

# Measuring Public Transport Accessibility Levels

## **PTALs**

## Summary

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### Overview

Public Transport Accessibility Levels (PTALS) are a detailed and accurate measure of the accessibility of a point to the public transport network, taking into account walk access time and service availability. The method is essentially a way of measuring the density of the public transport network at any location within Greater London.

The current methodology was developed in 1992, by the London Borough of Hammersmith and Fulham. The model has been thoroughly reviewed and tested, and has been agreed by the London Borough-led PTAL development group as the most appropriate for use across London.

Walk times are calculated from specified point(s) of interest to all public transport access points: bus stops, rail stations, light rail stations, underground stations and Tramlink halts, within pre-defined catchments. The PTAL then incorporates a measure of service frequency by calculating an average waiting time based on the frequency of services at each public transport access point. A reliability factor is added and the total access time is calculated. A measure known as an Equivalent Doorstep Frequency (EDF) is then produced for each point. These are summed for all routes within the catchment and the PTALs for the different modes (bus, rail, etc) are then added to give a single value. The PTAL is categorized in 6 levels, 1 to 6 where 6 represents a high level of accessibility and 1 a low level of accessibility. Levels 1 and 6 have been further sub-divided into 2 sub-levels to provide greater clarity.

The measure therefore reflects:

- Walking time from the point-of interest to the public transport access points;
- The reliability of the service modes available;
- The number of services available within the catchment; and
- The level of service at the public transport access points - i.e. average waiting time.

It does not consider:

- The speed or utility of accessible services;
- Crowding, including the ability to board services; or,
- Ease of interchange.

The PTAL methodology was developed for London where a dense integrated public transport network means that nearly all destinations can be reached within a reasonable amount of time. Research using the ATOS (Access to Opportunities and Services) methodology shows that there is a strong correlation between PTALs and the time taken to reach key services – i.e. high PTAL areas generally have good access to services and low PTAL areas have poor access to services.

## Components of the PTAL Method

The process can be broken down into a series of stages:

- Define the point of interest
- Calculate the walk access times from the Point of Interest (POI) to the service access points (SAPs)
- Identify valid routes at each SAP and calculate average wait time
- For each valid route at the SAPs calculate the minimum total access time
- Convert total access times to the Equivalent Doorstop Frequencies - to compare the benefits offered by routes at different distances,
- Sum all EDFs with a weighting factor in favour of the most dominant route for each mode
- PTALs are then determined using 6 banded levels.

### Define the Points of Interest

The exact location of the point of interest may have a considerable bearing on the final PTAL score. The proximity of local public transport services and the nature of the local walk network will vary from point to point. If the PTAL is being calculated for a large development, for example a new supermarket, a number of points may be required to reflect different PTALs across the area.

### Calculate the walk access times

#### *Public transport access points*

There are approximately 12,000 public transport network stops or access points within Greater London. Station locations are based on station entrances. Bus access points represent a pair or group of bus stops. For instance where there is a stop either side of the road for each service direction there would be one SAP. Similarly outside a rail station, where there may be two or more stops, a single SAP is generally used to represent this cluster of stops.

#### *Walk access times*

Walk access times are measured from the POI to the SAPs using the Ordnance Survey's representation of the road network - ITN (Integrated Transport Network). Distances between the POI and the SAPs are converted to a measure of time using an assumed average walk speed of 4.8 kph.

A number of parameters define the extent of the walk catchment area. For buses the maximum walk time is defined as 8 minutes or a distance of 640 metres. For rail, underground and light rail services the maximum walking time is defined as being 12 minutes or a walking distance of 960 metres. Any SAPs beyond these distances are rejected.

Table 1 below summarises the walk speed, maximum walk distances and reliability factors used in the calculations.

**Table 1 Model Parameters**

<b>Parameter</b>	<b>Unit</b>	<b>Value</b>
Walk Speed	Km/Hr	4.8
Walk Speed	Metres/Minute	80
<b>Bus</b>		
Reliability	Minutes	2
Maximum Walk Time	Minutes	8
Maximum Walk Distance	Metres	640
<b>Rail</b>		
Reliability	Minutes	0.75
Maximum Walk Time	Minutes	12
Maximum Walk Distance	Metres	960

### Identify Valid Routes

Routes are identified for each valid SAP:

- The routes depend on the time period chosen. Generally service frequency data is selected from the morning peak period, specifically between 08.15 to 09.15;
- For each POI route information is only considered once. Where a route occurs twice or more - because it serves more than one SAP within the POI catchment area - the SAP that is nearest to the POI is used;
- Within each route (for example, the Victoria Underground line) different 'run' patterns are considered as separate entities with separate frequency patterns;
- At any SAP, routes will normally be bi-directional. In TfL's PTAL calculator it is the direction with the highest frequency that is considered in the model;
- For train services only those routes with at least 2 stops within the Greater London boundary (i.e. the origin stop and at least one other station) are considered. This is particularly significant for POIs where the SAPS include London major termini stations.

Bus frequency data is derived from TfL's BusNet system. This is a comprehensive database giving a global view of current bus and tram routes and their geographic routings and services. Service information is based on the contractual requirements agreed between the operators and TfL and is therefore regarded as the most reliable data source available within TfL for calculating PTALs. Timetables offer a range of bus time intervals and can give the impression that higher frequency levels are possible. These times though are designed to reflect local road and traffic conditions which can change from day to day.

Table 2 below shows how the Public Transport Accessibility Index is built up, for a point served by 4 bus services and an Underground station. Note that the Northern Line branches are treated as separate services.

**Table 2 PTAL calculation for a single point**

Parameters											
Walk Speed (metres/min)	80										
Bus reliability (mins)	2										
Rail reliability (mins)	0.75										
Peak hour services											

Site Details											
New Offices	X 526919	Y 189652									

Site	Services	Stop	Route	Distance	Frequency	Weight	Walk Time	SWT	Access	EDF	Accessibility Index	
New Offices	Bus Services	TX08	F12	303	4	0.5	3.79	9.50	13.29	2.26	1.13	
		TW04	3A	408	6	0.5	5.10	7.00	12.10	2.48	1.24	
		TW04	23	408	10	1	5.10	5.00	10.10	2.97	2.97	
		TW03	125	511	6	0.5	6.39	7.00	13.39	2.24	1.12	
	Rail/LUL/DLR	East Finchley	via CX		699	9	0.5	8.74	4.08	12.82	2.34	1.17
			via Bank		699	9	1	8.74	4.08	12.82	2.34	2.34
											<b>9.97</b>	

**Calculating Total Access Time**

Total access time is made up of a combination of factors: combining the walk time from the POI to the SAP and the time spent waiting at the SAP for the desired service to arrive.

**Total Access Time = Walk Time + Average Waiting Time**

*Average Waiting Time*

Waiting time is the average time between when a passenger arrives at a stop or station, and the arrival of the desired service. In PTALs passengers are assumed to arrive at the SAP at random.

For each selected route the scheduled waiting time (SWT) is calculated. This is estimated as half the headway (i.e. the interval between services,) so  $SWT = 0.5 * (60/Frequency)$ .

Thus a 10 minute service frequency (6 buses per hour) would give an SWT of 5 - on average a passenger would have to wait 5 minutes for a bus/train to appear.

To derive the Average Waiting Time, reliability factors are applied to the SWT according to the mode of transport used. The regularity of buses, underground and rail services are affected by a variety of factors, with bus services the worst affected. To allow for reliability additional wait times assumed are 2 minutes for buses and 0.75 minutes for rail services.

## Calculating Equivalent Doorstep Frequency

The access time is converted to an Equivalent Doorstep Frequency (EDF) where:

$$\text{EDF} = 30 / \text{Total Access Time (minutes)}$$

This treats access time as a notional Average Waiting Time as though the route was available at the "doorstep" of the selected POI.

## Calculating the Accessibility Index for the POI

Summation of the EDF values gives the accessibility index. There are a number of additional factors that should be considered:

- Routes often travel in parallel for some distance so the range and frequency of destinations are likely to be less than that suggested by the number of routes included in the calculation.
- Travellers often have to change routes in order to reach the desired destination - this can add significant delays to the journey

Halving the EDF values for all but the most accessible or dominant route for each transport mode compensates for these factors. Transport modes are divided into three groups:

- Buses
- National Rail
- LUL – all LUL services together with DLR and Tramlink services

Thus for a single transport mode the AIs can be calculated using the following formula:

$$\text{AI}_{\text{mode}} = \text{EDF}_{\text{max}} + (0.5 * \text{All other EDFs})$$









Calculating the overall accessibility index is a sum of the individual AIs over all modes:

$$\text{AI}_{\text{poi}} = \sum(\text{AI}_{\text{mode1}} + \text{AI}_{\text{mode1}} + \text{AI}_{\text{mode2}} + \text{AI}_{\text{mode3}} \dots \text{AI}_{\text{mode n}})$$

## PTALs

The final formula given above calculates the PTAI - the Public Transport Accessibility Index. These indices can now be allocated to bands of Public Transport Accessibility Levels (PTALs) where band 1 (1a and 1b) represents a low level of accessibility and 6 (6a and 6b) a high level. The table below shows the relationship between PTAI scores and the final PTAL levels. A value of 0 would indicate no access to the public transport network within the parameters given.

**Table 3 Public Transport Accessibility Levels**

<b>PTAL</b>	<b>Range of Index</b>	<b>Map Colour</b>	<b>Description</b>
1a (Low)	0.01 – 2.50		Very poor
1b	2.51 – 5.00		Very poor
2	5.01 – 10.00		Poor
3	10.01 – 15.00		Moderate
4	15.01 – 20.00		Good
5	20.01 – 25.00		Very Good
6a	25.01 – 40.00		Excellent
6b (High)	40.01 +		Excellent

**PTAL Web Site**

A PTAL calculator is available on the web at the following address:

[webpid.elgin.gov.uk](http://webpid.elgin.gov.uk)

or via TfL's Borough Partnership's web page.

The site allows you to search for a specific location by street name, co-ordinates or postcode and then calculate the PTAL value for the selected location.

**List of Abbreviations**

AI	Accessibility Index
ATOS	Access to Opportunities and Services
AWT	Average Waiting Time
BODS	Bus Origin and Destination Survey
EDF	Equivalent Doorstep Frequency
GIS	Geographic Information System
PDGIS	Planning and Development Geographic Information System - a GIS developed specifically for the Planning Department of London Transport, now being replaced.
POI	Point-of-Interest - the point for which the PTAL is being calculated. This can be an individual point or a grid of point.
PTAI	Public Transport Accessibility Indices
PTAL	Public Transport Accessibility Levels
RF	Reliability Factor
SAP	Service Access Point - bus stops, light rail stations, underground stations, tramlink halts etc. Points at which people have access to the public transport network.
SWT	Scheduled Waiting Time
TAT	Total Access Time
TfL	Transport for London