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FACULTY OF ENGINEERING AND BUILT ENVIRONMENT

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OPTIMAL RISK-BASED DESIGN OF BULK WATER SUPPLY SYSTEMS

By

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DECEMBER 2010

OPTIMAL RISK-BASED DESIGN OF BULK WATER SUPPLY SYSTEMS

By

GUSTAV VLOK

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ABSTRACT

Title	:	Optimal risk- based design of bulk water supply systems
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Bulk water supply systems generally consist of a source of water, a conveyor (feeder pipe, canal etc.) and a storage facility. Designing bulk water supply systems includes the sizing of these components to ensure a functional system. The design of bulk water supply systems has historically been done using deterministic guidelines. The conditions experienced by a bulk water supply system are however probabilistic in nature. The variation in water demand and pipe failures over its lifetime is an example of this and is dependent on various characteristics of the bulk water supply system. A relationship also exists between the storage capacity, the feeder pipe and the reliability of the bulk water supply system. The use of deterministic guidelines does not allow the designer to allow for variation in system characteristics or to exploit the relationship mentioned above in a beneficial way.

Probabilistic analysis techniques address the influence of variables in the bulk water supply system. It provides the designer with methods to size the infrastructure components to accommodate characteristics that are specific to the bulk water supply system under consideration. Numerous previous studies have been conducted that indicated the advantages that these risk-based techniques provide. Some of the work includes that done by the University of Johannesburg over the last 14 years. The quantification of the advantages in a financial sense has however not been done. This dissertation discusses the work performed to provide an indication of financial implications associated with the use of risk-based analysis techniques. The study follows the same stochastic methods that have been used by researchers at the University of Johannesburg in recent years. A Monte Carlo simulation method is used through the use of the Mocasim II software.

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A simple bulk water supply system consisting of a source, feeder pipe system and one storage facility were used throughout the study. A large number of bulk water supply systems were developed which represented variation in the (1) stochastic input, (2) size of development served, (3) length of feeder pipe and (4) feeder pipe configuration. The capacity of the feeder pipe system was deterministically determined and the stochastic analysis was utilized to determine the appropriate reservoir size that yields predetermined system reliability. The resulting bulk water supply systems were priced by determining estimated capital and recurring costs. A life cycle costing (LCC) analysis was subsequently performed to determine the financial implication over the long term.

The results obtained from the probabilistic analysis and the financial analysis were analysed. The analysis attempted to quantify the advantage of using risk-based techniques versus deterministic determination. Furthermore it evaluates the effect of variation in system characteristics. The evaluation of results indicated that stochastic analysis has a significant financial advantage to offer the funding agent. This advantage is more pronounced in the case of bulk water supply systems with short feeder pipes. A financial saving of as high as 30 % in comparison with design using deterministic guidelines were realized for feeder pipe lengths of 1000 m. The length of the feeder pipe stood out as a major influencing factor in the overall advantage of probabilistic analysis and also the effect of other variables. The influence of the capital cost on the overall life cycle cost is significant and provides an indication where the designer must focus his attention.

A number of recommendations are made. These recommendations are directed to the designer, water service providers and institutions that are involved in this field of research. These recommendations vary from awareness of the extent of the financial benefits of risk-based analysis, the importance of record keeping required when using risk-based techniques to further recommended study.

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"I do not feel obliged to believe that same God who endowed us with sense, reason, and intellect had intended for us to forgo their use."

~ Galileo Galilei

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation / Symbol	Description
$A or $	Australian Dollar (unless otherwise stated)
A	annual recurring cost
a	Annum
AADD	Average Annual Daily Demand
AC	Asbestos Cement
A_m	Annual recurring expenditure for maintenance
A_o	Annuity of converted capital cost
A_{op}	Annual operating cost
A_r	Installment
A_t	Gaussian white noise
Ave	Average
AWSS	Analysed Water Supply System
AWWA	American Water Works Association
C	Capitalized Cost
c	Cent
C_0	Initial capital will be required for construction
C_A	Capital cost
C_c	Life Cycle Cost using the capitalization method
C_{dow}	day-of-week demand factor
C_h	hourly demand factor
CI	Cast Iron
C_m	Construction cost of the feeder pipe
C_{ma}	Investment to fund annual maintenance
C_N	Nett-liability at end of period T
Config	Configuration
Cp	construction cost of the pumping station
C_R	Construction cost storage
C_R	Investment to replace infrastructure
C_α	Sum of instalments
D_{avg}	average demand for the period studied
D_d	average demand in day d
DD	Daily Demand under Seasonal Peak Conditions
DG	Deterministic Guideline
D_h	average demand for hour h

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Abbreviation / Symbol	Description
DVGW	Deutschen Verkehrswissenschaftlichen Gesellschaft
FPS	Feeder Pipe System
FRT	Failure Return Period
g	gravitational acceleration
GHz	GigaHertz
GRP	Glass Reinforced Polyester
h	total pressure head
HDP	Hourly Demand Pattern
i	lag counter
I_R	Compound Interest
j	lag counter
kg	kilogram
KIWA	Keuringsinstituut voor Waterleidingartikelen
kl	kilolitre
k_m	coefficient
km	kilometre
k_p	coefficient
kW	Kilowatt
kWh	Kilowatt hour
L	length of the pipe
LCC	Life Cycle Cost
ln e_d	daily white-noise process
lne_h	hourly white-noise process
m^2	Square meter
m^3	Cubic meter
md	number of daily autocorrelation lags
mh	number of hourly autocorrelation lags
Ml	Megalitre
no	Number
NPV	Nett Present Value
P	installed power of the pumping station expressed in kW
p	mass density of fluid
PDF	Probability Density Function
PE	Poly Ethylene
pH	measure of the acidity or basicity
P_{NA}	Nett Present Value of Capital and Maintenance cost
P_{NO}	Nett Present Value of Operational cost

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Abbreviation / Symbol	Description
P_{NS}	Nett Present Value of Salvage cost
P_S	Nett Present Value of system
PS	Pumping Station
$P_{\square}$	Nett Present Capital Cost
PVC	Polyvinyl Chloride
Q	Discharge
r	discount/interest rate
R	South African Rand
R_1	coefficient at lag 1
R_2	coefficient at lag 2
S_b	standby fraction
T	design life
t	duration of the fire event
uPVC	Unplasticized Polyvinyl Chloride
V_R	volume of reservoir
X_t	random variable at instant t
X_{t-1}	random variable at instant t-1
X_{t-2}	random variable at instant t-2
yr	Year
Φ_i	daily auto regression coefficient for lag i
ψ_j	hourly auto regression coefficient for lag j
%	Percentage
a	salvage factor
s	standard deviation of the logs of the durations
#	Number of
μ	mean of the logs of the durations
υ_h	hourly demand residual function
Δt	time between successive fire events
n	combined efficiency of pump and prime mover
ß	Maintenance factor
υ_d	daily demand residual function

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LIST OF TERMINOLOGY

Phrase	Description
Red Book	Guidelines for the provision of Engineering Services and Amenities in residential township development (May 1995); issued by Dept. of Housing in collaboration with the National Housing Board published by CSIR, Pretoria, South Africa
Deterministic	Derived from a fixed cause.
Risk- based design	Design method that accommodates the risk inducing events and the probability of these events occurring.
Probabilistic analysis	Analysis using methods accommodating the variable and random nature of factors influencing the performance of a designed system.
Monte Carlo simulation	Probabilistic method relying on multiple simulations using input parameters subject to variation.
Stochastic models	An analysis method accommodating factors of a variable and random nature.
Capital Cost	Cost associated with construction of infrastructure
Recurring Cost / Operation and Maintenance Cost	Cost associated with operation and maintenance of infrastructure
Design Life	The foreseen life expectancy of infrastructure for design and costing purposes

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

A typical bulk water supply system consists of four major components: Source, Pumping System (if required), Pipeline and Storage facility. Since the goal of a bulk water supply system is to ensure a reliable supply to the consumer, a failure at the storage facility constitutes a failure of the system. The designer's aim is to avoid this circumstance from occurring. The risk of a failure occurring in the water supply system is dependent on the probability of a causative event occurring in the system. Examples of these events are pipe failures and increase in water demand experienced in the water supply system. These conditions are probabilistic in nature i.e. subject to variation which cannot be deterministically known.

The designer of these components has however over the years been guided by deterministic guidelines (van Zyl *et al*, 2010). This has ensured reliable systems but not necessarily the most optimal solutions. This was evident in studies such as those conducted by Grosman and Basson, which indicated that reservoirs with less than the prescribed (deterministically determined) storage capacity performed more than satisfactorily over a number of years (Grosman & Basson, 1985).

At present, guidelines in major centres of the world for the sizing of municipal storage tanks are still based on deterministic parameters (van Zyl *et al*, 2010). Parameters such as the annual average daily demand (AADD), which the system is expected to deliver, are frequently used to determine the reservoir size. The conditions which a water supply system are subjected to are however probabilistic in nature. Previous studies have concluded that the utilization of risk-based design techniques have possible financial advantages to offer the client without jeopardizing the delivery of water to the consumer (Grosman & Basson, 1985).

The performance of a bulk water supply system is not only dependent on the size of the individual components but also on the configuration which is utilized and the varying conditions the system are subjected to.

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The use of risk-based design techniques have been avoided in the past due to a lack of available computational power and the fact that it would be extremely time consuming without the use of present day computing power. The tempo at which the computation ability of personal computers has improved has now made it possible to consider the use of these techniques.

Risk-based design techniques have for years been used in other fields of engineering such as hydrological source development and structural analysis (Nel & Haarhoff, 1996). The use of these techniques in the design of bulk water supply can be regarded as quite new but previous studies extend as far back as 1972 (Damelin, Shamir, & Arad, 1972). In essence risk-based techniques refer to methods that accommodate the events that impose risk on the system under consideration. The probability of these risk-inducing events having an effect on the system is also taken into account.

A number of studies have been completed in the last 15 years. A probabilistic, risk based, technique using stochastic models for estimating the reliability of bulk water supply systems was introduced in 1996 by Nel and Haarhoff. The technique, based on an extended time Monte Carlo simulation of the system, incorporates both deterministic and probabilistic behaviour parameters, i.e. water consumption, pipe reliability and fire events. This technique has been further refined by Kretzman and van Zyl (2004) with the development of computer software named "Mocasim II". It is this software that is utilized for the evaluation of system reliability in this study. The use of the term "risk-based" and "probabilistic" is both used when referring to these design techniques.

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Previous studies such as those conducted by van Zyl and Haarhoff (1999) dealt with the sizing of the individual components as well as the configuration of the components as factors influencing reliability. In the abovementioned study a request is made that the cost implication be evaluated with regards to optimal feeder pipe and reservoir configuration. This study addresses that request by evaluating the cost implication of risk-based design approaches on bulk water supply system design with size and configuration used as the primary design variables.

1.2 OBJECTIVES OF THE STUDY

The utilization of risk-based analysis techniques have been studied for a number of years and have also been applied in practice (Nel & Haarhoff, 1996). Studies such as those by Grosman and Basson have concluded that the use of these techniques could have practical and financial benefits due to the installation of components with less capacity without compromising acceptable risk of failure (Grosman & Basson, 1985). The extent of these benefits have however not been evaluated. The objective of this study is to quantify the advantages which utilization of risk-based analysis could provide by including the financial impact into the design considerations. A second objective is to attempt to provide guidelines with regard to optimal configuration and capacity when faced with the design of bulk water supply systems.

1.3 SCOPE OF THE STUDY

The study deals with the optimal design of bulk water supply systems. In particular, this study is focusing on the optimal design of the feeder pipe configuration and determination of storage capacity. As elaborated on in Section 2.4, the determination of feeder pipe capacity using deterministic guidelines has been used by engineers in the past. The capacity of feeder pipe and therefore also pump requirements are not considered as variables in the optimal design of the bulk water supply system. The reliability of the source and the failures in the demand pipe are also not considered in the design of the system.

The study builds on previous studies conducted at the University of Johannesburg and uses the same methods. Reference is made to a number of risk-based analysis techniques. In this study however, the technique employed is a probabilistic method that is based on extended time Monte Carlo simulation using techniques developed by Kretzman and van Zyl (Kretzman & van Zyl, 2004).

The practical feasibility and viability of the design and construction of bulk water supply systems have been kept in mind in the evaluation of different alternatives. The adoption of configurations of parallel sections is an example of this. The construction of more than three pipelines in parallel was not considered.

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Infrastructure cost models are based on information provided in literature used as guidelines to municipal institutions abroad (Australia). Cost models were not based on information pertaining to specific pipe material, bedding conditions, topography or other factors influencing expenditure.

The scope of the study is met by using a fixed layout and a base model of input parameters and then evaluating sensitivity of the results to variation within these criteria.

1.4 ORGANISATION OF THE DISSERTATION

The field of study has a number of facets that forms the backbone of applying the methodology in practice. As a first step an overview of current design approaches for bulk water supply systems is presented in Chapter 2.

Following this, the theory behind the use of risk-based analysis as a tool in designing is presented in Chapter 3. As previously mentioned, literature from authors in this field of study found go as far back as 1972 (Damelin, Shamir, & Arad, 1972). These were studied and in some cases used as a departure point for the work done as reported in this dissertation. Thorough risk-based analysis of water supply systems would be impossible without the use of computer technology. The use of computer software developed specifically for this purpose is therefore an integral part of this study. The probabilistic method that has been developed by others is discussed and explained in Chapter 3.

The costing of bulk water supply systems is discussed in Chapter 4. An overview of the different types of costing is given as background. Thereafter the use of cost models is discussed and how this is applied to the study. As part of the costing process the determination of expected life cycle expenditure is emphasized. The calculation of a system's total Life Cycle Cost (LCC) is outlined and its application discussed.

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After these subjects are introduced, the application of risk-based methods is discussed. A methodology is given which is used to analyse the water supply systems and to report the results in a structured manner. The variations accommodated in the analyses are outlined. After the application of the method, the results are evaluated. From the evaluation of these results a number of conclusions are drawn and recommendations are provided which may be useful for the optimal design of bulk water supply systems.

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CHAPTER 2: LITERATURE REVIEW: DESIGN OF BULK WATER SUPPLY SYSTEMS

2.1 COMPONENTS

Bulk Water Supply Systems can be described as the infrastructure that conveys large volumes of water. Water is transferred from either natural sources or treatment facilities to strategically located storage facilities from where water can be distributed to consumers. Although a bulk water supply system can take the form of a network of large diameter pipelines to a number of reservoirs in different locations, this study will focus on simple bulk water supply systems comprising mainly the following three components:

- Source;
- Feeder pipe from source to storage facility; and
- Storage facility.

These three components will be discussed to outline their functionality and characteristics.

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2.1.1 Source

The natural sources in a bulk water supply system are generally one of the following: storage dam, river or groundwater. These natural sources generally require some level of treatment to bring the quality of the water to an acceptable standard. Subsequent to treatment, water is stored in a clear water reservoir. From there, water needs to be conveyed either directly to the consumer or to storage facilities in appropriate locations. The location of the treatment plant in relation to the consumer will determine the mode of conveyance which is used to bring water to the consumer. This can be either through pumping or the use of gravity. The latter will seldom be the mode of conveyance simply because water is generally sourced from low lying locations. In addition to the conveyance of treated water, bulk water supply systems also includes the conveyance of raw water between locations.

This study assumes the use of pumping equipment to transfer water from the natural source to a storage facility. The capacity of the pumping facility is equal to that of the feeder pipe, which is discussed below.

2.1.2 Feeder Pipe

The feeder pipe from the source to the storage facility will generally be a pipeline, the diameter being reliant on the demand which needs to be catered for. It has been recommended that the determination of feeder pipe capacity be done using the empirical design rule whereby a factor of 1.5 is applied to the AADD to determine the supply capacity (Haarhoff *et al.*, 1999). This recommendation is followed throughout the study to illustrate the advantages of risk-based analysis on other design considerations. It must however be seen as a limitation of this study of which the effect can be evaluated in future studies.

A number of materials are available from which such a pipeline can be constructed; most notably steel, plastic, glass reinforced polyester (GRP) or concrete. The feeder pipe also includes hydraulic control equipment such as isolation valves, air valves, pressure reducing valves and other items which ensure an efficient and safe operation of the system.

It is noted from previous studies that the configuration of the feeder pipe have a significant effect on the risk profile of a system (van Zyl and Haarhoff, 1999). More detail of the findings of these studies is provided below.

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2.1.3 Storage Facility

The main functions of a storage facility are to ensure the availability of water to the consumer by balancing the constant inflow with the variable outflow and to provide water during interruptions in supply (Haarhoff *et al.*, 1999). It can be said that whenever the sum of the available volume in the reservoir and the inflow over any period is greater than the required outflow over the same period, the reservoir is succeeding in its goal. Whenever this is not the case, the reservoir will run dry, which will constitute a failure of the reservoir and therefore also the bulk water supply system.

To determine the storage capacity required, it is important to be aware of the functions of such a facility. The functions include demand storage, fire storage, emergency storage, control provision for pumps, operation freeboard and bottom storage (Nel & Haarhoff, 1996). These functions are briefly described by Nel & Haarhoff (1996) as follows:

- "Demand balancing storage" is the volume which is required to cater for the consumer demand;

- "Fire storage" is the volume which is required to ensure adequate supply of water in the case of a fire emergency;
- "Emergency storage" is storage required in case of unforeseen events such as mechanical or material failures upstream of the reservoir;
- "Control provision for pumps" is storage required to ensure pump cycles of acceptable duration;
- "Operation freeboard" is the volume required above the top water level to the overflow to provide officials time to shut the system in case of malfunction; and
- "Bottom storage" is the volume which is added to allow for the fact that the reservoir is never drawn down completely to avoid the ingress of debris and sediment which accumulates at the bottom of the reservoir.

The required capacity is the sum of these requirements. It is important that the designer all these requirements to determine the total volume required.

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2.2 TYPES OF SYSTEMS

There is a distinction between rural and urban bulk water supply systems. Although the make-up of the systems is similar in some regards there are distinct differences. Simple bulk water supply systems consists of a source, feeder pipe and storage facility. In that regard rural and urban systems are similar. The differences lie in the conditions which are imposed on the systems such as demand characteristics, failure probabilities and maintenance response.

Previous studies, such as those conducted by Haarhoff *et al.* (1999), have indicated that rural systems are subjected to more constant consumer demand in comparison with urban systems. This is mainly due to the type of reticulation which is utilized with residents having to source water from communal taps or standpipes in rural settings. This intermittent filling of containers causes water consumption in the home to be "off-line" and reduces diurnal peaks.

Fire demands differ from urban to rural locations (Haarhoff *et al.*, 1999). The consumer catered for in urban locations also include commercial and even industrial consumers which carries a fire risk profile quite different from rural residential consumers.

The risk of damage to rural water supply systems is generally lower for rural systems. Damage to pipelines is usually caused by construction or maintenance activities at or near infrastructure. In an urban environment which consists of intricate networks of road, sewer, stormwater and communication infrastructure these activities are more frequent than what is experienced in rural locations. For this reason the probability of failure is different for the two types of systems.

Lastly, rural communities are located further away from municipal offices and yards. This leads to longer response times in the case of emergencies and failures. It could then be expected that emergency storage volume should be greater when sizing storage requirements for rural use compared to that for urban use.

The application of risk based analysis includes the use of demand and failure models and the evaluation of the effects which these differences have on design requirements.

2.3 DESIGN CONSIDERATIONS

As reported by Haarhoff *et al.* (1999), an interaction exists between the size of the storage facility, the supply capacity of the feeder pipe system and the reliability of the supply. The reliability of a bulk water supply system can be expressed statistically by referring to the probability of the unavailability of water to the consumer. This interaction, reported by Haarhoff *et al.* (1999) and shown in Figure 1, is rarely exploited by design engineers due to the more readily accepted method of using deterministic design codes (van Zyl and Haarhoff, 1999).

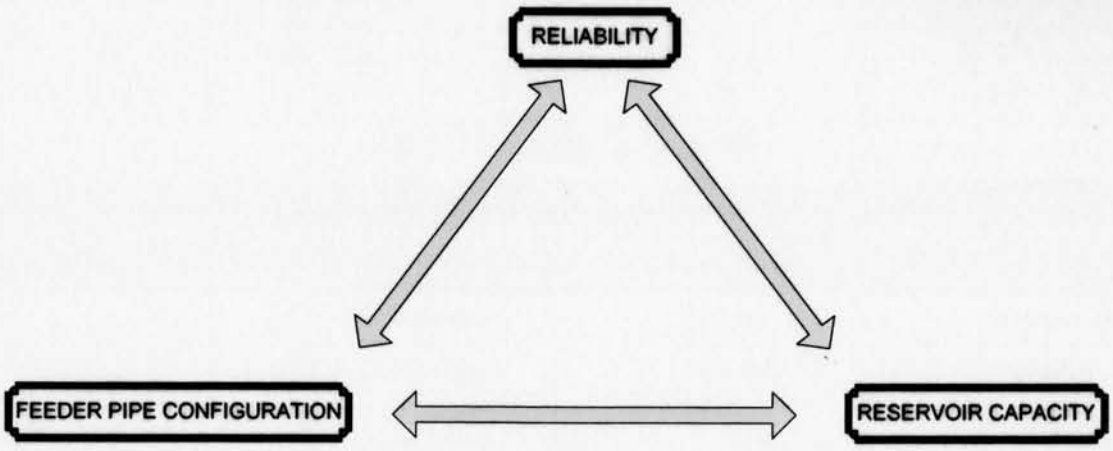

Figure 1: Relationship between infrastructure capacity and system reliability (Haarhoff et al., 1999)

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As alluded to before, a number of previous studies have indicated the possible advantage of using risk-based design techniques. This work showed the following advantages, without jeopardizing system reliability, which could be expected when risk-based design techniques are used in the design process:

- Construction of smaller storage facilities when adopting other feeder pipe configurations (van Zyl & Haarhoff, 1999);
- Smaller reservoir sizes (van Zyl *et al.*, 2008);
- Improved operational conditions identified when changing layout characteristics (Kretzman & van Zyl, 2004);
- Adopting beneficial layout configurations with associated increase in system reliability (Nel & Haarhoff, 1996);
- Determining optimal relationship between supply capacity and reservoir capacity to achieve acceptable system reliability (Grosman & Basson, 1985); and
- Accommodation of alternative demand patterns in the sizing of storage facilities (Haarhoff *et al.*, 1999).

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Population surveys have identified the tolerance which people have towards unavailability of water in terms of duration and frequency (Kwietniewski and Roman, 1997). It was concluded that no individual failure should exceed 24 hours and that the failure frequency is dependent on the size of the development. Failure frequencies of one a year are tolerated in the case of small developments (< 500 residents) whereas a failure frequency of 1 in 50 years is considered tolerable for large developments (> 50000). Furthermore a relationship between failure duration and failure frequency was evident. It was stated that water consumers would rather accept longer interruptions which occur less frequently than shorter disruptions more often. There are therefore certain social requirements which effect the decision making of designers.

It can therefore be summarized that the underlying factors which would influence the reliability are (1) the capacity of the supply system and the storage facility, (2) the reliability of the supply source, (3) the configuration of the supply system and (4) the characteristics of the demand patterns. Of course these factors influence the capacity of the infrastructure on their part and the relationship between them determine the overall reliability of the system.

2.4 EXISTING GUIDELINES

The sizing of storage tanks has for years been based on deterministic guidelines (Nel & Haarhoff, 1996). The design parameters indicated in Table 1 represent the storage requirements as set out in design guidelines used in the USA, France and South Africa (van Zyl *et al.*, 2008). These design parameters gives typical storage requirements for three components namely balancing, fire and emergency.

Table 1: Design Parameters

Country	Storage requirements		
	Balancing (B)	**Fire (F)**	**Emergency (E)**
USA	35 % of peak day	680 m^3	1 peak day
France	30 % peak day	120 m^3	2 average days
South Africa	Included in E	108 m^3	2 average days

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It is important to realize that these parameters are often recommended by various authorities for residential development. The sizing of storage tanks is therefore done without considering the characteristics of a development, which tend to differ from one development to the next.

This design practice has been shown to result in storage tanks of greater size than are required when probability of failure is considered (van Zyl *et al.*, 2008). It also results in designs which have different inherent safety factors built into the design.

Deterministic design guidelines are also often used in the sizing of the feeder pipe. As pointed out by Nel and Haarhoff (1996), feeder capacity has generally been taken as 1.5 times the Average Annual Daily Demand (AADD) in South Africa. Since the introduction of methods using reliability theory, a number of studies have analysed the characteristics of urban and rural bulk water supply systems. According to Haarhoff *et al.* (1999), the empirical design rule of sizing the feeder pipe as described above is deemed appropriate in most cases for urban water supply. It is anticipated that probabilistic design methods for the sizing of the feeder pipes, for example the analytical probabilistic model proposed by Fillion (2009), will be introduced as the advantage of computer based computational techniques is increasingly exploited in design offices.

Deterministic guidelines are also utilized in the determination of input data. An example of this is the use of fire demand guidelines as presented in Table 2, taken from the work done by Nel and Haarhoff (1996). These deterministic guidelines, in the absence of historical data, can be used to develop input models, as discussed later in the dissertation.

The use of these design guidelines has been appropriate due to the tedious and time consuming effort which is associated with statistical design methods prior to the availability of fast computational power. In some cases, such as the determination of the feeder pipe size, it is believed that it is still advantageous to use such guidelines (Haarhoff *et al.*, 1999). This is not always the case, and the use of modern computers has made it possible to use these statistical methods as a viable alternative.

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Table 2: Fire Demand Guidelines

Parameter	Fire Risk Category	Design Guideline			
		National Housing (1994)	KIWA (1977)	DVGW (1978)	AWWA (1981)
Fire Flow Rate (l/min)	High	12000	6000	3200	17700
	Medium	6000	1500	1600	11800
	Low	900	1500	800	3800
Fire Duration (h)	High	6	2	2	4
	Medium	4	2	2	3
	Low	2	2	2	2
Volume of fire water (m^3)	High	4320	720	3384	4248
	Medium	1440	360	192	2124
	Low	108	180	96	456

2.5 LAYOUT OF SYSTEM

When designing bulk water supply systems, a number of factors dictate the sizing and configuration which will be implemented. Two of these factors are the financial implication and the reliability of the system. These two factors are also interdependent of each other with higher reliability of a system usually resulting in higher associated cost. An example of this is the use of larger reservoirs or using better quality pipe material, both of which increases reliability but also capital cost of the infrastructure.

The layout of a bulk water supply system will usually consist of the source, a mode of conveyance and the storage facility being connected to each other. The determination of the best design involves the consideration of measures to be implemented to ensure reliability whilst keeping the cost to a minimum.

For each component within the bulk water supply system, a number of measures exists which will increase the reliability of the system. In terms of the pumping station as source, backup measures are often considered for the mechanical and electrical equipment. This can be in the form of standby pumps or alternative forms of energy such as diesel powered generators (dependant on feasibility thereof). The measures which influence the reliability of the system due to the characteristics of the feeder pipe include the pipe material, capacity and the configuration used.

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From previous studies, and most recently that of van Zyl and Haarhoff (van Zyl & Haarhoff, 1999), it is evident that the use of pipelines in parallel greatly increases the reliability of water supply systems.

This is graphically presented in Figure 2, which indicated the number of reservoir failures when a combination of reservoir sizes and number of parallel pipes were analysed with the same stochastic input parameters.

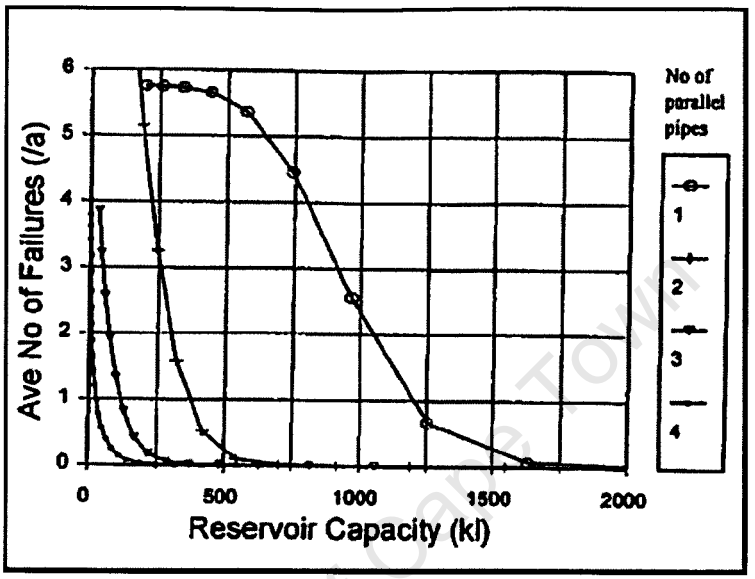

Figure 2: Annual Average Number of Reservoir Failures for Different Numbers of Parallel Feeder Pipes (van Zyl & Haarhoff, 1999)

The same paper referred to above concluded that the second way of increasing the reliability of a water supply system was to introduce interconnection pipes between pipes laid in parallel. The linking of the pipes with the appropriate installation of isolation valves makes it possible to isolate any part of the pipeline. This design makes it possible to isolate the section which has failed to avoid overall disruption of supply during the repair operations. The effect of this on the reliability of the water supply system was graphically presented in the abovementioned paper as presented in Figure 3.

Configurations to be considered therefore include the use of parallel pipes and connections between these parallel pipes. The selection of reservoir size has a tremendous effect on the reliability of the system. The volume in the storage facility determines how long a maintenance crew has at its disposal to repair any failures at the source or feeder pipe to avoid a failure of the system.

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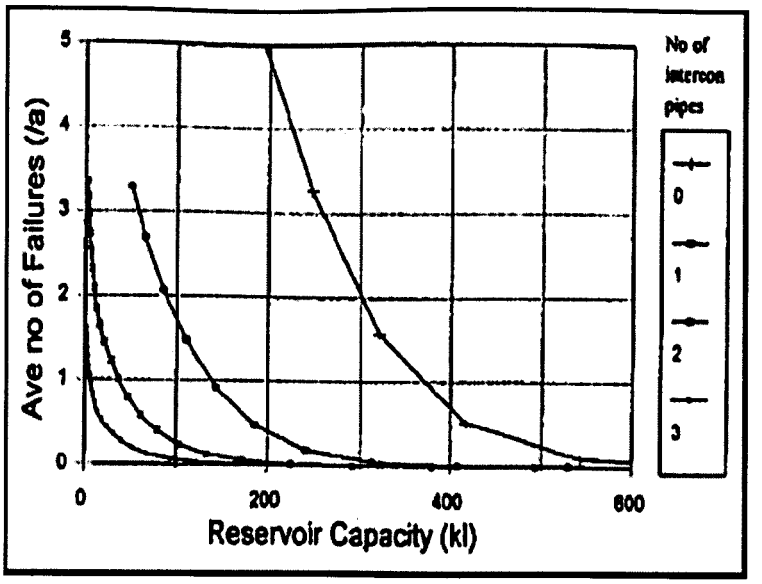

Figure 3: Annual Average Number of Reservoir Failures for Two Parallel Feeder Pipes and Different Numbers of Inter Connecting Pipes (van Zyl & Haarhoff, 1999)

The designer of the system therefor needs to take these measures into account. To summarize, these measures include:

- Source: Backup measures;
- Feeder Pipe: Pipe material, Capacity and configurations used; and
- Reservoir: Capacity.

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CHAPTER 3: LITERATURE REVIEW: RISK-BASED ANALYSIS

3.1 ANALYSIS METHOD

3.1.1 Overview

In the preceding section it was indicated that the factors which influence the performance of a bulk water supply systems are variable in nature. This results in the performance of the system also being variable nature. Factors such as the water demand placed on the system (consumer and fire related) and the failure of infrastructure will influence the performance substantially and these are not constant over time. To analyse the performance of a bulk water system in a stochastic manner it is therefore prudent to allow for these influencing factors.

The "Monte Carlo" simulation method is a probabilistic design method used by designers. According to Nel & Haarhoff (1996), "The Monte Carlo simulation is a well-established tool for the probabilistic evaluation of engineering systems as diverse as structural analysis, hydrology, scour at bridge piers and counter-current air stripping." This method relies on the use of input parameters for each variable influencing factor. Parameters are therefore ascertained for consumer demand, fire demand and pipe failure. Stochastic descriptions are generated for these input parameters and the model is subjected to a large number of these combinations. An evaluation of the input parameters used will indicate the assumed characteristics of each parameter in a statistical sense. Subsequent to the calculation of system performance, the results are reported in a statistical manner which can then be evaluated by the designer against criteria of acceptability.

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The advantages of the use of this method as a design tool in the design of bulk water supply systems has been shown in previous studies such as those conducted by Haarhoff, Nel, van Zyl, Kretzman, van der Walt and other researchers in the water supply industry. One of the benefits which make this method attractive is that the relationship between the chosen design and the reliability thereof is quantified.

As with the majority of design methods or analyses, the accuracy of results is reliant on the accuracy of the input parameters used. These input parameters will be discussed in more detail below.

3.1.2 Stochastic Unit Models

The Oxford English dictionary defines the word "stochastic " as " adj. (1) determined by a random distribution of probabilities, (2) (of a process) characterized by a sequence of random variables, (3) governed by the laws of probability". This definition indicates that a stochastic model is a model which represents the random nature of the factors which can affect a process or system.

The input parameters referred to are in the form of stochastic unit models which reflect the conditions which the system will be subjected to. The choice and complexity of the model is dependent on characteristics of the data being modelled and the accuracy which is required (Grosman and Basson, 1985). A number of different types of models have been developed for the purposes of modelling input data for use in stochastically analysing water supply infrastructure. According to van Zyl *et al.* (2008) some examples include the Poisson rectangular pulse method (Buchberger and Wu, 1995), auto regressive integrated moving average method (Bougadis *et al.* 2005), state space method (Billings and Agthe, 1999), multiple regression model (Maidment *et al.*,1986), adaptive smooth filtering approach (Homwongs *et al.*, 1994), pattern recognition (Shvartser *et al.*, 1993) and artificial neural networks (Jain *et al.*, 2001).

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Stochastic models are classified and grouped according to the statistical methods adopted in their development. Using demand models as an example, Aly and Wanakule (2004) classified these models into three categories namely end use, econometric and time series models. To illustrate the general structure of one type of stochastic model, the following explanation of a time series model is provided. Time series modelling of the linear regression type and of the following types are generally being used according to Grosman and Basson (1985):

- Auto regressive of the order *p* (AR(*p*));
- Moving Average of the order q (MA(q));
- Auto-Regressive Moving Average (ARMA(p,q)); and
- Auto-Regressive Integrated Moving Average (ARIMA(p,d,q)).

Previous studies examined have opted for the use of an auto-regressive model with the order (p) of two. The order (p) is dependent on the correlation between subsequent data points and it was found that strong correlation in daily consumption is seen in the lag of one and two days but dropping of significantly thereafter (Grosman and Basson, 1985). The general form of the AR (2) model is represented as Equation 3.1:

$$X_t = (R_1 \times X_{t-1}) \times (R_2 \times X_{t-2}) + A_t \quad \text{..... Eq. 3-1}$$

Where:

X_t = random variable at instant t

X_{t-1} = random variable at instant t-1

X_{t-2} = random variable at instant t-2

R_1 = coefficient at lag 1

R_2 = coefficient at lag 2

A_t = Gaussian white noise, i.e. a normally distributed random sequence having a mean of zero and a standard deviation of one.

The benefits of using time series models such as auto-regression stems from the simplicity with which data can be presented. The coefficients generated have significance, can be extracted from the data and can be easily understood by the designer without having to possess intricate knowledge of statistical analysis. The model includes the allowance for persistence (the interrelation of adjacent measurements) and randomness. Any model used should possess these characteristics to ensure accuracy of the resulting conditions.

The model used by van Zyl *et al.* (2008) for water demand consists of both deterministic and stochastic elements which allows for the probabilistic nature and persistence of expected demand. The model used for pipe failure allows for the probability of failure and the expected duration of the failure, these being the critical parameters to be accounted for. To model the occurrence of fire demands within the system, a model which accounts for the fire frequency, duration and flow rate is used.

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The remainder of this chapter will deal with the models generated for consumer demand, pipe failure and fire demand.

3.1.3 Consumer Demand

The demand which is placed on the system by the consumer is in the majority of cases highly variable in nature. This can be attributed to the large number of factors which characterizes the quantity and duration of flow which is required by the consumer to meet demand requirements.

As outlined by van Zyl *et al.* (2008), these factors can be categorized as socio-economic, climatic or structural in nature. Table 3 indicates some of the factors which influence instantaneous water demand.

Table 3: Factors influencing Water Demand

Socio-economic	Climatic	Structural
Household size	Temperature	Number of users
Income	Rainfall	Water metering (if any)
Stand size	Humidity	Plumbing fitting properties
Social status	Time since last rainfall	Pressure
Number of household appliances	Number of preceding hot days	Network capacity
Social patterns		Type of distribution
Public and school holidays		
Tourism		
Water price		
Gardening culture		

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It has been found that most of the variables are stochastic in nature and their combined effect determines the demand which will be experienced by the water supply system. It is due to this cumulative effect that consumer demand is regarded as a stochastic variable itself.

The prediction of water demand has been an active study field in recent times. Work done by Maidment and Miaou (1986), Shvartser *et al.* (1993), Homwongs *et al.* (1994), Buchberger and Lu (1995), Zhou *et al.* (2002), Bougadis *et al.* (2005), Aly and Wanakule (2004) and Alcocer *et al.* (2004) have all focused on the development of models to predict consumer demand.

These models have been very useful in assisting operation and maintenance personnel by providing forecasts of expected supply conditions. The research referred to above identifies the patterns which occur and the effect which the above mentioned variables have on the identified patterns.

It could be said that certain correlations between variables and the resulting water use identified through research are expected. Examples of this are the increase in water use with (1) corresponding increase in temperature (Maidment and Miaou, 1986), (2) public holidays such as Christmas (Homwongs *et al.*, 1994) or (3) increased operating pressure in the supply system. Similarly the shape of the patterns could also follow expected diurnal variation such as systems serving smaller population having higher diurnal variations than those serving larger populations. This is due to larger populations consisting of many differing patterns contributing to the overall pattern experienced by the supply system whereas an individual behaviour in a small population impose a greater influence (Shvarster *et al*, 1993). Various mathematical and statistical methods describe these patterns and are used to derive forecasting models.

The majority of models reports future water demands in terms of daily or hourly demands due to its use as operational tool. The most widely used methods are time series and regression analysis. One of the earliest comprehensive studies of modelling monthly water use was to model it as a time series as reported by Salas and Yevjevich (1972). Their work included the investigation of coherence and cross correlations of water use, air precipitation and air temperature. Since then various models have been introduced with each model accommodating a certain set of variables.

Maidment and Miaou's (1986) model relied on air temperature and rainfall to predict water use and Zhou *et al.* (2000) used evaporation and precipitation characteristics as variables in the forecasting of consumer demand.

Other methods include the use of regression, artificial neural networks, algorithms and even combinations of these models. It is important to note that these tools are readily available and that input models can be derived from these forecasting techniques in the absence of historical data from similar supply areas.

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Average demands are easily identified as the average consumption over the period modelled. Cyclic patterns are observed on a seasonal, weekly and daily level. Persistence describes the correlation which exists between the water demands experienced in a system at two adjacent points in time.

It has been observed that persistence is more pronounced in water demand than correlation with weather parameters (Aly & Wanakule, 2004). Persistence is accommodated in the model on a daily and hourly level by the inclusion of autocorrelation coefficients. An Autocorrelation coefficient of zero (0) indicates the absence of any correlation between water demands at two adjacent points in time whereas correlation becomes stronger as the coefficient tends to the number one (1).

Average demands and cyclic patterns are viewed as deterministic factors which influence the water demand experienced by the system. The removal of the deterministic component from the data yields a remaining component which can be described as white noise. This white noise constitutes the randomness which is observed in water demand data and can be described by a normal or lognormal distribution. A good model normally yields a white noise component which has a zero mean and a constant variance (Homwongs *et al.*, 1994).

The demand model used by van Zyl *et al.* (2008) utilizes a multiplicative model with the deterministic and random components being multiplied to obtain the water demand placed on the system. This is done by first determining the daily demand using the following:

$$D_d = D_{avg} \times C_{dow} \times v_d \quad \text{..... Eq. 3-2}$$

Where:

D_d = is the average demand in day d;

D_{avg} = is the average demand for the period studied; and

C_{dow} = is the day-of-week demand factor and

v_d = is die daily demand residual function, described by:

$$\ln v_d = \sum_{i=1}^{md} \phi_i \ln v_{d-i} + \ln \varepsilon_d;\ \ln \varepsilon_d \sim IN(0, \sigma_D^2) \quad \text{..... Eq. 3-3}$$

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Where:

i = is a lag counter;

m_d = the number of daily autocorrelation lags;

ϕ_i = the daily auto regression coefficient for lag i; and

$\ln\varepsilon_d$ = a white-noise process.

The notation $\ln \varepsilon_d \sim IN(0, \sigma_D^2)$ indicates that the natural logarithms of the residuals are normally distributed and independently distributed with mean 0 and variance s^2_D.

After the daily demand has been determined, it is used to determine the hourly demand as follows:

$$D_h = D_d \times C_h \times v_h \quad \text{..... Eq. 3-4}$$

Where:

D_h = is the average demand for hour h;

D_d = is the average demand for the current day;

C_h = is the hourly demand factor; and

v_h = is die hourly demand residual function described by:

$$\ln v_h = \sum_{j=1}^{mh} \psi_j \ln v_{h-j} + \ln \varepsilon_h;\ \ln \varepsilon_h \sim IN(0, \sigma_H^2) \quad \text{..... Eq. 3-5}$$

Where:

j = is a lag counter;

mh = the number of hourly autocorrelation lags;

ψ_j = the hourly auto regression coefficient for lag j; and

$\ln\varepsilon_h$ = a white-noise process.

This model therefore requires the following information as input to perform a stochastic simulation:

- Cyclic patterns (Seasonal, Weekly, Daily);

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- Daily and hourly auto correlation coefficient;
- Autocorrelation between daily water demands;
- Autocorrelation between hourly water demands;
- Standard deviation of white noise distribution at daily level (Mean = 0); and
- Standard deviation of white noise distribution at hourly level (Mean = 0).

Analysis of historical records, if available, could be used to obtain these input parameters. In the absence of historical data, the prediction models as mentioned earlier can be used to derive a sequence of expected water demands which the system should accommodate. For the purpose of this model, as shall be presented in Chapter 5 of this dissertation, the main requirement is to have a representative model for expected water demand in an urban setting. The sensitivity of these parameters on the reliability of the water supply system has been a topic of research in recent times. Van Zyl *et al.* (2010) have concluded that the reliability of water supply systems is more sensitive towards certain parameters than others.

These input parameters have been categorized as major parameters, to represent those with greater influence, and minor parameters with lesser influence on the reliability of water supply systems. Table 4 indicates the parameters according to these two categories as identified by van Zyl *et al.* (2010). This is presented to draw attention to the parameters which tend to influence the accuracy of the probabilistic analysis being conducted. (It must be noted that the above mentioned study utilize demands experienced under seasonal peak conditions and hence this is not seen as an influencing parameter.)

Table 4: Input Parameters according to Sensitivity Category

Major Parameters	Minor Parameters
Supply Ratio	# of Daily Autocorrelation lags
Day of Week Peak Factor (Weekly Cyclic pattern)	Daily Autocorrelation
Hourly Peak Factor (Hourly Cyclic Pattern)	Day of the Week Pattern shape
Daily Random distribution	Hourly Demand Pattern Shape
Hourly Autocorrelation	# of Hourly Autocorrelation lags
Hourly Random distribution	

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A model was derived by van Zyl *et al.* (2008) after it was identified that water demand unit model's normally consist of four generic components namely, (1) average demand, (2) cyclic patterns, (3) persistence and (4) randomness. These four components are all incorporated into the proposed model.

The demand data was derived from measured data of three small residential towns located in the east of France. The data consisted of hourly demands measured over a three year period. After a procedure of "cleaning up" the data to remove all days with incomplete data, the data was statistically analysed. The demands displayed typical seasonal demand patterns which were removed by dividing each day's demand by the average weekly demand factor.

According to van Zyl *et al.* (2008), the process of "cleaning up" the data involved the identification of the average day-of-the-week demand factors and the analysis of the residuals. This provided the daily autocorrelation and white noise components.

The day-of-the-week factors varied from 0.93 to 0.14 with highest demands displayed over the weekend. The daily autocorrelations observed showed a positive coefficient at lag one but negative coefficients for a number of days afterwards. The model adopted accordingly utilized a lag one auto-correlation of 0.12. The natural logarithms of the daily white noise component displayed a normal distribution with the natural logarithm of the standard deviation equal to 0.068. Hourly demand patterns were then extracted to determine the hourly autocorrelation and white noise components. The hourly factors varied between 0.38 and 1.49 with strong correlation which are dominated by a lag-one coefficient of 0.7. The statistical analysis of the randomness of the hourly demands produced a white noise component with the natural logarithms of the standard deviation equal to 0.13.

Seasonal demand patterns are slow and van Zyl *et al.* (2008) opted to adopt only hourly and weekly demand patterns in the model used. The average daily demand reflected is therefore the demand experienced under seasonal peak conditions. The results obtained are also likewise interpreted as the reliability of the system under seasonal peak conditions.

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3.1.4 Fire Demand

The water demands placed on the water supply systems also from time to time includes the provision of water for fire fighting. As mentioned in Section 2.4, the characteristics of this fire demand are normally described in terms of flow rate and duration of flow to be accommodated. Previous studies such as those conducted by van Zyl and Haarhoff (2007) has shown that deterministic guidelines often yields reservoir capacity for this purpose much larger than what is required should stochastic models be used. The reason for this was reported to be the unlikely probability that a fire will occur whilst the balancing and emergency storage volume are exhausted.

The stochastic nature of fire demands placed on the system therefore leads the designer to adopt a fire demand model which will represent the characteristics of these occurrences. The model to be determined should describe three characteristics of fire occurrences namely the frequency and duration of occurrence and the flow rate which will be required in the process of extinguishing the fire.

The model used by van Zyl *et al.* (2008) of the fire occurrences is developed using a Poisson process, which follows an exponential distribution. Fire events are therefore modelled by simulating the times between successive fires. The probability density function of this exponential distribution is given by:

$$f(\Delta t;\lambda) = \lambda \times e^{-\lambda \Delta t}, \Delta t \geq 0 \quad \text{Eq. 3-6}$$

Where:

Δt = is the time between successive fire events. For the purpose of the simulation, fires which occur at the same node before the end of the current fire are ignored.

Once a fire occurs, the fire duration and flow rate are estimated using log-normal distributions which are defined by the average and standard deviation of the distributions. The probability density function of a log-normal distribution, in this case representing the fire duration, is given by:

$$f(t;\mu,\sigma) = \frac{1}{t\sigma\sqrt{2\pi}} e^{-(\ln t-\mu)^2/2\sigma^2}, t \geq 0 \quad \text{Eq. 3-7}$$

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Once a fire occurs, the fire duration and flow rate are estimated using log-normal distributions which are defined by the average and standard deviation of the distributions. The probability density function of a log-normal distribution, in this case representing the fire duration, is given by:

$$f(t;\mu,\sigma) = \frac{1}{t\sigma\sqrt{2\pi}} e^{-(\ln t-\mu)^2/2\sigma^2}, t \geq 0 \quad \text{Eq. 3-7}$$

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Where:

t = is the duration of the fire event;

μ = is the mean of the logs of the durations; and

s = the standard deviation of the logs of the durations.

Two ways have been identified to determine the characteristics which will be imposed on the system in this regard. Firstly, deterministic guidelines such as those indicated in Section 2.4 can be used as a base for the model. This can be illustrated by the following example. Assume the National Housing guideline is used and the fire risk category for the area under consideration is deemed as "medium". From the guideline a fire flow rate of 100 l/s and a fire duration of 4 hours are normally applicable should the design follow deterministic guidelines. The designer however knows from experience that, although the average fire flow rate could be 100 l/s, approximately 90 % of the time flow rates will be less than 165 l/s. Similarly he also estimates that the fire duration will 80 % of the time be less than 6 hr with an average of 4 hours as recommended by the guideline used. These estimations can then be used to determine a log-normal distribution that would satisfy these criteria.

In this case the natural logarithms of the average and standard deviation will be 0.145 l/s and 0.0067 l/s respectively for the fire flow rate distribution and 1.39 hours and 0.48 hours respectively for the fire duration. The cumulative frequency for these distributions can be presented in Figure 4 and Figure 5. The frequency of the fire occurrence is accommodated in the model by simply specifying the number of expected occurrences per year.

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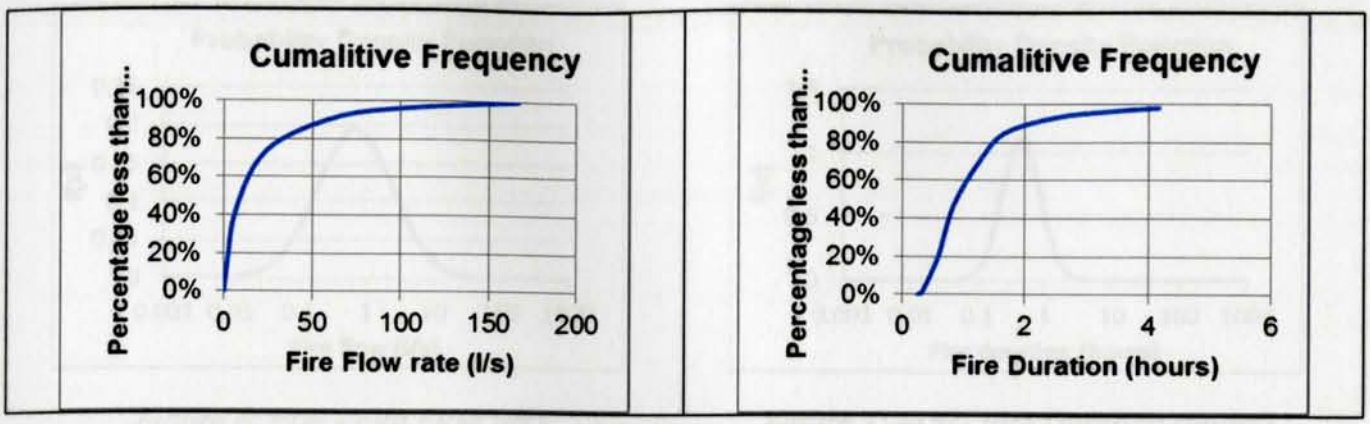

Figure 4: Cumulative Frequency - Fire Flow Rate

Figure 5: Cumulative Frequency - Fire Duration

The use of deterministic guidelines to derive a fire model will still beg the question whether the model derived is representative of expected fire occurrences for the project area under consideration. The second way in deriving the fire model addresses that uncertainty.

This is possible by, in the event of data being available, using historical fire records to derive the model from. For urban settings this is quite attainable from the local fire department. Nel and Haarhoff (1997) analysed actual data from 149 large fires that occurred in the Johannesburg municipal area. A large fire was being defined as a fire which required in excess of 5 m^3 of water to extinguish.

This data confirmed that both fire flow rate and duration followed log-normal distributions (van Zyl & Haarhoff, 2007) and could be represented by log-normal distributions with a mean and standard deviation of 3.7 l/s and 3.7 l/s respectively for fire flow rate and 0.674 hours and 1.93 hours respectively for fire duration. The probability density functions (PDF) of the distributions with these characteristics are shown in Figure 6 and Figure 7. The cumulative frequency plots of these distributions are also shown in Figure 8 and Figure 9.

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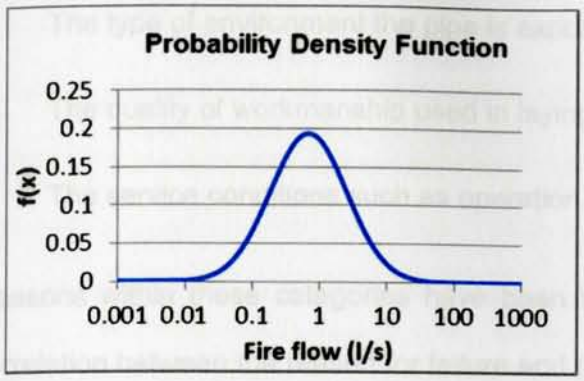

Figure 6: PDF - Fire Flow (l/s)

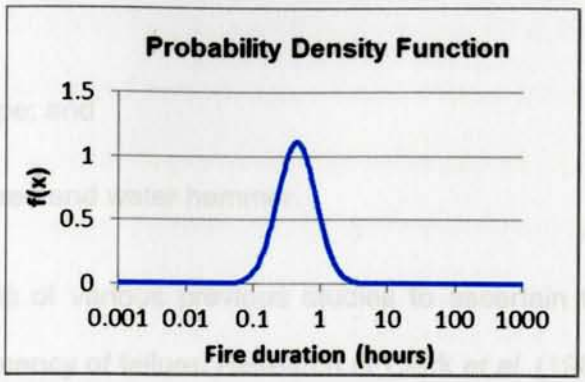

Figure 7: PDF - Fire Duration (hours)

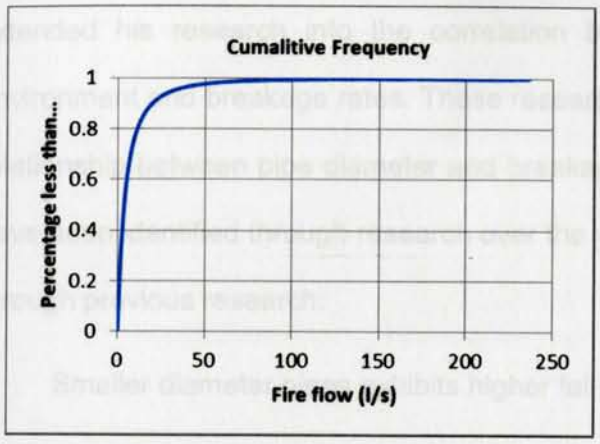

Figure 8: Cumulative Frequency - Fire Flow rate

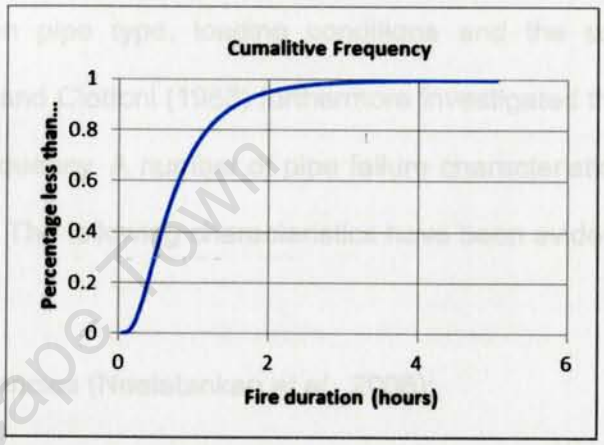

Figure 9: Cumulative Frequency - Fire duration

3.1.5 Pipe Failure

The objective of a pipe is to effectively transfer fluid from one point to another. Any circumstance which jeopardizes the way in which the pipe meets this objective impacts directly on the reliability of the system. The inability of a pipe to perform as envisaged during the design stage can occur in a number of ways. Pipe breakage types were classified by O'Day *et al.* (1986) into the following three categories: (1) Circumferential breaks; (2) longitudinal breaks; and (3) split bell (caused by transverse stresses on the pipe joint). A fourth type of breakage was also documented by Rajani and Kleiner (2001) as holes due to corrosion. This is mostly dependent on the pipe material and the internal and external conditions the pipe are exposed to.

The reasons for pipe failures, whether in the form of leaking or pipe bursts, are numerous. As reported in previous studies by Shamir and Howard (1979) and Clark *et al.* (1982), these reasons can be classified in the following categories:

- The quality and age of the pipe itself;

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- The type of environment the pipe is exposed to;
- The quality of workmanship used in laying the pipe; and
- The service conditions such as operation pressures and water hammer.

Reasons within these categories have been the topic of various previous studies to ascertain the correlation between the reason for failure and the frequency of failure. Research of Clark *et al.* (1982) and Kettler & Goulter (1985) showed a relationship between pipe age and breakage rates. Clark also extended his research into the correlation between pipe type, loading conditions and the soil environment and breakage rates. These researchers and Ciottoni (1983) furthermore investigated the relationship between pipe diameter and breakage frequency. A number of pipe failure characteristics have been identified through research over the years. The following characteristics have been evident through previous research:

- Smaller diameter pipes exhibits higher fail frequencies (Neelatankan *et al.,* 2008);
- The minority of pipes are responsible for the majority of breaks in a water supply system (Clark *et al.*,1982);
- Temporal (Seasonal) and spatial clustering of pipe breakage occurs (Goulter *et al.*,1993, Sægrov *et al.* 1999);
- Failure rates are increasing due to age (Moglia *et al.,* 2006); and
- Different rates of failure are observed in urban settings than in rural areas (Haarhoff *et al.,* 1999 & Kretzman and van Zyl, 2004).

All these studies provided valuable information to further research in development of failure prediction models and preventative measures to be adopted in the design, operation and maintenance of water supply systems.

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The pipe material has been shown to play a significant role in the expected breakage frequency. Breakage frequency is often expressed in the number of breaks occurring per length of pipe per year (failures/km/yr). Pearson *et al.* (2005) reported the findings of an analysis conducted as part of the UK research program (WaterUK 2000). These findings reported the burst frequency of different pipe systems in different countries as presented in Figure 10.

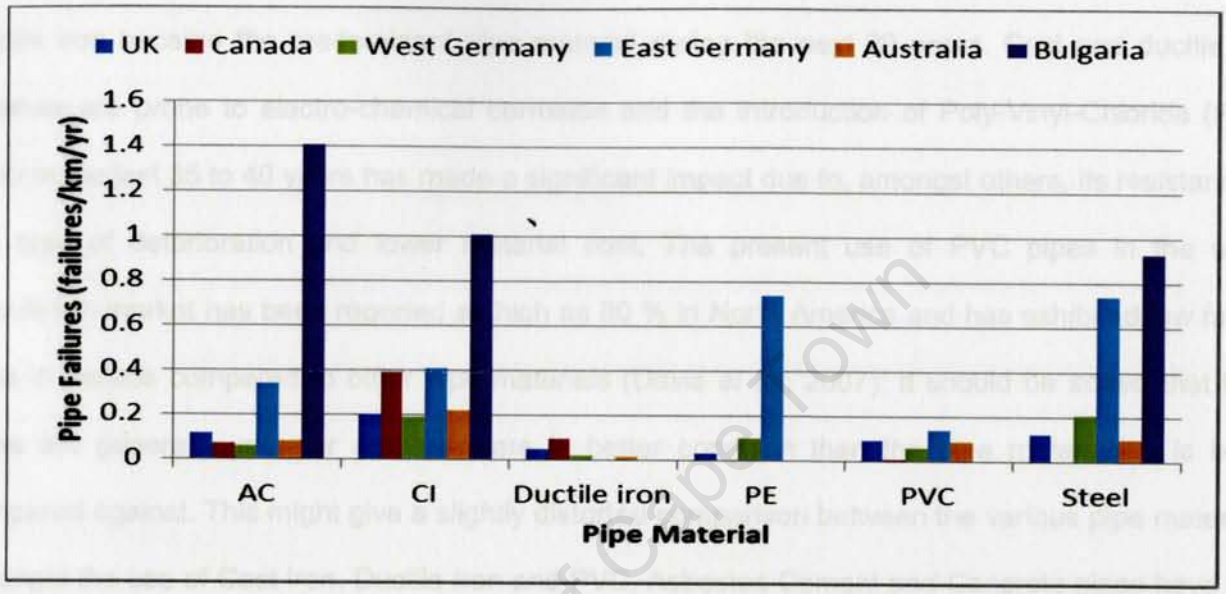

Figure 10: Burst Frequencies of Different Pipe Systems in Different Countries (Pearson et al., 2005)

The data from the study by Pearson *et al.* (2005) presented above indicates that the pipe material has a significant influence on burst frequency and with the exception of a few instances the following can be concluded:

- Asbestos Cement shows higher burst frequencies than Cast Iron;
- Ductile Iron shows lower burst frequencies than Cast Iron;
- PVC shows the lowest burst frequencies; and
- Steel tends to exhibit mid to high burst frequencies.

The use of these materials has been changing over the years due to new pipe manufacturing technology and knowledge of materials greatly influencing the pipe construction landscape. During the late 19th century to the early 20th century, according to Rajani and Kleiner (2007), grey cast iron pipes were manufactured by pouring molten cast iron in upright sand moulds placed in a pit.

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These were also known as pit cast iron. A new manufacturing process, in which horizontal casting of iron into spinning moulds was adopted, was introduced in the 1920's. These pipes were known as spun cast iron and exhibited improved durability and material uniformity. Ductile iron, in which the composition of the iron is changed to prevent graphitisation, was introduced in the late 1940's with manufacturing only starting in earnest in the 1960's.

Ductile iron became the predominant pipe material during the next 20 years. Cast and ductile iron however are prone to electro-chemical corrosion and the introduction of Poly-Vinyl-Chloride (PVC) pipes in the last 35 to 40 years has made a significant impact due to, amongst others, its resistance to this type of deterioration and lower material cost. The present use of PVC pipes in the water reticulation market has been reported as high as 80 % in North America and has exhibited low failure rates in service compared to other pipe materials (Davis *et al.*, 2007). It should be added that PVC pipes are generally younger and therefore in better condition than the pipe materials it is being compared against. This might give a slightly distorted comparison between the various pipe materials. Amongst the use of Cast Iron, Ductile Iron and PVC, Asbestos Cement and Concrete pipes have also had its share of the pipe manufacturing market. These materials show susceptibility to deterioration by means of chemical corrosion, especially where low pH levels are present in the soil environment.

This background is provided to indicate the change that occurred over the years in the use of different types of materials in the manufacturing process. This can be assumed to continue with new materials being developed and considered by pipe designers on an on-going basis. Amongst the reasons for introducing new products on the market are to provide longer lasting, more durable pipes. As this happens, it can be concluded that the reliability of pipe infrastructure will improve in relation to improvements made in this field of research.

Whatever the type of breakage, these occurrences prevents the water supply system from performing effectively. The consequences of pipe failure, as stated by Makar & Kleiner (2000), can be categorized into three categories:

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Whatever the type of breakage, these occurrences prevents the water supply system from performing effectively. The consequences of pipe failure, as stated by Makar & Kleiner (2000), can be categorized into three categories:

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1. Direct cost to the water purveyor:

- Cost of breakage repair
- Cost of lost water
- Cost of direct damage to property
- Liabilities (e.g. death or injury)

2. Indirect costs:

- Loss of production and or business in a plant
- Accelerated deterioration of trenches, roads, sewers, underground cables, etc.
- Loss due to fire which could not be extinguished due to water outage or diminished hydraulic capacity

3. Social costs

- Adverse effects of pipe failure on water quality due to intrusion of contaminants
- Cost due to service disruption
- Costs due to disruption in traffic and business
- Costs due to disruption of service to special facilities

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These significant implications of pipe failures have led designers and researchers to develop methods and models to reduce pipe breakage and to act pro-actively to avoid down-time of water supply systems. Other pro-active strategies include the replacement of pipes after leak detection activities have provided information relating to the condition of pipelines and the provision of cathodic protection in the case of steel pipes to extend the life of infrastructure. These three strategies are discussed in more detail in this section and differ from reactive strategies such as the replacement of pipes subsequent to failures which have occurred.

These methods and models are approached from two perspectives, the first being the prediction of breakage rates and the second that of evaluation of the options in rehabilitating the water supply system in an optimal way. We are concerned with the former and various studies have been focusing on the prediction of pipe failures. The early 1980's saw the first proposal of models for the prediction of pipe failures with the work done by Clark *et al.* (1982), Kettler & Goulter (1985) and O'Day *et al.* (1986) utilizing linear statistical models. These models accommodated the reasons for failures referred to earlier in this section although it did not account for the temporal and spatial clustering that are observed in reality.

Andreou *et al.* (1987) developed more complex models which relied on survival data analysis based on the proportional hazards approach and Poisson distribution. Goulter *et al.* (1993) proposed an alternative probabilistic approach that accommodated the temporal and spatial clustering of pipe breaks, a model that was developed using linear regression analysis. The work initiated by Andreou *et al.* (1987) was further used by Eisenbeis (1994) and Lei and Sægrov (1998) and proved to work at pipe level (Le Gat & Eisenbeis, 2000). Le Gat and Eisenbeis (2000) illustrated the usefulness of survival theory approach using the Weibull Proportional Hazard Model (WPHM) but also came to the conclusion that, due to the uniqueness of each network, a "universal" model is unlikely to exist. Results from a given area cannot be directly transferred to another one. Studies in this field of research are ongoing and work by Kleiner and Rajani (2000), in which more time–dependent variables are being accommodated, and Nafi *et al.* (2006), in which Genetic Algorithms are used, provides further input which can be incorporated into management practices.

The use of the models described is above all dependent on historical pipe breakage data. The recording of pipe failures by Water Utilities has been lacking in the past but this situation has been changing over the last couple of years. This is due in part by the focus being placed on operation and maintenance procedures. The development of management software, especially Decision Support Systems (DSS) in the management of water supply systems, has created awareness in the efficient recording of failures in infrastructure. It is coincidental that the effective use of probabilistic design techniques requires similar data. It is expected that the required data will become more and more available as the advantages of these techniques is realized.

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The inspection of pipes by means of a water audit, as mentioned by Saegrov *et al.* (1999) remains the most basic technique to evaluate the condition of a pipe. This is done by comparing the incoming and outgoing flow of a pipe and is a cheap method to evaluate the pipe's performance. It however does not provide any indication of the locality of pipe damage. This disadvantage is addressed by leak detection, which is more costly. The detection of leaks are done in various ways, each one with its own advantages and disadvantages.

Whether acoustic, remote field inspection, ultrasonic or thermal imaging methods are used depends on the material, age, depth and other characteristics of the pipe under consideration. It is also important to note that early detection of leaks leads to pre-emptive repair prior to complete failure. This in turn leads to lower failure rates and more reliable water supply systems.

A third strategy, which leads to lower pipe failure rates, is the protection of pipelines against internal and external damage inducing factors. One example of this protection, albeit only in the case of steel pipes, is the provision of cathodic protection. Rajani and Kleiner (2007) states that cathodic protection has been implemented in many cities in recent years to slow down corrosion rates and as a result reduce breaks and leaks in metallic pipes. The case histories analysed by the same authors indicate that cathodic protection programs have resulted in a significant decrease in failures in the majority of cases. Also proposed by Rajani and Kleiner (2007) was the use of predictive models and financial evaluation to lead municipal engineers in the decision making process with regard to the implementation of cathodic protection.

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Another example of this strategy is the introduction of pressure management schemes. Pressure reduction is most often implemented to reduce water loss due to leakage. An added advantage is the reduction in pipe failure rates as presented in the research done by Pearson *et al.* (2005).

The modelling of pipe failure requires the definition of the failure in terms of the occurrence rate and the duration of the interruption. Literature, such as those referred to in Table 5, indicated that pipe failures are recorded in terms of the occurrences per year per length of pipe installed.

The occurrence rate in terms of breaks per year is therefore utilized in this study. The duration of the disruption is described by a log-normal distribution with a specific mean and standard deviation which would be descriptive of a given system.

The designer's experience and discretion are paramount in the selection of input data of failure models. The analysis of historic data of similar events is required to increase confidence in the accuracy of the model. Table 5 indicates data which are provided in literature. The data shown provides a good indication of the failure models to be adopted. From the discussion provided here it is evident that the characteristics of a failure are dependent on a number of factors and that variation is likely to occur.

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Table 5: Pipe Failure Data found in Literature

Author	Year	Urban/Rural	Pipe Material	Frequency (no/km/yr)	Repair Duration		
					Type	Average	Standard Deviation
Kettler and Goulter	1985	Not Stated	Not Stated	0.375 to 1.06			
Cullinane	1987	Urban	Not Stated	0 to 0.313			
Su *et al.*	1987	Urban	Not Stated	0.063 to 0.194			
Wagner *et al.*	1988	Urban	Not Stated	0.058 to 2.064			
JE van Zyl, J Haarhoff	1999	Rural	Not Stated	0.1	Normal	16.8	4
Haarhoff *et al.*	1999	Not Stated	Fibre Cement	0.074			
Haarhoff *et al.*	1999	Rural	PVC	0.041			
Haarhoff *et al.*	1999	Urban	Steel (<250 mm)	0.6			
G Pelletier *et al.*	2003	Urban	Not Stated	0.2 to 0.4			
HA Kretzman and JE van Zyl	2004	Not Stated	Not Stated	0.23 (average)	lognormal	6	0.84
D Pearson *et al.*	2005	See Figure 10					
P Davis *et al.*	2006	Not Stated	uPVC (100 mm)	0.02 to 0.06			
P Davis *et al.*	2006	Not Stated	uPVC (200 mm)	0.015 to 0.055			
P Davis *et al.*	2006	Not Stated	uPVC (300 mm)	0.05 to 0.14			
JE van Zyl, J Haarhoff	2007	Urban	Various (<200 mm)	0.58	lognormal	3.5	0.49
JE van Zyl, J Haarhoff	2007	Urban	Various (200 -300 mm)	0.23	lognormal	5.1	0.71
JE van Zyl, J Haarhoff	2007	Urban	Various (300-450 mm)	0.125	lognormal	6	0.84
JE van Zyl, J Haarhoff	2007	Urban	Various (450 -600 mm)	0.125	lognormal	6.58	0.92
JE van Zyl, J Haarhoff	2007	Urban	Various (>600 mm)	0.1	lognormal	8.05	1.1
Rajani, Kleiner	2007	Urban	Steel (before CP)	0.25 to 0.75			
Rajani, Kleiner	2007	Urban	Steel (after CP)	0.1 to 0.18			
JE van Zyl, O Piller, Y le Gat	2008	Not Stated	Not Stated	Not Stated per km	Expected 5 hr with 95% under 12 hours		

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The model adopted by van Zyl *et al.* (2008) assumed a supply pipe which will experience a failure occurrence rate of two failures per year. The duration of a failure was modelled by allowing for a lognormal distribution with an expected duration of 5 hours and that 95 % of repairs will be completed in 12 hours. This distribution representing this model is described by an average and standard deviation of 1.49 and 0.48 respectively (logarithms of the value). For the purpose of van Zyl's model, no failures were modelled on the demand pipe, which was considered conservative.

3.2 COMPUTER SOFTWARE FOR RISK-BASED ANALYSIS

A method to determine the reliability of a system has, as mentioned in Chapter 1, been developed by Kretzman and van Zyl with the introduction of software entitled "Mocasim II". The use of probabilistic analysis utilizing stochastic input models as design tool requires the use of very long simulation runs, the ability to implement stochastic unit models and to handle pressure dependent demands (Kretzman & van Zyl, 2004). This has been achieved by Kretzman and van Zyl in the development of the "Mocasim II" software.

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The advantage of the "Mocasim II" software lies in the fact that it uses the EPANET source code, which is a hydraulic simulation tool which is available as public domain software (Rossman 2000). Developed by the National Risk Management Research Laboratory of the US Environmental Protection Agency, EPANET is well known in the engineering industry as a reliable tool for simulating hydraulic performance of a water network system.

Various changes are made to the EPANET source code to convert it to a stochastic analysis tool (Kretzman & van Zyl, 2004). The developers have developed an object oriented toolkit for EPANET, called Ooten, to implement the necessary changes when doing a Monte-Carlo simulation run.

A number of changes are made to the EPANET source code. To achieve long simulation runs the tank levels at the end of a day are carried forward to represent the starting tank level of the following day (Kretzman & van Zyl, 2004). This is necessary because each day a new set of flow and failure conditions are generated and applied to the hydraulic simulation of the day. These flow and failure conditions are based on the stochastic unit models provided by the user.

Continuity of the simulation is therefore guaranteed by performing one daily simulation after another until the simulation period set by the user has lapsed. Generally hydraulic analysis software and specifically EPANET uses fixed demands to determine the conditions in a system. In reality however, demands are dependent on hydraulic pressure. This is important to consider when system pressure is low e.g. due to a pipe failure. The application of probabilistic analysis with its associated long simulation runs calls for more realistic conditions by incorporating pressure dependent abstraction from the system. This is satisfied by "Mocasim II" by using a modified version of the emitter functionality of EPANET(van Zyl and Haarhoff, 2007).

An added advantage of using "Mocasim II" is its versatility with regards to complexity of system. Any water network system modelled in EPANET can be analysed by "Mocasim II". For the purpose of this study a fairly simple system is analysed but the designer can place an EPANET tank anywhere in a network to analyse tank reliability. The EPANET reservoir uses a fixed hydraulic head (unless head patterns are specified) but the "Mocasim II" software calculates the volume of water in the reservoir based on the in- and outflow figures at any given time. The user provides a range of tank sizes to be analysed and the software will record when the tank would have run dry (van Zyl *et al.*, 2008). The duration of the failure is also recorded.

After the simulation is completed, the performance criteria are logged and the data is statistically analysed. The Mocasim II software has been extensively tested and used in previous studies (Haarhoff *et al.*, 1999).

The appropriate duration of simulation was determined by van Zyl *et al.* (2008) to ensure results of sufficient accuracy. This was determined by running the base model for a range of different duration and observing the stability of the results. It was found that the tank failure sizes were within 5 % of the ultimate value at a minimum of 2000 tank failures. The accuracy of this was confirmed by running the models from 10 different random seeds.

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CHAPTER 4: LITERATURE REVIEW: COSTING OF BULK WATER SUPPLY SYSTEMS

4.1 TYPES OF COSTING

A number of factors influence the methods and practices which will be used when costing any engineering infrastructure. The procedure to be adopted will be influenced mainly by the purpose of the costing exercise. By defining the purpose of the costing a number of requirements for the costing are implied, such as the required accuracy, breakdown and time input. The purpose of the costing can range from a feasibility analysis to the financial control during construction. The former is used for comparative analysis and does not usually require the accuracy required by the latter. It does however rely on the relative accuracy between different components of infrastructure. Since every stage of an engineering project requires different levels of costing accuracy it is evident that a number of types of costing are used in the industry.

As outlined by Clark and Dorsey (1982) the following types of costing are commonly used:

- Order-of-magnitude estimates

  These estimates are used to obtain a "ball-park" figure and to get a first indication of the funds required. This can be used to check subsequent estimates.

- Study estimates

  These estimates do not require detailed costing of components but rely on known costs relative to capacity or production quality. Examples of this are unit process estimates for water treatment and factor estimates used in the chemical process industry.

- Preliminary estimates

  These estimates rely on the costing of each item of infrastructure and are of high accuracy. It is also used when a costing model is not available in a form to permit a study estimate.

- Definitive estimates

  These estimates call for a completed engineering design to ensure the highest accuracy. The only difference between this method and a detailed estimate is the fact that definitive estimates does not account for any site specific conditions which might be expected.

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- Detailed estimates

  These estimates call for complete site specific information and working drawings. The purpose is to use the costing for financial control during the construction stage.

The evaluation of design techniques and particularly the feasibility thereof generally relies on the use of unit cost models and it therefore falls in the "Study Estimates" category. The ease of applying cost and ensuring that a comparative analysis is possible, are important factors when developing the necessary tools to perform these analyses.

4.2 UNIT COST MODELS

The calculation of estimated cost could be aided by the use of unit cost models. The term "Unit Cost Model" can best be described by an explanation of the trend which occurs when infrastructure of different sizes are priced. The cost of an infrastructure component can often be described as a cost relative to its capacity. The effect of economy of scale usually results in a decrease in this relative cost with an associated increase capacity. To illustrate this, consider the following example: A 11 Ml reservoir has an estimated construction cost of $ 7.7 million whilst a 25 Ml reservoir has an associated estimated cost of $ 14.3 million. It is therefore calculated that the unit cost of an 11 Ml reservoir is $ 700 per kl and that of a 25 Ml reservoir $ 570 per kl. It can therefore be seen that the unit cost decreases with an increase in capacity.

Whereas the cost of storage facilities is sometimes described in terms of the cost per storage volume, which decrease with an increase in capacity, the cost of pumping stations and feeder pipes are often described in terms of cost per kilowatt (kW) and meter (m) respectively. These costs usually increase when expressed in relation to these parameters. The method for cost model development proposed by Swamee and Sharma (2008) has been considered in this study and is discussed under the development of a model for the source, feeder pipe and storage infrastructure.

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When estimations are made across a range of capacities for a specific component of infrastructure, the relationship between cost and capacity can be seen. This information can also be graphically and mathematically presented. This representation is referred to as a model for that specific component of infrastructure. The application of the model in the estimation process provides a quick method to produce cost estimations for a large number of alternatives. This characteristic makes it a valuable tool in the costing process.

The accuracy of a unit cost model depends on the data being used and its accuracy in relation to the site conditions which will be experienced. It is important to have data for different components which are accurate in relation to each other so that alternatives with different make-up can be compared. Data obtained in the book "Design of Water Supply Pipe Networks, Swamee & Sharma (2008)" includes unit cost models for bulk water infrastructure components. The data referred to was obtained from Samra and Essery (2003), which is data that was applicable to the east coast of Australia in 2003. The unit cost models for the source, feeder pipe and storage facilities derived from this data is discussed in more detail in the following pages.

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4.2.1 Source

The source in this study, as discussed in Section 2.1, refers to the pumping station providing energy to the system to convey water from a low lying location to the storage reservoir at a higher elevation. Swamee and Sharma proposed the development of a unit cost model for pumping stations by deriving an equation for the cost in the following form:

$$C_p = k_p P^m \quad \text{..... Eq. 4-1}$$

Where:

Cp = the construction cost of the pumping station;

P = installed power of the pumping station expressed in kW;

k_p = a coefficient; and

m = an exponent.

The installed power (P) can be calculated by the following equation:

$$P = (1 + s_b) \times \frac{pgQh}{n} \quad \text{Eq. 4-2}$$

Where:

s_b = standby fraction;

p = mass density of fluid;

g = gravitational acceleration;

Q = Discharge;

h = total pressure head; and

n = combined efficiency of pump and prime mover.

The data evaluated by Swamee and Sharma however indicated that a "power equation" would accurately represent the data they analysed. The model therefore used in this study takes the following form:

$$C_p = 5560P^{0.723} \quad \text{Eq. 4-3}$$

and can be represented graphically as presented in Figure 11.

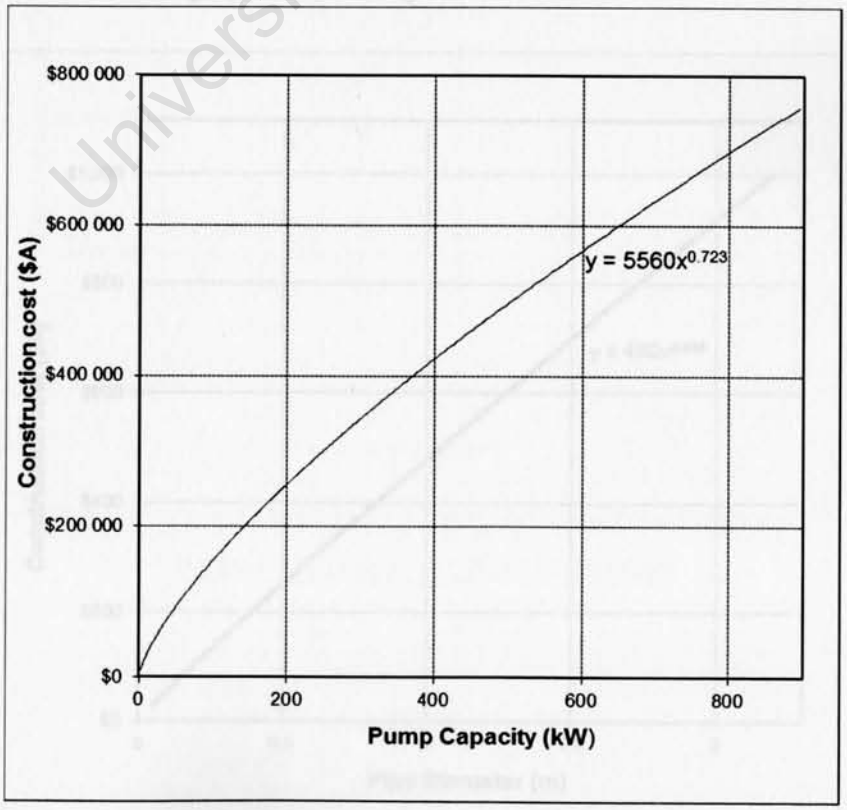

Figure 11: Unit Cost Model: Source

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4.2.2 Feeder Pipe

As proposed by Swamee and Sharma, the following relationship is used in the development of a unit cost model for the feeder pipe:

$$C_m = k_m L D^m \quad \text{..... Eq. 4-4}$$

Where:

C_m = Construction cost of the feeder pipe;

L = length of the pipe;

k_m = a coefficient; and

m = an exponent.

The data received from the same source as previously mentioned provided the construction cost per linear meter of Ductile Iron Cement Mortar lined pipes. This cost include all associated fixtures, specials and appurtenances such as valves, pipe markers etc. The equation representing the data is:

$$C_m = 480 L D^{0.935} \quad \text{..... Eq. 4-5}$$

This unit cost model is indicated graphically on Figure 12.

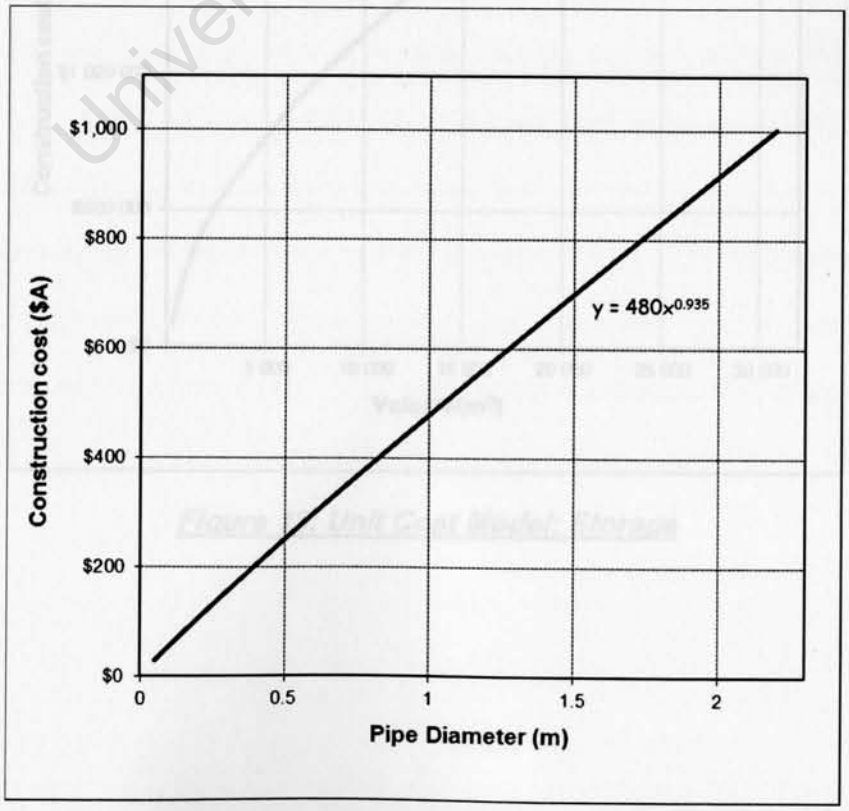

Figure 12: Unit Cost Model: Feeder Pipe

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4.2.3 Storage

The storage referred to in this study is in the form of a concrete surface reservoir. It was found that the Australian data (Samra & Essery, 2003) could be represented by the following equation:

$$C_R = \frac{290V_R}{\left[1+\left(\frac{V_R}{1100}\right)^{5.6}\right]^{0.075}} \quad \text{..... Eq. 4-6}$$

Where:

C_R = Construction cost storage; and

V_R = volume of reservoir (m^3).

Though cost models for reservoirs can also accommodate the staging height of the structure this was not required for the purpose of this study. This unit cost model is indicated graphically on Figure 13.

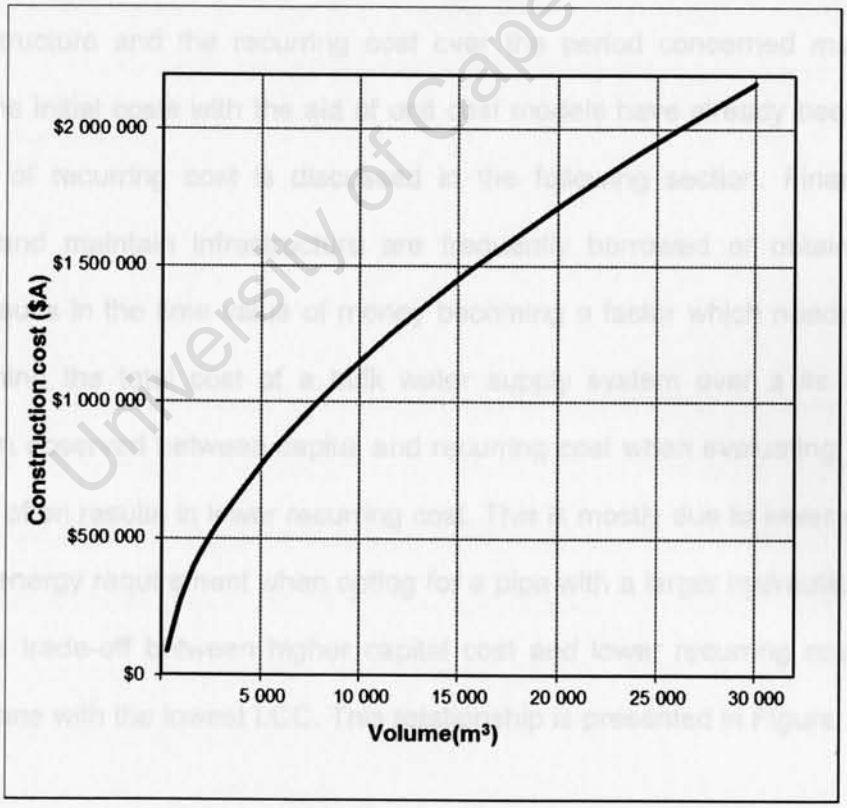

Figure 13: Unit Cost Model: Storage

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4.3 LIFE CYCLE COSTING

The financial comparison of various alternatives is an important aspect of any feasibility analysis. The calculation of the capital cost is however not the only financial consideration which is part of this comparison. Each alternative has, based on the design of the infrastructure, different associated operation and maintenance requirements. These requirements have, in turn, its own associated financial impact on the owner of the infrastructure. In order to account for all expenditure which will be associated with a certain alternative, the total life cycle cost (LCC) associated with the infrastructure is determined. The financial comparison between alternatives can then be done at the hand of these LCC's after this has been determined for each alternative.

Life cycle costing is a financial analysis technique which is used to determine the total cost of a system over its life span or certain period. In order to determine the LCC of a system the initial cost to provide the infrastructure and the recurring cost over the period concerned must be known The determination of the initial costs with the aid of unit cost models have already been discussed whilst the determination of recurring cost is discussed in the following section. Financial resources to provide, operate and maintain infrastructure are frequently borrowed or obtained from invested resources. This results in the time value of money becoming a factor which needs to be considered for when determining the total cost of a bulk water supply system over a its operational life. A relationship is often observed between capital and recurring cost when evaluating pumping mains. A higher capital cost often results in lower recurring cost. This is mostly due to lower operating cost due to lower electrical energy requirement when opting for a pipe with a larger hydraulic capacity. There is therefore usually a trade-off between higher capital cost and lower recurring cost with the optimal solution being the one with the lowest LCC. This relationship is presented in Figure 14.

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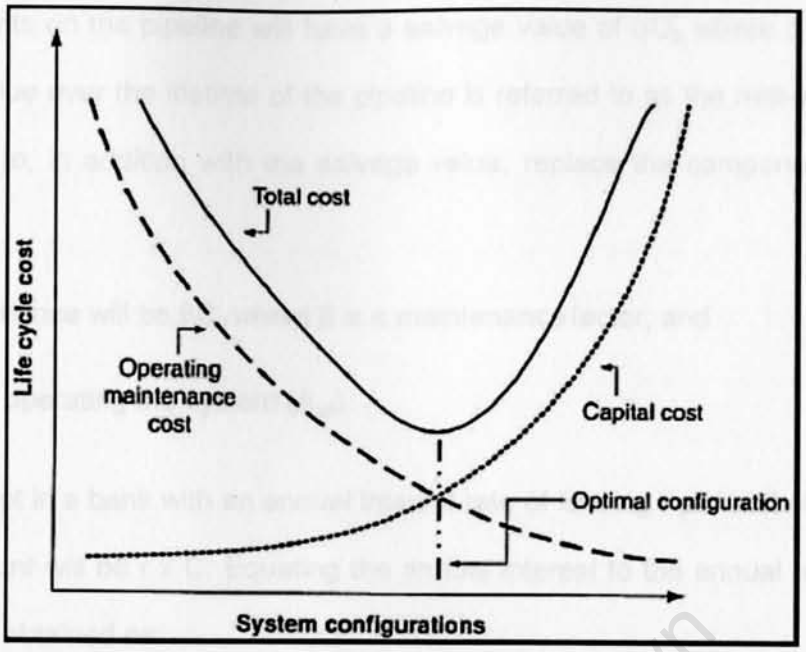

Figure 14: Relationship between Capital and Recurring Cost and resulting Total Cost (Swamee and Sharma, 2008)

A number of methods are used to determine LCC such as the capitalization, annuity and nett-present value (NPV) methods. These methods will be explained in more detail below and the method used in this study will be introduced.

4.3.1 Methods

Capitalization Method

This method relies on all recurring cost being converted into capital costs (Swamee & Sharma, 2008). In essence this method calculates the amount of money to be available at the start-up of the project to ensure that the interest yielded from the funds be used to cover all expenditure expected during the life of the infrastructure and to provide funds for the replacement of the system at the end of its design life. The discussion provided by Swamee and Sharma (2008) will be used to illustrate all the LCC methods. Consider the following financial requirements:

A pipeline has the design life of T years. The financial implications which will face the pipeline over T years are the following:

- Initial capital will be required to construct the pipeline (C_0);

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- The components on the pipeline will have a salvage value of αC_0, where α is a salvage factor. The loss in value over the lifetime of the pipeline is referred to as the nett-liability and needs to be recovered to, in addition with the salvage value, replace the component at the end of its design life;
- Annual maintenance will be βC_0 where β is a maintenance factor; and
- Annual cost in operating the system (A_{op}).

If an amount C is kept in a bank with an annual interest rate of lending r per unit of money, the annual interest on the amount will be r x C. Equating the annual interest to the annual recurring cost A, the capitalized cost C is obtained as:

$$C = \frac{A}{r} \quad \text{Eq. 4-7}$$

The nett-liability of the infrastructure at the end of period T is:

$$C_N = (1 - \alpha)C_0 \quad \text{Eq. 4-8}$$

Then also, the compound interest which will be yielded from keeping an amount C_R in the bank is:

$$I_R = C_R[(1 + r)^T - 1] \quad \text{Eq. 4-9}$$

This interest shall account for the nett liability of the infrastructure which will be incurred during its design life T, therefore:

$C_N = I_R$ from which C_R can be presented in terms of C_0, r and T.

$$C_R = \frac{(1-\square)C_0}{[(1+r)^T-1]} \quad \text{Eq. 4-10}$$

C_R is therefore the amount required in the bank to yield interest to the value of the nett-liability, making it possible to replace the component.

The amount C_{ma} that is required to yield enough interest to provide sufficient funds for annual maintenance is calculated by using Equation 4-11:

$$C_{ma} = \frac{\beta C_0}{r} \quad \text{Eq. 4-11}$$

The amount C_c that should be available is the sum of C_0, C_R, C_{ma} and A_{op}, therefore,

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$$C_c = \left\{C_0\left[1 + \frac{1-\alpha}{(1+r)^T-1} + \frac{\beta}{r}\right]\right\} + \frac{A_{op}}{r} \quad \text{..... Eq. 4-12}$$

This equation can therefore be used to calculate the total LCC of the system in perpetuity for any alternative where its capital cost, salvage value, maintenance factor and prevailing interest rate are known. These parameters are discussed in more detail under Section 4.4. The capitalization method is convenient in cases when components within a system have varying design lives.

Annuity Method

This method converts all costs into recurring costs (Swamee & Sharma, 2008). In essence this method calculates the money that needs to be available at recurring intervals to repay any debt which would have been incurred if all funds required throughout the life of the project were borrowed.

In a similar way to the discussion of the capitalization method, consider the following financial needs to render, operate and maintain a pipeline system:

- Initial capital will be required to construct the pipeline (C_0);
- The nett-liability = (I -α) C_0 over the pipeline's design life. A salvage value αC_0 will be recovered at the end of the pipeline's design life;
- Annual maintenance will be βC_0 where β is a maintenance factor; and
- Annual cost in operating the system (A_{op}).

The annuity when converting the initial capital cost C_O to a perpetual recurring cost is given by:

$$A_0 = rC_0 \quad \text{..... Eq. 4-13}$$

The nett-liability has been given as:

$$C_N = (1 - \alpha)C_0 \quad \text{..... Eq. 4-14}$$

An instalment A_r that is deposited into a bank for T years at an interest rate of r will grow to $A_R(1 + r)^{T-1}$.A second instalment in the following year will grow to $A_R(1 + r)^{T-2}$ and so will all the instalments add to $C_a = A_r[1 + (1 + r) + (1 + r)^2 + \ldots + (1 + r)^{T-1}]$.

Summing up this geometric series, one gets:

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$$C_a = \frac{\{A_r \times (1+r)^T - 1\}}{r} \quad \text{Eq. 4-15}$$

Equating $C_N = C_a$, Ar, the annuity that will account for the nett – liability, can be represented in terms of α, r, T and C_0:

$$A_r = \frac{(1-\alpha)r}{(1+r)^T - 1} C_0 \quad \text{Eq. 4-16}$$

The annual maintenance cost $A_m = \beta C_0$ and annual operational cost A_{op} are already recurring costs needing no further conversion.

The sum of A_0, A_r, A_m and A_{op} gives the total annuity that represents the LCC of the system in terms of recurring cost:

$$A = \left\{ rC_0 \left[1 + \frac{1-\alpha}{(1+r)^T - 1} + \frac{\beta}{r} \right] \right\} + A_{op} \quad \text{Eq. 4-17}$$

This equation reveals that the annuity is r times the capitalized cost. One can therefore either use the capitalization method or the annuity method where these principles mentioned are considered.

Net Present Value or Present Value Method

The net present value method is widely used as a comparative evaluation tool (Swamee & Sharma, 2008). This method relies on the principle to calculate the current worth of all tangible associated income and expense which would be associated with the infrastructure over its design life. In essence it determines the amount of money to be invested so that it will be sufficient to cover the nett-expense associated with the system.

The following costs are generally applicable to the system:

- The initial capital cost required;
- The recurring expenditure of maintenance of the system (A_m);
- The recurring expenditure of operation of the system (A_{op}); and
- The income expected from the salvaged material at the end of the system's design life.

The net present capital cost of a future expenditure is derived as presented in Equation 4-18.

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$$P_v = F(1+r)^{-T} \quad \text{Eq. 4-18}$$

Where:

F = is future cost;

r = is discount rate; and

T = is the analysis period.

The annual recurring expenditure for maintenance $A_m = \beta C_A$ over the period T, where β is a maintenance factor and C_A is the capital cost of the infrastructure, can be converted to net present value P_{NA} as:

$$P_{NA} = \beta C_A\left[(1+r)^{-1} + (1+r)^{-2} + \ldots + (1+r)^{-(T-1)} + (1+r)^{-T}\right] \quad \text{Eq. 4-19}$$

The sum of the geometric series and therefore the net present value for recurring maintenance costs is presented by the following equation (Equation 4-20):

$$P_{NA} = \beta C_A \frac{(1+r)^T - 1}{r(1+r)^T} \quad \text{Eq. 4-20}$$

The same can be applied to the recurring operational cost:

$$P_{NO} = A_{op} \frac{(1+r)^T - 1}{r(1+r)^T} \quad \text{Eq. 4-21}$$

The net present capital cost of the salvage value is determined using Equation 4-18 yielding the following equation (Equation 4-22):

$$P_{NS} = \alpha C_A (1+r)^{-T} \quad \text{Eq. 4-22}$$

Where α is a salvage factor.

The sum of the initial capital cost, the net present value of the income derived from the salvaging of material and the net present value of the recurring operation and maintenance cost yields the net present value of the system. This is presented mathematically by Equation 4-23.

$$P_S = \left\{C_A \times \left[1 - \alpha(1+r)^{-T} + \beta \frac{(1+r)^T - 1}{r(1+r)^T}\right]\right\} + \left\{A_{op} \frac{(1+r)^T - 1}{r(1+r)^T}\right\} \quad \text{Eq. 4-23}$$

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This value can then be used to compare various alternatives with each other. This method gives a good indication of the cost incurred by the implementation and maintenance of a system in terms of present time value of money. In cases where components within a system have varying design lives, this method becomes difficult to use. This is due to the fact that incurred expenditure has to be converted to present value over a period that is the lowest common multiple of the design lives of the various components.

4.4 COST FUNCTION PARAMETERS

In the preceding sections a number of parameters have been introduced. These parameters are:

- α = a salvage factor of the component as a percentage of the original cost after design life T;
- β = maintenance factor of the component as a percentage of the original cost;
- T = design life of the component; and
- r = discount rate.

These parameters are based on the characteristics of the component in terms of its value to the owner. The salvage value is influenced by the type of material and the resell value.

The maintenance factor is influenced by the extent of maintenance which will be expected from the owner of the infrastructure. This is in turn influenced by the owner's budgetary allowance and resource capability for maintenance. The design life is influenced by the type of material and the conditions to which the infrastructure are exposed to. Lastly these factors also influence each other. Due to these relationships it can be deducted that these factors are influenced by the region where the infrastructure is installed. Parameters as proposed by Swamee and Sharma (2008) are presented in Table 6.

Table 6: Cost Parameters

Item no.	Description	α	β	T
1	Pipes			
1.1	Mild Steel	20%	0.5 %	120
1.2	Unplastized Poly Vinyl Chloride (uPVC)	0 %	0.5%	60

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Item no.	Description	α	β	T
2	Pump Station Civil Structure	0 %	1.5%	50-60
3	Pump Station Mechanical Equipment	20%	3%	12-15
4	Concrete Reservoir	0 %	1.5%	100-120

Whereas the recurring maintenance is determined by applying a maintenance factor β, the operation of the infrastructure is mainly based on the energy requirements of the pumping activity. The power absorbed by the pumping equipment can be calculated using the formula Equation 4-24.

$$P = pgQh/n \quad \text{Eq. 4-24}$$

Where:

p = mass density of fluid;

g = gravitational acceleration;

Q = Discharge;

h = total pressure head; and

n = combined efficiency of pump and prime mover.

The choice of discount rate (r) to be used in the analysis of a project's LCC is important due to the associated implication that such a decision entail.

The different methods of life cycle analysis elaborated on above all considers the effect of capital expenditure at the construction stage and the recurring costs such as operation and maintenance of infrastructure during the life of beneficial use. Earlier it was stated that a trade-off exists between higher capital cost and lower recurring cost. The discount rate determines the effect that these costs will have in relation with each other and is therefore an important consideration to find the optimal solution. The design of pumping systems specifically includes the operation of the system which includes the expenditure of electrical energy. The electrical energy which is required to satisfy the required hydraulic head has an associated recurring cost. The optimal configuration between the size of pipe and the required hydraulic head (required electrical energy) are therefore greatly influenced by the discount rate used in the LCC analysis.

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Generally, for state owned infrastructure, the discount rate is taken as the rate at which government provides money to water authorities for water systems minus the inflation experienced (Swamee & Sharma, 2008). It must be noted that inflation is not always considered due to the fact that unrealistic results are obtained such as salvage values being greater than the initial cost. This is not acceptable in engineering systems where the value of infrastructure remains unchanged whereas inflation causes a dilution of money in the form of cash. (Swamee & Sharma, 2008). This is confirmed by Simpson (2008) who states that many water utilities around the world use a discount rate equal to the interest rate or the current cost of capital of between 6 and 8 % per annum.

The discount rate is seen as a social recovery factor and it is evident from literature that it is widely debated what the appropriate discount rate in the design of water infrastructure should be. Ramboud and Torrecillas (2005) provide a range of discount rates used by governments as presented in Table 7.

Table 7: Discount rates used in different government agencies (Ramboud and Torrecillas, 2005)

American Government Agencies and Organizations	**Discount Rate**
Office of Management and Budget	10%
Bureau of Land Management	10%
U.S Fish and Wildlife Service	7.8% (nominal rate)
U.S Forest Service	4%
Congressional Budget Office	2%
Government Accounting Office	Average cost treasury debt
Municipal Governments	3%
Other non-American governments	
English Government	3.5%, for time periods beyond 30 years the discount rate declines
Dutch Agencies	8% (nominal), 4% (real rate)

A consideration which has also recently come to the surface is the lowering of the discount rate to assist the global drive to combat climate change. Simpson (2008) reports the findings of *The Stern Report: The Economics of Climate Change (2006)*, commissioned by Gordon Brown, then UK Chancellor of the Exchequer.

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The Stern report contains two messages: Global warming is occurring and it is induced by emissions of carbon dioxide, methane and other "greenhouse" gases (Jensen & Webster, 2007). Simpson reports that *The Stern Report* also recommends that drastic and decisive action be taken to cut emissions by 3% per annum over the next century. Work done, amongst others, by Weitzman (2007) have investigated the consideration of lowering discount rates to subsequently lower harmful emissions. In the design of water supply systems a higher discount rate tends to favour the installation of larger pumps and smaller pipes which in turns leads to a higher CO_2 footprint. Lowering the discount rate therefore subsequently reduces CO_2 emissions but leads to higher initial capital costs due to larger pipes. The resulting effect of climate change over the long term is still extremely uncertain. The observed increase in the concentration in the Earth's atmosphere over the last century is however evident (Simpson, 2008) and should not be disregarded. A recommendation put forward by Weitzman (2007) to is to reduce discount rates to between 2% and 4% to consider recent conclusions in this regard.

The unit cost models have been discussed under Section 4.2 and it was stated that the cost models were derived from data applicable to the east coast of Australia in 2003. An electrical tariff structure is presented from the work done by Gibbs *et al.* (2010). It represented the applicable electrical tariff in Sydney in 2005 and can be presented in Figure 15.

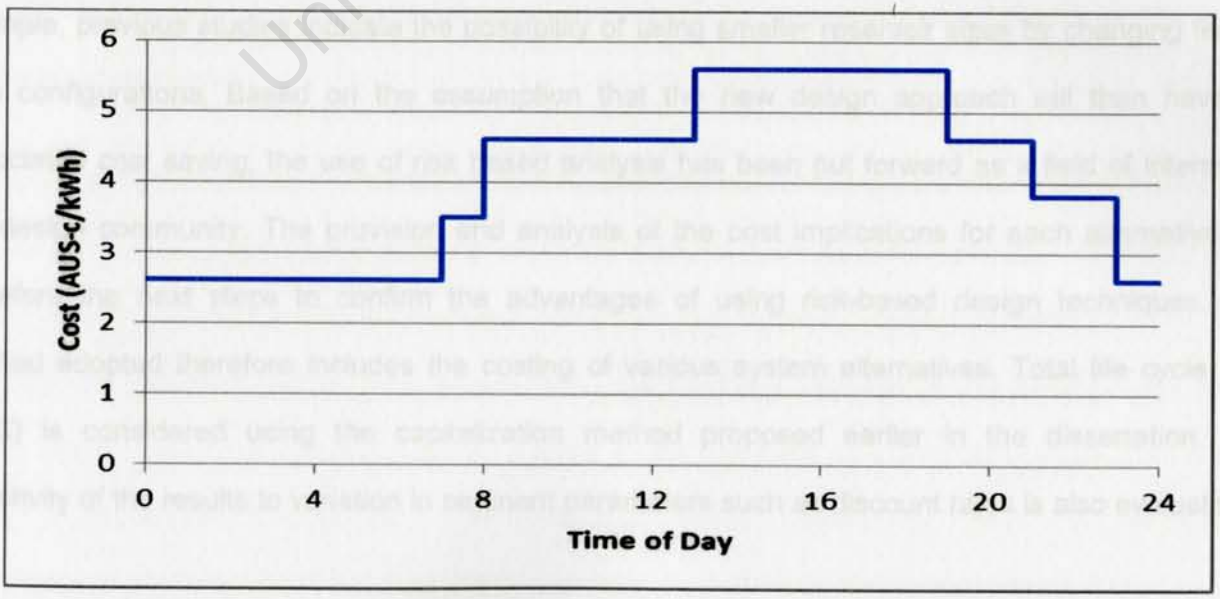

Figure 15: Electricity Cost- Sydney 2005 (Gibbs, Dandy and Maier 2010)

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CHAPTER 5: METHODOLOGY

5.1 CONSIDERATIONS

In order to study the cost implications of a design developed using risk-based techniques, it is important to consider the major contributing factors that would influence system reliability. It has been reported that reliability is influenced by the capacity of the storage infrastructure as well as the feeder pipe configuration that the relationship between these factors is important. As previously discussed, this study will deal with a simple supply system consisting of a single source, a feeder pipe system and a storage facility from where water is supplied to the consumer. The methodology has to ensure that variations that could occur within these components are accommodated.

The evaluation approach adopted should first and foremost accommodate these variables without being overly complex and time consuming as a large number of analyses are required. It is also important that the approach delivers a clear picture of the variation in reliability for a wide spectrum of input variables. This is explained in more detail in the following sections.

An analysis of the various alternatives using the method described below confirms most of the previous work which has been done in this field. Previous work done is used as a departure point to proceed with this study into the evaluation of cost implications which could be expected. As an example, previous studies indicate the possibility of using smaller reservoir sizes by changing feeder pipe configurations. Based on the assumption that the new design approach will then have an associated cost saving, the use of risk based analysis has been put forward as a field of interest to the design community. The provision and analysis of the cost implications for each alternative are therefore the next steps to confirm the advantages of using risk-based design techniques. The method adopted therefore includes the costing of various system alternatives. Total life cycle cost (LCC) is considered using the capitalization method proposed earlier in the dissertation. The sensitivity of the results to variation in pertinent parameters such as discount rates is also evaluated.

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The approach adopted is discussed in more detail below. The discussion focuses on the input criteria, layout configurations and analysis methodology and costing of the various alternative bulk water supply systems analysed. This section deals with the input parameters which define the hydraulic properties of the various alternatives. The stochastic components are discussed in depth in Chapter 6.

In the development of alternative bulk water supply systems a numbering system was used to easily identify the system being analysed. The numbering system consists of 4 digits. As presented in Figure 16, the first digit represents the change in stochastic input accommodated by the input file. Stochastic variables accommodated are the variation in user demand, fire occurrence characteristics and pipe failure characteristics. The use of one (1) or two (2) as first digit represents the shape of the hourly demand pattern (HDP) the water supply systems is subjected to. A one (1) indicates a pattern with lower peaks commonly encountered in a rural setting and a two (2) a pattern of higher peaks such as that associated with an urban setting. The number three (3) represents a change in the characteristics of fire occurrence and four (4) a change in pipe failure characteristics. As explained in Section 6.1.1, the simulations with the user demand pattern as accommodated in those simulations with a two (2) as first digit are taken as the "base models". The other simulations with one (1), three (3) and four (4) as first digit are then subjected to a comparative analysis against the "base models" (2). As explained in Chapter 6, stochastic input files have been created for all these scenarios, based on the trends expected in each case.

The second digit represents the size of development being supplied with water. Four different sizes are adopted in this study. These sizes are provided in terms of the daily demand (DD) expected under seasonal peak conditions with the numbers one (1) to four (4) being used to represent a DD of 20, 80, 160 and 240 litres per second respectively. The third digit represents the length of the feeder supply system with once again four different levels being analysed. The third digit ranges from one (1) to four (4) for lengths of 1000, 5000, 10000 and 25000 meters respectively. The fourth digit indicates the feeder pipe configuration adopted in the water supply system under consideration.

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These configurations are discussed in Section 5.3 with the numbers one (1) to ten (10) used to represent the various configurations as presented in Section 5.3. **Reference to the analysed water supply systems and its unique number will henceforth be done using the abbreviation "AWSS" and its four-digit number.**

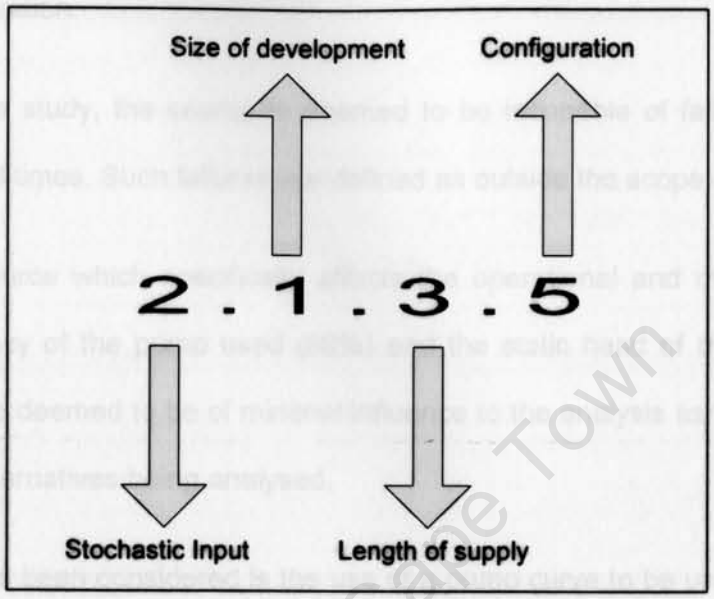

Figure 16: Numbering System of AWSS's

5.2 INPUT CRITERIA

In the development of the various supply systems all the parameters except the ones defining the numbering system as described above are fixed across all the alternatives. As discussed, the variable parameters are the stochastic demand input (shape of demand pattern), the size of development, the length of feeder supply and the layout configuration. The parameters which are fixed describe the characteristics of the source, feeder supply system and storage facility. The parameters are discussed under these headings.

5.2.1 Source

The source is dealt with as a pumping station with the capacity to supply a discharge of 1.5 times the required Average Annual Daily Demand (AADD). From previous studies van Zyl and Haarhoff (1999) concluded that the design rule requiring that the feeder design capacity be 1.5 times the annual average daily demand is appropriate in most urban designs.

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As discussed in Section 3.1.2, the analysis is performed under seasonal peak conditions. Seasonal peak factors are found to be approximately 1.25 times the AADD. It has therefore deemed that an approximate design peak factor of 1.5 divided by 1.25, therefore 1.2 of the daily demand under seasonal peak conditions would be used as the capacity of the pumping source of the water supply systems under consideration.

For the purpose of this study, the source is deemed to be incapable of failing and that an infinite supply is available at all times. Such failures are defined as outside the scope of this study.

Input criteria at the source which specifically affects the operational and maintenance cost of the system are the efficiency of the pump used (90%) and the static head of the water supply system (0 m). These values are deemed to be of minimal influence to the analysis as these variables shall be consistent across all alternatives being analysed.

Another input which has been considered is the use of a pump curve to be used during analysis. The shape of pump curves differs quite substantially from one pump model to another as well as from one size to the next. The pump curve shape is most relevant where failure will occur in a pipe that is laid in parallel. This is illustrated by the system curve in Figure 17, showing the duty points of the system with the both pipes in operation and with one pipe not in operation due to failure which has occurred. The effect of the pump curve results in a flow under failure conditions which is approximately 60 % of the flow experienced under normal conditions. In reality this percentage will depend on the shape of the pump curve which is mainly governed by the type of pump. It was decided that the effect of the pump curve was not going to be accounted for during this study due to the difficulty in determining them for each alternative. This was done by simulating the source as a reservoir with a fixed head. Under failure conditions the flow through the operational pipe will be proportional to the number of pipes installed i.e the installation of two pipes in parallel will allow half the total supply through each pipe, regardless of failure or not.

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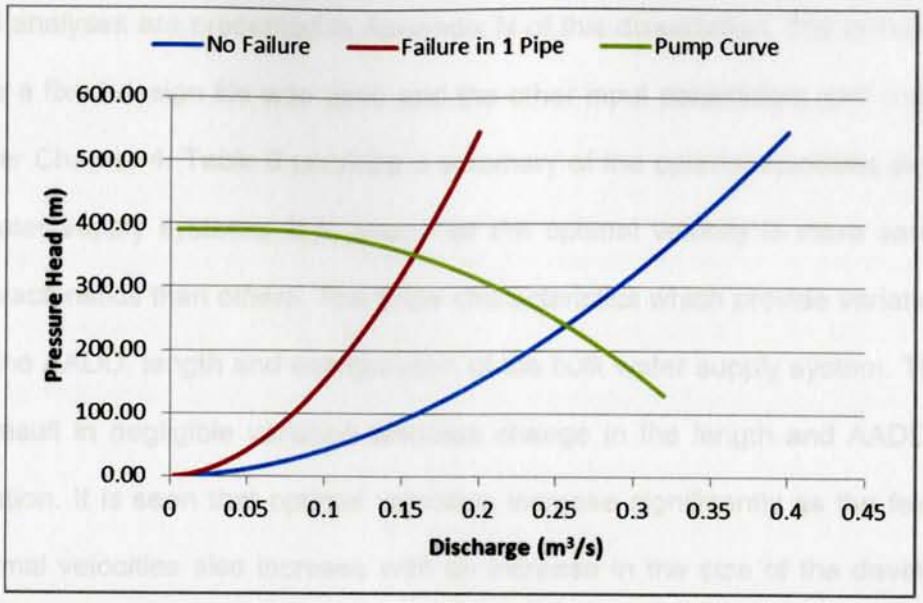

Figure 17: Pump Curve Effect- Normal vs Failure Conditions

The determination of the required head at the source is described under Section 5.2.2. The determined head allows the determination of the electrical requirements of the required pumps and therefore also affects the associated cost.

5.2.2 Feeder Supply System

The capacity of the feeder supply system is based on the deterministic guideline of 1.5 times the AADD. As mentioned in Section 3.1.2, the simulations are performed under seasonal peak conditions. The seasonal demand pattern used by Nel and Haarhoff (1996) revealed a maximum seasonal factor of 1.28 during the course of the year. Adoption of a seasonal peak factor of 1.25 resulted in the feeder pipe system designed to a capacity of 1.5 ÷ 1.25 = 1.2 of the average demand under seasonal peak conditions.

Firstly the diameter was determined by considering the optimal velocity which is applicable to water supply systems of various sizes. This was done by performing a financial analysis of the LCC's involved when adopting a range of diameters for the system. These financial analyses were done for the configurations involving a single, two pipes in parallel and three pipes in parallel feeder pipe system. The analyses also determined the optimal velocity over the range of AADD and feeder pipe lengths evaluated during this study.

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These financial analyses are presented in Appendix N of this dissertation. The present value method was used since a fixed design life was used and the other input parameters and cost models are as referred to under Chapter 4. Table 8 provides a summary of the optimal velocities determined for the various bulk water supply systems. It is seen that the optimal velocity is more sensitive to certain variation in characteristics than others. The three characteristics which provide variation as presented in Table 8 are the AADD, length and configuration of the bulk water supply system. The configuration was found to result in negligible variation whereas change in the length and AADD result in more significant variation. It is seen that optimal velocities increase significantly as the feeder pipe length increases. Optimal velocities also increase with an increase in the size of the development served. The increase associated with a change in length is more significant than for a change in AADD. Both these variations are accommodated in the determination of the optimal flow velocity, which would impact the sizing of the feeder pipes. The optimal velocities used in the determination are presented in Table 8.

Table 8: Optimal Velocity Determination (m/s)

		Single Feeder Pipe	Two pipes in parallel	Three pipes in parallel	Optimal Velocity Used
AADD = 20 l/s	1000 m	1.16	1.20	1.20	1.2
	25000 m	1.41	1.41	1.41	1.4
AADD = 80 l/s	1000 m	1.29	1.29	1.29	1.3
	25000 m	1.47	1.47	1.48	1.5
AADD = 160 l/s	1000 m	1.31	1.31	1.32	1.3
	25000 m	1.50	1.50	1.51	1.5
AADD = 240 l/s	1000 m	1.34	1.34	1.36	1.35
	25000 m	1.54	1.54	1.52	1.55

As described in Section 5.2.1, the source was simulated as a reservoir with a fixed head. The head was determined by ensuring the flow of 1.2 times the daily demand under seasonal conditions through the feeder pipe systems operating under optimal flow velocities. The calculation of the required head was done by assuming no secondary losses through the feeder pipe system and a Hazen Williams C-value of 140. The spreadsheet used in determining the hydraulic head is bound into Appendix N of this dissertation.

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No failures are simulated at interconnections between pipes laid in parallel.

5.2.3 Storage facilities

The only input concerning the storage facilities is the range of tank sizes to be considered during the analysis. As proposed by van Zyl *et al.* (2008), a failure rate of one in ten years under seasonal peak demand is a reasonable design value. The range of tank sizes specified for analysis was therefore chosen to ensure that tanks sizes with an associated failure rate of one in ten years was part of the analysis.

In accordance with the work done by van Zyl *et al.* (2008), the duration of simulation was selected to ensure a minimum of 2000 failures for the respective reservoir sizes representing a 1 in 10 year failure return period (FRT).

5.3 LAYOUTS CONSIDERED

It has been stated that reliability of a water supply systems depends on a number of factors, which includes the configuration of the layout. Ten different feeder pipe configurations are analysed in order to get a clear picture of the effect on reliability together with the associated cost when considering these variations. Previous studies such as those by van Zyl and Haarhoff (van Zyl & Haarhoff, 1999) have confirmed that the use of pipelines in parallel greatly increases the reliability of water supply systems. This has therefore been included as a variation which must be analysed.

A second way of increasing the reliability of a water supply system is the introduction of interconnection pipes between pipes laid in parallel (van Zyl and Haarhoff, 1999). The linking of the pipes with the appropriate addition of isolation valves makes it possible to isolate any part of the pipeline. This design makes it possible to isolate the section that has failed to avoid overall disruption of supply during the repair operations. The placing of interconnections between parallel pipes at varying intervals has therefore been included in the analysis.

With these design options in mind, the following layout configurations have been considered:

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Configuration 1

This configuration consists of a single feeder pipe connecting the source to the storage reservoir.

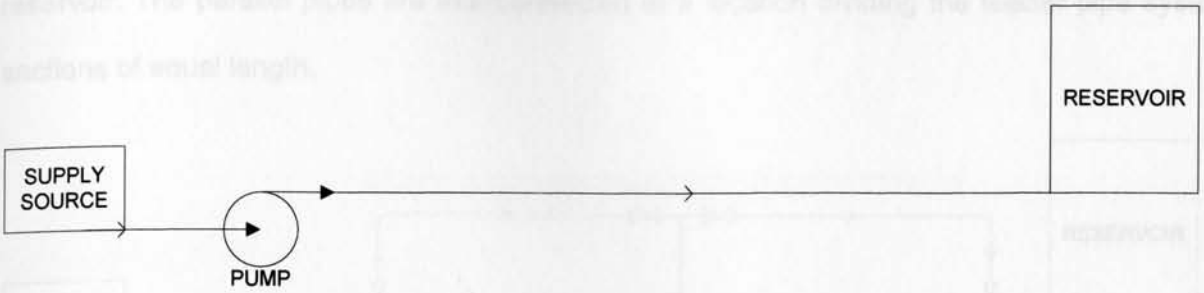

Figure 18: System Layout - Configuration 1

Configuration 2

This configuration consists of two feeder pipes in parallel connecting the source to the storage reservoir.

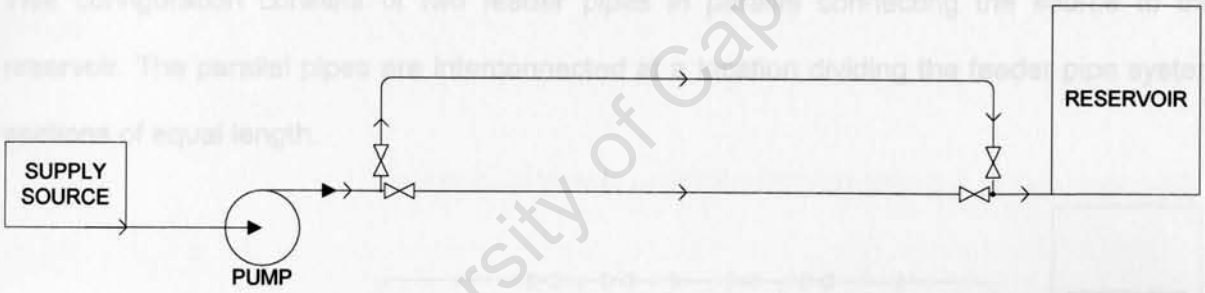

Figure 19: System Layout - Configuration 2

Configuration 3

This configuration consists of three feeder pipes in parallel connecting the source to the storage reservoir.

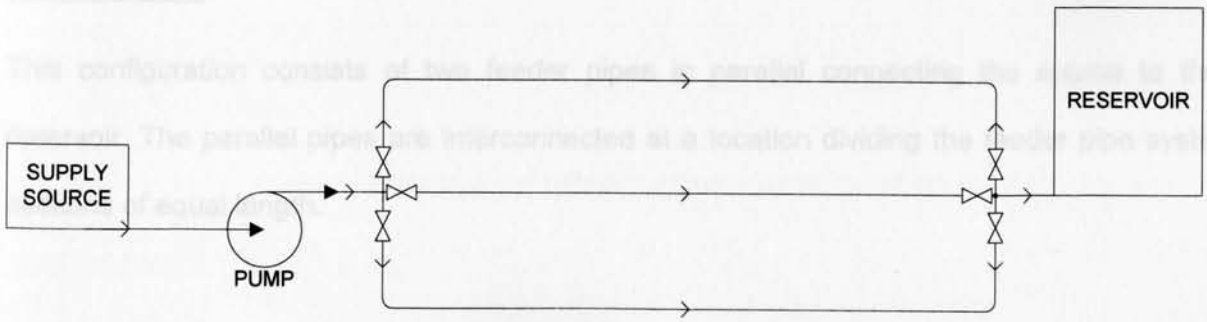

Figure 20: System Layout - Configuration 3

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Configuration 4

This configuration consists of two feeder pipes in parallel connecting the source to the storage reservoir. The parallel pipes are interconnected at a location dividing the feeder pipe system in two sections of equal length.

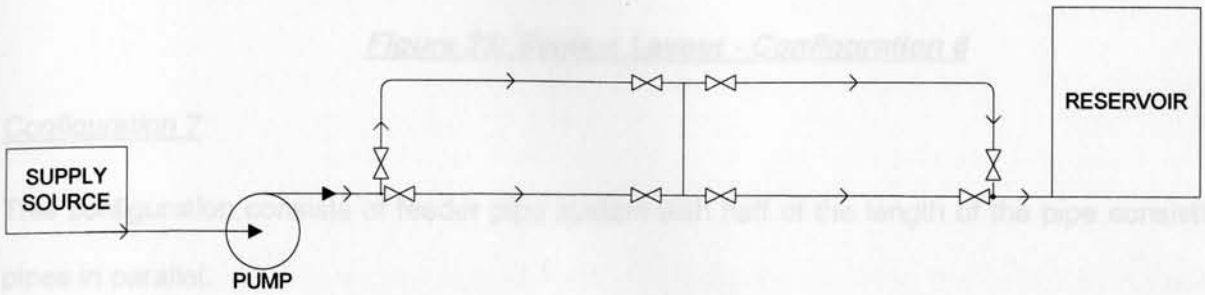

Figure 21: System Layout - Configuration 4

Configuration 5

This configuration consists of two feeder pipes in parallel connecting the source to the storage reservoir. The parallel pipes are interconnected at a location dividing the feeder pipe system in three sections of equal length.

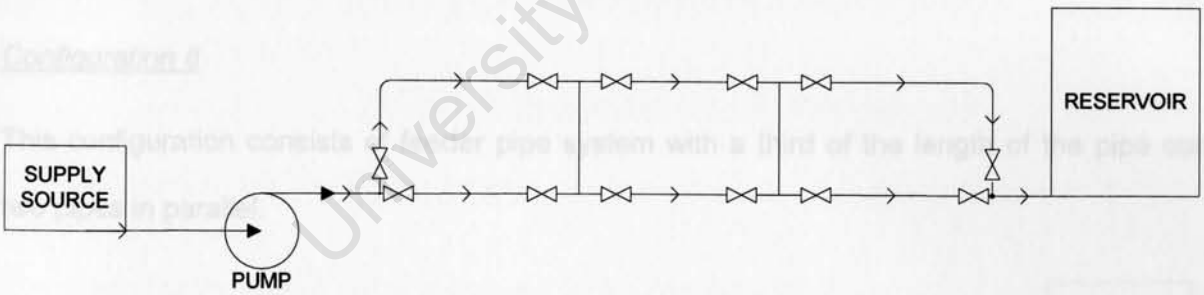

Figure 22: System Layout - Configuration 5

Configuration 6

This configuration consists of two feeder pipes in parallel connecting the source to the storage reservoir. The parallel pipes are interconnected at a location dividing the feeder pipe system in four sections of equal length.

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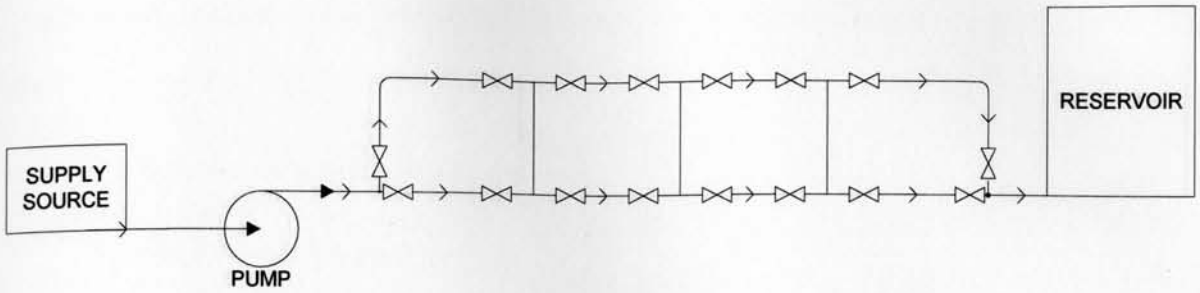

Figure 23: System Layout - Configuration 6

Configuration 7

This configuration consists of feeder pipe system with half of the length of the pipe consisting of two pipes in parallel.

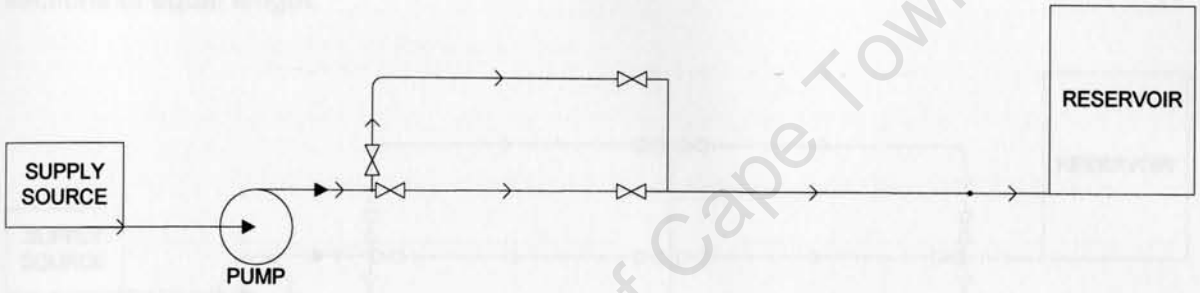

Figure 24: System Layout - Configuration 7

Configuration 8

This configuration consists of feeder pipe system with a third of the length of the pipe consisting of two pipes in parallel.

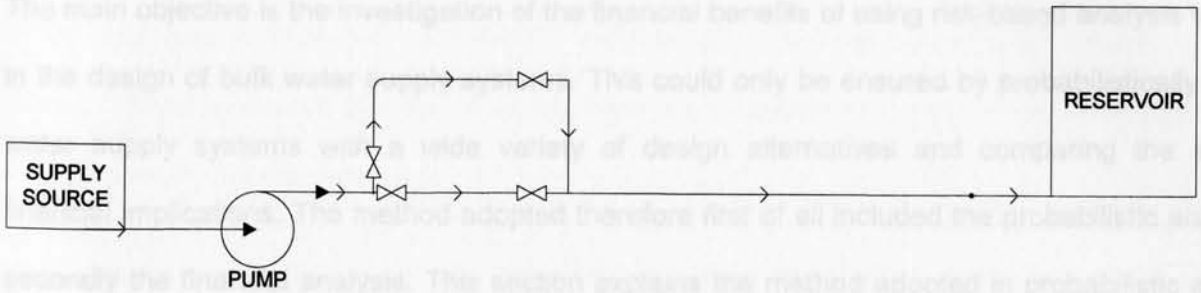

Figure 25: System Layout - Configuration 8

Configuration 9

This configuration consists of feeder pipe system with a quarter of the length of the pipe consisting of two pipes in parallel.

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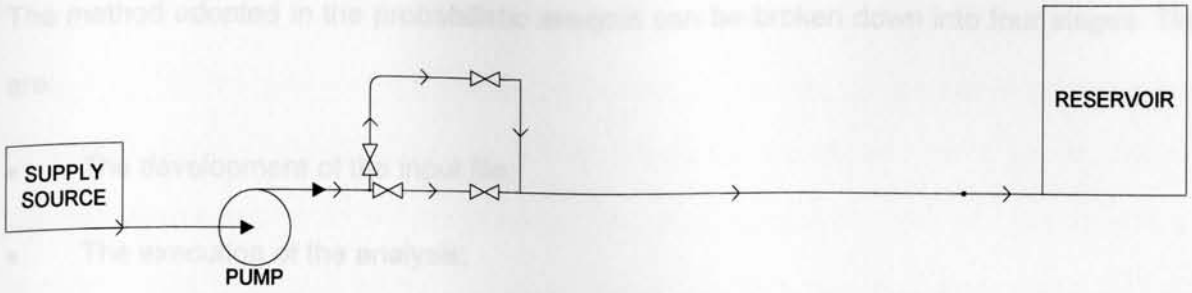

Figure 26: System Layout - Configuration 9

Configuration 10

This configuration consists of three feeder pipes in parallel connecting the source to the storage reservoir. The parallel pipes are interconnected at a location dividing the feeder pipe system in two sections of equal length.

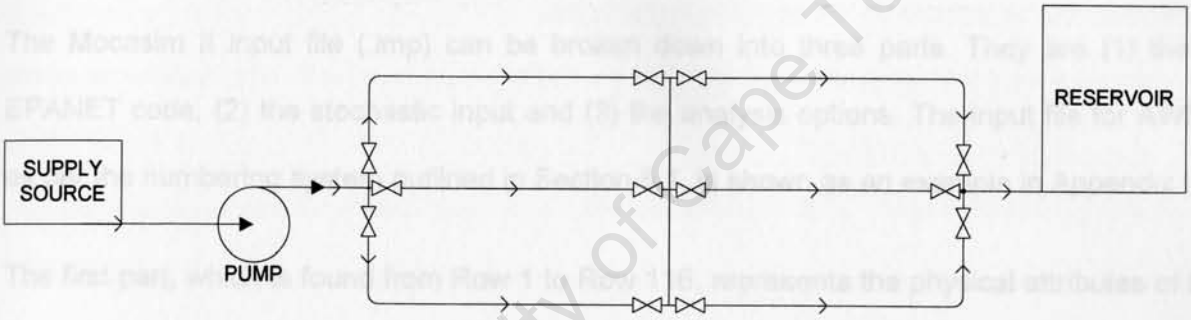

Figure 27: System Layout - Configuration 10

5.4 ANALYSIS METHODOLOGY

The main objective is the investigation of the financial benefits of using risk-based analysis techniques in the design of bulk water supply systems. This could only be ensured by probabilistically analysing water supply systems with a wide variety of design alternatives and comparing the associated financial implications. The method adopted therefore first of all included the probabilistic analysis and secondly the financial analysis. This section explains the method adopted in probabilistic analysis of the various water supply systems whilst Chapter 4 provides an explanation of the costing done. The variation in water supply systems is dealt with under Section 6.1 to ensure an easy to follow structure between the variations analysed and the results obtained and reported in the subsequent sections.

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The method adopted in the probabilistic analysis can be broken down into four stages. These stages are:

- The development of the input file;
- The execution of the analysis;
- The receipt of the output file; and
- The analysis of the output file.

The four stages are discussed below to provide a thorough understanding of the methodology adopted during this study.

5.4.1 The Development of the Input File

The Mocasim II input file (.imp) can be broken down into three parts. They are (1) the system in EPANET code, (2) the stochastic input and (3) the analysis options. The input file for AWSS 2.1.1.1, as per the numbering system outlined in Section 5.1, is shown as an example in Appendix L1.

The first part, which is found from Row 1 to Row 116, represents the physical attributes of the system under consideration as well as the demand patterns which the system are subjected to. The system under consideration can therefore first be developed in EPANET and analysed to ensure that the system is accurately represented before being exported to a ".net" file which can be copied into the input file. An input model was therefore developed for all the various water supply system which had to be analysed. Analysis of the EPANET models confirmed the correct input criteria such as the pressure head to ensure that the capacity of the feeder pipe with the pre-determined pipe diameters was as specified in Section 5.2.2.

The second part of the input file, which is found from Row 117 to Row 143 in the explanatory example in Appendix L1, represents the stochastic input of the bulk water supply system. The nature of the input has been discussed in Section 3.1.2 and the specific input data is provided in Section 6.1 of this dissertation. The stochastic input, as previously explained, represents the random nature of the consumer demand, fire demand and pipe failures which would be occurring over the analysis period.

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The third part of the input file, which is found from Row 144 to Row 169, represents the analysis options which the simulation must accommodate. The first option specifies the duration of the simulation. It has been explained in Section 3.2 that previous work done by van Zyl *et al.* (2008) indicated that a simulation which results in a minimum number of 2000 failures provides a sufficiently accurate result. The same article also states that a bulk water supply system with a FRT of 1 failure in 10 years under seasonal peak conditions is regarded of sufficient reliability for a water service provider. With this in mind it was concluded that a simulation run should have a duration of 8 000 000 days, which is slightly more than 20 000 years. The tank size which would represent a system FRT of 1 failure in 10 years would therefore have more than 2000 failures and in doing, yield reliable results.

Two other important analysis inputs are to indicate the infrastructure component to be analysed and the range of sizes which must be included in the analysis. As discussed earlier, the water supply systems analysed for the purpose of this study all consists of a single source, a feeder pipe system and a single storage reservoir. The sizing of the source and feeder supply is done using deterministic methods with the reservoir size determined probabilistically. The "TANK" is therefore selected as the component (Row 187) to be analysed and a range of sizes is provided. The range of sizes is indicated by providing a minimum size (Row 188), an incremental size (Row 190 and Row 191) and a maximum size (Row 189). The range of reservoir capacities which is analysed depends on the simulation time involved and the confidence that the reservoir size that would result in a FRT of 1 in 10 years is also analysed. The example shown in Appendix L1 specified reservoir size ranging from 144 kl to 1728 kl in increments of 144 kl. The maximum and minimum capacities represented 2 hr and 24 hr of the associated daily demand under seasonal peak conditions respectively.

Analysis options which won't be discussed in detail deals with the provision of the flow and failure characteristic within link and nodes in the system. This is a useful feature which can be used to analyse the performance of other components in the bulk water supply system.

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5.4.2 Execution of the Analysis

The execution of the analysis is done merely by clicking on an execution (.exe) file which initiates the Mocasim II analysis. The duration of the analyses depends greatly on the duration specified as analysis option and the complexity of the system. The analyses executed during this study ranged from one to three hours per analysis using a 1.8GHz Intel Celeron Dual Core processer.

5.4.3 The Receipt of the Output File

Upon completion of the analysis an output file (.out) is generated by the Mocasim II software. The result follow the format as specified in the "analysis options" of the input file. An example of the output file is shown in Appendix L2. This output file is the results generated with the execution of the input file in Appendix L2. As seen in Row 3 to Row 15 a summary of the system failures is given by first of all indicating the number of failures experienced by the system through the specified range of reservoir sizes accommodated. The average, standard deviation, minimum and maximum of the failure durations are also provided. The results are therefore presented statistically and can be analysed further. During this study it was mostly the results provided in Row 3 to 15 which are analysed as discussed below. The output provided in the rest of the file is mainly data on flow and failure events within link and nodes in the system. These outputs are not used in the analysis of the results.

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The example provided in Appendix L2 is used in the next paragraph to discuss the analysis of the output and how the results are forwarded to the graphical presentations and the costing of the water supply systems.

5.4.4 The Analysis of the Output File

The output file provides a number of characteristics of the failures which are recorded during the simulation period. It also provides this over a range of reservoir sizes for each water supply system under consideration. These statistical results are analysed to provide a presentation of the reliability of the system.

As stated previously the results given in Row 3 to Row 15 of the output file (Appendix L1) are used to do this analysis. The first failure characteristic that is given is the total number of failures experienced over the simulation period (Column 4 in Table 9). This is divided by the simulation period to obtain a

figure of the average number of failures per year (Column 5 in Table 9). This study relies on the comparison of the various systems with each other in terms of reliability. By taking the inverse of the average number of failures per year the reliability of the system is expressed in terms of a FRT (Column 6 in Table 9). This figure indicates the average number of years which will elapse between failures. It has been stated previously that a FRT of 1 in 10 years is deemed acceptable under the demand conditions utilized during this study. The reservoir size that would represent a FRT of 1 in 10 years is therefore identified and forwarded to the cost analysis. The identification of this reservoir size is explained in more detail below. The results of the example used during this chapter are once again shown to explain the analysis discussed above. Columns 1 and 4 in Table 9 represent results which have been generated and provided in Row 3 to Row 15 of the output file (Appendix L2).

Table 9: Analysis of Output file - No of Failures

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Capacity			No of Failures	Failure/a	FRT (1: # years)
(kl)	Hours of Daily Demand under Seasonal Peak (DD)	Hours of AADD			
1728	2	2.5	5606756	255.808	0.004
3456	4	5	2137829	97.538	0.010
5184	6	7.5	797101	36.368	0.027
6912	8	10	320913	14.642	0.068
8640	10	12.5	127356	5.811	0.172
10368	12	15	50393	2.299	0.435
12096	14	17.5	20099	0.917	1.090
13824	16	20	8354	0.381	2.624
15552	18	22.5	3653	0.167	6.000
17280	20	25	1590	0.073	13.785
19008	22	27.5	751	0.034	29.185
20736	24	30	391	0.018	56.056

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It has been mentioned that the input file specified the range of reservoir sizes to be in increments representing 2 hours of the daily demand under seasonal peak conditions. This is indicated in Column 2 of Table 9. In the analysis it was evident that it would be more meaningful to present the reservoir size in terms of the AADD. Direct comparison is then possible between obtained reservoir size through reliability analysis and reservoir sizes specified by Red Book standards.

A graphical presentation of the FRT for AWSS 4.4.1.1 is shown in Figure 28. The exponential nature of the curve should be noted. It indicates that a small increase in reservoir size result in a large increase in system reliability when FRT's of 1 in 10 years is exceeded. For the purpose of the study it was imperative to find the most accurate point which would indicate the reservoir size for a 1 in 10 year FRT. The line drawn through the data points as presented in Figure 28 is a "guestimate" executed by the Excel software by drawing a curved line through all the data points. Three methods are considered to identify the applicable reservoir size. Firstly a "trend line" was drawn through all the points using an equation of the form: $y = me^x$, with "m" being a constant coefficient. The "trend line" is indicated in Figure 30, which shows the area on the graph that this study is concerned with. Secondly, a linear interpolation was done between the two adjacent data points nearest to the location on the graph intersecting the 1 in 10 year FRT. This point is indicated with a green triangle in Figure 30. The third alternative method was identified whilst observing that, when the y-axis is drawn using a logarithmic scale, the data points follow approximately a linear pattern. This is indicated in Figure 29. It was found that a linear interpolation between the logarithms of the two adjacent points yield a much more accurate result compared to the other two methods. The results of the three methods are indicated in Figure 30. Whilst the "trend line" method and the " linear interpolation" method intersect the 1 in 10 year FRT some distance from the red "curved excel line", the result of the third method (log-interpolation) presents a very accurate result. This method has therefore been used throughout the study to determine the reservoir sizes representing a 1 in 10 year FRT of the bulk water supply systems.

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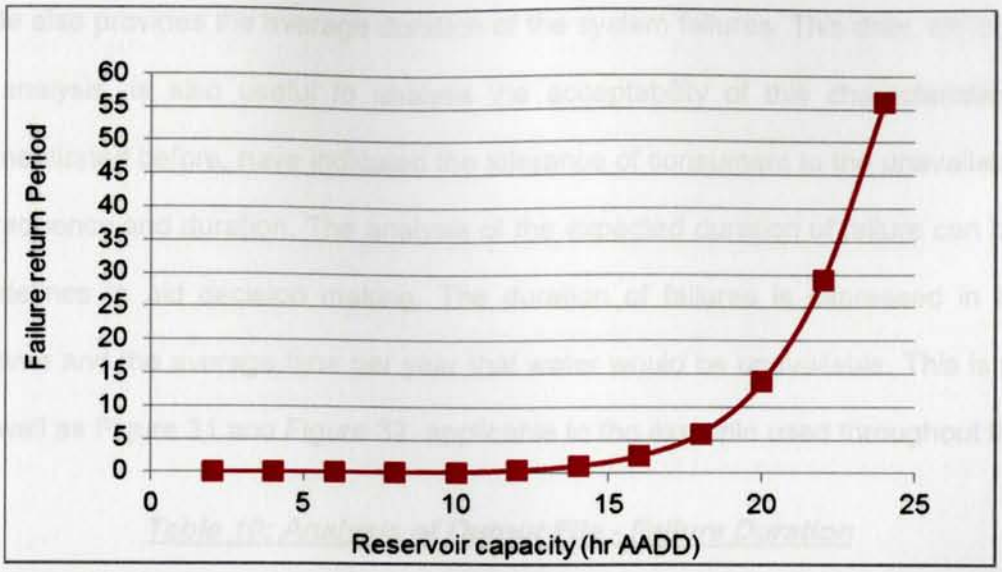

Figure 28: AWSS 4.4.1.1 - FRT vs Reservoir Capacity (Y-axis: Normal scale)

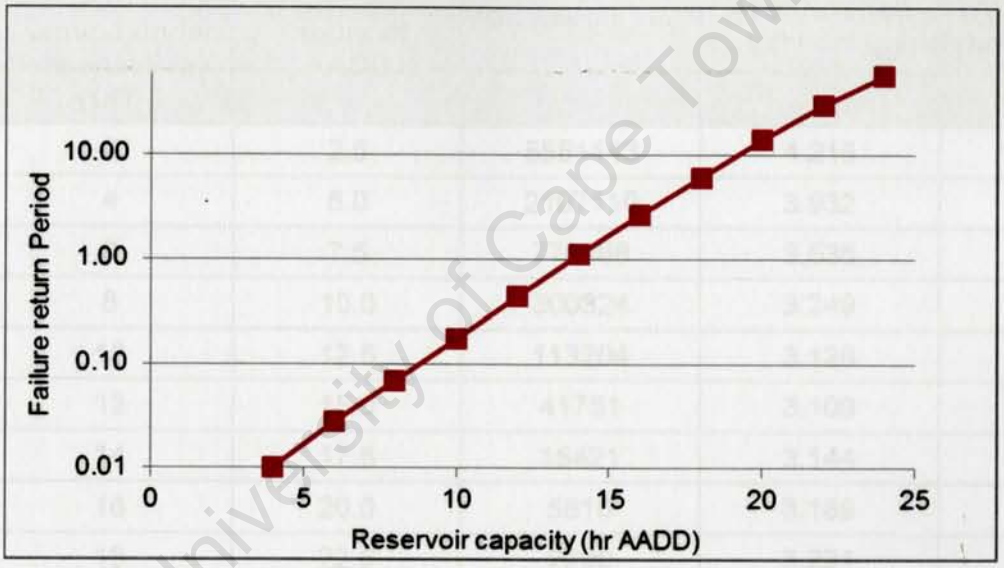

Figure 29: AWSS4.4.1.1 - FRT vs Reservoir Capacity (Y-axis: Log scale)

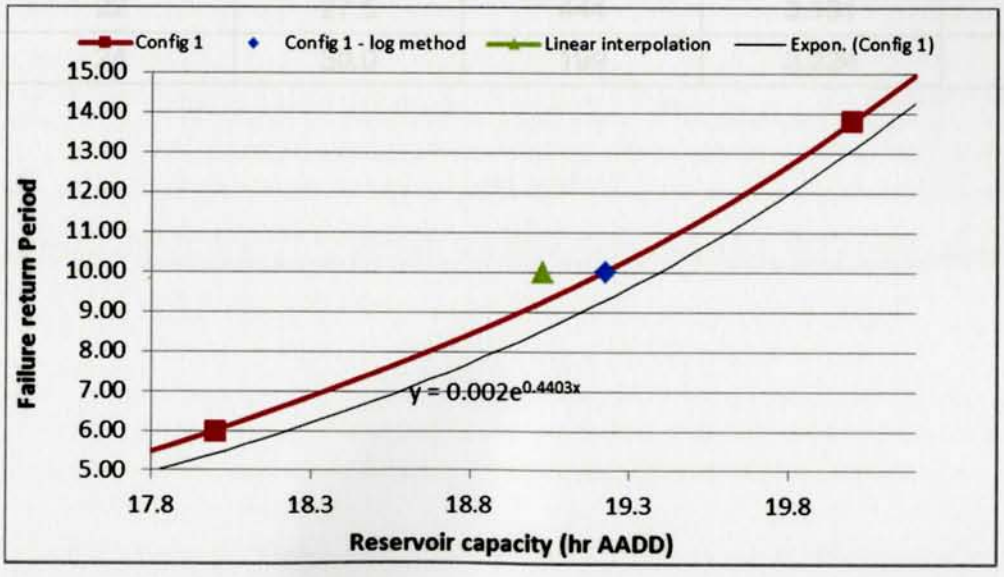

Figure 30: AWSS 4.4.1.1 - FRT vs. Reservoir Capacity-Results of 3 Methods

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The output file also provides the average duration of the system failures. This data, although not used in the cost analysis, is also useful to analyse the acceptability of this characteristic. Population surveys, as mentioned before, have indicated the tolerance of consumers to the unavailability of water in terms of frequency and duration. The analysis of the expected duration of failure can be compared to these guidelines to aid decision making. The duration of failures is expressed in terms of the average fail time and the average time per year that water would be unavailable. This is presented in Table 10 as well as Figure 31 and Figure 32, applicable to the example used throughout this chapter.

Table 10: Analysis of Output File - Failure Duration

Capacity			No of Failures	Ave Duration (hours)	Ave fail time (hours/annum)
(kl)	Hours of Daily Demand under Seasonal Peak (DD)	Hours of AADD			
144	2	2.5	5581143	4.215	1073.245
288	4	5.0	2107110	3.932	377.975
432	6	7.5	770468	3.535	124.258
576	8	10.0	300324	3.249	44.522
720	10	12.5	113204	3.128	16.155
864	12	15.0	41751	3.109	5.922
1008	14	17.5	15421	3.144	2.212
1152	16	20.0	5810	3.169	0.840
1296	18	22.5	2290	3.221	0.337
1440	20	25.0	992	3.205	0.145
1584	22	27.5	444	3.151	0.064
1728	24	30.0	199	3.224	0.029

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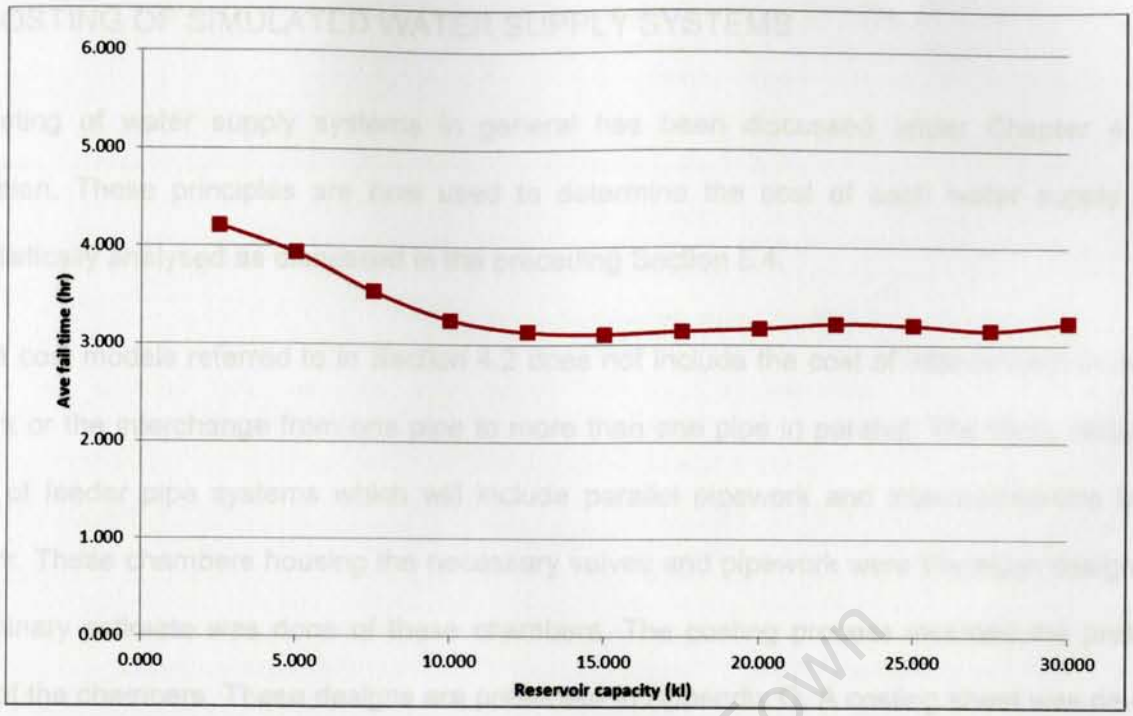

Figure 31: AWSS 2.1.1.1 - Average fail time (hr) vs. Reservoir capacity

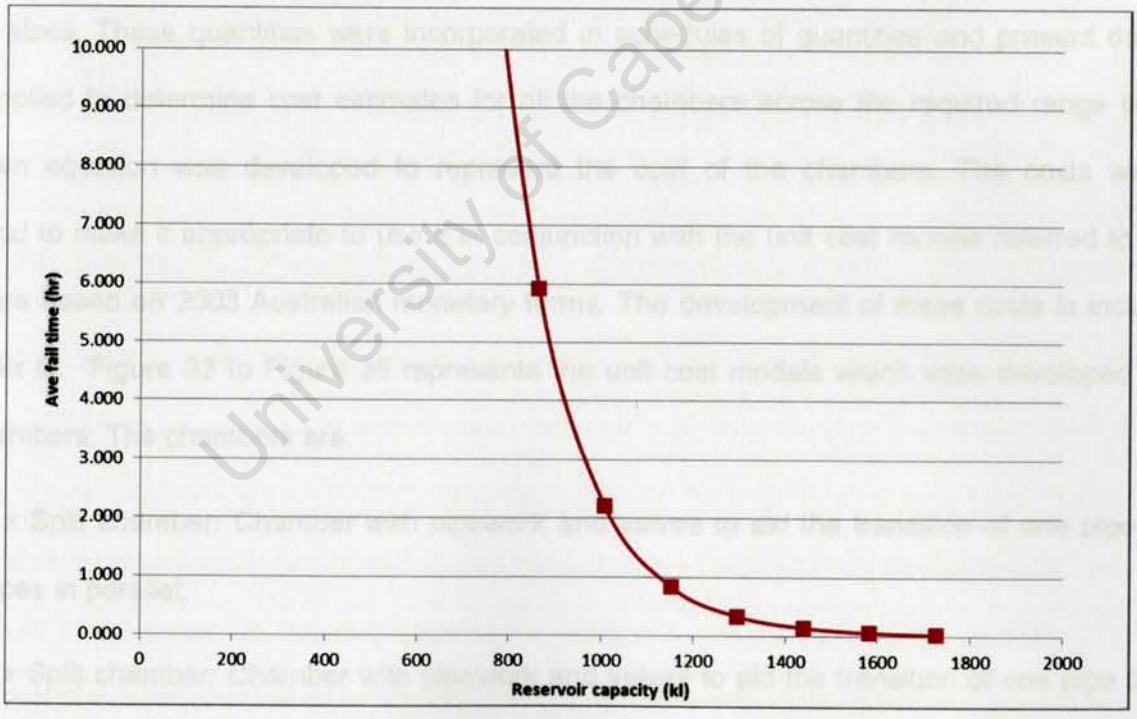

Figure 32: AWSS 2.1.1.1 - Average fail time (hr/annum) vs. Reservoir capacity

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5.5 COSTING OF SIMULATED WATER SUPPLY SYSTEMS

The costing of water supply systems in general has been discussed under Chapter 4 of this dissertation. These principles are now used to determine the cost of each water supply system probabilistically analysed as discussed in the preceding Section 5.4.

The unit cost models referred to in Section 4.2 does not include the cost of interconnection between pipework or the interchange from one pipe to more than one pipe in parallel. The study requires the costing of feeder pipe systems which will include parallel pipework and interconnections between pipework. These chambers housing the necessary valves and pipework were therefore designed and a preliminary estimate was done of these chambers. The costing process included the preliminary design of the chambers. These designs are presented in Appendix O. A costing sheet was developed to determine the size and associated material requirements for the chambers accommodating a range of pipe sizes. These quantities were incorporated in schedules of quantities and present day rates were applied to determine cost estimates for all the chambers across the required range of sizes. Lastly an equation was developed to represent the cost of the chambers. The costs were de-escalated to make it appropriate to use it in conjunction with the unit cost models referred to above, which are based on 2003 Australian monetary terms. The development of these costs is included in Appendix O. Figure 33 to Figure 36 represents the unit cost models which were developed for the four chambers. The chambers are:

- 2 x Split chamber: Chamber with pipework and valves to aid the transition of one pipe to two pipes in parallel;
- 3 x Split chamber: Chamber with pipework and valves to aid the transition of one pipe to three pipes in parallel;
- 2 pipe Interconnection: Chamber with pipework and valves to aid the interconnection of two parallel pipes; and
- 3 pipe Interconnection: Chamber with pipework and valves to aid the interconnection of three parallel pipes.

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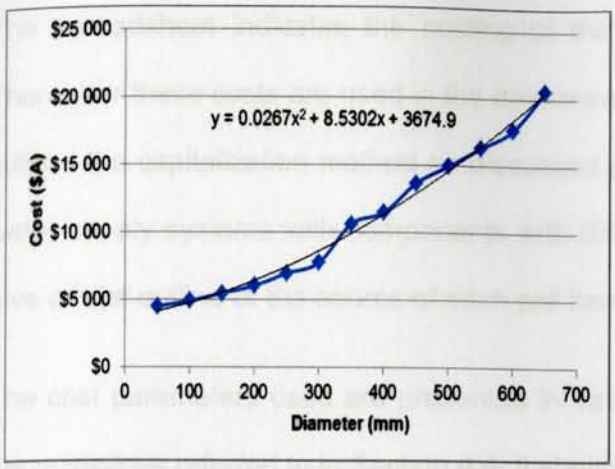

Figure 33: Unit Model - 2 x Split Chamber

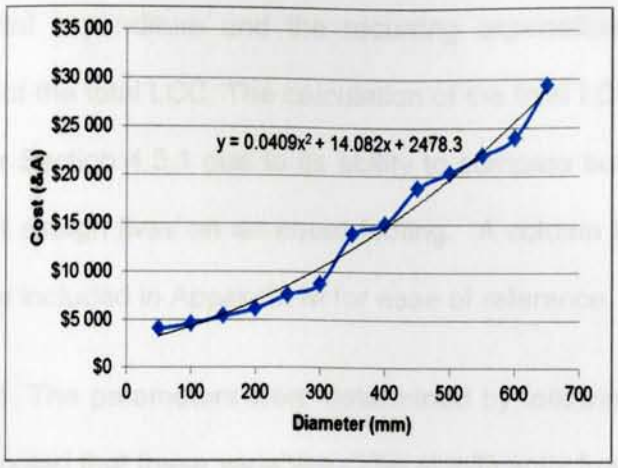

Figure 34: Unit Model - 3 x Split Chamber

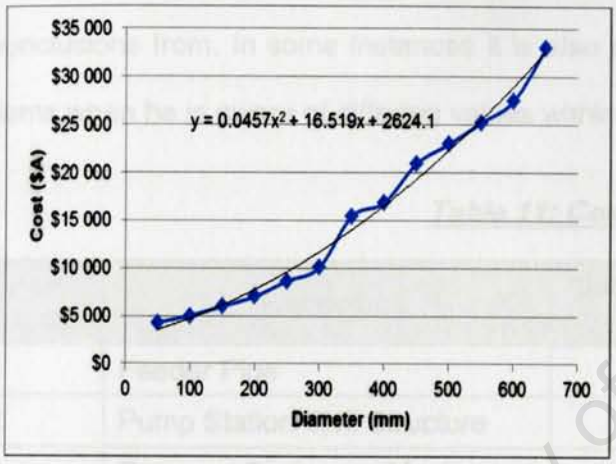

Figure 35: Unit Model - 2 Pipe Interconnection

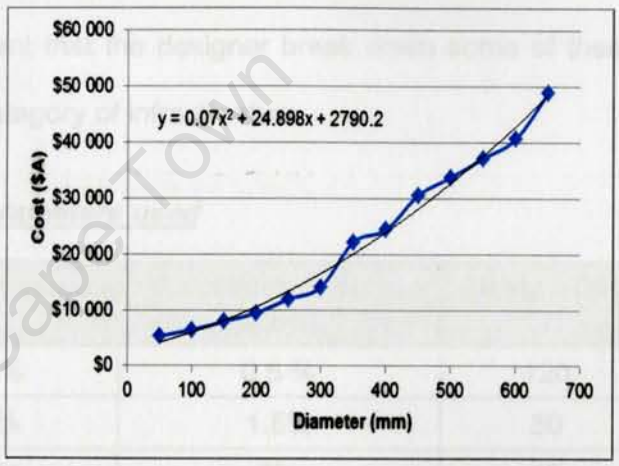

Figure 36: Unit Model - 3 Pipe Interconnection

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The costing of the water supply systems are executed by developing a spreadsheet that would incorporate all the required input and provide the total LCC in a consistent manner. Two important considerations are incorporated in the design of a spreadsheet for this study. Firstly, the number of inputs required to calculate the estimated cost was kept to a minimum and secondly, unit cost models are utilized which would be representative of the expected cost across a range of design capacities. This spreadsheet provides an easy way to incorporate the results into tables and graphs to allow for the recognition of emerging trends and to assist the analysis of data.

An example of the spreadsheet used to determine the LCC is shown in Appendix M. The spreadsheet are broken down into 3 main sections namely (1) Input Parameters, (2) Infrastructure Sizing and (3) Costing.

The spreadsheet indicates the costing of the capital expenditure and the recurring expenditure. Thereafter these costs are used in the determination of the total LCC. The calculation of the total LCC utilizes the capitalization method as discussed under Section 4.3.1 due to its ability to compare bulk water supply systems with components with different design lives on an equal footing. A column to give a brief outline of the source of each cell has been included in Appendix M for ease of reference.

The cost parameters used are presented in Table 11. The parameters were determined by following the guidelines referred to in Section 4.4. It should be noted that these variables differ significantly from one locale to the next and that the results and the sensitivity analysis provide a base to draw conclusions from. In some instances it is also prudent that the designer break down some of these items when he is aware of differing values within a category of infrastructure.

Table 11: Cost Parameters used

Item no.	Description	Salvage value (a)	Maintenance factor (ß)	Design Life (T)
1	Feeder Pipe	15%	0.5 %	120
2	Pump Station Civil Structure	5 %	1.5%	50
3	Pump Station Mechanical Equipment	20%	3%	15
4	Concrete Reservoir	0 %	1.5%	120

The electrical tariff structure used during the LCC analysis had to bear relation to the unit cost models used to calculate the capital expenditure. The average electricity tariff as found in the work done by Gibbs *et al.* (2010) was found to be 4.05 c/kWh and it was de-escalated to 2003 using the CPI index applicable to Sydney as published by the Australian Bureau of Statistics on a quarterly basis. The de-escalated electricity tariff that was used in this study was 3.9 c/kWh.

A calculation of each alternative water supply system was done using this spreadsheet template. The results are then forwarded to representative table and graphs used in the discussion of the results (Section 6.2).

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Apart from the variations in the input models of the bulk water supply systems, it was also deemed important to investigate variation in the other criteria such as the prevailing discount rate, electricity tariff, salvage cost and even static head of the system. The spreadsheet shown in Appendix M assisted this process due to the ease of changing any of these variables and forwarding the results to summary tables. The following variations are evaluated:

- Increase in electricity (300%);
- Lowering of Discount Rate from 4% to 2%;
- Addition of static hydraulic head (0.5 % & 2% slope); and
- Removal of salvage cost of material from analysis.

The results of these variations are reported in Section 6.2 of this dissertation.

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CHAPTER 6: APPLICATION OF RISK-BASED ANALYSIS

6.1 SYSTEM DESCRIPTION

6.1.1 Variations Analysed

The layout of the system has been described in a previous chapter of this dissertation. This section will describe the input parameters for the demands and failure rates imposed on the system. These variable characteristics have been discussed and have been referred to by addressing the following three characteristics:

- User demand characteristics;
- Fire demand characteristics; and
- Pipe failure characteristics.

It is therefore necessary to ensure that variations analysed include variation in all three of these input criteria. And furthermore it is important to evaluate these variations in isolation of each other. For these reasons four rounds of analysis was performed. The first round of analysis is considered to be the "base" analysis. The following three rounds of analyses include variation in demand pattern, fire frequency and pipe failure frequency respectively. This ensures that the variation in the three characteristic conditions experienced and referred to above are considered.

The "base analysis", as a first round of analysis, refers to a bulk water supply system with characteristics similar to that which a bulk water supply system in an urban setting will experience was described by the input parameters. The analyses forming part of the first round of analysis are all represented by the number "2" as first digit according to the numbering system that was introduced in Section 5.1 of this dissertation. The input data of the first round of analysis is provided in Section 6.1.2 of this dissertation.

The analyses forming part of the second round of analysis, the input of which is described under Section 6.1.3, are represented by the digit "1" as first digit of the analysis numbering system. The only difference between the two sets of analyses is the hourly demand peak factors which are used, with the second round of analyses having lower demand peaks.

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The analyses forming part of the third round of analysis are described in Section 6.1.4 and involve the use of a higher fire frequency. The other input criteria are identical to the input criteria of the "base" analysis. These analyses are all represented by the digit "3" as first digit of the numbering system.

The analyses forming part of the fourth round of analysis are described in Section 6.1.5 and involve the use of a higher pipe failure rate. The other input criteria are once again identical to the input criteria of the "base" analysis. These analyses are all represented by the digit "4" as first digit of the numbering system.

It is therefore evident that a large number of simulations were subjected to risk-based analysis. Based on (1) the consideration factors stated in Section 5.1, (2) the different configurations outlined in Section 5.3 and (3) the elaboration of the variations in stochastic input considered, Table 12 presents a summary of all the simulations analysed during this study. A total of 320 simulations have therefore been analysed from which a good indication was received of trends that emerge in the comparison of the results of the various simulations. In this dissertation the following terminology are used in the discussion of simulations:

- "Series #" - All simulations with the same stochastic input represented by the first digit according to the numbering system;
- "Series #.#" - All simulations with the same stochastic input and size of development (DD) represented by the first digit and second digit according to the numbering system; and
- "Series #.#.#" - All simulations with the same stochastic input, size of development (DD) and length of feeder pipe as represented by the first, second and third digit according to the numbering system;

Table 12: Summary of all simulations analysed

Simulation numbers	Stochastic Input	DD (l/s)	Length (m)	# of simulations)
2.1.1.1 to 2.1.1.10	Base Analysis	20	1000	10
2.1.2.1 to 2.1.2.10	Base Analysis	20	5000	10
2.1.3.1 to 2.1.3.10	Base Analysis	20	10000	10
2.1.4.1 to 2.1.4.10	Base Analysis	20	25000	10

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Simulation numbers	Stochastic input	DD (l/s)	Length (m)	# of simulations)
2.2.1.1 to 2.2.1.10	Base Analysis	80	1000	10
2.2.2.1 to 2.2.2.10	Base Analysis	80	5000	10
2.2.3.1 to 2.2.3.10	Base Analysis	80	10000	10
2.2.4.1 to 2.2.4.10	Base Analysis	80	25000	10
2.3.1.1 to 2.3.1.10	Base Analysis	160	1000	10
2.3.2.1 to 2.3.2.10	Base Analysis	160	5000	10
2.3.3.1 to 2.3.3.10	Base Analysis	160	10000	10
2.3.4.1 to 2.3.4.10	Base Analysis	160	25000	10
2.4.1.1 to 2.4.1.10	Base Analysis	240	1000	10
2.4.2.1 to 2.4.2.10	Base Analysis	240	5000	10
2.4.3.1 to 2.4.3.10	Base Analysis	240	10000	10
2.4.4.1 to 2.4.4.10	Base Analysis	240	25000	10
1.2.1.1 to 1.2.1.10	Flatter Demand Pattern	80	1000	10
1.2.2.1 to 1.2.2.10	Flatter Demand Pattern	80	5000	10
1.2.3.1 to 1.2.3.10	Flatter Demand Pattern	80	10000	10
1.2.4.1 to 1.2.4.10	Flatter Demand Pattern	80	25000	10
1.4.1.1 to 1.4.1.10	Flatter Demand Pattern	240	1000	10
1.4.2.1 to 1.4.2.10	Flatter Demand Pattern	240	5000	10
1.4.3.1 to 1.4.3.10	Flatter Demand Pattern	240	10000	10
1.4.4.1 to 1.4.4.10	Flatter Demand Pattern	240	25000	10
3.1.1.1 to 3.1.1.10	Higher Fire Rate	20	1000	10
3.1.4.1 to 3.1.4.10	Higher Fire Rate	20	25000	10
3.4.1.1 to 3.4.1.10	Higher Fire Rate	240	1000	10
3.4.4.1 to 3.4.4.10	Higher Fire Rate	240	25000	10
4.1.1.1 to 4.1.1.10	Higher Pipe Failure Rate	20	1000	10
4.1.4.1 to 4.1.4.10	Higher Pipe Failure Rate	20	25000	10
4.4.1.1 to 4.4.1.10	Higher Pipe Failure Rate	240	1000	10
4.4.4.1 to 4.4.4.10	Higher Pipe Failure Rate	240	25000	10

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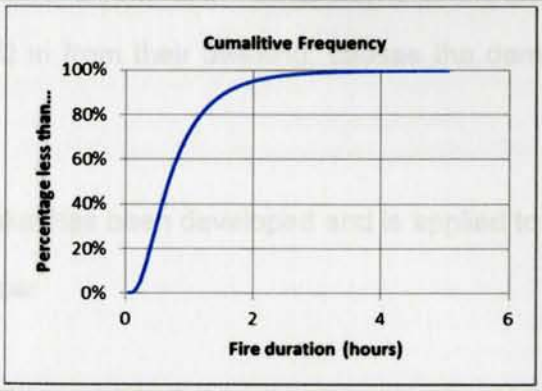
6.1.2 Water Supply System: Base Analysis

The input of the system used as the "base" analysis has been taken directly from a study performed by van Zyl *et al.* (2008), which has been discussed previously. The study investigated the implications of sizing municipal storage tanks using reliability analysis techniques. The input data, in terms of the three types pointed out above, will be described as documented by van Zyl *et al.* (2008).

The input is summarized in Table 13 below. The input such as the hourly and week-of-the-day demand factors which were not published was obtained from the author and is also shown in Table 13.

Table 13: Input for "Urban" Water Supply System

Water Demand													
Hourly peak factors	Hour	1	2	3	4	5	6	7	8	9	10	11	12
	PF	0.44	0.39	0.38	0.41	0.45	0.52	0.77	1.05	1.34	1.47	1.49	1.47
	Hour	13	14	15	16	17	18	19	20	21	22	23	24
	PF	1.43	1.41	1.21	1.12	1.16	1.25	1.32	1.36	1.26	0.97	0.78	0.55
Day of the Week peak Factors	Day						1	2	3	4	5	6	7
	Peak factor						1.01	0.93	0.94	0.94	0.98	1.14	1.06
Daily Random distribution: Type							Lognormal						
Daily Random distribution: Mean							1						
Daily Random distribution: Standard deviation							0.068 (logarithm of value)						
Daily Autocorrelation: Number of days lag							1						
Daily Autocorrelation: Number							0.12						
Diurnal Random distribution: Type							Lognormal						
Diurnal Random distribution: Mean							1						
Diurnal Random distribution: Standard deviation							0.13 (logarithm of value)						
Diurnal Autocorrelation: Number of hours lag							1						
Diurnal Autocorrelation: Number							0.7						
Fire Characteristics													
Fire Rate (fires/annum)							6						
Fire duration: Distribution Type							Lognormal						
Fire duration: Mean (hrs)							-0.393 (logarithm of value)						
Fire duration: Standard deviation (hrs)							0.66 (logarithm of value)						
Cumulative Frequency Plot: Fire duration													
Fire flow: Distribution Type							Lognormal						
Fire flow: Mean (l/s)							1.31 (logarithm of value)						

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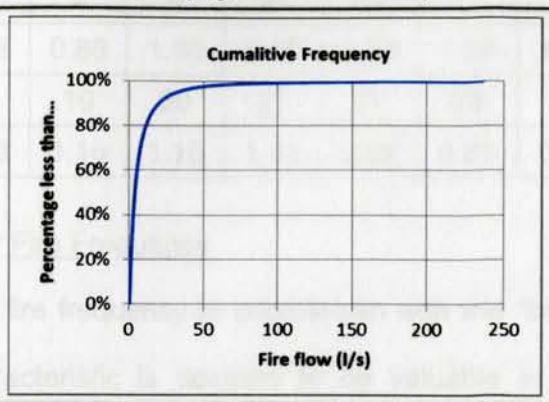
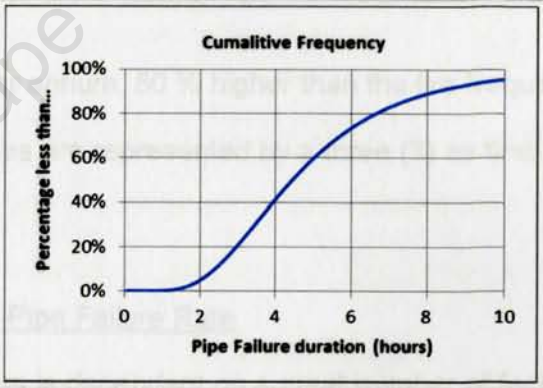
Fire flow: Standard deviation (l/s)	1.31 (logarithm of value)
Cumulative Frequency Plot: Fire flow	
Pipe Failure Characteristics	
Failure Rate (failures/km/a)	2
Pipe Failure duration: Distribution Type	Lognormal
Pipe Failure duration: Mean (hrs)	1.49 (logarithm of value)
Pipe Failure duration: Standard deviation (hrs)	0.48 (logarithm of value)
Cumulative Frequency Plot: Pipe Failure Duration	

6.1.3 Variation 1: Water Supply System with a Flatter Demand Pattern

The variation in consumer demand pattern is applied as it is known that demand patterns between urban and rural areas differ (Haarhoff *et al.*, 1999). This is attributed to the fact that the point of supply is different than in urban settings in that standpipes are often used. This change, where consumers often uses containers to fetch water as far away as 200 m from their dwelling, causes the demand pattern to flatten considerably.

An arbitrary demand pattern, with substantially lower peaks, has been developed and is applied to the model. These peak factors are indicated in Table 14 below:

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Table 14: Demand Pattern - Round 2 Analysis (First digit = "1")

Hourly peak factors	Hour	1	2	3	4	5	6	7	8	9	10	11	12
	PF	0.71	0.69	0.68	0.7	0.72	0.76	0.88	1.03	1.17	1.24	1.25	1.24
	Hour	13	14	15	16	17	18	19	20	21	22	23	24
	PF	1.22	1.21	1.11	1.06	1.08	1.13	1.16	1.18	1.13	0.98	0.89	0.77

6.1.4 Variation 2: Water Supply System with a Higher Fire Frequency

The third round of analyses involved a variation in the fire frequency in comparison with the "base" input. As stated previously, variation in the fire characteristic is deemed to be valuable in the evaluation of the effect of various different inputs. In the absence of available information such as statistical surveys, it is likely that fire frequency could be dependent on a number of factors, among which the type of energy used for cooking. It is anticipated that the use of open fires and/ or gas could substantially affect the number of fires experienced in a residential development.

For the purpose of the study a fire frequency of 9 fires per annum, 50 % higher than the fire frequency used in the "base" analyses, was adopted. These analyses are represented by a three (3) as first digit using the numbering system employed.

6.1.5 Variation 3: Water Supply System with a Higher Pipe Failure Rate

The pipe failure rate experienced in a water supply system is dependent on a great number of factors. This has been discussed in detail in Section 3.1.2 of this dissertation. It is therefore evident that significant variation could be expected dependent on factors such as the pipe material, age of pipe, workmanship and even the area of installation.

The model adopted in the first round of analysis utilized a pipe failure frequency of 2 breaks/km/annum, which is considered quite high based on historical data. This failure rate has been doubled to 4 breaks/km/annum for the fourth round of analysis. These analyses are represented by a four (4) as first digit using the numbering system employed.

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6.2 RESULTS AND INTERPRETATION

6.2.1 Introduction to Presentation of Results

The preceding sections of this dissertation described the principles of utilizing risk based design methods and the apparent advantages which has been identified from previous studies. It furthermore recalled the need expressed in previous studies to quantify the financial implications associated with using risk-based methods. The methodology outlined in Chapter 5 was applied in the probabilistic analysis of the various bulk water supply systems. These bulk water supply systems are subjected to the conditions described by the input data and reservoir sizes are obtained which would result in a failure return period (FRT) of 1 in 10 years. The financial expenditure, both in terms of expected capital and annual expenditure, was coupled to the analysed bulk water supply systems. This section reports on the results that are obtained from the probabilistic analysis which determined the reservoir sizes, as well as the financial implications as determined through costs estimation.

This section will first present the results obtained from the risk-based analysis. The number of variations analysed provides a good indication of trends which emerge when comparisons are made. The reporting of these results provides a good basis from where to continue with the presentation of financial results.

The presentation of the determined reservoir sizes is made by describing the relationship between the different variations and also by comparing the results with reservoir size determination using deterministic guidelines (DG). The following order is applied to the presentation of results:

- All results are presented and ranked according to size;
- The determined sizes are compared to "Red Book" Guidelines;
- The effect of variation in AADD is shown;
- The effect of variation in length of feeder pipe is shown;
- The effect of flatter demand pattern (Series 1 vs. Series 2) is shown;
- The effect of a higher fire rate (Series 3 vs. Series 2) is shown; and
- The effect of a higher pipe failure rate (Series 4 vs. Series 2) is shown.

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Secondly, the section will proceed to report the financial results. As outlined in Chapter 4, the estimated capital, operation and maintenance (recurring) cost of each bulk water supply system has been determined. The estimated operational life of the infrastructure has been accommodated as well as the salvage cost of material accounted for. The reporting of financial impact is dealt with by first presenting the expenditure to be incurred during the construction of the infrastructure. Thereafter the operational and maintenance cost are shown. Only after these have been reported is the Life Cycle Cost (LCC) reported. The capital, annual recurring costs and LCC are reported separately and at the hand of the following:

- The financial implication is shown and the various configurations ranked in terms of value;
- The cost of probabilistically determined bulk water supply systems is compared to those sized according to deterministic guidelines (Red Book);
- The contribution of the cost of separate infrastructure components to the LCC is shown;
- The effect of variation in AADD is shown;
- The effect of variation in length of feeder pipe is shown; and
- The effect of variation in demand pattern, fire rate and pipe failure frequency is shown.

These results will provide a good indication of the effect of varying stochastic input. Up to this point a number of assumptions have been made in the determination of the financial implications. The discussion of results will proceed to report deviations from the original results caused by variation in some of the fixed input parameters. The following are therefore also reported:

- The sensitivity of results to a change in electrical tariff is shown;
- The sensitivity of results to a change in static head is shown;
- The sensitivity of results to a change in salvage cost is shown; and
- The sensitivity of results to a change in discount rate is shown.

The systematic reporting of the findings provides a good foundation for interpretation, and the development of conclusions.

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6.2.2 Reservoir Size

Results and Ranking

The output file generated through the use of the Mocasim II program has been discussed in Section 5.4. It has been mentioned that a total number of 320 simulations were analysed. The tabulated results of Configuration 1 and 2 are provided as typical results in Appendix A. The results of all the configurations are presented graphically in the same Appendix with graphs depicting the "reservoir capacity" versus "FRT" and "average failure time" respectively. The tabulated results indicate the results as received from the Mocasim II output file as well as results for the "failures per annum", "average failure time per annum' and most importantly the FRT for the reservoir size evaluated. The FRT is presented as the actual number and also the log of the number for the purpose of finding the reservoir size through interpolation. This has been discussed in detail in Section 5.4.

For the purpose of comparing the various simulations with each other, the reservoir sizes that would result in a FRT of 1 in 10 years have been extracted from the above data. A summary of this reservoir size for each of the simulations is provided in Appendix B. The reservoir size has been indicated in terms of the hourly volume under Daily Demand experienced under seasonal peak conditions (DD) as well as Average Annual Daily Demand (AADD). The minimum and maximum reservoir size over the range of 10 feeder pipe configurations is also indicated (i.t.o hours of AADD). To further indicate the results obtained, Table 15 provides the ranking of each of the simulations across the different feeder pipe configurations as well as the maximum and minimum reservoir size.

It is evident from Table 15 that Configuration 1 always requires the largest required reservoir size.

Our attention is now turned towards comparing the sizes obtained from the risk-based analysis to those from deterministic guidelines and thereafter the effect that variation in the system characteristics will have on the required reservoir size.

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Comparison to Red Book

The sizes obtained from risk-based analysis are in the vast majority of cases much smaller then sizes proposed by deterministic guidelines. The comparison is made by comparing the maximum size across the range of configurations to a deterministic guideline (DG) such as 48 hours of AADD, which is used in South Africa (Red Book). It must be noted that a volume for fire demand is normally added to this deterministic guideline which would increase the difference between the risk-based determined reservoir size and the deterministically guided size. Table 15 summarizes the maximum sizes determined through the risk-based analysis. It is noted that required reservoir sizes approach towards the deterministically guided size and even exceeds it in two instances (AWSS 4.4.1.1 and 4.4.4.1). The reason for this is elaborated on in the following sections.

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Table 15: Reservoir Size - Ranking of Configurations, Maximum and Minimum Size

Description	Series2.1.1	Series2.1.2	Series2.1.3	Series2.1.4	Series2.2.1	Series2.2.2	Series2.2.3	Series2.2.4	Series2.3.1	Series2.3.2	Series2.3.3	Series2.3.4	Series2.4.1	Series2.4.2	Series2.4.3	Series2.4.4	Series1.2.1	Series1.2.2	Series1.2.3	Series1.2.4	Series1.4.1	Series1.4.2	Series1.4.3	Series1.4.4	Series3.1.1	Series3.1.4	Series3.4.1	Series3.4.4	Series4.1.1	Series4.1.4	Series4.4.1	Series4.4.4
RANKING (10 = biggest, 1 = smallest)																																
Configuration 1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Configuration 2	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Configuration 3	4	5	5	5	4	5	5	5	4	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5
Configuration 4	5	4	4	4	5	4	4	4	5	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	5	4
Configuration 5	2	3	3	3	2	3	3	3	3	3	3	3	2	3	3	3	2	3	3	3	2	3	3	3	3	3	3	3	1	3	2	3
Configuration 6	3	1	1	1	3	1	1	1	2	1	1	1	3	1	1	1	3	1	1	1	3	1	1	1	1	1	1	1	3	1	3	1
Configuration 7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Configuration 8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	9	8	9	8	8	8	8	8
Configuration 9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	9	8	9	9	9	9	9
Configuration 10	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2	2	2	1	2
SIZING																																
Max res size (HR OF AADD)	22.63	27.61	31.44	40.85	22.49	27.52	31.31	40.74	21.23	26.37	30.08	38.77	22.49	27.51	31.86	40.73	19.28	24.80	28.91	38.49	19.27	24.80	29.38	38.48	22.81	41.11	22.53	40.91	24.18	58.28	24.04	58.13
Min res size (HR OF AADD)	21.08	21.35	21.76	23.00	20.90	21.18	21.59	22.82	19.56	19.80	20.16	21.21	20.90	21.18	21.59	22.80	17.23	17.55	18.03	19.33	17.22	17.54	18.02	19.32	21.13	23.08	20.88	22.79	21.13	25.24	20.97	25.07

KEY TO ANALYSES

Stochastic Input	Base Analyses																Flatter Demand Pattern								Higher Fire Rate				Higher Pipe Failure Rate			
AADD (l/s)	20				80				160				240				80				160				20		240		20		240	
Length (m)	1000	5000	10000	25000	1000	5000	10000	25000	1000	5000	10000	25000	1000	5000	10000	25000	1000	5000	10000	25000	1000	5000	10000	25000	1000	25000	1000	25000	1000	25000	1000	25000

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Effect of Different Configurations

The smallest required reservoir sizes occur when feeder pipe configurations such as multiple feeder pipes in parallel with interconnection pipes are utilized. Configuration 6 and 10 stands out as the most reliable feeder pipe systems amongst the configurations included in the analyses. The results indicated that the largest reservoir size across the range of feeder pipe configurations would always be required for Configurations 1, the configuration with a single feeder pipe from the source to the storage facility. This can be seen in Figure 37, along with another observation which is also made and discussed below.

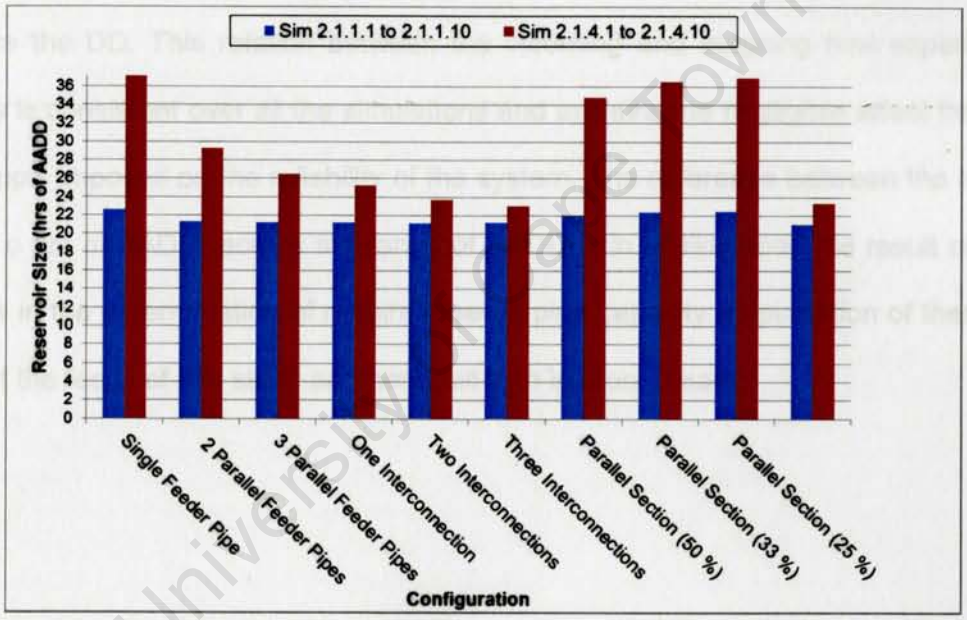

Figure 37: Reservoir Size vs. Configuration (Series 2.1.1 and 2.1.4)

Figure 37 also indicates the effect of pipe length on reservoir size. For short pipe lengths (Series 2.1.1), the variation in reservoir size is quite insignificant whereas for long pipe lengths (Series 2.1.4) it is much more pronounced. This indicates that, for configurations that yield a high reliability, the effect of the impact of an increase in failure inducing events does not result in significant larger requirements in terms of reservoir sizes.

Effect of AADD

The effect of AADD is evaluated by viewing the required reservoir sizes between ranges of simulations where the only difference is the size of the supply. Figure 38 to Figure 41 shown below

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indicates the reservoir sizes across a range of FRT's for all the configurations as indicated by the numbering system. The results presented graphically are all for Series 2 simulations i.e simulations with the "base input model" as described earlier. A comparison between Figure 38 and Figure 39 and between Figure 40 and Figure 41, in which the only difference is the variation in DD from 20 l/s to 240 l/s, reveals that the reservoir sizes when expressed in terms of the DD, or for that matter AADD remains very similar. This negligible difference is also presented in Table 16, where the required reservoir sizes for Configuration 1 are shown (in terms of hrs of AADD, not DD as seen in graphs).

This result is expected due to sizing methodology of the feeder pipe system. It has been explained that the feeder pipe is sized by ensuring a capacity that is a fixed multiple of the user demand, in this case 1.2 times the DD. This relation between the incoming and outgoing flow experienced by the storage facility is consistent over all the simulations and explains the negligible effect that a change in the size of supply imposes on the reliability of the system. The difference between the reservoir sizes (expressed i.t.o hrs of AADD) across the range of AADD is in all likelihood the result of the rounding off of numbers in the determination of required feeder pipe capacity. Explanation of these differences is however not the focus of this study and not dealt with in more detail.

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Length = 1000 m	AADD = 20 l/s	Length = 1000 m	AADD = 240 l/s

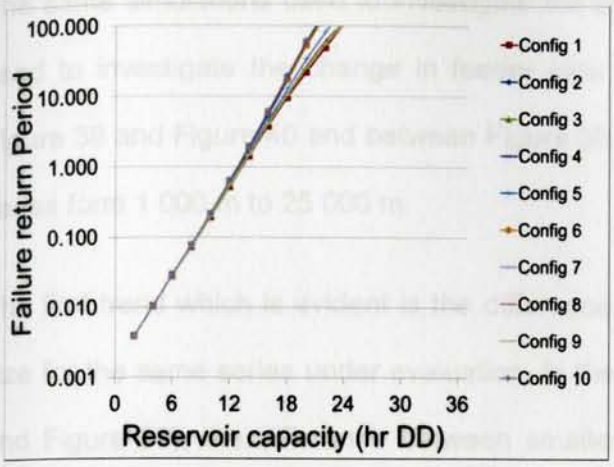

Figure 38: Reservoir Capacity - AWSS 2.1.1.1 to 2.1.1.10

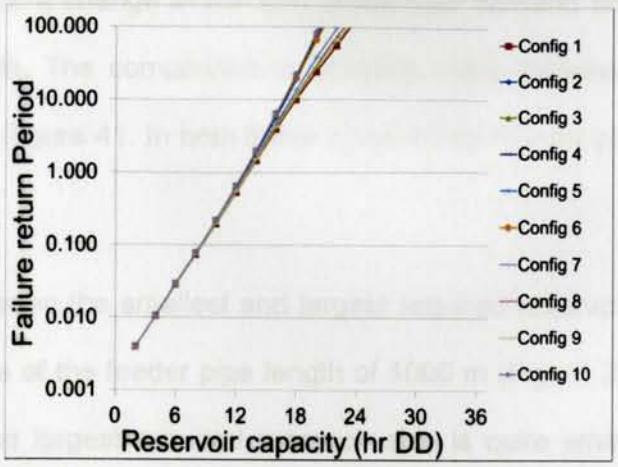

Figure 39: Reservoir Capacity – AWSS 2.4.1.1 to 2.4.1.10

Length = 25000 m	AADD = 20 l/s	Length = 25000 m	AADD = 240 l/s

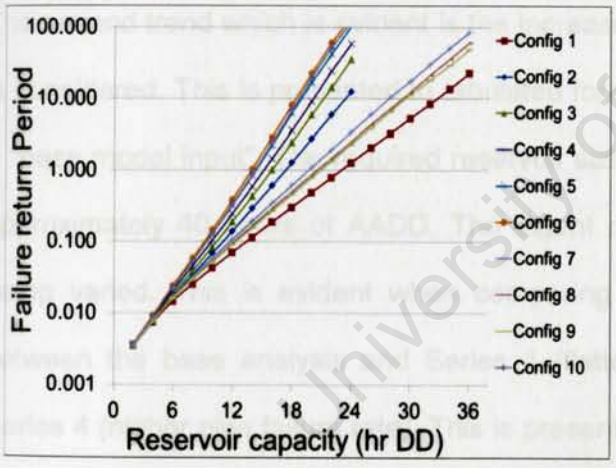

Figure 40: Reservoir Capacity - AWSS 2.1.4.1 to 2.1.4.10

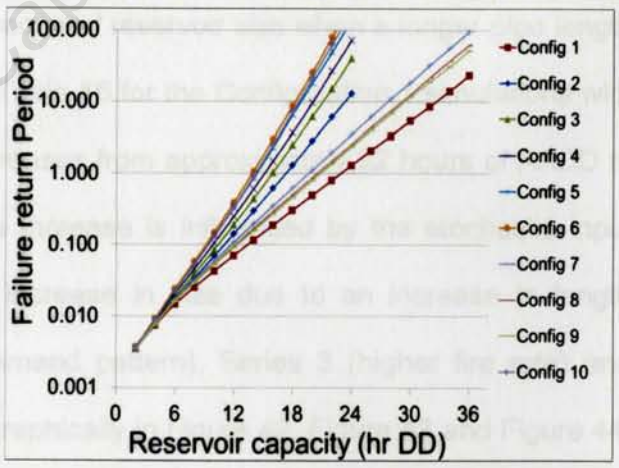

Figure 41: Reservoir Capacity - AWSS 2.4.4.1 to 2.4.4.10

Table 16: Reservoir Size (hr of AADD) - Configuration 1 (Base Analyses)

		Length of Feeder Pipe			
		1000	5000	10000	25000
Consumer Demand	DD 20 l/s	22.63 hrs	27.61 hrs	31.44 hrs	40.85 hrs
	DD 80 l/s	22.49 hrs	27.52 hrs	31.31 hrs	40.74 hrs
	DD 160 l/s	21.23 hrs	26.37 hrs	30.08 hrs	38.77 hrs
	DD 240 l/s	22.49 hrs	27.51 hrs	31.86 hrs	40.73 hrs

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Effect of Length

The same simulations used to investigate the effect of a change in the size of the user demand are used to investigate the change in feeder pipe length. The comparison is however made between Figure 38 and Figure 40 and between Figure 39 and Figure 41. In both these comparisons the length varies form 1 000 m to 25 000 m.

The first trend which is evident is the difference between the smallest and largest required reservoir size for the same series under evaluation. In the case of the feeder pipe length of 1000 m (Figure 38 and Figure 39), the difference between smallest and largest required reservoir size is quite small whereas for feeder pipe lengths of 25 000 m (Figure 40 and Figure 41) the difference is much more considerable. This is explained by realizing that the more reliable feeder pipe configurations are less influenced by an increase in the number of pipe failures resulting from longer pipe lengths.

The second trend which is evident is the increase in required reservoir size when a longer pipe length is considered. This is presented in tabulated form in Table 16 for the Configuration 1 simulations with a "base model input". The required reservoir size increases from approximately 22 hours of AADD to approximately 40 hours of AADD. The extent of the increase is influenced by the stochastic input being varied. This is evident when comparing the increase in size due to an increase in length between the base analysis and Series 1 (flatter demand pattern), Series 3 (higher fire rate) and Series 4 (higher pipe failure rate). This is presented graphically in Figure 42, Figure 43 and Figure 44, in which it can be seen that the increase in reservoir size is much more pronounced in the case of a higher pipe failure rate. Average reservoir sizes over the range of DD's are depicted in the graphs.

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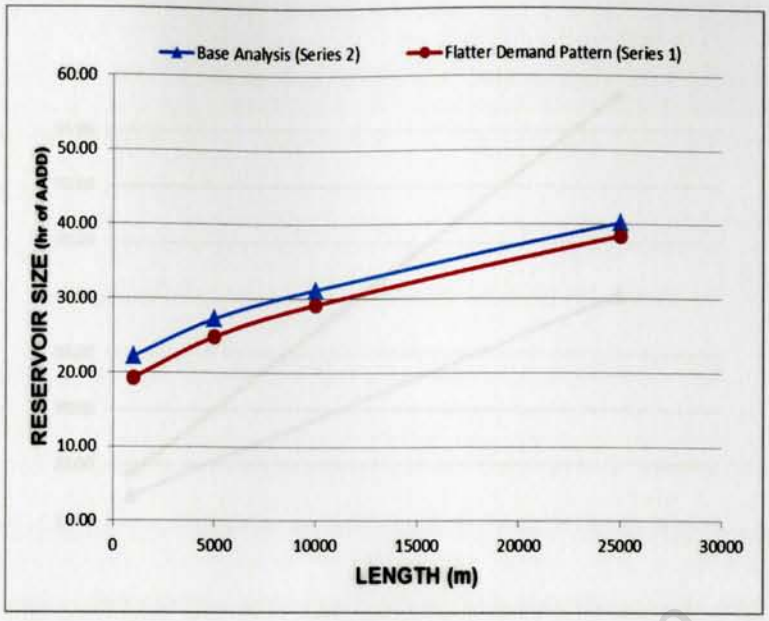

Figure 42: Reservoir Size vs. Length (Series 2 and 1)

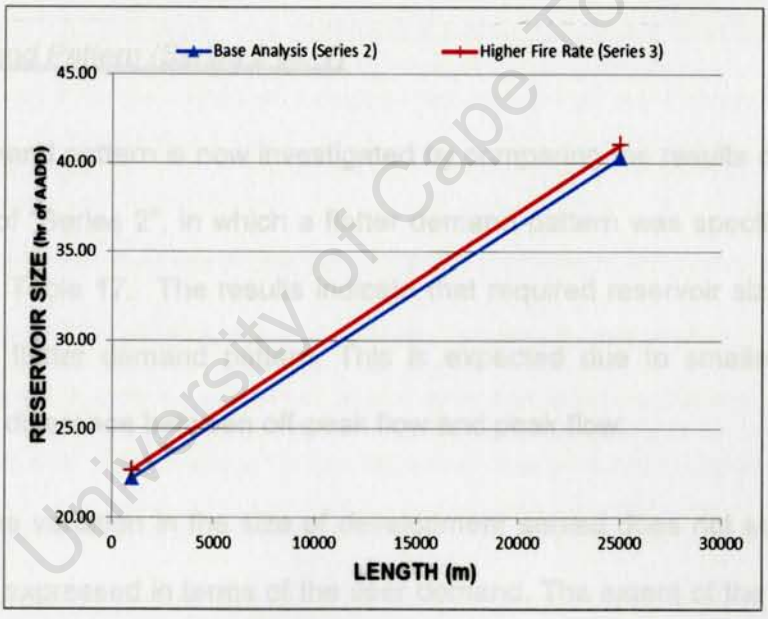

Figure 43: Reservoir Size vs. Length (Series 2 and 3)

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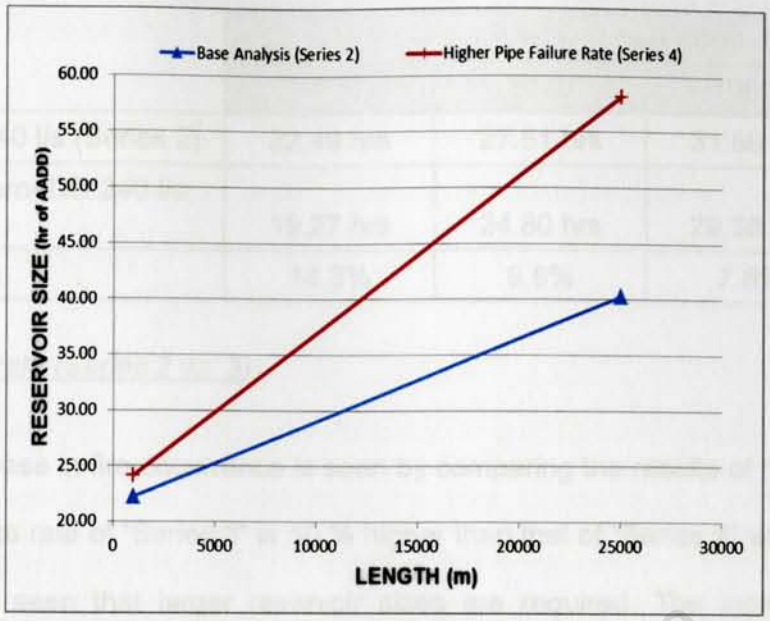

Figure 44: Reservoir Size vs. Length (Series 2 and 4)

Effect of Flatter Demand Pattern (Series 2 vs. 1)

A variation in the demand pattern is now investigated by comparing the results of the "Base Analysis- Series 1" with those of "Series 2", in which a flatter demand pattern was specified. The summary of results is indicated in Table 17. The results indicate that required reservoir sizes decrease with the accommodation of a flatter demand pattern. This is expected due to smaller balancing volumes required to off-set the difference between off-peak flow and peak flow.

It is re-iterated that the variation in the size of development served does not significantly impact the reservoir sizing when expressed in terms of the user demand. The extent of the decrease in required size is shown. For shorter pipe lengths the effect of a flatter demand pattern is more pronounced than longer pipe lengths.

Table 17: Required reservoir sizes (Configuration 1) - Series 2 and 1 (hrs of AADD)

	Feeder Pipe Length (m)			
	1000	5000	10000	25000
Base Analysis- DD 80 l/s (Series 2)	22.49 hrs	27.52 hrs	31.31 hrs	40.74 hrs
Flatter Demand Pattern- DD 80 l/s (Series 1)	19.28 hrs	24.80 hrs	28.91 hrs	38.49 hrs
Decrease in Size (%)	14.3%	9.9%	7.7%	5.5%

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	Feeder Pipe Length (m)			
	1000	5000	10000	25000
Base Analysis- DD 240 l/s (Series 2)	22.49 hrs	27.51 hrs	31.86 hrs	40.73 hrs
Flatter Demand Pattern- DD 240 l/s (Series 1)	19.27 hrs	24.80 hrs	29.38 hrs	38.48 hrs
Decrease in Size (%)	14.3%	9.9%	7.8%	5.5%

Effect of Higher Fire rate (Series 2 vs. 3)

The effect of an increase in fire occurrence is seen by comparing the results of "Series 2" with "Series 3". The fire occurrence rate of "Series 3" is 50 % higher than that of "Series 2" with all other input data being identical. It is seen that larger reservoir sizes are required. The increase is however not substantial, being below 1% for the comparisons indicated below in Table 18. This can be attributed to the fact that the required fire volume is reasonably small compared to volumes required daily for consumption. It is noted that the effect of a higher fire rate becomes smaller with a corresponding increase in the user demand.

A last thing to be aware of is that the probability of a fire and pipe failure occurring simultaneously is increased when longer pipe lengths are considered. A pipe failure and fire occurrence occurring simultaneously will result in only one system failure whereas the two events occurring a day apart could result in two failures. This, viewed in isolation, will result in less system failures per incident (pipe failure or fire occurrence) due to. The effect of this is however difficult to quantify and not deemed of much importance due to the effect of longer pipe lengths on system failure being more substantial than fire occurrence.

Table 18: Required Reservoir Size (Configuration 1) - Series 2 and 3 (hrs of AADD)

	Feeder Pipe Length (m)	
	1000	25000
Base Analysis- DD 20 l/s (Series 2)	22.63 hrs	40.85 hrs
Higher Fire Rate- DD 20 l/s (Series 3)	22.81 hrs	41.11 hrs
Increase in Size	0.8%	0.6%
Base Analysis- DD 240 l/s (Series 2)	22.49 hrs	40.73 hrs
Higher Fire Rate- DD 240 l/s (Series 3)	22.53 hrs	40.91 hrs
Increase in Size	0.2%	0.4%

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Effect of Higher Pipe Failure Rate (Series 2 vs. 4)

The comparison between the results of "Series 2" and "Series 4" draws one's attention to the effect of longer pipe lengths once again. Series 4 bulk water supply systems experienced twice the amount of pipe failures as those of "Series 2".

As expected larger reservoir sizes are required when higher pipe failure rates are experienced in the system. This is indicated in Table 19. The increase in pipe failures results in larger emergency volumes being required and, as the length of the pipe increases, the number of pipe failures experienced in the system is increased. The effect of this is dramatic, reservoir sizes increase by up to 42.7 % to accommodate the increased number of failures in the longer pipelines.

Table 19: Required reservoir size (Configuration 1) - Series 2 and 4 (hrs of AADD)

	Feeder Pipe Length (m)	
	1000	**25000**
Base Analysis- DD 20 l/s (Series 2)	22.63 hrs	40.85 hrs
Higher Pipe Failure Rate- DD 20 l/s (Series 4)	24.18 hrs	58.28 hrs
Increase in Size	6.9%	42.7%
Base Analysis- DD 240 l/s(Series 2)	22.49 hrs	40.73 hrs
Higher Pipe Failure Rate- DD 240 l/s (Series 4)	24.04 hrs	58.13 hrs
Increase in Size	6.9%	42.7%

6.2.3 Financial Analysis

The previous section documented the variation found in determined reservoir sizes when using risk-based analysis. It was confirmed that reservoir sizes smaller than those prescribed by deterministic guidelines, can be justified without compromising the reliability of the bulk water supply system. The results of the financial analysis will now be reported to quantify the extent, if any, of the financial advantage which is associated with this design method. It was seen that certain trends emerged which can guide the designer in the determination of reservoir sizes. It will now be indicated whether these trends are reflected in the financial implication of the various bulk water supply systems and how they could influence decision making in the design phase.

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Each of the bulk water supply systems were priced using the unit costing methods as described in Chapter 4. These estimations are presented in Appendix C. In order to analyse the estimates obtained, various other tables and graphs have been produced to summarize the results.

A comprehensive summary of all the estimates referred to in Table 12 is provided in Appendix D1. This summary details the capital, operation, maintenance and LCC of each of the bulk water supply systems analysed. It also provides a breakdown of these components in finer detail to aid in the investigation of trends emerging from the estimates. The financial results are discussed systematically by dealing with capital, recurring and LCC's separately. Only after a systematic analysis of each contributing factor is it possible to reflect on the emerging trends and to provide an interpretation.

The identification of trends emerging from the estimations to aid the designer is one of the goals of the study. It was observed that a change in length of the feeder pipe results in a trend between the least and second least expensive configurations in the majority of instances. This observation is observed in the evaluation of the capital, recurring and total life cycle cost estimations.

Capital Cost

The total capital cost of each bulk water supply system analysed is presented in Appendix D1. These costs were ranked in terms of value across the ten configurations simulated.

Table 20 indicates the two configurations with the lowest associated capital cost. It also indicates the capital cost as a percentage of the associated cost of the equivalent deterministically determined water supply system. It was observed that Configuration 1 generally stood out as the configuration with the lowest associated capital value and that the second lowest configuration is generally similar in cost.

Table 20: Capital Cost - Configuration and % (relative to deterministic guideline) - Rank 1 & 2

Series	Lowest		2nd Lowest		Difference
	Configuration	% (relative to DG)	Configuration	% (relative to DG)	
2.1.1	Configuration 1	68.67%	Configuration 9	71.54%	2.87%
2.1.2	Configuration 1	84.76%	Configuration 9	89.62%	4.85%
2.1.3	Configuration 1	91.58%	Configuration 9	97.98%	6.40%

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Series	Lowest		2nd Lowest		Difference
	Configuration	% (relative to DG)	Configuration	% (relative to DG)	
2.1.4	Configuration 1	98.18%	Configuration 9	106.26%	8.08%
2.2.1	Configuration 1	68.93%	Configuration 9	71.00%	2.07%
2.2.2	Configuration 1	83.69%	Configuration 9	87.68%	3.99%
2.2.3	Configuration 1	90.60%	Configuration 9	96.19%	5.59%
2.2.4	Configuration 1	97.86%	Configuration 9	105.31%	7.44%
2.3.1	Configuration 1	66.69%	Configuration 9	67.59%	0.91%
2.3.2	Configuration 1	82.04%	Configuration 9	82.13%	0.09%
2.3.3	Configuration 9	89.36%	Configuration 1	89.47%	0.11%
2.3.4	Configuration 9	96.40%	Configuration 1	97.16%	0.76%
2.4.1	Configuration 1	68.36%	Configuration 9	70.08%	1.72%
2.4.2	Configuration 1	82.72%	Configuration 9	86.11%	3.39%
2.4.3	Configuration 1	90.17%	Configuration 9	94.84%	4.67%
2.4.4	Configuration 1	97.61%	Configuration 9	104.60%	6.98%
1.2.1	Configuration 1	64.11%	Configuration 9	65.98%	1.87%
1.2.2	Configuration 1	81.19%	Configuration 9	84.99%	3.81%
1.2.3	Configuration 1	89.08%	Configuration 9	94.47%	5.39%
1.2.4	Configuration 1	97.17%	Configuration 9	104.51%	7.35%
1.4.1	Configuration 1	63.46%	Configuration 9	64.98%	1.52%
1.4.2	Configuration 1	80.07%	Configuration 9	83.31%	3.24%
1.4.3	Configuration 1	88.49%	Configuration 9	92.98%	4.49%
1.4.4	Configuration 1	96.84%	Configuration 9	103.72%	6.88%
3.1.1	Configuration 1	68.96%	Configuration 9	71.44%	2.47%
3.1.4	Configuration 1	98.25%	Configuration 9	106.26%	8.01%
3.4.1	Configuration 1	68.43%	Configuration 9	69.81%	1.38%
3.4.4	Configuration 1	97.67%	Configuration 9	104.61%	6.93%
4.1.1	Configuration 1	71.15%	Configuration 9	73.37%	2.22%
4.1.4	Configuration 1	102.42%	Configuration 9	109.46%	7.04%
4.4.1	Configuration 1	70.62%	Configuration 9	71.77%	1.15%
4.4.4	Configuration 1	103.08%	Configuration 9	108.72%	5.64%

The extent which the cost between risk-based determined systems and deterministically determined systems varies is a function of feeder pipe length. For short pipe lengths (1000 m), the capital cost of the lowest configuration is between 60 % and 70 % of the capital cost of a deterministically designed bulk water supply system. As the length increases the cost of the "risk-based designed" water supply system approaches that of the equivalent deterministically designed water supply system. For long pipe lengths (25 000 m), the difference in cost becomes negligible, the risk-based designed water supply system being 95 % to 102 % of the cost of deterministically designed water supply systems.

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The capital cost of Configuration 1 is one of the least expensive options. This together with the fact that required reservoir sizes are without exception the largest across the ten configurations leads to an initial conclusion that reservoir size is not a major cost driver in the various bulk water supply systems. This is however not an accurate conclusion when the breakdown of the capital cost into the three major components (PS, FPS & Storage) is observed. To aid the analysis of the breakdown of the components, the ratio of the contributing components was determined. This is presented in tabulated form in Appendix E with the associated contributions indicated as a percentage.

The observation of trends in the results was briefly mentioned earlier in Section 6.2.3. To emphasize the importance of such trends, a trend indicated in Table 20 will be indicated and the implication stated.

It is observed that the difference between the two lowest configurations in relation to deterministically designed water supply system for Series 2.3.1 is 0.91 %. In the case of Series 2.3.1, Configuration 1 is the lowest with Configuration 9 the next lowest.

With an increase in pipe length the difference decreases to 0.09 % (Series 2.3.2). Should this trend be consistent it can be concluded that the longer the pipe length, the more likely Configuration 1 will fail to remain as the most financially attractive option with respect to the capital cost. This is indeed the case for this series with Configuration 9 surpassing Configuration 1 as the configuration with the lowest capital cost for lengths 10000m (Series 2.3.3) and 25 000 m (Series 2.3.4).

It is important to note that the trend identified for one configuration not necessarily holds for another series. This is the case when comparing the capital cost of Configuration 9 to that of Configuration 1 for Series 2.1.1. Table 20 indicates that longer lengths will decrease the likelihood for Configuration 9 to challenge Configuration 1 as a viable alternative. This is the case for most of the series'.

Similar trends are observed when analysing recurring and total LCC in the same way. The contribution of capital and recurring cost in the total LCC therefore needs to be noted to understand the trends which prevail.

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The breakdown of the different infrastructure components in relation to the total capital cost is indicated for AWSS's 2.1.1.1, 2.1.4.1, 2.4.1.1 and 2.4.4.1 in Figure 45 to Figure 48. It is observed that for short lengths (AWSS 2.1.1.1 and 2.4.1.1) the cost of storage is the largest capital cost driver. It is only in the case of long pipe lengths (AWSS 2.1.4.1 and 2.4.4.1) that the cost of storage becomes less insignificant. To understand this it is necessary to recall that the difference in required reservoir sizes across different configurations were quite small for feeder pipe lengths of 1000m. The difference in cost between the various feeder pipe configurations therefore outweighs the difference in storage cost in the case of shorter pipe lengths. It is therefore noted that the capital cost of Configuration 1 makes it the most attractive alternative from a capital cost perspective although large reservoir sizes are required.

The cost associated with the source (pumping station), is found not to be a significant contributor to the total cost of the bulk water supply system. As indicated in Figure 45 to Figure 48, the pumping station contributes less than 6 % of the total capital cost of the bulk water supply system.

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Length = 1000 m	AADD = 20 l/s	Length = 25000 m	AADD = 20 l/s

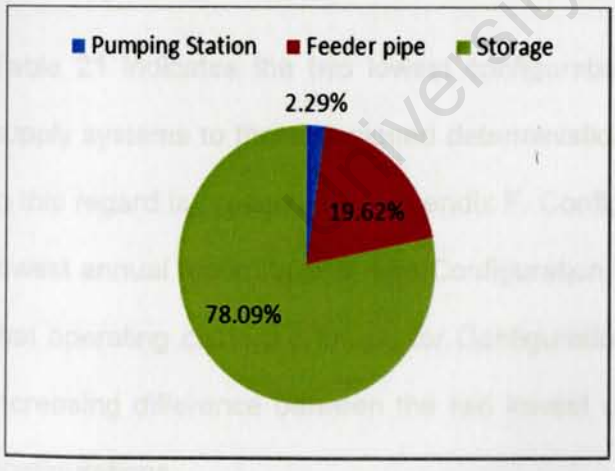

Figure 45: AWSS 2.1.1.1 - Capital Cost breakdown

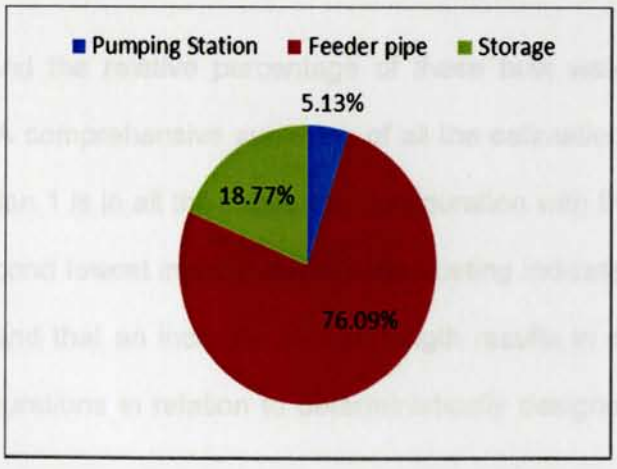

Figure 46: AWSS 2.1.4.1 - Capital Cost breakdown

Length = 1000 m	AADD = 240 l/s	Length = 25000 m	AADD = 240 l/s

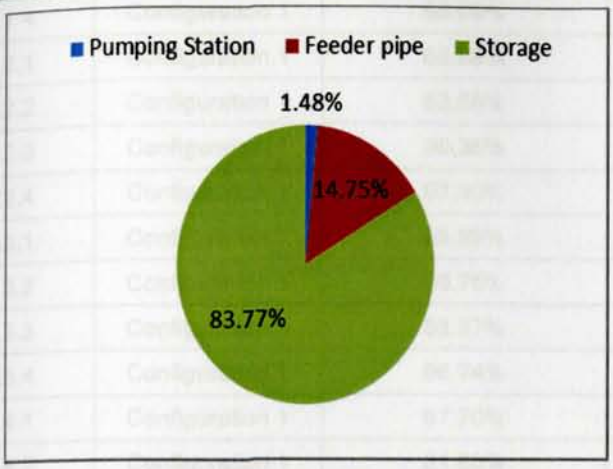

Figure 47: AWSS 2.4.1.1 - Capital Cost Breakdown

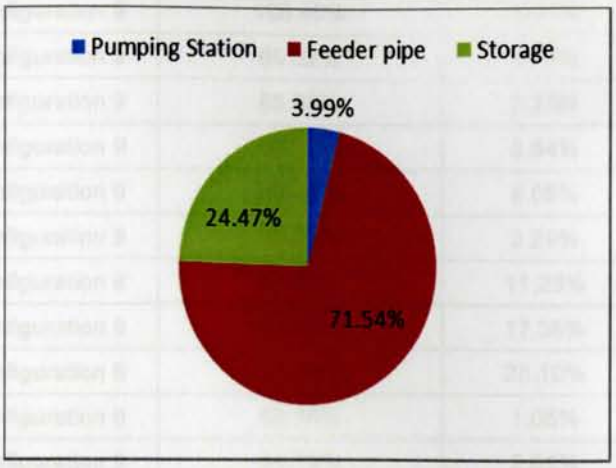

Figure 48: AWSS 2.4.4.1 - Capital Cost Breakdown

Recurring Cost (Operation and Maintenance)

The annual recurring cost for each of the analysed bulk water supply systems is indicated in the summary tables in Appendix D1. The ranking of the different configurations follows a similar trend as the ranking of capital cost.

Table 21 indicates the two lowest configurations and the relative percentage of these bulk water supply systems to those designed deterministically. A comprehensive summary of all the estimations in this regard is presented in Appendix F. Configuration 1 is in all the cases the configuration with the lowest annual recurring cost with Configuration 9 second lowest in most cases. The costing indicates that operating costs are lowest for Configuration 1 and that an increase in pipe length results in an increasing difference between the two lowest configurations in relation to deterministically designed configurations.

Table 21: Recurring Cost - Configuration & % (relative to deterministic guideline) - Rank 1 & 2

Series	Lowest		2nd Lowest		Difference
	Configuration	% (relative to DG)	Configuration	% (relative to DG)	
2.1.1	Configuration 1	67.33%	Configuration 9	68.86%	1.53%
2.1.2	Configuration 1	83.03%	Configuration 9	86.74%	3.71%
2.1.3	Configuration 1	90.91%	Configuration 9	96.94%	6.03%

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Series	Lowest		2nd Lowest		Difference
	Configuration	% (relative to DG)	Configuration	% (relative to DG)	
2.1.4	Configuration 1	98.09%	Configuration 9	106.46%	8.37%
2.2.1	Configuration 1	68.08%	Configuration 9	69.32%	1.24%
2.2.2	Configuration 1	82.58%	Configuration 9	85.93%	3.35%
2.2.3	Configuration 1	90.36%	Configuration 9	96.00%	5.64%
2.2.4	Configuration 1	97.90%	Configuration 9	105.95%	8.05%
2.3.1	Configuration 1	65.99%	Configuration 8	69.28%	3.29%
2.3.2	Configuration 1	80.75%	Configuration 8	91.99%	11.23%
2.3.3	Configuration 1	88.37%	Configuration 8	105.73%	17.36%
2.3.4	Configuration 1	96.74%	Configuration 8	121.85%	25.10%
2.4.1	Configuration 1	67.70%	Configuration 9	68.74%	1.05%
2.4.2	Configuration 1	81.83%	Configuration 9	84.73%	2.89%
2.4.3	Configuration 1	90.08%	Configuration 9	94.91%	4.83%
2.4.4	Configuration 1	97.70%	Configuration 9	105.38%	7.68%
1.2.1	Configuration 1	63.14%	Configuration 9	64.17%	1.03%
1.2.2	Configuration 1	79.91%	Configuration 9	83.06%	3.15%
1.2.3	Configuration 1	88.81%	Configuration 9	94.24%	5.43%
1.2.4	Configuration 1	97.22%	Configuration 9	105.17%	7.95%
1.4.1	Configuration 1	62.69%	Configuration 9	63.53%	0.84%
1.4.2	Configuration 1	79.05%	Configuration 9	81.78%	2.74%
1.4.3	Configuration 1	88.39%	Configuration 9	93.03%	4.64%
1.4.4	Configuration 1	96.95%	Configuration 9	104.53%	7.58%
3.1.1	Configuration 1	67.64%	Configuration 9	68.75%	1.11%
3.1.4	Configuration 1	98.16%	Configuration 9	106.46%	8.30%
3.4.1	Configuration 1	67.77%	Configuration 9	68.46%	0.70%
3.4.4	Configuration 1	97.76%	Configuration 9	105.39%	7.64%
4.1.1	Configuration 1	69.92%	Configuration 9	70.76%	0.85%
4.1.4	Configuration 1	102.54%	Configuration 9	109.82%	7.28%
4.4.1	Configuration 1	70.00%	Configuration 5	70.38%	0.38%
4.4.4	Configuration 1	102.97%	Configuration 9	109.36%	6.39%

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The effect of the pipe length is also evident when comparing the contribution of recurring cost to the total annual recurring cost for different lengths. This is indicated graphically in Figure 49 to Figure 52. A comparison between Figure 49 and Figure 50 and between Figure 51 and Figure 52 indicates that the contribution of operational cost to the annual recurring cost increases substantially with an increase in length. This is due to the increase in friction which needs to be overcome by the pumping system when longer pipe lengths are considered.

A consistent trend is observed between bulk water supply systems with an increase in length. The analysis of the trend was discussed in the preceding discussion of capital cost. The difference between the two lowest configurations consistently increase from approximately 1.5 % to 10 % as the length increase from 1000 m to 25 000m. A conclusion can be made that, for the input data as utilized in the analyses, an increase in length decreases the likelihood of any other Configuration challenging Configuration 1 as the configuration with the lowest associated recurring cost

Length = 1000 m	AADD = 20 l/s	Length = 25000 m	AADD = 20 l/s

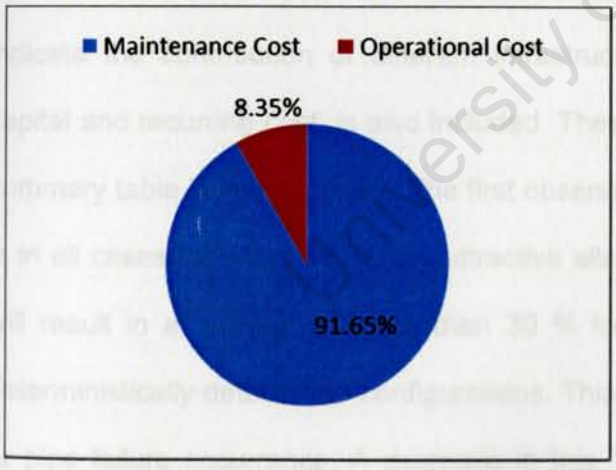

Figure 49: Sim 2.1.1.1 - Recurring Cost Breakdown

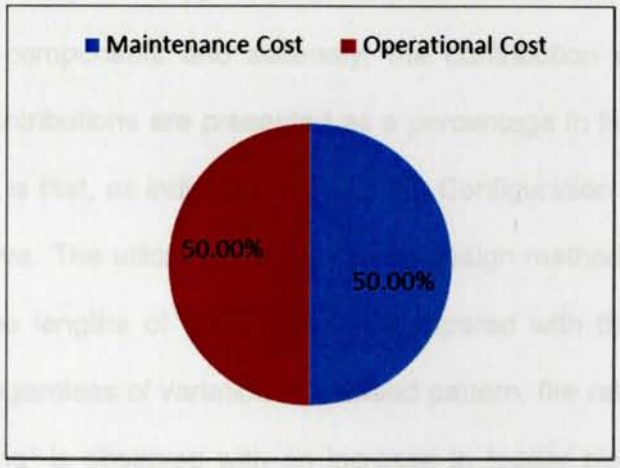

Figure 50: Sim 2.1.4.1 - Recurring Cost Breakdown

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Length = 1000 m	AADD = 240 l/s	Length = 25000 m	AADD = 240 l/s

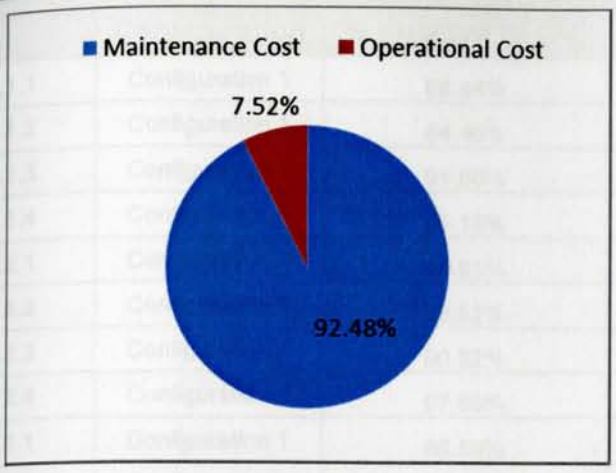

Figure 51: Sim 2.4.1.1 - Recurring Cost Breakdown

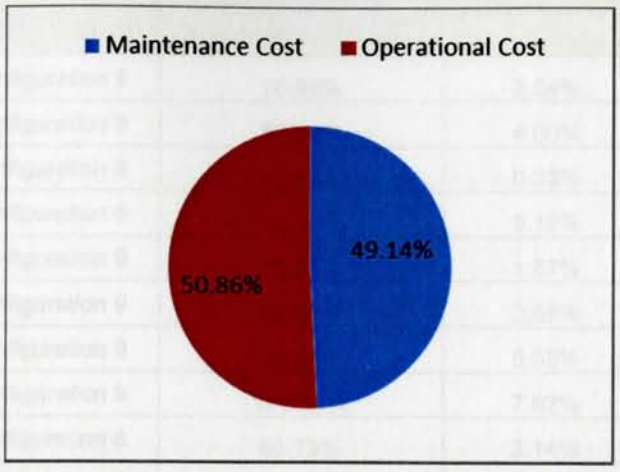

Figure 52: Sim 2.4.4.1 - Recurring Cost Breakdown

Life Cycle Cost

The total LCC has been determined by using the capitalization method as described in Section 4.3.1. These financial estimations are summarized in tabulated form in Appendix D1. A breakdown to firstly indicate the contribution of different infrastructure components and secondly, the contribution of capital and recurring cost, is also included. These contributions are presented as a percentage in the summary table in Appendix D2. The first observation is that, as indicated in Table 22, Configuration 1 is in all cases the most financially attractive alternative. The utilization of risk-based design methods will result in a "saving" of more than 30 % for pipe lengths of 1000 m when compared with the deterministically determined configurations. This is regardless of variation in demand pattern, fire rate or pipe failure occurrence. A decrease in this "saving" is observed with an increase in feeder pipe length.

The second lowest configuration is in all cases Configuration 9. A trend is however, as observed in the analysis of the annual recurring cost, identified that an increase in pipe length will decrease the likelihood of Configuration 1 failing to be the configuration with the lowest LCC.

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Table 22: LCC - Configuration & % (relative to deterministic guideline) - Rank 1 & 2

Series	Lowest		2nd Lowest		Difference
	Configuration	% (relative to DG)	Configuration	% (relative to DG)	
2.1.1	Configuration 1	68.44%	Configuration 9	70.98%	2.54%
2.1.2	Configuration 1	84.46%	Configuration 9	89.06%	4.60%
2.1.3	Configuration 1	91.50%	Configuration 9	97.83%	6.33%
2.1.4	Configuration 1	98.18%	Configuration 9	106.34%	8.16%
2.2.1	Configuration 1	68.81%	Configuration 9	70.67%	1.87%
2.2.2	Configuration 1	83.52%	Configuration 9	87.38%	3.86%
2.2.3	Configuration 1	90.62%	Configuration 9	96.25%	5.63%
2.2.4	Configuration 1	97.89%	Configuration 9	105.51%	7.62%
2.3.1	Configuration 1	66.59%	Configuration 8	68.73%	2.14%
2.3.2	Configuration 1	81.82%	Configuration 8	87.27%	5.45%
2.3.3	Configuration 1	89.27%	Configuration 8	97.44%	8.17%
2.3.4	Configuration 1	97.08%	Configuration 8	108.38%	11.30%
2.4.1	Configuration 1	68.27%	Configuration 9	69.82%	1.55%
2.4.2	Configuration 1	82.59%	Configuration 9	85.88%	3.29%
2.4.3	Configuration 1	90.22%	Configuration 9	94.96%	4.74%
2.4.4	Configuration 1	97.66%	Configuration 9	104.85%	7.19%
1.2.1	Configuration 1	63.97%	Configuration 9	65.64%	1.67%
1.2.2	Configuration 1	80.99%	Configuration 9	84.66%	3.67%
1.2.3	Configuration 1	89.12%	Configuration 9	94.54%	5.42%
1.2.4	Configuration 1	97.21%	Configuration 9	104.73%	7.52%
1.4.1	Configuration 1	63.35%	Configuration 9	64.70%	1.35%
1.4.2	Configuration 1	79.92%	Configuration 9	83.06%	3.14%
1.4.3	Configuration 1	88.55%	Configuration 9	93.11%	4.56%
1.4.4	Configuration 1	96.90%	Configuration 9	103.98%	7.08%
3.1.1	Configuration 1	68.74%	Configuration 9	70.88%	2.14%
3.1.4	Configuration 1	98.25%	Configuration 9	106.34%	8.09%
3.4.1	Configuration 1	68.34%	Configuration 9	69.55%	1.21%
3.4.4	Configuration 1	97.72%	Configuration 9	104.86%	7.14%
4.1.1	Configuration 1	70.94%	Configuration 9	72.82%	1.88%
4.1.4	Configuration 1	102.42%	Configuration 9	109.54%	7.12%
4.4.1	Configuration 1	70.53%	Configuration 9	71.51%	0.98%
4.4.4	Configuration 1	103.03%	Configuration 9	108.90%	5.87%

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An analysis of the extent of each infrastructure's contribution to the total LCC reveals a similar trend as observed during the analysis of capital cost. This is graphically presented in Appendix G1 for all the various bulk water supply systems analysed. It is once again observed that the cost of the storage facility dominates as the major contributor to the LCC in the case of shorter pipe lengths (1000m). And once again, an increase in length results in the storage facility and the feeder pipe swopping roles as the major cost driver. The trend is similar throughout all the analyses performed and is indicated in the presentation of the result for Series 2.1.1 and Series 2.1.4 for each of the ten configurations analysed.

Length = 1000 m	AADD = 20 l/s

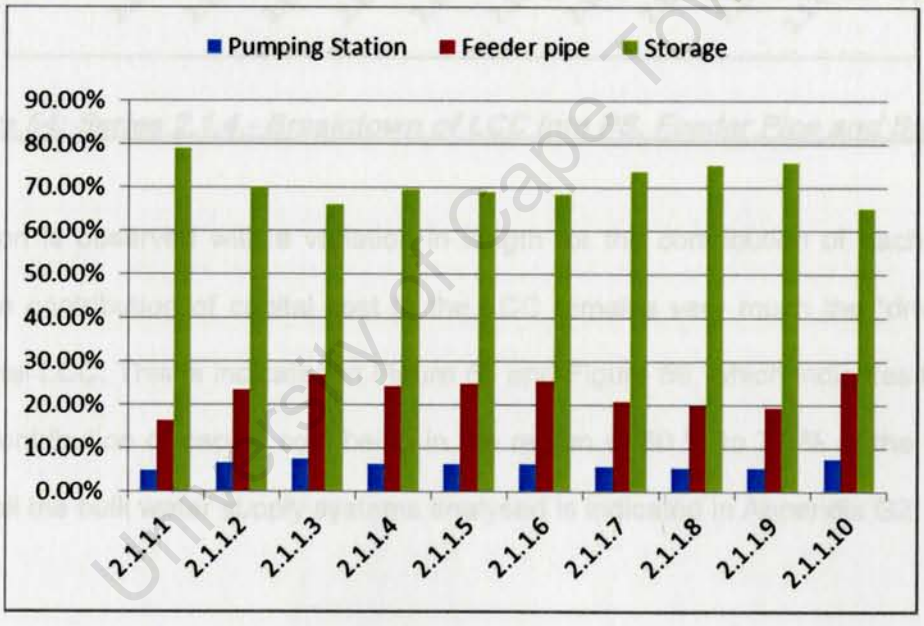

Figure 53: Series 2.1.1 - Breakdown of LCC into PS, Feeder Pipe and Storage

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Length = 25000 m	AADD = 20 l/s

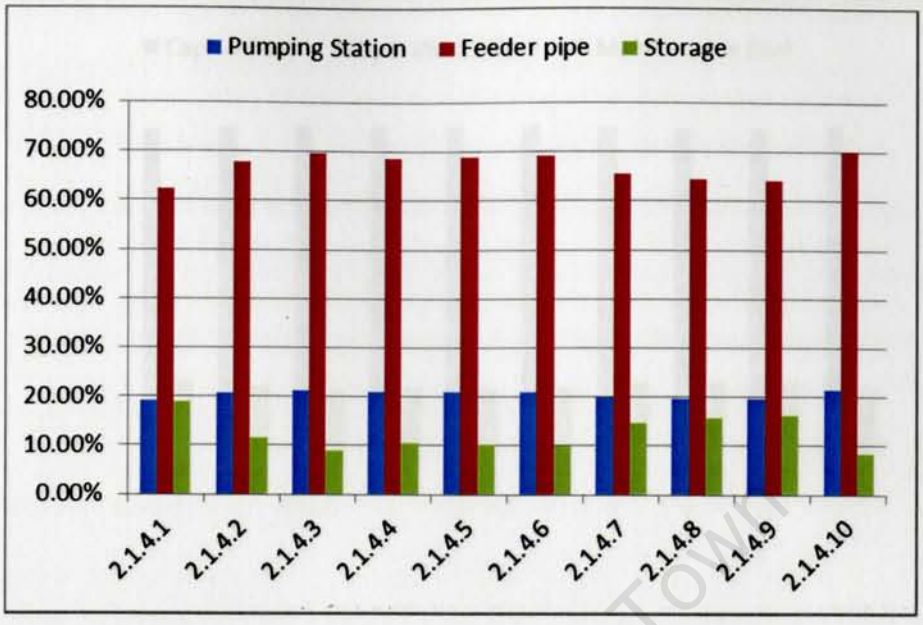

Figure 54: Series 2.1.4 - Breakdown of LCC into PS, Feeder Pipe and Storage

Whilst a variation is observed with a variation in length for the contribution of each component as seen above, the contribution of capital cost to the LCC remains very much the "driving force" with regard to the total LCC. This is indicated in Figure 55 and Figure 56, which indicates that, regardless of length, the contribution of capital cost being in the region of 60 % to 77 % of the total LCC. This breakdown for all the bulk water supply systems analysed is indicated in Appendix G2.

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Length = 1000 m	AADD = 20 l/s

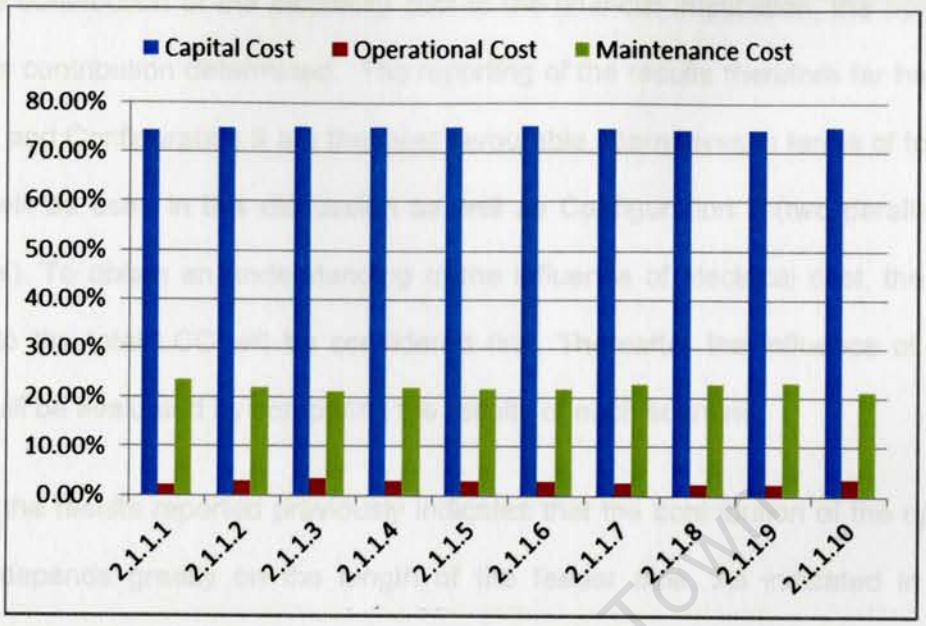

Figure 55: Series 2.1.1 - Breakdown of LCC into Capital, Operational and Maintenance

Length = 25000 m	AADD = 20 l/s

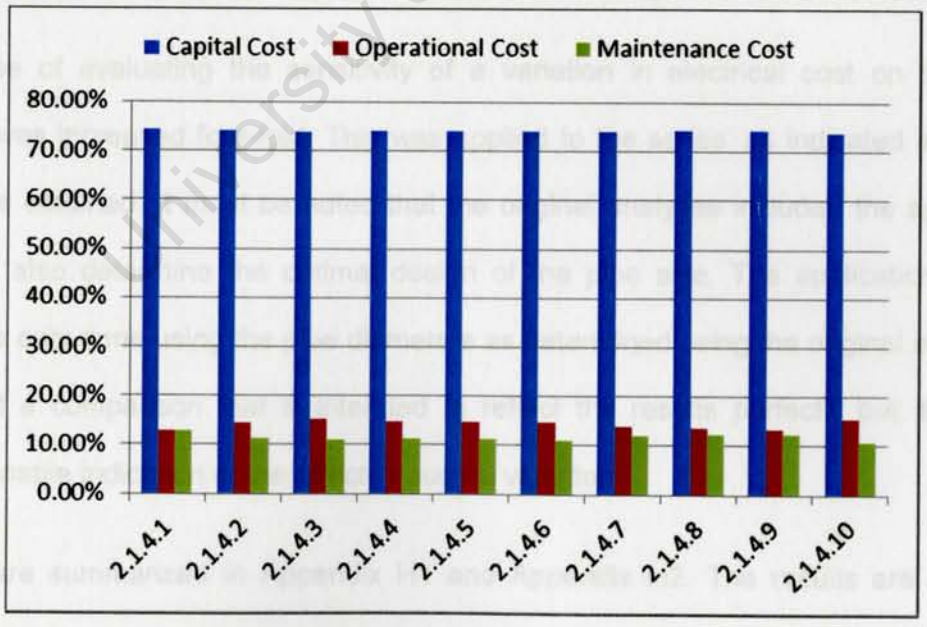

Figure 56: Series 2.1.4 - Breakdown of LCC into Capital, Operational and Maintenance

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Effect of electricity cost

To evaluate the contribution of the electricity cost to the financial implication, the operational cost is analysed and its contribution determined. The reporting of the results therefore far has indicated that Configuration 1 and Configuration 9 are the most favourable alternatives in terms of total LCC. These configurations will be used in this discussion as well as Configuration 2 (two parallel pipes without interconnections). To obtain an understanding of the influence of electrical cost, the contribution of electrical cost to the total LCC will be considered first. Thereafter the influence of an increase in electrical tariff will be evaluated by comparing the results of each scenario.

Examination of the results reported previously indicates that the contribution of the operating cost to the total LCC depends greatly on the length of the feeder pipe. As indicated in Table 23, the contribution varies from below 5% for pipe lengths of 1000m to more than 20 % for 25 000m feeder pipe length. This increase is mainly due to the fact that, whilst operating cost increase linearly with an increase in length, maintenance cost does not due to the associated variation in reservoir size and the associated cost which is dependent on economy of scale.

For the purpose of evaluating the sensitivity of a variation in electrical cost on the results, the electrical tariff was increased four-fold. This was applied to the series' as indicated in Table 23 and the results were obtained. It must be noted that the original analyses included the application of an interest rate to also determine the optimal design of the pipe size. The application of the higher electrical tariff is only done using the pipe diameters as determined using the original electrical tariff. It is therefore not a comparison that is intended to reflect the results perfectly but it is believed to provide a reasonable indication of the effect of such a variation.

These results are summarized in Appendix H1 and Appendix H2. The results are summarized in *Table 23*. It is firstly noted that the contribution of operating cost to the total LCC has increased substantially. The contribution of operating cost to LCC now ranges from 7% to 45% compared to the original results displaying a range of 5 % to 20 %. The substantial contribution, especially at longer pipe lengths, does however not affect the cost ranking of the alternatives. Using the tabulated format as used in previous analysis, the results for the lowest configuration of the original input and the

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increased electrical tariff is indicated in Table 24. The most favourable configuration remains to be Configuration 1, mainly due to the fact that Configuration 1 remains with the lowest associated operating cost of all the configurations based on the various design approaches which have been applied.

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Table 23: Contribution of Operational Cost to LCC - Change in Electrical Tariff

	Original Electrical Tariff						Increased Electrical Tariff (x4)					
	Configuration 1		Configuration 2		Configuration 9		Configuration 1		Configuration 2		Configuration 9	
	Length		Length		Length		Length		Length		Length	
	1000m	25000m	1000m	25000m	1000m	25000m	1000m	25000m	1000m	25000m	1000m	25000m
Series 2.1	2.15%	12.92%	2.99%	14.55%	2.33%	13.42%	8.08%	37.23%	10.97%	40.50%	8.72%	38.26%
Series 2.2	2.12%	13.95%	2.99%	15.90%	2.32%	14.56%	7.96%	39.33%	10.98%	43.06%	8.67%	40.53%
Series 2.3	2.16%	10.50%	5.31%	20.33%	4.86%	21.58%	7.45%	38.33%	10.38%	42.19%	8.15%	39.56%
Series 2.4	1.98%	14.04%	2.83%	16.18%	2.18%	14.71%	7.49%	39.51%	10.45%	43.57%	8.20%	40.82%
Series 1.2	2.28%	14.05%	3.24%	16.03%	2.50%	14.67%	8.53%	39.53%	11.81%	43.29%	9.29%	40.74%
Series 1.4	2.14%	14.15%	3.08%	16.33%	2.36%	14.83%	8.04%	39.72%	11.28%	43.83%	8.80%	41.05%

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Table 24: Lowest Configuration & % (relative to deterministic guideline) Original Input vs. Higher Electrical Tariff (x4)

Series	Original Input		Higher Electrical Tariff (x 4)	
	Lowest Configuration	% (relative to DG)	Lowest Configuration	% (relative to DG)
2.1.1	Configuration 1	68.44%	Configuration 1	69.78%
2.1.2	Configuration 1	84.46%	Configuration 1	86.58%
2.1.3	Configuration 1	91.50%	Configuration 1	93.28%
2.1.4	Configuration 1	98.18%	Configuration 1	98.68%
2.2.1	Configuration 1	68.81%	Configuration 1	70.11%
2.2.2	Configuration 1	83.52%	Configuration 1	85.84%
2.2.3	Configuration 1	90.62%	Configuration 1	92.66%
2.2.4	Configuration 1	97.89%	Configuration 1	98.51%
2.3.1	Configuration 1	66.59%	Configuration 1	67.84%
2.3.2	Configuration 1	81.82%	Configuration 1	84.20%
2.3.3	Configuration 1	89.27%	Configuration 1	91.53%
2.3.4	Configuration 1	97.08%	Configuration 1	97.92%
2.4.1	Configuration 1	68.27%	Configuration 1	69.50%
2.4.2	Configuration 1	82.59%	Configuration 1	84.95%
2.4.3	Configuration 1	90.22%	Configuration 1	92.32%
2.4.4	Configuration 1	97.66%	Configuration 1	98.34%
1.2.1	Configuration 1	63.97%	Configuration 1	65.48%
1.2.2	Configuration 1	80.99%	Configuration 1	83.66%
1.2.3	Configuration 1	89.12%	Configuration 1	91.48%
1.2.4	Configuration 1	97.21%	Configuration 1	98.02%
1.4.1	Configuration 1	63.35%	Configuration 1	64.78%
1.4.2	Configuration 1	79.92%	Configuration 1	82.65%
1.4.3	Configuration 1	88.55%	Configuration 1	91.00%
1.4.4	Configuration 1	96.90%	Configuration 1	97.80%

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Additional Static Head

An increase in the static head imposed on the system will result in additional annual operating cost. The results are expected to be similar to an increase in the electrical tariff with only the extent of the increase which would differ. It was decided not to add a constant head but rather to apply a fixed gradient to the pipeline. A gradient of 0.5 % and 2.0 % was applied over the length of the pipeline.

The results are summarized in Table 25. The results returned, as expected, indicated a slight increase in the lowest configurations cost relative to the deterministic guidelines (DG). Since the operating cost of the lowest configuration, Configuration 1, is the lowest of all the configurations, the addition of static head does not result in a change of the most favourable alternative. A summary of all the results is presented in Appendix I1 and Appendix I2.

Table 25: LCC - Lowest Configuration (% indicated) - Additional Static Head

Series	Original Input		Additional Static Head (0.5%)		Additional Static Head (2.0%)	
	Lowest Configuration	% (rel. to DG)	Lowest Configuration	% (rel. to DG)	Lowest Configuration	% (rel. to DG)
2.1.1	Configuration 1	68.44%	Configuration 1	68.93%	Configuration 1	70.22%
2.1.2	Configuration 1	84.46%	Configuration 1	85.09%	Configuration 1	86.63%
2.1.3	Configuration 1	91.50%	Configuration 1	91.94%	Configuration 1	92.98%
2.1.4	Configuration 1	98.18%	Configuration 1	98.29%	Configuration 1	98.55%
2.2.1	Configuration 1	68.81%	Configuration 1	69.59%	Configuration 1	71.57%
2.2.2	Configuration 1	83.52%	Configuration 1	84.67%	Configuration 1	87.20%
2.2.3	Configuration 1	90.62%	Configuration 1	91.48%	Configuration 1	93.25%
2.2.4	Configuration 1	97.89%	Configuration 1	98.13%	Configuration 1	98.60%
2.3.1	Configuration 1	66.59%	Configuration 1	67.66%	Configuration 1	70.28%
2.3.2	Configuration 1	81.82%	Configuration 1	83.48%	Configuration 1	86.86%
2.3.3	Configuration 1	89.27%	Configuration 1	90.62%	Configuration 1	93.03%
2.3.4	Configuration 1	97.08%	Configuration 1	97.55%	Configuration 1	98.30%
2.4.1	Configuration 1	68.27%	Configuration 1	69.45%	Configuration 1	72.26%
2.4.2	Configuration 1	82.59%	Configuration 1	84.44%	Configuration 1	88.02%
2.4.3	Configuration 1	90.22%	Configuration 1	91.61%	Configuration 1	94.03%
2.4.4	Configuration 1	97.66%	Configuration 1	98.08%	Configuration 1	98.73%
1.2.1	Configuration 1	63.97%	Configuration 1	64.88%	Configuration 1	67.16%
1.2.2	Configuration 1	80.99%	Configuration 1	82.32%	Configuration 1	85.23%
1.2.3	Configuration 1	89.12%	Configuration 1	90.11%	Configuration 1	92.17%
1.2.4	Configuration 1	97.21%	Configuration 1	97.53%	Configuration 1	98.14%
1.4.1	Configuration 1	63.35%	Configuration 1	64.71%	Configuration 1	67.97%
1.4.2	Configuration 1	79.92%	Configuration 1	82.05%	Configuration 1	86.18%
1.4.3	Configuration 1	88.55%	Configuration 1	90.18%	Configuration 1	93.00%
1.4.4	Configuration 1	96.90%	Configuration 1	97.46%	Configuration 1	98.32%
3.1.1	Configuration 1	68.74%	Configuration 1	69.23%	Configuration 1	70.50%
3.1.4	Configuration 1	98.25%	Configuration 1	98.36%	Configuration 1	98.61%
3.4.1	Configuration 1	68.34%	Configuration 1	69.51%	Configuration 1	72.32%
3.4.4	Configuration 1	97.72%	Configuration 1	98.13%	Configuration 1	98.77%
4.1.1	Configuration 1	70.94%	Configuration 1	71.39%	Configuration 1	72.58%

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Series	Original Input		Additional Static Head (0.5%)		Additional Static Head (2.0%)	
	Lowest Configuration	% (rel. to DG)	Lowest Configuration	% (rel. to DG)	Lowest Configuration	% (rel. to DG)
4.1.4	Configuration 1	102.42%	Configuration 1	102.27%	Configuration 1	101.92%
4.4.1	Configuration 1	70.53%	Configuration 1	71.63%	Configuration 1	74.24%
4.4.4	Configuration 1	103.03%	Configuration 1	102.48%	Configuration 1	101.64%

Effect of Variation in Discount Rate

The choice of discount rate was discussed in Section 4.4. A lower discount rate will increase the influence of operating cost. This variation was applied by utilizing a 2% discount rate, a decrease of 2 % from the discount rate used originally. The results are bound into Appendix J1 and Appendix J2 of this dissertation. A summary of the results is presented in Table 26. The results indicate the higher contribution of the operating cost to the total LCC. It does however not influence the choice of most attractive configuration as indicated in Table 26 for the same reason that has been provided for an increase in electrical tariff or additional static head namely the fact that Configuration 1 remains as the configuration with the lowest operating cost.

Table 26: LCC - Lowest Configuration (% indicated) - Lower Discount Rate (2%)

Series	Original Input (4% Discount Rate)		2.0% Discount Rate	
	Lowest Configuration	% (relative to DG)	Lowest Configuration	% (relative to DG)
2.1.1	Configuration 1	68.44%	Configuration 1	68.34%
2.1.2	Configuration 1	84.46%	Configuration 1	84.31%
2.1.3	Configuration 1	91.50%	Configuration 1	91.46%
2.1.4	Configuration 1	98.18%	Configuration 1	98.18%
2.2.1	Configuration 1	68.81%	Configuration 1	68.75%
2.2.2	Configuration 1	83.52%	Configuration 1	83.43%
2.2.3	Configuration 1	90.62%	Configuration 1	90.63%
2.2.4	Configuration 1	97.89%	Configuration 1	97.91%
2.3.1	Configuration 1	66.59%	Configuration 1	66.50%
2.3.2	Configuration 1	81.82%	Configuration 1	81.69%
2.3.3	Configuration 1	89.27%	Configuration 1	89.30%
2.3.4	Configuration 1	97.08%	Configuration 1	97.11%
2.4.1	Configuration 1	68.27%	Configuration 1	68.22%
2.4.2	Configuration 1	82.59%	Configuration 1	82.51%
2.4.3	Configuration 1	90.22%	Configuration 1	90.24%
2.4.4	Configuration 1	97.66%	Configuration 1	97.68%

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Series	Original Input (4% Discount Rate)		2.0% Discount Rate	
	Lowest Configuration	% (relative to DG)	Lowest Configuration	% (relative to DG)
1.2.1	Configuration 1	63.97%	Configuration 1	63.91%
1.2.2	Configuration 1	80.99%	Configuration 1	80.89%
1.2.3	Configuration 1	89.12%	Configuration 1	89.12%
1.2.4	Configuration 1	97.21%	Configuration 1	97.23%
1.4.1	Configuration 1	63.35%	Configuration 1	63.30%
1.4.2	Configuration 1	79.92%	Configuration 1	79.83%
1.4.3	Configuration 1	88.55%	Configuration 1	88.57%
1.4.4	Configuration 1	96.90%	Configuration 1	96.92%
3.1.1	Configuration 1	68.74%	Configuration 1	68.64%
3.1.4	Configuration 1	98.25%	Configuration 1	98.25%
3.4.1	Configuration 1	68.34%	Configuration 1	68.29%
3.4.4	Configuration 1	97.72%	Configuration 1	97.73%
4.1.1	Configuration 1	70.94%	Configuration 1	70.85%
4.1.4	Configuration 1	102.42%	Configuration 1	102.43%
4.4.1	Configuration 1	70.53%	Configuration 1	70.49%
4.4.4	Configuration 1	103.03%	Configuration 1	103.01%

Effect of No Salvage Value

Lastly the removal of salvage cost from the analyses was applied to complete the evaluation of effect of variation in fixed input. The summary of these results is found in Appendix K1 and Appendix K2 and Table 27.

This variation was found to have almost no effect due to the long design life being applied. Both total LCC costs as well as the difference between lowest configurations in relation to deterministically determined configurations (Table 27) indicates negligible change and is not considered a great factor influencing decision making.

Table 27: LCC - Lowest Configuration (% indicated) - No Salvage Value

Series	Original Input		No salvage value	
	Lowest Configuration	% (relative to DG)	Lowest Configuration	% (relative to DG)
2.1.1	Configuration 1	68.44%	Configuration 1	68.47%
2.1.2	Configuration 1	84.46%	Configuration 1	84.50%
2.1.3	Configuration 1	91.50%	Configuration 1	91.53%
2.1.4	Configuration 1	98.18%	Configuration 1	98.19%
2.2.1	Configuration 1	68.81%	Configuration 1	68.83%

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Series	Original Input		No salvage value	
	Lowest Configuration	% (relative to DG)	Lowest Configuration	% (relative to DG)
2.2.2	Configuration 1	83.52%	Configuration 1	83.56%
2.2.3	Configuration 1	90.62%	Configuration 1	90.65%
2.2.4	Configuration 1	97.89%	Configuration 1	97.90%
2.3.1	Configuration 1	66.59%	Configuration 1	66.60%
2.3.2	Configuration 1	81.82%	Configuration 1	81.85%
2.3.3	Configuration 1	89.27%	Configuration 1	89.34%
2.3.4	Configuration 1	97.08%	Configuration 1	97.11%
2.4.1	Configuration 1	68.27%	Configuration 1	68.29%
2.4.2	Configuration 1	82.59%	Configuration 1	82.62%
2.4.3	Configuration 1	90.22%	Configuration 1	90.25%
2.4.4	Configuration 1	97.66%	Configuration 1	97.67%
1.2.1	Configuration 1	63.97%	Configuration 1	64.00%
1.2.2	Configuration 1	80.99%	Configuration 1	81.03%
1.2.3	Configuration 1	89.12%	Configuration 1	89.15%
1.2.4	Configuration 1	97.21%	Configuration 1	97.22%
1.4.1	Configuration 1	63.35%	Configuration 1	63.38%
1.4.2	Configuration 1	79.92%	Configuration 1	79.95%
1.4.3	Configuration 1	88.55%	Configuration 1	88.58%
1.4.4	Configuration 1	96.90%	Configuration 1	96.91%
3.1.1	Configuration 1	68.74%	Configuration 1	68.77%
3.1.4	Configuration 1	98.25%	Configuration 1	98.25%
3.4.1	Configuration 1	68.34%	Configuration 1	68.36%
3.4.4	Configuration 1	97.72%	Configuration 1	97.72%
4.1.1	Configuration 1	70.94%	Configuration 1	70.97%
4.1.4	Configuration 1	102.42%	Configuration 1	102.41%
4.4.1	Configuration 1	70.53%	Configuration 1	70.55%
4.4.4	Configuration 1	103.03%	Configuration 1	103.02%

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CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSIONS

The design of bulk water supply systems has in the past predominately been done using deterministic guidelines for the sizing of infrastructure components (Nel & Haarhoff, 1996). The advantage of these methods is the ease and simplicity of these methods but it has been found that it does not necessarily result in the most optimal solution (van Zyl & Haarhoff, 1999). Previous studies have concluded that both the determination of size and the choice of layout with the use of deterministic guidelines yield conservative designs. The use of deterministic guidelines has however been used due to the lack of other feasible alternatives. The introduction of personal computers over the last couple of decades has however changed this and new design methods have entered the world of the designer.

The conditions imposed on bulk water supply system are probabilistic in nature. The use of risk-based analysis is an example of new techniques introduced as a result of the availability of greater computational power in the form of present day personal computers. Risk-based analysis such as Monte Carlo simulation, the method utilized during this investigation, relies on such computational power.

Studies by the University of Johannesburg, amongst others, have shown the advantages of using risk-based design techniques. The financial aspect of the advantages has however not been investigated. This investigation addresses that shortcoming. The financial variation for various probabilistic inputs, hydraulic conditions and layout configurations was determined, analysed and interpreted. This yielded a number of conclusions.

For the purpose of the study it was deemed that a bulk water supply system with a failure return period (FRT) of 1 in 10 years under peak seasonal demand conditions would be sufficient. Reservoir sizes were therefore determined that would result in the required reliability of the bulk water supply system.

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The determination of reservoir sizes confirmed that the use of risk-based analysis lead to smaller reservoir sizes than those determined using deterministic guidelines. It indicated that the feeder pipe length plays a major role in the extent of the differences between the results from the two design approaches. This study applied a variation in feeder pipe length from 1000 m to 25 000 m. It was determined that for feeder pipe length of 1000m, reservoir sizes which are approximately 30 % smaller when risk-based design approaches are used. The feeder pipe length was revealed as a major factor in the determination of reservoir size whilst a variation in the size of development served did not influence the size of the reservoir when expressed in terms of the average user demand. A system with one feeder pipe required the largest reservoir size when compared to other feeder pipe configurations.

The evaluation of the effect of variation in the stochastic variables on the required reservoir size indicated that demand pattern has a moderate effect with approximately 15 % smaller sizes required for pipe lengths of 1000m. The effect of demand pattern reduces with a decrease in pipe length. A variation fire rate was found to be almost negligible. A variation in the rate of pipe failure occurrence showed similar results as an increase in pipe length with it having moderate to severe implications, dependent on pipe length.

The conclusions for the determination of reservoir size are summarized in Table 28.

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Table 28: Reservoir Size - Conclusions

Description of Conclusion	Conclusion
Risk- based design vs. Deterministic design	Risk-based design yield smaller sizes, the shorter the feeder pipe length the bigger the difference between the resulting size determinations
Effect of Configuration	Single feeder pipe requires the largest sizes. The longer the length, the bigger the difference between resulting sizes. Configuration yielding high reliability (parallel feeders, interconnection pipes) is not substantially affected by higher failure inducing events i.t.o reservoir requirements.
Effect of variation in AADD	Negligible (when expressed in terms of hours of AADD)
Effect of variation in Feeder Pipe Length	Moderate to severe
Effect of variation in User Demand Pattern	Moderate effect
Effect of variation in Fire Rate	Negligible

Description of Conclusion	Conclusion
Effect of variation in pipe failure	Moderate to Severe effect (dependent on feeder pipe length)

The results for capital cost and recurring cost were reported separately. There after the results obtained from the determination of the total life cycle cost (LCC) were discussed to complete the reporting of financial implications.

The evaluation of the determined capital cost revealed that pumping stations are not major contributors to the total capital cost, regardless of variation in the stochastic, hydraulic and physical variables. The cost of storage (reservoir) and conveyance (feeder pipe system) are the major contributors and are mainly dependent on the length of the feeder pipe. The longer the length, the more does the feeder pipe contribute to the capital cost and the storage cost less. Similarly to capital cost, the use of risk-based methods have significant associated financial advantages of as high as 30 % in comparison with design using deterministic guidelines.

The evaluation of the recurring cost revealed Configuration 1 as the lowest cost alternative. This advantage is reinforced with an increase in feeder pipe length. Operational cost increases substantially as a cost driver with an increase in length.

The evaluation of the total LCC's indicated that bulk water supply systems with single feeder pipes have, in all cases, the lowest associated cost. A trend was observed that indicated the possibility that this could not be the case for feeder pipe length shorter than 1000 m in length. The cost evaluation indicated that significant financial saving is possible with the use of risk-based design methods compared to deterministically derived designs. Capital cost remains the largest driver to the total LCC across all the analysed variations in input.

The effect of variation in electrical tariffs, static head, discount rate and salvage value were found to be insignificant. Although a cost variation is observed it does not influence the choice of favoured configuration. The summary of conclusions drawn from the financial evaluation is presented in Table 29.

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Table 29: Financial Analysis - Conclusions

Description of Conclusion		Conclusion
Capital Cost	Risk- based design vs. Deterministic design	Risk-based design yield less expensive designs, the shorter the feeder pipe length the bigger the saving.
	Effect of Configuration	Not a significant difference between the least and second-least expensive configuration.
	Effect of variation in AADD	Negligible
Recurring Cost	Effect of Configuration	Configuration 1 lowest cost. Increase in length increases Configuration 1 attractiveness
	Contribution of operational Cost	Increase in length increase contribution of operational cost dramatically.
Life Cycle Cost	Effect of Configuration	Configuration 1 lowest cost. Increase in length increases Configuration 1 attractiveness
	Contribution of Capital Cost	Largest contributor, regardless of variation in input.
	Effect of other variation (electrical, static head, interest rate and salvage cost)	Negligible to choice of configuration

7.2 RECOMMENDATIONS

From the preceding conclusions a number of recommendations can be made. The recommendations are made to three groups of the water industry namely, the designer, the water services provider and institutions interested in conducting further study.

Designers are recommended to take note of the following when designing bulk water supply systems:

- The use of risk-based design techniques is especially advantageous in the design of bulk water supply systems with short feeder pipe lengths;
- The designer of bulk water supply systems with longer feeder pipe lengths should focus on reducing the capital cost of the feeder pipe and the associated operating cost;
- The consideration of parallel feeder pipe sections or interconnections are not recommended except when sections of the pipelines are exposed to higher failure probabilities; and

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- The use of parallel feeder pipe sections in the case of short feeder pipe lengths can be advantageous due to the small contribution of the feeder pipe in the total cost where small lengths are considered.

Water Services Providers are recommended to take note of the following:

- The use of risk-based design can have significant financial advantages; and
- The collations of information such as pipe break statistics and demand patterns, not only for the management of assets, but also to aid the designer in the application of risk-based design is vitally important to ensure project specific designs.

The following further studies are recommended in this field of engineering:

- This study used a deterministic method in sizing the feeder pipe. It is recommended that other methods be used and its effect on the reservoir size and overall financial implication be evaluated;
- The financial advantage of risk-based designs for use with shorter feeder pipe lengths need to be ascertained;
- The advantage of considering parallel sections or interconnections over sections where higher probability of pipe failure is expected is to be investigated;
- The effect of an increase in water demand on the choice of configuration and construction scheduling; and
- The simulation of the source as a pumping station, with behaviour similar to that of a pump with the pump curve, needs to be accommodated.

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CHAPTER 8: BIBLIOGRAPHY

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CHAPTER 9: DECLARATION

I know the meaning of plagiarism and declare that all the work in the document, save for that which is properly acknowledged, is my own.

Signed Signed by candidate Date 01 DECEMBER 2010

APPENDIX A: MOCASIM II RESULTS

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Input models	AWSS 2.1.1.1 and 2.1.1.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	20									

Configuration 1

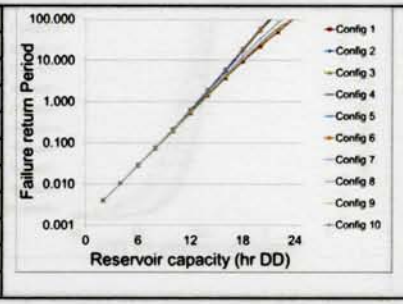
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FR
2	144	5581143	4.215	3.196	0.000	36.084	254.640	1073.245	0.004	-2.406	
4	288	2107110	3.932	2.816	0.000	34.991	96.137	377.975	0.010	-1.983	
6	432	770468	3.535	2.508	0.000	33.925	35.153	124.258	0.028	-1.546	
8	576	300324	3.249	2.358	0.000	32.918	13.702	44.522	0.073	-1.137	
10	720	113204	3.128	2.334	0.000	31.712	5.165	16.155	0.194	-0.713	
12	864	41751	3.109	2.375	0.000	30.204	1.905	5.922	0.525	-0.280	
14	1008	15421	3.144	2.427	0.000	28.454	0.704	2.212	1.421	0.153	
16	1152	5810	3.169	2.524	0.001	27.024	0.265	0.840	3.772	0.577	
18	1296	2290	3.221	2.673	0.001	25.726	0.104	0.337	9.571	0.981	18.1048
20	1440	992	3.205	2.773	0.014	24.062	0.045	0.145	22.095	1.344	
22	1584	444	3.151	2.892	0.017	21.069	0.020	0.064	49.364	1.693	
24	1728	199	3.224	2.959	0.040	17.919	0.009	0.029	110.140	2.042	

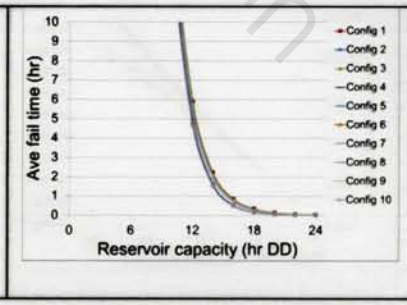
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	144	5583900	4.212	3.190	0.000	17.485	254.765	1072.980	0.004	-2.406	
4	288	2103832	3.922	2.803	0.000	17.301	95.987	376.432	0.010	-1.982	
6	432	759446	3.518	2.481	0.000	17.301	34.650	121.905	0.029	-1.540	
8	576	289346	3.218	2.297	0.000	17.301	13.201	42.488	0.076	-1.121	
10	720	105239	3.063	2.224	0.000	17.301	4.802	14.706	0.208	-0.681	
12	864	36521	2.992	2.212	0.001	17.226	1.666	4.986	0.600	-0.222	
14	1008	12047	2.984	2.194	0.002	16.907	0.550	1.640	1.819	0.260	
16	1152	4021	2.877	2.173	0.001	16.742	0.183	0.528	5.451	0.736	17.0675
18	1296	1290	2.833	2.194	0.001	16.577	0.059	0.167	16.991	1.230	
20	1440	412	2.899	2.326	0.002	16.413	0.019	0.054	53.199	1.726	
22	1584	154	2.924	2.701	0.021	16.248	0.007	0.021	142.323	2.153	
24	1728	75	2.883	2.845	0.055	16.083	0.003	0.010	292.237	2.466	

SUMMARY: Series 2.1.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	18.10	10
2	17.07	6
3	16.95	4
4	16.98	5
5	16.92	2
6	16.94	3
7	17.55	7
8	17.87	8
9	17.95	9
10	16.86	1





Not to be used for tender

Input models	AWSS 2.1.2.1 and 2.1.2.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	20								

Configuration 1

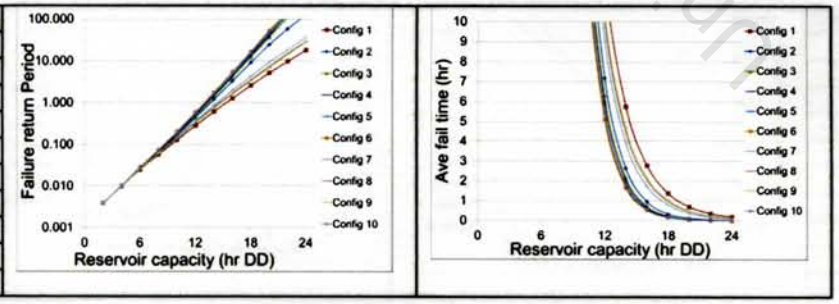
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	144	5698293	4.247	3.228	0.000	40.661	259.985	1104.196	0.004	-2.415	
4	288	2247346	3.980	2.879	0.000	38.541	102.535	408.106	0.010	-2.011	
6	432	889862	3.634	2.653	0.000	34.188	40.600	147.556	0.025	-1.609	
8	576	388865	3.439	2.601	0.000	32.293	17.742	61.016	0.056	-1.249	
10	720	172242	3.403	2.649	0.000	30.582	7.859	26.743	0.127	-0.895	
12	864	77988	3.431	2.716	0.000	28.860	3.558	12.209	0.281	-0.551	
14	1008	36091	3.490	2.778	0.000	27.185	1.647	5.747	0.607	-0.217	
16	1152	17338	3.531	2.827	0.000	25.915	0.791	2.793	1.264	0.102	
18	1296	8476	3.570	2.875	0.001	24.180	0.387	1.380	2.586	0.413	
20	1440	4258	3.623	2.914	0.001	22.095	0.194	0.704	5.147	0.712	
22	1584	2253	3.595	2.909	0.004	20.257	0.103	0.370	9.728	0.988	22.08735
24	1728	1199	3.566	2.836	0.018	17.537	0.055	0.195	18.280	1.262	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	144	5714547	4.240	3.206	0.000	32.417	260.726	1105.594	0.004	-2.416	
4	288	2230891	3.948	2.828	0.000	26.747	101.784	401.812	0.010	-2.008	
6	432	843766	3.579	2.538	0.000	25.099	38.497	137.772	0.026	-1.585	
8	576	340285	3.324	2.389	0.000	23.962	15.526	51.600	0.064	-1.191	
10	720	133376	3.186	2.343	0.000	22.256	6.085	19.389	0.164	-0.784	
12	864	49831	3.158	2.346	0.000	19.545	2.274	7.180	0.440	-0.357	
14	1008	18343	3.146	2.356	0.000	15.320	0.837	2.633	1.195	0.077	
16	1152	6700	3.128	2.364	0.001	14.311	0.306	0.956	3.271	0.515	
18	1296	2404	3.162	2.438	0.005	14.167	0.110	0.347	9.117	0.960	18.18877
20	1440	903	3.216	2.460	0.006	14.071	0.041	0.133	24.272	1.385	
22	1584	379	3.153	2.468	0.018	14.071	0.017	0.055	57.831	1.762	
24	1728	172	3.155	2.608	0.013	14.071	0.008	0.025	127.429	2.105	

SUMMARY: Series 2.1.2 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	22.09	10
2	18.19	6
3	17.64	5
4	17.45	4
5	17.27	3
6	17.08	1
7	20.21	7
8	20.82	8
9	21.07	9
10	17.17	2



UWC Technology Park

Input models	AWSS 2.1.3.1 and 2.1.3.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	20									

Configuration 1

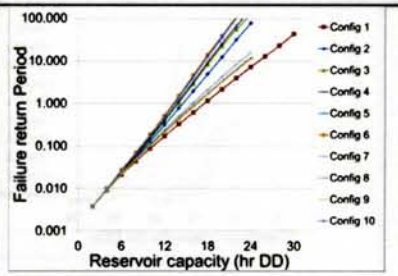
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
8	576	505258	3.607	2.788	0.000	37.300	23.052	83.157	0.043	-1.363	
10	720	251471	3.598	2.843	0.000	37.300	11.473	41.280	0.087	-1.060	
12	864	128154	3.640	2.901	0.000	35.625	5.847	21.283	0.171	-0.767	
14	1008	66838	3.682	2.941	0.000	32.404	3.049	11.227	0.328	-0.484	
16	1152	35474	3.694	2.984	0.000	30.660	1.619	5.979	0.618	-0.209	
18	1296	18807	3.728	3.038	0.000	29.518	0.858	3.198	1.165	0.066	
20	1440	10182	3.756	3.083	0.000	28.587	0.465	1.745	2.153	0.333	
22	1584	5559	3.795	3.109	0.000	27.620	0.254	0.963	3.943	0.596	
24	1728	3056	3.865	3.140	0.000	25.819	0.139	0.539	7.172	0.856	25.15425
26	1872	1718	3.843	3.143	0.000	23.468	0.078	0.301	12.758	1.106	
28	2016	959	3.763	3.217	0.000	20.755	0.044	0.165	22.855	1.359	
30	2160	510	3.810	3.297	0.000	17.748	0.023	0.089	42.976	1.633	

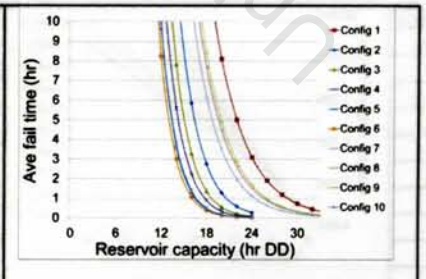
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
8	576	409151	3.423	2.480	0.000	23.764	18.668	63.900	0.054	-1.271	
10	720	172049	3.310	2.456	0.000	22.016	7.850	25.985	0.127	-0.895	
12	864	69730	3.297	2.478	0.000	22.016	3.181	10.491	0.314	-0.503	
14	1008	28009	3.302	2.486	0.000	22.016	1.278	4.219	0.783	-0.107	
16	1152	11240	3.282	2.480	0.000	19.494	0.513	1.683	1.950	0.290	
18	1296	4466	3.272	2.440	0.001	17.690	0.204	0.667	4.908	0.691	19.55703
20	1440	1790	3.213	2.406	0.000	16.727	0.082	0.262	12.245	1.088	
22	1584	696	3.213	2.405	0.011	16.186	0.032	0.102	31.491	1.498	
24	1728	287	3.147	2.489	0.071	15.655	0.013	0.041	76.369	1.883	
26	144	5876994	4.277	3.225	0.000	35.043	268.138	1146.818	0.004	-2.428	
28	288	2393062	3.979	2.855	0.000	28.171	109.183	434.397	0.009	-2.038	
30	432	954376	3.642	2.596	0.000	25.785	43.543	158.593	0.023	-1.639	

SUMMARY: Series 2.1.3 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	25.15	10
2	19.56	6
3	18.40	5
4	18.17	4
5	17.63	3
6	17.40	1
7	22.58	7
8	23.41	8
9	23.67	9
10	17.56	2





University of Stellenbosch

Input models	AWSS 2.1.4.1 and 2.1.4.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	80									

Configuration 1

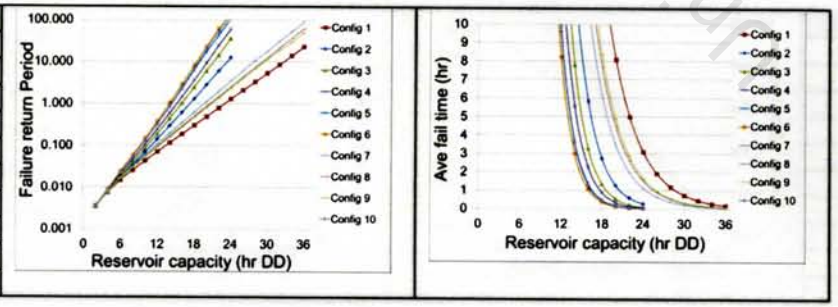
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	1008	190862	3.939	3.177	0.000	39.452	8.708	34.298	0.115	-0.940	
16	1152	117644	3.941	3.194	0.000	36.384	5.368	21.151	0.186	-0.730	
18	1296	72795	3.932	3.205	0.000	35.349	3.321	13.060	0.301	-0.521	
20	1440	45043	3.936	3.221	0.000	34.854	2.055	8.088	0.487	-0.313	
22	1584	27783	3.949	3.226	0.000	32.983	1.268	5.006	0.789	-0.103	
24	1728	17159	3.954	3.228	0.001	29.844	0.783	3.095	1.277	0.106	
26	1872	10626	3.960	3.224	0.002	28.348	0.485	1.920	2.063	0.314	
28	2016	6667	3.922	3.214	0.003	27.039	0.304	1.193	3.288	0.517	
30	2160	4111	3.934	3.195	0.003	25.810	0.188	0.738	5.332	0.727	
32	2304	2590	3.857	3.181	0.004	24.366	0.118	0.456	8.462	0.927	32.68254076
34	2448	1588	3.846	3.128	0.004	21.781	0.072	0.279	13.802	1.140	
36	2592	959	3.918	3.045	0.004	17.443	0.044	0.171	22.855	1.359	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	144	6361451	4.380	3.283	0.000	37.714	290.241	1271.114	0.003	-2.463	
4	288	2884115	4.073	2.942	0.000	37.661	131.588	535.981	0.008	-2.119	
6	432	1309706	3.810	2.748	0.000	36.591	59.755	227.643	0.017	-1.776	
8	576	646327	3.665	2.682	0.000	35.290	29.489	108.063	0.034	-1.470	
10	720	319628	3.601	2.669	0.000	34.092	14.583	52.509	0.069	-1.164	
12	864	156539	3.566	2.678	0.000	32.718	7.142	25.466	0.140	-0.854	
14	1008	75198	3.566	2.681	0.000	30.743	3.431	12.233	0.291	-0.535	
16	1152	36017	3.558	2.665	0.001	28.475	1.643	5.846	0.609	-0.216	
18	1296	17138	3.517	2.663	0.001	27.161	0.782	2.750	1.279	0.107	
20	1440	7903	3.546	2.666	0.000	25.903	0.361	1.279	2.773	0.443	
22	1584	3684	3.523	2.616	0.001	24.771	0.168	0.592	5.949	0.774	23.40705211
24	1728	1761	3.382	2.528	0.004	23.032	0.080	0.272	12.446	1.095	

SUMMARY: Series 2.1.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
	32.68	10
	23.41	6
	21.18	5
	20.18	4
	18.94	3
	18.40	1
	27.79	7
	29.19	8
	29.52	9
0	18.71	2



Uncontrolled when printed

Input models	AWSS 2.2.1.1 and 2.2.1.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	80									

Configuration 1

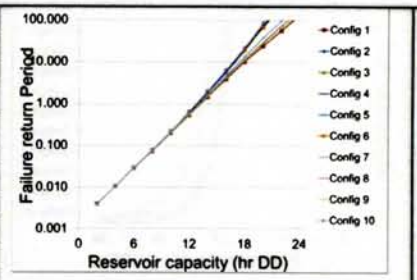
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	576	5575417	4.215	3.195	0.000	36.084	254.378	1072.317	0.004	-2.405	
4	1152	2103002	3.933	2.815	0.000	34.991	95.949	377.335	0.010	-1.982	
6	1728	767950	3.535	2.507	0.000	33.925	35.038	123.865	0.029	-1.545	
8	2304	298764	3.249	2.356	0.000	32.918	13.631	44.292	0.073	-1.135	
10	2880	112328	3.128	2.331	0.000	31.712	5.125	16.030	0.195	-0.710	
12	3456	41253	3.109	2.371	0.000	30.204	1.882	5.852	0.531	-0.275	
14	4032	15121	3.150	2.425	0.000	28.454	0.690	2.173	1.449	0.161	
16	4608	5623	3.190	2.525	0.001	27.024	0.257	0.818	3.898	0.591	17.99344
18	5184	2185	3.248	2.675	0.001	25.726	0.100	0.324	10.031	1.001	
20	5760	917	3.268	2.787	0.018	24.062	0.042	0.137	23.902	1.378	
22	6336	393	3.266	2.935	0.017	21.069	0.018	0.059	55.771	1.746	
24	6912	164	3.454	3.070	0.043	17.919	0.007	0.026	133.645	2.126	

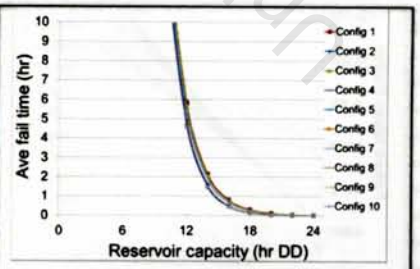
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	5578277	4.212	3.189	0.000	17.180	254.509	1072.053	0.004	-2.406	
4	1152	2099762	3.922	2.802	0.000	17.180	95.802	375.776	0.010	-1.981	
6	1728	756859	3.519	2.479	0.000	16.377	34.532	121.500	0.029	-1.538	
8	2304	287796	3.217	2.293	0.000	16.170	13.131	42.245	0.076	-1.118	
10	2880	104280	3.061	2.218	0.000	16.170	4.758	14.566	0.210	-0.677	
12	3456	36008	2.989	2.201	0.001	16.059	1.643	4.911	0.609	-0.216	
14	4032	11744	2.980	2.174	0.002	15.277	0.536	1.597	1.866	0.271	
16	4608	3831	2.861	2.134	0.001	14.536	0.175	0.500	5.721	0.757	16.93481
18	5184	1160	2.807	2.103	0.001	13.838	0.053	0.149	18.895	1.276	
20	5760	322	2.882	2.136	0.019	13.196	0.015	0.042	68.068	1.833	
22	6336	89	2.905	2.559	0.021	12.534	0.004	0.012	246.268	2.391	
24	6912	24	3.359	2.904	0.071	11.513	0.001	0.004	913.242	2.961	

SUMMARY: Series 2.2.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	17.99	10
2	16.93	6
3	16.82	4
4	16.83	5
5	16.78	2
6	16.80	3
7	17.44	7
8	17.74	8
9	17.83	9
10	16.72	1





Junkyard Design Tool

Input models	AWSS 2.2.2.1 and 2.2.2.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	80								

Configuration 1

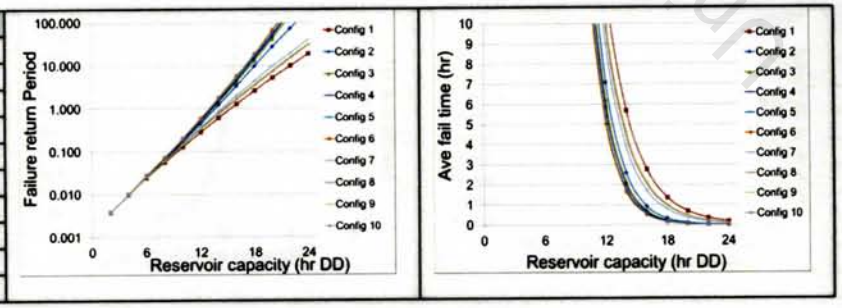
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	576	5692765	4.248	3.227	0.000	40.661	259.732	1103.271	0.004	-2.415	
4	1152	2243364	3.981	2.879	0.000	38.541	102.353	407.459	0.010	-2.010	
6	1728	887246	3.635	2.652	0.000	34.188	40.481	147.136	0.025	-1.607	
8	2304	387169	3.439	2.600	0.000	32.293	17.665	60.753	0.057	-1.247	
10	2880	171222	3.404	2.648	0.000	30.582	7.812	26.591	0.128	-0.893	
12	3456	77376	3.432	2.714	0.000	28.860	3.530	12.116	0.283	-0.548	
14	4032	35705	3.492	2.776	0.000	27.185	1.629	5.689	0.614	-0.212	
16	4608	17092	3.533	2.826	0.000	25.915	0.780	2.755	1.282	0.108	
18	5184	8323	3.578	2.874	0.001	24.180	0.380	1.359	2.633	0.421	
20	5760	4168	3.632	2.914	0.001	22.095	0.190	0.691	5.259	0.721	
22	6336	2202	3.595	2.902	0.004	20.257	0.100	0.361	9.954	0.998	22.01442
24	6912	1155	3.578	2.836	0.018	17.537	0.053	0.189	18.976	1.278	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	5708936	4.241	3.205	0.000	32.417	260.470	1104.633	0.004	-2.416	
4	1152	2226615	3.949	2.828	0.000	26.747	101.589	401.129	0.010	-2.007	
6	1728	841193	3.579	2.536	0.000	25.099	38.379	137.353	0.026	-1.584	
8	2304	338671	3.323	2.386	0.000	23.962	15.452	51.345	0.065	-1.189	
10	2880	132352	3.185	2.339	0.000	22.256	6.039	19.232	0.166	-0.781	
12	3456	49232	3.156	2.338	0.000	19.545	2.246	7.089	0.445	-0.351	
14	4032	17967	3.144	2.344	0.001	15.321	0.820	2.578	1.220	0.086	
16	4608	6459	3.123	2.338	0.000	13.891	0.295	0.920	3.393	0.531	
18	5184	2238	3.158	2.393	0.005	13.614	0.102	0.322	9.793	0.991	18.04037
20	5760	796	3.202	2.365	0.007	12.161	0.036	0.116	27.535	1.440	
22	6336	300	3.145	2.307	0.079	11.315	0.014	0.043	73.059	1.864	
24	6912	114	3.140	2.352	0.013	10.716	0.005	0.016	192.261	2.284	

SUMMARY: Series 2.2.2 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	22.01	10
2	18.04	6
3	17.53	5
4	17.33	4
5	17.15	3
6	16.95	1
7	20.07	7
8	20.71	8
9	21.00	9
10	17.04	2



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Input models	AWSS 2.2.3.1 and 2.2.3.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	80									

Configuration 1

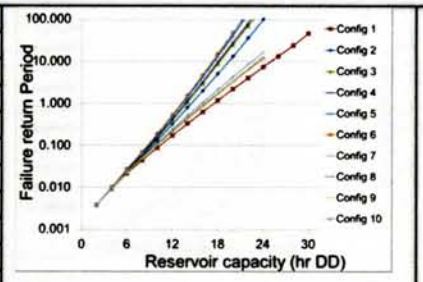
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
8	2304	503488	3.607	2.787	0.000	37.300	22.972	82.869	0.044	-1.361	
10	2880	250365	3.598	2.842	0.000	37.300	11.423	41.095	0.088	-1.058	
12	3456	127418	3.640	2.899	0.000	35.625	5.813	21.163	0.172	-0.764	
14	4032	66349	3.682	2.940	0.000	32.404	3.027	11.147	0.330	-0.481	
16	4608	35144	3.696	2.983	0.000	30.660	1.603	5.926	0.624	-0.205	
18	5184	18597	3.727	3.038	0.000	29.518	0.848	3.162	1.179	0.071	
20	5760	10025	3.760	3.080	0.000	28.587	0.457	1.720	2.186	0.340	
22	6336	5464	3.790	3.104	0.000	27.620	0.249	0.945	4.011	0.603	
24	6912	2976	3.866	3.137	0.000	25.819	0.136	0.525	7.365	0.867	25.05008
26	7488	1662	3.847	3.134	0.000	23.468	0.076	0.292	13.188	1.120	
28	8064	918	3.771	3.220	0.000	20.756	0.042	0.158	23.876	1.378	
30	8640	475	3.862	3.323	0.000	17.748	0.022	0.084	46.143	1.664	

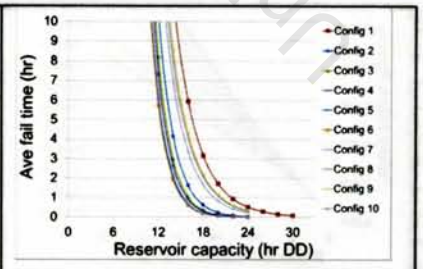
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	5871525	4.278	3.225	0.000	35.043	267.888	1145.892	0.004	-2.428	
4	1152	2388900	3.979	2.855	0.000	28.171	108.994	433.719	0.009	-2.037	
6	1728	951683	3.642	2.595	0.000	25.785	43.421	158.156	0.023	-1.638	
8	2304	407296	3.423	2.478	0.000	23.765	18.583	63.610	0.054	-1.269	
10	2880	170866	3.310	2.453	0.000	22.017	7.796	25.804	0.128	-0.892	
12	3456	68999	3.297	2.473	0.000	22.017	3.148	10.380	0.318	-0.498	
14	4032	27583	3.298	2.476	0.000	22.017	1.258	4.151	0.795	-0.100	
16	4608	10960	3.279	2.467	0.000	19.495	0.500	1.640	2.000	0.301	
18	5184	4287	3.265	2.418	0.000	17.691	0.196	0.639	5.113	0.709	19.43319
20	5760	1681	3.178	2.364	0.001	14.058	0.077	0.244	13.039	1.115	
22	6336	614	3.147	2.342	0.016	12.119	0.028	0.088	35.697	1.553	
24	6912	220	3.189	2.351	0.071	10.523	0.010	0.032	99.626	1.998	

SUMMARY: Series 2.2.3 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	25.05	10
2	19.43	6
3	18.27	5
4	18.05	4
5	17.53	3
6	17.27	1
7	22.48	7
8	23.31	8
9	23.57	9
10	17.42	2





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Input models	AWSS 2.2.4.1 and 2.2.4.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	20								

Configuration 1

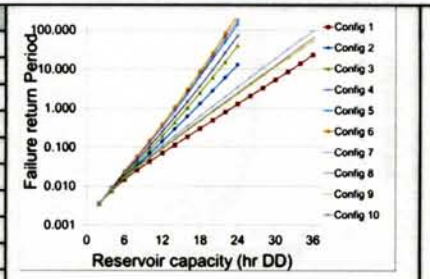
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	4032	190039	3.940	3.177	0.000	39.452	8.671	34.159	0.115	-0.938	
16	4608	117069	3.941	3.193	0.000	36.384	5.341	21.049	0.187	-0.728	
18	5184	72341	3.933	3.205	0.000	35.349	3.301	12.982	0.303	-0.519	
20	5760	44732	3.935	3.220	0.000	34.854	2.041	8.032	0.490	-0.310	
22	6336	27546	3.950	3.226	0.000	32.983	1.257	4.965	0.796	-0.099	
24	6912	16985	3.954	3.230	0.000	29.844	0.775	3.064	1.290	0.111	
26	7488	10513	3.962	3.227	0.002	28.348	0.480	1.900	2.085	0.319	
28	8064	6574	3.931	3.217	0.003	27.039	0.300	1.179	3.334	0.523	
30	8640	4047	3.942	3.201	0.001	25.810	0.185	0.728	5.416	0.734	
32	9216	2534	3.878	3.189	0.005	24.367	0.116	0.448	8.649	0.937	32.5911
34	9792	1551	3.870	3.142	0.005	21.782	0.071	0.274	14.131	1.150	
36	10368	932	3.952	3.051	0.005	17.444	0.043	0.168	23.517	1.371	

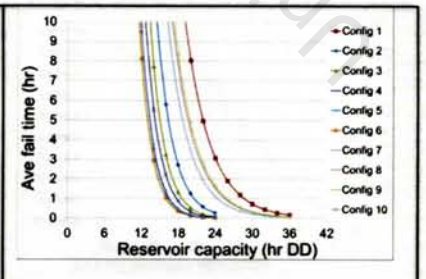
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	6356019	4.380	3.282	0.000	37.714	289.993	1270.148	0.003	-2.462	
4	1152	2879839	4.074	2.942	0.000	37.661	131.393	535.242	0.008	-2.119	
6	1728	1306582	3.810	2.747	0.000	36.592	59.613	227.115	0.017	-1.775	
8	2304	644082	3.665	2.680	0.000	35.290	29.386	107.690	0.034	-1.468	
10	2880	318049	3.601	2.667	0.000	34.092	14.511	52.252	0.069	-1.162	
12	3456	155469	3.567	2.676	0.000	32.719	7.093	25.299	0.141	-0.851	
14	4032	74556	3.567	2.678	0.001	30.744	3.402	12.134	0.294	-0.532	
16	4608	35621	3.559	2.661	0.001	28.476	1.625	5.784	0.615	-0.211	
18	5184	16883	3.517	2.655	0.000	27.161	0.770	2.709	1.298	0.113	
20	5760	7741	3.547	2.655	0.001	25.904	0.353	1.253	2.831	0.452	
22	6336	3591	3.516	2.595	0.001	24.772	0.164	0.576	6.104	0.786	23.31011
24	6912	1690	3.372	2.493	0.007	23.033	0.077	0.260	12.969	1.113	

SUMMARY: Series 2.2.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	32.59	10
2	23.31	6
3	21.06	5
4	20.07	4
5	18.81	3
6	18.25	1
7	27.68	7
8	29.14	8
9	29.41	9
10	18.60	2





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Input models	AWSS 2.3.1.1 and 2.3.1.2
Simulation period (years)	8000000
Simulation period (days)	21917.81
Daily Demand under seasonal peak (DD) (l/s)	160

Configuration 1

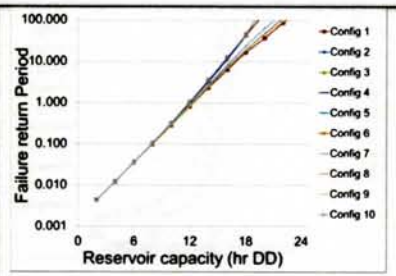
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1152	5085403	4.034	3.104	0.000	36.029	232.022	936.072	0.004	-2.366	
4	2304	1823953	3.801	2.758	0.000	34.950	83.218	316.299	0.012	-1.920	
6	3456	626858	3.414	2.446	0.000	33.896	28.600	97.649	0.035	-1.456	
8	4608	225329	3.118	2.277	0.000	32.885	10.281	32.053	0.097	-1.012	
10	5760	78509	2.994	2.256	0.000	31.666	3.582	10.725	0.279	-0.554	
12	6912	27082	2.995	2.325	0.000	30.161	1.236	3.701	0.809	-0.092	
14	8064	9550	3.049	2.414	0.000	28.404	0.436	1.329	2.295	0.361	
16	9216	3548	3.104	2.568	0.000	26.986	0.162	0.502	6.178	0.791	16.98632
18	10368	1336	3.329	2.735	0.004	25.687	0.061	0.203	16.406	1.215	
20	11520	604	3.294	2.862	0.006	24.001	0.028	0.091	36.288	1.560	
22	12672	256	3.470	3.008	0.006	20.976	0.012	0.041	85.616	1.933	
24	13824	120	3.344	3.066	0.031	17.829	0.005	0.018	182.648	2.262	

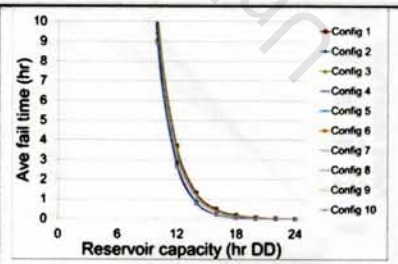
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1152	5088791	4.030	3.098	0.000	16.787	232.176	935.744	0.004	-2.366	
4	2304	1819552	3.789	2.746	0.000	16.787	83.017	314.530	0.012	-1.919	
6	3456	614511	3.398	2.414	0.000	15.291	28.037	95.263	0.036	-1.448	
8	4608	214482	3.079	2.200	0.000	15.110	9.786	30.127	0.102	-0.991	
10	5760	71155	2.900	2.105	0.000	15.110	3.246	9.414	0.308	-0.511	
12	6912	22228	2.835	2.079	0.000	13.713	1.014	2.875	0.986	-0.006	
14	8064	6752	2.787	2.046	0.000	12.502	0.308	0.859	3.246	0.511	15.80804
16	9216	1945	2.730	2.034	0.001	12.502	0.089	0.242	11.269	1.052	
18	10368	528	2.692	2.010	0.016	11.390	0.024	0.065	41.511	1.618	
20	11520	140	2.537	2.030	0.056	11.195	0.006	0.016	156.556	2.195	
22	12672	32	2.927	2.278	0.146	9.821	0.001	0.004	684.932	2.836	
24	13824	10	2.472	2.058	0.124	7.789	0.000	0.001	2191.781	3.341	

SUMMARY: Series 2.3.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	16.99	10
2	15.81	6
3	15.70	4
4	15.71	5
5	15.66	3
6	15.66	2
7	16.40	7
8	16.68	8
9	16.76	9
10	15.65	1



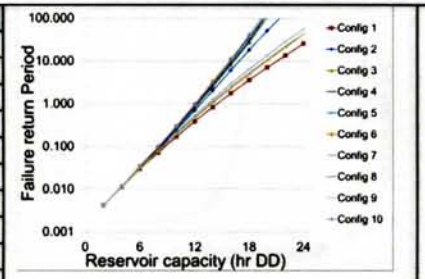


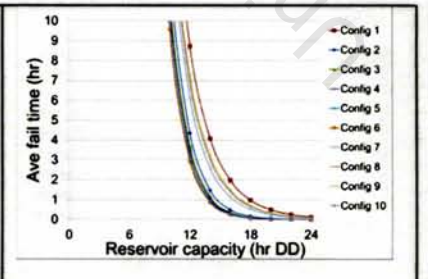
UWL acknowledges Kunyikan

Input models	AWSS 2.3.2.1 and 2.3.2.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	160									
Configuration 1										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1152	5208696	4.069	3.136	0.000	40.616	237.647	966.890	0.004	-2.376	
4	2304	1963692	3.849	2.824	0.000	38.454	89.593	344.868	0.011	-1.952	
6	3456	740347	3.520	2.600	0.000	34.048	33.778	118.885	0.030	-1.529	
8	4608	306235	3.327	2.548	0.000	32.293	13.972	46.483	0.072	-1.145	
10	5760	130279	3.297	2.609	0.000	30.582	5.944	19.597	0.168	-0.774	
12	6912	57276	3.347	2.684	0.000	28.860	2.613	8.746	0.383	-0.417	
14	8064	26297	3.408	2.747	0.000	27.185	1.200	4.089	0.833	-0.079	
16	9216	12538	3.453	2.802	0.001	25.410	0.572	1.975	1.748	0.243	
18	10368	6114	3.503	2.858	0.002	23.374	0.279	0.977	3.585	0.554	
20	11520	3105	3.537	2.893	0.009	21.627	0.142	0.501	7.059	0.849	21.09235
22	12672	1641	3.475	2.872	0.002	19.695	0.075	0.260	13.356	1.126	
24	13824	854	3.425	2.826	0.012	17.498	0.039	0.133	25.665	1.409	
Configuration 2										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1152	5224885	4.060	3.113	0.000	32.216	238.385	967.795	0.004	-2.377	
4	2304	1941911	3.813	2.768	0.000	26.255	88.600	337.863	0.011	-1.947	
6	3456	690108	3.459	2.470	0.000	24.928	31.486	108.896	0.032	-1.498	
8	4608	256990	3.186	2.294	0.000	23.740	11.725	37.358	0.085	-1.069	
10	5760	92220	3.040	2.237	0.000	21.944	4.208	12.789	0.238	-0.624	
12	6912	31801	2.995	2.246	0.000	18.984	1.451	4.345	0.689	-0.162	
14	8064	10857	2.986	2.261	0.001	14.824	0.495	1.479	2.019	0.305	
16	9216	3624	2.993	2.293	0.003	13.294	0.165	0.495	6.048	0.782	16.92516
18	10368	1222	3.055	2.368	0.011	11.973	0.056	0.170	17.936	1.254	
20	11520	431	3.064	2.278	0.008	11.123	0.020	0.060	50.853	1.706	
22	12672	160	2.940	2.240	0.045	10.780	0.007	0.021	136.986	2.137	
24	13824	44	3.551	2.203	0.184	9.992	0.002	0.007	498.132	2.697	

SUMMARY: Series 2.3.2 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	21.09	10
2	16.93	6
3	16.37	5
4	16.22	4
5	16.03	3
6	15.84	1
7	19.20	7
8	19.80	8
9	19.99	9
10	15.91	2





UNRESTRICTED

Input models	AWSS 2.3.3.1 and 2.3.3.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	160								

Configuration 1

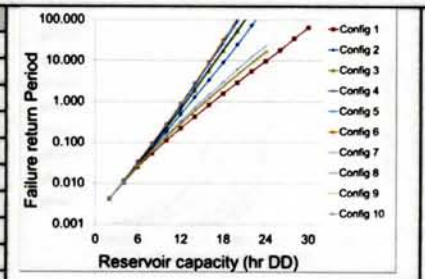
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
8	4608	413141	3.493	2.740	0.000	37.299	18.850	65.851	0.053	-1.275	
10	5760	199551	3.492	2.804	0.000	37.299	9.105	31.796	0.110	-0.959	
12	6912	100044	3.535	2.864	0.000	35.210	4.565	16.137	0.219	-0.659	
14	8064	51667	3.568	2.904	0.001	32.143	2.357	8.412	0.424	-0.372	
16	9216	26790	3.602	2.961	0.001	30.575	1.222	4.403	0.818	-0.087	
18	10368	14054	3.649	3.025	0.001	29.421	0.641	2.339	1.560	0.193	
20	11520	7542	3.675	3.069	0.000	28.493	0.344	1.265	2.906	0.463	
22	12672	4038	3.730	3.131	0.001	27.511	0.184	0.687	5.428	0.735	
24	13824	2236	3.765	3.130	0.000	25.358	0.102	0.384	9.802	0.991	24.06711
26	14976	1233	3.755	3.175	0.005	23.085	0.056	0.211	17.776	1.250	
28	16128	634	3.823	3.287	0.002	19.896	0.029	0.111	34.571	1.539	
30	17280	340	3.850	3.426	0.031	17.380	0.016	0.060	64.464	1.809	

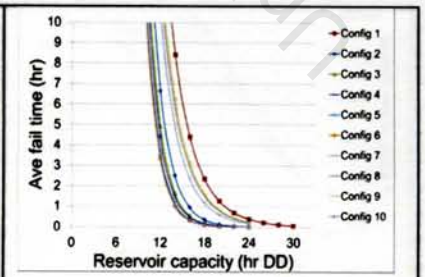
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1152	5395027	4.097	3.131	0.000	34.901	246.148	1008.538	0.004	-2.391	
4	2304	2100148	3.839	2.793	0.000	27.649	95.819	367.854	0.010	-1.981	
6	3456	791161	3.512	2.526	0.000	25.551	36.097	126.780	0.028	-1.557	
8	4608	314071	3.287	2.392	0.000	23.182	14.329	47.096	0.070	-1.156	
10	5760	121857	3.173	2.366	0.000	20.114	5.560	17.643	0.180	-0.745	
12	6912	46095	3.162	2.384	0.000	20.114	2.103	6.649	0.475	-0.323	
14	8064	17280	3.167	2.412	0.000	19.430	0.788	2.497	1.268	0.103	
16	9216	6519	3.180	2.388	0.001	17.595	0.297	0.946	3.362	0.527	
18	10368	2452	3.134	2.337	0.007	13.865	0.112	0.351	8.939	0.951	18.2214
20	11520	890	3.023	2.305	0.010	11.324	0.041	0.123	24.627	1.391	
22	12672	302	3.090	2.233	0.010	11.103	0.014	0.043	72.576	1.861	
24	13824	101	2.992	2.115	0.005	8.530	0.005	0.014	217.008	2.336	

SUMMARY: Series 2.3.3 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	24.07	10
2	18.22	6
3	17.06	5
4	16.86	4
5	16.32	3
6	16.13	1
7	21.41	7
8	22.33	8
9	22.56	9
10	16.25	2





Input models	AWSS 2.3.4.1 and 2.3.4.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	160								

Configuration 1

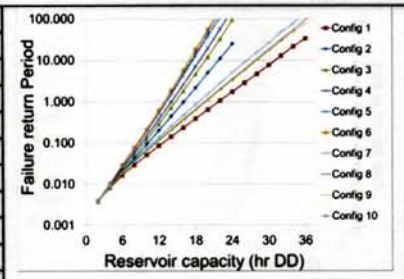
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	8064	154013	3.821	3.126	0.000	38.387	7.027	26.847	0.142	-0.847	
16	9216	92818	3.830	3.144	0.000	34.309	4.235	16.220	0.236	-0.627	
18	10368	56107	3.831	3.166	0.000	33.030	2.560	9.806	0.391	-0.408	
20	11520	33980	3.838	3.188	0.000	32.026	1.550	5.950	0.645	-0.190	
22	12672	20497	3.870	3.204	0.000	30.814	0.935	3.619	1.069	0.029	
24	13824	12598	3.850	3.201	0.000	29.477	0.575	2.213	1.740	0.240	
26	14976	7605	3.878	3.203	0.000	28.187	0.347	1.346	2.882	0.460	
28	16128	4687	3.845	3.179	0.000	27.039	0.214	0.822	4.676	0.670	
30	17280	2844	3.887	3.170	0.000	25.810	0.130	0.504	7.707	0.887	31.01594
32	18432	1703	3.846	3.174	0.000	24.367	0.078	0.299	12.870	1.110	
34	19584	1013	3.911	3.087	0.005	21.782	0.046	0.181	21.637	1.335	
36	20736	651	3.695	2.914	0.004	16.587	0.030	0.110	33.668	1.527	

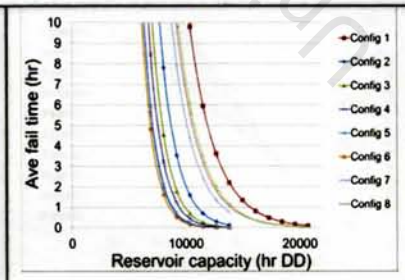
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1152	5904301	4.198	3.188	0.000	37.687	269.384	1130.997	0.004	-2.430	
4	2304	2575549	3.930	2.873	0.000	37.551	117.509	461.756	0.009	-2.070	
6	3456	1114359	3.671	2.670	0.000	36.263	50.843	186.641	0.020	-1.706	
8	4608	514988	3.523	2.588	0.000	34.994	23.496	82.769	0.043	-1.371	
10	5760	239430	3.444	2.570	0.000	33.768	10.924	37.622	0.092	-1.038	
12	6912	109664	3.424	2.586	0.000	32.312	5.003	17.133	0.200	-0.699	
14	8064	49853	3.429	2.595	0.000	29.979	2.275	7.800	0.440	-0.357	
16	9216	22658	3.423	2.591	0.001	28.023	1.034	3.539	0.967	-0.014	
18	10368	10089	3.433	2.620	0.001	26.804	0.460	1.580	2.172	0.337	
20	11520	4441	3.469	2.579	0.001	25.599	0.203	0.703	4.935	0.693	21.78717
22	12672	2015	3.319	2.450	0.001	24.346	0.092	0.305	10.877	1.037	
24	13824	874	3.212	2.407	0.003	21.973	0.040	0.128	25.078	1.399	

SUMMARY: Series 2.3.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	31.02	10
2	21.79	6
3	19.61	5
4	18.69	4
5	17.54	3
6	16.96	1
7	26.41	7
8	27.76	8
9	28.01	9
10	17.32	2





Uncontrolled when printed

Input models	AWSS 2.4.1.1 and 2.4.1.2
Simulation period (years)	8000000
Simulation period (days)	21917.81
Daily Demand under seasonal peak (DD) (l/s)	240

Configuration 1

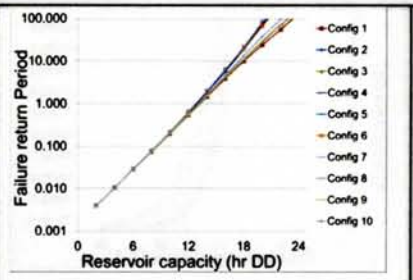
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1728	5574298	4.215	3.195	0.000	36.084	254.327	1072.091	0.004	-2.405	
4	3456	2102331	3.933	2.815	0.000	34.991	95.919	377.210	0.010	-1.982	
6	5184	767572	3.535	2.507	0.000	33.925	35.020	123.803	0.029	-1.544	
8	6912	298577	3.249	2.356	0.000	32.918	13.623	44.261	0.073	-1.134	
10	8640	112233	3.128	2.331	0.000	31.712	5.121	16.016	0.195	-0.709	
12	10368	41204	3.110	2.371	0.000	30.204	1.880	5.846	0.532	-0.274	
14	12096	15101	3.151	2.426	0.000	28.454	0.689	2.171	1.451	0.162	
16	13824	5616	3.191	2.526	0.001	27.024	0.256	0.818	3.903	0.591	17.98861
18	15552	2180	3.252	2.676	0.001	25.726	0.099	0.323	10.054	1.002	
20	17280	914	3.275	2.788	0.018	24.062	0.042	0.137	23.980	1.380	
22	19008	393	3.264	2.936	0.017	21.069	0.018	0.059	55.771	1.746	
24	20736	164	3.453	3.070	0.043	17.919	0.007	0.026	133.645	2.126	

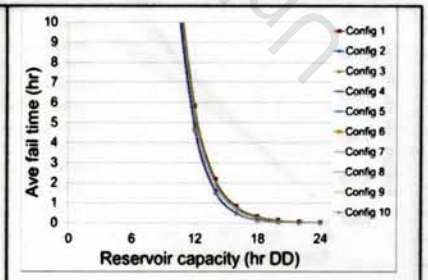
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	5577210	4.212	3.189	0.000	17.180	254.460	1071.832	0.004	-2.406	
4	3456	2099058	3.922	2.802	0.000	17.180	95.770	375.646	0.010	-1.981	
6	5184	756468	3.518	2.479	0.000	16.377	34.514	121.435	0.029	-1.538	
8	6912	287568	3.217	2.293	0.000	15.356	13.120	42.210	0.076	-1.118	
10	8640	104177	3.061	2.218	0.000	15.356	4.753	14.550	0.210	-0.677	
12	10368	35958	2.989	2.201	0.000	14.301	1.641	4.904	0.610	-0.215	
14	12096	11727	2.977	2.172	0.002	12.808	0.535	1.593	1.869	0.272	
16	13824	3816	2.859	2.126	0.001	12.769	0.174	0.498	5.744	0.759	16.92793
18	15552	1155	2.794	2.075	0.001	11.831	0.053	0.147	18.976	1.278	
20	17280	320	2.831	2.051	0.019	11.683	0.015	0.041	68.493	1.836	
22	19008	86	2.792	2.372	0.022	11.089	0.004	0.011	254.858	2.406	
24	20736	23	3.005	2.406	0.071	9.119	0.001	0.003	952.948	2.979	

SUMMARY: Series 2.4.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	17.99	10
2	16.93	6
3	16.81	4
4	16.82	5
5	16.78	2
6	16.79	3
7	17.43	7
8	17.73	8
9	17.82	9
10	16.72	1





Uniwater Adaptation Model

Input models	AWSS 2.4.2.1 and 2.4.2.2
Simulation period (years)	8000000
Simulation period (days)	21917.81
Daily Demand under seasonal peak (DD) (l/s)	240

Configuration 1

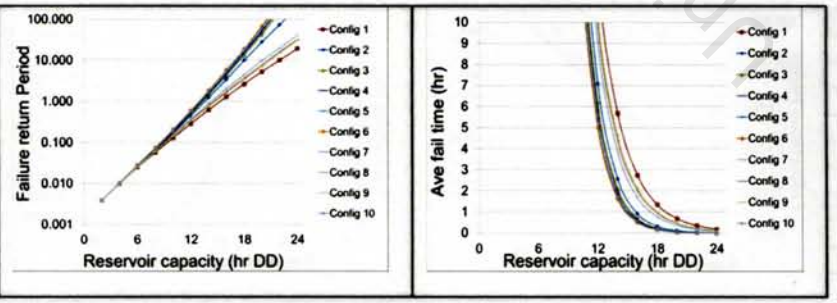
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1728	5691615	4.248	3.227	0.000	40.661	259.680	1103.042	0.004	-2.414	
4	3456	2242641	3.981	2.879	0.000	38.541	102.320	407.326	0.010	-2.010	
6	5184	886852	3.635	2.652	0.000	34.188	40.463	147.067	0.025	-1.607	
8	6912	386939	3.439	2.600	0.000	32.293	17.654	60.715	0.057	-1.247	
10	8640	171114	3.404	2.648	0.000	30.582	7.807	26.571	0.128	-0.892	
12	10368	77304	3.432	2.714	0.000	28.860	3.527	12.105	0.284	-0.547	
14	12096	35675	3.492	2.776	0.000	27.185	1.628	5.684	0.614	-0.212	
16	13824	17076	3.533	2.826	0.000	25.915	0.779	2.752	1.284	0.108	
18	15552	8317	3.576	2.874	0.001	24.180	0.379	1.357	2.635	0.421	
20	17280	4161	3.632	2.915	0.001	22.095	0.190	0.690	5.267	0.722	
22	19008	2199	3.594	2.903	0.004	20.257	0.100	0.361	9.967	0.999	22.0102
24	20736	1154	3.579	2.836	0.003	17.537	0.053	0.188	18.993	1.279	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	5707830	4.241	3.205	0.000	32.417	260.420	1104.401	0.004	-2.416	
4	3456	2225854	3.949	2.827	0.000	26.747	101.555	400.997	0.010	-2.007	
6	5184	840817	3.579	2.536	0.000	25.099	38.362	137.284	0.026	-1.584	
8	6912	338442	3.323	2.386	0.000	23.962	15.441	51.307	0.065	-1.189	
10	8640	132240	3.184	2.338	0.000	22.257	6.033	19.213	0.166	-0.781	
12	10368	49188	3.155	2.338	0.000	19.545	2.244	7.081	0.446	-0.351	
14	12096	17946	3.144	2.344	0.001	15.321	0.819	2.574	1.221	0.087	
16	13824	6443	3.125	2.337	0.000	13.891	0.294	0.919	3.402	0.532	
18	15552	2233	3.161	2.393	0.005	13.614	0.102	0.322	9.815	0.992	18.03608
20	17280	795	3.204	2.364	0.007	12.161	0.036	0.116	27.570	1.440	
22	19008	300	3.144	2.306	0.068	11.315	0.014	0.043	73.059	1.864	
24	20736	114	3.125	2.356	0.013	10.716	0.005	0.016	192.261	2.284	

SUMMARY: Series 2.4.2 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	22.01	10
2	18.04	6
3	17.53	5
4	17.32	4
5	17.14	3
6	16.94	1
7	20.07	7
8	20.71	8
9	20.95	9
10	17.03	2



Input models	AWSS 2.4.3.1 and 2.4.3.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	240									

Configuration 1

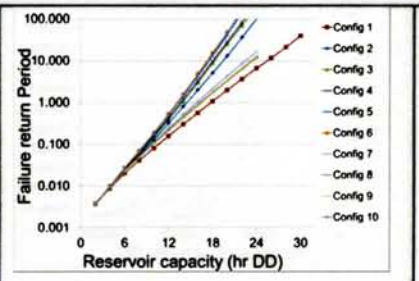
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
8	6912	539331	3.650	2.804	0.000	37.300	24.607	89.810	0.041	-1.391	
10	8640	271440	3.637	2.856	0.000	37.300	12.384	45.044	0.081	-1.093	
12	10368	139358	3.673	2.911	0.000	35.763	6.358	23.353	0.157	-0.803	
14	12096	72866	3.716	2.954	0.000	32.492	3.325	12.354	0.301	-0.522	
16	13824	38878	3.724	2.996	0.000	30.707	1.774	6.606	0.564	-0.249	
18	15552	20594	3.766	3.041	0.000	29.550	0.940	3.539	1.064	0.027	
20	17280	11103	3.800	3.087	0.000	28.618	0.507	1.925	1.974	0.295	
22	19008	6078	3.832	3.102	0.000	27.656	0.277	1.063	3.606	0.557	
24	20736	3340	3.860	3.146	0.004	25.963	0.152	0.588	6.562	0.817	25.48795
26	22464	1896	3.796	3.155	0.004	23.472	0.087	0.328	11.560	1.063	
28	24192	1043	3.791	3.215	0.002	21.135	0.048	0.180	21.014	1.323	
30	25920	560	3.773	3.283	0.008	18.036	0.026	0.096	39.139	1.593	

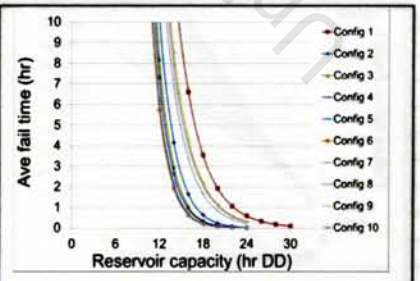
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	5870368	4.277	3.225	0.000	35.043	267.836	1145.653	0.004	-2.428	
4	3456	2388099	3.979	2.855	0.000	28.171	108.957	433.579	0.009	-2.037	
6	5184	951217	3.642	2.595	0.000	25.785	43.399	158.077	0.023	-1.637	
8	6912	407043	3.423	2.478	0.000	23.765	18.571	63.564	0.054	-1.269	
10	8640	170732	3.309	2.453	0.000	22.017	7.790	25.779	0.128	-0.892	
12	10368	68909	3.298	2.473	0.000	22.017	3.144	10.368	0.318	-0.497	
14	12096	27535	3.300	2.476	0.001	22.017	1.256	4.145	0.796	-0.099	
16	13824	10943	3.279	2.467	0.000	19.495	0.499	1.637	2.003	0.302	
18	15552	4279	3.266	2.416	0.000	17.691	0.195	0.638	5.122	0.709	19.42932
20	17280	1678	3.177	2.364	0.001	14.058	0.077	0.243	13.062	1.116	
22	19008	609	3.158	2.345	0.016	12.119	0.028	0.088	35.990	1.556	
24	20736	217	3.208	2.356	0.071	10.524	0.010	0.032	101.004	2.004	

SUMMARY: Series 2.4.3– All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	25.49	10
2	19.43	6
3	18.26	5
4	18.04	4
5	17.52	3
6	17.27	1
7	22.47	7
8	23.30	8
9	23.57	9
10	17.41	2





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Input models	AWSS 2.4.4.1 and 2.4.4.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	240								

Configuration 1

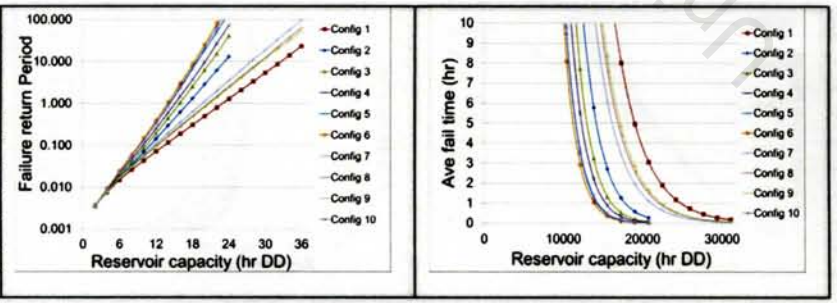
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	12096	189924	3.940	3.177	0.000	39.452	8.665	34.137	0.115	-0.938	
16	13824	116980	3.941	3.193	0.000	36.384	5.337	21.033	0.187	-0.727	
18	15552	72290	3.933	3.205	0.000	35.349	3.298	12.972	0.303	-0.518	
20	17280	44695	3.935	3.220	0.000	34.854	2.039	8.025	0.490	-0.309	
22	19008	27524	3.950	3.226	0.000	32.983	1.256	4.961	0.796	-0.099	
24	20736	16966	3.955	3.229	0.000	29.844	0.774	3.061	1.292	0.111	
26	22464	10503	3.962	3.226	0.002	28.348	0.479	1.899	2.087	0.319	
28	24192	6569	3.930	3.216	0.001	27.039	0.300	1.178	3.337	0.523	
30	25920	4039	3.946	3.200	0.001	25.810	0.184	0.727	5.427	0.735	
32	27648	2532	3.876	3.190	0.000	24.367	0.116	0.448	8.656	0.937	32.58651
34	29376	1548	3.873	3.142	0.005	21.782	0.071	0.274	14.159	1.151	
36	31104	932	3.947	3.051	0.005	17.444	0.043	0.168	23.517	1.371	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	6354920	4.380	3.282	0.000	37.714	289.943	1269.917	0.003	-2.462	
4	3456	2879036	4.074	2.942	0.000	37.661	131.356	535.093	0.008	-2.118	
6	5184	1306106	3.810	2.747	0.000	36.592	59.591	227.022	0.017	-1.775	
8	6912	643752	3.664	2.680	0.000	35.291	29.371	107.628	0.034	-1.468	
10	8640	317811	3.601	2.667	0.000	34.092	14.500	52.212	0.069	-1.161	
12	10368	155345	3.566	2.676	0.000	32.719	7.088	25.276	0.141	-0.851	
14	12096	74486	3.566	2.678	0.000	30.744	3.398	12.119	0.294	-0.531	
16	13824	35564	3.559	2.661	0.001	28.476	1.623	5.775	0.616	-0.210	
18	15552	16849	3.519	2.655	0.000	27.161	0.769	2.705	1.301	0.114	
20	17280	7725	3.548	2.656	0.001	25.904	0.352	1.251	2.837	0.453	
22	19008	3584	3.517	2.595	0.001	24.772	0.164	0.575	6.115	0.786	23.30523
24	20736	1687	3.371	2.494	0.008	23.033	0.077	0.259	12.992	1.114	

SUMMARY: Series 2.4.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	32.59	10
2	23.31	6
3	21.06	5
4	20.07	4
5	18.81	3
6	18.24	1
7	27.67	7
8	29.13	8
9	29.41	9
10	18.59	2



Input models	AWSS 1.2.1.1 and 1.2.1.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	80									

Configuration 1

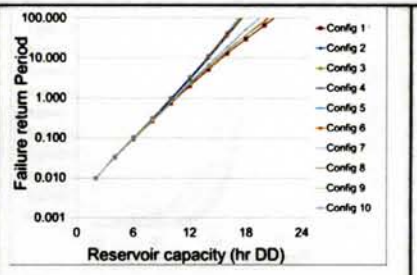
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	576	2233001	3.805	3.039	0.000	36.760	101.881	387.663	0.010	-2.008	
4	1152	676607	3.745	2.849	0.000	35.063	30.870	115.612	0.032	-1.490	
6	1728	235767	3.594	2.753	0.000	33.153	10.757	38.655	0.093	-1.032	
8	2304	83354	3.523	2.743	0.000	31.915	3.803	13.398	0.263	-0.580	
10	2880	29733	3.507	2.744	0.000	30.296	1.357	4.757	0.737	-0.132	
12	3456	11047	3.461	2.744	0.001	28.374	0.504	1.745	1.984	0.298	
14	4032	4257	3.374	2.784	0.001	26.777	0.194	0.655	5.149	0.712	15.42069
16	4608	1672	3.455	2.899	0.003	25.397	0.076	0.264	13.109	1.118	
18	5184	727	3.456	2.916	0.003	23.714	0.033	0.115	30.148	1.479	
20	5760	331	3.396	2.945	0.002	21.732	0.015	0.051	66.217	1.821	
22	6336	145	3.527	3.092	0.009	19.852	0.007	0.023	151.157	2.179	
24	6912	65	3.730	3.338	0.007	18.058	0.003	0.011	337.197	2.528	

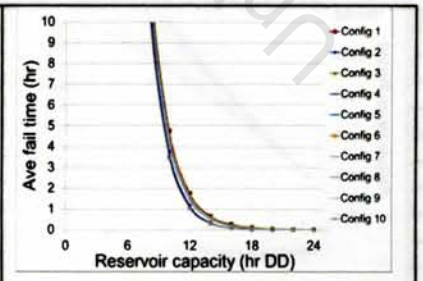
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	2236154	3.800	3.038	0.000	33.220	102.025	387.712	0.010	-2.009	
4	1152	663546	3.752	2.844	0.000	28.738	30.274	113.580	0.033	-1.481	
6	1728	222400	3.614	2.730	0.000	26.181	10.147	36.670	0.099	-1.006	
8	2304	74015	3.520	2.695	0.000	23.336	3.377	11.886	0.296	-0.529	
10	2880	23695	3.479	2.684	0.000	20.803	1.081	3.761	0.925	-0.034	
12	3456	7474	3.427	2.621	0.003	19.424	0.341	1.168	2.933	0.467	
14	4032	2228	3.361	2.572	0.002	19.424	0.102	0.342	9.837	0.993	14.02547
16	4608	615	3.325	2.549	0.013	14.621	0.028	0.093	35.639	1.552	
18	5184	169	3.284	2.525	0.019	13.246	0.008	0.025	129.691	2.113	
20	5760	40	3.745	2.936	0.019	12.343	0.002	0.007	547.945	2.739	
22	6336	9	4.190	2.741	0.447	9.414	0.000	0.002	2435.312	3.387	
24	6912	5	3.693	1.109	1.884	5.162	0.000	0.001	4383.562	3.642	

SUMMARY: Series 1.2.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	15.42	10
2	14.03	6
3	13.91	5
4	13.88	4
5	13.82	2
6	13.86	3
7	14.75	7
8	15.07	8
9	15.17	9
10	13.79	1





University of Pretoria

Input models	AWSS 1.2.2.1 and 1.2.2.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	80								

Configuration 1

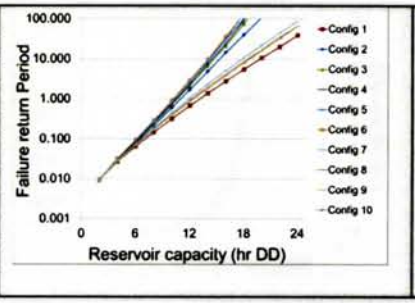
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	576	2406493	3.833	3.073	0.000	40.292	109.796	420.796	0.009	-2.041	
4	1152	827219	3.743	2.932	0.000	37.970	37.742	141.280	0.026	-1.577	
6	1728	342269	3.620	2.894	0.000	35.137	15.616	56.527	0.064	-1.194	
8	2304	150954	3.566	2.920	0.000	32.537	6.887	24.558	0.145	-0.838	
10	2880	69491	3.544	2.951	0.000	30.173	3.171	11.237	0.315	-0.501	
12	3456	32712	3.563	2.980	0.000	28.216	1.492	5.318	0.670	-0.174	
14	4032	15973	3.566	2.997	0.000	26.401	0.729	2.598	1.372	0.137	
16	4608	7920	3.586	3.018	0.001	24.559	0.361	1.296	2.767	0.442	
18	5184	4023	3.616	3.022	0.000	22.622	0.184	0.664	5.448	0.736	19.84129
20	5760	2080	3.663	3.021	0.001	20.798	0.095	0.348	10.537	1.023	
22	6336	1099	3.595	3.001	0.003	18.946	0.050	0.180	19.943	1.300	
24	6912	558	3.579	3.001	0.001	17.437	0.025	0.091	39.279	1.594	

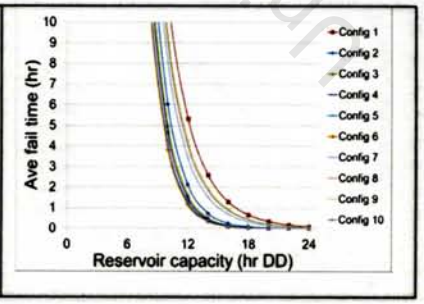
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	2422411	3.829	3.076	0.000	47.906	110.523	423.202	0.009	-2.043	
4	1152	774434	3.787	2.919	0.000	47.906	35.334	133.816	0.028	-1.548	
6	1728	282236	3.679	2.837	0.000	42.897	12.877	47.380	0.078	-1.110	
8	2304	102777	3.620	2.823	0.000	35.738	4.689	16.975	0.213	-0.671	
10	2880	36709	3.598	2.813	0.000	30.950	1.675	6.026	0.597	-0.224	
12	3456	13024	3.589	2.829	0.000	28.319	0.594	2.133	1.683	0.226	
14	4032	4520	3.570	2.833	0.006	25.872	0.206	0.736	4.849	0.686	15.33958
16	4608	1534	3.615	2.914	0.000	21.857	0.070	0.253	14.288	1.155	
18	5184	554	3.686	2.893	0.017	19.015	0.025	0.093	39.563	1.597	
20	5760	202	3.607	2.761	0.005	14.011	0.009	0.033	108.504	2.035	
22	6336	72	3.702	2.802	0.025	11.940	0.003	0.012	304.414	2.483	
24	6912	23	4.071	2.692	0.413	10.929	0.001	0.004	952.948	2.979	

SUMMARY: Series 1.2.2 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	19.84	10
2	15.34	6
3	14.70	5
4	14.47	4
5	14.22	3
6	14.04	1
7	17.84	7
8	18.47	8
9	18.72	9
10	14.10	2





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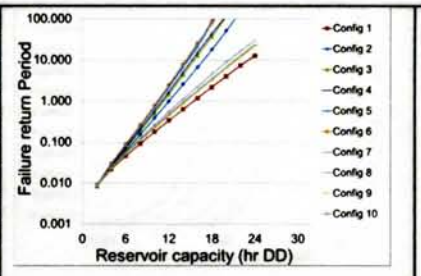
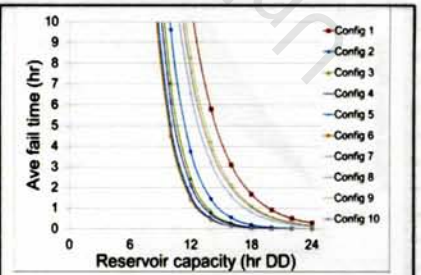
Input models	AWSS 1.2.3.1 and 1.2.3.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	80									
Configuration 1										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	576	2624132	3.867	3.115	0.000	40.213	119.726	462.979	0.008	-2.078	
4	1152	1020743	3.760	3.017	0.000	38.621	46.571	175.122	0.021	-1.668	
6	1728	482407	3.650	3.007	0.000	37.039	22.010	80.332	0.045	-1.343	
8	2304	241266	3.623	3.033	0.000	36.508	11.008	39.878	0.091	-1.042	
10	2880	124544	3.622	3.060	0.000	33.818	5.682	20.581	0.176	-0.755	
12	3456	65643	3.634	3.070	0.000	32.674	2.995	10.884	0.334	-0.476	
14	4032	34875	3.636	3.087	0.000	31.379	1.591	5.785	0.628	-0.202	
16	4608	18597	3.647	3.095	0.000	29.581	0.848	3.094	1.179	0.071	
18	5184	10066	3.653	3.098	0.000	27.946	0.459	1.678	2.177	0.338	
20	5760	5508	3.659	3.130	0.002	26.535	0.251	0.919	3.979	0.600	
22	6336	2992	3.693	3.134	0.004	25.073	0.137	0.504	7.325	0.865	23.12908
24	6912	1724	3.603	3.123	0.003	23.192	0.079	0.283	12.713	1.104	
Configuration 2											
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	2660073	3.861	3.121	0.000	38.289	121.366	468.570	0.008	-2.084	
4	1152	919648	3.826	2.999	0.000	35.868	41.959	160.540	0.024	-1.623	
6	1728	362692	3.751	2.947	0.000	34.212	16.548	62.072	0.060	-1.219	
8	2304	144291	3.707	2.940	0.000	33.561	6.583	24.405	0.152	-0.818	
10	2880	56859	3.704	2.943	0.000	30.875	2.594	9.608	0.385	-0.414	
12	3456	22159	3.695	2.928	0.000	30.159	1.011	3.735	0.989	-0.005	
14	4032	8526	3.701	2.888	0.000	27.888	0.389	1.440	2.571	0.410	
16	4608	3284	3.654	2.803	0.000	25.930	0.150	0.548	6.674	0.824	16.81737
18	5184	1221	3.613	2.739	0.002	23.332	0.056	0.201	17.951	1.254	
20	5760	427	3.635	2.790	0.006	19.157	0.019	0.071	51.330	1.710	
22	6336	142	3.730	2.669	0.069	12.839	0.006	0.024	154.351	2.189	
24	6912	47	3.193	2.243	0.243	9.296	0.002	0.007	466.336	2.669	

SUMMARY: Series 1.2.3 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	23.13	10
2	16.82	6
3	15.54	5
4	15.24	4
5	14.70	3
6	14.42	1
7	20.37	7
8	21.26	8
9	21.45	9
10	14.53	2





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Input models	AWSS 1.2.4.1 and 1.2.4.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	80								

Configuration 1

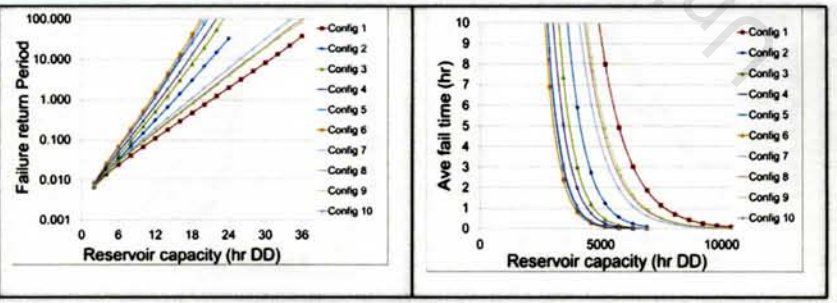
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	4032	122964	3.769	3.215	0.000	34.418	5.610	21.147	0.178	-0.749	
16	4608	75890	3.751	3.214	0.000	32.993	3.462	12.989	0.289	-0.539	
18	5184	46781	3.748	3.218	0.000	31.849	2.134	8.000	0.469	-0.329	
20	5760	28915	3.731	3.207	0.000	30.761	1.319	4.922	0.758	-0.120	
22	6336	17834	3.727	3.205	0.000	29.670	0.814	3.033	1.229	0.090	
24	6912	11031	3.724	3.209	0.001	28.493	0.503	1.874	1.987	0.298	
26	7488	6843	3.705	3.205	0.001	27.200	0.312	1.157	3.203	0.506	
28	8064	4245	3.696	3.189	0.000	25.809	0.194	0.716	5.163	0.713	
30	8640	2662	3.642	3.154	0.002	24.206	0.121	0.442	8.234	0.916	30.79251
32	9216	1630	3.605	3.176	0.005	21.886	0.074	0.268	13.447	1.129	
34	9792	987	3.625	3.129	0.004	19.166	0.045	0.163	22.206	1.346	
36	10368	574	3.721	2.966	0.006	14.989	0.026	0.097	38.184	1.582	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	576	3365130	3.968	3.245	0.000	43.894	153.534	609.208	0.007	-2.186	
4	1152	1388746	3.940	3.174	0.000	41.261	63.362	249.649	0.016	-1.802	
6	1728	650002	3.920	3.155	0.000	39.834	29.656	116.265	0.034	-1.472	
8	2304	312689	3.895	3.149	0.000	39.834	14.266	55.574	0.070	-1.154	
10	2880	150093	3.876	3.139	0.000	37.668	6.848	26.543	0.146	-0.836	
12	3456	71329	3.862	3.117	0.000	35.216	3.254	12.568	0.307	-0.512	
14	4032	33786	3.829	3.080	0.001	32.561	1.541	5.902	0.649	-0.188	
16	4608	15756	3.795	3.066	0.001	29.515	0.719	2.728	1.391	0.143	
18	5184	7233	3.791	3.088	0.001	27.446	0.330	1.251	3.030	0.481	
20	5760	3271	3.798	3.025	0.001	26.078	0.149	0.567	6.701	0.826	21.01144
22	6336	1482	3.706	2.940	0.006	23.973	0.068	0.251	14.789	1.170	
24	6912	676	3.625	2.891	0.032	21.281	0.031	0.112	32.423	1.511	

SUMMARY: Series 1.2.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	30.79	10
2	21.01	6
3	18.55	5
4	17.44	4
5	16.10	3
6	15.47	1
7	25.77	7
8	27.18	8
9	27.45	9
10	15.87	2



UNDER DEVELOPMENT

Input models	AWSS 1.4.1.1 and 1.4.1.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	240									

Configuration 1

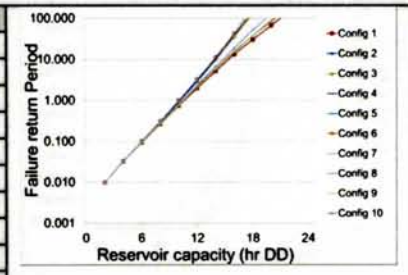
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1728	2231998	3.805	3.039	0.000	36.760	101.835	387.508	0.010	-2.008	
4	3456	676210	3.745	2.849	0.000	35.063	30.852	115.542	0.032	-1.489	
6	5184	235563	3.594	2.753	0.000	33.153	10.748	38.622	0.093	-1.031	
8	6912	83263	3.523	2.743	0.000	31.915	3.799	13.384	0.263	-0.580	
10	8640	29693	3.507	2.744	0.000	30.296	1.355	4.752	0.738	-0.132	
12	10368	11030	3.463	2.744	0.001	28.374	0.503	1.743	1.987	0.298	
14	12096	4250	3.377	2.784	0.000	26.777	0.194	0.655	5.157	0.712	15.41785
16	13824	1670	3.456	2.899	0.003	25.397	0.076	0.263	13.124	1.118	
18	15552	726	3.460	2.916	0.003	23.714	0.033	0.115	30.190	1.480	
20	17280	331	3.395	2.945	0.002	21.732	0.015	0.051	66.217	1.821	
22	19008	145	3.527	3.092	0.009	19.852	0.007	0.023	151.157	2.179	
24	20736	65	3.729	3.338	0.007	18.058	0.003	0.011	337.197	2.528	

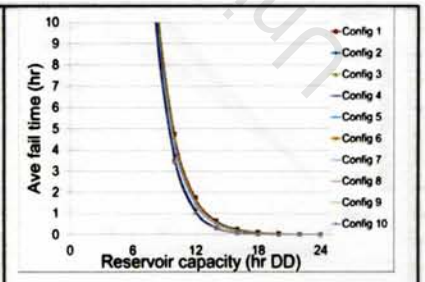
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	2235108	3.800	3.037	0.000	33.220	101.977	387.554	0.010	-2.009	
4	3456	663104	3.752	2.844	0.000	28.738	30.254	113.505	0.033	-1.481	
6	5184	222168	3.614	2.730	0.000	26.181	10.136	36.634	0.099	-1.006	
8	6912	73911	3.520	2.694	0.000	23.336	3.372	11.871	0.297	-0.528	
10	8640	23649	3.479	2.684	0.000	20.803	1.079	3.753	0.927	-0.033	
12	10368	7453	3.424	2.620	0.001	19.424	0.340	1.164	2.941	0.468	
14	12096	2216	3.359	2.570	0.002	19.424	0.101	0.340	9.891	0.995	14.01699
16	13824	608	3.313	2.547	0.013	14.621	0.028	0.092	36.049	1.557	
18	15552	164	3.229	2.526	0.019	13.246	0.007	0.024	133.645	2.126	
20	17280	36	3.557	3.006	0.019	12.343	0.002	0.006	608.828	2.784	
22	19008	7	3.881	3.038	0.447	9.414	0.000	0.001	3131.115	3.496	
24	20736	3	3.317	1.073	1.884	4.465	0.000	0.000	7305.936	3.864	

SUMMARY: Series 1.4.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	15.42	10
2	14.02	6
3	13.91	5
4	13.87	4
5	13.82	2
6	13.86	3
7	14.75	7
8	15.06	8
9	15.16	9
10	13.78	1





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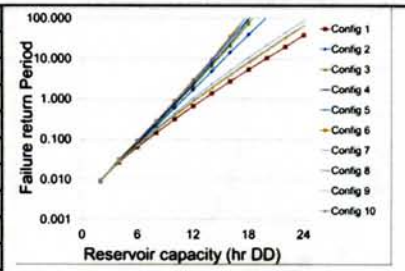
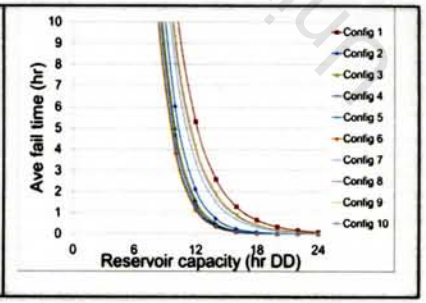
Input models	AWSS 1.4.2.1 and 1.4.2.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	240									
Configuration 1										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1728	2405491	3.833	3.073	0.000	40.292	109.751	420.640	0.009	-2.040	
4	3456	826790	3.743	2.932	0.000	37.970	37.722	141.203	0.027	-1.577	
6	5184	342055	3.620	2.893	0.000	35.137	15.606	56.488	0.064	-1.193	
8	6912	150848	3.565	2.919	0.000	32.537	6.882	24.538	0.145	-0.838	
10	8640	69429	3.544	2.951	0.000	30.173	3.168	11.227	0.316	-0.501	
12	10368	32685	3.563	2.980	0.000	28.216	1.491	5.313	0.671	-0.174	
14	12096	15960	3.565	2.997	0.000	26.401	0.728	2.596	1.373	0.138	
16	13824	7914	3.585	3.017	0.001	24.559	0.361	1.294	2.769	0.442	
18	15552	4017	3.616	3.021	0.000	22.622	0.183	0.663	5.456	0.737	19.84093
20	17280	2080	3.657	3.019	0.001	20.798	0.095	0.347	10.537	1.023	
22	19008	1099	3.589	3.002	0.003	18.946	0.050	0.180	19.943	1.300	
24	20736	558	3.575	3.004	0.001	17.437	0.025	0.091	39.279	1.594	
Configuration 2										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	2421434	3.829	3.076	0.000	47.906	110.478	423.048	0.009	-2.043	
4	3456	773951	3.787	2.919	0.000	47.906	35.312	133.735	0.028	-1.548	
6	5184	281985	3.680	2.837	0.000	42.897	12.866	47.339	0.078	-1.109	
8	6912	102643	3.620	2.823	0.000	35.738	4.683	16.955	0.214	-0.671	
10	8640	36646	3.599	2.813	0.000	30.950	1.672	6.018	0.598	-0.223	
12	10368	13005	3.589	2.829	0.000	28.319	0.593	2.130	1.685	0.227	
14	12096	4512	3.570	2.835	0.007	25.872	0.206	0.735	4.858	0.686	15.33526
16	13824	1530	3.619	2.915	0.000	21.857	0.070	0.253	14.325	1.156	
18	15552	552	3.696	2.891	0.017	19.015	0.025	0.093	39.706	1.599	
20	17280	201	3.621	2.757	0.005	14.011	0.009	0.033	109.044	2.038	
22	19008	72	3.702	2.802	0.025	11.940	0.003	0.012	304.414	2.483	
24	20736	23	4.071	2.692	0.413	10.929	0.001	0.004	952.948	2.979	

SUMMARY: Series 1.4.2 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	19.84	10
2	15.34	6
3	14.69	5
4	14.47	4
5	14.21	3
6	14.04	1
7	17.83	7
8	18.46	8
9	18.71	9
10	14.09	2





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Input models	AWSS 1.4.3.1 and 1.4.3.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	240								

Configuration 1

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1728	2743347	3.9217	3.15111	1.18E-06	40.2163	125.165	490.860	0.008	-2.097	
4	3456	1082901	3.821	3.054	0.000	38.625	49.407	188.780	0.020	-1.694	
6	5184	518429	3.712	3.041	0.000	37.044	23.653	87.803	0.042	-1.374	
8	6912	261871	3.679	3.064	0.000	36.721	11.948	43.951	0.084	-1.077	
10	8640	136052	3.673	3.087	0.000	33.818	6.207	22.802	0.161	-0.793	
12	10368	71865	3.687	3.098	0.000	32.674	3.279	12.090	0.305	-0.516	
14	12096	38456	3.683	3.114	0.000	31.379	1.755	6.461	0.570	-0.244	
16	13824	20501	3.698	3.120	0.000	29.581	0.935	3.459	1.069	0.029	
18	15552	11087	3.719	3.124	0.001	27.946	0.506	1.881	1.977	0.296	
20	17280	6096	3.722	3.144	0.002	26.535	0.278	1.035	3.595	0.556	
22	19008	3335	3.736	3.151	0.001	25.073	0.152	0.569	6.572	0.818	23.5048
24	20736	1909	3.672	3.131	0.006	23.192	0.087	0.320	11.481	1.060	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	2659026	3.861	3.121	0.000	38.289	121.318	468.403	0.008	-2.084	
4	3456	919074	3.826	2.999	0.000	35.868	41.933	160.447	0.024	-1.623	
6	5184	362357	3.751	2.947	0.000	34.212	16.533	62.021	0.060	-1.218	
8	6912	144139	3.707	2.940	0.000	33.561	6.576	24.379	0.152	-0.818	
10	8640	56779	3.704	2.943	0.000	30.875	2.591	9.596	0.386	-0.413	
12	10368	22116	3.696	2.928	0.000	30.159	1.009	3.730	0.991	-0.004	
14	12096	8516	3.700	2.888	0.000	27.888	0.389	1.438	2.574	0.411	
16	13824	3278	3.655	2.803	0.000	25.930	0.150	0.547	6.686	0.825	16.81315
18	15552	1218	3.616	2.740	0.002	23.332	0.056	0.201	17.995	1.255	
20	17280	425	3.637	2.795	0.006	19.157	0.019	0.071	51.571	1.712	
22	19008	141	3.752	2.661	0.069	12.839	0.006	0.024	155.445	2.192	
24	20736	47	3.190	2.240	0.243	9.296	0.002	0.007	466.336	2.669	

SUMMARY: Series 1.4.3 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1		
2		
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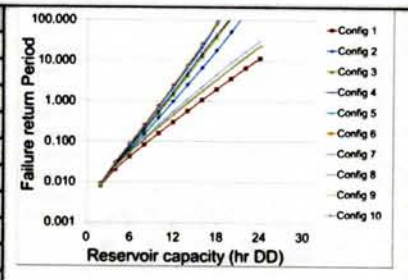
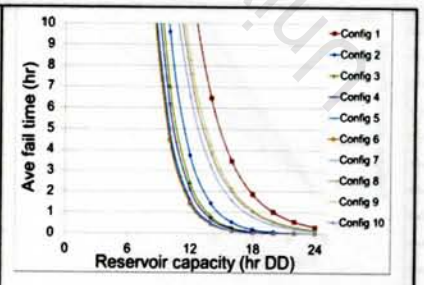
10		





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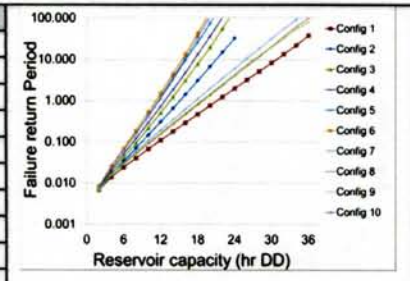
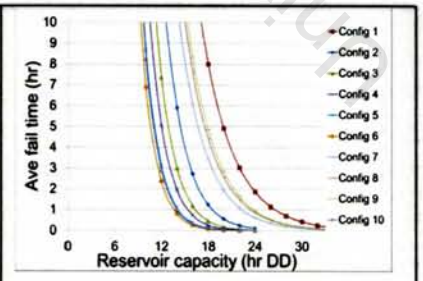
Input models	AWSS 1.4.4.1 and 1.4.4.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	240									
Configuration 1										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	12096	122880	3.769	3.215	0.000	34.418	5.606	21.132	0.178	-0.749	
16	13824	75837	3.751	3.214	0.000	32.993	3.460	12.979	0.289	-0.539	
18	15552	46749	3.748	3.218	0.000	31.849	2.133	7.993	0.469	-0.329	
20	17280	28888	3.731	3.208	0.000	30.761	1.318	4.918	0.759	-0.120	
22	19008	17810	3.729	3.206	0.000	29.670	0.813	3.030	1.231	0.090	
24	20736	11022	3.724	3.209	0.001	28.493	0.503	1.873	1.989	0.299	
26	22464	6837	3.704	3.205	0.001	27.200	0.312	1.156	3.206	0.506	
28	24192	4240	3.696	3.190	0.001	25.809	0.193	0.715	5.169	0.713	
30	25920	2660	3.641	3.154	0.002	24.206	0.121	0.442	8.240	0.916	30.7877
32	27648	1627	3.605	3.178	0.005	21.886	0.074	0.268	13.471	1.129	
34	29376	986	3.624	3.130	0.004	19.166	0.045	0.163	22.229	1.347	
36	31104	574	3.715	2.967	0.006	14.990	0.026	0.097	38.184	1.582	
Configuration 2										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	3364046	3.968	3.245	0.000	43.894	153.485	609.030	0.007	-2.186	
4	3456	1388063	3.940	3.174	0.000	41.261	63.330	249.535	0.016	-1.802	
6	5184	649616	3.920	3.155	0.000	39.834	29.639	116.194	0.034	-1.472	
8	6912	312443	3.896	3.149	0.000	39.834	14.255	55.532	0.070	-1.154	
10	8640	149958	3.876	3.139	0.000	37.668	6.842	26.518	0.146	-0.835	
12	10368	71229	3.863	3.117	0.000	35.216	3.250	12.553	0.308	-0.512	
14	12096	33732	3.829	3.080	0.000	32.561	1.539	5.894	0.650	-0.187	
16	13824	15731	3.795	3.066	0.000	29.515	0.718	2.724	1.393	0.144	
18	15552	7214	3.796	3.088	0.001	27.446	0.329	1.249	3.038	0.483	
20	17280	3266	3.797	3.025	0.000	26.078	0.149	0.566	6.711	0.827	21.00695
22	19008	1479	3.705	2.940	0.006	23.973	0.067	0.250	14.819	1.171	
24	20736	674	3.627	2.888	0.032	21.281	0.031	0.112	32.519	1.512	

University of Pretoria

SUMMARY: Series 1.4.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	30.79	10
2	21.01	6
3	18.55	5
4	17.44	4
5	16.09	3
6	15.46	1
7	25.75	7
8	27.17	8
9	27.45	9
10	15.85	2





Input models	AWSS 3.1.1.1 and 3.1.1.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	20								

Configuration 1

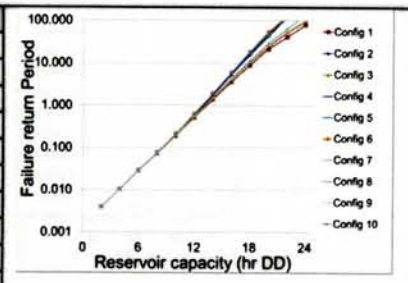
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	144	5586172	4.212	3.196	0.000	38.945	254.869	1073.603	0.004	-2.406	
4	288	2109977	3.929	2.819	0.000	37.356	96.268	378.248	0.010	-1.983	
6	432	770331	3.539	2.518	0.000	35.549	35.146	124.390	0.028	-1.546	
8	576	300741	3.266	2.373	0.000	34.037	13.721	44.807	0.073	-1.137	
10	720	114260	3.146	2.358	0.000	32.276	5.213	16.403	0.192	-0.717	
12	864	42316	3.134	2.398	0.000	30.126	1.931	6.051	0.518	-0.286	
14	1008	15772	3.142	2.476	0.000	28.573	0.720	2.261	1.390	0.143	
16	1152	6048	3.179	2.609	0.001	27.393	0.276	0.877	3.624	0.559	
18	1296	2442	3.287	2.787	0.001	26.271	0.111	0.366	8.975	0.953	18.24933
20	1440	1026	3.499	3.033	0.004	25.108	0.047	0.164	21.362	1.330	
22	1584	531	3.503	3.234	0.026	23.310	0.024	0.085	41.276	1.616	
24	1728	272	3.784	3.591	0.067	20.434	0.012	0.047	80.580	1.906	

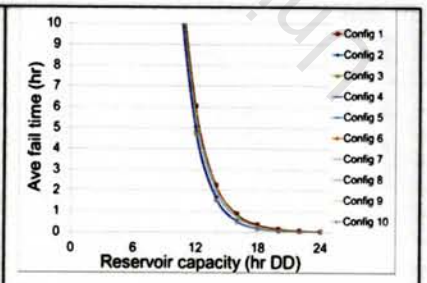
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	144	5584834	4.215	3.191	0.000	24.806	254.808	1074.011	0.004	-2.406	
4	288	2108090	3.923	2.803	0.000	24.806	96.182	377.353	0.010	-1.983	
6	432	763023	3.520	2.481	0.000	20.677	34.813	122.537	0.029	-1.542	
8	576	291673	3.220	2.299	0.000	18.712	13.308	42.849	0.075	-1.124	
10	720	106527	3.058	2.231	0.000	15.268	4.860	14.861	0.206	-0.687	
12	864	36802	3.007	2.217	0.000	13.826	1.679	5.050	0.596	-0.225	
14	1008	12456	2.951	2.216	0.000	13.826	0.568	1.677	1.760	0.245	
16	1152	4098	2.935	2.192	0.002	13.758	0.187	0.549	5.348	0.728	17.16531
18	1296	1400	2.898	2.209	0.016	13.250	0.064	0.185	15.656	1.195	
20	1440	502	2.837	2.295	0.013	12.980	0.023	0.065	43.661	1.640	
22	1584	191	3.131	2.477	0.040	12.029	0.009	0.027	114.753	2.060	
24	1728	107	3.172	2.416	0.075	11.840	0.005	0.015	204.839	2.311	

SUMMARY: Series 3.1.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	18.25	10
2	17.17	6
3	17.05	5
4	16.99	4
5	16.98	3
6	16.90	1
7	17.72	7
8	17.93	9
9	17.90	8
10	16.93	2



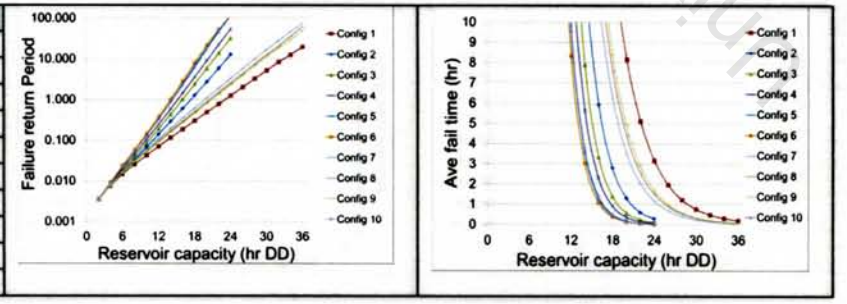


University of the Free State

Input models		AWSS 3.1.4.1 and 3.1.4.2								
Simulation period (years)		8000000								
Simulation period (days)		21917.81								
Daily Demand under seasonal peak (DD) (l/s)		20								
Configuration 1										
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	1008	191323	3.934	3.174	0.000	38.637	8.729	34.343	0.115	-0.941	
16	1152	117926	3.941	3.197	0.000	36.685	5.380	21.204	0.186	-0.731	
18	1296	72877	3.948	3.212	0.000	35.066	3.325	13.126	0.301	-0.522	
20	1440	45026	3.973	3.227	0.000	34.413	2.054	8.162	0.487	-0.313	
22	1584	28141	3.973	3.229	0.002	34.413	1.284	5.101	0.779	-0.109	
24	1728	17554	3.963	3.223	0.001	34.413	0.801	3.174	1.249	0.096	
26	1872	10844	3.968	3.210	0.002	34.413	0.495	1.963	2.021	0.306	
28	2016	6780	3.921	3.221	0.003	32.987	0.309	1.213	3.233	0.510	
30	2160	4233	3.934	3.218	0.002	31.741	0.193	0.760	5.178	0.714	
32	2304	2644	3.975	3.198	0.001	30.446	0.121	0.480	8.290	0.919	32.89173
34	2448	1736	3.873	3.173	0.002	28.651	0.079	0.307	12.625	1.101	
36	2592	1115	3.806	3.177	0.002	24.694	0.051	0.194	19.657	1.294	
Configuration 2											
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	144	6364414	4.379	3.282	0.000	35.650	290.376	1271.454	0.003	-2.463	
4	288	2887320	4.074	2.946	0.000	33.092	131.734	536.671	0.008	-2.120	
6	432	1311765	3.816	2.753	0.000	31.565	59.849	228.373	0.017	-1.777	
8	576	649806	3.668	2.685	0.000	31.357	29.647	108.738	0.034	-1.472	
10	720	322149	3.603	2.680	0.000	31.357	14.698	52.961	0.068	-1.167	
12	864	157990	3.575	2.688	0.000	31.038	7.208	25.766	0.139	-0.858	
14	1008	76222	3.570	2.686	0.000	25.144	3.478	12.416	0.288	-0.541	
16	1152	36726	3.537	2.667	0.000	23.667	1.676	5.927	0.597	-0.224	
18	1296	17381	3.519	2.657	0.001	21.453	0.793	2.791	1.261	0.101	
20	1440	8156	3.494	2.652	0.001	17.648	0.372	1.300	2.687	0.429	
22	1584	3759	3.464	2.650	0.007	16.001	0.172	0.594	5.831	0.766	23.39336
24	1728	1733	3.485	2.638	0.007	16.001	0.079	0.276	12.647	1.102	

SUMMARY: Series 3.1.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	32.89	10
2	23.39	6
3	21.26	5
4	20.26	4
5	18.95	3
6	18.46	1
7	28.03	7
8	29.09	8
9	29.52	9
10	18.75	2



University of Pretoria

Input models	AWSS 3.4.1 and 3.4.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	240								

Configuration 1

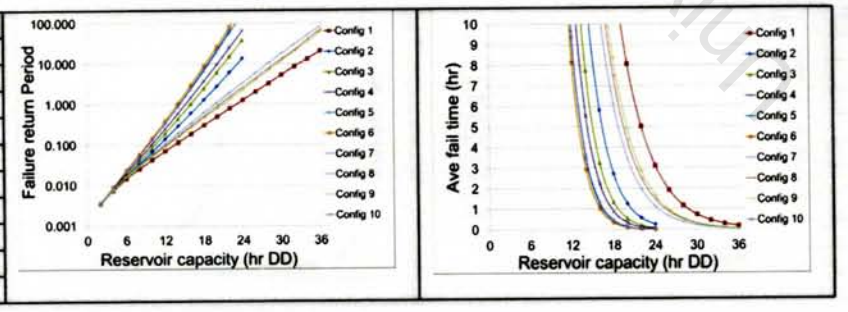
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
14	12096	189924	3.935	3.173	0.000	38.637	8.665	34.101	0.115	-0.938	
16	13824	116958	3.942	3.196	0.000	36.685	5.336	21.035	0.187	-0.727	
18	15552	72194	3.948	3.210	0.000	35.066	3.294	13.005	0.304	-0.518	
20	17280	44526	3.975	3.225	0.000	34.413	2.031	8.075	0.492	-0.308	
22	19008	27731	3.981	3.228	0.000	34.413	1.265	5.037	0.790	-0.102	
24	20736	17265	3.969	3.220	0.002	34.413	0.788	3.126	1.269	0.104	
26	22464	10642	3.972	3.207	0.001	34.413	0.486	1.929	2.060	0.314	
28	24192	6644	3.916	3.219	0.004	32.967	0.303	1.187	3.299	0.518	
30	25920	4111	3.947	3.214	0.001	31.724	0.188	0.740	5.332	0.727	
32	27648	2560	3.982	3.188	0.002	30.423	0.117	0.465	8.562	0.933	32.72502
34	29376	1668	3.877	3.159	0.005	28.617	0.076	0.295	13.140	1.119	
36	31104	1065	3.796	3.147	0.003	24.612	0.049	0.184	20.580	1.313	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	6354860	4.379	3.282	0.000	35.650	289.940	1269.687	0.003	-2.462	
4	3456	2879554	4.075	2.945	0.000	33.092	131.380	535.346	0.008	-2.119	
6	5184	1306490	3.816	2.751	0.000	31.565	59.609	227.468	0.017	-1.775	
8	6912	645974	3.668	2.683	0.000	31.357	29.473	108.091	0.034	-1.469	
10	8640	319564	3.602	2.678	0.000	31.357	14.580	52.520	0.069	-1.164	
12	10368	156212	3.575	2.687	0.000	31.038	7.127	25.477	0.140	-0.853	
14	12096	75114	3.572	2.684	0.000	25.144	3.427	12.240	0.292	-0.535	
16	13824	36052	3.540	2.664	0.000	23.667	1.645	5.823	0.608	-0.216	
18	15552	16963	3.519	2.657	0.001	21.455	0.774	2.724	1.292	0.111	
20	17280	7875	3.496	2.653	0.003	17.651	0.359	1.256	2.783	0.445	
22	19008	3564	3.477	2.650	0.007	16.001	0.163	0.565	6.150	0.789	23.21219
24	20736	1598	3.518	2.638	0.007	16.001	0.073	0.256	13.716	1.137	

SUMMARY: Series 3.4.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	32.73	10
2	23.21	6
3	21.07	5
4	20.11	4
5	18.76	3
6	18.24	1
7	27.85	7
8	28.96	8
9	29.43	9
10	18.56	2



University of Pretoria

Input models	AWSS 3.4.1.1 and 3.4.1.2
Simulation period (years)	8000000
Simulation period (days)	21917.81
Daily Demand under seasonal peak (DD) (l/s)	240

Configuration 1

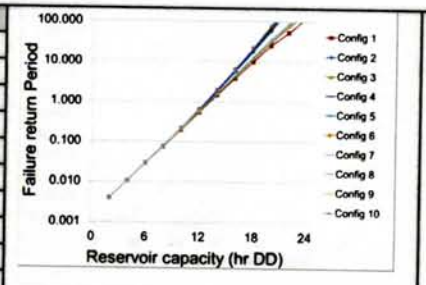
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	1728	5575935	4.213	3.195	0.000	38.945	254.402	1071.844	0.004	-2.406	
4	3456	2102790	3.930	2.818	0.000	37.356	95.940	377.070	0.010	-1.982	
6	5184	765818	3.540	2.515	0.000	35.549	34.940	123.684	0.029	-1.543	
8	6912	298043	3.264	2.368	0.000	34.037	13.598	44.386	0.074	-1.133	
10	8640	112596	3.144	2.349	0.000	32.276	5.137	16.151	0.195	-0.711	
12	10368	41363	3.129	2.384	0.000	30.126	1.887	5.904	0.530	-0.276	
14	12096	15184	3.138	2.453	0.000	28.573	0.693	2.174	1.443	0.159	
16	13824	5713	3.165	2.567	0.001	27.393	0.261	0.825	3.836	0.584	
18	15552	2219	3.258	2.690	0.001	26.271	0.101	0.330	9.877	0.995	18.0264
20	17280	871	3.451	2.876	0.004	25.108	0.040	0.137	25.164	1.401	
22	19008	413	3.361	3.011	0.026	23.310	0.019	0.063	53.070	1.725	
24	20736	170	3.684	3.365	0.071	20.435	0.008	0.029	128.928	2.110	

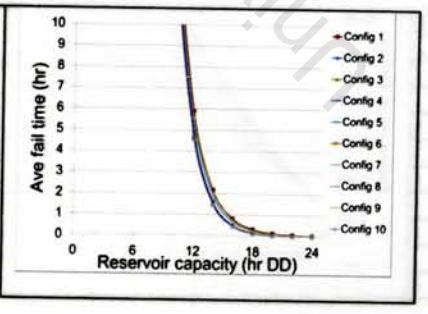
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	5574516	4.216	3.191	0.000	24.806	254.337	1072.253	0.004	-2.405	
4	3456	2100785	3.925	2.802	0.000	24.806	95.848	376.191	0.010	-1.982	
6	5184	758610	3.521	2.478	0.000	20.677	34.612	121.855	0.029	-1.539	
8	6912	289017	3.220	2.294	0.000	18.712	13.186	42.455	0.076	-1.120	
10	8640	105032	3.056	2.224	0.000	15.268	4.792	14.646	0.209	-0.681	
12	10368	35991	3.003	2.207	0.000	13.826	1.642	4.931	0.609	-0.215	
14	12096	11985	2.946	2.199	0.000	13.826	0.547	1.611	1.829	0.262	
16	13824	3820	2.922	2.151	0.002	13.758	0.174	0.509	5.738	0.759	16.97413
18	15552	1221	2.847	2.109	0.016	13.250	0.056	0.159	17.951	1.254	
20	17280	370	2.756	2.146	0.013	12.110	0.017	0.047	59.237	1.773	
22	19008	101	3.066	2.356	0.058	10.407	0.005	0.014	217.008	2.336	
24	20736	35	3.131	2.125	0.128	7.078	0.002	0.005	626.223	2.797	

SUMMARY: Series 3.4.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	18.03	10
2	16.97	6
3	16.86	5
4	16.80	4
5	16.79	3
6	16.70	1
7	17.51	7
8	17.72	9
9	17.68	8
10	16.71	2





University of Pretoria

Input models	AWSS 4.1.1.1 and 4.1.1.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	20								

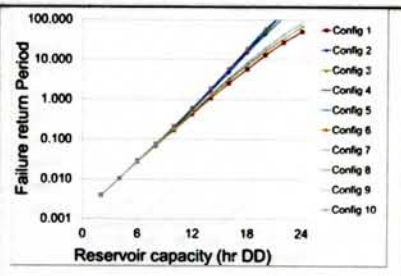
Configuration 1

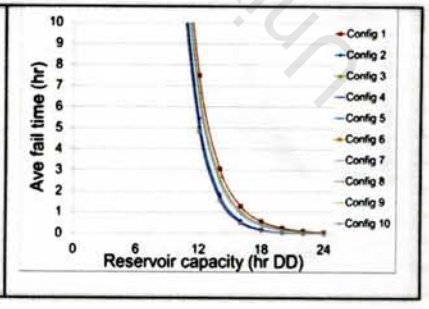
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	144	5613524	4.223	3.204	0.000	37.511	256.117	1081.480	0.004	-2.408	
4	288	2142685	3.945	2.834	0.000	36.008	97.760	385.678	0.010	-1.990	
6	432	800022	3.567	2.555	0.000	34.622	36.501	130.184	0.027	-1.562	
8	576	322728	3.312	2.436	0.000	33.344	14.724	48.763	0.068	-1.168	
10	720	128379	3.219	2.446	0.000	33.095	5.857	18.856	0.171	-0.768	
12	864	50962	3.225	2.509	0.000	33.095	2.325	7.498	0.430	-0.366	
14	1008	20448	3.284	2.599	0.000	33.095	0.933	3.064	1.072	0.030	
16	1152	8565	3.344	2.677	0.000	31.252	0.391	1.307	2.559	0.408	
18	1296	3790	3.368	2.768	0.000	29.009	0.173	0.582	5.783	0.762	19.3453
20	1440	1679	3.547	2.854	0.007	27.038	0.077	0.272	13.054	1.116	
22	1584	807	3.641	3.006	0.059	25.045	0.037	0.134	27.160	1.434	
24	1728	434	3.763	3.016	0.037	22.384	0.020	0.075	50.502	1.703	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	144	5616361	4.218	3.193	0.000	33.858	256.246	1080.971	0.004	-2.409	
4	288	2134346	3.928	2.808	0.000	31.464	97.380	382.462	0.010	-1.988	
6	432	780433	3.531	2.495	0.000	28.978	35.607	125.736	0.028	-1.552	
8	576	301344	3.250	2.322	0.000	27.512	13.749	44.677	0.073	-1.138	
10	720	112150	3.093	2.258	0.000	25.293	5.117	15.825	0.195	-0.709	
12	864	39394	3.031	2.253	0.000	22.768	1.797	5.448	0.556	-0.255	
14	1008	13441	3.012	2.255	0.001	17.440	0.613	1.847	1.631	0.212	
16	1152	4584	2.902	2.243	0.001	15.448	0.209	0.607	4.781	0.680	17.28672
18	1296	1456	2.923	2.296	0.001	12.755	0.066	0.194	15.053	1.178	
20	1440	506	2.896	2.333	0.006	12.357	0.023	0.067	43.316	1.637	
22	1584	187	2.904	2.406	0.074	12.057	0.009	0.025	117.208	2.069	
24	1728	87	2.803	2.332	0.001	11.755	0.004	0.011	251.929	2.401	

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	19.35	10
2	17.29	6
3	17.05	4
4	17.08	5
5	16.90	1
6	16.97	3
7	18.42	7
8	18.73	8
9	18.85	9
10	16.93	2





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Input models	AWSS 4.1.4.1 and 4.1.4.2								
Simulation period (years)	8000000								
Simulation period (days)	21917.81								
Daily Demand under seasonal peak (DD) (l/s)	20								

Configuration 1

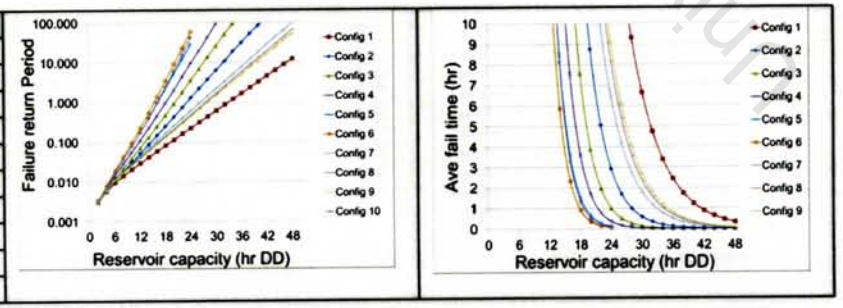
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
26	1872	68027	4.198	3.394	0.000	38.228	3.104	13.030	0.322	-0.492	
28	2016	48744	4.192	3.382	0.000	36.795	2.224	9.322	0.450	-0.347	
30	2160	34957	4.179	3.368	0.000	35.206	1.595	6.665	0.627	-0.203	
32	2304	24991	4.179	3.371	0.000	33.541	1.140	4.765	0.877	-0.057	
34	2448	17893	4.175	3.366	0.000	30.812	0.816	3.409	1.225	0.088	
36	2592	12904	4.154	3.360	0.000	30.209	0.589	2.445	1.699	0.230	
38	2736	9279	4.137	3.353	0.000	30.209	0.423	1.751	2.362	0.373	
40	2880	6592	4.162	3.349	0.000	28.891	0.301	1.252	3.325	0.522	
42	3024	4714	4.173	3.345	0.000	26.959	0.215	0.897	4.650	0.667	
44	3168	3397	4.162	3.330	0.000	26.959	0.155	0.645	6.452	0.810	
46	3312	2430	4.158	3.320	0.000	26.959	0.111	0.461	9.020	0.955	46.62751
48	3456	1749	4.159	3.279	0.000	26.959	0.080	0.332	12.532	1.098	

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
26	1872	9820	3.787	2.888	0.001	23.316	0.448	1.697	2.232	0.349	
28	2016	5728	3.784	2.867	0.001	22.776	0.261	0.989	3.826	0.583	
30	2160	3385	3.748	2.853	0.001	20.871	0.154	0.579	6.475	0.811	31.69029
32	2304	2024	3.694	2.847	0.017	17.899	0.092	0.341	10.829	1.035	
34	2448	1141	3.805	2.871	0.002	14.970	0.052	0.198	19.209	1.284	
36	2592	688	3.822	2.833	0.001	14.156	0.031	0.120	31.857	1.503	
38	2736	408	3.952	2.903	0.088	14.096	0.019	0.074	53.720	1.730	
40	2880	254	4.048	2.981	0.099	13.896	0.012	0.047	86.291	1.936	
42	3024	168	3.927	2.930	0.071	12.950	0.008	0.030	130.463	2.115	
44	3168	111	3.720	2.899	0.026	12.950	0.005	0.019	197.458	2.295	
46	3312	70	3.717	3.017	0.032	12.023	0.003	0.012	313.112	2.496	
48	3456	44	4.048	2.921	0.084	11.595	0.002	0.008	498.132	2.697	

SUMMARY: Series 4.1.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	46.63	10
2	31.69	6
3	27.03	5
4	24.06	4
5	21.54	3
6	20.19	1
7	37.11	7
8	38.56	8
9	39.43	9
10	21.00	2



UWP 2016 Draft for review

Input models	AWSS 4.4.1.1 and 4.4.1.2
Simulation period (years)	8000000
Simulation period (days)	21917.81
Daily Demand under seasonal peak (DD) (l/s)	20

Configuration 1

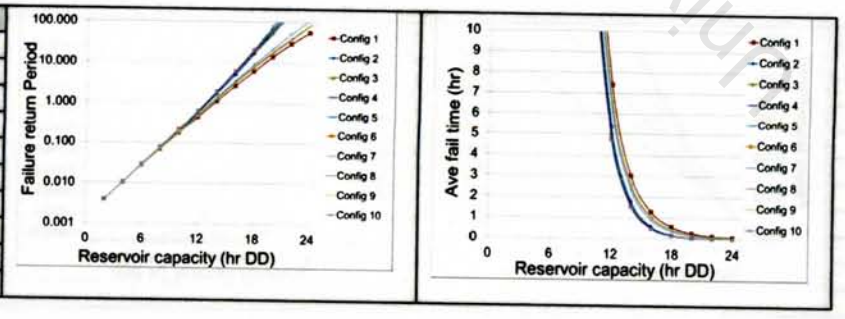
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
2	2	1728	5606756	4.223	3.204	0.000	37.511	255.808	1080.329	0.004	-2.408
4	4	3456	2137829	3.946	2.833	0.000	36.008	97.538	384.904	0.010	-1.989
6	6	5184	797101	3.567	2.553	0.000	34.622	36.368	129.721	0.027	-1.561
8	8	6912	320913	3.312	2.434	0.000	33.344	14.642	48.487	0.068	-1.166
10	10	8640	127356	3.219	2.444	0.000	33.095	5.811	18.702	0.172	-0.764
12	12	10368	50393	3.223	2.507	0.000	33.095	2.299	7.410	0.435	-0.362
14	14	12096	20099	3.286	2.599	0.000	33.095	0.917	3.013	1.090	0.038
16	16	13824	8354	3.349	2.680	0.001	31.252	0.381	1.276	2.624	0.419
18	18	15552	3653	3.380	2.778	0.004	29.009	0.167	0.563	6.000	0.778
20	20	17280	1590	3.572	2.886	0.007	27.038	0.073	0.259	13.785	1.139
22	22	19008	751	3.674	3.067	0.010	25.045	0.034	0.126	29.185	1.465
24	24	20736	391	3.842	3.094	0.037	22.384	0.018	0.069	56.056	1.749

Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
2	1728	5609708	4.219	3.193	0.000	33.858	255.943	1079.826	0.004	-2.408	
4	3456	2129579	3.928	2.808	0.000	31.464	97.162	381.687	0.010	-1.987	
6	5184	777499	3.531	2.493	0.000	28.978	35.473	125.273	0.028	-1.550	
8	6912	299481	3.249	2.318	0.000	27.512	13.664	44.392	0.073	-1.136	
10	8640	111080	3.090	2.250	0.000	25.293	5.068	15.662	0.197	-0.705	
12	10368	38808	3.026	2.238	0.000	22.768	1.771	5.358	0.565	-0.248	
14	12096	13084	3.004	2.231	0.001	17.440	0.597	1.793	1.675	0.224	
16	13824	4371	2.877	2.195	0.001	15.448	0.199	0.574	5.014	0.700	17.14936
18	15552	1315	2.894	2.233	0.001	12.755	0.060	0.174	16.668	1.222	
20	17280	410	2.865	2.197	0.006	11.937	0.019	0.054	53.458	1.728	
22	19008	125	2.882	2.144	0.111	10.705	0.006	0.016	175.342	2.244	
24	20736	39	2.760	1.834	0.001	9.136	0.002	0.005	561.995	2.750	

SUMMARY: Series 4.4.1 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	19.23	10
2	17.15	6
3	16.92	4
4	16.94	5
5	16.79	2
6	16.84	3
7	18.24	7
8	18.58	8
9	18.74	9
10	16.78	1



Unrestricted

Input models	AWSS 4.4.4.1 and 4.4.4.2									
Simulation period (years)	8000000									
Simulation period (days)	21917.81									
Daily Demand under seasonal peak (DD) (l/s)	20									

Configuration 1

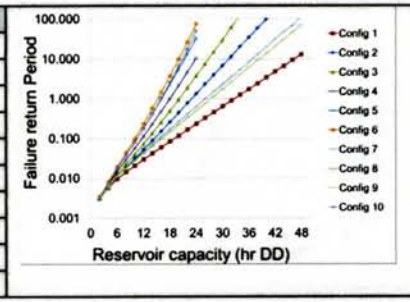
Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum	Failure/a	Ave fail time	Actual	log	Reservoir Size for 1: 10 year FRT
26	22464	67570	4.198	3.395	0.000	38.229	3.083	12.942	0.324	-0.489	
28	24192	48389	4.192	3.383	0.000	36.795	2.208	9.254	0.453	-0.344	
30	25920	34664	4.180	3.370	0.000	35.207	1.582	6.610	0.632	-0.199	
32	27648	24752	4.182	3.371	0.000	33.542	1.129	4.722	0.885	-0.053	
34	29376	17725	4.176	3.366	0.000	30.813	0.809	3.377	1.237	0.092	
36	31104	12760	4.155	3.362	0.000	30.209	0.582	2.419	1.718	0.235	
38	32832	9155	4.142	3.355	0.000	30.209	0.418	1.730	2.394	0.379	
40	34560	6495	4.169	3.351	0.000	28.898	0.296	1.235	3.375	0.528	
42	36288	4638	4.178	3.345	0.000	26.959	0.212	0.884	4.726	0.674	
44	38016	3340	4.162	3.335	0.000	26.959	0.152	0.634	6.562	0.817	
46	39744	2381	4.168	3.328	0.000	26.959	0.109	0.453	9.205	0.964	46.50118
48	41472	1711	4.160	3.296	0.000	26.959	0.078	0.325	12.810	1.108	

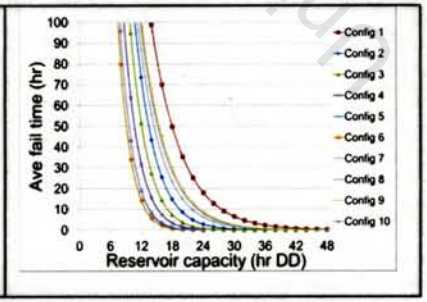
Configuration 2

Reservoir size i.t.o hours of DD	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum					
26	22464	9631	3.784	2.882	0.000	23.317	0.439	1.663	2.276	0.357	
28	24192	5589	3.782	2.864	0.001	22.731	0.255	0.964	3.922	0.593	
30	25920	3288	3.756	2.854	0.001	20.809	0.150	0.564	6.666	0.824	31.55713
32	27648	1953	3.705	2.846	0.020	17.659	0.089	0.330	11.223	1.050	
34	29376	1091	3.818	2.869	0.002	14.973	0.050	0.190	20.090	1.303	
36	31104	652	3.836	2.813	0.024	14.157	0.030	0.114	33.616	1.527	
38	32832	378	3.996	2.883	0.101	14.096	0.017	0.069	57.984	1.763	
40	34560	229	4.115	2.945	0.101	13.897	0.010	0.043	95.711	1.981	
42	36288	147	3.914	2.914	0.228	12.608	0.007	0.026	149.101	2.173	
44	38016	89	3.735	2.875	0.254	11.596	0.004	0.015	246.268	2.391	
46	39744	49	3.791	3.041	0.044	11.596	0.002	0.008	447.302	2.651	
48	41472	27	4.053	3.049	0.089	11.596	0.001	0.005	811.771	2.909	

SUMMARY: Series 4.4.4 – All Configurations

CONFIGURATION	Reservoir Size for 1:10 year FRT	Rank
1	46.50	10
2	31.56	6
3	26.85	5
4	23.93	4
5	21.39	3
6	20.06	1
7	36.95	7
8	38.46	8
9	39.31	9
10	20.87	2





University of Pretoria

APPENDIX B: RESERVOIR SIZES

University of Cape Town

SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period

Simulation Number	Res capacity for 1:10 Year Failure Return Period (hr of DD)	Res capacity for 1:10 Year Failure Return Period (hr of AADD)	Rank	Minimum	Maximum
2.1.1.1	18.10	22.63	10	21.08	22.63
2.1.1.2	17.07	21.33	6		
2.1.1.3	16.95	21.19	4		
2.1.1.4	16.98	21.22	5		
2.1.1.5	16.92	21.14	2		
2.1.1.6	16.94	21.17	3		
2.1.1.7	17.55	21.94	7		
2.1.1.8	17.87	22.34	8		
2.1.1.9	17.95	22.44	9		
2.1.1.10	16.86	21.08	1		
Red Book 48 hr 2.1.1	38.40	48.00			
Red Book 24 hr 2.1.1	19.20	24.00			
2.1.2.1	22.09	27.61	10	21.35	27.61
2.1.2.2	18.19	22.74	6		
2.1.2.3	17.64	22.05	5		
2.1.2.4	17.45	21.81	4		
2.1.2.5	17.27	21.59	3		
2.1.2.6	17.08	21.35	1		
2.1.2.7	20.21	25.26	7		
2.1.2.8	20.82	26.03	8		
2.1.2.9	21.07	26.33	9		
2.1.2.10	17.17	21.46	2		
Red Book 48 hr 2.1.2	38.40	48.00			
Red Book 24 hr 2.1.2	19.20	24.00			
2.1.3.1	25.15	31.44	10	21.76	31.44
2.1.3.2	19.56	24.45	6		
2.1.3.3	18.40	23.00	5		
2.1.3.4	18.17	22.71	4		
2.1.3.5	17.63	22.04	3		
2.1.3.6	17.40	21.76	1		
2.1.3.7	22.58	28.22	7		
2.1.3.8	23.41	29.27	8		
2.1.3.9	23.67	29.59	9		
2.1.3.10	17.56	21.95	2		
Red Book 48 hr 2.1.3	38.40	48.00			
Red Book 24 hr 2.1.3	19.20	24.00			

University of Cape Town

SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period

Simulation Number	Res capacity for 1:10 Year Failure Return Period (hr of DD)	Res capacity for 1:10 Year Failure Return Period (hr of AADD)	Rank	Minimum	Maximum
2.1.4.1	32.68	40.85	10	23.00	40.85
2.1.4.2	23.41	29.26	6		
2.1.4.3	21.18	26.48	5		
2.1.4.4	20.18	25.22	4		
2.1.4.5	18.94	23.67	3		
2.1.4.6	18.40	23.00	1		
2.1.4.7	27.79	34.74	7		
2.1.4.8	29.19	36.49	8		
2.1.4.9	29.52	36.90	9		
2.1.4.10	18.71	23.39	2		
Red Book 48 hr 2.1.4	38.40	48.00			
Red Book 24 hr 2.1.4	19.20	24.00			
2.2.1.1	17.99	22.49	10	20.90	22.49
2.2.1.2	16.93	21.17	6		
2.2.1.3	16.82	21.02	4		
2.2.1.4	16.83	21.03	5		
2.2.1.5	16.78	20.98	2		
2.2.1.6	16.80	21.00	3		
2.2.1.7	17.44	21.80	7		
2.2.1.8	17.74	22.17	8		
2.2.1.9	17.83	22.29	9		
2.2.1.10	16.72	20.90	1		
Red Book 48 hr 2.2.1	38.40	48.00			
Red Book 24 hr 2.2.1	19.20	24.00			
2.2.2.1	22.01	27.52	10	21.18	27.52
2.2.2.2	18.04	22.55	6		
2.2.2.3	17.53	21.91	5		
2.2.2.4	17.33	21.66	4		
2.2.2.5	17.15	21.43	3		
2.2.2.6	16.95	21.18	1		
2.2.2.7	20.07	25.09	7		
2.2.2.8	20.71	25.89	8		
2.2.2.9	21.00	26.25	9		
2.2.2.10	17.04	21.29	2		
Red Book 48 hr 2.2.2	38.40	48.00			
Red Book 24 hr 2.2.2	19.20	24.00			

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SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period					
Simulation Number	**Res capacity for 1:10 Year Failure Return Period (hr of DD)**	**Res capacity for 1:10 Year Failure Return Period (hr of AADD)**	**Rank**	**Minimum**	**Maximum**
2.2.3.1	25.05	31.31	10	21.59	31.31
2.2.3.2	19.43	24.29	6		
2.2.3.3	18.27	22.83	5		
2.2.3.4	18.05	22.56	4		
2.2.3.5	17.53	21.91	3		
2.2.3.6	17.27	21.59	1		
2.2.3.7	22.48	28.09	7		
2.2.3.8	23.31	29.13	8		
2.2.3.9	23.57	29.47	9		
2.2.3.10	17.42	21.77	2		
Red Book 48 hr 2.2.3	38.40	48.00			
Red Book 24 hr 2.2.3	19.20	24.00			
2.2.4.1	32.59	40.74	10	22.82	40.74
2.2.4.2	23.31	29.14	6		
2.2.4.3	21.06	26.33	5		
2.2.4.4	20.07	25.09	4		
2.2.4.5	18.81	23.52	3		
2.2.4.6	18.25	22.82	1		
2.2.4.7	27.68	34.60	7		
2.2.4.8	29.14	36.43	8		
2.2.4.9	29.41	36.77	9		
2.2.4.10	18.60	23.24	2		
Red Book 48 hr 2.2.4	38.40	48.00			
Red Book 24 hr 2.2.4	19.20	24.00			
2.3.1.1	16.99	21.23	10	19.56	21.23
2.3.1.2	15.81	19.76	6		
2.3.1.3	15.70	19.63	4		
2.3.1.4	15.71	19.64	5		
2.3.1.5	15.66	19.57	3		
2.3.1.6	15.66	19.57	2		
2.3.1.7	16.40	20.50	7		
2.3.1.8	16.68	20.86	8		
2.3.1.9	16.76	20.95	9		
2.3.1.10	15.65	19.56	1		
Red Book 48 hr 2.3.1	38.40	48.00			
Red Book 24 hr 2.3.1	19.20	24.00			

University of Cape Town

SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period

Simulation Number	Res capacity for 1:10 Year Failure Return Period (hr of DD)	Res capacity for 1:10 Year Failure Return Period (hr of AADD)	Rank	Minimum	Maximum
2.3.2.1	21.09	26.37	10	19.80	26.37
2.3.2.2	16.93	21.16	6		
2.3.2.3	16.37	20.46	5		
2.3.2.4	16.22	20.28	4		
2.3.2.5	16.03	20.03	3		
2.3.2.6	15.84	19.80	1		
2.3.2.7	19.20	24.01	7		
2.3.2.8	19.80	24.75	8		
2.3.2.9	19.99	24.99	9		
2.3.2.10	15.91	19.89	2		
Red Book 48 hr 2.3.2	38.40	48.00			
Red Book 24 hr 2.3.2	19.20	24.00			
2.3.3.1	24.07	30.08	10	20.16	30.08
2.3.3.2	18.22	22.78	6		
2.3.3.3	17.06	21.32	5		
2.3.3.4	16.86	21.08	4		
2.3.3.5	16.32	20.41	3		
2.3.3.6	16.13	20.16	1		
2.3.3.7	21.41	26.77	7		
2.3.3.8	22.33	27.91	8		
2.3.3.9	22.56	28.19	9		
2.3.3.10	16.25	20.32	2		
Red Book 48 hr 2.3.3	38.40	48.00			
Red Book 24 hr 2.3.3	19.20	24.00			
2.3.4.1	31.02	38.77	10	21.21	38.77
2.3.4.2	21.79	27.23	6		
2.3.4.3	19.61	24.51	5		
2.3.4.4	18.69	23.36	4		
2.3.4.5	17.54	21.93	3		
2.3.4.6	16.96	21.21	1		
2.3.4.7	26.41	33.01	7		
2.3.4.8	27.76	34.70	8		
2.3.4.9	28.01	35.02	9		
2.3.4.10	17.32	21.66	2		
Red Book 48 hr 2.3.4	38.40	48.00			
Red Book 24 hr 2.3.4	19.20	24.00			

University of Cape Town

SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period					
Simulation Number	**Res capacity for 1:10 Year Failure Return Period (hr of DD)**	**Res capacity for 1:10 Year Failure Return Period (hr of AADD)**	**Rank**	**Minimum**	**Maximum**
2.4.1.1	17.99	22.49	10	20.90	22.49
2.4.1.2	16.93	21.16	6		
2.4.1.3	16.81	21.01	4		
2.4.1.4	16.82	21.02	5		
2.4.1.5	16.78	20.97	2		
2.4.1.6	16.79	20.99	3		
2.4.1.7	17.43	21.79	7		
2.4.1.8	17.73	22.17	8		
2.4.1.9	17.82	22.28	9		
2.4.1.10	16.72	20.90	1		
Red Book 48 hr 2.4.1	38.40	48.00			
Red Book 24 hr 2.4.1	19.20	24.00			
2.4.2.1	22.01	27.51	10	21.18	27.51
2.4.2.2	18.04	22.55	6		
2.4.2.3	17.53	21.91	5		
2.4.2.4	17.32	21.65	4		
2.4.2.5	17.14	21.43	3		
2.4.2.6	16.94	21.18	1		
2.4.2.7	20.07	25.08	7		
2.4.2.8	20.71	25.88	8		
2.4.2.9	20.95	26.19	9		
2.4.2.10	17.03	21.29	2		
Red Book 48 hr 2.4.2	38.40	48.00			
Red Book 24 hr 2.4.2	19.20	24.00			
2.4.3.1	25.49	31.86	10	21.59	31.86
2.4.3.2	19.43	24.29	6		
2.4.3.3	18.26	22.83	5		
2.4.3.4	18.04	22.56	4		
2.4.3.5	17.52	21.90	3		
2.4.3.6	17.27	21.59	1		
2.4.3.7	22.47	28.09	7		
2.4.3.8	23.30	29.13	8		
2.4.3.9	23.57	29.46	9		
2.4.3.10	17.41	21.76	2		
Red Book 48 hr 2.4.3	38.40	48.00			
Red Book 24 hr 2.4.3	19.20	24.00			

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SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period

Simulation Number	Res capacity for 1:10 Year Failure Return Period (hr of DD)	Res capacity for 1:10 Year Failure Return Period (hr of AADD)	Rank	Minimum	Maximum
2.4.4.1	32.59	40.73	10	22.80	40.73
2.4.4.2	23.31	29.13	6		
2.4.4.3	21.06	26.32	5		
2.4.4.4	20.07	25.09	4		
2.4.4.5	18.81	23.51	3		
2.4.4.6	18.24	22.80	1		
2.4.4.7	27.67	34.59	7		
2.4.4.8	29.13	36.41	8		
2.4.4.9	29.41	36.76	9		
2.4.4.10	18.59	23.23	2		
Red Book 48 hr 2.4.4	38.40	48.00			
Red Book 24 hr 2.4.4	19.20	24.00			
1.2.1.1	15.42	19.28	10	17.23	19.28
1.2.1.2	14.03	17.53	6		
1.2.1.3	13.91	17.39	5		
1.2.1.4	13.88	17.35	4		
1.2.1.5	13.82	17.28	2		
1.2.1.6	13.86	17.33	3		
1.2.1.7	14.75	18.44	7		
1.2.1.8	15.07	18.83	8		
1.2.1.9	15.17	18.96	9		
1.2.1.10	13.79	17.23	1		
Red Book 48 hr 1.2.1	38.40	48.00			
Red Book 24 hr 1.2.1	19.20	24.00			
1.2.2.1	19.84	24.80	10	17.55	24.80
1.2.2.2	15.34	19.17	6		
1.2.2.3	14.70	18.38	5		
1.2.2.4	14.47	18.09	4		
1.2.2.5	14.22	17.77	3		
1.2.2.6	14.04	17.55	1		
1.2.2.7	17.84	22.29	7		
1.2.2.8	18.47	23.09	8		
1.2.2.9	18.72	23.40	9		
1.2.2.10	14.10	17.62	2		
Red Book 48 hr 1.2.2	38.40	48.00			
Red Book 24 hr 1.2.2	19.20	24.00			

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SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period					
Simulation Number	**Res capacity for 1:10 Year Failure Return Period (hr of DD)**	**Res capacity for 1:10 Year Failure Return Period (hr of AADD)**	**Rank**	**Minimum**	**Maximum**
1.2.3.1	23.13	28.91	10	18.03	28.91
1.2.3.2	16.82	21.02	6		
1.2.3.3	15.54	19.42	5		
1.2.3.4	15.24	19.05	4		
1.2.3.5	14.70	18.37	3		
1.2.3.6	14.42	18.03	1		
1.2.3.7	20.37	25.46	7		
1.2.3.8	21.26	26.58	8		
1.2.3.9	21.45	26.81	9		
1.2.3.10	14.53	18.16	2		
Red Book 48 hr 1.2.3	38.40	48.00			
Red Book 24 hr 1.2.3	19.20	24.00			
1.2.4.1	30.79	38.49	10	19.33	38.49
1.2.4.2	21.01	26.26	6		
1.2.4.3	18.55	23.19	5		
1.2.4.4	17.44	21.80	4		
1.2.4.5	16.10	20.13	3		
1.2.4.6	15.47	19.33	1		
1.2.4.7	25.77	32.21	7		
1.2.4.8	27.18	33.98	8		
1.2.4.9	27.45	34.31	9		
1.2.4.10	15.87	19.83	2		
Red Book 48 hr 1.2.4	38.40	48.00			
Red Book 24 hr 1.2.4	19.20	24.00			
1.4.1.1	15.42	19.27	10	17.22	19.27
1.4.1.2	14.02	17.52	6		
1.4.1.3	13.91	17.39	5		
1.4.1.4	13.87	17.34	4		
1.4.1.5	13.82	17.27	2		
1.4.1.6	13.86	17.33	3		
1.4.1.7	14.75	18.43	7		
1.4.1.8	15.06	18.83	8		
1.4.1.9	15.16	18.95	9		
1.4.1.10	13.78	17.22	1		
Red Book 48 hr 1.4.1	38.40	48.00			
Red Book 24 hr 1.4.1	19.20	24.00			

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SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period

Simulation Number	Res capacity for 1:10 Year Failure Return Period (hr of DD)	Res capacity for 1:10 Year Failure Return Period (hr of AADD)	Rank	Minimum	Maximum
1.4.2.1	19.84	24.80	10	17.54	24.80
1.4.2.2	15.34	19.17	6		
1.4.2.3	14.69	18.37	5		
1.4.2.4	14.47	18.08	4		
1.4.2.5	14.21	17.76	3		
1.4.2.6	14.04	17.54	1		
1.4.2.7	17.83	22.29	7		
1.4.2.8	18.46	23.08	8		
1.4.2.9	18.71	23.39	9		
1.4.2.10	14.09	17.61	2		
Red Book 48 hr 1.4.2	38.40	48.00			
Red Book 24 hr 1.4.2	19.20	24.00			
1.4.3.1	23.50	29.38	10	18.02	29.38
1.4.3.2	16.81	21.02	6		
1.4.3.3	15.53	19.42	5		
1.4.3.4	15.23	19.04	4		
1.4.3.5	14.69	18.36	3		
1.4.3.6	14.41	18.02	1		
1.4.3.7	20.36	25.45	7		
1.4.3.8	21.26	26.57	8		
1.4.3.9	21.45	26.81	9		
1.4.3.10	14.52	18.15	2		
Red Book 48 hr 1.4.3	38.40	48.00			
Red Book 24 hr 1.4.3	19.20	24.00			
1.4.4.1	30.79	38.48	10	19.32	38.48
1.4.4.2	21.01	26.26	6		
1.4.4.3	18.55	23.18	5		
1.4.4.4	17.44	21.80	4		
1.4.4.5	16.09	20.12	3		
1.4.4.6	15.46	19.32	1		
1.4.4.7	25.75	32.19	7		
1.4.4.8	27.17	33.96	8		
1.4.4.9	27.45	34.31	9		
1.4.4.10	15.85	19.82	2		
Red Book 48 hr 1.4.4	38.40	48.00			
Red Book 24 hr 1.4.4	19.20	24.00			

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SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period					
Simulation Number	**Res capacity for 1:10 Year Failure Return Period (hr of DD)**	**Res capacity for 1:10 Year Failure Return Period (hr of AADD)**	**Rank**	**Minimum**	**Maximum**
3.1.1.1	18.25	22.81	10	21.13	22.81
3.1.1.2	17.17	21.46	6		
3.1.1.3	17.05	21.32	5		
3.1.1.4	16.99	21.24	4		
3.1.1.5	16.98	21.23	3		
3.1.1.6	16.90	21.13	1		
3.1.1.7	17.72	22.15	7		
3.1.1.8	17.93	22.42	9		
3.1.1.9	17.90	22.37	8		
3.1.1.10	16.93	21.16	2		
Red Book 48 hr 3.1.1	38.40	48.00			
Red Book 24 hr 3.1.1	19.20	24.00			
3.1.4.1	32.89	41.11	10	23.08	41.11
3.1.4.2	23.39	29.24	6		
3.1.4.3	21.26	26.58	5		
3.1.4.4	20.26	25.33	4		
3.1.4.5	18.95	23.69	3		
3.1.4.6	18.46	23.08	1		
3.1.4.7	28.03	35.04	7		
3.1.4.8	29.09	36.36	8		
3.1.4.9	29.52	36.90	9		
3.1.4.10	18.75	23.43	2		
Red Book 48 hr 3.1.4	38.40	48.00			
Red Book 24 hr 3.1.4	19.20	24.00			
3.4.1.1	18.03	22.53	10	20.88	22.53
3.4.1.2	16.97	21.22	6		
3.4.1.3	16.86	21.07	5		
3.4.1.4	16.80	21.01	4		
3.4.1.5	16.79	20.99	3		
3.4.1.6	16.70	20.88	1		
3.4.1.7	17.51	21.89	7		
3.4.1.8	17.72	22.15	9		
3.4.1.9	17.68	22.10	8		
3.4.1.10	16.71	20.88	2		
Red Book 48 hr 3.4.1	38.40	48.00			
Red Book 24 hr 3.4.1	19.20	24.00			

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SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period

Simulation Number	Res capacity for 1:10 Year Failure Return Period (hr of DD)	Res capacity for 1:10 Year Failure Return Period (hr of AADD)	Rank	Minimum	Maximum
3.4.4.1	32.73	40.91	10	22.79	40.91
3.4.4.2	23.21	29.02	6		
3.4.4.3	21.07	26.34	5		
3.4.4.4	20.11	25.14	4		
3.4.4.5	18.76	23.45	3		
3.4.4.6	18.24	22.79	1		
3.4.4.7	27.85	34.82	7		
3.4.4.8	28.96	36.20	8		
3.4.4.9	29.43	36.79	9		
3.4.4.10	18.56	23.20	2		
Red Book 48 hr 3.4.4	48.00	60.00			
Red Book 24 hr 3.4.4	24.00	30.00			
4.1.1.1	19.35	24.18	10	21.13	24.18
4.1.1.2	17.29	21.61	6		
4.1.1.3	17.05	21.31	4		
4.1.1.4	17.08	21.35	5		
4.1.1.5	16.90	21.13	1		
4.1.1.6	16.97	21.21	3		
4.1.1.7	18.42	23.02	7		
4.1.1.8	18.73	23.42	8		
4.1.1.9	18.85	23.56	9		
4.1.1.10	16.93	21.16	2		
Red Book 48 hr 4.1.1	38.40	48.00			
Red Book 24 hr 4.1.1	19.20	24.00			
4.1.4.1	46.63	58.28	10	25.24	58.28
4.1.4.2	31.69	39.61	6		
4.1.4.3	27.03	33.78	5		
4.1.4.4	24.06	30.07	4		
4.1.4.5	21.54	26.92	3		
4.1.4.6	20.19	25.24	1		
4.1.4.7	37.11	46.39	7		
4.1.4.8	38.56	48.20	8		
4.1.4.9	39.43	49.29	9		
4.1.4.10	21.00	26.25	2		
Red Book 48 hr 4.1.4	38.40	48.00			
Red Book 24 hr 4.1.4	19.20	24.00			

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SUMMARY: DETERMINED RESERVOIR SIZE FOR 1: 10 Year Failure Return Period

Simulation Number	Res capacity for 1:10 Year Failure Return Period (hr of DD)	Res capacity for 1:10 Year Failure Return Period (hr of AADD)	Rank	Minimum	Maximum
4.4.1.1	19.23	24.04	10	20.97	24.04
4.4.1.2	17.15	21.44	6		
4.4.1.3	16.92	21.15	4		
4.4.1.4	16.94	21.18	5		
4.4.1.5	16.79	20.98	2		
4.4.1.6	16.84	21.05	3		
4.4.1.7	18.24	22.80	7		
4.4.1.8	18.58	23.23	8		
4.4.1.9	18.74	23.43	9		
4.4.1.10	16.78	20.97	1		
Red Book 48 hr 4.4.1	38.40	48.00			
Red Book 24 hr 4.4.1	19.20	24.00			
4.4.4.1	46.50	58.13	10	25.07	58.13
4.4.4.2	31.56	39.45	6		
4.4.4.3	26.85	33.56	5		
4.4.4.4	23.93	29.91	4		
4.4.4.5	21.39	26.74	3		
4.4.4.6	20.06	25.07	1		
4.4.4.7	36.95	46.19	7		
4.4.4.8	38.46	48.07	8		
4.4.4.9	39.31	49.14	9		
4.4.4.10	20.87	26.09	2		
Red Book 48 hr 4.4.4	38.40	48.00			
Red Book 24 hr 4.4.4	19.20	24.00			

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APPENDIX C: PRICING OF SIMULATIONS

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COST ESTIMATION : SERIES 2.1.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	8.69	13.04	16.53	13.04	13.04	13.04	10.87	10.14	9.78	16.53	8.69	8.69
Supply length		m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	2.3	3.4	4.3	3.4	3.4	3.4	2.8	2.7	2.6	4.3	2.3	2.3
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	160	113	92	113	113	113	113	113	113	92	160	160
Pipe diameter 2		mm	0	0	0	0	0	0	160	160	160	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	1.30	1.23	1.22	1.22	1.22	1.22	1.26	1.29	1.29	1.21	2.76	1.38
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$10 070.88	$13 501.73	$16 027.59	$13 501.73	$13 501.73	$13 501.73	$11 834.18	$11 258.32	$10 966.13	$16 027.59	$10 070.88	$10 070.88
Feeder pipe system														
Cost (Samra and Essery Cost data and Interconnections estimation)			$86 301.48	$134 784.12	$163 157.83	$139 854.06	$144 924.00	$149 993.94	$115 520.19	$109 098.87	$105 868.22	$168 836.10	$86 301.48	$86 301.48
Storage														
Cost (Samra and Essery Cost data)			$343 489.42	$329 385.29	$327 720.37	$328 100.74	$327 229.75	$327 554.54	$336 061.30	$340 400.52	$341 419.37	$326 458.69	$544 203.89	$357 566.91
Total Cost (Samra and Essery Cost data)			**$439 861.78**	**$477 651.14**	**$506 905.79**	**$481 456.54**	**$485 655.48**	**$491 050.22**	**$463 415.67**	**$460 757.71**	**$458 273.71**	**$511 322.38**	**$640 576.25**	**$453 939.27**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	2.3	3.4	4.3	3.4	3.4	3.4	2.8	2.7	2.6	4.3	2.3	2.3
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$517.98	$776.99	$984.99	$776.99	$776.99	$776.99	$647.49	$604.32	$582.73	$984.99	$517.98	$517.98
MAINTENANCE COST														
Yearly maintenance cost			$5 666.57	$5 752.12	$5 895.08	$5 758.50	$5 770.78	$5 801.01	$5 739.23	$5 766.34	$5 762.59	$5 904.54	$6 697.29	$5 897.73
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$302.13	$405.05	$480.83	$405.05	$405.05	$405.05	$355.03	$337.75	$326.98	$480.83	$302.13	$302.13
PS Mechanical	15		$804.25	$810.10	$961.66	$810.10	$810.10	$810.10	$710.05	$675.50	$657.97	$961.66	$804.25	$804.25
Feeder pipe system	120		$12 945.22	$20 217.62	$24 473.67	$20 978.11	$21 738.60	$22 499.09	$17 328.03	$16 364.83	$15 883.23	$25 325.42	$12 945.22	$12 945.22
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/\{(1+r)^T-1\}\}+\beta/r]\}+Aop/r$													
PS Civil			$9 248.50	$12 399.19	$14 718.78	$12 399.19	$12 399.19	$12 399.19	$10 867.81	$10 336.97	$10 070.64	$14 718.78	$9 248.50	$9 248.50
PS Mechanical			$6 265.56	$8 400.06	$9 971.51	$8 400.06	$8 400.06	$8 400.06	$7 362.60	$7 004.32	$6 822.54	$9 971.51	$6 265.56	$6 265.56
PS Electrical			$14 032.14	$20 878.22	$26 347.59	$20 876.22	$20 876.22	$20 876.22	$17 459.33	$16 318.21	$15 747.20	$26 347.59	$14 032.14	$14 032.14
Feeder pipe system: Civil			$95 802.93	$149 623.32	$181 120.86	$155 251.44	$160 879.56	$166 507.68	$128 238.50	$121 110.23	$117 546.09	$187 424.29	$95 802.93	$95 802.93
Feeder pipe system: Mechanical			$1 726.03	$2 695.68	$3 263.16	$2 797.08	$2 898.48	$2 999.88	$2 310.40	$2 181.98	$2 117.76	$3 376.72	$1 726.03	$1 726.03
Storage			$475 430.19	$455 880.71	$453 603.95	$454 130.43	$452 924.87	$453 374.43	$465 148.80	$471 154.79	$472 564.99	$451 857.84	$753 242.87	$494 915.11
			$602 506.35	**$649 878.18**	**$689 025.86**	**$653 854.42**	**$658 378.36**	**$664 557.46**	**$631 387.43**	**$628 108.50**	**$624 869.22**	**$693 696.54**	**$880 318.03**	**$621 990.27**

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 2.1.2

DESIGN PARAMETERS														
Daily Demand (Seasonal Peak)		l/s	20	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	48.01	72.02	91.30	72.02	72.02	72.02	60.01	56.01	54.01	91.30	48.01	48.01	48.01
Supply length		m	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital:	PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital:	PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital:	Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital:	Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING															
Source :Pumping Station															
Description	Formula	Unit													
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24	24
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	12.6	18.8	23.9	18.8	18.8	18.8	15.7	14.7	14.1	23.9	12.6	12.6	12.6
Feeder pipe															
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	156	111	90	111	111	111	111	111	111	90	156	156	156
Pipe diameter 2		mm	0	0	0	0	0	0	156	156	156	0	0	0	0
Pipe 1 - Length		m	5000	10000	15000	10000	10000	10000	5000	3333	2500	15000	5000	5000	5000
Pipe 1 - Length		m	0	0	0	0	0	0	2500	3333	3750	0	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^3 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^3 + 14.082x$	No	0	0	2	0	0	0	0	0	0	0	0	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^3 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^3 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0	0
Storage															
Reservoir capacity		Ml	1.59	1.31	1.27	1.26	1.24	1.23	1.45	1.50	1.52	1.24	2.76	1.38	
CAPITAL COST															
Source :Pumping Station															
Cost (Samra and Essery Cost data)			$34 644.50	$46 446.87	$55 135.99	$46 446.87	$46 446.87	$46 446.87	$40 710.38	$38 729.36	$37 724.22	$55 135.99	$34 644.50	$34 644.50	
Feeder pipe system															
Cost (Samra and Essery Cost data)			$423 350.47	$622 236.98	$768 084.21	$627 245.99	$632 254.99	$637 264.00	$527 738.07	$496 238.43	$480 488.61	$773 892.37	$423 350.47	$423 350.47	
Storage															
Cost (Samra and Essery Cost data)			$391 513.76	$344 597.42	$337 243.44	$334 686.23	$332 162.77	$329 513.90	$369 857.14	$377 148.45	$379 938.46	$330 734.56	$544 203.89	$357 566.91	
Total Cost (Samra and Essery Cost data)			**$849 508.74**	**$1 013 281.27**	**$1 160 463.64**	**$1 008 378.09**	**$1 010 864.64**	**$1 013 224.77**	**$938 305.59**	**$912 116.24**	**$898 151.29**	**$1 159 862.92**	**$1 002 198.86**	**$835 561.88**	
OPERATING COST															
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	12.6	18.8	23.9	18.8	18.8	18.8	15.7	14.7	14.1	23.9	12.6	12.6	
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16	
Operating Cost / year		R	$2 860.57	$4 290.97	$5 439.63	$4 290.97	$4 290.97	$4 290.97	$3 575.77	$3 337.37	$3 218.17	$5 439.63	$2 860.57	$2 860.57	
MAINTENANCE COST															
Yearly maintenance cost			$8 342.83	$8 753.90	$9 461.46	$8 630.28	$8 617.47	$8 602.79	$8 601.79	$8 533.46	$8 486.31	$9 391.87	$10 633.18	$7 833.63	
SALVAGE VALUE AT END OF DESIGN LIFE															
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	
PS Civil		50	$1 039.34	$1 393.41	$1 654.08	$1 393.41	$1 393.41	$1 393.41	$1 221.31	$1 161.88	$1 131.73	$1 654.08	$1 039.34	$1 039.34	
PS Mechanical		15	$2 078.67	$2 786.81	$3 308.16	$2 786.81	$2 786.81	$2 786.81	$2 442.62	$2 323.76	$2 263.45	$3 308.16	$2 078.67	$2 078.67	
Feeder pipe system		120	$63 502.57	$93 335.55	$115 212.63	$94 086.90	$94 838.25	$95 589.60	$79 160.71	$74 435.76	$72 073.29	$116 053.86	$63 502.57	$63 502.57	
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
LIFE CYCLE COST															
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/r]+Aop/r$														
PS Civil			$31 815.44	$42 654.04	$50 633.60	$42 654.04	$42 654.04	$42 654.04	$37 385.99	$35 568.74	$34 643.68	$50 633.60	$31 815.44	$31 815.44	
PS Mechanical			$21 553.96	$28 896.76	$34 302.67	$28 896.76	$28 896.76	$28 896.76	$25 327.82	$24 095.34	$23 470.00	$34 302.67	$21 553.96	$21 553.96	
PS Electrical			$75 238.65	$112 267.38	$141 917.83	$112 267.38	$112 267.38	$93 770.72	$87 597.76	$84 509.71	$141 917.83	$75 238.65	$75 238.65		
Feeder pipe system: Civil			$469 959.68	$690 742.80	$852 647.23	$696 303.28	$701 863.76	$707 424.24	$585 839.93	$550 872.31	$533 388.50	$858 872.83	$469 959.68	$469 959.68	
Feeder pipe system: Mechanical			$8 467.01	$12 444.74	$15 361.68	$12 544.92	$12 645.10	$12 745.28	$10 554.78	$9 924.77	$9 609.77	$15 473.85	$8 467.01	$8 467.01	
Storage			$541 901.59	$476 963.79	$466 785.01	$463 245.53	$459 752.77	$456 066.41	$511 926.25	$522 018.29	$525 879.99	$457 775.95	$753 242.87	$494 915.11	
			$1 148 938.33	**$1 363 969.51**	**$1 561 648.02**	**$1 358 911.91**	**$1 368 079.80**	**$1 380 074.11**	**$1 284 805.48**	**$1 230 975.21**	**$1 211 501.65**	**$1 556 976.72**	**$1 380 277.61**	**$1 101 949.85**	

Samra & Essery Data Only

COST ESTIMATION : SERIES 2.1.3

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	115.81	173.72	220.23	173.72	173.72	173.72	144.77	135.12	130.29	220.23	115.81	115.81
Supply length		m	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Power required	P = (ρ x g x Q x Ht)/n	kW	30.3	45.4	57.6	45.4	45.4	45.4	37.9	35.3	34.1	57.6	30.3	30.3
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	150	106	87	106	106	106	106	106	106	87	150	150
Pipe diameter 2		mm	0	0	0	0	0	0	150	150	150	0	0	0
Pipe 1 - Length		m	10000	20000	30000	20000	20000	20000	10000	6667	5000	30000	10000	10000
Pipe 1 - Length		m	0	0	0	0	0	0	5000	6667	7500	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.062x$	No	0	0	2	0	0	0	0	0	0	0	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	2	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	1.81	1.41	1.32	1.31	1.27	1.25	1.63	1.69	1.70	1.26	2.76	1.36
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$85 481.96	$87 789.76	$104 213.15	$87 789.76	$87 789.76	$87 789.76	$76 947.15	$73 202.81	$71 302.96	$104 213.15	$85 481.96	$85 481.96
Feeder pipe system														
Cost (Samra and Essery Cost data)			$816 778.76	$1 191 185.29	$1 474 146.90	$1 196 083.98	$1 200 982.67	$1 205 881.35	$1 008 866.59	$948 093.69	$917 707.24	$1 479 627.96	$816 778.76	$816 778.76
Storage														
Cost (Samra and Essery Cost data)			$424 085.21	$361 993.41	$347 316.38	$344 330.19	$337 111.56	$334 041.98	$396 900.99	$405 935.65	$406 677.94	$336 213.79	$544 203.89	$357 566.91
Total Cost (Samra and Essery Cost data)			**$1 306 345.94**	**$1 640 968.46**	**$1 925 676.43**	**$1 628 203.93**	**$1 625 883.98**	**$1 627 713.09**	**$1 482 714.74**	**$1 427 232.15**	**$1 397 688.16**	**$1 920 054.90**	**$1 426 464.61**	**$1 239 827.64**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	30.3	45.4	57.6	45.4	45.4	45.4	37.9	35.3	34.1	57.6	30.3	30.3
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$6 900.33	$10 350.77	$13 121.58	$10 350.77	$10 350.77	$10 350.77	$8 625.55	$8 050.48	$7 762.94	$13 121.58	$6 900.33	$6 900.33
MAINTENANCE COST														
Yearly maintenance cost			$11 113.09	$12 281.28	$13 643.45	$12 040.83	$11 957.04	$11 935.49	$11 782.71	$11 576.17	$11 446.00	$13 504.32	$12 914.87	$10 115.31
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$1 964.46	$2 633.69	$3 126.39	$2 633.69	$2 633.69	$2 633.69	$2 308.41	$2 196.08	$2 139.09	$3 126.39	$1 964.46	$1 964.46
PS Mechanical		15	$3 928.92	$5 267.39	$6 252.79	$5 267.39	$5 267.39	$5 267.39	$4 616.83	$4 392.17	$4 278.18	$6 252.79	$3 928.92	$3 928.92
Feeder pipe system		120	$122 516.81	$178 677.79	$221 122.03	$179 412.60	$180 147.40	$180 882.20	$151 329.99	$142 214.05	$137 656.09	$221 944.19	$122 516.81	$122 516.81
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	Cc= {C0[1+[(1- α)/((1+r)^T-1)]+ β /r]}+Aop/r													
PS Civil			$60 134.73	$80 620.88	$95 703.14	$80 620.88	$80 620.88	$80 620.88	$70 863.67	$67 225.09	$65 480.41	$95 703.14	$60 134.73	$60 134.73
PS Mechanical			$40 739.38	$54 618.10	$64 835.86	$54 618.10	$54 618.10	$54 618.10	$47 872.41	$45 542.88	$44 360.91	$64 835.86	$40 739.38	$40 739.38
PS Electrical			$179 547.67	$268 206.66	$339 242.37	$268 206.66	$268 206.66	$268 206.66	$223 910.83	$209 131.30	$201 738.66	$339 242.37	$179 547.67	$179 547.67
Feeder pipe system: Civil			$906 702.86	$1 322 330.07	$1 636 444.82	$1 327 768.08	$1 333 206.09	$1 338 644.10	$1 119 938.80	$1 052 475.04	$1 018 743.16	$1 642 529.13	$906 702.86	$906 702.86
Feeder pipe system: Mechanical			$16 335.58	$23 823.71	$29 482.94	$23 921.68	$24 019.65	$24 117.63	$20 177.33	$18 961.87	$18 354.14	$29 592.56	$16 335.58	$16 335.58
Storage			$586 984.35	$501 041.91	$480 727.16	$476 593.92	$466 602.47	$462 353.81	$549 358.16	$561 863.20	$565 658.85	$465 359.85	$753 242.87	$494 915.11
			$1 790 444.57	**$2 250 841.32**	**$2 846 436.08**	**$2 231 729.31**	**$2 227 273.85**	**$2 228 861.17**	**$2 031 921.00**	**$1 955 199.38**	**$1 914 336.13**	**$2 637 262.90**	**$1 956 703.09**	**$1 696 375.33**

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 2.1.4

DESIGN PARAMETERS														
Daily Demand (Seasonal Peak)	l/s	20	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	316.34	474.52	601.55	474.52	474.52	474.52	395.43	369.07	355.89	601.55	316.34	316.34	316.34
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	82.8	124.1	157.4	124.1	124.1	124.1	103.4	96.5	93.1	157.4	82.8	82.8
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	148	104	85	104	104	104	104	104	104	85	148	148
Pipe diameter 2		mm	0	0	0	0	0	0	148	148	148	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	2	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	0	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	2.35	1.69	1.53	1.45	1.36	1.32	2.00	2.10	2.13	1.35	2.76	1.38

CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$135 406.09	$181 534.99	$215 495.91	$181 534.99	$181 534.99	$181 534.99	$159 114.24	$151 371.54	$147 443.02	$215 495.91	$135 406.09	$135 406.09
Feeder pipe system														
Cost (Samra and Essery Cost data)			$2 007 523.44	$2 913 464.00	$3 611 480.34	$2 918 312.55	$2 923 161.10	$2 928 009.64	$2 465 351.14	$2 315 980.19	$2 241 294.71	$3 616 903.58	$2 007 523.44	$2 007 523.44
Storage														
Cost (Samra and Essery Cost data)			$495 315.00	$405 881.22	$381 317.12	$369 527.98	$354 239.82	$347 395.00	$450 172.91	$463 504.96	$466 539.63	$351 351.67	$544 203.89	$357 566.91
Total Cost (Samra and Essery Cost data)			**$2 638 244.53**	**$3 500 880.22**	**$4 208 293.38**	**$3 469 375.52**	**$3 458 935.91**	**$3 486 938.63**	**$3 074 638.29**	**$2 930 856.69**	**$2 855 277.36**	**$4 183 751.18**	**$2 687 133.42**	**$2 500 496.44**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	82.8	124.1	157.4	124.1	124.1	124.1	103.4	96.5	93.1	157.4	82.8	82.8
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$18 848.17	$28 272.99	$35 841.41	$28 272.99	$28 272.99	$28 272.99	$23 560.58	$21 989.78	$21 204.37	$35 841.41	$18 848.17	$18 848.17
MAINTENANCE COST														
Yearly maintenance cost			$18 848.48	$22 907.20	$25 975.22	$21 986.14	$21 781.06	$21 702.63	$20 702.31	$20 076.47	$19 708.49	$25 552.85	$19 581.82	$18 782.26
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$4 062.18	$5 446.05	$6 464.88	$5 446.05	$5 446.05	$5 446.05	$4 773.43	$4 541.15	$4 423.29	$6 464.88	$4 062.18	$4 062.18
PS Mechanical		15	$8 124.37	$10 892.10	$12 929.75	$10 892.10	$10 892.10	$10 892.10	$9 546.85	$9 082.29	$8 846.58	$12 929.75	$8 124.37	$8 124.37
Feeder pipe system		120	$301 128.52	$437 019.60	$541 722.05	$437 746.88	$438 474.16	$439 201.45	$369 802.67	$347 397.03	$336 194.21	$542 535.54	$301 128.52	$301 128.52
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/r]\}+Aop/r$													
PS Civil			$124 348.88	$166 710.91	$197 898.59	$166 710.91	$166 710.91	$166 710.91	$146 121.03	$139 010.60	$135 402.87	$197 898.59	$124 348.88	$124 348.88
PS Mechanical			$84 242.44	$112 941.38	$134 070.05	$112 941.38	$112 941.38	$112 941.38	$98 992.38	$94 175.29	$91 731.17	$134 070.05	$84 242.44	$84 242.44
PS Electrical			$485 760.40	$726 339.75	$919 201.13	$726 339.75	$726 339.75	$726 339.75	$606 119.27	$566 016.85	$545 959.49	$919 201.13	$485 760.40	$485 760.40
Feeder pipe system: Civil			$2 228 543.80	$3 234 224.62	$4 009 089.99	$3 239 607.17	$3 244 989.53	$3 250 371.88	$2 736 776.51	$2 570 960.41	$2 488 052.36	$4 015 110.30	$2 228 543.80	$2 228 543.80
Feeder pipe system: Mechanical			$40 150.47	$58 269.28	$72 229.61	$58 366.25	$58 463.22	$58 560.19	$49 307.02	$46 319.60	$44 825.89	$72 338.07	$40 150.47	$40 150.47
Storage			$885 574.84	$561 787.86	$527 788.23	$511 470.65	$490 310.03	$480 835.97	$623 092.82	$641 545.96	$645 746.31	$486 312.48	$753 242.87	$494 915.11
			$3 848 620.83	**$4 860 274.01**	**$5 860 277.59**	**$4 818 436.12**	**$4 799 754.82**	**$4 795 766.08**	**$4 260 409.04**	**$4 058 028.72**	**$3 961 716.19**	**$5 824 930.62**	**$3 716 288.87**	**$3 457 961.10**

Samra & Essery Data

COST ESTIMATION : SERIES 2.2.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	4.70	7.04	8.93	7.04	7.04	7.04	5.87	5.48	5.28	8.93	4.70	4.70
Supply length		m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Power required	P = (ρ x g x Q x Ht)/n	kW	4.9	7.4	9.3	7.4	7.4	7.4	6.1	5.7	5.5	9.3	4.9	4.9
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	307	217	177	217	217	217	217	217	217	177	307	307
Pipe diameter 2		mm	0	0	0	0	0	0	307	307	307	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	0	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	2	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	5.18	4.88	4.84	4.85	4.83	4.84	5.02	5.11	5.14	4.82	11.06	5.53
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$17 575.65	$23 563.16	$27 971.27	$23 563.16	$23 563.16	$23 563.16	$20 652.96	$19 647.96	$19 138.04	$27 971.27	$17 575.65	$17 575.65
Feeder pipe system														
Cost (Samra and Essery Cost data)			$158 938.83	$243 453.78	$297 803.23	$251 807.99	$260 182.22	$268 516.45	$207 975.95	$196 150.01	$190 237.04	$307 195.13	$158 938.83	$158 938.83
Storage														
Cost (Samra and Essery Cost data)			$783 774.85	$756 885.45	$753 631.39	$753 864.15	$752 779.65	$753 128.51	$789 668.26	$777 338.01	$779 721.52	$751 191.64	$1 216 585.40	$813 844.50
Total Cost (Samra and Essery Cost data)			$960 289.32	$1 023 702.38	$1 079 405.90	$1 029 235.30	$1 036 525.03	$1 045 208.13	$998 297.16	$993 135.98	$989 096.59	$1 086 358.05	$1 393 099.87	$990 358.97
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	4.9	7.4	9.3	7.4	7.4	7.4	6.1	5.7	5.5	9.3	4.9	4.9
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$1 118.96	$1 678.48	$2 127.80	$1 678.48	$1 678.48	$1 678.48	$1 396.72	$1 305.47	$1 258.84	$2 127.80	$1 118.96	$1 118.96
MAINTENANCE COST														
Yearly maintenance cost			$12 730.59	$12 807.89	$13 078.79	$12 807.35	$12 832.85	$12 879.85	$12 795.56	$12 841.23	$12 842.22	$13 089.16	$19 222.75	$13 181.63
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$527.27	$706.89	$839.14	$706.89	$706.89	$706.89	$619.59	$589.44	$574.14	$839.14	$527.27	$527.27
PS Mechanical		15	$1 054.54	$1 413.79	$1 678.28	$1 413.79	$1 413.79	$1 413.79	$1 239.18	$1 178.88	$1 148.28	$1 678.28	$1 054.54	$1 054.54
Feeder pipe system		120	$23 840.82	$36 518.06	$44 670.48	$37 771.20	$39 024.33	$40 277.47	$31 196.39	$29 422.50	$28 535.56	$46 079.27	$23 840.82	$23 840.82
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Co=(C0[1+\{[1-\alpha\ y]/[(1+r)^t-1]\}+\beta/r]+Aop/r$													
PS Civil			$16 140.43	$21 639.00	$25 687.15	$21 639.00	$21 639.00	$21 639.00	$18 966.44	$18 043.51	$17 575.23	$25 687.15	$16 140.43	$16 140.43
PS Mechanical			$10 934.63	$14 659.74	$17 402.23	$14 659.74	$14 659.74	$14 659.74	$12 849.17	$12 223.91	$11 906.66	$17 402.23	$10 934.63	$10 934.63
PS Electrical			$29 863.37	$44 495.11	$56 201.85	$44 495.11	$44 495.11	$44 495.11	$37 188.22	$34 748.84	$33 528.35	$56 201.85	$29 863.37	$29 863.37
Feeder pipe system: Civil			$178 437.36	$270 257.05	$330 590.19	$279 531.05	$288 805.05	$298 079.05	$230 873.27	$217 745.35	$211 181.39	$341 016.10	$178 437.36	$178 437.36
Feeder pipe system: Mechanical			$3 178.78	$4 869.08	$5 956.06	$5 036.16	$5 203.24	$5 370.33	$4 159.52	$3 923.00	$3 804.74	$6 143.90	$3 178.78	$3 178.78
Storage			$1 064 837.57	$1 047 342.62	$1 043 115.44	$1 043 437.61	$1 041 936.52	$1 042 419.39	$1 065 312.37	$1 075 928.22	$1 079 227.27	$1 039 738.54	$1 683 896.82	$1 126 457.53
			$1 321 392.13	$1 403 262.86	$1 478 952.82	$1 408 798.67	$1 416 738.67	$1 426 662.82	$1 369 349.00	$1 362 612.83	$1 357 223.64	$1 486 189.76	$1 920 453.39	$1 363 012.10

University of Canberra
Samra & Essery data

COST ESTIMATION : SERIES 2.2.2

INFRASTRUCTURE														
Daily Demand (Seasonal Peak)		l/s	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	25.73	38.60	48.94	38.60	38.60	38.60	32.17	30.02	28.95	48.94	25.73	25.73
Supply length		m	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital:	PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital:	PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital:	Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital:	Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	26.9	40.4	51.2	40.4	40.4	40.4	33.7	31.4	30.3	51.2	26.9	26.9
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	301	213	174	213	213	213	213	213	213	174	301	301
Pipe diameter 2		mm	0	0	0	0	0	0	301	301	301	0	0	0
Pipe 1 - Length		m	5000	10000	15000	10000	10000	10000	5000	3333	2500	15000	5000	5000
Pipe 1 - Length		m	0	0	0	0	0	0	2500	3333	3750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	6.34	5.20	5.05	4.99	4.94	4.88	5.78	5.97	8.05	4.91	11.06	5.53
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$80 134.28	$80 620.27	$95 702.42	$80 620.27	$80 620.27	$80 620.27	$70 663.14	$67 224.58	$65 479.91	$95 702.42	$80 134.28	$80 134.28
Feeder pipe system														
Cost (Samra and Essery Cost data)			$780 795.83	$1 142 766.44	$1 413 855.12	$1 150 974.14	$1 159 181.85	$1 167 389.56	$968 479.73	$910 384.16	$881 336.37	$1 423 083.37	$780 795.83	$780 795.83
Storage														
Cost (Samra and Essery Cost data)			$881 046.76	$784 960.00	$771 972.12	$766 855.28	$762 154.73	$756 991.71	$835 109.95	$850 481.19	$857 258.41	$759 281.47	$1 216 585.40	$813 844.50
Total Cost (Samra and Essery Cost data)			**$1 721 976.87**	**$2 008 346.71**	**$2 281 529.86**	**$1 998 449.69**	**$2 001 956.85**	**$2 005 001.54**	**$1 874 252.82**	**$1 828 089.93**	**$1 804 074.70**	**$2 278 067.26**	**$2 067 515.51**	**$1 954 774.61**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	26.9	40.4	51.2	40.4	40.4	40.4	33.7	31.4	30.3	51.2	26.9	26.9
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$6 133.31	$9 200.21	$11 663.02	$9 200.21	$9 200.21	$9 200.21	$7 686.76	$7 155.61	$6 900.04	$11 663.02	$6 133.31	$6 133.31
MAINTENANCE COST														
Yearly maintenance cost			$17 733.05	$18 310.56	$19 625.02	$18 080.03	$18 050.56	$18 014.15	$18 089.81	$17 994.63	$17 933.45	$19 480.80	$22 766.13	$16 725.02
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$1 804.03	$2 418.61	$2 871.07	$2 418.61	$2 418.61	$2 418.61	$2 119.89	$2 016.74	$1 984.40	$2 871.07	$1 804.03	$1 804.03
PS Mechanical		15	$3 608.06	$4 837.22	$5 742.15	$4 837.22	$4 837.22	$4 837.22	$4 239.79	$4 033.48	$3 928.79	$5 742.15	$3 608.06	$3 608.06
Feeder pipe system		120	$117 119.37	$171 414.97	$212 078.27	$172 646.12	$173 877.28	$175 108.43	$145 271.96	$136 557.62	$132 200.46	$213 462.51	$117 119.37	$117 119.37
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/r]\}+Aop/r$													
PS Civil			$55 223.73	$74 036.85	$87 887.40	$74 036.85	$74 036.85	$74 036.85	$64 892.81	$61 735.05	$60 132.85	$87 887.40	$55 223.73	$55 223.73
PS Mechanical			$37 412.34	$50 157.83	$59 540.94	$50 157.63	$50 157.63	$50 157.63	$43 962.83	$41 823.55	$40 738.11	$59 540.94	$37 412.34	$37 412.34
PS Electrical			$159 797.23	$238 671.85	$301 863.48	$238 671.85	$238 671.85	$238 671.85	$199 265.27	$186 116.89	$179 539.98	$301 863.48	$159 797.23	$159 797.23
Feeder pipe system: Civil			$866 758.35	$1 268 580.48	$1 569 514.96	$1 277 691.83	$1 286 803.17	$1 295 914.51	$1 075 105.50	$1 010 813.84	$978 368.01	$1 579 759.20	$866 758.35	$866 758.35
Feeder pipe system: Mechanical			$15 615.92	$22 855.33	$28 277.10	$23 019.48	$23 183.64	$23 347.79	$19 369.59	$18 207.68	$17 626.73	$28 461.67	$15 615.92	$15 615.92
Storage			$1 219 473.45	$1 086 477.96	$1 068 501.19	$1 061 418.87	$1 054 912.75	$1 047 766.52	$1 155 891.45	$1 177 167.07	$1 186 547.56	$1 050 935.82	$1 683 898.82	$1 126 457.53
			$2 354 281.02	**$2 740 780.09**	**$3 115 585.06**	**$2 724 996.50**	**$2 727 765.88**	**$2 729 806.14**	**$2 558 487.46**	**$2 495 864.06**	**$2 462 953.22**	**$3 108 448.49**	**$2 818 706.39**	**$2 281 265.10**

Samra & Essery Data

COST ESTIMATION : SERIES 2.2.3

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	61.25	91.88	116.48	91.88	91.88	91.88	76.57	71.46	68.91	116.48	61.25	61.25
Supply length		m	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Power required	P = (ρ x g x Q x Ht)/n	kW	64.1	96.1	121.9	96.1	96.1	96.1	80.1	74.8	72.1	121.9	64.1	64.1
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	290	205	168	205	205	205	205	205	205	168	290	290
Pipe diameter 2		mm	0	0	0	0	0	0	290	290	290	0	0	0
Pipe 1 - Length		m	10000	20000	30000	20000	20000	20000	10000	6667	5000	30000	10000	10000
Pipe 1 - Length		m	0	0	0	0	0	0	5000	6667	7500	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	7.21	5.60	5.28	5.20	5.05	4.98	6.47	6.71	6.79	5.02	11.06	5.53
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$112 564.83	$150 912.38	$179 144.52	$150 912.38	$150 912.38	$150 912.38	$132 273.71	$125 837.11	$122 571.28	$179 144.52	$112 564.83	$112 564.83
Feeder pipe system														
Cost (Samra and Essery Cost data)			$1 510 285.24	$2 197 630.23	$2 722 954.51	$2 205 571.89	$2 213 513.58	$2 221 455.22	$1 860 509.26	$1 748 135.61	$1 691 948.78	$2 731 885.24	$1 510 285.24	$1 510 285.24
Storage														
Cost (Samra and Essery Cost data)			$949 596.19	$819 563.27	$790 674.05	$785 226.68	$771 908.07	$765 459.04	$891 696.53	$910 693.40	$916 695.04	$789 070.45	$1 216 585.40	$813 844.50
Total Cost (Samra and Essery Cost data)			$2 572 446.26	$3 168 105.87	$3 692 773.08	$3 141 710.95	$3 136 334.00	$3 137 826.64	$2 884 479.51	$2 784 666.12	$2 731 215.10	$3 680 100.21	$2 839 435.47	$2 436 694.58
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	64.1	96.1	121.9	96.1	96.1	96.1	80.1	74.8	72.1	121.9	64.1	64.1
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$14 598.00	$21 897.57	$27 759.35	$21 897.57	$21 897.57	$21 897.57	$18 247.79	$17 031.19	$16 422.89	$27 759.35	$14 598.00	$14 598.00
MAINTENANCE COST														
Yearly maintenance cost			$22 943.53	$24 820.91	$27 302.16	$24 345.57	$24 185.50	$24 126.47	$24 027.19	$23 684.62	$23 460.40	$27 022.76	$26 948.37	$20 907.25
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$3 376.94	$4 527.37	$5 374.34	$4 527.37	$4 527.37	$4 527.37	$3 968.21	$3 775.11	$3 677.14	$5 374.34	$3 376.94	$3 376.94
PS Mechanical		15	$6 753.89	$9 054.74	$10 748.67	$9 054.74	$9 054.74	$9 054.74	$7 936.42	$7 550.23	$7 354.28	$10 748.67	$6 753.89	$6 753.89
Feeder pipe system		120	$226 542.79	$329 644.53	$408 443.18	$330 835.78	$332 027.03	$333 218.28	$279 076.39	$262 220.34	$253 792.32	$409 782.79	$226 542.79	$226 542.79
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	Cc= {C0[1+{(1- α)/((1+r)^T-1)}+ β /r]+Aop/r													
PS Civil			$103 372.82	$138 588.92	$164 515.64	$138 588.92	$138 588.92	$138 588.92	$121 472.29	$115 561.30	$112 562.15	$164 515.64	$103 372.82	$103 372.82
PS Mechanical			$70 031.83	$93 889.62	$111 454.16	$93 889.62	$93 889.62	$93 889.62	$82 293.64	$78 289.13	$76 257.30	$111 454.16	$70 031.83	$70 031.83
PS Electrical			$377 050.75	$563 662.35	$713 241.84	$563 662.35	$563 662.35	$563 662.35	$470 414.07	$439 307.26	$423 748.75	$713 241.84	$377 050.75	$377 050.75
Feeder pipe system: Civil			$1 676 561.65	$2 439 580.59	$3 022 740.96	$2 448 396.60	$2 457 212.61	$2 466 028.62	$2 065 343.95	$1 940 598.40	$1 878 225.62	$3 032 654.96	$1 676 561.65	$1 676 561.65
Feeder pipe system: Mechanical			$30 205.70	$43 952.60	$54 459.09	$44 111.44	$44 270.27	$44 429.10	$37 210.19	$34 962.71	$33 838.98	$54 637.70	$30 205.70	$30 205.70
Storage			$1 314 354.02	$1 134 372.99	$1 094 386.89	$1 086 847.08	$1 068 412.53	$1 059 486.31	$1 234 214.01	$1 260 507.93	$1 268 814.91	$1 064 484.93	$1 683 898.82	$1 126 457.53
			$3 571 578.76	$4 414 047.08	$5 160 798.80	$4 375 496.01	$4 366 036.31	$4 366 084.93	$4 010 948.15	$3 869 226.73	$3 793 447.71	$5 140 989.23	$3 941 121.57	$3 383 680.28

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 2.2.4

KEY ASSUMPTIONS		Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	Config 11	Config 12	Config 13
Daily Demand (Seasonal Peak)	l/s	80	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	166.31	249.47	316.25	249.47	249.47	249.47	207.89	194.03	187.10	316.25	166.31	166.31	166.31
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Power required	$P = (\rho \times g \times Q \times Ht)/n$	kW	174.0	261.0	330.9	261.0	261.0	261.0	217.5	203.0	195.8	330.9	174.0	174.0
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	285	202	165	202	202	202	202	202	202	165	285	285
Pipe diameter 2		mm	0	0	0	0	0	0	285	285	285	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	9.39	6.71	6.07	5.78	5.42	5.26	7.97	8.39	8.47	5.36	11.06	5.53

CAPITAL COST													
Source :Pumping Station													
Cost (Samra and Essery Cost data)		$231 757.45	$310 710.44	$388 837.04	$310 710.44	$310 710.44	$310 710.44	$272 335.68	$259 083.49	$252 359.53	$368 837.04	$231 757.45	$231 757.45
Feeder pipe system													
Cost (Samra and Essery Cost data)		$3 716 343.63	$5 388 413.10	$6 682 697.20	$5 396 233.56	$5 404 054.02	$5 411 874.47	$4 558 862.95	$4 282 346.23	$4 144 087.87	$6 691 492.22	$3 716 343.63	$3 716 343.63
Storage													
Cost (Samra and Essery Cost data)		$1 106 185.05	$910 762.15	$858 732.13	$835 137.59	$804 327.00	$790 303.02	$1 006 286.14	$1 036 679.12	$1 042 262.35	$798 893.40	$1 216 585.40	$813 644.50
Total Cost (Samra and Essery Cost data)		**$5 054 286.13**	**$6 609 885.70**	**$7 910 266.37**	**$6 542 081.59**	**$6 519 091.46**	**$6 512 887.93**	**$5 837 484.77**	**$5 578 108.84**	**$5 438 709.75**	**$7 859 222.66**	**$5 164 686.48**	**$4 761 945.58**
OPERATING COST													
Power required	$P = (\rho \times g \times Q \times Ht)/n$	kW	174.0	261.0	330.9	261.0	261.0	261.0	217.5	203.0	195.8	330.9	174.0	174.0
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$39 635.52	$59 454.82	$75 370.34	$59 454.82	$59 454.82	$59 454.82	$49 545.17	$46 241.95	$44 590.34	$75 370.34	$39 635.52	$39 635.52
MAINTENANCE COST													
Yearly maintenance cost			$37 538.42	$43 772.74	$50 056.61	$42 677.48	$42 254.42	$42 083.16	$40 666.43	$39 604.57	$38 928.44	$49 203.00	$39 194.43	$33 153.31

SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50	$6 952.72	$9 321.31	$11 065.11	$9 321.31	$9 321.31	$9 321.31	$8 170.07	$7 772.50	$7 570.79	$11 065.11	$6 952.72	$6 952.72
PS Mechanical	15	$13 905.45	$18 642.63	$22 130.22	$18 642.63	$18 642.63	$18 642.63	$16 340.14	$15 545.01	$15 141.57	$22 130.22	$13 905.45	$13 905.45
Feeder pipe system	120	$557 451.54	$808 261.97	$1 002 404.56	$809 435.03	$810 608.10	$811 781.17	$683 829.44	$642 351.93	$621 613.18	$1 003 723.83	$557 451.54	$557 451.54
Storage	120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

LIFE CYCLE COST													
Capitalization method	$Cc = \{C0[1+((1-\alpha)/((1+r)^T-1))+\beta/r]\}+Aop/r$												
PS Civil		$212 832.22	$285 337.94	$338 717.94	$285 337.94	$285 337.94	$285 337.94	$250 098.85	$237 926.82	$231 751.94	$338 717.94	$212 832.22	$212 832.22
PS Mechanical		$144 187.11	$193 307.45	$229 470.71	$193 307.45	$193 307.45	$193 307.45	$169 432.72	$161 187.91	$157 004.62	$229 470.71	$144 187.11	$144 187.11
PS Electrical		$1 015 801.86	$1 519 771.90	$1 923 908.43	$1 519 771.90	$1 519 771.90	$1 519 771.90	$1 287 905.31	$1 183 900.27	$1 141 887.23	$1 923 908.43	$1 015 801.86	$1 015 801.86
Feeder pipe system: Civil		$4 125 498.31	$5 981 655.99	$7 418 435.62	$5 990 337.45	$5 999 018.90	$6 007 700.36	$5 060 775.66	$4 753 815.55	$4 600 335.49	$7 428 198.94	$4 125 498.31	$4 125 498.31
Feeder pipe system: Mechanical		$74 326.87	$107 766.26	$133 653.94	$107 924.67	$108 081.08	$108 237.49	$91 177.26	$85 646.92	$82 881.76	$133 829.84	$74 326.87	$74 326.87
Storage		$1 531 091.61	$1 260 603.09	$1 188 587.36	$1 155 929.71	$1 113 284.19	$1 093 873.33	$1 392 819.65	$1 434 687.15	$1 442 615.01	$1 105 763.44	$1 683 898.82	$1 126 457.53
		$7 103 737.96	**$8 348 444.83**	**$11 232 774.01**	**$9 252 609.11**	**$9 218 801.46**	**$9 208 228.47**	**$8 232 207.45**	**$7 857 364.63**	**$7 656 476.04**	**$11 159 889.31**	**$7 256 545.19**	**$6 669 103.90**

Samra & Essery Data Only

COST ESTIMATION : SERIES 2.3.1

INPUT PARAMETERS		Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)	l/s	160	160	160	160	160	160	160	160	160	160	160	160
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	3.43	9.02	16.99	9.02	9.02	9.02	5.77	5.33	8.06	16.99	3.43	3.43
Supply length	m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Power required	P = (ρ x g x Q x Ht)/n	kW	7.2	18.9	35.6	18.9	18.9	18.9	12.1	11.2	16.9	35.6	7.2	7.2
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Pipe diameter 1		mm	426	268	202	268	268	268	283	278	252	202	426	426
Pipe diameter 2		mm	0	0	0	0	0	0	400	406	371	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	9.78	9.11	9.04	9.05	9.02	9.02	9.45	9.61	9.65	9.02	22.12	11.06

CAPITAL COST													
Source :Pumping Station													
Cost (Samra and Essery Cost data)		$23 125.40	$46 522.63	$73 519.41	$46 522.63	$46 522.63	$46 522.63	$33 678.63	$31 790.34	$42 894.60	$73 519.41	$23 125.40	$23 125.40
Feeder pipe system													
Cost (Samra and Essery Cost data)		$215 923.06	$296 174.09	$336 500.92	$306 513.50	$316 852.91	$327 192.32	$265 950.82	$251 318.76	$223 676.72	$347 168.91	$215 923.06	$215 923.06
Storage													
Cost (Samra and Essery Cost data)		$1 133 144.65	$1 086 868.59	$1 082 553.97	$1 082 999.29	$1 080 855.10	$1 080 760.07	$1 110 411.44	$1 121 438.08	$1 124 265.82	$1 080 630.45	$1 818 612.09	$1 216 585.40
Total Cost (Samra and Essery Cost data)		**$1 372 193.11**	**$1 429 565.31**	**$1 492 574.31**	**$1 436 035.43**	**$1 444 230.65**	**$1 454 475.02**	**$1 410 040.89**	**$1 404 547.18**	**$1 390 837.14**	**$1 501 318.77**	**$2 057 660.55**	**$1 455 633.85**

OPERATING COST													
Power required	P = (ρ x g x Q x Ht)/n	kW	7.2	18.9	35.6	18.9	18.9	18.9	12.1	11.2	16.9	35.6	7.2	7.2
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$1 635.51	$4 300.66	$8 098.68	$4 300.66	$4 300.66	$4 300.66	$2 750.88	$2 539.85	$3 843.82	$8 098.68	$1 635.51	$1 635.51

MAINTENANCE COST													
Yearly maintenance cost		$18 312.66	$18 258.43	$18 670.71	$18 252.09	$18 271.62	$18 321.89	$18 329.45	$18 402.43	$18 419.90	$18 695.20	$28 594.68	$19 564.28

SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$693.76	$1 395.68	$2 205.58	$1 395.68	$1 395.68	$1 395.68	$1 010.36	$953.71	$1 286.84	$2 205.58	$693.76	$693.76
PS Mechanical		15	$1 387.52	$2 791.36	$4 411.16	$2 791.36	$2 791.36	$2 791.36	$2 020.72	$1 907.42	$2 573.68	$4 411.16	$1 387.52	$1 387.52
Feeder pipe system		120	$32 388.46	$44 426.11	$50 475.14	$45 977.03	$47 527.94	$49 078.85	$39 892.62	$37 697.81	$33 551.51	$52 075.34	$32 388.46	$32 388.46
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

LIFE CYCLE COST													
Capitalization method	Cc= (C0[1+{[1- α)/{(1+r)^T-1}]+ β /r]}+Aop/r												
PS Civil		$21 236.99	$42 723.81	$67 515.84	$42 723.81	$42 723.81	$42 723.81	$30 928.44	$29 194.35	$39 391.85	$67 515.84	$21 236.99	$21 236.99
PS Mechanical		$14 387.39	$28 943.90	$45 739.85	$28 943.90	$28 943.90	$28 943.90	$20 953.04	$19 778.25	$26 686.73	$45 739.85	$14 387.39	$14 387.39
PS Electrical		$43 373.66	$112 517.61	$210 370.30	$112 517.61	$112 517.61	$112 517.61	$72 391.97	$66 913.79	$100 706.79	$210 370.30	$43 373.66	$43 373.66
Feeder pipe system: Civil		$239 695.33	$328 781.66	$373 548.34	$340 259.42	$351 737.16	$363 214.90	$295 230.95	$278 987.95	$248 302.63	$385 390.83	$239 695.33	$239 695.33
Feeder pipe system: Mechanical		$4 318.46	$5 923.46	$6 730.02	$6 130.27	$6 337.06	$6 543.85	$5 319.02	$5 026.38	$4 473.53	$6 943.38	$4 318.46	$4 318.46
Storage		$1 568 406.91	$1 504 355.34	$1 498 383.39	$1 498 999.77	$1 496 031.96	$1 495 900.42	$1 536 941.44	$1 552 203.82	$1 556 117.56	$1 495 721.01	$2 517 175.34	$1 683 898.62
		$1 891 418.73	**$2 023 246.62**	**$2 202 287.75**	**$2 029 574.98**	**$2 038 291.29**	**$2 049 844.28**	**$1 961 784.88**	**$1 952 104.34**	**$1 975 679.09**	**$2 211 661.21**	**$2 840 187.16**	**$2 006 910.64**

University of Canberra
Samra & Essery Data Only

COST ESTIMATION : SERIES 2.3.2

DESIGN CRITERIA														
Daily Demand (Seasonal Peak)	l/s	160	160	160	160	160	160	160	160	160	160	160	160	160
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	17.16	45.11	84.95	45.11	45.11	45.11	28.86	26.64	40.32	84.95	17.16	17.16	17.16
Supply length	m	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Power required	$P = (\rho \times g \times Q \times Ht)/n$	kW	35.9	94.4	177.8	94.4	94.4	94.4	60.4	55.8	84.4	177.8	35.9	35.9
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Pipe diameter 1		mm	426	268	202	268	268	268	283	278	252	202	426	426
Pipe diameter 2		mm	0	0	0	0	0	0	400	408	371	0	0	0
Pipe 1 - Length		m	5000	10000	15000	10000	10000	10000	5000	3333	2500	15000	5000	5000
Pipe 1 - Length		m	0	0	0	0	0	0	2500	3333	3750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	12.15	9.75	9.43	9.35	9.23	9.12	11.06	11.41	11.52	9.16	22.12	11.06
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$74 036.28	$148 942.82	$235 373.38	$148 942.82	$148 942.82	$148 942.82	$107 822.55	$101 777.23	$137 327.62	$235 373.38	$74 036.28	$74 036.28
Feeder pipe system														
Cost (Samra and Essery Cost data)			$1 079 615.28	$1 417 814.77	$1 626 607.22	$1 428 154.18	$1 438 493.59	$1 448 833.00	$1 263 914.74	$1 191 744.22	$1 058 225.66	$1 637 275.15	$1 079 615.28	$1 079 615.28
Storage														
Cost (Samra and Essery Cost data)			$1 284 755.17	$1 130 776.48	$1 108 981.18	$1 103 386.81	$1 095 586.08	$1 088 143.92	$1 216 754.63	$1 238 610.82	$1 245 523.58	$1 090 868.91	$1 818 612.09	$1 216 585.40
Total Cost (Samra and Essery Cost data)			**$2 438 406.73**	**$2 697 534.07**	**$2 970 961.78**	**$2 680 483.81**	**$2 683 022.49**	**$2 685 919.75**	**$2 588 491.92**	**$2 532 132.27**	**$2 441 076.86**	**$2 963 537.44**	**$2 972 263.65**	**$2 370 236.96**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/n$	kW	35.9	94.4	177.8	94.4	94.4	94.4	60.4	55.8	84.4	177.8	35.9	35.9
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$8 177.54	$21 503.29	$40 493.39	$21 503.29	$21 503.29	$21 503.29	$13 754.30	$12 699.27	$19 219.12	$40 493.39	$8 177.54	$8 177.54
MAINTENANCE COST														
Yearly maintenance cost			$25 424.57	$25 569.94	$27 168.56	$25 210.79	$25 145.48	$25 085.54	$25 670.68	$25 576.01	$25 374.72	$26 950.52	$33 432.43	$24 402.03
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$2 221.09	$4 468.28	$7 061.20	$4 468.28	$4 468.28	$4 468.28	$3 234.66	$3 053.32	$4 119.83	$7 061.20	$2 221.09	$2 221.09
PS Mechanical		15	$4 442.18	$8 936.57	$14 122.40	$8 936.57	$8 936.57	$8 936.57	$6 469.35	$6 106.63	$8 239.66	$14 122.40	$4 442.18	$4 442.18
Feeder pipe system		120	$161 942.29	$212 672.22	$243 991.08	$214 223.13	$215 774.04	$217 324.95	$189 587.21	$178 761.63	$158 733.85	$245 591.27	$161 942.29	$161 942.29
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{CD[1+\{(1-\alpha)/([1+r)^T-1]\}+\beta/r]\}+Aop/r$													
PS Civil			$67 990.51	$136 780.21	$216 152.88	$136 780.21	$136 780.21	$136 780.21	$99 017.80	$93 466.14	$126 113.49	$216 152.88	$67 990.51	$67 990.51
PS Mechanical			$46 061.42	$92 664.27	$146 436.75	$92 664.27	$92 664.27	$92 664.27	$67 081.43	$63 320.36	$85 437.91	$146 436.75	$46 061.42	$46 061.42
PS Electrical			$212 397.28	$553 593.50	$1 037 637.47	$553 593.50	$553 593.50	$553 593.50	$355 448.40	$328 422.80	$495 240.68	$1 037 637.47	$212 397.28	$212 397.28
Feeder pipe system: Civil			$1 198 476.63	$1 573 910.54	$1 805 690.21	$1 585 388.28	$1 596 866.02	$1 608 343.76	$1 403 066.73	$1 322 950.52	$1 174 732.11	$1 817 532.64	$1 198 476.63	$1 198 476.63
Feeder pipe system: Mechanical			$21 592.31	$28 356.30	$32 532.14	$28 563.06	$28 769.87	$28 976.68	$25 278.29	$23 834.88	$21 164.51	$32 745.50	$21 592.31	$21 592.31
Storage			$1 778 253.88	$1 565 129.06	$1 534 961.79	$1 527 218.51	$1 516 421.38	$1 506 120.55	$1 664 133.06	$1 714 384.63	$1 723 952.71	$1 509 919.94	$2 517 175.34	$1 683 898.82
			$3 324 772.03	$3 950 433.89	$4 773 411.24	$3 924 207.86	$3 925 095.34	$3 928 478.95	$3 634 925.72	$3 548 379.32	$3 626 641.42	$4 780 425.18	$4 063 883.48	$3 230 416.97

Samra & Essery Data

COST ESTIMATION : SERIES 2.3.3

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 68hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	160	160	160	160	160	160	160	160	160	160	160	160
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	34.31	90.23	169.91	90.23	90.23	90.23	57.71	53.28	80.64	169.91	34.31	34.31
Supply length		m	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Power required	P = (ρ x g x Q x Ht)/n	kW	71.8	188.8	355.6	188.8	188.8	188.8	120.8	111.5	168.8	355.6	71.8	71.8
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Pipe diameter 1		mm	426	268	202	268	268	268	283	278	252	202	426	426
Pipe diameter 2		mm	0	0	0	0	0	0	400	406	371	0	0	0
Pipe 1 - Length		m	10000	20000	30000	20000	20000	20000	10000	6667	5000	30000	10000	10000
Pipe 1 - Length		m	0	0	0	0	0	0	5000	6667	7500	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	13.86	10.50	9.82	9.71	9.40	9.29	12.33	12.88	12.99	9.36	22.12	11.06
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$122 205.06	$245 846.63	$388 509.48	$245 846.63	$245 846.63	$245 846.63	$177 973.07	$167 994.60	$226 674.45	$388 509.48	$122 205.06	$122 205.06
Feeder pipe system														
Cost (Samra and Essery Cost data)			$2 159 230.69	$2 819 865.61	$3 239 240.91	$2 830 205.03	$2 840 544.44	$2 850 883.85	$2 511 369.61	$2 367 276.06	$2 101 411.83	$3 249 908.85	$2 159 230.69	$2 159 230.69
Storage														
Cost (Samra and Essery Cost data)			$1 386 927.83	$1 180 226.40	$1 135 827.08	$1 128 333.97	$1 107 339.79	$1 099 620.11	$1 296 079.13	$1 327 902.27	$1 335 721.94	$1 104 541.25	$1 818 612.09	$1 216 585.40
Total Cost (Samra and Essery Cost data)			**$3 668 363.58**	**$4 245 938.65**	**$4 763 577.47**	**$4 204 385.63**	**$4 193 730.87**	**$4 196 350.59**	**$3 985 421.80**	**$3 863 172.93**	**$3 663 808.22**	**$4 742 959.58**	**$4 100 047.84**	**$3 496 021.15**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	71.8	188.8	355.6	188.8	188.8	188.8	120.8	111.5	168.8	355.6	71.8	71.8
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$16 355.07	$43 006.57	$80 966.68	$43 006.57	$43 006.57	$43 006.57	$27 508.60	$25 398.54	$38 438.24	$80 966.68	$16 355.07	$16 355.07
MAINTENANCE COST														
Yearly maintenance cost			$32 846.56	$34 310.38	$37 196.41	$33 583.67	$33 320.45	$33 256.36	$33 813.36	$33 468.46	$32 854.97	$36 780.46	$39 321.83	$30 291.43
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$3 668.15	$7 375.40	$11 655.28	$7 375.40	$7 375.40	$7 375.40	$5 339.19	$5 039.84	$6 800.23	$11 655.28	$3 668.15	$3 668.15
PS Mechanical		15	$7 332.30	$14 750.80	$23 310.57	$14 750.80	$14 750.80	$14 750.80	$10 678.38	$10 079.68	$13 600.47	$23 310.57	$7 332.30	$7 332.30
Feeder pipe system		120	$323 884.60	$422 979.84	$485 886.14	$424 530.75	$426 061.67	$427 632.56	$376 705.44	$355 091.41	$315 211.78	$487 486.33	$323 884.60	$323 884.60
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/r]\}+Aop/r$													
PS Civil			$112 225.84	$225 770.89	$356 783.93	$225 770.89	$225 770.89	$225 770.89	$163 439.85	$154 276.22	$208 164.30	$356 783.93	$112 225.84	$112 225.84
PS Mechanical			$76 029.46	$152 952.65	$241 709.85	$152 952.65	$152 952.65	$152 952.65	$110 725.34	$104 517.27	$141 024.74	$241 709.85	$76 029.48	$76 029.48
PS Electrical			$422 013.67	$1 101 592.80	$2 066 431.74	$1 101 592.80	$1 101 592.80	$1 101 592.80	$706 847.06	$653 022.91	$985 323.43	$2 066 431.74	$422 013.67	$422 013.67
Feeder pipe system: Civil			$2 396 953.41	$3 130 321.62	$3 595 868.47	$3 141 799.36	$3 153 277.10	$3 164 754.84	$2 787 861.43	$2 627 903.76	$2 332 768.93	$3 607 710.90	$2 396 953.41	$2 396 953.41
Feeder pipe system: Mechanical			$43 184.61	$56 397.31	$64 784.82	$56 604.10	$56 810.89	$57 017.68	$50 227.39	$47 345.52	$42 028.24	$64 998.18	$43 184.61	$43 184.61
Storage			$1 919 873.00	$1 633 573.65	$1 572 119.71	$1 561 748.35	$1 532 689.92	$1 522 004.96	$1 793 927.59	$1 837 974.61	$1 848 797.95	$1 528 816.41	$2 517 175.34	$1 683 808.82
			$4 970 080.01	**$6 300 808.92**	**$7 097 686.53**	**$6 240 468.14**	**$6 223 094.24**	**$6 224 093.81**	**$5 613 029.86**	**$5 425 040.28**	**$5 588 107.60**	**$7 886 481.02**	**$5 567 582.34**	**$4 734 306.82**

University of Capetown
Samra & Essery Data Known

COST ESTIMATION : SERIES 2.3.4

DESIGN PARAMETERS													
Daily Demand (Seasonal Peak)	l/s	160	160	160	160	160	160	160	160	160	160	160	160
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	85.78	225.56	424.76	225.56	225.56	225.56	144.28	133.21	201.60	424.76	85.78	85.78
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING													
Source :Pumping Station													
Description	Formula	Unit											
Discharge capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	179.5	472.1	888.9	472.1	472.1	472.1	301.9	278.8	421.9	888.9	179.5	179.5
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	192	192	192	192	192	192	192	192	192	192	192	192
Pipe diameter 1		mm	426	268	202	268	268	268	283	278	252	202	426	426
Pipe diameter 2		mm	0	0	0	0	0	0	400	408	371	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	17.87	12.55	11.29	10.78	10.10	9.77	15.21	15.99	16.14	9.98	22.12	11.06
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$237 028.09	$476 842.43	$753 550.30	$476 842.43	$476 842.43	$476 842.43	$345 195.33	$325 841.16	$439 656.20	$753 550.30	$237 028.09	$237 028.09
Feeder pipe system														
Cost (Samra and Essery Cost data)			$5 398 076.72	$7 026 018.16	$8 077 140.75	$7 036 357.57	$7 046 696.98	$7 057 036.39	$6 253 734.23	$5 893 871.60	$5 230 970.35	$8 087 808.68	$5 398 076.72	$5 398 076.72
Storage														
Cost (Samra and Essery Cost data)			$1 606 746.00	$1 309 134.94	$1 231 554.24	$1 197 841.27	$1 164 424.73	$1 132 306.96	$1 463 712.82	$1 506 768.71	$1 514 575.20	$1 140 176.66	$1 818 612.09	$1 216 585.40
Total Cost (Samra and Essery Cost data)			**$7 241 850.81**	**$8 811 995.53**	**$10 062 245.28**	**$8 710 841.27**	**$8 677 964.15**	**$8 666 185.78**	**$8 062 642.38**	**$7 726 481.47**	**$7 185 201.75**	**$9 987 535.64**	**$7 453 716.90**	**$6 861 890.21**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	179.5	472.1	888.9	472.1	472.1	472.1	301.9	278.8	421.9	888.9	179.5	179.5
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$40 887.66	$107 516.43	$202 466.70	$107 516.43	$107 516.43	$107 516.43	$68 771.50	$63 496.35	$96 095.59	$202 466.70	$40 887.66	$40 887.66
MAINTENANCE COST														
Yearly maintenance cost			$53 509.26	$59 630.91	$66 545.23	$58 010.20	$57 413.65	$57 133.58	$56 745.36	$55 394.47	$53 357.97	$65 317.91	$56 687.25	$47 656.85
SALVAGE VALUE AT END OF DESIGN LIFE			Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Component	Design life													
PS Civil		50	$7 110.84	$14 305.27	$22 606.51	$14 305.27	$14 305.27	$14 305.27	$10 355.86	$9 775.23	$13 189.69	$22 606.51	$7 110.84	$7 110.84
PS Mechanical		15	$14 221.69	$28 610.55	$45 213.02	$28 610.55	$28 610.55	$28 610.55	$20 711.72	$19 550.47	$26 379.37	$45 213.02	$14 221.69	$14 221.69
Feeder pipe system		120	$809 711.51	$1 053 902.72	$1 211 571.11	$1 055 453.64	$1 057 004.55	$1 058 555.46	$938 060.13	$884 080.74	$784 645.55	$1 213 171.30	$809 711.51	$809 711.51
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/[(1+r)^T-1]\}+\beta/r]\}+Aop/r$													
PS Civil			$217 672.46	$437 903.65	$692 015.65	$437 903.65	$437 903.65	$437 903.65	$317 008.80	$299 233.08	$403 754.03	$692 015.65	$217 672.46	$217 672.46
PS Mechanical			$147 466.22	$296 665.90	$468 818.76	$296 665.90	$296 665.90	$296 665.90	$214 782.10	$202 720.97	$273 530.61	$468 818.76	$147 466.22	$147 466.22
PS Electrical			$1 047 672.09	$2 739 171.28	$5 142 674.10	$2 739 171.28	$2 739 171.28	$2 739 171.28	$1 756 395.88	$1 622 436.64	$2 449 652.87	$5 142 674.10	$1 047 672.09	$1 047 672.09
Feeder pipe system: Civil			$5 992 383.53	$7 799 554.86	$8 966 401.87	$7 811 032.60	$7 822 510.34	$7 833 988.08	$6 942 245.53	$6 542 783.46	$5 806 879.41	$8 978 244.30	$5 992 383.53	$5 992 383.53
Feeder pipe system: Mechanical			$107 961.53	$140 520.36	$161 542.81	$140 727.15	$140 933.94	$141 140.73	$125 074.68	$117 877.43	$104 619.41	$161 756.17	$107 961.53	$107 961.53
Storage			$2 223 927.48	$1 811 998.39	$1 704 617.47	$1 657 677.90	$1 597 861.07	$1 567 247.45	$2 025 952.55	$2 085 547.02	$2 096 352.13	$1 586 444.76	$2 517 175.34	$1 683 896.82
			$9 737 083.32	**$13 225 814.44**	**$17 136 070.66**	**$13 083 178.47**	**$13 035 046.17**	**$13 018 117.07**	**$11 381 437.55**	**$10 870 576.61**	**$11 134 788.46**	**$17 029 963.74**	**$10 030 331.18**	**$9 197 054.86**

Samra & Essery Data

COST ESTIMATION : SERIES 2.4.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 65hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	2.71	4.06	5.15	4.06	4.06	4.06	3.38	3.16	3.05	5.15	2.71	2.71
Supply length		m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	521	369	301	369	369	369	369	369	369	301	521	521
Pipe diameter 2		mm	0	0	0	0	0	0	521	521	521	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	15.54	14.63	14.52	14.53	14.50	14.51	15.06	15.32	15.40	14.45	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$26 117.08	$35 014.41	$41 564.78	$35 014.41	$35 014.41	$35 014.41	$30 689.90	$29 196.49	$28 438.76	$41 564.78	$26 117.08	$26 117.08
Feeder pipe system														
Cost (Samra and Essery Cost data)			$260 988.68	$398 392.16	$489 314.97	$413 310.58	$428 229.00	$443 147.41	$340 135.12	$320 716.10	$311 006.59	$505 934.91	$260 988.68	$260 988.68
Storage														
Cost (Samra and Essery Cost data)			$1 482 038.50	$1 430 708.58	$1 424 981.56	$1 425 388.52	$1 423 291.69	$1 424 153.30	$1 455 349.84	$1 469 851.04	$1 474 173.29	$1 420 435.36	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$1 769 144.26**	**$1 864 115.15**	**$1 955 861.30**	**$1 873 713.51**	**$1 886 535.10**	**$1 902 315.12**	**$1 826 174.85**	**$1 819 763.63**	**$1 813 618.64**	**$1 967 935.06**	**$2 587 874.70**	**$1 826 236.81**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$1 935.22	$2 902.91	$3 679.99	$2 902.91	$2 902.91	$2 902.91	$2 419.06	$2 257.78	$2 177.14	$3 679.99	$1 935.22	$1 935.22
MAINTENANCE COST														
Yearly maintenance cost			$23 801.92	$23 809.74	$24 245.26	$23 804.53	$23 847.67	$23 935.18	$23 843.96	$23 949.15	$23 957.71	$24 260.17	$36 082.87	$24 658.30
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$783.51	$1 050.43	$1 246.94	$1 050.43	$1 050.43	$1 050.43	$920.70	$875.89	$853.16	$1 246.94	$783.51	$783.51
PS Mechanical		15	$1 567.02	$2 100.86	$2 493.89	$2 100.86	$2 100.86	$2 100.86	$1 841.39	$1 751.79	$1 706.33	$2 493.89	$1 567.02	$1 567.02
Feeder pipe system		120	$39 148.30	$59 758.82	$73 397.25	$61 996.59	$64 234.35	$66 472.11	$51 020.27	$48 107.42	$46 850.99	$75 690.24	$39 148.30	$39 148.30
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/r]\}+Aop/r$													
PS Civil			$23 984.37	$32 155.14	$38 170.61	$32 155.14	$32 155.14	$32 155.14	$28 183.77	$26 812.32	$26 116.46	$38 170.61	$23 984.37	$23 984.37
PS Mechanical			$16 248.65	$21 784.09	$25 859.38	$21 784.09	$21 784.09	$21 784.09	$19 093.62	$18 164.50	$17 693.08	$25 859.38	$16 248.65	$16 248.65
PS Electrical			$51 188.09	$76 336.89	$96 467.89	$76 336.89	$76 336.89	$76 336.89	$83 775.73	$59 583.17	$57 485.70	$96 467.89	$51 188.09	$51 188.09
Feeder pipe system: Civil			$289 722.50	$442 253.58	$543 186.61	$458 814.43	$475 375.31	$491 936.18	$377 582.64	$356 025.67	$345 247.18	$561 636.34	$289 722.50	$289 722.50
Feeder pipe system: Mechanical			$5 219.77	$7 967.84	$9 786.30	$8 266.21	$8 564.58	$8 862.95	$6 802.70	$6 414.32	$6 220.13	$10 118.70	$5 219.77	$5 219.77
Storage			$2 051 317.47	$1 980 270.76	$1 972 343.88	$1 972 907.16	$1 970 004.91	$1 971 197.47	$2 014 377.19	$2 034 448.58	$2 040 431.09	$1 968 051.41	$3 184 537.74	$2 130 340.35
			$2 437 666.85	**$2 580 768.09**	**$2 685 814.67**	**$2 570 263.73**	**$2 584 239.72**	**$2 602 272.53**	**$2 509 815.66**	**$2 501 446.55**	**$2 493 193.64**	**$2 686 364.33**	**$3 570 901.12**	**$2 516 703.73**

University of Capetown
Samra & Essery Data

COST ESTIMATION : SERIES 2.4.2

DESIGN PARAMETERS													
Daily Demand (Seasonal Peak)	l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	14.79	22.18	28.12	22.18	22.18	22.18	18.48	17.25	16.63	28.12	14.79	14.79
Supply length	m	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

INFRASTRUCTURE SIZING													
Source :Pumping Station													
Description	Formula	Unit											
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	46.4	69.6	88.3	69.6	69.6	69.6	58.0	54.2	52.2	88.3	46.4	46.4
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	512	362	295	362	362	362	362	362	362	295	512	512
Pipe diameter 2		mm	0	0	0	0	0	0	512	512	512	0	0	0
Pipe 1 - Length		m	5000	10000	15000	10000	10000	10000	5000	3333	2500	15000	5000	5000
Pipe 1 - Length		m	0	0	0	0	0	0	2500	3333	3750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	19.02	15.58	15.14	14.97	14.81	14.64	17.34	17.89	18.10	14.71	33.18	16.58

CAPITAL COST													
Source :Pumping Station													
Cost (Samra and Essery Cost data)		$89 142.71	$119 511.03	$141 868.72	$119 511.03	$119 511.03	$119 511.03	$104 750.64	$99 653.34	$97 067.05	$141 868.72	$89 142.71	$89 142.71
Feeder pipe system													
Cost (Samra and Essery Cost data)		$1 282 944.45	$1 876 210.93	$2 323 319.42	$1 890 797.98	$1 905 385.04	$1 919 972.09	$1 589 836.23	$1 494 378.00	$1 446 648.89	$2 339 578.00	$1 282 944.45	$1 282 944.45
Storage													
Cost (Samra and Essery Cost data)		$1 666 029.96	$1 484 305.68	$1 459 857.96	$1 449 924.01	$1 441 254.51	$1 431 386.00	$1 579 000.65	$1 608 087.35	$1 619 051.65	$1 435 668.71	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)		**$3 038 117.12**	**$3 480 027.64**	**$3 925 046.10**	**$3 460 233.02**	**$3 466 150.57**	**$3 479 869.12**	**$3 273 587.52**	**$3 202 118.69**	**$3 162 767.59**	**$3 917 115.43**	**$3 672 886.11**	**$2 911 218.22**
OPERATING COST													
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	46.4	69.6	88.3	69.6	69.6	69.6	58.0	54.2	52.2	88.3	46.4	46.4
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$10 572.05	$15 858.49	$20 103.67	$15 858.49	$15 858.49	$15 858.49	$13 215.27	$12 334.20	$11 893.66	$20 103.67	$10 572.05	$10 572.05
MAINTENANCE COST													
Yearly maintenance cost			$32 314.43	$32 864.65	$34 961.53	$32 421.86	$32 364.76	$32 289.66	$32 702.65	$32 609.66	$32 509.10	$34 679.98	$41 835.51	$30 410.94
SALVAGE VALUE AT END OF DESIGN LIFE													
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$2 674.28	$3 585.33	$4 256.06	$3 585.33	$3 585.33	$3 585.33	$3 142.52	$2 989.60	$2 912.01	$4 256.06	$2 674.28	$2 674.28
PS Mechanical	15		$5 348.56	$7 170.66	$8 512.12	$7 170.66	$7 170.66	$7 170.66	$6 285.04	$5 979.20	$5 824.02	$8 512.12	$5 348.56	$5 348.56
Feeder pipe system	120		$192 441.67	$281 431.64	$348 497.91	$283 619.70	$285 807.76	$287 995.81	$236 475.43	$224 156.70	$216 997.33	$350 936.70	$192 441.67	$192 441.67
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST													
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/r]\}+Aop/r$													
PS Civil			$81 863.35	$109 751.80	$130 283.77	$109 751.80	$109 751.80	$109 751.80	$96 196.74	$91 515.68	$89 140.59	$130 283.77	$81 863.35	$81 863.35
PS Mechanical			$55 459.83	$74 353.38	$88 263.14	$74 353.38	$74 353.38	$74 353.38	$65 170.25	$61 998.99	$60 389.94	$88 263.14	$55 459.83	$55 459.83
PS Electrical			$273 884.21	$409 309.79	$517 842.62	$409 309.79	$409 309.79	$409 309.79	$341 642.55	$319 067.76	$307 776.32	$517 842.62	$273 884.21	$273 884.21
Feeder pipe system: Civil			$1 424 191.54	$2 082 774.30	$2 579 107.66	$2 098 967.33	$2 115 160.36	$2 131 353.40	$1 764 870.89	$1 658 903.09	$1 605 919.18	$2 597 156.25	$1 424 191.54	$1 424 191.54
Feeder pipe system: Mechanical			$25 658.89	$37 524.22	$46 466.39	$37 815.96	$38 107.70	$38 399.44	$31 796.72	$29 887.56	$28 932.98	$46 791.56	$25 658.89	$25 658.89
Storage			$2 305 983.52	$2 054 455.52	$2 020 616.97	$2 006 867.20	$1 994 867.58	$1 981 208.39	$2 185 524.62	$2 225 784.07	$2 240 959.96	$1 987 136.17	$3 184 537.74	$2 130 340.35
			$4 167 041.36	**$4 768 169.01**	**$5 382 580.56**	**$4 737 065.46**	**$4 741 580.81**	**$4 744 376.39**	**$4 485 281.77**	**$4 367 157.15**	**$4 333 119.97**	**$5 367 473.52**	**$5 045 895.56**	**$3 991 398.18**

Samra & Essery Data

COST ESTIMATION : SERIES 2.4.3

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 44ltr	RED BOOK 34ltr
Daily Demand (Seasonal Peak)		l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	34.98	52.48	66.52	52.48	52.48	52.48	43.73	40.81	39.36	66.52	34.98	34.98
Supply length		m	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	P = (ρ x g x Q x Ht)/η	kW	109.8	164.7	208.8	164.7	164.7	164.7	137.3	128.1	123.5	208.8	109.8	109.8
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	494	350	285	350	350	350	350	350	350	285	494	494
Pipe diameter 2		mm	0	0	0	0	0	0	494	494	494	0	0	0
Pipe 1 - Length		m	10000	20000	30000	20000	20000	20000	10000	6667	5000	30000	10000	10000
Pipe 1 - Length		m	0	0	0	0	0	0	5000	6667	7500	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	22.02	16.79	15.78	15.59	15.14	14.92	19.41	20.13	20.36	15.04	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$166 142.57	$222 742.49	$264 412.36	$222 742.49	$222 742.49	$222 742.49	$195 232.34	$185 732.09	$180 911.81	$264 412.36	$166 142.57	$166 142.57
Feeder pipe system														
Cost (Samra and Essery Cost data)			$2 484 448.75	$3 613 431.42	$4 479 274.31	$3 627 416.78	$3 641 402.13	$3 655 387.49	$3 056 860.84	$2 874 003.98	$2 781 575.55	$4 494 876.01	$2 484 448.75	$2 484 448.75
Storage														
Cost (Samra and Essery Cost data)			$1 813 991.00	$1 549 766.58	$1 495 136.48	$1 484 697.66	$1 459 473.99	$1 447 407.01	$1 686 071.78	$1 722 042.94	$1 733 419.46	$1 454 039.56	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$4 464 582.32**	**$5 385 940.49**	**$6 238 823.16**	**$5 334 856.92**	**$5 323 616.61**	**$5 325 536.99**	**$4 940 164.97**	**$4 781 779.02**	**$4 895 906.83**	**$6 213 327.92**	**$4 951 360.26**	**$4 189 722.37**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/η	kW	109.8	164.7	208.8	164.7	164.7	164.7	137.3	128.1	123.5	208.8	109.8	109.8
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$25 012.06	$37 519.10	$47 562.62	$37 519.10	$37 519.10	$37 519.10	$31 265.59	$29 181.09	$28 138.84	$47 562.62	$25 012.06	$25 012.06
MAINTENANCE COST														
Yearly maintenance cost			$41 326.76	$43 585.63	$47 520.42	$42 679.52	$42 371.09	$42 260.02	$42 578.75	$42 095.13	$41 754.47	$46 981.96	$48 628.43	$37 203.86
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$4 984.28	$8 682.27	$7 932.37	$6 682.27	$6 682.27	$6 682.27	$5 856.97	$5 571.96	$5 427.35	$7 932.37	$4 984.28	$4 984.28
PS Mechanical	15		$9 968.55	$13 364.55	$15 864.74	$13 364.55	$13 364.55	$13 364.55	$11 713.94	$11 143.93	$10 854.71	$15 864.74	$9 968.55	$9 968.55
Feeder pipe system	120		$372 667.31	$542 014.71	$671 891.15	$544 112.52	$546 210.32	$548 308.12	$458 829.13	$431 100.60	$417 236.33	$674 231.40	$372 667.31	$372 667.31
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{[1-\alpha)/([1+r)^T-1]\}+\beta/r]\}+Aop/r$													
PS Civil			$152 575.43	$204 553.42	$242 820.54	$204 553.42	$204 553.42	$204 553.42	$179 289.74	$170 585.28	$166 138.62	$242 820.54	$152 575.43	$152 575.43
PS Mechanical			$103 365.04	$138 578.48	$164 503.25	$138 578.48	$138 578.48	$138 578.48	$121 463.14	$115 552.59	$112 553.67	$164 503.25	$103 365.04	$103 365.04
PS Electrical			$643 162.37	$961 922.27	$1 217 489.84	$961 922.27	$961 922.27	$961 922.27	$802 627.23	$749 493.38	$722 916.92	$1 217 489.84	$643 162.37	$643 162.37
Feeder pipe system: Civil			$2 757 976.69	$4 011 255.87	$4 972 424.63	$4 026 780.96	$4 042 306.05	$4 057 831.14	$3 395 629.28	$3 190 420.41	$3 087 815.98	$4 989 744.01	$2 757 976.69	$2 757 976.69
Feeder pipe system: Mechanical			$49 688.97	$72 268.63	$89 585.49	$72 548.34	$72 828.04	$73 107.75	$61 177.22	$57 480.08	$55 631.51	$89 897.52	$49 688.97	$49 688.97
Storage			$2 510 779.19	$2 145 061.19	$2 069 446.64	$2 054 998.06	$2 020 085.51	$2 003 383.37	$2 333 723.79	$2 383 512.15	$2 399 258.61	$2 012 563.60	$3 184 537.74	$2 130 340.35
			$6 217 547.70	**$7 533 639.86**	**$8 756 270.36**	**$7 459 381.53**	**$7 440 273.77**	**$7 439 378.43**	**$6 893 910.39**	**$6 867 023.89**	**$6 844 317.30**	**$8 717 018.76**	**$6 891 306.24**	**$6 837 106.86**

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 2.4.4

Daily Demand (Seasonal Peak)		l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	94.73	142.09	180.13	142.09	142.09	142.09	118.41	110.51	106.57	180.13	94.73	94.73
Supply length		m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

INFRASTRUCTURE SIZING													
Source :Pumping Station													
Description	Formula	Unit											
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	346.9	334.5	565.5	297.4	297.4
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	486	344	281	344	344	344	344	344	344	281	486	486
Pipe diameter 2		mm	0	0	0	0	0	0	486	486	486	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2xPipe Splits	$y = 0.0287x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	28.15	20.14	18.19	17.34	16.25	15.78	23.91	25.17	25.41	16.06	33.18	16.59

CAPITAL COST													
Source :Pumping Station													
Cost (Samra and Essery Cost data)			$341 398.74	$457 703.32	$543 328.82	$457 703.32	$457 703.32	$457 703.32	$401 173.98	$381 652.35	$371 747.38	$543 328.82	$341 398.74	$341 398.74
Feeder pipe system													
Cost (Samra and Essery Cost data)			$6 116 636.13	$8 866 841.40	$10 998 744.17	$8 880 552.65	$8 894 263.89	$8 907 975.14	$7 501 505.75	$7 046 393.87	$6 818 837.92	$11 014 046.28	$6 116 636.13	$6 116 636.13
Storage													
Cost (Samra and Essery Cost data)			$2 091 813.00	$1 722 201.28	$1 623 776.47	$1 579 256.64	$1 520 778.67	$1 494 203.89	$1 902 551.12	$1 960 185.21	$1 970 885.85	$1 510 420.02	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$8 549 847.87**	**$11 046 746.00**	**$13 165 849.45**	**$10 917 511.80**	**$10 872 745.68**	**$10 889 882.36**	**$9 805 230.85**	**$9 388 231.43**	**$9 161 451.15**	**$13 067 795.11**	**$8 788 803.81**	**$7 997 166.93**

OPERATING COST													
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	346.9	334.5	565.5	297.4	297.4
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$67 727.54	$101 593.95	$128 789.74	$101 593.95	$101 593.95	$101 593.95	$84 660.75	$79 016.35	$76 194.15	$128 789.74	$67 727.54	$67 727.54

MAINTENANCE COST													
Yearly maintenance cost			$65 442.64	$74 655.80	$84 892.32	$72 760.17	$71 951.57	$71 621.51	$70 137.77	$68 527.30	$67 449.00	$83 268.49	$66 576.98	$57 152.41

SALVAGE VALUE AT END OF DESIGN LIFE													
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$10 241.96	$13 731.10	$16 299.86	$13 731.10	$13 731.10	$13 731.10	$12 035.22	$11 449.57	$11 152.42	$16 299.86	$10 241.96	$10 241.96
PS Mechanical		15	$20 483.92	$27 462.20	$32 599.73	$27 462.20	$27 462.20	$27 462.20	$24 070.44	$22 899.14	$22 304.84	$32 599.73	$20 483.92	$20 483.92
Feeder pipe system		120	$917 495.42	$1 330 026.21	$1 649 811.82	$1 332 082.90	$1 334 139.58	$1 336 196.27	$1 125 225.86	$1 056 959.06	$1 022 825.69	$1 652 106.94	$917 495.42	$917 495.42
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

LIFE CYCLE COST													
Capitalization method	$Cc = (C0[1+\{(1-\alpha)/\{(1+r)^T-1\}\}+\beta/r])+Aop/r$												
PS Civil			$313 520.24	$420 327.43	$498 960.78	$420 327.43	$420 327.43	$420 327.43	$368 414.25	$350 486.76	$341 390.62	$498 960.78	$313 520.24	$313 520.24
PS Mechanical			$212 400.07	$284 758.56	$338 030.18	$284 758.56	$284 758.56	$284 758.56	$249 589.03	$237 443.72	$231 281.37	$338 030.18	$212 400.07	$212 400.07
PS Electrical			$1 729 888.94	$2 589 051.98	$3 278 151.25	$2 589 051.98	$2 589 051.98	$2 589 051.98	$2 159 644.92	$2 016 436.30	$1 944 816.49	$3 278 151.25	$1 729 888.94	$1 729 888.94
Feeder pipe system: Civil			$6 790 053.48	$9 843 045.42	$12 209 662.22	$9 856 266.23	$9 873 487.03	$9 886 707.83	$8 327 391.74	$7 822 173.85	$7 569 564.90	$12 226 649.04	$6 790 053.48	$6 790 053.48
Feeder pipe system: Mechanical			$122 332.72	$177 336.83	$219 974.88	$177 611.05	$177 885.28	$178 159.50	$150 030.11	$140 927.88	$136 376.76	$220 280.93	$122 332.72	$122 332.72
Storage			$2 895 317.87	$2 383 731.32	$2 247 499.67	$2 185 877.55	$2 104 938.47	$2 068 155.82	$2 633 356.94	$2 713 101.68	$2 727 912.63	$2 090 600.86	$3 184 537.74	$2 130 340.35
			$12 063 513.32	**$15 666 251.84**	**$18 792 278.96**	**$15 515 892.90**	**$15 450 448.75**	**$15 429 161.13**	**$13 888 427.00**	**$13 280 570.18**	**$12 951 342.77**	**$18 652 673.03**	**$12 362 733.18**	**$11 296 535.80**

Samra & Essery Data Template

COST ESTIMATION : SERIES 1.2.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	4.70	7.04	8.93	7.04	7.04	7.04	5.87	5.48	5.28	8.93	4.70	4.70
Supply length		m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Power required	P = (ρ x g x Q x Ht)/n	kW	4.9	7.4	9.3	7.4	7.4	7.4	6.1	5.7	5.5	9.3	4.9	4.9
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	307	217	177	217	217	217	217	217	217	177	307	307
Pipe diameter 2		mm	0	0	0	0	0	0	307	307	307	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	0	500	667	750	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	2	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	0	2	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	0	1	0
Storage														
Reservoir capacity		Ml	4.44	4.04	4.01	4.00	3.98	3.99	4.25	4.34	4.37	3.97	11.06	5.53
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$17 575.65	$23 583.16	$27 971.27	$23 583.16	$23 583.16	$23 583.16	$20 652.96	$19 647.96	$19 138.04	$27 971.27	$17 575.65	$17 575.65
Feeder pipe system														
Cost (Samra and Essery Cost data)			$158 938.83	$243 453.76	$297 803.23	$251 607.99	$260 162.22	$268 516.45	$207 975.95	$196 150.01	$190 237.04	$307 195.13	$158 938.83	$158 938.83
Storage														
Cost (Samra and Essery Cost data)			$716 667.47	$678 297.55	$675 122.79	$674 230.81	$672 569.89	$673 707.66	$698 417.04	$707 100.71	$709 851.38	$671 582.22	$1 216 585.40	$813 844.50
Total Cost (Samra and Essery Cost data)			**$893 181.94**	**$945 314.46**	**$1 000 897.30**	**$949 601.96**	**$956 295.27**	**$965 787.27**	**$927 045.95**	**$922 896.68**	**$919 226.46**	**$1 006 748.62**	**$1 393 099.87**	**$990 358.97**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	4.9	7.4	9.3	7.4	7.4	7.4	6.1	5.7	5.5	9.3	4.9	4.9
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$1 118.96	$1 678.48	$2 127.80	$1 678.48	$1 678.48	$1 678.48	$1 398.72	$1 305.47	$1 258.84	$2 127.80	$1 118.96	$1 118.96
MAINTENANCE COST														
Yearly maintenance cost			$11 723.98	$11 632.08	$11 901.16	$11 612.85	$11 629.70	$11 668.54	$11 726.80	$11 787.67	$11 794.16	$11 895.02	$19 222.75	$13 181.63
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$527.27	$706.89	$839.14	$706.89	$706.89	$706.89	$619.59	$589.44	$574.14	$839.14	$527.27	$527.27
PS Mechanical		15	$1 054.54	$1 413.79	$1 678.28	$1 413.79	$1 413.79	$1 413.79	$1 239.18	$1 178.88	$1 148.28	$1 678.28	$1 054.54	$1 054.54
Feeder pipe system		120	$23 840.82	$36 518.06	$44 670.48	$37 771.20	$39 024.33	$40 277.47	$31 196.39	$29 422.50	$28 535.56	$46 079.27	$23 840.82	$23 840.82
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	Cc= {C0[1+{[1- α)/{[(1+r)^T-1]}+ β /r]}+Aop/r													
PS Civil			$16 140.43	$21 639.00	$25 667.15	$21 639.00	$21 639.00	$21 639.00	$18 966.44	$18 043.51	$17 575.23	$25 667.15	$16 140.43	$16 140.43
PS Mechanical			$10 934.63	$14 659.74	$17 402.23	$14 659.74	$14 659.74	$14 659.74	$12 849.17	$12 223.91	$11 906.66	$17 402.23	$10 934.63	$10 934.63
PS Electrical			$29 863.37	$44 495.11	$56 201.85	$44 495.11	$44 495.11	$44 495.11	$37 188.22	$34 748.84	$33 528.35	$56 201.85	$29 863.37	$29 863.37
Feeder pipe system: Civil			$176 437.36	$270 257.05	$330 590.19	$279 531.05	$288 805.05	$298 079.05	$230 873.27	$217 745.35	$211 181.39	$341 016.10	$176 437.36	$176 437.36
Feeder pipe system: Mechanical			$3 178.78	$4 869.06	$5 956.06	$5 036.16	$5 203.24	$5 370.33	$4 159.52	$3 923.00	$3 804.74	$6 143.90	$3 178.78	$3 178.78
Storage			$991 952.97	$938 844.44	$934 450.20	$933 215.59	$930 916.66	$932 491.49	$966 692.22	$978 711.44	$982 518.70	$929 549.63	$1 883 898.82	$1 126 457.53
			$1 228 507.54	$1 294 764.42	$1 370 287.88	$1 298 676.85	$1 305 718.83	$1 316 734.72	$1 270 728.84	$1 268 396.05	$1 260 518.07	$1 376 000.86	$1 920 483.39	$1 363 012.10

University of Capetown
Samra & Essey Data

COST ESTIMATION : SERIES 1.2.2

DESIGN PARAMETERS														
Daily Demand (Seasonal Peak)	l/s	80	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	25.73	38.60	48.94	38.60	38.60	38.60	32.17	30.02	28.95	48.94	25.73	25.73	25.73
Supply length	m	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96	96
Power required	P = (ρ x g x Q x Ht)/n	kW	26.9	40.4	51.2	40.4	40.4	40.4	33.7	31.4	30.3	51.2	26.9	26.9	26.9
Feeder pipe															
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	301	213	174	213	213	213	213	213	213	174	301	301	301
Pipe diameter 2		mm	0	0	0	0	0	0	301	301	301	0	0	0	0
Pipe 1 - Length		m	5000	10000	15000	10000	10000	10000	5000	3333	2500	15000	5000	5000	5000
Pipe 1 - Length		m	0	0	0	0	0	0	2500	3333	3750	0	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0	0
Storage															
Reservoir capacity		Ml	5.71	4.42	4.23	4.17	4.09	4.04	5.14	5.32	5.39	4.06	11.06	5.53	
CAPITAL COST															
Source :Pumping Station															
Cost (Samra and Essery Cost data)			$80 134.28	$80 620.27	$95 702.42	$80 620.27	$80 620.27	$80 620.27	$70 663.14	$67 224.58	$65 479.91	$95 702.42	$60 134.28	$60 134.28	
Feeder pipe system															
Cost (Samra and Essery Cost data)			$780 795.83	$1 142 766.44	$1 413 855.12	$1 150 974.14	$1 159 181.85	$1 167 389.56	$968 479.73	$910 384.16	$881 336.37	$1 423 083.37	$780 795.83	$780 795.83	
Storage															
Cost (Samra and Essery Cost data)			$829 502.96	$714 477.99	$697 084.89	$690 803.69	$683 664.11	$676 771.34	$779 780.68	$795 824.20	$801 923.44	$680 345.86	$1 216 585.40	$813 844.50	
Total Cost (Samra and Essery Cost data)			$1 670 433.07	$1 937 864.70	$2 206 642.43	$1 922 398.10	$1 923 466.23	$1 918 781.17	$1 818 923.55	$1 773 432.94	$1 748 739.73	$2 199 131.65	$2 057 515.51	$1 654 774.61	
OPERATING COST															
Power required	P = (ρ x g x Q x Ht)/n	kW	26.9	40.4	51.2	40.4	40.4	40.4	33.7	31.4	30.3	51.2	26.9	26.9	
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16	
Operating Cost / year		R	$6 133.31	$9 200.21	$11 663.02	$9 200.21	$9 200.21	$9 200.21	$7 666.76	$7 155.61	$6 900.04	$11 663.02	$6 133.31	$6 133.31	
MAINTENANCE COST															
Yearly maintenance cost			$16 959.89	$17 253.33	$18 901.71	$16 939.25	$16 873.20	$16 840.84	$17 259.87	$17 174.97	$17 103.43	$18 296.77	$22 766.13	$16 725.02	
SALVAGE VALUE AT END OF DESIGN LIFE															
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	
PS Civil		50	$1 804.03	$2 418.61	$2 871.07	$2 418.61	$2 418.61	$2 418.61	$2 119.89	$2 016.74	$1 984.40	$2 871.07	$1 804.03	$1 804.03	
PS Mechanical		15	$3 608.06	$4 837.22	$5 742.15	$4 837.22	$4 837.22	$4 837.22	$4 239.79	$4 033.48	$3 928.79	$5 742.15	$3 608.06	$3 608.06	
Feeder pipe system		120	$117 119.37	$171 414.97	$212 078.27	$172 646.12	$173 877.28	$175 108.43	$145 271.96	$136 557.82	$132 200.46	$213 462.51	$117 119.37	$117 119.37	
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
LIFE CYCLE COST															
Capitalization method	Cc= {C0[1+{(1- α)/((1+r)^T-1)}+ β /r]}+Aop/r														
PS Civil			$55 223.73	$74 036.85	$87 887.40	$74 036.85	$74 036.85	$74 036.85	$64 892.81	$61 735.05	$60 132.85	$87 887.40	$55 223.73	$55 223.73	
PS Mechanical			$37 412.34	$50 157.63	$59 540.94	$50 157.63	$50 157.63	$50 157.63	$43 962.63	$41 823.55	$40 738.11	$59 540.94	$37 412.34	$37 412.34	
PS Electrical			$159 797.23	$238 671.85	$301 863.48	$238 671.85	$238 671.85	$238 671.85	$199 265.27	$186 116.89	$179 539.98	$301 863.48	$159 797.23	$159 797.23	
Feeder pipe system: Civil			$866 758.35	$1 288 580.48	$1 569 514.96	$1 277 691.83	$1 286 803.17	$1 295 914.51	$1 075 105.50	$1 010 813.84	$978 368.01	$1 579 759.20	$866 758.35	$866 758.35	
Feeder pipe system: Mechanical			$15 615.92	$22 855.33	$28 277.10	$23 019.48	$23 183.64	$23 347.79	$19 369.59	$18 207.68	$17 626.73	$28 461.67	$15 615.92	$15 615.92	
Storage			$1 148 130.72	$968 922.48	$964 848.36	$956 154.43	$946 272.40	$939 500.23	$1 079 309.16	$1 101 515.30	$1 109 957.38	$941 679.54	$1 663 898.82	$1 126 457.53	
			$2 282 938.28	$2 643 224.61	$3 011 932.23	$2 619 732.06	$2 619 125.53	$2 621 628.85	$2 481 905.17	$2 420 012.31	$2 386 363.06	$2 999 192.22	$2 818 706.39	$2 261 286.10	

Property of Cape Peninsula University of Technology
Samra & Essery Data

COST ESTIMATION : SERIES 1.2.3

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	61.25	91.88	116.48	91.88	91.88	91.88	76.57	71.46	68.91	116.48	61.25	61.25
Supply length		m	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Power required	P = (ρ x g x Q x Ht)/n	kW	64.1	96.1	121.9	96.1	96.1	96.1	80.1	74.8	72.1	121.9	64.1	64.1
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	290	205	168	205	205	205	205	205	205	168	290	290
Pipe diameter 2		mm	0	0	0	0	0	0	290	290	290	0	0	0
Pipe 1 - Length		m	10000	20000	30000	20000	20000	20000	10000	6667	5000	30000	10000	10000
Pipe 1 - Length		m	0	0	0	0	0	0	5000	6667	7500	0	0	0
# of 2xPipe Splits	$y = 0.0287x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	6.66	4.84	4.47	4.39	4.23	4.15	5.87	6.12	6.18	4.18	11.06	5.53
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$112 564.83	$150 912.38	$179 144.52	$150 912.38	$150 912.38	$150 912.38	$132 273.71	$125 837.11	$122 571.28	$179 144.52	$112 564.83	$112 564.83
Feeder pipe system														
Cost (Samra and Essery Cost data)			$1 510 285.24	$2 197 630.23	$2 722 954.51	$2 205 571.89	$2 213 513.56	$2 221 455.22	$1 860 509.26	$1 748 135.61	$1 691 948.78	$2 731 885.24	$1 510 285.24	$1 510 285.24
Storage														
Cost (Samra and Essery Cost data)			$906 652.88	$753 636.83	$719 828.05	$711 675.17	$898 923.06	$889 402.06	$842 292.38	$863 479.22	$867 912.57	$892 300.60	$1 216 585.40	$813 844.50
Total Cost (Samra and Essery Cost data)			$2 529 502.95	$3 102 179.43	$3 621 927.08	$3 068 159.44	$3 061 348.99	$3 061 769.65	$2 835 075.36	$2 737 451.94	$2 682 432.63	$3 603 330.36	$2 839 435.47	$2 436 694.56
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	64.1	96.1	121.9	96.1	96.1	96.1	80.1	74.8	72.1	121.9	64.1	64.1
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$14 598.00	$21 897.57	$27 759.35	$21 897.57	$21 897.57	$21 897.57	$18 247.79	$17 031.19	$16 422.89	$27 759.35	$14 598.00	$14 598.00
MAINTENANCE COST														
Yearly maintenance cost			$22 299.38	$23 832.01	$26 239.47	$23 242.29	$23 060.72	$22 987.61	$23 286.12	$22 976.40	$22 728.66	$25 871.21	$26 948.37	$20 907.25
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$3 376.94	$4 527.37	$5 374.34	$4 527.37	$4 527.37	$4 527.37	$3 968.21	$3 775.11	$3 677.14	$5 374.34	$3 376.94	$3 376.94
PS Mechanical		15	$6 753.89	$9 054.74	$10 748.67	$9 054.74	$9 054.74	$9 054.74	$7 936.42	$7 550.23	$7 354.28	$10 748.67	$6 753.89	$6 753.89
Feeder pipe system		120	$226 542.79	$329 644.53	$408 443.18	$330 835.78	$332 027.03	$333 218.28	$279 076.39	$262 220.34	$253 792.32	$409 782.79	$226 542.79	$226 542.79
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+[(1-\alpha)/((1+r)^T-1)]+\beta/r]\}+Aop/r$													
PS Civil			$103 372.82	$138 588.92	$164 515.84	$138 588.92	$138 588.92	$138 588.92	$121 472.29	$115 581.30	$112 562.15	$164 515.84	$103 372.82	$103 372.82
PS Mechanical			$70 031.83	$93 889.62	$111 454.16	$93 889.62	$93 889.62	$93 889.62	$82 293.64	$78 289.13	$76 257.30	$111 454.16	$70 031.83	$70 031.83
PS Electrical			$377 050.75	$563 662.35	$713 241.84	$563 662.35	$563 662.35	$563 662.35	$470 414.07	$439 307.26	$423 748.75	$713 241.84	$377 050.75	$377 050.75
Feeder pipe system: Civil			$1 676 561.65	$2 439 580.59	$3 022 740.98	$2 448 396.60	$2 457 212.61	$2 466 028.62	$2 065 343.95	$1 940 598.40	$1 878 225.62	$3 032 654.96	$1 676 561.65	$1 676 561.65
Feeder pipe system: Mechanical			$30 205.70	$43 952.60	$54 459.09	$44 111.44	$44 270.27	$44 429.10	$37 210.19	$34 962.71	$33 838.98	$54 637.70	$30 205.70	$30 205.70
Storage			$1 254 915.37	$1 043 122.96	$998 327.60	$985 043.05	$964 624.37	$954 214.41	$1 185 832.78	$1 195 157.89	$1 201 294.18	$958 226.33	$1 883 898.82	$1 126 457.53
			$3 512 138.12	$4 322 797.05	$5 062 739.31	$4 273 691.98	$4 262 248.15	$4 260 813.03	$3 942 566.92	$3 803 876.69	$3 725 926.98	$5 034 730.82	$3 941 121.57	$3 383 680.28

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 1.2.4

DESIGN PARAMETERS														
Daily Demand (Seasonal Peak)	l/s	80	80	80	80	80	80	80	80	80	80	80	80	80
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	166.31	249.47	316.25	249.47	249.47	249.47	207.89	194.03	187.10	316.25	166.31	166.31	
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	

INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Power required	P = (ρ x g x Q x Ht)/n	kW	174.0	261.0	330.9	261.0	261.0	261.0	217.5	203.0	195.8	330.9	174.0	174.0
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	96	96	96	96	96	96	96	96	96	96	96	96
Pipe diameter 1		mm	285	202	165	202	202	202	202	202	202	165	285	285
Pipe diameter 2		mm	0	0	0	0	0	0	285	285	285	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	0	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	2	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	8.87	6.05	5.34	5.02	4.64	4.45	7.42	7.83	7.91	4.57	11.06	5.53

CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$231 757.45	$310 710.44	$368 837.04	$310 710.44	$310 710.44	$310 710.44	$272 335.68	$259 083.49	$252 359.53	$368 837.04	$231 757.45	$231 757.45
Feeder pipe system														
Cost (Samra and Essery Cost data)			$3 716 343.63	$5 388 413.10	$6 682 697.20	$5 396 233.56	$5 404 054.02	$5 411 874.47	$4 558 862.95	$4 282 346.23	$4 144 087.87	$6 691 492.22	$3 716 343.63	$3 716 343.63
Storage														
Cost (Samra and Essery Cost data)			$1 070 356.59	$857 536.58	$797 795.15	$769 783.93	$734 827.30	$717 870.35	$965 333.34	$995 724.26	$1 001 381.06	$728 629.32	$1 216 585.40	$813 644.50
Total Cost (Samra and Essery Cost data)			**$5 018 457.67**	**$6 556 660.13**	**$7 849 329.38**	**$6 476 727.94**	**$6 449 591.76**	**$6 440 455.26**	**$5 796 531.97**	**$5 537 153.98**	**$5 397 828.46**	**$7 788 958.58**	**$5 164 686.48**	**$4 761 945.58**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	174.0	261.0	330.9	261.0	261.0	261.0	217.5	203.0	195.8	330.9	174.0	174.0
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$39 635.52	$59 454.82	$75 370.34	$59 454.82	$59 454.82	$59 454.82	$49 545.17	$46 241.95	$44 590.34	$75 370.34	$39 635.52	$39 635.52
MAINTENANCE COST														
Yearly maintenance cost			$37 000.99	$42 974.36	$49 142.55	$41 697.17	$41 211.93	$40 996.67	$40 052.14	$38 990.25	$38 315.22	$48 149.04	$39 194.43	$33 153.31

SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$6 952.72	$9 321.31	$11 065.11	$9 321.31	$9 321.31	$9 321.31	$8 170.07	$7 772.50	$7 570.79	$11 065.11	$6 952.72	$6 952.72
PS Mechanical	15		$13 905.45	$18 642.63	$22 130.22	$18 642.63	$18 642.63	$18 642.63	$16 340.14	$15 545.01	$15 141.57	$22 130.22	$13 905.45	$13 905.45
Feeder pipe system	120		$557 451.54	$808 261.97	$1 002 404.56	$809 435.03	$810 608.10	$811 781.17	$683 829.44	$642 351.93	$621 613.18	$1 003 723.83	$557 451.54	$557 451.54
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

LIFE CYCLE COST														
Capitalization method	Cc= {C0[1+{(1- α)/((1+r)^T-1)}+ β /r]}+Aop/r													
PS Civil			$212 832.22	$285 337.94	$338 717.94	$285 337.94	$285 337.94	$285 337.94	$250 096.85	$237 926.82	$231 751.94	$338 717.94	$212 832.22	$212 832.22
PS Mechanical			$144 187.11	$193 307.45	$229 470.71	$193 307.45	$193 307.45	$193 307.45	$169 432.72	$161 187.91	$157 004.62	$229 470.71	$144 187.11	$144 187.11
PS Electrical			$1 015 801.86	$1 519 771.90	$1 923 908.43	$1 519 771.90	$1 519 771.90	$1 519 771.90	$1 267 905.31	$1 183 900.27	$1 141 887.23	$1 923 908.43	$1 015 801.86	$1 015 801.86
Feeder pipe system: Civil			$4 125 498.31	$5 981 655.99	$7 418 435.82	$5 990 337.45	$5 999 018.90	$6 007 700.36	$5 060 775.66	$4 753 815.55	$4 600 335.49	$7 428 198.94	$4 125 498.31	$4 125 498.31
Feeder pipe system: Mechanical			$74 326.87	$107 768.26	$133 653.94	$107 924.67	$108 081.08	$108 237.49	$91 177.26	$85 646.92	$82 861.76	$133 829.84	$74 326.87	$74 326.87
Storage			$1 481 500.77	$1 186 932.57	$1 104 243.33	$1 065 472.48	$1 017 088.34	$993 617.91	$1 336 136.10	$1 378 200.75	$1 386 030.44	$1 008 509.61	$1 663 898.82	$1 126 457.53
			$7 054 147.14	**$9 274 774.11**	**$11 148 429.96**	**$9 162 151.88**	**$9 122 605.61**	**$9 107 973.04**	**$8 175 523.90**	**$7 999 678.23**	**$7 599 881.47**	**$11 062 636.47**	**$7 256 545.19**	**$6 609 163.90**

Samra & Essery Data

COST ESTIMATION : SERIES 1.4.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	2.71	4.06	5.15	4.06	4.06	4.06	3.38	3.16	3.05	5.15	2.71	2.71
Supply length		m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	P = (ρ x g x Q x Ht)/η	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	521	369	301	369	369	369	369	369	369	301	521	521
Pipe diameter 2		mm	0	0	0	0	0	0	521	521	521	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	13.32	12.11	12.02	11.99	11.94	11.98	12.74	13.02	13.10	11.91	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$26 117.08	$35 014.41	$41 564.78	$35 014.41	$35 014.41	$35 014.41	$30 689.90	$29 196.49	$28 438.76	$41 564.78	$26 117.08	$26 117.08
Feeder pipe system														
Cost (Samra and Essery Cost data)			$260 968.68	$396 392.16	$489 314.97	$413 310.58	$428 229.00	$443 147.41	$340 135.12	$320 716.10	$311 006.59	$505 934.91	$260 968.68	$260 968.68
Storage														
Cost (Samra and Essery Cost data)			$1 355 235.34	$1 282 391.68	$1 276 812.09	$1 274 794.68	$1 271 825.83	$1 274 264.50	$1 320 616.59	$1 337 141.03	$1 342 126.31	$1 269 714.67	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			$1 642 341.10	$1 715 798.25	$1 807 691.83	$1 723 119.67	$1 738 069.23	$1 752 426.32	$1 691 441.60	$1 687 053.62	$1 681 571.66	$1 817 214.36	$2 587 874.70	$1 826 236.81
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/η	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$1 935.22	$2 902.91	$3 679.99	$2 902.91	$2 902.91	$2 902.91	$2 419.06	$2 257.78	$2 177.14	$3 679.99	$1 935.22	$1 935.22
MAINTENANCE COST														
Yearly maintenance cost			$21 899.87	$21 584.98	$22 022.72	$21 545.62	$21 575.66	$21 606.85	$21 822.96	$21 958.50	$21 977.00	$21 999.36	$36 082.87	$24 658.30
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$783.51	$1 050.43	$1 246.94	$1 050.43	$1 050.43	$1 050.43	$920.70	$875.89	$853.16	$1 246.94	$783.51	$783.51
PS Mechanical		15	$1 567.02	$2 100.86	$2 493.89	$2 100.86	$2 100.86	$2 100.86	$1 841.39	$1 751.79	$1 706.33	$2 493.89	$1 567.02	$1 567.02
Feeder pipe system		120	$39 148.30	$59 758.82	$73 397.25	$61 996.59	$64 234.35	$66 472.11	$51 020.27	$48 107.42	$46 650.99	$75 890.24	$39 148.30	$39 148.30
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = (C0[1+\{[1-\alpha)/\{[(1+r)^T-1]\}+\beta/r]\}+Aop)/r$													
PS Civil			$23 984.37	$32 155.14	$38 170.61	$32 155.14	$32 155.14	$32 155.14	$28 183.77	$26 812.32	$26 116.46	$38 170.61	$23 984.37	$23 984.37
PS Mechanical			$16 248.65	$21 784.09	$25 859.38	$21 784.09	$21 784.09	$21 784.09	$19 093.62	$18 164.50	$17 693.08	$25 859.38	$16 248.65	$16 248.65
PS Electrical			$51 188.09	$76 336.89	$96 467.89	$76 336.89	$76 336.89	$76 336.89	$63 775.73	$59 583.17	$57 485.70	$96 467.89	$51 188.09	$51 188.09
Feeder pipe system: Civil			$289 722.50	$442 253.56	$543 186.61	$458 814.43	$475 375.31	$491 936.18	$377 582.64	$356 025.67	$345 247.18	$561 636.34	$289 722.50	$289 722.50
Feeder pipe system: Mechanical			$5 219.77	$7 967.84	$9 786.30	$8 266.21	$8 564.58	$8 862.95	$6 802.70	$6 414.32	$6 220.13	$10 118.70	$5 219.77	$5 219.77
Storage			$1 875 806.83	$1 774 982.55	$1 767 259.72	$1 764 467.39	$1 760 358.15	$1 763 733.56	$1 827 890.36	$1 850 782.15	$1 857 662.37	$1 757 436.05	$3 184 537.74	$2 130 340.35
			$2 262 170.21	$2 355 479.87	$2 490 730.61	$2 361 823.96	$2 374 573.96	$2 394 806.61	$2 323 328.82	$2 317 782.12	$2 310 424.92	$2 489 888.97	$3 570 901.12	$2 516 703.73

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 1.4.2

Daily Demand (Seasonal Peak)	l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	14.79	22.18	28.12	22.18	22.18	22.18	18.48	17.25	16.63	28.12	14.79	14.79
Supply length	m	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

INFRASTRUCTURE SIZING

Source :Pumping Station													
Description	Formula	Unit											
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	P = (ρ x g x Q x Ht)/n	kW	46.4	69.6	88.3	69.6	69.6	69.6	58.0	54.2	52.2	88.3	46.4	46.4
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	512	362	295	362	362	362	362	362	362	295	512	512
Pipe diameter 2		mm	0	0	0	0	0	0	512	512	512	0	0	0
Pipe 1 - Length		m	5000	10000	15000	10000	10000	10000	5000	3333	2500	15000	5000	5000
Pipe 1 - Length		m	0	0	0	0	0	0	2500	3333	3750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	17.14	13.25	12.70	12.50	12.28	12.13	15.41	15.95	16.17	12.17	33.18	16.58

CAPITAL COST													
Source :Pumping Station													
Cost (Samra and Essery Cost data)		$89 142.71	$119 511.03	$141 868.72	$119 511.03	$119 511.03	$119 511.03	$104 750.64	$99 653.34	$97 067.05	$141 868.72	$89 142.71	$89 142.71
Feeder pipe system													
Cost (Samra and Essery Cost data)		$1 282 944.45	$1 876 210.93	$2 323 319.42	$1 890 797.98	$1 905 385.04	$1 919 972.09	$1 589 836.23	$1 494 378.00	$1 446 648.89	$2 339 578.00	$1 282 944.45	$1 282 944.45
Storage													
Cost (Samra and Essery Cost data)		$1 568 725.29	$1 351 020.09	$1 317 967.05	$1 306 103.04	$1 292 673.39	$1 283 379.19	$1 474 643.64	$1 504 491.33	$1 516 274.32	$1 286 160.14	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)		**$2 940 812.45**	**$3 346 742.04**	**$3 783 156.19**	**$3 316 412.04**	**$3 317 569.45**	**$3 322 862.31**	**$3 169 230.51**	**$3 098 522.67**	**$3 059 990.26**	**$3 767 606.87**	**$3 672 856.11**	**$2 911 218.22**

OPERATING COST													
Power required	P = (ρ x g x Q x Ht)/n	kW	46.4	69.6	88.3	69.6	69.6	69.6	58.0	54.2	52.2	88.3	46.4	46.4
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$10 572.05	$15 858.49	$20 103.67	$15 858.49	$15 858.49	$15 858.49	$13 215.27	$12 334.20	$11 893.66	$20 103.67	$10 572.05	$10 572.05
MAINTENANCE COST													
Yearly maintenance cost			$30 854.86	$30 865.37	$32 833.16	$30 264.55	$30 136.04	$30 089.56	$31 137.29	$31 055.72	$30 967.44	$32 437.35	$41 835.51	$30 410.94

SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$2 674.28	$3 585.33	$4 256.06	$3 585.33	$3 585.33	$3 585.33	$3 142.52	$2 989.60	$2 912.01	$4 256.06	$2 674.28	$2 674.28
PS Mechanical		15	$5 348.56	$7 170.66	$8 512.12	$7 170.66	$7 170.66	$7 170.66	$6 285.04	$5 979.20	$5 824.02	$8 512.12	$5 348.56	$5 348.56
Feeder pipe system		120	$192 441.67	$281 431.64	$348 497.91	$283 619.70	$285 807.76	$287 995.81	$238 475.43	$224 156.70	$216 997.33	$350 936.70	$192 441.67	$192 441.67
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

LIFE CYCLE COST													
Capitalization method	Cc= {C0[1+{(1- α)/[(1+r)^T-1]}+ β /r]}+Aop/r												
PS Civil		$81 863.35	$109 751.80	$130 283.77	$109 751.80	$109 751.80	$109 751.80	$96 196.74	$91 515.68	$89 140.59	$130 283.77	$81 863.35	$81 863.35
PS Mechanical		$55 459.83	$74 353.38	$88 263.14	$74 353.38	$74 353.38	$74 353.38	$65 170.25	$61 998.99	$60 389.94	$88 263.14	$55 459.83	$55 459.83
PS Electrical		$273 884.21	$409 309.79	$517 642.62	$409 309.79	$409 309.79	$409 309.79	$341 642.55	$319 067.76	$307 776.32	$517 642.62	$273 884.21	$273 884.21
Feeder pipe system: Civil		$1 424 191.54	$2 082 774.30	$2 579 107.86	$2 098 967.33	$2 115 160.36	$2 131 353.40	$1 764 870.89	$1 656 903.09	$1 605 919.18	$2 597 156.25	$1 424 191.54	$1 424 191.54
Feeder pipe system: Mechanical		$25 658.89	$37 524.22	$46 466.39	$37 815.96	$38 107.70	$38 399.44	$31 796.72	$29 887.56	$28 932.98	$46 791.56	$25 658.89	$25 658.89
Storage		$2 171 302.29	$1 869 972.41	$1 824 223.08	$1 807 801.87	$1 789 213.65	$1 776 349.38	$2 041 082.10	$2 082 394.86	$2 098 703.91	$1 780 198.54	$3 184 537.74	$2 130 340.35
		$4 032 360.11	**$4 583 685.89**	**$5 186 186.86**	**$4 538 000.13**	**$4 536 896.66**	**$4 539 517.18**	**$4 340 759.25**	**$4 243 767.94**	**$4 190 862.92**	**$5 160 536.88**	**$5 046 866.56**	**$3 991 368.16**

Samra & Essery Data Not to be Copied or Used

COST ESTIMATION : SERIES 1.4.3

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	34.98	52.48	66.52	52.48	52.48	52.48	43.73	40.81	39.36	66.52	34.98	34.98
Supply length		m	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	P = (ρ x g x Q x Ht)/η	kW	109.8	164.7	208.8	164.7	164.7	164.7	137.3	128.1	123.5	208.8	109.8	109.8
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	494	350	285	350	350	350	350	350	350	285	494	494
Pipe diameter 2		mm	0	0	0	0	0	0	494	494	494	0	0	0
Pipe 1 - Length		m	10000	20000	30000	20000	20000	20000	10000	6667	5000	30000	10000	10000
Pipe 1 - Length		m	0	0	0	0	0	0	5000	6667	7500	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	20.31	14.53	13.42	13.16	12.69	12.45	17.59	18.37	18.53	12.55	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$166 142.57	$222 742.49	$264 412.36	$222 742.49	$222 742.49	$222 742.49	$195 232.34	$185 732.09	$180 911.81	$264 412.36	$166 142.57	$166 142.57
Feeder pipe system														
Cost (Samra and Essery Cost data)			$2 484 448.75	$3 613 431.42	$4 479 274.31	$3 627 416.78	$3 641 402.13	$3 655 387.49	$3 058 860.84	$2 874 003.98	$2 781 575.55	$4 494 876.01	$2 484 448.75	$2 484 448.75
Storage														
Cost (Samra and Essery Cost data)			$1 730 739.40	$1 425 073.82	$1 361 087.45	$1 345 659.86	$1 317 701.59	$1 303 382.25	$1 592 570.63	$1 632 777.24	$1 641 231.94	$1 309 029.85	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$4 381 330.72**	**$5 261 247.73**	**$6 104 774.12**	**$5 195 819.13**	**$5 181 846.22**	**$5 181 512.22**	**$4 846 663.82**	**$4 692 513.32**	**$4 603 719.30**	**$6 068 318.21**	**$4 951 360.26**	**$4 189 722.37**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/η	kW	109.8	164.7	208.8	164.7	164.7	164.7	137.3	128.1	123.5	208.8	109.8	109.8
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$25 012.08	$37 519.10	$47 562.62	$37 519.10	$37 519.10	$37 519.10	$31 265.59	$29 181.09	$28 138.84	$47 562.62	$25 012.08	$25 012.08
MAINTENANCE COST														
Yearly maintenance cost			$40 077.99	$41 715.24	$45 509.69	$40 593.96	$40 244.51	$40 099.64	$41 174.23	$40 756.15	$40 371.66	$44 806.83	$48 628.43	$37 203.86
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$4 984.28	$6 682.27	$7 932.37	$6 682.27	$6 682.27	$6 682.27	$5 856.97	$5 571.96	$5 427.35	$7 932.37	$4 984.28	$4 984.28
PS Mechanical		15	$9 968.55	$13 364.55	$15 864.74	$13 364.55	$13 364.55	$13 364.55	$11 713.94	$11 143.93	$10 854.71	$15 864.74	$9 968.55	$9 968.55
Feeder pipe system		120	$372 667.31	$542 014.71	$671 891.15	$544 112.52	$548 210.32	$548 308.12	$458 829.13	$431 100.80	$417 236.33	$674 231.40	$372 667.31	$372 667.31
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	Cc= (C0[1+{(1- α)/((1+r)^T-1)}+ β /r])+Aop/r													
PS Civil			$152 575.43	$204 553.42	$242 820.54	$204 553.42	$204 553.42	$204 553.42	$179 289.74	$170 565.28	$166 138.62	$242 820.54	$152 575.43	$152 575.43
PS Mechanical			$103 365.04	$138 578.48	$164 503.25	$138 578.48	$138 578.48	$138 578.48	$121 463.14	$115 552.59	$112 553.67	$164 503.25	$103 365.04	$103 365.04
PS Electrical			$643 162.37	$961 922.27	$1 217 489.84	$961 922.27	$961 922.27	$961 922.27	$802 627.23	$749 493.38	$722 918.92	$1 217 489.84	$643 162.37	$643 162.37
Feeder pipe system: Civil			$2 757 976.69	$4 011 255.87	$4 972 424.63	$4 026 780.96	$4 042 306.05	$4 057 831.14	$3 395 629.28	$3 190 420.41	$3 087 815.96	$4 989 744.01	$2 757 976.69	$2 757 976.69
Feeder pipe system: Mechanical			$49 688.97	$72 268.63	$89 585.49	$72 548.34	$72 828.04	$73 107.75	$61 177.22	$57 480.08	$55 631.51	$89 897.52	$49 688.97	$49 688.97
Storage			$2 395 549.08	$1 972 471.58	$1 883 906.83	$1 862 553.22	$1 823 855.66	$1 804 035.96	$2 204 307.08	$2 259 957.81	$2 271 660.12	$1 811 852.93	$3 184 537.74	$2 130 340.35
			$6 102 317.58	**$7 361 050.25**	**$8 570 730.88**	**$7 266 936.68**	**$7 244 043.92**	**$7 240 029.63**	**$6 764 493.67**	**$6 543 469.55**	**$6 416 718.81**	**$8 516 306.09**	**$6 891 306.24**	**$5 837 108.86**

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 1.4.4

INPUT ASSUMPTIONS														
Daily Demand (Seasonal Peak)	l/s	240	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	94.73	142.09	180.13	142.09	142.09	142.09	118.41	110.51	106.57	180.13	94.73	94.73	94.73
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	P = (ρ x g x Q x Ht)/n	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	346.9	334.5	565.5	297.4	297.4
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	486	344	281	344	344	344	344	344	344	281	486	486
Pipe diameter 2		mm	0	0	0	0	0	0	486	486	486	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2x Pipe Splits	$y = 0.0287x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	26.60	18.15	16.02	15.06	13.90	13.36	22.25	23.47	23.72	13.70	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$341 398.74	$457 703.32	$543 328.82	$457 703.32	$457 703.32	$457 703.32	$401 173.96	$381 652.35	$371 747.38	$543 328.82	$341 398.74	$341 398.74
Feeder pipe system														
Cost (Samra and Essery Cost data)			$6 116 636.13	$8 866 841.40	$10 998 744.17	$8 880 552.65	$8 894 263.89	$8 907 975.14	$7 501 505.75	$7 046 393.87	$6 818 837.92	$11 014 046.28	$6 116 636.13	$6 116 636.13
Storage														
Cost (Samra and Essery Cost data)			$2 024 042.78	$1 821 553.93	$1 508 470.67	$1 455 469.77	$1 389 348.60	$1 357 319.23	$1 824 762.59	$1 882 446.52	$1 893 712.20	$1 377 334.07	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$8 482 077.86**	**$10 946 098.64**	**$13 050 543.66**	**$10 793 725.73**	**$10 741 315.81**	**$10 722 997.68**	**$9 727 442.32**	**$9 310 492.74**	**$9 084 297.50**	**$12 934 709.17**	**$8 758 803.81**	**$7 997 166.93**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	346.9	334.5	565.5	297.4	297.4
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$67 727.54	$101 593.95	$128 789.74	$101 593.95	$101 593.95	$101 593.95	$84 660.75	$79 016.35	$76 194.15	$128 789.74	$67 727.54	$67 727.54
MAINTENANCE COST														
Yearly maintenance cost			$64 426.09	$73 328.09	$83 162.73	$70 903.38	$69 980.12	$69 568.24	$68 970.94	$67 361.52	$66 291.70	$81 272.20	$68 576.96	$57 152.41
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$10 241.96	$13 731.10	$16 299.86	$13 731.10	$13 731.10	$13 731.10	$12 035.22	$11 449.57	$11 152.42	$16 299.86	$10 241.96	$10 241.96
PS Mechanical	15		$20 483.92	$27 462.20	$32 599.73	$27 462.20	$27 462.20	$27 462.20	$24 070.44	$22 899.14	$22 304.84	$32 599.73	$20 483.92	$20 483.92
Feeder pipe system	120		$917 495.42	$1 330 026.21	$1 649 811.62	$1 332 082.90	$1 334 139.58	$1 336 196.27	$1 125 225.86	$1 056 959.08	$1 022 825.69	$1 652 106.94	$917 495.42	$917 495.42
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	Cc= {C0[1+{(1- α)/((1+r)^T-1)}+ β /r]}+Aop/r													
PS Civil			$313 520.24	$420 327.43	$498 960.78	$420 327.43	$420 327.43	$420 327.43	$368 414.25	$350 486.76	$341 390.62	$498 960.78	$313 520.24	$313 520.24
PS Mechanical			$212 400.07	$284 758.56	$338 030.18	$284 758.56	$284 758.56	$284 758.56	$249 589.03	$237 443.72	$231 281.37	$338 030.18	$212 400.07	$212 400.07
PS Electrical			$1 729 888.94	$2 589 051.98	$3 278 151.25	$2 589 051.98	$2 589 051.98	$2 589 051.98	$2 159 644.92	$2 016 436.30	$1 944 816.49	$3 278 151.25	$1 729 888.94	$1 729 888.94
Feeder pipe system: Civil			$6 790 053.48	$9 843 045.42	$12 209 662.22	$9 858 266.23	$9 873 487.03	$9 888 707.83	$8 327 391.74	$7 822 173.85	$7 589 564.90	$12 226 649.04	$6 790 053.48	$6 790 053.48
Feeder pipe system: Mechanical			$122 332.72	$177 336.83	$219 974.86	$177 611.05	$177 885.28	$178 159.50	$150 030.11	$140 927.88	$136 376.76	$220 280.93	$122 332.72	$122 332.72
Storage			$2 801 515.84	$2 244 423.41	$2 087 902.74	$2 014 543.19	$1 923 023.63	$1 878 691.18	$2 525 688.36	$2 605 529.78	$2 821 122.81	$1 906 394.10	$3 184 537.74	$2 130 340.35
			$11 969 711.28	**$15 556 943.83**	**$18 632 682.06**	**$15 344 588.44**	**$15 268 533.91**	**$15 239 686.49**	**$13 780 756.42**	**$13 172 996.27**	**$12 944 562.96**	**$18 468 466.27**	**$12 362 733.10**	**$11 298 536.80**

Sample Data Only
Samra & Essery

COST ESTIMATION : SERIES 3.1.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	8.69	13.04	16.53	13.04	13.04	13.04	10.87	10.14	9.78	16.53	8.69	8.69
Supply length		m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Power required	P = (ρ x g x Q x Ht)/n	kW	2.3	3.4	4.3	3.4	3.4	3.4	2.8	2.7	2.6	4.3	2.3	2.3
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	160	113	92	113	113	113	113	113	113	92	160	160
Pipe diameter 2		mm	0	0	0	0	0	0	160	160	160	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0257x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	1.31	1.24	1.23	1.22	1.22	1.22	1.26	1.29	1.29	1.22	2.76	1.38
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$10 070.88	$13 501.73	$16 027.59	$13 501.73	$13 501.73	$13 501.73	$11 834.18	$11 258.32	$10 966.13	$16 027.59	$10 070.88	$10 070.88
Feeder pipe system														
Cost (Samra and Essery Cost data and interconnections estimation)			$86 301.48	$134 784.12	$163 157.83	$139 854.06	$144 924.00	$149 993.94	$115 520.19	$109 098.87	$105 888.22	$168 836.10	$86 301.48	$86 301.48
Storage														
Cost (Samra and Essery Cost data)			$345 383.37	$330 733.21	$329 169.34	$328 270.73	$328 184.19	$327 058.38	$338 315.75	$341 217.56	$340 759.31	$327 391.56	$544 203.89	$357 566.91
Total Cost (Samra and Essery Cost data)			**$441 755.73**	**$479 019.07**	**$508 354.76**	**$481 626.52**	**$488 609.93**	**$490 554.04**	**$465 670.12**	**$461 574.75**	**$457 613.66**	**$512 255.26**	**$640 576.25**	**$453 938.27**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	2.3	3.4	4.3	3.4	3.4	3.4	2.8	2.7	2.6	4.3	2.3	2.3
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$517.98	$776.99	$984.99	$776.99	$776.99	$776.99	$647.49	$604.32	$582.73	$984.99	$517.98	$517.98
MAINTENANCE COST														
Yearly maintenance cost			$5 715.13	$5 772.64	$5 916.81	$5 761.05	$5 785.10	$5 793.56	$5 773.05	$5 778.59	$5 752.89	$5 918.54	$6 697.29	$5 697.73
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$302.13	$405.05	$480.83	$405.05	$405.05	$405.05	$355.03	$337.75	$328.98	$480.83	$302.13	$302.13
PS Mechanical	15		$604.25	$810.10	$961.66	$810.10	$810.10	$810.10	$710.05	$675.50	$657.97	$961.66	$604.25	$604.25
Feeder pipe system	120		$12 945.22	$20 217.62	$24 473.67	$20 978.11	$21 738.60	$22 499.09	$17 328.03	$16 364.83	$15 883.23	$25 325.42	$12 945.22	$12 945.22
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/\{(1+\eta)^T-1\}\}+\beta/\eta]\}+Aop/r$													
PS Civil			$9 248.50	$12 399.19	$14 718.78	$12 399.19	$12 399.19	$12 399.19	$10 867.81	$10 338.97	$10 070.64	$14 718.78	$9 248.50	$9 248.50
PS Mechanical			$6 265.56	$8 400.06	$9 971.51	$8 400.06	$8 400.06	$8 400.06	$7 362.60	$7 004.32	$6 822.54	$9 971.51	$6 265.56	$6 265.56
PS Electrical			$14 032.14	$20 876.22	$26 347.59	$20 876.22	$20 876.22	$20 876.22	$17 459.33	$16 318.21	$15 747.20	$26 347.59	$14 032.14	$14 032.14
Feeder pipe system: Civil			$95 802.93	$149 623.32	$181 120.86	$155 251.44	$160 879.56	$166 507.68	$128 238.50	$121 110.23	$117 546.09	$187 424.29	$95 802.93	$95 802.93
Feeder pipe system: Mechanical			$1 726.03	$2 695.68	$3 263.16	$2 797.08	$2 898.48	$2 999.88	$2 310.40	$2 181.96	$2 117.76	$3 376.72	$1 726.03	$1 726.03
Storage			$478 065.49	$457 774.08	$455 609.50	$454 365.71	$454 245.94	$452 687.65	$468 269.22	$472 285.67	$471 651.40	$453 148.84	$753 242.87	$494 915.11
			$605 140.85	**$661 788.98**	**$691 031.40**	**$654 089.71**	**$659 899.45**	**$663 870.68**	**$634 507.86**	**$629 239.38**	**$623 955.63**	**$694 967.74**	**$880 318.03**	**$621 990.27**

University of Canberra
Samra & Essery Data Known

COST ESTIMATION : SERIES 3.1.4

DESIGN PARAMETERS		Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	Config 11	Config 12	Config 13
Daily Demand (Seasonal Peak)	l/s	20	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	316.34	474.52	601.55	474.52	474.52	474.52	395.43	369.07	355.89	601.55	316.34	316.34	316.34
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Power required	$P = (\rho \times g \times Q \times Hl)/\eta$	kW	82.8	124.1	157.4	124.1	124.1	124.1	103.4	96.5	93.1	157.4	82.8	82.8
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	148	104	85	104	104	104	104	104	104	85	148	148
Pipe diameter 2		mm	0	0	0	0	0	0	148	148	148	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^3 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	2.37	1.88	1.53	1.48	1.36	1.33	2.02	2.09	2.13	1.35	2.76	1.38
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$135 406.09	$181 534.99	$215 495.91	$181 534.99	$181 534.99	$181 534.99	$159 114.24	$151 371.54	$147 443.02	$215 495.91	$135 406.09	$135 406.09
Feeder pipe system														
Cost (Samra and Essery Cost data)			$2 007 523.44	$2 913 464.00	$3 611 480.34	$2 918 312.55	$2 923 161.10	$2 928 009.64	$2 465 351.14	$2 315 980.19	$2 241 294.71	$3 616 903.58	$2 007 523.44	$2 007 523.44
Storage														
Cost (Samra and Essery Cost data)			$497 169.54	$405 735.11	$382 214.72	$370 530.46	$354 413.67	$348 186.60	$452 478.61	$482 496.71	$466 539.63	$351 833.58	$544 203.89	$357 566.91
Total Cost (Samra and Essery Cost data)			**$2 640 099.08**	**$3 500 734.11**	**$4 209 190.97**	**$3 470 378.00**	**$3 458 109.76**	**$3 457 731.24**	**$3 076 944.00**	**$2 929 848.45**	**$2 855 277.36**	**$4 184 233.07**	**$2 687 133.42**	**$2 500 496.45**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Hl)/\eta$	kW	82.8	124.1	157.4	124.1	124.1	124.1	103.4	96.5	93.1	157.4	82.8	82.8
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$18 848.17	$28 272.99	$35 841.41	$28 272.99	$28 272.99	$28 272.99	$23 560.58	$21 989.78	$21 204.37	$35 841.41	$18 848.17	$18 848.17
MAINTENANCE COST														
Yearly maintenance cost			$18 878.30	$22 505.00	$25 986.68	$22 001.18	$21 783.67	$21 714.50	$20 736.90	$20 061.34	$19 708.49	$25 560.08	$19 581.82	$16 782.26
SALVAGE VALUE AT END OF DESIGN LIFE			Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Component	Design life													
PS Civil		50	$4 062.18	$5 446.05	$6 464.88	$5 446.05	$5 446.05	$5 446.05	$4 773.43	$4 541.15	$4 423.29	$6 464.88	$4 062.18	$4 062.18
PS Mechanical		15	$8 124.37	$10 892.10	$12 929.75	$10 892.10	$10 892.10	$10 892.10	$9 546.85	$9 082.29	$8 846.58	$12 929.75	$8 124.37	$8 124.37
Feeder pipe system		120	$301 128.52	$437 019.60	$541 722.05	$437 746.88	$438 474.16	$439 201.45	$369 802.67	$347 397.03	$336 194.21	$542 535.54	$301 128.52	$301 128.52
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = (C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/i]+Aop)/i$													
PS Civil			$124 348.88	$166 710.91	$197 898.59	$166 710.91	$166 710.91	$166 710.91	$146 121.03	$139 010.60	$135 402.87	$197 898.59	$124 348.88	$124 348.88
PS Mechanical			$84 242.44	$112 941.38	$134 070.05	$112 941.38	$112 941.38	$112 941.38	$98 992.38	$94 175.29	$91 731.17	$134 070.05	$84 242.44	$84 242.44
PS Electrical			$485 760.40	$726 339.75	$919 201.13	$726 339.75	$726 339.75	$726 339.75	$606 119.27	$586 016.85	$545 959.49	$919 201.13	$485 760.40	$485 760.40
Feeder pipe system: Civil			$2 228 543.80	$3 234 224.82	$4 009 089.99	$3 239 607.17	$3 244 989.53	$3 250 371.88	$2 736 776.51	$2 570 960.41	$2 488 052.36	$4 015 110.30	$2 228 543.80	$2 228 543.80
Feeder pipe system: Mechanical			$40 150.47	$58 269.28	$72 229.61	$58 366.25	$58 463.22	$58 560.19	$49 307.02	$46 319.60	$44 825.89	$72 338.07	$40 150.47	$40 150.47
Storage			$688 141.75	$561 585.63	$529 030.61	$512 858.21	$490 550.66	$481 931.65	$626 284.19	$640 150.43	$645 746.31	$486 979.50	$753 242.87	$494 915.11
			$3 861 187.74	**$4 860 071.77**	**$5 861 519.87**	**$4 816 823.67**	**$4 799 995.44**	**$4 796 855.76**	**$4 263 600.41**	**$4 086 633.19**	**$3 961 718.10**	**$5 825 887.84**	**$3 716 288.87**	**$3 467 991.19**

Sample Essery Data Only

COST ESTIMATION : SERIES 3.4.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)		l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	2.71	4.06	5.15	4.06	4.06	4.06	3.38	3.16	3.05	5.15	2.71	2.71
Supply length		m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works		%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe		%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage		%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	P = (ρ x g x Q x Ht)/n	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	521	369	301	369	369	369	369	369	369	301	521	521
Pipe diameter 2		mm	0	0	0	0	0	0	521	521	521	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^3 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	15.57	14.67	14.56	14.52	14.51	14.43	15.13	15.31	15.27	14.43	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$26 117.08	$35 014.41	$41 564.78	$35 014.41	$35 014.41	$35 014.41	$30 689.90	$29 196.49	$28 438.76	$41 564.78	$26 117.08	$26 117.08
Feeder pipe system														
Cost (Samra and Essery Cost data)			$260 988.68	$398 392.16	$489 314.97	$413 310.58	$428 229.00	$443 147.41	$340 135.12	$320 716.10	$311 006.59	$505 934.91	$260 988.68	$260 988.68
Storage														
Cost (Samra and Essery Cost data)			$1 483 843.33	$1 432 971.74	$1 427 236.29	$1 424 669.06	$1 424 115.81	$1 419 743.48	$1 459 264.66	$1 469 105.59	$1 467 105.89	$1 419 803.97	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$1 770 949.09**	**$1 866 378.31**	**$1 958 116.04**	**$1 872 994.04**	**$1 887 359.22**	**$1 897 905.30**	**$1 830 089.67**	**$1 819 018.18**	**$1 806 551.24**	**$1 967 303.66**	**$2 587 874.70**	**$1 826 236.81**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$1 935.22	$2 902.91	$3 679.99	$2 902.91	$2 902.91	$2 902.91	$2 419.06	$2 257.78	$2 177.14	$3 679.99	$1 935.22	$1 935.22
MAINTENANCE COST														
Yearly maintenance cost			$23 828.99	$23 843.86	$24 279.08	$23 793.74	$23 860.03	$23 869.04	$23 902.68	$23 937.97	$23 851.70	$24 250.69	$36 082.67	$24 658.30
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$783.51	$1 050.43	$1 246.94	$1 050.43	$1 050.43	$1 050.43	$920.70	$875.89	$853.16	$1 246.94	$783.51	$783.51
PS Mechanical	15		$1 567.02	$2 100.86	$2 493.89	$2 100.86	$2 100.86	$2 100.86	$1 841.39	$1 751.79	$1 706.33	$2 493.89	$1 567.02	$1 567.02
Feeder pipe system	120		$39 148.30	$59 758.62	$73 397.25	$61 995.59	$64 234.35	$66 472.11	$51 020.27	$48 107.42	$46 650.99	$75 890.24	$39 148.30	$39 148.30
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{(1-\alpha)/((1+r)^T-1)\}+\beta/r]\}+Acp/r$													
PS Civil			$23 984.37	$32 155.14	$38 170.61	$32 155.14	$32 155.14	$32 155.14	$28 183.77	$26 812.32	$26 116.46	$38 170.61	$23 984.37	$23 984.37
PS Mechanical			$16 248.65	$21 784.09	$25 859.38	$21 784.09	$21 784.09	$21 784.09	$19 093.62	$18 164.50	$17 693.08	$25 859.38	$16 248.65	$16 248.65
PS Electrical			$51 188.09	$76 336.89	$96 467.89	$76 336.89	$76 336.89	$76 336.89	$63 775.73	$59 583.17	$57 485.70	$96 467.89	$51 188.09	$51 188.09
Feeder pipe system: Civil			$289 722.50	$442 253.56	$543 186.61	$458 814.43	$475 375.31	$491 936.18	$377 582.64	$356 025.67	$345 247.18	$561 636.34	$289 722.50	$289 722.50
Feeder pipe system: Mechanical			$5 219.77	$7 967.84	$9 786.30	$8 266.21	$8 564.58	$8 862.95	$6 802.70	$6 414.32	$6 220.13	$10 118.70	$5 219.77	$5 219.77
Storage			$2 053 815.57	$1 963 403.25	$1 975 464.70	$1 971 911.34	$1 971 145.59	$1 965 093.75	$2 019 795.76	$2 033 416.79	$2 030 648.96	$1 965 177.48	$3 184 537.74	$2 130 340.35
			$2 440 178.96	**$2 563 900.57**	**$2 686 936.50**	**$2 580 267.91**	**$2 585 361.40**	**$2 596 168.81**	**$2 515 234.23**	**$2 500 416.78**	**$2 483 411.52**	**$2 697 430.40**	**$3 579 901.12**	**$2 516 793.73**

University of Canberra
Samra & Essery Data

COST ESTIMATION : SERIES 3.4.4

DESIGN CRITERIA														
Daily Demand (Seasonal Peak)	l/s	240	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	94.73	142.09	180.13	142.09	142.09	142.09	118.41	110.51	106.57	180.13	94.73	94.73	94.73
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	P = (ρ x g x Q x Ht)/n	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	348.9	334.5	565.5	297.4	297.4
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	486	344	281	344	344	344	344	344	344	281	486	486
Pipe diameter 2		mm	0	0	0	0	0	0	488	486	486	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^3 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	28.27	20.06	18.20	17.38	16.21	15.76	24.07	25.02	25.43	16.03	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$341 396.74	$457 703.32	$543 328.82	$457 703.32	$457 703.32	$457 703.32	$401 173.98	$381 652.35	$371 747.38	$543 328.82	$341 396.74	$341 396.74
Feeder pipe system														
Cost (Samra and Essery Cost data)			$6 116 636.13	$8 866 841.40	$10 998 744.17	$8 680 552.65	$8 894 263.89	$8 907 975.14	$7 501 505.75	$7 046 393.87	$6 818 837.92	$11 014 046.28	$6 116 636.13	$6 116 636.13
Storage														
Cost (Samra and Essery Cost data)			$2 096 965.35	$1 718 210.18	$1 624 370.54	$1 581 039.92	$1 518 538.58	$1 493 824.81	$1 909 857.91	$1 953 504.47	$1 971 781.38	$1 509 012.05	$2 300 786.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$8 555 000.23**	**$11 042 754.90**	**$13 166 443.52**	**$10 919 295.88**	**$10 870 505.79**	**$10 859 503.27**	**$9 812 537.63**	**$9 381 550.09**	**$9 162 366.68**	**$13 066 387.14**	**$8 756 803.81**	**$7 967 165.93**
OPERATING COST														
Power required	P = (ρ x g x Q x Ht)/n	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	348.9	334.5	565.5	297.4	297.4
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$67 727.54	$101 593.95	$128 789.74	$101 593.95	$101 593.95	$101 593.95	$84 660.75	$79 016.35	$76 194.15	$128 789.74	$67 727.54	$67 727.54
MAINTENANCE COST														
Yearly maintenance cost			$65 519.93	$74 775.93	$84 901.23	$72 788.94	$71 917.97	$71 615.82	$70 247.37	$68 427.39	$67 462.73	$83 247.37	$68 576.98	$57 152.41
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil		50	$10 241.96	$13 731.10	$16 299.86	$13 731.10	$13 731.10	$13 731.10	$12 035.22	$11 449.57	$11 152.42	$16 299.86	$10 241.96	$10 241.96
PS Mechanical		15	$20 483.92	$27 462.20	$32 599.73	$27 462.20	$27 462.20	$27 462.20	$24 070.44	$22 899.14	$22 304.84	$32 599.73	$20 483.92	$20 483.92
Feeder pipe system		120	$917 495.42	$1 330 026.21	$1 649 811.62	$1 332 082.90	$1 334 139.58	$1 336 196.27	$1 125 225.86	$1 056 959.06	$1 022 825.69	$1 652 106.94	$917 495.42	$917 495.42
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+\{[1-\alpha)/\{(1+r)^T-1\}]+\beta/r\}]+Aop/r$													
PS Civil			$313 520.24	$420 327.43	$498 960.78	$420 327.43	$420 327.43	$420 327.43	$368 414.25	$350 486.76	$341 390.62	$498 960.78	$313 520.24	$313 520.24
PS Mechanical			$212 400.07	$284 758.56	$338 030.18	$284 758.56	$284 758.56	$284 758.56	$249 589.03	$237 443.72	$231 281.37	$338 030.18	$212 400.07	$212 400.07
PS Electrical			$1 729 888.94	$2 589 051.98	$3 278 151.25	$2 589 051.98	$2 589 051.98	$2 589 051.98	$2 159 644.92	$2 016 436.30	$1 944 816.49	$3 278 151.25	$1 729 888.94	$1 729 888.94
Feeder pipe system: Civil			$6 790 053.48	$9 843 045.42	$12 209 862.22	$9 858 266.23	$9 873 487.03	$9 888 707.83	$8 327 391.74	$7 822 173.85	$7 569 564.90	$12 226 649.04	$6 790 053.48	$6 790 053.48
Feeder pipe system: Mechanical			$122 332.72	$177 336.83	$219 974.88	$177 611.05	$177 885.28	$178 159.50	$150 030.11	$140 927.88	$136 376.76	$220 280.93	$122 332.72	$122 332.72
Storage			$2 902 449.34	$3 278 207.16	$2 248 321.94	$2 188 347.20	$2 101 837.92	$2 067 631.12	$2 643 470.39	$2 703 882.43	$2 729 179.84	$2 088 652.07	$3 184 537.74	$2 130 340.35
			$12 070 844.79	**$15 982 727.38**	**$18 793 101.25**	**$15 518 362.45**	**$15 447 348.20**	**$15 428 636.43**	**$13 896 560.45**	**$13 271 350.93**	**$12 952 609.97**	**$18 650 724.24**	**$12 362 733.18**	**$11 298 535.80**

Samra & Essery Data Only

COST ESTIMATION : SERIES 4.1.1

INPUT PARAMETERS		Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 48hr	RED BOOK 24hr
Daily Demand (Seasonal Peak)	l/s	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	8.69	13.04	16.53	13.04	13.04	13.04	10.87	10.14	9.78	16.53	8.69	8.69
Supply length	m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Power required	P = (ρ x g x Q x Ht)/n	kW	2.3	3.4	4.3	3.4	3.4	3.4	2.8	2.7	2.6	4.3	2.3	2.3
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	160	113	92	113	113	113	113	113	113	92	160	160
Pipe diameter 2		mm	0	0	0	0	0	0	160	160	160	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	1.39	1.24	1.23	1.23	1.22	1.22	1.33	1.35	1.36	1.22	2.76	1.38

CAPITAL COST													
Source :Pumping Station													
Cost (Samra and Essery Cost data)		$10 070.88	$13 501.73	$16 027.59	$13 501.73	$13 501.73	$13 501.73	$11 834.18	$11 258.32	$10 966.13	$16 027.59	$10 070.88	$10 070.88
Feeder pipe system													
Cost (Samra and Essery Cost data and interconnections estimation)		$86 301.48	$134 784.12	$163 157.83	$139 854.06	$144 924.00	$149 993.94	$115 520.19	$109 098.87	$105 888.22	$168 836.10	$86 301.48	$86 301.48
Storage													
Cost (Samra and Essery Cost data)		$359 377.43	$332 420.55	$329 121.73	$329 491.87	$327 073.36	$327 992.00	$347 592.00	$351 685.65	$353 129.87	$327 403.07	$544 203.89	$357 566.91
Total Cost (Samra and Essery Cost data)		**$455 749.78**	**$480 706.41**	**$508 307.15**	**$482 848.56**	**$485 499.10**	**$491 487.67**	**$474 946.37**	**$472 042.84**	**$469 984.21**	**$512 266.76**	**$640 576.25**	**$453 939.27**
OPERATING COST													
Power required	P = (ρ x g x Q x Ht)/n kW	2.3	3.4	4.3	3.4	3.4	3.4	2.8	2.7	2.6	4.3	2.3	2.3
Energy Charge	AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day		16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year	R	$517.98	$776.99	$984.99	$776.99	$776.99	$776.99	$647.49	$604.32	$582.73	$984.99	$517.98	$517.98
MAINTENANCE COST													
Yearly maintenance cost		$5 924.89	$5 797.95	$5 916.10	$5 779.35	$5 766.44	$5 807.57	$5 912.19	$5 935.81	$5 938.24	$5 916.71	$8 697.29	$5 897.73

SALVAGE VALUE AT END OF DESIGN LIFE													
Component	Design life	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50	$302.13	$405.05	$480.83	$405.05	$405.05	$405.05	$355.03	$337.75	$328.98	$480.83	$302.13	$302.13
PS Mechanical	15	$604.25	$810.10	$961.66	$810.10	$810.10	$810.10	$710.05	$675.50	$657.97	$961.66	$604.25	$604.25
Feeder pipe system	120	$12 945.22	$20 217.62	$24 473.67	$20 978.11	$21 738.60	$22 499.09	$17 328.03	$16 364.83	$15 883.23	$25 325.42	$12 945.22	$12 945.22
Storage	120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

LIFE CYCLE COST													
Capitalization method	$Cc = \{C0[1+\{[1-\alpha)/((1+r)^T-1]\}+\beta/f]\}+Aop/r$												
PS Civil		$9 248.50	$12 399.19	$14 718.78	$12 399.19	$12 399.19	$12 399.19	$10 867.81	$10 338.97	$10 070.64	$14 718.78	$9 248.50	$9 248.50
PS Mechanical		$8 265.56	$8 400.06	$9 971.51	$8 400.06	$8 400.06	$8 400.06	$7 362.80	$7 004.32	$6 822.54	$9 971.51	$8 265.56	$8 265.56
PS Electrical		$14 032.14	$20 876.22	$26 347.59	$20 876.22	$20 876.22	$20 876.22	$17 459.33	$16 318.21	$15 747.20	$26 347.59	$14 032.14	$14 032.14
Feeder pipe system: Civil		$95 802.93	$149 623.32	$181 120.86	$155 251.44	$160 879.56	$166 507.68	$128 238.50	$121 110.23	$117 546.09	$187 424.29	$95 802.93	$95 802.93
Feeder pipe system: Mechanical		$1 726.03	$2 695.68	$3 263.16	$2 797.08	$2 898.48	$2 999.88	$2 310.40	$2 181.98	$2 117.76	$3 376.72	$1 726.03	$1 726.03
Storage		$497 421.08	$460 109.56	$455 543.80	$456 054.81	$452 708.42	$453 979.92	$481 108.65	$486 774.74	$488 773.71	$453 164.77	$753 242.87	$494 915.11
		$624 496.24	**$654 104.03**	**$690 965.50**	**$655 778.80**	**$658 181.93**	**$665 182.95**	**$647 347.29**	**$643 728.45**	**$641 077.95**	**$695 003.67**	**$880 318.03**	**$621 990.27**

University of Cape Town
Samra & Essery Data

COST ESTIMATION : SERIES 4.1.4

SYSTEM DESIGN DATA														
Daily Demand (Seasonal Peak)		l/s	20	20	20	20	20	20	20	20	20	20	20	20
Pumping efficency		%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head		m	316.34	474.52	601.55	474.52	474.52	474.52	395.43	369.07	355.89	601.55	316.34	316.34
Supply length		m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil		years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical		years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil		years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage		years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil		%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical		%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil		%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion		%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion		%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion		%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion		%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion		%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital:	PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital:	PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital:	Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital:	Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate		%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
DESIGN CALCULATIONS														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Power required	$P = (\rho \times g \times Q \times H)/\eta$	kW	82.8	124.1	157.4	124.1	124.1	124.1	103.4	96.5	93.1	157.4	82.8	82.8
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	24	24	24	24	24	24	24	24	24	24	24	24
Pipe diameter 1		mm	148	104	85	104	104	104	104	104	104	85	148	148
Pipe diameter 2		mm	0	0	0	0	0	0	148	148	148	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	3.36	2.28	1.95	1.73	1.55	1.45	2.67	2.78	2.84	1.51	2.76	1.36
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$135 406.09	$181 534.99	$215 495.91	$181 534.99	$181 534.99	$181 534.99	$159 114.24	$151 371.54	$147 443.02	$215 495.91	$135 406.09	$135 406.09
Feeder pipe system														
Cost (Samra and Essery Cost data)			$2 007 523.44	$2 913 464.00	$3 611 480.34	$2 918 312.55	$2 923 161.10	$2 928 009.64	$2 465 351.14	$2 315 980.19	$2 241 294.71	$3 616 903.58	$2 007 523.44	$2 007 523.44
Storage														
Cost (Samra and Essery Cost data)			$609 235.68	$486 440.82	$442 750.19	$412 744.82	$385 330.98	$369 674.83	$533 465.23	$545 523.53	$552 674.22	$379 218.61	$544 203.89	$357 566.91
Total Cost (Samra and Essery Cost data)			**$2 752 165.22**	**$3 581 439.82**	**$4 269 726.45**	**$3 512 592.37**	**$3 490 027.07**	**$3 479 219.27**	**$3 157 930.61**	**$3 012 875.27**	**$2 941 411.94**	**$4 211 618.09**	**$2 687 133.42**	**$2 500 496.45**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times H)/\eta$	kW	82.8	124.1	157.4	124.1	124.1	124.1	103.4	96.5	93.1	157.4	82.8	82.8
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$18 848.17	$26 272.99	$35 841.41	$26 272.99	$26 272.99	$26 272.99	$23 560.58	$21 989.78	$21 204.37	$35 841.41	$18 848.17	$18 848.17
MAINTENANCE COST														
Yearly maintenance cost			$20 557.29	$23 715.59	$26 898.71	$22 634.39	$22 247.43	$22 036.82	$21 951.70	$21 308.74	$21 000.51	$25 970.86	$19 581.82	$16 782.26
SALVAGE VALUE AT END OF DESIGN LIFE			Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Component	Design life													
PS Civil		50	$4 062.18	$5 446.05	$6 464.88	$5 446.05	$5 446.05	$5 446.05	$4 773.43	$4 541.15	$4 423.29	$6 464.88	$4 062.18	$4 062.18
PS Mechanical		15	$8 124.37	$10 892.10	$12 929.75	$10 892.10	$10 892.10	$10 892.10	$9 546.85	$9 082.29	$8 846.58	$12 929.75	$8 124.37	$8 124.37
Feeder pipe system		120	$301 128.52	$437 019.60	$541 722.05	$437 746.88	$438 474.16	$439 201.45	$369 802.67	$347 397.03	$336 194.21	$542 535.54	$301 128.52	$301 128.52
Storage		120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = (C0[1+\{(1-\alpha)/\{(1+r)^T-1\}\}+\beta/r]+Aop/r$													
PS Civil			$124 348.88	$166 710.91	$197 898.59	$166 710.91	$166 710.91	$166 710.91	$146 121.03	$139 010.60	$135 402.87	$197 898.59	$124 348.88	$124 348.88
PS Mechanical			$84 242.44	$112 941.38	$134 070.05	$112 941.38	$112 941.38	$112 941.38	$98 992.38	$94 175.29	$91 731.17	$134 070.05	$84 242.44	$84 242.44
PS Electrical			$485 760.40	$726 339.75	$919 201.13	$726 339.75	$726 339.75	$726 339.75	$606 119.27	$566 016.85	$545 959.49	$919 201.13	$485 760.40	$485 760.40
Feeder pipe system: Civil			$2 228 543.80	$3 234 224.82	$4 009 089.99	$3 239 607.17	$3 244 989.53	$3 250 371.88	$2 736 776.51	$2 570 980.41	$2 488 052.36	$4 015 110.30	$2 228 543.80	$2 228 543.80
Feeder pipe system: Mechanical			$40 150.47	$58 269.28	$72 229.61	$58 366.25	$58 463.22	$58 560.19	$49 307.02	$46 319.60	$44 825.89	$72 338.07	$40 150.47	$40 150.47
Storage			$843 254.61	$673 291.92	$612 818.90	$571 287.90	$533 343.88	$511 673.64	$738 379.29	$755 069.42	$764 966.82	$524 883.63	$753 242.87	$494 915.11
			$3 806 300.80	**$4 971 778.06**	**$5 945 309.28**	**$4 875 253.37**	**$4 842 788.67**	**$4 826 597.75**	**$4 375 695.51**	**$4 171 552.18**	**$4 070 938.61**	**$5 863 801.77**	**$3 716 286.87**	**$3 457 981.10**

Samra & Essery Data

COST ESTIMATION : SERIES 4.4.1

INPUT PARAMETERS			Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	RED BOOK 44ltr	RED BOOK 88ltr
Daily Demand (Seasonal Peak)	l/s		240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency	%		90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m		2.71	4.06	5.15	4.06	4.06	4.06	3.38	3.16	3.05	5.15	2.71	2.71
Supply length	m		1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Design life (T): PS Civil	years		50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years		15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years		120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years		120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%		15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%		60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%		30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%		98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%		1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%		0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%		0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%		1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING														
Source :Pumping Station														
Description	Formula	Unit												
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	521	369	301	369	369	369	369	369	369	301	521	521
Pipe diameter 2		mm	0	0	0	0	0	0	521	521	521	0	0	0
Pipe 1 - Length		m	1000	2000	3000	2000	2000	2000	1000	667	500	3000	1000	1000
Pipe 1 - Length		m	0	0	0	0	0	0	500	667	750	0	0	0
# of 2x Pipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3x Pipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	16.61	14.82	14.62	14.64	14.50	14.55	15.76	16.06	16.19	14.50	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$26 117.06	$35 014.41	$41 564.78	$35 014.41	$35 014.41	$35 014.41	$30 689.90	$29 196.49	$28 438.76	$41 564.78	$26 117.06	$26 117.06
Feeder pipe system														
Cost (Samra and Essery Cost data)			$260 988.68	$396 392.16	$489 314.97	$413 310.58	$428 229.00	$443 147.41	$340 135.12	$320 716.10	$311 006.59	$505 934.91	$260 988.68	$260 988.68
Storage														
Cost (Samra and Essery Cost data)			$1 540 443.69	$1 441 533.06	$1 430 401.11	$1 431 400.86	$1 423 702.78	$1 426 249.81	$1 494 080.48	$1 510 273.50	$1 517 794.82	$1 423 398.43	$2 300 768.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$1 827 549.45**	**$1 874 939.65**	**$1 961 280.86**	**$1 879 725.85**	**$1 886 946.19**	**$1 904 411.63**	**$1 864 905.50**	**$1 860 186.09**	**$1 857 240.17**	**$1 970 898.12**	**$2 587 874.70**	**$1 826 236.81**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	8.5	12.7	16.2	12.7	12.7	12.7	10.6	9.9	9.6	16.2	8.5	8.5
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$1 935.22	$2 902.91	$3 679.99	$2 902.91	$2 902.91	$2 902.91	$2 419.06	$2 257.78	$2 177.14	$3 679.99	$1 935.22	$1 935.22
MAINTENANCE COST														
Yearly maintenance cost			$24 677.99	$23 972.10	$24 326.55	$23 894.71	$23 853.83	$23 966.63	$24 424.92	$24 555.49	$24 612.03	$24 304.61	$36 082.87	$24 658.30
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$783.51	$1 050.43	$1 246.94	$1 050.43	$1 050.43	$1 050.43	$920.70	$875.89	$853.16	$1 246.94	$783.51	$783.51
PS Mechanical	15		$1 567.02	$2 100.86	$2 493.89	$2 100.86	$2 100.86	$2 100.86	$1 841.39	$1 751.79	$1 706.33	$2 493.89	$1 567.02	$1 567.02
Feeder pipe system	120		$39 148.30	$59 758.82	$73 397.25	$61 996.59	$64 234.35	$66 472.11	$51 020.27	$48 107.42	$46 650.99	$75 890.24	$39 148.30	$39 148.30
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{C0[1+((1-\alpha)/((1+r)^T-1))+\beta/r]\}+Aop/r$													
PS Civil			$23 984.37	$32 155.14	$38 170.61	$32 155.14	$32 155.14	$32 155.14	$28 183.77	$26 812.32	$26 116.46	$38 170.61	$23 984.37	$23 984.37
PS Mechanical			$16 248.65	$21 784.09	$25 859.38	$21 784.09	$21 784.09	$21 784.09	$19 093.62	$18 164.50	$17 693.08	$25 859.38	$16 248.65	$16 248.65
PS Electrical			$51 188.09	$76 336.69	$96 467.89	$76 336.69	$76 336.69	$76 336.69	$63 775.73	$59 583.17	$57 485.70	$96 467.89	$51 188.09	$51 188.09
Feeder pipe system: Civil			$289 722.50	$442 253.56	$543 186.81	$458 814.43	$475 375.31	$491 936.18	$377 582.64	$356 025.67	$345 247.18	$561 636.34	$289 722.50	$289 722.50
Feeder pipe system: Mechanical			$5 219.77	$7 967.84	$9 786.30	$8 266.21	$8 564.58	$8 862.95	$6 802.70	$6 414.32	$6 220.13	$10 118.70	$5 219.77	$5 219.77
Storage			$2 132 157.20	$1 995 253.16	$1 979 845.18	$1 981 228.96	$1 970 573.91	$1 974 099.29	$2 067 985.01	$2 090 398.06	$2 100 808.47	$1 970 152.64	$3 184 537.74	$2 130 340.35
			$2 518 526.58	**$2 575 750.48**	**$2 693 318.96**	**$2 578 585.53**	**$2 584 786.72**	**$2 605 174.35**	**$2 563 423.48**	**$2 557 398.04**	**$2 553 571.02**	**$2 702 408.96**	**$3 570 901.12**	**$2 516 703.73**

University of Cape Town
Samra & Essery Data Known

COST ESTIMATION : SERIES 4.4.4

DESIGN PARAMETERS		Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8	Config 9	Config 10	Config 11	Config 12
Daily Demand (Seasonal Peak)	l/s	240	240	240	240	240	240	240	240	240	240	240	240
Pumping efficency	%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Pumping head	m	94.73	142.09	180.13	142.09	142.09	142.09	118.41	110.51	106.57	180.13	94.73	94.73
Supply length	m	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Design life (T): PS Civil	years	50	50	50	50	50	50	50	50	50	50	50	50
Design life (T): PS Mechanical	years	15	15	15	15	15	15	15	15	15	15	15	15
Design life (T): Feeder pipe-Civil	years	120	120	120	120	120	120	120	120	120	120	120	120
Design life (T): Storage	years	120	120	120	120	120	120	120	120	120	120	120	120
Salvage value: PS Civil	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Salvage value: PS Mechanical	%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Salvage value: Feeder pipe-Civil	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Salvage value: Storage	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PS: Civil portion	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PS: Mechanical portion	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
PS: Electrical portion	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Feeder Pipe: Civil Portion	%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Feeder Pipe: Mechanical Portion	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Yearly Maintenance as % of capital: Storage	%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Discount rate	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
INFRASTRUCTURE SIZING													
Source :Pumping Station													
Description	Formula	Unit											
Discharge capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	346.9	334.5	565.5	297.4	297.4
Feeder pipe														
Pipe capacity	1.2 x DD	l/s	288	288	288	288	288	288	288	288	288	288	288	288
Pipe diameter 1		mm	486	344	281	344	344	344	344	344	344	281	486	486
Pipe diameter 2		mm	0	0	0	0	0	0	486	486	486	0	0	0
Pipe 1 - Length		m	25000	50000	75000	50000	50000	50000	25000	16667	12500	75000	25000	25000
Pipe 1 - Length		m	0	0	0	0	0	0	12500	16667	18750	0	0	0
# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x$	No	0	2	0	2	2	2	2	2	2	0	0	0
# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x$	No	0	0	2	0	0	0	0	0	0	2	0	0
# of 2 Pipe interconnections	$y = 0.0457x^2 + 16.519x$	No	0	0	0	1	2	3	0	0	0	0	0	0
# of 3 Pipe interconnections	$y = 0.07x^2 + 24.898x + 2$	No	0	0	0	0	0	0	0	0	0	1	0	0
Storage														
Reservoir capacity		Ml	40.18	27.27	23.20	20.66	18.49	17.33	31.92	33.23	33.97	18.03	33.18	16.59
CAPITAL COST														
Source :Pumping Station														
Cost (Samra and Essery Cost data)			$341 398.74	$457 703.32	$543 328.82	$457 703.32	$457 703.32	$457 703.32	$401 173.98	$381 652.35	$371 747.38	$543 328.82	$341 398.74	$341 398.74
Feeder pipe system														
Cost (Samra and Essery Cost data)			$6 116 636.13	$8 866 841.40	$10 998 744.17	$8 880 552.65	$8 894 263.89	$8 907 975.14	$7 501 505.75	$7 046 393.87	$6 818 837.92	$11 014 046.26	$6 116 636.13	$6 116 636.13
Storage														
Cost (Samra and Essery Cost data)			$2 570 928.63	$2 053 229.35	$1 869 644.67	$1 748 846.00	$1 638 852.86	$1 578 687.54	$2 249 938.75	$2 302 803.71	$2 332 346.81	$1 615 376.55	$2 300 766.94	$1 539 131.05
Total Cost (Samra and Essery Cost data)			**$9 028 963.50**	**$11 377 774.06**	**$13 411 717.86**	**$11 087 101.96**	**$10 990 820.07**	**$10 944 366.00**	**$10 152 618.47**	**$9 730 849.93**	**$9 522 932.11**	**$13 172 751.64**	**$8 758 803.81**	**$7 997 165.93**
OPERATING COST														
Power required	$P = (\rho \times g \times Q \times Ht)/\eta$	kW	297.4	446.1	565.5	446.1	446.1	446.1	371.7	346.9	334.5	565.5	297.4	297.4
Energy Charge		AUS$/kWh	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pumping hours /day			16	16	16	16	16	16	16	16	16	16	16	16
Operating Cost / year		R	$67 727.54	$101 593.95	$128 789.74	$101 593.95	$101 593.95	$101 593.95	$84 660.75	$79 016.35	$76 194.15	$128 789.74	$67 727.54	$67 727.54
MAINTENANCE COST														
Yearly maintenance cost			$72 629.38	$79 801.22	$88 580.34	$75 304.03	$73 722.69	$72 888.76	$75 348.58	$73 666.88	$72 871.21	$84 842.83	$66 576.96	$57 152.41
SALVAGE VALUE AT END OF DESIGN LIFE														
Component	Design life		Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
PS Civil	50		$10 241.96	$13 731.10	$16 299.86	$13 731.10	$13 731.10	$13 731.10	$12 035.22	$11 449.57	$11 152.42	$16 299.86	$10 241.96	$10 241.96
PS Mechanical	15		$20 483.92	$27 462.20	$32 599.73	$27 462.20	$27 462.20	$27 462.20	$24 070.44	$22 899.14	$22 304.84	$32 599.73	$20 483.92	$20 483.92
Feeder pipe system	120		$917 495.42	$1 330 026.21	$1 649 811.82	$1 332 082.90	$1 334 139.58	$1 336 196.27	$1 125 225.86	$1 056 959.06	$1 022 825.69	$1 652 106.94	$917 495.42	$917 495.42
Storage	120		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
LIFE CYCLE COST														
Capitalization method	$Cc = \{CO[1+\{(1-\alpha)/[(1+r)^T-1]\}+\beta/r]\}+Aop/r$													
PS Civil			$313 520.24	$420 327.43	$498 960.78	$420 327.43	$420 327.43	$420 327.43	$368 414.25	$350 486.76	$341 390.62	$498 960.78	$313 520.24	$313 520.24
PS Mechanical			$212 400.07	$284 758.56	$338 030.18	$284 758.56	$284 758.56	$284 758.56	$249 589.03	$237 443.72	$231 281.37	$338 030.18	$212 400.07	$212 400.07
PS Electrical			$1 729 888.94	$2 589 051.98	$3 278 151.25	$2 589 051.98	$2 589 051.98	$2 589 051.98	$2 159 644.92	$2 016 436.30	$1 944 816.49	$3 278 151.25	$1 729 888.94	$1 729 888.94
Feeder pipe system: Civil			$6 790 053.48	$9 843 045.42	$12 209 662.22	$9 856 266.23	$9 873 487.03	$9 888 707.83	$8 327 391.74	$7 822 173.85	$7 569 564.90	$12 226 649.04	$6 790 053.48	$6 790 053.48
Feeder pipe system: Mechanical			$122 332.72	$177 336.83	$219 974.88	$177 611.05	$177 885.28	$178 159.50	$150 030.11	$140 927.88	$136 376.76	$220 280.93	$122 332.72	$122 332.72
Storage			$3 556 470.86	$2 841 913.51	$2 587 810.50	$2 420 610.77	$2 268 367.19	$2 185 091.23	$3 114 182.70	$3 187 354.10	$3 228 245.25	$2 235 873.18	$3 184 537.74	$2 130 340.35
			$12 728 866.31	**$16 186 433.74**	**$19 132 589.81**	**$15 750 626.02**	**$15 613 877.46**	**$15 546 098.54**	**$14 389 252.77**	**$13 754 822.59**	**$13 451 675.39**	**$18 797 945.35**	**$12 362 733.18**	**$11 296 535.80**

Samra & Essery Data Version

APPENDIX D1: SUMMARY OF COST ESTIMATIONS

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.1.1.1	$10 070.88	$86 301.48	$343 489.42	$439 861.78	1	$5 686.57	$517.98	$6 204.55	1	$29 546.20	$97 528.96	$475 430.19	$602 505.35	1
2.1.1.2	$13 501.73	$134 784.12	$329 365.29	$477 651.14	5	$5 752.12	$776.99	$6 529.11	5	$41 675.47	$152 319.00	$455 880.71	$649 875.18	5
2.1.1.3	$16 027.59	$163 157.83	$327 720.37	$506 905.79	9	$5 895.08	$984.99	$6 880.06	9	$51 037.89	$184 384.01	$453 603.95	$689 025.86	9
2.1.1.4	$13 501.73	$139 854.06	$328 100.74	$481 456.54	6	$5 758.50	$776.99	$6 535.49	6	$41 675.47	$158 048.52	$454 130.43	$653 854.42	6
2.1.1.5	$13 501.73	$144 924.00	$327 229.75	$485 655.48	7	$5 770.78	$776.99	$6 547.78	7	$41 675.47	$163 778.04	$452 924.87	$658 378.38	7
2.1.1.6	$13 501.73	$149 993.94	$327 554.54	$491 050.22	8	$5 801.01	$776.99	$6 578.00	8	$41 675.47	$169 507.56	$453 374.43	$664 557.46	8
2.1.1.7	$11 834.18	$115 520.19	$336 061.30	$463 415.67	4	$5 739.23	$647.49	$6 386.72	4	$35 689.73	$130 548.90	$465 148.80	$631 387.43	4
2.1.1.8	$11 258.32	$109 098.87	$340 400.52	$460 757.71	3	$5 766.34	$604.32	$6 370.65	3	$33 661.50	$123 292.20	$471 154.79	$628 108.50	3
2.1.1.9	$10 966.13	$105 888.22	$341 419.37	$458 273.71	2	$5 762.59	$582.73	$6 345.32	2	$32 640.38	$119 663.85	$472 564.99	$624 869.22	2
2.1.1.10	$16 027.59	$168 836.10	$326 458.69	$511 322.38	1	$5 904.54	$984.99	$6 889.53	1	$51 037.89	$190 801.01	$451 857.64	$693 696.54	1
RB 48 hr 2.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$29 546.20	$97 528.96	$753 242.87	$880 318.03	
RB 24 hr 2.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$29 546.20	$97 528.96	$494 915.11	$621 990.27	
2.1.2.1	$34 644.50	$423 350.47	$391 513.76	$849 508.74	1	$8 342.83	$2 860.57	$11 203.41	1	$128 608.06	$478 426.69	$541 901.59	$1 148 936.33	1
2.1.2.2	$46 446.87	$622 236.98	$344 597.42	$1 013 281.27	8	$8 753.90	$4 290.97	$13 044.88	8	$183 818.18	$703 187.54	$476 963.79	$1 363 969.51	8
2.1.2.3	$55 135.99	$768 084.21	$337 243.44	$1 160 463.64	1	$9 461.46	$5 439.63	$14 901.09	1	$226 854.09	$868 008.92	$466 785.01	$1 561 648.02	1
2.1.2.4	$46 446.87	$627 245.99	$334 686.23	$1 008 379.09	5	$8 630.28	$4 290.97	$12 921.26	7	$183 818.18	$708 848.20	$463 245.53	$1 355 911.91	5
2.1.2.5	$46 446.87	$632 254.99	$332 162.77	$1 010 864.64	6	$8 617.47	$4 290.97	$12 908.45	6	$183 818.18	$714 508.86	$459 752.77	$1 358 079.80	6
2.1.2.6	$46 446.87	$637 264.00	$329 513.90	$1 013 224.77	7	$8 602.79	$4 290.97	$12 893.76	5	$183 818.18	$720 169.52	$456 086.41	$1 360 074.11	7
2.1.2.7	$40 710.38	$527 738.07	$369 857.14	$938 305.59	4	$8 601.79	$3 575.77	$12 177.57	4	$156 484.53	$596 394.69	$511 926.25	$1 264 805.48	4
2.1.2.8	$38 729.36	$496 238.43	$377 148.45	$912 116.24	3	$8 533.46	$3 337.37	$11 870.83	3	$147 259.84	$560 797.08	$522 018.29	$1 230 075.21	3
2.1.2.9	$37 724.22	$480 488.61	$379 938.46	$898 151.29	2	$8 486.31	$3 218.17	$11 704.48	2	$142 623.39	$542 998.27	$525 879.99	$1 211 501.65	2
2.1.2.10	$55 135.99	$773 692.37	$330 734.56	$1 159 562.92	9	$9 391.87	$5 439.63	$14 831.50	9	$226 854.09	$874 346.68	$457 775.95	$1 558 976.72	9
RB 48 hr 2.1.2	$34 644.50	$423 350.47	$544 203.89	$1 002 198.86		$10 633.18	$2 860.57	$13 493.76		$128 608.06	$478 426.69	$753 242.87	$1 360 277.61	
RB 24 hr 2.1.2	$34 644.50	$423 350.47	$357 566.91	$815 561.88		$7 833.63	$2 860.57	$10 694.20		$128 608.06	$478 426.69	$494 915.11	$1 101 949.85	
2.1.3.1	$65 481.96	$816 778.76	$424 085.21	$1 306 345.94	1	$11 113.09	$6 900.33	$18 013.42	1	$280 421.78	$923 038.44	$586 984.35	$1 790 444.57	1
2.1.3.2	$87 789.76	$1 191 185.29	$361 993.41	$1 640 968.46	8	$12 281.28	$10 350.77	$22 632.05	8	$403 445.64	$1 346 153.77	$501 041.91	$2 250 641.32	8
2.1.3.3	$104 213.15	$1 474 146.90	$347 316.38	$1 925 676.43	1	$13 643.45	$13 121.58	$26 765.03	1	$499 781.36	$1 665 927.56	$480 727.16	$2 646 436.08	1
2.1.3.4	$87 789.76	$1 196 083.98	$344 330.19	$1 628 203.93	7	$12 040.83	$10 350.77	$22 391.60	7	$403 445.64	$1 351 689.76	$476 593.92	$2 231 729.31	7
2.1.3.5	$87 789.76	$1 200 982.67	$337 111.56	$1 625 883.98	5	$11 957.04	$10 350.77	$22 307.81	6	$403 445.64	$1 357 225.74	$466 602.47	$2 227 273.85	5
2.1.3.6	$87 789.76	$1 205 881.35	$334 041.98	$1 627 713.09	6	$11 935.49	$10 350.77	$22 286.26	5	$403 445.64	$1 362 761.73	$462 353.81	$2 228 561.17	6
2.1.3.7	$76 947.15	$1 008 866.59	$396 900.99	$1 482 714.74	4	$11 782.71	$8 625.55	$20 408.26	4	$342 446.71	$1 140 116.13	$549 358.16	$2 031 921.00	4
2.1.3.8	$73 202.81	$948 093.69	$405 935.65	$1 427 232.15	3	$11 576.17	$8 050.48	$19 626.65	3	$321 899.26	$1 071 436.92	$561 863.20	$1 955 199.38	3
2.1.3.9	$71 302.98	$917 707.24	$408 677.94	$1 397 688.16	2	$11 446.00	$7 762.94	$19 208.94	2	$311 579.97	$1 037 097.31	$565 658.85	$1 914 336.13	2
2.1.3.10	$104 213.15	$1 479 627.96	$336 213.79	$1 920 054.90	9	$13 504.32	$13 121.58	$26 625.90	9	$499 781.36	$1 672 121.69	$465 359.85	$2 637 262.90	9
RB 48 hr 2.1.3	$65 481.96	$816 778.76	$544 203.89	$1 426 464.61		$12 914.87	$6 900.33	$19 815.20		$280 421.78	$923 038.44	$753 242.87	$1 956 703.09	
RB 24 hr 2.1.3	$65 481.96	$816 778.76	$357 566.91	$1 239 827.64		$10 115.31	$6 900.33	$17 015.65		$280 421.78	$923 038.44	$494 915.11	$1 698 375.33	
2.1.4.1	$135 406.09	$2 007 523.44	$495 315.00	$2 638 244.53	1	$18 848.48	$18 848.17	$37 696.65	1	$694 351.72	$2 268 694.27	$685 574.84	$3 648 620.83	1
2.1.4.2	$181 534.99	$2 913 464.00	$405 881.22	$3 500 880.22	8	$22 507.20	$28 272.99	$50 780.18	8	$1 005 992.04	$3 292 494.10	$561 787.86	$4 860 274.01	8
2.1.4.3	$215 495.91	$3 611 480.34	$381 317.12	$4 208 293.38	1	$25 975.22	$35 841.41	$61 816.63	1	$1 251 169.77	$4 081 319.60	$527 788.23	$5 860 277.59	1
2.1.4.4	$181 534.99	$2 918 312.55	$369 527.98	$3 469 375.52	7	$21 986.14	$28 272.99	$50 259.13	7	$1 005 992.04	$3 297 973.43	$511 470.65	$4 815 436.12	7
2.1.4.5	$181 534.99	$2 923 161.10	$354 239.82	$3 458 935.91	6	$21 781.06	$28 272.99	$50 054.05	6	$1 005 992.04	$3 303 452.75	$490 310.03	$4 799 754.82	6
2.1.4.6	$181 534.99	$2 928 009.64	$347 395.00	$3 456 939.63	5	$21 702.63	$28 272.99	$49 975.62	5	$1 005 992.04	$3 308 932.07	$480 835.97	$4 795 760.08	5
2.1.4.7	$159 114.24	$2 465 351.14	$450 172.91	$3 074 638.29	4	$20 702.31	$23 560.58	$44 262.89	4	$851 232.68	$2 786 083.54	$623 092.82	$4 260 409.04	4
2.1.4.8	$151 371.54	$2 315 980.19	$463 504.96	$2 930 856.69	3	$20 076.47	$21 989.78	$42 066.24	3	$799 202.74	$2 617 280.02	$641 545.96	$4 058 028.72	3
2.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$21 204.37	$40 912.86	2	$773 093.53	$2 532 878.25	$645 746.31	$3 951 718.10	2
2.1.4.10	$215 495.91	$3 616 903.58	$351 351.67	$4 183 751.16	9	$25 552.85	$35 841.41	$61 394.26	9	$1 251 169.77	$4 087 448.37	$486 312.48	$5 824 930.62	9
RB 48 hr 2.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$694 351.72	$2 268 694.27	$753 242.87	$3 716 288.87	
RB 24 hr 2.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$694 351.72	$2 268 694.27	$494 915.11	$3 457 961.10	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$447 607.29	$12 949.52	$141 948.54
$486 984.42	$19 424.79	$143 465.98
$517 432.22	$24 624.63	$146 969.01
$490 816.79	$19 424.79	$143 612.84
$495 046.31	$19 424.79	$143 907.29
$500 482.51	$19 424.79	$144 650.15
$472 008.35	$16 187.16	$143 191.93
$469 114.87	$15 107.94	$143 885.68
$466 500.95	$14 568.34	$143 799.93
$521 880.44	$24 624.63	$147 191.47
$650 152.05	$12 949.52	$217 216.46
$461 813.15	$12 949.52	$147 227.60
$869 909.52	$71 514.37	$207 512.44
$1 039 403.16	$107 274.34	$217 292.01
$1 191 041.03	$135 990.71	$234 616.28
$1 034 448.65	$107 274.34	$214 188.92
$1 036 949.23	$107 274.34	$213 856.23
$1 039 323.26	$107 274.34	$213 476.51
$961 685.63	$89 394.35	$213 725.49
$934 544.99	$83 434.36	$212 095.86
$920 090.84	$80 454.36	$210 956.45
$1 190 123.56	$135 990.71	$232 862.45
$1 023 992.01	$71 514.37	$264 771.24
$835 653.11	$71 514.37	$194 782.37
$1 342 150.96	$172 508.36	$275 785.25
$1 687 817.94	$258 769.26	$304 054.11
$1 980 995.64	$328 039.45	$337 400.99
$1 674 929.55	$258 769.26	$298 030.50
$1 672 580.99	$258 769.26	$295 923.60
$1 674 419.31	$258 769.26	$295 372.60
$1 524 236.63	$215 638.81	$292 045.55
$1 466 903.32	$201 261.99	$287 034.06
$1 436 406.92	$194 073.59	$283 855.62
$1 975 314.50	$328 039.45	$333 908.95
$1 463 364.98	$172 508.36	$320 829.76
$1 275 026.08	$172 508.36	$250 840.89
$2 711 223.29	$471 204.24	$466 193.30
$3 598 053.05	$706 824.74	$555 396.22
$4 323 890.55	$896 035.32	$640 351.72
$3 566 253.68	$706 824.74	$542 357.70
$3 555 711.49	$706 824.74	$537 218.59
$3 553 689.62	$706 824.74	$535 245.73
$3 160 000.06	$589 014.49	$511 394.49
$3 012 162.63	$549 744.41	$496 121.68
$2 934 499.80	$530 109.37	$487 108.93
$4 299 116.28	$896 035.32	$629 779.02
$2 760 557.99	$471 204.24	$484 526.63
$2 572 219.09	$471 204.24	$414 537.77

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.2.1.1	$17 575.65	$158 938.83	$783 774.85	$960 289.32	1	$12 730.59	$1 118.96	$13 849.55	1	$56 938.43	$179 616.14	$1 084	$1 321 392.13	1
2.2.1.2	$23 563.16	$243 453.76	$756 685.45	$1 023 702.36	5	$12 807.89	$1 678.48	$14 486.38	6	$80 793.85	$275 126.12	$1 047	$1 403 262.59	5
2.2.1.3	$27 971.27	$297 803.23	$753 631.39	$1 079 405.90	9	$13 078.79	$2 127.80	$15 206.59	9	$99 291.23	$336 546.25	$1 043	$1 478 952.92	9
2.2.1.4	$23 563.16	$251 807.99	$753 864.15	$1 029 235.30	6	$12 807.35	$1 678.48	$14 485.83	5	$80 793.85	$284 567.21	$1 043	$1 408 798.67	6
2.2.1.5	$23 563.16	$260 162.22	$752 779.65	$1 036 505.03	7	$12 832.85	$1 678.48	$14 511.33	7	$80 793.85	$294 008.29	$1 041	$1 416 738.67	7
2.2.1.6	$23 563.16	$268 516.45	$753 128.51	$1 045 208.13	8	$12 879.85	$1 678.48	$14 558.34	8	$80 793.85	$303 449.38	$1 042	$1 426 662.62	8
2.2.1.7	$20 652.96	$207 975.95	$769 668.26	$998 297.16	4	$12 795.56	$1 398.72	$14 194.28	4	$69 003.83	$235 032.79	$1 065	$1 369 349.00	4
2.2.1.8	$19 647.96	$196 150.01	$777 338.01	$993 135.98	3	$12 841.23	$1 305.47	$14 146.70	3	$65 016.26	$221 668.35	$1 075	$1 362 612.83	3
2.2.1.9	$19 138.04	$190 237.04	$779 721.52	$989 096.59	2	$12 842.22	$1 258.84	$14 101.06	2	$63 010.24	$214 986.13	$1 079	$1 357 223.64	2
2.2.1.10	$27 971.27	$307 195.13	$751 191.64	$1 086 358.05	1	$13 089.16	$2 127.80	$15 216.95	1	$99 291.23	$347 160.00	$1 039	$1 486 189.76	1
RB 48 hr 2.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$1 118.96	$20 341.71		$56 938.43	$179 616.14	$1 683	$1 920 453.39	
RB 24 hr 2.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$13 181.63	$1 118.96	$14 300.59		$56 938.43	$179 616.14	$1 126	$1 363 012.10	
2.2.2.1	$60 134.28	$780 795.83	$881 046.76	$1 721 976.87	1	$17 733.05	$6 133.31	$23 866.36	1	$252 433.30	$882 374.27	$1 219	$2 354 281.02	1
2.2.2.2	$80 620.27	$1 142 766.44	$784 960.00	$2 008 346.71	8	$18 310.56	$9 200.21	$27 510.77	8	$362 866.32	$1 291 435.81	$1 086	$2 740 780.09	8
2.2.2.3	$95 702.42	$1 413 855.12	$771 972.12	$2 281 529.66	1	$19 625.02	$11 663.02	$31 288.04	1	$449 291.81	$1 597 792.06	$1 068	$3 115 585.06	1
2.2.2.4	$80 620.27	$1 150 974.14	$766 855.28	$1 998 449.69	5	$18 080.03	$9 200.21	$27 280.23	7	$362 866.32	$1 300 711.31	$1 061	$2 724 996.50	5
2.2.2.5	$80 620.27	$1 159 181.85	$762 154.73	$2 001 956.85	6	$18 050.56	$9 200.21	$27 250.76	6	$362 866.32	$1 309 986.81	$1 054	$2 727 765.88	6
2.2.2.6	$80 620.27	$1 167 389.56	$756 991.71	$2 005 001.54	7	$18 014.15	$9 200.21	$27 214.36	5	$362 866.32	$1 319 262.31	$1 047	$2 729 895.14	7
2.2.2.7	$70 663.14	$968 479.73	$835 109.95	$1 874 252.82	4	$18 089.81	$7 666.76	$25 756.57	4	$308 120.91	$1 094 475.09	$1 155	$2 558 487.46	4
2.2.2.8	$67 224.58	$910 384.16	$850 481.19	$1 828 089.93	3	$17 994.83	$7 155.61	$25 150.44	3	$289 675.49	$1 028 821.52	$1 177	$2 495 664.08	3
2.2.2.9	$65 479.91	$881 336.37	$857 258.41	$1 804 074.70	2	$17 933.45	$6 900.04	$24 833.49	2	$280 410.93	$995 994.74	$1 186	$2 462 953.22	2
2.2.2.10	$95 702.42	$1 423 083.37	$759 281.47	$2 278 067.26	9	$19 480.80	$11 663.02	$31 143.82	9	$449 291.81	$1 608 220.87	$1 050	$3 108 448.49	9
RB 48 hr 2.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$6 133.31	$28 899.44		$252 433.30	$882 374.27	$1 683	$2 818 706.39	
RB 24 hr 2.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$16 725.02	$6 133.31	$22 858.33		$252 433.30	$882 374.27	$1 126	$2 261 265.10	
2.2.3.1	$112 564.83	$1 510 285.24	$949 596.19	$2 572 446.26	1	$22 943.53	$14 598.00	$37 541.53	1	$550 455.40	$1 706 767.35	$1 314	$3 571 576.76	1
2.2.3.2	$150 912.38	$2 197 630.23	$819 563.27	$3 168 105.87	8	$24 820.91	$21 897.57	$46 718.48	8	$796 140.90	$2 483 533.20	$1 134	$4 414 047.08	8
2.2.3.3	$179 144.52	$2 722 954.51	$790 674.05	$3 692 773.08	1	$27 302.16	$27 759.35	$55 061.51	1	$989 211.64	$3 077 200.07	$1 094	$5 160 798.60	1
2.2.3.4	$150 912.38	$2 205 571.89	$785 226.68	$3 141 710.95	7	$24 345.57	$21 897.57	$46 243.14	7	$796 140.90	$2 492 508.04	$1 086	$4 375 496.01	7
2.2.3.5	$150 912.38	$2 213 513.56	$771 908.07	$3 136 334.00	5	$24 185.50	$21 897.57	$46 083.07	6	$796 140.90	$2 501 482.88	$1 068	$4 366 036.31	5
2.2.3.6	$150 912.38	$2 221 455.22	$765 459.04	$3 137 826.64	6	$24 128.47	$21 897.57	$46 026.04	5	$796 140.90	$2 510 457.72	$1 059	$4 366 084.93	6
2.2.3.7	$132 273.71	$1 860 509.26	$891 696.53	$2 884 479.51	4	$24 027.19	$18 247.79	$42 274.97	4	$674 180.00	$2 102 554.13	$1 234	$4 010 948.15	4
2.2.3.8	$125 837.11	$1 748 135.61	$910 693.40	$2 784 666.12	3	$23 684.62	$17 031.19	$40 715.81	3	$633 157.69	$1 975 561.11	$1 260	$3 869 226.73	3
2.2.3.9	$122 571.28	$1 691 948.78	$916 695.04	$2 731 215.10	2	$23 460.40	$16 422.89	$39 883.29	2	$612 568.20	$1 912 064.60	$1 268	$3 793 447.71	2
2.2.3.10	$179 144.52	$2 731 885.24	$769 070.45	$3 680 100.21	9	$27 022.76	$27 759.35	$54 782.11	9	$989 211.64	$3 087 292.66	$1 064	$5 140 989.23	9
RB 48 hr 2.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$14 598.00	$41 546.37		$550 455.40	$1 706 767.35	$1 683	$3 941 121.57	
RB 24 hr 2.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$20 907.25	$14 598.00	$35 505.26		$550 455.40	$1 706 767.35	$1 126	$3 383 680.28	
2.2.4.1	$231 757.45	$3 716 343.63	$1 106	$5 054 286.13	1	$37 538.42	$39 635.52	$77 173.94	1	$1 372 821.19	$4 199 825.18	$1 531	$7 103 737.98	1
2.2.4.2	$310 710.44	$5 388 413.10	$910 762.15	$6 609 885.70	8	$43 772.74	$59 454.82	$103 227.57	8	$1 998 417.29	$6 089 424.25	$1 260	$9 348 444.63	8
2.2.4.3	$368 837.04	$6 682 697.20	$858 732.13	$7 910 266.37	1	$50 056.61	$75 370.34	$125 426.94	1	$2 492 097.08	$7 552 089.57	$1 188	$11 232 774.01	1
2.2.4.4	$310 710.44	$5 396 233.56	$835 137.59	$6 542 081.59	7	$42 677.48	$59 454.82	$102 132.30	7	$1 998 417.29	$6 098 262.12	$1 155	$9 252 609.11	7
2.2.4.5	$310 710.44	$5 404 054.02	$804 327.00	$6 519 091.46	6	$42 254.42	$59 454.82	$101 709.24	6	$1 998 417.29	$6 107 099.98	$1 113	$9 218 801.46	6
2.2.4.6	$310 710.44	$5 411 874.47	$790 303.02	$6 512 887.93	5	$42 083.16	$59 454.82	$101 537.99	5	$1 998 417.29	$6 115 937.85	$1 093	$9 208 228.47	5
2.2.4.7	$272 335.68	$4 558 862.95	$1 006	$5 837 484.77	4	$40 666.43	$49 545.17	$90 211.60	4	$1 687 434.88	$5 151 952.92	$1 392	$8 232 207.45	4
2.2.4.8	$259 083.49	$4 282 346.23	$1 036	$5 578 108.84	3	$39 604.57	$46 241.95	$85 846.52	3	$1 583 015.00	$4 839 462.47	$1 434	$7 857 364.63	3
2.2.4.9	$252 359.53	$4 144 087.87	$1 042	$5 438 709.75	2	$38 928.44	$44 590.34	$83 518.79	2	$1 530 643.79	$4 683 217.25	$1 442	$7 656 476.04	2
2.2.4.10	$368 837.04	$6 691 492.22	$798 893.40	$7 859 222.66	9	$49 203.00	$75 370.34	$124 573.34	9	$2 492 097.08	$7 562 028.78	$1 105	$11 159 889.31	9
RB 48 hr 2.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$39 635.52	$78 829.94		$1 372 821.19	$4 199 825.18	$1 683	$7 256 545.19	
RB 24 hr 2.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$33 153.31	$39 635.52	$72 788.83		$1 372 821.19	$4 199 825.18	$1 126	$6 699 103.90	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$975 550.78	$27 973.99	$317 867.36
$1 041 711.78	$41 962.07	$319 588.73
$1 099 532.64	$53 194.94	$326 225.34
$1 047 282.46	$41 962.07	$319 554.14
$1 054 605.75	$41 962.07	$320 170.85
$1 063 375.49	$41 962.07	$321 325.06
$1 015 011.81	$34 968.03	$319 369.15
$1 009 435.79	$32 636.68	$320 540.36
$1 005 172.83	$31 471.01	$320 579.81
$1 106 533.88	$53 194.94	$326 460.94
$1 412 308.08	$27 973.99	$480 171.32
$1 005 894.63	$27 973.99	$329 143.48
$1 759 573.97	$153 332.79	$441 374.26
$2 055 867.87	$230 005.17	$454 907.06
$2 336 918.67	$291 575.47	$487 090.91
$2 045 868.10	$230 005.17	$449 123.23
$2 049 394.74	$230 005.17	$448 365.97
$2 052 454.70	$230 005.17	$447 435.28
$1 916 994.38	$191 668.98	$449 824.10
$1 869 179.06	$178 890.25	$447 594.77
$1 844 319.35	$172 500.89	$446 132.99
$2 333 410.65	$291 575.47	$483 462.38
$2 098 172.34	$153 332.79	$567 201.25
$1 691 758.89	$153 332.79	$416 173.42
$2 636 814.19	$364 950.03	$569 812.54
$3 251 579.23	$547 439.27	$615 028.58
$3 791 068.25	$693 983.80	$675 746.55
$3 224 931.52	$547 439.27	$603 125.22
$3 219 493.45	$547 439.27	$599 103.59
$3 220 987.60	$547 439.27	$597 658.06
$2 958 725.12	$456 194.65	$596 028.38
$2 855 701.86	$425 779.77	$587 745.10
$2 800 595.34	$410 572.34	$582 280.04
$3 778 266.22	$693 983.80	$668 739.21
$2 906 238.05	$364 950.03	$669 933.50
$2 499 824.60	$364 950.03	$518 905.66
$5 183 680.41	$990 887.93	$929 169.64
$6 781 226.53	$1 486	$1 080 847.58
$8 113 807.16	$1 884	$1 234 708.40
$6 712 792.21	$1 486	$1 053 446.37
$6 689 580.53	$1 486	$1 042 850.41
$6 683 308.52	$1 486	$1 038 549.42
$5 988 314.60	$1 238	$1 005 263.61
$5 721 907.46	$1 156	$979 408.37
$5 578 866.64	$1 114	$962 850.83
$8 062 284.59	$1 884	$1 213 346.27
$5 295 087.49	$990 887.93	$970 569.77
$4 888 674.04	$990 887.93	$819 541.93

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.3.1.1	$23 125.40	$215 923.06	$1 133	$1 372 193.11	1	$18 312.66	$1 635.51	$19 948.17	1	$78 998.04	$244 013.79	$1 568	$1 891 418.73	1
2.3.1.2	$46 522.63	$296 174.09	$1 086	$1 429 565.31	5	$18 258.43	$4 300.66	$22 559.09	6	$184 185.12	$334 705.16	$1 504	$2 023 245.62	5
2.3.1.3	$73 519.41	$336 500.92	$1 082	$1 492 574.31	9	$18 670.71	$8 098.68	$26 769.39	9	$323 626.00	$380 278.36	$1 498	$2 202 287.75	9
2.3.1.4	$46 522.63	$306 513.50	$1 082	$1 436 035.43	6	$18 252.09	$4 300.66	$22 552.74	5	$184 185.12	$346 389.69	$1 498	$2 029 574.58	6
2.3.1.5	$46 522.63	$316 852.91	$1 080	$1 444 230.65	7	$18 271.62	$4 300.66	$22 572.28	7	$184 185.12	$358 074.22	$1 496	$2 038 291.29	7
2.3.1.6	$46 522.63	$327 192.32	$1 080	$1 454 475.02	8	$18 321.89	$4 300.66	$22 622.55	8	$184 185.12	$369 758.75	$1 495	$2 049 844.28	8
2.3.1.7	$33 678.63	$265 950.82	$1 110	$1 410 040.89	4	$18 329.45	$2 750.86	$21 080.31	3	$124 273.46	$300 549.97	$1 536	$1 961 764.86	3
2.3.1.8	$31 790.34	$251 318.76	$1 121	$1 404 547.18	3	$18 402.43	$2 539.85	$20 942.28	2	$115 886.39	$284 014.33	$1 552	$1 952 104.34	2
2.3.1.9	$42 894.60	$223 676.72	$1 124	$1 390 837.14	2	$18 419.90	$3 843.82	$22 263.72	4	$166 785.37	$252 776.17	$1 556	$1 975 679.09	4
2.3.1.10	$73 519.41	$347 168.91	$1 080	$1 501 318.77	1	$18 695.20	$8 098.68	$26 793.88	1	$323 626.00	$392 334.21	$1 495	$2 211 681.21	1
RB 48 hr 2.3.1	$23 125.40	$215 923.06	$1 818	$2 057 660.55		$28 594.68	$1 635.51	$30 230.18		$78 998.04	$244 013.79	$2 517	$2 840 187.16	
RB 24 hr 2.3.1	$23 125.40	$215 923.06	$1 216	$1 455 633.85		$19 564.28	$1 635.51	$21 199.78		$78 998.04	$244 013.79	$1 683	$2 006 910.64	
2.3.2.1	$74 036.28	$1 079 615.28	$1 284	$2 438 406.73	1	$25 424.57	$8 177.54	$33 602.11	1	$326 449.21	$1 220 068.94	$1 778	$3 324 772.03	1
2.3.2.2	$148 942.82	$1 417 814.77	$1 130	$2 697 534.07	8	$25 569.94	$21 503.29	$47 073.22	8	$783 037.97	$1 602 266.84	$1 565	$3 950 433.89	8
2.3.2.3	$235 373.38	$1 626 607.22	$1 108	$2 970 961.78	1	$27 168.56	$40 493.39	$67 661.96	1	$1 400 227.09	$1 838 222.36	$1 534	$4 773 411.24	1
2.3.2.4	$148 942.82	$1 428 154.18	$1 103	$2 680 483.81	5	$25 210.79	$21 503.29	$46 714.08	7	$783 037.97	$1 613 951.37	$1 527	$3 924 207.85	5
2.3.2.5	$148 942.82	$1 438 493.59	$1 095	$2 683 022.49	6	$25 145.48	$21 503.29	$46 648.76	6	$783 037.97	$1 625 635.89	$1 516	$3 925 095.24	6
2.3.2.6	$148 942.82	$1 448 833.00	$1 088	$2 685 919.75	7	$25 085.54	$21 503.29	$46 588.83	5	$783 037.97	$1 637 320.42	$1 506	$3 926 478.95	7
2.3.2.7	$107 822.55	$1 263 914.74	$1 216	$2 588 491.92	4	$25 670.68	$13 754.30	$39 424.98	3	$521 547.63	$1 428 345.03	$1 684	$3 634 025.72	4
2.3.2.8	$101 777.23	$1 191 744.22	$1 238	$2 532 132.27	3	$25 576.01	$12 699.27	$38 275.28	2	$485 209.29	$1 346 785.41	$1 714	$3 546 379.32	2
2.3.2.9	$137 327.62	$1 058 225.66	$1 245	$2 441 076.86	2	$25 374.72	$19 219.12	$44 593.84	4	$706 792.09	$1 195 896.62	$1 723	$3 626 641.42	3
2.3.2.10	$235 373.38	$1 637 275.15	$1 090	$2 963 537.44	9	$26 950.52	$40 493.39	$67 443.91	9	$1 400 227.09	$1 850 278.14	$1 509	$4 760 425.18	9
RB 48 hr 2.3.2	$74 036.28	$1 079 615.28	$1 818	$2 972 263.65		$33 432.43	$8 177.54	$41 609.96		$326 449.21	$1 220 068.94	$2 517	$4 063 693.48	
RB 24 hr 2.3.2	$74 036.28	$1 079 615.28	$1 216	$2 370 236.96		$24 402.03	$8 177.54	$32 579.56		$326 449.21	$1 220 068.94	$1 683	$3 230 416.97	
2.3.3.1	$122 205.06	$2 159 230.69	$1 386	$3 668 363.58	2	$32 846.56	$16 355.07	$49 201.63	1	$610 268.97	$2 440 138.03	$1 919	$4 970 080.01	1
2.3.3.2	$245 846.63	$2 819 865.61	$1 180	$4 245 938.65	8	$34 310.36	$43 006.57	$77 316.93	8	$1 480 316.33	$3 186 718.93	$1 633	$6 300 608.92	8
2.3.3.3	$388 509.48	$3 239 240.91	$1 135	$4 763 577.47	1	$37 196.41	$80 986.68	$118 183.09	1	$2 664 925.53	$3 660 653.29	$1 572	$7 897 698.53	1
2.3.3.4	$245 846.63	$2 830 205.03	$1 128	$4 204 385.63	7	$33 583.67	$43 006.57	$76 590.24	7	$1 480 316.33	$3 198 403.46	$1 561	$6 240 468.14	7
2.3.3.5	$245 846.63	$2 840 544.44	$1 107	$4 193 730.87	5	$33 320.45	$43 006.57	$76 327.03	6	$1 480 316.33	$3 210 087.99	$1 532	$6 223 094.24	5
2.3.3.6	$245 846.63	$2 850 883.85	$1 099	$4 196 350.59	6	$33 256.36	$43 006.57	$76 262.93	5	$1 480 316.33	$3 221 772.52	$1 522	$6 224 093.81	6
2.3.3.7	$177 973.07	$2 511 369.61	$1 296	$3 985 421.80	4	$33 813.36	$27 508.60	$61 321.96	3	$981 012.25	$2 838 088.82	$1 793	$5 613 028.66	4
2.3.3.8	$167 994.60	$2 367 276.06	$1 327	$3 863 172.93	3	$33 468.46	$25 398.54	$58 867.00	2	$911 816.39	$2 675 249.28	$1 837	$5 425 040.28	2
2.3.3.9	$226 674.45	$2 101 411.83	$1 335	$3 663 808.22	1	$32 854.97	$38 438.24	$71 293.20	4	$1 334 512.47	$2 374 797.17	$1 848	$5 558 107.60	3
2.3.3.10	$388 509.48	$3 249 908.85	$1 104	$4 742 959.58	9	$36 780.46	$80 986.68	$117 767.14	9	$2 664 925.53	$3 672 709.08	$1 528	$7 866 451.02	9
RB 48 hr 2.3.3	$122 205.06	$2 159 230.69	$1 818	$4 100 047.84		$39 321.83	$16 355.07	$55 676.89		$610 268.97	$2 440 138.03	$2 517	$5 567 582.34	
RB 24 hr 2.3.3	$122 205.06	$2 159 230.69	$1 216	$3 498 021.15		$30 291.43	$16 355.07	$46 646.49		$610 268.97	$2 440 138.03	$1 683	$4 734 305.82	
2.3.4.1	$237 028.09	$5 398 076.72	$1 606	$7 241 850.81	2	$53 509.26	$40 887.66	$94 396.92	1	$1 412 810.77	$6 100 345.07	$2 223	$9 737 083.32	1
2.3.4.2	$476 842.43	$7 026 018.16	$1 309	$8 811 995.53	8	$59 630.91	$107 516.43	$167 147.34	8	$3 473 740.82	$7 940 075.22	$1 811	$13 225 814.44	8
2.3.4.3	$753 550.30	$8 077 140.75	$1 231	$10 062 245.28	1	$66 545.23	$202 466.70	$269 011.93	1	$6 303 508.50	$9 127 944.69	$1 704	$17 136 070.66	1
2.3.4.4	$476 842.43	$7 036 357.57	$1 197	$8 710 841.27	7	$58 010.20	$107 516.43	$165 526.63	7	$3 473 740.82	$7 951 759.75	$1 657	$13 083 178.47	7
2.3.4.5	$476 842.43	$7 046 696.98	$1 154	$8 677 964.15	6	$57 413.65	$107 516.43	$164 930.08	6	$3 473 740.82	$7 963 444.28	$1 597	$13 035 046.17	6
2.3.4.6	$476 842.43	$7 057 036.39	$1 132	$8 666 185.79	5	$57 133.58	$107 516.43	$164 650.01	5	$3 473 740.82	$7 975 128.80	$1 567	$13 016 117.07	5
2.3.4.7	$345 195.33	$6 253 734.23	$1 463	$8 062 642.38	4	$56 745.36	$68 771.50	$125 516.85	3	$2 288 164.78	$7 067 320.22	$2 025	$11 381 437.55	4
2.3.4.8	$325 841.16	$5 893 871.60	$1 506	$7 726 481.47	3	$55 394.47	$63 496.35	$118 890.82	2	$2 124 390.69	$6 660 640.89	$2 085	$10 870 578.61	2
2.3.4.9	$439 656.20	$5 230 970.35	$1 514	$7 185 201.75	1	$53 357.97	$96 095.59	$149 453.57	4	$3 126 937.51	$5 911 498.82	$2 096	$11 134 788.46	3
2.3.4.10	$753 550.30	$8 087 808.68	$1 146	$9 987 535.64	9	$65 317.91	$202 466.70	$267 784.60	9	$6 303 508.50	$9 140 000.48	$1 586	$17 029 953.74	9
RB 48 hr 2.3.4	$237 028.09	$5 398 076.72	$1 818	$7 453 716.90		$56 687.25	$40 887.66	$97 574.91		$1 412 810.77	$6 100 345.07	$2 517	$10 030 331.18	
RB 24 hr 2.3.4	$237 028.09	$5 398 076.72	$1 216	$6 851 690.21		$47 656.85	$40 887.66	$88 544.51		$1 412 810.77	$6 100 345.07	$1 683	$9 197 054.66	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 393 254.26	$40 887.68	$457 276.80
$1 460 008.87	$107 516.43	$455 720.32
$1 533 894.23	$202 466.97	$465 926.55
$1 466 522.24	$107 516.43	$455 535.91
$1 474 776.45	$107 516.43	$455 998.42
$1 485 098.49	$107 516.43	$457 229.36
$1 435 422.03	$68 771.52	$457 571.31
$1 429 175.65	$63 496.32	$459 432.36
$1 419 645.27	$96 095.62	$459 938.21
$1 542 702.19	$202 466.97	$466 512.06
$2 084 972.40	$40 887.68	$714 327.09
$1 477 455.89	$40 887.68	$488 567.08
$2 487 418.34	$204 438.38	$632 915.31
$2 777 147.84	$537 582.14	$635 703.91
$3 085 928.87	$1 012	$675 147.54
$2 759 926.35	$537 582.14	$626 699.36
$2 762 472.44	$537 582.14	$625 040.66
$2 765 380.37	$537 582.14	$623 516.43
$2 651 560.95	$343 857.48	$638 607.29
$2 592 476.66	$317 481.74	$636 420.92
$2 514 440.92	$480 477.97	$631 722.53
$3 078 420.59	$1 012	$669 669.76
$3 026 143.45	$204 438.38	$833 111.66
$2 418 626.94	$204 438.38	$607 351.65
$3 745 437.39	$408 876.63	$815 765.99
$4 374 735.30	$1 075	$850 709.33
$4 951 219.47	$2 024	$921 812.08
$4 332 787.61	$1 075	$832 516.25
$4 322 019.95	$1 075	$825 910.01
$4 324 647.82	$1 075	$824 281.70
$4 086 258.13	$687 714.95	$839 055.58
$3 959 283.50	$634 963.49	$830 793.29
$3 781 031.00	$960 955.93	$816 120.66
$4 930 397.32	$2 024	$911 386.72
$4 181 058.13	$408 876.63	$977 647.58
$3 573 541.62	$408 876.63	$751 887.57
$7 390 655.43	$1 022	$1 324 236.31
$9 064 696.07	$2 687	$1 473 207.65
$10 430 965.31	$5 061	$1 643 437.91
$8 962 603.66	$2 687	$1 432 664.10
$8 929 410.98	$2 687	$1 417 724.48
$8 917 509.47	$2 687	$1 410 696.89
$8 259 150.61	$1 719	$1 402 999.56
$7 913 042.86	$1 587	$1 370 127.03
$7 411 526.74	$2 402	$1 320 871.90
$10 355 558.16	$5 061	$1 612 728.14
$7 604 453.51	$1 022	$1 403 686.10
$6 996 937.00	$1 022	$1 177 926.09

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.4.1.1	$26 117.08	$260 988.68	$1 482	$1 769 144.26	1	$23 801.92	$1 935.22	$25 737.14	1	$91 421.11	$294 942.27	$2 051	$2 437 680.85	1
2.4.1.2	$35 014.41	$398 392.16	$1 430	$1 864 115.15	5	$23 809.74	$2 902.91	$26 712.64	6	$130 275.92	$450 221.40	$1 980	$2 560 768.09	5
2.4.1.3	$41 564.78	$489 314.97	$1 424	$1 955 861.30	9	$24 245.26	$3 679.99	$27 925.25	9	$160 497.89	$552 972.91	$1 972	$2 685 814.67	9
2.4.1.4	$35 014.41	$413 310.58	$1 425	$1 873 713.51	6	$23 804.53	$2 902.91	$26 707.43	5	$130 275.92	$467 080.64	$1 972	$2 570 263.73	6
2.4.1.5	$35 014.41	$428 229.00	$1 423	$1 886 535.10	7	$23 847.67	$2 902.91	$26 750.57	7	$130 275.92	$483 939.89	$1 970	$2 584 220.72	7
2.4.1.6	$35 014.41	$443 147.41	$1 424	$1 902 315.12	8	$23 935.18	$2 902.91	$26 838.09	8	$130 275.92	$500 799.13	$1 971	$2 602 272.53	8
2.4.1.7	$30 689.90	$340 135.12	$1 455	$1 826 174.85	4	$23 843.96	$2 419.06	$26 263.02	4	$111 053.12	$384 385.34	$2 014	$2 509 815.66	4
2.4.1.8	$29 196.49	$320 716.10	$1 469	$1 819 763.63	3	$23 949.15	$2 257.78	$26 206.93	3	$104 559.98	$362 439.99	$2 034	$2 501 448.55	3
2.4.1.9	$28 438.76	$311 006.59	$1 474	$1 813 618.64	2	$23 957.71	$2 177.14	$26 134.85	2	$101 295.24	$351 467.32	$2 040	$2 493 193.64	2
2.4.1.10	$41 564.78	$505 934.91	$1 420	$1 967 935.05	1	$24 260.17	$3 679.99	$27 940.15	1	$160 497.89	$571 755.03	$1 966	$2 698 304.33	1
RB 48 hr 2.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$91 421.11	$294 942.27	$3 184	$3 570 901.12	
RB 24 hr 2.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$91 421.11	$294 942.27	$2 130	$2 516 703.73	
2.4.2.1	$89 142.71	$1 282 944.45	$1 666	$3 038 117.12	1	$32 314.43	$10 572.05	$42 886.48	1	$411 207.39	$1 449 850.43	$2 305	$4 167 041.35	1
2.4.2.2	$119 511.03	$1 876 210.93	$1 484	$3 480 027.64	8	$32 864.65	$15 858.49	$48 723.15	8	$593 414.97	$2 120 298.52	$2 054	$4 768 169.01	8
2.4.2.3	$141 868.72	$2 323 319.42	$1 459	$3 925 046.10	1	$34 961.53	$20 103.67	$55 065.20	1	$736 389.54	$2 625 574.05	$2 020	$5 382 580.55	1
2.4.2.4	$119 511.03	$1 890 797.98	$1 449	$3 460 233.02	5	$32 421.86	$15 858.49	$48 280.36	7	$593 414.97	$2 136 783.29	$2 006	$4 737 065.46	5
2.4.2.5	$119 511.03	$1 905 385.04	$1 441	$3 466 150.57	6	$32 364.76	$15 858.49	$48 223.25	6	$593 414.97	$2 153 268.06	$1 994	$4 741 550.61	6
2.4.2.6	$119 511.03	$1 919 972.09	$1 431	$3 470 869.12	7	$32 289.66	$15 858.49	$48 148.16	5	$593 414.97	$2 169 752.84	$1 981	$4 744 376.20	7
2.4.2.7	$104 750.64	$1 589 836.23	$1 579	$3 273 587.52	4	$32 702.65	$13 215.27	$45 917.92	4	$503 009.54	$1 796 667.61	$2 185	$4 485 201.77	4
2.4.2.8	$99 653.34	$1 494 378.00	$1 608	$3 202 118.69	3	$32 609.66	$12 334.20	$44 943.87	3	$472 582.43	$1 688 790.65	$2 225	$4 387 157.15	3
2.4.2.9	$97 067.05	$1 446 648.89	$1 619	$3 162 767.59	2	$32 509.10	$11 893.66	$44 402.77	2	$457 306.84	$1 634 852.16	$2 240	$4 333 118.97	2
2.4.2.10	$141 868.72	$2 339 578.00	$1 435	$3 917 115.43	9	$34 679.98	$20 103.67	$54 783.65	9	$736 389.54	$2 643 947.81	$1 987	$5 367 473.52	9
RB 48 hr 2.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$10 572.05	$52 407.57		$411 207.39	$1 449 850.43	$3 184	$5 045 595.56	
RB 24 hr 2.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$30 410.94	$10 572.05	$40 983.00		$411 207.39	$1 449 850.43	$2 130	$3 991 398.18	
2.4.3.1	$166 142.57	$2 484 448.75	$1 813	$4 464 582.32	1	$41 326.76	$25 012.08	$66 338.84	1	$899 102.84	$2 807 665.67	$2 510	$6 217 547.70	1
2.4.3.2	$222 742.49	$3 613 431.42	$1 549	$5 385 940.49	8	$43 585.63	$37 519.10	$81 104.73	8	$1 305 054.17	$4 083 524.50	$2 145	$7 533 639.86	8
2.4.3.3	$264 412.36	$4 479 274.31	$1 495	$6 238 823.16	1	$47 520.42	$47 562.62	$95 083.05	1	$1 624 813.63	$5 062 010.12	$2 069	$8 756 270.39	1
2.4.3.4	$222 742.49	$3 627 416.78	$1 484	$5 334 856.92	7	$42 679.52	$37 519.10	$80 198.62	7	$1 305 054.17	$4 099 329.30	$2 054	$7 459 381.53	7
2.4.3.5	$222 742.49	$3 641 402.13	$1 459	$5 323 618.61	5	$42 371.09	$37 519.10	$79 890.19	6	$1 305 054.17	$4 115 134.09	$2 020	$7 440 273.77	6
2.4.3.6	$222 742.49	$3 655 387.49	$1 447	$5 325 536.99	6	$42 260.02	$37 519.10	$79 779.11	5	$1 305 054.17	$4 130 938.89	$2 003	$7 439 376.43	5
2.4.3.7	$195 232.34	$3 058 860.84	$1 686	$4 940 164.97	4	$42 576.75	$31 265.59	$73 842.34	4	$1 103 380.10	$3 456 806.49	$2 333	$6 893 910.39	4
2.4.3.8	$185 732.09	$2 874 003.98	$1 722	$4 781 779.02	3	$42 095.13	$29 181.09	$71 276.22	3	$1 035 611.25	$3 247 900.49	$2 383	$6 667 023.89	3
2.4.3.9	$180 911.81	$2 781 575.55	$1 733	$4 695 906.83	2	$41 754.47	$28 138.84	$69 893.31	2	$1 001 611.20	$3 143 447.49	$2 399	$6 544 317.30	2
2.4.3.10	$264 412.36	$4 494 876.01	$1 454	$6 213 327.92	9	$46 981.98	$47 562.62	$94 544.60	9	$1 624 813.63	$5 079 641.53	$2 012	$8 717 018.76	9
RB 48 hr 2.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$25 012.08	$73 640.51		$899 102.84	$2 807 665.67	$3 184	$6 891 306.24	
RB 24 hr 2.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$37 203.86	$25 012.08	$62 215.95		$899 102.84	$2 807 665.67	$2 130	$5 837 108.86	
2.4.4.1	$341 398.74	$6 116 636.13	$2 091	$8 549 847.87	1	$65 442.64	$67 727.54	$133 170.19	1	$2 255 809.25	$6 912 386.20	$2 895	$12 063 513.32	1
2.4.4.2	$457 703.32	$8 866 841.40	$1 722	$11 046 746.00	8	$74 835.80	$101 593.95	$176 429.75	8	$3 294 137.97	$10 020 382.25	$2 383	$15 698 251.54	8
2.4.4.3	$543 328.82	$10 998 744.17	$1 623	$13 165 849.45	1	$84 892.32	$128 789.74	$213 682.06	1	$4 115 142.21	$12 429 637.11	$2 247	$18 792 278.98	1
2.4.4.4	$457 703.32	$8 880 552.65	$1 579	$10 917 511.60	7	$72 760.17	$101 593.95	$174 354.13	7	$3 294 137.97	$10 035 877.28	$2 185	$15 515 892.80	7
2.4.4.5	$457 703.32	$8 894 263.89	$1 520	$10 872 745.88	6	$71 951.57	$101 593.95	$173 545.53	6	$3 294 137.97	$10 051 372.31	$2 104	$15 450 448.75	6
2.4.4.6	$457 703.32	$8 907 975.14	$1 494	$10 859 882.36	5	$71 621.51	$101 593.95	$173 215.46	5	$3 294 137.97	$10 066 867.34	$2 068	$15 429 161.13	5
2.4.4.7	$401 173.98	$7 501 505.75	$1 902	$9 805 230.85	4	$70 137.77	$84 660.75	$154 798.52	4	$2 777 648.20	$8 477 421.86	$2 633	$13 888 427.00	4
2.4.4.8	$381 652.35	$7 046 393.87	$1 960	$9 388 211.43	3	$68 527.30	$79 016.35	$147 543.65	3	$2 604 366.77	$7 963 101.73	$2 713	$13 280 570.18	3
2.4.4.9	$371 747.38	$6 818 837.92	$1 970	$9 161 451.15	2	$67 449.00	$76 194.15	$143 643.15	2	$2 517 488.47	$7 705 941.66	$2 727	$12 951 342.77	2
2.4.4.10	$543 328.82	$11 014 046.28	$1 510	$13 067 795.11	9	$83 268.49	$128 789.74	$212 058.22	9	$4 115 142.21	$12 446 929.96	$2 090	$18 652 673.03	9
RB 48 hr 2.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 255 809.25	$6 912 386.20	$3 184	$12 352 733.18	
RB 24 hr 2.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 255 809.25	$6 912 386.20	$2 130	$11 298 535.80	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 794 904.94	$48 380.50	$594 395.41
$1 893 948.02	$72 572.64	$594 247.43
$1 988 906.81	$91 999.68	$604 908.19
$1 903 611.18	$72 572.64	$594 079.91
$1 916 526.97	$72 572.64	$595 121.11
$1 932 428.17	$72 572.64	$597 271.72
$1 854 090.43	$60 476.57	$595 248.67
$1 847 077.04	$56 444.55	$597 926.97
$1 840 599.93	$54 428.54	$598 165.17
$2 001 065.35	$91 999.68	$605 239.31
$2 621 101.29	$48 380.50	$901 419.32
$1 852 518.12	$48 380.50	$615 805.11
$3 098 086.66	$264 301.36	$804 653.32
$3 554 780.87	$396 462.35	$816 925.78
$4 011 758.93	$502 591.73	$868 229.89
$3 534 783.54	$396 462.35	$805 819.57
$3 540 732.84	$396 462.35	$804 355.42
$3 545 472.20	$396 462.35	$802 441.64
$3 341 228.32	$330 381.86	$813 591.59
$3 267 296.45	$308 355.03	$811 505.66
$3 226 666.40	$297 341.61	$809 110.96
$4 003 731.19	$502 591.73	$861 150.60
$3 738 613.75	$264 301.36	$1 042 680.44
$2 970 030.58	$264 301.36	$757 066.23
$4 565 287.70	$625 302.05	$1 026 957.95
$5 515 055.26	$937 977.45	$1 080 607.15
$6 390 392.44	$1 189	$1 176 812.44
$5 463 484.56	$937 977.45	$1 057 919.51
$5 452 122.48	$937 977.45	$1 050 173.84
$5 454 037.05	$937 977.45	$1 047 361.93
$5 055 499.02	$781 639.75	$1 056 771.62
$4 892 303.44	$729 527.18	$1 045 193.28
$4 803 938.58	$703 470.90	$1 036 907.81
$6 364 640.95	$1 189	$1 163 312.30
$5 056 504.51	$625 302.05	$1 209 499.68
$4 287 921.34	$625 302.05	$923 885.47
$8 749 550.27	$1 693	$1 620 774.48
$11 309 674.77	$2 539	$1 848 727.90
$13 477 724.40	$3 219	$2 094 811.18
$11 179 241.02	$2 539	$1 796 802.91
$11 134 046.20	$2 539	$1 776 553.67
$11 121 044.50	$2 539	$1 768 267.76
$10 037 217.79	$2 116	$1 734 690.49
$9 609 594.96	$1 975	$1 695 566.55
$9 377 311.20	$1 904	$1 669 177.92
$13 378 752.61	$3 219	$2 054 177.02
$8 960 411.66	$1 693	$1 699 132.96
$8 191 828.48	$1 693	$1 413 518.75

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
1.2.1.1	$17 575.65	$158 938.83	$716 667.47	$893 181.94	1	$11 723.98	$1 118.96	$12 842.94	1	$56 938.43	$179 616.14	$991 952.97	$1 228 507.54	1
1.2.1.2	$23 563.16	$243 453.76	$678 297.55	$945 314.46	5	$11 632.08	$1 678.48	$13 310.56	7	$80 793.85	$275 126.12	$938 844.44	$1 294 764.42	5
1.2.1.3	$27 971.27	$297 803.23	$675 122.79	$1 000 897.30	9	$11 901.16	$2 127.80	$14 028.96	1	$99 291.23	$336 546.25	$934 450.20	$1 370 287.68	9
1.2.1.4	$23 563.16	$251 807.99	$674 230.81	$949 601.96	6	$11 612.85	$1 678.48	$13 291.33	5	$80 793.85	$284 567.21	$933 215.59	$1 298 576.65	6
1.2.1.5	$23 563.16	$260 162.22	$672 569.89	$956 295.27	7	$11 629.70	$1 678.48	$13 308.19	6	$80 793.85	$294 008.29	$930 916.68	$1 305 718.83	7
1.2.1.6	$23 563.16	$268 516.45	$673 707.66	$965 787.27	8	$11 688.54	$1 678.48	$13 367.02	8	$80 793.85	$303 449.38	$932 491.49	$1 316 734.72	8
1.2.1.7	$20 652.96	$207 975.95	$698 417.04	$927 045.95	4	$11 726.80	$1 398.72	$13 125.52	4	$69 003.83	$235 032.79	$966 692.22	$1 270 728.84	4
1.2.1.8	$19 647.96	$196 150.01	$707 100.71	$922 898.68	3	$11 787.67	$1 305.47	$13 093.14	3	$65 016.26	$221 668.35	$978 711.44	$1 265 396.05	3
1.2.1.9	$19 138.04	$190 237.04	$709 851.38	$919 226.46	2	$11 794.16	$1 258.84	$13 053.00	2	$63 010.24	$214 986.13	$982 518.70	$1 260 515.07	2
1.2.1.10	$27 971.27	$307 195.13	$671 582.22	$1 006 748.62	1	$11 895.02	$2 127.80	$14 022.81	9	$99 291.23	$347 160.00	$929 549.63	$1 376 000.86	1
RB 48 hr 1.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$1 118.96	$20 341.71		$56 938.43	$179 616.14	$1 683	$1 920 453.39	
RB 24 hr 1.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$13 181.63	$1 118.96	$14 300.59		$56 938.43	$179 616.14	$1 126	$1 363 012.10	
1.2.2.1	$60 134.28	$780 795.83	$829 502.96	$1 670 433.07	1	$16 959.89	$6 133.31	$23 093.20	1	$252 433.30	$882 374.27	$1 148	$2 282 938.28	1
1.2.2.2	$80 620.27	$1 142 766.44	$714 477.99	$1 937 864.70	8	$17 253.33	$9 200.21	$26 453.54	8	$362 866.32	$1 291 435.81	$988 922.48	$2 643 224.61	8
1.2.2.3	$95 702.42	$1 413 855.12	$697 084.89	$2 206 642.43	1	$18 501.71	$11 663.02	$30 164.73	1	$449 291.81	$1 597 792.06	$964 848.36	$3 011 932.23	1
1.2.2.4	$80 620.27	$1 150 974.14	$690 803.69	$1 922 398.10	5	$16 939.25	$9 200.21	$26 139.46	7	$362 866.32	$1 300 711.31	$956 154.43	$2 619 732.06	6
1.2.2.5	$80 620.27	$1 159 181.85	$683 664.11	$1 923 466.23	6	$16 873.20	$9 200.21	$26 073.40	6	$362 866.32	$1 309 986.81	$946 272.40	$2 619 125.53	5
1.2.2.6	$80 620.27	$1 167 389.56	$678 771.34	$1 926 781.17	7	$16 840.84	$9 200.21	$26 041.05	5	$362 866.32	$1 319 262.31	$939 500.23	$2 621 628.85	7
1.2.2.7	$70 663.14	$968 479.73	$779 780.68	$1 818 923.55	4	$17 259.87	$7 666.76	$24 926.63	4	$308 120.91	$1 094 475.09	$1 079	$2 481 905.17	4
1.2.2.8	$67 224.58	$910 384.16	$795 824.20	$1 773 432.94	3	$17 174.97	$7 155.61	$24 330.58	3	$289 675.49	$1 028 821.52	$1 101	$2 420 012.31	3
1.2.2.9	$65 479.91	$881 336.37	$801 923.44	$1 748 739.73	2	$17 103.43	$6 900.04	$24 003.46	2	$280 410.93	$995 994.74	$1 109	$2 386 363.05	2
1.2.2.10	$95 702.42	$1 423 083.37	$680 345.86	$2 199 131.65	9	$18 296.77	$11 663.02	$29 959.79	9	$449 291.81	$1 608 220.87	$941 679.54	$2 999 192.22	9
RB 48 hr 1.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$6 133.31	$28 899.44		$252 433.30	$882 374.27	$1 683	$2 818 706.39	
RB 24 hr 1.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$16 725.02	$6 133.31	$22 858.33		$252 433.30	$882 374.27	$1 126	$2 261 265.10	
1.2.3.1	$112 564.83	$1 510 285.24	$906 652.88	$2 529 502.95	1	$22 299.38	$14 598.00	$36 897.38	1	$550 455.40	$1 706 767.35	$1 254	$3 512 138.12	1
1.2.3.2	$150 912.38	$2 197 630.23	$753 636.83	$3 102 179.43	8	$23 832.01	$21 897.57	$45 729.58	8	$796 140.90	$2 483 533.20	$1 043	$4 322 797.05	8
1.2.3.3	$179 144.52	$2 722 954.51	$719 828.05	$3 621 927.08	1	$26 239.47	$27 759.35	$53 998.82	1	$989 211.64	$3 077 200.07	$996 327.60	$5 062 739.31	1
1.2.3.4	$150 912.38	$2 205 571.89	$711 675.17	$3 068 159.44	7	$23 242.29	$21 897.57	$45 139.86	7	$796 140.90	$2 492 508.04	$985 043.05	$4 273 691.98	7
1.2.3.5	$150 912.38	$2 213 513.56	$696 923.06	$3 061 348.99	5	$23 060.72	$21 897.57	$44 958.29	6	$796 140.90	$2 501 482.88	$964 624.37	$4 262 248.15	6
1.2.3.6	$150 912.38	$2 221 455.22	$689 402.06	$3 061 769.65	6	$22 987.61	$21 897.57	$44 885.18	5	$796 140.90	$2 510 457.72	$954 214.41	$4 260 813.03	5
1.2.3.7	$132 273.71	$1 860 509.26	$842 292.38	$2 835 075.36	4	$23 286.12	$18 247.79	$41 533.91	4	$674 180.00	$2 102 554.13	$1 165	$3 942 566.92	4
1.2.3.8	$125 837.11	$1 748 135.61	$863 479.22	$2 737 451.94	3	$22 976.40	$17 031.19	$40 007.60	3	$633 157.69	$1 975 561.11	$1 195	$3 803 876.69	3
1.2.3.9	$122 571.28	$1 691 948.78	$867 912.57	$2 682 432.63	2	$22 728.66	$16 422.89	$39 151.55	2	$612 568.20	$1 912 064.60	$1 201	$3 725 926.98	2
1.2.3.10	$179 144.52	$2 731 885.24	$692 300.60	$3 603 330.36	9	$25 871.21	$27 759.35	$53 630.56	9	$989 211.64	$3 087 292.66	$958 226.33	$5 034 730.62	9
RB 48 hr 1.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$14 598.00	$41 546.37		$550 455.40	$1 706 767.35	$1 683	$3 941 121.57	
RB 24 hr 1.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$20 907.25	$14 598.00	$35 505.26		$550 455.40	$1 706 767.35	$1 126	$3 383 680.28	
1.2.4.1	$231 757.45	$3 716 343.63	$1 070	$5 018 457.67	1	$37 000.99	$39 635.52	$76 636.51	1	$1 372 821.19	$4 199 825.18	$1 481	$7 054 147.14	1
1.2.4.2	$310 710.44	$5 388 413.10	$857 536.58	$6 556 660.13	8	$42 974.36	$59 454.82	$102 429.18	8	$1 998 417.29	$6 089 424.25	$1 186	$9 274 774.11	8
1.2.4.3	$368 837.04	$6 682 697.20	$797 795.15	$7 849 329.38	1	$49 142.55	$75 370.34	$124 512.89	1	$2 492 097.08	$7 552 089.57	$1 104	$11 148 429.98	1
1.2.4.4	$310 710.44	$5 396 233.56	$769 783.93	$6 476 727.94	7	$41 697.17	$59 454.82	$101 151.99	7	$1 998 417.29	$6 098 262.12	$1 065	$9 162 151.88	7
1.2.4.5	$310 710.44	$5 404 054.02	$734 827.30	$6 449 591.76	6	$41 211.93	$59 454.82	$100 666.75	6	$1 998 417.29	$6 107 099.98	$1 017	$9 122 605.61	6
1.2.4.6	$310 710.44	$5 411 874.47	$717 870.35	$6 440 455.26	5	$40 996.67	$59 454.82	$100 451.50	5	$1 998 417.29	$6 115 937.85	$993 617.91	$9 107 973.04	5
1.2.4.7	$272 335.68	$4 558 862.95	$965 333.34	$5 796 531.97	4	$40 052.14	$49 545.17	$89 597.31	4	$1 687 434.88	$5 151 952.92	$1 336	$8 175 523.90	4
1.2.4.8	$259 083.49	$4 282 346.23	$995 724.26	$5 537 153.98	3	$38 990.25	$46 241.95	$85 232.20	3	$1 583 015.00	$4 839 462.47	$1 378	$7 800 678.23	3
1.2.4.9	$252 359.53	$4 144 087.87	$1 001	$5 397 828.46	2	$38 315.22	$44 590.34	$82 905.57	2	$1 530 643.79	$4 683 217.25	$1 386	$7 599 891.47	2
1.2.4.10	$368 837.04	$6 691 492.22	$728 629.32	$7 788 958.58	9	$48 149.04	$75 370.34	$123 519.38	9	$2 492 097.08	$7 562 028.78	$1 008	$11 062 635.47	9
RB 48 hr 1.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$39 635.52	$78 829.94		$1 372 821.19	$4 199 825.18	$1 683	$7 256 545.19	
RB 24 hr 1.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$33 153.31	$39 635.52	$72 788.83		$1 372 821.19	$4 199 825.18	$1 126	$6 699 103.90	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$907 831.45	$27 973.99	$292 702.10
$962 609.07	$41 962.07	$290 193.27
$1 020 308.13	$53 194.94	$296 784.62
$966 922.94	$41 962.07	$289 691.64
$973 664.57	$41 962.07	$290 092.19
$983 230.41	$41 962.07	$291 542.24
$943 110.86	$34 968.03	$292 649.95
$938 558.00	$32 636.68	$294 201.37
$934 665.56	$31 471.01	$294 378.51
$1 026 198.51	$53 194.94	$296 607.41
$1 412 308.08	$27 973.99	$480 171.32
$1 005 894.63	$27 973.99	$329 143.48
$1 707 560.15	$153 332.79	$422 045.34
$1 984 743.14	$230 005.17	$428 476.30
$2 261 348.56	$291 575.47	$459 008.20
$1 969 123.01	$230 005.17	$420 603.88
$1 970 188.38	$230 005.17	$418 931.99
$1 973 521.04	$230 005.17	$418 102.64
$1 861 160.57	$191 668.98	$429 075.62
$1 814 023.66	$178 890.25	$427 098.40
$1 788 479.79	$172 500.89	$425 382.38
$2 253 755.23	$291 575.47	$453 861.53
$2 098 172.34	$153 332.79	$567 201.25
$1 691 758.89	$153 332.79	$416 173.42
$2 593 479.29	$364 950.03	$553 708.80
$3 185 051.62	$547 439.27	$590 306.17
$3 719 576.21	$693 983.80	$649 179.30
$3 150 709.31	$547 439.27	$575 543.40
$3 143 824.66	$547 439.27	$570 984.21
$3 144 237.06	$547 439.27	$569 136.69
$2 908 870.45	$456 194.65	$577 501.82
$2 808 057.14	$425 779.77	$570 039.78
$2 751 368.03	$410 572.34	$563 986.62
$3 700 796.30	$693 983.80	$639 950.52
$2 906 238.05	$364 950.03	$669 933.50
$2 499 824.60	$364 950.03	$518 905.66
$5 147 525.24	$990 887.93	$915 733.97
$6 727 515.60	$1 486	$1 060 887.99
$8 052 314.49	$1 884	$1 211 857.03
$6 646 842.60	$1 486	$1 028 938.75
$6 619 447.06	$1 486	$1 016 788.02
$6 610 215.35	$1 486	$1 011 387.17
$5 946 988.36	$1 238	$989 906.31
$5 680 579.13	$1 156	$964 050.30
$5 537 612.55	$1 114	$947 520.34
$7 991 379.78	$1 884	$1 186 997.24
$5 295 087.49	$990 887.93	$970 569.77
$4 888 674.04	$990 887.93	$819 541.93

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
1.4.1.1	$26 117.08	$260 988.68	$1 355	$1 642 341.10	1	$21 899.87	$1 935.22	$23 835.09	1	$91 421.11	$294 942.27	$1 875	$2 262 170.21	1
1.4.1.2	$35 014.41	$398 392.16	$1 282	$1 715 798.25	5	$21 584.98	$2 902.91	$24 487.89	7	$130 275.92	$450 221.40	$1 774	$2 355 479.87	5
1.4.1.3	$41 564.78	$489 314.97	$1 276	$1 807 691.83	9	$22 022.72	$3 679.99	$25 702.70	1	$160 497.89	$552 972.91	$1 767	$2 480 730.51	9
1.4.1.4	$35 014.41	$413 310.58	$1 274	$1 723 119.67	6	$21 545.62	$2 902.91	$24 448.53	5	$130 275.92	$467 080.64	$1 764	$2 361 823.96	6
1.4.1.5	$35 014.41	$428 229.00	$1 271	$1 735 069.23	7	$21 575.68	$2 902.91	$24 478.58	6	$130 275.92	$483 939.89	$1 760	$2 374 573.96	7
1.4.1.6	$35 014.41	$443 147.41	$1 274	$1 752 426.32	8	$21 686.85	$2 902.91	$24 589.76	8	$130 275.92	$500 799.13	$1 763	$2 394 808.61	8
1.4.1.7	$30 689.90	$340 135.12	$1 320	$1 691 441.60	4	$21 822.96	$2 419.06	$24 242.02	4	$111 053.12	$384 385.34	$1 827	$2 323 328.82	4
1.4.1.8	$29 196.49	$320 716.10	$1 337	$1 687 053.62	3	$21 958.50	$2 257.78	$24 216.28	3	$104 559.98	$362 439.99	$1 850	$2 317 762.12	3
1.4.1.9	$28 438.76	$311 006.59	$1 342	$1 681 571.66	2	$21 977.00	$2 177.14	$24 154.14	2	$101 295.24	$351 467.32	$1 857	$2 310 424.92	2
1.4.1.10	$41 564.78	$505 934.91	$1 269	$1 817 214.36	1	$21 999.36	$3 679.99	$25 679.34	9	$160 497.89	$571 755.03	$1 757	$2 489 688.97	1
RB 48 hr 1.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$91 421.11	$294 942.27	$3 184	$3 570 901.12	
RB 24 hr 1.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$91 421.11	$294 942.27	$2 130	$2 516 703.73	
1.4.2.1	$89 142.71	$1 282 944.45	$1 568	$2 940 812.45	1	$30 854.86	$10 572.05	$41 426.91	1	$411 207.39	$1 449 850.43	$2 171	$4 032 360.11	1
1.4.2.2	$119 511.03	$1 876 210.93	$1 351	$3 346 742.04	8	$30 865.37	$15 858.49	$46 723.86	8	$593 414.97	$2 120 298.52	$1 869	$4 583 685.89	8
1.4.2.3	$141 868.72	$2 323 319.42	$1 317	$3 783 155.19	1	$32 833.16	$20 103.67	$52 936.83	1	$736 389.54	$2 625 574.05	$1 824	$5 186 186.66	1
1.4.2.4	$119 511.03	$1 890 797.98	$1 306	$3 316 412.04	5	$30 264.55	$15 858.49	$46 123.04	7	$593 414.97	$2 136 783.29	$1 807	$4 538 000.13	6
1.4.2.5	$119 511.03	$1 905 385.04	$1 292	$3 317 569.45	6	$30 136.04	$15 858.49	$45 994.53	6	$593 414.97	$2 153 268.06	$1 789	$4 535 896.68	5
1.4.2.6	$119 511.03	$1 919 972.09	$1 283	$3 322 862.31	7	$30 069.56	$15 858.49	$45 928.05	5	$593 414.97	$2 169 752.84	$1 776	$4 539 517.18	7
1.4.2.7	$104 750.64	$1 589 836.23	$1 474	$3 169 230.51	4	$31 137.29	$13 215.27	$44 352.57	4	$503 009.54	$1 796 667.61	$2 041	$4 340 759.26	4
1.4.2.8	$99 653.34	$1 494 378.00	$1 504	$3 098 522.67	3	$31 055.72	$12 334.20	$43 389.93	3	$472 582.43	$1 688 790.65	$2 082	$4 243 767.94	3
1.4.2.9	$97 067.05	$1 446 648.89	$1 516	$3 059 990.25	2	$30 967.44	$11 893.66	$42 861.11	2	$457 306.84	$1 634 852.16	$2 098	$4 190 862.92	2
1.4.2.10	$141 868.72	$2 339 578.00	$1 286	$3 767 606.87	9	$32 437.35	$20 103.67	$52 541.02	9	$736 389.54	$2 643 947.81	$1 780	$5 160 535.88	9
RB 48 hr 1.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$10 572.05	$52 407.57		$411 207.39	$1 449 850.43	$3 184	$5 045 595.56	
RB 24 hr 1.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$30 410.94	$10 572.05	$40 983.00		$411 207.39	$1 449 850.43	$2 130	$3 991 398.18	
1.4.3.1	$166 142.57	$2 484 448.75	$1 730	$4 381 330.72	1	$40 077.99	$25 012.08	$65 090.07	1	$899 102.84	$2 807 665.67	$2 395	$6 102 317.58	1
1.4.3.2	$222 742.49	$3 613 431.42	$1 425	$5 261 247.73	8	$41 715.24	$37 519.10	$79 234.34	8	$1 305 054.17	$4 083 524.50	$1 972	$7 361 050.25	8
1.4.3.3	$264 412.36	$4 479 274.31	$1 361	$6 104 774.12	1	$45 509.69	$47 562.62	$93 072.31	1	$1 624 813.63	$5 062 010.12	$1 883	$8 570 730.58	1
1.4.3.4	$222 742.49	$3 627 416.78	$1 345	$5 195 819.13	7	$40 593.96	$37 519.10	$78 113.05	7	$1 305 054.17	$4 099 329.30	$1 862	$7 266 936.68	7
1.4.3.5	$222 742.49	$3 641 402.13	$1 317	$5 181 846.22	6	$40 244.51	$37 519.10	$77 763.61	6	$1 305 054.17	$4 115 134.09	$1 823	$7 244 043.92	6
1.4.3.6	$222 742.49	$3 655 387.49	$1 303	$5 181 512.22	5	$40 099.64	$37 519.10	$77 618.74	5	$1 305 054.17	$4 130 938.89	$1 804	$7 240 029.03	5
1.4.3.7	$195 232.34	$3 058 860.84	$1 592	$4 846 663.82	4	$41 174.23	$31 265.59	$72 439.82	4	$1 103 380.10	$3 456 806.49	$2 204	$6 764 493.67	4
1.4.3.8	$185 732.09	$2 874 003.98	$1 632	$4 692 513.32	3	$40 756.15	$29 181.09	$69 937.23	3	$1 035 611.25	$3 247 900.49	$2 259	$6 543 469.55	3
1.4.3.9	$180 911.81	$2 781 575.55	$1 641	$4 603 719.30	2	$40 371.66	$28 138.84	$68 510.49	2	$1 001 611.20	$3 143 447.49	$2 271	$6 416 718.81	2
1.4.3.10	$264 412.36	$4 494 876.01	$1 309	$6 068 318.21	9	$44 806.83	$47 562.62	$92 369.45	9	$1 624 813.63	$5 079 641.53	$1 811	$8 516 308.09	9
RB 48 hr 1.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$25 012.08	$73 640.51		$899 102.84	$2 807 665.67	$3 184	$6 891 306.24	
RB 24 hr 1.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$37 203.86	$25 012.08	$62 215.95		$899 102.84	$2 807 665.67	$2 130	$5 837 108.86	
1.4.4.1	$341 398.74	$6 116 636.13	$2 024	$8 482 077.66	1	$64 426.09	$67 727.54	$132 153.63	1	$2 255 809.25	$6 912 386.20	$2 801	$11 969 711.28	1
1.4.4.2	$457 703.32	$8 866 841.40	$1 621	$10 946 098.64	8	$73 326.09	$101 593.95	$174 920.04	8	$3 294 137.97	$10 020 382.25	$2 244	$15 558 943.63	8
1.4.4.3	$543 328.82	$10 998 744.17	$1 508	$13 050 543.65	1	$83 162.73	$128 789.74	$211 952.47	1	$4 115 142.21	$12 429 637.11	$2 087	$18 632 682.06	1
1.4.4.4	$457 703.32	$8 880 552.65	$1 455	$10 793 725.73	7	$70 903.38	$101 593.95	$172 497.34	7	$3 294 137.97	$10 035 877.28	$2 014	$15 344 558.44	7
1.4.4.5	$457 703.32	$8 894 263.89	$1 389	$10 741 315.81	6	$69 980.12	$101 593.95	$171 574.08	6	$3 294 137.97	$10 051 372.31	$1 923	$15 268 533.91	6
1.4.4.6	$457 703.32	$8 907 975.14	$1 357	$10 722 997.69	5	$69 568.24	$101 593.95	$171 162.19	5	$3 294 137.97	$10 066 867.34	$1 878	$15 239 696.49	5
1.4.4.7	$401 173.98	$7 501 505.75	$1 824	$9 727 442.32	4	$68 970.94	$84 660.75	$153 631.69	4	$2 777 648.20	$8 477 421.86	$2 525	$13 780 758.42	4
1.4.4.8	$381 652.35	$7 046 393.87	$1 882	$9 310 492.74	3	$67 361.52	$79 016.35	$146 377.87	3	$2 604 366.77	$7 963 101.73	$2 605	$13 172 998.27	3
1.4.4.9	$371 747.38	$6 818 837.92	$1 893	$9 084 297.50	2	$66 291.70	$76 194.15	$142 485.84	2	$2 517 488.47	$7 705 941.66	$2 621	$12 844 552.95	2
1.4.4.10	$543 328.82	$11 014 046.28	$1 377	$12 934 709.17	9	$81 272.20	$128 789.74	$210 061.93	9	$4 115 142.21	$12 446 929.96	$1 906	$18 468 466.27	9
RB 48 hr 1.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 255 809.25	$6 912 386.20	$3 184	$12 352 733.18	
RB 24 hr 1.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 255 809.25	$6 912 386.20	$2 130	$11 298 535.80	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 666 945.48	$48 380.50	$546 844.22
$1 744 278.64	$72 572.64	$538 628.60
$1 839 386.20	$91 999.68	$549 344.63
$1 751 644.09	$72 572.64	$537 607.22
$1 763 679.91	$72 572.64	$538 321.41
$1 781 172.56	$72 572.64	$541 063.42
$1 718 128.56	$60 476.57	$544 723.70
$1 713 156.86	$56 444.55	$548 160.71
$1 707 348.83	$54 428.54	$548 647.56
$1 848 970.25	$91 999.68	$548 719.05
$2 621 101.29	$48 380.50	$901 419.32
$1 852 518.12	$48 380.50	$615 805.11
$2 999 894.68	$264 301.36	$768 164.07
$3 420 279.86	$396 462.35	$766 943.68
$3 868 574.13	$502 591.73	$815 020.80
$3 389 651.08	$396 462.35	$751 886.70
$3 390 796.82	$396 462.35	$748 637.50
$3 396 115.74	$396 462.35	$746 939.09
$3 235 919.68	$330 381.86	$774 457.71
$3 162 755.76	$308 355.03	$772 657.16
$3 122 951.85	$297 341.61	$770 569.46
$3 852 859.27	$502 591.73	$805 084.88
$3 738 613.75	$264 301.36	$1 042 680.44
$2 970 030.58	$264 301.36	$757 066.23
$4 481 276.94	$625 302.05	$995 738.60
$5 389 225.44	$937 977.45	$1 033 847.37
$6 255 121.02	$1 189	$1 126 544.05
$5 323 178.90	$937 977.45	$1 005 780.34
$5 309 057.27	$937 977.45	$997 009.19
$5 308 698.94	$937 977.45	$993 352.64
$4 961 145.24	$781 639.75	$1 021 708.69
$4 802 223.73	$729 527.18	$1 011 718.64
$4 710 910.42	$703 470.90	$1 002 337.49
$6 218 308.92	$1 189	$1 108 933.66
$5 056 504.51	$625 302.05	$1 209 499.68
$4 287 921.34	$625 302.05	$923 885.47
$8 681 162.06	$1 693	$1 595 360.65
$11 208 109.62	$2 539	$1 810 985.14
$13 361 367.14	$3 219	$2 051 571.51
$11 054 326.36	$2 539	$1 750 383.21
$11 001 417.64	$2 539	$1 727 267.40
$10 982 911.60	$2 539	$1 716 936.01
$9 958 719.91	$2 116	$1 705 519.79
$9 531 167.56	$1 975	$1 666 422.04
$9 299 454.00	$1 904	$1 640 245.30
$13 244 453.07	$3 219	$2 004 269.79
$8 960 411.66	$1 693	$1 699 132.96
$8 191 828.48	$1 693	$1 413 518.75

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
3.1.1.1	$10 070.88	$86 301.48	$345 393.37	$441 765.73	1	$5 715.13	$517.98	$6 233.11	1	$29 546.20	$97 528.96	$478 065.49	$605 140.65	1
3.1.1.2	$13 501.73	$134 784.12	$330 733.21	$479 019.07	5	$5 772.64	$776.99	$6 549.63	6	$41 675.47	$152 319.00	$457 774.08	$651 768.56	5
3.1.1.3	$16 027.59	$163 157.83	$329 169.34	$508 354.76	9	$5 916.81	$984.99	$6 901.80	9	$51 037.89	$184 384.01	$455 609.50	$691 031.40	9
3.1.1.4	$13 501.73	$139 854.06	$328 270.73	$481 626.52	6	$5 761.05	$776.99	$6 538.04	5	$41 675.47	$158 048.52	$454 365.71	$654 089.71	6
3.1.1.5	$13 501.73	$144 924.00	$328 184.19	$486 609.93	7	$5 785.10	$776.99	$6 562.09	7	$41 675.47	$163 778.04	$454 245.94	$659 699.45	7
3.1.1.6	$13 501.73	$149 993.94	$327 058.36	$490 554.04	8	$5 793.56	$776.99	$6 570.55	8	$41 675.47	$169 507.56	$452 687.65	$663 870.68	8
3.1.1.7	$11 834.18	$115 520.19	$338 315.75	$465 670.12	4	$5 773.05	$647.49	$6 420.53	4	$35 689.73	$130 548.90	$468 269.22	$634 507.86	4
3.1.1.8	$11 258.32	$109 098.87	$341 217.56	$461 574.75	3	$5 778.59	$604.32	$6 382.91	3	$33 661.50	$123 292.20	$472 285.67	$629 239.38	3
3.1.1.9	$10 966.13	$105 888.22	$340 759.31	$457 613.66	2	$5 752.69	$582.73	$6 335.42	2	$32 640.38	$119 663.85	$471 651.40	$623 955.63	2
3.1.1.10	$16 027.59	$168 836.10	$327 391.56	$512 255.26	1	$5 918.54	$984.99	$6 903.52	1	$51 037.89	$190 801.01	$453 148.84	$694 987.74	1
RB 48 hr 3.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$29 546.20	$97 528.96	$753 242.87	$880 318.03	
RB 24 hr 3.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$29 546.20	$97 528.96	$494 915.11	$621 990.27	
3.1.4.1	$135 406.09	$2 007 523.44	$497 169.54	$2 640 099.08	1	$18 876.30	$18 848.17	$37 724.47	1	$694 351.72	$2 268 694.27	$688 141.75	$3 651 187.74	1
3.1.4.2	$181 534.99	$2 913 464.00	$405 735.11	$3 500 734.11	8	$22 505.00	$28 272.99	$50 777.99	8	$1 005 992.04	$3 292 494.10	$561 585.63	$4 860 071.77	8
3.1.4.3	$215 495.91	$3 611 480.34	$382 214.72	$4 209 190.97	1	$25 988.68	$35 841.41	$61 830.09	1	$1 251 169.77	$4 081 319.60	$529 030.61	$5 861 519.97	1
3.1.4.4	$181 534.99	$2 918 312.55	$370 530.46	$3 470 378.00	7	$22 001.18	$28 272.99	$50 274.17	7	$1 005 992.04	$3 297 973.43	$512 858.21	$4 816 823.67	7
3.1.4.5	$181 534.99	$2 923 161.10	$354 413.67	$3 459 109.76	6	$21 783.67	$28 272.99	$50 056.66	6	$1 005 992.04	$3 303 452.75	$490 550.66	$4 799 995.44	6
3.1.4.6	$181 534.99	$2 928 009.64	$348 186.60	$3 457 731.24	5	$21 714.50	$28 272.99	$49 987.49	5	$1 005 992.04	$3 308 932.07	$481 931.65	$4 796 855.76	5
3.1.4.7	$159 114.24	$2 465 351.14	$452 478.61	$3 076 944.00	4	$20 736.90	$23 560.58	$44 297.48	4	$851 232.68	$2 786 083.54	$626 284.19	$4 263 600.41	4
3.1.4.8	$151 371.54	$2 315 980.19	$462 496.71	$2 929 848.45	3	$20 061.34	$21 989.78	$42 051.12	3	$799 202.74	$2 617 280.02	$640 150.43	$4 056 633.19	3
3.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$21 204.37	$40 912.86	2	$773 093.53	$2 532 878.25	$645 746.31	$3 951 718.10	2
3.1.4.10	$215 495.91	$3 616 903.58	$351 833.58	$4 184 233.07	9	$25 560.08	$35 841.41	$61 401.49	9	$1 251 169.77	$4 087 448.37	$486 979.50	$5 825 597.64	9
RB 48 hr 3.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$694 351.72	$2 268 694.27	$753 242.87	$3 716 288.87	
RB 24 hr 3.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$694 351.72	$2 268 694.27	$494 915.11	$3 457 961.10	
3.4.1.1	$26 117.08	$260 988.68	$1 483	$1 770 949.09	1	$23 828.99	$1 935.22	$25 764.21	1	$91 421.11	$294 942.27	$2 053	$2 440 178.95	1
3.4.1.2	$35 014.41	$398 392.16	$1 432	$1 866 378.31	5	$23 843.68	$2 902.91	$26 746.59	6	$130 275.92	$450 221.40	$1 983	$2 563 900.57	5
3.4.1.3	$41 564.78	$489 314.97	$1 427	$1 958 116.04	9	$24 279.08	$3 679.99	$27 959.07	1	$160 497.89	$552 972.91	$1 975	$2 688 935.50	9
3.4.1.4	$35 014.41	$413 310.58	$1 424	$1 872 994.04	6	$23 793.74	$2 902.91	$26 696.64	5	$130 275.92	$467 080.64	$1 971	$2 569 267.91	6
3.4.1.5	$35 014.41	$428 229.00	$1 424	$1 887 359.22	7	$23 860.03	$2 902.91	$26 762.93	7	$130 275.92	$483 939.89	$1 971	$2 585 361.40	7
3.4.1.6	$35 014.41	$443 147.41	$1 419	$1 897 905.30	8	$23 869.04	$2 902.91	$26 771.94	8	$130 275.92	$500 799.13	$1 965	$2 596 168.81	8
3.4.1.7	$30 689.90	$340 135.12	$1 459	$1 830 089.67	4	$23 902.68	$2 419.06	$26 321.75	4	$111 053.12	$384 385.34	$2 019	$2 515 234.23	4
3.4.1.8	$29 196.49	$320 716.10	$1 469	$1 819 018.18	3	$23 937.97	$2 257.78	$26 195.75	3	$104 559.98	$362 439.99	$2 033	$2 500 416.76	3
3.4.1.9	$28 438.76	$311 006.59	$1 467	$1 806 551.24	2	$23 851.70	$2 177.14	$26 028.84	2	$101 295.24	$351 467.32	$2 030	$2 483 411.52	2
3.4.1.10	$41 564.78	$505 934.91	$1 419	$1 967 303.66	1	$24 250.69	$3 679.99	$27 930.68	9	$160 497.89	$571 755.03	$1 965	$2 697 430.40	1
RB 48 hr 3.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$91 421.11	$294 942.27	$3 184	$3 570 901.12	
RB 24 hr 3.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$91 421.11	$294 942.27	$2 130	$2 516 703.73	
3.4.4.1	$341 398.74	$6 116 636.13	$2 096	$8 555 000.23	1	$65 519.93	$67 727.54	$133 247.47	1	$2 255 809.25	$6 912 386.20	$2 902	$12 070 644.79	1
3.4.4.2	$457 703.32	$8 866 841.40	$1 718	$11 042 754.90	8	$74 775.93	$101 593.95	$176 369.89	8	$3 294 137.97	$10 020 382.25	$2 378	$15 692 727.38	8
3.4.4.3	$543 328.82	$10 998 744.17	$1 624	$13 166 443.52	1	$84 901.23	$128 789.74	$213 690.97	1	$4 115 142.21	$12 429 637.11	$2 248	$18 793 101.25	1
3.4.4.4	$457 703.32	$8 880 552.65	$1 581	$10 919 295.88	7	$72 786.94	$101 593.95	$174 380.89	7	$3 294 137.97	$10 035 877.28	$2 188	$15 518 362.45	7
3.4.4.5	$457 703.32	$8 894 263.89	$1 518	$10 870 505.79	6	$71 917.97	$101 593.95	$173 511.93	6	$3 294 137.97	$10 051 372.31	$2 101	$15 447 348.20	6
3.4.4.6	$457 703.32	$8 907 975.14	$1 493	$10 859 503.27	5	$71 615.82	$101 593.95	$173 209.78	5	$3 294 137.97	$10 066 867.34	$2 067	$15 428 636.43	5
3.4.4.7	$401 173.98	$7 501 505.75	$1 909	$9 812 537.63	4	$70 247.37	$84 660.75	$154 908.12	4	$2 777 648.20	$8 477 421.86	$2 643	$13 898 540.45	4
3.4.4.8	$381 652.35	$7 046 393.87	$1 953	$9 381 550.69	3	$68 427.39	$79 016.35	$147 443.74	3	$2 604 366.77	$7 963 101.73	$2 703	$13 271 350.93	3
3.4.4.9	$371 747.38	$6 818 837.92	$1 971	$9 162 366.68	2	$67 462.73	$76 194.15	$143 656.88	2	$2 517 488.47	$7 705 941.66	$2 729	$12 952 609.97	2
3.4.4.10	$543 328.82	$11 014 046.28	$1 509	$13 066 387.14	9	$83 247.37	$128 789.74	$212 037.10	9	$4 115 142.21	$12 446 929.96	$2 088	$18 650 724.24	9
RB 48 hr 3.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 255 809.25	$6 912 386.20	$3 184	$12 352 733.18	
RB 24 hr 3.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 255 809.25	$6 912 386.20	$2 130	$11 298 535.80	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$449 528.61	$12 949.52	$142 662.52
$488 364.81	$19 424.79	$143 978.95
$518 894.40	$24 624.63	$147 512.37
$490 988.33	$19 424.79	$143 676.59
$496 009.46	$19 424.79	$144 265.21
$499 981.81	$19 424.79	$144 464.09
$474 283.36	$16 187.16	$144 037.35
$469 939.37	$15 107.94	$144 192.07
$465 834.88	$14 568.34	$143 552.41
$522 821.82	$24 624.63	$147 541.29
$650 152.05	$12 949.52	$217 216.46
$461 813.15	$12 949.52	$147 227.60
$2 713 094.74	$471 204.24	$466 888.75
$3 597 905.60	$706 824.74	$555 341.43
$4 324 796.34	$896 035.32	$640 688.32
$3 567 265.30	$706 824.74	$542 733.63
$3 555 886.92	$706 824.74	$537 283.79
$3 554 488.44	$706 824.74	$535 542.58
$3 162 326.80	$589 014.49	$512 259.13
$3 011 145.19	$549 744.41	$495 743.58
$2 934 499.80	$530 109.37	$487 108.93
$4 299 602.59	$896 035.32	$629 959.74
$2 760 557.99	$471 204.24	$484 526.63
$2 572 219.09	$471 204.24	$414 537.77
$1 796 726.23	$48 380.50	$595 072.22
$1 896 231.82	$72 572.64	$595 096.12
$1 991 182.11	$91 999.68	$605 753.71
$1 902 885.16	$72 572.64	$593 810.12
$1 917 358.61	$72 572.64	$595 430.16
$1 927 978.14	$72 572.64	$595 618.04
$1 858 040.94	$60 476.57	$596 716.72
$1 846 324.79	$56 444.55	$597 647.42
$1 833 468.08	$54 428.54	$595 514.90
$2 000 428.19	$91 999.68	$605 002.53
$2 621 101.29	$48 380.50	$901 419.32
$1 852 518.12	$48 380.50	$615 805.11
$8 754 749.61	$1 693	$1 622 706.61
$11 305 647.27	$2 539	$1 847 231.24
$13 478 323.88	$3 219	$2 095 033.96
$11 181 041.57	$2 539	$1 797 472.01
$11 131 785.69	$2 539	$1 775 713.64
$11 120 661.95	$2 539	$1 768 125.60
$10 044 591.20	$2 116	$1 737 430.53
$9 602 873.48	$1 975	$1 693 068.78
$9 378 235.08	$1 904	$1 669 521.24
$13 377 331.80	$3 219	$2 053 649.03
$8 960 411.66	$1 693	$1 699 132.96
$8 191 828.48	$1 693	$1 413 518.75

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
4.1.1.1	$10 070.88	$86 301.48	$359 377.43	$455 749.78	1	$5 924.89	$517.98	$6 442.87	1	$29 546.20	$97 528.96	$497 421.08	$624 496.24	1
4.1.1.2	$13 501.73	$134 784.12	$332 420.55	$480 706.41	5	$5 797.95	$776.99	$6 574.94	7	$41 675.47	$152 319.00	$460 109.56	$654 104.03	5
4.1.1.3	$16 027.59	$163 157.83	$329 121.73	$508 307.15	9	$5 916.10	$984.99	$6 901.08	9	$51 037.89	$184 384.01	$455 543.60	$690 965.50	9
4.1.1.4	$13 501.73	$139 854.06	$329 491.07	$482 846.86	6	$5 779.35	$776.99	$6 556.35	5	$41 675.47	$158 048.52	$456 054.81	$655 778.80	6
4.1.1.5	$13 501.73	$144 924.00	$327 073.36	$485 499.10	7	$5 768.44	$776.99	$6 545.43	4	$41 675.47	$163 778.04	$452 708.42	$658 161.93	7
4.1.1.6	$13 501.73	$149 993.94	$327 992.00	$491 487.67	8	$5 807.57	$776.99	$6 584.56	8	$41 675.47	$169 507.56	$453 979.92	$665 162.95	8
4.1.1.7	$11 834.18	$115 520.19	$347 592.00	$474 946.37	4	$5 912.19	$647.49	$6 559.68	6	$35 689.73	$130 548.90	$481 108.65	$647 347.29	4
4.1.1.8	$11 258.32	$109 098.87	$351 685.65	$472 042.84	3	$5 935.61	$604.32	$6 539.93	3	$33 661.50	$123 292.20	$486 774.74	$643 728.45	3
4.1.1.9	$10 966.13	$105 888.22	$353 129.87	$469 984.21	2	$5 938.24	$582.73	$6 520.98	2	$32 640.38	$119 663.85	$488 773.71	$641 077.95	2
4.1.1.10	$16 027.59	$168 836.10	$327 403.07	$512 266.76	1	$5 918.71	$984.99	$6 903.69	1	$51 037.89	$190 801.01	$453 164.77	$695 003.67	1
RB 48 hr 4.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$29 546.20	$97 528.96	$753 242.87	$880 318.03	
RB 24 hr 4.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$29 546.20	$97 528.96	$494 915.11	$621 990.27	
4.1.4.1	$135 406.09	$2 007 523.44	$609 235.68	$2 752 165.22	1	$20 557.29	$18 848.17	$39 405.46	1	$694 351.72	$2 268 694.27	$843 254.61	$3 806 300.60	1
4.1.4.2	$181 534.99	$2 913 464.00	$486 440.82	$3 581 439.82	8	$23 715.59	$28 272.99	$51 988.58	8	$1 005 992.04	$3 292 494.10	$673 291.92	$4 971 778.06	8
4.1.4.3	$215 495.91	$3 611 480.34	$442 750.19	$4 269 726.45	1	$26 896.71	$35 841.41	$62 738.13	1	$1 251 169.77	$4 081 319.60	$612 818.90	$5 945 308.26	1
4.1.4.4	$181 534.99	$2 918 312.55	$412 744.82	$3 512 592.37	7	$22 634.39	$28 272.99	$50 907.38	7	$1 005 992.04	$3 297 973.43	$571 287.90	$4 875 253.37	7
4.1.4.5	$181 534.99	$2 923 161.10	$385 330.98	$3 490 027.07	6	$22 247.43	$28 272.99	$50 520.42	6	$1 005 992.04	$3 303 452.75	$533 343.88	$4 842 788.67	6
4.1.4.6	$181 534.99	$2 928 009.64	$369 674.63	$3 479 219.27	5	$22 036.82	$28 272.99	$50 309.81	5	$1 005 992.04	$3 308 932.07	$511 673.64	$4 826 597.75	5
4.1.4.7	$159 114.24	$2 465 351.14	$533 465.23	$3 157 930.61	4	$21 951.70	$23 560.58	$45 512.28	4	$851 232.68	$2 786 083.54	$738 379.29	$4 375 695.51	4
4.1.4.8	$151 371.54	$2 315 980.19	$545 523.53	$3 012 875.27	3	$21 306.74	$21 989.78	$43 296.52	3	$799 202.74	$2 617 280.02	$755 069.42	$4 171 552.18	3
4.1.4.9	$147 443.02	$2 241 294.71	$552 674.22	$2 941 411.94	2	$21 000.51	$21 204.37	$42 204.88	2	$773 093.53	$2 532 878.25	$764 966.82	$4 070 938.61	2
4.1.4.10	$215 495.91	$3 616 903.58	$379 218.61	$4 211 618.09	9	$25 970.86	$35 841.41	$61 812.27	9	$1 251 169.77	$4 087 448.37	$524 883.63	$5 863 501.77	9
RB 48 hr 4.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$694 351.72	$2 268 694.27	$753 242.87	$3 716 288.87	
RB 24 hr 4.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$694 351.72	$2 268 694.27	$494 915.11	$3 457 961.10	
4.4.1.1	$26 117.08	$260 988.68	$1 540	$1 827 549.45	1	$24 677.99	$1 935.22	$26 613.21	1	$91 421.11	$294 942.27	$2 132	$2 518 520.58	1
4.4.1.2	$35 014.41	$398 392.16	$1 441	$1 874 939.65	5	$23 972.10	$2 902.91	$26 875.01	8	$130 275.92	$450 221.40	$1 995	$2 575 750.48	5
4.4.1.3	$41 564.78	$489 314.97	$1 430	$1 961 280.86	9	$24 326.55	$3 679.99	$28 006.54	1	$160 497.89	$552 972.91	$1 979	$2 693 315.98	9
4.4.1.4	$35 014.41	$413 310.58	$1 431	$1 879 725.85	6	$23 894.71	$2 902.91	$26 797.62	4	$130 275.92	$467 080.64	$1 981	$2 578 585.53	6
4.4.1.5	$35 014.41	$428 229.00	$1 423	$1 886 946.19	7	$23 853.83	$2 902.91	$26 756.74	2	$130 275.92	$483 939.89	$1 970	$2 584 789.72	7
4.4.1.6	$35 014.41	$443 147.41	$1 426	$1 904 411.63	8	$23 966.63	$2 902.91	$26 869.54	7	$130 275.92	$500 799.13	$1 974	$2 605 174.35	8
4.4.1.7	$30 689.90	$340 135.12	$1 494	$1 864 905.50	4	$24 424.92	$2 419.06	$26 843.98	6	$111 053.12	$384 385.34	$2 067	$2 563 423.48	4
4.4.1.8	$29 196.49	$320 716.10	$1 510	$1 860 186.09	3	$24 555.49	$2 257.78	$26 813.27	5	$104 559.98	$362 439.99	$2 090	$2 557 398.04	3
4.4.1.9	$28 438.76	$311 006.59	$1 517	$1 857 240.17	2	$24 612.03	$2 177.14	$26 789.17	3	$101 295.24	$351 467.32	$2 100	$2 553 571.02	2
4.4.1.10	$41 564.78	$505 934.91	$1 423	$1 970 898.12	1	$24 304.61	$3 679.99	$27 984.60	9	$160 497.89	$571 755.03	$1 970	$2 702 405.56	1
RB 48 hr 4.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$91 421.11	$294 942.27	$3 184	$3 570 901.12	
RB 24 hr 4.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$91 421.11	$294 942.27	$2 130	$2 516 703.73	
4.4.4.1	$341 398.74	$6 116 636.13	$2 570	$9 028 963.50	1	$72 629.38	$67 727.54	$140 356.92	1	$2 255 809.25	$6 912 386.20	$3 558	$12 726 666.31	1
4.4.4.2	$457 703.32	$8 866 841.40	$2 053	$11 377 774.06	8	$79 801.22	$101 593.95	$181 395.18	8	$3 294 137.97	$10 020 382.25	$2 841	$16 156 433.74	8
4.4.4.3	$543 328.82	$10 998 744.17	$1 869	$13 411 717.65	1	$88 580.34	$128 789.74	$217 370.08	1	$4 115 142.21	$12 429 637.11	$2 587	$19 132 589.81	1
4.4.4.4	$457 703.32	$8 880 552.65	$1 748	$11 087 101.96	7	$75 304.03	$101 593.95	$176 897.98	7	$3 294 137.97	$10 035 877.28	$2 420	$15 750 626.02	7
4.4.4.5	$457 703.32	$8 894 263.89	$1 638	$10 990 820.07	6	$73 722.69	$101 593.95	$175 316.64	6	$3 294 137.97	$10 051 372.31	$2 268	$15 613 877.46	6
4.4.4.6	$457 703.32	$8 907 975.14	$1 578	$10 944 366.00	5	$72 888.76	$101 593.95	$174 482.72	5	$3 294 137.97	$10 066 867.34	$2 185	$15 546 096.54	5
4.4.4.7	$401 173.98	$7 501 505.75	$2 249	$10 152 618.47	4	$75 348.58	$84 660.75	$160 009.33	4	$2 777 648.20	$8 477 421.86	$3 114	$14 369 252.77	4
4.4.4.8	$381 652.35	$7 046 393.87	$2 302	$9 730 849.93	3	$73 666.88	$79 016.35	$152 683.23	3	$2 604 366.77	$7 963 101.73	$3 187	$13 754 822.59	3
4.4.4.9	$371 747.38	$6 818 837.92	$2 332	$9 522 932.11	2	$72 871.21	$76 194.15	$149 065.36	2	$2 517 488.47	$7 705 941.66	$3 228	$13 451 675.39	2
4.4.4.10	$543 328.82	$11 014 046.28	$1 615	$13 172 751.64	9	$84 842.83	$128 789.74	$213 632.57	9	$4 115 142.21	$12 446 929.96	$2 235	$18 797 945.35	9
RB 48 hr 4.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 255 809.25	$6 912 386.20	$3 184	$12 352 733.18	
4 hr 4.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 255 809.25	$6 912 386.20	$2 130	$11 298 535.80	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$463 640.18	$12 949.52	$147 906.54
$490 067.54	$19 424.79	$144 611.70
$518 846.36	$24 624.63	$147 494.52
$492 219.79	$19 424.79	$144 134.21
$494 888.49	$19 424.79	$143 848.64
$500 923.96	$19 424.79	$144 814.20
$483 644.19	$16 187.16	$147 515.94
$480 502.90	$15 107.94	$148 117.60
$478 318.24	$14 568.34	$148 191.37
$522 833.43	$24 624.63	$147 545.61
$650 152.05	$12 949.52	$217 216.46
$461 813.15	$12 949.52	$147 227.60
$2 826 182.80	$471 204.24	$508 913.56
$3 679 347.26	$706 824.74	$585 606.07
$4 385 883.82	$896 035.32	$663 389.12
$3 609 864.61	$706 824.74	$558 564.02
$3 587 086.16	$706 824.74	$548 877.77
$3 576 172.42	$706 824.74	$543 600.59
$3 244 051.92	$589 014.49	$542 629.11
$3 094 929.13	$549 744.41	$526 878.64
$3 021 419.84	$530 109.37	$519 409.40
$4 327 237.33	$896 035.32	$640 229.12
$2 760 557.99	$471 204.24	$484 526.63
$2 572 219.09	$471 204.24	$414 537.77
$1 853 842.73	$48 380.50	$616 297.35
$1 904 871.23	$72 572.64	$598 306.62
$1 994 375.78	$91 999.68	$606 940.52
$1 909 678.35	$72 572.64	$596 334.54
$1 916 941.81	$72 572.64	$595 275.27
$1 934 543.80	$72 572.64	$598 057.91
$1 893 174.25	$60 476.57	$609 772.66
$1 887 868.10	$56 444.55	$613 085.39
$1 884 619.24	$54 428.54	$614 523.25
$2 004 055.43	$91 999.68	$606 350.46
$2 621 101.29	$48 380.50	$901 419.32
$1 852 518.12	$48 380.50	$615 805.11
$9 233 034.90	$1 693	$1 800 442.84
$11 643 721.44	$2 539	$1 972 863.42
$13 725 834.64	$3 219	$2 187 011.76
$11 350 377.85	$2 539	$1 860 399.29
$11 253 197.10	$2 539	$1 820 831.49
$11 206 298.54	$2 539	$1 799 949.13
$10 387 773.20	$2 116	$1 864 960.85
$9 955 357.93	$1 975	$1 824 055.99
$9 742 088.46	$1 904	$1 804 733.28
$13 484 666.23	$3 219	$2 093 535.72
$8 960 411.66	$1 693	$1 699 132.96
$8 191 828.48	$1 693	$1 413 518.75

APPENDIX D2: SUMMARY OF COST ESTIMATIONS AS PERCENTAGE

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.1.1.1	2.29%	19.62%	78.09%	68.67%	91.65%	8.35%	67.33%	4.90%	16.19%	78.91%	68.44%	74.29%	2.15%	23.56%
2.1.1.2	2.83%	28.22%	68.96%	74.57%	88.10%	11.90%	70.85%	6.41%	23.44%	70.15%	73.82%	74.94%	2.99%	22.08%
2.1.1.3	3.16%	32.19%	64.65%	79.13%	85.68%	14.32%	74.66%	7.41%	26.76%	65.83%	78.27%	75.10%	3.57%	21.33%
2.1.1.4	2.80%	29.05%	68.15%	75.16%	88.11%	11.89%	70.92%	6.37%	24.17%	69.45%	74.27%	75.07%	2.97%	21.96%
2.1.1.5	2.78%	29.84%	67.38%	75.82%	88.13%	11.87%	71.05%	6.33%	24.88%	68.79%	74.79%	75.19%	2.95%	21.86%
2.1.1.6	2.75%	30.55%	66.70%	76.66%	88.19%	11.81%	71.38%	6.27%	25.51%	68.22%	75.49%	75.31%	2.92%	21.77%
2.1.1.7	2.55%	24.93%	72.52%	72.34%	89.86%	10.14%	69.31%	5.65%	20.68%	73.67%	71.72%	74.76%	2.56%	22.68%
2.1.1.8	2.44%	23.68%	73.88%	71.93%	90.51%	9.49%	69.13%	5.36%	19.63%	75.01%	71.35%	74.69%	2.41%	22.91%
2.1.1.9	2.39%	23.11%	74.50%	71.54%	90.82%	9.18%	68.86%	5.22%	19.15%	75.63%	70.98%	74.66%	2.33%	23.01%
2.1.1.10	3.13%	33.02%	63.85%	79.82%	85.70%	14.30%	74.76%	7.36%	27.50%	65.14%	78.80%	75.23%	3.55%	21.22%
RB 48 hr 2.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	3.36%	11.08%	85.56%	100.00%	73.85%	1.47%	24.67%
RB 24 hr 2.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	4.75%	15.68%	79.57%	70.66%	74.25%	2.08%	23.67%
2.1.2.1	4.08%	49.83%	46.09%	84.76%	74.47%	25.53%	83.03%	11.19%	41.64%	47.17%	84.46%	75.71%	6.22%	18.06%
2.1.2.2	4.58%	61.41%	34.01%	101.11%	67.11%	32.89%	96.67%	13.48%	51.55%	34.97%	100.27%	76.20%	7.86%	15.93%
2.1.2.3	4.75%	66.19%	29.06%	115.79%	63.50%	36.50%	110.43%	14.53%	55.58%	29.89%	114.80%	76.27%	8.71%	15.02%
2.1.2.4	4.61%	62.20%	33.19%	100.62%	66.79%	33.21%	95.76%	13.56%	52.28%	34.16%	99.68%	76.29%	7.91%	15.80%
2.1.2.5	4.59%	62.55%	32.86%	100.86%	66.76%	33.24%	95.66%	13.54%	52.61%	33.85%	99.84%	76.35%	7.90%	15.75%
2.1.2.6	4.58%	62.89%	32.52%	101.10%	66.72%	33.28%	95.55%	13.52%	52.95%	33.53%	99.99%	76.42%	7.89%	15.70%
2.1.2.7	4.34%	56.24%	39.42%	93.62%	70.64%	29.36%	90.25%	12.37%	47.15%	40.47%	92.98%	76.03%	7.07%	16.90%
2.1.2.8	4.25%	54.41%	41.35%	91.01%	71.89%	28.11%	87.97%	11.97%	45.59%	42.44%	90.43%	75.97%	6.78%	17.24%
2.1.2.9	4.20%	53.50%	42.30%	89.62%	72.50%	27.50%	86.74%	11.77%	44.82%	43.41%	89.06%	75.95%	6.64%	17.41%
2.1.2.10	4.75%	66.72%	28.52%	115.70%	63.32%	36.68%	109.91%	14.55%	56.08%	29.36%	114.61%	76.34%	8.72%	14.94%
RB 48 hr 2.1.2	3.46%	42.24%	54.30%	100.00%	78.80%	21.20%	100.00%	9.45%	35.17%	55.37%	100.00%	75.28%	5.26%	19.46%
RB 24 hr 2.1.2	4.25%	51.91%	43.84%	81.38%	73.25%	26.75%	79.25%	11.67%	43.42%	44.91%	81.01%	75.83%	6.49%	17.68%
2.1.3.1	5.01%	62.52%	32.46%	91.58%	61.69%	38.31%	90.91%	15.66%	51.55%	32.78%	91.50%	74.96%	9.63%	15.40%
2.1.3.2	5.35%	72.59%	22.06%	115.04%	54.26%	45.74%	114.22%	17.93%	59.81%	22.26%	115.02%	74.99%	11.50%	13.51%
2.1.3.3	5.41%	76.55%	18.04%	135.00%	50.97%	49.03%	135.07%	18.89%	62.95%	18.17%	135.25%	74.86%	12.40%	12.75%
2.1.3.4	5.39%	73.46%	21.15%	114.14%	53.77%	46.23%	113.00%	18.08%	60.57%	21.36%	114.06%	75.05%	11.60%	13.35%
2.1.3.5	5.40%	73.87%	20.73%	113.98%	53.60%	46.40%	112.58%	18.11%	60.94%	20.95%	113.83%	75.10%	11.62%	13.29%
2.1.3.6	5.39%	74.08%	20.52%	114.11%	53.56%	46.44%	112.47%	18.10%	61.15%	20.75%	113.89%	75.13%	11.61%	13.25%
2.1.3.7	5.19%	68.04%	26.77%	103.94%	57.73%	42.27%	102.99%	16.85%	56.11%	27.04%	103.84%	75.01%	10.61%	14.37%
2.1.3.8	5.13%	66.43%	28.44%	100.05%	58.98%	41.02%	99.05%	16.46%	54.80%	28.74%	99.92%	75.03%	10.29%	14.68%
2.1.3.9	5.10%	65.66%	29.24%	97.98%	59.59%	40.41%	96.94%	16.28%	54.18%	29.55%	97.83%	75.03%	10.14%	14.83%
2.1.3.10	5.43%	77.06%	17.51%	134.60%	50.72%	49.28%	134.37%	18.95%	63.40%	17.65%	134.78%	74.90%	12.44%	12.66%
RB 48 hr 2.1.3	4.59%	57.26%	38.15%	100.00%	65.18%	34.82%	100.00%	14.33%	47.17%	38.50%	100.00%	74.79%	8.82%	16.40%
RB 24 hr 2.1.3	5.28%	65.88%	28.84%	86.92%	59.45%	40.55%	85.87%	16.51%	54.35%	29.14%	86.80%	75.07%	10.16%	14.77%
2.1.4.1	5.13%	76.09%	18.77%	98.18%	50.00%	50.00%	98.09%	19.03%	62.18%	18.79%	98.18%	74.31%	12.91%	12.78%
2.1.4.2	5.19%	83.22%	11.59%	130.28%	44.32%	55.68%	132.14%	20.70%	67.74%	11.56%	130.78%	74.03%	14.54%	11.43%
2.1.4.3	5.12%	85.82%	9.06%	156.61%	42.02%	57.98%	160.86%	21.35%	69.64%	9.01%	157.69%	73.78%	15.29%	10.93%
2.1.4.4	5.23%	84.12%	10.65%	129.11%	43.75%	56.25%	130.78%	20.89%	68.49%	10.62%	129.58%	74.06%	14.68%	11.26%
2.1.4.5	5.25%	84.51%	10.24%	128.72%	43.52%	56.48%	130.25%	20.96%	68.83%	10.22%	129.15%	74.08%	14.73%	11.19%
2.1.4.6	5.25%	84.70%	10.05%	128.65%	43.43%	56.57%	130.04%	20.98%	69.00%	10.03%	129.05%	74.10%	14.74%	11.16%
2.1.4.7	5.18%	80.18%	14.64%	114.42%	46.77%	53.23%	115.18%	19.98%	65.39%	14.63%	114.64%	74.17%	13.83%	12.00%
2.1.4.8	5.16%	79.02%	15.81%	109.07%	47.73%	52.27%	109.46%	19.69%	64.50%	15.81%	109.20%	74.23%	13.55%	12.23%
2.1.4.9	5.16%	78.50%	16.34%	106.26%	48.17%	51.83%	106.46%	19.56%	64.10%	16.34%	106.34%	74.26%	13.41%	12.33%
2.1.4.10	5.15%	86.45%	8.40%	155.70%	41.62%	58.38%	159.76%	21.48%	70.17%	8.35%	156.74%	73.81%	15.38%	10.81%
RB 48 hr 2.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	18.68%	61.05%	20.27%	100.00%	74.28%	12.68%	13.04%
RB 24 hr 2.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	20.08%	65.61%	14.31%	93.05%	74.39%	13.63%	11.99%

Universiti Teknologi MARA

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.2.1.1	1.83%	16.55%	81.62%	68.93%	91.92%	8.08%	68.08%	4.31%	13.59%	82.10%	68.81%	73.83%	2.12%	24.06%
2.2.1.2	2.30%	23.78%	73.92%	73.48%	88.41%	11.59%	71.22%	5.76%	19.61%	74.64%	73.07%	74.23%	2.99%	22.77%
2.2.1.3	2.59%	27.59%	69.82%	77.48%	86.01%	13.99%	74.76%	6.71%	22.76%	70.53%	77.01%	74.35%	3.60%	22.06%
2.2.1.4	2.29%	24.47%	73.25%	73.88%	88.41%	11.59%	71.21%	5.73%	20.20%	74.07%	73.36%	74.34%	2.98%	22.68%
2.2.1.5	2.27%	25.10%	72.63%	74.40%	88.43%	11.57%	71.34%	5.70%	20.75%	73.54%	73.77%	74.44%	2.96%	22.60%
2.2.1.6	2.25%	25.69%	72.06%	75.03%	88.47%	11.53%	71.57%	5.66%	21.27%	73.07%	74.29%	74.54%	2.94%	22.52%
2.2.1.7	2.07%	20.83%	77.10%	71.66%	90.15%	9.85%	69.78%	5.04%	17.16%	77.80%	71.30%	74.12%	2.55%	23.32%
2.2.1.8	1.98%	19.75%	78.27%	71.29%	90.77%	9.23%	69.55%	4.77%	16.27%	78.96%	70.95%	74.08%	2.40%	23.52%
2.2.1.9	1.93%	19.23%	78.83%	71.00%	91.07%	8.93%	69.32%	4.64%	15.84%	79.52%	70.67%	74.06%	2.32%	23.62%
2.2.1.10	2.57%	28.28%	69.15%	77.98%	86.02%	13.98%	74.81%	6.68%	23.36%	69.96%	77.39%	74.45%	3.58%	21.97%
RB 48 hr 2.2.1	1.26%	11.41%	87.33%	100.00%	94.50%	5.50%	100.00%	2.96%	9.35%	87.68%	100.00%	73.54%	1.46%	25.00%
RB 24 hr 2.2.1	1.77%	16.05%	82.18%	71.09%	92.18%	7.82%	70.30%	4.18%	13.18%	82.64%	70.97%	73.80%	2.05%	24.15%
2.2.2.1	3.49%	45.34%	51.16%	83.69%	74.30%	25.70%	82.58%	10.72%	37.48%	51.80%	83.52%	74.74%	6.51%	18.75%
2.2.2.2	4.01%	56.90%	39.08%	97.61%	66.56%	33.44%	95.19%	13.24%	47.12%	39.64%	97.24%	75.01%	8.39%	16.60%
2.2.2.3	4.19%	61.97%	33.84%	110.89%	62.72%	37.28%	108.27%	14.42%	51.28%	34.30%	110.53%	75.01%	9.36%	15.63%
2.2.2.4	4.03%	57.59%	38.37%	97.13%	66.28%	33.72%	94.40%	13.32%	47.73%	38.95%	96.68%	75.08%	8.44%	16.48%
2.2.2.5	4.03%	57.90%	38.07%	97.30%	66.24%	33.76%	94.30%	13.30%	48.02%	38.67%	96.77%	75.13%	8.43%	16.44%
2.2.2.6	4.02%	58.22%	37.76%	97.45%	66.19%	33.81%	94.17%	13.29%	48.33%	38.38%	96.85%	75.18%	8.43%	16.39%
2.2.2.7	3.77%	51.67%	44.56%	91.09%	70.23%	29.77%	89.12%	12.04%	42.78%	45.18%	90.77%	74.93%	7.49%	17.58%
2.2.2.8	3.68%	49.80%	46.52%	88.85%	71.55%	28.45%	87.03%	11.61%	41.22%	47.17%	88.54%	74.90%	7.17%	17.93%
2.2.2.9	3.63%	48.85%	47.52%	87.68%	72.21%	27.79%	85.93%	11.39%	40.44%	48.18%	87.38%	74.88%	7.00%	18.11%
2.2.2.10	4.20%	62.47%	33.33%	110.72%	62.55%	37.45%	107.77%	14.45%	51.74%	33.81%	110.28%	75.07%	9.38%	15.55%
RB 48 hr 2.2.2	2.92%	37.95%	59.13%	100.00%	78.78%	21.22%	100.00%	8.96%	31.30%	59.74%	100.00%	74.44%	5.44%	20.12%
RB 24 hr 2.2.2	3.63%	47.18%	49.18%	80.43%	73.17%	26.83%	79.10%	11.16%	39.02%	49.82%	80.22%	74.81%	6.78%	18.40%
2.2.3.1	4.38%	58.71%	36.91%	90.60%	61.12%	38.88%	90.36%	15.41%	47.79%	36.80%	90.62%	73.83%	10.22%	15.95%
2.2.3.2	4.76%	69.37%	25.87%	111.58%	53.13%	46.87%	112.45%	18.04%	56.26%	25.70%	112.00%	73.66%	12.40%	13.93%
2.2.3.3	4.85%	73.74%	21.41%	130.05%	49.58%	50.42%	132.53%	19.17%	59.63%	21.21%	130.95%	73.46%	13.45%	13.09%
2.2.3.4	4.80%	70.20%	24.99%	110.65%	52.65%	47.35%	111.30%	18.20%	56.97%	24.84%	111.02%	73.70%	12.51%	13.78%
2.2.3.5	4.81%	70.58%	24.61%	110.46%	52.48%	47.52%	110.92%	18.23%	57.29%	24.47%	110.78%	73.74%	12.54%	13.72%
2.2.3.6	4.81%	70.80%	24.39%	110.51%	52.42%	47.58%	110.78%	18.23%	57.50%	24.27%	110.78%	73.77%	12.54%	13.69%
2.2.3.7	4.59%	64.50%	30.91%	101.59%	56.84%	43.16%	101.75%	16.81%	52.42%	30.77%	101.77%	73.77%	11.37%	14.86%
2.2.3.8	4.52%	62.78%	32.70%	98.07%	58.17%	41.83%	98.00%	16.36%	51.06%	32.58%	98.18%	73.81%	11.00%	15.19%
2.2.3.9	4.49%	61.95%	33.56%	96.19%	58.82%	41.18%	96.00%	16.15%	50.40%	33.45%	96.25%	73.83%	10.82%	15.35%
2.2.3.10	4.87%	74.23%	20.90%	129.61%	49.33%	50.67%	131.86%	19.24%	60.05%	20.71%	130.44%	73.49%	13.50%	13.01%
RB 48 hr 2.2.3	3.96%	53.19%	42.85%	100.00%	64.86%	35.14%	100.00%	13.97%	43.31%	42.73%	100.00%	73.74%	9.26%	17.00%
RB 24 hr 2.2.3	4.62%	61.98%	33.40%	85.82%	58.88%	41.12%	85.46%	16.27%	50.44%	33.29%	85.86%	73.88%	10.79%	15.34%
2.2.4.1	4.59%	73.53%	21.89%	97.86%	48.64%	51.36%	97.90%	19.33%	59.12%	21.55%	97.89%	72.97%	13.95%	13.08%
2.2.4.2	4.70%	81.52%	13.78%	127.98%	42.40%	57.60%	130.95%	21.38%	65.14%	13.48%	128.83%	72.54%	15.90%	11.56%
2.2.4.3	4.66%	84.48%	10.86%	153.16%	39.91%	60.09%	159.11%	22.19%	67.23%	10.58%	154.80%	72.23%	16.77%	10.99%
2.2.4.4	4.75%	82.48%	12.77%	126.67%	41.79%	58.21%	129.56%	21.60%	65.91%	12.49%	127.51%	72.55%	16.06%	11.39%
2.2.4.5	4.77%	82.90%	12.34%	126.22%	41.54%	58.46%	129.02%	21.68%	66.25%	12.08%	127.04%	72.56%	16.12%	11.31%
2.2.4.6	4.77%	83.09%	12.13%	126.10%	41.45%	58.55%	128.81%	21.70%	66.42%	11.88%	126.90%	72.58%	16.14%	11.28%
2.2.4.7	4.67%	78.10%	17.24%	113.03%	45.08%	54.92%	114.44%	20.50%	62.58%	16.92%	113.45%	72.74%	15.05%	12.21%
2.2.4.8	4.64%	76.77%	18.58%	108.00%	46.13%	53.87%	108.90%	20.15%	61.59%	18.26%	108.28%	72.82%	14.71%	12.46%
2.2.4.9	4.64%	76.20%	19.16%	105.31%	46.61%	53.39%	105.95%	19.99%	61.17%	18.84%	105.51%	72.86%	14.56%	12.58%
2.2.4.10	4.69%	85.14%	10.17%	152.17%	39.50%	60.50%	158.03%	22.33%	67.76%	9.91%	153.79%	72.24%	16.88%	10.87%
RB 48 hr 2.2.4	4.49%	71.96%	23.56%	100.00%	49.72%	50.28%	100.00%	18.92%	57.88%	23.21%	100.00%	72.97%	13.66%	13.38%
RB 24 hr 2.2.4	4.87%	78.04%	17.09%	92.20%	45.55%	54.45%	92.34%	20.49%	62.69%	16.82%	92.32%	72.98%	14.79%	12.23%

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.3.1.1	1.69%	15.74%	82.58%	66.69%	91.80%	8.20%	65.99%	4.18%	12.90%	82.92%	66.59%	73.66%	2.16%	24.18%
2.3.1.2	3.25%	20.72%	76.03%	69.48%	80.94%	19.06%	74.62%	9.10%	16.54%	74.35%	71.24%	72.16%	5.31%	22.52%
2.3.1.3	4.93%	22.55%	72.53%	72.54%	69.75%	30.25%	88.55%	14.69%	17.27%	68.04%	77.54%	69.65%	9.19%	21.16%
2.3.1.4	3.24%	21.34%	75.42%	69.79%	80.93%	19.07%	74.60%	9.08%	17.07%	73.86%	71.46%	72.26%	5.30%	22.44%
2.3.1.5	3.22%	21.94%	74.84%	70.19%	80.95%	19.05%	74.67%	9.04%	17.57%	73.40%	71.77%	72.35%	5.27%	22.37%
2.3.1.6	3.20%	22.50%	74.31%	70.69%	80.99%	19.01%	74.83%	8.99%	18.04%	72.98%	72.17%	72.45%	5.25%	22.31%
2.3.1.7	2.39%	18.86%	78.75%	68.53%	86.95%	13.05%	69.73%	6.33%	15.32%	78.34%	69.07%	73.17%	3.51%	23.32%
2.3.1.8	2.26%	17.89%	79.84%	68.26%	87.87%	12.13%	69.28%	5.94%	14.55%	79.51%	68.73%	73.21%	3.25%	23.54%
2.3.1.9	3.08%	16.08%	80.83%	67.59%	82.74%	17.26%	73.65%	8.44%	12.79%	78.76%	69.56%	71.86%	4.86%	23.28%
2.3.1.10	4.90%	23.12%	71.98%	72.96%	69.77%	30.23%	88.63%	14.63%	17.74%	67.63%	77.87%	69.75%	9.15%	21.09%
RB 48 hr 2.3.1	1.12%	10.49%	88.38%	100.00%	94.59%	5.41%	100.00%	2.78%	8.59%	88.63%	100.00%	73.41%	1.44%	25.15%
RB 24 hr 2.3.1	1.59%	14.83%	83.58%	70.74%	92.29%	7.71%	70.13%	3.94%	12.16%	83.91%	70.66%	73.62%	2.04%	24.34%
2.3.2.1	3.04%	44.28%	52.69%	82.04%	75.66%	24.34%	80.75%	9.82%	36.70%	53.48%	81.82%	74.81%	6.15%	19.04%
2.3.2.2	5.52%	52.56%	41.92%	90.76%	54.32%	45.68%	113.13%	19.82%	40.56%	39.62%	97.21%	70.30%	13.61%	16.09%
2.3.2.3	7.92%	54.75%	37.33%	99.96%	40.15%	59.85%	162.61%	29.33%	38.51%	32.16%	117.46%	64.65%	21.21%	14.14%
2.3.2.4	5.56%	53.28%	41.16%	90.18%	53.97%	46.03%	112.27%	19.95%	41.13%	38.92%	96.57%	70.33%	13.70%	15.97%
2.3.2.5	5.55%	53.61%	40.83%	90.27%	53.90%	46.10%	112.11%	19.95%	41.42%	38.63%	96.59%	70.38%	13.70%	15.92%
2.3.2.6	5.55%	53.94%	40.51%	90.37%	53.84%	46.16%	111.97%	19.94%	41.70%	38.36%	96.62%	70.43%	13.69%	15.88%
2.3.2.7	4.17%	48.83%	47.01%	87.09%	65.11%	34.89%	94.75%	14.35%	39.30%	46.34%	89.43%	72.96%	9.46%	17.57%
2.3.2.8	4.02%	47.06%	48.92%	85.19%	66.82%	33.18%	91.99%	13.68%	37.98%	48.34%	87.27%	73.10%	8.95%	17.95%
2.3.2.9	5.63%	43.35%	51.02%	82.13%	56.90%	43.10%	107.17%	19.49%	32.98%	47.54%	89.24%	69.33%	13.25%	17.42%
2.3.2.10	7.94%	55.25%	36.81%	99.71%	39.96%	60.04%	162.09%	29.41%	38.87%	31.72%	117.15%	64.67%	21.27%	14.07%
RB 48 hr 2.3.2	2.49%	36.32%	61.19%	100.00%	80.35%	19.65%	100.00%	8.03%	30.02%	61.94%	100.00%	74.47%	5.03%	20.50%
RB 24 hr 2.3.2	3.12%	45.55%	51.33%	79.75%	74.90%	25.10%	78.30%	10.11%	37.77%	52.13%	79.49%	74.87%	6.33%	18.80%
2.3.3.1	3.33%	58.86%	37.81%	89.47%	66.76%	33.24%	88.37%	12.28%	49.10%	38.62%	89.27%	75.36%	8.23%	16.41%
2.3.3.2	5.79%	66.41%	27.80%	103.56%	44.38%	55.62%	138.87%	23.49%	50.58%	25.93%	113.17%	69.43%	17.06%	13.50%
2.3.3.3	8.16%	68.00%	23.84%	116.18%	31.47%	68.53%	212.27%	33.74%	46.35%	19.91%	141.85%	62.69%	25.64%	11.67%
2.3.3.4	5.85%	67.32%	26.84%	102.54%	43.85%	56.15%	137.56%	23.72%	51.25%	25.03%	112.09%	69.43%	17.23%	13.34%
2.3.3.5	5.86%	67.73%	26.40%	102.28%	43.65%	56.35%	137.09%	23.79%	51.58%	24.63%	111.77%	69.45%	17.28%	13.27%
2.3.3.6	5.86%	67.94%	26.20%	102.35%	43.61%	56.39%	136.97%	23.78%	51.76%	24.45%	111.79%	69.48%	17.27%	13.24%
2.3.3.7	4.47%	63.01%	32.52%	97.20%	55.14%	44.86%	110.14%	17.48%	50.56%	31.96%	100.82%	72.80%	12.25%	14.95%
2.3.3.8	4.35%	61.28%	34.37%	94.22%	56.85%	43.15%	105.73%	16.81%	49.31%	33.88%	97.44%	72.98%	11.70%	15.31%
2.3.3.9	6.19%	57.36%	36.46%	89.36%	46.08%	53.92%	128.05%	24.01%	42.73%	33.26%	99.83%	68.03%	17.29%	14.68%
2.3.3.10	8.19%	68.52%	23.29%	115.68%	31.23%	68.77%	211.52%	33.88%	46.69%	19.43%	141.29%	62.68%	25.74%	11.59%
RB 48 hr 2.3.3	2.98%	52.66%	44.36%	100.00%	70.63%	29.37%	100.00%	10.96%	43.83%	45.21%	100.00%	75.10%	7.34%	17.56%
RB 24 hr 2.3.3	3.49%	61.73%	34.78%	85.32%	64.94%	35.06%	83.78%	12.89%	51.54%	35.57%	85.03%	75.48%	8.64%	15.88%
2.3.4.1	3.27%	74.54%	22.19%	97.16%	56.69%	43.31%	96.74%	14.51%	62.65%	22.84%	97.08%	75.90%	10.50%	13.60%
2.3.4.2	5.41%	79.73%	14.86%	118.22%	35.68%	64.32%	171.30%	26.26%	60.03%	13.70%	131.86%	68.54%	20.32%	11.14%
2.3.4.3	7.49%	80.27%	12.24%	135.00%	24.74%	75.26%	275.70%	36.79%	53.27%	9.95%	170.84%	60.87%	29.54%	9.59%
2.3.4.4	5.47%	80.78%	13.75%	116.87%	35.05%	64.95%	169.64%	26.55%	60.78%	12.67%	130.44%	68.50%	20.54%	10.95%
2.3.4.5	5.49%	81.20%	13.30%	116.42%	34.81%	65.19%	169.03%	26.65%	61.09%	12.26%	129.96%	68.50%	20.62%	10.88%
2.3.4.6	5.50%	81.43%	13.07%	116.27%	34.70%	65.30%	168.74%	26.69%	61.27%	12.04%	129.77%	68.51%	20.65%	10.84%
2.3.4.7	4.28%	77.56%	18.15%	108.17%	45.21%	54.79%	128.64%	20.10%	62.10%	17.80%	113.47%	72.57%	15.11%	12.33%
2.3.4.8	4.22%	76.28%	19.50%	103.66%	46.59%	53.41%	121.85%	19.54%	61.27%	19.19%	108.38%	72.79%	14.60%	12.60%
2.3.4.9	6.12%	72.80%	21.08%	96.40%	35.70%	64.30%	153.17%	28.08%	53.09%	18.83%	111.01%	66.56%	21.58%	11.86%
2.3.4.10	7.54%	80.98%	11.48%	133.99%	24.39%	75.61%	274.44%	37.01%	53.67%	9.32%	169.78%	60.81%	29.72%	9.47%
RB 48 hr 2.3.4	3.18%	72.42%	24.40%	100.00%	58.10%	41.90%	100.00%	14.09%	60.82%	25.10%	100.00%	75.81%	10.19%	13.99%
RB 24 hr 2.3.4	3.46%	78.78%	17.76%	91.92%	53.82%	46.18%	90.75%	15.36%	66.33%	18.31%	91.69%	76.08%	11.11%	12.81%

Property of Curtin University

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.4.1.1	1.48%	14.75%	83.77%	68.36%	92.48%	7.52%	67.70%	3.75%	12.10%	84.15%	68.27%	73.63%	1.98%	24.38%
2.4.1.2	1.88%	21.37%	76.75%	72.03%	89.13%	10.87%	70.26%	5.09%	17.58%	77.33%	71.71%	73.96%	2.83%	23.21%
2.4.1.3	2.13%	25.02%	72.86%	75.58%	86.82%	13.18%	73.45%	5.98%	20.59%	73.44%	75.21%	74.05%	3.43%	22.52%
2.4.1.4	1.87%	22.06%	76.07%	72.40%	89.13%	10.87%	70.25%	5.07%	18.17%	76.76%	71.98%	74.06%	2.82%	23.11%
2.4.1.5	1.86%	22.70%	75.44%	72.90%	89.15%	10.85%	70.36%	5.04%	18.73%	76.23%	72.37%	74.16%	2.81%	23.03%
2.4.1.6	1.84%	23.30%	74.86%	73.51%	89.18%	10.82%	70.59%	5.01%	19.24%	75.75%	72.87%	74.26%	2.79%	22.95%
2.4.1.7	1.68%	18.63%	79.69%	70.57%	90.79%	9.21%	69.08%	4.42%	15.32%	80.26%	70.29%	73.87%	2.41%	23.72%
2.4.1.8	1.60%	17.62%	80.77%	70.32%	91.38%	8.62%	68.93%	4.18%	14.49%	81.33%	70.05%	73.84%	2.26%	23.90%
2.4.1.9	1.57%	17.15%	81.28%	70.08%	91.67%	8.33%	68.74%	4.06%	14.10%	81.84%	69.82%	73.82%	2.18%	23.99%
2.4.1.10	2.11%	25.71%	72.18%	76.04%	86.83%	13.17%	73.49%	5.95%	21.19%	72.86%	75.56%	74.16%	3.41%	22.43%
RB 48 hr 2.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.56%	8.26%	89.18%	100.00%	73.40%	1.35%	25.24%
RB 24 hr 2.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.63%	11.72%	84.65%	70.48%	73.61%	1.92%	24.47%
2.4.2.1	2.93%	42.23%	54.84%	82.72%	75.35%	24.65%	81.83%	9.87%	34.79%	55.34%	82.59%	74.35%	6.34%	19.31%
2.4.2.2	3.43%	53.91%	42.65%	94.75%	67.45%	32.55%	92.97%	12.45%	44.47%	43.09%	94.50%	74.55%	8.31%	17.13%
2.4.2.3	3.61%	59.19%	37.19%	106.87%	63.49%	36.51%	105.07%	13.68%	48.78%	37.54%	106.68%	74.53%	9.34%	16.13%
2.4.2.4	3.45%	54.64%	41.90%	94.21%	67.15%	32.85%	92.12%	12.53%	45.11%	42.37%	93.89%	74.62%	8.37%	17.01%
2.4.2.5	3.45%	54.97%	41.58%	94.37%	67.11%	32.89%	92.02%	12.52%	45.41%	42.07%	93.97%	74.67%	8.36%	16.96%
2.4.2.6	3.44%	55.32%	41.24%	94.50%	67.06%	32.94%	91.87%	12.51%	45.73%	41.76%	94.03%	74.73%	8.36%	16.91%
2.4.2.7	3.20%	48.57%	48.23%	89.13%	71.22%	28.78%	87.62%	11.21%	40.06%	48.73%	88.89%	74.49%	7.37%	18.14%
2.4.2.8	3.11%	46.67%	50.22%	87.18%	72.56%	27.44%	85.76%	10.77%	38.49%	50.73%	86.95%	74.47%	7.03%	18.50%
2.4.2.9	3.07%	45.74%	51.19%	86.11%	73.21%	26.79%	84.73%	10.55%	37.73%	51.72%	85.88%	74.47%	6.86%	18.67%
2.4.2.10	3.62%	59.73%	36.65%	106.65%	63.30%	36.70%	104.53%	13.72%	49.26%	37.02%	106.38%	74.59%	9.36%	16.04%
RB 48 hr 2.4.2	2.43%	34.93%	62.64%	100.00%	79.83%	20.17%	100.00%	8.15%	28.73%	63.12%	100.00%	74.10%	5.24%	20.67%
RB 24 hr 2.4.2	3.06%	44.07%	52.87%	79.26%	74.20%	25.80%	78.20%	10.30%	36.32%	53.37%	79.11%	74.41%	6.62%	18.97%
2.4.3.1	3.72%	55.65%	40.63%	90.17%	62.30%	37.70%	90.08%	14.46%	45.16%	40.38%	90.22%	73.43%	10.06%	16.52%
2.4.3.2	4.14%	67.09%	28.77%	108.78%	53.74%	46.26%	110.14%	17.32%	54.20%	28.47%	109.32%	73.21%	12.45%	14.34%
2.4.3.3	4.24%	71.80%	23.97%	126.00%	49.98%	50.02%	129.12%	18.56%	57.81%	23.63%	127.06%	72.98%	13.58%	13.44%
2.4.3.4	4.18%	67.99%	27.83%	107.75%	53.22%	46.78%	108.91%	17.50%	54.96%	27.55%	108.24%	73.24%	12.57%	14.18%
2.4.3.5	4.18%	68.40%	27.42%	107.52%	53.04%	46.96%	108.49%	17.54%	55.31%	27.15%	107.97%	73.28%	12.61%	14.11%
2.4.3.6	4.18%	68.64%	27.18%	107.56%	52.97%	47.03%	108.34%	17.54%	55.53%	26.93%	107.95%	73.31%	12.61%	14.08%
2.4.3.7	3.95%	61.92%	34.13%	99.77%	57.66%	42.34%	100.27%	16.01%	50.14%	33.85%	100.04%	73.33%	11.34%	15.33%
2.4.3.8	3.88%	60.10%	36.01%	96.58%	59.06%	40.94%	96.79%	15.53%	48.72%	35.75%	96.75%	73.38%	10.94%	15.68%
2.4.3.9	3.85%	59.23%	36.91%	94.84%	59.74%	40.26%	94.91%	15.31%	48.03%	36.66%	94.96%	73.41%	10.75%	15.84%
2.4.3.10	4.26%	72.34%	23.40%	125.49%	49.69%	50.31%	128.39%	18.64%	58.27%	23.09%	126.49%	73.01%	13.64%	13.35%
RB 48 hr 2.4.3	3.36%	50.18%	46.47%	100.00%	66.03%	33.97%	100.00%	13.05%	40.74%	46.21%	100.00%	73.38%	9.07%	17.55%
RB 24 hr 2.4.3	3.97%	59.30%	36.74%	84.62%	59.80%	40.20%	84.49%	15.40%	48.10%	36.50%	84.70%	73.46%	10.71%	15.83%
2.4.4.1	3.99%	71.54%	24.47%	97.61%	49.14%	50.86%	97.70%	18.70%	57.30%	24.00%	97.66%	72.53%	14.04%	13.44%
2.4.4.2	4.14%	80.27%	15.59%	126.12%	42.42%	57.58%	129.44%	20.98%	63.83%	15.18%	127.08%	72.04%	16.18%	11.78%
2.4.4.3	4.13%	83.54%	12.33%	150.32%	39.73%	60.27%	156.77%	21.90%	66.14%	11.96%	152.13%	71.72%	17.13%	11.15%
2.4.4.4	4.19%	81.34%	14.47%	124.65%	41.73%	58.27%	127.92%	21.23%	64.68%	14.09%	125.61%	72.05%	16.37%	11.58%
2.4.4.5	4.21%	81.80%	13.99%	124.14%	41.46%	58.54%	127.32%	21.32%	65.06%	13.62%	125.08%	72.06%	16.44%	11.50%
2.4.4.6	4.21%	82.03%	13.76%	123.99%	41.35%	58.65%	127.08%	21.35%	65.25%	13.40%	124.90%	72.08%	16.46%	11.46%
2.4.4.7	4.09%	76.51%	19.40%	111.95%	45.31%	54.69%	113.57%	20.00%	61.04%	18.96%	112.43%	72.27%	15.24%	12.49%
2.4.4.8	4.07%	75.06%	20.88%	107.19%	46.45%	53.55%	108.25%	19.61%	59.96%	20.43%	107.51%	72.36%	14.87%	12.77%
2.4.4.9	4.06%	74.43%	21.51%	104.60%	46.96%	53.04%	105.38%	19.44%	59.50%	21.06%	104.85%	72.40%	14.71%	12.89%
2.4.4.10	4.16%	84.28%	11.56%	149.20%	39.27%	60.73%	155.58%	22.06%	66.73%	11.21%	151.00%	71.73%	17.26%	11.01%
RB 48 hr 2.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.26%	55.96%	25.78%	100.00%	72.54%	13.71%	13.76%
RB 24 hr 2.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	19.97%	61.18%	18.86%	91.47%	72.50%	14.99%	12.51%

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.2.1.1	1.97%	17.79%	80.24%	64.11%	91.29%	8.71%	63.14%	4.63%	14.62%	80.74%	63.97%	73.90%	2.28%	23.83%
1.2.1.2	2.49%	25.75%	71.75%	67.86%	87.39%	12.61%	65.43%	6.24%	21.25%	72.51%	67.42%	74.35%	3.24%	22.41%
1.2.1.3	2.79%	29.75%	67.45%	71.85%	84.83%	15.17%	68.97%	7.25%	24.56%	68.19%	71.35%	74.46%	3.88%	21.66%
1.2.1.4	2.48%	26.52%	71.00%	68.16%	87.37%	12.63%	65.34%	6.22%	21.91%	71.86%	67.62%	74.46%	3.23%	22.31%
1.2.1.5	2.46%	27.21%	70.33%	68.65%	87.39%	12.61%	65.42%	6.19%	22.52%	71.30%	67.99%	74.57%	3.21%	22.22%
1.2.1.6	2.44%	27.80%	69.76%	69.33%	87.44%	12.56%	65.71%	6.14%	23.05%	70.82%	68.56%	74.67%	3.19%	22.14%
1.2.1.7	2.23%	22.43%	75.34%	66.55%	89.34%	10.66%	64.53%	5.43%	18.50%	76.07%	66.17%	74.22%	2.75%	23.03%
1.2.1.8	2.13%	21.25%	76.62%	66.25%	90.03%	9.97%	64.37%	5.14%	17.52%	77.34%	65.89%	74.17%	2.58%	23.25%
1.2.1.9	2.08%	20.70%	77.22%	65.98%	90.36%	9.64%	64.17%	5.00%	17.06%	77.95%	65.64%	74.15%	2.50%	23.35%
1.2.1.10	2.78%	30.51%	66.71%	72.27%	84.83%	15.17%	68.94%	7.22%	25.23%	67.55%	71.65%	74.58%	3.87%	21.56%
RB 48 hr 1.2.1	1.26%	11.41%	87.33%	100.00%	94.50%	5.50%	100.00%	2.96%	9.35%	87.68%	100.00%	73.54%	1.46%	25.00%
RB 24 hr 1.2.1	1.77%	16.05%	82.18%	71.09%	92.18%	7.82%	70.30%	4.18%	13.18%	82.64%	70.97%	73.80%	2.05%	24.15%
1.2.2.1	3.60%	46.74%	49.66%	81.19%	73.44%	26.56%	79.91%	11.06%	38.65%	50.29%	80.99%	74.80%	6.72%	18.49%
1.2.2.2	4.16%	58.97%	36.87%	94.18%	65.22%	34.78%	91.54%	13.73%	48.86%	37.41%	93.77%	75.09%	8.70%	16.21%
1.2.2.3	4.34%	64.07%	31.59%	107.25%	61.34%	38.66%	104.38%	14.92%	53.05%	32.03%	106.86%	75.08%	9.68%	15.24%
1.2.2.4	4.19%	59.87%	35.93%	93.43%	64.80%	35.20%	90.45%	13.85%	49.65%	36.50%	92.94%	75.17%	8.78%	16.06%
1.2.2.5	4.19%	60.27%	35.54%	93.48%	64.71%	35.29%	90.22%	13.85%	50.02%	36.13%	92.92%	75.22%	8.78%	16.00%
1.2.2.6	4.18%	60.59%	35.23%	93.65%	64.67%	35.33%	90.11%	13.84%	50.32%	35.84%	93.01%	75.28%	8.77%	15.95%
1.2.2.7	3.88%	53.24%	42.87%	88.40%	69.24%	30.76%	86.25%	12.41%	44.10%	43.49%	88.05%	74.99%	7.72%	17.29%
1.2.2.8	3.79%	51.33%	44.87%	86.19%	70.59%	29.41%	84.19%	11.97%	42.51%	45.52%	85.86%	74.96%	7.39%	17.65%
1.2.2.9	3.74%	50.40%	45.86%	84.99%	71.25%	28.75%	83.06%	11.75%	41.74%	46.51%	84.66%	74.95%	7.23%	17.83%
1.2.2.10	4.35%	64.71%	30.94%	106.88%	61.07%	38.93%	103.67%	14.98%	53.62%	31.40%	106.40%	75.15%	9.72%	15.13%
RB 48 hr 1.2.2	2.92%	37.95%	59.13%	100.00%	78.78%	21.22%	100.00%	8.96%	31.30%	59.74%	100.00%	74.44%	5.44%	20.12%
RB 24 hr 1.2.2	3.63%	47.18%	49.18%	80.43%	73.17%	26.83%	79.10%	11.16%	39.02%	49.82%	80.22%	74.81%	6.78%	18.40%
1.2.3.1	4.45%	59.71%	35.84%	89.08%	60.44%	39.56%	88.81%	15.67%	48.60%	35.73%	89.12%	73.84%	10.39%	15.77%
1.2.3.2	4.86%	70.84%	24.29%	109.25%	52.12%	47.88%	110.07%	18.42%	57.45%	24.13%	109.68%	73.68%	12.66%	13.66%
1.2.3.3	4.95%	75.18%	19.87%	127.56%	48.59%	51.41%	129.97%	19.54%	60.78%	19.68%	128.46%	73.47%	13.71%	12.82%
1.2.3.4	4.92%	71.89%	23.20%	108.06%	51.49%	48.51%	108.65%	18.63%	58.32%	23.05%	108.44%	73.72%	12.81%	13.47%
1.2.3.5	4.93%	72.31%	22.77%	107.82%	51.29%	48.71%	108.21%	18.68%	58.69%	22.63%	108.15%	73.76%	12.84%	13.40%
1.2.3.6	4.93%	72.55%	22.52%	107.83%	51.21%	48.79%	108.04%	18.69%	58.92%	22.40%	108.11%	73.79%	12.85%	13.36%
1.2.3.7	4.67%	65.62%	29.71%	99.85%	56.07%	43.93%	99.97%	17.10%	53.33%	29.57%	100.04%	73.78%	11.57%	14.65%
1.2.3.8	4.60%	63.86%	31.54%	96.41%	57.43%	42.57%	96.30%	16.65%	51.94%	31.42%	96.52%	73.82%	11.19%	14.99%
1.2.3.9	4.57%	63.08%	32.36%	94.47%	58.05%	41.95%	94.24%	16.44%	51.32%	32.24%	94.54%	73.84%	11.02%	15.14%
1.2.3.10	4.97%	75.82%	19.21%	126.90%	48.24%	51.76%	129.09%	19.65%	61.32%	19.03%	127.75%	73.51%	13.78%	12.71%
RB 48 hr 1.2.3	3.96%	53.19%	42.85%	100.00%	64.86%	35.14%	100.00%	13.97%	43.31%	42.73%	100.00%	73.74%	9.26%	17.00%
RB 24 hr 1.2.3	4.62%	61.98%	33.40%	85.82%	58.88%	41.12%	85.46%	16.27%	50.44%	33.29%	85.86%	73.88%	10.79%	15.34%
1.2.4.1	4.62%	74.05%	21.33%	97.17%	48.28%	51.72%	97.22%	19.46%	59.54%	21.00%	97.21%	72.97%	14.05%	12.98%
1.2.4.2	4.74%	82.18%	13.08%	126.95%	41.96%	58.04%	129.94%	21.55%	65.66%	12.80%	127.81%	72.54%	16.03%	11.44%
1.2.4.3	4.70%	85.14%	10.16%	151.98%	39.47%	60.53%	157.95%	22.35%	67.74%	9.90%	153.63%	72.23%	16.90%	10.87%
1.2.4.4	4.80%	83.32%	11.89%	125.40%	41.22%	58.78%	128.32%	21.81%	66.56%	11.63%	126.26%	72.55%	16.22%	11.23%
1.2.4.5	4.82%	83.79%	11.39%	124.88%	40.94%	59.06%	127.70%	21.91%	66.94%	11.15%	125.72%	72.56%	16.29%	11.15%
1.2.4.6	4.82%	84.03%	11.15%	124.70%	40.81%	59.19%	127.43%	21.94%	67.15%	10.91%	125.51%	72.58%	16.32%	11.10%
1.2.4.7	4.70%	78.65%	16.65%	112.23%	44.70%	55.30%	113.66%	20.64%	63.02%	16.34%	112.66%	72.74%	15.15%	12.11%
1.2.4.8	4.68%	77.34%	17.98%	107.21%	45.75%	54.25%	108.12%	20.29%	62.04%	17.67%	107.50%	72.82%	14.82%	12.36%
1.2.4.9	4.68%	76.77%	18.55%	104.51%	46.22%	53.78%	105.17%	20.14%	61.62%	18.24%	104.73%	72.86%	14.67%	12.47%
1.2.4.10	4.74%	85.91%	9.35%	150.81%	38.98%	61.02%	156.69%	22.53%	68.36%	9.12%	152.45%	72.24%	17.03%	10.73%
RB 48 hr 1.2.4	4.49%	71.96%	23.56%	100.00%	49.72%	50.28%	100.00%	18.92%	57.88%	23.21%	100.00%	72.97%	13.66%	13.38%
RB 24 hr 1.2.4	4.87%	78.04%	17.09%	92.20%	45.55%	54.45%	92.34%	20.49%	62.69%	16.82%	92.32%	72.98%	14.79%	12.23%

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.4.1.1	1.59%	15.89%	82.52%	63.46%	91.88%	8.12%	62.69%	4.04%	13.04%	82.92%	63.35%	73.69%	2.14%	24.17%
1.4.1.2	2.04%	23.22%	74.74%	66.30%	88.15%	11.85%	64.41%	5.53%	19.11%	75.36%	65.96%	74.05%	3.08%	22.87%
1.4.1.3	2.30%	27.07%	70.63%	69.85%	85.68%	14.32%	67.61%	6.47%	22.29%	71.24%	69.47%	74.15%	3.71%	22.14%
1.4.1.4	2.03%	23.99%	73.98%	66.58%	88.13%	11.87%	64.31%	5.52%	19.78%	74.71%	66.14%	74.16%	3.07%	22.76%
1.4.1.5	2.02%	24.68%	73.30%	67.05%	88.14%	11.86%	64.39%	5.49%	20.38%	74.13%	66.50%	74.27%	3.06%	22.67%
1.4.1.6	2.00%	25.29%	72.71%	67.72%	88.19%	11.81%	64.68%	5.44%	20.91%	73.65%	67.06%	74.38%	3.03%	22.59%
1.4.1.7	1.81%	20.11%	78.08%	65.36%	90.02%	9.98%	63.76%	4.78%	16.54%	78.68%	65.06%	73.95%	2.60%	23.45%
1.4.1.8	1.73%	19.01%	79.26%	65.19%	90.68%	9.32%	63.70%	4.51%	15.64%	79.85%	64.91%	73.91%	2.44%	23.65%
1.4.1.9	1.69%	18.49%	79.81%	64.98%	90.99%	9.01%	63.53%	4.38%	15.21%	80.40%	64.70%	73.90%	2.36%	23.75%
1.4.1.10	2.29%	27.84%	69.87%	70.22%	85.67%	14.33%	67.55%	6.45%	22.96%	70.59%	69.72%	74.27%	3.70%	22.04%
RB 48 hr 1.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.56%	8.26%	89.18%	100.00%	73.40%	1.35%	25.24%
RB 24 hr 1.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.63%	11.72%	84.65%	70.48%	73.61%	1.92%	24.47%
1.4.2.1	3.03%	43.63%	53.34%	80.07%	74.48%	25.52%	79.05%	10.20%	35.96%	53.85%	79.92%	74.40%	6.55%	19.05%
1.4.2.2	3.57%	56.06%	40.37%	91.12%	66.06%	33.94%	89.15%	12.95%	46.26%	40.80%	90.85%	74.62%	8.65%	16.73%
1.4.2.3	3.75%	61.41%	34.84%	103.00%	62.02%	37.98%	101.01%	14.20%	50.63%	35.17%	102.79%	74.59%	9.69%	15.72%
1.4.2.4	3.60%	57.01%	39.38%	90.30%	65.62%	34.38%	88.01%	13.08%	47.09%	39.84%	89.94%	74.69%	8.74%	16.57%
1.4.2.5	3.60%	57.43%	38.96%	90.33%	65.52%	34.48%	87.76%	13.08%	47.47%	39.45%	89.90%	74.75%	8.74%	16.50%
1.4.2.6	3.60%	57.78%	38.62%	90.47%	65.47%	34.53%	87.64%	13.07%	47.80%	39.13%	89.97%	74.81%	8.73%	16.45%
1.4.2.7	3.31%	50.16%	46.53%	86.29%	70.20%	29.80%	84.63%	11.59%	41.39%	47.02%	86.03%	74.55%	7.61%	17.84%
1.4.2.8	3.22%	48.23%	48.56%	84.36%	71.57%	28.43%	82.79%	11.14%	39.79%	49.07%	84.11%	74.53%	7.27%	18.21%
1.4.2.9	3.17%	47.28%	49.55%	83.31%	72.25%	27.75%	81.78%	10.91%	39.01%	50.08%	83.06%	74.52%	7.09%	18.39%
1.4.2.10	3.77%	62.10%	34.14%	102.58%	61.74%	38.26%	100.25%	14.27%	51.23%	34.50%	102.28%	74.66%	9.74%	15.60%
RB 48 hr 1.4.2	2.43%	34.93%	62.64%	100.00%	79.83%	20.17%	100.00%	8.15%	28.73%	63.12%	100.00%	74.10%	5.24%	20.67%
RB 24 hr 1.4.2	3.06%	44.07%	52.87%	79.26%	74.20%	25.80%	78.20%	10.30%	36.32%	53.37%	79.11%	74.41%	6.62%	18.97%
1.4.3.1	3.79%	56.71%	39.50%	88.49%	61.57%	38.43%	88.39%	14.73%	46.01%	39.26%	88.55%	73.44%	10.25%	16.32%
1.4.3.2	4.23%	68.68%	27.09%	106.26%	52.65%	47.35%	107.60%	17.73%	55.47%	26.80%	106.82%	73.21%	12.74%	14.04%
1.4.3.3	4.33%	73.37%	22.30%	123.29%	48.90%	51.10%	126.39%	18.96%	59.06%	21.98%	124.37%	72.98%	13.87%	13.14%
1.4.3.4	4.29%	69.81%	25.90%	104.94%	51.97%	48.03%	106.07%	17.96%	56.41%	25.63%	105.45%	73.25%	12.91%	13.84%
1.4.3.5	4.30%	70.27%	25.43%	104.66%	51.75%	48.25%	105.60%	18.02%	56.81%	25.18%	105.12%	73.29%	12.95%	13.76%
1.4.3.6	4.30%	70.55%	25.15%	104.65%	51.66%	48.34%	105.40%	18.03%	57.06%	24.92%	105.06%	73.32%	12.96%	13.72%
1.4.3.7	4.03%	63.11%	32.86%	97.89%	56.84%	43.16%	98.37%	16.31%	51.10%	32.59%	98.16%	73.34%	11.56%	15.10%
1.4.3.8	3.96%	61.25%	34.80%	94.77%	58.28%	41.72%	94.97%	15.83%	49.64%	34.54%	94.95%	73.39%	11.15%	15.46%
1.4.3.9	3.93%	60.42%	35.65%	92.98%	58.93%	41.07%	93.03%	15.61%	48.99%	35.40%	93.11%	73.42%	10.96%	15.62%
1.4.3.10	4.36%	74.07%	21.57%	122.56%	48.51%	51.49%	125.43%	19.08%	59.65%	21.28%	123.58%	73.02%	13.96%	13.02%
RB 48 hr 1.4.3	3.36%	50.18%	46.47%	100.00%	66.03%	33.97%	100.00%	13.05%	40.74%	46.21%	100.00%	73.38%	9.07%	17.55%
RB 24 hr 1.4.3	3.97%	59.30%	36.74%	84.62%	59.80%	40.20%	84.49%	15.40%	48.10%	36.50%	84.70%	73.46%	10.71%	15.83%
1.4.4.1	4.02%	72.11%	23.86%	96.84%	48.75%	51.25%	96.95%	18.85%	57.75%	23.41%	96.90%	72.53%	14.15%	13.33%
1.4.4.2	4.18%	81.00%	14.81%	124.97%	41.92%	58.08%	128.33%	21.17%	64.40%	14.43%	125.96%	72.04%	16.32%	11.64%
1.4.4.3	4.16%	84.28%	11.56%	149.00%	39.24%	60.76%	155.50%	22.09%	66.71%	11.21%	150.84%	71.71%	17.28%	11.01%
1.4.4.4	4.24%	82.28%	13.48%	123.23%	41.10%	58.90%	126.55%	21.47%	65.40%	13.13%	124.22%	72.04%	16.55%	11.41%
1.4.4.5	4.26%	82.80%	12.93%	122.63%	40.79%	59.21%	125.88%	21.57%	65.83%	12.59%	123.60%	72.05%	16.63%	11.31%
1.4.4.6	4.27%	83.07%	12.66%	122.43%	40.64%	59.36%	125.57%	21.62%	66.06%	12.33%	123.37%	72.07%	16.67%	11.27%
1.4.4.7	4.12%	77.12%	18.76%	111.06%	44.89%	55.11%	112.71%	20.16%	61.52%	18.33%	111.56%	72.27%	15.36%	12.38%
1.4.4.8	4.10%	75.68%	20.22%	106.30%	46.02%	53.98%	107.39%	19.77%	60.45%	19.78%	106.64%	72.35%	15.00%	12.65%
1.4.4.9	4.09%	75.06%	20.85%	103.72%	46.53%	53.47%	104.53%	19.60%	59.99%	20.41%	103.98%	72.40%	14.83%	12.77%
1.4.4.10	4.20%	85.15%	10.65%	147.68%	38.69%	61.31%	154.11%	22.28%	67.40%	10.32%	149.51%	71.71%	17.43%	10.85%
RB 48 hr 1.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.26%	55.96%	25.78%	100.00%	72.54%	13.71%	13.76%
RB 24 hr 1.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	19.97%	61.18%	18.86%	91.47%	72.50%	14.99%	12.51%

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
3.1.1.1	2.28%	19.54%	78.18%	68.96%	91.69%	8.31%	67.64%	4.88%	16.12%	79.00%	68.74%	74.28%	2.14%	23.58%
3.1.1.2	2.82%	28.14%	69.04%	74.78%	88.14%	11.86%	71.07%	6.39%	23.37%	70.24%	74.04%	74.93%	2.98%	22.09%
3.1.1.3	3.15%	32.10%	64.75%	79.36%	85.73%	14.27%	74.90%	7.39%	26.68%	65.93%	78.50%	75.09%	3.56%	21.35%
3.1.1.4	2.80%	29.04%	68.16%	75.19%	88.12%	11.88%	70.95%	6.37%	24.16%	69.47%	74.30%	75.06%	2.97%	21.97%
3.1.1.5	2.77%	29.78%	67.44%	75.96%	88.16%	11.84%	71.21%	6.32%	24.83%	68.86%	74.94%	75.19%	2.94%	21.87%
3.1.1.6	2.75%	30.58%	66.67%	76.58%	88.17%	11.83%	71.30%	6.28%	25.53%	68.19%	75.41%	75.31%	2.93%	21.76%
3.1.1.7	2.54%	24.81%	72.65%	72.70%	89.92%	10.08%	69.67%	5.62%	20.57%	73.80%	72.08%	74.75%	2.55%	22.70%
3.1.1.8	2.44%	23.64%	73.92%	72.06%	90.53%	9.47%	69.26%	5.35%	19.59%	75.06%	71.48%	74.68%	2.40%	22.92%
3.1.1.9	2.40%	23.14%	74.46%	71.44%	90.80%	9.20%	68.75%	5.23%	19.18%	75.59%	70.88%	74.66%	2.33%	23.01%
3.1.1.10	3.13%	32.96%	63.91%	79.97%	85.73%	14.27%	74.91%	7.34%	27.45%	65.20%	78.95%	75.23%	3.54%	21.23%
RB 48 hr 3.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	3.36%	11.08%	85.56%	100.00%	73.85%	1.47%	24.67%
RB 24 hr 3.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	4.75%	15.68%	79.57%	70.66%	74.25%	2.08%	23.67%
3.1.4.1	5.13%	76.04%	18.83%	98.25%	50.04%	49.96%	98.16%	19.02%	62.14%	18.85%	98.25%	74.31%	12.91%	12.79%
3.1.4.2	5.19%	83.22%	11.59%	130.28%	44.32%	55.68%	132.13%	20.70%	67.75%	11.56%	130.78%	74.03%	14.54%	11.43%
3.1.4.3	5.12%	85.80%	9.08%	156.64%	42.03%	57.97%	160.89%	21.35%	69.63%	9.03%	157.73%	73.78%	15.29%	10.93%
3.1.4.4	5.23%	84.09%	10.68%	129.15%	43.76%	56.24%	130.82%	20.88%	68.47%	10.65%	129.61%	74.06%	14.67%	11.27%
3.1.4.5	5.25%	84.51%	10.25%	128.73%	43.52%	56.48%	130.25%	20.96%	68.82%	10.22%	129.16%	74.08%	14.73%	11.19%
3.1.4.6	5.25%	84.68%	10.07%	128.68%	43.44%	56.56%	130.07%	20.97%	68.98%	10.05%	129.08%	74.10%	14.74%	11.16%
3.1.4.7	5.17%	80.12%	14.71%	114.51%	46.81%	53.19%	115.27%	19.97%	65.35%	14.69%	114.73%	74.17%	13.81%	12.01%
3.1.4.8	5.17%	79.05%	15.79%	109.03%	47.71%	52.29%	109.42%	19.70%	64.52%	15.78%	109.16%	74.23%	13.55%	12.22%
3.1.4.9	5.16%	78.50%	16.34%	106.26%	48.17%	51.83%	106.46%	19.56%	64.10%	16.34%	106.34%	74.26%	13.41%	12.33%
3.1.4.10	5.15%	86.44%	8.41%	155.71%	41.63%	58.37%	159.77%	21.48%	70.16%	8.36%	156.76%	73.81%	15.38%	10.81%
RB 48 hr 3.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	18.68%	61.05%	20.27%	100.00%	74.28%	12.68%	13.04%
RB 24 hr 3.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	20.08%	65.61%	14.31%	93.05%	74.39%	13.63%	11.99%
3.4.1.1	1.47%	14.74%	83.79%	68.43%	92.49%	7.51%	67.77%	3.75%	12.09%	84.17%	68.34%	73.63%	1.98%	24.39%
3.4.1.2	1.88%	21.35%	76.78%	72.12%	89.15%	10.85%	70.35%	5.08%	17.56%	77.36%	71.80%	73.96%	2.83%	23.21%
3.4.1.3	2.12%	24.99%	72.89%	75.67%	86.84%	13.16%	73.54%	5.97%	20.56%	73.47%	75.30%	74.05%	3.42%	22.53%
3.4.1.4	1.87%	22.07%	76.06%	72.38%	89.13%	10.87%	70.22%	5.07%	18.18%	76.75%	71.95%	74.06%	2.82%	23.11%
3.4.1.5	1.86%	22.69%	75.46%	72.93%	89.15%	10.85%	70.40%	5.04%	18.72%	76.24%	72.40%	74.16%	2.81%	23.03%
3.4.1.6	1.84%	23.35%	74.81%	73.34%	89.16%	10.84%	70.42%	5.02%	19.29%	75.69%	72.70%	74.26%	2.80%	22.94%
3.4.1.7	1.68%	18.59%	79.74%	70.72%	90.81%	9.19%	69.23%	4.42%	15.28%	80.30%	70.44%	73.87%	2.40%	23.72%
3.4.1.8	1.61%	17.63%	80.76%	70.29%	91.38%	8.62%	68.90%	4.18%	14.50%	81.32%	70.02%	73.84%	2.26%	23.90%
3.4.1.9	1.57%	17.22%	81.21%	69.81%	91.64%	8.36%	68.46%	4.08%	14.15%	81.77%	69.55%	73.83%	2.19%	23.98%
3.4.1.10	2.11%	25.72%	72.17%	76.02%	86.82%	13.18%	73.47%	5.95%	21.20%	72.85%	75.54%	74.16%	3.41%	22.43%
RB 48 hr 3.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.56%	8.26%	89.18%	100.00%	73.40%	1.35%	25.24%
RB 24 hr 3.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.63%	11.72%	84.65%	70.48%	73.61%	1.92%	24.47%
3.4.4.1	3.99%	71.50%	24.51%	97.67%	49.17%	50.83%	97.76%	18.69%	57.27%	24.05%	97.72%	72.53%	14.03%	13.44%
3.4.4.2	4.14%	80.30%	15.56%	126.08%	42.40%	57.60%	129.39%	20.99%	63.85%	15.15%	127.04%	72.04%	16.18%	11.77%
3.4.4.3	4.13%	83.54%	12.34%	150.32%	39.73%	60.27%	156.77%	21.90%	66.14%	11.96%	152.14%	71.72%	17.13%	11.15%
3.4.4.4	4.19%	81.33%	14.48%	124.67%	41.74%	58.26%	127.93%	21.23%	64.67%	14.10%	125.63%	72.05%	16.37%	11.58%
3.4.4.5	4.21%	81.82%	13.97%	124.11%	41.45%	58.55%	127.30%	21.32%	65.07%	13.61%	125.05%	72.06%	16.44%	11.50%
3.4.4.6	4.21%	82.03%	13.76%	123.98%	41.35%	58.65%	127.08%	21.35%	65.25%	13.40%	124.90%	72.08%	16.46%	11.46%
3.4.4.7	4.09%	76.45%	19.46%	112.03%	45.35%	54.65%	113.65%	19.99%	61.00%	19.02%	112.51%	72.27%	15.23%	12.50%
3.4.4.8	4.07%	75.11%	20.82%	107.11%	46.41%	53.59%	108.17%	19.62%	60.00%	20.37%	107.44%	72.36%	14.88%	12.76%
3.4.4.9	4.06%	74.42%	21.52%	104.61%	46.96%	53.04%	105.39%	19.44%	59.49%	21.07%	104.86%	72.40%	14.71%	12.89%
3.4.4.10	4.16%	84.29%	11.55%	149.18%	39.26%	60.74%	155.56%	22.06%	66.74%	11.20%	150.98%	71.73%	17.26%	11.01%
RB 48 hr 3.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.26%	55.96%	25.78%	100.00%	72.54%	13.71%	13.76%
RB 24 hr 3.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	19.97%	61.18%	18.86%	91.47%	72.50%	14.99%	12.51%

Property of Cost Part

SUMMARY OF FINANCIAL ANALYSIS: ORIGINAL INPUT

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
4.1.1.1	2.21%	18.94%	78.85%	71.15%	91.96%	8.04%	69.92%	4.73%	15.62%	79.65%	70.94%	74.24%	2.07%	23.68%
4.1.1.2	2.81%	28.04%	69.15%	75.04%	88.18%	11.82%	71.35%	6.37%	23.29%	70.34%	74.30%	74.92%	2.97%	22.11%
4.1.1.3	3.15%	32.10%	64.75%	79.35%	85.73%	14.27%	74.89%	7.39%	26.68%	65.93%	78.49%	75.09%	3.56%	21.35%
4.1.1.4	2.80%	28.96%	68.24%	75.38%	88.15%	11.85%	71.15%	6.36%	24.10%	69.54%	74.49%	75.06%	2.96%	21.98%
4.1.1.5	2.78%	29.85%	67.37%	75.79%	88.13%	11.87%	71.03%	6.33%	24.88%	68.78%	74.76%	75.19%	2.95%	21.86%
4.1.1.6	2.75%	30.52%	66.73%	76.73%	88.20%	11.80%	71.45%	6.27%	25.48%	68.25%	75.56%	75.31%	2.92%	21.77%
4.1.1.7	2.49%	24.32%	73.19%	74.14%	90.13%	9.87%	71.18%	5.51%	20.17%	74.32%	73.54%	74.71%	2.50%	22.79%
4.1.1.8	2.39%	23.11%	74.50%	73.69%	90.76%	9.24%	70.97%	5.23%	19.15%	75.62%	73.12%	74.64%	2.35%	23.01%
4.1.1.9	2.33%	22.53%	75.14%	73.37%	91.06%	8.94%	70.76%	5.09%	18.67%	76.24%	72.82%	74.61%	2.27%	23.12%
4.1.1.10	3.13%	32.96%	63.91%	79.97%	85.73%	14.27%	74.92%	7.34%	27.45%	65.20%	78.95%	75.23%	3.54%	21.23%
R3 48 hr 4.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	3.36%	11.08%	85.56%	100.00%	73.85%	1.47%	24.67%
RB 24 hr 4.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	4.75%	15.68%	79.57%	70.66%	74.25%	2.08%	23.67%
4.1.4.1	4.92%	72.94%	22.14%	102.42%	52.17%	47.83%	102.54%	18.24%	59.60%	22.15%	102.42%	74.25%	12.38%	13.37%
4.1.4.2	5.07%	81.35%	13.58%	133.28%	45.62%	54.38%	135.28%	20.23%	66.22%	13.54%	133.78%	74.00%	14.22%	11.78%
4.1.4.3	5.05%	84.58%	10.37%	158.90%	42.87%	57.13%	163.25%	21.04%	68.65%	10.31%	159.98%	73.77%	15.07%	11.16%
4.1.4.4	5.17%	83.08%	11.75%	130.72%	44.46%	55.54%	132.47%	20.63%	67.65%	11.72%	131.19%	74.04%	14.50%	11.46%
4.1.4.5	5.20%	83.76%	11.04%	129.88%	44.04%	55.96%	131.46%	20.77%	68.21%	11.01%	130.31%	74.07%	14.60%	11.33%
4.1.4.6	5.22%	84.16%	10.63%	129.48%	43.80%	56.20%	130.91%	20.84%	68.56%	10.60%	129.88%	74.09%	14.64%	11.26%
4.1.4.7	5.04%	78.07%	16.89%	117.52%	48.23%	51.77%	118.43%	19.45%	63.67%	16.87%	117.74%	74.14%	13.46%	12.40%
4.1.4.8	5.02%	76.87%	18.11%	112.12%	49.21%	50.79%	112.66%	19.16%	62.74%	18.10%	112.25%	74.19%	13.18%	12.63%
4.1.4.9	5.01%	76.20%	18.79%	109.46%	49.76%	50.24%	109.82%	18.99%	62.22%	18.79%	109.54%	74.22%	13.02%	12.76%
4.1.4.10	5.12%	85.88%	9.00%	156.73%	42.02%	57.98%	160.84%	21.34%	69.71%	8.95%	157.78%	73.80%	15.28%	10.92%
RB 48 hr 4.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	18.68%	61.05%	20.27%	100.00%	74.28%	12.68%	13.04%
RB 24 hr 4.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	20.08%	65.61%	14.31%	93.05%	74.39%	13.63%	11.99%
4.4.1.1	1.43%	14.28%	84.29%	70.62%	92.73%	7.27%	70.00%	3.63%	11.71%	84.66%	70.53%	73.61%	1.92%	24.47%
4.4.1.2	1.87%	21.25%	76.88%	72.45%	89.20%	10.80%	70.69%	5.06%	17.48%	77.46%	72.13%	73.95%	2.82%	23.23%
4.4.1.3	2.12%	24.95%	72.93%	75.79%	86.86%	13.14%	73.67%	5.96%	20.53%	73.51%	75.42%	74.05%	3.42%	22.54%
4.4.1.4	1.86%	21.99%	76.15%	72.64%	89.17%	10.83%	70.49%	5.05%	18.11%	76.83%	72.21%	74.06%	2.81%	23.13%
4.4.1.5	1.86%	22.69%	75.45%	72.91%	89.15%	10.85%	70.38%	5.04%	18.72%	76.24%	72.38%	74.16%	2.81%	23.03%
4.4.1.6	1.84%	23.27%	74.89%	73.59%	89.20%	10.80%	70.68%	5.00%	19.22%	75.78%	72.96%	74.26%	2.79%	22.96%
4.4.1.7	1.65%	18.24%	80.12%	72.06%	90.99%	9.01%	70.61%	4.33%	14.99%	80.67%	71.79%	73.85%	2.36%	23.79%
4.4.1.8	1.57%	17.24%	81.19%	71.88%	91.58%	8.42%	70.53%	4.09%	14.17%	81.74%	71.62%	73.82%	2.21%	23.97%
4.4.1.9	1.53%	16.75%	81.72%	71.77%	91.87%	8.13%	70.46%	3.97%	13.76%	82.27%	71.51%	73.80%	2.13%	24.07%
4.4.1.10	2.11%	25.67%	72.22%	76.16%	86.85%	13.15%	73.61%	5.94%	21.16%	72.90%	75.68%	74.16%	3.40%	22.44%
RB 48 hr 4.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.56%	8.26%	89.18%	100.00%	73.40%	1.35%	25.24%
RB 24 hr 4.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.63%	11.72%	84.65%	70.48%	73.61%	1.92%	24.47%
4.4.4.1	3.78%	67.74%	28.47%	103.08%	51.75%	48.25%	102.97%	17.73%	54.31%	27.96%	103.03%	72.55%	13.30%	14.15%
4.4.4.2	4.02%	77.93%	18.05%	129.90%	43.99%	56.01%	133.08%	20.39%	62.02%	17.59%	130.79%	72.07%	15.72%	12.21%
4.4.4.3	4.05%	82.01%	13.94%	153.12%	40.75%	59.25%	159.47%	21.51%	64.97%	13.53%	154.89%	71.74%	16.83%	11.43%
4.4.4.4	4.13%	80.10%	15.77%	126.58%	42.57%	57.43%	129.78%	20.91%	63.72%	15.37%	127.51%	72.06%	16.13%	11.81%
4.4.4.5	4.16%	80.92%	14.91%	125.48%	42.05%	57.95%	128.62%	21.10%	64.37%	14.53%	126.40%	72.07%	16.27%	11.66%
4.4.4.6	4.18%	81.39%	14.42%	124.95%	41.77%	58.23%	128.01%	21.19%	64.75%	14.06%	125.85%	72.08%	16.34%	11.58%
4.4.4.7	3.95%	73.89%	22.16%	115.91%	47.09%	52.91%	117.39%	19.33%	59.00%	21.67%	116.32%	72.29%	14.73%	12.98%
4.4.4.8	3.92%	72.41%	23.66%	111.10%	48.25%	51.75%	112.02%	18.93%	57.89%	23.17%	111.35%	72.38%	14.36%	13.26%
4.4.4.9	3.90%	71.60%	24.49%	108.72%	48.89%	51.11%	109.36%	18.72%	57.29%	24.00%	108.90%	72.42%	14.16%	13.42%
4.4.4.10	4.12%	83.61%	12.26%	150.39%	39.71%	60.29%	156.73%	21.89%	66.21%	11.89%	152.18%	71.73%	17.13%	11.14%
RB 48 hr 4.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.26%	55.96%	25.78%	100.00%	72.54%	13.71%	13.76%
RB 24 hr 4.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	19.97%	61.18%	18.86%	91.47%	72.50%	14.99%	12.51%

APPENDIX E: CAPITAL COST BREAKDOWN

University of Cape Town

Ratio of Components to Total Capital Cost

Pumping Station

	Configuration 1		Configuration 2		Configuration 3		Configuration 4		Configuration 5		Configuration 6		Configuration 7		Configuration 8		Configuration 9		Configuration 10	
	Length		Length		Length		Length		Length		Length		Length		Length		Length		Length	
	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m
Series 2.1	2.29%	5.13%	2.83%	5.19%	3.16%	5.12%	2.80%	5.23%	2.78%	5.25%	2.75%	5.25%	2.55%	5.18%	2.44%	5.16%	2.39%	5.16%	3.13%	5.15%
Series 2.2	1.83%	4.59%	2.30%	4.70%	2.59%	4.66%	2.29%	4.75%	2.27%	4.77%	2.25%	4.77%	2.07%	4.67%	1.98%	4.64%	1.93%	4.64%	2.57%	4.69%
Series 2.3	1.69%	3.27%	3.25%	5.41%	4.93%	7.49%	3.24%	5.47%	3.22%	5.49%	3.20%	5.50%	2.39%	4.28%	2.26%	4.22%	3.08%	6.12%	4.90%	7.54%
Series 2.4	1.48%	3.99%	1.88%	4.14%	2.13%	4.13%	1.87%	4.19%	1.86%	4.21%	1.84%	4.21%	1.68%	4.09%	1.60%	4.07%	1.57%	4.06%	2.11%	4.16%
Series 1.2	1.97%	4.62%	2.49%	4.74%	2.79%	4.70%	2.48%	4.80%	2.46%	4.82%	2.44%	4.82%	2.23%	4.70%	2.13%	4.68%	2.08%	4.68%	2.78%	4.74%
Series 1.4	1.59%	4.02%	2.04%	4.18%	2.30%	4.16%	2.03%	4.24%	2.02%	4.26%	2.00%	4.27%	1.81%	4.12%	1.73%	4.10%	1.69%	4.09%	2.29%	4.20%
Series 3.1	2.28%	5.13%	2.82%	5.19%	3.15%	5.12%	2.80%	5.23%	2.77%	5.25%	2.75%	5.25%	2.54%	5.17%	2.44%	5.17%	2.40%	5.16%	3.13%	5.15%
Series 3.4	1.47%	3.99%	1.88%	4.14%	2.12%	4.13%	1.87%	4.19%	1.86%	4.21%	1.84%	4.21%	1.68%	4.09%	1.61%	4.07%	1.57%	4.06%	2.11%	4.16%
Series 4.1	2.21%	4.92%	2.81%	5.07%	3.15%	5.05%	2.80%	5.17%	2.78%	5.20%	2.75%	5.22%	2.49%	5.04%	2.39%	5.02%	2.33%	5.01%	3.13%	5.12%
Series 4.4	1.43%	3.78%	1.87%	4.02%	2.12%	4.05%	1.86%	4.13%	1.86%	4.16%	1.84%	4.18%	1.65%	3.95%	1.57%	3.92%	1.53%	3.90%	2.11%	4.12%

Feeder Pipe

	Configuration 1		Configuration 2		Configuration 3		Configuration 4		Configuration 5		Configuration 6		Configuration 7		Configuration 8		Configuration 9		Configuration 10	
	Length		Length		Length		Length		Length		Length		Length		Length		Length		Length	
	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m
Series 2.1	19.62%	76.09%	28.22%	83.22%	32.19%	85.82%	29.05%	84.12%	29.84%	84.51%	30.55%	84.70%	24.93%	80.18%	23.68%	79.02%	23.11%	78.50%	33.02%	86.45%
Series 2.2	16.55%	73.53%	23.78%	81.52%	27.59%	84.48%	24.47%	82.48%	25.10%	82.90%	25.69%	83.09%	20.83%	78.10%	19.75%	76.77%	19.23%	76.20%	28.28%	85.14%
Series 2.3	15.74%	74.54%	20.72%	79.73%	22.55%	80.27%	21.34%	80.78%	21.94%	81.20%	22.50%	81.43%	18.86%	77.56%	17.89%	76.28%	16.08%	72.80%	23.12%	80.98%
Series 2.4	14.75%	71.54%	21.37%	80.27%	25.02%	83.54%	22.06%	81.34%	22.70%	81.80%	23.30%	82.03%	18.63%	76.51%	17.62%	75.06%	17.15%	74.43%	25.71%	84.28%
Series 1.2	17.79%	74.05%	25.75%	82.18%	29.75%	85.14%	26.52%	83.32%	27.21%	83.79%	27.80%	84.03%	22.43%	78.65%	21.25%	77.34%	20.70%	76.77%	30.51%	85.91%
Series 1.4	15.89%	72.11%	23.22%	81.00%	27.07%	84.28%	23.99%	82.28%	24.68%	82.80%	25.29%	83.07%	20.11%	77.12%	19.01%	75.68%	18.49%	75.06%	27.84%	85.15%
Series 3.1	19.54%	76.04%	28.14%	83.22%	32.10%	85.80%	29.04%	84.09%	29.78%	84.51%	30.58%	84.68%	24.81%	80.12%	23.64%	79.05%	23.14%	78.50%	32.96%	86.44%
Series 3.4	14.74%	71.50%	21.35%	80.30%	24.99%	83.54%	22.07%	81.33%	22.69%	81.82%	23.35%	82.03%	18.59%	76.45%	17.63%	75.11%	17.22%	74.42%	25.72%	84.29%
Series 4.1	18.94%	72.94%	28.04%	81.35%	32.10%	84.58%	28.96%	83.08%	29.85%	83.76%	30.52%	84.16%	24.32%	78.07%	23.11%	76.87%	22.53%	76.20%	32.96%	85.88%
Series 4.4	14.28%	67.74%	21.25%	77.93%	24.95%	82.01%	21.99%	80.10%	22.69%	80.92%	23.27%	81.39%	18.24%	73.89%	17.24%	72.41%	16.75%	71.60%	25.67%	83.61%

Property of CSA Group

torage facility

	Configuration 1		Configuration 2		Configuration 3		Configuration 4		Configuration 5		Configuration 6		Configuration 7		Configuration 8		Configuration 9		Configuration 10	
	Length		Length		Length		Length		Length		Length		Length		Length		Length		Length	
	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m
eries 2.1	78.09%	18.77%	68.96%	11.59%	64.65%	9.06%	68.15%	10.65%	67.38%	10.24%	66.70%	10.05%	72.52%	14.64%	73.88%	15.81%	74.50%	16.34%	63.85 %	8.40%
eries 2.2	81.62%	21.89%	73.92%	13.78%	69.82%	10.86%	73.25%	12.77%	72.63%	12.34%	72.06%	12.13%	77.10%	17.24%	78.27%	18.58%	78.83%	19.16%	69.15 %	10.17%
eries 2.3	82.58%	22.19%	76.03%	14.86%	72.53%	12.24%	75.42%	13.75%	74.84%	13.30%	74.31%	13.07%	78.75%	18.15%	79.84%	19.50%	80.83%	21.08%	71.98 %	11.48%
eries 2.4	83.77%	24.47%	76.75%	15.59%	72.86%	12.33%	76.07%	14.47%	75.44%	13.99%	74.86%	13.76%	79.69%	19.40%	80.77%	20.88%	81.28%	21.51%	72.18 %	11.56%
eries 1.2	80.24%	21.33%	71.75%	13.08%	67.45%	10.16%	71.00%	11.89%	70.33%	11.39%	69.76%	11.15%	75.34%	16.65%	76.62%	17.98%	77.22%	18.55%	66.71 %	9.35%
eries 1.4	82.52%	23.86%	74.74%	14.81%	70.63%	11.56%	73.98%	13.48%	73.30%	12.93%	72.71%	12.66%	78.08%	18.76%	79.26%	20.22%	79.81%	20.85%	69.87 %	10.65%
eries 3.1	78.18%	18.83%	69.04%	11.59%	64.75%	9.08%	68.16%	10.68%	67.44%	10.25%	66.67%	10.07%	72.65%	14.71%	73.92%	15.79%	74.46%	16.34%	63.91 %	8.41%
eries 3.4	83.79%	24.51%	76.78%	15.56%	72.89%	12.34%	76.06%	14.48%	75.46%	13.97%	74.81%	13.76%	79.74%	19.46%	80.76%	20.82%	81.21%	21.52%	72.17 %	11.55%
eries 4.1	78.85%	22.14%	69.15%	13.58%	64.75%	10.37%	68.24%	11.75%	67.37%	11.04%	66.73%	10.63%	73.19%	16.89%	74.50%	18.11%	75.14%	18.79%	63.91 %	9.00%
eries 4.4	84.29%	28.47%	76.88%	18.05%	72.93%	13.94%	76.15%	15.77%	75.45%	14.91%	74.89%	14.42%	80.12%	22.16%	81.19%	23.66%	81.72%	24.49%	72.22 %	12.26%

University of Cape Town

APPENDIX E

APPENDIX F: RECURRING COST BREAKDOWN

University of Cape Town

Contribution of Operation and Maintenance to Yearly Recurring Cost

Operation

	Configuration 1		Configuration 2		Configuration 3		Configuration 4		Configuration 5		Configuration 6		Configuration 7		Configuration 8		Configuration 9		Configuration 10	
	Length		Length		Length		Length		Length		Length		Length		Length		Length		Length	
	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m
Series 2.1	8.35%	50.00%	11.90%	55.68%	14.32%	57.98%	11.89%	56.25%	11.87%	56.48%	11.81%	56.57%	10.14%	53.23%	9.49%	52.27%	9.18%	51.83%	14.30%	58.38%
Series 2.2	8.08%	51.36%	11.59%	57.60%	13.99%	60.09%	11.59%	58.21%	11.57%	58.46%	11.53%	58.55%	9.85%	54.92%	9.23%	53.87%	8.93%	53.39%	13.98%	60.50%
Series 2.3	8.20%	43.31%	19.06%	64.32%	30.25%	75.26%	19.07%	64.95%	19.05%	65.19%	19.01%	65.30%	13.05%	54.79%	12.13%	53.41%	17.26%	64.30%	30.23%	75.61%
Series 2.4	7.52%	50.86%	10.87%	57.58%	13.18%	60.27%	10.87%	58.27%	10.85%	58.54%	10.82%	58.65%	9.21%	54.69%	8.62%	53.55%	8.33%	53.04%	13.17%	60.73%
Series 1.2	8.71%	51.72%	12.61%	58.04%	15.17%	60.53%	12.63%	58.78%	12.61%	59.06%	12.56%	59.19%	10.66%	55.30%	9.97%	54.25%	9.64%	53.78%	15.17%	61.02%
Series 1.4	8.12%	51.25%	11.85%	58.08%	14.32%	60.76%	11.87%	58.90%	11.86%	59.21%	11.81%	59.36%	9.98%	55.11%	9.32%	53.98%	9.01%	53.47%	14.33%	61.31%
Series 3.1	8.31%	49.96%	11.86%	55.68%	14.27%	57.97%	11.88%	56.24%	11.84%	56.48%	11.83%	56.56%	10.08%	53.19%	9.47%	52.29%	9.20%	51.83%	14.27%	58.37%
Series 3.4	7.51%	50.83%	10.85%	57.60%	13.16%	60.27%	10.87%	58.26%	10.85%	58.55%	10.84%	58.65%	9.19%	54.65%	8.62%	53.59%	8.36%	53.04%	13.18%	60.74%
Series 4.1	8.04%	47.83%	11.82%	54.38%	14.27%	57.13%	11.85%	55.54%	11.87%	55.96%	11.80%	56.20%	9.87%	51.77%	9.24%	50.79%	8.94%	50.24%	14.27%	57.98%
Series 4.4	7.27%	48.25%	10.80%	56.01%	13.14%	59.25%	10.83%	57.43%	10.85%	57.95%	10.80%	58.23%	9.01%	52.91%	8.42%	51.75%	8.13%	51.11%	13.15%	60.29%

Maintenance

	Configuration 1		Configuration 2		Configuration 3		Configuration 4		Configuration 5		Configuration 6		Configuration 7		Configuration 8		Configuration 9		Configuration 10	
	Length		Length		Length		Length		Length		Length		Length		Length		Length		Length	
	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m	1000 m	25000 m
Series 2.1	91.65%	50.00%	88.10%	44.32%	85.68%	42.02%	88.11%	43.75%	88.13%	43.52%	88.19%	43.43%	89.86%	46.77%	90.51%	47.73%	90.82%	48.17%	85.70%	41.62%
Series 2.2	91.92%	48.64%	88.41%	42.40%	86.01%	39.91%	88.41%	41.79%	88.43%	41.54%	88.47%	41.45%	90.15%	45.08%	90.77%	46.13%	91.07%	46.61%	86.02%	39.50%
Series 2.3	91.80%	56.69%	80.94%	35.68%	69.75%	24.74%	80.93%	35.05%	80.95%	34.81%	80.99%	34.70%	86.95%	45.21%	87.87%	46.59%	82.74%	35.70%	69.77%	24.39%
Series 2.4	92.48%	49.14%	89.13%	42.42%	86.82%	39.73%	89.13%	41.73%	89.15%	41.46%	89.18%	41.35%	90.79%	45.31%	91.38%	46.45%	91.67%	46.96%	86.83%	39.27%
Series 1.2	91.29%	48.28%	87.39%	41.96%	84.83%	39.47%	87.37%	41.22%	87.39%	40.94%	87.44%	40.81%	89.34%	44.70%	90.03%	45.75%	90.36%	46.22%	84.83%	38.98%
Series 1.4	91.88%	48.75%	88.15%	41.92%	85.68%	39.24%	88.13%	41.10%	88.14%	40.79%	88.19%	40.64%	90.02%	44.89%	90.68%	46.02%	90.99%	46.53%	85.67%	38.69%
Series 3.1	91.69%	50.04%	88.14%	44.32%	85.73%	42.03%	88.12%	43.76%	88.16%	43.52%	88.17%	43.44%	89.92%	46.81%	90.53%	47.71%	90.80%	48.17%	85.73%	41.63%
Series 3.4	92.49%	49.17%	89.15%	42.40%	86.84%	39.73%	89.13%	41.74%	89.15%	41.45%	89.16%	41.35%	90.81%	45.35%	91.38%	46.41%	91.64%	46.96%	86.82%	39.26%
Series 4.1	91.96%	52.17%	88.18%	45.62%	85.73%	42.87%	88.15%	44.46%	88.13%	44.04%	88.20%	43.80%	90.13%	48.23%	90.76%	49.21%	91.06%	49.76%	85.73%	42.02%
Series 4.4	92.73%	51.75%	89.20%	43.99%	86.86%	40.75%	89.17%	42.57%	89.15%	42.05%	89.20%	41.77%	90.99%	47.09%	91.58%	48.25%	91.87%	48.89%	86.85%	39.71%

Property of Cisco Systems

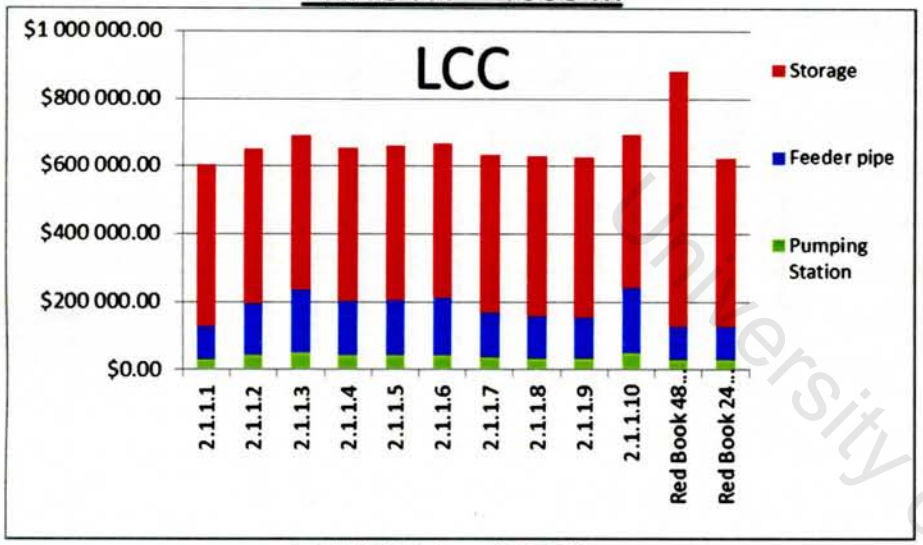
APPENDIX G1: LCC- BREAKDOWN (INFRASTRUCTURE COMPONENTS)

University of Cape Town

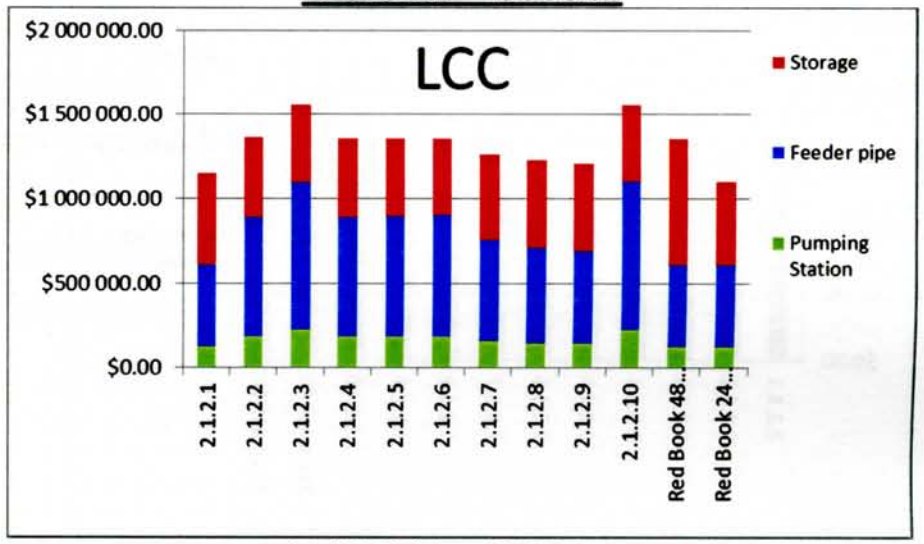
SERIES 2.1

Base Analysis & DD=20l/s

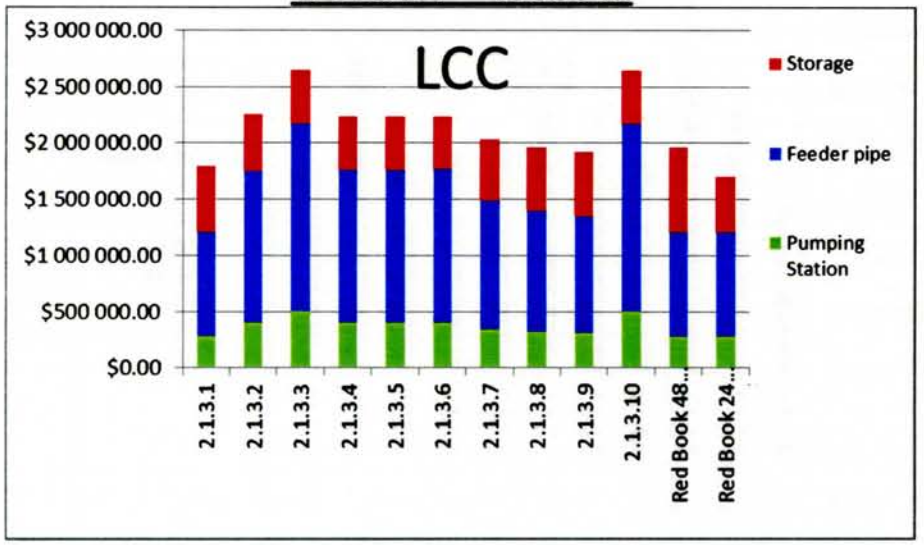
LENGTH = 1000 m



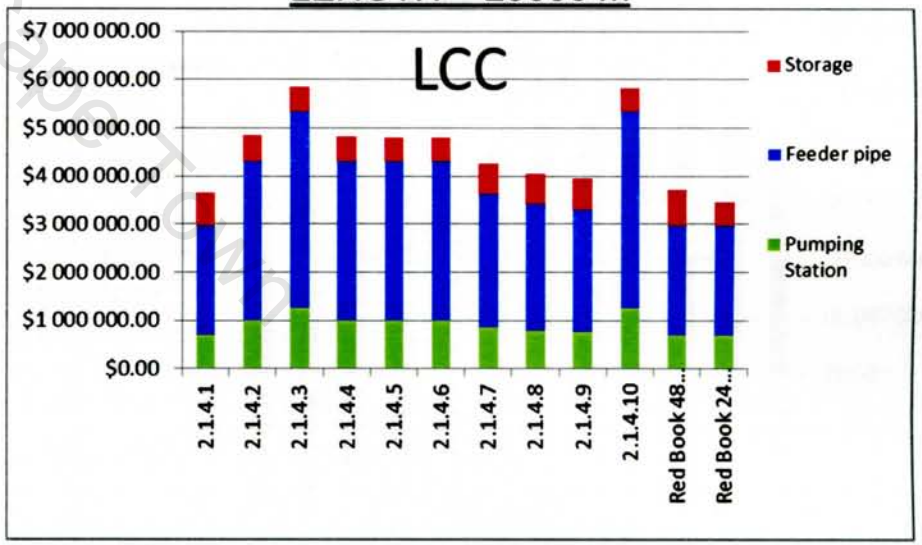
LENGTH = 5000 m



LENGTH = 10000 m



LENGTH = 25000 m

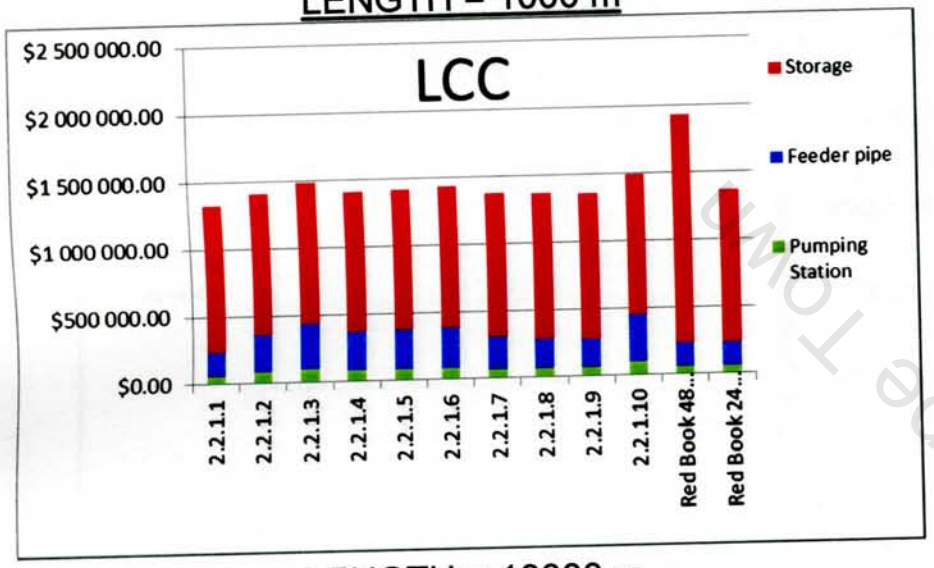


University of Cape Town

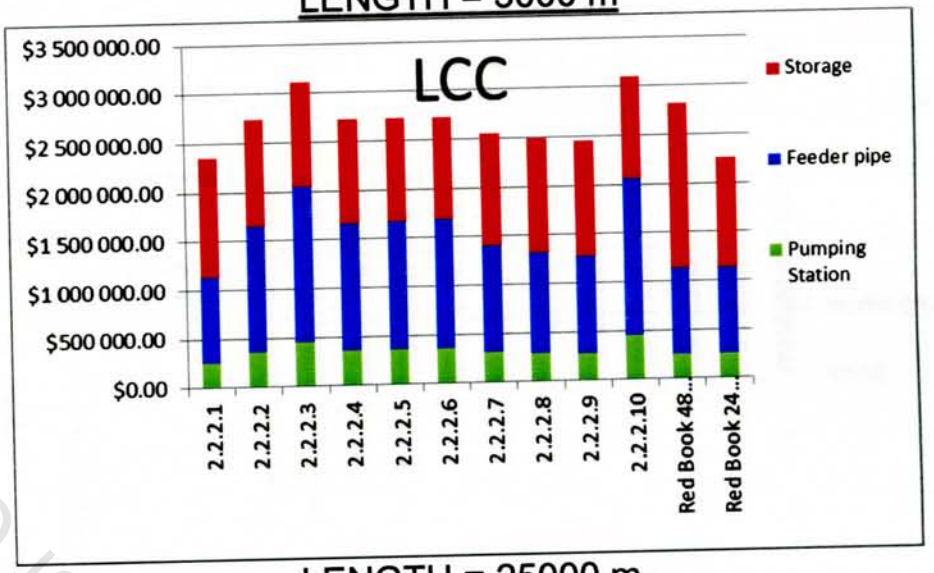
SERIES 2.2

Base Analysis & DD=80l/s

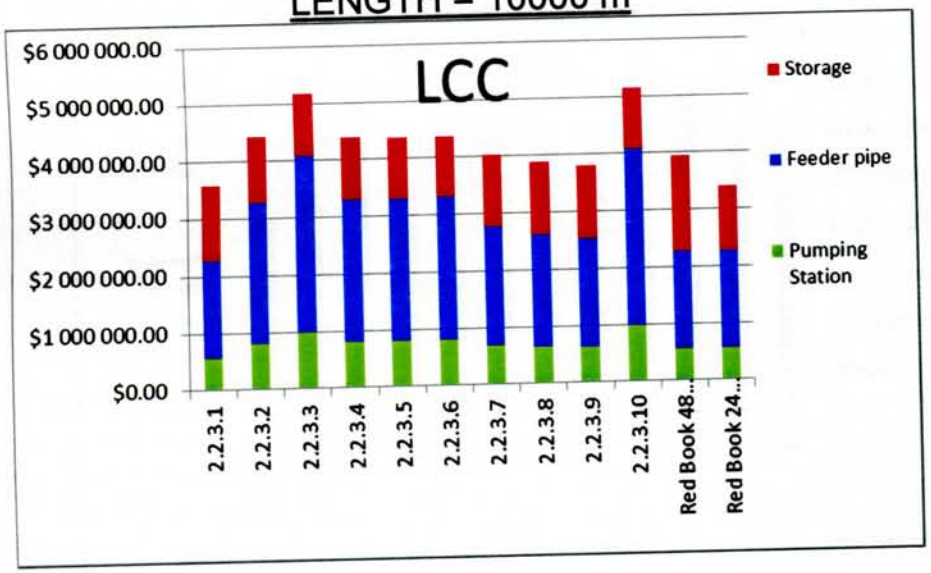
LENGTH = 1000 m



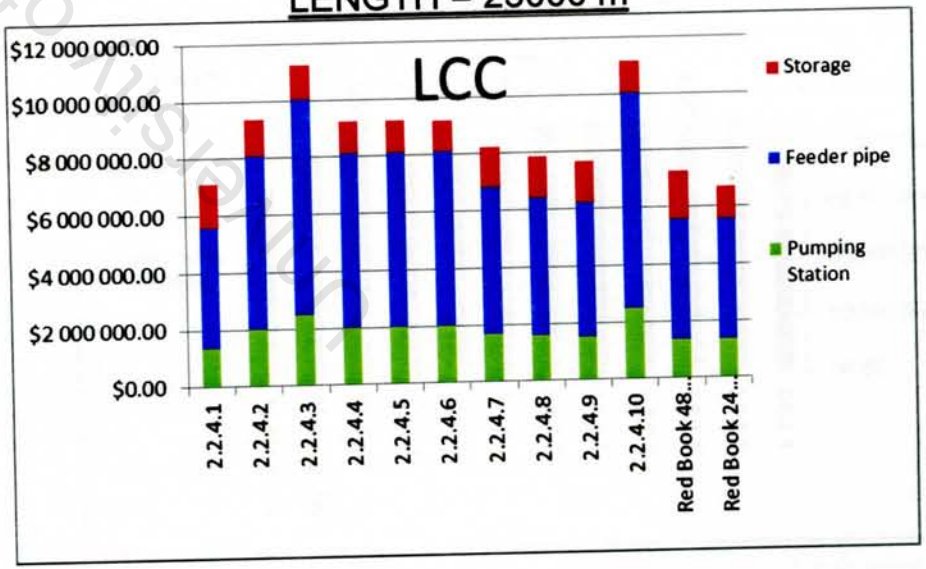
LENGTH = 5000 m



LENGTH = 10000 m



LENGTH = 25000 m

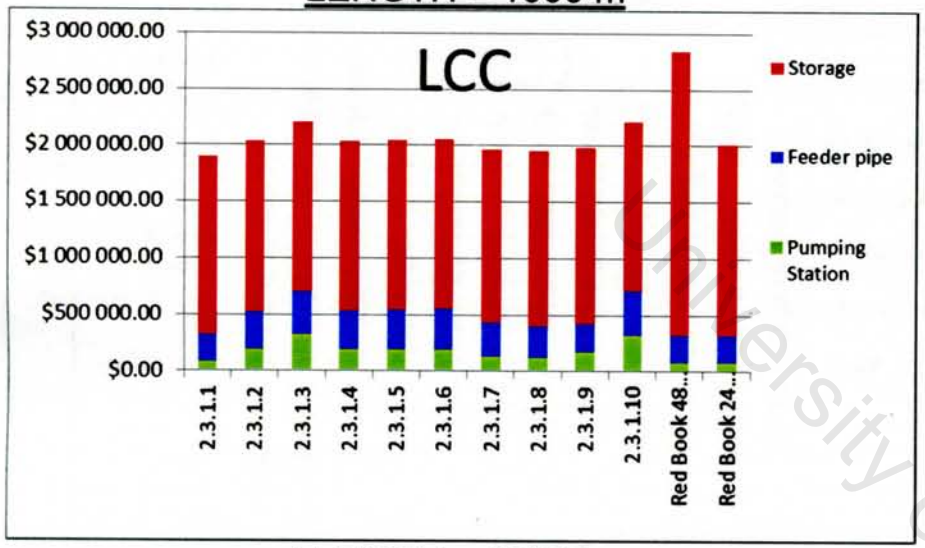


University of Cape Town

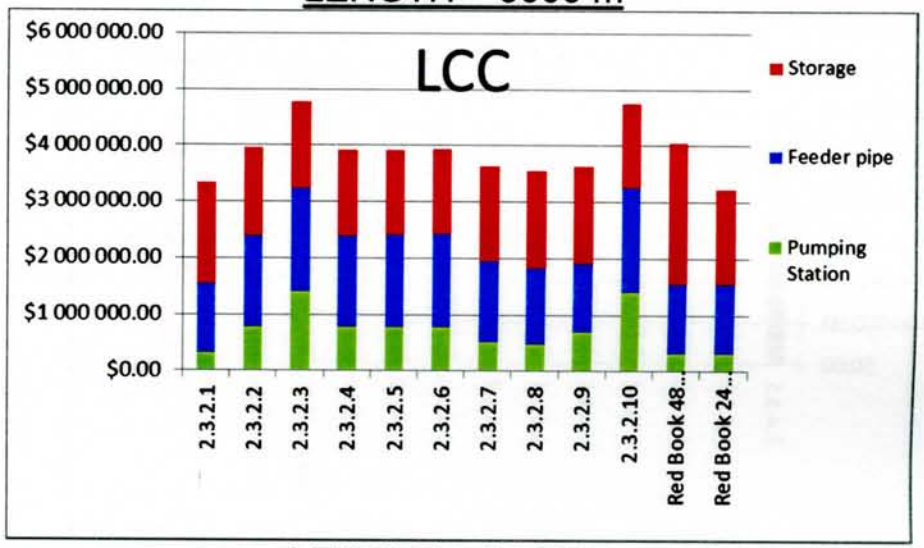
SERIES 2.3

Base Analysis & DD=160l/s

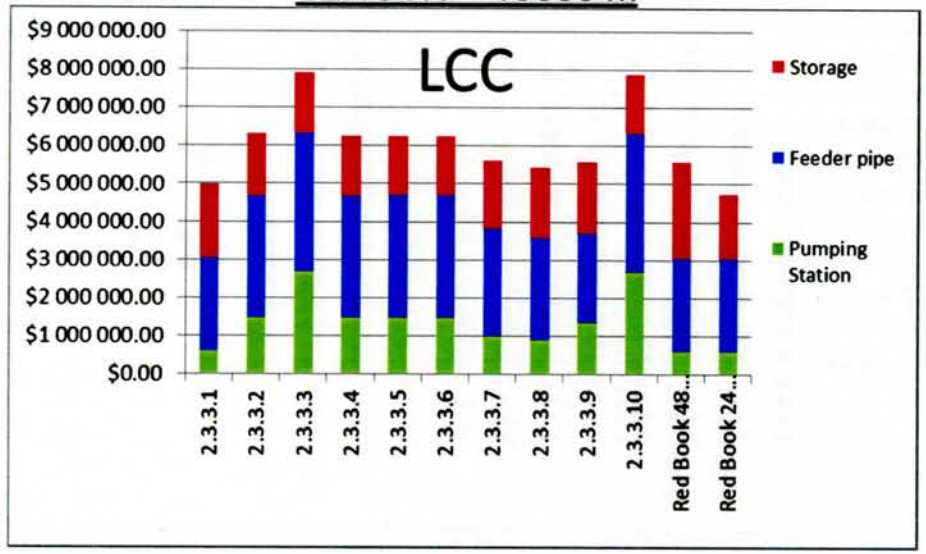
LENGTH = 1000 m



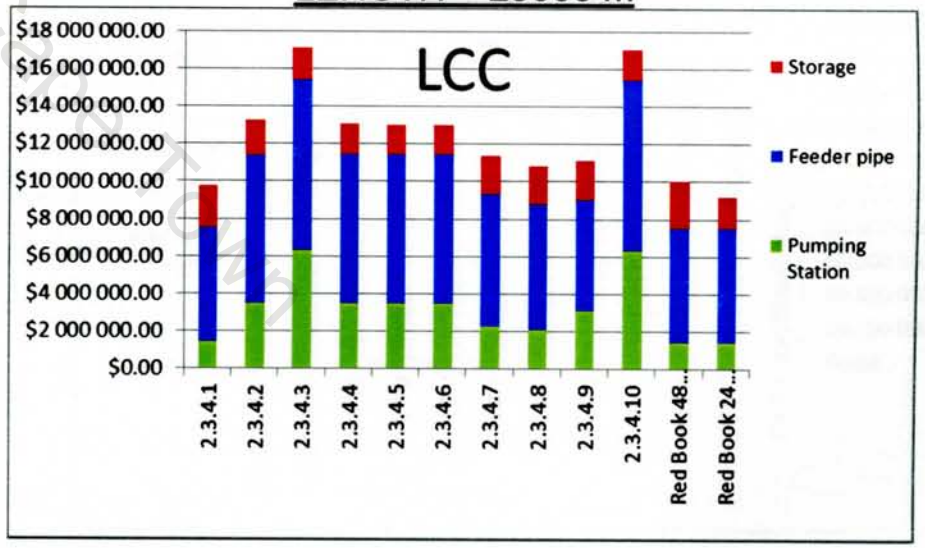
LENGTH = 5000 m



LENGTH = 10000 m



LENGTH = 25000 m

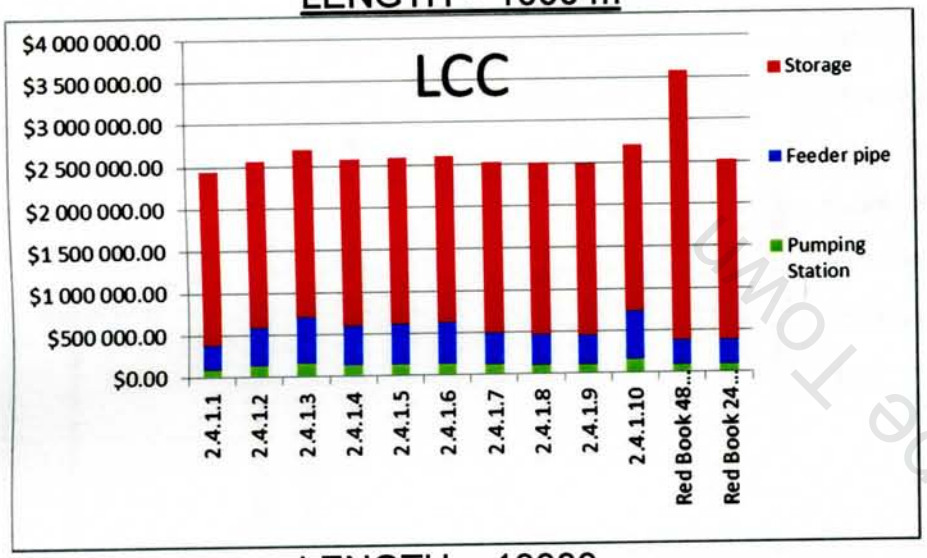


University of Cape Town

SERIES 2.4

Base Analysis & DD=240l/s

LENGTH = 1000 m



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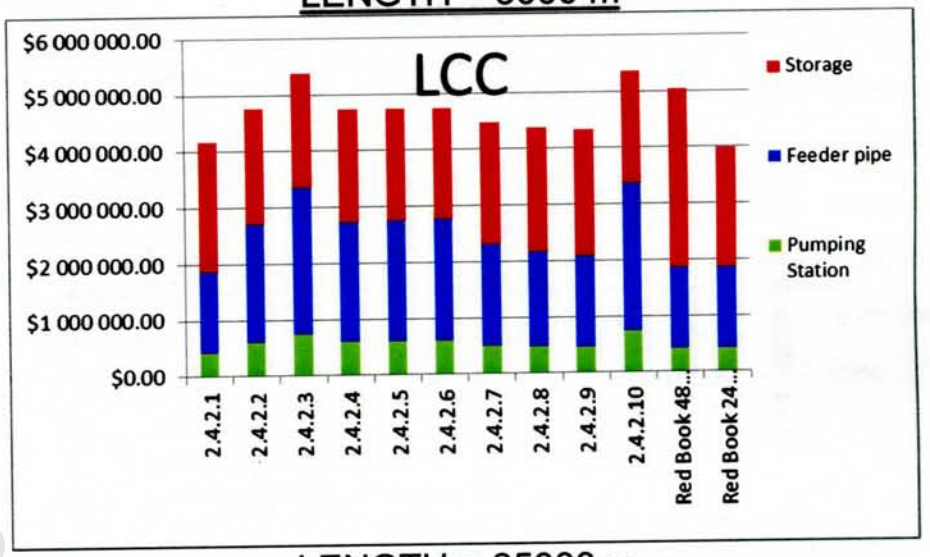
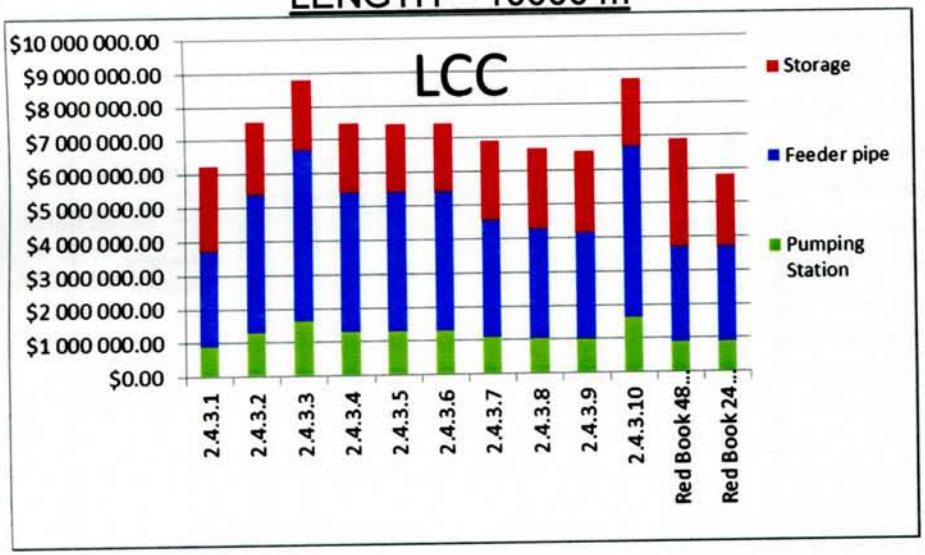
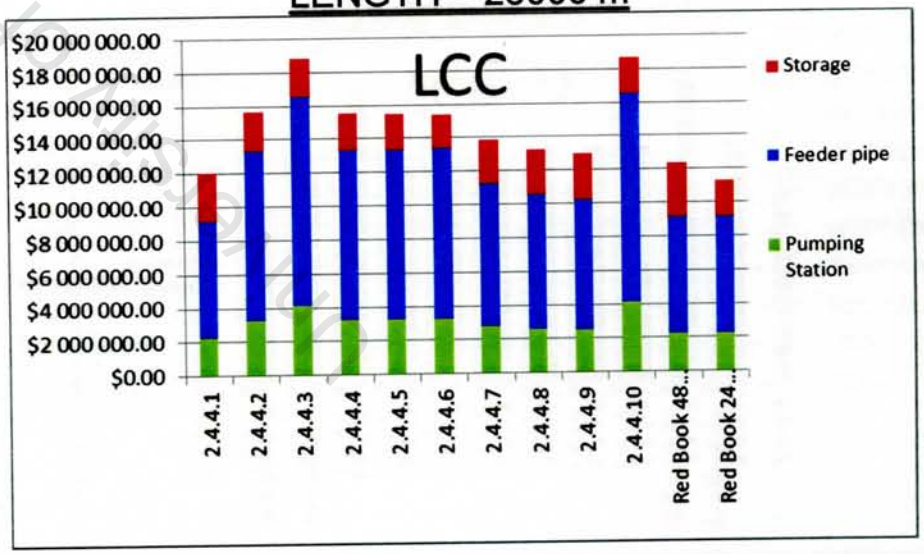


LENGTH = 10000 m



LENGTH = 25000 m

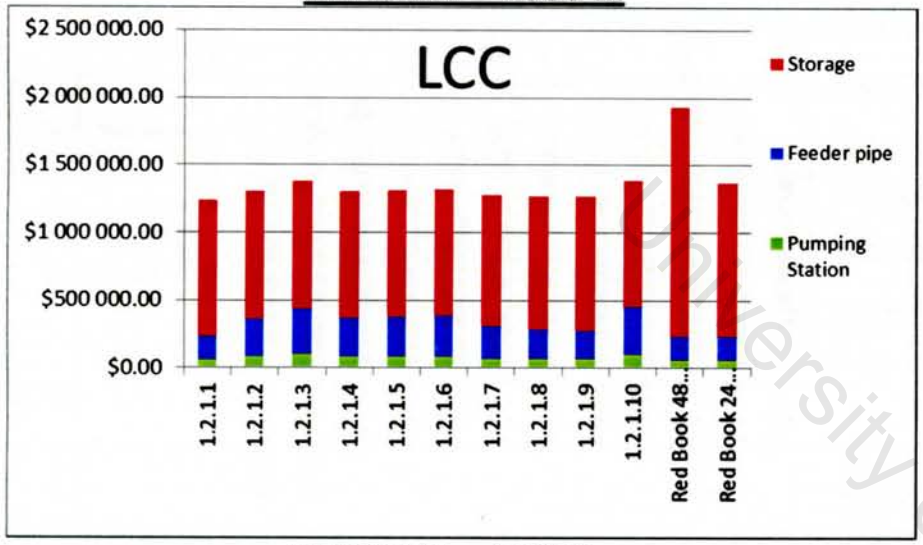


Property of Cape Town

SERIES 1.2

Flatter Demand & DD=80l/s

LENGTH = 1000 m



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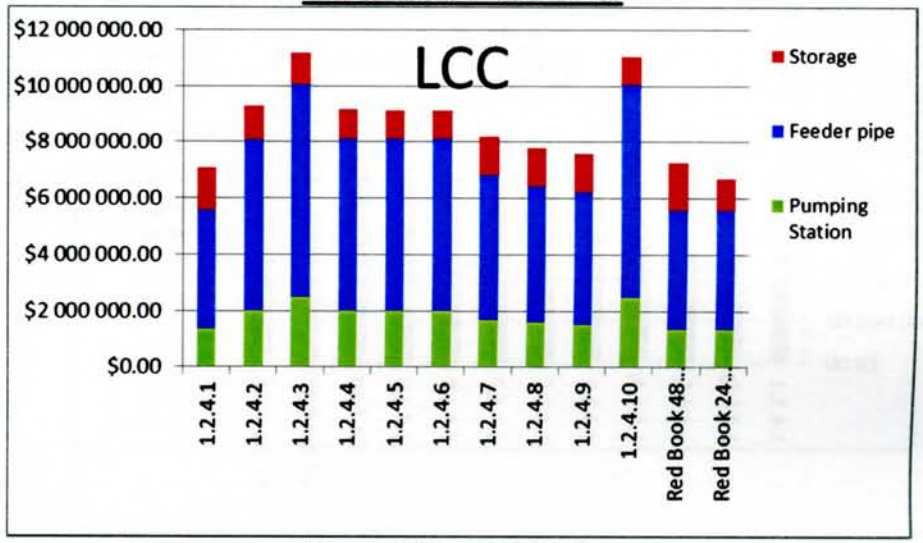
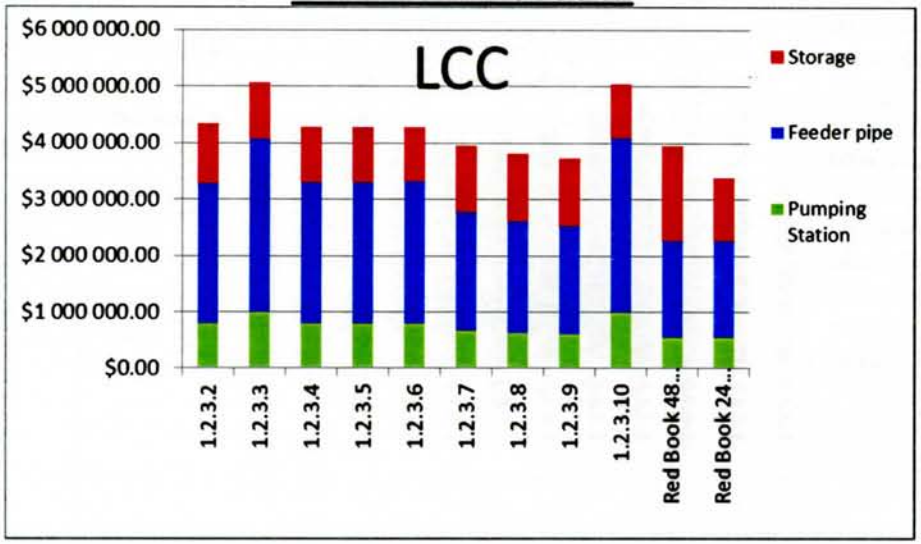
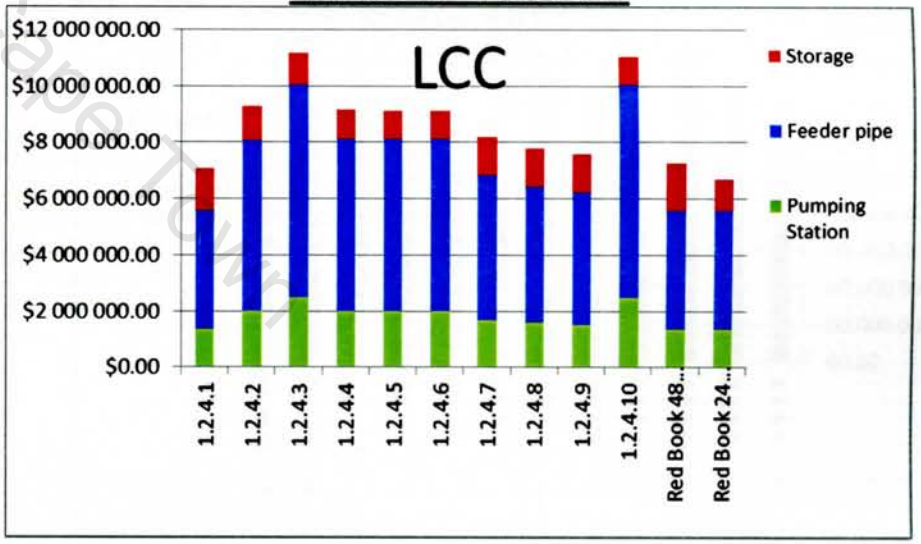


LENGTH = 10000 m



LENGTH = 25000 m

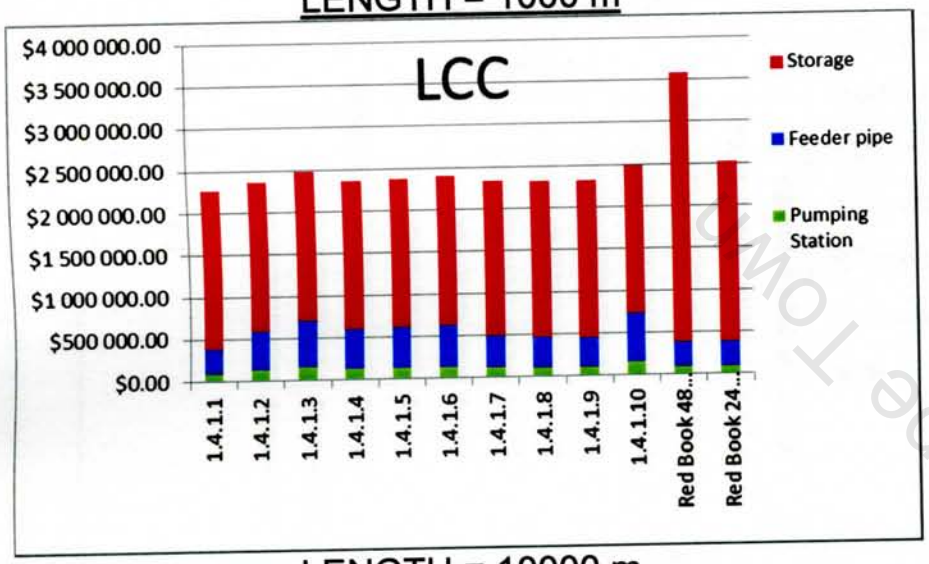


University of Cape Town

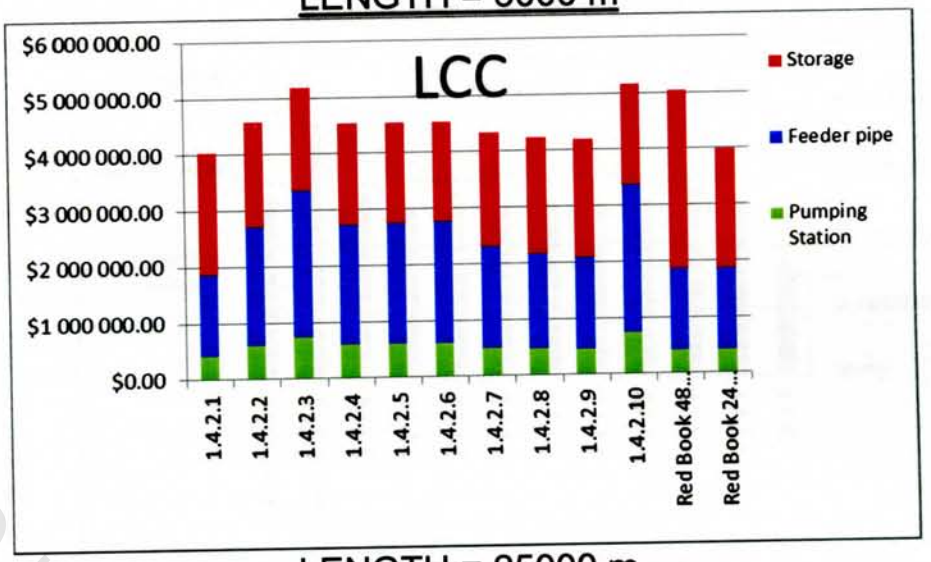
SERIES 1.4

Flatter Demand & DD=24/s

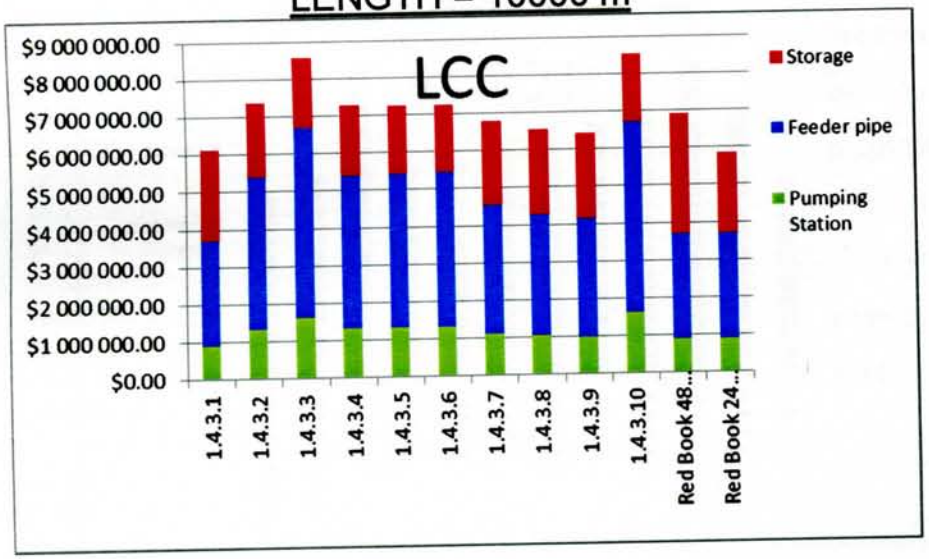
LENGTH = 1000 m



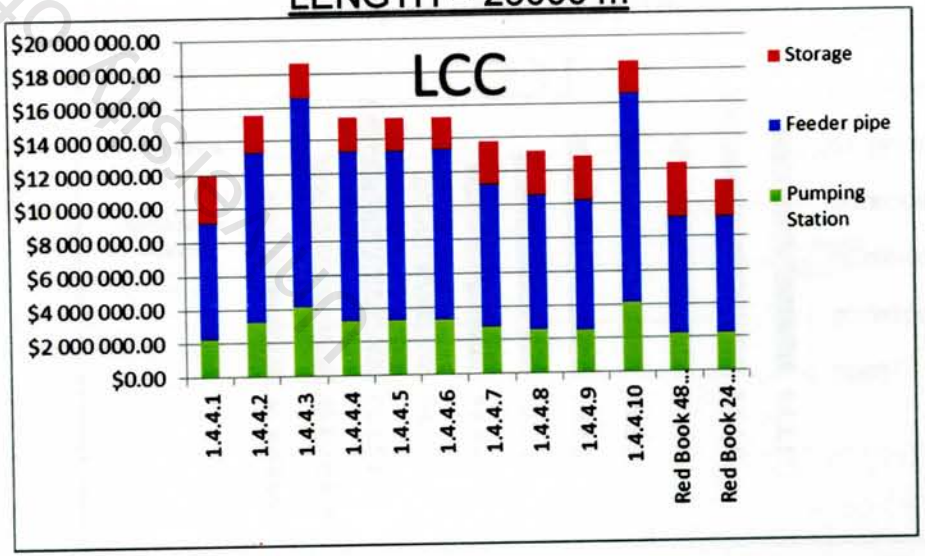
LENGTH = 5000 m



LENGTH = 10000 m



LENGTH = 25000 m

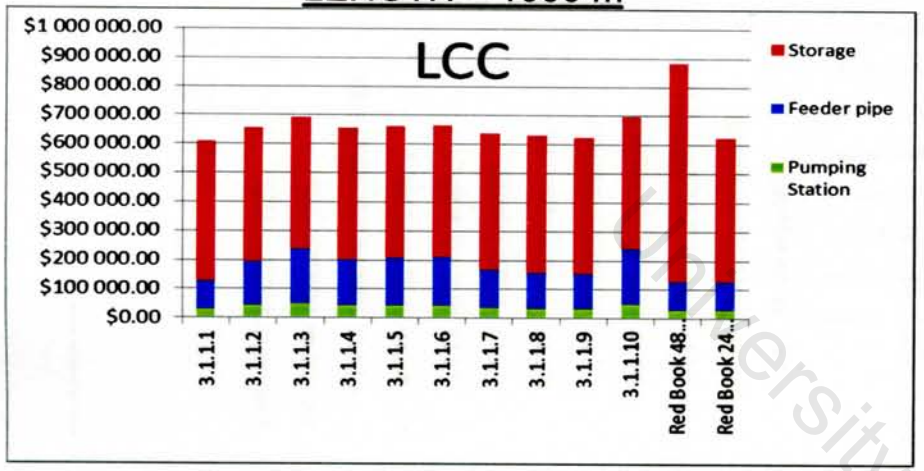


University of Cape Town

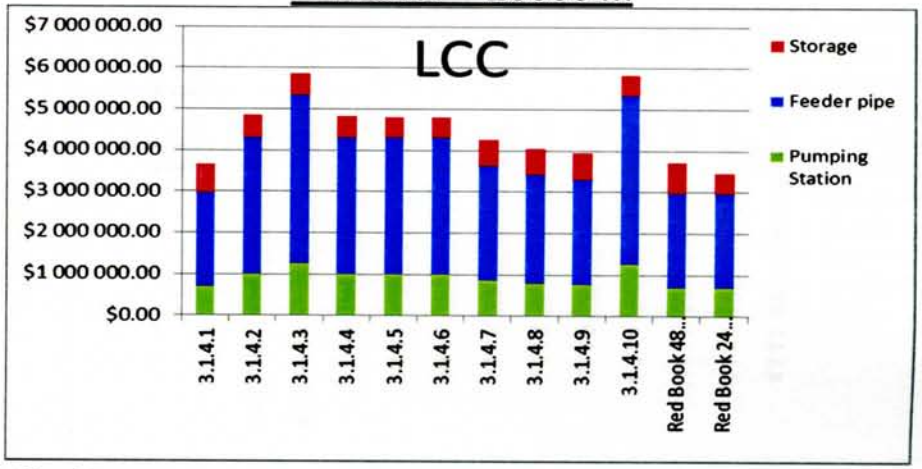
SERIES 3.1

Higher Fire Rate & DD=20l/s

LENGTH = 1000 m



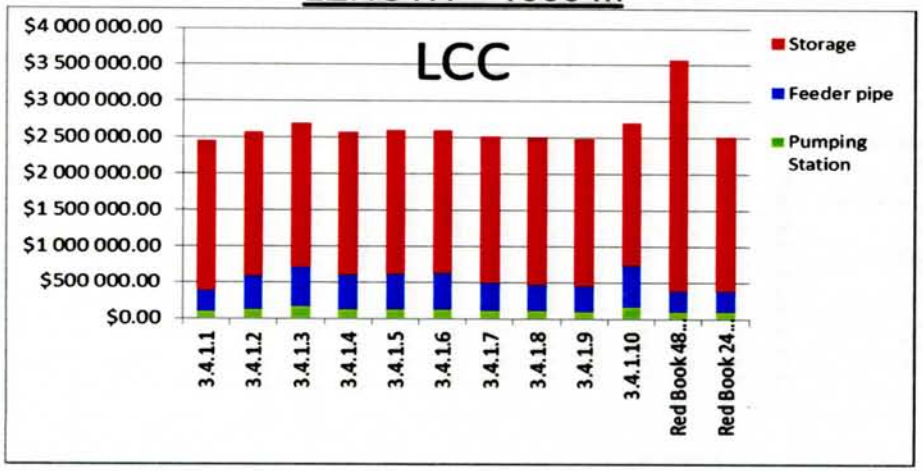
LENGTH = 25000 m



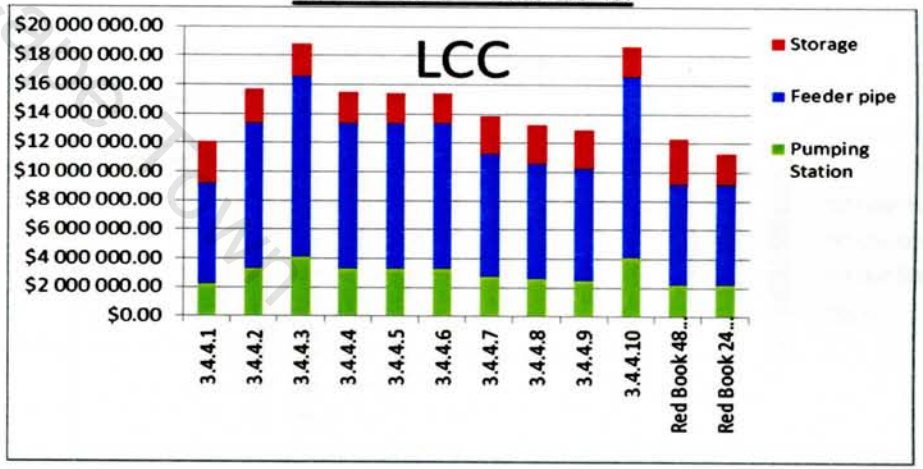
SERIES 3.4

Higher Fire Rate & DD=240l/s

LENGTH = 1000 m



LENGTH = 25000 m

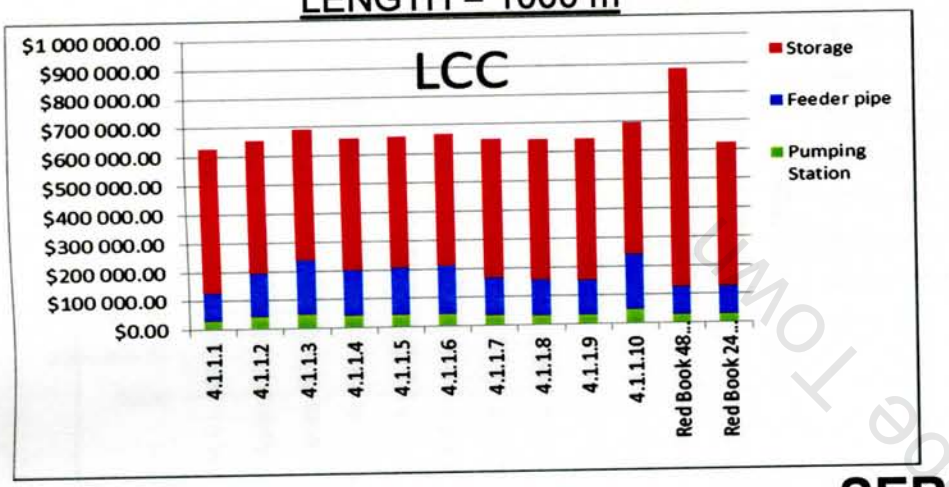


University of Cape Town

SERIES 4.1

Higher Pipe Failure Rate & DD=20l/s

LENGTH = 1000 m



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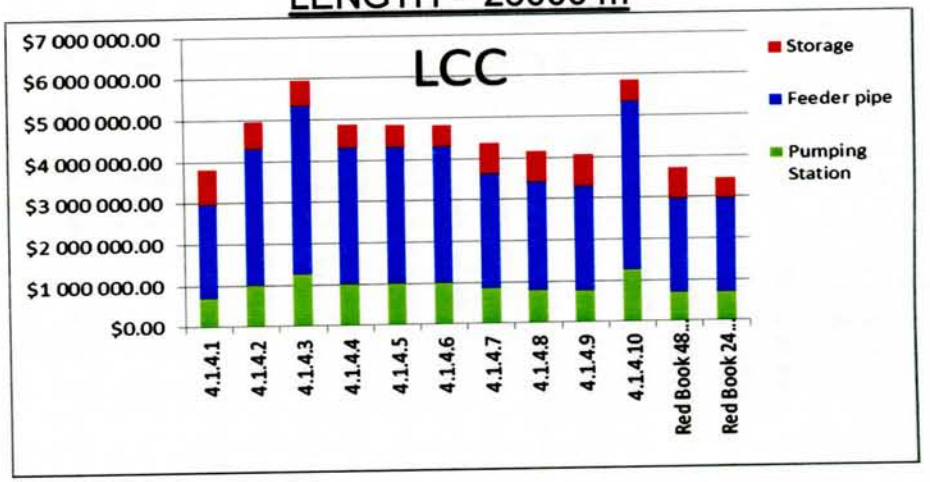
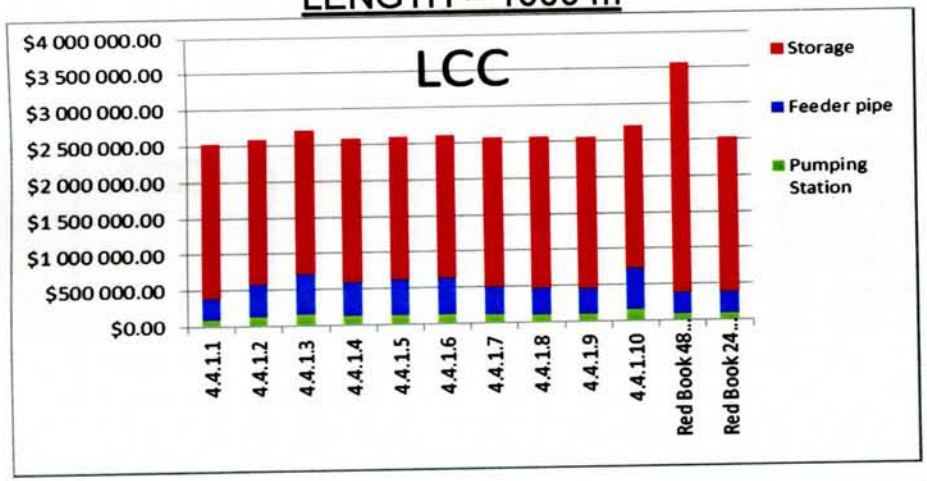


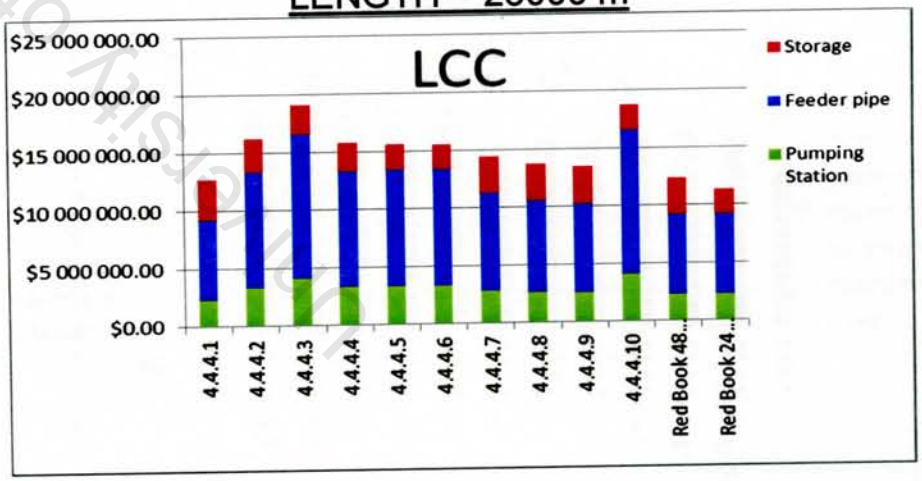
SERIES 4.4

Higher Pipe Failure Rate & DD=240l/s

LENGTH = 1000 m



LENGTH = 25000 m



University of Pretoria

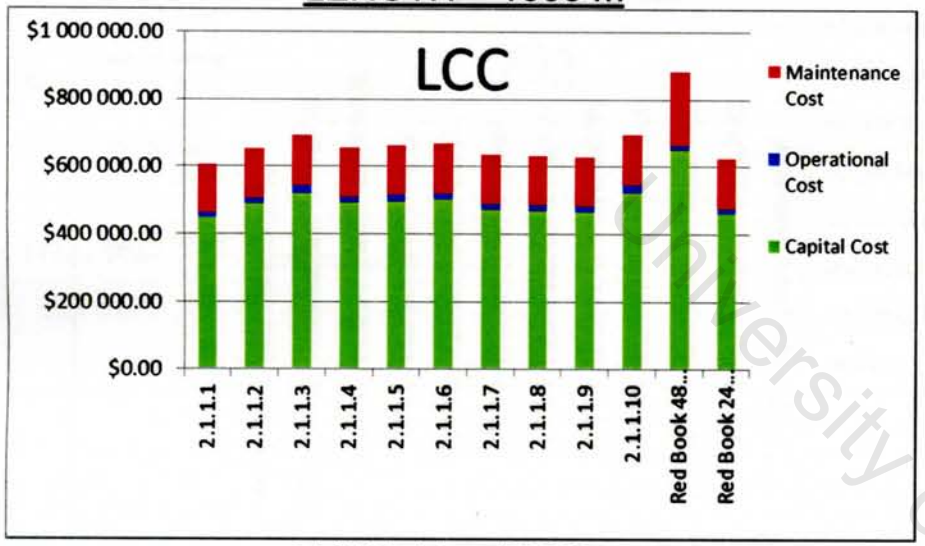
APPENDIX G2: LCC- BREAKDOWN (CAPITAL AND RECURRING COSTS)

University of Cape Town

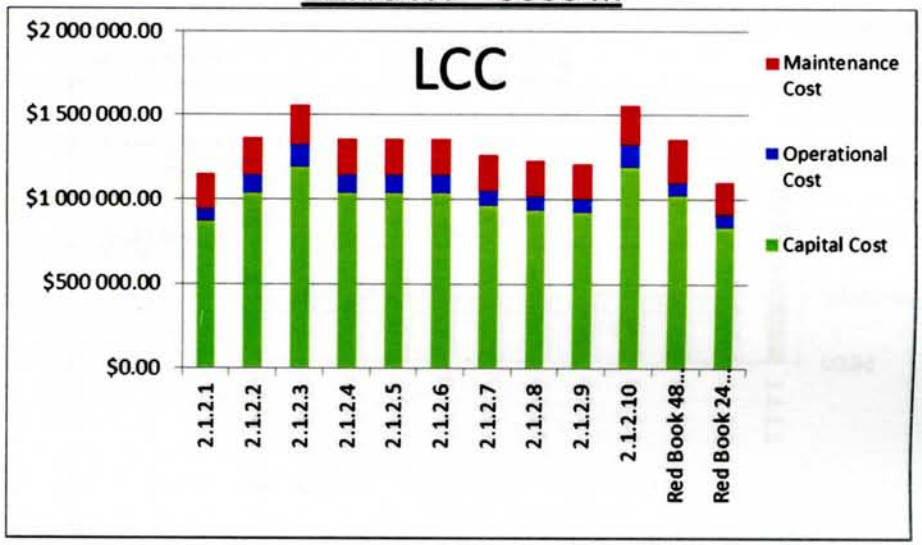
SERIES 2.1

Base Analysis & DD=20l/s

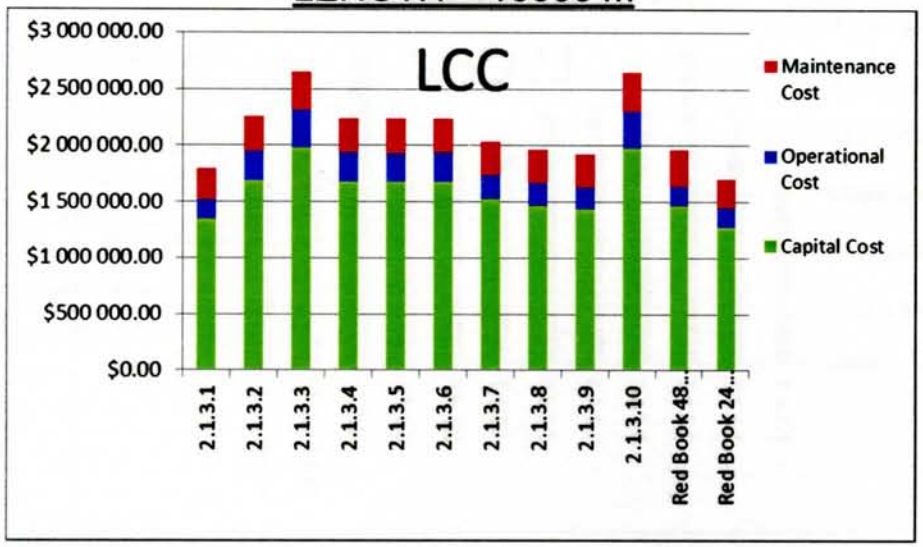
LENGTH = 1000 m



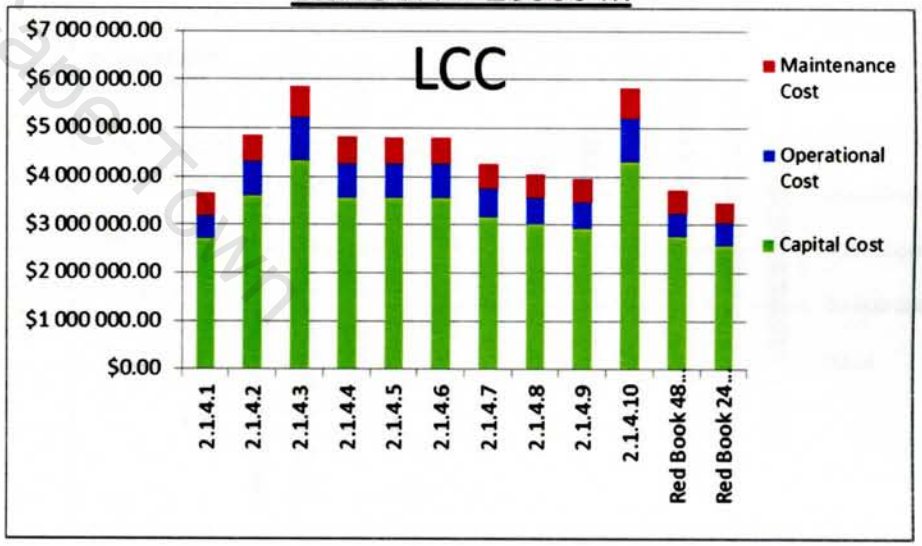
LENGTH = 5000 m



LENGTH = 10000 m



LENGTH = 25000 m

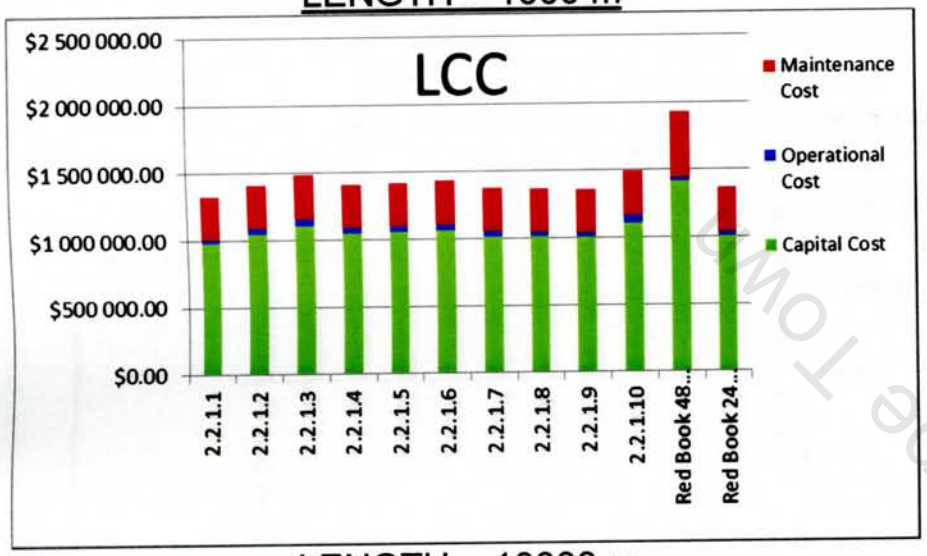


University of Cape Town

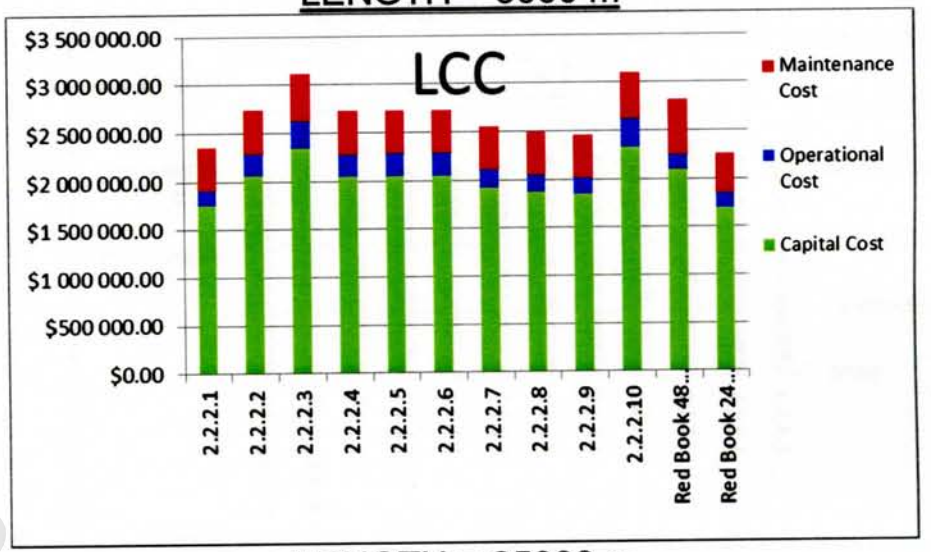
SERIES 2.2

Base Analysis & DD=80l/s

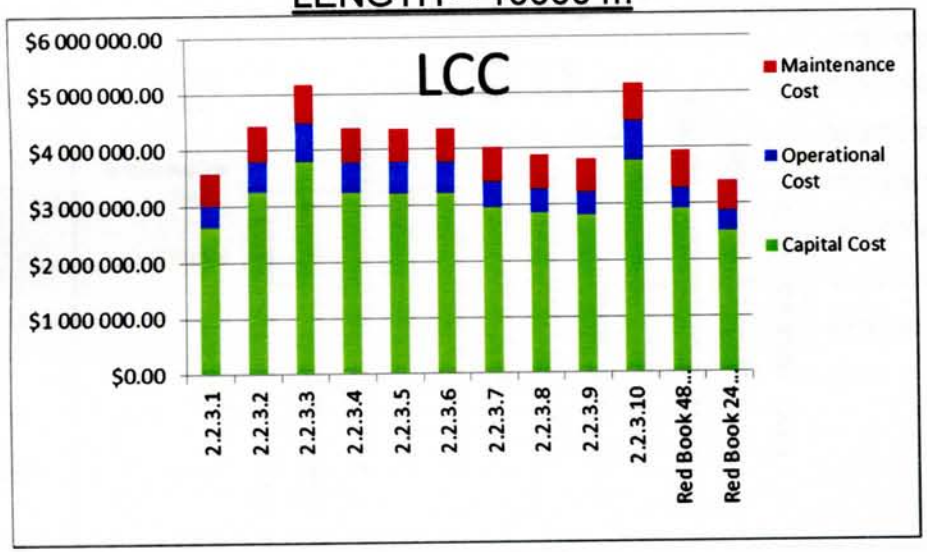
LENGTH = 1000 m



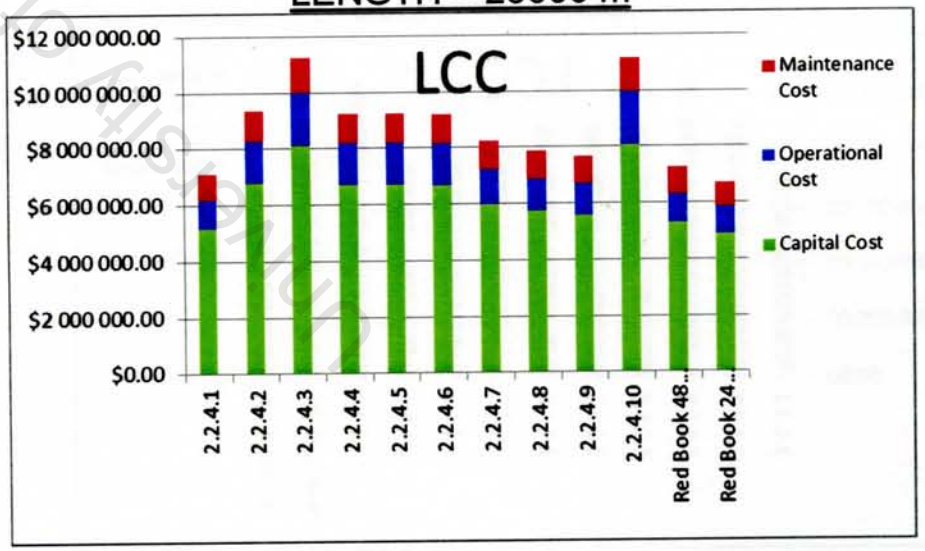
LENGTH = 5000 m



LENGTH = 10000 m



LENGTH = 25000 m

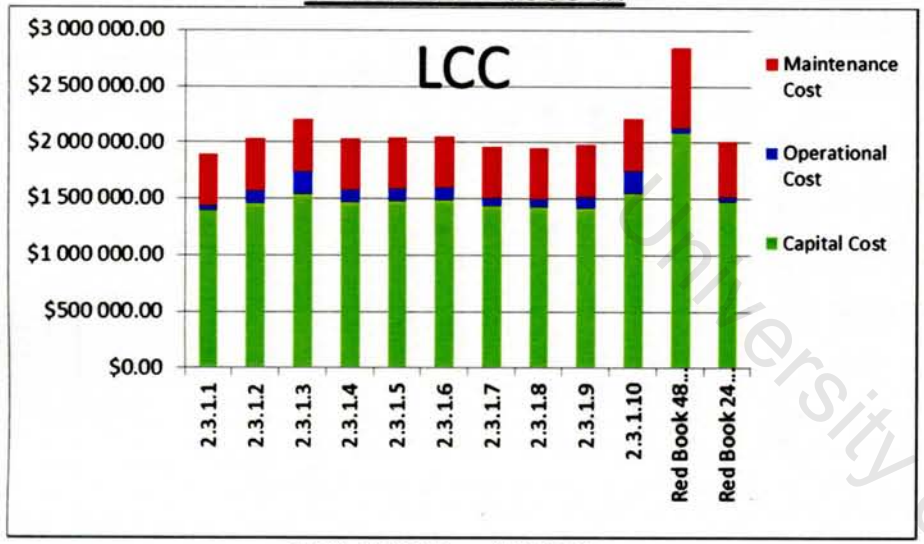


University of Cape Town

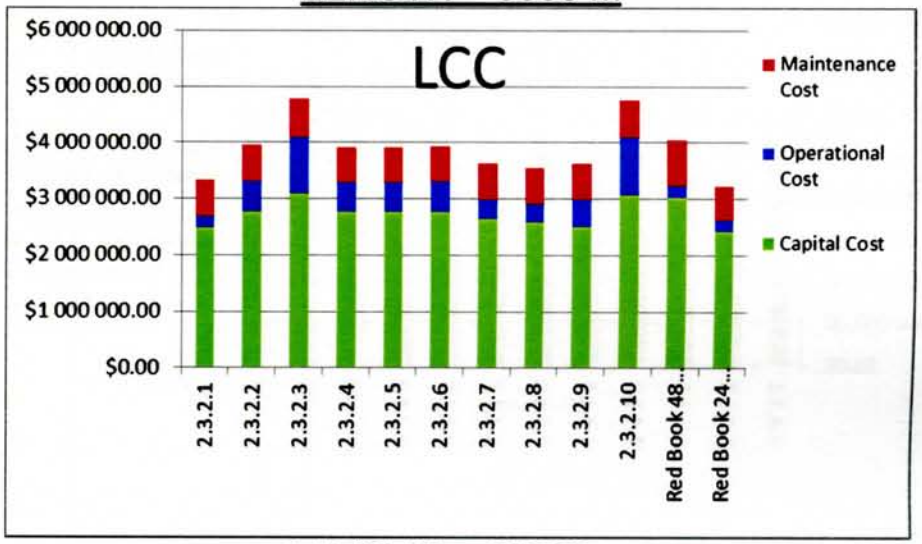
SERIES 2.3

Base Analysis & DD=160l/s

LENGTH = 1000 m



LENGTH = 5000 m



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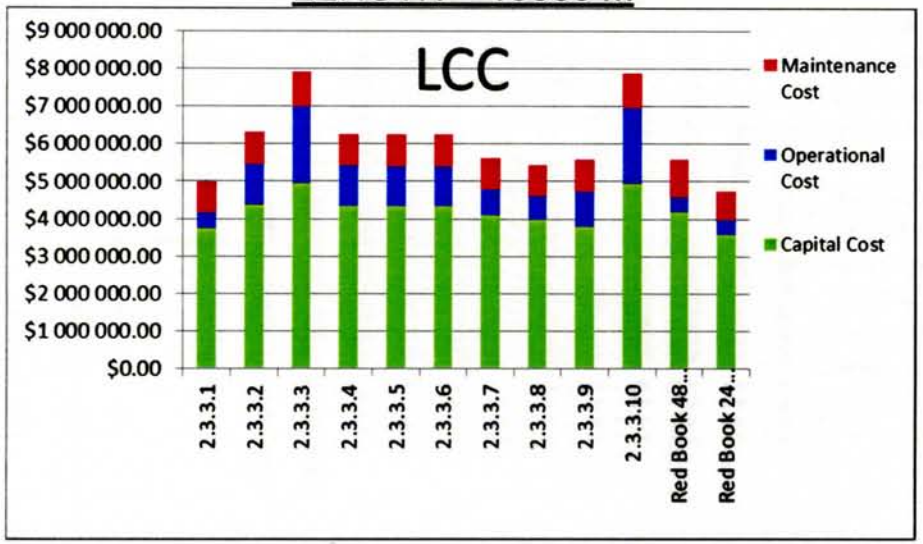

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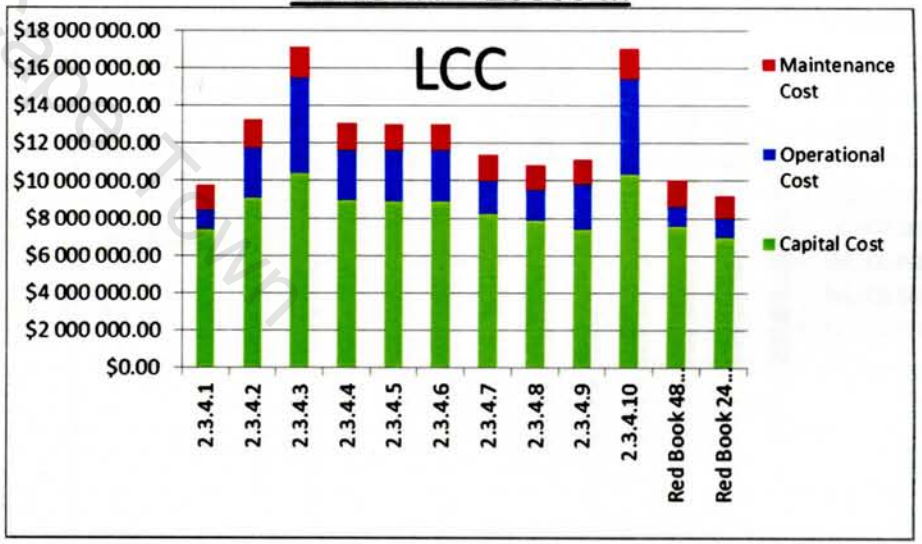

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SERIES 2.4

Base Analysis & DD=240l/s

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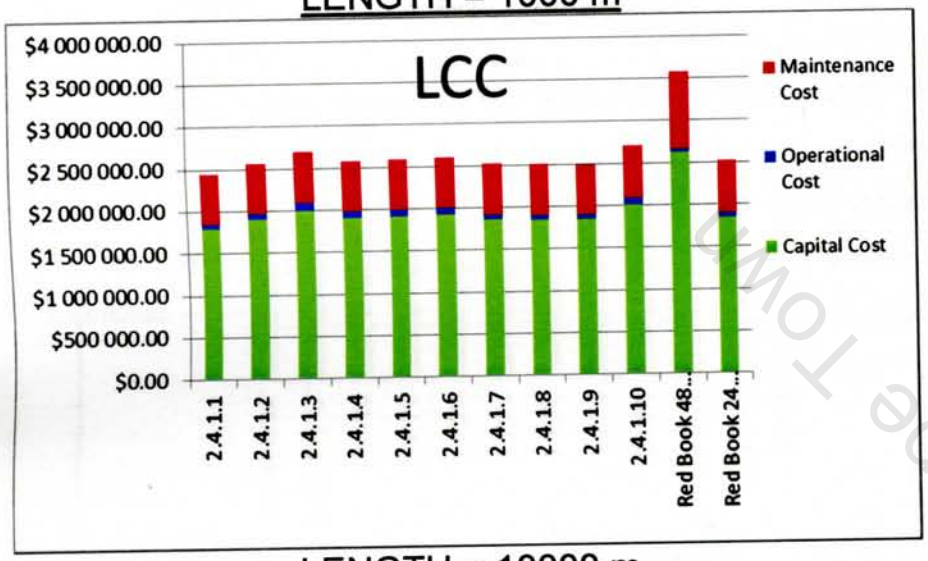

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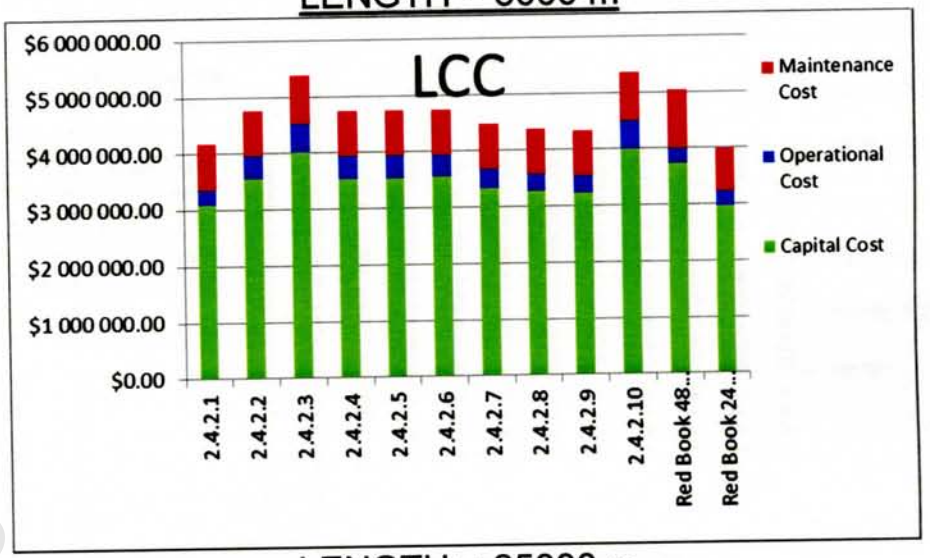

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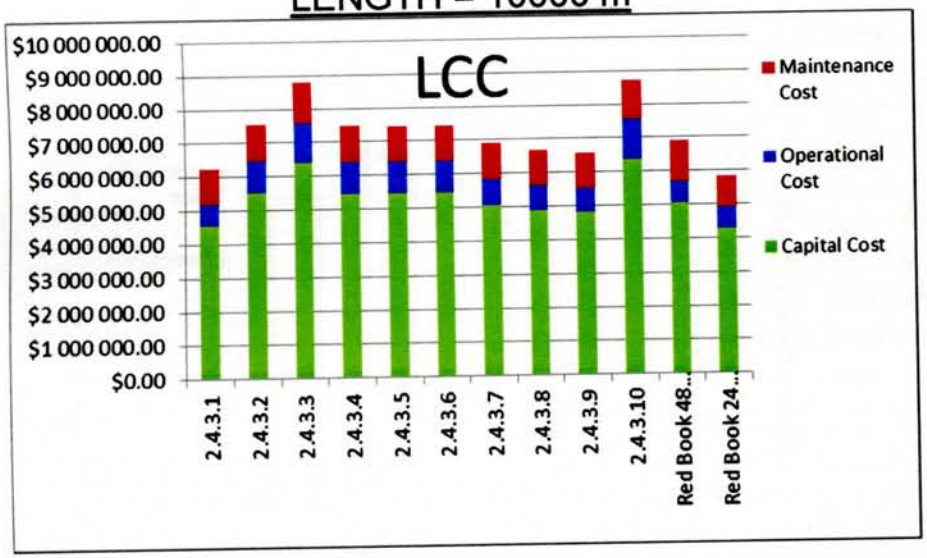

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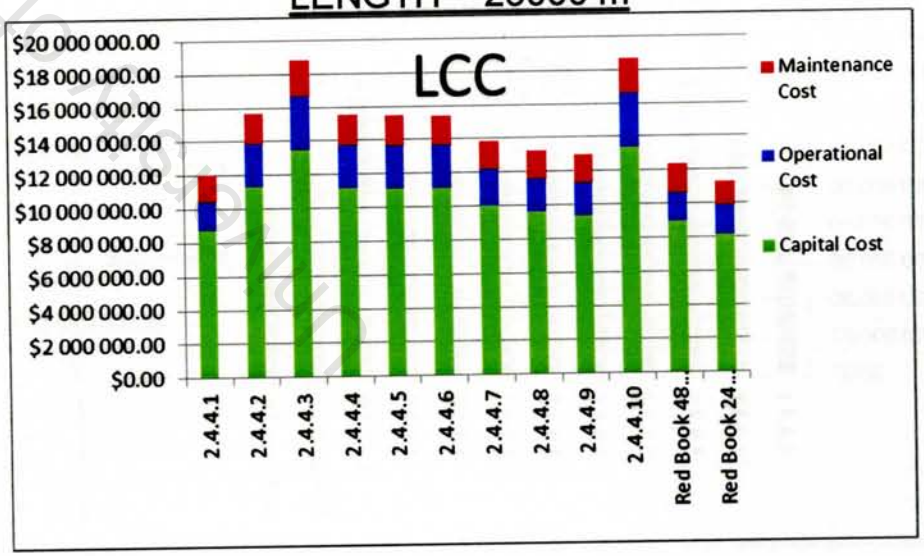

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SERIES 1.2

Flatter Demand & DD=80l/s

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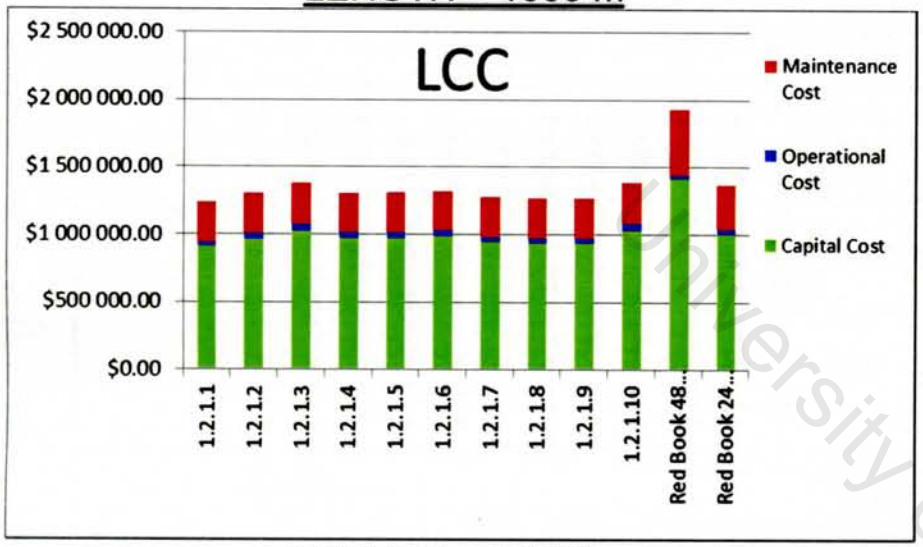

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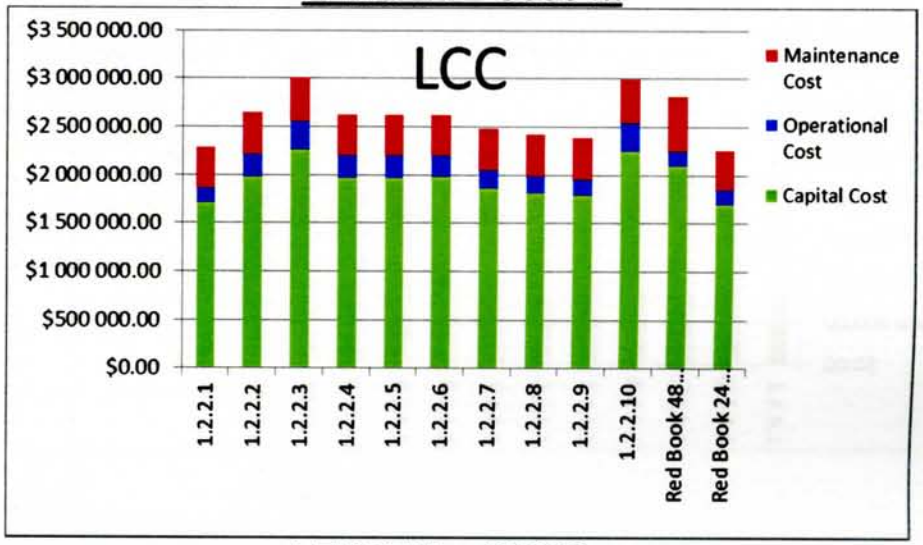

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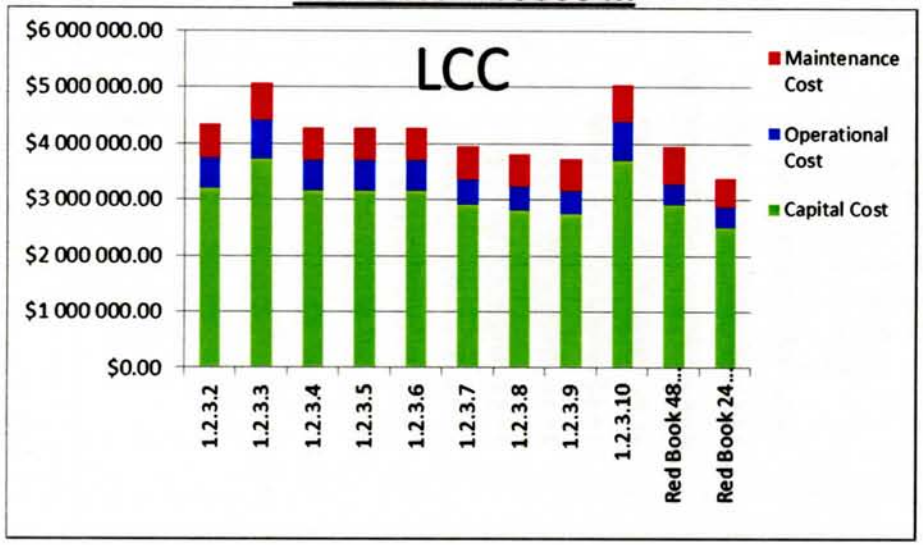

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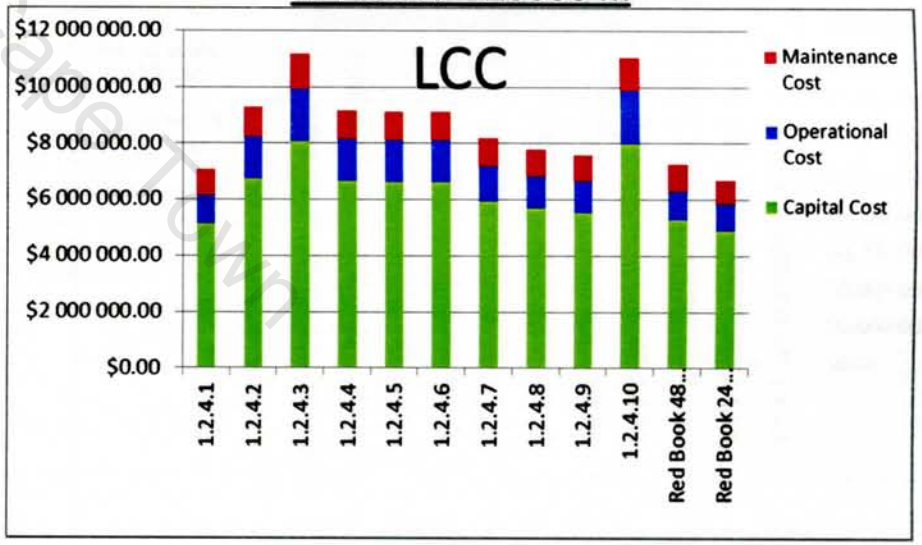

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SERIES 1.4

Flatter Demand & DD=24/s

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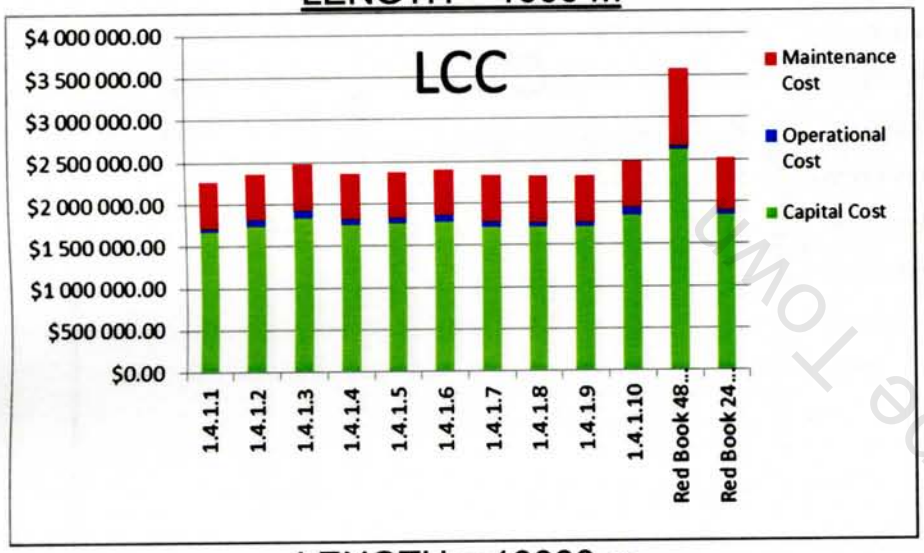

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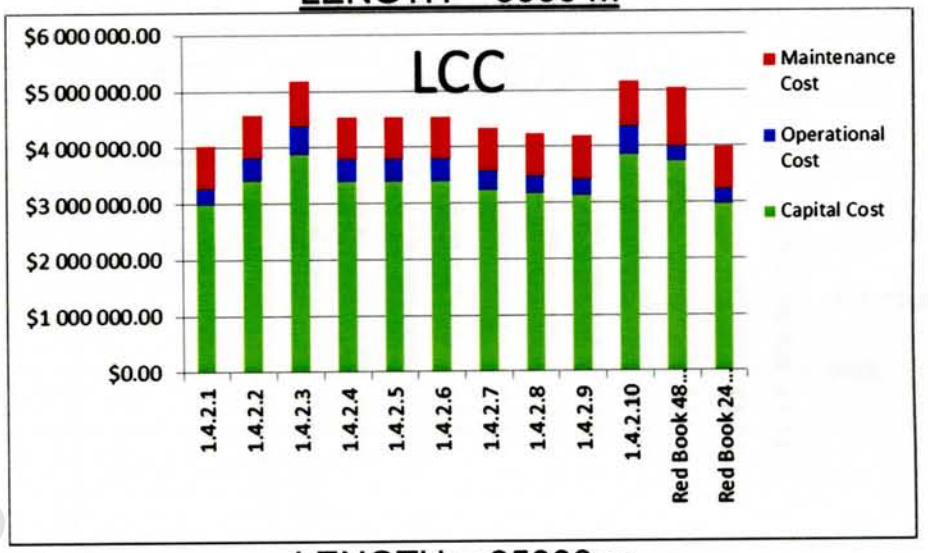

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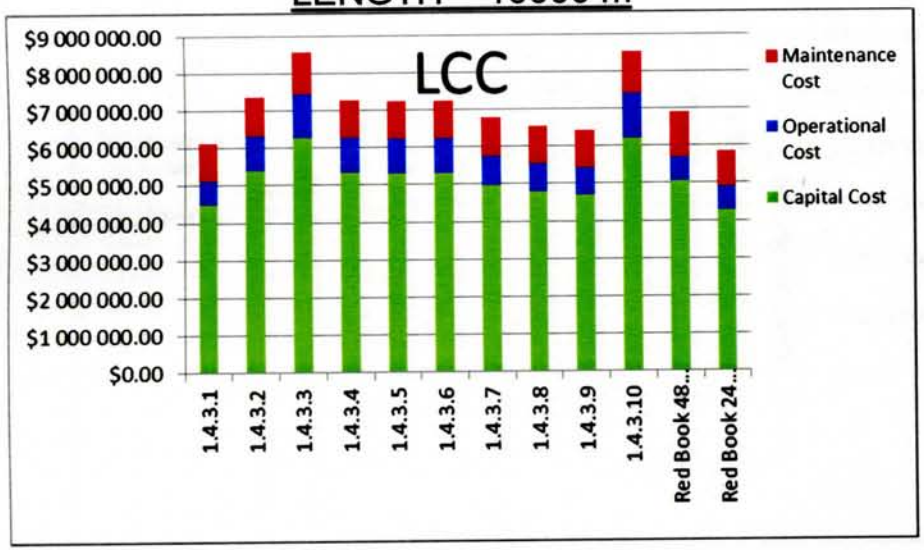

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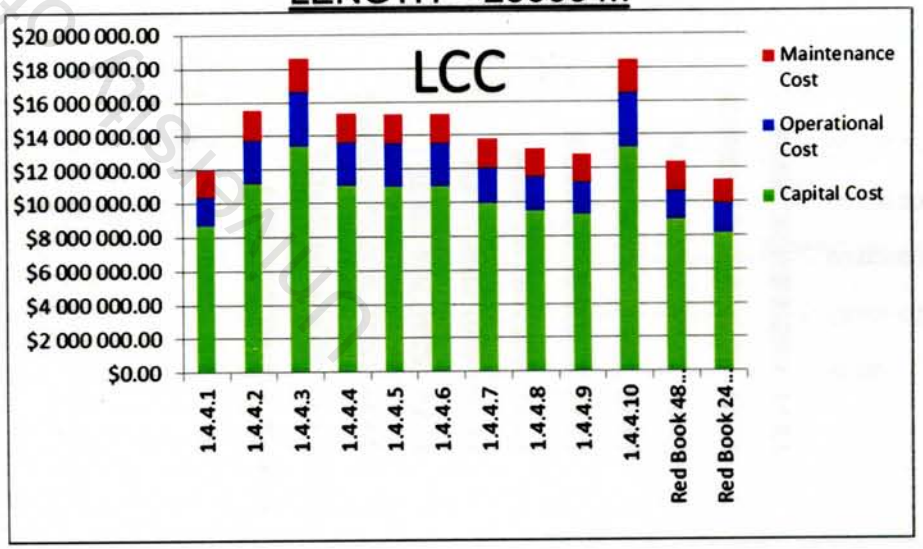

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SERIES 3.1

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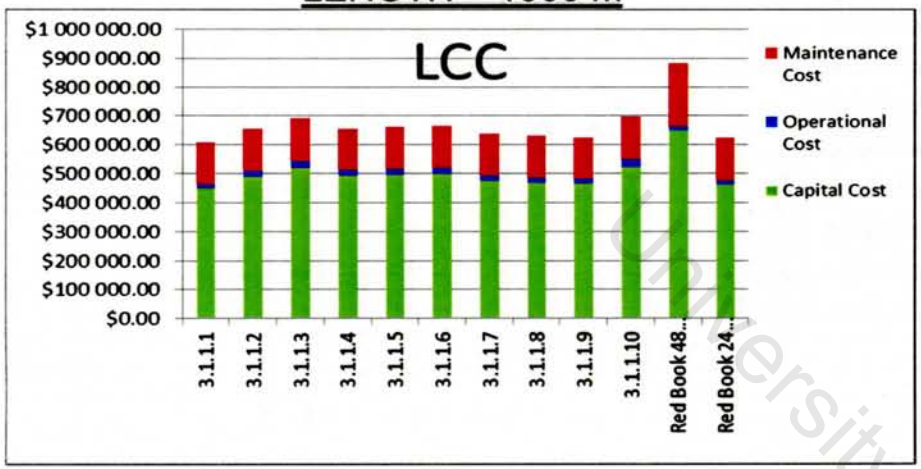

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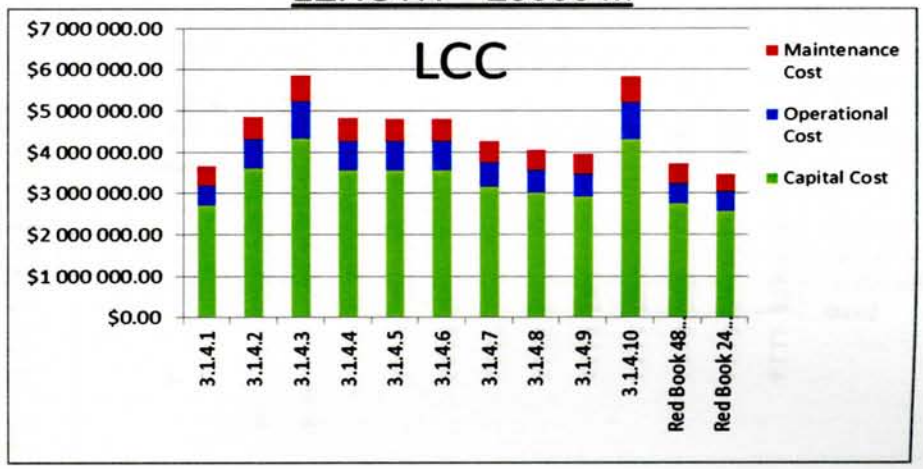

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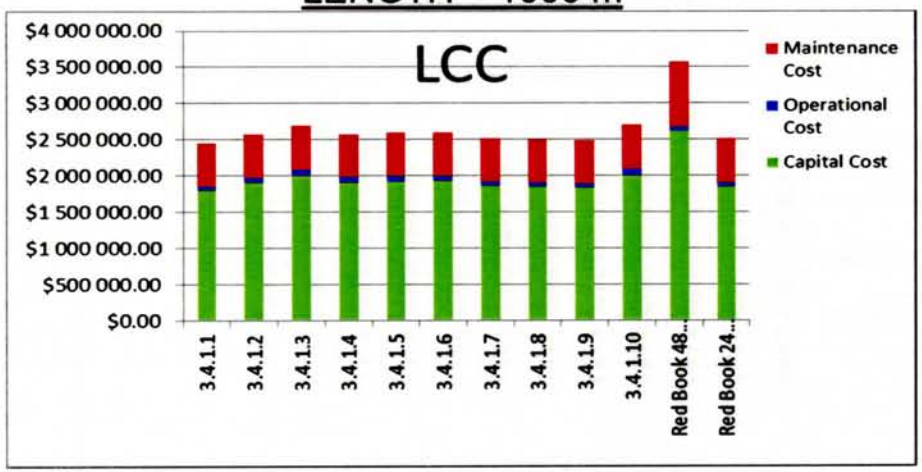

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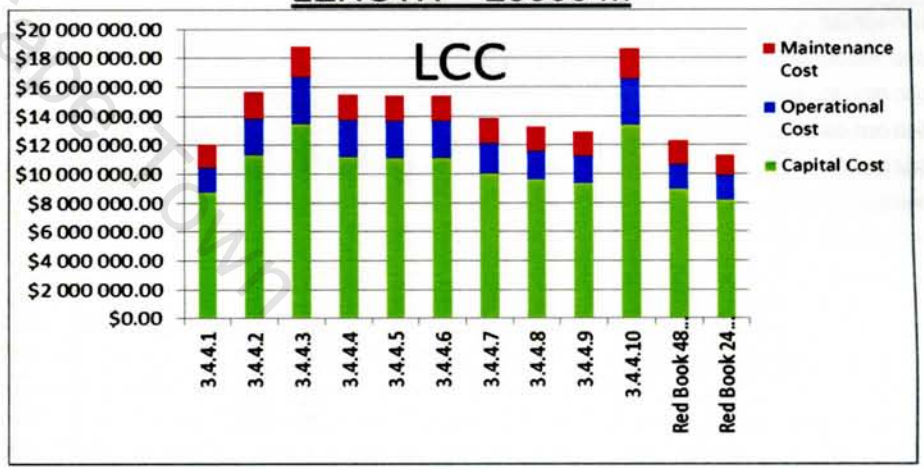

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SERIES 4.1

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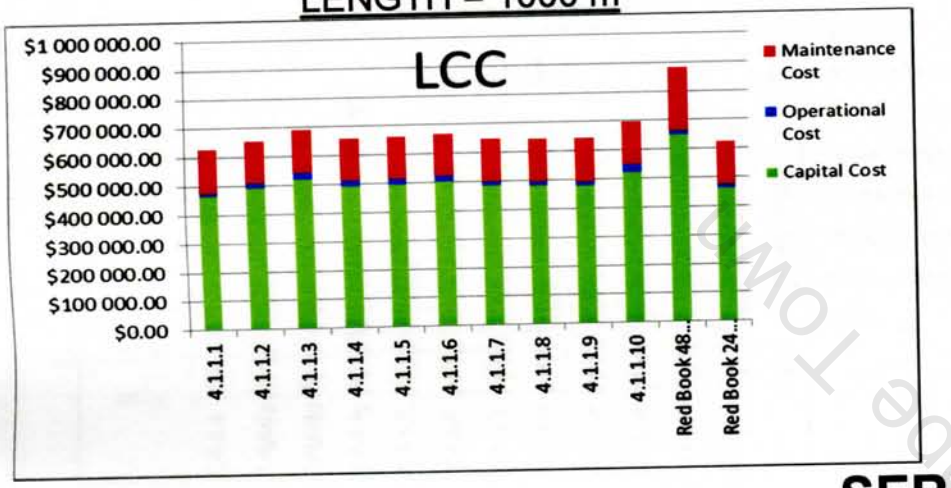

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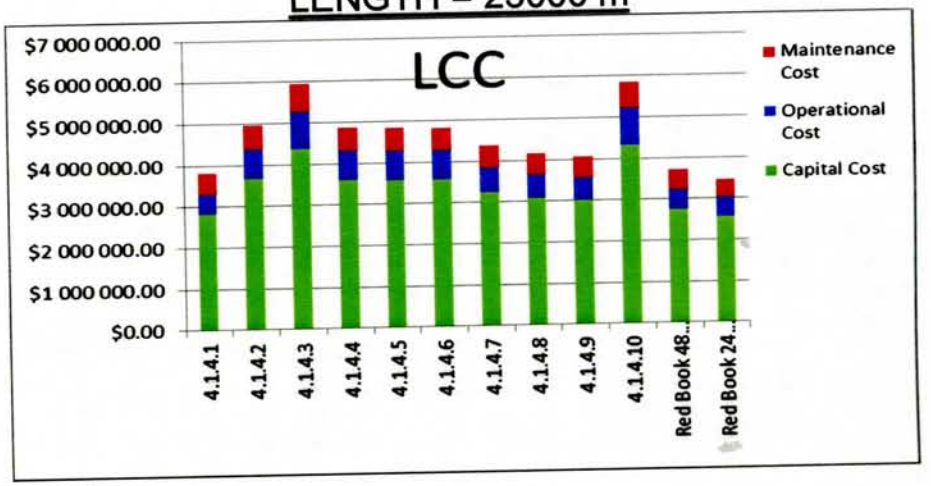

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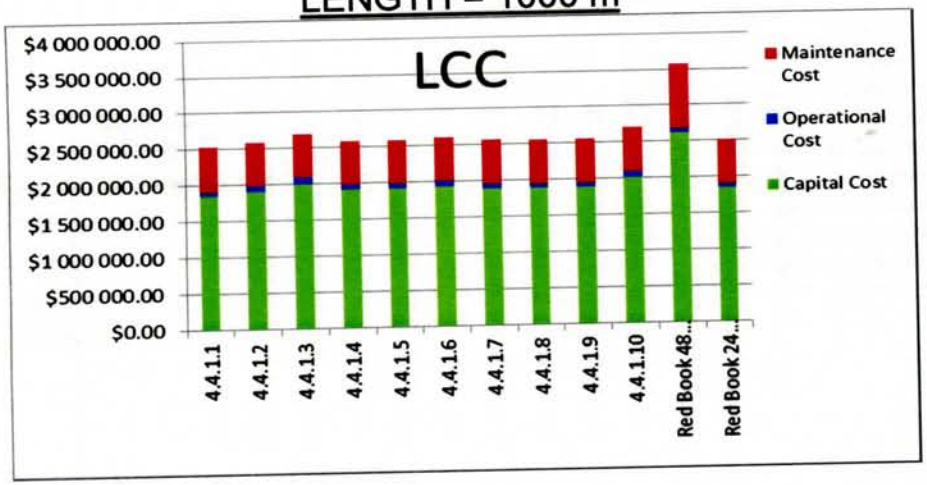

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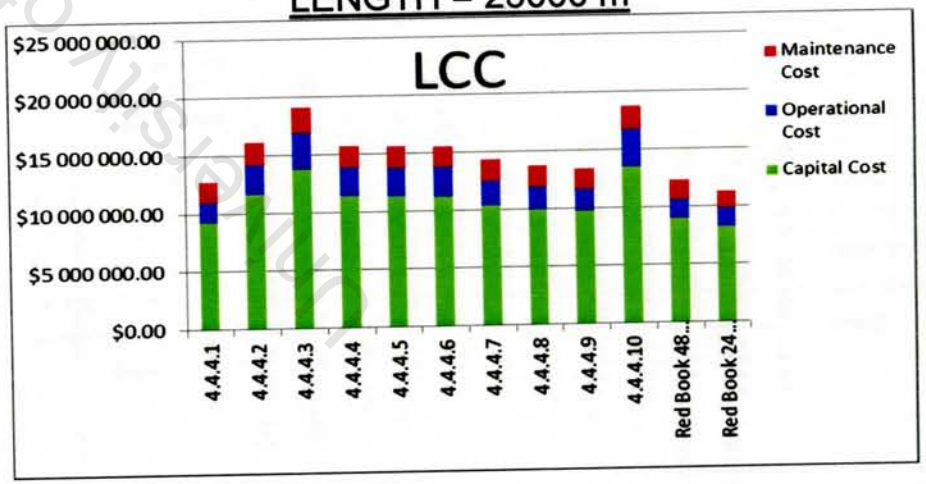

APPENDIX H1: SUMMARY OF COST ESTIMATIONS - HIGHER ELECTRICAL TARIFF (X4)

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SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.1.1.1	$10 070.88	$86 301.48	$343 489.42	$439 861.78	1	$5 686.57	$2 071.92	$7 758.50	1	$68 394.77	$97 528.96	$475 430.19	$641 353.92	1	$447 607.29	$51 798.09	$141 948.54
2.1.1.2	$13 501.73	$134 784.12	$329 365.29	$477 651.14	5	$5 752.12	$3 107.97	$8 860.08	5	$99 949.84	$152 319.00	$455 880.71	$708 149.55	5	$486 984.42	$77 699.15	$143 465.98
2.1.1.3	$16 027.59	$163 157.83	$327 720.37	$506 905.79	9	$5 895.08	$3 939.94	$9 835.02	9	$124 911.77	$184 384.01	$453 603.95	$762 899.74	9	$517 432.22	$98 498.51	$146 969.01
2.1.1.4	$13 501.73	$139 854.06	$328 100.74	$481 456.54	6	$5 758.50	$3 107.97	$8 866.47	6	$99 949.84	$158 048.52	$454 130.43	$712 128.79	6	$490 816.79	$77 699.15	$143 612.84
2.1.1.5	$13 501.73	$144 924.00	$327 229.75	$485 655.48	7	$5 770.78	$3 107.97	$8 878.75	7	$99 949.84	$163 778.04	$452 924.87	$716 652.75	7	$495 046.31	$77 699.15	$143 907.29
2.1.1.6	$13 501.73	$149 993.94	$327 554.54	$491 050.22	8	$5 801.01	$3 107.97	$8 908.97	8	$99 949.84	$169 507.56	$453 374.43	$722 831.82	8	$500 482.51	$77 699.15	$144 650.15
2.1.1.7	$11 834.18	$115 520.19	$336 061.30	$463 415.67	4	$5 739.23	$2 589.94	$8 329.17	4	$84 251.20	$130 548.90	$465 148.80	$679 948.90	4	$472 008.35	$64 748.62	$143 191.93
2.1.1.8	$11 258.32	$109 098.87	$340 400.52	$460 757.71	3	$5 766.34	$2 417.27	$8 183.61	3	$78 985.34	$123 292.20	$471 154.79	$673 432.33	3	$469 114.87	$60 431.78	$143 885.68
2.1.1.9	$10 966.13	$105 888.22	$341 419.37	$458 273.71	2	$5 762.59	$2 330.93	$8 093.52	2	$76 345.40	$119 663.85	$472 564.99	$668 574.24	2	$466 500.95	$58 273.36	$143 799.93
2.1.1.10	$16 027.59	$168 836.10	$326 458.69	$511 322.38	1	$5 904.54	$3 939.94	$9 844.48	1	$124 911.77	$190 801.01	$451 857.64	$767 570.42	1	$521 880.44	$98 498.51	$147 191.47
RB 48 hr 2.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$2 071.92	$10 769.21		$68 394.77	$97 528.96	$753 242.87	$919 166.60		$650 152.05	$51 798.09	$217 216.46
RB 24 hr 2.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$3 705.21	$2 071.92	$5 777.13		$71 180.57	$129 244.75	$418 479.11	$618 904.43		$475 339.08	$51 798.09	$91 767.26
2.1.2.1	$34 644.50	$423 350.47	$391 513.76	$849 508.74	1	$8 342.83	$11 442.30	$19 785.13	1	$343 151.16	$478 426.69	$541 901.59	$1 363 479.44	1	$869 909.52	$286 057.47	$207 512.44
2.1.2.2	$46 446.87	$622 236.98	$344 597.42	$1 013 281.27	8	$8 753.90	$17 163.89	$25 917.80	8	$505 641.20	$703 187.54	$476 963.79	$1 685 792.53	8	$1 039 403.16	$429 097.36	$217 292.01
2.1.2.3	$55 135.99	$768 084.21	$337 243.44	$1 160 463.64	1	$9 461.46	$21 758.51	$31 219.97	1	$634 826.22	$868 008.92	$466 785.01	$1 969 620.15	1	$1 191 041.03	$543 962.84	$234 616.28
2.1.2.4	$46 446.87	$627 245.99	$334 686.23	$1 008 379.09	5	$8 630.28	$17 163.89	$25 794.18	7	$505 641.20	$708 848.20	$463 245.53	$1 677 734.93	5	$1 034 448.65	$429 097.36	$214 188.92
2.1.2.5	$46 446.87	$632 254.99	$332 162.77	$1 010 864.64	6	$8 617.47	$17 163.89	$25 781.37	6	$505 641.20	$714 508.86	$459 752.77	$1 679 902.82	6	$1 036 949.23	$429 097.36	$213 856.23
2.1.2.6	$46 446.87	$637 264.00	$329 513.90	$1 013 224.77	7	$8 602.79	$17 163.89	$25 766.68	5	$505 641.20	$720 169.52	$456 086.41	$1 681 897.13	7	$1 039 323.26	$429 097.36	$213 476.51
2.1.2.7	$40 710.38	$527 738.07	$369 857.14	$938 305.59	4	$8 601.79	$14 303.10	$22 904.89	4	$424 667.59	$596 394.69	$511 926.25	$1 532 988.54	4	$961 685.63	$357 577.42	$213 725.49
2.1.2.8	$38 729.36	$496 238.43	$377 148.45	$912 116.24	3	$8 533.46	$13 349.50	$21 882.96	3	$397 562.92	$560 797.08	$522 018.29	$1 480 378.29	3	$934 544.99	$333 737.43	$212 095.86
2.1.2.9	$37 724.22	$480 488.61	$379 938.46	$898 151.29	2	$8 486.31	$12 872.70	$21 359.00	2	$383 986.47	$542 998.27	$525 879.99	$1 452 864.73	2	$920 090.84	$321 817.44	$210 956.45
2.1.2.10	$55 135.99	$773 692.37	$330 734.56	$1 159 562.92	9	$9 391.87	$21 758.51	$31 150.38	9	$634 826.22	$874 346.68	$457 775.95	$1 966 948.85	9	$1 190 123.56	$543 962.84	$232 862.45
RB 48 hr 2.1.2	$34 644.50	$423 350.47	$544 203.89	$1 002 198.86		$10 633.18	$11 442.30	$22 075.48		$343 151.16	$478 426.69	$753 242.87	$1 574 820.72		$1 023 992.01	$286 057.47	$264 771.24
RB 24 hr 2.1.2	$34 644.50	$423 350.47	$357 566.91	$815 561.88		$10 913.09	$11 442.30	$22 355.39		$352 734.50	$634 007.98	$418 479.11	$1 405 221.59		$850 570.39	$286 057.47	$268 593.73
2.1.3.1	$65 481.96	$816 778.76	$424 085.21	$1 306 345.94	1	$11 113.09	$27 601.34	$38 714.43	1	$797 946.86	$923 038.44	$586 984.35	$2 307 969.65	1	$1 342 150.96	$690 033.44	$275 785.25
2.1.3.2	$87 789.76	$1 191 185.29	$361 993.41	$1 640 968.46	8	$12 281.28	$41 403.08	$53 684.37	8	$1 179 753.43	$1 346 153.77	$501 041.91	$3 026 949.11	8	$1 687 817.94	$1 035	$304 054.11
2.1.3.3	$104 213.15	$1 474 146.90	$347 316.38	$1 925 676.43	1	$13 643.45	$52 486.31	$66 129.77	1	$1 483 899.72	$1 665 927.56	$480 727.16	$3 630 554.44	1	$1 980 995.64	$1 312	$337 400.99
2.1.3.4	$87 789.76	$1 196 083.98	$344 330.19	$1 628 203.93	7	$12 040.83	$41 403.08	$53 443.91	7	$1 179 753.43	$1 351 689.76	$476 593.92	$3 008 037.10	7	$1 674 929.55	$1 035	$298 030.50
2.1.3.5	$87 789.76	$1 200 982.67	$337 111.56	$1 625 883.98	5	$11 957.04	$41 403.08	$53 360.12	6	$1 179 753.43	$1 357 225.74	$466 602.47	$3 003 581.64	5	$1 672 580.99	$1 035	$295 923.60
2.1.3.6	$87 789.76	$1 205 881.35	$334 041.98	$1 627 713.09	6	$11 935.49	$41 403.08	$53 338.57	5	$1 179 753.43	$1 362 761.73	$462 353.81	$3 004 868.97	6	$1 674 419.31	$1 035	$295 372.60
2.1.3.7	$76 947.15	$1 008 866.59	$396 900.99	$1 482 714.74	4	$11 782.71	$34 502.21	$46 284.92	4	$989 363.15	$1 140 116.13	$549 358.16	$2 678 837.43	4	$1 524 236.63	$862 555.25	$292 045.55
2.1.3.8	$73 202.81	$948 093.69	$405 935.65	$1 427 232.15	3	$11 576.17	$32 201.92	$43 778.09	3	$925 685.25	$1 071 436.92	$561 863.20	$2 558 985.36	3	$1 466 903.32	$805 047.98	$287 034.06
2.1.3.9	$71 302.98	$917 707.24	$408 677.94	$1 397 688.16	2	$11 446.00	$31 051.77	$42 497.77	2	$893 800.73	$1 037 097.31	$565 658.85	$2 496 556.88	2	$1 436 406.92	$776 294.34	$283 855.62
2.1.3.10	$104 213.15	$1 479 627.96	$336 213.79	$1 920 054.90	9	$13 504.32	$52 486.31	$65 990.63	9	$1 483 899.72	$1 672 121.69	$465 359.85	$3 621 381.26	9	$1 975 314.50	$1 312	$333 908.95
RB 48 hr 2.1.3	$65 481.96	$816 778.76	$544 203.89	$1 426 464.61		$12 914.87	$27 601.34	$40 516.21		$797 946.86	$923 038.44	$753 242.87	$2 474 228.17		$1 463 364.98	$690 033.44	$320 829.76
RB 24 hr 2.1.3	$65 481.96	$816 778.76	$357 566.91	$1 239 827.64		$19 367.57	$27 601.34	$46 968.90		$816 060.44	$1 223 204.63	$418 479.11	$2 457 744.18		$1 291 689.35	$690 033.44	$476 021.39
2.1.4.1	$135 406.09	$2 007 523.44	$495 315.00	$2 638 244.53	1	$18 848.48	$75 392.68	$94 241.16	1	$2 107 964.45	$2 268 694.27	$685 574.84	$5 062 233.56	1	$2 711 223.29	$1 884	$466 193.30
2.1.4.2	$181 534.99	$2 913 464.00	$405 881.22	$3 500 880.22	8	$22 507.20	$113 091.96	$135 599.15	8	$3 126 466.25	$3 292 494.10	$561 787.86	$6 980 748.22	8	$3 598 053.05	$2 827	$555 396.22
2.1.4.3	$215 495.91	$3 611 480.34	$381 317.12	$4 208 293.38	1	$25 975.22	$143 365.65	$169 340.87	1	$3 939 275.71	$4 081 319.60	$527 788.23	$8 548 383.54	1	$4 323 890.55	$3 584	$640 351.72
2.1.4.4	$181 534.99	$2 918 312.55	$369 527.98	$3 469 375.52	7	$21 986.14	$113 091.96	$135 078.10	7	$3 126 466.25	$3 297 973.43	$511 470.65	$6 935 910.33	7	$3 566 253.68	$2 827	$542 357.70
2.1.4.5	$181 534.99	$2 923 161.10	$354 239.82	$3 458 935.91	6	$21 781.06	$113 091.96	$134 873.02	6	$3 126 466.25	$3 303 452.75	$490 310.03	$6 920 229.03	6	$3 555 711.49	$2 827	$537 218.59
2.1.4.6	$181 534.99	$2 928 009.64	$347 395.00	$3 456 939.63	5	$21 702.63	$113 091.96	$134 794.59	5	$3 126 466.25	$3 308 932.07	$480 835.97	$6 916 234.30	5	$3 553 689.62	$2 827	$535 245.73
2.1.4.7	$159 114.24	$2 465 351.14	$450 172.91	$3 074 638.29	4	$20 702.31	$94 242.32	$114 944.63	4	$2 618 276.15	$2 786 083.54	$623 092.82	$6 027 452.51	4	$3 160 000.06	$2 356	$511 394.49
2.1.4.8	$151 371.54	$2 315 980.19	$463 504.96	$2 930 856.69	3	$20 076.47	$87 959.11	$108 035.57	3	$2 448 435.96	$2 617 280.02	$641 545.96	$5 707 261.94	3	$3 012 162.63	$2 198	$496 121.68
2.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$84 817.50	$104 525.99	2	$2 363 421.64	$2 532 878.25	$645 746.31	$5 542 046.20	2	$2 934 499.80	$2 120	$487 108.93
2.1.4.10	$215 495.91	$3 616 903.58	$351 351.67	$4 183 751.16	9	$25 552.85	$143 365.65	$168 918.50	9	$3 939 275.71	$4 087 448.37	$486 312.48	$8 513 036.56	9	$4 299 116.28	$3 584	$629 779.02
RB 48 hr 2.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$75 392.68	$94 974.50		$2 107 964.45	$2 268 694.27	$753 242.87	$5 129 901.60		$2 760 557.99	$1 884	$484 526.63
RB 24 hr 2.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$44 511.02	$75 392.68	$119 903.70		$2 145 420.40	$3 006 459.14	$418 479.11	$5 570 358.64		$2 592 841.42	$1 884	$1 092 700.25

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.1.1.1	$10 070.88	$86 301.48	$343 489.42	$439 861.78	1	$5 686.57	$2 071.92	$7 758.50	1	$68 394.77	$97 528.96	$475 430.19	$641 353.92	1	$447 607.29	$51 798.09	$141 948.54
2.1.1.2	$13 501.73	$134 784.12	$329 365.29	$477 651.14	5	$5 752.12	$3 107.97	$8 860.08	5	$99 949.84	$152 319.00	$455 880.71	$708 149.55	5	$486 984.42	$77 699.15	$143 465.98
2.1.1.3	$16 027.59	$163 157.83	$327 720.37	$506 905.79	9	$5 895.08	$3 939.94	$9 835.02	9	$124 911.77	$184 384.01	$453 603.95	$762 899.74	9	$517 432.22	$98 498.51	$146 969.01
2.1.1.4	$13 501.73	$139 854.06	$328 100.74	$481 456.54	6	$5 758.50	$3 107.97	$8 866.47	6	$99 949.84	$158 048.52	$454 130.43	$712 128.79	6	$490 816.79	$77 699.15	$143 612.84
2.1.1.5	$13 501.73	$144 924.00	$327 229.75	$485 655.48	7	$5 770.78	$3 107.97	$8 878.75	7	$99 949.84	$163 778.04	$452 924.87	$716 652.75	7	$495 046.31	$77 699.15	$143 907.29
2.1.1.6	$13 501.73	$149 993.94	$327 554.54	$491 050.22	8	$5 801.01	$3 107.97	$8 908.97	8	$99 949.84	$169 507.56	$453 374.43	$722 831.82	8	$500 482.51	$77 699.15	$144 650.15
2.1.1.7	$11 834.18	$115 520.19	$336 061.30	$463 415.67	4	$5 739.23	$2 589.94	$8 329.17	4	$84 251.20	$130 548.90	$465 148.80	$679 948.90	4	$472 008.35	$64 748.62	$143 191.93
2.1.1.8	$11 258.32	$109 098.87	$340 400.52	$460 757.71	3	$5 766.34	$2 417.27	$8 183.61	3	$78 985.34	$123 292.20	$471 154.79	$673 432.33	3	$469 114.87	$60 431.78	$143 885.68
2.1.1.9	$10 966.13	$105 888.22	$341 419.37	$458 273.71	2	$5 762.59	$2 330.93	$8 093.52	2	$76 345.40	$119 663.85	$472 564.99	$668 574.24	2	$466 500.95	$58 273.36	$143 799.93
2.1.1.10	$16 027.59	$168 836.10	$326 458.69	$511 322.38	1	$5 904.54	$3 939.94	$9 844.48	1	$124 911.77	$190 801.01	$451 857.64	$767 570.42	1	$521 880.44	$98 498.51	$147 191.47
RB 48 hr 2.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$2 071.92	$10 769.21		$68 394.77	$97 528.96	$753 242.87	$919 166.60		$650 152.05	$51 798.09	$217 216.46
RB 24 hr 2.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$3 705.21	$2 071.92	$5 777.13		$71 180.57	$129 244.75	$418 479.11	$618 904.43		$475 339.08	$51 798.09	$91 767.26
2.1.2.1	$34 644.50	$423 350.47	$391 513.76	$849 508.74	1	$8 342.83	$11 442.30	$19 785.13	1	$343 151.16	$478 426.69	$541 901.59	$1 363 479.44	1	$869 909.52	$286 057.47	$207 512.44
2.1.2.2	$46 446.87	$622 236.98	$344 597.42	$1 013 281.27	8	$8 753.90	$17 163.89	$25 917.80	8	$505 641.20	$703 187.54	$476 963.79	$1 685 792.53	8	$1 039 403.16	$429 097.36	$217 292.01
2.1.2.3	$55 135.99	$768 084.21	$337 243.44	$1 160 463.64	1	$9 461.46	$21 758.51	$31 219.97	1	$634 826.22	$868 008.92	$466 785.01	$1 969 620.15	1	$1 191 041.03	$543 962.84	$234 616.28
2.1.2.4	$46 446.87	$627 245.99	$334 686.23	$1 008 379.09	5	$8 630.28	$17 163.89	$25 794.18	7	$505 641.20	$708 848.20	$463 245.53	$1 677 734.93	5	$1 034 448.65	$429 097.36	$214 188.92
2.1.2.5	$46 446.87	$632 254.99	$332 162.77	$1 010 864.64	6	$8 617.47	$17 163.89	$25 781.37	6	$505 641.20	$714 508.86	$459 752.77	$1 679 902.82	6	$1 036 949.23	$429 097.36	$213 856.23
2.1.2.6	$46 446.87	$637 264.00	$329 513.90	$1 013 224.77	7	$8 602.79	$17 163.89	$25 766.68	5	$505 641.20	$720 169.52	$456 086.41	$1 681 897.13	7	$1 039 323.26	$429 097.36	$213 476.51
2.1.2.7	$40 710.38	$527 738.07	$369 857.14	$938 305.59	4	$8 601.79	$14 303.10	$22 904.89	4	$424 667.59	$596 394.69	$511 926.25	$1 532 988.54	4	$961 685.63	$357 577.42	$213 725.49
2.1.2.8	$38 729.36	$496 238.43	$377 148.45	$912 116.24	3	$8 533.46	$13 349.50	$21 882.96	3	$397 562.92	$560 797.08	$522 018.29	$1 480 378.29	3	$934 544.99	$333 737.43	$212 095.86
2.1.2.9	$37 724.22	$480 488.61	$379 938.46	$898 151.29	2	$8 486.31	$12 872.70	$21 359.00	2	$383 986.47	$542 998.27	$525 879.99	$1 452 864.73	2	$920 090.84	$321 817.44	$210 956.45
2.1.2.10	$55 135.99	$773 692.37	$330 734.56	$1 159 562.92	9	$9 391.87	$21 758.51	$31 150.38	9	$634 826.22	$874 346.68	$457 775.95	$1 966 948.85	9	$1 190 123.56	$543 962.84	$232 862.45
RB 48 hr 2.1.2	$34 644.50	$423 350.47	$544 203.89	$1 002 198.86		$10 633.18	$11 442.30	$22 075.48		$343 151.16	$478 426.69	$753 242.87	$1 574 820.72		$1 023 992.01	$286 057.47	$264 771.24
RB 24 hr 2.1.2	$34 644.50	$423 350.47	$357 566.91	$815 561.88		$10 913.09	$11 442.30	$22 355.39		$352 734.50	$634 007.98	$418 479.11	$1 405 221.59		$850 570.39	$286 057.47	$268 593.73
2.1.3.1	$65 481.96	$816 778.76	$424 085.21	$1 306 345.94	1	$11 113.09	$27 601.34	$38 714.43	1	$797 946.86	$923 038.44	$586 984.35	$2 307 969.65	1	$1 342 150.96	$690 033.44	$275 785.25
2.1.3.2	$87 789.76	$1 191 185.29	$361 993.41	$1 640 968.46	8	$12 281.28	$41 403.08	$53 684.37	8	$1 179 753.43	$1 346 153.77	$501 041.91	$3 026 949.11	8	$1 687 817.94	$1 035	$304 054.11
2.1.3.3	$104 213.15	$1 474 146.90	$347 316.38	$1 925 676.43	1	$13 643.45	$52 486.31	$66 129.77	1	$1 483 899.72	$1 665 927.56	$480 727.16	$3 630 554.44	1	$1 980 995.64	$1 312	$337 400.99
2.1.3.4	$87 789.76	$1 196 083.98	$344 330.19	$1 628 203.93	7	$12 040.83	$41 403.08	$53 443.91	7	$1 179 753.43	$1 351 689.76	$476 593.92	$3 008 037.10	7	$1 674 929.55	$1 035	$298 030.50
2.1.3.5	$87 789.76	$1 200 982.67	$337 111.56	$1 625 883.98	5	$11 957.04	$41 403.08	$53 360.12	6	$1 179 753.43	$1 357 225.74	$466 602.47	$3 003 581.64	5	$1 672 580.99	$1 035	$295 923.60
2.1.3.6	$87 789.76	$1 205 881.35	$334 041.98	$1 627 713.09	6	$11 935.49	$41 403.08	$53 338.57	5	$1 179 753.43	$1 362 761.73	$462 353.81	$3 004 868.97	6	$1 674 419.31	$1 035	$295 372.60
2.1.3.7	$76 947.15	$1 008 866.59	$396 900.99	$1 482 714.74	4	$11 782.71	$34 502.21	$46 284.92	4	$989 363.15	$1 140 116.13	$549 358.16	$2 678 837.43	4	$1 524 236.63	$862 555.25	$292 045.55
2.1.3.8	$73 202.81	$948 093.69	$405 935.65	$1 427 232.15	3	$11 576.17	$32 201.92	$43 778.09	3	$925 685.25	$1 071 436.92	$561 863.20	$2 558 985.36	3	$1 466 903.32	$805 047.98	$287 034.06
2.1.3.9	$71 302.98	$917 707.24	$408 677.94	$1 397 688.16	2	$11 446.00	$31 051.77	$42 497.77	2	$893 800.73	$1 037 097.31	$565 658.85	$2 496 556.88	2	$1 436 406.92	$776 294.34	$283 855.62
2.1.3.10	$104 213.15	$1 479 627.96	$336 213.79	$1 920 054.90	9	$13 504.32	$52 486.31	$65 990.63	9	$1 483 899.72	$1 672 121.69	$465 359.85	$3 621 381.26	9	$1 975 314.50	$1 312	$333 908.95
RB 48 hr 2.1.3	$65 481.96	$816 778.76	$544 203.89	$1 426 464.61		$12 914.87	$27 601.34	$40 516.21		$797 946.86	$923 038.44	$753 242.87	$2 474 228.17		$1 463 364.98	$690 033.44	$320 829.76
RB 24 hr 2.1.3	$65 481.96	$816 778.76	$357 566.91	$1 239 827.64		$19 367.57	$27 601.34	$46 968.90		$816 060.44	$1 223 204.63	$418 479.11	$2 457 744.18		$1 291 689.35	$690 033.44	$476 021.39
2.1.4.1	$135 406.09	$2 007 523.44	$495 315.00	$2 638 244.53	1	$18 848.48	$75 392.68	$94 241.16	1	$2 107 964.45	$2 268 694.27	$685 574.84	$5 062 233.56	1	$2 711 223.29	$1 884	$466 193.30
2.1.4.2	$181 534.99	$2 913 464.00	$405 881.22	$3 500 880.22	8	$22 507.20	$113 091.96	$135 599.15	8	$3 126 466.25	$3 292 494.10	$561 787.86	$6 980 748.22	8	$3 598 053.05	$2 827	$555 396.22
2.1.4.3	$215 495.91	$3 611 480.34	$381 317.12	$4 208 293.38	1	$25 975.22	$143 365.65	$169 340.87	1	$3 939 275.71	$4 081 319.60	$527 788.23	$8 548 383.54	1	$4 323 890.55	$3 584	$640 351.72
2.1.4.4	$181 534.99	$2 918 312.55	$369 527.98	$3 469 375.52	7	$21 986.14	$113 091.96	$135 078.10	7	$3 126 466.25	$3 297 973.43	$511 470.65	$6 935 910.33	7	$3 566 253.68	$2 827	$542 357.70
2.1.4.5	$181 534.99	$2 923 161.10	$354 239.82	$3 458 935.91	6	$21 781.06	$113 091.96	$134 873.02	6	$3 126 466.25	$3 303 452.75	$490 310.03	$6 920 229.03	6	$3 555 711.49	$2 827	$537 218.59
2.1.4.6	$181 534.99	$2 928 009.64	$347 395.00	$3 456 939.63	5	$21 702.63	$113 091.96	$134 794.59	5	$3 126 466.25	$3 308 932.07	$480 835.97	$6 916 234.30	5	$3 553 689.62	$2 827	$535 245.73
2.1.4.7	$159 114.24	$2 465 351.14	$450 172.91	$3 074 638.29	4	$20 702.31	$94 242.32	$114 944.63	4	$2 618 276.15	$2 786 083.54	$623 092.82	$6 027 452.51	4	$3 160 000.06	$2 356	$511 394.49
2.1.4.8	$151 371.54	$2 315 980.19	$463 504.96	$2 930 856.69	3	$20 076.47	$87 959.11	$108 035.57	3	$2 448 435.96	$2 617 280.02	$641 545.96	$5 707 261.94	3	$3 012 162.63	$2 198	$496 121.68
2.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$84 817.50	$104 525.99	2	$2 363 421.64	$2 532 878.25	$645 746.31	$5 542 046.20	2	$2 934 499.80	$2 120	$487 108.93
2.1.4.10	$215 495.91	$3 616 903.58	$351 351.67	$4 183 751.16	9	$25 552.85	$143 365.65	$168 918.50	9	$3 939 275.71	$4 087 448.37	$486 312.48	$8 513 036.56	9	$4 299 116.28	$3 584	$629 779.02
RB 48 hr 2.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$75 392.68	$94 974.50		$2 107 964.45	$2 268 694.27	$753 242.87	$5 129 901.60		$2 760 557.99	$1 884	$484 526.63
RB 24 hr 2.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$44 511.02	$75 392.68	$119 903.70		$2 145 420.40	$3 006 459.14	$418 479.11	$5 570 358.64		$2 592 841.42	$1 884	$1 092 700.25

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.2.1.1	$17 575.65	$158 938.83	$783 774.85	$960 289.32	1	$12 730.59	$4 475.84	$17 206.43	1	$140 860.39	$179 616.14	$1 084	$1 405 314.09	1
2.2.1.2	$23 563.16	$243 453.76	$756 685.45	$1 023 702.36	5	$12 807.89	$6 713.93	$19 521.83	6	$206 680.07	$275 126.12	$1 047	$1 529 148.81	5
2.2.1.3	$27 971.27	$297 803.23	$753 631.39	$1 079 405.90	9	$13 078.79	$8 511.19	$21 589.98	9	$258 876.04	$336 546.25	$1 043	$1 638 537.74	9
2.2.1.4	$23 563.16	$251 807.99	$753 864.15	$1 029 235.30	6	$12 807.35	$6 713.93	$19 521.28	5	$206 680.07	$284 567.21	$1 043	$1 534 684.89	6
2.2.1.5	$23 563.16	$260 162.22	$752 779.65	$1 036 505.03	7	$12 832.85	$6 713.93	$19 546.78	7	$206 680.07	$294 008.29	$1 041	$1 542 624.88	7
2.2.1.6	$23 563.16	$268 516.45	$753 128.51	$1 045 208.13	8	$12 879.85	$6 713.93	$19 593.79	8	$206 680.07	$303 449.38	$1 042	$1 552 548.84	8
2.2.1.7	$20 652.96	$207 975.95	$769 668.26	$998 297.16	4	$12 795.56	$5 594.88	$18 390.45	4	$173 907.92	$235 032.79	$1 065	$1 474 253.09	4
2.2.1.8	$19 647.96	$196 150.01	$777 338.01	$993 135.98	3	$12 841.23	$5 221.87	$18 063.10	3	$162 926.31	$221 668.35	$1 075	$1 460 522.88	3
2.2.1.9	$19 138.04	$190 237.04	$779 721.52	$989 096.59	2	$12 842.22	$5 035.36	$17 877.58	2	$157 423.27	$214 986.13	$1 079	$1 451 636.67	2
2.2.1.10	$27 971.27	$307 195.13	$751 191.64	$1 086 358.05	1	$13 089.16	$8 511.19	$21 600.35	1	$258 876.04	$347 160.00	$1 039	$1 645 774.58	1
RB 48 hr 2.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$4 475.84	$23 698.58		$140 860.39	$179 616.14	$1 683	$2 004 375.35	
RB 24 hr 2.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$7 581.94	$4 475.84	$12 057.77		$145 722.16	$238 026.16	$952 484.44	$1 336 232.75	
2.2.2.1	$60 134.28	$780 795.83	$881 046.76	$1 721 976.87	1	$17 733.05	$24 533.25	$42 266.30	1	$712 431.68	$882 374.27	$1 219	$2 814 279.40	1
2.2.2.2	$80 620.27	$1 142 766.44	$784 960.00	$2 008 346.71	8	$18 310.56	$36 800.83	$55 111.39	8	$1 052 881.82	$1 291 435.81	$1 086	$3 430 795.59	8
2.2.2.3	$95 702.42	$1 413 855.12	$771 972.12	$2 281 529.66	1	$19 625.02	$46 652.07	$66 277.10	1	$1 324 018.21	$1 597 792.06	$1 068	$3 990 311.45	1
2.2.2.4	$80 620.27	$1 150 974.14	$766 855.28	$1 998 449.69	5	$18 080.03	$36 800.83	$54 880.85	7	$1 052 881.82	$1 300 711.31	$1 061	$3 415 012.00	5
2.2.2.5	$80 620.27	$1 159 181.85	$762 154.73	$2 001 956.85	6	$18 050.56	$36 800.83	$54 851.38	6	$1 052 881.82	$1 309 986.81	$1 054	$3 417 781.38	6
2.2.2.6	$80 620.27	$1 167 389.56	$756 991.71	$2 005 001.54	7	$18 014.15	$36 800.83	$54 814.98	5	$1 052 881.82	$1 319 262.31	$1 047	$3 419 910.64	7
2.2.2.7	$70 663.14	$968 479.73	$835 109.95	$1 874 252.82	4	$18 089.81	$30 667.04	$48 756.85	4	$883 127.85	$1 094 475.09	$1 155	$3 133 494.40	4
2.2.2.8	$67 224.58	$910 384.16	$850 481.19	$1 828 089.93	3	$17 994.83	$28 622.44	$46 617.27	3	$826 346.24	$1 028 821.52	$1 177	$3 032 334.84	3
2.2.2.9	$65 479.91	$881 336.37	$857 258.41	$1 804 074.70	2	$17 933.45	$27 600.14	$45 533.59	2	$797 913.59	$995 994.74	$1 186	$2 980 455.88	2
2.2.2.10	$95 702.42	$1 423 083.37	$759 281.47	$2 278 067.26	9	$19 480.80	$46 652.07	$66 132.88	9	$1 324 018.21	$1 608 220.87	$1 050	$3 983 174.89	9
RB 48 hr 2.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$24 533.25	$47 299.38		$712 431.68	$882 374.27	$1 683	$3 278 704.77	
RB 24 hr 2.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$20 827.69	$24 533.25	$45 360.94		$729 065.98	$1 169 316.74	$952 484.44	$2 850 867.16	
2.2.3.1	$112 564.83	$1 510 285.24	$949 596.19	$2 572 446.26	1	$22 943.53	$58 392.00	$81 335.53	1	$1 645 305.47	$1 706 767.35	$1 314	$4 666 426.84	1
2.2.3.2	$150 912.38	$2 197 630.23	$819 563.27	$3 168 105.87	8	$24 820.91	$87 590.28	$112 411.19	8	$2 438 458.70	$2 483 533.20	$1 134	$6 056 364.89	8
2.2.3.3	$179 144.52	$2 722 954.51	$790 674.05	$3 692 773.08	1	$27 302.16	$111 037.41	$138 339.57	1	$3 071 163.04	$3 077 200.07	$1 094	$7 242 750.00	1
2.2.3.4	$150 912.38	$2 205 571.89	$785 226.68	$3 141 710.95	7	$24 345.57	$87 590.28	$111 935.85	7	$2 438 458.70	$2 492 508.04	$1 086	$6 017 813.82	7
2.2.3.5	$150 912.38	$2 213 513.56	$771 908.07	$3 136 334.00	5	$24 185.50	$87 590.28	$111 775.78	6	$2 438 458.70	$2 501 482.88	$1 068	$6 008 354.11	5
2.2.3.6	$150 912.38	$2 221 455.22	$765 459.04	$3 137 826.64	6	$24 128.47	$87 590.28	$111 718.75	5	$2 438 458.70	$2 510 457.72	$1 059	$6 008 402.74	6
2.2.3.7	$132 273.71	$1 860 509.26	$891 696.53	$2 884 479.51	4	$24 027.19	$72 991.14	$97 018.33	4	$2 042 763.95	$2 102 554.13	$1 234	$5 379 532.09	4
2.2.3.8	$125 837.11	$1 748 135.61	$910 693.40	$2 784 666.12	3	$23 684.62	$68 124.76	$91 809.38	3	$1 910 497.01	$1 975 561.11	$1 260	$5 146 566.05	3
2.2.3.9	$122 571.28	$1 691 948.78	$916 695.04	$2 731 215.10	2	$23 460.40	$65 691.57	$89 151.97	2	$1 844 285.21	$1 912 064.60	$1 268	$5 025 164.72	2
2.2.3.10	$179 144.52	$2 731 885.24	$769 070.45	$3 680 100.21	9	$27 022.76	$111 037.41	$138 060.17	9	$3 071 163.04	$3 087 292.66	$1 064	$7 222 940.63	9
RB 48 hr 2.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$58 392.00	$85 340.37		$1 645 305.47	$1 706 767.35	$1 683	$5 035 971.65	
RB 24 hr 2.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$36 413.66	$58 392.00	$94 805.66		$1 676 443.09	$2 261 797.18	$952 484.44	$4 890 724.71	
2.2.4.1	$231 757.45	$3 716 343.63	$1 106	$5 054 286.13	1	$37 538.42	$158 542.07	$196 080.49	1	$4 345 484.98	$4 199 825.18	$1 531	$10 076 401.77	1
2.2.4.2	$310 710.44	$5 388 413.10	$910 762.15	$6 609 885.70	8	$43 772.74	$237 819.28	$281 592.03	8	$6 457 528.87	$6 089 424.25	$1 260	$13 807 556.22	8
2.2.4.3	$368 837.04	$6 682 697.20	$858 732.13	$7 910 266.37	1	$50 056.61	$301 481.35	$351 537.96	1	$8 144 872.44	$7 552 089.57	$1 188	$16 885 549.37	1
2.2.4.4	$310 710.44	$5 396 233.56	$835 137.59	$6 542 081.59	7	$42 677.48	$237 819.28	$280 496.76	7	$6 457 528.87	$6 098 262.12	$1 155	$13 711 720.70	7
2.2.4.5	$310 710.44	$5 404 054.02	$804 327.00	$6 519 091.46	6	$42 254.42	$237 819.28	$280 073.71	6	$6 457 528.87	$6 107 099.98	$1 113	$13 677 913.05	6
2.2.4.6	$310 710.44	$5 411 874.47	$790 303.02	$6 512 887.93	5	$42 083.16	$237 819.28	$279 902.45	5	$6 457 528.87	$6 115 937.85	$1 093	$13 667 340.05	5
2.2.4.7	$272 335.68	$4 558 862.95	$1 006	$5 837 484.77	4	$40 666.43	$198 180.68	$238 847.11	4	$5 403 322.56	$5 151 952.92	$1 392	$11 948 095.14	4
2.2.4.8	$259 083.49	$4 282 346.23	$1 036	$5 578 108.84	3	$39 604.57	$184 967.81	$224 572.38	3	$5 051 161.39	$4 839 462.47	$1 434	$11 325 511.01	3
2.2.4.9	$252 359.53	$4 144 087.87	$1 042	$5 438 709.75	2	$38 928.44	$178 361.37	$217 289.81	2	$4 874 919.52	$4 683 217.25	$1 442	$11 000 751.78	2
2.2.4.10	$368 837.04	$6 691 492.22	$798 893.40	$7 859 222.66	9	$49 203.00	$301 481.35	$350 684.35	9	$8 144 872.44	$7 562 028.78	$1 105	$16 812 664.67	9
RB 48 hr 2.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$158 542.07	$197 736.49		$4 345 484.98	$4 199 825.18	$1 683	$10 229 208.98	
RB 24 hr 2.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$82 799.49	$158 542.07	$241 341.56		$4 409 593.58	$5 565 581.47	$952 484.44	$10 927 659.49	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$975 550.78	$111 895.95	$317 867.36
$1 041 711.78	$167 848.29	$319 588.73
$1 099 532.64	$212 779.75	$326 225.34
$1 047 282.46	$167 848.29	$319 554.14
$1 054 605.75	$167 848.29	$320 170.85
$1 063 375.49	$167 848.29	$321 325.06
$1 015 011.81	$139 872.12	$319 369.15
$1 009 435.79	$130 546.73	$320 540.36
$1 005 172.83	$125 884.03	$320 579.81
$1 106 533.88	$212 779.75	$326 460.94
$1 412 308.08	$111 895.95	$480 171.32
$1 036 377.78	$111 895.95	$187 959.02
$1 759 573.97	$613 331.17	$441 374.26
$2 055 867.87	$920 020.67	$454 907.06
$2 336 918.67	$1 166	$487 090.91
$2 045 868.10	$920 020.67	$449 123.23
$2 049 394.74	$920 020.67	$448 365.97
$2 052 454.70	$920 020.67	$447 435.28
$1 916 994.38	$766 675.92	$449 824.10
$1 869 179.06	$715 561.00	$447 594.77
$1 844 319.35	$690 003.54	$446 132.99
$2 333 410.65	$1 166	$483 462.38
$2 098 172.34	$613 331.17	$567 201.25
$1 724 651.69	$613 331.17	$512 884.30
$2 636 814.19	$1 459	$569 812.54
$3 251 579.23	$2 189	$615 028.58
$3 791 068.25	$2 775	$675 746.55
$3 224 931.52	$2 189	$603 125.22
$3 219 493.45	$2 189	$599 103.59
$3 220 987.60	$2 189	$597 658.06
$2 958 725.12	$1 824	$596 028.38
$2 855 701.86	$1 703	$587 745.10
$2 800 595.34	$1 642	$582 280.04
$3 778 266.22	$2 775	$668 739.21
$2 906 238.05	$1 459	$669 933.50
$2 535 685.98	$1 459	$895 238.62
$5 183 680.41	$3 963	$929 169.64
$6 781 226.53	$5 945	$1 080 847.58
$8 113 807.16	$7 537	$1 234 708.40
$6 712 792.21	$5 945	$1 053 446.37
$6 689 580.53	$5 945	$1 042 850.41
$6 683 308.52	$5 945	$1 038 549.42
$5 988 314.60	$4 954	$1 005 263.61
$5 721 907.46	$4 624	$979 408.37
$5 578 866.64	$4 459	$962 850.83
$8 062 284.59	$7 537	$1 213 346.27
$5 295 087.49	$3 963	$970 569.77
$4 931 284.03	$3 963	$2 032 823.73

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.3.1.1	$21 638.84	$219 766.52	$1 133	$1 374 550.01	1	$18 316.72	$5 967.63	$24 284.35	1	$184 851.24	$248 357.27	$1 568	$2 001 615.42	1	$1 395 056.15	$149 190.72	$457 368.55
2.3.1.2	$29 010.56	$335 479.61	$1 086	$1 451 358.76	5	$18 276.33	$8 951.68	$27 228.01	5	$271 600.92	$379 124.17	$1 504	$2 155 080.43	5	$1 475 218.87	$223 791.90	$456 069.67
2.3.1.3	$34 437.75	$411 618.58	$1 082	$1 528 610.30	9	$18 647.67	$11 347.96	$29 995.63	9	$340 451.92	$465 168.53	$1 498	$2 304 003.84	9	$1 555 142.24	$283 698.96	$465 162.64
2.3.1.4	$29 010.56	$347 465.87	$1 082	$1 459 475.72	6	$18 278.23	$8 951.68	$27 229.90	6	$271 600.92	$392 669.80	$1 498	$2 163 270.49	6	$1 483 391.60	$223 791.90	$456 087.00
2.3.1.5	$29 010.56	$359 452.13	$1 080	$1 469 317.79	7	$18 305.99	$8 951.68	$27 257.67	7	$271 600.92	$406 215.43	$1 496	$2 173 848.31	7	$1 493 305.16	$223 791.90	$456 751.24
2.3.1.6	$29 010.56	$371 438.39	$1 080	$1 481 209.02	8	$18 364.50	$8 951.68	$27 316.18	8	$271 600.92	$419 761.05	$1 495	$2 187 262.39	8	$1 505 286.57	$223 791.90	$458 183.92
2.3.1.7	$25 427.56	$286 424.04	$1 110	$1 422 263.04	4	$18 347.65	$7 459.65	$25 807.31	4	$228 395.61	$323 686.67	$1 536	$2 089 023.71	4	$1 444 557.14	$186 491.31	$457 975.26
2.3.1.8	$24 190.23	$270 072.19	$1 121	$1 415 700.49	3	$18 418.67	$6 962.31	$25 380.98	3	$213 922.96	$305 207.50	$1 552	$2 071 334.08	3	$1 437 484.67	$174 057.78	$459 791.63
2.3.1.9	$23 562.42	$261 896.26	$1 124	$1 409 724.50	2	$18 413.81	$6 713.64	$25 127.45	2	$206 671.58	$295 967.92	$1 556	$2 058 757.06	2	$1 431 225.65	$167 841.02	$459 690.39
2.3.1.10	$34 437.75	$425 030.15	$1 080	$1 540 098.34	1	$18 685.87	$11 347.96	$30 033.83	1	$340 451.92	$480 324.88	$1 495	$2 316 497.81	1	$1 566 714.61	$283 698.96	$466 084.24
RB 48 hr 2.3.1	$21 638.84	$219 766.52	$1 818	$2 060 017.45		$28 598.73	$5 967.63	$34 566.36		$184 851.24	$248 357.27	$2 517	$2 950 383.85		$2 086 774.29	$149 190.72	$714 418.84
RB 24 hr 2.3.1	$21 638.84	$219 766.52	$1 216	$1 457 990.75		$10 889.40	$5 967.63	$16 857.02		$190 836.97	$329 121.46	$1 423	$1 943 791.44		$1 524 563.51	$149 190.72	$270 037.22
2.3.2.1	$74 036.29	$1 079 615.25	$1 284	$2 438 406.70	1	$25 424.57	$32 710.15	$58 134.72	1	$939 764.48	$1 220 068.91	$1 778	$3 938 087.26	1	$2 487 418.32	$817 753.64	$632 915.31
2.3.2.2	$99 258.29	$1 578 909.87	$1 130	$2 808 944.65	8	$25 868.63	$49 066.49	$74 935.12	8	$1 390 238.71	$1 784 319.78	$1 565	$4 739 687.57	8	$2 870 256.73	$1 226	$642 768.51
2.3.2.3	$117 827.18	$1 954 734.63	$1 108	$3 181 542.99	1	$27 610.23	$62 201.15	$89 811.38	1	$1 749 206.38	$2 209 037.85	$1 534	$5 493 206.02	1	$3 252 808.42	$1 555	$685 368.86
2.3.2.4	$99 258.29	$1 590 642.31	$1 103	$2 793 287.40	5	$25 516.45	$49 066.49	$74 582.94	7	$1 390 238.71	$1 797 578.55	$1 527	$4 715 035.77	5	$2 854 438.83	$1 226	$633 934.60
2.3.2.5	$99 258.29	$1 602 374.74	$1 095	$2 797 219.10	6	$25 458.10	$49 066.49	$74 524.59	6	$1 390 238.71	$1 810 837.33	$1 516	$4 717 497.41	6	$2 858 388.52	$1 226	$632 446.55
2.3.2.6	$99 258.29	$1 614 107.17	$1 088	$2 801 509.38	7	$25 405.13	$49 066.49	$74 471.62	5	$1 390 238.71	$1 824 096.10	$1 506	$4 720 455.36	7	$2 862 700.06	$1 226	$631 092.96
2.3.2.7	$86 999.25	$1 347 530.33	$1 216	$2 651 284.21	4	$25 876.36	$40 888.32	$66 764.68	4	$1 165 581.61	$1 522 838.68	$1 684	$4 372 553.35	4	$2 706 805.10	$1 022	$643 540.26
2.3.2.8	$82 765.75	$1 270 403.82	$1 238	$2 591 780.40	3	$25 775.39	$38 162.26	$63 937.65	3	$1 090 453.42	$1 435 678.31	$1 714	$4 240 516.36	3	$2 645 251.03	$954 056.54	$641 208.79
2.3.2.9	$80 617.74	$1 231 840.56	$1 245	$2 557 981.89	2	$25 664.36	$36 799.23	$62 463.59	2	$1 052 837.80	$1 392 098.13	$1 723	$4 168 888.64	2	$2 610 378.49	$919 980.81	$638 529.34
2.3.2.10	$117 827.18	$1 967 867.16	$1 090	$3 176 583.25	9	$27 404.51	$62 201.15	$89 605.66	9	$1 749 206.38	$2 223 878.86	$1 509	$5 483 005.19	9	$3 247 783.46	$1 555	$680 193.00
RB 48 hr 2.3.2	$74 036.29	$1 079 615.25	$1 818	$2 972 263.63		$33 432.43	$32 710.15	$66 142.57		$939 764.48	$1 220 068.91	$2 517	$4 677 008.72		$3 026 143.43	$817 753.64	$833 111.66
RB 24 hr 2.3.2	$74 036.29	$1 079 615.25	$1 216	$2 370 236.94		$29 081.92	$32 710.15	$61 792.07		$960 244.35	$1 616 827.51	$1 423	$4 000 904.87		$2 466 899.35	$817 753.64	$716 251.88
2.3.3.1	$138 587.88	$2 088 288.52	$1 386	$3 613 804.24	1	$32 658.96	$77 853.98	$110 512.94	1	$2 174 740.57	$2 359 966.56	$1 919	$6 454 380.14	1	$3 696 777.40	$1 946	$811 253.19
2.3.3.2	$185 800.72	$3 037 375.07	$1 180	$4 403 402.20	8	$34 785.44	$116 784.01	$151 569.45	8	$3 225 797.38	$3 432 525.50	$1 633	$8 291 896.53	8	$4 510 253.79	$2 919	$862 042.53
2.3.3.3	$220 559.66	$3 764 730.68	$1 135	$5 121 117.42	1	$38 110.77	$148 046.03	$186 156.80	1	$4 064 630.17	$4 254 507.19	$1 572	$9 891 257.07	1	$5 246 748.96	$3 701	$943 357.38
2.3.3.4	$185 800.72	$3 048 647.68	$1 128	$4 362 782.37	7	$34 063.42	$116 784.01	$150 847.42	7	$3 225 797.38	$3 445 264.63	$1 561	$8 232 810.36	7	$4 469 246.39	$2 919	$843 963.76
2.3.3.5	$185 800.72	$3 059 920.28	$1 107	$4 353 060.80	5	$33 804.87	$116 784.01	$150 588.87	6	$3 225 797.38	$3 458 003.76	$1 532	$8 216 491.06	5	$4 459 419.01	$2 919	$837 471.84
2.3.3.6	$185 800.72	$3 071 192.89	$1 099	$4 356 613.73	6	$33 745.43	$116 784.01	$150 529.44	5	$3 225 797.38	$3 470 742.89	$1 522	$8 218 545.23	6	$4 462 987.16	$2 919	$835 957.85
2.3.3.7	$162 853.12	$2 571 234.09	$1 296	$4 030 166.34	4	$33 958.46	$97 319.00	$131 277.45	4	$2 701 354.70	$2 905 741.43	$1 793	$7 401 023.73	4	$4 125 515.45	$2 432	$842 533.39
2.3.3.8	$154 928.49	$2 415 853.76	$1 327	$3 898 684.52	3	$33 578.07	$90 830.66	$124 408.73	3	$2 526 086.56	$2 730 146.74	$1 837	$7 094 207.92	3	$3 990 029.28	$2 270	$833 412.20
2.3.3.9	$150 907.65	$2 338 163.60	$1 335	$3 824 793.18	2	$33 265.91	$87 586.49	$120 852.39	2	$2 438 356.05	$2 642 349.40	$1 848	$6 929 503.40	2	$3 914 038.97	$2 189	$825 802.22
2.3.3.10	$220 559.66	$3 777 357.11	$1 104	$5 102 458.02	9	$37 704.61	$148 046.03	$185 750.64	9	$4 064 630.17	$4 268 776.27	$1 528	$9 862 222.85	9	$5 227 900.18	$3 701	$933 171.93
RB 48 hr 2.3.3	$138 587.88	$2 088 288.52	$1 818	$4 045 488.50		$39 134.22	$77 853.98	$116 988.20		$2 174 740.57	$2 359 966.56	$2 517	$7 051 882.47		$4 132 398.14	$1 946	$973 134.79
RB 24 hr 2.3.3	$138 587.88	$2 088 288.52	$1 216	$3 443 461.80		$50 481.87	$77 853.98	$128 335.85		$2 213 076.66	$3 127 412.60	$1 423	$6 764 322.28		$3 576 808.93	$1 946	$1 241 163.79
2.3.4.1	$285 335.79	$5 138 630.46	$1 606	$7 030 712.26	1	$52 704.77	$211 383.93	$264 088.70	1	$5 754 827.93	$5 807 145.88	$2 223	$13 785 901.29	1	$7 196 530.42	$5 284	$1 304 772.61
2.3.4.2	$382 541.36	$7 449 258.55	$1 309	$9 140 934.85	8	$60 785.24	$317 084.14	$377 869.38	8	$8 557 526.61	$8 418 377.51	$1 811	$18 787 902.50	8	$9 359 791.24	$7 927	$1 501 007.82
2.3.4.3	$454 105.82	$9 239 861.98	$1 231	$10 925 522.05	1	$69 304.50	$401 964.69	$471 269.19	1	$10 797 477.69	$10 441 931.34	$1 704	$22 944 026.50	1	$11 185 396.37	$10 049	$1 709 512.92
2.3.4.4	$382 541.36	$7 460 322.13	$1 197	$9 040 504.76	7	$59 168.15	$317 084.14	$376 252.29	7	$8 557 526.61	$8 430 880.42	$1 657	$18 646 084.92	7	$9 258 428.50	$7 927	$1 460 552.98
2.3.4.5	$382 541.36	$7 471 385.71	$1 154	$9 008 351.80	6	$58 575.22	$317 084.14	$375 659.36	6	$8 557 526.61	$8 443 383.33	$1 597	$18 598 771.00	6	$9 225 965.49	$7 927	$1 445 702.07
2.3.4.6	$382 541.36	$7 482 449.30	$1 132	$8 997 297.61	5	$58 298.77	$317 084.14	$375 382.91	5	$8 557 526.61	$8 455 886.24	$1 567	$18 580 660.29	5	$9 214 793.66	$7 927	$1 438 763.20
2.3.4.7	$335 295.01	$6 302 230.15	$1 463	$8 101 237.98	4	$56 886.85	$264 234.03	$321 120.89	4	$7 158 412.65	$7 122 125.26	$2 025	$16 306 490.47	4	$8 294 223.89	$6 605	$1 406 415.73
2.3.4.8	$318 979.14	$5 919 887.35	$1 506	$7 745 635.19	3	$55 454.55	$246 617.33	$302 071.89	3	$6 691 106.78	$6 690 041.18	$2 085	$15 466 694.98	3	$7 929 697.52	$6 165	$1 371 564.15
2.3.4.9	$310 700.71	$5 728 715.95	$1 514	$7 553 991.86	2	$54 531.35	$237 808.98	$292 340.34	2	$6 457 255.28	$6 473 999.14	$2 096	$15 027 606.55	2	$7 733 419.91	$5 945	$1 348 962.08
2.3.4.10	$454 105.82	$9 252 258.08	$1 146	$10 852 540.57	9	$68 085.82	$401 964.69	$470 050.51	9	$10 797 477.69	$10 455 940.11	$1 586	$22 839 862.56	9	$11 111 730.50	$10 049	$1 679 014.85
RB 48 hr 2.3.4	$285 335.79	$5 138 630.46	$1 818	$7 242 578.35		$55 882.76	$211 383.93	$267 266.69		$5 754 827.93	$5 807 145.88	$2 517	$14 079 149.15		$7 410 328.49	$5 284	$1 384 222.39
RB 24 hr 2.3.4	$285 335.79	$5 138 630.46	$1 216	$6 640 551.65		$114 276.92	$211 383.93	$325 660.85		$5 833 757.33	$7 695 592.58	$1 423	$14 953 182.93		$6 863 048.06	$5 284	$2 805 536.60

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.4.1.1	$26 117.08	$260 988.68	$1 482	$1 769 144.26	1	$23 801.92	$7 740.88	$31 542.80	1	$236 562.61	$294 942.27	$2 051	$2 582 822.35	1
2.4.1.2	$35 014.41	$398 392.16	$1 430	$1 864 115.15	5	$23 809.74	$11 611.62	$35 421.36	6	$347 993.84	$450 221.40	$1 980	$2 778 486.00	5
2.4.1.3	$41 564.78	$489 314.97	$1 424	$1 955 861.30	9	$24 245.26	$14 719.95	$38 965.21	9	$436 496.91	$552 972.91	$1 972	$2 961 813.70	9
2.4.1.4	$35 014.41	$413 310.58	$1 425	$1 873 713.51	6	$23 804.53	$11 611.62	$35 416.15	5	$347 993.84	$467 080.64	$1 972	$2 787 981.65	6
2.4.1.5	$35 014.41	$428 229.00	$1 423	$1 886 535.10	7	$23 847.67	$11 611.62	$35 459.29	7	$347 993.84	$483 939.89	$1 970	$2 801 938.63	7
2.4.1.6	$35 014.41	$443 147.41	$1 424	$1 902 315.12	8	$23 935.18	$11 611.62	$35 546.81	8	$347 993.84	$500 799.13	$1 971	$2 819 990.44	8
2.4.1.7	$30 689.90	$340 135.12	$1 455	$1 826 174.85	4	$23 843.96	$9 676.25	$33 520.21	4	$292 482.83	$384 385.34	$2 014	$2 691 245.37	4
2.4.1.8	$29 196.49	$320 716.10	$1 469	$1 819 763.63	3	$23 949.15	$9 031.13	$32 980.28	3	$273 893.62	$362 439.99	$2 034	$2 670 782.19	3
2.4.1.9	$28 438.76	$311 006.59	$1 474	$1 813 618.64	2	$23 957.71	$8 708.57	$32 666.27	2	$264 580.84	$351 467.32	$2 040	$2 656 479.25	2
2.4.1.10	$41 564.78	$505 934.91	$1 420	$1 967 935.05	1	$24 260.17	$14 719.95	$38 980.11	1	$436 496.91	$571 755.03	$1 966	$2 974 303.35	1
RB 48 hr 2.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$7 740.88	$43 823.75		$236 562.61	$294 942.27	$3 184	$3 716 042.62	
RB 24 hr 2.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$13 411.65	$7 740.88	$21 152.53		$243 787.10	$390 855.61	$1 801	$2 435 967.65	
2.4.2.1	$89 142.71	$1 282 944.45	$1 666	$3 038 117.12	1	$32 314.43	$42 288.22	$74 602.65	1	$1 204 111.48	$1 449 850.43	$2 305	$4 959 945.44	1
2.4.2.2	$119 511.03	$1 876 210.93	$1 484	$3 480 027.64	8	$32 864.65	$63 433.98	$96 298.63	8	$1 782 802.02	$2 120 298.52	$2 054	$5 957 556.06	8
2.4.2.3	$141 868.72	$2 323 319.42	$1 459	$3 925 046.10	1	$34 961.53	$80 414.68	$115 376.20	1	$2 244 164.73	$2 625 574.05	$2 020	$6 890 355.75	1
2.4.2.4	$119 511.03	$1 890 797.98	$1 449	$3 460 233.02	5	$32 421.86	$63 433.98	$95 855.84	7	$1 782 802.02	$2 136 783.29	$2 006	$5 926 452.52	5
2.4.2.5	$119 511.03	$1 905 385.04	$1 441	$3 466 150.57	6	$32 364.76	$63 433.98	$95 798.73	6	$1 782 802.02	$2 153 268.06	$1 994	$5 930 937.67	6
2.4.2.6	$119 511.03	$1 919 972.09	$1 431	$3 470 869.12	7	$32 289.66	$63 433.98	$95 723.64	5	$1 782 802.02	$2 169 752.84	$1 981	$5 933 763.25	7
2.4.2.7	$104 750.64	$1 589 836.23	$1 579	$3 273 587.52	4	$32 702.65	$52 861.10	$85 563.74	4	$1 494 155.12	$1 796 667.61	$2 185	$5 476 347.35	4
2.4.2.8	$99 653.34	$1 494 378.00	$1 608	$3 202 118.69	3	$32 609.66	$49 336.80	$81 946.47	3	$1 397 647.51	$1 688 790.65	$2 225	$5 312 222.23	3
2.4.2.9	$97 067.05	$1 446 648.89	$1 619	$3 162 767.59	2	$32 509.10	$47 574.66	$80 083.76	2	$1 349 331.68	$1 634 852.16	$2 240	$5 225 143.80	2
2.4.2.10	$141 868.72	$2 339 578.00	$1 435	$3 917 115.43	9	$34 679.98	$80 414.68	$115 094.66	9	$2 244 164.73	$2 643 947.81	$1 987	$6 875 248.71	9
RB 48 hr 2.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$42 288.22	$84 123.73		$1 204 111.48	$1 449 850.43	$3 184	$5 838 499.65	
RB 24 hr 2.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$35 048.26	$42 288.22	$77 336.47		$1 228 770.08	$1 921 332.52	$1 801	$4 951 427.54	
2.4.3.1	$166 142.57	$2 484 448.75	$1 813	$4 464 582.32	1	$41 326.76	$100 048.33	$141 375.09	1	$2 775 008.98	$2 807 665.67	$2 510	$8 093 453.84	1
2.4.3.2	$222 742.49	$3 613 431.42	$1 549	$5 385 940.49	8	$43 585.63	$150 076.39	$193 662.02	8	$4 118 986.52	$4 083 524.50	$2 145	$10 347 572.21	8
2.4.3.3	$264 412.36	$4 479 274.31	$1 495	$6 238 823.16	1	$47 520.42	$190 250.48	$237 770.91	1	$5 192 010.18	$5 062 010.12	$2 069	$12 323 466.93	1
2.4.3.4	$222 742.49	$3 627 416.78	$1 484	$5 334 856.92	7	$42 679.52	$150 076.39	$192 755.91	7	$4 118 986.52	$4 099 329.30	$2 054	$10 273 313.88	7
2.4.3.5	$222 742.49	$3 641 402.13	$1 459	$5 323 618.61	5	$42 371.09	$150 076.39	$192 447.49	6	$4 118 986.52	$4 115 134.09	$2 020	$10 254 206.12	6
2.4.3.6	$222 742.49	$3 655 387.49	$1 447	$5 325 536.99	6	$42 260.02	$150 076.39	$192 336.41	5	$4 118 986.52	$4 130 938.89	$2 003	$10 253 308.78	5
2.4.3.7	$195 232.34	$3 058 860.84	$1 686	$4 940 164.97	4	$42 576.75	$125 062.36	$167 639.11	4	$3 448 299.35	$3 456 806.49	$2 333	$9 238 829.63	4
2.4.3.8	$185 732.09	$2 874 003.98	$1 722	$4 781 779.02	3	$42 095.13	$116 724.35	$158 819.48	3	$3 224 192.79	$3 247 900.49	$2 383	$8 855 605.44	3
2.4.3.9	$180 911.81	$2 781 575.55	$1 733	$4 695 906.83	2	$41 754.47	$112 555.34	$154 309.81	2	$3 112 023.90	$3 143 447.49	$2 399	$8 654 729.99	2
2.4.3.10	$264 412.36	$4 494 876.01	$1 454	$6 213 327.92	9	$46 981.98	$190 250.48	$237 232.46	9	$5 192 010.18	$5 079 641.53	$2 012	$12 284 215.31	9
RB 48 hr 2.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$100 048.33	$148 676.76		$2 775 008.98	$2 807 665.67	$3 184	$8 767 212.38	
RB 24 hr 2.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$60 541.34	$100 048.33	$160 589.67		$2 820 967.23	$3 720 700.58	$1 801	$8 342 992.75	
2.4.4.1	$341 398.74	$6 116 636.13	$2 091	$8 549 847.87	1	$65 442.64	$270 910.17	$336 352.81	1	$7 335 374.96	$6 912 386.20	$2 895	$17 143 079.03	1
2.4.4.2	$457 703.32	$8 866 841.40	$1 722	$11 046 746.00	8	$74 835.80	$406 375.82	$481 211.62	8	$10 913 684.58	$10 020 382.25	$2 383	$23 317 798.15	8
2.4.4.3	$543 328.82	$10 998 744.17	$1 623	$13 165 849.45	1	$84 892.32	$515 158.94	$600 051.27	1	$13 774 372.42	$12 429 637.11	$2 247	$28 451 509.19	1
2.4.4.4	$457 703.32	$8 880 552.65	$1 579	$10 917 511.60	7	$72 760.17	$406 375.82	$479 135.99	7	$10 913 684.58	$10 035 877.28	$2 185	$23 135 439.42	7
2.4.4.5	$457 703.32	$8 894 263.89	$1 520	$10 872 745.88	6	$71 951.57	$406 375.82	$478 327.39	6	$10 913 684.58	$10 051 372.31	$2 104	$23 069 995.36	6
2.4.4.6	$457 703.32	$8 907 975.14	$1 494	$10 859 882.36	5	$71 621.51	$406 375.82	$477 997.33	5	$10 913 684.58	$10 066 867.34	$2 068	$23 048 707.75	5
2.4.4.7	$401 173.98	$7 501 505.75	$1 902	$9 805 230.85	4	$70 137.77	$338 643.00	$408 780.77	4	$9 127 204.37	$8 477 421.86	$2 633	$20 237 983.16	4
2.4.4.8	$381 652.35	$7 046 393.87	$1 960	$9 388 211.43	3	$68 527.30	$316 065.39	$384 592.69	3	$8 530 592.78	$7 963 101.73	$2 713	$19 206 796.19	3
2.4.4.9	$371 747.38	$6 818 837.92	$1 970	$9 161 451.15	2	$67 449.00	$304 776.58	$372 225.58	2	$8 232 049.41	$7 705 941.66	$2 727	$18 665 903.70	2
2.4.4.10	$543 328.82	$11 014 046.28	$1 510	$13 067 795.11	9	$83 268.49	$515 158.94	$598 427.43	9	$13 774 372.42	$12 446 929.96	$2 090	$28 311 903.25	9
RB 48 hr 2.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$270 910.17	$339 487.15		$7 335 374.96	$6 912 386.20	$3 184	$17 432 298.90	
RB 24 hr 2.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$136 514.95	$270 910.17	$407 425.13		$7 429 812.46	$9 160 249.98	$1 801	$18 391 387.37	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 794 904.94	$193 522.00	$594 395.41
$1 893 948.02	$290 290.55	$594 247.43
$1 988 906.81	$367 998.70	$604 908.19
$1 903 611.18	$290 290.55	$594 079.91
$1 916 526.97	$290 290.55	$595 121.11
$1 932 428.17	$290 290.55	$597 271.72
$1 854 090.43	$241 906.28	$595 248.67
$1 847 077.04	$225 778.19	$597 926.97
$1 840 599.93	$217 714.14	$598 165.17
$2 001 065.35	$367 998.70	$605 239.31
$2 621 101.29	$193 522.00	$901 419.32
$1 909 764.19	$193 522.00	$332 681.45
$3 098 086.66	$1 057	$804 653.32
$3 554 780.87	$1 585	$816 925.78
$4 011 758.93	$2 010	$868 229.89
$3 534 783.54	$1 585	$805 819.57
$3 540 732.84	$1 585	$804 355.42
$3 545 472.20	$1 585	$802 441.64
$3 341 228.32	$1 321	$813 591.59
$3 267 296.45	$1 233	$811 505.66
$3 226 666.40	$1 189	$809 110.96
$4 003 731.19	$2 010	$861 150.60
$3 738 613.75	$1 057	$1 042 680.44
$3 030 845.13	$1 057	$863 376.95
$4 565 287.70	$2 501	$1 026 957.95
$5 515 055.26	$3 751	$1 080 607.15
$6 390 392.44	$4 756	$1 176 812.44
$5 463 484.56	$3 751	$1 057 919.51
$5 452 122.48	$3 751	$1 050 173.84
$5 454 037.05	$3 751	$1 047 361.93
$5 055 499.02	$3 126	$1 056 771.62
$4 892 303.44	$2 918	$1 045 193.28
$4 803 938.58	$2 813	$1 036 907.81
$6 364 640.95	$4 756	$1 163 312.30
$5 056 504.51	$2 501	$1 209 499.68
$4 353 095.57	$2 501	$1 488 688.99
$8 749 550.27	$6 772	$1 620 774.48
$11 309 674.77	$10 159	$1 848 727.90
$13 477 724.40	$12 878	$2 094 811.18
$11 179 241.02	$10 159	$1 796 802.91
$11 134 046.20	$10 159	$1 776 553.67
$11 121 044.50	$10 159	$1 768 267.76
$10 037 217.79	$8 466	$1 734 690.49
$9 609 594.96	$7 901	$1 695 566.55
$9 377 311.20	$7 619	$1 669 177.92
$13 378 752.61	$12 878	$2 054 177.02
$8 960 411.66	$6 772	$1 699 132.96
$8 266 925.60	$6 772	$3 351 707.49

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
1.2.1.1	$17 575.65	$158 938.83	$716 667.47	$893 181.94	1	$11 723.98	$4 475.84	$16 199.82	1	$140 860.39	$179 616.14	$991 952.97	$1 312 429.50	1
1.2.1.2	$23 563.16	$243 453.76	$678 297.55	$945 314.46	5	$11 632.08	$6 713.93	$18 346.01	7	$206 680.07	$275 126.12	$938 844.44	$1 420 650.63	5
1.2.1.3	$27 971.27	$297 803.23	$675 122.79	$1 000 897.30	9	$11 901.16	$8 511.19	$20 412.36	1	$258 876.04	$336 546.25	$934 450.20	$1 529 872.50	9
1.2.1.4	$23 563.16	$251 807.99	$674 230.81	$949 601.96	6	$11 612.85	$6 713.93	$18 326.78	5	$206 680.07	$284 567.21	$933 215.59	$1 424 462.87	6
1.2.1.5	$23 563.16	$260 162.22	$672 569.89	$956 295.27	7	$11 629.70	$6 713.93	$18 343.64	6	$206 680.07	$294 008.29	$930 916.68	$1 431 605.04	7
1.2.1.6	$23 563.16	$268 516.45	$673 707.66	$965 787.27	8	$11 688.54	$6 713.93	$18 402.47	8	$206 680.07	$303 449.38	$932 491.49	$1 442 620.94	8
1.2.1.7	$20 652.96	$207 975.95	$698 417.04	$927 045.95	4	$11 726.80	$5 594.88	$17 321.68	4	$173 907.92	$235 032.79	$966 692.22	$1 375 632.93	4
1.2.1.8	$19 647.96	$196 150.01	$707 100.71	$922 898.68	3	$11 787.67	$5 221.87	$17 009.54	3	$162 926.31	$221 668.35	$978 711.44	$1 363 306.10	3
1.2.1.9	$19 138.04	$190 237.04	$709 851.38	$919 226.46	2	$11 794.16	$5 035.36	$16 829.53	2	$157 423.27	$214 986.13	$982 518.70	$1 354 928.10	2
1.2.1.10	$27 971.27	$307 195.13	$671 582.22	$1 006 748.62	1	$11 895.02	$8 511.19	$20 406.21	9	$258 876.04	$347 160.00	$929 549.63	$1 535 585.68	1
RB 48 hr 1.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$4 475.84	$23 698.58		$140 860.39	$179 616.14	$1 683	$2 004 375.35	
RB 24 hr 1.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$13 181.63	$4 475.84	$17 657.47		$140 860.39	$179 616.14	$1 126	$1 446 934.06	
1.2.2.1	$60 134.28	$780 795.83	$829 502.96	$1 670 433.07	1	$16 959.89	$24 533.25	$41 493.14	1	$712 431.68	$882 374.27	$1 148	$2 742 936.66	1
1.2.2.2	$80 620.27	$1 142 766.44	$714 477.99	$1 937 864.70	8	$17 253.33	$36 800.83	$54 054.16	8	$1 052 881.82	$1 291 435.81	$988 922.48	$3 333 240.11	8
1.2.2.3	$95 702.42	$1 413 855.12	$697 084.89	$2 206 642.43	1	$18 501.71	$46 652.07	$65 153.79	1	$1 324 018.21	$1 597 792.06	$964 848.36	$3 886 658.62	1
1.2.2.4	$80 620.27	$1 150 974.14	$690 803.69	$1 922 398.10	5	$16 939.25	$36 800.83	$53 740.08	7	$1 052 881.82	$1 300 711.31	$956 154.43	$3 309 747.56	6
1.2.2.5	$80 620.27	$1 159 181.85	$683 664.11	$1 923 466.23	6	$16 873.20	$36 800.83	$53 674.02	6	$1 052 881.82	$1 309 986.81	$946 272.40	$3 309 141.03	5
1.2.2.6	$80 620.27	$1 167 389.56	$678 771.34	$1 926 781.17	7	$16 840.84	$36 800.83	$53 641.67	5	$1 052 881.82	$1 319 262.31	$939 500.23	$3 311 644.35	7
1.2.2.7	$70 663.14	$968 479.73	$779 780.68	$1 818 923.55	4	$17 259.87	$30 667.04	$47 926.91	4	$883 127.85	$1 094 475.09	$1 079	$3 056 912.11	4
1.2.2.8	$67 224.58	$910 384.16	$795 824.20	$1 773 432.94	3	$17 174.97	$28 622.44	$45 797.41	3	$826 346.24	$1 028 821.52	$1 101	$2 956 683.06	3
1.2.2.9	$65 479.91	$881 336.37	$801 923.44	$1 748 739.73	2	$17 103.43	$27 600.14	$44 703.57	2	$797 913.59	$995 994.74	$1 109	$2 903 865.70	2
1.2.2.10	$95 702.42	$1 423 083.37	$680 345.86	$2 199 131.65	9	$18 296.77	$46 652.07	$64 948.84	9	$1 324 018.21	$1 608 220.87	$941 679.54	$3 873 918.62	9
RB 48 hr 1.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$24 533.25	$47 299.38		$712 431.68	$882 374.27	$1 683	$3 278 704.77	
RB 24 hr 1.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$16 725.02	$24 533.25	$41 258.26		$712 431.68	$882 374.27	$1 126	$2 721 263.48	
1.2.3.1	$112 564.83	$1 510 285.24	$906 652.88	$2 529 502.95	1	$22 299.38	$58 392.00	$80 691.38	1	$1 645 305.47	$1 706 767.35	$1 254	$4 606 988.20	1
1.2.3.2	$150 912.38	$2 197 630.23	$753 636.83	$3 102 179.43	8	$23 832.01	$87 590.28	$111 422.29	8	$2 438 458.70	$2 483 533.20	$1 043	$5 965 114.86	8
1.2.3.3	$179 144.52	$2 722 954.51	$719 828.05	$3 621 927.08	1	$26 239.47	$111 037.41	$137 276.88	1	$3 071 163.04	$3 077 200.07	$996 327.60	$7 144 690.71	1
1.2.3.4	$150 912.38	$2 205 571.89	$711 675.17	$3 068 159.44	7	$23 242.29	$87 590.28	$110 832.58	7	$2 438 458.70	$2 492 508.04	$985 043.05	$5 916 009.79	7
1.2.3.5	$150 912.38	$2 213 513.56	$696 923.06	$3 061 348.99	5	$23 060.72	$87 590.28	$110 651.00	6	$2 438 458.70	$2 501 482.88	$964 624.37	$5 904 565.95	6
1.2.3.6	$150 912.38	$2 221 455.22	$689 402.06	$3 061 769.65	6	$22 987.61	$87 590.28	$110 577.90	5	$2 438 458.70	$2 510 457.72	$954 214.41	$5 903 130.83	5
1.2.3.7	$132 273.71	$1 860 509.26	$842 292.38	$2 835 075.36	4	$23 286.12	$72 991.14	$96 277.27	4	$2 042 763.95	$2 102 554.13	$1 165	$5 311 150.86	4
1.2.3.8	$125 837.11	$1 748 135.61	$863 479.22	$2 737 451.94	3	$22 976.40	$68 124.76	$91 101.17	3	$1 910 497.01	$1 975 561.11	$1 195	$5 081 216.01	3
1.2.3.9	$122 571.28	$1 691 948.78	$867 912.57	$2 682 432.63	2	$22 728.66	$65 691.57	$88 420.23	2	$1 844 285.21	$1 912 064.60	$1 201	$4 957 643.99	2
1.2.3.10	$179 144.52	$2 731 885.24	$692 300.60	$3 603 330.36	9	$25 871.21	$111 037.41	$136 908.62	9	$3 071 163.04	$3 087 292.66	$958 226.33	$7 116 682.03	9
RB 48 hr 1.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$58 392.00	$85 340.37		$1 645 305.47	$1 706 767.35	$1 683	$5 035 971.65	
RB 24 hr 1.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$20 907.25	$58 392.00	$79 299.26		$1 645 305.47	$1 706 767.35	$1 126	$4 478 530.36	
1.2.4.1	$231 757.45	$3 716 343.63	$1 070	$5 018 457.67	1	$37 000.99	$158 542.07	$195 543.06	1	$4 345 484.98	$4 199 825.18	$1 481	$10 026 810.93	1
1.2.4.2	$310 710.44	$5 388 413.10	$857 536.58	$6 556 660.13	8	$42 974.36	$237 819.28	$280 793.65	8	$6 457 528.87	$6 089 424.25	$1 186	$13 733 885.70	8
1.2.4.3	$368 837.04	$6 682 697.20	$797 795.15	$7 849 329.38	1	$49 142.55	$301 481.35	$350 623.90	1	$8 144 872.44	$7 552 089.57	$1 104	$16 801 205.33	1
1.2.4.4	$310 710.44	$5 396 233.56	$769 783.93	$6 476 727.94	7	$41 697.17	$237 819.28	$279 516.46	7	$6 457 528.87	$6 098 262.12	$1 065	$13 621 263.47	7
1.2.4.5	$310 710.44	$5 404 054.02	$734 827.30	$6 449 591.76	6	$41 211.93	$237 819.28	$279 031.21	6	$6 457 528.87	$6 107 099.98	$1 017	$13 581 717.20	6
1.2.4.6	$310 710.44	$5 411 874.47	$717 870.35	$6 440 455.26	5	$40 996.67	$237 819.28	$278 815.96	5	$6 457 528.87	$6 115 937.85	$993 617.91	$13 567 084.63	5
1.2.4.7	$272 335.68	$4 558 862.95	$965 333.34	$5 796 531.97	4	$40 052.14	$198 180.68	$238 232.82	4	$5 403 322.56	$5 151 952.92	$1 336	$11 891 411.59	4
1.2.4.8	$259 083.49	$4 282 346.23	$995 724.26	$5 537 153.98	3	$38 990.25	$184 967.81	$223 958.05	3	$5 051 161.39	$4 839 462.47	$1 378	$11 268 824.62	3
1.2.4.9	$252 359.53	$4 144 087.87	$1 001	$5 397 828.46	2	$38 315.22	$178 361.37	$216 676.60	2	$4 874 919.52	$4 683 217.25	$1 386	$10 944 167.21	2
1.2.4.10	$368 837.04	$6 691 492.22	$728 629.32	$7 788 958.58	9	$48 149.04	$301 481.35	$349 630.39	9	$8 144 872.44	$7 562 028.78	$1 008	$16 715 410.83	9
RB 48 hr 1.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$158 542.07	$197 736.49		$4 345 484.98	$4 199 825.18	$1 683	$10 229 208.98	
RB 24 hr 1.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$33 153.31	$158 542.07	$191 695.38		$4 345 484.98	$4 199 825.18	$1 126	$9 671 767.69	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$907 831.45	$111 895.95	$292 702.10
$962 609.07	$167 848.29	$290 193.27
$1 020 308.13	$212 779.75	$296 784.62
$966 922.94	$167 848.29	$289 691.64
$973 664.57	$167 848.29	$290 092.19
$983 230.41	$167 848.29	$291 542.24
$943 110.86	$139 872.12	$292 649.95
$938 558.00	$130 546.73	$294 201.37
$934 665.56	$125 884.03	$294 378.51
$1 026 198.51	$212 779.75	$296 607.41
$1 412 308.08	$111 895.95	$480 171.32
$1 005 894.63	$111 895.95	$329 143.48
$1 707 560.15	$613 331.17	$422 045.34
$1 984 743.14	$920 020.67	$428 476.30
$2 261 348.56	$1 166	$459 008.20
$1 969 123.01	$920 020.67	$420 603.88
$1 970 188.38	$920 020.67	$418 931.99
$1 973 521.04	$920 020.67	$418 102.64
$1 861 160.57	$766 675.92	$429 075.62
$1 814 023.66	$715 561.00	$427 098.40
$1 788 479.79	$690 003.54	$425 382.38
$2 253 755.23	$1 166	$453 861.53
$2 098 172.34	$613 331.17	$567 201.25
$1 691 758.89	$613 331.17	$416 173.42
$2 593 479.29	$1 459	$553 708.80
$3 185 051.62	$2 189	$590 306.17
$3 719 576.21	$2 775	$649 179.30
$3 150 709.31	$2 189	$575 543.40
$3 143 824.66	$2 189	$570 984.21
$3 144 237.06	$2 189	$569 136.69
$2 908 870.45	$1 824	$577 501.82
$2 808 057.14	$1 703	$570 039.78
$2 751 368.03	$1 642	$563 986.62
$3 700 796.30	$2 775	$639 950.52
$2 906 238.05	$1 459	$669 933.50
$2 499 824.60	$1 459	$518 905.66
$5 147 525.24	$3 963	$915 733.97
$6 727 515.60	$5 945	$1 060 887.99
$8 052 314.49	$7 537	$1 211 857.03
$6 646 842.60	$5 945	$1 028 938.75
$6 619 447.06	$5 945	$1 016 788.02
$6 610 215.35	$5 945	$1 011 387.17
$5 946 988.36	$4 954	$989 906.31
$5 680 579.13	$4 624	$964 050.30
$5 537 612.55	$4 459	$947 520.34
$7 991 379.78	$7 537	$1 186 997.24
$5 295 087.49	$3 963	$970 569.77
$4 888 674.04	$3 963	$819 541.93

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
1.4.1.1	$26 117.08	$260 988.68	$1 355	$1 642 341.10	1	$21 899.87	$7 740.88	$29 640.75	1	$236 562.61	$294 942.27	$1 875	$2 407 311.71	1	$1 666 945.48	$193 522.00	$546 844.22
1.4.1.2	$35 014.41	$398 392.16	$1 282	$1 715 798.25	5	$21 584.98	$11 611.62	$33 196.61	7	$347 993.84	$450 221.40	$1 774	$2 573 197.78	5	$1 744 278.64	$290 290.55	$538 628.60
1.4.1.3	$41 564.78	$489 314.97	$1 276	$1 807 691.83	9	$22 022.72	$14 719.95	$36 742.66	1	$436 496.91	$552 972.91	$1 767	$2 756 729.54	9	$1 839 386.20	$367 998.70	$549 344.63
1.4.1.4	$35 014.41	$413 310.58	$1 274	$1 723 119.67	6	$21 545.62	$11 611.62	$33 157.24	5	$347 993.84	$467 080.64	$1 764	$2 579 541.87	6	$1 751 644.09	$290 290.55	$537 607.22
1.4.1.5	$35 014.41	$428 229.00	$1 271	$1 735 069.23	7	$21 575.68	$11 611.62	$33 187.30	6	$347 993.84	$483 939.89	$1 760	$2 592 291.87	7	$1 763 679.91	$290 290.55	$538 321.41
1.4.1.6	$35 014.41	$443 147.41	$1 274	$1 752 426.32	8	$21 686.85	$11 611.62	$33 298.47	8	$347 993.84	$500 799.13	$1 763	$2 612 526.53	8	$1 781 172.56	$290 290.55	$541 063.42
1.4.1.7	$30 689.90	$340 135.12	$1 320	$1 691 441.60	4	$21 822.96	$9 676.25	$31 499.21	4	$292 482.83	$384 385.34	$1 827	$2 504 758.53	4	$1 718 128.56	$241 906.28	$544 723.70
1.4.1.8	$29 196.49	$320 716.10	$1 337	$1 687 053.62	3	$21 958.50	$9 031.13	$30 989.63	3	$273 893.62	$362 439.99	$1 850	$2 487 095.76	3	$1 713 156.86	$225 778.19	$548 160.71
1.4.1.9	$28 438.76	$311 006.59	$1 342	$1 681 571.66	2	$21 977.00	$8 708.57	$30 685.57	2	$264 580.84	$351 467.32	$1 857	$2 473 710.53	2	$1 707 348.83	$217 714.14	$548 647.56
1.4.1.10	$41 564.78	$505 934.91	$1 269	$1 817 214.36	1	$21 999.36	$14 719.95	$36 719.30	9	$436 496.91	$571 755.03	$1 757	$2 765 688.00	1	$1 848 970.25	$367 998.70	$548 719.05
RB 48 hr 1.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$7 740.88	$43 823.75		$236 562.61	$294 942.27	$3 184	$3 716 042.62		$2 621 101.29	$193 522.00	$901 419.32
RB 24 hr 1.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$7 740.88	$32 399.18		$236 562.61	$294 942.27	$2 130	$2 661 845.24		$1 852 518.12	$193 522.00	$615 805.11
1.4.2.1	$89 142.71	$1 282 944.45	$1 568	$2 940 812.45	1	$30 854.86	$42 288.22	$73 143.08	1	$1 204 111.48	$1 449 850.43	$2 171	$4 825 264.21	1	$2 999 894.68	$1 057	$768 164.07
1.4.2.2	$119 511.03	$1 876 210.93	$1 351	$3 346 742.04	8	$30 865.37	$63 433.98	$94 299.34	8	$1 782 802.02	$2 120 298.52	$1 869	$5 773 072.95	8	$3 420 279.86	$1 585	$766 943.68
1.4.2.3	$141 868.72	$2 323 319.42	$1 317	$3 783 155.19	1	$32 833.16	$80 414.68	$113 247.84	1	$2 244 164.73	$2 625 574.05	$1 824	$6 693 961.86	1	$3 868 574.13	$2 010	$815 020.80
1.4.2.4	$119 511.03	$1 890 797.98	$1 306	$3 316 412.04	5	$30 264.55	$63 433.98	$93 698.52	7	$1 782 802.02	$2 136 783.29	$1 807	$5 727 387.19	6	$3 389 651.08	$1 585	$751 886.70
1.4.2.5	$119 511.03	$1 905 385.04	$1 292	$3 317 569.45	6	$30 136.04	$63 433.98	$93 570.01	6	$1 782 802.02	$2 153 268.06	$1 789	$5 725 283.73	5	$3 390 796.82	$1 585	$748 637.50
1.4.2.6	$119 511.03	$1 919 972.09	$1 283	$3 322 862.31	7	$30 069.56	$63 433.98	$93 503.54	5	$1 782 802.02	$2 169 752.84	$1 776	$5 728 904.23	7	$3 396 115.74	$1 585	$746 939.09
1.4.2.7	$104 750.64	$1 589 836.23	$1 474	$3 169 230.51	4	$31 137.29	$52 861.10	$83 998.39	4	$1 494 155.12	$1 796 667.61	$2 041	$5 331 904.83	4	$3 235 919.68	$1 321	$774 457.71
1.4.2.8	$99 653.34	$1 494 378.00	$1 504	$3 098 522.67	3	$31 055.72	$49 336.80	$80 392.53	3	$1 397 647.51	$1 688 790.65	$2 082	$5 168 833.02	3	$3 162 755.76	$1 233	$772 657.16
1.4.2.9	$97 067.05	$1 446 648.89	$1 516	$3 059 990.25	2	$30 967.44	$47 574.66	$78 542.10	2	$1 349 331.68	$1 634 852.16	$2 098	$5 082 887.75	2	$3 122 951.85	$1 189	$770 569.46
1.4.2.10	$141 868.72	$2 339 578.00	$1 286	$3 767 606.87	9	$32 437.35	$80 414.68	$112 852.03	9	$2 244 164.73	$2 643 947.81	$1 780	$6 668 311.08	9	$3 852 859.27	$2 010	$805 084.88
RB 48 hr 1.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$42 288.22	$84 123.73		$1 204 111.48	$1 449 850.43	$3 184	$5 838 499.65		$3 738 613.75	$1 057	$1 042 680.44
RB 24 hr 1.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$30 410.94	$42 288.22	$72 699.16		$1 204 111.48	$1 449 850.43	$2 130	$4 784 302.27		$2 970 030.58	$1 057	$757 066.23
1.4.3.1	$166 142.57	$2 484 448.75	$1 730	$4 381 330.72	1	$40 077.99	$100 048.33	$140 126.32	1	$2 775 008.98	$2 807 665.67	$2 395	$7 978 223.72	1	$4 481 276.94	$2 501	$995 738.60
1.4.3.2	$222 742.49	$3 613 431.42	$1 425	$5 261 247.73	8	$41 715.24	$150 076.39	$191 791.63	8	$4 118 986.52	$4 083 524.50	$1 972	$10 174 982.60	8	$5 389 225.44	$3 751	$1 033 847.37
1.4.3.3	$264 412.36	$4 479 274.31	$1 361	$6 104 774.12	1	$45 509.69	$190 250.48	$235 760.17	1	$5 192 010.18	$5 062 010.12	$1 883	$12 137 927.13	1	$6 255 121.02	$4 756	$1 126 544.05
1.4.3.4	$222 742.49	$3 627 416.78	$1 345	$5 195 819.13	7	$40 593.96	$150 076.39	$190 670.35	7	$4 118 986.52	$4 099 329.30	$1 862	$10 080 869.04	7	$5 323 178.90	$3 751	$1 005 780.34
1.4.3.5	$222 742.49	$3 641 402.13	$1 317	$5 181 846.22	6	$40 244.51	$150 076.39	$190 320.90	6	$4 118 986.52	$4 115 134.09	$1 823	$10 057 976.27	6	$5 309 057.27	$3 751	$997 009.19
1.4.3.6	$222 742.49	$3 655 387.49	$1 303	$5 181 512.22	5	$40 099.64	$150 076.39	$190 176.04	5	$4 118 986.52	$4 130 938.89	$1 804	$10 053 961.38	5	$5 308 698.94	$3 751	$993 352.64
1.4.3.7	$195 232.34	$3 058 860.84	$1 592	$4 846 663.82	4	$41 174.23	$125 062.36	$166 236.59	4	$3 448 299.35	$3 456 806.49	$2 204	$9 109 412.92	4	$4 961 145.24	$3 126	$1 021 708.69
1.4.3.8	$185 732.09	$2 874 003.98	$1 632	$4 692 513.32	3	$40 756.15	$116 724.35	$157 480.49	3	$3 224 192.79	$3 247 900.49	$2 259	$8 732 051.10	3	$4 802 223.73	$2 918	$1 011 718.64
1.4.3.9	$180 911.81	$2 781 575.55	$1 641	$4 603 719.30	2	$40 371.66	$112 555.34	$152 927.00	2	$3 112 023.90	$3 143 447.49	$2 271	$8 527 131.50	2	$4 710 910.42	$2 813	$1 002 337.49
1.4.3.10	$264 412.36	$4 494 876.01	$1 309	$6 068 318.21	9	$44 806.83	$190 250.48	$235 057.32	9	$5 192 010.18	$5 079 641.53	$1 811	$12 083 504.64	9	$6 218 308.92	$4 756	$1 108 933.66
RB 48 hr 1.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$100 048.33	$148 676.76		$2 775 008.98	$2 807 665.67	$3 184	$8 767 212.38		$5 056 504.51	$2 501	$1 209 499.68
RB 24 hr 1.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$37 203.86	$100 048.33	$137 252.19		$2 775 008.98	$2 807 665.67	$2 130	$7 713 015.00		$4 287 921.34	$2 501	$923 885.47
1.4.4.1	$341 398.74	$6 116 636.13	$2 024	$8 482 077.66	1	$64 426.09	$270 910.17	$335 336.26	1	$7 335 374.96	$6 912 386.20	$2 801	$17 049 277.00	1	$8 681 162.06	$6 772	$1 595 360.65
1.4.4.2	$457 703.32	$8 866 841.40	$1 621	$10 946 098.64	8	$73 326.09	$406 375.82	$479 701.91	8	$10 913 684.58	$10 020 382.25	$2 244	$23 178 490.25	8	$11 208 109.62	$10 159	$1 810 985.14
1.4.4.3	$543 328.82	$10 998 744.17	$1 508	$13 050 543.65	1	$83 162.73	$515 158.94	$598 321.68	1	$13 774 372.42	$12 429 637.11	$2 087	$28 291 912.27	1	$13 361 367.14	$12 878	$2 051 571.51
1.4.4.4	$457 703.32	$8 880 552.65	$1 455	$10 793 725.73	7	$70 903.38	$406 375.82	$477 279.20	7	$10 913 684.58	$10 035 877.28	$2 014	$22 964 105.05	7	$11 054 326.36	$10 159	$1 750 383.21
1.4.4.5	$457 703.32	$8 894 263.89	$1 389	$10 741 315.81	6	$69 980.12	$406 375.82	$476 355.94	6	$10 913 684.58	$10 051 372.31	$1 923	$22 888 080.53	6	$11 001 417.64	$10 159	$1 727 267.40
1.4.4.6	$457 703.32	$8 907 975.14	$1 357	$10 722 997.69	5	$69 568.24	$406 375.82	$475 944.06	5	$10 913 684.58	$10 066 867.34	$1 878	$22 859 243.10	5	$10 982 911.60	$10 159	$1 716 936.01
1.4.4.7	$401 173.98	$7 501 505.75	$1 824	$9 727 442.32	4	$68 970.94	$338 643.00	$407 613.94	4	$9 127 204.37	$8 477 421.86	$2 525	$20 130 314.59	4	$9 958 719.91	$8 466	$1 705 519.79
1.4.4.8	$381 652.35	$7 046 393.87	$1 882	$9 310 492.74	3	$67 361.52	$316 065.39	$383 426.91	3	$8 530 592.78	$7 963 101.73	$2 605	$19 099 224.29	3	$9 531 167.56	$7 901	$1 666 422.04
1.4.4.9	$371 747.38	$6 818 837.92	$1 893	$9 084 297.50	2	$66 291.70	$304 776.58	$371 068.28	2	$8 232 049.41	$7 705 941.66	$2 621	$18 559 113.89	2	$9 299 454.00	$7 619	$1 640 245.30
1.4.4.10	$543 328.82	$11 014 046.28	$1 377	$12 934 709.17	9	$81 272.20	$515 158.94	$596 431.14	9	$13 774 372.42	$12 446 929.96	$1 906	$28 127 696.48	9	$13 244 453.07	$12 878	$2 004 269.79
RB 48 hr 1.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$270 910.17	$339 487.15		$7 335 374.96	$6 912 386.20	$3 184	$17 432 298.90		$8 960 411.66	$6 772	$1 699 132.96
RB 24 hr 1.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$270 910.17	$328 062.58		$7 335 374.96	$6 912 386.20	$2 130	$16 378 101.51		$8 191 828.48	$6 772	$1 413 518.75

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
3.1.1.1	$10 070.88	$86 301.48	$343 489.42	$439 861.78	1	$5 686.57	$2 071.92	$7 758.50	1	$68 394.77	$97 528.96	$475 430.19	$641 353.92	1	$447 607.29	$51 798.09	$141 948.54
3.1.1.2	$13 501.73	$134 784.12	$329 365.29	$477 651.14	5	$5 752.12	$3 107.97	$8 860.08	5	$99 949.84	$152 319.00	$455 880.71	$708 149.55	5	$486 984.42	$77 699.15	$143 465.98
3.1.1.3	$16 027.59	$163 157.83	$327 720.37	$506 905.79	9	$5 895.08	$3 939.94	$9 835.02	9	$124 911.77	$184 384.01	$453 603.95	$762 899.74	9	$517 432.22	$98 498.51	$146 969.01
3.1.1.4	$13 501.73	$139 854.06	$328 100.74	$481 456.54	6	$5 758.50	$3 107.97	$8 866.47	6	$99 949.84	$158 048.52	$454 130.43	$712 128.79	6	$490 816.79	$77 699.15	$143 612.84
3.1.1.5	$13 501.73	$144 924.00	$327 229.75	$485 655.48	7	$5 770.78	$3 107.97	$8 878.75	7	$99 949.84	$163 778.04	$452 924.87	$716 652.75	7	$495 046.31	$77 699.15	$143 907.29
3.1.1.6	$13 501.73	$149 993.94	$327 554.54	$491 050.22	8	$5 801.01	$3 107.97	$8 908.97	8	$99 949.84	$169 507.56	$453 374.43	$722 831.82	8	$500 482.51	$77 699.15	$144 650.15
3.1.1.7	$11 834.18	$115 520.19	$336 061.30	$463 415.67	4	$5 739.23	$2 589.94	$8 329.17	4	$84 251.20	$130 548.90	$465 148.80	$679 948.90	4	$472 008.35	$64 748.62	$143 191.93
3.1.1.8	$11 258.32	$109 098.87	$340 400.52	$460 757.71	3	$5 766.34	$2 417.27	$8 183.61	3	$78 985.34	$123 292.20	$471 154.79	$673 432.33	3	$469 114.87	$60 431.78	$143 885.68
3.1.1.9	$10 966.13	$105 888.22	$341 419.37	$458 273.71	2	$5 762.59	$2 330.93	$8 093.52	2	$76 345.40	$119 663.85	$472 564.99	$668 574.24	2	$466 500.95	$58 273.36	$143 799.93
3.1.1.10	$16 027.59	$168 836.10	$326 458.69	$511 322.38	1	$5 904.54	$3 939.94	$9 844.48	1	$124 911.77	$190 801.01	$451 857.64	$767 570.42	1	$521 880.44	$98 498.51	$147 191.47
RB 48 hr 3.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$2 071.92	$10 769.21		$68 394.77	$97 528.96	$753 242.87	$919 166.60		$650 152.05	$51 798.09	$217 216.46
RB 24 hr 3.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$3 705.21	$2 071.92	$5 777.13		$71 180.57	$129 244.75	$418 479.11	$618 904.43		$475 339.08	$51 798.09	$91 767.26
3.1.4.1	$34 644.50	$423 350.47	$391 513.76	$849 508.74	1	$8 342.83	$11 442.30	$19 785.13	1	$343 151.16	$478 426.69	$541 901.59	$1 363 479.44	1	$869 909.52	$286 057.47	$207 512.44
3.1.4.2	$46 446.87	$622 236.98	$344 597.42	$1 013 281.27	8	$8 753.90	$17 163.89	$25 917.80	8	$505 641.20	$703 187.54	$476 963.79	$1 685 792.53	8	$1 039 403.16	$429 097.36	$217 292.01
3.1.4.3	$55 135.99	$768 084.21	$337 243.44	$1 160 463.64	1	$9 461.46	$21 758.51	$31 219.97	1	$634 826.22	$868 008.92	$466 785.01	$1 969 620.15	1	$1 191 041.03	$543 962.84	$234 616.28
3.1.4.4	$46 446.87	$627 245.99	$334 686.23	$1 008 379.09	5	$8 630.28	$17 163.89	$25 794.18	7	$505 641.20	$708 848.20	$463 245.53	$1 677 734.93	5	$1 034 448.65	$429 097.36	$214 188.92
3.1.4.5	$46 446.87	$632 254.99	$332 162.77	$1 010 864.64	6	$8 617.47	$17 163.89	$25 781.37	6	$505 641.20	$714 508.86	$459 752.77	$1 679 902.82	6	$1 036 949.23	$429 097.36	$213 856.23
3.1.4.6	$46 446.87	$637 264.00	$329 513.90	$1 013 224.77	7	$8 602.79	$17 163.89	$25 766.68	5	$505 641.20	$720 169.52	$456 086.41	$1 681 897.13	7	$1 039 323.26	$429 097.36	$213 476.51
3.1.4.7	$40 710.38	$527 738.07	$369 857.14	$938 305.59	4	$8 601.79	$14 303.10	$22 904.89	4	$424 667.59	$596 394.69	$511 926.25	$1 532 988.54	4	$961 685.63	$357 577.42	$213 725.49
3.1.4.8	$38 729.36	$496 238.43	$377 148.45	$912 116.24	3	$8 533.46	$13 349.50	$21 882.96	3	$397 562.92	$560 797.08	$522 018.29	$1 480 378.29	3	$934 544.99	$333 737.43	$212 095.86
3.1.4.9	$37 724.22	$480 488.61	$379 938.46	$898 151.29	2	$8 486.31	$12 872.70	$21 359.00	2	$383 986.47	$542 998.27	$525 879.99	$1 452 864.73	2	$920 090.84	$321 817.44	$210 956.45
3.1.4.10	$55 135.99	$773 692.37	$330 734.56	$1 159 562.92	9	$9 391.87	$21 758.51	$31 150.38	9	$634 826.22	$874 346.68	$457 775.95	$1 966 948.85	9	$1 190 123.56	$543 962.84	$232 862.45
RB 48 hr 3.1.4	$34 644.50	$423 350.47	$544 203.89	$1 002 198.86		$10 633.18	$11 442.30	$22 075.48		$343 151.16	$478 426.69	$753 242.87	$1 574 820.72		$1 023 992.01	$286 057.47	$264 771.24
RB 24 hr 3.1.4	$34 644.50	$423 350.47	$357 566.91	$815 561.88		$10 913.09	$11 442.30	$22 355.39		$352 734.50	$634 007.98	$418 479.11	$1 405 221.59		$850 570.39	$286 057.47	$268 593.73
3.4.1.1	$65 481.96	$816 778.76	$424 085.21	$1 306 345.94	1	$11 113.09	$27 601.34	$38 714.43	1	$797 946.86	$923 038.44	$586 984.35	$2 307 969.65	1	$1 342 150.96	$690 033.44	$275 785.25
3.4.1.2	$87 789.76	$1 191 185.29	$361 993.41	$1 640 968.46	8	$12 281.28	$41 403.08	$53 684.37	8	$1 179 753.43	$1 346 153.77	$501 041.91	$3 026 949.11	8	$1 687 817.94	$1 035	$304 054.11
3.4.1.3	$104 213.15	$1 474 146.90	$347 316.38	$1 925 676.43	1	$13 643.45	$52 486.31	$66 129.77	1	$1 483 899.72	$1 665 927.56	$480 727.16	$3 630 554.44	1	$1 980 995.64	$1 312	$337 400.99
3.4.1.4	$87 789.76	$1 196 083.98	$344 330.19	$1 628 203.93	7	$12 040.83	$41 403.08	$53 443.91	7	$1 179 753.43	$1 351 689.76	$476 593.92	$3 008 037.10	7	$1 674 929.55	$1 035	$298 030.50
3.4.1.5	$87 789.76	$1 200 982.67	$337 111.56	$1 625 883.98	5	$11 957.04	$41 403.08	$53 360.12	6	$1 179 753.43	$1 357 225.74	$466 602.47	$3 003 581.64	5	$1 672 580.99	$1 035	$295 923.60
3.4.1.6	$87 789.76	$1 205 881.35	$334 041.98	$1 627 713.09	6	$11 935.49	$41 403.08	$53 338.57	5	$1 179 753.43	$1 362 761.73	$462 353.81	$3 004 868.97	6	$1 674 419.31	$1 035	$295 372.60
3.4.1.7	$76 947.15	$1 008 866.59	$396 900.99	$1 482 714.74	4	$11 782.71	$34 502.21	$46 284.92	4	$989 363.15	$1 140 116.13	$549 358.16	$2 678 837.43	4	$1 524 236.63	$862 555.25	$292 045.55
3.4.1.8	$73 202.81	$948 093.69	$405 935.65	$1 427 232.15	3	$11 576.17	$32 201.92	$43 778.09	3	$925 685.25	$1 071 436.92	$561 863.20	$2 558 985.36	3	$1 466 903.32	$805 047.98	$287 034.06
3.4.1.9	$71 302.98	$917 707.24	$408 677.94	$1 397 688.16	2	$11 446.00	$31 051.77	$42 497.77	2	$893 800.73	$1 037 097.31	$565 658.85	$2 496 556.88	2	$1 436 406.92	$776 294.34	$283 855.62
3.4.1.10	$104 213.15	$1 479 627.96	$336 213.79	$1 920 054.90	9	$13 504.32	$52 486.31	$65 990.63	9	$1 483 899.72	$1 672 121.69	$465 359.85	$3 621 381.26	9	$1 975 314.50	$1 312	$333 908.95
RB 48 hr 3.4.1	$65 481.96	$816 778.76	$544 203.89	$1 426 464.61		$12 914.87	$27 601.34	$40 516.21		$797 946.86	$923 038.44	$753 242.87	$2 474 228.17		$1 463 364.98	$690 033.44	$320 829.76
RB 24 hr 3.4.1	$65 481.96	$816 778.76	$357 566.91	$1 239 827.64		$19 367.57	$27 601.34	$46 968.90		$816 060.44	$1 223 204.63	$418 479.11	$2 457 744.18		$1 291 689.35	$690 033.44	$476 021.39
3.4.4.1	$135 406.09	$2 007 523.44	$495 315.00	$2 638 244.53	1	$18 848.48	$75 392.68	$94 241.16	1	$2 107 964.45	$2 268 694.27	$685 574.84	$5 062 233.56	1	$2 711 223.29	$1 884	$466 193.30
3.4.4.2	$181 534.99	$2 913 464.00	$405 881.22	$3 500 880.22	8	$22 507.20	$113 091.96	$135 599.15	8	$3 126 466.25	$3 292 494.10	$561 787.86	$6 980 748.22	8	$3 598 053.05	$2 827	$555 396.22
3.4.4.3	$215 495.91	$3 611 480.34	$381 317.12	$4 208 293.38	1	$25 975.22	$143 365.65	$169 340.87	1	$3 939 275.71	$4 081 319.60	$527 788.23	$8 548 383.54	1	$4 323 890.55	$3 584	$640 351.72
3.4.4.4	$181 534.99	$2 918 312.55	$369 527.98	$3 469 375.52	7	$21 986.14	$113 091.96	$135 078.10	7	$3 126 466.25	$3 297 973.43	$511 470.65	$6 935 910.33	7	$3 566 253.68	$2 827	$542 357.70
3.4.4.5	$181 534.99	$2 923 161.10	$354 239.82	$3 458 935.91	6	$21 781.06	$113 091.96	$134 873.02	6	$3 126 466.25	$3 303 452.75	$490 310.03	$6 920 229.03	6	$3 555 711.49	$2 827	$537 218.59
3.4.4.6	$181 534.99	$2 928 009.64	$347 395.00	$3 456 939.63	5	$21 702.63	$113 091.96	$134 794.59	5	$3 126 466.25	$3 308 932.07	$480 835.97	$6 916 234.30	5	$3 553 689.62	$2 827	$535 245.73
3.4.4.7	$159 114.24	$2 465 351.14	$450 172.91	$3 074 638.29	4	$20 702.31	$94 242.32	$114 944.63	4	$2 618 276.15	$2 786 083.54	$623 092.82	$6 027 452.51	4	$3 160 000.06	$2 356	$511 394.49
3.4.4.8	$151 371.54	$2 315 980.19	$463 504.96	$2 930 856.69	3	$20 076.47	$87 959.11	$108 035.57	3	$2 448 435.96	$2 617 280.02	$641 545.96	$5 707 261.94	3	$3 012 162.63	$2 198	$496 121.68
3.4.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$84 817.50	$104 525.99	2	$2 363 421.64	$2 532 878.25	$645 746.31	$5 542 046.20	2	$2 934 499.80	$2 120	$487 108.93
3.4.4.10	$215 495.91	$3 616 903.58	$351 351.67	$4 183 751.16	9	$25 552.85	$143 365.65	$168 918.50	9	$3 939 275.71	$4 087 448.37	$486 312.48	$8 513 036.56	9	$4 299 116.28	$3 584	$629 779.02
RB 48 hr 3.4.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$75 392.68	$94 974.50		$2 107 964.45	$2 268 694.27	$753 242.87	$5 129 901.60		$2 760 557.99	$1 884	$484 526.63
RB 24 hr 3.4.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$44 511.02	$75 392.68	$119 903.70		$2 145 420.40	$3 006 459.14	$418 479.11	$5 570 358.64		$2 592 841.42	$1 884	$1 092 700.25

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
4.1.1.1	$17 575.65	$158 938.83	$783 774.85	$960 289.32	1	$12 730.59	$4 475.84	$17 206.43	1	$140 860.39	$179 616.14	$1 084	$1 405 314.09	1
4.1.1.2	$23 563.16	$243 453.76	$756 685.45	$1 023 702.36	5	$12 807.89	$6 713.93	$19 521.83	6	$206 680.07	$275 126.12	$1 047	$1 529 148.81	5
4.1.1.3	$27 971.27	$297 803.23	$753 631.39	$1 079 405.90	9	$13 078.79	$8 511.19	$21 589.98	9	$258 876.04	$336 546.25	$1 043	$1 638 537.74	9
4.1.1.4	$23 563.16	$251 807.99	$753 864.15	$1 029 235.30	6	$12 807.35	$6 713.93	$19 521.28	5	$206 680.07	$284 567.21	$1 043	$1 534 684.89	6
4.1.1.5	$23 563.16	$260 162.22	$752 779.65	$1 036 505.03	7	$12 832.85	$6 713.93	$19 546.78	7	$206 680.07	$294 008.29	$1 041	$1 542 624.88	7
4.1.1.6	$23 563.16	$268 516.45	$753 128.51	$1 045 208.13	8	$12 879.85	$6 713.93	$19 593.79	8	$206 680.07	$303 449.38	$1 042	$1 552 548.84	8
4.1.1.7	$20 652.96	$207 975.95	$769 668.26	$998 297.16	4	$12 795.56	$5 594.88	$18 390.45	4	$173 907.92	$235 032.79	$1 065	$1 474 253.09	4
4.1.1.8	$19 647.96	$196 150.01	$777 338.01	$993 135.98	3	$12 841.23	$5 221.87	$18 063.10	3	$162 926.31	$221 668.35	$1 075	$1 460 522.88	3
4.1.1.9	$19 138.04	$190 237.04	$779 721.52	$989 096.59	2	$12 842.22	$5 035.36	$17 877.58	2	$157 423.27	$214 986.13	$1 079	$1 451 636.67	2
4.1.1.10	$27 971.27	$307 195.13	$751 191.64	$1 086 358.05	1	$13 089.16	$8 511.19	$21 600.35	1	$258 876.04	$347 160.00	$1 039	$1 645 774.58	1
RB 48 hr 4.1.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$4 475.84	$23 698.58		$140 860.39	$179 616.14	$1 683	$2 004 375.35	
RB 24 hr 4.1.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$7 581.94	$4 475.84	$12 057.77		$145 722.16	$238 026.16	$952 484.44	$1 336 232.75	
4.1.4.1	$60 134.28	$780 795.83	$881 046.76	$1 721 976.87	1	$17 733.05	$24 533.25	$42 266.30	1	$712 431.68	$882 374.27	$1 219	$2 814 279.40	1
4.1.4.2	$80 620.27	$1 142 766.44	$784 960.00	$2 008 346.71	8	$18 310.56	$36 800.83	$55 111.39	8	$1 052 881.82	$1 291 435.81	$1 086	$3 430 795.59	8
4.1.4.3	$95 702.42	$1 413 855.12	$771 972.12	$2 281 529.66	1	$19 625.02	$46 652.07	$66 277.10	1	$1 324 018.21	$1 597 792.06	$1 068	$3 990 311.45	1
4.1.4.4	$80 620.27	$1 150 974.14	$766 855.28	$1 998 449.69	5	$18 080.03	$36 800.83	$54 880.85	7	$1 052 881.82	$1 300 711.31	$1 061	$3 415 012.00	5
4.1.4.5	$80 620.27	$1 159 181.85	$762 154.73	$2 001 956.85	6	$18 050.56	$36 800.83	$54 851.38	6	$1 052 881.82	$1 309 986.81	$1 054	$3 417 781.38	6
4.1.4.6	$80 620.27	$1 167 389.56	$756 991.71	$2 005 001.54	7	$18 014.15	$36 800.83	$54 814.98	5	$1 052 881.82	$1 319 262.31	$1 047	$3 419 910.64	7
4.1.4.7	$70 663.14	$968 479.73	$835 109.95	$1 874 252.82	4	$18 089.81	$30 667.04	$48 756.85	4	$883 127.85	$1 094 475.09	$1 155	$3 133 494.40	4
4.1.4.8	$67 224.58	$910 384.16	$850 481.19	$1 828 089.93	3	$17 994.83	$28 622.44	$46 617.27	3	$826 346.24	$1 028 821.52	$1 177	$3 032 334.84	3
4.1.4.9	$65 479.91	$881 336.37	$857 258.41	$1 804 074.70	2	$17 933.45	$27 600.14	$45 533.59	2	$797 913.59	$995 994.74	$1 186	$2 980 455.88	2
4.1.4.10	$95 702.42	$1 423 083.37	$759 281.47	$2 278 067.26	9	$19 480.80	$46 652.07	$66 132.88	9	$1 324 018.21	$1 608 220.87	$1 050	$3 983 174.89	9
RB 48 hr 4.1.4	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$24 533.25	$47 299.38		$712 431.68	$882 374.27	$1 683	$3 278 704.77	
RB 24 hr 4.1.4	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$20 827.69	$24 533.25	$45 360.94		$729 065.98	$1 169 316.74	$952 484.44	$2 850 867.16	
4.4.1.1	$112 564.83	$1 510 285.24	$949 596.19	$2 572 446.26	1	$22 943.53	$58 392.00	$81 335.53	1	$1 645 305.47	$1 706 767.35	$1 314	$4 666 426.84	1
4.4.1.2	$150 912.38	$2 197 630.23	$819 563.27	$3 168 105.87	8	$24 820.91	$87 590.28	$112 411.19	8	$2 438 458.70	$2 483 533.20	$1 134	$6 056 364.89	8
4.4.1.3	$179 144.52	$2 722 954.51	$790 674.05	$3 692 773.08	1	$27 302.16	$111 037.41	$138 339.57	1	$3 071 163.04	$3 077 200.07	$1 094	$7 242 750.00	1
4.4.1.4	$150 912.38	$2 205 571.89	$785 226.68	$3 141 710.95	7	$24 345.57	$87 590.28	$111 935.85	7	$2 438 458.70	$2 492 508.04	$1 086	$6 017 813.82	7
4.4.1.5	$150 912.38	$2 213 513.56	$771 908.07	$3 136 334.00	5	$24 185.50	$87 590.28	$111 775.78	6	$2 438 458.70	$2 501 482.88	$1 068	$6 008 354.11	5
4.4.1.6	$150 912.38	$2 221 455.22	$765 459.04	$3 137 826.64	6	$24 128.47	$87 590.28	$111 718.75	5	$2 438 458.70	$2 510 457.72	$1 059	$6 008 402.74	6
4.4.1.7	$132 273.71	$1 860 509.26	$891 696.53	$2 884 479.51	4	$24 027.19	$72 991.14	$97 018.33	4	$2 042 763.95	$2 102 554.13	$1 234	$5 379 532.09	4
4.4.1.8	$125 837.11	$1 748 135.61	$910 693.40	$2 784 666.12	3	$23 684.62	$68 124.76	$91 809.38	3	$1 910 497.01	$1 975 561.11	$1 260	$5 146 566.05	3
4.4.1.9	$122 571.28	$1 691 948.78	$916 695.04	$2 731 215.10	2	$23 460.40	$65 691.57	$89 151.97	2	$1 844 285.21	$1 912 064.60	$1 268	$5 025 164.72	2
4.4.1.10	$179 144.52	$2 731 885.24	$769 070.45	$3 680 100.21	9	$27 022.76	$111 037.41	$138 060.17	9	$3 071 163.04	$3 087 292.66	$1 064	$7 222 940.63	9
RB 48 hr 4.4.1	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$58 392.00	$85 340.37		$1 645 305.47	$1 706 767.35	$1 683	$5 035 971.65	
RB 24 hr 4.4.1	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$36 413.66	$58 392.00	$94 805.66		$1 676 443.09	$2 261 797.18	$952 484.44	$4 890 724.71	
4.4.4.1	$231 757.45	$3 716 343.63	$1 106	$5 054 286.13	1	$37 538.42	$158 542.07	$196 080.49	1	$4 345 484.98	$4 199 825.18	$1 531	$10 076 401.77	1
4.4.4.2	$310 710.44	$5 388 413.10	$910 762.15	$6 609 885.70	8	$43 772.74	$237 819.28	$281 592.03	8	$6 457 528.87	$6 089 424.25	$1 260	$13 807 556.22	8
4.4.4.3	$368 837.04	$6 682 697.20	$858 732.13	$7 910 266.37	1	$50 056.61	$301 481.35	$351 537.96	1	$8 144 872.44	$7 552 089.57	$1 188	$16 885 549.37	1
4.4.4.4	$310 710.44	$5 396 233.56	$835 137.59	$6 542 081.59	7	$42 677.48	$237 819.28	$280 496.76	7	$6 457 528.87	$6 098 262.12	$1 155	$13 711 720.70	7
4.4.4.5	$310 710.44	$5 404 054.02	$804 327.00	$6 519 091.46	6	$42 254.42	$237 819.28	$280 073.71	6	$6 457 528.87	$6 107 099.98	$1 113	$13 677 913.05	6
4.4.4.6	$310 710.44	$5 411 874.47	$790 303.02	$6 512 887.93	5	$42 083.16	$237 819.28	$279 902.45	5	$6 457 528.87	$6 115 937.85	$1 093	$13 667 340.05	5
4.4.4.7	$272 335.68	$4 558 862.95	$1 006	$5 837 484.77	4	$40 666.43	$198 180.68	$238 847.11	4	$5 403 322.56	$5 151 952.92	$1 392	$11 948 095.14	4
4.4.4.8	$259 083.49	$4 282 346.23	$1 036	$5 578 108.84	3	$39 604.57	$184 967.81	$224 572.38	3	$5 051 161.39	$4 839 462.47	$1 434	$11 325 511.01	3
4.4.4.9	$252 359.53	$4 144 087.87	$1 042	$5 438 709.75	2	$38 928.44	$178 361.37	$217 289.81	2	$4 874 919.52	$4 683 217.25	$1 442	$11 000 751.78	2
4.4.4.10	$368 837.04	$6 691 492.22	$798 893.40	$7 859 222.66	9	$49 203.00	$301 481.35	$350 684.35	9	$8 144 872.44	$7 562 028.78	$1 105	$16 812 664.67	9
RB 48 hr 4.4.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$158 542.07	$197 736.49		$4 345 484.98	$4 199 825.18	$1 683	$10 229 208.98	
RB 24 hr 4.4.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$82 799.49	$158 542.07	$241 341.56		$4 409 593.58	$5 565 581.47	$952 484.44	$10 927 659.49	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$975 550.78	$111 895.95	$317 867.36
$1 041 711.78	$167 848.29	$319 588.73
$1 099 532.64	$212 779.75	$326 225.34
$1 047 282.46	$167 848.29	$319 554.14
$1 054 605.75	$167 848.29	$320 170.85
$1 063 375.49	$167 848.29	$321 325.06
$1 015 011.81	$139 872.12	$319 369.15
$1 009 435.79	$130 546.73	$320 540.36
$1 005 172.83	$125 884.03	$320 579.81
$1 106 533.88	$212 779.75	$326 460.94
$1 412 308.08	$111 895.95	$480 171.32
$1 036 377.78	$111 895.95	$187 959.02
$1 759 573.97	$613 331.17	$441 374.26
$2 055 867.87	$920 020.67	$454 907.06
$2 336 918.67	$1 166	$487 090.91
$2 045 868.10	$920 020.67	$449 123.23
$2 049 394.74	$920 020.67	$448 365.97
$2 052 454.70	$920 020.67	$447 435.28
$1 916 994.38	$766 675.92	$449 824.10
$1 869 179.06	$715 561.00	$447 594.77
$1 844 319.35	$690 003.54	$446 132.99
$2 333 410.65	$1 166	$483 462.38
$2 098 172.34	$613 331.17	$567 201.25
$1 724 651.69	$613 331.17	$512 884.30
$2 636 814.19	$1 459	$569 812.54
$3 251 579.23	$2 189	$615 028.58
$3 791 068.25	$2 775	$675 746.55
$3 224 931.52	$2 189	$603 125.22
$3 219 493.45	$2 189	$599 103.59
$3 220 987.60	$2 189	$597 658.06
$2 958 725.12	$1 824	$596 028.38
$2 855 701.86	$1 703	$587 745.10
$2 800 595.34	$1 642	$582 280.04
$3 778 266.22	$2 775	$668 739.21
$2 906 238.05	$1 459	$669 933.50
$2 535 685.98	$1 459	$895 238.62
$5 183 680.41	$3 963	$929 169.64
$6 781 226.53	$5 945	$1 080 847.58
$8 113 807.16	$7 537	$1 234 708.40
$6 712 792.21	$5 945	$1 053 446.37
$6 689 580.53	$5 945	$1 042 850.41
$6 683 308.52	$5 945	$1 038 549.42
$5 988 314.60	$4 954	$1 005 263.61
$5 721 907.46	$4 624	$979 408.37
$5 578 866.64	$4 459	$962 850.83
$8 062 284.59	$7 537	$1 213 346.27
$5 295 087.49	$3 963	$970 569.77
$4 931 284.03	$3 963	$2 032 823.73

APPENDIX H2: SUMMARY OF COST ESTIMATIONS AS PERCENTAGE - HIGHER ELECTRICAL TARIFF (X4)

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.1.1.1	2.29%	19.62%	78.09%	68.67%	73.29%	26.71%	72.04%	10.66%	15.21%	74.13%	69.78%	69.79%	8.08%	22.13%
2.1.1.2	2.83%	28.22%	68.96%	74.57%	64.92%	35.08%	82.27%	14.11%	21.51%	64.38%	77.04%	68.77%	10.97%	20.26%
2.1.1.3	3.16%	32.19%	64.65%	79.13%	59.94%	40.06%	91.33%	16.37%	24.17%	59.46%	83.00%	67.82%	12.91%	19.26%
2.1.1.4	2.80%	29.05%	68.15%	75.16%	64.95%	35.05%	82.33%	14.04%	22.19%	63.77%	77.48%	68.92%	10.91%	20.17%
2.1.1.5	2.78%	29.84%	67.38%	75.82%	65.00%	35.00%	82.45%	13.95%	22.85%	63.20%	77.97%	69.08%	10.84%	20.08%
2.1.1.6	2.75%	30.55%	66.70%	76.66%	65.11%	34.89%	82.73%	13.83%	23.45%	62.72%	78.64%	69.24%	10.75%	20.01%
2.1.1.7	2.55%	24.93%	72.52%	72.34%	68.91%	31.09%	77.34%	12.39%	19.20%	68.41%	73.97%	69.42%	9.52%	21.06%
2.1.1.8	2.44%	23.68%	73.88%	71.93%	70.46%	29.54%	75.99%	11.73%	18.31%	69.96%	73.27%	69.66%	8.97%	21.37%
2.1.1.9	2.39%	23.11%	74.50%	71.54%	71.20%	28.80%	75.15%	11.42%	17.90%	70.68%	72.74%	69.78%	8.72%	21.51%
2.1.1.10	3.13%	33.02%	63.85%	79.82%	59.98%	40.02%	91.41%	16.27%	24.86%	58.87%	83.51%	67.99%	12.83%	19.18%
RB 48 hr 2.1.1	1.57%	13.47%	84.96%	100.00%	80.76%	19.24%	100.00%	7.44%	10.61%	81.95%	100.00%	70.73%	5.64%	23.63%
RB 24 hr 2.1.1	2.22%	19.01%	78.77%	70.86%	64.14%	35.86%	53.64%	11.50%	20.88%	67.62%	67.33%	76.80%	8.37%	14.83%
2.1.2.1	4.08%	49.83%	46.09%	84.76%	42.17%	57.83%	89.62%	25.17%	35.09%	39.74%	86.58%	63.80%	20.98%	15.22%
2.1.2.2	4.58%	61.41%	34.01%	101.11%	33.78%	66.22%	117.41%	29.99%	41.71%	28.29%	107.05%	61.66%	25.45%	12.89%
2.1.2.3	4.75%	66.19%	29.06%	115.79%	30.31%	69.69%	141.42%	32.23%	44.07%	23.70%	125.07%	60.47%	27.62%	11.91%
2.1.2.4	4.61%	62.20%	33.19%	100.62%	33.46%	66.54%	116.85%	30.14%	42.25%	27.61%	106.53%	61.66%	25.58%	12.77%
2.1.2.5	4.59%	62.55%	32.86%	100.86%	33.43%	66.57%	116.79%	30.10%	42.53%	27.37%	106.67%	61.73%	25.54%	12.73%
2.1.2.6	4.58%	62.89%	32.52%	101.10%	33.39%	66.61%	116.72%	30.06%	42.82%	27.12%	106.80%	61.79%	25.51%	12.69%
2.1.2.7	4.34%	56.24%	39.42%	93.62%	37.55%	62.45%	103.76%	27.70%	38.90%	33.39%	97.34%	62.73%	23.33%	13.94%
2.1.2.8	4.25%	54.41%	41.35%	91.01%	39.00%	61.00%	99.13%	26.86%	37.88%	35.26%	94.00%	63.13%	22.54%	14.33%
2.1.2.9	4.20%	53.50%	42.30%	89.62%	39.73%	60.27%	96.75%	26.43%	37.37%	36.20%	92.26%	63.33%	22.15%	14.52%
2.1.2.10	4.75%	66.72%	28.52%	115.70%	30.15%	69.85%	141.11%	32.27%	44.45%	23.27%	124.90%	60.51%	27.66%	11.84%
RB 48 hr 2.1.2	3.46%	42.24%	54.30%	100.00%	48.17%	51.83%	100.00%	21.79%	30.38%	47.83%	100.00%	65.02%	18.16%	16.81%
RB 24 hr 2.1.2	4.25%	51.91%	43.84%	81.38%	48.82%	51.18%	101.27%	25.10%	45.12%	29.78%	89.23%	60.53%	20.36%	19.11%
2.1.3.1	5.01%	62.52%	32.46%	91.58%	28.71%	71.29%	95.55%	34.57%	39.99%	25.43%	93.28%	58.15%	29.90%	11.95%
2.1.3.2	5.35%	72.59%	22.06%	115.04%	22.88%	77.12%	132.50%	38.98%	44.47%	16.55%	122.34%	55.76%	34.20%	10.04%
2.1.3.3	5.41%	76.55%	18.04%	135.00%	20.63%	79.37%	163.22%	40.87%	45.89%	13.24%	146.73%	54.56%	36.14%	9.29%
2.1.3.4	5.39%	73.46%	21.15%	114.14%	22.53%	77.47%	131.91%	39.22%	44.94%	15.84%	121.57%	55.68%	34.41%	9.91%
2.1.3.5	5.40%	73.87%	20.73%	113.98%	22.41%	77.59%	131.70%	39.28%	45.19%	15.53%	121.39%	55.69%	34.46%	9.85%
2.1.3.6	5.39%	74.08%	20.52%	114.11%	22.38%	77.62%	131.65%	39.26%	45.35%	15.39%	121.45%	55.72%	34.45%	9.83%
2.1.3.7	5.19%	68.04%	26.77%	103.94%	25.46%	74.54%	114.24%	36.93%	42.56%	20.51%	108.27%	56.90%	32.20%	10.90%
2.1.3.8	5.13%	66.43%	28.44%	100.05%	26.44%	73.56%	108.05%	36.17%	41.87%	21.96%	103.43%	57.32%	31.46%	11.22%
2.1.3.9	5.10%	65.66%	29.24%	97.98%	26.93%	73.07%	104.89%	35.80%	41.54%	22.66%	100.90%	57.54%	31.09%	11.37%
2.1.3.10	5.43%	77.06%	17.51%	134.60%	20.46%	79.54%	162.87%	40.98%	46.17%	12.85%	146.36%	54.55%	36.23%	9.22%
RB 48 hr 2.1.3	4.59%	57.26%	38.15%	100.00%	31.88%	68.12%	100.00%	32.25%	37.31%	30.44%	100.00%	59.14%	27.89%	12.97%
RB 24 hr 2.1.3	5.28%	65.88%	28.84%	86.92%	41.23%	58.77%	115.93%	33.20%	49.77%	17.03%	99.33%	52.56%	28.08%	19.37%
2.1.4.1	5.13%	76.09%	18.77%	98.18%	20.00%	80.00%	99.23%	41.64%	44.82%	13.54%	98.68%	53.56%	37.23%	9.21%
2.1.4.2	5.19%	83.22%	11.59%	130.28%	16.60%	83.40%	142.77%	44.79%	47.17%	8.05%	136.08%	51.54%	40.50%	7.96%
2.1.4.3	5.12%	85.82%	9.06%	156.61%	15.34%	84.66%	178.30%	46.08%	47.74%	6.17%	166.64%	50.58%	41.93%	7.49%
2.1.4.4	5.23%	84.12%	10.65%	129.11%	16.28%	83.72%	142.23%	45.08%	47.55%	7.37%	135.21%	51.42%	40.76%	7.82%
2.1.4.5	5.25%	84.51%	10.24%	128.72%	16.15%	83.85%	142.01%	45.18%	47.74%	7.09%	134.90%	51.38%	40.86%	7.76%
2.1.4.6	5.25%	84.70%	10.05%	128.65%	16.10%	83.90%	141.93%	45.20%	47.84%	6.95%	134.82%	51.38%	40.88%	7.74%
2.1.4.7	5.18%	80.18%	14.64%	114.42%	18.01%	81.99%	121.03%	43.44%	46.22%	10.34%	117.50%	52.43%	39.09%	8.48%
2.1.4.8	5.16%	79.02%	15.81%	109.07%	18.58%	81.42%	113.75%	42.90%	45.86%	11.24%	111.25%	52.78%	38.53%	8.69%
2.1.4.9	5.16%	78.50%	16.34%	106.26%	18.86%	81.14%	110.06%	42.65%	45.70%	11.65%	108.03%	52.95%	38.26%	8.79%
2.1.4.10	5.15%	86.45%	8.40%	155.70%	15.13%	84.87%	177.86%	46.27%	48.01%	5.71%	165.95%	50.50%	42.10%	7.40%
RB 48 hr 2.1.4	5.04%	74.71%	20.25%	100.00%	20.62%	79.38%	100.00%	41.09%	44.22%	14.68%	100.00%	53.81%	36.74%	9.45%
RB 24 hr 2.1.4	5.42%	80.28%	14.30%	93.05%	37.12%	62.88%	126.25%	38.51%	53.97%	7.51%	108.59%	46.55%	33.84%	19.62%

Property of Sasakawa

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.2.1.1	1.83%	16.55%	81.62%	68.93%	73.99%	26.01%	72.61%	10.02%	12.78%	77.20%	70.11%	69.42%	7.96%	22.62%
2.2.1.2	2.30%	23.78%	73.92%	73.48%	65.61%	34.39%	82.38%	13.52%	17.99%	68.49%	76.29%	68.12%	10.98%	20.90%
2.2.1.3	2.59%	27.59%	69.82%	77.48%	60.58%	39.42%	91.10%	15.80%	20.54%	63.66%	81.75%	67.10%	12.99%	19.91%
2.2.1.4	2.29%	24.47%	73.25%	73.88%	65.61%	34.39%	82.37%	13.47%	18.54%	67.99%	76.57%	68.24%	10.94%	20.82%
2.2.1.5	2.27%	25.10%	72.63%	74.40%	65.65%	34.35%	82.48%	13.40%	19.06%	67.54%	76.96%	68.36%	10.88%	20.75%
2.2.1.6	2.25%	25.69%	72.06%	75.03%	65.73%	34.27%	82.68%	13.31%	19.55%	67.14%	77.46%	68.49%	10.81%	20.70%
2.2.1.7	2.07%	20.83%	77.10%	71.66%	69.58%	30.42%	77.60%	11.80%	15.94%	72.26%	73.55%	68.85%	9.49%	21.66%
2.2.1.8	1.98%	19.75%	78.27%	71.29%	71.09%	28.91%	76.22%	11.16%	15.18%	73.67%	72.87%	69.11%	8.94%	21.95%
2.2.1.9	1.93%	19.23%	78.83%	71.00%	71.83%	28.17%	75.44%	10.84%	14.81%	74.35%	72.42%	69.24%	8.67%	22.08%
2.2.1.10	2.57%	28.28%	69.15%	77.98%	60.60%	39.40%	91.15%	15.73%	21.09%	63.18%	82.11%	67.23%	12.93%	19.84%
RB 48 hr 2.2.1	1.26%	11.41%	87.33%	100.00%	81.11%	18.89%	100.00%	7.03%	8.96%	84.01%	100.00%	70.46%	5.58%	23.96%
RB 24 hr 2.2.1	1.77%	16.05%	82.18%	71.09%	62.88%	37.12%	50.88%	10.91%	17.81%	71.28%	66.67%	77.56%	8.37%	14.07%
2.2.2.1	3.49%	45.34%	51.16%	83.69%	41.96%	58.04%	89.36%	25.31%	31.35%	43.33%	85.84%	62.52%	21.79%	15.68%
2.2.2.2	4.01%	56.90%	39.08%	97.61%	33.22%	66.78%	116.52%	30.69%	37.64%	31.67%	104.64%	59.92%	26.82%	13.26%
2.2.2.3	4.19%	61.97%	33.84%	110.89%	29.61%	70.39%	140.12%	33.18%	40.04%	26.78%	121.70%	58.56%	29.23%	12.21%
2.2.2.4	4.03%	57.59%	38.37%	97.13%	32.94%	67.06%	116.03%	30.83%	38.09%	31.08%	104.16%	59.91%	26.94%	13.15%
2.2.2.5	4.03%	57.90%	38.07%	97.30%	32.91%	67.09%	115.97%	30.81%	38.33%	30.87%	104.24%	59.96%	26.92%	13.12%
2.2.2.6	4.02%	58.22%	37.76%	97.45%	32.86%	67.14%	115.89%	30.79%	38.58%	30.64%	104.31%	60.01%	26.90%	13.08%
2.2.2.7	3.77%	51.67%	44.56%	91.09%	37.10%	62.90%	103.08%	28.18%	34.93%	36.89%	95.57%	61.18%	24.47%	14.36%
2.2.2.8	3.68%	49.80%	46.52%	88.85%	38.60%	61.40%	98.56%	27.25%	33.93%	38.82%	92.49%	61.64%	23.60%	14.76%
2.2.2.9	3.63%	48.85%	47.52%	87.68%	39.39%	60.61%	96.27%	26.77%	33.42%	39.81%	90.90%	61.88%	23.15%	14.97%
2.2.2.10	4.20%	62.47%	33.33%	110.72%	29.46%	70.54%	139.82%	33.24%	40.38%	26.38%	121.49%	58.58%	29.28%	12.14%
RB 48 hr 2.2.2	2.92%	37.95%	59.13%	100.00%	48.13%	51.87%	100.00%	21.73%	26.91%	51.36%	100.00%	63.99%	18.71%	17.30%
RB 24 hr 2.2.2	3.63%	47.18%	49.18%	80.43%	45.92%	54.08%	95.90%	25.57%	41.02%	33.41%	86.95%	60.50%	21.51%	17.99%
2.2.3.1	4.38%	58.71%	36.91%	90.60%	28.21%	71.79%	95.31%	35.26%	36.58%	28.17%	92.66%	56.51%	31.28%	12.21%
2.2.3.2	4.76%	69.37%	25.87%	111.58%	22.08%	77.92%	131.72%	40.26%	41.01%	18.73%	120.26%	53.69%	36.16%	10.16%
2.2.3.3	4.85%	73.74%	21.41%	130.05%	19.74%	80.26%	162.10%	42.40%	42.49%	15.11%	143.82%	52.34%	38.33%	9.33%
2.2.3.4	4.80%	70.20%	24.99%	110.65%	21.75%	78.25%	131.16%	40.52%	41.42%	18.06%	119.50%	53.59%	36.39%	10.02%
2.2.3.5	4.81%	70.58%	24.61%	110.46%	21.64%	78.36%	130.98%	40.58%	41.63%	17.78%	119.31%	53.58%	36.45%	9.97%
2.2.3.6	4.81%	70.80%	24.39%	110.51%	21.60%	78.40%	130.91%	40.58%	41.78%	17.63%	119.31%	53.61%	36.44%	9.95%
2.2.3.7	4.59%	64.50%	30.91%	101.59%	24.77%	75.23%	113.68%	37.97%	39.08%	22.94%	106.82%	55.00%	33.92%	11.08%
2.2.3.8	4.52%	62.78%	32.70%	98.07%	25.80%	74.20%	107.58%	37.12%	38.39%	24.49%	102.20%	55.49%	33.09%	11.42%
2.2.3.9	4.49%	61.95%	33.56%	96.19%	26.32%	73.68%	104.47%	36.70%	38.05%	25.25%	99.79%	55.73%	32.68%	11.59%
2.2.3.10	4.87%	74.23%	20.90%	129.61%	19.57%	80.43%	161.78%	42.52%	42.74%	14.74%	143.43%	52.31%	38.43%	9.26%
RB 48 hr 2.2.3	3.96%	53.19%	42.85%	100.00%	31.58%	68.42%	100.00%	32.67%	33.89%	33.44%	100.00%	57.71%	28.99%	13.30%
RB 24 hr 2.2.3	4.62%	61.98%	33.40%	85.82%	38.41%	61.59%	111.09%	34.28%	46.25%	19.48%	97.12%	51.85%	29.85%	18.30%
2.2.4.1	4.59%	73.53%	21.89%	97.86%	19.14%	80.86%	99.16%	43.13%	41.68%	15.19%	98.51%	51.44%	39.33%	9.22%
2.2.4.2	4.70%	81.52%	13.78%	127.98%	15.54%	84.46%	142.41%	46.77%	44.10%	9.13%	134.98%	49.11%	43.06%	7.83%
2.2.4.3	4.66%	84.48%	10.86%	153.16%	14.24%	85.76%	177.78%	48.24%	44.73%	7.04%	165.07%	48.05%	44.64%	7.31%
2.2.4.4	4.75%	82.48%	12.77%	126.67%	15.21%	84.79%	141.85%	47.09%	44.47%	8.43%	134.04%	48.96%	43.36%	7.68%
2.2.4.5	4.77%	82.90%	12.34%	126.22%	15.09%	84.91%	141.64%	47.21%	44.65%	8.14%	133.71%	48.91%	43.47%	7.62%
2.2.4.6	4.77%	83.09%	12.13%	126.10%	15.03%	84.97%	141.55%	47.25%	44.75%	8.00%	133.61%	48.90%	43.50%	7.60%
2.2.4.7	4.67%	78.10%	17.24%	113.03%	17.03%	82.97%	120.79%	45.22%	43.12%	11.66%	116.80%	50.12%	41.47%	8.41%
2.2.4.8	4.64%	76.77%	18.58%	108.00%	17.64%	82.36%	113.57%	44.60%	42.73%	12.67%	110.72%	50.52%	40.83%	8.65%
2.2.4.9	4.64%	76.20%	19.16%	105.31%	17.92%	82.08%	109.89%	44.31%	42.57%	13.11%	107.54%	50.71%	40.53%	8.75%
2.2.4.10	4.69%	85.14%	10.17%	152.17%	14.03%	85.97%	177.35%	48.44%	44.98%	6.58%	164.36%	47.95%	44.83%	7.22%
RB 48 hr 2.2.4	4.49%	71.96%	23.56%	100.00%	19.82%	80.18%	100.00%	42.48%	41.06%	16.46%	100.00%	51.76%	38.75%	9.49%
RB 24 hr 2.2.4	4.87%	78.04%	17.09%	92.20%	34.31%	65.69%	122.05%	40.35%	50.93%	8.72%	106.83%	45.13%	36.27%	18.60%

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SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.3.1.1	1.57%	15.99%	82.44%	66.73%	75.43%	24.57%	70.25%	9.24%	12.41%	78.36%	67.84%	69.70%	7.45%	22.85%
2.3.1.2	2.00%	23.11%	74.89%	70.45%	67.12%	32.88%	78.77%	12.60%	17.59%	69.81%	73.04%	68.45%	10.38%	21.16%
2.3.1.3	2.25%	26.93%	70.82%	74.20%	62.17%	37.83%	86.78%	14.78%	20.19%	65.03%	78.09%	67.50%	12.31%	20.19%
2.3.1.4	1.99%	23.81%	74.20%	70.85%	67.13%	32.87%	78.78%	12.56%	18.15%	69.29%	73.32%	68.57%	10.35%	21.08%
2.3.1.5	1.97%	24.46%	73.56%	71.33%	67.16%	32.84%	78.86%	12.49%	18.69%	68.82%	73.68%	68.69%	10.29%	21.01%
2.3.1.6	1.96%	25.08%	72.96%	71.90%	67.23%	32.77%	79.03%	12.42%	19.19%	68.39%	74.13%	68.82%	10.23%	20.95%
2.3.1.7	1.79%	20.14%	78.07%	69.04%	71.09%	28.91%	74.66%	10.93%	15.49%	73.57%	70.81%	69.15%	8.93%	21.92%
2.3.1.8	1.71%	19.08%	79.21%	68.72%	72.57%	27.43%	73.43%	10.33%	14.73%	74.94%	70.21%	69.40%	8.40%	22.20%
2.3.1.9	1.67%	18.58%	79.75%	68.43%	73.28%	26.72%	72.69%	10.04%	14.38%	75.59%	69.78%	69.52%	8.15%	22.33%
2.3.1.10	2.24%	27.60%	70.17%	74.76%	62.22%	37.78%	86.89%	14.70%	20.73%	64.57%	78.52%	67.63%	12.25%	20.12%
RB 48 hr 2.3.1	1.05%	10.67%	88.28%	100.00%	82.74%	17.26%	100.00%	6.27%	8.42%	85.32%	100.00%	70.73%	5.06%	24.21%
RB 24 hr 2.3.1	1.48%	15.07%	83.44%	70.78%	64.60%	35.40%	48.77%	9.82%	16.93%	73.25%	65.88%	78.43%	7.68%	13.89%
2.3.2.1	3.04%	44.28%	52.69%	82.04%	43.73%	56.27%	87.89%	23.86%	30.98%	45.16%	84.20%	63.16%	20.77%	16.07%
2.3.2.2	3.53%	56.21%	40.26%	94.51%	34.52%	65.48%	113.29%	29.33%	37.65%	33.02%	101.34%	60.56%	25.88%	13.56%
2.3.2.3	3.70%	61.44%	34.86%	107.04%	30.74%	69.26%	135.78%	31.84%	40.21%	27.94%	117.45%	59.22%	28.31%	12.48%
2.3.2.4	3.55%	56.95%	39.50%	93.98%	34.21%	65.79%	112.76%	29.49%	38.12%	32.39%	100.81%	60.54%	26.02%	13.44%
2.3.2.5	3.55%	57.28%	39.17%	94.11%	34.16%	65.84%	112.67%	29.47%	38.39%	32.14%	100.87%	60.59%	26.00%	13.41%
2.3.2.6	3.54%	57.62%	38.84%	94.26%	34.11%	65.89%	112.59%	29.45%	38.64%	31.91%	100.93%	60.64%	25.99%	13.37%
2.3.2.7	3.28%	50.83%	45.89%	89.20%	38.76%	61.24%	100.94%	26.66%	34.83%	38.52%	93.49%	61.90%	23.38%	14.72%
2.3.2.8	3.19%	49.02%	47.79%	87.20%	40.31%	59.69%	96.67%	25.72%	33.86%	40.43%	90.67%	62.38%	22.50%	15.12%
2.3.2.9	3.15%	48.16%	48.69%	86.06%	41.09%	58.91%	94.44%	25.25%	33.39%	41.35%	89.14%	62.62%	22.07%	15.32%
2.3.2.10	3.71%	61.95%	34.34%	106.87%	30.58%	69.42%	135.47%	31.90%	40.56%	27.54%	117.23%	59.23%	28.36%	12.41%
RB 48 hr 2.3.2	2.49%	36.32%	61.19%	100.00%	50.55%	49.45%	100.00%	20.09%	26.09%	53.82%	100.00%	64.70%	17.48%	17.81%
RB 24 hr 2.3.2	3.12%	45.55%	51.33%	79.75%	47.06%	52.94%	93.42%	24.00%	40.41%	35.59%	85.54%	61.66%	20.44%	17.90%
2.3.3.1	3.83%	57.79%	38.38%	89.33%	29.55%	70.45%	94.47%	33.69%	36.56%	29.74%	91.53%	57.28%	30.16%	12.57%
2.3.3.2	4.22%	68.98%	26.80%	108.85%	22.95%	77.05%	129.56%	38.90%	41.40%	19.70%	117.58%	54.39%	35.21%	10.40%
2.3.3.3	4.31%	73.51%	22.18%	126.59%	20.47%	79.53%	159.12%	41.09%	43.01%	15.89%	140.26%	53.04%	37.42%	9.54%
2.3.3.4	4.26%	69.88%	25.86%	107.84%	22.58%	77.42%	128.94%	39.18%	41.85%	18.97%	116.75%	54.29%	35.46%	10.25%
2.3.3.5	4.27%	70.29%	25.44%	107.60%	22.45%	77.55%	128.72%	39.26%	42.09%	18.65%	116.51%	54.27%	35.53%	10.19%
2.3.3.6	4.26%	70.49%	25.24%	107.69%	22.42%	77.58%	128.67%	39.25%	42.23%	18.52%	116.54%	54.30%	35.52%	10.17%
2.3.3.7	4.04%	63.80%	32.16%	99.62%	25.87%	74.13%	112.21%	36.50%	39.26%	24.24%	104.95%	55.74%	32.87%	11.38%
2.3.3.8	3.97%	61.97%	34.06%	96.37%	26.99%	73.01%	106.34%	35.61%	38.48%	25.91%	100.60%	56.24%	32.01%	11.75%
2.3.3.9	3.95%	61.13%	34.92%	94.54%	27.53%	72.47%	103.30%	35.19%	38.13%	26.68%	98.26%	56.48%	31.60%	11.92%
2.3.3.10	4.32%	74.03%	21.65%	126.13%	20.30%	79.70%	158.78%	41.21%	43.28%	15.50%	139.85%	53.01%	37.53%	9.46%
RB 48 hr 2.3.3	3.43%	51.62%	44.95%	100.00%	33.45%	66.55%	100.00%	30.84%	33.47%	35.70%	100.00%	58.60%	27.60%	13.80%
RB 24 hr 2.3.3	4.02%	60.65%	35.33%	85.12%	39.34%	60.66%	109.70%	32.72%	46.23%	21.05%	95.92%	52.88%	28.77%	18.35%
2.3.4.1	4.06%	73.09%	22.85%	97.07%	19.96%	80.04%	98.81%	41.74%	42.12%	16.13%	97.92%	52.20%	38.33%	9.46%
2.3.4.2	4.18%	81.49%	14.32%	126.21%	16.09%	83.91%	141.38%	45.55%	44.81%	9.64%	133.44%	49.82%	42.19%	7.99%
2.3.4.3	4.16%	84.57%	11.27%	150.85%	14.71%	85.29%	176.33%	47.06%	45.51%	7.43%	162.96%	48.75%	43.80%	7.45%
2.3.4.4	4.23%	82.52%	13.25%	124.82%	15.73%	84.27%	140.78%	45.89%	45.22%	8.89%	132.44%	49.65%	42.51%	7.83%
2.3.4.5	4.25%	82.94%	12.82%	124.38%	15.59%	84.41%	140.56%	46.01%	45.40%	8.59%	132.10%	49.61%	42.62%	7.77%
2.3.4.6	4.25%	83.16%	12.58%	124.23%	15.53%	84.47%	140.45%	46.06%	45.51%	8.43%	131.97%	49.59%	42.66%	7.74%
2.3.4.7	4.14%	77.79%	18.07%	111.86%	17.72%	82.28%	120.15%	43.90%	43.68%	12.42%	115.82%	50.86%	40.51%	8.62%
2.3.4.8	4.12%	76.43%	19.45%	106.95%	18.36%	81.64%	113.02%	43.26%	43.25%	13.48%	109.86%	51.27%	39.86%	8.87%
2.3.4.9	4.11%	75.84%	20.05%	104.30%	18.65%	81.35%	109.38%	42.97%	43.08%	13.95%	106.74%	51.46%	39.56%	8.98%
2.3.4.10	4.18%	85.25%	10.56%	149.84%	14.48%	85.52%	175.87%	47.27%	45.78%	6.95%	162.22%	48.65%	44.00%	7.35%
RB 48 hr 2.3.4	3.94%	70.95%	25.11%	100.00%	20.91%	79.09%	100.00%	40.87%	41.25%	17.88%	100.00%	52.63%	37.53%	9.83%
RB 24 hr 2.3.4	4.30%	77.38%	18.32%	91.69%	35.09%	64.91%	121.85%	39.01%	51.46%	9.52%	106.21%	45.90%	35.34%	18.76%

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SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.4.1.1	1.48%	14.75%	83.77%	68.36%	75.46%	24.54%	71.98%	9.16%	11.42%	79.42%	69.50%	69.49%	7.49%	23.01%
2.4.1.2	1.88%	21.37%	76.75%	72.03%	67.22%	32.78%	80.83%	12.52%	16.20%	71.27%	74.77%	68.16%	10.45%	21.39%
2.4.1.3	2.13%	25.02%	72.86%	75.58%	62.22%	37.78%	88.91%	14.74%	18.67%	66.59%	79.70%	67.15%	12.42%	20.42%
2.4.1.4	1.87%	22.06%	76.07%	72.40%	67.21%	32.79%	80.81%	12.48%	16.75%	70.76%	75.03%	68.28%	10.41%	21.31%
2.4.1.5	1.86%	22.70%	75.44%	72.90%	67.25%	32.75%	80.91%	12.42%	17.27%	70.31%	75.40%	68.40%	10.36%	21.24%
2.4.1.6	1.84%	23.30%	74.86%	73.51%	67.33%	32.67%	81.11%	12.34%	17.76%	69.90%	75.89%	68.53%	10.29%	21.18%
2.4.1.7	1.68%	18.63%	79.69%	70.57%	71.13%	28.87%	76.49%	10.87%	14.28%	74.85%	72.42%	68.89%	8.99%	22.12%
2.4.1.8	1.60%	17.62%	80.77%	70.32%	72.62%	27.38%	75.26%	10.26%	13.57%	76.17%	71.87%	69.16%	8.45%	22.39%
2.4.1.9	1.57%	17.15%	81.28%	70.08%	73.34%	26.66%	74.54%	9.96%	13.23%	76.81%	71.49%	69.29%	8.20%	22.52%
2.4.1.10	2.11%	25.71%	72.18%	76.04%	62.24%	37.76%	88.95%	14.68%	19.22%	66.10%	80.04%	67.28%	12.37%	20.35%
RB 48 hr 2.4.1	1.01%	10.09%	88.91%	100.00%	82.34%	17.66%	100.00%	6.37%	7.94%	85.70%	100.00%	70.53%	5.21%	24.26%
RB 24 hr 2.4.1	1.43%	14.29%	84.28%	70.57%	63.40%	36.60%	48.27%	10.01%	16.05%	73.95%	65.55%	78.40%	7.94%	13.66%
2.4.2.1	2.93%	42.23%	54.84%	82.72%	43.32%	56.68%	88.68%	24.28%	29.23%	46.49%	84.95%	62.46%	21.31%	16.22%
2.4.2.2	3.43%	53.91%	42.65%	94.75%	34.13%	65.87%	114.47%	29.93%	35.59%	34.48%	102.04%	59.67%	26.62%	13.71%
2.4.2.3	3.61%	59.19%	37.19%	106.87%	30.30%	69.70%	137.15%	32.57%	38.11%	29.33%	118.02%	58.22%	29.18%	12.60%
2.4.2.4	3.45%	54.64%	41.90%	94.21%	33.82%	66.18%	113.95%	30.08%	36.06%	33.86%	101.51%	59.64%	26.76%	13.60%
2.4.2.5	3.45%	54.97%	41.58%	94.37%	33.78%	66.22%	113.88%	30.06%	36.31%	33.63%	101.58%	59.70%	26.74%	13.56%
2.4.2.6	3.44%	55.32%	41.24%	94.50%	33.73%	66.27%	113.79%	30.05%	36.57%	33.39%	101.63%	59.75%	26.73%	13.52%
2.4.2.7	3.20%	48.57%	48.23%	89.13%	38.22%	61.78%	101.71%	27.28%	32.81%	39.91%	93.80%	61.01%	24.13%	14.86%
2.4.2.8	3.11%	46.67%	50.22%	87.18%	39.79%	60.21%	97.41%	26.31%	31.79%	41.90%	90.99%	61.51%	23.22%	15.28%
2.4.2.9	3.07%	45.74%	51.19%	86.11%	40.59%	59.41%	95.20%	25.82%	31.29%	42.89%	89.49%	61.75%	22.76%	15.48%
2.4.2.10	3.62%	59.73%	36.65%	106.65%	30.13%	69.87%	136.82%	32.64%	38.46%	28.90%	117.76%	58.23%	29.24%	12.53%
RB 48 hr 2.4.2	2.43%	34.93%	62.64%	100.00%	49.73%	50.27%	100.00%	20.62%	24.83%	54.54%	100.00%	64.03%	18.11%	17.86%
RB 24 hr 2.4.2	3.06%	44.07%	52.87%	79.26%	45.32%	54.68%	91.93%	24.82%	38.80%	36.38%	84.81%	61.21%	21.35%	17.44%
2.4.3.1	3.72%	55.65%	40.63%	90.17%	29.23%	70.77%	95.09%	34.29%	34.69%	31.02%	92.32%	56.41%	30.90%	12.69%
2.4.3.2	4.14%	67.09%	28.77%	108.78%	22.51%	77.49%	130.26%	39.81%	39.46%	20.73%	118.03%	53.30%	36.26%	10.44%
2.4.3.3	4.24%	71.80%	23.97%	126.00%	19.99%	80.01%	159.92%	42.13%	41.08%	16.79%	140.56%	51.86%	38.60%	9.55%
2.4.3.4	4.18%	67.99%	27.83%	107.75%	22.14%	77.86%	129.65%	40.09%	39.90%	20.00%	117.18%	53.18%	36.52%	10.30%
2.4.3.5	4.18%	68.40%	27.42%	107.52%	22.02%	77.98%	129.44%	40.17%	40.13%	19.70%	116.96%	53.17%	36.59%	10.24%
2.4.3.6	4.18%	68.64%	27.18%	107.56%	21.97%	78.03%	129.37%	40.17%	40.29%	19.54%	116.95%	53.19%	36.59%	10.21%
2.4.3.7	3.95%	61.92%	34.13%	99.77%	25.40%	74.60%	112.75%	37.32%	37.42%	25.26%	105.38%	54.72%	33.84%	11.44%
2.4.3.8	3.88%	60.10%	36.01%	96.58%	26.51%	73.49%	106.82%	36.41%	36.68%	26.92%	101.01%	55.25%	32.95%	11.80%
2.4.3.9	3.85%	59.23%	36.91%	94.84%	27.06%	72.94%	103.79%	35.96%	36.32%	27.72%	98.72%	55.51%	32.51%	11.98%
2.4.3.10	4.26%	72.34%	23.40%	125.49%	19.80%	80.20%	159.56%	42.27%	41.35%	16.38%	140.12%	51.81%	38.72%	9.47%
RB 48 hr 2.4.3	3.36%	50.18%	46.47%	100.00%	32.71%	67.29%	100.00%	31.65%	32.02%	36.32%	100.00%	57.68%	28.53%	13.80%
RB 24 hr 2.4.3	3.97%	59.30%	36.74%	84.62%	37.70%	62.30%	108.01%	33.81%	44.60%	21.59%	95.16%	52.18%	29.98%	17.84%
2.4.4.1	3.99%	71.54%	24.47%	97.61%	19.46%	80.54%	99.08%	42.79%	40.32%	16.89%	98.34%	51.04%	39.51%	9.45%
2.4.4.2	4.14%	80.27%	15.59%	126.12%	15.55%	84.45%	141.75%	46.80%	42.97%	10.22%	133.76%	48.50%	43.57%	7.93%
2.4.4.3	4.13%	83.54%	12.33%	150.32%	14.15%	85.85%	176.75%	48.41%	43.69%	7.90%	163.21%	47.37%	45.27%	7.36%
2.4.4.4	4.19%	81.34%	14.47%	124.65%	15.19%	84.81%	141.14%	47.17%	43.38%	9.45%	132.72%	48.32%	43.91%	7.77%
2.4.4.5	4.21%	81.80%	13.99%	124.14%	15.04%	84.96%	140.90%	47.31%	43.57%	9.12%	132.34%	48.26%	44.04%	7.70%
2.4.4.6	4.21%	82.03%	13.76%	123.99%	14.98%	85.02%	140.80%	47.35%	43.68%	8.97%	132.22%	48.25%	44.08%	7.67%
2.4.4.7	4.09%	76.51%	19.40%	111.95%	17.16%	82.84%	120.41%	45.10%	41.89%	13.01%	116.09%	49.60%	41.83%	8.57%
2.4.4.8	4.07%	75.06%	20.88%	107.19%	17.82%	82.18%	113.29%	44.41%	41.46%	14.13%	110.18%	50.03%	41.14%	8.83%
2.4.4.9	4.06%	74.43%	21.51%	104.60%	18.12%	81.88%	109.64%	44.10%	41.28%	14.61%	107.08%	50.24%	40.82%	8.94%
2.4.4.10	4.16%	84.28%	11.56%	149.20%	13.91%	86.09%	176.27%	48.65%	43.96%	7.38%	162.41%	47.25%	45.49%	7.26%
RB 48 hr 2.4.4	3.90%	69.83%	26.27%	100.00%	20.20%	79.80%	100.00%	42.08%	39.65%	18.27%	100.00%	51.40%	38.85%	9.75%
RB 24 hr 2.4.4	4.27%	76.49%	19.25%	91.30%	33.51%	66.49%	120.01%	40.40%	49.81%	9.79%	105.50%	44.95%	36.83%	18.22%

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.2.1.1	1.97%	17.79%	80.24%	64.11%	72.37%	27.63%	68.36%	10.73%	13.69%	75.58%	65.48%	69.17%	8.53%	22.30%
1.2.1.2	2.49%	25.75%	71.75%	67.86%	63.40%	36.60%	77.41%	14.55%	19.37%	66.09%	70.88%	67.76%	11.81%	20.43%
1.2.1.3	2.79%	29.75%	67.45%	71.85%	58.30%	41.70%	86.13%	16.92%	22.00%	61.08%	76.33%	66.69%	13.91%	19.40%
1.2.1.4	2.48%	26.52%	71.00%	68.16%	63.37%	36.63%	77.33%	14.51%	19.98%	65.51%	71.07%	67.88%	11.78%	20.34%
1.2.1.5	2.46%	27.21%	70.33%	68.65%	63.40%	36.60%	77.40%	14.44%	20.54%	65.03%	71.42%	68.01%	11.72%	20.26%
1.2.1.6	2.44%	27.80%	69.76%	69.33%	63.52%	36.48%	77.65%	14.33%	21.03%	64.64%	71.97%	68.16%	11.63%	20.21%
1.2.1.7	2.23%	22.43%	75.34%	66.55%	67.70%	32.30%	73.09%	12.64%	17.09%	70.27%	68.63%	68.56%	10.17%	21.27%
1.2.1.8	2.13%	21.25%	76.62%	66.25%	69.30%	30.70%	71.77%	11.95%	16.26%	71.79%	68.02%	68.84%	9.58%	21.58%
1.2.1.9	2.08%	20.70%	77.22%	65.98%	70.08%	29.92%	71.01%	11.62%	15.87%	72.51%	67.60%	68.98%	9.29%	21.73%
1.2.1.10	2.78%	30.51%	66.71%	72.27%	58.29%	41.71%	86.11%	16.86%	22.61%	60.53%	76.61%	66.83%	13.86%	19.32%
RB 48 hr 1.2.1	1.26%	11.41%	87.33%	100.00%	81.11%	18.89%	100.00%	7.03%	8.96%	84.01%	100.00%	70.46%	5.58%	23.96%
RB 24 hr 1.2.1	1.77%	16.05%	82.18%	71.09%	74.65%	25.35%	74.51%	9.74%	12.41%	77.85%	72.19%	69.52%	7.73%	22.75%
1.2.2.1	3.60%	46.74%	49.66%	81.19%	40.87%	59.13%	87.72%	25.97%	32.17%	41.86%	83.66%	62.25%	22.36%	15.39%
1.2.2.2	4.16%	58.97%	36.87%	94.18%	31.92%	68.08%	114.28%	31.59%	38.74%	29.67%	101.66%	59.54%	27.60%	12.85%
1.2.2.3	4.34%	64.07%	31.59%	107.25%	28.40%	71.60%	137.75%	34.07%	41.11%	24.82%	118.54%	58.18%	30.01%	11.81%
1.2.2.4	4.19%	59.87%	35.93%	93.43%	31.52%	68.48%	113.62%	31.81%	39.30%	28.89%	100.95%	59.49%	27.80%	12.71%
1.2.2.5	4.19%	60.27%	35.54%	93.48%	31.44%	68.56%	113.48%	31.82%	39.59%	28.60%	100.93%	59.54%	27.80%	12.66%
1.2.2.6	4.18%	60.59%	35.23%	93.65%	31.40%	68.60%	113.41%	31.79%	39.84%	28.37%	101.00%	59.59%	27.78%	12.63%
1.2.2.7	3.88%	53.24%	42.87%	88.40%	36.01%	63.99%	101.33%	28.89%	35.80%	35.31%	93.24%	60.88%	25.08%	14.04%
1.2.2.8	3.79%	51.33%	44.87%	86.19%	37.50%	62.50%	96.82%	27.95%	34.80%	37.26%	90.18%	61.35%	24.20%	14.45%
1.2.2.9	3.74%	50.40%	45.86%	84.99%	38.26%	61.74%	94.51%	27.48%	34.30%	38.22%	88.57%	61.59%	23.76%	14.65%
1.2.2.10	4.35%	64.71%	30.94%	106.88%	28.17%	71.83%	137.31%	34.18%	41.51%	24.31%	118.15%	58.18%	30.11%	11.72%
RB 48 hr 1.2.2	2.92%	37.95%	59.13%	100.00%	48.13%	51.87%	100.00%	21.73%	26.91%	51.36%	100.00%	63.99%	18.71%	17.30%
RB 24 hr 1.2.2	3.63%	47.18%	49.18%	80.43%	40.54%	59.46%	87.23%	26.18%	32.43%	41.39%	83.00%	62.17%	22.54%	15.29%
1.2.3.1	4.45%	59.71%	35.84%	89.08%	27.64%	72.36%	94.55%	35.71%	37.05%	27.24%	91.48%	56.29%	31.69%	12.02%
1.2.3.2	4.86%	70.84%	24.29%	109.25%	21.39%	78.61%	130.56%	40.88%	41.63%	17.49%	118.45%	53.39%	36.71%	9.90%
1.2.3.3	4.95%	75.18%	19.87%	127.56%	19.11%	80.89%	160.86%	42.99%	43.07%	13.95%	141.87%	52.06%	38.85%	9.09%
1.2.3.4	4.92%	71.89%	23.20%	108.06%	20.97%	79.03%	129.87%	41.22%	42.13%	16.65%	117.48%	53.26%	37.01%	9.73%
1.2.3.5	4.93%	72.31%	22.77%	107.82%	20.84%	79.16%	129.66%	41.30%	42.37%	16.34%	117.25%	53.24%	37.09%	9.67%
1.2.3.6	4.93%	72.55%	22.52%	107.83%	20.79%	79.21%	129.57%	41.31%	42.53%	16.16%	117.22%	53.26%	37.09%	9.64%
1.2.3.7	4.67%	65.62%	29.71%	99.85%	24.19%	75.81%	112.82%	38.46%	39.59%	21.95%	105.46%	54.77%	34.36%	10.87%
1.2.3.8	4.60%	63.86%	31.54%	96.41%	25.22%	74.78%	106.75%	37.60%	38.88%	23.52%	100.90%	55.26%	33.52%	11.22%
1.2.3.9	4.57%	63.08%	32.36%	94.47%	25.71%	74.29%	103.61%	37.20%	38.57%	24.23%	98.44%	55.50%	33.13%	11.38%
1.2.3.10	4.97%	75.82%	19.21%	126.90%	18.90%	81.10%	160.43%	43.15%	43.38%	13.46%	141.32%	52.00%	39.01%	8.99%
RB 48 hr 1.2.3	3.96%	53.19%	42.85%	100.00%	31.58%	68.42%	100.00%	32.67%	33.89%	33.44%	100.00%	57.71%	28.99%	13.30%
RB 24 hr 1.2.3	4.62%	61.98%	33.40%	85.82%	26.37%	73.63%	92.92%	36.74%	38.11%	25.15%	88.93%	55.82%	32.60%	11.59%
1.2.4.1	4.62%	74.05%	21.33%	97.17%	18.92%	81.08%	98.89%	43.34%	41.89%	14.78%	98.02%	51.34%	39.53%	9.13%
1.2.4.2	4.74%	82.18%	13.08%	126.95%	15.30%	84.70%	142.00%	47.02%	44.34%	8.64%	134.26%	48.98%	43.29%	7.72%
1.2.4.3	4.70%	85.14%	10.16%	151.98%	14.02%	85.98%	177.32%	48.48%	44.95%	6.57%	164.25%	47.93%	44.86%	7.21%
1.2.4.4	4.80%	83.32%	11.89%	125.40%	14.92%	85.08%	141.36%	47.41%	44.77%	7.82%	133.16%	48.80%	43.65%	7.55%
1.2.4.5	4.82%	83.79%	11.39%	124.88%	14.77%	85.23%	141.11%	47.55%	44.97%	7.49%	132.77%	48.74%	43.78%	7.49%
1.2.4.6	4.82%	84.03%	11.15%	124.70%	14.70%	85.30%	141.00%	47.60%	45.08%	7.32%	132.63%	48.72%	43.82%	7.45%
1.2.4.7	4.70%	78.65%	16.65%	112.23%	16.81%	83.19%	120.48%	45.44%	43.32%	11.24%	116.25%	50.01%	41.66%	8.32%
1.2.4.8	4.68%	77.34%	17.98%	107.21%	17.41%	82.59%	113.26%	44.82%	42.95%	12.23%	110.16%	50.41%	41.04%	8.56%
1.2.4.9	4.68%	76.77%	18.55%	104.51%	17.68%	82.32%	109.58%	44.54%	42.79%	12.66%	106.99%	50.60%	40.74%	8.66%
1.2.4.10	4.74%	85.91%	9.35%	150.81%	13.77%	86.23%	176.82%	48.73%	45.24%	6.03%	163.41%	47.81%	45.09%	7.10%
RB 48 hr 1.2.4	4.49%	71.96%	23.56%	100.00%	19.82%	80.18%	100.00%	42.48%	41.06%	16.46%	100.00%	51.76%	38.75%	9.49%
RB 24 hr 1.2.4	4.87%	78.04%	17.09%	92.20%	17.29%	82.71%	96.94%	44.93%	43.42%	11.65%	94.55%	50.55%	40.98%	8.47%

Investigation Report

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.4.1.1	1.59%	15.89%	82.52%	63.46%	73.88%	26.12%	67.64%	9.83%	12.25%	77.92%	64.78%	69.25%	8.04%	22.72%
1.4.1.2	2.04%	23.22%	74.74%	66.30%	65.02%	34.98%	75.75%	13.52%	17.50%	68.98%	69.25%	67.79%	11.28%	20.93%
1.4.1.3	2.30%	27.07%	70.63%	69.85%	59.94%	40.06%	83.84%	15.83%	20.06%	64.11%	74.18%	66.72%	13.35%	19.93%
1.4.1.4	2.03%	23.99%	73.98%	66.58%	64.98%	35.02%	75.66%	13.49%	18.11%	68.40%	69.42%	67.91%	11.25%	20.84%
1.4.1.5	2.02%	24.68%	73.30%	67.05%	65.01%	34.99%	75.73%	13.42%	18.67%	67.91%	69.76%	68.04%	11.20%	20.77%
1.4.1.6	2.00%	25.29%	72.71%	67.72%	65.13%	34.87%	75.98%	13.32%	19.17%	67.51%	70.30%	68.18%	11.11%	20.71%
1.4.1.7	1.81%	20.11%	78.08%	65.36%	69.28%	30.72%	71.88%	11.68%	15.35%	72.98%	67.40%	68.59%	9.66%	21.75%
1.4.1.8	1.73%	19.01%	79.26%	65.19%	70.86%	29.14%	70.71%	11.01%	14.57%	74.41%	66.93%	68.88%	9.08%	22.04%
1.4.1.9	1.69%	18.49%	79.81%	64.98%	71.62%	28.38%	70.02%	10.70%	14.21%	75.10%	66.57%	69.02%	8.80%	22.18%
1.4.1.10	2.29%	27.84%	69.87%	70.22%	59.91%	40.09%	83.79%	15.78%	20.67%	63.54%	74.43%	66.85%	13.31%	19.84%
RB 48 hr 1.4.1	1.01%	10.09%	88.91%	100.00%	82.34%	17.66%	100.00%	6.37%	7.94%	85.70%	100.00%	70.53%	5.21%	24.26%
RB 24 hr 1.4.1	1.43%	14.29%	84.28%	70.57%	76.11%	23.89%	73.93%	8.89%	11.08%	80.03%	71.63%	69.60%	7.27%	23.13%
1.4.2.1	3.03%	43.63%	53.34%	80.07%	42.18%	57.82%	86.95%	24.95%	30.05%	45.00%	82.65%	62.17%	21.91%	15.92%
1.4.2.2	3.57%	56.06%	40.37%	91.12%	32.73%	67.27%	112.10%	30.88%	36.73%	32.39%	98.88%	59.25%	27.47%	13.28%
1.4.2.3	3.75%	61.41%	34.84%	103.00%	28.99%	71.01%	134.62%	33.53%	39.22%	27.25%	114.65%	57.79%	30.03%	12.18%
1.4.2.4	3.60%	57.01%	39.38%	90.30%	32.30%	67.70%	111.38%	31.13%	37.31%	31.56%	98.10%	59.18%	27.69%	13.13%
1.4.2.5	3.60%	57.43%	38.96%	90.33%	32.21%	67.79%	111.23%	31.14%	37.61%	31.25%	98.06%	59.22%	27.70%	13.08%
1.4.2.6	3.60%	57.78%	38.62%	90.47%	32.16%	67.84%	111.15%	31.12%	37.87%	31.01%	98.12%	59.28%	27.68%	13.04%
1.4.2.7	3.31%	50.16%	46.53%	86.29%	37.07%	62.93%	99.85%	28.02%	33.70%	38.28%	91.32%	60.69%	24.79%	14.52%
1.4.2.8	3.22%	48.23%	48.56%	84.36%	38.63%	61.37%	95.56%	27.04%	32.67%	40.29%	88.53%	61.19%	23.86%	14.95%
1.4.2.9	3.17%	47.28%	49.55%	83.31%	39.43%	60.57%	93.36%	26.55%	32.16%	41.29%	87.06%	61.44%	23.40%	15.16%
1.4.2.10	3.77%	62.10%	34.14%	102.58%	28.74%	71.26%	134.15%	33.65%	39.65%	26.70%	114.21%	57.78%	30.15%	12.07%
RB 48 hr 1.4.2	2.43%	34.93%	62.64%	100.00%	49.73%	50.27%	100.00%	20.62%	24.83%	54.54%	100.00%	64.03%	18.11%	17.86%
RB 24 hr 1.4.2	3.06%	44.07%	52.87%	79.26%	41.83%	58.17%	86.42%	25.17%	30.30%	44.53%	81.94%	62.08%	22.10%	15.82%
1.4.3.1	3.79%	56.71%	39.50%	88.49%	28.60%	71.40%	94.25%	34.78%	35.19%	30.03%	91.00%	56.17%	31.35%	12.48%
1.4.3.2	4.23%	68.68%	27.09%	106.26%	21.75%	78.25%	129.00%	40.48%	40.13%	19.39%	116.06%	52.97%	36.87%	10.16%
1.4.3.3	4.33%	73.37%	22.30%	123.29%	19.30%	80.70%	158.57%	42.78%	41.70%	15.52%	138.45%	51.53%	39.19%	9.28%
1.4.3.4	4.29%	69.81%	25.90%	104.94%	21.29%	78.71%	128.24%	40.86%	40.66%	18.48%	114.98%	52.80%	37.22%	9.98%
1.4.3.5	4.30%	70.27%	25.43%	104.66%	21.15%	78.85%	128.01%	40.95%	40.91%	18.13%	114.72%	52.78%	37.30%	9.91%
1.4.3.6	4.30%	70.55%	25.15%	104.65%	21.09%	78.91%	127.91%	40.97%	41.09%	17.94%	114.68%	52.80%	37.32%	9.88%
1.4.3.7	4.03%	63.11%	32.86%	97.89%	24.77%	75.23%	111.81%	37.85%	37.95%	24.20%	103.90%	54.46%	34.32%	11.22%
1.4.3.8	3.96%	61.25%	34.80%	94.77%	25.88%	74.12%	105.92%	36.92%	37.20%	25.88%	99.60%	55.00%	33.42%	11.59%
1.4.3.9	3.93%	60.42%	35.65%	92.98%	26.40%	73.60%	102.86%	36.50%	36.86%	26.64%	97.26%	55.25%	33.00%	11.75%
1.4.3.10	4.36%	74.07%	21.57%	122.56%	19.06%	80.94%	158.10%	42.97%	42.04%	14.99%	137.83%	51.46%	39.36%	9.18%
RB 48 hr 1.4.3	3.36%	50.18%	46.47%	100.00%	32.71%	67.29%	100.00%	31.65%	32.02%	36.32%	100.00%	57.68%	28.53%	13.80%
RB 24 hr 1.4.3	3.97%	59.30%	36.74%	84.62%	27.11%	72.89%	92.32%	35.98%	36.40%	27.62%	87.98%	55.59%	32.43%	11.98%
1.4.4.1	4.02%	72.11%	23.86%	96.84%	19.21%	80.79%	98.78%	43.02%	40.54%	16.43%	97.80%	50.92%	39.72%	9.36%
1.4.4.2	4.18%	81.00%	14.81%	124.97%	15.29%	84.71%	141.30%	47.09%	43.23%	9.68%	132.96%	48.36%	43.83%	7.81%
1.4.4.3	4.16%	84.28%	11.56%	149.00%	13.90%	86.10%	176.24%	48.69%	43.93%	7.38%	162.30%	47.23%	45.52%	7.25%
1.4.4.4	4.24%	82.28%	13.48%	123.23%	14.86%	85.14%	140.59%	47.52%	43.70%	8.77%	131.73%	48.14%	44.24%	7.62%
1.4.4.5	4.26%	82.80%	12.93%	122.63%	14.69%	85.31%	140.32%	47.68%	43.92%	8.40%	131.30%	48.07%	44.39%	7.55%
1.4.4.6	4.27%	83.07%	12.66%	122.43%	14.62%	85.38%	140.20%	47.74%	44.04%	8.22%	131.13%	48.05%	44.44%	7.51%
1.4.4.7	4.12%	77.12%	18.76%	111.06%	16.92%	83.08%	120.07%	45.34%	42.11%	12.55%	115.48%	49.47%	42.06%	8.47%
1.4.4.8	4.10%	75.68%	20.22%	106.30%	17.57%	82.43%	112.94%	44.66%	41.69%	13.64%	109.56%	49.90%	41.37%	8.73%
1.4.4.9	4.09%	75.06%	20.85%	103.72%	17.87%	82.13%	109.30%	44.36%	41.52%	14.12%	106.46%	50.11%	41.05%	8.84%
1.4.4.10	4.20%	85.15%	10.65%	147.68%	13.63%	86.37%	175.69%	48.97%	44.25%	6.78%	161.35%	47.09%	45.79%	7.13%
RB 48 hr 1.4.4	3.90%	69.83%	26.27%	100.00%	20.20%	79.80%	100.00%	42.08%	39.65%	18.27%	100.00%	51.40%	38.85%	9.75%
RB 24 hr 1.4.4	4.27%	76.49%	19.25%	91.30%	17.42%	82.58%	96.63%	44.79%	42.21%	13.01%	93.95%	50.02%	41.35%	8.63%

SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
3.1.1.1	2.29%	19.62%	78.09%	68.67%	73.29%	26.71%	72.04%	10.66%	15.21%	74.13%	69.78%	69.79%	8.08%	22.13%
3.1.1.2	2.83%	28.22%	68.96%	74.57%	64.92%	35.08%	82.27%	14.11%	21.51%	64.38%	77.04%	68.77%	10.97%	20.26%
3.1.1.3	3.16%	32.19%	64.65%	79.13%	59.94%	40.06%	91.33%	16.37%	24.17%	59.46%	83.00%	67.82%	12.91%	19.26%
3.1.1.4	2.80%	29.05%	68.15%	75.16%	64.95%	35.05%	82.33%	14.04%	22.19%	63.77%	77.48%	68.92%	10.91%	20.17%
3.1.1.5	2.78%	29.84%	67.38%	75.82%	65.00%	35.00%	82.45%	13.95%	22.85%	63.20%	77.97%	69.08%	10.84%	20.08%
3.1.1.6	2.75%	30.55%	66.70%	76.66%	65.11%	34.89%	82.73%	13.83%	23.45%	62.72%	78.64%	69.24%	10.75%	20.01%
3.1.1.7	2.55%	24.93%	72.52%	72.34%	68.91%	31.09%	77.34%	12.39%	19.20%	68.41%	73.97%	69.42%	9.52%	21.06%
3.1.1.8	2.44%	23.68%	73.88%	71.93%	70.46%	29.54%	75.99%	11.73%	18.31%	69.96%	73.27%	69.66%	8.97%	21.37%
3.1.1.9	2.39%	23.11%	74.50%	71.54%	71.20%	28.80%	75.15%	11.42%	17.90%	70.68%	72.74%	69.78%	8.72%	21.51%
3.1.1.10	3.13%	33.02%	63.85%	79.82%	59.98%	40.02%	91.41%	16.27%	24.86%	58.87%	83.51%	67.99%	12.83%	19.18%
RB 48 hr 3.1.1	1.57%	13.47%	84.96%	100.00%	80.76%	19.24%	100.00%	7.44%	10.61%	81.95%	100.00%	70.73%	5.64%	23.63%
RB 24 hr 3.1.1	2.22%	19.01%	78.77%	70.86%	64.14%	35.86%	53.64%	11.50%	20.88%	67.62%	67.33%	76.80%	8.37%	14.83%
3.1.4.1	4.08%	49.83%	46.09%	84.76%	42.17%	57.83%	89.62%	25.17%	35.09%	39.74%	86.58%	63.80%	20.98%	15.22%
3.1.4.2	4.58%	61.41%	34.01%	101.11%	33.78%	66.22%	117.41%	29.99%	41.71%	28.29%	107.05%	61.66%	25.45%	12.89%
3.1.4.3	4.75%	66.19%	29.06%	115.79%	30.31%	69.69%	141.42%	32.23%	44.07%	23.70%	125.07%	60.47%	27.62%	11.91%
3.1.4.4	4.61%	62.20%	33.19%	100.62%	33.46%	66.54%	116.85%	30.14%	42.25%	27.61%	106.53%	61.66%	25.58%	12.77%
3.1.4.5	4.59%	62.55%	32.86%	100.86%	33.43%	66.57%	116.79%	30.10%	42.53%	27.37%	106.67%	61.73%	25.54%	12.73%
3.1.4.6	4.58%	62.89%	32.52%	101.10%	33.39%	66.61%	116.72%	30.06%	42.82%	27.12%	106.80%	61.79%	25.51%	12.69%
3.1.4.7	4.34%	56.24%	39.42%	93.62%	37.55%	62.45%	103.76%	27.70%	38.90%	33.39%	97.34%	62.73%	23.33%	13.94%
3.1.4.8	4.25%	54.41%	41.35%	91.01%	39.00%	61.00%	99.13%	26.86%	37.88%	35.26%	94.00%	63.13%	22.54%	14.33%
3.1.4.9	4.20%	53.50%	42.30%	89.62%	39.73%	60.27%	96.75%	26.43%	37.37%	36.20%	92.26%	63.33%	22.15%	14.52%
3.1.4.10	4.75%	66.72%	28.52%	115.70%	30.15%	69.85%	141.11%	32.27%	44.45%	23.27%	124.90%	60.51%	27.66%	11.84%
RB 48 hr 3.1.4	3.46%	42.24%	54.30%	100.00%	48.17%	51.83%	100.00%	21.79%	30.38%	47.83%	100.00%	65.02%	18.16%	16.81%
RB 24 hr 3.1.4	4.25%	51.91%	43.84%	81.38%	48.82%	51.18%	101.27%	25.10%	45.12%	29.78%	89.23%	60.53%	20.36%	19.11%
3.4.1.1	5.01%	62.52%	32.46%	91.58%	28.71%	71.29%	95.55%	34.57%	39.99%	25.43%	93.28%	58.15%	29.90%	11.95%
3.4.1.2	5.35%	72.59%	22.06%	115.04%	22.88%	77.12%	132.50%	38.98%	44.47%	16.55%	122.34%	55.76%	34.20%	10.04%
3.4.1.3	5.41%	76.55%	18.04%	135.00%	20.63%	79.37%	163.22%	40.87%	45.89%	13.24%	146.73%	54.56%	36.14%	9.29%
3.4.1.4	5.39%	73.46%	21.15%	114.14%	22.53%	77.47%	131.91%	39.22%	44.94%	15.84%	121.57%	55.68%	34.41%	9.91%
3.4.1.5	5.40%	73.87%	20.73%	113.98%	22.41%	77.59%	131.70%	39.28%	45.19%	15.53%	121.39%	55.69%	34.46%	9.85%
3.4.1.6	5.39%	74.08%	20.52%	114.11%	22.38%	77.62%	131.65%	39.26%	45.35%	15.39%	121.45%	55.72%	34.45%	9.83%
3.4.1.7	5.19%	68.04%	26.77%	103.94%	25.46%	74.54%	114.24%	36.93%	42.56%	20.51%	108.27%	56.90%	32.20%	10.90%
3.4.1.8	5.13%	66.43%	28.44%	100.05%	26.44%	73.56%	108.05%	36.17%	41.87%	21.96%	103.43%	57.32%	31.46%	11.22%
3.4.1.9	5.10%	65.66%	29.24%	97.98%	26.93%	73.07%	104.89%	35.80%	41.54%	22.66%	100.90%	57.54%	31.09%	11.37%
3.4.1.10	5.43%	77.06%	17.51%	134.60%	20.46%	79.54%	162.87%	40.98%	46.17%	12.85%	146.36%	54.55%	36.23%	9.22%
RB 48 hr 3.4.1	4.59%	57.26%	38.15%	100.00%	31.88%	68.12%	100.00%	32.25%	37.31%	30.44%	100.00%	59.14%	27.89%	12.97%
RB 24 hr 3.4.1	5.28%	65.88%	28.84%	86.92%	41.23%	58.77%	115.93%	33.20%	49.77%	17.03%	99.33%	52.56%	28.08%	19.37%
3.4.4.1	5.13%	76.09%	18.77%	98.18%	20.00%	80.00%	99.23%	41.64%	44.82%	13.54%	98.68%	53.56%	37.23%	9.21%
3.4.4.2	5.19%	83.22%	11.59%	130.28%	16.60%	83.40%	142.77%	44.79%	47.17%	8.05%	136.08%	51.54%	40.50%	7.96%
3.4.4.3	5.12%	85.82%	9.06%	156.61%	15.34%	84.66%	178.30%	46.08%	47.74%	6.17%	166.64%	50.58%	41.93%	7.49%
3.4.4.4	5.23%	84.12%	10.65%	129.11%	16.28%	83.72%	142.23%	45.08%	47.55%	7.37%	135.21%	51.42%	40.76%	7.82%
3.4.4.5	5.25%	84.51%	10.24%	128.72%	16.15%	83.85%	142.01%	45.18%	47.74%	7.09%	134.90%	51.38%	40.86%	7.76%
3.4.4.6	5.25%	84.70%	10.05%	128.65%	16.10%	83.90%	141.93%	45.20%	47.84%	6.95%	134.82%	51.38%	40.88%	7.74%
3.4.4.7	5.18%	80.18%	14.64%	114.42%	18.01%	81.99%	121.03%	43.44%	46.22%	10.34%	117.50%	52.43%	39.09%	8.48%
3.4.4.8	5.16%	79.02%	15.81%	109.07%	18.58%	81.42%	113.75%	42.90%	45.86%	11.24%	111.25%	52.78%	38.53%	8.69%
3.4.4.9	5.16%	78.50%	16.34%	106.26%	18.86%	81.14%	110.06%	42.65%	45.70%	11.65%	108.03%	52.95%	38.26%	8.79%
3.4.4.10	5.15%	86.45%	8.40%	155.70%	15.13%	84.87%	177.86%	46.27%	48.01%	5.71%	165.95%	50.50%	42.10%	7.40%
RB 48 hr 3.4.4	5.04%	74.71%	20.25%	100.00%	20.62%	79.38%	100.00%	41.09%	44.22%	14.68%	100.00%	53.81%	36.74%	9.45%
RB 24 hr 3.4.4	5.42%	80.28%	14.30%	93.05%	37.12%	62.88%	126.25%	38.51%	53.97%	7.51%	108.59%	46.55%	33.84%	19.62%

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SUMMARY OF FINANCIAL ANALYSIS: HIGHER ELECTRICAL TARIFF (x4)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
4.1.1.1	1.83%	16.55%	81.62%	68.93%	73.99%	26.01%	72.61%	10.02%	12.78%	77.20%	70.11%	69.42%	7.96%	22.62%
4.1.1.2	2.30%	23.78%	73.92%	73.48%	65.61%	34.39%	82.38%	13.52%	17.99%	68.49%	76.29%	68.12%	10.98%	20.90%
4.1.1.3	2.59%	27.59%	69.82%	77.48%	60.58%	39.42%	91.10%	15.80%	20.54%	63.66%	81.75%	67.10%	12.99%	19.91%
4.1.1.4	2.29%	24.47%	73.25%	73.88%	65.61%	34.39%	82.37%	13.47%	18.54%	67.99%	76.57%	68.24%	10.94%	20.82%
4.1.1.5	2.27%	25.10%	72.63%	74.40%	65.65%	34.35%	82.48%	13.40%	19.06%	67.54%	76.96%	68.36%	10.88%	20.75%
4.1.1.6	2.25%	25.69%	72.06%	75.03%	65.73%	34.27%	82.68%	13.31%	19.55%	67.14%	77.46%	68.49%	10.81%	20.70%
4.1.1.7	2.07%	20.83%	77.10%	71.66%	69.58%	30.42%	77.60%	11.80%	15.94%	72.26%	73.55%	68.85%	9.49%	21.66%
4.1.1.8	1.98%	19.75%	78.27%	71.29%	71.09%	28.91%	76.22%	11.16%	15.18%	73.67%	72.87%	69.11%	8.94%	21.95%
4.1.1.9	1.93%	19.23%	78.83%	71.00%	71.83%	28.17%	75.44%	10.84%	14.81%	74.35%	72.42%	69.24%	8.67%	22.08%
4.1.1.10	2.57%	28.28%	69.15%	77.98%	60.60%	39.40%	91.15%	15.73%	21.09%	63.18%	82.11%	67.23%	12.93%	19.84%
RB 48 hr 4.1.1	1.26%	11.41%	87.33%	100.00%	81.11%	18.89%	100.00%	7.03%	8.96%	84.01%	100.00%	70.46%	5.58%	23.96%
RB 24 hr 4.1.1	1.77%	16.05%	82.18%	71.09%	62.88%	37.12%	50.88%	10.91%	17.81%	71.28%	66.67%	77.56%	8.37%	14.07%
4.1.4.1	3.49%	45.34%	51.16%	83.69%	41.96%	58.04%	89.36%	25.31%	31.35%	43.33%	85.84%	62.52%	21.79%	15.68%
4.1.4.2	4.01%	56.90%	39.08%	97.61%	33.22%	66.78%	116.52%	30.69%	37.64%	31.67%	104.64%	59.92%	26.82%	13.26%
4.1.4.3	4.19%	61.97%	33.84%	110.89%	29.61%	70.39%	140.12%	33.18%	40.04%	26.78%	121.70%	58.56%	29.23%	12.21%
4.1.4.4	4.03%	57.59%	38.37%	97.13%	32.94%	67.06%	116.03%	30.83%	38.09%	31.08%	104.16%	59.91%	26.94%	13.15%
4.1.4.5	4.03%	57.90%	38.07%	97.30%	32.91%	67.09%	115.97%	30.81%	38.33%	30.87%	104.24%	59.96%	26.92%	13.12%
4.1.4.6	4.02%	58.22%	37.76%	97.45%	32.86%	67.14%	115.89%	30.79%	38.58%	30.64%	104.31%	60.01%	26.90%	13.08%
4.1.4.7	3.77%	51.67%	44.56%	91.09%	37.10%	62.90%	103.08%	28.18%	34.93%	36.89%	95.57%	61.18%	24.47%	14.36%
4.1.4.8	3.68%	49.80%	46.52%	88.85%	38.60%	61.40%	98.56%	27.25%	33.93%	38.82%	92.49%	61.64%	23.60%	14.76%
4.1.4.9	3.63%	48.85%	47.52%	87.68%	39.39%	60.61%	96.27%	26.77%	33.42%	39.81%	90.90%	61.88%	23.15%	14.97%
4.1.4.10	4.20%	62.47%	33.33%	110.72%	29.46%	70.54%	139.82%	33.24%	40.38%	26.38%	121.49%	58.58%	29.28%	12.14%
RB 48 hr 4.1.4	2.92%	37.95%	59.13%	100.00%	48.13%	51.87%	100.00%	21.73%	26.91%	51.36%	100.00%	63.99%	18.71%	17.30%
RB 24 hr 4.1.4	3.63%	47.18%	49.18%	80.43%	45.92%	54.08%	95.90%	25.57%	41.02%	33.41%	86.95%	60.50%	21.51%	17.99%
4.4.1.1	4.38%	58.71%	36.91%	90.60%	28.21%	71.79%	95.31%	35.26%	36.58%	28.17%	92.66%	56.51%	31.28%	12.21%
4.4.1.2	4.76%	69.37%	25.87%	111.58%	22.08%	77.92%	131.72%	40.26%	41.01%	18.73%	120.26%	53.69%	36.16%	10.16%
4.4.1.3	4.85%	73.74%	21.41%	130.05%	19.74%	80.26%	162.10%	42.40%	42.49%	15.11%	143.82%	52.34%	38.33%	9.33%
4.4.1.4	4.80%	70.20%	24.99%	110.65%	21.75%	78.25%	131.16%	40.52%	41.42%	18.06%	119.50%	53.59%	36.39%	10.02%
4.4.1.5	4.81%	70.58%	24.61%	110.46%	21.64%	78.36%	130.98%	40.58%	41.63%	17.78%	119.31%	53.58%	36.45%	9.97%
4.4.1.6	4.81%	70.80%	24.39%	110.51%	21.60%	78.40%	130.91%	40.58%	41.78%	17.63%	119.31%	53.61%	36.44%	9.95%
4.4.1.7	4.59%	64.50%	30.91%	101.59%	24.77%	75.23%	113.68%	37.97%	39.08%	22.94%	106.82%	55.00%	33.92%	11.08%
4.4.1.8	4.52%	62.78%	32.70%	98.07%	25.80%	74.20%	107.58%	37.12%	38.39%	24.49%	102.20%	55.49%	33.09%	11.42%
4.4.1.9	4.49%	61.95%	33.56%	96.19%	26.32%	73.68%	104.47%	36.70%	38.05%	25.25%	99.79%	55.73%	32.68%	11.59%
4.4.1.10	4.87%	74.23%	20.90%	129.61%	19.57%	80.43%	161.78%	42.52%	42.74%	14.74%	143.43%	52.31%	38.43%	9.26%
RB 48 hr 4.4.1	3.96%	53.19%	42.85%	100.00%	31.58%	68.42%	100.00%	32.67%	33.89%	33.44%	100.00%	57.71%	28.99%	13.30%
RB 24 hr 4.4.1	4.62%	61.98%	33.40%	85.82%	38.41%	61.59%	111.09%	34.28%	46.25%	19.48%	97.12%	51.85%	29.85%	18.30%
4.4.4.1	4.59%	73.53%	21.89%	97.86%	19.14%	80.86%	99.16%	43.13%	41.68%	15.19%	98.51%	51.44%	39.33%	9.22%
4.4.4.2	4.70%	81.52%	13.78%	127.98%	15.54%	84.46%	142.41%	46.77%	44.10%	9.13%	134.98%	49.11%	43.06%	7.83%
4.4.4.3	4.66%	84.48%	10.86%	153.16%	14.24%	85.76%	177.78%	48.24%	44.73%	7.04%	165.07%	48.05%	44.64%	7.31%
4.4.4.4	4.75%	82.48%	12.77%	126.67%	15.21%	84.79%	141.85%	47.09%	44.47%	8.43%	134.04%	48.96%	43.36%	7.68%
4.4.4.5	4.77%	82.90%	12.34%	126.22%	15.09%	84.91%	141.64%	47.21%	44.65%	8.14%	133.71%	48.91%	43.47%	7.62%
4.4.4.6	4.77%	83.09%	12.13%	126.10%	15.03%	84.97%	141.55%	47.25%	44.75%	8.00%	133.61%	48.90%	43.50%	7.60%
4.4.4.7	4.67%	78.10%	17.24%	113.03%	17.03%	82.97%	120.79%	45.22%	43.12%	11.66%	116.80%	50.12%	41.47%	8.41%
4.4.4.8	4.64%	76.77%	18.58%	108.00%	17.64%	82.36%	113.57%	44.60%	42.73%	12.67%	110.72%	50.52%	40.83%	8.65%
4.4.4.9	4.64%	76.20%	19.16%	105.31%	17.92%	82.08%	109.89%	44.31%	42.57%	13.11%	107.54%	50.71%	40.53%	8.75%
4.4.4.10	4.69%	85.14%	10.17%	152.17%	14.03%	85.97%	177.35%	48.44%	44.98%	6.58%	164.36%	47.95%	44.83%	7.22%
RB 48 hr 4.4.4	4.49%	71.96%	23.56%	100.00%	19.82%	80.18%	100.00%	42.48%	41.06%	16.46%	100.00%	51.76%	38.75%	9.49%
RB 24 hr 4.4.4	4.87%	78.04%	17.09%	92.20%	34.31%	65.69%	122.05%	40.35%	50.93%	8.72%	106.83%	45.13%	36.27%	18.60%

APPENDIX I1: SUMMARY OF COST ESTIMATIONS - ADDITIONAL STATIC HEAD

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.1.1.1	$13 987.13	$86 301.48	$343 489.42	$443 778.03	1	$5 726.52	$815.89	$6 542.41	1	$43 447.88	$97 528.96	$475 430.19	$616 407.03	1	$453 062.58	$20 397.27	$142 947.18
2.1.1.2	$17 072.54	$134 784.12	$329 365.29	$481 221.95	5	$5 788.54	$1 074.90	$6 863.44	5	$55 007.87	$152 319.00	$455 880.71	$663 207.58	5	$491 958.50	$26 872.54	$144 376.54
2.1.1.3	$19 401.75	$163 157.83	$327 720.37	$510 279.95	9	$5 929.49	$1 282.90	$7 212.39	9	$64 046.21	$184 384.01	$453 603.95	$702 034.17	9	$522 132.37	$32 072.38	$147 829.42
2.1.1.4	$17 072.54	$139 854.06	$328 100.74	$485 027.34	6	$5 794.92	$1 074.90	$6 869.82	6	$55 007.87	$158 048.52	$454 130.43	$667 186.81	6	$495 790.88	$26 872.54	$144 523.40
2.1.1.5	$17 072.54	$144 924.00	$327 229.75	$489 226.29	7	$5 807.21	$1 074.90	$6 882.11	7	$55 007.87	$163 778.04	$452 924.87	$671 710.78	7	$500 020.39	$26 872.54	$144 817.84
2.1.1.6	$17 072.54	$149 993.94	$327 554.54	$494 621.03	8	$5 837.43	$1 074.90	$6 912.33	8	$55 007.87	$169 507.56	$453 374.43	$677 889.85	8	$505 456.60	$26 872.54	$145 560.71
2.1.1.7	$15 559.21	$115 520.19	$336 061.30	$467 140.70	4	$5 777.22	$945.40	$6 722.62	4	$49 276.28	$130 548.90	$465 148.80	$644 973.98	4	$477 197.26	$23 634.91	$144 141.81
2.1.1.8	$15 042.23	$109 098.87	$340 400.52	$464 541.63	3	$5 804.93	$902.23	$6 707.16	3	$47 345.10	$123 292.20	$471 154.79	$641 792.09	3	$474 385.82	$22 555.70	$144 850.58
2.1.1.9	$14 781.18	$105 888.22	$341 419.37	$462 088.76	2	$5 801.50	$880.64	$6 682.14	2	$46 375.28	$119 663.85	$472 564.99	$638 604.13	2	$471 815.27	$22 016.09	$144 772.77
2.1.1.10	$19 401.75	$168 836.10	$326 458.69	$514 696.54	1	$5 938.96	$1 282.90	$7 221.85	1	$64 046.21	$190 801.01	$451 857.64	$706 704.85	1	$526 580.59	$32 072.38	$148 051.88
RB 48 hr 2.1.1	$13 987.13	$86 301.48	$544 203.89	$644 492.50		$8 737.23	$815.89	$9 553.13		$43 447.88	$97 528.96	$753 242.87	$894 219.72			$20 397.27	$218 215.11
RB 24 hr 2.1.1	$13 987.13	$86 301.48	$357 566.91	$457 855.52		$5 937.68	$815.89	$6 753.57		$43 447.88	$97 528.96	$494 915.11	$635 891.95			$20 397.27	$148 226.24
2.1.2.1	$46 908.91	$423 350.47	$391 513.76	$861 773.14	1	$8 467.93	$4 350.13	$12 818.05	1	$186 058.40	$478 426.69	$541 901.59	$1 206 386.68	1	$886 993.69	$108 753.13	$210 639.87
2.1.2.2	$57 613.05	$622 236.98	$344 597.42	$1 024 447.45	8	$8 867.80	$5 780.52	$14 648.32	8	$239 458.66	$703 187.54	$476 963.79	$1 419 609.99	8	$1 054 957.50	$144 513.10	$220 139.39
2.1.2.3	$65 679.75	$768 084.21	$337 243.44	$1 171 007.40	1	$9 569.01	$6 929.18	$16 498.18	1	$281 468.84	$868 008.92	$466 785.01	$1 616 262.77	1	$1 205 728.36	$173 229.47	$237 304.94
2.1.2.4	$57 613.05	$627 245.99	$334 686.23	$1 019 545.27	5	$8 744.18	$5 780.52	$14 524.70	7	$239 458.66	$708 848.20	$463 245.53	$1 411 552.39	5	$1 050 003.00	$144 513.10	$217 036.30
2.1.2.5	$57 613.05	$632 254.99	$332 162.77	$1 022 030.82	6	$8 731.37	$5 780.52	$14 511.89	6	$239 458.66	$714 508.86	$459 752.77	$1 413 720.28	6	$1 052 503.58	$144 513.10	$216 703.60
2.1.2.6	$57 613.05	$637 264.00	$329 513.90	$1 024 390.95	7	$8 716.68	$5 780.52	$14 497.21	5	$239 458.66	$720 169.52	$456 086.41	$1 415 714.59	7	$1 054 877.61	$144 513.10	$216 323.88
2.1.2.7	$52 366.03	$527 738.07	$369 857.14	$949 961.24	4	$8 720.68	$5 065.32	$13 786.01	4	$212 931.65	$596 394.69	$511 926.25	$1 321 252.59	4	$977 921.80	$126 633.11	$216 697.68
2.1.2.8	$50 572.26	$496 238.43	$377 148.45	$923 959.14	3	$8 654.26	$4 826.92	$13 481.18	3	$204 015.55	$560 797.08	$522 018.29	$1 286 830.92	3	$951 042.00	$120 673.12	$215 115.80
2.1.2.9	$49 666.21	$480 488.61	$379 938.46	$910 093.27	2	$8 608.12	$4 707.72	$13 315.84	2	$199 542.38	$542 998.27	$525 879.99	$1 268 420.64	2	$936 725.86	$117 693.12	$214 001.66
2.1.2.10	$65 679.75	$773 692.37	$330 734.56	$1 170 106.69	9	$9 499.41	$6 929.18	$16 428.59	9	$281 468.84	$874 346.68	$457 775.95	$1 613 591.47	9	$1 204 810.89	$173 229.47	$235 551.11
RB 48 hr 2.1.2	$46 908.91	$423 350.47	$544 203.89	$1 014 463.27		$10 758.28	$4 350.13	$15 108.41		$186 058.40	$478 426.69	$753 242.87	$1 417 727.96			$108 753.13	$267 898.66
RB 24 hr 2.1.2	$46 908.91	$423 350.47	$357 566.91	$827 826.29		$7 958.73	$4 350.13	$12 308.85		$186 058.40	$478 426.69	$494 915.11	$1 159 400.20			$108 753.13	$197 909.80
2.1.3.1	$84 880.89	$816 778.76	$424 085.21	$1 325 744.86	1	$11 310.96	$9 879.44	$21 190.39	1	$386 868.47	$923 038.44	$586 984.35	$1 896 891.26	1	$1 369 173.40	$246 985.88	$280 731.98
2.1.3.2	$105 406.59	$1 191 185.29	$361 993.41	$1 658 585.29	8	$12 460.97	$13 329.87	$25 790.85	8	$506 955.47	$1 346 153.77	$501 041.91	$2 354 151.15	8	$1 712 357.96	$333 246.78	$308 546.41
2.1.3.3	$120 827.82	$1 474 146.90	$347 316.38	$1 942 291.10	1	$13 812.92	$16 100.68	$29 913.60	1	$601 639.64	$1 665 927.56	$480 727.16	$2 748 294.36	1	$2 004 139.66	$402 516.97	$341 637.73
2.1.3.4	$105 406.59	$1 196 083.98	$344 330.19	$1 645 820.76	7	$12 220.52	$13 329.87	$25 550.39	7	$506 955.47	$1 351 689.76	$476 593.92	$2 335 239.14	7	$1 699 469.57	$333 246.78	$302 522.79
2.1.3.5	$105 406.59	$1 200 982.67	$337 111.56	$1 643 500.81	5	$12 136.73	$13 329.87	$25 466.61	6	$506 955.47	$1 357 225.74	$466 602.47	$2 330 783.68	5	$1 697 121.01	$333 246.78	$300 415.89
2.1.3.6	$105 406.59	$1 205 881.35	$334 041.98	$1 645 329.92	6	$12 115.18	$13 329.87	$25 445.06	5	$506 955.47	$1 362 761.73	$462 353.81	$2 332 071.00	6	$1 698 959.33	$333 246.78	$299 864.89
2.1.3.7	$95 355.92	$1 008 866.59	$396 900.99	$1 501 123.50	4	$11 970.48	$11 604.65	$23 575.13	4	$447 261.64	$1 140 116.13	$549 358.16	$2 136 735.93	4	$1 549 879.81	$290 116.33	$296 739.79
2.1.3.8	$91 915.50	$948 093.69	$405 935.65	$1 445 944.84	3	$11 767.04	$11 029.58	$22 796.62	3	$427 215.06	$1 071 436.92	$561 863.20	$2 060 515.17	3	$1 492 969.86	$275 739.51	$291 805.80
2.1.3.9	$90 176.72	$917 707.24	$408 677.94	$1 416 561.90	2	$11 638.51	$10 742.04	$22 380.55	2	$417 161.17	$1 037 097.31	$565 658.85	$2 019 917.32	2	$1 462 697.79	$268 551.11	$288 668.43
2.1.3.10	$120 827.82	$1 479 627.96	$336 213.79	$1 936 669.57	9	$13 673.79	$16 100.68	$29 774.47	9	$601 639.64	$1 672 121.69	$465 359.85	$2 739 121.18	9	$1 998 458.52	$402 516.97	$338 145.69
RB 48 hr 2.1.3	$84 880.89	$816 778.76	$544 203.89	$1 445 863.53		$13 112.74	$9 879.44	$22 992.17		$386 868.47	$923 038.44	$753 242.87	$2 063 149.78			$246 985.88	$325 776.48
RB 24 hr 2.1.3	$84 880.89	$816 778.76	$357 566.91	$1 259 226.56		$10 313.18	$9 879.44	$20 192.62		$386 868.47	$923 038.44	$494 915.11	$1 804 822.02			$246 985.88	$255 787.62
2.1.4.1	$172 265.34	$2 007 523.44	$495 315.00	$2 675 103.78	1	$19 224.45	$26 295.92	$45 520.37	1	$941 289.08	$2 268 694.27	$685 574.84	$3 895 558.18	1	$2 762 567.73	$657 398.04	$475 592.41
2.1.4.2	$214 971.10	$2 913 464.00	$405 881.22	$3 534 316.33	8	$22 848.24	$35 720.74	$58 568.99	8	$1 247 288.11	$3 292 494.10	$561 787.86	$5 101 570.08	8	$3 644 629.11	$893 018.54	$563 922.43
2.1.4.3	$247 013.54	$3 611 480.34	$381 317.12	$4 239 811.01	1	$26 296.70	$43 289.16	$69 585.86	1	$1 489 304.21	$4 081 319.60	$527 788.23	$6 098 412.03	1	$4 367 794.20	$1 082	$648 388.72
2.1.4.4	$214 971.10	$2 918 312.55	$369 527.98	$3 502 811.64	7	$22 327.19	$35 720.74	$58 047.93	7	$1 247 288.11	$3 297 973.43	$511 470.65	$5 056 732.19	7	$3 612 829.75	$893 018.54	$550 883.91
2.1.4.5	$214 971.10	$2 923 161.10	$354 239.82	$3 492 372.03	6	$22 122.11	$35 720.74	$57 842.85	6	$1 247 288.11	$3 303 452.75	$490 310.03	$5 041 050.89	6	$3 602 287.55	$893 018.54	$545 744.80
2.1.4.6	$214 971.10	$2 928 009.64	$347 395.00	$3 490 375.75	5	$22 043.68	$35 720.74	$57 764.42	5	$1 247 288.11	$3 308 932.07	$480 835.97	$5 037 056.16	5	$3 600 265.69	$893 018.54	$543 771.94
2.1.4.7	$194 069.58	$2 465 351.14	$450 172.91	$3 109 593.63	4	$21 058.86	$31 008.33	$52 067.19	4	$1 095 032.43	$2 786 083.54	$623 092.82	$4 504 208.79	4	$3 208 692.40	$775 208.29	$520 308.10
2.1.4.8	$186 910.74	$2 315 980.19	$463 504.96	$2 966 395.89	3	$20 438.96	$29 437.53	$49 876.49	3	$1 043 964.67	$2 617 280.02	$641 545.96	$4 302 790.65	3	$3 061 668.27	$735 938.21	$505 184.17
2.1.4.9	$183 291.79	$2 241 294.71	$466 539.63	$2 891 126.13	2	$20 074.14	$28 652.13	$48 726.27	2	$1 018 365.64	$2 532 878.25	$645 746.31	$4 196 990.20	2	$2 984 436.67	$716 303.17	$496 250.37
2.1.4.10	$247 013.54	$3 616 903.58	$351 351.67	$4 215 268.79	9	$25 874.33	$43 289.16	$69 163.50	9	$1 489 304.21	$4 087 448.37	$486 312.48	$6 063 065.06	9	$4 343 019.93	$1 082	$637 816.02
RB 48 hr 2.1.4	$172 265.34	$2 007 523.44	$544 203.89	$2 723 992.67		$19 957.78	$26 295.92	$46 253.70		$941 289.08	$2 268 694.27	$753 242.87	$3 963 226.22			$657 398.04	$493 925.74
RB 24 hr 2.1.4	$172 265.34	$2 007 523.44	$357 566.91	$2 537 355.69		$17 158.23	$26 295.92	$43 454.15		$941 289.08	$2 268 694.27	$494 915.11	$3 704 898.46			$657 398.04	$423 936.87

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.2.1.1	$29 688.73	$158 938.83	$783 774.85	$972 402.40	1	$12 854.14	$2 310.60	$15 164.74	1	$106 691.63	$179 616.14	$1 084	$1 371 145.33	1	$992 424.14	$57 765.00	$320 956.20
2.2.1.2	$34 728.07	$243 453.76	$756 685.45	$1 034 867.28	5	$12 921.78	$2 870.12	$15 791.90	6	$128 984.49	$275 126.12	$1 047	$1 451 453.23	5	$1 057 264.36	$71 753.08	$322 435.79
2.2.1.3	$38 578.76	$297 803.23	$753 631.39	$1 090 013.38	9	$13 186.99	$3 319.44	$16 506.43	9	$146 563.24	$336 546.25	$1 043	$1 526 224.93	9	$1 114 308.73	$82 985.95	$328 930.25
2.2.1.4	$34 728.07	$251 807.99	$753 864.15	$1 040 400.22	6	$12 921.23	$2 870.12	$15 791.35	5	$128 984.49	$284 567.21	$1 043	$1 456 989.31	6	$1 062 835.04	$71 753.08	$322 401.20
2.2.1.5	$34 728.07	$260 162.22	$752 779.65	$1 047 669.94	7	$12 946.73	$2 870.12	$15 816.86	7	$128 984.49	$294 008.29	$1 041	$1 464 929.31	7	$1 070 158.33	$71 753.08	$323 017.90
2.2.1.6	$34 728.07	$268 516.45	$753 128.51	$1 056 373.04	8	$12 993.74	$2 870.12	$15 863.86	8	$128 984.49	$303 449.38	$1 042	$1 474 853.26	8	$1 078 928.07	$71 753.08	$324 172.12
2.2.1.7	$32 246.17	$207 975.95	$769 668.26	$1 009 890.38	4	$12 913.81	$2 590.36	$15 504.18	4	$117 900.31	$235 032.79	$1 065	$1 418 245.47	4	$1 031 161.01	$64 759.04	$322 325.42
2.2.1.8	$31 402.61	$196 150.01	$777 338.01	$1 004 890.63	3	$12 961.13	$2 497.11	$15 458.23	3	$114 178.78	$221 668.35	$1 075	$1 411 775.35	3	$1 025 809.87	$62 427.69	$323 537.80
2.2.1.9	$30 977.56	$190 237.04	$779 721.52	$1 000 936.12	2	$12 962.98	$2 450.48	$15 413.46	2	$112 312.64	$214 986.13	$1 079	$1 406 526.04	2	$1 021 665.14	$61 262.02	$323 598.89
2.2.1.10	$38 578.76	$307 195.13	$751 191.64	$1 096 965.53	1	$13 197.35	$3 319.44	$16 516.79	1	$146 563.24	$347 160.00	$1 039	$1 533 461.77	1	$1 121 309.97	$82 985.95	$329 165.85
RB 48 hr 2.2.1	$29 688.73	$158 938.83	$1 216	$1 405 212.95		$19 346.30	$2 310.60	$21 656.90		$106 691.63	$179 616.14	$1 683	$1 970 206.59			$57 765.00	$483 260.16
RB 24 hr 2.2.1	$29 688.73	$158 938.83	$813 844.50	$1 002 472.05		$13 305.19	$2 310.60	$15 615.79		$106 691.63	$179 616.14	$1 126	$1 412 765.30			$57 765.00	$332 232.32
2.2.2.1	$98 231.80	$780 795.83	$881 046.76	$1 760 074.39	1	$18 121.64	$12 091.51	$30 213.16	1	$464 172.56	$882 374.27	$1 219	$2 566 020.28	1	$1 812 643.32	$302 287.83	$451 089.13
2.2.2.2	$115 672.77	$1 142 766.44	$784 960.00	$2 043 399.21	8	$18 668.09	$15 158.41	$33 826.50	8	$569 587.43	$1 291 435.81	$1 086	$2 947 501.20	8	$2 104 695.55	$378 960.21	$463 845.45
2.2.2.3	$128 974.13	$1 413 855.12	$771 972.12	$2 314 801.37	1	$19 964.39	$17 621.22	$37 585.61	1	$653 078.19	$1 597 792.06	$1 068	$3 319 371.44	1	$2 383 265.73	$440 530.51	$495 575.20
2.2.2.4	$115 672.77	$1 150 974.14	$766 855.28	$2 033 502.19	5	$18 437.56	$15 158.41	$33 595.97	7	$569 587.43	$1 300 711.31	$1 061	$2 931 717.61	5	$2 094 695.78	$378 960.21	$458 061.62
2.2.2.5	$115 672.77	$1 159 181.85	$762 154.73	$2 037 009.35	6	$18 408.09	$15 158.41	$33 566.50	6	$569 587.43	$1 309 986.81	$1 054	$2 934 486.98	6	$2 098 222.42	$378 960.21	$457 304.36
2.2.2.6	$115 672.77	$1 167 389.56	$756 991.71	$2 040 054.04	7	$18 371.69	$15 158.41	$33 530.09	5	$569 587.43	$1 319 262.31	$1 047	$2 936 616.25	7	$2 101 282.38	$378 960.21	$456 373.67
2.2.2.7	$107 088.54	$968 479.73	$835 109.95	$1 910 678.21	4	$18 461.35	$13 624.96	$32 086.31	4	$517 104.53	$1 094 475.09	$1 155	$2 767 471.08	4	$1 967 734.48	$340 624.02	$459 112.57
2.2.2.8	$104 168.55	$910 384.16	$850 481.19	$1 865 033.90	3	$18 371.66	$13 113.81	$31 485.47	3	$499 513.70	$1 028 821.52	$1 177	$2 705 502.30	3	$1 920 641.52	$327 845.29	$457 015.49
2.2.2.9	$102 696.77	$881 336.37	$857 258.41	$1 841 291.55	2	$18 313.07	$12 858.24	$31 171.30	2	$490 698.86	$995 994.74	$1 186	$2 673 241.15	2	$1 896 161.94	$321 455.93	$455 623.29
2.2.2.10	$128 974.13	$1 423 083.37	$759 281.47	$2 311 338.97	9	$19 820.17	$17 621.22	$37 441.40	9	$653 078.19	$1 608 220.87	$1 050	$3 312 234.87	9	$2 379 757.70	$440 530.51	$491 946.67
RB 48 hr 2.2.2	$98 231.80	$780 795.83	$1 216	$2 095 613.03		$23 154.72	$12 091.51	$35 246.24		$464 172.56	$882 374.27	$1 683	$3 030 445.65			$302 287.83	$576 916.12
RB 24 hr 2.2.2	$98 231.80	$780 795.83	$813 844.50	$1 692 872.13		$17 113.61	$12 091.51	$29 205.12		$464 172.56	$882 374.27	$1 126	$2 473 004.36			$302 287.83	$425 888.28
2.2.3.1	$173 298.97	$1 510 285.24	$949 596.19	$2 633 180.40	1	$23 563.02	$26 514.40	$50 077.42	1	$948 454.55	$1 706 767.35	$1 314	$3 969 575.92	1	$2 721 416.06	$662 860.11	$585 299.75
2.2.3.2	$206 611.82	$2 197 630.23	$819 563.27	$3 223 805.31	8	$25 389.04	$33 813.97	$59 203.01	8	$1 185 842.93	$2 483 533.20	$1 134	$4 803 749.11	8	$3 329 167.82	$845 349.35	$629 231.94
2.2.3.3	$231 927.54	$2 722 954.51	$790 674.05	$3 745 556.10	1	$27 840.54	$39 675.76	$67 516.30	1	$1 374 107.44	$3 077 200.07	$1 094	$5 545 694.40	1	$3 864 594.30	$991 893.88	$689 206.22
2.2.3.4	$206 611.82	$2 205 571.89	$785 226.68	$3 197 410.39	7	$24 913.70	$33 813.97	$58 727.67	7	$1 185 842.93	$2 492 508.04	$1 086	$4 765 198.04	7	$3 302 520.12	$845 349.35	$617 328.58
2.2.3.5	$206 611.82	$2 213 513.56	$771 908.07	$3 192 033.44	5	$24 753.63	$33 813.97	$58 567.60	6	$1 185 842.93	$2 501 482.88	$1 068	$4 755 738.34	5	$3 297 082.04	$845 349.35	$613 306.95
2.2.3.6	$206 611.82	$2 221 455.22	$765 459.04	$3 193 526.08	6	$24 696.60	$33 813.97	$58 510.58	5	$1 185 842.93	$2 510 457.72	$1 059	$4 755 786.96	6	$3 298 576.20	$845 349.35	$611 861.42
2.2.3.7	$190 235.28	$1 860 509.26	$891 696.53	$2 942 441.08	4	$24 618.39	$30 164.19	$54 782.58	4	$1 067 609.99	$2 102 554.13	$1 234	$4 404 378.13	4	$3 039 464.82	$754 104.73	$610 808.58
2.2.3.8	$184 656.42	$1 748 135.61	$910 693.40	$2 843 485.43	3	$24 284.57	$28 947.59	$53 232.17	3	$1 028 001.23	$1 975 561.11	$1 260	$4 264 070.26	3	$2 937 636.39	$723 689.85	$602 744.02
2.2.3.9	$181 842.71	$1 691 948.78	$916 695.04	$2 790 486.53	2	$24 064.97	$28 339.30	$52 404.26	2	$1 008 156.83	$1 912 064.60	$1 268	$4 189 036.34	2	$2 883 159.67	$708 482.42	$597 394.26
2.2.3.10	$231 927.54	$2 731 885.24	$769 070.45	$3 732 883.23	9	$27 561.14	$39 675.76	$67 236.90	9	$1 374 107.44	$3 087 292.66	$1 064	$5 525 885.03	9	$3 851 792.27	$991 893.88	$682 198.88
RB 48 hr 2.2.3	$173 298.97	$1 510 285.24	$1 216	$2 900 169.61		$27 567.86	$26 514.40	$54 082.26		$948 454.55	$1 706 767.35	$1 683	$4 339 120.73			$662 860.11	$685 420.70
RB 24 hr 2.2.3	$173 298.97	$1 510 285.24	$813 844.50	$2 497 428.71		$21 526.74	$26 514.40	$48 041.15		$948 454.55	$1 706 767.35	$1 126	$3 781 679.44			$662 860.11	$534 392.87
2.2.4.1	$347 569.35	$3 716 343.63	$1 106	$5 170 098.03	1	$38 719.70	$69 426.53	$108 146.23	1	$2 308 452.89	$4 199 825.18	$1 531	$8 039 369.69	1	$5 345 004.88	$1 735	$958 701.67
2.2.4.2	$416 767.33	$5 388 413.10	$910 762.15	$6 715 942.58	8	$44 854.52	$89 245.83	$134 100.35	8	$2 917 972.85	$6 089 424.25	$1 260	$10 268 000.19	8	$6 928 962.38	$2 231	$1 107 892.08
2.2.4.3	$469 267.61	$6 682 697.20	$858 732.13	$8 010 696.94	1	$51 081.00	$105 161.35	$156 242.34	1	$3 402 380.55	$7 552 089.57	$1 188	$12 143 057.48	1	$8 253 705.63	$2 629	$1 260 318.20
2.2.4.4	$416 767.33	$5 396 233.56	$835 137.59	$6 648 138.48	7	$43 759.26	$89 245.83	$133 005.09	7	$2 917 972.85	$6 098 262.12	$1 155	$10 172 164.67	7	$6 860 528.07	$2 231	$1 080 490.88
2.2.4.5	$416 767.33	$5 404 054.02	$804 327.00	$6 625 148.34	6	$43 336.20	$89 245.83	$132 582.03	6	$2 917 972.85	$6 107 099.98	$1 113	$10 138 357.02	6	$6 837 316.38	$2 231	$1 069 894.91
2.2.4.6	$416 767.33	$5 411 874.47	$790 303.02	$6 618 944.82	5	$43 164.94	$89 245.83	$132 410.77	5	$2 917 972.85	$6 115 937.85	$1 093	$10 127 784.03	5	$6 831 044.38	$2 231	$1 065 593.92
2.2.4.7	$382 768.61	$4 558 862.95	$1 006	$5 947 917.71	4	$41 792.85	$79 336.18	$121 129.02	4	$2 614 202.11	$5 151 952.92	$1 392	$9 158 974.68	4	$6 142 146.24	$1 983	$1 033 424.01
2.2.4.8	$371 178.63	$4 282 346.23	$1 036	$5 690 203.98	3	$40 747.94	$76 032.96	$116 780.90	3	$2 512 521.54	$4 839 462.47	$1 434	$8 786 871.16	3	$5 878 054.53	$1 900	$1 007 992.64
2.2.4.9	$365 331.49	$4 144 087.87	$1 042	$5 551 681.72	2	$40 080.76	$74 381.35	$114 462.11	2	$2 461 595.31	$4 683 217.25	$1 442	$8 587 427.57	2	$5 736 235.11	$1 859	$991 658.68
2.2.4.10	$469 267.61	$6 691 492.22	$798 893.40	$7 959 653.23	9	$50 227.39	$105 161.35	$155 388.74	9	$3 402 380.55	$7 562 028.78	$1 105	$12 070 172.78	9	$8 202 183.06	$2 629	$1 238 956.06
RB 48 hr 2.2.4	$347 569.35	$3 716 343.63	$1 216	$5 280 498.38		$40 375.71	$69 426.53	$109 802.23		$2 308 452.89	$4 199 825.18	$1 683	$8 192 176.90			$1 735	$1 000 101.80
RB 24 hr 2.2.4	$347 569.35	$3 716 343.63	$813 844.50	$4 877 757.48		$34 334.59	$69 426.53	$103 761.12		$2 308 452.89	$4 199 825.18	$1 126	$7 634 735.61			$1 735	$849 073.97

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.3.1.1	$43 147.36	$219 766.52	$1 133	$1 396 058.53	1	$18 536.11	$3 875.19	$22 411.29	1	$167 985.99	$248 357.27	$1 568	$1 984 750.16	1	$1 425 017.25	$96 879.70	$462 853.22
2.3.1.2	$49 004.53	$335 479.61	$1 086	$1 471 352.73	5	$18 480.27	$4 621.20	$23 101.47	5	$196 288.82	$379 124.17	$1 504	$2 079 768.34	5	$1 503 070.22	$115 529.99	$461 168.13
2.3.1.3	$53 519.32	$411 618.58	$1 082	$1 547 691.88	9	$18 842.30	$5 220.27	$24 062.57	9	$218 705.91	$465 168.53	$1 498	$2 182 257.82	9	$1 581 722.62	$130 506.76	$470 028.44
2.3.1.4	$49 004.53	$347 465.87	$1 082	$1 479 469.70	6	$18 482.17	$4 621.20	$23 103.36	6	$196 288.82	$392 669.80	$1 498	$2 087 958.40	6	$1 511 242.95	$115 529.99	$461 185.46
2.3.1.5	$49 004.53	$359 452.13	$1 080	$1 489 311.77	7	$18 509.93	$4 621.20	$23 131.13	7	$196 288.82	$406 215.43	$1 496	$2 098 536.21	7	$1 521 156.51	$115 529.99	$461 849.71
2.3.1.6	$49 004.53	$371 438.39	$1 080	$1 501 202.99	8	$18 568.44	$4 621.20	$23 189.64	8	$196 288.82	$419 761.05	$1 495	$2 111 950.29	8	$1 533 137.92	$115 529.99	$463 282.38
2.3.1.7	$46 111.61	$286 424.04	$1 110	$1 442 947.09	4	$18 558.63	$4 248.19	$22 806.82	4	$182 196.18	$323 686.67	$1 536	$2 042 824.29	4	$1 473 369.75	$106 204.84	$463 249.70
2.3.1.8	$45 131.86	$270 072.19	$1 121	$1 436 642.12	3	$18 632.28	$4 123.86	$22 756.14	3	$177 473.17	$305 207.50	$1 552	$2 034 884.30	3	$1 466 656.09	$103 096.46	$465 131.75
2.3.1.9	$44 638.92	$261 896.26	$1 124	$1 430 801.00	2	$18 628.79	$4 061.69	$22 690.48	2	$175 106.62	$295 967.92	$1 556	$2 027 192.10	2	$1 460 584.93	$101 542.27	$465 064.90
2.3.1.10	$53 519.32	$425 030.15	$1 080	$1 559 179.92	1	$18 880.50	$5 220.27	$24 100.77	1	$218 705.91	$480 324.88	$1 495	$2 194 751.79	1	$1 593 295.00	$130 506.76	$470 950.04
RB 48 hr 2.3.1	$43 147.36	$219 766.52	$1 818	$2 081 525.97		$28 818.12	$3 875.19	$32 693.30		$167 985.99	$248 357.27	$2 517	$2 933 518.59			$96 879.70	$719 903.51
RB 24 hr 2.3.1	$43 147.36	$219 766.52	$1 216	$1 479 499.28		$19 787.72	$3 875.19	$23 662.90		$167 985.99	$248 357.27	$1 683	$2 100 242.08			$96 879.70	$494 143.50
2.3.2.1	$141 819.08	$1 079 615.25	$1 284	$2 506 189.49	1	$26 115.96	$20 093.94	$46 209.90	1	$736 064.48	$1 220 068.91	$1 778	$3 734 387.27	1	$2 581 838.86	$502 348.49	$650 199.92
2.3.2.2	$162 142.47	$1 578 909.87	$1 130	$2 871 828.83	8	$26 510.05	$24 183.03	$50 693.08	8	$871 784.35	$1 784 319.78	$1 565	$4 221 233.21	8	$2 957 853.57	$604 575.66	$658 803.97
2.3.2.3	$177 777.00	$1 954 734.63	$1 108	$3 241 492.81	1	$28 221.72	$27 466.69	$55 688.41	1	$979 641.44	$2 209 037.85	$1 534	$4 723 641.08	1	$3 336 317.74	$686 667.26	$700 656.07
2.3.2.4	$162 142.47	$1 590 642.31	$1 103	$2 856 171.58	5	$26 157.87	$24 183.03	$50 340.89	7	$871 784.35	$1 797 578.55	$1 527	$4 196 581.41	5	$2 942 035.68	$604 575.66	$649 970.07
2.3.2.5	$162 142.47	$1 602 374.74	$1 095	$2 860 103.29	6	$26 099.52	$24 183.03	$50 282.54	6	$871 784.35	$1 810 837.33	$1 516	$4 199 043.05	6	$2 945 985.37	$604 575.66	$648 482.02
2.3.2.6	$162 142.47	$1 614 107.17	$1 088	$2 864 393.57	7	$26 046.55	$24 183.03	$50 229.57	5	$871 784.35	$1 824 096.10	$1 506	$4 202 001.00	7	$2 950 296.90	$604 575.66	$647 128.43
2.3.2.7	$152 110.96	$1 347 530.33	$1 216	$2 716 395.92	4	$26 540.50	$22 138.48	$48 678.99	4	$804 138.95	$1 522 838.68	$1 684	$4 011 110.69	4	$2 797 504.86	$553 462.08	$660 143.75
2.3.2.8	$148 710.80	$1 270 403.82	$1 238	$2 657 725.44	3	$26 448.03	$21 456.97	$47 905.00	3	$781 497.68	$1 435 678.31	$1 714	$3 931 560.62	3	$2 737 111.62	$536 424.21	$658 024.78
2.3.2.9	$146 999.53	$1 231 840.56	$1 245	$2 624 363.68	2	$26 341.45	$21 116.21	$47 457.66	2	$770 158.60	$1 392 098.13	$1 723	$3 886 209.43	2	$2 702 847.46	$527 905.28	$655 456.69
2.3.2.10	$177 777.00	$1 967 867.16	$1 090	$3 236 533.07	9	$28 015.99	$27 466.69	$55 482.69	9	$979 641.44	$2 223 878.86	$1 509	$4 713 440.25	9	$3 331 292.78	$686 667.26	$695 480.20
RB 48 hr 2.3.2	$141 819.08	$1 079 615.25	$1 818	$3 040 046.42		$34 123.81	$20 093.94	$54 217.75		$736 064.48	$1 220 068.91	$2 517	$4 473 308.72			$502 348.49	$850 396.27
RB 24 hr 2.3.2	$141 819.08	$1 079 615.25	$1 216	$2 438 019.72		$25 093.41	$20 093.94	$45 187.35		$736 064.48	$1 220 068.91	$1 683	$3 640 032.20			$502 348.49	$624 636.26
2.3.3.1	$247 042.98	$2 088 288.52	$1 386	$3 722 259.34	1	$33 765.20	$43 296.30	$77 061.50	1	$1 489 531.16	$2 359 966.56	$1 919	$5 769 170.73	1	$3 847 853.94	$1 082	$838 909.24
2.3.3.2	$286 049.16	$3 037 375.07	$1 180	$4 503 650.63	8	$35 807.97	$53 028.81	$88 836.78	8	$1 797 125.49	$3 432 525.50	$1 633	$6 863 224.65	8	$4 649 898.55	$1 325	$887 605.88
2.3.3.3	$315 943.66	$3 764 730.68	$1 135	$5 216 501.42	1	$39 083.68	$60 844.31	$99 928.00	1	$2 041 778.88	$4 254 507.19	$1 572	$7 868 405.78	1	$5 379 617.64	$1 521	$967 680.30
2.3.3.4	$286 049.16	$3 048 647.68	$1 128	$4 463 030.80	7	$35 085.95	$53 028.81	$88 114.76	7	$1 797 125.49	$3 445 264.63	$1 561	$6 804 138.48	7	$4 608 891.15	$1 325	$869 527.11
2.3.3.5	$286 049.16	$3 059 920.28	$1 107	$4 453 309.23	5	$34 827.40	$53 028.81	$87 856.21	6	$1 797 125.49	$3 458 003.76	$1 532	$6 787 819.17	5	$4 599 063.77	$1 325	$863 035.19
2.3.3.6	$286 049.16	$3 071 192.89	$1 099	$4 456 862.16	6	$34 767.97	$53 028.81	$87 796.78	5	$1 797 125.49	$3 470 742.89	$1 522	$6 789 873.34	6	$4 602 631.93	$1 325	$861 521.21
2.3.3.7	$266 819.51	$2 571 234.09	$1 296	$4 134 132.72	4	$35 018.92	$48 162.56	$83 181.47	4	$1 643 778.95	$2 905 741.43	$1 793	$6 343 447.97	4	$4 270 339.27	$1 204	$869 044.82
2.3.3.8	$260 291.65	$2 415 853.76	$1 327	$4 004 047.69	3	$34 652.78	$46 540.47	$81 193.25	3	$1 592 469.02	$2 730 146.74	$1 837	$6 160 590.37	3	$4 136 798.79	$1 163	$860 279.81
2.3.3.9	$257 004.15	$2 338 163.60	$1 335	$3 930 889.68	2	$34 348.09	$45 729.43	$80 077.52	2	$1 566 775.20	$2 642 349.40	$1 848	$6 057 922.55	2	$4 061 830.01	$1 143	$852 856.83
2.3.3.10	$315 943.66	$3 777 357.11	$1 104	$5 197 842.02	9	$38 677.53	$60 844.31	$99 521.84	9	$2 041 778.88	$4 268 776.27	$1 528	$7 839 371.55	9	$5 360 768.86	$1 521	$957 494.85
RB 48 hr 2.3.3	$247 042.98	$2 088 288.52	$1 818	$4 153 943.60		$40 240.46	$43 296.30	$83 536.76		$1 489 531.16	$2 359 966.56	$2 517	$6 366 673.06			$1 082	$1 000 790.84
RB 24 hr 2.3.3	$247 042.98	$2 088 288.52	$1 216	$3 551 916.90		$31 210.06	$43 296.30	$74 506.36		$1 489 531.16	$2 359 966.56	$1 683	$5 533 396.55			$1 082	$775 030.83
2.3.4.1	$492 493.88	$5 138 630.46	$1 606	$7 237 870.35	1	$54 817.78	$112 428.00	$167 245.78	1	$3 622 323.46	$5 807 145.88	$2 223	$11 653 396.82	1	$7 485 098.94	$2 810	$1 357 597.92
2.3.4.2	$573 701.74	$7 449 258.55	$1 309	$9 332 095.23	8	$62 735.07	$138 853.05	$201 588.12	8	$4 416 779.24	$8 418 377.51	$1 811	$14 647 155.14	8	$9 626 075.16	$3 471	$1 549 753.72
2.3.4.3	$635 829.88	$9 239 861.98	$1 231	$11 107 246.11	1	$71 158.09	$160 073.19	$231 231.28	1	$5 049 669.06	$10 441 931.34	$1 704	$17 196 217.87	1	$11 438 535.62	$4 001	$1 755 852.55
2.3.4.4	$573 701.74	$7 460 322.13	$1 197	$9 231 665.14	7	$61 117.99	$138 853.05	$199 971.04	7	$4 416 779.24	$8 430 880.42	$1 657	$14 505 337.55	7	$9 524 712.41	$3 471	$1 509 298.88
2.3.4.5	$573 701.74	$7 471 385.71	$1 154	$9 199 512.18	6	$60 525.06	$138 853.05	$199 378.11	6	$4 416 779.24	$8 443 383.33	$1 597	$14 458 023.64	6	$9 492 249.41	$3 471	$1 494 447.97
2.3.4.6	$573 701.74	$7 482 449.30	$1 132	$9 188 457.99	5	$60 248.61	$138 853.05	$199 101.66	5	$4 416 779.24	$8 455 886.24	$1 567	$14 439 912.92	5	$9 481 077.57	$3 471	$1 487 509.09
2.3.4.7	$533 690.40	$6 302 230.15	$1 463	$8 299 633.37	4	$58 910.49	$125 640.52	$184 551.01	4	$4 020 527.94	$7 122 125.26	$2 025	$13 168 605.76	4	$8 570 586.09	$3 141	$1 457 006.55
2.3.4.8	$520 097.95	$5 919 887.35	$1 506	$7 946 754.01	3	$57 505.97	$121 236.35	$178 742.32	3	$3 888 023.37	$6 690 041.18	$2 085	$12 663 611.57	3	$8 209 853.40	$3 030	$1 422 849.44
2.3.4.9	$513 250.56	$5 728 715.95	$1 514	$7 756 541.71	2	$56 597.36	$119 034.26	$175 631.63	2	$3 821 686.78	$6 473 999.14	$2 096	$12 392 038.05	2	$8 015 569.21	$2 975	$1 400 612.30
2.3.4.10	$635 829.88	$9 252 258.08	$1 146	$11 034 264.62	9	$69 939.41	$160 073.19	$230 012.59	9	$5 049 669.06	$10 455 940.11	$1 586	$17 092 053.93	9	$11 364 869.75	$4 001	$1 725 354.48
RB 48 hr 2.3.4	$492 493.88	$5 138 630.46	$1 818	$7 449 736.44		$57 995.77	$112 428.00	$170 423.77		$3 622 323.46	$5 807 145.88	$2 517	$11 946 644.68			$2 810	$1 437 047.71
RB 24 hr 2.3.4	$492 493.88	$5 138 630.46	$1 216	$6 847 709.75		$48 965.37	$112 428.00	$161 393.37		$3 622 323.46	$5 807 145.88	$1 683	$11 113 368.17			$2 810	$1 211 287.70

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.4.1.1	$55 651.80	$260 988.68	$1 482	$1 798 678.98	1	$24 103.17	$5 510.14	$29 613.31	1	$229 466.97	$294 942.27	$2 051	$2 575 726.71	1	$1 836 046.43	$137 753.52	$601 926.76
2.4.1.2	$62 557.87	$398 392.16	$1 430	$1 891 658.62	5	$24 090.68	$6 477.83	$30 568.51	6	$265 040.22	$450 221.40	$1 980	$2 695 532.39	5	$1 932 315.71	$161 945.66	$601 271.02
2.4.1.3	$67 897.76	$489 314.97	$1 424	$1 982 194.29	9	$24 513.86	$7 254.91	$31 768.76	9	$293 267.33	$552 972.91	$1 972	$2 818 584.11	9	$2 025 588.32	$181 372.70	$611 623.10
2.4.1.4	$62 557.87	$413 310.58	$1 425	$1 901 256.97	6	$24 085.47	$6 477.83	$30 563.30	5	$265 040.22	$467 080.64	$1 972	$2 705 028.03	6	$1 941 978.87	$161 945.66	$601 103.50
2.4.1.5	$62 557.87	$428 229.00	$1 423	$1 914 078.56	7	$24 128.61	$6 477.83	$30 606.44	7	$265 040.22	$483 939.89	$1 970	$2 718 985.02	7	$1 954 894.66	$161 945.66	$602 144.69
2.4.1.6	$62 557.87	$443 147.41	$1 424	$1 929 858.59	8	$24 216.13	$6 477.83	$30 693.95	8	$265 040.22	$500 799.13	$1 971	$2 737 036.83	8	$1 970 795.86	$161 945.66	$604 295.30
2.4.1.7	$59 143.49	$340 135.12	$1 455	$1 854 628.44	4	$24 134.19	$5 993.98	$30 128.17	4	$247 317.29	$384 385.34	$2 014	$2 646 079.83	4	$1 893 725.90	$149 849.59	$602 504.33
2.4.1.8	$57 988.58	$320 716.10	$1 469	$1 848 555.72	3	$24 242.83	$5 832.70	$30 075.53	3	$241 382.00	$362 439.99	$2 034	$2 638 270.57	3	$1 887 184.05	$145 817.57	$605 268.95
2.4.1.9	$57 407.82	$311 006.59	$1 474	$1 842 587.70	2	$24 253.19	$5 752.06	$30 005.25	2	$238 408.90	$351 467.32	$2 040	$2 630 307.30	2	$1 880 953.45	$143 801.56	$605 552.29
2.4.1.10	$67 897.76	$505 934.91	$1 420	$1 994 268.04	1	$24 528.76	$7 254.91	$31 783.67	1	$293 267.33	$571 755.03	$1 966	$2 831 073.77	1	$2 037 746.85	$181 372.70	$611 954.22
RB 48 hr 2.4.1	$55 651.80	$260 988.68	$2 300	$2 617 409.42		$36 384.13	$5 510.14	$41 894.27		$229 466.97	$294 942.27	$3 184	$3 708 946.98			$137 753.52	$908 950.68
RB 24 hr 2.4.1	$55 651.80	$260 988.68	$1 539	$1 855 771.54		$24 959.56	$5 510.14	$30 469.70		$229 466.97	$294 942.27	$2 130	$2 654 749.59			$137 753.52	$623 336.47
2.4.2.1	$182 340.53	$1 282 944.45	$1 666	$3 131 314.94	1	$33 265.05	$28 446.66	$61 711.70	1	$1 011 661.29	$1 449 850.43	$2 305	$4 767 495.25	1	$3 227 910.00	$711 166.48	$828 418.76
2.4.2.2	$206 254.41	$1 876 210.93	$1 484	$3 566 771.02	8	$33 749.43	$33 733.10	$67 482.53	8	$1 183 232.06	$2 120 298.52	$2 054	$5 357 986.10	8	$3 675 613.28	$843 327.47	$839 045.35
2.4.2.3	$224 710.08	$2 323 319.42	$1 459	$4 007 887.46	1	$35 806.51	$37 978.27	$73 784.78	1	$1 319 776.14	$2 625 574.05	$2 020	$5 965 967.16	1	$4 127 155.87	$949 456.85	$889 354.44
2.4.2.4	$206 254.41	$1 890 797.98	$1 449	$3 546 976.41	5	$33 306.65	$33 733.10	$67 039.74	7	$1 183 232.06	$2 136 783.29	$2 006	$5 326 882.55	5	$3 655 615.95	$843 327.47	$827 939.13
2.4.2.5	$206 254.41	$1 905 385.04	$1 441	$3 552 893.96	6	$33 249.54	$33 733.10	$66 982.64	6	$1 183 232.06	$2 153 268.06	$1 994	$5 331 367.70	6	$3 661 565.25	$843 327.47	$826 474.98
2.4.2.6	$206 254.41	$1 919 972.09	$1 431	$3 557 612.51	7	$33 174.45	$33 733.10	$66 907.54	5	$1 183 232.06	$2 169 752.84	$1 981	$5 334 193.29	7	$3 666 304.61	$843 327.47	$824 561.21
2.4.2.7	$194 438.45	$1 589 836.23	$1 579	$3 363 275.33	4	$33 617.46	$31 089.88	$64 707.34	4	$1 097 679.01	$1 796 667.61	$2 185	$5 079 871.24	4	$3 466 162.27	$777 246.98	$836 461.99
2.4.2.8	$190 438.68	$1 494 378.00	$1 608	$3 292 904.03	3	$33 535.67	$30 208.81	$63 744.48	3	$1 069 060.60	$1 688 790.65	$2 225	$4 983 635.31	3	$3 393 759.24	$755 220.15	$834 655.92
2.4.2.9	$188 426.70	$1 446 648.89	$1 619	$3 254 127.23	2	$33 440.97	$29 768.27	$63 209.24	2	$1 054 731.47	$1 634 852.16	$2 240	$4 930 543.59	2	$3 353 929.20	$744 206.73	$832 407.67
2.4.2.10	$224 710.08	$2 339 578.00	$1 435	$3 999 956.80	9	$35 524.96	$37 978.27	$73 503.24	9	$1 319 776.14	$2 643 947.81	$1 987	$5 950 860.12	9	$4 119 128.12	$949 456.85	$882 275.14
RB 48 hr 2.4.2	$182 340.53	$1 282 944.45	$2 300	$3 766 053.92		$42 786.13	$28 446.66	$71 232.79		$1 011 661.29	$1 449 850.43	$3 184	$5 646 049.46			$711 166.48	$1 066 445.88
RB 24 hr 2.4.2	$182 340.53	$1 282 944.45	$1 539	$3 004 416.03		$31 361.56	$28 446.66	$59 808.22		$1 011 661.29	$1 449 850.43	$2 130	$4 591 852.08			$711 166.48	$780 831.67
2.4.3.1	$315 631.92	$2 484 448.75	$1 813	$4 614 071.66	1	$42 851.55	$60 761.29	$103 612.85	1	$2 039 189.57	$2 807 665.67	$2 510	$7 357 634.43	1	$4 773 524.40	$1 519	$1 065 077.73
2.4.3.2	$361 370.73	$3 613 431.42	$1 549	$5 524 568.74	8	$44 999.64	$73 268.31	$118 267.94	8	$2 427 241.94	$4 083 524.50	$2 145	$8 655 827.63	8	$5 708 162.59	$1 831	$1 115 957.35
2.4.3.3	$396 542.30	$4 479 274.31	$1 495	$6 370 953.10	1	$48 868.15	$83 311.83	$132 179.98	1	$2 736 292.29	$5 062 010.12	$2 069	$9 867 749.05	1	$6 574 447.72	$2 082	$1 210 505.57
2.4.3.4	$361 370.73	$3 627 416.78	$1 484	$5 473 485.17	7	$44 093.53	$73 268.31	$117 361.84	7	$2 427 241.94	$4 099 329.30	$2 054	$8 581 569.30	7	$5 656 591.90	$1 831	$1 093 269.71
2.4.3.5	$361 370.73	$3 641 402.13	$1 459	$5 462 246.86	5	$43 785.10	$73 268.31	$117 053.41	6	$2 427 241.94	$4 115 134.09	$2 020	$8 562 461.54	6	$5 645 229.81	$1 831	$1 085 524.04
2.4.3.6	$361 370.73	$3 655 387.49	$1 447	$5 464 165.23	6	$43 674.02	$73 268.31	$116 942.33	5	$2 427 241.94	$4 130 938.89	$2 003	$8 561 564.20	5	$5 647 144.38	$1 831	$1 082 712.13
2.4.3.7	$338 797.37	$3 058 860.84	$1 686	$5 083 729.99	4	$44 041.11	$67 014.80	$111 055.91	4	$2 233 703.63	$3 456 806.49	$2 333	$8 024 233.91	4	$5 255 483.23	$1 675	$1 093 380.70
2.4.3.8	$331 144.89	$2 874 003.98	$1 722	$4 927 191.82	3	$43 578.34	$64 930.30	$108 508.64	3	$2 168 979.88	$3 247 900.49	$2 383	$7 800 392.52	3	$5 094 861.56	$1 623	$1 082 273.54
2.4.3.9	$327 293.19	$2 781 575.55	$1 733	$4 842 288.20	2	$43 247.56	$63 888.05	$107 135.61	2	$2 136 576.04	$3 143 447.49	$2 399	$7 679 282.13	2	$5 007 845.93	$1 597	$1 074 235.07
2.4.3.10	$396 542.30	$4 494 876.01	$1 454	$6 345 457.86	9	$48 329.70	$83 311.83	$131 641.54	9	$2 736 292.29	$5 079 641.53	$2 012	$9 828 497.42	9	$6 548 696.24	$2 082	$1 197 005.43
RB 48 hr 2.4.3	$315 631.92	$2 484 448.75	$2 300	$5 100 849.61		$50 153.22	$60 761.29	$110 914.51		$2 039 189.57	$2 807 665.67	$3 184	$8 031 392.97			$1 519	$1 247 619.46
RB 24 hr 2.4.3	$315 631.92	$2 484 448.75	$1 539	$4 339 211.72		$38 728.66	$60 761.29	$99 489.95		$2 039 189.57	$2 807 665.67	$2 130	$6 977 195.59			$1 519	$962 005.26
2.4.4.1	$627 270.85	$6 116 636.13	$2 091	$8 835 719.98	1	$68 358.54	$157 100.57	$225 459.11	1	$4 961 248.35	$6 912 386.20	$2 895	$14 768 952.42	1	$9 147 766.39	$3 927	$1 693 671.87
2.4.4.2	$722 356.24	$8 866 841.40	$1 722	$11 311 398.92	8	$77 535.26	$190 966.98	$268 502.24	8	$5 964 608.13	$10 020 382.25	$2 383	$18 368 721.70	8	$11 678 332.83	$4 774	$1 916 214.39
2.4.4.3	$795 347.61	$10 998 744.17	$1 623	$13 417 868.24	1	$87 462.91	$218 162.76	$305 625.67	1	$6 764 791.49	$12 429 637.11	$2 247	$21 441 928.27	1	$13 828 783.29	$5 454	$2 159 075.98
2.4.4.4	$722 356.24	$8 880 552.65	$1 579	$11 182 164.52	7	$75 459.63	$190 966.98	$266 426.61	7	$5 964 608.13	$10 035 877.28	$2 185	$18 186 362.96	7	$11 547 899.09	$4 774	$1 864 289.40
2.4.4.5	$722 356.24	$8 894 263.89	$1 520	$11 137 398.80	6	$74 651.03	$190 966.98	$265 618.01	6	$5 964 608.13	$10 051 372.31	$2 104	$18 120 918.91	6	$11 502 704.27	$4 774	$1 844 040.17
2.4.4.6	$722 356.24	$8 907 975.14	$1 494	$11 124 535.28	5	$74 320.97	$190 966.98	$265 287.95	5	$5 964 608.13	$10 066 867.34	$2 068	$18 099 631.29	5	$11 489 702.56	$4 774	$1 835 754.26
2.4.4.7	$675 455.34	$7 501 505.75	$1 902	$10 079 512.21	4	$72 935.44	$174 033.77	$246 969.21	4	$5 463 985.91	$8 477 421.86	$2 633	$16 574 764.70	4	$10 419 288.15	$4 350	$1 804 632.24
2.4.4.8	$659 544.50	$7 046 393.87	$1 960	$9 666 103.58	3	$71 361.80	$168 389.37	$239 751.17	3	$5 296 655.00	$7 963 101.73	$2 713	$15 972 858.41	3	$9 996 695.09	$4 209	$1 766 429.05
2.4.4.9	$651 533.81	$6 818 837.92	$1 970	$9 441 237.58	2	$70 302.82	$165 567.17	$235 869.99	2	$5 212 898.47	$7 705 941.66	$2 727	$15 646 752.76	2	$9 767 050.06	$4 139	$1 740 523.46
2.4.4.10	$795 347.61	$11 014 046.28	$1 510	$13 319 813.90	9	$85 839.08	$218 162.76	$304 001.84	9	$6 764 791.49	$12 446 929.96	$2 090	$21 302 322.32	9	$13 729 811.50	$5 454	$2 118 441.82
RB 48 hr 2.4.4	$627 270.85	$6 116 636.13	$2 300	$9 044 675.92		$71 492.88	$157 100.57	$228 593.44		$4 961 248.35	$6 912 386.20	$3 184	$15 058 172.29			$3 927	$1 772 030.35
RB 24 hr 2.4.4	$627 270.85	$6 116 636.13	$1 539	$8 283 038.03		$60 068.31	$157 100.57	$217 168.88		$4 961 248.35	$6 912 386.20	$2 130	$14 003 974.91			$3 927	$1 486 416.14

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
1.2.1.1	$29 688.73	$158 938.83	$716 667.47	$905 295.02	1	$11 847.53	$2 310.60	$14 158.13	1	$106 691.63	$179 616.14	$991 952.97	$1 278 260.74	1	$924 704.81	$57 765.00	$295 790.93
1.2.1.2	$34 728.07	$243 453.76	$678 297.55	$956 479.37	5	$11 745.96	$2 870.12	$14 616.08	7	$128 984.49	$275 126.12	$938 844.44	$1 342 955.06	5	$978 161.65	$71 753.08	$293 040.32
1.2.1.3	$38 578.76	$297 803.23	$675 122.79	$1 011 504.78	9	$12 009.36	$3 319.44	$15 328.80	1	$146 563.24	$336 546.25	$934 450.20	$1 417 559.69	9	$1 035 084.22	$82 985.95	$299 489.53
1.2.1.4	$34 728.07	$251 807.99	$674 230.81	$960 766.87	6	$11 726.73	$2 870.12	$14 596.85	5	$128 984.49	$284 567.21	$933 215.59	$1 346 767.29	6	$982 475.52	$71 753.08	$292 538.69
1.2.1.5	$34 728.07	$260 162.22	$672 569.89	$967 460.18	7	$11 743.59	$2 870.12	$14 613.71	6	$128 984.49	$294 008.29	$930 916.68	$1 353 909.47	7	$989 217.15	$71 753.08	$292 939.24
1.2.1.6	$34 728.07	$268 516.45	$673 707.66	$976 952.19	8	$11 802.42	$2 870.12	$14 672.55	8	$128 984.49	$303 449.38	$932 491.49	$1 364 925.36	8	$998 782.98	$71 753.08	$294 389.30
1.2.1.7	$32 246.17	$207 975.95	$698 417.04	$938 639.16	4	$11 845.05	$2 590.36	$14 435.41	4	$117 900.31	$235 032.79	$966 692.22	$1 319 625.32	4	$959 260.06	$64 759.04	$295 606.22
1.2.1.8	$31 402.61	$196 150.01	$707 100.71	$934 653.33	3	$11 907.57	$2 497.11	$14 404.67	3	$114 178.78	$221 668.35	$978 711.44	$1 314 558.57	3	$954 932.07	$62 427.69	$297 198.81
1.2.1.9	$30 977.56	$190 237.04	$709 851.38	$931 065.99	2	$11 914.93	$2 450.48	$14 365.41	2	$112 312.64	$214 986.13	$982 518.70	$1 309 817.47	2	$951 157.87	$61 262.02	$297 397.59
1.2.1.10	$38 578.76	$307 195.13	$671 582.22	$1 017 356.11	1	$12 003.21	$3 319.44	$15 322.65	9	$146 563.24	$347 160.00	$929 549.63	$1 423 272.87	1	$1 040 974.60	$82 985.95	$299 312.32
RB 48 hr 1.2.1	$29 688.73	$158 938.83	$1 216	$1 405 212.95		$19 346.30	$2 310.60	$21 656.90		$106 691.63	$179 616.14	$1 683	$1 970 206.59			$57 765.00	$483 260.16
RB 24 hr 1.2.1	$29 688.73	$158 938.83	$813 844.50	$1 002 472.05		$13 305.19	$2 310.60	$15 615.79		$106 691.63	$179 616.14	$1 126	$1 412 765.30			$57 765.00	$332 232.32
1.2.2.1	$98 231.80	$780 795.83	$829 502.96	$1 708 530.60	1	$17 348.49	$12 091.51	$29 440.00	1	$464 172.56	$882 374.27	$1 148	$2 494 677.55	1	$1 760 629.50	$302 287.83	$431 760.21
1.2.2.2	$115 672.77	$1 142 766.44	$714 477.99	$1 972 917.20	8	$17 610.86	$15 158.41	$32 769.27	8	$569 587.43	$1 291 435.81	$988 922.48	$2 849 945.72	8	$2 033 570.82	$378 960.21	$437 414.69
1.2.2.3	$128 974.13	$1 413 855.12	$697 084.89	$2 239 914.14	1	$18 841.09	$17 621.22	$36 462.31	1	$653 078.19	$1 597 792.06	$964 848.36	$3 215 718.61	1	$2 307 695.61	$440 530.51	$467 492.49
1.2.2.4	$115 672.77	$1 150 974.14	$690 803.69	$1 957 450.61	5	$17 296.79	$15 158.41	$32 455.20	7	$569 587.43	$1 300 711.31	$956 154.43	$2 826 453.17	6	$2 017 950.69	$378 960.21	$429 542.27
1.2.2.5	$115 672.77	$1 159 181.85	$683 664.11	$1 958 518.73	6	$17 230.73	$15 158.41	$32 389.14	6	$569 587.43	$1 309 986.81	$946 272.40	$2 825 846.64	5	$2 019 016.06	$378 960.21	$427 870.37
1.2.2.6	$115 672.77	$1 167 389.56	$678 771.34	$1 961 833.67	7	$17 198.38	$15 158.41	$32 356.79	5	$569 587.43	$1 319 262.31	$939 500.23	$2 828 349.96	7	$2 022 348.72	$378 960.21	$427 041.03
1.2.2.7	$107 088.54	$968 479.73	$779 780.68	$1 855 348.94	4	$17 631.41	$13 624.96	$31 256.37	4	$517 104.53	$1 094 475.09	$1 079	$2 690 888.79	4	$1 911 900.67	$340 624.02	$438 364.10
1.2.2.8	$104 168.55	$910 384.16	$795 824.20	$1 810 376.91	3	$17 551.80	$13 113.81	$30 665.61	3	$499 513.70	$1 028 821.52	$1 101	$2 629 850.53	3	$1 865 486.12	$327 845.29	$436 519.11
1.2.2.9	$102 696.77	$881 336.37	$801 923.44	$1 785 956.58	2	$17 483.04	$12 858.24	$30 341.28	2	$490 698.86	$995 994.74	$1 109	$2 596 650.97	2	$1 840 322.37	$321 455.93	$434 872.67
1.2.2.10	$128 974.13	$1 423 083.37	$680 345.86	$2 232 403.36	9	$18 636.14	$17 621.22	$36 257.36	9	$653 078.19	$1 608 220.87	$941 679.54	$3 202 978.60	9	$2 300 102.28	$440 530.51	$462 345.81
RB 48 hr 1.2.2	$98 231.80	$780 795.83	$1 216	$2 095 613.03		$23 154.72	$12 091.51	$35 246.24		$464 172.56	$882 374.27	$1 683	$3 030 445.65			$302 287.83	$576 916.12
RB 24 hr 1.2.2	$98 231.80	$780 795.83	$813 844.50	$1 692 872.13		$17 113.61	$12 091.51	$29 205.12		$464 172.56	$882 374.27	$1 126	$2 473 004.36			$302 287.83	$425 888.28
1.2.3.1	$173 298.97	$1 510 285.24	$906 652.88	$2 590 237.09	1	$22 918.87	$26 514.40	$49 433.27	1	$948 454.55	$1 706 767.35	$1 254	$3 910 137.28	1	$2 678 081.16	$662 860.11	$569 196.01
1.2.3.2	$206 611.82	$2 197 630.23	$753 636.83	$3 157 878.87	8	$24 400.14	$33 813.97	$58 214.12	8	$1 185 842.93	$2 483 533.20	$1 043	$4 712 499.09	8	$3 262 640.21	$845 349.35	$604 509.53
1.2.3.3	$231 927.54	$2 722 954.51	$719 828.05	$3 674 710.09	1	$26 777.85	$39 675.76	$66 453.61	1	$1 374 107.44	$3 077 200.07	$996 327.60	$5 447 635.11	1	$3 793 102.26	$991 893.88	$662 638.97
1.2.3.4	$206 611.82	$2 205 571.89	$711 675.17	$3 123 858.88	7	$23 810.43	$33 813.97	$57 624.40	7	$1 185 842.93	$2 492 508.04	$985 043.05	$4 663 394.01	7	$3 228 297.90	$845 349.35	$589 746.76
1.2.3.5	$206 611.82	$2 213 513.56	$696 923.06	$3 117 048.43	5	$23 628.85	$33 813.97	$57 442.83	6	$1 185 842.93	$2 501 482.88	$964 624.37	$4 651 950.18	6	$3 221 413.26	$845 349.35	$585 187.57
1.2.3.6	$206 611.82	$2 221 455.22	$689 402.06	$3 117 469.09	6	$23 555.75	$33 813.97	$57 369.72	5	$1 185 842.93	$2 510 457.72	$954 214.41	$4 650 515.06	5	$3 221 825.66	$845 349.35	$583 340.05
1.2.3.7	$190 235.28	$1 860 509.26	$842 292.38	$2 893 036.92	4	$23 877.33	$30 164.19	$54 041.52	4	$1 067 609.99	$2 102 554.13	$1 165	$4 335 996.90	4	$2 989 610.15	$754 104.73	$592 282.02
1.2.3.8	$184 656.42	$1 748 135.61	$863 479.22	$2 796 271.25	3	$23 576.36	$28 947.59	$52 523.96	3	$1 028 001.23	$1 975 561.11	$1 195	$4 198 720.23	3	$2 889 991.67	$723 689.85	$585 038.71
1.2.3.9	$181 842.71	$1 691 948.78	$867 912.57	$2 741 704.06	2	$23 333.23	$28 339.30	$51 672.52	2	$1 008 156.83	$1 912 064.60	$1 201	$4 121 515.61	2	$2 833 932.36	$708 482.42	$579 100.83
1.2.3.10	$231 927.54	$2 731 885.24	$692 300.60	$3 656 113.37	9	$26 409.60	$39 675.76	$66 085.35	9	$1 374 107.44	$3 087 292.66	$958 226.33	$5 419 626.42	9	$3 774 322.35	$991 893.88	$653 410.19
RB 48 hr 1.2.3	$173 298.97	$1 510 285.24	$1 216	$2 900 169.61		$27 567.86	$26 514.40	$54 082.26		$948 454.55	$1 706 767.35	$1 683	$4 339 120.73			$662 860.11	$685 420.70
RB 24 hr 1.2.3	$173 298.97	$1 510 285.24	$813 844.50	$2 497 428.71		$21 526.74	$26 514.40	$48 041.15		$948 454.55	$1 706 767.35	$1 126	$3 781 679.44			$662 860.11	$534 392.87
1.2.4.1	$347 569.35	$3 716 343.63	$1 070	$5 134 269.58	1	$38 182.27	$69 426.53	$107 608.80	1	$2 308 452.89	$4 199 825.18	$1 481	$7 989 778.84	1	$5 308 849.71	$1 735	$945 266.00
1.2.4.2	$416 767.33	$5 388 413.10	$857 536.58	$6 662 717.01	8	$44 056.14	$89 245.83	$133 301.97	8	$2 917 972.85	$6 089 424.25	$1 186	$10 194 329.67	8	$6 875 251.45	$2 231	$1 087 932.49
1.2.4.3	$469 267.61	$6 682 697.20	$797 795.15	$7 949 759.95	1	$50 166.94	$105 161.35	$155 328.29	1	$3 402 380.55	$7 552 089.57	$1 104	$12 058 713.45	1	$8 192 212.97	$2 629	$1 237 466.83
1.2.4.4	$416 767.33	$5 396 233.56	$769 783.93	$6 582 784.82	7	$42 778.95	$89 245.83	$132 024.78	7	$2 917 972.85	$6 098 262.12	$1 065	$10 081 707.44	7	$6 794 578.46	$2 231	$1 055 983.25
1.2.4.5	$416 767.33	$5 404 054.02	$734 827.30	$6 555 648.64	6	$42 293.71	$89 245.83	$131 539.54	6	$2 917 972.85	$6 107 099.98	$1 017	$10 042 161.17	6	$6 767 182.92	$2 231	$1 043 832.52
1.2.4.6	$416 767.33	$5 411 874.47	$717 870.35	$6 546 512.15	5	$42 078.45	$89 245.83	$131 324.28	5	$2 917 972.85	$6 115 937.85	$993 617.91	$10 027 528.61	5	$6 757 951.20	$2 231	$1 038 431.67
1.2.4.7	$382 768.61	$4 558 862.95	$965 333.34	$5 906 964.91	4	$41 178.55	$79 336.18	$120 514.73	4	$2 614 202.11	$5 151 952.92	$1 336	$9 102 291.14	4	$6 100 820.00	$1 983	$1 018 066.71
1.2.4.8	$371 178.63	$4 282 346.23	$995 724.26	$5 649 249.12	3	$40 133.62	$76 032.96	$116 166.58	3	$2 512 521.54	$4 839 462.47	$1 378	$8 730 184.76	3	$5 836 726.20	$1 900	$992 634.56
1.2.4.9	$365 331.49	$4 144 087.87	$1 001	$5 510 800.43	2	$39 467.54	$74 381.35	$113 848.89	2	$2 461 595.31	$4 683 217.25	$1 386	$8 530 843.00	2	$5 694 981.03	$1 859	$976 328.19
1.2.4.10	$469 267.61	$6 691 492.22	$728 629.32	$7 889 389.15	9	$49 173.43	$105 161.35	$154 334.78	9	$3 402 380.55	$7 562 028.78	$1 008	$11 972 918.94	9	$8 131 278.26	$2 629	$1 212 607.03
RB 48 hr 1.2.4	$347 569.35	$3 716 343.63	$1 216	$5 280 498.38		$40 375.71	$69 426.53	$109 802.23		$2 308 452.89	$4 199 825.18	$1 683	$8 192 176.90			$1 735	$1 000 101.80
RB 24 hr 1.2.4	$347 569.35	$3 716 343.63	$813 844.50	$4 877 757.48		$34 334.59	$69 426.53	$103 761.12		$2 308 452.89	$4 199 825.18	$1 126	$7 634 735.61			$1 735	$849 073.97

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
1.4.1.1	$55 651.80	$260 988.68	$1 355	$1 671 875.82	1	$22 201.12	$5 510.14	$27 711.26	1	$229 466.97	$294 942.27	$1 875	$2 400 216.07	1	$1 708 086.96	$137 753.52	$554 375.58
1.4.1.2	$62 557.87	$398 392.16	$1 282	$1 743 341.72	5	$21 865.93	$6 477.83	$28 343.75	7	$265 040.22	$450 221.40	$1 774	$2 490 244.17	5	$1 782 646.33	$161 945.66	$545 652.18
1.4.1.3	$67 897.76	$489 314.97	$1 276	$1 834 024.82	9	$22 291.31	$7 254.91	$29 546.22	1	$293 267.33	$552 972.91	$1 767	$2 613 499.95	9	$1 876 067.71	$181 372.70	$556 059.55
1.4.1.4	$62 557.87	$413 310.58	$1 274	$1 750 663.13	6	$21 826.56	$6 477.83	$28 304.39	5	$265 040.22	$467 080.64	$1 764	$2 496 588.25	6	$1 790 011.78	$161 945.66	$544 630.81
1.4.1.5	$62 557.87	$428 229.00	$1 271	$1 762 612.70	7	$21 856.62	$6 477.83	$28 334.45	6	$265 040.22	$483 939.89	$1 760	$2 509 338.26	7	$1 802 047.60	$161 945.66	$545 345.00
1.4.1.6	$62 557.87	$443 147.41	$1 274	$1 779 969.79	8	$21 967.79	$6 477.83	$28 445.62	8	$265 040.22	$500 799.13	$1 763	$2 529 572.91	8	$1 819 540.25	$161 945.66	$548 087.00
1.4.1.7	$59 143.49	$340 135.12	$1 320	$1 719 895.19	4	$22 113.19	$5 993.98	$28 107.17	4	$247 317.29	$384 385.34	$1 827	$2 459 592.99	4	$1 757 764.04	$149 849.59	$551 979.36
1.4.1.8	$57 988.58	$320 716.10	$1 337	$1 715 845.71	3	$22 252.18	$5 832.70	$28 084.88	3	$241 382.00	$362 439.99	$1 850	$2 454 584.14	3	$1 753 263.87	$145 817.57	$555 502.70
1.4.1.9	$57 407.82	$311 006.59	$1 342	$1 710 540.72	2	$22 272.49	$5 752.06	$28 024.55	2	$238 408.90	$351 467.32	$1 857	$2 447 538.58	2	$1 747 702.35	$143 801.56	$556 034.67
1.4.1.10	$67 897.76	$505 934.91	$1 269	$1 843 547.34	1	$22 267.95	$7 254.91	$29 522.86	9	$293 267.33	$571 755.03	$1 757	$2 622 458.41	1	$1 885 651.75	$181 372.70	$555 433.96
RB 48 hr 1.4.1	$55 651.80	$260 988.68	$2 300	$2 617 409.42		$36 384.13	$5 510.14	$41 894.27		$229 466.97	$294 942.27	$3 184	$3 708 946.98			$137 753.52	$908 950.68
RB 24 hr 1.4.1	$55 651.80	$260 988.68	$1 539	$1 855 771.54		$24 959.56	$5 510.14	$30 469.70		$229 466.97	$294 942.27	$2 130	$2 654 749.59			$137 753.52	$623 336.47
1.4.2.1	$182 340.53	$1 282 944.45	$1 568	$3 034 010.27	1	$31 805.47	$28 446.66	$60 252.13	1	$1 011 661.29	$1 449 850.43	$2 171	$4 632 814.02	1	$3 129 718.02	$711 166.48	$791 929.51
1.4.2.2	$206 254.41	$1 876 210.93	$1 351	$3 433 485.43	8	$31 750.15	$33 733.10	$65 483.25	8	$1 183 232.06	$2 120 298.52	$1 869	$5 173 502.99	8	$3 541 112.27	$843 327.47	$789 063.25
1.4.2.3	$224 710.08	$2 323 319.42	$1 317	$3 865 996.55	1	$33 678.15	$37 978.27	$71 656.42	1	$1 319 776.14	$2 625 574.05	$1 824	$5 769 573.26	1	$3 983 971.07	$949 456.85	$836 145.34
1.4.2.4	$206 254.41	$1 890 797.98	$1 306	$3 403 155.43	5	$31 149.33	$33 733.10	$64 882.43	7	$1 183 232.06	$2 136 783.29	$1 807	$5 127 817.22	6	$3 510 483.48	$843 327.47	$774 006.27
1.4.2.5	$206 254.41	$1 905 385.04	$1 292	$3 404 312.84	6	$31 020.82	$33 733.10	$64 753.92	6	$1 183 232.06	$2 153 268.06	$1 789	$5 125 713.77	5	$3 511 629.23	$843 327.47	$770 757.06
1.4.2.6	$206 254.41	$1 919 972.09	$1 283	$3 409 605.70	7	$30 954.34	$33 733.10	$64 687.44	5	$1 183 232.06	$2 169 752.84	$1 776	$5 129 334.27	7	$3 516 948.14	$843 327.47	$769 058.65
1.4.2.7	$194 438.45	$1 589 836.23	$1 474	$3 258 918.32	4	$32 052.11	$31 089.88	$63 141.99	4	$1 097 679.01	$1 796 667.61	$2 041	$4 935 428.73	4	$3 360 853.64	$777 246.98	$797 328.11
1.4.2.8	$190 438.68	$1 494 378.00	$1 504	$3 189 308.01	3	$31 981.73	$30 208.81	$62 190.54	3	$1 069 060.60	$1 688 790.65	$2 082	$4 840 246.11	3	$3 289 218.54	$755 220.15	$795 807.42
1.4.2.9	$188 426.70	$1 446 648.89	$1 516	$3 151 349.90	2	$31 899.31	$29 768.27	$61 667.58	2	$1 054 731.47	$1 634 852.16	$2 098	$4 788 287.55	2	$3 250 214.65	$744 206.73	$793 866.17
1.4.2.10	$224 710.08	$2 339 578.00	$1 286	$3 850 448.23	9	$33 282.33	$37 978.27	$71 260.61	9	$1 319 776.14	$2 643 947.81	$1 780	$5 743 922.49	9	$3 968 256.20	$949 456.85	$826 209.43
RB 48 hr 1.4.2	$182 340.53	$1 282 944.45	$2 300	$3 766 053.92		$42 786.13	$28 446.66	$71 232.79		$1 011 661.29	$1 449 850.43	$3 184	$5 646 049.46			$711 166.48	$1 066 445.88
RB 24 hr 1.4.2	$182 340.53	$1 282 944.45	$1 539	$3 004 416.03		$31 361.56	$28 446.66	$59 808.22		$1 011 661.29	$1 449 850.43	$2 130	$4 591 852.08			$711 166.48	$780 831.67
1.4.3.1	$315 631.92	$2 484 448.75	$1 730	$4 530 820.06	1	$41 602.78	$60 761.29	$102 364.07	1	$2 039 189.57	$2 807 665.67	$2 395	$7 242 404.31	1	$4 689 513.64	$1 519	$1 033 858.38
1.4.3.2	$361 370.73	$3 613 431.42	$1 425	$5 399 875.97	8	$43 129.25	$73 268.31	$116 397.55	8	$2 427 241.94	$4 083 524.50	$1 972	$8 483 238.03	8	$5 582 332.77	$1 831	$1 069 197.57
1.4.3.3	$396 542.30	$4 479 274.31	$1 361	$6 236 904.06	1	$46 857.41	$83 311.83	$130 169.24	1	$2 736 292.29	$5 062 010.12	$1 883	$9 682 209.24	1	$6 439 176.30	$2 082	$1 160 237.18
1.4.3.4	$361 370.73	$3 627 416.78	$1 345	$5 334 447.37	7	$42 007.96	$73 268.31	$115 276.27	7	$2 427 241.94	$4 099 329.30	$1 862	$8 389 124.46	7	$5 516 286.23	$1 831	$1 041 130.54
1.4.3.5	$361 370.73	$3 641 402.13	$1 317	$5 320 474.46	6	$41 658.52	$73 268.31	$114 926.82	6	$2 427 241.94	$4 115 134.09	$1 823	$8 366 231.69	6	$5 502 164.61	$1 831	$1 032 359.40
1.4.3.6	$361 370.73	$3 655 387.49	$1 303	$5 320 140.47	5	$41 513.65	$73 268.31	$114 781.96	5	$2 427 241.94	$4 130 938.89	$1 804	$8 362 216.81	5	$5 501 806.27	$1 831	$1 028 702.85
1.4.3.7	$338 797.37	$3 058 860.84	$1 592	$4 990 228.84	4	$42 638.60	$67 014.80	$109 653.40	4	$2 233 703.63	$3 456 806.49	$2 204	$7 894 817.20	4	$5 161 129.45	$1 675	$1 058 317.77
1.4.3.8	$331 144.89	$2 874 003.98	$1 632	$4 837 926.11	3	$42 239.36	$64 930.30	$107 169.65	3	$2 168 979.88	$3 247 900.49	$2 259	$7 676 838.18	3	$5 004 781.86	$1 623	$1 048 798.90
1.4.3.9	$327 293.19	$2 781 575.55	$1 641	$4 750 100.68	2	$41 864.75	$63 888.05	$105 752.79	2	$2 136 576.04	$3 143 447.49	$2 271	$7 551 683.65	2	$4 914 817.76	$1 597	$1 039 664.74
1.4.3.10	$396 542.30	$4 494 876.01	$1 309	$6 200 448.15	9	$46 154.56	$83 311.83	$129 466.39	9	$2 736 292.29	$5 079 641.53	$1 811	$9 627 786.75	9	$6 402 364.20	$2 082	$1 142 626.79
RB 48 hr 1.4.3	$315 631.92	$2 484 448.75	$2 300	$5 100 849.61		$50 153.22	$60 761.29	$110 914.51		$2 039 189.57	$2 807 665.67	$3 184	$8 031 392.97			$1 519	$1 247 619.46
RB 24 hr 1.4.3	$315 631.92	$2 484 448.75	$1 539	$4 339 211.72		$38 728.66	$60 761.29	$99 489.95		$2 039 189.57	$2 807 665.67	$2 130	$6 977 195.59			$1 519	$962 005.26
1.4.4.1	$627 270.85	$6 116 636.13	$2 024	$8 767 949.77	1	$67 341.99	$157 100.57	$224 442.55	1	$4 961 248.35	$6 912 386.20	$2 801	$14 675 150.39	1	$9 079 378.18	$3 927	$1 668 258.04
1.4.4.2	$722 356.24	$8 866 841.40	$1 621	$11 210 751.56	8	$76 025.55	$190 966.98	$266 992.53	8	$5 964 608.13	$10 020 382.25	$2 244	$18 229 413.79	8	$11 576 767.69	$4 774	$1 878 471.63
1.4.4.3	$795 347.61	$10 998 744.17	$1 508	$13 302 562.45	1	$85 733.33	$218 162.76	$303 896.09	1	$6 764 791.49	$12 429 637.11	$2 087	$21 282 331.34	1	$13 712 426.03	$5 454	$2 115 836.30
1.4.4.4	$722 356.24	$8 880 552.65	$1 455	$11 058 378.65	7	$73 602.84	$190 966.98	$264 569.82	7	$5 964 608.13	$10 035 877.28	$2 014	$18 015 028.60	7	$11 422 984.42	$4 774	$1 817 869.70
1.4.4.5	$722 356.24	$8 894 263.89	$1 389	$11 005 968.73	6	$72 679.58	$190 966.98	$263 646.56	6	$5 964 608.13	$10 051 372.31	$1 923	$17 939 004.07	6	$11 370 075.71	$4 774	$1 794 753.89
1.4.4.6	$722 356.24	$8 907 975.14	$1 357	$10 987 650.61	5	$72 267.70	$190 966.98	$263 234.68	5	$5 964 608.13	$10 066 867.34	$1 878	$17 910 166.65	5	$11 351 569.67	$4 774	$1 784 422.51
1.4.4.7	$675 455.34	$7 501 505.75	$1 824	$10 001 723.68	4	$71 768.61	$174 033.77	$245 802.38	4	$5 463 985.91	$8 477 421.86	$2 525	$16 467 096.13	4	$10 340 790.27	$4 350	$1 775 461.54
1.4.4.8	$659 544.50	$7 046 393.87	$1 882	$9 588 384.89	3	$70 196.02	$168 389.37	$238 585.39	3	$5 296 655.00	$7 963 101.73	$2 605	$15 865 286.50	3	$9 918 267.69	$4 209	$1 737 284.54
1.4.4.9	$651 533.81	$6 818 837.92	$1 893	$9 364 083.93	2	$69 145.52	$165 567.17	$234 712.69	2	$5 212 898.47	$7 705 941.66	$2 621	$15 539 962.94	2	$9 689 192.85	$4 139	$1 711 590.84
1.4.4.10	$795 347.61	$11 014 046.28	$1 377	$13 186 727.96	9	$83 842.79	$218 162.76	$302 005.55	9	$6 764 791.49	$12 446 929.96	$1 906	$21 118 115.55	9	$13 595 511.96	$5 454	$2 068 534.59
RB 48 hr 1.4.4	$627 270.85	$6 116 636.13	$2 300	$9 044 675.92		$71 492.88	$157 100.57	$228 593.44		$4 961 248.35	$6 912 386.20	$3 184	$15 058 172.29			$3 927	$1 772 030.35
RB 24 hr 1.4.4	$627 270.85	$6 116 636.13	$1 539	$8 283 038.03		$60 068.31	$157 100.57	$217 168.88		$4 961 248.35	$6 912 386.20	$2 130	$14 003 974.91			$3 927	$1 486 416.14

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
3.1.1.1	$13 987.13	$86 301.48	$345 393.37	$445 681.98	1	$5 755.08	$815.89	$6 570.97	1	$43 447.88	$97 528.96	$478 065.49	$619 042.33	1	$454 983.89	$20 397.27	$143 661.16
3.1.1.2	$17 072.54	$134 784.12	$330 733.21	$482 589.87	5	$5 809.06	$1 074.90	$6 883.96	6	$55 007.87	$152 319.00	$457 774.08	$665 100.95	5	$493 338.90	$26 872.54	$144 889.51
3.1.1.3	$19 401.75	$163 157.83	$329 169.34	$511 728.91	9	$5 951.23	$1 282.90	$7 234.12	9	$64 046.21	$184 384.01	$455 609.50	$704 039.71	9	$523 594.55	$32 072.38	$148 372.78
3.1.1.4	$17 072.54	$139 854.06	$328 270.73	$485 197.33	6	$5 797.47	$1 074.90	$6 872.37	5	$55 007.87	$158 048.52	$454 365.71	$667 422.10	6	$495 962.42	$26 872.54	$144 587.14
3.1.1.5	$17 072.54	$144 924.00	$328 184.19	$490 180.74	7	$5 821.52	$1 074.90	$6 896.42	7	$55 007.87	$163 778.04	$454 245.94	$673 031.84	7	$500 983.54	$26 872.54	$145 175.76
3.1.1.6	$17 072.54	$149 993.94	$327 058.36	$494 124.84	8	$5 829.99	$1 074.90	$6 904.89	8	$55 007.87	$169 507.56	$452 687.65	$677 203.08	8	$504 955.89	$26 872.54	$145 374.64
3.1.1.7	$15 559.21	$115 520.19	$338 315.75	$469 395.14	4	$5 811.04	$945.40	$6 756.44	4	$49 276.28	$130 548.90	$468 269.22	$648 094.40	4	$479 472.27	$23 634.91	$144 987.23
3.1.1.8	$15 042.23	$109 098.87	$341 217.56	$465 358.67	3	$5 817.19	$902.23	$6 719.42	3	$47 345.10	$123 292.20	$472 285.67	$642 922.97	3	$475 210.31	$22 555.70	$145 156.97
3.1.1.9	$14 781.18	$105 888.22	$340 759.31	$461 428.71	2	$5 791.60	$880.64	$6 672.24	2	$46 375.28	$119 663.85	$471 651.40	$637 690.53	2	$471 149.19	$22 016.09	$144 525.25
3.1.1.10	$19 401.75	$168 836.10	$327 391.56	$515 629.41	1	$5 952.95	$1 282.90	$7 235.85	1	$64 046.21	$190 801.01	$453 148.84	$707 996.06	1	$527 521.97	$32 072.38	$148 401.70
RB 48 hr 3.1.1	$13 987.13	$86 301.48	$544 203.89	$644 492.50		$8 737.23	$815.89	$9 553.13		$43 447.88	$97 528.96	$753 242.87	$894 219.72			$20 397.27	$218 215.11
RB 24 hr 3.1.1	$13 987.13	$86 301.48	$357 566.91	$457 855.52		$5 937.68	$815.89	$6 753.57		$43 447.88	$97 528.96	$494 915.11	$635 891.95			$20 397.27	$148 226.24
3.1.4.1	$172 265.34	$2 007 523.44	$497 169.54	$2 676 958.32	1	$19 252.27	$26 295.92	$45 548.19	1	$941 289.08	$2 268 694.27	$688 141.75	$3 898 125.09	1	$2 764 439.19	$657 398.04	$476 287.86
3.1.4.2	$214 971.10	$2 913 464.00	$405 735.11	$3 534 170.22	8	$22 846.05	$35 720.74	$58 566.79	8	$1 247 288.11	$3 292 494.10	$561 585.63	$5 101 367.85	8	$3 644 481.67	$893 018.54	$563 867.64
3.1.4.3	$247 013.54	$3 611 480.34	$382 214.72	$4 240 708.60	1	$26 310.16	$43 289.16	$69 599.33	1	$1 489 304.21	$4 081 319.60	$529 030.61	$6 099 654.41	1	$4 368 699.98	$1 082	$648 725.31
3.1.4.4	$214 971.10	$2 918 312.55	$370 530.46	$3 503 814.12	7	$22 342.22	$35 720.74	$58 062.97	7	$1 247 288.11	$3 297 973.43	$512 858.21	$5 058 119.75	7	$3 613 841.37	$893 018.54	$551 259.84
3.1.4.5	$214 971.10	$2 923 161.10	$354 413.67	$3 492 545.88	6	$22 124.72	$35 720.74	$57 845.46	6	$1 247 288.11	$3 303 452.75	$490 550.66	$5 041 291.52	6	$3 602 462.99	$893 018.54	$545 809.99
3.1.4.6	$214 971.10	$2 928 009.64	$348 186.60	$3 491 167.35	5	$22 055.55	$35 720.74	$57 776.29	5	$1 247 288.11	$3 308 932.07	$481 931.65	$5 038 151.84	5	$3 601 064.51	$893 018.54	$544 068.79
3.1.4.7	$194 069.58	$2 465 351.14	$452 478.61	$3 111 899.34	4	$21 093.44	$31 008.33	$52 101.78	4	$1 095 032.43	$2 786 083.54	$626 284.19	$4 507 400.16	4	$3 211 019.13	$775 208.29	$521 172.74
3.1.4.8	$186 910.74	$2 315 980.19	$462 496.71	$2 965 387.64	3	$20 423.84	$29 437.53	$49 861.37	3	$1 043 964.67	$2 617 280.02	$640 150.43	$4 301 395.12	3	$3 060 650.83	$735 938.21	$504 806.08
3.1.4.9	$183 291.79	$2 241 294.71	$466 539.63	$2 891 126.13	2	$20 074.14	$28 652.13	$48 726.27	2	$1 018 365.64	$2 532 878.25	$645 746.31	$4 196 990.20	2	$2 984 436.67	$716 303.17	$496 250.37
3.1.4.10	$247 013.54	$3 616 903.58	$351 833.58	$4 215 750.70	9	$25 881.56	$43 289.16	$69 170.72	9	$1 489 304.21	$4 087 448.37	$486 979.50	$6 063 732.08	9	$4 343 506.23	$1 082	$637 996.73
RB 48 hr 3.1.4	$172 265.34	$2 007 523.44	$544 203.89	$2 723 992.67		$19 957.78	$26 295.92	$46 253.70		$941 289.08	$2 268 694.27	$753 242.87	$3 963 226.22			$657 398.04	$493 925.74
RB 24 hr 3.1.4	$172 265.34	$2 007 523.44	$357 566.91	$2 537 355.69		$17 158.23	$26 295.92	$43 454.15		$941 289.08	$2 268 694.27	$494 915.11	$3 704 898.46			$657 398.04	$423 936.87
3.4.1.1	$55 651.80	$260 988.68	$1 483	$1 800 483.81	1	$24 130.24	$5 510.14	$29 640.38	1	$229 466.97	$294 942.27	$2 053	$2 578 224.81	1	$1 837 867.71	$137 753.52	$602 603.57
3.4.1.2	$62 557.87	$398 392.16	$1 432	$1 893 921.78	5	$24 124.63	$6 477.83	$30 602.45	6	$265 040.22	$450 221.40	$1 983	$2 698 664.87	5	$1 934 599.51	$161 945.66	$602 119.70
3.4.1.3	$67 897.76	$489 314.97	$1 427	$1 984 449.03	9	$24 547.68	$7 254.91	$31 802.58	1	$293 267.33	$552 972.91	$1 975	$2 821 704.94	9	$2 027 863.61	$181 372.70	$612 468.62
3.4.1.4	$62 557.87	$413 310.58	$1 424	$1 900 537.51	6	$24 074.68	$6 477.83	$30 552.51	5	$265 040.22	$467 080.64	$1 971	$2 704 032.21	6	$1 941 252.85	$161 945.66	$600 833.70
3.4.1.5	$62 557.87	$428 229.00	$1 424	$1 914 902.68	7	$24 140.97	$6 477.83	$30 618.80	7	$265 040.22	$483 939.89	$1 971	$2 720 125.70	7	$1 955 726.30	$161 945.66	$602 453.74
3.4.1.6	$62 557.87	$443 147.41	$1 419	$1 925 448.76	8	$24 149.98	$6 477.83	$30 627.81	8	$265 040.22	$500 799.13	$1 965	$2 730 933.11	8	$1 966 345.83	$161 945.66	$602 641.62
3.4.1.7	$59 143.49	$340 135.12	$1 459	$1 858 543.26	4	$24 192.91	$5 993.98	$30 186.89	4	$247 317.29	$384 385.34	$2 019	$2 651 498.40	4	$1 897 676.42	$149 849.59	$603 972.39
3.4.1.8	$57 988.58	$320 716.10	$1 469	$1 847 810.27	3	$24 231.65	$5 832.70	$30 064.35	3	$241 382.00	$362 439.99	$2 033	$2 637 238.78	3	$1 886 431.80	$145 817.57	$604 989.41
3.4.1.9	$57 407.82	$311 006.59	$1 467	$1 835 520.30	2	$24 147.18	$5 752.06	$29 899.24	2	$238 408.90	$351 467.32	$2 030	$2 620 525.17	2	$1 873 821.60	$143 801.56	$602 902.01
3.4.1.10	$67 897.76	$505 934.91	$1 419	$1 993 636.64	1	$24 519.29	$7 254.91	$31 774.20	9	$293 267.33	$571 755.03	$1 965	$2 830 199.84	1	$2 037 109.70	$181 372.70	$611 717.44
RB 48 hr 3.4.1	$55 651.80	$260 988.68	$2 300	$2 617 409.42		$36 384.13	$5 510.14	$41 894.27		$229 466.97	$294 942.27	$3 184	$3 708 946.98			$137 753.52	$908 950.68
RB 24 hr 3.4.1	$55 651.80	$260 988.68	$1 539	$1 855 771.54		$24 959.56	$5 510.14	$30 469.70		$229 466.97	$294 942.27	$2 130	$2 654 749.59			$137 753.52	$623 336.47
3.4.4.1	$627 270.85	$6 116 636.13	$2 096	$8 840 872.33	1	$68 435.82	$157 100.57	$225 536.39	1	$4 961 248.35	$6 912 386.20	$2 902	$14 776 083.90	1	$9 152 965.72	$3 927	$1 695 604.00
3.4.4.2	$722 356.24	$8 866 841.40	$1 718	$11 307 407.82	8	$77 475.39	$190 966.98	$268 442.37	8	$5 964 608.13	$10 020 382.25	$2 378	$18 363 197.54	8	$11 674 305.34	$4 774	$1 914 717.73
3.4.4.3	$795 347.61	$10 998 744.17	$1 624	$13 418 462.31	1	$87 471.82	$218 162.76	$305 634.58	1	$6 764 791.49	$12 429 637.11	$2 248	$21 442 750.53	1	$13 829 382.78	$5 454	$2 159 298.75
3.4.4.4	$722 356.24	$8 880 552.65	$1 581	$11 183 948.80	7	$75 486.40	$190 966.98	$266 453.37	7	$5 964 608.13	$10 035 877.28	$2 188	$18 188 832.61	7	$11 549 699.63	$4 774	$1 864 958.51
3.4.4.5	$722 356.24	$8 894 263.89	$1 518	$11 135 158.71	6	$74 617.43	$190 966.98	$265 584.41	6	$5 964 608.13	$10 051 372.31	$2 101	$18 117 818.36	6	$11 500 443.76	$4 774	$1 843 200.14
3.4.4.6	$722 356.24	$8 907 975.14	$1 493	$11 124 156.19	5	$74 315.28	$190 966.98	$265 282.26	5	$5 964 608.13	$10 066 867.34	$2 067	$18 099 106.59	5	$11 489 320.02	$4 774	$1 835 612.10
3.4.4.7	$675 455.34	$7 501 505.75	$1 909	$10 086 818.99	4	$73 045.04	$174 033.77	$247 078.81	4	$5 463 985.91	$8 477 421.86	$2 643	$16 584 878.16	4	$10 426 661.56	$4 350	$1 807 372.28
3.4.4.8	$659 544.50	$7 046 393.87	$1 953	$9 659 442.84	3	$71 261.89	$168 389.37	$239 651.26	3	$5 296 655.00	$7 963 101.73	$2 703	$15 963 639.16	3	$9 989 973.61	$4 209	$1 763 931.27
3.4.4.9	$651 533.81	$6 818 837.92	$1 971	$9 442 153.11	2	$70 316.56	$165 567.17	$235 883.72	2	$5 212 898.47	$7 705 941.66	$2 729	$15 648 019.96	2	$9 767 973.93	$4 139	$1 740 866.78
3.4.4.10	$795 347.61	$11 014 046.28	$1 509	$13 318 405.94	9	$85 817.96	$218 162.76	$303 980.72	9	$6 764 791.49	$12 446 929.96	$2 088	$21 300 373.52	9	$13 728 390.69	$5 454	$2 117 913.83
RB 48 hr 3.4.4	$627 270.85	$6 116 636.13	$2 300	$9 044 675.92		$71 492.88	$157 100.57	$228 593.44		$4 961 248.35	$6 912 386.20	$3 184	$15 058 172.29			$3 927	$1 772 030.35
RB 24 hr 3.4.4	$627 270.85	$6 116 636.13	$1 539	$8 283 038.03		$60 068.31	$157 100.57	$217 168.88		$4 961 248.35	$6 912 386.20	$2 130	$14 003 974.91			$3 927	$1 486 416.14

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
4.1.1.1	$13 987.13	$86 301.48	$359 377.43	$459 666.04	1	$5 964.84	$815.89	$6 780.73	1	$43 447.88	$97 528.96	$497 421.08	$638 397.92	1	$469 095.46	$20 397.27	$148 905.18
4.1.1.2	$17 072.54	$134 784.12	$332 420.55	$484 277.21	5	$5 834.37	$1 074.90	$6 909.27	7	$55 007.87	$152 319.00	$460 109.56	$667 436.43	5	$495 041.63	$26 872.54	$145 522.26
4.1.1.3	$19 401.75	$163 157.83	$329 121.73	$511 681.30	9	$5 950.51	$1 282.90	$7 233.41	9	$64 046.21	$184 384.01	$455 543.60	$703 973.82	9	$523 546.51	$32 072.38	$148 354.93
4.1.1.4	$17 072.54	$139 854.06	$329 491.07	$486 417.67	6	$5 815.78	$1 074.90	$6 890.68	5	$55 007.87	$158 048.52	$456 054.81	$669 111.19	6	$497 193.88	$26 872.54	$145 044.77
4.1.1.5	$17 072.54	$144 924.00	$327 073.36	$489 069.91	7	$5 804.86	$1 074.90	$6 879.76	4	$55 007.87	$163 778.04	$452 708.42	$671 494.32	7	$499 862.58	$26 872.54	$144 759.20
4.1.1.6	$17 072.54	$149 993.94	$327 992.00	$495 058.48	8	$5 843.99	$1 074.90	$6 918.89	8	$55 007.87	$169 507.56	$453 979.92	$678 495.34	8	$505 898.05	$26 872.54	$145 724.75
4.1.1.7	$15 559.21	$115 520.19	$347 592.00	$478 671.39	4	$5 950.18	$945.40	$6 895.58	6	$49 276.28	$130 548.90	$481 108.65	$660 933.83	4	$488 833.10	$23 634.91	$148 465.82
4.1.1.8	$15 042.23	$109 098.87	$351 685.65	$475 826.75	3	$5 974.21	$902.23	$6 876.44	3	$47 345.10	$123 292.20	$486 774.74	$657 412.04	3	$485 773.85	$22 555.70	$149 082.50
4.1.1.9	$14 781.18	$105 888.22	$353 129.87	$473 799.26	2	$5 977.16	$880.64	$6 857.80	2	$46 375.28	$119 663.85	$488 773.71	$654 812.85	2	$483 632.56	$22 016.09	$149 164.21
4.1.1.10	$19 401.75	$168 836.10	$327 403.07	$515 640.92	1	$5 953.12	$1 282.90	$7 236.02	1	$64 046.21	$190 801.01	$453 164.77	$708 011.99	1	$527 533.59	$32 072.38	$148 406.02
RB 48 hr 4.1.1	$13 987.13	$86 301.48	$544 203.89	$644 492.50		$8 737.23	$815.89	$9 553.13		$43 447.88	$97 528.96	$753 242.87	$894 219.72			$20 397.27	$218 215.11
RB 24 hr 4.1.1	$13 987.13	$86 301.48	$357 566.91	$457 855.52		$5 937.68	$815.89	$6 753.57		$43 447.88	$97 528.96	$494 915.11	$635 891.95			$20 397.27	$148 226.24
4.1.4.1	$172 265.34	$2 007 523.44	$609 235.68	$2 789 024.46	1	$20 933.26	$26 295.92	$47 229.18	1	$941 289.08	$2 268 694.27	$843 254.61	$4 053 237.95	1	$2 877 527.25	$657 398.04	$518 312.66
4.1.4.2	$214 971.10	$2 913 464.00	$486 440.82	$3 614 875.93	8	$24 056.64	$35 720.74	$59 777.38	8	$1 247 288.11	$3 292 494.10	$673 291.92	$5 213 074.14	8	$3 725 923.32	$893 018.54	$594 132.28
4.1.4.3	$247 013.54	$3 611 480.34	$442 750.19	$4 301 244.07	1	$27 218.19	$43 289.16	$70 507.36	1	$1 489 304.21	$4 081 319.60	$612 818.90	$6 183 442.70	1	$4 429 787.47	$1 082	$671 426.12
4.1.4.4	$214 971.10	$2 918 312.55	$412 744.82	$3 546 028.48	7	$22 975.44	$35 720.74	$58 696.18	7	$1 247 288.11	$3 297 973.43	$571 287.90	$5 116 549.44	7	$3 656 440.68	$893 018.54	$567 090.23
4.1.4.5	$214 971.10	$2 923 161.10	$385 330.98	$3 523 463.18	6	$22 588.48	$35 720.74	$58 309.22	6	$1 247 288.11	$3 303 452.75	$533 343.88	$5 084 084.75	6	$3 633 662.23	$893 018.54	$557 403.98
4.1.4.6	$214 971.10	$2 928 009.64	$369 674.63	$3 512 655.38	5	$22 377.87	$35 720.74	$58 098.61	5	$1 247 288.11	$3 308 932.07	$511 673.64	$5 067 893.83	5	$3 622 748.49	$893 018.54	$552 126.80
4.1.4.7	$194 069.58	$2 465 351.14	$533 465.23	$3 192 885.96	4	$22 308.24	$31 008.33	$53 316.58	4	$1 095 032.43	$2 786 083.54	$738 379.29	$4 619 495.27	4	$3 292 744.26	$775 208.29	$551 542.72
4.1.4.8	$186 910.74	$2 315 980.19	$545 523.53	$3 048 414.47	3	$21 669.24	$29 437.53	$51 106.77	3	$1 043 964.67	$2 617 280.02	$755 069.42	$4 416 314.11	3	$3 144 434.77	$735 938.21	$535 941.14
4.1.4.9	$183 291.79	$2 241 294.71	$552 674.22	$2 977 260.71	2	$21 366.16	$28 652.13	$50 018.29	2	$1 018 365.64	$2 532 878.25	$764 966.82	$4 316 210.71	2	$3 071 356.71	$716 303.17	$528 550.84
4.1.4.10	$247 013.54	$3 616 903.58	$379 218.61	$4 243 135.72	9	$26 292.34	$43 289.16	$69 581.50	9	$1 489 304.21	$4 087 448.37	$524 883.63	$6 101 636.21	9	$4 371 140.97	$1 082	$648 266.12
RB 48 hr 4.1.4	$172 265.34	$2 007 523.44	$544 203.89	$2 723 992.67		$19 957.78	$26 295.92	$46 253.70		$941 289.08	$2 268 694.27	$753 242.87	$3 963 226.22			$657 398.04	$493 925.74
RB 24 hr 4.1.4	$172 265.34	$2 007 523.44	$357 566.91	$2 537 355.69		$17 158.23	$26 295.92	$43 454.15		$941 289.08	$2 268 694.27	$494 915.11	$3 704 898.46			$657 398.04	$423 936.87
4.4.1.1	$55 651.80	$260 988.68	$1 540	$1 857 084.17	1	$24 979.25	$5 510.14	$30 489.39	1	$229 466.97	$294 942.27	$2 132	$2 656 566.44	1	$1 894 984.21	$137 753.52	$623 828.71
4.4.1.2	$62 557.87	$398 392.16	$1 441	$1 902 483.12	5	$24 253.05	$6 477.83	$30 730.87	8	$265 040.22	$450 221.40	$1 995	$2 710 514.78	5	$1 943 238.92	$161 945.66	$605 330.20
4.4.1.3	$67 897.76	$489 314.97	$1 430	$1 987 613.84	9	$24 595.15	$7 254.91	$31 850.06	1	$293 267.33	$552 972.91	$1 979	$2 826 085.42	9	$2 031 057.29	$181 372.70	$613 655.43
4.4.1.4	$62 557.87	$413 310.58	$1 431	$1 907 269.31	6	$24 175.66	$6 477.83	$30 653.48	3	$265 040.22	$467 080.64	$1 981	$2 713 349.82	6	$1 948 046.04	$161 945.66	$603 358.13
4.4.1.5	$62 557.87	$428 229.00	$1 423	$1 914 489.65	7	$24 134.78	$6 477.83	$30 612.60	2	$265 040.22	$483 939.89	$1 970	$2 719 554.02	7	$1 955 309.50	$161 945.66	$602 298.85
4.4.1.6	$62 557.87	$443 147.41	$1 426	$1 931 955.10	8	$24 247.57	$6 477.83	$30 725.40	7	$265 040.22	$500 799.13	$1 974	$2 739 938.65	8	$1 972 911.49	$161 945.66	$605 081.50
4.4.1.7	$59 143.49	$340 135.12	$1 494	$1 893 359.09	4	$24 715.15	$5 993.98	$30 709.13	6	$247 317.29	$384 385.34	$2 067	$2 699 687.65	4	$1 932 809.73	$149 849.59	$617 028.32
4.4.1.8	$57 988.58	$320 716.10	$1 510	$1 888 978.18	3	$24 849.17	$5 832.70	$30 681.87	5	$241 382.00	$362 439.99	$2 090	$2 694 220.05	3	$1 927 975.11	$145 817.57	$620 427.37
4.4.1.9	$57 407.82	$311 006.59	$1 517	$1 886 209.23	2	$24 907.52	$5 752.06	$30 659.58	4	$238 408.90	$351 467.32	$2 100	$2 690 684.68	2	$1 924 972.76	$143 801.56	$621 910.36
4.4.1.10	$67 897.76	$505 934.91	$1 423	$1 997 231.10	1	$24 573.21	$7 254.91	$31 828.12	9	$293 267.33	$571 755.03	$1 970	$2 835 175.00	1	$2 040 736.94	$181 372.70	$613 065.37
RB 48 hr 4.4.1	$55 651.80	$260 988.68	$2 300	$2 617 409.42		$36 384.13	$5 510.14	$41 894.27		$229 466.97	$294 942.27	$3 184	$3 708 946.98			$137 753.52	$908 950.68
RB 24 hr 4.4.1	$55 651.80	$260 988.68	$1 539	$1 855 771.54		$24 959.56	$5 510.14	$30 469.70		$229 466.97	$294 942.27	$2 130	$2 654 749.59			$137 753.52	$623 336.47
4.4.4.1	$627 270.85	$6 116 636.13	$2 570	$9 314 835.61	1	$75 545.27	$157 100.57	$232 645.84	1	$4 961 248.35	$6 912 386.20	$3 558	$15 432 105.41	1	$9 631 251.01	$3 927	$1 873 340.23
4.4.4.2	$722 356.24	$8 866 841.40	$2 053	$11 642 426.98	8	$82 500.68	$190 966.98	$273 467.66	8	$5 964 608.13	$10 020 382.25	$2 841	$18 826 903.90	8	$12 012 379.51	$4 774	$2 040 349.92
4.4.4.3	$795 347.61	$10 998 744.17	$1 869	$13 663 736.45	1	$91 150.94	$218 162.76	$309 313.70	1	$6 764 791.49	$12 429 637.11	$2 587	$21 782 239.09	1	$14 076 893.54	$5 454	$2 251 276.55
4.4.4.4	$722 356.24	$8 880 552.65	$1 748	$11 351 754.88	7	$78 003.49	$190 966.98	$268 970.47	7	$5 964 608.13	$10 035 877.28	$2 420	$18 421 096.18	7	$11 719 035.92	$4 774	$1 927 885.79
4.4.4.5	$722 356.24	$8 894 263.89	$1 638	$11 255 472.99	6	$76 422.15	$190 966.98	$267 389.12	6	$5 964 608.13	$10 051 372.31	$2 268	$18 284 347.62	6	$11 621 855.16	$4 774	$1 888 317.99
4.4.4.6	$722 356.24	$8 907 975.14	$1 578	$11 209 018.92	5	$75 588.22	$190 966.98	$266 555.20	5	$5 964 608.13	$10 066 867.34	$2 185	$18 216 566.70	5	$11 574 956.61	$4 774	$1 867 435.62
4.4.4.7	$675 455.34	$7 501 505.75	$2 249	$10 426 899.83	4	$78 146.25	$174 033.77	$252 180.03	4	$5 463 985.91	$8 477 421.86	$3 114	$17 055 590.47	4	$10 769 843.55	$4 350	$1 934 902.60
4.4.4.8	$659 544.50	$7 046 393.87	$2 302	$10 008 742.07	3	$76 501.38	$168 389.37	$244 890.75	3	$5 296 655.00	$7 963 101.73	$3 187	$16 447 110.82	3	$10 342 458.07	$4 209	$1 894 918.49
4.4.4.9	$651 533.81	$6 818 837.92	$2 332	$9 802 718.54	2	$75 725.04	$165 567.17	$241 292.21	2	$5 212 898.47	$7 705 941.66	$3 228	$16 147 085.38	2	$10 131 827.32	$4 139	$1 876 078.82
4.4.4.10	$795 347.61	$11 014 046.28	$1 615	$13 424 770.44	9	$87 413.43	$218 162.76	$305 576.19	9	$6 764 791.49	$12 446 929.96	$2 235	$21 447 594.64	9	$13 835 725.12	$5 454	$2 157 800.52
RB 48 hr 4.4.4	$627 270.85	$6 116 636.13	$2 300	$9 044 675.92		$71 492.88	$157 100.57	$228 593.44		$4 961 248.35	$6 912 386.20	$3 184	$15 058 172.29			$3 927	$1 772 030.35
RB 24 hr 4.4.4	$627 270.85	$6 116 636.13	$1 539	$8 283 038.03		$60 068.31	$157 100.57	$217 168.88		$4 961 248.35	$6 912 386.20	$2 130	$14 003 974.91			$3 927	$1 486 416.14

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
2.1.1.1	3.15%	19.45%	77.40%	68.86%	87.53%	12.47%	68.48%	7.05%	15.82%	77.13%	68.93%	3.31%		73.50%	3.31%
2.1.1.2	3.55%	28.01%	68.44%	74.67%	84.34%	15.66%	71.84%	8.29%	22.97%	68.74%	74.17%	4.05%		74.18%	4.05%
2.1.1.3	3.80%	31.97%	64.22%	79.18%	82.21%	17.79%	75.50%	9.12%	26.26%	64.61%	78.51%	4.57%		74.37%	4.57%
2.1.1.4	3.52%	28.83%	67.65%	75.26%	84.35%	15.65%	71.91%	8.24%	23.69%	68.07%	74.61%	4.03%		74.31%	4.03%
2.1.1.5	3.49%	29.62%	66.89%	75.91%	84.38%	15.62%	72.04%	8.19%	24.38%	67.43%	75.12%	4.00%		74.44%	4.00%
2.1.1.6	3.45%	30.33%	66.22%	76.75%	84.45%	15.55%	72.36%	8.11%	25.01%	66.88%	75.81%	3.96%		74.56%	3.96%
2.1.1.7	3.33%	24.73%	71.94%	72.48%	85.94%	14.06%	70.37%	7.64%	20.24%	72.12%	72.13%	3.66%		73.99%	3.66%
2.1.1.8	3.24%	23.49%	73.28%	72.08%	86.55%	13.45%	70.21%	7.38%	19.21%	73.41%	71.77%	3.51%		73.92%	3.51%
2.1.1.9	3.20%	22.92%	73.89%	71.70%	86.82%	13.18%	69.95%	7.26%	18.74%	74.00%	71.41%	3.45%		73.88%	3.45%
2.1.1.10	3.77%	32.80%	63.43%	79.86%	82.24%	17.76%	75.60%	9.06%	27.00%	63.94%	79.03%	4.54%		74.51%	4.54%
RB 48 hr 2.1.1	2.17%	13.39%	84.44%	100.00%	91.46%	8.54%	100.00%	4.86%	10.91%	84.23%	100.00%	2.28%		0.00%	8.55%
RB 24 hr 2.1.1	3.05%	18.85%	78.10%	71.04%	87.92%	12.08%	70.69%	6.83%	15.34%	77.83%	71.11%	3.21%		0.00%	12.10%
2.1.2.1	5.44%	49.13%	45.43%	84.95%	66.06%	33.94%	84.84%	15.42%	39.66%	44.92%	85.09%	9.01%		73.52%	9.01%
2.1.2.2	5.62%	60.74%	33.64%	100.98%	60.54%	39.46%	96.95%	16.87%	49.53%	33.60%	100.13%	10.18%		74.31%	10.18%
2.1.2.3	5.61%	65.59%	28.80%	115.43%	58.00%	42.00%	109.20%	17.41%	53.70%	28.88%	114.00%	10.72%		74.60%	10.72%
2.1.2.4	5.65%	61.52%	32.83%	100.50%	60.20%	39.80%	96.14%	16.96%	50.22%	32.82%	99.56%	10.24%		74.39%	10.24%
2.1.2.5	5.64%	61.86%	32.50%	100.75%	60.17%	39.83%	96.05%	16.94%	50.54%	32.52%	99.72%	10.22%		74.45%	10.22%
2.1.2.6	5.62%	62.21%	32.17%	100.98%	60.13%	39.87%	95.95%	16.91%	50.87%	32.22%	99.86%	10.21%		74.51%	10.21%
2.1.2.7	5.51%	55.55%	38.93%	93.64%	63.26%	36.74%	91.25%	16.12%	45.14%	38.75%	93.20%	9.58%		74.01%	9.58%
2.1.2.8	5.47%	53.71%	40.82%	91.08%	64.20%	35.80%	89.23%	15.85%	43.58%	40.57%	90.77%	9.38%		73.91%	9.38%
2.1.2.9	5.46%	52.80%	41.75%	89.71%	64.65%	35.35%	88.14%	15.73%	42.81%	41.46%	89.47%	9.28%		73.85%	9.28%
2.1.2.10	5.61%	66.12%	28.27%	115.34%	57.82%	42.18%	108.74%	17.44%	54.19%	28.37%	113.82%	10.74%		74.67%	10.74%
RB 48 hr 2.1.2	4.62%	41.73%	53.64%	100.00%	71.21%	28.79%	100.00%	13.12%	33.75%	53.13%	100.00%	7.67%		0.00%	28.87%
RB 24 hr 2.1.2	5.67%	51.14%	43.19%	81.60%	64.66%	35.34%	81.47%	16.05%	41.27%	42.69%	81.78%	9.38%		0.00%	35.46%
2.1.3.1	6.40%	61.61%	31.99%	91.69%	53.38%	46.62%	92.16%	20.39%	48.66%	30.94%	91.94%	13.02%		72.18%	13.02%
2.1.3.2	6.36%	71.82%	21.83%	114.71%	48.32%	51.68%	112.17%	21.53%	57.18%	21.28%	114.10%	14.16%		72.74%	14.16%
2.1.3.3	6.22%	75.90%	17.88%	134.33%	46.18%	53.82%	130.10%	21.89%	60.62%	17.49%	133.21%	14.65%		72.92%	14.65%
2.1.3.4	6.40%	72.67%	20.92%	113.83%	47.83%	52.17%	111.13%	21.71%	57.88%	20.41%	113.19%	14.27%		72.77%	14.27%
2.1.3.5	6.41%	73.07%	20.51%	113.67%	47.66%	52.34%	110.76%	21.75%	58.23%	20.02%	112.97%	14.30%		72.81%	14.30%
2.1.3.6	6.41%	73.29%	20.30%	113.80%	47.61%	52.39%	110.67%	21.74%	58.44%	19.83%	113.03%	14.29%		72.85%	14.29%
2.1.3.7	6.35%	67.21%	26.44%	103.82%	50.78%	49.22%	102.54%	20.93%	53.36%	25.71%	103.57%	13.58%		72.53%	13.58%
2.1.3.8	6.36%	65.57%	28.07%	100.01%	51.62%	48.38%	99.15%	20.73%	52.00%	27.27%	99.87%	13.38%		72.46%	13.38%
2.1.3.9	6.37%	64.78%	28.85%	97.97%	52.00%	48.00%	97.34%	20.65%	51.34%	28.00%	97.90%	13.30%		72.41%	13.30%
2.1.3.10	6.24%	76.40%	17.36%	133.95%	45.92%	54.08%	129.50%	21.96%	61.05%	16.99%	132.76%	14.70%		72.96%	14.70%
RB 48 hr 2.1.3	5.87%	56.49%	37.64%	100.00%	57.03%	42.97%	100.00%	18.75%	44.74%	36.51%	100.00%	11.97%		0.00%	43.12%
RB 24 hr 2.1.3	6.74%	64.86%	28.40%	87.09%	51.07%	48.93%	87.82%	21.44%	51.14%	27.42%	87.48%	13.68%		0.00%	49.12%
2.1.4.1	6.44%	75.04%	18.52%	98.21%	42.23%	57.77%	98.41%	24.16%	58.24%	17.60%	98.29%	16.88%		70.92%	16.88%
2.1.4.2	6.08%	82.43%	11.48%	129.75%	39.01%	60.99%	126.63%	24.45%	64.54%	11.01%	128.72%	17.50%		71.44%	17.50%
2.1.4.3	5.83%	85.18%	8.99%	155.65%	37.79%	62.21%	150.44%	24.42%	66.92%	8.65%	153.87%	17.75%		71.62%	17.75%
2.1.4.4	6.14%	83.31%	10.55%	128.59%	38.46%	61.54%	125.50%	24.67%	65.22%	10.11%	127.59%	17.66%		71.45%	17.66%
2.1.4.5	6.16%	83.70%	10.14%	128.21%	38.25%	61.75%	125.06%	24.74%	65.53%	9.73%	127.20%	17.71%		71.46%	17.71%
2.1.4.6	6.16%	83.89%	9.95%	128.13%	38.16%	61.84%	124.89%	24.76%	65.69%	9.55%	127.09%	17.73%		71.48%	17.73%
2.1.4.7	6.24%	79.28%	14.48%	114.16%	40.45%	59.55%	112.57%	24.31%	61.86%	13.83%	113.65%	17.21%		71.24%	17.21%
2.1.4.8	6.30%	78.07%	15.63%	108.90%	40.98%	59.02%	107.83%	24.26%	60.83%	14.91%	108.57%	17.10%		71.16%	17.10%
2.1.4.9	6.34%	77.52%	16.14%	106.14%	41.20%	58.80%	105.35%	24.26%	60.35%	15.39%	105.90%	17.07%		71.11%	17.07%
2.1.4.10	5.86%	85.80%	8.34%	154.75%	37.41%	62.59%	149.53%	24.56%	67.42%	8.02%	152.98%	17.85%		71.63%	17.85%
RB 48 hr 2.1.4	6.32%	73.70%	19.98%	100.00%	43.15%	56.85%	100.00%	23.75%	57.24%	19.01%	100.00%	16.59%		0.00%	57.10%
RB 24 hr 2.1.4	6.79%	79.12%	14.09%	93.15%	39.49%	60.51%	93.95%	25.41%	61.23%	13.36%	93.48%	17.74%		0.00%	60.80%

Property of Grundfos Pumps

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
2.2.1.1	3.05%	16.34%	80.60%	69.20%	84.76%	15.24%	70.02%	7.78%	13.10%	79.12%	69.59%	4.21%		72.38%	4.21%
2.2.1.2	3.36%	23.53%	73.12%	73.64%	81.83%	18.17%	72.92%	8.89%	18.96%	72.16%	73.67%	4.94%		72.84%	4.94%
2.2.1.3	3.54%	27.32%	69.14%	77.57%	79.89%	20.11%	76.22%	9.60%	22.05%	68.35%	77.47%	5.44%		73.01%	5.44%
2.2.1.4	3.34%	24.20%	72.46%	74.04%	81.82%	18.18%	72.92%	8.85%	19.53%	71.62%	73.95%	4.92%		72.95%	4.92%
2.2.1.5	3.31%	24.83%	71.85%	74.56%	81.85%	18.15%	73.03%	8.80%	20.07%	71.13%	74.35%	4.90%		73.05%	4.90%
2.2.1.6	3.29%	25.42%	71.29%	75.18%	81.91%	18.09%	73.25%	8.75%	20.57%	70.68%	74.86%	4.87%		73.15%	4.87%
2.2.1.7	3.19%	20.59%	76.21%	71.87%	83.29%	16.71%	71.59%	8.31%	16.57%	75.11%	71.98%	4.57%		72.71%	4.57%
2.2.1.8	3.12%	19.52%	77.36%	71.51%	83.85%	16.15%	71.38%	8.09%	15.70%	76.21%	71.66%	4.42%		72.66%	4.42%
2.2.1.9	3.09%	19.01%	77.90%	71.23%	84.10%	15.90%	71.17%	7.99%	15.28%	76.73%	71.39%	4.36%		72.64%	4.36%
2.2.1.10	3.52%	28.00%	68.48%	78.06%	79.90%	20.10%	76.27%	9.56%	22.64%	67.80%	77.83%	5.41%		73.12%	5.41%
RB 48 hr 2.2.1	2.11%	11.31%	86.58%	100.00%	89.33%	10.67%	100.00%	5.42%	9.12%	85.47%	100.00%	2.93%		0.00%	10.68%
RB 24 hr 2.2.1	2.96%	15.85%	81.18%	71.34%	85.20%	14.80%	72.11%	7.55%	12.71%	79.73%	71.71%	4.09%		0.00%	14.81%
2.2.2.1	5.58%	44.36%	50.06%	83.99%	59.98%	40.02%	85.72%	18.09%	34.39%	47.52%	84.67%	11.78%		70.64%	11.78%
2.2.2.2	5.66%	55.92%	38.41%	97.51%	55.19%	44.81%	95.97%	19.32%	43.81%	36.86%	97.26%	12.86%		71.41%	12.86%
2.2.2.3	5.57%	61.08%	33.35%	110.46%	53.12%	46.88%	106.64%	19.67%	48.14%	32.19%	109.53%	13.27%		71.80%	13.27%
2.2.2.4	5.69%	56.60%	37.71%	97.04%	54.88%	45.12%	95.32%	19.43%	44.37%	36.20%	96.74%	12.93%		71.45%	12.93%
2.2.2.5	5.68%	56.91%	37.42%	97.20%	54.84%	45.16%	95.23%	19.41%	44.64%	35.95%	96.83%	12.91%		71.50%	12.91%
2.2.2.6	5.67%	57.22%	37.11%	97.35%	54.79%	45.21%	95.13%	19.40%	44.92%	35.68%	96.90%	12.90%		71.55%	12.90%
2.2.2.7	5.60%	50.69%	43.71%	91.18%	57.54%	42.46%	91.03%	18.69%	39.55%	41.77%	91.32%	12.31%		71.10%	12.31%
2.2.2.8	5.59%	48.81%	45.60%	89.00%	58.35%	41.65%	89.33%	18.46%	38.03%	43.51%	89.28%	12.12%		70.99%	12.12%
2.2.2.9	5.58%	47.87%	46.56%	87.86%	58.75%	41.25%	88.44%	18.36%	37.26%	44.39%	88.21%	12.02%		70.93%	12.02%
2.2.2.10	5.58%	61.57%	32.85%	110.29%	52.94%	47.06%	106.23%	19.72%	48.55%	31.73%	109.30%	13.30%		71.85%	13.30%
RB 48 hr 2.2.2	4.69%	37.26%	58.05%	100.00%	65.69%	34.31%	100.00%	15.32%	29.12%	55.57%	100.00%	9.98%		0.00%	34.38%
RB 24 hr 2.2.2	5.80%	46.12%	48.07%	80.78%	58.60%	41.40%	82.86%	18.77%	35.68%	45.55%	81.61%	12.22%		0.00%	41.51%
2.2.3.1	6.58%	57.36%	36.06%	90.79%	47.05%	52.95%	92.59%	23.89%	43.00%	33.11%	91.48%	16.70%		68.56%	16.70%
2.2.3.2	6.41%	68.17%	25.42%	111.16%	42.88%	57.12%	109.47%	24.69%	51.70%	23.61%	110.71%	17.60%		69.30%	17.60%
2.2.3.3	6.19%	72.70%	21.11%	129.15%	41.24%	58.76%	124.84%	24.78%	55.49%	19.73%	127.81%	17.89%		69.69%	17.89%
2.2.3.4	6.46%	68.98%	24.56%	110.25%	42.42%	57.58%	108.59%	24.89%	52.31%	22.81%	109.82%	17.74%		69.30%	17.74%
2.2.3.5	6.47%	69.34%	24.18%	110.06%	42.27%	57.73%	108.29%	24.93%	52.60%	22.47%	109.60%	17.78%		69.33%	17.78%
2.2.3.6	6.47%	69.56%	23.97%	110.12%	42.21%	57.79%	108.19%	24.93%	52.79%	22.28%	109.60%	17.78%		69.36%	17.78%
2.2.3.7	6.47%	63.23%	30.30%	101.46%	44.94%	55.06%	101.29%	24.24%	47.74%	28.02%	101.50%	17.12%		69.01%	17.12%
2.2.3.8	6.49%	61.48%	32.03%	98.05%	45.62%	54.38%	98.43%	24.11%	46.33%	29.56%	98.27%	16.97%		68.89%	16.97%
2.2.3.9	6.52%	60.63%	32.85%	96.22%	45.92%	54.08%	96.90%	24.07%	45.64%	30.29%	96.54%	16.91%		68.83%	16.91%
2.2.3.10	6.21%	73.18%	20.60%	128.71%	40.99%	59.01%	124.32%	24.87%	55.87%	19.26%	127.35%	17.95%		69.70%	17.95%
RB 48 hr 2.2.3	5.98%	52.08%	41.95%	100.00%	50.97%	49.03%	100.00%	21.86%	39.33%	38.81%	100.00%	15.28%		0.00%	49.16%
RB 24 hr 2.2.3	6.94%	60.47%	32.59%	86.11%	44.81%	55.19%	88.83%	25.08%	45.13%	29.79%	87.15%	17.53%		0.00%	55.37%
2.2.4.1	6.72%	71.88%	21.40%	97.91%	35.80%	64.20%	98.49%	28.71%	52.24%	19.04%	98.13%	21.59%		66.49%	21.59%
2.2.4.2	6.21%	80.23%	13.56%	127.18%	33.45%	66.55%	122.13%	28.42%	59.30%	12.28%	125.34%	21.73%		67.48%	21.73%
2.2.4.3	5.86%	83.42%	10.72%	151.70%	32.69%	67.31%	142.29%	28.02%	62.19%	9.79%	148.23%	21.65%		67.97%	21.65%
2.2.4.4	6.27%	81.17%	12.56%	125.90%	32.90%	67.10%	121.13%	28.69%	59.95%	11.36%	124.17%	21.93%		67.44%	21.93%
2.2.4.5	6.29%	81.57%	12.14%	125.46%	32.69%	67.31%	120.75%	28.78%	60.24%	10.98%	123.76%	22.01%		67.44%	22.01%
2.2.4.6	6.30%	81.76%	11.94%	125.35%	32.60%	67.40%	120.59%	28.81%	60.39%	10.80%	123.63%	22.03%		67.45%	22.03%
2.2.4.7	6.44%	76.65%	16.92%	112.64%	34.50%	65.50%	110.32%	28.54%	56.25%	15.21%	111.80%	21.66%		67.06%	21.66%
2.2.4.8	6.52%	75.26%	18.22%	107.76%	34.89%	65.11%	106.36%	28.59%	55.08%	16.33%	107.26%	21.63%		66.90%	21.63%
2.2.4.9	6.58%	74.65%	18.77%	105.14%	35.02%	64.98%	104.24%	28.67%	54.54%	16.80%	104.82%	21.65%		66.80%	21.65%
2.2.4.10	5.90%	84.07%	10.04%	150.74%	32.32%	67.68%	141.52%	28.19%	62.65%	9.16%	147.34%	21.78%		67.95%	21.78%
RB 48 hr 2.2.4	6.58%	70.38%	23.04%	100.00%	36.77%	63.23%	100.00%	28.18%	51.27%	20.55%	100.00%	21.19%		0.00%	63.44%
RB 24 hr 2.2.4	7.13%	76.19%	16.68%	92.37%	33.09%	66.91%	94.50%	30.24%	55.01%	14.75%	93.20%	22.73%		0.00%	67.15%

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
2.3.1.1	3.09%	15.74%	81.17%	67.07%	82.71%	17.29%	68.55%	8.46%	12.51%	79.02%	67.66%	4.88%		71.80%	4.88%
2.3.1.2	3.33%	22.80%	73.87%	70.69%	80.00%	20.00%	70.66%	9.44%	18.23%	72.33%	70.90%	5.55%		72.27%	5.55%
2.3.1.3	3.46%	26.60%	69.95%	74.35%	78.31%	21.69%	73.60%	10.02%	21.32%	68.66%	74.39%	5.98%		72.48%	5.98%
2.3.1.4	3.31%	23.49%	73.20%	71.08%	80.00%	20.00%	70.67%	9.40%	18.81%	71.79%	71.18%	5.53%		72.38%	5.53%
2.3.1.5	3.29%	24.14%	72.57%	71.55%	80.02%	19.98%	70.75%	9.35%	19.36%	71.29%	71.54%	5.51%		72.49%	5.51%
2.3.1.6	3.26%	24.74%	71.99%	72.12%	80.07%	19.93%	70.93%	9.29%	19.88%	70.83%	71.99%	5.47%		72.59%	5.47%
2.3.1.7	3.20%	19.85%	76.95%	69.32%	81.37%	18.63%	69.76%	8.92%	15.85%	75.24%	69.64%	5.20%		72.12%	5.20%
2.3.1.8	3.14%	18.80%	78.06%	69.02%	81.88%	18.12%	69.60%	8.72%	15.00%	76.28%	69.37%	5.07%		72.08%	5.07%
2.3.1.9	3.12%	18.30%	78.58%	68.74%	82.10%	17.90%	69.40%	8.64%	14.60%	76.76%	69.10%	5.01%		72.05%	5.01%
2.3.1.10	3.43%	27.26%	69.31%	74.91%	78.34%	21.66%	73.72%	9.96%	21.89%	68.15%	74.82%	5.95%		72.60%	5.95%
RB 48 hr 2.3.1	2.07%	10.56%	87.37%	100.00%	88.15%	11.85%	100.00%	5.73%	8.47%	85.81%	100.00%	3.30%		0.00%	11.86%
RB 24 hr 2.3.1	2.92%	14.85%	82.23%	71.08%	83.62%	16.38%	72.38%	8.00%	11.83%	80.18%	71.59%	4.61%		0.00%	16.39%
2.3.2.1	5.66%	43.08%	51.26%	82.44%	56.52%	43.48%	85.23%	19.71%	32.67%	47.62%	83.48%	13.45%		69.14%	13.45%
2.3.2.2	5.65%	54.98%	39.37%	94.47%	52.30%	47.70%	93.50%	20.65%	42.27%	37.08%	94.36%	14.32%		70.07%	14.32%
2.3.2.3	5.48%	60.30%	34.21%	106.63%	50.68%	49.32%	102.71%	20.74%	46.77%	32.50%	105.60%	14.54%		70.63%	14.54%
2.3.2.4	5.68%	55.69%	38.63%	93.95%	51.96%	48.04%	92.85%	20.77%	42.83%	36.39%	93.81%	14.41%		70.11%	14.41%
2.3.2.5	5.67%	56.03%	38.31%	94.08%	51.91%	48.09%	92.74%	20.76%	43.13%	36.11%	93.87%	14.40%		70.16%	14.40%
2.3.2.6	5.66%	56.35%	37.99%	94.22%	51.86%	48.14%	92.64%	20.75%	43.41%	35.84%	93.93%	14.39%		70.21%	14.39%
2.3.2.7	5.60%	49.61%	44.79%	89.35%	54.52%	45.48%	89.78%	20.05%	37.97%	41.99%	89.67%	13.80%		69.74%	13.80%
2.3.2.8	5.60%	47.80%	46.60%	87.42%	55.21%	44.79%	88.36%	19.88%	36.52%	43.61%	87.89%	13.64%		69.62%	13.64%
2.3.2.9	5.60%	46.94%	47.46%	86.33%	55.51%	44.49%	87.53%	19.82%	35.82%	44.36%	86.88%	13.58%		69.55%	13.58%
2.3.2.10	5.49%	60.80%	33.71%	106.46%	50.50%	49.50%	102.33%	20.78%	47.18%	32.03%	105.37%	14.57%		70.68%	14.57%
RB 48 hr 2.3.2	4.67%	35.51%	59.82%	100.00%	62.94%	37.06%	100.00%	16.45%	27.27%	56.27%	100.00%	11.23%		0.00%	37.14%
RB 24 hr 2.3.2	5.82%	44.28%	49.90%	80.20%	55.53%	44.47%	83.34%	20.22%	33.52%	46.26%	81.37%	13.80%		0.00%	44.57%
2.3.3.1	6.64%	56.10%	37.26%	89.61%	43.82%	56.18%	92.25%	25.82%	40.91%	33.27%	90.62%	18.76%		66.70%	18.76%
2.3.3.2	6.35%	67.44%	26.21%	108.42%	40.31%	59.69%	106.34%	26.18%	50.01%	23.80%	107.80%	19.32%		67.75%	19.32%
2.3.3.3	6.06%	72.17%	21.77%	125.58%	39.11%	60.89%	119.62%	25.95%	54.07%	19.98%	123.59%	19.33%		68.37%	19.33%
2.3.3.4	6.41%	68.31%	25.28%	107.44%	39.82%	60.18%	105.48%	26.41%	50.63%	22.95%	106.87%	19.48%		67.74%	19.48%
2.3.3.5	6.42%	68.71%	24.87%	107.21%	39.64%	60.36%	105.17%	26.48%	50.94%	22.58%	106.61%	19.53%		67.75%	19.53%
2.3.3.6	6.42%	68.91%	24.67%	107.29%	39.60%	60.40%	105.10%	26.47%	51.12%	22.42%	106.65%	19.52%		67.79%	19.52%
2.3.3.7	6.45%	62.20%	31.35%	99.52%	42.10%	57.90%	99.57%	25.91%	45.81%	28.28%	99.64%	18.98%		67.32%	18.98%
2.3.3.8	6.50%	60.34%	33.16%	96.39%	42.68%	57.32%	97.19%	25.85%	44.32%	29.83%	96.76%	18.89%		67.15%	18.89%
2.3.3.9	6.54%	59.48%	33.98%	94.63%	42.89%	57.11%	95.86%	25.86%	43.62%	30.52%	95.15%	18.87%		67.05%	18.87%
2.3.3.10	6.08%	72.67%	21.25%	125.13%	38.86%	61.14%	119.14%	26.05%	54.45%	19.50%	123.13%	19.40%		68.38%	19.40%
RB 48 hr 2.3.3	5.95%	50.27%	43.78%	100.00%	48.17%	51.83%	100.00%	23.40%	37.07%	39.54%	100.00%	17.00%		0.00%	51.96%
RB 24 hr 2.3.3	6.96%	58.79%	34.25%	85.51%	41.89%	58.11%	89.19%	26.92%	42.65%	30.43%	86.91%	19.56%		0.00%	58.27%
2.3.4.1	6.80%	71.00%	22.20%	97.16%	32.78%	67.22%	98.14%	31.08%	49.83%	19.08%	97.55%	24.12%		64.23%	24.12%
2.3.4.2	6.15%	79.82%	14.03%	125.27%	31.12%	68.88%	118.29%	30.15%	57.47%	12.37%	122.60%	23.70%		65.72%	23.70%
2.3.4.3	5.72%	83.19%	11.09%	149.10%	30.77%	69.23%	135.68%	29.36%	60.72%	9.91%	143.94%	23.27%		66.52%	23.27%
2.3.4.4	6.21%	80.81%	12.97%	123.92%	30.56%	69.44%	117.34%	30.45%	58.12%	11.43%	121.42%	23.93%		65.66%	23.93%
2.3.4.5	6.24%	81.22%	12.55%	123.49%	30.36%	69.64%	116.99%	30.55%	58.40%	11.05%	121.02%	24.01%		65.65%	24.01%
2.3.4.6	6.24%	81.43%	12.32%	123.34%	30.26%	69.74%	116.83%	30.59%	58.56%	10.85%	120.87%	24.04%		65.66%	24.04%
2.3.4.7	6.43%	75.93%	17.64%	111.41%	31.92%	68.08%	108.29%	30.53%	54.08%	15.38%	110.23%	23.85%		65.08%	23.85%
2.3.4.8	6.54%	74.49%	18.96%	106.67%	32.17%	67.83%	104.88%	30.70%	52.83%	16.47%	106.00%	23.93%		64.83%	23.93%
2.3.4.9	6.62%	73.86%	19.53%	104.12%	32.23%	67.77%	103.06%	30.84%	52.24%	16.92%	103.73%	24.01%		64.68%	24.01%
2.3.4.10	5.76%	83.85%	10.39%	148.12%	30.41%	69.59%	134.97%	29.54%	61.17%	9.28%	143.07%	23.41%		66.49%	23.41%
RB 48 hr 2.3.4	6.61%	68.98%	24.41%	100.00%	34.03%	65.97%	100.00%	30.32%	48.61%	21.07%	100.00%	23.53%		0.00%	66.17%
RB 24 hr 2.3.4	7.19%	75.04%	17.77%	91.92%	30.34%	69.66%	94.70%	32.59%	52.25%	15.15%	93.03%	25.29%		0.00%	69.88%

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
2.4.1.1	3.09%	14.51%	82.40%	68.72%	81.39%	18.61%	70.69%	8.91%	11.45%	79.64%	69.45%	5.35%		71.28%	5.35%
2.4.1.2	3.31%	21.06%	75.63%	72.27%	78.81%	21.19%	72.97%	9.83%	16.70%	73.46%	72.68%	6.01%		71.69%	6.01%
2.4.1.3	3.43%	24.69%	71.89%	75.73%	77.16%	22.84%	75.83%	10.40%	19.62%	69.98%	75.99%	6.43%		71.87%	6.43%
2.4.1.4	3.29%	21.74%	74.97%	72.64%	78.81%	21.19%	72.95%	9.80%	17.27%	72.93%	72.93%	5.99%		71.79%	5.99%
2.4.1.5	3.27%	22.37%	74.36%	73.13%	78.84%	21.16%	73.06%	9.75%	17.80%	72.45%	73.31%	5.96%		71.90%	5.96%
2.4.1.6	3.24%	22.96%	73.80%	73.73%	78.90%	21.10%	73.27%	9.68%	18.30%	72.02%	73.80%	5.92%		72.00%	5.92%
2.4.1.7	3.19%	18.34%	78.47%	70.86%	80.11%	19.89%	71.91%	9.35%	14.53%	76.13%	71.34%	5.66%		71.57%	5.66%
2.4.1.8	3.14%	17.35%	79.51%	70.63%	80.61%	19.39%	71.79%	9.15%	13.74%	77.11%	71.13%	5.53%		71.53%	5.53%
2.4.1.9	3.12%	16.88%	80.01%	70.40%	80.83%	19.17%	71.62%	9.06%	13.36%	77.57%	70.92%	5.47%		71.51%	5.47%
2.4.1.10	3.40%	25.37%	71.23%	76.19%	77.17%	22.83%	75.87%	10.36%	20.20%	69.45%	76.33%	6.41%		71.98%	6.41%
RB 48 hr 2.4.1	2.13%	9.97%	87.90%	100.00%	86.85%	13.15%	100.00%	6.19%	7.95%	85.86%	100.00%	3.71%		0.00%	13.16%
RB 24 hr 2.4.1	3.00%	14.06%	82.94%	70.90%	81.92%	18.08%	72.73%	8.64%	11.11%	80.25%	71.58%	5.19%		0.00%	18.10%
2.4.2.1	5.82%	40.97%	53.21%	83.15%	53.90%	46.10%	86.63%	21.22%	30.41%	48.37%	84.44%	14.92%		67.71%	14.92%
2.4.2.2	5.78%	52.60%	41.61%	94.71%	50.01%	49.99%	94.74%	22.08%	39.57%	38.34%	94.90%	15.74%		68.60%	15.74%
2.4.2.3	5.61%	57.97%	36.42%	106.42%	48.53%	51.47%	103.58%	22.12%	44.01%	33.87%	105.67%	15.91%		69.18%	15.91%
2.4.2.4	5.81%	53.31%	40.88%	94.18%	49.68%	50.32%	94.11%	22.21%	40.11%	37.67%	94.35%	15.83%		68.63%	15.83%
2.4.2.5	5.81%	53.63%	40.57%	94.34%	49.64%	50.36%	94.03%	22.19%	40.39%	37.42%	94.43%	15.82%		68.68%	15.82%
2.4.2.6	5.80%	53.97%	40.23%	94.47%	49.58%	50.42%	93.93%	22.18%	40.68%	37.14%	94.48%	15.81%		68.73%	15.81%
2.4.2.7	5.78%	47.27%	46.95%	89.31%	51.95%	48.05%	90.84%	21.61%	35.37%	43.02%	89.97%	15.30%		68.23%	15.30%
2.4.2.8	5.78%	45.38%	48.83%	87.44%	52.61%	47.39%	89.49%	21.45%	33.89%	44.66%	88.27%	15.15%		68.10%	15.15%
2.4.2.9	5.79%	44.46%	49.75%	86.41%	52.91%	47.09%	88.74%	21.39%	33.16%	45.45%	87.33%	15.09%		68.02%	15.09%
2.4.2.10	5.62%	58.49%	35.89%	106.21%	48.33%	51.67%	103.19%	22.18%	44.43%	33.39%	105.40%	15.95%		69.22%	15.95%
RB 48 hr 2.4.2	4.84%	34.07%	61.09%	100.00%	60.07%	39.93%	100.00%	17.92%	25.68%	56.40%	100.00%	12.60%		0.00%	40.01%
RB 24 hr 2.4.2	6.07%	42.70%	51.23%	79.78%	52.44%	47.56%	83.96%	22.03%	31.57%	46.39%	81.33%	15.49%		0.00%	47.67%
2.4.3.1	6.84%	53.85%	39.31%	90.46%	41.36%	58.64%	93.42%	27.72%	38.16%	34.12%	91.61%	20.65%		64.88%	20.65%
2.4.3.2	6.54%	65.41%	28.05%	108.31%	38.05%	61.95%	106.63%	28.04%	47.18%	24.78%	107.77%	21.16%		65.95%	21.16%
2.4.3.3	6.22%	70.31%	23.47%	124.90%	36.97%	63.03%	119.17%	27.73%	51.30%	20.97%	122.86%	21.11%		66.63%	21.11%
2.4.3.4	6.60%	66.27%	27.13%	107.31%	37.57%	62.43%	105.81%	28.28%	47.77%	23.95%	106.85%	21.34%		65.92%	21.34%
2.4.3.5	6.62%	66.66%	26.72%	107.09%	37.41%	62.59%	105.53%	28.35%	48.06%	23.59%	106.61%	21.39%		65.93%	21.39%
2.4.3.6	6.61%	66.90%	26.49%	107.12%	37.35%	62.65%	105.43%	28.35%	48.25%	23.40%	106.60%	21.39%		65.96%	21.39%
2.4.3.7	6.66%	60.17%	33.17%	99.66%	39.66%	60.34%	100.13%	27.84%	43.08%	29.08%	99.91%	20.88%		65.50%	20.88%
2.4.3.8	6.72%	58.33%	34.95%	96.60%	40.16%	59.84%	97.83%	27.81%	41.64%	30.56%	97.12%	20.81%		65.32%	20.81%
2.4.3.9	6.76%	57.44%	35.80%	94.93%	40.37%	59.63%	96.59%	27.82%	40.93%	31.24%	95.62%	20.80%		65.21%	20.80%
2.4.3.10	6.25%	70.84%	22.91%	124.40%	36.71%	63.29%	118.69%	27.84%	51.68%	20.48%	122.38%	21.19%		66.63%	21.19%
RB 48 hr 2.4.3	6.19%	48.71%	45.11%	100.00%	45.22%	54.78%	100.00%	25.39%	34.96%	39.65%	100.00%	18.91%		0.00%	54.91%
RB 24 hr 2.4.3	7.27%	57.26%	35.47%	85.07%	38.93%	61.07%	89.70%	29.23%	40.24%	30.53%	86.87%	21.77%		0.00%	61.23%
2.4.4.1	7.10%	69.23%	23.67%	97.69%	30.32%	69.68%	98.63%	33.59%	46.80%	19.60%	98.08%	26.59%		61.94%	26.59%
2.4.4.2	6.39%	78.39%	15.23%	125.06%	28.88%	71.12%	117.46%	32.47%	54.55%	12.98%	121.99%	25.99%		63.58%	25.99%
2.4.4.3	5.93%	81.97%	12.10%	148.35%	28.62%	71.38%	133.70%	31.55%	57.97%	10.48%	142.39%	25.44%		64.49%	25.44%
2.4.4.4	6.46%	79.42%	14.12%	123.63%	28.32%	71.68%	116.55%	32.80%	55.18%	12.02%	120.77%	26.25%		63.50%	26.25%
2.4.4.5	6.49%	79.86%	13.65%	123.14%	28.10%	71.90%	116.20%	32.92%	55.47%	11.62%	120.34%	26.35%		63.48%	26.35%
2.4.4.6	6.49%	80.08%	13.43%	123.00%	28.02%	71.98%	116.05%	32.95%	55.62%	11.43%	120.20%	26.38%		63.48%	26.38%
2.4.4.7	6.70%	74.42%	18.88%	111.44%	29.53%	70.47%	108.04%	32.97%	51.15%	15.89%	110.07%	26.25%		62.86%	26.25%
2.4.4.8	6.82%	72.90%	20.28%	106.87%	29.76%	70.24%	104.88%	33.16%	49.85%	16.99%	106.07%	26.36%		62.59%	26.36%
2.4.4.9	6.90%	72.22%	20.88%	104.38%	29.81%	70.19%	103.18%	33.32%	49.25%	17.43%	103.91%	26.45%		62.42%	26.45%
2.4.4.10	5.97%	82.69%	11.34%	147.27%	28.24%	71.76%	132.99%	31.76%	58.43%	9.81%	141.47%	25.60%		64.45%	25.60%
RB 48 hr 2.4.4	6.94%	67.63%	25.44%	100.00%	31.28%	68.72%	100.00%	32.95%	45.90%	21.15%	100.00%	26.08%		0.00%	68.91%
RB 24 hr 2.4.4	7.57%	73.85%	18.58%	91.58%	27.66%	72.34%	95.00%	35.43%	49.36%	15.21%	93.00%	28.05%		0.00%	72.54%

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SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
1.2.1.1	3.28%	17.56%	79.16%	64.42%	83.68%	16.32%	65.37%	8.35%	14.05%	77.60%	64.88%	4.52%		72.34%	4.52%
1.2.1.2	3.63%	25.45%	70.92%	68.07%	80.36%	19.64%	67.49%	9.60%	20.49%	69.91%	68.16%	5.34%		72.84%	5.34%
1.2.1.3	3.81%	29.44%	66.74%	71.98%	78.35%	21.65%	70.78%	10.34%	23.74%	65.92%	71.95%	5.85%		73.02%	5.85%
1.2.1.4	3.61%	26.21%	70.18%	68.37%	80.34%	19.66%	67.40%	9.58%	21.13%	69.29%	68.36%	5.33%		72.95%	5.33%
1.2.1.5	3.59%	26.89%	69.52%	68.85%	80.36%	19.64%	67.48%	9.53%	21.72%	68.76%	68.72%	5.30%		73.06%	5.30%
1.2.1.6	3.55%	27.49%	68.96%	69.52%	80.44%	19.56%	67.75%	9.45%	22.23%	68.32%	69.28%	5.26%		73.17%	5.26%
1.2.1.7	3.44%	22.16%	74.41%	66.80%	82.06%	17.94%	66.66%	8.93%	17.81%	73.26%	66.98%	4.91%		72.69%	4.91%
1.2.1.8	3.36%	20.99%	75.65%	66.51%	82.66%	17.34%	66.51%	8.69%	16.86%	74.45%	66.72%	4.75%		72.64%	4.75%
1.2.1.9	3.33%	20.43%	76.24%	66.26%	82.94%	17.06%	66.33%	8.57%	16.41%	75.01%	66.48%	4.68%		72.62%	4.68%
1.2.1.10	3.79%	30.20%	66.01%	72.40%	78.34%	21.66%	70.75%	10.30%	24.39%	65.31%	72.24%	5.83%		73.14%	5.83%
RB 48 hr 1.2.1	2.11%	11.31%	86.58%	100.00%	89.33%	10.67%	100.00%	5.42%	9.12%	85.47%	100.00%	2.93%		0.00%	10.68%
RB 24 hr 1.2.1	2.96%	15.85%	81.18%	71.34%	85.20%	14.80%	72.11%	7.55%	12.71%	79.73%	71.71%	4.09%		0.00%	14.81%
1.2.2.1	5.75%	45.70%	48.55%	81.53%	58.93%	41.07%	83.53%	18.61%	35.37%	46.02%	82.32%	12.12%		70.58%	12.12%
1.2.2.2	5.86%	57.92%	36.21%	94.15%	53.74%	46.26%	92.97%	19.99%	45.31%	34.70%	94.04%	13.30%		71.35%	13.30%
1.2.2.3	5.76%	63.12%	31.12%	106.89%	51.67%	48.33%	103.45%	20.31%	49.69%	30.00%	106.11%	13.70%		71.76%	13.70%
1.2.2.4	5.91%	58.80%	35.29%	93.41%	53.29%	46.71%	92.08%	20.15%	46.02%	33.83%	93.27%	13.41%		71.40%	13.41%
1.2.2.5	5.91%	59.19%	34.91%	93.46%	53.20%	46.80%	91.89%	20.16%	46.36%	33.49%	93.25%	13.41%		71.45%	13.41%
1.2.2.6	5.90%	59.51%	34.60%	93.62%	53.15%	46.85%	91.80%	20.14%	46.64%	33.22%	93.33%	13.40%		71.50%	13.40%
1.2.2.7	5.77%	52.20%	42.03%	88.53%	56.41%	43.59%	88.68%	19.22%	40.67%	40.11%	88.80%	12.66%		71.05%	12.66%
1.2.2.8	5.75%	50.29%	43.96%	86.39%	57.24%	42.76%	87.00%	18.99%	39.12%	41.89%	86.78%	12.47%		70.94%	12.47%
1.2.2.9	5.75%	49.35%	44.90%	85.22%	57.62%	42.38%	86.08%	18.90%	38.36%	42.75%	85.69%	12.38%		70.87%	12.38%
1.2.2.10	5.78%	63.75%	30.48%	106.53%	51.40%	48.60%	102.87%	20.39%	50.21%	29.40%	105.69%	13.75%		71.81%	13.75%
RB 48 hr 1.2.2	4.69%	37.26%	58.05%	100.00%	65.69%	34.31%	100.00%	15.32%	29.12%	55.57%	100.00%	9.98%		0.00%	34.38%
RB 24 hr 1.2.2	5.80%	46.12%	48.07%	80.78%	58.60%	41.40%	82.86%	18.77%	35.68%	45.55%	81.61%	12.22%		0.00%	41.51%
1.2.3.1	6.69%	58.31%	35.00%	89.31%	46.36%	53.64%	91.40%	24.26%	43.65%	32.09%	90.11%	16.95%		68.49%	16.95%
1.2.3.2	6.54%	69.59%	23.87%	108.89%	41.91%	58.09%	107.64%	25.16%	52.70%	22.14%	108.60%	17.94%		69.23%	17.94%
1.2.3.3	6.31%	74.10%	19.59%	126.71%	40.30%	59.70%	122.88%	25.22%	56.49%	18.29%	125.55%	18.21%		69.63%	18.21%
1.2.3.4	6.61%	70.60%	22.78%	107.71%	41.32%	58.68%	106.55%	25.43%	53.45%	21.12%	107.47%	18.13%		69.23%	18.13%
1.2.3.5	6.63%	71.01%	22.36%	107.48%	41.13%	58.87%	106.21%	25.49%	53.77%	20.74%	107.21%	18.17%		69.25%	18.17%
1.2.3.6	6.63%	71.26%	22.11%	107.49%	41.06%	58.94%	106.08%	25.50%	53.98%	20.52%	107.18%	18.18%		69.28%	18.18%
1.2.3.7	6.58%	64.31%	29.11%	99.75%	44.18%	55.82%	99.92%	24.62%	48.49%	26.89%	99.93%	17.39%		68.95%	17.39%
1.2.3.8	6.60%	62.52%	30.88%	96.42%	44.89%	55.11%	97.12%	24.48%	47.05%	28.46%	96.76%	17.24%		68.83%	17.24%
1.2.3.9	6.63%	61.71%	31.66%	94.54%	45.16%	54.84%	95.54%	24.46%	46.39%	29.15%	94.99%	17.19%		68.76%	17.19%
1.2.3.10	6.34%	74.72%	18.94%	126.07%	39.96%	60.04%	122.19%	25.35%	56.97%	17.68%	124.90%	18.30%		69.64%	18.30%
RB 48 hr 1.2.3	5.98%	52.08%	41.95%	100.00%	50.97%	49.03%	100.00%	21.86%	39.33%	38.81%	100.00%	15.28%		0.00%	49.16%
RB 24 hr 1.2.3	6.94%	60.47%	32.59%	86.11%	44.81%	55.19%	88.83%	25.08%	45.13%	29.79%	87.15%	17.53%		0.00%	55.37%
1.2.4.1	6.77%	72.38%	20.85%	97.23%	35.48%	64.52%	98.00%	28.89%	52.56%	18.54%	97.53%	21.72%		66.45%	21.72%
1.2.4.2	6.26%	80.87%	12.87%	126.18%	33.05%	66.95%	121.40%	28.62%	59.73%	11.64%	124.44%	21.89%		67.44%	21.89%
1.2.4.3	5.90%	84.06%	10.04%	150.55%	32.30%	67.70%	141.46%	28.22%	62.63%	9.16%	147.20%	21.80%		67.94%	21.80%
1.2.4.4	6.33%	81.97%	11.69%	124.66%	32.40%	67.60%	120.24%	28.94%	60.49%	10.57%	123.07%	22.13%		67.40%	22.13%
1.2.4.5	6.36%	82.43%	11.21%	124.15%	32.15%	67.85%	119.80%	29.06%	60.81%	10.13%	122.58%	22.22%		67.39%	22.22%
1.2.4.6	6.37%	82.67%	10.97%	123.98%	32.04%	67.96%	119.60%	29.10%	60.99%	9.91%	122.40%	22.25%		67.39%	22.25%
1.2.4.7	6.48%	77.18%	16.34%	111.86%	34.17%	65.83%	109.76%	28.72%	56.60%	14.68%	111.11%	21.79%		67.03%	21.79%
1.2.4.8	6.57%	75.80%	17.63%	106.98%	34.55%	65.45%	105.80%	28.78%	55.43%	15.79%	106.57%	21.77%		66.86%	21.77%
1.2.4.9	6.63%	75.20%	18.17%	104.36%	34.67%	65.33%	103.69%	28.86%	54.90%	16.25%	104.13%	21.80%		66.76%	21.80%
1.2.4.10	5.95%	84.82%	9.24%	149.41%	31.86%	68.14%	140.56%	28.42%	63.16%	8.42%	146.15%	21.96%		67.91%	21.96%
RB 48 hr 1.2.4	6.58%	70.38%	23.04%	100.00%	36.77%	63.23%	100.00%	28.18%	51.27%	20.55%	100.00%	21.19%		0.00%	63.44%
RB 24 hr 1.2.4	7.13%	76.19%	16.68%	92.37%	33.09%	66.91%	94.50%	30.24%	55.01%	14.75%	93.20%	22.73%		0.00%	67.15%

Property of Flygt

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
1.4.1.1	3.33%	15.61%	81.06%	63.88%	80.12%	19.88%	66.15%	9.56%	12.29%	78.15%	64.71%	5.74%		71.16%	5.74%
1.4.1.2	3.59%	22.85%	73.56%	66.61%	77.15%	22.85%	67.66%	10.64%	18.08%	71.28%	67.14%	6.50%		71.59%	6.50%
1.4.1.3	3.70%	26.68%	69.62%	70.07%	75.45%	24.55%	70.53%	11.22%	21.16%	67.62%	70.46%	6.94%		71.78%	6.94%
1.4.1.4	3.57%	23.61%	72.82%	66.89%	77.11%	22.89%	67.56%	10.62%	18.71%	70.68%	67.31%	6.49%		71.70%	6.49%
1.4.1.5	3.55%	24.30%	72.16%	67.34%	77.14%	22.86%	67.63%	10.56%	19.29%	70.15%	67.66%	6.45%		71.81%	6.45%
1.4.1.6	3.51%	24.90%	71.59%	68.01%	77.23%	22.77%	67.90%	10.48%	19.80%	69.72%	68.20%	6.40%		71.93%	6.40%
1.4.1.7	3.44%	19.78%	76.78%	65.71%	78.67%	21.33%	67.09%	10.06%	15.63%	74.32%	66.32%	6.09%		71.47%	6.09%
1.4.1.8	3.38%	18.69%	77.93%	65.56%	79.23%	20.77%	67.04%	9.83%	14.77%	75.40%	66.18%	5.94%		71.43%	5.94%
1.4.1.9	3.36%	18.18%	78.46%	65.35%	79.47%	20.53%	66.89%	9.74%	14.36%	75.90%	65.99%	5.88%		71.41%	5.88%
1.4.1.10	3.68%	27.44%	68.87%	70.43%	75.43%	24.57%	70.47%	11.18%	21.80%	67.01%	70.71%	6.92%		71.90%	6.92%
RB 48 hr 1.4.1	2.13%	9.97%	87.90%	100.00%	86.85%	13.15%	100.00%	6.19%	7.95%	85.86%	100.00%	3.71%		0.00%	13.16%
RB 24 hr 1.4.1	3.00%	14.06%	82.94%	70.90%	81.92%	18.08%	72.73%	8.64%	11.11%	80.25%	71.58%	5.19%		0.00%	18.10%
1.4.2.1	6.01%	42.29%	51.70%	80.56%	52.79%	47.21%	84.58%	21.84%	31.30%	46.87%	82.05%	15.35%		67.56%	15.35%
1.4.2.2	6.01%	54.64%	39.35%	91.17%	48.49%	51.51%	91.93%	22.87%	40.98%	36.15%	91.63%	16.30%		68.45%	16.30%
1.4.2.3	5.81%	60.10%	34.09%	102.65%	47.00%	53.00%	100.59%	22.87%	45.51%	31.62%	102.19%	16.46%		69.05%	16.46%
1.4.2.4	6.06%	55.56%	38.38%	90.36%	48.01%	51.99%	91.09%	23.07%	41.67%	35.25%	90.82%	16.45%		68.46%	16.45%
1.4.2.5	6.06%	55.97%	37.97%	90.39%	47.91%	52.09%	90.90%	23.08%	42.01%	34.91%	90.78%	16.45%		68.51%	16.45%
1.4.2.6	6.05%	56.31%	37.64%	90.54%	47.85%	52.15%	90.81%	23.07%	42.30%	34.63%	90.85%	16.44%		68.57%	16.44%
1.4.2.7	5.97%	48.78%	45.25%	86.53%	50.76%	49.24%	88.64%	22.24%	36.40%	41.36%	87.41%	15.75%		68.10%	15.75%
1.4.2.8	5.97%	46.86%	47.17%	84.69%	51.43%	48.57%	87.31%	22.09%	34.89%	43.02%	85.73%	15.60%		67.96%	15.60%
1.4.2.9	5.98%	45.91%	48.12%	83.68%	51.73%	48.27%	86.57%	22.03%	34.14%	43.83%	84.81%	15.54%		67.88%	15.54%
1.4.2.10	5.84%	60.76%	33.40%	102.24%	46.71%	53.29%	100.04%	22.98%	46.03%	30.99%	101.73%	16.53%		69.09%	16.53%
RB 48 hr 1.4.2	4.84%	34.07%	61.09%	100.00%	60.07%	39.93%	100.00%	17.92%	25.68%	56.40%	100.00%	12.60%		0.00%	40.01%
RB 24 hr 1.4.2	6.07%	42.70%	51.23%	79.78%	52.44%	47.56%	83.96%	22.03%	31.57%	46.39%	81.33%	15.49%		0.00%	47.67%
1.4.3.1	6.97%	54.83%	38.20%	88.82%	40.64%	59.36%	92.29%	28.16%	38.77%	33.08%	90.18%	20.97%		64.75%	20.97%
1.4.3.2	6.69%	66.92%	26.39%	105.86%	37.05%	62.95%	104.94%	28.61%	48.14%	23.25%	105.63%	21.59%		65.80%	21.59%
1.4.3.3	6.36%	71.82%	21.82%	122.27%	36.00%	64.00%	117.36%	28.26%	52.28%	19.46%	120.55%	21.51%		66.51%	21.51%
1.4.3.4	6.77%	68.00%	25.23%	104.58%	36.44%	63.56%	103.93%	28.93%	48.86%	22.20%	104.45%	21.83%		65.76%	21.83%
1.4.3.5	6.79%	68.44%	24.77%	104.31%	36.25%	63.75%	103.62%	29.01%	49.19%	21.80%	104.17%	21.89%		65.77%	21.89%
1.4.3.6	6.79%	68.71%	24.50%	104.30%	36.17%	63.83%	103.49%	29.03%	49.40%	21.57%	104.12%	21.90%		65.79%	21.90%
1.4.3.7	6.79%	61.30%	31.91%	97.83%	38.88%	61.12%	98.86%	28.29%	43.79%	27.92%	98.30%	21.22%		65.37%	21.22%
1.4.3.8	6.84%	59.41%	33.75%	94.85%	39.41%	60.59%	96.62%	28.25%	42.31%	29.44%	95.59%	21.14%		65.19%	21.14%
1.4.3.9	6.89%	58.56%	34.55%	93.12%	39.59%	60.41%	95.35%	28.29%	41.63%	30.08%	94.03%	21.15%		65.08%	21.15%
1.4.3.10	6.40%	72.49%	21.11%	121.56%	35.65%	64.35%	116.73%	28.42%	52.76%	18.82%	119.88%	21.63%		66.50%	21.63%
RB 48 hr 1.4.3	6.19%	48.71%	45.11%	100.00%	45.22%	54.78%	100.00%	25.39%	34.96%	39.65%	100.00%	18.91%		0.00%	54.91%
RB 24 hr 1.4.3	7.27%	57.26%	35.47%	85.07%	38.93%	61.07%	89.70%	29.23%	40.24%	30.53%	86.87%	21.77%		0.00%	61.23%
1.4.4.1	7.15%	69.76%	23.08%	96.94%	30.00%	70.00%	98.18%	33.81%	47.10%	19.09%	97.46%	26.76%		61.87%	26.76%
1.4.4.2	6.44%	79.09%	14.46%	123.95%	28.47%	71.53%	116.80%	32.72%	54.97%	12.31%	121.06%	26.19%		63.51%	26.19%
1.4.4.3	5.98%	82.68%	11.34%	147.08%	28.21%	71.79%	132.94%	31.79%	58.40%	9.81%	141.33%	25.63%		64.43%	25.63%
1.4.4.4	6.53%	80.31%	13.16%	122.26%	27.82%	72.18%	115.74%	33.11%	55.71%	11.18%	119.64%	26.50%		63.41%	26.50%
1.4.4.5	6.56%	80.81%	12.62%	121.68%	27.57%	72.43%	115.33%	33.25%	56.03%	10.72%	119.13%	26.61%		63.38%	26.61%
1.4.4.6	6.57%	81.07%	12.35%	121.48%	27.45%	72.55%	115.15%	33.30%	56.21%	10.49%	118.94%	26.66%		63.38%	26.66%
1.4.4.7	6.75%	75.00%	18.24%	110.58%	29.20%	70.80%	107.53%	33.18%	51.48%	15.34%	109.36%	26.42%		62.80%	26.42%
1.4.4.8	6.88%	73.49%	19.63%	106.01%	29.42%	70.58%	104.37%	33.39%	50.19%	16.42%	105.36%	26.53%		62.52%	26.53%
1.4.4.9	6.96%	72.82%	20.22%	103.53%	29.46%	70.54%	102.68%	33.55%	49.59%	16.87%	103.20%	26.64%		62.35%	26.64%
1.4.4.10	6.03%	83.52%	10.44%	145.80%	27.76%	72.24%	132.11%	32.03%	58.94%	9.03%	140.24%	25.83%		64.38%	25.83%
RB 48 hr 1.4.4	6.94%	67.63%	25.44%	100.00%	31.28%	68.72%	100.00%	32.95%	45.90%	21.15%	100.00%	26.08%		0.00%	68.91%
RB 24 hr 1.4.4	7.57%	73.85%	18.58%	91.58%	27.66%	72.34%	95.00%	35.43%	49.36%	15.21%	93.00%	28.05%		0.00%	72.54%

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
3.1.1.1	3.14%	19.36%	77.50%	69.15%	87.58%	12.42%	68.78%	7.02%	15.75%	77.23%	69.23%	3.29%		73.50%	3.29%
3.1.1.2	3.54%	27.93%	68.53%	74.88%	84.39%	15.61%	72.06%	8.27%	22.90%	68.83%	74.38%	4.04%		74.18%	4.04%
3.1.1.3	3.79%	31.88%	64.32%	79.40%	82.27%	17.73%	75.73%	9.10%	26.19%	64.71%	78.73%	4.56%		74.37%	4.56%
3.1.1.4	3.52%	28.82%	67.66%	75.28%	84.36%	15.64%	71.94%	8.24%	23.68%	68.08%	74.64%	4.03%		74.31%	4.03%
3.1.1.5	3.48%	29.57%	66.95%	76.06%	84.41%	15.59%	72.19%	8.17%	24.33%	67.49%	75.26%	3.99%		74.44%	3.99%
3.1.1.6	3.46%	30.36%	66.19%	76.67%	84.43%	15.57%	72.28%	8.12%	25.03%	66.85%	75.73%	3.97%		74.56%	3.97%
3.1.1.7	3.31%	24.61%	72.07%	72.83%	86.01%	13.99%	70.72%	7.60%	20.14%	72.25%	72.48%	3.65%		73.98%	3.65%
3.1.1.8	3.23%	23.44%	73.32%	72.21%	86.57%	13.43%	70.34%	7.36%	19.18%	73.46%	71.90%	3.51%		73.91%	3.51%
3.1.1.9	3.20%	22.95%	73.85%	71.60%	86.80%	13.20%	69.84%	7.27%	18.77%	73.96%	71.31%	3.45%		73.88%	3.45%
3.1.1.10	3.76%	32.74%	63.49%	80.01%	82.27%	17.73%	75.74%	9.05%	26.95%	64.00%	79.17%	4.53%		74.51%	4.53%
RB 48 hr 3.1.1	2.17%	13.39%	84.44%	100.00%	91.46%	8.54%	100.00%	4.86%	10.91%	84.23%	100.00%	2.28%		0.00%	8.55%
RB 24 hr 3.1.1	3.05%	18.85%	78.10%	71.04%	87.92%	12.08%	70.69%	6.83%	15.34%	77.83%	71.11%	3.21%		0.00%	12.10%
3.1.4.1	6.44%	74.99%	18.57%	98.27%	42.27%	57.73%	98.47%	24.15%	58.20%	17.65%	98.36%	16.86%		70.92%	16.86%
3.1.4.2	6.08%	82.44%	11.48%	129.74%	39.01%	60.99%	126.62%	24.45%	64.54%	11.01%	128.72%	17.51%		71.44%	17.51%
3.1.4.3	5.82%	85.16%	9.01%	155.68%	37.80%	62.20%	150.47%	24.42%	66.91%	8.67%	153.91%	17.74%		71.62%	17.74%
3.1.4.4	6.14%	83.29%	10.58%	128.63%	38.48%	61.52%	125.53%	24.66%	65.20%	10.14%	127.63%	17.66%		71.45%	17.66%
3.1.4.5	6.16%	83.70%	10.15%	128.21%	38.25%	61.75%	125.06%	24.74%	65.53%	9.73%	127.20%	17.71%		71.46%	17.71%
3.1.4.6	6.16%	83.87%	9.97%	128.16%	38.17%	61.83%	124.91%	24.76%	65.68%	9.57%	127.12%	17.73%		71.48%	17.73%
3.1.4.7	6.24%	79.22%	14.54%	114.24%	40.49%	59.51%	112.64%	24.29%	61.81%	13.89%	113.73%	17.20%		71.24%	17.20%
3.1.4.8	6.30%	78.10%	15.60%	108.86%	40.96%	59.04%	107.80%	24.27%	60.85%	14.88%	108.53%	17.11%		71.15%	17.11%
3.1.4.9	6.34%	77.52%	16.14%	106.14%	41.20%	58.80%	105.35%	24.26%	60.35%	15.39%	105.90%	17.07%		71.11%	17.07%
3.1.4.10	5.86%	85.80%	8.35%	154.76%	37.42%	62.58%	149.55%	24.56%	67.41%	8.03%	153.00%	17.85%		71.63%	17.85%
RB 48 hr 3.1.4	6.32%	73.70%	19.98%	100.00%	43.15%	56.85%	100.00%	23.75%	57.24%	19.01%	100.00%	16.59%		0.00%	57.10%
RB 24 hr 3.1.4	6.79%	79.12%	14.09%	93.15%	39.49%	60.51%	93.95%	25.41%	61.23%	13.36%	93.48%	17.74%		0.00%	60.80%
3.4.1.1	3.09%	14.50%	82.41%	68.79%	81.41%	18.59%	70.75%	8.90%	11.44%	79.66%	69.51%	5.34%		71.28%	5.34%
3.4.1.2	3.30%	21.04%	75.66%	72.36%	78.83%	21.17%	73.05%	9.82%	16.68%	73.50%	72.76%	6.00%		71.69%	6.00%
3.4.1.3	3.42%	24.66%	71.92%	75.82%	77.19%	22.81%	75.91%	10.39%	19.60%	70.01%	76.08%	6.43%		71.87%	6.43%
3.4.1.4	3.29%	21.75%	74.96%	72.61%	78.80%	21.20%	72.93%	9.80%	17.27%	72.92%	72.91%	5.99%		71.79%	5.99%
3.4.1.5	3.27%	22.36%	74.37%	73.16%	78.84%	21.16%	73.09%	9.74%	17.79%	72.47%	73.34%	5.95%		71.90%	5.95%
3.4.1.6	3.25%	23.02%	73.74%	73.56%	78.85%	21.15%	73.11%	9.71%	18.34%	71.96%	73.63%	5.93%		72.00%	5.93%
3.4.1.7	3.18%	18.30%	78.52%	71.01%	80.14%	19.86%	72.05%	9.33%	14.50%	76.18%	71.49%	5.65%		71.57%	5.65%
3.4.1.8	3.14%	17.36%	79.51%	70.60%	80.60%	19.40%	71.76%	9.15%	13.74%	77.10%	71.10%	5.53%		71.53%	5.53%
3.4.1.9	3.13%	16.94%	79.93%	70.13%	80.76%	19.24%	71.37%	9.10%	13.41%	77.49%	70.65%	5.49%		71.51%	5.49%
3.4.1.10	3.41%	25.38%	71.22%	76.17%	77.17%	22.83%	75.84%	10.36%	20.20%	69.44%	76.31%	6.41%		71.98%	6.41%
RB 48 hr 3.4.1	2.13%	9.97%	87.90%	100.00%	86.85%	13.15%	100.00%	6.19%	7.95%	85.86%	100.00%	3.71%		0.00%	13.16%
RB 24 hr 3.4.1	3.00%	14.06%	82.94%	70.90%	81.92%	18.08%	72.73%	8.64%	11.11%	80.25%	71.58%	5.19%		0.00%	18.10%
3.4.4.1	7.10%	69.19%	23.72%	97.75%	30.34%	69.66%	98.66%	33.58%	46.78%	19.64%	98.13%	26.58%		61.94%	26.58%
3.4.4.2	6.39%	78.42%	15.20%	125.02%	28.86%	71.14%	117.43%	32.48%	54.57%	12.95%	121.95%	26.00%		63.57%	26.00%
3.4.4.3	5.93%	81.97%	12.11%	148.36%	28.62%	71.38%	133.70%	31.55%	57.97%	10.49%	142.40%	25.44%		64.49%	25.44%
3.4.4.4	6.46%	79.40%	14.14%	123.65%	28.33%	71.67%	116.56%	32.79%	55.18%	12.03%	120.79%	26.25%		63.50%	26.25%
3.4.4.5	6.49%	79.88%	13.64%	123.11%	28.10%	71.90%	116.18%	32.92%	55.48%	11.60%	120.32%	26.35%		63.48%	26.35%
3.4.4.6	6.49%	80.08%	13.43%	122.99%	28.01%	71.99%	116.05%	32.96%	55.62%	11.42%	120.19%	26.38%		63.48%	26.38%
3.4.4.7	6.70%	74.37%	18.93%	111.52%	29.56%	70.44%	108.09%	32.95%	51.12%	15.94%	110.14%	26.23%		62.87%	26.23%
3.4.4.8	6.83%	72.95%	20.22%	106.80%	29.74%	70.26%	104.84%	33.18%	49.88%	16.94%	106.01%	26.37%		62.58%	26.37%
3.4.4.9	6.90%	72.22%	20.88%	104.39%	29.81%	70.19%	103.19%	33.31%	49.25%	17.44%	103.92%	26.45%		62.42%	26.45%
3.4.4.10	5.97%	82.70%	11.33%	147.25%	28.23%	71.77%	132.98%	31.76%	58.44%	9.81%	141.45%	25.61%		64.45%	25.61%
RB 48 hr 3.4.4	6.94%	67.63%	25.44%	100.00%	31.28%	68.72%	100.00%	32.95%	45.90%	21.15%	100.00%	26.08%		0.00%	68.91%
RB 24 hr 3.4.4	7.57%	73.85%	18.58%	91.58%	27.66%	72.34%	95.00%	35.43%	49.36%	15.21%	93.00%	28.05%		0.00%	72.54%

FOR REVIEW ONLY

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (0.5 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost					Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design		Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost					As % of total LCC cost		
4.1.1.1	3.04%	18.77%	78.18%	71.32%	87.97%	12.03%	70.98%	6.81%	15.28%	77.92%	71.39%	3.20%		73.48%	3.20%
4.1.1.2	3.53%	27.83%	68.64%	75.14%	84.44%	15.56%	72.32%	8.24%	22.82%	68.94%	74.64%	4.03%		74.17%	4.03%
4.1.1.3	3.79%	31.89%	64.32%	79.39%	82.26%	17.74%	75.72%	9.10%	26.19%	64.71%	78.72%	4.56%		74.37%	4.56%
4.1.1.4	3.51%	28.75%	67.74%	75.47%	84.40%	15.60%	72.13%	8.22%	23.62%	68.16%	74.83%	4.02%		74.31%	4.02%
4.1.1.5	3.49%	29.63%	66.88%	75.88%	84.38%	15.62%	72.02%	8.19%	24.39%	67.42%	75.09%	4.00%		74.44%	4.00%
4.1.1.6	3.45%	30.30%	66.25%	76.81%	84.46%	15.54%	72.43%	8.11%	24.98%	66.91%	75.88%	3.96%		74.56%	3.96%
4.1.1.7	3.25%	24.13%	72.62%	74.27%	86.29%	13.71%	72.18%	7.46%	19.75%	72.79%	73.91%	3.58%		73.96%	3.58%
4.1.1.8	3.16%	22.93%	73.91%	73.83%	86.88%	13.12%	71.98%	7.20%	18.75%	74.04%	73.52%	3.43%		73.89%	3.43%
4.1.1.9	3.12%	22.35%	74.53%	73.52%	87.16%	12.84%	71.79%	7.08%	18.27%	74.64%	73.23%	3.36%		73.86%	3.36%
4.1.1.10	3.76%	32.74%	63.49%	80.01%	82.27%	17.73%	75.75%	9.05%	26.95%	64.01%	79.18%	4.53%		74.51%	4.53%
RB 48 hr 4.1.1	2.17%	13.39%	84.44%	100.00%	91.46%	8.54%	100.00%	4.86%	10.91%	84.23%	100.00%	2.28%		0.00%	8.55%
RB 24 hr 4.1.1	3.05%	18.85%	78.10%	71.04%	87.92%	12.08%	70.69%	6.83%	15.34%	77.83%	71.11%	3.21%		0.00%	12.10%
4.1.4.1	6.18%	71.98%	21.84%	102.39%	44.32%	55.68%	102.11%	23.22%	55.97%	20.80%	102.27%	16.22%		70.99%	16.22%
4.1.4.2	5.95%	80.60%	13.46%	132.71%	40.24%	59.76%	129.24%	23.93%	63.16%	12.92%	131.54%	17.13%		71.47%	17.13%
4.1.4.3	5.74%	83.96%	10.29%	157.90%	38.60%	61.40%	152.44%	24.09%	66.00%	9.91%	156.02%	17.50%		71.64%	17.50%
4.1.4.4	6.06%	82.30%	11.64%	130.18%	39.14%	60.86%	126.90%	24.38%	64.46%	11.17%	129.10%	17.45%		71.46%	17.45%
4.1.4.5	6.10%	82.96%	10.94%	129.35%	38.74%	61.26%	126.06%	24.53%	64.98%	10.49%	128.28%	17.56%		71.47%	17.56%
4.1.4.6	6.12%	83.36%	10.52%	128.95%	38.52%	61.48%	125.61%	24.61%	65.29%	10.10%	127.87%	17.62%		71.48%	17.62%
4.1.4.7	6.08%	77.21%	16.71%	117.21%	41.84%	58.16%	115.27%	23.70%	60.31%	15.98%	116.56%	16.78%		71.28%	16.78%
4.1.4.8	6.13%	75.97%	17.90%	111.91%	42.40%	57.60%	110.49%	23.64%	59.26%	17.10%	111.43%	16.66%		71.20%	16.66%
4.1.4.9	6.16%	75.28%	18.56%	109.30%	42.72%	57.28%	108.14%	23.59%	58.68%	17.72%	108.91%	16.60%		71.16%	16.60%
4.1.4.10	5.82%	85.24%	8.94%	155.77%	37.79%	62.21%	150.43%	24.41%	66.99%	8.60%	153.96%	17.74%		71.64%	17.74%
RB 48 hr 4.1.4	6.32%	73.70%	19.98%	100.00%	43.15%	56.85%	100.00%	23.75%	57.24%	19.01%	100.00%	16.59%		0.00%	57.10%
RB 24 hr 4.1.4	6.79%	79.12%	14.09%	93.15%	39.49%	60.51%	93.95%	25.41%	61.23%	13.36%	93.48%	17.74%		0.00%	60.80%
4.4.1.1	3.00%	14.05%	82.95%	70.95%	81.93%	18.07%	72.78%	8.64%	11.10%	80.26%	71.63%	5.19%		71.33%	5.19%
4.4.1.2	3.29%	20.94%	75.77%	72.69%	78.92%	21.08%	73.35%	9.78%	16.61%	73.61%	73.08%	5.97%		71.69%	5.97%
4.4.1.3	3.42%	24.62%	71.97%	75.94%	77.22%	22.78%	76.02%	10.38%	19.57%	70.06%	76.20%	6.42%		71.87%	6.42%
4.4.1.4	3.28%	21.67%	75.05%	72.87%	78.87%	21.13%	73.17%	9.77%	17.21%	73.02%	73.16%	5.97%		71.79%	5.97%
4.4.1.5	3.27%	22.37%	74.36%	73.14%	78.84%	21.16%	73.07%	9.75%	17.79%	72.46%	73.32%	5.95%		71.90%	5.95%
4.4.1.6	3.24%	22.94%	73.82%	73.81%	78.92%	21.08%	73.34%	9.67%	18.28%	72.05%	73.87%	5.91%		72.01%	5.91%
4.4.1.7	3.12%	17.96%	78.91%	72.34%	80.48%	19.52%	73.30%	9.16%	14.24%	76.60%	72.79%	5.55%		71.59%	5.55%
4.4.1.8	3.07%	16.98%	79.95%	72.17%	80.99%	19.01%	73.24%	8.96%	13.45%	77.59%	72.64%	5.41%		71.56%	5.41%
4.4.1.9	3.04%	16.49%	80.47%	72.06%	81.24%	18.76%	73.18%	8.86%	13.06%	78.08%	72.55%	5.34%		71.54%	5.34%
4.4.1.10	3.40%	25.33%	71.27%	76.31%	77.21%	22.79%	75.97%	10.34%	20.17%	69.49%	76.44%	6.40%		71.98%	6.40%
RB 48 hr 4.4.1	2.13%	9.97%	87.90%	100.00%	86.85%	13.15%	100.00%	6.19%	7.95%	85.86%	100.00%	3.71%		0.00%	13.16%
RB 24 hr 4.4.1	3.00%	14.06%	82.94%	70.90%	81.92%	18.08%	72.73%	8.64%	11.11%	80.25%	71.58%	5.19%		0.00%	18.10%
4.4.4.1	6.73%	65.67%	27.60%	102.99%	32.47%	67.53%	101.77%	32.15%	44.79%	23.06%	102.48%	25.45%		62.41%	25.45%
4.4.4.2	6.20%	76.16%	17.64%	128.72%	30.17%	69.83%	119.63%	31.68%	53.22%	15.09%	125.03%	25.36%		63.80%	25.36%
4.4.4.3	5.82%	80.50%	13.68%	151.07%	29.47%	70.53%	135.31%	31.06%	57.06%	11.88%	144.65%	25.04%		64.63%	25.04%
4.4.4.4	6.36%	78.23%	15.41%	125.51%	29.00%	71.00%	117.66%	32.38%	54.48%	13.14%	122.33%	25.92%		63.62%	25.92%
4.4.4.5	6.42%	79.02%	14.56%	124.44%	28.58%	71.42%	116.97%	32.62%	54.97%	12.41%	121.42%	26.11%		63.56%	26.11%
4.4.4.6	6.44%	79.47%	14.08%	123.93%	28.36%	71.64%	116.61%	32.74%	55.26%	12.00%	120.97%	26.21%		63.54%	26.21%
4.4.4.7	6.48%	71.94%	21.58%	115.28%	30.99%	69.01%	110.32%	32.04%	49.70%	18.26%	113.26%	25.51%		63.15%	25.51%
4.4.4.8	6.59%	70.40%	23.01%	110.66%	31.24%	68.76%	107.13%	32.20%	48.42%	19.38%	109.22%	25.60%		62.88%	25.60%
4.4.4.9	6.65%	69.56%	23.79%	108.38%	31.38%	68.62%	105.56%	32.28%	47.72%	19.99%	107.23%	25.63%		62.75%	25.63%
4.4.4.10	5.92%	82.04%	12.03%	148.43%	28.61%	71.39%	133.68%	31.54%	58.03%	10.42%	142.43%	25.43%		64.51%	25.43%
RB 48 hr 4.4.4	6.94%	67.63%	25.44%	100.00%	31.28%	68.72%	100.00%	32.95%	45.90%	21.15%	100.00%	26.08%		0.00%	68.91%
RB 24 hr 4.4.4	7.57%	73.85%	18.58%	91.58%	27.66%	72.34%	95.00%	35.43%	49.36%	15.21%	93.00%	28.05%		0.00%	72.54%

APPENDIX I2: SUMMARY OF COST ESTIMATIONS AS PERCENTAGE - ADDITIONAL STATIC HEAD

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.1.1.1	$23 878.40	$86 301.48	$343 489.42	$453 669.30	1	$5 827.41	$1 709.62	$7 537.03	1	$82 091.82	$97 528.96	$475 430.19	$655 050.97	1	$466 840.99	$42 740.53	$145 469.46
2.1.1.2	$26 442.32	$134 784.12	$329 365.29	$490 591.73	5	$5 884.11	$1 968.63	$7 852.74	5	$92 792.39	$152 319.00	$455 880.71	$700 992.10	5	$505 010.48	$49 215.80	$146 765.83
2.1.1.3	$28 433.89	$163 157.83	$327 720.37	$519 312.08	9	$6 021.62	$2 176.63	$8 198.25	9	$101 274.31	$184 384.01	$453 603.95	$739 262.28	9	$534 714.03	$54 415.64	$150 132.61
2.1.1.4	$26 442.32	$139 854.06	$328 100.74	$494 397.12	6	$5 890.49	$1 968.63	$7 859.12	6	$92 792.39	$158 048.52	$454 130.43	$704 971.34	6	$508 842.85	$49 215.80	$146 912.69
2.1.1.5	$26 442.32	$144 924.00	$327 229.75	$498 596.07	7	$5 902.78	$1 968.63	$7 871.41	7	$92 792.39	$163 778.04	$452 924.87	$709 495.30	7	$513 072.37	$49 215.80	$147 207.14
2.1.1.6	$26 442.32	$149 993.94	$327 554.54	$503 990.80	8	$5 933.00	$1 968.63	$7 901.63	8	$92 792.39	$169 507.56	$453 374.43	$715 674.38	8	$518 508.58	$49 215.80	$147 950.00
2.1.1.7	$25 172.87	$115 520.19	$336 061.30	$476 754.36	4	$5 875.28	$1 839.13	$7 714.41	4	$87 462.73	$130 548.90	$465 148.80	$683 160.43	4	$490 588.97	$45 978.16	$146 593.29
2.1.1.8	$24 744.28	$109 098.87	$340 400.52	$474 243.67	3	$5 903.89	$1 795.96	$7 699.85	3	$85 677.20	$123 292.20	$471 154.79	$680 124.19	3	$487 900.64	$44 898.95	$147 324.60
2.1.1.9	$24 528.91	$105 888.22	$341 419.37	$471 836.49	2	$5 900.93	$1 774.37	$7 675.30	2	$84 782.67	$119 663.85	$472 564.99	$677 011.51	2	$485 393.73	$44 359.35	$147 258.44
2.1.1.10	$28 433.89	$168 836.10	$326 458.69	$523 728.68	1	$6 031.09	$2 176.63	$8 207.71	1	$101 274.31	$190 801.01	$451 857.64	$743 932.96	1	$539 162.25	$54 415.64	$150 355.07
RB 48 hr 2.1.1	$23 878.40	$86 301.48	$544 203.89	$654 383.76		$8 838.13	$1 709.62	$10 547.75		$82 091.82	$97 528.96	$753 242.87	$932 863.66			$42 740.53	$220 737.38
RB 24 hr 2.1.1	$23 878.40	$86 301.48	$357 566.91	$467 746.79		$6 038.57	$1 709.62	$7 748.19		$82 091.82	$97 528.96	$494 915.11	$674 535.89			$42 740.53	$150 748.51
2.1.2.1	$78 189.57	$423 350.47	$391 513.76	$893 053.80	1	$8 786.99	$8 818.78	$17 605.77	1	$349 324.80	$478 426.69	$541 901.59	$1 369 653.07	1	$930 567.23	$220 469.41	$218 616.43
2.1.2.2	$87 165.91	$622 236.98	$344 597.42	$1 054 000.31	8	$9 169.24	$10 249.18	$19 418.41	8	$399 877.67	$703 187.54	$476 963.79	$1 580 029.00	8	$1 096 124.25	$256 229.38	$227 675.37
2.1.2.3	$94 124.14	$768 084.21	$337 243.44	$1 199 451.79	1	$9 859.14	$11 397.83	$21 256.97	1	$440 061.10	$868 008.92	$466 785.01	$1 774 855.03	1	$1 245 351.02	$284 945.75	$244 558.26
2.1.2.4	$87 165.91	$627 245.99	$334 686.23	$1 049 098.13	5	$9 045.62	$10 249.18	$19 294.79	7	$399 877.67	$708 848.20	$463 245.53	$1 571 971.40	5	$1 091 169.74	$256 229.38	$224 572.28
2.1.2.5	$87 165.91	$632 254.99	$332 162.77	$1 051 583.68	6	$9 032.81	$10 249.18	$19 281.98	6	$399 877.67	$714 508.86	$459 752.77	$1 574 139.29	6	$1 093 670.33	$256 229.38	$224 239.58
2.1.2.6	$87 165.91	$637 264.00	$329 513.90	$1 053 943.81	7	$9 018.12	$10 249.18	$19 267.30	5	$399 877.67	$720 169.52	$456 086.41	$1 576 133.60	7	$1 096 044.35	$256 229.38	$223 859.86
2.1.2.7	$82 724.42	$527 738.07	$369 857.14	$980 319.63	4	$9 030.34	$9 533.98	$18 564.31	4	$374 678.16	$596 394.69	$511 926.25	$1 482 999.10	4	$1 020 210.64	$238 349.39	$224 439.07
2.1.2.8	$81 223.62	$496 238.43	$377 148.45	$954 610.50	3	$8 966.90	$9 295.58	$18 262.48	3	$366 244.87	$560 797.08	$522 018.29	$1 449 060.24	3	$993 738.94	$232 389.40	$222 931.90
2.1.2.9	$80 469.23	$480 488.61	$379 938.46	$940 896.30	2	$8 922.31	$9 176.38	$18 098.68	2	$362 021.65	$542 998.27	$525 879.99	$1 430 899.91	2	$979 634.08	$229 409.40	$221 856.43
2.1.2.10	$94 124.14	$773 692.37	$330 734.56	$1 198 551.08	9	$9 789.55	$11 397.83	$21 187.38	9	$440 061.10	$874 346.68	$457 775.95	$1 772 183.74	9	$1 244 433.55	$284 945.75	$242 804.43
RB 48 hr 2.1.2	$78 189.57	$423 350.47	$544 203.89	$1 045 743.92		$11 077.34	$8 818.78	$19 896.12		$349 324.80	$478 426.69	$753 242.87	$1 580 994.36			$220 469.41	$275 875.23
RB 24 hr 2.1.2	$78 189.57	$423 350.47	$357 566.91	$859 106.95		$8 277.79	$8 818.78	$17 096.57		$349 324.80	$478 426.69	$494 915.11	$1 322 666.59			$220 469.41	$205 886.36
2.1.3.1	$135 242.80	$816 778.76	$424 085.21	$1 376 106.77	1	$11 824.65	$18 816.74	$30 641.39	1	$693 296.80	$923 038.44	$586 984.35	$2 203 319.59	1	$1 439 326.89	$470 418.44	$293 574.27
2.1.3.2	$152 749.73	$1 191 185.29	$361 993.41	$1 705 928.44	8	$12 943.87	$22 267.17	$35 211.05	8	$808 408.91	$1 346 153.77	$501 041.91	$2 655 604.59	8	$1 778 306.34	$556 679.34	$320 618.91
2.1.3.3	$166 266.94	$1 474 146.90	$347 316.38	$1 987 730.22	1	$14 276.40	$25 037.98	$39 314.38	1	$899 955.27	$1 665 927.56	$480 727.16	$3 046 609.99	1	$2 067 435.75	$625 949.53	$353 224.71
2.1.3.4	$152 749.73	$1 196 083.98	$344 330.19	$1 693 163.90	7	$12 703.42	$22 267.17	$34 970.59	7	$808 408.91	$1 351 689.76	$476 593.92	$2 636 692.59	7	$1 765 417.95	$556 679.34	$314 595.29
2.1.3.5	$152 749.73	$1 200 982.67	$337 111.56	$1 690 843.95	5	$12 619.63	$22 267.17	$34 886.81	6	$808 408.91	$1 357 225.74	$466 602.47	$2 632 237.12	5	$1 763 069.39	$556 679.34	$312 488.39
2.1.3.6	$152 749.73	$1 205 881.35	$334 041.98	$1 692 673.06	6	$12 598.08	$22 267.17	$34 865.26	5	$808 408.91	$1 362 761.73	$462 353.81	$2 633 524.45	6	$1 764 907.71	$556 679.34	$311 937.39
2.1.3.7	$144 098.22	$1 008 866.59	$396 900.99	$1 549 865.80	4	$12 467.65	$20 541.96	$33 009.61	4	$751 020.87	$1 140 116.13	$549 358.16	$2 440 495.16	4	$1 617 777.19	$513 548.89	$309 169.08
2.1.3.8	$141 170.16	$948 093.69	$405 935.65	$1 495 199.51	3	$12 269.44	$19 966.88	$32 236.32	3	$731 818.66	$1 071 436.92	$561 863.20	$2 365 118.78	3	$1 561 580.97	$499 172.07	$304 365.74
2.1.3.9	$139 697.40	$917 707.24	$408 677.94	$1 466 082.57	2	$12 143.62	$19 679.35	$31 822.97	2	$722 203.15	$1 037 097.31	$565 658.85	$2 324 959.31	2	$1 531 679.44	$491 983.67	$301 296.20
2.1.3.10	$166 266.94	$1 479 627.96	$336 213.79	$1 982 108.69	9	$14 137.27	$25 037.98	$39 175.25	9	$899 955.27	$1 672 121.69	$465 359.85	$3 037 436.81	9	$2 061 754.62	$625 949.53	$349 732.66
RB 48 hr 2.1.3	$135 242.80	$816 778.76	$544 203.89	$1 496 225.44		$13 626.43	$18 816.74	$32 443.17		$693 296.80	$923 038.44	$753 242.87	$2 369 578.11			$470 418.44	$338 618.77
RB 24 hr 2.1.3	$135 242.80	$816 778.76	$357 566.91	$1 309 588.47		$10 826.87	$18 816.74	$29 643.61		$693 296.80	$923 038.44	$494 915.11	$2 111 250.35			$470 418.44	$268 629.90
2.1.4.1	$268 725.97	$2 007 523.44	$495 315.00	$2 771 564.40	1	$20 208.35	$48 639.18	$68 847.52	1	$1 658 836.33	$2 268 694.27	$685 574.84	$4 613 105.44	1	$2 896 936.13	$1 215	$500 189.87
2.1.4.2	$305 438.17	$2 913 464.00	$405 881.22	$3 624 783.39	8	$23 771.01	$58 064.00	$81 835.01	8	$1 954 958.05	$3 292 494.10	$561 787.86	$5 809 240.02	8	$3 770 648.55	$1 451	$586 991.53
2.1.4.3	$333 729.97	$3 611 480.34	$381 317.12	$4 326 527.44	1	$27 181.20	$65 632.42	$92 813.62	1	$2 190 793.16	$4 081 319.60	$527 788.23	$6 799 900.98	1	$4 488 589.06	$1 640	$670 501.41
2.1.4.4	$305 438.17	$2 918 312.55	$369 527.98	$3 593 278.70	7	$23 249.95	$58 064.00	$81 313.95	7	$1 954 958.05	$3 297 973.43	$511 470.65	$5 764 402.13	7	$3 738 849.18	$1 451	$573 953.01
2.1.4.5	$305 438.17	$2 923 161.10	$354 239.82	$3 582 839.09	6	$23 044.87	$58 064.00	$81 108.87	6	$1 954 958.05	$3 303 452.75	$490 310.03	$5 748 720.83	6	$3 728 306.99	$1 451	$568 813.90
2.1.4.6	$305 438.17	$2 928 009.64	$347 395.00	$3 580 842.81	5	$22 966.44	$58 064.00	$81 030.44	5	$1 954 958.05	$3 308 932.07	$480 835.97	$5 744 726.10	5	$3 726 285.12	$1 451	$566 841.04
2.1.4.7	$287 306.95	$2 465 351.14	$450 172.91	$3 202 831.00	4	$22 009.88	$53 351.59	$75 361.47	4	$1 807 267.79	$2 786 083.54	$623 092.82	$5 216 444.15	4	$3 338 570.83	$1 333	$544 083.63
2.1.4.8	$281 165.81	$2 315 980.19	$463 504.96	$3 060 650.96	3	$21 400.37	$51 780.78	$73 181.15	3	$1 757 877.19	$2 617 280.02	$641 545.96	$5 016 703.17	3	$3 192 964.35	$1 294	$529 219.21
2.1.4.9	$278 075.93	$2 241 294.71	$466 539.63	$2 985 910.27	2	$21 040.94	$50 995.38	$72 036.33	2	$1 733 150.08	$2 532 878.25	$645 746.31	$4 911 774.64	2	$3 116 469.75	$1 274	$520 420.33
2.1.4.10	$333 729.97	$3 616 903.58	$351 351.67	$4 301 985.22	9	$26 758.84	$65 632.42	$92 391.26	9	$2 190 793.16	$4 087 448.37	$486 312.48	$6 764 554.01	9	$4 463 814.79	$1 640	$659 928.71
RB 48 hr 2.1.4	$268 725.97	$2 007 523.44	$544 203.89	$2 820 453.29		$20 941.68	$48 639.18	$69 580.86		$1 658 836.33	$2 268 694.27	$753 242.87	$4 680 773.48			$1 215	$518 523.20
RB 24 hr 2.1.4	$268 725.97	$2 007 523.44	$357 566.91	$2 633 816.32		$18 142.13	$48 639.18	$66 781.30		$1 658 836.33	$2 268 694.27	$494 915.11	$4 422 445.71			$1 215	$448 534.33

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.2.1.1	$58 367.77	$158 938.83	$783 774.85	$1 001 081.44	1	$13 146.67	$5 885.52	$19 032.19	1	$243 327.34	$179 616.14	$1 084	$1 507 781.04	1
2.2.1.2	$62 328.82	$243 453.76	$756 685.45	$1 062 468.03	5	$13 203.30	$6 445.04	$19 648.35	6	$263 843.19	$275 126.12	$1 047	$1 586 311.93	5
2.2.1.3	$65 440.96	$297 803.23	$753 631.39	$1 116 875.59	9	$13 460.98	$6 894.36	$20 355.34	9	$280 204.82	$336 546.25	$1 043	$1 659 866.51	9
2.2.1.4	$62 328.82	$251 807.99	$753 864.15	$1 068 000.97	6	$13 202.76	$6 445.04	$19 647.80	5	$263 843.19	$284 567.21	$1 043	$1 591 848.01	6
2.2.1.5	$62 328.82	$260 162.22	$752 779.65	$1 075 270.69	7	$13 228.26	$6 445.04	$19 673.30	7	$263 843.19	$294 008.29	$1 041	$1 599 788.01	7
2.2.1.6	$62 328.82	$268 516.45	$753 128.51	$1 083 973.79	8	$13 275.26	$6 445.04	$19 720.31	8	$263 843.19	$303 449.38	$1 042	$1 609 711.96	8
2.2.1.7	$60 360.75	$207 975.95	$769 668.26	$1 038 004.95	4	$13 200.58	$6 165.28	$19 365.87	4	$253 605.78	$235 032.79	$1 065	$1 553 950.95	4
2.2.1.8	$59 699.26	$196 150.01	$777 338.01	$1 033 187.28	3	$13 249.75	$6 072.03	$19 321.78	3	$250 184.31	$221 668.35	$1 075	$1 547 780.89	3
2.2.1.9	$59 367.46	$190 237.04	$779 721.52	$1 029 326.02	2	$13 252.56	$6 025.40	$19 277.96	2	$248 471.84	$214 986.13	$1 079	$1 542 685.24	2
2.2.1.10	$65 440.96	$307 195.13	$751 191.64	$1 123 827.74	1	$13 471.35	$6 894.36	$20 365.71	1	$280 204.82	$347 160.00	$1 039	$1 667 103.36	1
RB 48 hr 2.2.1	$58 367.77	$158 938.83	$1 216	$1 433 891.99		$19 638.83	$5 885.52	$25 524.35		$243 327.34	$179 616.14	$1 683	$2 106 842.29	
RB 24 hr 2.2.1	$58 367.77	$158 938.83	$813 844.50	$1 031 151.09		$13 597.71	$5 885.52	$19 483.23		$243 327.34	$179 616.14	$1 126	$1 549 401.01	
2.2.2.1	$189 331.31	$780 795.83	$881 046.76	$1 851 173.90	1	$19 050.86	$29 966.12	$49 016.98	1	$1 061 168.48	$882 374.27	$1 219	$3 163 016.20	1
2.2.2.2	$203 150.61	$1 142 766.44	$784 960.00	$2 130 877.05	8	$19 560.37	$33 033.01	$52 593.38	8	$1 160 614.88	$1 291 435.81	$1 086	$3 538 528.65	8
2.2.2.3	$213 991.62	$1 413 855.12	$771 972.12	$2 399 818.86	1	$20 831.57	$35 495.83	$56 327.40	1	$1 240 051.02	$1 597 792.06	$1 068	$3 906 344.27	1
2.2.2.4	$203 150.61	$1 150 974.14	$766 855.28	$2 120 980.03	5	$19 329.84	$33 033.01	$52 362.85	7	$1 160 614.88	$1 300 711.31	$1 061	$3 522 745.06	5
2.2.2.5	$203 150.61	$1 159 181.85	$762 154.73	$2 124 487.19	6	$19 300.37	$33 033.01	$52 333.38	6	$1 160 614.88	$1 309 986.81	$1 054	$3 525 514.44	6
2.2.2.6	$203 150.61	$1 167 389.56	$756 991.71	$2 127 531.88	7	$19 263.96	$33 033.01	$52 296.97	5	$1 160 614.88	$1 319 262.31	$1 047	$3 527 643.71	7
2.2.2.7	$196 287.57	$968 479.73	$835 109.95	$1 999 877.24	4	$19 371.18	$31 499.57	$50 870.75	4	$1 110 968.49	$1 094 475.09	$1 155	$3 361 335.04	4
2.2.2.8	$193 979.46	$910 384.16	$850 481.19	$1 954 844.81	3	$19 287.73	$30 988.42	$50 276.15	3	$1 094 386.03	$1 028 821.52	$1 177	$3 300 374.63	3
2.2.2.9	$192 821.46	$881 336.37	$857 258.41	$1 931 416.24	2	$19 232.34	$30 732.84	$49 965.18	2	$1 086 088.29	$995 994.74	$1 186	$3 268 630.59	2
2.2.2.10	$213 991.62	$1 423 083.37	$759 281.47	$2 396 356.46	9	$20 687.35	$35 495.83	$56 183.18	9	$1 240 051.02	$1 608 220.87	$1 050	$3 899 207.71	9
RB 48 hr 2.2.2	$189 331.31	$780 795.83	$1 216	$2 186 712.54		$24 083.94	$29 966.12	$54 050.06		$1 061 168.48	$882 374.27	$1 683	$3 627 441.57	
RB 24 hr 2.2.2	$189 331.31	$780 795.83	$813 844.50	$1 783 971.64		$18 042.83	$29 966.12	$48 008.94		$1 061 168.48	$882 374.27	$1 126	$3 070 000.28	
2.2.3.1	$321 255.08	$1 510 285.24	$949 596.19	$2 781 136.51	1	$25 072.17	$62 263.61	$87 335.78	1	$2 086 014.53	$1 706 767.35	$1 314	$5 107 135.90	1
2.2.3.2	$348 063.86	$2 197 630.23	$819 563.27	$3 365 257.36	8	$26 831.85	$69 563.18	$96 395.04	8	$2 312 684.29	$2 483 533.20	$1 134	$5 930 590.48	8
2.2.3.3	$369 030.30	$2 722 954.51	$790 674.05	$3 882 658.86	1	$29 238.99	$75 424.96	$104 663.96	1	$2 493 781.24	$3 077 200.07	$1 094	$6 665 368.20	1
2.2.3.4	$348 063.86	$2 205 571.89	$785 226.68	$3 338 862.44	7	$26 356.51	$69 563.18	$95 919.69	7	$2 312 684.29	$2 492 508.04	$1 086	$5 892 039.41	7
2.2.3.5	$348 063.86	$2 213 513.56	$771 908.07	$3 333 485.48	5	$26 196.44	$69 563.18	$95 759.62	6	$2 312 684.29	$2 501 482.88	$1 068	$5 882 579.70	5
2.2.3.6	$348 063.86	$2 221 455.22	$765 459.04	$3 334 978.12	6	$26 139.41	$69 563.18	$95 702.60	5	$2 312 684.29	$2 510 457.72	$1 059	$5 882 628.33	6
2.2.3.7	$334 762.33	$1 860 509.26	$891 696.53	$3 086 968.13	4	$26 092.57	$65 913.40	$92 005.97	4	$2 199 518.92	$2 102 554.13	$1 234	$5 536 287.06	4
2.2.3.8	$330 283.50	$1 748 135.61	$910 693.40	$2 989 112.50	3	$25 769.97	$64 696.80	$90 466.77	3	$2 161 722.99	$1 975 561.11	$1 260	$5 397 792.03	3
2.2.3.9	$328 035.34	$1 691 948.78	$916 695.04	$2 936 679.16	2	$25 556.13	$64 088.51	$89 644.64	2	$2 142 810.63	$1 912 064.60	$1 268	$5 323 690.14	2
2.2.3.10	$369 030.30	$2 731 885.24	$769 070.45	$3 869 985.99	9	$28 959.59	$75 424.96	$104 384.56	9	$2 493 781.24	$3 087 292.66	$1 064	$6 645 558.83	9
RB 48 hr 2.2.3	$321 255.08	$1 510 285.24	$1 216	$3 048 125.72		$29 077.01	$62 263.61	$91 340.62		$2 086 014.53	$1 706 767.35	$1 683	$5 476 680.71	
RB 24 hr 2.2.3	$321 255.08	$1 510 285.24	$813 844.50	$2 645 384.82		$23 035.90	$62 263.61	$85 299.51		$2 086 014.53	$1 706 767.35	$1 126	$4 919 239.42	
2.2.4.1	$632 168.15	$3 716 343.63	$1 106	$5 454 696.83	1	$41 622.61	$158 799.55	$200 422.16	1	$5 011 793.60	$4 199 825.18	$1 531	$10 742 710.39	1
2.2.4.2	$688 275.05	$5 388 413.10	$910 762.15	$6 987 450.31	8	$47 623.90	$178 618.85	$226 242.76	8	$5 599 739.64	$6 089 424.25	$1 260	$12 949 766.98	8
2.2.4.3	$732 087.43	$6 682 697.20	$858 732.13	$8 273 516.76	1	$53 761.76	$194 534.37	$248 296.13	1	$6 069 829.79	$7 552 089.57	$1 188	$14 810 506.71	1
2.2.4.4	$688 275.05	$5 396 233.56	$835 137.59	$6 919 646.20	7	$46 528.64	$178 618.85	$225 147.49	7	$5 599 739.64	$6 098 262.12	$1 155	$12 853 931.46	7
2.2.4.5	$688 275.05	$5 404 054.02	$804 327.00	$6 896 656.07	6	$46 105.58	$178 618.85	$224 724.43	6	$5 599 739.64	$6 107 099.98	$1 113	$12 820 123.81	6
2.2.4.6	$688 275.05	$5 411 874.47	$790 303.02	$6 890 452.54	5	$45 934.32	$178 618.85	$224 553.18	5	$5 599 739.64	$6 115 937.85	$1 093	$12 809 550.82	5
2.2.4.7	$660 449.97	$4 558 862.95	$1 006	$6 225 599.06	4	$44 625.20	$168 709.20	$213 334.40	4	$5 306 142.96	$5 151 952.92	$1 392	$11 850 915.53	4
2.2.4.8	$651 075.15	$4 282 346.23	$1 036	$5 970 100.51	3	$43 602.88	$165 405.98	$209 008.87	3	$5 208 112.96	$4 839 462.47	$1 434	$11 482 462.58	3
2.2.4.9	$646 368.33	$4 144 087.87	$1 042	$5 832 718.56	2	$42 947.33	$163 754.38	$206 701.71	2	$5 159 065.95	$4 683 217.25	$1 442	$11 284 898.21	2
2.2.4.10	$732 087.43	$6 691 492.22	$798 893.40	$8 222 473.04	9	$52 908.15	$194 534.37	$247 442.52	9	$6 069 829.79	$7 562 028.78	$1 105	$14 737 622.01	9
RB 48 hr 2.2.4	$632 168.15	$3 716 343.63	$1 216	$5 565 097.18		$43 278.61	$158 799.55	$202 078.16		$5 011 793.60	$4 199 825.18	$1 683	$10 895 517.60	
RB 24 hr 2.2.4	$632 168.15	$3 716 343.63	$813 844.50	$5 162 356.28		$37 237.50	$158 799.55	$196 037.05		$5 011 793.60	$4 199 825.18	$1 126	$10 338 076.31	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 032 373.67	$147 138.02	$328 269.35
$1 095 711.85	$161 126.10	$329 473.98
$1 151 727.43	$172 358.97	$335 780.11
$1 101 282.52	$161 126.10	$329 439.39
$1 108 605.81	$161 126.10	$330 056.09
$1 117 375.55	$161 126.10	$331 210.31
$1 070 324.25	$154 132.06	$329 494.64
$1 065 226.73	$151 800.71	$330 753.44
$1 061 211.89	$150 635.04	$330 838.31
$1 158 728.67	$172 358.97	$336 015.71
	$147 138.02	$490 573.31
	$147 138.02	$339 545.47
$1 939 543.74	$749 152.95	$474 319.51
$2 226 551.03	$825 825.33	$486 152.29
$2 501 693.98	$887 395.63	$517 254.66
$2 216 551.27	$825 825.33	$480 368.47
$2 220 077.91	$825 825.33	$479 611.21
$2 223 137.86	$825 825.33	$478 680.52
$2 091 987.57	$787 489.14	$481 858.33
$2 045 746.95	$774 710.41	$479 917.27
$2 021 704.46	$768 321.05	$478 605.08
$2 498 185.95	$887 395.63	$513 626.13
	$749 152.95	$600 146.50
	$749 152.95	$449 118.66
$2 927 517.00	$1 556	$623 028.56
$3 526 208.68	$1 739	$665 302.21
$4 055 576.65	$1 885	$724 167.42
$3 499 560.97	$1 739	$653 398.85
$3 494 122.90	$1 739	$649 377.22
$3 495 617.05	$1 739	$647 931.69
$3 240 789.12	$1 647	$647 662.98
$3 140 493.01	$1 617	$639 878.93
$3 086 804.10	$1 602	$634 673.38
$4 042 774.62	$1 885	$717 160.09
	$1 556	$723 149.51
	$1 556	$572 121.67
$5 741 447.29	$3 969	$1 031 274.37
$7 307 169.10	$4 465	$1 177 126.55
$8 619 810.21	$4 863	$1 327 337.25
$7 238 734.79	$4 465	$1 149 725.35
$7 215 523.10	$4 465	$1 139 129.38
$7 209 251.10	$4 465	$1 134 828.39
$6 528 952.74	$4 217	$1 104 232.76
$6 267 946.73	$4 135	$1 079 366.25
$6 127 715.76	$4 093	$1 063 323.07
$8 568 287.64	$4 863	$1 305 975.12
	$3 969	$1 072 674.50
	$3 969	$921 646.66

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.3.1.1	$91 888.08	$219 766.52	$1 133	$1 444 799.25	1	$19 033.26	$11 025.03	$30 058.29	1	$427 056.10	$248 357.27	$1 568	$2 243 820.27	1	$1 492 912.43	$275 625.74	$475 282.10
2.3.1.2	$96 342.47	$335 479.61	$1 086	$1 518 690.67	5	$18 963.12	$11 771.04	$30 734.16	5	$453 047.17	$379 124.17	$1 504	$2 336 526.68	5	$1 569 011.34	$294 276.04	$473 239.30
2.3.1.3	$99 863.03	$411 618.58	$1 082	$1 594 035.58	9	$19 315.01	$12 370.11	$31 685.12	9	$473 825.77	$465 168.53	$1 498	$2 437 377.69	9	$1 646 278.80	$309 252.81	$481 846.09
2.3.1.4	$96 342.47	$347 465.87	$1 082	$1 526 807.63	6	$18 965.01	$11 771.04	$30 736.05	6	$453 047.17	$392 669.80	$1 498	$2 344 716.74	6	$1 577 184.07	$294 276.04	$473 256.63
2.3.1.5	$96 342.47	$359 452.13	$1 080	$1 536 649.70	7	$18 992.78	$11 771.04	$30 763.82	7	$453 047.17	$406 215.43	$1 496	$2 355 294.55	7	$1 587 097.64	$294 276.04	$473 920.88
2.3.1.6	$96 342.47	$371 438.39	$1 080	$1 548 540.93	8	$19 051.29	$11 771.04	$30 822.33	8	$453 047.17	$419 761.05	$1 495	$2 368 708.64	8	$1 599 079.04	$294 276.04	$475 353.56
2.3.1.7	$94 125.37	$286 424.04	$1 110	$1 490 960.85	4	$19 048.37	$11 398.04	$30 446.41	4	$440 068.27	$323 686.67	$1 536	$2 300 696.38	4	$1 540 252.29	$284 950.89	$475 493.20
2.3.1.8	$93 381.89	$270 072.19	$1 121	$1 484 892.15	3	$19 124.43	$11 273.70	$30 398.13	3	$435 734.65	$305 207.50	$1 552	$2 293 145.77	3	$1 533 867.76	$281 842.51	$477 435.50
2.3.1.9	$93 009.30	$261 896.26	$1 124	$1 479 171.38	2	$19 122.16	$11 211.53	$30 333.70	2	$433 566.43	$295 967.92	$1 556	$2 285 651.91	2	$1 527 964.24	$280 288.32	$477 399.35
2.3.1.10	$99 863.03	$425 030.15	$1 080	$1 605 523.62	1	$19 353.21	$12 370.11	$31 723.32	1	$473 825.77	$480 324.88	$1 495	$2 449 871.66	1	$1 657 851.17	$309 252.81	$482 767.68
RB 48 hr 2.3.1	$91 888.08	$219 766.52	$1 818	$2 130 266.69		$29 315.27	$11 025.03	$40 340.30		$427 056.10	$248 357.27	$2 517	$3 192 588.70			$275 625.74	$732 332.39
RB 24 hr 2.3.1	$91 888.08	$219 766.52	$1 216	$1 528 239.99		$20 284.87	$11 025.03	$31 309.90		$427 056.10	$248 357.27	$1 683	$2 359 312.19			$275 625.74	$506 572.38
2.3.2.1	$296 946.24	$1 079 615.25	$1 284	$2 661 316.65	1	$27 698.26	$55 843.15	$83 541.40	1	$1 885 442.26	$1 220 068.91	$1 778	$4 883 765.05	1	$2 797 928.97	$1 396	$689 757.35
2.3.2.2	$312 512.30	$1 578 909.87	$1 130	$3 022 198.66	8	$28 043.82	$59 932.24	$87 976.06	8	$2 013 322.11	$1 784 319.78	$1 565	$5 362 770.97	8	$3 167 316.79	$1 498	$697 148.28
2.3.2.3	$324 800.00	$1 954 734.63	$1 108	$3 388 515.82	1	$29 721.35	$63 215.90	$92 937.25	1	$2 115 663.67	$2 209 037.85	$1 534	$5 859 663.31	1	$3 541 118.87	$1 580	$738 146.94
2.3.2.4	$312 512.30	$1 590 642.31	$1 103	$3 006 541.42	5	$27 691.64	$59 932.24	$87 623.88	7	$2 013 322.11	$1 797 578.55	$1 527	$5 338 119.17	5	$3 151 498.89	$1 498	$688 314.37
2.3.2.5	$312 512.30	$1 602 374.74	$1 095	$3 010 473.12	6	$27 633.29	$59 932.24	$87 565.53	6	$2 013 322.11	$1 810 837.33	$1 516	$5 340 580.81	6	$3 155 448.58	$1 498	$686 826.32
2.3.2.6	$312 512.30	$1 614 107.17	$1 088	$3 014 763.40	7	$27 580.32	$59 932.24	$87 512.56	5	$2 013 322.11	$1 824 096.10	$1 506	$5 343 538.76	7	$3 159 760.12	$1 498	$685 472.74
2.3.2.7	$304 767.35	$1 347 530.33	$1 216	$2 869 052.32	4	$28 097.60	$57 887.69	$85 985.29	4	$1 949 444.94	$1 522 838.68	$1 684	$5 156 416.68	4	$3 010 153.24	$1 447	$699 071.13
2.3.2.8	$302 168.95	$1 270 403.82	$1 238	$2 811 183.59	3	$28 013.30	$57 206.18	$85 219.48	3	$1 928 124.94	$1 435 678.31	$1 714	$5 078 187.88	3	$2 950 876.82	$1 430	$697 156.61
2.3.2.9	$300 866.53	$1 231 840.56	$1 245	$2 778 230.68	2	$27 910.90	$56 865.42	$84 776.32	2	$1 917 459.65	$1 392 098.13	$1 723	$5 033 510.48	2	$2 917 182.18	$1 421	$694 692.78
2.3.2.10	$324 800.00	$1 967 867.16	$1 090	$3 383 556.08	9	$29 515.63	$63 215.90	$92 731.53	9	$2 115 663.67	$2 223 878.86	$1 509	$5 849 462.48	9	$3 536 093.91	$1 580	$732 971.07
RB 48 hr 2.3.2	$296 946.24	$1 079 615.25	$1 818	$3 195 173.58		$35 706.11	$55 843.15	$91 549.26		$1 885 442.26	$1 220 068.91	$2 517	$5 622 686.50			$1 396	$889 953.69
RB 24 hr 2.3.2	$296 946.24	$1 079 615.25	$1 216	$2 593 146.89		$26 675.71	$55 843.15	$82 518.86		$1 885 442.26	$1 220 068.91	$1 683	$4 789 409.99			$1 396	$664 193.68
2.3.3.1	$499 967.92	$2 088 288.52	$1 386	$3 975 184.27	1	$36 345.03	$114 794.72	$151 139.75	1	$3 693 808.64	$2 359 966.56	$1 919	$7 973 448.21	1	$4 200 175.08	$2 869	$903 405.10
2.3.3.2	$530 267.12	$3 037 375.07	$1 180	$4 747 868.59	8	$38 299.00	$124 527.23	$162 826.22	8	$3 987 053.98	$3 432 525.50	$1 633	$9 053 153.14	8	$4 990 090.98	$3 113	$949 881.46
2.3.3.3	$554 125.02	$3 764 730.68	$1 135	$5 454 682.78	1	$41 513.13	$132 342.73	$173 855.87	1	$4 221 759.14	$4 254 507.19	$1 572	$10 048 386.04	1	$5 711 401.17	$3 308	$1 028 416.55
2.3.3.4	$530 267.12	$3 048 647.68	$1 128	$4 707 248.76	7	$37 576.97	$124 527.23	$162 104.20	7	$3 987 053.98	$3 445 264.63	$1 561	$8 994 066.97	7	$4 949 083.58	$3 113	$931 802.69
2.3.3.5	$530 267.12	$3 059 920.28	$1 107	$4 697 527.19	5	$37 318.42	$124 527.23	$161 845.65	6	$3 987 053.98	$3 458 003.76	$1 532	$8 977 747.66	5	$4 939 256.20	$3 113	$925 310.77
2.3.3.6	$530 267.12	$3 071 192.89	$1 099	$4 701 080.12	6	$37 258.99	$124 527.23	$161 786.22	5	$3 987 053.98	$3 470 742.89	$1 522	$8 979 801.83	6	$4 942 824.36	$3 113	$923 796.78
2.3.3.7	$515 202.87	$2 571 234.09	$1 296	$4 382 516.08	4	$37 552.43	$119 660.97	$157 213.40	4	$3 840 571.97	$2 905 741.43	$1 793	$8 540 241.00	4	$4 616 334.06	$2 991	$932 382.58
2.3.3.8	$510 143.96	$2 415 853.76	$1 327	$4 253 900.00	3	$37 201.27	$118 038.89	$155 240.16	3	$3 791 682.85	$2 730 146.74	$1 837	$8 359 804.20	3	$4 484 839.80	$2 950	$923 992.15
2.3.3.9	$507 607.29	$2 338 163.60	$1 335	$4 181 492.83	2	$36 904.24	$117 227.85	$154 132.09	2	$3 767 226.40	$2 642 349.40	$1 848	$8 258 373.75	2	$4 410 916.93	$2 930	$916 760.63
2.3.3.10	$554 125.02	$3 777 357.11	$1 104	$5 436 023.38	9	$41 106.98	$132 342.73	$173 449.71	9	$4 221 759.14	$4 268 776.27	$1 528	$10 019 351.81	9	$5 692 552.39	$3 308	$1 018 231.10
RB 48 hr 2.3.3	$499 967.92	$2 088 288.52	$1 818	$4 406 868.53		$42 820.30	$114 794.72	$157 615.02		$3 693 808.64	$2 359 966.56	$2 517	$8 570 950.54			$2 869	$1 065 286.70
RB 24 hr 2.3.3	$499 967.92	$2 088 288.52	$1 216	$3 804 841.84		$33 789.90	$114 794.72	$148 584.62		$3 693 808.64	$2 359 966.56	$1 683	$7 737 674.02			$2 869	$839 526.69
2.3.4.1	$979 943.34	$5 138 630.46	$1 606	$7 725 319.81	1	$59 789.76	$291 174.05	$350 963.81	1	$8 894 285.02	$5 807 145.88	$2 223	$16 925 358.38	1	$8 164 109.68	$7 279	$1 481 897.53
2.3.4.2	$1 043	$7 449 258.55	$1 309	$9 801 857.08	8	$67 526.65	$317 599.10	$385 125.74	8	$9 659 591.84	$8 418 377.51	$1 811	$19 889 967.74	8	$10 280 447.29	$7 939	$1 669 542.99
2.3.4.3	$1 093	$9 239 861.98	$1 231	$11 564 832.41	1	$75 825.47	$338 819.24	$414 644.70	1	$10 272 416.52	$10 441 931.34	$1 704	$22 418 965.33	1	$12 075 947.37	$8 470	$1 872 537.06
2.3.4.4	$1 043	$7 460 322.13	$1 197	$9 701 426.99	7	$65 909.56	$317 599.10	$383 508.66	7	$9 659 591.84	$8 430 880.42	$1 657	$19 748 150.15	7	$10 179 084.54	$7 939	$1 629 088.15
2.3.4.5	$1 043	$7 471 385.71	$1 154	$9 669 274.03	6	$65 316.63	$317 599.10	$382 915.73	6	$9 659 591.84	$8 443 383.33	$1 597	$19 700 836.24	6	$10 146 621.54	$7 939	$1 614 237.24
2.3.4.6	$1 043	$7 482 449.30	$1 132	$9 658 219.84	5	$65 040.18	$317 599.10	$382 639.28	5	$9 659 591.84	$8 455 886.24	$1 567	$19 682 725.52	5	$10 135 449.70	$7 939	$1 607 298.36
2.3.4.7	$1 011	$6 302 230.15	$1 463	$8 777 837.44	4	$63 788.17	$304 386.57	$368 174.74	4	$9 277 253.20	$7 122 125.26	$2 025	$18 425 331.02	4	$9 236 718.12	$7 609	$1 578 948.59
2.3.4.8	$1 001	$5 919 887.35	$1 506	$8 427 943.65	3	$62 414.10	$299 982.40	$362 396.50	3	$9 149 668.83	$6 690 041.18	$2 085	$17 925 257.03	3	$8 880 144.30	$7 499	$1 545 552.80
2.3.4.9	$995 968.00	$5 728 715.95	$1 514	$8 239 259.14	2	$61 521.08	$297 780.31	$359 301.39	2	$9 085 850.01	$6 473 999.14	$2 096	$17 656 201.29	2	$8 687 988.30	$7 444	$1 523 705.24
2.3.4.10	$1 093	$9 252 258.08	$1 146	$11 491 850.93	9	$74 606.79	$338 819.24	$413 426.02	9	$10 272 416.52	$10 455 940.11	$1 586	$22 314 801.39	9	$12 002 281.50	$8 470	$1 842 038.99
RB 48 hr 2.3.4	$979 943.34	$5 138 630.46	$1 818	$7 937 185.90		$62 967.76	$291 174.05	$354 141.80		$8 894 285.02	$5 807 145.88	$2 517	$17 218 606.24			$7 279	$1 561 347.32
RB 24 hr 2.3.4	$979 943.34	$5 138 630.46	$1 216	$7 335 159.21		$53 937.36	$291 174.05	$345 111.40		$8 894 285.02	$5 807 145.88	$1 683	$16 385 329.72			$7 279	$1 335 587.31

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.4.1.1	$121 555.26	$260 988.68	$1 482	$1 864 582.43	1	$24 775.38	$16 234.90	$41 010.29	1	$606 194.07	$294 942.27	$2 051	$2 952 453.82	1	$1 927 849.08	$405 872.60	$618 732.14
2.4.1.2	$126 751.45	$398 392.16	$1 430	$1 955 852.19	5	$24 745.45	$17 202.59	$41 948.04	6	$638 949.47	$450 221.40	$1 980	$3 069 441.63	5	$2 021 736.52	$430 064.73	$617 640.38
2.4.1.3	$130 865.69	$489 314.97	$1 424	$2 045 162.21	9	$25 156.13	$17 979.67	$43 135.80	9	$665 156.72	$552 972.91	$1 972	$3 190 473.50	9	$2 113 301.81	$449 491.77	$627 679.92
2.4.1.4	$126 751.45	$413 310.58	$1 425	$1 965 450.55	6	$24 740.25	$17 202.59	$41 942.83	5	$638 949.47	$467 080.64	$1 972	$3 078 937.27	6	$2 031 399.68	$430 064.73	$617 472.86
2.4.1.5	$126 751.45	$428 229.00	$1 423	$1 978 272.14	7	$24 783.39	$17 202.59	$41 985.97	7	$638 949.47	$483 939.89	$1 970	$3 092 894.26	7	$2 044 315.47	$430 064.73	$618 514.06
2.4.1.6	$126 751.45	$443 147.41	$1 424	$1 994 052.16	8	$24 870.90	$17 202.59	$42 073.49	8	$638 949.47	$500 799.13	$1 971	$3 110 946.07	8	$2 060 216.67	$430 064.73	$620 664.66
2.4.1.7	$124 163.77	$340 135.12	$1 455	$1 919 648.72	4	$24 797.39	$16 718.75	$41 516.14	4	$622 588.93	$384 385.34	$2 014	$3 021 351.47	4	$1 984 298.30	$417 968.67	$619 084.50
2.4.1.8	$123 296.62	$320 716.10	$1 469	$1 913 863.76	3	$24 908.97	$16 557.47	$41 466.44	3	$617 127.86	$362 439.99	$2 034	$3 014 016.43	3	$1 978 157.29	$413 936.64	$621 922.50
2.4.1.9	$122 862.16	$311 006.59	$1 474	$1 908 042.05	2	$24 920.83	$16 476.83	$41 397.65	2	$614 395.87	$351 467.32	$2 040	$3 006 294.28	2	$1 972 130.50	$411 920.63	$622 243.14
2.4.1.10	$130 865.69	$505 934.91	$1 420	$2 057 235.96	1	$25 171.03	$17 979.67	$43 150.71	1	$665 156.72	$571 755.03	$1 966	$3 202 963.16	1	$2 125 460.35	$449 491.77	$628 011.04
RB 48 hr 2.4.1	$121 555.26	$260 988.68	$2 300	$2 683 312.88		$37 056.34	$16 234.90	$53 291.25		$606 194.07	$294 942.27	$3 184	$4 085 674.08			$405 872.60	$925 756.06
RB 24 hr 2.4.1	$121 555.26	$260 988.68	$1 539	$1 921 674.99		$25 631.77	$16 234.90	$41 866.68		$606 194.07	$294 942.27	$2 130	$3 031 476.70			$405 872.60	$640 141.85
2.4.2.1	$392 261.56	$1 282 944.45	$1 666	$3 341 235.97	1	$35 406.24	$82 070.47	$117 476.71	1	$2 698 203.78	$1 449 850.43	$2 305	$6 454 037.74	1	$3 520 327.26	$2 051	$881 948.63
2.4.2.2	$410 370.87	$1 876 210.93	$1 484	$3 770 887.48	8	$35 831.42	$87 356.91	$123 188.34	8	$2 860 208.68	$2 120 298.52	$2 054	$7 034 962.72	8	$3 959 944.84	$2 183	$891 095.04
2.4.2.3	$424 694.05	$2 323 319.42	$1 459	$4 207 871.43	1	$37 846.35	$91 602.09	$129 448.43	1	$2 989 942.47	$2 625 574.05	$2 020	$7 636 133.49	1	$4 405 730.93	$2 290	$940 350.35
2.4.2.4	$410 370.87	$1 890 797.98	$1 449	$3 751 092.87	5	$35 388.63	$87 356.91	$122 745.55	7	$2 860 208.68	$2 136 783.29	$2 006	$7 003 859.17	5	$3 939 947.51	$2 183	$879 988.83
2.4.2.5	$410 370.87	$1 905 385.04	$1 441	$3 757 010.42	6	$35 331.53	$87 356.91	$122 688.44	6	$2 860 208.68	$2 153 268.06	$1 994	$7 008 344.32	6	$3 945 896.81	$2 183	$878 524.68
2.4.2.6	$410 370.87	$1 919 972.09	$1 431	$3 761 728.97	7	$35 256.43	$87 356.91	$122 613.35	5	$2 860 208.68	$2 169 752.84	$1 981	$7 011 169.91	7	$3 950 636.17	$2 183	$876 610.90
2.4.2.7	$401 355.35	$1 589 836.23	$1 579	$3 570 192.23	4	$35 728.02	$84 713.69	$120 441.71	4	$2 779 270.72	$1 796 667.61	$2 185	$6 761 462.95	4	$3 754 394.82	$2 117	$889 225.80
2.4.2.8	$398 332.94	$1 494 378.00	$1 608	$3 500 798.29	3	$35 656.20	$83 832.62	$119 488.82	3	$2 752 263.00	$1 688 790.65	$2 225	$6 666 837.71	3	$3 683 353.24	$2 095	$887 668.96
2.4.2.9	$396 818.44	$1 446 648.89	$1 619	$3 462 518.97	2	$35 566.57	$83 392.08	$118 958.65	2	$2 738 753.70	$1 634 852.16	$2 240	$6 614 565.82	2	$3 644 216.17	$2 084	$885 547.56
2.4.2.10	$424 694.05	$2 339 578.00	$1 435	$4 199 940.76	9	$37 564.80	$91 602.09	$129 166.89	9	$2 989 942.47	$2 643 947.81	$1 987	$7 621 026.45	9	$4 397 703.19	$2 290	$933 271.06
RB 48 hr 2.4.2	$392 261.56	$1 282 944.45	$2 300	$3 975 974.95		$44 927.32	$82 070.47	$126 997.80		$2 698 203.78	$1 449 850.43	$3 184	$7 332 591.95			$2 051	$1 119 975.75
RB 24 hr 2.4.2	$392 261.56	$1 282 944.45	$1 539	$3 214 337.07		$33 502.76	$82 070.47	$115 573.23		$2 698 203.78	$1 449 850.43	$2 130	$6 278 394.57			$2 051	$834 361.54
2.4.3.1	$658 466.79	$2 484 448.75	$1 813	$4 956 906.54	1	$46 348.47	$168 008.92	$214 357.39	1	$5 285 367.69	$2 807 665.67	$2 510	$10 603 812.54	1	$5 251 088.91	$4 200	$1 152 500.63
2.4.3.2	$693 552.49	$3 613 431.42	$1 549	$5 856 750.49	8	$48 387.89	$180 515.94	$228 903.83	8	$5 655 863.87	$4 083 524.50	$2 145	$11 884 449.55	8	$6 170 887.44	$4 512	$1 200 663.70
2.4.3.3	$721 241.41	$4 479 274.31	$1 495	$6 695 652.21	1	$52 180.08	$190 559.46	$242 739.54	1	$5 952 582.91	$5 062 010.12	$2 069	$13 084 039.66	1	$7 026 749.34	$4 763	$1 293 303.84
2.4.3.4	$693 552.49	$3 627 416.78	$1 484	$5 805 666.92	7	$47 481.78	$180 515.94	$227 997.72	7	$5 655 863.87	$4 099 329.30	$2 054	$11 810 191.22	7	$6 119 316.75	$4 512	$1 177 976.06
2.4.3.5	$693 552.49	$3 641 402.13	$1 459	$5 794 428.61	5	$47 173.36	$180 515.94	$227 689.29	6	$5 655 863.87	$4 115 134.09	$2 020	$11 791 083.47	6	$6 107 954.66	$4 512	$1 170 230.39
2.4.3.6	$693 552.49	$3 655 387.49	$1 447	$5 796 346.99	6	$47 062.28	$180 515.94	$227 578.21	5	$5 655 863.87	$4 130 938.89	$2 003	$11 790 186.12	5	$6 109 869.23	$4 512	$1 167 418.48
2.4.3.7	$676 096.85	$3 058 860.84	$1 686	$5 421 029.48	4	$47 481.57	$174 262.43	$221 744.00	4	$5 470 759.50	$3 456 806.49	$2 333	$11 261 289.78	4	$5 725 337.01	$4 356	$1 179 392.07
2.4.3.8	$670 239.94	$2 874 003.98	$1 722	$5 266 286.87	3	$47 037.11	$172 177.93	$219 215.04	3	$5 408 994.82	$3 247 900.49	$2 383	$11 040 407.47	3	$5 567 216.55	$4 304	$1 168 742.78
2.4.3.9	$667 304.13	$2 781 575.55	$1 733	$5 182 299.14	2	$46 715.67	$171 135.67	$217 851.35	2	$5 378 100.35	$3 143 447.49	$2 399	$10 920 806.45	2	$5 481 476.74	$4 278	$1 160 937.85
2.4.3.10	$721 241.41	$4 494 876.01	$1 454	$6 670 156.97	9	$51 641.64	$190 559.46	$242 201.09	9	$5 952 582.91	$5 079 641.53	$2 012	$13 044 788.04	9	$7 000 997.86	$4 763	$1 279 803.70
RB 48 hr 2.4.3	$658 466.79	$2 484 448.75	$2 300	$5 443 684.48		$53 650.14	$168 008.92	$221 659.06		$5 285 367.69	$2 807 665.67	$3 184	$11 277 571.09			$4 200	$1 335 042.36
RB 24 hr 2.4.3	$658 466.79	$2 484 448.75	$1 539	$4 682 046.59		$42 225.57	$168 008.92	$210 234.49		$5 285 367.69	$2 807 665.67	$2 130	$10 223 373.71			$4 200	$1 049 428.15
2.4.4.1	$1 288	$6 116 636.13	$2 091	$9 497 013.20	1	$75 103.73	$425 219.64	$500 323.37	1	$12 754 027.76	$6 912 386.20	$2 895	$22 561 731.83	1	$10 068 939.22	$10 630	$1 862 301.64
2.4.4.2	$1 361	$8 866 841.40	$1 722	$11 951 014.20	8	$84 059.34	$459 086.05	$543 145.39	8	$13 721 662.57	$10 020 382.25	$2 383	$26 125 776.14	8	$12 569 308.57	$11 477	$2 079 316.29
2.4.4.3	$1 419	$10 998 744.17	$1 623	$14 042 358.15	1	$93 832.71	$486 281.83	$580 114.54	1	$14 496 919.52	$12 429 637.11	$2 247	$29 174 056.30	1	$14 698 689.59	$12 157	$2 318 320.90
2.4.4.4	$1 361	$8 880 552.65	$1 579	$11 821 779.80	7	$81 983.71	$459 086.05	$541 069.76	7	$13 721 662.57	$10 035 877.28	$2 185	$25 943 417.40	7	$12 438 874.83	$11 477	$2 027 391.30
2.4.4.5	$1 361	$8 894 263.89	$1 520	$11 777 014.07	6	$81 175.11	$459 086.05	$540 261.16	6	$13 721 662.57	$10 051 372.31	$2 104	$25 877 973.34	6	$12 393 680.01	$11 477	$2 007 142.06
2.4.4.6	$1 361	$8 907 975.14	$1 494	$11 764 150.55	5	$80 845.04	$459 086.05	$539 931.09	5	$13 721 662.57	$10 066 867.34	$2 068	$25 856 685.73	5	$12 380 678.30	$11 477	$1 998 856.15
2.4.4.7	$1 325	$7 501 505.75	$1 902	$10 729 519.40	4	$79 565.51	$442 152.84	$521 718.36	4	$13 238 166.08	$8 477 421.86	$2 633	$24 348 944.88	4	$11 324 739.69	$11 053	$1 970 384.07
2.4.4.8	$1 313	$7 046 393.87	$1 960	$10 319 766.34	3	$78 029.16	$436 508.44	$514 537.60	3	$13 076 859.52	$7 963 101.73	$2 713	$23 753 062.93	3	$10 907 238.80	$10 912	$1 933 113.06
2.4.4.9	$1 307	$6 818 837.92	$1 970	$10 096 766.96	2	$76 989.22	$433 686.24	$510 675.46	2	$12 996 179.13	$7 705 941.66	$2 727	$23 430 033.43	2	$10 680 193.93	$10 842	$1 907 683.45
2.4.4.10	$1 419	$11 014 046.28	$1 510	$13 944 303.81	9	$92 208.87	$486 281.83	$578 490.71	9	$14 496 919.52	$12 446 929.96	$2 090	$29 034 450.35	9	$14 599 717.80	$12 157	$2 277 686.74
RB 48 hr 2.4.4	$1 288	$6 116 636.13	$2 300	$9 705 969.14		$78 238.07	$425 219.64	$503 457.71		$12 754 027.76	$6 912 386.20	$3 184	$22 850 951.70			$10 630	$1 940 660.12
RB 24 hr 2.4.4	$1 288	$6 116 636.13	$1 539	$8 944 331.26		$66 813.50	$425 219.64	$492 033.14		$12 754 027.76	$6 912 386.20	$2 130	$21 796 754.31			$10 630	$1 655 045.91

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
1.2.1.1	$58 367.77	$158 938.83	$716 667.47	$933 974.06	1	$12 140.06	$5 885.52	$18 025.58	1	$243 327.34	$179 616.14	$991 952.97	$1 414 896.45	1	$964 654.34	$147 138.02	$303 104.09
1.2.1.2	$62 328.82	$243 453.76	$678 297.55	$984 080.12	5	$12 027.49	$6 445.04	$18 472.53	7	$263 843.19	$275 126.12	$938 844.44	$1 477 813.75	5	$1 016 609.14	$161 126.10	$300 078.51
1.2.1.3	$65 440.96	$297 803.23	$675 122.79	$1 038 366.99	9	$12 283.36	$6 894.36	$19 177.71	1	$280 204.82	$336 546.25	$934 450.20	$1 551 201.28	9	$1 072 502.92	$172 358.97	$306 339.39
1.2.1.4	$62 328.82	$251 807.99	$674 230.81	$988 367.62	6	$12 008.26	$6 445.04	$18 453.30	5	$263 843.19	$284 567.21	$933 215.59	$1 481 625.99	6	$1 020 923.01	$161 126.10	$299 576.88
1.2.1.5	$62 328.82	$260 162.22	$672 569.89	$995 060.93	7	$12 025.11	$6 445.04	$18 470.16	6	$263 843.19	$294 008.29	$930 916.68	$1 488 768.16	7	$1 027 664.63	$161 126.10	$299 977.43
1.2.1.6	$62 328.82	$268 516.45	$673 707.66	$1 004 552.93	8	$12 083.95	$6 445.04	$18 529.00	8	$263 843.19	$303 449.38	$932 491.49	$1 499 784.06	8	$1 037 230.47	$161 126.10	$301 427.49
1.2.1.7	$60 360.75	$207 975.95	$698 417.04	$966 753.74	4	$12 131.82	$6 165.28	$18 297.10	4	$253 605.78	$235 032.79	$966 692.22	$1 455 330.80	4	$998 423.30	$154 132.06	$302 775.44
1.2.1.8	$59 699.26	$196 150.01	$707 100.71	$962 949.98	3	$12 196.19	$6 072.03	$18 268.22	3	$250 184.31	$221 668.35	$978 711.44	$1 450 564.10	3	$994 348.94	$151 800.71	$304 414.45
1.2.1.9	$59 367.46	$190 237.04	$709 851.38	$959 455.89	2	$12 204.50	$6 025.40	$18 229.91	2	$248 471.84	$214 986.13	$982 518.70	$1 445 976.67	2	$990 704.62	$150 635.04	$304 637.01
1.2.1.10	$65 440.96	$307 195.13	$671 582.22	$1 044 218.31	1	$12 277.21	$6 894.36	$19 171.57	9	$280 204.82	$347 160.00	$929 549.63	$1 556 914.45	1	$1 078 393.30	$172 358.97	$306 162.18
RB 48 hr 1.2.1	$58 367.77	$158 938.83	$1 216	$1 433 891.99		$19 638.83	$5 885.52	$25 524.35		$243 327.34	$179 616.14	$1 683	$2 106 842.29			$147 138.02	$490 573.31
RB 24 hr 1.2.1	$58 367.77	$158 938.83	$813 844.50	$1 031 151.09		$13 597.71	$5 885.52	$19 483.23		$243 327.34	$179 616.14	$1 126	$1 549 401.01			$147 138.02	$339 545.47
1.2.2.1	$189 331.31	$780 795.83	$829 502.96	$1 799 630.10	1	$18 277.70	$29 966.12	$48 243.82	1	$1 061 168.48	$882 374.27	$1 148	$3 091 673.46	1	$1 887 529.93	$749 152.95	$454 990.58
1.2.2.2	$203 150.61	$1 142 766.44	$714 477.99	$2 060 395.04	8	$18 503.14	$33 033.01	$51 536.15	8	$1 160 614.88	$1 291 435.81	$988 922.48	$3 440 973.17	8	$2 155 426.31	$825 825.33	$459 721.54
1.2.2.3	$213 991.62	$1 413 855.12	$697 084.89	$2 324 931.63	1	$19 708.26	$35 495.83	$55 204.09	1	$1 240 051.02	$1 597 792.06	$964 848.36	$3 802 691.44	1	$2 426 123.87	$887 395.63	$489 171.95
1.2.2.4	$203 150.61	$1 150 974.14	$690 803.69	$2 044 928.44	5	$18 189.06	$33 033.01	$51 222.08	7	$1 160 614.88	$1 300 711.31	$956 154.43	$3 417 480.62	6	$2 139 806.18	$825 825.33	$451 849.12
1.2.2.5	$203 150.61	$1 159 181.85	$683 664.11	$2 045 996.57	6	$18 123.01	$33 033.01	$51 156.02	6	$1 160 614.88	$1 309 986.81	$946 272.40	$3 416 874.10	5	$2 140 871.54	$825 825.33	$450 177.22
1.2.2.6	$203 150.61	$1 167 389.56	$678 771.34	$2 049 311.51	7	$18 090.65	$33 033.01	$51 123.67	5	$1 160 614.88	$1 319 262.31	$939 500.23	$3 419 377.42	7	$2 144 204.21	$825 825.33	$449 347.88
1.2.2.7	$196 287.57	$968 479.73	$779 780.68	$1 944 547.97	4	$18 541.24	$31 499.57	$50 040.81	4	$1 110 968.49	$1 094 475.09	$1 079	$3 284 752.75	4	$2 036 153.76	$787 489.14	$461 109.85
1.2.2.8	$193 979.46	$910 384.16	$795 824.20	$1 900 187.82	3	$18 467.87	$30 988.42	$49 456.29	3	$1 094 386.03	$1 028 821.52	$1 101	$3 224 722.86	3	$1 990 591.55	$774 710.41	$459 420.90
1.2.2.9	$192 821.46	$881 336.37	$801 923.44	$1 876 081.27	2	$18 402.31	$30 732.84	$49 135.15	2	$1 086 088.29	$995 994.74	$1 109	$3 192 040.41	2	$1 965 864.89	$768 321.05	$457 854.47
1.2.2.10	$213 991.62	$1 423 083.37	$680 345.86	$2 317 420.85	9	$19 503.32	$35 495.83	$54 999.14	9	$1 240 051.02	$1 608 220.87	$941 679.54	$3 789 951.43	9	$2 418 530.54	$887 395.63	$484 025.27
RB 48 hr 1.2.2	$189 331.31	$780 795.83	$1 216	$2 186 712.54		$24 083.94	$29 966.12	$54 050.06		$1 061 168.48	$882 374.27	$1 683	$3 627 441.57			$749 152.95	$600 146.50
RB 24 hr 1.2.2	$189 331.31	$780 795.83	$813 844.50	$1 783 971.64		$18 042.83	$29 966.12	$48 008.94		$1 061 168.48	$882 374.27	$1 126	$3 070 000.28			$749 152.95	$449 118.66
1.2.3.1	$321 255.08	$1 510 285.24	$906 652.88	$2 738 193.20	1	$24 428.02	$62 263.61	$86 691.64	1	$2 086 014.53	$1 706 767.35	$1 254	$5 047 697.26	1	$2 884 182.09	$1 556	$606 924.82
1.2.3.2	$348 063.86	$2 197 630.23	$753 636.83	$3 299 330.92	8	$25 842.95	$69 563.18	$95 406.14	8	$2 312 684.29	$2 483 533.20	$1 043	$5 839 340.45	8	$3 459 681.07	$1 739	$640 579.80
1.2.3.3	$369 030.30	$2 722 954.51	$719 828.05	$3 811 812.85	1	$28 176.30	$75 424.96	$103 601.27	1	$2 493 781.24	$3 077 200.07	$996 327.60	$6 567 308.91	1	$3 984 084.61	$1 885	$697 600.17
1.2.3.4	$348 063.86	$2 205 571.89	$711 675.17	$3 265 310.93	7	$25 253.24	$69 563.18	$94 816.42	7	$2 312 684.29	$2 492 508.04	$985 043.05	$5 790 235.38	7	$3 425 338.76	$1 739	$625 817.03
1.2.3.5	$348 063.86	$2 213 513.56	$696 923.06	$3 258 500.48	5	$25 071.67	$69 563.18	$94 634.85	6	$2 312 684.29	$2 501 482.88	$964 624.37	$5 778 791.54	6	$3 418 454.11	$1 739	$621 257.84
1.2.3.6	$348 063.86	$2 221 455.22	$689 402.06	$3 258 921.14	6	$24 998.56	$69 563.18	$94 561.74	5	$2 312 684.29	$2 510 457.72	$954 214.41	$5 777 356.42	5	$3 418 866.51	$1 739	$619 410.32
1.2.3.7	$334 762.33	$1 860 509.26	$842 292.38	$3 037 563.97	4	$25 351.51	$65 913.40	$91 264.91	4	$2 199 518.92	$2 102 554.13	$1 165	$5 467 905.84	4	$3 190 934.45	$1 647	$629 136.42
1.2.3.8	$330 283.50	$1 748 135.61	$863 479.22	$2 941 898.33	3	$25 061.76	$64 696.80	$89 758.56	3	$2 161 722.99	$1 975 561.11	$1 195	$5 332 441.99	3	$3 092 848.29	$1 617	$622 173.61
1.2.3.9	$328 035.34	$1 691 948.78	$867 912.57	$2 887 896.70	2	$24 824.39	$64 088.51	$88 912.90	2	$2 142 810.63	$1 912 064.60	$1 201	$5 256 169.41	2	$3 037 576.80	$1 602	$616 379.95
1.2.3.10	$369 030.30	$2 731 885.24	$692 300.60	$3 793 216.13	9	$27 808.04	$75 424.96	$103 233.01	9	$2 493 781.24	$3 087 292.66	$958 226.33	$6 539 300.22	9	$3 965 304.71	$1 885	$688 371.39
RB 48 hr 1.2.3	$321 255.08	$1 510 285.24	$1 216	$3 048 125.72		$29 077.01	$62 263.61	$91 340.62		$2 086 014.53	$1 706 767.35	$1 683	$5 476 680.71			$1 556	$723 149.51
RB 24 hr 1.2.3	$321 255.08	$1 510 285.24	$813 844.50	$2 645 384.82		$23 035.90	$62 263.61	$85 299.51		$2 086 014.53	$1 706 767.35	$1 126	$4 919 239.42			$1 556	$572 121.67
1.2.4.1	$632 168.15	$3 716 343.63	$1 070	$5 418 868.37	1	$41 085.18	$158 799.55	$199 884.73	1	$5 011 793.60	$4 199 825.18	$1 481	$10 693 119.55	1	$5 705 292.12	$3 969	$1 017 838.69
1.2.4.2	$688 275.05	$5 388 413.10	$857 536.58	$6 934 224.74	8	$46 825.52	$178 618.85	$225 444.37	8	$5 599 739.64	$6 089 424.25	$1 186	$12 876 096.46	8	$7 253 458.17	$4 465	$1 157 166.96
1.2.4.3	$732 087.43	$6 682 697.20	$797 795.15	$8 212 579.77	1	$52 847.70	$194 534.37	$247 382.08	1	$6 069 829.79	$7 552 089.57	$1 104	$14 726 162.68	1	$8 558 317.54	$4 863	$1 304 485.88
1.2.4.4	$688 275.05	$5 396 233.56	$769 783.93	$6 854 292.54	7	$45 548.33	$178 618.85	$224 167.19	7	$5 599 739.64	$6 098 262.12	$1 065	$12 763 474.23	7	$7 172 785.18	$4 465	$1 125 217.72
1.2.4.5	$688 275.05	$5 404 054.02	$734 827.30	$6 827 156.37	6	$45 063.09	$178 618.85	$223 681.94	6	$5 599 739.64	$6 107 099.98	$1 017	$12 723 927.96	6	$7 145 389.64	$4 465	$1 113 066.99
1.2.4.6	$688 275.05	$5 411 874.47	$717 870.35	$6 818 019.87	5	$44 847.83	$178 618.85	$223 466.69	5	$5 599 739.64	$6 115 937.85	$993 617.91	$12 709 295.40	5	$7 136 157.92	$4 465	$1 107 666.14
1.2.4.7	$660 449.97	$4 558 862.95	$965 333.34	$6 184 646.26	4	$44 010.90	$168 709.20	$212 720.11	4	$5 306 142.96	$5 151 952.92	$1 336	$11 794 231.98	4	$6 487 626.50	$4 217	$1 088 875.46
1.2.4.8	$651 075.15	$4 282 346.23	$995 724.26	$5 929 145.65	3	$42 988.56	$165 405.98	$208 394.55	3	$5 208 112.96	$4 839 462.47	$1 378	$11 425 776.18	3	$6 226 618.41	$4 135	$1 064 008.18
1.2.4.9	$646 368.33	$4 144 087.87	$1 001	$5 791 837.26	2	$42 334.11	$163 754.38	$206 088.49	2	$5 159 065.95	$4 683 217.25	$1 386	$11 228 313.64	2	$6 086 461.68	$4 093	$1 047 992.59
1.2.4.10	$732 087.43	$6 691 492.22	$728 629.32	$8 152 208.97	9	$51 854.19	$194 534.37	$246 388.56	9	$6 069 829.79	$7 562 028.78	$1 008	$14 640 368.17	9	$8 497 382.83	$4 863	$1 279 626.09
RB 48 hr 1.2.4	$632 168.15	$3 716 343.63	$1 216	$5 565 097.18		$43 278.61	$158 799.55	$202 078.16		$5 011 793.60	$4 199 825.18	$1 683	$10 895 517.60			$3 969	$1 072 674.50
RB 24 hr 1.2.4	$632 168.15	$3 716 343.63	$813 844.50	$5 162 356.28		$37 237.50	$158 799.55	$196 037.05		$5 011 793.60	$4 199 825.18	$1 126	$10 338 076.31			$3 969	$921 646.66

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
1.4.1.1	$121 555.26	$260 988.68	$1 355	$1 737 779.28	1	$22 873.34	$16 234.90	$39 108.24	1	$606 194.07	$294 942.27	$1 875	$2 776 943.17	1	$1 799 889.62	$405 872.60	$571 180.96
1.4.1.2	$126 751.45	$398 392.16	$1 282	$1 807 535.29	5	$22 520.70	$17 202.59	$39 723.29	7	$638 949.47	$450 221.40	$1 774	$2 864 153.41	5	$1 872 067.14	$430 064.73	$562 021.54
1.4.1.3	$130 865.69	$489 314.97	$1 276	$1 896 992.74	9	$22 933.59	$17 979.67	$40 913.26	1	$665 156.72	$552 972.91	$1 767	$2 985 389.34	9	$1 963 781.20	$449 491.77	$572 116.37
1.4.1.4	$126 751.45	$413 310.58	$1 274	$1 814 856.71	6	$22 481.34	$17 202.59	$39 683.93	5	$638 949.47	$467 080.64	$1 764	$2 870 497.50	6	$1 879 432.59	$430 064.73	$561 000.17
1.4.1.5	$126 751.45	$428 229.00	$1 271	$1 826 806.27	7	$22 511.40	$17 202.59	$39 713.99	6	$638 949.47	$483 939.89	$1 760	$2 883 247.50	7	$1 891 468.41	$430 064.73	$561 714.36
1.4.1.6	$126 751.45	$443 147.41	$1 274	$1 844 163.36	8	$22 622.57	$17 202.59	$39 825.16	8	$638 949.47	$500 799.13	$1 763	$2 903 482.15	8	$1 908 961.05	$430 064.73	$564 456.36
1.4.1.7	$124 163.77	$340 135.12	$1 320	$1 784 915.47	4	$22 776.39	$16 718.75	$39 495.14	4	$622 588.93	$384 385.34	$1 827	$2 834 864.63	4	$1 848 336.44	$417 968.67	$568 559.53
1.4.1.8	$123 296.62	$320 716.10	$1 337	$1 781 153.75	3	$22 918.32	$16 557.47	$39 475.79	3	$617 127.86	$362 439.99	$1 850	$2 830 330.00	3	$1 844 237.11	$413 936.64	$572 156.25
1.4.1.9	$122 862.16	$311 006.59	$1 342	$1 775 995.07	2	$22 940.12	$16 476.83	$39 416.95	2	$614 395.87	$351 467.32	$1 857	$2 823 525.56	2	$1 838 879.40	$411 920.63	$572 725.53
1.4.1.10	$130 865.69	$505 934.91	$1 269	$1 906 515.27	1	$22 910.22	$17 979.67	$40 889.90	9	$665 156.72	$571 755.03	$1 757	$2 994 347.80	1	$1 973 365.25	$449 491.77	$571 490.78
RB 48 hr 1.4.1	$121 555.26	$260 988.68	$2 300	$2 683 312.88		$37 056.34	$16 234.90	$53 291.25		$606 194.07	$294 942.27	$3 184	$4 085 674.08			$405 872.60	$925 756.06
RB 24 hr 1.4.1	$121 555.26	$260 988.68	$1 539	$1 921 674.99		$25 631.77	$16 234.90	$41 866.68		$606 194.07	$294 942.27	$2 130	$3 031 476.70			$405 872.60	$640 141.85
1.4.2.1	$392 261.56	$1 282 944.45	$1 568	$3 243 931.30	1	$33 946.67	$82 070.47	$116 017.14	1	$2 698 203.78	$1 449 850.43	$2 171	$6 319 356.50	1	$3 422 135.28	$2 051	$845 459.38
1.4.2.2	$410 370.87	$1 876 210.93	$1 351	$3 637 601.88	8	$33 832.14	$87 356.91	$121 189.05	8	$2 860 208.68	$2 120 298.52	$1 869	$6 850 479.60	8	$3 825 443.83	$2 183	$841 112.94
1.4.2.3	$424 694.05	$2 323 319.42	$1 317	$4 065 980.52	1	$35 717.98	$91 602.09	$127 320.07	1	$2 989 942.47	$2 625 574.05	$1 824	$7 439 739.60	1	$4 262 546.13	$2 290	$887 141.26
1.4.2.4	$410 370.87	$1 890 797.98	$1 306	$3 607 271.89	5	$33 231.32	$87 356.91	$120 588.23	7	$2 860 208.68	$2 136 783.29	$1 807	$6 804 793.84	6	$3 794 815.05	$2 183	$826 055.96
1.4.2.5	$410 370.87	$1 905 385.04	$1 292	$3 608 429.30	6	$33 102.81	$87 356.91	$120 459.72	6	$2 860 208.68	$2 153 268.06	$1 789	$6 802 690.39	5	$3 795 960.79	$2 183	$822 806.76
1.4.2.6	$410 370.87	$1 919 972.09	$1 283	$3 613 722.16	7	$33 036.33	$87 356.91	$120 393.24	5	$2 860 208.68	$2 169 752.84	$1 776	$6 806 310.89	7	$3 801 279.70	$2 183	$821 108.35
1.4.2.7	$401 355.35	$1 589 836.23	$1 474	$3 465 835.22	4	$34 162.66	$84 713.69	$118 876.35	4	$2 779 270.72	$1 796 667.61	$2 041	$6 617 020.44	4	$3 649 086.18	$2 117	$850 091.92
1.4.2.8	$398 332.94	$1 494 378.00	$1 504	$3 397 202.27	3	$34 102.26	$83 832.62	$117 934.88	3	$2 752 263.00	$1 688 790.65	$2 082	$6 523 448.50	3	$3 578 812.54	$2 095	$848 820.45
1.4.2.9	$396 818.44	$1 446 648.89	$1 516	$3 359 741.64	2	$34 024.91	$83 392.08	$117 416.99	2	$2 738 753.70	$1 634 852.16	$2 098	$6 472 309.77	2	$3 540 501.62	$2 084	$847 006.06
1.4.2.10	$424 694.05	$2 339 578.00	$1 286	$4 050 432.20	9	$35 322.17	$91 602.09	$126 924.26	9	$2 989 942.47	$2 643 947.81	$1 780	$7 414 088.82	9	$4 246 831.27	$2 290	$877 205.34
RB 48 hr 1.4.2	$392 261.56	$1 282 944.45	$2 300	$3 975 974.95		$44 927.32	$82 070.47	$126 997.80		$2 698 203.78	$1 449 850.43	$3 184	$7 332 591.95			$2 051	$1 119 975.75
RB 24 hr 1.4.2	$392 261.56	$1 282 944.45	$1 539	$3 214 337.07		$33 502.76	$82 070.47	$115 573.23		$2 698 203.78	$1 449 850.43	$2 130	$6 278 394.57			$2 051	$834 361.54
1.4.3.1	$658 466.79	$2 484 448.75	$1 730	$4 873 654.93	1	$45 099.70	$168 008.92	$213 108.62	1	$5 285 367.69	$2 807 665.67	$2 395	$10 488 582.43	1	$5 167 078.15	$4 200	$1 121 281.28
1.4.3.2	$693 552.49	$3 613 431.42	$1 425	$5 732 057.73	8	$46 517.50	$180 515.94	$227 033.44	8	$5 655 863.87	$4 083 524.50	$1 972	$11 711 859.95	8	$6 045 057.62	$4 512	$1 153 903.92
1.4.3.3	$721 241.41	$4 479 274.31	$1 361	$6 561 603.17	1	$50 169.35	$190 559.46	$240 728.80	1	$5 952 582.91	$5 062 010.12	$1 883	$12 898 499.86	1	$6 891 477.93	$4 763	$1 243 035.45
1.4.3.4	$693 552.49	$3 627 416.78	$1 345	$5 666 629.12	7	$45 396.22	$180 515.94	$225 912.15	7	$5 655 863.87	$4 099 329.30	$1 862	$11 617 746.38	7	$5 979 011.08	$4 512	$1 125 836.89
1.4.3.5	$693 552.49	$3 641 402.13	$1 317	$5 652 656.21	6	$45 046.77	$180 515.94	$225 562.71	6	$5 655 863.87	$4 115 134.09	$1 823	$11 594 853.61	6	$5 964 889.46	$4 512	$1 117 065.74
1.4.3.6	$693 552.49	$3 655 387.49	$1 303	$5 652 322.22	5	$44 901.91	$180 515.94	$225 417.84	5	$5 655 863.87	$4 130 938.89	$1 804	$11 590 838.73	5	$5 964 531.12	$4 512	$1 113 409.19
1.4.3.7	$676 096.85	$3 058 860.84	$1 592	$5 327 528.32	4	$46 079.05	$174 262.43	$220 341.48	4	$5 470 759.50	$3 456 806.49	$2 204	$11 131 873.07	4	$5 630 983.23	$4 356	$1 144 329.14
1.4.3.8	$670 239.94	$2 874 003.98	$1 632	$5 177 021.17	3	$45 698.13	$172 177.93	$217 876.05	3	$5 408 994.82	$3 247 900.49	$2 259	$10 916 853.12	3	$5 477 136.84	$4 304	$1 135 268.14
1.4.3.9	$667 304.13	$2 781 575.55	$1 641	$5 090 111.62	2	$45 332.86	$171 135.67	$216 468.53	2	$5 378 100.35	$3 143 447.49	$2 271	$10 793 207.96	2	$5 388 448.57	$4 278	$1 126 367.53
1.4.3.10	$721 241.41	$4 494 876.01	$1 309	$6 525 147.26	9	$49 466.49	$190 559.46	$240 025.95	9	$5 952 582.91	$5 079 641.53	$1 811	$12 844 077.37	9	$6 854 665.83	$4 763	$1 225 425.06
RB 48 hr 1.4.3	$658 466.79	$2 484 448.75	$2 300	$5 443 684.48		$53 650.14	$168 008.92	$221 659.06		$5 285 367.69	$2 807 665.67	$3 184	$11 277 571.09			$4 200	$1 335 042.36
RB 24 hr 1.4.3	$658 466.79	$2 484 448.75	$1 539	$4 682 046.59		$42 225.57	$168 008.92	$210 234.49		$5 285 367.69	$2 807 665.67	$2 130	$10 223 373.71			$4 200	$1 049 428.15
1.4.4.1	$1 288	$6 116 636.13	$2 024	$9 429 242.99	1	$74 087.18	$425 219.64	$499 306.81	1	$12 754 027.76	$6 912 386.20	$2 801	$22 467 929.80	1	$10 000 551.02	$10 630	$1 836 887.81
1.4.4.2	$1 361	$8 866 841.40	$1 621	$11 850 366.84	8	$82 549.63	$459 086.05	$541 635.68	8	$13 721 662.57	$10 020 382.25	$2 244	$25 986 468.23	8	$12 467 743.43	$11 477	$2 041 573.53
1.4.4.3	$1 419	$10 998 744.17	$1 508	$13 927 052.36	1	$92 103.12	$486 281.83	$578 384.96	1	$14 496 919.52	$12 429 637.11	$2 087	$29 014 459.37	1	$14 582 332.33	$12 157	$2 275 081.23
1.4.4.4	$1 361	$8 880 552.65	$1 455	$11 697 993.93	7	$80 126.92	$459 086.05	$539 212.97	7	$13 721 662.57	$10 035 877.28	$2 014	$25 772 083.03	7	$12 313 960.16	$11 477	$1 980 971.60
1.4.4.5	$1 361	$8 894 263.89	$1 389	$11 645 584.01	6	$79 203.66	$459 086.05	$538 289.71	6	$13 721 662.57	$10 051 372.31	$1 923	$25 696 058.51	6	$12 261 051.45	$11 477	$1 957 855.79
1.4.4.6	$1 361	$8 907 975.14	$1 357	$11 627 265.89	5	$78 791.77	$459 086.05	$537 877.82	5	$13 721 662.57	$10 066 867.34	$1 878	$25 667 221.08	5	$12 242 545.41	$11 477	$1 947 524.40
1.4.4.7	$1 325	$7 501 505.75	$1 824	$10 651 730.87	4	$78 398.69	$442 152.84	$520 551.53	4	$13 238 166.08	$8 477 421.86	$2 525	$24 241 276.30	4	$11 246 241.81	$11 053	$1 941 213.37
1.4.4.8	$1 313	$7 046 393.87	$1 882	$10 242 047.65	3	$76 863.38	$436 508.44	$513 371.82	3	$13 076 859.52	$7 963 101.73	$2 605	$23 645 491.02	3	$10 828 811.40	$10 912	$1 903 968.55
1.4.4.9	$1 307	$6 818 837.92	$1 893	$10 019 613.31	2	$75 831.92	$433 686.24	$509 518.16	2	$12 996 179.13	$7 705 941.66	$2 621	$23 323 243.61	2	$10 602 336.73	$10 842	$1 878 750.83
1.4.4.10	$1 419	$11 014 046.28	$1 377	$13 811 217.87	9	$90 212.59	$486 281.83	$576 494.42	9	$14 496 919.52	$12 446 929.96	$1 906	$28 850 243.58	9	$14 465 418.26	$12 157	$2 227 779.51
RB 48 hr 1.4.4	$1 288	$6 116 636.13	$2 300	$9 705 969.14		$78 238.07	$425 219.64	$503 457.71		$12 754 027.76	$6 912 386.20	$3 184	$22 850 951.70			$10 630	$1 940 660.12
RB 24 hr 1.4.4	$1 288	$6 116 636.13	$1 539	$8 944 331.26		$66 813.50	$425 219.64	$492 033.14		$12 754 027.76	$6 912 386.20	$2 130	$21 796 754.31			$10 630	$1 655 045.91

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
3.1.1.1	$23 878.40	$86 301.48	$345 393.37	$455 573.25	1	$5 855.97	$1 709.62	$7 565.59	1	$82 091.82	$97 528.96	$478 065.49	$657 686.27	1	$468 762.30	$42 740.53	$146 183.44
3.1.1.2	$26 442.32	$134 784.12	$330 733.21	$491 959.65	5	$5 904.63	$1 968.63	$7 873.26	6	$92 792.39	$152 319.00	$457 774.08	$702 885.48	5	$506 390.88	$49 215.80	$147 278.80
3.1.1.3	$28 433.89	$163 157.83	$329 169.34	$520 761.05	9	$6 043.35	$2 176.63	$8 219.98	9	$101 274.31	$184 384.01	$455 609.50	$741 267.82	9	$536 176.21	$54 415.64	$150 675.98
3.1.1.4	$26 442.32	$139 854.06	$328 270.73	$494 567.11	6	$5 893.04	$1 968.63	$7 861.67	5	$92 792.39	$158 048.52	$454 365.71	$705 206.63	6	$509 014.39	$49 215.80	$146 976.44
3.1.1.5	$26 442.32	$144 924.00	$328 184.19	$499 550.51	7	$5 917.09	$1 968.63	$7 885.73	7	$92 792.39	$163 778.04	$454 245.94	$710 816.37	7	$514 035.52	$49 215.80	$147 565.05
3.1.1.6	$26 442.32	$149 993.94	$327 058.36	$503 494.62	8	$5 925.56	$1 968.63	$7 894.19	8	$92 792.39	$169 507.56	$452 687.65	$714 987.60	8	$518 007.87	$49 215.80	$147 763.93
3.1.1.7	$25 172.87	$115 520.19	$338 315.75	$479 008.81	4	$5 909.10	$1 839.13	$7 748.23	4	$87 462.73	$130 548.90	$468 269.22	$686 280.85	4	$492 863.98	$45 978.16	$147 438.71
3.1.1.8	$24 744.28	$109 098.87	$341 217.56	$475 060.71	3	$5 916.15	$1 795.96	$7 712.11	3	$85 677.20	$123 292.20	$472 285.67	$681 255.07	3	$488 725.13	$44 898.95	$147 630.99
3.1.1.9	$24 528.91	$105 888.22	$340 759.31	$471 176.44	2	$5 891.03	$1 774.37	$7 665.40	2	$84 782.67	$119 663.85	$471 651.40	$676 097.92	2	$484 727.65	$44 359.35	$147 010.92
3.1.1.10	$28 433.89	$168 836.10	$327 391.56	$524 661.55	1	$6 045.08	$2 176.63	$8 221.71	1	$101 274.31	$190 801.01	$453 148.84	$745 224.16	1	$540 103.63	$54 415.64	$150 704.90
RB 48 hr 3.1.1	$23 878.40	$86 301.48	$544 203.89	$654 383.76		$8 838.13	$1 709.62	$10 547.75		$82 091.82	$97 528.96	$753 242.87	$932 863.66			$42 740.53	$220 737.38
RB 24 hr 3.1.1	$23 878.40	$86 301.48	$357 566.91	$467 746.79		$6 038.57	$1 709.62	$7 748.19		$82 091.82	$97 528.96	$494 915.11	$674 535.89			$42 740.53	$150 748.51
3.1.4.1	$268 725.97	$2 007 523.44	$497 169.54	$2 773 418.95	1	$20 236.17	$48 639.18	$68 875.34	1	$1 658 836.33	$2 268 694.27	$688 141.75	$4 615 672.35	1	$2 898 807.58	$1 215	$500 885.32
3.1.4.2	$305 438.17	$2 913 464.00	$405 735.11	$3 624 637.28	8	$23 768.82	$58 064.00	$81 832.81	8	$1 954 958.05	$3 292 494.10	$561 585.63	$5 809 037.78	8	$3 770 501.11	$1 451	$586 936.74
3.1.4.3	$333 729.97	$3 611 480.34	$382 214.72	$4 327 425.03	1	$27 194.67	$65 632.42	$92 827.09	1	$2 190 793.16	$4 081 319.60	$529 030.61	$6 801 143.36	1	$4 489 494.84	$1 640	$670 838.00
3.1.4.4	$305 438.17	$2 918 312.55	$370 530.46	$3 594 281.18	7	$23 264.99	$58 064.00	$81 328.99	7	$1 954 958.05	$3 297 973.43	$512 858.21	$5 765 789.68	7	$3 739 860.80	$1 451	$574 328.94
3.1.4.5	$305 438.17	$2 923 161.10	$354 413.67	$3 583 012.94	6	$23 047.48	$58 064.00	$81 111.48	6	$1 954 958.05	$3 303 452.75	$490 550.66	$5 748 961.46	6	$3 728 482.43	$1 451	$568 879.09
3.1.4.6	$305 438.17	$2 928 009.64	$348 186.60	$3 581 634.41	5	$22 978.32	$58 064.00	$81 042.31	5	$1 954 958.05	$3 308 932.07	$481 931.65	$5 745 821.77	5	$3 727 083.95	$1 451	$567 137.89
3.1.4.7	$287 306.95	$2 465 351.14	$452 478.61	$3 205 136.70	4	$22 044.47	$53 351.59	$75 396.05	4	$1 807 267.79	$2 786 083.54	$626 284.19	$5 219 635.52	4	$3 340 897.56	$1 333	$544 948.27
3.1.4.8	$281 165.81	$2 315 980.19	$462 496.71	$3 059 642.71	3	$21 385.24	$51 780.78	$73 166.03	3	$1 757 877.19	$2 617 280.02	$640 150.43	$5 015 307.64	3	$3 191 946.91	$1 294	$528 841.12
3.1.4.9	$278 075.93	$2 241 294.71	$466 539.63	$2 985 910.27	2	$21 040.94	$50 995.38	$72 036.33	2	$1 733 150.08	$2 532 878.25	$645 746.31	$4 911 774.64	2	$3 116 469.75	$1 274	$520 420.33
3.1.4.10	$333 729.97	$3 616 903.58	$351 833.58	$4 302 467.13	9	$26 766.07	$65 632.42	$92 398.49	9	$2 190 793.16	$4 087 448.37	$486 979.50	$6 765 221.03	9	$4 464 301.09	$1 640	$660 109.42
RB 48 hr 3.1.4	$268 725.97	$2 007 523.44	$544 203.89	$2 820 453.29		$20 941.68	$48 639.18	$69 580.86		$1 658 836.33	$2 268 694.27	$753 242.87	$4 680 773.48			$1 215	$518 523.20
RB 24 hr 3.1.4	$268 725.97	$2 007 523.44	$357 566.91	$2 633 816.32		$18 142.13	$48 639.18	$66 781.30		$1 658 836.33	$2 268 694.27	$494 915.11	$4 422 445.71			$1 215	$448 534.33
3.4.1.1	$121 555.26	$260 988.68	$1 483	$1 866 387.26	1	$24 802.46	$16 234.90	$41 037.36	1	$606 194.07	$294 942.27	$2 053	$2 954 951.91	1	$1 929 670.36	$405 872.60	$619 408.95
3.4.1.2	$126 751.45	$398 392.16	$1 432	$1 958 115.35	5	$24 779.40	$17 202.59	$41 981.99	6	$638 949.47	$450 221.40	$1 983	$3 072 574.11	5	$2 024 020.32	$430 064.73	$618 489.06
3.4.1.3	$130 865.69	$489 314.97	$1 427	$2 047 416.95	9	$25 189.95	$17 979.67	$43 169.62	1	$665 156.72	$552 972.91	$1 975	$3 193 594.33	9	$2 115 577.11	$449 491.77	$628 525.44
3.4.1.4	$126 751.45	$413 310.58	$1 424	$1 964 731.08	6	$24 729.45	$17 202.59	$41 932.04	5	$638 949.47	$467 080.64	$1 971	$3 077 941.45	6	$2 030 673.66	$430 064.73	$617 203.06
3.4.1.5	$126 751.45	$428 229.00	$1 424	$1 979 096.26	7	$24 795.75	$17 202.59	$41 998.34	7	$638 949.47	$483 939.89	$1 971	$3 094 034.94	7	$2 045 147.11	$430 064.73	$618 823.10
3.4.1.6	$126 751.45	$443 147.41	$1 419	$1 989 642.34	8	$24 804.75	$17 202.59	$42 007.34	8	$638 949.47	$500 799.13	$1 965	$3 104 842.35	8	$2 055 766.64	$430 064.73	$619 010.98
3.4.1.7	$124 163.77	$340 135.12	$1 459	$1 923 563.54	4	$24 856.12	$16 718.75	$41 574.86	4	$622 588.93	$384 385.34	$2 019	$3 026 770.04	4	$1 988 248.82	$417 968.67	$620 552.56
3.4.1.8	$123 296.62	$320 716.10	$1 469	$1 913 118.31	3	$24 897.79	$16 557.47	$41 455.26	3	$617 127.86	$362 439.99	$2 033	$3 012 984.64	3	$1 977 405.04	$413 936.64	$621 642.96
3.4.1.9	$122 862.16	$311 006.59	$1 467	$1 900 974.64	2	$24 814.82	$16 476.83	$41 291.64	2	$614 395.87	$351 467.32	$2 030	$2 996 512.15	2	$1 964 998.65	$411 920.63	$619 592.87
3.4.1.10	$130 865.69	$505 934.91	$1 419	$2 056 604.57	1	$25 161.56	$17 979.67	$43 141.23	9	$665 156.72	$571 755.03	$1 965	$3 202 089.23	1	$2 124 823.20	$449 491.77	$627 774.26
RB 48 hr 3.4.1	$121 555.26	$260 988.68	$2 300	$2 683 312.88		$37 056.34	$16 234.90	$53 291.25		$606 194.07	$294 942.27	$3 184	$4 085 674.08			$405 872.60	$925 756.06
RB 24 hr 3.4.1	$121 555.26	$260 988.68	$1 539	$1 921 674.99		$25 631.77	$16 234.90	$41 866.68		$606 194.07	$294 942.27	$2 130	$3 031 476.70			$405 872.60	$640 141.85
3.4.4.1	$1 288	$6 116 636.13	$2 096	$9 502 165.56	1	$75 181.01	$425 219.64	$500 400.65	1	$12 754 027.76	$6 912 386.20	$2 902	$22 568 863.30	1	$10 074 138.56	$10 630	$1 864 233.77
3.4.4.2	$1 361	$8 866 841.40	$1 718	$11 947 023.09	8	$83 999.47	$459 086.05	$543 085.52	8	$13 721 662.57	$10 020 382.25	$2 378	$26 120 251.98	8	$12 565 281.08	$11 477	$2 077 819.63
3.4.4.3	$1 419	$10 998 744.17	$1 624	$14 042 952.22	1	$93 841.62	$486 281.83	$580 123.45	1	$14 496 919.52	$12 429 637.11	$2 248	$29 174 878.56	1	$14 699 289.08	$12 157	$2 318 543.68
3.4.4.4	$1 361	$8 880 552.65	$1 581	$11 823 564.08	7	$82 010.47	$459 086.05	$541 096.52	7	$13 721 662.57	$10 035 877.28	$2 188	$25 945 887.05	7	$12 440 675.37	$11 477	$2 028 060.40
3.4.4.5	$1 361	$8 894 263.89	$1 518	$11 774 773.99	6	$81 141.51	$459 086.05	$540 227.56	6	$13 721 662.57	$10 051 372.31	$2 101	$25 874 872.80	6	$12 391 419.50	$11 477	$2 006 302.03
3.4.4.6	$1 361	$8 907 975.14	$1 493	$11 763 771.46	5	$80 839.36	$459 086.05	$539 925.41	5	$13 721 662.57	$10 066 867.34	$2 067	$25 856 161.02	5	$12 380 295.76	$11 477	$1 998 713.99
3.4.4.7	$1 325	$7 501 505.75	$1 909	$10 736 826.18	4	$79 675.12	$442 152.84	$521 827.96	4	$13 238 166.08	$8 477 421.86	$2 643	$24 359 058.33	4	$11 332 113.10	$11 053	$1 973 124.11
3.4.4.8	$1 313	$7 046 393.87	$1 953	$10 313 105.60	3	$77 929.25	$436 508.44	$514 437.69	3	$13 076 859.52	$7 963 101.73	$2 703	$23 743 843.67	3	$10 900 517.32	$10 912	$1 930 615.28
3.4.4.9	$1 307	$6 818 837.92	$1 971	$10 097 682.49	2	$77 002.95	$433 686.24	$510 689.20	2	$12 996 179.13	$7 705 941.66	$2 729	$23 431 300.63	2	$10 681 117.81	$10 842	$1 908 026.78
3.4.4.10	$1 419	$11 014 046.28	$1 509	$13 942 895.84	9	$92 187.75	$486 281.83	$578 469.59	9	$14 496 919.52	$12 446 929.96	$2 088	$29 032 501.55	9	$14 598 296.99	$12 157	$2 277 158.75
RB 48 hr 3.4.4	$1 288	$6 116 636.13	$2 300	$9 705 969.14		$78 238.07	$425 219.64	$503 457.71		$12 754 027.76	$6 912 386.20	$3 184	$22 850 951.70			$10 630	$1 940 660.12
RB 24 hr 3.4.4	$1 288	$6 116 636.13	$1 539	$8 944 331.26		$66 813.50	$425 219.64	$492 033.14		$12 754 027.76	$6 912 386.20	$2 130	$21 796 754.31			$10 630	$1 655 045.91

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
4.1.1.1	$23 878.40	$86 301.48	$359 377.43	$469 557.30	1	$6 065.73	$1 709.62	$7 775.35	1	$82 091.82	$97 528.96	$497 421.08	$677 041.86	1
4.1.1.2	$26 442.32	$134 784.12	$332 420.55	$493 646.99	5	$5 929.94	$1 968.63	$7 898.57	7	$92 792.39	$152 319.00	$460 109.56	$705 220.95	5
4.1.1.3	$28 433.89	$163 157.83	$329 121.73	$520 713.44	9	$6 042.64	$2 176.63	$8 219.27	9	$101 274.31	$184 384.01	$455 543.60	$741 201.92	9
4.1.1.4	$26 442.32	$139 854.06	$329 491.07	$495 787.45	6	$5 911.35	$1 968.63	$7 879.98	5	$92 792.39	$158 048.52	$456 054.81	$706 895.72	6
4.1.1.5	$26 442.32	$144 924.00	$327 073.36	$498 439.68	7	$5 900.43	$1 968.63	$7 869.06	3	$92 792.39	$163 778.04	$452 708.42	$709 278.85	7
4.1.1.6	$26 442.32	$149 993.94	$327 992.00	$504 428.26	8	$5 939.56	$1 968.63	$7 908.19	8	$92 792.39	$169 507.56	$453 979.92	$716 279.87	8
4.1.1.7	$25 172.87	$115 520.19	$347 592.00	$488 285.06	4	$6 048.24	$1 839.13	$7 887.37	6	$87 462.73	$130 548.90	$481 108.65	$699 120.29	4
4.1.1.8	$24 744.28	$109 098.87	$351 685.65	$485 528.79	3	$6 073.17	$1 795.96	$7 869.13	4	$85 677.20	$123 292.20	$486 774.74	$695 744.14	3
4.1.1.9	$24 528.91	$105 888.22	$353 129.87	$483 546.99	2	$6 076.58	$1 774.37	$7 850.96	2	$84 782.67	$119 663.85	$488 773.71	$693 220.24	2
4.1.1.10	$28 433.89	$168 836.10	$327 403.07	$524 673.06	1	$6 045.25	$2 176.63	$8 221.88	1	$101 274.31	$190 801.01	$453 164.77	$745 240.09	1
RB 48 hr 4.1.1	$23 878.40	$86 301.48	$544 203.89	$654 383.76		$8 838.13	$1 709.62	$10 547.75		$82 091.82	$97 528.96	$753 242.87	$932 863.66	
RB 24 hr 4.1.1	$23 878.40	$86 301.48	$357 566.91	$467 746.79		$6 038.57	$1 709.62	$7 748.19		$82 091.82	$97 528.96	$494 915.11	$674 535.89	
4.1.4.1	$268 725.97	$2 007 523.44	$609 235.68	$2 885 485.09	1	$21 917.16	$48 639.18	$70 556.33	1	$1 658 836.33	$2 268 694.27	$843 254.61	$4 770 785.21	1
4.1.4.2	$305 438.17	$2 913 464.00	$486 440.82	$3 705 342.99	8	$24 979.40	$58 064.00	$83 043.40	8	$1 954 958.05	$3 292 494.10	$673 291.92	$5 920 744.08	8
4.1.4.3	$333 729.97	$3 611 480.34	$442 750.19	$4 387 960.51	1	$28 102.70	$65 632.42	$93 735.12	1	$2 190 793.16	$4 081 319.60	$612 818.90	$6 884 931.65	1
4.1.4.4	$305 438.17	$2 918 312.55	$412 744.82	$3 636 495.54	7	$23 898.20	$58 064.00	$81 962.20	7	$1 954 958.05	$3 297 973.43	$571 287.90	$5 824 219.38	7
4.1.4.5	$305 438.17	$2 923 161.10	$385 330.98	$3 613 930.24	6	$23 511.24	$58 064.00	$81 575.24	6	$1 954 958.05	$3 303 452.75	$533 343.88	$5 791 754.68	6
4.1.4.6	$305 438.17	$2 928 009.64	$369 674.63	$3 603 122.45	5	$23 300.64	$58 064.00	$81 364.63	5	$1 954 958.05	$3 308 932.07	$511 673.64	$5 775 563.77	5
4.1.4.7	$287 306.95	$2 465 351.14	$533 465.23	$3 286 123.32	4	$23 259.26	$53 351.59	$76 610.85	4	$1 807 267.79	$2 786 083.54	$738 379.29	$5 331 730.62	4
4.1.4.8	$281 165.81	$2 315 980.19	$545 523.53	$3 142 669.53	3	$22 630.65	$51 780.78	$74 411.43	3	$1 757 877.19	$2 617 280.02	$755 069.42	$5 130 226.63	3
4.1.4.9	$278 075.93	$2 241 294.71	$552 674.22	$3 072 044.86	2	$22 332.96	$50 995.38	$73 328.34	2	$1 733 150.08	$2 532 878.25	$764 966.82	$5 030 995.15	2
4.1.4.10	$333 729.97	$3 616 903.58	$379 218.61	$4 329 852.15	9	$27 176.84	$65 632.42	$92 809.26	9	$2 190 793.16	$4 087 448.37	$524 883.63	$6 803 125.16	9
RB 48 hr 4.1.4	$268 725.97	$2 007 523.44	$544 203.89	$2 820 453.29		$20 941.68	$48 639.18	$69 580.86		$1 658 836.33	$2 268 694.27	$753 242.87	$4 680 773.48	
RB 24 hr 4.1.4	$268 725.97	$2 007 523.44	$357 566.91	$2 633 816.32		$18 142.13	$48 639.18	$66 781.30		$1 658 836.33	$2 268 694.27	$494 915.11	$4 422 445.71	
4.4.1.1	$121 555.26	$260 988.68	$1 540	$1 922 987.63	1	$25 651.46	$16 234.90	$41 886.37	1	$606 194.07	$294 942.27	$2 132	$3 033 293.54	1
4.4.1.2	$126 751.45	$398 392.16	$1 441	$1 966 676.69	5	$24 907.82	$17 202.59	$42 110.41	8	$638 949.47	$450 221.40	$1 995	$3 084 424.03	5
4.4.1.3	$130 865.69	$489 314.97	$1 430	$2 050 581.77	9	$25 237.42	$17 979.67	$43 217.09	1	$665 156.72	$552 972.91	$1 979	$3 197 974.81	9
4.4.1.4	$126 751.45	$413 310.58	$1 431	$1 971 462.89	6	$24 830.43	$17 202.59	$42 033.02	3	$638 949.47	$467 080.64	$1 981	$3 087 259.07	6
4.4.1.5	$126 751.45	$428 229.00	$1 423	$1 978 683.23	7	$24 789.55	$17 202.59	$41 992.14	2	$638 949.47	$483 939.89	$1 970	$3 093 463.26	7
4.4.1.6	$126 751.45	$443 147.41	$1 426	$1 996 148.67	8	$24 902.35	$17 202.59	$42 104.94	7	$638 949.47	$500 799.13	$1 974	$3 113 847.89	8
4.4.1.7	$124 163.77	$340 135.12	$1 494	$1 958 379.37	4	$25 378.35	$16 718.75	$42 097.10	6	$622 588.93	$384 385.34	$2 067	$3 074 959.29	4
4.4.1.8	$123 296.62	$320 716.10	$1 510	$1 954 286.21	3	$25 515.31	$16 557.47	$42 072.77	5	$617 127.86	$362 439.99	$2 090	$3 069 965.91	3
4.4.1.9	$122 862.16	$311 006.59	$1 517	$1 951 663.58	2	$25 575.15	$16 476.83	$42 051.97	4	$614 395.87	$351 467.32	$2 100	$3 066 671.66	2
4.4.1.10	$130 865.69	$505 934.91	$1 423	$2 060 199.03	1	$25 215.48	$17 979.67	$43 195.15	9	$665 156.72	$571 755.03	$1 970	$3 207 064.39	1
RB 48 hr 4.4.1	$121 555.26	$260 988.68	$2 300	$2 683 312.88		$37 056.34	$16 234.90	$53 291.25		$606 194.07	$294 942.27	$3 184	$4 085 674.08	
RB 24 hr 4.4.1	$121 555.26	$260 988.68	$1 539	$1 921 674.99		$25 631.77	$16 234.90	$41 866.68		$606 194.07	$294 942.27	$2 130	$3 031 476.70	
4.4.4.1	$1 288	$6 116 636.13	$2 570	$9 976 128.83	1	$82 290.46	$425 219.64	$507 510.10	1	$12 754 027.76	$6 912 386.20	$3 558	$23 224 884.82	1
4.4.4.2	$1 361	$8 866 841.40	$2 053	$12 282 042.26	8	$89 024.76	$459 086.05	$548 110.81	8	$13 721 662.57	$10 020 382.25	$2 841	$26 583 958.33	8
4.4.4.3	$1 419	$10 998 744.17	$1 869	$14 288 226.36	1	$97 520.73	$486 281.83	$583 802.57	1	$14 496 919.52	$12 429 637.11	$2 587	$29 514 367.12	1
4.4.4.4	$1 361	$8 880 552.65	$1 748	$11 991 370.16	7	$84 527.56	$459 086.05	$543 613.61	7	$13 721 662.57	$10 035 877.28	$2 420	$26 178 150.62	7
4.4.4.5	$1 361	$8 894 263.89	$1 638	$11 895 088.27	6	$82 946.22	$459 086.05	$542 032.27	6	$13 721 662.57	$10 051 372.31	$2 268	$26 041 402.06	6
4.4.4.6	$1 361	$8 907 975.14	$1 578	$11 848 634.20	5	$82 112.30	$459 086.05	$541 198.35	5	$13 721 662.57	$10 066 867.34	$2 185	$25 973 621.14	5
4.4.4.7	$1 325	$7 501 505.75	$2 249	$11 076 907.02	4	$84 776.33	$442 152.84	$526 929.17	4	$13 238 166.08	$8 477 421.86	$3 114	$24 829 770.64	4
4.4.4.8	$1 313	$7 046 393.87	$2 302	$10 662 404.84	3	$83 168.74	$436 508.44	$519 677.18	3	$13 076 859.52	$7 963 101.73	$3 187	$24 227 315.34	3
4.4.4.9	$1 307	$6 818 837.92	$2 332	$10 458 247.92	2	$82 411.44	$433 686.24	$516 097.68	2	$12 996 179.13	$7 705 941.66	$3 228	$23 930 366.05	2
4.4.4.10	$1 419	$11 014 046.28	$1 615	$14 049 260.35	9	$93 783.22	$486 281.83	$580 065.05	9	$14 496 919.52	$12 446 929.96	$2 235	$29 179 722.67	9
RB 48 hr 4.4.4	$1 288	$6 116 636.13	$2 300	$9 705 969.14		$78 238.07	$425 219.64	$503 457.71		$12 754 027.76	$6 912 386.20	$3 184	$22 850 951.70	
RB 24 hr 4.4.4	$1 288	$6 116 636.13	$1 539	$8 944 331.26		$66 813.50	$425 219.64	$492 033.14		$12 754 027.76	$6 912 386.20	$2 130	$21 796 754.31	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$482 873.87	$42 740.53	$151 427.46
$508 093.60	$49 215.80	$147 911.55
$536 128.16	$54 415.64	$150 658.12
$510 245.86	$49 215.80	$147 434.06
$512 914.56	$49 215.80	$147 148.49
$518 950.02	$49 215.80	$148 114.05
$502 224.82	$45 978.16	$150 917.31
$499 288.67	$44 898.95	$151 556.52
$497 211.01	$44 359.35	$151 649.88
$540 115.24	$54 415.64	$150 709.21
	$42 740.53	$220 737.38
	$42 740.53	$150 748.51
$3 011 895.64	$1 215	$542 910.12
$3 851 942.76	$1 451	$617 201.38
$4 550 582.33	$1 640	$693 538.81
$3 782 460.12	$1 451	$590 159.33
$3 759 681.66	$1 451	$580 473.08
$3 748 767.93	$1 451	$575 195.90
$3 422 622.68	$1 333	$575 318.25
$3 275 730.85	$1 294	$559 976.18
$3 203 389.79	$1 274	$552 720.80
$4 491 935.83	$1 640	$670 378.81
	$1 215	$518 523.20
	$1 215	$448 534.33
$1 986 786.86	$405 872.60	$640 634.09
$2 032 659.73	$430 064.73	$621 699.57
$2 118 770.78	$449 491.77	$629 712.25
$2 037 466.85	$430 064.73	$619 727.49
$2 044 730.31	$430 064.73	$618 668.21
$2 062 332.30	$430 064.73	$621 450.86
$2 023 382.13	$417 968.67	$633 608.49
$2 018 948.35	$413 936.64	$637 080.92
$2 016 149.81	$411 920.63	$638 601.22
$2 128 450.43	$449 491.77	$629 122.19
	$405 872.60	$925 756.06
	$405 872.60	$640 141.85
$10 552 423.85	$10 630	$2 041 970.00
$12 903 355.25	$11 477	$2 203 451.81
$14 946 799.84	$12 157	$2 410 521.48
$12 610 011.66	$11 477	$2 090 987.69
$12 512 830.90	$11 477	$2 051 419.88
$12 465 932.35	$11 477	$2 030 537.52
$11 675 295.09	$11 053	$2 100 654.43
$11 253 001.78	$10 912	$2 061 602.49
$11 044 971.19	$10 842	$2 043 238.81
$14 705 631.42	$12 157	$2 317 045.44
	$10 630	$1 940 660.12
	$10 630	$1 655 045.91

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.1.1.1	5.26%	19.02%	75.71%	69.33%	77.32%	22.68%	71.46%	12.53%	14.89%	72.58%	70.22%	71.27%	6.52%	22.21%
2.1.1.2	5.39%	27.47%	67.14%	74.97%	74.93%	25.07%	74.45%	13.24%	21.73%	65.03%	75.14%	72.04%	7.02%	20.94%
2.1.1.3	5.48%	31.42%	63.11%	79.36%	73.45%	26.55%	77.73%	13.70%	24.94%	61.36%	79.25%	72.33%	7.36%	20.31%
2.1.1.4	5.35%	28.29%	66.36%	75.55%	74.95%	25.05%	74.51%	13.16%	22.42%	64.42%	75.57%	72.18%	6.98%	20.84%
2.1.1.5	5.30%	29.07%	65.63%	76.19%	74.99%	25.01%	74.63%	13.08%	23.08%	63.84%	76.06%	72.32%	6.94%	20.75%
2.1.1.6	5.25%	29.76%	64.99%	77.02%	75.09%	24.91%	74.91%	12.97%	23.69%	63.35%	76.72%	72.45%	6.88%	20.67%
2.1.1.7	5.28%	24.23%	70.49%	72.86%	76.16%	23.84%	73.14%	12.80%	19.11%	68.09%	73.23%	71.81%	6.73%	21.46%
2.1.1.8	5.22%	23.00%	71.78%	72.47%	76.68%	23.32%	73.00%	12.60%	18.13%	69.27%	72.91%	71.74%	6.60%	21.66%
2.1.1.9	5.20%	22.44%	72.36%	72.10%	76.88%	23.12%	72.77%	12.52%	17.68%	69.80%	72.57%	71.70%	6.55%	21.75%
2.1.1.10	5.43%	32.24%	62.33%	80.03%	73.48%	26.52%	77.81%	13.61%	25.65%	60.74%	79.75%	72.47%	7.31%	20.21%
RB 48 hr 2.1.1	3.65%	13.19%	83.16%	100.00%	83.79%	16.21%	100.00%	8.80%	10.45%	80.75%	100.00%	0.00%	16.22%	83.78%
RB 24 hr 2.1.1	5.10%	18.45%	76.44%	71.48%	77.94%	22.06%	73.46%	12.17%	14.46%	73.37%	72.31%	0.00%	22.09%	77.91%
2.1.2.1	8.76%	47.40%	43.84%	85.40%	49.91%	50.09%	88.49%	25.50%	34.93%	39.56%	86.63%	67.94%	16.10%	15.96%
2.1.2.2	8.27%	59.04%	32.69%	100.79%	47.22%	52.78%	97.60%	25.31%	44.50%	30.19%	99.94%	69.37%	16.22%	14.41%
2.1.2.3	7.85%	64.04%	28.12%	114.70%	46.38%	53.62%	106.84%	24.79%	48.91%	26.30%	112.26%	70.17%	16.05%	13.78%
2.1.2.4	8.31%	59.79%	31.90%	100.32%	46.88%	53.12%	96.98%	25.44%	45.09%	29.47%	99.43%	69.41%	16.30%	14.29%
2.1.2.5	8.29%	60.12%	31.59%	100.56%	46.85%	53.15%	96.91%	25.40%	45.39%	29.21%	99.57%	69.48%	16.28%	14.25%
2.1.2.6	8.27%	60.46%	31.26%	100.78%	46.81%	53.19%	96.84%	25.37%	45.69%	28.94%	99.69%	69.54%	16.26%	14.20%
2.1.2.7	8.44%	53.83%	37.73%	93.74%	48.64%	51.36%	93.31%	25.26%	40.22%	34.52%	93.80%	68.79%	16.07%	15.13%
2.1.2.8	8.51%	51.98%	39.51%	91.29%	49.10%	50.90%	91.79%	25.27%	38.70%	36.02%	91.65%	68.58%	16.04%	15.38%
2.1.2.9	8.55%	51.07%	40.38%	89.97%	49.30%	50.70%	90.97%	25.30%	37.95%	36.75%	90.51%	68.46%	16.03%	15.50%
2.1.2.10	7.85%	64.55%	27.59%	114.61%	46.20%	53.80%	106.49%	24.83%	49.34%	25.83%	112.09%	70.22%	16.08%	13.70%
RB 48 hr 2.1.2	7.48%	40.48%	52.04%	100.00%	55.68%	44.32%	100.00%	22.10%	30.26%	47.64%	100.00%	0.00%	44.42%	55.58%
RB 24 hr 2.1.2	9.10%	49.28%	41.62%	82.15%	48.42%	51.58%	85.93%	26.41%	36.17%	37.42%	83.66%	0.00%	51.71%	48.29%
2.1.3.1	9.83%	59.35%	30.82%	91.97%	38.59%	61.41%	94.45%	31.47%	41.89%	26.64%	92.98%	65.33%	21.35%	13.32%
2.1.3.2	8.95%	69.83%	21.22%	114.02%	36.76%	63.24%	108.53%	30.44%	50.69%	18.87%	112.07%	66.96%	20.96%	12.07%
2.1.3.3	8.36%	74.16%	17.47%	132.85%	36.31%	63.69%	121.18%	29.54%	54.68%	15.78%	128.57%	67.86%	20.55%	11.59%
2.1.3.4	9.02%	70.64%	20.34%	113.16%	36.33%	63.67%	107.79%	30.66%	51.26%	18.08%	111.27%	66.96%	21.11%	11.93%
2.1.3.5	9.03%	71.03%	19.94%	113.01%	36.17%	63.83%	107.53%	30.71%	51.56%	17.73%	111.08%	66.98%	21.15%	11.87%
2.1.3.6	9.02%	71.24%	19.73%	113.13%	36.13%	63.87%	107.47%	30.70%	51.75%	17.56%	111.14%	67.02%	21.14%	11.84%
2.1.3.7	9.30%	65.09%	25.61%	103.59%	37.77%	62.23%	101.75%	30.77%	46.72%	22.51%	102.99%	66.29%	21.04%	12.67%
2.1.3.8	9.44%	63.41%	27.15%	99.93%	38.06%	61.94%	99.36%	30.94%	45.30%	23.76%	99.81%	66.03%	21.11%	12.87%
2.1.3.9	9.53%	62.60%	27.88%	97.99%	38.16%	61.84%	98.09%	31.06%	44.61%	24.33%	98.12%	65.88%	21.16%	12.96%
2.1.3.10	8.39%	74.65%	16.96%	132.47%	36.09%	63.91%	120.75%	29.63%	55.05%	15.32%	128.18%	67.88%	20.61%	11.51%
RB 48 hr 2.1.3	9.04%	54.59%	36.37%	100.00%	42.00%	58.00%	100.00%	29.26%	38.95%	31.79%	100.00%	0.00%	58.15%	41.85%
RB 24 hr 2.1.3	10.33%	62.37%	27.30%	87.53%	36.52%	63.48%	91.37%	32.84%	43.72%	23.44%	89.10%	0.00%	63.65%	36.35%
2.1.4.1	9.70%	72.43%	17.87%	98.27%	29.35%	70.65%	98.95%	35.96%	49.18%	14.86%	98.55%	62.80%	26.36%	10.84%
2.1.4.2	8.43%	80.38%	11.20%	128.52%	29.05%	70.95%	117.61%	33.65%	56.68%	9.67%	124.11%	64.91%	24.99%	10.10%
2.1.4.3	7.71%	83.47%	8.81%	153.40%	29.29%	70.71%	133.39%	32.22%	60.02%	7.76%	145.27%	66.01%	24.13%	9.86%
2.1.4.4	8.50%	81.22%	10.28%	127.40%	28.59%	71.41%	116.86%	33.91%	57.21%	8.87%	123.15%	64.86%	25.18%	9.96%
2.1.4.5	8.53%	81.59%	9.89%	127.03%	28.41%	71.59%	116.57%	34.01%	57.46%	8.53%	122.82%	64.85%	25.25%	9.89%
2.1.4.6	8.53%	81.77%	9.70%	126.96%	28.34%	71.66%	116.46%	34.03%	57.60%	8.37%	122.73%	64.86%	25.27%	9.87%
2.1.4.7	8.97%	76.97%	14.06%	113.56%	29.21%	70.79%	108.31%	34.65%	53.41%	11.94%	111.44%	64.00%	25.57%	10.43%
2.1.4.8	9.19%	75.67%	15.14%	108.52%	29.24%	70.76%	105.17%	35.04%	52.17%	12.79%	107.18%	63.65%	25.80%	10.55%
2.1.4.9	9.31%	75.06%	15.62%	105.87%	29.21%	70.79%	103.53%	35.29%	51.57%	13.15%	104.94%	63.45%	25.96%	10.60%
2.1.4.10	7.76%	84.08%	8.17%	152.53%	28.96%	71.04%	132.78%	32.39%	60.42%	7.19%	144.52%	65.99%	24.26%	9.76%
RB 48 hr 2.1.4	9.53%	71.18%	19.29%	100.00%	30.10%	69.90%	100.00%	35.44%	48.47%	16.09%	100.00%	0.00%	70.11%	29.89%
RB 24 hr 2.1.4	10.20%	76.22%	13.58%	93.38%	27.17%	72.83%	95.98%	37.51%	51.30%	11.19%	94.48%	0.00%	73.05%	26.95%

Property of Grundfos

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost			
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design
	As % of total capital cost				As % of total O&M			As % of total LCC cost			
2.2.1.1	5.83%	15.88%	78.29%	69.82%	69.08%	30.92%	74.56%	16.14%	11.91%	71.95%	71.57%
2.2.1.2	5.87%	22.91%	71.22%	74.10%	67.20%	32.80%	76.98%	16.63%	17.34%	66.02%	75.29%
2.2.1.3	5.86%	26.66%	67.48%	77.89%	66.13%	33.87%	79.75%	16.88%	20.28%	62.84%	78.78%
2.2.1.4	5.84%	23.58%	70.59%	74.48%	67.20%	32.80%	76.98%	16.57%	17.88%	65.55%	75.56%
2.2.1.5	5.80%	24.20%	70.01%	74.99%	67.24%	32.76%	77.08%	16.49%	18.38%	65.13%	75.93%
2.2.1.6	5.75%	24.77%	69.48%	75.60%	67.32%	32.68%	77.26%	16.39%	18.85%	64.76%	76.40%
2.2.1.7	5.82%	20.04%	74.15%	72.39%	68.16%	31.84%	75.87%	16.32%	15.12%	68.56%	73.76%
2.2.1.8	5.78%	18.98%	75.24%	72.05%	68.57%	31.43%	75.70%	16.16%	14.32%	69.51%	73.46%
2.2.1.9	5.77%	18.48%	75.75%	71.79%	68.74%	31.26%	75.53%	16.11%	13.94%	69.96%	73.22%
2.2.1.10	5.82%	27.33%	66.84%	78.38%	66.15%	33.85%	79.79%	16.81%	20.82%	62.37%	79.13%
RB 48 hr 2.2.1	4.07%	11.08%	84.84%	100.00%	76.94%	23.06%	100.00%	11.55%	8.53%	79.93%	100.00%
RB 24 hr 2.2.1	5.66%	15.41%	78.93%	71.91%	69.79%	30.21%	76.33%	15.70%	11.59%	72.70%	73.54%
2.2.2.1	10.23%	42.18%	47.59%	84.66%	38.87%	61.13%	90.69%	33.55%	27.90%	38.55%	87.20%
2.2.2.2	9.53%	53.63%	36.84%	97.45%	37.19%	62.81%	97.30%	32.80%	36.50%	30.70%	97.55%
2.2.2.3	8.92%	58.92%	32.17%	109.75%	36.98%	63.02%	104.21%	31.74%	40.90%	27.35%	107.69%
2.2.2.4	9.58%	54.27%	36.16%	96.99%	36.92%	63.08%	96.88%	32.95%	36.92%	30.13%	97.11%
2.2.2.5	9.56%	54.56%	35.87%	97.15%	36.88%	63.12%	96.82%	32.92%	37.16%	29.92%	97.19%
2.2.2.6	9.55%	54.87%	35.58%	97.29%	36.84%	63.16%	96.76%	32.90%	37.40%	29.70%	97.25%
2.2.2.7	9.81%	48.43%	41.76%	91.46%	38.08%	61.92%	94.12%	33.05%	32.56%	34.39%	92.66%
2.2.2.8	9.92%	46.57%	43.51%	89.40%	38.36%	61.64%	93.02%	33.16%	31.17%	35.67%	90.98%
2.2.2.9	9.98%	45.63%	44.38%	88.33%	38.49%	61.51%	92.44%	33.23%	30.47%	36.30%	90.11%
2.2.2.10	8.93%	59.39%	31.68%	109.59%	36.82%	63.18%	103.95%	31.80%	41.24%	26.95%	107.49%
RB 48 hr 2.2.2	8.66%	35.71%	55.64%	100.00%	44.56%	55.44%	100.00%	29.25%	24.32%	46.42%	100.00%
RB 24 hr 2.2.2	10.61%	43.77%	45.62%	81.58%	37.58%	62.42%	88.82%	34.57%	28.74%	36.69%	84.63%
2.2.3.1	11.55%	54.30%	34.14%	91.24%	28.71%	71.29%	95.62%	40.85%	33.42%	25.74%	93.25%
2.2.3.2	10.34%	65.30%	24.35%	110.40%	27.84%	72.16%	105.53%	39.00%	41.88%	19.13%	108.29%
2.2.3.3	9.50%	70.13%	20.36%	127.38%	27.94%	72.06%	114.59%	37.41%	46.17%	16.42%	121.70%
2.2.3.4	10.42%	66.06%	23.52%	109.54%	27.48%	72.52%	105.01%	39.25%	42.30%	18.45%	107.58%
2.2.3.5	10.44%	66.40%	23.16%	109.36%	27.36%	72.64%	104.84%	39.31%	42.52%	18.16%	107.41%
2.2.3.6	10.44%	66.61%	22.95%	109.41%	27.31%	72.69%	104.78%	39.31%	42.68%	18.01%	107.41%
2.2.3.7	10.84%	60.27%	28.89%	101.27%	28.36%	71.64%	100.73%	39.73%	37.98%	22.29%	101.09%
2.2.3.8	11.05%	58.48%	30.47%	98.06%	28.49%	71.51%	99.04%	40.05%	36.60%	23.35%	98.56%
2.2.3.9	11.17%	57.61%	31.22%	96.34%	28.51%	71.49%	98.14%	40.25%	35.92%	23.83%	97.21%
2.2.3.10	9.54%	70.59%	19.87%	126.96%	27.74%	72.26%	114.28%	37.53%	46.46%	16.02%	121.34%
RB 48 hr 2.2.3	10.54%	49.55%	39.91%	100.00%	31.83%	68.17%	100.00%	38.09%	31.16%	30.75%	100.00%
RB 24 hr 2.2.3	12.14%	57.09%	30.76%	86.79%	27.01%	72.99%	93.39%	42.41%	34.70%	22.90%	89.82%
2.2.4.1	11.59%	68.13%	20.28%	98.02%	20.77%	79.23%	99.18%	46.65%	39.09%	14.25%	98.60%
2.2.4.2	9.85%	77.12%	13.03%	125.56%	21.05%	78.95%	111.96%	43.24%	47.02%	9.73%	118.85%
2.2.4.3	8.85%	80.77%	10.38%	148.67%	21.65%	78.35%	122.87%	40.98%	50.99%	8.03%	135.93%
2.2.4.4	9.95%	77.98%	12.07%	124.34%	20.67%	79.33%	111.42%	43.56%	47.44%	8.99%	117.97%
2.2.4.5	9.98%	78.36%	11.66%	123.93%	20.52%	79.48%	111.21%	43.68%	47.64%	8.68%	117.66%
2.2.4.6	9.99%	78.54%	11.47%	123.82%	20.46%	79.54%	111.12%	43.72%	47.75%	8.54%	117.57%
2.2.4.7	10.61%	73.23%	16.16%	111.87%	20.92%	79.08%	105.57%	44.77%	43.47%	11.75%	108.77%
2.2.4.8	10.91%	71.73%	17.36%	107.28%	20.86%	79.14%	103.43%	45.36%	42.15%	12.50%	105.39%
2.2.4.9	11.08%	71.05%	17.87%	104.81%	20.78%	79.22%	102.29%	45.72%	41.50%	12.78%	103.57%
2.2.4.10	8.90%	81.38%	9.72%	147.75%	21.38%	78.62%	122.45%	41.19%	51.31%	7.50%	135.26%
RB 48 hr 2.2.4	11.36%	66.78%	21.86%	100.00%	21.42%	78.58%	100.00%	46.00%	38.55%	15.45%	100.00%
RB 24 hr 2.2.4	12.25%	71.99%	15.76%	92.76%	19.00%	81.00%	97.01%	48.48%	40.62%	10.90%	94.88%

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
As % of total LCC cost		
68.47%	9.76%	21.77%
69.07%	10.16%	20.77%
69.39%	10.38%	20.23%
69.18%	10.12%	20.70%
69.30%	10.07%	20.63%
69.41%	10.01%	20.58%
68.88%	9.92%	21.20%
68.82%	9.81%	21.37%
68.79%	9.76%	21.45%
69.51%	10.34%	20.16%
0.00%	23.07%	76.93%
0.00%	30.23%	69.77%
61.32%	23.68%	15.00%
62.92%	23.34%	13.74%
64.04%	22.72%	13.24%
62.92%	23.44%	13.64%
62.97%	23.42%	13.60%
63.02%	23.41%	13.57%
62.24%	23.43%	14.34%
61.99%	23.47%	14.54%
61.85%	23.51%	14.64%
64.07%	22.76%	13.17%
0.00%	55.52%	44.48%
0.00%	62.52%	37.48%
57.32%	30.48%	12.20%
59.46%	29.32%	11.22%
60.85%	28.29%	10.86%
59.39%	29.52%	11.09%
59.40%	29.56%	11.04%
59.42%	29.56%	11.01%
58.54%	29.76%	11.70%
58.18%	29.96%	11.85%
57.98%	30.10%	11.92%
60.83%	28.37%	10.79%
0.00%	68.28%	31.72%
0.00%	73.12%	26.88%
53.45%	36.96%	9.60%
56.43%	34.48%	9.09%
58.20%	32.84%	8.96%
56.32%	34.74%	8.94%
56.28%	34.83%	8.89%
56.28%	34.86%	8.86%
55.09%	35.59%	9.32%
54.59%	36.01%	9.40%
54.30%	36.28%	9.42%
58.14%	33.00%	8.86%
0.00%	78.73%	21.27%
0.00%	81.16%	18.84%

Universiti Sains Malaysia

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.3.1.1	6.36%	15.21%	78.43%	67.82%	63.32%	36.68%	74.51%	19.03%	11.07%	69.90%	70.28%	66.53%	12.28%	21.18%
2.3.1.2	6.34%	22.09%	71.57%	71.29%	61.70%	38.30%	76.19%	19.39%	16.23%	64.38%	73.19%	67.15%	12.59%	20.25%
2.3.1.3	6.26%	25.82%	67.91%	74.83%	60.96%	39.04%	78.54%	19.44%	19.08%	61.48%	76.34%	67.54%	12.69%	19.77%
2.3.1.4	6.31%	22.76%	70.93%	71.67%	61.70%	38.30%	76.19%	19.32%	16.75%	63.93%	73.44%	67.27%	12.55%	20.18%
2.3.1.5	6.27%	23.39%	70.34%	72.13%	61.74%	38.26%	76.26%	19.24%	17.25%	63.52%	73.77%	67.38%	12.49%	20.12%
2.3.1.6	6.22%	23.99%	69.79%	72.69%	61.81%	38.19%	76.41%	19.13%	17.72%	63.15%	74.19%	67.51%	12.42%	20.07%
2.3.1.7	6.31%	19.21%	74.48%	69.99%	62.56%	37.44%	75.47%	19.13%	14.07%	66.80%	72.06%	66.95%	12.39%	20.67%
2.3.1.8	6.29%	18.19%	75.52%	69.70%	62.91%	37.09%	75.35%	19.00%	13.31%	67.69%	71.83%	66.89%	12.29%	20.82%
2.3.1.9	6.29%	17.71%	76.01%	69.44%	63.04%	36.96%	75.19%	18.97%	12.95%	68.08%	71.59%	66.85%	12.26%	20.89%
2.3.1.10	6.22%	26.47%	67.31%	75.37%	61.01%	38.99%	78.64%	19.34%	19.61%	61.05%	76.74%	67.67%	12.62%	19.71%
RB 48 hr 2.3.1	4.31%	10.32%	85.37%	100.00%	72.67%	27.33%	100.00%	13.38%	7.78%	78.84%	100.00%	0.00%	27.34%	72.66%
RB 24 hr 2.3.1	6.01%	14.38%	79.61%	71.74%	64.79%	35.21%	77.61%	18.10%	10.53%	71.37%	73.90%	0.00%	35.24%	64.76%
2.3.2.1	11.16%	40.57%	48.28%	83.29%	33.16%	66.84%	91.25%	38.61%	24.98%	36.41%	86.86%	57.29%	28.59%	14.12%
2.3.2.2	10.34%	52.24%	37.42%	94.59%	31.88%	68.12%	96.10%	37.54%	33.27%	29.19%	95.38%	59.06%	27.94%	13.00%
2.3.2.3	9.59%	57.69%	32.73%	106.05%	31.98%	68.02%	101.52%	36.11%	37.70%	26.20%	104.21%	60.43%	26.97%	12.60%
2.3.2.4	10.39%	52.91%	36.70%	94.10%	31.60%	68.40%	95.71%	37.72%	33.67%	28.61%	94.94%	59.04%	28.07%	12.89%
2.3.2.5	10.38%	53.23%	36.39%	94.22%	31.56%	68.44%	95.65%	37.70%	33.91%	28.39%	94.98%	59.08%	28.06%	12.86%
2.3.2.6	10.37%	53.54%	36.09%	94.35%	31.52%	68.48%	95.59%	37.68%	34.14%	28.19%	95.04%	59.13%	28.04%	12.83%
2.3.2.7	10.62%	46.97%	42.41%	89.79%	32.68%	67.32%	93.92%	37.81%	29.53%	32.66%	91.71%	58.38%	28.07%	13.56%
2.3.2.8	10.75%	45.19%	44.06%	87.98%	32.87%	67.13%	93.09%	37.97%	28.27%	33.76%	90.32%	58.11%	28.16%	13.73%
2.3.2.9	10.83%	44.34%	44.83%	86.95%	32.92%	67.08%	92.60%	38.09%	27.66%	34.25%	89.52%	57.96%	28.24%	13.80%
2.3.2.10	9.60%	58.16%	32.24%	105.90%	31.83%	68.17%	101.29%	36.17%	38.02%	25.81%	104.03%	60.45%	27.02%	12.53%
RB 48 hr 2.3.2	9.29%	33.79%	56.92%	100.00%	39.00%	61.00%	100.00%	33.53%	21.70%	44.77%	100.00%	0.00%	61.07%	38.93%
RB 24 hr 2.3.2	11.45%	41.63%	46.92%	81.16%	32.33%	67.67%	90.14%	39.37%	25.47%	35.16%	85.18%	0.00%	67.76%	32.24%
2.3.3.1	12.58%	52.53%	34.89%	90.20%	24.05%	75.95%	95.89%	46.33%	29.60%	24.08%	93.03%	52.68%	35.99%	11.33%
2.3.3.2	11.17%	63.97%	24.86%	107.74%	23.52%	76.48%	103.31%	44.04%	37.92%	18.04%	105.63%	55.12%	34.39%	10.49%
2.3.3.3	10.16%	69.02%	20.82%	123.78%	23.88%	76.12%	110.30%	42.01%	42.34%	15.65%	117.24%	56.84%	32.93%	10.23%
2.3.3.4	11.26%	64.76%	23.97%	106.82%	23.18%	76.82%	102.85%	44.33%	38.31%	17.36%	104.94%	55.03%	34.61%	10.36%
2.3.3.5	11.29%	65.14%	23.57%	106.60%	23.06%	76.94%	102.68%	44.41%	38.52%	17.07%	104.75%	55.02%	34.68%	10.31%
2.3.3.6	11.28%	65.33%	23.39%	106.68%	23.03%	76.97%	102.65%	44.40%	38.65%	16.95%	104.77%	55.04%	34.67%	10.29%
2.3.3.7	11.76%	58.67%	29.57%	99.45%	23.89%	76.11%	99.75%	44.97%	34.02%	21.01%	99.64%	54.05%	35.03%	10.92%
2.3.3.8	11.99%	56.79%	31.22%	96.53%	23.96%	76.04%	98.49%	45.36%	32.66%	21.99%	97.54%	53.65%	35.30%	11.05%
2.3.3.9	12.14%	55.92%	31.94%	94.89%	23.94%	76.06%	97.79%	45.62%	32.00%	22.39%	96.35%	53.41%	35.49%	11.10%
2.3.3.10	10.19%	69.49%	20.32%	123.35%	23.70%	76.30%	110.05%	42.14%	42.61%	15.26%	116.90%	56.82%	33.02%	10.16%
RB 48 hr 2.3.3	11.35%	47.39%	41.27%	100.00%	27.17%	72.83%	100.00%	43.10%	27.53%	29.37%	100.00%	0.00%	72.93%	27.07%
RB 24 hr 2.3.3	13.14%	54.89%	31.97%	86.34%	22.74%	77.26%	94.27%	47.74%	30.50%	21.76%	90.28%	0.00%	77.37%	22.63%
2.3.4.1	12.68%	66.52%	20.80%	97.33%	17.04%	82.96%	99.10%	52.55%	34.31%	13.14%	98.30%	48.24%	43.01%	8.76%
2.3.4.2	10.65%	76.00%	13.36%	123.49%	17.53%	82.47%	108.75%	48.57%	42.32%	9.11%	115.51%	51.69%	39.92%	8.39%
2.3.4.3	9.45%	79.90%	10.65%	145.70%	18.29%	81.71%	117.08%	45.82%	46.58%	7.60%	130.20%	53.86%	37.78%	8.35%
2.3.4.4	10.76%	76.90%	12.35%	122.23%	17.19%	82.81%	108.29%	48.91%	42.69%	8.39%	114.69%	51.54%	40.21%	8.25%
2.3.4.5	10.79%	77.27%	11.94%	121.82%	17.06%	82.94%	108.12%	49.03%	42.86%	8.11%	114.42%	51.50%	40.30%	8.19%
2.3.4.6	10.80%	77.47%	11.72%	121.68%	17.00%	83.00%	108.05%	49.08%	42.96%	7.96%	114.31%	51.49%	40.34%	8.17%
2.3.4.7	11.53%	71.80%	16.68%	110.59%	17.33%	82.67%	103.96%	50.35%	38.65%	11.00%	107.01%	50.13%	41.30%	8.57%
2.3.4.8	11.88%	70.24%	17.88%	106.18%	17.22%	82.78%	102.33%	51.04%	37.32%	11.63%	104.10%	49.54%	41.84%	8.62%
2.3.4.9	12.09%	69.53%	18.38%	103.81%	17.12%	82.88%	101.46%	51.46%	36.67%	11.87%	102.54%	49.21%	42.16%	8.63%
2.3.4.10	9.51%	80.51%	9.97%	144.78%	18.05%	81.95%	116.74%	46.03%	46.86%	7.11%	129.60%	53.79%	37.96%	8.25%
RB 48 hr 2.3.4	12.35%	64.74%	22.91%	100.00%	17.78%	82.22%	100.00%	51.66%	33.73%	14.62%	100.00%	0.00%	82.34%	17.66%
RB 24 hr 2.3.4	13.36%	70.05%	16.59%	92.42%	15.63%	84.37%	97.45%	54.28%	35.44%	10.28%	95.16%	0.00%	84.50%	15.50%

Property of Kenya Water Institute

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.4.1.1	6.52%	14.00%	79.48%	69.49%	60.41%	39.59%	76.96%	20.53%	9.99%	69.48%	72.26%	65.30%	13.75%	20.96%
2.4.1.2	6.48%	20.37%	73.15%	72.89%	58.99%	41.01%	78.71%	20.82%	14.67%	64.52%	75.13%	65.87%	14.01%	20.12%
2.4.1.3	6.40%	23.93%	69.68%	76.22%	58.32%	41.68%	80.94%	20.85%	17.33%	61.82%	78.09%	66.24%	14.09%	19.67%
2.4.1.4	6.45%	21.03%	72.52%	73.25%	58.99%	41.01%	78.70%	20.75%	15.17%	64.08%	75.36%	65.98%	13.97%	20.05%
2.4.1.5	6.41%	21.65%	71.95%	73.72%	59.03%	40.97%	78.79%	20.66%	15.65%	63.69%	75.70%	66.10%	13.90%	20.00%
2.4.1.6	6.36%	22.22%	71.42%	74.31%	59.11%	40.89%	78.95%	20.54%	16.10%	63.36%	76.14%	66.22%	13.82%	19.95%
2.4.1.7	6.47%	17.72%	75.81%	71.54%	59.73%	40.27%	77.90%	20.61%	12.72%	66.67%	73.95%	65.68%	13.83%	20.49%
2.4.1.8	6.44%	16.76%	76.80%	71.32%	60.07%	39.93%	77.81%	20.48%	12.03%	67.50%	73.77%	65.63%	13.73%	20.63%
2.4.1.9	6.44%	16.30%	77.26%	71.11%	60.20%	39.80%	77.68%	20.44%	11.69%	67.87%	73.58%	65.60%	13.70%	20.70%
2.4.1.10	6.36%	24.59%	69.05%	76.67%	58.33%	41.67%	80.97%	20.77%	17.85%	61.38%	78.39%	66.36%	14.03%	19.61%
RB 48 hr 2.4.1	4.53%	9.73%	85.74%	100.00%	69.54%	30.46%	100.00%	14.84%	7.22%	77.94%	100.00%	0.00%	30.48%	69.52%
RB 24 hr 2.4.1	6.33%	13.58%	80.09%	71.62%	61.22%	38.78%	78.56%	20.00%	9.73%	70.27%	74.20%	0.00%	38.80%	61.20%
2.4.2.1	11.74%	38.40%	49.86%	84.04%	30.14%	69.86%	92.50%	41.81%	22.46%	35.73%	88.02%	54.54%	31.79%	13.67%
2.4.2.2	10.88%	49.76%	39.36%	94.84%	29.09%	70.91%	97.00%	40.66%	30.14%	29.20%	95.94%	56.29%	31.04%	12.67%
2.4.2.3	10.09%	55.21%	34.69%	105.83%	29.24%	70.76%	101.93%	39.16%	34.38%	26.46%	104.14%	57.70%	29.99%	12.31%
2.4.2.4	10.94%	50.41%	38.65%	94.34%	28.83%	71.17%	96.65%	40.84%	30.51%	28.65%	95.52%	56.25%	31.18%	12.56%
2.4.2.5	10.92%	50.72%	38.36%	94.49%	28.80%	71.20%	96.61%	40.81%	30.72%	28.46%	95.58%	56.30%	31.16%	12.54%
2.4.2.6	10.91%	51.04%	38.05%	94.61%	28.75%	71.25%	96.55%	40.80%	30.95%	28.26%	95.62%	56.35%	31.15%	12.50%
2.4.2.7	11.24%	44.53%	44.23%	89.79%	29.66%	70.34%	94.84%	41.10%	26.57%	32.32%	92.21%	55.53%	31.32%	13.15%
2.4.2.8	11.38%	42.69%	45.93%	88.05%	29.84%	70.16%	94.09%	41.28%	25.33%	33.39%	90.92%	55.25%	31.44%	13.31%
2.4.2.9	11.46%	41.78%	46.76%	87.09%	29.90%	70.10%	93.67%	41.40%	24.72%	33.88%	90.21%	55.09%	31.52%	13.39%
2.4.2.10	10.11%	55.71%	34.18%	105.63%	29.08%	70.92%	101.71%	39.23%	34.69%	26.07%	103.93%	57.70%	30.05%	12.25%
RB 48 hr 2.4.2	9.87%	32.27%	57.87%	100.00%	35.38%	64.62%	100.00%	36.80%	19.77%	43.43%	100.00%	0.00%	64.69%	35.31%
RB 24 hr 2.4.2	12.20%	39.91%	47.88%	80.84%	28.99%	71.01%	91.00%	42.98%	23.09%	33.93%	85.62%	0.00%	71.09%	28.91%
2.4.3.1	13.28%	50.12%	36.60%	91.06%	21.62%	78.38%	96.71%	49.84%	26.48%	23.68%	94.03%	49.52%	39.61%	10.87%
2.4.3.2	11.84%	61.70%	26.46%	107.59%	21.14%	78.86%	103.27%	47.59%	34.36%	18.05%	105.38%	51.92%	37.97%	10.10%
2.4.3.3	10.77%	66.90%	22.33%	123.00%	21.50%	78.50%	109.51%	45.49%	38.69%	15.82%	116.02%	53.70%	36.41%	9.88%
2.4.3.4	11.95%	62.48%	25.57%	106.65%	20.83%	79.17%	102.86%	47.89%	34.71%	17.40%	104.72%	51.81%	38.21%	9.97%
2.4.3.5	11.97%	62.84%	25.19%	106.44%	20.72%	79.28%	102.72%	47.97%	34.90%	17.13%	104.55%	51.80%	38.27%	9.92%
2.4.3.6	11.97%	63.06%	24.97%	106.48%	20.68%	79.32%	102.67%	47.97%	35.04%	16.99%	104.55%	51.82%	38.28%	9.90%
2.4.3.7	12.47%	56.43%	31.10%	99.58%	21.41%	78.59%	100.04%	48.58%	30.70%	20.72%	99.86%	50.84%	38.69%	10.47%
2.4.3.8	12.73%	54.57%	32.70%	96.74%	21.46%	78.54%	98.90%	48.99%	29.42%	21.59%	97.90%	50.43%	38.99%	10.59%
2.4.3.9	12.88%	53.67%	33.45%	95.20%	21.44%	78.56%	98.28%	49.25%	28.78%	21.97%	96.84%	50.19%	39.18%	10.63%
2.4.3.10	10.81%	67.39%	21.80%	122.53%	21.32%	78.68%	109.27%	45.63%	38.94%	15.43%	115.67%	53.67%	36.52%	9.81%
RB 48 hr 2.4.3	12.10%	45.64%	42.26%	100.00%	24.20%	75.80%	100.00%	46.87%	24.90%	28.24%	100.00%	0.00%	75.88%	24.12%
RB 24 hr 2.4.3	14.06%	53.06%	32.87%	86.01%	20.08%	79.92%	94.85%	51.70%	27.46%	20.84%	90.65%	0.00%	80.01%	19.99%
2.4.4.1	13.57%	64.41%	22.03%	97.85%	15.01%	84.99%	99.38%	56.53%	30.64%	12.83%	98.73%	44.63%	47.12%	8.25%
2.4.4.2	11.40%	74.19%	14.41%	123.13%	15.48%	84.52%	107.88%	52.52%	38.35%	9.12%	114.33%	48.11%	43.93%	7.96%
2.4.4.3	10.11%	78.33%	11.56%	144.68%	16.17%	83.83%	115.23%	49.69%	42.61%	7.70%	127.67%	50.38%	41.67%	7.95%
2.4.4.4	11.52%	75.12%	13.36%	121.80%	15.15%	84.85%	107.47%	52.89%	38.68%	8.43%	113.53%	47.95%	44.24%	7.81%
2.4.4.5	11.56%	75.52%	12.91%	121.34%	15.03%	84.97%	107.31%	53.02%	38.84%	8.13%	113.25%	47.89%	44.35%	7.76%
2.4.4.6	11.58%	75.72%	12.70%	121.21%	14.97%	85.03%	107.24%	53.07%	38.93%	8.00%	113.15%	47.88%	44.39%	7.73%
2.4.4.7	12.35%	69.91%	17.73%	110.55%	15.25%	84.75%	103.63%	54.37%	34.82%	10.82%	106.56%	46.51%	45.40%	8.09%
2.4.4.8	12.73%	68.28%	18.99%	106.32%	15.16%	84.84%	102.20%	55.05%	33.52%	11.42%	103.95%	45.92%	45.94%	8.14%
2.4.4.9	12.95%	67.53%	19.52%	104.03%	15.08%	84.92%	101.43%	55.47%	32.89%	11.64%	102.53%	45.58%	46.27%	8.14%
2.4.4.10	10.18%	78.99%	10.83%	143.67%	15.94%	84.06%	114.90%	49.93%	42.87%	7.20%	127.06%	50.28%	41.87%	7.84%
RB 48 hr 2.4.4	13.28%	63.02%	23.70%	100.00%	15.54%	84.46%	100.00%	55.81%	30.25%	13.94%	100.00%	0.00%	84.56%	15.44%
RB 24 hr 2.4.4	14.41%	68.39%	17.21%	92.15%	13.58%	86.42%	97.73%	58.51%	31.71%	9.77%	95.39%	0.00%	86.53%	13.47%

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.2.1.1	6.25%	17.02%	76.73%	65.14%	67.35%	32.65%	70.62%	17.20%	12.69%	70.11%	67.16%	68.18%	10.40%	21.42%
1.2.1.2	6.33%	24.74%	68.93%	68.63%	65.11%	34.89%	72.37%	17.85%	18.62%	63.53%	70.14%	68.79%	10.90%	20.31%
1.2.1.3	6.30%	28.68%	65.02%	72.42%	64.05%	35.95%	75.13%	18.06%	21.70%	60.24%	73.63%	69.14%	11.11%	19.75%
1.2.1.4	6.31%	25.48%	68.22%	68.93%	65.07%	34.93%	72.30%	17.81%	19.21%	62.99%	70.32%	68.91%	10.87%	20.22%
1.2.1.5	6.26%	26.15%	67.59%	69.40%	65.11%	34.89%	72.36%	17.72%	19.75%	62.53%	70.66%	69.03%	10.82%	20.15%
1.2.1.6	6.20%	26.73%	67.07%	70.06%	65.22%	34.78%	72.59%	17.59%	20.23%	62.18%	71.19%	69.16%	10.74%	20.10%
1.2.1.7	6.24%	21.51%	72.24%	67.42%	66.30%	33.70%	71.68%	17.43%	16.15%	66.42%	69.08%	68.60%	10.59%	20.80%
1.2.1.8	6.20%	20.37%	73.43%	67.16%	66.76%	33.24%	71.57%	17.25%	15.28%	67.47%	68.85%	68.55%	10.46%	20.99%
1.2.1.9	6.19%	19.83%	73.98%	66.91%	66.95%	33.05%	71.42%	17.18%	14.87%	67.95%	68.63%	68.51%	10.42%	21.07%
1.2.1.10	6.27%	29.42%	64.31%	72.82%	64.04%	35.96%	75.11%	18.00%	22.30%	59.70%	73.90%	69.26%	11.07%	19.66%
RB 48 hr 1.2.1	4.07%	11.08%	84.84%	100.00%	76.94%	23.06%	100.00%	11.55%	8.53%	79.93%	100.00%	0.00%	23.07%	76.93%
RB 24 hr 1.2.1	5.66%	15.41%	78.93%	71.91%	69.79%	30.21%	76.33%	15.70%	11.59%	72.70%	73.54%	0.00%	30.23%	69.77%
1.2.2.1	10.52%	43.39%	46.09%	82.30%	37.89%	62.11%	89.26%	34.32%	28.54%	37.14%	85.23%	61.05%	24.23%	14.72%
1.2.2.2	9.86%	55.46%	34.68%	94.22%	35.90%	64.10%	95.35%	33.73%	37.53%	28.74%	94.86%	62.64%	24.00%	13.36%
1.2.2.3	9.20%	60.81%	29.98%	106.32%	35.70%	64.30%	102.14%	32.61%	42.02%	25.37%	104.83%	63.80%	23.34%	12.86%
1.2.2.4	9.93%	56.28%	33.78%	93.52%	35.51%	64.49%	94.77%	33.96%	38.06%	27.98%	94.21%	62.61%	24.16%	13.22%
1.2.2.5	9.93%	56.66%	33.41%	93.56%	35.43%	64.57%	94.65%	33.97%	38.34%	27.69%	94.20%	62.66%	24.17%	13.18%
1.2.2.6	9.91%	56.96%	33.12%	93.72%	35.39%	64.61%	94.59%	33.94%	38.58%	27.48%	94.26%	62.71%	24.15%	13.14%
1.2.2.7	10.09%	49.80%	40.10%	88.93%	37.05%	62.95%	92.58%	33.82%	33.32%	32.86%	90.55%	61.99%	23.97%	14.04%
1.2.2.8	10.21%	47.91%	41.88%	86.90%	37.34%	62.66%	91.50%	33.94%	31.90%	34.16%	88.90%	61.73%	24.02%	14.25%
1.2.2.9	10.28%	46.98%	42.74%	85.79%	37.45%	62.55%	90.91%	34.02%	31.20%	34.77%	88.00%	61.59%	24.07%	14.34%
1.2.2.10	9.23%	61.41%	29.36%	105.98%	35.46%	64.54%	101.76%	32.72%	42.43%	24.85%	104.48%	63.81%	23.41%	12.77%
RB 48 hr 1.2.2	8.66%	35.71%	55.64%	100.00%	44.56%	55.44%	100.00%	29.25%	24.32%	46.42%	100.00%	0.00%	55.52%	44.48%
RB 24 hr 1.2.2	10.61%	43.77%	45.62%	81.58%	37.58%	62.42%	88.82%	34.57%	28.74%	36.69%	84.63%	0.00%	62.52%	37.48%
1.2.3.1	11.73%	55.16%	33.11%	89.83%	28.18%	71.82%	94.91%	41.33%	33.81%	24.86%	92.17%	57.14%	30.84%	12.02%
1.2.3.2	10.55%	66.61%	22.84%	108.24%	27.09%	72.91%	104.45%	39.61%	42.53%	17.86%	106.62%	59.25%	29.78%	10.97%
1.2.3.3	9.68%	71.43%	18.88%	125.05%	27.20%	72.80%	113.42%	37.97%	46.86%	15.17%	119.91%	60.67%	28.71%	10.62%
1.2.3.4	10.66%	67.55%	21.80%	107.13%	26.63%	73.37%	103.81%	39.94%	43.05%	17.01%	105.73%	59.16%	30.03%	10.81%
1.2.3.5	10.68%	67.93%	21.39%	106.90%	26.49%	73.51%	103.61%	40.02%	43.29%	16.69%	105.52%	59.16%	30.09%	10.75%
1.2.3.6	10.68%	68.17%	21.15%	106.92%	26.44%	73.56%	103.53%	40.03%	43.45%	16.52%	105.49%	59.18%	30.10%	10.72%
1.2.3.7	11.02%	61.25%	27.73%	99.65%	27.78%	72.22%	99.92%	40.23%	38.45%	21.32%	99.84%	58.36%	30.14%	11.51%
1.2.3.8	11.23%	59.42%	29.35%	96.51%	27.92%	72.08%	98.27%	40.54%	37.05%	22.41%	97.37%	58.00%	30.33%	11.67%
1.2.3.9	11.36%	58.59%	30.05%	94.74%	27.92%	72.08%	97.34%	40.77%	36.38%	22.85%	95.97%	57.79%	30.48%	11.73%
1.2.3.10	9.73%	72.02%	18.25%	124.44%	26.94%	73.06%	113.02%	38.14%	47.21%	14.65%	119.40%	60.64%	28.84%	10.53%
RB 48 hr 1.2.3	10.54%	49.55%	39.91%	100.00%	31.83%	68.17%	100.00%	38.09%	31.16%	30.75%	100.00%	0.00%	68.28%	31.72%
RB 24 hr 1.2.3	12.14%	57.09%	30.76%	86.79%	27.01%	72.99%	93.39%	42.41%	34.70%	22.90%	89.82%	0.00%	73.12%	26.88%
1.2.4.1	11.67%	68.58%	19.75%	97.37%	20.55%	79.45%	98.91%	46.87%	39.28%	13.85%	98.14%	53.35%	37.13%	9.52%
1.2.4.2	9.93%	77.71%	12.37%	124.60%	20.77%	79.23%	111.56%	43.49%	47.29%	9.22%	118.18%	56.33%	34.68%	8.99%
1.2.4.3	8.91%	81.37%	9.71%	147.57%	21.36%	78.64%	122.42%	41.22%	51.28%	7.50%	135.16%	58.12%	33.03%	8.86%
1.2.4.4	10.04%	78.73%	11.23%	123.17%	20.32%	79.68%	110.93%	43.87%	47.78%	8.35%	117.14%	56.20%	34.99%	8.82%
1.2.4.5	10.08%	79.16%	10.76%	122.68%	20.15%	79.85%	110.69%	44.01%	48.00%	7.99%	116.78%	56.16%	35.10%	8.75%
1.2.4.6	10.09%	79.38%	10.53%	122.51%	20.07%	79.93%	110.58%	44.06%	48.12%	7.82%	116.65%	56.15%	35.14%	8.72%
1.2.4.7	10.68%	73.71%	15.61%	111.13%	20.69%	79.31%	105.27%	44.99%	43.68%	11.33%	108.25%	55.01%	35.76%	9.23%
1.2.4.8	10.98%	72.23%	16.79%	106.54%	20.63%	79.37%	103.13%	45.58%	42.36%	12.06%	104.87%	54.50%	36.19%	9.31%
1.2.4.9	11.16%	71.55%	17.29%	104.07%	20.54%	79.46%	101.98%	45.95%	41.71%	12.34%	103.05%	54.21%	36.46%	9.33%
1.2.4.10	8.98%	82.08%	8.94%	146.49%	21.05%	78.95%	121.93%	41.46%	51.65%	6.89%	134.37%	58.04%	33.22%	8.74%
RB 48 hr 1.2.4	11.36%	66.78%	21.86%	100.00%	21.42%	78.58%	100.00%	46.00%	38.55%	15.45%	100.00%	0.00%	78.73%	21.27%
RB 24 hr 1.2.4	12.25%	71.99%	15.76%	92.76%	19.00%	81.00%	97.01%	48.48%	40.62%	10.90%	94.88%	0.00%	81.16%	18.84%

Property of Parsons Brinckerhoff

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.4.1.1	6.99%	15.02%	77.99%	64.76%	58.49%	41.51%	73.39%	21.83%	10.62%	67.55%	67.97%	64.82%	14.62%	20.57%
1.4.1.2	7.01%	22.04%	70.95%	67.36%	56.69%	43.31%	74.54%	22.31%	15.72%	61.97%	70.10%	65.36%	15.02%	19.62%
1.4.1.3	6.90%	25.79%	67.31%	70.70%	56.05%	43.95%	76.77%	22.28%	18.52%	59.20%	73.07%	65.78%	15.06%	19.16%
1.4.1.4	6.98%	22.77%	70.24%	67.63%	56.65%	43.35%	74.47%	22.26%	16.27%	61.47%	70.26%	65.47%	14.98%	19.54%
1.4.1.5	6.94%	23.44%	69.62%	68.08%	56.68%	43.32%	74.52%	22.16%	16.78%	61.05%	70.57%	65.60%	14.92%	19.48%
1.4.1.6	6.87%	24.03%	69.10%	68.73%	56.80%	43.20%	74.73%	22.01%	17.25%	60.75%	71.06%	65.75%	14.81%	19.44%
1.4.1.7	6.96%	19.06%	73.99%	66.52%	57.67%	42.33%	74.11%	21.96%	13.56%	64.48%	69.39%	65.20%	14.74%	20.06%
1.4.1.8	6.92%	18.01%	75.07%	66.38%	58.06%	41.94%	74.08%	21.80%	12.81%	65.39%	69.27%	65.16%	14.63%	20.22%
1.4.1.9	6.92%	17.51%	75.57%	66.19%	58.20%	41.80%	73.97%	21.76%	12.45%	65.79%	69.11%	65.13%	14.59%	20.28%
1.4.1.10	6.86%	26.54%	66.60%	71.05%	56.03%	43.97%	76.73%	22.21%	19.09%	58.69%	73.29%	65.90%	15.01%	19.09%
RB 48 hr 1.4.1	4.53%	9.73%	85.74%	100.00%	69.54%	30.46%	100.00%	14.84%	7.22%	77.94%	100.00%	0.00%	30.48%	69.52%
RB 24 hr 1.4.1	6.33%	13.58%	80.09%	71.62%	61.22%	38.78%	78.56%	20.00%	9.73%	70.27%	74.20%	0.00%	38.80%	61.20%
1.4.2.1	12.09%	39.55%	48.36%	81.59%	29.26%	70.74%	91.35%	42.70%	22.94%	34.36%	86.18%	54.15%	32.47%	13.38%
1.4.2.2	11.28%	51.58%	37.14%	91.49%	27.92%	72.08%	95.43%	41.75%	30.95%	27.30%	93.43%	55.84%	31.88%	12.28%
1.4.2.3	10.45%	57.14%	32.41%	102.26%	28.05%	71.95%	100.25%	40.19%	35.29%	24.52%	101.46%	57.29%	30.78%	11.92%
1.4.2.4	11.38%	52.42%	36.21%	90.73%	27.56%	72.44%	94.95%	42.03%	31.40%	26.57%	92.80%	55.77%	32.09%	12.14%
1.4.2.5	11.37%	52.80%	35.82%	90.76%	27.48%	72.52%	94.85%	42.05%	31.65%	26.30%	92.77%	55.80%	32.10%	12.10%
1.4.2.6	11.36%	53.13%	35.51%	90.89%	27.44%	72.56%	94.80%	42.02%	31.88%	26.10%	92.82%	55.85%	32.09%	12.06%
1.4.2.7	11.58%	45.87%	42.55%	87.17%	28.74%	71.26%	93.61%	42.00%	27.15%	30.85%	90.24%	55.15%	32.01%	12.85%
1.4.2.8	11.73%	43.99%	44.29%	85.44%	28.92%	71.08%	92.86%	42.19%	25.89%	31.92%	88.97%	54.86%	32.13%	13.01%
1.4.2.9	11.81%	43.06%	45.13%	84.50%	28.98%	71.02%	92.46%	42.31%	25.26%	32.43%	88.27%	54.70%	32.21%	13.09%
1.4.2.10	10.49%	57.76%	31.75%	101.87%	27.83%	72.17%	99.94%	40.33%	35.66%	24.01%	101.11%	57.28%	30.89%	11.83%
RB 48 hr 1.4.2	9.87%	32.27%	57.87%	100.00%	35.38%	64.62%	100.00%	36.80%	19.77%	43.43%	100.00%	0.00%	64.69%	35.31%
RB 24 hr 1.4.2	12.20%	39.91%	47.88%	80.84%	28.99%	71.01%	91.00%	42.98%	23.09%	33.93%	85.62%	0.00%	71.09%	28.91%
1.4.3.1	13.51%	50.98%	35.51%	89.53%	21.16%	78.84%	96.14%	50.39%	26.77%	22.84%	93.00%	49.26%	40.05%	10.69%
1.4.3.2	12.10%	63.04%	24.86%	105.30%	20.49%	79.51%	102.42%	48.29%	34.87%	16.84%	103.85%	51.61%	38.53%	9.85%
1.4.3.3	10.99%	68.26%	20.74%	120.54%	20.84%	79.16%	108.60%	46.15%	39.24%	14.61%	114.37%	53.43%	36.93%	9.64%
1.4.3.4	12.24%	64.01%	23.75%	104.10%	20.09%	79.91%	101.92%	48.68%	35.29%	16.03%	103.02%	51.46%	38.84%	9.69%
1.4.3.5	12.27%	64.42%	23.31%	103.84%	19.97%	80.03%	101.76%	48.78%	35.49%	15.73%	102.81%	51.44%	38.92%	9.63%
1.4.3.6	12.27%	64.67%	23.06%	103.83%	19.92%	80.08%	101.70%	48.80%	35.64%	15.56%	102.78%	51.46%	38.94%	9.61%
1.4.3.7	12.69%	57.42%	29.89%	97.87%	20.91%	79.09%	99.41%	49.15%	31.05%	19.80%	98.71%	50.58%	39.14%	10.28%
1.4.3.8	12.95%	55.51%	31.54%	95.10%	20.97%	79.03%	98.29%	49.55%	29.75%	20.70%	96.80%	50.17%	39.43%	10.40%
1.4.3.9	13.11%	54.65%	32.24%	93.50%	20.94%	79.06%	97.66%	49.83%	29.12%	21.05%	95.71%	49.92%	39.64%	10.44%
1.4.3.10	11.05%	68.89%	20.06%	119.87%	20.61%	79.39%	108.29%	46.34%	39.55%	14.11%	113.89%	53.37%	37.09%	9.54%
RB 48 hr 1.4.3	12.10%	45.64%	42.26%	100.00%	24.20%	75.80%	100.00%	46.87%	24.90%	28.24%	100.00%	0.00%	75.88%	24.12%
RB 24 hr 1.4.3	14.06%	53.06%	32.87%	86.01%	20.08%	79.92%	94.85%	51.70%	27.46%	20.84%	90.65%	0.00%	80.01%	19.99%
1.4.4.1	13.67%	64.87%	21.47%	97.15%	14.84%	85.16%	99.18%	56.77%	30.77%	12.47%	98.32%	44.51%	47.31%	8.18%
1.4.4.2	11.49%	74.82%	13.68%	122.09%	15.24%	84.76%	107.58%	52.80%	38.56%	8.64%	113.72%	47.98%	44.17%	7.86%
1.4.4.3	10.19%	78.97%	10.83%	143.49%	15.92%	84.08%	114.88%	49.96%	42.84%	7.20%	126.97%	50.26%	41.90%	7.84%
1.4.4.4	11.64%	75.92%	12.44%	120.52%	14.86%	85.14%	107.10%	53.24%	38.94%	7.82%	112.78%	47.78%	44.53%	7.69%
1.4.4.5	11.70%	76.37%	11.93%	119.98%	14.71%	85.29%	106.92%	53.40%	39.12%	7.48%	112.45%	47.72%	44.67%	7.62%
1.4.4.6	11.71%	76.61%	11.67%	119.80%	14.65%	85.35%	106.84%	53.46%	39.22%	7.32%	112.32%	47.70%	44.72%	7.59%
1.4.4.7	12.44%	70.43%	17.13%	109.74%	15.06%	84.94%	103.40%	54.61%	34.97%	10.42%	106.08%	46.39%	45.60%	8.01%
1.4.4.8	12.82%	68.80%	18.38%	105.52%	14.97%	85.03%	101.97%	55.30%	33.68%	11.02%	103.48%	45.80%	46.15%	8.05%
1.4.4.9	13.05%	68.05%	18.90%	103.23%	14.88%	85.12%	101.20%	55.72%	33.04%	11.24%	102.07%	45.46%	46.49%	8.06%
1.4.4.10	10.28%	79.75%	9.97%	142.30%	15.65%	84.35%	114.51%	50.25%	43.14%	6.61%	126.25%	50.14%	42.14%	7.72%
RB 48 hr 1.4.4	13.28%	63.02%	23.70%	100.00%	15.54%	84.46%	100.00%	55.81%	30.25%	13.94%	100.00%	0.00%	84.56%	15.44%
RB 24 hr 1.4.4	14.41%	68.39%	17.21%	92.15%	13.58%	86.42%	97.73%	58.51%	31.71%	9.77%	95.39%	0.00%	86.53%	13.47%

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
3.1.1.1	5.24%	18.94%	75.82%	69.62%	77.40%	22.60%	71.73%	12.48%	14.83%	72.69%	70.50%	71.27%	6.50%	22.23%
3.1.1.2	5.37%	27.40%	67.23%	75.18%	75.00%	25.00%	74.64%	13.20%	21.67%	65.13%	75.35%	72.04%	7.00%	20.95%
3.1.1.3	5.46%	31.33%	63.21%	79.58%	73.52%	26.48%	77.93%	13.66%	24.87%	61.46%	79.46%	72.33%	7.34%	20.33%
3.1.1.4	5.35%	28.28%	66.38%	75.58%	74.96%	25.04%	74.53%	13.16%	22.41%	64.43%	75.60%	72.18%	6.98%	20.84%
3.1.1.5	5.29%	29.01%	65.70%	76.34%	75.04%	24.96%	74.76%	13.05%	23.04%	63.90%	76.20%	72.32%	6.92%	20.76%
3.1.1.6	5.25%	29.79%	64.96%	76.94%	75.06%	24.94%	74.84%	12.98%	23.71%	63.31%	76.64%	72.45%	6.88%	20.67%
3.1.1.7	5.26%	24.12%	70.63%	73.20%	76.26%	23.74%	73.46%	12.74%	19.02%	68.23%	73.57%	71.82%	6.70%	21.48%
3.1.1.8	5.21%	22.97%	71.83%	72.60%	76.71%	23.29%	73.12%	12.58%	18.10%	69.33%	73.03%	71.74%	6.59%	21.67%
3.1.1.9	5.21%	22.47%	72.32%	72.00%	76.85%	23.15%	72.67%	12.54%	17.70%	69.76%	72.48%	71.69%	6.56%	21.74%
3.1.1.10	5.42%	32.18%	62.40%	80.18%	73.53%	26.47%	77.95%	13.59%	25.60%	60.81%	79.89%	72.48%	7.30%	20.22%
RB 48 hr 3.1.1	3.65%	13.19%	83.16%	100.00%	83.79%	16.21%	100.00%	8.80%	10.45%	80.75%	100.00%	0.00%	16.22%	83.78%
RB 24 hr 3.1.1	5.10%	18.45%	76.44%	71.48%	77.94%	22.06%	73.46%	12.17%	14.46%	73.37%	72.31%	0.00%	22.09%	77.91%
3.1.4.1	9.69%	72.38%	17.93%	98.33%	29.38%	70.62%	98.99%	35.94%	49.15%	14.91%	98.61%	62.80%	26.34%	10.85%
3.1.4.2	8.43%	80.38%	11.19%	128.51%	29.05%	70.95%	117.61%	33.65%	56.68%	9.67%	124.10%	64.91%	24.99%	10.10%
3.1.4.3	7.71%	83.46%	8.83%	153.43%	29.30%	70.70%	133.41%	32.21%	60.01%	7.78%	145.30%	66.01%	24.13%	9.86%
3.1.4.4	8.50%	81.19%	10.31%	127.44%	28.61%	71.39%	116.88%	33.91%	57.20%	8.89%	123.18%	64.86%	25.18%	9.96%
3.1.4.5	8.52%	81.58%	9.89%	127.04%	28.41%	71.59%	116.57%	34.01%	57.46%	8.53%	122.82%	64.85%	25.25%	9.90%
3.1.4.6	8.53%	81.75%	9.72%	126.99%	28.35%	71.65%	116.47%	34.02%	57.59%	8.39%	122.75%	64.87%	25.26%	9.87%
3.1.4.7	8.96%	76.92%	14.12%	113.64%	29.24%	70.76%	108.36%	34.62%	53.38%	12.00%	111.51%	64.01%	25.55%	10.44%
3.1.4.8	9.19%	75.69%	15.12%	108.48%	29.23%	70.77%	105.15%	35.05%	52.19%	12.76%	107.15%	63.64%	25.81%	10.54%
3.1.4.9	9.31%	75.06%	15.62%	105.87%	29.21%	70.79%	103.53%	35.29%	51.57%	13.15%	104.94%	63.45%	25.96%	10.60%
3.1.4.10	7.76%	84.07%	8.18%	152.55%	28.97%	71.03%	132.79%	32.38%	60.42%	7.20%	144.53%	65.99%	24.25%	9.76%
RB 48 hr 3.1.4	9.53%	71.18%	19.29%	100.00%	30.10%	69.90%	100.00%	35.44%	48.47%	16.09%	100.00%	0.00%	70.11%	29.89%
RB 24 hr 3.1.4	10.20%	76.22%	13.58%	93.38%	27.17%	72.83%	95.98%	37.51%	51.30%	11.19%	94.48%	0.00%	73.05%	26.95%
3.4.1.1	6.51%	13.98%	79.50%	69.56%	60.44%	39.56%	77.01%	20.51%	9.98%	69.50%	72.32%	65.30%	13.74%	20.96%
3.4.1.2	6.47%	20.35%	73.18%	72.97%	59.02%	40.98%	78.78%	20.80%	14.65%	64.55%	75.20%	65.87%	14.00%	20.13%
3.4.1.3	6.39%	23.90%	69.71%	76.30%	58.35%	41.65%	81.01%	20.83%	17.32%	61.86%	78.17%	66.24%	14.07%	19.68%
3.4.1.4	6.45%	21.04%	72.51%	73.22%	58.98%	41.02%	78.68%	20.76%	15.18%	64.07%	75.33%	65.98%	13.97%	20.05%
3.4.1.5	6.40%	21.64%	71.96%	73.76%	59.04%	40.96%	78.81%	20.65%	15.64%	63.71%	75.73%	66.10%	13.90%	20.00%
3.4.1.6	6.37%	22.27%	71.36%	74.15%	59.05%	40.95%	78.83%	20.58%	16.13%	63.29%	75.99%	66.21%	13.85%	19.94%
3.4.1.7	6.45%	17.68%	75.86%	71.69%	59.79%	40.21%	78.01%	20.57%	12.70%	66.73%	74.08%	65.69%	13.81%	20.50%
3.4.1.8	6.44%	16.76%	76.79%	71.30%	60.06%	39.94%	77.79%	20.48%	12.03%	67.49%	73.75%	65.63%	13.74%	20.63%
3.4.1.9	6.46%	16.36%	77.18%	70.84%	60.10%	39.90%	77.48%	20.50%	11.73%	67.77%	73.34%	65.58%	13.75%	20.68%
3.4.1.10	6.36%	24.60%	69.04%	76.64%	58.32%	41.68%	80.95%	20.77%	17.86%	61.37%	78.37%	66.36%	14.04%	19.61%
RB 48 hr 3.4.1	4.53%	9.73%	85.74%	100.00%	69.54%	30.46%	100.00%	14.84%	7.22%	77.94%	100.00%	0.00%	30.48%	69.52%
RB 24 hr 3.4.1	6.33%	13.58%	80.09%	71.62%	61.22%	38.78%	78.56%	20.00%	9.73%	70.27%	74.20%	0.00%	38.80%	61.20%
3.4.4.1	13.56%	64.37%	22.07%	97.90%	15.02%	84.98%	99.39%	56.51%	30.63%	12.86%	98.77%	44.64%	47.10%	8.26%
3.4.4.2	11.40%	74.22%	14.38%	123.09%	15.47%	84.53%	107.87%	52.53%	38.36%	9.10%	114.31%	48.11%	43.94%	7.95%
3.4.4.3	10.11%	78.32%	11.57%	144.68%	16.18%	83.82%	115.23%	49.69%	42.60%	7.71%	127.67%	50.38%	41.67%	7.95%
3.4.4.4	11.52%	75.11%	13.37%	121.82%	15.16%	84.84%	107.48%	52.89%	38.68%	8.43%	113.54%	47.95%	44.23%	7.82%
3.4.4.5	11.57%	75.54%	12.90%	121.31%	15.02%	84.98%	107.30%	53.03%	38.85%	8.12%	113.23%	47.89%	44.36%	7.75%
3.4.4.6	11.58%	75.72%	12.70%	121.20%	14.97%	85.03%	107.24%	53.07%	38.93%	8.00%	113.15%	47.88%	44.39%	7.73%
3.4.4.7	12.35%	69.87%	17.79%	110.62%	15.27%	84.73%	103.65%	54.35%	34.80%	10.85%	106.60%	46.52%	45.38%	8.10%
3.4.4.8	12.73%	68.32%	18.94%	106.26%	15.15%	84.85%	102.18%	55.07%	33.54%	11.39%	103.91%	45.91%	45.96%	8.13%
3.4.4.9	12.94%	67.53%	19.53%	104.04%	15.08%	84.92%	101.44%	55.47%	32.89%	11.65%	102.54%	45.58%	46.27%	8.14%
3.4.4.10	10.18%	78.99%	10.82%	143.65%	15.94%	84.06%	114.90%	49.93%	42.87%	7.19%	127.05%	50.28%	41.87%	7.84%
RB 48 hr 3.4.4	13.28%	63.02%	23.70%	100.00%	15.54%	84.46%	100.00%	55.81%	30.25%	13.94%	100.00%	0.00%	84.56%	15.44%
RB 24 hr 3.4.4	14.41%	68.39%	17.21%	92.15%	13.58%	86.42%	97.73%	58.51%	31.71%	9.77%	95.39%	0.00%	86.53%	13.47%

Property of Cranfield University

SUMMARY OF FINANCIAL ANALYSIS: ADDITIONAL STATIC HEAD (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
4.1.1.1	5.09%	18.38%	76.54%	71.76%	78.01%	21.99%	73.72%	12.13%	14.41%	73.47%	72.58%	71.32%	6.31%	22.37%
4.1.1.2	5.36%	27.30%	67.34%	75.44%	75.08%	24.92%	74.88%	13.16%	21.60%	65.24%	75.60%	72.05%	6.98%	20.97%
4.1.1.3	5.46%	31.33%	63.21%	79.57%	73.52%	26.48%	77.92%	13.66%	24.88%	61.46%	79.45%	72.33%	7.34%	20.33%
4.1.1.4	5.33%	28.21%	66.46%	75.76%	75.02%	24.98%	74.71%	13.13%	22.36%	64.52%	75.78%	72.18%	6.96%	20.86%
4.1.1.5	5.31%	29.08%	65.62%	76.17%	74.98%	25.02%	74.60%	13.08%	23.09%	63.83%	76.03%	72.31%	6.94%	20.75%
4.1.1.6	5.24%	29.74%	65.02%	77.08%	75.11%	24.89%	74.98%	12.95%	23.66%	63.38%	76.78%	72.45%	6.87%	20.68%
4.1.1.7	5.16%	23.66%	71.19%	74.62%	76.68%	23.32%	74.78%	12.51%	18.67%	68.82%	74.94%	71.84%	6.58%	21.59%
4.1.1.8	5.10%	22.47%	72.43%	74.20%	77.18%	22.82%	74.60%	12.31%	17.72%	69.96%	74.58%	71.76%	6.45%	21.78%
4.1.1.9	5.07%	21.90%	73.03%	73.89%	77.40%	22.60%	74.43%	12.23%	17.26%	70.51%	74.31%	71.72%	6.40%	21.88%
4.1.1.10	5.42%	32.18%	62.40%	80.18%	73.53%	26.47%	77.95%	13.59%	25.60%	60.81%	79.89%	72.48%	7.30%	20.22%
RB 48 hr 4.1.1	3.65%	13.19%	83.16%	100.00%	83.79%	16.21%	100.00%	8.80%	10.45%	80.75%	100.00%	0.00%	16.22%	83.78%
RB 24 hr 4.1.1	5.10%	18.45%	76.44%	71.48%	77.94%	22.06%	73.46%	12.17%	14.46%	73.37%	72.31%	0.00%	22.09%	77.91%
4.1.4.1	9.31%	69.57%	21.11%	102.31%	31.06%	68.94%	101.40%	34.77%	47.55%	17.68%	101.92%	63.13%	25.49%	11.38%
4.1.4.2	8.24%	78.63%	13.13%	131.37%	30.08%	69.92%	119.35%	33.02%	55.61%	11.37%	126.49%	65.06%	24.52%	10.42%
4.1.4.3	7.61%	82.30%	10.09%	155.58%	29.98%	70.02%	134.71%	31.82%	59.28%	8.90%	147.09%	66.09%	23.83%	10.07%
4.1.4.4	8.40%	80.25%	11.35%	128.93%	29.16%	70.84%	117.79%	33.57%	56.63%	9.81%	124.43%	64.94%	24.92%	10.13%
4.1.4.5	8.45%	80.89%	10.66%	128.13%	28.82%	71.18%	117.24%	33.75%	57.04%	9.21%	123.73%	64.91%	25.06%	10.02%
4.1.4.6	8.48%	81.26%	10.26%	127.75%	28.64%	71.36%	116.94%	33.85%	57.29%	8.86%	123.39%	64.91%	25.13%	9.96%
4.1.4.7	8.74%	75.02%	16.23%	116.51%	30.36%	69.64%	110.10%	33.90%	52.25%	13.85%	113.91%	64.19%	25.02%	10.79%
4.1.4.8	8.95%	73.69%	17.36%	111.42%	30.41%	69.59%	106.94%	34.27%	51.02%	14.72%	109.60%	63.85%	25.23%	10.92%
4.1.4.9	9.05%	72.96%	17.99%	108.92%	30.46%	69.54%	105.39%	34.45%	50.35%	15.21%	107.48%	63.67%	25.34%	10.99%
4.1.4.10	7.71%	83.53%	8.76%	153.52%	29.28%	70.72%	133.38%	32.20%	60.08%	7.72%	145.34%	66.03%	24.12%	9.85%
RB 48 hr 4.1.4	9.53%	71.18%	19.29%	100.00%	30.10%	69.90%	100.00%	35.44%	48.47%	16.09%	100.00%	0.00%	70.11%	29.89%
RB 24 hr 4.1.4	10.20%	76.22%	13.58%	93.38%	27.17%	72.83%	95.98%	37.51%	51.30%	11.19%	94.48%	0.00%	73.05%	26.95%
4.4.1.1	6.32%	13.57%	80.11%	71.66%	61.24%	38.76%	78.60%	19.98%	9.72%	70.29%	74.24%	65.50%	13.38%	21.12%
4.4.1.2	6.44%	20.26%	73.30%	73.29%	59.15%	40.85%	79.02%	20.72%	14.60%	64.69%	75.49%	65.90%	13.94%	20.16%
4.4.1.3	6.38%	23.86%	69.76%	76.42%	58.40%	41.60%	81.10%	20.80%	17.29%	61.91%	78.27%	66.25%	14.06%	19.69%
4.4.1.4	6.43%	20.96%	72.61%	73.47%	59.07%	40.93%	78.87%	20.70%	15.13%	64.17%	75.56%	66.00%	13.93%	20.07%
4.4.1.5	6.41%	21.64%	71.95%	73.74%	59.03%	40.97%	78.80%	20.65%	15.64%	63.70%	75.71%	66.10%	13.90%	20.00%
4.4.1.6	6.35%	22.20%	71.45%	74.39%	59.14%	40.86%	79.01%	20.52%	16.08%	63.40%	76.21%	66.23%	13.81%	19.96%
4.4.1.7	6.34%	17.37%	76.29%	72.98%	60.29%	39.71%	78.99%	20.25%	12.50%	67.25%	75.26%	65.80%	13.59%	20.61%
4.4.1.8	6.31%	16.41%	77.28%	72.83%	60.65%	39.35%	78.95%	20.10%	11.81%	68.09%	75.14%	65.76%	13.48%	20.75%
4.4.1.9	6.30%	15.94%	77.77%	72.73%	60.82%	39.18%	78.91%	20.03%	11.46%	68.50%	75.06%	65.74%	13.43%	20.82%
4.4.1.10	6.35%	24.56%	69.09%	76.78%	58.38%	41.62%	81.05%	20.74%	17.83%	61.43%	78.50%	66.37%	14.02%	19.62%
RB 48 hr 4.4.1	4.53%	9.73%	85.74%	100.00%	69.54%	30.46%	100.00%	14.84%	7.22%	77.94%	100.00%	0.00%	30.48%	69.52%
RB 24 hr 4.4.1	6.33%	13.58%	80.09%	71.62%	61.22%	38.78%	78.56%	20.00%	9.73%	70.27%	74.20%	0.00%	38.80%	61.20%
4.4.4.1	12.92%	61.31%	25.77%	102.78%	16.21%	83.79%	100.80%	54.92%	29.76%	15.32%	101.64%	45.44%	45.77%	8.79%
4.4.4.2	11.09%	72.19%	16.72%	126.54%	16.24%	83.76%	108.87%	51.62%	37.69%	10.69%	116.34%	48.54%	43.17%	8.29%
4.4.4.3	9.94%	76.98%	13.09%	147.21%	16.70%	83.30%	115.96%	49.12%	42.11%	8.77%	129.16%	50.64%	41.19%	8.17%
4.4.4.4	11.36%	74.06%	14.58%	123.55%	15.55%	84.45%	107.98%	52.42%	38.34%	9.25%	114.56%	48.17%	43.84%	7.99%
4.4.4.5	11.45%	74.77%	13.78%	122.55%	15.30%	84.70%	107.66%	52.69%	38.60%	8.71%	113.96%	48.05%	44.07%	7.88%
4.4.4.6	11.49%	75.18%	13.32%	122.08%	15.17%	84.83%	107.50%	52.83%	38.76%	8.41%	113.67%	47.99%	44.19%	7.82%
4.4.4.7	11.97%	67.72%	20.31%	114.12%	16.09%	83.91%	104.66%	53.32%	34.14%	12.54%	108.66%	47.02%	44.52%	8.46%
4.4.4.8	12.32%	66.09%	21.60%	109.85%	16.00%	84.00%	103.22%	53.98%	32.87%	13.16%	106.02%	46.45%	45.04%	8.51%
4.4.4.9	12.50%	65.20%	22.30%	107.75%	15.97%	84.03%	102.51%	54.31%	32.20%	13.49%	104.72%	46.15%	45.31%	8.54%
4.4.4.10	10.11%	78.40%	11.50%	144.75%	16.17%	83.83%	115.22%	49.68%	42.66%	7.66%	127.70%	50.40%	41.66%	7.94%
RB 48 hr 4.4.4	13.28%	63.02%	23.70%	100.00%	15.54%	84.46%	100.00%	55.81%	30.25%	13.94%	100.00%	0.00%	84.56%	15.44%
RB 24 hr 4.4.4	14.41%	68.39%	17.21%	92.15%	13.58%	86.42%	97.73%	58.51%	31.71%	9.77%	95.39%	0.00%	86.53%	13.47%

APPENDIX J1: SUMMARY OF COST ESTIMATIONS - LOWER INTEREST RATE (2%)

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.1.1.1	$10 070.88	$86 301.48	$343 489.42	$439 861.78	1	$5 686.57	$517.98	$6 204.55	1	$51 487.81	$114 807.14	$636 281.46	$802 576.41	1
2.1.1.2	$13 501.73	$134 784.12	$329 365.29	$477 651.14	5	$5 752.12	$776.99	$6 529.11	5	$73 155.69	$179 303.75	$610 117.85	$862 577.30	5
2.1.1.3	$16 027.59	$163 157.83	$327 720.37	$506 905.79	9	$5 895.08	$984.99	$6 880.06	9	$89 973.24	$217 049.39	$607 070.80	$914 093.43	9
2.1.1.4	$13 501.73	$139 854.06	$328 100.74	$481 456.54	6	$5 758.50	$776.99	$6 535.49	6	$73 155.69	$186 048.31	$607 775.40	$866 979.40	6
2.1.1.5	$13 501.73	$144 924.00	$327 229.75	$485 655.48	7	$5 770.78	$776.99	$6 547.78	7	$73 155.69	$192 792.87	$606 161.97	$872 110.53	7
2.1.1.6	$13 501.73	$149 993.94	$327 554.54	$491 050.22	8	$5 801.01	$776.99	$6 578.00	8	$73 155.69	$199 537.43	$606 763.62	$879 456.74	8
2.1.1.7	$11 834.18	$115 520.19	$336 061.30	$463 415.67	4	$5 739.23	$647.49	$6 386.72	4	$62 443.40	$153 676.88	$622 521.59	$838 641.86	4
2.1.1.8	$11 258.32	$109 098.87	$340 400.52	$460 757.71	3	$5 766.34	$604.32	$6 370.65	3	$58 821.78	$145 134.58	$630 559.58	$834 515.94	3
2.1.1.9	$10 966.13	$105 888.22	$341 419.37	$458 273.71	2	$5 762.59	$582.73	$6 345.32	2	$57 000.16	$140 863.44	$632 446.89	$830 310.49	2
2.1.1.10	$16 027.59	$168 836.10	$326 458.69	$511 322.38	1	$5 904.54	$984.99	$6 889.53	1	$89 973.24	$224 603.21	$604 733.66	$919 310.11	1
RB 48 hr 2.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$51 487.81	$114 807.14	$1 008	$1 174 380.86	
RB 24 hr 2.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$51 487.81	$114 807.14	$662 358.68	$828 653.63	
2.1.2.1	$34 644.50	$423 350.47	$391 513.76	$849 508.74	1	$8 342.83	$2 860.57	$11 203.41	1	$231 055.81	$563 184.50	$725 241.99	$1 519 482.30	1
2.1.2.2	$46 446.87	$622 236.98	$344 597.42	$1 013 281.27	8	$8 753.90	$4 290.97	$13 044.88	8	$332 564.01	$827 763.87	$638 333.92	$1 798 661.80	8
2.1.2.3	$55 135.99	$768 084.21	$337 243.44	$1 160 463.64	1	$9 461.46	$5 439.63	$14 901.09	1	$412 074.63	$1 021 784.91	$624 711.38	$2 058 570.92	1
2.1.2.4	$46 446.87	$627 245.99	$334 686.23	$1 008 379.09	5	$8 630.28	$4 290.97	$12 921.26	7	$332 564.01	$834 427.37	$619 974.40	$1 786 965.78	5
2.1.2.5	$46 446.87	$632 254.99	$332 162.77	$1 010 864.64	6	$8 617.47	$4 290.97	$12 908.45	6	$332 564.01	$841 090.86	$615 299.93	$1 788 954.80	6
2.1.2.6	$46 446.87	$637 264.00	$329 513.90	$1 013 224.77	7	$8 602.79	$4 290.97	$12 893.76	5	$332 564.01	$847 754.36	$610 393.15	$1 790 711.52	7
2.1.2.7	$40 710.38	$527 738.07	$369 857.14	$938 305.59	4	$8 601.79	$3 575.77	$12 177.57	4	$282 228.38	$702 051.66	$685 125.16	$1 669 405.19	4
2.1.2.8	$38 729.36	$496 238.43	$377 148.45	$912 116.24	3	$8 533.46	$3 337.37	$11 870.83	3	$265 274.88	$660 147.59	$698 631.62	$1 624 054.09	3
2.1.2.9	$37 724.22	$480 488.61	$379 938.46	$898 151.29	2	$8 486.31	$3 218.17	$11 704.48	2	$256 760.96	$639 195.55	$703 799.84	$1 599 756.35	2
2.1.2.10	$55 135.99	$773 692.37	$330 734.56	$1 159 562.92	9	$9 391.87	$5 439.63	$14 831.50	9	$412 074.63	$1 029 245.47	$612 654.31	$2 053 974.40	9
RB 48 hr 2.1.2	$34 644.50	$423 350.47	$544 203.89	$1 002 198.86		$10 633.18	$2 860.57	$13 493.76		$231 055.81	$563 184.50	$1 008	$1 802 326.23	
RB 24 hr 2.1.2	$34 644.50	$423 350.47	$357 566.91	$815 561.88		$7 833.63	$2 860.57	$10 694.20		$231 055.81	$563 184.50	$662 358.68	$1 456 598.99	
2.1.3.1	$65 481.96	$816 778.76	$424 085.21	$1 306 345.94	1	$11 113.09	$6 900.33	$18 013.42	1	$511 397.69	$1 086 563.43	$785 577.51	$2 383 538.63	1
2.1.3.2	$87 789.76	$1 191 185.29	$361 993.41	$1 640 968.46	8	$12 281.28	$10 350.77	$22 632.05	8	$740 600.63	$1 584 637.65	$670 558.34	$2 995 796.63	8
2.1.3.3	$104 213.15	$1 474 146.90	$347 316.38	$1 925 676.43	1	$13 643.45	$13 121.58	$26 765.03	1	$920 870.67	$1 961 062.39	$643 370.55	$3 525 303.61	1
2.1.3.4	$87 789.76	$1 196 083.98	$344 330.19	$1 628 203.93	7	$12 040.83	$10 350.77	$22 391.60	7	$740 600.63	$1 591 154.39	$637 838.91	$2 969 593.94	7
2.1.3.5	$87 789.76	$1 200 982.67	$337 111.56	$1 625 883.98	5	$11 957.04	$10 350.77	$22 307.81	6	$740 600.63	$1 597 671.13	$624 467.08	$2 962 738.84	5
2.1.3.6	$87 789.76	$1 205 881.35	$334 041.98	$1 627 713.09	6	$11 935.49	$10 350.77	$22 286.26	5	$740 600.63	$1 604 187.86	$618 780.98	$2 963 569.48	6
2.1.3.7	$76 947.15	$1 008 866.59	$396 900.99	$1 482 714.74	4	$11 782.71	$8 625.55	$20 408.26	4	$626 790.11	$1 342 098.49	$735 221.32	$2 704 109.92	4
2.1.3.8	$73 202.81	$948 093.69	$405 935.65	$1 427 232.15	3	$11 576.17	$8 050.48	$19 626.65	3	$588 522.59	$1 261 252.11	$751 957.17	$2 601 731.87	3
2.1.3.9	$71 302.98	$917 707.24	$408 677.94	$1 397 688.16	2	$11 446.00	$7 762.94	$19 208.94	2	$569 318.58	$1 220 828.91	$757 036.99	$2 547 184.47	2
2.1.3.10	$104 213.15	$1 479 627.96	$336 213.79	$1 920 054.90	9	$13 504.32	$13 121.58	$26 625.90	9	$920 870.67	$1 968 353.87	$622 804.05	$3 512 028.59	9
RB 48 hr 2.1.3	$65 481.96	$816 778.76	$544 203.89	$1 426 464.61		$12 914.87	$6 900.33	$19 815.20		$511 397.69	$1 086 563.43	$1 008	$2 606 047.03	
RB 24 hr 2.1.3	$65 481.96	$816 778.76	$357 566.91	$1 239 827.64		$10 115.31	$6 900.33	$17 015.65		$511 397.69	$1 086 563.43	$662 358.68	$2 260 319.79	
2.1.4.1	$135 406.09	$2 007 523.44	$495 315.00	$2 638 244.53	1	$18 848.48	$18 848.17	$37 696.65	1	$1 286 457.38	$2 670 614.93	$917 523.90	$4 874 596.21	1
2.1.4.2	$181 534.99	$2 913 464.00	$405 881.22	$3 500 880.22	8	$22 507.20	$28 272.99	$50 780.18	8	$1 874 905.77	$3 875 790.59	$751 856.34	$6 502 552.71	8
2.1.4.3	$215 495.91	$3 611 480.34	$381 317.12	$4 208 293.38	1	$25 975.22	$35 841.41	$61 816.63	1	$2 339 617.11	$4 804 363.99	$706 353.68	$7 850 334.78	1
2.1.4.4	$181 534.99	$2 918 312.55	$369 527.98	$3 469 375.52	7	$21 986.14	$28 272.99	$50 259.13	7	$1 874 905.77	$3 882 240.63	$684 515.42	$6 441 661.82	7
2.1.4.5	$181 534.99	$2 923 161.10	$354 239.82	$3 458 935.91	6	$21 781.06	$28 272.99	$50 054.05	6	$1 874 905.77	$3 888 690.67	$656 195.56	$6 419 792.00	6
2.1.4.6	$181 534.99	$2 928 009.64	$347 395.00	$3 456 939.63	5	$21 702.63	$28 272.99	$49 975.62	5	$1 874 905.77	$3 895 140.70	$643 516.17	$6 413 562.65	5
2.1.4.7	$159 114.24	$2 465 351.14	$450 172.91	$3 074 638.29	4	$20 702.31	$23 560.58	$44 262.89	4	$1 582 317.13	$3 279 664.60	$833 902.47	$5 695 884.20	4
2.1.4.8	$151 371.54	$2 315 980.19	$463 504.96	$2 930 856.69	3	$20 076.47	$21 989.78	$42 066.24	3	$1 484 103.80	$3 080 955.94	$858 598.83	$5 423 658.56	3
2.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$21 204.37	$40 912.86	2	$1 434 851.85	$2 981 601.61	$864 220.27	$5 280 673.72	2
2.1.4.10	$215 495.91	$3 616 903.58	$351 351.67	$4 183 751.16	9	$25 552.85	$35 841.41	$61 394.26	9	$2 339 617.11	$4 811 578.53	$650 845.54	$7 802 041.18	9
RB 48 hr 2.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$1 286 457.38	$2 670 614.93	$1 008	$4 965 158.23	
RB 24 hr 2.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$1 286 457.38	$2 670 614.93	$662 358.68	$4 619 430.99	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$492 780.29	$25 899.04	$283 897.08
$536 795.76	$38 849.58	$286 931.96
$570 906.15	$49 249.26	$293 938.02
$540 904.14	$38 849.58	$287 225.68
$545 446.38	$38 849.58	$287 814.58
$551 306.85	$38 849.58	$289 300.31
$519 883.69	$32 374.31	$286 383.86
$516 528.69	$30 215.89	$287 771.36
$513 573.94	$29 136.68	$287 599.86
$575 677.92	$49 249.26	$294 382.93
$714 048.89	$25 899.04	$434 432.93
$508 299.39	$25 899.04	$294 455.19
$961 428.68	$143 028.74	$415 024.88
$1 149 529.10	$214 548.68	$434 584.03
$1 317 356.94	$271 981.42	$469 232.56
$1 144 039.25	$214 548.68	$428 377.85
$1 146 693.67	$214 548.68	$427 712.46
$1 149 209.83	$214 548.68	$426 953.01
$1 063 165.51	$178 788.71	$427 450.98
$1 032 993.64	$166 868.72	$424 191.73
$1 016 934.73	$160 908.72	$421 912.91
$1 316 268.08	$271 981.42	$465 724.91
$1 129 755.02	$143 028.74	$529 542.48
$924 005.51	$143 028.74	$389 564.74
$1 486 951.40	$345 016.72	$551 570.51
$1 870 149.87	$517 538.53	$608 108.23
$2 194 422.72	$656 078.90	$674 801.98
$1 855 994.41	$517 538.53	$596 060.99
$1 853 353.12	$517 538.53	$591 847.20
$1 855 285.76	$517 538.53	$590 745.19
$1 688 741.19	$431 277.62	$584 091.11
$1 625 139.75	$402 523.99	$574 068.12
$1 591 326.06	$388 147.17	$567 711.25
$2 188 131.78	$656 078.90	$667 817.90
$1 619 370.80	$345 016.72	$641 659.51
$1 413 621.30	$345 016.72	$501 681.78
$2 999 801.13	$942 408.49	$932 386.60
$3 978 110.79	$1 413	$1 110 792.44
$4 777 560.71	$1 792	$1 280 703.44
$3 943 296.94	$1 413	$1 084 715.41
$3 931 705.35	$1 413	$1 074 437.18
$3 929 421.72	$1 413	$1 070 491.46
$3 495 066.25	$1 178	$1 022 788.97
$3 331 926.40	$1 099	$992 243.35
$3 246 237.13	$1 060	$974 217.86
$4 750 412.50	$1 792	$1 259 558.04
$3 053 696.48	$942 408.49	$969 053.27
$2 847 946.97	$942 408.49	$829 075.53

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.2.1.1	$17 575.65	$158 938.83	$783 774.85	$960 289.32	1	$12 730.59	$1 118.96	$13 849.55	1	$100 605.37	$211 436.84	$1 451	$1 763 910.52	1
2.2.1.2	$23 563.16	$243 453.76	$756 685.45	$1 023 702.36	5	$12 807.89	$1 678.48	$14 486.38	6	$143 795.00	$323 867.32	$1 401	$1 869 350.11	5
2.2.1.3	$27 971.27	$297 803.23	$753 631.39	$1 079 405.90	9	$13 078.79	$2 127.80	$15 206.59	9	$177 461.16	$396 168.60	$1 396	$1 969 660.21	9
2.2.1.4	$23 563.16	$251 807.99	$753 864.15	$1 029 235.30	6	$12 807.35	$1 678.48	$14 485.83	5	$143 795.00	$334 980.98	$1 396	$1 875 237.60	6
2.2.1.5	$23 563.16	$260 162.22	$752 779.65	$1 036 505.03	7	$12 832.85	$1 678.48	$14 511.33	7	$143 795.00	$346 094.65	$1 394	$1 884 342.31	7
2.2.1.6	$23 563.16	$268 516.45	$753 128.51	$1 045 208.13	8	$12 879.85	$1 678.48	$14 558.34	8	$143 795.00	$357 208.31	$1 395	$1 896 102.21	8
2.2.1.7	$20 652.96	$207 975.95	$769 668.26	$998 297.16	4	$12 795.56	$1 398.72	$14 194.28	4	$122 412.48	$276 671.08	$1 425	$1 824 820.77	4
2.2.1.8	$19 647.96	$196 150.01	$777 338.01	$993 135.98	3	$12 841.23	$1 305.47	$14 146.70	3	$115 196.21	$260 938.99	$1 439	$1 816 079.91	3
2.2.1.9	$19 138.04	$190 237.04	$779 721.52	$989 096.59	2	$12 842.22	$1 258.84	$14 101.06	2	$111 569.22	$253 072.95	$1 444	$1 809 002.09	2
2.2.1.10	$27 971.27	$307 195.13	$751 191.64	$1 086 358.05	1	$13 089.16	$2 127.80	$15 216.95	1	$177 461.16	$408 662.68	$1 391	$1 977 634.88	1
RB 48 hr 2.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$1 118.96	$20 341.71		$100 605.37	$211 436.84	$2 253	$2 565 650.88	
RB 24 hr 2.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$13 181.63	$1 118.96	$14 300.59		$100 605.37	$211 436.84	$1 507	$1 819 611.69	
2.2.2.1	$60 134.28	$780 795.83	$881 046.76	$1 721 976.87	1	$17 733.05	$6 133.31	$23 866.36	1	$459 458.80	$1 038 695.22	$1 632	$3 130 209.30	1
2.2.2.2	$80 620.27	$1 142 766.44	$784 960.00	$2 008 346.71	8	$18 310.56	$9 200.21	$27 510.77	8	$664 855.73	$1 520 225.89	$1 454	$3 639 145.32	8
2.2.2.3	$95 702.42	$1 413 855.12	$771 972.12	$2 281 529.66	1	$19 625.02	$11 663.02	$31 288.04	1	$826 318.07	$1 880 856.05	$1 430	$4 137 179.01	1
2.2.2.4	$80 620.27	$1 150 974.14	$766 855.28	$1 998 449.69	5	$18 080.03	$9 200.21	$27 280.23	7	$664 855.73	$1 531 144.63	$1 420	$3 616 526.78	5
2.2.2.5	$80 620.27	$1 159 181.85	$762 154.73	$2 001 956.85	6	$18 050.56	$9 200.21	$27 250.76	6	$664 855.73	$1 542 063.37	$1 411	$3 618 738.20	6
2.2.2.6	$80 620.27	$1 167 389.56	$756 991.71	$2 005 001.54	7	$18 014.15	$9 200.21	$27 214.36	5	$664 855.73	$1 552 982.11	$1 402	$3 620 092.94	7
2.2.2.7	$70 663.14	$968 479.73	$835 109.95	$1 874 252.82	4	$18 089.81	$7 666.76	$25 756.57	4	$562 883.61	$1 288 371.72	$1 546	$3 398 217.04	4
2.2.2.8	$67 224.58	$910 384.16	$850 481.19	$1 828 089.93	3	$17 994.83	$7 155.61	$25 150.44	3	$528 589.24	$1 211 086.99	$1 575	$3 315 111.71	3
2.2.2.9	$65 479.91	$881 336.37	$857 258.41	$1 804 074.70	2	$17 933.45	$6 900.04	$24 833.49	2	$511 377.53	$1 172 444.63	$1 587	$3 271 811.80	2
2.2.2.10	$95 702.42	$1 423 083.37	$759 281.47	$2 278 067.26	9	$19 480.80	$11 663.02	$31 143.82	9	$826 318.07	$1 893 132.41	$1 406	$4 125 947.15	9
RB 48 hr 2.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$6 133.31	$28 899.44		$459 458.80	$1 038 695.22	$2 253	$3 751 762.70	
RB 24 hr 2.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$16 725.02	$6 133.31	$22 858.33		$459 458.80	$1 038 695.22	$1 507	$3 005 723.51	
2.2.3.1	$112 564.83	$1 510 285.24	$949 596.19	$2 572 446.26	1	$22 943.53	$14 598.00	$37 541.53	1	$1 015 912.33	$2 009 137.34	$1 759	$4 784 086.25	1
2.2.3.2	$150 912.38	$2 197 630.23	$819 563.27	$3 168 105.87	8	$24 820.91	$21 897.57	$46 718.48	8	$1 478 326.83	$2 923 514.60	$1 518	$5 920 004.40	8
2.2.3.3	$179 144.52	$2 722 954.51	$790 674.05	$3 692 773.08	1	$27 302.16	$27 759.35	$55 061.51	1	$1 843 150.03	$3 622 355.19	$1 464	$6 930 153.67	1
2.2.3.4	$150 912.38	$2 205 571.89	$785 226.68	$3 141 710.95	7	$24 345.57	$21 897.57	$46 243.14	7	$1 478 326.83	$2 934 079.43	$1 454	$5 866 963.97	7
2.2.3.5	$150 912.38	$2 213 513.56	$771 908.07	$3 136 334.00	5	$24 185.50	$21 897.57	$46 083.07	6	$1 478 326.83	$2 944 644.25	$1 429	$5 852 857.32	6
2.2.3.6	$150 912.38	$2 221 455.22	$765 459.04	$3 137 826.64	6	$24 128.47	$21 897.57	$46 026.04	5	$1 478 326.83	$2 955 209.07	$1 417	$5 851 475.93	5
2.2.3.7	$132 273.71	$1 860 509.26	$891 696.53	$2 884 479.51	4	$24 027.19	$18 247.79	$42 274.97	4	$1 248 479.23	$2 475 041.49	$1 651	$5 375 303.70	4
2.2.3.8	$125 837.11	$1 748 135.61	$910 693.40	$2 784 666.12	3	$23 684.62	$17 031.19	$40 715.81	3	$1 171 294.93	$2 325 550.46	$1 686	$5 183 818.25	3
2.2.3.9	$122 571.28	$1 691 948.78	$916 695.04	$2 731 215.10	2	$23 460.40	$16 422.89	$39 883.29	2	$1 132 582.00	$2 250 804.94	$1 698	$5 081 477.27	2
2.2.3.10	$179 144.52	$2 731 885.24	$769 070.45	$3 680 100.21	9	$27 022.76	$27 759.35	$54 782.11	9	$1 843 150.03	$3 634 235.77	$1 424	$6 902 015.63	9
RB 48 hr 2.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$14 598.00	$41 546.37		$1 015 912.33	$2 009 137.34	$2 253	$5 278 658.35	
RB 24 hr 2.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$20 907.25	$14 598.00	$35 505.26		$1 015 912.33	$2 009 137.34	$1 507	$4 532 619.15	
2.2.4.1	$231 757.45	$3 716 343.63	$1 106	$5 054 286.13	1	$37 538.42	$39 635.52	$77 173.94	1	$2 570 640.75	$4 943 863.96	$2 049	$9 563 607.25	1
2.2.4.2	$310 710.44	$5 388 413.10	$910 762.15	$6 609 885.70	8	$43 772.74	$59 454.82	$103 227.57	8	$3 762 215.01	$7 168 223.39	$1 687	$12 617 538.62	8
2.2.4.3	$368 837.04	$6 682 697.20	$858 732.13	$7 910 266.37	1	$50 056.61	$75 370.34	$125 426.94	1	$4 705 682.82	$8 890 013.70	$1 590	$15 186 416.09	1
2.2.4.4	$310 710.44	$5 396 233.56	$835 137.59	$6 542 081.59	7	$42 677.48	$59 454.82	$102 132.30	7	$3 762 215.01	$7 178 626.96	$1 547	$12 487 854.89	7
2.2.4.5	$310 710.44	$5 404 054.02	$804 327.00	$6 519 091.46	6	$42 254.42	$59 454.82	$101 709.24	6	$3 762 215.01	$7 189 030.54	$1 489	$12 441 184.79	6
2.2.4.6	$310 710.44	$5 411 874.47	$790 303.02	$6 512 887.93	5	$42 083.16	$59 454.82	$101 537.99	5	$3 762 215.01	$7 199 434.12	$1 463	$12 425 610.27	5
2.2.4.7	$272 335.68	$4 558 862.95	$1 006	$5 837 484.77	4	$40 666.43	$49 545.17	$90 211.60	4	$3 169 227.24	$6 064 670.13	$1 864	$11 097 946.70	4
2.2.4.8	$259 083.49	$4 282 346.23	$1 036	$5 578 108.84	3	$39 604.57	$46 241.95	$85 846.52	3	$2 970 394.31	$5 696 819.05	$1 920	$10 587 562.79	3
2.2.4.9	$252 359.53	$4 144 087.87	$1 042	$5 438 709.75	2	$38 928.44	$44 590.34	$83 518.79	2	$2 870 729.18	$5 512 893.51	$1 930	$10 314 314.52	2
2.2.4.10	$368 837.04	$6 691 492.22	$798 893.40	$7 859 222.66	9	$49 203.00	$75 370.34	$124 573.34	9	$4 705 682.82	$8 901 713.74	$1 479	$15 087 270.57	9
RB 48 hr 2.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$39 635.52	$78 829.94		$2 570 640.75	$4 943 863.96	$2 253	$9 768 113.40	
RB 24 hr 2.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$33 153.31	$39 635.52	$72 788.83		$2 570 640.75	$4 943 863.96	$1 507	$9 022 074.20	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 072 227.82	$55 947.98	$635 734.73
$1 146 248.50	$83 924.14	$639 177.47
$1 210 819.65	$106 389.88	$652 450.68
$1 152 205.17	$83 924.14	$639 108.28
$1 160 076.48	$83 924.14	$640 341.69
$1 169 527.94	$83 924.14	$642 650.13
$1 116 146.40	$69 936.06	$638 738.31
$1 109 725.83	$65 273.36	$641 080.72
$1 104 900.46	$62 942.02	$641 159.61
$1 218 323.11	$106 389.88	$652 921.89
$1 549 360.27	$55 947.98	$960 342.64
$1 105 376.75	$55 947.98	$658 286.97
$1 940 795.19	$306 665.58	$882 748.53
$2 269 320.87	$460 010.33	$909 814.11
$2 579 846.25	$583 150.93	$974 181.83
$2 258 269.99	$460 010.33	$898 246.46
$2 261 995.93	$460 010.33	$896 731.94
$2 265 212.05	$460 010.33	$894 870.56
$2 115 230.89	$383 337.96	$899 648.20
$2 062 141.66	$357 780.50	$895 189.55
$2 034 544.05	$345 001.77	$892 265.98
$2 575 871.46	$583 150.93	$966 924.76
$2 310 694.61	$306 665.58	$1 134 402.51
$1 866 711.09	$306 665.58	$832 346.83
$2 914 561.11	$729 900.05	$1 139 625.09
$3 595 068.70	$1 094	$1 230 057.17
$4 190 692.97	$1 387	$1 351 493.10
$3 565 834.99	$1 094	$1 206 250.44
$3 559 771.60	$1 094	$1 198 207.18
$3 561 281.28	$1 094	$1 195 316.12
$3 270 857.64	$912 389.29	$1 192 056.77
$3 156 768.50	$851 559.55	$1 175 490.20
$3 095 772.52	$821 144.67	$1 164 560.08
$4 176 569.60	$1 387	$1 337 478.43
$3 208 891.30	$729 900.05	$1 339 866.99
$2 764 907.78	$729 900.05	$1 037 811.32
$5 723 492.12	$1 981	$1 858 339.28
$7 483 102.41	$2 972	$2 161 695.15
$8 948 482.38	$3 768	$2 469 416.80
$7 408 221.09	$2 972	$2 106 892.74
$7 382 742.92	$2 972	$2 085 700.81
$7 375 770.38	$2 972	$2 077 098.84
$6 610 161.01	$2 477	$2 010 527.23
$6 316 648.45	$2 312	$1 958 816.75
$6 159 095.71	$2 229	$1 925 701.65
$8 892 061.13	$3 768	$2 426 692.53
$5 845 198.00	$1 981	$1 941 139.54
$5 401 214.48	$1 981	$1 639 083.86

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.3.1.1	$21 638.84	$219 766.52	$1 133	$1 374 550.01	1	$18 316.72	$1 491.91	$19 808.63	1	$129 576.77	$292 356.11	$2 099	$2 520 975.52	1	$1 531 643.07	$74 595.36	$914 737.09
2.3.1.2	$29 010.56	$335 479.61	$1 086	$1 451 358.76	5	$18 276.33	$2 237.92	$20 514.25	5	$185 607.92	$446 289.61	$2 013	$2 645 218.17	5	$1 621 182.89	$111 895.95	$912 139.33
2.3.1.3	$34 437.75	$411 618.58	$1 082	$1 528 610.30	9	$18 647.67	$2 836.99	$21 484.66	9	$229 351.22	$547 577.53	$2 005	$2 782 256.97	9	$1 710 082.21	$141 849.48	$930 325.28
2.3.1.4	$29 010.56	$347 465.87	$1 082	$1 459 475.72	6	$18 278.23	$2 237.92	$20 516.15	6	$185 607.92	$462 234.97	$2 006	$2 653 996.03	6	$1 629 926.09	$111 895.95	$912 173.99
2.3.1.5	$29 010.56	$359 452.13	$1 080	$1 469 317.79	7	$18 305.99	$2 237.92	$20 543.91	7	$185 607.92	$478 180.33	$2 002	$2 665 969.49	7	$1 640 571.05	$111 895.95	$913 502.48
2.3.1.6	$29 010.56	$371 438.39	$1 080	$1 481 209.02	8	$18 364.50	$2 237.92	$20 602.42	8	$185 607.92	$494 125.70	$2 002	$2 681 738.80	8	$1 653 475.01	$111 895.95	$916 367.84
2.3.1.7	$25 427.56	$286 424.04	$1 110	$1 422 263.04	4	$18 347.65	$1 864.91	$20 212.57	4	$157 853.72	$381 030.83	$2 056	$2 595 816.07	4	$1 586 619.89	$93 245.66	$915 950.53
2.3.1.8	$24 190.23	$270 072.19	$1 121	$1 415 700.49	3	$18 418.67	$1 740.58	$20 159.25	3	$148 493.04	$359 277.90	$2 077	$2 585 128.28	3	$1 578 516.12	$87 028.89	$919 583.26
2.3.1.9	$23 562.42	$261 896.26	$1 124	$1 409 724.50	2	$18 413.81	$1 678.41	$20 092.22	2	$143 789.49	$348 401.44	$2 082	$2 574 786.39	2	$1 571 485.09	$83 920.51	$919 380.79
2.3.1.10	$34 437.75	$425 030.15	$1 080	$1 540 098.34	1	$18 685.87	$2 836.99	$21 522.86	1	$229 351.22	$565 418.98	$2 001	$2 796 535.28	1	$1 722 517.32	$141 849.48	$932 168.47
RB 48 hr 2.3.1	$21 638.84	$219 766.52	$1 818	$2 060 017.45		$28 598.73	$1 491.91	$30 090.64		$129 576.77	$292 356.11	$3 368	$3 790 738.73		$2 287 305.70	$74 595.36	$1 428 837.67
RB 24 hr 2.3.1	$21 638.84	$219 766.52	$1 216	$1 457 990.75		$19 568.33	$1 491.91	$21 060.24		$129 576.77	$292 356.11	$2 253	$2 675 541.56		$1 623 628.55	$74 595.36	$977 317.65
2.3.2.1	$74 036.29	$1 079 615.25	$1 284	$2 438 406.70	1	$25 424.57	$8 177.54	$33 602.11	1	$596 993.19	$1 436 215.66	$2 379	$4 413 095.54	1	$2 738 388.11	$408 876.82	$1 265 830.62
2.3.2.2	$99 258.29	$1 578 909.87	$1 130	$2 808 944.65	8	$25 868.63	$12 266.62	$38 135.25	8	$865 533.30	$2 100 428.91	$2 094	$5 060 618.05	8	$3 161 749.87	$613 331.17	$1 285 537.01
2.3.2.3	$117 827.18	$1 954 734.63	$1 108	$3 181 542.99	1	$27 610.23	$15 550.29	$43 160.52	1	$1 076 897.57	$2 600 389.81	$2 054	$5 731 569.48	1	$3 583 317.39	$777 514.37	$1 370 737.73
2.3.2.4	$99 258.29	$1 590 642.31	$1 103	$2 793 287.40	5	$25 516.45	$12 266.62	$37 783.07	7	$865 533.30	$2 116 036.60	$2 043	$5 025 488.97	5	$3 144 288.60	$613 331.17	$1 267 869.20
2.3.2.5	$99 258.29	$1 602 374.74	$1 095	$2 797 219.10	6	$25 458.10	$12 266.62	$37 724.72	6	$865 533.30	$2 131 644.30	$2 029	$5 026 646.55	6	$3 148 422.28	$613 331.17	$1 264 893.10
2.3.2.6	$99 258.29	$1 614 107.17	$1 088	$2 801 509.38	7	$25 405.13	$12 266.62	$37 671.75	5	$865 533.30	$2 147 251.99	$2 015	$5 028 468.36	7	$3 152 951.26	$613 331.17	$1 262 185.93
2.3.2.7	$86 999.25	$1 347 530.33	$1 216	$2 651 284.21	4	$25 876.36	$10 222.08	$36 098.44	4	$732 157.52	$1 792 623.96	$2 253	$4 778 703.65	4	$2 980 519.14	$511 103.99	$1 287 080.52
2.3.2.8	$82 765.75	$1 270 403.82	$1 238	$2 591 780.40	3	$25 775.39	$9 540.57	$35 315.96	3	$687 325.05	$1 690 022.31	$2 294	$4 671 756.05	3	$2 912 310.20	$477 028.27	$1 282 417.59
2.3.2.9	$80 617.74	$1 231 840.56	$1 245	$2 557 981.89	2	$25 664.36	$9 199.81	$34 864.17	2	$664 829.38	$1 638 721.49	$2 307	$4 610 764.78	2	$2 873 715.70	$459 990.41	$1 277 058.67
2.3.2.10	$117 827.18	$1 967 867.16	$1 090	$3 176 583.25	9	$27 404.51	$15 550.29	$42 954.79	9	$1 076 897.57	$2 617 860.05	$2 020	$5 715 525.52	9	$3 577 625.16	$777 514.37	$1 360 386.00
RB 48 hr 2.3.2	$74 036.29	$1 079 615.25	$1 818	$2 972 263.63		$33 432.43	$8 177.54	$41 609.96		$596 993.19	$1 436 215.66	$3 368	$5 402 014.70		$3 326 914.57	$408 876.82	$1 666 223.31
RB 24 hr 2.3.2	$74 036.29	$1 079 615.25	$1 216	$2 370 236.94		$24 402.03	$8 177.54	$32 579.56		$596 993.19	$1 436 215.66	$2 253	$4 286 817.54		$2 663 237.43	$408 876.82	$1 214 703.29
2.3.3.1	$138 587.88	$2 088 288.52	$1 386	$3 613 804.24	1	$32 658.96	$19 463.50	$52 122.45	1	$1 325 308.17	$2 778 056.98	$2 569	$6 672 516.99	1	$4 076 835.83	$973 174.77	$1 622 506.38
2.3.3.2	$185 800.72	$3 037 375.07	$1 180	$4 403 402.20	8	$34 785.44	$29 196.00	$63 981.44	8	$1 931 895.06	$4 040 629.88	$2 186	$8 158 782.05	8	$4 974 896.88	$1 459	$1 724 085.06
2.3.3.3	$220 559.66	$3 764 730.68	$1 135	$5 121 117.42	1	$38 110.77	$37 011.51	$75 122.28	1	$2 410 988.15	$5 008 233.40	$2 104	$9 523 233.14	1	$5 785 943.02	$1 850	$1 886 714.75
2.3.3.4	$185 800.72	$3 048 647.68	$1 128	$4 362 782.37	7	$34 063.42	$29 196.00	$63 259.42	7	$1 931 895.06	$4 055 625.87	$2 090	$8 077 652.23	7	$4 929 924.60	$1 459	$1 687 927.52
2.3.3.5	$185 800.72	$3 059 920.28	$1 107	$4 353 060.80	5	$33 804.87	$29 196.00	$63 000.87	6	$1 931 895.06	$4 070 621.85	$2 051	$8 053 758.51	5	$4 919 014.72	$1 459	$1 674 943.68
2.3.3.6	$185 800.72	$3 071 192.89	$1 099	$4 356 613.73	6	$33 745.43	$29 196.00	$62 941.44	5	$1 931 895.06	$4 085 617.84	$2 036	$8 054 454.52	6	$4 922 738.70	$1 459	$1 671 915.71
2.3.3.7	$162 853.12	$2 571 234.09	$1 296	$4 030 166.34	4	$33 958.46	$24 329.75	$58 288.21	4	$1 630 275.59	$3 420 521.03	$2 400	$7 451 659.87	4	$4 550 105.64	$1 216	$1 685 066.79
2.3.3.8	$154 928.49	$2 415 853.76	$1 327	$3 898 684.52	3	$33 578.07	$22 707.66	$56 285.74	3	$1 529 035.93	$3 213 818.07	$2 459	$7 202 666.61	3	$4 400 458.98	$1 135	$1 666 824.41
2.3.3.9	$150 907.65	$2 338 163.60	$1 335	$3 824 793.18	2	$33 265.91	$21 896.62	$55 162.53	2	$1 478 267.39	$3 110 466.60	$2 474	$7 063 031.78	2	$4 316 596.24	$1 094	$1 651 604.43
2.3.3.10	$220 559.66	$3 777 357.11	$1 104	$5 102 458.02	9	$37 704.61	$37 011.51	$74 716.12	9	$2 410 988.15	$5 025 030.38	$2 046	$9 482 076.10	9	$5 765 156.88	$1 850	$1 866 343.86
RB 48 hr 2.3.3	$138 587.88	$2 088 288.52	$1 818	$4 045 488.50		$39 134.22	$19 463.50	$58 597.72		$1 325 308.17	$2 778 056.98	$3 368	$7 472 171.00		$4 552 726.65	$973 174.77	$1 946 269.58
RB 24 hr 2.3.3	$138 587.88	$2 088 288.52	$1 216	$3 443 461.80		$30 103.82	$19 463.50	$49 567.32		$1 325 308.17	$2 778 056.98	$2 253	$6 356 973.83		$3 889 049.50	$973 174.77	$1 494 749.56
2.3.4.1	$285 335.79	$5 138 630.46	$1 606	$7 030 712.26	1	$52 704.77	$52 845.98	$105 550.75	1	$3 367 299.47	$6 835 936.73	$2 976	$13 179 580.28	1	$7 927 735.93	$2 642	$2 609 545.22
2.3.4.2	$382 541.36	$7 449 258.55	$1 309	$9 140 934.85	8	$60 785.24	$79 271.03	$140 056.27	8	$4 935 538.48	$9 909 772.75	$2 425	$17 270 359.14	8	$10 304 791.78	$3 963	$3 002 015.64
2.3.4.3	$454 105.82	$9 239 861.98	$1 231	$10 925 522.05	1	$69 304.50	$100 491.17	$169 795.67	1	$6 178 381.17	$12 291 818.29	$2 281	$20 751 536.50	1	$12 307 952.06	$5 024	$3 419 025.83
2.3.4.4	$382 541.36	$7 460 322.13	$1 197	$9 040 504.76	7	$59 168.15	$79 271.03	$138 439.19	7	$4 935 538.48	$9 924 490.67	$2 218	$17 078 545.64	7	$10 193 887.96	$3 963	$2 921 105.97
2.3.4.5	$382 541.36	$7 471 385.71	$1 154	$9 008 351.80	6	$58 575.22	$79 271.03	$137 846.26	6	$4 935 538.48	$9 939 208.59	$2 138	$17 013 209.04	6	$10 158 253.18	$3 963	$2 891 404.14
2.3.4.6	$382 541.36	$7 482 449.30	$1 132	$8 997 297.61	5	$58 298.77	$79 271.03	$137 569.81	5	$4 935 538.48	$9 953 926.51	$2 097	$16 986 955.89	5	$10 145 877.78	$3 963	$2 877 526.39
2.3.4.7	$335 295.01	$6 302 230.15	$1 463	$8 101 237.98	4	$56 886.85	$66 058.51	$122 945.36	4	$4 154 865.50	$8 383 877.16	$2 711	$15 250 131.37	4	$9 134 374.49	$3 302	$2 812 831.46
2.3.4.8	$318 979.14	$5 919 887.35	$1 506	$7 745 635.19	3	$55 454.55	$61 654.33	$117 108.89	3	$3 893 200.27	$7 875 245.29	$2 791	$14 559 591.21	3	$8 733 746.26	$3 082	$2 743 128.29
2.3.4.9	$310 700.71	$5 728 715.95	$1 514	$7 553 991.86	2	$54 531.35	$59 452.25	$113 983.60	2	$3 762 061.51	$7 620 929.36	$2 805	$14 188 597.30	2	$8 518 060.85	$2 972	$2 697 924.17
2.3.4.10	$454 105.82	$9 252 258.08	$1 146	$10 852 540.57	9	$68 085.82	$100 491.17	$168 576.99	9	$6 178 381.17	$12 308 308.86	$2 123	$20 609 873.23	9	$12 227 284.93	$5 024	$3 358 029.70
RB 48 hr 2.3.4	$285 335.79	$5 138 630.46	$1 818	$7 242 578.35		$55 882.76	$52 845.98	$108 728.74		$3 367 299.47	$6 835 936.73	$3 368	$13 572 042.05		$8 161 298.13	$2 642	$2 768 444.79
RB 24 hr 2.3.4	$285 335.79	$5 138 630.46	$1 216	$6 640 551.65		$46 852.36	$52 845.98	$99 698.34		$3 367 299.47	$6 835 936.73	$2 253	$12 456 844.89		$7 497 620.99	$2 642	$2 316 924.77

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.4.1.1	$26 117.08	$260 988.68	$1 482	$1 769 144.26	1	$23 801.92	$1 935.22	$25 737.14	1	$163 121.03	$347 194.08	$2 745	$3 255 650.42	1
2.4.1.2	$35 014.41	$398 392.16	$1 430	$1 864 115.15	5	$23 809.74	$2 902.91	$26 712.64	6	$234 112.23	$529 982.38	$2 650	$3 414 346.12	5
2.4.1.3	$41 564.78	$489 314.97	$1 424	$1 955 861.30	9	$24 245.26	$3 679.99	$27 925.25	9	$289 609.93	$650 937.29	$2 639	$3 580 189.95	9
2.4.1.4	$35 014.41	$413 310.58	$1 425	$1 873 713.51	6	$23 804.53	$2 902.91	$26 707.43	5	$234 112.23	$549 828.40	$2 640	$3 424 337.23	6
2.4.1.5	$35 014.41	$428 229.00	$1 423	$1 886 535.10	7	$23 847.67	$2 902.91	$26 750.57	7	$234 112.23	$569 674.42	$2 636	$3 440 299.08	7
2.4.1.6	$35 014.41	$443 147.41	$1 424	$1 902 315.12	8	$23 935.18	$2 902.91	$26 838.09	8	$234 112.23	$589 520.44	$2 638	$3 461 741.14	8
2.4.1.7	$30 689.90	$340 135.12	$1 455	$1 826 174.85	4	$23 843.96	$2 419.06	$26 263.02	4	$198 932.10	$452 482.85	$2 695	$3 347 312.03	4
2.4.1.8	$29 196.49	$320 716.10	$1 469	$1 819 763.63	3	$23 949.15	$2 257.78	$26 206.93	3	$187 073.50	$426 649.67	$2 722	$3 336 482.35	3
2.4.1.9	$28 438.76	$311 006.59	$1 474	$1 813 618.64	2	$23 957.71	$2 177.14	$26 134.85	2	$181 116.18	$413 733.08	$2 730	$3 325 615.00	2
2.4.1.10	$41 564.78	$505 934.91	$1 420	$1 967 935.05	1	$24 260.17	$3 679.99	$27 940.15	1	$289 609.93	$673 046.85	$2 631	$3 593 878.12	1
RB 48 hr 2.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$163 121.03	$347 194.08	$4 261	$4 772 270.65	
RB 24 hr 2.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$163 121.03	$347 194.08	$2 851	$3 361 408.94	
2.4.2.1	$89 142.71	$1 282 944.45	$1 666	$3 038 117.12	1	$32 314.43	$10 572.05	$42 886.48	1	$755 102.51	$1 706 705.16	$3 086	$5 547 969.64	1
2.4.2.2	$119 511.03	$1 876 210.93	$1 484	$3 480 027.64	8	$32 864.65	$15 858.49	$48 723.15	8	$1 096 586.35	$2 495 929.47	$2 749	$6 342 050.85	8
2.4.2.3	$141 868.72	$2 323 319.42	$1 459	$3 925 046.10	1	$34 961.53	$20 103.67	$55 065.20	1	$1 365 653.04	$3 090 719.33	$2 704	$7 160 620.34	1
2.4.2.4	$119 511.03	$1 890 797.98	$1 449	$3 460 233.02	5	$32 421.86	$15 858.49	$48 280.36	7	$1 096 586.35	$2 515 334.67	$2 685	$6 297 767.28	5
2.4.2.5	$119 511.03	$1 905 385.04	$1 441	$3 466 150.57	6	$32 364.76	$15 858.49	$48 223.25	6	$1 096 586.35	$2 534 739.88	$2 669	$6 301 113.06	6
2.4.2.6	$119 511.03	$1 919 972.09	$1 431	$3 470 869.12	7	$32 289.66	$15 858.49	$48 148.16	5	$1 096 586.35	$2 554 145.09	$2 651	$6 302 237.80	7
2.4.2.7	$104 750.64	$1 589 836.23	$1 579	$3 273 587.52	4	$32 702.65	$13 215.27	$45 917.92	4	$926 921.17	$2 114 964.28	$2 924	$5 966 833.91	4
2.4.2.8	$99 653.34	$1 494 378.00	$1 608	$3 202 118.69	3	$32 609.66	$12 334.20	$44 943.87	3	$869 915.95	$1 987 975.89	$2 978	$5 836 720.64	3
2.4.2.9	$97 067.05	$1 446 648.89	$1 619	$3 162 767.59	2	$32 509.10	$11 893.66	$44 402.77	2	$841 317.70	$1 924 481.69	$2 999	$5 764 938.52	2
2.4.2.10	$141 868.72	$2 339 578.00	$1 435	$3 917 115.43	9	$34 679.98	$20 103.67	$54 783.65	9	$1 365 653.04	$3 112 348.19	$2 659	$7 137 440.90	9
RB 48 hr 2.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$10 572.05	$52 407.57		$755 102.51	$1 706 705.16	$4 261	$6 723 763.21	
RB 24 hr 2.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$30 410.94	$10 572.05	$40 983.00		$755 102.51	$1 706 705.16	$2 851	$5 312 901.49	
2.4.3.1	$166 142.57	$2 484 448.75	$1 813	$4 464 582.32	1	$41 326.76	$25 012.08	$66 338.84	1	$1 672 750.29	$3 305 070.21	$3 360	$8 338 066.22	1
2.4.3.2	$222 742.49	$3 613 431.42	$1 549	$5 385 940.49	8	$43 585.63	$37 519.10	$81 104.73	8	$2 441 913.97	$4 806 959.51	$2 870	$10 119 668.61	8
2.4.3.3	$264 412.36	$4 479 274.31	$1 495	$6 238 823.16	1	$47 520.42	$47 562.62	$95 083.05	1	$3 049 967.70	$5 958 793.11	$2 769	$11 778 358.88	1
2.4.3.4	$222 742.49	$3 627 416.78	$1 484	$5 334 856.92	7	$42 679.52	$37 519.10	$80 198.62	7	$2 441 913.97	$4 825 564.28	$2 750	$10 017 739.38	7
2.4.3.5	$222 742.49	$3 641 402.13	$1 459	$5 323 618.61	5	$42 371.09	$37 519.10	$79 890.19	6	$2 441 913.97	$4 844 169.04	$2 703	$9 989 619.70	6
2.4.3.6	$222 742.49	$3 655 387.49	$1 447	$5 325 536.99	6	$42 260.02	$37 519.10	$79 779.11	5	$2 441 913.97	$4 862 773.80	$2 681	$9 985 871.53	5
2.4.3.7	$195 232.34	$3 058 860.84	$1 686	$4 940 164.97	4	$42 576.75	$31 265.59	$73 842.34	4	$2 059 338.94	$4 069 212.48	$3 123	$9 251 838.96	4
2.4.3.8	$185 732.09	$2 874 003.98	$1 722	$4 781 779.02	3	$42 095.13	$29 181.09	$71 276.22	3	$1 930 974.94	$3 823 296.80	$3 189	$8 944 192.43	3
2.4.3.9	$180 911.81	$2 781 575.55	$1 733	$4 695 906.83	2	$41 754.47	$28 138.84	$69 893.31	2	$1 866 614.67	$3 700 338.96	$3 210	$8 777 948.24	2
2.4.3.10	$264 412.36	$4 494 876.01	$1 454	$6 213 327.92	9	$46 981.98	$47 562.62	$94 544.60	9	$3 049 967.70	$5 979 548.09	$2 693	$11 722 985.71	9
RB 48 hr 2.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$25 012.08	$73 640.51		$1 672 750.29	$3 305 070.21	$4 261	$9 239 776.04	
RB 24 hr 2.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$37 203.86	$25 012.08	$62 215.95		$1 672 750.29	$3 305 070.21	$2 851	$7 828 914.32	
2.4.4.1	$341 398.74	$6 116 636.13	$2 091	$8 549 847.87	1	$65 442.64	$67 727.54	$133 170.19	1	$4 253 825.99	$8 136 980.83	$3 874	$16 265 691.35	1
2.4.4.2	$457 703.32	$8 866 841.40	$1 722	$11 046 746.00	8	$74 835.80	$101 593.95	$176 429.75	8	$6 242 661.06	$11 795 587.80	$3 190	$21 228 462.86	8
2.4.4.3	$543 328.82	$10 998 744.17	$1 623	$13 165 849.45	1	$84 892.32	$128 789.74	$213 682.06	1	$7 820 013.14	$14 631 664.95	$3 007	$25 459 569.49	1
2.4.4.4	$457 703.32	$8 880 552.65	$1 579	$10 917 511.60	7	$72 760.17	$101 593.95	$174 354.13	7	$6 242 661.06	$11 813 827.92	$2 925	$20 981 909.78	7
2.4.4.5	$457 703.32	$8 894 263.89	$1 520	$10 872 745.88	6	$71 951.57	$101 593.95	$173 545.53	6	$6 242 661.06	$11 832 068.03	$2 817	$20 891 826.87	6
2.4.4.6	$457 703.32	$8 907 975.14	$1 494	$10 859 882.36	5	$71 621.51	$101 593.95	$173 215.46	5	$6 242 661.06	$11 850 308.15	$2 767	$20 860 839.75	5
2.4.4.7	$401 173.98	$7 501 505.75	$1 902	$9 805 230.85	4	$70 137.77	$84 660.75	$154 798.52	4	$5 252 367.22	$9 979 277.37	$3 524	$18 755 939.51	4
2.4.4.8	$381 652.35	$7 046 393.87	$1 960	$9 388 211.43	3	$68 527.30	$79 016.35	$147 543.65	3	$4 920 545.27	$9 373 840.56	$3 631	$17 925 405.36	3
2.4.4.9	$371 747.38	$6 818 837.92	$1 970	$9 161 451.15	2	$67 449.00	$76 194.15	$143 643.15	2	$4 754 267.99	$9 071 122.15	$3 650	$17 476 231.58	2
2.4.4.10	$543 328.82	$11 014 046.28	$1 510	$13 067 795.11	9	$83 268.49	$128 789.74	$212 058.22	9	$7 820 013.14	$14 652 021.40	$2 797	$25 269 943.90	9
RB 48 hr 2.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$4 253 825.99	$8 136 980.83	$4 261	$16 652 762.36	
RB 24 hr 2.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$4 253 825.99	$8 136 980.83	$2 851	$15 241 900.64	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 970 098.60	$96 761.00	$1 188 790.81
$2 080 705.98	$145 145.28	$1 188 494.86
$2 186 374.23	$183 999.35	$1 209 816.37
$2 091 032.13	$145 145.28	$1 188 159.83
$2 104 911.58	$145 145.28	$1 190 242.22
$2 122 052.43	$145 145.28	$1 194 543.44
$2 035 861.56	$120 953.14	$1 190 497.33
$2 027 739.32	$112 889.09	$1 195 853.94
$2 020 427.58	$108 857.07	$1 196 330.35
$2 199 400.16	$183 999.35	$1 210 478.61
$2 872 671.01	$96 761.00	$1 802 838.64
$2 033 037.71	$96 761.00	$1 231 610.23
$3 410 060.27	$528 602.73	$1 609 306.64
$3 915 274.58	$792 924.70	$1 633 851.56
$4 418 977.10	$1 005	$1 736 459.78
$3 893 203.44	$792 924.70	$1 611 639.14
$3 899 477.52	$792 924.70	$1 608 710.84
$3 904 429.81	$792 924.70	$1 604 883.29
$3 678 887.00	$660 763.72	$1 627 183.19
$3 596 999.26	$616 710.05	$1 623 011.33
$3 552 033.38	$594 683.22	$1 618 221.91
$4 409 956.24	$1 005	$1 722 301.19
$4 109 799.60	$528 602.73	$2 085 360.88
$3 270 166.30	$528 602.73	$1 514 132.46
$5 033 546.22	$1 250	$2 053 915.90
$6 082 499.40	$1 875	$2 161 214.30
$7 046 602.98	$2 378	$2 353 624.87
$6 025 945.46	$1 875	$2 115 839.02
$6 013 317.12	$1 875	$2 100 347.69
$6 015 192.77	$1 875	$2 094 723.86
$5 575 016.22	$1 563	$2 113 543.24
$5 394 751.51	$1 459	$2 090 386.55
$5 297 190.81	$1 406	$2 073 815.63
$7 018 230.09	$2 378	$2 326 624.59
$5 570 172.58	$1 250	$2 418 999.36
$4 730 539.28	$1 250	$1 847 770.95
$9 637 765.25	$3 386	$3 241 548.96
$12 451 309.32	$5 079	$3 697 455.80
$14 830 460.31	$6 439	$4 189 622.37
$12 308 606.21	$5 079	$3 593 605.82
$12 259 021.78	$5 079	$3 553 107.35
$12 244 606.48	$5 079	$3 536 535.52
$11 053 521.08	$4 233	$3 469 380.98
$10 583 454.91	$3 950	$3 391 133.11
$10 328 168.45	$3 809	$3 338 355.84
$14 722 103.04	$6 439	$4 108 354.05
$9 868 119.30	$3 386	$3 398 265.92
$9 028 486.00	$3 386	$2 827 037.50

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
1.2.1.1	$17 575.65	$158 938.83	$716 667.47	$893 181.94	1	$11 723.98	$1 118.96	$12 842.94	1	$100 605.37	$211 436.84	$1 327	$1 639 600.49	1
1.2.1.2	$23 563.16	$243 453.76	$678 297.55	$945 314.46	5	$11 632.08	$1 678.48	$13 310.56	7	$143 795.00	$323 867.32	$1 256	$1 724 143.98	5
1.2.1.3	$27 971.27	$297 803.23	$675 122.79	$1 000 897.30	9	$11 901.16	$2 127.80	$14 028.96	1	$177 461.16	$396 168.60	$1 250	$1 824 230.49	9
1.2.1.4	$23 563.16	$251 807.99	$674 230.81	$949 601.96	6	$11 612.85	$1 678.48	$13 291.33	5	$143 795.00	$334 980.98	$1 248	$1 727 724.40	6
1.2.1.5	$23 563.16	$260 162.22	$672 569.89	$956 295.27	7	$11 629.70	$1 678.48	$13 308.19	6	$143 795.00	$346 094.65	$1 245	$1 735 761.36	7
1.2.1.6	$23 563.16	$268 516.45	$673 707.66	$965 787.27	8	$11 688.54	$1 678.48	$13 367.02	8	$143 795.00	$357 208.31	$1 247	$1 748 982.64	8
1.2.1.7	$20 652.96	$207 975.95	$698 417.04	$927 045.95	4	$11 726.80	$1 398.72	$13 125.52	4	$122 412.48	$276 671.08	$1 293	$1 692 834.67	4
1.2.1.8	$19 647.96	$196 150.01	$707 100.71	$922 898.68	3	$11 787.67	$1 305.47	$13 093.14	3	$115 196.21	$260 938.99	$1 309	$1 685 971.98	3
1.2.1.9	$19 138.04	$190 237.04	$709 851.38	$919 226.46	2	$11 794.16	$1 258.84	$13 053.00	2	$111 569.22	$253 072.95	$1 314	$1 679 574.32	2
1.2.1.10	$27 971.27	$307 195.13	$671 582.22	$1 006 748.62	1	$11 895.02	$2 127.80	$14 022.81	9	$177 461.16	$408 662.68	$1 244	$1 830 166.00	1
RB 48 hr 1.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$1 118.96	$20 341.71		$100 605.37	$211 436.84	$2 253	$2 565 650.88	
RB 24 hr 1.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$13 181.63	$1 118.96	$14 300.59		$100 605.37	$211 436.84	$1 507	$1 819 611.69	
1.2.2.1	$60 134.28	$780 795.83	$829 502.96	$1 670 433.07	1	$16 959.89	$6 133.31	$23 093.20	1	$459 458.80	$1 038 695.22	$1 536	$3 034 729.33	1
1.2.2.2	$80 620.27	$1 142 766.44	$714 477.99	$1 937 864.70	8	$17 253.33	$9 200.21	$26 453.54	8	$664 855.73	$1 520 225.89	$1 323	$3 508 584.11	8
1.2.2.3	$95 702.42	$1 413 855.12	$697 084.89	$2 206 642.43	1	$18 501.71	$11 663.02	$30 164.73	1	$826 318.07	$1 880 856.05	$1 291	$3 998 457.54	1
1.2.2.4	$80 620.27	$1 150 974.14	$690 803.69	$1 922 398.10	5	$16 939.25	$9 200.21	$26 139.46	7	$664 855.73	$1 531 144.63	$1 279	$3 475 648.45	7
1.2.2.5	$80 620.27	$1 159 181.85	$683 664.11	$1 923 466.23	6	$16 873.20	$9 200.21	$26 073.40	6	$664 855.73	$1 542 063.37	$1 266	$3 473 341.80	5
1.2.2.6	$80 620.27	$1 167 389.56	$678 771.34	$1 926 781.17	7	$16 840.84	$9 200.21	$26 041.05	5	$664 855.73	$1 552 982.11	$1 257	$3 475 197.15	6
1.2.2.7	$70 663.14	$968 479.73	$779 780.68	$1 818 923.55	4	$17 259.87	$7 666.76	$24 926.63	4	$562 883.61	$1 288 371.72	$1 444	$3 295 724.83	4
1.2.2.8	$67 224.58	$910 384.16	$795 824.20	$1 773 432.94	3	$17 174.97	$7 155.61	$24 330.58	3	$528 589.24	$1 211 086.99	$1 474	$3 213 864.83	3
1.2.2.9	$65 479.91	$881 336.37	$801 923.44	$1 748 739.73	2	$17 103.43	$6 900.04	$24 003.46	2	$511 377.53	$1 172 444.63	$1 485	$3 169 309.03	2
1.2.2.10	$95 702.42	$1 423 083.37	$680 345.86	$2 199 131.65	9	$18 296.77	$11 663.02	$29 959.79	9	$826 318.07	$1 893 132.41	$1 260	$3 979 726.44	9
RB 48 hr 1.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$6 133.31	$28 899.44		$459 458.80	$1 038 695.22	$2 253	$3 751 762.70	
RB 24 hr 1.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$16 725.02	$6 133.31	$22 858.33		$459 458.80	$1 038 695.22	$1 507	$3 005 723.51	
1.2.3.1	$112 564.83	$1 510 285.24	$906 652.88	$2 529 502.95	1	$22 299.38	$14 598.00	$36 897.38	1	$1 015 912.33	$2 009 137.34	$1 679	$4 704 537.86	1
1.2.3.2	$150 912.38	$2 197 630.23	$753 636.83	$3 102 179.43	8	$23 832.01	$21 897.57	$45 729.58	8	$1 478 326.83	$2 923 514.60	$1 396	$5 797 881.95	8
1.2.3.3	$179 144.52	$2 722 954.51	$719 828.05	$3 621 927.08	1	$26 239.47	$27 759.35	$53 998.82	1	$1 843 150.03	$3 622 355.19	$1 333	$6 798 918.19	1
1.2.3.4	$150 912.38	$2 205 571.89	$711 675.17	$3 068 159.44	7	$23 242.29	$21 897.57	$45 139.86	7	$1 478 326.83	$2 934 079.43	$1 318	$5 730 716.80	7
1.2.3.5	$150 912.38	$2 213 513.56	$696 923.06	$3 061 348.99	5	$23 060.72	$21 897.57	$44 958.29	6	$1 478 326.83	$2 944 644.25	$1 290	$5 713 954.73	6
1.2.3.6	$150 912.38	$2 221 455.22	$689 402.06	$3 061 769.65	6	$22 987.61	$21 897.57	$44 885.18	5	$1 478 326.83	$2 955 209.07	$1 277	$5 710 587.61	5
1.2.3.7	$132 273.71	$1 860 509.26	$842 292.38	$2 835 075.36	4	$23 286.12	$18 247.79	$41 533.91	4	$1 248 479.23	$2 475 041.49	$1 560	$5 283 787.20	4
1.2.3.8	$125 837.11	$1 748 135.61	$863 479.22	$2 737 451.94	3	$22 976.40	$17 031.19	$40 007.60	3	$1 171 294.93	$2 325 550.46	$1 599	$5 096 358.47	3
1.2.3.9	$122 571.28	$1 691 948.78	$867 912.57	$2 682 432.63	2	$22 728.66	$16 422.89	$39 151.55	2	$1 132 582.00	$2 250 804.94	$1 607	$4 991 112.39	2
1.2.3.10	$179 144.52	$2 731 885.24	$692 300.60	$3 603 330.36	9	$25 871.21	$27 759.35	$53 630.56	9	$1 843 150.03	$3 634 235.77	$1 282	$6 759 806.78	9
RB 48 hr 1.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$14 598.00	$41 546.37		$1 015 912.33	$2 009 137.34	$2 253	$5 278 658.35	
RB 24 hr 1.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$20 907.25	$14 598.00	$35 505.26		$1 015 912.33	$2 009 137.34	$1 507	$4 532 619.15	
1.2.4.1	$231 757.45	$3 716 343.63	$1 070	$5 018 457.67	1	$37 000.99	$39 635.52	$76 636.51	1	$2 570 640.75	$4 943 863.96	$1 982	$9 497 238.44	1
1.2.4.2	$310 710.44	$5 388 413.10	$857 536.58	$6 556 660.13	8	$42 974.36	$59 454.82	$102 429.18	8	$3 762 215.01	$7 168 223.39	$1 588	$12 518 943.31	8
1.2.4.3	$368 837.04	$6 682 697.20	$797 795.15	$7 849 329.38	1	$49 142.55	$75 370.34	$124 512.89	1	$4 705 682.82	$8 890 013.70	$1 477	$15 073 536.12	1
1.2.4.4	$310 710.44	$5 396 233.56	$769 783.93	$6 476 727.94	7	$41 697.17	$59 454.82	$101 151.99	7	$3 762 215.01	$7 178 626.96	$1 425	$12 366 793.46	7
1.2.4.5	$310 710.44	$5 404 054.02	$734 827.30	$6 449 591.76	6	$41 211.93	$59 454.82	$100 666.75	6	$3 762 215.01	$7 189 030.54	$1 361	$12 312 443.20	6
1.2.4.6	$310 710.44	$5 411 874.47	$717 870.35	$6 440 455.26	5	$40 996.67	$59 454.82	$100 451.50	5	$3 762 215.01	$7 199 434.12	$1 329	$12 291 435.64	5
1.2.4.7	$272 335.68	$4 558 862.95	$965 333.34	$5 796 531.97	4	$40 052.14	$49 545.17	$89 597.31	4	$3 169 227.24	$6 064 670.13	$1 788	$11 022 085.53	4
1.2.4.8	$259 083.49	$4 282 346.23	$995 724.26	$5 537 153.98	3	$38 990.25	$46 241.95	$85 232.20	3	$2 970 394.31	$5 696 819.05	$1 844	$10 511 697.80	3
1.2.4.9	$252 359.53	$4 144 087.87	$1 001	$5 397 828.46	2	$38 315.22	$44 590.34	$82 905.57	2	$2 870 729.18	$5 512 893.51	$1 854	$10 238 585.82	2
1.2.4.10	$368 837.04	$6 691 492.22	$728 629.32	$7 788 958.58	9	$48 149.04	$75 370.34	$123 519.38	9	$4 705 682.82	$8 901 713.74	$1 349	$14 957 113.05	9
RB 48 hr 1.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$39 635.52	$78 829.94		$2 570 640.75	$4 943 863.96	$2 253	$9 768 113.40	
RB 24 hr 1.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$33 153.31	$39 635.52	$72 788.83		$2 570 640.75	$4 943 863.96	$1 507	$9 022 074.20	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$998 248.32	$55 947.98	$585 404.19
$1 059 833.30	$83 924.14	$580 386.54
$1 124 271.38	$106 389.88	$593 569.23
$1 064 416.98	$83 924.14	$579 383.28
$1 071 652.85	$83 924.14	$580 184.37
$1 081 974.01	$83 924.14	$583 084.49
$1 037 598.71	$69 936.06	$585 299.90
$1 032 295.88	$65 273.36	$588 402.74
$1 027 875.29	$62 942.02	$588 757.01
$1 130 561.30	$106 389.88	$593 214.82
$1 549 360.27	$55 947.98	$960 342.64
$1 105 376.75	$55 947.98	$658 286.97
$1 883 973.06	$306 665.58	$844 090.68
$2 191 621.17	$460 010.33	$856 952.61
$2 497 290.20	$583 150.93	$918 016.41
$2 174 430.35	$460 010.33	$841 207.77
$2 175 467.50	$460 010.33	$837 863.97
$2 178 981.53	$460 010.33	$836 205.28
$2 054 235.63	$383 337.96	$858 151.24
$2 001 887.53	$357 780.50	$854 196.81
$1 973 542.51	$345 001.77	$850 764.75
$2 488 852.46	$583 150.93	$907 723.05
$2 310 694.61	$306 665.58	$1 134 402.51
$1 866 711.09	$306 665.58	$832 346.83
$2 867 220.20	$729 900.05	$1 107 417.61
$3 522 391.07	$1 094	$1 180 612.34
$4 112 591.99	$1 387	$1 298 358.60
$3 484 751.46	$1 094	$1 151 086.81
$3 477 107.77	$1 094	$1 141 968.43
$3 477 435.69	$1 094	$1 138 273.38
$3 216 394.26	$912 389.29	$1 155 003.65
$3 104 719.36	$851 559.55	$1 140 079.57
$3 041 994.49	$821 144.67	$1 127 973.23
$4 091 938.14	$1 387	$1 279 901.04
$3 208 891.30	$729 900.05	$1 339 866.99
$2 764 907.78	$729 900.05	$1 037 811.32
$5 683 994.65	$1 981	$1 831 467.93
$7 424 426.28	$2 972	$2 121 775.97
$8 881 305.15	$3 768	$2 423 714.06
$7 336 174.91	$2 972	$2 057 877.50
$7 306 126.11	$2 972	$2 033 576.03
$7 295 920.25	$2 972	$2 022 774.33
$6 565 014.44	$2 477	$1 979 812.62
$6 271 499.61	$2 312	$1 928 100.60
$6 114 027.98	$2 229	$1 895 040.68
$8 814 601.67	$3 768	$2 373 994.48
$5 845 198.00	$1 981	$1 941 139.54
$5 401 214.48	$1 981	$1 639 083.86

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
1.4.1.1	$26 117.08	$260 988.68	$1 355	$1 642 341.10	1	$21 899.87	$1 935.22	$23 835.09	1	$163 121.03	$347 194.08	$2 510	$3 020 759.63	1
1.4.1.2	$35 014.41	$398 392.16	$1 282	$1 715 798.25	5	$21 584.98	$2 902.91	$24 487.89	7	$234 112.23	$529 982.38	$2 375	$3 139 603.18	5
1.4.1.3	$41 564.78	$489 314.97	$1 276	$1 807 691.83	9	$22 022.72	$3 679.99	$25 702.70	1	$289 609.93	$650 937.29	$2 365	$3 305 720.11	9
1.4.1.4	$35 014.41	$413 310.58	$1 274	$1 723 119.67	6	$21 545.62	$2 902.91	$24 448.53	5	$234 112.23	$549 828.40	$2 361	$3 145 376.47	6
1.4.1.5	$35 014.41	$428 229.00	$1 271	$1 735 069.23	7	$21 575.68	$2 902.91	$24 478.58	6	$234 112.23	$569 674.42	$2 355	$3 159 722.98	7
1.4.1.6	$35 014.41	$443 147.41	$1 274	$1 752 426.32	8	$21 686.85	$2 902.91	$24 589.76	8	$234 112.23	$589 520.44	$2 360	$3 184 086.40	8
1.4.1.7	$30 689.90	$340 135.12	$1 320	$1 691 441.60	4	$21 822.96	$2 419.06	$24 242.02	4	$198 932.10	$452 482.85	$2 446	$3 097 731.51	4
1.4.1.8	$29 196.49	$320 716.10	$1 337	$1 687 053.62	3	$21 958.50	$2 257.78	$24 216.28	3	$187 073.50	$426 649.67	$2 476	$3 090 649.69	3
1.4.1.9	$28 438.76	$311 006.59	$1 342	$1 681 571.66	2	$21 977.00	$2 177.14	$24 154.14	2	$181 116.18	$413 733.08	$2 486	$3 081 010.53	2
1.4.1.10	$41 564.78	$505 934.91	$1 269	$1 817 214.36	1	$21 999.36	$3 679.99	$25 679.34	9	$289 609.93	$673 046.85	$2 352	$3 314 682.38	1
RB 48 hr 1.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$163 121.03	$347 194.08	$4 261	$4 772 270.65	
RB 24 hr 1.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$163 121.03	$347 194.08	$2 851	$3 361 408.94	
1.4.2.1	$89 142.71	$1 282 944.45	$1 568	$2 940 812.45	1	$30 854.86	$10 572.05	$41 426.91	1	$755 102.51	$1 706 705.16	$2 905	$5 367 721.99	1
1.4.2.2	$119 511.03	$1 876 210.93	$1 351	$3 346 742.04	8	$30 865.37	$15 858.49	$46 723.86	8	$1 096 586.35	$2 495 929.47	$2 502	$6 095 151.96	8
1.4.2.3	$141 868.72	$2 323 319.42	$1 317	$3 783 155.19	1	$32 833.16	$20 103.67	$52 936.83	1	$1 365 653.04	$3 090 719.33	$2 441	$6 897 780.92	1
1.4.2.4	$119 511.03	$1 890 797.98	$1 306	$3 316 412.04	5	$30 264.55	$15 858.49	$46 123.04	7	$1 096 586.35	$2 515 334.67	$2 419	$6 031 352.61	7
1.4.2.5	$119 511.03	$1 905 385.04	$1 292	$3 317 569.45	6	$30 136.04	$15 858.49	$45 994.53	6	$1 096 586.35	$2 534 739.88	$2 394	$6 025 880.67	5
1.4.2.6	$119 511.03	$1 919 972.09	$1 283	$3 322 862.31	7	$30 069.56	$15 858.49	$45 928.05	5	$1 096 586.35	$2 554 145.09	$2 377	$6 028 069.27	6
1.4.2.7	$104 750.64	$1 589 836.23	$1 474	$3 169 230.51	4	$31 137.29	$13 215.27	$44 352.57	4	$926 921.17	$2 114 964.28	$2 731	$5 773 522.47	4
1.4.2.8	$99 653.34	$1 494 378.00	$1 504	$3 098 522.67	3	$31 055.72	$12 334.20	$43 389.93	3	$869 915.95	$1 987 975.89	$2 786	$5 644 818.87	3
1.4.2.9	$97 067.05	$1 446 648.89	$1 516	$3 059 990.25	2	$30 967.44	$11 893.66	$42 861.11	2	$841 317.70	$1 924 481.69	$2 808	$5 574 553.29	2
1.4.2.10	$141 868.72	$2 339 578.00	$1 286	$3 767 606.87	9	$32 437.35	$20 103.67	$52 541.02	9	$1 365 653.04	$3 112 348.19	$2 382	$6 860 490.50	9
RB 48 hr 1.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$10 572.05	$52 407.57		$755 102.51	$1 706 705.16	$4 261	$6 723 763.21	
RB 24 hr 1.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$30 410.94	$10 572.05	$40 983.00		$755 102.51	$1 706 705.16	$2 851	$5 312 901.49	
1.4.3.1	$166 142.57	$2 484 448.75	$1 730	$4 381 330.72	1	$40 077.99	$25 012.08	$65 090.07	1	$1 672 750.29	$3 305 070.21	$3 206	$8 183 850.55	1
1.4.3.2	$222 742.49	$3 613 431.42	$1 425	$5 261 247.73	8	$41 715.24	$37 519.10	$79 234.34	8	$2 441 913.97	$4 806 959.51	$2 639	$9 888 687.13	8
1.4.3.3	$264 412.36	$4 479 274.31	$1 361	$6 104 774.12	1	$45 509.69	$47 562.62	$93 072.31	1	$3 049 967.70	$5 958 793.11	$2 521	$11 530 045.79	1
1.4.3.4	$222 742.49	$3 627 416.78	$1 345	$5 195 819.13	7	$40 593.96	$37 519.10	$78 113.05	7	$2 441 913.97	$4 825 564.28	$2 492	$9 760 185.09	7
1.4.3.5	$222 742.49	$3 641 402.13	$1 317	$5 181 846.22	6	$40 244.51	$37 519.10	$77 763.61	6	$2 441 913.97	$4 844 169.04	$2 440	$9 726 999.83	6
1.4.3.6	$222 742.49	$3 655 387.49	$1 303	$5 181 512.22	5	$40 099.64	$37 519.10	$77 618.74	5	$2 441 913.97	$4 862 773.80	$2 414	$9 719 079.36	5
1.4.3.7	$195 232.34	$3 058 860.84	$1 592	$4 846 663.82	4	$41 174.23	$31 265.59	$72 439.82	4	$2 059 338.94	$4 069 212.48	$2 950	$9 078 636.97	4
1.4.3.8	$185 732.09	$2 874 003.98	$1 632	$4 692 513.32	3	$40 756.15	$29 181.09	$69 937.23	3	$1 930 974.94	$3 823 296.80	$3 024	$8 778 836.21	3
1.4.3.9	$180 911.81	$2 781 575.55	$1 641	$4 603 719.30	2	$40 371.66	$28 138.84	$68 510.49	2	$1 866 614.67	$3 700 338.96	$3 040	$8 607 179.62	2
1.4.3.10	$264 412.36	$4 494 876.01	$1 309	$6 068 318.21	9	$44 806.83	$47 562.62	$92 369.45	9	$3 049 967.70	$5 979 548.09	$2 424	$11 454 369.03	9
RB 48 hr 1.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$25 012.08	$73 640.51		$1 672 750.29	$3 305 070.21	$4 261	$9 239 776.04	
RB 24 hr 1.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$37 203.86	$25 012.08	$62 215.95		$1 672 750.29	$3 305 070.21	$2 851	$7 828 914.32	
1.4.4.1	$341 398.74	$6 116 636.13	$2 024	$8 482 077.66	1	$64 426.09	$67 727.54	$132 153.63	1	$4 253 825.99	$8 136 980.83	$3 749	$16 140 153.48	1
1.4.4.2	$457 703.32	$8 866 841.40	$1 621	$10 946 098.64	8	$73 326.09	$101 593.95	$174 920.04	8	$6 242 661.06	$11 795 587.80	$3 003	$21 042 023.21	8
1.4.4.3	$543 328.82	$10 998 744.17	$1 508	$13 050 543.65	1	$83 162.73	$128 789.74	$211 952.47	1	$7 820 013.14	$14 631 664.95	$2 794	$25 245 976.47	1
1.4.4.4	$457 703.32	$8 880 552.65	$1 455	$10 793 725.73	7	$70 903.38	$101 593.95	$172 497.34	7	$6 242 661.06	$11 813 827.92	$2 696	$20 752 608.23	7
1.4.4.5	$457 703.32	$8 894 263.89	$1 389	$10 741 315.81	6	$69 980.12	$101 593.95	$171 574.08	6	$6 242 661.06	$11 832 068.03	$2 573	$20 648 365.18	6
1.4.4.6	$457 703.32	$8 907 975.14	$1 357	$10 722 997.69	5	$69 568.24	$101 593.95	$171 162.19	5	$6 242 661.06	$11 850 308.15	$2 514	$20 607 273.94	5
1.4.4.7	$401 173.98	$7 501 505.75	$1 824	$9 727 442.32	4	$68 970.94	$84 660.75	$153 631.69	4	$5 252 367.22	$9 979 277.37	$3 380	$18 611 843.65	4
1.4.4.8	$381 652.35	$7 046 393.87	$1 882	$9 310 492.74	3	$67 361.52	$79 016.35	$146 377.87	3	$4 920 545.27	$9 373 840.56	$3 487	$17 781 438.88	3
1.4.4.9	$371 747.38	$6 818 837.92	$1 893	$9 084 297.50	2	$66 291.70	$76 194.15	$142 485.84	2	$4 754 267.99	$9 071 122.15	$3 507	$17 333 311.79	2
1.4.4.10	$543 328.82	$11 014 046.28	$1 377	$12 934 709.17	9	$81 272.20	$128 789.74	$210 061.93	9	$7 820 013.14	$14 652 021.40	$2 551	$25 023 414.85	9
RB 48 hr 1.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$4 253 825.99	$8 136 980.83	$4 261	$16 652 762.36	
RB 24 hr 1.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$4 253 825.99	$8 136 980.83	$2 851	$15 241 900.64	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 830 310.19	$96 761.00	$1 093 688.44
$1 917 200.72	$145 145.28	$1 077 257.19
$2 023 031.49	$183 999.35	$1 098 689.27
$1 925 016.75	$145 145.28	$1 075 214.45
$1 937 934.88	$145 145.28	$1 076 642.82
$1 956 814.29	$145 145.28	$1 082 126.84
$1 887 330.98	$120 953.14	$1 089 447.39
$1 881 439.17	$112 889.09	$1 096 321.43
$1 874 858.35	$108 857.07	$1 097 295.11
$2 033 244.94	$183 999.35	$1 097 438.09
$2 872 671.01	$96 761.00	$1 802 838.64
$2 033 037.71	$96 761.00	$1 231 610.23
$3 302 791.13	$528 602.73	$1 536 328.14
$3 768 339.89	$792 924.70	$1 533 887.36
$4 262 555.86	$1 005	$1 630 041.59
$3 734 654.50	$792 924.70	$1 503 773.41
$3 735 680.97	$792 924.70	$1 497 275.00
$3 741 266.38	$792 924.70	$1 493 878.18
$3 563 843.32	$660 763.72	$1 548 915.43
$3 482 794.51	$616 710.05	$1 545 314.31
$3 438 731.15	$594 683.22	$1 541 138.91
$4 245 137.27	$1 005	$1 610 169.77
$4 109 799.60	$528 602.73	$2 085 360.88
$3 270 166.30	$528 602.73	$1 514 132.46
$4 941 769.25	$1 250	$1 991 477.20
$5 945 037.50	$1 875	$2 067 694.73
$6 898 826.67	$2 378	$2 253 088.09
$5 872 669.52	$1 875	$2 011 560.67
$5 857 026.54	$1 875	$1 994 018.39
$5 856 419.17	$1 875	$1 986 705.29
$5 471 940.10	$1 563	$2 043 417.37
$5 296 344.57	$1 459	$2 023 437.28
$5 195 562.84	$1 406	$2 004 674.99
$6 858 370.69	$2 378	$2 217 867.31
$5 570 172.58	$1 250	$2 418 999.36
$4 730 539.28	$1 250	$1 847 770.95
$9 563 055.04	$3 386	$3 190 721.30
$12 340 355.19	$5 079	$3 621 970.28
$14 703 346.64	$6 439	$4 103 143.02
$12 172 144.07	$5 079	$3 500 766.42
$12 114 132.64	$5 079	$3 454 534.80
$12 093 704.17	$5 079	$3 433 872.03
$10 967 766.63	$4 233	$3 411 039.58
$10 497 777.45	$3 950	$3 332 844.09
$10 243 113.90	$3 809	$3 280 490.60
$14 575 388.45	$6 439	$4 008 539.59
$9 868 119.30	$3 386	$3 398 265.92
$9 028 486.00	$3 386	$2 827 037.50

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
3.1.1.1	$10 070.88	$86 301.48	$345 393.37	$441 765.73	1	$5 715.13	$517.98	$6 233.11	1	$51 487.81	$114 807.14	$639 808.36	$806 103.31	1
3.1.1.2	$13 501.73	$134 784.12	$330 733.21	$479 019.07	5	$5 772.64	$776.99	$6 549.63	6	$73 155.69	$179 303.75	$612 651.80	$865 111.25	5
3.1.1.3	$16 027.59	$163 157.83	$329 169.34	$508 354.76	9	$5 916.81	$984.99	$6 901.80	9	$89 973.24	$217 049.39	$609 754.88	$916 777.50	9
3.1.1.4	$13 501.73	$139 854.06	$328 270.73	$481 626.52	6	$5 761.05	$776.99	$6 538.04	5	$73 155.69	$186 048.31	$608 090.29	$867 294.29	6
3.1.1.5	$13 501.73	$144 924.00	$328 184.19	$486 609.93	7	$5 785.10	$776.99	$6 562.09	7	$73 155.69	$192 792.87	$607 929.99	$873 878.55	7
3.1.1.6	$13 501.73	$149 993.94	$327 058.36	$490 554.04	8	$5 793.56	$776.99	$6 570.55	8	$73 155.69	$199 537.43	$605 844.49	$878 537.61	8
3.1.1.7	$11 834.18	$115 520.19	$338 315.75	$465 670.12	4	$5 773.05	$647.49	$6 420.53	4	$62 443.40	$153 676.88	$626 697.74	$842 818.01	4
3.1.1.8	$11 258.32	$109 098.87	$341 217.56	$461 574.75	3	$5 778.59	$604.32	$6 382.91	3	$58 821.78	$145 134.58	$632 073.07	$836 029.43	3
3.1.1.9	$10 966.13	$105 888.22	$340 759.31	$457 613.66	2	$5 752.69	$582.73	$6 335.42	2	$57 000.16	$140 863.44	$631 224.20	$829 087.79	2
3.1.1.10	$16 027.59	$168 836.10	$327 391.56	$512 255.26	1	$5 918.54	$984.99	$6 903.52	1	$89 973.24	$224 603.21	$606 461.71	$921 038.16	1
RB 48 hr 3.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$51 487.81	$114 807.14	$1 008	$1 174 380.86	
RB 24 hr 3.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$51 487.81	$114 807.14	$662 358.68	$828 653.63	
3.1.4.1	$135 406.09	$2 007 523.44	$497 169.54	$2 640 099.08	1	$18 876.30	$18 848.17	$37 724.47	1	$1 286 457.38	$2 670 614.93	$920 959.26	$4 878 031.58	1
3.1.4.2	$181 534.99	$2 913 464.00	$405 735.11	$3 500 734.11	8	$22 505.00	$28 272.99	$50 777.99	8	$1 874 905.77	$3 875 790.59	$751 585.69	$6 502 282.05	8
3.1.4.3	$215 495.91	$3 611 480.34	$382 214.72	$4 209 190.97	1	$25 988.68	$35 841.41	$61 830.09	1	$2 339 617.11	$4 804 363.99	$708 016.40	$7 851 997.49	1
3.1.4.4	$181 534.99	$2 918 312.55	$370 530.46	$3 470 378.00	7	$22 001.18	$28 272.99	$50 274.17	7	$1 874 905.77	$3 882 240.63	$686 372.42	$6 443 518.82	7
3.1.4.5	$181 534.99	$2 923 161.10	$354 413.67	$3 459 109.76	6	$21 783.67	$28 272.99	$50 056.66	6	$1 874 905.77	$3 888 690.67	$656 517.60	$6 420 114.05	6
3.1.4.6	$181 534.99	$2 928 009.64	$348 186.60	$3 457 731.24	5	$21 714.50	$28 272.99	$49 987.49	5	$1 874 905.77	$3 895 140.70	$644 982.55	$6 415 029.02	5
3.1.4.7	$159 114.24	$2 465 351.14	$452 478.61	$3 076 944.00	4	$20 736.90	$23 560.58	$44 297.48	4	$1 582 317.13	$3 279 664.60	$838 173.57	$5 700 155.30	4
3.1.4.8	$151 371.54	$2 315 980.19	$462 496.71	$2 929 848.45	3	$20 061.34	$21 989.78	$42 051.12	3	$1 484 103.80	$3 080 955.94	$856 731.15	$5 421 790.89	3
3.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$21 204.37	$40 912.86	2	$1 434 851.85	$2 981 601.61	$864 220.27	$5 280 673.72	2
3.1.4.10	$215 495.91	$3 616 903.58	$351 833.58	$4 184 233.07	9	$25 560.08	$35 841.41	$61 401.49	9	$2 339 617.11	$4 811 578.53	$651 738.23	$7 802 933.87	9
RB 48 hr 3.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$1 286 457.38	$2 670 614.93	$1 008	$4 965 158.23	
RB 24 hr 3.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$1 286 457.38	$2 670 614.93	$662 358.68	$4 619 430.99	
3.4.1.1	$26 117.08	$260 988.68	$1 483	$1 770 949.09	1	$23 828.99	$1 935.22	$25 764.21	1	$163 121.03	$347 194.08	$2 748	$3 258 993.68	1
3.4.1.2	$35 014.41	$398 392.16	$1 432	$1 866 378.31	5	$23 843.68	$2 902.91	$26 746.59	6	$234 112.23	$529 982.38	$2 654	$3 418 538.41	5
3.4.1.3	$41 564.78	$489 314.97	$1 427	$1 958 116.04	9	$24 279.08	$3 679.99	$27 959.07	1	$289 609.93	$650 937.29	$2 643	$3 584 366.64	9
3.4.1.4	$35 014.41	$413 310.58	$1 424	$1 872 994.04	6	$23 793.74	$2 902.91	$26 696.64	5	$234 112.23	$549 828.40	$2 639	$3 423 004.50	6
3.4.1.5	$35 014.41	$428 229.00	$1 424	$1 887 359.22	7	$23 860.03	$2 902.91	$26 762.93	7	$234 112.23	$569 674.42	$2 638	$3 441 825.68	7
3.4.1.6	$35 014.41	$443 147.41	$1 419	$1 897 905.30	8	$23 869.04	$2 902.91	$26 771.94	8	$234 112.23	$589 520.44	$2 629	$3 453 572.36	8
3.4.1.7	$30 689.90	$340 135.12	$1 459	$1 830 089.67	4	$23 902.68	$2 419.06	$26 321.75	4	$198 932.10	$452 482.85	$2 703	$3 354 563.86	4
3.4.1.8	$29 196.49	$320 716.10	$1 469	$1 819 018.18	3	$23 937.97	$2 257.78	$26 195.75	3	$187 073.50	$426 649.67	$2 721	$3 335 101.48	3
3.4.1.9	$28 438.76	$311 006.59	$1 467	$1 806 551.24	2	$23 851.70	$2 177.14	$26 028.84	2	$181 116.18	$413 733.08	$2 717	$3 312 523.31	2
3.4.1.10	$41 564.78	$505 934.91	$1 419	$1 967 303.66	1	$24 250.69	$3 679.99	$27 930.68	9	$289 609.93	$673 046.85	$2 630	$3 592 708.52	1
RB 48 hr 3.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$163 121.03	$347 194.08	$4 261	$4 772 270.65	
RB 24 hr 3.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$163 121.03	$347 194.08	$2 851	$3 361 408.94	
3.4.4.1	$341 398.74	$6 116 636.13	$2 096	$8 555 000.23	1	$65 519.93	$67 727.54	$133 247.47	1	$4 253 825.99	$8 136 980.83	$3 884	$16 275 235.60	1
3.4.4.2	$457 703.32	$8 866 841.40	$1 718	$11 042 754.90	8	$74 775.93	$101 593.95	$176 369.89	8	$6 242 661.06	$11 795 587.80	$3 182	$21 221 069.73	8
3.4.4.3	$543 328.82	$10 998 744.17	$1 624	$13 166 443.52	1	$84 901.23	$128 789.74	$213 690.97	1	$7 820 013.14	$14 631 664.95	$3 008	$25 460 669.95	1
3.4.4.4	$457 703.32	$8 880 552.65	$1 581	$10 919 295.88	7	$72 786.94	$101 593.95	$174 380.89	7	$6 242 661.06	$11 813 827.92	$2 928	$20 985 214.98	7
3.4.4.5	$457 703.32	$8 894 263.89	$1 518	$10 870 505.79	6	$71 917.97	$101 593.95	$173 511.93	6	$6 242 661.06	$11 832 068.03	$2 812	$20 887 677.32	6
3.4.4.6	$457 703.32	$8 907 975.14	$1 493	$10 859 503.27	5	$71 615.82	$101 593.95	$173 209.78	5	$6 242 661.06	$11 850 308.15	$2 767	$20 860 137.52	5
3.4.4.7	$401 173.98	$7 501 505.75	$1 909	$9 812 537.63	4	$70 247.37	$84 660.75	$154 908.12	4	$5 252 367.22	$9 979 277.37	$3 537	$18 769 474.62	4
3.4.4.8	$381 652.35	$7 046 393.87	$1 953	$9 381 550.69	3	$68 427.39	$79 016.35	$147 443.74	3	$4 920 545.27	$9 373 840.56	$3 618	$17 913 066.97	3
3.4.4.9	$371 747.38	$6 818 837.92	$1 971	$9 162 366.68	2	$67 462.73	$76 194.15	$143 656.88	2	$4 754 267.99	$9 071 122.15	$3 652	$17 477 927.51	2
3.4.4.10	$543 328.82	$11 014 046.28	$1 509	$13 066 387.14	9	$83 247.37	$128 789.74	$212 037.10	9	$7 820 013.14	$14 652 021.40	$2 795	$25 267 335.77	9
RB 48 hr 3.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$4 253 825.99	$8 136 980.83	$4 261	$16 652 762.36	
RB 24 hr 3.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$4 253 825.99	$8 136 980.83	$2 851	$15 241 900.64	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$494 879.22	$25 899.04	$285 325.04
$538 303.77	$38 849.58	$287 957.90
$572 503.50	$49 249.26	$295 024.74
$541 091.54	$38 849.58	$287 353.18
$546 498.56	$38 849.58	$288 530.41
$550 759.86	$38 849.58	$288 928.17
$522 369.01	$32 374.31	$288 074.69
$517 429.40	$30 215.89	$288 384.14
$512 846.29	$29 136.68	$287 104.82
$576 706.32	$49 249.26	$295 082.59
$714 048.89	$25 899.04	$434 432.93
$508 299.39	$25 899.04	$294 455.19
$3 001 845.58	$942 408.49	$933 777.51
$3 977 949.72	$1 413	$1 110 682.86
$4 778 550.22	$1 792	$1 281 376.64
$3 944 402.08	$1 413	$1 085 467.27
$3 931 897.00	$1 413	$1 074 567.57
$3 930 294.39	$1 413	$1 071 085.16
$3 497 608.07	$1 178	$1 024 518.25
$3 330 814.90	$1 099	$991 487.17
$3 246 237.13	$1 060	$974 217.86
$4 750 943.76	$1 792	$1 259 919.48
$3 053 696.48	$942 408.49	$969 053.27
$2 847 946.97	$942 408.49	$829 075.53
$1 972 088.25	$96 761.00	$1 190 144.43
$2 083 200.90	$145 145.28	$1 190 192.23
$2 188 859.87	$183 999.35	$1 211 507.42
$2 090 238.99	$145 145.28	$1 187 620.23
$2 105 820.09	$145 145.28	$1 190 860.31
$2 117 191.02	$145 145.28	$1 191 236.07
$2 040 177.28	$120 953.14	$1 193 433.44
$2 026 917.54	$112 889.09	$1 195 294.85
$2 012 636.44	$108 857.07	$1 191 029.80
$2 198 704.11	$183 999.35	$1 210 005.07
$2 872 671.01	$96 761.00	$1 802 838.64
$2 033 037.71	$96 761.00	$1 231 610.23
$9 643 445.23	$3 386	$3 245 413.23
$12 446 909.51	$5 079	$3 694 462.47
$14 831 115.22	$6 439	$4 190 067.92
$12 310 573.21	$5 079	$3 594 944.03
$12 256 552.30	$5 079	$3 551 427.28
$12 244 188.57	$5 079	$3 536 251.21
$11 061 576.12	$4 233	$3 474 861.07
$10 576 112.08	$3 950	$3 386 137.55
$10 329 177.73	$3 809	$3 339 042.49
$14 720 550.89	$6 439	$4 107 298.07
$9 868 119.30	$3 386	$3 398 265.92
$9 028 486.00	$3 386	$2 827 037.50

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0%)

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
4.1.1.1	$10 070.88	$86 301.48	$359 377.43	$455 749.78	1	$5 924.89	$517.98	$6 442.87	1	$51 487.81	$114 807.14	$665 712.48	$832 007.43	1
4.1.1.2	$13 501.73	$134 784.12	$332 420.55	$480 706.41	5	$5 797.95	$776.99	$6 574.94	7	$73 155.69	$179 303.75	$615 777.44	$868 236.88	5
4.1.1.3	$16 027.59	$163 157.83	$329 121.73	$508 307.15	9	$5 916.10	$984.99	$6 901.08	9	$89 973.24	$217 049.39	$609 666.68	$916 689.31	9
4.1.1.4	$13 501.73	$139 854.06	$329 491.07	$482 846.86	6	$5 779.35	$776.99	$6 556.35	5	$73 155.69	$186 048.31	$610 350.85	$869 554.85	6
4.1.1.5	$13 501.73	$144 924.00	$327 073.36	$485 499.10	7	$5 768.44	$776.99	$6 545.43	4	$73 155.69	$192 792.87	$605 872.28	$871 820.84	7
4.1.1.6	$13 501.73	$149 993.94	$327 992.00	$491 487.67	8	$5 807.57	$776.99	$6 584.56	8	$73 155.69	$199 537.43	$607 573.96	$880 267.08	8
4.1.1.7	$11 834.18	$115 520.19	$347 592.00	$474 946.37	4	$5 912.19	$647.49	$6 559.68	6	$62 443.40	$153 676.88	$643 881.11	$860 001.38	4
4.1.1.8	$11 258.32	$109 098.87	$351 685.65	$472 042.84	3	$5 935.61	$604.32	$6 539.93	3	$58 821.78	$145 134.58	$651 464.19	$855 420.55	3
4.1.1.9	$10 966.13	$105 888.22	$353 129.87	$469 984.21	2	$5 938.24	$582.73	$6 520.98	2	$57 000.16	$140 863.44	$654 139.47	$852 003.07	2
4.1.1.10	$16 027.59	$168 836.10	$327 403.07	$512 266.76	1	$5 918.71	$984.99	$6 903.69	1	$89 973.24	$224 603.21	$606 483.03	$921 059.48	1
RB 48 hr 4.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$51 487.81	$114 807.14	$1 008	$1 174 380.86	
RB 24 hr 4.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$51 487.81	$114 807.14	$662 358.68	$828 653.63	
4.1.4.1	$135 406.09	$2 007 523.44	$609 235.68	$2 752 165.22	1	$20 557.29	$18 848.17	$39 405.46	1	$1 286 457.38	$2 670 614.93	$1 128	$5 085 623.44	1
4.1.4.2	$181 534.99	$2 913 464.00	$486 440.82	$3 581 439.82	8	$23 715.59	$28 272.99	$51 988.58	8	$1 874 905.77	$3 875 790.59	$901 085.33	$6 651 781.70	8
4.1.4.3	$215 495.91	$3 611 480.34	$442 750.19	$4 269 726.45	1	$26 896.71	$35 841.41	$62 738.13	1	$2 339 617.11	$4 804 363.99	$820 152.60	$7 964 133.69	1
4.1.4.4	$181 534.99	$2 918 312.55	$412 744.82	$3 512 592.37	7	$22 634.39	$28 272.99	$50 907.38	7	$1 874 905.77	$3 882 240.63	$764 570.51	$6 521 716.91	7
4.1.4.5	$181 534.99	$2 923 161.10	$385 330.98	$3 490 027.07	6	$22 247.43	$28 272.99	$50 520.42	6	$1 874 905.77	$3 888 690.67	$713 788.97	$6 477 385.41	6
4.1.4.6	$181 534.99	$2 928 009.64	$369 674.63	$3 479 219.27	5	$22 036.82	$28 272.99	$50 309.81	5	$1 874 905.77	$3 895 140.70	$684 787.08	$6 454 833.56	5
4.1.4.7	$159 114.24	$2 465 351.14	$533 465.23	$3 157 930.61	4	$21 951.70	$23 560.58	$45 512.28	4	$1 582 317.13	$3 279 664.60	$988 193.57	$5 850 175.30	4
4.1.4.8	$151 371.54	$2 315 980.19	$545 523.53	$3 012 875.27	3	$21 306.74	$21 989.78	$43 296.52	3	$1 484 103.80	$3 080 955.94	$1 010	$5 575 590.17	3
4.1.4.9	$147 443.02	$2 241 294.71	$552 674.22	$2 941 411.94	2	$21 000.51	$21 204.37	$42 204.88	2	$1 434 851.85	$2 981 601.61	$1 023	$5 440 229.85	2
4.1.4.10	$215 495.91	$3 616 903.58	$379 218.61	$4 211 618.09	9	$25 970.86	$35 841.41	$61 812.27	9	$2 339 617.11	$4 811 578.53	$702 466.38	$7 853 662.02	9
RB 48 hr 4.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$1 286 457.38	$2 670 614.93	$1 008	$4 965 158.23	
RB 24 hr 4.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$1 286 457.38	$2 670 614.93	$662 358.68	$4 619 430.99	
4.4.1.1	$26 117.08	$260 988.68	$1 540	$1 827 549.45	1	$24 677.99	$1 935.22	$26 613.21	1	$163 121.03	$347 194.08	$2 853	$3 363 840.47	1
4.4.1.2	$35 014.41	$398 392.16	$1 441	$1 874 939.65	5	$23 972.10	$2 902.91	$26 875.01	8	$234 112.23	$529 982.38	$2 670	$3 434 397.48	5
4.4.1.3	$41 564.78	$489 314.97	$1 430	$1 961 280.86	9	$24 326.55	$3 679.99	$28 006.54	1	$289 609.93	$650 937.29	$2 649	$3 590 229.16	9
4.4.1.4	$35 014.41	$413 310.58	$1 431	$1 879 725.85	6	$23 894.71	$2 902.91	$26 797.62	4	$234 112.23	$549 828.40	$2 651	$3 435 474.52	6
4.4.1.5	$35 014.41	$428 229.00	$1 423	$1 886 946.19	7	$23 853.83	$2 902.91	$26 756.74	2	$234 112.23	$569 674.42	$2 637	$3 441 060.58	7
4.4.1.6	$35 014.41	$443 147.41	$1 426	$1 904 411.63	8	$23 966.63	$2 902.91	$26 869.54	7	$234 112.23	$589 520.44	$2 641	$3 465 624.73	8
4.4.1.7	$30 689.90	$340 135.12	$1 494	$1 864 905.50	4	$24 424.92	$2 419.06	$26 843.98	6	$198 932.10	$452 482.85	$2 767	$3 419 056.87	4
4.4.1.8	$29 196.49	$320 716.10	$1 510	$1 860 186.09	3	$24 555.49	$2 257.78	$26 813.27	5	$187 073.50	$426 649.67	$2 797	$3 411 361.10	3
4.4.1.9	$28 438.76	$311 006.59	$1 517	$1 857 240.17	2	$24 612.03	$2 177.14	$26 789.17	3	$181 116.18	$413 733.08	$2 811	$3 406 419.73	2
4.4.1.10	$41 564.78	$505 934.91	$1 423	$1 970 898.12	1	$24 304.61	$3 679.99	$27 984.60	9	$289 609.93	$673 046.85	$2 636	$3 599 366.92	1
RB 48 hr 4.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$163 121.03	$347 194.08	$4 261	$4 772 270.65	
RB 24 hr 4.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$163 121.03	$347 194.08	$2 851	$3 361 408.94	
4.4.4.1	$341 398.74	$6 116 636.13	$2 570	$9 028 963.50	1	$72 629.38	$67 727.54	$140 356.92	1	$4 253 825.99	$8 136 980.83	$4 762	$17 153 207.47	1
4.4.4.2	$457 703.32	$8 866 841.40	$2 053	$11 377 774.06	8	$79 801.22	$101 593.95	$181 395.18	8	$6 242 661.06	$11 795 587.80	$3 803	$21 841 660.86	8
4.4.4.3	$543 328.82	$10 998 744.17	$1 869	$13 411 717.65	1	$88 580.34	$128 789.74	$217 370.08	1	$7 820 013.14	$14 631 664.95	$3 463	$25 915 016.94	1
4.4.4.4	$457 703.32	$8 880 552.65	$1 748	$11 087 101.96	7	$75 304.03	$101 593.95	$176 897.98	7	$6 242 661.06	$11 813 827.92	$3 239	$21 296 059.78	7
4.4.4.5	$457 703.32	$8 894 263.89	$1 638	$10 990 820.07	6	$73 722.69	$101 593.95	$175 316.64	6	$6 242 661.06	$11 832 068.03	$3 035	$21 110 548.07	6
4.4.4.6	$457 703.32	$8 907 975.14	$1 578	$10 944 366.00	5	$72 888.76	$101 593.95	$174 482.72	5	$6 242 661.06	$11 850 308.15	$2 924	$21 017 337.67	5
4.4.4.7	$401 173.98	$7 501 505.75	$2 249	$10 152 618.47	4	$75 348.58	$84 660.75	$160 009.33	4	$5 252 367.22	$9 979 277.37	$4 167	$19 399 442.02	4
4.4.4.8	$381 652.35	$7 046 393.87	$2 302	$9 730 849.93	3	$73 666.88	$79 016.35	$152 683.23	3	$4 920 545.27	$9 373 840.56	$4 265	$18 560 110.57	3
4.4.4.9	$371 747.38	$6 818 837.92	$2 332	$9 522 932.11	2	$72 871.21	$76 194.15	$149 065.36	2	$4 754 267.99	$9 071 122.15	$4 320	$18 145 840.66	2
4.4.4.10	$543 328.82	$11 014 046.28	$1 615	$13 172 751.64	9	$84 842.83	$128 789.74	$213 632.57	9	$7 820 013.14	$14 652 021.40	$2 992	$25 464 365.89	9
RB 48 hr 4.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$4 253 825.99	$8 136 980.83	$4 261	$16 652 762.36	
RB 24 hr 4.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$4 253 825.99	$8 136 980.83	$2 851	$15 241 900.64	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$510 295.31	$25 899.04	$295 813.08
$540 163.90	$38 849.58	$289 223.41
$572 451.01	$49 249.26	$294 989.04
$542 436.84	$38 849.58	$288 268.43
$545 273.98	$38 849.58	$287 697.29
$551 789.11	$38 849.58	$289 628.40
$532 595.19	$32 374.31	$295 031.88
$528 969.46	$30 215.89	$296 235.20
$526 483.65	$29 136.68	$296 382.74
$576 719.01	$49 249.26	$295 091.22
$714 048.89	$25 899.04	$434 432.93
$508 299.39	$25 899.04	$294 455.19
$3 125 387.84	$942 408.49	$1 017 827.11
$4 066 920.08	$1 413	$1 171 212.14
$4 845 284.82	$1 792	$1 326 778.24
$3 990 939.40	$1 413	$1 117 128.04
$3 965 980.39	$1 413	$1 097 755.55
$3 953 982.90	$1 413	$1 087 201.19
$3 586 888.11	$1 178	$1 085 258.21
$3 422 344.07	$1 099	$1 053 757.28
$3 341 192.31	$1 060	$1 038 818.80
$4 781 133.15	$1 792	$1 280 458.24
$3 053 696.48	$942 408.49	$969 053.27
$2 847 946.97	$942 408.49	$829 075.53
$2 034 484.77	$96 761.00	$1 232 594.71
$2 092 638.97	$145 145.28	$1 196 613.24
$2 192 348.77	$183 999.35	$1 213 881.04
$2 097 660.16	$145 145.28	$1 192 669.08
$2 105 364.77	$145 145.28	$1 190 550.54
$2 124 363.63	$145 145.28	$1 196 115.82
$2 078 558.42	$120 953.14	$1 219 545.32
$2 072 301.23	$112 889.09	$1 226 170.78
$2 068 516.16	$108 857.07	$1 229 046.50
$2 202 666.66	$183 999.35	$1 212 700.91
$2 872 671.01	$96 761.00	$1 802 838.64
$2 033 037.71	$96 761.00	$1 231 610.23
$10 165 944.64	$3 386	$3 600 885.68
$12 816 236.27	$5 079	$3 945 726.85
$15 101 506.61	$6 439	$4 374 023.52
$12 495 563.45	$5 079	$3 720 798.59
$12 389 187.34	$5 079	$3 641 662.99
$12 337 741.66	$5 079	$3 599 898.26
$11 436 482.88	$4 233	$3 729 921.70
$10 961 181.25	$3 950	$3 648 111.98
$10 726 666.81	$3 809	$3 609 466.56
$14 837 807.63	$6 439	$4 187 071.45
$9 868 119.30	$3 386	$3 398 265.92
$9 028 486.00	$3 386	$2 827 037.50

APPENDIX J2: SUMMARY OF COST ESTIMATIONS AS PERCENTAGE - LOWER INTEREST RATE (2%)

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.1.1.1	2.29%	19.62%	78.09%	68.67%	91.65%	8.35%	67.33%	6.42%	14.30%	79.28%	68.34%	61.40%	3.23%	35.37%
2.1.1.2	2.83%	28.22%	68.96%	74.57%	88.10%	11.90%	70.85%	8.48%	20.79%	70.73%	73.45%	62.23%	4.50%	33.26%
2.1.1.3	3.16%	32.19%	64.65%	79.13%	85.68%	14.32%	74.66%	9.84%	23.74%	66.41%	77.84%	62.46%	5.39%	32.16%
2.1.1.4	2.80%	29.05%	68.15%	75.16%	88.11%	11.89%	70.92%	8.44%	21.46%	70.10%	73.82%	62.39%	4.48%	33.13%
2.1.1.5	2.78%	29.84%	67.38%	75.82%	88.13%	11.87%	71.05%	8.39%	22.11%	69.51%	74.26%	62.54%	4.45%	33.00%
2.1.1.6	2.75%	30.55%	66.70%	76.66%	88.19%	11.81%	71.38%	8.32%	22.69%	68.99%	74.89%	62.69%	4.42%	32.90%
2.1.1.7	2.55%	24.93%	72.52%	72.34%	89.86%	10.14%	69.31%	7.45%	18.32%	74.23%	71.41%	61.99%	3.86%	34.15%
2.1.1.8	2.44%	23.68%	73.88%	71.93%	90.51%	9.49%	69.13%	7.05%	17.39%	75.56%	71.06%	61.90%	3.62%	34.48%
2.1.1.9	2.39%	23.11%	74.50%	71.54%	90.82%	9.18%	68.86%	6.86%	16.97%	76.17%	70.70%	61.85%	3.51%	34.64%
2.1.1.10	3.13%	33.02%	63.85%	79.82%	85.70%	14.30%	74.76%	9.79%	24.43%	65.78%	78.28%	62.62%	5.36%	32.02%
RB 48 hr 2.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	4.38%	9.78%	85.84%	100.00%	60.80%	2.21%	36.99%
RB 24 hr 2.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	6.21%	13.85%	79.93%	70.56%	61.34%	3.13%	35.53%
2.1.2.1	4.08%	49.83%	46.09%	84.76%	74.47%	25.53%	83.03%	15.21%	37.06%	47.73%	84.31%	63.27%	9.41%	27.31%
2.1.2.2	4.58%	61.41%	34.01%	101.11%	67.11%	32.89%	96.67%	18.49%	46.02%	35.49%	99.80%	63.91%	11.93%	24.16%
2.1.2.3	4.75%	66.19%	29.06%	115.79%	63.50%	36.50%	110.43%	20.02%	49.64%	30.35%	114.22%	63.99%	13.21%	22.79%
2.1.2.4	4.61%	62.20%	33.19%	100.62%	66.79%	33.21%	95.76%	18.61%	46.70%	34.69%	99.15%	64.02%	12.01%	23.97%
2.1.2.5	4.59%	62.55%	32.86%	100.86%	66.76%	33.24%	95.66%	18.59%	47.02%	34.39%	99.26%	64.10%	11.99%	23.91%
2.1.2.6	4.58%	62.89%	32.52%	101.10%	66.72%	33.28%	95.55%	18.57%	47.34%	34.09%	99.36%	64.18%	11.98%	23.84%
2.1.2.7	4.34%	56.24%	39.42%	93.62%	70.64%	29.36%	90.25%	16.91%	42.05%	41.04%	92.63%	63.69%	10.71%	25.60%
2.1.2.8	4.25%	54.41%	41.35%	91.01%	71.89%	28.11%	87.97%	16.33%	40.65%	43.02%	90.11%	63.61%	10.27%	26.12%
2.1.2.9	4.20%	53.50%	42.30%	89.62%	72.50%	27.50%	86.74%	16.05%	39.96%	43.99%	88.76%	63.57%	10.06%	26.37%
2.1.2.10	4.75%	66.72%	28.52%	115.70%	63.32%	36.68%	109.91%	20.06%	50.11%	29.83%	113.96%	64.08%	13.24%	22.67%
RB 48 hr 2.1.2	3.46%	42.24%	54.30%	100.00%	78.80%	21.20%	100.00%	12.82%	31.25%	55.93%	100.00%	62.68%	7.94%	29.38%
RB 24 hr 2.1.2	4.25%	51.91%	43.84%	81.38%	73.25%	26.75%	79.25%	15.86%	38.66%	45.47%	80.82%	63.44%	9.82%	26.74%
2.1.3.1	5.01%	62.52%	32.46%	91.58%	61.69%	38.31%	90.91%	21.46%	45.59%	32.96%	91.46%	62.38%	14.47%	23.14%
2.1.3.2	5.35%	72.59%	22.06%	115.04%	54.26%	45.74%	114.22%	24.72%	52.90%	22.38%	114.96%	62.43%	17.28%	20.30%
2.1.3.3	5.41%	76.55%	18.04%	135.00%	50.97%	49.03%	135.07%	26.12%	55.63%	18.25%	135.27%	62.25%	18.61%	19.14%
2.1.3.4	5.39%	73.46%	21.15%	114.14%	53.77%	46.23%	113.00%	24.94%	53.58%	21.48%	113.95%	62.50%	17.43%	20.07%
2.1.3.5	5.40%	73.87%	20.73%	113.98%	53.60%	46.40%	112.58%	25.00%	53.93%	21.08%	113.69%	62.56%	17.47%	19.98%
2.1.3.6	5.39%	74.08%	20.52%	114.11%	53.56%	46.44%	112.47%	24.99%	54.13%	20.88%	113.72%	62.60%	17.46%	19.93%
2.1.3.7	5.19%	68.04%	26.77%	103.94%	57.73%	42.27%	102.99%	23.18%	49.63%	27.19%	103.76%	62.45%	15.95%	21.60%
2.1.3.8	5.13%	66.43%	28.44%	100.05%	58.98%	41.02%	99.05%	22.62%	48.48%	28.90%	99.83%	62.46%	15.47%	22.06%
2.1.3.9	5.10%	65.66%	29.24%	97.98%	59.59%	40.41%	96.94%	22.35%	47.93%	29.72%	97.74%	62.47%	15.24%	22.29%
2.1.3.10	5.43%	77.06%	17.51%	134.60%	50.72%	49.28%	134.37%	26.22%	56.05%	17.73%	134.76%	62.30%	18.68%	19.02%
RB 48 hr 2.1.3	4.59%	57.26%	38.15%	100.00%	65.18%	34.82%	100.00%	19.62%	41.69%	38.68%	100.00%	62.14%	13.24%	24.62%
RB 24 hr 2.1.3	5.28%	65.88%	28.84%	86.92%	59.45%	40.55%	85.87%	22.63%	48.07%	29.30%	86.73%	62.54%	15.26%	22.20%
2.1.4.1	5.13%	76.09%	18.77%	98.18%	50.00%	50.00%	98.09%	26.39%	54.79%	18.82%	98.18%	61.54%	19.33%	19.13%
2.1.4.2	5.19%	83.22%	11.59%	130.28%	44.32%	55.68%	132.14%	28.83%	59.60%	11.56%	130.96%	61.18%	21.74%	17.08%
2.1.4.3	5.12%	85.82%	9.06%	156.61%	42.02%	57.98%	160.86%	29.80%	61.20%	9.00%	158.11%	60.86%	22.83%	16.31%
2.1.4.4	5.23%	84.12%	10.65%	129.11%	43.75%	56.25%	130.78%	29.11%	60.27%	10.63%	129.74%	61.22%	21.95%	16.84%
2.1.4.5	5.25%	84.51%	10.24%	128.72%	43.52%	56.48%	130.25%	29.21%	60.57%	10.22%	129.30%	61.24%	22.02%	16.74%
2.1.4.6	5.25%	84.70%	10.05%	128.65%	43.43%	56.57%	130.04%	29.23%	60.73%	10.03%	129.17%	61.27%	22.04%	16.69%
2.1.4.7	5.18%	80.18%	14.64%	114.42%	46.77%	53.23%	115.18%	27.78%	57.58%	14.64%	114.72%	61.36%	20.68%	17.96%
2.1.4.8	5.16%	79.02%	15.81%	109.07%	47.73%	52.27%	109.46%	27.36%	56.81%	15.83%	109.23%	61.43%	20.27%	18.29%
2.1.4.9	5.16%	78.50%	16.34%	106.26%	48.17%	51.83%	106.46%	27.17%	56.46%	16.37%	106.35%	61.47%	20.08%	18.45%
2.1.4.10	5.15%	86.45%	8.40%	155.70%	41.62%	58.38%	159.76%	29.99%	61.67%	8.34%	157.14%	60.89%	22.97%	16.14%
RB 48 hr 2.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	25.91%	53.79%	20.30%	100.00%	61.50%	18.98%	19.52%
RB 24 hr 2.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	27.85%	57.81%	14.34%	93.04%	61.65%	20.40%	17.95%
2.2.1.1	1.83%	16.55%	81.62%	68.93%	91.92%	8.08%	68.08%	5.70%	11.99%	82.31%	68.75%	60.79%	3.17%	36.04%

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SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.2.1.2	2.30%	23.78%	73.92%	73.48%	88.41%	11.59%	71.22%	7.69%	17.33%	74.98%	72.86%	61.32%	4.49%	34.19%
2.2.1.3	2.59%	27.59%	69.82%	77.48%	86.01%	13.99%	74.76%	9.01%	20.11%	70.88%	76.77%	61.47%	5.40%	33.13%
2.2.1.4	2.29%	24.47%	73.25%	73.88%	88.41%	11.59%	71.21%	7.67%	17.86%	74.47%	73.09%	61.44%	4.48%	34.08%
2.2.1.5	2.27%	25.10%	72.63%	74.40%	88.43%	11.57%	71.34%	7.63%	18.37%	74.00%	73.45%	61.56%	4.45%	33.98%
2.2.1.6	2.25%	25.69%	72.06%	75.03%	88.47%	11.53%	71.57%	7.58%	18.84%	73.58%	73.90%	61.68%	4.43%	33.89%
2.2.1.7	2.07%	20.83%	77.10%	71.66%	90.15%	9.85%	69.78%	6.71%	15.16%	78.13%	71.13%	61.16%	3.83%	35.00%
2.2.1.8	1.98%	19.75%	78.27%	71.29%	90.77%	9.23%	69.55%	6.34%	14.37%	79.29%	70.78%	61.11%	3.59%	35.30%
2.2.1.9	1.93%	19.23%	78.83%	71.00%	91.07%	8.93%	69.32%	6.17%	13.99%	79.84%	70.51%	61.08%	3.48%	35.44%
2.2.1.10	2.57%	28.28%	69.15%	77.98%	86.02%	13.98%	74.81%	8.97%	20.66%	70.36%	77.08%	61.61%	5.38%	33.02%
RB 48 hr 2.2.1	1.26%	11.41%	87.33%	100.00%	94.50%	5.50%	100.00%	3.92%	8.24%	87.84%	100.00%	60.39%	2.18%	37.43%
RB 24 hr 2.2.1	1.77%	16.05%	82.18%	71.09%	92.18%	7.82%	70.30%	5.53%	11.62%	82.85%	70.92%	60.75%	3.07%	36.18%
2.2.2.1	3.49%	45.34%	51.16%	83.69%	74.30%	25.70%	82.58%	14.68%	33.18%	52.14%	83.43%	62.00%	9.80%	28.20%
2.2.2.2	4.01%	56.90%	39.08%	97.61%	66.56%	33.44%	95.19%	18.27%	41.77%	39.96%	97.00%	62.36%	12.64%	25.00%
2.2.2.3	4.19%	61.97%	33.84%	110.89%	62.72%	37.28%	108.27%	19.97%	45.46%	34.56%	110.27%	62.36%	14.10%	23.55%
2.2.2.4	4.03%	57.59%	38.37%	97.13%	66.28%	33.72%	94.40%	18.38%	42.34%	39.28%	96.40%	62.44%	12.72%	24.84%
2.2.2.5	4.03%	57.90%	38.07%	97.30%	66.24%	33.76%	94.30%	18.37%	42.61%	39.01%	96.45%	62.51%	12.71%	24.78%
2.2.2.6	4.02%	58.22%	37.76%	97.45%	66.19%	33.81%	94.17%	18.37%	42.90%	38.74%	96.49%	62.57%	12.71%	24.72%
2.2.2.7	3.77%	51.67%	44.56%	91.09%	70.23%	29.77%	89.12%	16.56%	37.91%	45.52%	90.58%	62.25%	11.28%	26.47%
2.2.2.8	3.68%	49.80%	46.52%	88.85%	71.55%	28.45%	87.03%	15.94%	36.53%	47.52%	88.36%	62.20%	10.79%	27.00%
2.2.2.9	3.63%	48.85%	47.52%	87.68%	72.21%	27.79%	85.93%	15.63%	35.83%	48.54%	87.21%	62.18%	10.54%	27.27%
2.2.2.10	4.20%	62.47%	33.33%	110.72%	62.55%	37.45%	107.77%	20.03%	45.88%	34.09%	109.97%	62.43%	14.13%	23.44%
RB 48 hr 2.2.2	2.92%	37.95%	59.13%	100.00%	78.78%	21.22%	100.00%	12.25%	27.69%	60.07%	100.00%	61.59%	8.17%	30.24%
RB 24 hr 2.2.2	3.63%	47.18%	49.18%	80.43%	73.17%	26.83%	79.10%	15.29%	34.56%	50.16%	80.11%	62.11%	10.20%	27.69%
2.2.3.1	4.38%	58.71%	36.91%	90.60%	61.12%	38.88%	90.36%	21.24%	42.00%	36.77%	90.63%	60.92%	15.26%	23.82%
2.2.3.2	4.76%	69.37%	25.87%	111.58%	53.13%	46.87%	112.45%	24.97%	49.38%	25.64%	112.15%	60.73%	18.49%	20.78%
2.2.3.3	4.85%	73.74%	21.41%	130.05%	49.58%	50.42%	132.53%	26.60%	52.27%	21.13%	131.29%	60.47%	20.03%	19.50%
2.2.3.4	4.80%	70.20%	24.99%	110.65%	52.65%	47.35%	111.30%	25.20%	50.01%	24.79%	111.14%	60.78%	18.66%	20.56%
2.2.3.5	4.81%	70.58%	24.61%	110.46%	52.48%	47.52%	110.92%	25.26%	50.31%	24.43%	110.88%	60.82%	18.71%	20.47%
2.2.3.6	4.81%	70.80%	24.39%	110.51%	52.42%	47.58%	110.78%	25.26%	50.50%	24.23%	110.85%	60.86%	18.71%	20.43%
2.2.3.7	4.59%	64.50%	30.91%	101.59%	56.84%	43.16%	101.75%	23.23%	46.04%	30.73%	101.83%	60.85%	16.97%	22.18%
2.2.3.8	4.52%	62.78%	32.70%	98.07%	58.17%	41.83%	98.00%	22.60%	44.86%	32.54%	98.20%	60.90%	16.43%	22.68%
2.2.3.9	4.49%	61.95%	33.56%	96.19%	58.82%	41.18%	96.00%	22.29%	44.29%	33.42%	96.26%	60.92%	16.16%	22.92%
2.2.3.10	4.87%	74.23%	20.90%	129.61%	49.33%	50.67%	131.86%	26.70%	52.65%	20.64%	130.75%	60.51%	20.11%	19.38%
RB 48 hr 2.2.3	3.96%	53.19%	42.85%	100.00%	64.86%	35.14%	100.00%	19.25%	38.06%	42.69%	100.00%	60.79%	13.83%	25.38%
RB 24 hr 2.2.3	4.62%	61.98%	33.40%	85.82%	58.88%	41.12%	85.46%	22.41%	44.33%	33.26%	85.87%	61.00%	16.10%	22.90%
2.2.4.1	4.59%	73.53%	21.89%	97.86%	48.64%	51.36%	97.90%	26.88%	51.69%	21.43%	97.91%	59.85%	20.72%	19.43%
2.2.4.2	4.70%	81.52%	13.78%	127.98%	42.40%	57.60%	130.95%	29.82%	56.81%	13.37%	129.17%	59.31%	23.56%	17.13%
2.2.4.3	4.66%	84.48%	10.86%	153.16%	39.91%	60.09%	159.11%	30.99%	58.54%	10.47%	155.47%	58.92%	24.82%	16.26%
2.2.4.4	4.75%	82.48%	12.77%	126.67%	41.79%	58.21%	129.56%	30.13%	57.48%	12.39%	127.84%	59.32%	23.81%	16.87%
2.2.4.5	4.77%	82.90%	12.34%	126.22%	41.54%	58.46%	129.02%	30.24%	57.78%	11.98%	127.37%	59.34%	23.89%	16.76%
2.2.4.6	4.77%	83.09%	12.13%	126.10%	41.45%	58.55%	128.81%	30.28%	57.94%	11.78%	127.21%	59.36%	23.92%	16.72%
2.2.4.7	4.67%	78.10%	17.24%	113.03%	45.08%	54.92%	114.44%	28.56%	54.65%	16.80%	113.61%	59.56%	22.32%	18.12%
2.2.4.8	4.64%	76.77%	18.58%	108.00%	46.13%	53.87%	108.90%	28.06%	53.81%	18.14%	108.39%	59.66%	21.84%	18.50%
2.2.4.9	4.64%	76.20%	19.16%	105.31%	46.61%	53.39%	105.95%	27.83%	53.45%	18.72%	105.59%	59.71%	21.62%	18.67%
2.2.4.10	4.69%	85.14%	10.17%	152.17%	39.50%	60.50%	158.03%	31.19%	59.00%	9.81%	154.45%	58.94%	24.98%	16.08%
RB 48 hr 2.2.4	4.49%	71.96%	23.56%	100.00%	49.72%	50.28%	100.00%	26.32%	50.61%	23.07%	100.00%	59.84%	20.29%	19.87%
RB 24 hr 2.2.4	4.87%	78.04%	17.09%	92.20%	45.55%	54.45%	92.34%	28.49%	54.80%	16.71%	92.36%	59.87%	21.97%	18.17%
2.3.1.1	1.57%	15.99%	82.44%	66.73%	92.47%	7.53%	65.83%	5.14%	11.60%	83.26%	66.50%	60.76%	2.96%	36.29%
2.3.1.2	2.00%	23.11%	74.89%	70.45%	89.09%	10.91%	68.17%	7.02%	16.87%	76.11%	69.78%	61.29%	4.23%	34.48%

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.3.1.3	2.25%	26.93%	70.82%	74.20%	86.80%	13.20%	71.40%	8.24%	19.68%	72.08%	73.40%	61.46%	5.10%	33.44%
2.3.1.4	1.99%	23.81%	74.20%	70.85%	89.09%	10.91%	68.18%	6.99%	17.42%	75.59%	70.01%	61.41%	4.22%	34.37%
2.3.1.5	1.97%	24.46%	73.56%	71.33%	89.11%	10.89%	68.27%	6.96%	17.94%	75.10%	70.33%	61.54%	4.20%	34.27%
2.3.1.6	1.96%	25.08%	72.96%	71.90%	89.14%	10.86%	68.47%	6.92%	18.43%	74.65%	70.74%	61.66%	4.17%	34.17%
2.3.1.7	1.79%	20.14%	78.07%	69.04%	90.77%	9.23%	67.17%	6.08%	14.68%	79.24%	68.48%	61.12%	3.59%	35.29%
2.3.1.8	1.71%	19.08%	79.21%	68.72%	91.37%	8.63%	67.00%	5.74%	13.90%	80.36%	68.20%	61.06%	3.37%	35.57%
2.3.1.9	1.67%	18.58%	79.75%	68.43%	91.65%	8.35%	66.77%	5.58%	13.53%	80.88%	67.92%	61.03%	3.26%	35.71%
2.3.1.10	2.24%	27.60%	70.17%	74.76%	86.82%	13.18%	71.53%	8.20%	20.22%	71.58%	73.77%	61.59%	5.07%	33.33%
RB 48 hr 2.3.1	1.05%	10.67%	88.28%	100.00%	95.04%	4.96%	100.00%	3.42%	7.71%	88.87%	100.00%	60.34%	1.97%	37.69%
RB 24 hr 2.3.1	1.48%	15.07%	83.44%	70.78%	92.92%	7.08%	69.99%	4.84%	10.93%	84.23%	70.58%	60.68%	2.79%	36.53%
2.3.2.1	3.04%	44.28%	52.69%	82.04%	75.66%	24.34%	80.75%	13.53%	32.54%	53.93%	81.69%	62.05%	9.27%	28.68%
2.3.2.2	3.53%	56.21%	40.26%	94.51%	67.83%	32.17%	91.65%	17.10%	41.51%	41.39%	93.68%	62.48%	12.12%	25.40%
2.3.2.3	3.70%	61.44%	34.86%	107.04%	63.97%	36.03%	103.73%	18.79%	45.37%	35.84%	106.10%	62.52%	13.57%	23.92%
2.3.2.4	3.55%	56.95%	39.50%	93.98%	67.53%	32.47%	90.80%	17.22%	42.11%	40.67%	93.03%	62.57%	12.20%	25.23%
2.3.2.5	3.55%	57.28%	39.17%	94.11%	67.48%	32.52%	90.66%	17.22%	42.41%	40.37%	93.05%	62.63%	12.20%	25.16%
2.3.2.6	3.54%	57.62%	38.84%	94.26%	67.44%	32.56%	90.54%	17.21%	42.70%	40.09%	93.09%	62.70%	12.20%	25.10%
2.3.2.7	3.28%	50.83%	45.89%	89.20%	71.68%	28.32%	86.75%	15.32%	37.51%	47.17%	88.46%	62.37%	10.70%	26.93%
2.3.2.8	3.19%	49.02%	47.79%	87.20%	72.99%	27.01%	84.87%	14.71%	36.18%	49.11%	86.48%	62.34%	10.21%	27.45%
2.3.2.9	3.15%	48.16%	48.69%	86.06%	73.61%	26.39%	83.79%	14.42%	35.54%	50.04%	85.35%	62.33%	9.98%	27.70%
2.3.2.10	3.71%	61.95%	34.34%	106.87%	63.80%	36.20%	103.23%	18.84%	45.80%	35.36%	105.80%	62.59%	13.60%	23.80%
RB 48 hr 2.3.2	2.49%	36.32%	61.19%	100.00%	80.35%	19.65%	100.00%	11.05%	26.59%	62.36%	100.00%	61.59%	7.57%	30.84%
RB 24 hr 2.3.2	3.12%	45.55%	51.33%	79.75%	74.90%	25.10%	78.30%	13.93%	33.50%	52.57%	79.36%	62.13%	9.54%	28.34%
2.3.3.1	3.83%	57.79%	38.38%	89.33%	62.66%	37.34%	88.95%	19.86%	41.63%	38.50%	89.30%	61.10%	14.58%	24.32%
2.3.3.2	4.22%	68.98%	26.80%	108.85%	54.37%	45.63%	109.19%	23.68%	49.52%	26.80%	109.19%	60.98%	17.89%	21.13%
2.3.3.3	4.31%	73.51%	22.18%	126.59%	50.73%	49.27%	128.20%	25.32%	52.59%	22.09%	127.45%	60.76%	19.43%	19.81%
2.3.3.4	4.26%	69.88%	25.86%	107.84%	53.85%	46.15%	107.96%	23.92%	50.21%	25.88%	108.10%	61.03%	18.07%	20.90%
2.3.3.5	4.27%	70.29%	25.44%	107.60%	53.66%	46.34%	107.51%	23.99%	50.54%	25.47%	107.78%	61.08%	18.13%	20.80%
2.3.3.6	4.26%	70.49%	25.24%	107.69%	53.61%	46.39%	107.41%	23.99%	50.72%	25.29%	107.79%	61.12%	18.12%	20.76%
2.3.3.7	4.04%	63.80%	32.16%	99.62%	58.26%	41.74%	99.47%	21.88%	45.90%	32.22%	99.73%	61.06%	16.33%	22.61%
2.3.3.8	3.97%	61.97%	34.06%	96.37%	59.66%	40.34%	96.05%	21.23%	44.62%	34.15%	96.39%	61.09%	15.76%	23.14%
2.3.3.9	3.95%	61.13%	34.92%	94.54%	60.31%	39.69%	94.14%	20.93%	44.04%	35.03%	94.52%	61.12%	15.50%	23.38%
2.3.3.10	4.32%	74.03%	21.65%	126.13%	50.46%	49.54%	127.51%	25.43%	53.00%	21.58%	126.90%	60.80%	19.52%	19.68%
RB 48 hr 2.3.3	3.43%	51.62%	44.95%	100.00%	66.78%	33.22%	100.00%	17.74%	37.18%	45.08%	100.00%	60.93%	13.02%	26.05%
RB 24 hr 2.3.3	4.02%	60.65%	35.33%	85.12%	60.73%	39.27%	84.59%	20.85%	43.70%	35.45%	85.08%	61.18%	15.31%	23.51%
2.3.4.1	4.06%	73.09%	22.85%	97.07%	49.93%	50.07%	97.08%	25.55%	51.87%	22.58%	97.11%	60.15%	20.05%	19.80%
2.3.4.2	4.18%	81.49%	14.32%	126.21%	43.40%	56.60%	128.81%	28.58%	57.38%	14.04%	127.25%	59.67%	22.95%	17.38%
2.3.4.3	4.16%	84.57%	11.27%	150.85%	40.82%	59.18%	156.16%	29.77%	59.23%	10.99%	152.90%	59.31%	24.21%	16.48%
2.3.4.4	4.23%	82.52%	13.25%	124.82%	42.74%	57.26%	127.33%	28.90%	58.11%	12.99%	125.84%	59.69%	23.21%	17.10%
2.3.4.5	4.25%	82.94%	12.82%	124.38%	42.49%	57.51%	126.78%	29.01%	58.42%	12.57%	125.35%	59.71%	23.30%	17.00%
2.3.4.6	4.25%	83.16%	12.58%	124.23%	42.38%	57.62%	126.53%	29.05%	58.60%	12.35%	125.16%	59.73%	23.33%	16.94%
2.3.4.7	4.14%	77.79%	18.07%	111.86%	46.27%	53.73%	113.08%	27.24%	54.98%	17.78%	112.36%	59.90%	21.66%	18.44%
2.3.4.8	4.12%	76.43%	19.45%	106.95%	47.35%	52.65%	107.71%	26.74%	54.09%	19.17%	107.28%	59.99%	21.17%	18.84%
2.3.4.9	4.11%	75.84%	20.05%	104.30%	47.84%	52.16%	104.83%	26.51%	53.71%	19.77%	104.54%	60.03%	20.95%	19.01%
2.3.4.10	4.18%	85.25%	10.56%	149.84%	40.39%	59.61%	155.04%	29.98%	59.72%	10.30%	151.86%	59.33%	24.38%	16.29%
RB 48 hr 2.3.4	3.94%	70.95%	25.11%	100.00%	51.40%	48.60%	100.00%	24.81%	50.37%	24.82%	100.00%	60.13%	19.47%	20.40%
RB 24 hr 2.3.4	4.30%	77.38%	18.32%	91.69%	46.99%	53.01%	91.69%	27.03%	54.88%	18.09%	91.78%	60.19%	21.21%	18.60%
2.4.1.1	1.48%	14.75%	83.77%	68.36%	92.48%	7.52%	67.70%	5.01%	10.66%	84.33%	68.22%	60.51%	2.97%	36.51%
2.4.1.2	1.88%	21.37%	76.75%	72.03%	89.13%	10.87%	70.26%	6.86%	15.52%	77.62%	71.55%	60.94%	4.25%	34.81%
2.4.1.3	2.13%	25.02%	72.86%	75.58%	86.82%	13.18%	73.45%	8.09%	18.18%	73.73%	75.02%	61.07%	5.14%	33.79%

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SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.4.1.4	1.87%	22.06%	76.07%	72.40%	89.13%	10.87%	70.25%	6.84%	16.06%	77.11%	71.75%	61.06%	4.24%	34.70%
2.4.1.5	1.86%	22.70%	75.44%	72.90%	89.15%	10.85%	70.36%	6.80%	16.56%	76.64%	72.09%	61.18%	4.22%	34.60%
2.4.1.6	1.84%	23.30%	74.86%	73.51%	89.18%	10.82%	70.59%	6.76%	17.03%	76.21%	72.54%	61.30%	4.19%	34.51%
2.4.1.7	1.68%	18.63%	79.69%	70.57%	90.79%	9.21%	69.08%	5.94%	13.52%	80.54%	70.14%	60.82%	3.61%	35.57%
2.4.1.8	1.60%	17.62%	80.77%	70.32%	91.38%	8.62%	68.93%	5.61%	12.79%	81.61%	69.91%	60.77%	3.38%	35.84%
2.4.1.9	1.57%	17.15%	81.28%	70.08%	91.67%	8.33%	68.74%	5.45%	12.44%	82.11%	69.69%	60.75%	3.27%	35.97%
2.4.1.10	2.11%	25.71%	72.18%	76.04%	86.83%	13.17%	73.49%	8.06%	18.73%	73.21%	75.31%	61.20%	5.12%	33.68%
RB 48 hr 2.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	3.42%	7.28%	89.31%	100.00%	60.20%	2.03%	37.78%
RB 24 hr 2.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	4.85%	10.33%	84.82%	70.44%	60.48%	2.88%	36.64%
2.4.2.1	2.93%	42.23%	54.84%	82.72%	75.35%	24.65%	81.83%	13.61%	30.76%	55.63%	82.51%	61.47%	9.53%	29.01%
2.4.2.2	3.43%	53.91%	42.65%	94.75%	67.45%	32.55%	92.97%	17.29%	39.36%	43.35%	94.32%	61.74%	12.50%	25.76%
2.4.2.3	3.61%	59.19%	37.19%	106.87%	63.49%	36.51%	105.07%	19.07%	43.16%	37.77%	106.50%	61.71%	14.04%	24.25%
2.4.2.4	3.45%	54.64%	41.90%	94.21%	67.15%	32.85%	92.12%	17.41%	39.94%	42.65%	93.66%	61.82%	12.59%	25.59%
2.4.2.5	3.45%	54.97%	41.58%	94.37%	67.11%	32.89%	92.02%	17.40%	40.23%	42.37%	93.71%	61.89%	12.58%	25.53%
2.4.2.6	3.44%	55.32%	41.24%	94.50%	67.06%	32.94%	91.87%	17.40%	40.53%	42.07%	93.73%	61.95%	12.58%	25.47%
2.4.2.7	3.20%	48.57%	48.23%	89.13%	71.22%	28.78%	87.62%	15.53%	35.45%	49.02%	88.74%	61.66%	11.07%	27.27%
2.4.2.8	3.11%	46.67%	50.22%	87.18%	72.56%	27.44%	85.76%	14.90%	34.06%	51.04%	86.81%	61.63%	10.57%	27.81%
2.4.2.9	3.07%	45.74%	51.19%	86.11%	73.21%	26.79%	84.73%	14.59%	33.38%	52.02%	85.74%	61.61%	10.32%	28.07%
2.4.2.10	3.62%	59.73%	36.65%	106.65%	63.30%	36.70%	104.53%	19.13%	43.61%	37.26%	106.15%	61.79%	14.08%	24.13%
RB 48 hr 2.4.2	2.43%	34.93%	62.64%	100.00%	79.83%	20.17%	100.00%	11.23%	25.38%	63.39%	100.00%	61.12%	7.86%	31.01%
RB 24 hr 2.4.2	3.06%	44.07%	52.87%	79.26%	74.20%	25.80%	78.20%	14.21%	32.12%	53.66%	79.02%	61.55%	9.95%	28.50%
2.4.3.1	3.72%	55.65%	40.63%	90.17%	62.30%	37.70%	90.08%	20.06%	39.64%	40.30%	90.24%	60.37%	15.00%	24.63%
2.4.3.2	4.14%	67.09%	28.77%	108.78%	53.74%	46.26%	110.14%	24.13%	47.50%	28.37%	109.52%	60.11%	18.54%	21.36%
2.4.3.3	4.24%	71.80%	23.97%	126.00%	49.98%	50.02%	129.12%	25.89%	50.59%	23.51%	127.47%	59.83%	20.19%	19.98%
2.4.3.4	4.18%	67.99%	27.83%	107.75%	53.22%	46.78%	108.91%	24.38%	48.17%	27.45%	108.42%	60.15%	18.73%	21.12%
2.4.3.5	4.18%	68.40%	27.42%	107.52%	53.04%	46.96%	108.49%	24.44%	48.49%	27.06%	108.12%	60.20%	18.78%	21.03%
2.4.3.6	4.18%	68.64%	27.18%	107.56%	52.97%	47.03%	108.34%	24.45%	48.70%	26.85%	108.07%	60.24%	18.79%	20.98%
2.4.3.7	3.95%	61.92%	34.13%	99.77%	57.66%	42.34%	100.27%	22.26%	43.98%	33.76%	100.13%	60.26%	16.90%	22.84%
2.4.3.8	3.88%	60.10%	36.01%	96.58%	59.06%	40.94%	96.79%	21.59%	42.75%	35.66%	96.80%	60.32%	16.31%	23.37%
2.4.3.9	3.85%	59.23%	36.91%	94.84%	59.74%	40.26%	94.91%	21.26%	42.15%	36.58%	95.00%	60.35%	16.03%	23.63%
2.4.3.10	4.26%	72.34%	23.40%	125.49%	49.69%	50.31%	128.39%	26.02%	51.01%	22.98%	126.88%	59.87%	20.29%	19.85%
RB 48 hr 2.4.3	3.36%	50.18%	46.47%	100.00%	66.03%	33.97%	100.00%	18.10%	35.77%	46.13%	100.00%	60.28%	13.54%	26.18%
RB 24 hr 2.4.3	3.97%	59.30%	36.74%	84.62%	59.80%	40.20%	84.49%	21.37%	42.22%	36.42%	84.73%	60.42%	15.97%	23.60%
2.4.4.1	3.99%	71.54%	24.47%	97.61%	49.14%	50.86%	97.70%	26.15%	50.03%	23.82%	97.68%	59.25%	20.82%	19.93%
2.4.4.2	4.14%	80.27%	15.59%	126.12%	42.42%	57.58%	129.44%	29.41%	55.56%	15.03%	127.48%	58.65%	23.93%	17.42%
2.4.4.3	4.13%	83.54%	12.33%	150.32%	39.73%	60.27%	156.77%	30.72%	57.47%	11.81%	152.88%	58.25%	25.29%	16.46%
2.4.4.4	4.19%	81.34%	14.47%	124.65%	41.73%	58.27%	127.92%	29.75%	56.30%	13.94%	126.00%	58.66%	24.21%	17.13%
2.4.4.5	4.21%	81.80%	13.99%	124.14%	41.46%	58.54%	127.32%	29.88%	56.63%	13.48%	125.46%	58.68%	24.31%	17.01%
2.4.4.6	4.21%	82.03%	13.76%	123.99%	41.35%	58.65%	127.08%	29.93%	56.81%	13.27%	125.27%	58.70%	24.35%	16.95%
2.4.4.7	4.09%	76.51%	19.40%	111.95%	45.31%	54.69%	113.57%	28.00%	53.21%	18.79%	112.63%	58.93%	22.57%	18.50%
2.4.4.8	4.07%	75.06%	20.88%	107.19%	46.45%	53.55%	108.25%	27.45%	52.29%	20.26%	107.64%	59.04%	22.04%	18.92%
2.4.4.9	4.06%	74.43%	21.51%	104.60%	46.96%	53.04%	105.38%	27.20%	51.91%	20.89%	104.94%	59.10%	21.80%	19.10%
2.4.4.10	4.16%	84.28%	11.56%	149.20%	39.27%	60.73%	155.58%	30.95%	57.98%	11.07%	151.75%	58.26%	25.48%	16.26%
RB 48 hr 2.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	25.54%	48.86%	25.59%	100.00%	59.26%	20.34%	20.41%
RB 24 hr 2.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	27.91%	53.39%	18.71%	91.53%	59.23%	22.22%	18.55%
1.2.1.1	1.97%	17.79%	80.24%	64.11%	91.29%	8.71%	63.14%	6.14%	12.90%	80.97%	63.91%	60.88%	3.41%	35.70%
1.2.1.2	2.49%	25.75%	71.75%	67.86%	87.39%	12.61%	65.43%	8.34%	18.78%	72.88%	67.20%	61.47%	4.87%	33.66%
1.2.1.3	2.79%	29.75%	67.45%	71.85%	84.83%	15.17%	68.97%	9.73%	21.72%	68.55%	71.10%	61.63%	5.83%	32.54%
1.2.1.4	2.48%	26.52%	71.00%	68.16%	87.37%	12.63%	65.34%	8.32%	19.39%	72.29%	67.34%	61.61%	4.86%	33.53%

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.2.1.5	2.46%	27.21%	70.33%	68.65%	87.39%	12.61%	65.42%	8.28%	19.94%	71.78%	67.65%	61.74%	4.84%	33.43%
1.2.1.6	2.44%	27.80%	69.76%	69.33%	87.44%	12.56%	65.71%	8.22%	20.42%	71.35%	68.17%	61.86%	4.80%	33.34%
1.2.1.7	2.23%	22.43%	75.34%	66.55%	89.34%	10.66%	64.53%	7.23%	16.34%	76.43%	65.98%	61.29%	4.13%	34.58%
1.2.1.8	2.13%	21.25%	76.62%	66.25%	90.03%	9.97%	64.37%	6.83%	15.48%	77.69%	65.71%	61.23%	3.87%	34.90%
1.2.1.9	2.08%	20.70%	77.22%	65.98%	90.36%	9.64%	64.17%	6.64%	15.07%	78.29%	65.46%	61.20%	3.75%	35.05%
1.2.1.10	2.78%	30.51%	66.71%	72.27%	84.83%	15.17%	68.94%	9.70%	22.33%	67.97%	71.33%	61.77%	5.81%	32.41%
RB 48 hr 1.2.1	1.26%	11.41%	87.33%	100.00%	94.50%	5.50%	100.00%	3.92%	8.24%	87.84%	100.00%	60.39%	2.18%	37.43%
RB 24 hr 1.2.1	1.77%	16.05%	82.18%	71.09%	92.18%	7.82%	70.30%	5.53%	11.62%	82.85%	70.92%	60.75%	3.07%	36.18%
1.2.2.1	3.60%	46.74%	49.66%	81.19%	73.44%	26.56%	79.91%	15.14%	34.23%	50.63%	80.89%	62.08%	10.11%	27.81%
1.2.2.2	4.16%	58.97%	36.87%	94.18%	65.22%	34.78%	91.54%	18.95%	43.33%	37.72%	93.52%	62.46%	13.11%	24.42%
1.2.2.3	4.34%	64.07%	31.59%	107.25%	61.34%	38.66%	104.38%	20.67%	47.04%	32.29%	106.58%	62.46%	14.58%	22.96%
1.2.2.4	4.19%	59.87%	35.93%	93.43%	64.80%	35.20%	90.45%	19.13%	44.05%	36.82%	92.64%	62.56%	13.24%	24.20%
1.2.2.5	4.19%	60.27%	35.54%	93.48%	64.71%	35.29%	90.22%	19.14%	44.40%	36.46%	92.58%	62.63%	13.24%	24.12%
1.2.2.6	4.18%	60.59%	35.23%	93.65%	64.67%	35.33%	90.11%	19.13%	44.69%	36.18%	92.63%	62.70%	13.24%	24.06%
1.2.2.7	3.88%	53.24%	42.87%	88.40%	69.24%	30.76%	86.25%	17.08%	39.09%	43.83%	87.84%	62.33%	11.63%	26.04%
1.2.2.8	3.79%	51.33%	44.87%	86.19%	70.59%	29.41%	84.19%	16.45%	37.68%	45.87%	85.66%	62.29%	11.13%	26.58%
1.2.2.9	3.74%	50.40%	45.86%	84.99%	71.25%	28.75%	83.06%	16.14%	36.99%	46.87%	84.48%	62.27%	10.89%	26.84%
1.2.2.10	4.35%	64.71%	30.94%	106.88%	61.07%	38.93%	103.67%	20.76%	47.57%	31.67%	106.08%	62.54%	14.65%	22.81%
RB 48 hr 1.2.2	2.92%	37.95%	59.13%	100.00%	78.78%	21.22%	100.00%	12.25%	27.69%	60.07%	100.00%	61.59%	8.17%	30.24%
RB 24 hr 1.2.2	3.63%	47.18%	49.18%	80.43%	73.17%	26.83%	79.10%	15.29%	34.56%	50.16%	80.11%	62.11%	10.20%	27.69%
1.2.3.1	4.45%	59.71%	35.84%	89.08%	60.44%	39.56%	88.81%	21.59%	42.71%	35.70%	89.12%	60.95%	15.51%	23.54%
1.2.3.2	4.86%	70.84%	24.29%	109.25%	52.12%	47.88%	110.07%	25.50%	50.42%	24.08%	109.84%	60.75%	18.88%	20.36%
1.2.3.3	4.95%	75.18%	19.87%	127.56%	48.59%	51.41%	129.97%	27.11%	53.28%	19.61%	128.80%	60.49%	20.41%	19.10%
1.2.3.4	4.92%	71.89%	23.20%	108.06%	51.49%	48.51%	108.65%	25.80%	51.20%	23.00%	108.56%	60.81%	19.11%	20.09%
1.2.3.5	4.93%	72.31%	22.77%	107.82%	51.29%	48.71%	108.21%	25.87%	51.53%	22.59%	108.25%	60.85%	19.16%	19.99%
1.2.3.6	4.93%	72.55%	22.52%	107.83%	51.21%	48.79%	108.04%	25.89%	51.75%	22.36%	108.18%	60.89%	19.17%	19.93%
1.2.3.7	4.67%	65.62%	29.71%	99.85%	56.07%	43.93%	99.97%	23.63%	46.84%	29.53%	100.10%	60.87%	17.27%	21.86%
1.2.3.8	4.60%	63.86%	31.54%	96.41%	57.43%	42.57%	96.30%	22.98%	45.63%	31.39%	96.55%	60.92%	16.71%	22.37%
1.2.3.9	4.57%	63.08%	32.36%	94.47%	58.05%	41.95%	94.24%	22.69%	45.10%	32.21%	94.55%	60.95%	16.45%	22.60%
1.2.3.10	4.97%	75.82%	19.21%	126.90%	48.24%	51.76%	129.09%	27.27%	53.76%	18.97%	128.06%	60.53%	20.53%	18.93%
RB 48 hr 1.2.3	3.96%	53.19%	42.85%	100.00%	64.86%	35.14%	100.00%	19.25%	38.06%	42.69%	100.00%	60.79%	13.83%	25.38%
RB 24 hr 1.2.3	4.62%	61.98%	33.40%	85.82%	58.88%	41.12%	85.46%	22.41%	44.33%	33.26%	85.87%	61.00%	16.10%	22.90%
1.2.4.1	4.62%	74.05%	21.33%	97.17%	48.28%	51.72%	97.22%	27.07%	52.06%	20.88%	97.23%	59.85%	20.87%	19.28%
1.2.4.2	4.74%	82.18%	13.08%	126.95%	41.96%	58.04%	129.94%	30.05%	57.26%	12.69%	128.16%	59.31%	23.75%	16.95%
1.2.4.3	4.70%	85.14%	10.16%	151.98%	39.47%	60.53%	157.95%	31.22%	58.98%	9.80%	154.31%	58.92%	25.00%	16.08%
1.2.4.4	4.80%	83.32%	11.89%	125.40%	41.22%	58.78%	128.32%	30.42%	58.05%	11.53%	126.60%	59.32%	24.04%	16.64%
1.2.4.5	4.82%	83.79%	11.39%	124.88%	40.94%	59.06%	127.70%	30.56%	58.39%	11.06%	126.05%	59.34%	24.14%	16.52%
1.2.4.6	4.82%	84.03%	11.15%	124.70%	40.81%	59.19%	127.43%	30.61%	58.57%	10.82%	125.83%	59.36%	24.19%	16.46%
1.2.4.7	4.70%	78.65%	16.65%	112.23%	44.70%	55.30%	113.66%	28.75%	55.02%	16.22%	112.84%	59.56%	22.48%	17.96%
1.2.4.8	4.68%	77.34%	17.98%	107.21%	45.75%	54.25%	108.12%	28.26%	54.20%	17.55%	107.61%	59.66%	22.00%	18.34%
1.2.4.9	4.68%	76.77%	18.55%	104.51%	46.22%	53.78%	105.17%	28.04%	53.84%	18.12%	104.82%	59.72%	21.78%	18.51%
1.2.4.10	4.74%	85.91%	9.35%	150.81%	38.98%	61.02%	156.69%	31.46%	59.51%	9.02%	153.12%	58.93%	25.20%	15.87%
RB 48 hr 1.2.4	4.49%	71.96%	23.56%	100.00%	49.72%	50.28%	100.00%	26.32%	50.61%	23.07%	100.00%	59.84%	20.29%	19.87%
RB 24 hr 1.2.4	4.87%	78.04%	17.09%	92.20%	45.55%	54.45%	92.34%	28.49%	54.80%	16.71%	92.36%	59.87%	21.97%	18.17%
1.4.1.1	1.59%	15.89%	82.52%	63.46%	91.88%	8.12%	62.69%	5.40%	11.49%	83.11%	63.30%	60.59%	3.20%	36.21%
1.4.1.2	2.04%	23.22%	74.74%	66.30%	88.15%	11.85%	64.41%	7.46%	16.88%	75.66%	65.79%	61.07%	4.62%	34.31%
1.4.1.3	2.30%	27.07%	70.63%	69.85%	85.68%	14.32%	67.61%	8.76%	19.69%	71.55%	69.27%	61.20%	5.57%	33.24%
1.4.1.4	2.03%	23.99%	73.98%	66.58%	88.13%	11.87%	64.31%	7.44%	17.48%	75.08%	65.91%	61.20%	4.61%	34.18%
1.4.1.5	2.02%	24.68%	73.30%	67.05%	88.14%	11.86%	64.39%	7.41%	18.03%	74.56%	66.21%	61.33%	4.59%	34.07%

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SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.4.1.6	2.00%	25.29%	72.71%	67.72%	88.19%	11.81%	64.68%	7.35%	18.51%	74.13%	66.72%	61.46%	4.56%	33.99%
1.4.1.7	1.81%	20.11%	78.08%	65.36%	90.02%	9.98%	63.76%	6.42%	14.61%	78.97%	64.91%	60.93%	3.90%	35.17%
1.4.1.8	1.73%	19.01%	79.26%	65.19%	90.68%	9.32%	63.70%	6.05%	13.80%	80.14%	64.76%	60.88%	3.65%	35.47%
1.4.1.9	1.69%	18.49%	79.81%	64.98%	90.99%	9.01%	63.53%	5.88%	13.43%	80.69%	64.56%	60.85%	3.53%	35.61%
1.4.1.10	2.29%	27.84%	69.87%	70.22%	85.67%	14.33%	67.55%	8.74%	20.31%	70.96%	69.46%	61.34%	5.55%	33.11%
RB 48 hr 1.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	3.42%	7.28%	89.31%	100.00%	60.20%	2.03%	37.78%
RB 24 hr 1.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	4.85%	10.33%	84.82%	70.44%	60.48%	2.88%	36.64%
1.4.2.1	3.03%	43.63%	53.34%	80.07%	74.48%	25.52%	79.05%	14.07%	31.80%	54.14%	79.83%	61.53%	9.85%	28.62%
1.4.2.2	3.57%	56.06%	40.37%	91.12%	66.06%	33.94%	89.15%	17.99%	40.95%	41.06%	90.65%	61.83%	13.01%	25.17%
1.4.2.3	3.75%	61.41%	34.84%	103.00%	62.02%	37.98%	101.01%	19.80%	44.81%	35.39%	102.59%	61.80%	14.57%	23.63%
1.4.2.4	3.60%	57.01%	39.38%	90.30%	65.62%	34.38%	88.01%	18.18%	41.70%	40.11%	89.70%	61.92%	13.15%	24.93%
1.4.2.5	3.60%	57.43%	38.96%	90.33%	65.52%	34.48%	87.76%	18.20%	42.06%	39.74%	89.62%	61.99%	13.16%	24.85%
1.4.2.6	3.60%	57.78%	38.62%	90.47%	65.47%	34.53%	87.64%	18.19%	42.37%	39.44%	89.65%	62.06%	13.15%	24.78%
1.4.2.7	3.31%	50.16%	46.53%	86.29%	70.20%	29.80%	84.63%	16.05%	36.63%	47.31%	85.87%	61.73%	11.44%	26.83%
1.4.2.8	3.22%	48.23%	48.56%	84.36%	71.57%	28.43%	82.79%	15.41%	35.22%	49.37%	83.95%	61.70%	10.93%	27.38%
1.4.2.9	3.17%	47.28%	49.55%	83.31%	72.25%	27.75%	81.78%	15.09%	34.52%	50.39%	82.91%	61.69%	10.67%	27.65%
1.4.2.10	3.77%	62.10%	34.14%	102.58%	61.74%	38.26%	100.25%	19.91%	45.37%	34.73%	102.03%	61.88%	14.65%	23.47%
RB 48 hr 1.4.2	2.43%	34.93%	62.64%	100.00%	79.83%	20.17%	100.00%	11.23%	25.38%	63.39%	100.00%	61.12%	7.86%	31.01%
RB 24 hr 1.4.2	3.06%	44.07%	52.87%	79.26%	74.20%	25.80%	78.20%	14.21%	32.12%	53.66%	79.02%	61.55%	9.95%	28.50%
1.4.3.1	3.79%	56.71%	39.50%	88.49%	61.57%	38.43%	88.39%	20.44%	40.39%	39.18%	88.57%	60.38%	15.28%	24.33%
1.4.3.2	4.23%	68.68%	27.09%	106.26%	52.65%	47.35%	107.60%	24.69%	48.61%	26.70%	107.02%	60.12%	18.97%	20.91%
1.4.3.3	4.33%	73.37%	22.30%	123.29%	48.90%	51.10%	126.39%	26.45%	51.68%	21.87%	124.79%	59.83%	20.63%	19.54%
1.4.3.4	4.29%	69.81%	25.90%	104.94%	51.97%	48.03%	106.07%	25.02%	49.44%	25.54%	105.63%	60.17%	19.22%	20.61%
1.4.3.5	4.30%	70.27%	25.43%	104.66%	51.75%	48.25%	105.60%	25.10%	49.80%	25.09%	105.27%	60.21%	19.29%	20.50%
1.4.3.6	4.30%	70.55%	25.15%	104.65%	51.66%	48.34%	105.40%	25.12%	50.03%	24.84%	105.19%	60.26%	19.30%	20.44%
1.4.3.7	4.03%	63.11%	32.86%	97.89%	56.84%	43.16%	98.37%	22.68%	44.82%	32.49%	98.26%	60.27%	17.22%	22.51%
1.4.3.8	3.96%	61.25%	34.80%	94.77%	58.28%	41.72%	94.97%	22.00%	43.55%	34.45%	95.01%	60.33%	16.62%	23.05%
1.4.3.9	3.93%	60.42%	35.65%	92.98%	58.93%	41.07%	93.03%	21.69%	42.99%	35.32%	93.15%	60.36%	16.35%	23.29%
1.4.3.10	4.36%	74.07%	21.57%	122.56%	48.51%	51.49%	125.43%	26.63%	52.20%	21.17%	123.97%	59.88%	20.76%	19.36%
RB 48 hr 1.4.3	3.36%	50.18%	46.47%	100.00%	66.03%	33.97%	100.00%	18.10%	35.77%	46.13%	100.00%	60.28%	13.54%	26.18%
RB 24 hr 1.4.3	3.97%	59.30%	36.74%	84.62%	59.80%	40.20%	84.49%	21.37%	42.22%	36.42%	84.73%	60.42%	15.97%	23.60%
1.4.4.1	4.02%	72.11%	23.86%	96.84%	48.75%	51.25%	96.95%	26.36%	50.41%	23.23%	96.92%	59.25%	20.98%	19.77%
1.4.4.2	4.18%	81.00%	14.81%	124.97%	41.92%	58.08%	128.33%	29.67%	56.06%	14.28%	126.36%	58.65%	24.14%	17.21%
1.4.4.3	4.16%	84.28%	11.56%	149.00%	39.24%	60.76%	155.50%	30.98%	57.96%	11.07%	151.60%	58.24%	25.51%	16.25%
1.4.4.4	4.24%	82.28%	13.48%	123.23%	41.10%	58.90%	126.55%	30.08%	56.93%	12.99%	124.62%	58.65%	24.48%	16.87%
1.4.4.5	4.26%	82.80%	12.93%	122.63%	40.79%	59.21%	125.88%	30.23%	57.30%	12.46%	123.99%	58.67%	24.60%	16.73%
1.4.4.6	4.27%	83.07%	12.66%	122.43%	40.64%	59.36%	125.57%	30.29%	57.51%	12.20%	123.75%	58.69%	24.65%	16.66%
1.4.4.7	4.12%	77.12%	18.76%	111.06%	44.89%	55.11%	112.71%	28.22%	53.62%	18.16%	111.76%	58.93%	22.74%	18.33%
1.4.4.8	4.10%	75.68%	20.22%	106.30%	46.02%	53.98%	107.39%	27.67%	52.72%	19.61%	106.78%	59.04%	22.22%	18.74%
1.4.4.9	4.09%	75.06%	20.85%	103.72%	46.53%	53.47%	104.53%	27.43%	52.33%	20.24%	104.09%	59.09%	21.98%	18.93%
1.4.4.10	4.20%	85.15%	10.65%	147.68%	38.69%	61.31%	154.11%	31.25%	58.55%	10.20%	150.27%	58.25%	25.73%	16.02%
RB 48 hr 1.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	25.54%	48.86%	25.59%	100.00%	59.26%	20.34%	20.41%
RB 24 hr 1.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	27.91%	53.39%	18.71%	91.53%	59.23%	22.22%	18.55%
3.1.1.1	2.28%	19.54%	78.18%	68.96%	91.69%	8.31%	67.64%	6.39%	14.24%	79.37%	68.64%	61.39%	3.21%	35.40%
3.1.1.2	2.82%	28.14%	69.04%	74.78%	88.14%	11.86%	71.07%	8.46%	20.73%	70.82%	73.67%	62.22%	4.49%	33.29%
3.1.1.3	3.15%	32.10%	64.75%	79.36%	85.73%	14.27%	74.90%	9.81%	23.68%	66.51%	78.06%	62.45%	5.37%	32.18%
3.1.1.4	2.80%	29.04%	68.16%	75.19%	88.12%	11.88%	70.95%	8.43%	21.45%	70.11%	73.85%	62.39%	4.48%	33.13%
3.1.1.5	2.77%	29.78%	67.44%	75.96%	88.16%	11.84%	71.21%	8.37%	22.06%	69.57%	74.41%	62.54%	4.45%	33.02%
3.1.1.6	2.75%	30.58%	66.67%	76.58%	88.17%	11.83%	71.30%	8.33%	22.71%	68.96%	74.81%	62.69%	4.42%	32.89%

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
3.1.1.7	2.54%	24.81%	72.65%	72.70%	89.92%	10.08%	69.67%	7.41%	18.23%	74.36%	71.77%	61.98%	3.84%	34.18%
3.1.1.8	2.44%	23.64%	73.92%	72.06%	90.53%	9.47%	69.26%	7.04%	17.36%	75.60%	71.19%	61.89%	3.61%	34.49%
3.1.1.9	2.40%	23.14%	74.46%	71.44%	90.80%	9.20%	68.75%	6.88%	16.99%	76.13%	70.60%	61.86%	3.51%	34.63%
3.1.1.10	3.13%	32.96%	63.91%	79.97%	85.73%	14.27%	74.91%	9.77%	24.39%	65.85%	78.43%	62.61%	5.35%	32.04%
RB 48 hr 3.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	4.38%	9.78%	85.84%	100.00%	60.80%	2.21%	36.99%
RB 24 hr 3.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	6.21%	13.85%	79.93%	70.56%	61.34%	3.13%	35.53%
3.1.4.1	5.13%	76.04%	18.83%	98.25%	50.04%	49.96%	98.16%	26.37%	54.75%	18.88%	98.25%	61.54%	19.32%	19.14%
3.1.4.2	5.19%	83.22%	11.59%	130.28%	44.32%	55.68%	132.13%	28.83%	59.61%	11.56%	130.96%	61.18%	21.74%	17.08%
3.1.4.3	5.12%	85.80%	9.08%	156.64%	42.03%	57.97%	160.89%	29.80%	61.19%	9.02%	158.14%	60.86%	22.82%	16.32%
3.1.4.4	5.23%	84.09%	10.68%	129.15%	43.76%	56.24%	130.82%	29.10%	60.25%	10.65%	129.77%	61.22%	21.94%	16.85%
3.1.4.5	5.25%	84.51%	10.25%	128.73%	43.52%	56.48%	130.25%	29.20%	60.57%	10.23%	129.30%	61.24%	22.02%	16.74%
3.1.4.6	5.25%	84.68%	10.07%	128.68%	43.44%	56.56%	130.07%	29.23%	60.72%	10.05%	129.20%	61.27%	22.04%	16.70%
3.1.4.7	5.17%	80.12%	14.71%	114.51%	46.81%	53.19%	115.27%	27.76%	57.54%	14.70%	114.80%	61.36%	20.67%	17.97%
3.1.4.8	5.17%	79.05%	15.79%	109.03%	47.71%	52.29%	109.42%	27.37%	56.83%	15.80%	109.20%	61.43%	20.28%	18.29%
3.1.4.9	5.16%	78.50%	16.34%	106.26%	48.17%	51.83%	106.46%	27.17%	56.46%	16.37%	106.35%	61.47%	20.08%	18.45%
3.1.4.10	5.15%	86.44%	8.41%	155.71%	41.63%	58.37%	159.77%	29.98%	61.66%	8.35%	157.15%	60.89%	22.97%	16.15%
RB 48 hr 3.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	25.91%	53.79%	20.30%	100.00%	61.50%	18.98%	19.52%
RB 24 hr 3.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	27.85%	57.81%	14.34%	93.04%	61.65%	20.40%	17.95%
3.4.1.1	1.47%	14.74%	83.79%	68.43%	92.49%	7.51%	67.77%	5.01%	10.65%	84.34%	68.29%	60.51%	2.97%	36.52%
3.4.1.2	1.88%	21.35%	76.78%	72.12%	89.15%	10.85%	70.35%	6.85%	15.50%	77.65%	71.63%	60.94%	4.25%	34.82%
3.4.1.3	2.12%	24.99%	72.89%	75.67%	86.84%	13.16%	73.54%	8.08%	18.16%	73.76%	75.11%	61.07%	5.13%	33.80%
3.4.1.4	1.87%	22.07%	76.06%	72.38%	89.13%	10.87%	70.22%	6.84%	16.06%	77.10%	71.73%	61.06%	4.24%	34.70%
3.4.1.5	1.86%	22.69%	75.46%	72.93%	89.15%	10.85%	70.40%	6.80%	16.55%	76.65%	72.12%	61.18%	4.22%	34.60%
3.4.1.6	1.84%	23.35%	74.81%	73.34%	89.16%	10.84%	70.42%	6.78%	17.07%	76.15%	72.37%	61.30%	4.20%	34.49%
3.4.1.7	1.68%	18.59%	79.74%	70.72%	90.81%	9.19%	69.23%	5.93%	13.49%	80.58%	70.29%	60.82%	3.61%	35.58%
3.4.1.8	1.61%	17.63%	80.76%	70.29%	91.38%	8.62%	68.90%	5.61%	12.79%	81.60%	69.89%	60.78%	3.38%	35.84%
3.4.1.9	1.57%	17.22%	81.21%	69.81%	91.64%	8.36%	68.46%	5.47%	12.49%	82.04%	69.41%	60.76%	3.29%	35.96%
3.4.1.10	2.11%	25.72%	72.17%	76.02%	86.82%	13.18%	73.47%	8.06%	18.73%	73.21%	75.28%	61.20%	5.12%	33.68%
RB 48 hr 3.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	3.42%	7.28%	89.31%	100.00%	60.20%	2.03%	37.78%
RB 24 hr 3.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	4.85%	10.33%	84.82%	70.44%	60.48%	2.88%	36.64%
3.4.4.1	3.99%	71.50%	24.51%	97.67%	49.17%	50.83%	97.76%	26.14%	50.00%	23.87%	97.73%	59.25%	20.81%	19.94%
3.4.4.2	4.14%	80.30%	15.56%	126.08%	42.40%	57.60%	129.39%	29.42%	55.58%	15.00%	127.43%	58.65%	23.94%	17.41%
3.4.4.3	4.13%	83.54%	12.34%	150.32%	39.73%	60.27%	156.77%	30.71%	57.47%	11.82%	152.89%	58.25%	25.29%	16.46%
3.4.4.4	4.19%	81.33%	14.48%	124.67%	41.74%	58.26%	127.93%	29.75%	56.30%	13.96%	126.02%	58.66%	24.21%	17.13%
3.4.4.5	4.21%	81.82%	13.97%	124.11%	41.45%	58.55%	127.30%	29.89%	56.65%	13.47%	125.43%	58.68%	24.32%	17.00%
3.4.4.6	4.21%	82.03%	13.76%	123.98%	41.35%	58.65%	127.08%	29.93%	56.81%	13.27%	125.27%	58.70%	24.35%	16.95%
3.4.4.7	4.09%	76.45%	19.46%	112.03%	45.35%	54.65%	113.65%	27.98%	53.17%	18.85%	112.71%	58.93%	22.55%	18.51%
3.4.4.8	4.07%	75.11%	20.82%	107.11%	46.41%	53.59%	108.17%	27.47%	52.33%	20.20%	107.57%	59.04%	22.06%	18.90%
3.4.4.9	4.06%	74.42%	21.52%	104.61%	46.96%	53.04%	105.39%	27.20%	51.90%	20.90%	104.96%	59.10%	21.80%	19.10%
3.4.4.10	4.16%	84.29%	11.55%	149.18%	39.26%	60.74%	155.56%	30.95%	57.99%	11.06%	151.73%	58.26%	25.49%	16.26%
RB 48 hr 3.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	25.54%	48.86%	25.59%	100.00%	59.26%	20.34%	20.41%
RB 24 hr 3.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	27.91%	53.39%	18.71%	91.53%	59.23%	22.22%	18.55%
4.1.1.1	2.21%	18.94%	78.85%	71.15%	91.96%	8.04%	69.92%	6.19%	13.80%	80.01%	70.85%	61.33%	3.11%	35.55%
4.1.1.2	2.81%	28.04%	69.15%	75.04%	88.18%	11.82%	71.35%	8.43%	20.65%	70.92%	73.93%	62.21%	4.47%	33.31%
4.1.1.3	3.15%	32.10%	64.75%	79.35%	85.73%	14.27%	74.89%	9.82%	23.68%	66.51%	78.06%	62.45%	5.37%	32.18%
4.1.1.4	2.80%	28.96%	68.24%	75.38%	88.15%	11.85%	71.15%	8.41%	21.40%	70.19%	74.04%	62.38%	4.47%	33.15%
4.1.1.5	2.78%	29.85%	67.37%	75.79%	88.13%	11.87%	71.03%	8.39%	22.11%	69.50%	74.24%	62.54%	4.46%	33.00%
4.1.1.6	2.75%	30.52%	66.73%	76.73%	88.20%	11.80%	71.45%	8.31%	22.67%	69.02%	74.96%	62.68%	4.41%	32.90%
4.1.1.7	2.49%	24.32%	73.19%	74.14%	90.13%	9.87%	71.18%	7.26%	17.87%	74.87%	73.23%	61.93%	3.76%	34.31%

Intellectual Property

SUMMARY OF FINANCIAL ANALYSIS: LOWER INTEREST RATE (2.0 %)

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
4.1.1.8	2.39%	23.11%	74.50%	73.69%	90.76%	9.24%	70.97%	6.88%	16.97%	76.16%	72.84%	61.84%	3.53%	34.63%
4.1.1.9	2.33%	22.53%	75.14%	73.37%	91.06%	8.94%	70.76%	6.69%	16.53%	76.78%	72.55%	61.79%	3.42%	34.79%
4.1.1.10	3.13%	32.96%	63.91%	79.97%	85.73%	14.27%	74.92%	9.77%	24.39%	65.85%	78.43%	62.61%	5.35%	32.04%
RB 48 hr 4.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	4.38%	9.78%	85.84%	100.00%	60.80%	2.21%	36.99%
RB 24 hr 4.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	6.21%	13.85%	79.93%	70.56%	61.34%	3.13%	35.53%
4.1.4.1	4.92%	72.94%	22.14%	102.42%	52.17%	47.83%	102.54%	25.30%	52.51%	22.19%	102.43%	61.46%	18.53%	20.01%
4.1.4.2	5.07%	81.35%	13.58%	133.28%	45.62%	54.38%	135.28%	28.19%	58.27%	13.55%	133.97%	61.14%	21.25%	17.61%
4.1.4.3	5.05%	84.58%	10.37%	158.90%	42.87%	57.13%	163.25%	29.38%	60.33%	10.30%	160.40%	60.84%	22.50%	16.66%
4.1.4.4	5.17%	83.08%	11.75%	130.72%	44.46%	55.54%	132.47%	28.75%	59.53%	11.72%	131.35%	61.19%	21.68%	17.13%
4.1.4.5	5.20%	83.76%	11.04%	129.88%	44.04%	55.96%	131.46%	28.95%	60.03%	11.02%	130.46%	61.23%	21.82%	16.95%
4.1.4.6	5.22%	84.16%	10.63%	129.48%	43.80%	56.20%	130.91%	29.05%	60.34%	10.61%	130.00%	61.26%	21.90%	16.84%
4.1.4.7	5.04%	78.07%	16.89%	117.52%	48.23%	51.77%	118.43%	27.05%	56.06%	16.89%	117.82%	61.31%	20.14%	18.55%
4.1.4.8	5.02%	76.87%	18.11%	112.12%	49.21%	50.79%	112.66%	26.62%	55.26%	18.12%	112.29%	61.38%	19.72%	18.90%
4.1.4.9	5.01%	76.20%	18.79%	109.46%	49.76%	50.24%	109.82%	26.37%	54.81%	18.82%	109.57%	61.42%	19.49%	19.10%
4.1.4.10	5.12%	85.88%	9.00%	156.73%	42.02%	57.98%	160.84%	29.79%	61.27%	8.94%	158.18%	60.88%	22.82%	16.30%
RB 48 hr 4.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	25.91%	53.79%	20.30%	100.00%	61.50%	18.98%	19.52%
RB 24 hr 4.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	27.85%	57.81%	14.34%	93.04%	61.65%	20.40%	17.95%
4.4.1.1	1.43%	14.28%	84.29%	70.62%	92.73%	7.27%	70.00%	4.85%	10.32%	84.83%	70.49%	60.48%	2.88%	36.64%
4.4.1.2	1.87%	21.25%	76.88%	72.45%	89.20%	10.80%	70.69%	6.82%	15.43%	77.75%	71.97%	60.93%	4.23%	34.84%
4.4.1.3	2.12%	24.95%	72.93%	75.79%	86.86%	13.14%	73.67%	8.07%	18.13%	73.80%	75.23%	61.06%	5.13%	33.81%
4.4.1.4	1.86%	21.99%	76.15%	72.64%	89.17%	10.83%	70.49%	6.81%	16.00%	77.18%	71.99%	61.06%	4.22%	34.72%
4.4.1.5	1.86%	22.69%	75.45%	72.91%	89.15%	10.85%	70.38%	6.80%	16.56%	76.64%	72.11%	61.18%	4.22%	34.60%
4.4.1.6	1.84%	23.27%	74.89%	73.59%	89.20%	10.80%	70.68%	6.76%	17.01%	76.23%	72.62%	61.30%	4.19%	34.51%
4.4.1.7	1.65%	18.24%	80.12%	72.06%	90.99%	9.01%	70.61%	5.82%	13.23%	80.95%	71.64%	60.79%	3.54%	35.67%
4.4.1.8	1.57%	17.24%	81.19%	71.88%	91.58%	8.42%	70.53%	5.48%	12.51%	82.01%	71.48%	60.75%	3.31%	35.94%
4.4.1.9	1.53%	16.75%	81.72%	71.77%	91.87%	8.13%	70.46%	5.32%	12.15%	82.54%	71.38%	60.72%	3.20%	36.08%
4.4.1.10	2.11%	25.67%	72.22%	76.16%	86.85%	13.15%	73.61%	8.05%	18.70%	73.25%	75.42%	61.20%	5.11%	33.69%
RB 48 hr 4.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	3.42%	7.28%	89.31%	100.00%	60.20%	2.03%	37.78%
RB 24 hr 4.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	4.85%	10.33%	84.82%	70.44%	60.48%	2.88%	36.64%
4.4.4.1	3.78%	67.74%	28.47%	103.08%	51.75%	48.25%	102.97%	24.80%	47.44%	27.76%	103.01%	59.27%	19.74%	20.99%
4.4.4.2	4.02%	77.93%	18.05%	129.90%	43.99%	56.01%	133.08%	28.58%	54.00%	17.41%	131.16%	58.68%	23.26%	18.07%
4.4.4.3	4.05%	82.01%	13.94%	153.12%	40.75%	59.25%	159.47%	30.18%	56.46%	13.36%	155.62%	58.27%	24.85%	16.88%
4.4.4.4	4.13%	80.10%	15.77%	126.58%	42.57%	57.43%	129.78%	29.31%	55.47%	15.21%	127.88%	58.68%	23.85%	17.47%
4.4.4.5	4.16%	80.92%	14.91%	125.48%	42.05%	57.95%	128.62%	29.57%	56.05%	14.38%	126.77%	58.69%	24.06%	17.25%
4.4.4.6	4.18%	81.39%	14.42%	124.95%	41.77%	58.23%	128.01%	29.70%	56.38%	13.91%	126.21%	58.70%	24.17%	17.13%
4.4.4.7	3.95%	73.89%	22.16%	115.91%	47.09%	52.91%	117.39%	27.07%	51.44%	21.48%	116.49%	58.95%	21.82%	19.23%
4.4.4.8	3.92%	72.41%	23.66%	111.10%	48.25%	51.75%	112.02%	26.51%	50.51%	22.98%	111.45%	59.06%	21.29%	19.66%
4.4.4.9	3.90%	71.60%	24.49%	108.72%	48.89%	51.11%	109.36%	26.20%	49.99%	23.81%	108.97%	59.11%	20.99%	19.89%
4.4.4.10	4.12%	83.61%	12.26%	150.39%	39.71%	60.29%	156.73%	30.71%	57.54%	11.75%	152.91%	58.27%	25.29%	16.44%
RB 48 hr 4.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	25.54%	48.86%	25.59%	100.00%	59.26%	20.34%	20.41%
RB 24 hr 4.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	27.91%	53.39%	18.71%	91.53%	59.23%	22.22%	18.55%

APPENDIX K1: SUMMARY OF COST ESTIMATIONS - NO SALVAGE VALUE

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.1.1.1	$10 070.88	$86 301.48	$343 489.42	$439 861.78	1	$5 686.57	$517.98	$6 204.55	1	$30 350.10	$97 644.64	$475 430.19	$603 424.94	1
2.1.1.2	$13 501.73	$134 784.12	$329 365.29	$477 651.14	5	$5 752.12	$776.99	$6 529.11	5	$42 753.24	$152 499.67	$455 880.71	$651 133.62	5
2.1.1.3	$16 027.59	$163 157.83	$327 720.37	$506 905.79	9	$5 895.08	$984.99	$6 880.06	9	$52 317.28	$184 602.72	$453 603.95	$690 523.96	9
2.1.1.4	$13 501.73	$139 854.06	$328 100.74	$481 456.54	6	$5 758.50	$776.99	$6 535.49	6	$42 753.24	$158 235.99	$454 130.43	$655 119.66	6
2.1.1.5	$13 501.73	$144 924.00	$327 229.75	$485 655.48	7	$5 770.78	$776.99	$6 547.78	7	$42 753.24	$163 972.31	$452 924.87	$659 650.42	7
2.1.1.6	$13 501.73	$149 993.94	$327 554.54	$491 050.22	8	$5 801.01	$776.99	$6 578.00	8	$42 753.24	$169 708.62	$453 374.43	$665 836.29	8
2.1.1.7	$11 834.18	$115 520.19	$336 061.30	$463 415.67	4	$5 739.23	$647.49	$6 386.72	4	$36 634.39	$130 703.75	$465 148.80	$632 486.94	4
2.1.1.8	$11 258.32	$109 098.87	$340 400.52	$460 757.71	3	$5 766.34	$604.32	$6 370.65	3	$34 560.19	$123 438.45	$471 154.79	$629 153.43	3
2.1.1.9	$10 966.13	$105 888.22	$341 419.37	$458 273.71	2	$5 762.59	$582.73	$6 345.32	2	$33 515.74	$119 805.79	$472 564.99	$625 886.53	2
2.1.1.10	$16 027.59	$168 836.10	$326 458.69	$511 322.38	1	$5 904.54	$984.99	$6 889.53	1	$52 317.28	$191 027.33	$451 857.64	$695 202.25	1
RB 48 hr 2.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$30 350.10	$97 644.64	$753 242.87	$881 237.62	
RB 24 hr 2.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$30 350.10	$97 644.64	$494 915.11	$622 909.86	
2.1.2.1	$34 644.50	$423 350.47	$391 513.76	$849 508.74	1	$8 342.83	$2 860.57	$11 203.41	1	$131 373.53	$478 994.18	$541 901.59	$1 152 269.30	1
2.1.2.2	$46 446.87	$622 236.98	$344 597.42	$1 013 281.27	8	$8 753.90	$4 290.97	$13 044.88	8	$187 525.77	$704 021.64	$476 963.79	$1 368 511.20	8
2.1.2.3	$55 135.99	$768 084.21	$337 243.44	$1 160 463.64	1	$9 461.46	$5 439.63	$14 901.09	1	$231 255.29	$869 038.51	$466 785.01	$1 567 078.81	1
2.1.2.4	$46 446.87	$627 245.99	$334 686.23	$1 008 379.09	5	$8 630.28	$4 290.97	$12 921.26	7	$187 525.77	$709 689.01	$463 245.53	$1 360 460.31	5
2.1.2.5	$46 446.87	$632 254.99	$332 162.77	$1 010 864.64	6	$8 617.47	$4 290.97	$12 908.45	6	$187 525.77	$715 356.38	$459 752.77	$1 362 634.91	6
2.1.2.6	$46 446.87	$637 264.00	$329 513.90	$1 013 224.77	7	$8 602.79	$4 290.97	$12 893.76	5	$187 525.77	$721 023.75	$456 086.41	$1 364 635.93	7
2.1.2.7	$40 710.38	$527 738.07	$369 857.14	$938 305.59	4	$8 601.79	$3 575.77	$12 177.57	4	$159 734.21	$597 102.11	$511 926.25	$1 268 762.57	4
2.1.2.8	$38 729.36	$496 238.43	$377 148.45	$912 116.24	3	$8 533.46	$3 337.37	$11 870.83	3	$150 351.39	$561 462.27	$522 018.29	$1 233 831.95	3
2.1.2.9	$37 724.22	$480 486.61	$379 938.46	$898 151.29	2	$8 486.31	$3 218.17	$11 704.48	2	$145 634.70	$543 642.35	$525 879.99	$1 215 157.05	2
2.1.2.10	$55 135.99	$773 692.37	$330 734.56	$1 159 562.92	9	$9 391.87	$5 439.63	$14 831.50	9	$231 255.29	$875 383.79	$457 775.95	$1 564 415.03	9
RB 48 hr 2.1.2	$34 644.50	$423 350.47	$544 203.89	$1 002 198.86		$10 633.18	$2 860.57	$13 493.76		$131 373.53	$478 994.18	$753 242.87	$1 363 610.58	
RB 24 hr 2.1.2	$34 644.50	$423 350.47	$357 566.91	$815 561.88		$7 833.63	$2 860.57	$10 694.20		$131 373.53	$478 994.18	$494 915.11	$1 105 282.82	
2.1.3.1	$65 481.96	$816 778.76	$424 085.21	$1 306 345.94	1	$11 113.09	$6 900.33	$18 013.42	1	$285 648.83	$924 133.31	$586 984.35	$1 796 766.50	1
2.1.3.2	$87 789.76	$1 191 185.29	$361 993.41	$1 640 968.46	8	$12 281.28	$10 350.77	$22 632.05	8	$410 453.39	$1 347 750.53	$501 041.91	$2 259 245.83	8
2.1.3.3	$104 213.15	$1 474 146.90	$347 316.38	$1 925 676.43	1	$13 643.45	$13 121.58	$26 765.03	1	$508 100.10	$1 667 903.61	$480 727.16	$2 656 730.88	1
2.1.3.4	$87 789.76	$1 196 083.98	$344 330.19	$1 628 203.93	7	$12 040.83	$10 350.77	$22 391.60	7	$410 453.39	$1 353 293.08	$476 593.92	$2 240 340.39	7
2.1.3.5	$87 789.76	$1 200 982.67	$337 111.56	$1 625 883.98	5	$11 957.04	$10 350.77	$22 307.81	6	$410 453.39	$1 358 835.63	$466 602.47	$2 235 891.49	5
2.1.3.6	$87 789.76	$1 205 881.35	$334 041.98	$1 627 713.09	6	$11 935.49	$10 350.77	$22 286.26	5	$410 453.39	$1 364 378.18	$462 353.81	$2 237 185.38	6
2.1.3.7	$76 947.15	$1 008 866.59	$396 900.99	$1 482 714.74	4	$11 782.71	$8 625.55	$20 408.26	4	$348 588.96	$1 141 468.49	$549 358.16	$2 039 415.61	4
2.1.3.8	$73 202.81	$948 093.69	$405 935.65	$1 427 232.15	3	$11 576.17	$8 050.48	$19 626.65	3	$327 742.63	$1 072 707.81	$561 863.20	$1 962 313.64	3
2.1.3.9	$71 302.98	$917 707.24	$408 677.94	$1 397 688.16	2	$11 446.00	$7 762.94	$19 208.94	2	$317 271.68	$1 038 327.47	$565 658.85	$1 921 258.00	2
2.1.3.10	$104 213.15	$1 479 627.96	$336 213.79	$1 920 054.90	9	$13 504.32	$13 121.58	$26 625.90	9	$508 100.10	$1 674 105.09	$465 359.85	$2 647 565.05	9
RB 48 hr 2.1.3	$65 481.96	$816 778.76	$544 203.89	$1 426 464.61		$12 914.87	$6 900.33	$19 815.20		$285 648.83	$924 133.31	$753 242.87	$1 963 025.02	
RB 24 hr 2.1.3	$65 481.96	$816 778.76	$357 566.91	$1 239 827.64		$10 115.31	$6 900.33	$17 015.65		$285 648.83	$924 133.31	$494 915.11	$1 704 697.25	
2.1.4.1	$135 406.09	$2 007 523.44	$495 315.00	$2 638 244.53	1	$18 848.48	$18 848.17	$37 696.65	1	$705 160.42	$2 271 385.31	$685 574.84	$3 662 120.56	1
2.1.4.2	$181 534.99	$2 913 464.00	$405 881.22	$3 500 880.22	8	$22 507.20	$28 272.99	$50 780.18	8	$1 020 482.94	$3 296 399.53	$561 787.86	$4 878 670.34	8
2.1.4.3	$215 495.91	$3 611 480.34	$381 317.12	$4 208 293.38	1	$25 975.22	$35 841.41	$61 816.63	1	$1 268 371.58	$4 086 160.70	$527 788.23	$5 882 320.50	1
2.1.4.4	$181 534.99	$2 918 312.55	$369 527.98	$3 469 375.52	7	$21 986.14	$28 272.99	$50 259.13	7	$1 020 482.94	$3 301 885.35	$511 470.65	$4 833 838.95	7
2.1.4.5	$181 534.99	$2 923 161.10	$354 239.82	$3 458 935.91	6	$21 781.06	$28 272.99	$50 054.05	6	$1 020 482.94	$3 307 371.18	$490 310.03	$4 818 164.15	6
2.1.4.6	$181 534.99	$2 928 009.64	$347 395.00	$3 456 939.63	5	$21 702.63	$28 272.99	$49 975.62	5	$1 020 482.94	$3 312 857.00	$480 835.97	$4 814 175.91	5
2.1.4.7	$159 114.24	$2 465 351.14	$450 172.91	$3 074 638.29	4	$20 702.31	$23 560.58	$44 262.89	4	$863 933.87	$2 789 388.28	$623 092.82	$4 276 414.97	4
2.1.4.8	$151 371.54	$2 315 980.19	$463 504.96	$2 930 856.69	3	$20 076.47	$21 989.78	$42 066.24	3	$811 285.87	$2 620 384.53	$641 545.96	$4 073 216.36	3
2.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$21 204.37	$40 912.86	2	$784 863.07	$2 535 882.66	$645 746.31	$3 966 492.04	2
2.1.4.10	$215 495.91	$3 616 903.58	$351 351.67	$4 183 751.16	9	$25 552.85	$35 841.41	$61 394.26	9	$1 268 371.58	$4 092 296.74	$486 312.48	$5 846 980.80	9
RB 48 hr 2.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$705 160.42	$2 271 385.31	$753 242.87	$3 729 788.60	
RB 24 hr 2.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$705 160.42	$2 271 385.31	$494 915.11	$3 471 460.84	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$448 526.88	$12 949.52	$141 948.54
$488 242.86	$19 424.79	$143 465.98
$518 930.32	$24 624.63	$146 969.01
$492 082.03	$19 424.79	$143 612.84
$496 318.34	$19 424.79	$143 907.29
$501 761.34	$19 424.79	$144 650.15
$473 107.86	$16 187.16	$143 191.93
$470 159.81	$15 107.94	$143 885.68
$467 518.26	$14 568.34	$143 799.93
$523 386.15	$24 624.63	$147 191.47
$651 071.64	$12 949.52	$217 216.46
$462 732.74	$12 949.52	$147 227.60
$873 242.49	$71 514.37	$207 512.44
$1 043 944.84	$107 274.34	$217 292.01
$1 196 471.82	$135 990.71	$234 616.28
$1 038 997.05	$107 274.34	$214 188.92
$1 041 504.34	$107 274.34	$213 856.23
$1 043 885.09	$107 274.34	$213 476.51
$965 642.73	$89 394.35	$213 725.49
$938 301.73	$83 434.36	$212 095.86
$923 746.23	$80 454.36	$210 956.45
$1 195 561.87	$135 990.71	$232 862.45
$1 027 324.97	$71 514.37	$264 771.24
$838 986.08	$71 514.37	$194 782.37
$1 348 472.88	$172 508.36	$275 785.25
$1 696 422.45	$258 769.26	$304 054.11
$1 991 290.44	$328 039.45	$337 400.99
$1 683 540.63	$258 769.26	$298 030.50
$1 681 198.63	$258 769.26	$295 923.60
$1 683 043.52	$258 769.26	$295 372.60
$1 531 731.25	$215 638.81	$292 045.55
$1 474 017.58	$201 261.99	$287 034.06
$1 443 328.79	$194 073.59	$283 855.62
$1 985 616.65	$328 039.45	$333 908.95
$1 469 686.90	$172 508.36	$320 829.76
$1 281 348.00	$172 508.36	$250 840.89
$2 724 723.02	$471 204.24	$466 193.30
$3 616 449.38	$706 824.74	$555 396.22
$4 345 933.47	$896 035.32	$640 351.72
$3 584 656.51	$706 824.74	$542 357.70
$3 574 120.82	$706 824.74	$537 218.59
$3 572 105.45	$706 824.74	$535 245.73
$3 176 005.99	$589 014.49	$511 394.49
$3 027 350.28	$549 744.41	$496 121.68
$2 949 273.74	$530 109.37	$487 108.93
$4 321 166.46	$896 035.32	$629 779.02
$2 774 057.72	$471 204.24	$484 526.63
$2 585 718.83	$471 204.24	$414 537.77

Series	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.2.1.1	$17 575.65	$158 938.83	$783 774.85	$960 289.32	1	$12 730.59	$1 118.96	$13 849.55	1	$58 341.39	$179 829.19	$1 084	$1 323 008.15	1
2.2.1.2	$23 563.16	$243 453.76	$756 685.45	$1 023 702.36	5	$12 807.89	$1 678.48	$14 486.38	6	$82 674.76	$275 452.47	$1 047	$1 405 469.85	5
2.2.1.3	$27 971.27	$297 803.23	$753 631.39	$1 079 405.90	9	$13 078.79	$2 127.80	$15 206.59	9	$101 524.02	$336 946.45	$1 043	$1 481 584.91	9
2.2.1.4	$23 563.16	$251 807.99	$753 864.15	$1 029 235.30	6	$12 807.35	$1 678.48	$14 485.83	5	$82 674.76	$284 904.75	$1 043	$1 411 017.13	6
2.2.1.5	$23 563.16	$260 162.22	$752 779.65	$1 036 505.03	7	$12 832.85	$1 678.48	$14 511.33	7	$82 674.76	$294 357.03	$1 041	$1 418 968.32	7
2.2.1.6	$23 563.16	$268 516.45	$753 128.51	$1 045 208.13	8	$12 879.85	$1 678.48	$14 558.34	8	$82 674.76	$303 809.32	$1 042	$1 428 903.48	8
2.2.1.7	$20 652.96	$207 975.95	$769 668.26	$998 297.16	4	$12 795.56	$1 398.72	$14 194.28	4	$70 652.44	$235 311.58	$1 065	$1 371 276.39	4
2.2.1.8	$19 647.96	$196 150.01	$777 338.01	$993 135.98	3	$12 841.23	$1 305.47	$14 146.70	3	$66 584.64	$221 931.28	$1 075	$1 364 444.15	3
2.2.1.9	$19 138.04	$190 237.04	$779 721.52	$989 096.59	2	$12 842.22	$1 258.84	$14 101.06	2	$64 537.92	$215 241.14	$1 079	$1 359 006.33	2
2.2.1.10	$27 971.27	$307 195.13	$751 191.64	$1 086 358.05	1	$13 089.16	$2 127.80	$15 216.95	1	$101 524.02	$347 571.79	$1 039	$1 488 834.34	1
RB 48 hr 2.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$1 118.96	$20 341.71		$58 341.39	$179 829.19	$1 683	$1 922 069.40	
RB 24 hr 2.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$13 181.63	$1 118.96	$14 300.59		$58 341.39	$179 829.19	$1 126	$1 364 628.12	
2.2.2.1	$60 134.28	$780 795.83	$881 046.76	$1 721 976.87	1	$17 733.05	$6 133.31	$23 866.36	1	$257 233.48	$883 420.91	$1 219	$2 360 127.84	1
2.2.2.2	$80 620.27	$1 142 766.44	$784 960.00	$2 008 346.71	8	$18 310.56	$9 200.21	$27 510.77	8	$369 301.78	$1 292 967.66	$1 086	$2 748 747.40	8
2.2.2.3	$95 702.42	$1 413 855.12	$771 972.12	$2 281 529.66	1	$19 625.02	$11 663.02	$31 288.04	1	$456 931.19	$1 599 687.30	$1 068	$3 125 119.67	1
2.2.2.4	$80 620.27	$1 150 974.14	$766 855.28	$1 998 449.69	5	$18 080.03	$9 200.21	$27 280.23	7	$369 301.78	$1 302 254.16	$1 061	$2 732 974.81	5
2.2.2.5	$80 620.27	$1 159 181.85	$762 154.73	$2 001 956.85	6	$18 050.56	$9 200.21	$27 250.76	6	$369 301.78	$1 311 540.66	$1 054	$2 735 755.19	6
2.2.2.6	$80 620.27	$1 167 389.56	$756 991.71	$2 005 001.54	7	$18 014.15	$9 200.21	$27 214.36	5	$369 301.78	$1 320 827.16	$1 047	$2 737 895.46	7
2.2.2.7	$70 663.14	$968 479.73	$835 109.95	$1 874 252.82	4	$18 089.81	$7 666.76	$25 756.57	4	$313 761.55	$1 095 773.32	$1 155	$2 565 426.32	4
2.2.2.8	$67 224.58	$910 384.16	$850 481.19	$1 828 089.93	3	$17 994.83	$7 155.61	$25 150.44	3	$295 041.65	$1 030 041.87	$1 177	$2 502 250.59	3
2.2.2.9	$65 479.91	$881 336.37	$857 258.41	$1 804 074.70	2	$17 933.45	$6 900.04	$24 833.49	2	$285 637.82	$997 176.15	$1 186	$2 469 361.52	2
2.2.2.10	$95 702.42	$1 423 083.37	$759 281.47	$2 278 067.26	9	$19 480.80	$11 663.02	$31 143.82	9	$456 931.19	$1 610 128.48	$1 050	$3 117 995.48	9
RB 48 hr 2.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$6 133.31	$28 899.44		$257 233.48	$883 420.91	$1 683	$2 824 553.20	
RB 24 hr 2.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$16 725.02	$6 133.31	$22 858.33		$257 233.48	$883 420.91	$1 126	$2 267 111.92	
2.2.3.1	$112 564.83	$1 510 285.24	$949 596.19	$2 572 446.26	1	$22 943.53	$14 598.00	$37 541.53	1	$559 440.80	$1 708 791.85	$1 314	$3 582 586.67	1
2.2.3.2	$150 912.38	$2 197 630.23	$819 563.27	$3 168 105.87	8	$24 820.91	$21 897.57	$46 718.48	8	$808 187.37	$2 486 479.07	$1 134	$4 429 039.43	8
2.2.3.3	$179 144.52	$2 722 954.51	$790 674.05	$3 692 773.08	1	$27 302.16	$27 759.35	$55 061.51	1	$1 003 511.72	$3 080 850.13	$1 094	$5 178 748.74	1
2.2.3.4	$150 912.38	$2 205 571.89	$785 226.68	$3 141 710.95	7	$24 345.57	$21 897.57	$46 243.14	7	$808 187.37	$2 495 464.55	$1 086	$4 390 499.00	7
2.2.3.5	$150 912.38	$2 213 513.56	$771 908.07	$3 136 334.00	5	$24 185.50	$21 897.57	$46 083.07	6	$808 187.37	$2 504 450.04	$1 068	$4 381 049.94	5
2.2.3.6	$150 912.38	$2 221 455.22	$765 459.04	$3 137 826.64	6	$24 128.47	$21 897.57	$46 026.04	5	$808 187.37	$2 513 435.53	$1 059	$4 381 109.21	6
2.2.3.7	$132 273.71	$1 860 509.26	$891 696.53	$2 884 479.51	4	$24 027.19	$18 247.79	$42 274.97	4	$684 738.66	$2 105 048.10	$1 234	$4 024 000.77	4
2.2.3.8	$125 837.11	$1 748 135.61	$910 693.40	$2 784 666.12	3	$23 684.62	$17 031.19	$40 715.81	3	$643 202.55	$1 977 904.44	$1 260	$3 881 614.92	3
2.2.3.9	$122 571.28	$1 691 948.78	$916 695.04	$2 731 215.10	2	$23 460.40	$16 422.89	$39 883.29	2	$622 352.37	$1 914 332.62	$1 268	$3 805 499.90	2
2.2.3.10	$179 144.52	$2 731 885.24	$769 070.45	$3 680 100.21	9	$27 022.76	$27 759.35	$54 782.11	9	$1 003 511.72	$3 090 954.69	$1 064	$5 158 951.34	9
RB 48 hr 2.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$14 598.00	$41 546.37		$559 440.80	$1 708 791.85	$1 683	$3 952 131.48	
RB 24 hr 2.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$20 907.25	$14 598.00	$35 505.26		$559 440.80	$1 708 791.85	$1 126	$3 394 690.19	
2.2.4.1	$231 757.45	$3 716 343.63	$1 106	$5 054 286.13	1	$37 538.42	$39 635.52	$77 173.94	1	$1 391 321.06	$4 204 806.85	$1 531	$7 127 219.52	1
2.2.4.2	$310 710.44	$5 388 413.10	$910 762.15	$6 609 885.70	8	$43 772.74	$59 454.82	$103 227.57	8	$2 023 219.53	$6 096 647.29	$1 260	$9 380 469.91	8
2.2.4.3	$368 837.04	$6 682 697.20	$858 732.13	$7 910 266.37	1	$50 056.61	$75 370.34	$125 426.94	1	$2 521 539.24	$7 561 047.56	$1 188	$11 271 174.16	1
2.2.4.4	$310 710.44	$5 396 233.56	$835 137.59	$6 542 081.59	7	$42 677.48	$59 454.82	$102 132.30	7	$2 023 219.53	$6 105 495.64	$1 155	$9 284 644.87	7
2.2.4.5	$310 710.44	$5 404 054.02	$804 327.00	$6 519 091.46	6	$42 254.42	$59 454.82	$101 709.24	6	$2 023 219.53	$6 114 343.99	$1 113	$9 250 847.71	6
2.2.4.6	$310 710.44	$5 411 874.47	$790 303.02	$6 512 887.93	5	$42 083.16	$59 454.82	$101 537.99	5	$2 023 219.53	$6 123 192.34	$1 093	$9 240 285.20	5
2.2.4.7	$272 335.68	$4 558 862.95	$1 006	$5 837 484.77	4	$40 666.43	$49 545.17	$90 211.60	4	$1 709 173.88	$5 158 063.96	$1 392	$8 260 057.50	4
2.2.4.8	$259 083.49	$4 282 346.23	$1 036	$5 578 108.84	3	$39 604.57	$46 241.95	$85 846.52	3	$1 603 696.16	$4 845 202.85	$1 434	$7 883 786.16	3
2.2.4.9	$252 359.53	$4 144 087.87	$1 042	$5 438 709.75	2	$38 928.44	$44 590.34	$83 518.79	2	$1 550 788.21	$4 688 772.30	$1 442	$7 682 175.51	2
2.2.4.10	$368 837.04	$6 691 492.22	$798 893.40	$7 859 222.66	9	$49 203.00	$75 370.34	$124 573.34	9	$2 521 539.24	$7 570 998.56	$1 105	$11 198 301.25	9
RB 48 hr 2.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$39 635.52	$78 829.94		$1 391 321.06	$4 204 806.85	$1 683	$7 280 026.74	
RB 24 hr 2.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$33 153.31	$39 635.52	$72 788.83		$1 391 321.06	$4 204 806.85	$1 126	$6 722 585.45	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$977 166.80	$27 973.99	$317 867.36
$1 043 919.04	$41 962.07	$319 588.73
$1 102 164.62	$53 194.94	$326 225.34
$1 049 500.91	$41 962.07	$319 554.14
$1 056 835.41	$41 962.07	$320 170.85
$1 065 616.34	$41 962.07	$321 325.06
$1 016 939.21	$34 968.03	$319 369.15
$1 011 267.11	$32 636.68	$320 540.36
$1 006 955.52	$31 471.01	$320 579.81
$1 109 178.46	$53 194.94	$326 460.94
$1 413 924.09	$27 973.99	$480 171.32
$1 007 510.65	$27 973.99	$329 143.48
$1 765 420.78	$153 332.79	$441 374.26
$2 063 835.17	$230 005.17	$454 907.06
$2 346 453.29	$291 575.47	$487 090.91
$2 053 846.41	$230 005.17	$449 123.23
$2 057 384.05	$230 005.17	$448 365.97
$2 060 455.01	$230 005.17	$447 435.28
$1 923 933.24	$191 668.98	$449 824.10
$1 875 765.56	$178 890.25	$447 594.77
$1 850 727.65	$172 500.89	$446 132.99
$2 342 957.63	$291 575.47	$483 462.38
$2 104 019.16	$153 332.79	$567 201.25
$1 697 605.71	$153 332.79	$416 173.42
$2 647 824.10	$364 950.03	$569 812.54
$3 266 571.58	$547 439.27	$615 028.58
$3 809 018.39	$693 983.80	$675 746.55
$3 239 934.51	$547 439.27	$603 125.22
$3 234 507.08	$547 439.27	$599 103.59
$3 236 011.88	$547 439.27	$597 658.06
$2 971 777.74	$456 194.65	$596 028.38
$2 868 090.05	$425 779.77	$587 745.10
$2 812 647.52	$410 572.34	$582 280.04
$3 796 228.33	$693 983.80	$668 739.21
$2 917 247.96	$364 950.03	$669 933.50
$2 510 834.51	$364 950.03	$518 905.66
$5 207 161.96	$990 887.93	$929 169.64
$6 813 251.81	$1 486	$1 080 847.58
$8 152 207.31	$1 884	$1 234 708.40
$6 744 827.98	$1 486	$1 053 446.37
$6 721 626.77	$1 486	$1 042 850.41
$6 715 365.25	$1 486	$1 038 549.42
$6 016 164.66	$1 238	$1 005 263.61
$5 748 328.99	$1 156	$979 408.37
$5 604 566.11	$1 114	$962 850.83
$8 100 696.53	$1 884	$1 213 346.27
$5 318 569.04	$990 887.93	$970 569.77
$4 912 155.59	$990 887.93	$819 541.93

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
2.3.1.1	$21 638.84	$219 766.52	$1 133	$1 374 550.01	1	$18 316.72	$1 491.91	$19 808.63	1	$74 685.51	$248 651.86	$1 568	$1 891 744.28	1	$1 397 078.05	$37 297.68	$457 368.55
2.3.1.2	$29 010.56	$335 479.61	$1 086	$1 451 358.76	5	$18 276.33	$2 237.92	$20 514.25	5	$106 072.74	$379 573.88	$1 504	$1 990 001.96	5	$1 477 984.32	$55 947.98	$456 069.67
2.3.1.3	$34 437.75	$411 618.58	$1 082	$1 528 610.30	9	$18 647.67	$2 836.99	$21 484.66	9	$130 426.67	$465 720.29	$1 498	$2 094 530.35	9	$1 558 442.97	$70 924.74	$465 162.64
2.3.1.4	$29 010.56	$347 465.87	$1 082	$1 459 475.72	6	$18 278.23	$2 237.92	$20 516.15	6	$106 072.74	$393 135.57	$1 498	$1 998 208.09	6	$1 486 173.11	$55 947.98	$456 087.00
2.3.1.5	$29 010.56	$359 452.13	$1 080	$1 469 317.79	7	$18 305.99	$2 237.92	$20 543.91	7	$106 072.74	$406 697.26	$1 496	$2 008 801.97	7	$1 496 102.75	$55 947.98	$456 751.24
2.3.1.6	$29 010.56	$371 438.39	$1 080	$1 481 209.02	8	$18 364.50	$2 237.92	$20 602.42	8	$106 072.74	$420 258.96	$1 495	$2 022 232.12	8	$1 508 100.22	$55 947.98	$458 183.92
2.3.1.7	$25 427.56	$286 424.04	$1 110	$1 422 263.04	4	$18 347.65	$1 864.91	$20 212.57	4	$90 556.86	$324 070.62	$1 536	$1 951 568.91	4	$1 446 970.82	$46 622.83	$457 975.26
2.3.1.8	$24 190.23	$270 072.19	$1 121	$1 415 700.49	3	$18 418.67	$1 740.58	$20 159.25	3	$85 310.59	$305 569.53	$1 552	$1 943 083.74	3	$1 439 777.67	$43 514.45	$459 791.63
2.3.1.9	$23 562.42	$261 896.26	$1 124	$1 409 724.50	2	$18 413.81	$1 678.41	$20 092.22	2	$82 671.67	$296 318.99	$1 556	$1 935 108.21	2	$1 433 457.57	$41 960.25	$459 690.39
2.3.1.10	$34 437.75	$425 030.15	$1 080	$1 540 098.34	1	$18 685.87	$2 836.99	$21 522.86	1	$130 426.67	$480 894.62	$1 495	$2 107 042.30	1	$1 570 033.32	$70 924.74	$466 084.24
RB 48 hr 2.3.1	$21 638.84	$219 766.52	$1 818	$2 060 017.45		$28 598.73	$1 491.91	$30 090.64		$74 685.51	$248 651.86	$2 517	$2 840 512.70		$2 088 796.19	$37 297.68	$714 418.84
RB 24 hr 2.3.1	$21 638.84	$219 766.52	$1 216	$1 457 990.75		$19 568.33	$1 491.91	$21 060.24		$74 685.51	$248 651.86	$1 683	$2 007 236.19		$1 481 279.68	$37 297.68	$488 658.83
2.3.2.1	$74 036.29	$1 079 615.25	$1 284	$2 438 406.70	1	$25 424.57	$8 177.54	$33 602.11	1	$332 359.14	$1 221 516.10	$1 778	$3 332 129.13	1	$2 494 775.41	$204 438.41	$632 915.31
2.3.2.2	$99 258.29	$1 578 909.87	$1 130	$2 808 944.65	8	$25 868.63	$12 266.62	$38 135.25	8	$478 165.18	$1 786 436.27	$1 565	$3 829 730.53	8	$2 880 296.44	$306 665.58	$642 768.51
2.3.2.3	$117 827.18	$1 954 734.63	$1 108	$3 181 542.99	1	$27 610.23	$15 550.29	$43 160.52	1	$592 340.30	$2 211 658.12	$1 534	$4 338 960.22	1	$3 264 834.17	$388 757.18	$685 368.86
2.3.2.4	$99 258.29	$1 590 642.31	$1 103	$2 793 287.40	5	$25 516.45	$12 266.62	$37 783.07	7	$478 165.18	$1 799 710.77	$1 527	$3 805 094.46	5	$2 864 494.28	$306 665.58	$633 934.60
2.3.2.5	$99 258.29	$1 602 374.74	$1 095	$2 797 219.10	6	$25 458.10	$12 266.62	$37 724.72	6	$478 165.18	$1 812 985.27	$1 516	$3 807 571.82	6	$2 868 459.69	$306 665.58	$632 446.55
2.3.2.6	$99 258.29	$1 614 107.17	$1 088	$2 801 509.38	7	$25 405.13	$12 266.62	$37 671.75	5	$478 165.18	$1 826 259.77	$1 506	$3 810 545.50	7	$2 872 786.95	$306 665.58	$631 092.96
2.3.2.7	$86 999.25	$1 347 530.33	$1 216	$2 651 284.21	4	$25 876.36	$10 222.08	$36 098.44	4	$405 870.27	$1 524 645.01	$1 684	$3 614 648.34	4	$2 715 556.09	$255 552.00	$643 540.26
2.3.2.8	$82 765.75	$1 270 403.82	$1 238	$2 591 780.40	3	$25 775.39	$9 540.57	$35 315.96	3	$381 517.74	$1 437 381.26	$1 714	$3 533 283.62	3	$2 653 560.69	$238 514.13	$641 208.79
2.3.2.9	$80 617.74	$1 231 840.56	$1 245	$2 557 981.89	2	$25 664.36	$9 199.81	$34 864.17	2	$369 287.45	$1 393 749.38	$1 723	$3 486 989.54	2	$2 618 465.00	$229 995.20	$638 529.34
2.3.2.10	$117 827.18	$1 967 867.16	$1 090	$3 176 583.25	9	$27 404.51	$15 550.29	$42 954.79	9	$592 340.30	$2 226 516.74	$1 509	$4 328 776.99	9	$3 259 826.81	$388 757.18	$680 193.00
RB 48 hr 2.3.2	$74 036.29	$1 079 615.25	$1 818	$2 972 263.63		$33 432.43	$8 177.54	$41 609.96		$332 359.14	$1 221 516.10	$2 517	$4 071 050.58		$3 033 500.52	$204 438.41	$833 111.66
RB 24 hr 2.3.2	$74 036.29	$1 079 615.25	$1 216	$2 370 236.94		$24 402.03	$8 177.54	$32 579.56		$332 359.14	$1 221 516.10	$1 683	$3 237 774.07		$2 425 984.01	$204 438.41	$607 351.65
2.3.3.1	$138 587.88	$2 088 288.52	$1 386	$3 613 804.24	1	$32 658.96	$19 463.50	$52 122.45	1	$726 041.09	$2 362 765.87	$1 919	$5 008 479.96	1	$3 710 639.38	$486 587.39	$811 253.19
2.3.3.2	$185 800.72	$3 037 375.07	$1 180	$4 403 402.20	8	$34 785.44	$29 196.00	$63 981.44	8	$1 050 928.63	$3 436 597.03	$1 633	$6 121 099.32	8	$4 529 156.73	$729 900.05	$862 042.53
2.3.3.3	$220 559.66	$3 764 730.68	$1 135	$5 121 117.42	1	$38 110.77	$37 011.51	$75 122.28	1	$1 306 373.14	$4 259 553.72	$1 572	$7 138 046.57	1	$5 269 401.51	$925 287.68	$943 357.38
2.3.3.4	$185 800.72	$3 048 647.68	$1 128	$4 362 782.37	7	$34 063.42	$29 196.00	$63 259.42	7	$1 050 928.63	$3 449 351.27	$1 561	$6 062 028.25	7	$4 488 164.44	$729 900.05	$843 963.76
2.3.3.5	$185 800.72	$3 059 920.28	$1 107	$4 353 060.80	5	$33 804.87	$29 196.00	$63 000.87	6	$1 050 928.63	$3 462 105.51	$1 532	$6 045 724.06	5	$4 478 352.17	$729 900.05	$837 471.84
2.3.3.6	$185 800.72	$3 071 192.89	$1 099	$4 356 613.73	6	$33 745.43	$29 196.00	$62 941.44	5	$1 050 928.63	$3 474 859.75	$1 522	$6 047 793.34	6	$4 481 935.44	$729 900.05	$835 957.85
2.3.3.7	$162 853.12	$2 571 234.09	$1 296	$4 030 166.34	4	$33 958.46	$24 329.75	$58 288.21	4	$889 623.18	$2 909 188.11	$1 793	$5 592 738.88	4	$4 141 961.77	$608 243.72	$842 533.39
2.3.3.8	$154 928.49	$2 415 853.76	$1 327	$3 898 684.52	3	$33 578.07	$22 707.66	$56 285.74	3	$835 378.80	$2 733 385.14	$1 837	$5 406 738.54	3	$4 005 634.73	$567 691.61	$833 412.20
2.3.3.9	$150 907.65	$2 338 163.60	$1 335	$3 824 793.18	2	$33 265.91	$21 896.62	$55 162.53	2	$808 155.49	$2 645 483.65	$1 848	$5 302 437.09	2	$3 929 219.32	$547 415.55	$825 802.22
2.3.3.10	$220 559.66	$3 777 357.11	$1 104	$5 102 458.02	9	$37 704.61	$37 011.51	$74 716.12	9	$1 306 373.14	$4 273 839.72	$1 528	$7 109 029.27	9	$5 250 569.66	$925 287.68	$933 171.93
RB 48 hr 2.3.3	$138 587.88	$2 088 288.52	$1 818	$4 045 488.50		$39 134.22	$19 463.50	$58 597.72		$726 041.09	$2 362 765.87	$2 517	$5 605 982.29		$4 146 260.12	$486 587.39	$973 134.79
RB 24 hr 2.3.3	$138 587.88	$2 088 288.52	$1 216	$3 443 461.80		$30 103.82	$19 463.50	$49 567.32		$726 041.09	$2 362 765.87	$1 683	$4 772 705.78		$3 538 743.61	$486 587.39	$747 374.78
2.3.4.1	$285 335.79	$5 138 630.46	$1 606	$7 030 712.26	1	$52 704.77	$52 845.98	$105 550.75	1	$1 814 155.96	$5 814 034.09	$2 223	$9 852 117.53	1	$7 226 195.36	$1 321	$1 304 772.61
2.3.4.2	$382 541.36	$7 449 258.55	$1 309	$9 140 934.85	8	$60 785.24	$79 271.03	$140 056.27	8	$2 642 735.12	$8 428 363.06	$1 811	$12 883 096.57	8	$9 400 312.89	$1 981	$1 501 007.82
2.3.4.3	$454 105.82	$9 239 861.98	$1 231	$10 925 522.05	1	$69 304.50	$100 491.17	$169 795.67	1	$3 296 888.46	$10 454 317.15	$1 704	$15 455 823.08	1	$11 234 030.86	$2 512	$1 709 512.92
2.3.4.4	$382 541.36	$7 460 322.13	$1 197	$9 040 504.76	7	$59 168.15	$79 271.03	$138 439.19	7	$2 642 735.12	$8 440 880.80	$1 657	$12 741 293.82	7	$9 298 964.97	$1 981	$1 460 552.98
2.3.4.5	$382 541.36	$7 471 385.71	$1 154	$9 008 351.80	6	$58 575.22	$79 271.03	$137 846.26	6	$2 642 735.12	$8 453 398.54	$1 597	$12 693 994.73	6	$9 266 516.80	$1 981	$1 445 702.07
2.3.4.6	$382 541.36	$7 482 449.30	$1 132	$8 997 297.61	5	$58 298.77	$79 271.03	$137 569.81	5	$2 642 735.12	$8 465 916.28	$1 567	$12 675 898.85	5	$9 255 359.79	$1 981	$1 438 763.20
2.3.4.7	$335 295.01	$6 302 230.15	$1 463	$8 101 237.98	4	$56 886.85	$66 058.51	$122 945.36	4	$2 230 789.20	$7 130 573.25	$2 025	$11 387 315.01	4	$8 329 436.57	$1 651	$1 406 415.73
2.3.4.8	$318 979.14	$5 919 887.35	$1 506	$7 745 635.19	3	$55 454.55	$61 654.33	$117 108.89	3	$2 092 494.08	$6 697 976.65	$2 085	$10 876 017.74	3	$7 963 095.27	$1 541	$1 371 564.15
2.3.4.9	$310 700.71	$5 728 715.95	$1 514	$7 553 991.86	2	$54 531.35	$59 452.25	$113 983.60	2	$2 023 138.33	$6 481 678.35	$2 096	$10 601 168.81	2	$7 765 900.58	$1 486	$1 348 962.08
2.3.4.10	$454 105.82	$9 252 258.08	$1 146	$10 852 540.57	9	$68 085.82	$100 491.17	$168 576.99	9	$3 296 888.46	$10 468 342.54	$1 586	$15 351 675.76	9	$11 160 381.61	$2 512	$1 679 014.85
RB 48 hr 2.3.4	$285 335.79	$5 138 630.46	$1 818	$7 242 578.35		$55 882.76	$52 845.98	$108 728.74		$1 814 155.96	$5 814 034.09	$2 517	$10 145 365.39		$7 439 993.43	$1 321	$1 384 222.39
RB 24 hr 2.3.4	$285 335.79	$5 138 630.46	$1 216	$6 640 551.65		$46 852.36	$52 845.98	$99 698.34		$1 814 155.96	$5 814 034.09	$1 683	$9 312 088.87		$6 832 476.92	$1 321	$1 158 462.38

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
2.4.1.1	$26 117.08	$260 988.68	$1 482	$1 769 144.26	1	$23 801.92	$1 935.22	$25 737.14	1	$93 505.89	$295 292.12	$2 051	$2 440 115.48	1
2.4.1.2	$35 014.41	$398 392.16	$1 430	$1 864 115.15	5	$23 809.74	$2 902.91	$26 712.64	6	$133 070.92	$450 755.43	$1 980	$2 564 097.12	5
2.4.1.3	$41 564.78	$489 314.97	$1 424	$1 955 861.30	9	$24 245.26	$3 679.99	$27 925.25	9	$163 815.77	$553 628.82	$1 972	$2 689 788.47	9
2.4.1.4	$35 014.41	$413 310.58	$1 425	$1 873 713.51	6	$23 804.53	$2 902.91	$26 707.43	5	$133 070.92	$467 634.68	$1 972	$2 573 612.77	6
2.4.1.5	$35 014.41	$428 229.00	$1 423	$1 886 535.10	7	$23 847.67	$2 902.91	$26 750.57	7	$133 070.92	$484 513.92	$1 970	$2 587 589.75	7
2.4.1.6	$35 014.41	$443 147.41	$1 424	$1 902 315.12	8	$23 935.18	$2 902.91	$26 838.09	8	$133 070.92	$501 393.16	$1 971	$2 605 661.56	8
2.4.1.7	$30 689.90	$340 135.12	$1 455	$1 826 174.85	4	$23 843.96	$2 419.06	$26 263.02	4	$113 502.92	$384 841.29	$2 014	$2 512 721.40	4
2.4.1.8	$29 196.49	$320 716.10	$1 469	$1 819 763.63	3	$23 949.15	$2 257.78	$26 206.93	3	$106 890.57	$362 869.90	$2 034	$2 504 209.06	3
2.4.1.9	$28 438.76	$311 006.59	$1 474	$1 813 618.64	2	$23 957.71	$2 177.14	$26 134.85	2	$103 565.34	$351 884.21	$2 040	$2 495 880.64	2
2.4.1.10	$41 564.78	$505 934.91	$1 420	$1 967 935.05	1	$24 260.17	$3 679.99	$27 940.15	1	$163 815.77	$572 433.23	$1 966	$2 702 300.40	1
RB 48 hr 2.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$93 505.89	$295 292.12	$3 184	$3 573 335.74	
RB 24 hr 2.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$93 505.89	$295 292.12	$2 130	$2 519 138.36	
2.4.2.1	$89 142.71	$1 282 944.45	$1 666	$3 038 117.12	1	$32 314.43	$10 572.05	$42 886.48	1	$418 323.14	$1 451 570.19	$2 305	$4 175 876.86	1
2.4.2.2	$119 511.03	$1 876 210.93	$1 484	$3 480 027.64	8	$32 864.65	$15 858.49	$48 723.15	8	$602 954.85	$2 122 813.53	$2 054	$4 780 223.91	8
2.4.2.3	$141 868.72	$2 323 319.42	$1 459	$3 925 046.10	1	$34 961.53	$20 103.67	$55 065.20	1	$747 714.11	$2 628 688.40	$2 020	$5 397 019.48	1
2.4.2.4	$119 511.03	$1 890 797.98	$1 449	$3 460 233.02	5	$32 421.86	$15 858.49	$48 280.36	7	$602 954.85	$2 139 317.86	$2 006	$4 749 139.91	5
2.4.2.5	$119 511.03	$1 905 385.04	$1 441	$3 466 150.57	6	$32 364.76	$15 858.49	$48 223.25	6	$602 954.85	$2 155 822.19	$1 994	$4 753 644.62	6
2.4.2.6	$119 511.03	$1 919 972.09	$1 431	$3 470 869.12	7	$32 289.66	$15 858.49	$48 148.16	5	$602 954.85	$2 172 326.51	$1 981	$4 756 489.76	7
2.4.2.7	$104 750.64	$1 589 836.23	$1 579	$3 273 587.52	4	$32 702.65	$13 215.27	$45 917.92	4	$511 371.19	$1 798 798.75	$2 185	$4 495 694.55	4
2.4.2.8	$99 653.34	$1 494 378.00	$1 608	$3 202 118.69	3	$32 609.66	$12 334.20	$44 943.87	3	$480 537.19	$1 690 793.82	$2 225	$4 397 115.08	3
2.4.2.9	$97 067.05	$1 446 648.89	$1 619	$3 162 767.59	2	$32 509.10	$11 893.66	$44 402.77	2	$465 055.15	$1 636 791.36	$2 240	$4 342 806.48	2
2.4.2.10	$141 868.72	$2 339 578.00	$1 435	$3 917 115.43	9	$34 679.98	$20 103.67	$54 783.65	9	$747 714.11	$2 647 083.96	$1 987	$5 381 934.24	9
RB 48 hr 2.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$10 572.05	$52 407.57		$418 323.14	$1 451 570.19	$3 184	$5 054 431.07	
RB 24 hr 2.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$30 410.94	$10 572.05	$40 983.00		$418 323.14	$1 451 570.19	$2 130	$4 000 233.69	
2.4.3.1	$166 142.57	$2 484 448.75	$1 813	$4 464 582.32	1	$41 326.76	$25 012.08	$66 338.84	1	$912 365.05	$2 810 996.01	$2 510	$6 234 140.25	1
2.4.3.2	$222 742.49	$3 613 431.42	$1 549	$5 385 940.49	8	$43 585.63	$37 519.10	$81 104.73	8	$1 322 834.43	$4 088 368.22	$2 145	$7 556 263.84	8
2.4.3.3	$264 412.36	$4 479 274.31	$1 495	$6 238 823.16	1	$47 520.42	$47 562.62	$95 083.05	1	$1 645 920.16	$5 068 014.47	$2 069	$8 783 381.28	1
2.4.3.4	$222 742.49	$3 627 416.78	$1 484	$5 334 856.92	7	$42 679.52	$37 519.10	$80 198.62	7	$1 322 834.43	$4 104 191.76	$2 054	$7 482 024.25	7
2.4.3.5	$222 742.49	$3 641 402.13	$1 459	$5 323 618.61	5	$42 371.09	$37 519.10	$79 890.19	6	$1 322 834.43	$4 120 015.30	$2 020	$7 462 935.24	6
2.4.3.6	$222 742.49	$3 655 387.49	$1 447	$5 325 536.99	6	$42 260.02	$37 519.10	$79 779.11	5	$1 322 834.43	$4 135 838.84	$2 003	$7 462 056.65	5
2.4.3.7	$195 232.34	$3 058 860.84	$1 686	$4 940 164.97	4	$42 576.75	$31 265.59	$73 842.34	4	$1 118 964.39	$3 460 906.82	$2 333	$6 913 595.00	4
2.4.3.8	$185 732.09	$2 874 003.98	$1 722	$4 781 779.02	3	$42 095.13	$29 181.09	$71 276.22	3	$1 050 437.18	$3 251 753.02	$2 383	$6 685 702.36	3
2.4.3.9	$180 911.81	$2 781 575.55	$1 733	$4 695 906.83	2	$41 754.47	$28 138.84	$69 893.31	2	$1 016 052.36	$3 147 176.12	$2 399	$6 562 487.09	2
2.4.3.10	$264 412.36	$4 494 876.01	$1 454	$6 213 327.92	9	$46 981.98	$47 562.62	$94 544.60	9	$1 645 920.16	$5 085 666.80	$2 012	$8 744 150.57	9
RB 48 hr 2.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$25 012.08	$73 640.51		$912 365.05	$2 810 996.01	$3 184	$6 907 898.80	
RB 24 hr 2.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$37 203.86	$25 012.08	$62 215.95		$912 365.05	$2 810 996.01	$2 130	$5 853 701.42	
2.4.4.1	$341 398.74	$6 116 636.13	$2 091	$8 549 847.87	1	$65 442.64	$67 727.54	$133 170.19	1	$2 283 061.16	$6 920 585.40	$2 895	$12 098 964.43	1
2.4.4.2	$457 703.32	$8 866 841.40	$1 722	$11 046 746.00	8	$74 835.80	$101 593.95	$176 429.75	8	$3 330 673.82	$10 032 268.04	$2 383	$15 746 673.17	8
2.4.4.3	$543 328.82	$10 998 744.17	$1 623	$13 165 849.45	1	$84 892.32	$128 789.74	$213 682.06	1	$4 158 513.05	$12 444 380.66	$2 247	$18 850 393.38	1
2.4.4.4	$457 703.32	$8 880 552.65	$1 579	$10 917 511.60	7	$72 760.17	$101 593.95	$174 354.13	7	$3 330 673.82	$10 047 781.45	$2 185	$15 564 332.81	7
2.4.4.5	$457 703.32	$8 894 263.89	$1 520	$10 872 745.88	6	$71 951.57	$101 593.95	$173 545.53	6	$3 330 673.82	$10 063 294.85	$2 104	$15 498 907.14	6
2.4.4.6	$457 703.32	$8 907 975.14	$1 494	$10 859 882.36	5	$71 621.51	$101 593.95	$173 215.46	5	$3 330 673.82	$10 078 808.26	$2 068	$15 477 637.90	5
2.4.4.7	$401 173.98	$7 501 505.75	$1 902	$9 805 230.85	4	$70 137.77	$84 660.75	$154 798.52	4	$2 809 671.64	$8 487 477.44	$2 633	$13 930 506.02	4
2.4.4.8	$381 652.35	$7 046 393.87	$1 960	$9 388 211.43	3	$68 527.30	$79 016.35	$147 543.65	3	$2 634 831.90	$7 972 547.25	$2 713	$13 320 480.83	3
2.4.4.9	$371 747.38	$6 818 837.92	$1 970	$9 161 451.15	2	$67 449.00	$76 194.15	$143 643.15	2	$2 547 162.95	$7 715 082.15	$2 727	$12 990 157.73	2
2.4.4.10	$543 328.82	$11 014 046.28	$1 510	$13 067 795.11	9	$83 268.49	$128 789.74	$212 058.22	9	$4 158 513.05	$12 461 694.03	$2 090	$18 710 807.94	9
RB 48 hr 2.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 283 061.16	$6 920 585.40	$3 184	$12 388 184.30	
RB 24 hr 2.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 283 061.16	$6 920 585.40	$2 130	$11 333 986.92	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 797 339.57	$48 380.50	$594 395.41
$1 897 277.05	$72 572.64	$594 247.43
$1 992 880.60	$91 999.68	$604 908.19
$1 906 960.21	$72 572.64	$594 079.91
$1 919 896.00	$72 572.64	$595 121.11
$1 935 817.20	$72 572.64	$597 271.72
$1 856 996.17	$60 476.57	$595 248.67
$1 849 837.54	$56 444.55	$597 926.97
$1 843 286.93	$54 428.54	$598 165.17
$2 005 061.42	$91 999.68	$605 239.31
$2 623 535.92	$48 380.50	$901 419.32
$1 854 952.75	$48 380.50	$615 805.11
$3 106 922.17	$264 301.36	$804 653.32
$3 566 835.77	$396 462.35	$816 925.78
$4 026 197.86	$502 591.73	$868 229.89
$3 546 857.99	$396 462.35	$805 819.57
$3 552 826.84	$396 462.35	$804 355.42
$3 557 585.76	$396 462.35	$802 441.64
$3 351 721.10	$330 381.86	$813 591.59
$3 277 254.39	$308 355.03	$811 505.66
$3 236 353.91	$297 341.61	$809 110.96
$4 018 191.91	$502 591.73	$861 150.60
$3 747 449.26	$264 301.36	$1 042 680.44
$2 978 866.09	$264 301.36	$757 066.23
$4 581 880.26	$625 302.05	$1 026 957.95
$5 537 679.24	$937 977.45	$1 080 607.15
$6 417 503.33	$1 189	$1 176 812.44
$5 486 127.29	$937 977.45	$1 057 919.51
$5 474 783.95	$937 977.45	$1 050 173.84
$5 476 717.27	$937 977.45	$1 047 361.93
$5 075 183.63	$781 639.75	$1 056 771.62
$4 910 981.90	$729 527.18	$1 045 193.28
$4 822 108.38	$703 470.90	$1 036 907.81
$6 391 772.76	$1 189	$1 163 312.30
$5 073 097.07	$625 302.05	$1 209 499.68
$4 304 513.90	$625 302.05	$923 885.47
$8 785 001.38	$1 693	$1 620 774.48
$11 358 096.40	$2 539	$1 848 727.90
$13 535 838.79	$3 219	$2 094 811.18
$11 227 681.03	$2 539	$1 796 802.91
$11 182 504.59	$2 539	$1 776 553.67
$11 169 521.27	$2 539	$1 768 267.76
$10 079 296.81	$2 116	$1 734 690.49
$9 649 505.61	$1 975	$1 695 566.55
$9 416 126.16	$1 904	$1 669 177.92
$13 436 887.51	$3 219	$2 054 177.02
$8 995 862.77	$1 693	$1 699 132.96
$8 227 279.60	$1 693	$1 413 518.75

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
1.2.1.1	$17 575.65	$158 938.83	$716 667.47	$893 181.94	1	$11 723.98	$1 118.96	$12 842.94	1	$58 341.39	$179 829.19	$991 952.97	$1 230 123.56	1
1.2.1.2	$23 563.16	$243 453.76	$678 297.55	$945 314.46	5	$11 632.08	$1 678.48	$13 310.56	7	$82 674.76	$275 452.47	$938 844.44	$1 296 971.67	5
1.2.1.3	$27 971.27	$297 803.23	$675 122.79	$1 000 897.30	9	$11 901.16	$2 127.80	$14 028.96	1	$101 524.02	$336 945.45	$934 450.20	$1 372 919.67	9
1.2.1.4	$23 563.16	$251 807.99	$674 230.81	$949 601.96	6	$11 612.85	$1 678.48	$13 291.33	5	$82 674.76	$284 904.75	$933 215.59	$1 300 795.11	6
1.2.1.5	$23 563.16	$260 162.22	$672 569.89	$956 295.27	7	$11 629.70	$1 678.48	$13 308.19	6	$82 674.76	$294 357.03	$930 916.68	$1 307 948.48	7
1.2.1.6	$23 563.16	$268 516.45	$673 707.66	$965 787.27	8	$11 688.54	$1 678.48	$13 367.02	8	$82 674.76	$303 809.32	$932 491.49	$1 318 975.57	8
1.2.1.7	$20 652.96	$207 975.95	$698 417.04	$927 045.95	4	$11 726.80	$1 398.72	$13 125.52	4	$70 652.44	$235 311.58	$966 692.22	$1 272 656.24	4
1.2.1.8	$19 647.96	$196 150.01	$707 100.71	$922 898.68	3	$11 787.67	$1 305.47	$13 093.14	3	$66 584.64	$221 931.28	$978 711.44	$1 267 227.37	3
1.2.1.9	$19 138.04	$190 237.04	$709 851.38	$919 226.46	2	$11 794.16	$1 258.84	$13 053.00	2	$64 537.92	$215 241.14	$982 518.70	$1 262 297.76	2
1.2.1.10	$27 971.27	$307 195.13	$671 582.22	$1 006 748.62	1	$11 895.02	$2 127.80	$14 022.81	9	$101 524.02	$347 571.79	$929 549.63	$1 378 645.44	1
RB 48 hr 1.2.1	$17 575.65	$158 938.83	$1 216	$1 393 099.87		$19 222.75	$1 118.96	$20 341.71		$58 341.39	$179 829.19	$1 683	$1 922 069.40	
RB 24 hr 1.2.1	$17 575.65	$158 938.83	$813 844.50	$990 358.97		$13 181.63	$1 118.96	$14 300.59		$58 341.39	$179 829.19	$1 126	$1 364 628.12	
1.2.2.1	$60 134.28	$780 795.83	$829 502.96	$1 670 433.07	1	$16 959.89	$6 133.31	$23 093.20	1	$257 233.48	$883 420.91	$1 148	$2 288 785.10	1
1.2.2.2	$80 620.27	$1 142 766.44	$714 477.99	$1 937 864.70	8	$17 253.33	$9 200.21	$26 453.54	8	$369 301.78	$1 292 967.66	$988 922.48	$2 651 191.92	8
1.2.2.3	$95 702.42	$1 413 855.12	$697 084.89	$2 206 642.43	1	$18 501.71	$11 663.02	$30 164.73	1	$456 931.19	$1 599 687.30	$964 848.36	$3 021 466.84	1
1.2.2.4	$80 620.27	$1 150 974.14	$690 803.69	$1 922 398.10	5	$16 939.25	$9 200.21	$26 139.46	7	$369 301.78	$1 302 254.16	$956 154.43	$2 627 710.37	6
1.2.2.5	$80 620.27	$1 159 181.85	$683 664.11	$1 923 466.23	6	$16 873.20	$9 200.21	$26 073.40	6	$369 301.78	$1 311 540.66	$946 272.40	$2 627 114.84	5
1.2.2.6	$80 620.27	$1 167 389.56	$678 771.34	$1 926 781.17	7	$16 840.84	$9 200.21	$26 041.05	5	$369 301.78	$1 320 827.16	$939 500.23	$2 629 629.17	7
1.2.2.7	$70 663.14	$968 479.73	$779 780.68	$1 818 923.55	4	$17 259.87	$7 666.76	$24 926.63	4	$313 761.55	$1 095 773.32	$1 079	$2 488 844.03	4
1.2.2.8	$67 224.58	$910 384.16	$795 824.20	$1 773 432.94	3	$17 174.97	$7 155.61	$24 330.58	3	$295 041.65	$1 030 041.87	$1 101	$2 426 598.82	3
1.2.2.9	$65 479.91	$881 336.37	$801 923.44	$1 748 739.73	2	$17 103.43	$6 900.04	$24 003.46	2	$285 637.82	$997 176.15	$1 109	$2 392 771.34	2
1.2.2.10	$95 702.42	$1 423 083.37	$680 345.86	$2 199 131.65	9	$18 296.77	$11 663.02	$29 959.79	9	$456 931.19	$1 610 128.48	$941 679.54	$3 008 739.21	9
RB 48 hr 1.2.2	$60 134.28	$780 795.83	$1 216	$2 057 515.51		$22 766.13	$6 133.31	$28 899.44		$257 233.48	$883 420.91	$1 683	$2 824 553.20	
RB 24 hr 1.2.2	$60 134.28	$780 795.83	$813 844.50	$1 654 774.61		$16 725.02	$6 133.31	$22 858.33		$257 233.48	$883 420.91	$1 126	$2 267 111.92	
1.2.3.1	$112 564.83	$1 510 285.24	$906 652.88	$2 529 502.95	1	$22 299.38	$14 598.00	$36 897.38	1	$559 440.80	$1 708 791.85	$1 254	$3 523 148.03	1
1.2.3.2	$150 912.38	$2 197 630.23	$753 636.83	$3 102 179.43	8	$23 832.01	$21 897.57	$45 729.58	8	$808 187.37	$2 486 479.07	$1 043	$4 337 789.40	8
1.2.3.3	$179 144.52	$2 722 954.51	$719 828.05	$3 621 927.08	1	$26 239.47	$27 759.35	$53 998.82	1	$1 003 511.72	$3 080 850.13	$996 327.60	$5 080 689.45	1
1.2.3.4	$150 912.38	$2 205 571.89	$711 675.17	$3 068 159.44	7	$23 242.29	$21 897.57	$45 139.86	7	$808 187.37	$2 495 464.55	$985 043.05	$4 288 694.97	7
1.2.3.5	$150 912.38	$2 213 513.56	$696 923.06	$3 061 348.99	5	$23 060.72	$21 897.57	$44 958.29	6	$808 187.37	$2 504 450.04	$964 624.37	$4 277 261.78	6
1.2.3.6	$150 912.38	$2 221 455.22	$689 402.06	$3 061 769.65	6	$22 987.61	$21 897.57	$44 885.18	5	$808 187.37	$2 513 435.53	$954 214.41	$4 275 837.31	5
1.2.3.7	$132 273.71	$1 860 509.26	$842 292.38	$2 835 075.36	4	$23 286.12	$18 247.79	$41 533.91	4	$684 738.66	$2 105 048.10	$1 165	$3 955 619.54	4
1.2.3.8	$125 837.11	$1 748 135.61	$863 479.22	$2 737 451.94	3	$22 976.40	$17 031.19	$40 007.60	3	$643 202.55	$1 977 904.44	$1 195	$3 816 264.89	3
1.2.3.9	$122 571.28	$1 691 948.78	$867 912.57	$2 682 432.63	2	$22 728.66	$16 422.89	$39 151.55	2	$622 352.37	$1 914 332.62	$1 201	$3 737 979.16	2
1.2.3.10	$179 144.52	$2 731 885.24	$692 300.60	$3 603 330.36	9	$25 871.21	$27 759.35	$53 630.56	9	$1 003 511.72	$3 090 954.69	$958 226.33	$5 052 692.74	9
RB 48 hr 1.2.3	$112 564.83	$1 510 285.24	$1 216	$2 839 435.47		$26 948.37	$14 598.00	$41 546.37		$559 440.80	$1 708 791.85	$1 683	$3 952 131.48	
RB 24 hr 1.2.3	$112 564.83	$1 510 285.24	$813 844.50	$2 436 694.56		$20 907.25	$14 598.00	$35 505.26		$559 440.80	$1 708 791.85	$1 126	$3 394 690.19	
1.2.4.1	$231 757.45	$3 716 343.63	$1 070	$5 018 457.67	1	$37 000.99	$39 635.52	$76 636.51	1	$1 391 321.06	$4 204 806.85	$1 481	$7 077 628.68	1
1.2.4.2	$310 710.44	$5 388 413.10	$857 536.58	$6 556 660.13	8	$42 974.36	$59 454.82	$102 429.18	8	$2 023 219.53	$6 096 647.29	$1 186	$9 306 799.39	8
1.2.4.3	$368 837.04	$6 682 697.20	$797 795.15	$7 849 329.38	1	$49 142.55	$75 370.34	$124 512.89	1	$2 521 539.24	$7 561 047.56	$1 104	$11 186 830.13	1
1.2.4.4	$310 710.44	$5 396 233.56	$769 783.93	$6 476 727.94	7	$41 697.17	$59 454.82	$101 151.99	7	$2 023 219.53	$6 105 495.64	$1 065	$9 194 187.64	7
1.2.4.5	$310 710.44	$5 404 054.02	$734 827.30	$6 449 591.76	6	$41 211.93	$59 454.82	$100 666.75	6	$2 023 219.53	$6 114 343.99	$1 017	$9 154 651.86	6
1.2.4.6	$310 710.44	$5 411 874.47	$717 870.35	$6 440 455.26	5	$40 996.67	$59 454.82	$100 451.50	5	$2 023 219.53	$6 123 192.34	$993 617.91	$9 140 029.77	5
1.2.4.7	$272 335.68	$4 558 862.95	$965 333.34	$5 796 531.97	4	$40 052.14	$49 545.17	$89 597.31	4	$1 709 173.88	$5 158 063.96	$1 336	$8 203 373.95	4
1.2.4.8	$259 083.49	$4 282 346.23	$995 724.26	$5 537 153.98	3	$38 990.25	$46 241.95	$85 232.20	3	$1 603 696.16	$4 845 202.85	$1 378	$7 827 099.77	3
1.2.4.9	$252 359.53	$4 144 087.87	$1 001	$5 397 828.46	2	$38 315.22	$44 590.34	$82 905.57	2	$1 550 788.21	$4 688 772.30	$1 386	$7 625 590.94	2
1.2.4.10	$368 837.04	$6 691 492.22	$728 629.32	$7 788 958.58	9	$48 149.04	$75 370.34	$123 519.38	9	$2 521 539.24	$7 570 998.56	$1 008	$11 101 047.41	9
RB 48 hr 1.2.4	$231 757.45	$3 716 343.63	$1 216	$5 164 686.48		$39 194.43	$39 635.52	$78 829.94		$1 391 321.06	$4 204 806.85	$1 683	$7 280 026.74	
RB 24 hr 1.2.4	$231 757.45	$3 716 343.63	$813 844.50	$4 761 945.58		$33 153.31	$39 635.52	$72 788.83		$1 391 321.06	$4 204 806.85	$1 126	$6 722 585.45	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$909 447.47	$27 973.99	$292 702.10
$964 816.33	$41 962.07	$290 193.27
$1 022 940.11	$53 194.94	$296 784.62
$969 141.40	$41 962.07	$289 691.64
$975 894.22	$41 962.07	$290 092.19
$985 471.26	$41 962.07	$291 542.24
$945 038.26	$34 968.03	$292 649.95
$940 389.32	$32 636.68	$294 201.37
$936 448.25	$31 471.01	$294 378.51
$1 028 843.09	$53 194.94	$296 607.41
$1 413 924.09	$27 973.99	$480 171.32
$1 007 510.65	$27 973.99	$329 143.48
$1 713 406.96	$153 332.79	$422 045.34
$1 992 710.45	$230 005.17	$428 476.30
$2 270 883.17	$291 575.47	$459 008.20
$1 977 101.32	$230 005.17	$420 603.88
$1 978 177.69	$230 005.17	$418 931.99
$1 981 521.36	$230 005.17	$418 102.64
$1 868 099.43	$191 668.98	$429 075.62
$1 820 610.16	$178 890.25	$427 098.40
$1 794 888.08	$172 500.89	$425 382.38
$2 263 302.22	$291 575.47	$453 861.53
$2 104 019.16	$153 332.79	$567 201.25
$1 697 605.71	$153 332.79	$416 173.42
$2 604 489.20	$364 950.03	$553 708.80
$3 200 043.96	$547 439.27	$590 306.17
$3 737 526.35	$693 983.80	$649 179.30
$3 165 712.30	$547 439.27	$575 543.40
$3 158 838.30	$547 439.27	$570 984.21
$3 159 261.35	$547 439.27	$569 136.69
$2 921 923.07	$456 194.65	$577 501.82
$2 820 445.33	$425 779.77	$570 039.78
$2 763 420.21	$410 572.34	$563 986.62
$3 718 758.42	$693 983.80	$639 950.52
$2 917 247.96	$364 950.03	$669 933.50
$2 510 834.51	$364 950.03	$518 905.66
$5 171 006.79	$990 887.93	$915 733.97
$6 759 540.88	$1 486	$1 060 887.99
$8 090 714.64	$1 884	$1 211 857.03
$6 678 878.37	$1 486	$1 028 938.75
$6 651 493.31	$1 486	$1 016 788.02
$6 642 272.08	$1 486	$1 011 387.17
$5 974 838.41	$1 238	$989 906.31
$5 707 000.67	$1 156	$964 050.30
$5 563 312.02	$1 114	$947 520.34
$8 029 791.72	$1 884	$1 186 997.24
$5 318 569.04	$990 887.93	$970 569.77
$4 912 155.59	$990 887.93	$819 541.93

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
1.4.1.1	$26 117.08	$260 988.68	$1 355	$1 642 341.10	1	$21 899.87	$1 935.22	$23 835.09	1	$93 505.89	$295 292.12	$1 875	$2 264 604.83	1
1.4.1.2	$35 014.41	$398 392.16	$1 282	$1 715 798.25	5	$21 584.98	$2 902.91	$24 487.89	7	$133 070.92	$450 755.43	$1 774	$2 358 808.90	5
1.4.1.3	$41 564.78	$489 314.97	$1 276	$1 807 691.83	9	$22 022.72	$3 679.99	$25 702.70	1	$163 815.77	$553 628.82	$1 767	$2 484 704.30	9
1.4.1.4	$35 014.41	$413 310.58	$1 274	$1 723 119.67	6	$21 545.62	$2 902.91	$24 448.53	5	$133 070.92	$467 634.68	$1 764	$2 365 172.99	6
1.4.1.5	$35 014.41	$428 229.00	$1 271	$1 735 069.23	7	$21 575.68	$2 902.91	$24 478.58	6	$133 070.92	$484 513.92	$1 760	$2 377 942.99	7
1.4.1.6	$35 014.41	$443 147.41	$1 274	$1 752 426.32	8	$21 686.85	$2 902.91	$24 589.76	8	$133 070.92	$501 393.16	$1 763	$2 398 197.64	8
1.4.1.7	$30 689.90	$340 135.12	$1 320	$1 691 441.60	4	$21 822.96	$2 419.06	$24 242.02	4	$113 502.92	$384 841.29	$1 827	$2 326 234.57	4
1.4.1.8	$29 196.49	$320 716.10	$1 337	$1 687 053.62	3	$21 958.50	$2 257.78	$24 216.28	3	$106 890.57	$362 869.90	$1 850	$2 320 522.63	3
1.4.1.9	$28 438.76	$311 006.59	$1 342	$1 681 571.66	2	$21 977.00	$2 177.14	$24 154.14	2	$103 565.34	$351 884.21	$1 857	$2 313 111.92	2
1.4.1.10	$41 564.78	$505 934.91	$1 269	$1 817 214.36	1	$21 999.36	$3 679.99	$25 679.34	9	$163 815.77	$572 433.23	$1 757	$2 493 685.04	1
RB 48 hr 1.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$93 505.89	$295 292.12	$3 184	$3 573 335.74	
RB 24 hr 1.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$93 505.89	$295 292.12	$2 130	$2 519 138.36	
1.4.2.1	$89 142.71	$1 282 944.45	$1 568	$2 940 812.45	1	$30 854.86	$10 572.05	$41 426.91	1	$418 323.14	$1 451 570.19	$2 171	$4 041 195.62	1
1.4.2.2	$119 511.03	$1 876 210.93	$1 351	$3 346 742.04	8	$30 865.37	$15 858.49	$46 723.86	8	$602 954.85	$2 122 813.53	$1 869	$4 595 740.79	8
1.4.2.3	$141 868.72	$2 323 319.42	$1 317	$3 783 155.19	1	$32 833.16	$20 103.67	$52 936.83	1	$747 714.11	$2 628 688.40	$1 824	$5 200 625.59	1
1.4.2.4	$119 511.03	$1 890 797.98	$1 306	$3 316 412.04	5	$30 264.55	$15 858.49	$46 123.04	7	$602 954.85	$2 139 317.86	$1 807	$4 550 074.58	6
1.4.2.5	$119 511.03	$1 905 385.04	$1 292	$3 317 569.45	6	$30 136.04	$15 858.49	$45 994.53	6	$602 954.85	$2 155 822.19	$1 789	$4 547 990.68	5
1.4.2.6	$119 511.03	$1 919 972.09	$1 283	$3 322 862.31	7	$30 069.56	$15 858.49	$45 928.05	5	$602 954.85	$2 172 326.51	$1 776	$4 551 630.74	7
1.4.2.7	$104 750.64	$1 589 836.23	$1 474	$3 169 230.51	4	$31 137.29	$13 215.27	$44 352.57	4	$511 371.19	$1 798 798.75	$2 041	$4 351 252.04	4
1.4.2.8	$99 653.34	$1 494 378.00	$1 504	$3 098 522.67	3	$31 055.72	$12 334.20	$43 389.93	3	$480 537.19	$1 690 793.82	$2 082	$4 253 725.88	3
1.4.2.9	$97 067.05	$1 446 648.89	$1 516	$3 059 990.25	2	$30 967.44	$11 893.66	$42 861.11	2	$465 055.15	$1 636 791.36	$2 098	$4 200 550.43	2
1.4.2.10	$141 868.72	$2 339 578.00	$1 286	$3 767 606.87	9	$32 437.35	$20 103.67	$52 541.02	9	$747 714.11	$2 647 083.96	$1 780	$5 174 996.60	9
RB 48 hr 1.4.2	$89 142.71	$1 282 944.45	$2 300	$3 672 856.11		$41 835.51	$10 572.05	$52 407.57		$418 323.14	$1 451 570.19	$3 184	$5 054 431.07	
RB 24 hr 1.4.2	$89 142.71	$1 282 944.45	$1 539	$2 911 218.22		$30 410.94	$10 572.05	$40 983.00		$418 323.14	$1 451 570.19	$2 130	$4 000 233.69	
1.4.3.1	$166 142.57	$2 484 448.75	$1 730	$4 381 330.72	1	$40 077.99	$25 012.08	$65 090.07	1	$912 365.05	$2 810 996.01	$2 395	$6 118 910.14	1
1.4.3.2	$222 742.49	$3 613 431.42	$1 425	$5 261 247.73	8	$41 715.24	$37 519.10	$79 234.34	8	$1 322 834.43	$4 088 368.22	$1 972	$7 383 674.23	8
1.4.3.3	$264 412.36	$4 479 274.31	$1 361	$6 104 774.12	1	$45 509.69	$47 562.62	$93 072.31	1	$1 645 920.16	$5 068 014.47	$1 883	$8 597 841.47	1
1.4.3.4	$222 742.49	$3 627 416.78	$1 345	$5 195 819.13	7	$40 593.96	$37 519.10	$78 113.05	7	$1 322 834.43	$4 104 191.76	$1 862	$7 289 579.41	7
1.4.3.5	$222 742.49	$3 641 402.13	$1 317	$5 181 846.22	6	$40 244.51	$37 519.10	$77 763.61	6	$1 322 834.43	$4 120 015.30	$1 823	$7 266 705.39	6
1.4.3.6	$222 742.49	$3 655 387.49	$1 303	$5 181 512.22	5	$40 099.64	$37 519.10	$77 618.74	5	$1 322 834.43	$4 135 838.84	$1 804	$7 262 709.25	5
1.4.3.7	$195 232.34	$3 058 860.84	$1 592	$4 846 663.82	4	$41 174.23	$31 265.59	$72 439.82	4	$1 118 964.39	$3 460 906.82	$2 204	$6 784 178.29	4
1.4.3.8	$185 732.09	$2 874 003.98	$1 632	$4 692 513.32	3	$40 756.15	$29 181.09	$69 937.23	3	$1 050 437.18	$3 251 753.02	$2 259	$6 562 148.02	3
1.4.3.9	$180 911.81	$2 781 575.55	$1 641	$4 603 719.30	2	$40 371.66	$28 138.84	$68 510.49	2	$1 016 052.36	$3 147 176.12	$2 271	$6 434 888.60	2
1.4.3.10	$264 412.36	$4 494 876.01	$1 309	$6 068 318.21	9	$44 806.83	$47 562.62	$92 369.45	9	$1 645 920.16	$5 085 666.80	$1 811	$8 543 439.89	9
RB 48 hr 1.4.3	$166 142.57	$2 484 448.75	$2 300	$4 951 360.26		$48 628.43	$25 012.08	$73 640.51		$912 365.05	$2 810 996.01	$3 184	$6 907 898.80	
RB 24 hr 1.4.3	$166 142.57	$2 484 448.75	$1 539	$4 189 722.37		$37 203.86	$25 012.08	$62 215.95		$912 365.05	$2 810 996.01	$2 130	$5 853 701.42	
1.4.4.1	$341 398.74	$6 116 636.13	$2 024	$8 482 077.66	1	$64 426.09	$67 727.54	$132 153.63	1	$2 283 061.16	$6 920 585.40	$2 801	$12 005 162.40	1
1.4.4.2	$457 703.32	$8 866 841.40	$1 621	$10 946 098.64	8	$73 326.09	$101 593.95	$174 920.04	8	$3 330 673.82	$10 032 268.04	$2 244	$15 607 365.27	8
1.4.4.3	$543 328.82	$10 998 744.17	$1 508	$13 050 543.65	1	$83 162.73	$128 789.74	$211 952.47	1	$4 158 513.05	$12 444 380.66	$2 087	$18 690 796.45	1
1.4.4.4	$457 703.32	$8 880 552.65	$1 455	$10 793 725.73	7	$70 903.38	$101 593.95	$172 497.34	7	$3 330 673.82	$10 047 781.45	$2 014	$15 392 998.45	7
1.4.4.5	$457 703.32	$8 894 263.89	$1 389	$10 741 315.81	6	$69 980.12	$101 593.95	$171 574.08	6	$3 330 673.82	$10 063 294.85	$1 923	$15 316 992.30	6
1.4.4.6	$457 703.32	$8 907 975.14	$1 357	$10 722 997.69	5	$69 568.24	$101 593.95	$171 162.19	5	$3 330 673.82	$10 078 808.26	$1 878	$15 288 173.26	5
1.4.4.7	$401 173.98	$7 501 505.75	$1 824	$9 727 442.32	4	$68 970.94	$84 660.75	$153 631.69	4	$2 809 671.64	$8 487 477.44	$2 525	$13 822 837.44	4
1.4.4.8	$381 652.35	$7 046 393.87	$1 882	$9 310 492.74	3	$67 361.52	$79 016.35	$146 377.87	3	$2 634 831.90	$7 972 547.25	$2 605	$13 212 908.93	3
1.4.4.9	$371 747.38	$6 818 837.92	$1 893	$9 084 297.50	2	$66 291.70	$76 194.15	$142 485.84	2	$2 547 162.95	$7 715 082.15	$2 621	$12 883 367.91	2
1.4.4.10	$543 328.82	$11 014 046.28	$1 377	$12 934 709.17	9	$81 272.20	$128 789.74	$210 061.93	9	$4 158 513.05	$12 461 694.03	$1 906	$18 526 601.17	9
RB 48 hr 1.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 283 061.16	$6 920 585.40	$3 184	$12 388 184.30	
RB 24 hr 1.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 283 061.16	$6 920 585.40	$2 130	$11 333 986.92	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$1 669 380.11	$48 380.50	$546 844.22
$1 747 607.67	$72 572.64	$538 628.60
$1 843 359.99	$91 999.68	$549 344.63
$1 754 993.13	$72 572.64	$537 607.22
$1 767 048.94	$72 572.64	$538 321.41
$1 784 561.58	$72 572.64	$541 063.42
$1 721 034.30	$60 476.57	$544 723.70
$1 715 917.36	$56 444.55	$548 160.71
$1 710 035.83	$54 428.54	$548 647.56
$1 852 966.32	$91 999.68	$548 719.05
$2 623 535.92	$48 380.50	$901 419.32
$1 854 952.75	$48 380.50	$615 805.11
$3 008 730.19	$264 301.36	$768 164.07
$3 432 334.76	$396 462.35	$766 943.68
$3 883 013.06	$502 591.73	$815 020.80
$3 401 725.53	$396 462.35	$751 886.70
$3 402 890.83	$396 462.35	$748 637.50
$3 408 229.30	$396 462.35	$746 939.09
$3 246 412.47	$330 381.86	$774 457.71
$3 172 713.69	$308 355.03	$772 657.16
$3 132 639.36	$297 341.61	$770 569.46
$3 867 319.99	$502 591.73	$805 084.88
$3 747 449.26	$264 301.36	$1 042 680.44
$2 978 866.09	$264 301.36	$757 066.23
$4 497 869.49	$625 302.05	$995 738.60
$5 411 849.42	$937 977.45	$1 033 847.37
$6 282 231.91	$1 189	$1 126 544.05
$5 345 821.63	$937 977.45	$1 005 780.34
$5 331 718.75	$937 977.45	$997 009.19
$5 331 379.16	$937 977.45	$993 352.64
$4 980 829.85	$781 639.75	$1 021 708.69
$4 820 902.20	$729 527.18	$1 011 718.64
$4 729 080.21	$703 470.90	$1 002 337.49
$6 245 440.72	$1 189	$1 108 933.66
$5 073 097.07	$625 302.05	$1 209 499.68
$4 304 513.90	$625 302.05	$923 885.47
$8 716 613.18	$1 693	$1 595 360.65
$11 256 531.25	$2 539	$1 810 985.14
$13 419 481.53	$3 219	$2 051 571.51
$11 102 766.37	$2 539	$1 750 383.21
$11 049 876.03	$2 539	$1 727 267.40
$11 031 388.37	$2 539	$1 716 936.01
$10 000 798.93	$2 116	$1 705 519.79
$9 571 078.21	$1 975	$1 666 422.04
$9 338 268.96	$1 904	$1 640 245.30
$13 302 587.97	$3 219	$2 004 269.79
$8 995 862.77	$1 693	$1 699 132.96
$8 227 279.60	$1 693	$1 413 518.75

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost					Life Cycle Cost		
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank	Capital Cost	Operational Cost	Maintenance Cost
3.1.1.1	$10 070.88	$86 301.48	$345 393.37	$441 765.73	1	$5 715.13	$517.98	$6 233.11	1	$30 350.10	$97 644.64	$478 065.49	$606 060.23	1	$450 448.19	$12 949.52	$142 662.52
3.1.1.2	$13 501.73	$134 784.12	$330 733.21	$479 019.07	5	$5 772.64	$776.99	$6 549.63	6	$42 753.24	$152 499.67	$457 774.08	$653 027.00	5	$489 623.26	$19 424.79	$143 978.95
3.1.1.3	$16 027.59	$163 157.83	$329 169.34	$508 354.76	9	$5 916.81	$984.99	$6 901.80	9	$52 317.28	$184 602.72	$455 609.50	$692 529.50	9	$520 392.50	$24 624.63	$147 512.37
3.1.1.4	$13 501.73	$139 854.06	$328 270.73	$481 626.52	6	$5 761.05	$776.99	$6 538.04	5	$42 753.24	$158 235.99	$454 365.71	$655 354.94	6	$492 253.57	$19 424.79	$143 676.59
3.1.1.5	$13 501.73	$144 924.00	$328 184.19	$486 609.93	7	$5 785.10	$776.99	$6 562.09	7	$42 753.24	$163 972.31	$454 245.94	$660 971.48	7	$497 281.49	$19 424.79	$144 265.21
3.1.1.6	$13 501.73	$149 993.94	$327 058.36	$490 554.04	8	$5 793.56	$776.99	$6 570.55	8	$42 753.24	$169 708.62	$452 687.65	$665 149.51	8	$501 260.64	$19 424.79	$144 464.09
3.1.1.7	$11 834.18	$115 520.19	$338 315.75	$465 670.12	4	$5 773.05	$647.49	$6 420.53	4	$36 634.39	$130 703.75	$468 269.22	$635 607.36	4	$475 382.86	$16 187.16	$144 037.35
3.1.1.8	$11 258.32	$109 098.87	$341 217.56	$461 574.75	3	$5 778.59	$604.32	$6 382.91	3	$34 560.19	$123 438.45	$472 285.67	$630 284.31	3	$470 984.30	$15 107.94	$144 192.07
3.1.1.9	$10 966.13	$105 888.22	$340 759.31	$457 613.66	2	$5 752.69	$582.73	$6 335.42	2	$33 515.74	$119 805.79	$471 651.40	$624 972.93	2	$466 852.18	$14 568.34	$143 552.41
3.1.1.10	$16 027.59	$168 836.10	$327 391.56	$512 255.26	1	$5 918.54	$984.99	$6 903.52	1	$52 317.28	$191 027.33	$453 148.84	$696 493.45	1	$524 327.53	$24 624.63	$147 541.29
RB 48 hr 3.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$30 350.10	$97 644.64	$753 242.87	$881 237.62		$651 071.64	$12 949.52	$217 216.46
RB 24 hr 3.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$30 350.10	$97 644.64	$494 915.11	$622 909.86		$462 732.74	$12 949.52	$147 227.60
3.1.4.1	$135 406.09	$2 007 523.44	$497 169.54	$2 640 099.08	1	$18 876.30	$18 848.17	$37 724.47	1	$705 160.42	$2 271 385.31	$688 141.75	$3 664 687.47	1	$2 726 594.48	$471 204.24	$466 888.75
3.1.4.2	$181 534.99	$2 913 464.00	$405 735.11	$3 500 734.11	8	$22 505.00	$28 272.99	$50 777.99	8	$1 020 482.94	$3 296 399.53	$561 585.63	$4 878 468.10	8	$3 616 301.93	$706 824.74	$555 341.43
3.1.4.3	$215 495.91	$3 611 480.34	$382 214.72	$4 209 190.97	1	$25 988.68	$35 841.41	$61 830.09	1	$1 268 371.58	$4 086 160.70	$529 030.61	$5 883 562.88	1	$4 346 839.25	$896 035.32	$640 688.32
3.1.4.4	$181 534.99	$2 918 312.55	$370 530.46	$3 470 378.00	7	$22 001.18	$28 272.99	$50 274.17	7	$1 020 482.94	$3 301 885.35	$512 858.21	$4 835 226.50	7	$3 585 668.13	$706 824.74	$542 733.63
3.1.4.5	$181 534.99	$2 923 161.10	$354 413.67	$3 459 109.76	6	$21 783.67	$28 272.99	$50 056.66	6	$1 020 482.94	$3 307 371.18	$490 550.66	$4 818 404.78	6	$3 574 296.25	$706 824.74	$537 283.79
3.1.4.6	$181 534.99	$2 928 009.64	$348 186.60	$3 457 731.24	5	$21 714.50	$28 272.99	$49 987.49	5	$1 020 482.94	$3 312 857.00	$481 931.65	$4 815 271.59	5	$3 572 904.27	$706 824.74	$535 542.58
3.1.4.7	$159 114.24	$2 465 351.14	$452 478.61	$3 076 944.00	4	$20 736.90	$23 560.58	$44 297.48	4	$863 933.87	$2 789 388.28	$626 284.19	$4 279 606.34	4	$3 178 332.72	$589 014.49	$512 259.13
3.1.4.8	$151 371.54	$2 315 980.19	$462 496.71	$2 929 848.45	3	$20 061.34	$21 989.78	$42 051.12	3	$811 285.87	$2 620 384.53	$640 150.43	$4 071 820.83	3	$3 026 332.84	$549 744.41	$495 743.58
3.1.4.9	$147 443.02	$2 241 294.71	$466 539.63	$2 855 277.36	2	$19 708.49	$21 204.37	$40 912.86	2	$784 863.07	$2 535 882.66	$645 746.31	$3 966 492.04	2	$2 949 273.74	$530 109.37	$487 108.93
3.1.4.10	$215 495.91	$3 616 903.58	$351 833.58	$4 184 233.07	9	$25 560.08	$35 841.41	$61 401.49	9	$1 268 371.58	$4 092 296.74	$486 979.50	$5 847 647.82	9	$4 321 652.77	$896 035.32	$629 959.74
RB 48 hr 3.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$705 160.42	$2 271 385.31	$753 242.87	$3 729 788.60		$2 774 057.72	$471 204.24	$484 526.63
RB 24 hr 3.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$705 160.42	$2 271 385.31	$494 915.11	$3 471 460.84		$2 585 718.83	$471 204.24	$414 537.77
3.4.1.1	$26 117.08	$260 988.68	$1 483	$1 770 949.09	1	$23 828.99	$1 935.22	$25 764.21	1	$93 505.89	$295 292.12	$2 053	$2 442 613.57	1	$1 799 160.86	$48 380.50	$595 072.22
3.4.1.2	$35 014.41	$398 392.16	$1 432	$1 866 378.31	5	$23 843.68	$2 902.91	$26 746.59	6	$133 070.92	$450 755.43	$1 983	$2 567 229.61	5	$1 899 560.85	$72 572.64	$595 096.12
3.4.1.3	$41 564.78	$489 314.97	$1 427	$1 958 116.04	9	$24 279.08	$3 679.99	$27 959.07	1	$163 815.77	$553 628.82	$1 975	$2 692 909.29	9	$1 995 155.90	$91 999.68	$605 753.71
3.4.1.4	$35 014.41	$413 310.58	$1 424	$1 872 994.04	6	$23 793.74	$2 902.91	$26 696.64	5	$133 070.92	$467 634.68	$1 971	$2 572 616.95	6	$1 906 234.19	$72 572.64	$593 810.12
3.4.1.5	$35 014.41	$428 229.00	$1 424	$1 887 359.22	7	$23 860.03	$2 902.91	$26 762.93	7	$133 070.92	$484 513.92	$1 971	$2 588 730.43	7	$1 920 727.64	$72 572.64	$595 430.16
3.4.1.6	$35 014.41	$443 147.41	$1 419	$1 897 905.30	8	$23 869.04	$2 902.91	$26 771.94	8	$133 070.92	$501 393.16	$1 965	$2 599 557.84	8	$1 931 367.17	$72 572.64	$595 618.04
3.4.1.7	$30 689.90	$340 135.12	$1 459	$1 830 089.67	4	$23 902.68	$2 419.06	$26 321.75	4	$113 502.92	$384 841.29	$2 019	$2 518 139.98	4	$1 860 946.68	$60 476.57	$596 716.72
3.4.1.8	$29 196.49	$320 716.10	$1 469	$1 819 018.18	3	$23 937.97	$2 257.78	$26 195.75	3	$106 890.57	$362 869.90	$2 033	$2 503 177.26	3	$1 849 085.29	$56 444.55	$597 647.42
3.4.1.9	$28 438.76	$311 006.59	$1 467	$1 806 551.24	2	$23 851.70	$2 177.14	$26 028.84	2	$103 565.34	$351 884.21	$2 030	$2 486 098.52	2	$1 836 155.08	$54 428.54	$595 514.90
3.4.1.10	$41 564.78	$505 934.91	$1 419	$1 967 303.66	1	$24 250.69	$3 679.99	$27 930.68	9	$163 815.77	$572 433.23	$1 965	$2 701 426.47	1	$2 004 424.27	$91 999.68	$605 002.53
RB 48 hr 3.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$93 505.89	$295 292.12	$3 184	$3 573 335.74		$2 623 535.92	$48 380.50	$901 419.32
RB 24 hr 3.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$93 505.89	$295 292.12	$2 130	$2 519 138.36		$1 854 952.75	$48 380.50	$615 805.11
3.4.4.1	$341 398.74	$6 116 636.13	$2 096	$8 555 000.23	1	$65 519.93	$67 727.54	$133 247.47	1	$2 283 061.16	$6 920 585.40	$2 902	$12 106 095.91	1	$8 790 200.72	$1 693	$1 622 706.61
3.4.4.2	$457 703.32	$8 866 841.40	$1 718	$11 042 754.90	8	$74 775.93	$101 593.95	$176 369.89	8	$3 330 673.82	$10 032 268.04	$2 378	$15 741 149.01	8	$11 354 068.91	$2 539	$1 847 231.24
3.4.4.3	$543 328.82	$10 998 744.17	$1 624	$13 166 443.52	1	$84 901.23	$128 789.74	$213 690.97	1	$4 158 513.05	$12 444 380.66	$2 248	$18 851 215.64	1	$13 536 438.28	$3 219	$2 095 033.96
3.4.4.4	$457 703.32	$8 880 552.65	$1 581	$10 919 295.88	7	$72 786.94	$101 593.95	$174 380.89	7	$3 330 673.82	$10 047 781.45	$2 188	$15 566 802.47	7	$11 229 481.58	$2 539	$1 797 472.01
3.4.4.5	$457 703.32	$8 894 263.89	$1 518	$10 870 505.79	6	$71 917.97	$101 593.95	$173 511.93	6	$3 330 673.82	$10 063 294.85	$2 101	$15 495 806.59	6	$11 180 244.08	$2 539	$1 775 713.64
3.4.4.6	$457 703.32	$8 907 975.14	$1 493	$10 859 503.27	5	$71 615.82	$101 593.95	$173 209.78	5	$3 330 673.82	$10 078 808.26	$2 067	$15 477 113.20	5	$11 169 138.72	$2 539	$1 768 125.60
3.4.4.7	$401 173.98	$7 501 505.75	$1 909	$9 812 537.63	4	$70 247.37	$84 660.75	$154 908.12	4	$2 809 671.64	$8 487 477.44	$2 643	$13 940 619.47	4	$10 086 670.22	$2 116	$1 737 430.53
3.4.4.8	$381 652.35	$7 046 393.87	$1 953	$9 381 550.69	3	$68 427.39	$79 016.35	$147 443.74	3	$2 634 831.90	$7 972 547.25	$2 703	$13 311 261.58	3	$9 642 784.13	$1 975	$1 693 068.78
3.4.4.9	$371 747.38	$6 818 837.92	$1 971	$9 162 366.68	2	$67 462.73	$76 194.15	$143 656.88	2	$2 547 162.95	$7 715 082.15	$2 729	$12 991 424.93	2	$9 417 050.04	$1 904	$1 669 521.24
3.4.4.10	$543 328.82	$11 014 046.28	$1 509	$13 066 387.14	9	$83 247.37	$128 789.74	$212 037.10	9	$4 158 513.05	$12 461 694.03	$2 088	$18 708 859.14	9	$13 435 466.70	$3 219	$2 053 649.03
RB 48 hr 3.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 283 061.16	$6 920 585.40	$3 184	$12 388 184.30		$8 995 862.77	$1 693	$1 699 132.96
RB 24 hr 3.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 283 061.16	$6 920 585.40	$2 130	$11 333 986.92		$8 227 279.60	$1 693	$1 413 518.75

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

	Capital Cost					Operation and Maintenance (per annum)				Life Cycle Cost				
Series	Pumping Station	Feeder pipe	Storage	Total	Rank	Maintenance Cost	Operational Cost	Total	Rank	Pumping Station	Feeder pipe	Storage	Total	Rank
4.1.1.1	$10 070.88	$86 301.48	$359 377.43	$455 749.78	1	$5 924.89	$517.98	$6 442.87	1	$30 350.10	$97 644.64	$497 421.08	$625 415.83	1
4.1.1.2	$13 501.73	$134 784.12	$332 420.55	$480 706.41	5	$5 797.95	$776.99	$6 574.94	7	$42 753.24	$152 499.67	$460 109.56	$655 362.47	5
4.1.1.3	$16 027.59	$163 157.83	$329 121.73	$508 307.15	9	$5 916.10	$984.99	$6 901.08	9	$52 317.28	$184 602.72	$455 543.60	$692 463.60	9
4.1.1.4	$13 501.73	$139 854.06	$329 491.07	$482 846.86	6	$5 779.35	$776.99	$6 556.35	5	$42 753.24	$158 235.99	$456 054.81	$657 044.03	6
4.1.1.5	$13 501.73	$144 924.00	$327 073.36	$485 499.10	7	$5 768.44	$776.99	$6 545.43	4	$42 753.24	$163 972.31	$452 708.42	$659 433.96	7
4.1.1.6	$13 501.73	$149 993.94	$327 992.00	$491 487.67	8	$5 807.57	$776.99	$6 584.56	8	$42 753.24	$169 708.62	$453 979.92	$666 441.78	8
4.1.1.7	$11 834.18	$115 520.19	$347 592.00	$474 946.37	4	$5 912.19	$647.49	$6 559.68	6	$36 634.39	$130 703.75	$481 108.65	$648 446.80	4
4.1.1.8	$11 258.32	$109 098.87	$351 685.65	$472 042.84	3	$5 935.61	$604.32	$6 539.93	3	$34 560.19	$123 438.45	$486 774.74	$644 773.38	3
4.1.1.9	$10 966.13	$105 888.22	$353 129.87	$469 984.21	2	$5 938.24	$582.73	$6 520.98	2	$33 515.74	$119 805.79	$488 773.71	$642 095.25	2
4.1.1.10	$16 027.59	$168 836.10	$327 403.07	$512 266.76	1	$5 918.71	$984.99	$6 903.69	1	$52 317.28	$191 027.33	$453 164.77	$696 509.38	1
RB 48 hr 4.1.1	$10 070.88	$86 301.48	$544 203.89	$640 576.25		$8 697.29	$517.98	$9 215.27		$30 350.10	$97 644.64	$753 242.87	$881 237.62	
RB 24 hr 4.1.1	$10 070.88	$86 301.48	$357 566.91	$453 939.27		$5 897.73	$517.98	$6 415.71		$30 350.10	$97 644.64	$494 915.11	$622 909.86	
4.1.4.1	$135 406.09	$2 007 523.44	$609 235.68	$2 752 165.22	1	$20 557.29	$18 848.17	$39 405.46	1	$705 160.42	$2 271 385.31	$843 254.61	$3 819 800.33	1
4.1.4.2	$181 534.99	$2 913 464.00	$486 440.82	$3 581 439.82	8	$23 715.59	$28 272.99	$51 988.58	8	$1 020 482.94	$3 296 399.53	$673 291.92	$4 990 174.40	8
4.1.4.3	$215 495.91	$3 611 480.34	$442 750.19	$4 269 726.45	1	$26 896.71	$35 841.41	$62 738.13	1	$1 268 371.58	$4 086 160.70	$612 818.90	$5 967 351.17	1
4.1.4.4	$181 534.99	$2 918 312.55	$412 744.82	$3 512 592.37	7	$22 634.39	$28 272.99	$50 907.38	7	$1 020 482.94	$3 301 885.35	$571 287.90	$4 893 656.20	7
4.1.4.5	$181 534.99	$2 923 161.10	$385 330.98	$3 490 027.07	6	$22 247.43	$28 272.99	$50 520.42	6	$1 020 482.94	$3 307 371.18	$533 343.88	$4 861 198.00	6
4.1.4.6	$181 534.99	$2 928 009.64	$369 674.63	$3 479 219.27	5	$22 036.82	$28 272.99	$50 309.81	5	$1 020 482.94	$3 312 857.00	$511 673.64	$4 845 013.58	5
4.1.4.7	$159 114.24	$2 465 351.14	$533 465.23	$3 157 930.61	4	$21 951.70	$23 560.58	$45 512.28	4	$863 933.87	$2 789 388.28	$738 379.29	$4 391 701.44	4
4.1.4.8	$151 371.54	$2 315 980.19	$545 523.53	$3 012 875.27	3	$21 306.74	$21 989.78	$43 296.52	3	$811 285.87	$2 620 384.53	$755 069.42	$4 186 739.82	3
4.1.4.9	$147 443.02	$2 241 294.71	$552 674.22	$2 941 411.94	2	$21 000.51	$21 204.37	$42 204.88	2	$784 863.07	$2 535 882.66	$764 966.82	$4 085 712.54	2
4.1.4.10	$215 495.91	$3 616 903.58	$379 218.61	$4 211 618.09	9	$25 970.86	$35 841.41	$61 812.27	9	$1 268 371.58	$4 092 296.74	$524 883.63	$5 885 551.95	9
RB 48 hr 4.1.4	$135 406.09	$2 007 523.44	$544 203.89	$2 687 133.42		$19 581.82	$18 848.17	$38 429.99		$705 160.42	$2 271 385.31	$753 242.87	$3 729 788.60	
RB 24 hr 4.1.4	$135 406.09	$2 007 523.44	$357 566.91	$2 500 496.45		$16 782.26	$18 848.17	$35 630.43		$705 160.42	$2 271 385.31	$494 915.11	$3 471 460.84	
4.4.1.1	$26 117.08	$260 988.68	$1 540	$1 827 549.45	1	$24 677.99	$1 935.22	$26 613.21	1	$93 505.89	$295 292.12	$2 132	$2 520 955.21	1
4.4.1.2	$35 014.41	$398 392.16	$1 441	$1 874 939.65	5	$23 972.10	$2 902.91	$26 875.01	8	$133 070.92	$450 755.43	$1 995	$2 579 079.52	5
4.4.1.3	$41 564.78	$489 314.97	$1 430	$1 961 280.86	9	$24 326.55	$3 679.99	$28 006.54	1	$163 815.77	$553 628.82	$1 979	$2 697 289.77	9
4.4.1.4	$35 014.41	$413 310.58	$1 431	$1 879 725.85	6	$23 894.71	$2 902.91	$26 797.62	4	$133 070.92	$467 634.68	$1 981	$2 581 934.56	6
4.4.1.5	$35 014.41	$428 229.00	$1 423	$1 886 946.19	7	$23 853.83	$2 902.91	$26 756.74	2	$133 070.92	$484 513.92	$1 970	$2 588 158.75	7
4.4.1.6	$35 014.41	$443 147.41	$1 426	$1 904 411.63	8	$23 966.63	$2 902.91	$26 869.54	7	$133 070.92	$501 393.16	$1 974	$2 608 563.38	8
4.4.1.7	$30 689.90	$340 135.12	$1 494	$1 864 905.50	4	$24 424.92	$2 419.06	$26 843.98	6	$113 502.92	$384 841.29	$2 067	$2 566 329.22	4
4.4.1.8	$29 196.49	$320 716.10	$1 510	$1 860 186.09	3	$24 555.49	$2 257.78	$26 813.27	5	$106 890.57	$362 869.90	$2 090	$2 560 158.54	3
4.4.1.9	$28 438.76	$311 006.59	$1 517	$1 857 240.17	2	$24 612.03	$2 177.14	$26 789.17	3	$103 565.34	$351 884.21	$2 100	$2 556 258.02	2
4.4.1.10	$41 564.78	$505 934.91	$1 423	$1 970 898.12	1	$24 304.61	$3 679.99	$27 984.60	9	$163 815.77	$572 433.23	$1 970	$2 706 401.64	1
RB 48 hr 4.4.1	$26 117.08	$260 988.68	$2 300	$2 587 874.70		$36 082.87	$1 935.22	$38 018.09		$93 505.89	$295 292.12	$3 184	$3 573 335.74	
RB 24 hr 4.4.1	$26 117.08	$260 988.68	$1 539	$1 826 236.81		$24 658.30	$1 935.22	$26 593.52		$93 505.89	$295 292.12	$2 130	$2 519 138.36	
4.4.4.1	$341 398.74	$6 116 636.13	$2 570	$9 028 963.50	1	$72 629.38	$67 727.54	$140 356.92	1	$2 283 061.16	$6 920 585.40	$3 558	$12 762 117.42	1
4.4.4.2	$457 703.32	$8 866 841.40	$2 053	$11 377 774.06	8	$79 801.22	$101 593.95	$181 395.18	8	$3 330 673.82	$10 032 268.04	$2 841	$16 204 855.37	8
4.4.4.3	$543 328.82	$10 998 744.17	$1 869	$13 411 717.65	1	$88 580.34	$128 789.74	$217 370.08	1	$4 158 513.05	$12 444 380.66	$2 587	$19 190 704.20	1
4.4.4.4	$457 703.32	$8 880 552.65	$1 748	$11 087 101.96	7	$75 304.03	$101 593.95	$176 897.98	7	$3 330 673.82	$10 047 781.45	$2 420	$15 799 066.03	7
4.4.4.5	$457 703.32	$8 894 263.89	$1 638	$10 990 820.07	6	$73 722.69	$101 593.95	$175 316.64	6	$3 330 673.82	$10 063 294.85	$2 268	$15 662 335.86	6
4.4.4.6	$457 703.32	$8 907 975.14	$1 578	$10 944 366.00	5	$72 888.76	$101 593.95	$174 482.72	5	$3 330 673.82	$10 078 808.26	$2 185	$15 594 573.31	5
4.4.4.7	$401 173.98	$7 501 505.75	$2 249	$10 152 618.47	4	$75 348.58	$84 660.75	$160 009.33	4	$2 809 671.64	$8 487 477.44	$3 114	$14 411 331.78	4
4.4.4.8	$381 652.35	$7 046 393.87	$2 302	$9 730 849.93	3	$73 666.88	$79 016.35	$152 683.23	3	$2 634 831.90	$7 972 547.25	$3 187	$13 794 733.25	3
4.4.4.9	$371 747.38	$6 818 837.92	$2 332	$9 522 932.11	2	$72 871.21	$76 194.15	$149 065.36	2	$2 547 162.95	$7 715 082.15	$3 228	$13 490 490.35	2
4.4.4.10	$543 328.82	$11 014 046.28	$1 615	$13 172 751.64	9	$84 842.83	$128 789.74	$213 632.57	9	$4 158 513.05	$12 461 694.03	$2 235	$18 856 080.26	9
RB 48 hr 4.4.4	$341 398.74	$6 116 636.13	$2 300	$8 758 803.81		$68 576.98	$67 727.54	$136 304.52		$2 283 061.16	$6 920 585.40	$3 184	$12 388 184.30	
RB 24 hr 4.4.4	$341 398.74	$6 116 636.13	$1 539	$7 997 165.93		$57 152.41	$67 727.54	$124 879.96		$2 283 061.16	$6 920 585.40	$2 130	$11 333 986.92	

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
$464 559.76	$12 949.52	$147 831.01
$491 325.98	$19 424.79	$144 510.44
$520 344.46	$24 624.63	$147 374.31
$493 485.03	$19 424.79	$144 032.95
$496 160.53	$19 424.79	$143 747.38
$502 202.79	$19 424.79	$144 712.94
$484 743.70	$16 187.16	$147 427.18
$481 547.84	$15 107.94	$148 033.16
$479 335.54	$14 568.34	$148 109.12
$524 339.14	$24 624.63	$147 425.40
$651 071.64	$12 949.52	$217 140.93
$462 732.74	$12 949.52	$147 152.07
$2 839 682.53	$471 204.24	$508 913.56
$3 697 743.59	$706 824.74	$585 606.07
$4 407 926.74	$896 035.32	$663 389.12
$3 628 267.44	$706 824.74	$558 564.02
$3 605 495.49	$706 824.74	$548 877.77
$3 594 588.25	$706 824.74	$543 600.59
$3 260 057.84	$589 014.49	$542 629.11
$3 110 116.77	$549 744.41	$526 878.64
$3 036 193.78	$530 109.37	$519 409.40
$4 349 287.51	$896 035.32	$640 229.12
$2 774 057.72	$471 204.24	$484 526.63
$2 585 718.83	$471 204.24	$414 537.77
$1 856 277.35	$48 380.50	$616 297.35
$1 908 200.26	$72 572.64	$598 306.62
$1 998 349.58	$91 999.68	$606 940.52
$1 913 027.38	$72 572.64	$596 334.54
$1 920 310.84	$72 572.64	$595 275.27
$1 937 932.83	$72 572.64	$598 057.91
$1 896 079.99	$60 476.57	$609 772.66
$1 890 628.61	$56 444.55	$613 085.39
$1 887 306.24	$54 428.54	$614 523.25
$2 008 051.50	$91 999.68	$606 350.46
$2 623 535.92	$48 380.50	$901 419.32
$1 854 952.75	$48 380.50	$615 805.11
$9 268 486.01	$1 693	$1 800 442.84
$11 692 143.07	$2 539	$1 972 863.42
$13 783 949.04	$3 219	$2 187 011.76
$11 398 817.87	$2 539	$1 860 399.29
$11 301 655.49	$2 539	$1 820 831.49
$11 254 775.31	$2 539	$1 799 949.13
$10 429 852.21	$2 116	$1 864 960.85
$9 995 268.59	$1 975	$1 824 055.99
$9 780 903.43	$1 904	$1 804 733.28
$13 542 801.13	$3 219	$2 093 535.72
$8 995 862.77	$1 693	$1 699 132.96
$8 227 279.60	$1 693	$1 413 518.75

APPENDIX K2: SUMMARY OF COST ESTIMATIONS AS PERCENTAGE - NO SALVAGE VALUE

University of Cape Town

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.1.1.1	2.29%	19.62%	78.09%	68.67%	91.65%	8.35%	67.33%	5.03%	16.18%	78.79%	68.47%	74.33%	2.15%	23.52%
2.1.1.2	2.83%	28.22%	68.96%	74.57%	88.10%	11.90%	70.85%	6.57%	23.42%	70.01%	73.89%	74.98%	2.98%	22.03%
2.1.1.3	3.16%	32.19%	64.65%	79.13%	85.68%	14.32%	74.66%	7.58%	26.73%	65.69%	78.36%	75.15%	3.57%	21.28%
2.1.1.4	2.80%	29.05%	68.15%	75.16%	88.11%	11.89%	70.92%	6.53%	24.15%	69.32%	74.34%	75.11%	2.97%	21.92%
2.1.1.5	2.78%	29.84%	67.38%	75.82%	88.13%	11.87%	71.05%	6.48%	24.86%	68.66%	74.85%	75.24%	2.94%	21.82%
2.1.1.6	2.75%	30.55%	66.70%	76.66%	88.19%	11.81%	71.38%	6.42%	25.49%	68.09%	75.56%	75.36%	2.92%	21.72%
2.1.1.7	2.55%	24.93%	72.52%	72.34%	89.86%	10.14%	69.31%	5.79%	20.67%	73.54%	71.77%	74.80%	2.56%	22.64%
2.1.1.8	2.44%	23.68%	73.88%	71.93%	90.51%	9.49%	69.13%	5.49%	19.62%	74.89%	71.39%	74.73%	2.40%	22.87%
2.1.1.9	2.39%	23.11%	74.50%	71.54%	90.82%	9.18%	68.86%	5.35%	19.14%	75.50%	71.02%	74.70%	2.33%	22.98%
2.1.1.10	3.13%	33.02%	63.85%	79.82%	85.70%	14.30%	74.76%	7.53%	27.48%	65.00%	78.89%	75.29%	3.54%	21.17%
RB 48 hr 2.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	3.44%	11.08%	85.48%	100.00%	73.88%	1.47%	24.65%
RB 24 hr 2.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	4.87%	15.68%	79.45%	70.69%	74.29%	2.08%	23.64%
2.1.2.1	4.08%	49.83%	46.09%	84.76%	74.47%	25.53%	83.03%	11.40%	41.57%	47.03%	84.50%	75.78%	6.21%	18.01%
2.1.2.2	4.58%	61.41%	34.01%	101.11%	67.11%	32.89%	96.67%	13.70%	51.44%	34.85%	100.36%	76.28%	7.84%	15.88%
2.1.2.3	4.75%	66.19%	29.06%	115.79%	63.50%	36.50%	110.43%	14.76%	55.46%	29.79%	114.92%	76.35%	8.68%	14.97%
2.1.2.4	4.61%	62.20%	33.19%	100.62%	66.79%	33.21%	95.76%	13.78%	52.17%	34.05%	99.77%	76.37%	7.89%	15.74%
2.1.2.5	4.59%	62.55%	32.86%	100.86%	66.76%	33.24%	95.66%	13.76%	52.50%	33.74%	99.93%	76.43%	7.87%	15.69%
2.1.2.6	4.58%	62.89%	32.52%	101.10%	66.72%	33.28%	95.55%	13.74%	52.84%	33.42%	100.08%	76.50%	7.86%	15.64%
2.1.2.7	4.34%	56.24%	39.42%	93.62%	70.64%	29.36%	90.25%	12.59%	47.06%	40.35%	93.04%	76.11%	7.05%	16.85%
2.1.2.8	4.25%	54.41%	41.35%	91.01%	71.89%	28.11%	87.97%	12.19%	45.51%	42.31%	90.48%	76.05%	6.76%	17.19%
2.1.2.9	4.20%	53.50%	42.30%	89.62%	72.50%	27.50%	86.74%	11.98%	44.74%	43.28%	89.11%	76.02%	6.62%	17.36%
2.1.2.10	4.75%	66.72%	28.52%	115.70%	63.32%	36.68%	109.91%	14.78%	55.96%	29.26%	114.73%	76.42%	8.69%	14.88%
RB 48 hr 2.1.2	3.46%	42.24%	54.30%	100.00%	78.80%	21.20%	100.00%	9.63%	35.13%	55.24%	100.00%	75.34%	5.24%	19.42%
RB 24 hr 2.1.2	4.25%	51.91%	43.84%	81.38%	73.25%	26.75%	79.25%	11.89%	43.34%	44.78%	81.06%	75.91%	6.47%	17.62%
2.1.3.1	5.01%	62.52%	32.46%	91.58%	61.69%	38.31%	90.91%	15.90%	51.43%	32.67%	91.53%	75.05%	9.60%	15.35%
2.1.3.2	5.35%	72.59%	22.06%	115.04%	54.26%	45.74%	114.22%	18.17%	59.65%	22.18%	115.09%	75.09%	11.45%	13.46%
2.1.3.3	5.41%	76.55%	18.04%	135.00%	50.97%	49.03%	135.07%	19.13%	62.78%	18.09%	135.34%	74.95%	12.35%	12.70%
2.1.3.4	5.39%	73.46%	21.15%	114.14%	53.77%	46.23%	113.00%	18.32%	60.41%	21.27%	114.13%	75.15%	11.55%	13.30%
2.1.3.5	5.40%	73.87%	20.73%	113.98%	53.60%	46.40%	112.58%	18.36%	60.77%	20.87%	113.90%	75.19%	11.57%	13.24%
2.1.3.6	5.39%	74.08%	20.52%	114.11%	53.56%	46.44%	112.47%	18.35%	60.99%	20.67%	113.97%	75.23%	11.57%	13.20%
2.1.3.7	5.19%	68.04%	26.77%	103.94%	57.73%	42.27%	102.99%	17.09%	55.97%	26.94%	103.89%	75.11%	10.57%	14.32%
2.1.3.8	5.13%	66.43%	28.44%	100.05%	58.98%	41.02%	99.05%	16.70%	54.67%	28.63%	99.96%	75.12%	10.26%	14.63%
2.1.3.9	5.10%	65.66%	29.24%	97.98%	59.59%	40.41%	96.94%	16.51%	54.04%	29.44%	97.87%	75.12%	10.10%	14.77%
2.1.3.10	5.43%	77.06%	17.51%	134.60%	50.72%	49.28%	134.37%	19.19%	63.23%	17.58%	134.87%	75.00%	12.39%	12.61%
RB 48 hr 2.1.3	4.59%	57.26%	38.15%	100.00%	65.18%	34.82%	100.00%	14.55%	47.08%	38.37%	100.00%	74.87%	8.79%	16.34%
RB 24 hr 2.1.3	5.28%	65.88%	28.84%	86.92%	59.45%	40.55%	85.87%	16.76%	54.21%	29.03%	86.84%	75.17%	10.12%	14.71%
2.1.4.1	5.13%	76.09%	18.77%	98.18%	50.00%	50.00%	98.09%	19.26%	62.02%	18.72%	98.19%	74.40%	12.87%	12.73%
2.1.4.2	5.19%	83.22%	11.59%	130.28%	44.32%	55.68%	132.14%	20.92%	67.57%	11.52%	130.80%	74.13%	14.49%	11.38%
2.1.4.3	5.12%	85.82%	9.06%	156.61%	42.02%	57.98%	160.86%	21.56%	69.47%	8.97%	157.71%	73.88%	15.23%	10.89%
2.1.4.4	5.23%	84.12%	10.65%	129.11%	43.75%	56.25%	130.78%	21.11%	68.31%	10.58%	129.60%	74.16%	14.62%	11.22%
2.1.4.5	5.25%	84.51%	10.24%	128.72%	43.52%	56.48%	130.25%	21.18%	68.64%	10.18%	129.18%	74.18%	14.67%	11.15%
2.1.4.6	5.25%	84.70%	10.05%	128.65%	43.43%	56.57%	130.04%	21.20%	68.81%	9.99%	129.07%	74.20%	14.68%	11.12%
2.1.4.7	5.18%	80.18%	14.64%	114.42%	46.77%	53.23%	115.18%	20.20%	65.23%	14.57%	114.66%	74.27%	13.77%	11.96%
2.1.4.8	5.16%	79.02%	15.81%	109.07%	47.73%	52.27%	109.46%	19.92%	64.33%	15.75%	109.21%	74.32%	13.50%	12.18%
2.1.4.9	5.16%	78.50%	16.34%	106.26%	48.17%	51.83%	106.46%	19.79%	63.93%	16.28%	106.35%	74.35%	13.36%	12.28%
2.1.4.10	5.15%	86.45%	8.40%	155.70%	41.62%	58.38%	159.76%	21.69%	69.99%	8.32%	156.76%	73.90%	15.32%	10.77%
RB 48 hr 2.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	18.91%	60.90%	20.20%	100.00%	74.38%	12.63%	12.99%
RB 24 hr 2.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	20.31%	65.43%	14.26%	93.07%	74.49%	13.57%	11.94%
2.2.1.1	1.83%	16.55%	81.62%	68.93%	91.92%	8.08%	68.08%	4.41%	13.59%	82.00%	68.83%	73.86%	2.11%	24.03%
2.2.1.2	2.30%	23.78%	73.92%	73.48%	88.41%	11.59%	71.22%	5.88%	19.60%	74.52%	73.12%	74.28%	2.99%	22.74%

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.2.1.3	2.59%	27.59%	69.82%	77.48%	86.01%	13.99%	74.76%	6.85%	22.74%	70.41%	77.08%	74.39%	3.59%	22.02%
2.2.1.4	2.29%	24.47%	73.25%	73.88%	88.41%	11.59%	71.21%	5.86%	20.19%	73.95%	73.41%	74.38%	2.97%	22.65%
2.2.1.5	2.27%	25.10%	72.63%	74.40%	88.43%	11.57%	71.34%	5.83%	20.74%	73.43%	73.83%	74.48%	2.96%	22.56%
2.2.1.6	2.25%	25.69%	72.06%	75.03%	88.47%	11.53%	71.57%	5.79%	21.26%	72.95%	74.34%	74.58%	2.94%	22.49%
2.2.1.7	2.07%	20.83%	77.10%	71.66%	90.15%	9.85%	69.78%	5.15%	17.16%	77.69%	71.34%	74.16%	2.55%	23.29%
2.2.1.8	1.98%	19.75%	78.27%	71.29%	90.77%	9.23%	69.55%	4.88%	16.27%	78.85%	70.99%	74.12%	2.39%	23.49%
2.2.1.9	1.93%	19.23%	78.83%	71.00%	91.07%	8.93%	69.32%	4.75%	15.84%	79.41%	70.71%	74.09%	2.32%	23.59%
2.2.1.10	2.57%	28.28%	69.15%	77.98%	86.02%	13.98%	74.81%	6.82%	23.35%	69.84%	77.46%	74.50%	3.57%	21.93%
RB 48 hr 2.2.1	1.26%	11.41%	87.33%	100.00%	94.50%	5.50%	100.00%	3.04%	9.36%	87.61%	100.00%	73.56%	1.46%	24.98%
RB 24 hr 2.2.1	1.77%	16.05%	82.18%	71.09%	92.18%	7.82%	70.30%	4.28%	13.18%	82.55%	71.00%	73.83%	2.05%	24.12%
2.2.2.1	3.49%	45.34%	51.16%	83.69%	74.30%	25.70%	82.58%	10.90%	37.43%	51.67%	83.56%	74.80%	6.50%	18.70%
2.2.2.2	4.01%	56.90%	39.08%	97.61%	66.56%	33.44%	95.19%	13.44%	47.04%	39.53%	97.32%	75.08%	8.37%	16.55%
2.2.2.3	4.19%	61.97%	33.84%	110.89%	62.72%	37.28%	108.27%	14.62%	51.19%	34.19%	110.64%	75.08%	9.33%	15.59%
2.2.2.4	4.03%	57.59%	38.37%	97.13%	66.28%	33.72%	94.40%	13.51%	47.65%	38.84%	96.76%	75.15%	8.42%	16.43%
2.2.2.5	4.03%	57.90%	38.07%	97.30%	66.24%	33.76%	94.30%	13.50%	47.94%	38.56%	96.86%	75.20%	8.41%	16.39%
2.2.2.6	4.02%	58.22%	37.76%	97.45%	66.19%	33.81%	94.17%	13.49%	48.24%	38.27%	96.93%	75.26%	8.40%	16.34%
2.2.2.7	3.77%	51.67%	44.56%	91.09%	70.23%	29.77%	89.12%	12.23%	42.71%	45.06%	90.83%	74.99%	7.47%	17.53%
2.2.2.8	3.68%	49.80%	46.52%	88.85%	71.55%	28.45%	87.03%	11.79%	41.16%	47.04%	88.59%	74.96%	7.15%	17.89%
2.2.2.9	3.63%	48.85%	47.52%	87.68%	72.21%	27.79%	85.93%	11.57%	40.38%	48.05%	87.42%	74.95%	6.99%	18.07%
2.2.2.10	4.20%	62.47%	33.33%	110.72%	62.55%	37.45%	107.77%	14.65%	51.64%	33.71%	110.39%	75.14%	9.35%	15.51%
RB 48 hr 2.2.2	2.92%	37.95%	59.13%	100.00%	78.78%	21.22%	100.00%	9.11%	31.28%	59.62%	100.00%	74.49%	5.43%	20.08%
RB 24 hr 2.2.2	3.63%	47.18%	49.18%	80.43%	73.17%	26.83%	79.10%	11.35%	38.97%	49.69%	80.26%	74.88%	6.76%	18.36%
2.2.3.1	4.38%	58.71%	36.91%	90.60%	61.12%	38.88%	90.36%	15.62%	47.70%	36.69%	90.65%	73.91%	10.19%	15.91%
2.2.3.2	4.76%	69.37%	25.87%	111.58%	53.13%	46.87%	112.45%	18.25%	56.14%	25.61%	112.07%	73.75%	12.36%	13.89%
2.2.3.3	4.85%	73.74%	21.41%	130.05%	49.58%	50.42%	132.53%	19.38%	59.49%	21.13%	131.04%	73.55%	13.40%	13.05%
2.2.3.4	4.80%	70.20%	24.99%	110.65%	52.65%	47.35%	111.30%	18.41%	56.84%	24.75%	111.09%	73.79%	12.47%	13.74%
2.2.3.5	4.81%	70.58%	24.61%	110.46%	52.48%	47.52%	110.92%	18.45%	57.17%	24.39%	110.85%	73.83%	12.50%	13.67%
2.2.3.6	4.81%	70.80%	24.39%	110.51%	52.42%	47.58%	110.78%	18.45%	57.37%	24.18%	110.85%	73.86%	12.50%	13.64%
2.2.3.7	4.59%	64.50%	30.91%	101.59%	56.84%	43.16%	101.75%	17.02%	52.31%	30.67%	101.82%	73.85%	11.34%	14.81%
2.2.3.8	4.52%	62.78%	32.70%	98.07%	58.17%	41.83%	98.00%	16.57%	50.96%	32.47%	98.22%	73.89%	10.97%	15.14%
2.2.3.9	4.49%	61.95%	33.56%	96.19%	58.82%	41.18%	96.00%	16.35%	50.30%	33.34%	96.29%	73.91%	10.79%	15.30%
2.2.3.10	4.87%	74.23%	20.90%	129.61%	49.33%	50.67%	131.86%	19.45%	59.91%	20.63%	130.54%	73.59%	13.45%	12.96%
RB 48 hr 2.2.3	3.96%	53.19%	42.85%	100.00%	64.86%	35.14%	100.00%	14.16%	43.24%	42.61%	100.00%	73.81%	9.23%	16.95%
RB 24 hr 2.2.3	4.62%	61.98%	33.40%	85.82%	58.88%	41.12%	85.46%	16.48%	50.34%	33.18%	85.90%	73.96%	10.75%	15.29%
2.2.4.1	4.59%	73.53%	21.89%	97.86%	48.64%	51.36%	97.90%	19.52%	59.00%	21.48%	97.90%	73.06%	13.90%	13.04%
2.2.4.2	4.70%	81.52%	13.78%	127.98%	42.40%	57.60%	130.95%	21.57%	64.99%	13.44%	128.85%	72.63%	15.85%	11.52%
2.2.4.3	4.66%	84.48%	10.86%	153.16%	39.91%	60.09%	159.11%	22.37%	67.08%	10.55%	154.82%	72.33%	16.72%	10.95%
2.2.4.4	4.75%	82.48%	12.77%	126.67%	41.79%	58.21%	129.56%	21.79%	65.76%	12.45%	127.54%	72.64%	16.01%	11.35%
2.2.4.5	4.77%	82.90%	12.34%	126.22%	41.54%	58.46%	129.02%	21.87%	66.09%	12.03%	127.07%	72.66%	16.07%	11.27%
2.2.4.6	4.77%	83.09%	12.13%	126.10%	41.45%	58.55%	128.81%	21.90%	66.27%	11.84%	126.93%	72.67%	16.09%	11.24%
2.2.4.7	4.67%	78.10%	17.24%	113.03%	45.08%	54.92%	114.44%	20.69%	62.45%	16.86%	113.46%	72.83%	15.00%	12.17%
2.2.4.8	4.64%	76.77%	18.58%	108.00%	46.13%	53.87%	108.90%	20.34%	61.46%	18.20%	108.29%	72.91%	14.66%	12.42%
2.2.4.9	4.64%	76.20%	19.16%	105.31%	46.61%	53.39%	105.95%	20.19%	61.03%	18.78%	105.52%	72.96%	14.51%	12.53%
2.2.4.10	4.69%	85.14%	10.17%	152.17%	39.50%	60.50%	158.03%	22.52%	67.61%	9.87%	153.82%	72.34%	16.83%	10.84%
RB 48 hr 2.2.4	4.49%	71.96%	23.56%	100.00%	49.72%	50.28%	100.00%	19.11%	57.76%	23.13%	100.00%	73.06%	13.61%	13.33%
RB 24 hr 2.2.4	4.87%	78.04%	17.09%	92.20%	45.55%	54.45%	92.34%	20.70%	62.55%	16.76%	92.34%	73.07%	14.74%	12.19%
2.3.1.1	1.57%	15.99%	82.44%	66.73%	92.47%	7.53%	65.83%	3.95%	13.14%	82.91%	66.60%	73.85%	1.97%	24.18%
2.3.1.2	2.00%	23.11%	74.89%	70.45%	89.09%	10.91%	68.17%	5.33%	19.07%	75.60%	70.06%	74.27%	2.81%	22.92%
2.3.1.3	2.25%	26.93%	70.82%	74.20%	86.80%	13.20%	71.40%	6.23%	22.24%	71.54%	73.74%	74.41%	3.39%	22.21%
2.3.1.4	1.99%	23.81%	74.20%	70.85%	89.09%	10.91%	68.18%	5.31%	19.67%	75.02%	70.35%	74.38%	2.80%	22.82%

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
2.3.1.5	1.97%	24.46%	73.56%	71.33%	89.11%	10.89%	68.27%	5.28%	20.25%	74.47%	70.72%	74.48%	2.79%	22.74%
2.3.1.6	1.96%	25.08%	72.96%	71.90%	89.14%	10.86%	68.47%	5.25%	20.78%	73.97%	71.19%	74.58%	2.77%	22.66%
2.3.1.7	1.79%	20.14%	78.07%	69.04%	90.77%	9.23%	67.17%	4.64%	16.61%	78.75%	68.70%	74.14%	2.39%	23.47%
2.3.1.8	1.71%	19.08%	79.21%	68.72%	91.37%	8.63%	67.00%	4.39%	15.73%	79.88%	68.41%	74.10%	2.24%	23.66%
2.3.1.9	1.67%	18.58%	79.75%	68.43%	91.65%	8.35%	66.77%	4.27%	15.31%	80.42%	68.13%	74.08%	2.17%	23.76%
2.3.1.10	2.24%	27.60%	70.17%	74.76%	86.82%	13.18%	71.53%	6.19%	22.82%	70.99%	74.18%	74.51%	3.37%	22.12%
RB 48 hr 2.3.1	1.05%	10.67%	88.28%	100.00%	95.04%	4.96%	100.00%	2.63%	8.75%	88.62%	100.00%	73.54%	1.31%	25.15%
RB 24 hr 2.3.1	1.48%	15.07%	83.44%	70.78%	92.92%	7.08%	69.99%	3.72%	12.39%	83.89%	70.66%	73.80%	1.86%	24.34%
2.3.2.1	3.04%	44.28%	52.69%	82.04%	75.66%	24.34%	80.75%	9.97%	36.66%	53.37%	81.85%	74.87%	6.14%	18.99%
2.3.2.2	3.53%	56.21%	40.26%	94.51%	67.83%	32.17%	91.65%	12.49%	46.65%	40.87%	94.07%	75.21%	8.01%	16.78%
2.3.2.3	3.70%	61.44%	34.86%	107.04%	63.97%	36.03%	103.73%	13.65%	50.97%	35.38%	106.58%	75.24%	8.96%	15.80%
2.3.2.4	3.55%	56.95%	39.50%	93.98%	67.53%	32.47%	90.80%	12.57%	47.30%	40.14%	93.47%	75.28%	8.06%	16.66%
2.3.2.5	3.55%	57.28%	39.17%	94.11%	67.48%	32.52%	90.66%	12.56%	47.62%	39.83%	93.53%	75.34%	8.05%	16.61%
2.3.2.6	3.54%	57.62%	38.84%	94.26%	67.44%	32.56%	90.54%	12.55%	47.93%	39.53%	93.60%	75.39%	8.05%	16.56%
2.3.2.7	3.28%	50.83%	45.89%	89.20%	71.68%	28.32%	86.75%	11.23%	42.18%	46.59%	88.79%	75.13%	7.07%	17.80%
2.3.2.8	3.19%	49.02%	47.79%	87.20%	72.99%	27.01%	84.87%	10.80%	40.68%	48.52%	86.79%	75.10%	6.75%	18.15%
2.3.2.9	3.15%	48.16%	48.69%	86.06%	73.61%	26.39%	83.79%	10.59%	39.97%	49.44%	85.65%	75.09%	6.60%	18.31%
2.3.2.10	3.71%	61.95%	34.34%	106.87%	63.80%	36.20%	103.23%	13.68%	51.44%	34.88%	106.33%	75.31%	8.98%	15.71%
RB 48 hr 2.3.2	2.49%	36.32%	61.19%	100.00%	80.35%	19.65%	100.00%	8.16%	30.00%	61.83%	100.00%	74.51%	5.02%	20.46%
RB 24 hr 2.3.2	3.12%	45.55%	51.33%	79.75%	74.90%	25.10%	78.30%	10.27%	37.73%	52.01%	79.53%	74.93%	6.31%	18.76%
2.3.3.1	3.83%	57.79%	38.38%	89.33%	62.66%	37.34%	88.95%	14.50%	47.18%	38.33%	89.34%	74.09%	9.72%	16.20%
2.3.3.2	4.22%	68.98%	26.80%	108.85%	54.37%	45.63%	109.19%	17.17%	56.14%	26.69%	109.19%	73.99%	11.92%	14.08%
2.3.3.3	4.31%	73.51%	22.18%	126.59%	50.73%	49.27%	128.20%	18.30%	59.67%	22.02%	127.33%	73.82%	12.96%	13.22%
2.3.3.4	4.26%	69.88%	25.86%	107.84%	53.85%	46.15%	107.96%	17.34%	56.90%	25.76%	108.13%	74.04%	12.04%	13.92%
2.3.3.5	4.27%	70.29%	25.44%	107.60%	53.66%	46.34%	107.51%	17.38%	57.27%	25.35%	107.84%	74.07%	12.07%	13.85%
2.3.3.6	4.26%	70.49%	25.24%	107.69%	53.61%	46.39%	107.41%	17.38%	57.46%	25.17%	107.88%	74.11%	12.07%	13.82%
2.3.3.7	4.04%	63.80%	32.16%	99.62%	58.26%	41.74%	99.47%	15.91%	52.02%	32.08%	99.76%	74.06%	10.88%	15.06%
2.3.3.8	3.97%	61.97%	34.06%	96.37%	59.66%	40.34%	96.05%	15.45%	50.56%	33.99%	96.45%	74.09%	10.50%	15.41%
2.3.3.9	3.95%	61.13%	34.92%	94.54%	60.31%	39.69%	94.14%	15.24%	49.89%	34.87%	94.59%	74.10%	10.32%	15.57%
2.3.3.10	4.32%	74.03%	21.65%	126.13%	50.46%	49.54%	127.51%	18.38%	60.12%	21.51%	126.81%	73.86%	13.02%	13.13%
RB 48 hr 2.3.3	3.43%	51.62%	44.95%	100.00%	66.78%	33.22%	100.00%	12.95%	42.15%	44.90%	100.00%	73.96%	8.68%	17.36%
RB 24 hr 2.3.3	4.02%	60.65%	35.33%	85.12%	60.73%	39.27%	84.59%	15.21%	49.51%	35.28%	85.14%	74.15%	10.20%	15.66%
2.3.4.1	4.06%	73.09%	22.85%	97.07%	49.93%	50.07%	97.08%	18.41%	59.01%	22.57%	97.11%	73.35%	13.41%	13.24%
2.3.4.2	4.18%	81.49%	14.32%	126.21%	43.40%	56.60%	128.81%	20.51%	65.42%	14.06%	126.99%	72.97%	15.38%	11.65%
2.3.4.3	4.16%	84.57%	11.27%	150.85%	40.82%	59.18%	156.16%	21.33%	67.64%	11.03%	152.34%	72.68%	16.25%	11.06%
2.3.4.4	4.23%	82.52%	13.25%	124.82%	42.74%	57.26%	127.33%	20.74%	66.25%	13.01%	125.59%	72.98%	15.55%	11.46%
2.3.4.5	4.25%	82.94%	12.82%	124.38%	42.49%	57.51%	126.78%	20.82%	66.59%	12.59%	125.12%	73.00%	15.61%	11.39%
2.3.4.6	4.25%	83.16%	12.58%	124.23%	42.38%	57.62%	126.53%	20.85%	66.79%	12.36%	124.94%	73.02%	15.63%	11.35%
2.3.4.7	4.14%	77.79%	18.07%	111.86%	46.27%	53.73%	113.08%	19.59%	62.62%	17.79%	112.24%	73.15%	14.50%	12.35%
2.3.4.8	4.12%	76.43%	19.45%	106.95%	47.35%	52.65%	107.71%	19.24%	61.58%	19.18%	107.20%	73.22%	14.17%	12.61%
2.3.4.9	4.11%	75.84%	20.05%	104.30%	47.84%	52.16%	104.83%	19.08%	61.14%	19.77%	104.49%	73.26%	14.02%	12.72%
2.3.4.10	4.18%	85.25%	10.56%	149.84%	40.39%	59.61%	155.04%	21.48%	68.19%	10.33%	151.32%	72.70%	16.36%	10.94%
RB 48 hr 2.3.4	3.94%	70.95%	25.11%	100.00%	51.40%	48.60%	100.00%	17.88%	57.31%	24.81%	100.00%	73.33%	13.02%	13.64%
RB 24 hr 2.3.4	4.30%	77.38%	18.32%	91.69%	46.99%	53.01%	91.69%	19.48%	62.44%	18.08%	91.79%	73.37%	14.19%	12.44%
2.4.1.1	1.48%	14.75%	83.77%	68.36%	92.48%	7.52%	67.70%	3.83%	12.10%	84.07%	68.29%	73.66%	1.98%	24.36%
2.4.1.2	1.88%	21.37%	76.75%	72.03%	89.13%	10.87%	70.26%	5.19%	17.58%	77.23%	71.76%	73.99%	2.83%	23.18%
2.4.1.3	2.13%	25.02%	72.86%	75.58%	86.82%	13.18%	73.45%	6.09%	20.58%	73.33%	75.27%	74.09%	3.42%	22.49%
2.4.1.4	1.87%	22.06%	76.07%	72.40%	89.13%	10.87%	70.25%	5.17%	18.17%	76.66%	72.02%	74.10%	2.82%	23.08%
2.4.1.5	1.86%	22.70%	75.44%	72.90%	89.15%	10.85%	70.36%	5.14%	18.72%	76.13%	72.41%	74.20%	2.80%	23.00%
2.4.1.6	1.84%	23.30%	74.86%	73.51%	89.18%	10.82%	70.59%	5.11%	19.24%	75.65%	72.92%	74.29%	2.79%	22.92%

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost			
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design
	As % of total capital cost				As % of total O&M			As % of total LCC cost			
2.4.1.7	1.68%	18.63%	79.69%	70.57%	90.79%	9.21%	69.08%	4.52%	15.32%	80.17%	70.32%
2.4.1.8	1.60%	17.62%	80.77%	70.32%	91.38%	8.62%	68.93%	4.27%	14.49%	81.24%	70.08%
2.4.1.9	1.57%	17.15%	81.28%	70.08%	91.67%	8.33%	68.74%	4.15%	14.10%	81.75%	69.85%
2.4.1.10	2.11%	25.71%	72.18%	76.04%	86.83%	13.17%	73.49%	6.06%	21.18%	72.75%	75.62%
RB 48 hr 2.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.62%	8.26%	89.12%	100.00%
RB 24 hr 2.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.71%	11.72%	84.57%	70.50%
2.4.2.1	2.93%	42.23%	54.84%	82.72%	75.35%	24.65%	81.83%	10.02%	34.76%	55.22%	82.62%
2.4.2.2	3.43%	53.91%	42.65%	94.75%	67.45%	32.55%	92.97%	12.61%	44.41%	42.98%	94.57%
2.4.2.3	3.61%	59.19%	37.19%	106.87%	63.49%	36.51%	105.07%	13.85%	48.71%	37.44%	106.78%
2.4.2.4	3.45%	54.64%	41.90%	94.21%	67.15%	32.85%	92.12%	12.70%	45.05%	42.26%	93.96%
2.4.2.5	3.45%	54.97%	41.58%	94.37%	67.11%	32.89%	92.02%	12.68%	45.35%	41.97%	94.05%
2.4.2.6	3.44%	55.32%	41.24%	94.50%	67.06%	32.94%	91.87%	12.68%	45.67%	41.65%	94.11%
2.4.2.7	3.20%	48.57%	48.23%	89.13%	71.22%	28.78%	87.62%	11.37%	40.01%	48.61%	88.95%
2.4.2.8	3.11%	46.67%	50.22%	87.18%	72.56%	27.44%	85.76%	10.93%	38.45%	50.62%	87.00%
2.4.2.9	3.07%	45.74%	51.19%	86.11%	73.21%	26.79%	84.73%	10.71%	37.69%	51.60%	85.92%
2.4.2.10	3.62%	59.73%	36.65%	106.65%	63.30%	36.70%	104.53%	13.89%	49.18%	36.92%	106.48%
RB 48 hr 2.4.2	2.43%	34.93%	62.64%	100.00%	79.83%	20.17%	100.00%	8.28%	28.72%	63.00%	100.00%
RB 24 hr 2.4.2	3.06%	44.07%	52.87%	79.26%	74.20%	25.80%	78.20%	10.46%	36.29%	53.26%	79.14%
2.4.3.1	3.72%	55.65%	40.63%	90.17%	62.30%	37.70%	90.08%	14.63%	45.09%	40.27%	90.25%
2.4.3.2	4.14%	67.09%	28.77%	108.78%	53.74%	46.26%	110.14%	17.51%	54.11%	28.39%	109.39%
2.4.3.3	4.24%	71.80%	23.97%	126.00%	49.98%	50.02%	129.12%	18.74%	57.70%	23.56%	127.15%
2.4.3.4	4.18%	67.99%	27.83%	107.75%	53.22%	46.78%	108.91%	17.68%	54.85%	27.47%	108.31%
2.4.3.5	4.18%	68.40%	27.42%	107.52%	53.04%	46.96%	108.49%	17.73%	55.21%	27.07%	108.03%
2.4.3.6	4.18%	68.64%	27.18%	107.56%	52.97%	47.03%	108.34%	17.73%	55.42%	26.85%	108.02%
2.4.3.7	3.95%	61.92%	34.13%	99.77%	57.66%	42.34%	100.27%	16.18%	50.06%	33.76%	100.08%
2.4.3.8	3.88%	60.10%	36.01%	96.58%	59.06%	40.94%	96.79%	15.71%	48.64%	35.65%	96.78%
2.4.3.9	3.85%	59.23%	36.91%	94.84%	59.74%	40.26%	94.91%	15.48%	47.96%	36.56%	95.00%
2.4.3.10	4.26%	72.34%	23.40%	125.49%	49.69%	50.31%	128.39%	18.82%	58.16%	23.02%	126.58%
RB 48 hr 2.4.3	3.36%	50.18%	46.47%	100.00%	66.03%	33.97%	100.00%	13.21%	40.69%	46.10%	100.00%
RB 24 hr 2.4.3	3.97%	59.30%	36.74%	84.62%	59.80%	40.20%	84.49%	15.59%	48.02%	36.39%	84.74%
2.4.4.1	3.99%	71.54%	24.47%	97.61%	49.14%	50.86%	97.70%	18.87%	57.20%	23.93%	97.67%
2.4.4.2	4.14%	80.27%	15.59%	126.12%	42.42%	57.58%	129.44%	21.15%	63.71%	15.14%	127.11%
2.4.4.3	4.13%	83.54%	12.33%	150.32%	39.73%	60.27%	156.77%	22.06%	66.02%	11.92%	152.16%
2.4.4.4	4.19%	81.34%	14.47%	124.65%	41.73%	58.27%	127.92%	21.40%	64.56%	14.04%	125.64%
2.4.4.5	4.21%	81.80%	13.99%	124.14%	41.46%	58.54%	127.32%	21.49%	64.93%	13.58%	125.11%
2.4.4.6	4.21%	82.03%	13.76%	123.99%	41.35%	58.65%	127.08%	21.52%	65.12%	13.36%	124.94%
2.4.4.7	4.09%	76.51%	19.40%	111.95%	45.31%	54.69%	113.57%	20.17%	60.93%	18.90%	112.45%
2.4.4.8	4.07%	75.06%	20.88%	107.19%	46.45%	53.55%	108.25%	19.78%	59.85%	20.37%	107.53%
2.4.4.9	4.06%	74.43%	21.51%	104.60%	46.96%	53.04%	105.38%	19.61%	59.39%	21.00%	104.86%
2.4.4.10	4.16%	84.28%	11.56%	149.20%	39.27%	60.73%	155.58%	22.23%	66.60%	11.17%	151.04%
RB 48 hr 2.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.43%	55.86%	25.71%	100.00%
RB 24 hr 2.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	20.14%	61.06%	18.80%	91.49%
1.2.1.1	1.97%	17.79%	80.24%	64.11%	91.29%	8.71%	63.14%	4.74%	14.62%	80.64%	64.00%
1.2.1.2	2.49%	25.75%	71.75%	67.86%	87.39%	12.61%	65.43%	6.37%	21.24%	72.39%	67.48%
1.2.1.3	2.79%	29.75%	67.45%	71.85%	84.83%	15.17%	68.97%	7.39%	24.54%	68.06%	71.43%
1.2.1.4	2.48%	26.52%	71.00%	68.16%	87.37%	12.63%	65.34%	6.36%	21.90%	71.74%	67.68%
1.2.1.5	2.46%	27.21%	70.33%	68.65%	87.39%	12.61%	65.42%	6.32%	22.51%	71.17%	68.05%
1.2.1.6	2.44%	27.80%	69.76%	69.33%	87.44%	12.56%	65.71%	6.27%	23.03%	70.70%	68.62%
1.2.1.7	2.23%	22.43%	75.34%	66.55%	89.34%	10.66%	64.53%	5.55%	18.49%	75.96%	66.21%
1.2.1.8	2.13%	21.25%	76.62%	66.25%	90.03%	9.97%	64.37%	5.25%	17.51%	77.23%	65.93%

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
As % of total LCC cost		
73.90%	2.41%	23.69%
73.87%	2.25%	23.88%
73.85%	2.18%	23.97%
74.20%	3.40%	22.40%
73.42%	1.35%	25.23%
73.63%	1.92%	24.45%
74.40%	6.33%	19.27%
74.62%	8.29%	17.09%
74.60%	9.31%	16.09%
74.68%	8.35%	16.97%
74.74%	8.34%	16.92%
74.79%	8.34%	16.87%
74.55%	7.35%	18.10%
74.53%	7.01%	18.46%
74.52%	6.85%	18.63%
74.66%	9.34%	16.00%
74.14%	5.23%	20.63%
74.47%	6.61%	18.93%
73.50%	10.03%	16.47%
73.29%	12.41%	14.30%
73.06%	13.54%	13.40%
73.32%	12.54%	14.14%
73.36%	12.57%	14.07%
73.39%	12.57%	14.04%
73.41%	11.31%	15.29%
73.45%	10.91%	15.63%
73.48%	10.72%	15.80%
73.10%	13.60%	13.30%
73.44%	9.05%	17.51%
73.53%	10.68%	15.78%
72.61%	13.99%	13.40%
72.13%	16.13%	11.74%
71.81%	17.08%	11.11%
72.14%	16.32%	11.54%
72.15%	16.39%	11.46%
72.17%	16.41%	11.42%
72.35%	15.19%	12.45%
72.44%	14.83%	12.73%
72.49%	14.66%	12.85%
71.81%	17.21%	10.98%
72.62%	13.67%	13.72%
72.59%	14.94%	12.47%
73.93%	2.27%	23.79%
74.39%	3.24%	22.37%
74.51%	3.87%	21.62%
74.50%	3.23%	22.27%
74.61%	3.21%	22.18%
74.71%	3.18%	22.10%
74.26%	2.75%	23.00%
74.21%	2.58%	23.22%

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
1.2.1.9	2.08%	20.70%	77.22%	65.98%	90.36%	9.64%	64.17%	5.11%	17.05%	77.84%	65.67%	74.19%	2.49%	23.32%
1.2.1.10	2.78%	30.51%	66.71%	72.27%	84.83%	15.17%	68.94%	7.36%	25.21%	67.42%	71.73%	74.63%	3.86%	21.51%
RB 48 hr 1.2.1	1.26%	11.41%	87.33%	100.00%	94.50%	5.50%	100.00%	3.04%	9.36%	87.61%	100.00%	73.56%	1.46%	24.98%
RB 24 hr 1.2.1	1.77%	16.05%	82.18%	71.09%	92.18%	7.82%	70.30%	4.28%	13.18%	82.55%	71.00%	73.83%	2.05%	24.12%
1.2.2.1	3.60%	46.74%	49.66%	81.19%	73.44%	26.56%	79.91%	11.24%	38.60%	50.16%	81.03%	74.86%	6.70%	18.44%
1.2.2.2	4.16%	58.97%	36.87%	94.18%	65.22%	34.78%	91.54%	13.93%	48.77%	37.30%	93.86%	75.16%	8.68%	16.16%
1.2.2.3	4.34%	64.07%	31.59%	107.25%	61.34%	38.66%	104.38%	15.12%	52.94%	31.93%	106.97%	75.16%	9.65%	15.19%
1.2.2.4	4.19%	59.87%	35.93%	93.43%	64.80%	35.20%	90.45%	14.05%	49.56%	36.39%	93.03%	75.24%	8.75%	16.01%
1.2.2.5	4.19%	60.27%	35.54%	93.48%	64.71%	35.29%	90.22%	14.06%	49.92%	36.02%	93.01%	75.30%	8.76%	15.95%
1.2.2.6	4.18%	60.59%	35.23%	93.65%	64.67%	35.33%	90.11%	14.04%	50.23%	35.73%	93.10%	75.35%	8.75%	15.90%
1.2.2.7	3.88%	53.24%	42.87%	88.40%	69.24%	30.76%	86.25%	12.61%	44.03%	43.37%	88.11%	75.06%	7.70%	17.24%
1.2.2.8	3.79%	51.33%	44.87%	86.19%	70.59%	29.41%	84.19%	12.16%	42.45%	45.39%	85.91%	75.03%	7.37%	17.60%
1.2.2.9	3.74%	50.40%	45.86%	84.99%	71.25%	28.75%	83.06%	11.94%	41.67%	46.39%	84.71%	75.01%	7.21%	17.78%
1.2.2.10	4.35%	64.71%	30.94%	106.88%	61.07%	38.93%	103.67%	15.19%	53.52%	31.30%	106.52%	75.22%	9.69%	15.08%
RB 48 hr 1.2.2	2.92%	37.95%	59.13%	100.00%	78.78%	21.22%	100.00%	9.11%	31.28%	59.62%	100.00%	74.49%	5.43%	20.08%
RB 24 hr 1.2.2	3.63%	47.18%	49.18%	80.43%	73.17%	26.83%	79.10%	11.35%	38.97%	49.69%	80.26%	74.88%	6.76%	18.36%
1.2.3.1	4.45%	59.71%	35.84%	89.08%	60.44%	39.56%	88.81%	15.88%	48.50%	35.62%	89.15%	73.93%	10.36%	15.72%
1.2.3.2	4.86%	70.84%	24.29%	109.25%	52.12%	47.88%	110.07%	18.63%	57.32%	24.05%	109.76%	73.77%	12.62%	13.61%
1.2.3.3	4.95%	75.18%	19.87%	127.56%	48.59%	51.41%	129.97%	19.75%	60.64%	19.61%	128.56%	73.56%	13.66%	12.78%
1.2.3.4	4.92%	71.89%	23.20%	108.06%	51.49%	48.51%	108.65%	18.84%	58.19%	22.97%	108.52%	73.82%	12.76%	13.42%
1.2.3.5	4.93%	72.31%	22.77%	107.82%	51.29%	48.71%	108.21%	18.89%	58.55%	22.55%	108.23%	73.85%	12.80%	13.35%
1.2.3.6	4.93%	72.55%	22.52%	107.83%	51.21%	48.79%	108.04%	18.90%	58.78%	22.32%	108.19%	73.89%	12.80%	13.31%
1.2.3.7	4.67%	65.62%	29.71%	99.85%	56.07%	43.93%	99.97%	17.31%	53.22%	29.47%	100.09%	73.87%	11.53%	14.60%
1.2.3.8	4.60%	63.86%	31.54%	96.41%	57.43%	42.57%	96.30%	16.85%	51.83%	31.32%	96.56%	73.91%	11.16%	14.94%
1.2.3.9	4.57%	63.08%	32.36%	94.47%	58.05%	41.95%	94.24%	16.65%	51.21%	32.14%	94.58%	73.93%	10.98%	15.09%
1.2.3.10	4.97%	75.82%	19.21%	126.90%	48.24%	51.76%	129.09%	19.86%	61.17%	18.96%	127.85%	73.60%	13.73%	12.67%
RB 48 hr 1.2.3	3.96%	53.19%	42.85%	100.00%	64.86%	35.14%	100.00%	14.16%	43.24%	42.61%	100.00%	73.81%	9.23%	16.95%
RB 24 hr 1.2.3	4.62%	61.98%	33.40%	85.82%	58.88%	41.12%	85.46%	16.48%	50.34%	33.18%	85.90%	73.96%	10.75%	15.29%
1.2.4.1	4.62%	74.05%	21.33%	97.17%	48.28%	51.72%	97.22%	19.66%	59.41%	20.93%	97.22%	73.06%	14.00%	12.94%
1.2.4.2	4.74%	82.18%	13.08%	126.95%	41.96%	58.04%	129.94%	21.74%	65.51%	12.75%	127.84%	72.63%	15.97%	11.40%
1.2.4.3	4.70%	85.14%	10.16%	151.98%	39.47%	60.53%	157.95%	22.54%	67.59%	9.87%	153.66%	72.32%	16.84%	10.83%
1.2.4.4	4.80%	83.32%	11.89%	125.40%	41.22%	58.78%	128.32%	22.01%	66.41%	11.59%	126.29%	72.64%	16.17%	11.19%
1.2.4.5	4.82%	83.79%	11.39%	124.88%	40.94%	59.06%	127.70%	22.10%	66.79%	11.11%	125.75%	72.66%	16.24%	11.11%
1.2.4.6	4.82%	84.03%	11.15%	124.70%	40.81%	59.19%	127.43%	22.14%	66.99%	10.87%	125.55%	72.67%	16.26%	11.07%
1.2.4.7	4.70%	78.65%	16.65%	112.23%	44.70%	55.30%	113.66%	20.84%	62.88%	16.29%	112.68%	72.83%	15.10%	12.07%
1.2.4.8	4.68%	77.34%	17.98%	107.21%	45.75%	54.25%	108.12%	20.49%	61.90%	17.61%	107.51%	72.91%	14.77%	12.32%
1.2.4.9	4.68%	76.77%	18.55%	104.51%	46.22%	53.78%	105.17%	20.34%	61.49%	18.18%	104.75%	72.96%	14.62%	12.43%
1.2.4.10	4.74%	85.91%	9.35%	150.81%	38.98%	61.02%	156.69%	22.71%	68.20%	9.08%	152.49%	72.33%	16.97%	10.69%
RB 48 hr 1.2.4	4.49%	71.96%	23.56%	100.00%	49.72%	50.28%	100.00%	19.11%	57.76%	23.13%	100.00%	73.06%	13.61%	13.33%
RB 24 hr 1.2.4	4.87%	78.04%	17.09%	92.20%	45.55%	54.45%	92.34%	20.70%	62.55%	16.76%	92.34%	73.07%	14.74%	12.19%
1.4.1.1	1.59%	15.89%	82.52%	63.46%	91.88%	8.12%	62.69%	4.13%	13.04%	82.83%	63.38%	73.72%	2.14%	24.15%
1.4.1.2	2.04%	23.22%	74.74%	66.30%	88.15%	11.85%	64.41%	5.64%	19.11%	75.25%	66.01%	74.09%	3.08%	22.83%
1.4.1.3	2.30%	27.07%	70.63%	69.85%	85.68%	14.32%	67.61%	6.59%	22.28%	71.13%	69.53%	74.19%	3.70%	22.11%
1.4.1.4	2.03%	23.99%	73.98%	66.58%	88.13%	11.87%	64.31%	5.63%	19.77%	74.60%	66.19%	74.20%	3.07%	22.73%
1.4.1.5	2.02%	24.68%	73.30%	67.05%	88.14%	11.86%	64.39%	5.60%	20.38%	74.03%	66.55%	74.31%	3.05%	22.64%
1.4.1.6	2.00%	25.29%	72.71%	67.72%	88.19%	11.81%	64.68%	5.55%	20.91%	73.54%	67.11%	74.41%	3.03%	22.56%
1.4.1.7	1.81%	20.11%	78.08%	65.36%	90.02%	9.98%	63.76%	4.88%	16.54%	78.58%	65.10%	73.98%	2.60%	23.42%
1.4.1.8	1.73%	19.01%	79.26%	65.19%	90.68%	9.32%	63.70%	4.61%	15.64%	79.76%	64.94%	73.95%	2.43%	23.62%
1.4.1.9	1.69%	18.49%	79.81%	64.98%	90.99%	9.01%	63.53%	4.48%	15.21%	80.31%	64.73%	73.93%	2.35%	23.72%
1.4.1.10	2.29%	27.84%	69.87%	70.22%	85.67%	14.33%	67.55%	6.57%	22.96%	70.48%	69.79%	74.31%	3.69%	22.00%

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
RB 48 hr 1.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.62%	8.26%	89.12%	100.00%	73.42%	1.35%	25.23%
RB 24 hr 1.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.71%	11.72%	84.57%	70.50%	73.63%	1.92%	24.45%
1.4.2.1	3.03%	43.63%	53.34%	80.07%	74.48%	25.52%	79.05%	10.35%	35.92%	53.73%	79.95%	74.45%	6.54%	19.01%
1.4.2.2	3.57%	56.06%	40.37%	91.12%	66.06%	33.94%	89.15%	13.12%	46.19%	40.69%	90.92%	74.69%	8.63%	16.69%
1.4.2.3	3.75%	61.41%	34.84%	103.00%	62.02%	37.98%	101.01%	14.38%	50.55%	35.08%	102.89%	74.66%	9.66%	15.67%
1.4.2.4	3.60%	57.01%	39.38%	90.30%	65.62%	34.38%	88.01%	13.25%	47.02%	39.73%	90.02%	74.76%	8.71%	16.52%
1.4.2.5	3.60%	57.43%	38.96%	90.33%	65.52%	34.48%	87.76%	13.26%	47.40%	39.34%	89.98%	74.82%	8.72%	16.46%
1.4.2.6	3.60%	57.78%	38.62%	90.47%	65.47%	34.53%	87.64%	13.25%	47.73%	39.03%	90.05%	74.88%	8.71%	16.41%
1.4.2.7	3.31%	50.16%	46.53%	86.29%	70.20%	29.80%	84.63%	11.75%	41.34%	46.91%	86.09%	74.61%	7.59%	17.80%
1.4.2.8	3.22%	48.23%	48.56%	84.36%	71.57%	28.43%	82.79%	11.30%	39.75%	48.95%	84.16%	74.59%	7.25%	18.16%
1.4.2.9	3.17%	47.28%	49.55%	83.31%	72.25%	27.75%	81.78%	11.07%	38.97%	49.96%	83.11%	74.58%	7.08%	18.34%
1.4.2.10	3.77%	62.10%	34.14%	102.58%	61.74%	38.26%	100.25%	14.45%	51.15%	34.40%	102.39%	74.73%	9.71%	15.56%
RB 48 hr 1.4.2	2.43%	34.93%	62.64%	100.00%	79.83%	20.17%	100.00%	8.28%	28.72%	63.00%	100.00%	74.14%	5.23%	20.63%
RB 24 hr 1.4.2	3.06%	44.07%	52.87%	79.26%	74.20%	25.80%	78.20%	10.46%	36.29%	53.26%	79.14%	74.47%	6.61%	18.93%
1.4.3.1	3.79%	56.71%	39.50%	88.49%	61.57%	38.43%	88.39%	14.91%	45.94%	39.15%	88.58%	73.51%	10.22%	16.27%
1.4.3.2	4.23%	68.68%	27.09%	106.26%	52.65%	47.35%	107.60%	17.92%	55.37%	26.71%	106.89%	73.29%	12.70%	14.00%
1.4.3.3	4.33%	73.37%	22.30%	123.29%	48.90%	51.10%	126.39%	19.14%	58.95%	21.91%	124.46%	73.07%	13.83%	13.10%
1.4.3.4	4.29%	69.81%	25.90%	104.94%	51.97%	48.03%	106.07%	18.15%	56.30%	25.55%	105.53%	73.34%	12.87%	13.80%
1.4.3.5	4.30%	70.27%	25.43%	104.66%	51.75%	48.25%	105.60%	18.20%	56.70%	25.10%	105.19%	73.37%	12.91%	13.72%
1.4.3.6	4.30%	70.55%	25.15%	104.65%	51.66%	48.34%	105.40%	18.21%	56.95%	24.84%	105.14%	73.41%	12.91%	13.68%
1.4.3.7	4.03%	63.11%	32.86%	97.89%	56.84%	43.16%	98.37%	16.49%	51.01%	32.49%	98.21%	73.42%	11.52%	15.06%
1.4.3.8	3.96%	61.25%	34.80%	94.77%	58.28%	41.72%	94.97%	16.01%	49.55%	34.44%	94.99%	73.47%	11.12%	15.42%
1.4.3.9	3.93%	60.42%	35.65%	92.98%	58.93%	41.07%	93.03%	15.79%	48.91%	35.30%	93.15%	73.49%	10.93%	15.58%
1.4.3.10	4.36%	74.07%	21.57%	122.56%	48.51%	51.49%	125.43%	19.27%	59.53%	21.21%	123.68%	73.10%	13.92%	12.98%
RB 48 hr 1.4.3	3.36%	50.18%	46.47%	100.00%	66.03%	33.97%	100.00%	13.21%	40.69%	46.10%	100.00%	73.44%	9.05%	17.51%
RB 24 hr 1.4.3	3.97%	59.30%	36.74%	84.62%	59.80%	40.20%	84.49%	15.59%	48.02%	36.39%	84.74%	73.53%	10.68%	15.78%
1.4.4.1	4.02%	72.11%	23.86%	96.84%	48.75%	51.25%	96.95%	19.02%	57.65%	23.34%	96.91%	72.61%	14.10%	13.29%
1.4.4.2	4.18%	81.00%	14.81%	124.97%	41.92%	58.08%	128.33%	21.34%	64.28%	14.38%	125.99%	72.12%	16.27%	11.60%
1.4.4.3	4.16%	84.28%	11.56%	149.00%	39.24%	60.76%	155.50%	22.25%	66.58%	11.17%	150.88%	71.80%	17.23%	10.98%
1.4.4.4	4.24%	82.28%	13.48%	123.23%	41.10%	58.90%	126.55%	21.64%	65.28%	13.09%	124.26%	72.13%	16.50%	11.37%
1.4.4.5	4.26%	82.80%	12.93%	122.63%	40.79%	59.21%	125.88%	21.74%	65.70%	12.55%	123.64%	72.14%	16.58%	11.28%
1.4.4.6	4.27%	83.07%	12.66%	122.43%	40.64%	59.36%	125.57%	21.79%	65.93%	12.29%	123.41%	72.16%	16.61%	11.23%
1.4.4.7	4.12%	77.12%	18.76%	111.06%	44.89%	55.11%	112.71%	20.33%	61.40%	18.27%	111.58%	72.35%	15.31%	12.34%
1.4.4.8	4.10%	75.68%	20.22%	106.30%	46.02%	53.98%	107.39%	19.94%	60.34%	19.72%	106.66%	72.44%	14.95%	12.61%
1.4.4.9	4.09%	75.06%	20.85%	103.72%	46.53%	53.47%	104.53%	19.77%	59.88%	20.35%	104.00%	72.48%	14.79%	12.73%
1.4.4.10	4.20%	85.15%	10.65%	147.68%	38.69%	61.31%	154.11%	22.45%	67.26%	10.29%	149.55%	71.80%	17.38%	10.82%
RB 48 hr 1.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.43%	55.86%	25.71%	100.00%	72.62%	13.67%	13.72%
RB 24 hr 1.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	20.14%	61.06%	18.80%	91.49%	72.59%	14.94%	12.47%
3.1.1.1	2.28%	19.54%	78.18%	68.96%	91.69%	8.31%	67.64%	5.01%	16.11%	78.88%	68.77%	74.32%	2.14%	23.54%
3.1.1.2	2.82%	28.14%	69.04%	74.78%	88.14%	11.86%	71.07%	6.55%	23.35%	70.10%	74.10%	74.98%	2.97%	22.05%
3.1.1.3	3.15%	32.10%	64.75%	79.36%	85.73%	14.27%	74.90%	7.55%	26.66%	65.79%	78.59%	75.14%	3.56%	21.30%
3.1.1.4	2.80%	29.04%	68.16%	75.19%	88.12%	11.88%	70.95%	6.52%	24.15%	69.33%	74.37%	75.11%	2.96%	21.92%
3.1.1.5	2.77%	29.78%	67.44%	75.96%	88.16%	11.84%	71.21%	6.47%	24.81%	68.72%	75.00%	75.23%	2.94%	21.83%
3.1.1.6	2.75%	30.58%	66.67%	76.58%	88.17%	11.83%	71.30%	6.43%	25.51%	68.06%	75.48%	75.36%	2.92%	21.72%
3.1.1.7	2.54%	24.81%	72.65%	72.70%	89.92%	10.08%	69.67%	5.76%	20.56%	73.67%	72.13%	74.79%	2.55%	22.66%
3.1.1.8	2.44%	23.64%	73.92%	72.06%	90.53%	9.47%	69.26%	5.48%	19.58%	74.93%	71.52%	74.73%	2.40%	22.88%
3.1.1.9	2.40%	23.14%	74.46%	71.44%	90.80%	9.20%	68.75%	5.36%	19.17%	75.47%	70.92%	74.70%	2.33%	22.97%
3.1.1.10	3.13%	32.96%	63.91%	79.97%	85.73%	14.27%	74.91%	7.51%	27.43%	65.06%	79.04%	75.28%	3.54%	21.18%
RB 48 hr 3.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	3.44%	11.08%	85.48%	100.00%	73.88%	1.47%	24.65%

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost				Life Cycle Cost		
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Capital Cost	Operational Cost	Maintenance Cost
	As % of total capital cost				As % of total O&M			As % of total LCC cost				As % of total LCC cost		
RB 24 hr 3.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	4.87%	15.68%	79.45%	70.69%	74.29%	2.08%	23.64%
3.1.4.1	5.13%	76.04%	18.83%	98.25%	50.04%	49.96%	98.16%	19.24%	61.98%	18.78%	98.25%	74.40%	12.86%	12.74%
3.1.4.2	5.19%	83.22%	11.59%	130.28%	44.32%	55.68%	132.13%	20.92%	67.57%	11.51%	130.80%	74.13%	14.49%	11.38%
3.1.4.3	5.12%	85.80%	9.08%	156.64%	42.03%	57.97%	160.89%	21.56%	69.45%	8.99%	157.75%	73.88%	15.23%	10.89%
3.1.4.4	5.23%	84.09%	10.68%	129.15%	43.76%	56.24%	130.82%	21.11%	68.29%	10.61%	129.64%	74.16%	14.62%	11.22%
3.1.4.5	5.25%	84.51%	10.25%	128.73%	43.52%	56.48%	130.25%	21.18%	68.64%	10.18%	129.19%	74.18%	14.67%	11.15%
3.1.4.6	5.25%	84.68%	10.07%	128.68%	43.44%	56.56%	130.07%	21.19%	68.80%	10.01%	129.10%	74.20%	14.68%	11.12%
3.1.4.7	5.17%	80.12%	14.71%	114.51%	46.81%	53.19%	115.27%	20.19%	65.18%	14.63%	114.74%	74.27%	13.76%	11.97%
3.1.4.8	5.17%	79.05%	15.79%	109.03%	47.71%	52.29%	109.42%	19.92%	64.35%	15.72%	109.17%	74.32%	13.50%	12.17%
3.1.4.9	5.16%	78.50%	16.34%	106.26%	48.17%	51.83%	106.46%	19.79%	63.93%	16.28%	106.35%	74.35%	13.36%	12.28%
3.1.4.10	5.15%	86.44%	8.41%	155.71%	41.63%	58.37%	159.77%	21.69%	69.98%	8.33%	156.78%	73.90%	15.32%	10.77%
RB 48 hr 3.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	18.91%	60.90%	20.20%	100.00%	74.38%	12.63%	12.99%
RB 24 hr 3.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	20.31%	65.43%	14.26%	93.07%	74.49%	13.57%	11.94%
3.4.1.1	1.47%	14.74%	83.79%	68.43%	92.49%	7.51%	67.77%	3.83%	12.09%	84.08%	68.36%	73.66%	1.98%	24.36%
3.4.1.2	1.88%	21.35%	76.78%	72.12%	89.15%	10.85%	70.35%	5.18%	17.56%	77.26%	71.84%	73.99%	2.83%	23.18%
3.4.1.3	2.12%	24.99%	72.89%	75.67%	86.84%	13.16%	73.54%	6.08%	20.56%	73.36%	75.36%	74.09%	3.42%	22.49%
3.4.1.4	1.87%	22.07%	76.06%	72.38%	89.13%	10.87%	70.22%	5.17%	18.18%	76.65%	71.99%	74.10%	2.82%	23.08%
3.4.1.5	1.86%	22.69%	75.46%	72.93%	89.15%	10.85%	70.40%	5.14%	18.72%	76.14%	72.45%	74.20%	2.80%	23.00%
3.4.1.6	1.84%	23.35%	74.81%	73.34%	89.16%	10.84%	70.42%	5.12%	19.29%	75.59%	72.75%	74.30%	2.79%	22.91%
3.4.1.7	1.68%	18.59%	79.74%	70.72%	90.81%	9.19%	69.23%	4.51%	15.28%	80.21%	70.47%	73.90%	2.40%	23.70%
3.4.1.8	1.61%	17.63%	80.76%	70.29%	91.38%	8.62%	68.90%	4.27%	14.50%	81.23%	70.05%	73.87%	2.25%	23.88%
3.4.1.9	1.57%	17.22%	81.21%	69.81%	91.64%	8.36%	68.46%	4.17%	14.15%	81.68%	69.57%	73.86%	2.19%	23.95%
3.4.1.10	2.11%	25.72%	72.17%	76.02%	86.82%	13.18%	73.47%	6.06%	21.19%	72.75%	75.60%	74.20%	3.41%	22.40%
RB 48 hr 3.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.62%	8.26%	89.12%	100.00%	73.42%	1.35%	25.23%
RB 24 hr 3.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.71%	11.72%	84.57%	70.50%	73.63%	1.92%	24.45%
3.4.4.1	3.99%	71.50%	24.51%	97.67%	49.17%	50.83%	97.76%	18.86%	57.17%	23.98%	97.72%	72.61%	13.99%	13.40%
3.4.4.2	4.14%	80.30%	15.56%	126.08%	42.40%	57.60%	129.39%	21.16%	63.73%	15.11%	127.07%	72.13%	16.14%	11.74%
3.4.4.3	4.13%	83.54%	12.34%	150.32%	39.73%	60.27%	156.77%	22.06%	66.01%	11.93%	152.17%	71.81%	17.08%	11.11%
3.4.4.4	4.19%	81.33%	14.48%	124.67%	41.74%	58.26%	127.93%	21.40%	64.55%	14.06%	125.66%	72.14%	16.32%	11.55%
3.4.4.5	4.21%	81.82%	13.97%	124.11%	41.45%	58.55%	127.30%	21.49%	64.94%	13.56%	125.09%	72.15%	16.39%	11.46%
3.4.4.6	4.21%	82.03%	13.76%	123.98%	41.35%	58.65%	127.08%	21.52%	65.12%	13.36%	124.93%	72.17%	16.41%	11.42%
3.4.4.7	4.09%	76.45%	19.46%	112.03%	45.35%	54.65%	113.65%	20.15%	60.88%	18.96%	112.53%	72.35%	15.18%	12.46%
3.4.4.8	4.07%	75.11%	20.82%	107.11%	46.41%	53.59%	108.17%	19.79%	59.89%	20.31%	107.45%	72.44%	14.84%	12.72%
3.4.4.9	4.06%	74.42%	21.52%	104.61%	46.96%	53.04%	105.39%	19.61%	59.39%	21.01%	104.87%	72.49%	14.66%	12.85%
3.4.4.10	4.16%	84.29%	11.55%	149.18%	39.26%	60.74%	155.56%	22.23%	66.61%	11.16%	151.02%	71.81%	17.21%	10.98%
RB 48 hr 3.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.43%	55.86%	25.71%	100.00%	72.62%	13.67%	13.72%
RB 24 hr 3.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	20.14%	61.06%	18.80%	91.49%	72.59%	14.94%	12.47%
4.1.1.1	2.21%	18.94%	78.85%	71.15%	91.96%	8.04%	69.92%	4.85%	15.61%	79.53%	70.97%	74.29%	2.07%	23.64%
4.1.1.2	2.81%	28.04%	69.15%	75.04%	88.18%	11.82%	71.35%	6.52%	23.27%	70.21%	74.37%	74.98%	2.96%	22.05%
4.1.1.3	3.15%	32.10%	64.75%	79.35%	85.73%	14.27%	74.89%	7.56%	26.66%	65.79%	78.58%	75.16%	3.56%	21.29%
4.1.1.4	2.80%	28.96%	68.24%	75.38%	88.15%	11.85%	71.15%	6.51%	24.08%	69.41%	74.56%	75.12%	2.96%	21.92%
4.1.1.5	2.78%	29.85%	67.37%	75.79%	88.13%	11.87%	71.03%	6.48%	24.87%	68.65%	74.83%	75.25%	2.95%	21.80%
4.1.1.6	2.75%	30.52%	66.73%	76.73%	88.20%	11.80%	71.45%	6.42%	25.46%	68.12%	75.63%	75.37%	2.92%	21.72%
4.1.1.7	2.49%	24.32%	73.19%	74.14%	90.13%	9.87%	71.18%	5.65%	20.16%	74.19%	73.58%	74.76%	2.50%	22.74%
4.1.1.8	2.39%	23.11%	74.50%	73.69%	90.76%	9.24%	70.97%	5.36%	19.14%	75.50%	73.17%	74.69%	2.34%	22.96%
4.1.1.9	2.33%	22.53%	75.14%	73.37%	91.06%	8.94%	70.76%	5.22%	18.66%	76.12%	72.86%	74.66%	2.27%	23.07%
4.1.1.10	3.13%	32.96%	63.91%	79.97%	85.73%	14.27%	74.92%	7.51%	27.43%	65.06%	79.04%	75.29%	3.54%	21.17%
RB 48 hr 4.1.1	1.57%	13.47%	84.96%	100.00%	94.38%	5.62%	100.00%	3.44%	11.08%	85.48%	100.00%	73.89%	1.47%	24.64%
RB 24 hr 4.1.1	2.22%	19.01%	78.77%	70.86%	91.93%	8.07%	69.62%	4.87%	15.68%	79.45%	70.69%	74.29%	2.08%	23.63%
4.1.4.1	4.92%	72.94%	22.14%	102.42%	52.17%	47.83%	102.54%	18.46%	59.46%	22.08%	102.41%	74.34%	12.34%	13.32%

SUMMARY OF FINANCIAL ANALYSIS: NO SALVAGE COST

Series	Capital Cost				Operation and Maintenance (per annum)			Life Cycle Cost			
	Pumping Station	Feeder pipe	Storage	Total as % of RB Design	Maintenance Cost	Operational Cost	Total as % of RB Design	Pumping Station	Feeder pipe	Storage	Total as % of RB Design
	As % of total capital cost				As % of total O&M			As % of total LCC cost			
4.1.4.2	5.07%	81.35%	13.58%	133.28%	45.62%	54.38%	135.28%	20.45%	66.06%	13.49%	133.79%
4.1.4.3	5.05%	84.58%	10.37%	158.90%	42.87%	57.13%	163.25%	21.26%	68.48%	10.27%	159.99%
4.1.4.4	5.17%	83.08%	11.75%	130.72%	44.46%	55.54%	132.47%	20.85%	67.47%	11.67%	131.20%
4.1.4.5	5.20%	83.76%	11.04%	129.88%	44.04%	55.96%	131.46%	20.99%	68.04%	10.97%	130.33%
4.1.4.6	5.22%	84.16%	10.63%	129.48%	43.80%	56.20%	130.91%	21.06%	68.38%	10.56%	129.90%
4.1.4.7	5.04%	78.07%	16.89%	117.52%	48.23%	51.77%	118.43%	19.67%	63.51%	16.81%	117.75%
4.1.4.8	5.02%	76.87%	18.11%	112.12%	49.21%	50.79%	112.66%	19.38%	62.59%	18.03%	112.25%
4.1.4.9	5.01%	76.20%	18.79%	109.46%	49.76%	50.24%	109.82%	19.21%	62.07%	18.72%	109.54%
4.1.4.10	5.12%	85.88%	9.00%	156.73%	42.02%	57.98%	160.84%	21.55%	69.53%	8.92%	157.80%
RB 48 hr 4.1.4	5.04%	74.71%	20.25%	100.00%	50.95%	49.05%	100.00%	18.91%	60.90%	20.20%	100.00%
RB 24 hr 4.1.4	5.42%	80.28%	14.30%	93.05%	47.10%	52.90%	92.72%	20.31%	65.43%	14.26%	93.07%
4.4.1.1	1.43%	14.28%	84.29%	70.62%	92.73%	7.27%	70.00%	3.71%	11.71%	84.58%	70.55%
4.4.1.2	1.87%	21.25%	76.88%	72.45%	89.20%	10.80%	70.69%	5.16%	17.48%	77.36%	72.18%
4.4.1.3	2.12%	24.95%	72.93%	75.79%	86.86%	13.14%	73.67%	6.07%	20.53%	73.40%	75.48%
4.4.1.4	1.86%	21.99%	76.15%	72.64%	89.17%	10.83%	70.49%	5.15%	18.11%	76.73%	72.26%
4.4.1.5	1.86%	22.69%	75.45%	72.91%	89.15%	10.85%	70.38%	5.14%	18.72%	76.14%	72.43%
4.4.1.6	1.84%	23.27%	74.89%	73.59%	89.20%	10.80%	70.68%	5.10%	19.22%	75.68%	73.00%
4.4.1.7	1.65%	18.24%	80.12%	72.06%	90.99%	9.01%	70.61%	4.42%	15.00%	80.58%	71.82%
4.4.1.8	1.57%	17.24%	81.19%	71.88%	91.58%	8.42%	70.53%	4.18%	14.17%	81.65%	71.65%
4.4.1.9	1.53%	16.75%	81.72%	71.77%	91.87%	8.13%	70.46%	4.05%	13.77%	82.18%	71.54%
4.4.1.10	2.11%	25.67%	72.22%	76.16%	86.85%	13.15%	73.61%	6.05%	21.15%	72.80%	75.74%
RB 48 hr 4.4.1	1.01%	10.09%	88.91%	100.00%	94.91%	5.09%	100.00%	2.62%	8.26%	89.12%	100.00%
RB 24 hr 4.4.1	1.43%	14.29%	84.28%	70.57%	92.72%	7.28%	69.95%	3.71%	11.72%	84.57%	70.50%
4.4.4.1	3.78%	67.74%	28.47%	103.08%	51.75%	48.25%	102.97%	17.89%	54.23%	27.88%	103.02%
4.4.4.2	4.02%	77.93%	18.05%	129.90%	43.99%	56.01%	133.08%	20.55%	61.91%	17.54%	130.81%
4.4.4.3	4.05%	82.01%	13.94%	153.12%	40.75%	59.25%	159.47%	21.67%	64.85%	13.48%	154.91%
4.4.4.4	4.13%	80.10%	15.77%	126.58%	42.57%	57.43%	129.78%	21.08%	63.60%	15.32%	127.53%
4.4.4.5	4.16%	80.92%	14.91%	125.48%	42.05%	57.95%	128.62%	21.27%	64.25%	14.48%	126.43%
4.4.4.6	4.18%	81.39%	14.42%	124.95%	41.77%	58.23%	128.01%	21.36%	64.63%	14.01%	125.88%
4.4.4.7	3.95%	73.89%	22.16%	115.91%	47.09%	52.91%	117.39%	19.50%	58.89%	21.61%	116.33%
4.4.4.8	3.92%	72.41%	23.66%	111.10%	48.25%	51.75%	112.02%	19.10%	57.79%	23.11%	111.35%
4.4.4.9	3.90%	71.60%	24.49%	108.72%	48.89%	51.11%	109.36%	18.88%	57.19%	23.93%	108.90%
4.4.4.10	4.12%	83.61%	12.26%	150.39%	39.71%	60.29%	156.73%	22.05%	66.09%	11.86%	152.21%
RB 48 hr 4.4.4	3.90%	69.83%	26.27%	100.00%	50.31%	49.69%	100.00%	18.43%	55.86%	25.71%	100.00%
RB 24 hr 4.4.4	4.27%	76.49%	19.25%	91.30%	45.77%	54.23%	91.62%	20.14%	61.06%	18.80%	91.49%

Life Cycle Cost		
Capital Cost	Operational Cost	Maintenance Cost
As % of total LCC cost		
74.10%	14.16%	11.74%
73.87%	15.02%	11.12%
74.14%	14.44%	11.41%
74.17%	14.54%	11.29%
74.19%	14.59%	11.22%
74.23%	13.41%	12.36%
74.28%	13.13%	12.58%
74.31%	12.97%	12.71%
73.90%	15.22%	10.88%
74.38%	12.63%	12.99%
74.49%	13.57%	11.94%
73.63%	1.92%	24.45%
73.99%	2.81%	23.20%
74.09%	3.41%	22.50%
74.09%	2.81%	23.10%
74.20%	2.80%	23.00%
74.29%	2.78%	22.93%
73.88%	2.36%	23.76%
73.85%	2.20%	23.95%
73.83%	2.13%	24.04%
74.20%	3.40%	22.40%
73.42%	1.35%	25.23%
73.63%	1.92%	24.45%
72.62%	13.27%	14.11%
72.15%	15.67%	12.17%
71.83%	16.78%	11.40%
72.15%	16.08%	11.78%
72.16%	16.22%	11.63%
72.17%	16.29%	11.54%
72.37%	14.69%	12.94%
72.46%	14.32%	13.22%
72.50%	14.12%	13.38%
71.82%	17.08%	11.10%
72.62%	13.67%	13.72%
72.59%	14.94%	12.47%

APPENDIX L1: MOCASIM II INPUT FILE

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MOCASIM INPUT FILE

1	[TITLE]						
2	CONFIGURATION 1: Urban						
3							
4	[JUNCTIONS]						
5	;ID	Elev	Demand	Pattern			
6	2	1	0		;		
7	USERS	0	20		;		
8							
9	[RESERVOIRS]						
10	;ID	Head	Pattern				
11	SOURCE	9.51696		;			
12	TANK	1		;			
13							
14	[TANKS]						
15	;ID	Elevation	InitLevel	MinLevel	MaxLevel	Diameter	MinVol
16							
17	[PIPES]						
18	;ID	Node1	Node2	Length	Diameter	Roughness	MinorLoss
19	2	TANK	USERS	1	3000	140	0
20	1	2	TANK	1000	160	140	0
21	3	SOURCE	2	1	3000	140	0
22	2	Status					
23	1	Open	;				
24	3	Open	;				
25		Open	;				
26							
27	[PUMPS]						
28	;ID	Node1	Node2	Parameters			
29							

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30	*[VALVES]*						
31	;ID	Node1	Node2	Diameter	Type	Setting	MinorLoss
32							
33	[TAGS]						
34							
35	[DEMANDS]						
36	;Junction	Demand	Pattern	Category			
37							
38	[STATUS]						
39	;ID	Status/Setting					
40							
41	[PATTERNS]						
42	;ID	Multipliers					
43	1	1					
44	;						
45	seasonal	1					
46	;						
47	dow	1.01	0.93	0.94	0.94	0.98	1.14
48	dow	1.06					
49	;						
50	hourly	0.44	0.39	0.38	0.41	0.45	0.52
51	hourly	0.77	1.05	1.34	1.47	1.49	1.47
52	hourly	1.43	1.41	1.21	1.12	1.16	1.25
53	hourly	1.32	1.36	1.26	0.97	0.78	0.55
54	;						
55	temphour	1	1	1	1	1	1
56	temphour	1	1	1	1	1	1
57	temphour	1	1	1	1	1	1
58	temphour	1	1	1	1	1	1
59							
60	[CURVES]						

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61	;ID	X-Value	Y-Value				
62							
63	[CONTROLS]						
64							
65	[RULES]						
66							
67	[ENERGY]						
68	Global Efficiency	75					
69	Global Price	0					
70	Demand Charge	0					
71							
72	[EMITTERS]						
73	;Junction	Coefficient					
74							
75	[QUALITY]						
76	;Node	InitQual					
77							
78	[SOURCES]						
79	;Node	Type	Quality	Pattern			
80							
81	[REACTIONS]						
82	;Type	Pipe/Tank	Coefficient				
83							
84	[REACTIONS]						
85	Order Bulk	1					
86	Order Tank	1					
87	Order Wall	1					
88	Global Bulk	0					
89	Global Wall	0					
90	Limiting Potential	0					
91	Roughness Correlation	0					

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92							
93	[MIXING]						
94	;Tank	Model					
95							
96	[TIMES]						
97	Duration	24:00:00					
98	Hydraulic Timestep	01:00					
99	Quality Timestep	00:05					
100	Pattern Timestep	01:00					
101	Pattern Start	00:00					
102	Report Timestep	01:00					
103	Report Start	00:00					
104	Start ClockTime	12:00 AM					
105	Statistic	NONE					
106							
107	[REPORT]						
108	Status	No					
109	Summary	No					
110	Page	0					
111							
112	[OPTIONS]						
113	Units	LPS					
114	Headloss	H-W					
115	Specific Gravity	1					
116	Viscosity	1					
117	Trials	40					
118	Accuracy	0.001					
119	Unbalanced	Continue 10					
120	Pattern	1					
121	Demand Multiplier	1					
122	Emitter Exponent	0.5					

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123	Quality	None mg/L					
124	Diffusivity	1					
125	Tolerance	0.01					
126							
127	[COORDINATES]						
128	;Node	X-Coord	Y-Coord				
129	2	1674.17	6831.83				
130	USERS	6914.41	6801.8				
131	SOURCE	-7.51	6831.83				
132	TANK	6313.81	6786.79				
133							
134	[VERTICES]						
135	;Link	X-Coord	Y-Coord				
136							
137	[LABELS]						
138	;X-Coord	Y-Coord	Label & Anchor Node				
139							
140	[BACKDROP]						
141	DIMENSIONS	0	0	10000	10000		
142	UNITS	None					
143	FILE						
144	OFFSET	0	0				
145							
146	[END]						
147							
148	[MSCONCDEMANDMODELS]						
149	;NOTE: For lognormal distribution the average and std dev should be given for the log of the values						
150	;ID	Seasonal pat	DOW pat	Diurnal pat	Day random	Day std dev	Diurn rand dist

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					dist		
151	demandM0	none	dow	hourly	lognormal	0.068	lognormal
152	;ID	Diur std dev	Day autocorr no	Day autocorr value	Diurnal autocorr no	Diurnal autocorr value	
153	demandM0	0.13	1	0.12	1	0.7	
154							
155							
156	[MSFIREMODELS]						
157	;NOTE: For lognormal distribution the average and std dev should be given for the log of the values						
158	;ID	Fire rate (/a)	Duration dist (hours)	Duration ave (hours)	Duration stdev (hours)	Demand dist (l/s)	Demand ave (l/s)
159	fireM0	6	lognormal	-0.393	0.66	lognormal	1.31
160	;ID	Demand stdev (l/s)					
161	fireM0	1.31					
162							
163							
164	[MSFAILMODELS]						
165	;NOTE: For lognormal distribution the average and std dev should be given for the log of the values						
166	;ID	Concurrent	Failure rate (/km/a)	Duration dist	Duration ave (hours)	Duration stdev (hours)	
167	failM0	no	2	lognormal	1.49	0.48	
168							
169	[MSDEMANDS]						
170	;Junction	Demand model					

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171	USERS	demandM0					
172							
173	[MSFIRES]						
174	;Junction	Fire model					
175	USERS	fireM0					
176							
177	[MSFAILURES]						
178	;Link	Fail model					
179	1	failM0					
180							
181	[MSOPTIONS]						
182	Duration	8000000					
183	Days per Year	365					
184	Days per Week	7					
185	Seasons per year	1					
186	Critical Pressure	0					
187	Reservoir	TANK					
188	Minimum size	144 ;2 hr of DD					
189	Maximum size	1728 ;24 hr of DD					
190	Multiply	1					
191	Add	144 ;2 hr ofDD					
192	Write Log	No					
193	Log file	runbase.lg					
194	Write failures	2000					
195	Failures tank size	720 ;write fails for 10 h tank					
196	Failures file						
197	Event statistics	Yes					
198	Results file						
199	Random seed	0					
200							

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201	*[MSSTATISTICS]*						
202	;Type	ID	Parameter	Minimum	Maximum	No of bins	
203	node	USERS	demand	0	200	20	
204	link	1	flow	0	150	20	
205							
206	[MSEND]						

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APPENDIX L2: MOCASIM II OUTPUT FILE

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MOCASIM OUTPUT FILE

Row								
1	TANK RELIABILITY ANALYSIS FOR NODE TANK							
2	Time unit = 3600 s							
3	Capacity	No of Failures	Ave Duration	Dur Stdev	Minimum	Maximum		
4	144	5581143	4.21476	3.1957	2.89E-06	36.0844		
5	288	2107110	3.93163	2.8159	1.56E-06	34.9913		
6	432	770468	3.53481	2.50839	4.16E-05	33.925		
7	576	300324	3.24927	2.35773	4.19E-05	32.9179		
8	720	113204	3.12786	2.3341	1.07E-05	31.7121		
9	864	41751	3.10864	2.37469	0.000179	30.2039		
10	1008	15421	3.14428	2.4267	0.000129	28.4537		
11	1152	5810	3.16906	2.52386	0.001094	27.0243		
12	1296	2290	3.22128	2.67256	0.000741	25.726		
13	1440	992	3.20474	2.77348	0.014425	24.0618		
14	1584	444	3.15066	2.89209	0.016736	21.0691		
15	1728	199	3.2237	2.95929	0.039594	17.9186		
16								
17	NODE STATISTICS							
18	Days between fire events for junction USERS:							
19	No of points	Average	Std Deviation	Minimum	Maximum			
20	131617	60.7816	60.8873	0.000301	953.558			
21								
22	Duration of fire events for junction USERS:							
23	Ln of values was logged.							
24	No of points	Average	Std Deviation	Minimum	Maximum			
25	131617	-0.39348	0.660125	-3.02705	2.50956			
26								
27	Flows of fire events for junction USERS:							
28	No of points	Average	Std Deviation	Minimu	Maximum			
29	131617	8.70791	18.0544	0.015397	721.622			
30								
31	Demand at junction USERS							
32	No of points	Average	Std Deviation	Minimum	Maximum			
33	192000000	20.3864	9.38174	2.53118	583.741			
34								
35	Bins:	<= 0	0	10	20	30	40	50
36	Frequency:	0	3.89E+07	5.05E+07	7.22E+07	2.70E+07	3.21E+06	219376
37	Bins:		60	70	80	90	100	110
38	Frequency:		12479	1153	374	237	163	122
39	Bins:		120	130	140	150	160	170
40	Frequency:		78	53	43	27	26	23

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MOCASIM OUTPUT FILE

41	Bins:		180	190	200			
42	Frequency:		19	7	77			
43								
44	LINK STATISTICS							
45	Days between failure events for pipe 1:							
46	No of points	Average	Std Deviation	Minimum	Maximum			
47	43567	183.617	181.706	0.097262	2090.45			
48								
49	Duration of failure events for pipe 1:							
50	Ln of values was logged.							
51	No of points	Average	Std Deviation	Minimum	Maximum			
52	43567	1.48661	0.479548	-0.62034	3.4621			
53								
54	Flowrate in pipe 1							
55	No of points	Average	Std Deviation	Minimum	Maximum			
56	192000000	23.973	0.777317	0	24			
57								
58	Bins:	<= 0	0	7.5	15	22.5	30	37.5
59	Frequency:	216164	0	0	0	1.92E+08	0	0
60	Bins:		45	52.5	60	67.5	75	82.5
61	Frequency:		0	0	0	0	0	0
62	Bins:		90	97.5	105	112.5	120	127.5
63	Frequency:		0	0	0	0	0	0
64	Bins:		135	142.5	150			
65	Frequency:		0	0	0			

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APPENDIX M: TEMPLATE - COSTING SPREADSHEET

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Row	Spreadsheet as used in determination of Life cycle Cost (LCC)			Comment
1	INPUT PARAMETERS		Config 1	The configuration is discussed under Section 5.3
2	Daily Demand (Seasonal Peak)	l/s	20	The daily demand is represented by the second digit as outlined under Section 5.1. Four different sizes of development are analysed.
3	Pumping efficency	%	90%	The efficiency of the pump is used in the determination of the required electrical power which in turns are used to calculate the cost of the pumping station.
4	Pumping head	m	9.52	The pumping head is calculated with a separate spreadsheet discussed under Section 5.2.2.
5	Supply length	m	1000	The supply length is represented by the third digit as outlined under Section 5.1. Four different ranges of supply length are analysed.
6	Design life (T): PS Civil	years	50	The design life (T) and salvage factor (a) of the infrastructure is taken from Swamee and Sharma (2008) as set out in Section 5.5.
7	Design life (T): PS Mechanical	years	15	
8	Design life (T): Feeder pipe-Civil	years	120	
9	Design life (T): Storage	years	120	
10	Salvage value: PS Civil	%	5%	
11	Salvage value: PS Mechanical	%	20%	
12	Salvage value: Feeder pipe-Civil	%	15%	
13	Salvage value: Storage	%	0%	
14	PS: Civil portion	%	60%	The portioning of the infrastructure is based on rule-of-thumb values as assumed by the student.
15	PS: Mechanical portion	%	30%	
16	PS: Electrical portion	%	10%	
17	Feeder Pipe: Civil Portion	%	98%	
18	Feeder Pipe: Mechanical Portion	%	2%	
19	Yearly Maintenance as % of capital: PS Civil Works	%	1.50%	The maintenance factor (ß) of the infrastructure is taken from Swamee and Sharma (2008) as set out in Section 5.5.
20	Yearly Maintenance as % of capital: PS Mech/Elec Works	%	0.30%	
21	Yearly Maintenance as % of capital: Feeder pipe	%	0.50%	
22	Yearly Maintenance as % of capital: Storage	%	1.50%	
23	Discount rate	%	4%	The discount rate is discussed under Section 4.4 & 5.5 of this dissertation.

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Row	Spreadsheet as used in determination of Life cycle Cost (LCC)				Comment
1	INPUT PARAMETERS			Config 1	The configuration is discussed under Section 5.3
24	INFRASTRUCTURE SIZING				
25	Source :Pumping Station				
26	Description	Formula	Unit		
27	Discharge capacity	1.2 x DD	l/s	24	The supply from the pumping station is 1.2 x the daily demand under seasonal peak conditions as discussed in Section 5.2.1 of this dissertation.
28	Power required	P = (p x g x Q x Ht)/n	kW	2.5	The required power has been calculated by the formula and represents the size of the pumping station which in turns are used to calculate the cost of the pumping station.
29					
30	Feeder pipe				
31	Pipe capacity	1.2 x DD	l/s	24	The feeder pipe capacity is 1.2 x the daily demand under seasonal peak conditions as discussed in Section 5.2.2 of this dissertation.
32	Pipe diameter 1		mm	160	The pipe diameter is calculated with a separate spreadsheet as discussed under Section 5.2.2.
33	Pipe diameter 2		mm	0	The pipe diameter is calculated with a separate spreadsheet as discussed under Section 5.2.2.
34	Pipe 1 - Length		m	1000	The length Pipe 1 is as derived according to the configuration analysed.
35	Pipe 2 - Length		m	0	The length Pipe 2 is as derived according to the configuration analysed.
36	# of 2xPipe Splits	$y = 0.0267x^2 + 8.5302x + 3674.9$	No	0	The number of 2 x Pipe Splits is taken from the configuration analysed.
37	# of 3xPipe Splits	$y = 0.0409x^2 + 14.082x + 2478.3$	No	0	The number of 3 x Pipe Splits is taken from the configuration analysed.
38	# of 2 Pipe Interconnections	$y = 0.0457x^2 + 16.519x + 2624.1$	No	0	The number of 2 x Pipe Interconnections is taken from the configuration analysed.
39	# of 3 Pipe Interconnections	$y = 0.07x^2 + 24.898x + 2790.2$	No	0	The number of 3 x Pipe Interconnections is taken from the configuration analysed.
40					
41	Storage				
42	Reservoir capacity		Ml	1.30	The reservoir capacity is taken from the results of the stochastic simulation for a system with a failure return period of 1 in 10 years. (Refer Annexure A & B)

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Row	Spreadsheet as used in determination of Life cycle Cost (LCC)				Comment
1	**INPUT PARAMETERS**			Config 1	The configuration is discussed under Section 5.3
43	**CAPITAL COST**				
44	Source :Pumping Station				
45	Cost (Samra and Essery Cost data)			$10 754.28	The cost is calculated using the Unit Cost model described under Section 4.2.1.
46					
47	Feeder pipe system				
48	Cost (Samra and Essery Cost data and Interconnections estimation)			$86 515.40	The cost is calculated using the Unit Cost model described under Section 4.2.2.
49					
50	Storage				
51	Cost (Samra and Essery Cost data)			$342 837.28	The cost is calculated using the Unit Cost model described under Section 4.2.3.
52					
53	**Total Cost (Samra and Essery Cost data)**			**$440 106.96**	Sum of calculated cost for pumping station, feeder pipe system and Storage facility.
54					
55	**OPERATING COST**				
56	Power required	P = (*p* x g x Q x Ht)/*n*	kW	2.5	See Row 28
57	Energy Charge		AUS$/kWh	0.039	Electrical tariff as decribed under Section 5.5.
58	Pumping hours /day			16	The average hours the pumps will be operating is 24 divided by the supply ration of the supply system (1.5 x AADD) = 16
59	Operating Cost / year		R	$567.22	The yearly electrical cost for operating the system is P x "electrical tariff" x "pumping hours per year".
60					
61	**MAINTENANCE COST**				
62	Yearly maintenance cost			$5 681.60	The yearly maintenance cost is calculated by multiplying the cost of infrastructure with the associated maintenance factor (ß).
63					
64	**SALVAGE VALUE AT END OF DESIGN LIFE**				
65	Component	Design life		Value	
66	PS Civil	50		$322.63	
67	PS Mechanical	15		$645.26	The salvage cost at the end of the design life is calculated by multiplying the cost of infrastructure with the associated salvage factor (a).
68	Feeder pipe system	120		$12 977.31	
69	Storage	120		$0.00	

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Row	Spreadsheet as used in determination of Life cycle Cost (LCC)			Comment
1	**INPUT PARAMETERS**		**Config 1**	The configuration is discussed under Section 5.3
70				
71	**LIFE CYCLE COST**			
72	Capitalization method	$Cc= \{C0[1+\{(1- a)/\{(1+r)^T-1\}\}+ ß /r]\}+Aop/r$		
73	PS Civil		$9 876.09	
74	PS Mechanical		$6 690.74	
75	PS Electrical		$15 255.95	
76	Feeder pipe system: Civil		$96 040.40	The life cycle cost is calculated using the formula as discussed in Section 4.3.1 of the dissertation.
77	Feeder pipe system: Mechanical		$1 730.31	
78	Storage		$474 527.55	
79			**$604 121.04**	
80				
81	Annuity method	$A = \{rC0 [1+((1- a)/(1+r)^T-1)+ß/r]\}+A_{op}$		
82	PS Civil		$395.04	
83	PS Mechanical		$267.63	
84	PS Electrical		$610.24	
85	Feeder pipe system: Civil		$3 841.62	The life cycle cost is calculated using the formula as discussed in Section 4.3.1 of the dissertation. (TOTAL DERIVED FROM THE USE OF THE ANNUITY METHOD IS NOT USED IN THE COMPARISON OF ALTERNATIVES)
86	Feeder pipe system: Mechanical		$69.21	
87	Storage		$18 981.10	
88			**$24 164.84**	

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APPENDIX N: PIPE DIAMETER DETERMINATION

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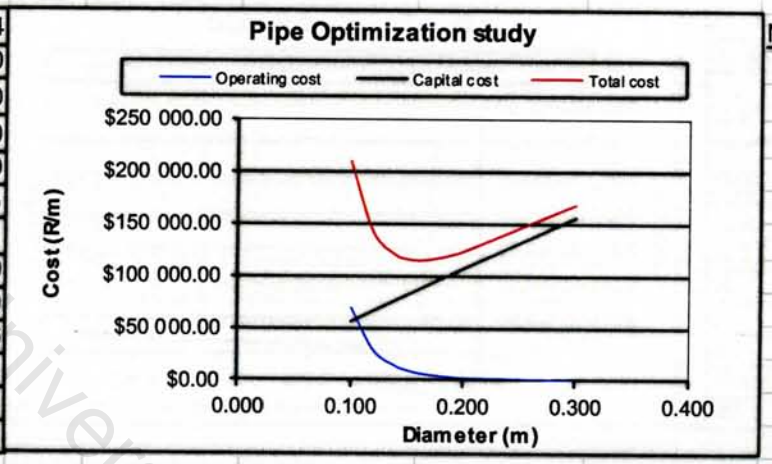
SINGLE FEEDER PIPE: 20 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.024
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85)}/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

Optimization

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity (m/s)	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)- Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
	See note (a)	q / (2)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See dissertation	See note (g)	See dissertation	See cost model	= (12)	See cost model	See note (h)
0.100	0.01	3.06	85.35	0.00	85.35	22.33	$5 085.50	$69 113.59	$2 379.42	$32 337.06	$55 749.53	$55 749.53	$52 516.74	$209 716.91
0.120	0.01	2.12	35.12	0.00	35.12	9.19	$2 092.77	$28 441.39	$1 436.06	$19 516.51	$66 111.30	$66 111.30	$27 637.57	$141 706.76
0.140	0.02	1.56	16.58	0.00	16.58	4.34	$987.85	$13 425.17	$1 024.25	$13 919.95	$76 360.88	$76 360.88	$16 061.25	$119 767.27
0.150	0.02	1.36	11.85	0.00	11.85	3.10	$705.94	$9 593.98	$911.14	$12 382.68	$81 449.15	$81 449.15	$12 597.33	$116 023.15
0.155	0.02	1.27	10.10	0.00	10.10	2.64	$601.75	$8 178.02	$868.87	$11 808.29	$83 984.93	$83 984.93	$11 223.75	$115 194.99
0.160	0.02	1.19	8.65	0.00	8.65	2.26	$515.55	$7 006.47	$834.04	$11 334.92	$86 515.40	$86 515.40	$10 036.66	$114 893.45
0.161	0.02	1.18	8.39	0.00	8.39	2.20	$500.14	$6 797.06	$827.86	$11 250.88	$87 020.87	$87 020.87	$9 818.88	$114 887.69
0.162	0.02	1.16	8.14	0.00	8.14	2.13	$485.28	$6 595.16	$821.92	$11 170.10	$87 526.14	$87 526.14	$9 607.12	$114 898.52
0.163	0.02	1.15	7.90	0.00	7.90	2.07	$470.96	$6 400.44	$816.20	$11 092.48	$88 031.21	$88 031.21	$9 401.20	$114 925.32
0.164	0.02	1.14	7.67	0.00	7.67	2.01	$457.13	$6 212.61	$810.72	$11 017.90	$88 536.07	$88 536.07	$9 200.90	$114 967.48
0.165	0.02	1.12	7.45	0.00	7.45	1.95	$443.80	$6 031.38	$805.45	$10 946.27	$89 040.73	$89 040.73	$9 006.06	$115 024.44
0.170	0.02	1.06	6.44	0.00	6.44	1.68	$383.75	$5 215.27	$782.10	$10 629.05	$91 561.10	$91 561.10	$8 107.46	$115 512.88
0.180	0.03	0.94	4.88	0.00	4.88	1.28	$290.51	$3 948.08	$748.12	$10 167.16	$96 587.52	$96 587.52	$6 629.50	$117 332.27
0.190	0.03	0.85	3.75	0.00	3.75	0.98	$223.26	$3 034.12	$727.19	$9 882.76	$101 595.82	$101 595.82	$5 480.29	$119 993.00
0.200	0.03	0.76	2.92	0.00	2.92	0.76	$173.91	$2 363.46	$715.93	$9 729.66	$106 587.01	$106 587.01	$4 574.76	$123 254.88
0.300	0.07	0.34	0.41	0.00	0.41	0.11	$24.14	$328.08	$822.50	$11 178.09	$155 721.87	$155 721.87	$1 097.36	$168 325.41

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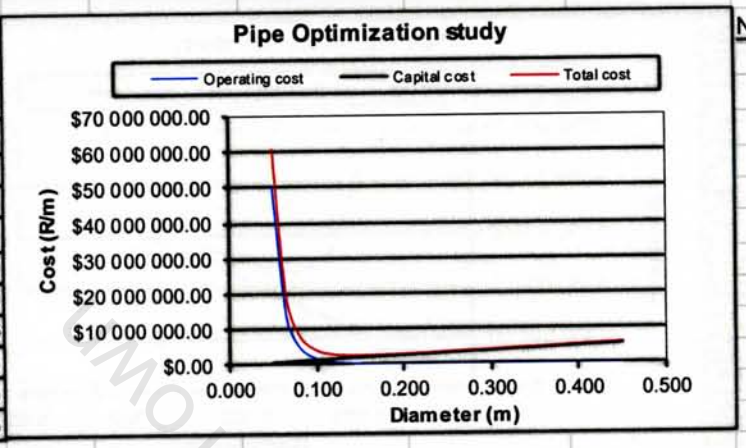
SINGLE FEEDER PIPE: 20 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.024
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85})/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

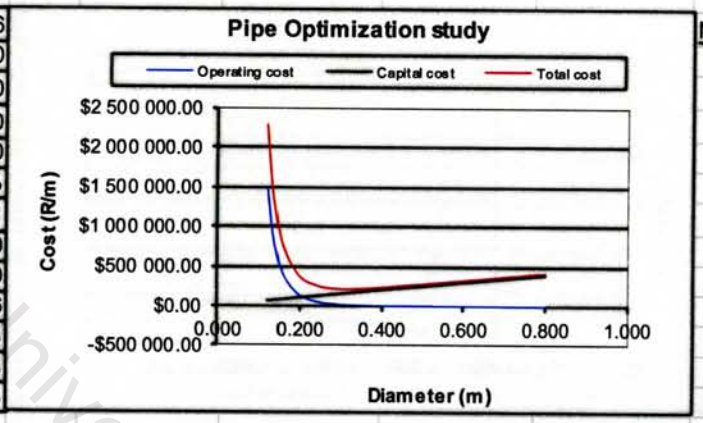
Optimization

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
	See note (a)	q / (2)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See dissertation	See note (g)	See dissertation	See cost model	= (12)	See cost model	See note (h)
0.050	0.00	12.22	62398.54	0.00	62398.54	#######	$3 717 830.89	$50 526 535.14	$250 816.19	$3 408 673.89	$728 984.34	$728 984.34	$6 179 281.73	$60 843 475.10
0.065	0.00	7.23	17388.83	0.00	17388.83	4548.92	$1 036 061.43	$14 080 412.94	$102 788.39	$1 396 927.77	$931 655.25	$931 655.25	$2 453 252.86	$18 862 248.82
0.080	0.01	4.77	6325.72	0.00	6325.72	1654.81	$376 899.29	$5 122 184.32	$52 894.18	$718 849.23	$1 131 280.72	$1 131 280.72	$1 180 944.52	$8 153 258.78
0.100	0.01	3.06	2133.82	0.00	2133.82	558.21	$127 137.47	$1 727 839.66	$28 499.90	$387 322.91	$1 393 738.34	$1 393 738.34	$538 280.16	$4 047 181.07
0.120	0.01	2.12	878.10	0.00	878.10	229.71	$52 319.17	$711 034.66	$19 594.97	$266 302.02	$1 652 782.52	$1 652 782.52	$283 276.41	$2 913 395.61
0.130	0.01	1.81	594.64	0.00	594.64	155.56	$35 429.86	$481 503.35	$17 454.28	$237 209.30	$1 781 222.94	$1 781 222.94	$213 704.02	$2 713 639.61
0.140	0.02	1.56	414.49	0.00	414.49	108.43	$24 696.19	$335 629.33	$16 130.02	$219 212.29	$1 909 022.11	$1 909 022.11	$164 622.84	$2 628 486.58
0.145	0.02	1.45	349.38	0.00	349.38	91.40	$20 816.68	$282 905.42	$15 683.04	$213 137.66	$1 972 696.75	$1 972 696.75	$145 488.95	$2 614 228.78
0.146	0.02	1.43	337.88	0.00	337.88	88.39	$20 131.45	$273 593.03	$15 607.49	$212 110.89	$1 985 414.39	$1 985 414.39	$142 010.46	$2 613 128.77
0.147	0.02	1.41	326.83	0.00	326.83	85.50	$19 473.24	$264 647.64	$15 536.15	$211 141.39	$1 998 126.38	$1 998 126.38	$138 638.02	$2 612 553.43
0.148	0.02	1.40	316.22	0.00	316.22	82.72	$18 840.79	$256 052.42	$15 468.87	$210 227.04	$2 010 832.75	$2 010 832.75	$135 367.74	$2 612 479.94
0.149	0.02	1.38	306.01	0.00	306.01	80.05	$18 232.93	$247 791.45	$15 405.50	$209 365.79	$2 023 533.54	$2 023 533.54	$132 195.84	$2 612 886.62
0.150	0.02	1.36	296.21	0.00	296.21	77.49	$17 648.55	$239 849.60	$15 345.89	$208 555.70	$2 036 228.79	$2 036 228.79	$129 118.74	$2 613 752.84
0.160	0.02	1.19	216.32	0.00	216.32	56.59	$12 888.70	$175 161.69	$14 929.33	$202 894.47	$2 162 885.01	$2 162 885.01	$102 872.64	$2 643 813.80
0.200	0.03	0.76	72.97	0.00	72.97	19.09	$4 347.68	$59 086.38	$15 198.97	$206 558.96	$2 664 675.27	$2 664 675.27	$46 889.84	$2 977 210.45
0.300	0.07	0.34	10.13	0.00	10.13	2.65	$603.52	$8 202.06	$19 915.14	$270 653.22	$3 893 046.75	$3 893 046.75	$11 247.59	$4 183 149.62
0.400	0.13	0.19	2.50	0.00	2.50	0.65	$148.68	$2 020.56	$25 636.22	$348 404.63	$5 094 567.70	$5 094 567.70	$4 084.60	$5 449 077.48
0.450	0.16	0.15	1.41	0.00	1.41	0.37	$83.78	$1 138.57	$28 546.31	$387 953.62	$5 687 677.28	$5 687 677.28	$2 697.99	$6 079 467.45

SINGLE FEEDER PIPE: 80 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.096
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85})/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

Optimization

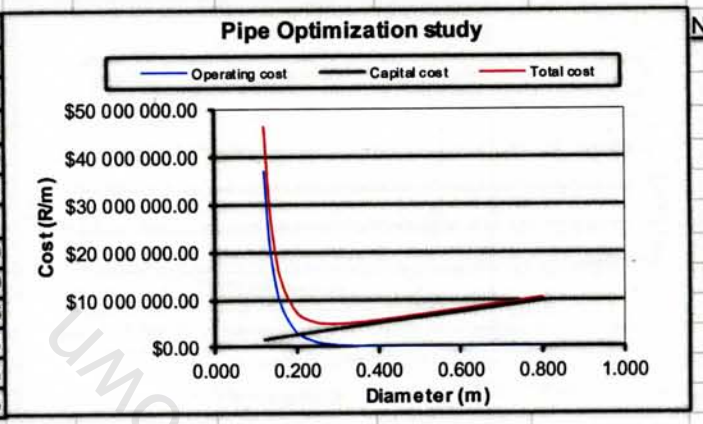
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)- Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
	See note (a)	q / (2)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See dissertation	See note (g)	See dissertation	See cost model	= (12)	See cost model	See note (h)
0.120	0.01	8.49	456.47	0.00	456.47	477.66	$108 790.72	$1 478 501.39	$19 567.43	$265 927.76	$66 111.30	$66 111.30	$480 921.84	$2 291 462.29
0.130	0.01	7.23	309.12	0.00	309.12	323.46	$73 671.65	$1 001 221.76	$14 868.56	$202 068.61	$71 248.92	$71 248.92	$362 807.94	$1 637 347.22
0.140	0.02	6.24	215.47	0.00	215.47	225.47	$51 352.43	$697 896.26	$11 561.09	$157 119.03	$76 360.88	$76 360.88	$279 482.22	$1 210 858.40
0.160	0.02	4.77	112.45	0.00	112.45	117.67	$26 800.33	$364 225.28	$7 418.50	$100 819.87	$86 515.40	$86 515.40	$174 648.14	$726 208.69
0.200	0.03	3.06	37.93	0.00	37.93	39.69	$9 040.42	$122 862.21	$3 717.15	$50 517.33	$106 587.01	$106 587.01	$79 605.46	$359 572.00
0.250	0.05	1.96	12.80	0.00	12.80	13.39	$3 049.56	$41 444.47	$2 107.96	$28 647.84	$131 315.24	$131 315.24	$36 284.55	$237 692.10
0.260	0.05	1.81	10.57	0.00	10.57	11.06	$2 519.33	$34 238.46	$1 945.28	$26 436.93	$136 220.14	$136 220.14	$31 604.37	$228 499.90
0.270	0.06	1.68	8.80	0.00	8.80	9.20	$2 096.35	$28 490.03	$1 812.43	$24 631.56	$141 112.78	$141 112.78	$27 671.73	$221 906.10
0.280	0.06	1.56	7.37	0.00	7.37	7.71	$1 756.08	$23 865.73	$1 703.80	$23 155.22	$145 993.66	$145 993.66	$24 345.83	$217 360.44
0.290	0.07	1.45	6.21	0.00	6.21	6.50	$1 480.22	$20 116.67	$1 614.96	$21 947.86	$150 863.22	$150 863.22	$21 516.15	$214 443.90
0.300	0.07	1.36	5.27	0.00	5.27	5.51	$1 254.94	$17 055.09	$1 542.42	$20 961.94	$155 721.87	$155 721.87	$19 095.18	$212 834.08
0.305	0.07	1.31	4.86	0.00	4.86	5.08	$1 157.88	$15 735.99	$1 511.36	$20 539.86	$158 147.23	$158 147.23	$18 015.56	$212 438.65
0.310	0.08	1.27	4.49	0.00	4.49	4.70	$1 069.73	$14 537.94	$1 483.37	$20 159.53	$160 570.01	$160 570.01	$17 013.08	$212 280.56
0.315	0.08	1.23	4.15	0.00	4.15	4.34	$989.54	$13 448.13	$1 458.20	$19 817.35	$162 990.24	$162 990.24	$16 081.11	$212 336.84
0.320	0.08	1.19	3.85	0.00	3.85	4.02	$916.48	$12 455.29	$1 435.59	$19 510.10	$165 407.98	$165 407.98	$15 213.68	$212 587.06
0.330	0.09	1.12	3.31	0.00	3.31	3.46	$788.94	$10 721.89	$1 397.24	$18 988.95	$170 236.14	$170 236.14	$13 651.48	$213 598.46
0.340	0.09	1.06	2.86	0.00	2.86	3.00	$682.19	$9 271.12	$1 366.85	$18 575.93	$175 054.80	$175 054.80	$12 289.38	$215 191.22
0.400	0.13	0.76	1.30	0.00	1.30	1.36	$309.15	$4 201.48	$1 296.29	$17 617.04	$203 782.71	$203 782.71	$6 934.47	$232 535.69
0.700	0.38	0.25	0.08	0.00	0.08	0.09	$20.26	$275.30	$1 758.07	$23 892.75	$343 880.78	$343 880.78	$966.66	$369 015.49
0.800	0.50	0.19	0.04	0.00	0.04	0.05	$10.57	$143.68	$1 972.21	$26 803.03	$389 610.25	$389 610.25	$604.06	$417 161.02

University of Pretoria

SINGLE FEEDER PIPE: 80 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.096
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85})/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

Optimization

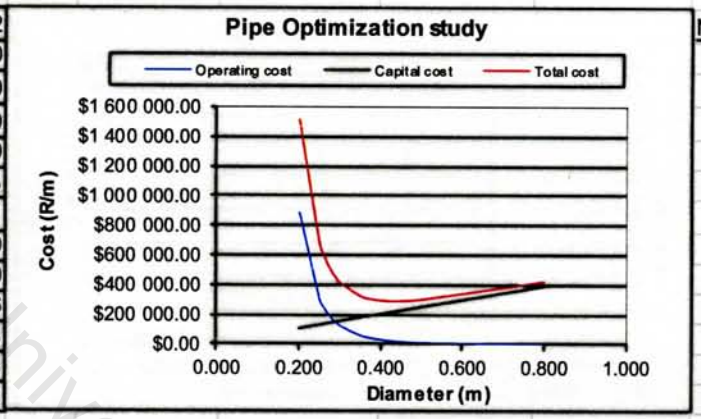
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
0.120	0.01	8.49	######	0.00	11411.87	#####	$2 719 768.00	$36 962 534.74	$205 435.86	$2 791 940.33	$1 652 782.52	$1 652 782.52	$4 929 298.60	$46 336 556.19
0.130	0.01	7.23	7727.97	0.00	7727.97	#####	$1 841 791.24	$25 030 543.99	$157 652.83	$2 142 553.46	$1 781 222.94	$1 781 222.94	$3 718 667.97	$32 672 988.36
0.140	0.02	6.24	5386.74	0.00	5386.74	#####	$1 283 810.71	$17 447 406.52	$124 129.33	$1 686 958.08	$1 909 022.11	$1 909 022.11	$2 864 605.43	$23 907 992.14
0.160	0.02	4.77	2811.29	0.00	2811.29	#####	$670 008.35	$9 105 632.08	$82 417.98	$1 120 087.23	$2 162 885.01	$2 162 885.01	$1 790 088.84	$14 178 693.16
0.200	0.03	3.06	948.32	0.00	948.32	992.32	$226 010.41	$3 071 555.27	$45 960.62	$624 619.80	$2 664 675.27	$2 664 675.27	$815 931.05	$7 176 781.40
0.250	0.05	1.96	319.89	0.00	319.89	334.73	$76 238.91	$1 036 111.69	$31 290.62	$425 249.69	$3 282 881.10	$3 282 881.10	$371 905.27	$5 116 147.75
0.260	0.05	1.81	264.27	0.00	264.27	276.53	$62 983.14	$855 961.46	$29 984.91	$407 504.77	$3 405 503.46	$3 405 503.46	$323 934.93	$4 992 904.62
0.270	0.06	1.68	219.90	0.00	219.90	230.10	$52 408.65	$712 250.70	$28 984.16	$393 904.22	$3 527 819.57	$3 527 819.57	$283 626.60	$4 917 601.09
0.280	0.06	1.56	184.21	0.00	184.21	192.76	$43 902.06	$596 643.35	$28 230.69	$383 664.33	$3 649 841.50	$3 649 841.50	$249 537.14	$4 879 686.32
0.284	0.06	1.52	171.91	0.00	171.91	179.89	$40 971.72	$556 819.07	$27 988.06	$380 366.93	$3 698 570.44	$3 698 570.44	$237 380.30	$4 873 136.73
0.288	0.07	1.47	160.59	0.00	160.59	168.05	$38 273.93	$520 155.26	$27 775.21	$377 474.23	$3 747 254.78	$3 747 254.78	$225 973.52	$4 870 857.79
0.290	0.07	1.45	155.27	0.00	155.27	162.48	$37 005.50	$502 916.82	$27 679.25	$376 170.08	$3 771 580.43	$3 771 580.43	$220 533.78	$4 871 201.12
0.300	0.07	1.36	131.64	0.00	131.64	137.75	$31 373.58	$426 377.13	$27 294.02	$370 934.62	$3 893 046.75	$3 893 046.75	$195 719.63	$4 886 078.13
0.310	0.08	1.27	112.21	0.00	112.21	117.42	$26 743.18	$363 448.57	$27 046.40	$367 569.43	$4 014 250.13	$4 014 250.13	$174 378.79	$4 919 646.91
0.320	0.08	1.19	96.14	0.00	96.14	100.60	$22 912.06	$311 382.37	$26 913.42	$365 762.13	$4 135 199.59	$4 135 199.59	$155 935.49	$4 968 279.57
0.330	0.09	1.12	82.76	0.00	82.76	86.60	$19 723.39	$268 047.36	$26 876.45	$365 259.77	$4 255 903.58	$4 255 903.58	$139 923.39	$5 029 134.10
0.340	0.09	1.06	71.56	0.00	71.56	74.88	$17 054.63	$231 777.93	$26 920.34	$365 856.22	$4 376 370.01	$4 376 370.01	$125 962.28	$5 099 966.45
0.400	0.13	0.76	32.43	0.00	32.43	33.93	$7 728.81	$105 036.99	$28 315.88	$384 822.11	$5 094 567.70	$5 094 567.70	$71 076.14	$5 655 502.93
0.500	0.20	0.49	10.94	0.00	10.94	11.45	$2 607.12	$35 431.58	$32 678.42	$444 110.42	$6 276 509.64	$6 276 509.64	$32 396.84	$6 788 448.48
0.600	0.28	0.34	4.50	0.00	4.50	4.71	$1 072.87	$14 580.68	$37 897.37	$515 037.59	$7 443 079.63	$7 443 079.63	$17 049.23	$7 989 747.13
0.700	0.38	0.25	2.12	0.00	2.12	2.22	$506.43	$6 882.51	$43 381.42	$589 567.60	$8 597 019.53	$8 597 019.53	$9 907.96	$9 203 377.61
0.800	0.50	0.19	1.11	0.00	1.11	1.16	$264.30	$3 591.92	$48 948.94	$665 232.07	$9 740 256.28	$9 740 256.28	$6 191.48	$10 415 271.75

UNIVERSITY OF PRETORIA

SINGLE FEEDER PIPE: 160 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.192
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85})/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

Optimization

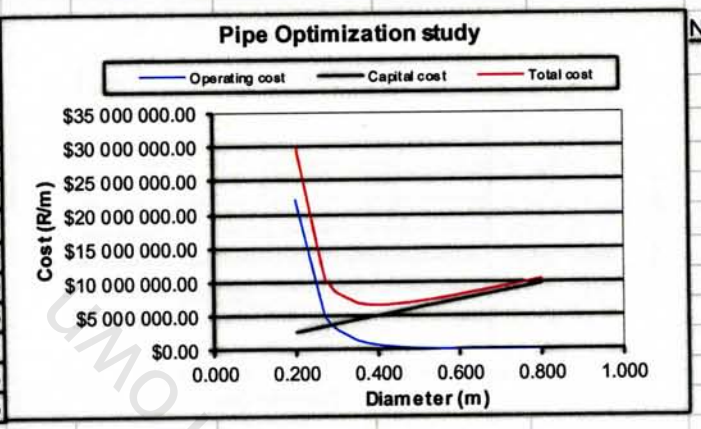
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)- Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
	See note (a)	q / (2)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See dissertation	See note (g)	See dissertation	See cost model	= (12)	See cost model	See note (h)
0.200	0.03	6.11	136.75	0.00	136.75	286.18	$65 181.44	$885 837.00	$13 815.75	$187 760.58	$106 587.01	$106 587.01	$332 070.42	$1 512 255.00
0.250	0.05	3.91	46.13	0.00	46.13	96.54	$21 987.31	$298 814.76	$6 710.95	$91 203.97	$131 315.24	$131 315.24	$151 359.29	$672 693.26
0.260	0.05	3.62	38.11	0.00	38.11	79.75	$18 164.35	$246 859.41	$5 954.55	$80 924.23	$136 220.14	$136 220.14	$131 836.15	$595 839.93
0.270	0.06	3.35	31.71	0.00	31.71	66.36	$15 114.66	$205 413.21	$5 322.82	$72 338.82	$141 112.78	$141 112.78	$115 431.33	$534 296.14
0.280	0.06	3.12	26.56	0.00	26.56	55.59	$12 661.36	$172 072.03	$4 792.27	$65 128.48	$145 993.66	$145 993.66	$101 557.48	$484 751.65
0.290	0.07	2.91	22.39	0.00	22.39	46.86	$10 672.39	$145 041.29	$4 344.46	$59 042.63	$150 863.22	$150 863.22	$89 753.59	$444 700.72
0.300	0.07	2.72	18.98	0.00	18.98	39.73	$9 048.14	$122 967.23	$3 964.80	$53 882.86	$155 721.87	$155 721.87	$79 654.65	$412 226.60
0.350	0.10	2.00	8.96	0.00	8.96	18.75	$4 270.99	$58 044.16	$2 750.94	$37 386.13	$179 864.25	$179 864.25	$46 290.38	$321 584.92
0.380	0.11	1.69	6.00	0.00	6.00	12.56	$2 861.50	$38 888.73	$2 357.30	$32 036.54	$194 240.10	$194 240.10	$34 652.61	$299 817.99
0.390	0.12	1.61	5.29	0.00	5.29	11.07	$2 521.48	$34 267.72	$2 260.03	$30 714.58	$199 015.38	$199 015.38	$31 623.90	$295 621.59
0.400	0.13	1.53	4.68	0.00	4.68	9.79	$2 228.99	$30 292.68	$2 175.99	$29 572.36	$203 782.71	$203 782.71	$28 926.81	$292 574.56
0.410	0.13	1.45	4.15	0.00	4.15	8.68	$1 976.44	$26 860.40	$2 103.43	$28 586.35	$208 542.29	$208 542.29	$26 518.06	$290 507.11
0.420	0.14	1.39	3.69	0.00	3.69	7.72	$1 757.58	$23 886.13	$2 040.91	$27 736.59	$213 294.34	$213 294.34	$24 360.87	$289 277.93
0.430	0.15	1.32	3.29	0.00	3.29	6.88	$1 567.29	$21 299.95	$1 987.15	$27 006.03	$218 039.03	$218 039.03	$22 423.89	$288 768.90
0.435	0.15	1.29	3.11	0.00	3.11	6.50	$1 481.49	$20 133.87	$1 963.22	$26 680.81	$220 408.68	$220 408.68	$21 529.44	$288 752.80
0.440	0.15	1.26	2.94	0.00	2.94	6.15	$1 401.28	$19 043.88	$1 941.09	$26 380.10	$222 776.56	$222 776.56	$20 680.28	$288 880.82
0.450	0.16	1.21	2.64	0.00	2.64	5.51	$1 256.02	$17 069.66	$1 901.81	$25 846.28	$227 507.09	$227 507.09	$19 106.98	$289 530.01
0.500	0.20	0.98	1.58	0.00	1.58	3.30	$751.89	$10 218.47	$1 782.70	$24 227.49	$251 060.39	$251 060.39	$13 184.98	$298 691.33
0.800	0.50	0.38	0.16	0.00	0.16	0.33	$76.22	$1 035.91	$2 048.84	$27 844.46	$389 610.25	$389 610.25	$2 519.83	$421 010.45
0.800	0.50	0.38	0.16	0.00	0.16	0.33	$76.22	$1 035.91	$2 048.84	$27 844.46	$389 610.25	$389 610.25	$2 519.83	$421 010.45

University of Cape Town

SINGLE FEEDER PIPE: 160 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.192
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85)}/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

Optimization

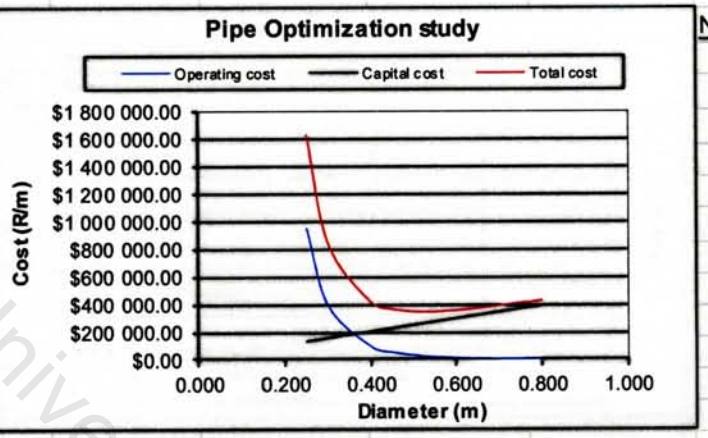
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
	See note (a)	q / (2)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See dissertation	See note (g)	See dissertation	See cost model	= (12)	See cost model	See note (h)
0.200	0.03	6.11	3418.68	0.00	3418.68	#####	$1 629 535.92	$22 145 924.89	$149 468.10	$2 031 320.24	$2 664 675.27	$2 664 675.27	$3 403 618.05	$30 245 538.46
0.270	0.06	3.35	792.74	0.00	792.74	#####	$377 866.58	$5 135 330.16	$64 964.50	$882 888.75	$3 527 819.57	$3 527 819.57	$1 183 135.04	$10 729 173.52
0.280	0.06	3.12	664.07	0.00	664.07	#####	$316 534.03	$4 301 800.73	$59 886.51	$813 877.15	$3 649 841.50	$3 649 841.50	$1 040 932.44	$9 806 451.82
0.290	0.07	2.91	559.75	0.00	559.75	#####	$266 809.79	$3 626 032.16	$55 655.75	$756 379.85	$3 771 580.43	$3 771 580.43	$919 946.28	$9 073 938.73
0.300	0.07	2.72	474.56	0.00	474.56	993.17	$226 203.60	$3 074 180.70	$52 122.64	$708 363.73	$3 893 046.75	$3 893 046.75	$816 435.23	$8 492 026.40
0.350	0.10	2.00	224.01	0.00	224.01	468.80	$106 774.77	$1 451 103.95	$41 461.51	$563 475.46	$4 496 606.33	$4 496 606.33	$474 461.98	$6 985 647.73
0.360	0.10	1.89	195.29	0.00	195.29	408.70	$93 086.53	$1 265 076.31	$40 269.45	$547 275.00	$4 616 619.53	$4 616 619.53	$429 658.86	$6 858 629.70
0.370	0.11	1.79	170.90	0.00	170.90	357.65	$81 458.73	$1 107 050.69	$39 287.90	$533 935.34	$4 736 416.20	$4 736 416.20	$390 145.40	$6 767 547.63
0.380	0.11	1.69	150.08	0.00	150.08	314.09	$71 537.52	$972 218.29	$38 487.15	$523 052.94	$4 856 002.58	$4 856 002.58	$355 178.45	$6 706 452.25
0.390	0.12	1.61	132.25	0.00	132.25	276.77	$63 036.98	$856 693.09	$37 842.33	$514 289.57	$4 975 384.55	$4 975 384.55	$324 135.09	$6 670 502.31
0.395	0.12	1.57	124.29	0.00	124.29	260.12	$59 245.06	$805 159.73	$37 571.70	$510 611.71	$5 035 000.64	$5 035 000.64	$309 917.50	$6 660 689.59
0.400	0.13	1.53	116.91	0.00	116.91	244.66	$55 724.72	$757 317.07	$37 332.47	$507 360.45	$5 094 567.70	$5 094 567.70	$296 490.78	$6 655 736.00
0.405	0.13	1.49	110.04	0.00	110.04	230.30	$52 453.45	$712 859.49	$37 122.51	$504 506.97	$5 154 086.38	$5 154 086.38	$283 801.86	$6 655 254.70
0.410	0.13	1.45	103.66	0.00	103.66	216.94	$49 410.89	$671 510.05	$36 939.86	$502 024.74	$5 213 557.31	$5 213 557.31	$271 801.82	$6 658 893.93
0.420	0.14	1.39	92.18	0.00	92.18	192.92	$43 939.59	$597 153.33	$36 649.45	$498 077.92	$5 332 358.41	$5 332 358.41	$249 691.33	$6 677 280.99
0.500	0.20	0.98	39.44	0.00	39.44	82.53	$18 797.33	$255 461.81	$36 788.22	$499 963.98	$6 276 509.64	$6 276 509.64	$135 141.92	$7 167 077.34
0.600	0.28	0.68	16.23	0.00	16.23	33.96	$7 735.41	$105 126.77	$40 060.20	$544 431.20	$7 443 079.63	$7 443 079.63	$71 120.06	$8 163 757.65
0.700	0.38	0.50	7.66	0.00	7.66	16.03	$3 651.34	$49 622.93	$44 638.32	$606 649.36	$8 597 019.53	$8 597 019.53	$41 330.61	$9 294 622.44
0.800	0.50	0.38	4.00	0.00	4.00	8.37	$1 905.60	$25 897.73	$49 734.38	$675 906.45	$9 740 256.28	$9 740 256.28	$25 827.45	$10 467 887.91
0.800	0.50	0.38	4.00	0.00	4.00	8.37	$1 905.60	$25 897.73	$49 734.38	$675 906.45	$9 740 256.28	$9 740 256.28	$25 827.45	$10 467 887.91

UMoT 2010

SINGLE FEEDER PIPE: 240 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.288
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85})/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

Optimization

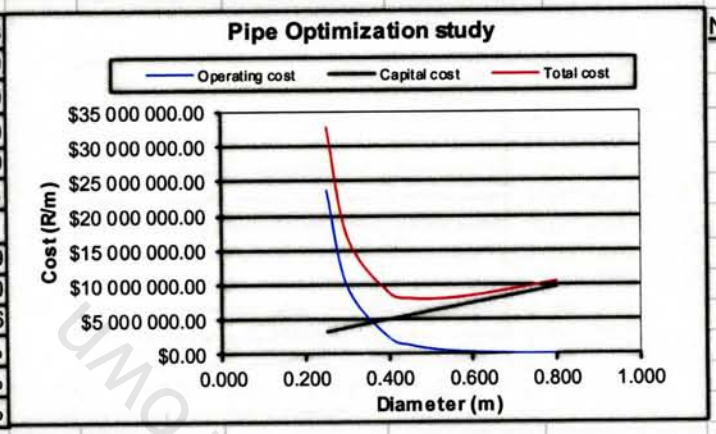
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)- Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
	See note (a)	q / (2)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See dissertation	See note (g)	See dissertation	See cost model	= (12)	See cost model	See note (h)
0.250	0.05	5.87	97.66	0.00	97.66	306.59	$69 828.43	$948 991.10	$14 617.49	$198 656.48	$131 315.24	$131 315.24	$349 022.89	$1 627 985.72
0.300	0.07	4.07	40.19	0.00	40.19	126.17	$28 735.55	$390 525.57	$8 125.71	$110 431.04	$155 721.87	$155 721.87	$183 677.50	$840 355.97
0.400	0.13	2.29	9.90	0.00	9.90	31.08	$7 078.94	$96 205.04	$3 687.03	$50 107.99	$203 782.71	$203 782.71	$66 703.01	$416 798.75
0.450	0.16	1.81	5.58	0.00	5.58	17.51	$3 988.92	$54 210.70	$2 899.90	$39 410.65	$227 507.09	$227 507.09	$44 059.23	$365 187.67
0.460	0.17	1.73	5.01	0.00	5.01	15.74	$3 584.01	$48 707.89	$2 792.28	$37 948.01	$232 230.80	$232 230.80	$40 778.17	$359 664.86
0.470	0.17	1.66	4.51	0.00	4.51	14.17	$3 227.63	$43 864.52	$2 696.91	$36 651.91	$236 947.83	$236 947.83	$37 804.32	$355 268.58
0.480	0.18	1.59	4.07	0.00	4.07	12.79	$2 913.10	$39 589.97	$2 612.42	$35 503.67	$241 658.34	$241 658.34	$35 103.26	$351 855.24
0.490	0.19	1.53	3.69	0.00	3.69	11.57	$2 634.79	$35 807.59	$2 537.61	$34 487.01	$246 362.48	$246 362.48	$32 645.05	$349 302.13
0.500	0.20	1.47	3.34	0.00	3.34	10.48	$2 387.90	$32 452.34	$2 471.44	$33 587.73	$251 060.39	$251 060.39	$30 403.55	$347 504.01
0.510	0.20	1.41	3.03	0.00	3.03	9.52	$2 168.37	$29 468.85	$2 413.00	$32 793.40	$255 752.18	$255 752.18	$28 355.87	$346 370.31
0.520	0.21	1.36	2.76	0.00	2.76	8.66	$1 972.71	$26 809.81	$2 361.47	$32 093.11	$260 438.01	$260 438.01	$26 481.94	$345 822.86
0.530	0.22	1.31	2.51	0.00	2.51	7.89	$1 797.95	$24 434.67	$2 316.15	$31 477.27	$265 117.98	$265 117.98	$24 764.07	$345 793.99
0.540	0.23	1.26	2.30	0.00	2.30	7.21	$1 641.51	$22 308.60	$2 276.43	$30 937.41	$269 792.21	$269 792.21	$23 186.70	$346 224.92
0.550	0.24	1.21	2.10	0.00	2.10	6.59	$1 501.18	$20 401.57	$2 241.75	$30 466.05	$274 460.82	$274 460.82	$21 736.03	$347 064.47
0.600	0.28	1.02	1.37	0.00	1.37	4.31	$982.66	$13 354.68	$2 128.63	$28 928.71	$297 723.19	$297 723.19	$16 000.23	$356 006.81
0.610	0.29	0.99	1.27	0.00	1.27	3.98	$906.66	$12 321.79	$2 115.63	$28 752.04	$302 360.21	$302 360.21	$15 095.60	$358 529.63
0.640	0.32	0.90	1.00	0.00	1.00	3.15	$717.64	$9 752.89	$2 091.12	$28 419.06	$316 241.97	$316 241.97	$12 747.85	$367 161.77
0.800	0.50	0.57	0.34	0.00	0.34	1.06	$242.08	$3 289.89	$2 180.47	$29 633.33	$389 610.25	$389 610.25	$5 810.53	$428 344.01

University of Cape Town

SINGLE FEEDER PIPE: 240 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.288
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	$(10.67 \times l \times q^{1.85})/(c^{1.85} \times (1)^{4.87})$
(c)	$k \times (3)^2/(2 \times g)$
(d)	l + (4) + (5)
(e)	g x (6) x q / *n*
(f)	(7) x p x 365 x t
(g)	mc x (13) + mm x (14)
(h)	=(9)+(13)+(14)+(11)

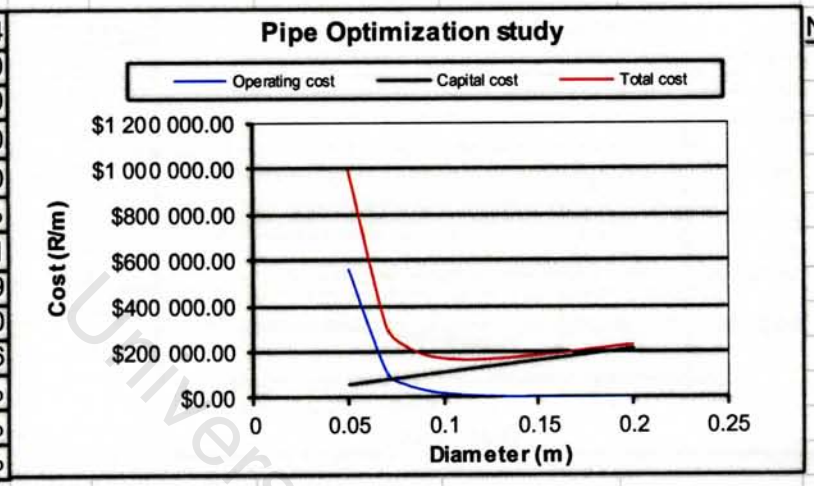
Optimization

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe		Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Total (R)		
	See note (a)	q / (2)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See dissertation	See note (g)	See dissertation	See cost model	= (12)	See cost model	See note (h)
0.250	0.05	5.87	2441.61	0.00	2441.61	#####	$1 745 710.65	$23 724 777.47	$159 509.43	$2 167 785.19	$3 282 881.10	$3 282 881.10	$3 577 375.58	$32 752 819.34
0.300	0.07	4.07	1004.76	0.00	1004.76	#####	$718 388.87	$9 763 139.15	$94 770.71	$1 287 964.90	$3 893 046.75	$3 893 046.75	$1 882 636.95	$16 826 787.76
0.400	0.13	2.29	247.52	0.00	247.52	777.02	$176 973.38	$2 405 125.99	$52 820.24	$717 844.27	$5 094 567.70	$5 094 567.70	$683 684.98	$8 901 222.94
0.450	0.16	1.81	139.48	0.00	139.48	437.84	$99 722.96	$1 355 267.57	$46 502.12	$631 978.97	$5 687 677.28	$5 687 677.28	$451 593.30	$8 126 517.13
0.460	0.17	1.73	125.32	0.00	125.32	393.40	$89 600.30	$1 217 697.32	$45 747.39	$621 721.94	$5 805 769.89	$5 805 769.89	$417 963.48	$8 063 152.63
0.470	0.17	1.66	112.86	0.00	112.86	354.28	$80 690.71	$1 096 613.08	$45 117.78	$613 165.30	$5 923 695.73	$5 923 695.73	$387 482.42	$8 020 956.53
0.480	0.18	1.59	101.86	0.00	101.86	319.76	$72 827.48	$989 749.21	$44 599.19	$606 117.56	$6 041 458.59	$6 041 458.59	$359 797.45	$7 997 122.81
0.490	0.19	1.53	92.13	0.00	92.13	289.21	$65 869.63	$895 189.71	$44 179.37	$600 412.10	$6 159 062.07	$6 159 062.07	$334 601.58	$7 989 265.46
0.500	0.20	1.47	83.49	0.00	83.49	262.11	$59 697.51	$811 308.58	$43 847.62	$595 903.51	$6 276 509.64	$6 276 509.64	$311 626.88	$7 995 348.61
0.550	0.24	1.21	52.49	0.00	52.49	164.78	$37 529.59	$510 039.36	$43 219.10	$587 361.71	$6 861 520.43	$6 861 520.43	$222 787.52	$8 181 709.02
0.600	0.28	1.02	34.36	0.00	34.36	107.86	$24 566.51	$333 866.93	$43 775.29	$594 920.53	$7 443 079.63	$7 443 079.63	$163 997.40	$8 535 864.48
0.610	0.29	0.99	31.70	0.00	31.70	99.52	$22 666.47	$308 044.67	$43 984.03	$597 757.38	$7 559 005.16	$7 559 005.16	$154 725.21	$8 619 532.42
0.620	0.30	0.95	29.29	0.00	29.29	91.94	$20 940.77	$284 591.85	$44 218.66	$600 945.96	$7 674 807.23	$7 674 807.23	$146 115.48	$8 706 460.51
0.630	0.31	0.92	27.09	0.00	27.09	85.05	$19 370.98	$263 257.96	$44 476.89	$604 455.47	$7 790 487.94	$7 790 487.94	$138 111.30	$8 796 312.68
0.640	0.32	0.90	25.09	0.00	25.09	78.77	$17 940.88	$243 822.35	$44 756.71	$608 258.24	$7 906 049.36	$7 906 049.36	$130 661.47	$8 888 791.42
0.650	0.33	0.87	23.27	0.00	23.27	73.04	$16 636.12	$226 090.31	$45 056.26	$612 329.27	$8 021 493.47	$8 021 493.47	$123 719.81	$8 983 632.86
0.700	0.38	0.75	16.22	0.00	16.22	50.91	$11 596.12	$157 595.04	$46 797.31	$635 990.66	$8 597 019.53	$8 597 019.53	$95 305.21	$9 485 910.44
0.750	0.44	0.65	11.59	0.00	11.59	36.38	$8 286.89	$112 621.59	$48 839.42	$663 743.64	$9 169 877.36	$9 169 877.36	$74 750.80	$10 020 993.38
0.800	0.50	0.57	8.46	0.00	8.46	26.57	$6 051.90	$82 247.32	$51 083.53	$694 241.79	$9 740 256.28	$9 740 256.28	$59 556.12	$10 576 301.51

PARALLEL FEEDER PIPE: 20 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.024
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

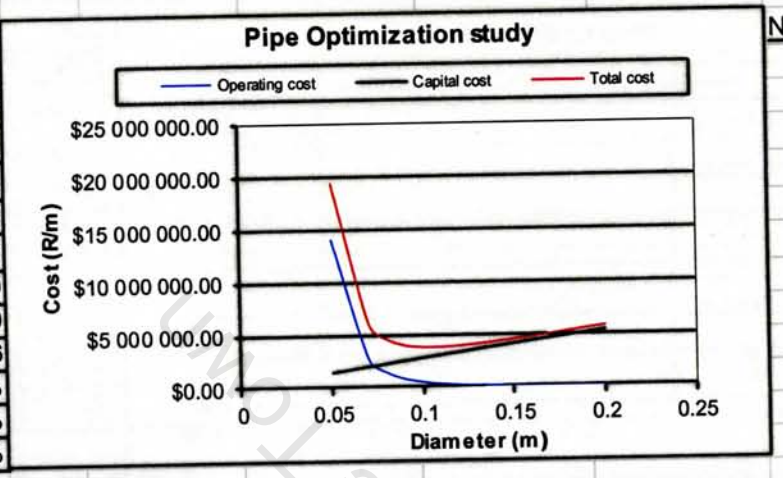
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i
0.05	0.002	6.11	692.36	0.00	692.36	181.12	$41 251.92	$560 627.01	$9 833.71	$133 643.32	$29 159.37	$29 159.37	$58 318.75	$238 552.90	$991 141.9
0.07	0.004	3.12	134.49	0.00	134.49	35.18	$8 013.10	$108 900.65	$3 317.68	$45 088.30	$39 939.99	$39 939.99	$79 879.97	$72 956.91	$306 825.8
0.08	0.005	2.39	70.19	0.00	70.19	18.36	$4 181.96	$56 834.19	$2 276.14	$30 933.49	$45 251.23	$45 251.23	$90 502.46	$45 590.69	$223 860.8
0.09	0.006	1.89	39.55	0.00	39.55	10.35	$2 356.50	$32 025.57	$1 709.75	$23 236.08	$50 519.38	$50 519.38	$101 038.75	$30 113.95	$186 414.3
0.1	0.008	1.53	23.68	0.00	23.68	6.19	$1 410.68	$19 171.58	$1 388.71	$18 873.07	$55 749.53	$55 749.53	$111 499.07	$20 780.46	$170 324.1
0.11	0.010	1.26	14.88	0.00	14.88	3.89	$886.84	$12 052.46	$1 203.71	$16 358.81	$60 945.75	$60 945.75	$121 891.49	$14 856.31	$165 159.0
0.112	0.010	1.22	13.63	0.00	13.63	3.57	$812.34	$11 039.93	$1 177.53	$16 003.08	$61 981.22	$61 981.22	$123 962.43	$13 943.05	$164 948.4
0.113	0.010	1.20	13.06	0.00	13.06	3.42	$777.92	$10 572.21	$1 165.52	$15 839.82	$62 498.50	$62 498.50	$124 997.00	$13 513.42	$164 922.4
0.114	0.010	1.18	12.51	0.00	12.51	3.27	$745.25	$10 128.18	$1 154.18	$15 685.69	$63 015.48	$63 015.48	$126 030.97	$13 100.64	$164 945.4
0.12	0.011	1.06	9.74	0.00	9.74	2.55	$580.52	$7 889.42	$1 098.55	$14 929.67	$66 111.30	$66 111.30	$132 222.60	$10 935.97	$165 977.6
0.13	0.013	0.90	6.60	0.00	6.60	1.73	$393.12	$5 342.61	$1 042.49	$14 167.82	$71 248.92	$71 248.92	$142 497.84	$8 250.10	$170 258.3
0.14	0.015	0.78	4.60	0.00	4.60	1.20	$274.02	$3 724.04	$1 017.82	$13 832.52	$76 360.88	$76 360.88	$152 721.77	$6 355.31	$176 633.6
0.16	0.020	0.60	2.40	0.00	2.40	0.63	$143.01	$1 943.54	$1 024.01	$13 916.64	$86 515.40	$86 515.40	$173 030.80	$3 971.43	$192 862.4
0.2	0.031	0.38	0.81	0.00	0.81	0.21	$48.24	$655.60	$1 138.28	$15 469.57	$106 587.01	$106 587.01	$213 174.02	$1 810.20	$231 109.3

University of Cape Town

PARALLEL FEEDER PIPE: 20 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.024
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

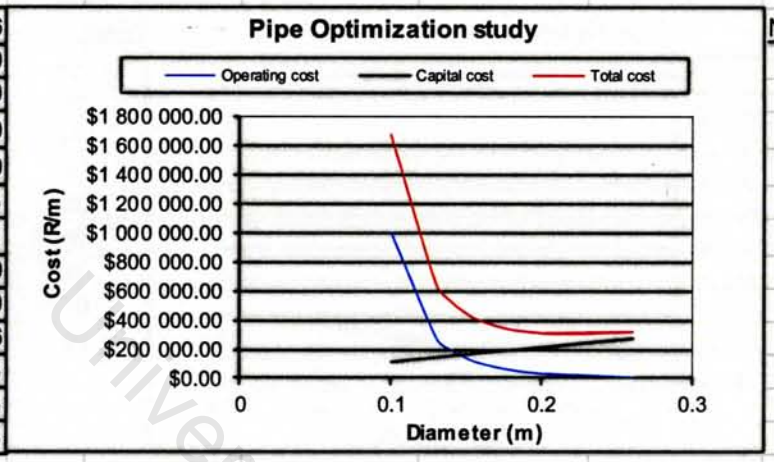
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i)
0.05	0.002	6.11	######	0.00	17308.88	#####	$1 031 297.92	$14 015 675.23	$105 093.55	$1 428 255.65	$728 984.34	$728 984.34	$1 457 968.68	$2 445 092.68	$19 346 992.24
0.07	0.004	3.12	3362.21	0.00	3362.21	879.56	$200 327.52	$2 722 516.32	$39 896.42	$542 205.33	$998 499.64	$998 499.64	$1 996 999.28	$747 785.52	$6 009 506.45
0.08	0.005	2.39	1754.71	0.00	1754.71	459.03	$104 548.99	$1 420 854.84	$30 004.42	$407 769.88	$1 131 280.72	$1 131 280.72	$2 262 561.43	$467 290.36	$4 558 476.51
0.09	0.006	1.89	988.76	0.00	988.76	258.66	$58 912.44	$800 639.34	$24 976.19	$339 434.51	$1 262 984.42	$1 262 984.42	$2 525 968.84	$308 658.53	$3 974 701.21
0.1	0.008	1.53	591.91	0.00	591.91	154.84	$35 266.96	$479 289.54	$22 457.11	$305 199.46	$1 393 738.34	$1 393 738.34	$2 787 476.67	$212 993.18	$3 784 958.85
0.104	0.008	1.41	488.99	0.00	488.99	127.92	$29 135.05	$395 954.77	$21 878.78	$297 339.76	$1 445 797.33	$1 445 797.33	$2 891 594.66	$185 520.17	$3 770 409.37
0.11	0.010	1.26	372.11	0.00	372.11	97.34	$22 171.02	$301 311.40	$21 327.34	$289 845.49	$1 523 643.65	$1 523 643.65	$3 047 287.30	$152 272.56	$3 790 716.76
0.12	0.011	1.06	243.58	0.00	243.58	63.72	$14 512.94	$197 235.59	$21 011.43	$285 552.25	$1 652 782.52	$1 652 782.52	$3 305 565.04	$112 090.23	$3 900 443.10
0.13	0.013	0.90	164.95	0.00	164.95	43.15	$9 827.97	$133 565.35	$21 194.67	$288 042.46	$1 781 222.94	$1 781 222.94	$3 562 445.89	$84 560.98	$4 068 614.69
0.14	0.015	0.78	114.98	0.00	114.98	30.08	$6 850.54	$93 101.01	$21 695.82	$294 853.26	$1 909 022.11	$1 909 022.11	$3 818 044.23	$65 139.95	$4 271 138.46
0.16	0.020	0.60	60.01	0.00	60.01	15.70	$3 575.23	$48 588.52	$23 257.09	$316 071.38	$2 162 885.01	$2 162 885.01	$4 325 770.01	$40 705.88	$4 731 135.79
0.2	0.031	0.38	20.24	0.00	20.24	5.30	$1 206.01	$16 390.11	$27 388.91	$372 224.23	$2 664 675.27	$2 664 675.27	$5 329 350.55	$18 553.94	$5 736 518.82

UNIVERSITY OF PRETORIA

PARALLEL FEEDER PIPE: 80 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.096
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

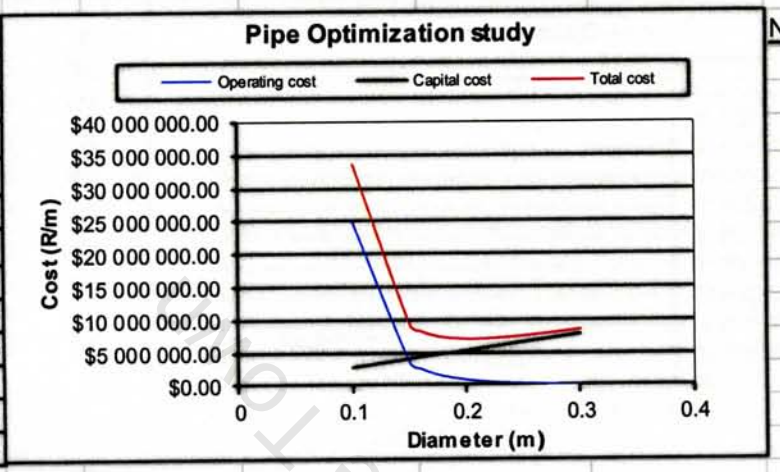
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i)
0.1	0.008	6.11	307.70	0.00	307.70	321.97	$73 332.93	$996 618.43	$15 021.54	$204 147.64	$55 749.53	$55 749.53	$111 499.07	$361 601.14	$1 673 866.28
0.13	0.013	3.62	85.75	0.00	85.75	89.73	$20 435.95	$277 731.27	$6 454.90	$87 724.17	$71 248.92	$71 248.92	$142 497.84	$143 560.22	$651 513.50
0.14	0.015	3.12	59.77	0.00	59.77	62.54	$14 244.77	$193 591.10	$5 187.16	$70 495.26	$76 360.88	$76 360.88	$152 721.77	$110 588.89	$527 397.02
0.15	0.018	2.72	42.71	0.00	42.71	44.69	$10 179.69	$138 345.32	$4 284.02	$58 221.26	$81 449.15	$81 449.15	$162 898.30	$86 738.26	$446 203.14
0.16	0.020	2.39	31.19	0.00	31.19	32.64	$7 434.21	$101 033.31	$3 629.43	$49 325.13	$86 515.40	$86 515.40	$173 030.80	$69 106.88	$392 496.12
0.18	0.025	1.89	17.58	0.00	17.58	18.39	$4 189.11	$56 931.39	$2 791.76	$37 940.89	$96 587.52	$96 587.52	$193 175.05	$45 647.05	$333 694.39
0.2	0.031	1.53	10.52	0.00	10.52	11.01	$2 507.74	$34 081.04	$2 325.84	$31 608.92	$106 587.01	$106 587.01	$213 174.02	$31 499.25	$310 363.23
0.21	0.035	1.39	8.30	0.00	8.30	8.68	$1 977.38	$26 873.30	$2 176.71	$29 582.21	$111 562.00	$111 562.00	$223 123.99	$26 527.26	$306 106.76
0.216	0.037	1.31	7.23	0.00	7.23	7.57	$1 723.89	$23 428.21	$2 106.29	$28 625.14	$114 539.56	$114 539.56	$229 079.11	$24 022.31	$305 154.78
0.218	0.037	1.29	6.92	0.00	6.92	7.24	$1 648.22	$22 399.89	$2 085.52	$28 342.88	$115 530.87	$115 530.87	$231 061.75	$23 255.25	$305 059.77
0.22	0.038	1.26	6.61	0.00	6.61	6.92	$1 576.52	$21 425.47	$2 065.99	$28 077.49	$116 521.60	$116 521.60	$233 043.20	$22 519.36	$305 065.53
0.23	0.042	1.16	5.33	0.00	5.33	5.57	$1 269.65	$17 254.98	$1 984.93	$26 975.91	$121 466.57	$121 466.57	$242 933.14	$19 256.73	$306 420.75
0.24	0.045	1.06	4.33	0.00	4.33	4.53	$1 031.98	$14 024.91	$1 927.05	$26 189.24	$126 397.58	$126 397.58	$252 795.15	$16 576.86	$309 586.16
0.25	0.049	0.98	3.55	0.00	3.55	3.71	$845.92	$11 496.38	$1 887.45	$25 651.10	$131 315.24	$131 315.24	$262 630.49	$14 357.51	$314 135.47
0.26	0.053	0.90	2.93	0.00	2.93	3.07	$698.84	$9 497.49	$1 862.43	$25 310.97	$136 220.14	$136 220.14	$272 440.28	$12 505.60	$319 754.33
0.2	0.031	1.53	10.52	0.00	10.52	11.01	$2 507.74	$34 081.04	$2 325.84	$31 608.92	$106 587.01	$106 587.01	$213 174.02	$31 499.25	$310 363.23

University of Cape Town

PARALLEL FEEDER PIPE: 80 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.096
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i)
0.1	0.008	6.11	7692.44	0.00	7692.44	#####	$1 833 323.21	$24 915 460.70	$162 189.33	$2 204 205.93	$1 393 738.34	$1 393 738.34	$2 787 476.67	$3 706 298.68	$33 613 441.99
0.15	0.018	2.72	1067.82	0.00	1067.82	#####	$254 492.28	$3 458 633.08	$55 923.89	$760 023.92	$2 036 228.79	$2 036 228.79	$4 072 457.58	$889 040.06	$9 180 154.63
0.16	0.020	2.39	779.83	0.00	779.83	816.01	$185 855.20	$2 525 832.85	$49 961.81	$678 997.27	$2 162 885.01	$2 162 885.01	$4 325 770.01	$708 323.93	$8 238 924.05
0.17	0.023	2.11	580.47	0.00	580.47	607.40	$138 341.60	$1 880 107.47	$45 777.20	$622 127.07	$2 289 027.38	$2 289 027.38	$4 578 054.76	$572 173.13	$7 652 462.43
0.18	0.025	1.89	439.43	0.00	439.43	459.82	$104 727.79	$1 423 284.84	$42 861.60	$582 503.16	$2 414 688.08	$2 414 688.08	$4 829 376.16	$467 868.03	$7 303 032.19
0.2	0.031	1.53	263.06	0.00	263.06	275.26	$62 693.56	$852 025.99	$39 561.05	$537 647.58	$2 664 675.27	$2 664 675.27	$5 329 350.55	$322 857.43	$7 041 881.55
0.204	0.033	1.47	238.87	0.00	238.87	249.96	$56 929.86	$773 695.39	$39 189.25	$532 594.63	$2 714 472.54	$2 714 472.54	$5 428 945.08	$301 113.00	$7 036 348.09
0.206	0.033	1.44	227.79	0.00	227.79	238.36	$54 288.23	$737 794.75	$39 031.27	$530 447.70	$2 739 347.30	$2 739 347.30	$5 478 694.61	$290 944.93	$7 037 881.99
0.208	0.034	1.41	217.32	0.00	217.32	227.40	$51 792.94	$703 883.01	$38 890.61	$528 536.02	$2 764 206.38	$2 764 206.38	$5 528 412.75	$281 213.54	$7 042 045.32
0.22	0.038	1.26	165.37	0.00	165.37	173.05	$39 413.10	$535 636.87	$38 363.06	$521 366.47	$2 913 040.03	$2 913 040.03	$5 826 080.06	$230 816.44	$7 113 899.85
0.24	0.045	1.06	108.25	0.00	108.25	113.27	$25 799.44	$350 622.82	$38 395.70	$521 810.07	$3 159 939.42	$3 159 939.42	$6 319 878.84	$169 907.61	$7 362 219.35
0.26	0.053	0.90	73.31	0.00	73.31	76.71	$17 471.04	$237 437.18	$39 182.17	$532 498.53	$3 405 503.46	$3 405 503.46	$6 811 006.93	$128 178.48	$7 709 121.11
0.28	0.062	0.78	51.10	0.00	51.10	53.47	$12 178.10	$165 504.31	$40 448.01	$549 701.65	$3 649 841.50	$3 649 841.50	$7 299 683.01	$98 739.86	$8 113 628.83
0.3	0.071	0.68	36.52	0.00	36.52	38.21	$8 702.79	$118 273.76	$42 028.26	$571 177.71	$3 893 046.75	$3 893 046.75	$7 786 093.50	$77 444.70	$8 552 989.68

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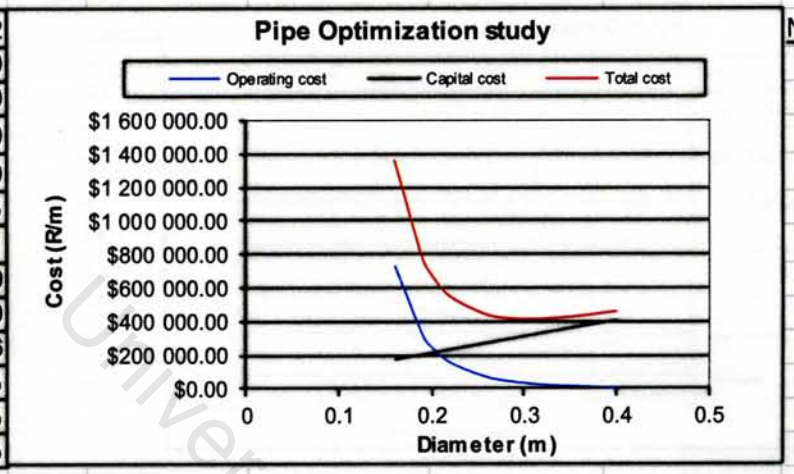
PARALLEL FEEDER PIPE: 160 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.192
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

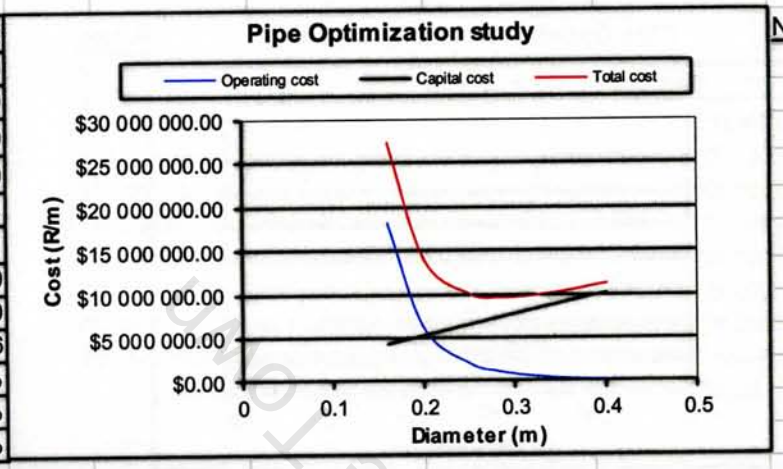
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i)
0.16	0.020	4.77	112.45	0.00	112.45	235.34	$53 600.67	$728 450.57	$12 396.20	$168 468.38	$86 515.40	$86 515.40	$173 030.80	$288 276.11	$1 358 225.85
0.19	0.028	3.39	48.70	0.00	48.70	101.91	$23 211.57	$315 452.78	$7 312.22	$99 375.48	$101 595.82	$101 595.82	$203 191.65	$157 406.60	$775 426.51
0.2	0.031	3.06	37.93	0.00	37.93	79.39	$18 080.83	$245 724.42	$6 321.78	$85 914.99	$106 587.01	$106 587.01	$213 174.02	$131 397.63	$676 211.06
0.22	0.038	2.53	23.85	0.00	23.85	49.91	$11 366.74	$154 477.75	$4 922.75	$66 901.84	$116 521.60	$116 521.60	$233 043.20	$93 938.47	$548 361.26
0.26	0.053	1.81	10.57	0.00	10.57	22.12	$5 038.65	$68 476.92	$3 448.86	$46 871.16	$136 220.14	$136 220.14	$272 440.28	$52 166.52	$439 954.87
0.29	0.066	1.45	6.21	0.00	6.21	13.00	$2 960.44	$40 233.35	$2 929.22	$39 809.10	$150 863.22	$150 863.22	$301 726.43	$35 514.78	$417 283.67
0.295	0.068	1.40	5.71	0.00	5.71	11.96	$2 723.96	$37 019.55	$2 870.55	$39 011.68	$153 293.88	$153 293.88	$306 587.76	$33 440.22	$416 059.22
0.3	0.071	1.36	5.27	0.00	5.27	11.02	$2 509.89	$34 110.17	$2 817.97	$38 297.09	$155 721.87	$155 721.87	$311 443.74	$31 518.71	$415 369.71
0.305	0.073	1.31	4.86	0.00	4.86	10.17	$2 315.76	$31 471.99	$2 770.94	$37 657.98	$158 147.23	$158 147.23	$316 294.46	$29 736.69	$415 161.11
0.31	0.075	1.27	4.49	0.00	4.49	9.39	$2 139.45	$29 075.89	$2 728.98	$37 087.72	$160 570.01	$160 570.01	$321 140.01	$28 081.98	$415 385.59
0.32	0.080	1.19	3.85	0.00	3.85	8.05	$1 832.96	$24 910.59	$2 658.55	$36 130.62	$165 407.98	$165 407.98	$330 815.97	$25 111.87	$416 969.05
0.34	0.091	1.06	2.86	0.00	2.86	5.99	$1 364.37	$18 542.23	$2 561.95	$34 817.70	$175 054.80	$175 054.80	$350 109.60	$20 284.98	$423 754.51
0.36	0.102	0.94	2.17	0.00	2.17	4.53	$1 032.86	$14 036.90	$2 510.13	$34 113.51	$184 664.78	$184 664.78	$369 329.56	$16 587.10	$434 067.07
0.38	0.113	0.85	1.67	0.00	1.67	3.49	$793.76	$10 787.44	$2 490.87	$33 851.76	$194 240.10	$194 240.10	$388 480.21	$13 711.76	$446 831.16
0.4	0.126	0.76	1.30	0.00	1.30	2.71	$618.30	$8 402.96	$2 495.67	$33 916.99	$203 782.71	$203 782.71	$407 565.42	$11 446.11	$461 331.47

University of Cape Town

PARALLEL FEEDER PIPE: 160 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.192
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i)
0.16	0.020	4.77	2811.29	0.00	2811.29	5883.46	$1 340 016.69	$18 211 264.16	$139 818.45	$1 900 178.37	$2 162 885.01	$2 162 885.01	$4 325 770.01	$2 954 740.01	$27 391 952.55
0.2	0.031	3.06	948.32	0.00	948.32	1984.64	$452 020.83	$6 143 110.55	$80 518.14	$1 094 267.77	$2 664 675.27	$2 664 675.27	$5 329 350.55	$1 346 784.62	$13 913 513.48
0.25	0.049	1.96	319.89	0.00	319.89	669.47	$152 477.82	$2 072 223.37	$57 383.65	$779 862.47	$3 282 881.10	$3 282 881.10	$6 565 762.21	$613 870.87	$10 031 718.92
0.28	0.062	1.56	184.21	0.00	184.21	385.51	$87 804.12	$1 193 286.69	$52 973.96	$719 933.44	$3 649 841.50	$3 649 841.50	$7 299 683.01	$411 888.70	$9 624 791.84
0.285	0.064	1.50	169.00	0.00	169.00	353.67	$80 552.69	$1 094 737.36	$52 587.58	$714 682.40	$3 710 745.68	$3 710 745.68	$7 421 491.35	$387 003.13	$9 617 914.24
0.295	0.068	1.40	142.87	0.00	142.87	298.99	$68 099.09	$925 488.85	$52 033.54	$707 152.83	$3 832 347.05	$3 832 347.05	$7 664 694.10	$342 751.81	$9 640 087.59
0.3	0.071	1.36	131.64	0.00	131.64	275.50	$62 747.15	$852 754.26	$51 852.74	$704 695.72	$3 893 046.75	$3 893 046.75	$7 786 093.50	$323 056.93	$9 666 600.42
0.31	0.075	1.27	112.21	0.00	112.21	234.84	$53 486.36	$726 897.14	$51 655.76	$702 018.66	$4 014 250.13	$4 014 250.13	$8 028 500.25	$287 831.51	$9 745 247.56
0.32	0.080	1.19	96.14	0.00	96.14	201.19	$45 824.12	$622 764.74	$51 647.55	$701 907.03	$4 135 199.59	$4 135 199.59	$8 270 399.17	$257 388.80	$9 852 459.75
0.34	0.091	1.06	71.56	0.00	71.56	149.76	$34 109.25	$463 555.87	$52 080.29	$707 788.11	$4 376 370.01	$4 376 370.01	$8 752 740.02	$207 914.70	$10 131 998.70
0.36	0.102	0.94	54.17	0.00	54.17	113.37	$25 821.49	$350 922.51	$52 966.70	$719 834.73	$4 616 619.53	$4 616 619.53	$9 233 239.06	$170 012.60	$10 474 008.89
0.38	0.113	0.85	41.63	0.00	41.63	87.13	$19 843.96	$269 685.93	$54 181.68	$736 346.68	$4 856 002.58	$4 856 002.58	$9 712 005.16	$140 541.29	$10 858 579.06
0.4	0.126	0.76	32.43	0.00	32.43	67.87	$15 457.61	$210 073.97	$55 638.44	$756 144.54	$5 094 567.70	$5 094 567.70	$10 189 135.40	$117 319.05	$11 272 672.96

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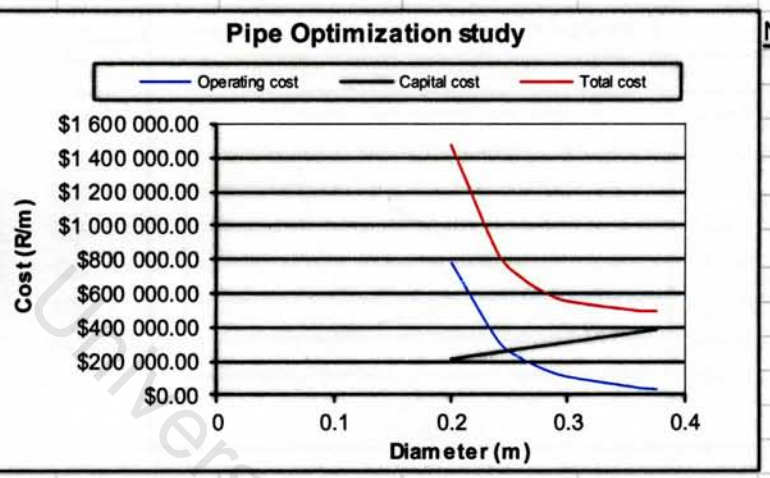
PARALLEL FEEDER PIPE: 240 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.288
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

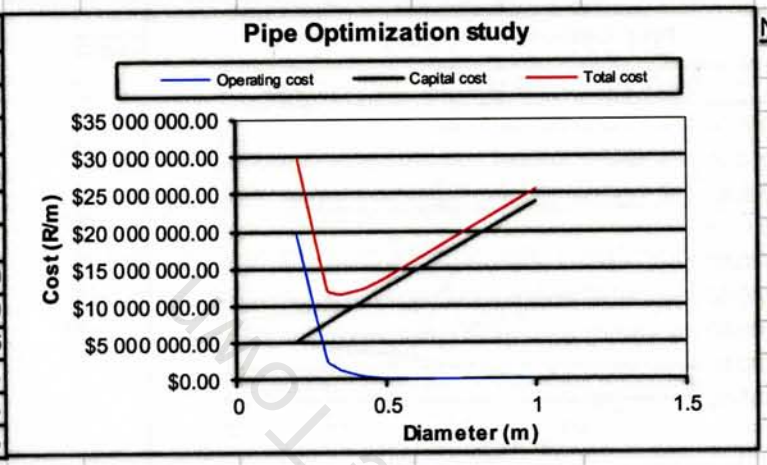
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i)
0.2	0.031	4.58	80.31	0.00	80.31	252.12	$57 422.03	$780 384.10	$13 185.58	$179 196.39	$106 587.01	$106 587.01	$213 174.02	$302 992.84	$1 475 747.34
0.24	0.045	3.18	33.05	0.00	33.05	103.75	$23 630.12	$321 140.99	$7 642.12	$103 858.92	$126 397.58	$126 397.58	$252 795.15	$159 453.63	$837 248.69
0.26	0.053	2.71	22.38	0.00	22.38	70.26	$16 002.00	$217 472.47	$6 173.88	$83 905.05	$136 220.14	$136 220.14	$272 440.28	$120 291.98	$694 109.78
0.28	0.062	2.34	15.60	0.00	15.60	48.97	$11 154.11	$151 588.02	$5 166.52	$70 214.73	$145 993.66	$145 993.66	$291 987.32	$92 664.65	$606 454.72
0.3	0.071	2.04	11.15	0.00	11.15	35.00	$7 971.02	$108 328.81	$4 464.41	$60 672.76	$155 721.87	$155 721.87	$311 443.74	$72 679.73	$553 125.04
0.36	0.102	1.41	4.59	0.00	4.59	14.40	$3 280.21	$44 579.10	$3 376.59	$45 888.97	$184 664.78	$184 664.78	$369 329.56	$38 248.58	$498 046.22
0.368	0.106	1.35	4.12	0.00	4.12	12.94	$2 947.24	$40 053.97	$3 301.00	$44 861.65	$188 498.96	$188 498.96	$376 997.91	$35 400.24	$497 313.78
0.37	0.108	1.34	4.01	0.00	4.01	12.60	$2 870.46	$39 010.55	$3 283.81	$44 628.03	$189 456.65	$189 456.65	$378 913.30	$34 731.06	$497 282.94
0.372	0.109	1.32	3.91	0.00	3.91	12.28	$2 796.09	$37 999.72	$3 267.26	$44 403.15	$190 414.00	$190 414.00	$380 828.01	$34 078.04	$497 308.92
0.374	0.110	1.31	3.81	0.00	3.81	11.96	$2 724.02	$37 020.29	$3 251.34	$44 186.75	$191 371.03	$191 371.03	$382 742.05	$33 440.70	$497 389.79
0.376	0.111	1.30	3.71	0.00	3.71	11.65	$2 654.18	$36 071.12	$3 236.02	$43 978.57	$192 327.72	$192 327.72	$384 655.43	$32 818.58	$497 523.71

University of Cape Town

PARALLEL FEEDER PIPE: 240 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.288
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 2) / (2)
(c)	$(10.67 \times l \times (q / 2)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(9)+(14)+(15)+(11)

Optimization

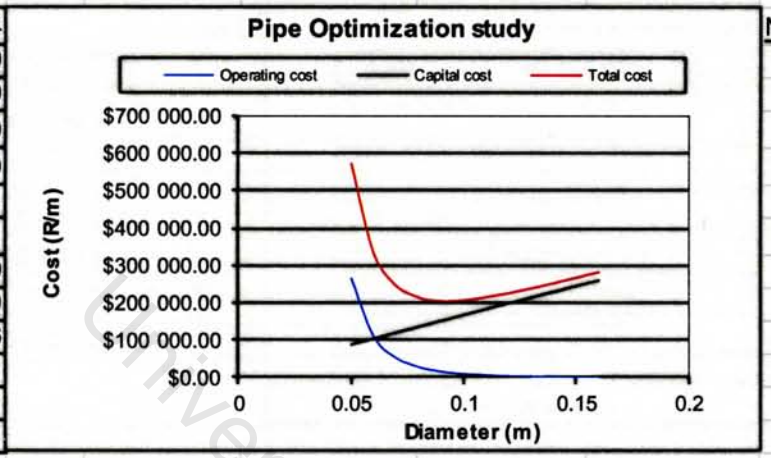
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe			Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	(12) + (13)	See cost model	See note (i)
0.2	0.031	4.58	2007.81	0.00	2007.81	#####	$1 435 550.69	$19 509 602.41	$150 870.03	$2 050 372.95	$2 664 675.27	$2 664 675.27	$5 329 350.55	$3 105 581.94	$29 994 907.84
0.3	0.071	2.04	278.71	0.00	278.71	874.94	$199 275.59	$2 708 220.29	$68 728.25	$934 039.30	$3 893 046.75	$3 893 046.75	$7 786 093.50	$744 944.48	$12 173 297.58
0.32	0.080	1.79	203.54	0.00	203.54	638.96	$145 530.57	$1 977 807.88	$65 092.75	$884 631.69	$4 135 199.59	$4 135 199.59	$8 270 399.17	$593 518.82	$11 726 357.57
0.33	0.086	1.68	175.22	0.00	175.22	550.04	$125 277.11	$1 702 556.80	$63 861.99	$867 905.29	$4 255 903.58	$4 255 903.58	$8 511 807.15	$532 573.86	$11 614 843.11
0.34	0.091	1.59	151.51	0.00	151.51	475.61	$108 325.90	$1 472 184.27	$62 941.11	$855 390.27	$4 376 370.01	$4 376 370.01	$8 752 740.02	$479 435.33	$11 559 749.89
0.35	0.096	1.50	131.56	0.00	131.56	413.00	$94 063.96	$1 278 359.85	$62 282.70	$846 442.24	$4 496 606.33	$4 496 606.33	$8 993 212.66	$432 915.96	$11 550 930.70
0.42	0.139	1.04	54.14	0.00	54.14	169.95	$38 708.88	$526 066.27	$62 436.67	$848 534.77	$5 332 358.41	$5 332 358.41	$10 664 716.82	$227 827.23	$12 267 145.09
0.44	0.152	0.95	43.16	0.00	43.16	135.50	$30 861.72	$419 420.80	$63 430.37	$862 039.40	$5 569 413.95	$5 569 413.95	$11 138 827.91	$193 405.72	$12 613 693.83
0.47	0.173	0.83	31.31	0.00	31.31	98.27	$22 382.99	$304 192.10	$65 369.91	$888 398.36	$5 923 695.73	$5 923 695.73	$11 847 391.47	$153 323.72	$13 193 305.64
0.48	0.181	0.80	28.25	0.00	28.25	88.70	$20 201.79	$274 548.88	$66 109.35	$898 447.58	$6 041 458.59	$6 041 458.59	$12 082 917.18	$142 368.99	$13 398 282.63
0.49	0.189	0.76	25.56	0.00	25.56	80.22	$18 271.73	$248 318.79	$66 886.59	$909 010.56	$6 159 062.07	$6 159 062.07	$12 318 124.14	$132 399.19	$13 607 852.68
1	0.785	0.18	0.79	0.00	0.79	2.49	$566.28	$7 695.99	$120 429.66	$1 636 678.35	$12 000 000.00	$12 000 000.00	$24 000 000.00	$10 741.44	$25 655 115.78

Not for Distribution

3 X PARALLEL FEEDER PIPE: 20 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.024
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

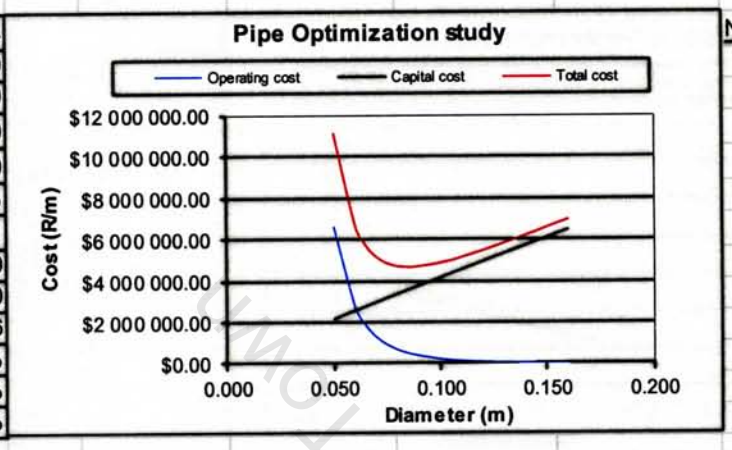
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.05	0.002	4.07	327.01	0.00	327.01	85.55	$19 483.87	$264 792.20	$5 985.10	$81 339.48	$29 159.37	$29 159.37	$29 159.37	$87 478.12	$138 692.77	$572 302.58
0.06	0.003	2.83	134.57	0.00	134.57	35.20	$8 017.94	$108 966.38	$3 438.23	$46 726.73	$34 579.02	$34 579.02	$34 579.02	$103 737.05	$72 988.74	$332 418.91
0.07	0.004	2.08	63.52	0.00	63.52	16.62	$3 784.70	$51 435.34	$2 295.76	$31 200.16	$39 939.99	$39 939.99	$39 939.99	$119 819.96	$42 416.57	$244 872.04
0.08	0.005	1.59	33.15	0.00	33.15	8.67	$1 975.20	$26 843.61	$1 739.01	$23 633.73	$45 251.23	$45 251.23	$45 251.23	$135 753.69	$26 506.07	$212 737.09
0.085	0.006	1.41	24.68	0.00	24.68	6.46	$1 470.24	$19 981.08	$1 574.80	$21 402.08	$47 890.34	$47 890.34	$47 890.34	$143 671.02	$21 411.19	$206 465.38
0.09	0.006	1.26	18.68	0.00	18.68	4.89	$1 113.01	$15 126.14	$1 458.11	$19 816.21	$50 519.38	$50 519.38	$50 519.38	$151 558.13	$17 508.01	$204 008.48
0.092	0.007	1.20	16.78	0.00	16.78	4.39	$1 000.03	$13 590.72	$1 421.69	$19 321.27	$51 568.30	$51 568.30	$51 568.30	$154 704.91	$16 204.20	$203 821.10
0.094	0.007	1.15	15.12	0.00	15.12	3.95	$900.59	$12 239.30	$1 390.14	$18 892.39	$52 615.75	$52 615.75	$52 615.75	$157 847.26	$15 022.47	$204 001.41
0.095	0.007	1.13	14.36	0.00	14.36	3.76	$855.35	$11 624.52	$1 376.01	$18 700.36	$53 138.93	$53 138.93	$53 138.93	$159 416.79	$14 473.04	$204 214.71
0.1	0.008	1.02	11.18	0.00	11.18	2.93	$666.28	$9 055.01	$1 319.51	$17 932.53	$55 749.53	$55 749.53	$55 749.53	$167 248.60	$12 081.59	$206 317.73
0.11	0.010	0.84	7.03	0.00	7.03	1.84	$418.87	$5 692.55	$1 259.68	$17 119.46	$60 945.75	$60 945.75	$60 945.75	$182 837.24	$8 637.34	$214 286.59
0.12	0.011	0.71	4.60	0.00	4.60	1.20	$274.19	$3 726.29	$1 245.99	$16 933.45	$66 111.30	$66 111.30	$66 111.30	$198 333.90	$6 358.08	$225 351.72
0.13	0.013	0.60	3.12	0.00	3.12	0.82	$185.68	$2 523.39	$1 260.60	$17 131.91	$71 248.92	$71 248.92	$71 248.92	$213 746.75	$4 796.55	$238 198.60
0.14	0.015	0.52	2.17	0.00	2.17	0.57	$129.42	$1 758.92	$1 293.21	$17 575.15	$76 360.88	$76 360.88	$76 360.88	$229 082.65	$3 694.93	$252 111.65
0.16	0.020	0.40	1.13	0.00	1.13	0.30	$67.55	$917.96	$1 390.09	$18 891.77	$86 515.40	$86 515.40	$86 515.40	$259 546.20	$2 308.96	$281 664.89

University of Cape Town

3 X PARALLEL FEEDER PIPE: 20 l/s, 2500m

Input Data

Discharge (m^3/s)	q	0.024
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

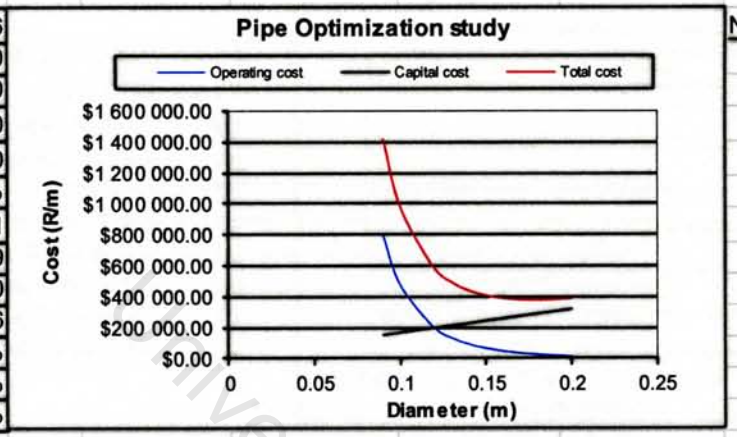
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.050	0.002	4.07	8175.23	0.00	8175.23	#####	$487 096.84	$6 619 805.00	$67 797.07	$921 384.30	$728 984.34	$728 984.34	$728 984.34	$2 186 953.03	$1 421 557.60	###########
0.060	0.003	2.83	3364.24	0.00	3364.24	880.09	$200 448.42	$2 724 159.48	$42 891.60	$582 910.89	$864 475.45	$864 475.45	$864 475.45	$2 593 426.35	$748 111.80	$6 648 608.52
0.065	0.003	2.41	2278.22	0.00	2278.22	595.98	$135 741.04	$1 844 765.09	$36 549.88	$496 724.81	$931 655.25	$931 655.25	$931 655.25	$2 794 965.74	$564 376.31	$5 700 831.96
0.070	0.004	2.08	1588.02	0.00	1588.02	415.43	$94 617.57	$1 285 883.62	$32 367.76	$439 888.40	$998 499.64	$998 499.64	$998 499.64	$2 995 498.93	$434 756.60	$5 156 027.55
0.075	0.004	1.81	1134.84	0.00	1134.84	296.87	$67 616.22	$918 926.48	$29 615.23	$402 480.63	$1 065 034.13	$1 065 034.13	$1 065 034.13	$3 195 102.40	$340 992.93	$4 857 502.44
0.080	0.005	1.59	828.77	0.00	828.77	216.81	$49 379.99	$671 090.18	$27 836.37	$378 305.33	$1 131 280.72	$1 131 280.72	$1 131 280.72	$3 393 842.15	$271 678.93	$4 714 916.58
0.082	0.005	1.51	734.87	0.00	734.87	192.24	$43 785.04	$595 053.01	$27 327.79	$371 393.57	$1 157 703.10	$1 157 703.10	$1 157 703.10	$3 473 109.31	$249 056.07	$4 688 611.96
0.084	0.006	1.44	653.50	0.00	653.50	170.95	$38 936.70	$529 162.42	$26 913.09	$365 757.68	$1 184 083.63	$1 184 083.63	$1 184 083.63	$3 552 250.90	$228 795.89	$4 675 966.90
0.085	0.006	1.41	616.90	0.00	616.90	161.38	$36 756.07	$499 526.98	$26 737.20	$363 367.27	$1 197 258.53	$1 197 258.53	$1 197 258.53	$3 591 775.60	$219 458.04	$4 674 127.90
0.086	0.006	1.38	582.74	0.00	582.74	152.45	$34 720.96	$471 869.23	$26 580.51	$361 237.77	$1 210 423.36	$1 210 423.36	$1 210 423.36	$3 631 270.09	$210 603.92	$4 674 981.01
0.087	0.006	1.35	550.84	0.00	550.84	144.10	$32 820.14	$446 036.46	$26 441.80	$359 352.75	$1 223 578.25	$1 223 578.25	$1 223 578.25	$3 670 734.74	$202 203.26	$4 678 327.20
0.100	0.008	1.02	279.57	0.00	279.57	73.13	$16 657.09	$226 375.34	$25 859.38	$351 437.38	$1 393 738.34	$1 393 738.34	$1 393 738.34	$4 181 215.01	$123 832.56	$4 882 860.28
0.110	0.010	0.84	175.75	0.00	175.75	45.98	$10 471.69	$142 313.71	$26 395.86	$358 728.32	$1 523 643.65	$1 523 643.65	$1 523 643.65	$4 570 930.96	$88 530.06	$5 160 503.05
0.120	0.011	0.71	115.05	0.00	115.05	30.10	$6 854.67	$93 157.20	$27 398.47	$372 354.19	$1 652 782.52	$1 652 782.52	$1 652 782.52	$4 958 347.56	$65 168.37	$5 489 027.32
0.130	0.013	0.60	77.91	0.00	77.91	20.38	$4 641.89	$63 084.84	$28 684.87	$389 836.71	$1 781 222.94	$1 781 222.94	$1 781 222.94	$5 343 668.83	$49 163.09	$5 845 753.47
0.140	0.015	0.52	54.31	0.00	54.31	14.21	$3 235.61	$43 972.95	$30 150.21	$409 751.14	$1 909 022.11	$1 909 022.11	$1 909 022.11	$5 727 066.34	$37 871.85	$6 218 662.28
0.160	0.020	0.40	28.34	0.00	28.34	7.41	$1 688.63	$22 949.05	$33 389.92	$453 779.89	$2 162 885.01	$2 162 885.01	$2 162 885.01	$6 488 655.02	$23 666.08	$6 989 050.04

UWC eTheses

3 X PARALLEL FEEDER PIPE: 80 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.096
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85)}/(c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2/(2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

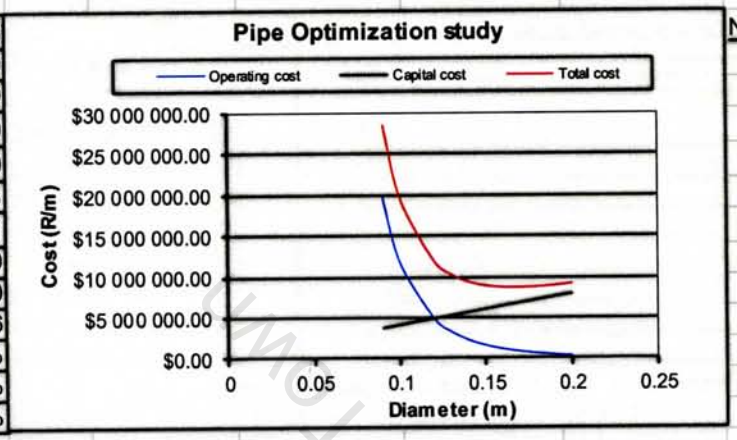
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.09	0.006	5.03	242.77	0.00	242.77	254.03	$57 858.77	$786 319.53	$12 944.08	$175 914.28	$50 519.38	$50 519.38	$50 519.38	$151 558.13	$304 657.24	$1 418 449.18
0.1	0.008	4.07	145.33	0.00	145.33	152.07	$34 636.20	$470 717.22	$9 245.53	$125 649.70	$55 749.53	$55 749.53	$55 749.53	$167 248.60	$210 232.05	$973 847.57
0.12	0.011	2.83	59.81	0.00	59.81	62.58	$14 253.37	$193 707.94	$5 417.16	$73 620.91	$66 111.30	$66 111.30	$66 111.30	$198 333.90	$110 637.15	$576 299.90
0.13	0.013	2.41	40.50	0.00	40.50	42.38	$9 652.19	$131 176.48	$4 407.32	$59 896.98	$71 248.92	$71 248.92	$71 248.92	$213 746.75	$83 464.78	$488 284.99
0.14	0.015	2.08	28.23	0.00	28.23	29.54	$6 728.01	$91 435.86	$3 717.23	$50 518.42	$76 360.88	$76 360.88	$76 360.88	$229 082.65	$64 295.51	$435 332.44
0.15	0.018	1.81	20.17	0.00	20.17	21.11	$4 808.01	$65 342.49	$3 238.89	$44 017.64	$81 449.15	$81 449.15	$81 449.15	$244 347.45	$50 428.94	$404 136.52
0.16	0.020	1.59	14.73	0.00	14.73	15.42	$3 511.28	$47 719.49	$2 904.86	$39 477.98	$86 515.40	$86 515.40	$86 515.40	$259 546.20	$40 178.20	$386 921.86
0.17	0.023	1.41	10.97	0.00	10.97	11.48	$2 613.63	$35 520.07	$2 671.63	$36 308.32	$91 561.10	$91 561.10	$91 561.10	$274 683.29	$32 455.33	$378 967.00
0.172	0.023	1.38	10.36	0.00	10.36	10.84	$2 468.92	$33 553.40	$2 634.35	$35 801.73	$92 567.88	$92 567.88	$92 567.88	$277 703.65	$31 145.90	$378 204.69
0.174	0.024	1.35	9.79	0.00	9.79	10.25	$2 333.76	$31 716.50	$2 599.75	$35 331.46	$93 573.91	$93 573.91	$93 573.91	$280 721.73	$29 903.54	$377 673.23
0.176	0.024	1.32	9.26	0.00	9.26	9.69	$2 207.41	$29 999.46	$2 567.65	$34 895.22	$94 579.19	$94 579.19	$94 579.19	$283 737.56	$28 724.10	$377 356.34
0.178	0.025	1.29	8.77	0.00	8.77	9.17	$2 089.22	$28 393.22	$2 537.90	$34 490.95	$95 583.72	$95 583.72	$95 583.72	$286 751.17	$27 603.72	$377 239.06
0.18	0.025	1.26	8.30	0.00	8.30	8.69	$1 978.58	$26 889.52	$2 510.37	$34 116.70	$96 587.52	$96 587.52	$96 587.52	$289 762.57	$26 538.84	$377 307.62
0.182	0.026	1.23	7.87	0.00	7.87	8.23	$1 874.92	$25 480.76	$2 484.90	$33 770.66	$97 590.60	$97 590.60	$97 590.60	$292 771.80	$25 526.13	$377 549.35
0.186	0.027	1.18	7.08	0.00	7.08	7.40	$1 686.56	$22 920.92	$2 439.72	$33 156.63	$99 594.61	$99 594.61	$99 594.61	$298 783.83	$23 645.10	$378 506.49
0.19	0.028	1.13	6.38	0.00	6.38	6.68	$1 520.55	$20 664.74	$2 401.47	$32 636.80	$101 595.82	$101 595.82	$101 595.82	$304 787.47	$21 938.39	$380 027.40
0.2	0.031	1.02	4.97	0.00	4.97	5.20	$1 184.44	$16 096.97	$2 331.34	$31 683.69	$106 587.01	$106 587.01	$106 587.01	$319 761.03	$18 313.41	$385 855.11

University of Cape Town

3 X PARALLEL FEEDER PIPE: 80 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.096
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

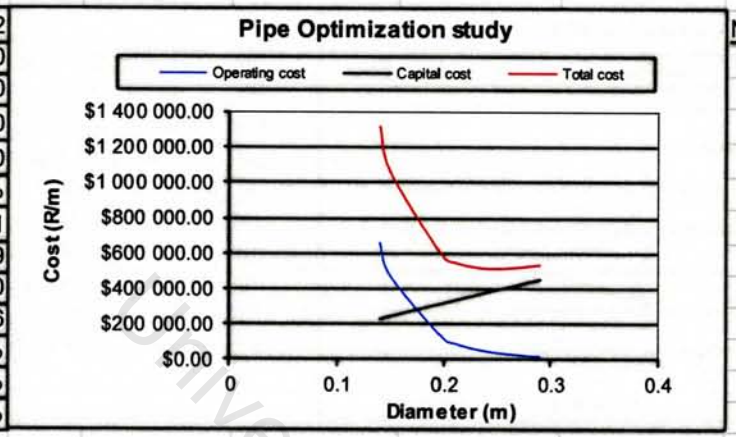
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.09	0.006	5.03	6069.24	0.00	6069.24	6350.85	$1 446 469.19	$19 657 988.28	$143 850.43	$1 954 974.26	$1 262 984.42	$1 262 984.42	$1 262 984.42	$3 788 953.25	$3 122 641.55	$28 524 557.34
0.1	0.008	4.07	3633.25	0.00	3633.25	3801.83	$865 904.92	$11 767 930.44	$107 098.59	$1 455 504.76	$1 393 738.34	$1 393 738.34	$1 393 738.34	$4 181 215.01	$2 154 812.83	$19 559 463.04
0.12	0.011	2.83	1495.14	0.00	1495.14	1564.52	$356 334.23	$4 842 698.42	$70 151.59	$953 382.94	$1 652 782.52	$1 652 782.52	$1 652 782.52	$4 958 347.56	$1 133 996.18	$11 888 425.10
0.13	0.013	2.41	1012.49	0.00	1012.49	1059.47	$241 304.87	$3 279 411.89	$60 937.86	$828 165.40	$1 781 222.94	$1 781 222.94	$1 781 222.94	$5 343 668.83	$855 487.90	$10 306 734.02
0.14	0.015	2.08	705.75	0.00	705.75	738.50	$168 200.26	$2 285 896.48	$54 995.69	$747 409.34	$1 909 022.11	$1 909 022.11	$1 909 022.11	$5 727 066.34	$659 008.90	$9 419 381.06
0.15	0.018	1.81	504.35	0.00	504.35	527.75	$120 200.36	$1 633 562.15	$51 218.67	$696 078.40	$2 036 228.79	$2 036 228.79	$2 036 228.79	$6 108 686.37	$516 880.88	$8 955 207.79
0.16	0.020	1.59	368.32	0.00	368.32	385.41	$87 782.08	$1 192 987.18	$48 915.83	$664 782.13	$2 162 885.01	$2 162 885.01	$2 162 885.01	$6 488 655.02	$411 813.95	$8 758 238.28
0.162	0.021	1.55	346.70	0.00	346.70	362.79	$82 628.92	$1 122 954.01	$48 589.88	$660 352.38	$2 188 153.50	$2 188 153.50	$2 188 153.50	$6 564 460.50	$394 189.54	$8 741 956.43
0.164	0.021	1.51	326.59	0.00	326.59	341.75	$77 836.03	$1 057 817.03	$48 301.90	$656 438.64	$2 213 401.72	$2 213 401.72	$2 213 401.72	$6 640 205.17	$377 521.96	$8 731 982.79
0.166	0.022	1.48	307.87	0.00	307.87	322.16	$73 374.27	$997 180.33	$48 049.39	$653 006.89	$2 238 629.94	$2 238 629.94	$2 238 629.94	$6 715 889.83	$361 748.53	$8 727 825.58
0.168	0.022	1.44	290.43	0.00	290.43	303.90	$69 217.20	$940 684.29	$47 830.03	$650 025.73	$2 263 838.41	$2 263 838.41	$2 263 838.41	$6 791 515.23	$346 811.36	$8 729 036.61
0.17	0.023	1.41	274.16	0.00	274.16	286.88	$65 340.73	$888 001.80	$47 641.69	$647 466.09	$2 289 027.38	$2 289 027.38	$2 289 027.38	$6 867 082.14	$332 656.95	$8 735 206.98
0.18	0.025	1.26	207.55	0.00	207.55	217.18	$49 464.44	$672 237.90	$47 100.91	$640 116.77	$2 414 688.08	$2 414 688.08	$2 414 688.08	$7 244 064.24	$272 014.78	$8 828 433.70
0.19	0.028	1.13	159.50	0.00	159.50	166.90	$38 013.70	$516 618.62	$47 092.90	$640 007.86	$2 539 895.58	$2 539 895.58	$2 539 895.58	$7 619 686.75	$224 861.62	$9 001 174.85
0.2	0.031	1.02	124.25	0.00	124.25	130.01	$29 611.07	$402 424.13	$47 478.40	$645 246.95	$2 664 675.27	$2 664 675.27	$2 664 675.27	$7 994 025.82	$187 706.77	$9 229 403.66

UWL ERE Only

3 X PARALLELFEEDER PIPE: 160 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.192
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

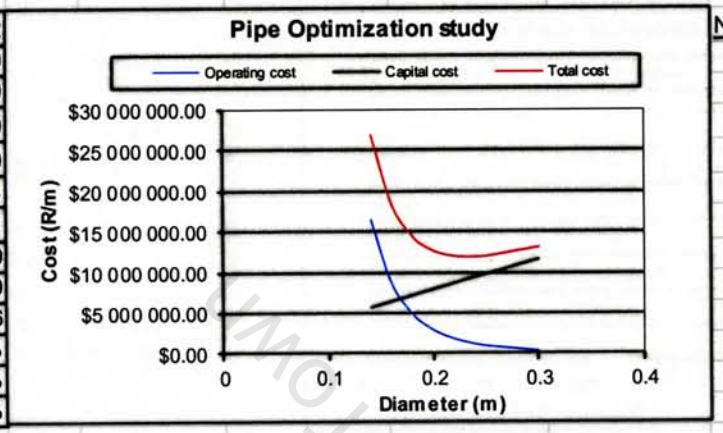
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.14	0.015	4.16	101.77	0.00	101.77	212.98	$48 508.98	$659 252.88	$11 873.64	$161 366.66	$76 360.88	$76 360.88	$76 360.88	$229 082.65	$268 205.70	$1 317 907.90
0.15	0.018	3.62	72.73	0.00	72.73	152.20	$34 665.80	$471 119.56	$9 636.22	$130 959.31	$81 449.15	$81 449.15	$81 449.15	$244 347.45	$210 361.96	$1 056 788.29
0.2	0.031	2.04	17.92	0.00	17.92	37.49	$8 539.84	$116 059.18	$4 654.55	$63 256.81	$106 587.01	$106 587.01	$106 587.01	$319 761.03	$76 393.54	$575 470.57
0.21	0.035	1.85	14.13	0.00	14.13	29.57	$6 733.76	$91 514.01	$4 246.84	$57 715.94	$111 562.00	$111 562.00	$111 562.00	$334 685.99	$64 335.24	$548 251.18
0.22	0.038	1.68	11.26	0.00	11.26	23.57	$5 368.68	$72 962.06	$3 932.43	$53 442.97	$116 521.60	$116 521.60	$116 521.60	$349 564.80	$54 615.08	$530 584.92
0.23	0.042	1.54	9.07	0.00	9.07	18.98	$4 323.66	$58 759.89	$3 690.09	$50 149.57	$121 466.57	$121 466.57	$121 466.57	$364 399.71	$46 702.37	$520 011.55
0.24	0.045	1.41	7.37	0.00	7.37	15.43	$3 514.28	$47 760.28	$3 504.08	$47 621.65	$126 397.58	$126 397.58	$126 397.58	$379 192.73	$40 203.02	$514 777.68
0.244	0.047	1.37	6.80	0.00	6.80	14.24	$3 242.48	$44 066.35	$3 442.69	$46 787.32	$128 366.21	$128 366.21	$128 366.21	$385 098.64	$37 930.00	$513 882.31
0.246	0.048	1.35	6.54	0.00	6.54	13.68	$3 116.10	$42 348.85	$3 414.46	$46 403.60	$129 349.74	$129 349.74	$129 349.74	$388 049.22	$36 855.29	$513 656.96
0.248	0.048	1.32	6.28	0.00	6.28	13.15	$2 995.62	$40 711.39	$3 387.77	$46 040.85	$130 332.75	$130 332.75	$130 332.75	$390 998.25	$35 819.37	$513 569.86
0.25	0.049	1.30	6.04	0.00	6.04	12.65	$2 880.70	$39 149.64	$3 362.55	$45 698.16	$131 315.24	$131 315.24	$131 315.24	$393 945.73	$34 820.54	$513 614.07
0.26	0.053	1.21	4.99	0.00	4.99	10.45	$2 379.83	$32 342.63	$3 256.47	$44 256.49	$136 220.14	$136 220.14	$136 220.14	$408 660.42	$30 329.20	$515 588.74
0.27	0.057	1.12	4.15	0.00	4.15	8.69	$1 980.27	$26 912.50	$3 178.90	$43 202.30	$141 112.78	$141 112.78	$141 112.78	$423 338.35	$26 555.24	$520 008.39
0.28	0.062	1.04	3.48	0.00	3.48	7.28	$1 658.85	$22 544.26	$3 124.45	$42 462.24	$145 993.66	$145 993.66	$145 993.66	$437 980.98	$23 363.53	$526 351.00
0.29	0.066	0.97	2.93	0.00	2.93	6.14	$1 398.26	$19 002.79	$3 088.87	$41 978.74	$150 863.22	$150 863.22	$150 863.22	$452 589.65	$20 648.02	$534 219.19

University of Cape Town

3 X PARALLEL FEEDER PIPE: 160 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.192
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85)} / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

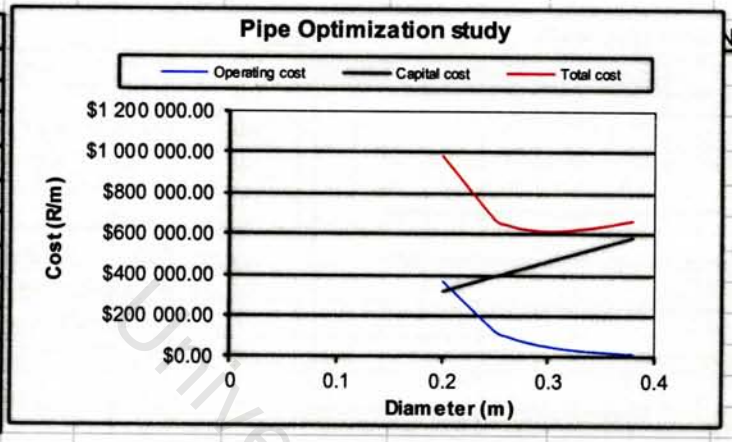
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.14	0.015	4.16	2544.23	0.00	2544.23	#####	$1 212 724.53	$16 481 322.08	$138 596.32	$1 883 569.19	$1 909 022.11	$1 909 022.11	$1 909 022.11	$5 727 066.34	$2 749 024.65	$26 840 982.27
0.16	0.020	3.18	1327.81	0.00	1327.81	#####	$632 909.16	$8 601 441.99	$101 157.78	$1 374 767.20	$2 162 885.01	$2 162 885.01	$2 162 885.01	$6 488 655.02	$1 717 862.54	$18 182 726.75
0.18	0.025	2.52	748.21	0.00	748.21	#####	$356 638.80	$4 846 837.74	$81 608.20	$1 109 082.03	$2 414 688.08	$2 414 688.08	$2 414 688.08	$7 244 064.24	$1 134 696.89	$14 334 680.90
0.19	0.028	2.26	575.00	0.00	575.00	#####	$274 078.94	$3 724 822.17	$75 618.42	$1 027 679.02	$2 539 895.58	$2 539 895.58	$2 539 895.58	$7 619 686.75	$937 999.69	$13 310 187.63
0.2	0.031	2.04	447.90	0.00	447.90	937.37	$213 495.94	$2 901 479.47	$71 290.53	$968 861.53	$2 664 675.27	$2 664 675.27	$2 664 675.27	$7 994 025.82	$783 009.96	$12 647 376.78
0.21	0.035	1.85	353.18	0.00	353.18	739.13	$168 344.03	$2 287 850.36	$68 212.39	$927 028.68	$2 789 049.91	$2 789 049.91	$2 789 049.91	$8 367 149.74	$659 416.11	$12 241 444.89
0.22	0.038	1.68	281.58	0.00	281.58	589.29	$134 216.91	$1 824 051.62	$66 087.10	$898 145.28	$2 913 040.03	$2 913 040.03	$2 913 040.03	$8 739 120.09	$559 787.54	$12 021 104.53
0.222	0.039	1.65	269.44	0.00	269.44	563.88	$128 430.07	$1 745 406.52	$65 756.16	$893 647.64	$2 937 793.58	$2 937 793.58	$2 937 793.58	$8 813 380.73	$542 231.35	$11 994 666.25
0.224	0.039	1.62	257.92	0.00	257.92	539.78	$122 941.31	$1 670 812.56	$65 453.02	$889 527.97	$2 962 532.63	$2 962 532.63	$2 962 532.63	$8 887 597.90	$525 375.88	$11 973 314.32
0.226	0.040	1.60	247.00	0.00	247.00	516.92	$117 732.83	$1 600 027.63	$65 176.35	$885 767.89	$2 987 257.34	$2 987 257.34	$2 987 257.34	$8 961 772.01	$509 187.29	$11 956 754.82
0.23	0.042	1.54	226.77	0.00	226.77	474.58	$108 091.40	$1 468 997.37	$64 697.35	$879 258.14	$3 036 664.22	$3 036 664.22	$3 036 664.22	$9 109 992.67	$478 684.74	$11 936 932.92
0.232	0.042	1.51	217.41	0.00	217.41	454.99	$103 628.50	$1 408 345.12	$64 492.69	$876 476.66	$3 061 346.67	$3 061 346.67	$3 061 346.67	$9 184 040.00	$464 312.16	$11 933 173.94
0.234	0.043	1.49	208.51	0.00	208.51	436.36	$99 385.83	$1 350 685.86	$64 309.79	$873 991.02	$3 086 015.28	$3 086 015.28	$3 086 015.28	$9 258 045.85	$450 488.99	$11 933 211.73
0.236	0.044	1.46	200.04	0.00	200.04	418.65	$95 350.78	$1 295 848.19	$64 147.64	$871 787.43	$3 110 670.20	$3 110 670.20	$3 110 670.20	$9 332 010.60	$437 189.80	$11 936 836.02
0.24	0.045	1.41	184.32	0.00	184.32	385.74	$87 857.12	$1 194 006.89	$63 881.83	$868 174.89	$3 159 939.42	$3 159 939.42	$3 159 939.42	$9 479 818.27	$412 068.41	$11 954 068.46
0.25	0.049	1.30	151.09	0.00	151.09	316.20	$72 017.47	$978 740.90	$63 519.20	$863 246.71	$3 282 881.10	$3 282 881.10	$3 282 881.10	$9 848 643.31	$356 899.68	$12 047 530.60
0.3	0.071	0.91	62.18	0.00	62.18	130.12	$29 636.38	$402 768.10	$65 908.61	$895 719.54	$3 893 046.75	$3 893 046.75	$3 893 046.75	$11 679 140.26	$187 822.75	$13 165 450.65

UNIVERSITY OF PRETORIA

3 X PARALLEL FEEDER PIPE: 240 l/s, 1000m

Input Data

Discharge (m^3/s)	q	0.288
Pipelength (m)	l	1000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85}) / (c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2 / (2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

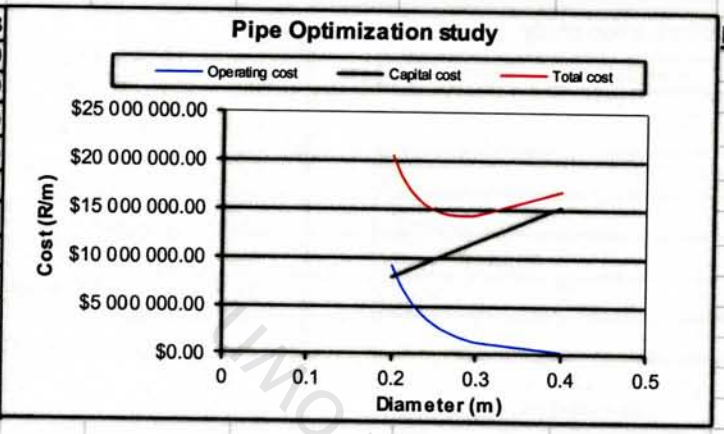
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.2	0.031	3.06	37.93	0.00	37.93	119.08	$27 121.25	$368 586.63	$8 645.11	$117 489.88	$106 587.01	$106 587.01	$106 587.01	$319 761.03	$176 157.65	$981 995.19
0.25	0.049	1.96	12.80	0.00	12.80	40.17	$9 148.67	$124 333.40	$5 181.47	$70 417.85	$131 315.24	$131 315.24	$131 315.24	$393 945.73	$80 293.50	$668 990.48
0.26	0.053	1.81	10.57	0.00	10.57	33.18	$7 557.98	$102 715.37	$4 840.77	$65 787.70	$136 220.14	$136 220.14	$136 220.14	$408 660.42	$69 936.81	$647 100.31
0.27	0.057	1.68	8.80	0.00	8.80	27.61	$6 289.04	$85 470.08	$4 566.07	$62 054.31	$141 112.78	$141 112.78	$141 112.78	$423 338.35	$61 234.33	$632 097.08
0.28	0.062	1.56	7.37	0.00	7.37	23.13	$5 268.25	$71 597.20	$4 344.88	$59 048.40	$145 993.66	$145 993.66	$145 993.66	$437 980.98	$53 874.50	$622 501.08
0.29	0.066	1.45	6.21	0.00	6.21	19.50	$4 440.66	$60 350.02	$4 167.46	$56 637.11	$150 863.22	$150 863.22	$150 863.22	$452 589.65	$47 612.74	$617 189.52
0.295	0.068	1.40	5.71	0.00	5.71	17.94	$4 085.95	$55 529.33	$4 092.67	$55 620.69	$153 293.88	$153 293.88	$153 293.88	$459 881.65	$44 831.48	$615 863.15
0.3	0.071	1.36	5.27	0.00	5.27	16.53	$3 764.83	$51 165.26	$4 026.04	$54 715.26	$155 721.87	$155 721.87	$155 721.87	$467 165.61	$42 255.42	$615 301.55
0.305	0.073	1.31	4.86	0.00	4.86	15.25	$3 473.65	$47 207.98	$3 966.86	$53 910.96	$158 147.23	$158 147.23	$158 147.23	$474 441.69	$39 866.36	$615 426.99
0.31	0.075	1.27	4.49	0.00	4.49	14.09	$3 209.18	$43 613.83	$3 914.47	$53 198.92	$160 570.01	$160 570.01	$160 570.01	$481 710.02	$37 647.98	$616 170.74
0.32	0.080	1.19	3.85	0.00	3.85	12.07	$2 749.45	$37 365.88	$3 827.76	$52 020.57	$165 407.98	$165 407.98	$165 407.98	$496 223.95	$33 666.11	$619 276.52
0.34	0.091	1.06	2.86	0.00	2.86	8.99	$2 046.56	$27 813.35	$3 713.62	$50 469.32	$175 054.80	$175 054.80	$175 054.80	$525 164.40	$27 194.97	$630 642.04
0.36	0.102	0.94	2.17	0.00	2.17	6.80	$1 549.29	$21 055.35	$3 659.47	$49 733.37	$184 664.78	$184 664.78	$184 664.78	$553 994.34	$22 237.42	$647 020.49
0.38	0.113	0.85	1.67	0.00	1.67	5.23	$1 190.64	$16 181.16	$3 648.91	$49 589.83	$194 240.10	$194 240.10	$194 240.10	$582 720.31	$18 382.61	$666 873.91

University of Cape Town

3 X PARALLEL FEEDER PIPE: 240 l/s, 25000m

Input Data

Discharge (m^3/s)	q	0.288
Pipelength (m)	l	25000
Static Head (m)	h	0
C value	c	140
k value (local losses)	k	0
Pump efficiency	*n*	90%
Gravitational acc. (m/s^2)	g	9.81
Operating tariff (c/kWh)	t	0.039
Investment period (years)	N	20
Pumping period/day (hours)	p	16
Interest rate	r	4%
Maintenance: Civil	mc	0.50%
Maintenance: Mechanical	mm	4%



Notes

(a)	0.25 x PI x (1)2
(b)	(q / 3) / (2)
(c)	$(10.67 \times l \times (q / 3)^{1.85)}/(c^{1.85} \times (1)^{4.87})$
(d)	$k \times (3)^2/(2 \times g)$
(e)	l + (4) + (5)
(f)	g x (6) x q / *n*
(g)	(7) x p x 365 x t
(h)	mc x (13) + mm x (14)
(i)	(12)+(13)+(14)
(j)	(9)+(15)+(16)+(11)

Optimization

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Diameter (m)	Area (m^2)	Velocity	hf (m)	hsec (m)	Htot (m)	kW	Operating cost/yr	PV: Operating cost	Maintenance cost/yr	PV: Maintenance Cost	Capital cost ($)-Feeder Pipe				Capital cost ($)- Pump Station	PV: Total cost (R)
											Pipe 1	Pipe 2	Pipe 3	Total (R)		
	See note (a)	See note (b)	See note (c)	See note (d)	See note (e)	See note (f)	See note (g)	See dissertation	See note (h)	See dissertation	See cost model	See cost model	See cost model	See note (i)	See cost model	See note (j)
0.2	0.031	3.06	948.32	0.00	948.32	2976.95	$678 031.24	$9 214 665.82	$112 192.56	$1 524 733.54	$2 664 675.27	$2 664 675.27	$2 664 675.27	$7 994 025.82	$1 805 560.85	$20 538 986.03
0.21	0.035	2.77	747.76	0.00	747.76	2347.36	$534 635.53	$7 265 871.34	$102 658.27	$1 395 159.33	$2 789 049.91	$2 789 049.91	$2 789 049.91	$8 367 149.74	$1 520 562.92	$18 548 743.32
0.22	0.038	2.53	596.17	0.00	596.17	1871.50	$426 252.88	$5 792 915.76	$95 328.68	$1 295 547.92	$2 913 040.03	$2 913 040.03	$2 913 040.03	$8 739 120.09	$1 290 827.09	$17 118 410.86
0.23	0.042	2.31	480.13	0.00	480.13	1507.21	$343 282.15	$4 665 316.45	$89 702.37	$1 219 084.53	$3 036 664.22	$3 036 664.22	$3 036 664.22	$9 109 992.67	$1 103 810.26	$16 098 203.90
0.24	0.045	2.12	390.25	0.00	390.25	1225.07	$279 021.09	$3 791 987.71	$85 407.02	$1 160 709.22	$3 159 939.42	$3 159 939.42	$3 159 939.42	$9 479 818.27	$950 198.13	$15 382 713.33
0.25	0.049	1.96	319.89	0.00	319.89	1004.20	$228 716.73	$3 108 335.06	$82 162.55	$1 116 615.83	$3 282 881.10	$3 282 881.10	$3 282 881.10	$9 848 643.31	$822 983.26	$14 896 577.46
0.26	0.053	1.81	264.27	0.00	264.27	829.60	$188 949.43	$2 567 884.37	$79 755.77	$1 083 906.94	$3 405 503.46	$3 405 503.46	$3 405 503.46	$10 216 510.39	$716 830.45	$14 585 132.16
0.27	0.057	1.68	219.90	0.00	219.90	690.31	$157 225.96	$2 136 752.09	$78 022.61	$1 060 352.67	$3 527 819.57	$3 527 819.57	$3 527 819.57	$10 583 458.72	$627 632.79	$14 408 196.27
0.28	0.062	1.56	184.21	0.00	184.21	578.27	$131 706.19	$1 789 930.04	$76 835.49	$1 044 219.42	$3 649 841.50	$3 649 841.50	$3 649 841.50	$10 949 524.51	$552 196.76	$14 335 870.73
0.282	0.062	1.54	177.93	0.00	177.93	558.57	$127 219.19	$1 728 950.31	$76 654.39	$1 041 758.12	$3 674 211.59	$3 674 211.59	$3 674 211.59	$11 022 634.76	$538 530.30	$14 331 873.48
0.284	0.063	1.52	171.91	0.00	171.91	539.67	$122 915.16	$1 670 457.20	$76 490.36	$1 039 528.96	$3 698 570.44	$3 698 570.44	$3 698 570.44	$11 095 711.31	$525 295.09	$14 330 992.56
0.286	0.064	1.49	166.14	0.00	166.14	521.54	$118 785.44	$1 614 332.86	$76 342.76	$1 037 523.00	$3 722 918.14	$3 722 918.14	$3 722 918.14	$11 168 754.42	$512 474.65	$14 333 084.93
0.288	0.065	1.47	160.59	0.00	160.59	504.14	$114 821.80	$1 560 465.79	$76 210.95	$1 035 731.68	$3 747 254.78	$3 747 254.78	$3 747 254.78	$11 241 764.34	$500 053.20	$14 338 015.01
0.29	0.066	1.45	155.27	0.00	155.27	487.43	$111 016.50	$1 508 750.47	$76 094.33	$1 034 146.83	$3 771 580.43	$3 771 580.43	$3 771 580.43	$11 314 741.30	$488 015.68	$14 345 654.29
0.3	0.071	1.36	131.64	0.00	131.64	413.25	$94 120.73	$1 279 131.39	$75 719.90	$1 029 058.09	$3 893 046.75	$3 893 046.75	$3 893 046.75	$11 679 140.26	$433 104.85	$14 420 434.58
0.4	0.126	0.76	32.43	0.00	32.43	101.80	$23 186.42	$315 110.96	$82 709.85	$1 124 053.80	$5 094 567.70	$5 094 567.70	$5 094 567.70	$15 283 703.10	$157 283.26	$16 880 151.12

PIPE DIAMETER DETERMINATION

Simulation #	Config #	Length	Q (l/s)	ΔH	P (kW)	Op V	Op V2	Pipe 1			Pipe 2			Pipe 3			Pipe 4			Pipe 5			Pipe 6			Pipe 7			Pipe 8		
								V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia
#.1.1.1	1	1000	24	8.69	2.27	1.20		1.20	8.69	0.16																					
#.1.1.2	2	1000	24	13.04	3.41	1.20		1.20	13.04	0.11	1.20	13.04	0.11																		
#.1.1.3	3	1000	24	16.53	4.32	1.20		1.20	16.53	0.09	1.20	16.53	0.09	1.20	16.53	0.09															
#.1.1.4	4	1000	24	13.04	3.41	1.20		1.20	6.52	0.11	1.20	6.52	0.11	1.20	6.52	0.11	1.20	6.52	0.11												
#.1.1.5	5	1000	24	13.04	3.41	1.20		1.20	4.35	0.11	1.20	4.35	0.11	1.20	4.35	0.11	1.20	4.35	0.11	1.20	4.35	0.11	1.20	4.35	0.11						
#.1.1.6	6	1000	24	13.04	3.41	1.20		1.20	3.26	0.11	1.20	3.26	0.11	1.20	3.26	0.11	1.20	3.26	0.11	1.20	3.26	0.11	1.20	3.26	0.11	1.20	3.26	0.11	1.20	3.26	0.11
#.1.1.7	7	1000	24	10.87	2.84	1.20	1.20	1.20	6.52	0.11	1.20	4.35	0.16	1.20	6.52	0.11															
#.1.1.8	8	1000	24	10.14	2.65	1.20	1.20	1.20	4.35	0.11	1.20	5.80	0.16	1.20	4.35	0.11															
#.1.1.9	9	1000	24	9.78	2.56	1.20	1.20	1.20	3.26	0.11	1.20	6.52	0.16	1.20	3.26	0.11															
#.1.1.10	10	1000	24	16.53	4.32	1.20		1.20	8.27	0.09	1.20	8.27	0.09	1.20	8.27	0.09	1.20	8.27	0.09	1.20	8.27	0.09	1.20	8.27	0.09						
#.1.2.1	1	5000	24	48.01	12.56	1.25		1.25	48.01	0.16																					
#.1.2.2	2	5000	24	72.02	18.84	1.25		1.25	72.02	0.11	1.25	72.02	0.11																		
#.1.2.3	3	5000	24	91.30	23.88	1.25		1.25	91.30	0.09	1.25	91.30	0.09	1.25	91.30	0.09															
#.1.2.4	4	5000	24	72.02	18.84	1.25		1.25	36.01	0.11	1.25	36.01	0.11	1.25	36.01	0.11	1.25	36.01	0.11												
#.1.2.5	5	5000	24	72.02	18.84	1.25		1.25	24.01	0.11	1.25	24.01	0.11	1.25	24.01	0.11	1.25	24.01	0.11	1.25	24.01	0.11	1.25	24.01	0.11						
#.1.2.6	6	5000	24	72.02	18.84	1.25		1.25	18.00	0.11	1.25	18.00	0.11	1.25	18.00	0.11	1.25	18.00	0.11	1.25	18.00	0.11	1.25	18.00	0.11	1.25	18.00	0.11	1.25	18.00	0.11
#.1.2.7	7	5000	24	60.01	15.70	1.25	1.25	1.25	36.01	0.11	1.25	24.01	0.16	1.25	36.01	0.11															
#.1.2.8	8	5000	24	56.01	14.65	1.25	1.25	1.25	24.01	0.11	1.25	32.01	0.16	1.25	24.01	0.11															
#.1.2.9	9	5000	24	54.01	14.13	1.25	1.25	1.25	18.00	0.11	1.25	36.01	0.16	1.25	18.00	0.11															
#.1.2.10	10	5000	24	91.30	23.88	1.25		1.25	45.65	0.09	1.25	45.65	0.09	1.25	45.65	0.09	1.25	45.65	0.09	1.25	45.65	0.09	1.25	45.65	0.09						
#.1.3.1	1	10000	24	115.81	30.30	1.35		1.35	115.81	0.15																					
#.1.3.2	2	10000	24	173.72	45.45	1.35		1.35	173.72	0.11	1.35	173.72	0.11																		
#.1.3.3	3	10000	24	220.23	57.61	1.35		1.35	220.23	0.09	1.35	220.23	0.09	1.35	220.23	0.09															
#.1.3.4	4	10000	24	173.72	45.45	1.35		1.35	86.86	0.11	1.35	86.86	0.11	1.35	86.86	0.11	1.35	86.86	0.11												
#.1.3.5	5	10000	24	173.72	45.45	1.35		1.35	57.91	0.11	1.35	57.91	0.11	1.35	57.91	0.11	1.35	57.91	0.11	1.35	57.91	0.11	1.35	57.91	0.11						
#.1.3.6	6	10000	24	173.72	45.45	1.35		1.35	43.43	0.11	1.35	43.43	0.11	1.35	43.43	0.11	1.35	43.43	0.11	1.35	43.43	0.11	1.35	43.43	0.11	1.35	43.43	0.11	1.35	43.43	0.11
#.1.3.7	7	10000	24	144.77	37.87	1.35	1.35	1.35	86.86	0.11	1.35	57.91	0.15	1.35	86.86	0.11															
#.1.3.8	8	10000	24	135.12	35.35	1.35	1.35	1.35	57.91	0.11	1.35	77.21	0.15	1.35	57.91	0.11															
#.1.3.9	9	10000	24	130.29	34.08	1.35	1.35	1.35	43.43	0.11	1.35	86.86	0.15	1.35	43.43	0.11															
#.1.3.10	10	10000	24	220.23	57.61	1.35		1.35	110.11	0.09	1.35	110.11	0.09	1.35	110.11	0.09	1.35	110.11	0.09	1.35	110.11	0.09	1.35	110.11	0.09						
#.1.4.1	1	25000	24	316.34	82.75	1.40		1.40	316.34	0.15																					
#.1.4.2	2	25000	24	474.52	124.14	1.40		1.40	474.52	0.10	1.40	474.52	0.10																		
#.1.4.3	3	25000	24	601.55	157.36	1.40		1.40	601.55	0.09	1.40	601.55	0.09	1.40	601.55	0.09															
#.1.4.4	4	25000	24	474.52	124.14	1.40		1.40	237.26	0.10	1.40	237.26	0.10	1.40	237.26	0.10	1.40	237.26	0.10												

Confidential Property of Pipeline Design

PIPE DIAMETER DETERMINATION

Simulation #	Config #	Length	Q (l/s)	ΔH	P (kW)	Op V	Op V2	Pipe 1			Pipe 2			Pipe 3			Pipe 4			Pipe 5			Pipe 6			Pipe 7			Pipe 8		
								V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia
#.1.4.5	5	25000	24	474.52	124.14	1.40		1.40	158.17	0.10	1.40	158.17	0.10	1.40	158.17	0.10	1.40	158.17	0.10	1.40	158.17	0.10	1.40	158.17	0.10						
#.1.4.6	6	25000	24	474.52	124.14	1.40		1.40	118.63	0.10	1.40	118.63	0.10	1.40	118.63	0.10	1.40	118.63	0.10	1.40	118.63	0.10	1.40	118.63	0.10	1.40	118.63	0.10	1.40	118.63	0.10
#.1.4.7	7	25000	24	395.43	103.44	1.40	1.40	1.40	237.26	0.10	1.40	158.17	0.15	1.40	237.26	0.10															
#.1.4.8	8	25000	24	369.07	96.55	1.40	1.40	1.40	158.17	0.10	1.40	210.89	0.15	1.40	158.17	0.10															
#.1.4.9	9	25000	24	355.89	93.10	1.40	1.40	1.40	118.63	0.10	1.40	237.25	0.15	1.40	118.63	0.10															
#.1.4.10	10	25000	24	601.55	157.36	1.40		1.40	300.77	0.09	1.40	300.77	0.09	1.40	300.77	0.09	1.40	300.77	0.09	1.40	300.77	0.09	1.40	300.77	0.09						
#.2.1.1	1	1000	96	4.70	4.91	1.30		1.30	4.70	0.31																					
#.2.1.2	2	1000	96	7.04	7.37	1.30		1.30	7.04	0.22	1.30	7.04	0.22																		
#.2.1.3	3	1000	96	8.93	9.34	1.30		1.30	8.93	0.18	1.30	8.93	0.18	1.30	8.93	0.18															
#.2.1.4	4	1000	96	7.04	7.37	1.30		1.30	3.52	0.22	1.30	3.52	0.22	1.30	3.52	0.22	1.30	3.52	0.22												
#.2.1.5	5	1000	96	7.04	7.37	1.30		1.30	2.35	0.22	1.30	2.35	0.22	1.30	2.35	0.22	1.30	2.35	0.22	1.30	2.35	0.22	1.30	2.35	0.22						
#.2.1.6	6	1000	96	7.04	7.37	1.30		1.30	1.76	0.22	1.30	1.76	0.22	1.30	1.76	0.22	1.30	1.76	0.22	1.30	1.76	0.22	1.30	1.76	0.22	1.30	1.76	0.22	1.30	1.76	0.22
#.2.1.7	7	1000	96	5.87	6.14	1.30	1.30	1.30	3.52	0.22	1.30	2.35	0.31	1.30	3.52	0.22															
#.2.1.8	8	1000	96	5.48	5.73	1.30	1.30	1.30	2.35	0.22	1.30	3.13	0.31	1.30	2.35	0.22															
#.2.1.9	9	1000	96	5.28	5.53	1.30	1.30	1.30	1.76	0.22	1.30	3.52	0.31	1.30	1.76	0.22															
#.2.1.10	10	1000	96	8.93	9.34	1.30		1.30	4.46	0.18	1.30	4.46	0.18	1.30	4.46	0.18	1.30	4.46	0.18	1.30	4.46	0.18	1.30	4.46	0.18						
#.2.2.1	1	5000	96	25.73	26.93	1.35		1.35	25.73	0.30																					
#.2.2.2	2	5000	96	38.60	40.39	1.35		1.35	38.60	0.21	1.35	38.60	0.21																		
#.2.2.3	3	5000	96	48.94	51.21	1.35		1.35	48.94	0.17	1.35	48.94	0.17	1.35	48.94	0.17															
#.2.2.4	4	5000	96	38.60	40.39	1.35		1.35	19.30	0.21	1.35	19.30	0.21	1.35	19.30	0.21	1.35	19.30	0.21												
#.2.2.5	5	5000	96	38.60	40.39	1.35		1.35	12.87	0.21	1.35	12.87	0.21	1.35	12.87	0.21	1.35	12.87	0.21	1.35	12.87	0.21	1.35	12.87	0.21						
#.2.2.6	6	5000	96	38.60	40.39	1.35		1.35	9.65	0.21	1.35	9.65	0.21	1.35	9.65	0.21	1.35	9.65	0.21	1.35	9.65	0.21	1.35	9.65	0.21	1.35	9.65	0.21	1.35	9.65	0.21
#.2.2.7	7	5000	96	32.17	33.66	1.35	1.35	1.35	19.30	0.21	1.35	12.87	0.30	1.35	19.30	0.21															
#.2.2.8	8	5000	96	30.02	31.42	1.35	1.35	1.35	12.87	0.21	1.35	17.16	0.30	1.35	12.87	0.21															
#.2.2.9	9	5000	96	28.95	30.30	1.35	1.35	1.35	9.65	0.21	1.35	19.30	0.30	1.35	9.65	0.21															
#.2.2.10	10	5000	96	48.94	51.21	1.35		1.35	24.47	0.17	1.35	24.47	0.17	1.35	24.47	0.17	1.35	24.47	0.17	1.35	24.47	0.17	1.35	24.47	0.17						
#.2.3.1	1	10000	96	61.25	64.09	1.45		1.45	61.25	0.29																					
#.2.3.2	2	10000	96	91.88	96.14	1.45		1.45	91.88	0.21	1.45	91.88	0.21																		
#.2.3.3	3	10000	96	116.48	121.88	1.45		1.45	116.48	0.17	1.45	116.48	0.17	1.45	116.48	0.17															
#.2.3.4	4	10000	96	91.88	96.14	1.45		1.45	45.94	0.21	1.45	45.94	0.21	1.45	45.94	0.21	1.45	45.94	0.21												
#.2.3.5	5	10000	96	91.88	96.14	1.45		1.45	30.63	0.21	1.45	30.63	0.21	1.45	30.63	0.21	1.45	30.63	0.21	1.45	30.63	0.21	1.45	30.63	0.21						
#.2.3.6	6	10000	96	91.88	96.14	1.45		1.45	22.97	0.21	1.45	22.97	0.21	1.45	22.97	0.21	1.45	22.97	0.21	1.45	22.97	0.21	1.45	22.97	0.21	1.45	22.97	0.21	1.45	22.97	0.21
#.2.3.7	7	10000	96	76.57	80.12	1.45	1.45	1.45	45.94	0.21	1.45	30.63	0.29	1.45	45.94	0.21															

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PIPE DIAMETER DETERMINATION

Simulation #	Config #	Length	Q (l/s)	ΔH	P (kW)	Op V	Op V2	Pipe 1			Pipe 2			Pipe 3			Pipe 4			Pipe 5			Pipe 6			Pipe 7			Pipe 8		
								V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia
#.2.3.8	8	10000	96	71.46	74.78	1.45	1.45	1.45	30.63	0.21	1.45	40.83	0.29	1.45	30.63	0.21															
#.2.3.9	9	10000	96	68.91	72.11	1.45	1.45	1.45	22.97	0.21	1.45	45.94	0.29	1.45	22.97	0.21															
#.2.3.10	10	10000	96	116.48	121.88	1.45		1.45	58.24	0.17	1.45	58.24	0.17	1.45	58.24	0.17	1.45	58.24	0.17	1.45	58.24	0.17	1.45	58.24	0.17						
#.2.4.1	1	25000	96	166.31	174.02	1.50		1.50	166.31	0.29																					
#.2.4.2	2	25000	96	249.47	261.04	1.50		1.50	249.47	0.20	1.50	249.47	0.20																		
#.2.4.3	3	25000	96	316.25	330.92	1.50		1.50	316.25	0.16	1.50	316.25	0.16	1.50	316.25	0.16															
#.2.4.4	4	25000	96	249.47	261.04	1.50		1.50	124.73	0.20	1.50	124.73	0.20	1.50	124.73	0.20	1.50	124.73	0.20												
#.2.4.5	5	25000	96	249.47	261.04	1.50		1.50	83.16	0.20	1.50	83.16	0.20	1.50	83.16	0.20	1.50	83.16	0.20	1.50	83.16	0.20	1.50	83.16	0.20						
#.2.4.6	6	25000	96	249.47	261.04	1.50		1.50	62.37	0.20	1.50	62.37	0.20	1.50	62.37	0.20	1.50	62.37	0.20	1.50	62.37	0.20	1.50	62.37	0.20	1.50	62.37	0.20	1.50	62.37	0.20
#.2.4.7	7	25000	96	207.89	217.53	1.50	1.50	1.50	124.73	0.20	1.50	83.15	0.29	1.50	124.73	0.20															
#.2.4.8	8	25000	96	194.03	203.03	1.50	1.50	1.50	83.16	0.20	1.50	110.87	0.29	1.50	83.16	0.20															
#.2.4.9	9	25000	96	187.10	195.78	1.50	1.50	1.50	62.37	0.20	1.50	124.73	0.29	1.50	62.37	0.20															
#.2.4.10	10	25000	96	316.25	330.92	1.50		1.50	158.12	0.16	1.50	158.12	0.16	1.50	158.12	0.16	1.50	158.12	0.16	1.50	158.12	0.16	1.50	158.12	0.16						
#.3.1.1	1	1000	192	3.13	6.55	1.30		1.30	3.13	0.43																					
#.3.1.2	2	1000	192	4.70	9.83	1.30		1.30	4.70	0.31	1.30	4.70	0.31																		
#.3.1.3	3	1000	192	5.95	12.46	1.30		1.30	5.95	0.25	1.30	5.95	0.25	1.30	5.95	0.25															
#.3.1.4	4	1000	192	4.70	9.83	1.30		1.30	2.35	0.31	1.30	2.35	0.31	1.30	2.35	0.31	1.30	2.35	0.31												
#.3.1.5	5	1000	192	4.70	9.83	1.30		1.30	1.57	0.31	1.30	1.57	0.31	1.30	1.57	0.31	1.30	1.57	0.31	1.30	1.57	0.31	1.30	1.57	0.31						
#.3.1.6	6	1000	192	4.70	9.83	1.30		1.30	1.17	0.31	1.30	1.17	0.31	1.30	1.17	0.31	1.30	1.17	0.31	1.30	1.17	0.31	1.30	1.17	0.31	1.30	1.17	0.31	1.30	1.17	0.31
#.3.1.7	7	1000	192	3.91	8.19	1.30	1.30	1.30	2.35	0.31	1.30	1.56	0.43	1.30	2.35	0.31															
#.3.1.8	8	1000	192	3.65	7.64	1.30	1.30	1.30	1.57	0.31	1.30	2.09	0.43	1.30	1.57	0.31															
#.3.1.9	9	1000	192	3.52	7.37	1.30	1.30	1.30	1.17	0.31	1.30	2.35	0.43	1.30	1.17	0.31															
#.3.1.10	10	1000	192	5.95	12.46	1.30		1.30	2.98	0.25	1.30	2.98	0.25	1.30	2.98	0.25	1.30	2.98	0.25	1.30	2.98	0.25	1.30	2.98	0.25						
#.3.2.1	1	5000	192	17.16	35.90	1.35		1.35	17.16	0.43																					
#.3.2.2	2	5000	192	25.73	53.86	1.35		1.35	25.73	0.30	1.35	25.73	0.30																		
#.3.2.3	3	5000	192	32.62	68.27	1.35		1.35	32.62	0.25	1.35	32.62	0.25	1.35	32.62	0.25															
#.3.2.4	4	5000	192	25.73	53.86	1.35		1.35	12.87	0.30	1.35	12.87	0.30	1.35	12.87	0.30	1.35	12.87	0.30												
#.3.2.5	5	5000	192	25.73	53.86	1.35		1.35	8.58	0.30	1.35	8.58	0.30	1.35	8.58	0.30	1.35	8.58	0.30	1.35	8.58	0.30	1.35	8.58	0.30						
#.3.2.6	6	5000	192	25.73	53.86	1.35		1.35	6.43	0.30	1.35	6.43	0.30	1.35	6.43	0.30	1.35	6.43	0.30	1.35	6.43	0.30	1.35	6.43	0.30	1.35	6.43	0.30	1.35	6.43	0.30
#.3.2.7	7	5000	192	21.45	44.88	1.35	1.35	1.35	12.87	0.30	1.35	8.58	0.43	1.35	12.87	0.30															
#.3.2.8	8	5000	192	20.02	41.89	1.35	1.35	1.35	8.58	0.30	1.35	11.44	0.43	1.35	8.58	0.30															
#.3.2.9	9	5000	192	19.30	40.39	1.35	1.35	1.35	6.43	0.30	1.35	12.87	0.43	1.35	6.43	0.30															
#.3.2.10	10	5000	192	32.62	68.27	1.35		1.35	16.31	0.25	1.35	16.31	0.25	1.35	16.31	0.25	1.35	16.31	0.25	1.35	16.31	0.25	1.35	16.31	0.25						
#.3.3.1	1	10000	192	40.83	85.46	1.45		1.45	40.83	0.41																					

PIPE DIAMETER DETERMINATION

Simulation #	Config #	Length	Q (l/s)	ΔH	P (kW)	Op V	Op V2	Pipe 1			Pipe 2			Pipe 3			Pipe 4			Pipe 5			Pipe 6			Pipe 7			Pipe 8		
								V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia
#.3.3.2	2	10000	192	61.25	128.19	1.45		1.45	61.25	0.29	1.45	61.25	0.29																		
#.3.3.3	3	10000	192	77.65	162.50	1.45		1.45	77.65	0.24	1.45	77.65	0.24	1.45	77.65	0.24															
#.3.3.4	4	10000	192	61.25	128.19	1.45		1.45	30.63	0.29	1.45	30.63	0.29	1.45	30.63	0.29	1.45	30.63	0.29												
#.3.3.5	5	10000	192	61.25	128.19	1.45		1.45	20.42	0.29	1.45	20.42	0.29	1.45	20.42	0.29	1.45	20.42	0.29	1.45	20.42	0.29	1.45	20.42	0.29						
#.3.3.6	6	10000	192	61.25	128.19	1.45		1.45	15.31	0.29	1.45	15.31	0.29	1.45	15.31	0.29	1.45	15.31	0.29	1.45	15.31	0.29	1.45	15.31	0.29	1.45	15.31	0.29	1.45	15.31	0.29
#.3.3.7	7	10000	192	51.04	106.82	1.45	1.45	1.45	30.63	0.29	1.45	20.42	0.41	1.45	30.63	0.29															
#.3.3.8	8	10000	192	47.64	99.70	1.45	1.45	1.45	20.42	0.29	1.45	27.22	0.41	1.45	20.42	0.29															
#.3.3.9	9	10000	192	45.94	96.14	1.45	1.45	1.45	15.31	0.29	1.45	30.63	0.41	1.45	15.31	0.29															
#.3.3.10	10	10000	192	77.65	162.50	1.45		1.45	38.82	0.24	1.45	38.82	0.24	1.45	38.82	0.24	1.45	38.82	0.24	1.45	38.82	0.24	1.45	38.82	0.24						
#.3.4.1	1	25000	192	110.87	232.02	1.50		1.50	110.87	0.40																					
#.3.4.2	2	25000	192	166.31	348.05	1.50		1.50	166.31	0.29	1.50	166.31	0.29																		
#.3.4.3	3	25000	192	210.83	441.22	1.50		1.50	210.83	0.23	1.50	210.83	0.23	1.50	210.83	0.23															
#.3.4.4	4	25000	192	166.31	348.05	1.50		1.50	83.15	0.29	1.50	83.15	0.29	1.50	83.15	0.29	1.50	83.15	0.29												
#.3.4.5	5	25000	192	166.31	348.05	1.50		1.50	55.44	0.29	1.50	55.44	0.29	1.50	55.44	0.29	1.50	55.44	0.29	1.50	55.44	0.29	1.50	55.44	0.29						
#.3.4.6	6	25000	192	166.31	348.05	1.50		1.50	41.58	0.29	1.50	41.58	0.29	1.50	41.58	0.29	1.50	41.58	0.29	1.50	41.58	0.29	1.50	41.58	0.29	1.50	41.58	0.29	1.50	41.58	0.29
#.3.4.7	7	25000	192	138.59	290.04	1.50	1.50	1.50	83.15	0.29	1.50	55.43	0.40	1.50	83.15	0.29															
#.3.4.8	8	25000	192	129.35	270.70	1.50	1.50	1.50	55.44	0.29	1.50	73.91	0.40	1.50	55.44	0.29															
#.3.4.9	9	25000	192	124.73	261.03	1.50	1.50	1.50	41.58	0.29	1.50	83.15	0.40	1.50	41.58	0.29															
#.3.4.10	10	25000	192	210.83	441.22	1.50		1.50	105.41	0.23	1.50	105.41	0.23	1.50	105.41	0.23	1.50	105.41	0.23	1.50	105.41	0.23	1.50	105.41	0.23						
#.4.1.1	1	1000	288	2.71	8.50	1.35		1.35	2.71	0.52																					
#.4.1.2	2	1000	288	4.06	12.75	1.35		1.35	4.06	0.37	1.35	4.06	0.37																		
#.4.1.3	3	1000	288	5.15	16.16	1.35		1.35	5.15	0.30	1.35	5.15	0.30	1.35	5.15	0.30															
#.4.1.4	4	1000	288	4.06	12.75	1.35		1.35	2.03	0.37	1.35	2.03	0.37	1.35	2.03	0.37	1.35	2.03	0.37												
#.4.1.5	5	1000	288	4.06	12.75	1.35		1.35	1.35	0.37	1.35	1.35	0.37	1.35	1.35	0.37	1.35	1.35	0.37	1.35	1.35	0.37	1.35	1.35	0.37						
#.4.1.6	6	1000	288	4.06	12.75	1.35		1.35	1.02	0.37	1.35	1.02	0.37	1.35	1.02	0.37	1.35	1.02	0.37	1.35	1.02	0.37	1.35	1.02	0.37	1.35	1.02	0.37	1.35	1.02	0.37
#.4.1.7	7	1000	288	3.38	10.62	1.35	1.35	1.35	2.03	0.37	1.35	1.35	0.52	1.35	2.03	0.37															
#.4.1.8	8	1000	288	3.16	9.91	1.35	1.35	1.35	1.35	0.37	1.35	1.80	0.52	1.35	1.35	0.37															
#.4.1.9	9	1000	288	3.05	9.56	1.35	1.35	1.35	1.02	0.37	1.35	2.03	0.52	1.35	1.02	0.37															
#.4.1.10	10	1000	288	5.15	16.16	1.35		1.35	2.57	0.30	1.35	2.57	0.30	1.35	2.57	0.30	1.35	2.57	0.30	1.35	2.57	0.30	1.35	2.57	0.30						
#.4.2.1	1	5000	288	14.79	46.42	1.40		1.40	14.79	0.51																					
#.4.2.2	2	5000	288	22.18	69.63	1.40		1.40	22.18	0.36	1.40	22.18	0.36																		
#.4.2.3	3	5000	288	28.12	88.27	1.40		1.40	28.12	0.30	1.40	28.12	0.30	1.40	28.12	0.30															
#.4.2.4	4	5000	288	22.18	69.63	1.40		1.40	11.09	0.36	1.40	11.09	0.36	1.40	11.09	0.36	1.40	11.09	0.36												
#.4.2.5	5	5000	288	22.18	69.63	1.40		1.40	7.39	0.36	1.40	7.39	0.36	1.40	7.39	0.36	1.40	7.39	0.36	1.40	7.39	0.36	1.40	7.39	0.36						

PIPE DIAMETER DETERMINATION

Simulation #	Config #	Length	Q (l/s)	ΔH	P (kW)	Op V	Op V2	Pipe 1			Pipe 2			Pipe 3			Pipe 4			Pipe 5			Pipe 6			Pipe 7			Pipe 8		
								V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia	V	Δh	Dia
#.4.2.6	6	5000	288	22.18	69.63	1.40		1.40	5.55	0.36	1.40	5.55	0.36	1.40	5.55	0.36	1.40	5.55	0.36	1.40	5.55	0.36	1.40	5.55	0.36	1.40	5.55	0.36	1.40	5.55	0.36
#.4.2.7	7	5000	288	18.48	58.02	1.40	1.40	1.40	11.09	0.36	1.40	7.39	0.51	1.40	11.09	0.36															
#.4.2.8	8	5000	288	17.25	54.15	1.40	1.40	1.40	7.39	0.36	1.40	9.86	0.51	1.40	7.39	0.36															
#.4.2.9	9	5000	288	16.63	52.22	1.40	1.40	1.40	5.55	0.36	1.40	11.09	0.51	1.40	5.55	0.36															
#.4.2.10	10	5000	288	28.12	88.27	1.40		1.40	14.06	0.30	1.40	14.06	0.30	1.40	14.06	0.30	1.40	14.06	0.30	1.40	14.06	0.30	1.40	14.06	0.30						
#.4.3.1	1	10000	288	34.98	109.82	1.50		1.50	34.98	0.49																					
#.4.3.2	2	10000	288	52.48	164.73	1.50		1.50	52.48	0.35	1.50	52.48	0.35																		
#.4.3.3	3	10000	288	66.52	208.83	1.50		1.50	66.52	0.29	1.50	66.52	0.29	1.50	66.52	0.29															
#.4.3.4	4	10000	288	52.48	164.73	1.50		1.50	26.24	0.35	1.50	26.24	0.35	1.50	26.24	0.35	1.50	26.24	0.35												
#.4.3.5	5	10000	288	52.48	164.73	1.50		1.50	17.49	0.35	1.50	17.49	0.35	1.50	17.49	0.35	1.50	17.49	0.35	1.50	17.49	0.35	1.50	17.49	0.35						
#.4.3.6	6	10000	288	52.48	164.73	1.50		1.50	13.12	0.35	1.50	13.12	0.35	1.50	13.12	0.35	1.50	13.12	0.35	1.50	13.12	0.35	1.50	13.12	0.35	1.50	13.12	0.35	1.50	13.12	0.35
#.4.3.7	7	10000	288	43.73	137.27	1.50	1.50	1.50	26.24	0.35	1.50	17.49	0.49	1.50	26.24	0.35															
#.4.3.8	8	10000	288	40.81	128.12	1.50	1.50	1.50	17.49	0.35	1.50	23.32	0.49	1.50	17.49	0.35															
#.4.3.9	9	10000	288	39.36	123.55	1.50	1.50	1.50	13.12	0.35	1.50	26.24	0.49	1.50	13.12	0.35															
#.4.3.10	10	10000	288	66.52	208.83	1.50		1.50	33.26	0.29	1.50	33.26	0.29	1.50	33.26	0.29	1.50	33.26	0.29	1.50	33.26	0.29	1.50	33.26	0.29						
#.4.4.1	1	25000	288	94.73	297.36	1.55		1.55	94.73	0.49																					
#.4.4.2	2	25000	288	142.09	446.06	1.55		1.55	142.09	0.34	1.55	142.09	0.34																		
#.4.4.3	3	25000	288	180.13	565.46	1.55		1.55	180.13	0.28	1.55	180.13	0.28	1.55	180.13	0.28															
#.4.4.4	4	25000	288	142.09	446.06	1.55		1.55	71.05	0.34	1.55	71.05	0.34	1.55	71.05	0.34	1.55	71.05	0.34												
#.4.4.5	5	25000	288	142.09	446.06	1.55		1.55	47.36	0.34	1.55	47.36	0.34	1.55	47.36	0.34	1.55	47.36	0.34	1.55	47.36	0.34	1.55	47.36	0.34						
#.4.4.6	6	25000	288	142.09	446.06	1.55		1.55	35.52	0.34	1.55	35.52	0.34	1.55	35.52	0.34	1.55	35.52	0.34	1.55	35.52	0.34	1.55	35.52	0.34	1.55	35.52	0.34	1.55	35.52	0.34
#.4.4.7	7	25000	288	118.41	371.71	1.55	1.55	1.55	71.05	0.34	1.55	47.36	0.49	1.55	71.05	0.34															
#.4.4.8	8	25000	288	110.51	346.93	1.55	1.55	1.55	47.36	0.34	1.55	63.15	0.49	1.55	47.36	0.34															
#.4.4.9	9	25000	288	106.57	334.54	1.55	1.55	1.55	35.52	0.34	1.55	71.04	0.49	1.55	35.52	0.34															
#.4.4.10	10	25000	288	180.13	565.46	1.55		1.55	90.06	0.28	1.55	90.06	0.28	1.55	90.06	0.28	1.55	90.06	0.28	1.55	90.06	0.28	1.55	90.06	0.28						

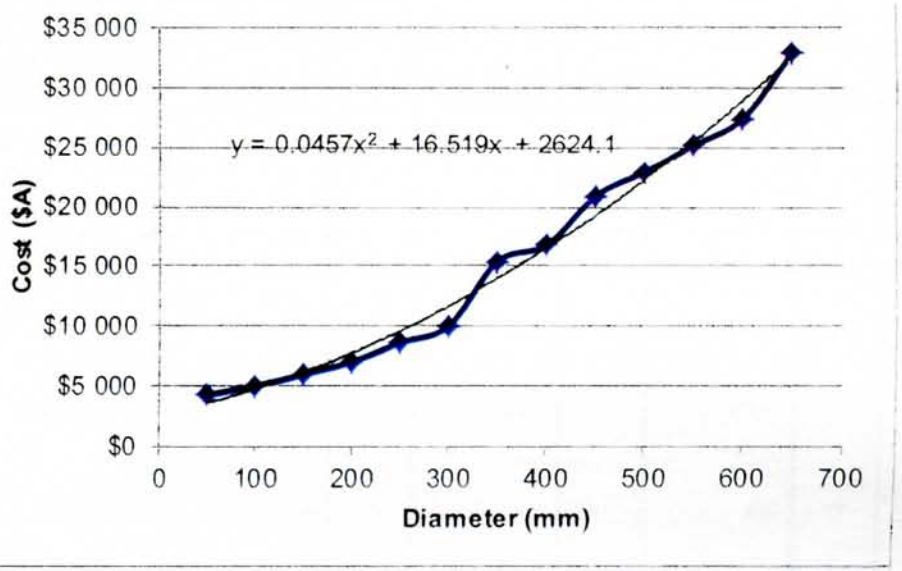
Unauthorized Reproduction

APPENDIX O: COSTING OF VALVE CHAMBERS

University of Cape Town

SUMMARY: 2 PIPE INTERCONNECTION

Diameter	Cost 2010 (SAR)	Cost 2007 (SAR)	Cost 2003 (AUS$)
50	R 53 667.60	R 42 603.07	$4 260.31
100	R 62 987.45	R 50 001.47	$5 000.15
150	R 75 248.27	R 59 734.51	$5 973.45
200	R 88 212.55	R 70 025.96	$7 002.60
250	R 108 663.12	R 86 260.29	$8 626.03
300	R 126 651.93	R 100 540.39	$10 054.04
350	R 194 325.79	R 154 262.08	$15 426.21
400	R 212 160.01	R 168 419.46	$16 841.95
450	R 263 896.45	R 209 489.51	$20 948.95
500	R 289 688.06	R 229 963.72	$22 996.37
550	R 318 010.92	R 252 447.32	$25 244.73
600	R 346 636.48	R 275 171.22	$27 517.12
650	R 415 927.30	R 330 176.50	$33 017.65



University of Cape Town

COSTING: 2 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05		0.1		0.15		0.2		0.25		0.3	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
	SANS	**SECTION : CHAMBER**														
1.1	1200 D	SITE PREPARATION														
		Clear and Strip Site (Provisional)														
1.1.1	8.3.1	Clear vegetation and trees of girth up to 2 m	m^2	6.00	26	155.51	27	164.91	29	176.48	31	184.82	33	197.82	35	208.2
1.1.2	8.2.10 SANS	Removal topsoil to nominal depth of 150mm, stockpile and maintain	m^2	15.00	26	388.77	27	412.29	29	441.21	31	462.04	33	494.54	35	520.6
1.2	1200 D	EARTHWORKS														
	8.3.2	*Bulk Excavation*														
1.2.1		Excavate in all materials, stockpile, maintain to be used for backfill / fill.	m^3	50.00	8	393.50	9	452.50	11	528.30	12	584.17	14	675.47	15	750.5
	8.3.3 (b)	*Extra-over excavations above for:*														
		(Provisional)														
1.2.2	8.3.5	Extra excavation in all materials to provide working space around	m^2		13	0.00	13	0.00	15	0.00	15	0.00	16	0.00	17	0.0
	SANS	CONCRETE (STRUCTURAL)														
1.3	1200 G															
		Form work														
1.3.1	8.2.1	Vertical rough plane	m^2	400.00	13	5 018.40	13	5 383.20	15	5 817.60	15	6 124.80	16	6 585.60	17	6 948.0
1.3.2	8.2.2	Vertical Smooth plane	m^2	600.00	12	7 053.12	13	7 709.76	14	8 491.68	15	9 044.64	16	9 874.08	18	10 526.4
1.3.3	8.2.2	Smooth Horizontal plane	m^2	600.00	5	3 149.16	6	3 579.00	7	4 127.76	8	4 530.96	9	5 185.68	10	5 722.2
1.3.4	8.2.5	Vertical and horizontal narrow widths up to 300mm wide	m	140.00	9	1 226.96	9	1 312.08	10	1 413.44	11	1 485.12	11	1 592.64	12	1 677.2
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00	9	876.40	9	937.20	10	1 009.60	11	1 060.80	11	1 137.60	12	1 198.0
	8.2.6	*Box out holes/form voids*														
		Larger, other than circular , of area over 0.1 m^2 Over and up to and including -														
1.3.6		500 mm deep	No	340.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.0
		Casting/grout in of pipes														
TOTAL CARRIED FORWARD TO NEXT PAGE						19 281.82		20 970.94		23 026.07		24 497.35		26 763.42		28 571.2

University of Cape Town

COSTING: 2 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05		0.1		0.15		0.2		0.25		0.3	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page				19 281.82		20 970.94		23 026.07		24 497.35		26 763.42		28 571.20
1.3.7		0 - # nominal flange diameter	No	2 400.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00
1.4	8.3	REINFORCEMENT														
	8.3.1 (a)	*Mild steel bars:*														
1.4.1		a) Diameter 25 mm; Basic price	t	12 000.00	0.07	860.49	0.08	959.68	0.09	1 083.76	0.10	1 173.96	0.11	1 317.35	0.12	1 433.62
		Extra-over for item 2.8.1 for bars														
1.4.2		(1) 8 mmm	t	1 000.00	0.01	7.17	0.01	8.00	0.01	9.03	0.01	9.78	0.01	10.98	0.01	11.95
1.4.3		(2) 10mm	t	1 000.00	0.04	43.02	0.05	47.98	0.05	54.19	0.06	58.70	0.07	65.87	0.07	71.68
1.4.4		(3) 12 mm	t	500.00	0.02	10.76	0.02	12.00	0.03	13.55	0.03	14.67	0.03	16.47	0.04	17.92
	8.3.1 (b)	*High-tensile steel bars:*														
1.4.5		a) Diameter 25 mm; Basic price	t	12 000.00	0.48	5 736.63	0.53	6 397.85	0.60	7 225.08	0.65	7 826.43	0.73	8 782.36	0.80	9 557.50
		Extra-over for item 2.8.2 for bars														
		(Provisional Quantities)														
1.4.6		1) 10 mm	t	1 000.00	0.05	47.81	0.05	53.32	0.06	60.21	0.07	65.22	0.07	73.19	0.08	79.65
1.4.7		2) 12 mm	t	500.00	0.29	143.42	0.32	159.95	0.36	180.63	0.39	195.66	0.44	219.56	0.48	238.94
1.4.8		3) 16 mm	t	500.00	0.14	71.71	0.16	79.97	0.18	90.31	0.20	97.83	0.22	109.78	0.24	119.47
1.4.9		4) 20 mm	t	500.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5		CONCRETE														
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19)	m²	115.00	4	502.80	5	578.20	6	675.05	6	746.44	8	863.10	8	958.99
		(Provisional Quantities)														
	8.4.3	*Strength Concrete, Class (35/19 MPa)*														
1.5.2		Foundations, floorslabs and bases	m³	2 000.00	1.1	2 186.10	1.3	2 513.90	1.5	2 935.00	1.6	3 245.40	1.9	3 752.60	2.1	4 169.50
1.5.3		Wall, columns and beams	m³	2 000.00	1.8	3 682.00	2.0	3 986.00	2.2	4 348.00	2.3	4 604.00	2.5	4 988.00	2.6	5 290.00
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00	1.0	2 099.44	1.2	2 386.00	1.4	2 751.84	1.5	3 020.64	1.7	3 457.12	1.9	3 814.80
	8.4.4	*Unformed Surface Finishes*														
1.5.5		Wood float finish	m²	18.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
1.5.6		Steel float finish	m²	35.00	7.8	272.29	9.0	314.99	10.6	370.15	11.7	410.91	13.7	477.89	15.2	533.09
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**														
1.6.1		*Mild Steel Pipe*	m	See table	5.0	1 282.14	5.2	2 005.68	5.5	3 379.40	5.5	4 714.54	5.9	5 676.44	6.1	7 538.64
1.6.2		*RSV Valves*	No	See table	4.0	4 408.00	4.0	6 592.00	4.0	9 336.00	4.0	15 040.00	4.0	26 160.00	4.0	34 104.00
1.6.3		*FlangeAdaptors*	No	See table	5.0	2 210.00	5.0	3 160.00	5.0	4 600.00	5.0	5 740.00	5.0	5 930.00	5.0	7 470.00
1.6.4		*Flexible Couplings*	No	See table	4.0	1 768.00	4.0	2 528.00	4.0	3 680.00	4.0	4 592.00	4.0	4 744.00	4.0	5 976.00
1.6.5		*Flanges*	No	See table	9.0	1 854.00	9.0	3 033.00	9.0	4 230.00	9.0	4 959.00	9.0	8 055.00	9.0	9 495.00
TOTAL CARRIED FORWARD TO SUMMARY						53 667.60		62 987.45		75 248.27		88 212.55		108 663.12		126 651.93

University of Cape Town

COSTING: 2 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35 QTY	0.35 AMOUNT	0.4 QTY	0.4 QTY	0.45 QTY	0.45 AMOUNT	0.5 QTY	0.5 AMOUNT	0.55 QTY	0.55 AMOUNT	0.6 QTY	0.6 AMOUNT	0.65 QTY	0.65 AMOUNT
	SANS	**SECTION : CHAMBER**																
1.1	1200 D	SITE PREPARATION *Clear and Strip Site (Provisional)*																
1.1.1	8.3.1	Clear vegetation and trees of girth up to 2 m	m²	6.00	38	228.84	40	240.08	42	252.70	44	266.95	47	282.78	50	299.07	53	319.1
1.1.2	8.2.10 SANS	Removal topsoil to nominal depth of 150mm.	m²	15.00	38	572.10	40	600.21	42	631.74	44	667.37	47	706.95	50	747.67	53	797.9
1.2	1200 D	EARTHWORKS																
1.2.1	8.3.2 8.3.3 (b)	*Bulk Excavation* Excavate in all materials, stockpile, maintain to be *Extra-over excavations above for:*	m³	50.00	18	907.04	20	994.14	22	1 094.24	24	1 210.25	27	1 342.42	30	1 481.44	33	1 657.6
1.2.2	8.3.5 SANS	*(Provisional)* Extra excavation in all materials to provide CONCRETE (STRUCTURAL)	m²		19	0.00	20	0.00	21	0.00	22	0.00	23	0.00	24	0.00	26	0.0
1.3	1200 G	Form work																
1.3.1	8.2.1	Vertical rough plane	m²	400.00	19	7 624.80	20	7 987.20	21	8 383.20	22	8 817.60	23	9 285.60	24	9 753.60	26	10 311.6
1.3.2	8.2.2	Vertical Smooth plane	m²	600.00	20	11 744.64	21	12 396.96	22	13 109.76	23	13 891.68	25	14 734.08	26	15 576.48	28	16 580.8
1.3.3	8.2.2	Smooth Horizontal plane	m²	600.00	11	6 833.40	12	7 450.32	14	8 157.24	15	8 974.08	17	9 902.04	18	10 875.60	20	12 106.2
1.3.4	8.2.5	Vertical and horizontal narrow widths up to	m	140.00	13	1 835.12	14	1 919.68	14	2 012.08	15	2 113.44	16	2 222.64	17	2 331.84	18	2 462.0
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00	13	1 310.80	14	1 371.20	14	1 437.20	15	1 509.60	16	1 587.60	17	1 665.60	18	1 758.6
	8.2.6	*Box out holes/form voids*																
1.3.6		Larger, other than circular , of area over 0.1 Over and up to and including 500 mm deep	No	340.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.0
		Casting/grout in of pipes																
TOTAL CARRIED FORWARD TO NEXT PAGE						32 076.74		33 979.79		36 098.16		38 470.96		41 084.11		43 751.29		47 014.1

University of Cape Town

COSTING: 2 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35		0.4		0.45		0.5		0.55		0.6		0.65	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page				32 076.74		33 979.79		36 098.16		38 470.96		41 084.11		43 751.29		47 014.19
1.3.7		0 - # nominal flange diameter	No	2 400.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00
1.4	8.3	REINFORCEMENT																
	8.3.1 (a)	*Mild steel bars:*																
1.4.1		a) Diameter 25 mm; Basic price	t	12 000.00	0.14	1 668.46	0.15	1 797.76	0.16	1 944.35	0.18	2 111.87	0.19	2 300.10	0.21	2 495.73	0.23	2 740.29
		Extra-over for item 2.8.1 for bars																
1.4.2		(1) 8 mmm	t	1 000.00	0.01	13.90	0.01	14.98	0.02	16.20	0.02	17.60	0.02	19.17	0.02	20.80	0.02	22.84
1.4.3		(2) 10mm	t	1 000.00	0.08	83.42	0.09	89.89	0.10	97.22	0.11	105.59	0.12	115.01	0.12	124.79	0.14	137.01
1.4.4		(3) 12 mm	t	500.00	0.04	20.86	0.04	22.47	0.05	24.30	0.05	26.40	0.06	28.75	0.06	31.20	0.07	34.25
	8.3.1 (b)	*High-tensile steel bars:*																
1.4.5		a) Diameter 25 mm; Basic price	t	12 000.00	0.93	11 123.06	1.00	11 985.03	1.08	12 962.35	1.17	14 079.11	1.28	15 334.03	1.39	16 638.19	1.52	18 268.62
		Extra-over for item 2.8.2 for bars																
		(Provisional Quantities)																
1.4.6		1) 10 mm	t	1 000.00	0.09	92.69	0.10	99.88	0.11	108.02	0.12	117.33	0.13	127.78	0.14	138.65	0.15	152.24
1.4.7		2) 12 mm	t	500.00	0.56	278.08	0.60	299.63	0.65	324.06	0.70	351.98	0.77	383.35	0.83	415.95	0.91	456.72
1.4.8		3) 16 mm	t	500.00	0.28	139.04	0.30	149.81	0.32	162.03	0.35	175.99	0.38	191.68	0.42	207.98	0.46	228.36
1.4.9		4) 20 mm	t	500.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5		CONCRETE																
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19)	m²	115.00	10	1 158.99	11	1 270.29	12	1 398.19	13	1 546.43	15	1 715.32	16	1 892.95	18	2 118.13
		(Provisional Quantities)																
	8.4.3	*Strength Concrete, Class*																
		(35/19 MPa)																
1.5.2		Foundations, floorslabs and bases	m³	2 000.00	2.5	5 039.10	2.8	5 523.00	3.0	6 079.10	3.4	6 723.60	3.7	7 457.90	4.1	8 230.20	4.6	9 209.25
1.5.3		Wall, columns and beams	m³	2 000.00	2.9	5 854.00	3.1	6 156.00	3.2	6 486.00	3.4	6 848.00	3.6	7 238.00	3.8	7 628.00	4.0	8 093.00
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00	2.3	4 555.60	2.5	4 966.88	2.7	5 438.16	3.0	5 982.72	3.3	6 601.36	3.6	7 250.40	4.0	8 070.84
	8.4.4	*Unformed Surface Finishes*																
1.5.5		Wood float finish	m²	18.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
1.5.6		Steel float finish	m²	35.00	18.5	648.91	20.4	713.48	22.5	787.87	25.0	874.30	27.8	973.01	30.8	1 077.03	34.5	1 209.22
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**																
1.6.1		*Mild Steel Pipe*	m	See table	6.5	9 543.94	6.8	11 341.12	7.2	13 524.43	7.5	21 488.19	7.8	23 733.36	8.1	26 085.33	8.7	30 270.34
1.6.2		*RSV Valves*	No	See table	4.0	79 648.00	4.0	86 320.00	4.0	124 968.00	4.0	129 280.00	4.0	139 896.00	4.0	150 512.00	4.0	203 860.00
1.6.3		*FlangeAdaptors*	No	See table	5.0	12 650.00	5.0	13 930.00	5.0	15 160.00	5.0	17 390.00	5.0	18 695.00	5.0	20 000.00	5.0	21 530.00
1.6.4		*Flexible Couplings*	No	See table	4.0	10 120.00	4.0	11 144.00	4.0	12 128.00	4.0	13 912.00	4.0	14 956.00	4.0	16 000.00	4.0	17 224.00
1.6.5		*Flanges*	No	See table	9.0	12 411.00	9.0	15 156.00	9.0	18 990.00	9.0	22 986.00	9.0	29 961.00	9.0	36 936.00	9.0	38 088.00
TOTAL CARRIED FORWARD TO SUMMARY						194 325.79		212 160.01		263 896.45		289 688.06		318 010.92		346 636.48		415 927.30

University of Cape Town

Characteristics of Valve Chamber: Connection between 2 Parallel Pipes

Input

Pipe Diameter	m	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
Distance between pipe and wall 1	m	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Distance between pipe and wall 2	m	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Distance between parallel pipes	m	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7
Distance between flange and walls	m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Length of Isolation valve	m	0.209	0.254	0.28	0.317	0.356	0.38	0.47	0.47	0.48	0.51	0.555	0.6	0.605
Length of T-Piece	m	0.36	0.36	0.46	0.46	0.56	0.61	0.71	0.81	0.92	1.02	1.12	1.22	1.475
Length of flange adaptor	m	0.102	0.109	0.114	0.105	0.108	0.11	0.152	0.153	0.153	0.154	0.154	0.154	0.154
Depth (bottom of floor to top of wall)	m	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Depth (NGL to bottom of floor)	m	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Floor thickness	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Wall thickness	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Roof thickness	m	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Roof overhang	m	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Thickness of blinding layer	m	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Site Clearance extra length	m	3	3	3	3	3	3	3	3	3	3	3	3	3
Site Clearance extra width	m	3	3	3	3	3	3	3	3	3	3	3	3	3
High Tensile steel	kg/m^3	120	120	120	120	120	120	120	120	120	120	120	120	120
High Tensile steel - 8 mm	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
High Tensile steel - 10 mm	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
High Tensile steel - 12 mm	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
High Tensile steel - 16 mm	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
High Tensile steel - 20 mm	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Allow % for mild steel rebar	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Calculations														
Length (outside dimensions)	m	2.082	2.186	2.348	2.404	2.588	2.69	3.054	3.156	3.286	3.448	3.638	3.828	4.093
Width (outside dimensions)	m	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5

Drive Digital Lab Team

CALCULATION OF QUANTITIES: Connection between 2 Parallel Pipes

		FEEDER PIPE DIAMETER (m)												
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
SITE PREPARATION														
Clear and Strip Site (Provisional)														
Clear vegetation and trees of girth up to 2 m	m^2	25.92	27.49	29.41	30.80	32.97	34.71	38.14	40.01	42.12	44.49	47.13	49.84	53.20
Removal topsoil to nominal depth of 150mm, stockpile and maintain	m^2	25.92	27.49	29.41	30.80	32.97	34.71	38.14	40.01	42.12	44.49	47.13	49.84	53.20
EARTHWORKS														
Bulk Excavation														
Excavate in all materials, stockpile, maintain to be used for backfill / fill compacted to 95% Mod AASHTO or dispose within freehaul distance	m^3	7.87	9.05	10.57	11.68	13.51	15.01	18.14	19.88	21.88	24.20	26.85	29.63	33.15
Extra excavation in all materials to provide working space around structure, 600mm wide	m^2	12.55	13.46	14.54	15.31	16.46	17.37	19.06	19.97	20.96	22.04	23.21	24.38	25.78
CONCRETE (STRUCTURAL)														
Form work														
Vertical rough plane	m^2	12.55	13.46	14.54	15.31	16.46	17.37	19.06	19.97	20.96	22.04	23.21	24.38	25.78
Vertical Smooth plane	m^2	11.76	12.85	14.15	15.07	16.46	17.54	19.57	20.66	21.85	23.15	24.56	25.96	27.63
Smooth Horizontal plane	m^2	5.25	5.97	6.88	7.55	8.64	9.54	11.39	12.42	13.60	14.96	16.50	18.13	20.18
Vertical and horizontal narrow widths up to 300mm wide	m	8.76	9.37	10.10	10.61	11.38	11.98	13.11	13.71	14.37	15.10	15.88	16.66	17.59
Chamfers exceeding 20 mm x 20 mm grooves	m	8.76	9.37	10.10	10.61	11.38	11.98	13.11	13.71	14.37	15.10	15.88	16.66	17.59
Box out holes/form voids														
Larger, other than circular , of area over 0,1 m^2 upto and including 0,5 m^2														
Over and up to and including														
- 500 mm deep	No	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Casting/grout in of pipes														
0 - # nominal flange diameter	No	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
REINFORCEMENT														
Mild steel bars:														

University of Cape Town

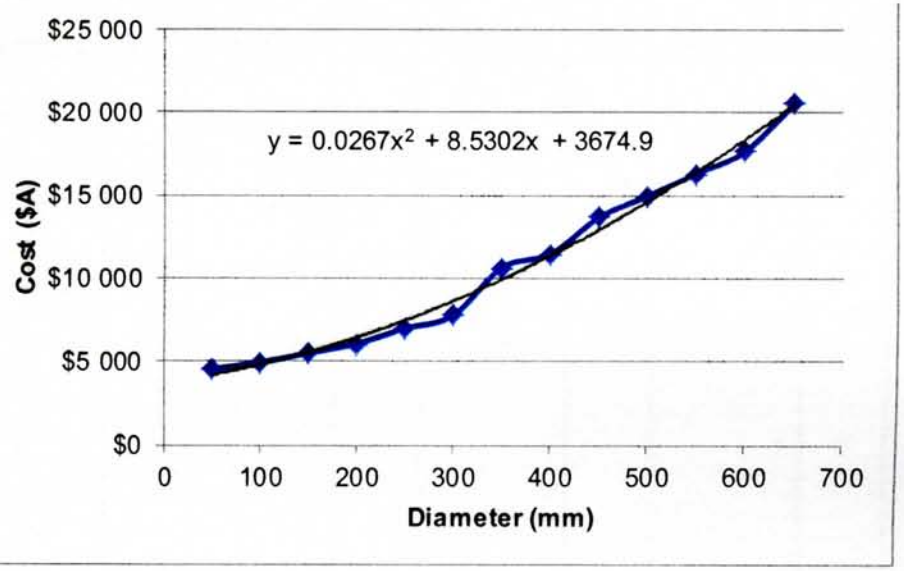
CALCULATION OF QUANTITIES: Connection between 2 Parallel Pipes
(CONTINUE)

		FEEDER PIPE DIAMETER (m)												
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
a) Diameter 25 mm; Basic price	t	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.18	0.19	0.21	0.23
Extra-over for item 2.8.1 for bars														
(Provisional Quantities)														
(1) 8 mmm	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
(2) 10mm	t	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.10	0.11	0.12	0.12	0.14
(3) 12 mm	t	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07
High-tensile steel bars:														
a) Diameter 25 mm; Basic price	t	0.48	0.53	0.60	0.65	0.73	0.80	0.93	1.00	1.08	1.17	1.28	1.39	1.52
Extra-over for item 2.8.2 for bars														
(Provisional Quantities)														
1) 10 mm	t	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15
2) 12 mm	t	0.29	0.32	0.36	0.39	0.44	0.48	0.56	0.60	0.65	0.70	0.77	0.83	0.91
3) 16 mm	t	0.14	0.16	0.18	0.20	0.22	0.24	0.28	0.30	0.32	0.35	0.38	0.42	0.46
4) 20 mm	t													
CONCRETE														
50 mm Blinding layer, Class (15/19)	m²	4.37	5.03	5.87	6.49	7.51	8.34	10.08	11.05	12.16	13.45	14.92	16.46	18.42
Strength Concrete, Class														
(35/19 MPa)														
Foundations, floorslabs and bases	m³	1.09	1.26	1.47	1.62	1.88	2.08	2.52	2.76	3.04	3.36	3.73	4.12	4.60
Wall, columns and beams	m³	1.84	1.99	2.17	2.30	2.49	2.65	2.93	3.08	3.24	3.42	3.62	3.81	4.05
Elevated floorslabs and elevated beams	m³	1.05	1.19	1.38	1.51	1.73	1.91	2.28	2.48	2.72	2.99	3.30	3.63	4.04
Unformed Surface Finishes														
Wood float finish	m²													
Steel float finish	m²	7.78	9.00	10.58	11.74	13.65	15.23	18.54	20.39	22.51	24.98	27.80	30.77	34.55
PIPE SPECIAL, PIPEWORK AND VALVES														
Mild Steel Pipe	m	5.03	5.16	5.48	5.54	5.85	6.06	6.53	6.83	7.15	7.46	7.76	8.06	8.67
RSV Valves	No	4	4	4	4	4	4	4	4	4	4	4	4	4
FlangeAdaptors	m	5	5	5	5	5	5	5	5	5	5	5	5	5
Flexible Couplings	No	4	4	4	4	4	4	4	4	4	4	4	4	4
Flanges	m	9	9	9	9	9	9	9	9	9	9	9	9	9

UNDER OBS OF REPAIR

SUMMARY: SPLIT TO TWO PARALLEL PIPES

Diameter	Cost 2010 (SAR)	Cost 2007 (SAR)	Cost 2003 (AUS$)
50	R 56 944.65	R 45 204.50	$4 520.45
100	R 62 042.87	R 49 251.63	$4 925.16
150	R 69 405.34	R 55 096.20	$5 509.62
200	R 76 330.41	R 60 593.54	$6 059.35
250	R 87 901.70	R 69 779.21	$6 977.92
300	R 97 943.05	R 77 750.35	$7 775.04
350	R 134 319.60	R 106 627.23	$10 662.72
400	R 144 803.96	R 114 950.05	$11 495.00
450	R 172 698.47	R 137 093.62	$13 709.36
500	R 188 961.51	R 150 003.74	$15 000.37
550	R 206 042.99	R 163 563.57	$16 356.36
600	R 223 215.25	R 177 195.46	$17 719.55
650	R 259 667.18	R 206 132.18	$20 613.22



University of Cape Town

COSTING: SPLIT TO TWO PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05		0.1		0.15		0.2		0.25		0.3	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
	SANS	**SECTION : CHAMBER**														
1.1	1200 D	SITE PREPARATION														
		Clear and Strip Site (Provisional)														
1.1.1	8.3.1	Clear vegetation and trees of girth up to 2 m	m^2	6.00	29	174.8613	30	178.1838	31	183.9786	31	186.6384	32	192.906	33	197.16
1.1.2	8.2.10	Removal topsoil to nominal depth of 150mm, stockpile and maintain	m^2	15.00	29	437.15325	30	445.4595	31	459.9465	31	466.596	32	482.265	33	492.9
	SANS															
1.2	1200 D	EARTHWORKS														
	8.3.2	*Bulk Excavation*														
1.2.1		Excavate in all materials, stockpile, maintain to be used for backfill / fill,	m^3	50.00	10	511.2495	11	533.547	11	571.599	12	590.436	13	632.61	13	662.
	8.3.3 (b)	*Extra-over excavations above for:*														
		(Provisional)														
1.2.2	8.3.5	Extra excavation in all materials to provide working space around	m^2		14	0	15	0	15	0	16	0	16	0	17	0
	SANS	CONCRETE (STRUCTURAL)														
1.3	1200 G															
		Form work														
1.3.1	8.2.1	Vertical rough plane	m^2	400.00	14	5785.2	15	5907.6	15	6124.8	16	6218.4	16	6448.8	17	6600
1.3.2	8.2.2	Vertical Smooth plane	m^2	600.00	14	8433.36	14	8653.68	15	9044.64	15	9213.12	16	9627.84	17	9900
1.3.3	8.2.2	Smooth Horizontal plane	m^2	600.00	7	4010.85	7	4171.74	7	4447.14	8	4582.08	8	4886.28	9	5100
1.3.4	8.2.5	Vertical and horizontal narrow widths up to 300mm wide	m	140.00	10	1405.88	10	1434.44	11	1485.12	11	1506.96	11	1560.72	11	1596
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00	10	1004.2	10	1024.6	11	1060.8	11	1076.4	11	1114.8	11	114
	8.2.6	*Box out holes/form voids*														
		Larger, other than circular , of area over 0,1 m^2 Over and up to and including -														
1.3.6		500 mm deep	No	340.00	3	1020	3	1020	3	1020	3	1020	3	1020	3	102
		Casting/grout in of pipes														
TOTAL CARRIED FORWARD TO NEXT PAGE						22 782.75		23 369.25		24 398.02		24 860.63		25 966.22		26 708.46

University of Cape Town

COSTING: SPLIT TO TWO PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05		0.1		0.15		0.2		0.25		0.3	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page				22 782.75		23 369.25		24 398.02		24 860.63		25 966.22		26 708.46
1.3.7		0 - # nominal flange diameter	No	2 400.00		7200	3	7200	3	7200	3	7200	3	7200	3	7200
1.4	8.3	REINFORCEMENT														
	8.3.1 (a)	*Mild steel bars:*														
1.4.1		a) Diameter 25 mm; Basic price	t	12 000.00		1062.1989	0.09	1098.177	0.10	1160.385	0.10	1189.827	0.10	1257.7702	0.11	1304.64
		Extra-over for item 2.8.1 for bars														
1.4.2		(1) 8 mmm	t	1 000.00		8.8516575	0.01	9.151479	0.01	9.669879	0.01	9.915228	0.01	10.481418	0.01	10.872
1.4.3		(2) 10mm	t	1 000.00		53.109945	0.05	54.90887	0.06	58.01927	0.06	59.49137	0.06	62.888508	0.07	65.232
1.4.4		(3) 12 mm	t	500.00		13.277486	0.03	13.72722	0.03	14.50482	0.03	14.87284	0.03	15.722127	0.03	16.308
	8.3.1 (b)	*High-tensile steel bars:*														
1.4.5		a) Diameter 25 mm; Basic price	t	12 000.00		7081.326	0.61	7321.183	0.64	7735.903	0.66	7932.182	0.70	8385.1344	0.72	8697.6
		Extra-over for item 2.8.2 for bars														
		(Provisional Quantities)														
1.4.6		1) 10 mm	t	1 000.00		59.01105	0.06	61.00986	0.06	64.46586	0.07	66.10152	0.07	69.87612	0.07	72.48
1.4.7		2) 12 mm	t	500.00		177.03315	0.37	183.0296	0.39	193.3976	0.40	198.3046	0.42	209.62836	0.43	217.44
1.4.8		3) 16 mm	t	500.00		88.516575	0.18	91.51479	0.19	96.69879	0.20	99.15228	0.21	104.81418	0.22	108.72
1.4.9		4) 20 mm	t	500.00		0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
1.5		CONCRETE														
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19)	m³	115.00		653.26325	6	681.7545	6	730.3765	7	754.446	7	808.335	7	846.4
		(Provisional Quantities)														
	8.4.3	*Strength Concrete, Class (35/19 MPa)*														
1.5.2		Foundations, floorslabs and bases	m³	2 000.00		2840.275	1.5	2964.15	1.6	3175.55	1.6	3280.2	1.8	3514.5	1.8	3680
1.5.3		Wall, columns and beams	m³	2 000.00		4321	2.2	4423	2.3	4604	2.3	4682	2.4	4874	2.5	5000
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00		2673.9	1.4	2781.16	1.5	2964.76	1.5	3054.72	1.6	3257.52	1.7	3400
	8.4.4	*Unformed Surface Finishes*														
1.5.5		Wood float finish	m²	18.00		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
1.5.6		Steel float finish	m²	35.00		357.168	10.7	373.4395	11.5	401.135	11.9	414.967	12.7	445.753	13.4	467.6
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**														
1.6.1		*Mild Steel Pipe*	m	See table		1068.96	4.2	1633.411	4.3	2650.45	4.3	3697.595	4.5	4363.06	4.6	5691.3
1.6.2		*RSV Valves*	No	See table		2204	2.0	3296	2.0	4668	2.0	7520	2.0	13080	2.0	17052
1.6.3		*FlangeAdaptors*	No	See table		1326	3.0	1896	3.0	2760	3.0	3444	3.0	3558	3.0	4482
1.6.4		*Flexible Couplings*	No	See table		1326	3.0	1896	3.0	2760	3.0	3444	3.0	3558	3.0	4482
1.6.5		*Flanges*	No	See table		1648	8.0	2696	8.0	3760	8.0	4408	8.0	7160	8.0	8440
TOTAL CARRIED FORWARD TO SUMMARY						56 944.65		62 042.87		69 405.34		76 330.41		87 901.70		97 943.05

University of Cape Town

COSTING: SPLIT TO TWO PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35		0.4		0.45		0.5		0.55		0.6		0.65	
					QTY	AMOUNT	QTY	QTY	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
	SANS	**SECTION : CHAMBER**																
1.1	1200 D	SITE PREPARATION																
		Clear and Strip Site (Provisional)																
1.1.1	8.3.1	Clear vegetation and trees of girth up to 2 m	m^2	6.00	34	206.4672	35	211.669	36	217.5531	37	223.872	38	230.7357	40	237.6864	41	248.6226
1.1.2	8.2.10	Removal topsoil to nominal depth of 150mm.	m^2	15.00	34	516.168	35	529.173	36	543.88275	37	559.68	38	576.83925	40	594.216	41	621.5565
	SANS																	
1.2	1200 D	EARTHWORKS																
	8.3.2	*Bulk Excavation*																
1.2.1		Excavate in all materials, stockpile, maintain to be	m^3	50.00	15	725.868	15	763.128	16	805.4865	17	851.4	18	901.7055	19	953.316	21	1033.659
	8.3.3 (b)	*Extra-over excavations above for:*																
		(Provisional)																
1.2.2	8.3.5	Extra excavation in all materials to provide working space around structure, 600mm wide	m^2		17	0	18	0	18	0	19	0	19	0	20	0	21	0
	SANS	CONCRETE (STRUCTURAL)																
1.3	1200 G																	
		Form work																
1.3.1	8.2.1	Vertical rough plane	m^2	400.00	17	6938.4	18	7119.6	18	7323.6	19	7540.8	19	7774.8	20	8008.8	21	8380.8
1.3.2	8.2.2	Vertical Smooth plane	m^2	600.00	18	10509.12	18	10835.2	19	11202.48	19	11593.44	20	12014.64	21	12435.84	22	13105.44
1.3.3	8.2.2	Smooth Horizontal plane	m^2	600.00	9	5556.96	10	5823.48	10	6126.27	11	6454.08	11	6812.85	12	7180.32	13	7753.14
1.3.4	8.2.5	Vertical and horizontal narrow widths up to	m	140.00	12	1674.96	12	1717.24	13	1764.84	13	1815.52	13	1870.12	14	1924.72	14	2011.52
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00	12	1196.4	12	1226.6	13	1260.6	13	1296.8	13	1335.8	14	1374.8	14	1436.8
	8.2.6	*Box out holes/form voids*																
1.3.6		Larger, other than circular , of area over 0.1 m^2 Over and up to and including 500 mm deep	No	340.00	3	1020	3	1020	3	1020	3	1020	3	1020	3	1020	3	1020
		Casting/grout in of pipes																
TOTAL CARRIED FORWARD TO NEXT PAGE						28 344.34		29 246.17		30 264.71		31 355.59		32 537.49		33 729.70		35 611.54

University of Cape Town

COSTING: SPLIT TO TWO PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35		0.4		0.45		0.5		0.55		0.6		0.65	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page				28 344.34		29 246.17		30 264.71		31 355.59		32 537.49		33 729.70		35 611.54
1.3.7		0 - # nominal flange diameter	No	2 400.00	3	7200	3	7200	3	7200	3	7200	3	7200	3	7200	3	7200
1.4	8.3	REINFORCEMENT																
1.4.1	8.3.1 (a)	*Mild steel bars:* a) Diameter 25 mm; Basic price	t	12 000.00	0.12	1406.0779	0.12	1463.9314	0.13	1529.5073	0.13	1600.2058	0.14	1677.2805	0.15	1755.7646	0.16	1878.6935
		Extra-over for item 2.8.1 for bars																
1.4.2		(1) 8 mmm	t	1 000.00	0.01	11.717316	0.01	12.199428	0.01	12.745895	0.01	13.335048	0.01	13.977338	0.01	14.631372	0.02	15.655779
1.4.3		(2) 10mm	t	1 000.00	0.07	70.303896	0.07	73.196568	0.08	76.475367	0.08	80.010288	0.08	83.864025	0.09	87.788232	0.09	93.934674
1.4.4		(3) 12 mm	t	500.00	0.04	17.575974	0.04	18.299142	0.04	19.118842	0.04	20.002572	0.04	20.966006	0.04	21.947058	0.05	23.483669
1.4.5	8.3.1 (b)	*High-tensile steel bars:* a) Diameter 25 mm; Basic price	t	12 000.00	0.78	9373.8528	0.81	9759.5424	0.85	10196.716	0.89	10668.038	0.93	11181.87	0.98	11705.098	1.04	12524.623
		Extra-over for item 2.8.2 for bars																
		(Provisional Quantities)																
1.4.6		1) 10 mm	t	1 000.00	0.08	78.11544	0.08	81.32952	0.08	84.97263	0.09	88.90032	0.09	93.18225	0.10	97.54248	0.10	104.37186
1.4.7		2) 12 mm	t	500.00	0.47	234.34632	0.49	243.98856	0.51	254.91789	0.53	266.70096	0.56	279.54675	0.59	292.62744	0.63	313.11558
1.4.8		3) 16 mm	t	500.00	0.23	117.17316	0.24	121.99428	0.25	127.45895	0.27	133.35048	0.28	139.77338	0.29	146.31372	0.31	156.55779
1.4.9		4) 20 mm	t	500.00	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
1.5		CONCRETE																
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19)	m³	115.00	8	927.498	8	975.108	9	1029.2328	9	1087.9	10	1152.1793	11	1218.126	11	1320.7865
		(Provisional Quantities)																
	8.4.3	*Strength Concrete, Class (35/19 MPa)*																
1.5.2		Foundations, floorslabs and bases	m³	2 000.00	2.0	4032.6	2.1	4239.6	2.2	4474.925	2.4	4730	2.5	5009.475	2.6	5296.2	2.9	5742.55
1.5.3		Wall, columns and beams	m³	2 000.00	2.6	5282	2.7	5433	2.8	5603	2.9	5784	3.0	5979	3.1	6174	3.2	6484
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00	1.9	3704.64	1.9	3882.32	2.0	4084.18	2.2	4302.72	2.3	4541.9	2.4	4786.88	2.6	5168.76
	8.4.4	*Unformed Surface Finishes*																
1.5.5		Wood float finish	m²	18.00	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
1.5.6		Steel float finish	m²	35.00	14.7	514.003	15.5	541.3975	16.4	572.558	17.3	606.368	18.4	643.447	19.5	681.541	21.2	740.775
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**																
1.6.1		*Mild Steel Pipe*	m	See table	4.8	6969.354	4.9	8163.88	5.1	9611.953	5.2	15084.388	5.4	16475.04	5.5	17919.092	5.9	20666.335
1.6.2		*RSV Valves*	No	See table	2.0	39824	2.0	43160	2.0	62484	2.0	64640	2.0	69948	2.0	75256	2.0	101930
1.6.3		*FlangeAdaptors*	No	See table	3.0	7590	3.0	8358	3.0	9096	3.0	10434	3.0	11217	3.0	12000	3.0	12918
1.6.4		*Flexible Couplings*	No	See table	3.0	7590	3.0	8358	3.0	9096	3.0	10434	3.0	11217	3.0	12000	3.0	12918
1.6.5		*Flanges*	No	See table	8.0	11032	8.0	13472	8.0	16880	8.0	20432	8.0	26632	8.0	32832	8.0	33856
TOTAL CARRIED FORWARD TO SUMMARY						134 319.60		144 803.96		172 698.47		188 961.51		206 042.99		223 215.25		259 667.18

University of Cape Town

Characteristics of Valve Chamber: SPLIT TO TWO PARALLEL PIPES

Input

Pipe Diameter	m	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.6
Distance between pipe and wall 1	m	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
Distance between pipe and wall 2	m	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Distance between parallel pipes	m	1	1	1	1	1	1	1	1	1	1	1	1	1
Distance between flange and walls	m	1	1	1	1	1	1	1	1	1	1	1	1	1
Length of Isolation valve	m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Length of T-Piece	m	0.209	0.254	0.28	0.317	0.356	0.38	0.47	0.47	0.48	0.51	0.555	0.6	0.605
Length of flange adaptor	m	0.36	0.36	0.46	0.46	0.56	0.61	0.71	0.81	0.92	1.02	1.12	1.22	1.475
Depth (bottom of floor to top of wall)	m	0.102	0.109	0.114	0.105	0.108	0.11	0.152	0.153	0.153	0.154	0.154	0.154	0.154
Depth (NGL to bottom of floor)	m	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Floor thickness	m	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Wall thickness	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Roof thickness	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Roof overhang	m	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Thickness of blinding layer	m	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Site Clearance extra length	m	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Site Clearance extra width	m	3	3	3	3	3	3	3	3	3	3	3	3	3
High Tensile steel	kg/m^3	3	3	3	3	3	3	3	3	3	3	3	3	3
High Tensile steel - 8 mm	%	120	120	120	120	120	120	120	120	120	120	120	120	120
High Tensile steel - 10 mm	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
High Tensile steel - 12 mm	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
High Tensile steel - 16 mm	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
High Tensile steel - 20 mm	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Allow % for mild steel rebar	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Calculations		15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Length (outside dimensions)	m													
Width (outside dimensions)	m	2.771	2.823	2.954	2.982	3.124	3.2	3.432	3.533	3.653	3.784	3.929	4.074	4.334

University of Cape Town

CALCULATION OF QUANTITIES: SPLIT TO TWO PARALLEL PIPES

		FEEDER PIPE DIAMETER (m)												
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
SITE PREPARATION														
Clear and Strip Site (Provisional)														
Clear vegetation and trees of girth up to 2 m	m^2	29.14	29.7	30.66	31.11	32.15	32.9	34.41	35.28	36.26	37.31	38.46	39.61	41.44
Removal topsoil to nominal depth of 150mm, stockpile and maintain	m^2	29.14	29.7	30.66	31.11	32.15	32.9	34.41	35.28	36.26	37.31	38.46	39.61	41.44
EARTHWORKS														
Bulk Excavation														
Excavate in all materials, stockpile, maintain to be used for backfill / fill compacted to 95%	m^3	10.22	10.67	11.43	11.81	12.65	13.2	14.52	15.26	16.11	17.03	18.03	19.07	20.67
Extra excavation in all materials to provide working space around structure, 600mm wide	m^2	14.46	14.77	15.31	15.55	16.12	16.5	17.35	17.8	18.31	18.85	19.44	20.02	20.95
CONCRETE (STRUCTURAL)														
Form work														
Vertical rough plane	m^2	14.46	14.77	15.31	15.55	16.12	16.5	17.35	17.8	18.31	18.85	19.44	20.02	20.95
Vertical Smooth plane	m^2	14.06	14.42	15.07	15.36	16.05	16.5	17.52	18.06	18.67	19.32	20.02	20.73	21.84
Smooth Horizontal plane	m^2	6.685	6.953	7.412	7.637	8.144	8.5	9.262	9.706	10.21	10.76	11.35	11.97	12.92
Vertical and horizontal narrow widths up to 300mm wide	m	10.04	10.25	10.61	10.76	11.15	11.4	11.96	12.27	12.61	12.97	13.36	13.75	14.37
Chamfers exceeding 20 mm x 20 mm grooves	m	10.04	10.25	10.61	10.76	11.15	11.4	11.96	12.27	12.61	12.97	13.36	13.75	14.37
Box out holes/form voids														
Larger, other than circular , of area over 0,1 m^2 upto and including 0,5 m^2														
Over and up to and including														
- 500 mm deep	No	3	3	3	3	3	3	3	3	3	3	3	3	3
Casting/grout in of pipes														
0 - # nominal flange diameter	No	3	3	3	3	3	3	3	3	3	3	3	3	3
REINFORCEMENT														
Mild steel bars:														

University of Cape Town

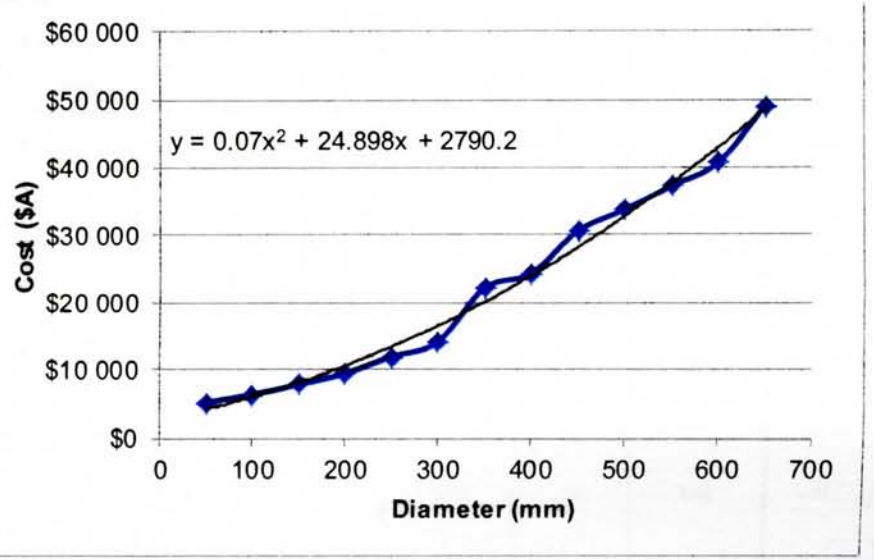
CALCULATION OF QUANTITIES: SPLIT TO TWO PARALLEL PIPES (CONTINUE)

		FEEDER PIPE DIAMETER (m)												
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
a) Diameter 25 mm; Basic price	t	0.089	0.092	0.097	0.099	0.105	0.11	0.117	0.122	0.127	0.133	0.14	0.146	0.157
Extra-over for item 2.8.1 for bars														
(Provisional Quantities)														
(1) 8 mmm	t	0.009	0.009	0.01	0.01	0.01	0.01	0.012	0.012	0.013	0.013	0.014	0.015	0.016
(2) 10mm	t	0.053	0.055	0.058	0.059	0.063	0.07	0.07	0.073	0.076	0.08	0.084	0.088	0.094
(3) 12 mm	t	0.027	0.027	0.029	0.03	0.031	0.03	0.035	0.037	0.038	0.04	0.042	0.044	0.047
High-tensile steel bars:														
a) Diameter 25 mm; Basic price	t	0.59	0.61	0.645	0.661	0.699	0.72	0.781	0.813	0.85	0.889	0.932	0.975	1.044
Extra-over for item 2.8.2 for bars														
(Provisional Quantities)														
1) 10 mm	t	0.059	0.061	0.064	0.066	0.07	0.07	0.078	0.081	0.085	0.089	0.093	0.098	0.104
2) 12 mm	t	0.354	0.366	0.387	0.397	0.419	0.43	0.469	0.488	0.51	0.533	0.559	0.585	0.626
3) 16 mm	t	0.177	0.183	0.193	0.198	0.21	0.22	0.234	0.244	0.255	0.267	0.28	0.293	0.313
4) 20 mm	t													
CONCRETE														
50 mm Blinding layer, Class (15/19)	m^2	5.681	5.928	6.351	6.56	7.029	7.36	8.065	8.479	8.95	9.46	10.02	10.59	11.49
Strength Concrete, Class														
(35/19 MPa)														
Foundations, floorslabs and bases	m^3	1.42	1.482	1.588	1.64	1.757	1.84	2.016	2.12	2.237	2.365	2.505	2.648	2.871
Wall, columns and beams	m^3	2.161	2.212	2.302	2.341	2.437	2.5	2.641	2.717	2.802	2.892	2.99	3.087	3.242
Elevated floorslabs and elevated beams	m^3	1.337	1.391	1.482	1.527	1.629	1.7	1.852	1.941	2.042	2.151	2.271	2.393	2.584
Unformed Surface Finishes														
Wood float finish	m^2													
Steel float finish	m^2	10.2	10.67	11.46	11.86	12.74	13.4	14.69	15.47	16.36	17.32	18.38	19.47	21.17
PIPE SPECIAL, PIPEWORK AND VALVES														
Mild Steel Pipe	m													
RSV Valves	No	4.192	4.199	4.354	4.345	4.498	4.58	4.767	4.918	5.083	5.234	5.384	5.534	5.917
FlangeAdaptors	m	2	2	2	2	2	2	2	2	2	2	2	2	2
Flexible Couplings	No	3	3	3	3	3	3	3	3	3	3	3	3	3
Flanges	m	3	3	3	3	3	3	3	3	3	3	3	3	3

UNDER PEER REVIEW

SUMMARY: 3 PIPE INTERCONNECTION

Diameter	Cost 2010 (SAR)	Cost 2007 (SAR)	Cost 2003 (AUS$)
50	R 66 085.09	R 52 460.48	$5 246.05
100	R 80 413.97	R 63 835.20	$6 383.52
150	R 99 070.76	R 78 645.57	$7 864.56
200	R 119 152.85	R 94 587.38	$9 458.74
250	R 150 030.08	R 119 098.72	$11 909.87
300	R 177 694.60	R 141 059.70	$14 105.97
350	R 279 430.50	R 221 820.94	$22 182.09
400	R 307 002.38	R 243 708.39	$24 370.84
450	R 385 458.99	R 305 989.77	$30 598.98
500	R 425 595.36	R 337 851.32	$33 785.13
550	R 469 048.28	R 372 345.64	$37 234.56
600	R 513 022.03	R 407 253.43	$40 725.34
650	R 617 618.08	R 490 285.15	$49 028.51



University of Cape Town

COSTING: 3 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05 QTY	0.05 AMOUNT	0.1 QTY	0.1 AMOUNT	0.15 QTY	0.15 AMOUNT	0.2 QTY	0.2 AMOUNT	0.25 QTY	0.25 AMOUNT	0.3 QTY	0.3 AMOUNT
	SANS	**SECTION : CHAMBER**														
1.1	1200 D	SITE PREPARATION *Clear and Strip Site (Provisional)*														
1.1.1	8.3.1	Clear vegetation and trees of girth up to 2 m	m^2	6.00	29	172.28	31	186.70	34	203.76	36	217.24	39	236.37	42	252.64
1.1.2	8.2.10 SANS	Removal topsoil to nominal depth of 150mm, stockpile	m^2	15.00	29	430.70	31	466.74	34	509.40	36	543.10	39	590.93	42	631.59
1.2	1200 D	EARTHWORKS														
1.2.1	8.3.2 8.3.3 (b)	*Bulk Excavation* Excavate in all materials, stockpile, maintain to be *Extra-over excavations above for:*	m^3	50.00	10	496.56	12	590.22	14	707.92	16	800.53	19	943.33	21	1 065.24
1.2.2	8.3.5 SANS	*(Provisional)* Extra excavation in all materials to provide CONCRETE (STRUCTURAL)	m^2		14	0.00	16	0.00	17	0.00	18	0.00	20	0.00	21	0.00
1.3	1200 G	Form work														
1.3.1	8.2.1	Vertical rough plane	m^2	400.00	14	5 678.40	16	6 223.20	17	6 837.60	18	7 324.80	20	7 965.60	21	8 508.00
1.3.2	8.2.2	Vertical Smooth plane	m^2	600.00	14	8 241.12	15	9 221.76	17	10 327.68	19	11 204.64	21	12 358.08	22	13 334.40
1.3.3	8.2.2	Smooth Horizontal plane	m^2	600.00	7	3 902.22	8	4 581.12	9	5 427.24	10	6 093.36	12	7 109.40	13	7 976.40
1.3.4	8.2.5	Vertical and horizontal narrow widths up to 300mm	m	140.00	10	1 380.96	11	1 508.08	12	1 651.44	13	1 765.12	14	1 914.64	15	2 041.20
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00	10	986.40	11	1 077.20	12	1 179.60	13	1 260.80	14	1 367.60	15	1 458.00
	8.2.6	*Box out holes/form voids*														
1.3.6		Larger, other than circular , of area over 0.1 m^2 Over and up to and including 500 mm deep	No	340.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00
		Casting/grout in of pipes														
TOTAL CARRIED FORWARD TO NEXT PAGE						22 308.64		24 875.02		27 864.64		30 229.59		33 505.95		36 287.4

University of Cape Town

COSTING: 3 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05		0.1		0.15		0.2		0.25		0.3	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page				22 308.64		24 875.02		27 864.64		30 229.59		33 505.95		36 287.47
1.3.7		0 - # nominal flange diameter	No	2 400.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00
1.4	8.3	REINFORCEMENT														
	8.3.1 (a)	*Mild steel bars:*														
1.4.1		a) Diameter 25 mm; Basic price	t	12 000.00	0.09	1 035.95	0.10	1 190.06	0.11	1 376.90	0.13	1 524.27	0.15	1 740.78	0.16	1 925.16
		Extra-over for item 2.8.1 for bars														
1.4.2		(1) 8 mmm	t	1 000.00	0.01	8.63	0.01	9.92	0.01	11.47	0.01	12.70	0.01	14.51	0.02	16.04
1.4.3		(2) 10mm	t	1 000.00	0.05	51.80	0.06	59.50	0.07	68.84	0.08	76.21	0.09	87.04	0.10	96.26
1.4.4		(3) 12 mm	t	500.00	0.03	12.95	0.03	14.88	0.03	17.21	0.04	19.05	0.04	21.76	0.05	24.06
	8.3.1 (b)	*High-tensile steel bars:*														
1.4.5		a) Diameter 25 mm; Basic price	t	12 000.00	0.58	6 906.33	0.66	7 933.74	0.76	9 179.32	0.85	10 161.82	0.97	11 605.18	1.07	12 834.43
		Extra-over for item 2.8.2 for bars														
		(Provisional Quantities)														
1.4.6		1) 10 mm	t	1 000.00	0.06	57.55	0.07	66.11	0.08	76.49	0.08	84.68	0.10	96.71	0.11	106.95
1.4.7		2) 12 mm	t	500.00	0.35	172.66	0.40	198.34	0.46	229.48	0.51	254.05	0.58	290.13	0.64	320.86
1.4.8		3) 16 mm	t	500.00	0.17	86.33	0.20	99.17	0.23	114.74	0.25	127.02	0.29	145.06	0.32	160.43
1.4.9		4) 20 mm	t	500.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5		CONCRETE														
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19)	m²	115.00	6	634.49	7	754.17	8	904.57	9	1 022.90	10	1 205.36	12	1 361.14
		(Provisional Quantities)														
	8.4.3	*Strength Concrete, Class (35/19 MPa)*														
1.5.2		Foundations, floorslabs and bases	m³	2 000.00	1.4	2 758.65	1.6	3 279.00	2.0	3 932.90	2.2	4 447.40	2.6	5 240.70	3.0	5 918.00
1.5.3		Wall, columns and beams	m³	2 000.00	2.1	4 232.00	2.3	4 686.00	2.6	5 198.00	2.8	5 604.00	3.1	6 138.00	3.3	6 590.00
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00	1.3	2 601.48	1.5	3 054.08	1.8	3 618.16	2.0	4 062.24	2.4	4 739.60	2.7	5 317.60
	8.4.4	*Unformed Surface Finishes*														
1.5.5		Wood float finish	m²	18.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
1.5.6		Steel float finish	m²	35.00	9.9	346.68	11.9	414.76	14.3	500.93	16.2	568.69	19.3	674.15	21.8	764.23
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**														
1.6.1		*Mild Steel Pipe*	m	See table	7.8	1 986.96	8.0	3 125.23	8.7	5 313.10	8.7	7 412.21	9.2	8 951.16	9.6	11 929.96
1.6.2		*RSV Valves*	No	See table	6.0	6 612.00	6.0	9 888.00	6.0	14 004.00	6.0	22 560.00	6.0	39 240.00	6.0	51 156.00
1.6.3		*FlangeAdaptors*	No	See table	8.0	3 536.00	8.0	5 056.00	8.0	7 360.00	8.0	9 184.00	8.0	9 488.00	8.0	11 952.00
1.6.4		*Flexible Couplings*	No	See table	6.0	2 652.00	6.0	3 792.00	6.0	5 520.00	6.0	6 888.00	6.0	7 116.00	6.0	8 964.00
1.6.5		*Flanges*	No	See table	14.0	2 884.00	14.0	4 718.00	14.0	6 580.00	14.0	7 714.00	14.0	12 530.00	14.0	14 770.00
TOTAL CARRIED FORWARD TO SUMMARY						66 085.09		80 413.97		99 070.76		119 152.85		150 030.08		177 694.60

UNIVERSITY OF CAPE TOWN

COSTING: 3 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35 QTY	0.35 AMOUNT	0.4 QTY	0.4 QTY	0.45 QTY	0.45 AMOUNT	0.5 QTY	0.5 AMOUNT	0.55 QTY	0.55 AMOUNT	0.6 QTY	0.6 AMOUNT	0.65 QTY	0.65 AMOUNT
	SANS	**SECTION : CHAMBER**																
1.1	1200 D	SITE PREPARATION																
		Clear and Strip Site (Provisional)																
1.1.1	8.3.1	Clear vegetation and trees of girth up to 2 m	m^2	6.00	47	281.51	50	299.18	53	318.70	57	340.45	61	364.43	65	389.20	70	419.20
1.1.2	8.2.10 SANS	Removal topsoil to nominal depth of 150mm,	m^2	15.00	47	703.78	50	747.95	53	796.75	57	851.14	61	911.07	65	972.99	70	1 047.99
1.2	1200 D	EARTHWORKS																
1.2.1	8.3.2	*Bulk Excavation* Excavate in all materials, stockpile, maintain to be	m^3	50.00	26	1 305.59	29	1 448.60	32	1 611.78	36	1 799.86	40	2 013.63	45	2 239.38	50	2 523.3
	8.3.3 (b)	*Extra-over excavations above for:*																
		(Provisional)																
1.2.2	8.3.5 SANS	Extra excavation in all materials to provide	m^2		23	0.00	25	0.00	26	0.00	28	0.00	29	0.00	31	0.00	33	0.0
1.3	1200 G	CONCRETE (STRUCTURAL)																
		Form work																
1.3.1	8.2.1	Vertical rough plane	m^2	400.00	23	9 364.80	25	9 907.20	26	10 483.20	28	11 097.60	29	11 745.60	31	12 393.60	33	13 131.60
1.3.2	8.2.2	Vertical Smooth plane	m^2	600.00	25	14 876.64	26	15 852.96	28	16 889.76	30	17 995.68	32	19 162.08	34	20 328.48	36	21 656.88
1.3.3	8.2.2	Smooth Horizontal plane	m^2	600.00	16	9 664.38	18	10 672.08	20	11 817.54	22	13 132.80	24	14 622.78	27	16 192.56	30	18 159.35
1.3.4	8.2.5	Vertical and horizontal narrow widths up to	m	140.00	16	2 241.12	17	2 367.68	18	2 502.08	19	2 645.44	20	2 796.64	21	2 947.84	22	3 120.04
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00	16	1 600.80	17	1 691.20	18	1 787.20	19	1 889.60	20	1 997.60	21	2 105.60	22	2 228.60
	8.2.6	*Box out holes/form voids*																
		Larger, other than circular , of area over 0.1 m^2 Over and up to and including -																
1.3.6		500 mm deep	No	340.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00	3	1 020.00
		Casting/grout in of pipes																
TOTAL CARRIED FORWARD TO NEXT PAGE						41 058.61		44 006.86		47 227.01		50 772.57		54 633.82		58 589.65		63 307.03

University of Cape Town

COSTING: 3 PIPE INTERCONNECTION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35		0.4		0.45		0.5		0.55		0.6		0.65	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page				41 058.61		44 006.86		47 227.01		50 772.57		54 633.82		58 589.65		63 307.03
1.3.7		0 - # nominal flange diameter	No	2 400.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00	3	7 200.00
1.4	8.3	REINFORCEMENT																
1.4.1	8.3.1 (a)	*Mild steel bars:* a) Diameter 25 mm; Basic price	t	12 000.00	0.19	2 268.02	0.21	2 475.20	0.23	2 707.42	0.25	2 970.26	0.27	3 264.12	0.30	3 570.92	0.33	3 949.32
1.4.2		*Extra-over for item 2.8.1 for bars* (1) 8 mmm	t	1 000.00	0.02	18.90	0.02	20.63	0.02	22.56	0.02	24.75	0.03	27.20	0.03	29.76	0.03	32.91
1.4.3		(2) 10mm	t	1 000.00	0.11	113.40	0.12	123.76	0.14	135.37	0.15	148.51	0.16	163.21	0.18	178.55	0.20	197.47
1.4.4		(3) 12 mm	t	500.00	0.06	28.35	0.06	30.94	0.07	33.84	0.07	37.13	0.08	40.80	0.08	44.64	0.10	49.37
1.4.5	8.3.1 (b)	*High-tensile steel bars:* a) Diameter 25 mm; Basic price	t	12 000.00	1.26	15 120.12	1.38	16 501.33	1.50	18 049.47	1.65	19 801.73	1.81	21 760.83	1.98	23 806.11	2.19	26 328.81
		Extra-over for item 2.8.2 for bars (Provisional Quantities)																
1.4.6		1) 10 mm	t	1 000.00	0.13	126.00	0.14	137.51	0.15	150.41	0.17	165.01	0.18	181.34	0.20	198.38	0.22	219.41
1.4.7		2) 12 mm	t	500.00	0.76	378.00	0.83	412.53	0.90	451.24	0.99	495.04	1.09	544.02	1.10	595.15	1.32	658.22
1.4.8		3) 16 mm	t	500.00	0.38	189.00	0.41	206.27	0.45	225.62	0.50	247.52	0.54	272.01	0.60	297.58	0.66	329.11
1.4.9		4) 20 mm	t	500.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5		CONCRETE																
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19) (Provisional Quantities)	m²	115.00	15	1 668.25	16	1 850.99	18	2 059.50	20	2 299.82	22	2 572.98	25	2 861.43	28	3 224.26
	8.4.3	*Strength Concrete, Class (35/19 MPa)*																
1.5.2		Foundations, floorslabs and bases	m³	2 000.00	3.6	7 253.25	4.0	8 047.80	4.5	8 954.35	5.0	9 999.20	5.6	11 186.85	6.2	12 441.00	7.0	14 018.53
1.5.3		Wall, columns and beams	m³	2 000.00	3.7	7 304.00	3.9	7 756.00	4.1	8 236.00	4.4	8 748.00	4.6	9 288.00	4.9	9 828.00	5.2	10 443.00
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00	3.2	6 442.92	3.6	7 114.72	3.9	7 878.36	4.4	8 755.20	4.9	9 748.52	5.4	10 795.04	6.1	12 106.26
	8.4.4	*Unformed Surface Finishes*																
1.5.5		Wood float finish	m²	18.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
1.5.6		Steel float finish	m²	35.00	27.0	943.66	30.0	1 050.15	33.5	1 172.03	37.5	1 312.93	42.1	1 473.54	47.0	1 643.45	53.1	1 857.84
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**																
1.6.1		*Mild Steel Pipe*	m	See table	10.3	15 120.00	10.8	18 007.68	11.4	21 515.80	11.9	34 249.69	12.4	37 895.04	12.9	41 718.39	13.8	48 374.56
1.6.2		*RSV Valves*	No	See table	6.0	119 472.00	6.0	129 480.00	6.0	187 452.00	6.0	193 920.00	6.0	209 844.00	6.0	225 768.00	6.0	305 790.00
1.6.3		*FlangeAdaptors*	No	See table	8.0	20 240.00	8.0	22 288.00	8.0	24 256.00	8.0	27 824.00	8.0	29 912.00	8.0	32 000.00	8.0	34 448.00
1.6.4		*Flexible Couplings*	No	See table	6.0	15 180.00	6.0	16 716.00	6.0	18 192.00	6.0	20 868.00	6.0	22 434.00	6.0	24 000.00	6.0	25 836.00
1.6.5		*Flanges*	No	See table	14.0	19 306.00	14.0	23 576.00	14.0	29 540.00	14.0	35 756.00	14.0	46 606.00	14.0	57 456.00	14.0	59 248.00
TOTAL CARRIED FORWARD TO SUMMARY						279 430.50		307 002.38		385 458.99		425 595.36		469 048.28		513 022.03		617 618.08

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Characteristics of Valve Chamber: 3 PIPE INTERCONNECTION

Input

Pipe Diameter	m	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
Distance between pipe and wall 1	m	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Distance between pipe and wall 2	m	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Distance between parallel pipes	m	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7
Distance between flange and walls	m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Length of Isolation valve	m	0.209	0.254	0.28	0.317	0.356	0.38	0.47	0.47	0.48	0.51	0.555	0.6	0.605
Length of T-Piece	m	0.36	0.36	0.46	0.46	0.56	0.61	0.71	0.81	0.92	1.02	1.12	1.22	1.475
Length of flange adaptor	m	0.102	0.109	0.114	0.105	0.108	0.11	0.152	0.153	0.153	0.154	0.154	0.154	0.154
Depth (bottom of floor to top of wall)	m	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Depth (NGL to bottom of floor)	m	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Floor thickness	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Wall thickness	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Roof thickness	m	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Roof overhang	m	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Thickness of blinding layer	m	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Site Clearance extra length	m	3	3	3	3	3	3	3	3	3	3	3	3	3
Site Clearance extra width	m	3	3	3	3	3	3	3	3	3	3	3	3	3
High Tensile steel	kg/m^3	120	120	120	120	120	120	120	120	120	120	120	120	120
High Tensile steel - 8 mm	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
High Tensile steel - 10 mm	%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
High Tensile steel - 12 mm	%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
High Tensile steel - 16 mm	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
High Tensile steel - 20 mm	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Allow % for mild steel rebar	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Calculations														
Length (outside dimensions)	m	2.082	2.186	2.348	2.404	2.588	2.69	3.054	3.156	3.286	3.448	3.638	3.828	4.093
Width (outside dimensions)	m	2.65	3	3.35	3.7	4.05	4.4	4.75	5.1	5.45	5.8	6.15	6.5	6.85

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CALCULATION OF QUANTITIES: 3 PIPE INTERCONNECTION

		FEEDER PIPE DIAMETER (m)												
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
SITE PREPARATION														
Clear and Strip Site (Provisional)														
Clear vegetation and trees of girth up to 2 m	m^2	28.71	31.12	33.96	36.21	39.40	42.11	46.92	49.86	53.12	56.74	60.74	64.87	69.87
Removal topsoil to nominal depth of 150mm, stockpile and maintain	m^2	28.71	31.12	33.96	36.21	39.40	42.11	46.92	49.86	53.12	56.74	60.74	64.87	69.87
EARTHWORKS														
Bulk Excavation														
Excavate in all materials, stockpile, maintain to be used for backfill / fill compacted to 95%	m^3	9.93	11.80	14.16	16.01	18.87	21.30	26.11	28.97	32.24	36.00	40.27	44.79	50.47
Extra excavation in all materials to provide working space around structure, 600mm wide	m^2	14.20	15.56	17.09	18.31	19.91	21.27	23.41	24.77	26.21	27.74	29.36	30.98	32.83
CONCRETE (STRUCTURAL)														
Form work														
Vertical rough plane	m^2	14.20	15.56	17.09	18.31	19.91	21.27	23.41	24.77	26.21	27.74	29.36	30.98	32.83
Vertical Smooth plane	m^2	13.74	15.37	17.21	18.67	20.60	22.22	24.79	26.42	28.15	29.99	31.94	33.88	36.09
Smooth Horizontal plane	m^2	6.50	7.64	9.05	10.16	11.85	13.29	16.11	17.79	19.70	21.89	24.37	26.99	30.27
Vertical and horizontal narrow widths up to 300mm wide	m	9.86	10.77	11.80	12.61	13.68	14.58	16.01	16.91	17.87	18.90	19.98	21.06	22.29
Chamfers exceeding 20 mm x 20 mm grooves	m	9.86	10.77	11.80	12.61	13.68	14.58	16.01	16.91	17.87	18.90	19.98	21.06	22.29
Box out holes/form voids														
Larger, other than circular , of area over 0,1 m^2 upto and including 0,5 m^2														
Over and up to and including														
- 500 mm deep	No	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Casting/grout in of pipes														
0 - # nominal flange diameter	No	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
REINFORCEMENT														
Mild steel bars:														

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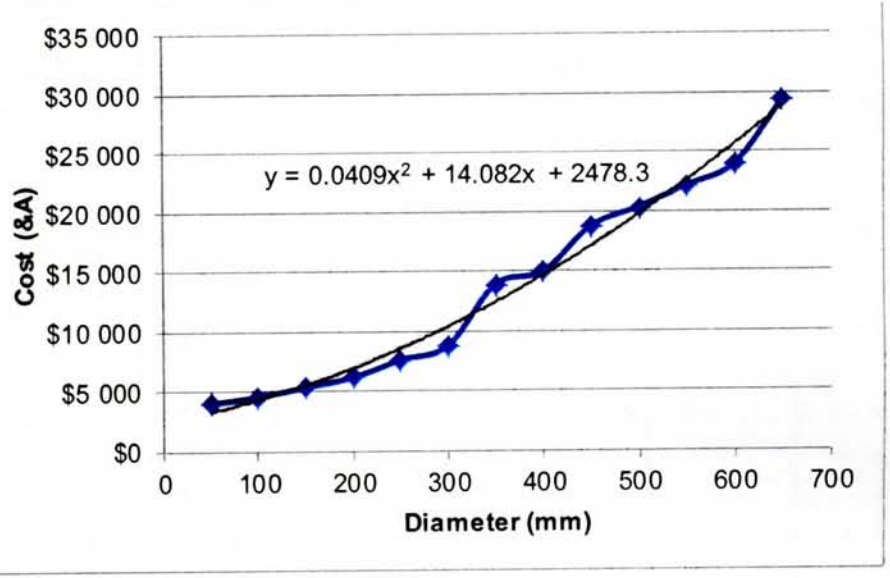
CALCULATION OF QUANTITIES: 3 PIPE INTERCONNECTION (CONTINUE)

		FEEDER PIPE DIAMETER (m)												
		0.05	**0.1**	**0.15**	**0.2**	**0.25**	**0.3**	**0.35**	**0.4**	**0.45**	**0.5**	**0.55**	**0.6**	**0.65**
a) Diameter 25 mm; Basic price	t	0.09	0.10	0.11	0.13	0.15	0.16	0.19	0.21	0.23	0.25	0.27	0.30	0.33
Extra-over for item 2.8.1 for bars														
(Provisional Quantities)														
(1) 8 mmm	t	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
(2) 10mm	t	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.18	0.20
(3) 12 mm	t	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.10
High-tensile steel bars:														
a) Diameter 25 mm; Basic price	t	0.58	0.66	0.76	0.85	0.97	1.07	1.26	1.38	1.50	1.65	1.81	1.98	2.19
Extra-over for item 2.8.2 for bars														
(Provisional Quantities)														
1) 10 mm	t	0.06	0.07	0.08	0.08	0.10	0.11	0.13	0.14	0.15	0.17	0.18	0.20	0.22
2) 12 mm	t	0.35	0.40	0.46	0.51	0.58	0.64	0.76	0.83	0.90	0.99	1.09	1.19	1.32
3) 16 mm	t	0.17	0.20	0.23	0.25	0.29	0.32	0.38	0.41	0.45	0.50	0.54	0.60	0.66
4) 20 mm	t													
CONCRETE														
50 mm Blinding layer, Class (15/19)	m^2	5.52	6.56	7.87	8.89	10.48	11.84	14.51	16.10	17.91	20.00	22.37	24.88	28.04
Strength Concrete, Class														
(35/19 MPa)														
Foundations, floorslabs and bases	m^3	1.38	1.64	1.97	2.22	2.62	2.96	3.63	4.02	4.48	5.00	5.59	6.22	7.01
Wall, columns and beams	m^3	2.12	2.34	2.60	2.80	3.07	3.30	3.65	3.88	4.12	4.37	4.64	4.91	5.22
Elevated floorslabs and elevated beams	m^3	1.30	1.53	1.81	2.03	2.37	2.66	3.22	3.56	3.94	4.38	4.87	5.40	6.05
Unformed Surface Finishes														
Wood float finish	m^2													
Steel float finish	m^2	9.91	11.85	14.31	16.25	19.26	21.84	26.96	30.00	33.49	37.51	42.10	46.96	53.08
PIPE SPECIAL, PIPEWORK AND VALVES														
Mild Steel Pipe	m	7.79	8.03	8.56	8.71	9.23	9.59	10.34	10.85	11.38	11.88	12.38	12.88	13.85
RSV Valves	No	6	6	6	6	6	6	6	6	6	6	6	6	6
FlangeAdaptors	m	8	8	8	8	8	8	8	8	8	8	8	8	8
Flexible Couplings	No	6	6	6	6	6	6	6	6	6	6	6	6	6
Flanges	m	14	14	14	14	14	14	14	14	14	14	14	14	14

UNDER RESTRICTED USE

SUMMARY: SPLIT TO THREE PARALLEL PIPES

Diameter	Cost 2010 (SAR)	Cost 2007 (SAR)	Cost 2003 (AUS$)
50	R 50 232.38	R 39 876.08	$3 987.61
100	R 57 161.21	R 45 376.41	$4 537.64
150	R 67 292.07	R 53 418.62	$5 341.86
200	R 77 488.11	R 61 512.56	$6 151.26
250	R 95 503.54	R 75 813.79	$7 581.38
300	R 110 266.35	R 87 532.98	$8 753.30
350	R 175 006.89	R 138 926.12	$13 892.61
400	R 188 881.46	R 149 940.19	$14 994.02
450	R 236 312.62	R 187 592.58	$18 759.26
500	R 256 442.62	R 203 572.42	$20 357.24
550	R 279 334.96	R 221 745.10	$22 174.51
600	R 302 484.63	R 240 122.05	$24 012.21
650	R 370 377.05	R 294 017.24	$29 401.72



University of Cape Town

COSTING: SPLIT TO THREE PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05		0.1		0.15		0.2		0.25		0.3	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
	SANS	**SECTION : CHAMBER**														
1.1	1200 D	SITE PREPARATION														
		Clear and Strip Site (Provisional)														
1.1.1	8.3.1	Clear vegetation and trees of girth up to 2 m	m^2	6.00	25	151.8502	26	157.9759	28	167.9486	29	171.8148	31	183.73344	32	190.5012
1.1.2	8.2.10 SANS	Removal topsoil to nominal depth of 150mm, stockpile and maintain	m^2	15.00	25	379.6254	26	394.9398	28	419.8715	29	429.5369	31	459.3336	32	476.253
1.2	1200 D	EARTHWORKS														
	8.3.2	*Bulk Excavation*														
1.2.1		Excavate in all materials, stockpile, maintain to be used for backfill / fill,	m^3	50.00	7	371.0124	8	408.629	9	472.0889	10	497.4116	12	577.6416	12	624.618
	8.3.3 (b)	*Extra-over excavations above for:*														
		(Provisional)														
1.2.2	8.3.5	Extra excavation in all materials to provide working space around	m^2		12	0	13	0	14	0	14	0	15	0	16	0
	SANS	CONCRETE (STRUCTURAL)														
1.3	1200 G															
		Form work			12	4874.4	13	5115.6	14	5498.4	14	5643.6	15	6081.6	16	6324
1.3.1	8.2.1	Vertical rough plane	m^2	400.00	11	6793.92	12	7228.08	13	7917.12	14	8178.48	15	8966.88	16	9403.2
1.3.2	8.2.2	Vertical Smooth plane	m^2	600.00	5	2984.856	5	3259.753	6	3721.099	7	3904.438	7	4483.104	8	4820.52
1.3.3	8.2.2	Smooth Horizontal plane	m^2	600.00	9	1193.36	9	1249.64	10	1338.96	10	1372.84	11	1475.04	11	1531.6
1.3.4	8.2.5	Vertical and horizontal narrow widths up to 300mm wide	m	140.00	9	852.4	9	892.6	10	956.4	10	980.6	11	1053.6	11	1094
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00												
	8.2.6	*Box out holes/form voids*														
1.3.6		Larger, other than circular , of area over 0.1 m^2 Over and up to and including - 500 mm deep	No	340.00	3	1020	3	1020	3	1020	3	1020	3	1020	3	1020
		Casting/grout in of pipes														
TOTAL CARRIED FORWARD TO NEXT PAGE																

University of Cape Town

COSTING: SPLIT TO THREE PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.05		0.1		0.15		0.2		0.25		0.3	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page				7200	3	7200	3	7200	3	7200	3	7200	3	7200
1.3.7		0 - # nominal flange diameter	No	2 400.00												
1.4	8.3	REINFORCEMENT														
	8.3.1 (a)	*Mild steel bars:*														
1.4.1		a) Diameter 25 mm; Basic price	t	12 000.00		822.2131	0.07	886.2836	0.08	992.0285	0.09	1033.49	0.10	1162.7124	0.10	1237.0082
		Extra-over for item 2.8.1 for bars														
1.4.2		(1) 8 mmm	t	1 000.00		6.851776	0.01	7.385697	0.01	8.266904	0.01	8.612421	0.01	9.6892704	0.01	10.308402
1.4.3		(2) 10mm	t	1 000.00		41.11065	0.04	44.31418	0.05	49.60142	0.05	51.67452	0.06	58.135622	0.06	61.850412
1.4.4		(3) 12 mm	t	500.00		10.27766	0.02	11.07855	0.02	12.40036	0.03	12.91863	0.03	14.533906	0.03	15.462603
	8.3.1 (b)	*High-tensile steel bars:*														
1.4.5		a) Diameter 25 mm; Basic price	t	12 000.00		5481.42	0.49	5908.557	0.55	6613.523	0.57	6889.937	0.65	7751.4163	0.69	8246.7216
		Extra-over for item 2.8.2 for bars														
		(Provisional Quantities)														
1.4.6		1) 10 mm	t	1 000.00		45.6785	0.05	49.23798	0.06	55.11269	0.06	57.41614	0.06	64.595136	0.07	68.72268
1.4.7		2) 12 mm	t	500.00		137.0355	0.30	147.7139	0.33	165.3381	0.34	172.2484	0.39	193.78541	0.41	206.16804
1.4.8		3) 16 mm	t	500.00		68.51776	0.15	73.85697	0.17	82.66904	0.17	86.12421	0.19	96.892704	0.21	103.08402
1.4.9		4) 20 mm	t	500.00		0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
1.5		CONCRETE														
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19)	m²	115.00		474.0714	5	522.137	5	603.2247	6	635.5815	6	738.0976	7	798.123
		(Provisional Quantities)														
	8.4.3	*Strength Concrete, Class (35/19 MPa)*														
1.5.2		Foundations, floorslabs and bases	m³	2 000.00		2061.18	1.1	2270.161	1.3	2622.716	1.4	2763.398	1.6	3209.12	1.7	3470.1
1.5.3		Wall, columns and beams	m³	2 000.00		3562	1.9	3763	2.0	4082	2.1	4203	2.3	4568	2.4	4770
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00		1989.904	1.1	2173.169	1.2	2480.733	1.3	2602.958	1.5	2988.736	1.6	3213.68
	8.4.4	*Unformed Surface Finishes*														
1.5.5		Wood float finish	m²	18.00		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
1.5.6		Steel float finish	m²	35.00		256.0642	8.1	283.211	9.4	329.2192	9.9	347.6442	11.6	406.2128	12.6	440.629
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**														
1.6.1		*Mild Steel Pipe*	m	See table		1128.63	4.4	1729.883	4.6	2827.35	4.6	3944.385	4.8	4698.68	5.0	6157.8
1.6.2		*RSV Valves*	No	See table		4408	4.0	6592	4.0	9336	4.0	15040	4.0	26160	4.0	34104
1.6.3		*FlangeAdaptors*	No	See table		1326	3.0	1896	3.0	2760	3.0	3444	3.0	3558	3.0	4482
1.6.4		*Flexible Couplings*	No	See table		1768	4.0	2528	4.0	3680	4.0	4592	4.0	4744	4.0	5976
1.6.5		*Flanges*	No	See table		824	4.0	1348	4.0	1880	4.0	2204	4.0	3580	4.0	4220
TOTAL CARRIED FORWARD TO SUMMARY						50 232.38		57 161.21		67 292.07		77 488.11		95 503.54		110 266.35

University of Cape Town

COSTING: SPLIT TO THREE PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35		0.4		0.45		0.5		0.55		0.6		0.65	
					QTY	AMOUNT	QTY	QTY	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
	SANS	**SECTION : CHAMBER**																
1.1	1200 D	SITE PREPARATION *Clear and Strip Site (Provisional)*																
1.1.1	8.3.1 8.2.10	Clear vegetation and trees of girth up to 2 m	m^2	6.00	36	214.38425	37	221.7268	39	231.31223	41	243.50227	43	258.24475	46	273.42043	49	295.30996
1.1.2	SANS	Removal topsoil to nominal depth of 150mm.	m^2	15.00	36	535.96062	37	554.31702	39	578.28057	41	608.75568	43	645.61188	46	683.55108	49	738.27491
1.2	1200 D	EARTHWORKS																
1.2.1	8.3.2 8.3.3 (b)	*Bulk Excavation* Excavate in all materials, stockpile, maintain to be *Extra-over excavations above for:*	m^3	50.00	16	797.64372	17	852.97212	19	926.55342	20	1022.1941	23	1140.7313	25	1265.7665	29	1451.0094
1.2.2	8.3.5	*(Provisional)* Extra excavation in all materials to provide	m^3		18	0	18	0	19	0	20	0	21	0	23	0	24	0
	SANS	CONCRETE (STRUCTURAL)																
1.3	1200 G																	
		Form work			18	7147.2	18	7390.8	19	7702.8	20	8090.4	21	8546.4	23	9002.4	24	9638.4
1.3.1	8.2.1	Vertical rough plane	m^2	400.00	18	10884.96	19	11323.44	20	11885.04	21	12582.72	22	13403.52	24	14224.32	26	15369.12
1.3.2	8.2.2	Vertical Smooth plane	m^2	600.00	10	6056.3448	11	6449.5608	12	6971.3028	13	7647.6672	14	8483.5152	16	9362.6832	18	10661.236
1.3.3	8.2.2	Smooth Horizontal plane	m^2	600.00	12	1723.68	13	1780.52	13	1853.32	14	1943.76	15	2050.16	15	2156.56	16	2304.96
1.3.4	8.2.5	Vertical and horizontal narrow widths up to	m	140.00	12	1231.2	13	1271.8	13	1323.8	14	1388.4	15	1464.4	15	1540.4	16	1646.4
1.3.5		Chamfers exceeding 20 mm x 20 mm grooves	m	100.00														
	8.2.6	*Box out holes/form voids*																
1.3.6		Larger, other than circular , of area over 0.1 m^2 Over and up to and including - 500 mm deep	No	340.00	3	1020	3	1020	3	1020	3	1020	3	1020	3	1020	3	102
		Casting/grout in of pipes																
TOTAL CARRIED FORWARD TO NEXT PAGE																		

University of Cape Town

COSTING: SPLIT TO THREE PARALLEL PIPES

ITEM NO	PAYMENT	DESCRIPTION	UNIT	RATE	0.35		0.4		0.45		0.5		0.55		0.6		0.65	
					QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT
		Total forwarded from previous page																
1.3.7		0 - # nominal flange diameter	No	2 400.00	3	7200	3	7200	3	7200	3	7200	3	7200	3	7200	3	7200
1.4	8.3	REINFORCEMENT																
	8.3.1 (a)	*Mild steel bars:*																
1.4.1		a) Diameter 25 mm; Basic price	t	12 000.00	0.13	1503.8911	0.13	1587.3236	0.14	1697.1179	0.15	1838.0845	0.17	2010.4279	0.18	2189.7891	0.20	2451.6707
		Extra-over for item 2.8.1 for bars																
1.4.2		(1) 8 mmm	t	1 000.00	0.01	12.532425	0.01	13.227697	0.01	14.142649	0.02	15.317371	0.02	16.753566	0.02	18.248242	0.02	20.430589
1.4.3		(2) 10mm	t	1 000.00	0.08	75.194553	0.08	79.366182	0.08	84.855893	0.09	91.904224	0.10	100.52139	0.11	109.48945	0.12	122.58353
1.4.4		(3) 12 mm	t	500.00	0.04	18.798638	0.04	19.841546	0.04	21.213973	0.05	22.976056	0.05	25.130348	0.05	27.372363	0.06	30.645883
	8.3.1 (b)	*High-tensile steel bars:*																
1.4.5		a) Diameter 25 mm; Basic price	t	12 000.00	0.84	10025.94	0.88	10582.158	0.94	11314.119	1.02	12253.897	1.12	13402.852	1.22	14598.594	1.36	16344.471
		Extra-over for item 2.8.2 for bars																
		(Provisional Quantities)																
1.4.6		1) 10 mm	t	1 000.00	0.08	83.549503	0.09	88.184647	0.09	94.284325	0.10	102.1158	0.11	111.69044	0.12	121.65495	0.14	136.20393
1.4.7		2) 12 mm	t	500.00	0.50	250.64851	0.53	264.55394	0.57	282.85298	0.61	306.34741	0.67	335.07131	0.73	364.96485	0.82	408.61178
1.4.8		3) 16 mm	t	500.00	0.25	125.32425	0.26	132.27697	0.28	141.42649	0.31	153.17371	0.34	167.53566	0.36	182.48242	0.41	204.30589
1.4.9		4) 20 mm	t	500.00	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
1.5		CONCRETE																
1.5.1	8.4.2	50 mm Blinding layer, Class (15/19)	m²	115.00	9	1019.2114	9	1089.9088	10	1183.9294	11	1306.1369	13	1457.6011	14	1617.3683	16	1854.0676
		(Provisional Quantities)																
	8.4.3	*Strength Concrete, Class (35/19 MPa)*																
1.5.2		Foundations, floorslabs and bases	m³	2 000.00	2.2	4431.354	2.4	4738.734	2.6	5147.519	2.8	5678.856	3.2	6337.396	3.5	7032.036	4.0	8061.1635
1.5.3		Wall, columns and beams	m³	2 000.00	2.7	5456	2.8	5659	3.0	5919	3.1	6242	3.3	6622	3.5	7002	3.8	7532
1.5.4		Elevated floorslabs and elevated beams	m³	2 000.00	2.0	4037.5632	2.1	4299.7072	2.3	4647.5352	2.5	5098.4448	2.8	5655.6768	3.1	6241.7888	3.6	7107.4908
	8.4.4	*Unformed Surface Finishes*																
1.5.5		Wood float finish	m²	18.00	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
1.5.6		Steel float finish	m²	35.00	16.2	568.00156	17.4	608.90326	19.0	663.40316	21.0	734.39884	23.5	822.60444	26.2	915.86404	30.1	1054.3769
1.6		**PIPE SPECIAL, PIPEWORK AND VALVES**																
1.6.1		*Mild Steel Pipe*	m	See table	5.3	7713.512	5.5	9095.14	5.7	10776.809	5.9	17009.564	6.1	18672.12	6.3	20405.876	6.8	23794.316
1.6.2		*RSV Valves*	No	See table	4.0	79648	4.0	86320	4.0	124968	4.0	129280	4.0	139896	4.0	150512	4.0	203860
1.6.3		*FlangeAdaptors*	No	See table	3.0	7590	3.0	8358	3.0	9096	3.0	10434	3.0	11217	3.0	12000	3.0	12918
1.6.4		*Flexible Couplings*	No	See table	4.0	10120	4.0	11144	4.0	12128	4.0	13912	4.0	14956	4.0	16000	4.0	17224
1.6.5		*Flanges*	No	See table	4.0	5516	4.0	6736	4.0	8440	4.0	10216	4.0	13316	4.0	16416	4.0	16928
TOTAL CARRIED FORWARD TO SUMMARY						175 006.89		188 881.46		236 312.62		256 442.62		279 334.96		302 484.63		370 377.05

University of Pretoria

Characteristics of Valve Chamber: SPLIT TO THREE PARALLEL PIPES

Input

Pipe Diameter	m	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
Distance between pipe and wall 1	m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Distance between pipe and wall 2	m	0.209	0.254	0.28	0.317	0.356	0.38	0.47	0.47	0.48	0.51	0.555	0.6	0.605
Distance between parallel pipes	m	0.36	0.36	0.46	0.46	0.56	0.61	0.71	0.81	0.92	1.02	1.12	1.22	1.475
Distance between flange and walls	m	0.102	0.109	0.114	0.105	0.108	0.11	0.152	0.153	0.153	0.154	0.154	0.154	0.154
Length of Isolation valve	m	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Length of T-Piece	m	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Length of flange adaptor	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Depth (bottom of floor to top of wall)	m	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Depth (NGL to bottom of floor)	m	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Floor thickness	m	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Wall thickness	m	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Roof thickness	m	3	3	3	3	3	3	3	3	3	3	3	3	3
Roof overhang	m	3	3	3	3	3	3	3	3	3	3	3	3	3
Thickness of blinding layer	m	120	120	120	120	120	120	120	120	120	120	120	120	120
Site Clearance extra length	m	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Site Clearance extra width	m	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
High Tensile steel	kg/m	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
High Tensile steel - 8 mm	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
High Tensile steel - 10 mm	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
High Tensile steel - 12 mm	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
High Tensile steel - 16 mm	%													
High Tensile steel - 20 mm	%	1.98	2.077	2.234	2.299	2.48	2.58	2.902	3.003	3.133	3.294	3.484	3.674	3.939
Allow % for mild steel rebar	%	2.082	2.186	2.348	2.404	2.588	2.69	3.054	3.156	3.286	3.448	3.638	3.828	4.093
Calculations		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Length (outside dimensions)	m	0.209	0.254	0.28	0.317	0.356	0.38	0.47	0.47	0.48	0.51	0.555	0.6	0.605
Width (outside dimensions)	m	0.36	0.36	0.46	0.46	0.56	0.61	0.71	0.81	0.92	1.02	1.12	1.22	1.475

University of Cape Town

CALCULATION OF QUANTITIES: SPLIT TO THREE PARALLEL PIPES

		FEEDER PIPE DIAMETER (m)												
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
SITE PREPARATION														
Clear and Strip Site (Provisional)														
Clear vegetation and trees of girth up to 2 m	m^2	25.30836	26.32932	27.99143	28.6358	30.62224	31.7502	35.73071	36.95447	38.55204	40.58371	43.04079	45.57007	49.21833
Removal topsoil to nominal depth of 150mm, stockpile and maintain	m^2	25.30836	26.32932	27.99143	28.6358	30.62224	31.7502	35.73071	36.95447	38.55204	40.58371	43.04079	45.57007	49.21833
EARTHWORKS														
Bulk Excavation														
Excavate in all materials, stockpile, maintain to be used for backfill / fill compacted to 95% Mod	m^3	7.420248	8.17258	9.441778	9.948233	11.55283	12.49236	15.95287	17.05944	18.53107	20.44388	22.81463	25.31533	29.02019
Extra excavation in all materials to provide working space around structure, 600mm wide	m^2	12.186	12.789	13.746	14.109	15.204	15.81	17.868	18.477	19.257	20.226	21.366	22.506	24.096
CONCRETE (STRUCTURAL)														
Form work														
Vertical rough plane	m^2	12.186	12.789	13.746	14.109	15.204	15.81	17.868	18.477	19.257	20.226	21.366	22.506	24.096
Vertical Smooth plane	m^2	11.3232	12.0468	13.1952	13.6308	14.9448	15.672	18.1416	18.8724	19.8084	20.9712	22.3392	23.7072	25.6152
Smooth Horizontal plane	m^2	4.97476	5.432922	6.201832	6.507396	7.47184	8.0342	10.09391	10.74927	11.61884	12.74611	14.13919	15.60447	17.76873
Vertical and horizontal narrow widths up to 300mm wide	m	8.524	8.926	9.564	9.806	10.536	10.94	12.312	12.718	13.238	13.884	14.644	15.404	16.464
Chamfers exceeding 20 mm x 20 mm grooves	m	8.524	8.926	9.564	9.806	10.536	10.94	12.312	12.718	13.238	13.884	14.644	15.404	16.464
Box out holes/form voids														
Larger, other than circular , of area over 0,1 m^2 upto and including 0,5 m^2														
Over and up to and including - deep	500 mm No	3	3	3	3	3	3	3	3	3	3	3	3	3
Casting/grout in of pipes														
0 - # nominal flange diameter	No	3	3	3	3	3	3	3	3	3	3	3	3	3
REINFORCEMENT														
Mild steel bars:														

University of Cape Town

CALCULATION OF QUANTITIES: SPLIT TO THREE PARALLEL PIPES (CONTINUE)

		FEEDER PIPE DIAMETER (m)												
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65
a) Diameter 25 mm; Basic price	t	0.069	0.074	0.083	0.086	0.097	0.103	0.125	0.132	0.141	0.153	0.168	0.182	0.204
Extra-over for item 2.8.1 for bars														
(Provisional Quantities)														
(1) 8 mmm	t	0.007	0.007	0.008	0.009	0.010	0.010	0.013	0.013	0.014	0.015	0.017	0.018	0.020
(2) 10mm	t	0.041	0.044	0.050	0.052	0.058	0.062	0.075	0.079	0.085	0.092	0.101	0.109	0.123
(3) 12 mm	t	0.021	0.022	0.025	0.026	0.029	0.031	0.038	0.040	0.042	0.046	0.050	0.055	0.061
High-tensile steel bars:														
a) Diameter 25 mm; Basic price	t	0.457	0.492	0.551	0.574	0.646	0.687	0.835	0.882	0.943	1.021	1.117	1.217	1.362
Extra-over for item 2.8.2 for bars														
(Provisional Quantities)														
1) 10 mm	t	0.046	0.049	0.055	0.057	0.065	0.069	0.084	0.088	0.094	0.102	0.112	0.122	0.136
2) 12 mm	t	0.274	0.295	0.331	0.344	0.388	0.412	0.501	0.529	0.566	0.613	0.670	0.730	0.817
3) 16 mm	t	0.137	0.148	0.165	0.172	0.194	0.206	0.251	0.265	0.283	0.306	0.335	0.365	0.409
4) 20 mm	t													
CONCRETE														
50 mm Blinding layer, Class (15/19)	m^2	4.122	4.540	5.245	5.527	6.418	6.940	8.863	9.477	10.295	11.358	12.675	14.064	16.122
Strength Concrete, Class														
(35/19 MPa)														
Foundations, floorslabs and bases	m^3	1.031	1.135	1.311	1.382	1.605	1.735	2.216	2.369	2.574	2.839	3.169	3.516	4.031
Wall, columns and beams	m^3	1.781	1.882	2.041	2.102	2.284	2.385	2.728	2.830	2.960	3.121	3.311	3.501	3.766
Elevated floorslabs and elevated beams	m^3	0.995	1.087	1.240	1.301	1.494	1.607	2.019	2.150	2.324	2.549	2.828	3.121	3.554
Unformed Surface Finishes														
Wood float finish	m^2													
Steel float finish	m^2	7.316	8.092	9.406	9.933	11.60	12.589	16.229	17.397	18.954	20.983	23.503	26.168	30.125
PIPE SPECIAL, PIPEWORK AND VALVES														
Mild Steel Pipe	m	4.426	4.447	4.662	4.635	4.844	4.950	5.276	5.479	5.699	5.902	6.102	6.302	6.812
RSV Valves	No	4	4	4	4	4	4	4	4	4	4	4	4	4
FlangeAdaptors	m	3	3	3	3	3	3	3	3	3	3	3	3	3
Flexible Couplings	No	4	4	4	4	4	4	4	4	4	4	4	4	4
Flanges	m	4	4	4	4	4	4	4	4	4	4	4	4	4

UNIVERSITY OF PRETORIA

COSTING SHEET: MATERIAL COST- PIPE SPECIALS, FITTINGS AND VALVES

Diameter	Total	Supply	Install
MS Pipe Special Rates			
0.05	R 255.00	R 112.00	R 143.00
0.1	R 389.00	R 112.00	R 277.00
0.15	R 610.00	R 140.00	R 470.00
0.2	R 851.00	R 168.00	R 683.00
0.25	R 970.00	R 196.00	R 774.00
0.3	R 1 244.00	R 224.00	R 1 020.00
0.35	R 1 462.00	R 252.00	R 1 210.00
0.4	R 1 660.00	R 280.00	R 1 380.00
0.45	R 1 891.00	R 336.00	R 1 555.00
0.5	R 2 882.00	R 392.00	R 2 490.00
0.55	R 3 060.00	R 420.00	R 2 640.00
0.6	R 3 238.00	R 448.00	R 2 790.00
0.65	R 3 493.00	R 476.00	R 3 017.00
0.7	R 3 748.00	R 504.00	R 3 244.00
0.8	R 4 490.00	R 560.00	R 3 930.00
Isolation Valves			
0.05	R 1 102.00	R 990.00	R 112.00
0.1	R 1 648.00	R 1 480.00	R 168.00
0.15	R 2 334.00	R 2 110.00	R 224.00
0.2	R 3 760.00	R 3 480.00	R 280.00
0.25	R 6 540.00	R 5 980.00	R 560.00
0.3	R 8 526.00	R 7 910.00	R 616.00
0.35	R 19 912.00	R 19 240.00	R 672.00
0.4	R 21 580.00	R 20 740.00	R 840.00
0.45	R 31 242.00	R 30 290.00	R 952.00
0.5	R 32 320.00	R 31 200.00	R 1 120.00
0.55	R 34 974.00	R 33 770.00	R 1 204.00
0.6	R 37 628.00	R 36 340.00	R 1 288.00
0.65	R 50 965.00	R 49 565.00	R 1 400.00
0.7	R 64 302.00	R 62 790.00	R 1 512.00
0.8	R 84 000.00	R 82 320.00	R 1 680.00
Flange Adaptors			
0.05	R 442.00	R 330.00	R 112.00
0.1	R 632.00	R 520.00	R 112.00
0.15	R 920.00	R 780.00	R 140.00
0.2	R 1 148.00	R 980.00	R 168.00
0.25	R 1 186.00	R 990.00	R 196.00
0.3	R 1 494.00	R 1 270.00	R 224.00
0.35	R 2 530.00	R 2 250.00	R 280.00
0.4	R 2 786.00	R 2 450.00	R 336.00
0.45	R 3 032.00	R 2 640.00	R 392.00
0.5	R 3 478.00	R 3 030.00	R 448.00
0.55	R 3 739.00	R 3 235.00	R 504.00
0.6	R 4 000.00	R 3 440.00	R 560.00

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Diameter	Total	Supply	Install
0.65	R 4 306.00	R 3 690.00	R 616.00
0.7	R 4 612.00	R 3 940.00	R 672.00
0.8	R 5 900.00	R 5 060.00	R 840.00
Flex Couplings			
0.05	R 442.00	R 330.00	R 112.00
0.1	R 632.00	R 520.00	R 112.00
0.15	R 920.00	R 780.00	R 140.00
0.2	R 1 148.00	R 980.00	R 168.00
0.25	R 1 186.00	R 990.00	R 196.00
0.3	R 1 494.00	R 1 270.00	R 224.00
0.35	R 2 530.00	R 2 250.00	R 280.00
0.4	R 2 786.00	R 2 450.00	R 336.00
0.45	R 3 032.00	R 2 640.00	R 392.00
0.5	R 3 478.00	R 3 030.00	R 448.00
0.55	R 3 739.00	R 3 235.00	R 504.00
0.6	R 4 000.00	R 3 440.00	R 560.00
0.65	R 4 306.00	R 3 690.00	R 616.00
0.7	R 4 612.00	R 3 940.00	R 672.00
0.8	R 5 900.00	R 5 060.00	R 840.00
Flanges			
0.05	R 206.00	R 150.00	R 56.00
0.1	R 337.00	R 225.00	R 112.00
0.15	R 470.00	R 330.00	R 140.00
0.2	R 551.00	R 355.00	R 196.00
0.25	R 895.00	R 615.00	R 280.00
0.3	R 1 055.00	R 775.00	R 280.00
0.35	R 1 379.00	R 1 015.00	R 364.00
0.4	R 1 684.00	R 1 320.00	R 364.00
0.45	R 2 110.00	R 1 690.00	R 420.00
0.5	R 2 554.00	R 2 050.00	R 504.00
0.55	R 3 329.00	R 2 825.00	R 504.00
0.6	R 4 104.00	R 3 600.00	R 504.00
0.65	R 4 232.00	R 3 700.00	R 532.00
0.7	R 4 360.00	R 3 800.00	R 560.00
0.8	R 5 890.00	R 5 190.00	R 700.00

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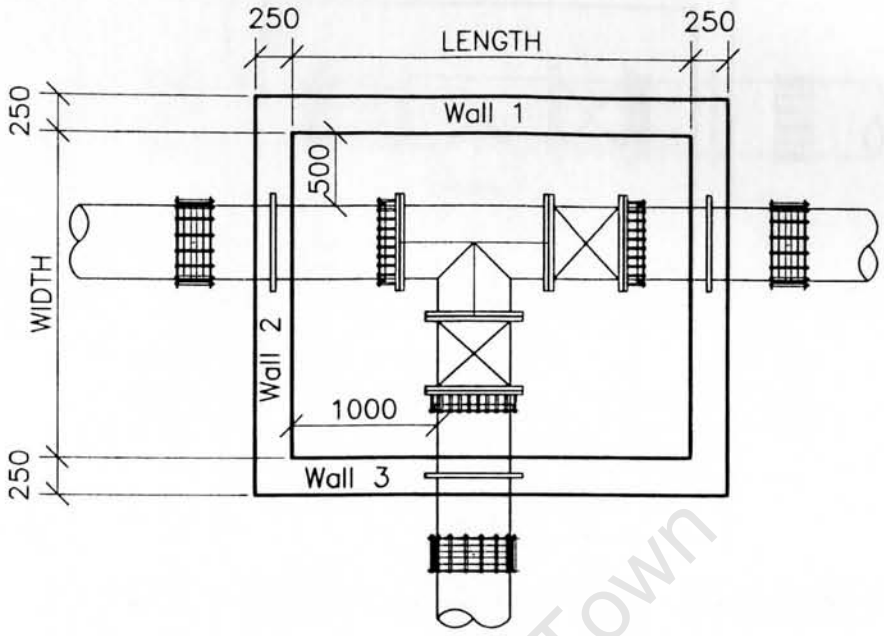
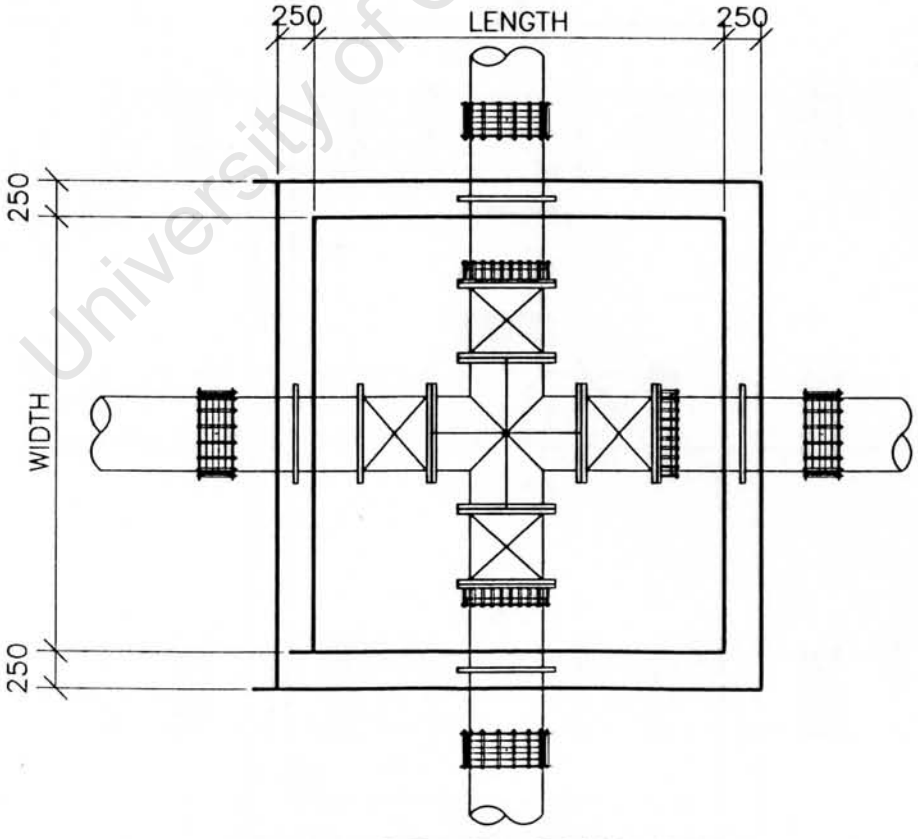


2 X SPLIT–CHAMBER



3 X SPLIT CHAMBER

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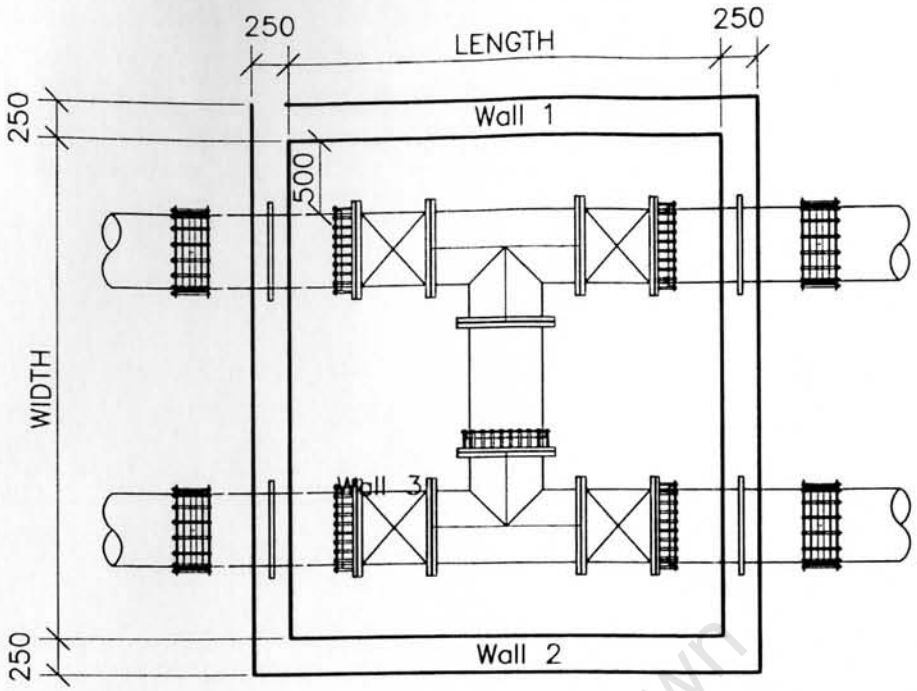
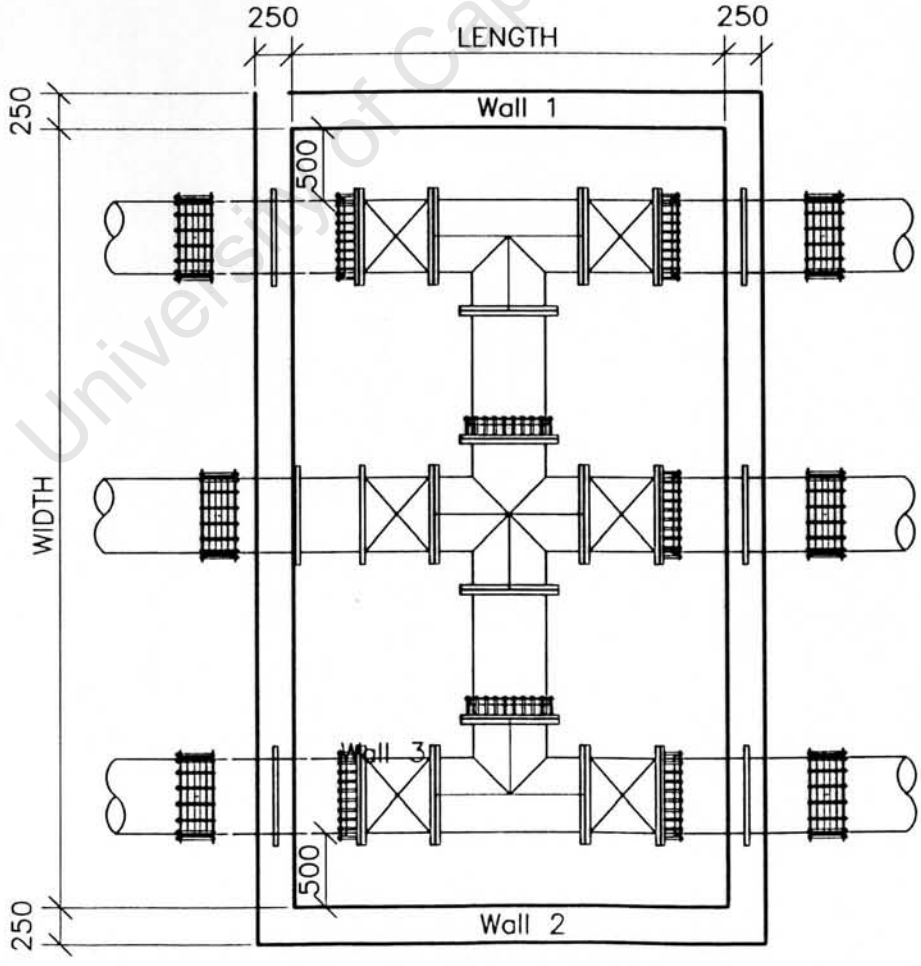


2 PIPE INTERCONNECTION CHAMBER



3 PIPE INTERCONNECTION CHAMBER

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