The Birmingham Civic Society

Birmingham Trees for Life

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The impact of poor air quality on health in Birmingham

1. Introduction

The particular point in the Scrutiny framework that Birmingham Trees for Life are addressing in this paper is the following:

- Are there other measures which can be taken, such as for example the planting of urban trees, to absorb airborne pollutants and improve air quality, and are there any plans in relation to these?

2. Background

We know that Birmingham is suffering from above average levels of Nitrogen dioxide and other pollutants, and as a result there are areas of the city which have particularly poor air quality. We know that this has a negative impact on public health for both citizens, and unborn children and their development and future health.

There is a considerable wealth of evidence from studies around the world that proves that tree leaves can filter out particulate matter and many other pollutants from the atmosphere. Similarly, other scientific studies show that the shade cast by trees, in addition to the transpiration of water during photosynthesis, can help to reduce air temperatures.

Research has shown that tree planting is a valuable part of the overall strategy to alleviate air pollution in cities – it is a very cost effective and controllable element of the package of measures that can be taken. **Retention of mature trees is also crucial to the ability of the tree canopy to contribute to this. The continuing removal of healthy mature trees and replacement with young trees reduces the ability of the overall tree canopy to trap particulates and absorb NO^2.**

However, the effects of trees and green infrastructure go far beyond the impact on air pollution, with much wider health and wellbeing benefits. Extensive research has been completed over several decades, around the world, and much of it gathered together by **Dr. Kathleen L. Wolf** of Washington University and summarised in her paper **Green Cities: Good Health** – referenced on the website: http://depts.washington.edu/hhwb/

Trees are part of the wider urban nature network, termed by Dr. Wolf 'Metro nature', which includes naturalistic areas, such as urban forests, greenbelts, conserved open spaces, and riparian (river) corridors. 'Metro nature' also includes culturally constructed nature such as parks, streetscapes, community gardens, pocket parks, and recreation paths; it also includes functional spaces that are integrated within built form to provide specific services or functions, such as green roofs, green walls, or other green infrastructure facilities which can be used where tree planting is not practicable. Last, but not least, urban gardens provide a vast network of greenery, including trees and shrubs, which form a vital part of urban green networks in our Cities.
There is also a considerable wealth of evidence for the beneficial effects of nature on general health and well-being referenced here: http://nhsforest.org/evidence

3. Key Health Benefits of Trees and 'Metro Nature'

Trees and woodland have a measureable impact on air quality, in particular by absorbing pollutants such as sulphur dioxide and ozone, intercepting harmful particulates from smoke, pollen and dust, and releasing oxygen through photosynthesis, thus reducing the incidence of diseases exacerbated by air borne pollutants. The negative effects of air pollutants are proportionately greater in urban areas, where trees are close to sources of pollution and nearer to people who might be affected – yet tree cover in urban areas is under threat.

The UK already has one of the world's highest rates of childhood asthma, with about 15 per cent of children affected. The predicted rise in air pollution will increase attributable deaths and hospital admissions, with as many as 1,500 additional deaths and hospital admissions each year ('Future health - Sustainable places for health and well-being', CABE 2009).

A study by Lancaster University estimated that doubling the tree cover in the West Midlands alone would reduce mortality as a result of poor air quality from particulates by 140 people per year.

Other key findings on the connection between 'Metro nature' and health include:
- Public housing residents with nearby trees and grass were more effective in coping with major life issues compared to those with homes surrounded by concrete.[35]
- Exposure to nearby green space and trees may have a positive effect on infant birth weight,[47] particularly for lower socioeconomic groups.[48]
- Studies in Japan of *Shinrin-yoku*, or forest walking, have found effects of improved immune system response, lowered stress indicators, reduced depression, and lower glucose levels in diabetics.[19,83]
- The character of a neighbourhood has a significant effect on residents' physical activity. People in communities with abundant green space generally enjoy better health.[8]
- People who use parks and open spaces are three times more likely to achieve recommended levels of physical activity than non-users.[12] People prefer nearby, attractive, and larger parks and open spaces for their activity.
- Physical activity has been linked to improvements in mental health and stress; many studies connect urban park use to decreased stress levels and improved moods. More than 100 studies have shown that relaxation and stress reduction are significant benefits associated with spending time in green areas.

(http://depts.washington.edu/hhwb/)
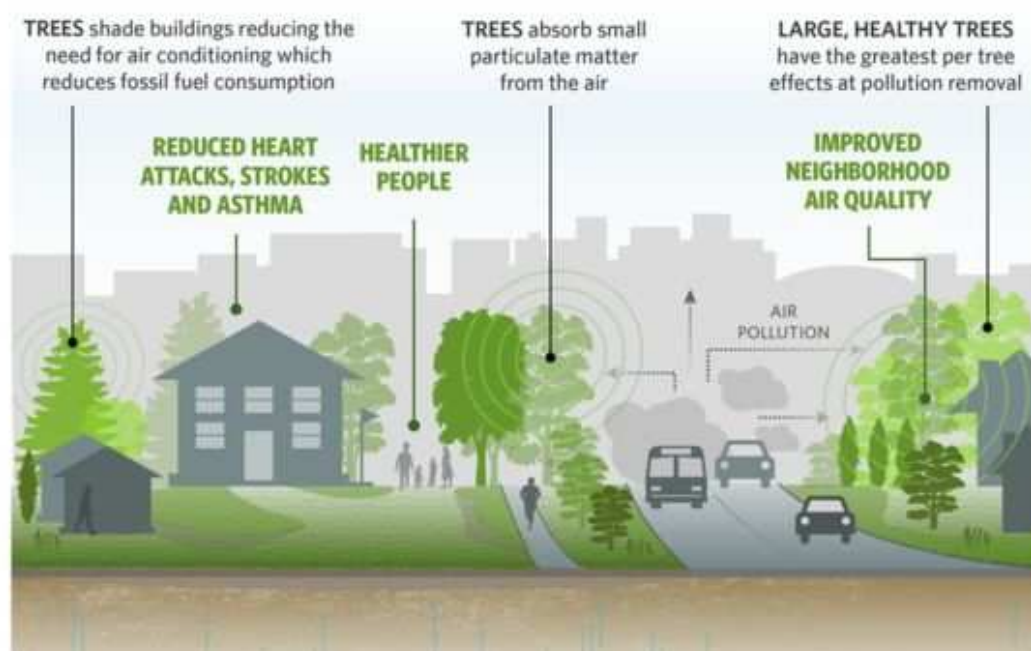
4. How trees help to alleviate air pollution

Planting trees is a cost-effective way to tackle urban air pollution: A study by US-based The Nature Conservancy (TNC) reported than the average reduction of particulate matter near a tree was between 7% and 24%. (http://www.bbc.co.uk/news/science-environment-37813709)

The report concluded that city trees provide a lot of benefits to people living in urban areas. "The average reduction of particulate matter near a tree is between 7-24%, while the cooling effect is up to 2°C (3.6°F)." The study of the use of trees in 245 cities around the world compared the cost-effectiveness of trees with other methods of cooling and cleaning air. "On that front, trees are cost competitive with other options". **However, the TNC report highlighted that most of the cities featured in the study were losing more trees than they were gaining.**

On average, one acre of new forest can sequester about 2.5 tons of carbon annually. Young trees absorb CO^2 at a rate of 13 pounds per tree each year. Trees reach their most productive stage of **carbon storage** at about 10 years at which point they are estimated to absorb 48 pounds of CO^2 per year. At that rate, they release enough oxygen back into the atmosphere to support two human beings. (http://urbanforestrynetwork.org/benefits/air%20quality.htm)

Although trees have long been part of urban life, either by design or consumed by expanding urban areas, they had been sidelined in the second half of the 20th Century. In a 2014 report, the London i-Tree Eco Urban Forest Survey, following what was described as the "largest city tree survey of its kind", it was calculated that London's trees provided "**at least £133 million of benefits every year** in terms of air pollution removal, carbon sequestration and reducing the amount of water going into drains". This report quantified the benefits of ecosystem services provided by London's urban forests (including removal of air pollution) at £6 billion, highlighting the economic as well as health and environmental benefits of planting more trees in cities. (http://www.forestry.gov.uk/pdf/LONDONI-TREEECOSUMMARY160331.pdf/%24FILE/LONDONI-TREEECOSUMMARY160331.pdf)

Researchers from Lancaster University placed a screen of 30 trees in planters in front of houses and then looked at the effect on the concentrations of fine-particulate air pollutants inside the homes. They reported that, compared to houses without the trees, the screened houses showed only half the indoor concentrations of particulate matter, ranging in size from 1 to 10 micrometers (PM_1, $PM_{2.5}$, and PM_{10}). Analysis of the trees' leaves showed that the surfaces of their leaves were trapping particles similar to those found inside the houses. (https://www.accessscience.com/content/urban-tree-leaves-remove-fine-particulate-air-pollution/BR0116141) (http://pubs.acs.org/doi/abs/10.1021/es404363m)

It must be noted that there have been findings that indicate that trees can also have an adverse effect on air quality through the emission of volatile organic compounds (VOCs), which can increase ozone. However, because VOC emissions are temperature dependent and trees generally lower air temperatures, increased tree cover can often lower overall VOC emissions and, consequently, ozone levels in urban areas. VOC emission rates vary by species, and careful selection of tree species, coupled with appropriate design of planting schemes, would ameliorate any potential adverse effects on ozone. (http://laqm.defra.gov.uk/laqm-faqs/faq105.html)

With so many benefits to people and the environment, trees are a cost-effective natural resource that should be a key focus of all investment and development opportunities in major cities. While trees should not replace other strategies to make air healthier, they can be used as part of a suite of interventions that aims to control particulate matter pollution, as well as mitigate against rising temperatures in cities. In designing tree planting schemes, some key principles should be incorporated into a city's planting plan, from choosing suitable tree species, to careful selection of the spaces to be planted, and the density and placement of the trees.

5. Summary of the benefits of urban trees

- Trees are the lungs of our planet. They soak up carbon dioxide from the atmosphere, acting as carbon sinks and using photosynthesis to convert the gas into oxygen.
- Certain trees are very adept at absorbing and storing harmful pollutants and degrading them into less harmful forms, relieving the negative effects of global warming.

Other benefits include: (http://www.civictrees.co.uk/our-top-10-benefits-of-trees/)

- Trees can act as effective sound barriers, reducing noise pollution.
- Trees also help to prevent flooding and flood damage.
- Trees provide a solution for managing soil erosion.
- Trees provide shade and much-needed cooling in urban environments.
- Trees can increase the value of both residential and commercial property and produce increased spending in retail areas.
- Trees and green spaces can have an impact on behaviour, reducing anti-social behaviour.
- Getting close to nature is considered one of the best ways of improving overall health and wellbeing – both mental and physical.
- Trees, particularly mature specimens, are a vital source of food and shelter for all kinds of wildlife, promoting biodiversity and boosting the local ecosystem.

Dr. Rob MacKenzie of Birmingham University says: '*Asking whether cities should have trees in it is a bit like asking whether a suit should have a person in it. There is every chance that urban trees could provide a "nature-based solution" to several pressing problems with the urban environment, but perhaps not in the way scientists and policy-makers seem currently to be thinking. Rather than providing a technical fix that disguises our obsession with the diminishing returns of the internal combustion engine, increasing urban tree numbers could change our entire perspective on cities, facilitating the creation of liveable cities that value nature as an integral part of social, economic and environmental capital.*
(https://theconversation.com/do-trees-really-help-clear-the-air-in-our-cities-48202)

6. So, what about Birmingham?

It has recently been calculated that Birmingham only has 18% tree canopy cover, compared to an average of 25-30% in other European cities. We have felled thousands of mature trees from Birmingham's streets, parks and open spaces, and more trees will continue to be lost to disease and old age. In recent years, the city centre, which, it could be argued, has the greatest need for more trees, has suffered a huge loss of mature trees due to development.

Since 2006, Birmingham Trees for Life (BTFL) has planted almost 60,000 trees in parks and open spaces. However BTFL has no jurisdiction over street trees, which includes almost all of those in the key city centre areas suffering from poor air quality and adverse heat island effects. Outside the PFI contract, there is no dedicated tree planting budget - tree planting is funded through planning agreements, and by BTFL which raises money through outside grants.

7. Recommendations:

- The Council needs to create a robust and enforceable planning framework to protect existing trees and ensure adequate, sustainable tree planting becomes "the norm" in all future new developments.
- Transport and Highway infrastructure schemes, which are currently exempt from many environmental and planning regulations, must be made to respect and protect existing mature trees, and pursue design solutions to retain and protect them. Indeed, such schemes offer a unique opportunity to create enhanced green corridors for the future with the right kind of "visionary planning and design".
- The Council needs to establish a "ring fenced" tree planting and maintenance budget for all City Council owned land, with consideration being given to innovative funding sources such as "Tree Bonds" secured through major new developments.
- Adopt the premise that all Birmingham trees are considered part of the **'urban forest',** where the aim is to increase the tree canopy cover to 25% during the life of the current Birmingham Development Plan to 2032.