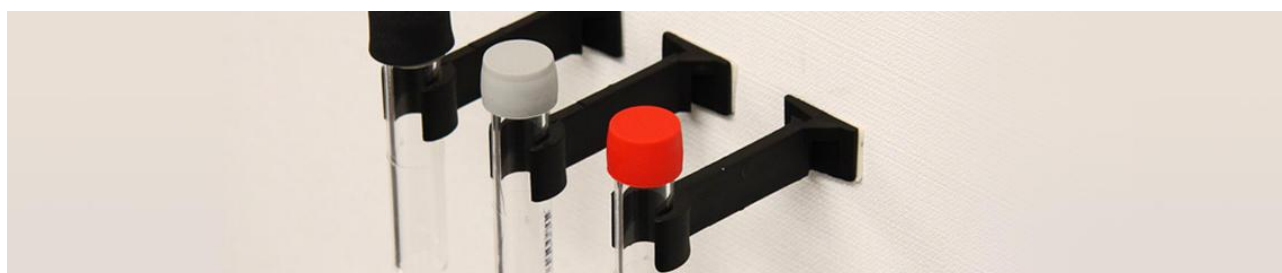


# Brussels measurement campaign

## Measurement methodology

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### Measurement tools



Palmes-type nitrogen dioxide (NO<sub>2</sub>) diffusion tubes.

A diffusion tube is a device capable of taking gas samples from the atmosphere. The diffusion sampler consists of a tube, one end of which contains a sorbent which fixes the pollutant. The pollutant is sampled onto the sorbent at a rate controlled by the molecular diffusion of the pollutant gas in the air. After exposure of the samplers over periods varying from a few days to a few weeks, the tubes are closed and returned to the laboratory for analysis.

Diffusion tubes are categorised as an “indicative” monitoring technique by the [European Environment Agency](#). This refers to a technique with a margin of uncertainty quoted as  $\pm 25\%$  (Annex I Directive 2008/50/EC on ambient air quality and cleaner air for Europe).

Diffusion tubes are currently used by public authorities to carry out indicative measurements. See, for instance, the [guidance](#) issued by the UK Department for Environment, Food and Rural Affairs, according to which diffusion tubes are “*useful for identifying areas of high NO<sub>2</sub> concentration, particularly when dealing with sources such as traffic emissions, which do not change much from day to day*”.

### Monitoring period

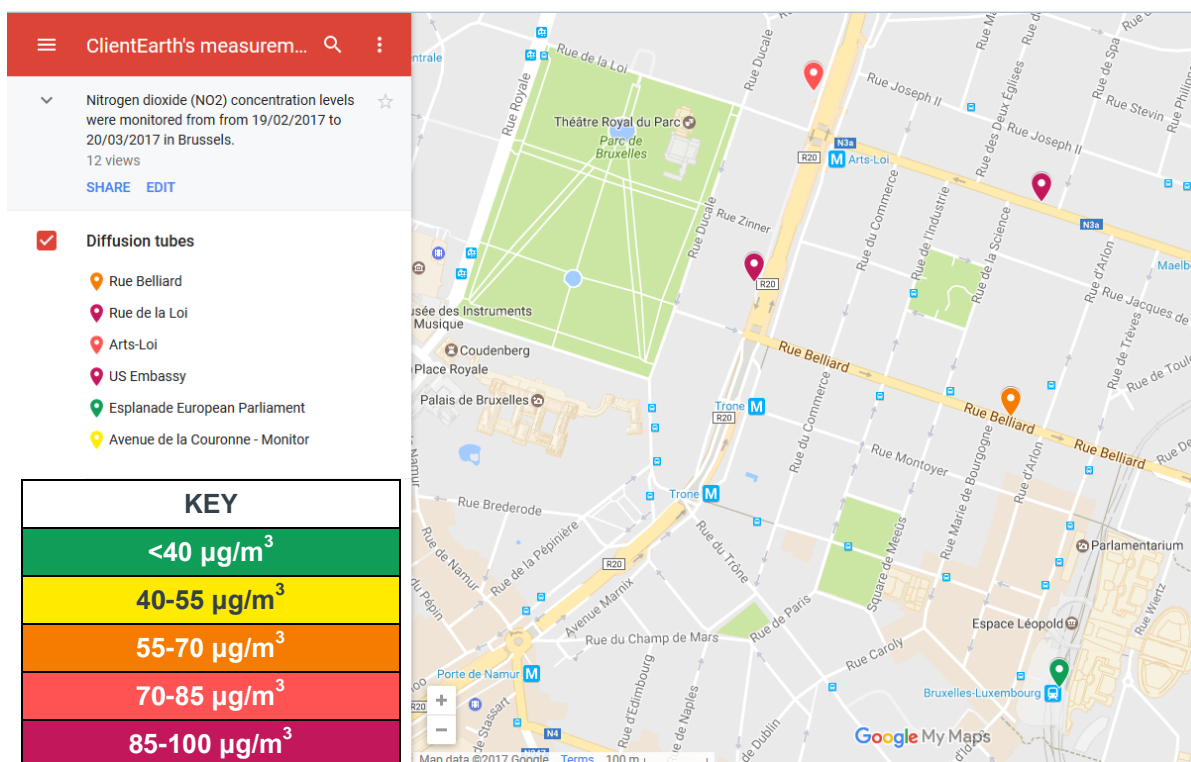
The monitoring was done over four weeks from 19 February to 20 March 2017.

## Location of samples

Seven NO<sub>2</sub> diffusion tubes were placed around the following areas: Rue Belliard, Rue de la Loi, Arts-Loi, Avenue des Arts and the Esplanade of the European Parliament.

Tubes were also placed at automatic monitors in Avenue de la Couronne to calibrate the results.

The following map (available also [here](#)) shows the exact location of the sampling points.



The siting of the sampling points followed the indicative guidance in Annex C, Section C of Directive 2008/50/EC on ambient air quality and cleaner air for Europe. In particular, all sampling points were:

- 2,5 m above the ground;
- at least 25 m from the edge of major junctions; and
- within 10 m from the kerbside.

In most locations, two samples were placed, to guard against the risk of malfunction.

## Analysis of samples

At the end of the monitoring period, the diffusion tubes were closed and sent them to Gradko International Limited, an accredited laboratory, for analysis.

The data returned from the laboratory offer the average NO<sub>2</sub> concentrations during the four week exposure period.

Location	Sample Number	Exposure Data		Time (hr.)	µg/m <sup>3</sup>
		Date On	Date Off		
Couronne	863552	19/02/17	20/03/17	692.12	43.09
Couronne	863551	19/02/17	20/03/17	692.12	41.61
Couronne	863550	19/02/17	20/03/17	692.12	42.25
Belliard 1	863549	19/02/17	20/03/17	691.97	69.22
Belliard 2	863548	19/02/2017	20/03/2017	691,97	72.45
Rue de la Loi 1	863547	19/02/2017	20/03/2017	691.58	105.71
Rue de la Loi 2	863546	19/02/17	20/03/17	691.58	91.01
Arts - Loi	863545	19/02/17	20/03/17	691.33	71.93
Avenue Des Arts (US Embassy)	863544	19/02/17	20/03/17	691.03	99.44
Esplanade EP	863543	19/02/17	20/03/17	690.28	30.96

## Validation of data

Diffusion tube measurements may exhibit substantial under- or over-estimation compared to official automated monitoring stations.

One usual way of correcting such under- or over-estimation is to co-locate three diffusion tubes within 1 m from an official monitoring station. By comparing the average NO<sub>2</sub> concentrations registered by the three samples and the official monitoring station, it is possible to calculate a bias correction factor.

ClientEarth co-located three diffusion tubes at the monitoring station Avenue de la Couronne (41R002). During the period of the monitoring campaign, the three diffusion samples recorded average NO<sub>2</sub> concentrations between 41.6 and 43.1 µg/m<sup>3</sup>. Conversely, the Avenue de la Couronne official station recorded 52.5 µg/m<sup>3</sup>.

The diffusion tubes, therefore, under-estimated the actual concentrations by 24%.

A similar validation is possible comparing the results over the four week measurement campaign and annual data from official monitoring stations, in order to obtain an estimation of what the samples' results mean in terms of annual average concentrations. Again, the results recorded by the diffusion tubes under-estimated the actual situation.

### Measurement and assessment approach

In collecting and assessing the measurement results, ClientEarth decided to adopt a conservative approach. In particular:

- all sampling points have been located at more than 25 m from the edge of major junctions (on average around 50 m), even if the Air Quality Directive allows measurements to be taken closer to the junctions;
- where more than one sample was available for the same location (Rue Belliard and Rue de la Loi), ClientEarth selected the diffusion tube which recorded the lower concentrations;
- ClientEarth published the raw data obtained from the diffusion tubes, even if the validation showed that these under-estimated actual concentrations by 24%.