East Darling Harbour
Ecologically Sustainable Design Report
21/08/2006

Client

Sydney Harbour Foreshore Authority

Advanced Environmental

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1 Summary Report

1.1 Introduction

This report addresses the Ecologically Sustainable Design (ESD) opportunities for the East Darling Harbour (EDH) development site. ESD is one of the cornerstones of the development and one of the three pivotal legs of a triple bottom line approach to the development that allows the measurement of environmental, social and financial performance.

A shift has occurred in community attitudes regarding management of finite resources which are now recognised as intergenerational issues. ESD criteria in development are now readily accepted by the investment community, recognising the benefits of assets that are designed with the environment in mind.

ESD at EDH is inseparable from the aspirations of Sydney as a whole. For Sydney to maintain a position as a global city and economic and financial centre for the country it needs to apply this same leading attitude to the ESD agenda inherent in urban renewal.

EDH provides that critical mass to both secure the financial sustainability of Australia's economic powerhouse combined with a sustainability agenda that reinforces Sydney's competitiveness in the region. In addition, EDH's close proximity to the CBD combined with the condensed nature of development help to reinforce the sustainable compact city model, a counter to city and suburban sprawl.

The following characteristics of EDH make it a unique opportunity for world leadership in ESD:

- Large precinct of Government land ownership
- Significant proposed new built form close to the existing CBD
- Large new foreshore public domain
- Located next to the harbour
- Located in close proximity to city infrastructure
- Limitations on existing infrastructure capacity make ESD critical
- High profile project

Precinct wide ESD initiatives provide a much greater chance than individual buildings to achieve complete ESD solutions through economies of scale, infrastructure establishment, tapping into adjoining site attributes and providing leadership to the City and the broader community about what can be achieved.

The staging of the development will also need to consider the 10-15 year timeframe for renewal of EDH and the ability of the site infrastructure to deal with evolving technologies and attitudes to sustainability.

The ESD initiatives proposed for EDH will require continued focus and attention once the development process is complete. This new phase of maintaining and enhancing the ESD framework is as critical to the continuing performance of the site as the initial application of initiatives when the project was conceived.

Operation guidelines, clear management responsibilities, contracts for maintenance and most importantly the attitude of the occupiers and visitors to the site are the means to ensure the ESD program evolves and maintains relevance for many years to come.

1.2 Approach

The objective of this report is to propose a range of strategies that will address the ESD requirements for the site to a degree that it can be considered a world leader in ESD.

There is a critical link between the general ESD initiatives of the site, the site infrastructure for energy and water supply and the Water Sensitive Urban Design of the site. The site infrastructure assessment and the principles of Water Sensitive Urban Design are coordinated with this study but also addressed in detail in separate sections of the Concept Plan.

The ESD initiatives proposed for the site have been benchmarked with objective, third party rating schemes that provide a common language for ESD performance.

The commercial buildings have been benchmarked against the Green Star rating tools developed by the Green Building Council of Australia (GBCA).

The residential buildings have been benchmarked against a future Green Star rating tool which we understand is a priority for the Green Building Council of Australia.

1.3 ESD Focus Areas

The key ESD aspects that must be addressed are:

i. Water

ii. Energy

iii. Micro-Climate

iv. Landscape

v. Transport

vi. Waste

vii. Materials

viii. Education

1.4 Assessment of ESD Measures

1.4.1 Water

Worldwide, and particularly in Australia, fresh water has become an increasingly precious natural resource. In recent years the debate regarding Sydney's freshwater, sewer and recycling management has lifted the public's awareness that initiatives to preserve this resource do not need to impact greatly on the lifestyle of the city's inhabitants.

Methods of reducing water consumption and re-using waste-water have become benchmarks for ESD minded developments internationally. Likewise, they are focal points of the EDH water strategy.

The issues that have been specifically targeted for water are:

- Management in Potable Water Demand
- Reduction in Wastewater Flow to Sewer

There are infrastructure limitations to the supply of both water and sewer services to the EDH site. The current sewer network is at capacity (pumping capacity and sewer mains capacity). The water supply infrastructure would also need to be upgraded to supply a development of the scope of EDH.

These restrictions provide a good economic reason for reducing potable water requirements and flows to sewer as well as the sound environmental considerations.

Preliminary studies indicate that significant savings could be made with a combination of policy and infrastructure initiatives implemented for the proposed development. Policy options refer to those initiatives that could be mandated as targets for proposed building development sites. Infrastructure options refer to those initiatives that could be implemented across the site. There exist options for extensive infrastructure initiatives that would have a benefit beyond the EDH site as well.

A range of options that represent these initiatives have been modelled. The options are described below.

- Option 1: The base case, which represents standard practice in current building design, with no measures to reduce consumption or flows to sewer – 2A rated water fittings, no alternative heat rejection initiatives or on-site water treatment
- Option 2: Application of Government policy using 4A fittings
- Option 3: As per Option 2 and including building rainwater collection as a policy initiative
- Option 4: As per Option 3 and including harbour heat rejection which removes the need for cooling towers for mechanical ventilation systems and saves the vast amounts of water they consume. Subject to further investigation this option may form the new base case for the project.
- Option 5: As per Option 4 but without harbour heat rejection and including on-site water recycling.
- Option 6: As per Option 5 and including harbour heat rejection
- Option 7: As per Option 6 and including harvesting water from the surrounding precinct waste water. This allows for the use of surplus water for irrigation purposes beyond the EDH site.

A summary of water savings is shown in Figure 1.1.

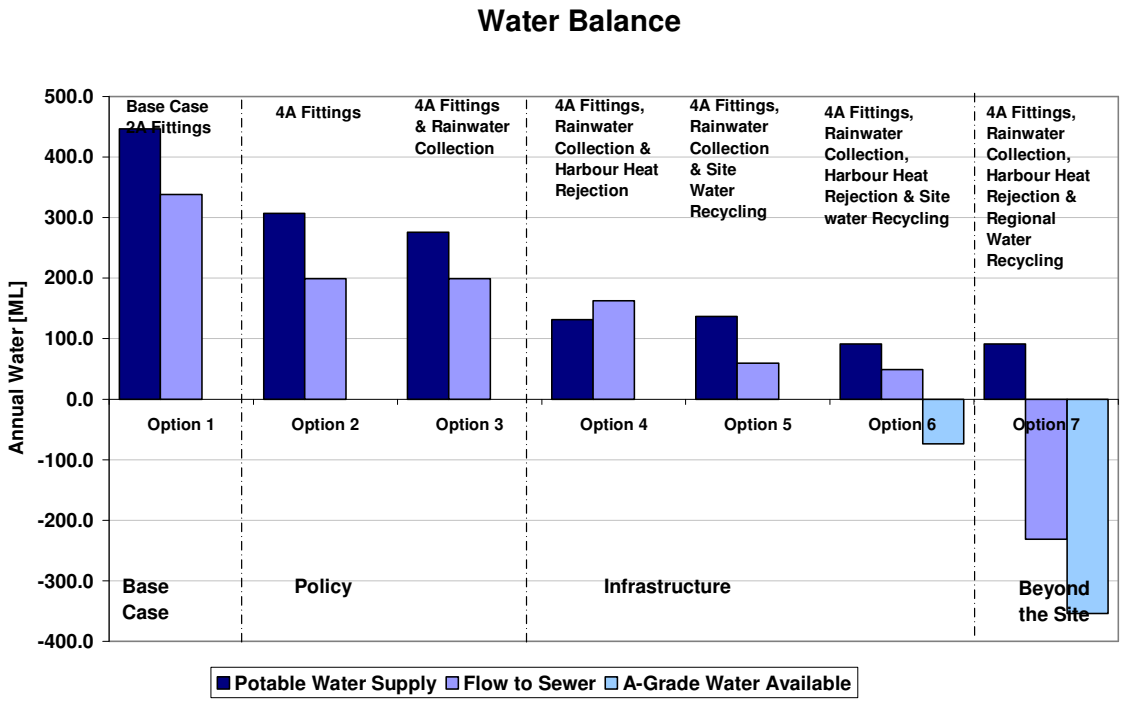

Figure 1.1: Water Balance showing possible water savings with a range of policy and infrastructure initiatives

Figure 1.1 indicates the limitations to initiatives that are confined to individual buildings versus the ability to configure site infrastructure to allow for major water saving measures. Following the Concept Plan phase, this project intends to investigate the feasibility of Options 4-7 as the new base case for the project. This work will focus on the funding, ownership and management options for water recycling plants on the EDH site.

1.4.2 Energy

Along with water, energy reduction initiatives have the most significant impact on the ability of the project to be a world leader in sustainability. It is also one of the areas that has the biggest infrastructure requirements to any new development (as detailed in the Infrastructure Report in the Concept Plan). For these reasons, the energy performance of the East Darling Harbour development is a critical ESD factor.

There are two facets that must be addressed in any strategy to deal with energy use on the site. They are:

- the amount of energy used (the cumulative amount of energy that the development uses annually)
- the peak demand for power (the highest instantaneous demand for power that the infrastructure must be able to supply to the development)

The amount of energy used is an indication of the quantity of Greenhouse Gas (GHG) emissions that the development produces through its energy use. This is quantified by the Australian Building Greenhouse Rating (ABGR) for commercial buildings, which rates buildings based on the amount of carbon dioxide (CO_2) that is emitted into the atmosphere.

Preliminary studies have shown that significant savings could be made with a combination of policy and infrastructure initiatives implemented for the site. A range of options that represent these initiatives have been modelled.

Again, policy options refer to those initiatives that could be as targets for proposed building development sites. Infrastructure options refer to options that could be implemented across the site. The options are described below.

- Base Case: Meeting the minimum energy use requirements set by the City of Sydney (4.5 star ABGR, which equates to 87 kg CO_2/m^2/annum)
- Option 1: Mandating 5 star ABGR to be achieved by all buildings on site (71 kg CO_2/m^2/annum)
- Option 2: Mandating 5 star ABGR plus a further 20% saving to be achieved by all buildings on site (57 kg CO_2/m^2/annum)
- Option 3: As in option 2, but including a site-wide Co-generation system sized to account for the peak electrical load[1].
- Option 4: As in option 3, but with a Co-generation system sized to account for the annual energy demand
- Option 5: As in option 4, but with a Co-generation system sized to account for the heating and cooling requirements of the site

Preliminary energy balance studies show that energy use savings could be made with policy initiatives. These potential savings are shown in Figure 1.2. These studies are based on the nominated GFA for each building type and how they would perform under the conditions described in each option.

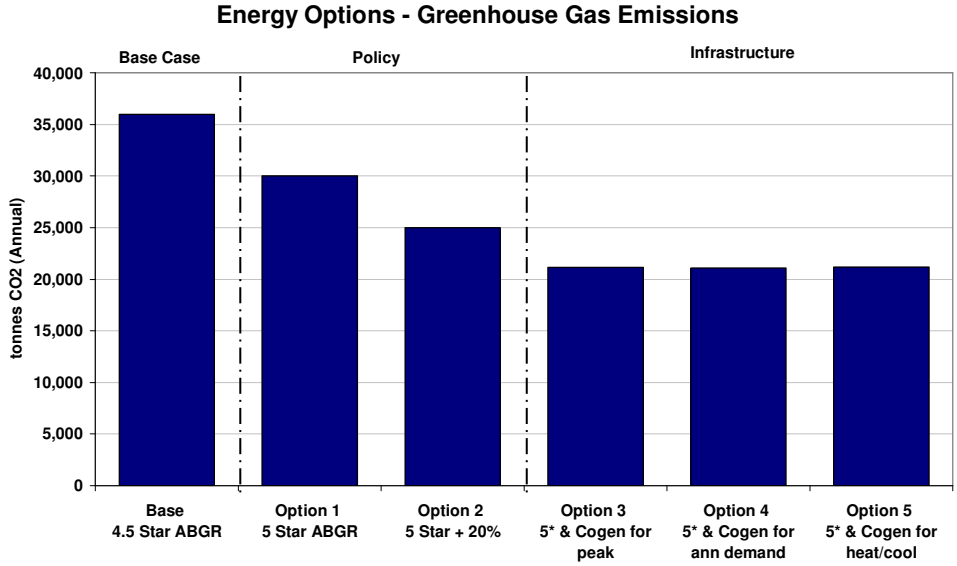

Figure 1.2: Energy balance results showing Energy Use changes with policy and infrastructure initiatives

The existing infrastructure for power supply is also a critical factor. It is possible that major upgrades will be required to existing substations and reticulation infrastructure to adequately supply a development of the scale of EDH. Initiatives that reduce the peak demand on the grid will have a significant impact on the required upgrades to the existing infrastructure.

There are significant benefits to the peak energy demand if some major infrastructural initiatives are implemented as well. These potential savings are shown in Figure 1.3.

[1] Co-generation is the generation of electricity (and waste heat) by burning gas on the site, generally making use of a gas turbine engine, as opposed to burning coal at a remote location as in standard electrical supply.

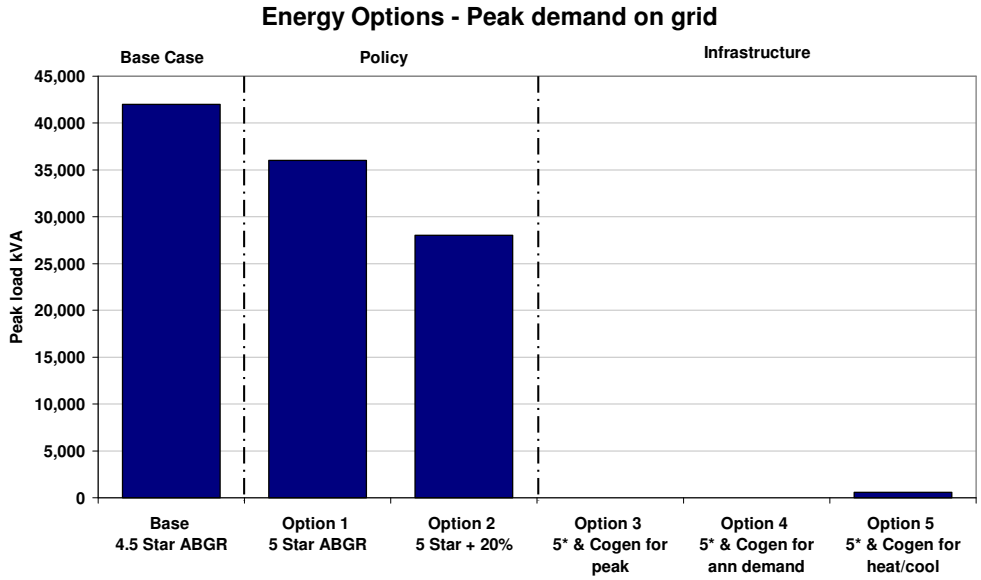

Figure 1.3: Energy balance results showing 'Peak Demand on the Grid' changes with policy and infrastructure initiatives.

Again similar to the water initiatives, energy reduction measures have the greatest opportunity when they are applied across the site. Following the Concept Plan phase, the project intends to investigate the feasibility of Options 3-5 as the new base case for the project. This work will focus on the ability of the project to procure alternative energy sources and their subsequent funding, management and operations.

1.4.3 Micro-Climate

The micro-climate of the site, as distinct from the surrounding areas must be managed and controlled to optimise occupant satisfaction with their environment. Wind, direct sun and noise all need to be considered when optimising the micro-climate of the development. These issues are addressed in separate sections of the Concept Plan.

1.4.4 Environmental Quality/Amenity

Central to the success of the development will be the occupant comfort and control that is achieved within the indoor spaces of the development. The provision of a naturally healthy and fresh environment while also delivering ESD goals will reinforce the environmental values of the development.

A process established by the Concept Plan to achieve quality architectural design over the life of the project will also improve the public and private amenity.

The scope for infrastructural input to address the indoor environment is limited. Policy however, should encourage an integrated environmental approach to apartment design and living, drawing on the principles of passive environmental design such as:

- Dual Aspect Natural Ventilation
- Double Height Buoyancy Ventilation (whereby double space heights and high level exhaust are used to vent air that is heated by the space load)
- Adjustable External Shading

An important part of achieving a 5 star Green Star rating for commercial buildings is a focus on indoor environmental quality (IEQ). Ventilation rates (a measure of the fresh air supplied to the space), air change effectiveness (a measure of the "age" of the air in a space), CO_2 monitoring and thermal comfort are all IEQ criteria that are covered under the Green Star rating tools.

Opportunities for improving the indoor IEQ of commercial office buildings include alternatives to conventional air conditioning systems such as displacement ventilation or chilled beam air conditioning systems.

The IEQ category is one of the most heavily weighted categories in the Green Star rating tools (along with energy). Alternative HVAC strategies of this sort are one way of being eligible for points under the IEQ category and also having a major energy benefit. These are necessary contributions to a 5 star Green Star rating.

1.4.5 Landscape

The landscaping of the site provides an opportunity to establish a significant ecologically sensitive space within Sydney. Within the Green Star Rating System, Land Use and Ecology is a category which rewards good landscaping design. Any policy decisions relating to landscaping at a building level should be made within this context.

The integration of water sensitive urban design with landscaping is addressed in separate sections of the Concept Plan.

Some key ESD criteria that the landscaping should address are:

- Ecology of the Site – the establishment of a significant ecologically sensitive space that encourages the growth of native eco-systems on the site
- Management of Stormwater Run-Off – natural treatment of site storm-water through wetlands, among other water sensitive urban design strategies
- Shading

1.4.6 Transport

The use of private motor vehicles is a major contributor to greenhouse gas emissions, as well as contributing to traffic congestion and the further reduction in available parking space within the city centre and adding to noise pollution.

EDH will focus on dominant public transport use along with legible pedestrian and cycle access to and across the site. For a detailed understanding of transport initiatives refer to the Transport section of the Concept Plan.

1.4.7 Waste

The requirement for raw materials in the construction of new buildings is a significant drain on natural resources. Most construction waste is readily recyclable and the growth of the availability of recycled materials is increasing the feasibility and potential for the use of recycled materials in construction.

The recycling of construction waste in Australia's largest cities has developed to an extent where as much as 80% of construction waste is recycled. In NSW, recycling targets are enforced and waste receipts allow builders to track the quantity of construction waste which is recycled. For most new construction, the biggest material demands are structural steel, concrete and timber.

It will be important for future phases of the project that policy initiatives are prepared to address material selection and the generation of waste products as a result of the development.

1.4.8 Materials

Generally, the use of building material will be a policy initiative. There are three key criteria in the use of materials at a policy level:

i. Reducing the impact of materials due to their embodied energy and the un-sustainability of their extraction

ii. Reducing the emission of Volatile Organic Chemicals and Formaldehyde[2] into indoor spaces

iii. Reduction in use of materials that are toxic and pollute the environment when they are broken down after disposal

The first of the criteria is largely dealt with in the waste section: the use of recycled materials has a significant impact on reducing the embodied environmental impact of materials.

The second criterion involves selecting finishes and materials that do not emit chemicals that negatively impact the indoor environmental quality. They are covered extensively in the Green Star rating scheme under the Indoor Environmental Quality Section.

The primary material cited under the third criterion is PVC. It too is covered under the Green Star rating scheme.

1.4.9 Education

The EDH development aims to be a showcase for world leadership in ESD. A significant part of this goal is the education of the public and the industry in the concepts and initiatives that have been adopted during this development.

There is scope to provide education at both a site and an individual building level. Key to both though is the provision of ESD initiatives that are visible, practical and effective. The development as a whole should provide environmental initiatives that are iconic in their demonstration of ESD in practice. These initiatives should be tracked against Key Performance Indicators that are agreed prior to commencement of development.

1.4.10 Conclusion

Of the ESD focus areas, water and energy are the highest profile. They have the largest impact on the site ecological footprint and are prominent in community attitudes to conservation and resource management. They are also the most critical in terms of existing infrastructural limitations that the site currently faces.

The other criteria are important in ensuring a well rounded approach to ESD is taken. A combination of these initiatives will ensure that the full benefit of good ESD is achieved and made accessible to the public.

In summary the issues that have been specifically targeted for water and energy are:

- Management of Potable Water Demand
- Reduction in Waste Water Flow to Sewer
- Reduction in the amount of Greenhouse Gasses Emissions (energy use)
- Reduction in the peak demand for energy

[2] Harmful chemicals contained in some paints, sealants, carpets and composite wood products that are emitted into the interior environment after application or installation.

1.5 Development of Key Performance Indicators

The development of Key Performance indicators (KPI's) at an early stage for each of the areas where ESD will be applied is critical so that the development has particular goals against which progress can be measured. The KPI's must meet show world leadership standards so that the development can demonstrate that it is a world leader in ESD.

For most of the policy initiatives, the KPI's will be benchmarked against current rating schemes, particularly the Green Star Rating Tools (developed by the Green Building Council of Australia). Infrastructural KPI's will be benchmarked against the current world's best practice for new developments.

The key KPI's for the site are:

- Green Star Office Design and Office As Built Ratings including 5 star +20% predicted ABGR rating for commercial buildings (energy use)
- 10% improvement on BASIX requirements and at least 60 weighted points on a future Green Star residential rating tool (5 star equivalence) for residential buildings
- A 35% reduction in Potable Water Consumption compared to a standard practice development
- A 40% reduction in Flow to Sewer compared to a standard practice development
- A 35% reduction in Greenhouse Gas Emissions compared to a standard practice development
- 10% of power purchased from low impact, renewable sources

The visible environmentally sustainable performance of the development as a whole and each of the buildings therein is essential in educating the wider community in the benefits of ESD. The project has the ability to market Sydney as a place that values the environment and supports economic growth with sound environmental principles.