Valuation Office
Agency

# The Feasibility of Using Statistical Models to Value Land in Wales

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# Executive Summary

Question: If the Valuation Office Agency had to value land in Wales for taxation purposes, how feasible would it be?

Answer: It is feasible based on the following assumptions:

- We start from the current and planned future practices of using model assisted valuation for Council Tax and non-domestic rating respectively.
- We use model assisted valuation on the most common property types.
- We attribute values to parcels of land associated with titles registered with His Majesty's Land Registry.
- Model Assisted Valuation could produce first-pass valuations that would need extensive expert adjustment by valuers to consider features specific to different parcels of land.

Even if land were valued in this way, the following caveats would apply:

- The valuation assumptions that define the hypothetical transaction and the permissible purposes for which the land will be used would have to be provided to the Valuation Office Agency, where these purposes differ from actual use.
- His Majesty's Land Registry would need a complete digital map (cadastre) of Welsh land ownership so that values could be attributed to the correct parcels of land.
- Standardised approaches to apportioning the total value of a property between land value and improvements would need to be laid out in the regulations, as there is insufficient evidence to do this individually for each property without considerable risk of challenge.
- The resulting values could only be regarded as 'notional' values, because they would not be evidenced against open-market value of land on a case-by-case basis.
- If yields are used to capitalise rental estimates, yield assumptions would similarly be required to be specified in regulations.
- The notional values produced would be suitable for comparing the value of properties within the same property type.
- Comparison across different property types would be less accurate than comparison within property types.
- There are risks of perverse incentives arising from using land values as the basis for policies which may incentivise change of land use.

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# Glossary

| | |
|---|---|
| **Apportionment** | The division of a value based on land and improvements into a value for land and a value for improvements. |
| **Cadastre** | A public record of interests in land, for the purposes of land valuation and taxation, (here assumed to be digital). |
| **Capitalisation** | A process to convert rental values into ‘capital’ sale values. |
| **Choropleth** | A map using colour variation to represent characteristics. |
| **Comparables (valuation)** | Valuation approach based on comparing the subject property to transactional evidence from similar properties. |
| **Easement** | The right of an owner of one piece of land to benefit from other land. |
| **Field (model)** | An assignment of value to every point in a region space. |
| **Geospatial dataset** | A digital dataset that includes a geometry that specifies locations and/or arrangements in a geographical coordinate system. |
| **Improvements (to land)** | Alterations to land that affect its value for a certain use, such as buildings, drainage, earthworks or utilities. |
| **Network (model)** | An assignment of value to locations along a group of interconnected lines. |
| **Notional value** | A value for property based on a hypothetical situation that cannot be sufficiently supported by evidence of open-market transactions to meet the standard required to count as a formal valuation. |
| **Model Assisted Valuation (MAV)** | An approach to property valuation that relies both on statistical models and professional valuer judgement. |
| **Permissive planning** | A planning system where planning consent is decided only after permission is sought. |
| **Residuals (valuation)** | An approach to valuation of land based on its developed potential. It involves calculating the value of the land by taking the developed value and subtracting the total development costs, including profit. |
| **Spatial Effects** | The contribution to the predictions of a statistical model, that varies with location rather than other variables. |

| | |
|---|---|
| **Statistical Model** | A mathematical representation that allows for the inference from a sample of evidence to a target population on the basis of a set of assumptions and mathematical rules. |
| **Unimproved land** | Land that has not had value added to it through alterations to its character, such as buildings, drainage, earthworks or utilities. |
| **Valuer** | A chartered surveyor qualified to provide formal, regulated property valuations. |
| **Yield** | An interest rate achieved by an investment. |

# 1. Introduction

The Welsh Government commissioned the Valuation Office Agency (VOA) to consider the question ‘were VOA to value land in Wales for taxation purposes, how would they do it?’.

The VOA provides the UK and Welsh Governments with valuation and property advice needed to support taxation and benefits. This report was compiled by the VOA Property Market Data Unit, supported by VOA District Valuer Services (DVS) team.

The VOA provide valuations for Council Tax and non-domestic rates in Wales, as well as bespoke valuations through DVS. We have considerable practical experience in conducting valuations at scale. DVS are experienced in valuing land for inheritance tax, capital gains tax, and other non-statutory purposes. Agricultural land is exempt from rating and so the VOA does not currently value this at scale.

The VOA has an internal Model Assisted Valuation (MAV) strategy and recently developed an automated valuation model to support preparations for the 2028 Council Tax revaluation in Wales. Further work is ongoing to test the feasibility of using MAV for non-domestic properties. This report builds on concepts developed in that work.

This report is based on our work to assess feasibility of using a MAV approach to valuation of land. We report on feasibility but make no comment on current or future policies of the Welsh Government. Values presented in this report are illustrative and do not represent final valuations.

# 2. Methodology

## 2.1 Valuation Assumptions

All valuations depend on valuation assumptions. These specify the scenario under which the value is to be considered, specifying, for example:

- a date on which a hypothetical sale or rental agreement would take place
- the circumstances of a transaction, such that it represents a fair value
- permissible uses to which the land/property in question may be put by the hypothetical buyer/occupier.

Where these assumptions rely on actual use, or the vacant possession of a property purchased or rented on the open market, the valuation assumption is relatively straightforward.

Traditional valuation approaches rely on a range of methods to establish value. These include:

- Comparison with open-market transactions of a similar nature (the 'comparables method')
- Consideration of the potential profitability of specialised, income producing properties e.g. a hotel (the 'profits method')
- Estimation of the capital value of a property by capitalising the income stream it might generate for an investor (the 'investment method')
- Consideration of the cost of acquiring a replacement building including constructing it and acquiring the land (the 'depreciated replacement cost method')
- Consideration of the value that would be paid for land or property with development potential, calculated by estimating the value of the planned development and deducting all costs and the developer's profit (e.g. the 'residuals method')

Each of these traditional valuation methods depend on establishing a value with reference to evidence. This evidence relies on comparison, whether that is of transaction values, profitability, or construction costs. This evidence is open to challenge, and these methods are regulated by the Royal Institution of Chartered Surveyors (RICS).

Commercial property contracts can be complicated and not transparent. They may involve incentives and terms that require adjustment to reflect open market value. In current practice, we require the occupier of commercial premises to provide details of their rent and lease agreements. These rent and lease details are then adjusted to form rental evidence of open market values for comparison where the comparables method is used to arrive at rental values.

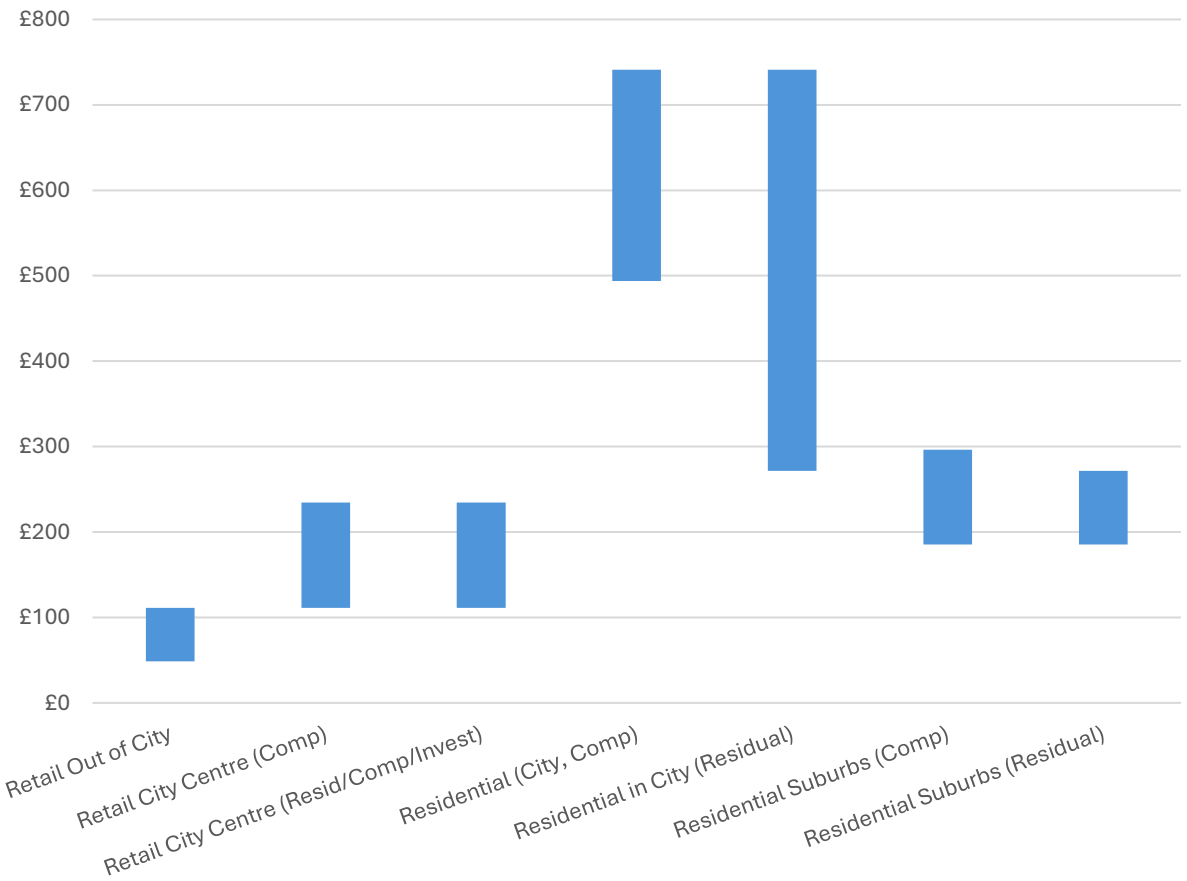
## 2.2 Use Of Land

The valuation of unimproved land is explicitly intended to allow for a range of economic uses of that land, independent of actual uses or improvements on it. Planning restrictions constrain what uses land may legally be put to. Given Wales's permissive planning system, no data on permissibility of the different uses is available unless a planning request has been specifically made.

The VOA has no opinion on permitted uses of land. Valuation assumptions around permissibility used to form valuations, especially where they deviate from actual use, will need to be provided by a relevant authority. The method presented is entirely conditional on these assumptions being provided.

These assumptions will have a significant influence on property values. Work by VOA DVS using traditional valuation approaches found significant variation in land values depending on location and the assumptions used for different property types, shown in Figure 1.

**Figure 1: Highest and lowest values for retail and residential (£/msq)**



## 2.3 Defining Land Ownership

Valuations depend on identifying the relevant land/property to which the valuation will apply. For this method, an exclusive and exhaustive dataset of land parcels in Wales, a 'cadastre', is required to ensure each parcel of land is given a single value, and ownership is known. We rely on His Majesty's Land Registry (HMLR) data from the National Polygon Service which provides geospatial data associated with each HMLR title. Land must be correctly registered, and it must be clear which legal interests are relevant for valuation. This issue is illustrated in Annex 2, Figure 8.

## 2.4 Model Assisted Valuation

As noted above, the VOA has a MAV approach for domestic properties in Wales as part of preparations for the 2028 Council Tax revaluation. We are also developing a MAV approach for shops and investigating other non-domestic property types. This work has provided insight in how we approached this feasibility work.

Unimproved land valuations represent the value of land independent of the added value of buildings or activity that takes place upon it ('improvements'). In Wales, almost all land has *some* improvements on it; even agricultural land is classified as improved.

The study takes the value of the combination of land and improvements (as evidenced by sales or leases), and then apportions a value between the land and improvements.

The study used two existing VOA models: Wales Council Tax model used for valuing residential property (model for houses) and a prototype dense shops model, used to value locations of densely clustered concentrations of shops. These are described in Annex 1. Agricultural land would also need to be valued, but the VOA does not model this as it is currently exempt from rating. The feasibility of additional modelling of agricultural land is considered in subsections 0-0.

We assessed feasibility of model assisted valuation of unimproved land by:

1. Take an existing VOA model (Wales Council Tax or dense shops)
2. Neutralise the influence of property characteristics using a 'representative property' which is assumed to have been provided.
3. Capitalise rental evidence (for commercial property) to create a figure representing the sale price of the property.
4. Apportion the value for each assessment between land and improvements.
5. Extract a £/$m^2$ figure for the location of each assessment (a central point in the case of residential, its location on the road network for retail)
6. Multiply this £/$m^2$ figure by size of land parcel associated with the land title provided by HMLR, known as a 'polygon'.

These six steps allow MAVs intended for Council Tax and non-domestic rates to be converted into land valuation approaches. If these six steps are feasible then notional land valuation at scale is feasible.

## 2.5 Neutralising Improvements

Step 2 is a key step in the method. The models can control for property characteristics, such as size and age, and in addition model patterns in value that vary by location, 'spatial effects', but are not accounted for by property characteristics. Neutralising property characteristics means considering a hypothetical set of characteristics which are held constant across the different locations, so the model only distinguishes between locations in terms of the spatial effects. For example, a pre-war semi-detached house of typical size is the assumed example of a "house".

This approach assumes that there are no value-significant property characteristics that have not been included in the model. These would show up as noise in the model, reducing its accuracy. If value-significant property characteristics correlate with location, the uplift due to those characteristics would be incorrectly attributed to the land value. Imagine a whole development being built by a well-known architect. The contribution of the architect's involvement to the property value would be attributed to the location, rather than the improvements, by the model.

Multiplying a £/$m^2$ figure by size of HMLR polygon abstracts away from any variation within the plot, which may sacrifice granularity of detail. A more complex option would be to sub-divide plots into different survey units with different valuation assumptions. Feasibility of this was not explored.

The data used in these six steps was a mixture of Land Transaction Tax data from Welsh Government, internal VOA data, and HMLR data, alongside some external data sources. Section 2.9 outlines data used.

The models have been tested against previous valuations, with performance measures in Annex 1. We have been able to demonstrate feasibility but have not determined if this approach is the *most* accurate, efficient or consistent. There may be further approaches which improve results. The methodology and outputs from our work have been quality assured by analytical and surveying professionals. We have considered factors relevant to the cost of scaling this work in subsection 4.13, but we do not make an economic case for the approach.

## 2.6 Comparability Of Valuations

Some additional assumptions relate to the potential use of the valuations. The need to apportion value between land and improvements is only required if point values (in £s) are required. If relative values, e.g. banding as currently used in Council Tax, are required, this can be achieved through neutralising property characteristics.

Capitalisation of rental values is only necessary if there is a need to compare values from commercial property (based on rental evidence) to values from domestic property (based on sales evidence). Rental data is used for non-domestic rates because there are more data available from rental agreements than from sales. Given the methodological assumption of starting with current processes, we assume the data currently used to build models of non-domestic property would continue to be used.

Capitalisation involves applying hypothesised yields using the formula:

Ratable value / percentage yield = capital value

Capitalising rental information is inherently noisy, and depends on identifying the appropriate yield to use. In the case of a hypothetical buyer investing for a hypothetical use, this is particularly challenging.

## 2.7 Site-Specific Factors

The MAV method provides a figure by a rules-based approach amenable to automation. It is assumed that these outputs represent first-pass valuations, and valuer review, including end-adjustments, may be needed to reflect site-specific factors which have significant effect on values, such as:

- Contamination
- Minerals and Mining Subsidence Reports
- Restrictions and Reservations
- Green Belt Land
- Planning
- Playing fields
- Access/Easements

These site-specific factors may create incentives, including perverse incentives to change the value of the land, e.g. by extracting minerals, changing planning status, or introducing contamination to affect land value.

## 2.8 Practical Considerations Around Use For Policy

Valuation often involves a time-lag between the date at which land is valued and the production of the valuation. The value of the land, and/or the legal interest in the land, may change during this period. This time-lag may also create incentives to change the value of the land to take advantage of the difference between open-market value and its Government valuation. If land-values are used to create a system of incentives/disincentives for particular behaviour by land-owners, potential unintended consequences should be carefully considered.

Valuations for Council Tax and non-domestic rating have processes by which statutory valuations may be challenged and appealed. If a land value policy is implemented a process for challenging or appealing will need to be considered.

## 2.9 Data Sources Used

Land and Transaction Tax records are the primary source of sales data for Welsh property. They are the main source of evidence for the Council Tax Model, and if a model for agricultural land were to be built, it would also use this as sales evidence.

'Rent and Lease Details' (RALDs) provided by occupiers to the VOA and internal VOA adjustment and analysis of this data is used as the source of rental evidence for the dense shops model, and would form the evidential basis of models for sparse shops, offices and industrials, as model development takes place in those areas.

VOA survey data, which are based on VOA inspections and provide property characteristics for every property assessed for Council Tax (~1.5m) or non-domestic rates (~125,000) in Wales. These data allow identification of different property types, and features of the properties that are used for the building of models. Not all properties are assessed for Council Tax or non-domestic rates. Agricultural land is not assessed and so not included in VOA survey data.

A number of external datasets are used to identify properties and their locations. Ordnance Survey AddressBase Premium; Ordnance Survey National Geographic Database; The National Statistics Postcode Lookup; HMLR House Price Index; HMLR National Polygon Service; HMLR Price Paid Service. To investigate Agricultural Land, where we lack comprehensive survey data, the Welsh Government's Agricultural Land Classification data was used.

# 3. Findings

With regards to feasibility of valuing land, steps 3 and 4 in the method represent particular challenges. There are two common methods by which apportionment of value between land and improvements might be achieved: a residuals approach and a comparables approach.

The residuals approach identifies the land value with the open market value of a development (i.e. a particular set of improvements) minus the costs of turning the land from its current state to the improved state:

Gross Development Value – Development Costs = Residual Land Value

The residuals approach ties the value of properties to the costs associated with creating them, and is highly sensitive to a number of input assumptions, such that a small change in the cost of materials and labour can change the land values from positive to negative, or *vice versa*.

The comparables approach identifies transactions on plots of unimproved (or minimally improved) land that are similar to the land to be valued, and arrives at a value based on that comparison. It relies heavily on availability of relevant similar comparables. Additionally, there is a need to understand any complications to the transaction used as evidence, such as rent-free periods, or included services.

Where evidence of comparable plots is available, it may not reflect open-market value due to:

- a special purchaser (e.g. an adjoining land-owner)
- connected parties (e.g. a transaction between close relations)
- hope value (e.g. an anticipated change in permissible use)

Apportionment, if evidenced at individual assessments, would be extremely vulnerable to challenge. Parallel work for the Welsh Government by VOA DVS found that insufficient useful comparables, and the sensitivity of the residuals approach to input assumptions is such that neither approach (nor a combination of them) can be sensibly applied at scale to produce individual land valuations defensible in terms of RICS guidance as representing open-market values.

A heuristic assumption of an apportionment of value, such that land is worth 30% and improvements are worth 70% of the total value, was used instead. In the absence of an evidenced-based method of arriving at this number for each valuation, this assumption was the best approach available. An apportionment assumption would be needed for each property type; agricultural land may need a different apportionment between land and improvements than high-rise flats, for example. Unless protected from challenge in some way, the apportionment of value between land and improvements would be vulnerable to objection. This apportionment assumption generates a ‘notional value’ which accounts for the valuation

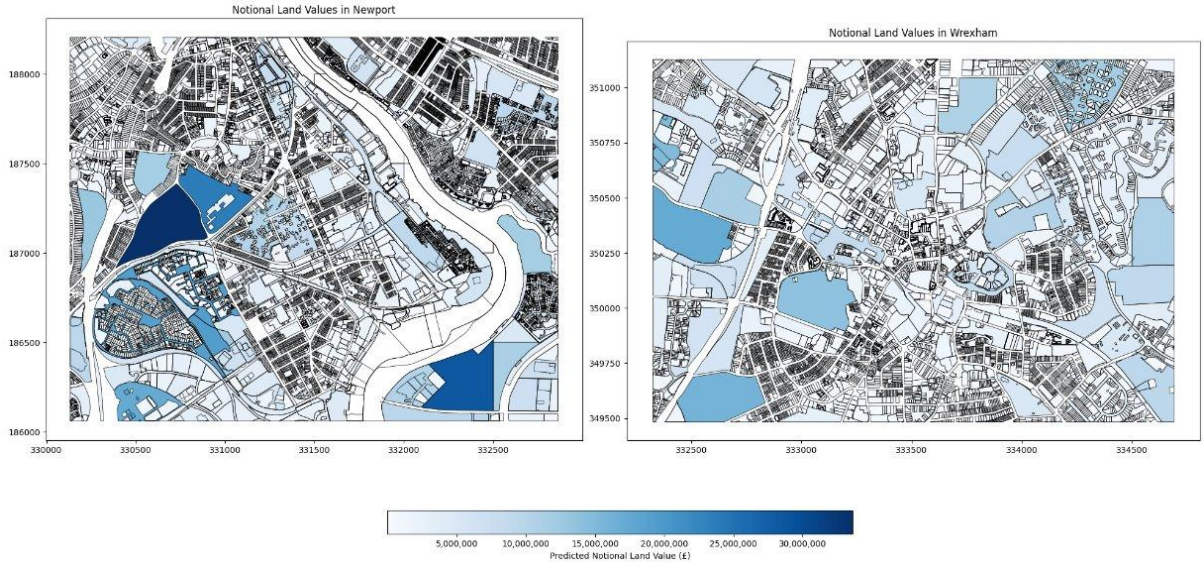
assumptions, and the difficulty of evidencing these values against comparable transactions.

Given the understanding that values generated are ‘notional values’, and based on given valuation assumptions, we found it is feasible to create first-pass notional valuations of plots of land using the method described above. Annex 2 outlines detail on the challenges and process of arriving at these notional values.

## 3.1 Medium Density Residential

Figure 2 outlines the findings from using the Council Tax model neutralised for a representative property to attribute values to HMLR polygons, in two Welsh towns, Newport and Wrexham. The colours represent the absolute values of those plots of land in GBP (£).

**Figure 2: Medium Density Residential land in Newport and Wrexham**




The valuation assumption was a £/$m^2$ rate based on a semi-detached house with garage of average size (108$m^2$) and average plot size (255$m^2$), built between 1930-1944, for private use. The model allows these assumptions to be changed as desired. Every property could have a unique valuation assumption as the basis for the notional valuation, provided there are accurate data on which HMLR title should be associated with which valuation assumption.

Apportionment of land value was based on multiplier of 0.3, based on a heuristic example. As mentioned, it would not be feasible to arrive at the apportionment value on a case-by-case basis and would require protection against challenge.

The values shown in Figure 2 are summarised below in Table 1.

**Table 1: Summary of medium-density residential land values**

| Medium Density Residential | Newport | | Wrexham | |
|---|---|---|---|---|
| | £ | £/m² | £ | £/m² |
| Range | 33,600,000 | 600 | 17,300,000 | 300 |
| Interquartile Range | 1000 | 100 | 144,339 | 50 |
| Median | 50,000 | 850 | 52,000 | 725 |
| Maximum | 33,600,000 | 1,300 | 17,200,000 | 930 |

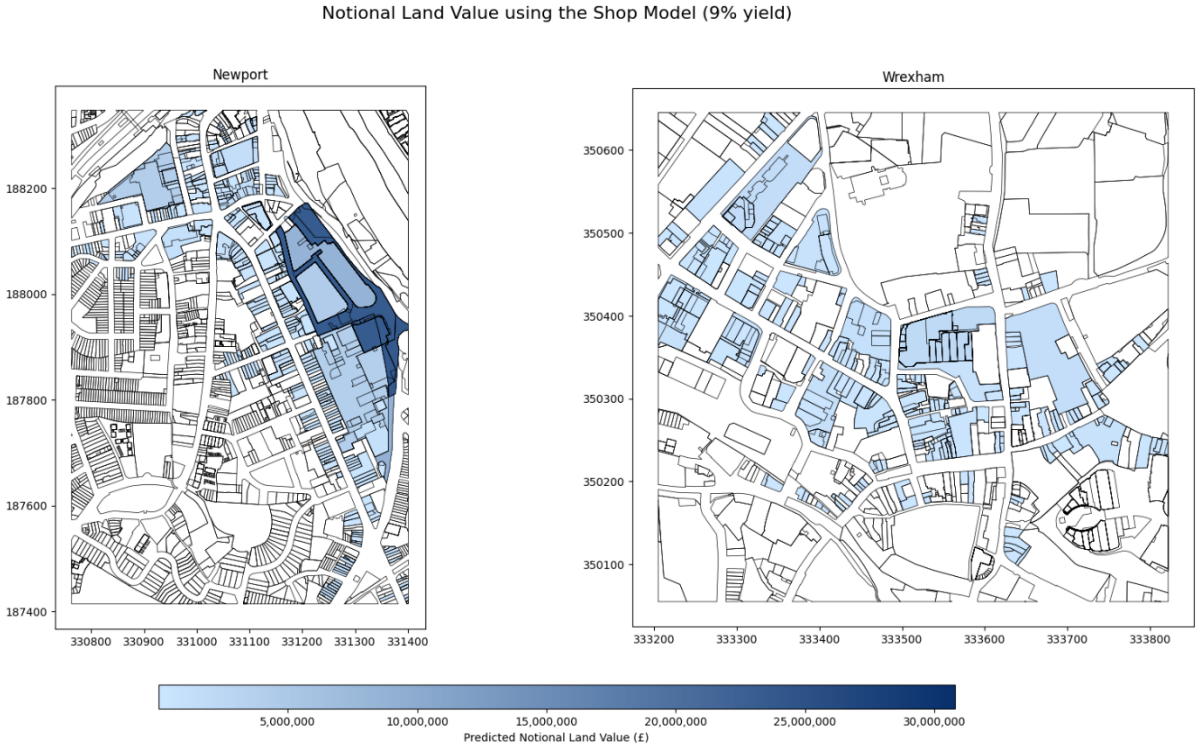
The higher values for individual plots often represent large areas of green space, such as Belle Vue Park (Newport), or Bellevue Park (Wrexham) whose value as e.g. social amenity or flood plain has not been taken into account in the model. The land belonging to hospitals, such as the Royal Gwent (Newport) and the Wrexham Maelor Hospital (Wrexham), also represent significant individual plots.

## 3.2 Retail

The Dense Shops Model is based on evidence of commercial transactions, which are not always transparent. An equivalent of the current process of collecting rent and lease details will be needed. Adjusting commercial transaction evidence to reflect open market value will also be needed.

The Dense Shops Model is still in development; values are solely based on location on the roads network, and values are only obtainable for the road network in areas with a comparatively dense concentration of shops. An alternative MAV approach to retail value would be needed outside these dense concentrations. Figure 3 demonstrates the assignment of shop values to HMLR plots based on a yield assumption of 9%, used as an illustrative example of a yield within the retail market. Capitalisation rates for hypothetical valuations will be vulnerable to challenge.

**Figure 3: Retail values in Newport and Wrexham**




A summary of the values shown in Figure 3 are in Table 2.

**Table 2: Summary of values for land under dense shops**

| Dense Shops (9% yield) | Newport | | Wrexham | |
|---|---|---|---|---|
| | £ | £/m$^2$ | £ | £/m$^2$ |
| Range | 30,800,000 | 470 | 2,100,000 | 160 |
| Interquartile Range | 530,000 | 60 | 160,000 | 50 |
| Median | 100,000 | 230 | 71,500 | 190 |
| Maximum | 30,800,000 | 575 | 2,100,000 | 400 |

The land underneath Friars Walk shopping centre (Newport) is notable for being a large and expensive plot. It is notable that the Dense Shops model did not include Eagles Meadow Shopping Centre in Wrexham. The shops in this shopping centre were more than 50m away from the main cluster of shops for Wrexham, and constitute a cluster of less than 50 shops (32 shops). That is below the threshold for inclusion in the model at this stage, and is why no values for that land are shown.

Several data challenges arise for the shops model, given its network-based approach, compared to the residential model. It requires, for example, assumptions around where the frontage of the hypothetical retail use would be, because value is driven by access to the shop.

Similarly, zoning is a key challenge. The shops model produces values for zoned shops where different areas of the shop are valued at different relativities; Zone A has a relativity of 1, Zone B 0.5, etc. The 'area in terms of main space' method gives a £/$m^2$ that considers these relativities. HMLR polygon size does not take into account these relativities, so these results were calculated assuming a typical-but-arbitrary proportioning of different zones:

- Zone A = 30%
- Zone B = 30%
- Zone C = 25%
- Storage = 15%

Further work would be needed to automate the calculation of sensible zoning assumptions for each polygon, particularly given polygons with irregular shapes. This would require significant computational resource to do at scale.

Shopping centres provide an interesting conceptual challenge. Individual units within shopping centres are priced by the model in terms of their positions on the shopping centres' internal paths, and the zoning is carried out relative to those paths. But these internal paths are the landlords' improvements, so wouldn't be considered in calculating unimproved land value. Shopping centre land, therefore, would be zoned and valued based on its perimeter, rather than internal structure that dictates values for actual shops. This could have consequences for the relative values of high-street and shopping centre locations according to such a valuation scheme, with shopping centre land having a bigger gap between its improved and unimproved values than land on the high-street.

## 3.3 Agricultural Land

As agricultural land is exempt from rating, the VOA does not actively collect survey data describing property characteristics of agricultural land. A significant proportion of land in Wales is agricultural, so would need to be included in a programme of valuing all Welsh land.

We analysed what proportion of land titles have transactions associated with them. We looked at two heavily agricultural local authority areas, Powys and Ceredigion to assess the potential for modelling work. The analyses are shown in Figures 4 and 5.

Welsh Government data on land use, based on satellite data, was used as a substitute for survey data, so we could assess what proportion of land titles were associated with transactions over the last 10 years. 428 Land Transaction Tax (LTT) records associated non-urban areas in Powys and 337 in Ceredigion over the last 10 years. This represents the maximum possible dataset for modelling. Grade 1 is 'excellent quality' land, where grade 5 is 'very poor'. The current grading methodology is described in: The Agricultural Land Classification of England and Wales Revised Guidelines and Criteria for Grading the Quality of Agricultural Land

(MAFF 1988) The data also include urban land, which was excluded from these figures.

**Figure 4: Transaction volumes of agricultural land in Powys**

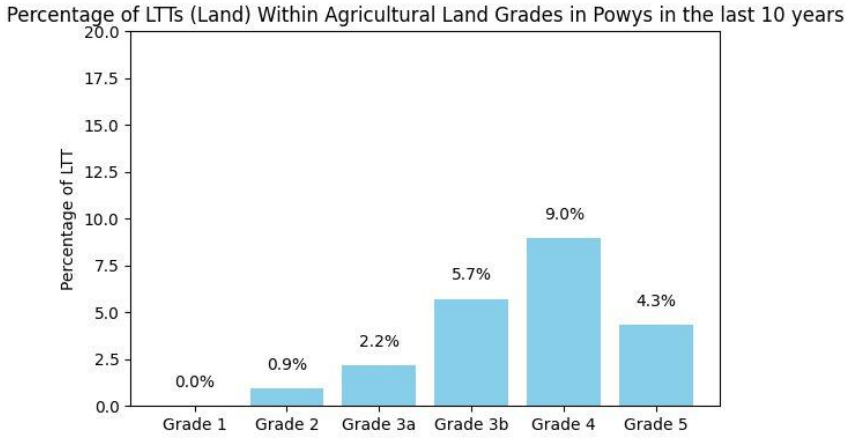
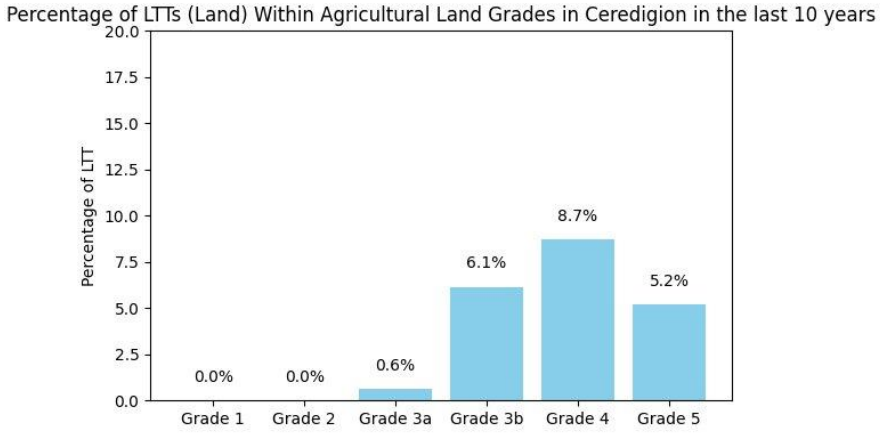



**Figure 5: Transaction volumes of agricultural land in Ceredigion**




While high quality agricultural land has low data volumes, there may be enough data to model grades 3b, 4 and 5. For comparison, Council Tax model for houses has 7.94 sales per 100 houses, so 7.94% of properties have sales. The Council Tax model for flats has 7.99% of properties with sales. Residential sales are different in character and complexity to land sales, and some land sales will reflect ‘hope value’ of potential residential development, or use not comparable with typical agricultural uses.

Agricultural land doesn’t tend to require apportionment between buildings and land. Given this, it is particularly affected by site-specific factors mentioned above:

- Contamination
- Minerals and Mining Subsidence Reports
- Restrictions and Reservations
- Green Belt Land
- Planning

- Access/Easements

In many cases, available public geospatial data could identify some of these factors, e.g. national parks. Detailed and accurate data on planning / restrictions is an area where public data would be most useful.

## 3.4 General Findings

Models for residential valuation exist and a proof-of-concept model for densely clustered of shops is in progress. Further models would be required to cover other main property types of offices and industrials, as well as sparsely located shops. These models, would produce first-pass notional values. All model outputs would be subject to adjustment by valuers where a model doesn't perform strongly, or relies on inappropriate assumptions.

The abstract nature of a notional land valuation makes it harder to defend and explain to the public, but crucially also harder to verify/adjust the models. There is no mechanism for valuers to change the spatial effects of models directly. The models are calibrated against valuations of the land plus improvements (i.e. values before apportionment), and based on transaction data that provides evidence of the total value of land plus improvements. Assessing land values in this way is logically harder than Council Tax valuation or non-domestic rating valuation, because it involves doing both of those things and then additional steps.

## 3.5 Potential Coverage

Based on current development timescales, it will be at least three years before it is feasible to attribute notional values to plots for valuation assumptions involving the most common categories of these additional property types, (roughly 60% of non-domestic rating assessments). This leaves valuation assumptions based on:

- other bulk property types (another 30% of non-domestic rating assessments)
- other valuation methods and specialist property classes (e.g. hospitals, schools, universities, castles, roughly 10% of non-domestic rating assessments)

which would still require manual valuation.

This study has only considered two categories of land use in detail. The assumptions needed to value land will change for different land uses.

# 4. Conclusions

## 4.1 Feasible In Principle

Generating notional land values is feasible, but depends on making assumptions around planning permissions and apportionment between land and improvements. Generating land values that can be individually defended as representing open-market value for the land alone is ***not*** feasible through a MAV approach.

## 4.2 Valuation Assumptions Required

Wales has a permissive planning system therefore it is not known what uses land can be put to until a planning application is submitted and reviewed. VOA cannot provide planning assumptions around what uses would be permitted. These assumptions should be stated if they differ from actual use, guided by Local Development Plans. Valuation assumptions may also differ from planning permissions, but this may raise fairness and policy concerns.

## 4.3 Apportionment Formula Needed

Apportionment calculations could be difficult to defend against individual appeals given the paucity of comparable evidence and sensitivity of the residuals method to local fluctuations in inflation. A general formula for apportionment could be specified in regulations / statute, to resolve such difficulties.

## 4.4 Cadastre Needed

Valuation of land depends on HMLR data:

- Registration of land with HMLR would need to be mandated
- A complete cadastre is needed to provide a complete and non-overlapping map of land ownership.
- This cadastre would need to be reflected in National Polygon Service data.

## 4.5 Extracting Spatial Effects From Models Is Feasible

The method of extracting spatial effects from models and applying them to HMLR plots is feasible. Significant data validation and cleaning would be required. In the case of retail, zoning creates additional challenges, such as identifying frontage, and working with irregularly shaped sites.

## 4.6 Capitalising Rents Is A Source Of Uncertainty

Capitalising rents for non-domestic properties is possible, but sensitive to yield calculations. There are risks to defensibility around yield assumptions. A standard process would need to be specified in policy, either based on reliable indices of Welsh market conditions appropriate to the properties being valued, or at a standardised rate specified in regulations. Comparing model outputs based on capitalisation of rents to outputs based on sales is riskier than making comparisons within the same property-type. Within the same property-type, the same assumptions

are consistently applied and so have the same effect on relative values. This is not true when comparing notional values based on different assumptions. The uncertainty around appropriate yields would mean that the ordering of values between notional values based on commercial valuation assumptions and residential valuations assumptions would change depending on the yield used.

Rental values are used in retail modelling because they are used for non-domestic rating, and commercial property has more rental agreements than sales. Residential is more likely to see owner-occupiers . It is possible to explore other approaches:

- using capital data instead of the rental data
- converting rental data to capital data
- using rental data for residential and agricultural land as the basis of modelling.

This would involve considerable further research.

## 4.7 Modelling Agricultural Land Could Be Explored Further

Modelling agricultural land values would be challenging, given the lack of survey data and  low data volumes of transactions for some grades of agricultural land. It could be explored further, as could existing geospatial data sources around value-significant features of land, such as:

- flood risk/management areas
- sites of special scientific interest
- former landfill sites
- mining/mining waste sites.

## 4.8 Advantages Of This Approach

Advantages of the approach considered are:

- It extends existing approaches, to minimise disruption of introducing new policy.
- It could be run alongside valuations for Council Tax and rating, if required
- It uses ‘explainable’ models, so is transparent about the considerations that arrive at a notional valuation. The explanations might be too technical for the general public, however.
- Where robust assumptions are needed, they apply generally, treating similar cases in the same way.

## 4.9 Disadvantages Of This Approach

There are disadvantages in valuing unimproved land:

- It is less easy to defend / explain to the public than traditional valuation approaches; it is less easy to directly evidence values in terms of market activity.

- It is more complex than either rating or Council Tax, since it is based on those approaches with extra steps to apportion value between land and improvements, and to capitalise rents (where required).

## 4.10 What Drives Land Value In Wales?

It is not possible to conclude what drives land values across Wales based on these approaches. We know 'location' is a significant driver of land values, but location includes everything that is not explicitly included in specified property attributes used in the models. It represents all the value-significant features that haven't otherwise been controlled for.

## 4.11 How Confident Can We Be In This Approach?

Modelling - The residential models have been audited by the International Association of Assessing Officers (IAAO). The shops model is still in development, but has potential to perform well at predicting rateable value with scope for further refinement.

Notional value - The assumptions used to generate notional values, from apportioning value to land and improvements to capitalising rents and zoning land for retail-based valuation assumptions are hard to verify against market evidence, so resulting values can only be regarded as *notional*, and assumptions would need to be defined in policy/legislation.

Land use - The assumptions required for modelling potential and different use of land would need to be considered.

## 4.12 Where Does This Approach Work Well?

This approach works better in densely populated areas, with homogenous building stock and liquid property markets. It will perform less well in one or more of the following circumstances:

- Land that doesn't transact very often
- Land where the value is not captured in sale price (e.g. public amenities, heritage assets)
- Land used for multiple purposes (e.g. mixed-use developments)

## 4.13 Could This Approach Be Scaled To The Whole Of Wales?

The approach could be scaled to the whole of Wales for valuation assumptions associated with non-specialist property (offices, industrials, shops, residential, land), where they exist in sufficient concentrations to enable mass appraisal.

The costs of scaling would depend on:

- Model building (data inputs, valuation and yield assumptions known)
- Model implementation
- IT support

- Valuation Adjustments
- Retraining of VOA staff
- Increased challenge

Costs are difficult to determine due to:

- High Degree of Complexity
- High Degree of Innovation
- Large Number of Stakeholders
- External Influences:
  - Political
  - Economic
  - Legislation/Regulations
  - Technology

In addition to costs, risks include:

- Risk of not delivering
- Risk of not delivering at cost/getting sufficient resources
- Modelling expertise
- Surveying expertise
- IT infrastructure
- Data of insufficient coverage and quality
- Risk of excess challenge/reputation
- Extra demand to respond to challenge
- Loss of public trust/engagement

# 5. Further Considerations / Suggestions For Additional Research

## 5.1 Can The Approach Be Explained To The Public?

Explainability may be difficult as there would be a need to outline simply the difference between relative and absolute value. Explanations would require four key elements:

- The value of their property (i.e. land + improvements)
- The value of the representative property used for the valuation assumption (i.e. land + improvements) in their location
- The notional value of the land based on the valuation assumption associated with the representative property
- The notional value of the improvements to their property (i.e. the actual value of their property less the notional value of the land)

Comparison of the notional value of improvements to their property is likely to be the most straightforward way to evidence the reliability of the other figures, as the effect in value of changes to property characteristics is relatively intuitive. There is an understanding that if your location is constant and build an extension, this affects your property price.

Given the models are planned for use (Council Tax Model already in use) there are no *extra* barriers, in principle, to explaining these, though their use to generate notional values may require special attention. Material on how the Council Tax model is explained in Annex 3.

## 5.2 Could This Approach Be Used To Tax Land In Wales?

Tax policy in Wales is a Welsh Government decision.

Where land is valued for uses other than its current use, there are a range of values that could be derived:

- A pub next to high-rise grade A+ offices would be valued more highly on an office-based valuation assumption than a pub-based one.
- A park in a residential area will be valued highly as residential land, even though its value is derived by being surrounded by homes that are desirable because they are located near a park.
- Social amenities may not transact because they are considered beyond price by the communities that use them, so their economic value is not reflected in financial transactions.
- Policies aimed at promoting economically valuable uses of land may find they disincentivise pro-social uses. Heritage assets, such as castles, have value to future generations that are not captured by their residential development value, or their value on a valuation assumption as military fortifications.

These differences in value pose policy questions for Welsh policymakers to consider.

# Annex 1 - Summary of modelling approaches

## Council Tax Model

### Spatial Random Fields

In addition to using property characteristics, and fixed effects due to Billing Authority, the Council Tax model creates spatial fields representing the contribution to value of different locations (i.e. everything that isn't included in the property characteristics, relative to other properties in the same Billing Authority).

The combination of these spatial fields and the fixed effects due to the Billing Authority are called the 'spatial effects' and represent the relative value of different locations for properties with the same property characteristics.

The model performance for the October 2025 delivery to Welsh Government predicts values for 1,198,536 houses based on 95,181 sales (7.94%) and has the following performance:

54% of predictions within 10% of house values

89% of predictions within 25% of house values

A similar model exists for 213,203 flats, based 17,032 sales (7.99%). It operates on the same operating principles as the houses model.

## Dense Shops Model

### Whittle-Matérn Fields on Metric Graphs

Commercial property presents a different modelling challenge to residential property. There are vastly fewer properties, more varied in character, and rental agreements are in general more complicated than sales, making usable rental data available for around 5-10% of properties. Of the different property classes, shops are anticipated to be the hardest to model, given the extreme location sensitivity of retail. The move from a high footfall high street, to a low footfall side-street can be a matter of metres as-the-crow-flies, but represent a drastically different value. Therefore, a different modelling approach has been taken.

The shops model treats shops as being located on a network of roads or paths that link the shops together. Distance on this network structure represents mutual influence of shops on each other, such that nearby shops have similar values, and more distant shops on this network are free to vary in value from each other. Given that shops markets are found to have places where physical distance doesn't reflect price difference (for example turning from the high street to a side street) this network structure allows for such 'discontinuities' to be accounted for within the network structure. This is a key area where development is anticipated.

Unlike the Council Tax model, which is based on spatial fields (i.e. every point within space is assigned a value), the dense shops model is *network* based, so only points on the network have values. This means that values will only be generated for

streets that currently have shops on them, and connecting streets, in areas where there is a sufficient density of shops in the relevant geographical area. Currently, for a ‘hotspot’ of shops to be included in the Dense Shops model, there needs to be a cluster of more than 50 shops, such that each shop is within 50m of another shop in that cluster. This model is still in development, with improvements in performance anticipated, but the prototype version of the model used for this report uses 10 years of rent data to achieve the following results:

35% of predictions within 10% of shop values

75% of predictions within 25% of shop values

It is worth noting that the model is not intended to be used to generate final valuations, but rather first-pass values that an experienced valuer can adjust to reflect nuances in the local context. It is assumed for this work that valuation of land would be subject to similar adjustments by experienced valuers.

# Annex 2 - Worked example of calculating land values on different scenarios

Figure 6, a map of Knighton shows LTT transactions (blue dots for domestic, orange dots for non-domestic) with a layer indicating flood risk, affecting a number of riverside properties, and HMLR polygons (orange polygons) representing land titles, against a background of ordnance survey mapping. It highlights a number of challenges of valuing land.

- There are places where what are clearly distinct properties are treated as having the same land title. It is not known whether they are owned by the same landlord or not.
- There are cases with paths across them (and so presumably easements) that would affect their value, depending on the obligations associated with them.
- There are areas that are currently used as woodland that have no good comparable evidence in a similar location.

**Figure 6: LTT transactions in Knighton**

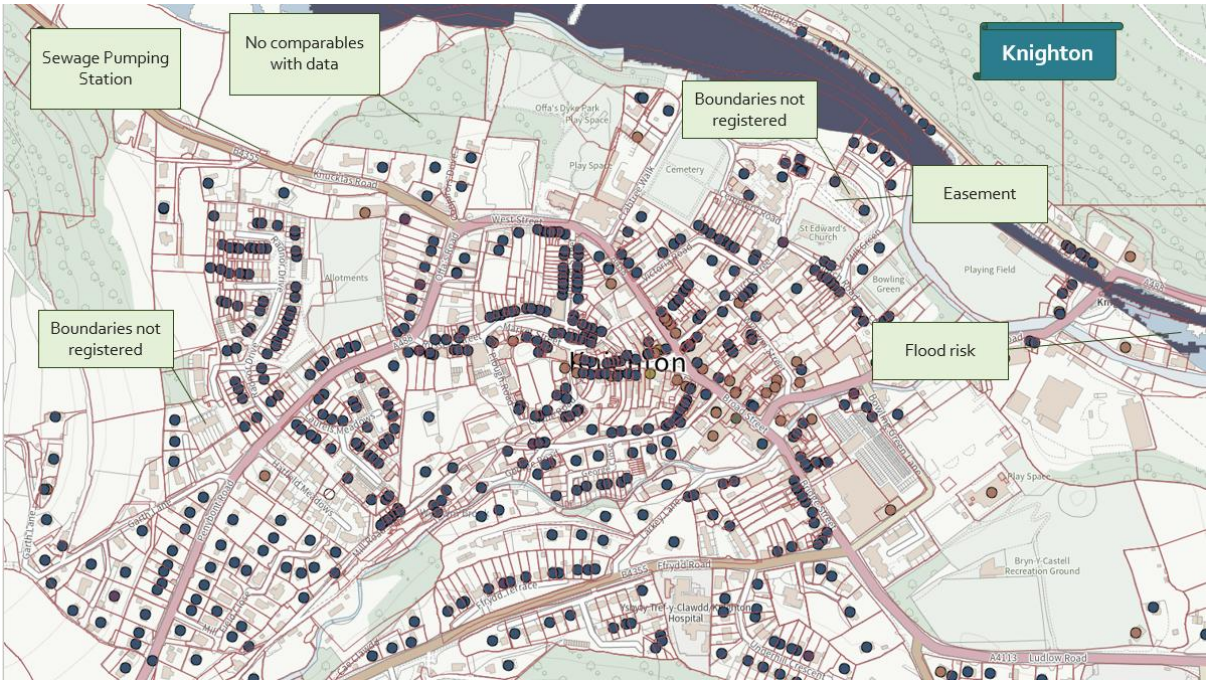
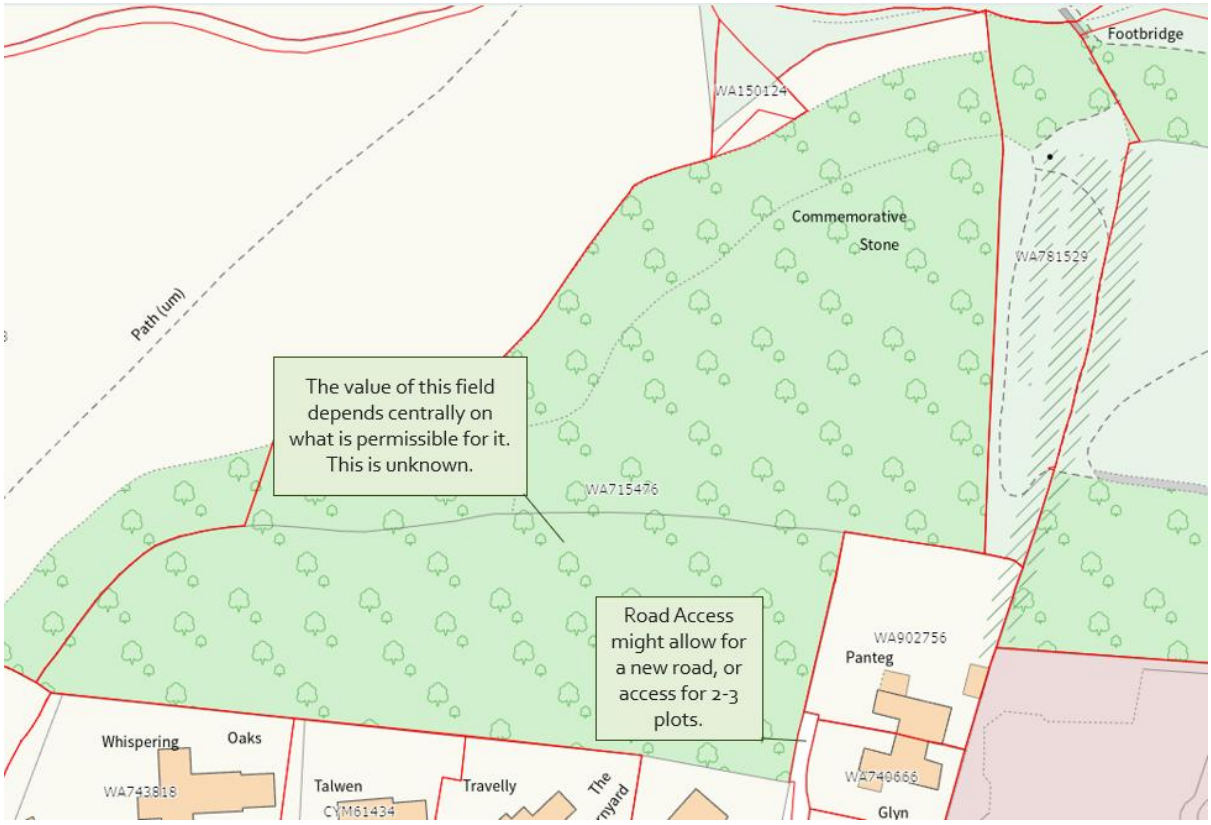


Figure 7 focusses in on one such area of woodland, where it is unclear whether planning permission would be granted for residential use, and *if it were* how many residences would be permissible.

**Figure 7: An area of woodland in Knighton**




A cadastre, i.e. an exclusive and exhaustive attribution of land ownership for all land parcels in Wales is needed to value land. Consider Figure 8, a map of Cardiff using the Council Tax model to produce values on the valuation assumption of medium-density residential use. The dark blue shape in Cardiff in the left image is the same as the dark blue shape in the right image. The only difference between the images is the order in which the image layers have been drawn. Overlapping HMLR polygons mean it is unclear to which titles land values should be attributed.

**Figure 8: Notional medium density residential land values in Cardiff**

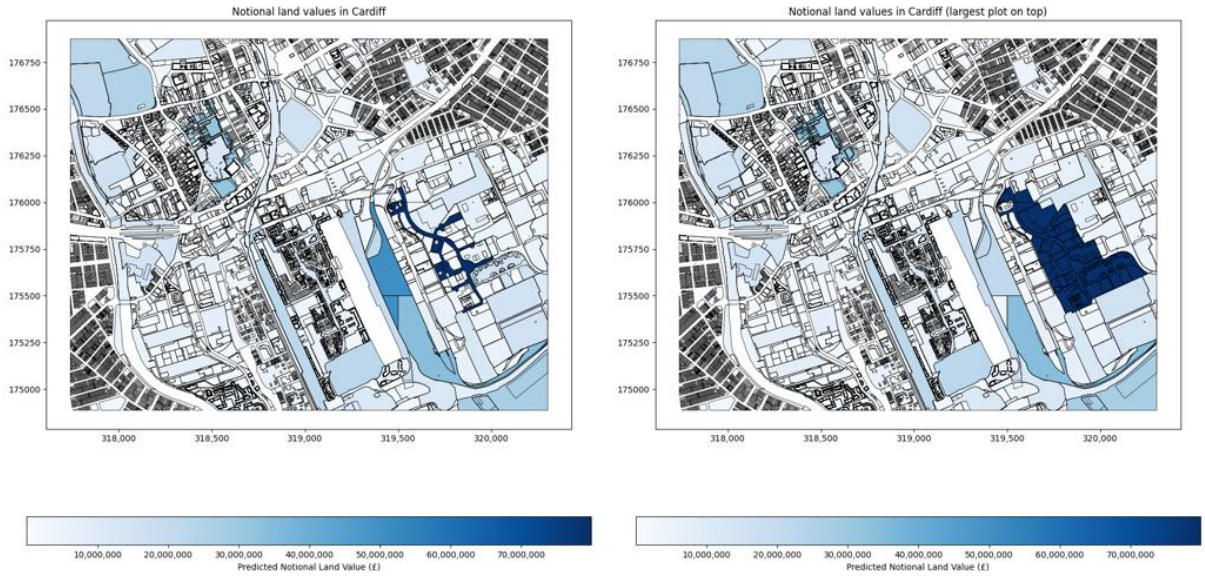
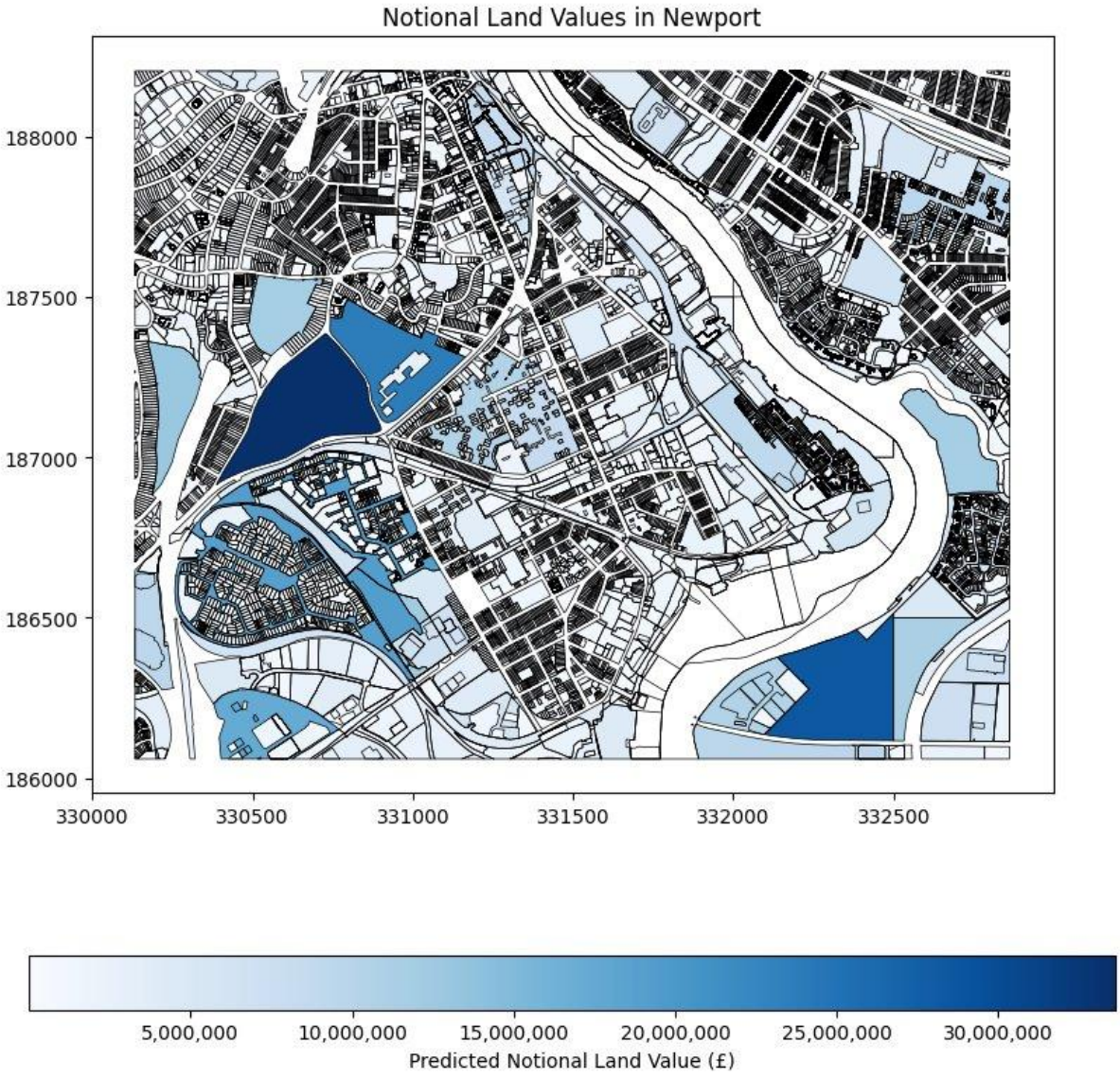





Figure 9 contains a number of interesting features. The darkest shape, which is roughly triangular is, is Belle Vue Park in Newport. Valuing it as a medium density residential site may not be appropriate, even though it would clearly command significant residential values. The £/$m^2$ rate assumes the same valuation assumptions apply throughout the plot, but for large/unusual plots, especially where parts of the plot are distant from road access, or other amenities, this assumption may need to be revised. The neighbouring hospital grounds similarly would also command significant residential value. A number of titles have been manually removed, since they represent ownership of the River Usk, which would presumably be an inappropriate location for medium-density residential developments.

**Figure 9: Notional medium density residential land values in Newport**

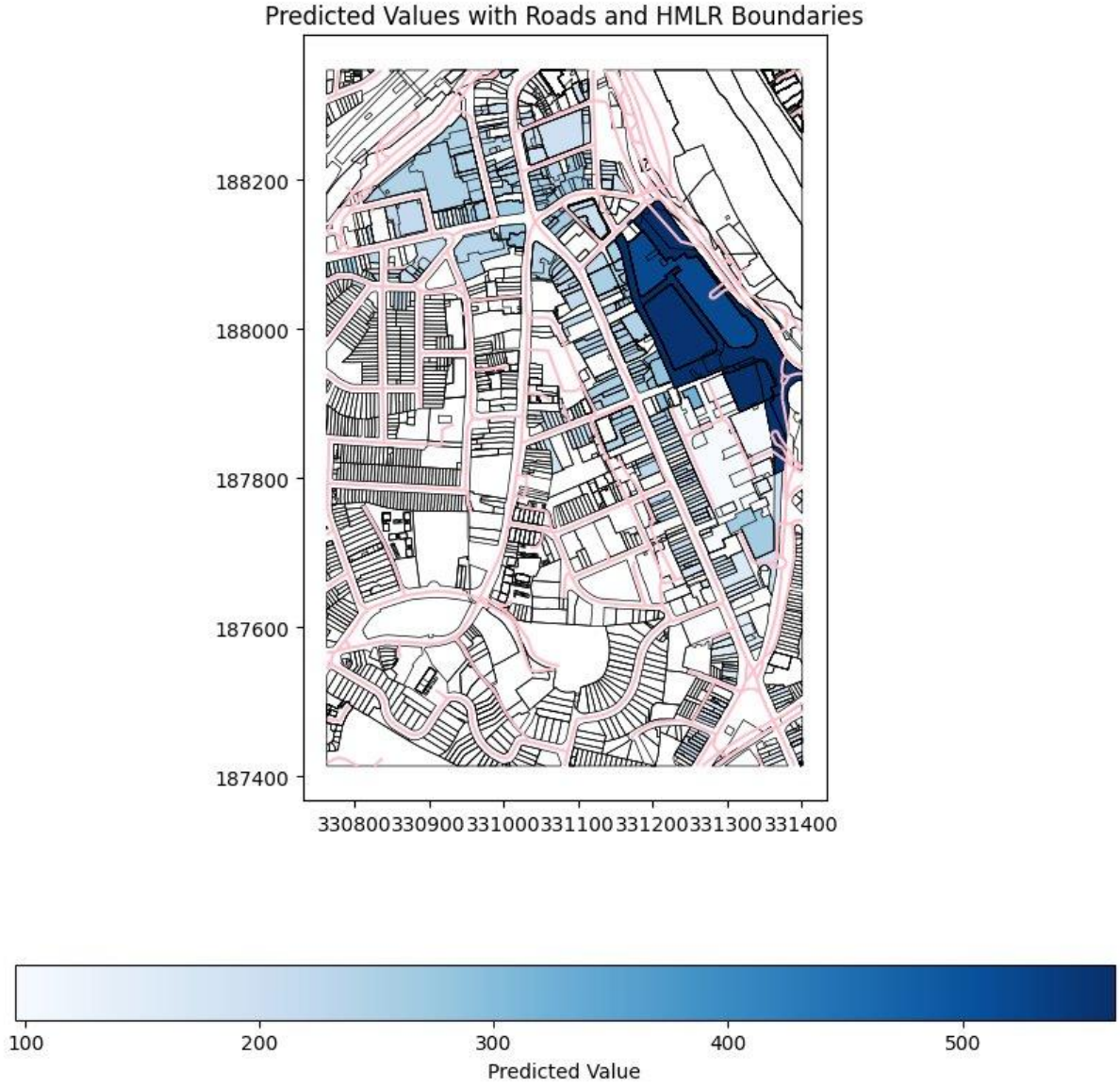



The land values are acquired by the following calculation:

(Model output /representative property size) x apportionment multiplier x polygon size. In this case the apportionment multiplier is 0.3.

The shops model is sensitive to positions on the roads network, as illustrated by Figure 10:

**Figure 10: Retail land values and the road network**



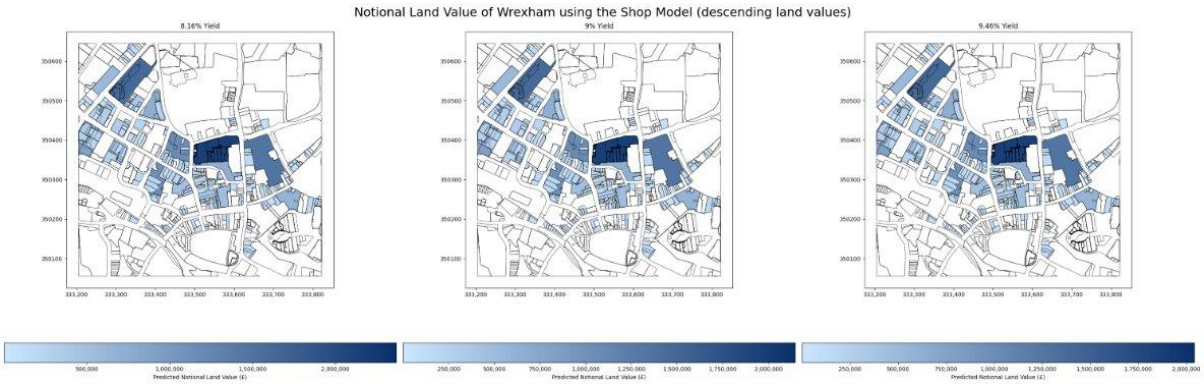

The location from which the value derives depends on which point on the road network the plot is ‘attached’ to, i.e. where the frontage of the hypothetical shop would be. Many plots don’t have a value at all because they lack the density of shops to have value on the shops model. A consequence of a network-based model rather than a field based model is that not all locations are assigned a value.

The calculation here requires a conversion from the relativity-weighted area-in-terms-of-main-space to unweighted total area, which is abbreviated as ‘area conversion’. The formula is:

((model output x area conversion)/percentage yield) x polygon size.

Figure 11 illustrates three different yield assumptions based on the local market in Wrexham. These were used for illustrative purposes, as it was not possible to identify local yield assumptions straightforwardly. This is because yield assumptions depend the perceived risk of the investment. In this case, it will depend on the hypothetical use to which the asset is put (given by the valuation assumption) and on the location in question. Assessing market sentiment towards hypothetical valuation assumptions is challenging, though in general yield rates will be comparable to alternative investment opportunities, so will usually be higher than the yield for gilts, and their value will reflect market sentiment about the assets in question.

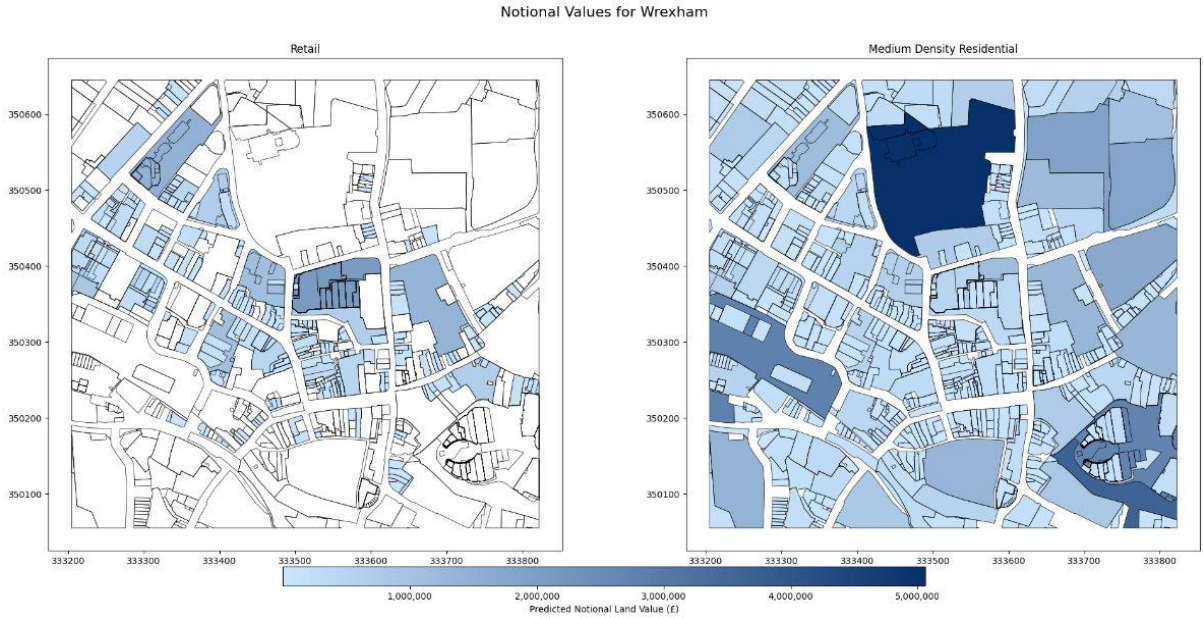
**Figure 11: Retail land in Wrexham based on three different yield assumptions**



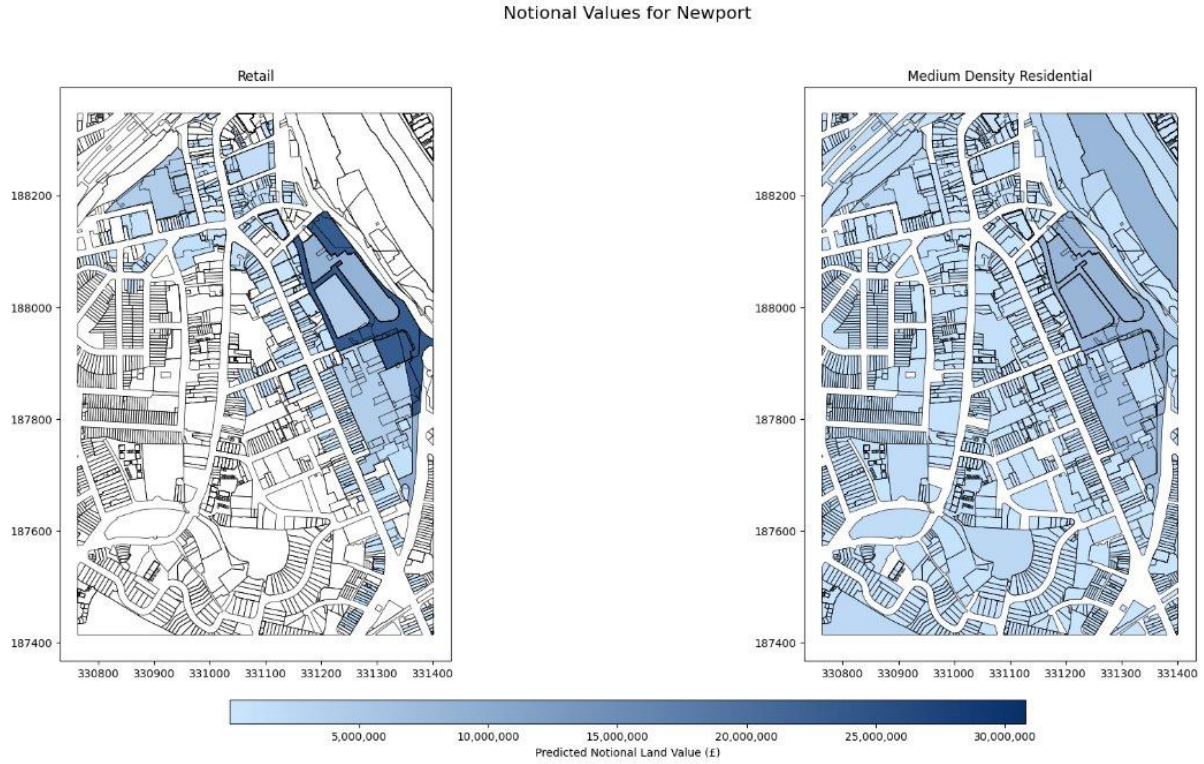

Zoning is a challenge for retail space, in that one needs to identify different regions to value them differently. This is possible using geospatial methods, though we have not yet developed an approach to do this at scale.

Figure 12 and Figure 13 compare medium-density residential and retail values for Wrexham and Newport, respectively. They illustrate the restriction of the retail model to an existing road/paths network for which evidence of retail values already exists. If land were valued on a Highest and Best Use (HABU) basis, then whichever model (and specific valuation assumption) gave the highest value, within the permissible range of uses, would be used for the valuation of that land.

## Figure 12: Retail and Medium Density Residential Values in Wrexham




## Figure 13: Retail and Medium Density Residential Values in Newport



## Annex 3 - Explaining Model Approaches To Public

Example material currently used to communicate modelling approaches:

Residential

A more detailed model specification is also available.