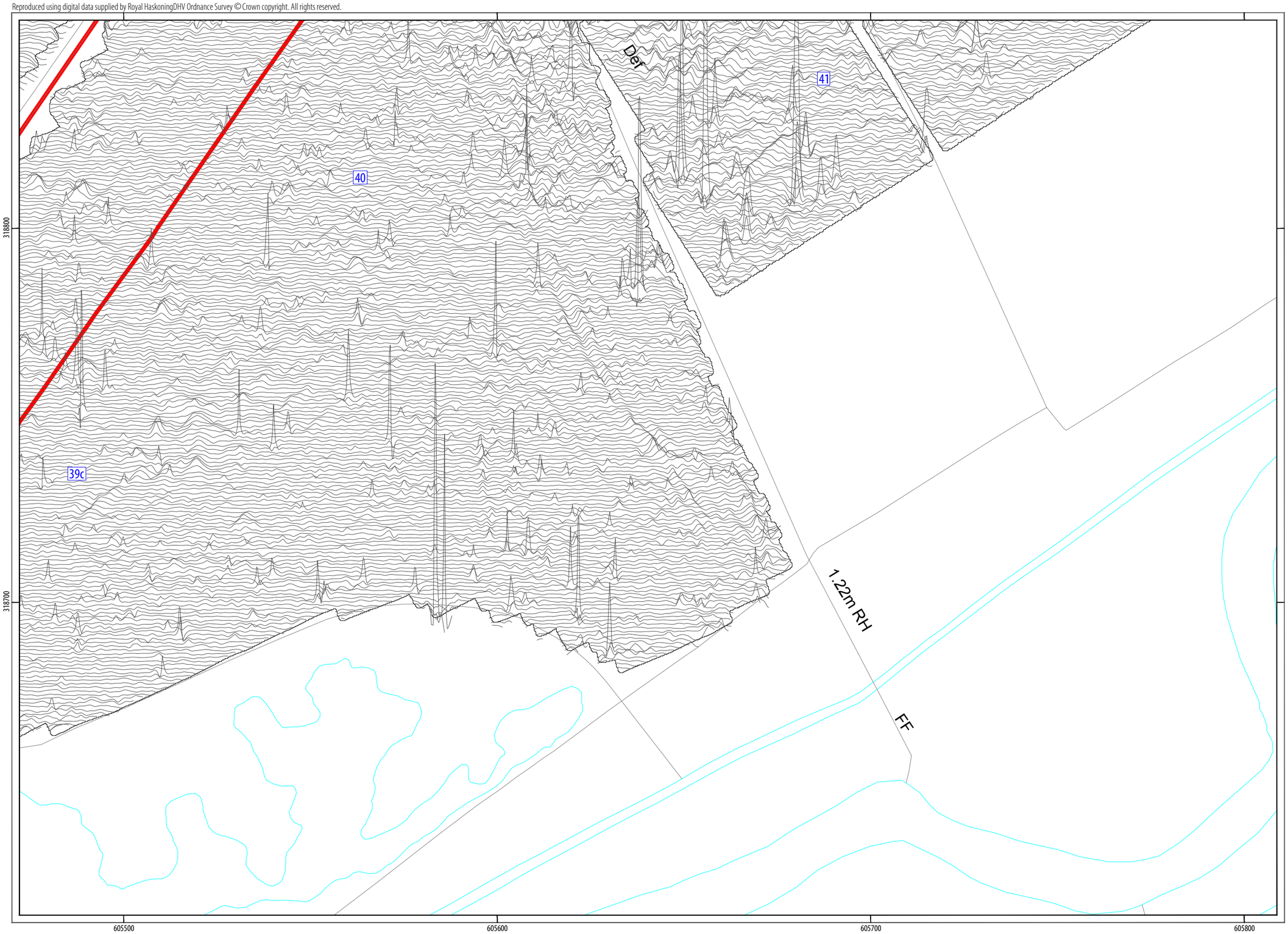
ILLUS 200 Processed greyscale magnetometer data; AAA2



norfolk vanguard red line boundary

20.0nT/cm

0 25m

1:1,000 @ A3

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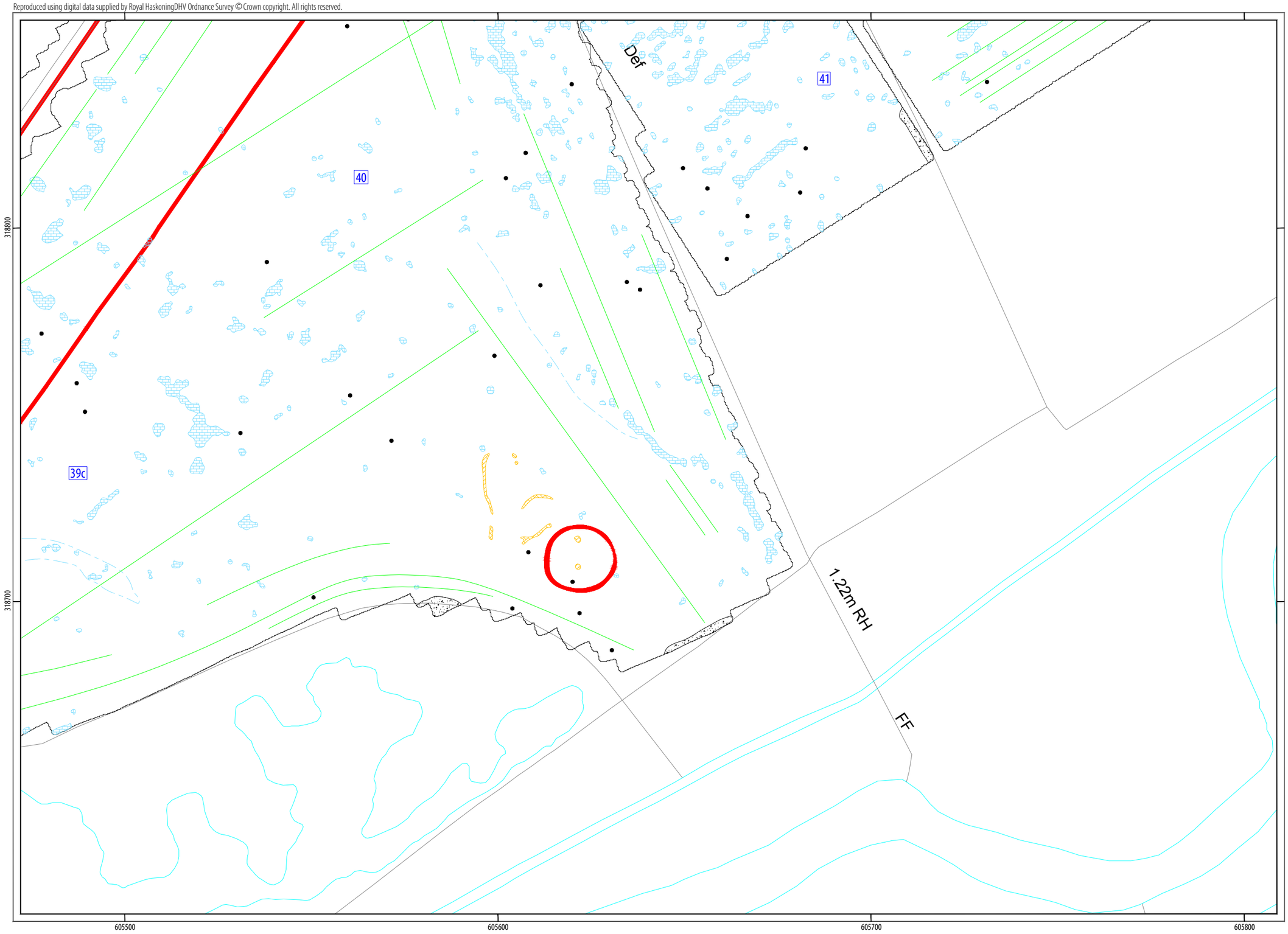
ILLUS 201 XY trace plot of minimally processed magnetometer data; AAA2



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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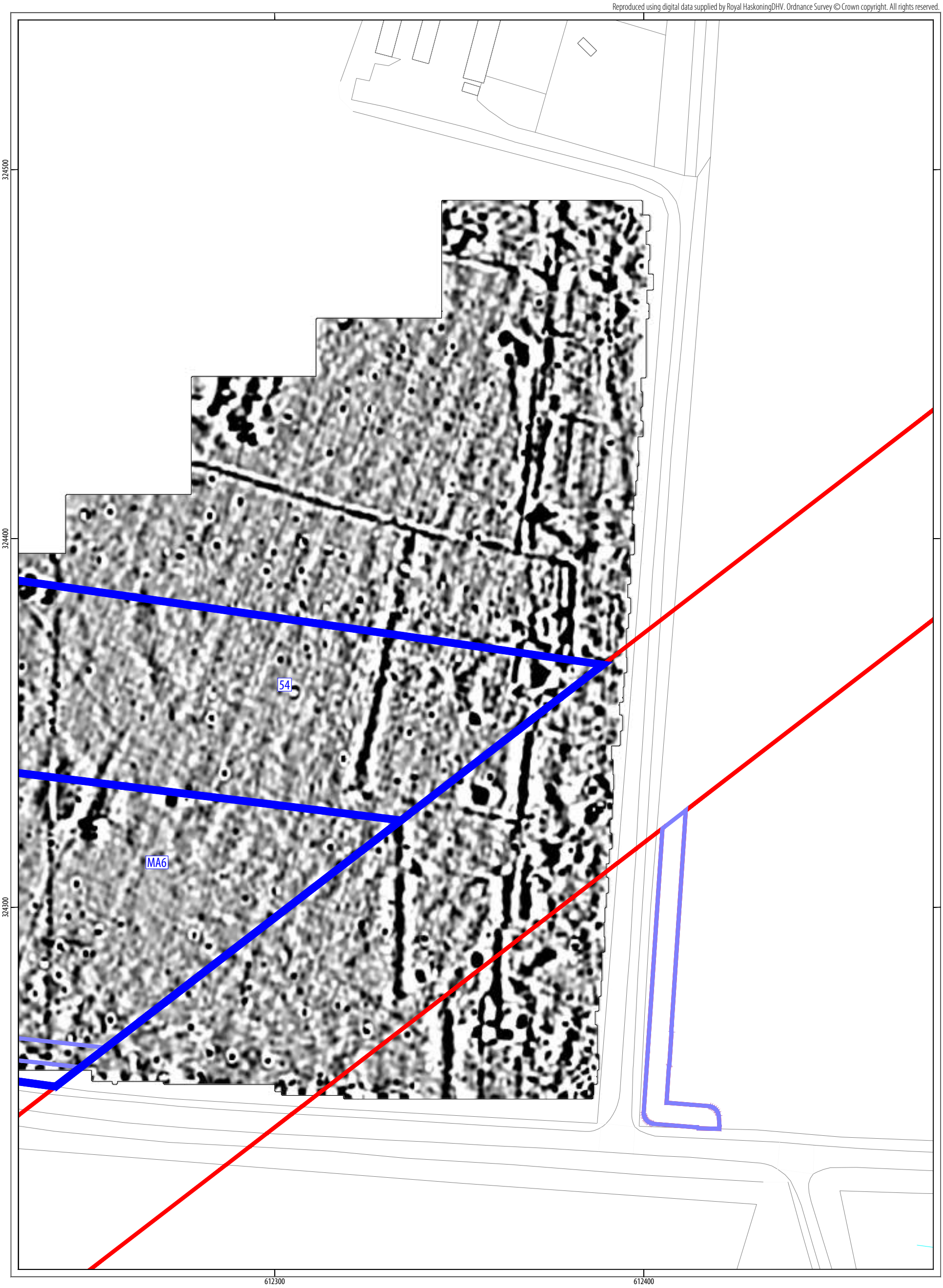
ILLUS 202 Interpretation of magnetometer data; AAA2



norfolk vanguard red line boundary
mobilisation area
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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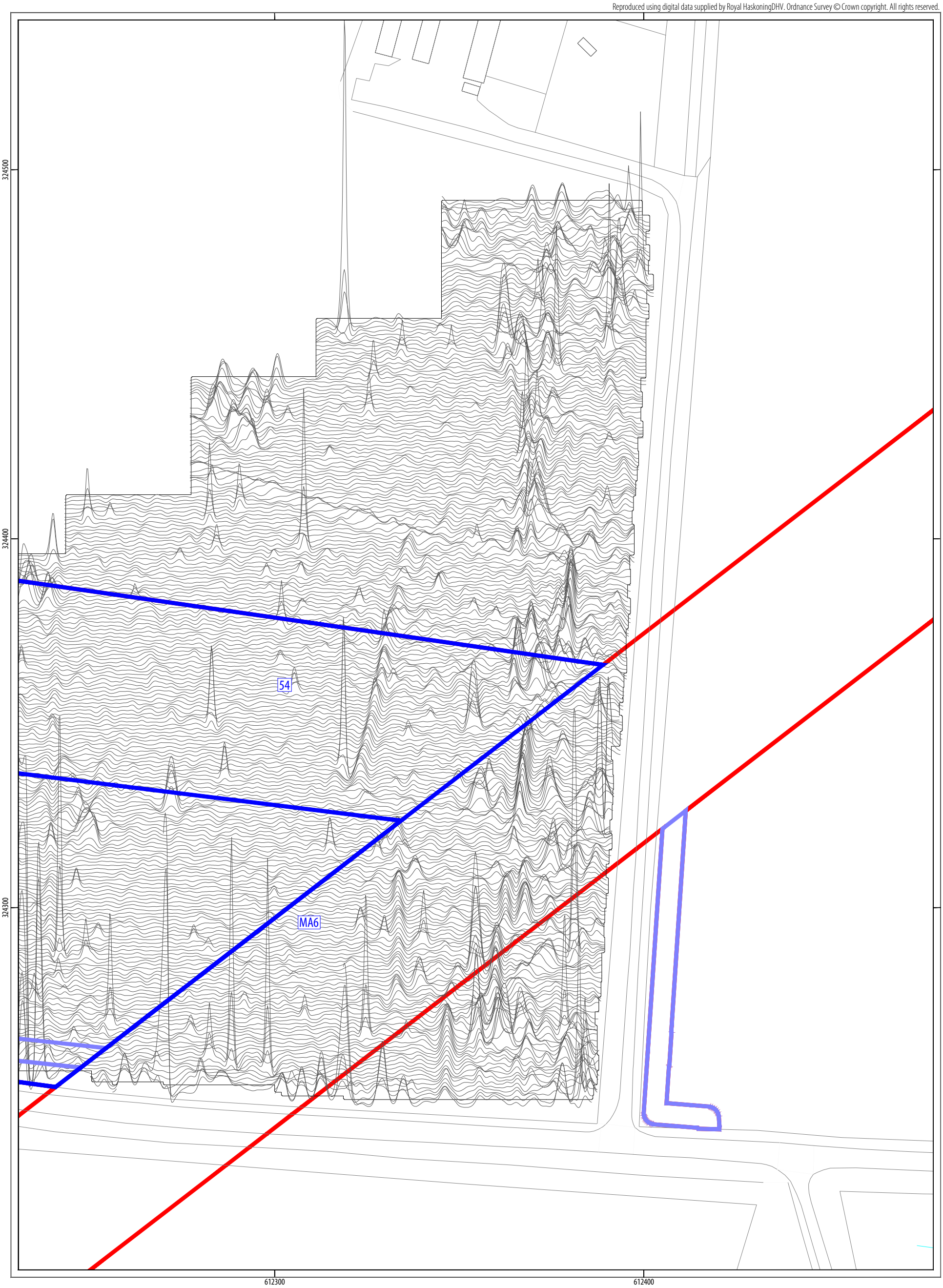
ILLUS 203 Processed greyscale magnetometer data; AAA3



norfolk vanguard red line boundary
mobilisation area
access route

20.0nT/cm

0 25m

1:1,000 @ A3

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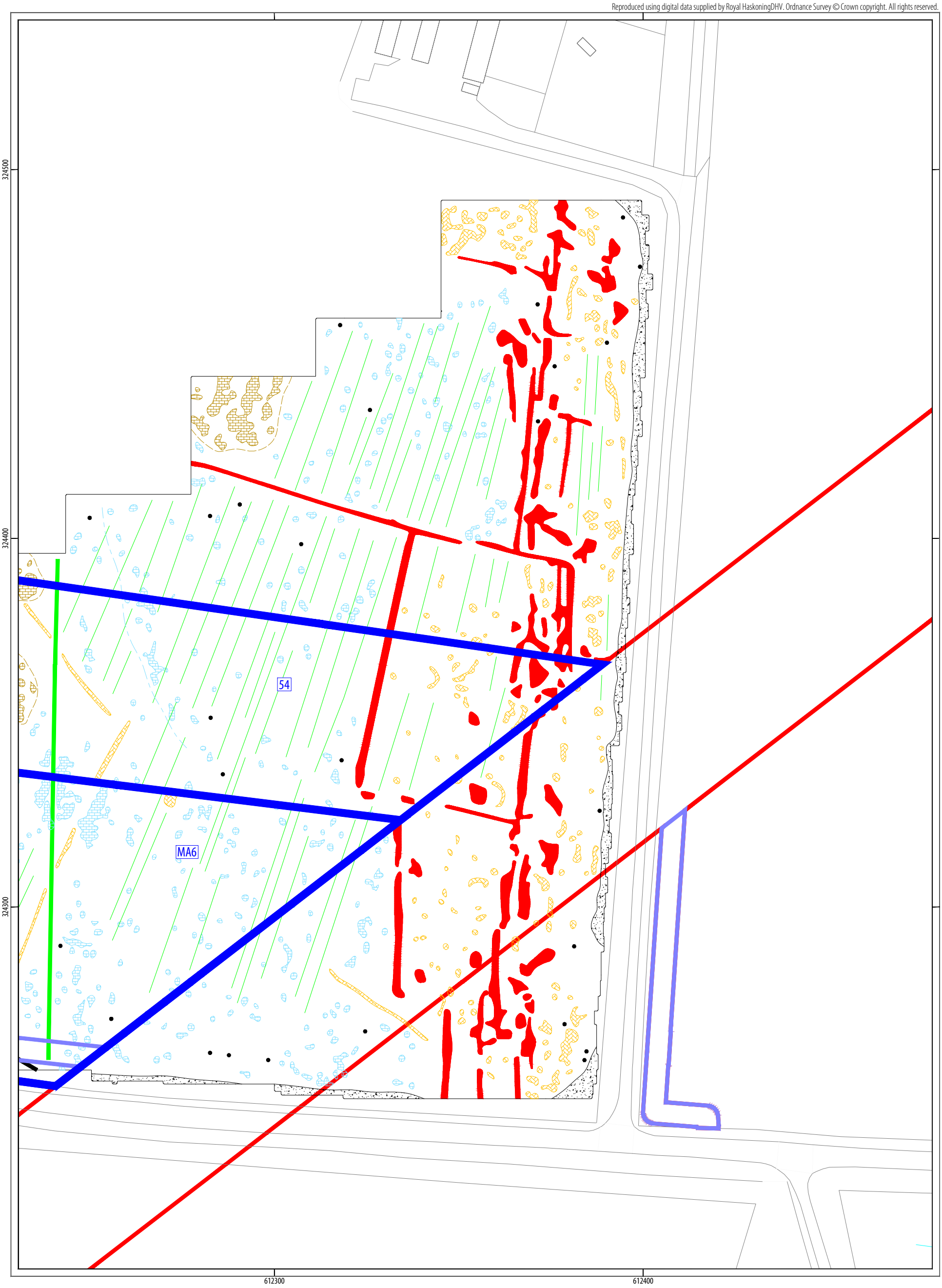
ILLUS 204 XY trace plot of minimally processed magnetometer data; AAA3



norfolk vanguard red line boundary
mobilisation area
access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
dipolar linear	service pipe
magnetic disturbance	ferrous material
linear trend	agricultural

TYPE OF ANOMALY	INTERPRETATION
linear	former field boundary
linear	geology
magnetic enhancement	geology
magnetic enhancement	quarrying
magnetic enhancement	archaeology?

0 25m
1:1,000 @ A3

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ILLUS 205 Interpretation of magnetometer data; AAA3

norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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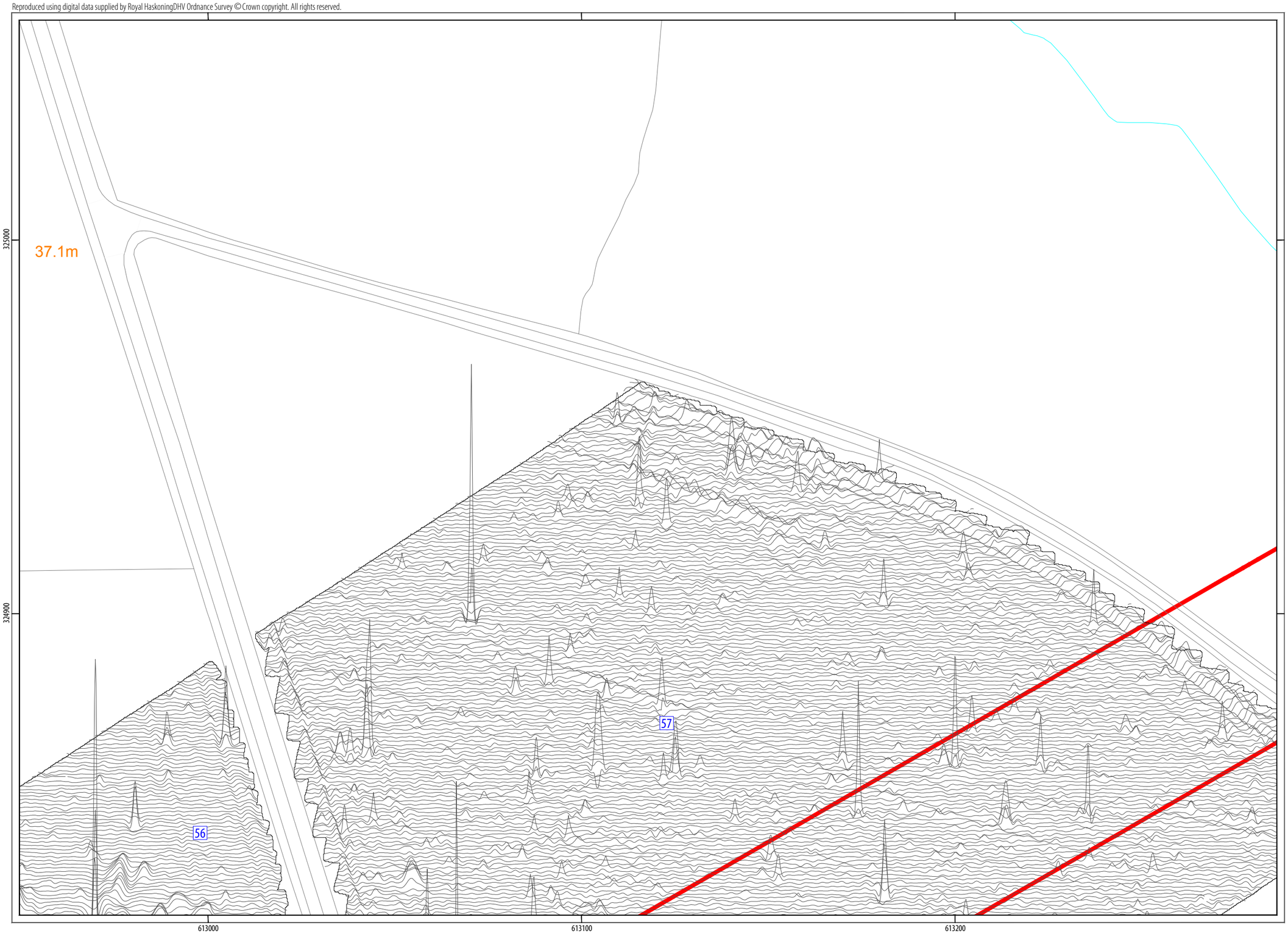
ILLUS 206 Processed greyscale magnetometer data; AAA4



norfolk vanguard red line boundary

20.0nT/cm

0 25m

1:1,000 @ A3

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Norfolk Vanguard Offshore Wind Farm

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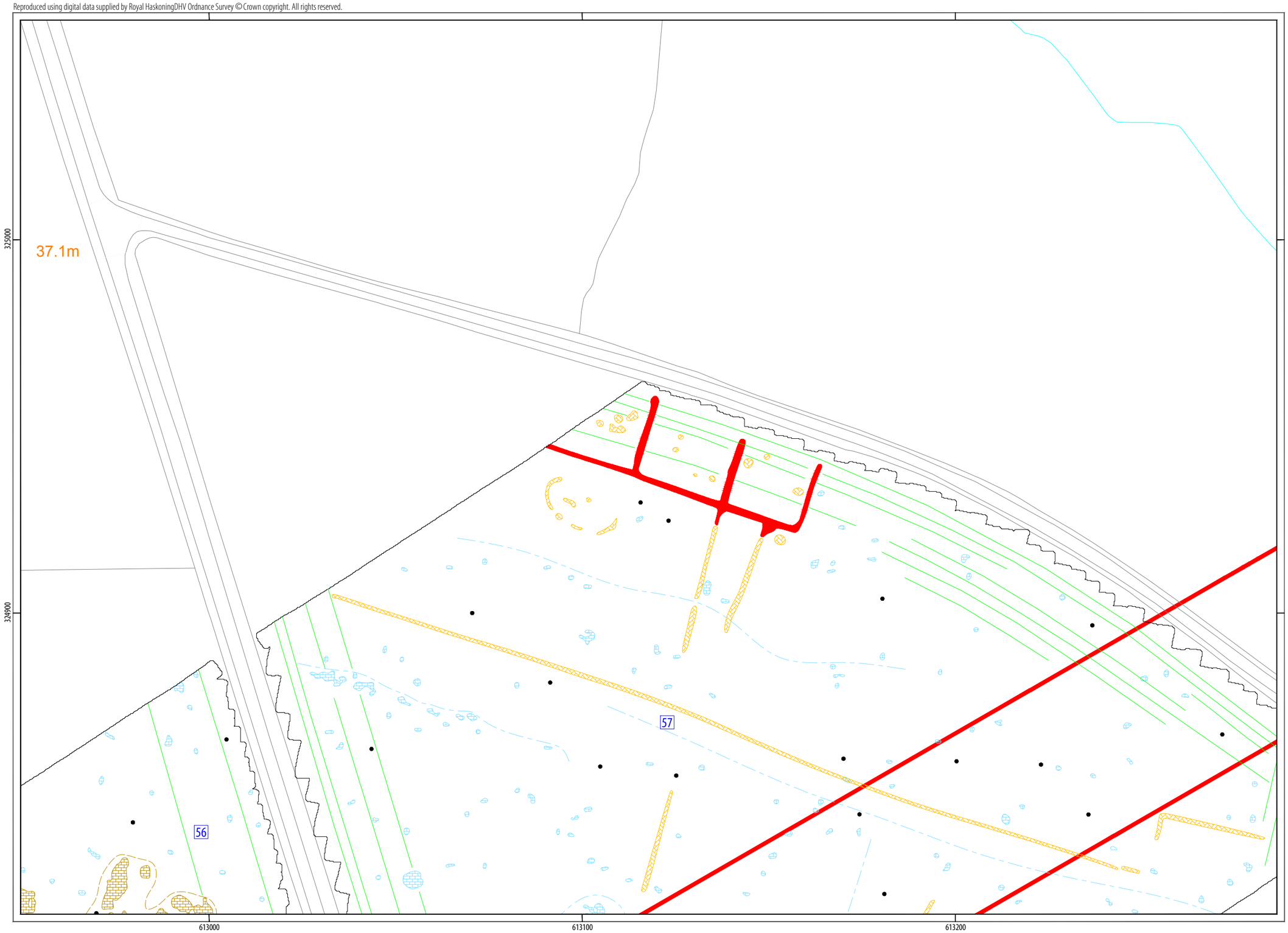
ILLUS 207 XY trace plot of minimally processed magnetometer data; AAA4



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
linear trend	agricultural
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	quarrying
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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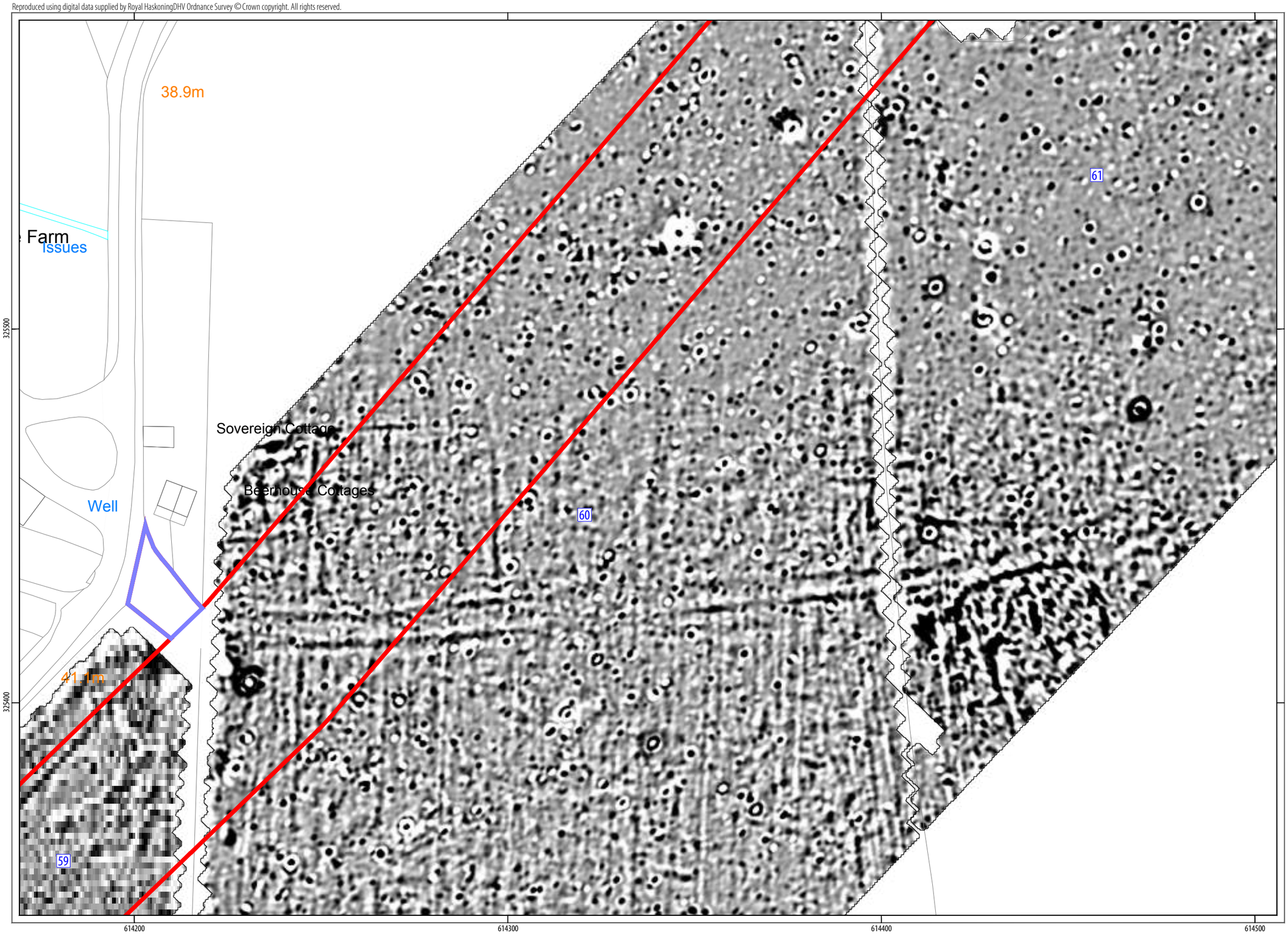
ILLUS 208 Interpretation of magnetometer data; AAA4



norfolk vanguard red line boundary
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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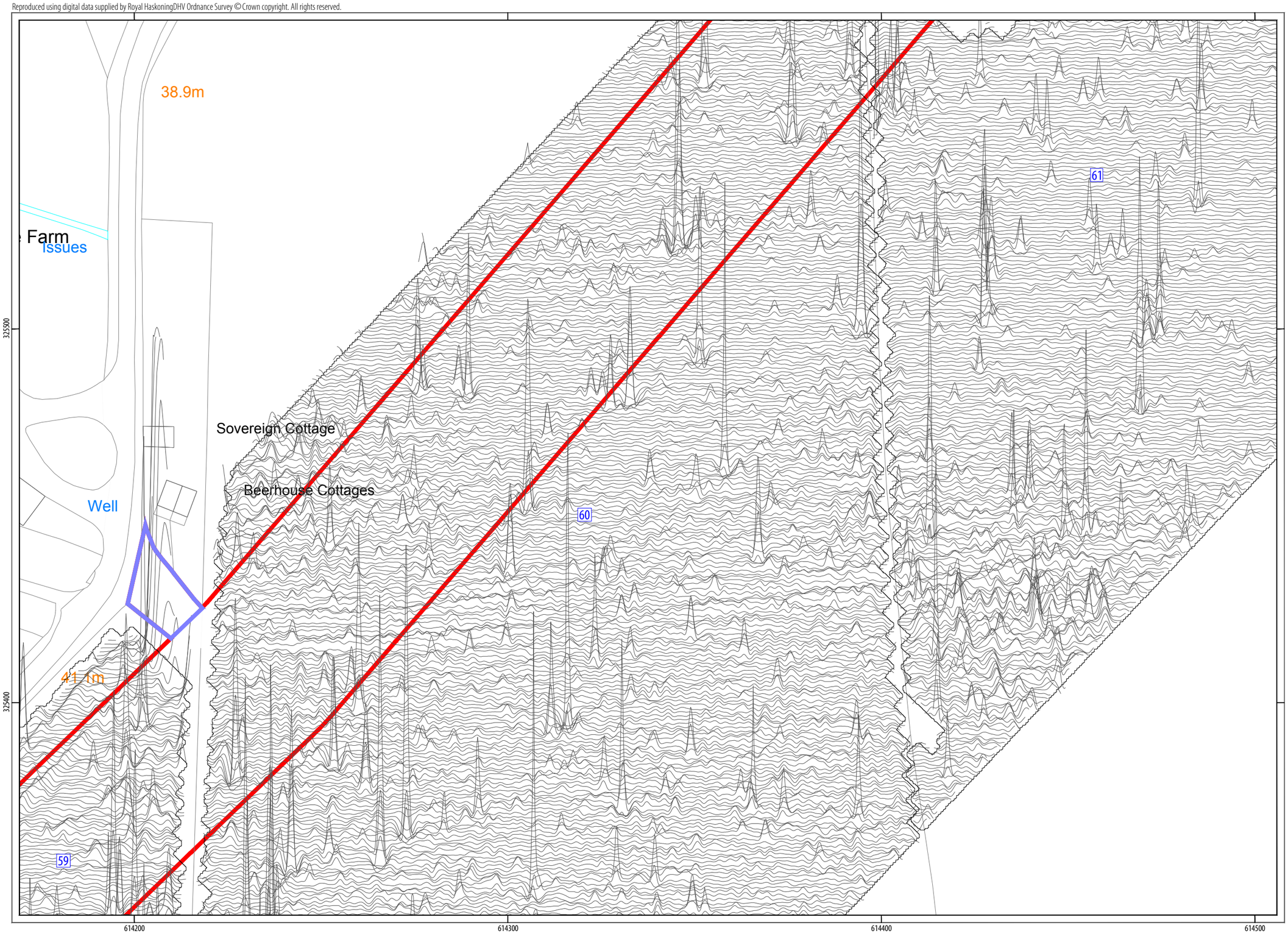
ILLUS 209 Processed greyscale magnetometer data; AAA5



norfolk vanguard red line boundary
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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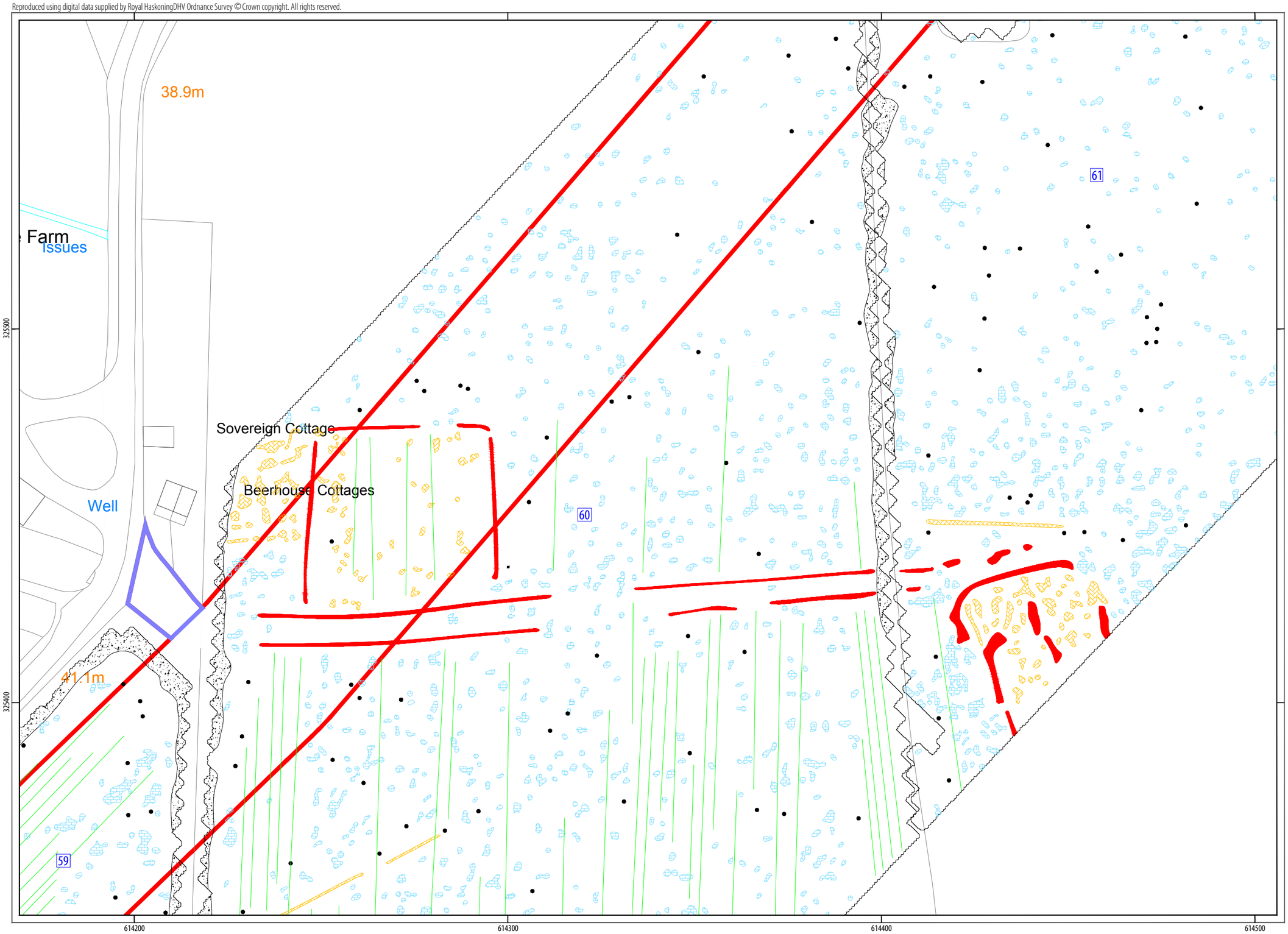
ILLUS 210 XY trace plot of minimally processed magnetometer data; AAA5



- norfolk vanguard red line boundary
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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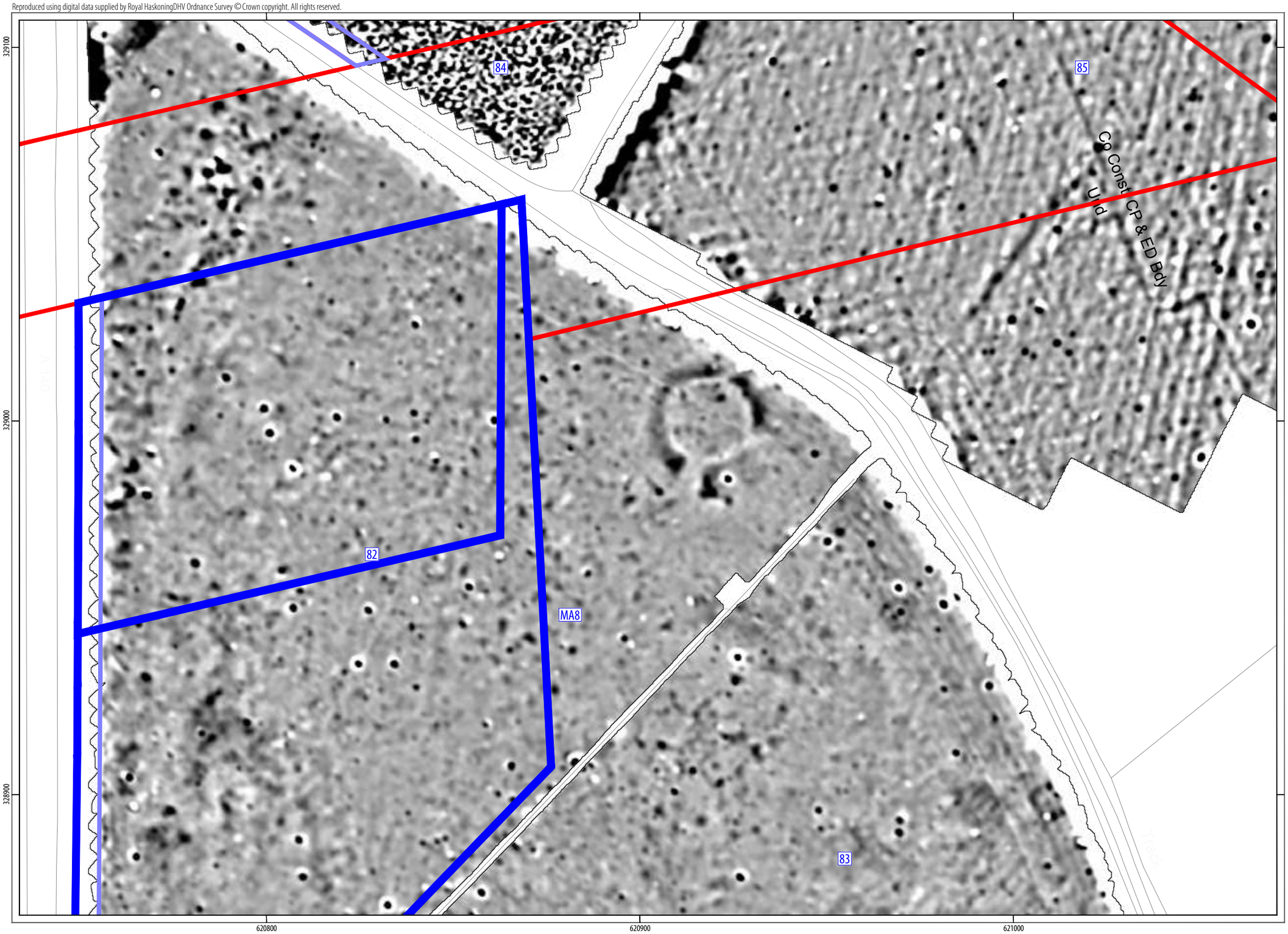
ILLUS 211 Interpretation of magnetometer data; AAA5



norfolk vanguard red line boundary
mobilisation area
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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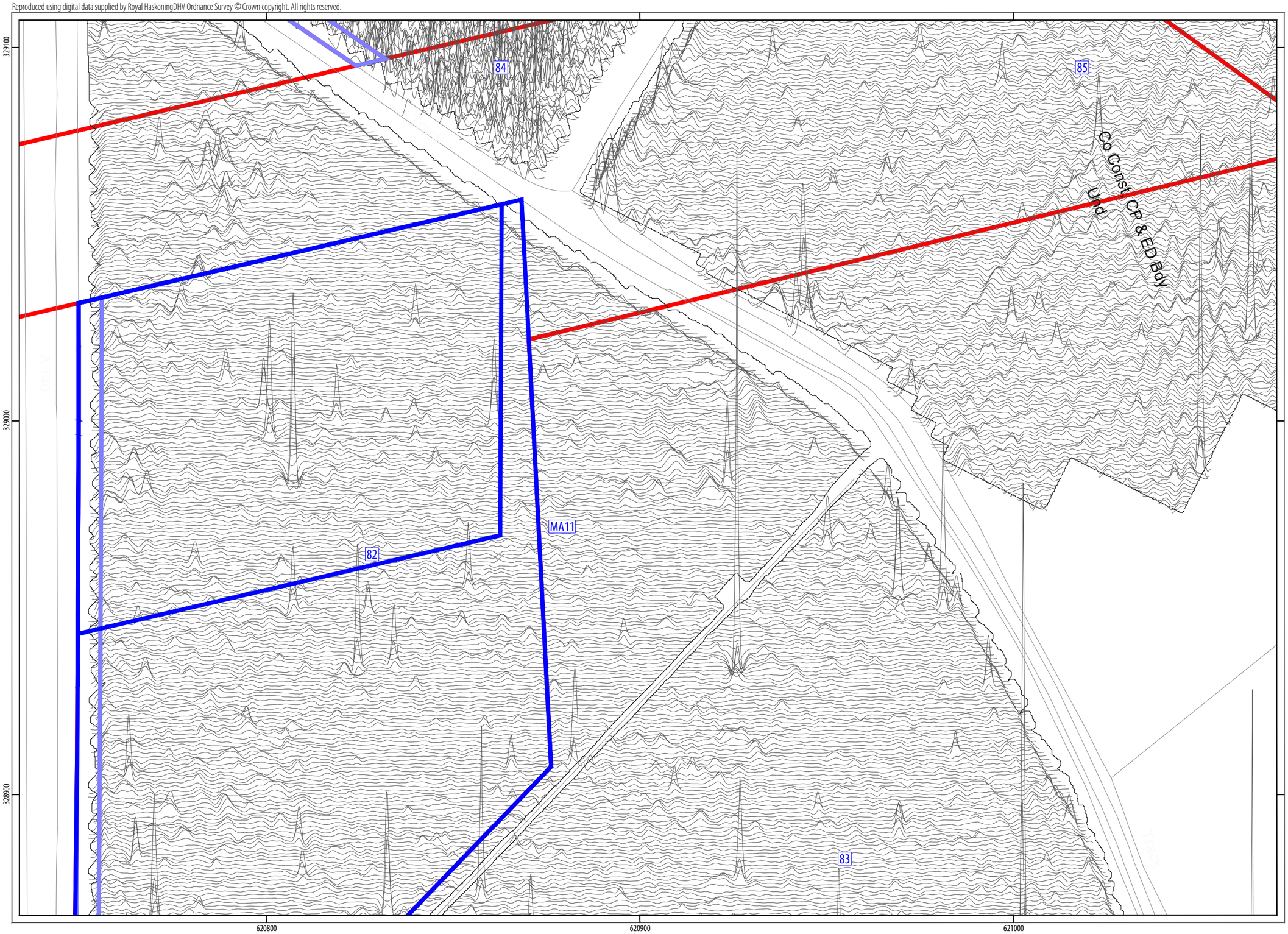
ILLUS 212 Processed greyscale magnetometer data; AAA6



norfolk vanguard red line boundary
mobilisation area
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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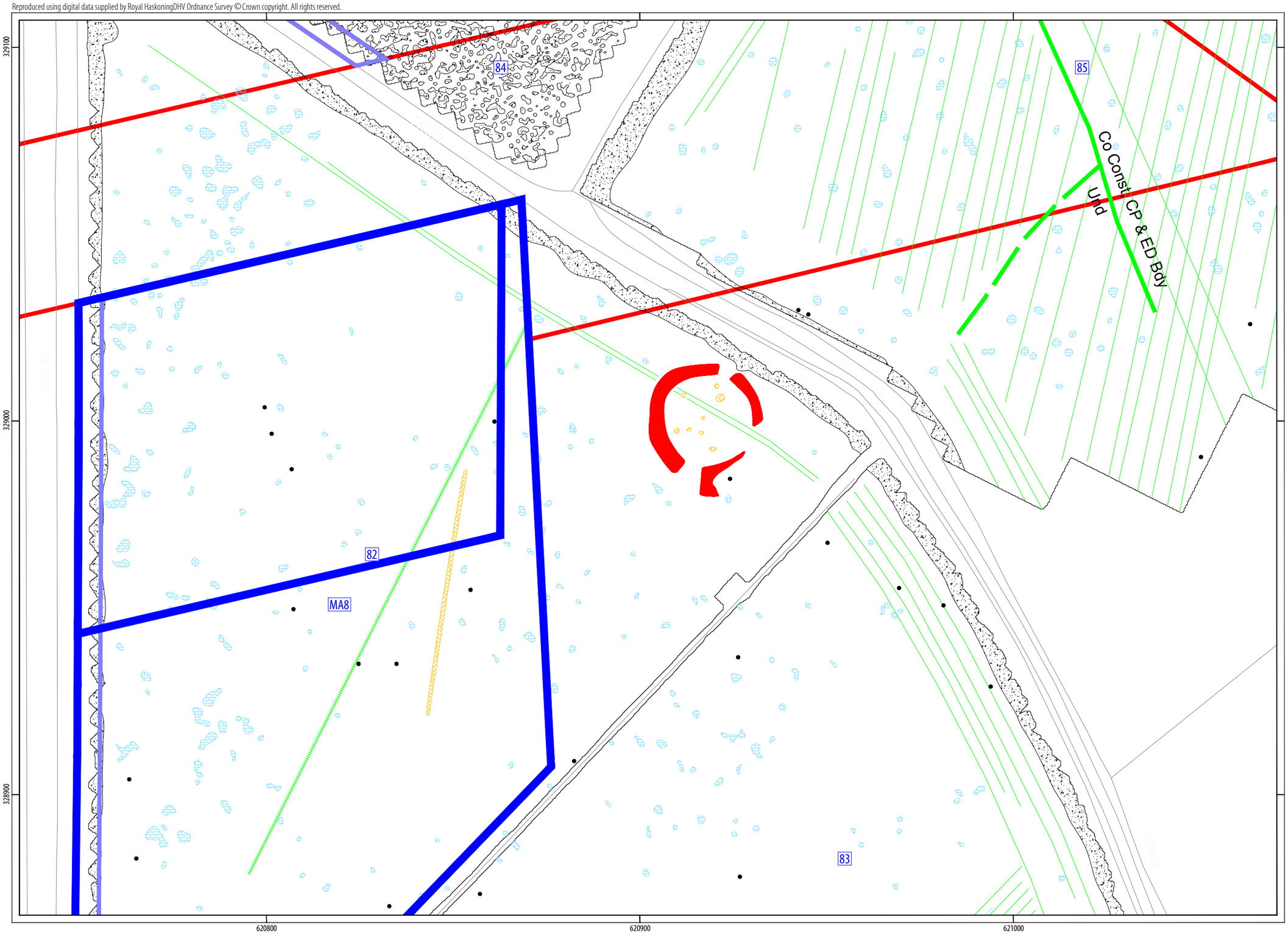
ILLUS 213 XY trace plot of minimally processed magnetometer data; AAA6



norfolk vanguard red line boundary
mobilisation area
access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear	former field boundary?
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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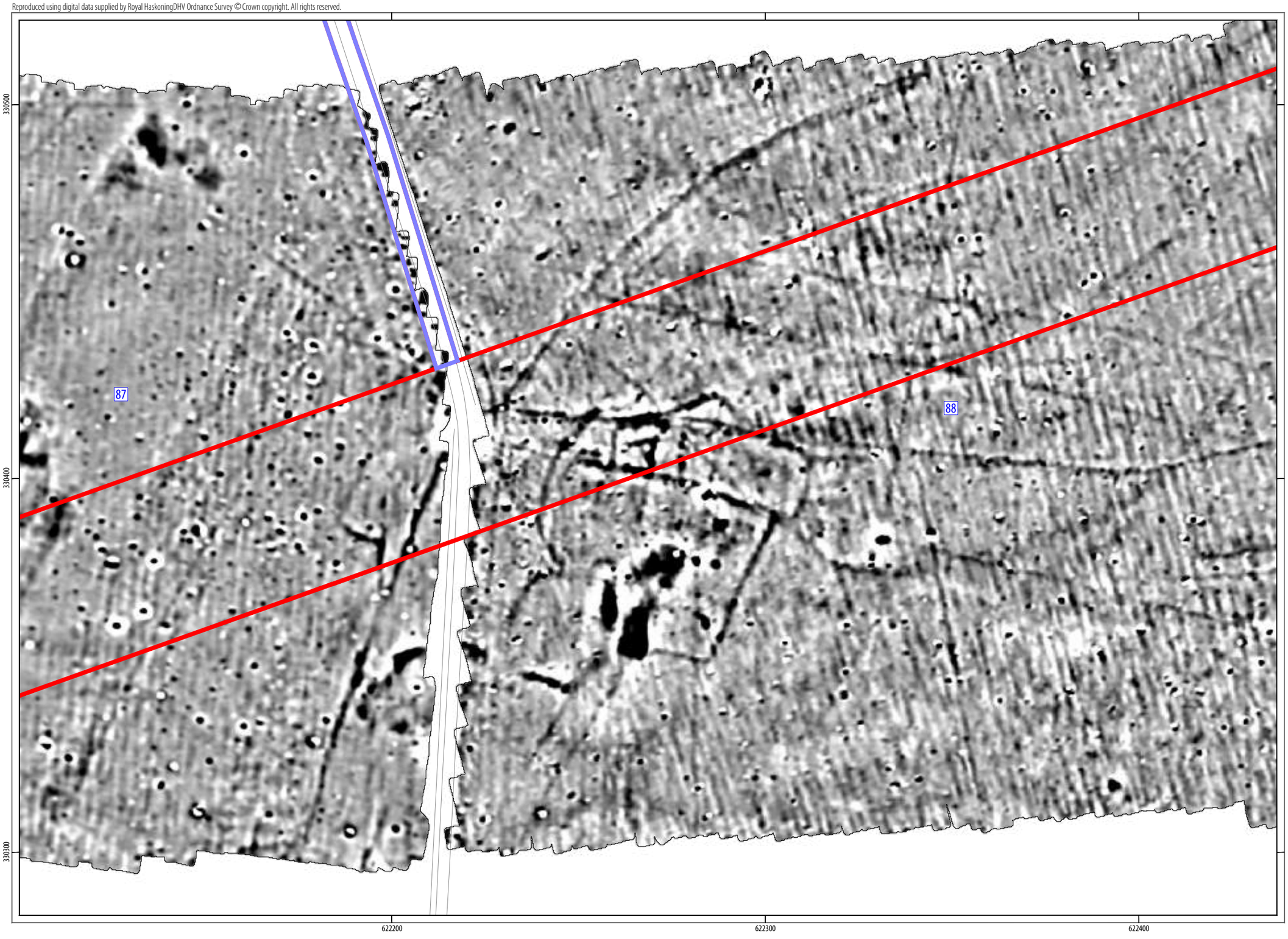
ILLUS 214 Interpretation of magnetometer data; AAA6



norfolk vanguard red line boundary
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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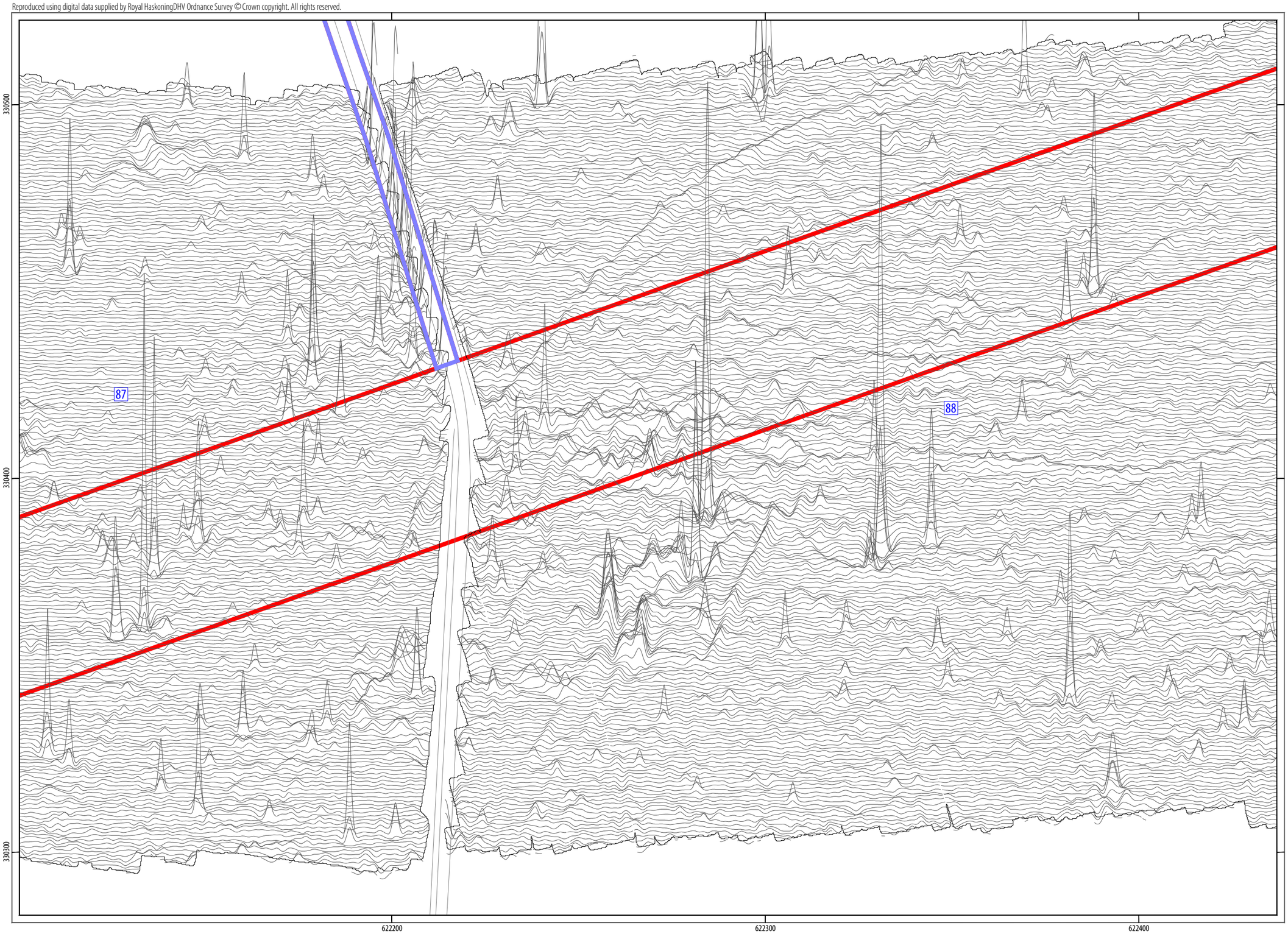
ILLUS 215 Processed greyscale magnetometer data; AAA7



norfolk vanguard red line boundary
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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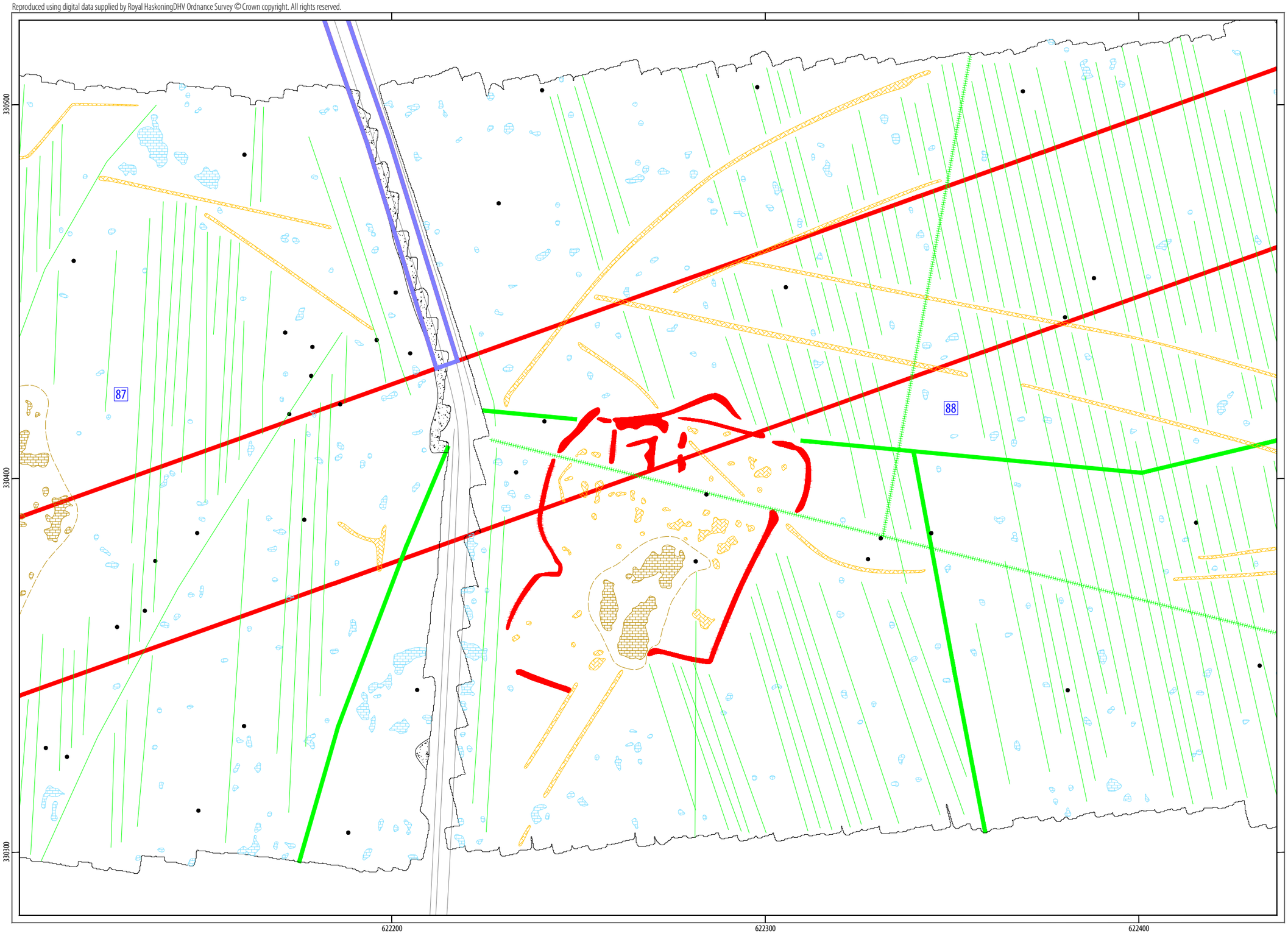
ILLUS 216 XY trace plot of minimally processed magnetometer data; AAA7



- norfolk vanguard red line boundary
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	drain
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	quarrying
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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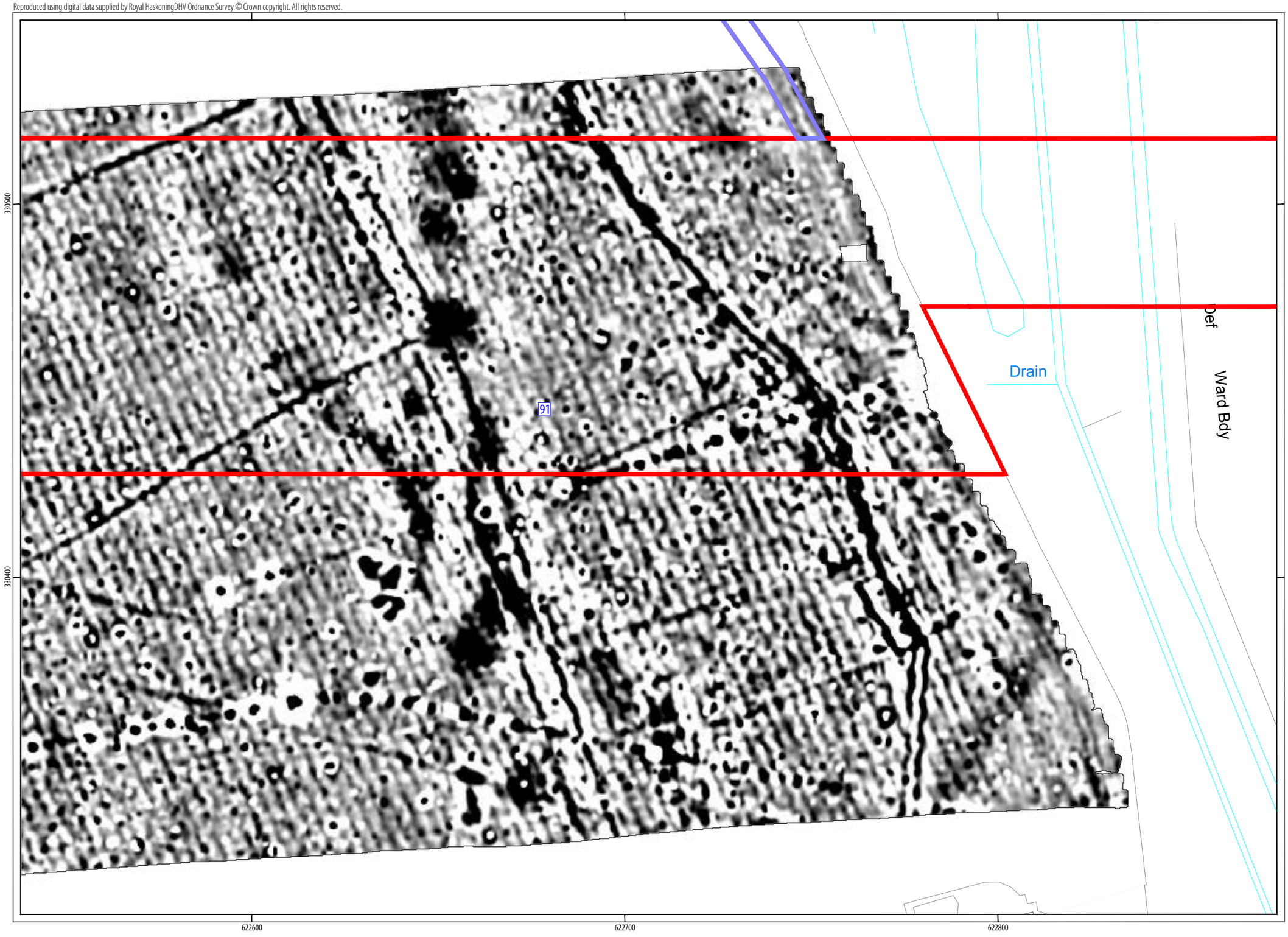
ILLUS 217 Interpretation of magnetometer data; AAA7



norfolk vanguard red line boundary
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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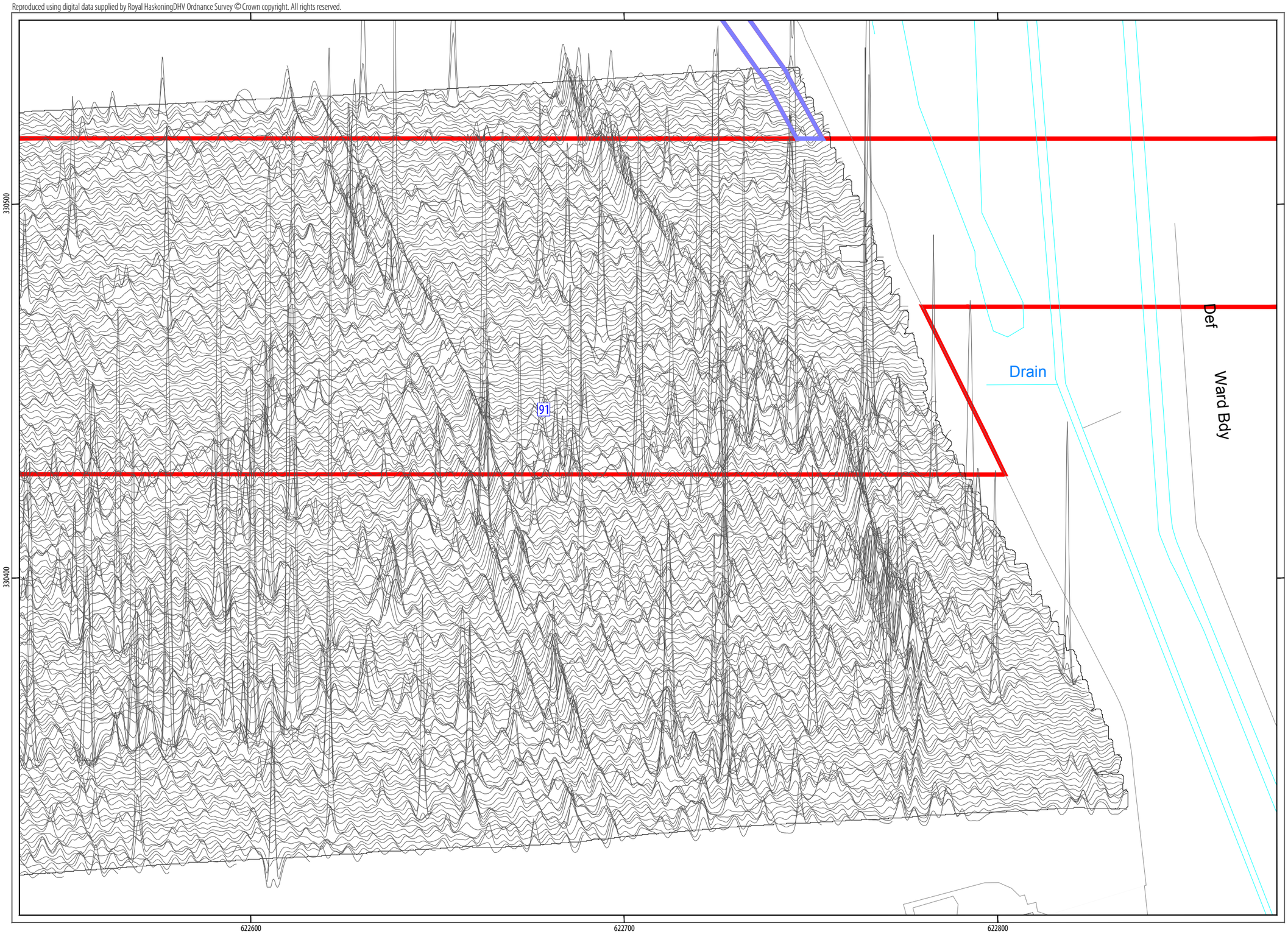
ILLUS 218 Processed greyscale magnetometer data; AAA8



norfolk vanguard red line boundary
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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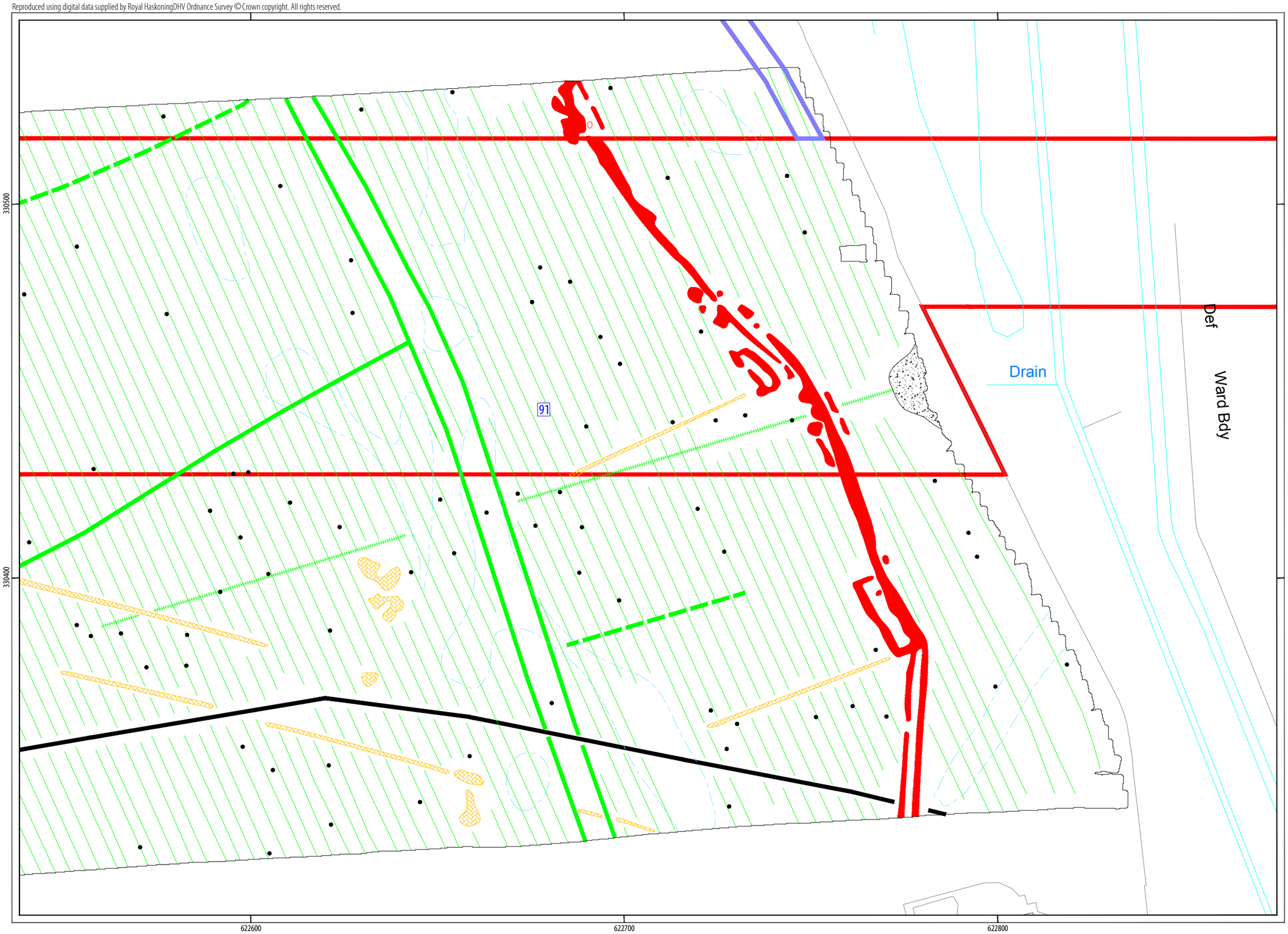
ILLUS 219 XY trace plot of minimally processed magnetometer data; AAA8



norfolk vanguard red line boundary
access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
dipolar linear	service pipe
magnetic disturbance	ferrous material
linear trend	drain
linear trend	agricultural
linear	former field boundary
linear	former field boundary?
linear trend	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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ILLUS 220 Interpretation of magnetometer data; AAA8

norfolk vanguard red line boundary
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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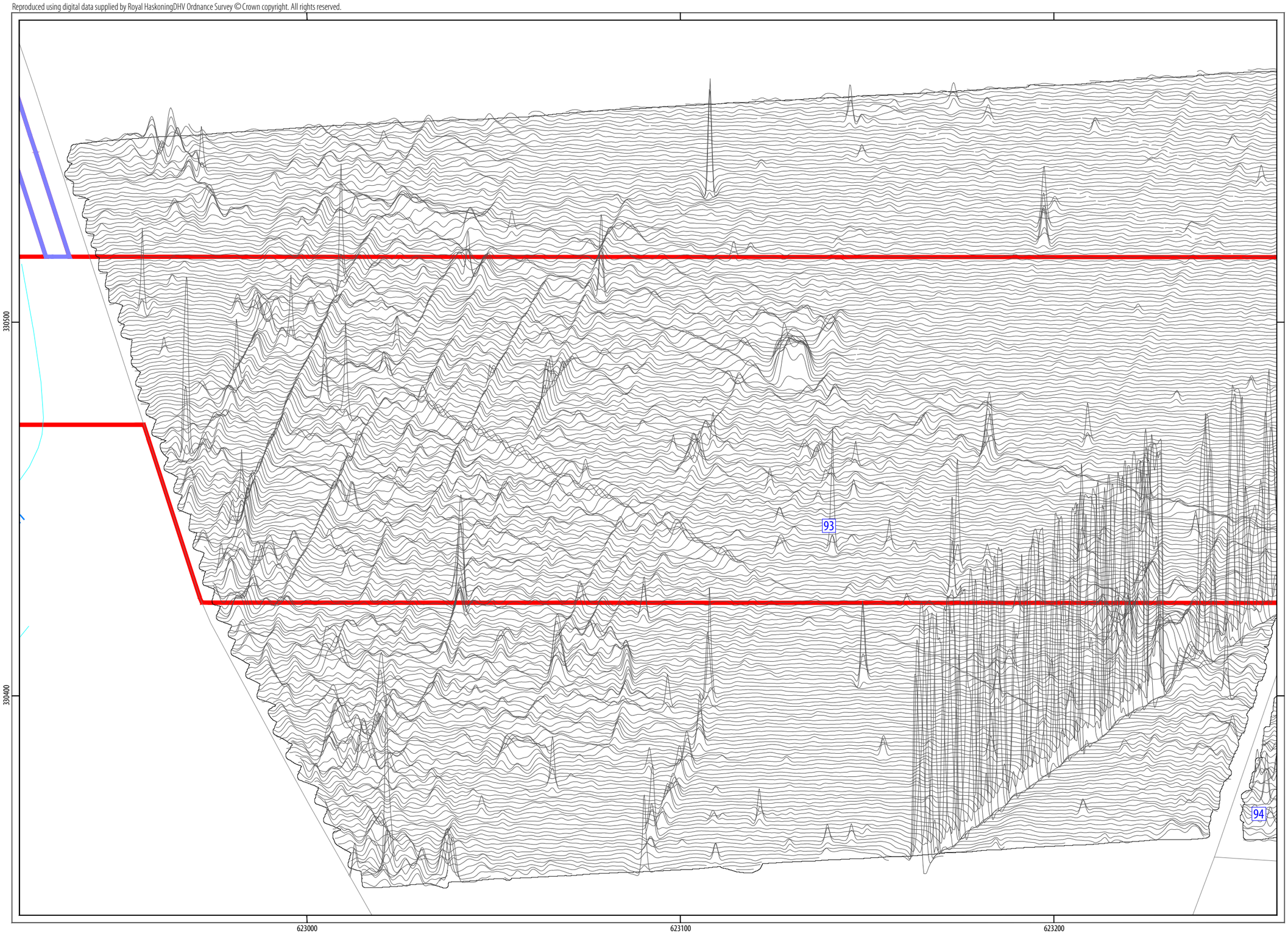
ILLUS 221 Processed greyscale magnetometer data; AAA9



norfolk vanguard red line boundary
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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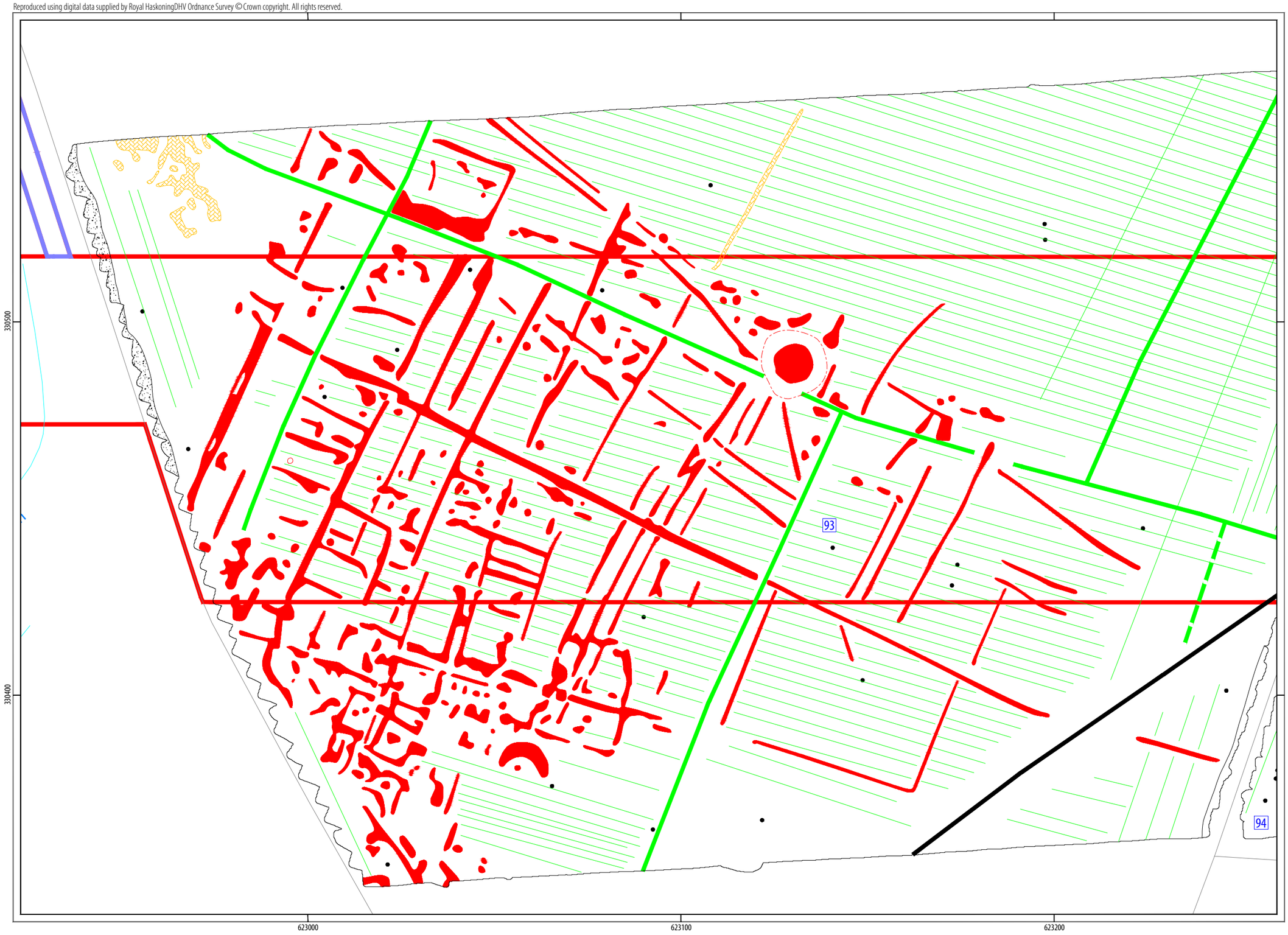
ILLUS 222 XY trace plot of minimally processed magnetometer data; AAA9



- norfolk vanguard red line boundary
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
dipolar linear	service pipe
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear	former field boundary?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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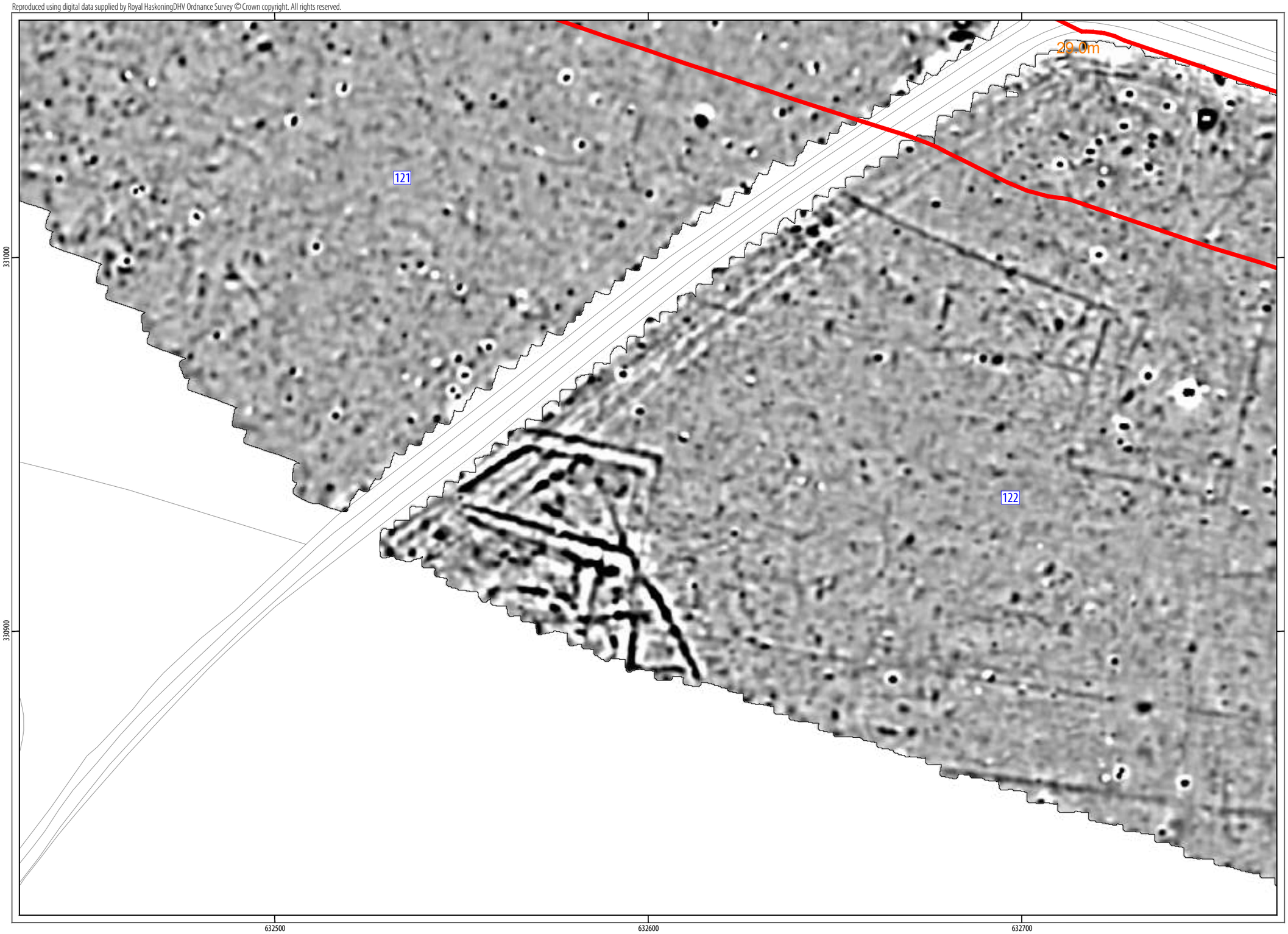
ILLUS 223 Interpretation of magnetometer data; AAA9



norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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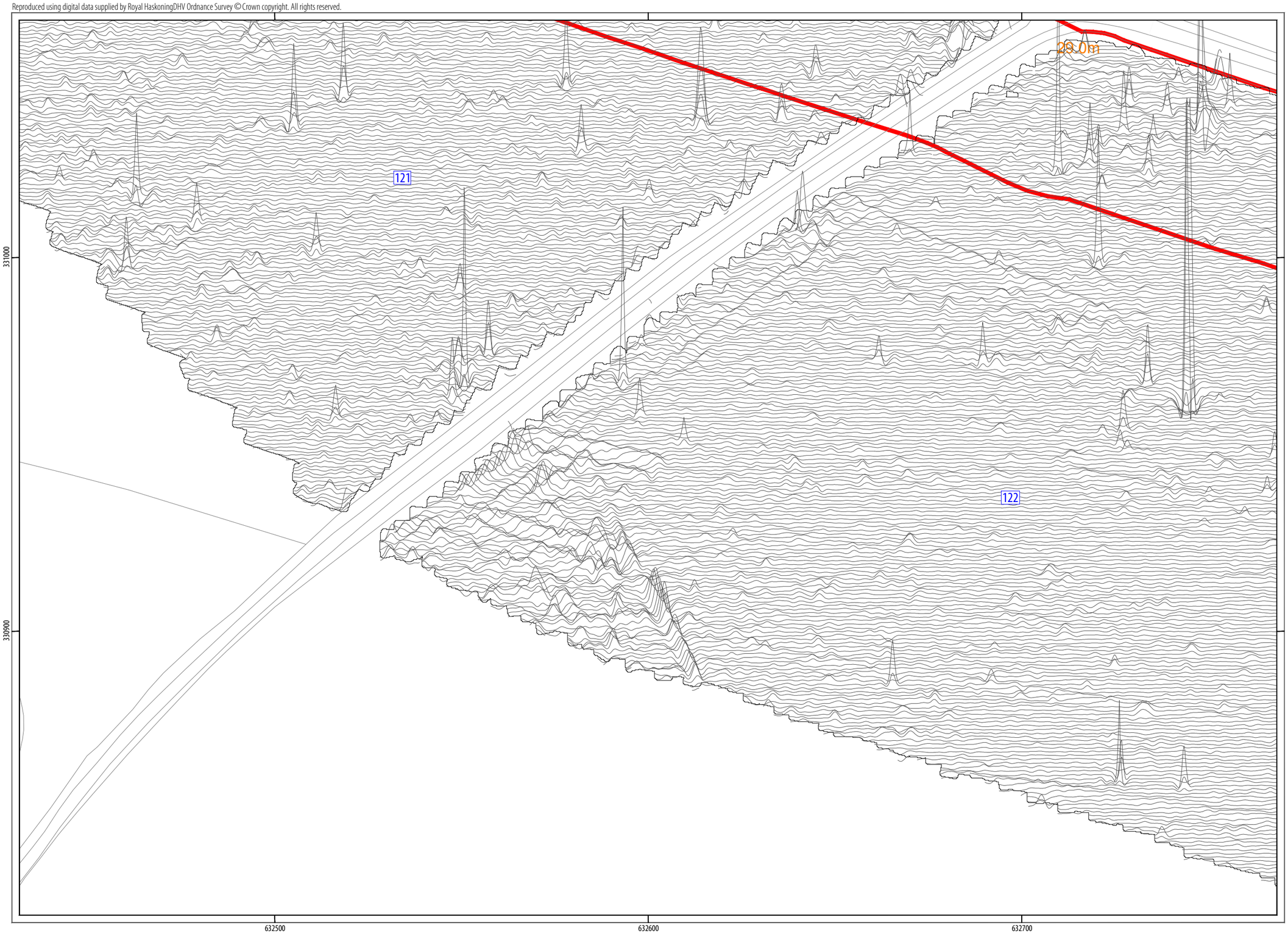
ILLUS 224 Processed greyscale magnetometer data; AAA10



norfolk vanguard red line boundary

20.0nT/cm

0 25m

1:1,000 @ A3

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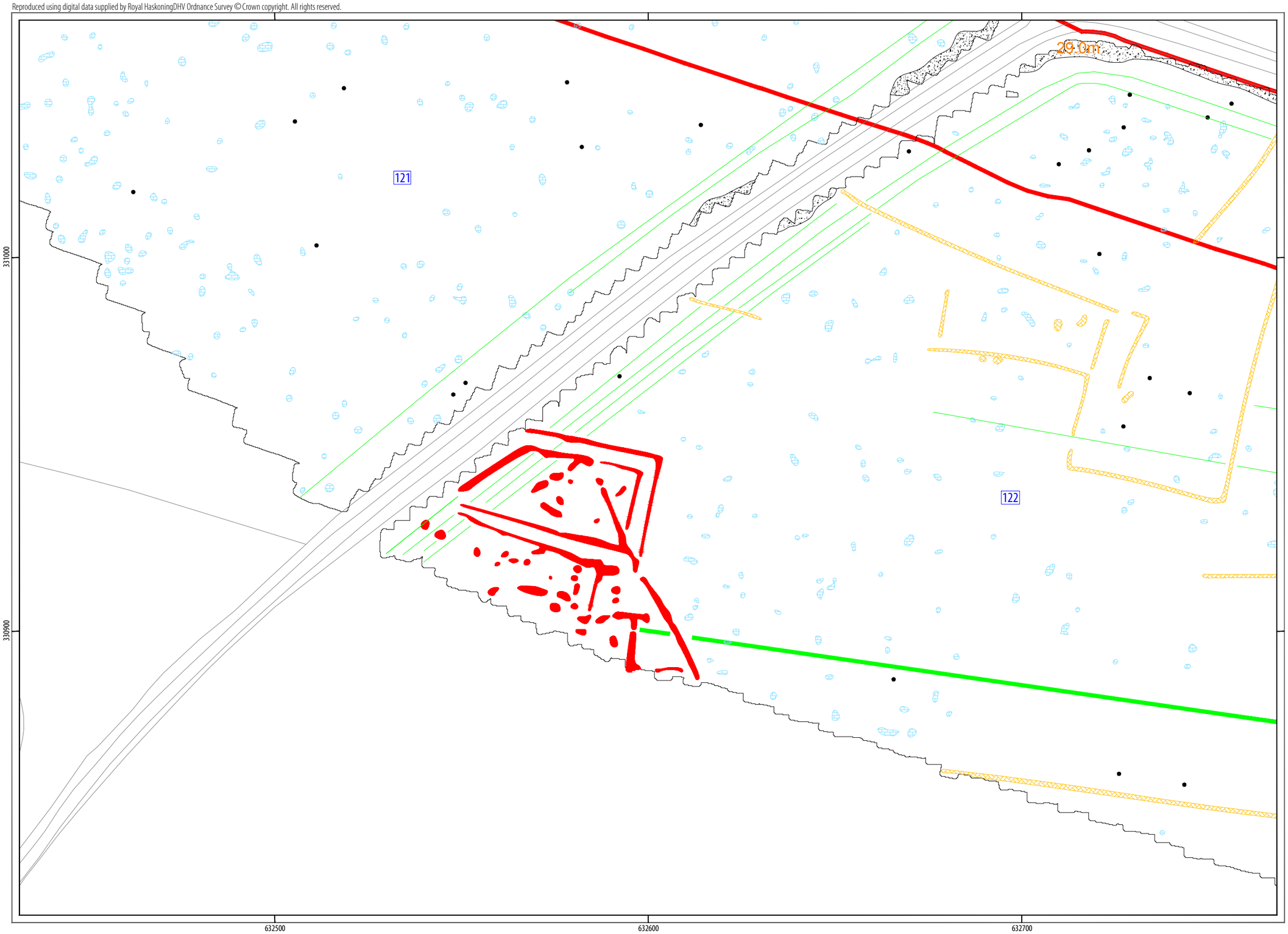
ILLUS 225 XY trace plot of minimally processed magnetometer data; AAA10



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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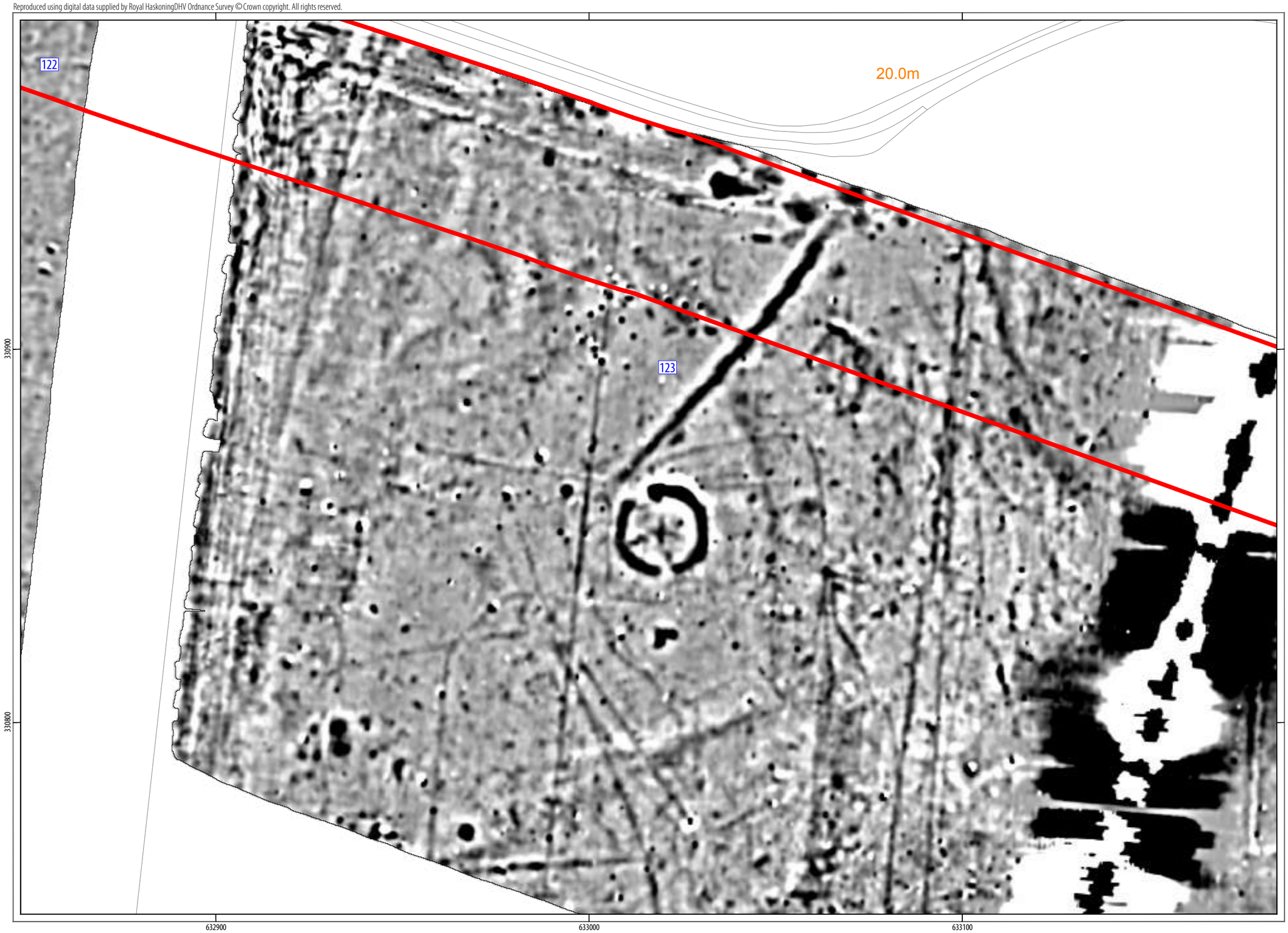
ILLUS 226 Interpretation of magnetometer data; AAA10



norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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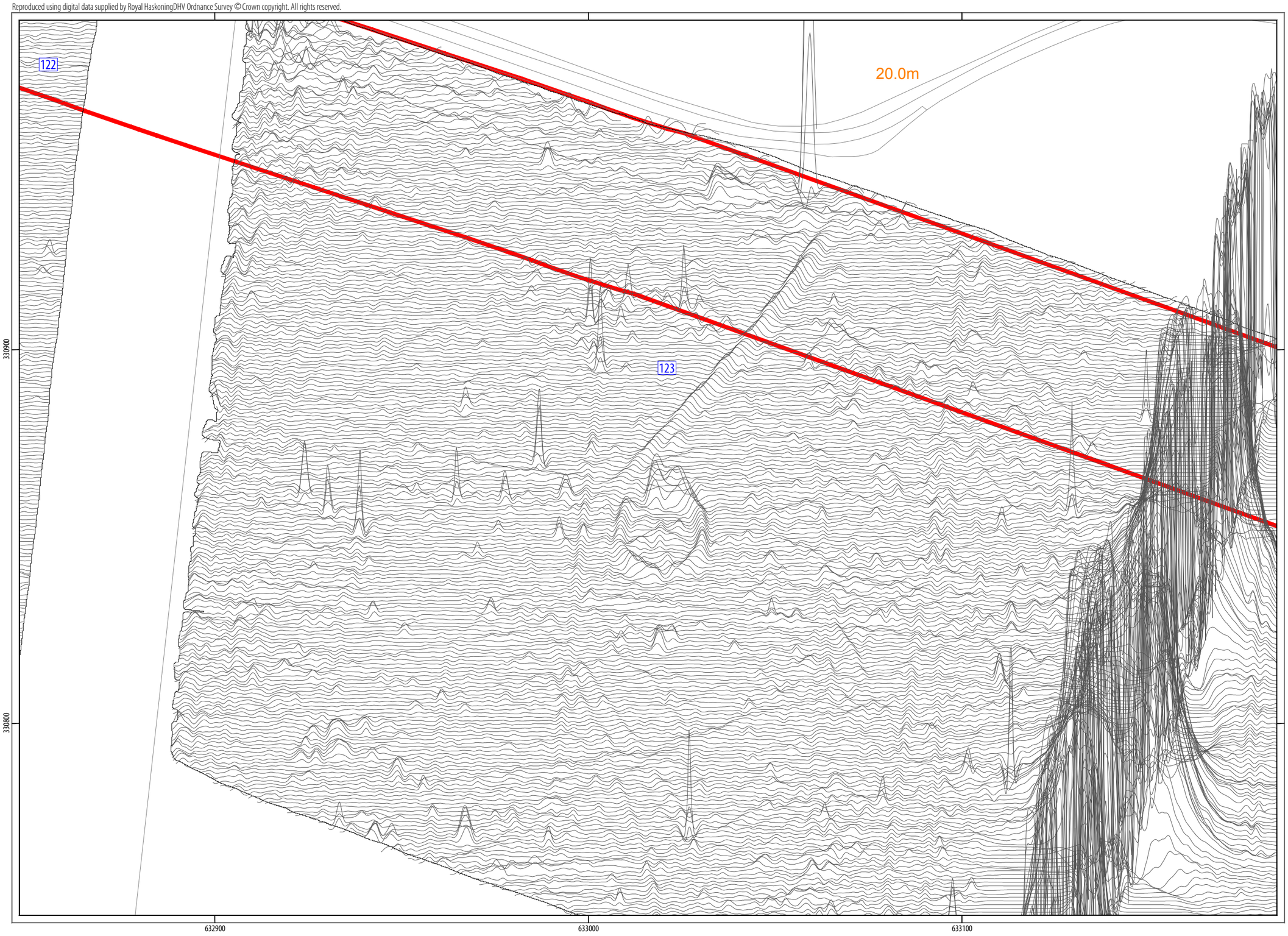
ILLUS 227 Processed greyscale magnetometer data; AAA11



norfolk vanguard red line boundary

20.0nT/cm

0 25m

1:1,000 @ A3

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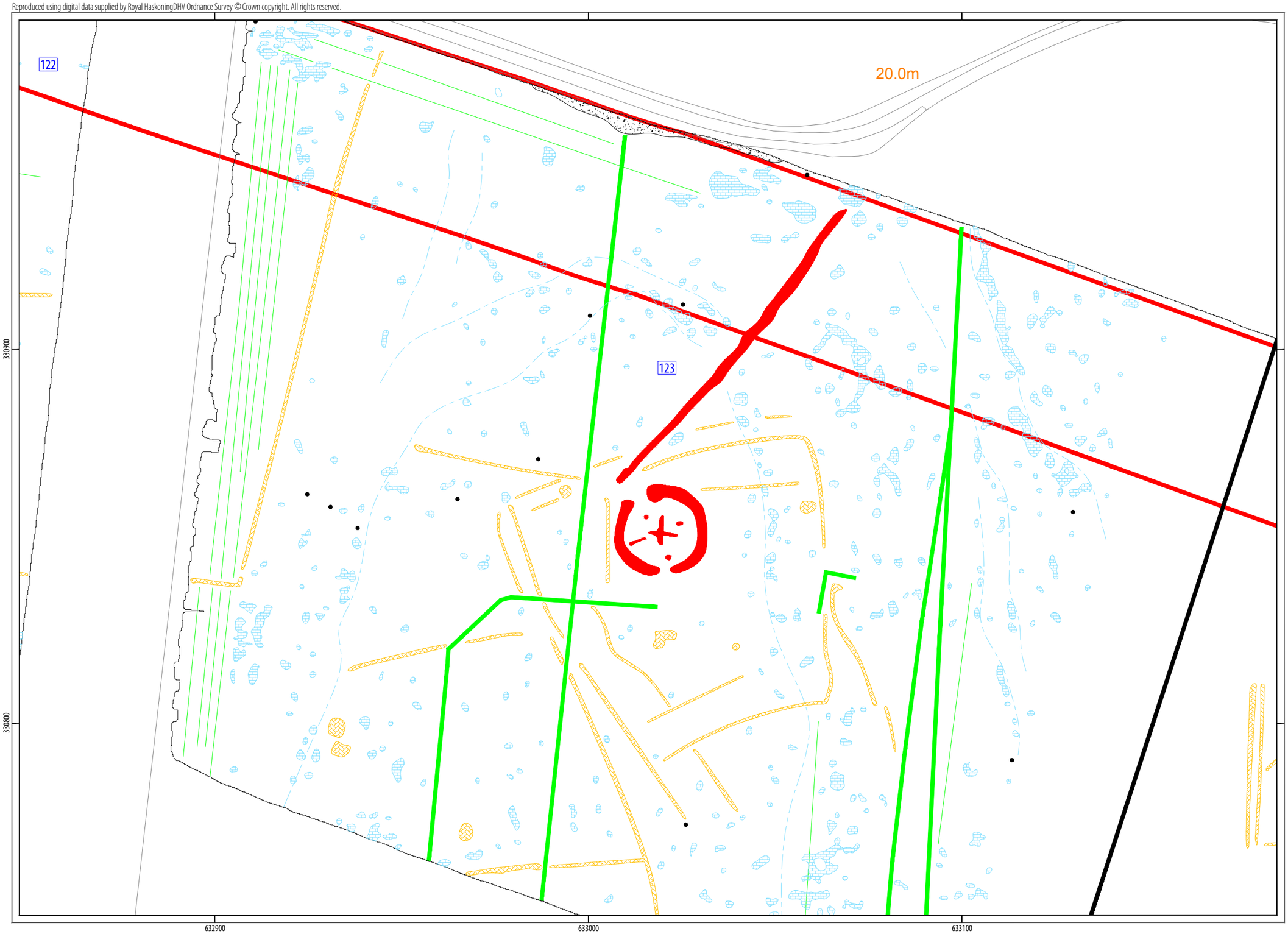
ILLUS 228 XY trace plot of minimally processed magnetometer data; AAA11



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
dipolar linear	service pipe
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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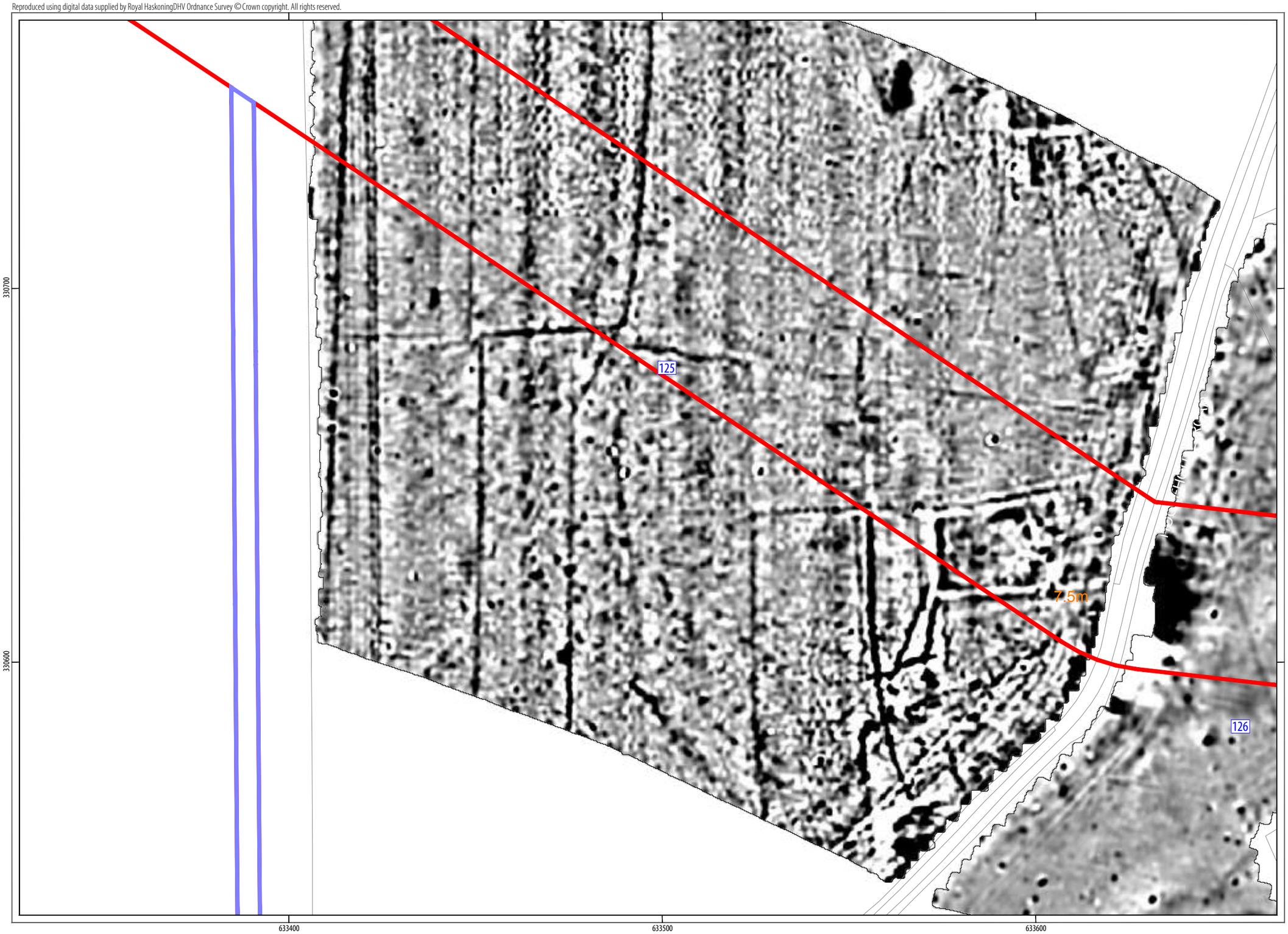
ILLUS 229 Interpretation of magnetometer data; AAA11



norfolk vanguard red line boundary
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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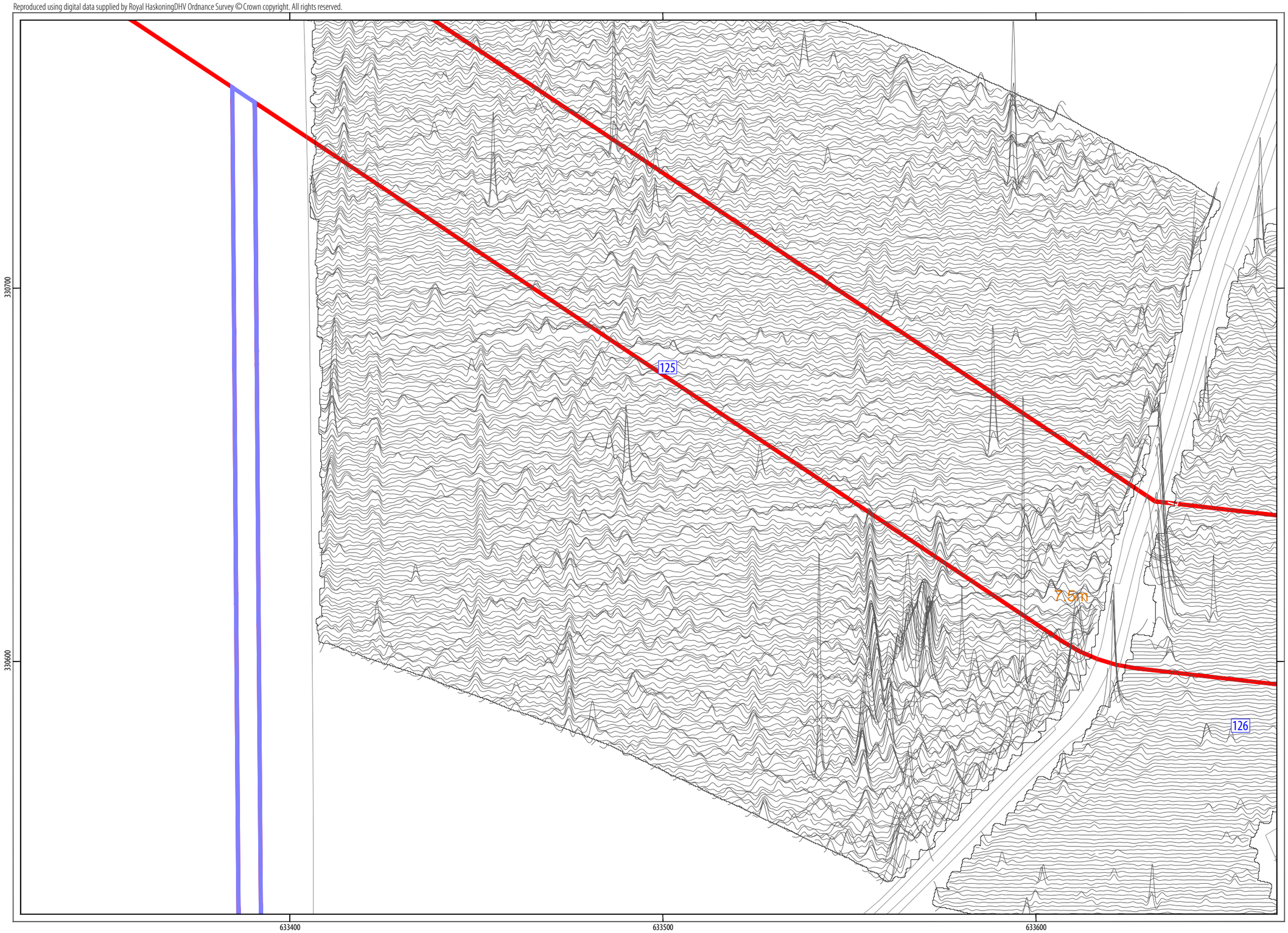
ILLUS 230 Processed greyscale magnetometer data; AAA12



norfolk vanguard red line boundary
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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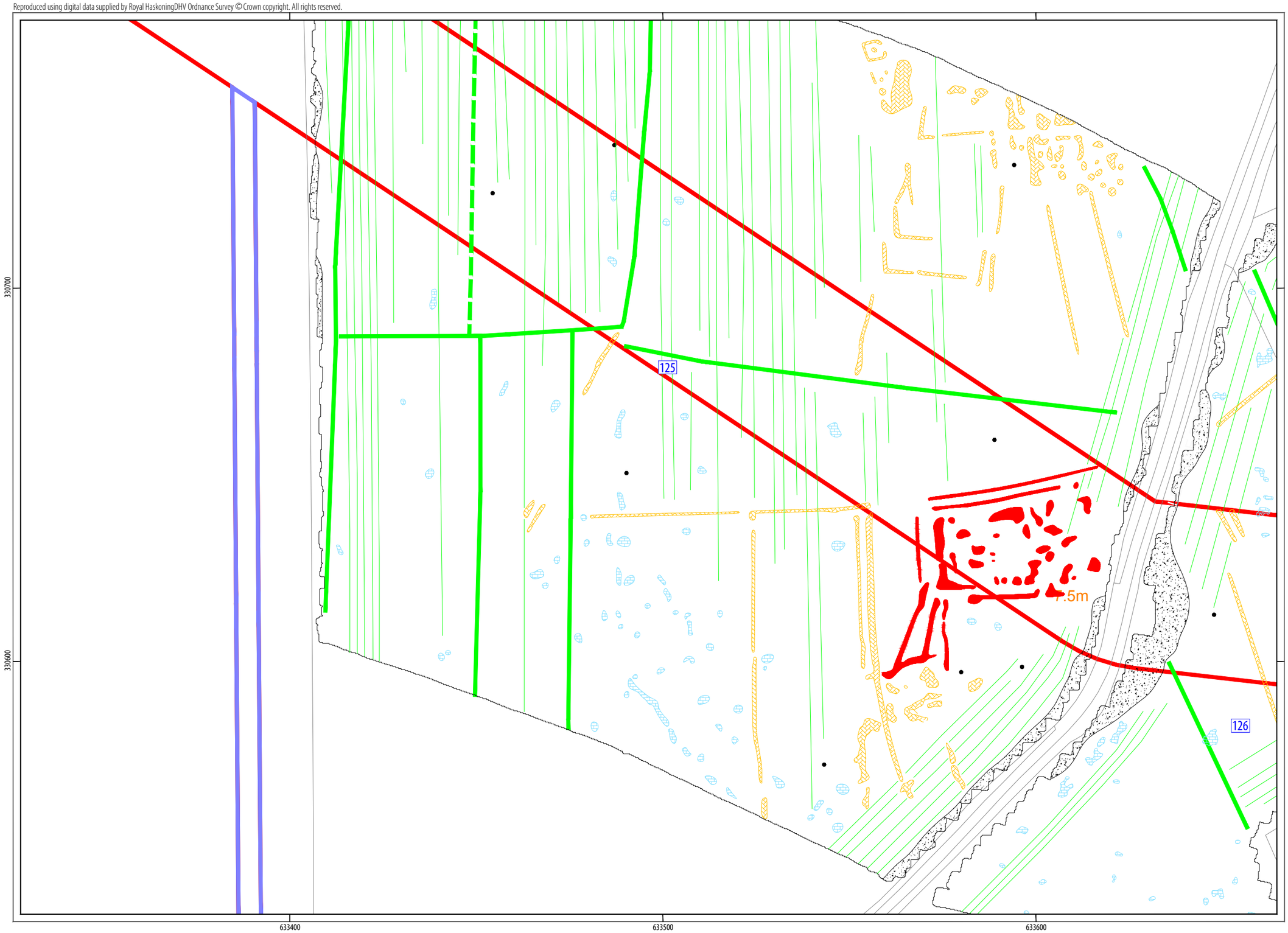
ILLUS 231 XY trace plot of minimally processed magnetometer data; AAA12



- norfolk vanguard red line boundary
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	drain
linear trend	agricultural
linear	former field boundary
linear	former field boundary?
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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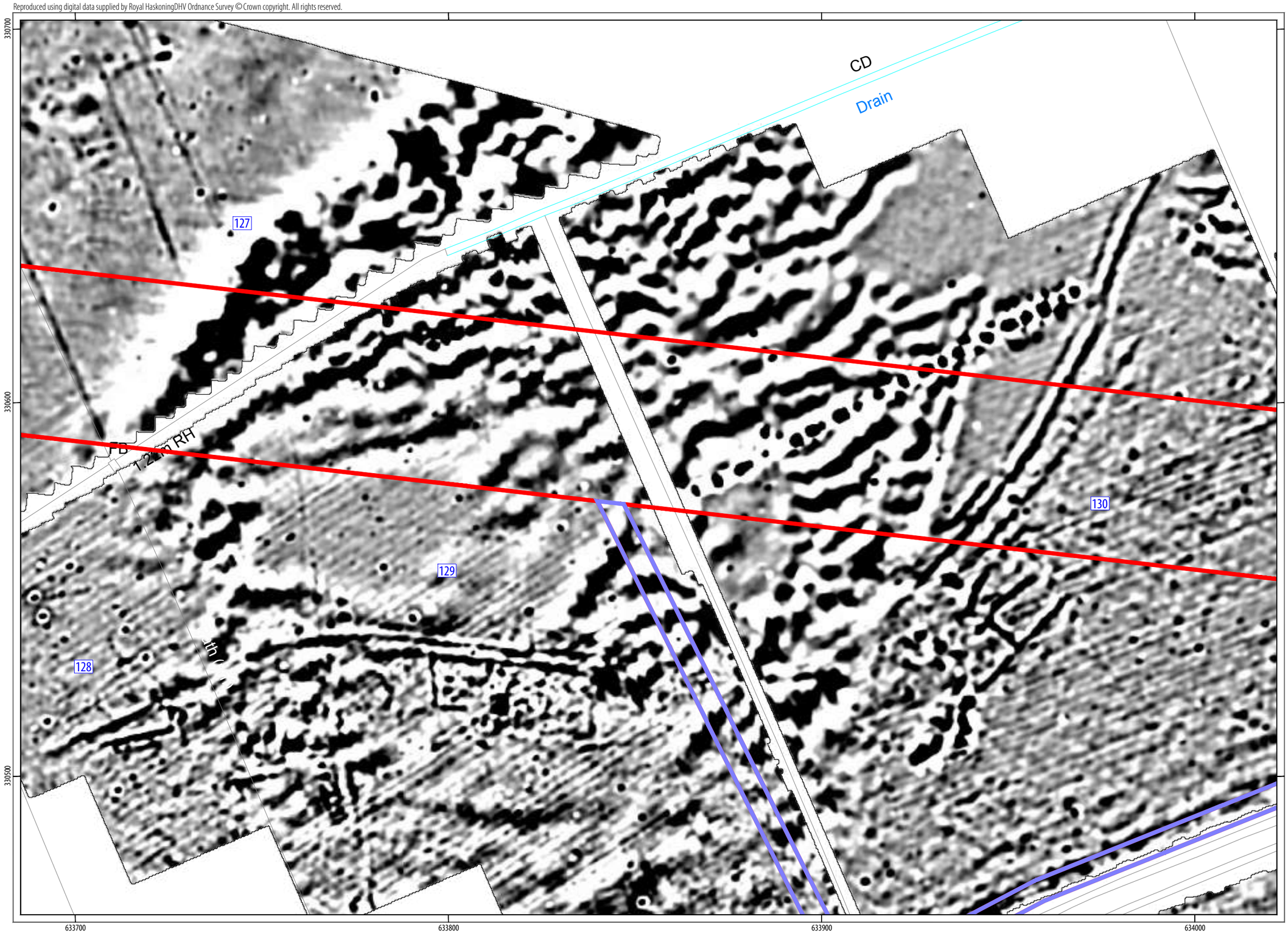
ILLUS 232 Interpretation of magnetometer data; AAA12



norfolk vanguard red line boundary
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

PROJECT NVOW17
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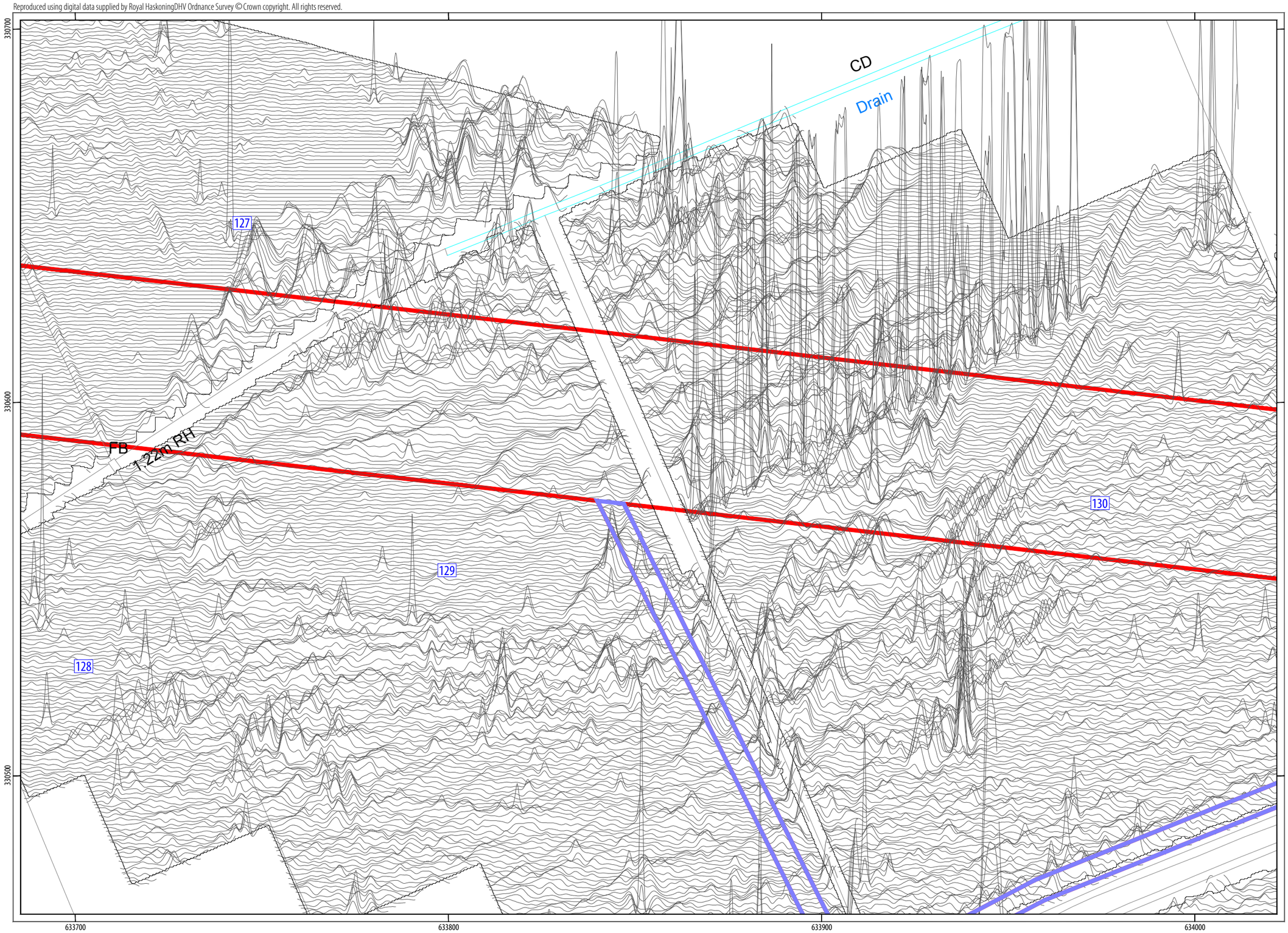
ILLUS 233 Processed greyscale magnetometer data; AAA13



norfolk vanguard red line boundary
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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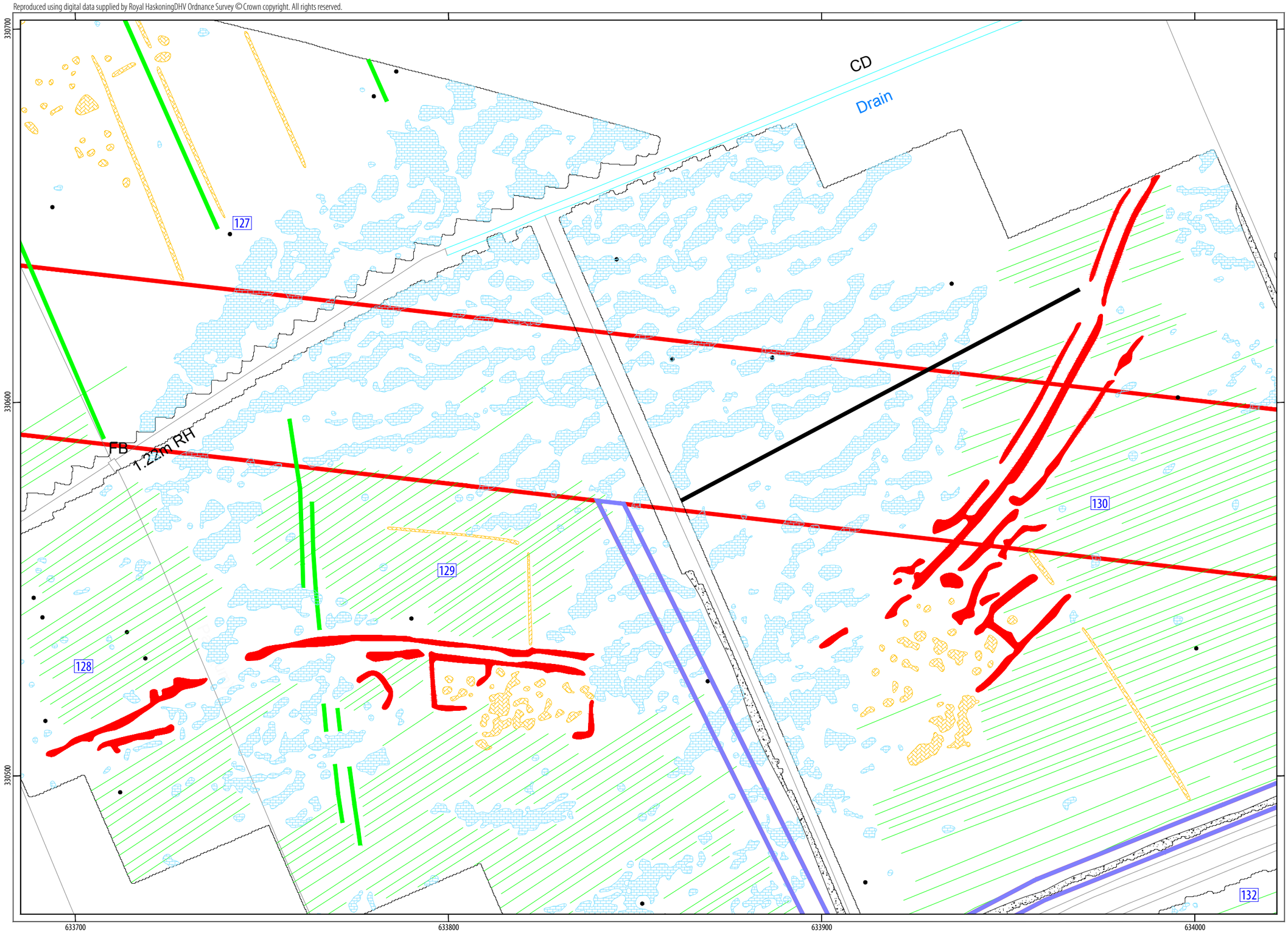
ILLUS 234 XY trace plot of minimally processed magnetometer data; AAA13



norfolk vanguard red line boundary
access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
dipolar linear	service pipe
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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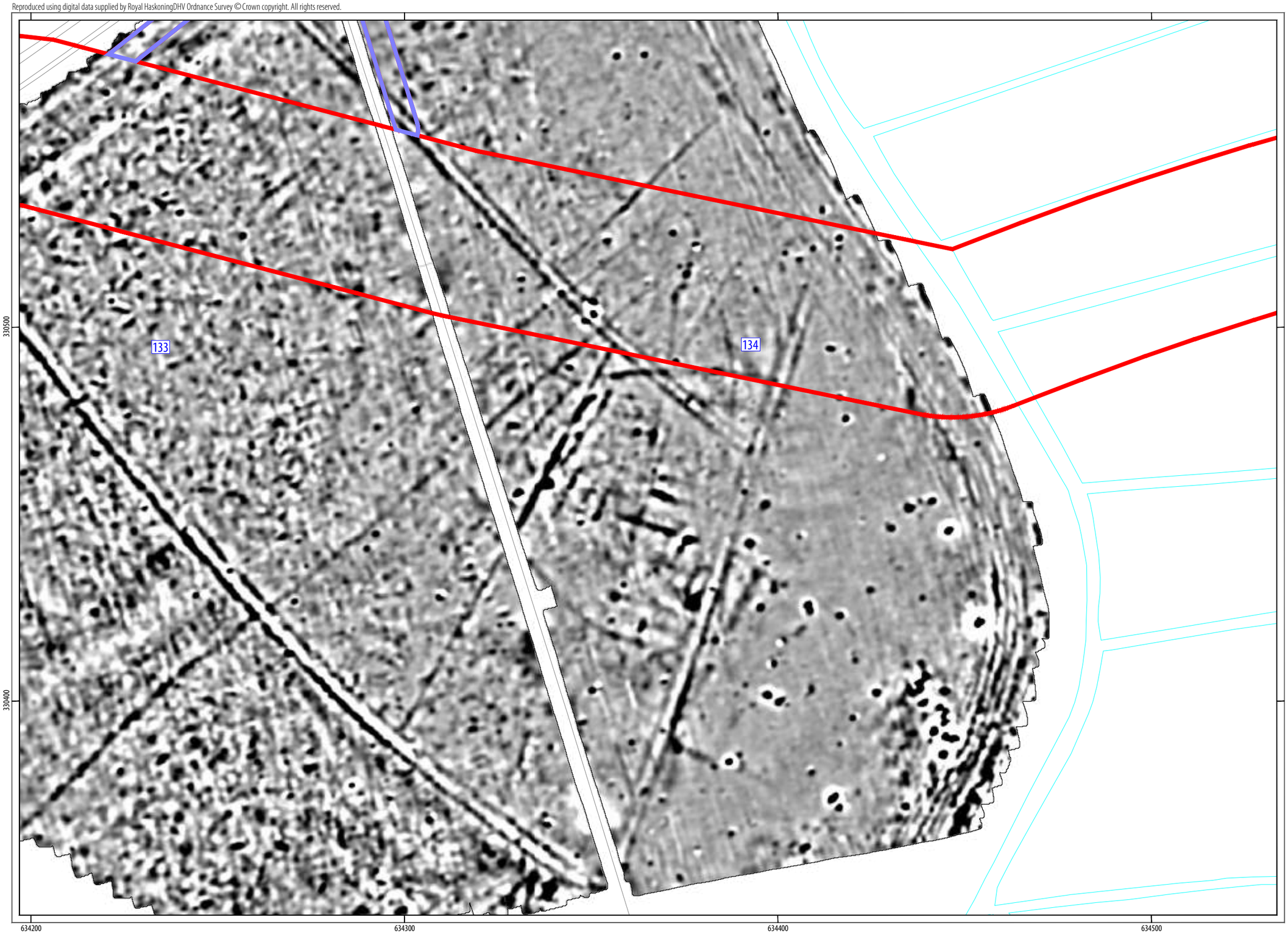
ILLUS 235 Interpretation of magnetometer data; AAA13



norfolk vanguard red line boundary
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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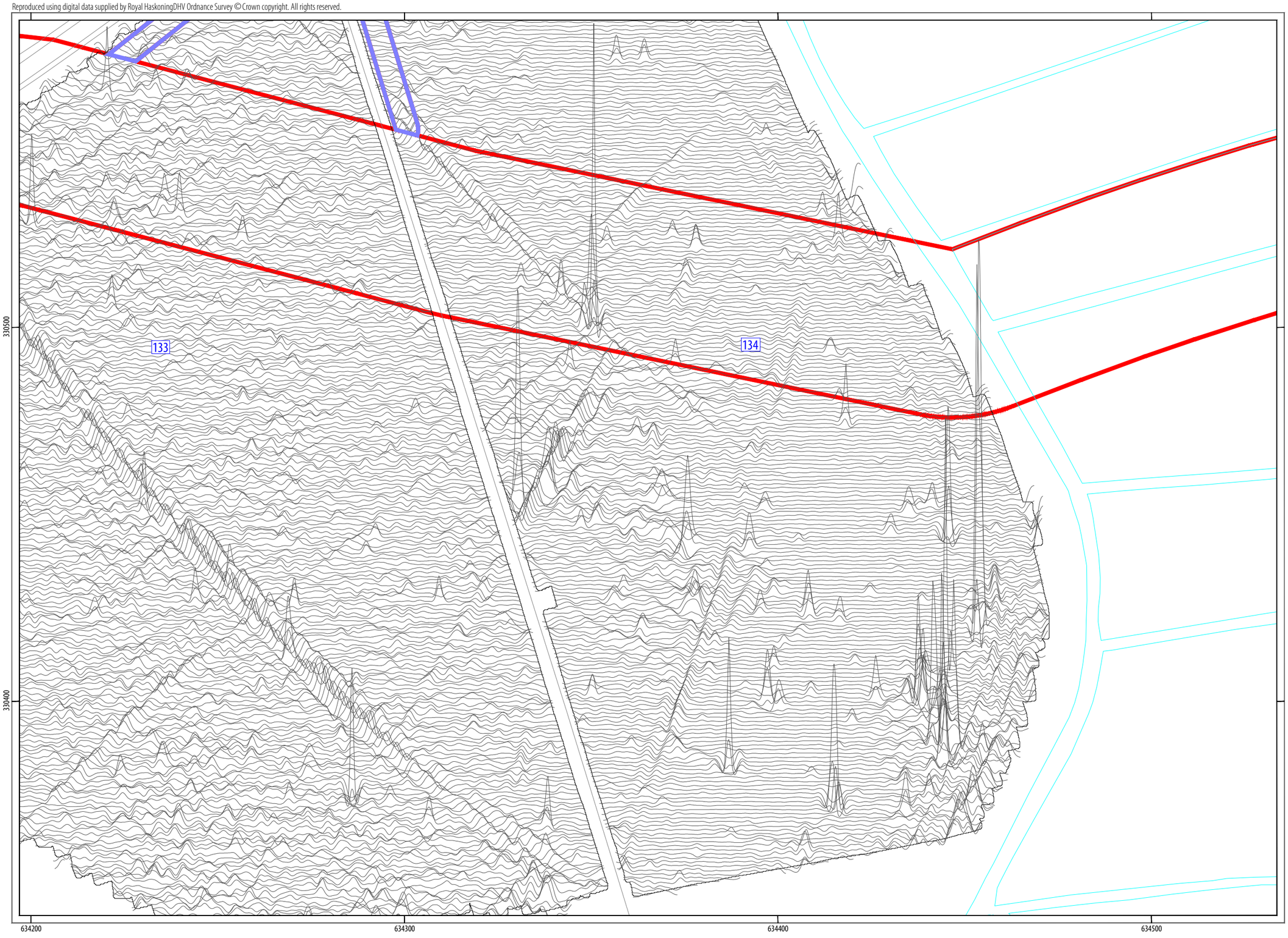
ILLUS 236 Processed greyscale magnetometer data; AAA14



norfolk vanguard red line boundary

access route

20.0nT/cm

0 25m

1:1,000 @ A3

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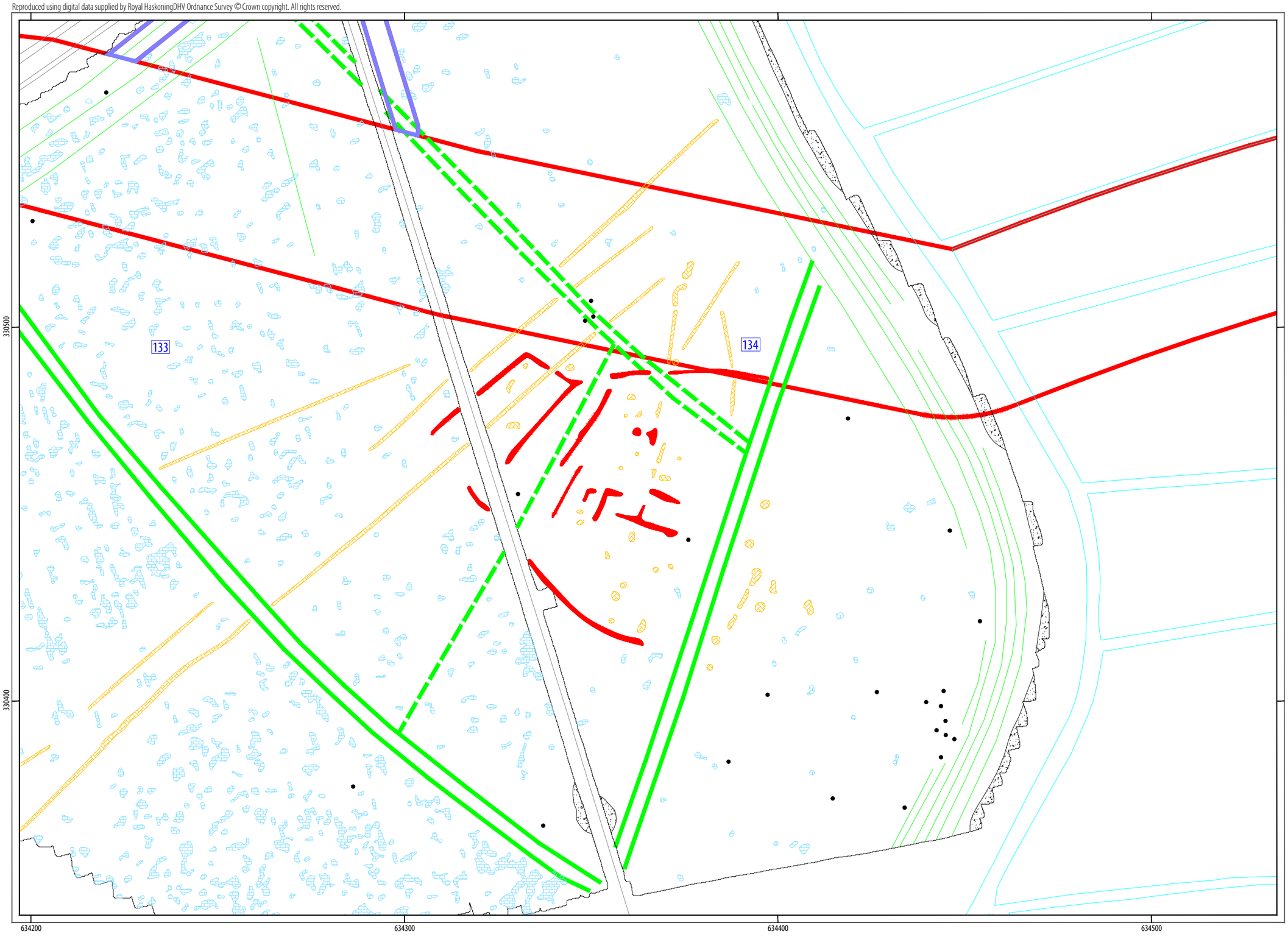
ILLUS 237 XY trace plot of minimally processed magnetometer data; AAA14



norfolk vanguard red line boundary
access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear	former field boundary?
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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ILLUS 238 Interpretation of magnetometer data; AAA14

330800
330700
330600
634900
635000

137
136

norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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ILLUS 239 Processed greyscale magnetometer data; AAA15 (west)

330800
330700
330600
634900
635000
137
136

norfolk vanguard red line boundary

20.0nT/cm

0 25m

1:1,000 @ A3

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ILLUS 240 XY trace plot of minimally processed magnetometer data; AAA15 (west)

330800
330700
330600
634900
635000
137
136

norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
magnetic disturbance	modern
linear trend	agricultural
linear	former field boundary

TYPE OF ANOMALY	INTERPRETATION
linear	former field boundary?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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ILLUS 241 Interpretation of magnetometer data; AAA15 (west)

330800
330700
330600

137
138
136

635100
635200

norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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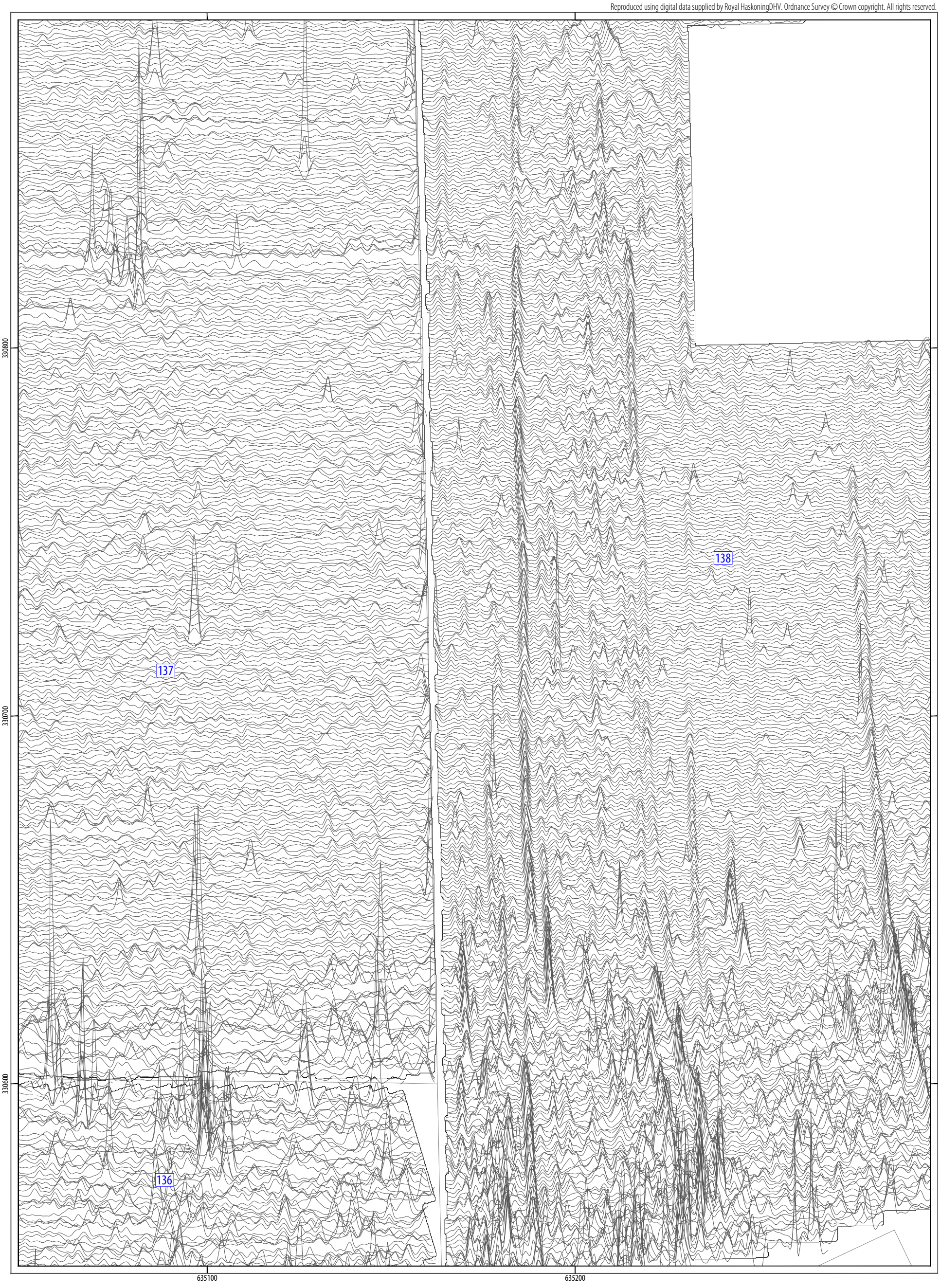
ILLUS 242 Processed greyscale magnetometer data; AAA15 (central)



20.0nT/cm

0 25m

1:1,000 @ A3

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ILLUS 243 XY trace plot of minimally processed magnetometer data; AAA15 (central)

330800
330700
330600
635100
635200
137
138
136

norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary?
linear	former field boundary

TYPE OF ANOMALY	INTERPRETATION
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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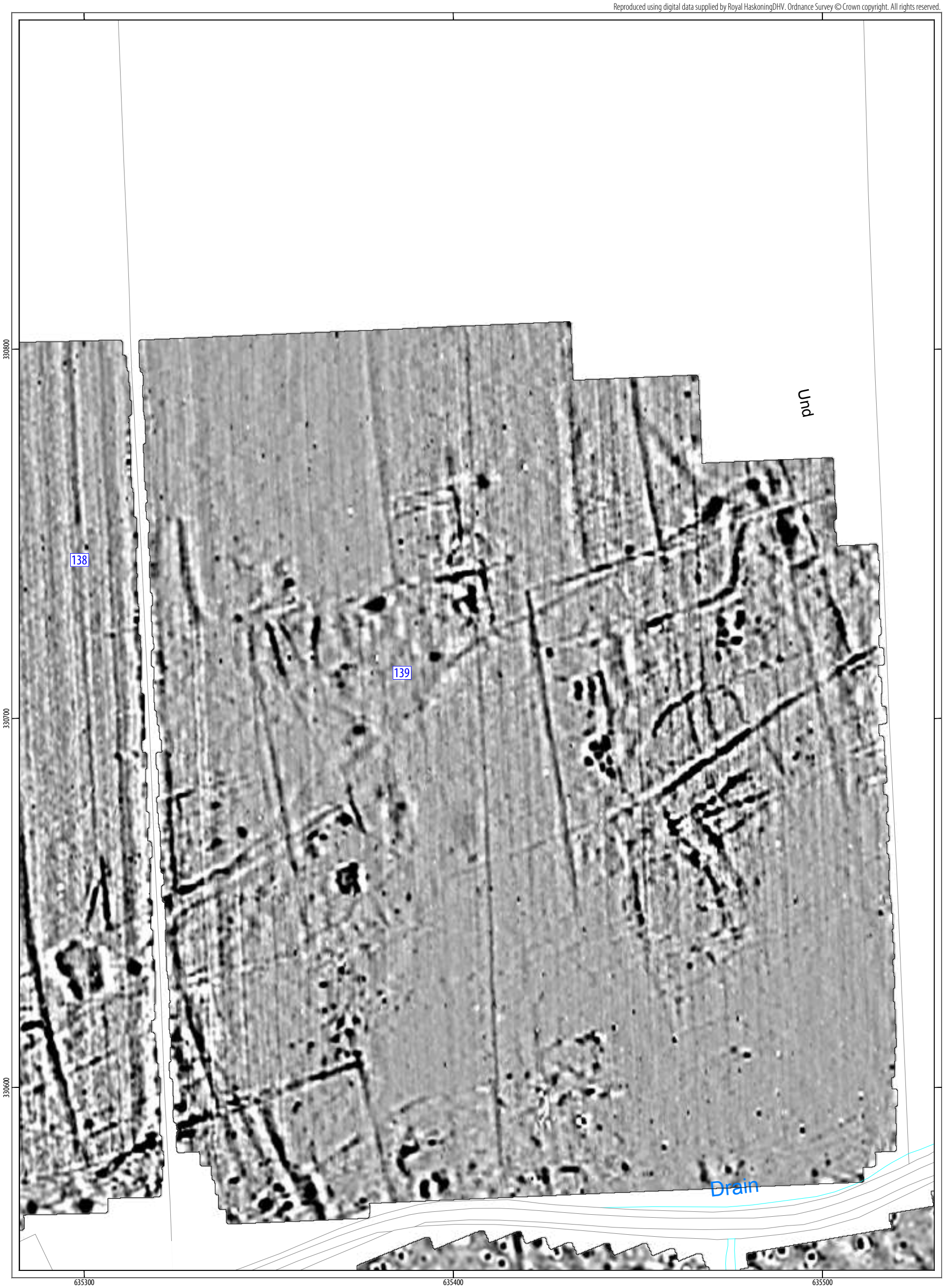
ILLUS 244 Interpretation of magnetometer data; AAA15 (central)



nT
-1.0
2.0

0
25m
1:1,000 @ A3

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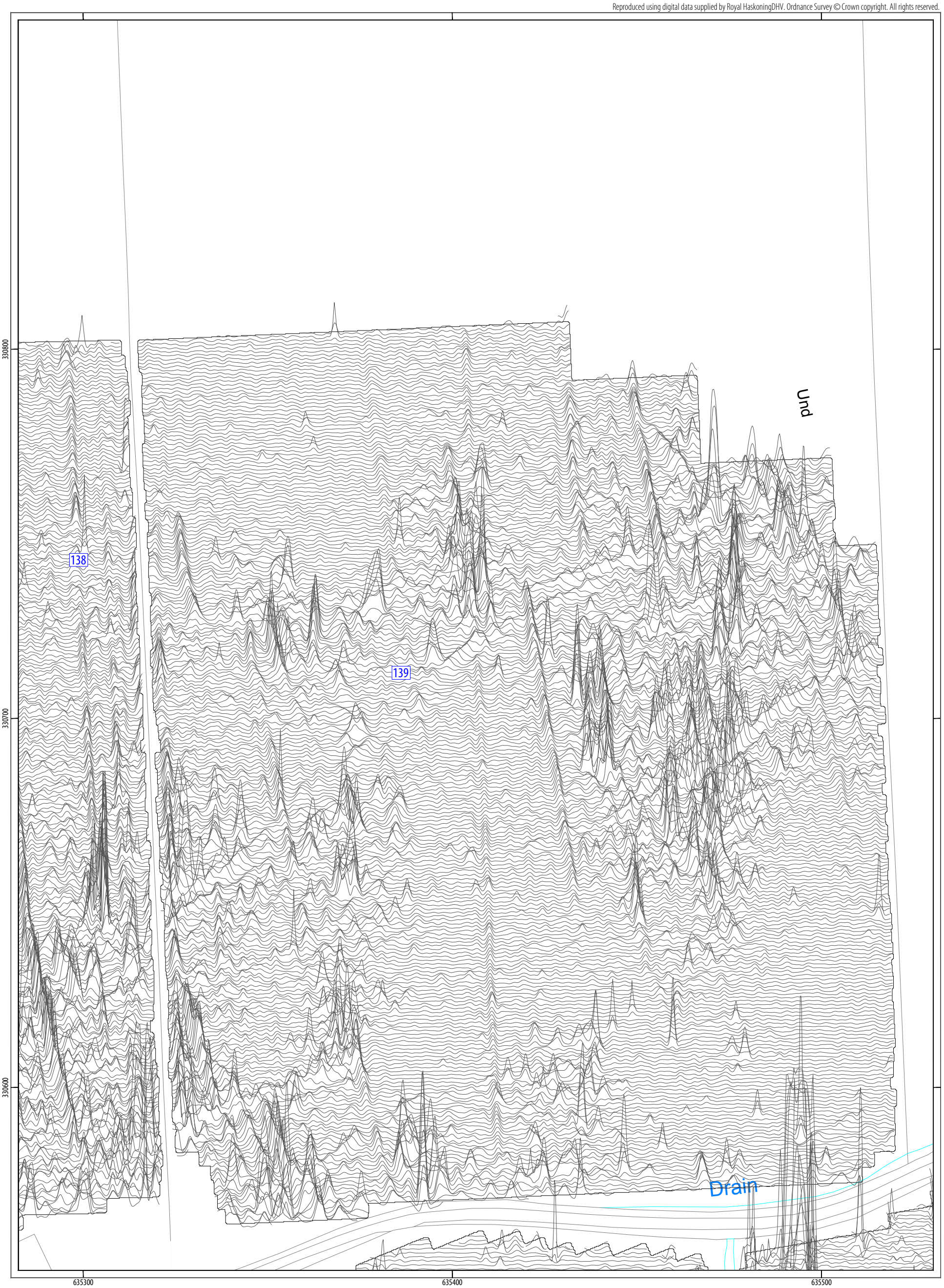
ILLUS 245 Processed greyscale magnetometer data; AAA15 (east)



20.0nT/cm

0 25m

1:1,000 @ A3

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ILLUS 246 XY trace plot of minimally processed magnetometer data; AAA15 (east)

330800
330700
330600
635300
635400
635500
138
139
Und
Drain

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology

TYPE OF ANOMALY	INTERPRETATION
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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ILLUS 247 Interpretation of magnetometer data; AAA15 (east)

norfolk vanguard red line boundary
mobilisation area
access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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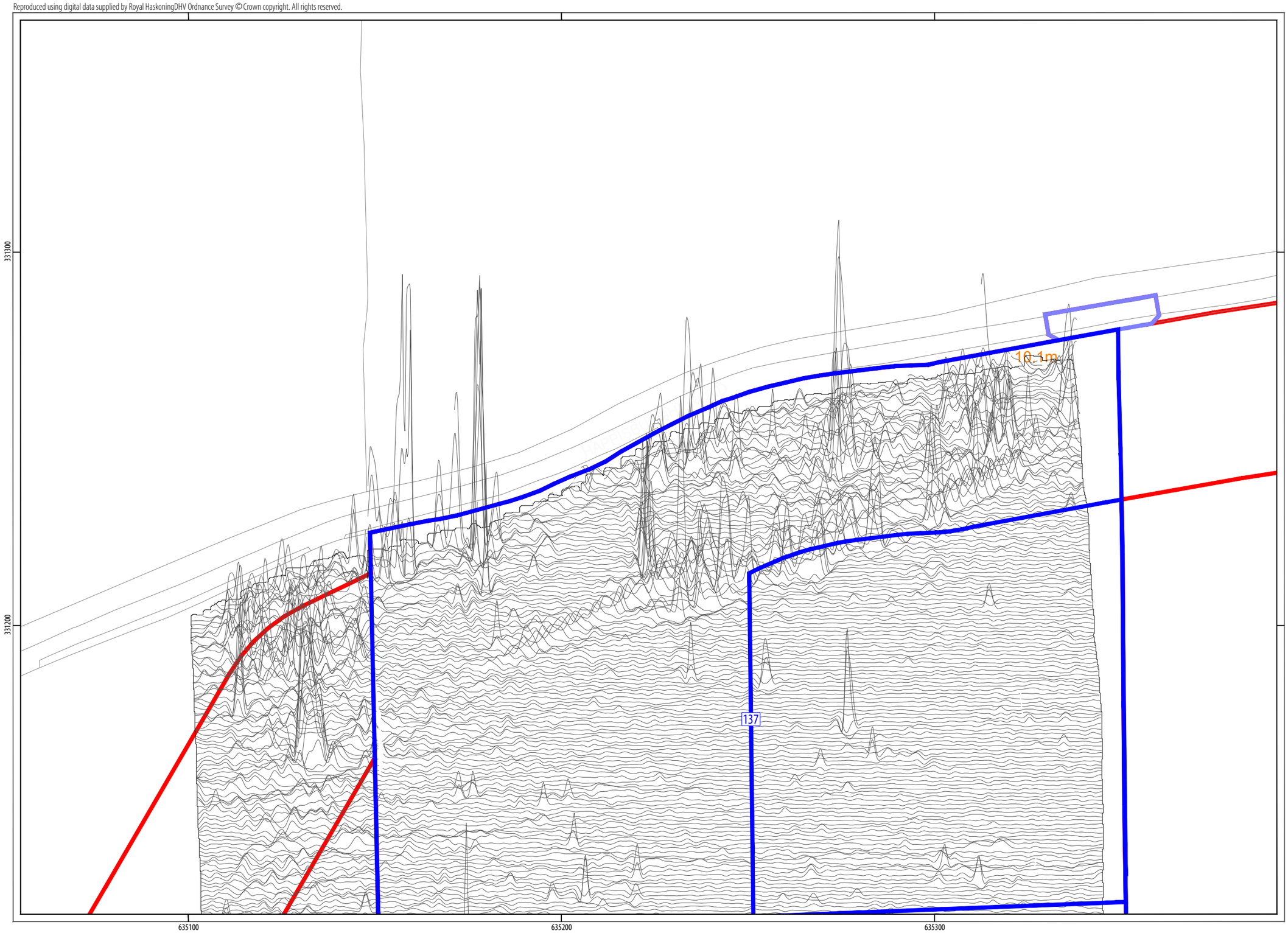
ILLUS 248 Processed greyscale magnetometer data; AAA16



norfolk vanguard red line boundary
mobilisation area
access route

20.0nT/cm

0 25m
1:1,000 @ A3

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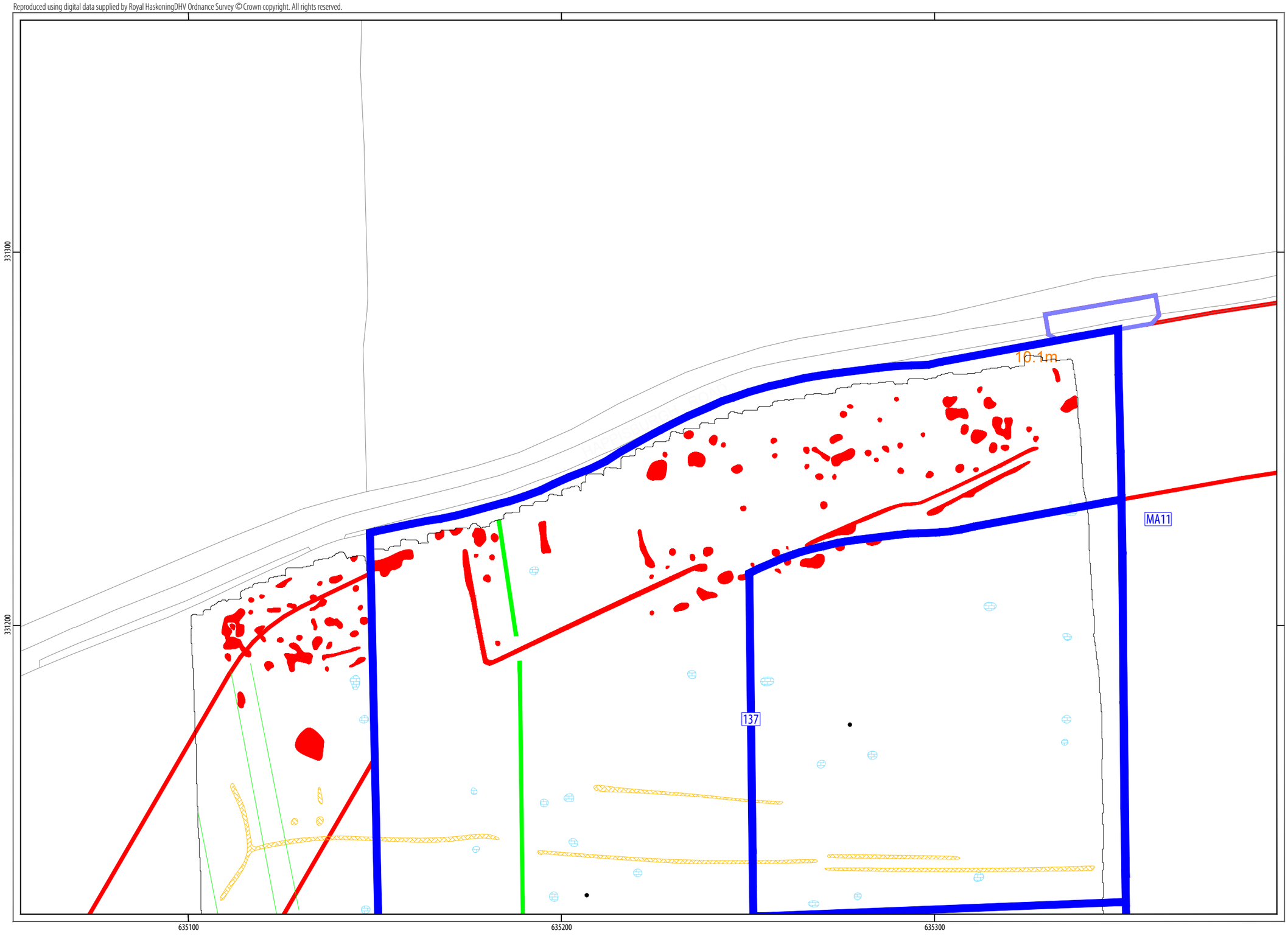
ILLUS 249 XY trace plot of minimally processed magnetometer data; AAA16



- norfolk vanguard red line boundary
- mobilisation area
- access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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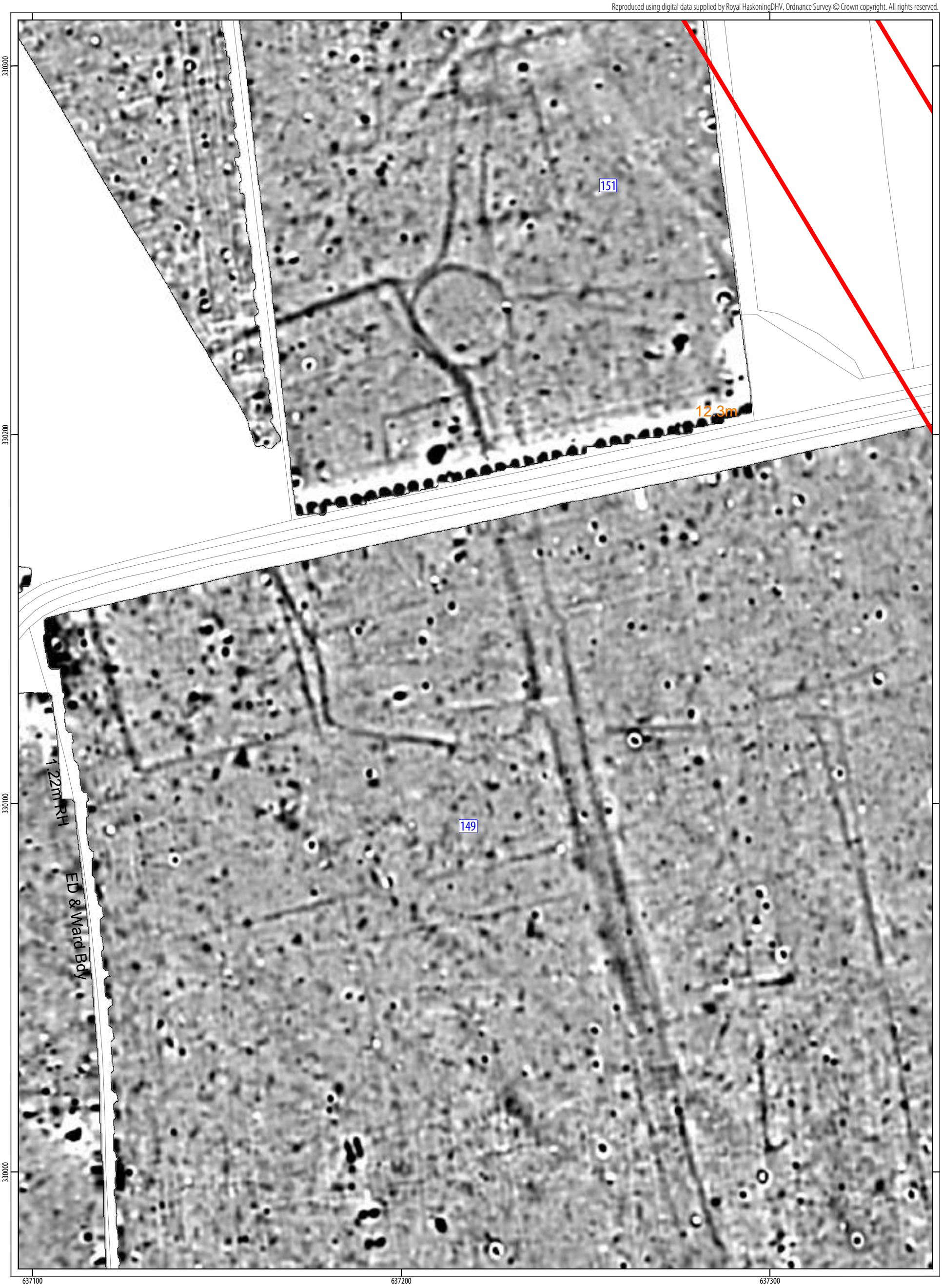
ILLUS 250 Interpretation of magnetometer data; AAA16



norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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ILLUS 251 Processed greyscale magnetometer data; AAA17

330300
330200
330100
330000
637100
637200
637300

151
149
12.3m
1.22m RH
ED & Ward Bdy

norfolk vanguard red line boundary

20.0nT/cm

0 25m
1:1,000 @ A3

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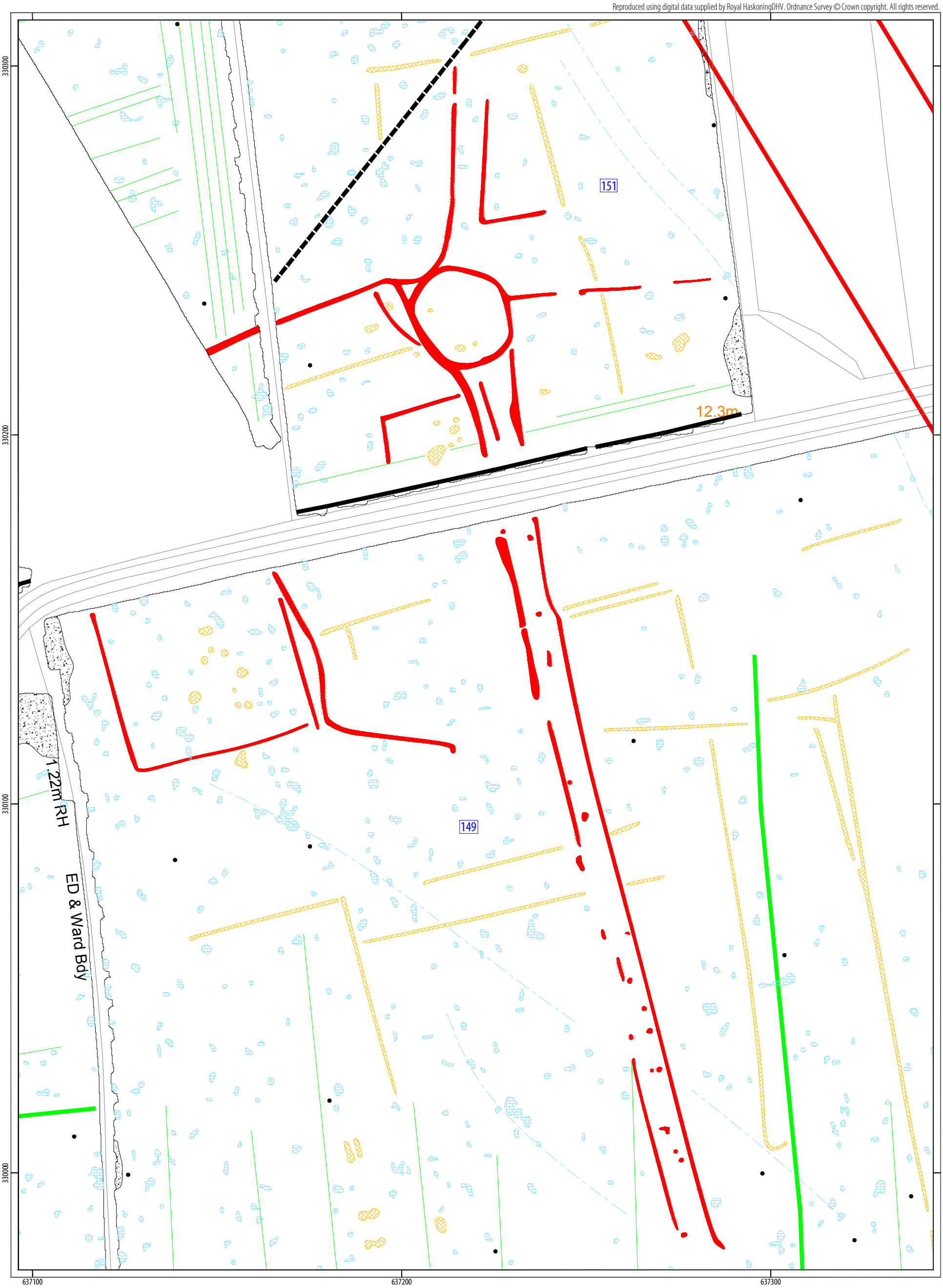
ILLUS 252 XY trace plot of minimally processed magnetometer data; AAA17



norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	service pipe
linear trend	agricultural

TYPE OF ANOMALY	INTERPRETATION
linear	former field boundary
linear	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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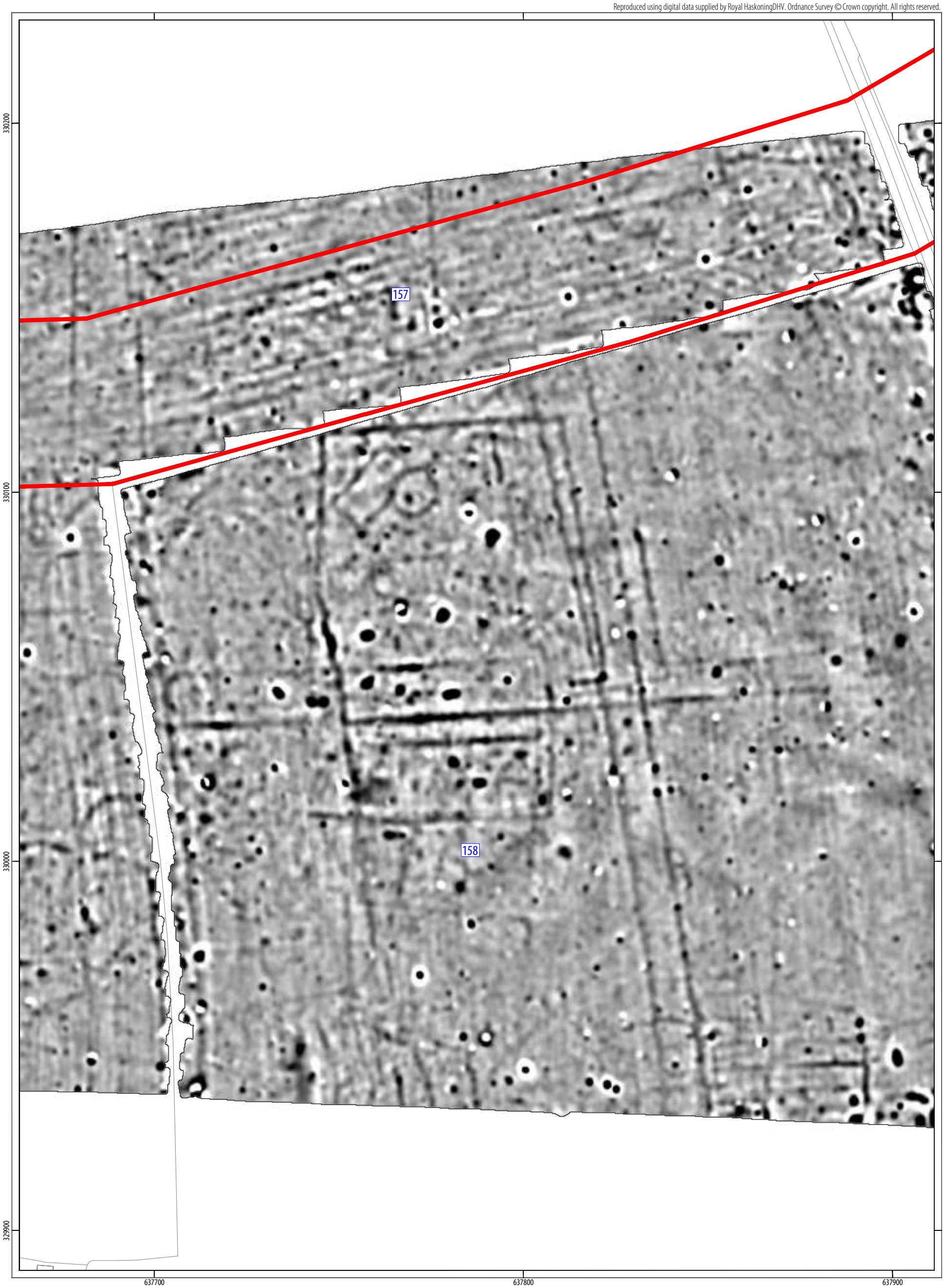
ILLUS 253 Interpretation of magnetometer data; AAA17



norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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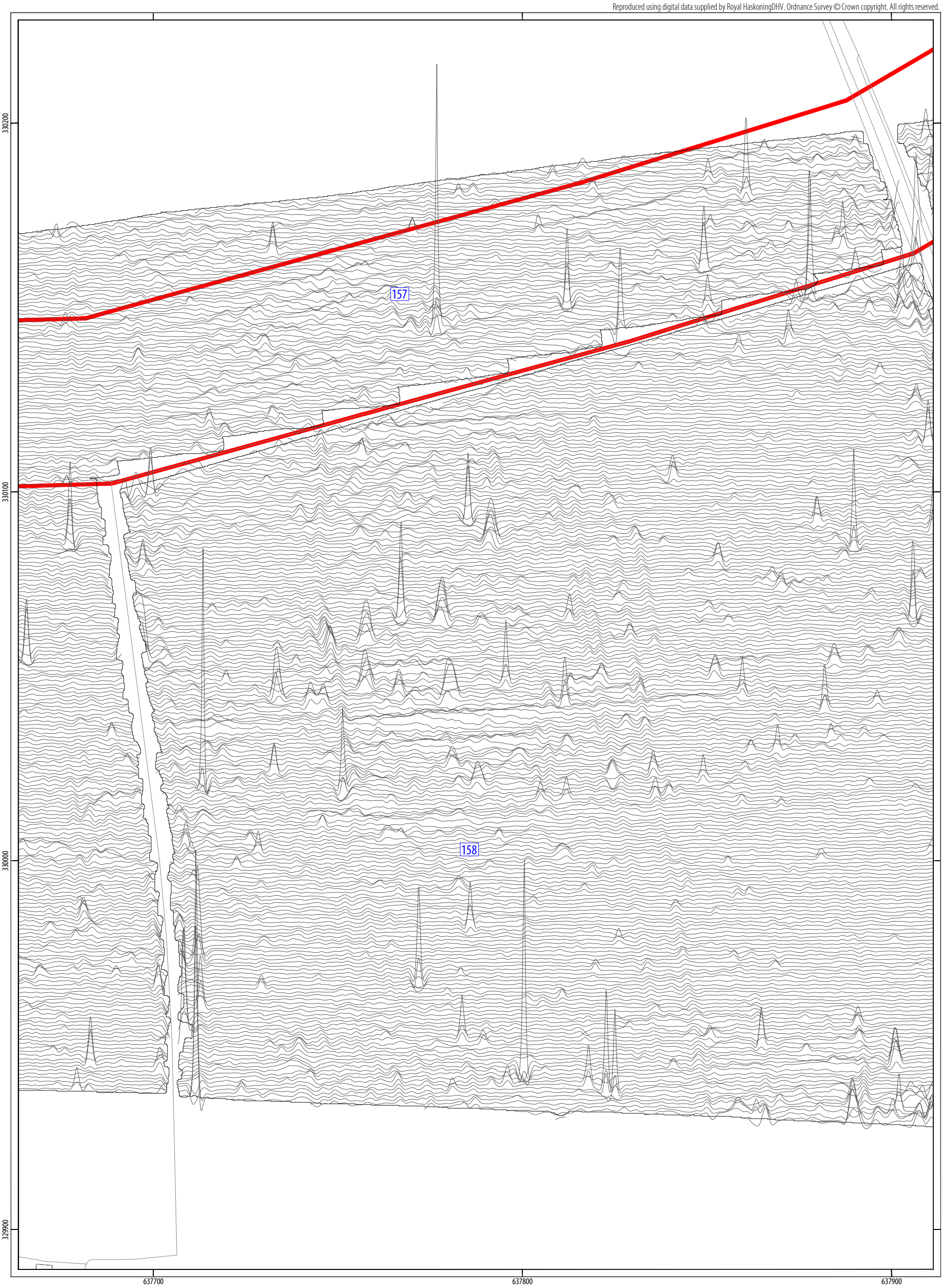
ILLUS 254 Processed greyscale magnetometer data; AAA18



norfolk vanguard red line boundary

20.0nT/cm

0 25m

1:1,000 @ A3

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ILLUS 255 XY trace plot of minimally processed magnetometer data; AAA18

330200
330100
330000
329900
637700
637800
637900
157
158

norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary?
linear	former field boundary

TYPE OF ANOMALY	INTERPRETATION
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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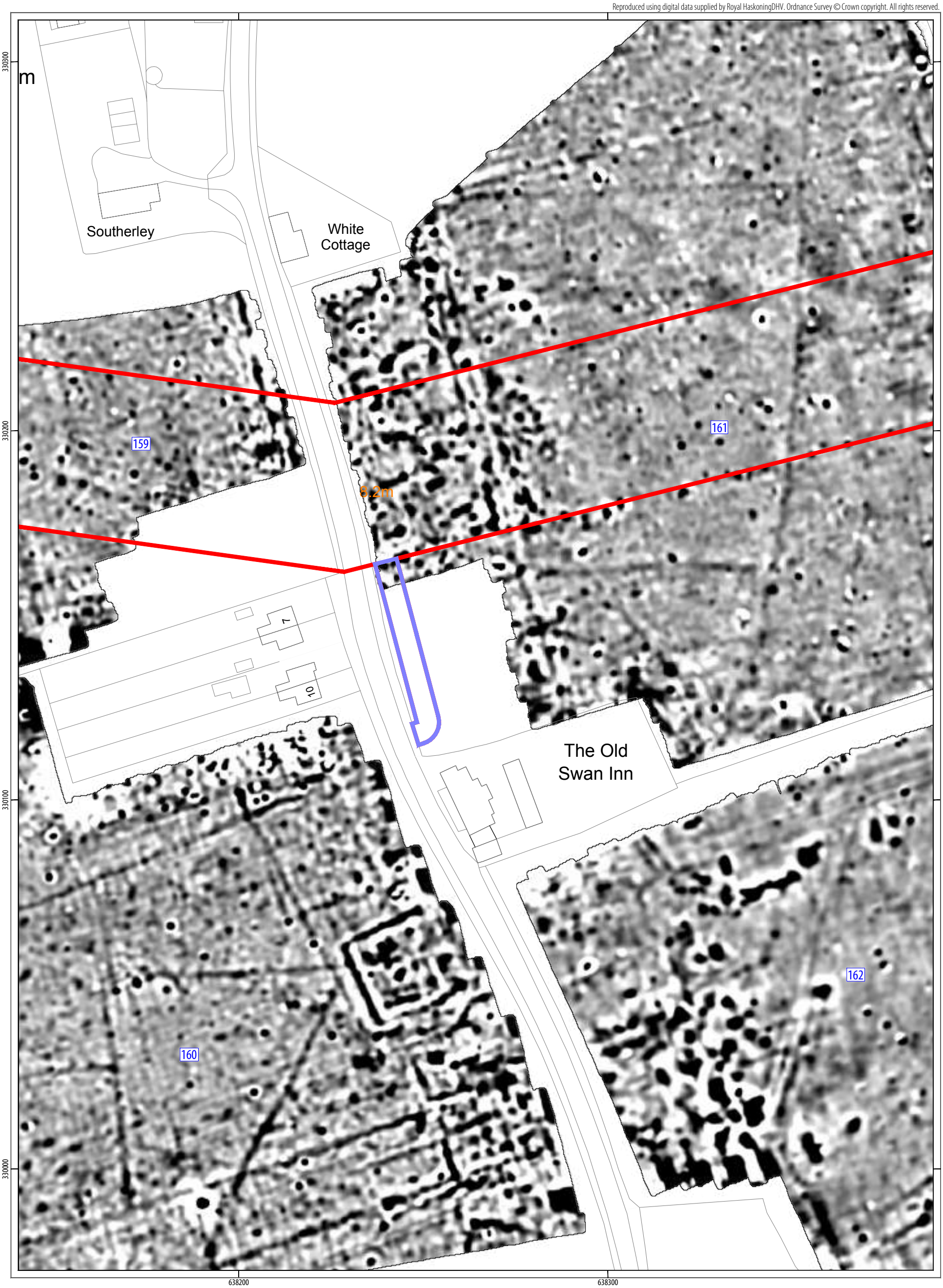
ILLUS 256 Interpretation of magnetometer data; AAA18



norfolk vanguard red line boundary

access route

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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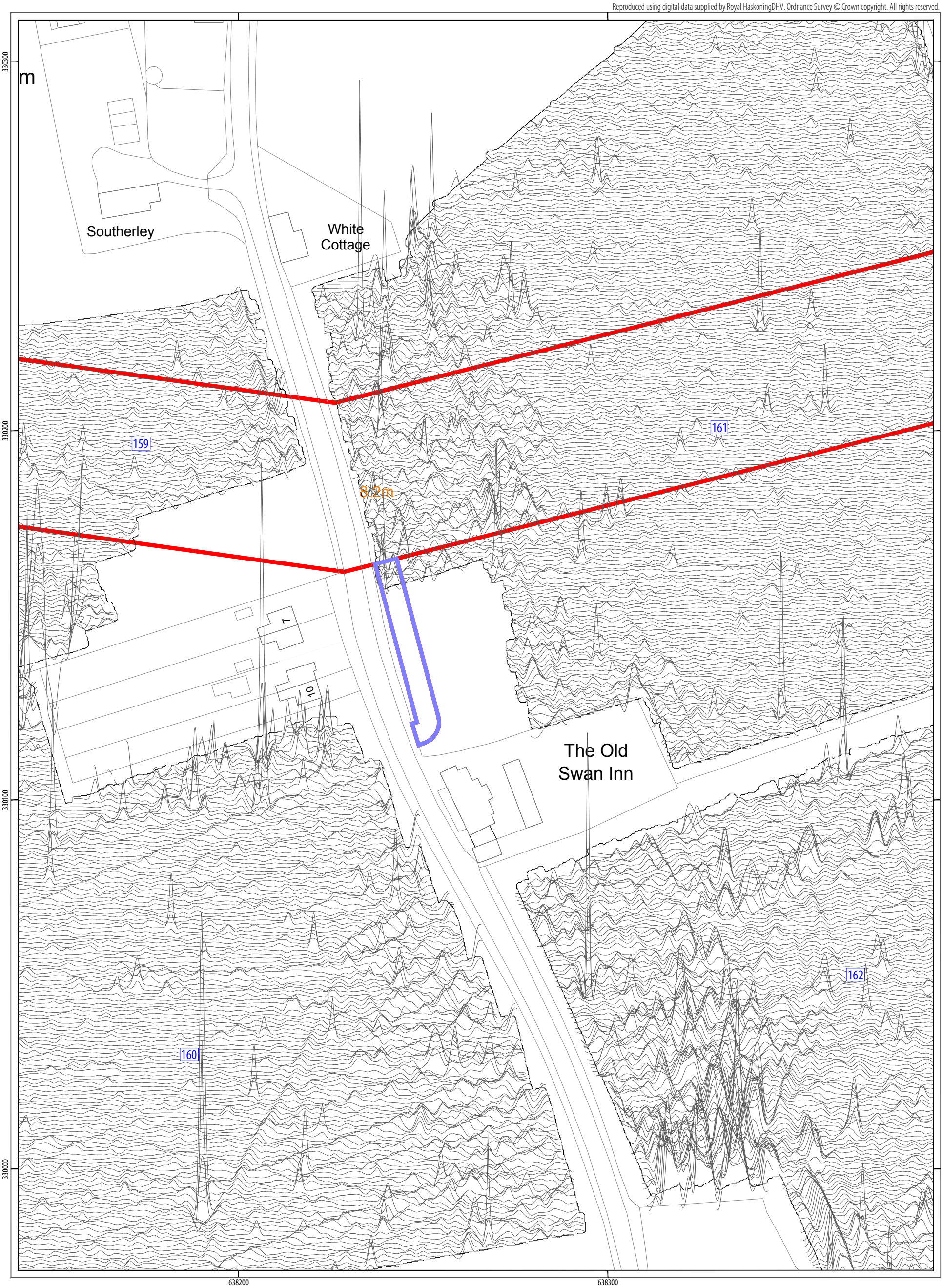
ILLUS 257 Processed greyscale magnetometer data; AAA19



norfolk vanguard red line boundary

access route

20.0nT/cm

0 25m

1:1,000 @ A3

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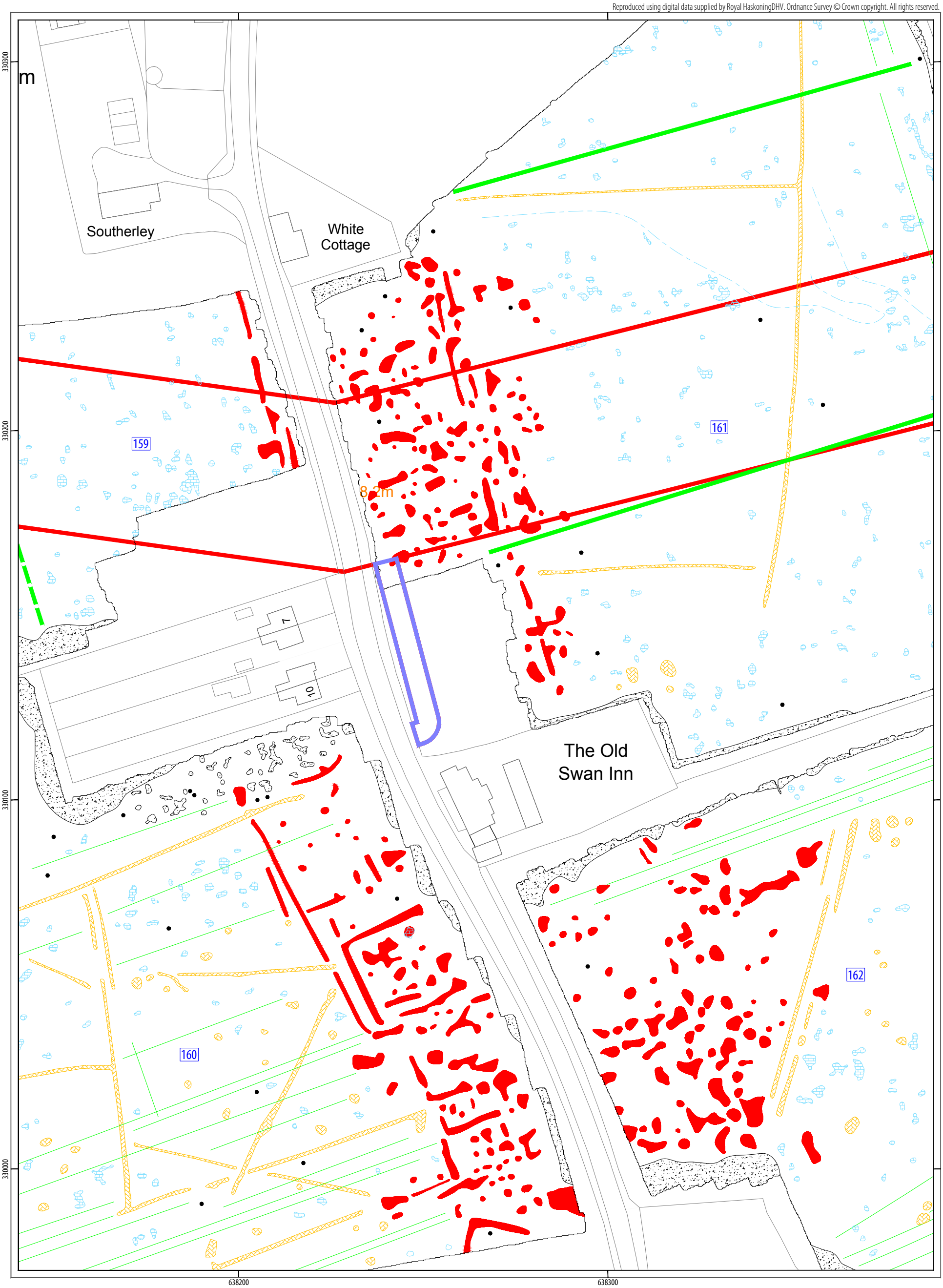
ILLUS 258 XY trace plot of minimally processed magnetometer data; AAA19



norfolk vanguard red line boundary
access route

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary?
linear	former field boundary

TYPE OF ANOMALY	INTERPRETATION
linear trend	geology
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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ILLUS 259 Interpretation of magnetometer data; AAA19

norfolk vanguard red line boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

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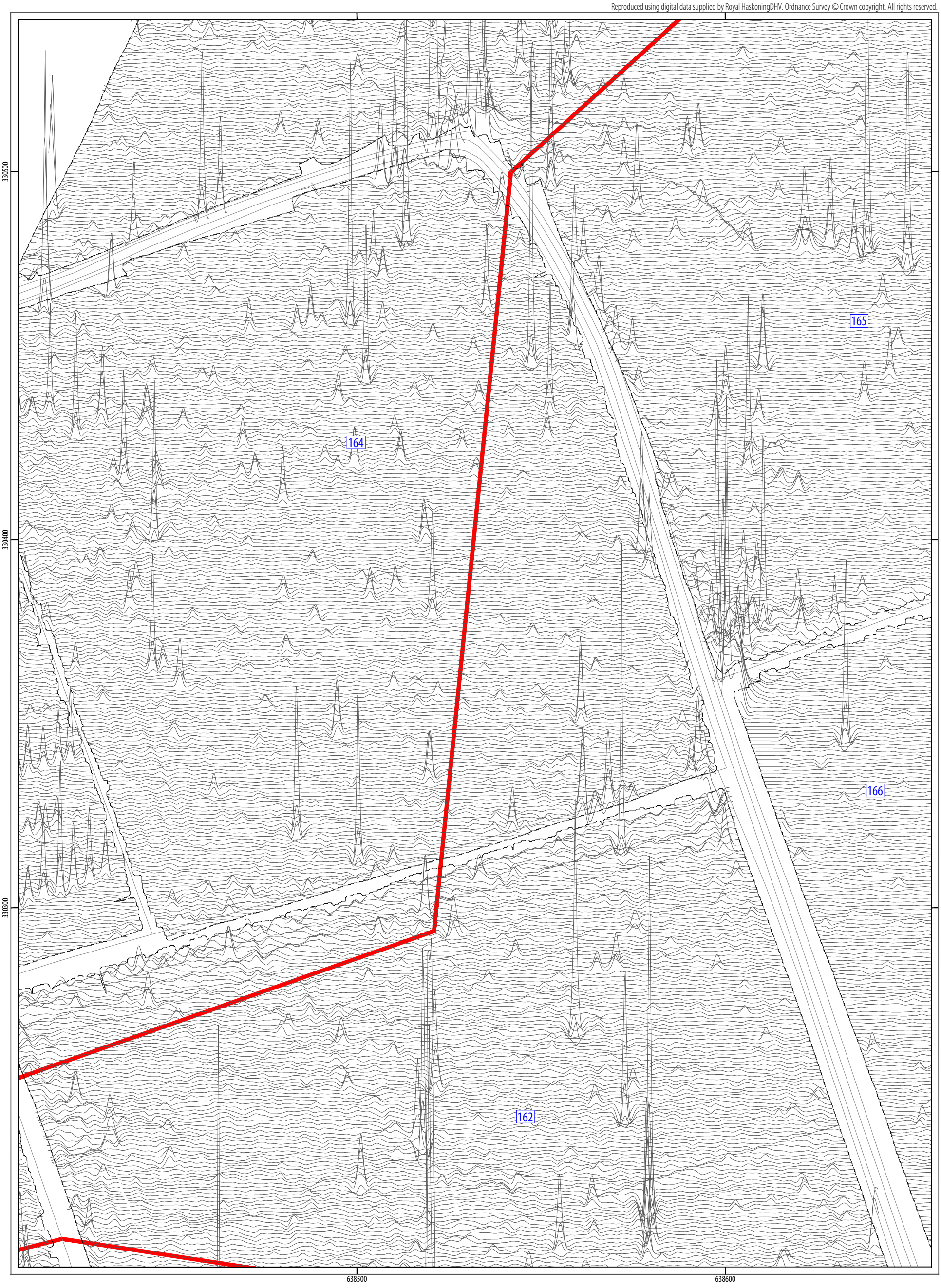
ILLUS 260 Processed greyscale magnetometer data; AAA20



norfolk vanguard red line boundary

20.0nT/cm

0 25m

1:1,000 @ A3

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ILLUS 261 XY trace plot of minimally processed magnetometer data; AAA20

330500
330400
330300
638500
638600
165
164
166
162

norfolk vanguard red line boundary

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary
linear trend	geology

TYPE OF ANOMALY	INTERPRETATION
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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ILLUS 262 Interpretation of magnetometer data; AAA20

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Types of magnetic anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes) These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

Data is also clipped to remove extreme values and to improve data contrast.

APPENDIX 5 DATA REPEATABILITY

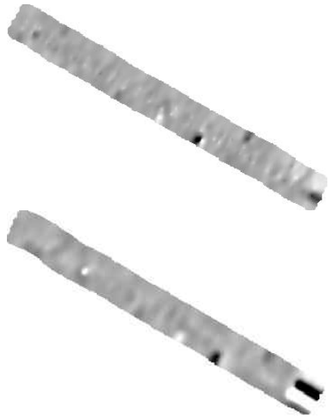
At the completion of each day of survey, a 30m traverse from the start of the final area covered that day was repeated prior to leaving site in order to demonstrate the repeatability of the results.

AREA 151
Surveyed at 09:13 and 11:37 on 18/01/2018

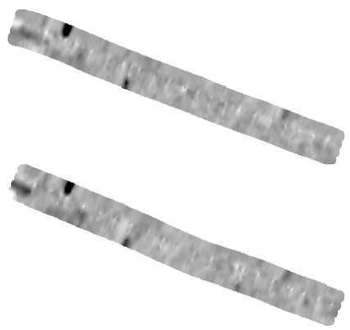
AREA 14
Surveyed at 10:16 and 12:21 on 03/11/2017

AREA 165
Surveyed at 08:44 and 10:27 on 19/10/2017

AREA 165
Surveyed at 09:23 and 16:13 on 17/10/2017



AREA 10
Surveyed at 09:42 and 14:43 on 31/01/2018



AREA 49
Surveyed at 13:53 and 15:28 on 23/01/2018

AREA 123
Surveyed at 09:10 and 11:40 on 30/01/2018

nT
-1.0 2.0

0 200m
1:7,500 @ A3

PROJECT NVOW17
Priority Archaeological Geophysical Survey
(Terrestrial Archaeology)
Norfolk Vanguard Offshore Wind Farm

CLIENT Royal HaskoningDHV

HEADLAND ARCHAEOLOGY

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APPENDIX 6 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-315394

Project details	
Project name	PRIORITY ARCHAEOLOGICAL GEOPHYSICAL SURVEY (TERRESTRIAL ARCHAEOLOGY)
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 600 hectares, along the onshore cable corridor and associated onshore project area for the Norfolk Vanguard Offshore Wind Farm, in order to provide further information about the archaeological potential of the cable route. This work was focussed on areas identified in the Archaeological Desk-Based (baseline) Assessment (DBA), as potentially containing buried archaeological remains following preliminary analysis of aerial photographs, LiDAR, and Historic Environment Record (HER) data. The survey successfully evaluated 127 Priority Archaeological Geophysical Survey Areas, identifying twenty distinct areas of clear archaeological activity ranging from isolated ring-ditches to extensive areas of settlement and enclosure. Most of these areas were previously known, although some were less extensive than has been identified by the geophysical survey, whilst several others were not known at all. These areas are assessed as being of high archaeological potential. Anomalies at numerous other locations have been interpreted as being of possible archaeological potential, including possible field systems, trackways, isolated ditches and pits. However, the weak, fragmentary nature of these possible archaeological anomalies, or an absence of supporting archaeological information (cropmarks or HER data), precludes a more confident interpretation. These anomalies are ascribed a moderate archaeological potential.
Project dates	Start: 17-10-2017 End: 09-03-2018
Previous/future work	Yes / Yes
Any associated project reference codes	NVOW17 - Contracting Unit No.
Any associated project reference codes	ENF142815 - HER event no.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Current Land use	Grassland Heathland 5 - Character undetermined
Monument type	N/A None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	"Geophysical Survey"
Development type	Wind farm developments
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology	CHALK (INCLUDING RED CHALK)

Solid geology (other)	CRAG GROUP
Drift geology	GLACIAL SAND AND GRAVEL
Drift geology	ALLUVIUM
Drift geology	RIVER TERRACE DEPOSITS
Drift geology	BOULDER CLAY AND MORAINIC DRIFT
Drift geology	SAND AND GRAVEL OF UNCERTAIN AGE OR ORIGIN
Techniques	Magnetometry
Project location	
Country	England
Site location	NORFOLK BROADLAND AYLSHAM NORFOLK VANGUARD OFFSHORE WIND FARM
Study area	600 Hectares
Site coordinates	TF 8863 1082 52.661807930992 0.789564636405 52 39 42 N 000 47 22 E Line
Site coordinates	TG 3894 3046 52.818099133426 1.546490768235 52 49 05 N 001 32 47 E Line
Project creators	
Name of Organisation	Headland Archaeology
Project brief originator	Consultant
Project design originator	Headland Archaeology
Project director/manager	Harrison, S
Project supervisor	Bishop, R
Type of sponsor/funding body	Developer
Project archives	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	''Survey''
Digital Media available	''Geophysics'','Survey''
Paper Archive Exists?	No
Project bibliography 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	PRIORITY ARCHAEOLOGICAL GEOPHYSICAL SURVEY (TERRESTRIAL ARCHAEOLOGY) NORFOLK VANGUARD OFFSHORE WIND FARM

Author(s)/Editor(s)	Harrison, D.
Date	2018
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
Description	PDF/A
Entered by	David Harrison (david.harrison@headlandarchaeology.com)
Entered on	Entered on 25 April 2018

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