

# Greater Manchester's Clean Air Plan to tackle Nitrogen Dioxide Exceedances at the Roadside

## Note 27: GM CAP: Demand Sifting Tool Operating Manual



Salford City Council



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<b>Date:</b>	1 <sup>st</sup> November 2019		

## **COVID-19 Pandemic Statement**

This work has not considered the impact of the COVID-19 pandemic. Whilst we are continuing, where possible, to develop the Greater Manchester Clean Air Plan, the pandemic has already had an impact on our ability to keep to the timescales previously indicated and there may be further impacts on timescales as the impact of the pandemic becomes clearer.

We are also mindful of the significant changes that could result from these exceptional times. We know that the transport sector has already been impacted by the pandemic, and government policies to stem its spread. The sector's ability to recover from revenue loss, whilst also being expected to respond to pre-pandemic clean air policy priorities by upgrading to a cleaner fleet, will clearly require further thought and consideration.

The groups most affected by our Clean Air Plan may require different levels of financial assistance than we had anticipated at the time of writing our previous submission to Government.

More broadly, we anticipate that there may be wider traffic and economic impacts that could significantly change the assumptions that sit behind our plans. We have begun to consider the impacts, and have committed to updating the government as the picture becomes clearer over time.

We remain committed to cleaning up Greater Manchester's air. However, given the extraordinary circumstances that will remain for some time, this piece of work remains unfinished until the impact of the COVID-19 pandemic has been fully considered by the Greater Manchester Authorities.

# 1 Introduction

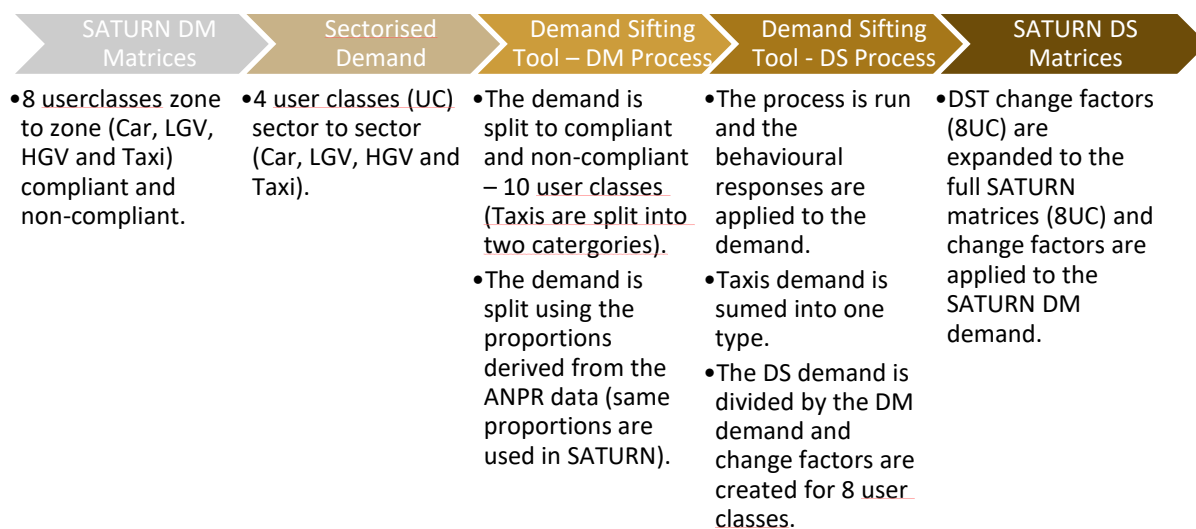
## 1.1 Overview

1.1.1 The Demand Sifting Tool (DST) has been developed to help with the decision-making process for the Clean Air Plan (CAP) for Transport for Greater Manchester (TfGM). The primary objectives of CAP are to improve air quality and reduce harmful pollution across Greater Manchester. The DST provides a high level summary of how various options compare.

1.1.2 The DST was initially a tool to help quickly sift the long list of options. It has now been enhanced to work with the other parts of the modelling system, including the cost models that estimate behavioural response, to provide a robust demand forecasting tool that is fit for the purpose of assessing the CAP proposals.

1.1.3 The DST process is illustrated in **Figure 1-1** below:

**Figure 1-1 DST Process**



1.1.4 In summary, the DST processes the Do Minimum (DM) demand that is exported from the SATURN traffic model for 1,072 zones, converts these in to a 62 sector system, applies various behavioural responses to the demand based on the charges imposed on each vehicle type, and then creates the Do Something (DS) demand change factors. The change factors are then applied to the DM demand in order to create the DS demand.

1.1.5 The DST can be used to:

- Test various options based on various charges imposed on different vehicle types;

- Compare options between different geographical areas and highway network; and
- Analyse the impact of switching from one mode to another.

## 1.2 Structure and scope of current document

1.2.1 This report gives guidance on how the DST operates and how to identify the relevant parts from a user perspective.

1.2.2 The report has the following structure:

- Chapter 2: inputs and assumptions;
- Chapter 3: DST calculations;
- Chapter 4: Outputs;
- Chapter 5: Installation instructions; and
- Chapter 6: File structure.

## 2 Inputs and Assumptions

- 2.1 There are various inputs and assumptions in the process, some of which are specific to the modelling years. The inputs are listed in **Table 2-1** below.
- 2.2 While the DST can test a variety of scenarios, in current runs only parts marked with ✓ change across years and are defined by the user, while other are invariant across all the years (percentage Split by Parking Type marked with X) or are not applied as measures (parking costs).

**Table 2-1 Assumptions**

Description	Source	Change by Year
DM Demand Data	SATURN Model / Sector to Sector – Four User Classes	✓
Values of time (£/hr)	WebTAG	✓
PPM and PPK Values	SATURN Model	✓
Base Model Average Speed	SATURN Model	✓
Percentage Split by Parking Type	TfGM Car Park Data	X
Base Parking Costs	TfGM Car Park Data	X
Own-Cost Elasticities for Cars	WebTAG Unit M2 Table A1	X
Proportion of Travel in work and non-work time	WebTAG Databook	X
Elasticities for Use	Calculation	X
Behavioural Response for Car	Cost Model	✓
Behavioural Response for LGV	Cost Model	✓

Description	Source	Change by Year
Behavioural Response for HGV	Cost Model	✓
Behavioural Response for Taxi (PHV/Hackney)	Cost Model	✓
Vehicles Compliant and Non-Compliant Proportions	ANPR Data	✓
Proportions of Switched Modes from Car to PT or Active	2011 Census JTW data for GM	X

2.3 DM Demand and Cost Data from the SATURN model are moved from the model zoning system of 1,034 zones to a 62-sector system. A description of the sectors is provided in **Table 2-2**.

**Table 2-2 Modelling Sectors**

Description	Sector(s)
Manchester Inner Ring Road	1
Intermediate Ring Road	2,3,4 and 5
M60	6,7,8,9,10,11,12 and 13
Bury / Bolton / Rochdale	14,15,16,17,18,19,20,21,22 and 23
Wigan / Oldham	24,25,26,27,28,29,30 and 31
Tameside / Stockport / Cheadle	32,33,34,35,36,37,38 and 39
Wythenshaw / Altrincham / Sale / Mottram / Leigh / Carrington / Bredbury / Middleton / M60toBoltonandBury	40,41,42,43,44,45,46,47,48 and 49

Rest of GM	50,51,52,53,54,55,56,57 and 62
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2.4 Measures which can be tested are:

- Charges by sector, vehicle and parking type (10 classes present in DST);
- Parking charges by sector and parking type;
- Improvements on PT system resulting in car demand reduction by sector to sector and peak; and
- Other measures not tested explicitly as percentage change.

### 3 DST Calculations – Do Minimum Process

3.1 There are two processes in the DST which are as follows:

- Do Minimum process; and
- Do Something process.

3.2 The Do Minimum process is explained in detail in this section.

3.3 The aim of the DM calculation is to process and replicate the DM demand that is used in SATURN by disaggregating the four user classes into ten user classes.

#### 3.4 DM Input

3.4.1 The main inputs into the DM process are as follows:

- Aggregated DM demand; and
- Compliant and non-compliant proportions.

#### 3.5 DM Demand Input

3.5.1 The format of the DM demand which is imported into the DST is as follows:

Origin Sector	Destination Sector	Distance Band	User Class	Time Period	Demand	Cost
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3.5.2 Where:

- Origin Sector and Destination Sector: follow sector system shown in **Table 3-3**;
- Distance Band: represents segmentation of demand by travelled distances using 12 different distance bands. See **Table 3-1** for full list;
- User Class: demand segmentation from SATURN model which is aggregated in four vehicle classes (Car, LGV, HGV and Taxi); and
- Modelled Time Periods: AM, Inter-peak and PM periods.

3.5.3 The creation of the DM demand input from SATURN DM demand and costs is carried out in an MS Access database. Cost is demand weighted.

3.5.4 The DM origin and destination trips are sectioned into 12 distance bands which are shown in **Table 3-1** below.



**Table 3-1 Distance Bands**

<b>Distance Band</b>	<b>Lower Limit (miles)</b>	<b>Upper Limit (miles)</b>
1	0	1
2	1	2
3	2	3
4	3	5
5	5	10
6	10	15
7	15	25
8	25	35
9	35	50
10	50	100
11	100	200
12	200	N/A

**3.6 Car DM Demand**

**3.6.1** The car demand is split by parking types which are listed in **Table 3-2**.

**Table 3-2 Parking Type**

Parking Type	Parking Reference
On Street (Pay)	P1
Car Park (Public Pay)	P2
Car Park (Private)	P3
Residential/Non-paid	P4

3.6.2 The parking type proportions are calculated using data received from TfGM. The proportions vary for each sector and peak period.

### 3.7 Taxi DM Demand

3.7.1 The ANPR data is used to split the taxi demand into two types:

- Hackney; and
- Private Hire Vehicle.

### 3.8 Process

3.8.1 The DM process is run through the Excel VBA macro. The process splits the DM demand by applying the compliant and non-compliant vehicle proportions that were used during the matrix building process for use in SATURN.

3.8.2 Once the process has finished running, the DM demand for each vehicle type gets generated in the following format:

Origin Sector	Destination Sector	Distance Band	Demand	Cost	Compliant Demand	Non-Compliant Demand
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### 3.9 Sectoring

#### **DM Summary by Mode and Peak**

3.9.1 The DM demand is summarised into the pre-defined sectors displayed in **Table 3-3** to enable outputs to be reported by individual area.

**Table 3-3 Aggregation Sectors**

<b>Aggregation Sector</b>	<b>Description</b>
1	Manchester Inner Ring Road
2	M60 Cordon
3	Bolton Centre
4	Bury Centre
5	Ashton-Under-Lyne
6	Cheadle
7	Stockport
8	Wigan
9	Rochdale
10	Oldham
11	Mottram
12	Greater Manchester

Source: DST

### 3.10 DM Vehicle Kilometres

3.10.1 To calculate the total vehicle kilometres, the middle value of each distance band is converted from miles to kilometres and then multiplied by the demand in the same distance band.

### 3.11 Output Summary

3.11.1 To aid checking, a number of basic input / output comparisons are reported e.g. the total number of vehicles (compliant and non-compliant) for each peak is summarised which can then be checked against the DM demand in SATURN.

## 4 DST Calculations – Do Something Process

4.1 The Do Something processes are explained in detail in this section.

4.2 The main purpose of the DS process is to see how various vehicle types respond to the CAZ charges, and create DM to DS change factors that can be applied to the DM demand in order to produce the DS demand for use in SATURN.

### 4.3 DS User Classes

4.3.1 The input to the DS process is the DM demand that is processed in the first stage of the DST. The vehicles user classes are defined as the following 10 user classes:

- Car – Compliant;
- Car - Non-Compliant;
- LGV – Compliant;
- LGV – Non-Compliant
- HGV – Compliant;
- HGV – Non-Compliant;
- Hackney – Compliant;
- Hackney – Non-Compliant;
- PHV – Compliant; and
- PHV – Non-Compliant.

### 4.4 Behavioural responses.

4.4.1 The behavioural responses are split into four categories:

- Pay Charge;
- Change Mode;
- Cancel Trip; and
- Upgrade Vehicle.

4.4.2 Depending on the level of charge, a probability for each response is modelled as a percentage change (static table) for LGVs, HGVs and Taxis. For car, an elasticity based approach has been developed.

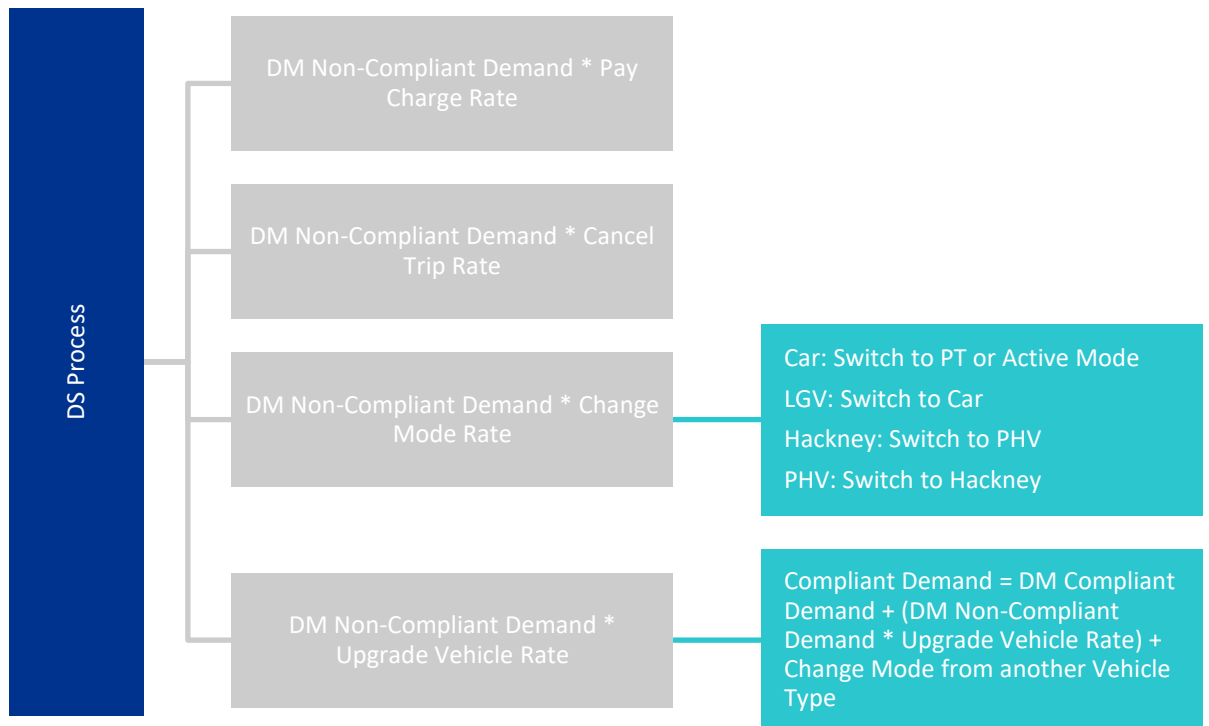
### 4.5 DS Calculations

4.5.1 The DS process is run through the Excel VBA macro which imports the DM demand and other inputs into the SQL Server database, and then uses numerous SQL queries to run the calculations.

4.5.2 The behavioural responses for each vehicle type and the CAZ charge are copied into the SQL Server database and then applied to the DM non-compliant demand.

4.5.3 The DS process is illustrated in **Figure 4-1** below.

**Figure 4-1 DS Process**



## **5 Output**

5.1 The Excel VBA macro creates several output files which are described in this section.

### **5.2 The DS Change Factors**

5.2.1 The DS change factors are calculated by dividing the DS demand by the DM demand. The change factors are created for each user class and peak period. The factors are sectioned into 12 distance bands.

5.2.2 The change factors are applied to the 62 sector to sector DM demand which is then disaggregated into the zone to zone DS demand for use in SATURN.

5.2.3 The application of the change factors to the original DM SATURN demand is carried out in an MS Access database.

### **5.3 DS Summary by Mode and Peak**

5.3.1 The DS demand is summarised into the pre-defined sectors that are stated in "DM Summary by Mode and Peak" section.

### **5.4 DS Vehicle Kilometres**

5.4.1 The total vehicle kilometres for each peak was calculated using the same calculation as the DM vehicle kilometres.

## **6 Installation Notes**

### **6.1 Required software**

6.1.1 To run the full tool the following are required:

- Office Excel 2016; and
- SQL Server 2014 Management Studio.

### **6.2 Required files**

6.2.1 The tool operates using two different files as starting point:

- TfGM CAZ - Model v38\_2021\_GM CAZ C\_7.5.xlsb : inputs/outputs/macros controlling the process; and
- TfGM\_CAZ\_Db.bak: Template for database used when calling SQL processes.

6.2.2 Both files **MUST** reside in the same folder. It needs to be attached to SQL Server before running Excel.

6.2.3 Under xlsb file and tab “SQL Setup” modify:

- Database name present under SQL Server Management Studio; and
- Output Directory: not require any action – this will be produced during the run.



## 7 File Structure

7.1 The current chapter will link inputs/assumptions and outputs listed in previous chapters with excel file structure to give the required information to run the tool and eventually check/modify main assumptions.

### 7.2 Macros

7.2.1 To run DM process select “Run Model” Button “Calculate”.

7.2.2 To run DS Process select “SQL Setup” Button “Run Model”.

### 7.3 Inputs and assumptions

7.3.1 Inputs and assumptions described previously can be identified in **Table 7-1**.

**Table 7-1 Inputs & Assumptions**

Description	Location
DM Demand Data	Access Data Columns A:G
Values of time (£/hr)	Assumptions & Parameters C5:F8
PPM and PPK Values	Assumptions & Parameters D15:I18
Base Model Average Speed	Assumptions & Parameters D24:E24
Percentage Split by Parking Type	Assumptions & Parameters F41:Q102
Base Parking Costs	Assumptions & Parameters F107:I177
Own-Cost Elasticities for Cars	Assumptions & Parameters E184:H187
Proportion of Travel in work and non-work time	Assumptions & Parameters E193:H198

Description	Location
Therefore Elasticities for Use	Assumptions & Parameters E204:H205
Behavioural Response for Car	Assumptions & Parameters E223:X227
Behavioural Response for LGV	Assumptions & Parameters E268:X278
Behavioural Response for HGV	Assumptions & Parameters E236:M246
Behavioural Response for Taxi (PHV/Hackney)	Assumptions & Parameters E286:X297
Vehicles Compliant and Non-Compliant Proportions	Assumptions & Parameters F341:F395
Proportions of Switched Modes from Car to PT or Active	Assumptions & Parameters C399:P433

7.3.2 Measures to include are listed under “MeasuresToInclude”.

#### 7.4 DM Reporting

7.4.1 Reporting for DM is produced under “Summary\_All\_Modes”.

#### 7.5 Outputs

7.5.1 Under Output directory defined during installation, files described under Chapter 4 will be produced, as shown in

7.5.2 **Table 7-2.**

**Table 7-2 Outputs**

<b>File name</b>	<b>Type</b>
SQL_Logfile.txt	General report
AM_Change.csv	DS Change Factors
IP_Change.csv	
PM_Change.csv	
DS_Summary_ByMode_AM.csv	DS Summary by Mode and Peak
DS_Summary_ByMode_PM.csv	
DS_Summary_ByMode_IP.csv	
DS_Vehkm_AM.csv	DS Veh km by Peak
DS_Vehkm_IP.csv	
DS_Vehkm_PM.csv	