EXECUTIVE SUMMARY

The geographically mismatch of the water demand centres and the water resources necessitate the transport of water over long distances and high elevation differences. On average water is transported about 350 km in South Africa (Basson, Van Niekerk & Van Rooyen, 1997). High energy costs and the increasing demand require that the water transfer infrastructure should function optimally. Since the 1930's various researchers contributed to the identification and development of factors and relationships to quantify the energy loss in pipelines, which led by 1958 to the development of pressures, head losses and discharge relationships (Chadwick and Morfett, 1999) for the design and evaluation of pipes and pipe systems.

There are various factors that influence the hydraulic capacity and pipeline designers need to take all of these into consideration during the design. For instance the estimation of roughness parameter for a pipeline has a significant effect on the hydraulic capacity and operational costs. An underestimation of this parameter can be catastrophic when the required demand cannot be met.

Life Cycle Costing Analyses of pipeline systems

In the current economic setting more than ever, cost estimation is one of the most important aspects of the design engineer. The Life Cycle Cost (LCC) of an asset is defined as the present value of the total cost of that asset over its operating life, including initial capital cost, operating and maintenance cost, energy cost and the cost or benefit of the eventual disposal of the asset (New South Wales DPWS Report, 2001). Life Cycle Costing Analysis techniques take into account the total costs that the project will impose upon the client during the whole of its life.

The objectives of life cycle costing are: to enable investment options to be more effectively evaluated, to consider the impact of all costs rather than only the initial capital costs, to perform a sensitivity analysis and to assist the effective management of the completed project.

This report is a simple guide to Life Cycle Costing Analysis, limited to the design/analyses of bulk pipelines and emanated from research funded by the Water Research Commission (WRC) entitled "*Review of factors that influence the energy loss in pipelines and procedures to evaluate the hydraulic performance for different internal conditions*".

During this study existing software was adapted that could assist designers in evaluating a pipeline system over its full life cycle. In other words the factors affecting the operational efficiency and functionality of a pipeline can now be analysed over the full life cycle of the pipeline. One of the governing issues during the planning and implementation stages of a pipeline, or a distribution network, is the selection of the most appropriate pipe material for the specific operational and field conditions. During the planning stage it becomes tedious to analyse all the different alternatives and to compare them on a sound and equal basis.

To assist the planner/designer in the evaluation process existing software that performs life cycle costing was adapted for this purpose and is called ***AQUA Hydraulic Utilities*** (see **Figures i** and **ii**). The program determines the life-cycle cost by calculating the Nett Present Value (NPV) and the Internal Rate of Return (IRR) for the different pipeline system alternatives.

A Step-by-step guide utilizing two examples, a gravity system and a pumping system, was also developed that demonstrates the calculations as performed in ***AQUA Hydraulic Utilities***. In this guide the different life cycle cost elements are introduced to the design engineer and it is indicated how these cost elements will effect the final decision.

Websites for downloading software and updates:
http://www.wrc.org or http://www.sinotechcc.co.za

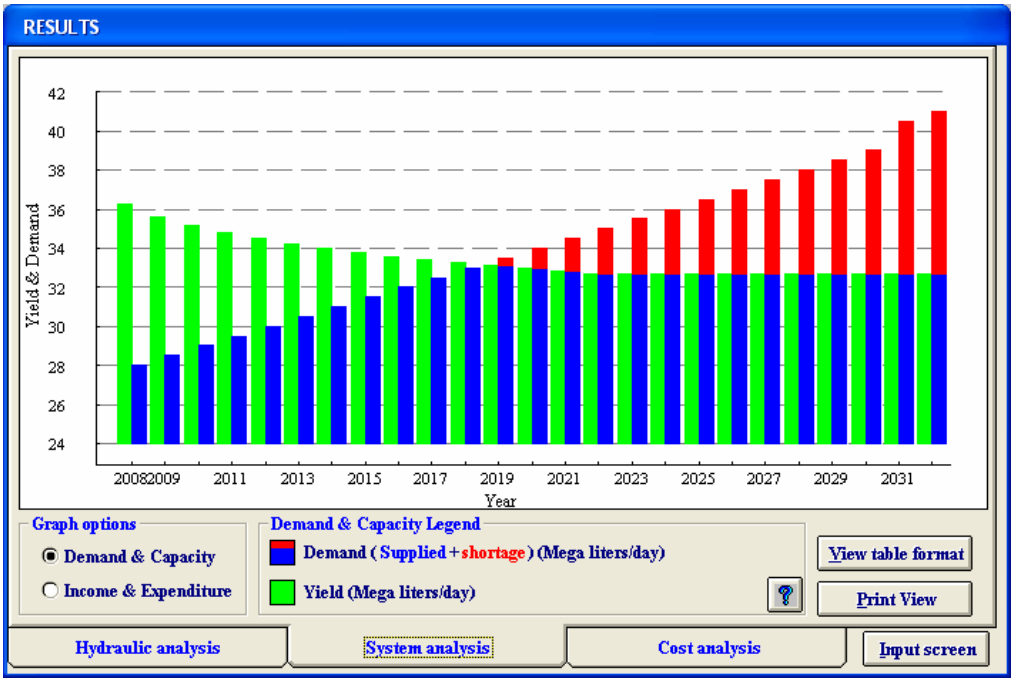

Figure i: System analysis - Demand and capacity results screen

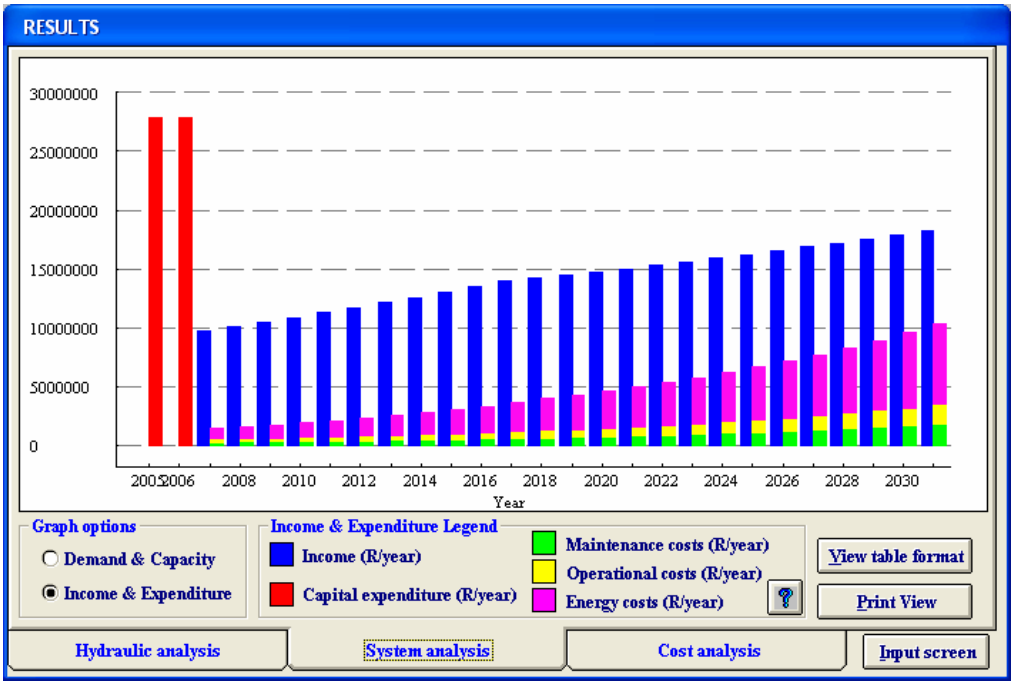

Figure ii: System analysis - Income and expenditure