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Abstract:	In 2012 the World Health Organisation's International Agency for Research on Cancer (IARC) reclassified diesel-engine exhaust and related ambient air pollution to be carcinogenic and associated with increased mortality from lung cancer. This could have critical consequences for both public and occupational health in enclosed railway stations where ventilation is often inadequate. Recent policies encouraging a shift to public transport, along with increasing passenger and train numbers, has led to a variety of co-benefits including increased health and well-being from more walking and cycling. This paper considers the unintended consequences of a reduction of air quality in crowded enclosed railway stations and concludes with a number of possible interventions to ensure that public health is not affected, especially by air pollution from stationary diesel trains. Pollution from electric trains can also lead to poor air quality due to the production of metal rich ultrafine particles from brake linings, friction between wheel and rail and from overhead pantographs. Current occupational health standards are not suitable for enclosed railway stations and need to be reconsidered in the light of the IARC findings. More measurements of the levels of particulates and nitrogen dioxide in enclosed railway stations need to be undertaken and published.

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In 2012 the World Health Organisation's International Agency for Research on Cancer (IARC) reclassified diesel-engine exhaust and related ambient air pollution to be carcinogenic and associated with increased mortality from lung cancer. This could have critical consequences for both public and occupational health in enclosed railway stations where ventilation is often inadequate. Recent policies encouraging a shift to public transport, along with increasing passenger and train numbers, has led to a variety of co-benefits including increased health and well-being from more walking and cycling. This paper considers the unintended consequences of a reduction of air quality in crowded enclosed railway stations and concludes with a number of possible interventions to ensure that public health is not affected, especially by air pollution from stationary diesel trains. Pollution from electric trains can also lead to poor air quality due to the production of metal rich ultrafine particles from brake linings, friction between wheel and rail and from overhead pantographs. Current occupational health standards are not suitable for enclosed railway stations and need to be reconsidered in the light of the IARC findings. More measurements of the levels of particulates and nitrogen dioxide in enclosed railway stations need to be undertaken and published.

Key Words: Pollution, Public Health, Railway Systems

1. Introduction

At a time when the general public are being encouraged to get out of their cars and walk, cycle and/or use public transport, it is important to assess not just the health co-benefits but also any unintended consequences. Enclosed railway stations such as Birmingham New Street, Marylebone, Paddington and Waverley which have a significant number of diesel trains, are most at risk. Effectively they are indoor environments that require substantial artificial ventilation to diffuse and dispose of the air pollution generated by both diesel and electric trains.

Road and rail traffic are key contributors to poor air quality in the UK. A COMEAP report (COMEAP, 2010) suggests that the average life expectancy in the UK is six months lower due to exposure to particulate air pollution produced by human activities with an estimated annual cost to society of up to £16 billion. Urban transport strategies (mostly aiming to reduce greenhouse gas emissions) can deliver several health co-benefits. For example, strategies that encourage walking and cycling have the added benefit of reducing air pollution and increasing physical activity, thus tackling one of the most pressing and challenging public health problems of the day. However, only one third of Europeans currently reach the recommended levels of physical activity.

Since the railways have been privatised in the UK passenger numbers have dramatically increased. More than 1653 million passenger journeys were made in 2014/15 compared to 1586 million in 2013/14, a 4.2% increase as reported by the Office of Rail and Road (ORR, 2015). This growth is greater than in other European countries with passenger numbers doubling in the UK since 1997/98, compared to increases of 37% in France, 21% in Germany and 18% in the Netherlands (RDG, 2015). Network Rail is planning to invest £35 billion over the next 5 years, a third of which will be spent on improving stations, electrification and new track, a third on track renewals and a third on running the railways. The train operating companies need to reduce the average age of the current rolling stock from almost 20 years old according to the Rail delivery Group (RDG, 2015). Despite the increase in the number of trains and passengers there has been no research to monitor the impact on air quality and occupational and/or public health in railway stations in the UK.

A recent Environmental Systems Research Institute (ESRI, 2008) survey found that Birmingham is the worst city in Britain for commuting times. Workers spend on average more than an hour a day (61.2 minutes) travelling to and from work with its complex network of roads and motorways and crowded rail network. Edinburgh came in second (55.3 minutes), London third (52.4 minutes) and Oxford fourth (51.5 minutes). There is a need to assess the impact on public health across cities with long commuting times – and to examine the key sources of air pollution associated these commutes.

The responsibility for monitoring air quality in railway stations rests with Local Authority Environmental Health Departments in conjunction with Network Rail or the delegated train operating company. The Railways Safety and Standards Board (RSSB) have just launched a new occupational health and well-being initiative (RSSB, 2014). RSSB were involved in a workshop on Railway Station Air Quality, organised by Public Health England (PHE) held at Kings College London in September 2014. It is imperative that if occupational or public health air quality guidelines are shown to be exceeded, the relevant stakeholders are made aware immediately and take appropriate measures to monitor and improve air quality.

Currently no station air quality data is made available to the public and this issue must be addressed. It has been suggested that the electrification of lines will improve the environment:

'Electric trains emit circa 20-35% less carbon per passenger than a diesel train. With zero emissions at the point of use, they improve air quality in pollution hot spots such as city centres and main line stations (Network Rail, 2015).

This implies that carbon dioxide is the main problem and disregards the increased ultrafine particulate pollution that electric trains produce from brake linings, friction and overhead cables (Salma, 2009; Abassi et al 2013; Loxham et al 2013; Martins et al 2016). Ultrafine particles, which are unregulated in the UK, are often metal rich and thus potentially more likely to cause health problems, such as cancer and emphysema, in workers and passengers than the larger, regulated dust particles (PM_{10} and $PM_{2.5}$) (Loxham, 2013).

Presently in the UK around 60% of journeys take place on electric trains and 40% on diesel trains (Department of Transport, 2009).

Diesel engines in buses, vans, cars and trains may be responsible for thousands of premature deaths a year and cost the NHS billions of pounds. (Kelly, 2014)

The serious health impacts of diesel exhaust pollution and other transport pollutants are at the forefront of the current European air pollution research agenda. The official death toll for air pollution in the UK is currently 29,000, but this does not take into account levels of nitrogen dioxide, which is mainly emitted by diesel engines.

Diesel cars have become increasingly popular in recent years as they discharge 15% less carbon dioxide (Hope, 2015). The number of diesel cars in the UK has risen from 1.6 million to 11 million and now accounts for a third of the Nation's vehicles (Swinford, 2015). In 2010, the Committee on the Medical Effects of Air Pollutants (COMEAP) highlighted the health issues surrounding diesel emissions and, five years on, the government are yet to act (COMEAP, 2010; Hope, 2015). Carslaw et al. (2011) showed that the concentration of NO_x has a clear declining trend prior to 2004 however between 2004 and 2009 this trend turns into a lesser positive trend. This may be the result of the increasing number of diesel cars on the roads. Additionally, particulate filters on diesel cars are not as effective in the real world as they are in testing laboratories. The newly uncovered 'Volkswagen' illegal emissions-rigging software has highlighted this problem. The Mayor of Paris has promised to ban diesel cars from the city centre by 2020. Finding alternatives to diesel vehicles (cars and trains) should be a priority in the UK as well.

Previously, the fraction of NOx directly emitted as NO_2 was only about 5 to 10% in countries with a small fraction of diesel engines. Due to the use of catalytic convertors and an increasing number of diesel engines with high fraction of NO_2 in the exhaust, this value may in some regions be as high as 40%. (Hertel and Goodsite, 2006, p9)

It is vital for the health and well-being of those passengers that might switch from commuting by car to using public transport that the air quality encountered in enclosed railway stations should pose no risk to public health. It is also important that the health of staff working at enclosed railway stations should be monitored and protected.

2. Air Pollutants in Railway Stations

Air pollutants in railway stations come from both diesel engine exhaust emissions (DEEEs) and electric train emissions, of which diesel emissions are more polluting and hazardous (AEA, 2001). Diesel engines release a variety of pollutants, these have a range of effects on human health and the length of exposure can significantly influence these effects. Those who are younger, in a fit state of health and exposed to moderate air pollution are less likely to experience any short term effects, however elevated levels or long term exposure could lead to the development of more serious conditions such as respiratory illness, heart disease or cancer. Each of the DEEEs has a damaging effect on health (Table 1); therefore it is of upmost importance to abide by the limits in place to help prevent health deterioration of both the public and employees.

3. Air Quality Guidelines for Public Health

The air quality objectives specifically for use by local authorities in carrying out their air quality management duties are set out in the Air Quality (England) Regulations 2000 and the Air Quality (England) (Amendment) Regulations 2002. Reference is also made to the Air Quality Standards Regulations which came into force in June 2010 implementing relevant parts of EU Directive 2008/50/EC on ambient air quality. The Environment Act requires that the UK Government produces a national 'Air Quality Strategy' (AQS) containing standards, objectives and measures for improving ambient air quality and to keep these policies under review. The current AQS was made in 2007 under Section 80 of the Environment Act 1995. On the basis of the above, numerical environmental quality standards relevant to the assessment are summarised and referred to as air quality limit values (Table 2).

The health impacts of NO_2 and Particulates are constantly under review (Mills et al, 2015) and the House of Commons Environmental Audit Committee Report 'Action on Air Quality' published in December 2014 summarises recent significant findings including:

- The recent *Review of evidence on health aspects of air pollution*, undertaken by the World Health Organisation (IARC, 2012) at the request of the European Commission (WHO, 2013), is to inform revision of the EU's air quality policies. This review confirmed evidence linking exposure to ambient air pollution with adverse effects on the respiratory and cardiovascular systems and suggested a possible association with the endocrine system (diabetes) and the nervous system. It also suggested that ambient NO_2 has a direct effect on respiratory outcomes.
- There are significant health effects below our limit values, and so not attaining our limit values should be seen in a very negative light.
- In April 2014, Public Health England calculated the local impact of particulate matter on premature mortality, ranging from 2.5% in some local authorities in rural Scotland and Northern Ireland to over 8% in some London boroughs (6.4% in Birmingham).

The significant health risks that NO_2 poses have been understood for many years. Hence, in the EU First Daughter Directive (Directive 1999/30/EC) limits were set for NO_2. The directive limits NO_2 concentrations in order to protect health and is limited to $40\mu gm^{-3}$ annually and an hourly limit of $200\mu gm^{-3}$, which must not be exceeded more than 18 times per calendar year (Air Quality Expert Group, 2004). These limits came into force on 1st January 2010 giving the UK ten years to achieve this target. With such ambitious targets the EU air quality directive (Directive 2008/50/EC), which came into effect in June 2008, stated that member states had the opportunity to apply for a five-year extension for meeting the NO_2 limits (European Commission, 2012). Yet despite not being on track on achieve the new EU law, the UK failed to apply for an extension. This has led to the UK breaching EU law since 2010 with 16 different cities and regions exceeding the limit values (European Commission, 2014). DEFRA states that average roadside concentrations of NO_2 have fallen 15% since 2010 whilst NO_2 emissions and background concentrations have halved over the last two decades (Rincon, 2015). Despite all this, major cities such as Birmingham, Leeds and London, are not set to achieve the EU limits until 2030 (DEFRA, 2014). Measurements show that the primary cause of the NO_2 exceeding limit values is vehicle emissions within cities and urban areas.

In order to comply with the NO_2 limit of 40μgm^{-3} annually, Air Quality Plans were published in September 2011 (DEFRA 2011) and December 2015 (DEFRA, 2015). For example, the West Midlands plan illustrates how the implementation of a low emission zone (LEZ) will affect NO_2 concentrations. The LEZ scenario would require all HGV and buses to meet the Euro VI emission standards for both NO_x and PM_{10} by 2020. If this could be achieved the NO_2 emissions for the area are projected to comply with the EU limits by 2020 (DEFRA, 2015). Although Air Quality Plans were created in September 2011, with aim of reducing emissions across the country, the UK is still failing to conform to EU law. Therefore, as a result a unanimous ruling, the EU ordered the government to prepare new air quality plans which were submitted to the European Commission in December 2015 (Rincon, 2015).

4. Air Quality Guidelines for Occupational Health

Workers are often exposed to harmful substances in the workplace, such as chemicals, dust and fumes, which could have a significant impact upon their health. Therefore, workplace exposure limits (WELs) have been set up in Britain to protect the health of employees (Health and Safety Executive, 2013). The workplace limits (EH40-2005) are referred to as time weighted averages (TWA) for both long term (8-hours) and short term (15 minutes). In reference to the rail network, employees are exposed to the emissions from diesel engines, but surprisingly there are no WELs for nitrogen dioxide or oxides of sulphur or particulate matter (PM). The regulated WEL for CO is much higher than the limits set for public health (Table 2). The probable reason for the higher occupational limit is that those working amongst potentially harmful substances are considered to be fitter and healthier than the more vulnerable general public. Though there are no limits for Polycyclic Aromatic Hydrocarbons it is one of the substances biologically monitored and has been set a guidance value by the Health and Safety Executive (HSE, 2013).

5. Air Quality Data for Railway Stations

There is very little published data on air quality at open or enclosed railway stations. The time spent by passengers waiting for trains will vary considerably from several minutes to up to an hour or so for delayed trains. Regular commuters will encounter any air pollution twice a day and up to 250 days per year. Thus both short term (acute e.g. asthma) and long-term (chronic e.g. bronchitis) health problems may be affected.

5.1 Amsterdam Airport Station (30 million passenger entries/exits)

The station is in the middle of a 5.1km long tunnel and is used by 60,000-150,000 people each day. There are three platform islands about 400m long and 25-30 trains per hour pass through during the day, all of which are electric powered by overhead catenary. All the platforms are cleaned daily using electrically powered ride-on machines. There is no active ventilation other than the 'piston action' of the trains. Loxham et al. (2013) found that metal rich (Fe) particle pollution from ultrafine dust ($PM_{0.1}$), generated by braking and wheel friction and friction with the overhead catenaries, was likely to cause more health problems than larger particles. These tiny dust particles have the potential to penetrate deep into the lungs - right into the alveoli. Over three sampling days in the underground platform tunnels beneath the airport, they found 'coarse' PM_{10} at 169 μg/m^3 , 'fine' $PM_{2.5}$ at 75.3 μg/m^3 and 'ultrafine' $PM_{0.1}$ at 37.7 μg/m^3. Underground PM was found to be rich in Fe, accounting for more than 40% by mass, and several other transition metals (Cu, Cr, Mn and Zn) (Loxham et al., 2013).

5.2 Paddington – London (35 million passenger entries/exits)

Paddington Station is an enclosed historic railway station with 70% of the trains powered by diesel. The enclosed canopy space is about 15m high by about 100m wide by about 250m long. Chong et al. (2015) carried out a five-day survey (17th-21st September 2012) of air quality and found that NO_2 levels were significantly higher than in nearby streets and regularly broke EU thresholds. Data was compared with the nearby Marylebone roadside air quality site (1.5km away) which has the reputation of being one of the worst sites in London for air quality. The comparisons indicated that train station air quality was more polluted than the nearby roadside. $PM_{2.5}$ within Paddington Station was shown to be statistically higher than Marylebone on 3 out of 5 days. Measured NO_2 within Paddington Station was statistically higher than Marylebone on 3 out of 5 days. Measured SO_2 within Paddington Station was statistically higher than Marylebone on all days of measurements. Hourly mean $PM_{2.5}$ mass concentrations averaged 16 μg/m^3 (min 2, max 68); hourly mean NO_2 concentrations averaged 140 μg/m^3 (min 94, max 229).

5.3 Waverley – Edinburgh (19 million passenger entries/exits)

Waverley Station is an enclosed railway station with more than 20 platforms in operation over the years. A recent study (Gardner, 2012) found NO_2 levels up to 7 times higher than the EU public health thresholds. Results, using diffusion tubes exposed for three weeks at various locations around the station, were in the range 200-300 μg/m^3 whereas nearby street levels (Princess Street, Cowgate, South Clerk Street) indicate a broad range 30-80 μg/m^3, compared to the annual Air Quality Standard of 40 μg/m^3. As a result of this study taxis were banned from entering the station from the 2nd June 2014 and now have to park in the open air outside.

5.4 New Street Station – Birmingham (35 million passenger entries/exits)

New Street Station in Birmingham is undergoing an extensive £600m revamp, which was completed in September 2015 (Thornes, 2015), however, platform improvements are still on going. It is envisaged that passenger numbers at the 'new' New Street Station may treble in the near future. Up to 140,000 people/day currently use the station and the annual numbers of passengers has increased by 8% in the last year to 35 million passengers despite the redevelopment. The unique underground nature of the platforms has changed little (Figure 1). The approximate enclosed space is about 5m high by 160m wide by about 240m long, giving a volume less than half that of the enclosed space at Paddington. A survey of air quality at the station was carried out before construction work began (Personal Communication, 2014):

The results provide a benchmark to which potential monitoring results may be compared. Network Rail is particularly concerned over the potential health effects of pollutant emissions from diesel engines on construction workers and station staff.

It is interesting that passenger health was not mentioned. A three month monitoring period during the summer and autumn of 2009 was used to look at the diesel exhaust pollutants: Oxides of Nitrogen (NO_X), Particulate Matter (PM_{10}), Carbon Dioxide (CO_2), Sulphur Dioxide (SO_2) and Polycyclic Aromatic Hydrocarbons (PAHs). The report concluded that the only pollutants that should be measured during the construction of the new station should be PM_{10} and CO_2 and not NO_2 despite the findings that:

..the nitrogen dioxide concentrations exceed the statuary annual mean air quality objective of 40 $\mu g/m^3$ at all locations…It is likely that the short-term hourly objective of 200 $\mu g/m^3$ was periodically exceeded on several occasions on all platforms and the concourse.

These observations (Table 3) by diffusion tube do not take into account the fact that the station has virtually no trains for a quarter of the day between midnight and 6am. Also the diffusion tubes were placed at the entrance to the platform 'tunnels' rather than in the centre of the tunnels where the pollution levels are likely to be highest.

Obviously diesel fumes affect passengers (public health) as well as staff (occupational health). However some staff members are on duty for several hours whereas most passengers pass through the station within half an hour – although this can be much longer when there are delays. The Confidential Incident Reporting & Analysis System (CIRAS) is a confidential reporting system for staff for health and safety problems. There have been two similar complaints (CIRAS, 2013a; CIRAS, 2013b) about air quality at the station. A member of staff:

‘*was concerned that the build-up of diesel fumes at Birmingham New Street is affecting the health of the staff who work there. Station workers are complaining about headaches and spells of dizziness*’ (CIRAS 2013a).

There were three responses from the train operating companies plus Network rail:

Cross Country Trains: ‘*Our national diesel engine shutdown policy requires that trains that are going to be standing for more than 15 minutes to be shut down upon arrival and restarted 10 minutes before departure’* (CIRAS, 2013a).

Virgin trains: *‘...we shut down engines on trains that are to be detained at New Street more than 20 minutes’* (CIRAS, 2013a).

Network Rail: ‘*The new ventilation system is an impulse fan system; on completion, the new system will consist of over 90 fans which will be visible from the platforms. To monitor the effectiveness of the ventilation the project measures carbon dioxide levels at platform level. Anyone experiencing adverse feelings while working on the station should report it immediately to their supervisor’* (CIRAS, 2013a).

This shows a primary concern with CO_2 and does not recognise that headaches and dizziness can be caused by other pollutants such as Nitrogen Dioxide. The decision to monitor carbon dioxide levels is based on HSE (2012) guidance on diesel emissions in the workplace which advises that DEEEs are not subject to COSHH (Control of Substances Hazardous to Health) regulations concerning the control of carcinogenic substances. However as already discussed, recent research has classified DEEEs as carcinogenic and HSE need to update their WELs. Carbon dioxide is recommended by HSE to be monitored as a general guide to ventilation and pollution levels. This recommendation urgently needs to be updated to include DEEEs and demand that other air pollutants be monitored.

As Birmingham New Street is an enclosed station it has recently taken measures to reduce pollutants around the platforms by installing fans. This impulse fan system responds to the levels of carbon dioxide (CO_2) in the station. The fans kick in once CO_2 exceeds 1000ppm and the speed of the fans increases relative to pollution levels. The fans only respond to CO_2 levels, therefore there may be harmful levels of other pollutants such as nitrogen dioxide (NO_2) and PM that may go unnoticed and the health of employees and passengers may be affected. Information gathering during the monitoring process at Birmingham New Street is on-going but it is hoped that with the use of fans, pollution levels do not exceed the workplace limits.

Conversely a recent survey conducted in April 2015 measured the levels of $PM_{2.5}$ and black carbon (BC) – a tracer of diesel emissions- during one-hour intervals at New Street using real time sensors. The concentrations reported were up to 58 µg/ m^3 for

$PM_{2.5}$ and up to 29 µg/m^3 for BC (Zulkifli, 2015). The highest concentrations measured at the platform level were associated with idling trains, with increases up to 6 times higher than concentrations measured with passing trains, suggesting that idling trains are the main source of exposure to high levels of air pollutants in railway stations.

6. Conclusions

The main findings of this review are that air quality at the enclosed railway stations considered do not meet European Air Quality Standards for Nitrogen Dioxide and Particulate pollution. Currently occupational health standards are used to determine air quality. This is probably not a problem for well ventilated outdoor railway stations. For enclosed railway stations, which are effectively 'indoors', public health guidelines could be used and it is likely that the air quality measured by the Daily Air Quality Index (Met Office, 2016) in enclosed railway stations could be classed as 'Very High' on a daily basis. To confirm this air pollution levels and public health effects for commuters using enclosed railway stations need to be monitored and compared to other forms of commuter transport into cities. Recommendations for interventions to improve air quality at enclosed railway stations should include: reducing the number of diesel trains; improving the quality of the diesel fuel used; using more up to date diesel trains with more efficient engines; fitting efficient diesel particle traps; reducing idling time at station platforms and increasing the amount of ventilation linked to NO_2 and/or particulate levels as well as CO_2 levels. Ultrafine particulates from electric trains should also be monitored and platforms and rail track beds should be regularly cleaned to remove particulates and prevent recirculation.

It is clear that a combination of public air quality standards and occupational air quality standards need to be developed to be applied in enclosed railway stations.

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TABLES

Table 1. The associated health effects from exposure to diesel engine exhaust emissions (DEEEs). (* BTEX stands for benzene, toluene, ethylbenzene, xylene)

Diesel Engine Exhaust Emissions (DEEEs)	Health Effect
Oxides of Nitrogen	Symptoms of bronchitis in asthmatic children increases in association with long-term exposure. Reduced lung function growth is currently being observed in cities of Europe and North America (WHO, 2015).
Particulate Matter	Fine particles can penetrate deep into lungs triggering inflammation and aggravation of heart and lung dieses (DEFRA, 2013).
Carbon Dioxide	CO_2 can cause headaches, dizziness, confusion and loss of consciousness when in higher concentrations (Harper and Health and Safety Executive, 2011).
Carbon Monoxide	Prevention of oxygen uptake by the blood leading to a reduction in oxygen supplied to the heart, particularly in those suffering from heart disease (DEFRA, 2013).
Oxides of Sulphur	Affects the respiratory system, function of the lungs and causes irritation of the eyes. When inhaled pollutants can cause inflammation of the respiratory tract resulting in coughing, aggravation of asthma and chronic bronchitis (WHO, 2015).
Polycyclic Aromatic Hydrocarbons	Short-term exposure can lead to impaired lung function in asthmatics, thrombotic effects in coronary heart disease sufferers, eye irritation, nausea, vomiting and diarrhea. Long-term exposure can result in cancerous illness, kidney and liver damage and cell damage (Kim et al., 2013).
BTEX* VOCs	Both carcinogenic and non-carcinogenic risks including; cancerous illnesses, respiratory irritation and central nervous system damage (Durmusolgu et al., 2009).

Table 2. Workplace Exposure Limits (in) and EU air quality standard (in $\mu g/m^3$) for pollutants that are present at train stations due to diesel emissions (Heath and Safety Executive, 2013 EH40-2005; European Commission, 2012)

Railway Emission	Workplace Exposure Limits		EU Air Quality Standards	
	8 Hour (TWA)	15 Mins (TWA)	1 Year	Short Term
Nitrogen Dioxide	n/a	n/a	40 $\mu g/m^3$	200 $\mu g/m^3$ (1 Hour, not to be exceeded more than 18 times annually)
PM_{10}	n/a	n/a	40 $\mu g/m^3$	50 $\mu g/m^3$ (24 Hours, not to be exceeded more than 35 times annually)
$PM_{2.5}$	n/a	n/a	25 $\mu g/m^3$	n/a
Carbon Dioxide	9150 mg/m^3	27400 mg/m^3	n/a	n/a
Carbon Monoxide	35 mg/m^3	232 mg/m^3	n/a	10 $\mu g/m^3$ (Maximum daily 8 hour mean)
Oxides of Sulphur	n/a	n/a	n/a	350 $\mu g/m^3$ (1 Hour, not to be exceeded more than 24 times annually) 125 $\mu g/m^3$ (24 Hours, not to be exceeded more than 3 times annually)
Polycyclic Aromatic Hydrocarbons	n/a	n/a	1 ng/m^3	n/a
Benzene	3.25 mg/m^3	n/a	5 $\mu g/m^3$	n/a

Table 3 The concentrations recorded over 3 months by diffusion tubes ($\mu g/m^3$) for NO_2 at New Street Station in 2009 pre revamp (Annual Air Quality Threshold 40 $\mu g/m^3$)

Location	NO_2 Concentration ($\mu g/m^3$)
Concourse	142.1
Platform 2	303.1
Platform 4	192.8
Platform 6	185.1
Platform 8	235.4
Platform 10	218.3
Platform 12	127.3

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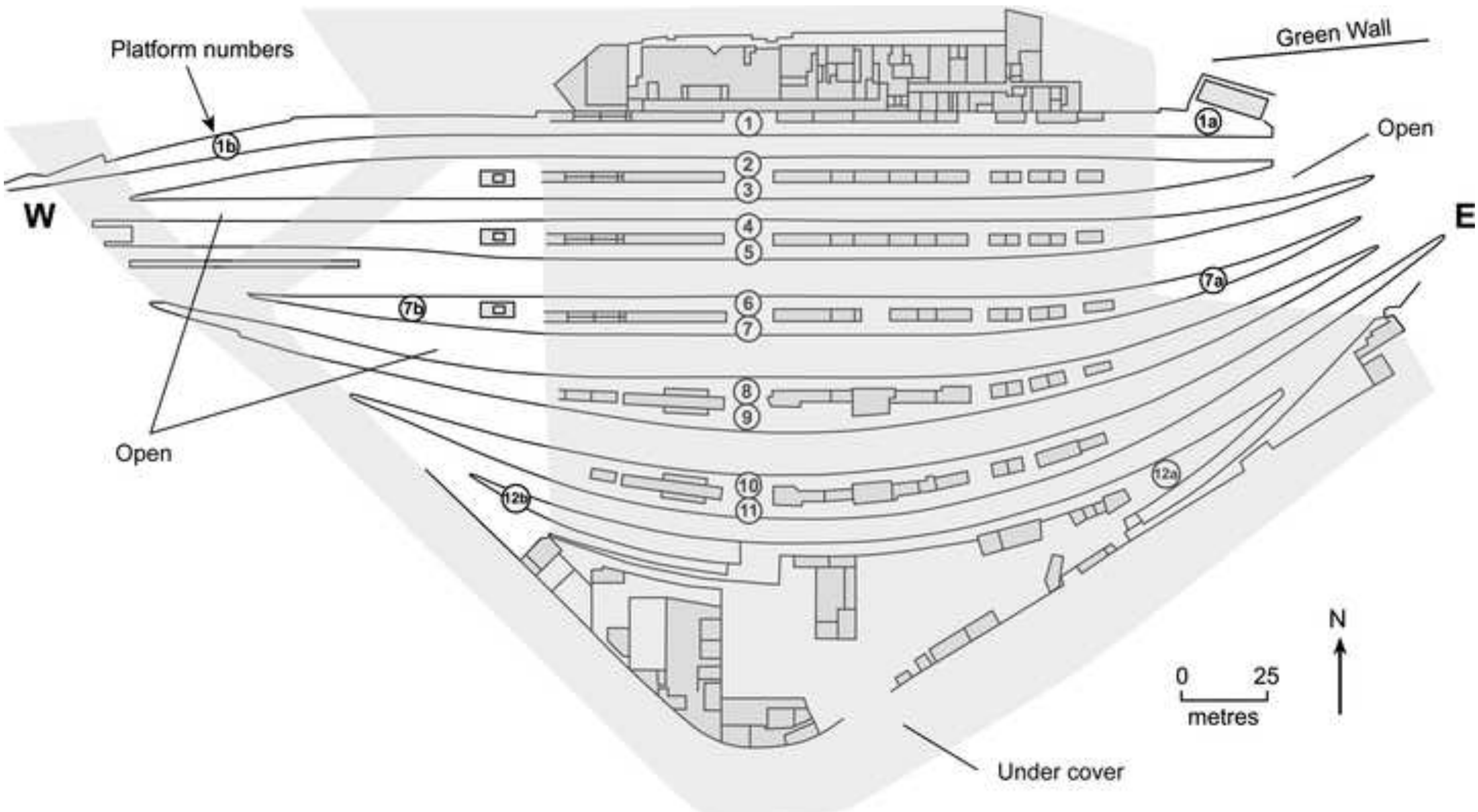

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