

# Desktop Parking Analysis



Dr Simon Dale and Usman Aziz

## Contents

Executive Summary .....	2
Introduction.....	4
Variables.....	4
Methodology.....	5
Gathering Data .....	5
Running the Regression Model.....	5
Testing and Validating the Model .....	6
Pre-Covid Estimate .....	6
Estimating Total LWPPs .....	6
Validation .....	7
Additional Studies.....	8
Lockdown One Scenario .....	9
Bounce Back Scenario .....	9
Recommendations .....	10
Appendices.....	12
Appendix A – 14 SIC Categories .....	12
Appendix B - Typology .....	12
Appendix C – Largest Employers by SIC Code (Pre-Covid).....	13
Appendix D – Largest Employers by SIC Code (Lockdown One) .....	14
Appendix E – Largest Employers by SIC Code (Bounce Back) .....	14

## Executive Summary

Leicester City Council commissioned Nottingham City Council to produce a report that estimated the number of Liable Workplace Parking Places (LWPPs) within the Leicester City Council Administrative Area, through a desktop exercise utilising information held within the Nottingham WPL licensing system. The Nottingham City Council WPL project team conducted two studies, one with the inclusion of NHS premises and one without the inclusion of NHS premises.

Nottingham City Council used a Multiple Regression Analysis (MRA) approach to establish the relationship between the number of LWPPs for the largest employers and four independent variables that were: Number of Employers (by each premises), the Rateable Value of each premises, the Standard Industrial Classification (SIC) Code which identifies the economic activity of each employer and Typology which acts as a geographical locator for where each premises is within the city. The MRA approach was used as it was the simplest model for data sets with more than one independent variable. The MRA was used to establish relationships between the number of LWPPs and the independent variables. The MRA gave coefficients which modelled the relationship and were then used to estimate how many LWPPs Leicester City Council would have if they had a mature WPL scheme as per Nottingham.

Iterations of the MRA were run for three different scenarios: pre-Covid (March 2020), lockdown one (May 2020) and a 'bounce back' scenario (September 2020). For the bounce back scenario, universities were modelled at 90% of their pre-Covid provisions. The results for each iteration established estimates as to the number of LWPPs Leicester City Council would have if they had a mature WPL scheme like Nottingham City Council's in place in each of these periods.

The results estimate the number of LWPPs with and without the inclusion of NHS premises.

The pre-Covid estimate without the inclusion of NHS premises was 21,741 LWPPs, whilst with the inclusion of NHS premises this figure rose to 25,784 LWPPs. In comparison, the lockdown one scenario (May 2020) estimated a reduction to 12,632 LWPPs without the inclusion of NHS premises and a reduction to 16,554 with the inclusion of NHS premises. The bounce back scenario where universities were modelled at 90% of their pre-Covid estimates, showed the estimated LWPPs rise to 16,767 without the inclusion of NHS premises and to 21,903 when NHS premises were included in the model.

The estimates stated above indicate the number of LWPPs Leicester City Council would have had at each period if they had a mature WPL scheme like Nottingham City Council's in place.

A number of external contexts may impact the above estimates. These are as follows:

- Post-Covid economic environment
- New working practices (working from home-hybrid and Covid resilience)
- Level of the WPL charge

- Maturity of the Nottingham scheme
- Displaced parking opportunity cost
- Scheme exemptions and discounts

The next stage of this process would be to carry out further iterations of the desktop study which account for the above variables. Following this, it is recommended that in spring 2022 a 'feet on the ground' Off-Street Parking Audit (OSPA) of the largest employers is conducted to sense check the desktop study estimates.

**Disclaimer:**

*The content of this report is based on information provided to the report author(s) from Leicester City Council and assumptions made on that information. Nottingham City Council provides no warranty as to the accuracy of the information set out in this report and accepts no liability for any reliance placed on the content of the report, including as to any potential income that could be generated through the operation of a Workplace Parking Levy scheme.*

## Introduction

Leicester City Council commissioned Nottingham City Council to produce a report that estimates the number of LWPPs within the Leicester City Council Administrative Area. The estimate uses data from Nottingham City Council's WPL licensing system and considers a number of variables. This report estimates the number of LWPPs that would have been licenced in the Leicester City Council Administrative Area at the start of March 2020, were Leicester to be subject to a similar WPL scheme to that in Nottingham. This report outlines the methodology used to make this estimate.

Due to the Covid-19 pandemic, the OSPA programmed by the Leicester City Council WPL project team for September 2020 was postponed until autumn 2021. In order to gain an idea of the potential number of LWPPs within the Leicester City Council Administrative Area, the Nottingham City Council WPL project team were commissioned to carry out a desktop exercise that provides an educated estimate of the potential number of LWPPs.

This report sets out the methodology used to carry out this research and then provides the estimated total number of LWPPs within the Leicester City Council Administrative Area for three scenarios: pre-Covid (March 2020), lockdown one (May 2020) and a 'bounce back' scenario (September 2020).

The desktop exercise utilised Multiple Regression Analysis (MRA) which estimates the relative impact of four key variables in determining the number of LWPPs that would be licensed for individual premises under a mature WPL scheme. These four variables are described in the next section of this report.

It should be noted that the estimate of the number of LWPPs that would be recorded were an OSPA to be carried out in Leicester would be substantially higher than the estimates provided in this report. This is because LWPPs are currently free whereas the estimates provided in this report assume that a mature WPL scheme is in place in Leicester, where LWPPs are not free. The normal economic pricing mechanism dictates that an OSPA would therefore record a higher number of LWPPs. To estimate the number of LWPPs that would be licensed under a WPL scheme utilising an OSPA, it would be necessary to apply a price elasticity to adjust the observed number of LWPPs downwards. This would then provide an equivalent estimate to that provided in this report.

## Variables

The first stage of the desktop exercise was to determine the variables which significantly affect the number of LWPPs an employer is likely to license for. Dr Simon Dale from the Highway Metrics team and the WPL operational team at Nottingham City Council held discussions and agreed on the following variables:

- **Standard Industrial Classification Code** – A 5-digit classification providing the framework for collecting and presenting a large range of statistical data according to economic activity. The Standard Industrial Classification (SIC)

code classifies the type of business each employer falls under. There are hundreds of SIC codes dependent on how far you go down each level; therefore, it was agreed to combine them and have a set of 14 SIC codes which each employer within the dataset would fall under. Appendix A lists the 14 SIC codes that were used for this study.

- **Typology** – 11 different ‘typologies’ were determined. The typology variable acts as a geographical locator. Some employers will have multiple premises around the city in locations with differing urban characteristics, e.g. the city centre, business parks and industrial estates. Where the site is located is likely to affect the number of LWPPs, for example, a city centre or business park is likely to be better served by public transport provision and safer active travel options. Conversely, an industrial estate may not be, therefore more commuters may travel there by car. Appendix B lists all 11 typologies and their definitions.
- **Number of Employees** – This variable sets out to inform the number of people that work at each premises.
- **Rateable Value** - A rateable value is assigned to non-domestic premises by the Valuation Office Agency. It is based on a property's annual market rent, its size and usage.

## Methodology

### Gathering Data

The second stage of the desktop exercise was to gather and populate a dataset of the largest employers in both Nottingham and Leicester. A workshop was held on 10 July 2020, which consisted of a presentation to the Leicester City Council project team that set out the data requirements and the methodology to gather the data for each variable. The Leicester City Council desktop analysis dataset was populated by William Atkin, who used a number of sources. The datasets collated were then sent to the Nottingham City Council WPL project team to be used as part of the desktop exercise.

The Nottingham City Council WPL project team ensured that the Nottingham WPL dataset was reflective of each scenario and double checked their data to ensure it was fully populated and accurate.

### Running the Regression Model

The Nottingham data was analysed for any collinearity or bias amongst the variables. The result reaffirmed that the variables were free from bias and were sufficiently independent to satisfy the conditions for the MRA to be robust.

The MRA was performed. To ensure that the model was valid and capable of making a valid prediction, the R-Squared value was observed. The R-Squared value is the proportion of variance in LWPPs that is explained by the independent variables (SIC Code, Typology, Number of Employees and Rateable Value). For the pre-Covid scenario, the model gave a value of 0.7966 which suggests that 79.66% of variance

in the dependent variable (LWPPs) is explained by the independent variables (SIC Code, Typology, Number of Employees and Rateable Value). For the lockdown one scenario, an R-Squared value of 0.6664 was given, whilst for the bounce back scenario, an R-Squared value of 0.6872 was given. In academia, an R-Squared value above 0.5 is generally required for a regression model to be deemed useful. In this case all of the R-Squared values are well above 0.5, therefore we can be confident that the model is capable of estimating the number of LWPPs that a Leicester employer would have licensed for any given premises for each scenario in a mature WPL scheme.

### Testing and Validating the Model

Further validation was conducted on the results of the model to ensure that all assumptions for the MRA were met. This is an important step as it is possible to generate a high R-Squared value, but if these assumptions are not satisfied then the model will not be fit for purpose. The tests performed demonstrated that all of the relevant assumptions were correct. Having established that the model was robust, an equation was created from this model and the data gathered by Leicester City Council was run through this equation to estimate the total number of LWPPs for the premises operated by the largest employers in the Leicester City Council Administrative Area. The largest employers in Leicester were identified as those with the largest number of employees.

In addition, these employers also had their SIC codes corrected to replicate the 14 different combined SIC codes that were in the Nottingham dataset.

It is important to note that the lists of the largest employers in each city were selected using different variables, largely for practical reasons. For Nottingham, they are the 50 employers with the largest number of LWPPs, while in Leicester they are the largest in terms of the number of employees. An examination of the Nottingham data shows that generally the largest employers who provide the largest number of LWPPs are also the largest with respect to the number of employees. This is an important assumption as clearly the largest 50 employers in Leicester could not be selected on the number of LWPPs as these are not yet known.

## Pre-Covid Estimate

### Estimating Total LWPPs

The model was applied to all premises operated by the largest employers (as specified above) in the Leicester City Council Administrative Area with and without the inclusion of the NHS premises. This estimated that the LWPPs for these employers with the inclusion of NHS premises is 16,503 for the largest employers in Leicester, while the estimated LWPPs for the largest employers in Leicester excluding NHS premises is 12,638.

The total LWPPs that would be licensed in Leicester under a WPL scheme based on the Nottingham model can be predicted under the assumption that the ratio of the top 50 employers' total LWPPs to the total LWPPs in Nottingham will be the same in Leicester. The equation is listed below:

Equation One:

$$\frac{\text{Total LWPPs In Nottingham}}{\text{LWPPs of the Top 50 employers in Nottingham}} \times \text{Estimated LWPPs of the largest employers in Leicester}$$

The above calculation predicts that the total number of LWPPs licensed within a WPL scheme in Leicester operating in early March 2020, including NHS premises, would have been 25,784 LWPPs.

In contrast, the above calculation predicts that without the inclusion of NHS premises, the total number of LWPPs that would be licensed within a WPL scheme in Leicester operating in early March 2020 would have been 21,741 LWPPs.

There are three key assumptions inherent in this approach and these assumptions are external to those tested as part of the model validation, as they affect the application of the model rather than the specification of it, namely:

1. That the ratio of LWPPs in the larger employers to that of all employers is the same in Leicester as it is in Nottingham. While this assumption seems to be reasonable, there is currently no data to support or refute this.
2. That the largest 50 employers in Leicester with respect to number of employees will also be the largest 50 employers with respect to provision of LWPPs. This assumption is supported by the MRA which shows that the number of employees is a key independent variable for predicting LWPPs, however it also shows that it is not the only variable that is important and this needs to be kept in mind when considering the results of this analysis.
3. That the relationships between the dependent variable i.e. LWPPs and the independent variables i.e. SIC Code, Typology, Number of Employees and Rateable Value, is the same in both cities. Currently there is no data to support this assumption since the number of LWPPs in Leicester is unknown. However, as the two cities are relatively similar in employment, geographical make-up and institutionally, this assumption seems justified.

As more employee data for each city is gathered, assumptions one and two become less critical in future analysis.

The overall MRA based analysis is robust according to the diagnostics, however the external assumptions make it important to validate this analysis with data that is as independent as possible, to ensure that the assumptions for the MRA are valid.

### Validation

As we know that workplace parking provision is strongly related to the number of jobs within an area, it was decided to base a validation on the number of jobs located in

Nottingham and Leicester respectively and the total LWPPs licenced in Nottingham. The job data is sourced from the Office for National Statistics (ONS) while the total LWPPs is an actual observed figure, not an estimate. As Nottingham and Leicester are relatively similar with respect to business, economic and institutional factors, we have used the following equation which holds the assumption that the relationship between the number of jobs and total LWPPs will be similar and thus we can estimate LWPPs in Leicester as follows:

$$\text{Estimated total LWPPs in Leicester} = (\text{Total LWPPs in Nottingham} \times \frac{\text{Total jobs in Leicester}}{\text{Total jobs in Nottingham}})$$

Given limited data availability, this method acts as the best independent validation available for the MRA based estimate presented in the previous section. It predicts that in March 2020, 26,089 LWPPs would be licensed under a Leicester WPL if NHS premises were liable for the WPL charge.

This is within 2% of the estimate generated by the primary methodology based on the MRA. While this validation methodology is basic, it does provide useful validation of the primary methodology.

Conducting this validation without the inclusion of NHS data gave a prediction of 22,430 LWPPs under a Leicester WPL. This figure falls within 3% of the estimate generated by the primary methodology.

## Additional Studies

Following a presentation of the original desktop study to the Leicester City Council WPL project team on 20 January 2021, the Nottingham City Council WPL project team were commissioned to conduct a further two desktop studies with data from two different scenarios. The studies for both scenarios were conducted with and without the inclusion of NHS premises within the Leicester City Council Administrative Area.

The first scenario was to conduct a desktop exercise on a dataset that reflected the situation post the first lockdown which began in March 2020, following the outbreak of Covid-19 in the United Kingdom.

The second scenario was to conduct a desktop exercise that estimated the number of LWPPs that may be licensed in Leicester once the lockdown was lifted. The most appropriate period for this was chosen to be the first week of September 2020, when the government's 'Eat Out to Help Out' campaign was in full flow and the 'rule of six' for social gatherings had not been announced. It was also agreed that for this scenario the universities would be modelled at 90% of their pre-Covid levels, since in Nottingham the universities do not begin their academic year until late September (University of Nottingham) and early October (Nottingham Trent University). This decision was made as analysis of the latest Nottingham City Council WPL database indicates that the education sector is the one sector that will likely go back towards the pre-Covid licensing levels.

Validations for the additional studies were not conducted as it would be inaccurate to use the pre-Covid employment figures. Therefore, to avoid any misleading figures it was agreed to avoid the use of the validation calculation for the additional studies.

### Lockdown One Scenario

The timeframe for this scenario was chosen to be May 2020, as this was the earliest period that reflected the number of LWPPs that were licensed by employers in Nottingham City Council's Administrative Area as a result of the first Covid-19 lockdown. The aim was to estimate the potential number of LWPPs within the Leicester City Council Administrative Area if a WPL was in place during the first 2020 Covid-19 lockdown. The output from Nottingham City Council's data suggested that the regression was robust and therefore we were able to go ahead with the estimating exercise. The LWPPs for the largest employers in Leicester amounted to 7,962 with the inclusion of NHS premises and 4,173 without the inclusion of NHS premises.

When Equation One was applied to estimate the total LWPPs, the estimates came out as 16,554 LWPPs with the inclusion of NHS premises and 12,632 LWPPs without the inclusion of NHS premises. The lockdown one scenario saw a 36% drop in the estimated LWPPs with the inclusion of NHS premises and a 42% drop in estimated LWPPs without the inclusion of NHS premises.

### Bounce Back Scenario

At the time the additional studies were requested, the United Kingdom was in its third Covid-19 lockdown. However, to estimate what a 'bounce back' scenario may have looked like, it was agreed with Leicester City Council that the Nottingham City Council WPL project team would use September 2020's data from the Nottingham City Council WPL back office system. The September period was chosen as it was around then that the government's 'Eat Out to Help Out' campaign was in full flow and a small recovery began. It was also agreed with the Leicester City Council WPL project team that the universities would be modelled at 90% occupancy of pre-Covid levels. This was agreed as the students at the universities in Nottingham did not return until late September and early October. The two universities had also taken a different short-term approach, therefore it was difficult to model a 'bounce back' scenario accurately when the universities were licensing with a short-term view. The LWPPs for the largest employers in Leicester amounted to 11,184 with the inclusion of NHS premises and 7,395 without the inclusion of NHS premises.

When Equation One was applied to estimate the total LWPPs, the estimates came out as 21,903 LWPPs with the inclusion of NHS premises and 16,767 LWPPs without the inclusion of NHS premises. The lockdown one scenario saw a 15% drop in the estimated LWPPs with the inclusion of NHS premises and a 23% drop in estimated LWPPs without the inclusion of NHS premises.

## Conclusion

The additional iterations of the desktop study provide further insight into the potential estimate of LWPPs if Leicester City Council had a mature WPL scheme in place like Nottingham City Council in each scenario.

The pre-Covid, lockdown one and 'bounce back' (with universities modelled at 90% of pre-Covid occupancy) scenarios provide useful estimates as to what the number of LWPPs would be in Leicester City Council if a mature scheme like Nottingham City Council's was in place, with a discount threshold of ten LWPPs. The three iterations provide the best-case scenario estimate (pre-Covid), worst-case scenario (lockdown one) and the likely middle scenario (the 'bounce back' scenario with universities modelled at 90%). Table One below shows the estimates with and without the inclusion of the NHS premises in the Leicester City Council Administrative Area.

Nottingham City Council predict that the number of LWPPs Leicester City Council will have licensed on day one of their WPL scheme, is likely to be around the September 2020 estimate with universities at 90% occupancy. However, there are a number of variables that must be considered and accounted for. The variables are listed in the next section below. Once these variables are considered and accounted for, it is likely that a more accurate estimate as to what Leicester City Council will have licensed on day one of their WPL scheme can be calculated.

Table One: Estimated LWPPs in all three scenarios

	<b>Without NHS premises</b>	<b>With NHS premises</b>
<b>Pre-Covid (March 2020)</b>	21,741	25,784
<b>Lockdown One (May 2020)</b>	12,632	16,554
<b>Bounce Back (September 2020)</b>	16,767	21,903

## Recommendations

It has been acknowledged by colleagues from Leicester City Council and De Montfort University that the study is a robust and valid method of estimating the number of LWPPs, given the limited available data. However, in order to ensure the estimate of the total LWPPs is as accurate as possible, Nottingham City Council recommend the following:

- Leicester City Council provide a more in-depth and thorough dataset including data on as many employers and premises as possible. The information should look to include the 'Number of Employees' and 'Rateable Value'. The more data, the more accurate the total LWPPs will be and the fewer assumptions will need to be relied upon.
- Leicester City Council conduct a sample-check style OSPA where samples of large, medium and small employers based on the 'Number of Employees' and

the 'Rateable Value' variables are audited to ensure that the results are in line with the desktop study.

- Nottingham City Council recommend a full OSPA for the larger employers and sampling the medium and smaller employers with data infilled by the MRA approach used in this report. It will be for Leicester City Council to determine where the balance between the survey and modelling approaches best lies.
- Leicester City Council determine whether the University Hospitals of Leicester are going to be required to pay the WPL charge or a percentage of it.
- Leicester City Council commission further iterations of the desktop study that consider the following factors, in order to gain a more accurate estimate as to the potential number of LWPPs in Leicester on day one of their WPL scheme:
  - Post-Covid economic environment
  - New working practices (working from home-hybrid and Covid resilience)
  - Level of the WPL charge
  - Maturity of the Nottingham scheme
  - Displaced parking opportunity cost
  - Scheme exemptions and discounts

## Appendices

### Appendix A – 14 SIC Categories

- Energy Supplier
- Higher Education
- Human Health
- Information and Communication
- Manufacturing
- Primary Education
- Professional, Scientific and Technical Activities
- Public Administration
- Retail
- Secondary Education
- Social Work Activities
- Telecommunications
- Transportation
- Wholesale

### Appendix B - Typology

1. **City Centre General** – High property values, limited availability of land, good public transport links with a mixture of retail and offices.
2. **Suburban Centre** – Out of town shopping area typified by reasonable public transport links.
3. **Industrial Park/Industrial estate/Trading estate** – Large regions typified by some transport links but mainly consisting of large car parks and a high volume of on street parking. *Usually factories/manufacturers and garages are present at sites like these with large car parks.*
4. **Technology Park** - Specialist technology companies
5. **Retail Park** – A type of shopping centre found on the fringes of most large towns and cities. They are generally located in highly accessible areas. *The retail parks usually have a large customer car park but are also served by public transport too.*
6. **City Centre Business Park** – An area located in the city centre/close to the city centre where many office buildings are grouped together. *Typified by good public transport links but some availability for parking as well.*
7. **Suburban Business Park** - An area located out of town where many office buildings are grouped together. *Typified by some good public transport links but availability for parking as well.*
8. **Recreation/Public Amenity** – Areas that are home to leisure centres, sports clubs and green areas.
9. **Residential** - Buildings that fall into regions where housing predominates. *These regions are usually typified by some good public transport links.*
10. **University and College Campuses** – Buildings that fall in a university/college campus or are within their portfolio of sites throughout the city.
11. **Hospitals** - Buildings that fall into the local NHS Trust's portfolio. *They are usually served by good public transport links and have large staff and customer surface and multi storey car parking facilities.*

## Appendix C – Largest Employers by SIC Code (Pre-Covid)

Table Two below shows the estimated number of LWPPs for the largest premises in Leicester for the pre-Covid scenario. The LWPPs in Table Two are based on the employee and premises data provided by Leicester City Council.

Table Two: Estimated LWPPs for the pre-Covid scenario for the largest premises in Leicester, including NHS premises

<b>SIC Code</b>	<b>Sum of Estimated WPPs</b>
<b>Energy Supplier</b>	101
<b>Higher Education</b>	2631
<b>Human Health</b>	3865
<b>Information and Communication</b>	304
<b>Manufacturing</b>	2299
<b>Primary Education</b>	340
<b>Professional, Scientific and Technical Activities</b>	2123
<b>Public Administration</b>	630
<b>Retail</b>	1195
<b>Secondary Education</b>	1378
<b>Social Work Activities</b>	283
<b>Transportation</b>	683
<b>Wholesale</b>	673
<b>Grand Total</b>	<b>16503</b>

According to the ONS there are 171,000 jobs based in the Leicester City Unitary Authority area.

## Appendix D – Largest Employers by SIC Code (Lockdown One)

Table Three below shows the estimated number of LWPPs for the largest premises in Leicester for the lockdown one scenario. The LWPPs in Table Three are based on the employee and premises data provided by Leicester City Council.

Table Three: Estimated LWPPs for the lockdown one scenario for the largest premises in Leicester, including NHS premises

SIC Code	Sum of Estimated WPPs
Energy Supplier	69
Higher Education	790
Human Health	3941
Information and Communication	165
Manufacturing	698
Primary Education	150
Professional, Scientific and Technical Activities	316
Public Administration	240
Retail	883
Secondary Education	132
Social Work Activities	202
Transportation	200
Wholesale	179
<b>Grand Total</b>	<b>7962</b>

## Appendix E – Largest Employers by SIC Code (Bounce Back)

Table Four below shows the estimated number of LWPPs for the largest premises in Leicester for the bounce back scenario. The LWPPs in Table Four are based on the employee and premises data provided by Leicester City Council.

Table Four: Estimated LWPPs for the bounce back scenario for the largest premises in Leicester including NHS premises

SIC Code	Sum of Estimated WPPs
Energy Supplier	18
Higher Education	2175
Human Health	3611
Information and Communication	128
Manufacturing	1048
Primary Education	372
Professional, Scientific and Technical Activities	614
Public Administration	344
Retail	775
Secondary Education	1220
Social Work Activities	226
Transportation	304
Wholesale	350
<b>Grand Total</b>	<b>11184</b>