Archaeological data as spatial data, and the role of GIS and data management with an overview of the HS2 project:

a personal perspective

Fred Farshid Aryankhesal, HS2 Phase One Heritage Data Manager

Figure 1: *Place/location is an integral part of any archaeological data and archaeological survey Phase One: Dews Farm, Hillingdon. Credit: ©HS2 Ltd*

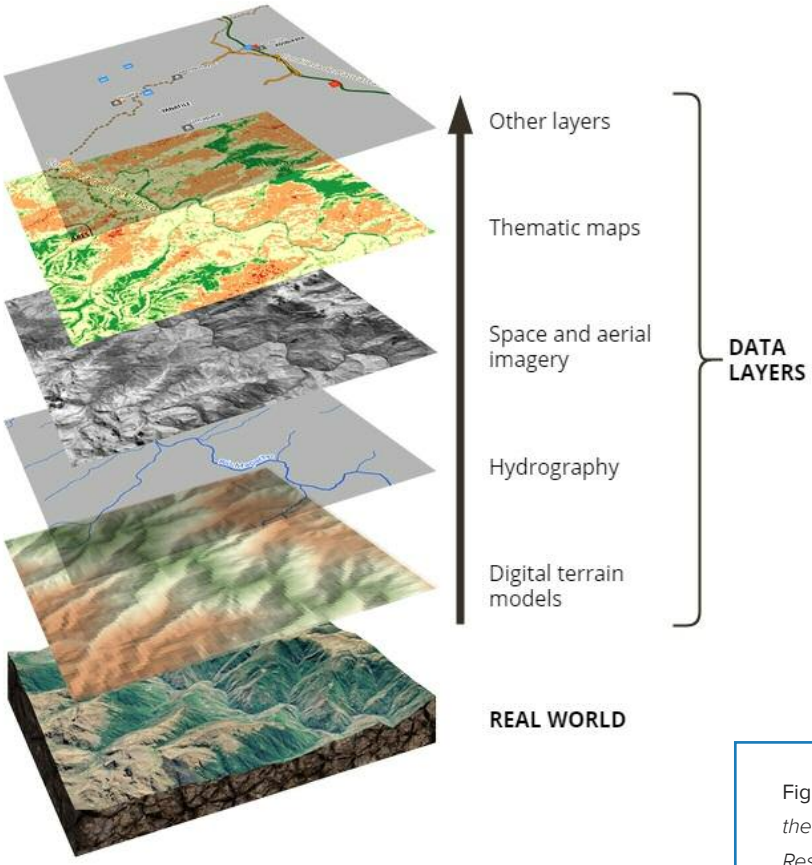
Have you ever thought of archaeological data as 'geospatial' (or simply 'spatial') data? A key aspect of archaeology is its association with location. Archaeology is one of the interdisciplinary fields like construction and economy in which 'place' matters. Without location, any archaeological data is lacking identity (Figure 1**). It is obvious that spatial data analysis is an integral part of the manipulation and management of archaeological data.**

Like many organisations, HS2 uses Geographic Information Systems (GIS) for capturing, gathering, cleaning, analysing, visualising/mapping and delivering spatial data in different layers, by which geometries/images have been joined to attribute tables (Figure 2).

As HS2 Phase One Heritage Data Manager, my role is to ensure that the data generated by our supply chain can be used in many ways by our various stakeholders.

I joined HS2 in November 2019, and although I am not by training an archaeologist, I am a specialist in GIS, town planning and spatial data analysis. I have worked on a range of projects including preparation of regional and urban strategic plans and urban regeneration projects, which have required the manipulation, presentation and management of spatial data.

As someone who is enthusiastic about history, joining the HS2 Phase One Historic Environment team was a golden opportunity to challenge myself to apply my spatial analysis and GIS skills to a new



HS2 uses Geographic Information Systems (GIS) for capturing, gathering, cleaning, analysing, visualising/ mapping and delivering spatial data in different layers

Figure 2: *Different spatial data layers, representing the features of the real world. Credit: © PAITITI Research 2020*

discipline with an abundance of new technical jargon. Thanks to my supportive and friendly managers and colleagues I gained enough confidence to settle into my new position, and little by little, I was able come up with new ideas and solutions to enhance the heritage data management of Phase One.

Capturing spatial archaeological data

Like any spatial data, archaeological data can be created and stored in two forms, namely vector data and raster data. In contrast to my previous jobs, in which I mainly dealt with vector data, at HS2 I realised the importance of raster data as the outcome of the majority of archaeological surveys including photogrammetry, light detection and ranging (LiDAR), ground-penetrating radar (GPR) and magnetometry surveys. Archaeologists use numerous methods to capture, digitise and store first-hand archaeological data from the real world in raster format. Those raster data, after being processed, are stored and visualised as raster catalogues (a GIS technique I learnt in this job) on the HS2 server and HS2 web map system known as G-Viewer (Figure 3).

However, I have learnt the result of the interpretation of the archaeological surveys, which are in raster format, are mainly prepared in vector data format. Besides that, the location of archaeological objects, test pits, listed buildings, sitework boundaries, local authority boundaries and intervention areas can also be represented by vector data (points, lines, polygons, and their relating attribute tables), as in Figure 4.

Spatial data gathering, cleaning and management

In the UK there are systems and organisations that provide standards and frameworks for recording and archiving archaeological data. However, where archaeological research is part of a construction project, Building Information Modelling (BIM) can be a valuable opportunity. BIM is an approach for managing information across the project lifecycle. It enables experts to record and archive every aspect of project asset data, connecting them based on their interrelationship and hierarchy. To put this into practice, the Historic Environment Research and Delivery Strategy (HERDS) as a subsystem of HS2's BIM has been established. Through this, the spatial data relating to archaeological assets, such as the boundaries of intervention areas and archaeological features, are recorded and archived with the help of GIS and are allocated a unique ID for each archaeological asset. Being involved in the HERDS system and dealing with archaeological data as asset data was a chance to get practical experience with BIM on a major project.

There has been an efficient integrated workflow between our supply chain, HS2 specialists and external stakeholders such as Historic England and local councils, who all benefit from the archaeological data we provide (Figure 5). My position as Heritage Data Manager requires me to act as a data hub, liaising and cooperating with all those involved. I monitor contractors' data delivery performance, develop and review GIS-related documents and procedures, assure data quality, upload the processed data and ensure the external transmittal of data packages for historic environment

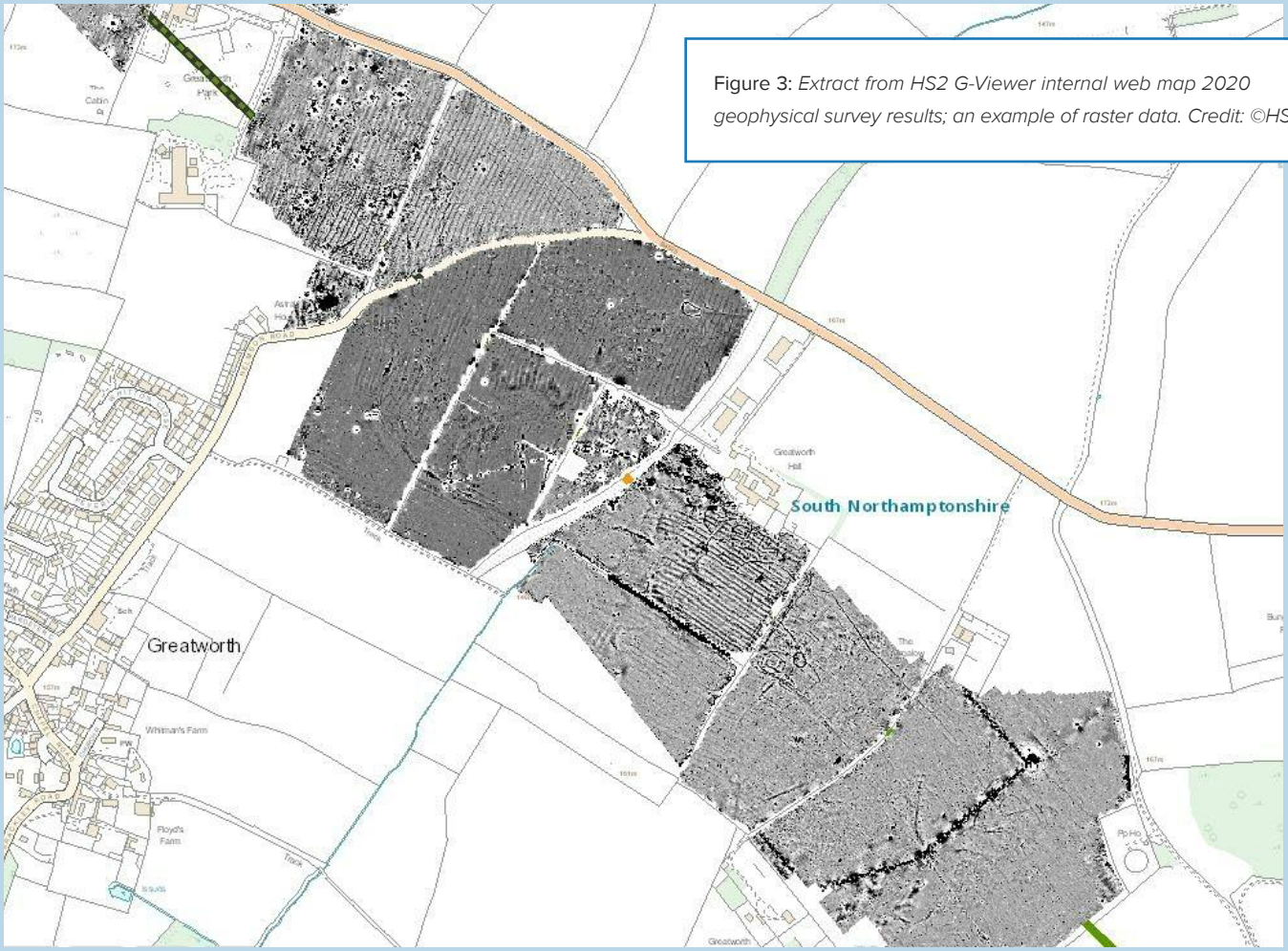


Figure 3: *Extract from HS2 G-Viewer internal web map 2020 geophysical survey results; an example of raster data. Credit: ©HS2 Ltd*

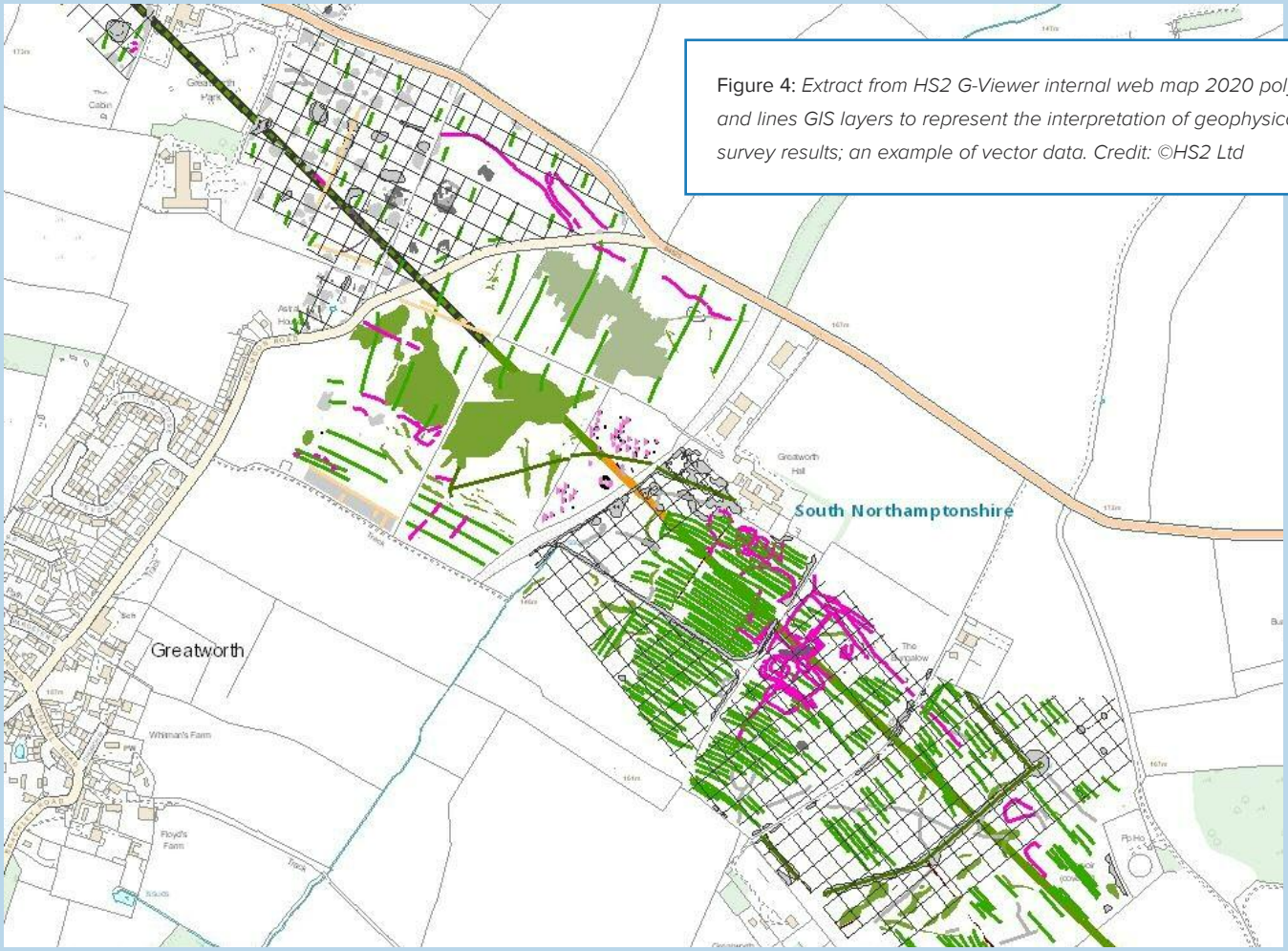


Figure 4: *Extract from HS2 G-Viewer internal web map 2020 polygons and lines GIS layers to represent the interpretation of geophysical survey results; an example of vector data. Credit: ©HS2 Ltd*

data users (Figure 5). To perform these duties effectively, I have had to challenge and improve my soft skills such as communication and teamwork.

Spatial data visualisation and delivery

The visualisation of archaeological data is of paramount importance to the analysis of archaeological work. For instance, analysis and interpretation of geophysical survey results cannot be conducted without a high-quality data visualisation. To provide the different HS2 teams, stakeholders, communities and researchers with good quality results, trends and comparisons in the appropriate format, deciding on the best methods and techniques of data visualisation and delivery can be another challenge.

In terms of mapping, spatial data visualisation, cartography and map design skills play a crucial role. In construction projects like HS2, the great benefit of visualising and mapping archaeological spatial data is that it provides clear information to the user. To guide us in the development of mitigation strategies at HS2 we have developed a web map platform, on which all the GIS data layers from different disciplines of work can be visualised according to the users' choice (Figure 6). My previous skills in web maps and cartography and map design helped me to perform effectively in my new role at HS2.

Working with archaeological data at HS2 has been an opportunity of a lifetime for me to challenge myself in a new discipline, and again to remind me how GIS and spatial data are the key parts of studies and surveys in a wide variety of different disciplines.

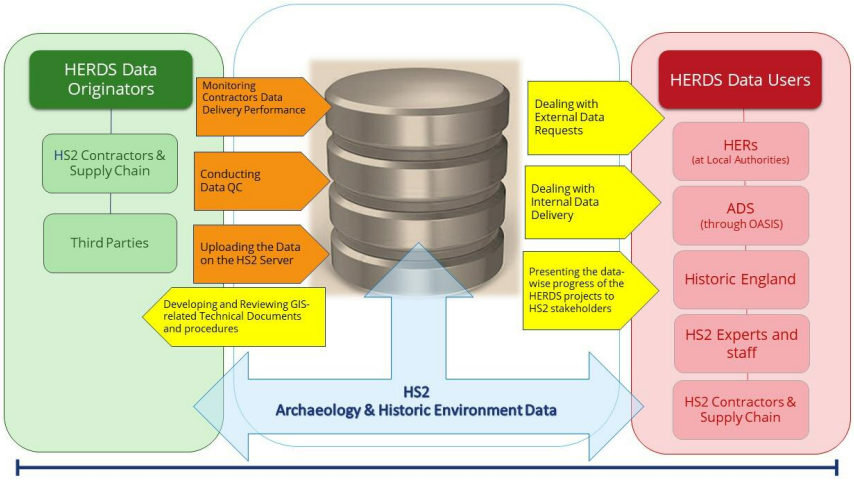


Figure 5: *HS2 archaeological data lifecycle based on the Historic Environment Research and Delivery Strategy. Credit: ©HS2 Ltd*

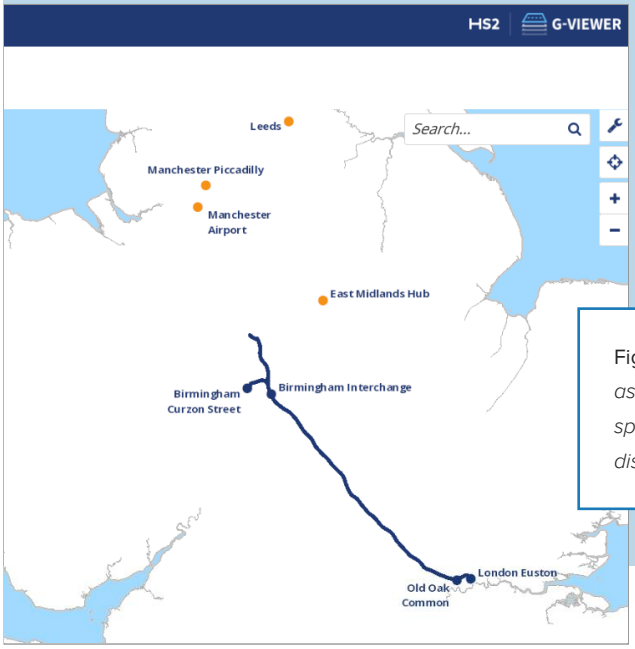


Figure 6: *HS2 G-Viewer platform as a live web map to visualise spatial data from different disciplines. Credit: ©HS2 Ltd*

Fred Farshid Aryankhesal

Since November 2019, Fred has been seconded from Atkins (a member of the SNC-Lavalin Group) to HS2 as Phase One Heritage Data Manager, where he applies his knowledge and experience of working with spatial data analysis and Geographic Information Systems (GIS) to cooperate with HS2's relevant contractors, supply chain and stakeholders for managing historic environmental and archaeological data.

Fred has got two Master's degrees, firstly, in Urban and Reginal Planning from University of Tehran, Iran (2009), and secondly, in Smart Cities and Urban Analytics from University College London (UCL), UK (2017). Fred has been working about 12 years as an Urban Planner, Spatial Data Analyst, GIS specialist and 3D Model Visualiser with different consulting engineers companies in Iran and The UK, and during this time he has gained a holistic understanding of Sustainable Development, built environment Conservation/Regeneration and Smart Cities.