# Whole Life Costing For Sustainable Drainage

This information sheet is summary of a report produced by HR Wallingford on Whole Life Costing for Sustainable Drainage.  This report was prepared as part of a DTI and industry funded research project to investigate the economic incentives, social impacts and ecological benefits of sustainable drainage systems (SUDS).

As part of this research, a series of reports have been produced:

**SR 622: An Assessment of the Social Impacts of Sustainable Drainage Systems in the UK**

**SR 625: Maximising the Ecological Benefits of Sustainable Drainage Schemes**

**SR 626: The Operation and Maintenance of Sustainable Drainage Systems (and Associated Costs)**

**SR 627: Whole Life Costing for Sustainable Drainage**

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## Introduction

Whole life costing involves estimating the total cost of a system or structure throughout its entire life.  It is about identifying future costs and referring them back to present day costs using standard accounting techniques such as Present Value.  It is recognised as an appropriate technique for use in valuing total costs of assets that have regular operating and/or recurrent maintenance costs, based on formalised maintenance programmes.

All expenditure incurred by a sustainable drainage system owner / operator results from the requirement to maintain the service of drainage of the surface water runoff.  Adopting a long-term approach complements the fact that sustainable drainage assets will have a relatively long “useful” life, providing appropriate management and maintenance is financed.

The guide provides a brief background to sustainable drainage, and sets out an approach for evaluating whole life costs for these systems. A case study is also presented.

## The need for whole life costing

Although capital costs of SUDS are likely to be lower than conventional drainage, maintenance requirements may be significant in comparison.  An understanding of long-term costs is therefore an important consideration for any adopting authority.

Property management companies, local authority service teams, or sewerage undertakers therefore need  tools to help understand the potential financial implications of taking responsibility for these systems in the long-term.

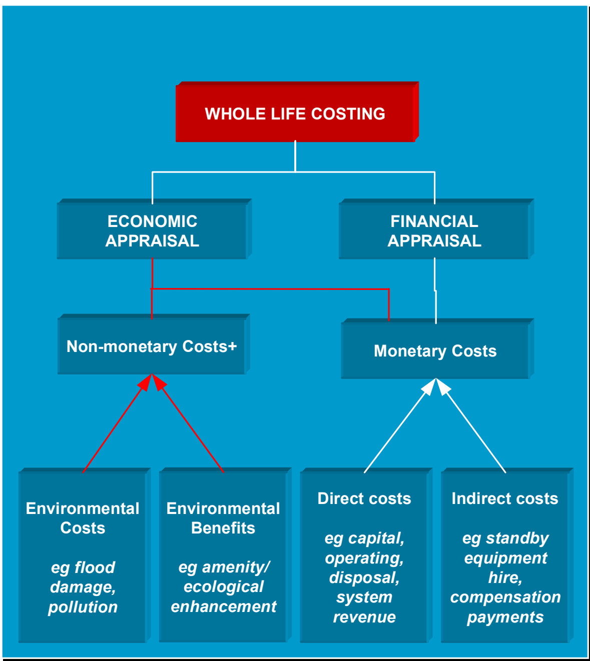
Whole life costing tools allow appropriate comparisons to be made between different drainage design solutions, and between a range of SUDS options.  Through encouraging a planned monitoring and maintenance regime, the approach promotes the explicit assessment and management of both short term and long term risk.  A tool that identifies the likely expenditure profile for the system over its design life will also allow future operators to enter into maintenance agreements with increased confidence, and with appropriate level of funding having been secured at the outset.

## Whole life costs

In considering the costs associated with SUDS, an economic or financial viewpoint can be taken. An economic appraisal seeks to evaluate all the costs and benefits to the community affected by a proposed development, while a financial appraisal is solely concerned with the tangible costs, earnings and revenues which accrue to the SUDS owner and operator.

In an economic appraisal, the major difficulty is usually the assessment of the benefits and risks associated with the scheme, which may not be readily measurable in cash terms.

The two approaches are summarised in the figure below:




## Discounting future costs

Present Value is the simplest and most commonly used discounting method available, and is appropriate for applying to SUDS which may require a varying time pattern of expenditure. Present Value has been defined as:

***" the value of a stream of benefits or costs when discounted back to the present time"***

It can be thought of as the sum of money that needs to be spent today to meet all future costs as they arise throughout the life cycle of a scheme or structure.

The formula for calculating present value is given below:

$$PV = \sum_{t=0}^{t=N} \frac{C_t}{(1+\frac{r}{100})^t}$$

Where:

$N$ = Time horizon in years $C_t$ = Total monetary costs in year $t$
$r$ = Discount rate

## Data required for a Whole Life Costing Approach

### Design Life

Design life is defined as the minimum length of time that a scheme or structure is required to perform its intended function.

There is some uncertainty over the design lives of sustainable drainage systems. However, with appropriate designs and regular maintenance, they should be long-lasting as there is low risk of structural failure.

### Capital Costs

SUDS capital costs should include (where appropriate):

- Planning and site investigation costs
- Design and project management/site supervision costs
- Clearance and land preparation work
- Material costs
- Construction (labour and equipment) costs
- Planting and post-construction landscaping costs
- Cost of land-take.

### Operation & Maintenance Costs

Sustainable drainage schemes require ongoing maintenance in order to ensure short-term operation and minimise risks to long term performance. Maintenance activities are likely to be an important consideration in determining lifetime costs.

Operation and maintenance activities can be classified as follows:

- **Monitoring**
  (This is most likely to include visual monitoring of litter build-up, water quality, sediment accumulation, plant growth, erosion damage, water levels)

- **Regular, planned maintenance**
  (e.g. rodding culverts, clearing debris from manholes, grass-cutting, vegetation management, sediment removal, jetting of permeable surfaces and silt traps)

- **Intermittent, irregular maintenance**
  (e.g. for major mid-life refurbishment such as geotextile replacement, vegetation replacement, soakaway replacement etc)

- **Unplanned maintenance / rehabilitation**
  (e.g. responding to problems e.g. blocked culverts/trash-racks, pollution incident, vegetation death etc)

Irregular maintenance and rehabilitation can often be 'managed out' through good design and effective regular management of the systems.

## Risk Costs

In sustainable drainage schemes, the residual risks can be managed to a certain extent through safe designs for exceedance, regular monitoring and appropriate maintenance. In most cases, the costs associated with the risks are likely to be 'public' or 'societal' costs and not be borne by the SUDS owner or operator.

Risks associated with flooding from conventional sewerage systems during extreme events and/or the impacts on receiving water quality from CSO spills have historically been considered by sewerage undertakers (adopting authorities), rather than the scheme developers. However, the move towards explicit recognition of all relevant costs and benefits at project appraisal stage means that such considerations may be important for the future.

## Environmental Costs

There are a range of environmental benefits that may accrue from implementing SUDS. These include amenity and recreation opportunities, biodiversity and ecological enhancement, aquifer and base flow augmentation, water quality improvements and net flood risk reductions.

There are methods now available for quantifying these benefits with monetary values, and several approaches are discussed in the document.

## Disposal Costs

There are some materials that that may require disposal as a result of operation and maintenance / rehabilitation activities.

These include:
- Vegetation (including aquatic planting and grass turfing)
- Granular fill
- Permeable surface blockwork
- Sediment
- Geotextiles.

## Residual Costs

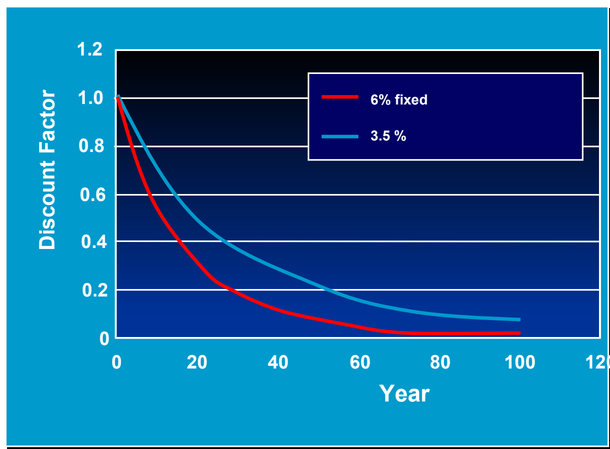
In a full economic evaluation, the residual value of the land used for the drainage components should be included. It is unlikely that any land close to development areas would depreciate in value within a 20 – 50 year period, and thus the net present worth of the land following the nominal operational lifetime should be accounted for.

## Discount Rate and Discount Period

The discount rate is the rate used to convert all future costs and benefits to 'present values' so that they can be compared.

In the public sector, the discount rate is set by the Treasury and they are currently recommending a rate of 3.5 %, a recent shift from a long-term value set at 6 %. This reduction in discount rate effectively puts a higher weight on future costs, with the aim of encouraging longer-term, more sustainable development.

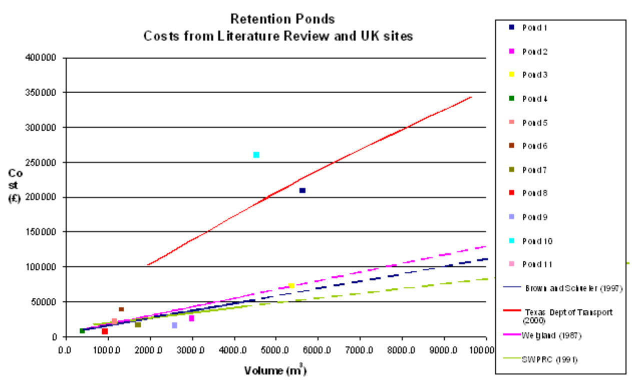
The following figure shows the variation with time of the contribution of annual expenditure to whole life cost, using the 3.5 and 6 % discount rates.




## Literature Review of Costs for SUDS

In attempting to determine reasonable cost estimates for sustainable drainage systems in the UK (that could be used for planning purposes), two approaches were followed. The first comprised a review and summary of cost estimates from literature. The second comprised a review and summary of real out-turn SUD construction costs and costed operation and maintenance schedules, collated from industry. Unfortunately, despite extensive consultation, very few scheme costs were found to be available.

The following figure shows an example of capital costs collated for retention ponds:




## Whole life costing methodology

The PV approach is summarised in the following figure:

Bob Bray (of Robert Bray Associates), in his report that forms part of this project (The Operation and Maintenance of Sustainable Drainage Systems), has undertaken a review of sustainable drainage operation and maintenance requirements. The report proposes appropriate maintenance schedules for each drainage component.

### Cost influences

The cost of constructing any SUD is inherently variable and will depend to a large extent on local conditions, and size of the development. Design criteria, together with topographic constraints, will determine flow rates and the volume of storage that is required. It should be remembered that design and performance criteria for SUDS should provide for health and safety, amenity and ecological benefits, in addition to hydraulic control and water quality treatment, and an economic appraisal of whole life costs will include environmental costs and benefits.

Influences on capital cost include:

- Hydraulic design criteria
- Water quality design criteria
- Region
- Land costs
- Soil type
- Materials availability
- Density of planting
- Public education
- Amenity / recreational facilities
- Inlet / outlet infrastructure design
- Construction programming and management
- Scale of development.

SUDS should be planned and designed for ease of maintenance, to keep ongoing costs at a minimum. Complex structures should be avoided, land must be allocated for access, and dedicated sediment traps should be designed upstream of SUDS components.