MOOI-MGENI RIVER TRANSFER SCHEME PHASE-2: FEASIBILITY STUDY

BRIDGING STUDY 7

THE ECONOMIC VIABILITY OF THE MMTS-2 AS A FIRST OPTION TO AUGMENT THE WATER SUPPLIES OF THE MGENI SYSTEM

Final Report

January 2008

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Title:	***Bridging Study No. 7: The economic viability of the MMTS-2 as a first option to augment the water supplies of the Mgeni System***
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Project Name:	*Mooi-Mgeni River Transfer Scheme Phase-2: Feasibility Study*
Status of report:	*Final*
DWAF Report No:	***P WMA 07/V20/00/1707***
BKS Report No:	***J00096***
Keywords:	*Water Augmentation; Mooi River Catchment; Mgeni Water Supply*
First Issue:	*3 October 2007*
Final Issue:	***3 January 2008***

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EXECUTIVE SUMMARY

Since 2004 the water supplies from the water resources of the Mgeni System, viz. the Durban/Pietermaritzburg region, have been insufficient to meet the growing water requirements of the Mgeni System water users and the assurance of water supply has recently reached unacceptable low levels.

The Department of Water Affairs and Forestry (DWAF) conducted various investigations since 1996 to establish from where next to augment the Mgeni System as there is no further scope for dam development within the Mgeni River catchment. These investigations proposed the development of schemes to transfer water from the Mkomazi and Mooi rivers to the Mgeni System. Such schemes could be constructed in stages in order to keep both capital costs and the associated increase of the water tariff to a minimum. Although both schemes are viable, the investigations indicated that it would be more economical to develop the proposed Mooi-Mgeni Transfer Scheme (MMTS) first and thereafter construct the proposed Mkomazi Water Project (MWP). The latter scheme, although able to supply more water than the MMTS, is vastly more expensive and it would take many years before all the water would be taken up by the users. As a consequence the MWP would have a greater tariff impact on the Mgeni System water users than the much cheaper MMTS. In accordance with this development strategy Phase-1 of the Mooi-Mgeni Transfer Scheme (MMTS-1) was completed in 2003. The latter comprised the construction of a higher weir (Mearns Weir) at the existing Mearns pumping station on the Mooi River and raising Midmar Dam on the

Mgeni River by 3.5m to create storage for the water transferred from the Mooi River. The MMTS-1 utilised the transfer infrastructure of the existing Mearns Transfer Scheme that was constructed as an emergency scheme during the severe drought of 1983 when Midmar Dam nearly went dry. Feasibility investigations into the development of Phase-2 of the Mooi-Mgeni Transfer Scheme (MMTS-2) started in 2000. The growth in water demand of the Mgeni System has been so extensive since 2003 that it is now necessary to implement the project. The MMTS-2 comprise the construction of a large dam (Spring Grove Dam) on the Mooi River upstream of the existing Mearns Weir, a fish barrier weir on the river upstream of the dam a pumping station at the dam and a transfer pipeline to the Mgeni River catchment.

It is currently planned to develop Phase-1 of the Mkomazi Water Project (MWP-1) once the water of the MMTS-2 is fully utilized. The MWP-1 would comprise the construction of a large dam (Smithfield Dam) on the Mkomazi River near Lundy's Hill from where water would be pumped via a 33km long tunnel to a balancing dam at Bainesfield where the raw water would be treated in a new water treatment works (WTW) to be constructed by Umgeni Water. From the Bainesfield WTW potable water would be transferred along a 22km long twin pipeline to a new reservoir at Umlaas Road from where water would be fed into the Mgeni System bulk water supply network. Phase-2 of the MWP (MWP-2) would comprise the construction of another large dam (Impendle Dam) higher up on the Mkomazi River near Impendle. The MWP has only been investigated at a pre-feasibility level. The DWAF is currently planning to commission a feasibility investigation into the project and with the long lead time required it is unlikely that construction of the MWP-1 can be completed before about 2018.

Some objections against the implementation of the MMTS-2 have been raised by the water users of the Mooi River catchment. The belief is, firstly, that the MMTS-2 will negatively impact on the economic development, mainly agriculture, of the Mooi catchment. Secondly, that water transferred from the Mooi to the Mgeni System could be better utilized in the Mooi catchment and that the economic benefit thereof, as well as job creation, would be greater in the Mooi catchment than in the Mgeni System. Thirdly, the Mooi catchment has greater agricultural potential than the Mkomazi catchment and as a result it would be better to develop a water project in the Mkomazi catchment than in the Mooi catchment. In fact no further water should be transferred from the Mooi catchment to the Mgeni System.
Conningarth Economists were commissioned to investigate the above issues and to come up with answers to the questions embodied in them. Conningarth have chosen to use Cost Benefit Analysis (CBA) and Economic Impact Analysis (EIA) as the instruments for undertaking these investigations.

To provide a framework within which these questions can be addressed, the DWAF has identified the following four tasks to be undertaken:

1. Comparison to determine the most appropriate scheme to implement to augment the water supplies of the Mgeni System – MWP-1 versus MMTS-2;
2. Determination of the most economic use of water – donor catchment (Mooi catchment) versus receiving catchment (Mgeni System supply area);
3. Determination of the economic benefits of MMTS-2 for the Mooi River Catchment; and
4. Review of the economic Study of Graham Muller & Associates (1997).

The CBA indicates clearly that it is financially and economically viable to augment the Mgeni water supply should the need arise. It is also clear that the MMTS-2 should be part of the augmentation of the Mgeni water supply, and should be implemented before the MWP-1. The desirability of commencing with MMTS-2 rather than MWP-1 is highlighted by the fact that the benefit cost ratio (BCR) and internal rate of return (IRR) for both the financial and economic CBAs for MMTS-2 are nearly double those calculated for MWP-1. The net reference value of water (URV) for the MMTS-2 is R1.20 per cubic metre against R4.20 per cubic metre for the **MWP-1**.

The CBA results are depicted in the table below:

Economic analysis	Unit	Mooi River (MMTS-2)	Mkomazi River (MWP-1)
Financial Results (Discount Rate 11.3%)			
Unit Reference Value	R/m^3	R1.20	R4.20
Benefit Cost Ratio	-	2.9	1.2
Internal Rate of Return	%	38%	14%
Economic Results (Discount Rate 8%)			
Benefit Cost Ratio	-	4.4	2.6
Internal Rate of Return	%	90%	26%

The main reason why the Mooi Transfer Scheme is a more attractive scheme than the Mkomazi Transfer Scheme is the fact that its water supply fits more closely with the demand for future water consumption. It produces a lower surplus of water in the first few years relative to the Mkomazi Transfer Scheme.

Comparing the most economic use of water with regard to the donor catchment vs. receiving catchment, the macroeconomic impact analysis shows clearly that the additional water brings

much more development to the Mgeni water supply area (receiving catchment) than the Mooi River catchment (donor catchment). In fact, the employment that will be created in the Mgeni supply area will be greater with a factor of 10 than the employment that will be lost in the donor catchment.

Most economic use of water – Donor Catchment vs. Receiving Catchment: Impact on Gross Domestic Product (GDP) and Employment per catchment (Rand and jobs per cubic metre of water) are as follows:

Economic impact	Unit	Direct impact	Total impact
Impact on GDP			
Mooi River Catchment	R/m^3	R0.53	R0.71
Mgeni System supply area	R/m^3	R10.23	R14.30
Impact on employment (numbers)			
Mooi River Catchment	$Jobs/m^3$	14	15
Mgeni System supply area	$Jobs/m^3$	116	185

The study also indicates clearly that there are not only negative impacts on the Mooi Catchment due to transferring water to the Mgeni water scheme. It also poses positive economic impacts such as:

- Development opportunities during the construction phase; such as the establishment of small business in the region;
- Benefits for current irrigation farmers in terms of assurance of future water supply; "The assurance of supply to irrigators on the Mooi River downstream of Mearns Weir will be improved for that portion of the water that they receive from the Upper Mooi River as this would be stored in Spring Grove Dam and only released when required by the irrigators. Currently this water is not available all the time as it is part of natural flow conditions.
- Opportunities for the creational activities on the new dam; and
- The contribution to the ecological reserve of the Mooi River from the proposed Spring Grove Dam.

As far as the Graham Muller report is concerned, it is concluded that no good purpose would be fulfilled by updating it, but that in its present form it still provides useful insights into the current problems.

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APPENDICES

1. INTRODUCTION

Since 2004 the water supplies from the water resources of the Mgeni System, viz. the Durban/Pietermaritzburg region, have been insufficient to meet the growing water requirements of the Mgeni System water users and the assurance of water supply has recently reached unacceptable low levels.

The Department of Water Affairs and Forestry (DWAF) conducted various investigations since 1996 to establish from where next to augment the Mgeni System as there is no further scope for dam development within the Mgeni River catchment. These investigations proposed the development of schemes to transfer water from the Mkomazi and Mooi rivers to the Mgeni System. Such schemes could be constructed in stages in order to keep both capital costs and the associated increase of the water tariff to a minimum. Although both schemes are viable, the investigations indicated that it would be more economical to develop the proposed Mooi-Mgeni Transfer Scheme (MMTS) first and thereafter construct the proposed Mkomazi Water Project (MWP). The latter scheme, although able to supply more water than the MMTS, is vastly more expensive and it would take many years before all the water would be taken up by the users. As a consequence the MWP would have a greater tariff impact on the Mgeni System water users than the much cheaper MMTS. In accordance with this development strategy Phase-1 of the Mooi-Mgeni Transfer Scheme (MMTS-1) was completed in 2003. The latter comprised the construction of a higher weir (Mearns Weir) at the existing Mearns pumping station on the Mooi River and raising Midmar Dam on the Mgeni River by 3.5m to create storage for the water transferred from the Mooi River. The MMTS-1 utilised the transfer infrastructure of the existing Mearns Transfer Scheme that was constructed as an emergency scheme during the severe drought of 1983 when Midmar Dam nearly went dry. Feasibility investigations into the development of Phase-2 of the Mooi-Mgeni Transfer Scheme (MMTS-2) started in 2000. The growth in water demand of the Mgeni System has been so extensive since 2003 that it is now necessary to implement the project. The MMTS-2 comprises the construction of a large dam (Spring Grove Dam) on the Mooi River upstream of the existing Mearns Weir, a fish barrier weir on the river upstream of the dam a pumping station at the dam and a transfer pipeline to the Mgeni River catchment.

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Some objections against the implementation of the MMTS-2 have been raised by the water users of the Mooi River catchment. The belief is, firstly, that the MMTS-2 will negatively impact on the economic development, mainly agriculture, of the Mooi catchment. Secondly, that water transferred from the Mooi to the Mgeni System could be better utilized in the Mooi catchment and that the economic benefit thereof, as well as job creation, would be greater in the Mooi catchment than in the Mgeni System. Thirdly, the Mooi catchment has greater agricultural potential than the Mkomazi catchment and as a result it would be better to develop a water project in the Mkomazi catchment than in the Mooi catchment. In fact the belief is that no further water should be transferred from the Mooi catchment to the Mgeni System.

Conningarth Economists were commissioned to investigate the above issues and to come up with answers to the questions embodied in them. Conningarth have chosen to use Cost Benefit Analysis (CBA) and Economic Impact Analysis (EIA) as the instruments for undertaking these investigations.

To provide a framework within which these questions can be addressed, the DWAF has identified the following four tasks to be undertaken:

1. Comparison to determine the most appropriate scheme to implement to augment the water supplies of the Mgeni System – MWP-1 versus MMTS-2;

2. Determination of the most economic use of water – donor catchment (Mooi catchment) versus receiving catchment (Mgeni System supply area);
3. Determination of the economic benefits of MMTS-2 for the Mooi River Catchment; and
4. Review of the economic Study of Graham Muller & Associates (1997).

This report on the findings of these investigations is structured as follows:

Chapter 1: Introduction.

Chapter 2: Economic Assessment Instruments.

This Chapter describes Cost Benefit Analyses, both financial and economic, and the Macroeconomic Impact Assessment, all of which are used in the investigation.

Chapter 3: Methodology: Data and Data Sources.

This Chapter describes the data used and their source, as well as the chief assumptions underlying the investigation.

Chapter 4: Comparison of the most appropriate scheme to implement – Mkomazi Water Project versus Mooi-Mgeni Transfer Schemes Phase-2.

Here will be found a description of the cost-benefit analyses undertaken, together with the resultant findings.

Chapter 5: Most Economic use of Water – Donor Catchment versus Receiving Catchment.

In this Chapter details of the Macro-economic analysis relating to the donor and receiving catchments are set out, together with the relevant findings.

Chapter 6: Economic Benefits of the MMTS-2 for the Mooi River catchment.

The benefits which will accrue to the inhabitants of the Mooi River catchment which arise from implementing MMTS-2 are set out in this Chapter.

Chapter 7: Economic study of Graham Muller (1998).

The report "A Socio-Economic Impact of Outcomes relating to the Mkomazi-Mgeni Augmentation Scheme" prepared by Graham Muller Associates in 1998 is reviewed and recommendations made regarding the need to update it.

Chapter 8: Summary and Conclusions.

In this Chapter the processes and findings of the investigations are summarised, and recommendations relating to appropriate courses of action set out.

2. ECONOMIC ASSESSMENT INSTRUMENTS

It was decided to use two instruments, 'economic and financial' to evaluate the economic feasibility of augmenting the water supplies of the Mgeni System from either the MMTS-2 or the MWP-1 and the economic impact of these projects; namely a Cost Benefit Analysis (CBA) and a Macro Economic Impact analysis.

2.1 Cost Benefit Analysis

Cost Benefit Analysis (CBA) provides a logical framework by means of which development programmes can be evaluated and, as such, serves as an aid in the decision-making process. A more detailed explanation of CBA can be found in Appendix A to this report.

In conducting a CBA of the proposed MMTS-2 and MWP-1 development plans, the various stakeholders which will be either positively or negatively impacted upon by this development have been identified. These include the benefits to the water users of the Mgeni System as well as the future negative impact which the farmers in the Mooi and Mkomazi can experience due to the fact that certain development opportunities are lost by transferring the water out of the catchments.

The various impacts have been calculated for each year over the twenty year period that was used to evaluate the project, and then discounted to present values, using a discount rate. The financial CBA has been done in current prices and discounted by a rate reflecting the cost of capital. The economic CBA has been done in constant prices and discounted by a social discount rate.

2.1.1 Financial and Economic CBA

The private and public sectors evaluate projects very differently. The private sector is mostly interested in the profitability of a project and the return on capital that will be achieved. In doing so, the private sector makes use of market prices (i.e. the prices that would be paid in the open market for inputs, labour, etc.) when determining the value of direct project-related costs and financial benefits. Furthermore, a financial CBA evaluates the project using market-determined interest and return rates that reflect the cost of private funds, uncertainties and risk.

In contrast, evaluating a public sector project involves determining a broader range of costs and benefits that will affect the community. Furthermore, when calculating the value of costs and benefits, economic analysis re-evaluates the project by making use of prices that reflect the relative economic scarcity/value of inputs and outputs. As such, in the public sector it is necessary to evaluate and weigh the wider benefits emanating from a project against the capital expenditure and costs associated with a project, using discount and return rates that reflect the time preferences of the community, known as the social discount rate.

The table below summarises the main differences between a financial and economic CBA.

Table 1: Comparison of Financial and Economic Cost Benefit Analysis

Attributes	Economic CBA	Financial CBA
Perspective	The broader community	Project shareholders/capital providers
Goal	The most effective application of scarce resources	Maximization of net value
Discount Rate	Social discount rate	Market determined weighted cost of capital
Unit of Valuation	Opportunity costs	Market prices
Scope	All aspects necessary for a rational, economic decision	Limited to aspects that affect profits
Benefits	Additional goods, services, income and/or cost saving	Profit and financial return on capital employed
Costs	Opportunity costs IRO of goods and services foregone	Financial payments and depreciation calculated according to generally accepted accounting principles

Source: WRC 2002

2.2 Macroeconomic Impact Assessment

2.1.2 Methodology

Macroeconomic impact analysis attempts to identify the impact that a specific project would have on a regional and/or national economy. Impacts are calculated in terms of economic performance indicators such as gross domestic product (GDP), and job creation.

A defining feature of multi-sector macroeconomic models is their recognition of the extent to which economic systems are characterised by interdependency, in terms of how economic impacts in one sector will have repercussions that are experienced, to a greater or lesser extent, throughout the economy. As such, these models can be used to quantify the magnitude of these repercussions, and assess the efficacy of alternative economic policies and development initiatives.

2.1.3 Social Accounting Matrix

A Social Accounting Matrix (SAM) is a comprehensive, economy-wide database that contains information regarding the flow of resources that take place between the different economic agents that exist within an economy (i.e. business enterprises, households, government, etc) during a given period of time – usually one calendar year.

The data requirements for all economic models can always be expressed in the form of a SAM. If it is not possible to express the data in this particular manner, the model will invariably be flawed, making its application in the model-building arena impossible. It is this particular characteristic of the SAM that has made it popular as the database of preference for multi-sector economic models that are used to assess the economic implications of policy changes (or shocks) that will have effects not only on macroeconomic aggregates such as GDP, job opportunities, the balance of payments, etc., but also upon the structure of the economy. As such, these models must have access to information on production, consumption, labour markets, and the functional distribution of income and the composition of trade.

A macroeconomic impact of the proposed port expansions of Durban was undertaken using the KwaZulu-Natal SAM built for eThekwini Metro by Conningarth Economists in 2004, and it is this SAM which underpins the macro-economic analysis undertaken in this study. A more detailed explanation of macroeconomic impact analysis and the SAM can be found in Appendix B to this report.

3. METHODOLOGY: DATA AND DATA SOURCES

3.1 Introduction

This chapter gives an overview of the overall methodology followed to incorporate the different data sets into the CBA and Macro Economic Impact Assessment models as well as the data used and the sources thereof.

The data which was used for the project inputs in the CBA model and Macro Economic Impact Assessment was taken from various sources and existing data bases and are discussed in the following paragraphs.

3.2 Model drivers

The implementation process of the new water supply infrastructure will be driven by the estimated future growth of water demand in the area of responsibility of Umgeni Water, the local water board. The current annual water use (2006/7), including losses in the bulk system, for the eThekwini Municipality is 363 million m^3.

It is forecast that the future water use of the Mgeni System will grow to around 656 million m^3 after 20 years (year 2027). This growth rate is underpinned by the assumption that the domestic consumption of water will grow by around 2% p.a. and that water usage by commerce and industry will grow by 4% p.a.

The relatively high projected growth in domestic consumption is based on natural population growth and the influx of population from other areas in KwaZulu-Natal, together with the improvement of water supplies to previously disadvantaged communities that do not have sufficient water supplies at present.

3.3 Capital and Operational Costs

The comparison of potential sources of water that is made in this report is between the Mkomazi River catchment and the Mooi River catchment. More specifically a comparison is required to see which of the two schemes (MMTS-2 and MWP-1) would provide the greatest opportunity cost.

MMTS-2 (Spring Grove Dam and appurtenant works) comprise the second phase of the Mooi River scheme, while MWP-1 (Smithfield Dam and appurtenant works) is the first phase of the Mkomazi River scheme. The manner in which this cost is requested is indicated below as an example where illustrative numbers are being used.

The estimated capital and operational costs of the transfer schemes are depicted in Table 2.

Table 2: Capital and Operational Costs for Donor Catchments

Cost/Value of water (July 2005 prices)	Unit	Mooi River Catchment	Mkomazi River Catchment
		MMTS-2	MWP-1
Transferable 99.0% stochastic yield	million m^3/a	60	147
Total capital cost (excl. VAT)	R million	358[1]	1503[2]
Total O&M cost (excl. VAT)	R million/a	8.72[1]	10.6[2]

Notes:

1. MMTS-2 costs based on July 2005 prices. (Source: DWAF)
2. MWP-1 costs based on March 1998 prices. (Source: DWAF 1999b)

For the purpose of the cost benefit analysis the 1998 prices of MWP-1 have been adjusted to 2005 prices by using the appropriate cost increase indices, published by Stats SA. This brings all prices in line at 2005 levels.

3.4 Tariffs for Economic Value of Water

The following tariffs and economic value of water ($R/m^{3)}$ have been assumed:

Table 3: Tariffs and Economic Value of Water in the Mgeni (Tariff year 2005; all prices exclusive of VAT)

Tariff for bulk water Mgeni water users	Uniform tariff throughout Mgeni System. Source: Umgeni Water	 R2.48/m^3
Economic value of water Low income households High income households Trade and industry	Source: Conningarth internal database	 R17.80/m^3 R10.60/m^3 R5.68/m^3

3.5 Assumptions underlying the calculation of opportunity costs

The future abstraction of water may affect future agricultural developments in the area. To calculate the opportunity costs that would be incurred, the assumptions tabled below are made. As this is a desktop study, the figures presented were estimated by Conningarth Economists from current production trends and anticipated future development in the specific area.

3.5.1 Mooi River

Table 4: Assumptions: Opportunity costs for Agriculture in the Mooi River

Assumptions	Dairy	Potatoes	Irrigated Maize
Hectare Percentage	80%	5%	15%
Percentage of water used:	89%	3%	8%
Average water consumed (m^3/ha/year)	9 350	4 580	4 530
Average production surplus/ha	R9 760	R6 253	R2 187

Source: Conningarth Economists; internal calculations.

In the case of the Mooi River it is evident from the above table that most of the opportunity costs lie in foregone dairy development. In the absence of definitive data, it was assumed for this study that 80% of future irrigation water would be used for dairy farming, whilst 5% would be used for potatoes, and 15% for maize.

3.5.2 Mkomazi River

Table 5: Assumptions: Opportunity costs for agriculture in the Mkomazi River

Assumptions	Dairy	Potatoes	Irrigated Maize
Hectare Percentage	50%	10%	40%
Percentage of water used:	68%	7%	26%
Average water consumed (m/ha/year)	9 530	4 580	4 530
Average production surplus/ha	R9 760	R6 253	R2 187

Source: Conningarth Economists; internal database and calculations.

In the case of the Mkomazi it is not that evident that there will be a negative impact on agriculture due to the unlimited availability of water. However, for purposes of scenario building, the same opportunity cost analysis was performed as was done for the Mooi River.

From the above it is evident that dairy farming plays a lesser role than it does in the Mooi River (e.g. 50% of the development hectares in the Mkomazi River are attributed to dairy farming as against 80% in the Mooi). On the other hand, development hectares in the Mkomazi attributed to potatoes are 10% and to irrigated maize, 40%.

It must, however, always be borne in mind that the availability of high-value productive land in the area is very limited. The potential for irrigation development has been estimated at of approximately 2 557 ha of land along the Mkomazi River 60 to 110 km upstream of the town of Umkomaas (KZN:DAEA, 2001).

3.6 Inflation

Although the CBA model in economic prices is calculated in constant 2005 prices the model for the financial CBA is done in current prices, which necessitates the consultants to take a position on inflation that would affect construction, operational costs and income over the project period. At present the Reserve Bank has put inflation targets in place to contain consumer inflation between 3% to 6%; it is

however also a fact that the construction sector has experienced an inflation rate of more than 10% the last three years.

We are however still of the opinion that the 3% to 6% is a realistic target and that over a longer period of time the inflation on the cost side will remain below 6%. For purposes of the financial model a 5% inflation rate is used.

3.7 Discount rate

For purposes of the economic CBA a real discount rate of 8% has been used. This is in line with the Manual for Cost-Benefit Analysis (WRC, 2002). In terms of the financial CBA, a discount rate of 11.3% has been used. This figure, which is inferred from appropriate statistics in the Reserve Bank Quarterly Bulletin, September 2007, takes into consideration the present interest rates and the historical trends of interest rates in South Africa.

4. COMPARISON OF THE MOST APPROPRIATE SCHEME TO IMPLEMENT – MWP-1 VERSUS MMTS-2

In this section two questions are being addressed. Firstly the appropriateness of the augmentation of the Mgeni system has been given attention and secondly a comparison between the Mooi and Mkomazi transfer schemes has been made to determine whether it is appropriate to build the Mooi Transfer scheme now, taking into account the fact that the Mkomazi will ultimately have to be built.

The vehicle used to address these questions is the CBA, and the results are summarised in Table 4 below. The final sheet of each CBA can be found in the following Appendices:

C - Mooi Financial CBA
D - Mooi Economic CBA
E - Mkomazi Financial CBA
F - Mkomazi Economic CBA

The NPV has not been used as a decision criterion due to the fact that sizes of the two dams differ. The decision criterion which is used is the Unit Reference Value (URV).

Table 6: CBA Results

Economic analysis	Unit	Mooi River (MMTS-2)	Mkomazi River (MWP-1)
Financial Results (Discount Rate 11.3%)			
Unit Reference Value (URV)	R/m^3	R1.20	R4.20
Benefit Cost Ratio (BCR)	-	2.9	1.2
Internal Rate of Return	%	38%	14%
Economic Results (Discount Rate 8%)			
Benefit Cost Ratio (BCR)	-	4.4	2.6
Internal Rate of Return	%	90%	26%

Source: Conningarth Economists: internal calculations.

From the above it is evident that both schemes are highly cost effective and economically viable. The Benefit Cost ratios (BCR) are greater than one, and the IRRs are much higher than the social discount rate of 8%. (The benchmarks for these indicators (BCR and IRR) are described in WRC, 2002.) The future benefits of

the water used in the Mgeni System are much higher than the capital costs of the opportunity costs in the donor catchments. However, each criterion used in the analysis clearly points to MMTS-2 as being the favoured alternative. The conclusion to be drawn is that if the Mgeni System is to be augmented, then, whilst both schemes are economically viable, it is clear that MMTS-2 is the preferred scheme.

In other words, the results show very clearly that it makes eminent sense that MMTS-2 should be implemented before the MWP-1, as was anticipated in the original DWAF development strategy. The IRR for MMTS-2 in the above table is double that of the MWP-1. For instance the IRR financial for MMTS-2 is 38% as against 14% for the MWP-1, the economic IRRs are respectively 90% of 26%. From a cost delivery point of view, the same conclusions can be drawn when comparing the reference values of both schemes. The URV for MWP-1 is R4.20/m^3 whilst that for MMTS-2 is R1.20/m^3.

There are many dimensions of the problem that interact to produce the outcome. These include the growth in the demand for water, the magnitude of the capital cost, the opportunity cost of the water. The main reason why the combined system produces a better result is that its water supply (also the capital used) fits more closely with the demand at this stage. The Mkomazi is a big river on which a relatively large dam with an equally high yield can be built, which implies that for the first few years of its service there will be an oversupply of water which cannot be utilised. In money terms this means that in the early stages there is unproductive capital tied up which has a negative effect on the cost effectiveness of the investment. This situation will also result in a higher water tariff than the case where all the water, the full yield of the dam, could be used right from the start.

5. MOST ECONOMIC USE OF WATER: DONOR CATCHMENT VS. RECEIVING CATCHMENT

This issue revolves around the concern that water transferred from the Mooi River to the Mgeni should indeed be used for the "greater good". As far as the financial aspects are concerned, this has already been demonstrated due to the fact that the benefits accruing when the water is used in the Mgeni system exceed the cost (including the opportunity cost of the irrigation water) of transferring the water from the donor catchment. It has further been demonstrated that the Mgeni system should initially be augmented from the Mooi River, and not from the Mkomazi.

It could be argued that from a macroeconomic standpoint, the development advantages of this water are greater in the donor catchment (Mooi River) than in the receiving system (Mgeni). However, the results in the table below, which are based on estimations using the KwaZulu-Natal SAM, demonstrate the opposite.

Table 7: Most economic use of water – Donor Catchment vs. Receiving Catchment: Impact on Gross Domestic Product (GDP) and Employment per catchment

Economic impact	Unit	Direct impact	Total impact
Impact on GDP:			
Mooi River Catchment	R/m^3	R0.53	R0.71
Mgeni System supply area	R/m^3	R10.23	R14.30
Impact on employment (numbers):	Jobs/Mm^3	14	15
Mooi River Catchment	Jobs/Mm^3	116	185
Mgeni System supply area			

Source: Conningarth Economists; internal databases

According to the table, the receiving catchment will produce, directly and indirectly 185 jobs per million m^3 of water, which is significantly higher than can be achieved in the donor catchment. This is also the case if GDP is used as a criterion.

The argument is normally put forward that agriculture (even irrigated agriculture) is very labour intensive. This is true if labour intensity is measured using capital as the other production factor. However, irrigation is very much water intensive, so that if jobs are measured against water use, irrigation is no longer seen as labour intensive. In comparison the water that is used in the receiving catchment is in

many cases used by less intensive water uses, where many jobs are created with limited use of water. For instance, in the service sector water use is minimal in terms of the jobs of GDP created.

Aspect to be noted:

In the above analysis it was assumed that if the water was not transferred to the Mgeni, it could be used (mostly for irrigation purposes) in the donor area. However, this is only true if the infrastructure is put in place in the donor area with very high attendant financial costs. In view of the relatively low yield of the Mooi River no further run-of-river abstraction is possible along the Mooi River, and current DWAF Policy is not to financially support commercial farmers anymore in the building of irrigation dams. It seems unlikely, therefore, that infrastructure will be put in place for the sole purpose of supporting irrigated agriculture.

6. ECONOMIC BENEFITS OF MMTS-2 FOR THE MOOI RIVER CATCHMENT

Although the argument can be raised that future development in the Mooi could be jeopardized by the anticipated transfer of water to the Mgeni, it is important to note that there are also several long- or short-term advantages that the transfer will bring to the Mooi. A few of these are discussed below.

6.1 Development opportunities during Construction Phase

a. By making use of the SAM for KwaZulu-Natal it is calculated that 1 500 man years of employment will be created directly, and another 600 indirectly, making a total of 2 100 over the construction period of the dam. This implies some 700 jobs per annum over the construction period of 3 years.

b. The infrastructure of the area will also be significantly improved with long-term beneficial effects for the local community. An example of this would be improvements to the R103 which would have to take place before construction of the dam, and remain thereafter.

6.2 Benefits for Irrigation Farmers

Current irrigation farmers below the dam wall will benefit significantly in terms of the improvement of assurance of supply. A certain portion of the dam's yield, the rightful share of the Upper Mooi for existing irrigators downstream will be stored in the dam. This water will be released from the dam into the river to the downstream users whenever they experience a shortfall. It is estimated that if the assurance of supply can be improved by 5 percentage points, the surplus value of the current irrigation farmers can be improved per annum by almost R1 million with the more regular supply of water brought about by the presence of the new dam. The NPV (8% Discount Rate) over the period is R8.6 million. The details of the analysis are given in Table 8.

Table 8: Benefits that will be derived by the current farmers through increasing the assurance of supply by the building of the Mooi Mgeni Transfer Scheme

	Percentage split of agricultural activities	Hectares impacted in the catchment area by the new dam	Percentage increase in production due to increase in assurance of supply	Additional economic surplus per annum generated by increased assurance
Dairy	80%	1616	5%	R788641
Irrigated Maize	15%	303	1%	R6627
Irrigated Potatoes	5%	101	3%	R18946
Total	**100%**	**2020**		**R814215**

Source: Conningarth Economist; internal databases and calculations

The Mooi River only experiences problems with assurance of supply in the winter months, as its catchments experience little or no rain during this period. Thus the largest effect of increasing the assurance of supply will be felt by Dairy Farmers that need to irrigate during the winter months. Maize and potatoes are grown in the summer months and thus will gain little or no benefit from the increase in water assurance (small gains could be felt early in the growing season). It was therefore estimated that the building of the dam would increase the production of the dairy farmers by 5 percentage points, potato farmers by 3 percentage points and maize farmers by 1 percentage point.

6.3 Recreational activities

The dam basin will offer many opportunities which could contribute to the local economy, e.g.

- Recreation activities on the lake, such as sailing, power boating, etc;
- Could become a great bass and trout fishing resort;
- Recreation and fishing will support the local recreation business and accommodations sectors that would create further job opportunities;
- Housing development on riparian zones of dam, etc.

6.4 Environmental

The Ecological Reserve of the Mooi River has not yet been implemented in the Mooi River and as such much of the current flow in the river that should go towards the Ecological Reserve is abstracted for other use. However, despite the Reserve not yet being implemented, the proposed Spring Grove Dam will release its share towards the Reserve from the day it becomes operational. Although not fully providing for the Reserve of the whole Mooi River downstream of the dam, the dam will make a substantial contribution towards the improvement of the ecological health of the river. If the dam is not built, the shortfalls for the Reserve will remain and the health of the river will deteriorate further.

7. ECONOMIC STUDY OF GRAHAM MULLER

In 1998 an economic study entitled "The socio-economic impact of outcomes relating to the Mkomazi-Mgeni Augmentation Scheme" was prepared by Graham Muller Associates for Umgeni Water. This report investigated the socio-economic impact on Durban and Pietermaritzburg of not implementing or delaying MWP-1, assuming that MMTS-2 had already been implemented. As such it did not concern itself with transfers of water from the Mooi River, but only with transfers from the Mkomazi. The report nevertheless brings additional insight into some issues under discussion in this report.

Two major findings, based on consideration of the impacts on GDP and job creation, are that there is an overwhelming need for augmentation of water supplies in the Mgeni, and that delays in putting water transfers in place will have a strongly negative economic impact on the area. Despite the fact that the report was prepared some nine to ten years ago, the underpinnings of the report are sound, and it is felt that it is not necessary at this stage to attempt to update it, since it appears unlikely that the above findings would change in the face of more current data – in fact it is probable that a more pessimistic picture would be painted.

There are several considerations supporting this view. The investigation appears to have been robustly constructed, and based upon reputable methodologies and data sources. The need for augmentation in the Mgeni is becoming patently more necessary; as is demonstrated by the worsening of assurance of supply to the Mgeni to below 95% (it should ideally be at 99%). The magnitude of the impacts calculated by Graham Muller & Associates are of such a magnitude that there would have to be significant improvements in the water supply situation if the major findings were to be reversed. This is clearly not the case.

Consequently the impacts of delaying additional augmentation schemes as calculated in the report should still be regarded as being clear indicators. Remembering that the Graham Muller report started with the premise that MMTS-2 had already been implemented, then it must be concluded that delays at this stage of implementing MWP-1 can only have more profoundly negative impacts. Graham Muller concluded that " the results of the analysis … show that a deficit [of water] of 10 percent occurs, even if timing is delayed by only two years. Beyond this the

shortages are greater and last for a longer period of time." This was at a time when it was anticipated that MWP-1 could be in place by 2009. Present indications are that MWP-1 could only be in place by 2018, and even if MMTS-2 could be in place by 2010, there would still be need for further augmentation by about 2011/12.

An additional impact, which could also be felt in the Mooi, is that a slow-down of development in the Durban/Pietermaritzburg area will bring about a reduction in growth of markets for produce and a slow-down of production in the Mooi River area, with attendant negative impacts on the economic indicators in the area. Although this effect was not directly calculated by Graham Muller, the magnitude of the impacts arising from delays make this conclusion almost inevitable.

8. SUMMARY AND CONCLUSIONS

In the Environmental Impact Assessment (EIA) process, questions were raised whether it is necessary that the Mooi Transfer Scheme should form part of DWAF's development strategy. In view of the perceived irrigation potential in the Mooi River catchment area that will be forfeited when additional water is transferred to Mgeni Water, it was argued that the construction of Mkomazi Transfer Scheme should commence immediately. A Cost-Benefit Analysis (CBA) as well as a macroeconomic impact analysis have therefore been performed to analyse the appropriateness of the inclusion of the Mooi Transfer Scheme as part of the future Mgeni Water Supply as proposed by the original DWAF development strategy.

The CBA indicates clearly that it is financially and economically viable to augment the Mgeni water supply should the need arise. It is also clear that MMMTS-2should be part of the augmentation of the Mgeni water supply. The desirability of commencing with MMTS-2 rather than MWP-1 is highlighted by the fact that the BCRs and IRRs for both the financial and economic CBAs for MMTS-2 are nearly double those calculated for MWP-1. The net reference value of water (URV) for the Mooi Transfer Scheme is R1.20 per cubic metre against R4.20 per cubic metre for MWP-1.

The main reason why the Mooi Transfer Scheme is a more attractive scheme than the Mkomazi Transfer Scheme is the fact that its water supply fits more closely with the demand for future water consumption. It produces a lower surplus of water in the first few years relative to the Mkomazi Transfer Scheme.

A further aspect which makes the Mooi Transfer Scheme more attractive is the uncertainty of the future increase in water demand. It is already forecast that the prevalence of HIV/Aids could nearly halt the natural population growth in the area. To commence now with a large scheme such as the Mkomazi Transfer Scheme could pose an economic risk. The Mooi Transfer Scheme is much smaller and fits well with the uncertainty of increases in the future water demand.

Comparing the most economic use of water with regard to the donor catchment vs. receiving catchment, the macroeconomic impact analysis shows clearly that the additional water brings much more development to the Mgeni water supply area

(receiving catchment) than the Mooi River catchment (donor catchment). In fact, the employment that will be created in the Mgeni supply area will be greater with a factor of 10 than the employment that will be lost in the donor catchment.

The study also indicates clearly that there are not only negative impacts on the Mooi Catchment due to transferring water to the Mgeni water scheme. It also poses positive economic impacts such as:

- Development opportunities during the construction phase; such as the establishment of small business in the region;
- Benefits for current irrigation farmers in terms of assurance of future water supply;
- Opportunities for the creational activities on the new dam; and
- The contribution to the environmental reserve.

As far as the Graham Muller report is concerned, it is concluded that no good purpose would be fulfilled by updating it, but that in its present form it still provides useful insights into the current problems.

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10. APPENDIX A: COST BENEFIT ANALYSIS

Introduction

The CBA method provides a logical framework for evaluating development programmes, and can serve as an aid in decision-making processes. The following is a brief overview of the theory underlying the CBA method.

In layman's terms, the principle of CBA can be described as the comparison of costs and benefits. The only factor that complicates the technique is the capitalization of costs and benefits to present values.

Discounting

Costs and benefits that are immediately incurred are judged differently by the community from costs and benefits that materialize over a period of time. Usually, a community would prefer receiving a benefit today rather than reaping benefits in the future, while deferred costs are more attractive than immediate payment. Therefore, the money value of costs and benefits over time cannot simply be added together.

The time preference of the community has to be taken into account through the use of a weighting process. This weighting by the community is done with the aid of a rate that reflects the value of a cost or benefit over time, a process referred to as discounting. This rate is known as the Social Discount Rate.

Suppose b_0, b1, …, b_n are the project benefits in years 0,1,2, …, n, and c_0, c_1, …, c_n are the costs in years 0,1,2, …, n, respectively, and i is the social discount rate, then the present value of the benefits is given by

$$b_0/(1 + i)^0 + b_1/(1 + i)^1 + \ldots + b_n/(1 + i)^n$$

and the present value of the costs are given by

$$c_0/(1 + i)^0 + c_1/(1 + i)^1 + \ldots + c_n/(1 + i)^n$$

When considering an appropriate social discount rate, note must be taken of the various viewpoints expressed in the economic literature (See WRC, 2002, pp71&72), as well as the rates applied in other countries and by international development institutions. The points of departure described in the literature can be divided broadly into three schools of thought, namely those who argue that the discount rate should be equal to the marginal return on capital (opportunity cost of capital), those whose argument rests on long-term real interest rates (cost of funding to the State), and those who advocate a social time preference rate.

The first two schools take an economic view, whilst the third school adopts a multiple-goal approach which includes social aims. In the debate in the literature, arguments and criticism are based on purely economic grounds, as well as on the basis of what exactly constitutes the "public interest". A lack of space makes detailed discussion of the arguments impossible, and the reader who wants more background on this interesting (and sometimes deeply philosophical) debate is referred to the book by Sugden and Williams (Sugden R. & Williams A. *Principles of Practical Cost-Benefit Analysis*, Oxford University Press, Oxford, 1978).

There is no consensus concerning which method should be used to determine the social discount rate. A relative pragmatic approach is proposed which takes the following into account:

The discount rate should not be influenced by business cycle conditions and policy, since the preferences that find expression in this rate are aimed at the extension of the long-term welfare structure.

A low discount rate generally favours projects with a high initial capital cost and low future current costs, while the opposite applies to high discount rates. Since labour costs are part of current expenditure, a high discount rate favours the employment of labour in future.

If the real social discount rate is lower than the real implicit discount rate in the private sector, then investment by the public sector will be encouraged at the expense of investment by the private sector. The larger the gap between the two, the stronger the effect.

The actual social discount rate that is used in analysing a specific project will be determined by the prices (financial or economic) that are used in the CBA.

The first step in conducting a CBA for a specific project is identifying those enterprises and stakeholders that will be either positively or negatively impacted by the project. The impacts can be calculated for each year over the entire lifespan of the project, and discounted to present values using the social discount rate.

These present values are then used to calculate various assessment criteria, which assist in the evaluation of the project. These criteria include:

Net Present Value (NPV)

The difference between the benefits and costs (the net benefit) in a specified future year is discounted to the present by using the social discount rate. The discounted sum of all these net benefits over the economic life of the project is defined as the net present value (NPV). In terms of the terminology set out above.

The criterion for the acceptance of a project is that the net present value must be positive; in other words, funds will be voted for a project only if the analysis produces a positive net present value. Where a choice has to be made between mutually exclusive projects, the project with the highest net present value will be chosen since it maximizes the net benefit to the community.

The Internal Rate of Return (IRR)

The internal rate of return (IRR) is the discount rate at which the present values of cost and benefits are equal. It is therefore the value of the discount rate r which satisfies the following equation:

Only projects with an internal rate of return higher than the social discount rate, which forms a lower limit, will be considered for funding. The internal rate of return must be handled carefully because there are situations in which the mathematical solution of the above equation is not unique. This happens when the stream of net benefits over the assessment period changes its sign (positive or negative) more than once.

The Discounted Benefit-Cost Ratio (BCR)

The discounted benefit cost ratio (BCR) is the ratio of the present value of the benefits, relative to the present value of the costs, i.e.

$$BCR = \{\Sigma b_j /(i+1)^j\} / \{\Sigma c_j /(1+i)^j\}$$

A project will only be considered for funding if the benefit cost ratio is greater than 1.

Doubt exists in the relevant literature about how costs and benefits should be dealt with. In practice, it is probably more common not to compute the benefit cost ratio using gross costs and gross benefits, but rather to compare the present worth of the net benefit with the present worth of capital costs. There are, however, some institutions that include some operating and maintenance costs as part of the costs with which the net benefit should be compared. It is recommended that only costs of a capital nature (assets and equipment with a life of more than a year) should form part of the costs with which the net benefit should be compared. The NPV, IRR and BCR criteria are not the only discounting measures used in CBA. There are also the net discounted end value, theoretically well founded and are the ones most commonly used in practice.

Shadow Prices

Shadow prices, as opposed to market and economic prices, are the opportunity costs of products and services when the market price, for whatever reason, does not reflect these costs in full. Examples are the shadow wages of labour, where minimum wages are fixed at levels higher than market prices; a shadow price for fuel, where taxes and subsidies are excluded; and shadow exchange rates, where exchange rates are pegged and/or limits are placed on capital flows. The shadow price is therefore the nominal (market) price, adjusted for the effect of interventions.

In practice, shadow prices should only be used when the market price of products and services do not reflect their scarcity value or economic contributions. In cases where market prices give an accurate indication of the scarcity of products and

services, market prices are used not only for financial analysis, but also for economic analysis.

11. APPENDIX B: MACROECONOMIC IMPACT ANALYSIS

Introduction

Macroeconomic impact analysis attempts to identify the impact that a specific project would have on a regional and/or national economy. Impacts are calculated in terms of economic performance indicators such as such as gross domestic product (GDP), capital formation, job creation, household income and expenditure, government income and expenditure, etc.

A defining feature of multi-sector macroeconomic models is their recognition of the extent to which economic systems are characterized by interdependency, in terms of which economic events that impact one sector will have repercussions that are experienced, to a greater or lesser extent, throughout the economy. As such, these models can be used to quantify the magnitude of these repercussions, and to assess the efficacy of alternative economic policies and development initiatives.

The Social Accounting Matrix

A Social Accounting Matrix (SAM) is a comprehensive, economy-wide database that contains information about the flow of resources that takes place between the different economic agents that exist within an economy (i.e. business enterprises, households, government, etc) during a given period of time – usually one calendar year.

The development of the ideas that underpin the SAM is largely attributable to Sir Richard Stone and the work undertaken by the Cambridge Growth Project in the 1950's and 60's. This group started out by integrating disaggregated production accounts in the form of input-output tables into the System of National Accounts (SNA). A SAM is a presentation of the SNA in a matrix format that incorporates an analysis of the interrelationships that exist between the various economic agents in the economy, including the distribution of income and expenditure amongst household groups, thereby, providing the national accounts with a social dimension.

A SAM is very similar to the traditional Input-Output Table in the sense that it reflects all of the inter-sectoral linkages that are present in an economy. However, in

addition to these inter-sectoral linkages, a SAM also reflects the activities of households, which are the basic unit where significant decisions regarding important economic variables such as expenditure and saving are taken. By combining households into meaningful groups, the SAM makes it possible to clearly distinguish between these household groups, and to study the economic welfare of each household group separately.

The data requirements for all economic models can always be expressed in the form of a SAM. If it is not possible to express the data in this particular manner, the model will invariably be flawed, making its application in the model-building arena impossible. It is this particular characteristic of the SAM that has made it popular as the database of preference for multi-sector economic models that are used to assess the economic implications of policy changes (or shocks) that will have effects not only on macroeconomic aggregates such as GDP, job opportunities, the balance of payments, etc., but also upon the structure of the economy. As such, these models must have access to information about production, consumption, labour markets, the functional distribution of income and the composition of trade.

The Structure of the SAM

When economic agents in an economy are involved in transactions, financial resources change hands. The SAM provides a complete database of all transactions that take place between these agents in a given period, thereby presenting a “snapshot” of the structure of the economy for that time period.

As a system for organizing information, a SAM represents a powerful tool in terms of which the economy can be described in a complete and consistent way:

- Complete in the sense that it provides a comprehensive accounting of all economic transactions for the entity being represented (i.e. country, region/province, city, etc.), and
- Consistent in that all incomes and expenditures are matched

Consequently, a SAM can provide a unifying structure within which the statistical authorities can compile and present the national accounts. As an economic framework, SAMs are not limited to economic data only. Considerable effort has been devoted to extending the SAM to incorporate social, demographic and environmental information.

The Concepts of Circular Flows and Double Entry Bookkeeping

The most basic principles underlying a SAM are the concepts of circular flows and double-entry bookkeeping.

Circular Flow

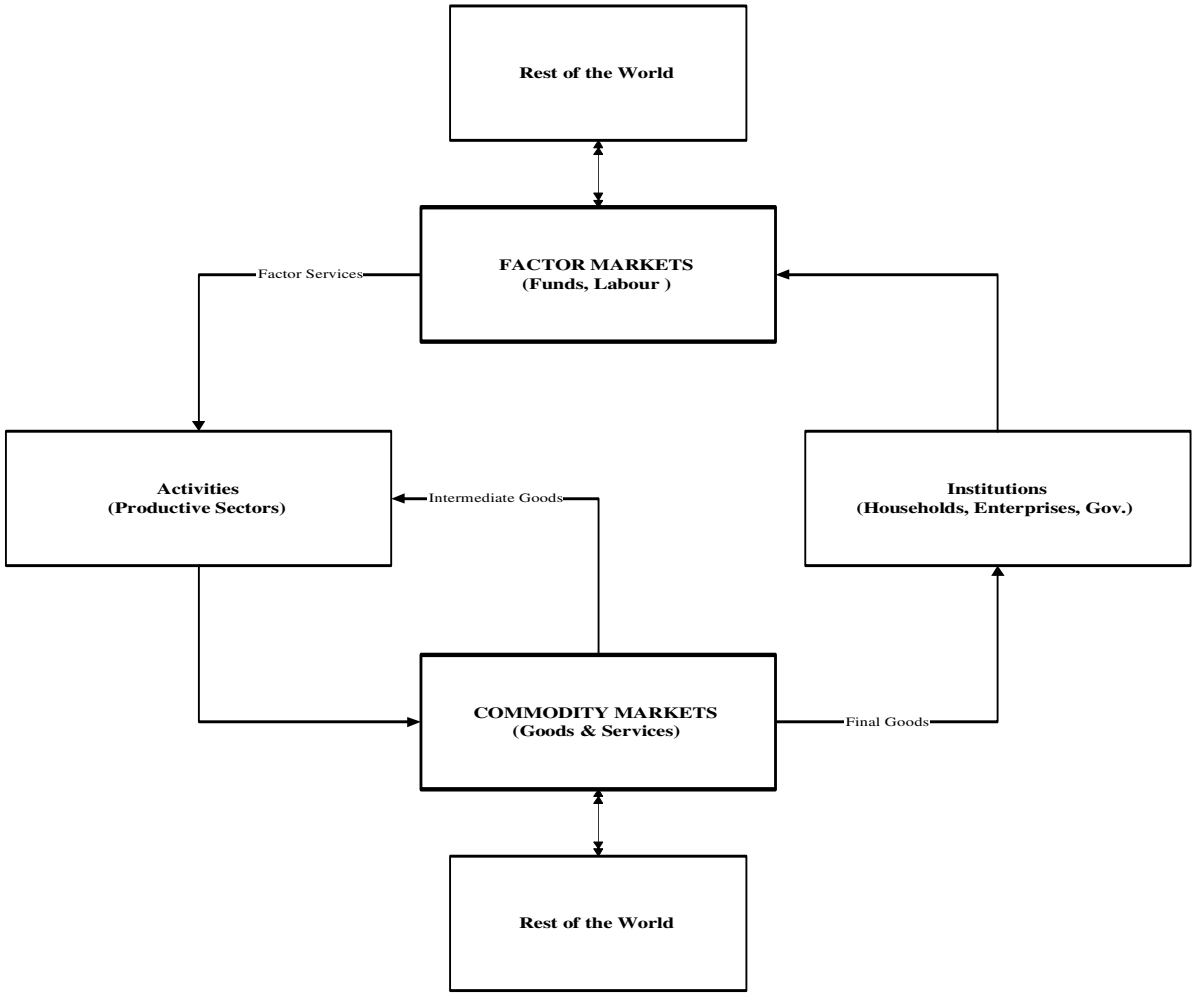
The concept of circular flows relates to a particular angle from which an economic system is viewed and traced. The various productive sectors (i.e. the "activities") in the economy act as producers and sellers of goods and services (i.e. the "commodities") to institutions such as households, business enterprises, and the government (the "purchasers" of the commodities). For their part, households, enterprises and the government act as sellers of factor services to the various activities, who then becoming the purchasers of these factors (i.e. labour, capital, etc.

Going one way around the circular flow, involves tracing out the flows of goods and services (i.e. the commodity markets). Going the other way around, the circular flow traces out the flows of funds (i.e. the factor markets). Transactions with the rest of the world can take place through both the commodity and factor markets. Diagram 9.1 on the following page presents a schematic representation of these flows.

According to the figure on the following page, a continuous flow of factor services exists from the factor markets to the activities in the economy, which in turn provides commodities (i.e. products/goods and services) to the commodity markets, from where these reach all of the institutions in the economy (i.e. households, enterprises and government). For their part, institutions provide factor services in factor markets, where activities act as purchasers.

The commodity market provides goods and services to two types of users. The first type of user includes the institutions, such as households, that use goods and services for purposes of final consumption (i.e. final goods). The second type of user is other producers in the economy that use goods and services in their own production process (i.e. intermediate goods). In addition, both the factor and commodity markets can interface with the rest of the world.

Diagram 1: Circular Flow of all Transactions in an Economy



Double Entry Bookkeeping

The SAM captures the monetary value of economic transactions, and organises them into a series of "accounts". There are six major types of accounts that form the basis of a SAM:

- Commodity Accounts that capture the value of products/goods and services traded in an economy.
- Activity Accounts that capture the value of products/goods and services produced in an economy.
- Factor Accounts that capture the value of payments made to the essential factors of production (i.e. labour, capital, land, etc).

- Institutional Accounts that capture the value of transactions by Business Enterprises, Households and Government, and
- The Rest of the World Accounts that capture the value of imports and exports.

Structurally, a SAM is a square matrix, within which each account has both a row and a column. The column entries record the expenditures/payments/out-goings for each account, whilst the incomes/receipts/in-comings for each account are recorded as row entries. As such, a SAM is a form of double entry bookkeeping where each entry is a transaction (that has both price and quantity dimensions), that identifies both its source and destination. Therefore, the total expenditures by each account must be exactly equal to the total receipts for the account. As such, the respective row and column totals must equate.

Consequently, a SAM provides a complete and consistent set of information about an economic system in an efficient and, ultimately, simple way. Moreover, it will provide that information in a manner that is consistent with the aggregate/macro accounts for the System of National Accounts (SNA). Furthermore, in the context of an entire economy, a SAM will contain not only the information provided by the SNA, but also further details on the transactions between various groups of agents within the system.

Economic Multipliers

Once a SAM has been developed, it becomes a powerful tool that can be used to conduct various macroeconomic analyses such as calculating sectoral multipliers. The multiplier concept is defined as the nature and extent of the impact/effect of an autonomous change in a specific economic quantity on another economic quantity or quantities. Samuelson (Samuelson, Paul A. *Economics*, McGraw Hill, New Yourk,1970) defines the multiplier concept as follows:

“The multiplier is the number of which the change in investment must be multiplied in order to present us with the resulting change in income”.

In order to make the multiplier concept more general, investment and income can be substituted respectively by other independent and dependent variables such as

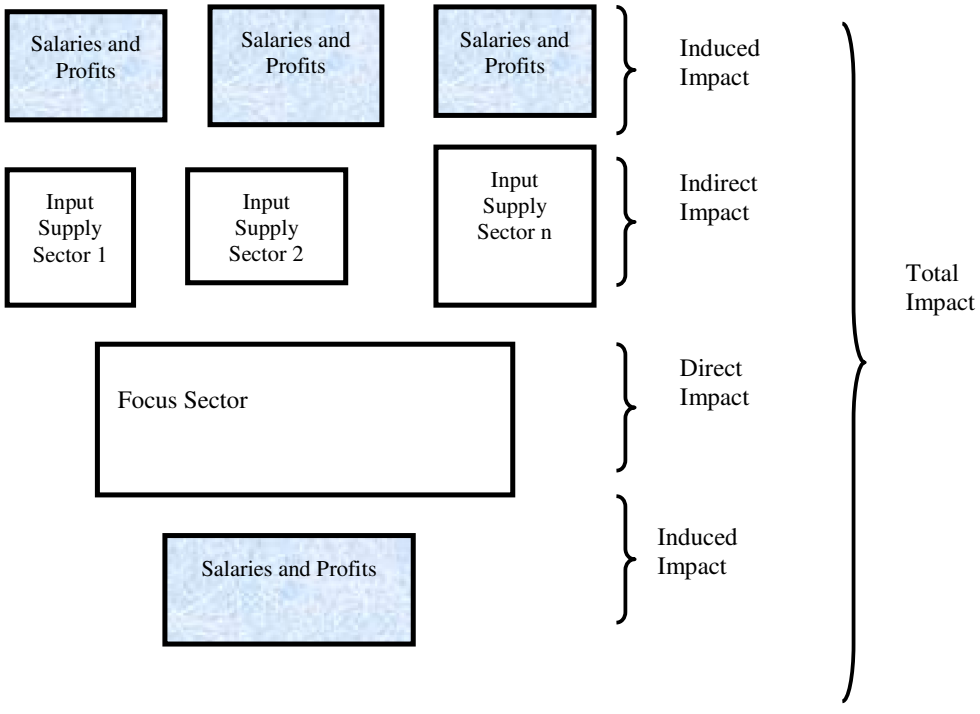
production output, interest rate changes, government and/or household expenditure, etc.

Direct, Indirect and Induced Impacts

Sophisticated macroeconomic modelling, utilizing a SAM as the database, highlights the direct impact that a specific project will have within its own industry environment, as well as the indirect impacts that the project will have on upstream industries that supply the project with key raw materials and other inputs; plus the induced impacts that the project will have throughout the broader economy that result from the increased expenditure by households and other institutions that benefit from the income they derive from direct and indirect involvement in the project.

These linkages are represented schematically in the diagram below.

Diagram 2: Schematic Representation of Direct, Indirect and Induced Impacts



Direct Multipliers

The direct multiplier measures the direct impact emanating from a particular sector on itself. For instance, the direct multiplier will measure how an increase in the production of a particular sector will effect employment within the same sector. These direct impacts are most closely related to the sector and, as such, are probably the most important impacts from a strategic planning point of view.

Indirect Multipliers

Indirect multipliers reflect the impacts that a particular sector will have on all other industries that supply inputs (materials) for the operations taking place in the sector. These 'backward linkages' are important as they measure the broader impact that changes in the direct sector will have on the economy. Frequently, these indirect impacts are very significant, and may even exceed the direct impacts themselves.

Induced Multipliers

Economic impacts will result from the paying out of salaries and wages to people who are employed in a particular sector, as well as the salaries and wages paid by businesses operating in the sectors indirectly linked to this sector due to the supply of inputs. These additional salaries and wages lead to an increased demand for various consumable goods that need to be supplied by various economic sectors throughout the broader economy. Clearly, these induced impacts can be considerable and are measured by using induced multipliers.

Economic Indicators

Macroeconomic modelling calculates the impact that a specific event such as an investment project would have on a variety of economic indicators. This section describes the most frequently measured indicators.

Gross Domestic Product

GDP reflects the magnitude of the value added in the economy. Value added consists of three elements, namely:

- Remuneration of employees;
- Gross operating surplus (which includes, amongst others, profits and depreciation);
- Net indirect taxes;

It is therefore possible to also assess the increase in new business sales by interpreting net indirect taxes. The same will apply to the increase in salaries and wages.

Capital Formation

For an economy to operate at a specific level, an amount of capital stock is needed to support such level of activity. Capital, together with labour and entrepreneurship form the basic factors needed for production in the economy. The effectiveness and efficiency with which these factors are combined influences, the overall level of productivity/profitability of the production process.

Employment Creation

As indicated above, labour is a key component of the production process. This study has determined the number of new employment opportunities that will be created by the construction and operation of the proposed projects. These opportunities are broken down into those created directly in the sector being analysed and those indirectly created and induced throughout the broader economy. The employment opportunities created during the construction phase will be mostly temporary, while those created during the operational phase will be mostly permanent.

Fiscal Impact

The government is directly or indirectly affected by changes in economic activities occurring within the various sectors of the economy. Therefore, it is important to calculate the impact that the construction and operation of the proposed projects will

have on government accounts (the fiscal impact). Usually, government receives income in the form of property income, direct tax (mainly personal tax and company tax) indirect tax (VAT – which results from additional household spending and customs and excise tax) and transfers. On the expenditure side there will be cost to government in providing services. The net effect between income and expenditure will also be determined.

Balance of Payments

The construction and operation of the infrastructure will have direct, indirect and induced impacts on the export and import of goods and services across all of the various economic sectors that are interconnected with this project. Imports consist of direct and indirect material imports, as well as goods consumed by households that are imported as a result of the induced impact resulting from increased household income.

Household Income

One of the elements of additional value-added (i.e. GDP) is remuneration of employees, which affects household income. This study has measured the magnitude of the changes that will occur to both household income and spending/saving patterns as a result of the construction of the Convention Complex. The specific impact on Low Income Households have been isolated, measured and reported on.

Social Services

There are also significant other social impacts that could result from the construction and operation of the projects, depending on government's social spending priorities. The existence of this program would for instance lead to the following that have been calculated:

- Number of additional educators;
- Number of additional beds serviced at hospitals;
- Number of additional doctors;

- Number of additional low-cost houses.

Effectiveness Criteria

Besides the macro-economic impacts reflected above, the macro-economic impact of the projects are also evaluated in terms of "effectiveness" (efficiency) criteria. These criteria measure the extent to which the project utilises resources effectively. Since capital is a scarce resource in South Africa, the effectiveness of the utilisation of capital in terms of labour/employment and GDP creation is measured in relation to the total South African economy.

When evaluating the construction and operation of the different projects and the related activities these efficiency criteria are the most reliable indicators as to whether or not the expansion will represent an effective use of capital. In order to make these comparisons, two key multipliers/ratios were calculated, i.e.

- The GDP/Capital ratio, and
- The Labour/Capital ratio.

Using these ratios, the contribution towards economic growth and job creation relative to the capital employed in the project can be established. If the decision-maker considers continuous, long-term economic growth to be more important than job creation in the short-term, then the GDP/Capital ratio is the more important of the two measures of macroeconomic effectiveness. On the other hand, if job creation, particularly in the short term, has priority, the Labour/Capital ratio is more important.

12. APPENDIX C: MOOI FINANCIAL CBA

FINANCIAL COST-BENEFIT ANALYSIS

Current Prices (R'000)

	NPV	TOTAL	UNIT	YEAR					
	Completion date								Continue to 2027
	11.3%			2007	2008	2009	2010	2011	2012
CAPITAL COSTS:									
BULK SERVICES									
WATER	R379 933	R467 275		R358 000	R0	R0	R0	R0	R0
TOTAL CAPITAL COSTS	R379 933	R467 275		R358 000	R0	R0	R0	R0	R0
MAINTENANCE & OPERATING COSTS									
WATER (BULK & INTERNAL)	R145 676	R499 138		R0	R5 292	R8 938	R11 686	R12 883	R14 204
TOTAL MAINTENANCE & OPERATING COSTS	R145 676	R499 138		R0	R5 292	R8 938	R11 686	R12 883	R14 204
TOTAL PROJECT EXPENDITURE	R525 609	R966 413		R358 000	R5 292	R8 938	R11 686	R12 883	R14 204

FINANCIAL REVENUE

	NPV	TOTAL	UNIT	YEAR					
	Completion date								
	11.30%			2007	2008	2009	2010	2011	2012
REVENUE FROM SERVICE CHARGES - WATER	R1 515 280	R4 493 996		R0	R82 663	R132 977	R165 569	R173 847	R182 540
TOTAL PROJECT REVENUE	R1 515 280	R4 493 996		R0	R82 663	R132 977	R165 569	R173 847	R182 540
TOTAL NET REVENUE (EXPENDITURE) BEFORE FINANCE	R989 671	R3 527 583		-R358 000	R77 371	R124 039	R153 883	R160 964	R168 336

	6%	8%	11.3%
NET PRESENT VALUE (R'000)	R1 740 126	R1 399 166	R989 671
BENEFIT COST RATIO	3.68	3.36	2.88
INTERNAL RATE OF RETURN			38.14%

13. APPENDIX D: MOOI ECONOMIC CBA

ECONOMIC COST BENEFIT ANALYSIS

Based on constant prices (R'000)

	NPV	TOTAL	UNIT	YEAR	Completion date				Continue to 2027
	8%			2007	2008	2009	2010	2011	2012
CONSTRUCTION COSTS:									
BULK SERVICES									
WATER	R321 466	R260 899		R334 351	R0	R0	R0	R0	R0
TOTAL CONSTRUCTION COSTS	R321 466	R260 899		R334 351	R0	R0	R0	R0	R0
MAINTENANCE & OPERATING COSTS									
WATER (BULK & INTERNAL)	R73 608	R149 556		R0	R4 476	R6 857	R8 131	R8 131	R8 131
OPPORTUNITY COSTS LOST-AGRICULTURE	R535 052	R1 089 647		R0	R31 446	R48 177	R59 413	R59 413	R59 413
OTHER ECONOMIC COSTS	R0	R0		R0	R0	R0	R0	R0	R0
TOTAL MAINTENANCE & OPERATING COSTS	R608 660	R1 239 203		R0	R35 921	R55 034	R67 544	R67 544	R67 544
TOTAL PROJECT ECONOMIC COSTS	R930 126	R1 500 103		R334 351	R35 921	R55 034	R67 544	R67 544	R67 544

ECONOMIC BENEFITS

	NPV	TOTAL	UNIT	YEAR	Completion date				
	8%			2007	2008	2009	2010	2011	2012
BENEFITS FROM SERVICE CHARGES-WATER	R4 113 687	R8 270 452		R0	R257 742	R393 823	R465 625	R463 743	R461 808
TOTAL PROJECT BENEFITS	R4 113 687	R8 270 452		R0	R257 742	R393 823	R465 625	R463 743	R461 808
TOTAL PROJECT NET BENEFITS (COSTS)	R3 183 561	R6 770 349		-R334 351	R221 820	R338 790	R398 081	R396 199	R394 264

	6.00%	8.00%	10.00%
NET PRESENT VALUE (R'000)	R3 775 462	R3 183 561	R2 712 479
INTERNAL RATE OF RETURN			89.55%
BENEFIT COST RATIO	4.68	4.42	4.18

14. APPENDIX E: MKOMAZI FINANCIAL CBA

FINANCIAL COST-BENEFIT ANALYSIS									
Based on current prices (R'000)				Completion date					Continue to 2027
	NPV	TOTAL	UNIT	YEAR					
	11.3%			2007	2008	2009	2010	2011	2012
CAPITAL COSTS:									
BULK SERVICES									
WATER	R2,456,484	R2,857,569		R2,355,766	R0	R0	R0	R0	R0
TOTAL CAPITAL COSTS	R2,456,484	R2,857,569		R2,355,766	R0	R0	R0	R0	R0
MAINTENANCE & OPERATING COSTS									
WATER (BULK & INTERNAL)	R145,449	R528,989		R0	R2,626	R4,435	R6,660	R9,377	R12,677
TOTAL MAINTENANCE & OPERATING COSTS	R145,449	R528,989		R0	R2,626	R4,435	R6,660	R9,377	R12,677
TOTAL PROJECT EXPENDITURE	R2,601,933	R3,386,558		R2,355,766	R2,626	R4,435	R6,660	R9,377	R12,677
FINANCIAL REVENUE				Completion date					
	NPV	TOTAL	UNIT	YEAR					
	11.30%			2007	2008	2009	2010	2011	2012
REVENUE FROM SERVICE CHARGES - WATER	R3,081,094	R10,133,909		R0	R82,663	R132,977	R190,178	R255,026	R328,361
TOTAL PROJECT REVENUE	R3,081,094	R10,133,909		R0	R82,663	R132,977	R190,178	R255,026	R328,361
TOTAL NET REVENUE (EXPENDITURE) BEFORE FINANCE	R479,161	R6,747,351		-R2,355,766	R80,037	R128,542	R183,518	R245,649	R315,683

	6%	8%	11.3%
NET PRESENT VALUE (R'000)	R2,304,349	R1,470,075	R479,161
BENEFIT COST RATIO	1.82	1.54	1.18
INTERNAL RATE OF RETURN			13.52%

15. APPENDIX F: MKOMAZI ECONOMIC CBA

ECONOMIC COST BENEFIT ANALYSIS

Based on constant prices (R'000) — Completion date — Continue to 2027

	NPV 8%	TOTAL	UNIT	YEAR 2007	2008	2009	2010	2011	2012
CONSTRUCTION COSTS:									
BULK SERVICES									
WATER	R2,120,403	R1,763,210		R2,203,684	R0	R0	R0	R0	R0
TOTAL CONSTRUCTION COSTS	R2,120,403	R1,763,210		R2,203,684	R0	R0	R0	R0	R0
MAINTENANCE & OPERATING COSTS									
WATER (BULK & INTERNAL)	R69,203	R150,391		R0	R2,221	R3,402	R4,634	R5,918	R7,257
OPPORTUNITY COSTS LOST-AGRICULTURE	R966,156	R2,147,105		R0	R28,801	R44,125	R60,101	R76,757	R94,123
OTHER ECONOMIC COSTS	R0	R0		R0	R0	R0	R0	R0	R0
TOTAL MAINTENANCE & OPERATING COSTS	R1,035,359	R2,297,496		R0	R31,022	R47,527	R64,735	R82,675	R101,380
TOTAL PROJECT ECONOMIC COSTS	R3,155,762	R4,060,706		R2,203,684	R31,022	R47,527	R64,735	R82,675	R101,380

ECONOMIC BENEFITS — Completion date

	NPV 8%	TOTAL	UNIT	YEAR 2007	2008	2009	2010	2011	2012
BENEFITS FROM SERVICE CHARGES-WATER	R8,259,455	R18,174,772		R0	R256,491	R392,528	R534,049	R681,282	R834,463
TOTAL PROJECT BENEFITS	R8,259,455	R18,174,772		R0	R256,491	R392,528	R534,049	R681,282	R834,463
TOTAL PROJECT NET BENEFITS (COSTS)	R5,103,693	R14,114,065		-R2,203,684	R225,469	R345,001	R469,315	R598,607	R733,084

	6.00%	8.00%	10.00%
NET PRESENT VALUE (R'000)	R6,555,209	R5,103,693	R3,964,880
INTERNAL RATE OF RETURN			26.10%
BENEFIT COST RATIO	2.98	2.62	2.31