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Geophysical survey in the graveyard of the Church of Ss David Lewis & Francis Xavier, Usk

Dr Tim Young
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Dr T.P. Young

Abstract

A ground resistivity survey was conducted across the graveyard of the church in an attempt to determine the possible extend of inhumations. The extant grave-markers and other features were recorded during the survey, as were the slight surface expressions of otherwise unmarked graves.

The area currently shows remains of a former path close to its north boundary. This has small areas of tarmac visible and similar surfacing is visible at the northern end of a hollow across the lower part of the graveyard along the line of another former path. Surface features and the geophysical data provide evidence for an arcuate path across the east end of the graveyard, probably curving approximately symmetrically behind (i.e. upslope of) a yew tree at either end. These paths divide the graveyard into three sectors:

- the sector nearest the church shows small grave-markers at its southern side, and a restored grave (Watkins) at its northern side. The geophysical data suggest that there are various graves adjacent to the church (Row 0), possibly on variable orientations because the church and graveyard are on different axes, and then a probably continuous row of graves (Row 1), with a further row (Row 2) adjacent to the lower path, but which may not certainly fully occupied.
- the second sector, between the two paths, contains sufficient space for four rows of graves. The western, Row 3, is narrow and adjacent to the lower path, shows only slight possible geophysical evidence for graves in its central part, and may even be empty (except for the large slab adjacent to the large McDonnell enclosure, marked VAULT, which may cover access to a vault below the enclosure, rather than being a separate grave). The second row (Row 4) contains five prominent graves (including the possible McDonnell vault) with geophysical evidence suggesting up to four others. The third row (Row 5) has the William Williams grave at, or close to, its northern end and the Fisher memorial close to its southern end. In between, there is subtle topographic evidence for graves, tallying well with geophysical evidence for approximately ten graves. The potential fourth row (Row 6), on the rising ground adjacent to the eastern path shows a rather variable resistivity, with a complex resistivity low to the south and slighter anomalies just to the north of the midline of the graveyard, which might possibly be graves, but the evidence is much weaker than for the row to the west.
- the third sector comprises the strongly rising ground at the east end of the graveyard. The central part of this sector is occupied by the steps. To the south of the steps is a very strong positive resistivity anomaly, possibly indicative of rubble or stonework (perhaps a base for a cross or statuary?). Other areas to both the south and north of the steps show slight oblique anomalies, possibly suggestive of former planting arrangements. There was no geophysical evidence for graves in this sector.

The southern margin of the graveyard shows a band of very variable resistivity up to 3m wide adjacent to the bounding wall. This zone shows considerable brick debris on the surface and may have been disturbed during construction or rebuilding of the wall. An alternative interpretation of this zone would be that it too represents a path. Given the evidence for the more elaborate nature of the eastern path and its almost symmetrically-placed Yew trees, a path on the south mirroring that on the north might not be unexpected. With or without a southern path it is clear that graveyard had a much more formal design than is currently apparent.

In summary, the geophysical evidence suggests the presence of five rows of graves, with the possibility of graves in a sixth row adjacent to the lower path. There was no clear evidence for additional graves in the more strongly rising eastern part of the graveyard, but there were hints of a more formal previous garden layout in this area.

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Methods

Survey rationale and background
The survey was undertaken to investigate the distribution of graves within the graveyard of the church of Ss David Lewis & Francis Xavier, Usk, [SO376010) with the aim of locating areas suitable for the interment of urns.

The site lies on bedrock of the Lower Llanbadoc Beds (Silurian) which crop out on the rising ground to the east, and which is overlain by alluvium to the west.

The survey was conducted on the 1th May 2016, 24th March 2016, under good dry conditions.

The survey was commissioned by Frank Evans.

Surveys are undertaken within the CIfA and HE guidelines.

Survey layout
The survey grid employed a base-line in alignment with the N wall of the chancel of the church, with a grid peg 1.3m from the church (survey grid x=0m) and one 26.3m (survey grid x=25m). A second line was laid out 8m north of the first to control the N-S walked traverses (Figure 1).

Grids were laid out using tape measures and were temporarily marked by bamboo canes. Key right-angled gridline intersections were established using a Nikon DT330 EDM.

Please note that the survey was not an accurately conducted topographical survey and that Figure 1 and the backdrop mapping to subsequent figures should only be regarded as indicative.

Ground resistivity
The ground resistivity survey was undertaken with a Geoscan RM15 resistivity meter, operating a 'parallel twin electrode' configuration, employing three electrodes with 0.5m probe spacing on a PA5 frame, via an MPX15 multiplexer.

In this configuration, the adjacent mobile electrode pairs had a 0.5m spacing (giving the main component of the response from 0.5-0.7m depth), with 0.5m between centres, to give a 0.5m effective traverse interval. The outer probes therefore had a 1.0m spacing (giving the main component of the response from 1.0-1.5m depth), with a 1.0m traverse interval.

Data were collected as a series of three measurements (left 0.5m-, right 0.5m-, 1.0m-spaced). Data were collected with a 0.5m sample interval (i.e. the raw 0.5m-spaced data has 0.5 x 0.5m node spacing and the 1.0m-spaced data has a 0.5 x 1.0m node spacing). Grids were walked on South to North traverses in a zig-zag pattern.

Data were downloaded from the instrument and collated using Geoscan Research's '*Geoplot*' software. The left and right datasets at 0.5m mobile probe spacing were merged into a single composite.

Data processing was then limited to one pass of the 'despike' function in Geoplot, with radius set to 1 and a threshold of 3 std. dev., using Gaussian statistics..

Data were then exported from Geoplot and imported to Golden Software's 'Surfer'. The data were gridded by kriging to a node-spacing of 0.125m for production of the final, less pixelated, image.

Use of this report
The technique chosen for the survey, ground resistivity, was selected for its utility in detecting cut features such as graves, where these are differentiated by groundwater content . As with any geophysical technique, it is always possible for archaeological features to be present, but not to be distinguished, or distinguishable, by variation in the physical properties being examined at the time of survey – in this case water content. Absence of detectable geophysical anomalies cannot be taken as indicative of the absence of archaeological features. All anomalies have been interpreted as far as possible, with contrasting possible interpretations given where appropriate. Geophysical techniques cannot provide an unambiguous evaluation of buried features. Where a higher degree of certainty is required, physical ground-truthing of any geophysical anomalies resolved by the survey will be required.

Results

The raw ground resistivity data (after correcting the assembly and despiking) are illustrated in Figure 2. The upper images show the results from the 0.5m-spaced mobile probes ((a) gives the raw data and (b) the despiked data) and the lower images the results from 1.0m-spaced mobile probes ((c) gives the raw data and (d) the despiked data).

Figures 3 and 4 display the interpolated data.

Data quality was generally good, but with very minor striping parallel to the traverses. Striping in 0.5m-spaced datasets may occur as a result of slight electrical asymmetry of the left and right electrode pairs on the frame.

Interpretation

The interpretation of the geophysical results is illustrated in Figures 5 and 6.

With the area of certain burials, the geophysical response over the graves is variable. The interpretative figure (Figure 5) mostly, therefore, illustrates the location of edges in the geophysical data, rather than areas of elevated or reduced resistivity.

Two areas of the graveyard, marked as 'a' and 'b' on Figure 6, show wider zones of low resistivity. In neither case is the cause of the anomaly clear, although both occur adjacent to yew trees. The groundwater in these areas may possibly be enhanced by natural seepage. Area 'b' apparently shows margins influenced by the oblique orientation of minor linear negative anomalies of the disturbed zone along the southern margin of the graveyard. These anomalies may be produced deliberate drainage features, perhaps associated with a putative southern path, but might equally be associated with landscaping or other groundworks.

The extent of paths is indicated by small areas of thin tarmac (mainly close to the entrance to the graveyard), by topography (either in the case of the lower path as a hollow, or as in the case of the upper path, slight breaks of slope demarking a narrow terrace), by zones of distinctive resistivity, typically lowered but variable, and by zones in which in which penetration of the probes of the resistivity frame encountered a 'crunchy' medium. The graveyard currently only shows a surfaced path close to its north boundary and an adjacent length of the lower path. Surface features and the geophysical data provide evidence for an arcuate path across the east end of the graveyard, probably curving approximately symmetrically behind (i.e. upslope of) the yew trees at either end. Between the yew trees the path exists as a terrace, but it is no longer expressed topographically in these suggested zones at either end.

The upper and lower paths divide the graveyard into three sectors:

- the sector between the church and lower path shows several small grave-markers towards its southern side, and a restored grave (Watkins) on its northern side. The geophysical data suggest that there are various graves adjacent to the church (Row 0 of Figure 6), possibly on variable orientations because the church and graveyard are on different axes, and then a probably continuous row of graves (Row 1), with a further possible row (Row 2) adjacent to the lower path. Row 1 is the first row largely within the area of the resistivity survey. Although individual discrete grave cuts are not well-imaged, discontinuities in the data mark edges of graves and suggest that the row is fully occupied. The precise alignment of the row on the southern side of the graveyard is uncertain and there is a marked discrepancy between the alignment of the row and the geophysical anomalies within it and that of the extant grave-markers that are slightly oblique. The Scully memorial lies in the adjacent Row 2 to the east. The space between Row 1 and the lower path includes two areas with probable geophysical evidence for graves, and it would appear likely that Row 2 is also fully occupied.

- the second sector, between the two paths contains sufficient space for four rows of graves. The western, Row 3, adjacent to the lower path, shows only slight possible geophysical evidence for graves in its central part, close to a yew tree, and may even be empty (except for the large slab adjacent to the large McDonnell enclosure, marked VAULT and which may cover access to a vault below the enclosure, rather than being a separate grave). The second row (Row 4) contains five prominent graves (including the possible McDonnell vault) with geophysical evidence suggesting up to four others. The third row (Row 5) has the William Williams grave at, or close to, its northern end and the Fisher memorial at its southern end. In between, there is subtle topographic evidence for graves, tallying well in location with geophysical evidence, probably for approximately ten graves. The potential fourth row, on the rising ground adjacent to the eastern path shows a rather variable resistivity, with a complex resistivity low to the south and slighter anomalies just to the north of the midline of the graveyard, which might possibly be graves, but the evidence is much weaker than for the row to the west.

- the third sector comprises the strongly rising ground at the east end of the graveyard. The central part of this sector is occupied by the steps. To the south of the steps is a very strong positive resistivity anomaly (marked as 'c' on Figure 6), possibly indicative of rubble or stonework (perhaps a base for a cross or statuary?). Other areas to both the south and north of the steps show slight oblique anomalies, possibly suggestive of former planting arrangements. There was no compelling geophysical evidence for graves in this sector.

The southern margin of the graveyard shows a band of very variable resistivity up to 3m wide adjacent to the bounding wall. This zone shows considerable brick debris on the surface and may have been disturbed during construction or rebuilding of the wall. An alternative interpretation of this zone would be that it too represents a path. Given the evidence for the more elaborate nature of the eastern path and its almost symmetrically-placed yew trees, a path on the south mirroring that on the north might not be unexpected. With or without a southern path it is clear that graveyard had a much more formal design than is currently apparent. In several areas of this disturbed zone there are oblique negative linear anomalies, including within and bounding negative anomaly 'b'. These anomalies are of uncertain origin, possibly indicative of drainage features or landscaping.

In summary, the geophysical evidence suggests the presence of five rows of graves, with the possibility of a few graves in a sixth row adjacent to the western path. There was no clear evidence for additional graves in the more strongly rising eastern part of the graveyard, although there is a slight possibility of graves immediately below the steps. There were hints of a possible previous formal garden layout in the easternmost area.

Summary

The survey has revealed various details of the layout of the graveyard. The former design appears to have been more symmetrical than at present, with an upper path probably curving upslope of the yew trees at either side, and possibly with a path along the southern wall as well as the northern. Slight negative linear

anomalies on oblique orientations at the east end of the site possibly suggest some formal planting arrangements.

The lower section of the graveyard appears largely full of graves, but there is a lack of evidence for graves in what has been labelled (Figure 6) as Row 3 and this may have been left clear of burials to emphasise the impressive structures present in Row 4. Row 5 appears full of graves across the width of the graveyard, and lies below the more steeply rising ground to the east.

There was little geophysical evidence for graves on the steeper ground of Row 6 and to the east of the upper path. Slight anomalies in the area below the foot of the steps in Row 6 might suggest burials, but these were not as marked as the anomalies in the lower parts of the graveyard. The clarity of the evidence from Row 5 provides some confidence that any similar graves in other areas of the eastern part of the graveyard would also have been imaged.

Linear negative anomalies were present on oblique orientations in the upper section. These might be associated with geology, former land-use or drainage, but perhaps the most likely interpretation is that these indicate bedding trenches for former formal planting.

The southern part of the steep slope close to the steps contains a strong positive resistivity anomaly. This might be due to better drained subsoil (perhaps gravel), but it is possible this marks rubble or stonework associated with a former feature of the graveyard. It would appear unlikely to be a grave, but could, for instance, be a base for a statue or cross.

Although small patches of poor-quality tarmac surfaces are visible on the paths in the lower part of the graveyard, the geophysical data suggest the presence of rather more extensive paths. These show an irregular geophysical response, suggesting they are not substantial structures, but a surface of gravel or clinker would be compatible with the evidence. The upper path appears to terminate upslope of the yew trees both to the north and south sides of the graveyard.

In summary, it appears extremely unlikely that the upper part of the graveyard (Row 6 and eastwards) contains further graves.

Figure Captions

Figure 1: location of the survey area showing baselines of the survey grid (pecked lines) on a sketchmap of the surface features and monuments of the graveyard. Grey circles indicate trees.

Figure 2: ground resistivity survey data as bitmapped images from Geoplot –
a. raw data, survey with 0.5m mobile probe spacing.
b. despiked data, survey with 0.5m mobile probe spacing.
c. raw data, survey with 1.0m mobile probe spacing.
d. despiked data, survey with 1.0m mobile probe spacing.

Figure 3: ground resistivity survey as interpolated data from Surfer –survey with 1.0m mobile probe spacing. Greyscale 20Ω (black) to 45Ω measured resistance (white).

Figure 4: ground resistivity survey as interpolated data from Surfer – survey with 0.5m mobile probe spacing. Greyscale 36Ω (black) to 70Ω measured resistance (white).

Figure 5: summary interpretation of ground resistivity survey on a sketchmap of the surface features and monuments of the graveyard. Grey circles indicate trees. Pale grey tone indicates positive area anomalies, darker tone indicates negative area anomalies, dotted lines indicate discontinuities within dataset.

Figure 6: as Figure 5, but annotated. See text for full explanation.

Figure 1

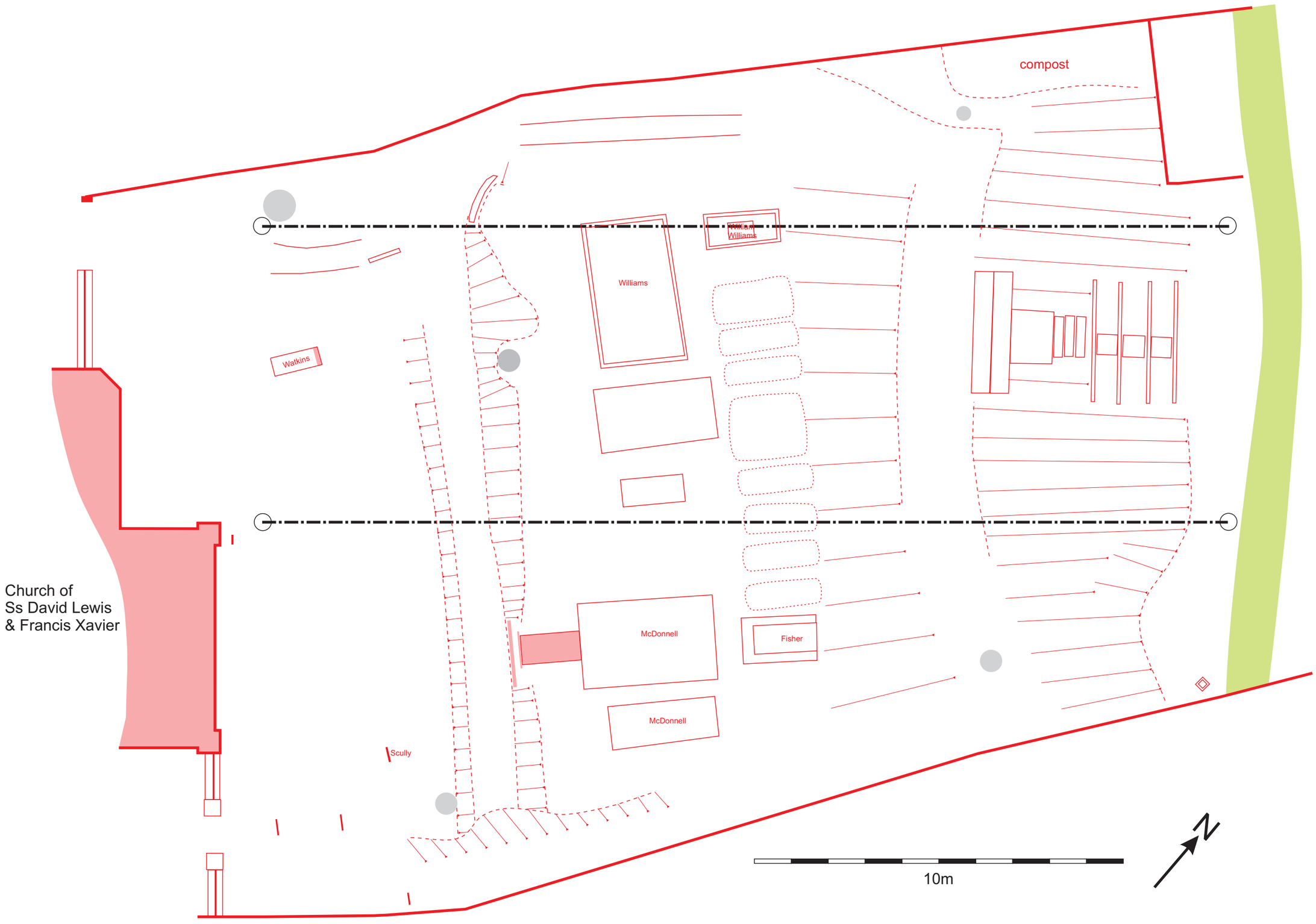
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Figure 2

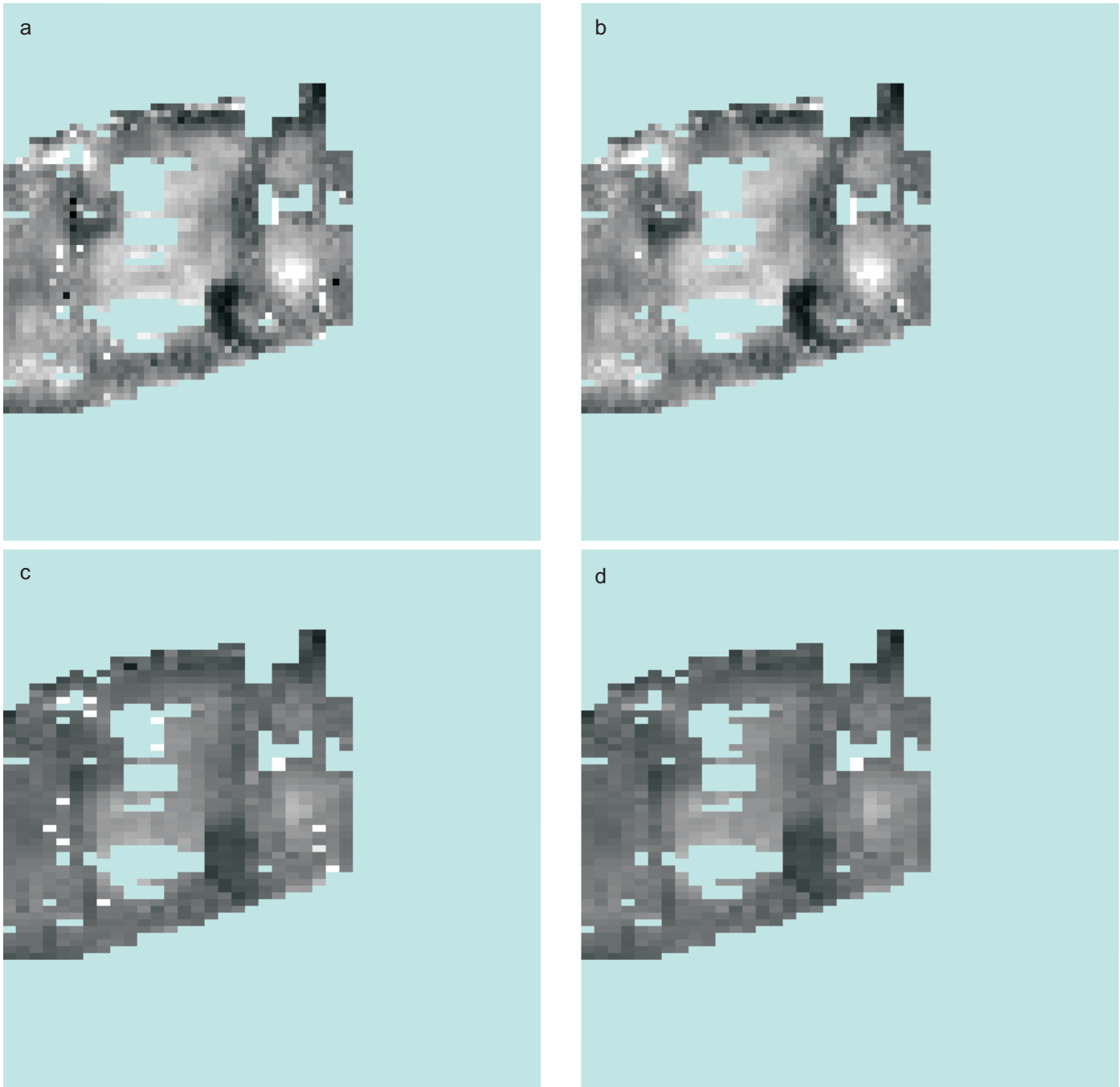

Figure 3

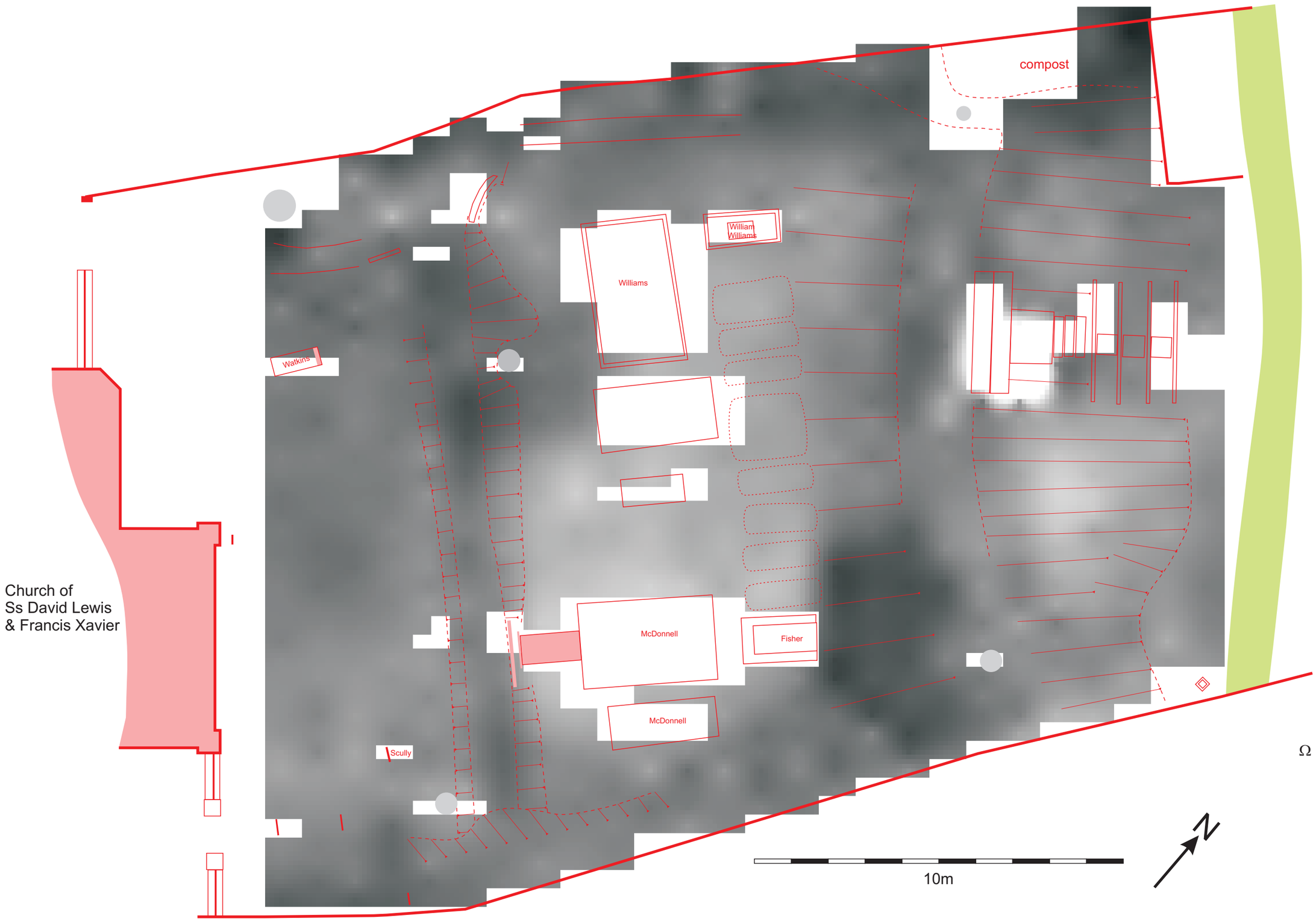
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Figure 4

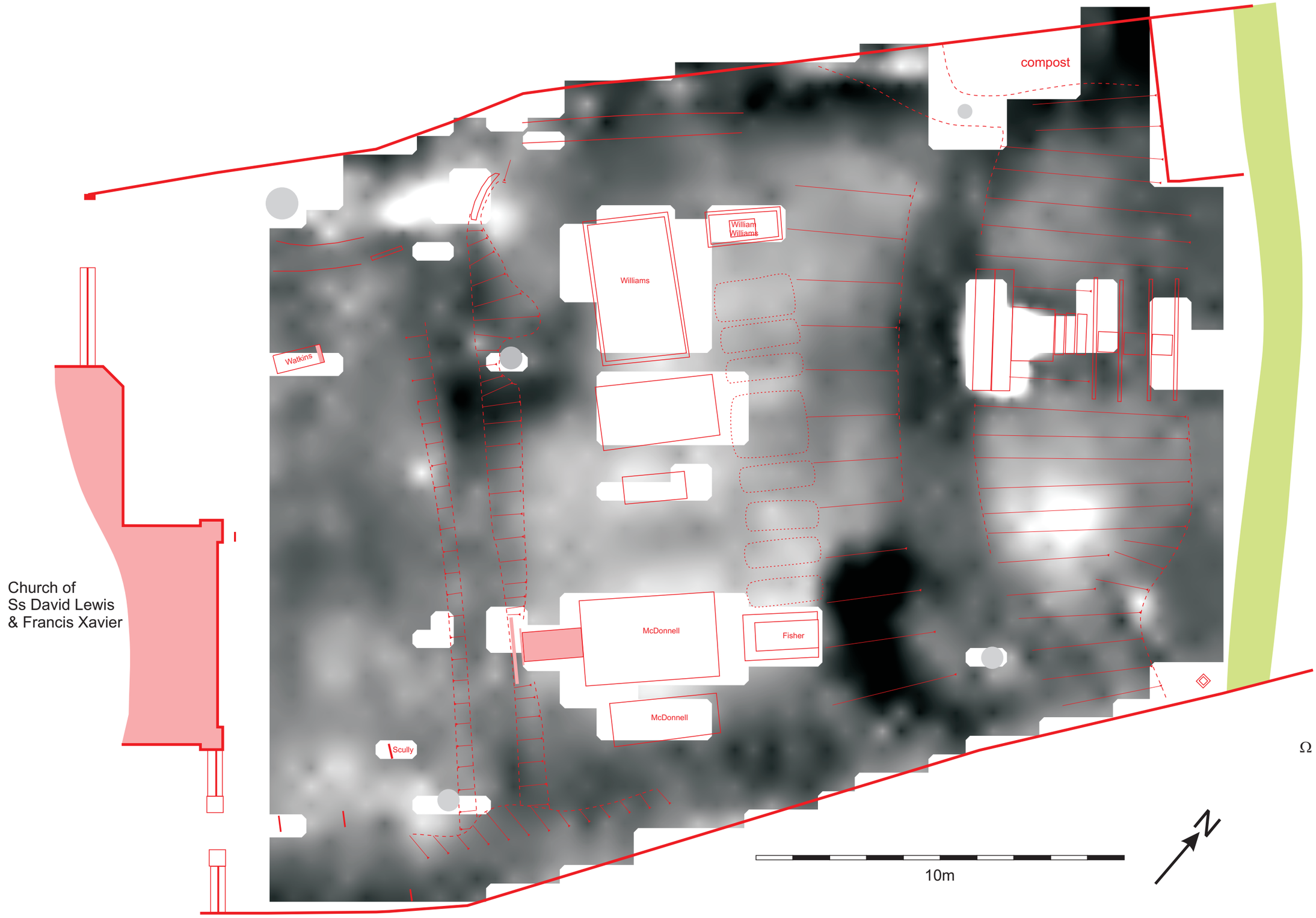
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Figure 5

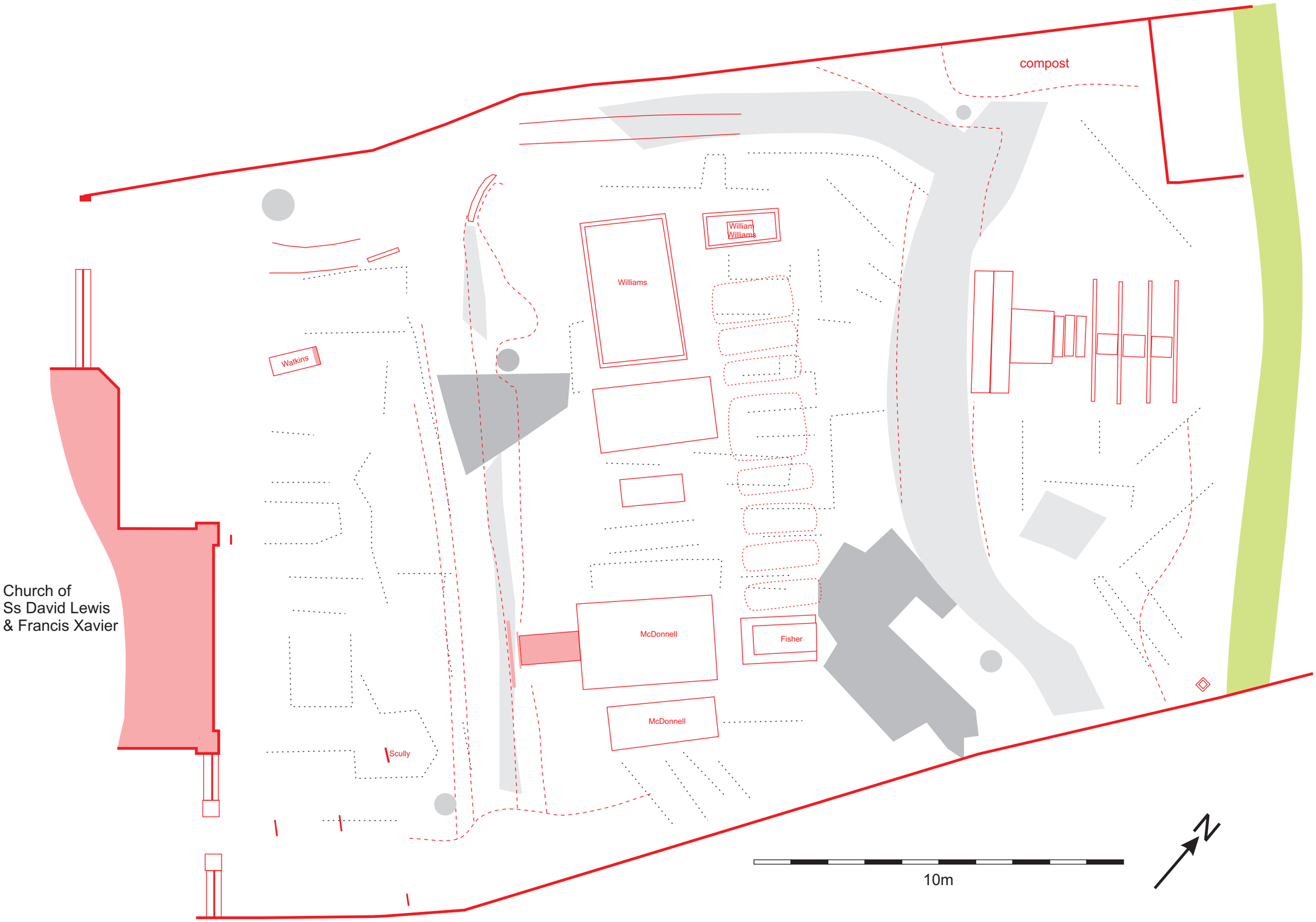
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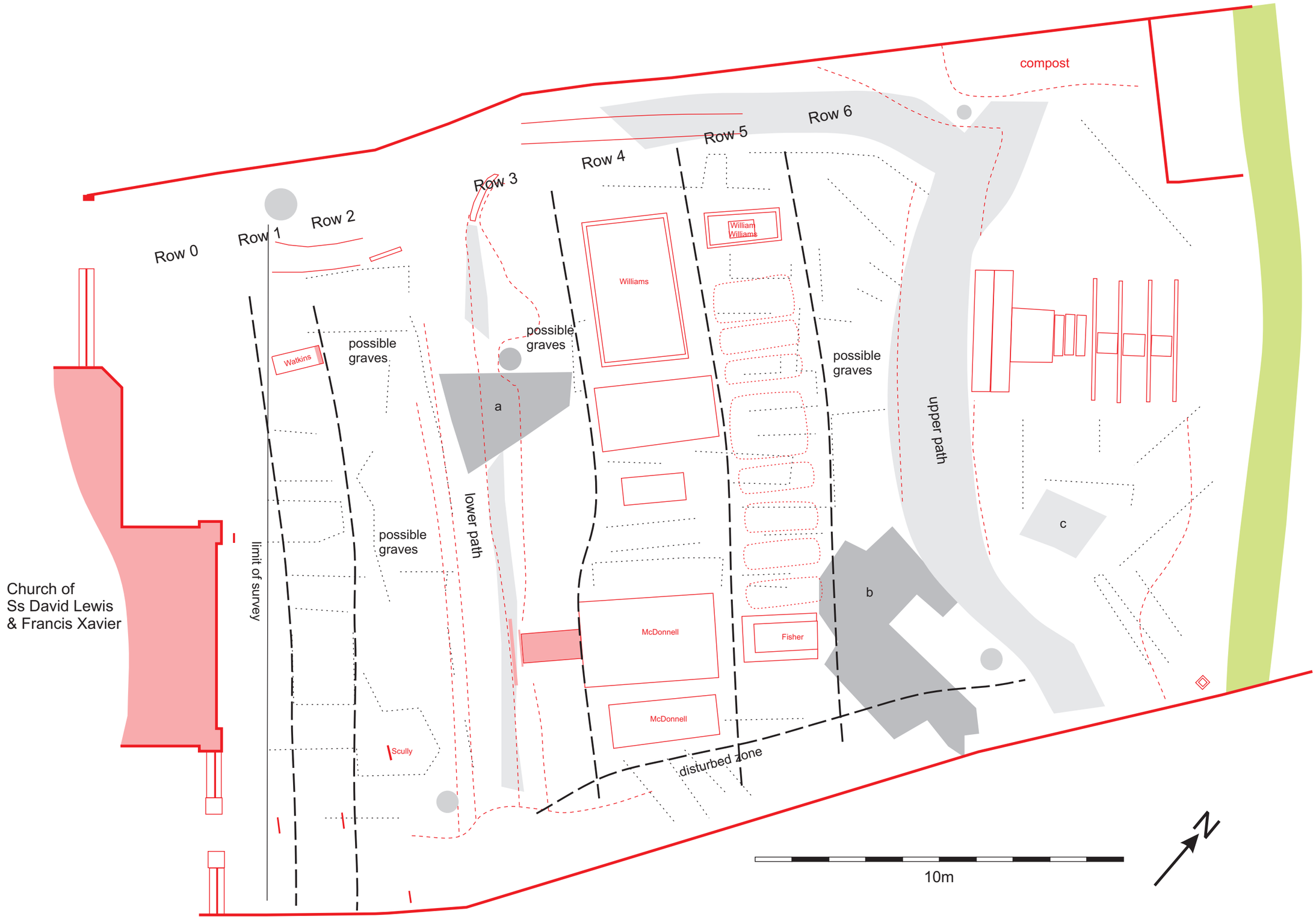
Figure 6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Row 0
Row 1
Row 2
Row 3
Row 4
Row 5
Row 6
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possible graves
Williams
William Williams
possible graves
possible graves
a
upper path
c
b
Church of Ss David Lewis & Francis Xavier
limit of survey
possible graves
lower path
McDonnell
Fisher
McDonnell
Scully
disturbed zone
10m
N

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geoarchaeological, archaeometallurgical & geophysical investigations

Unit 6, Block C,
Western Industrial Estate,
Caerphilly,
CF83 1BQ

Office: 029 20881431
Mobile: 07802 413704

E-Mail: Tim.Young@GeoArch.co.uk
Web: www.GeoArch.co.uk