

Scottish Index of Multiple Deprivation 2009

Geographic Access Domain Methodology

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1. Introduction

The Geographic Access domain was introduced in SIMD 2004 to capture a set of problems which operate at area level and which are seen by many as important in their own right. These are the problems (financial cost, time and inconvenience) of having to travel a relatively long distance to access basic services.

The domain measures aspects of access deprivation that are relevant to all people since it is important to be able to access key local services in both rural and urban areas¹. The development of the domain is summarised in table 1.1.

Table 1.1 – Development of Geographic Access

	SIMD 2004	SIMD 2006	SIMD 2009
	Services	Services	Services
Drive time	<ul style="list-style-type: none"> • GP • Primary School • Supermarket • Post Office • Petrol Station 	<ul style="list-style-type: none"> • GP • Primary School • Secondary School • Retail Centre • Post Office • Petrol Station 	<ul style="list-style-type: none"> • GP • Primary School • Secondary School • Retail Centre • Post Office • Petrol Station
Public Transport time	N/A	<ul style="list-style-type: none"> • GP • Retail Centre • Post Office 	<ul style="list-style-type: none"> • GP • Retail Centre • Post Office

For SIMD 2004, the Geographic Access domain was based on the time taken to drive to basic services. In calculating the Geographic Access Domain for SIMD 2006, the decision was taken to expand the number of services to include Secondary Schools and to remove supermarkets in favour of retail centres, in order to capture areas with several retail outlets, allowing greater choice and price comparison.

In addition to changes in service destinations, SIMD 2006 also introduced the calculation of travel times to basic services by public transport and/or walking. This highlights the additional inconvenience of travel to basic services for those without access to a car

For SIMD 2009 it was decided by the Office of the Chief Statistician that the Geographic Access domain indicators used should remain the same as those used in SIMD 2006.

¹ www.scotland.gov.uk/Publications/2004/10/20089/45173

2. Software

Citilabs 'Accession' software was used to calculate both drive times and public transport times in support of the SIMD 2009 Geographic Access domain. Accession utilises a Microsoft Access database to store the data, perform travel time calculations, and store results. While the 2GB database size limit imposed by MS Access would make calculations for the whole of Scotland impossible in most cases (due to the high number of Origin-Destination pairs involved), a modified version of Accession which writes results outside the database was developed for use in calculating the Geographic Access domain for SIMD 2009.

The use of a single piece of software for the calculation of both drive times and public transport times allows for a greater integration of these two elements of the indicator. Accession software works using schedule-based trips, routed through a road / public transport network, constrained by limiting the modes of transport available (i.e. car and ferry for drive times, walk and all public transport modes for public transport times). Additionally, the software will automatically substitute walk times where quicker than public transport times or where public transport is not available.

3. Data sources

The data sources used in calculating the Geographic Access domain for SIMD 2009 are summarised in table 3.1 below.

Table 3.1 – Data sources used in SIMD 2009 Geographic Access domain

Data Type	Dataset	SIMD 2006 Source		SIMD 2009
		DT	PTT	
Origins	Census output area population weighted centroids	GRO(S), 2001	GRO(S), 2001	GRO(S), 2001
Service destinations	GPs	PointX Data 2006	PointX quality assured using NHS ISD information	OS PointX (Dec 2008)
	Fuel Stations	Experian Catalist 2006	n/a	Experian Catalist Q1 2009
	Post Offices	PointX Data 2006	OS PointX	Royal Mail Network Change Q1 2009
	Primary Schools	PointX Data 2006	n/a	OS PointX (Dec 2008)
	Secondary Schools	PointX Data 2006	n/a	OS PointX (Dec 2008)
	Retail Centres	PointX Data 2006 (shops); CACI 2006 (centres)	CACI	CACI Retail Centres 2008
Transport Network	Road Network	OS OSCAR	ITN	OS ITN (Mar 2009)
	Public Transport Network	N/A	Traveline Scotland	National Public Transport Data Repository (Oct 2008)

3.1 Origins

As in SIMD 2004 and 2006, in order to define trip origins which represent the distribution of population throughout Scotland, population weighted census output area centroids were used. Census Output area centroids are created by GRO(S) and weighted according to the 'master' postcode grid reference within the output area. The master postcode is the postcode grid reference that is nearest the average, weighted by the household count, of all the postcode grid references for a census output area².

3.2 Destinations

GP Surgeries, Primary Schools, Secondary Schools

As in SIMD 2006, the locations for GP surgeries, Primary Schools and Secondary Schools were taken from the Ordnance Survey Point X dataset.

Fuel Stations

Following the methodology changes implemented in SIMD 2006, Fuel Station locations were again taken from the Experian Catalist dataset. Catalist is a proprietary product from Experian which holds data on fuel station locations throughout the UK³.

Retail Centres

Locations of retail centres were obtained from the CACI Retail Footprint 2008 dataset. Retail footprint is a gravity model that defines catchments for shopping centres selling comparison goods in Great Britain⁴.

For SIMD 2006, retail centre locations were determined using a combination of CACI retail zone polygon data and OS PointX point data for individual shops⁵. For SIMD 2009, it was determined that the inclusion of PointX data would have led to an unwieldy number of origin points for Accession to handle, therefore only the CACI retail footprint point data was used to represent the location of the retail centre.

Post Offices

In SIMD 2006, Post Office locations were obtained from the Ordnance Survey Point X dataset. In 2008 however the Royal Mail made significant changes to the Post Office network, in terms of closing some conventional branches and in many cases replacing them with 'outreach services'.

Outreach services fall into the following categories:

- **Mobile Post Office** - A travelling Post Office situated within a van operated by the subpostmaster that will visit small communities at set times and days each week, to deliver core Post Office products and services to customers.

² General Registers Office (Scotland) 2009

³ <http://www.catalist.com/>

⁴ <http://www.caci.co.uk/RetailFootprint.aspx>

⁵ <http://www.scotland.gov.uk/Resource/Doc/933/0039993.pdf>

- **Hosted service** - A fixed site Post Office branch from which the sub-postmaster or his assistants will transact core Post Office products and services during restricted hours each week. The premises are owned by a third party, for example, a shop or community centre.
- **Partner service** - A fixed site Post Office branch where a local partner (such as a pub landlord), appointed by the sub-postmaster, transacts a reduced range of Post Office products and services from the partner's own premises.
- **Home Delivery service** - A service for very small communities whereby the sub-postmaster delivers a reduced range of Post Office products and services which are ordered over the telephone by customers. The products may either be delivered to customer's home or at a local Drop-In Session. There will not be a physical Post Office building in the community.

Due to the varying availability and types of service provided by different outreach branches, particularly in relation to conventional branches, it was agreed that an arbitrary cut-off in terms of level of service provided at a location should be enforced. This was necessary to, as best as possible, give a representative picture of access to a equal level of post office services throughout Scotland.

Data was obtained from the Royal Mail which detailed opening hours for all conventional branches and outreach services in Scotland. After consultation with the Multiple Deprivation Advisory Group, it was therefore decided that the analysis should focus on post office services being provided for at least 6 hours or more per week. Additionally, it was decided that Home Delivery Services should not be included in the analysis as they do not occupy a fixed location which can be accessed by the customer but rather act on demand and take the service to the customer.

The final analysis in SIMD 2009 therefore represents drive time and public transport time to a post office service at a fixed location, available for 6 hours or more per week.

Number of service destinations

Table 3.2 details the number of destinations for each service type as compared to SIMD 2006 and SIMD 2004.

Table 3.2 Service destinations

Service	SIMD 2009 Number of origin points	SIMD 2006 Number of origin points	SIMD 2004 Number of origin points
GPs	1066	1046	1241
Fuel Stations	943	965	593
Post offices	1432	1718	2169
Primary Schools	2135	2172	2246

Secondary Schools	381	391	-
Retail Centres	402	11211	-

Major differences between SIMD 2009 and SIMD 2006 are noticeable for Post Offices and Retail Centres. These are due to Post Office branch closures and, methodology changes in the representation of retail centres as discussed above.

Service destinations within a 10km buffer south of the Scotland-England border were also included in the analysis to account for census output areas located in the south of Scotland for whom accessing services in England might be quicker.

3.3 Transport Network

Roads Network

For SIMD 2006, drive times were produced using the Ordnance Survey OSCAR road network whereas the public transport times were produced using the Ordnance Survey Integrated Transport Network (ITN) layer.

In calculating SIMD 2009, both the drive times and public transport times were produced using Ordnance Survey ITN.

Public Transport Network

For SIMD 2009, all public transport data was downloaded from the National Public Transport Data Repository⁶ (NPTDR) as per the most recent update (October 2008). Maintained by Thales on behalf of the Department for Transport the NPTDR holds public transport data for the UK by local authority.

The following public transport modes were taken into account in the calculation of SIMD 2009:

- Bus
- Coach
- Rail
- Light Rail (e.g. Metro/underground services)
- Ferry

4. Calculation of accessibility indicators for SIMD 2009

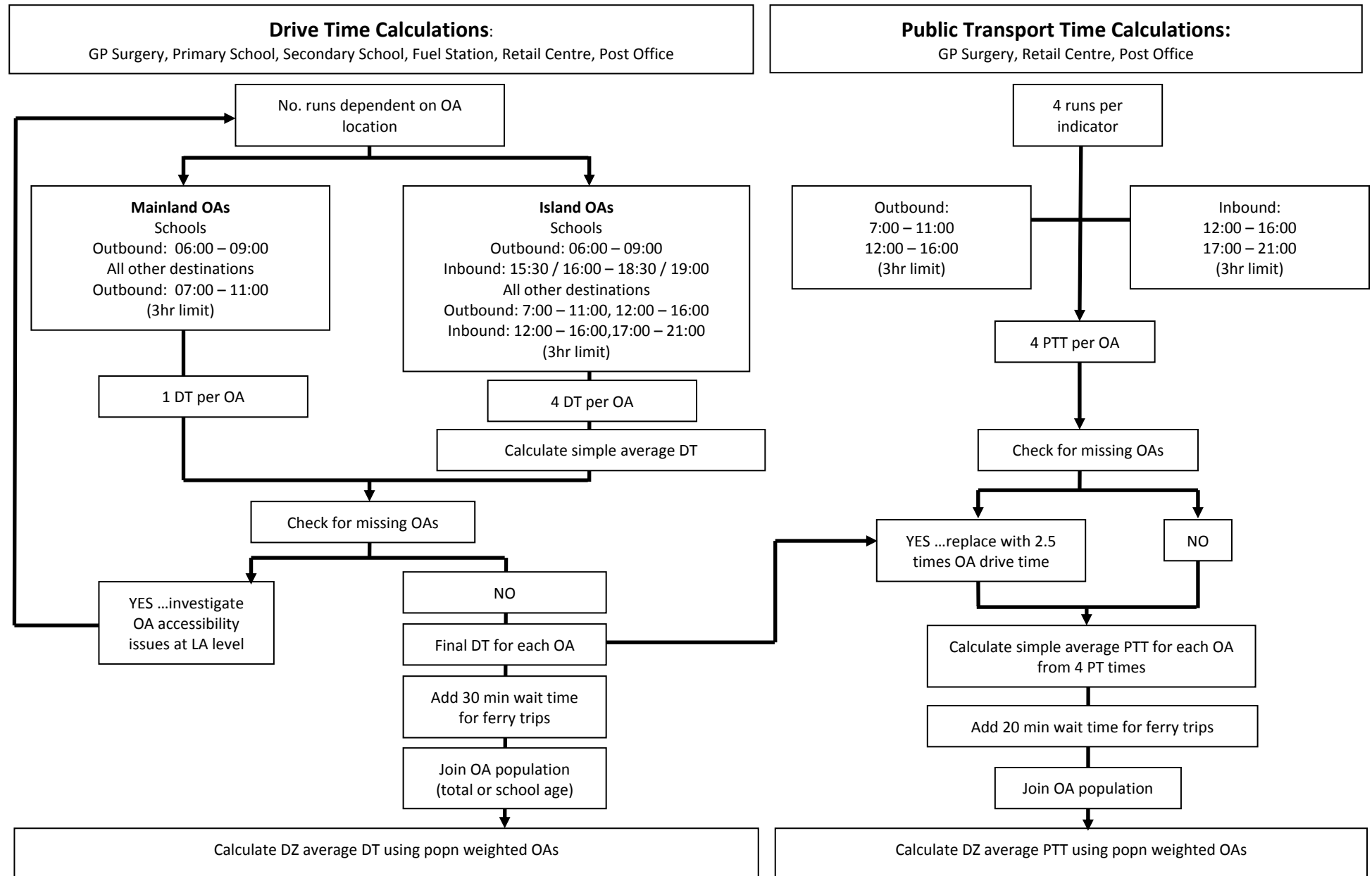
A key recommendation from the Geographic Access Domain in SIMD 2006 was that public transport time and drive time methodologies should be better integrated into a schedule based analysis⁷.

Figure 4.1 summarises the methodology used for calculating drive times and public transport times.

⁶ <http://www.nptdr.org.uk/>

⁷ www.scotland.gov.uk/simdpublictransport

Figure 4.1 – Summary of SIMD 2009 Geographic Access Domain calculation methodology



4.1 Public Transport Times

Public transport times were calculated for GP Surgeries, Post Offices and Retail Centres. Following from the methodology for Public Transport time calculation developed for SIMD 2006⁸:

- Public transport times were not calculated for Schools because public transport trips to school tend to use bespoke transport for which there is no national data.
- It was again deemed that public transport access to fuel stations is of little relevance.
- Public transport network coverage varies by time of day and day of the week. It is therefore necessary to consider multiple times of the day and both outbound (origin to destination) and inbound (destination to origin) trips to characterise the accessibility of service destinations from each census output area.
- Calculations were again performed for a Tuesday, deemed to be the most representative weekday.

Using Accession, a journey needs to start and finish within a chosen time period, and within a maximum travel time. As in SIMD 2006 a maximum journey time of 3 hours was imposed, while journey windows were set at 4 hours. Time windows were chosen to represent access throughout the day, in terms of two journeys from 'home' to the service destination and two journeys from the service destination 'back home'.

Table 4.1 shows the trip periods used in SIMD 2006 and SIMD 2009.

Table 4.1 Public Transport trip parameters

	SIMD 2006 trip parameters	SIMD 2009 trip parameters
Access to/from Post Offices	Analysis for Tuesday with arrival by the stated time and early arrival of up to an hour permitted. <ul style="list-style-type: none"> • Outbound times of day: 09:00, 11:00, 15:00. • Inbound times of day: 12:00, 17:00. 	Tuesday Outbound Journey windows: 07:00 – 11:00 (3 hour limit) 12:00 – 16:00 (3 hour limit) Inbound Journey windows: 12:00 – 16:00 (3 hour limit) 17:00 – 21:00 (3 hour limit)
Access to/from GP surgeries	Analysis for Tuesday with arrival by the stated time and early arrival of up to an hour permitted. <ul style="list-style-type: none"> • Outbound times of day: 09:00, 11:00, 15:00. • Inbound times of day: 12:00, 17:00. 	Tuesday Outbound Journey windows: 07:00 – 11:00 (3 hour limit) 12:00 – 16:00 (3 hour limit) Inbound Journey windows: 12:00 – 16:00 (3 hour limit) 17:00 – 21:00 (3 hour limit)
Access to/from retail centres	Analysis for Tuesday with arrival by the stated time and early arrival of up to an hour permitted. <ul style="list-style-type: none"> • Outbound times of day: 09:00, 11:00, 15:00. • Inbound times of day: 12:00, 17:00. 	Tuesday Outbound Journey windows: 07:00 – 11:00 (3 hour limit) 12:00 – 16:00 (3 hour limit) Inbound Journey windows: 12:00 – 16:00 (3 hour limit) 17:00 – 21:00 (3 hour limit)

Accession routes from the census output area centroid to the nearest road network node to access the road network, then through the road network to a public transport stop, if

⁸ www.scotland.gov.uk/simdpublictransport

available, at walking speed. Using as many different modes of public transport as necessary Accession then routes the trip through the public transport network to reach the service that can be reached in the shortest possible time – this may not necessarily be the geographically closest service destination. Walking distances of up to 500m were permitted to interchange between public transport services.

Four public transport times were generated for each census output area. Following the public transport time calculation methodology developed for SIMD 2006⁹, where a value was not generated for an output area (either due to data problems, or indicating the absence of bus services to the location), the drive time was used, factored by 2.5.

As in SIMD 2006, a 20 minute wait-time penalty was also added where trips involved a ferry journey.

Output area travel times were population weighted using 2001 census figures from GRO(S). This is the most recently available population data at output area level. Population weighted output area times were then aggregated to datazone level for incorporation in SIMD 2009.

4.2 Drive Times

Drive times were calculated for GP Surgeries, Primary Schools, Secondary Schools, Fuel Stations, Retail Centres and Post Offices.

A key aspect of the Geographic Access domain for SIMD 2009 was to move towards a schedule based approach to drive time calculation – i.e. running drive time calculations for the same 4 periods of the day as the public transport time calculations. For such an analysis to be effective however, speed profiles for each individual road link in the OS ITN layer at different times of the day would need to be obtained. Such data however was not available when putting together the methodology for SIMD 2009.

Given that a truly schedule based drive time analysis was not feasible therefore, it was decided to look at the elements of the drive time indicator which could feature a schedule based element – those trips requiring a ferry journey.

In SIMD 2006, drive times including a ferry journey were modelled by integrating ferry routes/speeds into the cost-speed grid upon which the travel times were based. For SIMD 2009 however, the use of Accession meant that actual ferry timetable data could be included in the drive time calculations.

Census output area origins were classified on the basis of the likelihood of a journey involving a ferry. Those output areas located on the mainland and not within 10km of a ferry port were classified as ‘Mainland’ output areas, while those output areas located on islands and on mainland Scotland within 10km of a ferry port were classified as ‘Island’ output areas. Table 4.2 shows the trip periods used to calculate indicators:

Table 4.2 Drive time trip parameters

	Island Output Areas	Mainland Output Areas
Access to/from Primary Schools	Tuesday Outbound: 06:00 – 09:00 Inbound: 15:30 – 18:30	Tuesday Outbound: 06:00 – 09:00

⁹ www.scotland.gov.uk/simdpublictransport

Access to/from Secondary Schools	Tuesday Outbound: 06:00 – 09:00 Inbound: 16:00 – 19:00	Tuesday Outbound: 06:00 – 09:00
Access to/from all other services	Tuesday Outbound Journey windows: 07:00 – 11:00 (3 hour limit) 12:00 – 16:00 (3 hour limit) Inbound Journey windows: 12:00 – 16:00 (3 hour limit) 17:00 – 21:00 (3 hour limit)	Tuesday Outbound: 07:00 – 11:00

As access to Schools is time constrained (i.e. there is a requirement to be there at a certain time, and to leave at a certain time), for Island output areas calculations were run for those time periods. As the other services modelled are not time constrained (i.e. can be accessed all day), for Island output areas the calculations were run for the same time periods as the public transport time analysis.

For Mainland output areas, there were no differing factors which would have caused a change in calculated travel time over the course of a day, therefore it was only necessary to run the calculation once.

Table 4.3 Road classes and speeds

Road Type	Car				Walk			
	SIMD 2009 [m/hr]	SIMD 2006 RURAL [m/hr]	SIMD 2006 URBAN [m/hr]	SIMD 2004 RURAL [m/hr]	SIMD 2004 URBAN [m/hr]	SIMD 2009 [m/hr]	SIMD 2006 [m/hr]	SIMD 2004 [m/hr]
Motorway	70	65	44	65	34 - 52	0	0	0
A Road	60	40	19	40	12 - 24	3	0	0
B Road	40	34	16	34	9 - 21	3	3	3
Minor and other road	30	25	14	25	9 - 18	3	3	3
Non-network road	30	25	14	25	9 - 18	3	3	3
Pedestrian road	0	25	14	25	9 - 18	3	3	3
Private road – acc. to public	30	25	14	25	9 - 18	3	3	3
Private road	30	25	14	25	9 - 18	3	3	3

Accession's default road speed profile was used in calculating drive times for SIMD 2009, as the use of Accession did not allow for an urban/rural split in road speeds. Approved by the Department for Transport, this speed profile routes slightly faster than the ones used for SIMD 2006 and SIMD 2004.

For output areas from which a journey involving a ferry would be required (i.e. those on an island without a service and without access via a causeway or bridge) a 30 minute ferry wait time penalty was added. Following from the SIMD 2006 methodology, this was to reflect the longer wait time experienced by an individual arriving with a car to board a ferry, as compared to foot passengers.

Output area drive times were population weighted using 2008 school age populations produced by the Scottish Government for Primary and Secondary schools and by 2001 output area populations produced by GRO(S) for all other services. Population weighted output area times were then aggregated to datazone level for incorporation in SIMD 2009.