King's Cross Central GIS – using online collaboration to manage the land

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Introduction

King's Cross Central is the largest regeneration project in Central London. Covering an area of 67 acres, this brownfield site has the best public transport accessibility in London. The development is closely tied to the Channel Tunnel Rail Link project which, on its 14th November 2007 opening, will connect Paris to King's Cross at a journey time of just over two hours. This will further enhance the accessibility of an area served by two major rail stations, six tube lines and four over-ground rail lines.

The project is led by Argent Group PLC, one of Britain's leading mixed use developers in collaboration with the landowners London and Continental Railways and DHL – Exel Supply Chain. Outline planning permission was granted in December 2006 for nearly 8 million sq ft of mixed use.

Argent hopes to draw a range of tenants to the development including the arts and culture sector. The British Film Institute's National Film Theatre, The University of the Arts (including Central St Martin's School of Art and Design) and a number of fringe theatres and independent cinemas will be contemplating a move to King's Cross Central.

The proposals include business and employment space; new homes (up to 1900); student housing; hotels and serviced apartments; shopping, food and drink; visitor, cultural and community uses, including a primary school, children's centre, pool and gym facilities, an indoor sports hall and 2 health centres. Over 40% of King's Cross Central would be public realm, with 20 new streets, ten new public spaces and three new bridges.

This is a long term project, with a 15-20 year completion target.

A core challenge facing Argent was to organise the complex land ownership information – with a web of titles, encumbrances and agreements. To support the work that is carried out by Argent's lawyers, Lovells, there was a need to map the information into an 'easy to use' system that both Argent and Lovells employees could use.

In collaboration with UCL's GE Department, Argent developed an internal GIS which provides information about land ownership in the King's Cross area. The system allows remote collaboration between Argent's lawyers and company workers, exploration of the information through a web-browser and integration of planning information with land ownership information. The system is based on Manifold GIS, and was implemented over a very short period – 3 months, and at very low development costs.

In this paper, we cover the major issues that were encountered through the project. We open with an overview of the challenge, following by the solutions,

Land Registry Documents

Famously, England does not have a cadastre – that is a map or survey based public record of land ownership. The Land Registry documents are the base for ownership, and the map does not have any statutory role. A title, for example, is generated when a plot of land changes hands or when it is leased. The leased land can in turn be leased to someone else. In addition, different parts of a given property may be leased to different leases under different conditions. Each transaction will generate a title.

In addition to the titles, other documents can have a legal influence on the property, such as an Agreement, describing rights over neighbouring lands, such as rights of way, or obligations, such as maintaining infrastructures, or restrictions, as in limitations against digging beyond a given depth. Clearly, someone's right is somebody else's restriction. Some of these issues can be modified depending on negotiations by the interested parties - which, by the way, will generate another Land Registry document.

Titles will make reference to interest-generating documents affecting its land. On the other hand, the latter will cross-refer to titles they may affect. The comprehensiveness of the cross-referencing is unclear.

When negotiating land, all these factors have to be taken in consideration, for example, if an owner got a right to maintain an underground pipe, the design of the buildings foundations should be take this into account, otherwise very expensive problems can emerge in the future.

For intensively used and sought after lands, the relations between the various layers of ownerships, leases, rights, obligations, restrictions, and so on, can potentially generate a large volume of documentation that has to be understood prior to any development plan. This is what Argent faced when they embarked on the development of King's Cross Central. The Eurotunnel extension, developments in King's Cross and St. Pancras Stations, an environmentally protected park, listed buildings, a mesh of Underground tunnels, buried structures from industrial times, archaeological findings, and a bewildering array of tenants and leases.

Moreover, the wording in Land Registry documents are legally binding; but as noted, their attached plans are not (from now on, the term plan is used specifically for a map attached to a Land Registry document). There seems to be a relaxed attitude towards drawing these plans, with thick lines drawn more for emphasis than for precision, poor labelling, and little pressure to redraw plans when boundaries change.

In these days, when urban land is at a premium, these inconsistencies can have a high cost in case of misjudgements. To avoid this, hefty fees are paid in the legal aid deployed for understanding the relationships between Land Registry documents.

The Matrix

The first step for the management of the land in Kind’s Cross Central, was the development of a legal matrix, linking titles, encumbrances and agreement. Lovells, the lawyers that represent Argent in the King's Cross Central venture, devised a document to help them make sense of what are known internally as the Encumbrances, i.e., the list of rights, restriction and obligations that may stand on the way to development. The original document was composed in Microsoft Word. It listed encumbrances according to landowner, and classified them into five different types according to the kind of impediment to construction and ease of negotiation. The document was made available to a number of partners and their lawyers. It took a large amount of man-hours building and maintaining it.

Figure 1 shows the Matrix table. Text has been obfuscated for confidentiality reasons.

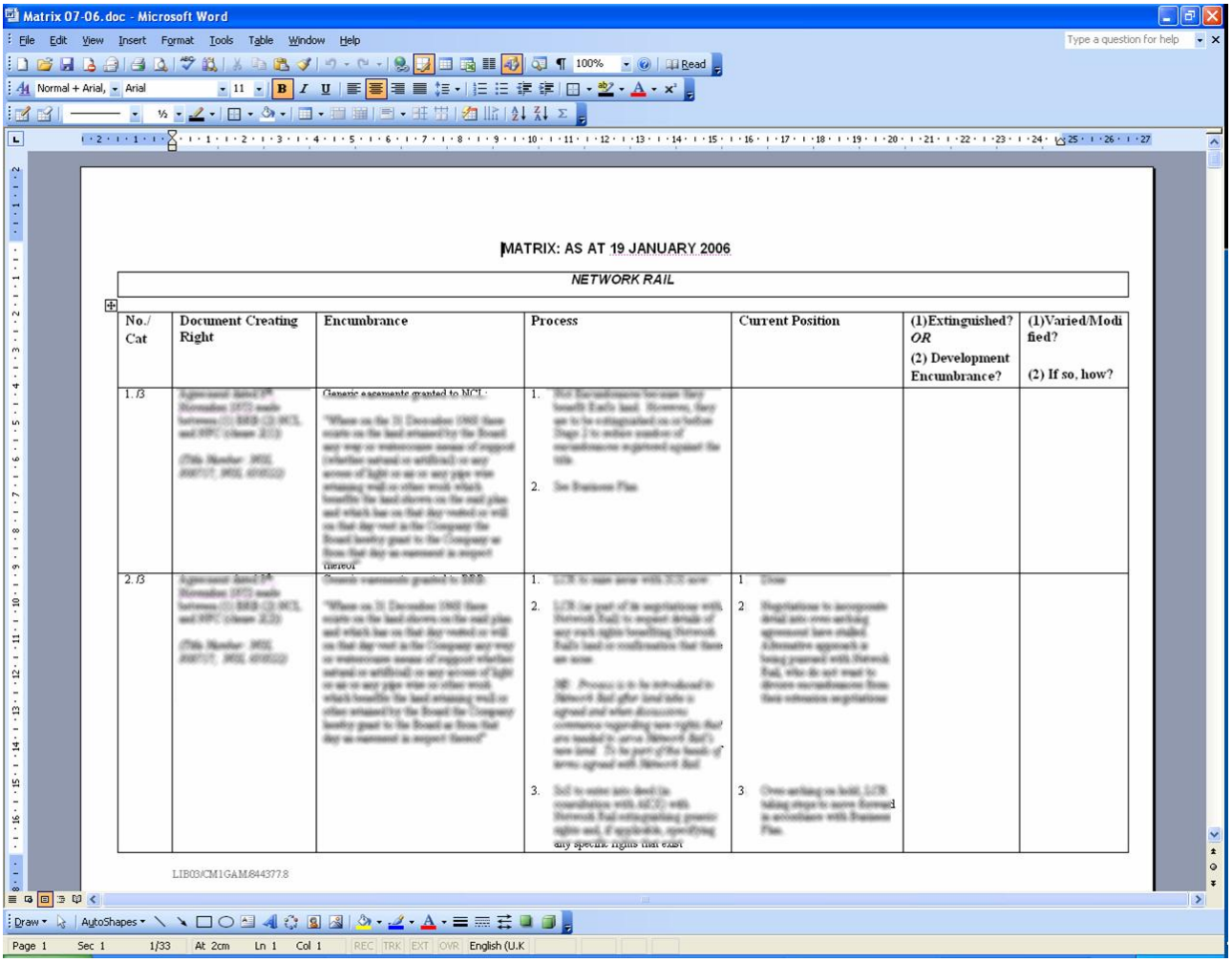

Figure 1 - Land ownership Matrix

The Matrix was a central working tool at the stage in which the contact with UCL was made to consider how working procedures can be improved.

A GIS Web Application

The Proposal

Enter GIS. Argent had a previous experience with GIS, used by some of their partners to make sense of boundaries affecting their lands; lands that eventually will be available to the King's Cross Central project. They decided to use the tool themselves, and contacted UCL – the department of Geomatic Engineering (GE) to evaluate the feasibility of resuscitating the tool for the project.

The proposed solution involved appointing a recent Masters graduate to conduct the work on site under supervision from Dr. M Haklay.

The idea entailed changing the Matrix from a flat table structure to a database, and linking this with the Land Registry plans to facilitate visualisation of the spatial extent of the relevant encumbrances.

The platform chosen for the GIS development was different to the platform initially used by Argent. For the King's Cross project, the system was based on Manifold GIS - partly for its shallow learning curve and partly for its extremely low cost as compared to the main commercial GIS in the market. All of the data previously generated in the old system was transferred over to the new system, without difficulties.

Taking into consideration that the easiest way to share GIS data with users with no GIS experience is through a website with a simple interface, the total cost of an Internet Map Server (IMS) capable Manifold product was about twenty times less than its competitors', not considering annual license maintenance fees, charged for using a typical IMS GIS.

Processing maps

The first stage of the work consisted in the production of a series of maps. Titles were the choice, with Agreements and other documents left for a later phase.

One restriction in the use of Land Registry documentation is that it is a breach of the law to reproduce the documents, either the text or the plan. As a result, Land Registry plans must be interpreted, and not digitised as is usual. This is a huge unnecessary restriction that stops the land owner from using information about its own land, and is a restriction that should be removed as it is slowing the adoption of GIS in the property sector.

The only option for a person who deals with such data is to go through a method that is tedious at best, when the plans are recent and surface features can be recognised at a glance. With titles older than 10 years (two or three were 100 years old), the process was excruciatingly slow and inefficient. The King's Cross area has been substantially changed since the station was first built, with the rate of change in the past few years being particularly high. Besides, older plans supplied by the Land Registry were electronic scans of the original paper maps, reproducing faithfully all the tearing, stretching and darkening of long-pressed creases and bends. Even if georeferencing of the images was an option, it would have been very difficult and in certain cases almost useless.

For base maps, the latest OS MasterMap series was used, together with a map of the area produced by EDAW, and a similar one by LCR, both Argent collaborators. From the latter, we also used maps showing ownership, rights of way and major leases, previously produced by LCR in ArcGIS and imported seamlessly to Manifold GIS. The three base maps were produced at different times and with different aims in mind, reflected in their distinct characteristics and degree of detail. The time interval between them is of about 2 to 3 years, the OS being the most recent and LCR the oldest. Where they matched contours, discrepancies between them were in general of about 50cm (established by inspection).

The amount of discrepancies that had to be negotiated in the production of title maps were large, and fell into two main categories. The most conspicuous were caused by the thick lines and casually drawn contours found in some Land Registry plans. Some lines' width could correspond to 2-3 meters on the ground. The second category had to do with which base map was used. Whenever possible, Land Registry plans were matched to ground features found on the OS map. At times, there were no recognisable features in this. EDAW's one was used. Failing that, LCR's was used. Some plans followed more obviously one of the base maps and not the others. Other, larger plans were matched to each of the base maps depending on the location within it.

The above created a mosaic of title maps, with large overlaps (caused by complex ownership relationships) and boundary mismatches where they should match. Having established with Argent and their lawyers that there was no way to guarantee more accuracy, the maps were accepted as guidelines, and any problem arising at boundaries would be treated as and when found. The maps were cleaned of slivers and other errors using Manifold's Topological Factory set of tools.

It is true that older plans could have been checked against historical maps. However, since generally the older the title the less important it is, and a general picture of the whole site was more important than the accurate capture of boundaries, the procedure was dismissed for a while.

And this is what these maps are: a private interpretation, by an interested party, of the non-legally binding part of legal documents dealing with land ownership. It is a laborious process that offers guidelines but not guarantees. Yet, even with these caveats they are immensely useful for both the legal team and for Argent, as they can help in identifying possible land issues that are emerging in the development.

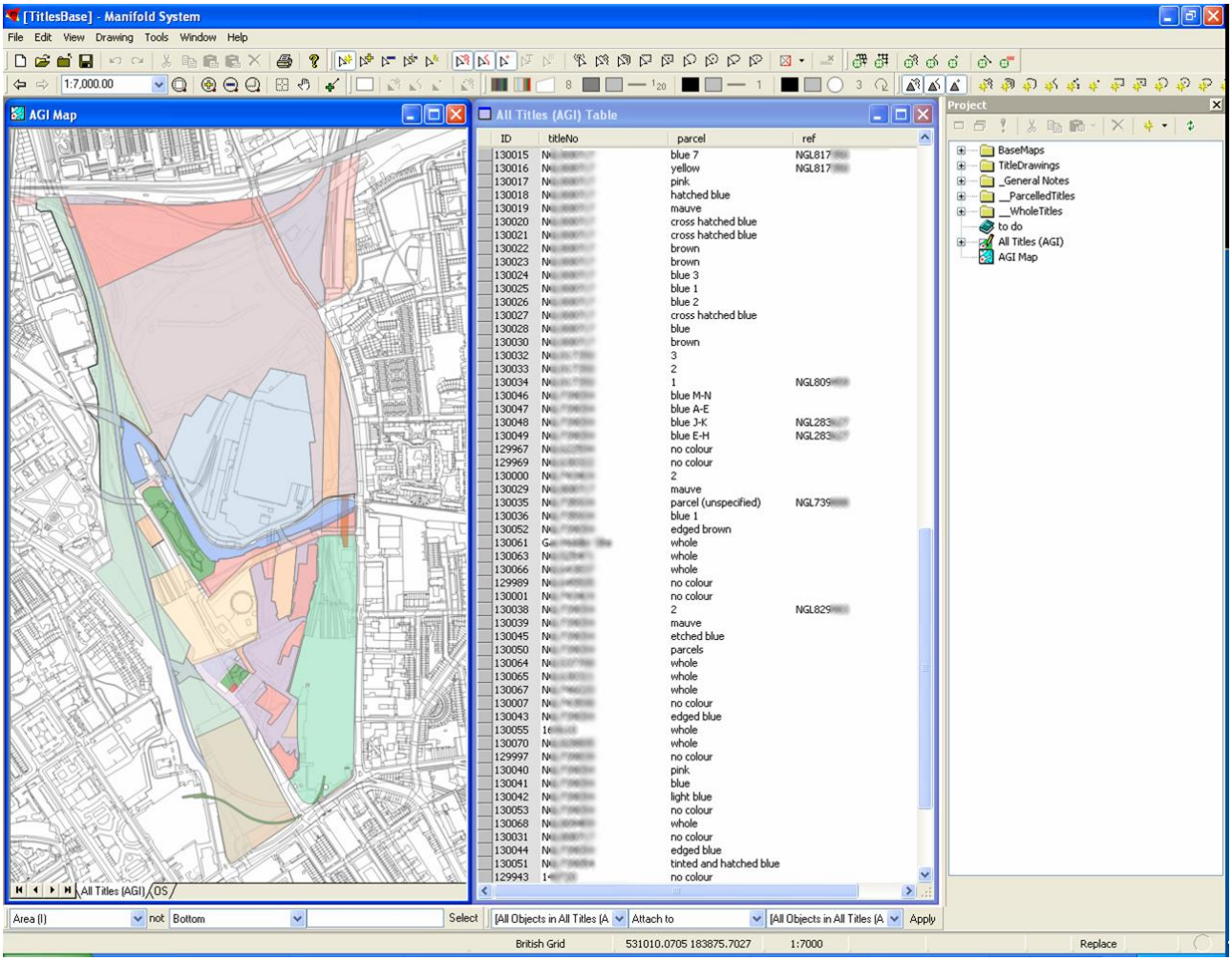

Figure 2 - Digitized title boundaries in Manifold

The Matrix database

In parallel to the processing of the map, it became clear that a central database that will hold the matrix and link it to the GIS will be beneficial for all parties involved. The Matrix was transformed from a flat table into an Access database. To ensure that the encumbrances could be linked to the maps they affected, in addition to decomposing the Matrix into a normalised database, the document's wordings were checked to lift a relevant set of attributes corresponding to features of the maps (coloured contours, labelling, and cross-references to other documents, be them other Titles, Deeds, and such like).

The task was somewhat laborious by the fact that some of these attributes were not comprehensively documented in the Matrix. The work was done in close communication with the lawyers to ensure that a common language was developed between the spatial and the legal aspects of the database. Once ready, the database was linked to the maps.

The Web Application

Manifold links to various databases, including Access. It was an easy exercise to link the database to the maps via queries driven by a form customised with Visual Basic. This pilot application was used to ascertain what the users would like to see in the website (see Figure 4).

Once the requirements were established, two websites were created. The Matrix was passed on to an SQL Server database and made accessible on the web according to the lawyers requirements. Although the form used is simple and does not have extensive searching capabilities, it suits the systematic way the lawyers maintain it (typically one document at a time, or a certain field across all documents sequentially. See Figure 3), can be queried easily by encumbrance, and resembles the original Matrix, a format those users are familiar with.

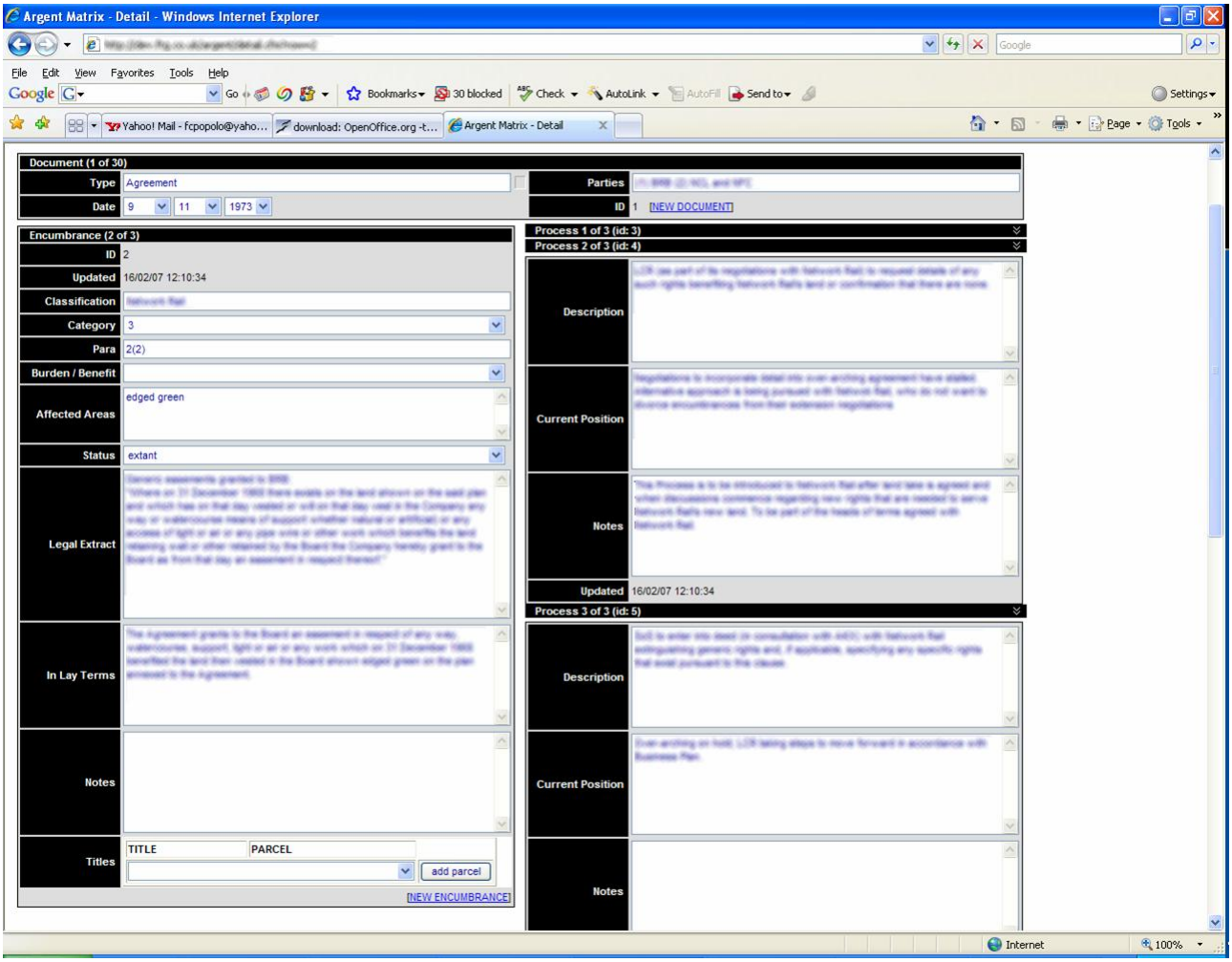

Figure 3 - Matrix application on the Intranet

The maps were placed on a separate website. Similarly to the Access database on the standalone version, Manifold links to the SQL Server database and queries it through its maps. By clicking on a mask representing where future buildings will be constructed, the website responds by showing which titles overlap the building footprint. A list of encumbrances relating to the selected titles appears. By selecting the desired encumbrance, the Matrix website is launched on a separate process. The website was developed in Javascript and Active Server Pages (ASP).

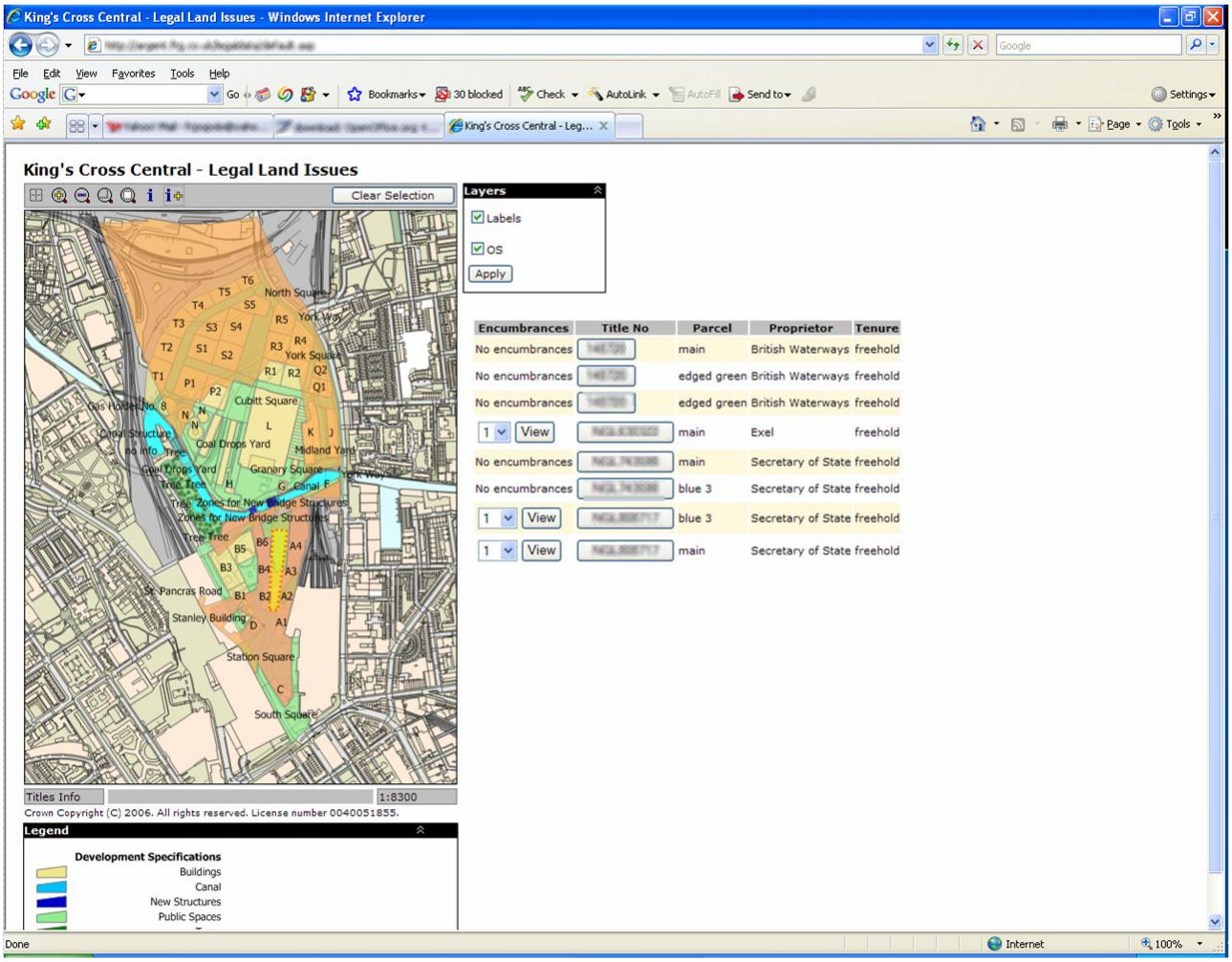

Figure 4 - Manifold IMS site with access to the Matrix

The work is still in progress. One of the requirements is that the Matrix website invokes the Legal Maps one. For this to happen, the remaining legal documents have to be digitised and their cross-reference to the titles resolved, as well as their own set of map-able attributes.

Conclusions

The creation of a King's Cross Central GIS provided several important insights:

First, even with all its limitation in terms of the legal status of mapping information, GIS is very valuable in terms of time and cost saving in land projects where a web of titles, agreements and rights need to be negotiated through. Despite of all the difficulties, the system was implemented within 5 months and is operational for over a year. The system has already saved Argent significant sub consultant's fees through the efficient handling of the matrix and recognising which titles and agreement relate to which part of the site.

Secondly, the implementation of a low cost spatial solution is an efficient way of dealing with GIS in such projects. In GIS projects, the major costs are data, labour and software. By reducing the cost of software significantly, more resources could be put into ensuring that the money is spent on labour that contributes directly to the project. Arguably, the amount of money that was saved on the IMS software alone was the equivalent of 4-5 working months.

Finally, the collaboration with UCL's Department of Geomatic Engineering was a major element in the success of the project. Despite of the size of its projects, Argent is a relatively small company in terms of the number of employees and does not have in house GIS team. By collaborating closely with us they gained knowledge and avoided the need to recruit an expert, as they benefited from the university's knowledge base and teaching experience.

Biography

Dr Muki Haklay is a Senior Lecture in GIS at UCL, where he is also the director of UCL Chorley Institute - an interdisciplinary research centre, with an aim to spatially enable UCL strategic research activities. Dr Haklay was the course director of the University of London M.Sc. in GIScience between 2002 and 2006 and continues to teach on this programme and other programmes in the department.
In addition to his extensive research and teaching work, Dr Haklay provide consultancy services in the area of Geographical Information Systems, building on over 19 years of practical experience combined with extensive academic knowledge about methods, techniques and best practices. Over the past few years he has worked with a wide range of clients, including central government (ODPM, MoD, Ordnance Survey), local government (Wandworth Council, Camden Police, Camden Primary Care Trust), third sector bodies (London Sustainability Exchange, Groundwork, Think London) and private sector companies (Geofutures, Argent Kings Cross Ltd,, Sitescope).

Filippo Campagna Popolo is now the IT Manager at Argent. He was contracted for the position after completing the project described in this paper. He has a Masters in GIScience from University College London and a BSc in Restoration Ecology from the University of East London. During the latter course he collaborated in two papers in analytical techniques applied to surface pattern recognition on mires.