

Historical Land Use Data Methodology

Introduction

In 1998 Landmark Information Group completed the creation of a unique database of Historical Land Use and Potentially Contaminative Industries based on the guidelines set out in the Environmental Protection Act 1990 and the Environment Act 1995. The database was produced from an historical map database created under a joint venture between Landmark and Ordnance Survey (OS) set up in 1995.

The resultant data has proved essential for investigations in to the existence of historically contaminated land. Local authorities throughout England, Scotland and Wales have been able to correctly identify and prioritise key “sources”, as defined within Section 57 of the Environment Act 1995, to establish the presence of “significant pollution linkages” within their specific area.

This document details the methodology, analysis and quality assurance involved in the creation of this database.

Section One: The Base Mapping

The joint venture between Landmark and OS was formed to undertake the task of creating a digital historical mapping archive of mainland UK based on 1:10 560, 1:10 000, 1:2 500 and 1:1 250 scale maps. This historical mapping archive begins with the maps first surveyed in Lancashire in September 1841. The rest of England, Wales and Scotland were surveyed in subsequent years, each county being revised three to five times before 1945. These sheets became known as the County Series because each county was surveyed separately and many of the counties were surveyed to different origins from their neighbours. In 1944/45 the origin was standardised for the entire country and mapping was transferred to the National Grid. The result was a new projection and a map naming convention which continued until the introduction of modern digital mapping (OS Land-Line[®]) in the mid-1990s.

Further details about the joint venture can be found in “Historical Data – A Technical Information Leaflet” produced by Landmark/OS.

Section Two: The Mapping Analysis

In 1996 Landmark began a systematic analysis of the 1:10 000 and 1:10 560 scale historical mapping to identify previous industrial uses of a potentially contaminative nature and key historical land use features. It was decided to restrict analysis to this scale, and not to analyse the larger scale (1:2 500 and 1:1 250) maps, because of the immense number of maps involved and the fact that the detail on the larger scale maps did not greatly amplify the detail on the 1:10 560/1:10 000 scale maps. The detail provided by the smaller scale mapping is sufficient to correctly identify all the major uses mapped by OS plus the vast majority of the smaller sites.

Landmark analysed the maps for up to six time periods (epochs). These epochs included up to four County Series map editions, at 1:10 560 scale, between 1846–1939, the first National Grid 1:10 560 or 1:10 000 maps from 1948 and the latest 1:10 000 National Grid Map.

Seven layers of data were created within a GIS to cover the whole of England, Wales and industrial Scotland: six contaminative use layers corresponding to specific time periods and one land use layer. Potentially contaminative uses were digitised and categorised (*a full list of categories can be found in Appendix A*) into the **six contaminative use layers**, based on each epoch. The seventh layer, **the land use layer** contains the following features: Areas of Unknown Fill (water), Areas of Unknown Fill (non-water), Former Marshes and Areas Liable to Flood.

The analysis was undertaken as a 3 step process: Manual Analysis, Methodology and Digitising. The entire process was then subject to Quality Assurance.



Step One: Manual Analysis

On the first available map for an area, all water features, rivers, streams, ponds, coastline etc, were highlighted. This process was then repeated on the next available map for the area. The second map was then placed over the first map on a light table. Any water feature which did not appear on a subsequent map was marked as an area of **"Disappeared Water"**. These sites were digitised into the land use layer and the process repeated for all epochs.

Potentially contaminative industries and land uses were also identified in the same way, beginning with the first available map and continuing through the subsequent epochs. All uses were grouped into categories based on features identified on the maps. On the first map all potentially contaminative features were highlighted and annotated with a code. A comparison was then made with the next epoch to establish which features remained through the time period and to digitise new sites. This process was repeated for each epoch.

Specific types of industry, e.g. brick works, collieries, mines, pits and quarries, by their nature, created areas which could be subject to infill. The extent of each of these features was mapped over time until there was no indication of their existence. When this occurred the largest area indicated by the analysis of the epoch layers was digitised into the Land Use layer as **"Unknown Fill (Non-water)"**.

In urban and other difficult areas (e.g. the Staffordshire potteries), the analysing process was carried out on a light table. In rural or light areas the same methods of analysis were used except the features were digitised directly onto the screen.

Step Two: Methodology

Three different kinds of features were created: point features, linear features and area features. Features covering an area of less than 100m x 100m on the ground were digitised as **points**, as they were insufficiently defined on the map. Those features which cover a definable area greater than 1ha on the ground were digitised as **polygons** around the boundary of each feature.

Due to changes in the railway network between the 1860s and the 1970s, it was decided that each length of railway line digitised would need to be identical in all the epochs in which the line occurred. This meant that if a siding was visible on a map in the epoch after the initial piece of track was analysed/digitised, the siding would then be analysed/digitised as a separate feature. To facilitate the analysing/digitising of the railway network natural breaks such as bridges and tunnels were used as start and end points for these **linear** features. Within each quarter sheet railways were analysed/digitised from the map edge to the first natural break, to a maximum length of 2km.

Certain additional features were also added to the Land Use Layer: Areas Liable to Flood, Pits Unspecified and Areas of Former Water.

In the early County Series mapping the words **"Liable to Flood"** are found next to some rivers. As the precise extent of the area liable to flooding was unknown the information was captured by digitising a point on the word "to". The extent of an area of "former marsh" is also not easily identifiable on the 1:10 560 and 1:10 000 maps. This information was captured by digitising points at 100m intervals for those marshes which are no longer visible in the latest map, and are in the proximity of an area where that mapping indicates the likelihood of development.

A specific category, **"Pits Unspecified"**, was created for when the mapping symbology indicates a pit but no text appears on the map. These features were digitised in the relevant epoch layers and copied into the Land Use layer when the following criteria were met:

- The pit is no longer visible on the latest map (epoch 6), or development has occurred where the pit had previously been
- The area of the pit is greater than 1ha on the ground and it is in the proximity of an area where the latest mapping indicates the likelihood of development.

Areas of **"Former Water"** (small streams, drains or ponds) were only digitised into the Land Use layer when the stream or pond was no longer visible on the latest map (epoch 6) and was in the proximity of an area where the latest mapping indicates the likelihood of development.



Step Three: Digitising

The digitising of potentially contaminative features found during analysis was undertaken in-house using software derived from *Genamap*. A contamination layer was allocated to each of the six epochs plus a Land Use layer in the National Grid projection. The system allowed a link between the graphical elements stored in *Genamap* and the attribute data, stored in an *Oracle* database, which contained feature type and date information.

For the mapping pre-digitising checks were carried out to compare the processed images with the paper copies to ensure the best possible processed image was loaded onto the system. Each individual TIFF image was checked and then compared against the most up to date mapping (epoch 6). In this way any mismatch caused by shrinkage of the original scanned paper map was limited. Further mismatch differences between epochs were checked to ensure that they were limited to less than 20 metres.

In urban areas the screen was divided into 16 equal boxes. The digitising process was then carried out by zooming in to each box in turn. This gave a standard working scale of 1:3 463. All digitising was carried out at this scale thus reducing the potential for compounded error due to different digitisers working at different scales on the same region. In rural areas the screen was divided into 9 boxes. All rural areas were then analysed at the scale of 1:4 684, but any digitising of features found in rural areas was done at 1:3 463 (as in urban areas).

Railways were the first features to be digitised. Linear features were copied from the most up-to-date maps to all epochs in which they appeared. Starting at the edge of the map and working in, points were chosen along the length of the rail by tracing its length with the mouse cursor and clicking at chosen points along its length.

For point and polygon features a keyword (contamination/land use types) was selected from the digitising application menu (*see Appendix A for details of the categories used*) and then, depending on the classification, a point/area and or linear feature was digitised. Once the feature had been digitised the next point was chosen and allocated a new sequential number. The classification and the date of the map on which the feature has been digitised were assigned to the feature. The sequential number allocated was a 12-digit GIS Unique Reference Number, called a gisurn. If the same contaminative feature then appeared in the subsequent epoch and in the same position, the original feature was simply copied to the following epoch. This meant the copied feature kept the same reference number as the original feature, but the date of the map in the next epoch would also be assigned to the feature. This linked the same occurrence of a feature through all epochs.

When features appeared for the first time annotated "Old" or "Disused", they were identified as the first likely potentially contaminative activity at this location and thus digitised. In certain instances active features (such as quarries), which subsequently became disused, were taken as active when they extended to larger areas in the immediately previous epoch. Unless there was a change on the map in subsequent epochs, features were generally taken to be no longer active once the words "Old" or "Disused" were appended to their description on the map.

After digitising features relating to potential contaminative uses, a check of land use was carried out. All water was checked for disappearance from one map edition to another. If any items merited inclusion in the Land Use layer (e.g. ponds that are no longer apparent or any water in one epoch which has been built on in another) these items were digitised in the epoch prior to their disappearance. In this way these items were accurately delineated. As with contamination features, gisurns were automatically allocated and coded as **"Potential Fill (Water)"**.

"Non-water Fill" was also highlighted in the Land Use layer, as detailed in the Manual Analysis section, but handled differently. Contaminative use features with the possibility of potential fill were checked against the previous epoch. If there was no longer any evidence of the original feature then it was copied through into the Land Use layer at its greatest extent and a gisurn allocated.

In cases where neighbouring counties mapped the same geographical area, each county was analysed in turn until every map covering that area had been examined and a cumulative picture built up. This was done whether the same origin or different origins were used for each of the counties. Whenever potentially contaminative uses appeared at the edge of a map and also on adjacent sheets, all the sheets required were matched to their neighbours. In most cases these potentially contaminative uses were digitised as a single feature even though it crossed the dividing line on the original mapping.



All of these steps were repeated methodically through every box on the screen, from the first available map to the latest epoch.

Section Three: Quality Assurance

All digitisers underwent an extensive training programme. Subsequently, trainee digitisers received individual supervision until they reached a required ability level at which point they joined the main digitising team. A User Manual was created which defined how all features would be handled.

All the data within the Landmark database has been through a rigorous three-part Quality Assessment:

- i. To ensure that the quality of the work undertaken was maintained, all digitised areas have been checked. In addition an independent group of experienced digitisers examined trial sections, generated at random on every area worked on.
- ii. Before digitising a new area, the scanning and cropping quality of each map was verified and the published date checked.
- iii. A supervisory team provided an overview of the process to ensure a uniformity of approach which resulted in a high degree of accuracy within the project. Any areas of work which caused concern were thoroughly re-examined and remedial action carried out if necessary.
- iv. Integrity of the digital data has been checked.

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Appendix A

Description	Remarks
Air shafts	Air shafts
Animal by-products (i.e. gelatine, soap, glue etc)	Animal by-products (i.e. animal parts) e.g. soaps, candles and bone works
Animal slaughtering and basic processing of meat (other than poultry)	Animal slaughtering and basic processing
Area liable to flood	Areas 'liable to flood' as indicated on the historical maps
Batteries, accumulators and primary cells [manufacture]	Batteries, accumulators, primary cells, electric motors, generators and transformers
Brewing and malting	Brewing and malting
Cement, lime and plaster products [manufacture]	Concrete, cement, lime and plaster products, also includes lime kilns
Cemetery or graveyard	Cemetery, modern burial grounds and grave yards
Chemical manufacturing general	Manufacture of cosmetics, manure, fertilisers and pesticides, detergents, oil, organic-based pharmaceuticals, glues, gelatines, recording tapes, photographic film
Clay bricks and tiles [manufacture]	Manufacture of clay bricks, breeze blocks and tiles, including associated activities e.g. brick fields, also solitary kilns (other than lime kilns)
Coal storage and depot	Coal storage/depot
Constructional steelwork, metal structures and products and building materials [manufacture]	Constructional steelwork, metal structures and products and building materials
Distribution, telecoms, medical, navigation, metering and lighting equipment [manufacture]	Manufacturing of distribution, telecoms, medical, navigation, metering and lighting
Disturbed ground	Disturbed ground greater than 200m in one dimension
Domestic appliances [manufacture]	Manufacturing of domestic appliances
Dyes and pigments [manufacture]	Dye and pigments
Electricity production and distribution (including large transformers)	Electricity generation and distribution, including large transfer stations
Factory or works — use not specified	Factory and works — use not specified
Food processing — major	Major food processing, includes dairies
Former marsh	Feature is only shown when land has subsequently been built on
Fuel: retail sale of automotive fuel	Sale of automotive fuel
Gas manufacture and distribution	Gas processing/manufacture and oil refining
General quarrying	Quarrying of all stone (including limestone, gypsum, chalk and slate) and ores, includes all open-cast mining and slant workings also slate/slab works, flint works, stone yards
Glass and glass products excluding flat glass [manufacture]	Flat glass and glass products manufacture
Heap, unknown constituents	Must be associated with relevant extraction industry including spoil and slag
Heavy product manufacture — rolling and drawing of iron, steel and ferroalloys	Heavy product manufacture, rolling and drawing of iron, steel and ferroalloys includes major tube works
Hospitals	All hospitals including sanatoriums but not lunatic asylums
Insulated wire and cable [manufacture]	Insulated wire and cable for electrical/telephonic purposes
Laundries and dry cleaning	Laundries and dry cleaning
Leather tanning and dressing	Tannery, leather goods and skinners
Machinery: engines, building and general industrial [manufacture]	Manufacturing of engines, building and general industrial machinery, including nuts and bolts, gas fittings, wire rope and ordnance accessories
Metal casting/foundries	Furnaces and metal processing/casting/forges/smelting including ferro and aluminum alloys, manganese works etc
Metals: treatment and coating including electroplating	Electro-plating, galvanising and anodizing
Military land	All military establishments including firing ranges (if not specified as civilian)
Mineral products non-metallic (including abrasives and asbestos) [miscellaneous manufacture]	Abrasives, asbestos etc
Mineral railway	Mineral railways
Mining and quarrying general	Areas of mining and single or groups of shafts other than coal and not specified including levels, or adits, etc



Mining of coal and lignite	Coal mining, the manufacturing of coke or charcoal included, are associated surface activities in area, also individual coal mine shafts
Motor vehicles: maintenance and repair e.g. Garages	Repair and sale of i) cars and bikes, ii) parts, iii) services
Natural and man-made textile manufacture and products	Natural and man-made textile manufacture and products including hemp rope
Office machinery and computers [manufacture]	Computers, office machinery, business/industrial electrical goods
Oil, petroleum, gas, refining and storage	Major oil and petrol storage and all gasometers which are not in gas works
Outfalls	Outfalls including warm water, industrial effluent and sewage unless directly attached to other sewerage feature e.g. end of sewer pipe
Paints, varnishes, printing inks, mastics and sealants [manufacture]	Paints, varnishes, printing inks, mastics, sealants and creosote
Paper packaging products [manufacture]	Pulp, paper and cardboard manufacture
Pipelines	Above ground pipelines other than sewerage
Plastic goods, all general manufacture, including building, packaging and tubing	All plastic goods, including building, packages, tubing etc and the manufacture of tar, bitumen and asphalt
Printing of newspapers	Printing of newspapers
Printing: miscellaneous excluding newspapers	Printing other than news print
Pulp, commodity grade paper and paperboard manufacture	Paper, card, etc products e.g. Packaging
Quarrying of sand and clay, operation of sand and gravel pits	Extraction of alluvial sediments (sand, stone, clay, peat, marl and gravel)
Railways	Railway tracks — up to 4 tracks wide
Recycling of metal waste and scrap metal	Recycling of metal waste including scrap yards and car breakers
Refuse disposal	Refuse and waste disposal including incinerators and sanitary depot
Road haulage	Transport depot — road haulage, corporation
Rubber natural products manufacture	Natural and synthetic rubber products including tyres and rubber products
Sawmilling, planing and impregnation (i.e. Treatment of timber)	Sawmilling, planing and impregnation (i.e. treatment of timber), wood products, telegraph works, timber yard e.g. veneer
Sewage	Sewerage, septic-tanks, includes all filter beds
Spirit distilling and compounding	Spirit distilling and compounding
Tableware and other ceramics [manufacture]	Tableware and other ceramics
Technical and environmental testing and analysis	Various technical and environmental testing and analysis
Transport manufacturing and repair	Manufacturing and repair including i) ships, ii) aerospace, iii) rail engines and rolling stock
Transport support and cargo handling	Boat building, wharf and quays, cargo/transport handling facilities
Transport: air and space, cargo and handling and transport support	Air and space transport
Transport: light manufacture	Manufacture of cars, lorries, buses, motorcycles, bicycles
Weapons and ammunition [manufacture and storage]	Civilian manufacture and storage of weapons, ammunition, explosives and rockets