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Guest Editors: Shaun McCarthy, Bea Ayling and Adam Donnan

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LONDON 2012 – A SUSTAINABLE ODYSSEY?

London 2012: it was one of those 'You will always remember where you were' moments, sadly most often associated with a sudden death. I remember my shock at the news of John Lennon's death. A quarter of a century later, I was driving to Brighton, with the radio on in the car waiting for news of the Olympic decision, so I heard about London's victory live on the M23. This is a memory tinged with tragedy too: we all remember where we were when we heard about the 7/7 atrocity in London. I had been slightly involved in the Olympic bid through my contribution to the London Sustainable Development Commission, but I had no idea that Jaques Rogge's announcement would change my life.

I now spend half of my time as Chair of the Commission for a Sustainable London 2012, which provides independent assurance and commentary to senior politicians and the public on the sustainability of the London 2012 programme. This is a new and (so far) unique organisation which, with hindsight, was a very courageous political move. The London 2012 bid contained a commitment to set up such an independent body. Never before has there been a body with unlimited access to internal information from the delivery bodies, and a free rein to report directly to the members of the Olympic Board[1] and directly to the public through our independent website and relationship with the media. This has enabled us to make a number of things happen, such as ground-breaking carbon footprint work, inspiring the market to develop a more sustainable PVC, reducing use of HFC in air conditioning and working towards a truly sustainable legacy.

This publication contains the most comprehensive series of thoughtful and informed articles about a sustainable Olympics I have ever seen. The wide variety of subject matter reflects the complexity of delivering Europe's largest construction programme and the biggest peace-time movement of people to stage the world's greatest sporting spectacle.

Dr Claire Holman, a valuable member of my Commission, gives us a perspective on air quality from her own personal experience in Beijing. The challenges faced by the Chinese authorities were huge, and things we take for granted like catalytic converters on vehicles proved to be an immense technical challenge. In the final analysis the weather, the indulgence of the IOC to move the start date by two weeks and a massive effort by the authorities saved the day. My own experience of the Beijing air quality during the games was quite good. It is disappointing, but probably not surprising, to see that Claire reports a deterioration of standards since the Games.

From Attilia Peano and Grazia Brunetta, we have a view of the use of Strategic Environmental Assessment for the winter Games in Turin in 2006. This shows a holistic approach being taken to sustainability with reviews at key stages. All of the environmental impacts have been taken into account along with social and economic issues such as accessibility, mobility and sports participation. The article reflects the huge challenge of quantifying the legacy impact of a 'mega-event' which the IOC is trying to address through the Olympic Games Impact (OGI) work with current and future host cities.

Gary Grant's article on biodiver-

1 Comprising the Olympics Minister, Tessa Jowell, the Mayor Boris Johnson, and chairs of the London Organising Committee of the Olympic Games (LOCOG), Seb Coe and British Olympic Association (BOA), Colin Moynahan.

sity reminds us that the low grade, industrial, mostly contaminated land that formed the foundation of the new Olympic Park was, in fact, home to many species and that the area had 'extensive areas of wasteland habitat'. The account of the detailed Biodiversity Action Plan developed to enable the ODA to fulfil its objective of enhancing the biodiversity of the park is a compelling and informative story. However, it tells only part of the story. There are significant biodiversity challenges at other venues, in particular, at the sailing venue in Weymouth, where the marine ecology of a world heritage Jurassic coastline presents a challenge.

Dr Gregory Bourne offers a view of the development of sustainability thinking around the Olympics in the recent past, from a focus on urban renewal in the 1960s through to a much more holistic approach in Sydney 2000. He argues that, in some cases, the legacy from the Games can actually heighten social tensions in the area targeted for regeneration. The Olympic Games Impact project is, once again, highlighted as a way of understanding the true nature of Olympic legacy.

Dr Mark Everard's article on PVC is one very close to my agenda. The Commission has recommended for two years that the London 2012 bodies have a common and robust approach to the impacts of this material; this has been discussed at ministerial level and I am pleased to see how much progress has been made. Mark addresses this technically complex and highly controversial topic by charting the history of PVC applications from Sydney to the current position.

Kanan Purkayastha addresses the issue of contaminated land. This was a significant challenge for the ODA given the large volume of material to be de-contaminated and the target set to divert 90% of waste from landfill. This has led to innovative on-site techniques being developed to de-contaminate soil and re-introduce it to the site.

Shaun McCarthy

During the course of setting up and running the Commission, I have had numerous conversations with Darren Johnson in his role as Green Party leader for the Greater London Assembly and it is a pleasure to see his contribution to this journal. Darren gives the project a cautious thumbs-up but, not surprisingly, calls for more effort in some areas. I share Darren's concerns about the future freight movements, sustainability of the Olympic Village, residual carbon footprint and the use of sustainable vehicles for officials. From our own positions, we will both ensure that these issues are addressed in the best possible way as we progress to Games time and beyond.

Dr Mike Sinclair-Williams is also well known to me and his work on sustainable transport infrastructure for the ODA has been exemplary. He highlights the five key themes of sustainability chosen by the London 2012 delivery bodies and explores their application in delivery of the transport infrastructure necessary to enable spectators to 'get to their venue of choice, on time'. It sounds simple but, when we consider that this means 9 million spectators in a very short period of time, we start to understand the scale of the challenge. Mike makes a simple but compelling case for use of public transport and describes how it will be delivered.

Dr Heather Barrett-Mold's article returns to the subject of biodiversity. Heather's description of the ecology of the parkland and public realm provides a great picture of what the park will be like, from a relatively rural environment to the north gradually giving way to more urban green space as we approach the main venues. She highlights the importance of the Olympic Park Legacy Company in maintaining and improving this maturing green space and concludes that the park 'will become fit for both wildlife and humans'.

Professor Sharon Beder looks in more detail at the issue of contaminated land at the Sydney Games, describing the site as 'a meter of dirt and a mountain of public relations'. The revelation that the site once contained a factory manufacturing Agent Orange for the Vietnam War brings the level of contamination on this site into sharp perspective. She contends that a 'quicker, cheaper and less reliable' option was chosen with an 'inferior contaminant method'.

For me, these articles emphasise the need to consider the long-term legacy impact of everything we do and everything we say with relation to the Olympics. Staging the Games is an honour and a privilege, but it also comes with a great responsibility: to set an example and respect the needs of generations to come. My great objective for the Games is to leave a legacy of knowledge, and I welcome the work of the Institution of Environmental Sciences, working with the London team, to analyse and publish the lessons learned as we learn them.

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BIODIVERSITY AND THE LONDON 2012 OLYMPIC PARK

GARY GRANT considers the impact of the 2012 Games on existing wildlife in the area and explains the steps being taken to safeguard its future

The Lower Lea Valley, in the East End of London, was selected as a suitable location for the London 2012 Olympic Park because it was dominated by neglected, contaminated brownfield land in need of clean-up and regeneration, located relatively close to central London with good transport links. The hosting of the 2012 Olympic and Paralympic Games has presented the capital with an opportunity to stimulate the regeneration of a relatively large district of east London which has suffered from chronic economic deprivation.

Although the Lower Lea Valley has large areas of built development and is crossed by many roads and railways, major sewers and a system of run-down waterways known as the Bow Back Rivers, at the time of the planning application in 2007 it also had extensive areas of 'wasteland' habitat. Once overlooked by many nature conservationists, and still assumed to be of little value by many others, brownfield (previously developed) sites have been shown to support a range of valuable habitats, including species-rich arrested pioneer communities that support rare invertebrates and other wildlife, as described by Harvey (2000)[1]. The run down waterways and adjacent wasteland habitats in the Olympic Park site constituted an extensive network of considerable ecological interest. Much of the wasteland habitat had been identified and designated by the Greater London Authority, however there were other areas (for example railway sidings) which were of ecological value but had not been designated. Sites and habitats of ecological value within the site or in close proximity to the site are listed in Table 1 and species of note listed in Table 2. The

Table 1: Sites of ecological value within the Olympic Park application site
Source: Environmental Statement for Olympic, Paralympic and Legacy Transformation Planning Applications submitted 2007

Designation	Site	Habitat	Impact of site clearance works
Site of Metropolitan Importance	Lea Valley (Part)	River Lea and Lee Navigation	Unaffected
Site of Metropolitan Importance	River Thames and its tributaries (Part)	Channelsea River is close to site	Unaffected
Site of Borough Importance Grade 1	Eastway Cycle Track and Bully Point Nature Reserve	Wasteland, scrub, allotments and pond	Cleared
Site of Borough Importance Grade 1	Lea Junction Railway Triangle	Reed bed, scrub	Largely retained – some minor impacts where bridge crossings constructed
Site of Borough Importance Grade 1	Greenway and Old Ford	Rough grassland, scrub and woodland	Largely retained – some minor losses at Old Ford
Site of Borough Importance Grade 1	Bow Back Rivers and Mill Meads	Rivers, wasteland, scrub	Rivers largely retained (apart from Pudding Mill River which was filled). Hydrology of Bow Back Rivers modified through the construction of new Prescott Lock. Mill Meads cleared.
Site of Borough Importance Grade 2	Arena Fields	Grassland	Cleared

map shows the extent of the Olympic Park planning application site and the locations of the designated nature conservation sites.

The Olympic, Paralympic and Legacy Transformation Planning Applications submitted in February 2007 and approved by the specially established planning authority in October of the same year[2] describe plans for new sporting venues, highways, bridges, river works, utilities, parks and open space, as well as their transformation for use after the Games. The application site covers an area of 246 hectares of the Lower Lea Valley from Hackney Marshes in the North to Stratford High Street and West Ham Station in the south. The open space component of the Olympic Park will cover approximately 100 hectares, effectively extending the Lee Valley Regional Park south towards the River Thames.

The Environmental Statement (ES) for the planning applications identified a number of ecological impacts associated with the proposals. These impacts included loss of habitat, including wasteland, scrub, trees, grassland, wetland (including the Pudding Mill River), shading of waterways, lighting, and disturbance. A positive effect predicted was the removal of several hectares of pernicious weeds including Japanese knotweed, giant hogweed, Himalayan balsam and floating pennywort. The loss of habitat has had an adverse effect on some of the species including birds and invertebrates that depend on it (see Table 2). The ES estimated that the loss of habitat in the form of non-statutory designated sites would total approximately 45 hectares. Although much of this habitat fell within the boundary of an area that would become open space, it was not possible to retain because most areas were contaminated and would need to be remediated before they could be made into a public park and ground remodelling would be required to create building platforms and access routes for vehicles and pedestrians. It was possible to retain and protect during construction some areas (known as safeguarded sites) which totalled approximately 11 hectares, including Old Ford Nature Reserve, the Greenway, Lea Junction Railway Triangle, certain tree groups and sections of river and canal bank that support mature willows and marginal aquatic vegetation.

Above: Bow Back Rivers near Carpenters Road in 2007. A Site of Borough Importance Grade 1. Retained and to be enhanced.

Below: Eastway Cycle Circuit in 2006. Part of a Site of Borough Importance Grade 1. Cleared for remediation and remodelling.

UK and local policy, for example Planning Policy Statement 9[3] which deals with the biological and geological conservation and the Mayor's Biodiversity Strategy (2002)[4] require planning authorities to minimise impacts on biodiversity and aim to maintain, enhance, restore or add to biodiversity conservation interests wherever possible. The Olympic Delivery Authority also has a Sustainability Strategy (2007)[5] which makes a commitment to protect and enhance the biodiversity and ecology of the Lower Lea Valley. Since 1994, the International Olympic Committee has recognised the importance of environment and sustainable development[6] and therefore the London Olympic planners had always anticipated the need to protect and enhance biodiversity right from the time of the preparation of the bid to hold the Games.

As a consequence of these policies and the findings of

Table 2: Some species of note recorded from the Olympic Park application site

Source: Environmental Statement for Olympic, Paralympic and Legacy Transformation Planning Applications submitted 2007

Species or group	Status	Location(s)	Impact of site clearance works
Native black poplar	London BAP	East Marsh	Unaffected
Trees with protection orders	TPO	Various	Largely unaffected
Bats – common pipistrelle, soprano pipistrelle, brown long-eared, noctule, Leisler's	European protected and UK Biodiversity Action Plan (BAP)	Mainly feeding along waterways and adjacent areas. No known roosts.	Some reduction in feeding habitat.
Amphibians – smooth newt and common toad	Schedule 5 Wildlife and Countryside Act 1981	Bully Point Pond	Pond cleared – animals moved to Lea Valley Regional Park beforehand.
Reptiles – Common lizard and grass snake	Wildlife and Countryside Act 1981	Single grass snake at Bully Point Pond. Small numbers of common lizards at Temple Mills	Fate of grass snake unknown. Temple Mills site unaffected.
Kingfisher	Schedule 1 Wildlife and Countryside Act 1981	Nest sites on waterways	Will be affected when river banks are remodelled
Sand martin	Wildlife and Countryside Act 1981	Waterworks River wall	Will be affected when river walls are renewed.
Black redstart	Schedule 1 Wildlife and Countryside Act 1981	A few records – none in recent years	Potential nesting sites lost
Song thrush	Wildlife and Countryside Act 1981, UK BAP. In decline (RSPB Red List)	Small numbers around Greenway and Bow Back Rivers	Some nesting and feeding sites lost

the ES, the project proponents agreed with the planning authority planning conditions which required the preparation and implementation of a Code of Construction Practice (CoCP), an Olympic Park Biodiversity Action Plan (BAP) and post ES ecological monitoring. The CoCP is intended to ensure that areas and features of ecological value are properly retained, protected and monitored during construction and that each of the construction projects has its own ecological management plan.

The Olympic Park BAP (2009)[7] was prepared in order to provide a framework for the development of a long term programme of habitat creation and management which was developed in association with partners and stakeholders, including the host boroughs (Hackney, Newham, Tower Hamlets and Waltham Forest), the London Development Agency, Natural England, London Wildlife Trust, British Waterways London, the Environment Agency, the Forestry Commission London Region and the Lee Valley Regional Park Authority. The area of habitat has fallen during the preparations for the Games, however the Olympic Park BAP will guide planners and designers as they build the open spaces and venues through a series of habitat-specific and species-specific action plans (HAPs and SAPs) which define aims, identify issues and describe strategies specific to each species or habitat. The ODA's Delivery Partner, which is managing the construction process, has implemented a management system that ensures that everyone involved in the construction understands their role and responsibilities in terms of following the CoCP and implementing the Olympic Park BAP.

The Olympic Park BAP takes account of the valuable habitats and notable species identified in the ES, the objectives of the UK BAP, London BAP, BAPs of the Olympic Host boroughs, the Lee Valley Regional Park BAP and some of the elements of the built environment (e.g. formal open space and venues) that will feature within the Olympic Park.

The key aims of the BAP are to:

- Establish targets and provide guidance on how to create habitats, encourage species and generally enhance biodiversity through the Olympics to Legacy Transformation phase in 2014. (This will be underpinned in the construction phase by the

Species or group	Status	Location(s)	Impact of site clearance works
Starling	Wildlife and Countryside Act 1981. In decline (RSPB Red List)	Small numbers around Eastway Cycle Circuit	Some nesting and feeding sites lost
Grey heron	Wildlife and Countryside Act 1981. London BAP	A few individuals along the waterways	Unaffected
Linnet	Wildlife and Countryside Act 1981. UK BAP. In decline (RSPB Red List)	A few individuals scattered across the site	Some nesting and feeding sites lost
House sparrow	Wildlife and Countryside Act 1981. London BAP. In decline (RSPB Red List)	A few individuals scattered across the site. 5 breeding pairs.	Some nesting and feeding sites lost
Brown-banded carder bee	UK BAP	Eastway Cycle Circuit area	Loss of habitat
Stictopleurus abutilon	Red data book (RDB) 1	Eastway Cycle Circuit area	Loss of habitat
Stictopleurus punctatonervosus	RDB 1	Eastway Cycle Circuit area and Pudding Mill River	Loss of habitat
Cicones undatus	RDB 1	Old Ford	Unaffected?
Bee wolf	RDB 2	Scattered across the site	Loss of habitat
Toadflax brocade moth	RDB 3	Eastway Cycle Circuit area	Loss of habitat
Olibrus flavicornis	RDB K	Old Ford, Greenway and Eastway Cycle Circuit area	Largely unaffected
Tumbling flower beetle	RDB K	Eastway Cycle Circuit area	Loss of habitat

Ecological Management Plan which includes measures to protect existing habitats and species.)

- Outline actions and set measurable targets for the establishment and conservation of selected habitats and species of conservation concern; and
- Provide the method and means for monitoring, measuring and reporting on the action plans.

Habitat action plans have been prepared for the following categories:

- Built environment
- Parks, squares and amenity space
- Allotments
- Brownfield habitats
- Species-rich grasslands
- Trees and scrub
- Wet woodland
- Rivers
- Reedbed
- Ponds.

Log wall near Old Ford Nature Reserve. Created to benefit invertebrates including *Mordellistena neuwaldeggiana* (a tumbling flower beetle) which is an Olympic Park BAP species.

Preliminary targets of area have been set for each category; however it is accepted that the exact quantity of each habitat type created may change a little as the detailed design for the Olympic Park landscape emerges. There is a commitment to create at least 45 hectares of new habitat overall by 2014 in order to compensate for areas of habitat cleared during the site preparation phase. It is anticipated that about 25% of the new habitat will be trees and shrubs and 50% species-rich grasslands. Many habitats will already be in place before the Games (by 2011) including amenity spaces, grasslands, reed beds and new river edge habitats; however further habitat creation will take place after the Games (the so called transformation phase) when temporary Olympic facilities are removed and work continues on the permanent park which will form the setting for a new urban district. Further details of the HAPs may be found in the Olympic Park BAP.[8]

Species action plans have been prepared for the following species:

- Black poplar
- Brown banded carder bee
- Toadflax brocade moth
- *Cicones undatus* (a fungus beetle)
- *Mordellistena neuwaldeggiana* (a tumbling flower beetle)
- *Olibrus flavicornis* (a beetle)
- *Stictopleurus abultilon* (a ground bug)
- *Stictopleurus punctatonervosus* (a ground bug)
- European eel
- Common frog
- Common toad
- Smooth newt
- Common lizard
- Grass snake
- Slow worm
- Black redstart
- Grey heron
- House sparrow
- Kingfisher
- Linnet
- Reed bunting
- Sand martin
- Song thrush
- Starling
- Swift
- Bats (generic)
- Water vole
- Otter.

These species action plans work in concert with the habitat action plans, ensuring for example that appropriate nesting boxes or holes are provided for birds (for example swift boxes under the Built Environment category) and ponds for amphibians. For many species, foraging and feeding habitat may differ from breeding habitat, however the two may need to be adjacent. Such considerations will guide park designers. An example of this will be terrestrial foraging habitat for amphibians created adjacent to new ponds. An early example of a feature created as part of the Olympic Park BAP process are log walls which will benefit *Mordellistena neuwaldeggiana* (a tumbling flower beetle). Again the full details of the SAPs may be found in the Olympic Park BAP.[9]

After the Games, responsibility for the operation of the Olympic Park and development of adjacent sites will pass to the London Development Agency (part of the Greater London Authority). Plans for the long term development of the Olympic Park and new communities of 10,000 homes in the adjacent sites are already being prepared in the form of the Legacy Masterplan Framework, which has recently been exhibited to the public as a draft.[10] It is expected that the Olympic Park BAP will be revised during the transformation phase (after the 2012 Games) and it is also envisaged that a number of new biodiversity action plans, derived from and meeting the aims of the Olympic Park BAP, will be prepared for each of the new districts which emerge around the perimeter of the Olympic Park.

An important role will be the coordination of implementation of the various biodiversity actions plans and ensuring that every plan and proposal makes reference to them. Implementation of the BAP will apply to all plans and proposals however urban because actions will range from large scale open space and riverside schemes, like the creation of new reed bed, through to building-specific scale projects, like green roofs and swift boxes.

Summary examples of Species Action Plans from Olympic Park BAP

Grass snake

The grass snake is protected under the 1981 Wildlife and Countryside Act (as amended). It is common on the outer edges of London but largely absent from the centre. It has been seen occasionally around the Bully Point area within the Olympic Park. It has strong association with wetlands and often feeds on amphibians. This species hibernates in winter and lays its eggs in piles of rotting vegetation in summer. The grass snake is listed as a Priority Species with the UKBAP and under Priority Species and Species of Conservation Concern within the London BAP (LBP 2007). The grass snake has suffered from loss of wetland habitat and reduction in prey species, disturbance to egg laying sites (compost heaps) and persecution.

The objective of the species action plan is to create an interconnected complex of wetland and grassland habitats which are suitable for the grass snake, in order to encourage natural recolonisation and conditions suitable for reintroduction. Four potential egg laying sites (compost

heaps) will be constructed from cut grass in secluded locations in the Bully Point area by 2014. Consideration will be given to the reintroduction of animals to the area once sufficient suitable habitat is available.

Kingfisher

The kingfisher and its nest is fully protected under the 1981 Wildlife and Countryside Act (as amended). It is also listed in Annex 1 of the Birds Directive. It nests in a hole in the riverbank and feeds on fish, small amphibians and invertebrates. Each pair usually occupies a length of watercourse of between 0.8 and 1.5 km. The kingfisher is widespread in Britain. It is present in nearly all outer London boroughs and has been observed along the Bow Back rivers which cross the Olympic Park. The kingfisher is a London Biodiversity Action Plan species. Kingfisher populations are vulnerable to water pollution, very cold winters, persecution, unsympathetic river works removing nest sites, clearance of bankside vegetation, improvement of bankside areas and lack of nesting sites on otherwise suitable river sections.

The objective is to create conditions with the potential to attract a breeding population of kingfisher within the Olympic Park by 2014. This will be achieved by improving the quality of riverine habitats and by providing two artificial nesting banks.

◆ Gary Grant was an author of the London Olympic Park BAP and is Director of Ecology with Design + Planning at AECOM *(gary.grant @aecom.com)*.

Map showing Olympic Park planning application boundary and pre-construction non-statutory designated nature conservation sites

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10 *www.legacy-now.co.uk/*

SUSTAINABLE TRANSPORT FOR THE LONDON 2012 OLYMPIC GAMES

Shifting nine million spectators to and from the Games will not necessarily undermine its credentials as the greenest Olympics ever, says **MIKE SINCLAIR-WILLIAMS**

During its quest to host the London 2012 Olympic and Paralympic Games, the bid team committed to being the 'greenest games' and wanted to enable all spectators to get to the venue of their choice on time by providing a 'safe and reliable transport system'. Normally transport and 'green' don't necessarily go hand-in-hand; in fact some would argue they are in competition. This article, therefore, provides a brief summary of how we at London 2012 and our partners are minimising the environmental impact of the transport arrangements and delivering a sustainable transport system. It starts with an introduction and background to the project, then focuses on the activities carried out to deliver sustainable transport and finally looks at some of the challenges faced in achieving a modicum of success in such a complex and new arena. Transport and 'green' can in fact be two sides of the same coin.

Background

Sustainability means different things to different people: see Bruntland, Stern *et al.* Historically however, it has been defined as a combination of social, economic and environmental aspects that, combined, provide a holistic view of the factors that contribute to sustainable living.

At London 2012 (L2012 is a combination of the Organising Committee and the Delivery Authority) we have adopted the concept of 'One Planet Living'[1] which is based on the philosophy that with current predicted use of materials and energy we will need three planets to be sustainable and therefore we must bring ourselves back to living within our means. As part of this philosophy L2012 has developed a number of cross cutting themes that will act as enablers to minimise the impacts from delivering the games. These are:

- climate change
- waste
- biodiversity and ecology
- inclusion; and
- healthy living.

Our mission is to ensure approximately 9 million ticket holders (spectators) are provided with transport to and from the Games in a safe and secure manner. Given this presents London with the greatest transport operation challenge in recent years, some would equally say that in its own right it is going to be difficult, particularly in the current economic climate. As such, we have had to prioritise our approach and focus on those areas which provide the best return for the available investment. We have taken a similar approach to sustainability and in particular carbon reduction.

Delivering Games-time transport

The Olympic and Paralympic Act places an obligation on the Transport team of the Olympic Delivery Authority to provide 'transportation systems and facilities' for the Games and obligates us to produce an overarching plan of how we intend to get there *(www.london2012.com/plans/transport/getting-ready/transport-plan.php)*. The plan set out our approach which has been to identify, through modelling previous games data, potential transport demand by mode – air, rail, bus, coach, waterways, etc – determine existing capacity for each mode and then carry out a gap analysis. The gap analysis identified a number of significant shortfalls in capacity that would have to be filled prior to 2012.

We then undertook analysis of UK data on modal uptake (UK domestic 2005) where it was recognised that the automobile accounted for approximately 54% of the total transport carbon emissions, followed by rail at 2% and buses at 3%. It was also common knowledge that mass transit options were reportedly better than single use automobile when compared for carbon emissions per passenger kilometre travelled.

Therefore, a key element of our strategy was the commitment to delivering a transport network that would enable 100% of the spectators to reach the venue of their choice by public transport or by cycling or walking. To do this we would need to work closely with what we term our delivery partners, i.e. those organisations which deliver the transport today such as TfL, Network Rail and the many train operating companies which serve London and the rest of the UK.

Context

Adopting a public transport approach to spectator travel also opened the opportunity to leave a lasting legacy through behavioural changes in public travel and improved transport infrastructure that would provide access to future local amenities, education establishments and health care provisions. From a sustainability perspective, therefore, we took a risk based approach by looking at areas where we can

1 The One Planet Living is a trademark of WWF and Bioregional

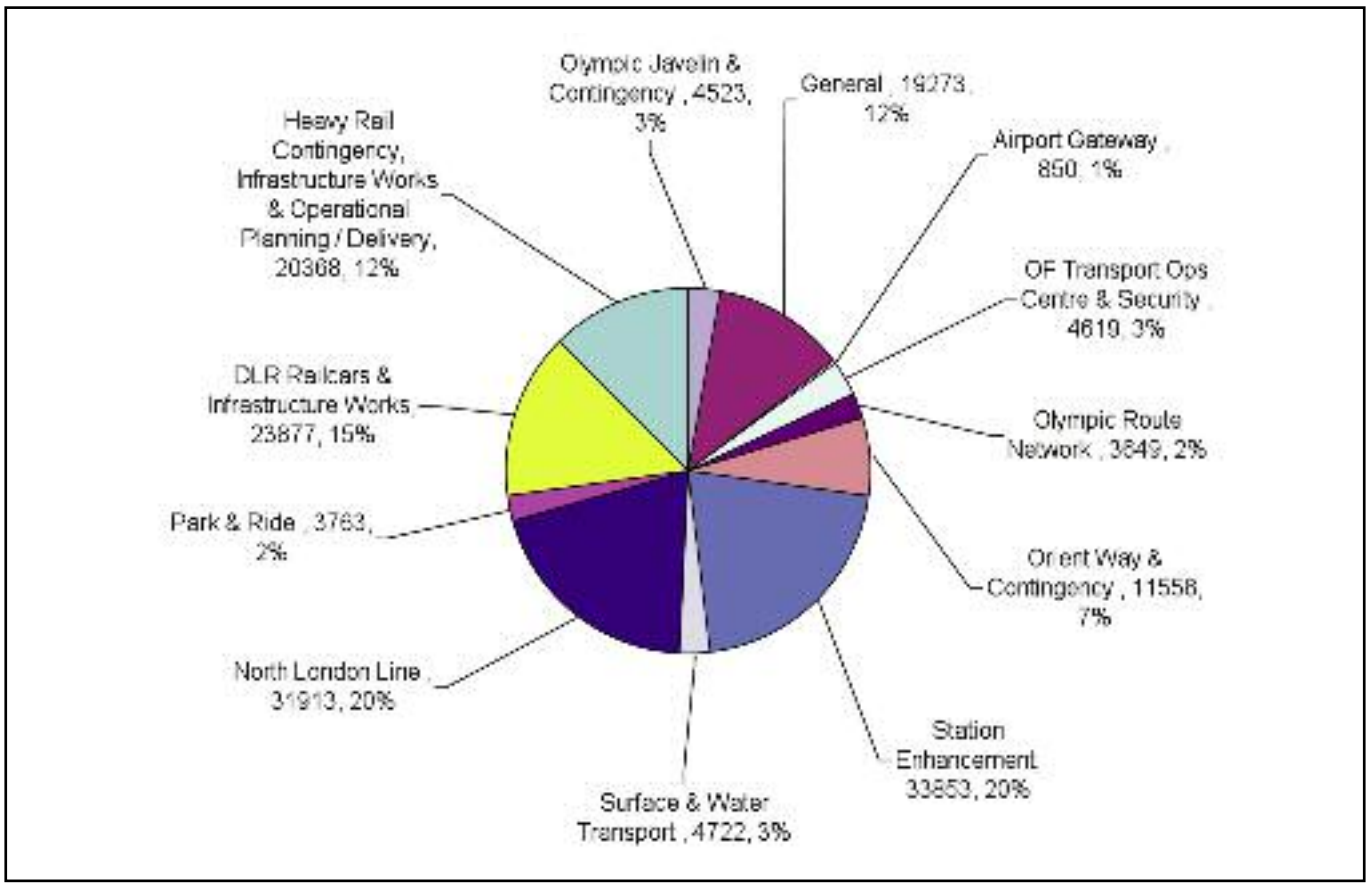

Figure 1: Carbon emissions by Infrastructure project

make a real impact given the nature of our project. As such, we have focused our efforts on:

- reducing the carbon and other greenhouse gas emissions associated with transporting spectators;
- promoting healthier lifestyles through walking and cycling; and
- making transport accessible.

To achieve this we have adopted policies of minimising the impact of the transport arrangements through maximising the use of existing infrastructure and operational capability and not building where no legacy value can be demonstrated. Where we have had to upgrade we have done so using sustainable practices and policies. In fact the ODA has a transport budget of £899m, £534m of which will be spent on infrastructure investment projects in London and around the venues outside London. These schemes fall into three main categories:

- enhancing transport projects, for example co-funding part of the new fleet of trains for the Docklands Light Railway;
- enabling projects to be started and finished before 2012 that would not otherwise materialise until some time after that date;
- directly managing and delivering transport projects, for example Stratford Regional Station upgrade.

So what does this mean from a carbon perspective?

By 2012 we will have contributed in a number of ways to many different schemes, all of which have emitted carbon or equivalent greenhouse gases as part of that construction phase. Therefore we decided to better understand where our carbon was emitted so that we could use this information to improve our decision making regarding carbon reduction measures.

As a result we commissioned a carbon footprint of the transport systems initial design (as set out in the London 2012 Transport Plan). This included both an appreciation of the infrastructure delivery elements and the spectator travel arrangements. However, this was not a normal carbon footprint study as most would know it. It was more in line with an impact assessment as it was carried out prior to the infrastructure being delivered and travel modes being operated. This was good as it allowed us to influence the design of the projects we were directly in control of. One such project demonstrated a 44% reduction in carbon when compared against a business as usual scenario.

Figure 1 illustrates the relative carbon emissions of each transport project. As illustrated, over 55% of the contribution comes from infrastructure projects that have been part funded by L2012, namely DLR rail cars (15%), North London Line (20%) and station enhancements (20%).

This also highlighted the order of magnitude difference between operational contribution and infrastructure/build. Construction activities, by their very nature, emit high volumes of carbon.

In order to understand the spectator contribution, modelling was carried out of various transport modes, ticket uptake and points of origin, i.e. overseas, UK mainland and in and around London. Background research also illustrated that approximately 56% of journeys by car were less than five miles and that 23% were less than two miles (DfT, 2007). These statistics provided a second key objective of increasing the modal share for cycling and walking.

To encourage ticket holders to use public transport – as opposed to taxis as was the preferred choice in Beijing – L2012 and its TfL delivery partner have agreed to provide free travel on public transport within the M25 boundary and to specific routes such as Eton Dorney (the rowing venue). Therefore, current modelling suggests that approximately 80% of spectators will use rail as the preferred choice. If this materialises, a significant carbon saving will be made when compared against a model of spectators using less sustainable forms of transport. Figure 2 below illustrates the distribution of spectator passenger kilometres against CO_2 emissions.

Figure 2 also illustrates that – if current predictions are correct – rail will be the dominant mode at 1,400 million km and 80,000 t/CO_2-e. Rail when compared to alternative modes emits far less CO_2 per passenger kilometre than others. For example, typical electric stock will generate 53.5g CO_2/passenger km, while the average bus emits 80g CO_2/passenger km and the car 160g CO_2/passenger km (*The Case for Rail*, RSSB 2007). There are nevertheless many caveats on using such figures, such as passenger loading/fuel mix, etc. Notwithstanding such caveats rail, it can be argued, remains the most sustainable form of mass transport.

The ubiquitous coach is also seen as a possible mode option as it has relatively good performance from an emission perspective, particularly if best in class vehicles are used. By 2012 most will be Euro 5 and have correspondingly low CO_2 emissions.

Figure 2 also highlighted that we needed to do more to boost the cycling and walking modes as these were predicted to be quite low. Consequently the ODA is putting in place upgraded infrastructure for cycling and walking. In and around London we have already put contracts in place to revive 80km of dedicated cycle paths and outside London we have planned a further upgrade programme.

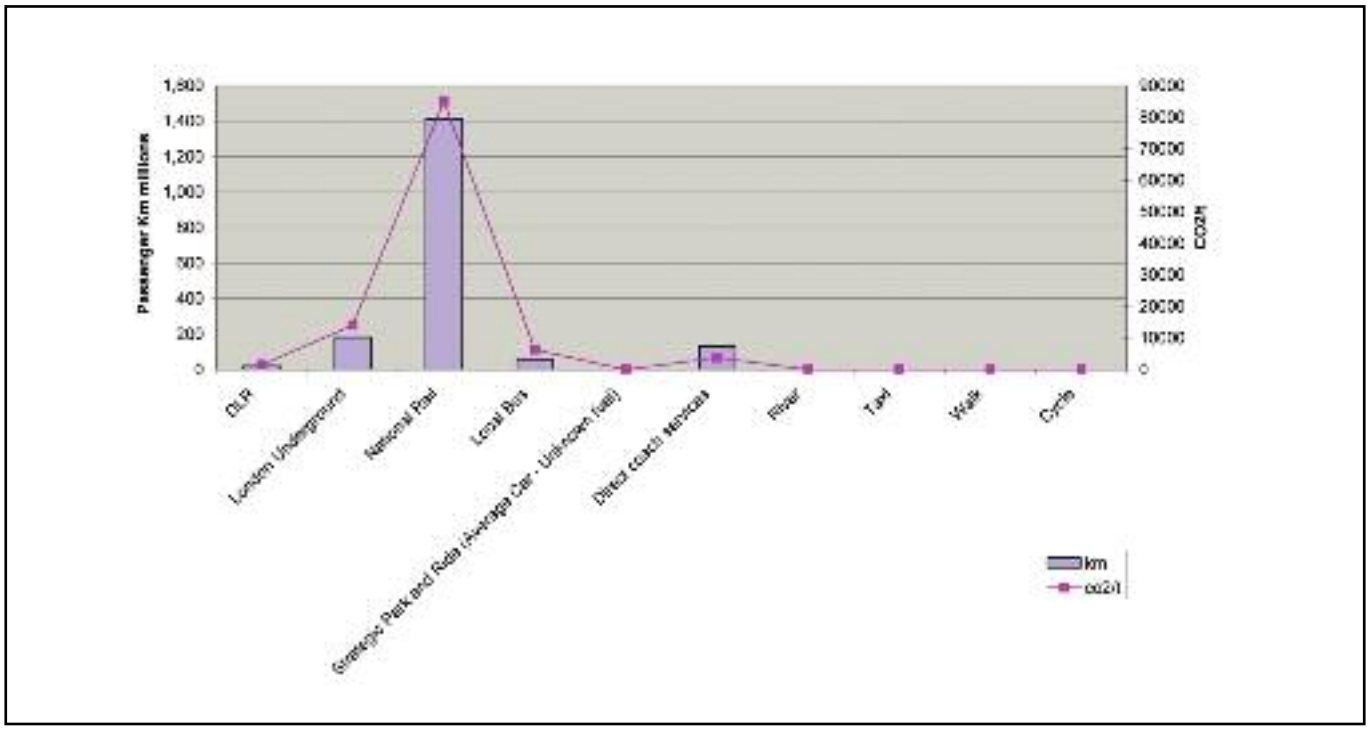

Figure 2: Spectator travel, London 2012

Aerial photo of Stratford Regional Station (July 2009) *Photo: London 2012*

Challenges faced

There are always challenges when trying to deliver a project of the size and complexity of the Olympic and Paralympic Games. There will continue to be competing demands and tensions between making transport available for spectators and Games Family (IOC, VVIPS and Athletes) and delivering a low carbon transport system. In attempting to measure our impact we commissioned a number of studies such as a Strategic Environmental Assessment (SEA) back in 2006, we adopted the recommendations in 2007 and are working through the commitments. One area that has caused us some difficulty is how we measure our carbon impact. Although we have followed the Greenhouse Gas Protocol Initiative (a corporate accounting and reporting standard jointly convened by the World Resource Institute and the World Business Council for Sustainable Development) for calculating our emissions and have had those figures audited, the question of what you do with the residual emissions is perplexing.

To explain, there are two possible ways of looking at Life Cycle Analysis, one based on additionality where you simply add, and the second where you look at the consequence of the action and its typical outcomes (see for example A. Pearson and T. Grant *Allocation Issues in Life Cycle Assessment Benefits of Recycling: the role of environmental rating schemes*). When building transport infrastructure, by the very nature of the task, you will emit carbon during the design, build and use phase. Currently this carbon can't legitimately be amortised over, say, the 30 years of rail use but must, according to current thinking, be offset at the time of emission (GHGP and Defra 2007, *The social cost of carbon and the shadow cost of carbon; What they are and how to use them in economic appraisal in UK*). The question, however, is whether transport should be penalised for providing a much longer legacy of modal shift and greater access. I leave that question to the reader to answer!

Conclusion

Our impacts on the environment as a transport provider are minimal in the broader sense of carbon, but we believe the small impacts we will make on behaviour and attitudes, coupled with the infrastructure legacy we leave, will outweight the small negative impact.

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ON THE RIGHT TRACK?

Will the Games deliver the legacy that Londoners expect? London Assembly member **DARREN JOHNSON** considers current performance and raises some questions about the likely end result

With three years to go, Olympic organisers have detailed plans about almost every aspect of the 2012 Games. As the delivery of stadia and infrastructure picks up speed, it is the right time to question whether goals on sustainability, quality of life, and the local economy are being met.

This article assesses the progress being made in key areas, and asks whether the current performance raises questions for the next three years, and beyond. Is the Olympic Delivery Authority (ODA) living up to promises on sustainable transport for freight and workers, on paying a living wage and using local businesses, and on green energy and waste reduction?

It concludes that Olympic organisers must be willing to stretch themselves further in the areas where they have made good progress, and ensure that no part of the project is left behind.

Sustainable transport for freight and workers

Current delivery:

Having set itself a target of delivering 50% of materials (by weight) to the Olympic construction site by rail or water, the ODA is currently achieving 57%[1], and in June 2009 a new £20m tidal lock was opened on Prescott Channel, near the main stadium. This will allow 350 tonne barges to take waste from the Olympic Park to a specialist recycling centre in Rainham, Essex[2]. However, rail freight sector representatives have called on the ODA to go further by requiring suppliers of all materials to use rail, rather than only those supplying bulk items. This could halve the number of road deliveries, cutting 800,000 lorry movements from the area.[3]

Ten per cent of the 4,500 construction workers on the Olympic Park are currently walking or cycling to work[4], and 67% travel there by public transport[5]. However, 400 bike parking spaces for over 4,000 workers are insufficient and will need to rise in number significantly as the workforce grows.[6]

On transport infrastructure projects, the ODA has won plaudits from the Commission for a Sustainable London 2012 and won industry awards for its sustainable approach to relocating major railway sidings from the aquatics centre site to the north-east of the park. The project was described as a good example of best practice in sustainable construction and reduction of embodied CO_2, with 99% of materials being either reused or recycled.[7,8] Having shown what can be achieved, this performance must be repeated across all Olympic transport infrastructure projects.

Future plans:

Given their current progress, Olympic organisers are expected to deliver the public transport improvements that will form a significant part of the sustainable legacy promise. However, the achievements made so far will be undermined if plans to provide more than 7,000 car parking spaces in and around Games venues are not drastically scaled back.

Public transport efforts are also being undermined by including park and ride in the mix. Encouraging spectators to drive to car parks outside of London and then busing them the rest of the way does not count as public transport.

More is being done for people arriving at the Games on foot or by bike at this Olympics that at any other Games. So it is disappointing that organisers only expect around 5%[9,10] of spectators to travel to London 2012 by the most sustainable means of transport. Much greater ambition is needed.

Most disappointing is the news that London 2012 has done nothing to question whether Olympic officials need to be provided with chauffeur driven cars. Current plans state that over 3,000 such cars will be made available, and if London 2012 is determined to provide them, they should do so only in conjunction with an automotive sponsor with an exemplary record of cutting emissions from its vehicles.

Supporting local business and workers

Current delivery:

Regenerating the East End was one of the core promises of the bid for 2012. Beyond the investment in new facilities and housing at the Olympic park and Stratford, providing opportunities for local businesses and workers is vital if this aim is to be achieved.

Artist's impression of Bridge FO6 after the Games *Photo: London 2012*

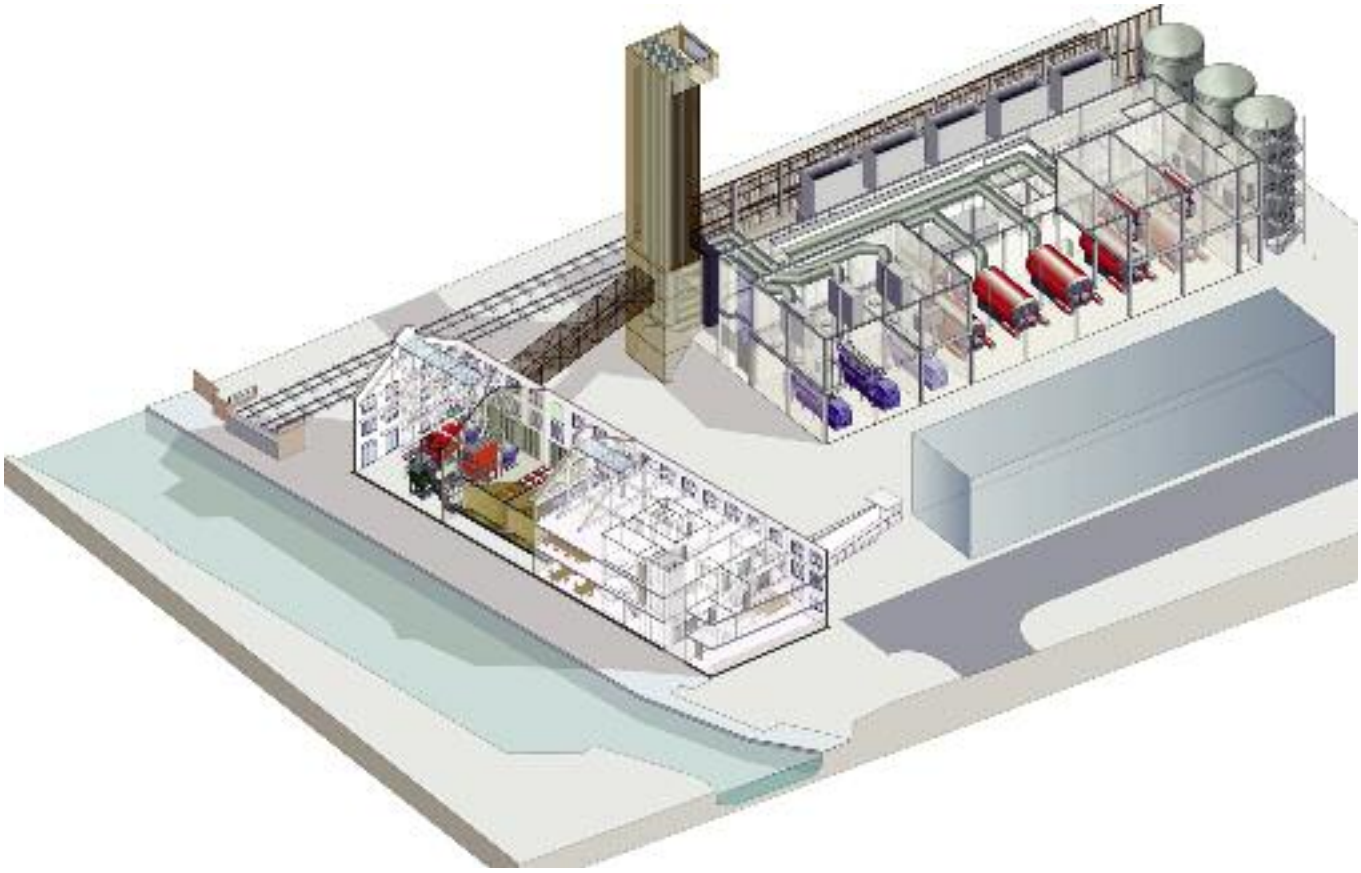
Of the 946 companies currently working with London 2012, 68% are small and medium enterprises, 98% are based in the UK, 53% are based in London and 13% are from Olympic boroughs[11]. Of the contractor workforce, 20% are from Olympic boroughs (compared with a target of 10%) and 10% were previously unemployed (compared with a target of 7%)[12]. Despite concerns that the only measure of being a local worker was having a permanent address within the one of the five Olympic boroughs, it does not appear that migrant workers are dominating the work force. 63% are British citizens, a further 8% are Irish, and only 14% are from outside the European Union.[13]

Future plans:

Given the progress that has been made so far to employ local workers, these targets should be significantly increased before the number of workers on the main site grows further. Of equal importance is the need to pay Olympics workers a living wage. The ODA currently claims that 2,344 workers are paid the living wage – 89% of those who voluntarily provide this information. However, with a total workforce of 4,434 only 53% are confirmed to be on a living wage[14] of £7.60 an hour[15]. It is clear that reporting in this area must improve. The need for an Olympics-wide policy to pay a living wage increases as the workforce gets bigger.

While 69% of contractors who have won work with the Olympics are small or medium enterprises there is no breakdown of this figure showing how the smallest businesses are getting Olympic opportunities[16]. The Olympics must be used to boost all small businesses (with between one and forty-nine employees), particularly small London based manufacturing companies. Despite having more enterprises than any other region in the UK, London has the lowest proportion of small businesses (21% compared with the north-west's 28%) and lost a third of its industrial jobs between 1985 and 2006, a more pronounced rate of decline than the rest of the UK.[17]

An important part of supporting the local community and economy will be the delivery of a vibrant Olympic Village. Due to the failure to secure any private sector funding, plans for the village have been scaled back. There will now be 2,818 apartments and townhouses instead of 4,500. While more than a third will be family homes, only 24% are for social rent and 12% for low cost ownership. However, an option has been included for allowing more than three quarters of the low cost homes to revert to market properties, which would leave less than a third of the village as affordable housing.[18]



Olympic Park Energy Centre cutaway *Photo: London 2012*

Energy and waste reduction

Current delivery:

Climate change has been put at the centre of the London 2012 Olympics, and some impressive strides are already being made. As shown above, sustainable transport and construction targets are being met and in some cases exceeded. Also, all permanent venues are currently being built to BREEAM excellent energy efficiency standards.

However, the ODA has so far only identified 17% of the 20% objective for renewable energy for the park in legacy mode, although the Commission for a Sustainable London 2012 understands that plans are in place to find the remainder[19,20]. Also, while the ODA's ongoing comprehensive carbon footprinting exercise has already been credited with influencing procurement for the Games, such as the decision to use recycled aggregate, it is hard to assess this work because its public release has been delayed until later this year.[21,22]

Finally, a site wide waste contractor has recently been appointed for the construction phase but the delay in putting this in place means that constructors have put their own measures in place, possibly jeopardising the target of diverting 90% of construction waste from landfill.[23]

Future plans:

Given that the ODA is still examining how to provide renewable energy for the legacy park it is worrying that it is still not yet clear how LOCOG will deliver 20% of Games time energy from renewable sources[24]. Furthermore, there is no target for, or monitoring of, the source of the energy used during the construction phase. The lack of ambition in this area is reflected by the fact that after the Games the energy centre's combined heat and power plant will only be low/zero carbon after the Games if a sustainable renewable fuel source can be found.[25] This is an area that needs improving.

Even if Olympic organisers were to be successful in minimising the amount of carbon they emitted, there will always be a residual footprint to offset. London 2012 must recognise this and comply with the Commission for a Sustainable 2012's call for 'the remaining footprint to be mitigated by a combination of initiatives to reduce carbon in the community and through wider influencing schemes using the inspirational power of the Games to change behaviour'.[26]

There is an ambitious target not to send any Games time waste to landfill, and commitments have also been

made not to incinerate any waste generated during the events. However there are no plans to provide new waste processing and recycling facilities on the site, and no targets for what to do with temporary materials that are used during the Games but disposed of afterwards.

Conclusion: what hope for a sustainable legacy?

With three years to go there has been progress towards delivering a Games that will be greener and do more for local communities than ever before. However, Olympic standards in these areas have never been high, and 2012's organisers could stretch themselves further to deliver a Games that is truly outstanding in all areas. As many of the plans for the Games themselves are already set in concrete, literally, focus should shift onto the long-term impact of London 2012, which is still very much up for grabs.

The new Chair of the Olympics legacy company has announced a major re-think for post-games options, with a new emphasis on a sporting legacy.[27] In a four week period in 2008 only 48% of Londoners took part in sport or active recreation, compared to 67% in the same period in 2007, and only 23% of adults believe that London 2012 will make them more likely to do sport. It is therefore vital that any sporting legacy is available to all.[28] Also, the legacy review and the fact that the Olympic village will be publicly owned[29], should be an opportunity to increase energy efficiency standards, introduce innovative housing delivery models such as community land trusts, and deliver a car free development. Finally, managing as much waste as possible within London is a mayoral priority that can only be met by delivering around 100 new local waste facilities. With east London and the Thames Gateway due to grow faster than the rest of the capital, it would be a huge mistake to miss the opportunity provided by the Games to deliver exemplar new energy from waste and recycling facilities on the site.

The 2012 Games are making good progress along the path that it has set itself. But the question of where that path is heading is still to be answered.

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PLANTING THE PARK

The Olympic legacy will include 102 hectares of parkland – one of the largest urban parks created in Europe for more than 150 years. **DR HEATHER BARRETT-MOLD** explains how the park will become an area fit for wildlife as well as humans

The 2012 Olympic Park is situated to the south of the Lee Valley and contains some valued habitats such as wetlands and wet woodland and as a consequence the Olympic Park Biodiversity Action Plan (BAP)[1] is an important document to be taken into consideration when any part of this development is considered and not least the landscaping and planting. More detail of the BAP and biodiversity specifically can be seen in the article in this edition by Gary Grant.

The Olympic Park BAP takes account of the objectives of the UK BAP, London BAP, BAPs of the Olympic Host boroughs and the Lee Valley Regional Park BAP, as well as taking account of a number of other policy documents such as:

- The London Plan (consolidated with alterations since 2004)
- Mayor of London Strategies and Supplementary Planning Guidance
- Lee Valley Regional Park Plan (LVRP) 2007
- East London Green Grid Framework Spatial Development Strategy Draft SPG (2007)
- Lower Lea Valley Opportunity Area Planning Framework
- East London Sub-Regional Development Framework (2006).

The London 2012 Games are being delivered by two organisations:

- The London Organising Committee of the Olympic Games and Paralympic Games Ltd (LOCOG), responsible for staging the Games – funded in the main by the private sector and not subject to EU procurement regulations; and
- The Olympic Delivery Authority (ODA), responsible for building the venues and infrastructure – funded by government and other organisations such as the London Development Agency, Lottery and Greater London Authority and subject to EU procurement regulations.

The Olympic Park Legacy Company is responsible for the management of the site post-Olympics.

The BAP sets targets and provides guidance for habitats, species and monitoring throughout the creation of the 2012 park through to legacy: see Table 1 opposite.

The ODA aims to transform former industrial land, much of it contaminated through years of industrial neglect, to create a total of 102 hectares of parklands. In legacy this will be classed as Metropolitan Open Land and of the 102ha, 45ha will be habitat. ODA Head of Parklands and Public Realm, John Hopkins, said: 'This is an opportunity to be involved in creating one of the biggest urban parks of its type in Europe for 150 years for the London 2012 Games and legacy. The southern part of the park will provide a festival atmosphere during the Games, hosting the main spectator entrance, Olympic Stadium, Aquatics Centre and London 2012 gardens.[2] In legacy it has been designed to retain this festival atmosphere for the enjoyment of people living around and visiting the area.'

In a meeting with John, it was clear that sustainable development is an important feature. Much of the soil was contaminated and 1.3 x 10^6 tonnes, i.e. 80% of the contaminated soil, has been treated and reclaimed. Similarly groundwater continues to be treated, in part through biological systems such as willows and reeds, and it is recognised that this will need to continue after the games until the groundwater is clean. There are targets for water reduction and initial irrigation is managed through the use of treated blackwater.[5]

The northern area of the park will have trees, woodland mixes, meadows, swales and frog ponds. The swales are currently being constructed, and form part of the overall landscape design. Water will flow into the swales from various sources but in part from the porous paving, and be absorbed so that they will vary in their saturation and will allow water to flow into the frog ponds. The meadows will be permanent in legacy, with one exception, and will contain a mix of native species. Annual mixes are proposed mainly in the southern area for Games-time display. The plants of the meadow mixes will be shorter for drier areas and longer for moister ones. Care is being taken with testing seed viability and adjusting the mix accordingly. Trials are taking place as of course it has to be right on the day in 2012. The first main sowing of these meadows will take place in March 2010 to January 2011. This gives time for two cuts through 2011 which will help to control weed growth but also time to rogue out any docks, or other difficult and persistent weeds. Within the woodland area

Table 1: The BAP habitat targets

UK BAP habitat type	Olympic Park habitats or features	Target (area of new habitat in ha)
Built environment	Installations or modifications to man made structures and buildings including bird boxes, bat boxes and voids, bee hotels, living roofs and living walls. (Target area is living roofs)	0.40
Parks, squares and amenity space	Species-rich lawns, ornamental trees and shrubberies established using native species. Ornamental planting designed specifically to benefit species identified in an Olympic Park Species Action Plan.	1.67
Allotments	Include native boundary hedges and trees with tall grassland verges, species-rich grassy paths, compost heaps, fallow plots with arable weeds, small ponds and other features to attract wildlife including bird boxes, bat boxes and bee hotels	1.04
Brownfield habitats	Bare ground and cliffs, stony ground, pioneer communities, tall ruderal, low scrub, vegetated gabions.	5.05
Species-rich grassland	Species-rich grasslands established on a variety of low fertility substrates, which may vary in soil pH from acid, through neutral to alkaline, maintained by a variety of cutting regimes which may result in swards of varying height.	23.69
Trees and scrub	Native trees and shrubs with associated woodland ground flora.	10.00
Wet woodland	Groups of alder, willow and birch with associated ground flora usually close to waterways with soils subjected to frequent waterlogging.	0.90
Rivers	All watercourses and waterways (target area is extension of River Lea at Bully Point)	0.27
Reedbed	Wetlands (including drainage features) dominated by common reed, but which may be comprised of other locally appropriate, native wetland plants.	1.80
Ponds	Ponds with shallow margins and native wetland vegetation.	0.18
	Minimum target of new SBI Grade1 equivalent habitat (2014)	45.0

attention will be paid to layering, and summer and winter colour with black poplar, disease resistant elms, cherries and willows.

The southern part of the park will focus on retaining a festival atmosphere from the Games, with riverside gardens, markets, events, cafés and bars in legacy. These southern area 2012 gardens are designed to show the achievements of the British as a people who have traditionally been gardeners; the heritage of plant hunting and collecting and the value of gardens for biodiversity. The designers are conscious of the fact that gardens are important for biodiversity, especially in cities, and that biodiversity and human cultural needs are not necessarily in opposition. There will be four garden character types covering a timeline of 500 years and four continents. Each of these areas will be characteristic and do not attempt to be plant collections. One area will be characteristic of temperate America and another of the southern hemisphere including South Africa, Australia and New Zealand and will relate to the work of scientists such as Banks and Darwin. A third area will be characteristic of Western Europe and the Mediterranean and the tulip wars. The fourth area will be reminiscent of temperate Asia including areas of the Himalayas and of Japan. There will be formal gardens with clipped hedges, strip planting and multi-stemmed trees as well as annual meadows. The south Park annual meadows will have native and non-native species. Sowing will take place on prepared soil in

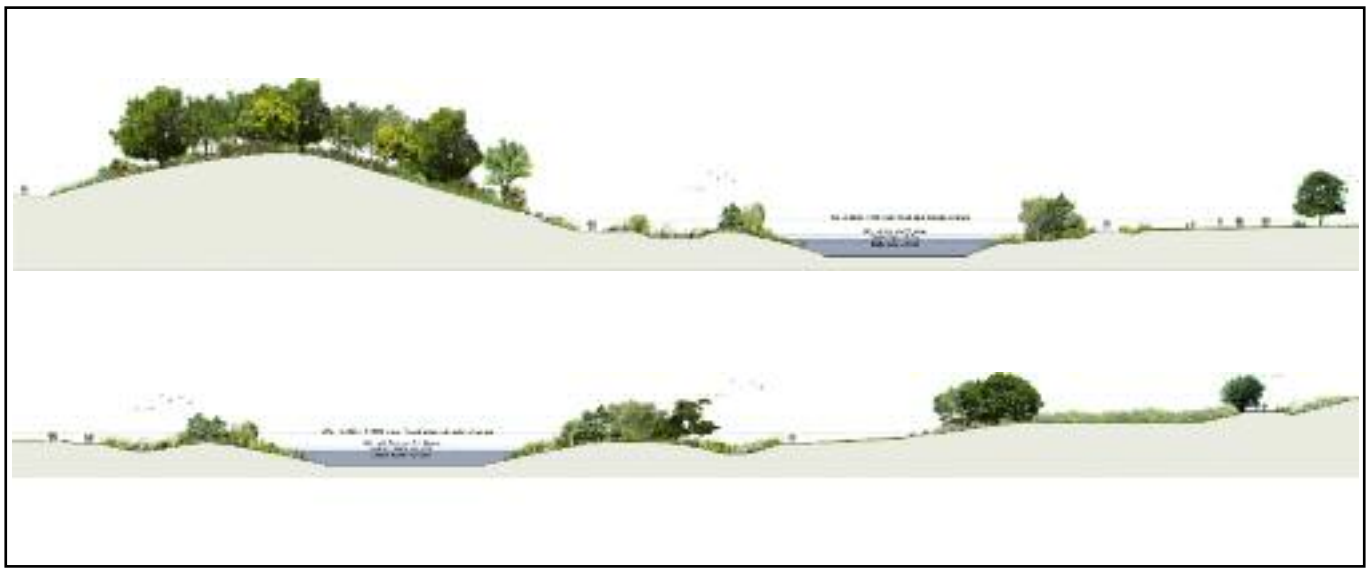

Figure 1: Sections of the North Park illustrating how a full range of habitats and ecotones will be created.[1]

late May and early June 2010 and then again in 2011 and 2012. 130,000 visitors a day are expected and this has to be managed in part through the design of these areas.

Around 2,000 semi-mature British-grown trees have been selected for the London 2012 Olympic Park. It will be a huge exercise in planting. The four to seven metre high trees have been grown by the selected supplier, Hilliers Nurseries in Hampshire, who have worked on projects including the 1951 Festival of Britain, the Manchester Commonwealth Games Stadium and the Millennium Dome. Most of the trees will be on site from 2011 and have been selected to withstand climate change and are predominantly native species. They include species such as ash, alder, willow, birch, hazel, cherry, black poplar, London plane and lime. Where possible, vegetation has been taken from the site and stored and will be returned for planting. This is the case with many of the black poplar and willows. A lot of seed has been collected from the site ready for planting back in situ. The London plane has been chosen as the main concourse tree for design purposes but also for its reliability and heat tolerance. Willow and alder will be planted in river areas to withstand flooding. John Hopkins stated: 'The UK horticultural industry is demonstrating its enthusiasm to help deliver the London 2012 Games. Selecting these trees takes us a step closer to creating a new park for London at the heart of the 2012 Games and its legacy.'[3]

The Park has a significant area of wetlands with 1.2km of river, 0.5ha of reed and three frog ponds. In the south area there will be 200m of soft bank. There are 700 habitat installations including two for otters in the hope that they will return to the site, and also a sand martin bank. There are 160,000 reeds on order to be planted as well as pond sedge, flag iris and purple loosestrife. These plants are being supplied by Salix. Some of the reeds originated from the site. In the north area there are three frog ponds, two of which will be ephemeral and one permanent, all fed by swales. The wet woodland is an important habitat that will be retained. Planting of the river banks will be achieved through the use of pre-stabilised and pre-planted coir pallets and reinforced pre-grown turf. The wetland channels will be kept open with hazel spiling. The plants by the water edge have to contend with a change in water level of 0.5m fall and rise each day. This type of planting is currently being trialled on site and grown at Thetford.

Standards for the management of the Olympic Park will follow the Green Flag scheme, which requires that parks are safe, secure, well maintained, clean, sustainable, take account of conservation and heritage, involve the community and be well promoted. Long term development of the habitats will involve some sophisticated management with, for example, variable cutting regimes and subsequent monitoring. Some areas will need to be cut frequently through the growing season to maintain a short sward, whilst other areas will be cut in late summer or autumn after wildflowers have set seed. In some locations, cuttings will need to be removed. Invasive alien plants pose a threat to waterways in particular. Reedbeds will require occasional cutting. Later thinning or coppicing of woodlands may be required.[1,4] Tim Marshall has been appointed to write a ten-year management plan for the park and this will be handed to the Olympic Park Legacy

Figure 2: Vision of part of the park in legacy *(www.london2012.com)*

Company. Tim has considerable experience of managing parks on a long term basis having been a landscape architect and Parks Administrator for Central Park, New York.[5]

The Olympic Park Legacy Company is now in place and is responsible for the legacy of the park. Consideration is being given to how governance can maximise private and public investment for the regeneration of the area and stewardship of the permanent assets being created. Following the Games the Olympic Park is expected to be transformed into one of the largest urban parks, of this type, created in Europe for more than 150 years. It will be connected to the tidal Thames estuary to the south and the Hertfordshire countryside to the north, and designed to enrich the local ecology, by restoring wetland habitats and planting native species. 'The canals and waterways of the River Lea will be cleaned and widened, and the natural floodplains of the area will be restored to provide a new wetland habitat for wildlife for birdwatchers and ecologists to enjoy. The natural river system of the valley will be restored, canals dredged and waterways widened.'[4] The park in transformation will become fit for both wildlife and humans.

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AN EVOLVING SUSTAINABLE DEVELOPMENT PERSPECTIVE: THE OLYMPIC GAMES

DR GREGORY BORNE describes how sustainable development has been integrated into the ethos of the Olympic Games and explains what still remains to be done

…to encourage and support a responsible concern for environmental issues, to promote sustainable development in sport and require that the Olympic Games are held accordingly. ***(IOC 2007:15)***

The increasing evidence of humanity's impact on the earth's fragile ecosystem over the past four decades has given rise to the idea that future developmental patterns need to be conducted sustainably. As the excerpt from the Olympic Charter illustrates, sustainable development is a concept that has been embedded in the underlying principles of the Olympic Games. This article will offer a perspective on a way of beginning to understand the impact of the Olympic Games and other events from an evolving sustainable development perspective. The article begins by examining sustainable development and its relationship to the Olympics. A brief evolution of the Olympic Games is presented and some of the milestone events that have catalysed the Olympics and sustainable development are outlined. What is emphasised here are the variability of impacts of the games on their host city and, ultimately, nation. Following this there is an outline of the innovative Olympic Games Global Impact Framework. The article ultimately argues that in order for this framework to be developed and to create a truly sustainable Olympic games in 2012, a reflexive sustainable development perspective is needed.

Sustainable development is now a mainstream idea throughout society. With this said, the concept remains ambiguous, convoluted and constantly changing. It is perhaps this quality, this constructive ambiguity that has facilitated its rapid rise on the political, social, and the economic agenda expanding beyond its environmental origins. Sustainable development has been catalysed in the past few years by its affiliation with global climate change and more specifically global warming. The London 2012 Olympic bid has not only taken these issues into account, it has explicitly used the language of sustainability, no matter how vague and tenuous, to present itself as the first sustainable Olympics. London's 2012 sustainability plan, *Towards a One Planet 2012* (2007), outlines an array of mechanisms and procedures for promoting a sustainable games. This is built on the foundation of five underlying goals: climate change, reducing waste, enhancing biodiversity, inclusion and healthy living. The recognition of these interconnected dimensions is an important step in maximising the positive impacts of the games on London as well as nationally. Importantly, in order to monitor progress towards these targets, the independent Commission for a Sustainable London has been established. The Commission's role is pivotal and the overall perspective that it takes on sustainable development will dictate its effectiveness.

The following section will offer a particular perspective on sustainable development that can accommodate these multiple and overlapping issues. This is done by initially outlining the main events that have had the most significant impact on the relationship between the Olympics and sustainable development to date and are ultimately responsible for London's Olympic bid. This particularly charts the evolution of the emphasis of the games from urban renewal to environmental sustainability and ultimately sustainable development. Moreover, what becomes clear is that the impacts of any particular games are dependent on a great many interrelated variables. Each city has issues that are unique with pre-existing conditions at the city, national and global level which affect overall impact.

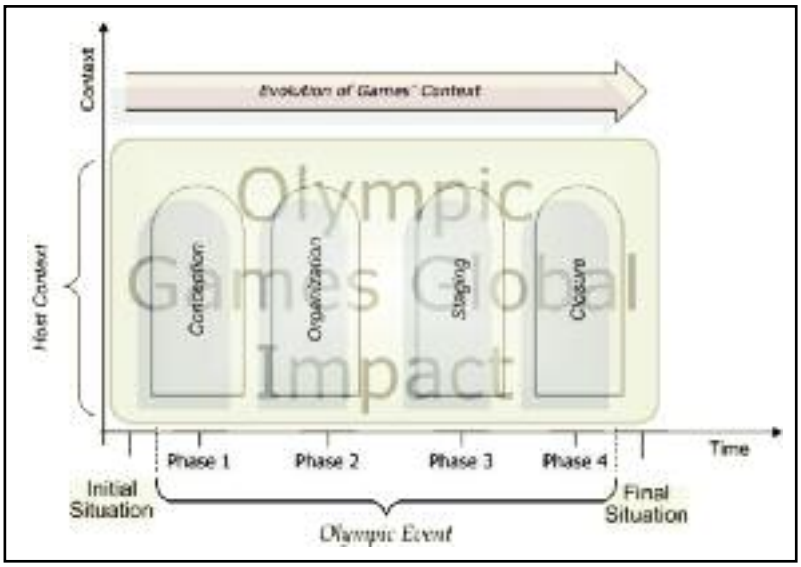
It is well documented that early Olympic bids focused directly on the advantages of urban renewal (Essex and Chalkley 1998). The Rome games of 1960 saw significant renewal that extended well beyond the initial construction of sporting facilities. Tokyo in 1964 used the games to legitimise and strengthen an existing ten-year renewal plan. The games of the 1970s highlighted the effect of external global pressures on the games in the wake of the oil shocks. The following games witnessed varying levels of investment with multiple and variable outputs and impacts. Importantly, it was the Seoul games of 1988 that

emphasised the need for increased environmental standards, especially in the areas of hygiene, air pollution, waste disposal and the significant effort to clean up the Han River. It is no coincidence that these efforts directly followed the publication of the Bruntland Report, *Our Common Future*, by the World Commission on Environment and Development in 1987. It was here that the often quoted 'official' definition of sustainable development was coined. Such events have served to raise awareness of environmental issues and embed sustainable development in the global consciousness. The 1992 United Nations Conference on Environment and Development or 'Earth Summit' has received the most visibility, particularly with reference to the publication of Agenda 21 which is considered by many as the blueprint for promoting sustainable development on a global basis.

The following years saw a number of initiatives that gradually raised the environment and sustainable development on the Olympic agenda. In 1994 the International Olympic Committee (IOC) entered into partnership with the United Nations Environment Programme. Following this the IOC established the Sport and Environment Commission in 1995 and in 1996 the IOC amended the Olympic charter to establish the environment as the third pillar of the Olympics. In 1999 the IOC adopted Agenda 21 at the third World Conference on Sport and the Environment in Rio. The result of these activities was firmly evident in the Sydney 2000 Olympics which saw a convergence between the Olympic Games and the language of sustainable development, with environmental sustainability playing a prominent role in Sydney's Olympic developments. There was recognition by the IOC particularly of the emphasis placed on environmental issues and cooperation with groups such as Greenpeace.

With the above in mind there remains the continuing challenge of translating the rhetoric and the good intention of sustainability into tangible outputs. Indeed, the translation of form into function is a common theme throughout sustainable development related debates. What is clear is that in order to fully understand the impacts of the games from a sustainable development perspective the negative as well as the positive effects need to be considered both directly and indirectly. This involves a shift away from a linear view of impacts, from initial bid and investment to tangible and intangible outputs and impacts. For example, Harvey (1989) has argued that the result of inter-urban competition such as the bidding process for the Games can produce socially wasteful investments which exacerbate rather than improve urban problems. Essex and Chalkley (1998), using the Seoul games as an exemplar, point out that there was a concerted effort to hide the deprived areas of the city leading to claims that such mega events can actually heighten social tensions. Keating (1991) has suggested that the Olympic Games provide advantages only to those with power, vested interest and investment in the games infrastructure. These can include property developers, construction companies, equipment suppliers as well as the commercial sponsors more broadly. With reference to the London 2012 Olympics concerns have been raised over the potential monopoly of multinational corporations as event suppliers. Controversy is already surrounding the potential monopoly during the games by McDonalds and Coca Cola and the impact this will have on the sustainable image of the Games. Many other issues are regularly evident in the media.

Recognising the complexity of the issues involved, the IOC has attempted to expand its understanding of the impact of any one games, and strengthen the relationship between the Olympics and sustainable development. A notable example of this is the commissioning by the IOC of the Olympic Games Global Impact Project Framework (OGGI) for the 2004 Athens games.

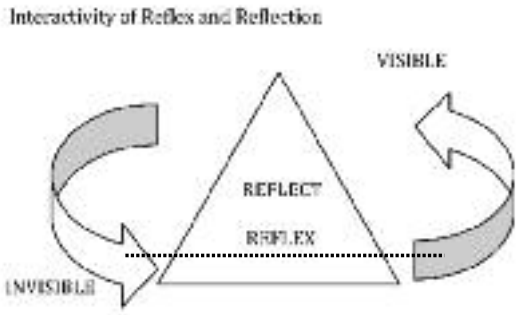


The Olympic Games Global Impact framework for the identification of the sustainable impact of the Olympic Games *(Source: Tzarilas et al 2006)*

Tzarilas *et al* (2006) point out that the Games' impact is defined by the interrelation between the Olympic event and its context of realisation. The framework fundamentally outlines two areas. Firstly space, where the regional, national and global levels are considered. The second is time; here analysis is based on a time scale from announcement of a city's candidacy for the games until a period two years after the conclusion of the games. This time scale is separated into the stages of conception, organisation, staging and closure. Applying the OGGI to the 2004 Athens Games, Tzarilas *et al* (2006) suggest that this process acts as an important evaluative tool for assessment of the impact of the games and a

significant move towards understanding how best to create a sustainable Games. The authors are, however, aware of the limitations of such a tool and suggest developing and expanding its scope and application. Any advancement on initial designs must be tempered with the practicalities of implementing and analysing an expanded model. For example, the post games assessment should be considerably extended, but questions over who would be responsible for such an assessment beyond the two-year period are raised.

What is suggested in this article is that this quantitative tool, as the authors propose, should be expanded to include qualitative elements and broadened in scope to accommodate unexpected impacts from the Games. This perspective displays strong synergies with the emerging perspective of reflexive sustainable development governance (Borne 2009). The notion of a reflexive sustainable development is a position that incorporates the various areas of sustainable development exposing complex, dynamic and non-linear systems. It is a term that combines two fundamental elements. Firstly, reflect, which is the ability to respond to events and circumstances in a purposeful knowledge-based way. This is relatively straightforward and underpins the main stream of assessment and evaluative techniques that are in operation today, even from a sustainable development point of view (Brandon and Lombardi 2005). However, the second dimension of reflexivity, which is reflex, is the ability to make room in an assessment, evaluation and overall governance process that considers the unintended and unforeseen consequences of a particular event.



(Source: Borne 2009)

The above diagram depicts the relationship between reflex and reflection and emphasises the cyclical nature of the processes involved. It is fundamentally the ability to step back from an event and assess the positive and negative outcomes whilst reintegrating these observations back into the evaluative process and governance structures. This form of evaluative process is important at all stages of the policy planning process yet lacks any form of coherent structure in the planning and implementation of so many events. Adopting this flexible perspective is essential when considering the magnitude of such events as the Olympic Games and moves past a sterile and prescriptive vision of sustainable development which will only serve to create at best a misleading and at worst counterproductive assessment of actual impacts.

This article has attempted to briefly highlight the way that sustainable development has been integrated into the underlying ethos of the Olympic Games. It has outlined the relationship between some of the milestone international events and the convergence of the principles of the Olympic Games and the ideas surrounding sustainable development. Moreover, it has argued that the impact of the games and any major event or development should be viewed from a multidimensional perspective that underpins the notion of sustainable development. Building on this it is also argued that while there is already progress towards this perspective more should be done to encourage a sustainable development from a reflexive standpoint. Ultimately, the Olympic Games are a celebration of the enduring strength of the human spirit and human ingenuity. Sustainable development could be understood as highlighting the limits and destructive nature of human ingenuity. However, it is also seen as a guiding concept to redirect human ingenuity as it faces new challenges. Promoting the principles of sustainable development at the 2012 Olympic Games exemplifies the ability of humanity to rise to these challenges.

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CONTAMINATED LAND MANAGEMENT AT THE OLYMPIC PARK SITE AND AN AFTER-GAMES SCENARIO

The clean-up of the Olympic site will require monitoring, maintenance – and keeping information in a form accessible to future generations – if the development is to be truly sustainable, says **KANAN PURKAYASTHA**

History suggests that most of the Olympic grounds around the world were built on a site affected by land contamination. The nature of contamination was different in different places and mitigation measures also varied from place to place in order to address diverse types of contaminants and also to comply with local regulatory requirements. As an example, the Sydney Olympic site[1] was built on an area previously used for land-filling between 1992 and 2000. The London Olympic ground was historically used for different industrial uses and also for land-filling. It has been reported[2] that the site was mainly used for low grade industries such as a car breaker's yard, a distribution centre, a bus yard and a fridge mountain. Besides these uses, the River Lea running through the site was used as an industrial waterway. Other reports suggest that the future Olympic park was a 100 year old waste tip and several factories and workshops nearby were known to be using radium paint between the 1930s and 1960s. In the past, mainly pre-1974, there was no control over the landfill activities, so dumping of household waste in combination with industrial waste, including radioactive wastes, is not unlikely. To decontaminate such a complex site, appropriate and detailed risk assessments and option appraisal for remediation techniques were vital. This article presents some mechanics of contaminated land management and its regulatory interactions.

Planning control and contaminated land regime

Part 2A of the Environmental Protection Act 1990 (EPA 1990) was introduced specifically to address the historical legacy of land contamination. It focuses on the identification and remediation of land which is so contaminated that it gives rise to significant harm or the possibility of significant harm to certain receptors which include controlled waters. Interestingly, it applies only where there is an unacceptable risk assessed on the basis of the current use. It is not directed to assessing risks in relation to a future use of the land, where planning control is used instead.

Planning Policy Statement 23(PPS 23) (Annex 2 para 2.12) states 'for planning purposes, the assessment of risks arising from contamination and remediation requirement should be considered on the basis of both the current use

and circumstances and its proposed new use. In most other respects, however, the underlying approach to identifying and dealing with risk, and the overall policy objective of safeguarding human health and the environment, are similar. A wider range of contamination and receptors is relevant to planning because of its wider spatial perspective but the degree of harm or pollution relevant to planning and the approach to remediation are essentially the same, i.e. unacceptable risk in planning terms includes the risks addressed by part 2A of the EPA 1990.'

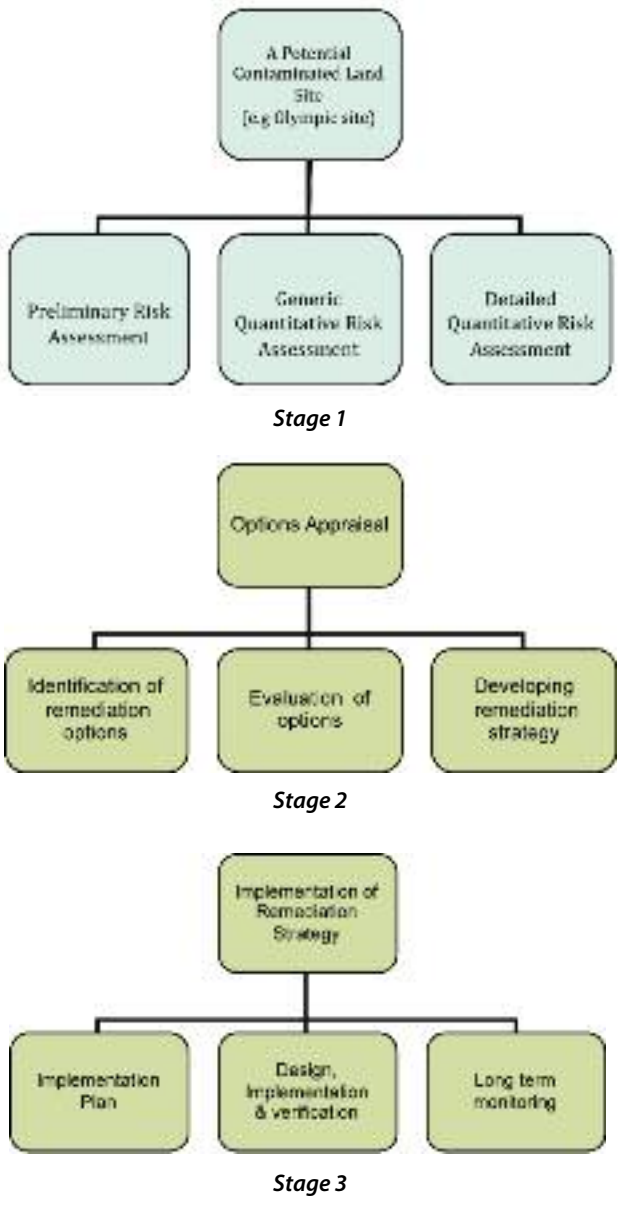
'Contaminated land' is a statutory term. In planning control the term 'land affected by contamination' is used. PPS 23 clarifies the intention of using this term, and states that 'this is intended to cover all cases where the actual or suspected presence of substances in, on or under the land may cause risks to people, property, human activities of the environment, regardless of whether or not the land meets the statutory definition of Part 2A'. Land clean-up activities at Olympic sites were carried out within the definition of 'land affected by contamination'.

Management of land affected by contamination

The scope of the Olympic site clean-up job was large as the site comprises of 2.5 square kilometres of land which was contaminated by heavy industrial use. Assessment of contamination showed that contaminants in the ground included heavy metals, such as arsenic, lead, hydrocarbons such as petrol, diesel and oil, ammonia and coal tar, asbestos and Japanese knotweed. This assessment was carried out to support the 2004 planning application. Over the year to July 2007 over 1,900 of the planned 2,700 boreholes and shallow trenches have been dug and tested.[3] Rock-like material with mild radioactive properties and also low level radium contamination was detected on site. Soil washing as a method of remediating the estimated 800,000 cubic metres of contaminated soil has been used.[4] Billions of tiny naturally occurring organisms are cleaning nearly 50,000

tonnes of contaminated soil on the Olympic park. These tiny organisms eat away pollutants such as petrol and oil left in the soil, though optimum soil condition is required for the effective use of bioremediation. Soil treatment is an important option for the site, but this and other methods require option appraisal according to the Model Procedures for the Management of Land Contamination (CLR 11)[5]. Remedial action varied according to the type and location of the waste and local hydro-geological conditions. As an example, in the case of the Sydney Olympic site, the remediation activities included the recovery, consolidation and onsite containment of approximately nine million cubic metres of waste, several areas of which were contaminated with naturally formed acid sulphate soils. When naturally occurring sulphides (from acid sulphate soils) are disturbed and exposed to air, oxidation occurs and sulphuric acid is ultimately produced. This acid can drain into waterways and have several detrimental environmental effects. Where acid sulphate soils were excavated, these soils were then transported, consolidated in deep pits or used as landfill moulds and covered in a manner designed to avoid acid leaching into local waterways and polluting the environment. Activities like this require a robust risk management framework. The risk management framework set out in the Model Procedure is applicable to a wide range of contexts, and in my opinion, applicable to Olympic ground clean-up as well. The model procedure follows a tiered approach. This is shown in Figure 1. First of all, risk assessment, then option appraisal for remediation and then implementation of remediation.

Figure 1: Model procedure for the management of land contamination



Everyone involved in land clean-up should be aware that there are regulatory interactions, some of which are shown in Figure 2. Who will do what, when and how would be governed by such interactions, though this is not a complete scenario.

It is not possible to discuss all the components presented in Figure 2 in this article. Contaminated land activity relates to the Clean Neighbourhood and Environmental Act 2005 (CN & EA 2005), in which section 104 indicates the authority for making any appeal against a remediation notice served. Sometimes there are judgments from the European Court of Justice (ECJ) of which we need to be aware. One such ruling is that as soon as contaminated land is dug out, it is classified as waste. Another ECJ judgment is that the administration had incorrectly transposed the EU EIA Directive to British law. This means that environmental impact assessment (EIA) can be carried out as a reserve matter. Contaminated land activities are closely related to the Building Regulation 2000 (Approved document C1 and C2, where C1 relates to site preparation and resistance to contaminants and C2 relates to resistance to moisture). These are some of the examples of the interactions presented in Figure 2.

Developers

DETR Circular 02/2000 (which is now withdrawn but pertinent to Olympic park development site) and current Defra Circular 01/2006 make clear that 'where new development is taking place, it will be the responsibility of the developer to carry out the necessary remediation'. PPS 23 states that '…a developer should be aware that actions or omissions on his part could lead to liability being incurred under Part 2A'. In this case PPS 23 gives an example as 'where development fails to address an existing unacceptable risk or creates such a risk by introducing a new receptor or pathway…' So, this is a caution for all. It should be fit for the purpose for which it is intended.

Verification

Quality assurance is an important issue throughout the implementation of a remediation strategy. CLR 11 indicates two main elements for such assurance:

1. an accurate and permanent record of remediation and the standard it has achieved
2. need for any maintenance and/or monitoring to achieve or demonstrate ongoing effectiveness of remediation.

In the case of (1) above, a developer should produce a verification report. According to CLR 11, 'a verification report provides a complete record of all remdiation activities on site and the data collected as identified in the verification plan to support compliance with agreed remediation objectives and criteria. It also includes a description of the work and details of any unexpected conditions found during remediation and how they were dealt with'.

It is important to bear in mind that the verification report for remediation work at the Olympic ground should, as a matter of good practice, be kept in an accessible form for at least 25 years as suggested by PPS 23.

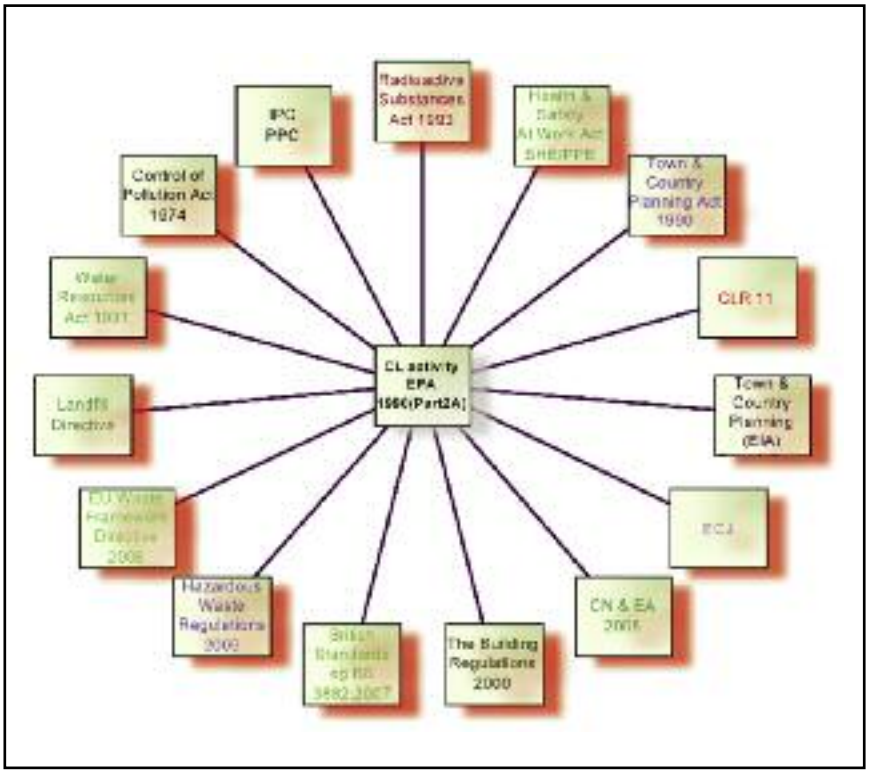


Figure 2: Regulatory interaction with contaminated land (CL) activity

The time to start planning ahead

Assessments of risk and remediation consider future use in addition to current use in a planning control regime. In my opinion, one can consider this further as 'future of the immediate future'. In the case of the Olympic Park development, immediate future use is as a sports ground, temporary shelter, offices, etc. But the long term plan for using the site after Olympic activities could be different. Current planning control activities should think about that aspect of development in order to make the development activities as a whole sustainable. Monitoring and maintenance schemes should be in place, not only for assessing the efficacy of remediation at the site but also the assessment of further needs for remediation and management in a post-Olympic stage of reuse and redevelopment (where necessary).

Besides the land clean-up issue, there are other interrelated environmental issues such as the Olympic Games' carbon footprint. The Olympic Delivery Authority (ODA) estimates that the carbon footprint of the 2012 games would be 3.4 million tonnes of CO_2 equivalent.[6]

Conclusions

Long term planning and an integrated approach to remediation, reclamation and green space creation on the Olympic site will bring a wide range of benefits to the environment and the community as a whole. A risk based approach should, therefore, be used which ensures that the risks are adequately assessed and appropriate remediation methods are adopted through an option appraisal. One should appreciate the effect of different remediation technologies on some important soil properties. Proper documentation in the form of a verification report for remediation work is paramount. There is no doubt that monitoring, maintenance and keeping information in an accessible form for future generations will make this current development effort more sustainable.

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MATERIAL USE AT THE OLYMPICS: A CASE STUDY OF PVC

Media coverage of sporting competition at the Olympic Games may last a short time but, reports **MARK EVERARD,** the construction phases beforehand and the role of infrastructure in regional regeneration afterwards have a long legacy

Issues of material choice in construction occasionally rise into the global spotlight as each successive recent Games has vied (or at least claimed) to 'out-green' the last. So it is illuminating to look at the profile of one such material, PVC, over time.

The history of PVC with the Olympics movement has been, to say the least, patchy. By and large, it has followed opinion about the material as expressed through the press, but latterly it may just be moving into leading informed opinion. At times, attitudes to PVC have been swept up by the tide of 'green materials' and 'green procurement', though generally informed by short-sighted opinion about 'green' or 'non-green' materials generally assessed uncritically and irrespective of the pedigree of manufacture or the implications of longevity, maintenance and recyclability. However, as society has become increasingly literate about the more complex implications of sustainable development, so too there has been a shift in attitude to the plastic.

The Berlin Olympics 1936 and beyond

That PVC has not automatically been the darling of the Olympics movement over recent decades is ironic. After all, one of the first commercial installations of PVC products was for water supply piping in the city of Berlin from around the time of the 1936 Berlin Olympics. Some of these pipes are still *in situ* and in use today, demonstrating a very efficient, largely maintenance-free delivery of services from a relatively small pool of inherently recyclable resources.

Sydney Olympics 2000

When, in September 1993, the Australian city of Sydney won the right to host the 2000 Olympic Games, it set about drafting the Environmental Guidelines for Olympic Construction. Greenpeace was given the opportunity by the Australian Olympic Co-ordination Authority to comment upon the Olympic Village and other aspects of construction and infrastructure for the Sydney Olympic Games. Greenpeace was at the time campaigning against all chlorinated products, for example in its campaigns in Europe including its PVC Alternatives Database. This was reflected in the environmental guidelines which note the aspiration of '…minimizing, and ideally avoiding, the use of chlorine-based products such as PVC'. As the books *Polymers, the Environment and Sustainable Development* (Azapagic *et al*, 2003) and *PVC: Reaching for Sustainability* (Everard, 2008) make clear, there was some substance to the Greenpeace attitude to PVC. However, much of it was invalidated by assumptions about outdated manufacturing methods and over-simplistic generalisations about chlorine-containing compounds, and critically also by a lack of comparative whole-life assessment of alternative materials to justify this position. For example, some suggested alternative materials – including copper for guttering and drainpipes – have their own potentially serious toxicological, persistence, supply shortage, ethical procurement and other issues which were entirely overlooked, and the greater durability and low maintenance requirements of PVC were not assessed in the overall judgment of sustainability.

The anti-PVC case for the Sydney games attracted considerable 'column inches' of unsporting language from various commentators. Even at the time of construction, minimisation of PVC at Sydney was far from unanimously supported, with the commitment weakened by the games' hosts merely to minimise PVC use (as reported in the online *Fact Sheet – The Environment*). The Australian consultancy BIS Shrapnel produced a report for the Vinyl Council of Australia in 1994 looking at *The Impact of Replacing PVC with Alternative Construction Materials*, which cast doubts on the benefits of PVC minimisation. Then, in 1996, CSIRO (the Commonwealth Scientific and Industrial Research Organisation: Australia's national science agency) published a review of the environmental aspects of PVC building products relative to available and commercially-viable alternatives, which came to some interesting conclusions (CSIRO, 1996). CSIRO states that, 'The adverse and environmental effects of using PVC in building products are very small, and no greater than those of other materials.' Furthermore, the report notes that, 'Although little detailed comparative information is available, the balance of evidence suggests that there is no alternative material to PVC in its major building product applications that has less overall effect on the environment.'

Informed by CSIRO's conclusions, the Minister for Public Works for the State of New South Wales (NSW wherein Sydney is located) acknowledged the situation by stating in writing in 1997 that, firstly, PVC was a proven and valuable material with the CSIRO report showing PVC's environmental profile to be sound and, secondly, in future government projects PVC and all other materials would be assessed on their true comparative merits (reported by the Vinyl Council of Australia). This position

The Athens Olympics

was formalised in the NSW Government's Procurement Policy Statement of January 1999, which states that, 'Products will be assessed equally and impartially on their demonstrated comparative merits in terms of performance, cost and environmental impacts. Expert scientific opinion, where available, should form the basis for such comparisons.'

CSIRO's conclusions were substantially verified by another CSIRO report in 1999, looking at new research results and public and industry responses emerging since the 1996 report. This 1999 CSIRO study reviewed all the scientific literature on PVC as a major building material, albeit from the limited perspective of 'manufacture-to-disposal' (i.e. ignoring capacity for reuse and recycling), yet still largely confirmed the conclusions of the 1996 report. It concluded that there was no valid scientific justification for an anti-PVC clause on environmental grounds as the plastic, the most heavily-scrutinised of all bulk materials, was not substantively worse for the environment than its alternatives.

In retrospect, and with the benefit of objective scientific assessment of PVC and alternative materials, it is hard to see what good was served by the PVC minimisation clause at the Sydney Olympics. In practice, the result of this clause was that the amount of PVC actually used on the Sydney site was about half of what it would otherwise have been, with the longer-term legacy including support for science-based, comparative evaluation of materials in public procurement in NSW. Upon completion of construction, the report *Olympic Facilities at Homebush Bay: The Impact of Replacing PVC with Alternative Construction Materials* (BIS Shrapnel, 2000) explored the economic impacts of PVC minimisation across three key application areas: (1) sewerage piping, stormwater drainage and DWV (drainage, waste and vent); (2) electrical and communications cabling and conduit; and (3) roofing, shade structures and temporary buildings (marquees). For this third category, there are generally no alternatives to PVC. The additional cost of not using PVC products at Olympic facilities at Homebush Bay was estimated to be US$10 million (16.7 million Australian dollars at 2000 rates) including labour costs, representing a 39% increase over baseline cost had there been no PVC minimisation clause. This is not to say that cost minimisation is of itself adequate rationale of sustainable decision-making. (For example, human societies throughout history have come to recognise that the cost-savings reaped by practices such as slave labour or illicit waste disposal are inherently

immoral, unsustainable and, ultimately, may have substantial hidden costs.) However, since the CSIRO reports found no net environmental benefit from these additional costs and also called into question the lack of comparative environmental analysis of substitute materials, the contribution to sustainability 'bought' by PVC minimisation remains moot.

Athens Olympics 2004

By the middle 2000s, spurred on by influence on the Sydney games, the Olympic movement, along with such prestigious sporting tournaments as the football World Cup and the Commonwealth Games, was seen by various pressure groups as a highly visible flagship for campaigning. Much good has come from this, with pressure at various Olympic Games making a tangible difference, or else promoting a clear message, about disparate sustainability issues such as repressive regimes and broader human rights; ethical performance along supply chains; racial and disability issues; environmental responsibility in the procurement of timber; and water efficiency in construction.

When Athens was still only a candidate host city for the 2004 Games, the Greek authorities made their position clear by stating that, 'The Olympic Games are a challenge as well as an opportunity for the broad implementation of programs and actions which are environmentally friendly and in accordance to the principles of sustainable development… Projects will be realised with the use of environmentally friendly technologies and materials, and this will be a prerequisite in all relevant tenders' (reported by IEMA, 2005). WWF advised the Athens Olympics that '…it is recommended that the use of materials from PVC, PCB and other chlorinated products is avoided.' This sweeping generalisation does rather ignore substantial distinctions in the nature of different chlorinated compounds, and of course the chlorine content of surrounding seawater and biological matter.

However, the Athens Olympics has since been roundly slated by environmental interest groups for paying at best only lip service to its own boldly-stated aspirations. From energy use to the lack of requirements for sustainable wood products, paint and other finishes, conservation and recycling of water, consultation with local communities and indeed choice of other materials including PVC, sustainability considerations do not seem to have been of great practical concern in delivery of the 2004 Olympic Games.

Beijing Olympics 2008

Greenpeace was again active in campaigning against PVC and other chlorinated chemicals in the run-up to the

The Beijing Olympics, 2008

Beijing Olympics, noting in its document Environmental Assessment of Olympic Sponsors that it had '…asked the three electronic sponsors of the 2008 Beijing Olympics, namely Lenovo, Panasonic, and Samsung, to provide PVC- and BFR-free products for the Olympics' although the document acknowledges that only one product produced by one company (just one model of phone supplied by Samsung) complied. Furthermore, a great deal of PVC-based merchandise, ranging from dolls and mascots to bags and flower pots, was available on-line for the Beijing games and is still listed at the time of publication of this article. Little or nothing relating to PVC is listed on the 'infrastructure' or other pages of the official website of the Beijing 2008 Olympic Games, and details remain scant regarding the attitude to PVC of the event's organisers. However, it is thought that the Beijing 2008 Olympics used rigid PVC for a range of lightweight and durable construction and related infrastructure projects, and the official website notes that swimming pools will be re-lined with PVC membrane. It seems that sustainability issues around PVC, as for other material choice considerations, was not a major preoccupation of the Beijing Games.

The opportunity for London 2012

Rather than starting out with blanket, naïve judgments about 'good' versus 'bad' materials, the Olympics Delivery Agency (ODA) for the London 2012 games is defining its role as a catalyst for change. This includes the potential for long-lasting local and regional regeneration, which is such a significant element today of assessment of bids for selection of host city for the Olympic Games. However, this 'catalyst for change' role is also being defined by the ODA team as relating to materials, transport, packaging, carbon footprint, social impact and a host of areas wherein the ODA intends to 'push the market' towards sustainability.

Timber, for example, will have to be certified under one of four accreditation schemes, high-performance concrete is expected to have a minimum pulverised fuel ash content, and recycled materials are encouraged. However, the major enlightenment with respect to materials is that the ODA does not seek to be prescriptive, but instead to work with industry to advance the sustainability case upon which final decisions will be made. Best practice is assumed; the procurement strategy is intended to go beyond this by pushing industry to the limits of sustainable innovation. There will be recognition of creativity, based upon a solid definition of sustainability and marked by practical steps towards it. Durability, biodegradability and/or capacity for recycling will all be explicitly factored into this overall assessment, which extends beyond material production alone to also consider design life, inputs into maintenance, capacity for reuse or recovery for recycling, and so forth. The ODA also set various requirements for materials handling, including that 50% of all products transported onto the Olympic site will arrive by train or boat, relieving road congestion and wear and also reducing associated carbon emissions. The scale of this challenge is formidable, with millions of tonnes of materials to be delivered and, on a daily basis, up to 9,000 workers to move on and off the site. Consequently, the ODA has spent millions of pounds improving rail and water links so that goods can be brought onto site by train and barge in addition to truck, contributing to timely delivery and the Games' sustainability credentials. The 9 June 2009 edition of the on-line magazine *Building* reports that the ODA was already beating its 50% target by moving 57% of materials by rail or water, though large, prefabricated structural items have to be brought in by road.

The 4 June 2009 edition of the on-line journal *Process Engineering* reported that Ian Pearson, Economic and Business Minister at the UK's Department for Business, Enterprise and Regulatory Reform (BERR), confirmed that PVC materials will be used at the 2012 Olympic Games in London. This is a welcome triumph for material choice based upon a 'level playing field' of sustainability criteria rather than uncritical reaction to single-issue campaigning. On this score, PVC has much to offer in various applications due to its light weight, durability, low maintenance requirements, inherent recyclability by physical and chemical routes, and long service life per unit of resources.

The case for PVC

It has long been accepted that two pieces of wood can be of significantly different sustainability impact at point of purchase, depending upon whether or not they comply with a number of requirements set out in various accreditation schemes including that of the exemplary Forest Stewardship Council (FSC). It is slowly dawning upon society that this is also the case for all other materials, from copper to aluminium, glass to concrete, and polyethylene to PVC. There is no doubt that different methods of production of ostensibly identical PVC may impart a radically different set of environmental and ethical impacts, particularly so when all additives entailed in compounding are also factored into the equation. The pinnacle for PVC is recycling by chemical or physical routes, which has massively lower embodied and other associated sustainability impacts. The distinction between PVC compounds, as indeed all other materials, from different suppliers and production methods is far from immaterial to their sustainability credentials.

However, we are, let's hope, beginning to put behind us a blinkered view merely of the procurement of a material, and starting to look with more discrimination at the whole use and reuse cycle to make rational judgments of overall sustainability. In use, the adaptable nature of PVC suits it well to the efficient delivery of a wide range of services. Furthermore, the material is tough and resistant, requires

little or no maintenance including no inputs of preservative or other troublesome chemicals, has a long life also averting the expense and disruption of more frequent replacement or repair, and remains stable with little or no loss of constituents over its very long service life. (The PVC pipes installed in Berlin in 1936, some of which are reportedly still in service, are a case in point.) As a thermoplastic, PVC is also inherently reusable or recyclable by either physical ('melt and squirt') or chemical routes when products reach end-of-life. The delivery of substantially extended human value per unit investment of energy and molecular content makes a considerable contribution to the sustainability of PVC in various durable applications.

These potential benefits in no way obviate the necessity for wider sustainability issues to be addressed in the PVC value chain. However, in many applications, including many durable infrastructure components such as those supporting the Olympics, PVC has the potential to deliver substantial sustainability benefits relative to alternative materials. Add to this the potential to reuse durable products and materials, and also its inherent recyclability, and each unit of investment of energy and matter in PVC delivers even more human benefit through successive extended lifetimes of service.

PVC making for 'greener' Games?

PVC serves as an example to illustrate wider material considerations. Incautious sourcing, dirty manufacture, wasteful use and profligate or cavalier disposal of PVC and indeed all other materials deserves every ounce of ire that environmental pressure groups can muster. However, blanket generalisations often serve only to drive naïve, reactionary decisions with dubious sustainability credentials. Sustainability is best served by making material choices that reflect optimal and increasing performance over life cycles of use and reuse, with informed decisions and targeted pressure exerted to maximise this for the benefit of all of society.

The messages implicit in this article will not be popular to those wedded to a blinkered focus on 'green materials' based on procurement alone, with no discrimination of different production methods, interest in fate at end-of-life of products, nor interest in major sustainability issues across extended use and reuse. However, the scientific reality is that PVC possesses many positive, sustainability-relevant properties in durable applications that are not equally shared with many competitor materials.

In London and in future Olympic Games, as indeed in all other long-life applications, a level playing field of scientific evaluation best serves the cause of sustainability.

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AIR QUALITY AND THE OLYMPIC DREAM: BEIJING 2008 AND LONDON 2012

China went to extraordinary lengths to protect athletes and spectators from the worst effects of the chronic atmospheric pollution in Beijing. **DR CLARE HOLMAN** looks at the air quality challenge now facing London

Standing in Tiananmen Square one Friday evening in July 2001, surrounded by locals, I felt hugely pleased that the International Olympics Committee (IOC) had that day announced that Beijing was to host the 2008 Olympics and was honoured to be sharing the celebrations with so many enthusiastic locals. Little did I know that six years later I would be appointed a Commissioner for a Sustainable London 2012, helping the London Olympic team deliver their promise of the most sustainable games of the modern era.

Beijing 2008 – One World One Dream

Since the 1980s, rapid industrial development, urbanisation and increases in traffic have resulted in severe air pollution in Beijing. With five ring roads and a ban on bicycles in the city centre, Beijing's growing affluent class have take to the car in a manner seen in few other Chinese cities. In recent years the number of cars in Beijing has increased sharply at a rate of 10-20% each year.

As part of an EU team advising the State Environmental Protection Authority on how to introduce European emission limits and the use of fiscal instruments such as fuel duty to control vehicle emissions, I had an insider's view on some of the challenges that lay ahead. The Chinese introduced Euro 1 emission limits for cars about eight years after they were mandated in Europe, and promised that by the Games new vehicles in Beijing would meet current EU standards. However, the Chinese authorities found understanding and implementing the complex requirements problematic. At the time there were reports of early Euro 1 cars coming off the production line with incomplete pollution control systems; no catalysts were fitted. Given the large cost on the international market of platinum and the other platinum group metals required to make the system work, it is perhaps unsurprising that the Chinese motor manufacturers sought to save costs. Another problem was that testing laboratories each interpreted the procedures for measuring vehicle emissions differently. When the same car was tested at a number of different laboratories, no correlation was found, making strict and consistent enforcement of the requirements difficult.

Despite efforts to reduce emission since the late 1990s researchers from the Chinese Research Academy of Environmental Sciences in Beijing (Wen-Xing *et al*, 2008), found that in the year before the Games the average daily concentrations of ozone and inhalable particles exceeded the Chinese air quality standards. Nitrogen dioxide was less of a problem and concentrations of sulphur dioxide and carbon monoxide were below the standards.

The emissions from the poorly-controlled and growing vehicle fleet and local industry combined with local weather conditions, particularly the dry air and lack of rain, cause the build up of air pollution. July, a month renowned for its poor air quality in Beijing, is when the Olympic Games typically commences. The first action was to postpone the start until 8 August, almost two weeks later than the start date of the London Games.

In the lead up to the Beijing Olympics there was increasing concern over whether poor air quality would impair athletes' performance. The IOC warned it might reschedule endurance events to avoid health risks. Sports scientists in the leading Olympic countries were involved in a secret competition to best equip their athletes for the conditions in Beijing. A number of teams, notably those from the USA and UK, developed special masks to protect their athletes' lungs. There were heated debates within the press as to whether athletes should be allowed to wear them during the games or just during training. The British masks were commissioned by UK Sport's Research and Innovation Unit and designed by scientists at Brunel University. The British Olympic Committee announced that its athletes would use them, if necessary, for the competitions. The Americans, on the other hand, not wanting to embarrass the Chinese authorities, announced that they would only wear them for training. The Canadians and Australians announced that their teams would not wear them at all.

A series of measures were introduced from 20 July including closing polluting industry, replacing the use of coal with gas where possible, and taking more than half Beijing's 3.5m cars off the road during the Games. The authorities also banned the use of more than 300,000 high emission vehicles, mostly heavy goods vehicles. Private vehicles were only allowed to drive on alternate days.

A week before the start of the Games, following four consecutive days of poor air quality, new emergency measures were announced to attempt to solve the problem (Farago, 2008). In the event of unfavourable weather 150 more factories and coal-fired power plants would be

London smog

closed, and another 10% of vehicles taken off the streets. Work was suspended on major construction sites.

UK consultants, Cambridge Environmental Research Consultants (CERC), were commissioned to provide three-day pollution forecasts that were posted daily on the internet by the Beijing Municipal Environmental Protection Bureau, to allow the Chinese authorities to monitor the effect these cuts had on air quality.

In the event, a weather front brought rain and cleaner air from the south, and this coupled with the control measures, saved the Chinese authorities from embarrassment. The day before the Opening Ceremony, the IOC praised China's 'extraordinary' efforts to clean up pollution ahead of the Games.

A study lead by Max Zhang (Cornell University, 2008) investigated air quality in the Beijing in the lead up to the Games. It found that car emissions of black carbon were down 33% in 2008 compared with their 2007 readings and ultrafine particles (PM_{10}) emissions decreased by 78%.

Another study investigated PM_{10} concentrations from two weeks prior to the Games, to four weeks after the Games (Wang *et al*, *2009)*. The researchers found that meteorological factors accounted for 40% of the variation in PM_{10} concentrations and the control measures 16%, suggesting that the weather was more important than the reduction in emissions in improving the air quality.

Since the Games, I understand that air quality has deteriorated as the restrictions on emissions were lifted.

London 2012 – Towards a One Planet Games

Air quality in London is much better than Beijing, yet the UK Air Quality Objectives and EU limit values are not being achieved, because the PM_{10} objectives/EU limit values are one third of those used in China.

The five London 2012 host boroughs – Greenwich, Hackney, Newham, Tower Hamlets and Waltham Forest – have all declared Air Quality Management Areas (AQMA) due to high concentrations of both PM_{10} and nitrogen dioxide (NO_2). Four of these cover the whole borough, and one covers the main roads in the borough (UK Air Quality Archive, 2009). The UK Government has recently applied to the European Commission for postponement of the deadline for achieving the PM_{10} objectives in London by three years to 2011. Other countries that have applied have had their applications rejected, so whether the UK will be successful is uncertain.

In London, while PM_{10} is a problem in some parts of the capital, exceedences of the annual mean nitrogen dioxide (NO_2) objective is much more widespread. According to the background concentrations maps – produced as part of the UK Government's Local Air Quality Management regime – 40 km² in London currently exceeds the EU annual mean limit value for nitrogen dioxide (NO_2) (UK Air Quality Archive, 2009). The UK Government has already announced that it intends to apply for postponement of the 2010 limit values to 2015. Analyses undertaken on behalf of Defra show that the EU limit value will continue to be exceeded in parts of London even in 2015 (Vaughan, 2009).

The London 2012 games slogan – 'Towards a One Planet Games' – comes from the One Planet Living® concept, developed by WWF and BioRegional, that if the whole world was to have the same impact as the developed countries do now, we would need three planets to sustain the global population. Through the building of venues and infrastructure, staging the Games themselves and then the long term legacy the London 2012 team is committed to sustainability, focusing on five key areas. These are combating climate change, reducing waste, enhancing biodiversity, promoting inclusion, and encouraging healthy living. None specifically focuses on air quality, and a search of both the London 2102 Sustainability Plan (London 2012, 2007a) and its update (London 2012, 2008) reveals just one reference to air quality. All competition venues will be operated as 'low emissions venues' at Games-time. Standards, higher than those for the London-wide Low Emissions Zone in force at the time, will apply to all accredited vehicles entering venues. The low emissions venue concept will extend to minimising emissions from fixed infrastructure, including temporary generators and cooling and refrigeration systems.

It is just under three years until the London 2012 Games start, and is therefore premature to judge their air quality performance. However, construction is well underway and the Olympic Delivery Authority (ODA) has signed up to London's guidance on reducing the impact of demolition and construction on dust and emissions (Greater London Council and London Councils, 2006). The London 2012 website states that, 'The monitoring and control measures detailed in the Best Practice Guidance will be adopted, in so far as is reasonably practicable.' The ODA has established a PM_{10} and dust deposition monitoring programme, and monthly reports are published on the website, and so far their contractors appear to be controlling emissions effectively most of the time.

However, the Campaign for Clean Air in London has joined forces with the Environmental Industries Commission (EIC) in calling for the ODA to ensure that the most polluting equipment used on site is fitted with pollution control technology, which will reduce particulate emissions by at least 85%, in line with the London guidance. The EIC, as the trade body for environmental technology equipment and services suppliers, has a direct interest in promoting the use of this technology. Danny Stevens, EIC's Policy Director, says: 'London is supposed to be a showcase for the world – demonstrating that it can put on the greenest Olympic games to date. Yet a commitment to tackle harmful emissions from the construction machinery used on site is being ignored.' There is ongoing discussion about the commercial feasibility of retrofitting expensive machinery with devices that may invalidate the manufacturers' warranties.

> "The UK Government has recently applied to the European Commission for postponement of the deadline for achieving the PM_{10} objectives in London by three years to 2011. Other countries that have applied have had their applications rejected, so whether the UK will be successful is uncertain."

London 2012's main contribution to cleaner air in London is the transport plan (London 2012, 2007b). As the ODA Chief Executive David Higgins recently said: 'Our aim is to get 100% of spectators to the Games using public transport, walking or cycling to events in 2012.' No public car parking will be provided, and tickets will include free use of London's public transport system. The only parking will be for the disabled and Games officials.

To realise the dream of a 'Public Transport Games' significant investment in public transport has and is continuing to take place. This includes the extension of the Docklands Light Railway from Canning Town to Stratford International with four new stations, and the Javelin® high speed service which will link St Pancras to Stratford in just seven minutes. Stratford Station, is being improved to cater for the anticipated 120,000 passengers who will arrive and depart each morning during the Games. Around 60% of all spectators travelling to the Olympic Park will use this station. A network of cycle paths and walking routes are being developed, connecting

the Olympic Park and other venues to the wider London networks.

During construction no parking has been provided for workers, and 10% are walking and cycling to the Olympic Park, with thousands more taking public transport to and from the site. The impact of deliveries to the Olympic Village has been reduced by opening up the waterways to allow 350 tonne barges to deliver construction material by water. Waste will be taken through the newly opened Three Mills Lock on the Prescott Channel to a specialist recycling centre in Rainham, Essex. One of the London 2012 sustainability targets is that 50% of construction materials (by weight) would be transported by rail or water. In April 2009, the ODA announced that it was achieving 57% of deliveries by rail alone.

"The limits are mandatory but current Defra cost benefit analysis suggests that the cost of achieving them outweighs the benefits. If the European Commission does not allow the deadlines to be deferred, it might well be that the Government considers it more cost effective to pay the fines than clean up our air."

Despite the impressive plans and sustainability targets clean air campaigners are using London 2012 as a focal point to gain political interest in meeting the EU air quality limit values. On 27 July 2009, three years to the day before the London 2012 opening ceremony, ClientEarth, a group of lawyers committed to protecting the planet, launched a campaign, with the support of the Campaign for Clean Air for London, to ensure full compliance with air quality laws in London in time for the Olympics. The long-established environmental pressure groups such as Friends of the Earth, seem to have forgotten about air pollution, and new groups have emerged to fill the gap.

The limits are mandatory but current Defra cost benefit analysis suggests that the cost of achieving them outweighs the benefits. If the European Commission does not allow the deadlines to be deferred, it might well be that the Government considers it more cost effective to pay the fines than clean up our air. What is clear is that these groups will be using the London Olympic and Paralympic Games to demand that serious attention is given to air quality. After all, official estimates are that thousands of lives are shortened each year as a result of poor air quality, particularly PM_{10} pollution in the UK. One of the legacies of the Beijing Olympics is that clean air is important, and our Government should not ignore it.

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STRATEGIC ENVIRONMENTAL ASSESSMENT OF THE TURIN 2006 OLYMPIC WINTER GAMES

ATTILIA PEANO and **GRAZIA BRUNETTA** look back at the planning for a 'mega event' – the 2006 Winter Olympics in Turin – and the assessment of the Games' legacy

1. What is the Olympic Programme? Why was a Strategic Environmental Assessment necessary?

The Programme for the 'Turin 2006 Winter Olympics' (or more briefly the Olympic Programme – OP) was a document, prepared by the Organising Committee, which defined and coordinated a set of actions to be carried out in order to implement the best possible conditions for hosting the Olympic Games in the city of Turin. Its intention was to strengthen and improve existing facilities, services, natural areas, road networks and transportation, reducing shortcomings, bottlenecks, and situations that might have jeopardised or impeded the overall success of the Olympic events. The Programme specified what was already contained in the dossier for candidate cities, which was used by the International Olympic Committee (IOC) to select Turin as the site for the Olympics.

Even if most of the facilities, equipment, and services necessary for the hosting of the Winter Olympics already existed, actions for the planned completion and improvement required a total public and private investment of over €1000 million. These new projects had significant effects on the physical, socio-economic, and cultural environment of Turin and other territories involved. On one hand, if not adequately controlled such projects might cause undesirable effects: on spaces and natural resources (initially on water, air, and land); on the landscape; and on the living conditions of the local communities. On the other hand, they might, if adequately controlled, improve environmental quality and increase long-term development opportunities for the local communities. They could also promote the image and attractiveness of Turin, with effects that would be felt well beyond the conclusion of the Games.

In particular, the OP concerns a package of interrelated actions necessary for the successful outcome of the Olympic event, initially outlining their typology and dimensions. Overall, this set of interventions can be categorised into two main types of development:

(i) the improvement of sports, recreation, and reception facilities in Turin and in the 'Olympic valleys';
(ii) the improvement of accessibility and mobility, including the completion of some infrastructural developments that had already been planned, or were already under way, and the proposal of new ones.

If, on one hand, the OP presents ample margins of flexibility regarding the completion of the planned projects, the interaction with other facilities, the planning and technical characteristics; on the other it introduces an element of considerable rigidity in the process of assessment. This rigidity concerns the indivisible nature of the interventions proposed in the programme. The package of interventions cannot, in fact, be modified, due to the agreements reached with the IOC during the candidacy phase. The feasibility of the OP, therefore, implies that all of the works outlined in the 'Candidate Dossier' (2000) can be carried out, even with the possibility of introducing eventual settlement variances, actions of environmental mitigation and compensation as a result of the SEA process.

Therefore, the Strategic Environmental Assessment (SEA) – provided for by Regional law 40/1998 as well as by the European Directive 2001/42/CE – 27 June – aimed to consider and highlight all the positive and negative impacts that implementation of the OP may generate on the physical, socio-economic, and cultural environment of the territories involved, in such a way as to avoid or minimise negative impacts and reinforce positive ones. It therefore assessed not only what would happen during preparation for the Games and during the Games themselves, but also what might happen subsequently as a result of the infrastructure projects. It considered each project as an integral part of the OP: the assessment looked at the system and not each individual project. This is where the Strategic Assessment is distinctly different from the Environmental Impact Assessment that is applied to individual projects.

According to the provisions established by the European Directive and the European Guidelines (EC, DG XI, 1998 and 1999; Spectra, 2000) the SEA process consists of evaluation and monitoring of all planned initiatives, from the elaboration phases, through to the implementation and management of the projects. Through this assessment approach, the Piedmont Region, in accordance with the Environmental Ministry, is called upon to express a 'judgment of compatibility' that should allow the Organising Committee to proceed with the development of the OP. In the following paragraphs we describe the studies that Turin Polytechnic carried out to support the preliminary phase (or *ex ante* stage), started in 2000, and the monitoring phase (*in itinere* and *ex post* stages) of the SEA process developed over the years 2003-07 (Brunetta and Peano, 2003; Peano, Gambino and Mondini, 2005; Peano, Bottero, Gambino, Mondini and Raffestin, 2007).

2. The approach of the Environmental Assessment Study. A multidisciplinary and articulated assessment process – the *ex ante* phase

The OP Environmental Assessment Study (EAS) has the basic objective of analysing the environmental impacts – both positive and negative – that the implementation of the Programme could potentially cause, over short or mid-term periods of time, on spatial, socio-economic, and cultural aspects of the area directly involved (Peano, 1992; Lewanski, 2002). Beginning with this aim, the elements of the EAS approach are outlined below:

- **Systemic character** – This defined a technical and deliberative assessment process within the decision making process, which aimed to involve, during the *ex ante* phase of open comparison, the institutional stakeholders associated with spatial planning (regional and municipal administration, mountain communities, province). The starting point of the *ex ante* assessment was the comparison of the proposals contained in the OP, which resulted in reaching a first level of consensus for the entire assessment process.
- **Procedural character** – This outlined an assessment process aimed to interact closely with the progressive definition of strategies, capable not only of reacting with flexibility and continuity to the specifications of localised and pre-planning adjustments, but also of orienting them towards quality objectives and environmental sustainability. To this end, the *ex ante* stage is not tied only to other phases of the SEA, but also to the Environmental Impact Assessment (EIA) of each Olympic project. The OP SEA is, therefore, a learning process that is gradually evolving, and not only a technical procedure of analysis and assessments.
- **Qualitative character** – The OP guidelines imply the prevalently qualitative nature of the assessment of probable effects on the environmental resources. The objective is, therefore, the assessment of the coherence of a series of planned actions and measures with objectives shared with local plans and Programmes, with the final goal of reaching a qualitative estimate of negative impact on the environment.

The assessment process in this initial stage (*ex ante*) of SEA has required a series of individual, specialised analyses – identification of the environmental context, defining of objectives, identifying alternatives, environmental assessment, defining indicators and monitoring procedures – to be integrated into assessments and the proposals for measures aimed at guaranteeing a functional relationship between the OP and the environmental system. In this article, only certain aspects of this process are discussed.

To begin with, the identification of the environmental context, which, in the case of the Olympics consists of a spatial context with a variable geometry in relation to the multiplicity of related problems, for which current and forecast scenarios have been constructed in order to guide the effects of the OP. In consideration of physical-environmental, socio-economic, urban-settlement, and infrastructural aspects, relevant situations and critical perspectives have emerged, at the levels of overall territorial systems and territorial subsystems (Turin and the 'Olympic valleys'). These consider natural and urban environments, local economies, including those of long-established tourist areas, the road and railway infrastructures, mobility, the Turin public transport system, and the lack of appeal of this city for activities and people.

The ten criteria specified by the European Guidelines were used to identify some crucial environmental issues. The ten criteria are:

- reduce the use of non-renewable energy resources to a minimum,
- use renewable resources within the limits of their regeneration capacity,
- environmentally correct use and management of dangerous and toxic substances and wastes,
- conserve and improve the state of fauna, flora, habitat, and landscapes,
- conserve and improve land and water quality,
- conserve and improve the quality of historical and cultural resources,
- conserve and improve the quality of the local environment,
- protection of the atmosphere,
- sensitise people to environmental problems and develop environmental education,
- promote participation in decisions made in favor of sustainable development.

The environmental issues identified included: energy, water and soil, biodiversity and landscape, mobility and transportation, and sustainable local development. All of these are considered as a strongly interwoven system. They have carried out a double role in the assessment: a) that of implementing a framework for the entire package of projects and for the defined strategies; b) that of orienting the entire planning and implementation process in terms of the rules and recommendations that the SEA determines for the project itself.

The relationships that the system of objectives presents has made it necessary to draw the attention of policy decision-makers to these reciprocal interrelationships and then to propose priorities, subordination, and absolute necessities. The *ex ante* SEA defined the following three goals: mitigation, rationalisation, and sustainability (see Table 1).

1. With reference to the direction presented by the key issues, every action was evaluated using a five- point scale, where –2 indicated a very bad trend, –1 bad, 0 neutral, +1 good and +2 very good.

Table 1: Integrated objectives of sustainability in the Environmental Assessment Study *(necessary objectives in bold type)*

INTEGRATED OBJECTIVES	MITIGATION	RATIONALISATION	SUSTAINABILITY
1. ENERGY improvement of energy balance	**1.1 reduction of waste of resources** 1.4 technological improvement for pressure reduction 1.5 technological improvement for increased efficiency in energy processes	1.2 limitation of energy demand 1.6 closing of water cycles 1.7 reuse of waste for energy	1.3 use of renewable sources 1.8 rationalisation of energy facilities
2. WATER AND SOIL improved stability and water and land management	**2.1 recovery of areas subject to landslides and erosion** **2.4 elimination of water pollution**	**2.2 erosion reduction and prevention** **2.5 reduction of flood risk**	2.3 improvement of slope stability 2.6 improvement of environmental and ecological quality
3. BIODIVERSITY AND LANDSCAPE safeguarding of biodiversity and functional improvement	**3.1 elimination of toxic pollution** 3.4 reduction of landscape degradation	**3.2 minimisation of anthropic impact** 3.5 safeguarding of landscape diversity	3.3 connective ecological development 3.6 creation of protected areas 3.7 landscape enhancement
4. MOBILITY – TRANSPORTATION improvement of cost/benefit ratios	**4.1 reduction of impact on infrastructures** **4.4 network safety** 4.7 traffic limitations	4.2 inter-modal shift of flows 4.5 functional adaptation of the transportation network	4.3 integrated reorganisation of mobility 4.6 logistics planning
5. SUSTAINABLE LOCAL DEVELOPMENT activation of endogenous development processes	**5.1 containment of high-impact tourism development**	5.2 supply redistribution 5.4 better use of social capital 5.6 territorial redistribution of sustainable development opportunities	5.3 promotion of tourism offerings 5.5 promotion of traditional activities 5.7 promotion of hospitality culture

3. The monitoring process

The monitoring of OP, which started in 2003, represented an evolution of the SEA process and was conducted through an *in itinere* phase concluded in February 2006 and an *ex post* phase completed in June 2007. The monitoring process had concentrated on the Olympics/Territory relationship taking into account not only the projects of the OP, but also other actions and activities linked to the realisation of the event. The basis of this assessment was the theme of the 'Olympic legacy'. In this respect, the long-term duration of the monitoring allowed in depth analyses of the relationship between city territory and 'mega events'.

The monitoring process started with an 'assessment grid' defining the objectives that should have been pursued in order to maximise the territorial benefits of the Olympic Games in terms of sustainability (functionality, efficiency, quality of life and social equity). The 'assessment grid' highlights the following five key issues:

- a territory open to external system
- a liveable environment
- the enterprises and development
- a new type of tourism
- the landscape resource.

The *in itinere* assessment methodology has allowed us to identify the strengths and weaknesses for each of the key-issues. Furthermore, following this perspective, the monitoring turned to the *ex post* assessment of the Olympic legacy through the analysis of specific actions and their inter-relationships.

The key issues were related to infrastructures able to influence the possibility of opening and strengthening the territorial system to new services for improving the quality of life of the local population; to economic and productive development; to new types of tourism; and to evaluation of natural, landscape and cultural heritage. For each key-issue, the monitoring identified several actions. The actions were analysed through data collection and processing according to a system of indicators and indexes provided for the specific case.[1] The monitoring identified and defined guidelines for two different territorial systems, Turin and the 'Olympic Mountains', which present different environmental perspectives.

4. After the Olympic Games – the legacy of a 'mega event'

More than three years after the celebration of the 'Turin 2006' Winter Olympic Games, the local authorities have not stopped to ask what remains at the end of the 'mega event', what the Olympic Games have left as a legacy, either positive or negative. The *ex post* assessment phase was intended to give some answers, or rather some arguments, reporting on what happened and the degree of benefit the city and the whole region had experienced. The analysis of the actions examined during the *in itinere* monitoring and their complex inter-relationship contributed towards this goal. As observed in the previous assessment phases, the systemic impacts of the Olympic actions showed, on the one hand, a few similarities between the urban area and the mountains – for example, the pivotal role played by the building processes and real estate market – and, on the other hand, many interesting differences – such as the different nature of the interconnections system (small, very focused for Turin, weak but very spread for the Mountains). This aspect highlights the importance of 'scenarios of change' to understand where the Olympic legacy can lead. The very last part of the monitoring aimed to demonstrate how the various elements of the Olympic legacy could be more or less evaluated in such different scenarios of territorial development. Therefore, it seemed necessary to consider the relationship between the five key issues and the alternative scenarios that they represented. In summary, the alternatives were:

- **a tendency scenario,** representing the choices and behaviours which arise from the past of a 'Fordist city' and the Mountains, dominated by consolidated models and images;
- **an innovative scenario,** characterised by noteworthy choices and behaviours directed towards the future, towards the reintroduction of the Mountains, the landscape and the natural context, towards the search for new development models and images for the city and the territory.

The innovative scenario, which to date has been weak and uncertain, includes strategies devoted to the evaluation of the Olympic legacy, looking at the elements considered in the monitoring in positive terms. In particular, the results of the *ex post* monitoring have focused on two of the five key issues:

- innovation and local development (key issue 'enterprises and development');
- tourism, sport and leisure (key issue 'new tourism').

To maximise the lessons learnt from the Olympic Games, the implementation of a strategic framework capable of playing a key role in a really innovative scenario appears to be indispensable, for example, in the Turin Strategic Plan and in the Regional Spatial Plan. This target can be reached by collecting all the cooperative efforts, new partnerships and opportunities which the Olympic experience has brought forward (Alexander, 2006; Brunetta, 2002 and 2006; Lichfield, 1998). An effective *ex post* Olympic strategy should not be based on the frantic chase of future mega events or a mere management of the physical legacy, but on new territorial governance, oriented towards new ideas and new vision for the city of Turin.

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OPINION: SYDNEY OLYMPIC SITE REMEDIATION

In the run-up to 2000, Australia faced the task of running the Sydney Olympics on top of 'the worst toxic waste dump in Australia'. **PROFESSOR SHARON BEDER** looks at the methods adopted to contain a cocktail of dioxins, asbestos, arsenic, cadmium, chromium, copper, lead, mercury and zinc

When Sydney won its bid to host the Olympic Games in the year 2000, it hyped the Games as the 'greenest' summer Olympics of all time. But a massive toxic waste dump lies underneath the fine landscaping of the Olympic site at Sydney Olympic Park (previously Homebush Bay). The dump is covered by a metre of dirt and a mountain of public relations.

Homebush Bay was an industrial site and armaments depot which, before its transformation, was subjected to years of unregulated waste dumping.[1] Asbestos-contaminated waste and chemicals including dioxins and pesticides had been found there, along with arsenic, cadmium, chromium, copper, lead, mercury and zinc.[2] It was the worst toxic waste dump in Australia, and the bay into which the waste leached was so contaminated that fishing in it was banned. The dioxin was largely the result of waste from a Union Carbide factory, which manufactured the notorious herbicide Agent Orange there during the Vietnam war.

In 1989, Australian government authorities decided to use Homebush Bay as the site for a future Olympic Games. Even the chance of winning an Olympic bid, however, could not justify spending the $190 million that experts estimated it would cost to contain and treat the toxic wastes buried there. The government therefore sought a cheaper, more modest remediation strategy that could be carried out in time for the 1993 Olympic bid.[3]

Authorities considered various options for dealing with the wastes. One possibility was to segregate and treat the wastes, but this would have been difficult and expensive. Another possibility would have been to take a 'bank vault' approach – sealing up and walling in the wastes. This approach would have entailed tightly containing the contaminated soil with double liners beneath, soil capping over the top, leachate drains, gas collection and treatment systems. This approach was used for a badly contaminated embankment where the Olympic swimming facility was to be built.[4] Heavily contaminated waste was removed to nearby secure landfill under a car park area. This landfill was lined and covered with topsoil. Leachate is monitored, collected and treated as necessary.

However the planners decided that the bank vault approach was too expensive to be used elsewhere on the site. A third, cheaper option was chosen that eliminated the gas collection and treatment systems and the double liners. This option meant that the wastes would continue to leak into underlying groundwater.

Contaminated materials were moved to an unlined landfill on the southern side of Haslams Creek forming a pile of waste 20 metres high and named Bradshaw's mountain. It was capped and landscaped with leachate drains installed. During the remediation work, visitors were told by a site guide that they could not get off the bus to inspect Bradshaw's mountain because anyone going within ten metres of it would need to be properly suited with respirators.

The Olympic Coordinating Authority said that the diversion of the creek near the State Sports Centre was to allow 'the free movement of fish'; however the decision was actually made because of the difficulty of catching the leachate going into it in its original position. It was thought that digging trenches to put the drains into that area could have endangered the lives of the workers.[5] Groundwater in the area had elevated levels of chlorobenzenes, organochlorines and cyanide. Surface water in the creek was also contaminated with chlorinated hydrocarbons. A major concern in this area was that acidic leachate was threatening to corrode pipelines buried under the western portion of the site, including oil and gas lines and high tension underground electricity lines.[6]

Wastes from around this creek were 'consolidated' and covered with a metre of clay and shale and made into a golf range. Beneath the grassy slopes are an accumulation of arsenic, lead, cadmium, asbestos, pesticides and low concentrations of dioxins and dibenzofurans. Drains are supposed to catch the contaminated leachate from this area.

A consultant to the government explained the reasoning behind the leaky landfill approach:

'The liability associated with deterioration and or failure of a "bank vault" secure landfill remained constant with time, but its probability of occurrence increased with time as the facility aged. By contrast the leaky landfill would over time carry less liability as the quality of leachate eventually improved. Therefore it is an intrinsically more robust or resilient way of limiting risks.'[7]

In other words, the waste would be disposed of by letting it slowly leak into the surrounding environment, rather than by alternative means that carried the risk of a

financial liability that might be incurred by a possible sudden major failure in the future.

It was the job of environmental consultants Inner City Fund (ICF) P/L to assess the health and environmental risks that were posed by the Homebush Bay site, before and after remediation. ICF are an Australian branch of a US firm set up in the 1960s to clean up big East Coast American cities. ICF was unable to come up with definitive conclusions because of numerous uncertainties that had yet to be resolved. For example, in its report on the State Sports Centre, ICF had to qualify its conclusion that after remediation there would be little chance of adverse ecological impacts with the provision that no leachate from the contaminated part of the site entered the creek and that the creek didn't intercept any contaminated soil.[8] Similarly, in its report on the contamination of Haslam's Creek South, ICF concluded that risks to people using the site from breathing in contaminants were probably within acceptable limits but that 'insufficient data was available for quantitative assessment'.

Environmental effects from toxic waste sites were also difficult to predict. Stuart Nicholson and Nirander Safaya, writing in *Environment, Science and Technology* said that there were no comprehensive data bases on hazardous waste site ecology to draw on 'other than general principles of ecotoxicology and some documented effects of contaminants on biota.'[9]

In public discussions, cost and liability issues associated with the leaky landfill approach were not raised. Instead, the public was told that it was the only feasible option, given the difficulty of treating the diverse range of chemicals that were present on the site. The option of a more secure 'bank vault' landfill was not discussed outside of consultants' reports.

By choosing the leaky landfill option, the planners were able to reduce the cost of remediation of the Olympic site from $190 million to $69 million, including landscaping and road base preparations. This enabled most of the remediation to be completed by 1993, in time for Sydney to win the bid for the 2000 Olympic Games.

In normal circumstances it is unlikely that an unlined hazardous waste landfill site would be approved on this site because of the risks of groundwater contamination and unexpected leachate movements. There would be noisy protests from local residents and environmentalists. However, these were special circumstances that seem to have allowed normal precautions to be waived.

Australian government guidelines were quite explicit about the need for community involvement in site remediation as part of the public's right to know. 'There is a demonstrated requirement for community consultation and participation during the investigation and clean-up of sites.'[10] Yet the remediation work at Homebush Bay went ahead without any environmental impact statement being prepared and publicly displayed. The consultant reports examining the contamination of the site, the possible remediation options and the risks associated with the toxic waste were not published.[11]

Moreover the environmental watchdogs have been strangely silent on this one. This can be largely explained by the close involvement of Greenpeace Australia and other key environmentalists with the Olympic Games and their focus on the development of Olympic facilities as a showcase for environmentally friendly technologies. It was convenient for them, as it was for the government, to quietly ignore the real environmental problem associated with the site.

The landfills were not the only waste problem associated with the Olympic site. A hazardous waste treatment plant was located between the Olympic sporting facilities and the athletes' village. The plant was already the subject of complaint from people living in the neighbourhood for noxious smells and chemical emissions.

There are clearly two approaches to dealing with the risks to human and environmental health posed by a hazardous waste site. One is to lessen those risks by reducing the contamination through treatment or removal of contaminated soil. Alternatively risks can be lessened by preventing exposure of humans, animals and plants to the contamination. The first alternative – treatment – is the more responsible way of dealing with contaminated sites because it is more permanent, but it is also much more expensive.

The NSW government chose the cheaper, quicker and less reliable approach of containment and an inferior containment method at that. The authorities argued that the technology to treat this mixture of toxic waste was just not available. Others disagreed. People in the industry, such as environmental consultant Beven Schwaiger, claimed that substances such as dioxin and heavy metals could be separated out and that this would remove some of the worst contaminants and reduce the amount of contaminated soil that had to be dealt with.[12] However treatment takes time.

The need for a quick clean up obviously affected remediation decisions. For example, removal of 80,000 tonnes of asbestos waste from the Olympic precinct posed a problem that was overcome by using unorthodox methods. With the agreement of union officials the waste, instead of being sealed and bagged, was wetted down and moved in bulk.[13]

Results of a study of sediments and surface water from wetlands on the Homebush site, partly funded by the Olympic Park Authority, were published recently. The study authors concluded that the remediation program had been a success in that persistent organic chlorines in the wetlands were 'within the chemical bounds expected from urban wetlands in Sydney'. The high levels of TCDDeq (equivalent to 2,3,7,8-tetrachlorodibenzo-p-dioxin, the most toxic dioxin) in sediments at the Bound-

ary Creek wetland and two other wetlands on the Olympic site were attributed to stormwater coming from the surrounding urban catchment rather than the mounds of waste in the immediate vicinity of the wetlands. The increases in TCDDeq and DDT concentrations in many wetland sediments from 2005 to 2006 were attributed to 'the heterogeneity of the POP concentrations' whereby sampling could happen upon more concentrated pockets of contamination or miss them.[14]

Only time, and some rigorous independent studies, will tell what the long-term outcomes of the 'leaky landfill' approach will be and whether the exigencies of the Olympic Games showed the way for future remediation projects or were merely a cheap fix with longer term costs for the environment and its users. In the meantime, in 2006 the fishing ban was extended to all commercial fishing in Sydney Harbour after a number of fish species were found to have elevated levels of dioxins, which according to the NSW Department of Primary Industries, 'are likely to have their sources in contaminated sediments in or near Homebush Bay'.[15]

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Map showing remediation work at the Sydney site

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IES: NEW MEMBERS

The Institution of Environmental Sciences is pleased to welcome the following new members and re-grades:

David Arscott	Learning Support Worker	A
Hannah Beswick	Air Quality Consultant and Office Environmental Manager	M
Jonathan Brookes	Air Quality Consultant	M
Natalie Brooks	Student	Af
Ian Buchan	Principal Transport Planner	M
Gen Cannibal	Technical Director for the Environment	M
Simon Carlyle	Senior Project Officer	M
Marc Carreras-Sospedra	Post-doctoral Scholar	A
Wing Cheung	Senior Environmental Engineer	M
Kam Chow	Environmental Officer	M
Rachel Conti	Senior Policy Officer (Air Quality)	M
Benjamin Coombes	Sustainable Development Officer	M
Benjamin Cornet	Environmental Scientist	M
Muhammad Dahlan	Environmental Engineer	M
Karl Dalton	Environmental Manager	M
Scott Darby	Graduate	A
Rhys Davies	Senior Consultant	M
Lesley Dinnett	Associate	M
Shonah Dobson	Environmnetal Scientist	A
Thomas Drew	Procurement Systems Administrator	A
Massimo Gilardenghi	Language Services	Af
Helen Glass	Associate - Cultural Heritage	M
Anthony Goslar	Environmental Superintendent	M
Paul Grimes	Health, Safety and Environmental Manager	A
Stephen Haynes	Senior Archaeologist	M
Victoria Hoblyn	Principal Consultant	M
Matthew Hutchinson	Sustainability Manager	Af
Philip Jackson	Director	M
Jennifer Jones	Principal Lecturer	M
Enan Keogh	Air Quality Consultant	M
Mohammed Kyari	Scientific Officer Coordinator	M
Trevor Lowans	Volunteer	A
Timothy McIntyre	Environmental Consultant	M
Wanda Mills	Field Surveyor	A
Omotayo Olumuyiwa	Graduate	A
Nor Ramli	Associate Professor	M
Robyn Rand	Student	Af
David Rollinson	Student	Af
Timothy Simmons	Sustainable Construction Manager	M
Andrew Skinner	Environmental Scientist	M
Lesley-Anne Stone	Graduate Air Quality Consultant	A
Stephen Stratton	Ambient Air Quality Monitoring Consultant	A
Eric Thomas	Assistant Director	M
Simon Tidbury	Graduate	A
Keith Tipping	Senior Planning Officer	M
Jennifer Ulyatt	Environmental Scientist	M
Emonena Uraih	Graduate Environmental Scientist	A
Hongbin Wang	Senior Air Quality Consultant	M

KEY: **F = Fellow** **M = Member** **A = Associate** **Af = Affiliate**