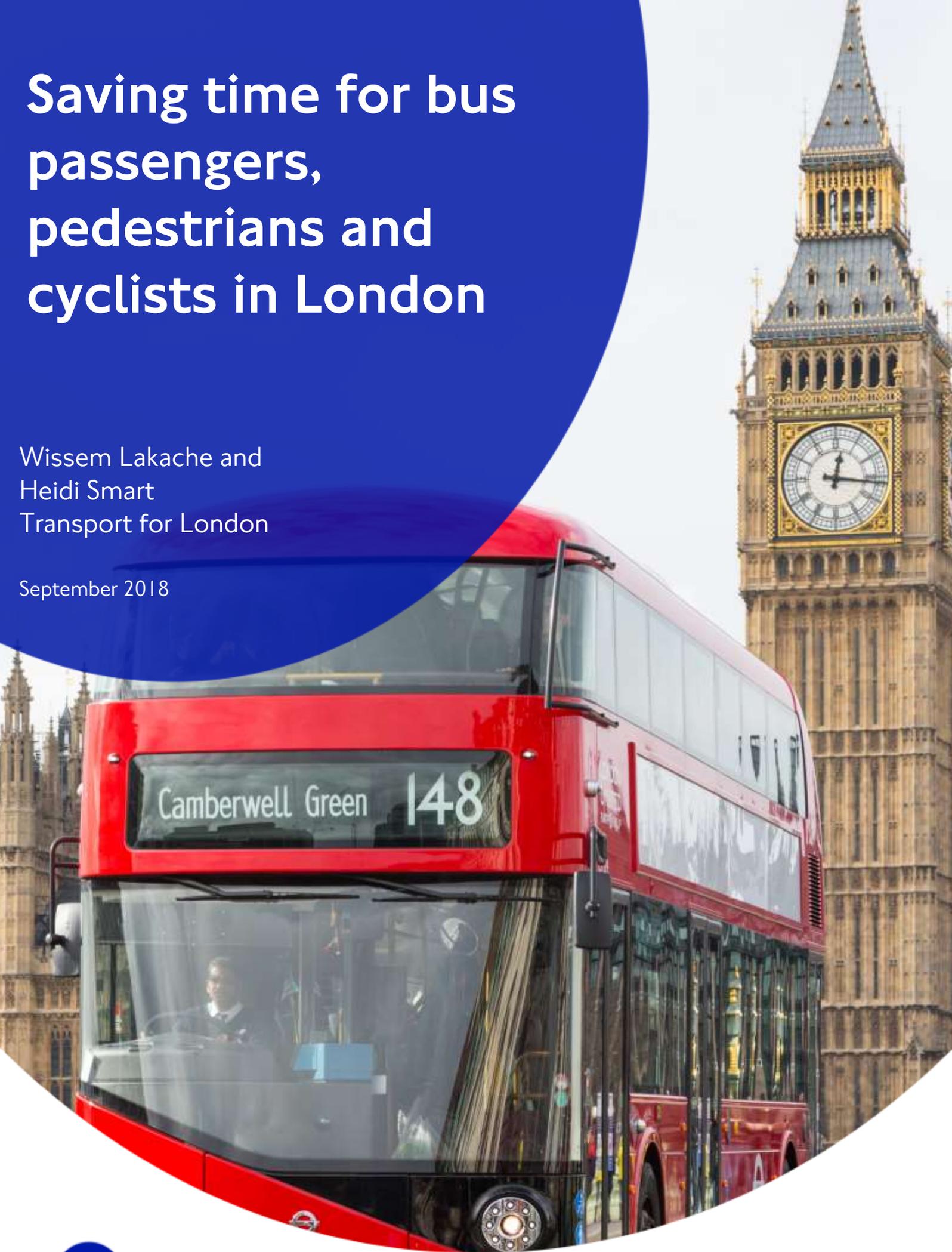


Saving time for bus passengers, pedestrians and cyclists in London

Wissem Lakache and
Heidi Smart
Transport for London

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Introduction

The Mayor's Transport Strategy, published in March 2018, sets out some ambitious targets to transform transportation in London. It sets out a Healthy Streets Approach to the whole of London for the first time, which encourages active, efficient and sustainable transport modes to be used to improve health and the human experience of using the streets. The aspiration to develop Healthy Streets and encourage more active travel is set out in a number of targets, including the target for 80% of trips to be taken using sustainable modes of transport (walking, cycling and public transport) by 2041, and the goal for all Londoners to do at least 20 minutes of active travel every day by 2041 (which is a big challenge, because only a third¹ report doing this now). The strategy wants to see a reduction in the dominance of motorised traffic on London's streets in order to improve air quality and reduce road danger.

A new direction for the annual signal timing review programme

Transport for London's Network Performance team is responsible for setting up and operating London's traffic control system in order that the roads work for everyone. Our programme of 1200 annual traffic signal timings reviews has been radically refocused to enable Healthy Streets and create a better experience for people choosing to travel by sustainable modes. We have developed new signal control techniques and technologies to give advantage to people using sustainable modes, when we can.

We are now using London's traffic control system in ways that we never thought possible, to help people move around the capital. We have developed an award winning² program utilising cutting edge traffic signal technology and network management techniques, combined with operational expertise to deliver Healthy Streets. Some of the new techniques include;

Differential Bus Priority	Giving advantage to a bus at a junction, but only if it is running late	2-5 seconds given back to each bus at a junction. Keeps disruption to a minimum for other junction users.
Call cancel	Currently in place to benefit buses, by cancelling pedestrian demand when they have already crossed	Next step? Selecting locations where emissions could be improved if traffic didn't have to stop unnecessarily.
Pedestrian SCOOT	Currently in 7 locations. Extends the green man invitation in places where sporadic, high volumes of pedestrians need to cross	20 more locations being explored for a further roll-out
Cycle SCOOT	Delay saving of around 6% for cyclists using segregated tracks	19 locations being explored for a further roll-out
Green Man Authority	Permanent green man, until traffic detected. Sites selected with high pedestrian flows and low traffic	10 locations being explored for trials
Emissions trials	Using signal strategies to reduce emissions when traffic congestion is known to be causing poor air quality and where there are high pedestrian levels.	Putney High Street was the first trial, which demonstrated a 43% reduction in bus nitrogen oxide. 5 further locations identified for trials.

¹ <http://content.tfl.gov.uk/healthy-streets-for-london.pdf>

² Excellence in Technology Winner at the London Transport Awards 2018

Traffic Signal Timing Reviews

Road junctions are a key constraining factor on the effective operation of the road network. Maximising their performance is an important part of good network management; this is done through carrying out Traffic Signal Timing Reviews.

As network conditions are always changing, the purpose of the reviews is to optimise traffic signal timings to make sure that they comply with the most current standards, ensure the needs of all road users are met as well as to deliver a stable road network to support local transport policies and to comply with the Network Management Duty.

1. Selection and different types of Reviews

Our annual Timing Review Programme (TRP) reviews 1,200 of the 6,300 traffic signals in London each year. We take a data-led approach to selecting the majority of locations. Our data tools can give us an indication of where buses are experiencing delays, where there are high volumes of pedestrians or popular cyclist routes. We also work with the London Boroughs who can nominate junctions for reviews and we also review the traffic signal timings at junction where new schemes are in place on the network.

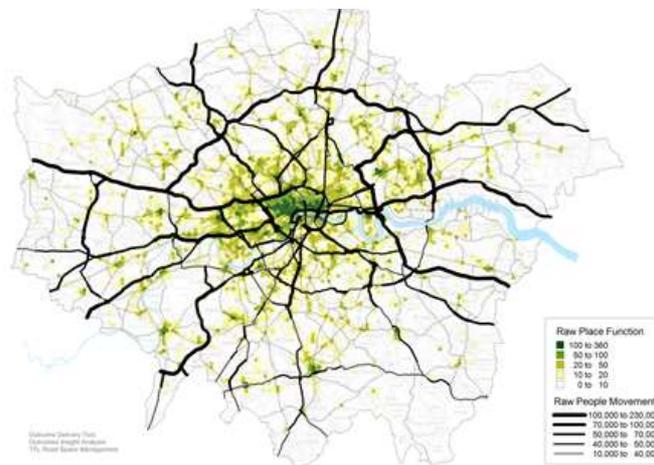


Figure 1: Movement and place utilisation on the TLRN indicating pedestrian density

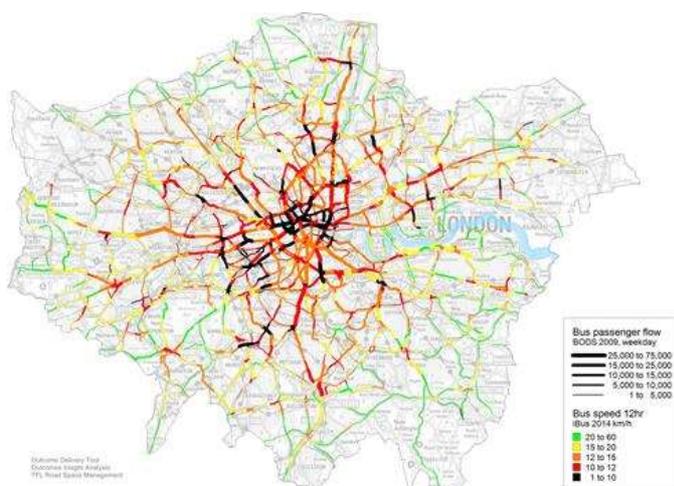


Figure 2: Movement and place utilisation on the TLRN indicating bus passenger numbers

These reviews are divided into different types which are:

- **Bus Operational:** This involves looking in depth at specific routes that are frequently delayed, and finding ways to improve the speed of the bus.
- **Customer Enquiry:** This is a review which has been triggered as part of a customer enquiry.
- **Fixed Time Operational:** This involves reviewing Fixed Time junctions.
- **Healthy Streets Ped Focussed:** These reviews look in depth at how to improve pedestrian movement.
- **Scheme Implementation:** When a construction of a scheme is completed, this is followed by a review of the new junctions and implementing the signal strategy that has been modelled.
- **SCOOT Implementation:** This review focusses on implementing and running new SCOOT at a site.
- **SCOOT Operational:** This involves looking at the change in network conditions and fine tuning SCOOT to allow for the perfect optimisation to be carried out in order to maximise the performance of the junction.
- **VA Operational:** These non-UTC reviews are carried out on sites running Vehicle Actuation. Different measures are applied to allow for a better timing strategy.
- **VISSIM Modelled Review:** VISSIM modelling is carried out on a region. Using the modelling software, new signal timing strategy is extracted and applied on street.

2. Process of a Signal Timing Review

The general process for any Signal Timing Review is divided in four stages: Start Up stage, Design stage, Implementation stage and finally the Close Out stage. All reviews are carried out by TfL's Network Managers.

Stage 1 – Start Up

The Start Up stage enables us to determine the existing site situation, by understanding the current system configuration, the current delays that are occurring for buses and pedestrians from our data and also carrying out time of day site visit observations to understand how the junction is being used. These will define the specific requirements by agreeing on review objectives. The steps that are undertaken in stage 1 are as follows:

- **Stakeholder Consultation:** Notify relevant stakeholders of the review and understand any local comments or considerations
- Carry out peak specific site visits to understand the existing site situation
- Undertake “Health Checks” on site, which includes a review of paper work and the UTC system for alarms, errors and issues that need to be corrected.
- Identify risks and limitations, as well as potential solutions
- Create a review objectives form where the observed issues, risks and solutions are recorded.

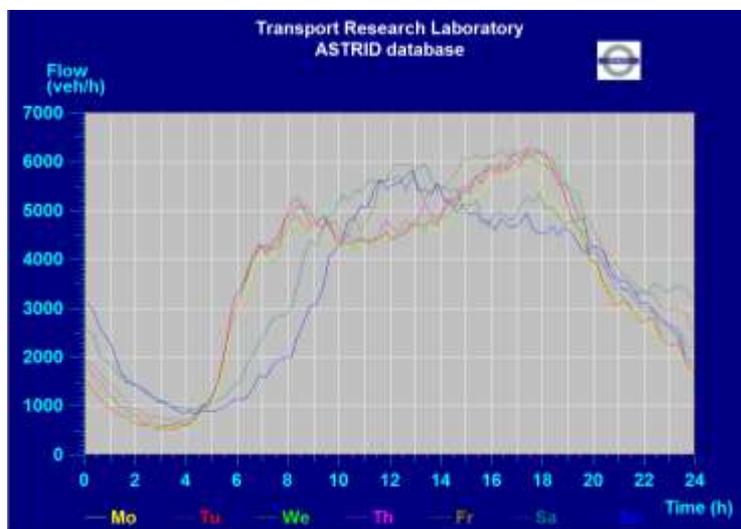


Figure 3: ASTRID is used to identify the different peaks

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ALARMS FOR JUNCTION 08/016 FOR FRIDAY 05/01/18
ALRM DATE TIME JUN:OTU G:R CTRL WAT FR ALARM TYPE
+1172 0501 1007 J08/016 G0181 SC01 SC01 01 W02 RESPONSE F4-G0
+1171 0501 1007 J08/016 G0181 SC01 SC01 01 W02 RESPONSE F3-G0
+0662 0501 0705 J08/016 G0181 SC11 SC01 01 W02 RESPONSE F2-G0
+0655 0501 0702 J08/016 G0181 SC11 SC01 01 W12 G3-G5 I/G LONG 19 FOR 11
+0538 0501 0925 J08/016 G0181 SC01 SC01 30 W02 RESPONSE F2-G0
+0383 0501 0421 J08/016 G0181 SC05 SC05 01 W02 RESPONSE F3-G0
+0235 0501 0530 J08/016 G0181 SC05 SC05 99 W02 RESPONSE F2-G0
+0001 0501 0059 J08/016 G0181 SC08 SC08 20 W02 RESPONSE F2-G0

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Figure 4: UTC system's alarms at junction 08/016

Stage 2 – Design

This is the planning and developing ideas stage where an agreed design and an implementation plan are produced. The Design stage includes and is not limited to the below tasks

- Data Collection, which can be site-based where flare usage, saturation flows and green signal usage can be gathered. Or UTC system data collection, where SCOOT stage lengths, offsets and cycle times can be extracted.
- Validation, ensuring that the UTC system matches street conditions.
- Modelling base and proposed scenarios for all peaks.
- Putting forward a design proposal as well as an implementation plan of the proposal.



Figure 5: Flare usage configuration for junction

Stage 3 – Implementation

Implementation of the design changes, this is the ‘doing’, taking action and resolving problems stage. These include:

- Testing of timings and strategy on street.
- Fine-tuning strategy by time of day, what works at 7am may not work at 7pm.
- Advanced facilities can be tested and implemented.
 - Gating – Targeted changes based on queues/delay
 - System Activated Strategy Selection (SASS) – More complex strategies based on wider range of triggers to address more extreme conditions
 - Activated Traffic Management (ATM) – Traffic entry towards Central London is controlled
 - iBus/Bus Priority/differential bus priority
- Preparing and testing contingency strategies for planned and unplanned events which will be used by Network Management Control Centre (NMCC).
- CLF timings update
- Ensuring that objectives of the review have been met.

COMMAND	PARAM1	PARAM2
SCOB	02	R545
SPAR	MAXS	N16/166/2=16
SPAR	MAXS	N16/165/2=16
SPAR	MAXS	N16/165/3=7
SPAR	MAXS	N16/183/2=20

Figure 6: Logic Triggers and Control Actions for a SASS located at Lodge Avenue roundabout

Stage 4 – Close Out

The Close Out stage is where the benefits will be measured, reports completed, summary case studies and short films prepared in order to explain the results to a broader, non-technical audience. Results and lessons learnt are shared through our Technical Forums which are held periodically. Further recommendations are captured in the Review Recommendations Log, which captures ideas for further investment, which could further improve the operational experience for all road users.

3. Assessing the Benefits of a Signal Timing Review

We have created a new way of measuring the benefits of any improvements we make for pedestrians and bus passengers, in the future this will also include cyclists. This forms TfL's new Operational Improvements to Sustainable Travel Metric which appears on the corporate scorecard.

This is an exciting step forward for our Network Managers as they can now see their good work being measured and reported. Having the data to hand showing who the biggest customers are in a particular review area means the traffic signal timings can be tailored to the key user group. For example, higher pedestrian numbers in an area – such as near a school or public space – would encourage our Network Managers to allow a pedestrian crossing to operate twice as frequently, thereby halving pedestrian wait times and so lowering their delay.

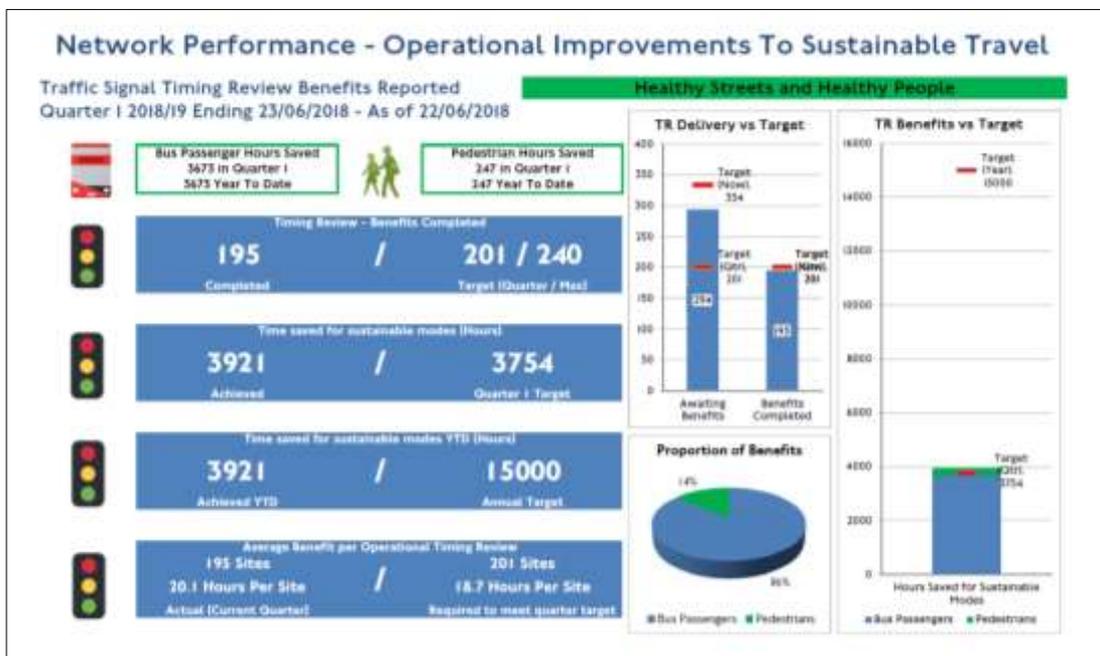


Figure 8: Quarter 1 Operational Improvements to Sustainable Travel performance data as part of TfL's Surface Scorecard

Of the scheduled 1,200 timings reviews this year, around 70% will be included in TfL's new performance metric. The remaining 30% seek to support Healthy Streets through scheme-related changes to the network, whether final design-related or as part of mitigation for construction works. Their benefits are measured and reported as part of the schemes themselves.

The visual in Figure 8 above highlights the proposed annual target of saving 15,000 passenger hours per day through our timing reviews.

The Timing Review Performance Data

TfL holds a huge amount of performance data which has allowed us to dig deep to choose the right data to represent the delay savings we are aiming to achieve.

TfL operates the most frequent and extensive bus network in the world with around 670 routes and 9,300 vehicles. By tracking each and every one of these buses each day between 5am and midnight using our iBus technology, we can collect information on bus travel times between bus stops. We then simply assess changes in this data by comparing a “pre-review” and a “post-review”. This allows our Network Managers to ask of their review: have bus journey times reduced or have my interventions caused bus speeds to reduce instead?

We can also get data from our Oyster card and contactless system which enables us to capture a wealth of data on unique bus journeys across the network. This means we have ready-made estimated bus passenger loadings for every bus route at stops through each of our timing review areas, which can also be split by time of day.

For pedestrian journeys, our traffic signal control system UTC SCOOT captures background information regarding green times for every traffic or pedestrian movement at every junction or crossing facility. We can then extract this data to calculate pedestrian delays. These can come in two ways: either a pedestrian green light increases or decreases, meaning users have more or less time to make their journey; or the time between consecutive green pedestrian signals changes, affecting their wait times.

We use data from the London Travel Demand Survey to gauge the pedestrian flows. This included 150,000 pedestrian trip movements by 24,000 people recorded over three years and this dataset was then scaled up to equate to over 6 million projected daily pedestrian trips. One notable conclusion of this process is that pedestrian movements tend to be much higher at junctions than at individual crossings, due to the increased number of movement options.

We are working on gathering information on cycle trips in our network and how we can then turn this data into a performance measure much the same as we have for both buses and pedestrians so far.

The Assessment Tools

To handle all this data, we have created two new tools to quickly read and output our final performance metric results: bus passenger -hours and pedestrian hours saved through implementation of our traffic signal timing reviews. We can also then combine these two results into a single number – which becomes the amount of time saved for sustainable modes.

Sustainable Mode Gains Calculator

This new Sustainable Mode Gains Calculator is a web application that takes in site type – area or single site, peak period, day type alongside a range of before and after dates for comparison and then outputs various data and performance visuals.

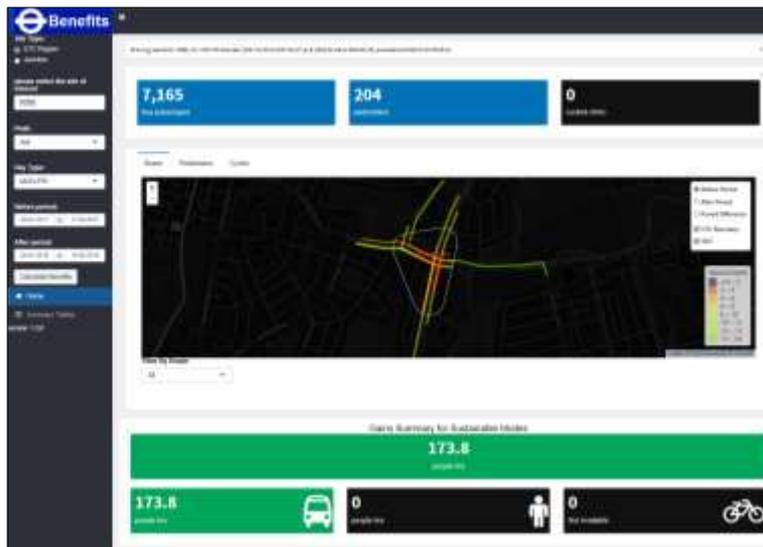


Figure 9: TfL's Sustainable Mode Gains Calculator showing example data for Greenford Road, LB Ealing

From screen as shown in Figure 9, you can see a summary of the number of bus passengers, pedestrians and – in the future – cyclists who are expected to be travelling through the chosen area. This is then further broken down on subsequent summary table to allow for deeper analysis, site by site or bus route by bus route for example.

Another helpful item displayed on the home screen is a map of the chosen area, showing bus speed changes. This can be used as a first visual representing the differences before and after the change being assessed.

The lower section of the home screen displays the Gains Summary for Sustainable Modes: this is the single combined benefit for all modes assessed. Currently our Calculator tool is only capable of computing bus data and performance results, but we are working on expanding the logic to incorporate our pedestrian calculations too. And again, we aim to follow this with the cycling element also as discussed above.

Route	Description	Change (p)	Total Pass. (p)	Total Pass. (p)	Change of Speed (p)	Weighted	Gain (p)	Loss (p)	Net Gain (p)
1	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
2	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
3	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
4	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
5	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
6	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
7	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
8	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
9	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
10	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
11	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
12	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
13	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
14	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
15	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
16	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
17	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
18	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
19	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00
20	Greenford Road (Greenford Station) to Greenford Road (Greenford Station)	300	100	100	0.00	0.00	0.00	0.00	0.00

Figure 10: TfL's Sustainable Mode Gains Calculator showing example summary bus performance data for Greenford Road, LB Ealing

Conclusion

A key message of the Mayor's Transport Strategy is bringing about change to our capital's transport mix. As such, the number one policy for the Mayor and TfL working with the London boroughs is that by 2041 80% of all trips will be made on foot, by cycle or using public transport.

This ambitious target can be simply broken down into reducing Londoners' dependency on cars in favour of more sustainable modes of transport, to create a healthier city for everyone to enjoy. A Healthy Streets Approach is therefore now at the heart of how we are managing and operating our streets through our traffic signal system.

TfL has always sought to consider the needs of every one of our customers. So Healthy Streets is enabling us to increasingly focus our operational strategies even more so on walking, cycling and London's bus network. Combining this approach with our raft of customer demand data within our network means we are now in a position to appropriately identify and report the benefits achieved through our yearly Signal Timing Review Programme.

Contact

Wissem Lakache
Network Manager

Network Performance Delivery.
Network Management
Palestra House, 197 Blackfriars Road,
London, SE1 8NJ.

Email WissemLakache@tfl.gov.uk

Heidi Smart
Principal Network Manager

Network Performance Delivery.
Network Management
Palestra House, 197 Blackfriars Road,
London, SE1 8NJ.

Email Heidi.Smart@tfl.gov.uk

