Olympic Delivery Authority

**Cost benefit analysis**
Reducing particulate emissions from non-road mobile machinery on the Olympic Park
**Summary report**
July 2010

# Summary

## 1. Introduction

The Olympic Park site presents a complex and challenging set of environment issues which need to be identified and managed. Many of the negative environmental effects of the Olympic Park project occur during the construction phase, and result from the removal of existing buildings and natural features, the remediation of land contamination, and the direct impacts of construction activity such as noise and dust. From the outset of the project, the Olympic Delivery Authority (ODA) has been committed to meeting high standards of environment management and has put in place measures to reduce the effects of the works on the environment. In terms of managing air quality and dust effects, the ODA committed, in its Sustainable Development Strategy, to follow the London Best Practice Guidance (LBPG) for the control of dust and emissions from construction and demolition.

The LBPG was produced in partnership between the GLA and London Councils, and was published in November 2006 by the Mayor of London. It sets out a series of recommended measures to minimise the effects of dust and emissions arising from the construction and demolition process. The ODA has identified and agreed measures for minimising dust and air quality effects on the Olympic Park with the Local Planning Authority. Furthermore, the ODA has put in place additional control measures such as an on-site weather station to determine the type of construction activity which may take place on any one day.

One of the LBPG measures, which requires Non Road Mobile Machinery (NRMM) to be retrofitted with appropriate exhaust after-treatment, has been the source of intense debate between the manufacturers, suppliers and users of exhaust filters and the NRMM manufacturers. This debate focuses on concerns about the efficiency of filter technology and its cost effectiveness. In responding to the concerns raised and assessing the applicability of introducing this measure, the ODA agreed to undertake a study to assess the costs and benefits of using filters on machinery in the Olympic Park.

The following short note provides a summary of the study and its results.

## 2. Managing dust and emissions on the Olympic Park

Before the commencement of work in 2007, the ODA assessed the existing air quality and determined the likely impact of the demolition, remediation, and construction activities of the environs in and around the areas of the Park. The Environmental Statement (ES) for the Olympic Park included a section on air quality and the associated impacts during the different phases of the programme. This assessment concluded that the impact of the works on air quality would be insignificant.

Despite this, and to ensure that air quality effects were managed during the demolition and construction phase of works, the ODA produced several framework documents which set out

requirements for contractors regarding the management of works on site. These documents include the ODAs Health, Safety and Environment Standard and the Code of Construction Practice (CoCP). In addition, the ODA prepared monitoring strategies (including the Olympic Park dust monitoring strategy) which provides details on how environmental effects will be monitored during the construction programme.

The CoCP includes a section relating to the control of vehicle emissions and the control of dust. Regarding the control of vehicle emissions, measures to be considered by contractors include the use of Ultra Low Sulphur Diesel (ULSD). The section relating to dust control references the London Best Practice Guidance ('The control of dust and emissions from construction and demolition'), and states that the measures outlined within this document should all be followed. All of the measures for dust control outlined in the London Best Practice Guidance are currently being applied by contractors on the Olympic Park.

### 3. The Use of Diesel Particulate Filters on the Olympic Park

The London Best Practice Guidance (LBPG) includes a requirement that all construction plant over 37kw operating on high risk sites should be fitted with suitable after-treatment devices ('*All non road mobile machinery (NRMM) to use ultra low sulphur tax exempt diesel (ULSD) where available and be fitted with appropriate exhaust after-treatment from the approved list'*). In this case, after-treatment devices are primarily considered to be Diesel Particulate Filters (DPF) or particulate traps.

The 'approved list', referred to in the LBPG requirement, is a list of approved exhaust after-treatment technologies. The list was developed and launched by the Energy Saving Trust in 2008 and by August 2008, there were a number of DPF manufacturers and suppliers with technologies listed. The ODA discussed the use of approved technologies on Olympic Park construction machinery with key stakeholders and contractors in late 2008 and early 2009. A number of issues and concerns emerged from these discussions raised by the plant hire, manufacture and ownership industries. These concerns included:

- The impact of filters on engine efficiency, fuel efficiency, noise;
- Implementation of the requirement (warranties);
- Training needs (operator training requirements, cost and time of training);
- Service requirements (management, maintenance and costs);
- Health and safety (driver visibility and/or hot surfaces);
- Cost effectiveness of the filters
- A lack of consultation in respect of this element of the Guidance

In addition, many of the companies pointed to the implementation of EU legislation requiring all new NRMM to meet higher emission limits.

Over the following 6 months, the ODA continued its extensive dialogue with DPF manufacturers, engine manufacturers, plant hire firms and contractors in order to better understand the issues and identify a suitable way forward.

Following a workshop on the 22nd July 2009 with all the key stakeholders (including representatives from the GLA and Defra), the ODA agreed to undertake a study to assess the cost effectiveness of using diesel particulate filters (DPFs) on Non Road Mobile Machinery within the Olympic Park.

## 4. The Study

The study proposed by the ODA was undertaken in two stages:

a. The development of an emissions inventory and detailed dispersion model.
b. The assessment of comparative costs and benefits resulting from the implementation of particulate control measures

The emissions inventory was drawn together by establishing all plant operating on the Olympic Park and calculating fuel consumption and exhaust emissions. These emissions were entered into an atmospheric dispersion model to calculate air pollutant concentrations at receptor locations around the boundary of the Olympic Park. Three operational scenarios were used to compare the effects of different measures on air quality:

- Scenario 1: All machinery on site is operated without the use of Ultra Low Diesel Sulphur or Diesel Particulate Filters
- Scenario 2: All machinery on site is operated with Ultra Low Sulphur Diesel but not DPFs
- Scenario 3: All machinery is required to use ULSD and DPFs

The emissions inventory set out the annual emissions of $PM_{10}$ and $PM_{2.5}$ from the Olympic Park construction site for each scenario. Emissions from Olympic Park construction traffic on the local road network were also included in the modelling.

For each scenario, the change in exposure, at the receptors, to pollutant concentrations was quantified and the potential health benefits of a reduction in concentrations of particulate matter was assessed and monetised by the Institute of Occupational Medicine. The costs of introducing these measures were then compared to the associated health benefits. Capital (i.e. up-front) and ongoing operating (i.e. every year) costs were estimated based on data gathered direct from manufacturers, a review of relevant literature and data provided direct by

the ODA (e.g. fuel costs). A range of costs were applied in the analysis to reflect the wide variability in retrofit costs for different sizes and types of plant.

This quantification of costs and benefits allowed a comparison of several different emission reduction techniques so that the ODA would be able to make an informed decision as to the best way to spend money relating to the control of particulate emissions.

## 5. The results

Under Scenario 1, the annual emissions of $PM_{10}$ and $PM_{2.5}$ when all machinery on site is operated without the use of Ultra Low Sulphur Diesel (ULSD) or Diesel Particulate Filters, is 11,406kg of $PM_{10}$ and 10,735kg of $PM_{2.5}$. When considered in terms of local air quality, $PM_{10}$ concentrations from the Olympic Park construction site at the local receptors range from 0.5 to 2.3$\mu m^{-3}$.

Scenario 2 considers the change in annual emissions and $PM_{10}$ concentrations from the Olympic Park construction site when all site machinery is operated with Ultra Low Sulphur Diesel. The results indicate a reduction in annual emissions of $PM_{10}$ and $PM_{2.5}$, to 8,186kg of $PM_{10}$ and 7,695 of $PM_{2.5}$, and a reduction in PM10 concentrations at the local receptors to 0.4–1.6 $\mu m^{-3}$. In terms of the monetised costs and benefits of using ULSD, the emission reductions associated with the use of ULSD by all plants are expected to result in benefits of approximately £0.4 million per year (sensitivity range of £0.3-0.6 million). The costs of using ULSD are estimated at £100k per year. The results of the cost benefit analysis indicate that annual benefits for the use of ULSD alone are expected to be over three times higher than the annual costs.

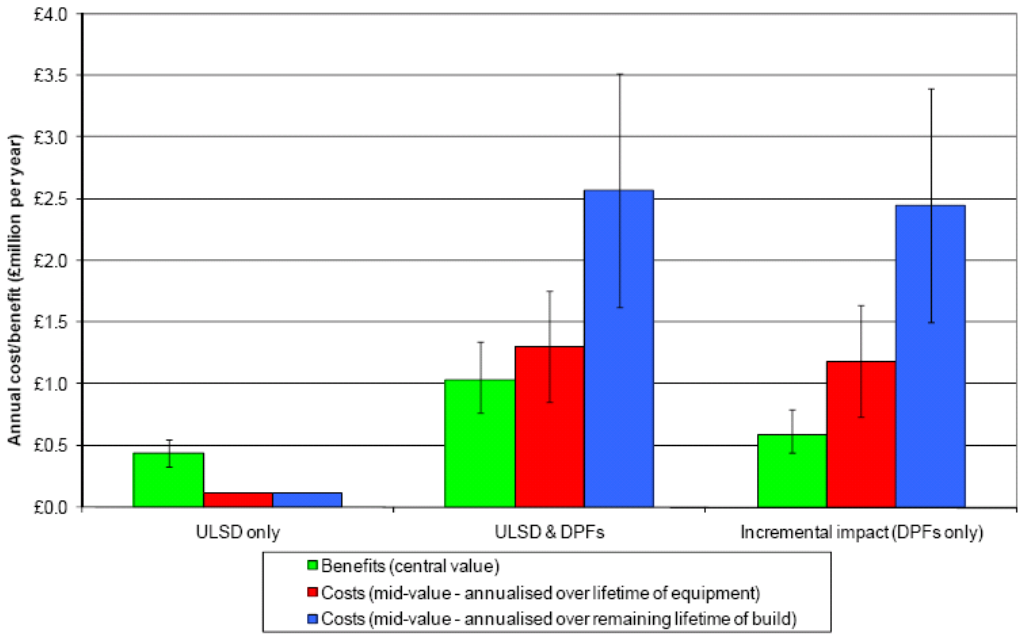
Scenario 3 considers the change in emissions of $PM_{10}$ and $PM_{2.5}$ as a result of using ULSD and retrofitting Diesel Particulate Filters (Note: for the DPFs to run effectively, the fuel needs to be ULSD hence its inclusion in this scenario). Annual emissions indicate a reduction in $PM_{10}$ and $PM_{2.5}$ to 2,578kg of $PM_{10}$ and 2,396 of $PM_{2.5}$. When these emissions reductions are considered in terms of local air quality, the $PM_{10}$ concentrations at local receptors for Scenario 3 range from 0.1-0.5 $\mu m^{-3}$. It is worth noting that in all three scenarios, the contribution of the Olympic Park construction site emissions to concentrations of $PM_{10}$ and $PM_{2.5}$ at locations around the boundary of the OPCS were not of sufficient magnitude to result in any exceedances of the annual mean air quality objectives at any of the modelled receptors. This was inclusive of the contribution of the road traffic emissions from the main roads in the area and the ambient background contribution.

When considered in terms of monetised benefits and costs, the emission reductions associated with the use of ULSD by all plants and DPFs by plants over 37kW are expected to

result in benefits of approximately £1.0 million per year (sensitivity range of £0.8-1.3 million). As a result, the retrofit of DPFs (relative to ULSD alone) is expected to result in additional benefits of approximately £0.6 million per year (sensitivity range of £0.4-0.8 million). This is based on the benefits of ULSD (£0.4 million) being subtracted from the combined benefits of DPFs and ULSD (£1 million) to provide the incremental monetised benefits of DPFs. This compares with estimated annualised costs for retro-fitting DPFs on plant over 37kW of £0.9-1.8 million, depending on the range of cost data applied and if the capital costs are annualised over the lifetime of the equipment (5 years).

The results of the cost benefit analysis for Scenario 3 indicate that the incremental benefits of retro-fitting DPFs are approximately half of the annual incremental costs. The chart below sets out the costs and benefits for Scenarios 2 and 3.

**Figure 6.1 Summary of costs and benefits of each scenario**




It should be noted that the cost benefit analysis is specific to the machinery on site and the location of the site in relation to the surrounding population. The findings are not directly transferable to other sites.

## 6. ODA decision

As a result of the study which has been undertaken, the ODA has taken the decision not to implement the requirement to retrofit DPFs to Non Road Mobile Machinery. The results of the study clearly demonstrate that the costs and benefits of DPFs do not represent good value for money when compared with other measures. The ODA requires all contractors to use Ultra Low Sulphur Diesel in its construction plant and machinery.

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