A Survey of GIS Standards for the English Archaeological Record Community

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Acknowledgements

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Executive Summary

This survey has documented the current uptake of GIS and GI standards in the English archaeological record-keeping community. The results suggest clearly that GIS is now in widespread use and that the majority of SMR staff are relatively comfortable with this technology and its procedures. Although GIS skills technology are now the norm in most HERs, the GIS tend to be very 'inward looking' and very few initiatives have been taken that focus on interoperability and spatial data exchange.

HERs continue to vary greatly in their organisation vis-à-vis parent authorities, their budgeting, technical expertise, domains of responsibility and interactions with other departments; in many cases, GIS infrastructure (e.g. software licenses, hardware, support) remains part of a wider corporate IT provision. This umbrella arrangement appears to work well on the whole, leading to few feelings of disenfranchisement, and often encouraging economies of scale (e.g. on software licenses). Any best practice guidelines about the management and exchange of spatial heritage data should therefore take account of such corporate structures where possible.

Almost all HERs employ a point coverage for their monument data and have digitized a large proportion, if not all, of their key attribute information. Many have also implemented a polygon-based coverage for monuments. Less fully implemented is the adoption of a comprehensive MIDAS model or the recording of spatial information for photographic archives. However, it is encouraging to see the progress that has been made in spatially enabling HER data since 2002.

HERs continue to exchange information in a wide variety of ways. These diverse practices reveal a healthy level of flexibility with respect to the requirements of the end-user, but a greater degree of consistency, and a more formal set of guidelines, is required. More specifically, investigations should be made into feature-based (rather than layer-based) spatial entity exchange via new XML-based and Open GIS technologies. The final section of this report provides an overview of recent initiatives in spatial interoperability and exchange.

Very few HERs have data online, but many are now considering it. "Online HERs" are primarily envisaged as limited public showcases, but their connection to the Internet can allow them to become participants in a national heritage exchange network. The FISH Toolkit, published during the completion of this survey, was designed to address many of the concerns and issue highlighted by this report. The practical benefits of the FISH toolkit must be actively demonstrated to HERs, especially as they begin to go online (http://www.heritage-standards.org).

The UK digital HER model is extremely ambitious, and is now at a critical juncture because of the large number of HERs that are expected to go online in the next few years. With the skillbase and technology now well-established, the next challenge for English Heritage and other UK heritage organisations will be to encourage, oversee and guide this online advent so that HERs may reach their full potential as networked heritage resources. The key to this process will be the endorsement of existing MIDAS and OGIS data standards in hand with the implementation of XML-based exchange protocols. This combination will ensure that HERs become truly interoperable heritage resources and avoid languishing in independent but idiosyncratic isolation.

1. Introduction

This report considers a range of issues relating to GIS working practices within the English archaeological record community. English Heritage is committed to promoting the collection, documentation and reliable exchange of digital data within this community, including the adoption of GIS and standards. GI standards in particular promote the efficient storage, integration and exchange of often disparate sources of digital heritage information. They also encourage the development of inter-operable GIS components and have been the subject of a wide range of recent national, European and international initiatives, both within the heritage community and beyond.

A systematic approach to inventorying archaeological and historic monuments can be traced back to the creation of the Royal Commission on the Historical Monuments of England in 1908, through the Ordnance Survey card index system of the 1970s, the initially uneven development of full-blown sites and monument records (SMRs) during the 1980-90s, and finally up to the recent extension of SMR remits to include a much broader definition of the heritage environment (Heritage Environment Records or HERs: Baker and Baker 1999; Fernie and Gilman 2000; Gilman 2004). This expanding emphasis, and the ambitious set of objectives associated with it, reflects not only government emphasis on more efficient organisational linkages within the public services *(Modernising Government* 1999), but also a wide range of recent initiatives within the heritage community that emphasise the importance of standardisation, inter-operability and public access to heritage data though the internet.[1]

The EH/ALGAO brief for the following work was "to scope the issues relating to GIS standards and working practices, identify the problems and develop high-level guidelines for best practice," and for this purpose, an on-line questionnaire about current GIS usage was developed and later completed by a large proportion of the English archaeological record community. This report discusses the outcome of this consultation exercise. The first section considers survey design, the responding sample of HERs and their feedback about the nature of the survey questions. Thereafter, the survey results are addressed in detail, following the order of the original questions, and profiling:

i) the prominence of GIS within the departments managing HERs, including numbers of GIS users/specialists, existing provisions for GIS training and IT budgets (4.1).
ii) the technical infrastructure underpinning the use of GIS in HERs, including software, operating systems and web map services (4.2).
iii) the types of digital spatial data stored by HERs, including information about formats and associated attribute data (4.3).
iv) the way this data is exchanged both within the organisation and beyond it.
v) the current awareness within the archaeological record community of various standards associated with the provision of geospatial heritage data, including XML, GML, WKT and SVG, as well as related initiatives such as Mastermap and the FISH 'interoperability toolkit' (4.4).

The final part of the report draws these results together and offers a series of recommendations on how GIS usage and data standards can be encouraged and supported.

1 *e.g.* ALGAO 2001; APPAG 2003: 18-19; Chitty 2002; also ADS, CIDOC CRM, FISH, HEIRNET, MIDAS, INSCRIPTION.

2. Survey Design and Response

The survey questionnaire was intended to address a wide range of issues and hence was both long (ca.80 questions) and technically-demanding. Despite these factors, a large number of institutions took the time to respond. Out of an estimated population of 88 English HERs (SMMRA 2004), some 57 (or 65%) replied either on-line or by telephone interview. In addition, four Welsh HERs, 1 Scottish HER, two UK-wide trusts (The National Trust and The Woodland Trust), and a National Park (North York Moors) also took the time to complete the questionnaire. The latter's replies are discussed as useful comparison to the English data in sections below, but are not included as part of the quantitative analysis. Apart from in figure 2, the term 'HER' is used inclusively throughout this report no distinction is made between those institutions that refer to themselves as 'HER's and those who have not yet met the formal requirements for doing so.

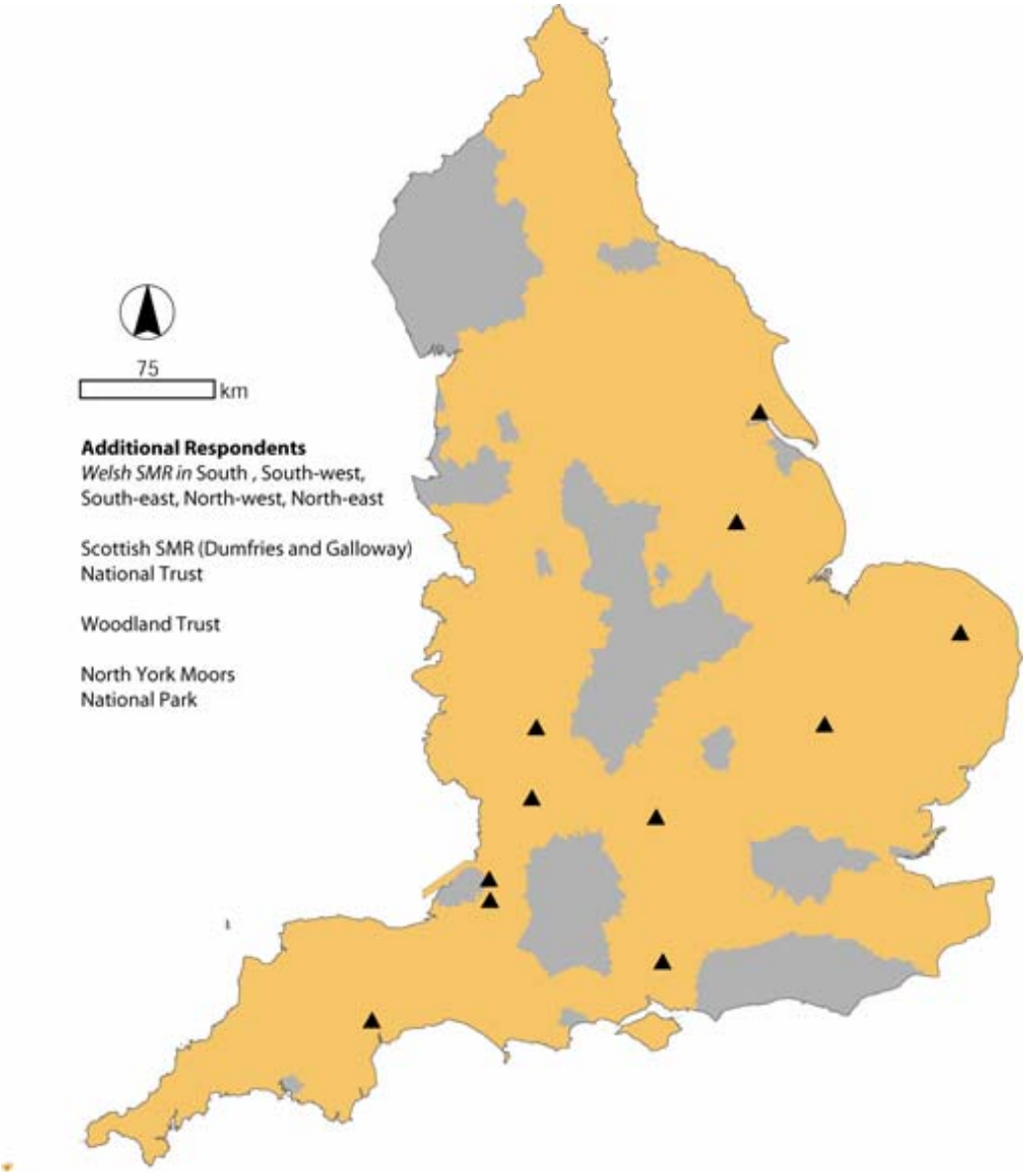

Figure 1 - Map of English Local Authority areas with responding HERs shown in orange and UADs as black triangles

The sample of English HERs has a wide geographic spread across the country and seems to be broadly representative of the main types of archaeological record-keeping organisation including county and district-based HERs, SMRs who by their own definition have not yet met the criteria for becoming HERs, as well as Urban Archaeological Databases (UADs), both within parent HERs and stand-alone (figures 1-2). Within this sample, there are some HERs who state that they have a very limited current capacity to use GIS or record digitally. This proportion is roughly the same as that recorded a few years ago for the total sample of English HERs (Newman 2002), but it remains possible that a small sample bias might have been introduced because HERs with more advanced GIS capabilities were more likely to fill in the survey than those with less. Likewise, some of the questions might be approached either 'optimistically' or 'pessimistically' (e.g. about the number of GIS specialists in their department), but generally both comments from the on-line questionnaire and telephone interviews suggest that most respondents were reporting pragmatically and honestly about the varying state of their technical infrastructure and knowledge.

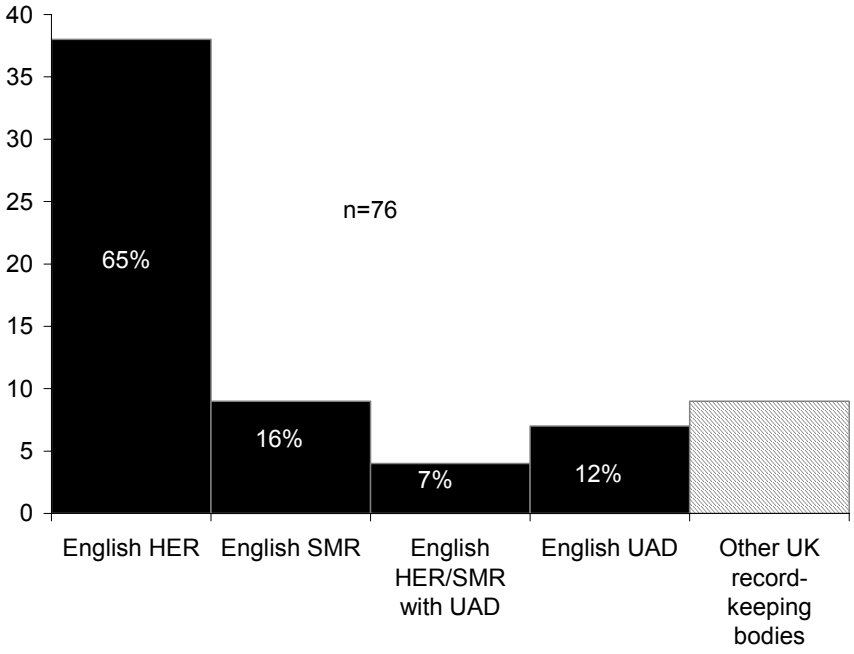

Figure 2 - Survey Responses by HER type. Percentages refer to the proportion of sampled English HERs (shown in black)

3. Results and Analysis

3.1. General

3.1.1. GIS Users

Respondents often found this first part of the survey hard to answer because the questions about budgets and personnel did not specify whether they were referring exclusively to the HER, the heritage/archaeology section responsible for it, a broader department (e.g. Planning) or the entire parent authority. This is an area where future questionnaires might clarify their procedures. However, this ambiguity also reflects a real diversity in the organisational structures responsible for HERs, with heritage and GIS responsibilities cross-cutting at a range of administrative levels.

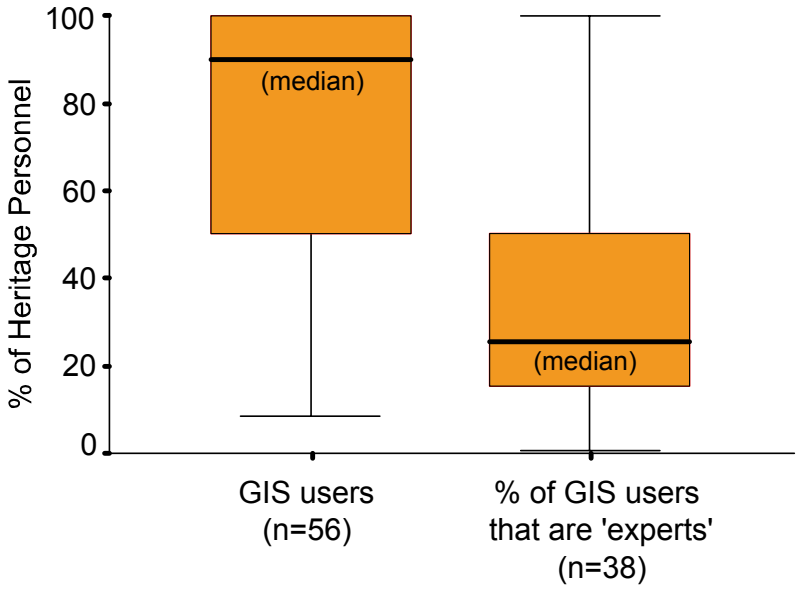

Figure 3 - *Boxplot of GIS users and specialists as a proportion of overall archaeological personnel in sampled English HER-holding bodies.*

Even so, the results indicate the extremely widespread use of GIS, for everyday activities and by many personnel (figure 3).[2] This is particularly true of smaller departments (in which individual employees often specialise less and cover a wider range of responsibilities) and dedicated HER staff, but less true of other heritage managers (e.g. museum staff). The surveyed sample of other record-keeping bodies (UK-wide, Scottish and Welsh) is small, but broadly confirm these impressions across the UK as a whole. Usually, about a quarter to half of GIS users were further characterised as 'expert' in this technology, though a wider range of questions would be necessary to ascertain exactly what this implied in terms of practical skills.

[2] Median estimates are used instead of averages throughout this report: the distributions of answers to most questions were heavily skewed one way or another, and medians better reflect this.

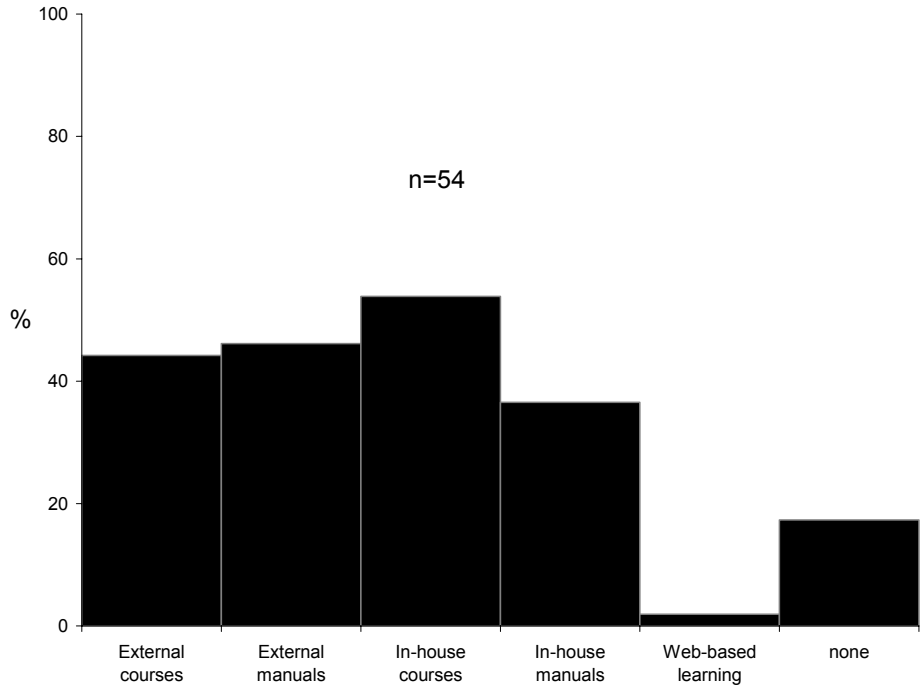

Figure 4 - Percentage of English HER-holding bodies using different types of GIS learning provision. (NB. Most organisation use more than one of these types)

Another sign of the degree to which GIS has pervaded the English archaeological record community, is the fact that almost all organisations have some kind of formal provision for developing staff GIS competency, including a broad range of internal and external courses and manuals (figure 4). In contrast, there is almost no evidence for web-based learning, despite significant commercial initiatives in this area (e.g. ESRI's Virtual Campus). This is surprising because the Internet holds obvious but untapped potential as a cost-effective learning tool, that could address a range of digital skill-sets, could be targeted at the type of competencies necessary in the heritage sector and could foster increasing standardisation across the HER community. Ironically, given the fact that only one of the largest and most technically-developed HERs says it currently uses web-based learning, such an approach should be a relatively democratic tool which is less vulnerable to the very different sizes of IT budget available in different organisations (see next section).

Recommendation
EH should consider whether there is any way to encourage web-base learning initiatives, explicitly targeted at HER staff. This is an excellent way to improve GIS skills across the board and foster consistent standards.

3.1.2. IT Budgets and Organisation

In many cases, IT is funded at a corporate level and thus budgets are either unknown to heritage staff or not itemise-able by department. Occasionally, no formal annual provision for IT/GIS exists and staff request funds on an ad hoc basis. In any case, some respondents (ca.26) were able to suggest approximate IT budgets on the order of £1-5000, with specific GIS-related allocations usually from £100 to no more than £1500. These estimates come from a range of HER types and sizes and may be a broadly-

representative guide representative of funding levels, though more detailed enquiry would be necessary to be certain.[3]

There is considerable variation in the funding structures, and links between heritage data managers and GIS developers. The GIS was the responsibility of the same person as the heritage data in about 40% of cases, but, broadly speaking, larger county councils tend to have separated these functions, and GIS forms part of a much wider corporate strategy. Indeed, in several key cases, heritage sections were (or are) central to the development of these strategies. Most HER managers appear happy with such corporate arrangements, both with respect to the provision of GIS infrastructure and the way responsibility for particular types of data are divided between different parent departments. In most cases, staff also seem to be able to acquire more specialist software and develop specific yet compatible heritage data standards where necessary. When respondents noted problems with this type of umbrella arrangement, it was usually in the context of a parent authority whose corporate GIS strategy has not yet been thought through or was still under development. In this respect, one or two respondents noted that while individual personnel within the Local Authority were usually enthusiastic and supportive, organisational structures sometimes acted as a break on small-scale innovation, not least because of the need to make such initiatives inter-operable with a much wider user-base (e.g. other departments within the Local Authority).

[3] These figures generally refer to the archaeological section of the Local Authority (not the HER alone, or to a wider Planning department) though there was some confusion on this issue.

3.2. Technical Infrastructure

The following table summarises the use of different GIS software in the HER community.

Software	Number of English HERs (% of sample)	Representation in 2002 (Newman 2002)	Comments
No GIS	4 (7%)	12%	
MapInfo	33 (57%)	52%	Over half have upgraded to v7.x
Arcview/ArcGIS	21 (36%)	24%	Over half have upgraded to ArcGIS
ArcSDE	6 (10%)	n/a	Web-serving, corporate licenses and often coupled with ArcIMS
ArcIMS	4 (7%)	n/a	Web-serving, corporate licenses
In-house GIS	2 (3%)		Only in one case is this the primary GIS platform.
MapXtreme	2 (3%)		Web-serving, corporate licenses
Wings	2 (3%)		Its use seems to be secondary to MapInfo or Arcview/ArcGIS
GGP	2 (3%)	4%	
Cartology DSI	1 (2%)	1%	
Geomedia	1 (2%)		Its use seems to be secondary to ArcGIS.
G-Sys GDMS	1 (2%)	1%	
Oracle Spatial Server	1 (2%)		Web-serving?
Proviewer	1 (2%)		Its use seems to be secondary to MapInfo or Arcview/ArcGIS.
GRASS	0		
Idrisi	0		

Table 1 - GIS software in use by the heritage community

Only 29% of SMRs were using GIS linked to a database in 1998 (Baker 19980, but by 2002, this number had leapt to 88% (Newman 2002: 3.3.2). This survey suggests possible further improvement by 2004, with 93% of the sampled HERs reporting the use of such tools.[4] MapInfo and Arcview/ArcGIS predominate, with one or other of these two systems deployed as the primary platform in 93% of those sampled organisations using GIS. This partly reflects the global market share of these products and their frequent corporate licensing to Local Authorities, but also the legacy and continued use of the Exegesis HBSMR system which, historically, encouraged the preferential uptake of MapInfo.[5]

Excluding these two most popular packages, most of the remaining variation in GIS software usage occurs at opposite ends of the HER size spectrum. On the one hand, some of the larger organizations have access to a range of other GIS software, in addition to MapInfo or ESRI products, often as a result of Local Authority corporate licenses. On the other, a few stand-alone UADs either do not yet support a GIS or experiment with more unusual software as their primary platform (e.g. G-Sys, GGP).

[4] It is also possible that the nature of this survey encouraged responses from those who are already using GIS tools and thereby slightly inflates this overall percentage.
[5] A formal question about the use of Exegesis was excluded from the survey at the company's own request.

Part of this trend probably relates to funding, with smaller organizations unable to achieve the economies of scale possible by arranging multiple-user corporate licenses with MapInfo and ESRI.[6] In direct contrast to the dominance of the vector-led, enterprise-scale platforms is the complete absence of (traditionally) cheaper and raster-led GIS such as Idrisi or GRASS. In one sense this is surprising because both packages are frequently used in other parts of the archaeological world, and the open-source nature and low- or non-existent cost of GRASS in particular might in some ways have made it an attractive alternative. However, the typical requirements of HERs for superior map-making capabilities, vector-led and database-friendly platforms and ' off-the-shelf' solutions have ensured that neither of these programs has made any impact.

All the respondents use Windows operating systems on their individual computers, and most were also running Windows-based servers, though three HERs did have Unix-based servers (8% of those who knew). Only six of the sampled HERs were running a Web Map Service (WMS), and only one or two of these was doing so using a broad range of HER data. Given the number of forthcoming initiatives to increase HER presence on-line (see below), these results may well change rapidly in the next few years.

Recommendation
There is no need to foster the exclusive uptake of any one GIS package by HERs, so long as those packages in use are fully compliant with interoperability standards (as some are not). The key method to integrate disparate HER datasets should not be the use of specific software, but the adoption of coherent data standards, web map services and on-line data exchange.

3.3. Data

This part of the survey is concerned with the types of spatial information you handle and how they are managed in terms of data types and file formats. The questionnaire first asked HERs to suggest the relative degree to which the HER GIS was deployed in a number of different types of activity (figure 5).

[6] There is also some limited use of simple map-viewing software (Map Explorer, Proviewer or bespoke) on machines and for users that do not require full GIS functionality.

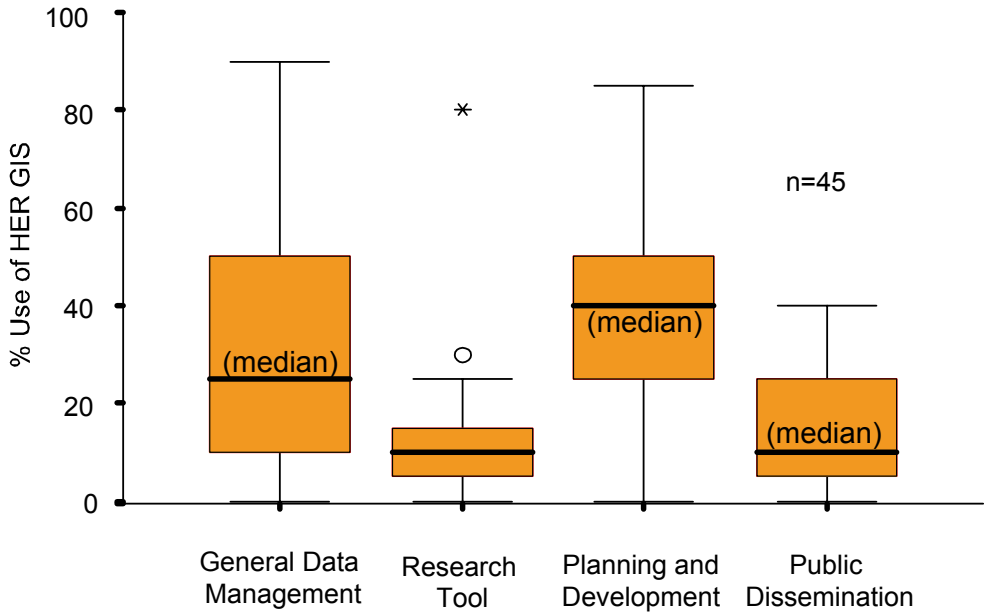

Figure 5 - Boxplot summarising the relative use of the HER GIS for different activities

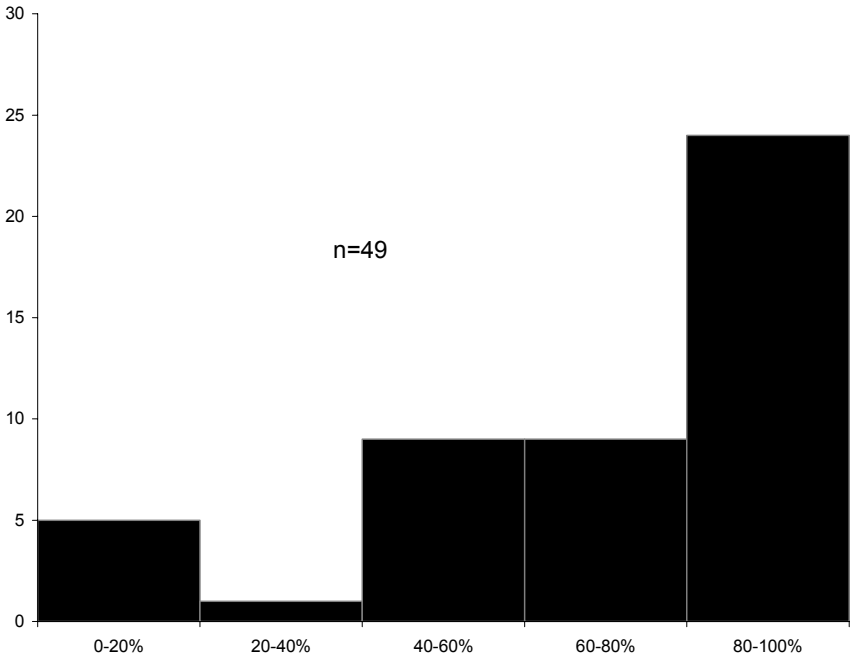

Figure 6 - Percentage of non-spatial (attribute) data which is digital

These results suggest the use of GIS in a wide variety of activities, and several respondents felt their GIS-led activities were so diverse that this question was difficult to answer as posed. Perhaps the most variable category was spatial management with some HERs using their GIS almost exclusively for this purpose. The degree to which planning issues were part of the GIS' remit obviously is reflected more broadly in the degree to which planning advice is the direct responsibility of the HER in question or whether such work is carried out in another section of the Local Authority. The one additional type of use that several HERs mentioned was for Historic Landscape Characterisation projects.

The use of databases preceded the use of GIS in several HERs and this is reflected in the generally advanced stage of attribute data digitisation (figure 6). The median proportion of attribute data said to be stored in digital format was 80% though this should probably be read as referring to core sites and monuments information, rather than all available archival material.

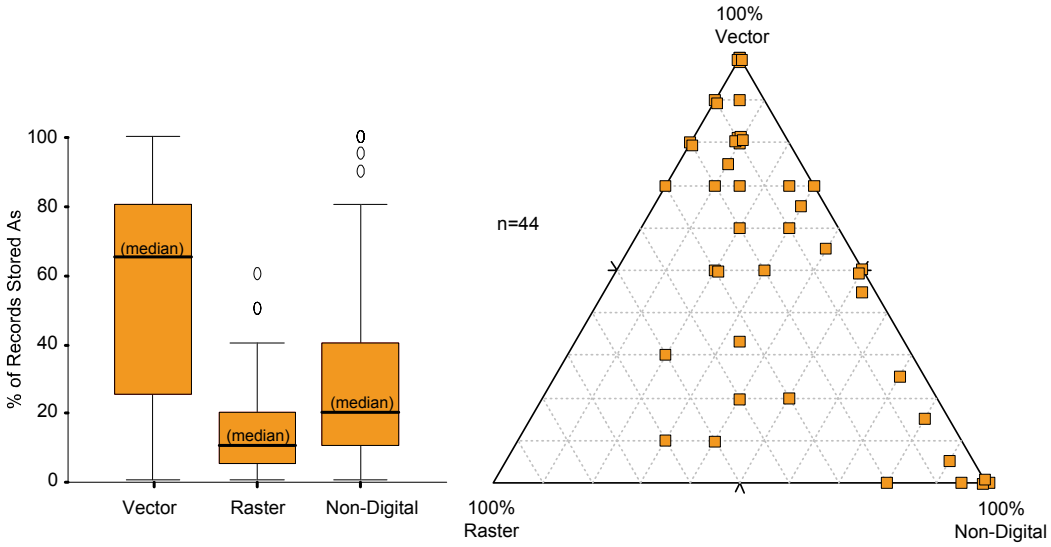

Figure 7 - Boxplot (left) and triangular plot (right) expressing the current state of spatial data recording in sampled English HERs.

The boxplot in figure 7 summarises the proportion of HER records kept in vector, raster and non-digital formats, for which the median responses from English HERs were 67% vector, 10% raster and 20% non-digital. The triangular plot in the same figure confirms that the vast majority of the digitising effort has so far gone into creating the sorts of object-oriented, vector entities (e.g. points or polygons for monuments) that support multiple attribute database linkages, and hence meet one of the key digital benchmarks set out for HERs (Chitty 2002: benchmark 3.3). A smaller group of organisations hold a larger proportion of raster-based data (e.g. site plans and aerial photographs), but there were no overall patterns in terms of the kinds of HER with this profile.

The following table summarises the results from the rest of the questions in this part of the survey:

Question/Answers	*Total*	*%*
Do you have a point coverage available for your monuments? (n=53)		
Yes	45	86.5%
Partially Implemented	4	7.7%
No	4	7.7%
Do you have a line and polygon coverage available for your monuments? (n=53)		
Yes	21	39.6%
Partially Implemented	22	41.5%
No	10	18.9%
Do you record spatial information for Events (as defined in MIDAS) in your HER? (n=54)		
Yes	33	61.1%
Partially Implemented	17	31.5%
No	4	7.4%
Do you record spatial information for Photographs and Images in your HER? (n=54)		
Yes	12	22.2%
Partially Implemented	13	24.1%
No	29	53.7%
Do you have any in-house spatial data format(s) and/or standard(s)? (n=51)		
Yes	9	17.6%
Partially Implemented	11	21.6%
No	31	60.8%
Do you store attribute data (e.g. monument type, character, etc.) in your GIS or in a separate database? (n=52)		
GIS	4	7.7%
Separate Database	22	42.3%
Bit of Both	25	48.1%
Don't Know	1	1.9%

Table 2 – Current uses of spatial referencing

These answers suggest that the basic goal of a point coverage for all monument data is well on the way to being achieved, as to a lesser extent is MIDAS compliance. However, the creation of more precise polygonal monument boundaries has been far less fully implemented. This problem has been documented before and it has been hard to assess exactly what financial resources are required to achieve compliance in this area (SMMRA 2004). In addition, the way HERs link broader heritage data to their special referents in a GIS seems quite variable, despite the fact that the ADS has clear guidelines on this issue and encouraging the use of a spatial identifier as the sole link to a separate database. The HER benchmarks also call for a dynamically linked GIS and database, though it is unclear how often this is actually the case. Future surveys should seek to clarify the wording of questions on this topic so that there is as little confusion in the answers as possible, but the impression remains that some HERs remain unclear about what this aspect of the HER benchmarks implies in practice.

No HERs describe having special in-house data formats, and all of them store data in the native file formats of their preferred GIS software (usually therefore either Arcview shapefiles or MapInfo tabfiles). One or two also have Oracle Spatial Server files or dxf

files of OS base-map data, but only one HER (with UAD) referred to the common use of newer ArcGIS geodatabase and .lyr file formats. Some HERs also possess informal guidelines about how to digitise features (particularly polygonal monuments), in-house styles for depicting them and or said they were adhering to ADS or NGDF-led guidelines for good practice (another benchmark criterion: Chitty 2002). Most were happy for EH to see any in-house manuals of this kind that they might have.

3.4. Exchange

The section of the survey devoted to data exchange aimed to consider the way digital information is shared (given and received) within and outside of HERs. Questions were designed not only to assess what methods are currently in use for sharing data, but also how HER personnel felt about their past experiences in this process (e.g. in their relations with national heritage projects).

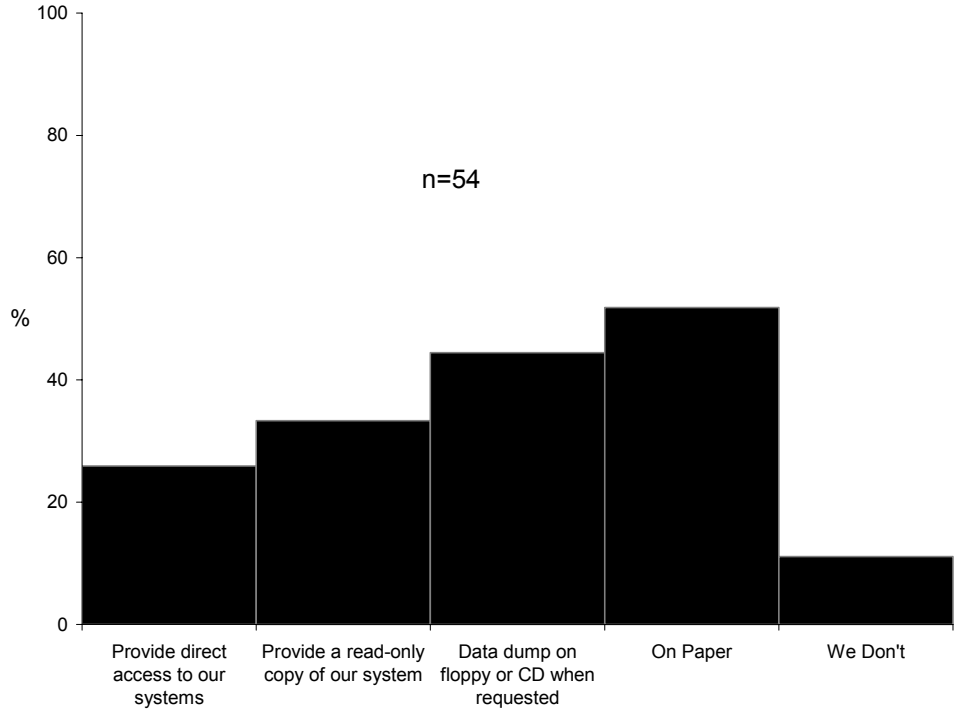

Figure 8 - Percentage of English HER-holding bodies using different methods of in-house spatial data exchange (nb. Most organisations use more than one of these methods).

Figure 8 shows that HERs deploy a range of methods for sharing spatial heritage data within their Local Authority. Most organisations use more than one method, and overall no single one stands out. This partly reflects the sheer diversity of contexts in which HERs exchange spatial and attribute data both in-house and externally. Many respondents noted that a level of flexibility is necessary with respect to how HERs operate as they must tailor for the varying expertise and particular requirements of the end-user (in-house or not). Moreover, several respondents emphasised the importance of HER personnel as *interpreters* of the raw HER data, suggesting that in certain contexts unguided access to HER data (at least in its presence form) would be undesirable.

However, this overall lack of a consistent model for data exchange may also have negative repercussions on the clarity of HER operating practices, may increase the risk that they maintain multiple, slightly altered copies of the same basic data, and restrict the

degree to which data dumps from more than one HER can be integrated. In this respect we can suggest:

Recommendation
The proper adoption of metadata and geospatial mark-up standards in tandem with the creation of online HERs (dynamically linked to the original datasets) would encourage a beneficial reduction in the diversity of data exchange practices in HERs, without inhibiting the degree to which record-keeping communities might cater for specific user needs.

The following table summarises the remaining survey questions from this section:

Question/Answers	***Total***	***%***
Do you accept/receive heritage information digitally, including GIS data? (n=54)		
Yes	41	75.9%
No	13	24.1%
If so, do you have guidance/standards for organisations wishing to deposit digital (spatial) data with you? (n=54)		
Yes	12	22.2%
No or N/A	42	77.8%
How would you describe the on-line, public presence of your HER? (n=54)		
No HER data online[7]	45	83.3%
Searchable online database	3	5.6%
Searchable online database and GIS	3	5.6%
Select HER data online for specific projects	2	3.7%
ADS data dump	1	1.9%

Table 3 - Data exchange and online presence

It is clear that a large proportion of HERs are prepared to receive heritage data digitally, but that far fewer of these have developed any formal guidelines as to how this might be done. At the level of national organisations, archives and projects, responses were extremely mixed about HER experiences in exchanging digital heritage data with these bodies. Several staff had had good experiences of receiving EH/NMP data as shapefiles and incorporating them relatively easily into the HER structure. English Nature data (from MAGIC) and Forestry Authority files were also mentioned as being easy to use and very helpful. Other respondents had been positive about the experience of receiving digital spatial data from private individuals, but said that the lack of standards sometimes made this a labour-intensive process.

In contrast to these positive comments, there were also some serious concerns about the excessive delays and lack of established schema for incorporating national datasets or large EH-supported heritage projects into HER structures (Humber Wetlands, Defence of Britain, NMP, Listed Buildings, Portable Antiquities Scheme). This was partly the result of bespoke formats, but also of poor structuring, documentation and quality control. However, the flip-side of these responses is the fact that respondents were sometimes unaware of the variety of ways in which they could request data or the current restrictions on precise publication associated with some national projects (e.g. Portable Antiquities Scheme). Poor communication and the uneven adoption of GI standards does indeed seem to be behind many of these problems and the results of this survey certainly do emphasise the need for improvement in both of these areas.

[7] The category includes some SMRs who actually responded 'Other' to this question but whose online presence appears extremely limited.

Recommendation
There is a need for formal guidance about how HERs can incorporate National Heritage Project datasets into their own recording structures. Future National Heritage Projects should seek to produce spatial datasets that include the types of information HERs require – in other words HERs should be identified as key end-users.

A key development which will need to be managed carefully in terms of interoperability is the emergence of online HERs. Very few HERs currently have online databases (spatial or aspatial). However, several are in the process of implementing such systems, and many others cite them as a clear goal of forthcoming funding applications (e.g. Heritage Lottery Fund or New Opportunities Fund) and corporate initiatives. However, there remains a real danger that in this quest for central funding, it is the smaller HERs that get left behind, not least because they are often more poorly equipped to go through the elaborate HLF application procedure.

Recommendation
There is some justification in a bottom-up rather than top-down approach to encouraging on-line provisions, perhaps offering targeted, pump-priming funds for the on-line publication of smaller HERs on the assumption that the larger organisations will eventually follow suit.

4. Standards-Based Spatial Initiatives

The questions in this section examined both the use and knowledge of spatial standards; In general, most HERs or their GIS officer were familiar with the standards available, though very few actively employed the standards; fortunately, many noted that the use of these standards was "under investigation", however this could entail anything from a "wait-and-see" approach to an active investigation into their use.

The HER community is not the only one to have encountered difficulties with spatial data exchange: the need to address the lack of standardisation and the challenge of interoperability throughout the spatial sector in all industries led to the creation in 1994 of the Open Geographic Consortium (OGC). The OGC is "a non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services;" its members include industry leaders such as ESRI, Oracle, IBM and MapInfo.

The OGC has published a number of specifications under the Open GIS (OGIS) moniker: these specifications address a range of topics associate with the exchange, storage, representation, and querying of spatial data. There are currently fourteen standards; while all will have some bearing on the Heritage sector, five standards in particular have immediate relevance for spatial data exchange in the Heritage sector; these are discussed below.

This section of the report aims to introduce these standards, and concludes with a comparison of their potential application to the HER community, with a special focus on their accessibility and ease of implementation.

More information on the OGC is found at *http://www.opengeospatial.org*.

Information on MapInfo's OGC compliance is available at *http://www.mapinfo.com/location/integration?txtDetailType=FREEFORM_TEXTAREA&txtDetailID=434*.

Information on ESRI's OGC compliance is available at *http://www.esri.com/library/whitepapers/pdfs/interoperability.pdf*.

4.1. Geographic Markup Language: GML

GML is an "XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features." It is a structured language and grammar used to record all forms of spatial entity, and the data associated with those entities, can be encoded in text. Because GML has been designed to accommodate *all* forms and uses of spatial data, its schema is extremely inclusive, comprehensive, and complex.

Its use within the heritage sector is most visible in the Ordnance Survey's use of GML in its new MasterMap coverages. We do not intend to provide a complete introduction to XML, MasterMap and GML here, but we do hope to remove some of the mystery surrounding the terms. Here is an example of a spatial entity in GML, taken from MasterMap:

```
<osgb:topographicMember>
        <osgb:TopographicArea fid="osgb1000000030205898">
                <osgb:featureCode>10021</osgb:featureCode>
                <osgb:version>1</osgb:version>
                <osgb:versionDate>2001-05-25</osgb:versionDate>
                <osgb:theme>Buildings</osgb:theme>
                <osgb:calculatedAreaValue>304.768450</osgb:calculatedAreaValue>
                <osgb:changeHistory>
                        <osgb:changeDate>1989-06-28</osgb:changeDate>
                        <osgb:reasonForChange>New</osgb:reasonForChange>
                </osgb:changeHistory>
                <osgb:descriptiveGroup>Building</osgb:descriptiveGroup>
                <osgb:make>Manmade</osgb:make>
                <osgb:physicalLevel>50</osgb:physicalLevel>
                <osgb:polygon>
                    <gml:Polygon srsName="osgb:BNG">
                       <gml:outerBoundaryIs>
                          <gml:LinearRing>
                           <gml:coordinates>291461.990,96221.210 291456.910,96217.600
291457.670,96216.530 291461.670,96210.960 291463.000,96209.100 291466.600,96204.100
291453.500,96193.900 291449.700,96198.750 291445.510,96195.710 291446.810,96193.900
291452.600,96185.800 291456.220,96188.580 291474.880,96202.930 291475.100,96203.100
291473.150,96205.800 291470.540,96209.410 291467.330,96213.850
291461.990,96221.210</gml:coordinates>
                          </gml:LinearRing>
                       </gml:outerBoundaryIs>
                    </gml:Polygon>
                </osgb:polygon>
        </osgb:TopographicArea>
 </osgb:topographicMember>[8]
```

This example is used to describe the attribute data and the geometry of a polygon which represents the boundary of a building. The geometry of the polygon is defined by x,y (easting, northing) coordinate pairs in the <gml:coordinates> element, with each pair separated by a space. Other elements describe the type of entity, the unique spatial identifier (TOID) as well as other metadata elements such as change history.

The GML 3.0 specification is found at *https://portal.opengeospatial.org/files/?artifact_id=7174*.

4.2. Well Known Text: WKT

The WKT format is a common standard for the textual description of simple feature geometries. It is not XML, but can be used within an XML schema to represent spatial geometry.

Although many may note that the "well known" part of "WKT" is a bit of a misnomer, it is a commonly recognized format that can be imported and exported by nearly all spatial databases and GIS. Here are a few examples of spatial entities represented in WKT:

[8] From the Cambridge OS MasterMap Technical Seminar - 4 February 2004: *http://www.ordnancesurvey.co.uk/products/osmastermap/powerpoint/ordnance_survey_preparing_for_OSMasterMap.ppt*, slide 37.

- A Point:
  POINT(15 20)
- A LineString with four points:
  LINESTRING(0 0, 10 10, 20 25, 50 60)
- A Polygon with one exterior ring and one interior ring:
  POLYGON((0 0,10 0,10 10,0 10,0 0),(5 5,7 5,7 7,5 7, 5 5))
- A MultiPoint with three Point values:
  MULTIPOINT(0 0, 20 20, 60 60)
- A MultiLineString with two LineString values:
  MULTILINESTRING((10 10, 20 20), (15 15, 30 15))
- A MultiPolygon with two Polygon values:
  MULTIPOLYGON(((0 0,10 0,10 10,0 10,0 0)),((5 5,7 5,7 7,5 7, 5 5)))
- A GeometryCollection consisting of two Point values and one LineString:
  GEOMETRYCOLLECTION(POINT(10 10), POINT(30 30), LINESTRING(15 15, 20 20))[9]

The WKT representation of the GML geometry example in the previous section would be:

POLYGON((291461.990 96221.210,291456.910 96217.600,291457.670 96216.530,291461.670 96210.960,291463.000 96209.100,291466.600 96204.100,291453.500 96193.900,291449.700 96198.750,291445.510 96195.710,291446.810 96193.900,291452.600 96185.800,291456.220 96188.580,291474.880 96202.930,291475.100 96203.100,291473.150 96205.800,291470.540 96209.410,291467.330 96213.850,291461.990 96221.210))

Like GML, WKT can represent the shapes and geometries of monuments and coverages encountered in the HER sector. Unlike GML, WKT geometry definitions are understood by nearly all enterprise level GIS and spatial databases, and can be imported and exported with ease. WKT is not an OGC standard by itself, but is instead incorporated into the Simple Features SQL standard.

The most accessible introductions to WKT are on the MySQL Website: *http://dev.mysql.com/doc/mysql/en/GIS_introduction.html* and the DB2 Website: *http://publib.boulder.ibm.com/infocenter/db2help/index.jsp?topic=/com.ibm.db2.udb.doc/opt/rsbp4120.htm*

A Backus-Naur grammar that specifies the formal production rules for writing WKT values is found at *http://www.jtc1sc32.org/sc32/jtc1sc32.nsf/Attachments/AB91B62160B95ABB88256E8F00021686/$FILE/32N1107-WD13249-3--SPATIAL.PDF*, page 105ff.

[9] From http://dev.mysql.com/doc/mysql/en/GIS_WKT_format.html. Accessed 22 June 2004.

4.3. Simple Features SQL: SFS

SFS provides a means to facilitate "publishing, storage, access, and simple operations on Simple Features (point, line, polygon, multi-point, etc)." SFS governs a broad range of standards that encompass the storage, manipulation and representation of spatial entities and their metadata. Within the context of this review, SFS defines functions that transfer WKT into binary geometries, and provides systems for comparing geometries such as determining whether a point falls within a specific polygon, or whether a line intersects another geometry. Elements of the SFS are used with the Historic Environment Exchange Protocol (HEEP), part of the FISH Toolkit.

Most enterprise-level database applications are SFS compliant in regards to the storage and querying of spatial data; this includes the big players (Oracle, IBM and Microsoft), as well as open source and freely available alternatives (PostgreSQL, and MySQL). In relation to spatial interoperability, SFS provides a grammar to facilitate remote querying between spatial datasets, and suggests an open database structure which can be used to store spatial data outside of a GIS. For the HER community, this means that the creation of a spatial server and the ability to store and deliver spatial entities on a feature-by-feature basis are now much more accessible than they were even two years ago.

The SFS standard is found at *http://www.opengis.org/docs/99-049.pdf*.

4.4. Web Map Services: WMS

The WMS provides protocols to "support the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple sources that are both remote and heterogeneous." In other words, WMS is a protocol that governs the querying and display of spatial data connected to the Internet. Unlike GML and WKT, it is *not* used to store or exchange spatial geometries, but only exchange their visual representations: maps.

The protocol is one of the most straightforward of the OGC's standards: a WMS client sends a request to a WMS server: the request (in XML format) contains the region of interest, the layers that should be shown, and the image format desired. The WMS server returns a simple image showing the requested features for the requested region. An intelligent WMS client will allow the panning and zooming features of any GIS application. Images are the only thing returned by a WMS Service; feature metadata is not accessible.

Perhaps the most exciting feature of WMS is that the protocol can be used to amalgamate the output of WMS servers.

For example, if every HER in South-East England provided a separate WMS coverage of their prehistoric features, EH could provide a WMS server of its own which could amalgamate those disparate dataets into a seamless coverage of the entire South-East, without data duplication or the problems associated with data import and export.

WMS is a very well-supported protocol that is in use and widely available. MapInfo and ArcGIS can transparently access layers delivered by WMS Services, and the two GIS servers from ESRI and MapInfo, ArcIMS and MapXtreme respectively, provide 'connectors' for users to deliver 'layers' over the Internet.

The WMS standard should be one of the first mechanisms that HERs and English Heritage employ for distributing spatial data in an open and accessible format.

An excellent example of a WMS client and Service is available from TerraServer, the Microsoft-owned data distributor for aerial photographs of the US:
http://terraserver.microsoft.com/ogcwms.aspx.
This Service provides an interface to spatial data via a web browser, but can also be accessed by MapInfo and ArcGIS. A whitepaper on the service is available here:
http://research.microsoft.com/scripts/pubs/view.asp?TR_ID=MSR-TR-2002-53

MapServer, the extremely popular Open Source spatial data engine developed by the University of Minnesota, also supports the WMS standard:
http://mapserver.gis.umn.edu/

The WMS specification is available from *http://portal.opengis.org/files/?artifact_id=5316*.

4.5. Web Feature Services: WFS

WMS delivers maps and only; the WFS is a sister protocol that allows users to query and interact with the geographic features represented on a WMS-delivered map. A WMS can exist without WFS, but to provide full querying and data retrieval at the attribute level, WFS must be employed.

The WFS specification is available at *https://portal.opengeospatial.org/files/?artifact_id=7176*.

4.6. The FISH Toolkit: MIDAS Spatial Schema

The spatial schema of the FISH Toolkit was designed specifically to address the needs of spatial exchange in the HER community. It combines elements of WMS, GML and WKT in an XML schema to record all elements of place and spatial representation. It is therefore compatible with OGC standards, but tailored towards the specific needs of the HER community.

The following page shows an example of an invented site, represented in MIDAS SPATIAL:

```
<midas:spatial xsi:schemaLocation="http://www.heritage-standards.org/midas/schema/1.0
http://195.74.122.210/~fish/midas/schema/1.0/midas_spatial.xsd">
<place>
        <address>
                <country>UK</country>
                <county>Devon</county>
                <city>Taunton</city>
                <streetaddress>Old Manor Farm</streetaddress>
                <streetaddress>23 Winding Way</streetaddress>
                <postcode>DE21 N32</postcode>
        </address>
        <namedplace>
                <location type="county" namespace="EH_CDP98">Devon</location>
                <location type="district" namespace="EH_CDP98">South Hams</location>
                <location type="civilparish">Chivelstone</location>
                <location type="locality">Easder Valley</location>
        </namedplace>
        <gridref namespace="OSGB36">ST673972</gridref>
        <geopolitical type="country">England</geopolitical>
</place>

<geometry>
        <boundingBox srs="EPSG:27700" minx="267000" miny="297000" maxx="267500"
        maxy="2975900"/>
        <spatialappellation type="centroid">
                <quickpoint>
                        <srs>EPSG:27700</srs>
                        <x>267350</x>
                        <y>297250</y>
                </quickpoint>
                <entity spatialtype="Point" uri="32453" namespace="WESTSHIRE GIS">
                        <wkt srs="EPSG:27700">POINT(267250 297250)</wkt>
                </entity>
                <capturemethod>Map reference</capturemethod>
        </spatialappellation>
        <spatialappellation type="scheduledarea">
                <entity spatialtype="Polygon" uri="21345" namespace="WESTSHIRE GIS">
                        <wkt srs="EPSG:27700"> POLYGON((267318 297302, 267471 297221,
                        334876 341874, 129435 194321, 267318 297302))</wkt>
                </entity>
                <capturemethod>Aerial Photo</capturemethod>
        </spatialappellation>
</geometry>

<representations>
        <representation namespace="O.S.1:10000">ST 69 NE</representation>
</representations>

</midas:spatial>
```

MIDAS SPATIAL aims to address all elements of spatial recording and is comprised of three primary elements: *place*, *geometry* and *representation*. *Place* is used to record all string-based representations of place, including addresses and geopolitical units; *Geometry* stores information for each spatial appellation associated with the entity, using WKT to represent geometry; *Representations*, the final element, records where representations of the spatial entity can be found on maps and APs.

A draft of the MIDAS spatial schema documentation is available here:
http://195.74.122.211/~fish/midas/docs/html/midas_spatial.html
http://195.74.122.211/~fish/heep/docs/html/ch08.html#id2900952

The schema itself can be accessed here:
http://195.74.122.211/~fish/midas/schema/1.0/midas_spatial.xsd.

More information on the FISH toolkit is available from:
http://www.heritage-standards.org

4.7. New Initiatives: Assessments and Conclusions

GML is an excellent medium for spatial data representation, but is too complex to be the panacea for all spatial problems currently encountered by the HER community. This is not only because GML is overly broad for the requirements of the HER spatial community, but GML also remains an exchange format that must be first transformed into something like WKT before it can be readily imported into a spatial database or GIS. English Heritage should actively educate users in GML and MasterMap, but primarily as a means of de-mystifying this often obscure standard. It is too soon to implement GML-centric initiatives, although this should be continuously monitored.

However, as XML is a central element of the FISH Toolkit, English Heritage should continue to educate and inform the HER community about XML in general, so that it does not remain the obscure technology it is perceived as currently.

We recommend that moves be made away from conceiving of and working with spatial data on as 'layers', and instead work with spatial features. We make this recommendation because it is the way that GIS technologies such as MasterMap and spatial servers are moving, but also because it will allow a more ready exchange, manipulation, and referencing of specific spatial entities.

WKT is the most straightforward and open format in which geometry can be represented. Its use should be employed to a greater extent by the HER community because:

- It is focused on feature based, rather than layer-based, spatial representation
- It is an open standard, unlike ESRI shapefiles and other proprietary formats
- It is it is a simple and straightforward way to represent spatial entities
- It is text-based, and can be recorded in a single field in a non-spatial database.
- It is a excellent format for archiving
- It can be imported and exported directly from most enterprise-level GIS and spatial database applications

When associated with the EPSG:27700 spatial reference system, either explicitly or implicitly, WKT can be used to extract and exchange every spatial entity that exists in all UK HERs.[10] We recommend that initiatives are put in place to encourage or enforce the WKT delivery of all spatial entities resulting from nationally sponsored heritage projects, and that other archiving bodies, such as the ADS, both accommodate and recommend WKT as the preferred standard.

[10] EPSG codes are the internationally standard for indicating spatial reference systems (SRS). Other EPSG codes reference other SRS, including EPSG:4326 for WGS84 (recorded in Lon/Lat, units = decimal degrees). Thus WKT can also be used for costal and off-shore sites, as well as those in Northern Ireland.

WMS technologies are well-supported by the Spatial industry and are conspicuously absent in the HER and Heritage sectors. The technology exists, is extremely easy to deploy, and is already included in ArcIMS and MapXtreme GIS servers. English Heritage should encourage WMS Services in the HER community and provide examples of their own.

MIDAS SPATIAL is very young but it combines the best aspects of a number of OGC standards, is compatible with them all, and is targeted specifically at the HER community. Its use should continue to be encouraged as part of the FISH Toolkit and elsewhere.

The following table summarises the survey questions from this section:

Questions/Answers	***Total***	***%***
Do you record spatial metadata for monuments? (n=53)		
Yes	39	73.6%
No	11	20.8%
Don't Know	3	5.7%
Can you or your IT Officer export heritage records in XML format? (n=54)		
Yes	9	16.7%
Currently under investigation	22	40.7%
No	19	35.2%
What is XML?	4	7.4%
Can you or your IT Officer import heritage records in XML format? (n=50)		
Yes	9	18.0%
Currently under investigation	20	40.0%
No	21	42.0%
Are you or your GIS Officer familiar with MasterMap? (n=52)		
Yes	39	75.0%
No	13	25.0%
Can you or your GIS Officer produce (export) spatial data in GML or WKT format? (n=51)		
Yes	3	5.9%
Currently under investigation	8	15.7%
No	17	33.3%
What is GML/WKT?	23	45.1%
Can you or your GIS Officer import spatial data in GML or WKT format? (n=50)		
Currently under investigation	9	18%
No or N/A	36	72%
Yes	5	10%
Do you use SVG for the display of GIS data? (n=45)		
Yes	3	6.7%
Currently under investigation	3	6.7%
No	39	86.7%
Are you familiar with the recent initiatives of FISH to develop an 'interoperability toolkit'? (n=53)		
Yes, I am very familiar	13	24.5%
Yes, I have heard of it	38	71.7%
No	2	3.8%

Table 4 - Knowledge and Use of Spatial Standards

5. Key Findings and Recommendations

5.1. Key Findings

- GIS is now a commonly used tool in the archaeological sections of Local Authorities and not simply a tool available to a few experts.

- There is a clear need for GI standards and easy ways to implement them. A large proportion of HERs are prepared to receive heritage data digitally, but that far fewer of these have developed any formal guidelines as to how this might be done.

- There exist a wide range of provisions for GIS training in archaeological sections or parent authorities. However, web-based learning of GIS skills by HER staff remains extremely limited at present

- IT budgets are usually very small, and HERs or archaeology sections are often reliant on software provisions and IT support offered across the entire Local Authority. This seems to work well in those cases where an effective corporate IT and GIS strategy is already in place.

- The type of GIS software used by HERs remains similar to those used in 2002. The dominance of ESRI and MapInfo packages reflect their global market share, though the popularity of Exegesis software is also notable.

- There is great variety in HER recording routines, exchange methods and GIS skills.

- Any guidelines about GI standards should take into account the varied bureaucratic structures and different stakeholders behind each HER.

- There is confusion among HERs about recent initiatives both within and beyond the HER world with respect to GI standards. This is an area where EH or ADS might provide assistance with a series of targeted workshops for HER personnel.

- Many forthcoming initiatives for internet access to HER spatial data envisage providing only limited querying facilities and basic datasets but not specialist information.

- The current online presence of HERs online is extremely limited, though many funding applications or corporate initiatives with this in mind are pending.

- The UK heritage sector is not realising the potential of existing spatial standards, particularly WKT and WMS.

5.2. Recommendations

- The proper adoption of metadata and geospatial mark-up standards in tandem with the creation of online HERs (dynamically linked to the original datasets) would encourage a beneficial reduction in the diversity of data exchange practices in HERs, without inhibiting the degree to which they might cater for specific user needs.

- EH should continue to promote existing ADS and NGDF standards and propose additional guidelines for interoperability.

- There is no need to foster the exclusive uptake of any one GIS package by HERs, so long as those packages in use are fully compliant with interoperability standards (as some are not).

- National funding bodies should favour those bids for money to put HER data online that can demonstrate clear interoperability compliance.

- A full national portal for HER data is desirable.

- EH should consider whether there is any way to encourage web-base learning initiatives, explicitly targeted at HER staff.

- HERs should be identified as key end-users of the digital data produced by future National Heritage Projects. HER data requirements should be acknowledged in the design of these projects from the beginning.

- EH and other national bodies (e.g. ADS) should assist HERs in applying for Heritage Lottery Fund or New Opportunities Fund money, with both technical advice and pump-priming grants, especially for smaller organisations.

- A greater emphasis should be made on spatial interoperability using WKT and WMS

6. Acronyms Employed

The heritage and GIS sectors place a close second and third behind the military for their use of acronym-heavy jargon. We have tried to keep their use to a minimum, and list here the few used in this report:

ADS	Archaeology Data Service
ALGAO	Association of Local Government Archaeological Officers
APPAG	All-Party Parliamentary Archaeology Group
CIDOC CRM	Comité International Pour la Documentation (International Documentation Committee) Conceptual Reeference Model
EH	English Heritage
FISH	Forum for Information Standards in Heritage
GIS	Geographic Information System(s)
GML	Geographic Markup Language
HEIRNET	Historic Environment Information Resources Network
HER	Historic Environment Record
HLF	Heritage Lottery Fund
INSCRIPTION	A collection of 'wordlists' maintained or recommended by the Forum on Information Standards in Heritage (FISH)
MIDAS	Monuments and Inventories Data Standard
NGDF	National Geospatial Data Framework
NMP	National Mapping Programme
NMR	National Monuments Record
NOF	New Opportunities Fund
OGC	Open Geographic Consortium
SFS	Simple Features SQL
SMR	Sites and Monuments Record
SVG	Scaleable Vector Graphics
UAD	Urban Archaeological Database
WFS	Web Features Services
WKT	Well Known Text
WMS	Web Map Services
XML	Extensible Markup Language

7. References

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8. Survey Form

N.B. A first draft of this survey form was developed by Oxford Archdigital Ltd in late June 2004 and then circulated amongst EH personnel (MS, BH, DB, AF). Their comments were then incorporated into a final draft that was put on-line at the beginning of August and advertised on the HER forum. The final deadline for replies was the 1st October 2004.

Section A. General Information

Name of Organisation

Contact Name, Email and Telephone

Type of Organisation:
(*HER / UAD / Heritage Project / Other - please specify)*

Principle Geographic Region of Concern:

Number of Active Employees/Personnel:
Fulltime:
Part-time:

How many people actively use GIS?
Count:
approx % of total personnel:

How many of these would you characterise as GIS experts/specialists?
Count:
approx % of total personnel:

What formal provisions do you have for developing staff competence in GIS?
(None / In-house courses; External courses; In-house manuals; External manuals; Web-based learning)

Parent Authority (if any)

What is your average annual expenditure on HER IT?

What percentage of this is GIS-related expenditure (not including data licenses)?

Is the GIS in your organisation the responsibility of the same person or department as the heritage data (e.g. if you are an HER, is the GIS managed by the same department in your LEA as the HE data?)?
(yes / no / n-a)

How do you reconcile your GIS needs with those of your parent authority? Please explain:

Additional comments on this section:

B. Technical Infrastructure

This section profiles the technical infrastructure in your organisation – questions are designed to assess the scale, type and purpose of the GI technologies you use.

What GIS technologies do you use, if any (please include no. of licenses)?
(None / ArcIMS / ArcView-ArcInfo / GeoMedia / GGP / Grass / Idrisi / MapInfo / MapXtreme / ORACLE spatial server / ArcSDE / Other - please specify)

What do you use GIS for (please include approximate percentage use)?
(we don't / General Data Management / Research Tool / Spatial Planning and Development Control / Disseminating Information to the Public / other – please specify)

What client Operating Systems does your HER Office use?
(Windows / Mac / Linux / Unix / Solaris / don't know)

What server Operating Systems does your HER Office use?
(Windows / Mac / Linux / Unix / Solaris / don't know)

Does your office use a Web Map Service for distributing spatial data?
(yes / no / don't know / what's a Web Map Service?)

If so, what data is shared via the WMS?

Additional comments on this section:

C. Data

This section is concerned with the types of spatial information you handle and how they are managed in terms of data types and file formats.

Approximately what percentage of your non-spatial (attribute) data is stored digitally (e.g. in databases)?

Approximately what percentage of your spatial data is stored as (N.B. please just give an approximate percentage that suggest the rough proportions of your primary spatial heritage data that fall into these three categories; calculations should not include such things as background topographic maps):
vector entities?
raster maps and images:
non-digital maps and plans:

Do you have a point coverage available for your monuments (i.e., monuments can be viewed as points in your GIS)?
(yes / no / partially implemented / don't know)

Do you have a line and polygon coverage available for your monuments?
(yes / no / partially implemented / don't know)

Do you record spatial information for Events (as defined in MIDAS) in your HER?
(yes / no / partially implemented / don't know)

Do you record spatial information for Photographs and Images in your HER?
(yes / no / partially implemented / don't know)

What file format(s) do you usually use to store your spatial data (e.g. ArcView Shapefiles, MapInfo TAB files, Oracle Spatial server, etc.?

Do you have any in-house spatial data format(s) and/or standard(s)?
(yes / no / partially implemented)

Would you be willing to provide EH with a document detailing these formats?
(yes / no / n-a)

Do you store attribute data (e.g. monument type, character, etc.) in your GIS or in a separate database?
(GIS / separate database / a bit of both / don't know)

Additional comments on this section:

Section D. Exchange
This section considers the way digital information is shared (given and received) within and outside your organisation. It asks about the methods by which you share data and for your assessment of the past success of this process.

How do you exchange heritage information within your organisation (i.e., other offices in your authority)?
(We don't / On paper / Direct access to our systems / A read only copy of our systems / Data dump on floppy or CD as requested)

How do you give heritage information to other heritage organisations?
(We don't / On paper / Direct access to our systems / A read only copy of our systems / Data dump on floppy or CD as requested)

How do you provide heritage records to the public?
(We don't / On paper / Data dump in CSV format or other file format / Other - please explain)

Do you accept/receive heritage information digitally, including GIS data?
(yes / no)

If so, do you have guidance/standards for organisations wishing to deposit digital (spatial) data with you?
(yes / no / n-a)

Would you be willing to provide EH with a document detailing this guidance?
(yes / no / n-a)

If you have exchanged digital information in the past (e.g. accessing national project data), can you briefly describe and comment upon your positive experiences?

If you have exchanged digital information in the past (e.g. accessing national project data), can you briefly describe and comment upon your negative experiences?

How would you describe the on-line, public presence of your HER?
(*No HER data online / Searchable online database / Searchable online GIS / Searchable online database and GIS / Select HER data online for specific projects / Other - please specify)*

Additional comments on this section:

Section E. Knowledge Systems and Interoperability
The collection of heritage metadata and the establishment of interoperable standards for the storage and exchange of heritage information is an area of growing concern. The following questions are intended to give us an impression of the familiarity of responding institutions with inter-operability and content standards initiatives.

Do you record spatial metadata for monuments (i.e., how the data was obtained, data precision, when it was recorded, etc.)?
(yes / no / don't know)

Can you or your IT Officer produce (export) heritage records in XML format?
(yes / no / currently under investigation / what is XML?)

Can you or your IT Officer import heritage records in XML format?
(yes / no / currently under investigation)

Are you or your GIS Officer familiar with MasterMap?
(yes / no)

Can you or your GIS Officer produce (export) spatial data in GML or WKT format?
(yes / no / currently under investigation / what is GML or WKT?)

Can you or your GIS Officer import spatial data in GML or WKT format?
(yes / no / currently under investigation)

Do you use SVG for the display of GIS data?
(yes / no / currently under investigation)

Are you familiar with the recent initiatives of FISH (The Forum for Information Standards in Heritage) to develop an 'interoperability toolkit'?
(yes, I am very familiar / yes, I've heard of it / no)

Do you have comments or concerns regarding the FISH 'Interoperability Toolkit' you would like to voice here?

What, if any, forthcoming initiatives are being investigated by you or your parent authority to increase access to spatial data?

Additional comments on this section: