Table 5-8 Summary of Additional Bulk Infrastructure Required for Temba S/A

Bulk Infrastructure	Location	Diameter (mm)	Unit	Quantity
Water Treatment Works	Kudube		Mld	48
	Temba		Mld	81
	Wallmannsthal		Mld	2.1
Reservoirs	Kudube/Temba		Ml	114
Pipelines		110	km	3.4
		250	km	4.5
		450	km	3.5
		600	km	4.0

5.5 Development Planning for the Eastern Zone

The Eastern Supply Zone comprises two Supply Areas, the Weltevreden Supply Area and the Bronkhorstspruit Supply Area. This Zone falls largely within the Olifants catchment and the main raw water sources are the Mkombo (Rhenosterkop) Dam on the Elands River in the north (supplemented by water from Loskop Dam) and the Premier Mine Dam on the Wilge River and Bronkhorstspruit Dam on the Bronkhorstspruit in the south. The Zone includes the rural farming areas of Bronkhorstspruit, Cullinan and Moretele 2 districts and the peri-urban area of the former Kwandebele.

Weltevreden WTW and Bronkhorstspruit WTW are linked via the main pipeline running through Kwandebele and there is some flexibility in deciding the split between the two treatment works. Prior to 1996, the yield of Mkombo Dam which is intended to be the main source of raw water to Weltevreden WTW was poor so water was imported from Loskop Dam to make up the shortfall. Following the heavy rainfall at the start of 1996, Mkombo Dam filled up and due to the large storage capacity (206 mcm), water supplies from the dam are assured into the next century. For this reason, the postponement of some of the strengthening work proposed under the Kwandebele Augmentation Scheme has been considered by DWAF and it is probably desirable that more demand than was assumed previously be met from Weltevreden which is located closer to the centre of demand and thus can meet the demand more cost effectively. For the purpose of the water balance and subsequent planning, the existing demarcation between the two Supply Areas was assumed and technical solutions prepared.

Using the existing demarcation, expansion of Weltevreden WTW by 9 Mld (giving 69 Mld capacity) and Bronkhorstspruit WTW by 19.4 Mld (giving 60.4 Mld) is required. The planning for the Kwandebele Augmentation Scheme shows increases in the capacity of Bronkhorstspruit WTW to 57 Mld by 1998 and 69 Mld by 2001. The proposals described below could be reworked if necessary to transfer the 9 Mld demand back to Bronkhorstspruit WTW in which case the demand in 2015 would coincide with the capacity included in the augmentation scheme.

5.5.1 Weltevreden Supply Area

The Weltevreden Supply Area comprises Moretele 2 District and the northern part of Kwandebele. At present, the Moretele 2 is not served by a surface water system and relies heavily on groundwater supplies which are in many places inadequate in terms of quality or quantity. There is extensive existing water supply infrastructure serving the Kwandebele area as described above and the northern part is supplied from Weltevreden WTW which is operated by DWAF in the absence of a water board or an effective Third Tier organization.

The Supply Area is subdivided into four Supply Blocks, i.e. Bloedfontein, Kameelrivier, Mapoch and Waalkraal.

(1) Bloedfontein Supply Block comprises the northern part of Mbibana, and the entire Moutse 1, and Moretele 2 Districts. The former two lie within the former Kwandebele while Moretele 2 formed part of Bophuthatswana. As a result, there is some existing water supply infrastructure in Moutse 1 and Mbibana while Moretele 2 relies completely on inadequate groundwater resources. It is proposed that a surface water scheme be implemented to serve Moretele 2 and the preferred option is that the area is supplied entirely from Weltevreden WTW.

Two alternatives that were considered comprised supplying the villages of Lefiso, Radijoko, Ramantsho, Semohlase and Moletsi from Weltevreden WTW as in the preferred option, while communities in the west of the Block would be served from either the MW treatment works at Temba or from a new water works treating water from Rust de Winter Dam. The water balance indicated that sufficient water resources are available to implement any of these options although water rights for irrigation from Rust de Winter Dam are held by Gauteng Province. Although these have not been taken up in recent years it is understood that a new scheme is now being implemented to use the water for irrigation. For this reason the preferred option of meeting the entire demand from Weltevreden which appears to be slightly more expensive than the Rust de Winter option is proposed. This option has the added benefit of utilising an existing (possibly extended), facility and not necessitating additional staffing and overhead costs associated with constructing an additional treatment works.

From Weltevreden, treated water is pumped to Bloedfontein Regional Reservoir (16 Ml). This supplies Spitspunt Regional Reservoir (2.7 Ml) via a booster pumping station which in turn supplies the surrounding villages in western Moutse 1 by gravity. The proposed new scheme comprises strengthening the pipework and pumps supplying Bloedfontein and Spitspunt reservoirs and providing 4.7 Ml of additional capacity at Spitspunt. A new 450 mm diameter gravity pipeline is proposed running in a south-westerly direction as far as Ga-Ramantshane but booster pumps will be required subsequently at Ga-Ramantshane, Nokaneng, Bamokgoko and Phake B. The new system will extend as far as Pankop at the west end of Moretele 2 and service reservoirs will be provided as required to serve the communities en route. New service reservoirs are required in the parts of Moutse 1 to be supplied from the Spitspunt system.

The villages of Seghoko, Semohlase and Ramantsho fall within Moretele 2 but would be best served by extending the existing system to Loding which would require upgrading to absorb the additional demand. Six small new local service reservoirs (150 to 300 kl) and a new pumping station at Ramantsho are also required in this area to provide the necessary assurance of supply.

Within Moutse 1, the construction of service reservoirs is proposed for communities which are at present served from the Bloedfontein Regional Reservoir without additional local storage. Fixed planning is in place to install gravity pipelines to Tweefontein and Witfontein Agricultural Holdings.

(2) Kameelrivier Supply Block is located south-west of Weltevreden WTW and includes a relatively small peri-urban/rural area served from the treatment works via Leeuwfontein Regional Reservoir, and a rural farming area. New infrastructure comprises an extension of the existing pipeline to Morwe and provision of a service reservoir, a new pumped supply to a service reservoir at Leeuwfontein B.

(3) Mapoch Supply Block comprises a small area located on the north side of the Kameel and Elands rivers and consists of the communities of Mapoch and Thabana which are served from Mapoch Regional Reservoir. New infrastructure proposed comprises only the strengthening of the pipeline to Thabana SR.

(4) Walkraal Supply Block covers most of the northern half of Kwandebele and comprises the area south of the Kameel and Elands rivers as far as the boundary with the Bronkhorstspruit Supply Area. As the system is continuous with the Bronkhorstspruit system, this boundary is not fixed and considerable latitude is available in the Tweefontein area as to whether communities are supplied from Weltevreden or Bronkhorstspruit.

From Weltevreden WTW a 10km long 700 mm diameter rising main delivers into Walkraal Regional Break Pressure Tank and Reservoir (24Ml). Both the main and the tank are adequate to accommodate the projected 2015 demands. From Walkraal, a further 10 km 600 mm diameter rising main supplies Moleti Regional Reservoir which is the main regional reservoir for the distribution system in this Block. Walkraal also supplies Siyabuswa SR (12 Ml) and in addition a new gravity main and local reservoir are proposed to serve Kameelrivier D.

From Moleti Regional Reservoir, four secondary mains supply further regional and local service reservoirs. A 350 mm diameter main supplies most of Moutse 3, forking to supply Matatla and Nganeng in the north-east of the district and villages towards Thabakhubedu in the south. From the northern branch further new branch pipelines and service reservoirs are proposed to serve communities at Mthenti, Kuilsrivier and Mpeleng. Off this main is Stomp Regional Reservoir from which it is proposed to supply six new service reservoirs (sized nominally as 0.15 Ml) to serve villages including Stomp, Mchipisane, Kgobokwane and Maganaubuswa on the south bank of the Elands River. The 250 mm main to the south-east supplies Elandsdoorn Regional Reservoir from which a new supply to a reservoir at Uitspanning and a new extension and reservoir to serve Elandsdoorn B are proposed. A further three reservoirs and associated pipework to serve Elandsdoorn C, Denniton S/H and Kalofane are also included in the proposals.

Two further mains from Moleti Regional Reservoir supply the area to the north-west in a loop which includes Klipplaatdrift Regional Reservoir. Most of the infrastructure is existing but new additional service reservoirs are proposed for Marothobolong, Wolwekraal A, and Twolne (under gravity via a new pipe from Makola). Additional storage is also required to supplement the existing reservoir at Mabhoko.

From Moleti, the principle north-south trunk main continues as a 600 mm diameter pumped system as far as Kwaggafontein Regional Reservoir from which it continues at the same direction under gravity towards Tweefontein. From Kwaggafontein Regional Reservoir, a 200 mm main runs back in the opposite direction for about 5 km to Mathys Lyn from where it turns to the south-west and supplied Boekenhouthoek Regional Reservoir. New pipelines and reservoirs to supply Matshipe A and Die Bron from this regional reservoir are proposed. Most areas of Kwaggafontein are already served but it is proposed that a new branch pipeline and service reservoir (1.36 Ml) be provided to serve Kwaggafontein D.

Table 5-9 below presents a summary of additional bulk infrastructure which will be required for the Weltevreden Supply Area to meet the projected 2015 primary water demand.

Table 5-9 Summary of Additional Bulk Infrastructure Required for Weltevreden S/A

Bulk Infrastructure	Location	Diameter (mm)	Unit	Quantity
Water Treatment Works	Weltevreden		Mld	9
Clear Water PS	Weltevreden		kld	9,345
	Spitspunt		kld	8,848
Reservoirs	Spitspunt		Ml	4.7
	Ga-Ramatshana		Ml	4.8
Pipeline		110 to 200	km	156.2
		250 to 400	km	21.9
		450 to 600	km	27.5
		650 to 800	km	Nil

5.5.2 Bronkhorstspruit Supply Area

The Bronkhorstspruit Supply Area includes Cullinan and Bronkhorstspruit Districts and the southern part of Kwandebele to the south side of Kwaggafontein. The Area has been subdivided into two Supply Blocks, i.e. Bronkhorstspruit and Cullinan. The Kwandebele area is fed from Weltevreden WTW in the north and Bronkhorstspruit WTW in the south and the two systems are linked allowing the demarcation between the two plants to be adjusted according to water resources availability and other factors.

(1) The Bronkhorstspruit Supply Block comprises Bronkhorstspruit and part of Kwandebele as described above and is supplied from Bronkhorstspruit WTW. The treatment works

is owned and operated by Bronkhorstspruit TLC and treats water abstracted from the Wilge River which in turn is regulated by Bronkhorstspruit Dam. Under the ongoing Kwandebele Augmentation Project, the yield of Bronkhorstspruit Dam has been increased by raw water transfer from the Grootdraai Dam via the Usutu-Vaal River GWS and there is planning to lay a raw water pipeline from the dam to the treatment works. The treatment works performs a local function but also supplies bulk water to the Ekandustria industrial area and Kwandebele. The augmentation project also provides for the strengthening of bulk potable supply mains in the southern Kwandebele area by additional main laying.

New infrastructure proposed for Bronkhorstspruit Supply Block comprises two additional service reservoirs at Ekandustria, 11 km of main from Tweefontein Regional Reservoir to supply a new reservoir to serve Klipfontein and Kameelpoort, and new service reservoirs to supply Tweefontein M (1.0 Ml) and Enkeldoringoog A (1.5 Ml).

(2) The Cullinan Supply Block comprises mostly rural farming areas with a low population density which rely on groundwater. The only significant water supply scheme is at Cullinan where Magalies Water operates the treatment works which has recently been uprated to 14.4 Mld. Raw water from the Premier Mine Dam on the Wilge River is pumped to a raw water storage reservoir at the treatment works. Treated water from the works is pumped into Cullinan Regional Reservoirs located nearby, from where a gravity line feeds to Refilwe SR and a pumping main supplies Zonderwater Regional Reservoirs and Rayton SR. From Zonderwater a gravity pipeline supplies two further service reservoirs. No significant new infrastructure is required within the Block and the treatment capacity is adequate to meet the projected demand in the target year. A slight shortfall in the capacity of Cullinan Regional Reservoir and pipelines and the service reservoir serving Elandia and Protem is projected by the 2015 so uprating just before the end of the planning horizon may be necessary.

Table 5-10 below presents a summary of additional bulk infrastructure which will be required for the Bronkhorstspruit Supply Area to meet the projected 2015 primary water demand.

Table 5-10 Summary of Additional Bulk Infrastructure Required for Bronkhorstspruit S/A

Bulk Infrastructure	Location	Diameter (mm)	Unit	Quantity
Water Treatment Works	Bronkhorstspruit		Mld	19.4
Clear Water PS			kld	Nil
Reservoirs	Ekandustria		Ml	20
	Cullinan		Ml	0.8
Pipeline		110 to 200	km	156.2
		250 to 400	km	21.9
		450 to 600	km	27.5
		650 to 800	km	Nil

5.6 Cost Estimates

During the infrastructure planning, some schemes were identified which were already fixed planning. The costs for such schemes were included in the estimated costs for the purpose of the Study and are shown separaely on the drawing entitled "Proposed Primary Water Supply Infrastructure Development Plan".

For planning and budgetary purposes, it will be necessary to divide the estimated capital costs between the role players responsible for water supply and sanitation within the Study Area. For this reason, costs were calculated separately for bulk and Third Tier functions using the cost models developed under Section 5.1. In respect of Third Tier costs, there is uncertainty surrounding the capacity of some local authorities to implement water supply projects. In addition, there is an absence of detail as to the exact area of jurisdiction of the various Third Tier organizations, and a lack of clarity as to the extent of involvement of the private sector or of other Government subsidy programmes. These factors prevented a more detailed division of capital costs into specific individual Third Tier organization.

Bulk infrastructure may be defined as the water supply facilities upstream of the flowmeter on the inlet to a service reservoir and comprises pipework, pumping stations, regional reservoirs, treatment works and raw water pipework. Third Tier or retail costs are associated with the provision of service reservoirs, and the downstream pipework, water towers, pumps and reticulation. For instances where a community is supplied directly from the regional reservoir, the retail costs would normally be for the facilities downstream of a flowmeter on the reservoir outlet.

The estimated capital expenditure that is required in order to ensure the water supply service-levels predicted for each community or supply unit for the year 2015 is summarised on the Planning Schematics for each individual Supply Block, and on the Cost Summary Sheets for each Supply Area. The total cost of the proposals for each Supply Area and Zone is described in Chapter 6. Bulk costs were broken down into treatment facilities, pipework, pumping stations and regional reservoirs while Third Tier costs were service reservoirs, pipework and reticulation.

The cost of reticulation was calculated on the Population and Demand spreadsheets. In these spreadsheets the number of properties within each town or village was identified from the population statistics; the development densities were then calculated from the settlement area and the number of properties; finally the reticulation cost per stand or plot was identified by applying the standard cost curves developed for this purpose as described in Section 5.1. Total reticulation costs for a specific settlement were arrived at by multiplying the number of properties for each design year by the unit reticulation cost applicable to the calculated settlement density.

An allowance was added to the sub-totals for both bulk and retail costs for engineering (15 %), VAT (14 %) and contingencies (20 %). The allowance for engineering is estimated on the basis of consultancy services for feasibility study, detailed design and construction supervision.

5.7 Recommendations on Sanitation Options

5.7.1 Introduction

The terms of reference for the JICA Study require a study on sanitation with a view to exploring sanitation options for the different levels of service of water supply adopted in the Study.

With regard to the provision of sanitation in the Study Area, the following were the major findings from the Situational Analysis:

(1) Approximately 75 % of the total population in the Study Area use a toilet which falls below the RDP level of a VIP toilet. They comprise about 94 % of the population in non-urban areas and 44 % of the population in urban areas.

(2) The percentage of households which are connected to mains sewerage is 56 % in urban areas and 22 % for the entire Study Area. There is virtually no mains sewerage in non-urban areas but about 6 % of households (4% of the total households in the Study Area) use septic tanks. With regard to the method of domestic wastewater treatment, approximately 72 % of households in the Study Area discharge domestic wastewater (toilet wastewater and other domestic wastewater) into the ground without treatment.

5.7.2 Recommended Sanitation Options

A flow chart for the improvement of sanitation is shown in Figure 5-1.

Improvement of sanitation has two major components as follows :

(1) improvement of the toilet itself; and

(2) improvement of the method for domestic wastewater treatment.

With regard to the first component, it is an urgent priority that improvement to at least the level of RDP should be implemented as soon as practicable over the entire Study Area, as it is part of the short-term sanitation policy of the Government. It is estimated that the total capital cost to achieve this objective will be approximately 350 million Rand.

As for the second component, a careful approach both to the selection of treatment method and to the prioritisation of communities for implementation is required, which must take the following into account :

(1) proximity of the community to both existing and planned mains sewerage;

(2) level of water supply in the community in terms of per-capita water consumption rate and service level (house connection, yard tap or communal tap);

(3) affordability of households in the community;

(4) institutional capacity of the community; and

(5) topographic and environmental considerations.

The flow chart shown in Figure 5-1 has been prepared in accordance with the per-capita water consumption rates of 120 lcd for a house connection, 70 lcd for a yard connection and 30 lcd for a communal tap, which were adopted in the projection of domestic water demand for rural areas. It provides for both on-site and off-site treatment options of domestic wastewater which are suitable for this range of water consumption rates. Technical features of these options are as follows :

Option 1 : Only toilet wastewater will be treated using an on-site septic tank. Other domestic wastewater will be discharged directly into the absorption pit provided at the effluent of the tank.

Option 2 : Both toilet wastewater and other domestic wastewater will be treated using an on-site septic tank.

Option 3 : Both toilet wastewater and other domestic wastewater will be treated using an off-site STED (Septic Tank Effluent Drainage) system with an interceptor tank at each household.

It is recommended that urban areas be provided with mains sewerage.

5.8 Environmental Impact

The Department of Water Affairs and Forestry (DWAF) follows a procedure of Integrated Environmental Management (IEM) for all proposed developments. This IEM procedure consists of certain successive levels of impact studies of which the Relevant Environmental Impact Prognosis (ROIP 1 - the Afrikaans acronym), which relates to a scoping and screening process, is the first. As part of this Study therefore, a ROIP 1 was prepared, a copy of which is included in Part G of the Data Book, and it is proposed that Phase 2 of the Study will include the preparation of a ROIP 2 which will involve a site investigation and input from appropriate specialists if necessary.

An Ecological Task Group is being formed comprising Provincial representatives responsible for environmental management and other interested parties which will address ecological concerns arising from the Study, identify and incorporate independent specialists and authorities, provide guidance in compliance with the IEM procedures and will ensure that environmental considerations receive the necessary attention in the decision making process during the Study and afterwards.

Inevitably, development leads to modifications in the environment and negative environmental impacts which often result from inappropriate management of development activities because of a lack of appreciation of the potential problems. All components of the environment that might be involved were identified so that appropriate ameliorative actions can be integrated with the project as a whole to obtain the best possible results.

Accent was placed on the impact of the proposed pipelines and other related surface structures as these were seen as the elements causing greatest concern. The construction of pipelines, reservoirs and treatment works could have an impact on the socio-economic aspects, i.e land use, settlement, infrastructure and population, and the ecological aspects, i.e. the vegetation, fauna, habitat, changes in flow regime and changes in water quality. Relevant data was extracted from the situational analysis reports to provide baseline information.

The aspects addressed in the ROIP 1 report are:

- the effect of abstraction from dams and the rivers downstream of the dams.

- the impact of the construction of pipelines, pump stations, reservoirs and water towers. The main activities to be expected during the construction of the proposed developments are the following:

  - Pre-construction: Surveying, clearing of vegetation and construction of access routes.

  - During Construction: Typical activities will be clearing of vegetation, stripping and stockpiling topsoil, excavations, disposal of excess material, transport of pipes, drilling, blasting additions or alterations to existing infrastructure and the importation of foreign workers.

  - Post-construction and Operational Phase: Rehabilitation of disturbed areas, implementation and maintenance of the pipelines, reservoirs, water towers and pump stations.

The ROIP 1 concluded that:

(1) The constriction of pipelines and related infrastructure will not cause substantial disturbance. The environmental consequences associated with these impacts are not considered to be significant if managed during and after construction as stipulated in the environmental management plan.

(2) The impacts of abstraction from dams on the dam itself and downstream of the dams are not considered to be significant, but with a large degree of uncertainty. By determining the in-stream flow requirements of the river, compensation water could then be released. This will influence the yield of the dam and need to be further investigated.

The ROIP 1 report recommended that the following be determined during Phase 2 for establishing the feasibility of the scheme:

(1) Social impacts

Undertake a socio-economic investigation to ascertain the following:

(a) The social and economic impacts associated with construction disturbances on the farming activities along the pipeline routes:

(b) This investigation should include meetings with the local communities to determine:
i) the interested and affected parties
ii) the preferences of the communities to any options or alternative developments.

(2) Ecological impacts

Confirm the statement that the downstream impacts associated with the proposed scheme will be minimal in view of the existing degraded river stretches.

Investigate the need for a study of the status quo of the existing river stretches to be impacted upon. Aspects to be borne in mind with the in-stream impacts are:

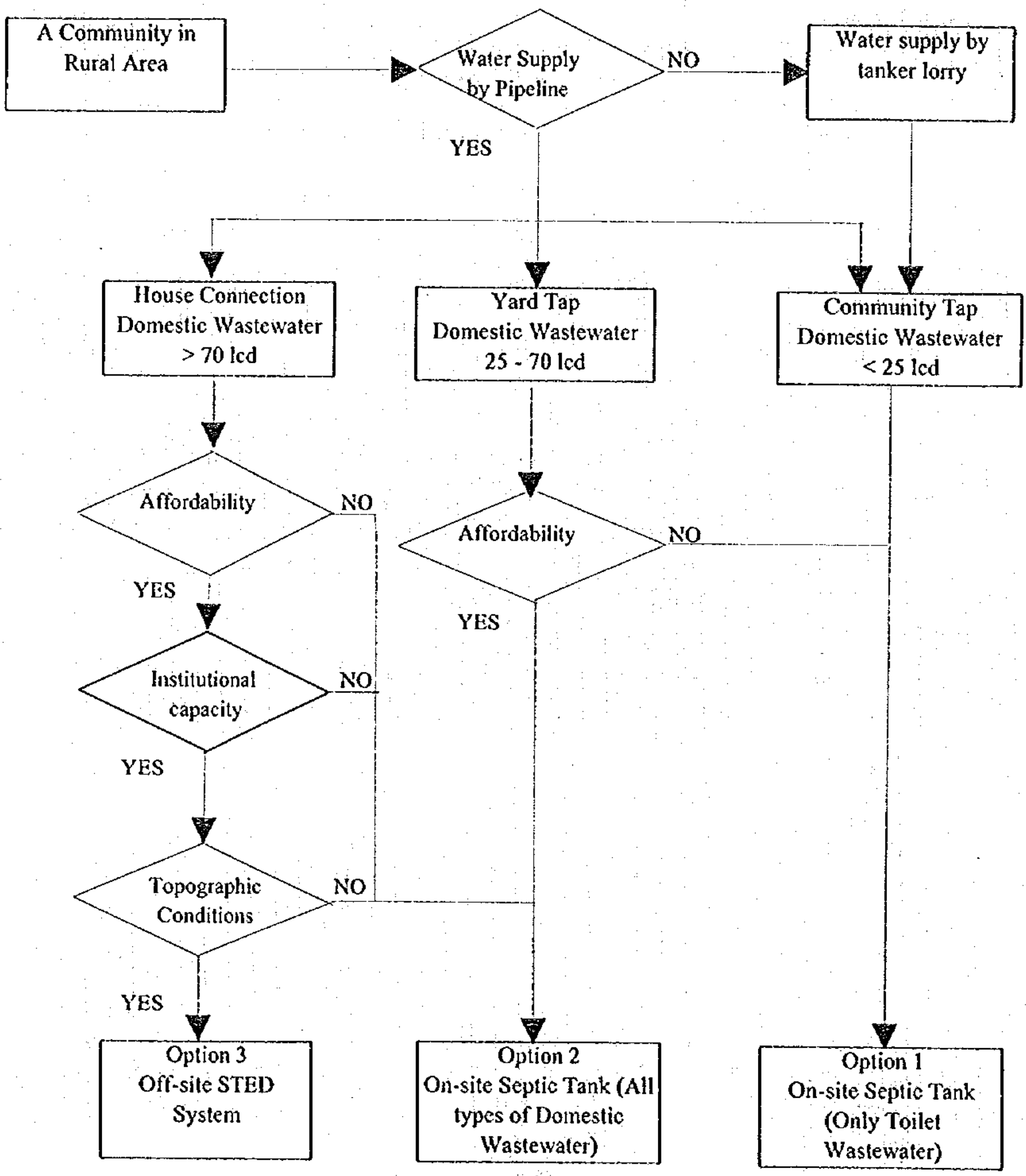
- flow regime and aquatic biota;
- riparian vegetation.

To be undertaken if the scheme is proven to be feasible:

- Compile an Environmental Management Plan for the construction phase and draw up appropriate rehabilitation guidelines to mitigate the disturbance and aesthetic impacts caused by the construction of the pipeline and associated infrastructure.
- Alert the contractor and labourers to the ecological and social impacts associated with construction activities.
- Landscaping specification for the river and canal crossings.
- An archaeological and historical sites reconnaissance survey of the proposed pipeline routes is recommended.
- General rehabilitation measures.

- Identify birds and their nesting sites where appropriate.
- Fish survey where appropriate.
- Identification of exotic aquatics.
- Define suitable operating rule for dams taking into account the recreational and tourism activities as well as downstream ecological requirements.
- Determine the in-stream flow requirement of the rivers downstream of dams in order to determine the amount of water to be released as compensation water.
- Liaise with all interested and affected parties.

Figure 5-1 : Flow Chart for Improvement of Sanitation



CHAPTER 6 : OUTPUTS FROM INFRASTRUCTURE PLANNING PROCESS

CHAPTER 6 OUTPUTS FROM INFRASTRUCTURE PLANNING PROCESS

6.1 Costs

The costs described in Section 5.6 are summarised in Tables 6-1, 6-2 and 6-3 for each Supply Area and Zone. Within the two tiers of organizations responsible for water supply, there is a further sub-division of costs that must be made for budgetary purposes. Under the RDP, Central Government will subsidise the capital cost of providing both bulk and retail level infrastructure for the portion up to the basic RDP level of service.

For bulk capital cost the apportionment was made pro-rata to the 2015 primary water demand for the RDP level of service, and to the predicted levels of service within the Supply Area under consideration. For retail level capital costs, the apportionment was achieved by establishing from the Population and Demand spreadsheets, those costs that are associated with reticulating all towns and villages within a specific Supply Area to the RDP level of service. The balance of the retail capital costs within the Supply Area were apportioned to the above RDP level of service portion.

Apportioned costs have also been identified separately for an Accelerated Investment Programme (priority projects), and for a Continuous Investment Programme (other upgrading and expansion projects) which are described in Section 6.2. These apportioned costs are shown in Table 6-4.

6.2 Programme and Disbursement Schedule

6.2.1 Short and Medium Term Development Plan

Due to the very large total cost estimated to provide infrastructure to meet the water demands in the target year, it is necessary to prioritise the work for implementation. Based on the principle in the White Paper of some for all rather than all for some, those areas which are totally unserved by surface water schemes at present and in most cases rely on inadequate groundwater supplies were selected for priority implementation. Such communities are mostly located in the northern parts of the Study Area and three priority regional water supply schemes have been identified. These are Northern Mankwe, the Klipvoor area in northern Moretele 1 and Odi 1 districts, and the entire Moretele 2 District. It is proposed that a Feasibility Study be conducted for these three areas during 1997 to lead on to possible detailed design, securing of finance, construction and implementation by 2002.

6.2.2 Long Term Development Plan

The balance of the capital works proposed comprises of some schemes to serve individual communities which are in a similar situation to those selected for the priority projects, and other upgrading work to strengthen existing infrastructure to meet the projected demand. While the former should also be considered for implementation in the near future, the latter type of project cannot practically be prioritised as implementation will be subject to the actual priorities of local and regional development and to political pressures. It has therefore been assumed that these upgrading and extension projects will constitute a Continuous Investment Programme which will be established by each of the role players. The period over which these projects shall be executed should be considered on a case by case basis by the management of the role player concerned and will be dependent on the availability of finance, management capacity, other infrastructural priorities (such as electricity, housing etc), and other factors. This category also includes existing fixed planning which was included in the overall cost estimation for the provision of water infrastructure in the Study Area. The sources of funding and the timing for implementation of such schemes may or may not have been determined already by the particular implementing agency.

6.2.3 Outline Summary of the Infrastructural Development

The infrastructure development proposed is almost exclusively based on the use of surface water to meet primary water demand due to considerations of quality and availability. It is assumed that conjunctive groundwater use in Thabazimbi will continue and that the dolomitic aquifer will be used to supplement the surface water source in Koster towards the end of the planning horizon. Table 6-5 shows the principal water treatment works in each Supply Area, the existing capacity, and that required to meet the projected demands in 2015. It can be concluded that very significant expansion will take place at Vaalkop WTW, Brits WTW and Temba / Kudube WTW's. Both Kudube and Temba treatment works supply the southern part of Moretele 1 District and future planning could transfer part of this load between the works to suit water quality and space constraints. It is proposed to construct a new water treatment plant at Klipvoor Dam to serve the priority project in Central Zone. Concerning the imported water into the Rand Water and Branardsvlei Supply Areas, it has been assumed that this will increase up to the limit of the capacity of the existing infrastructure. When this is reached options are available for relieving the demand in Soshanguve from Kudube (the preferred option proposed), relieving the Ga-Rankuwa demand from Brits or strengthening the existing supply. The latter option is undesirable when water is available locally. Three local options were evaluated for both the Klipvoor and Moretele 2 areas to determine the most preferable water source in each case.

6.3 Management Implications of Technical Solutions

The two significant outputs from the infrastructure planning progress which influence management of the water sector in the Study Area comprise estimated capital and O&M costs for the proposed works, and the zoning identified for the infrastructural planning which should inform the proposals for future business units of MW. Costs are addressed in the previous sections and developed further in the Capital Investment Plan and the future structure of MW is discussed in Supporting Report F and Chapter 8 of the Main Report.

The approach used for defining Supply Zones, Areas and Blocks is described in Section 2. These divisions not only lend themselves to current planning but are also appropriate to form the basis for the future management structure of MW and for future planning which needs to be done in a strategic context. The following considerations weigh in favour of following the zoning for the purpose of business units.

(1) As described elsewhere, water resources management is best done on a catchment basis and water boards should play a major role in this as issues of water quality will be of major interest to them. As described in Section 2 the separate Zones were based on the water sources used at present and the optimum water resource to be used to supply the

currently unserved areas. It makes sense that water board management operates on a zonal baisis and thus deals with the water resources system and infrastructure facilities within their Business Unit from a zone-wide perspective.

(2) The Zones match well with the areas of jurisdiction of local government.

(3) The existing east and west business units of MW fall within the Western and Central Zones used for planning with the exception of Cullinan WTW which is supplied from the Wilge River in the Olifants River Basin. The inclusion of Cullinan WTW within the Bronkhorstspruit / Weltevreden system in the Eastern Zone is therefore proposed.

From the technical proposals, the main centres of growth in water demand can be seen to be in the Brits, Valkop and Kudube / Temba areas. The stategic importance of the centres will increase. The increasing demands can be met due to the projected rising return flows in the Crocodile River system although the resulting adverse effect on water quality will require attention.

Also becuase of the proposed priority projects within the ESA, the role of Magalies Water in providing support to Third Tier institutions will be expanded.

Table 6-1 : Summary of Costs from Infrastructure Planning - Western Zone

	VAALKOP NORTH	VAALKOP SOUTH	BARNARD-SVLEI	KOSTER	ZONE TOTAL
Bulk Supply Costs					
Direct Costs					
WTW	41,666	21,667	0	423	63,756
Regional SR	16,067	15,920	0	0	31,987
PS	2,600	9,435	0	410	12,445
Pipelines	172,096	116,170	6,071	685	295,022
Sub Total	**232,429**	**163,192**	**6,071**	**1,518**	**403,210**
Indirect Costs					
Engineering	34,864	24,479	911	228	60,482
VAT	37,421	26,274	977	244	64,916
Contingency	60,943	42,789	1,592	398	105,722
Sub Total	**133,228**	**93,542**	**3,480**	**870**	**231,120**
Bulk Total	**365,657**	**256,734**	**9,551**	**2,388**	**634,330**
Third Tier Costs					
Direct Costs					
SR	9,206	3,956	2,828	1,036	17,026
Reticulation	84,350	92,423	24,440	3,120	204,333
Pipework	6,302	849	0	0	7,151
Sub Total	**99,858**	**97,228**	**27,268**	**4,156**	**228,510**
Indirect Costs					
Engineering	14,979	14,584	4,090	623	34,276
VAT	16,077	15,654	4,390	669	36,790
Contingency	26,183	25,493	7,150	1,090	59,916
Sub Total	**57,239**	**55,731**	**15,630**	**2,382**	**130,982**
Retail Total	**157,097**	**152,959**	**42,898**	**6,538**	**359,492**
TOTAL	522,754	409,693	52,449	8,926	993,822

Table 6-2 : Summary of Costs from Infrastructure Planning - Central Zone

	BRITS	KLIPVOOR	TEMBA	RAND	ZONE TOTAL
Bulk Supply Costs					
Direct Costs					
WTW	16,312	6,938	42,785	13,507	79,542
Regional SR	2,800	1,676	23,450	30,833	58,759
PS	312	931	0	3549	4,792
Pipelines	22,189	24,415	7,343	27,811	81,758
Sub Total	**41,613**	**33,960**	**73,578**	**75,700**	**224,851**
Indirect Costs					
Engineering	6,242	5,094	11,037	11,355	33,728
VAT	6,700	5,468	11,846	12,188	36,202
Contingency	10,911	8,904	19,292	19,849	58,956
Sub Total	**23,853**	**19,466**	**42,175**	**43,392**	**128,886**
Bulk Total	**65,466**	**53,426**	**115,753**	**119,092**	**353,737**
Third Tier Costs					
Direct Costs					
SR	4,980	3,180	39,243	49,500	96,903
Reticulation	34,109	19,475	37,353	174,920	265,857
Pipework	0	0	0	0	0
Sub Total	**39,089**	**22,655**	**76,596**	**224,420**	**362,760**
Indirect Costs					
Engineering	5,863	3,398	11,489	33,663	54,413
VAT	6,293	3,647	12,332	36,132	58,404
Contingency	10,249	5,940	20,083	58,843	95,115
Sub Total	**22,405**	**12,985**	**43,904**	**128,638**	**207,932**
Retail Total	**61,494**	**35,640**	**120,500**	**353,058**	**570,692**
TOTAL	**126,960**	**89,066**	**236,253**	**472,150**	**924,429**

Table 6-3 : Summary of Costs from Infrastructure Planning - Eastern Zone

	WELTER-VREDEN	BRONKHORST SPRUIT	ZONE TOTAL
Bulk Supply Costs			
Direct Costs			
WTW	2,984	6,471	9,455
Regional SR	3,158	10,773	13,931
PS	2,584	0	2,584
Pipelines	65,929	2,456	68,385
Sub Total	**74,655**	**19,700**	**94,355**
Indirect Costs			
Engineering	11,198	2,955	14,153
VAT	12,019	3,172	15,191
Contingency	19,574	5,165	24,739
Sub Total	**42,791**	**11,292**	**54,083**
Bulk Total	**117,446**	**30,992**	**148,438**
Third Tier Costs			
Direct Costs			
SR	14,703	2,967	17,670
Reticulation	214,101	77,495	291,596
Sub Total	**228,804**	**80,462**	**309,266**
Indirect Costs			
Engineering	34,321	12,069	46,390
VAT	36,837	12,954	49,792
Contingency	59,992	21,097	81,090
Sub Total	**131,150**	**46,121**	**177,271**
Retail Total	**359,954**	**126,583**	**486,537**
TOTAL	477,400	157,575	634,975

Figure 6-4 : Breakdown of Costs for RDP and Higher Level of Service

Zone	Supply Area	Cost (Million Rand)											
		Bulk						Retail					
		RDP		Above RDP		Total		RDP		Above RDP		Total	
		Accelerated	Continuous	Accelerated	Continuous	Accelerated	Continuous	Accelerated	Continuous	Accelerated	Continuous	Accelerated	Continuous
Western	Vaalkop N	12.625	6.274	39.978	306.780	52.603	313.054	11.872	40.016	27.892	77.316	39.764	117.332
	Vaalkop S	0	30.771	0	225.964	0	256.735	0	42.967	0	109.993	0	152.96
	Barnardsvlei	0	0.967	0	8.584	0	9.551	0	33.519	0	9.379	0	42.898
	Koster	0	0.834	0	1.554	0	2.388	0	1.194	0	5.344	0	6.538
	TOTAL	**12.625**	**38.846**	**39.978**	**542.882**	**52.603**	**581.728**	**11.872**	**117.696**	**27.892**	**202.032**	**39.764**	**319.728**
Central	Brits	0	6.276	0	59.190	0	65.466	0	17.695	0	43.8	0	61.495
	Klipvoor	31.787	0	21.639	0	53.426	0	23.180	0	12.459	0	35.639	0
	Rand Water	0	14.031	0	105.061	0	119.092	0	197.531	0	155.526	0	353.057
	Temba	0	37.489	0	78.264	0	115.753	0	93.039	0	27.462	0	120.501
	TOTAL	**31.787**	**57.796**	**21.639**	**242.515**	**53.426**	**300.311**	**23.180**	**308.265**	**12.459**	**226.788**	**35.639**	**535.053**
Eastern	Weltevreden	23.585	17.348	44.086	32.427	67.671	49.775	19.750	47.053	86.668	206.483	106.418	253.536
	Bronkhorstspruit	0	6.640	0	24.352	0	30.992	0	26.877	0	99.706	0	126.583
	TOTAL	**23.585**	**23.988**	**44.086**	**56.779**	**67.671**	**80.767**	**19.750**	**73.93**	**86.668**	**306.189**	**106.418**	**380.119**

Table 6-5 : Proposed Expansion of Water Treatment Works in the Study Area

Zone	Supply Area	Water Treatment Works	Existing Capacity* (Ml/d)	Proposed Capacity* (Ml/d)
Western	Vaalkop North	Vaalkop	120	295
	Vaalkop South	Bospoort	13.4	13.4
	Barnardsvlei	(Rand Water Importation)	(140)	(140)
	Koster	Koster Swartruggens	1.3 1.0	2.4 +0.8 (Boreholes) 1.3
Central	Brits	Brits Hartbeespoort	60 10	85 22
	Klipvoor	Klipvoor	-	3.9 / 16.4**
	Rand Water	(Rand Water Importation)	(300)	(300)
	Temba	Temba Kudube Wallmannsthal	18 20 12	99 108 14
Eastern	Weltevreden	Weltevreden	60	69
	Bronkhorstspruit	Bronkhorstspruit Cullinan	41 14	61 14

Note: * Capacities are quoted as summer peak demand.
** Figures for Klipvoor WTW are based on continuous operation or 5 day / 8 hours per day operation

APPENDIX 1

TO SUPPORTING REPORT E

<u>PLANNING SCHEMATICS</u>

PLANNING SCHEMATICS

TABLE OF CONTENTS

SUPPLY ZONE / SUPPLY AREA	PAGE NO.

VAALKOP NORTH SUPPLY AREA

TABLE OF CONTENTS

Rev. 31/10/96

COST SUMMARY FOR INFRASTRUCTURE

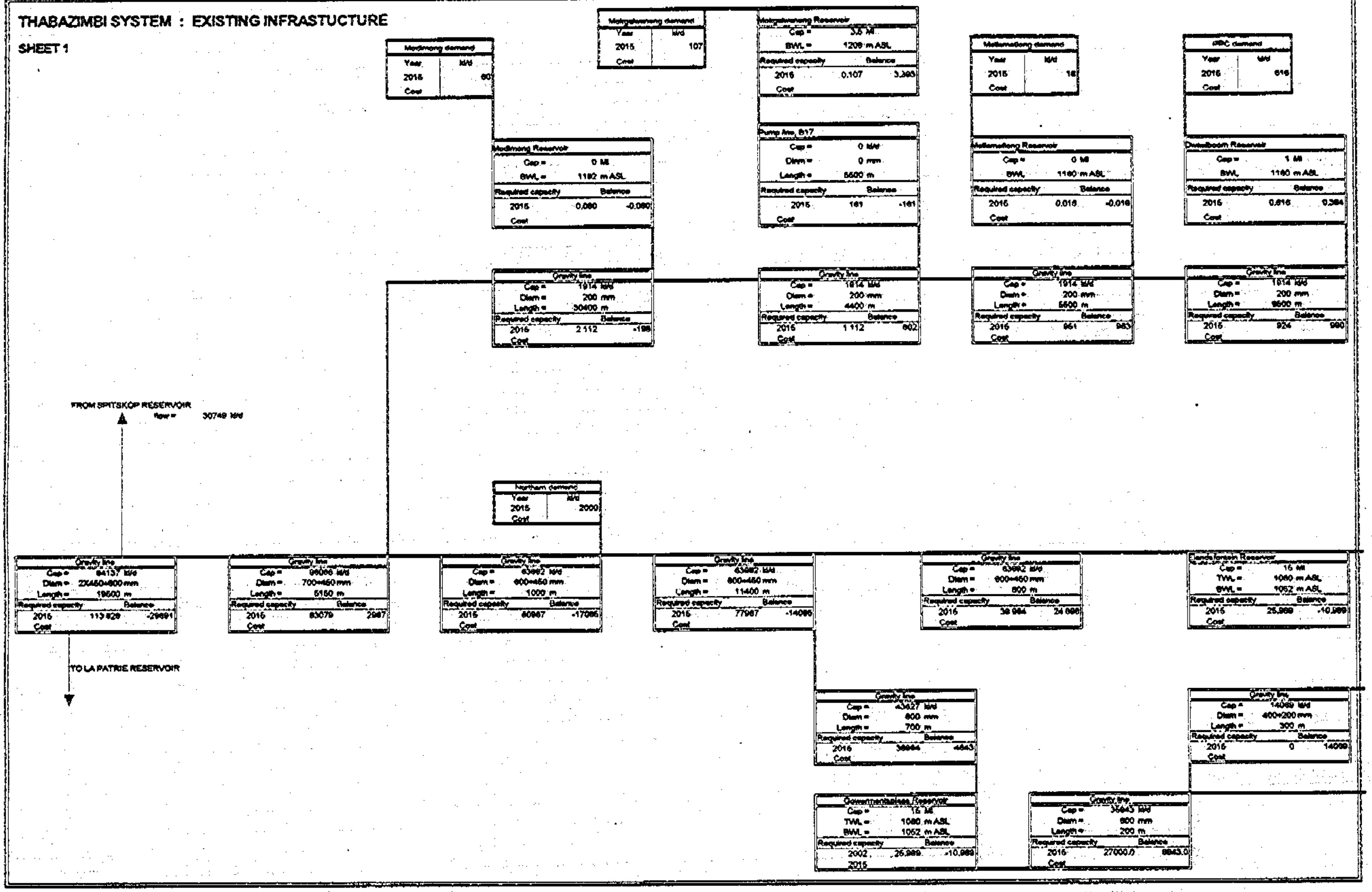
NAME OF SUPPLY AREA :	VAALKOP NORTH SUPPLY AREA
INCLUDING SUPPLY BLOCKS :	1. Thabazimbi and Mokgalwaneng Supply Blocks
	2. Sefikile Supply Block
	3. Saulspoort Supply Block
	4. Mogwase Supply Block
	5. Ramokokstad Supply Block
POPULATION SERVED (2015) :	259 285
AADD in mcm/a (2015) :	52.646

BULK COST :	QUANTITY	COST (R million)
Water Purification Works	Ml/d (Additional required capacity)	
1. Vaalkop WPW	115	41.666
Pump Stations	Kl/d	
: Capital Cost		
1. Vaalkop CWPS	150375	2.600
B : Annual Energy Cost		
1. Vaalkop CWPS		1.605
Reservoirs (Regional)	Ml	
1. La Patrie Reservoir	40	8.820
2. Elandsfontein	15	6.540
3. Spitskop	1.5	0.707
Pipelines (Bulk)	km	
1. 110/9 PVC	52.16	5.727
2. 125/9 PVC	12.72	1.779
3. 160/9 PVC	8.75	1.873
4. 200/12 PVC	38.50	12.506
5. 250/9 PVC	26.10	11.134
6. 315/9 PVC	5.15	2.405
7. 350 ST	73.10	39.647
8. 400 ST	36.00	21.359
9. 450 ST	12.40	7.960
10. 500 ST	24.70	17.834
11. 600 ST	25.50	22.032
12. 650 ST	6.00	5.598
13. 800 ST	16.50	22.242
Sub Total Bulk Construction Cost		232.429
Engineering Fees (15 %)		34.864
VAT (14 %)		37.421
Project Contingency (20%)		60.943
TOTAL : Bulk Cost		365.657
Bulk Cost per Capita (Rands)		R1 410

SECONDARY COST :	QUANTITY	COST (R million)
Reservoirs (Service)	Ml	
1. Thabazimbi and Mokgalwaneng Supply Blocks	0.35	0.297
2. Sefikile Supply Block	0.65	0.562
3. Saulspoort Supply Block	4.7	2.268
4. Mogwase Supply Block	16.7	5.521
5. Ramokokstad Supply Block	0.7	0.558
Water Towers	Ml	
N/A		
Pump Stations (Secondary)	Kl/d	
A : Capital Cost		
N/A		
B : Annual Energy Cost		
N/A		
Pipelines (Secondary)	km	
1. 110/9 PVC	12.500	1.375
2. 125/9 PVC	4.300	0.598
3. 140/9 PVC	1.500	0.255
4. 160/9 PVC	2.500	0.535
5. 400 ST	4.000	2.312
6. 500 ST	1.700	1.227
Reticulation	km	
1. Thabazimbi and Mokgalwaneng Supply Blocks		4.312
2. Sefikile Supply Block		5.975
3. Saulspoort Supply Block		58.597
4. Mogwase Supply Block		10.801
5. Ramokokstad Supply Block		4.665
Sub Total Secondary Construction Cost		99.868
Engineering Fees (15 %)		14.979
VAT (14 %)		16.077
Project Contingency (20%)		26.183
TOTAL : Secondary Cost		157.097
Secondary Cost per Capita (Rands)		R606
GRAND TOTAL COST	**MILLION RANDS**	**522.754**
Grand Total Cost per Capita (R)		**R2 016**

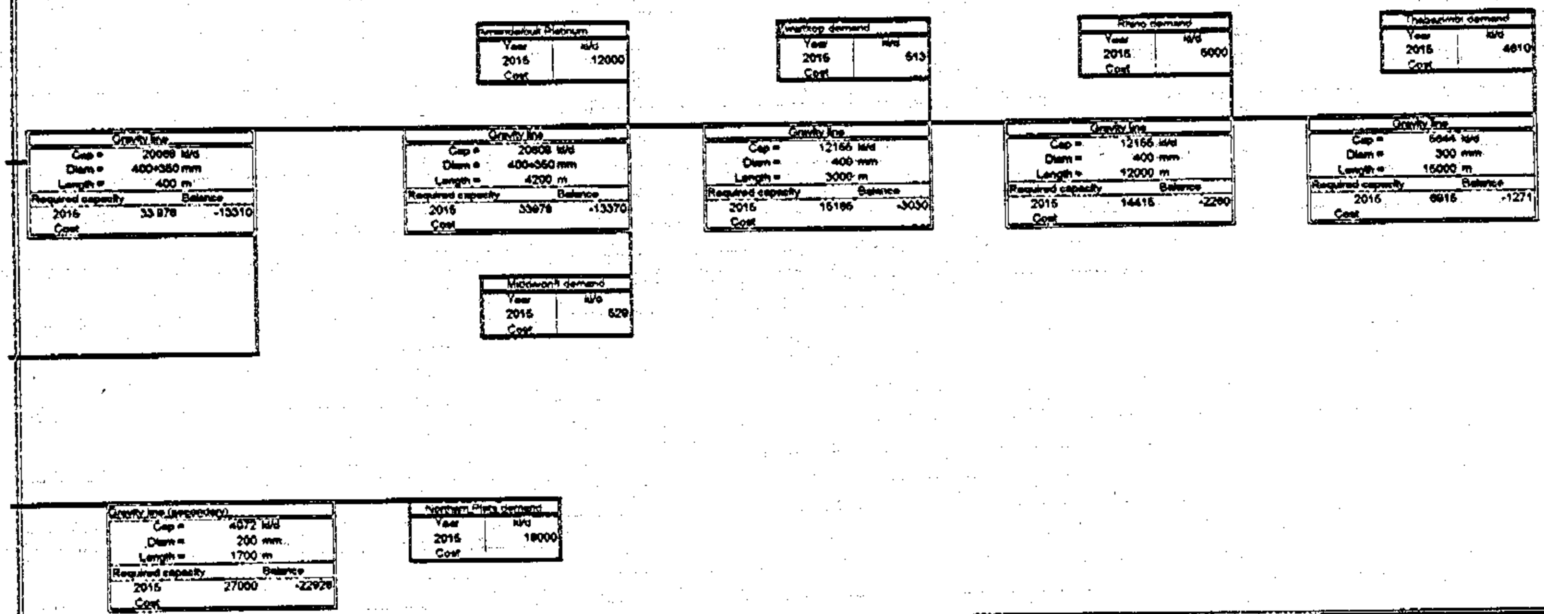
THABAZIMBI SYSTEM : EXISTING INFRASTUCTURE

SHEET 1

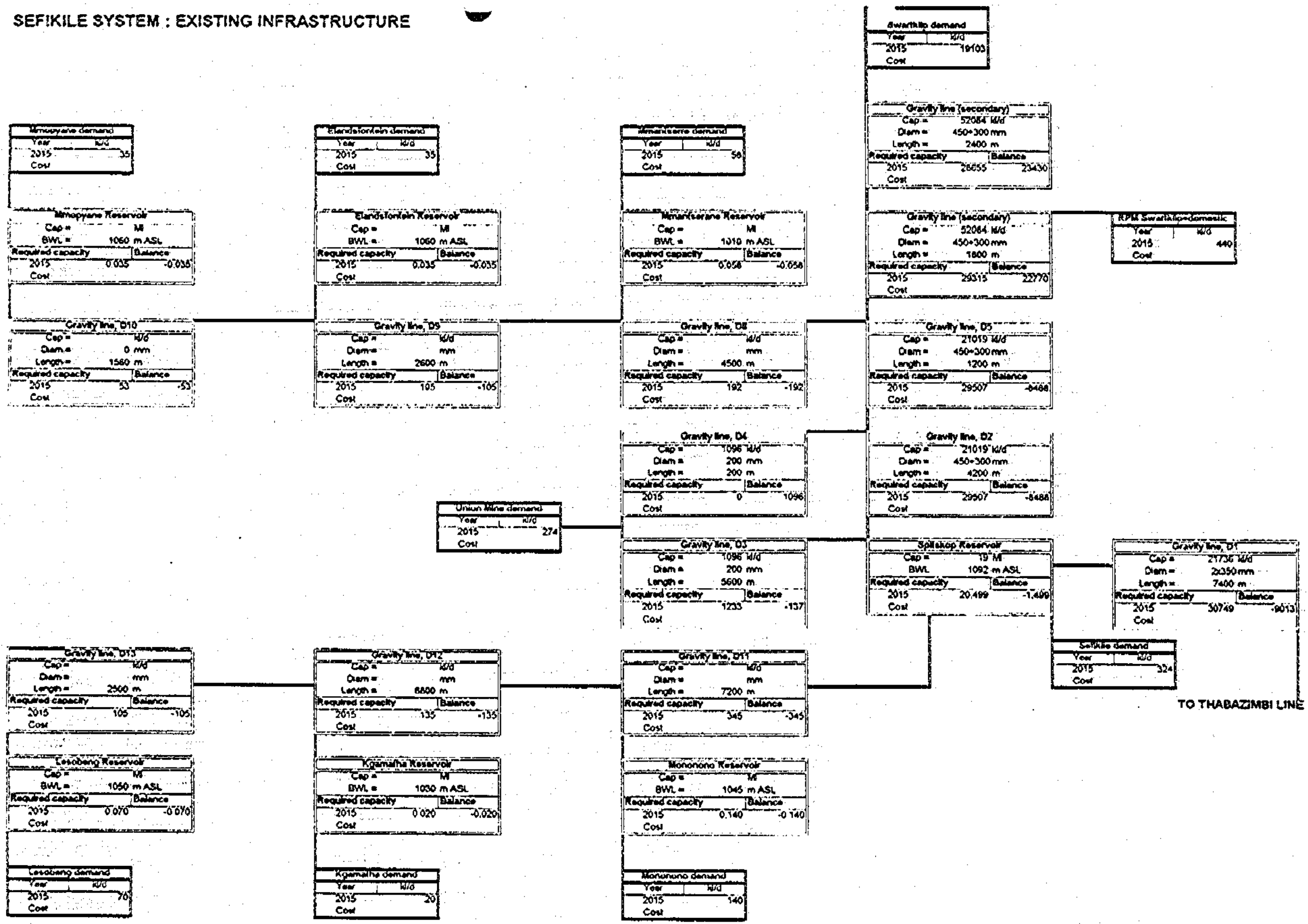


THABAZIMBI SYSTEM : EXISTING INFRASTUCTURE

SHEET 2

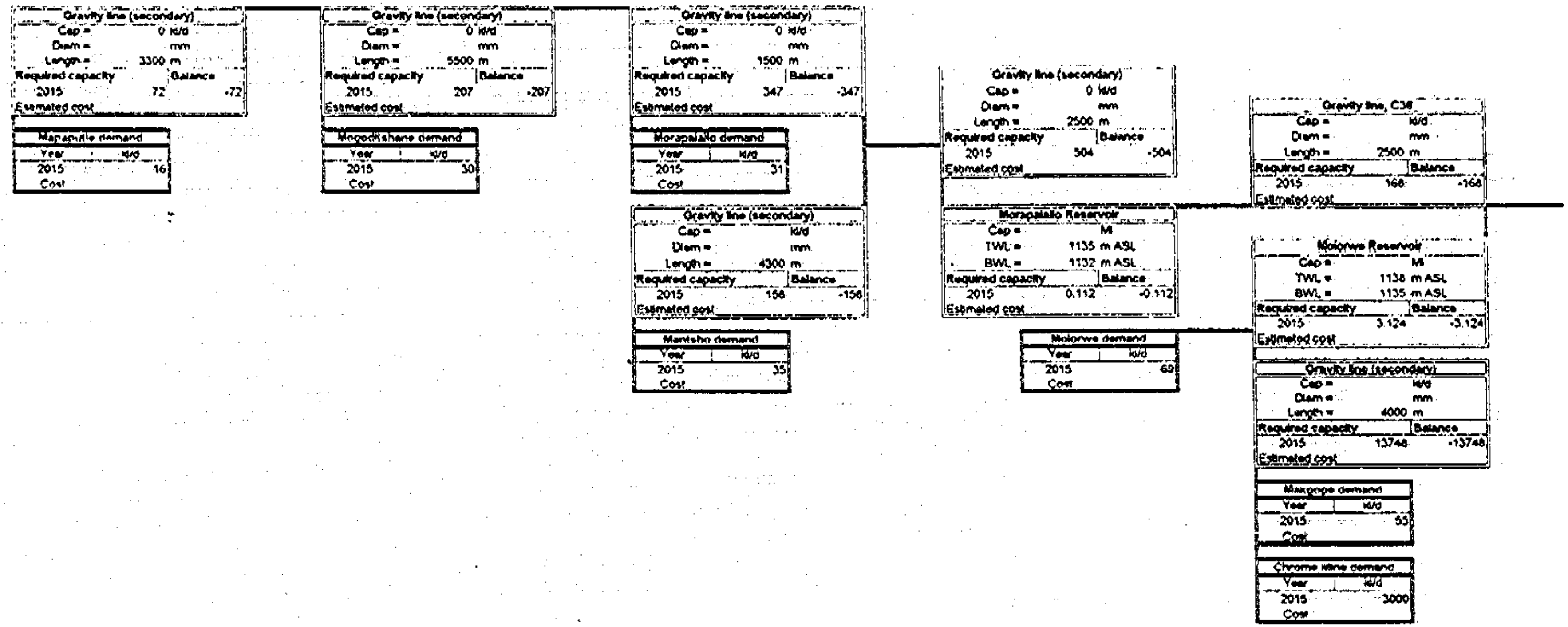


SEFIKILE SYSTEM : EXISTING INFRASTRUCTURE



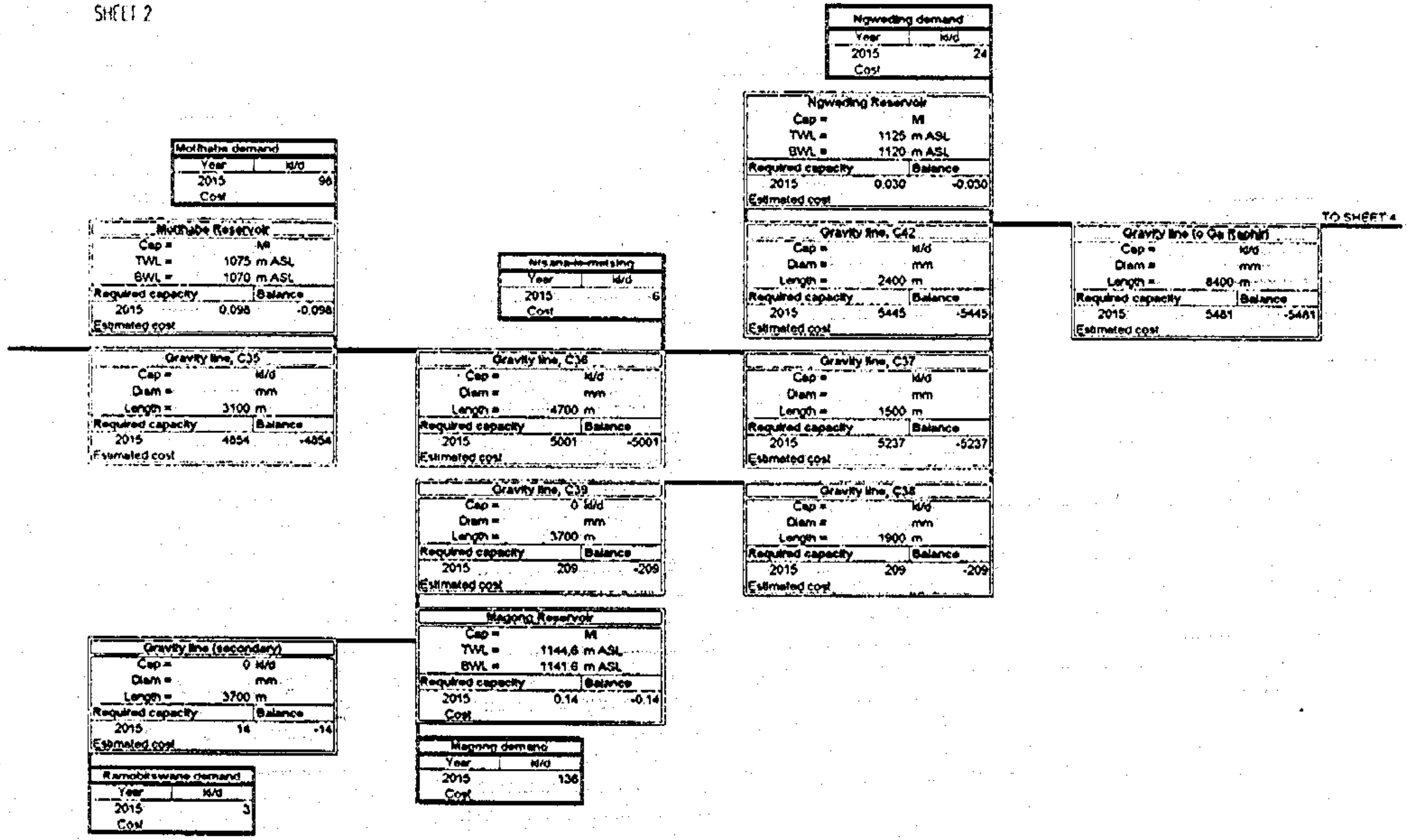
SAULSPOORT : EXISTING INFRASTRUCTURE

SHEET 1



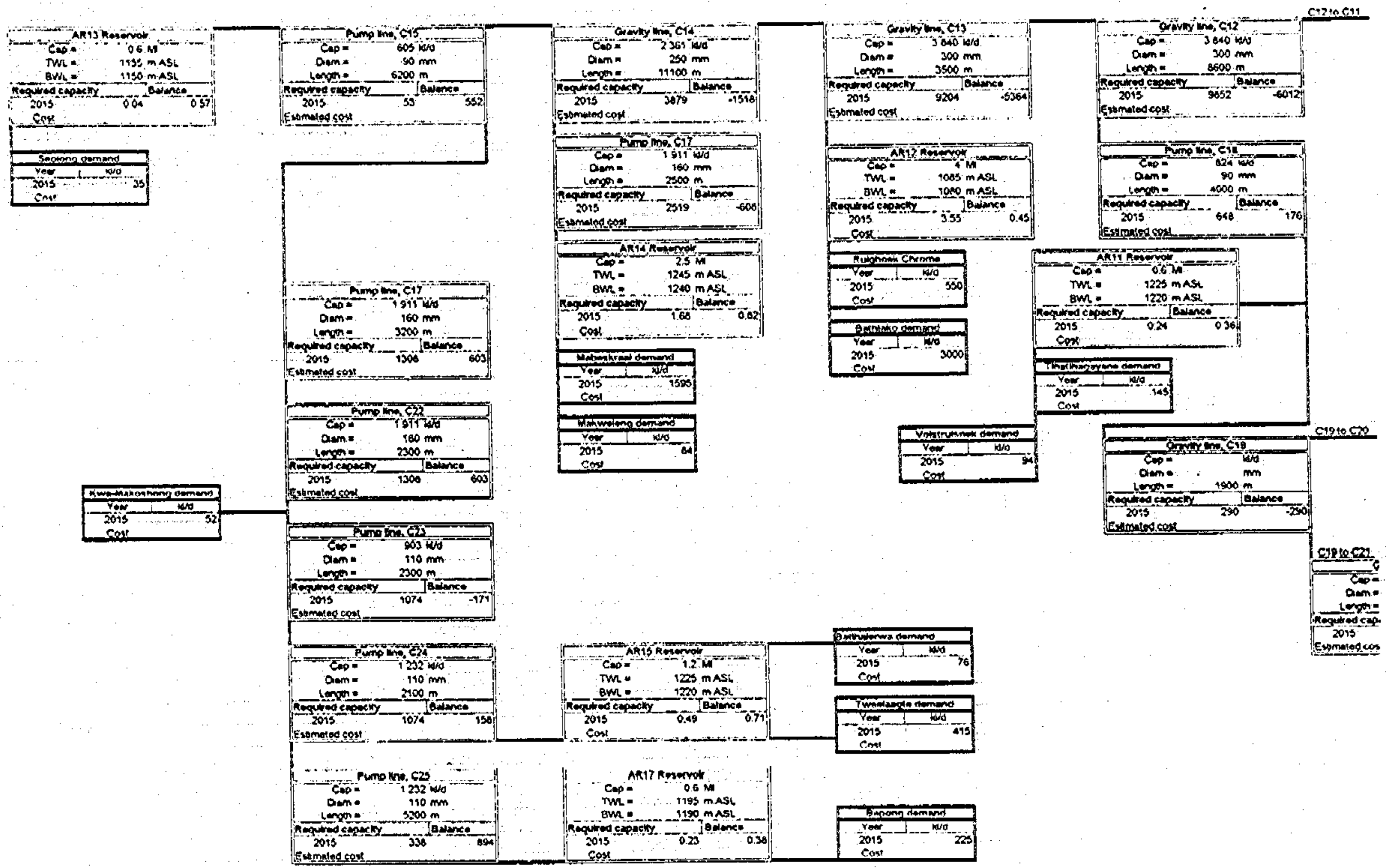
SAULSPOORT : EXISTING INFRASTRUCTURE

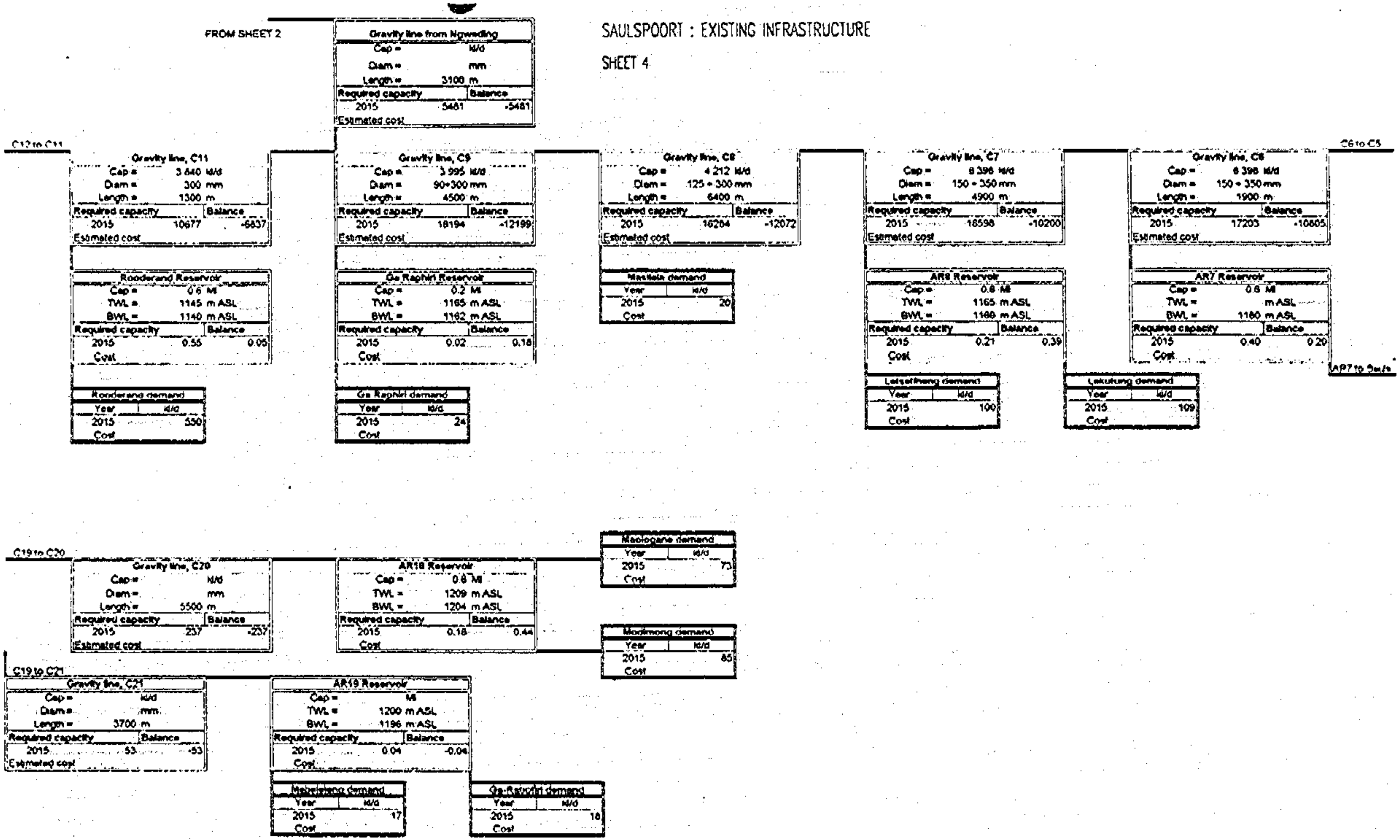
SHEET 2



SAULSPOORT : EXISTING INFRASTRUCTURE

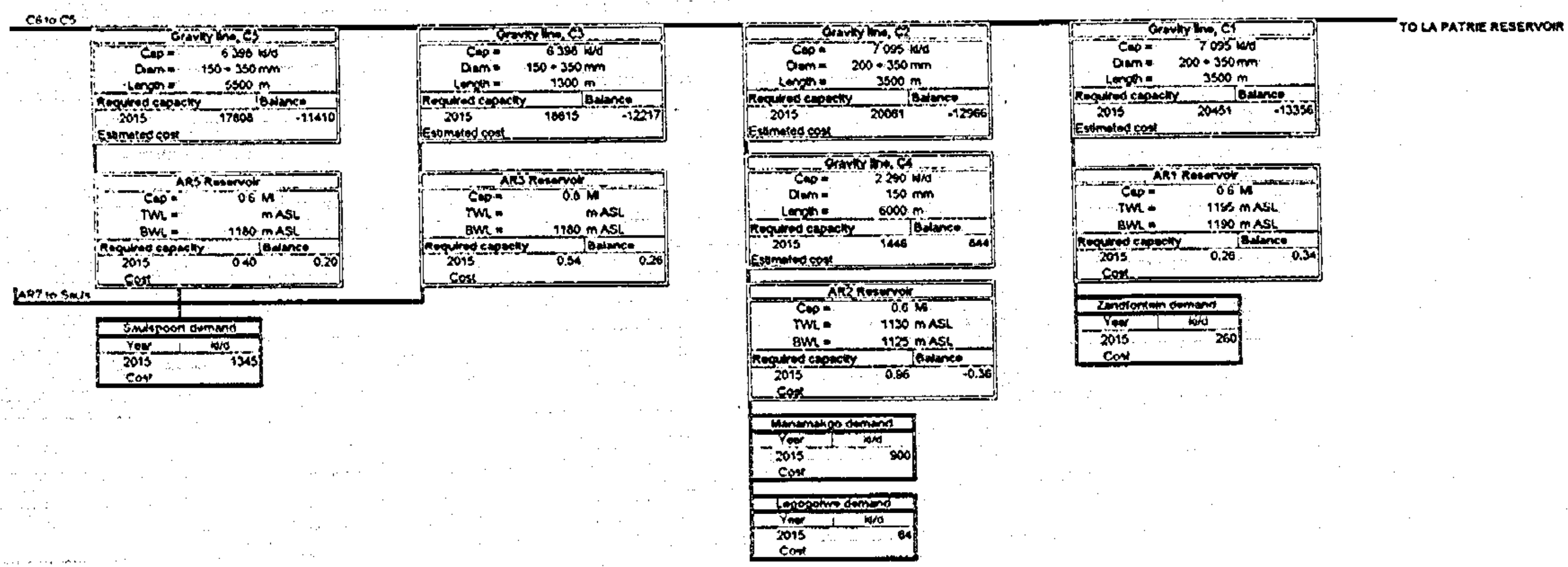
SHEET 3




SAULSPOORT : EXISTING INFRASTRUCTURE
SHEET 4
FROM SHEET 2
Gravity line from Ngweding
Cap = kl/d
Diam = mm
Length = 3100 m
Required capacity | Balance
2015 5481 -5481
Estimated cost
C12 to C11
Gravity line, C11
Cap = 3 640 kl/d
Diam = 300 mm
Length = 1300 m
Required capacity | Balance
2015 10677 -6837
Estimated cost
Gravity line, C9
Cap = 3 995 kl/d
Diam = 90+300 mm
Length = 4500 m
Required capacity | Balance
2015 18194 -12199
Estimated cost
Gravity line, C8
Cap = 4 212 kl/d
Diam = 125 + 300 mm
Length = 6400 m
Required capacity | Balance
2015 16284 -12072
Estimated cost
Gravity line, C7
Cap = 6 398 kl/d
Diam = 150 + 350 mm
Length = 4900 m
Required capacity | Balance
2015 16598 -10200
Estimated cost
Gravity line, C6
Cap = 6 398 kl/d
Diam = 150 + 350 mm
Length = 1900 m
Required capacity | Balance
2015 17203 -10805
Estimated cost
C6 to C5
Rooderand Reservoir
Cap = 0.6 Ml
TWL = 1145 m ASL
BWL = 1140 m ASL
Required capacity | Balance
2015 0.55 0.05
Cost
Ga Raphiri Reservoir
Cap = 0.2 Ml
TWL = 1165 m ASL
BWL = 1162 m ASL
Required capacity | Balance
2015 0.02 0.18
Cost
Masibela demand
Year | kl/d
2015 20
Cost
AR8 Reservoir
Cap = 0.6 Ml
TWL = 1165 m ASL
BWL = 1160 m ASL
Required capacity | Balance
2015 0.21 0.39
Cost
AR7 Reservoir
Cap = 0.6 Ml
TWL = m ASL
BWL = 1160 m ASL
Required capacity | Balance
2015 0.40 0.20
Cost
AR7 to Sauls
Rooderand demand
Year | kl/d
2015 550
Cost
Ga Raphiri demand
Year | kl/d
2015 24
Cost
Letsetheng demand
Year | kl/d
2015 100
Cost
Lekutung demand
Year | kl/d
2015 109
Cost
C19 to C20
Gravity line, C20
Cap = kl/d
Diam = mm
Length = 5500 m
Required capacity | Balance
2015 237 -237
Estimated cost
AR18 Reservoir
Cap = 0.8 Ml
TWL = 1209 m ASL
BWL = 1204 m ASL
Required capacity | Balance
2015 0.18 0.44
Cost
Maologane demand
Year | kl/d
2015 73
Cost
Modimong demand
Year | kl/d
2015 85
Cost
C19 to C21
Gravity line, C21
Cap = kl/d
Diam = mm
Length = 3700 m
Required capacity | Balance
2015 53 -53
Estimated cost
AR19 Reservoir
Cap = Ml
TWL = 1200 m ASL
BWL = 1196 m ASL
Required capacity | Balance
2015 0.04 -0.04
Cost
Mabieleleng demand
Year | kl/d
2015 17
Cost
Ga-Rapoto demand
Year | kl/d
2015 18
Cost

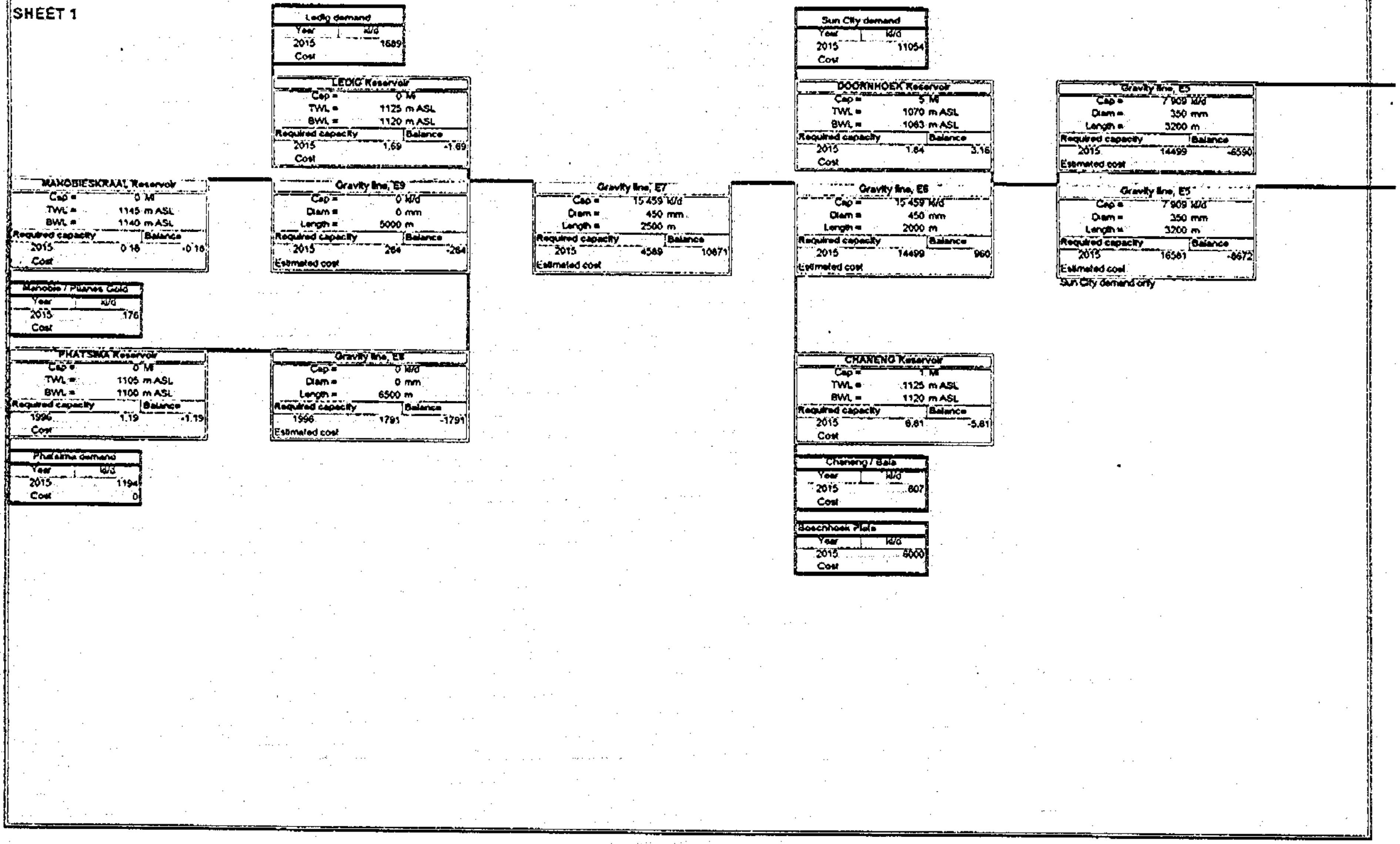
SAULSPOORT : EXISTING INFRASTRUCTURE

SHEET 5



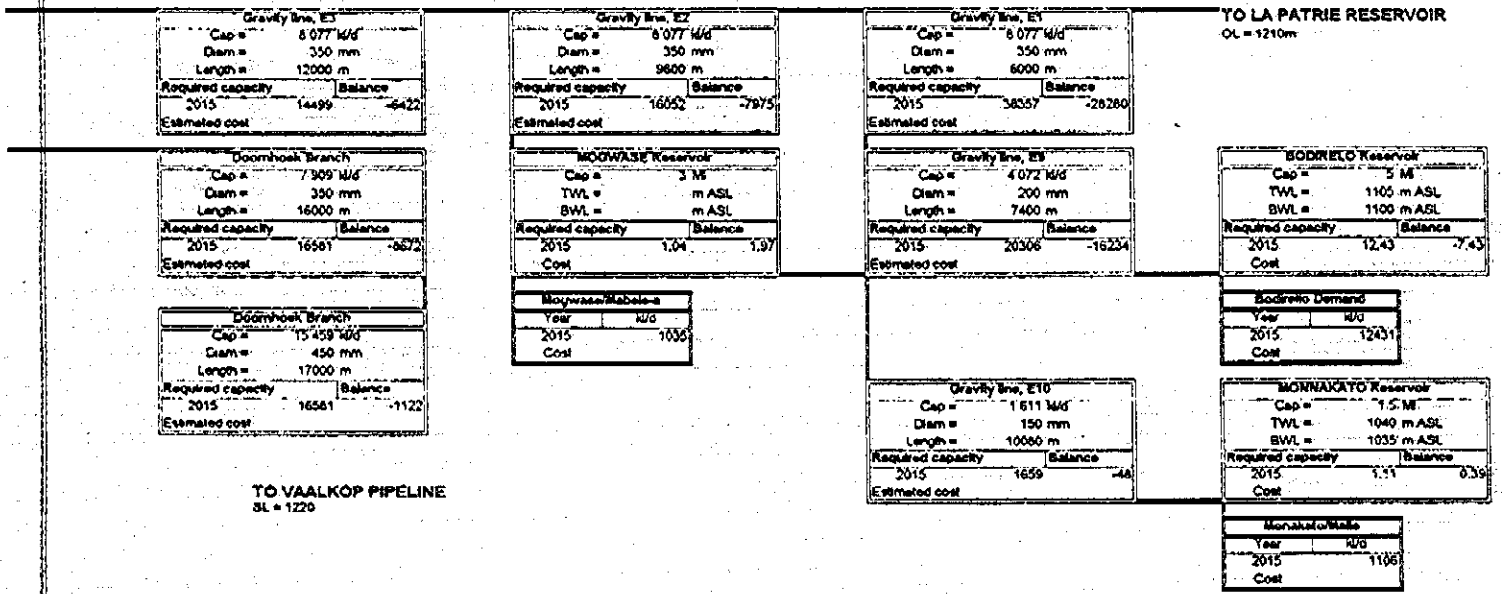
MOGWASE SYSTEM : EXISTING INFRASTRUCTURE

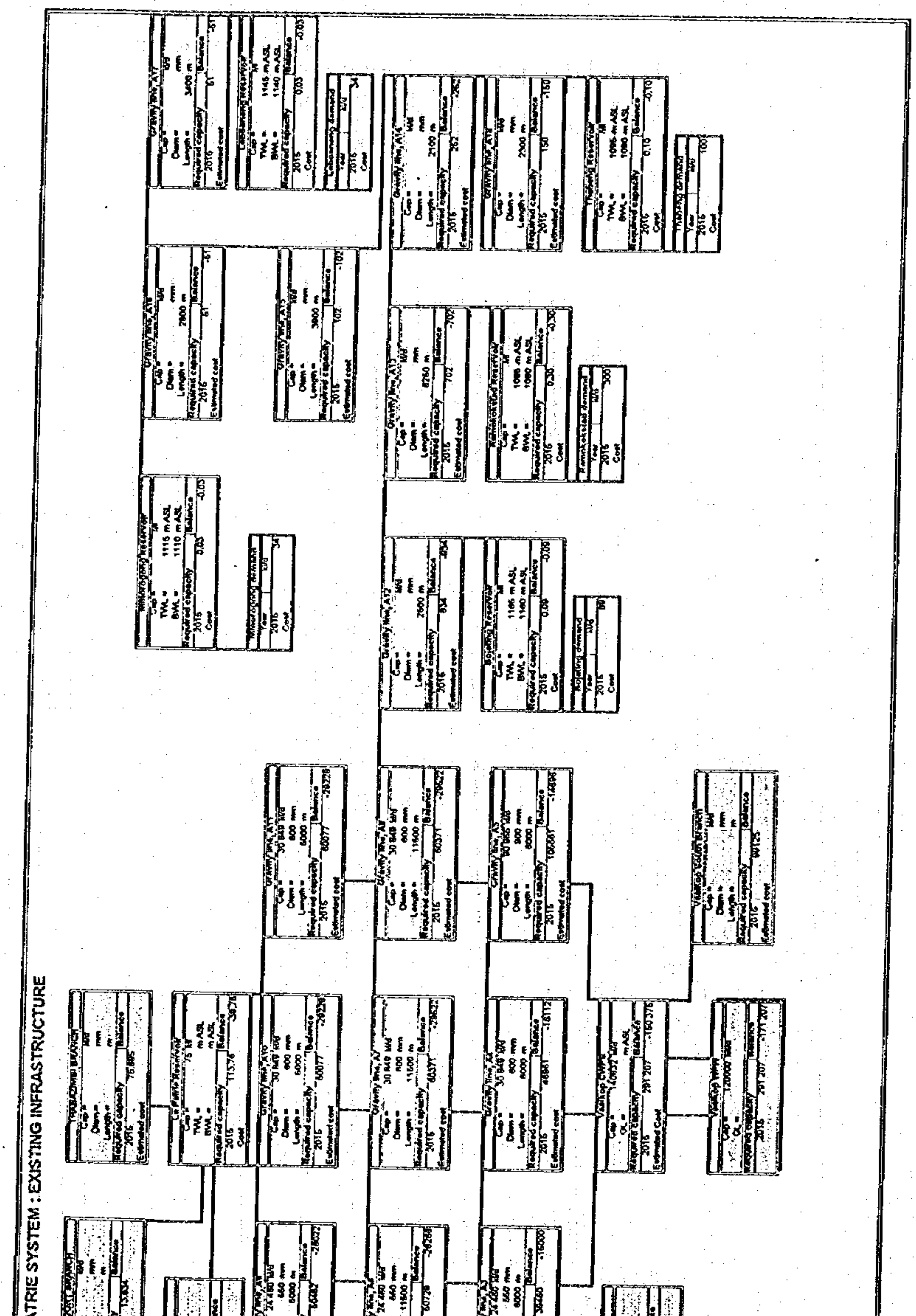
SHEET 1

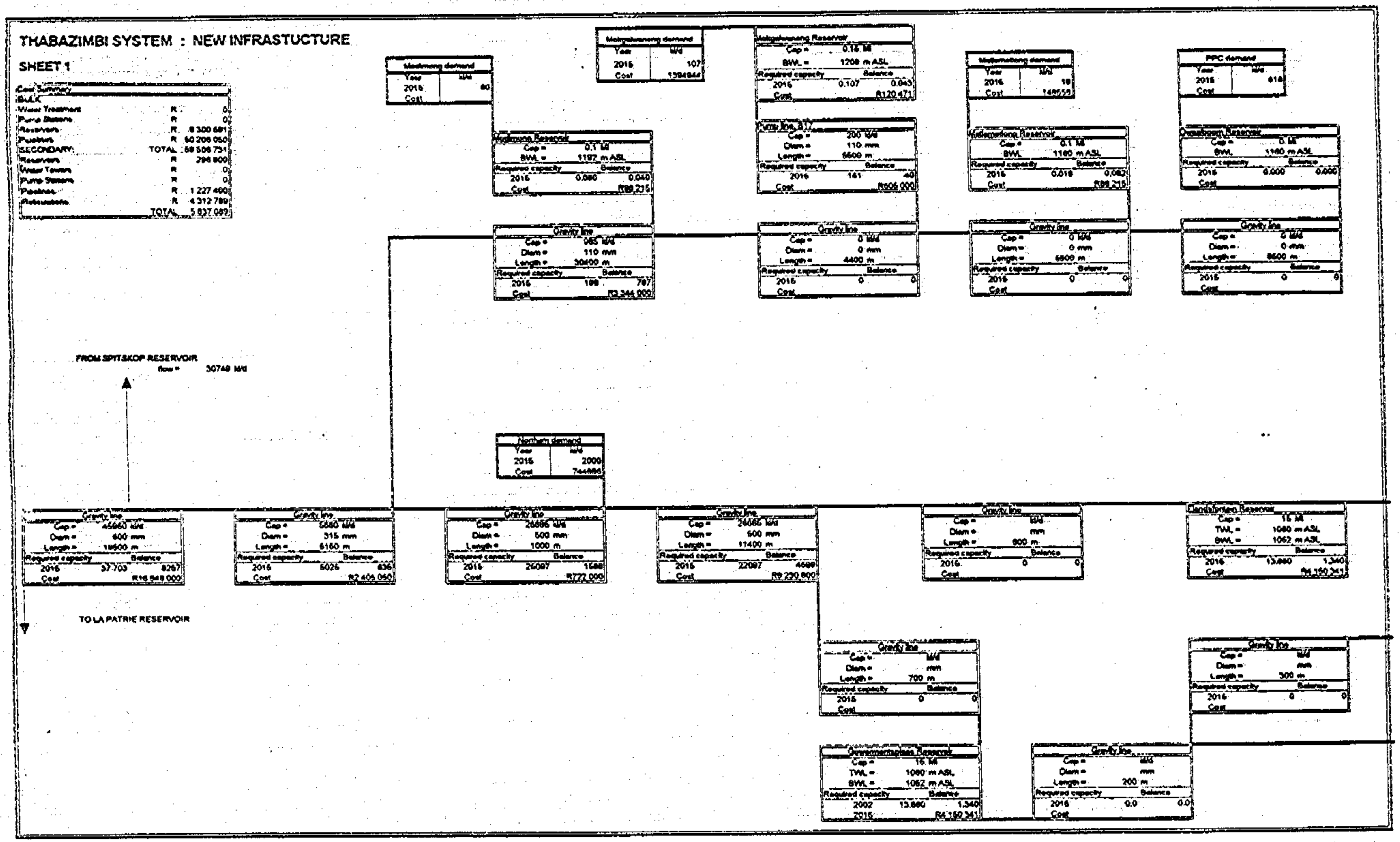


MOGWASE SYSTEM : EXISTING INFRASTRUCTURE

SHEET 2

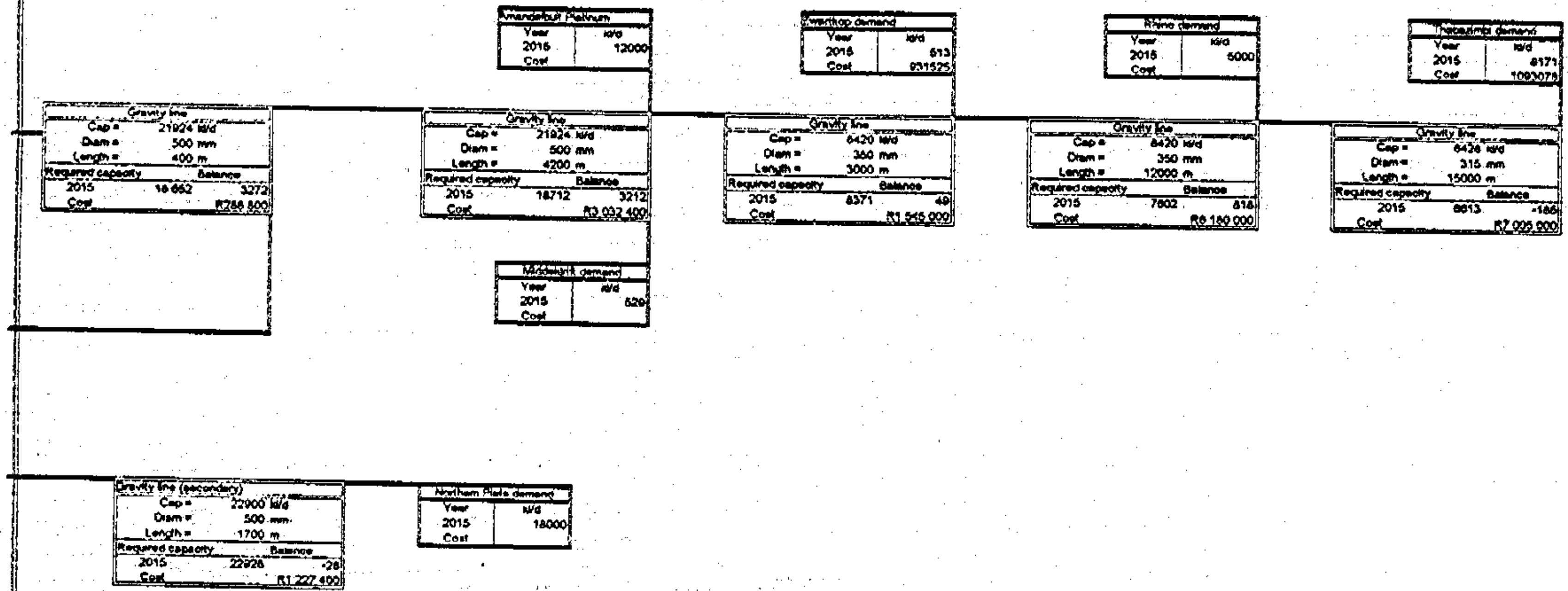



VAALKOP / LA PATRIE SYSTEM : EXISTING INFRASTRUCTURE

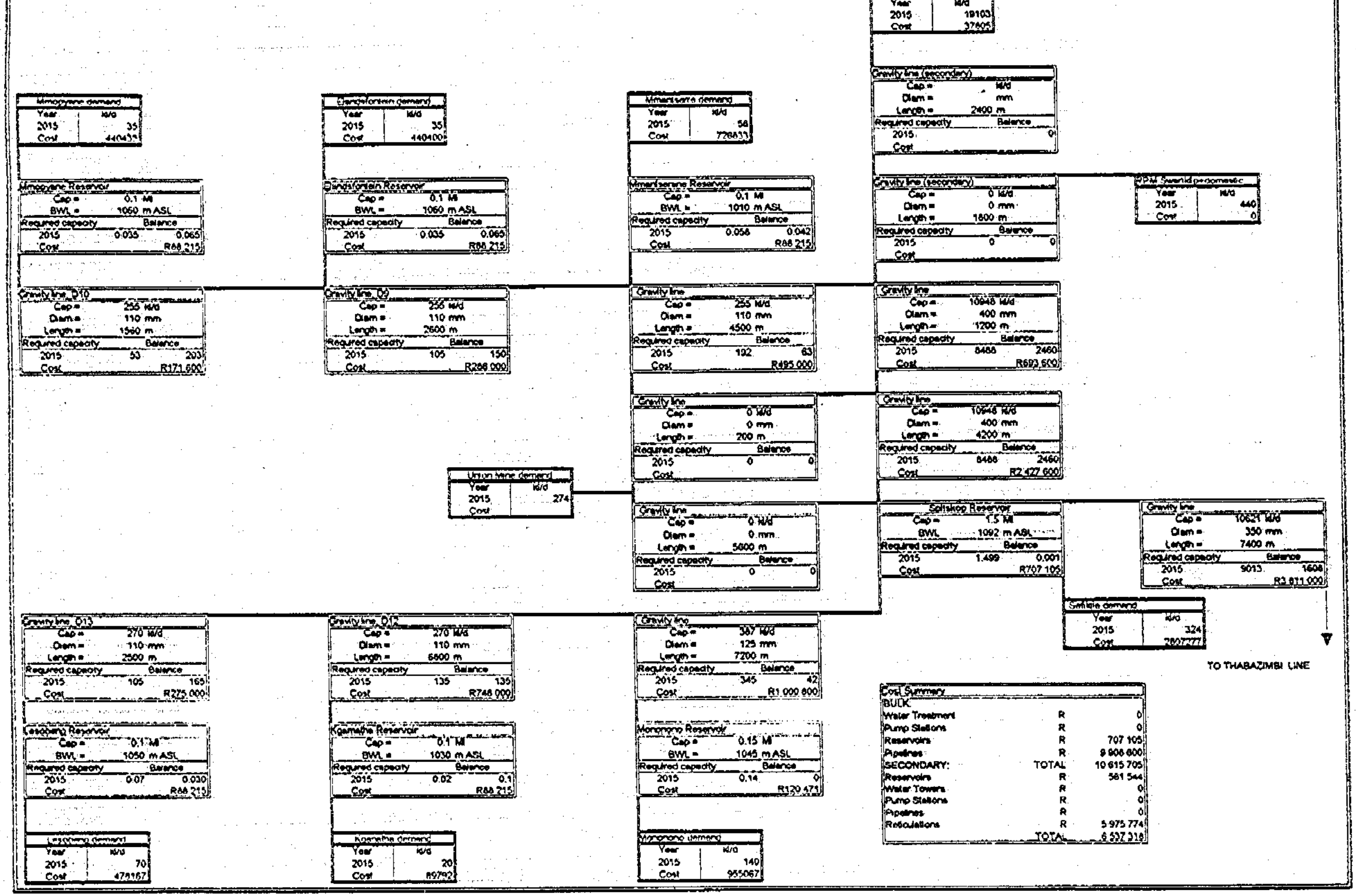

THABAZIMBI SYSTEM : NEW INFRASTUCTURE
SHEET 1
Cost Summary
BULK
TOTAL
SECONDARY:
TOTAL
FROM SPITSKOP RESERVOIR
flow = 30749 kl/d
TO LA PATRIE RESERVOIR
Gravity line
Cap = 45660 kl/d
Diam = 400 mm
Length = 19600 m
Required capacity Balance
2016 37 703 8267
Gravity line
Cap = 5660 kl/d
Diam = 315 mm
Length = 6160 m
Required capacity Balance
2016 5026 636
Cost R2 406 060
Gravity line
Cap = 26686 kl/d
Diam = 500 mm
Length = 1000 m
Required capacity Balance
2016 25097 1588
Cost R722 000
Gravity line
Cap = 26686 kl/d
Diam = 500 mm
Length = 11400 m
Required capacity Balance
2016 22097 4689
Cost R9 230 800
Gravity line
Cap = 985 kl/d
Diam = 110 mm
Length = 30400 m
Required capacity Balance
2016 198 787
Cost R3 344 000
Pump line 817
Cap = 200 kl/d
Diam = 110 mm
Length = 5600 m
Required capacity Balance
2016 161 40
Cost R606 000
Modimong Reservoir
Cap = 0.1 Ml
BWL = 1192 m ASL
Required capacity Balance
2016 0.060 0.040
Cost R99 215
Northern demand
Year kl/d
2016 2000
Modimong demand
Year kl/d
2016 60
Cost
Molomolong demand
Year kl/d
2016 19
PPC demand
Year kl/d
2016 618
Cost
Gravity line
Cap = 0 kl/d
Diam = 0 mm
Length = 4400 m
Required capacity Balance
2016 0 0
Cost
Gravity line
Cap = 0 kl/d
Diam = 0 mm
Length = 5800 m
Required capacity Balance
2016 0 0
Cost
Gravity line
Cap = 0 kl/d
Diam = 0 mm
Length = 8600 m
Required capacity Balance
2016 0 0
Cost
Gravity line
Cap = kl/d
Diam = mm
Length = 800 m
Required capacity Balance
2016 0 0
Cost
Gravity line
Cap = kl/d
Diam = mm
Length = 700 m
Required capacity Balance
2016 0 0
Cost
Gravity line
Cap = kl/d
Diam = mm
Length = 200 m
Required capacity Balance
2016 0.0 0.0
Cost
Gravity line
Cap = kl/d
Diam = mm
Length = 300 m
Required capacity Balance
2016 0 0
Cost
Cap = 16 Ml
TWL = 1080 m ASL
BWL = 1062 m ASL
Required capacity Balance
2016 13.660 1.340
Cost R4 150 341

THABAZIMBI SYSTEM : NEW INFRASTUCTURE

SHEET 2

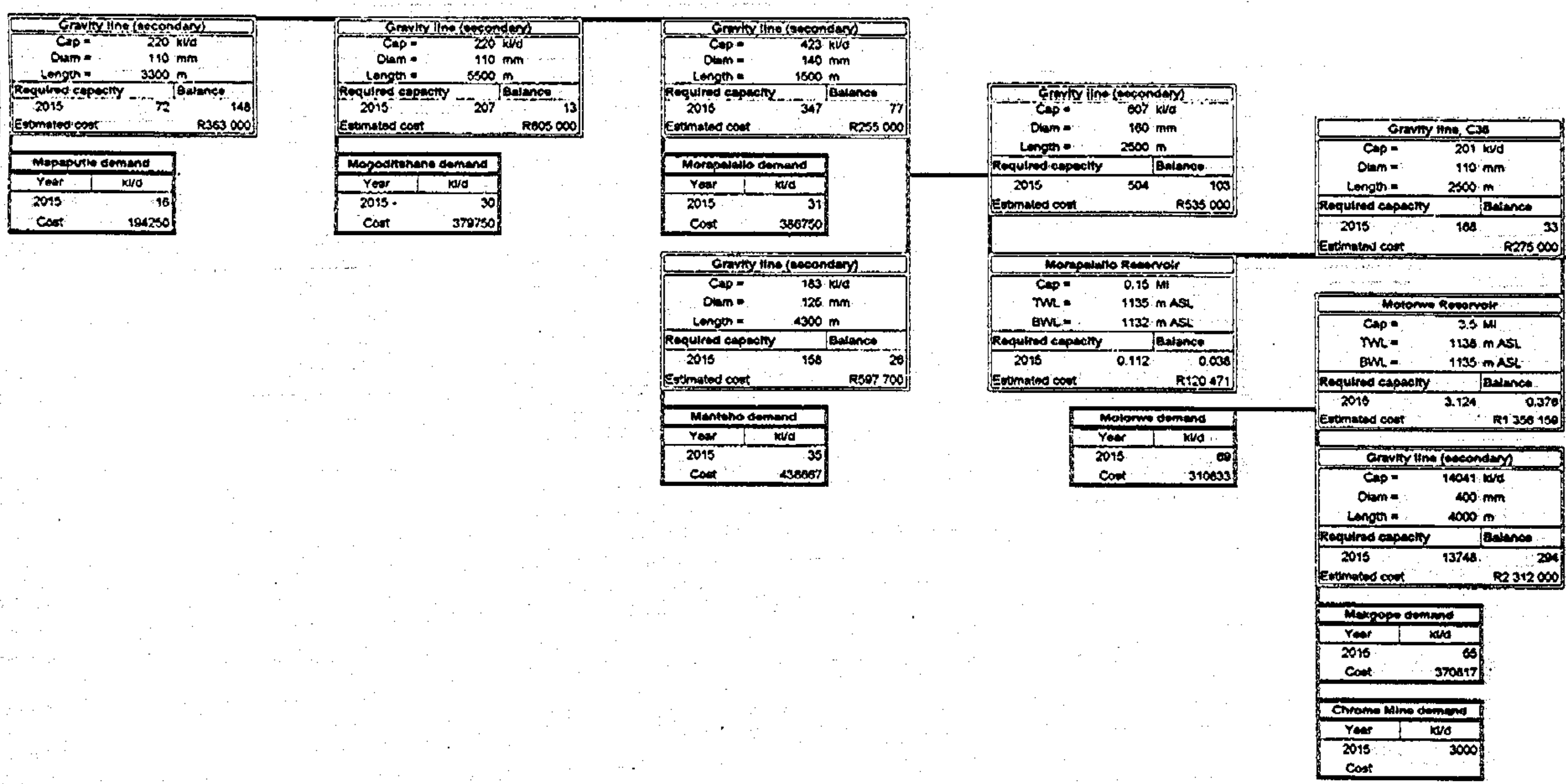


SEFIKILE SYSTEM : NEW INFRASTRUCTURE



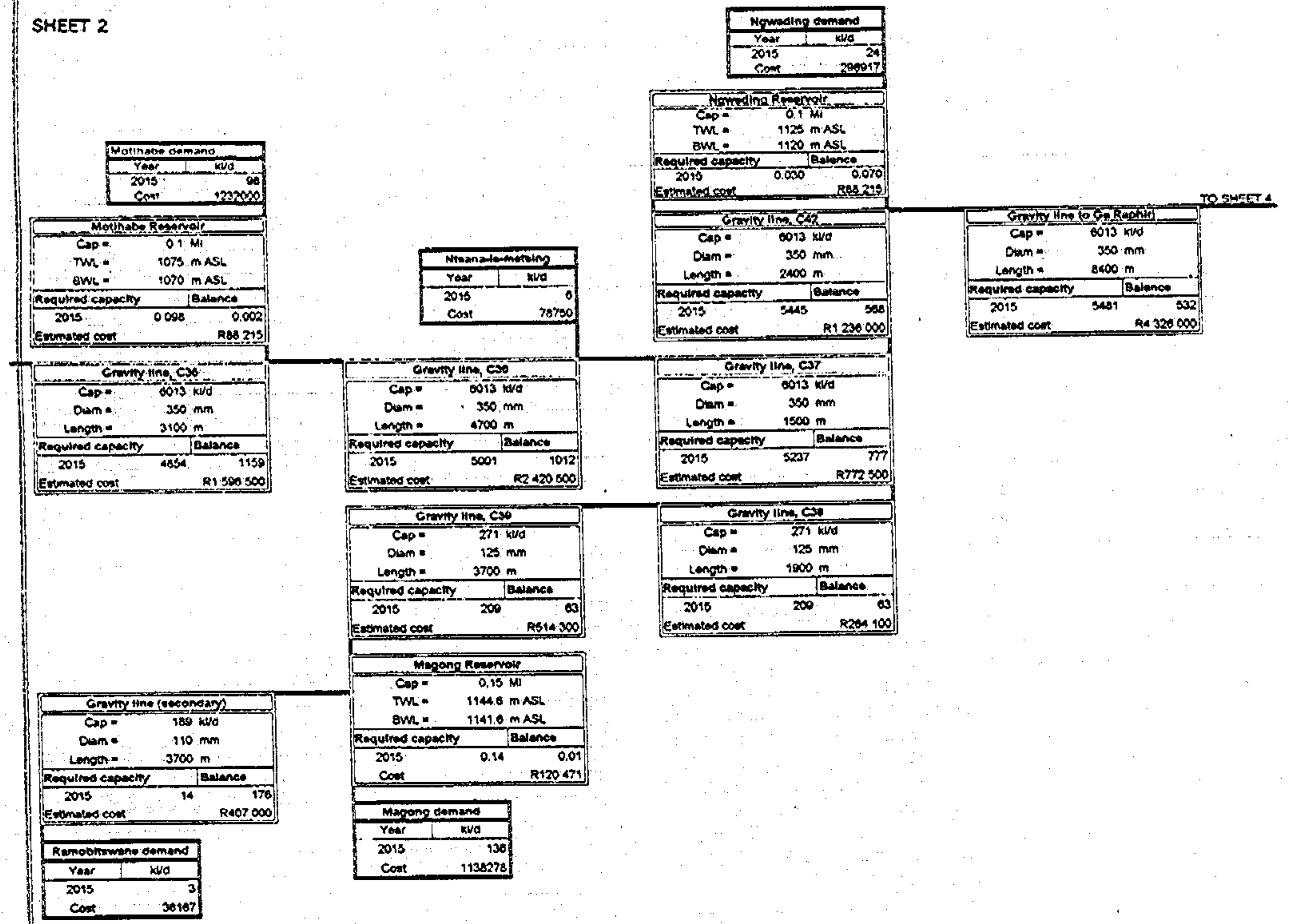
SAULSPOORT : NEW INFRASTRUCTURE

SHEET 1



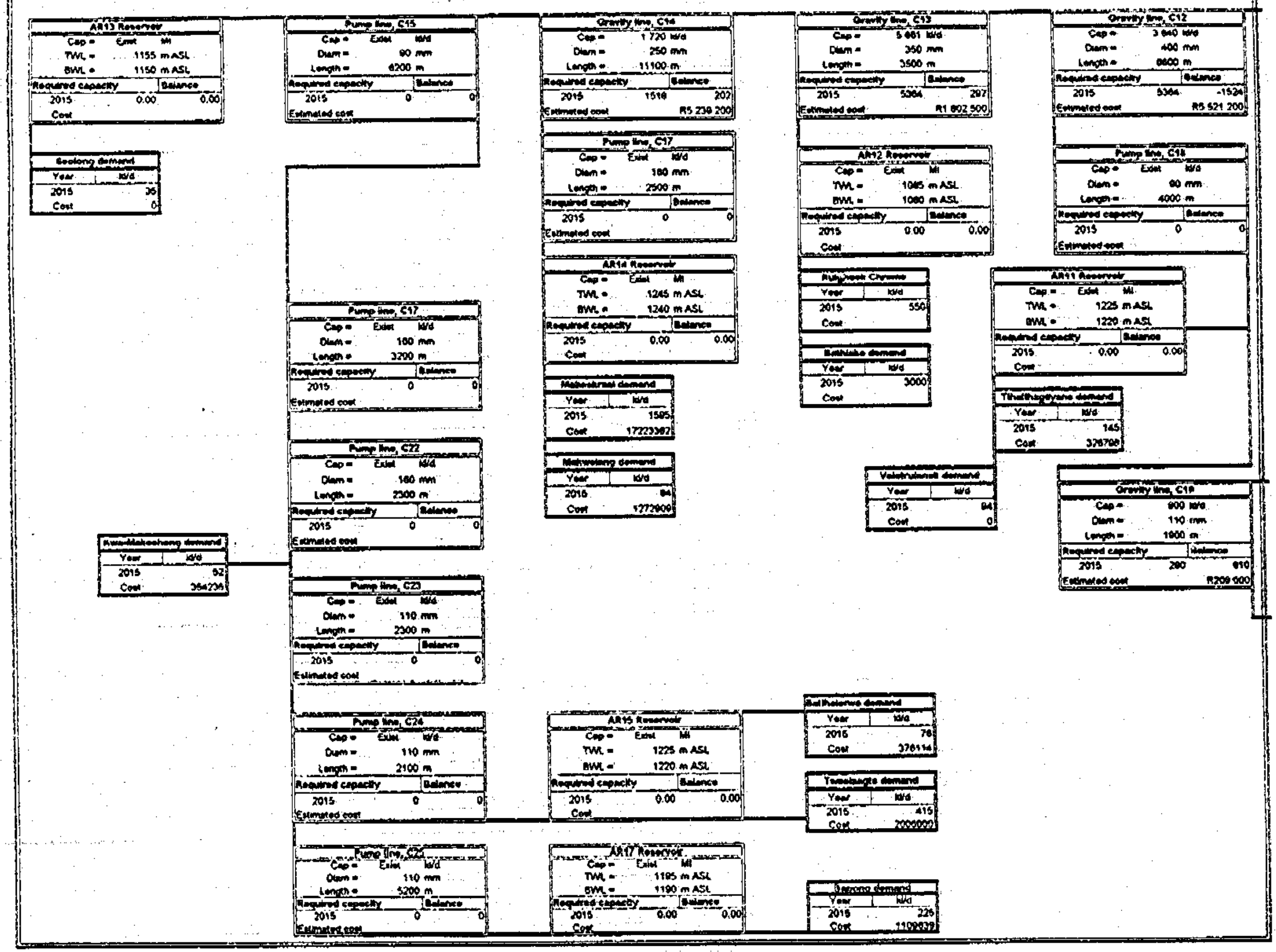
SAULSPOORT : NEW INFRASTRUCTURE

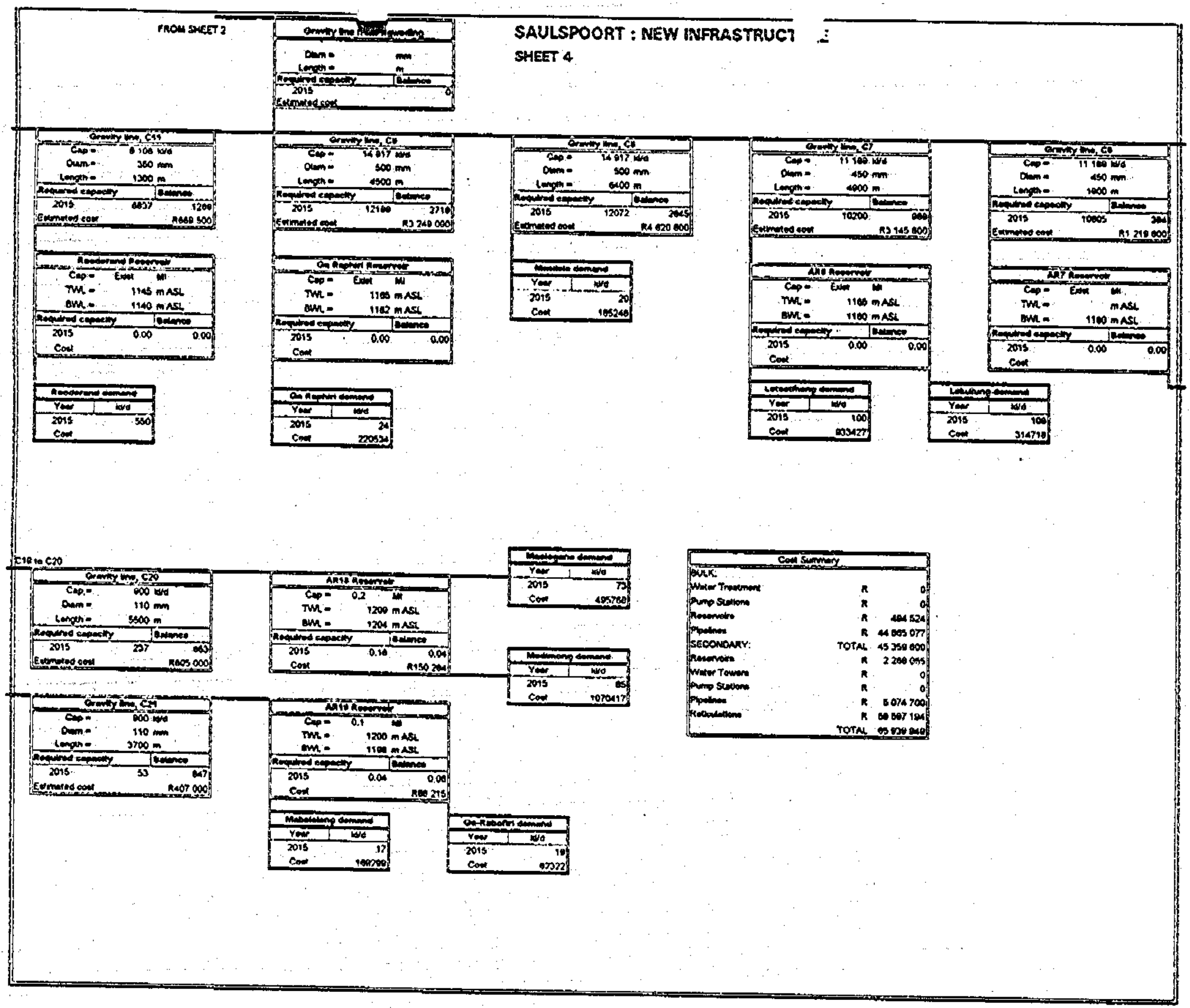
SHEET 2



SAULSPOORT : NEW INFRASTRUCTURE

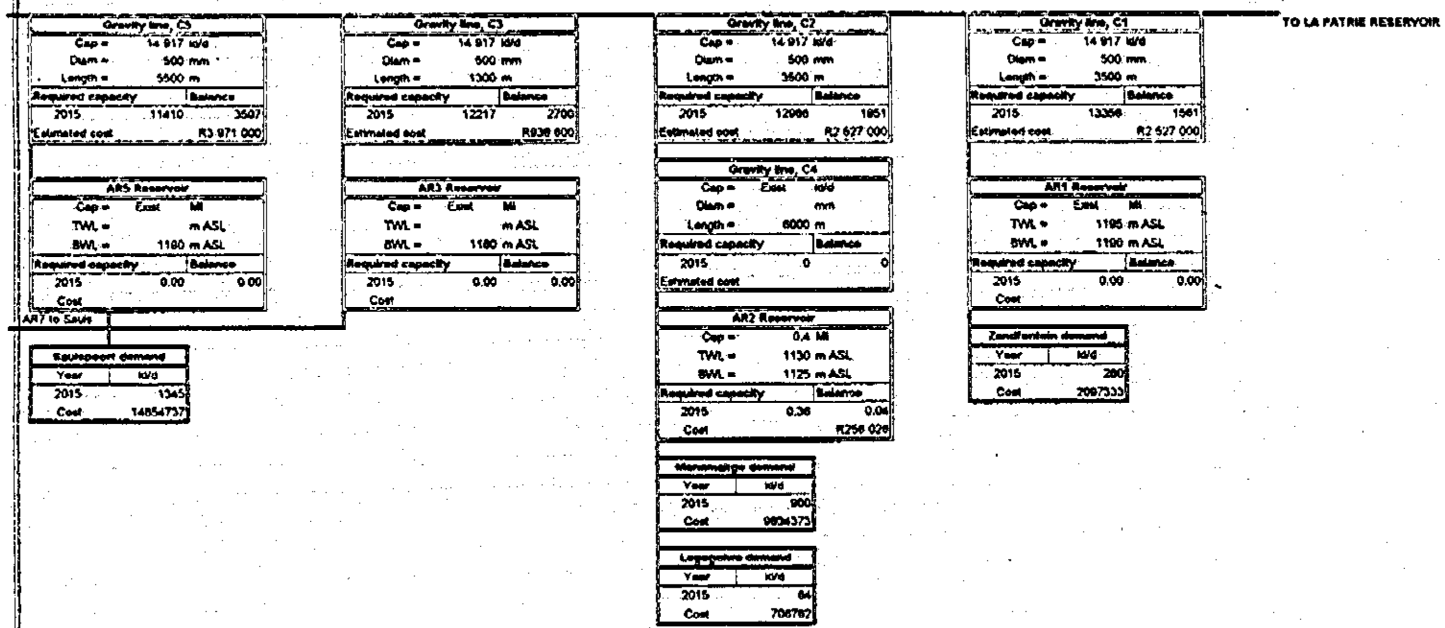
SHEET 3

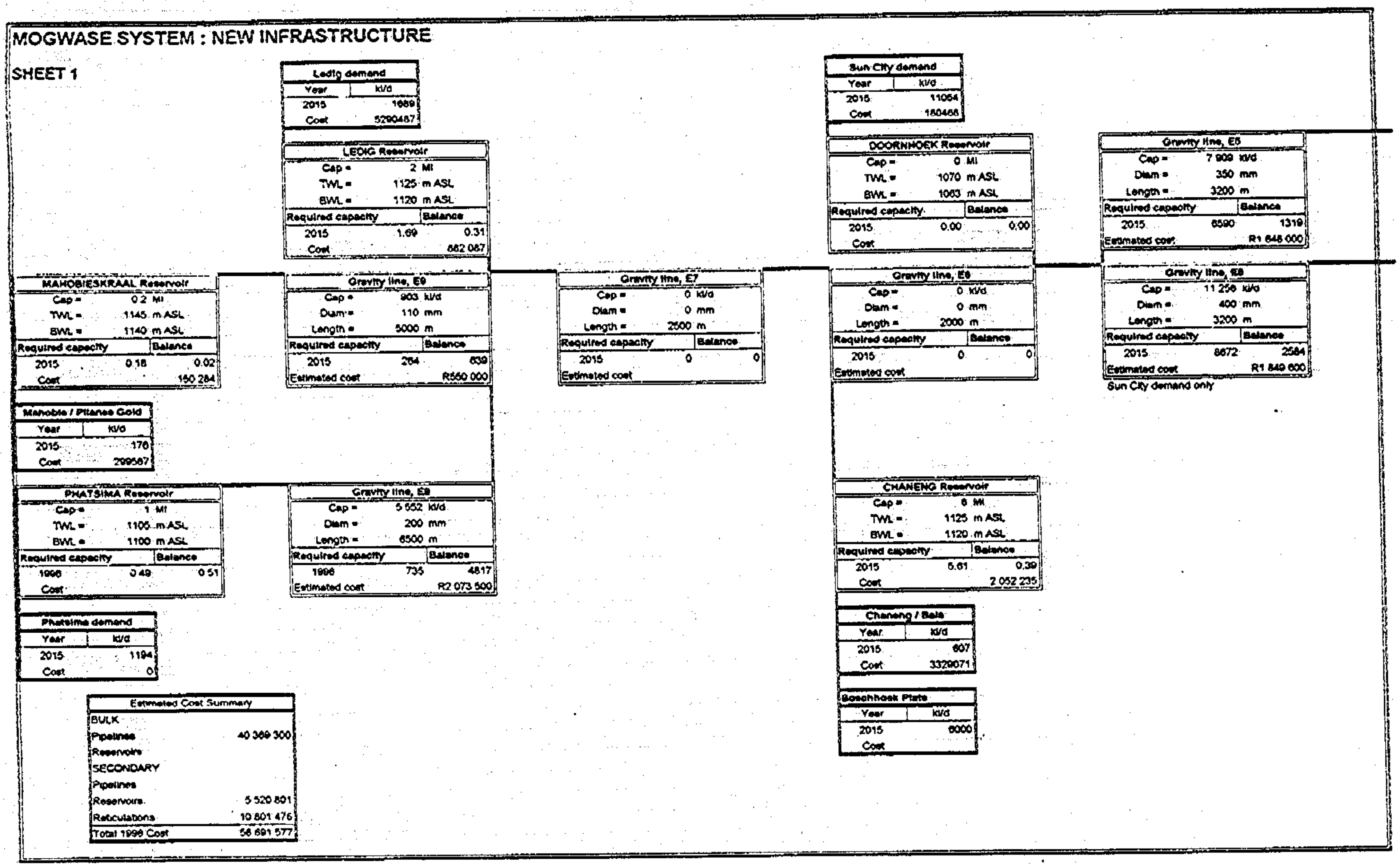



FROM SHEET 2
SAULSPOORT : NEW INFRASTRUCT
SHEET 4
Diam = mm
Length = m
Required capacity
Balance
2015
0
Estimated cost
Gravity line, C11
Cap = 8 106 kl/d
Diam = 350 mm
Length = 1300 m
Required capacity
Balance
2015
Estimated cost
Roodeland Reservoir
Cap = Exist Ml
TWL = 1145 m ASL
BWL = 1140 m ASL
Required capacity
Balance
2015 0.00 0.00
Cost
Roodeland demand
Year kl/d
2015 550
Cost
Gravity line, C9
Cap = 14 917 kl/d
Diam = 500 mm
Length = 4500 m
Required capacity
Balance
2015
Estimated cost
Ga Raphiri Reservoir
Cap = Exist Ml
TWL = 1185 m ASL
BWL = 1182 m ASL
Required capacity
Balance
2015 0.00 0.00
Cost
Ga Raphiri demand
Year kl/d
2015 24
Cost 220534
Cap = 14 917 kl/d
Diam = 500 mm
Length = 6400 m
Required capacity
Balance
2015 12072 2845
Estimated cost R4 620 800
Year kl/d
2015 20
Cost 185248
Gravity line, C7
Cap = 11 189 kl/d
Diam = 450 mm
Length = 4900 m
Required capacity
Balance
2015 10200
Estimated cost R3 145 800
Reservoir
Cap = Exist Ml
TWL = m ASL
BWL = m ASL
Required capacity
Balance
2015 0.00 0.00
Cost
Year kl/d
2015 100
Cost
Cap = 11 189 kl/d
Diam = 450 mm
Length = 1900 m
Required capacity
Balance
2015 10805 384
Estimated cost R1 219 800
AR7 Reservoir
Cap = Exist Ml
TWL = m ASL
BWL = 1180 m ASL
Required capacity
Balance
2015 0.00 0.00
Cost
Year kl/d
2015
Cost 314718
C19 to C20
Gravity line, C20
Cap = 900 kl/d
Diam = 110 mm
Length = 5500 m
Required capacity
Balance
2015 237
Estimated cost
Reservoir
Cap = 0.2 Ml
TWL = 1209 m ASL
BWL = 1204 m ASL
Required capacity
Balance
2015 0.04
Cost R150 264
Year kl/d
2015 73
Cost 495768
Year kl/d
2015 85
Cost 1070417
Gravity line, C21
Cap = 900 kl/d
Diam = 110 mm
Length = 3700 m
Required capacity
Balance
2015 53 847
Estimated cost R407 000
Reservoir
Cap = 0.1 Ml
TWL = 1200 m ASL
Required capacity
Balance
2015 0.04
Cost
Year kl/d
2015 17
Cost
Year kl/d
2015 19
Cost
Cost Summary
BULK:
Water Treatment R 0
Pump Stations R 0
Reservoirs R
Pipelines R
SECONDARY: TOTAL
Reservoirs R
Water Towers R 0
Pump Stations R 0
Pipelines R 5 074 700
R
TOTAL

SAULSPOORT : NEW INFRASTRUCTURE

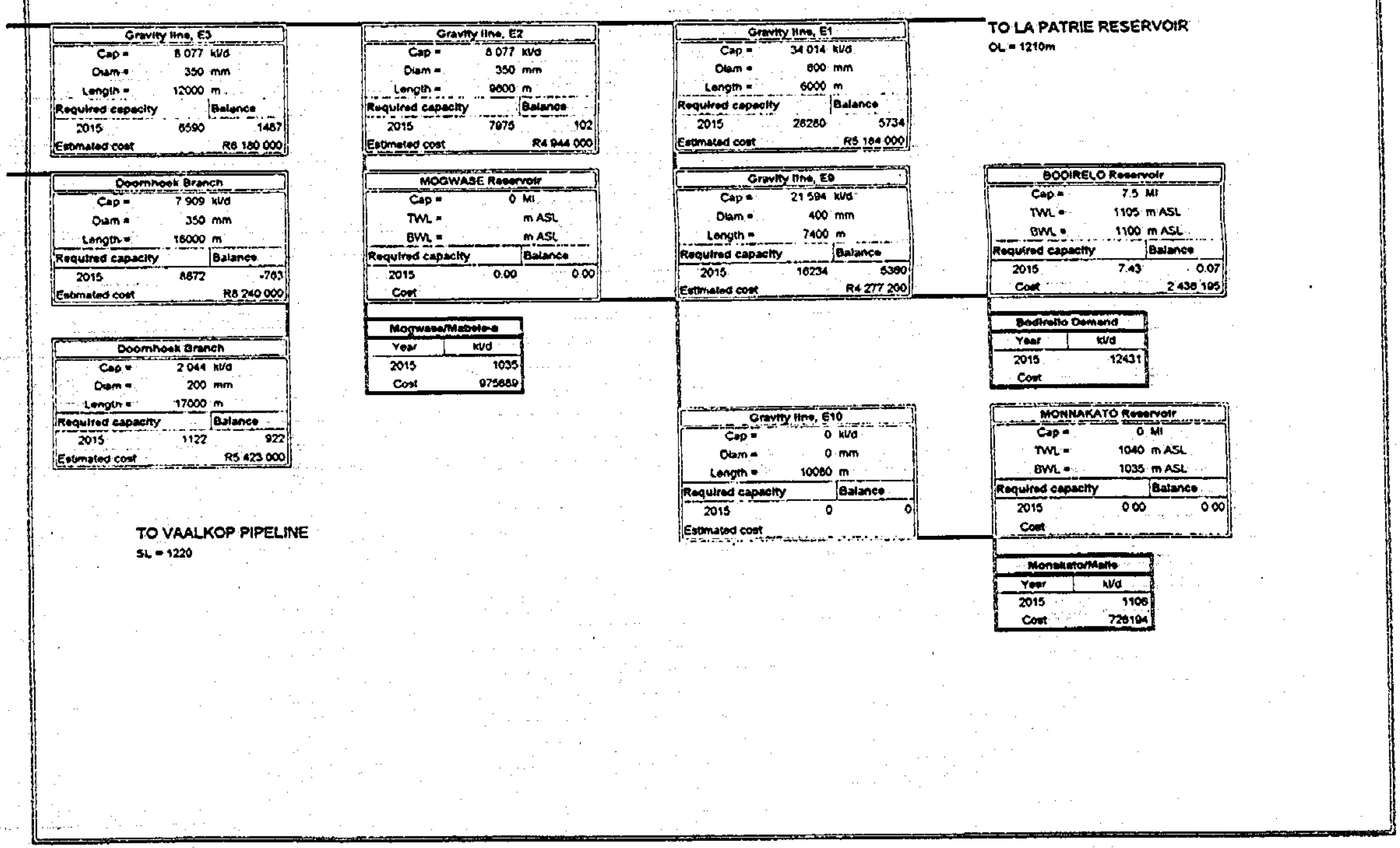
SHEET 5



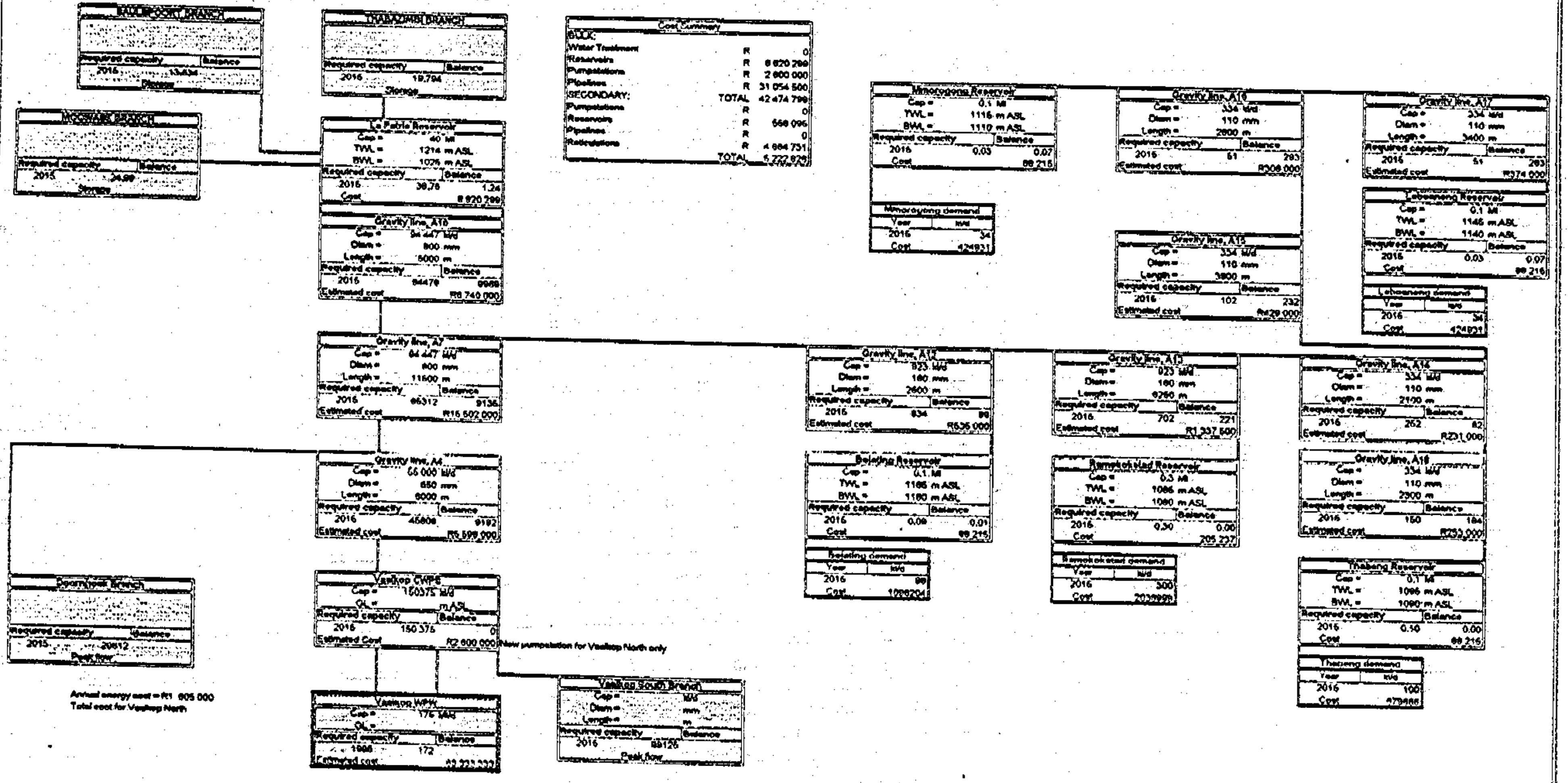

MOGWASE SYSTEM : NEW INFRASTRUCTURE
SHEET 1
Ledig demand
Year kl/d
2015 1689
Cost 5290487
LEDIG Reservoir
Cap = 2 Ml
TWL = 1125 m ASL
BWL = 1120 m ASL
Required capacity Balance
2015 1.69 0.31
Cost 662 087
MAHOBIESKRAAL Reservoir
Cap = 0.2 Ml
TWL = 1145 m ASL
BWL = 1140 m ASL
Required capacity Balance
2015 0.18 0.02
Cost 150 284
Gravity line, E9
Cap = 903 kl/d
Diam = 110 mm
Length = 5000 m
Required capacity Balance
2015 264 639
Estimated cost R550 000
Mahobie / Pilanes Gold
Year kl/d
2015 176
Cost 299567
PHATSIMA Reservoir
Cap = 1 Ml
TWL = 1105 m ASL
BWL = 1100 m ASL
Required capacity Balance
1996 0.49 0.51
Cost
Gravity line, E8
Cap = 5 552 kl/d
Diam = 200 mm
Length = 6500 m
Required capacity Balance
1996 735 4817
Estimated cost R2 073 500
Phatsima demand
Year kl/d
2015 1194
Cost 0
Estimated Cost Summary
BULK
Pipelines 40 369 300
Reservoirs
SECONDARY
Pipelines
Reservoirs 5 520 801
Reticulations 10 801 476
Total 1996 Cost 56 691 577
Gravity line, E7
Cap = 0 kl/d
Diam = 0 mm
Length = 2500 m
Required capacity Balance
2015 0 0
Estimated cost
Sun City demand
Year kl/d
2015 11064
Cost 160466
DOORNHOEK Reservoir
Cap = 0 Ml
TWL = 1070 m ASL
BWL = 1063 m ASL
Required capacity Balance
2015 0.00 0.00
Cost
Gravity line, E6
Cap = 0 kl/d
Diam = 0 mm
Length = 2000 m
Required capacity Balance
2015 0 0
Estimated cost
CHANENG Reservoir
Cap = 6 Ml
TWL = 1125 m ASL
BWL = 1120 m ASL
Required capacity Balance
2015 5.61 0.39
Cost 2 052 235
Chaneng / Bala
Year kl/d
2015 607
Cost 3329071
Boschhoek Plats
Year kl/d
2015 6000
Cost
Gravity line, E5
Cap = 7 909 kl/d
Diam = 350 mm
Length = 3200 m
Required capacity Balance
2015 6590 1319
Estimated cost R1 648 000
Gravity line, E8
Cap = 11 256 kl/d
Diam = 400 mm
Length = 3200 m
Required capacity Balance
2015 8672 2584
Estimated cost R1 849 600
Sun City demand only

MOGWASE SYSTEM : NEW INFRASTRUCTURE

SHEET 2



VAALKOP / LA PATRIE SYSTEM : NEW INFRASTRUCTURE



VAALKOP SOUTH SUPPLY AREA

TABLE OF CONTENTS

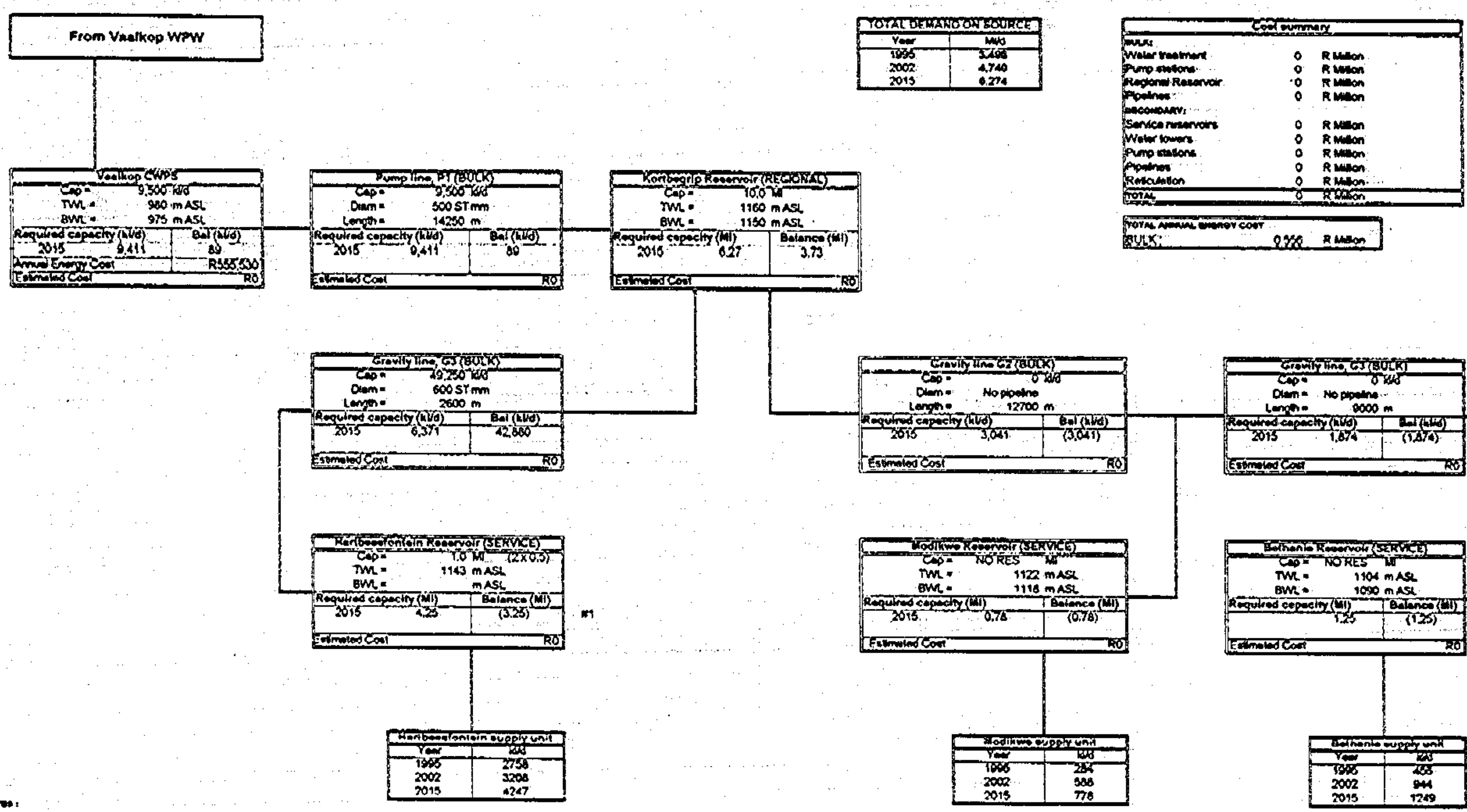
NOTE: NO NEW CAPITAL WORKS HAVE BEEN PROPOSED FOR BOSPOORT SUPPLY BLOCK.

COST SUMMARY FOR INFRASTRUCTURE

NAME OF SUPPLY AREA :	VAALKOP SOUTH SUPPLY AREA	
INCLUDING SUPPLY BLOCKS :	1. Bethanie Supply Block	
	2. Vaalkop Southern and Bospoort Supply Blocks	
POPULATION SERVED (2015) :	305,247	
AADD in mcm/a (2015) :	26.72	
BULK COST :	**QUANTITY**	**COST (R million)**
Water Purification Works	Kl/d (SDD)	
1. Vaalkop WPW	60,000	21.667
Pump Stations	Kl/d (SDD)	
A : Capital Cost		
1. Vaalkop CWPS	100,000	7.500
2. Townlands Booster PS	45,000	1.935
B : Annual Energy Cost (Not incl'd with Total)		
1. Vaalkop CWPS	-	*4.103*
2. Townlands Booster PS	-	*0.590*
Reservoirs (Regional)	Ml	
1. Bospoort Reservoir	2 x 35 = 70 Ml	15.920
Pipelines (Bulk)	km	
1. 110/9 PVC	5	0.445
2. 160/9 PVC	0.5	0.087
3. 250/9 PVC	9	3.456
4. 315/9 PVC	14	8.106
5. 450 ST	10	6.420
6. 700 ST	7.2	7.214
7. 800 ST	2.3	3.100
8. 950 ST	1.9	3.137
9. 1000 ST	45.73	79.936
10. 1050 ST	1.95	3.559
11. 1100 ST	0.37	0.710
Sub Total Construction Cost		163.193
Engineering Fees (15 %)		24.479
VAT (14 %)		26.274
Project Contingency (20%)		42.789
TOTAL : Bulk Cost		256.735
Bulk Cost per Capita (Rands)		R841

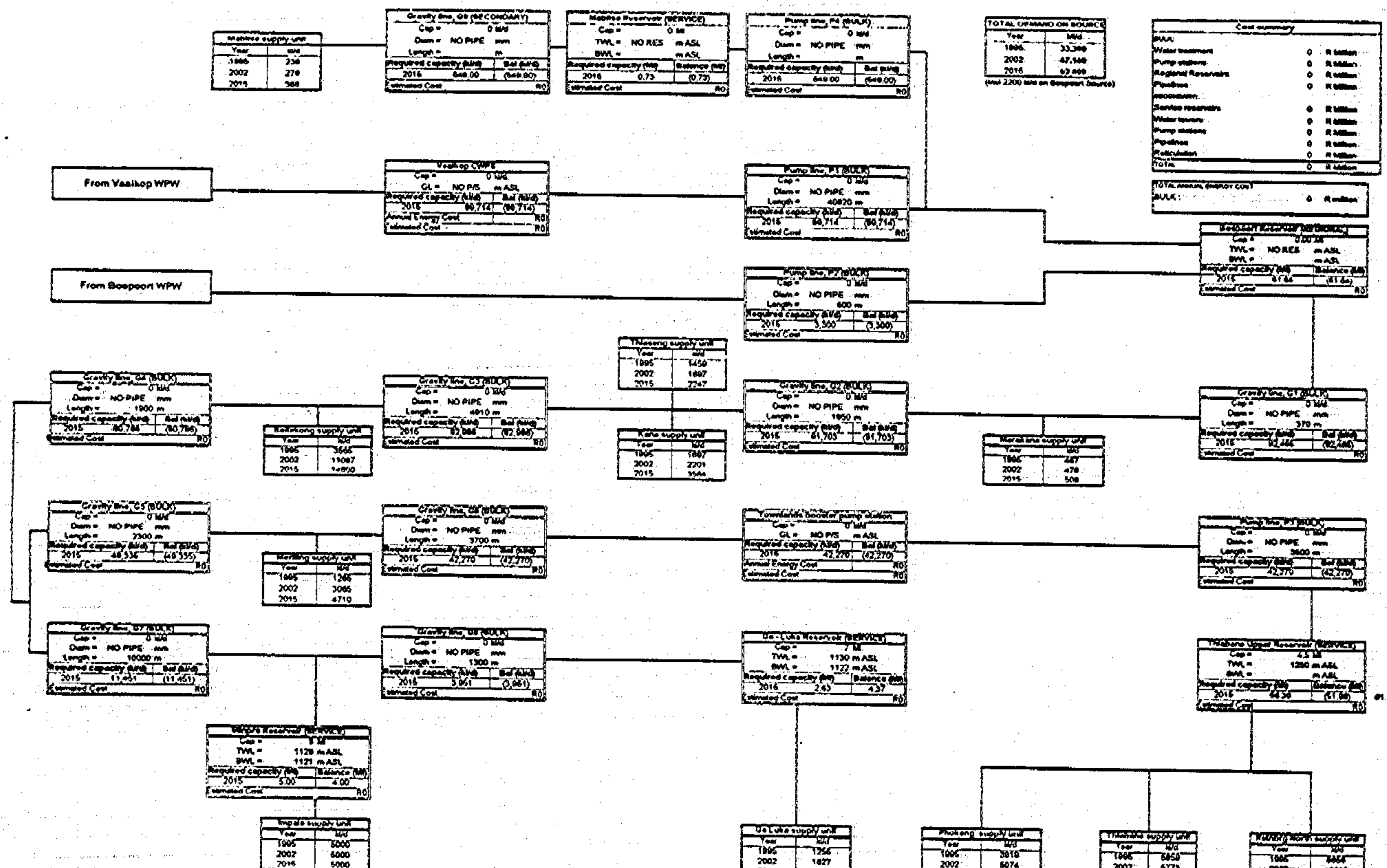
SECONDARY COST :	QUANTITY	COST (R million)
Reservoirs (Service)	Ml	
1. Modikwe Reservoir	2 x 0.6 = 1.2	0.699
2. Bethanie Reservoir	2 x 0.9 = 1.8	0.955
3. Thlabane Upper Reservoir	5	1.784
4. Mabitse Reservoir	1	0.518
Water Towers	Ml	
N/A	NIL	NIL
Pump Stations (Secondary)	Kl/d	
A : Capital Cost		
N/A	NIL	NIL
B : Annual Energy Cost (Not Incl'd with Total)		
N/A	NIL	NIL
Pipelines (Secondary)	km	
1. 140/9 PVC	6.2	0.849
Reticulation	km	
1. Bethanie Supply Block		12.347
2. Vaalkop Southern and Bospoort Supply Blocks		80.076
Sub Total Construction Cost		97.228
Engineering Fees (15 %)		14.584
VAT (14 %)		15.654
Project Contingency (20%)		25.493
TOTAL : Secondary Cost		152.960
Secondary Cost per Capita (Rands)		R501
GRAND TOTAL COST		409.695
Grand Total Cost per Capita (R)		R1,342

BETHANIE SUPPLY BLOCK : EXISTING INFRASTRUCTURE



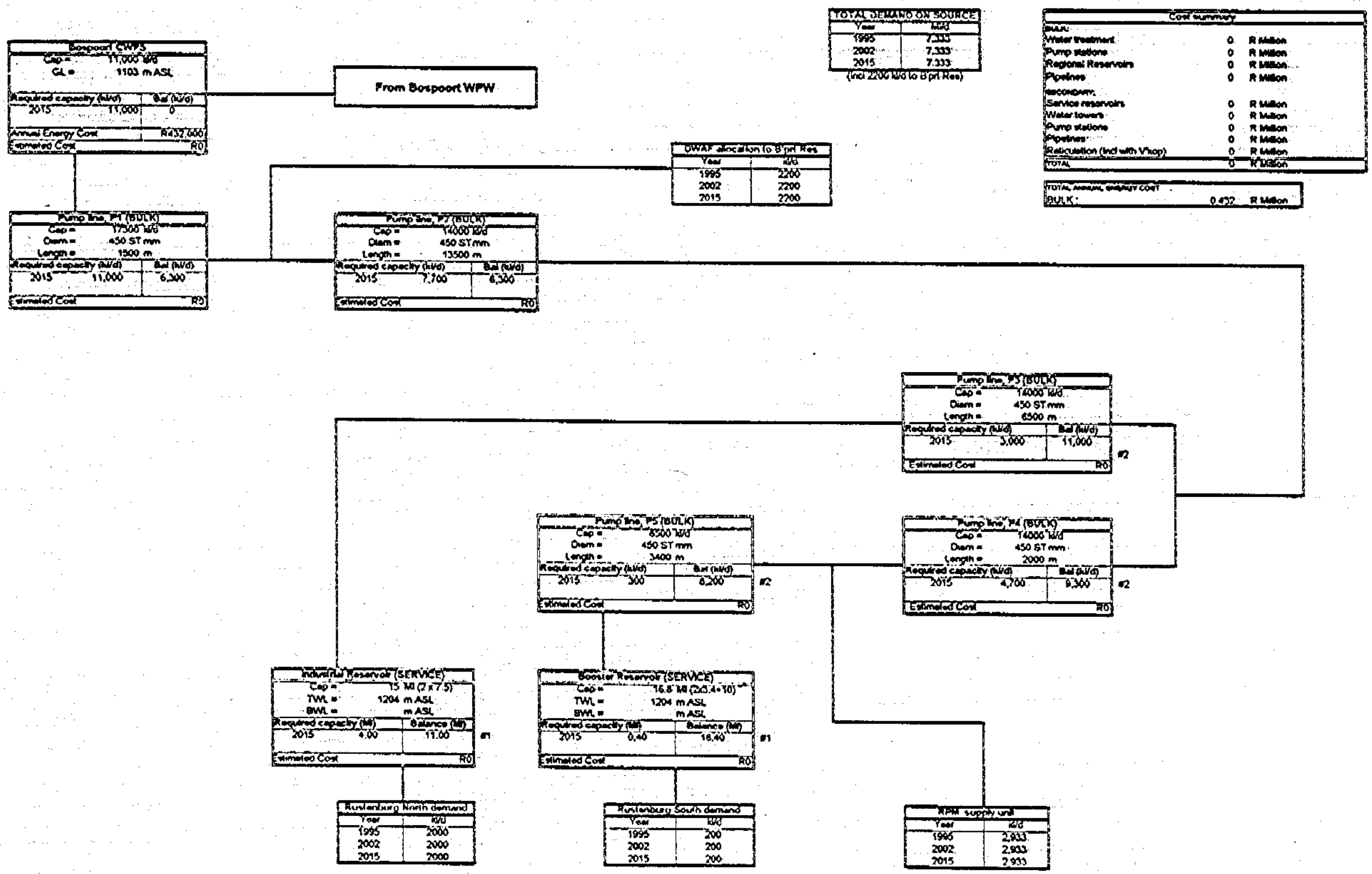
NOTES :
#1 Storage for Hartbeesfontein provided in Kortbegrip Reservoir

VAALKOP SOUTHERN SUPPLY BLOCK : EXISTING INFRASTRUCTURE



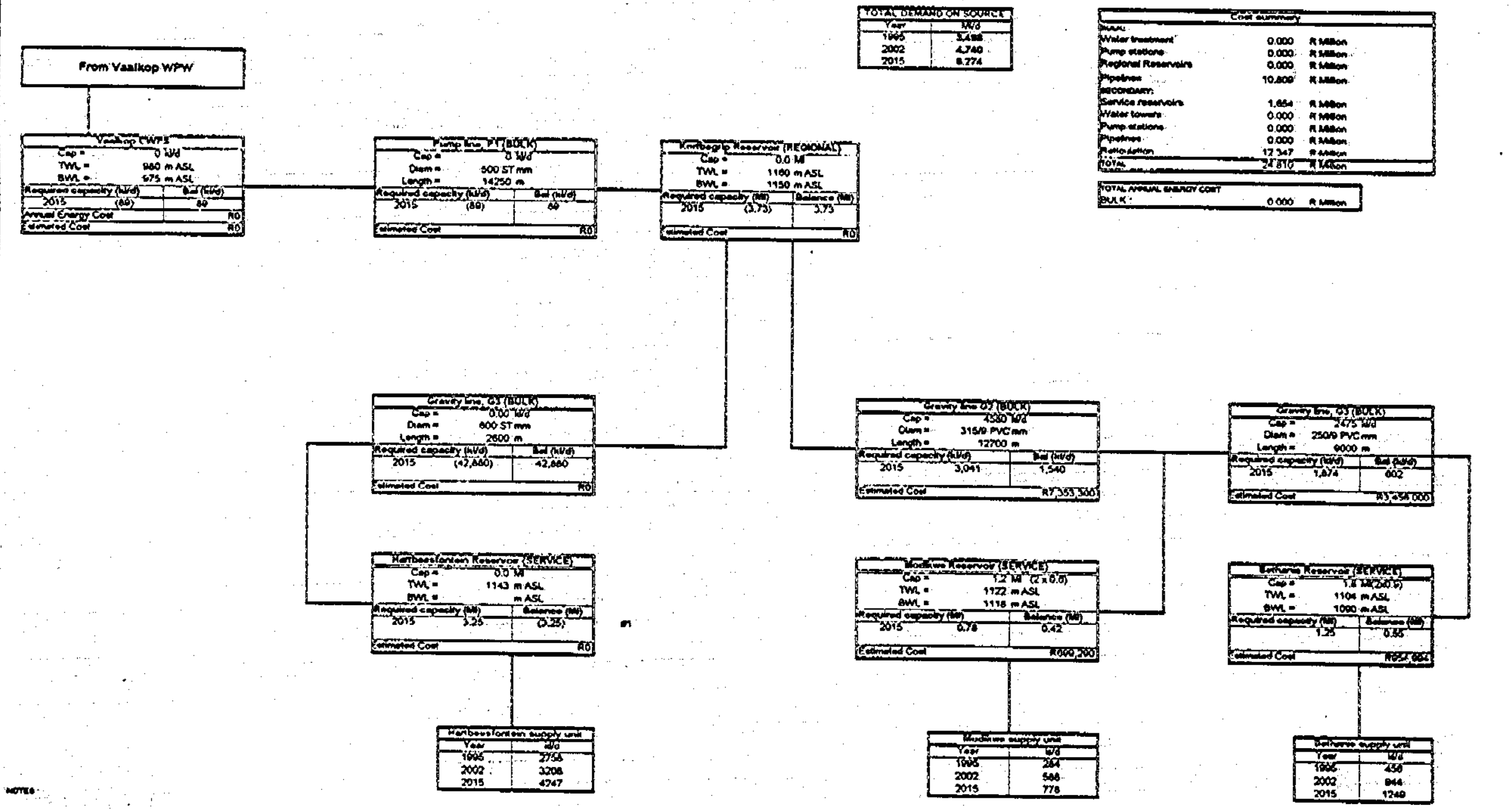
NOTES
#1 Additional service storage provided elsewhere by Rustenburg TLC and Bafokeng Tribal Authority

BOSPOORT SUPPLY BLOCK : EXISTING INFRASTRUCTURE



NOTES :
#1 Industrial and Booster reservoirs also provide storage for supplies from other supply blocks.
#2 Intermittent pumping to either Rustenburg North OR Rustenburg South, with low load factor.

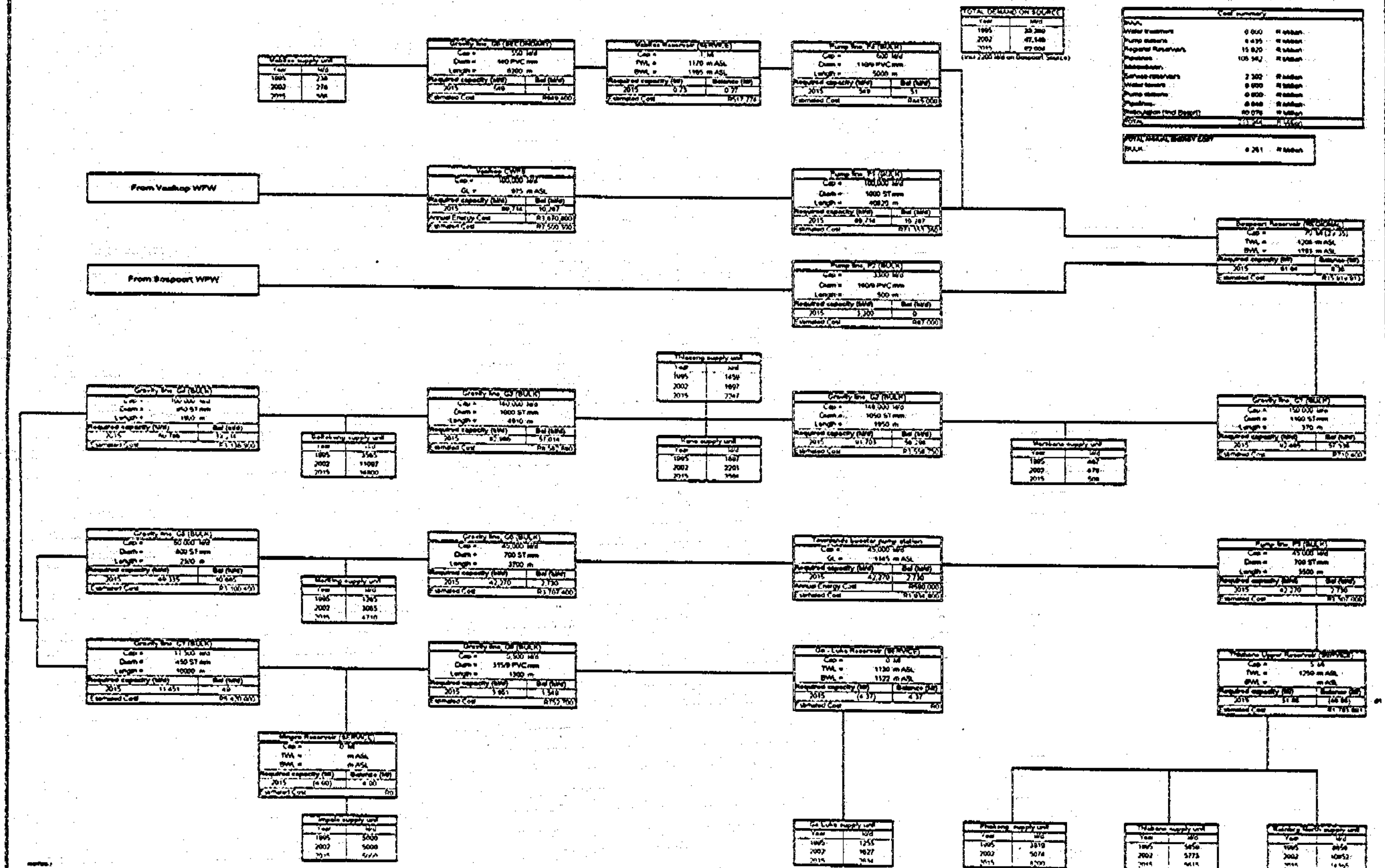
BETHANIE SUPPLY BLOCK : NEW INFRASTRUCTURE



NOTES:

#1 Storage for Hartbeesfontein provided in Koribegrip Reservoir.

VAALKOP SOUTHERN SUPPLY BLOCK : NEW INFRASTRUCTURE



notes:
#1 Additional service storage provided elsewhere by Rustenburg TLC and Bafokeng Tribal Authority

BARNARDSVLEI SUPPLY AREA

TABLE OF CONTENTS

NOTE: NO NEW CAPITAL WORKS HAVE BEEN PROPOSED FOR BARNARDSVLEI WESTERN SUPPLY BLOCK.

COST SUMMARY FOR INFRASTRUCTURE

NAME OF SUPPLY AREA :	BARNARDSVLEI SUPPLY AREA
INCLUDING SUPPLY BLOCKS :	1. Barnardsvlei Western Supply Block
	2. Barnardsvlei Eastern Supply Block
POPULATION SERVED (2015) :	406,832
AADD in mcm/a (2015) :	42.16

BULK COST :	QUANTITY	COST (R million)
Water Purification Works	Kl/d (SDD)	
N/A	NIL	NIL
Pump Stations	Kl/d (SDD)	
A : Capital Cost		
N/A	NIL	NIL
. Annual Energy Cost (Not Incl'd with Total)		
N/A	NIL	NIL
Reservoirs (Regional)	Ml	
N/A	NIL	NIL
Pipelines (Bulk)	km	
1. 300 ST	13	6.071
Sub Total Construction Cost		6.071
Engineering Fees (15 %)		0.911
VAT (14 %)		0.977
Project Contingency (20%)		1.592
TOTAL : Bulk Cost		9.551
Bulk Cost per Capita (Rands)		R23

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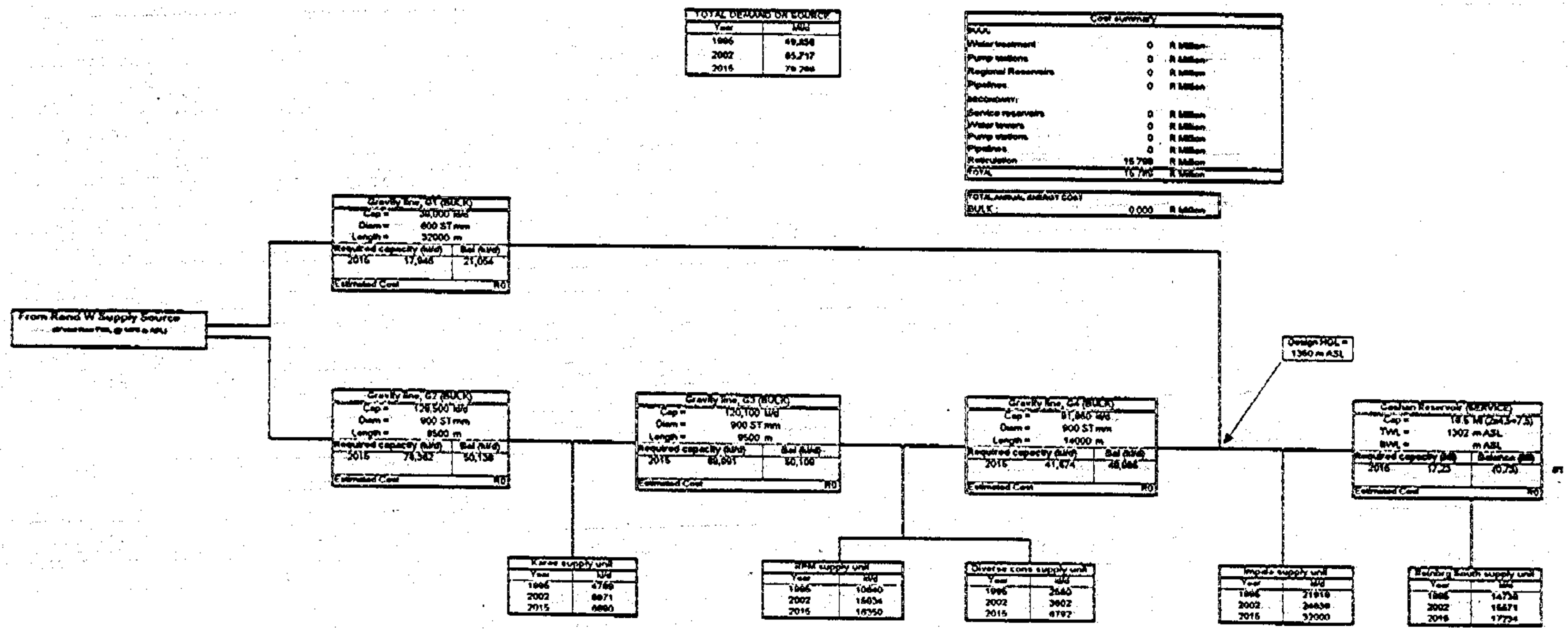
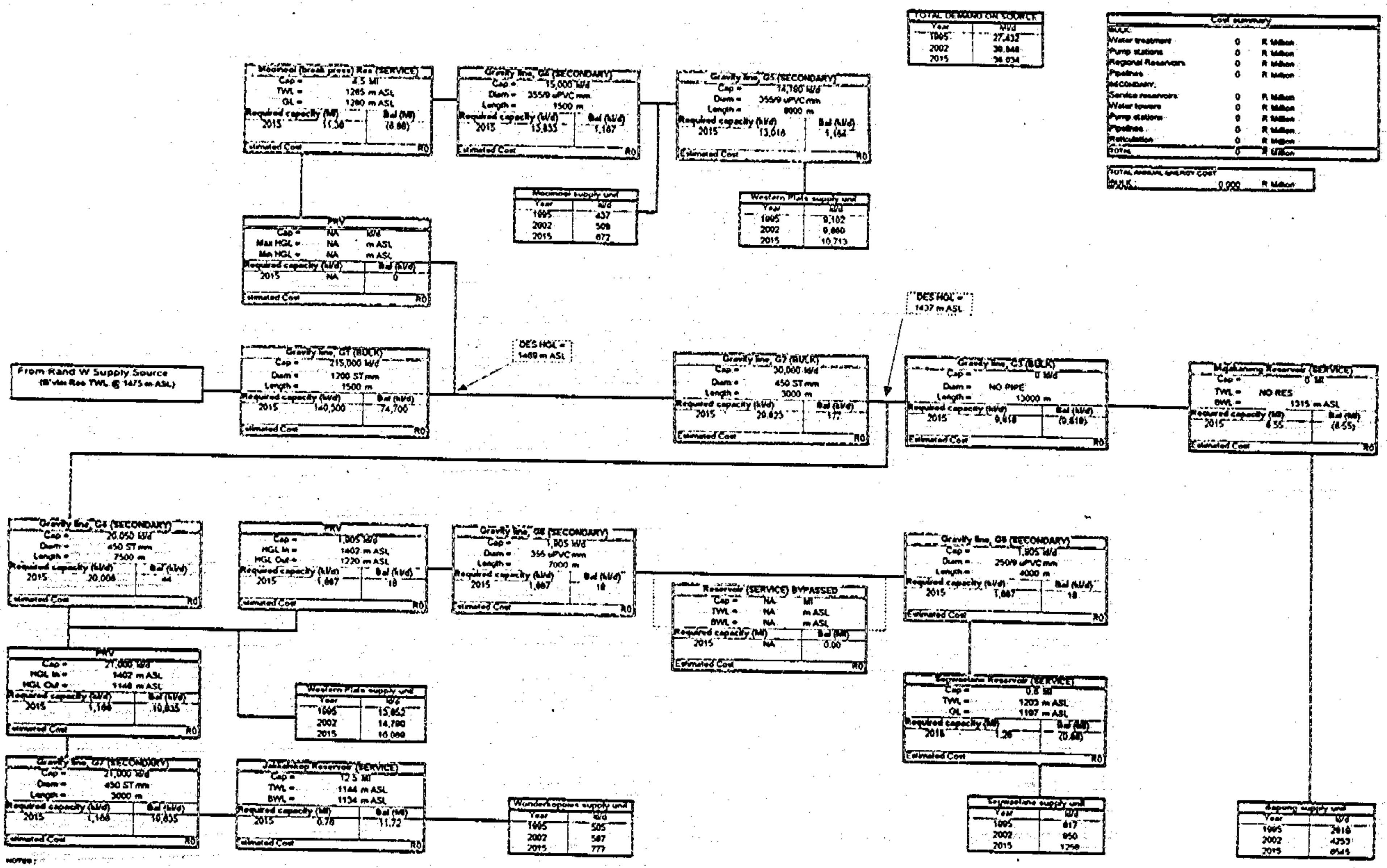
SECONDARY COST :	QUANTITY	COST (R million)
Reservoirs (Service)	Ml	
1. Majakaneng Reservoir	7	2.310
2. Segwaelane Reservoir	1	0.518
Water Towers	Ml	
N/A	NIL	NIL
Pump Stations (Secondary)	Kl/d	
A : Capital Cost		
N/A	NIL	NIL
B : Annual Energy Cost (Not Incl'd with Total)		
N/A	NIL	NIL
Pipelines (Secondary)	km	
N/A	NIL	NIL
Reticulation	km	
1. Barnardsvlei Western Supply Block		15.789
2. Barnardsvlei Eastern Supply Block		8.651
Sub Total Construction Cost		27.268
Engineering Fees (15 %)		4.090
VAT (14 %)		4.390
Project Contingency (20%)		7.150
TOTAL : Secondary Cost		42.898
Secondary Cost per Capita (Rands)		R105
GRAND TOTAL COST		52.449
Grand Total Cost per Capita (R)		R129

BARNARDSVLEI WESTERN SUPPLY BLOCK : EXISTING INFRASTRUCTURE



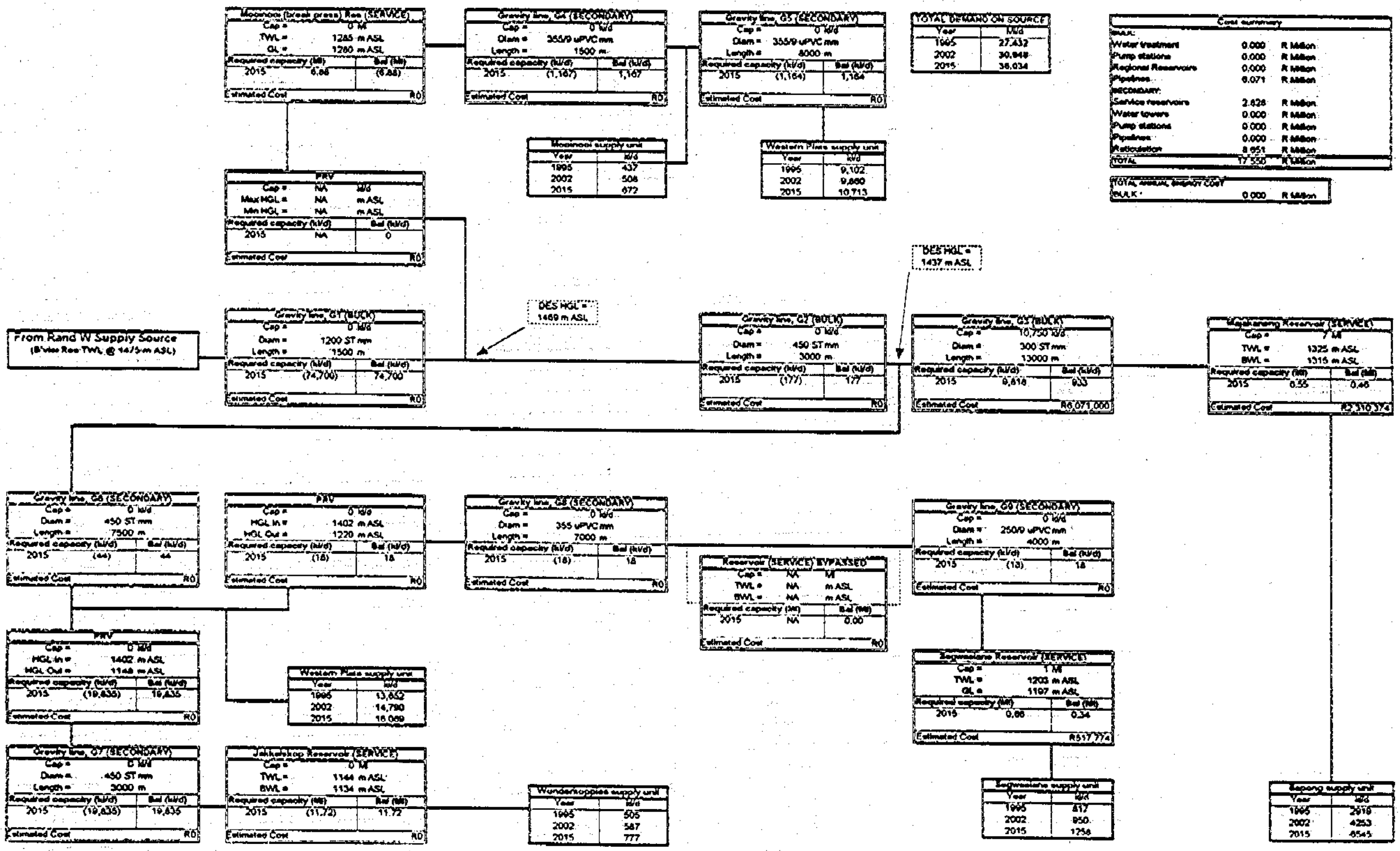
NOTES :
#1 Other reservoirs provide storage for Rusteburg South.

BARNARDSVLEI EASTERN SUPPLY BLOCK : EXISTING INFRASTRUCTURE



NOTES:
Western Platinum Mine has separate surface storage facilities for mining purposes.

BARNARDSVLEI EASTERN SUPPLY BLOCK : NEW INFRASTRUCTURE



NOTES :
Western Platinum Mine has separate surface storage facilities for mining purposes.

KOSTER SUPPLY AREA

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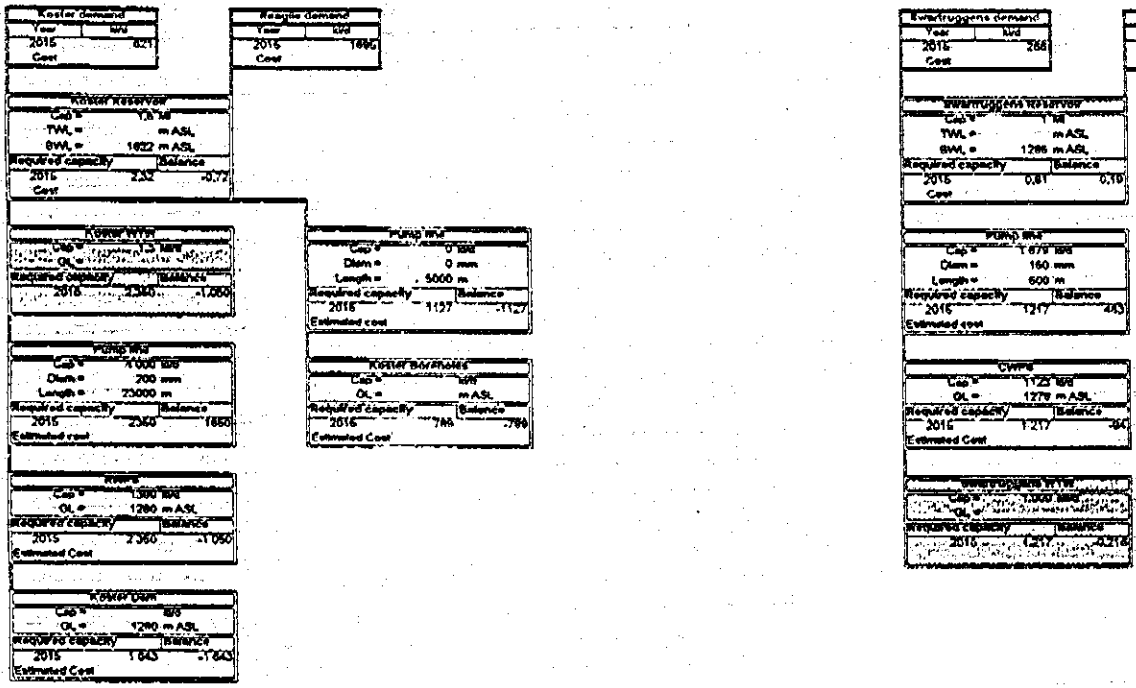
COST SUMMARY FOR INFRASTRUCTURE

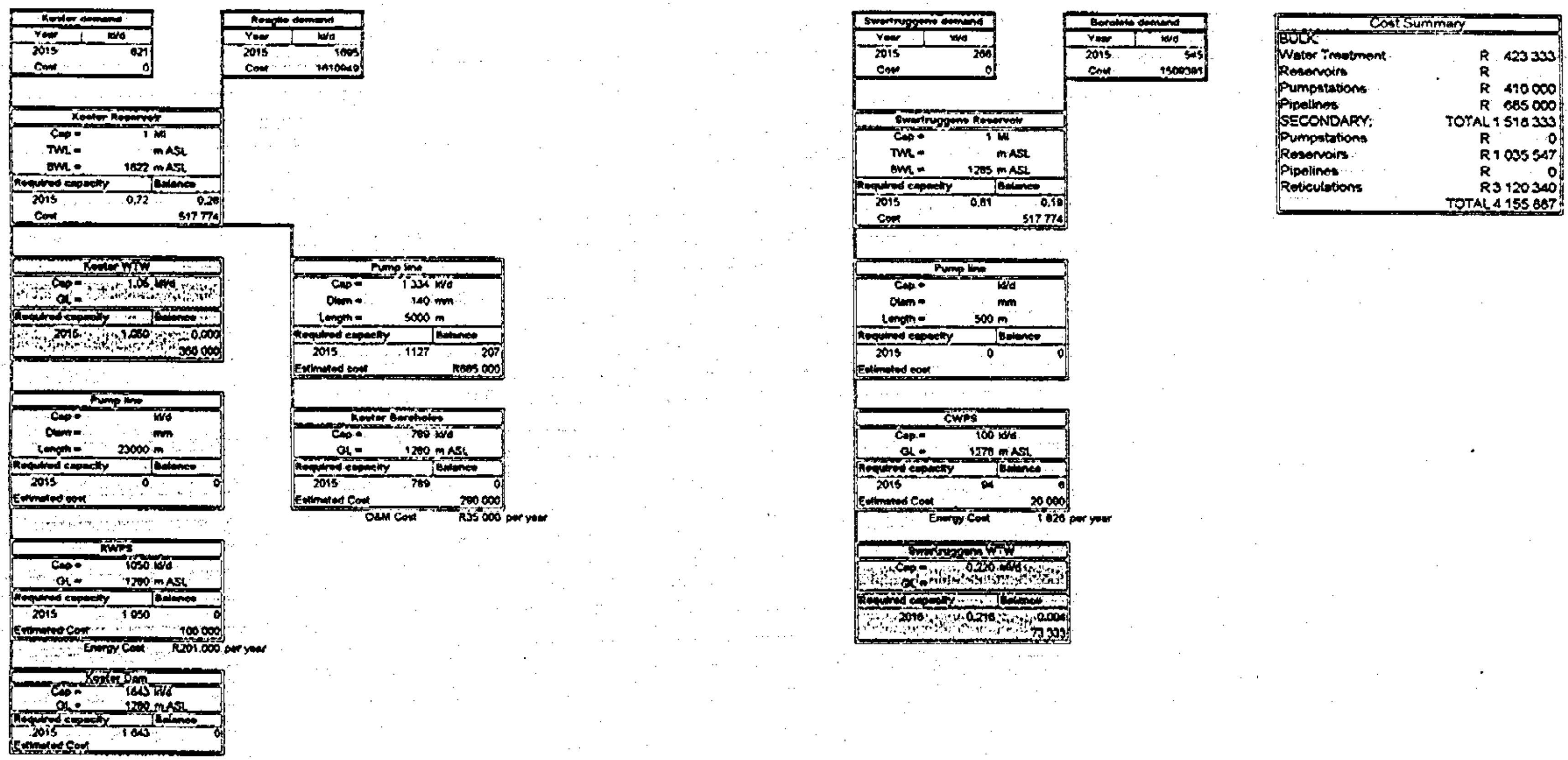
NAME OF SUPPLY AREA :	KOSTER	
INCLUDING SUPPLY BLOCKS :	KOSTER AND SWARTRUGGENS	
POPULATION SERVED (2015) :	21 558	
AADD in mcm/a (2015) :	1.173	
BULK COST :	**QUANTITY**	**COST (R million)**
Water Purification Works	Ml/d (Additional required capacity)	
	1.266	0.423
Pump Stations	Kl/d	
A : Capital Cost	1933	0.410
B : Annual Energy Cost		*0.238*
servoirs (Regional)	Ml	
	0	0.000
Pipelines (Bulk)	km	
140/9 uPVC	5.00	0.685
Sub Total Bulk Construction Cost		1.518
Engineering Fees (15 %)		0.228
VAT (14 %)		0.244
Project Contingency (20%)		0.398
TOTAL : Bulk Cost		2.388
Bulk Cost per Capita (Rands)		R111
SECONDARY COST :	**QUANTITY**	**COST (R million)**
Reservoirs (Service)	Ml	
	2	1.036
Water Towers	Ml	
N/A		
Pump Stations (Secondary)	Kl/d	
A : Capital Cost		
N/A		
B : Annual Energy Cost		
N/A		
Pipelines (Secondary)	km	
N/A		
Reticulation	km	

		3.120
Sub Total Secondary Construction Cost		4.156
Engineering Fees (15 %)		0.623
VAT (14 %)		0.669
Project Contingency (20%)		1.090
TOTAL : Secondary Cost		6.538
Secondary Cost per Capita (Rands)		R303
GRAND TOTAL COST	**MILLION RANDS**	**8.926**
Grand Total Cost per Capita (R)		**R414**

KOSTER SUPPLY AREA : EXISTING INFRASTRUCTURE



KOSTER SUPPLY AREA : NEW INFRASTRUCTURE



BRITS SUPPLY AREA

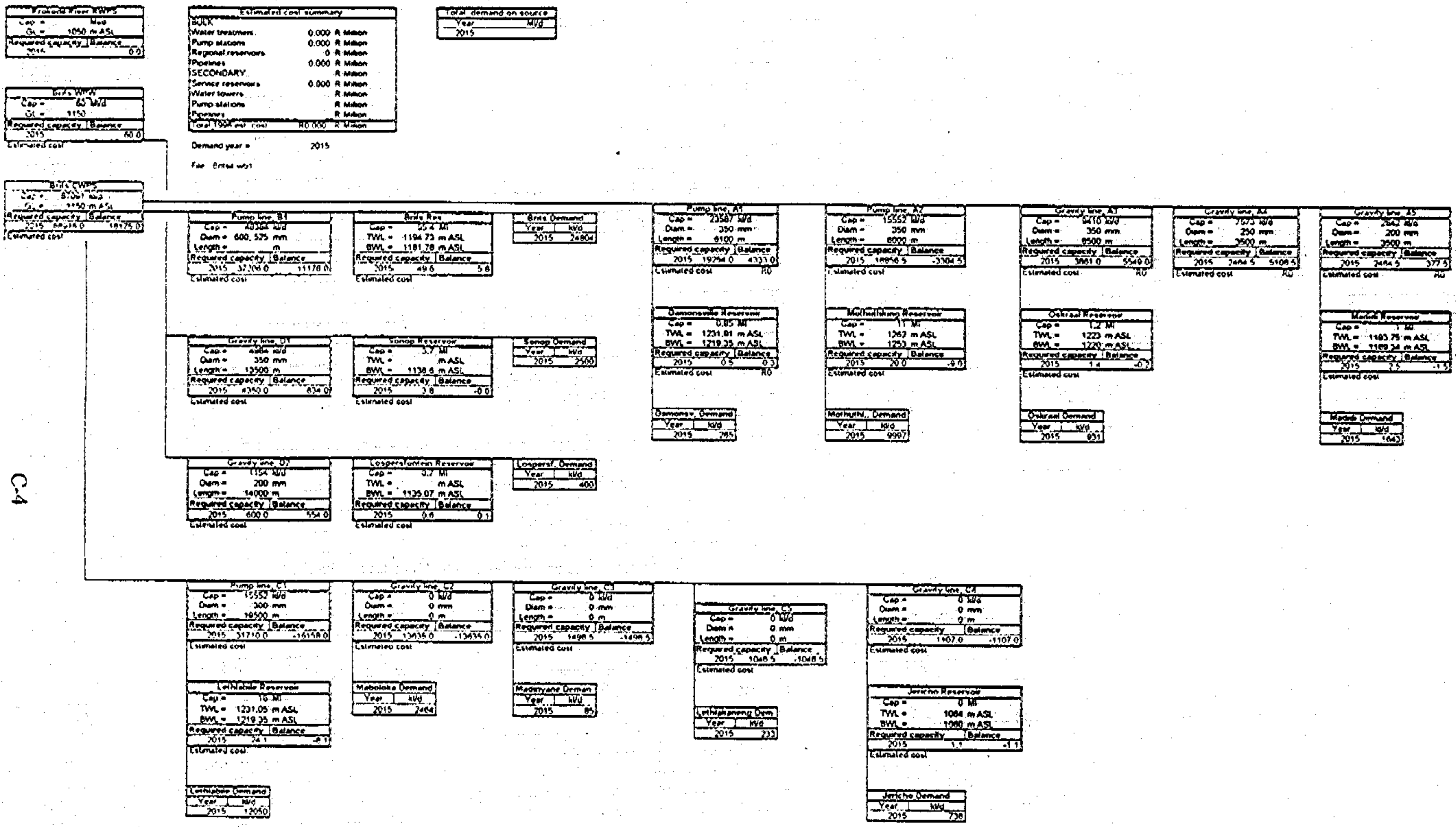
TABLE OF CONTENTS

COST SUMMARY FOR INFRASTRUCTURE

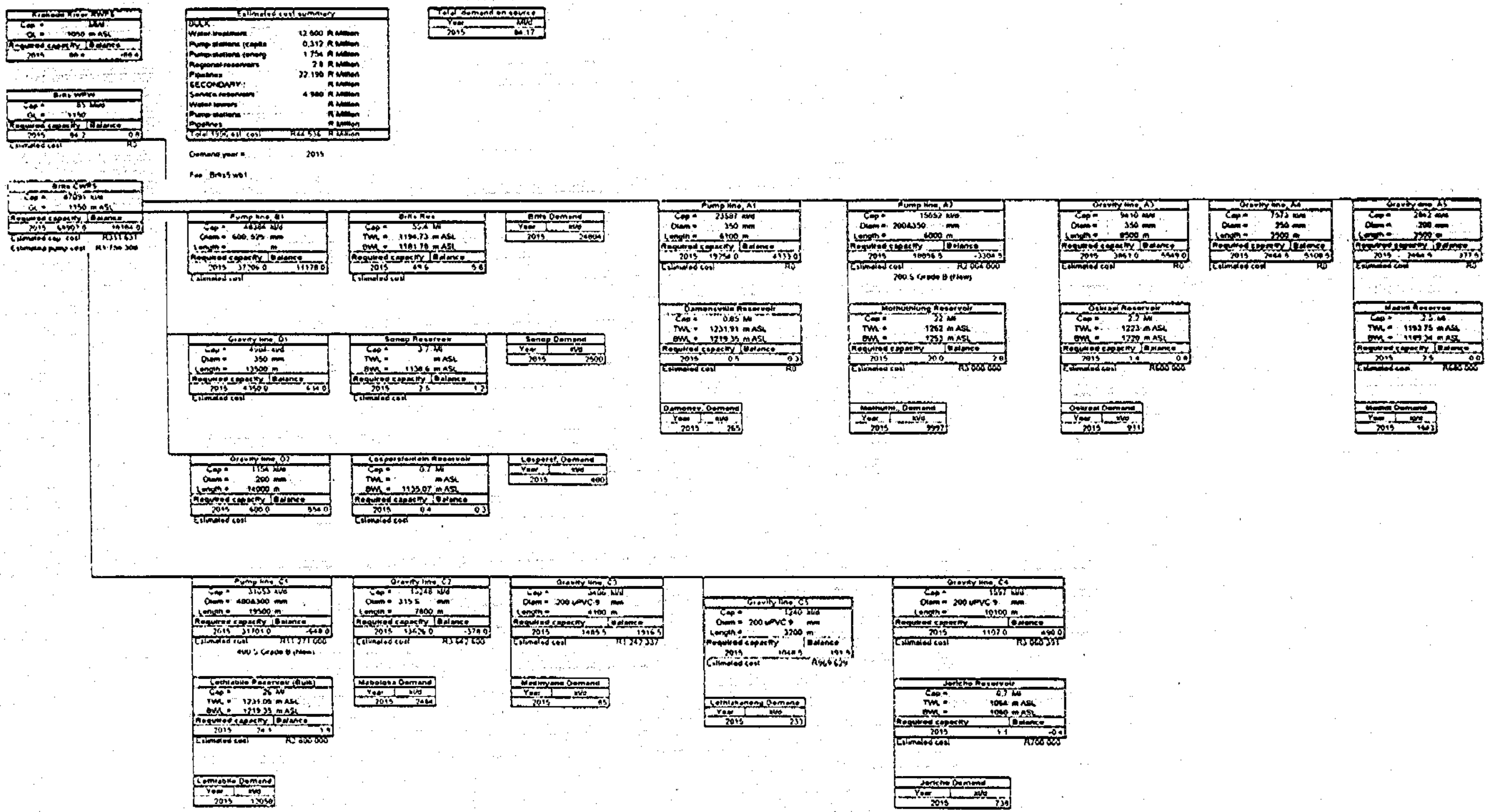
NAME OF SUPPLY AREA :	BRITS	
INCLUDING SUPPLY BLOCKS :	1. Brits	
	2. Hartebeespoort	
POPULATION SERVED (2015) :	236 899	
AADD in mcm/a (2015) :	25.931	
BULK COST :	**QUANTITY**	**COST (R million)**
Water Purification Works	Ml/d (Additional required capacity)	
Brits	25	12.500
Hartebeespoort	11.6	3.812
Pump Stations	Kl/d	
A : Capital Cost		
1. Brits CWPS		0.312
Annual Energy Cost		
1. Brits CWPS		*1.754*
Reservoirs (Regional)	Ml	
	10	2.800
Pipelines (Bulk)	km	
1. 200/9 PVC	17.40	5.271
2. 200 ST	6.00	2.004
3. 300 ST	7.80	3.643
4. 400 ST	19.50	11.271
Sub Total Bulk Construction Cost		41.613
Engineering Fees (15 %)		6.242
VAT (14 %)		6.700
Project Contingency (20%)		10.911
TOTAL : Bulk Cost		65.466
Bulk Cost per Capita (Rands)		R276
SECONDARY COST :	**QUANTITY**	**COST (R million)**
Reservoirs (Service)	Ml	
	14.7	4.980
Water Towers	Ml	
N/A		
Pump Stations (Secondary)	Kl/d	

A : Capital Cost		
N/A		
B : Annual Energy Cost		
N/A		
Pipelines (Secondary)	km	
N/A		
Reticulation	km	
Brits and Hartebeespoort		34.109
Sub Total Secondary Construction Cost		39.089
Engineering Fees (15 %)		5.863
VAT (14 %)		6.293
Project Contingency (20%)		10.249
TOTAL : Secondary Cost		61.495
Secondary Cost per Capita (Rands)		R260
GRAND TOTAL COST	MILLION RANDS	126.960
Grand Total Cost per Capita (R)		R536

Brits Supply Block : 1996 Existing Infrastructure



Brits Supply Block : New Infrastructure



KLIPVOOR SUPPLY AREA

TABLE OF CONTENTS

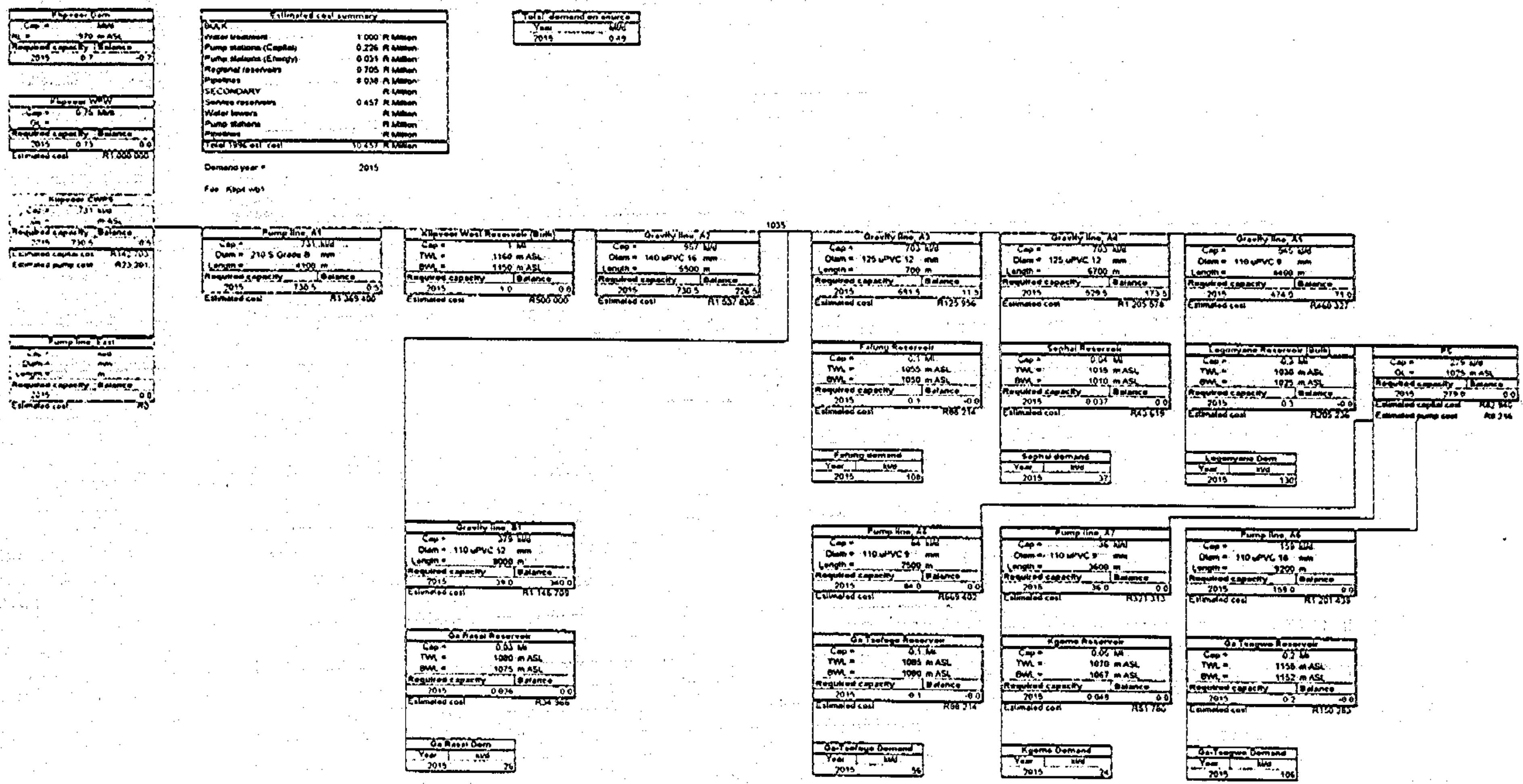
NOTE : THERE ARE CURRENTLY NO SURFACE WATER SUPPLY INFRASTRUCTURE IN KLIPVOOR SUPPLY AREA.

COST SUMMARY FOR INFRASTRUCTURE

NAME OF SUPPLY AREA :	KLIPVOOR SUPPLY AREA	
INCLUDING SUPPLY BLOCKS :	Moretele North	
	Klipvoor East	
	Klipvoor West	
POPULATION SERVED (2015) :	53,414	
AADD in mcm/a (2015) :	0.94	
BULK COST :	**QUANTITY**	**COST (R million)**
Water Purification Works	Ml/d (SDD)	
Klipvoor	3.878	R6.938
Pump Stations	Kl/d (SDD)	
A : Capital Cost		
Klipvoor West	731	R0.226
Klipvoor East	3,127	R0.376
Slagboom	1,171	R0.186
Sutelong	889	R0.143
Sub-total	**5,187**	**R0.931**
B : Annual Energy Cost (Not Incl'd with Total)		
Klipvoor West		R0.031
Klipvoor		R0.076
Slagboom		R0.028
Sutelong		R0.016
Sub-total		***R0.151***
Reservoirs (Regional)	Ml	
Klipvoor West	1.3	R0.705
Sutelong	1	R0.518
Bollantlokwe	0.841	R0.453
Sub-total	**1.841**	**R1.676**
Pipelines (Bulk)	km	
110 dia	112.6	R10.907
125 dia	20.9	R3.059
140 dia	12.8	R2.538
160 dia	31	R6.032
200 dia	5.7	R1.879
Total		**R24.415**
Sub Total Construction Cost		R33.960
Engineering Fees (15 %)		R5.094
VAT (14 %)		R5.468
Project Contingency (20%)		R8.904
TOTAL : Bulk Cost		**R53.426**
Bulk Cost per Capita (Rands)		**R1,000.222**

KLIPVOOR SUPPLY AREA		
SECONDARY COST :	**QUANTITY**	**COST (R million)**
Reservoirs (Service)	Ml	
Klipvoor East, Moretele N	3.74	R2.723
Klipvoor West		R0.457
Sub-total		R3.180
Water Towers	Ml	
	NIL	NIL
Pump Stations (Secondary)	Kl/d	
A : Capital Cost		
	NIL	NIL
B : Annual Energy Cost (Not Incl'd with Total)		
	NIL	NIL
Pipelines (Secondary)	km	
Reticulation	km	
Klipvoor West		R4.716
Moretele		R4.379
Klipvoor North		R10.379
Sub-total		**R19.474**
Sub Total Construction Cost		**R22.654**
Engineering Fees (15 %)		**R3.398**
VAT (14 %)		**R3.647**
Project Contingency (20%)		**R5.940**
TOTAL : Secondary Cost		**R35.639**
Secondary Cost per Capita (Rands)		**R667.227**
GRAND TOTAL COST		**R89.065**
Grand Total Cost per Capita (R)		**R1,667.449**

Klipvoor West Supply Block : New Infrastructure



Klipvoor supplying Moretele North and Klipvoor East (proposed planning to meet 2015 demand)

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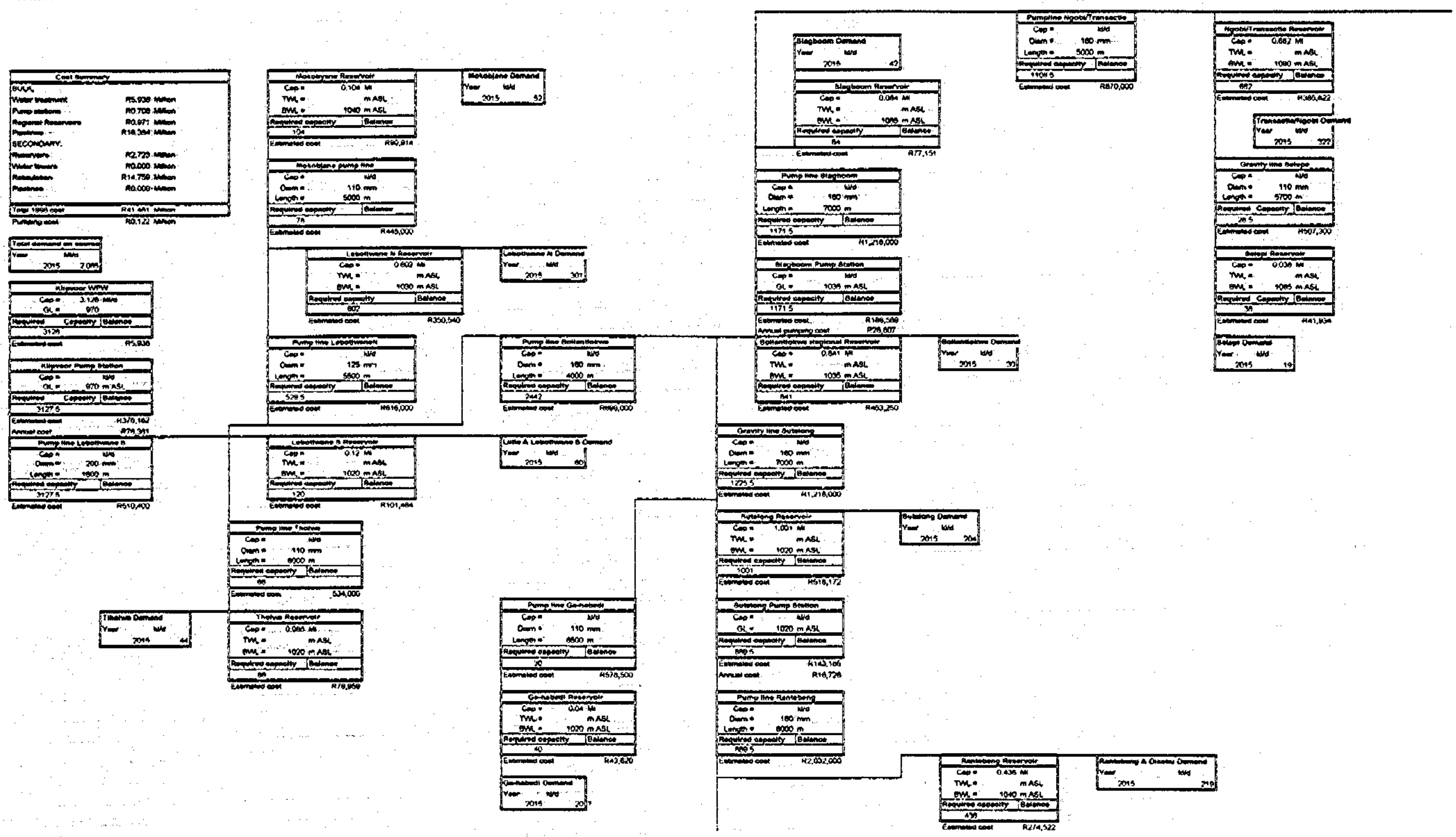
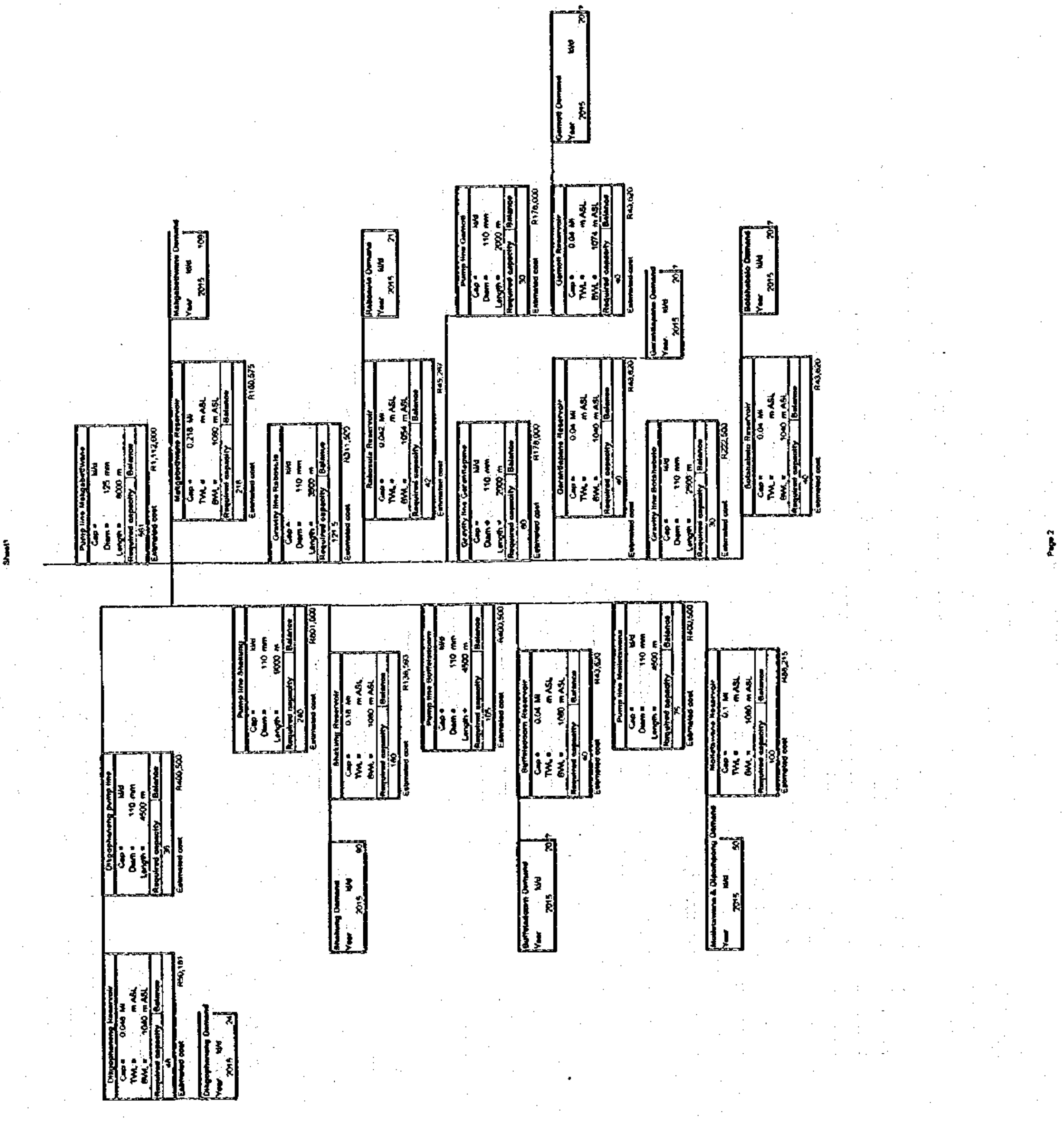
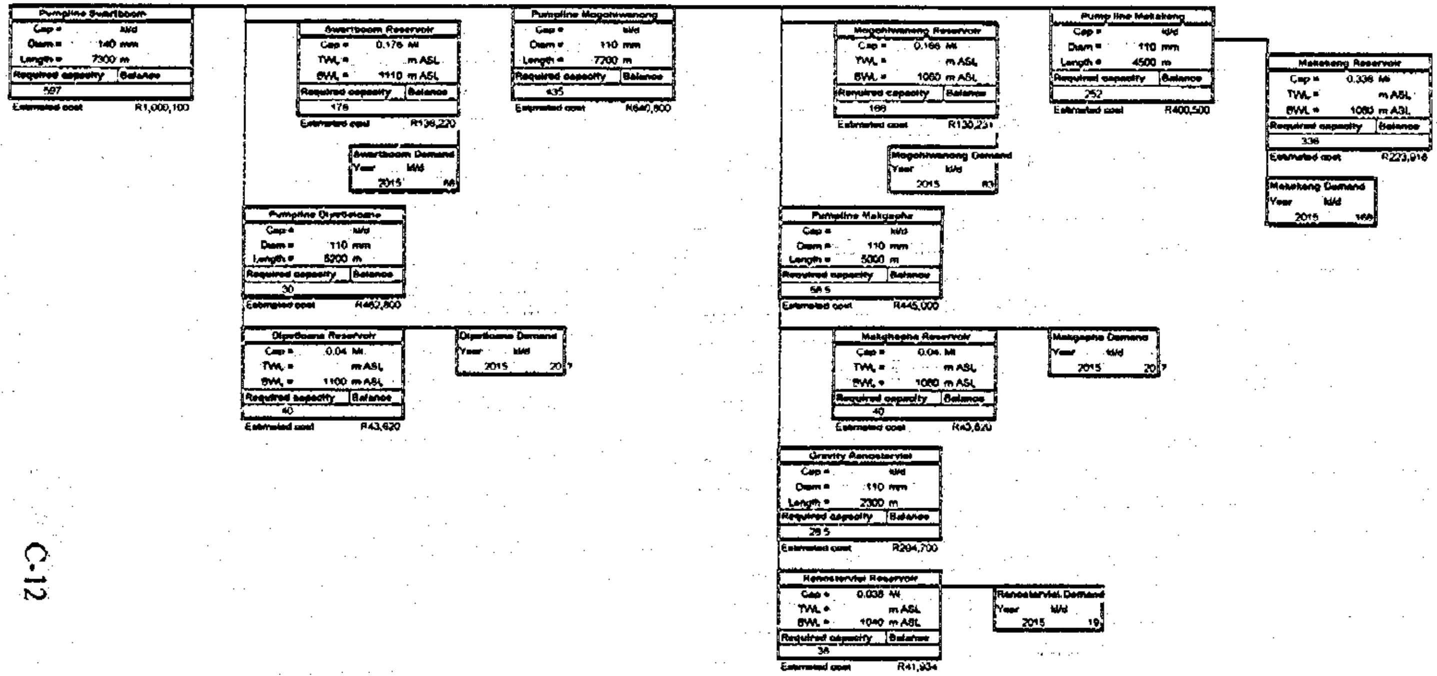
05-Nov-96







Pumpline Swartboom
Cap = kl/d
Diam = 140 mm
Length = 7300 m
Required capacity
Balance
597
Estimated cost R1,000,100
Swartboom Reservoir
Cap = 0.176 Ml
TWL = m ASL
BWL = 1110 m ASL
Required capacity
Balance
176
Estimated cost R139,220
Swartboom Demand
Year kl/d
2015
Pumpline Mogohiwanong
Cap = kl/d
Diam = 110 mm
Length = 7200 m
Required capacity
Balance
435
Estimated cost
Pumpline
Cap = kl/d
Diam = 110 mm
Length = 5200 m
Required capacity
Balance
30
Estimated cost
Reservoir
Cap = 0.04 Ml
TWL = m ASL
BWL = 1100 m ASL
Required capacity
Balance
40
Estimated cost R43,620
Demand
Year kl/d
2015
Mogohiwanong Reservoir
Cap = 0.166 Ml
TWL = m ASL
BWL = 1060 m ASL
Required capacity
Balance
166
Estimated cost
Mogohiwanong Demand
Year kl/d
2015
Pump line Makateng
Cap = kl/d
Diam = 110 mm
Length = 4500 m
Required capacity
Balance
252
Estimated cost R400,500
Makateng Reservoir
Cap = 0.336 Ml
TWL = m ASL
BWL = 1060 m ASL
Required capacity
Balance
336
Estimated cost R223,916
Makateng Demand
Year kl/d
2015
Pumpline Makgophe
Cap = kl/d
Diam = 110 mm
Length = 5000 m
Required capacity
Balance
58.5
Estimated cost R445,000
Makgophe Reservoir
Cap = 0.04 Ml
TWL = m ASL
BWL = 1080 m ASL
Required capacity
Balance
40
Estimated cost
Makgophe Demand
Year kl/d
2015
Gravity Rancsterviei
Cap = kl/d
Diam = 110 mm
Length = 2300 m
Required capacity
Balance
29.5
Estimated cost R204,700
Rancsterviei Reservoir
Cap = 0.038 Ml
TWL = m ASL
BWL = 1040 m ASL
Required capacity
Balance
38
Estimated cost R41,934
Rancsterviei Demand
Year kl/d
2015

RAND WATER SUPPLY AREA

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COST SUMMARY FOR INFRASTRUCTURE

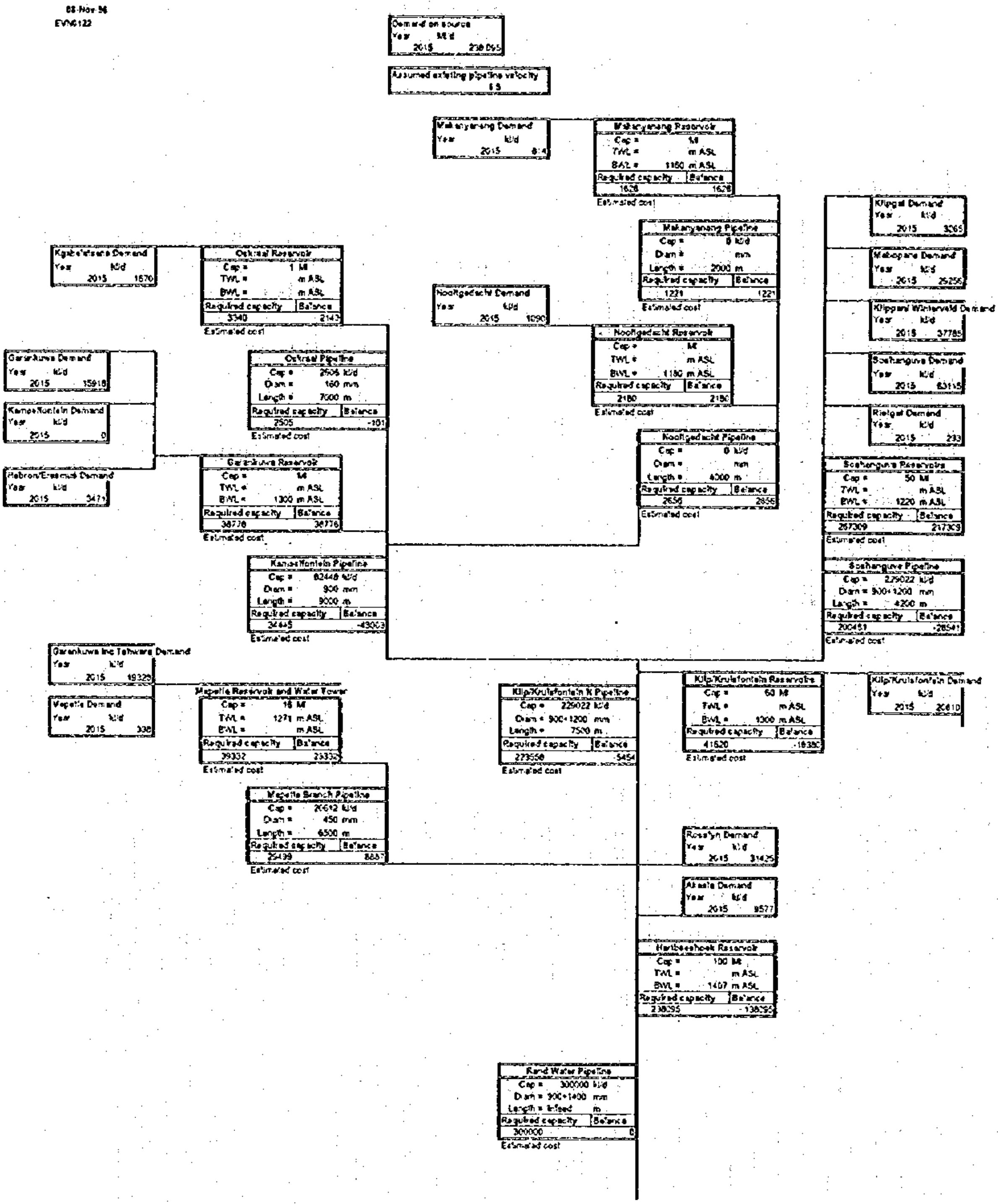
NAME OF SUPPLY AREA :	**RAND WATER SUPPLY AREA (Note: Import from Temba Supply Area to Soshanguve SR)**	
INCLUDING SUPPLY BLOCKS :		
Rand Water Supply Area		
POPULATION SERVED (2015) :	2,068,587	
AADD in mcm/a (2015) :	79.22	
BULK COST :	**QUANTITY**	**COST (R million)**
Water Purification Works	Ml/d (SDD)	
Kudube WTW *	41	**R13.507**
Pump Stations	Kl/d (SDD)	
Kudube *	41,218	**R3.549**
A : Capital Cost		
Sub-total		**R17.056**
B : Annual Energy Cost (Not Incl'd with Total)		
Rand Water Variable cost		R101.060
Sub-total		***R101.060***
Reservoirs (Regional)	Ml	
Hartbeeshoek	138	R22.860
Kudube *	45	R7.973
Sub-total		**R30.833**
Pipelines (Bulk)	km	
110 dia	7	R0.623
140 dia	2	R0.274
200 dia	4	R1.032
300 dia	6.5	R2.554
450 dia	0	R0.000
600 dia	27	R23.328
Total		**R27.811**
Sub Total Construction Cost		**R75.700**
Engineering Fees (15 %)		**R11.355**
VAT (14 %)		**R12.188**
Project Contingency (20%)		**R19.849**
TOTAL : Bulk Cost		**R119.092**
Bulk Cost per Capita (Rands)		**R57.572**

RAND WATER SUPPLY AREA		
SECONDARY COST :	QUANTITY	COST (R million)
Reservoirs (Service)	Ml	
	303.747	R49.500
Water Towers	Ml	
	NIL	NIL
Pump Stations (Secondary)	Kl/d	
A : Capital Cost		
	NIL	NIL
B : Annual Energy Cost (Not Incl'd with Total)		
	NIL	NIL
Pipelines (Secondary)	km	
Reticulation	km	
		R174.920
Sub Total Construction Cost		R224.420
Engineering Fees (15 %)		R33.663
VAT (14 %)		R36.132
Project Contingency (20%)		R58.843
TOTAL : Secondary Cost		R353.057
Secondary Cost per Capita (Rands)		R170.675
GRAND TOTAL COST		R472.149
Grand Total Cost per Capita (R)		R228.247

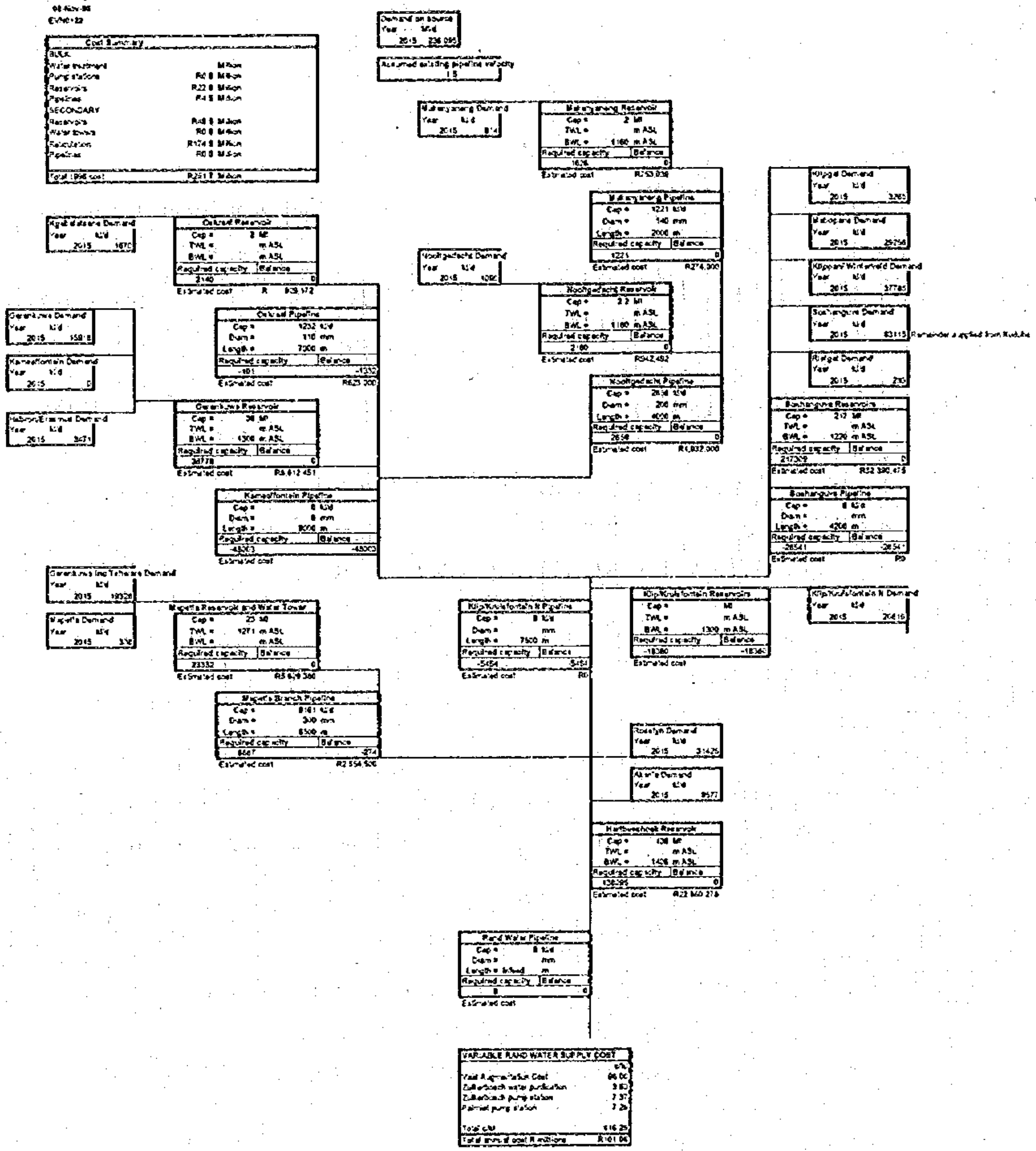
* indicates cost which arise in the Temba Supply Area to meet the projected demand in the Rand Water Supply Area

Rand Water Supply Area (Note: Soshanguve partly supplied from Kudube WTW (Existing and fixed planning tested against 2015 demands))

08-Nov-96
EVN0122



Rand Water Supply Area (Note: Soshanguve partly supplied from Kudube WTW (Proposed planning to meet 2015 demands))



TEMBA SUPPLY AREA

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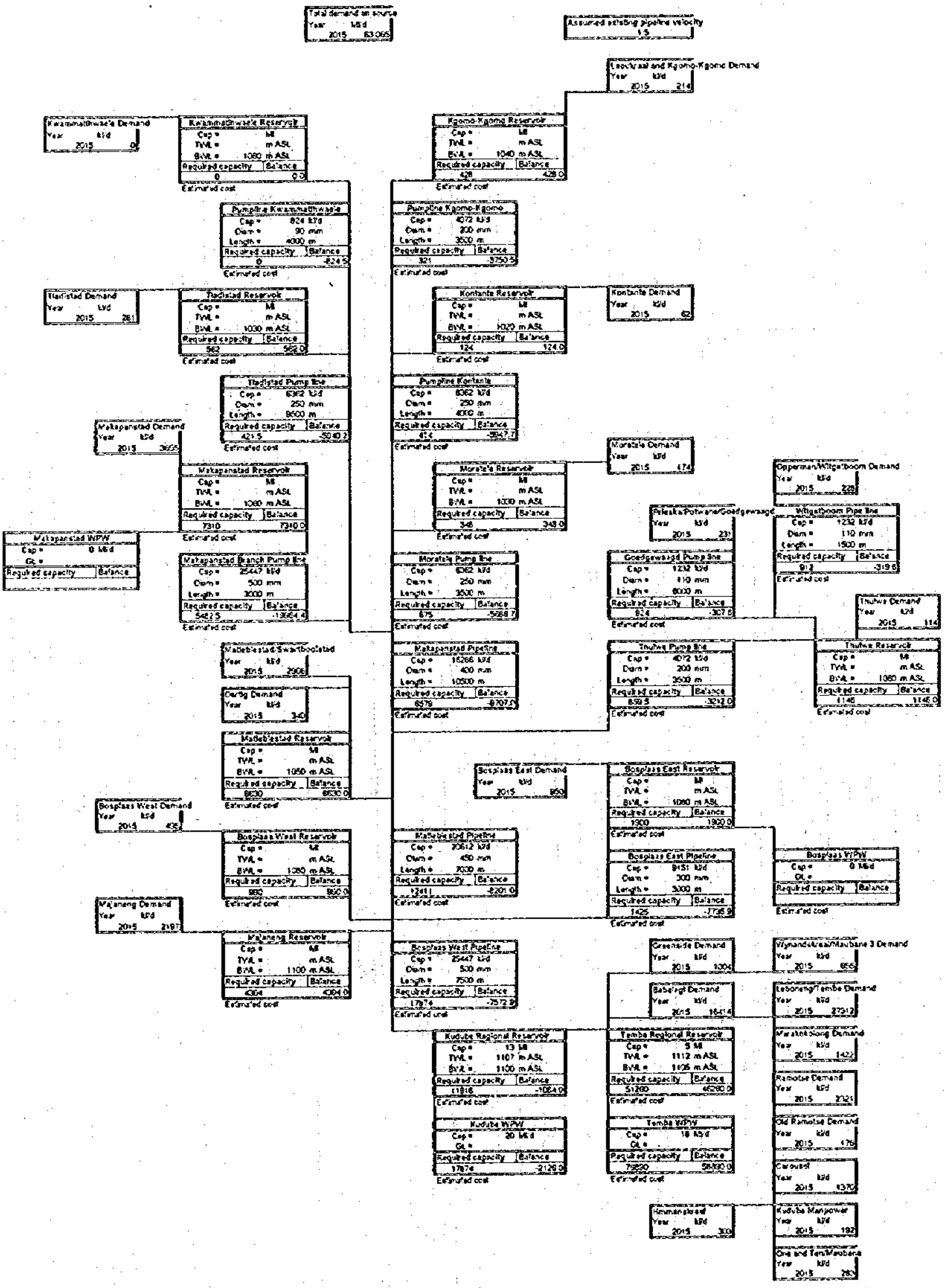
NOTE : ONLY EXPANSION OF WALLMANNSTHAL WTW IS PROVIDED REGARDING NEW CAPITAL WORKS IN WALLMANNSTHAL SUPPLY BLOCK SO PLANNING SCHEMATICS ARE NOT PROVIDED.

COST SUMMARY FOR INFRASTRUCTURE

NAME OF SUPPLY AREA :	**TEMBA SUPPLY AREA (Note: Water exported to Soshanguve SR from Kudube)**	
INCLUDING SUPPLY BLOCKS :		
Kudube North		
Kudube South		
Warmbaths/Nylstroom		
Wallmannsthal		
POPULATION SERVED (2015) :	805,884	
AADD in mcm/a (2015) :	56.12	
BULK COST :	**QUANTITY**	**COST (R million)**
Water Purification Works	Ml/d (SDD)	
Kudube WTW	48.000	R16.143
Wallmannsthal	2.115	R0.698
Temba WTW	81.000	R25.944
Sub-total		**R42.785**
Pump Stations	Kl/d (SDD)	
A : Capital Cost		
B : Annual Energy Cost (Not Incl'd with Total)		
Reservoirs (Regional)	Ml	
Kudube/Temba	114	**R23.450**
Pipelines (Bulk)	km	
110 dia	3.4	R0.303
250 dia	4.5	R1.769
450 dia	3.5	R2.247
600 dia	4	R3.024
Total		**R7.343**
Sub Total Construction Cost		**R73.578**
Engineering Fees (15 %)		**R11.037**
VAT (14 %)		**R11.846**
Project Contingency (20%)		**R19.292**
TOTAL : Bulk Cost		**R115.753**
Bulk Cost per Capita (Rands)		**R143.635**

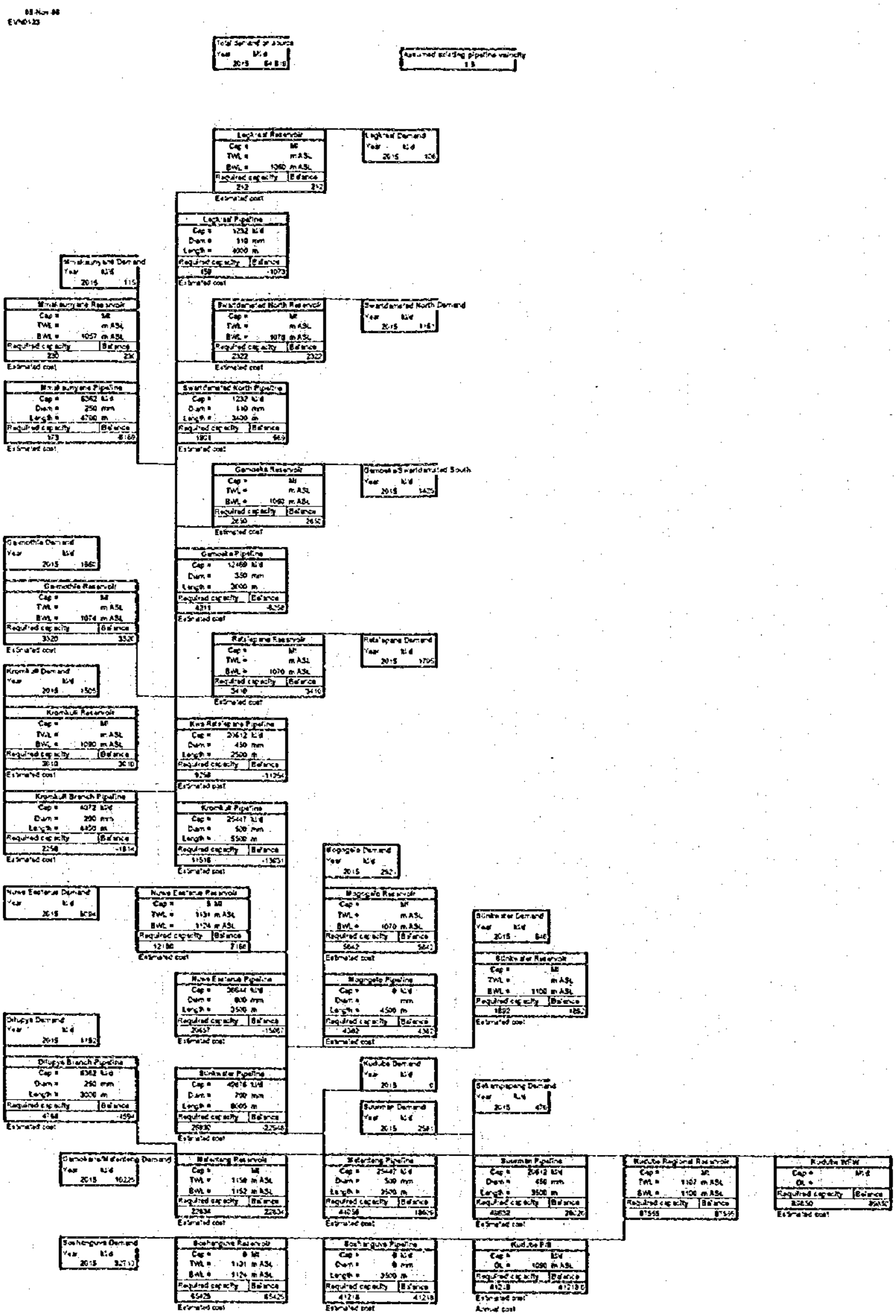
TEMBA SUPPLY AREA SECONDARY COST :	QUANTITY	COST (R million)
Reservoirs (Service)	Ml	
Kudube North	23.886	R9.143
Kudube South	118.242	R30.100
Sub-total	142.128	R39.243
Water Towers	Ml	
	NIL	NIL
Pump Stations (Secondary)	Kl/d	
A : Capital Cost		
	NIL	NIL
B : Annual Energy Cost (Not Incl'd with Total)		
	NIL	NIL
Pipelines (Secondary)	km	
Reticulation	km	
Kudube North		R23.803
Kudube South		R13.550
Sub-total		R37.353
Sub Total Construction Cost		R76.596
Engineering Fees (15 %)		R11.489
VAT (14 %)		R12.332
Project Contingency (20%)		R20.084
TOTAL : Secondary Cost		R120.501
Secondary Cost per Capita (Rands)		R149.527
GRAND TOTAL COST		R236.254
Grand Total Cost per Capita (R)		R293.161

Kudube North (Existing and fixed planning tested against 2015 demand)

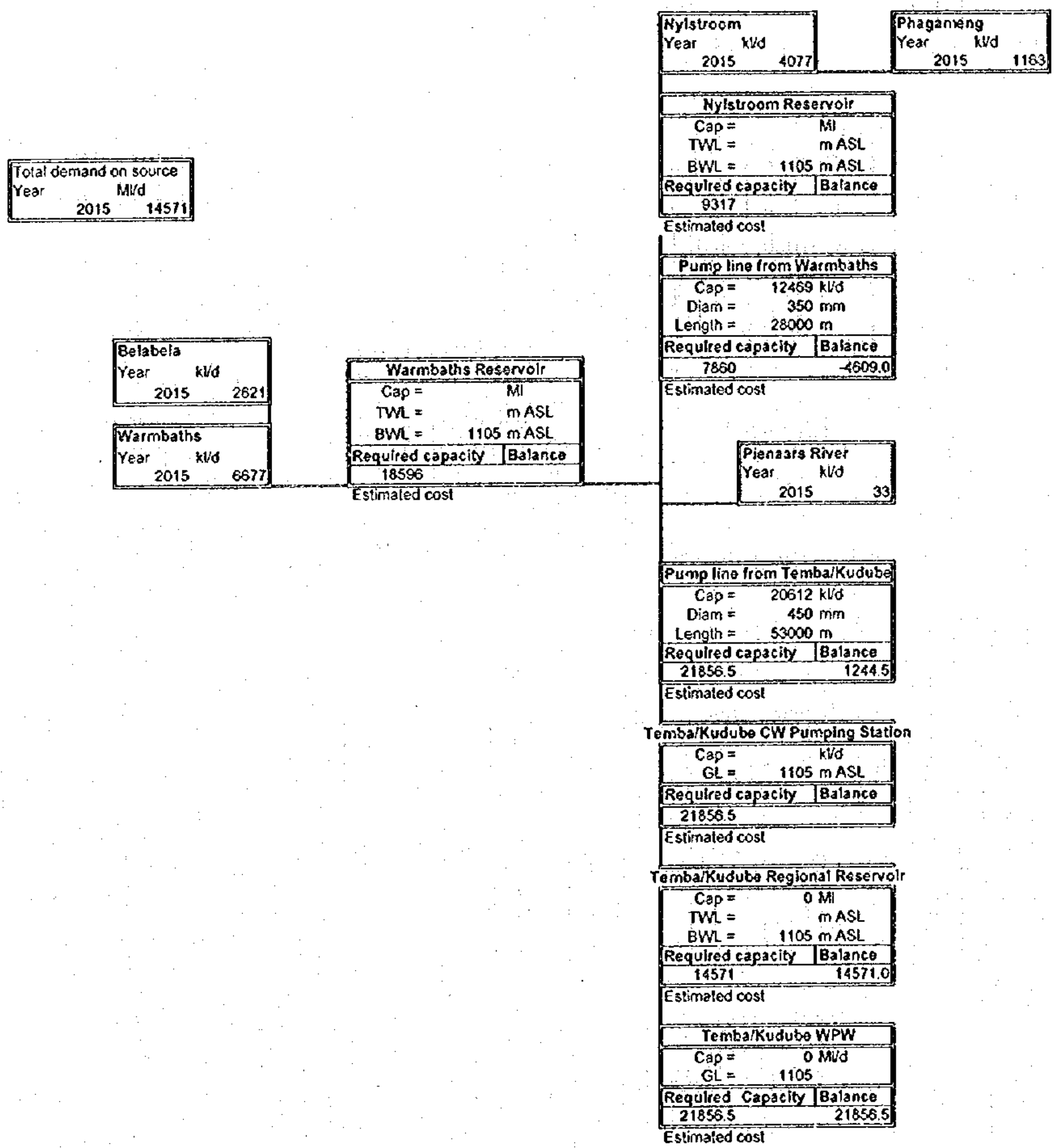


Sheet1

Kudube South (Note: Soshanguve partly supplied from Kudube WTW (Existing and fixed planning tested against 2015 demand))



Warmbad and Nylstroom (Fixed and existing tested against 2015 demand)
05-Nov-96
EVN0118



Kudube North (Proposed planning to meet 2015 demand)