

ESTABLISHING A GREEN RATING SYSTEM ON CIVIL ENGINEERING INFRASTRUCTURE PROJECTS

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ABSTRACT

As we face significant planetary issues such as global warming, it is clear that the engineering profession has a significant part to play in affecting the future of our planet. Globally, the construction industry is one of the main contributors to the depletion of natural resources and a major cause of unwanted side effects such as air and water pollution, solid waste, deforestation, health hazards, global warming, and other negative consequences.

In order to stay competitive and to meet upcoming stricter environmental regulations and customer requirements, designers have a key role in designing civil infrastructure so that it is environmentally sustainable. These and other factors have compelled the engineer to design with greater care and in more detail. The changing roles of engineers will be highlighted, in order to react to changes in climate.

The lack of appropriate tools and skills for sustainable design was often quoted as a barrier to sustainable design (Richardson et al, 2005).

A systematic and iterative analysis of the environmental impact of various design solutions is commonly suggested for infrastructure projects, but rarely happens.

This paper focuses on the concept of eco-efficiency in Infrastructure Design and the establishment of use of the proposed green rating system on infrastructure projects.

Mainstreaming environmental aspects and incorporating the eco-efficiency concept into various stages of infrastructure development have not been considered as much as they should have been. Engineers need to look at greener technologies rather than just using traditional engineering solutions.

Keywords: Green Technology, Infrastructure design, Eco-efficiency, Sustainable development, Green infrastructure

1 OBJECTIVES

In view of the inadequacy of tools to assess the environmental impacts of infrastructure design decisions, the objectives of this paper are as follows:

- To highlight the changing role of engineers;
- To highlight the need for environmentally friendly, ecologically sensitive innovative design, at the design stage of township infrastructure projects;
- To introduce environmentally conscious design decisions at inception stage, where they are influenced the most;
- To provide a standardised method for the selection of eco- friendly infrastructure

- design options allowing for environmental goals to be set, monitored and evaluated;
- To define green infrastructure solutions amongst engineers by establishing a common language and standard of measurement;
- To raise awareness of green engineering benefits and the environmental impact of consultants' design decision, in order to reduce the environmental impact of development.

2 THE CHANGING ROLE OF ENGINEERS

As we face significant planetary issues such as global warming, it is clear that the engineering profession has a significant part to play in affecting the future of our planet. Demands for energy, drinking water, clean air, safe waste disposal, and transportation will drive environmental protection, alongside infrastructure development.

Engineers have a critical role to play to achieve sustainable development. It is clearly no longer possible to be a professional engineer and ignore the challenges and opportunities that arise from needing to achieve sustainable development (Desha et al, 2007).

The engineering community also has a major opportunity to contribute to structuring of infrastructure projects. The lack of sustainability systems or tools has led to poor design solutions and continues to degrade the environment.

Engineers will have to be at the forefront of developments, whether finding ways to maximise water capture or ensuring conservation of the resource from supply through to distribution, the issues of innovation, technology, design, management will be crucial for the engineer in meeting future challenges.

Civil engineering projects can have significant site-specific and cumulative impacts on our ecological and social systems if not correctly planned, designed and implemented. Engineers are at the forefront of civil works and play an important role in ensuring environmental impacts are avoided or mitigated. Understanding the context of the environment in which they work is thus essential (Kilian and Gibson, 2007).

3 THE NEED TO IMPLEMENT GREEN TECHNOLOGY ON CIVIL ENGINEERING INFRASTRUCTURE PROJECTS

Civil engineering projects can have significant site-specific and cumulative impacts on our ecological and social systems if not correctly planned, designed and implemented.

In the area of sustainability, there is an urgent need to apply technologies and methods that deliver better and more sustainable performance in a way that is cost effective. Sustainable, adaptive and mitigative approaches to climate change, in the design of infrastructure are therefore important steering elements (FIDIC, 2009: p44).

Relatively few designers have as yet explored the transformative potential of ecological design and have preferred to remain apolitical and unconcerned with the distributional impacts of design as they affect the health of humans and ecosystems (Van Wyk, 2009).

Infrastructure development has been focused mainly on financing issues and engineering aspects in the region. Mainstreaming environmental aspects and incorporating the eco-efficiency concept into various stages of infrastructure development have not been considered as much as they should have been.

Improvement in the awareness of eco-efficiency concepts is urgently needed among policy-makers, planners and decision-makers. However, the criteria applicable to, and measures for developing eco-efficient and sustainable infrastructure are yet to be fully identified (United Nations Economic and Social Commission for Asia and the Pacific, 2006).

Infrastructure elements such as roads, water, sewage and stormwater can result in loss of critical ecosystems and biodiversity. There is a need to create an eco-sensitive

infrastructure design rating system that encourages and promotes the use of “softer” design solutions.

The rating of green buildings evaluates the environmental impacts of buildings but with little emphasis on the environmental performance of civil engineering infrastructure. The proposed research uses the concept of the green rating of green buildings and creates a decision toolkit that assesses the environmental impacts of infrastructure design decisions on development.

By utilizing improved environmentally friendly-seeking design solutions, this study aims to introduce environmentally friendly design decisions prior to the infrastructure design approval process.

4 THE INFLUENCE OF EARLY DESIGN DECISIONS ON THE ENVIRONMENTAL IMPACT AND SUSTAINABILITY ON INFRASTRUCTURE PROJECTS

It is essential that the environmental issues be integrated into achieving the most appropriate solutions. A sustainable project is managed by taking control of the client’s decision making processes as early as possible, to provide the certainty of decision making. This should be done by totally involving clients in the decision making process. Diligent attention to greener infrastructure solutions from the very earliest phases of a project will help guarantee that quality design environmental solutions are “built in” from the beginning. Figure 1 shows the declining influence of environmental interventions on a project.

It is important to implement the environmental management from the early stages of the process, since the “freedom” to make decisions, of importance for the environment, decreases with the progress of the project.

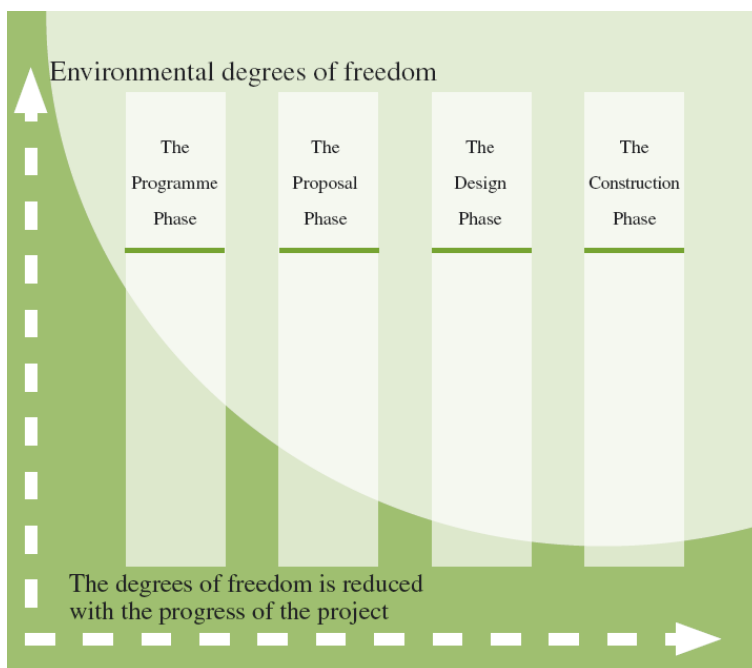


Figure 1: The environmental degrees of freedom (European Green Cities Network, 2004)

5 THE GREEN TOWNSHIP INFRASTRUCTURE TOOLKIT: A GREEN RATING SYSTEM ON INFRASTRUCTURE PROJECTS

This paper proposes a toolkit that enforces environmentally sustainable design on township infrastructure services by integrating a consideration of resources, the environment, ecologically sensitive innovative design, maintenance and recyclable materials, from the early design stages of a project.

The Green Township Infrastructure Design Toolkit uses the concept of eco-efficiency and would allow the designer to evaluate design options, enabling him/her to choose the one likely to yield the best performance with the least environmental impact, based on proven technology.

This toolkit is intended to encourage developers to consider green methods and practices in the earliest stages of project planning, by assessing a number of recommended green practices and its environmental impacts on infrastructure services design, placing fewer burdens on the environment.

The Green Township Infrastructure Design Toolkit is illustrated in Figure 2. The various Green Report Forms, enables the client to select a combination of alternatives and evaluate a number of possible design options – with their environmental implications – at each stage of the design process

During the briefing and preliminary design stage, 1 and 2, the client and engineer have a joint responsibility of deciding just how green the project should be, or alternatively of deciding what environmental quality of services can be provided. During the detailed stages (3), the engineer has the responsibility of designing, while maximising the green value of the project. Stage 4 gives the designers an opportunity to add environmental value at the construction stage, by analysing eco-friendly construction material.

The underlying structure of the Green Township Infrastructure Design Toolkit is based on a hierarchical breakdown of the project into five stages described in Table 1.

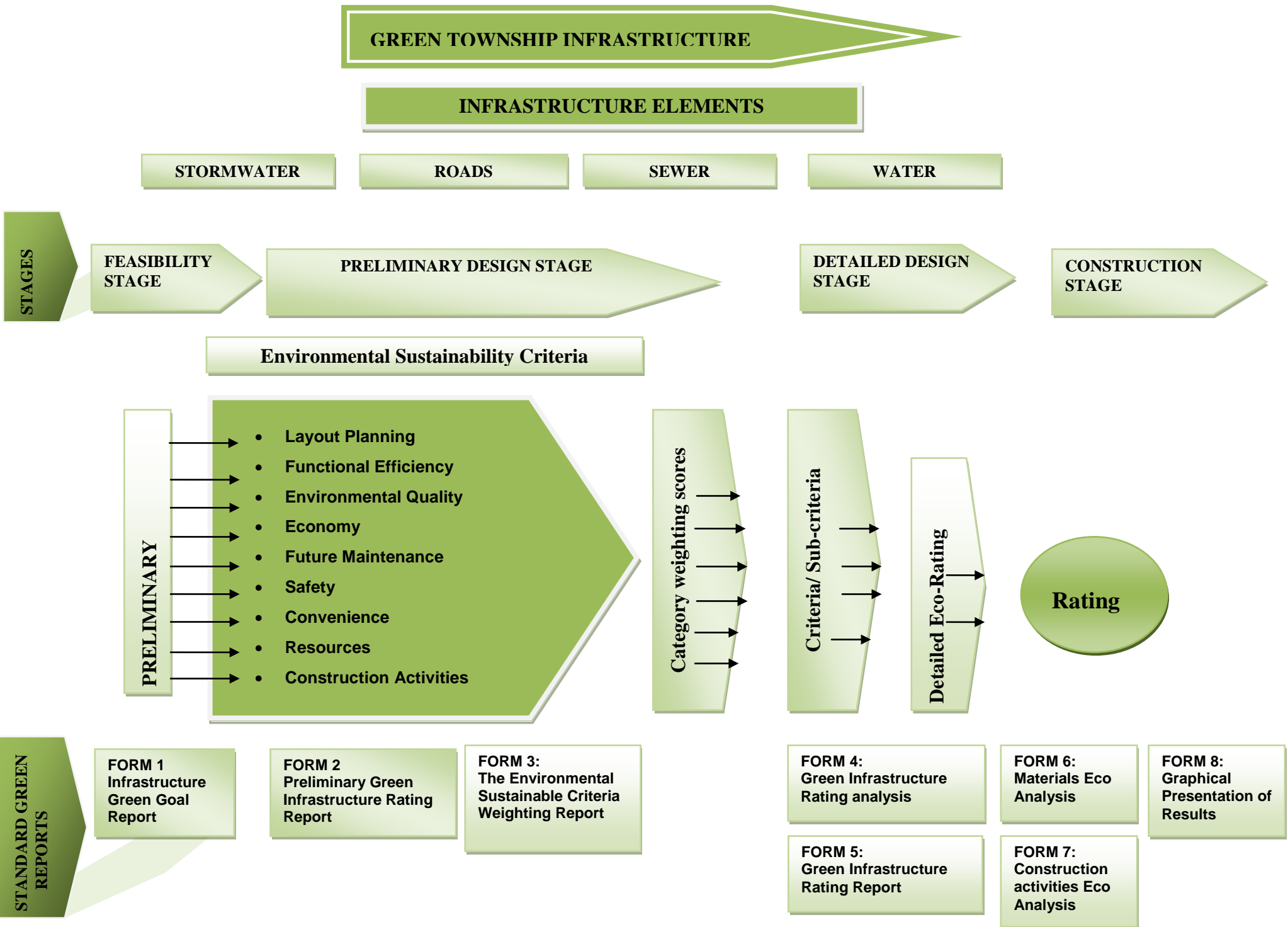


Figure 2: The Green Township Infrastructure Design

Table 1: Stages in the Green Township Infrastructure Design Toolkit

Stage		Activities
Stage 1	Feasibility Stage	Establishing environmental objectives / Preliminary eco rating
Stage 2	Scheme Design Stage	Preliminary eco rating
Stage 3	Preliminary Design Stage	Weighting of environmental sustainability categories
Stage 4	Detailed Design Stage	Detailed eco rating analysis
Stage 5	Construction Stage	Materials and construction activities eco analysis

6 ADVANTAGES OF USING THE ECO APPROACH TO INFRASTRUCTURE DESIGN

Green township infrastructure technologies will contribute to greenways and green corridors and provide linkages between habitats, and wetlands. Green technologies have a number of environmental, economic benefits and community benefits. The benefits of this approach are as follows:

- Conservation of natural resources;
- Reduces the ecological footprints of roads, sewer, stormwater and water, allowing ecosystems to function more naturally;
- Uses energy-efficiency systems and materials;
- Minimized impervious surfaces reducing soil erosion;
- Enhance and protect ecosystems and biodiversity;
- Conserves and reuses water and treats stormwater runoff on-site;
- Recharged ground water flow for streams, conserving water supplies.

7 CONCLUSIONS

A new paradigm for infrastructure design is required in order to maintain environmental sustainability. Engineers need to look at greener technologies rather than just using traditional engineering solutions. By using this green approach, sustainable design of township infrastructure services can be achieved by enforcing the consideration of resources, environmental impacts of ecologically sensitivity of design decisions, innovation, maintenance and materials, at the design stage of a project.

The proposed Green infrastructure toolkit provides a standardised method for the selection of eco- friendly infrastructure design options allowing for environmental goals to be set, monitored and evaluated.

As can be seen in this paper, there are numerous opportunities for improving eco-efficiency in infrastructure design. Green techniques provide adaptation benefits for a wide array of circumstances, by conserving and reusing water, promoting groundwater recharge, and reducing surface water discharges that could reduce to flooding.

Taking a greener approach to infrastructure development not only mitigates the potential environmental impacts of development but makes economic sense as well. By softening the environmental footprint, avoiding waste and finding efficiencies, clients and local governments can increase their long term sustainability.

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