Report No: P WMA
19/G10/00/2413/6

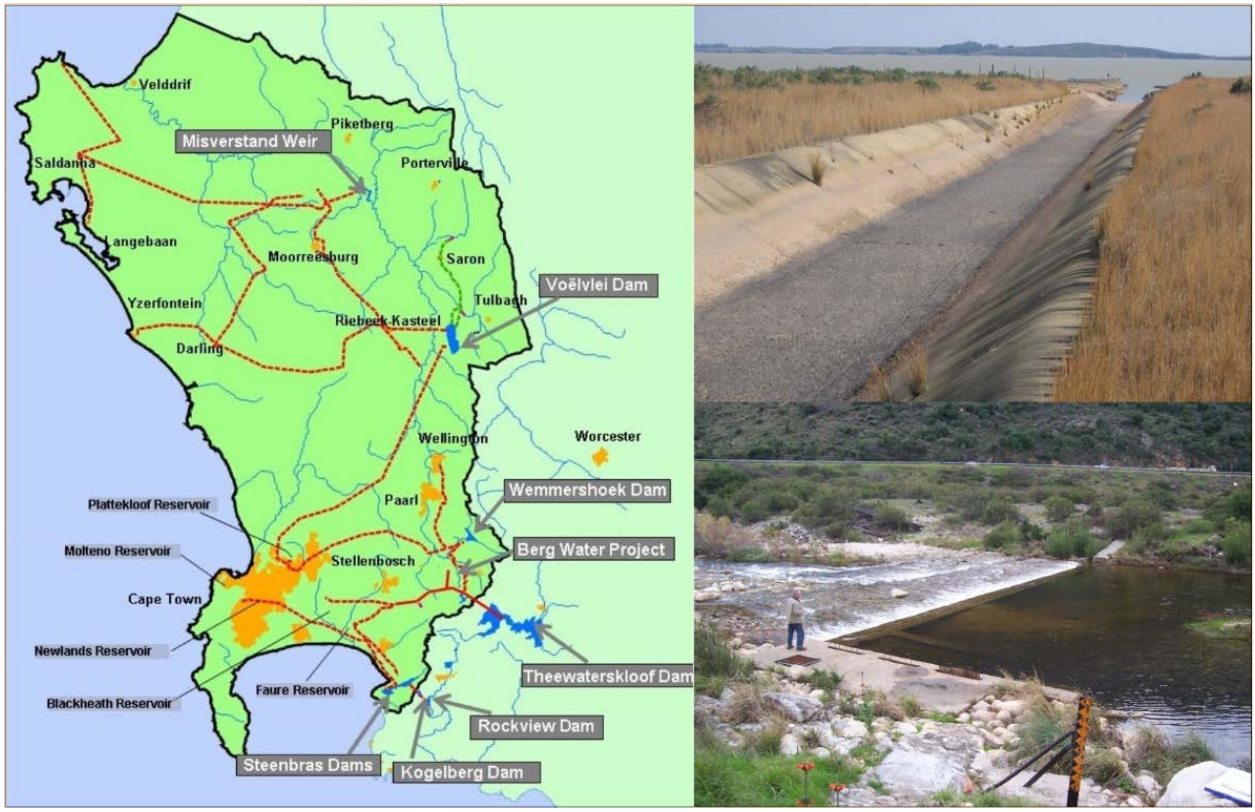
Department of Water Affairs
Directorate: Options Analysis

PRE-FEASIBILITY AND FEASIBILITY STUDIES FOR AUGMENTATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM BY MEANS OF FURTHER SURFACE WATER DEVELOPMENTS

REPORT No.3 – VOLUME 2
Breede-Berg (Michell's Pass) Water Transfer Scheme

APPENDIX No.10

Conveyance Infrastructure Design Report, for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme



December 2012

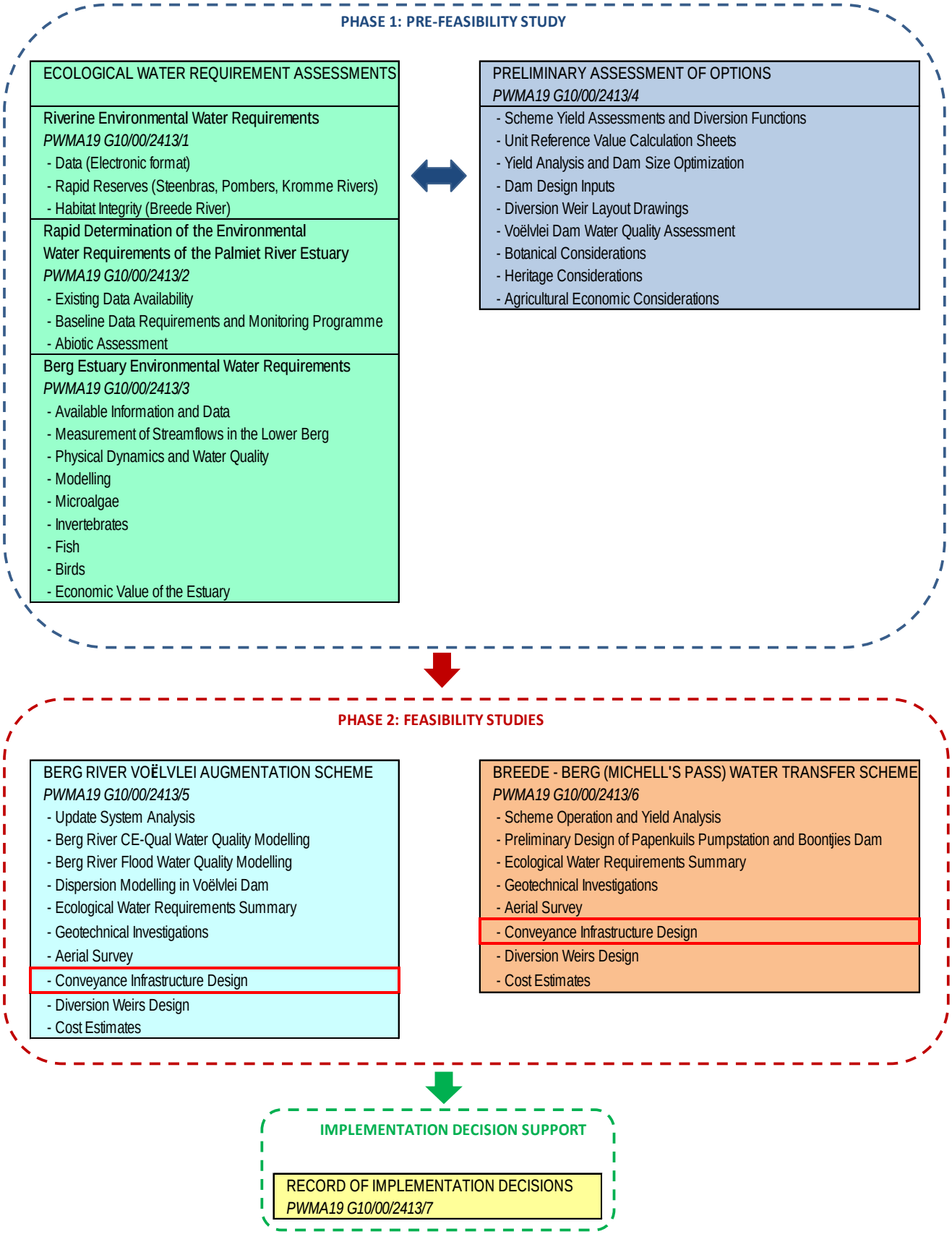
STUDY REPORT LIST

REPORT No	REPORT TITLE	VOLUME No.	DWA REPORT No.	VOLUME TITLE
1	ECOLOGICAL WATER REQUIREMENT ASSESSMENTS	Vol 1	PWMA19 G10/00/2413/1	**Riverine Environmental Water Requirements**
				Appendix 1: EWR data for the Breede River
				Appendix 2: EWR data for the Palmiet River
				Appendix 3: EWR data for the Berg River
				Appendix 4: Task 3.1: Rapid Reserve assessments (quantity) for the Steenbras, Pombers and Kromme Rivers
				Appendix 5: Habitat Integrity Report – Breede River
		Vol 2	PWMA19 G10/00/2413/2	**Rapid Determination of the Environmental Water Requirements of the Palmiet River Estuary**
				Appendix A: Summary of data available for the RDM investigations undertaken during 2007 and 2008
				Appendix B: Summary of baseline data requirements and the long-term monitoring programme
				Appendix C: Abiotic Specialist Report
		Vol 3	PWMA19 G10/00/2413/3	**Berg Estuary Environmental Water Requirements**
				Appendix A: Available information and data
				Appendix B: Measurement of streamflows in the Lower Berg downstream of Misverstand Dam
				Appendix C: Specialist Report – Physical dynamics and water quality
				Appendix D: Specialist Report – Modelling
				Appendix E: Specialist Report – Microalgae
				Appendix F: Specialist Report – Invertebrates
				Appendix G: Specialist Report – Fish
				Appendix H: Specialist Report – Birds
				Appendix I: Specialist Report – The economic value of the Berg River Estuary
2	PRELIMINARY ASSESSMENT OF OPTIONS		PWMA19 G10/00/2413/4	Appendix 1: Scheme Yield Assessments and Diversion Functions
				Appendix 2: Unit Reference Value Calculation Sheets
				Appendix 3: Yield Analysis and Dam Size Optimization
				Appendix 4: Dam Design Inputs
				Appendix 5: Diversion Weir Layout Drawings
				Appendix 6: Voëlvlei Dam Water Quality Assessment
				Appendix 7: Botanical Considerations
				Appendix 8: Heritage Considerations
				Appendix 9: Agricultural Economic Considerations

STUDY REPORT LIST (cntd)

REPORT No	REPORT TITLE	VOLUME No.	DWA REPORT No.	VOLUME TITLE
3	**FEASIBILITY STUDIES**	Vol 1	PWMA19 G10/00/2413/5	**Berg River-Voëlvlei Augmentation Scheme**
				Appendix 1: Updating of the Western Cape Water Supply System Analysis for the Berg River-Voëlvlei Augmentation Scheme
				Appendix 2: Configuration, Calibration and Application of the CE-QUAL-W2 model to Voëlvlei Dam for the Berg River-Voëlvlei Augmentation Scheme
				Appendix 3: Monitoring Water Quality During Flood Events in the Middle Berg River (Winter 2011), for the Berg River-Voëlvlei Augmentation Scheme
				Appendix 4: Dispersion Modelling in Voëlvlei Dam from Berg River Water Transfers for the Berg River-Voëlvlei Augmentation Scheme
				Appendix 7 - 12: See list under Volume 2 below
		Vol 2	PWMA19 G10/00/2413/6	**Breede-Berg (Michell's Pass) Water Transfer Scheme**
				Appendix 5: Scheme Operation and Yield Analyses with Ecological Flow Requirements for the Breede-Berg (Michell's Pass) Water Transfer Scheme
				Appendix 6: Preliminary Design of Papenkuils Pump Station Upgrade and Pre-Feasibility Design of the Boontjies Dam, for the Breede-Berg (Michell's Pass) Water Transfer Scheme
				Appendix 7: Ecological Water Requirements Assessment Summary for the Berg River-Voëlvlei Augmentation Scheme, and the Breede Berg (Michell's Pass) Water Transfer Scheme
				Appendix 8: Geotechnical Investigations for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme
				Appendix 9: LiDAR Aerial Survey, for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme
				Appendix 10: Conveyance Infrastructure Design Report, for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme
				Appendix 11: Diversion Weirs Design for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme
				Appendix 12: Cost Estimates for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme
4	**RECORD OF IMPLEMENTATION DECISIONS**		PWMA19 G10/00/2413/7	

STUDY REPORT MATRIX DIAGRAM



CONTENTS

1. INTRODUCTION

The Department of Water Affairs (DWA) appointed the Western Cape Water Consultants Joint Venture (WCWC JV) to undertake Pre-feasibility surface water investigations for the potential augmentation of the Western Cape Water Supply System, followed by Feasibility investigations of two (2) preferred options.

WorleyParsons RSA, as part of the joint venture, was commissioned to undertake investigations of conveyance infrastructure (including pump stations) for the Pre-feasibility Phase and Feasibility Phase in this regard.

2. BACKGROUND

During the Pre-feasibility Phase of the project, six (6) potential surface water augmentation options were identified and investigated towards possible augmentation of the Western Cape Water Supply System, namely:

- Berg River-Voëlvlei Augmentation Scheme
- Breede-Berg (Michell's Pass) Water Transfer Scheme
- Further Phases of Voëlvlei Dam Augmentation
- The Molenaars River Diversion
- The Upper Wit River Diversion
- Further Phases of the Palmiet Transfer Scheme

Through the Pre-feasibility investigation, it became clear that three (3) of these scheme options, namely the Berg River-Voëlvlei Augmentation Scheme, the Breede-Berg (Michell's Pass) Water Transfer Scheme and the potential raising of the Lower Steenbras Dam (further phases of the Palmiet Transfer) were the most economically viable schemes to be investigated to Feasibility Phase level. At this stage, a decision was taken by DWA to commence with two (2) of these options to Feasibility level under this Feasibility Study, and that the potential Lower Steenbras Dam raising may be subsequently further investigated.

This preliminary design entailed the following bulk scheme components, namely:

- Pipelines
- Pump stations
- Weirs (investigated by ASP Technology and reported on separately)
- An Ecological Water Requirement (EWR) Dam (as an alternative option within the Breede-Berg (Michell's Pass) Water Transfer Scheme – reported on separately)
- River rehabilitation and erosion protection

3. METHODOLOGY

The two (2) selected schemes and their conveyance infrastructure requirements have been investigated to Preliminary Design, taking the following criteria into consideration:

Physical criteria

- Topography
- Geology
- Hydrology
- Fauna and Flora

Engineering criteria

- Pipeline material characteristics
- Pipeline route lengths
- Flow requirements
- Hydraulic requirements and scheme design
- Pipeline transport and installation

- Pipeline access and maintenance
- Existing services
- Statutory approvals

Economic criteria

- Infrastructure costs

4. OPTIONS INVESTIGATED

4.1 BERG RIVER-VOËLVLEI AUGMENTATION SCHEME (BRVAS)

Three (3) potential diversion weir locations on the Berg River were identified during the Pre-Feasibility Phase involving the pumping of winter flood water from the Berg River to the existing Voëlvlei Dam (see Appendix 1), namely:

- The Lorelei Weir Option
- The Zonquasdrift Weir Option
- The Spes Bona Weir Option

Due to the favourable weir position associated with the Lorelei option (primarily influenced by preferred river hydraulics and geotechnical conditions), it was identified as the preferred site for the diversion of winter flood water from the Berg River. The weir can largely be positioned on rocky outcrops and bedrock within the river (unique to this location), therefore ensuring a much more securely anchored structure than the other two (2) locations could offer. The proposed weir position also provides a preferred weir canal off-take on the outside of the river bend and suitable adjacent pump station siting.

Furthermore the proposed rising main from the Lorelei weir provides the shortest conveyance length for the proposed rising main pipeline to the existing Voëlvlei Dam.

Three (3) alternative discharge point positions for the delivery of the raw water into the existing Voëlvlei Dam were investigated, namely:

- A Northern Discharge Point (close to the existing canal inlets)
- A Central Discharge Point (close to the existing Swartland intake)
- A Southern Discharge Point (between the existing Swartland and City of Cape Town intakes)

These three (3) potential discharge locations into the existing Voëlvlei Dam are shown in Figure A1.2 of Appendix 1.

The northern discharge point entails discharging winter flood water into the existing canal, that currently transfers water from the Klein Berg Diversion to Voëlvlei Dam. However, this option would adversely impact on a stretch of ecologically important Renosterveld, which is a very slow-growing and highly protected flora. Avoiding this area would result in the need for excessive pipeline lengths. Due to this ecological concern and the additional length of pipeline needed, this option was excluded from detailed investigation.

The central discharge point, although having the shortest pipeline route, is situated close to the Swartland WTW's intake and is therefore not preferred due to the potential water quality concerns relating to probable short-circuiting at the intake.

The southern discharge point entails discharging water to the south of the existing Swartland WTW's intake. A secluded bay with bedrock was identified approximately halfway between the existing Swartland WTW's intake and the City of Cape Town WTW's intake. This route is shorter than the northern route and there are only small patches of Renosterveld present (adjacent to the route). Discharging into the secluded bay also means that the suspended solids plume carried with the winter flood water from the Berg River, can settle without having an adverse water quality impact on both the Swartland WTW's intake and that of the City of Cape Town. This discharge position is located on solid bedrock, resulting in a stable foundation for the discharge structure. Taking all of the above into account, this option was identified as the preferred discharge point into Voëlvlei Dam.

In terms of the delivery rising main between the proposed Lorelei weir and the preferred southern discharge point, several alternative pipeline route options were identified and investigated. The pipeline route alignment was optimised to have as little impact on productive agricultural land, contain as few as possible horizontal bends and avoid unnecessarily crossing or adjoining existing services. Furthermore, two (2) alternative options for crossing the Berg River were also investigated, namely a buried pipeline underneath the river or over the river by means of a pipe bridge. For good protection and security purposes, it was decided to cross the river underneath by encasing the pipeline in concrete and incorporating gabion river rehabilitation work.

Two (2) alternatives were investigated in order to transfer water during summer without incurring water losses, as is currently the case with the existing canal. Provision has been made for connections from the existing Swartland canal near the Swartland WTW to the new pipeline and from the new pipeline to a discharge structure into the Berg River. This will enable the transfer of water from the canal at the Swartland WTW back to the Berg River. Alternatively, water can also be conveyed from Voëlvlei Dam via the new rising main by lowering and adapting the outlet to act as a combined outlet and intake (at a fixed water level).

The preferred pipeline route and long section of the BRVA Scheme is shown in Appendix 2.

4.2 BREEDE-BERG (MICHELL'S PASS) WATER TRANSFER SCHEME

Two (2) scheme options (Alternatives A and B) were investigated regarding the diversion of winter flood water from the Breede River (see Appendix 3) via the proposed Breede-Berg (Michell's Pass) Water Transfer Scheme, hereinafter referred to as the Michell's Pass Scheme (MPS), as discussed below.

Alternative A

Alternative A will divert surplus winter water via a low weir from the upper Breede River into a new gravity pipeline with discharge into the Boontjies River (a tributary of the Klein Berg River), from where water will be diverted into the existing Voëlvlei Dam, via the existing Klein Berg Diversion.

At present, irrigation water is conveyed by means of the open Artois Canal from the existing irrigation diversion at the DWA stream flow gauging station, H1H006. The initial design was to follow the existing canal alignment with the proposed new gravity pipeline as far as possible.

This was however not possible due to existing irrigators' preferences, which led to the investigation of various pipeline routes. As the proposed pipeline is a gravity pipeline, any pipeline route selections need to be below the hydraulic gradient, therefore limiting a direct pipeline route to the discharge point. The section of proposed pipeline between the proposed weir and the town of Wolseley stretches over several farms and agricultural land, consisting mostly of orchards.

Farm boundaries, farm roads and clearings between agricultural fields were used as far as possible, with regards to the proposed pipeline route. Site visits to all affected farms were also conducted, especially where the route was considered to be contentious by the land owners. The proposed pipeline route is shown in Appendix 4, as that agreed to in principle with existing land owners.

The initial design incorporated a discharge chute that would discharge water directly into the Boontjies River in close proximity to the town of Wolseley. This was however changed due to objections from the land owner and as a result of the required chute length. The discharge chute was therefore relocated to discharge water into the Blousloot River (a tributary of the Boontjies River), which entails a shorter discharge chute length. A balancing reservoir between the gravity pipeline and discharge chute shall form part of the proposed scheme.

In order to introduce summer EWR releases back into the Breede River, the possibility of providing EWR releases from the existing Koekedouw Dam (Ceres) was investigated for this alternative.

Alternative B

Alternative B will also divert surplus winter water via a low weir from the upper Breede River into a new gravity pipeline. The difference is that the pipeline route is longer and that water will be discharged into a new EWR Dam to be constructed in the Boontjies River as shown on Figure A4.2 in Appendix 4. The provision of summer EWR releases back into the Breede River is a prerequisite for the construction of the new dam and thus for this alternative.

In order to introduce summer EWR releases back into the Breede River, a new pump station is proposed at the toe of the new EWR dam wall, to pump stored winter water for summer EWR releases and irrigation back to the Breede River. This will include a rising main from the pump station, bypassing the balancing reservoir, and connecting to the gravity pipeline. The proposed gravity pipeline would then be used in reverse as a rising main to pump water back to the Breede River in summer for providing for the EWR and to provide water to the irrigators.

Current and future irrigators from the Artois Canal shall benefit from the proposed Michell's Pass Scheme by obtaining irrigation water, during the summer months, under pressure from the proposed gravity pipeline or from the EWR dam via the pump station and rising main.

The preferred pipeline route and long section of the Michell's Pass Scheme is shown in Appendix 4.

5. TOPOGRAPHICAL SURVEY

A detailed topographical survey was conducted prior to the preliminary design of the two (2) schemes. LiDar aerial survey technology was used, providing good quality aerial photographs and detailed terrain models along the proposed pipeline routes. Where, during subsequent route changes, the route fell outside of this surveyed area, Google Earth images and ASTER GDEM elevations were used to compliment the LiDar information in the design software model.

Long sections of the proposed pipeline routes were performed from the topographical survey model compiled.

6. GEOTECHNICAL STUDY

Geotechnical assessments along both pipeline routes have been conducted in order to better estimate the percentage of soft material, intermediate material and rock likely to be encountered during construction. The assessments comprised the profiling of trial pits along the pipeline routes, as far as possible equally spaced along the route and excavated to maximum excavator depth of approximately 3 m, depending on bedrock encountered. Limited rotary core drilling was undertaken at the Berg River abstraction site (Lorelei) in order to confirm the extent of the visible bedrock at this site.

The geotechnical investigations suggest that no in situ material is available for bedding and blanket use. Thus, all pipe bedding and blanket material will need to be imported from commercial sources, and this has been allowed for in the cost estimates.

No resistivity tests were conducted to give an indication of the soil corrositivity. A soil corrositivity investigation of the area should be conducted if this scheme progresses to detailed design phase, especially if Mild Steel (MS) and Ductile Iron (DI) pipes are considered.

Areas of high soil corrositivity should be avoided, except if pipeline materials are selected that are not affected by corrosive soils.

7. HYDROLOGY

The study area falls within the Berg River catchment which consists of high rainfall and runoff in the upstream mountain catchments and flat to slightly undulating terrain, with lower runoff in the middle and lower Berg River catchment areas.

No major waterways, except for the Berg River and Breede River abstraction points are found along the proposed pipeline routes. For the Michell's Pass Scheme a number of storm water courses from the high lying ground to the Boontjies River catchment need to be crossed. None of these storm water courses pose any major issues for construction, except during high rainfall periods and subsequent flooding when precautionary measures will need to be taken.

Pipeline routes should as far as possible be located above the 1 in 100 year flood line and pipelines must be adequately anchored in flood plains and storm water course crossings.

The hydrology of the study area varies in its age and reliability. That of the Berg River has recently been updated in the Berg River Water Availability Assessment Study (2008). However, the hydrology of the Breede River dates back more than 20 years in some catchments, and thus is considered as a high priority for updating.

8. FAUNA AND FLORA

Fauna and flora issues will form part of the Environmental Impact Assessment (EIA) that will be conducted under a separate appointment.

Issues arising from the environmental impact assessment investigation will need to be considered in the detail design of the project, should either of these two (2) schemes proceed to implementation.

No major fauna and flora constraints are foreseen at this stage as all pipeline routes have been aligned to avoid the environmentally sensitive Renosterveld.

9. PIPE MATERIAL SELECTION

Buried piping must resist internal pressure, external loads, differential settlement and the corrosive action of soils. The profile, flow velocity, size and stiffness of the pipe all affect the design. Various pipe materials are available on the market. Typical material considered for large diameter pipes are mild steel (MS), ductile iron (DI) and glass-fibre reinforced polyester (GRP).

A comparison between these pipeline materials are shown below:

TABLE 9-1: PIPELINE MATERIAL COMPARISON

Material	Nominal Bore Range (mm)	Working Pressure Range (m)	Jointing	Pipe Classification	Main Advantages	Main Disadvantages
GRP	250 – 2400	60 - 320 Depending stiffness class	Coupling, bell and spigot	Flexible	Light weight, corrosion resistant	Repair work, bedding and backfill sensitive
DI	80 – 2000	250 – 640	Spigot and socket, flange	Rigid	Strength, pressure range	Weight, protection against corrosion
MS	50 – 4000	80 – 1850 Depending grade	Flange, threaded coupling, spigot and socket, welded joint	Semi Rigid	Strength, pressure range	Weight, protection against corrosion

For the purpose of the preliminary design, Glass-fibre Reinforced Polyester (GRP) pipes were selected as the preferred pipeline material. Should either of the two (2) schemes proceed to Detail Design, further consideration can then be given to alternative pipeline materials such as Mild Steel (MS) or Ductile Iron (DI).

10. PIPELINE ROUTE LENGTHS

The various pipeline route lengths for each scheme variation considered are as follows:

- BRVA Scheme (Lorelei Weir Option)
  - Pipeline route to Northern Discharge Point = 8 115 m
  - Pipeline route to Central Discharge Point = 5 000 m
  - Pipeline Route to Southern Discharge Point = 6 300 m (Preferred route primarily due to water quality considerations)
- Michell's Pass Scheme
  - Pipeline Route to Blousloot Tributary Discharge Point (Alt. A) = 7 600 m
  - Pipeline Route to proposed Boontjies EWR Dam Pump Station (Alt. B) = 10 760 m

From the above-mentioned, it is clear that where technically and environmentally feasible, the shortest (and hence most economic) pipeline routes have been selected.

11. FLOW REQUIREMENTS

The flow requirements are based on design flows as developed from the yield analysis assessment and are described in the main report for each of the two (2) potential schemes.

12. HYDRAULIC REQUIREMENTS AND SCHEME DESIGN

12.1 BERG RIVER-VOËLVLEI AUGMENTATION SCHEME

Pipeline

Two (2) design flows were investigated for this scheme, namely 4 m^3/s and 6 m^3/s. The cover above the pipe has been maintained at a minimum of 1 m. The selected pipe material is GRP with a stiffness of 5 000 N/m^2 and a total length of approximately 6 300 m.

The design parameters for the BRVA Scheme are summarized as follows:

Design flow	4 m^3/s	6 m^3/s
Rising main properties	∅ 1700 mm GRP	∅ 1900 mm GRP
Rising main length	6 300 m	6 300 m
Static head	28,0 m	28,0 m
Dynamic head	35,8 m	37,5 m
Maximum flow velocity	1,762 m/s	2,116 m/s

Note: Colebrook White & Darcy-Weisbach formulas used to determine head loss

Air-valves have been allowed for at high points. Scour valves have been allowed for at low points to facilitate scouring and drainage of the pipeline. The necessary valves have been allowed for to divert canal water from the Swartland WTW to the Berg River, as well as in-line valves to isolate sections of the pipeline for scouring, isolating and maintenance purposes.

Pump station

The design parameters for the pump station, pumping raw water from the Berg River in winter, are as follows:

Design flow	4 m^3/s	6 m^3/s
Rising main static pressure	28,0 m	28,0 m
Friction losses	7,8 m	9,5 m
Inlet static pressure	1,8 m	1,8 m
Pump duty	34,0 m @ 4 m^3/s	35,7 m @ 6 m^3/s

During winter, water from the Berg River will flow into the sump at the pump station. A level transmitter on the weir will provide an input value for the flow calculation to determine the amount of water to be abstracted and pumped to Voëlvlei Dam, where after the pumping will commence according to the approved operating rules for the scheme.

At the commencement of pumping, the pipeline could be partially empty. As such, the first pump will start by means of a variable speed drive and slowly fill the pipeline until water is discharged into Voëlvlei Dam. Flow will be measured at the pump station in order to monitor the volumes abstracted and the abstraction rates.

As the winter flow in the Berg River increases, a second variable speed drive pump will start to increase the abstraction rate. The rest of the pumps will follow until the required flow rate is achieved. The pump(s) speed can then be adjusted to provide the permissible flow as defined by the operating rules. This adjustment can be made locally at the pump station, or remotely via a SCADA system. A fifth pump will be installed as a back-up.

A SCADA system will be provided for remote monitoring of the pumping system status (site unknown at this stage), including the pumps' operational status, flow, system pressure, dam level, etc. If so required, the system can also be utilised to provide a remote control facility.

The proposed pump station specifications and schematic layout are shown in Appendix 5.

12.2 BREEDE-BERG (MICHELL'S PASS) WATER TRANSFER SCHEME

Pipeline

The required design flow of 5 m^3/s resulted in a pipe diameter of 2 000 mm being required at an average depth of 3,5 m and flow velocity of 1,592 m/s. The cover above the pipe has been maintained at a minimum of 1 m. The selected pipe material is GRP with a stiffness of 5 000 N/m² and a total length of approximately 7 600 m.

The design parameters for the Michell's Pass Scheme are as follows:

- Pipeline hydraulics
  - Colebrook White & Darcy-Weisbach formulas used to determine head loss
  - Gravity main properties : ∅ 2 000 mm GRP
  - Gravity main length : 7 600 m
  - Design flow : 5 m³/s
  - Maximum flow velocity : 1,592 m/s

Air-valves have been allowed for at high points. Scour valves have been allowed for at low points to facilitate scouring and drainage of the pipeline. The necessary valves have been allowed for at the

balancing tank, connection points, as well as in-line valves to isolate sections of the pipeline for scouring, isolating and maintenance purposes.

Scheme without provision of Boontjies River EWR dam (Alternative A)

This alternative assumes that provision for the summer EWRs downstream of the diversion site can possibly be made by means of releases from Koekedouw Dam. The existing summer irrigation rights to the Artois and Wolseley farmers will be made via the gravity pipeline.

The proposed gravity pipeline would transfer winter flood water to a closed discharge chute, which discharges water approximately 800 m further into the Blousloot, an offshoot of the Boontjies River, and tributary of the Klein Berg River, from where the water would be diverted into the existing Voëlvlei Dam.

A balancing tank is used to ensure control at the chute inlet, while an appropriate outlet structure is proposed at the discharge point into the Blousloot Tribuatry, to safeguard the river morphology from excessive velocities. The required chute size was determined for a discharge of 5 m^3/s and average surface slope of 0.0415 m/m using inlet control and Manning Flow Principles. Initially it was proposed that the chute should discharge flow directly into the Boontjies River (in close proximity to Wolseley), but land owners were not in support of the interruption to agricultural activities that the installation of a chute on this route would have. Despite the steeper slope, the new proposed route spans a shorter distance and has a lower level of impact on farming activities.

Erosion control and control of the stream position in the Boontjies River are proposed in the form of erosion control weirs (see Appendix 6). These weirs are proposed at regular intervals in order to mitigate vertical and lateral erosion and to control the position of the rivers as far as possible.

Scheme with provision of Boontjies River EWR dam (Alternative B)

An alternative to providing summer EWR releases from Koekedouw Dam, involves making provision for additional storage of surplus winter water in a proposed dam on the Boontjies River, a tributary of the Klein Berg River. The proposed scheme would allow for winter water to be diverted from the proposed Michell's Pass Diversion weir, and conveyed under gravity via the pipeline to the Boontjies River where it would be discharged under controlled means into the proposed Boontjies Dam.

In winter the dam would fill and water spilled and/or released from it, would then flow into the Klein Berg River and be diverted in Voëlvlei Dam via the existing Klein Berg Diversion. The water stored in the Boontjies Dam would then be available in summer for pumping to the Artois irrigators who would be supplied in this manner as an alternative to their current summer abstractions from the Breede River. The summer flows in the Breede River at Michell's Pass would remain undiverted and would thus be available towards meeting the EWR requirements downstream of the proposed Diversion. Any shortfalls in providing for the summer EWRs would also be pumped from the water stored in the Boontjies Dam back to the Breede River to meet that need. The indicative size of the dam would be one of about 8 million cubic meters.

Pump station for providing EWR flows in summer

The potential Boontjies River EWR dam has been assessed at pre-feasibility level, due to its late inclusion as an alternative within the Michell's Pass Scheme. The pump station at the potential dam will pump water stored during winter to the Breede River (in summer) for providing the summer EWRs downstream of the proposed diversion weir. It will also deliver water to the irrigators as per the existing summer water rights.

The design parameters for that pump station (EWR flow requirements and irrigation supply) are as follows:

- Pump station pumping water from the potential Boontjies River EWR dam
  - Design flow : max 1 m^3/s
  - Friction losses : 3 m
  - Rising mains diameter : ∅ 1 100 mm & ∅ 2 000 mm GRP

- Length : 10 760 m
- Maximum flow velocity : 1,052 m/s
- Pump duty (dam full) : 39 m @ 1 m^3/s
- Pump duty (dam empty) : 60 m @ 1 m^3/s

13. PIPELINE TRANSPORT AND INSTALLATION

Transport and installation of pipelines will be via the existing tar and gravel roads in the study area. GRP and MS pipes will have a weight benefit to DI pipes in respect of transport and installation operations.

14. PIPELINE ACCESS AND MAINTENANCE

Pipeline access and maintenance will, where possible, be via existing tar and gravel roads to the proposed rising mains. Where the proposed routes do not follow cadastral boundaries between farms, new pipeline access roads will need to be constructed.

15. EXISTING SERVICES

For the proposed BRVA Scheme, the proposed pipeline crosses a variety of services including a river, canal, railway lines, regional road, farms roads, farm fences, power lines, telephone lines, etc. There will be minimum impact on agricultural land crossed as most of these lands are only used for grazing purposes, without major impact on the farmers.

The proposed Michell's Pass Scheme pipeline crosses a variety of services including a river, regional roads, farms roads, farm fences, power lines, telephone lines, etc. There will be a large impact on agricultural land crossed, as most of these lands have orchards under irrigation, which would therefore have a significant impact on the farmers.

Crossing of existing services should be co-ordinated and applicable wayleaves obtained from the relevant authorities. The future upgrade of main roads needs to be taken into account during the detail design of the proposed pipelines, should either of the two (2) schemes proceed to implementation.

16. STATUTORY APPROVALS

Construction of the proposed infrastructure for both potential schemes has environmental and heritage implications and both will require a full environmental impact assessment (EIA) process, as required under the National Environmental Management Act (Act 107 of 1998).

17. COST ESTIMATES

Cost estimates are based on current market related rates and should be escalated on an annual basis.

The cost estimates include the conveyance infrastructure, diversion weirs for both schemes, as well as the potential Boontjies River EWR dam for the Michell's Pass Scheme.

The cost estimates for the BRVA and Michell's Pass Schemes are as follows:

COST ESTIMATE SUMMARY : BRVA SCHEME - 4 m^3/s

December 2012

DESCRIPTION	UNIT	QTE	RATE	ESTIMATED COST (R)
A: Estimated Construction Cost - Berg River Weir Structure				
Preliminary & General	5%			R 1,672,500.00
Berg River Weir Structure[A)]	Sum	1	33,450,000.00	R 33,450,000.00
Subtotal A				**R 35,122,500.00**
B: Estimated Construction Cost - Mechanical/Electrical				
Preliminary & General	5%			R 1,825,000.00
Berg River Pump Station (Mechanical/Electrical)[B)]	Sum	1	36,500,000.00	R 36,500,000.00
Subtotal B				**R 38,325,000.00**
C: Estimated Construction Cost - Civil				
Preliminary & General	25%			R 25,437,500.00
Berg River Pump Station (Civil)	Sum	1	5,000,000.00	R 5,000,000.00
Voëlvlei Rising Main[C)]	Sum	1	96,750,000.00	R 96,750,000.00
Subtotal C				**R 127,187,500.00**
D: Estimated Construction Cost - River Protection				
Preliminary & General	5%			R 7,500.00
Voëlvlei Outlet Structure	Sum	1	50,000.00	R 50,000.00
Berg River Protection	Sum	1	100,000.00	R 100,000.00
Subtotal D				**R 157,500.00**
SUBTOTAL 1				**R 200,792,500.00**
Contingencies	10%			R 20,079,250.00
Escalation	0%			R 0.00
SUBTOTAL 2				**R 20,079,250.00**
TOTAL CONSTRUCTION COST (Excl VAT)				**R 220,871,750.00**

Estimated Professional Fees	
Professional Fees	R 13,331,446.25
Recoverable Expenditures	R 3,350,000.00
Supervision	R 360,000.00
Site and Occupational Health & Safety Supervision	R 156,000.00
TOTAL PROFESSIONAL FEES (Excl VAT)	**R 17,197,446.25**

Estimated Other Fees	
Servitude and Property Cost	R 5,040,000.00
TOTAL OTHER FEES (Excl VAT)	**R 5,040,000.00**

TOTAL PROJECT COST (Excl VAT)	**R 243,109,196.25**
VAT (14 %)	**R 34,035,287.48**
TOTAL PROJECT COST (Incl VAT)	**R 277,144,483.73**

*Power supply to be finalized with ESKOM when design is finalized

A) Assumed to be equal to that of the 6m^3/s weir (Appendix 7.1)

B) Refer to Appendix 7.2

C) Refer to Appendix 7.3

COST ESTIMATE SUMMARY : BRVA SCHEME - 6 m^3/s

December 2012

DESCRIPTION	UNIT	QTE	RATE	ESTIMATED COST (R)
A: Estimated Construction Cost - Berg River Weir Structure				
Preliminary & General	5%			R 1,672,500.00
Berg River Weir Structure[A)]	Sum	1	33,450,000.00	R 33,450,000.00
Subtotal A				**R 35,122,500.00**
B: Estimated Construction Cost - Mechanical/Electrical				
Preliminary & General	5%			R 2,290,000.00
Berg River Pump Station (Mechanical/Electrical)[B)]	Sum	1	45,800,000.00	R 45,800,000.00
Subtotal B				**R 48,090,000.00**
C: Estimated Construction Cost - Civil				
Preliminary & General	25%			R 28,750,000.00
Berg River Pump Station (Civil)	Sum	1	5,000,000.00	R 5,000,000.00
Voëlvlei Rising Main[C)]	Sum	1	110,000,000.00	R 110,000,000.00
Subtotal C				**R 143,750,000.00**
D: Estimated Construction Cost - River Protection				
Preliminary & General	5%			R 7,500.00
Voëlvlei Outlet Structure	Sum	1	50,000.00	R 50,000.00
Berg River Protection	Sum	1	100,000.00	R 100,000.00
Subtotal D				**R 157,500.00**
SUBTOTAL 1				**R 227,120,000.00**
Contingencies	10%			R 22,712,000.00
Escalation	0%			R 0.00
SUBTOTAL 2				**R 22,712,000.00**
TOTAL CONSTRUCTION COST (Excl VAT)				**R 249,832,000.00**

Estimated Professional Fees	
Professional Fees	R 14,924,260.00
Recoverable Expenditures	R 3,750,000.00
Supervision	R 360,000.00
Site and Occupational Health & Safety Supervision	R 156,000.00
TOTAL PROFESSIONAL FEES (Excl VAT)	**R 19,190,260.00**

Estimated Other Fees	
Servitude and Property Cost	R 5,040,000.00
TOTAL OTHER FEES (Excl VAT)	**R 5,040,000.00**

TOTAL PROJECT COST (Excl VAT)	**R 274,062,260.00**
VAT (14 %)	**R 38,368,716.40**
TOTAL PROJECT COST (Incl VAT)	**R 312,430,976.40**

*Power supply to be finalized with ESKOM when design is finalized

A) Refer to Appendix 7.1

B) Refer to Appendix 7.2

C) Refer to Appendix 7.3

COST ESTIMATE SUMMARY : Michell's Pass Scheme - Alternative A (without provision for summer EWR pumping scheme)

December 2012

DESCRIPTION	UNIT	QTE	RATE	ESTIMATED COST (R)
A: Estimated Construction Cost - Michells Pass Weir Structure				
Preliminary & General	5%			R 2,383,750.00
Michells Pass Weir Structure[A)]	Sum	1	47,675,000.00	R 47,675,000.00
Subtotal A				**R 50,058,750.00**
B: Estimated Construction Cost - Civil				
Preliminary & General	25%			R 35,562,500.00
Gravity Main (Breede Weir to Balancing Tank)[B)]	Sum	1	138,500,000.00	R 138,500,000.00
Balancing Tank[C)]	Sum	1	3,750,000.00	R 3,750,000.00
Subtotal B				**R 177,812,500.00**
C: Estimated Construction Cost - Chutes and River Protection				
Preliminary & General	5%			R 3,275,000.00
Blousloot Closed Chute[C)]	Sum	1	15,500,000.00	R 15,500,000.00
Blousloot and Boontjies River Protection[C)]	Sum	1	50,000,000.00	R 50,000,000.00
Subtotal C				**R 68,775,000.00**
D: Estimated Construction Cost - Papenkuils Pump Station				
Preliminary & General (Civil)	25%			R 2,375,000.00
Pump Station Upgrade (Civil)	Sum	1	9,500,000.00	R 9,500,000.00
Preliminary & General (Mechanical/Electrical)	15%			R 10,200,000.00
Pump Station Upgrade (Mechanical/Electrical)	Sum	1	68,000,000.00	R 68,000,000.00
Subtotal D				**R 90,075,000.00**
SUBTOTAL 1				**R 386,721,250.00**
Contingencies	10%			R 38,672,125.00
Escalation	0%			R 0.00
SUBTOTAL 2				**R 38,672,125.00**
TOTAL CONSTRUCTION COST (Excl VAT)				**R 425,393,375.00**

Estimated Professional Fees	
Professional Fees	R 24,380,668.75
Recoverable Expenditures	R 7,676,529.38
Supervision	R 360,000.00
Site and Occupational Health & Safety Supervision	R 156,000.00
TOTAL PROFESSIONAL FEES (VAT excl)	**R 32,573,198.13**

Estimated Other Fees	
Servitude and Property Cost	R 6,080,000.00
TOTAL OTHER FEES (Excl VAT)	**R 6,080,000.00**

TOTAL PROJECT COST (Excl VAT)	**R 464,046,573.13**
VAT (14 %)	**R 64,966,520.24**
TOTAL PROJECT COST (Incl VAT)	**R 529,013,093.36**

*Power supply to be finalized with ESKOM when design is finalized

A) Refer to Appendix 8.1.1

B) Refer to Appendix 8.1.2

C) Refer to Appendix 8.1.3

COST ESTIMATE SUMMARY : Michell's Pass Scheme - Alternative B
(with provision for summer EWR pumping scheme)

December 2012

DESCRIPTION	UNIT	QTE	RATE	ESTIMATED COST (R)
A: Estimated Construction Cost - Michells Pass Weir Structure				
Preliminary & General	5%			R 2,383,750.00
Michells Pass Weir Structure[A)]	Sum	1	47,675,000.00	R 47,675,000.00
Subtotal A				**R 50,058,750.00**
B: Estimated Construction Cost - Mechanical/Electrical				
Preliminary & General	5%			R 650,000.00
New Boontjies Dam Pump Station (Mech/Elec)[B)]	Sum	1	13,000,000.00	R 13,000,000.00
Subtotal B				**R 13,650,000.00**
C: Estimated Construction Cost - Civil				
Preliminary & General	25%			R 50,716,250.00
Gravity Main (Breede Weir to New Boontjies Dam)[C)]	Sum	1	184,115,000.00	R 184,115,000.00
Balancing Tank[D)]	Sum	1	3,750,000.00	R 3,750,000.00
New Boontjies Dam Pump Station (Civil)	Sum	1	3,500,000.00	R 3,500,000.00
New Rising Main (Boontjies PST to Gravity Main)[C)]	Sum	1	11,500,000.00	R 11,500,000.00
Subtotal C				**R 253,581,250.00**
D: Estimated Construction Cost - Chutes and River Protection				
Preliminary & General	5%			R 2,775,000.00
Boontjies Dam Closed Chute[D)]	Sum	1	15,500,000.00	R 15,500,000.00
Boontjies River Protection[C)]	Sum	1	40,000,000.00	R 40,000,000.00
Subtotal D				**R 58,275,000.00**
E: Estimated Construction Cost - Boontjies EWR Dam				
Preliminary & General	20%			R 16,300,000.00
Boontjies EWR Dam	Sum	1	81,500,000.00	R 81,500,000.00
Subtotal E				**R 97,800,000.00**
F: Estimated Construction Cost - Papenkuils Pump Station				
Preliminary & General (Civil)	25%			R 2,375,000.00
Pump Station Upgrade (Civil)	Sum	1	9,500,000.00	R 9,500,000.00
Preliminary & General (Mechanical/Electrical)	15%			R 10,200,000.00
Pump Station Upgrade (Mechanical/Electrical)	Sum	1	68,000,000.00	R 68,000,000.00
Subtotal F				**R 90,075,000.00**
SUBTOTAL 1				**R 563,440,000.00**
Contingencies (Boontjies EWR Dam = 15%)	10%			R 61,234,000.00
Escalation	0%			R 0.00
SUBTOTAL 2				**R 61,234,000.00**
TOTAL CONSTRUCTION COST (Excl VAT)				**R 624,674,000.00**

Estimated Professional Fees	
Professional Fees	R 34,344,700.00
Recoverable Expenditures	R 10,577,975.00
Supervision	R 450,000.00
Site and Occupational Health & Safety Supervision	R 195,000.00
TOTAL PROFESSIONAL FEES (VAT excl)	**R 45,567,675.00**

Estimated Other Fees	
Servitude and Property Cost	R 19,532,000.00
TOTAL OTHER FEES (Excl VAT)	**R 19,532,000.00**

TOTAL PROJECT COST (Excl VAT)	**R 689,773,675.00**
VAT (14 %)	**R 96,568,314.50**
TOTAL PROJECT COST (Incl VAT)	**R 786,341,989.50**

*Power supply to be finalized with ESKOM when design is finalized

A) Refer to Appendix 8.2.1

B) Refer to Appendix 8.2.2

C) Refer to Appendix 8.2.3

D) Assumed to be equal to that of Alternative A

APPENDIX 1 – BRVA SCHEME OPTIONS

1:30 000

PREFERRED LORELEI PUMP STATION (OPTION 1a)

PREFERRED WEIR (OPTION 1a)

PREFERRED RISING MAIN (OPTION 1a)

PROPOSED ZONQUASDRIFT WEIR (OPTION 2a)

PROPOSED ZONQUASDRIFT PUMP STATION (OPTION 2a)

WTW

PROPOSED OUTLET STRUCTURE (OPTION 1a & 2a)

RISING MAIN SECTION COVERED UNDER OPTIONS 1a & 2a

VOëLVLEI DAM

PROPOSED RISING MAIN (OPTION 1b & 2b)

PROPOSED WEIR (OPTION 3)

PROPOSED SPES BONA PUMP STATION (OPTION 3)

PROPOSED RISING MAIN (OPTION 3)

WTW

PROPOSED WTW CONNECTION (OPTION 1b & 2b)

PROPOSED SETTLING DAM (OPTION 3)

AUGMENTATION OF THE WESTERN CAPE SUPPLY SYSTEM

BRVA SCHEME PRE-FEASIBILITY PHASE OPTIONS

DEC 2012 | FIGURE A1.1

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1:20 000

WEIR

PUMP STATION

SUMMER RELEASE OUTLET STRUCTURE

SUMMER RELEASE CONNECTION

POTENTIAL NORTHERN OUTLET STRUCTURE

POTENTIAL CENTRAL OUTLET STRUCTURE

PREFERRED SOUTHERN OUTLET STRUCTURE

Berg River

RE/91
2/92
21/73
17/73
24/73
20/73
13/73
2/199
1/359
1/648
10/73
5/73
19/73
25/73
2/647
1/199
RE/412
RE/412
3/1129
2/201
4/201
4/201
RE/200
2/648
5/1129
RE/1129
6/1129
1/201
1/201
2/403
441
392
392 8/207
8/207
RE/207
RE/648
7/207
7/207
7/207
7/207
4/207
383
383
2/203
9/203
3/203
1/203
9/203
8/203
7/203
6/254
6/254
3/254
1/207
1/207
3/207
3/207
649
RE/206
RE/206
5/207
5/207
19/254
4/254
19/254
4/254

AUGMENTATION OF THE WESTERN CAPE SUPPLY SYSTEM

BRVA SCHEME FEASIBILITY PHASE: DISCHARGE OPTIONS

DEC 2012 | FIGURE A1.2

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APPENDIX 2 – PIPELINE ROUTES AND LONG SECTIONS: BRVA SCHEME

1:15 000

WEIR

PUMP STATION

SUMMER RELEASE OUTLET STRUCTURE

SUMMER RELEASE CONNECTION

OUTLET STRUCTURE

Berg River

20/73
13/73
10/73
1/648
2/647
25/73
5/73
19/73
2/199
1/359
1/199
RE/412
3/1129
2/201
2/648
4/201
4/201
RE/200
5/1129
RE/1129
6/1129
1/201
1/201
2/403
441
392
392
RE/207
8/207
8/207
RE/648
383
383
7/207
7/207
7/207
7/207
2/203
9/203
3/203
1/203
9/203
8/203
7/203
6/254
4/207
1/207

AUGMENTATION OF THE WESTERN CAPE SUPPLY SYSTEM

BRVA SCHEME FEASIBILITY PHASE: PREFERRED OPTION

DEC 2012 | FIGURE A2.1

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PLAN

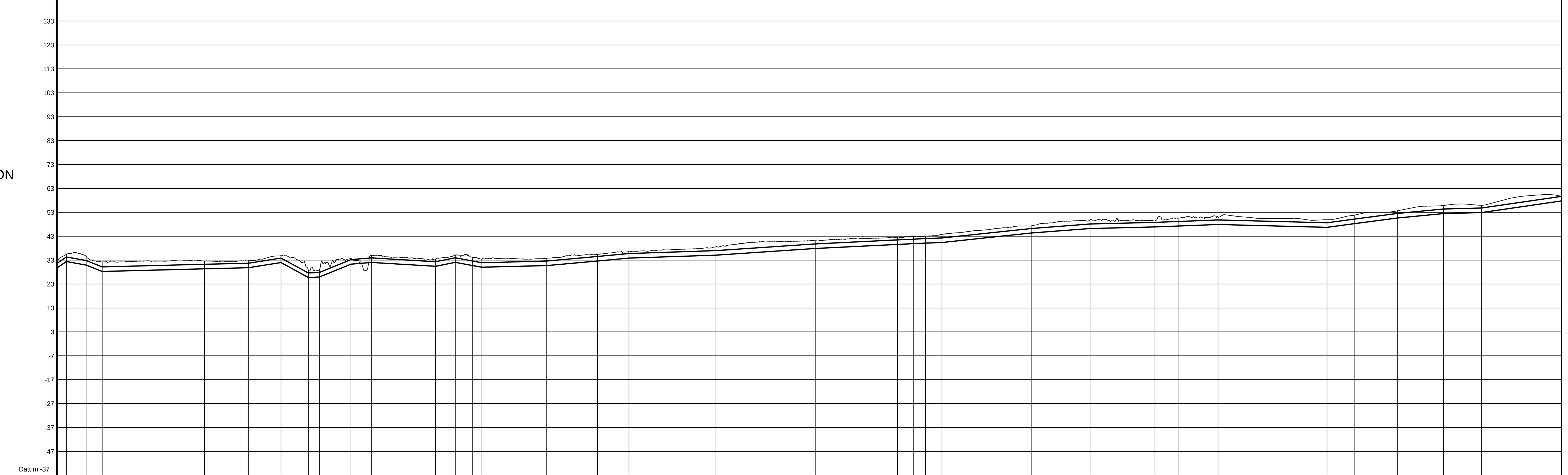
SCALE:

1:7500

LONGITUDINAL SECTION

1:1000

1:10000



POINT NUMBER	CHAINAGE DISTANCE	GROUND LEVEL	INVERT LEVEL	DEPTH OF PIPE
[254]	0.00	52.581	49.68	2.90
PI 01 [112]	40.35	55.324	52.42	2.90
PI 02 [116]	122.83	54.589	50.94	3.65
	190.21	52.141	48.28	3.86
PI 03 [123]	617.62	52.608	49.35	3.25
PI 04 [128]	800.99	52.714	49.81	2.90
Under2 [247]	937.87	54.873	51.97	2.90
	1052.01	48.640	45.74	2.90
	1098.41	48.852	45.95	2.90
	1230.55	53.708	51.31	2.40
Under3 [248]	1315.56	54.934	52.03	2.90
	1584.49	53.320	50.42	2.90
PI 07 [137]	1666.43	54.975	52.08	2.90
PI 08 [141]	1739.28	54.107	50.73	3.37
PI 09 [145]	1777.63	53.427	50.03	3.40
	2048.78	53.788	50.73	3.06
PI 10 [150]	2260.95	55.441	52.62	2.82
PI 11 [155]	2392.47	56.576	53.87	2.71
	2756.44	58.591	55.07	3.52
	3171.42	61.329	57.87	3.45
PI 12 [208]	3515.55	62.444	59.56	2.88
PI 13 [162]	3583.38	62.854	59.89	2.97
PI 14 [166]	3632.20	62.996	60.12	2.88
PI 15 [169]	3701.50	63.798	60.39	3.41
	4074.52	67.311	64.33	2.98
PI 16 [174]	4320.24	69.812	66.21	3.60
	4591.78	69.408	66.91	2.50
PI 17 [177]	4691.97	70.664	67.28	3.38
	4855.66	70.795	67.90	2.90
	5311.29	69.885	66.73	3.15
PI 18 [181]	5424.94	71.788	68.23	3.56
PI 19 [219]	5605.42	73.608	70.61	3.00
	5798.71	75.851	72.50	3.35
PI 20 [185]	5957.67	75.901	72.90	3.00
PI 21 [187]	6292.15	79.676	77.78	1.90

DISTANCE / GRADE	
40.4 m	6.798 %
82.5 m	1.800 %
67.4 m	3.945 %
427.4 m	0.251 %
183.4 m	0.251 %
136.9 m	1.577 %
114.3 m	5.461 %
46.4 m	0.457 %
132.2 m	4.053 %
85.0 m	0.854 %
268.9 m	0.600 %
82.0 m	2.020 %
72.9 m	1.842 %
38.3 m	1.842 %
271.2 m	0.260 %
212.2 m	0.890 %
131.5 m	0.949 %
364.0 m	0.330 %
415.0 m	0.676 %
344.1 m	0.490 %
67.8 m	0.482 %
48.8 m	0.473 %
69.3 m	0.393 %
373.0 m	1.056 %
245.7 m	0.765 %
271.5 m	0.256 %
100.2 m	0.374 %
163.7 m	0.374 %
455.6 m	0.255 %
113.7 m	1.317 %
180.5 m	1.317 %
193.3 m	0.979 %
159.0 m	0.252 %
334.5 m	1.457 %

TYPE & CLASS PIPE: GRP Class 9 1900 (all sections)

CROSSINGS

FITTINGS

FOR INFORMATION ONLY	✓
PRELIMINARY	
FOR APPROVAL	
FOR TENDER PURPOSES	
FOR CONSTRUCTION	
AS BUILT	

AMENDMENT

NO.	DATE	CHECKED	DONE BY	DESCRIPTION

SCALE FOR REDUCED PLAN

0 10 20 30 40 50 60 70 80 90 100

100mm ON ORIGINAL PLAN

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

WorleyParsons
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Incorporating KV3 ENGINEERS
P.O.Box 398
BELLVILLE 7535
TEL:(021) 912 3000
FAX:(021) 912 3222
E-MAIL: capetown.office@worleyparsons.com

DESIGNED

DRAWN

CHECKED

CONSULTING ENGINEER

DATE

CLIENT

DATE

CLIENT

DEPARTMENT OF WATER AFFAIRS / AURECON

PROJECT

AUGMENTATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM

DRAWING DESCRIPTION

SUPPLY VOËLVLEI DAM FROM BERG RIVER WEIR

SCALE AS SHOWN

ORIGINAL DWG SIZE A0

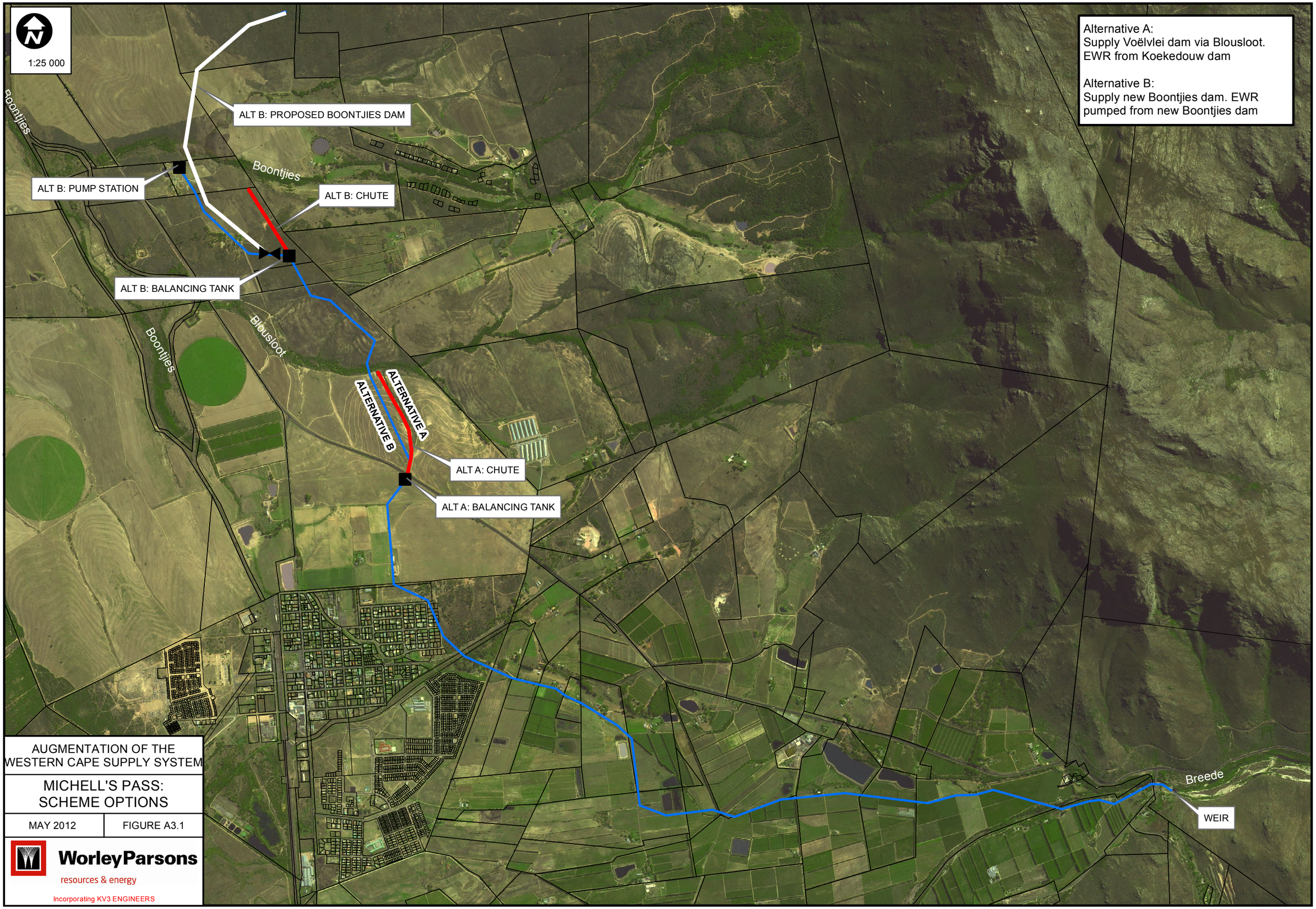
DATE MAY 2012

DRAWING NUMBER 23777KD0/A2.1.1

REV NO 00

P:\WaterDept\Western Cape\23777KS0 Western Cape Augmentation Scheme\Phase 2\G Data\Civil Designer\Voëlvlei 2011-12-05\Plans for Report\Voelvlei Phase 2 a_Preferred option CLEAN.dwg

APPENDIX 3 – MICHELL'S PASS SCHEME OPTIONS


1:25 000
Alternative A:
Supply Voëlvlei dam via Blousloot.
EWR from Koekedouw dam
Alternative B:
Supply new Boontjies dam. EWR
pumped from new Boontjies dam
ALT B: PROPOSED BOONTJIES DAM
ALT B: PUMP STATION
ALT B: CHUTE
ALT B: BALANCING TANK
Boontjies
Boontjies
Boontjies
Blousloot
ALTERNATIVE A
ALTERNATIVE B
ALT A: CHUTE
ALT A: BALANCING TANK
Breede
WEIR
AUGMENTATION OF THE WESTERN CAPE SUPPLY SYSTEM
MICHELL'S PASS: SCHEME OPTIONS
MAY 2012
FIGURE A3.1
WorleyParsons
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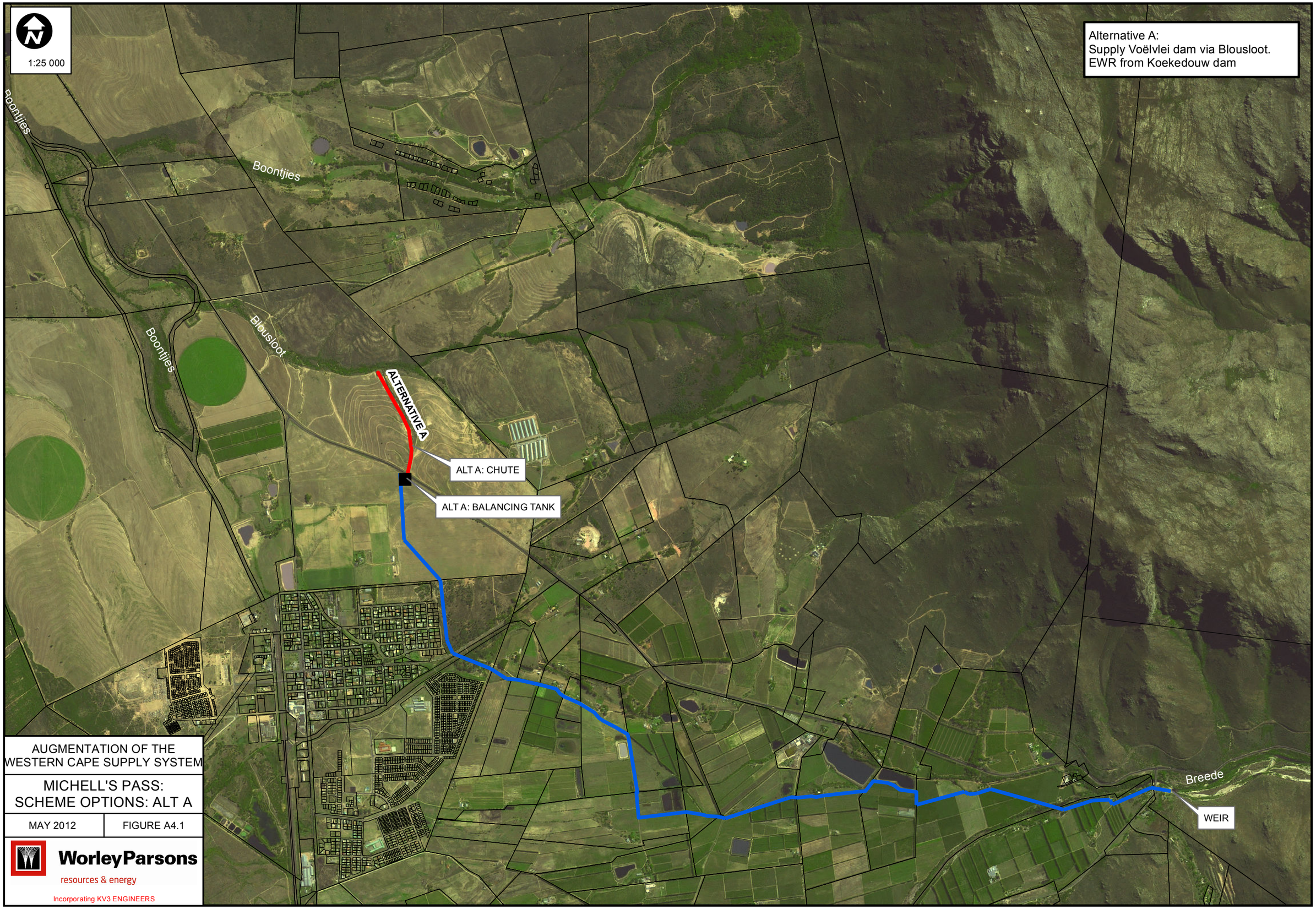
Incorporating KV3 ENGINEERS

APPENDIX 4 – PIPELINE ROUTES AND LONG SECTIONS: MICHELL'S PASS SCHEME



AUGMENTATION OF THE WESTERN CAPE SUPPLY SYSTEM

MICHELL'S PASS: SCHEME OPTIONS: ALT A

MAY 2012	FIGURE A4.1

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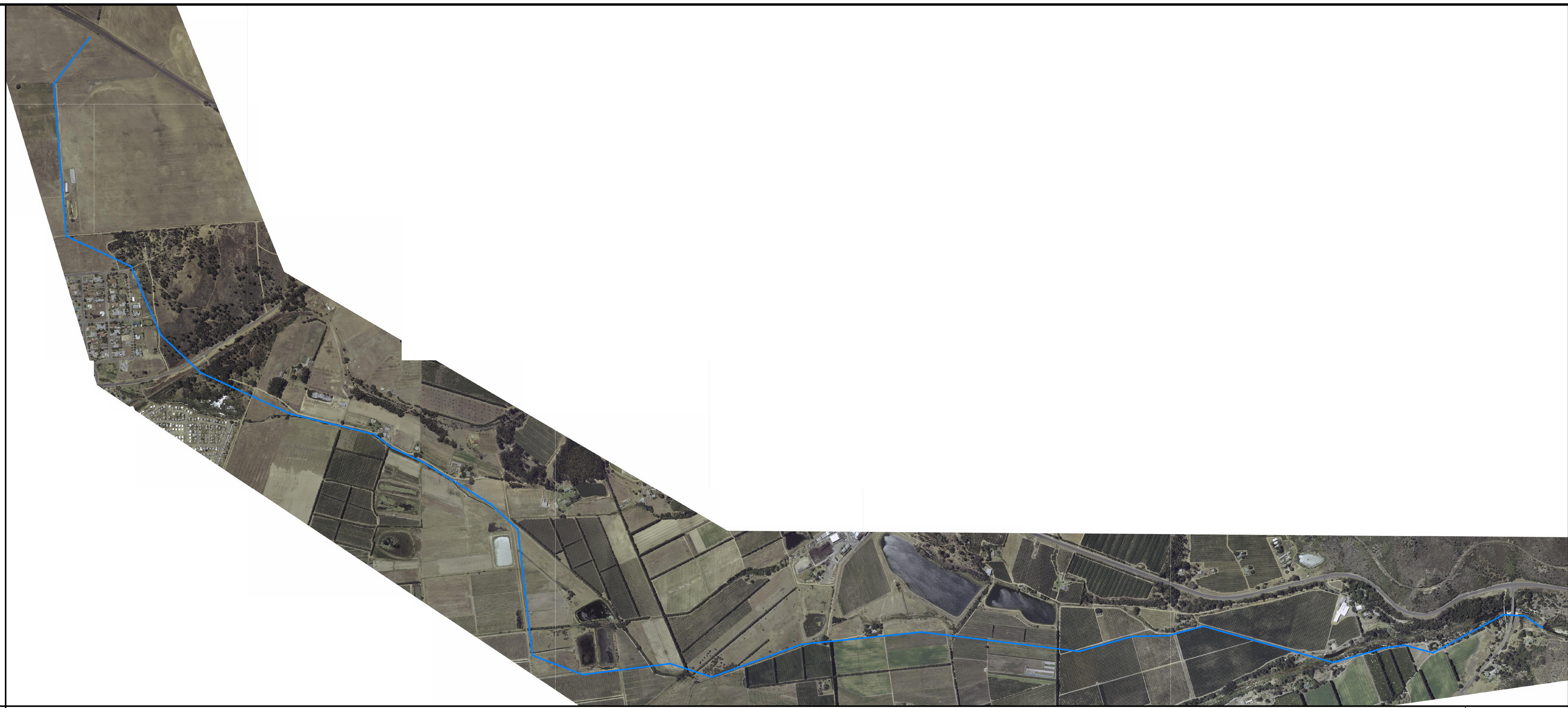
PLAN

SCALE:

1:10000



LONGITUDINAL SECTION

1:1000

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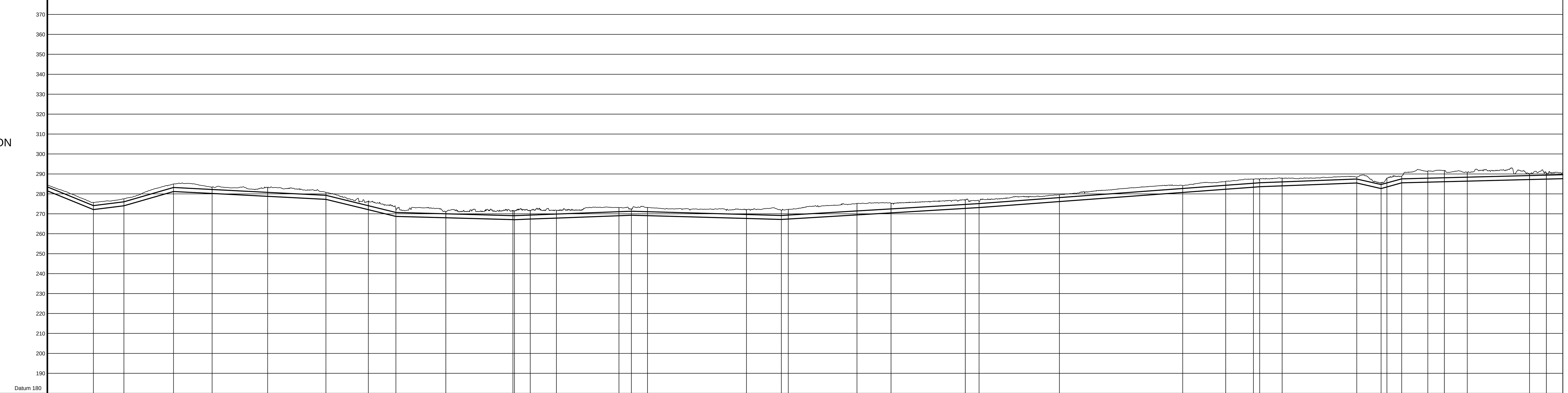

POINT NUMBER	CHAINAGE DISTANCE	GROUND LEVEL	INVERT LEVEL	DEPTH OF PIPE
[27]	0.00	284.505	281.51	3.00
[29]	230.94	275.619	272.12	3.50
	383.72	277.508	274.01	3.50
	632.32	284.951	281.20	3.75
[26]	825.61	283.250	280.20	3.05
[25]	1103.86	283.300	278.76	4.53
[24]	1395.96	280.756	277.26	3.50
[23]	1608.27	276.347	272.07	4.28
	1746.38	272.195	268.69	3.50
[22]	1996.45	271.019	268.01	3.01
[21]	[illegible]	[illegible]	[illegible]	[illegible]
[20]	2419.61	271.573	267.36	4.21
[19]	2550.90	271.625	267.86	3.76
[18]	2864.10	273.156	269.05	4.10
	2926.39	272.288	269.29	3.00
[17]	3007.15	273.209	269.06	4.15
[16]	3502.89	272.101	267.66	4.44
[15]	3677.55	271.667	267.17	4.50
	3712.59	272.224	267.38	4.85
[14]	4056.62	275.213	269.45	5.76
[13]	4227.27	275.187	270.48	4.71
[12]	4599.44	277.040	272.72	4.32
	4668.18	276.131	273.13	3.00
[11]	5070.89	279.534	276.12	3.41
[10]	5688.67	284.207	280.71	3.49
[9]	5903.94	286.273	282.31	3.96
[8]	6043.06	287.463	283.35	4.12
	6074.25	287.078	283.58	3.50
[7]	6186.94	287.931	284.01	3.92
	6560.51	288.451	285.45	3.00
	6682.79	285.675	282.68	3.00
[6]	6711.89	287.917	283.49	4.43
	6785.86	288.801	285.55	3.25
[5]	6916.62	291.410	285.88	5.53
[4]	6999.66	291.750	286.10	5.65
[3]	7114.28	290.763	286.39	4.38
[2]	7426.60	290.011	287.18	2.83
[28]	7510.66	290.439	287.40	3.04
[1]	7593.03	290.605	287.60	3.00

DISTANCE	GRADE
231.1 m	4.064 %
152.8 m	1.236 %
248.7 m	2.893 %
193.3 m	0.517 %
278.3 m	0.517 %
292.1 m	0.517 %
212.4 m	2.443 %
138.2 m	2.443 %
250.1 m	0.275 %
336.2 m	0.275 %
7.6 m	0.275 %
79.4 m	0.380 %
131.3 m	0.380 %
313.2 m	0.380 %
62.3 m	0.380 %
80.8 m	0.282 %
495.7 m	0.282 %
174.7 m	0.282 %
35.0 m	0.602 %
344.0 m	0.602 %
170.7 m	0.602 %
372.2 m	0.602 %
68.7 m	0.602 %
402.7 m	0.743 %
617.8 m	0.743 %
215.3 m	0.743 %
139.1 m	0.743 %
31.2 m	0.743 %
112.7 m	0.385 %
373.6 m	0.385 %
122.3 m	2.270 %
29.1 m	[illegible]
74.0 m	2.791 %
130.8 m	0.254 %
83.0 m	0.254 %
114.6 m	0.254 %
312.3 m	0.254 %
84.1 m	0.254 %
82.4 m	0.254 %

TYPE & CLASS PIPE: GRP Class 10, 2000 (all segments)

CROSSINGS

FITTINGS

AMENDMENT				
NO.	DATE	CHECKED	DONE BY	DESCRIPTION

SCALE FOR REDUCED PLAN

0 10 20 30 40 50 60 70 80 90 100

100mm ON ORIGINAL PLAN

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

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DESIGNED

DRAWN

CHECKED

CONSULTING ENGINEER

DATE

CLIENT

DATE

CLIENT

DEPARTMENT OF WATER AFFAIRS / AURECON

PROJECT

AUGMENTATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM

DRAWING DESCRIPTION

ALTERNATIVE A:
SUPPLY VOËLVLEI DAM FROM BREEDE RIVER WEIR VIA BLOUSLOOT. EWR FROM KOEKEDOUW DAM

SCALE: AS SHOWN

ORIGINAL DWG SIZE A0

DATE: MAY 2012

DRAWING NUMBER: 23777KD0/A4.1.1

REV NO: 00

FOR INFORMATION ONLY	✓
PRELIMINARY	
FOR APPROVAL	
FOR TENDER PURPOSES	
FOR CONSTRUCTION	
AS BUILT	

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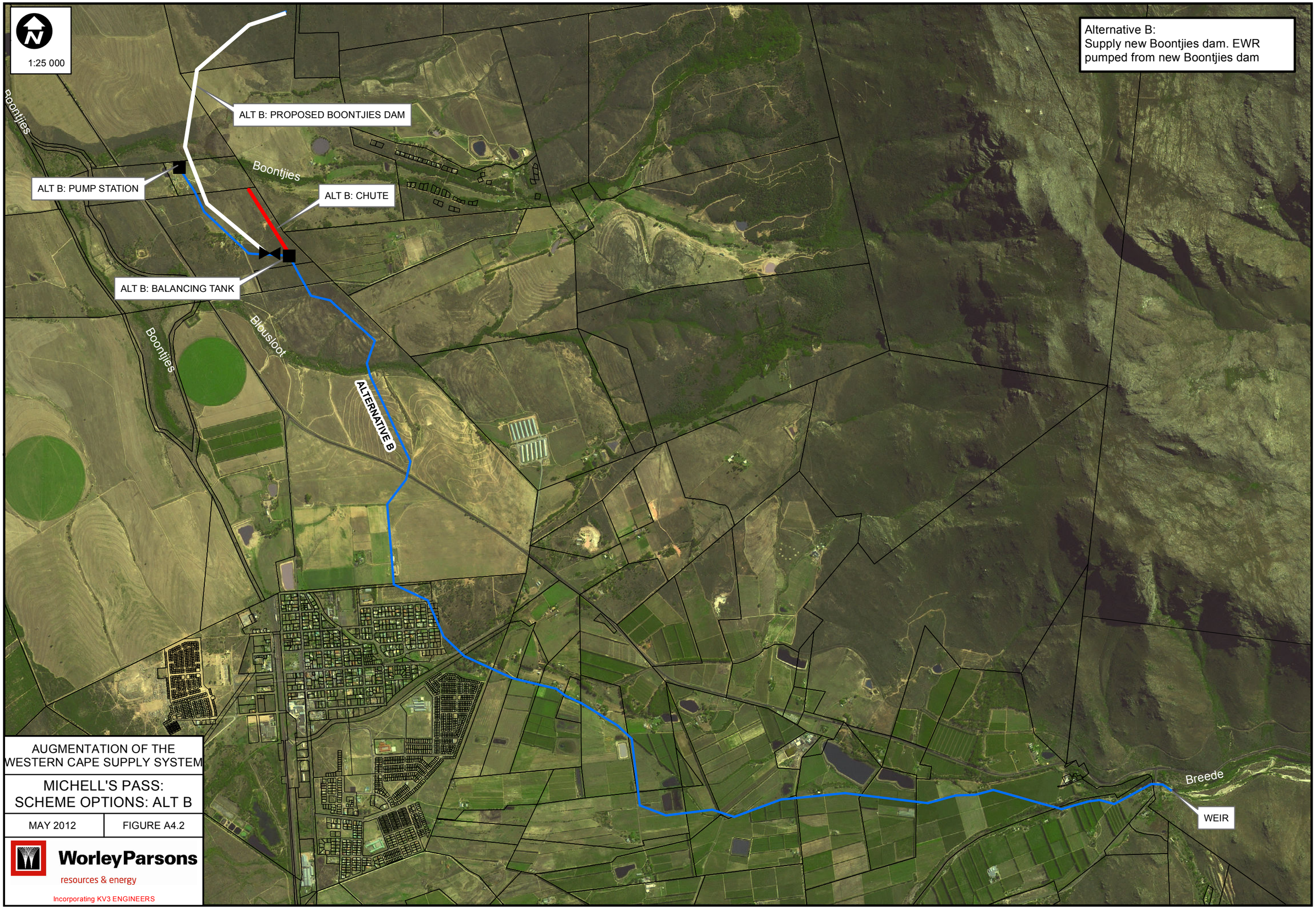

AUGMENTATION OF THE WESTERN CAPE SUPPLY SYSTEM

MICHELL'S PASS: SCHEME OPTIONS: ALT B

MAY 2012	FIGURE A4.2

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Incorporating KV3 ENGINEERS

PLAN

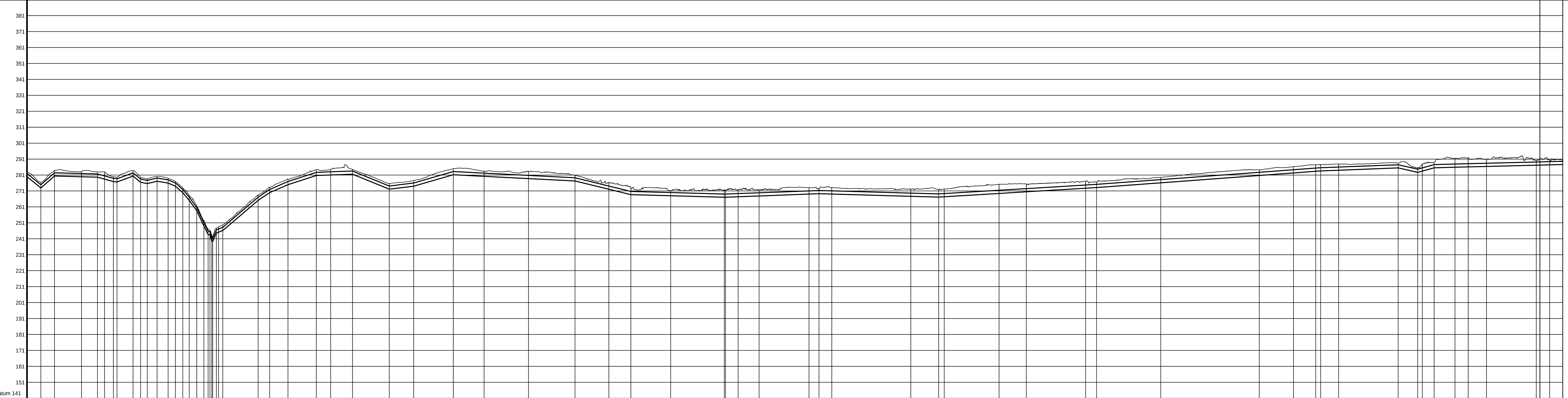
SCALE:

1:12500

LONGITUDINAL SECTION

1:1250

1:12500



POINT NUMBER	CHAINAGE DISTANCE	GROUND LEVEL	INVERT LEVEL	DEPTH OF PIPE
[62]	0.00	282.963	279.96	3.00
	86.80	276.379	272.88	3.50
	172.63	283.896	280.40	3.50
[63]	341.80	283.035	279.93	3.10
	441.85	282.960	279.66	3.30
[34]	486.32	282.978	278.43	4.55
	542.28	279.887	276.89	3.00
	565.09	279.781	276.66	3.10
	665.34	283.857	280.36	3.50
	712.78	279.562	276.46	3.10
	754.87	278.652	275.65	3.00
	816.17	280.100	277.12	2.98
	885.33	278.959	275.96	3.00
[33]	930.86	277.009	274.01	3.00
	977.38	272.931	269.93	3.00
	1018.07	268.168	265.17	3.00
	1065.16	261.617	258.62	3.00
[32]	1109.71	252.495	249.02	3.47
	[illegible]	[illegible]	[illegible]	[illegible]
[31]	1226.26	249.722	246.22	3.50
	1450.08	268.089	265.09	3.00
	1522.45	272.950	269.95	3.00
	1637.66	278.145	274.94	3.20
	1815.14	284.439	280.69	3.75
[30]	1905.36	284.498	281.01	3.49
[27]	2042.11	284.505	281.51	3.00
[29]	2273.06	275.619	272.12	3.50
	2425.83	277.508	274.01	3.50
	2674.43	284.951	281.20	3.75
[26]	2867.73	283.250	280.20	3.05
[25]	3145.98	283.300	278.76	4.53
[24]	3438.08	280.756	277.26	3.50
[23]	3650.38	276.347	272.07	4.28
	3788.50	272.195	268.69	3.50
[22]	4038.56	271.019	268.01	3.01
[21]	[illegible]	[illegible]	[illegible]	[illegible]
[20]	4461.72	271.573	267.36	4.21
[19]	4593.02	271.625	267.86	3.76
[18]	4906.21	273.156	269.05	4.10
	4968.50	272.288	269.29	3.00
[17]	5049.27	273.209	269.06	4.15
[16]	5545.01	272.101	267.66	4.44
[15]	5719.67	271.667	267.17	4.50
	5754.70	272.224	267.38	4.85
[14]	6098.73	275.213	269.45	5.76
[13]	6269.38	275.187	270.48	4.71
[12]	6641.55	277.040	272.72	4.32
	6710.29	276.131	273.13	3.00
[11]	7113.00	279.534	276.12	3.41
[10]	7730.78	284.207	280.71	3.49
[9]	7946.06	286.273	282.31	3.96
[8]	8085.17	287.463	283.35	4.12
	8116.37	287.078	283.58	3.50
[7]	8229.05	287.931	284.01	3.92
	8602.63	288.451	285.45	3.00
[6]	8724.91	285.675	282.68	3.00
	8754.01	287.917	283.49	4.43
	8827.97	288.801	285.55	3.25
[5]	8958.74	291.410	285.88	5.53
[4]	9041.77	291.750	286.10	5.65
[3]	9156.39	290.763	286.39	4.38
[2]	9468.72	290.011	287.18	2.83
[28]	9552.77	290.439	287.40	3.04
[1]	9635.15	290.605	287.60	3.00

DISTANCE / GRADE: 87.1 m; 86.2 m 8.758 %; 169.2 m 0.273 %; 100.0 m 0.273 %; ... 222.6 m 8.506 %; 72.5 m 6.717 %; 115.3 m 4.335 %; 177.6 m 3.236 %; 90.2 m 0.360 %; 136.8 m 0.360 %; 231.1 m 4.064 %; 152.8 m 1.236 %; 248.7 m 2.893 %; 193.3 m 0.517 %; 278.3 m 0.517 %; 292.1 m 0.517 %; 212.4 m 2.443 %; 138.2 m 2.443 %; 250.1 m 0.275 %; 336.2 m 0.275 %; 7.6 m; 131.3 m 0.380 %; 313.2 m 0.380 %; 62.3 m 0.380 %; 80.8 m 0.282 %; 495.7 m 0.282 %; 174.7 m 0.282 %; 35.0 m 0.602 %; 344.0 m 0.602 %; 170.7 m 0.602 %; 372.2 m 0.602 %; 68.7 m 0.602 %; 402.7 m 0.743 %; 617.8 m 0.743 %; 215.3 m 0.743 %; 139.1 m 0.743 %; 31.2 m; 112.7 m 0.385 %; 373.6 m 0.385 %; 122.3 m 2.270 %; 29.1 m; 74.0 m; 130.8 m 0.254 %; 83.0 m 0.254 %; 114.6 m 0.254 %; 312.3 m 0.254 %; 84.1 m 0.254 %; 82.4 m 0.254 %

TYPE & CLASS PIPE: GRP Class 10 / 2000 (all sections)

CROSSINGS

FITTINGS

FOR INFORMATION ONLY	✓
PRELIMINARY	
FOR APPROVAL	
FOR TENDER PURPOSES	
FOR CONSTRUCTION	
AS BUILT	

AMENDMENT

NO.	DATE	CHECKED	DONE BY	DESCRIPTION

SCALE FOR REDUCED PLAN

0 10 20 30 40 50 60 70 80 90 100

100mm ON ORIGINAL PLAN

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

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DESIGNED

DRAWN

CHECKED

CONSULTING ENGINEER

DATE

CLIENT

DATE

CLIENT

DEPARTMENT OF WATER AFFAIRS / AURECON

PROJECT

AUGMENTATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM

DRAWING DESCRIPTION

ALTERNATIVE B: SUPPLY NEW BOONTJIES DAM FROM BREEDE RIVER WEIR

SCALE: AS SHOWN

ORIGINAL DWG SIZE A0

DATE: MAY 2012

DRAWING NUMBER: 23777KD0/A4.2.1

REV NO: 00

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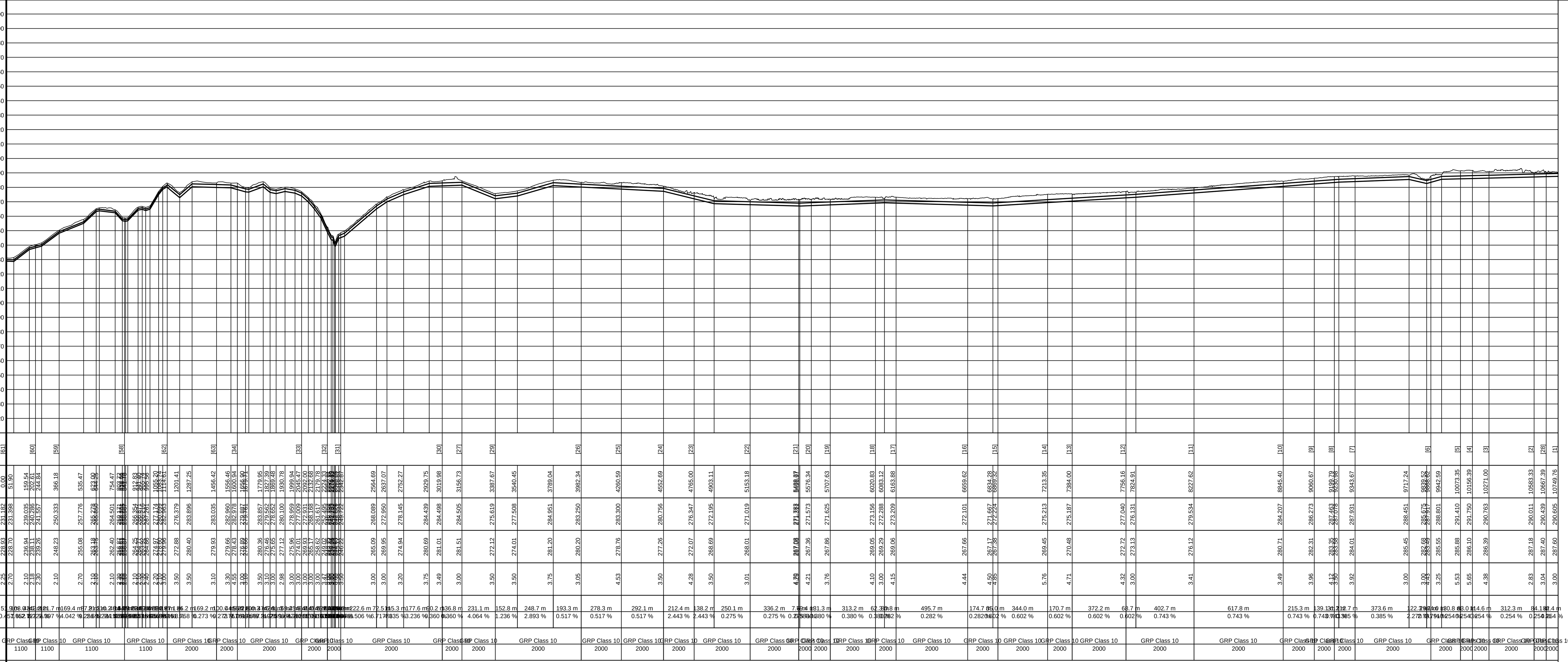
PLAN

SCALE:
1:12500

LONGITUDINAL SECTION

1:1500
1:15000



CROSSINGS

FITTINGS

FOR INFORMATION ONLY	✓
PRELIMINARY	
FOR APPROVAL	
FOR TENDER PURPOSES	
FOR CONSTRUCTION	
AS BUILT	

AMENDMENT

NO.	DATE	CHECKED	DONE BY	DESCRIPTION

SCALE FOR REDUCED PLAN
0 10 20 30 40 50 60 70 80 90 100
100mm ON ORIGINAL PLAN

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

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CONSULTING ENGINEER
DATE
CLIENT
DATE

CLIENT
DEPARTMENT OF WATER AFFAIRS / AURECON

PROJECT
AUGMENTATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM

DRAWING DESCRIPTION
ALTERNATIVE B: EWR PUMPED FROM NEW BOONTJIES DAM TO BREEDE RIVER WEIR

SCALE: AS SHOWN
ORIGINAL DWG SIZE A0
DATE: MAY 2012
DRAWING NUMBER: 23777KD0/A4.2.2
REV NO: 00

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APPENDIX 5 – PUMP STATION SPECIFICATIONS

Pump Station Specifications

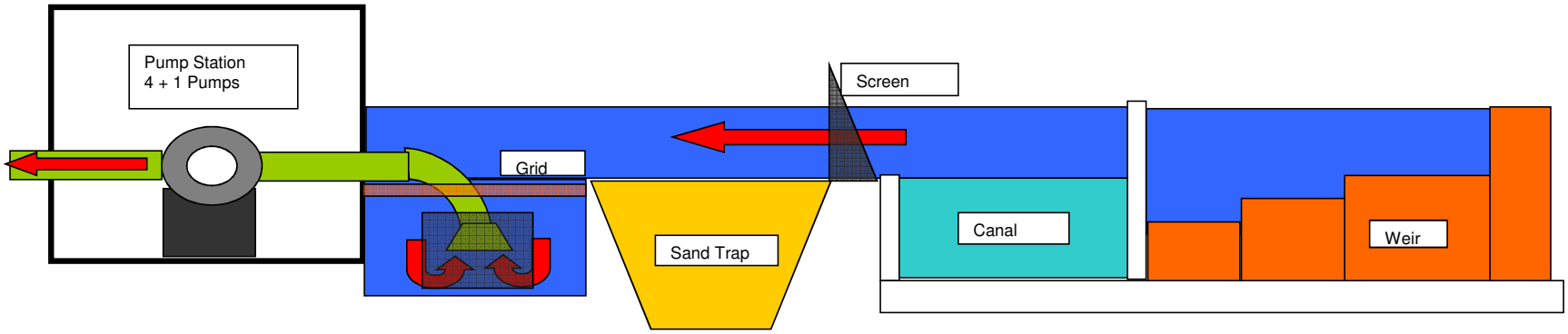
Berg River-Voëlvlei Augmentation Scheme - Berg River Pump Station

		4m^3/s	**6m^3/s**
Mech	Pumps	3+1 off - total of 4m^3/s @ 35.8m	4+1 off - total of 6m^3/s @ 37.5m
	Jetpumps	4 off	5 off
	Flow meter	2 x Magflow - 800mm	2 x Magflow - 800mm
	NRV	4 off - non slam - 1000mm	5 off - non slam - 1000mm
	Inlet isolating valves	4 off - Butterfly valves - 1200mm	5 off - Butterfly valves - 1200mm
	Outlet isolating valves	4 off - Butterfly valves - 1000mm	5 off - Butterfly valves - 1000mm
	Outlet manifold isolating valve	1 off - Butterfly valve 1700mm	1 off - Butterfly valve 1900mm
	Air valves	6 off	7 off
	Piping	Steel - coupon coated	Steel - coupon coated
Electrical	Eskom connection	MV bulk connection (cost excluded from estimated cost)	MV bulk connection (cost excluded from estimated cost)
	Transformer and protection	4MVA , MV/400V	5MVA , MV/400V
	Motors	750 kW 400 volt 3 phase	750 kW 400 volt 3 phase
	Motor control centre	4 variable speed drives PLC for control Pumpset protection to include, overload, over temperature, bearing temperature	5 variable speed drives PLC for control Pumpset protection to include, overload, over temperature, bearing temperature
	Instrumentation	Delivery flow, suction and delivery pressure	Delivery flow, suction and delivery pressure
	General electrical installation	LV busbar connection, cabling	LV busbar connection, cabling

Michell's Pass Scheme - New Boontjies EWR Dam Pump Station

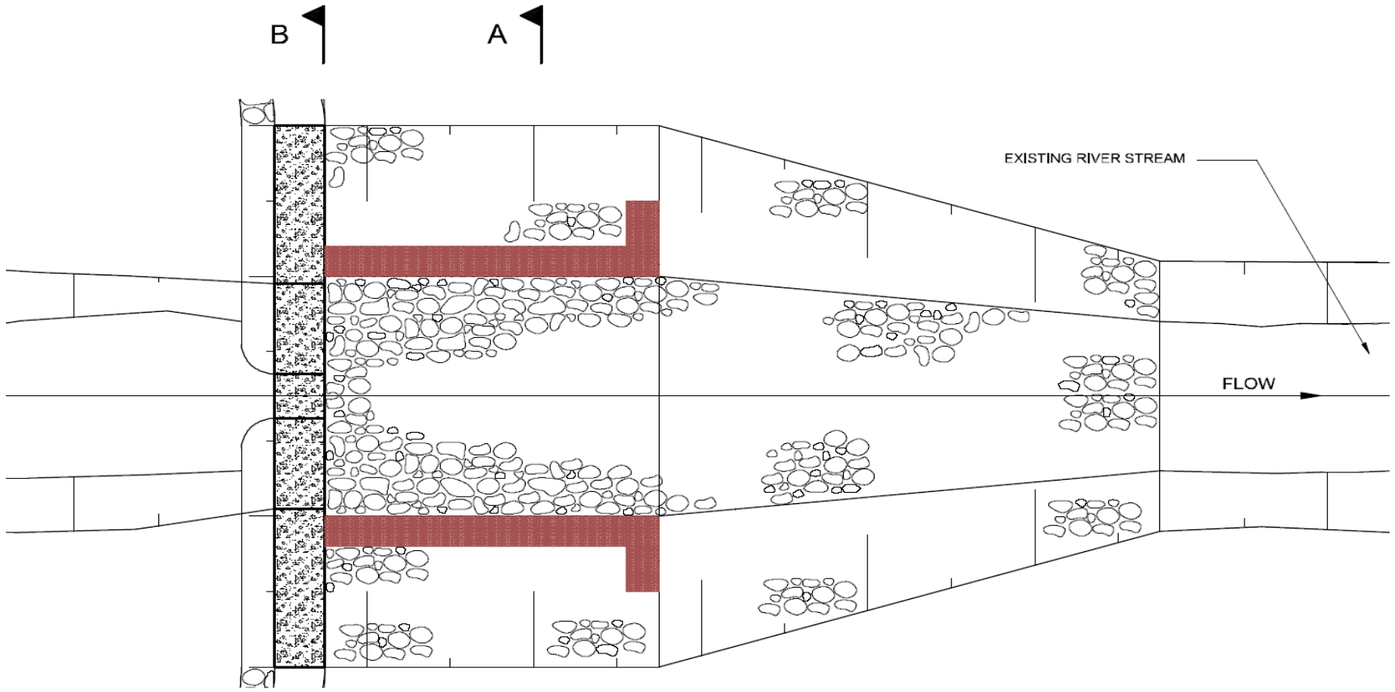
Mech	Pumps	3 off - 0.55 m3/s @ 60m
	Flow meter	Magflow - 600 mm
	NRV	3 off - non slam - 600mm
	Inlet isolating valves	3 off - Gate valves - 750mm
	Outlet isolating valves	3 off - Gate valves - 600mm
	Manifold intake valve	1 off - Butterfly valve 900mm
	Outlet manifold isolating valve	2 off - Butterfly valve 900mm
	Air valves	5 off - 200 mm
	Piping	Steel - coupon coated
Electrical	Eskom connection	MV bulk connection (cost excluded from estimated cost)
	Transformer and protection	1.6 MVA , MV/400V
	Motors	432 kW 400 volt 3 phase
	Motor control centre	3 variable speed drives PLC for control Pumpset protection to include, overload, overtemperature, bearing temperature
	Instrumentation	Delivery flow, suction and delivery pressure
	General electrical installation	LV busbar connection, cabling

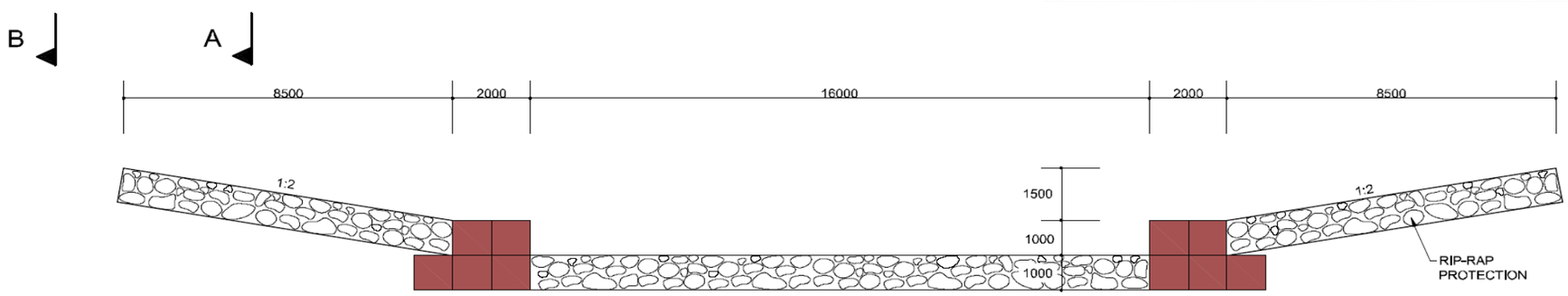
Berg River-Voëlvlei Augmentation Scheme - Section through abstraction point at Berg River Pump Station



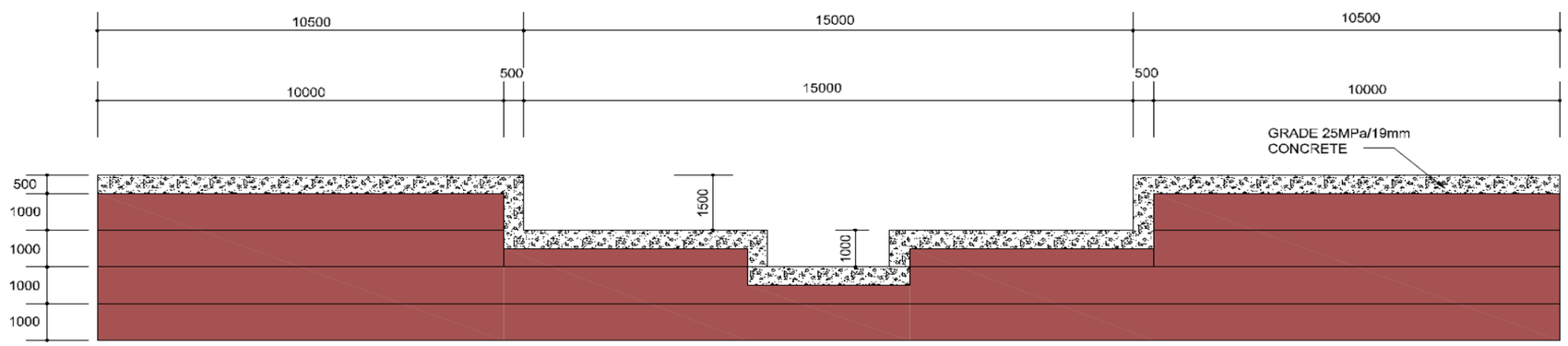
APPENDIX 6 – TYPICAL RIVER PROTECTION DETAIL: MICHELL'S PASS SCHEME ALTERNATIVE A

Typical River Protection Detail - Michell's Pass Scheme





SECTION A-A



SECTION B-B

APPENDIX 7 – COST ESTIMATES: BRVA SCHEME

APPENDIX 7.1 – BERG RIVER WEIR WORKS

SCHEDULE: BERG RIVER WEIR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Bypass canal area	m²	5250	10.00	52500	00
1.1.2		Weir and embankment area	m²	5650	10.00	56500	00
1.1.3		Abstraction structure area	m²	1300	10.00	13000	00
	SABS 1200 D	**EARTHWORKS**					
1.2	8.3.2	**EXCAVATION**					
		Excavation in all materials, backfill, fill and dispose of surplus and unsuitable materials for:					
1.2.1		Bypass canal	m³	17500	55.00	962500	00
1.2.2		Weir embankment	m³	8750	55.00	481250	00
1.2.3		Crump weir	m³	2200	55.00	121000	00
1.2.4		Abstraction structure	m³	10500	55.00	577500	00
	8.3.2 (b)	Extra over for:					
1.2.5		Intermediate material	m³	13650	30.00	409500	00
1.2.6		Hard rock material	m³	1950	320.00	624000	00
1.2.7		Extra over for temporary stockpiling of material	m³	17500	15.00	262500	00
1.3	8.3.2	**EXCAVATION ANCILLARIES**					
	8.3.3.4	Overhaul					
1.3.1		Limited overhaul	m³	22500	12.00	270000	00
1.3.2		Long overhaul	m³km	450000	8.00	3600000	00
	SABS 1200 G	**CONCRETE (STRUCTURAL)**					
1.4	8.1.3	**CONCRETE**					
	8.4.2	Blinding layer in 20 MPa/19mm concrete					
1.4.1		50mm minimum thickness under crump weir	m²	675	55.00	37125	00
TOTAL CARRIED FORWARD						7467375	00

SCHEDULE: BERG RIVER WEIR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						7467375	00
1.4.2		50mm minimum thickness under abstraction structure	m^2	900	55.00	49500	00
	8.4.3	Strength concrete: Grade - 20MPa/19mm					
1.4.3		Gravel trap benching	m^3	295	1100.00	324500	00
	8.4.3	Strength concrete: Grade - 30 MPa/19mm					
1.4.4		Crump weir	m^3	1900	1300.00	2470000	00
1.4.5		Abstraction structure	m^3	2450	1300.00	3185000	00
1.5	8.1.2	**REINFORCEMENT**					
	8.3.1	Mild steel bars:					
1.5.1	8.1.2.2	Diameter 25mm: Basic price	t	70	12000.00	840000	00
	8.1.2.3	Extra-over for item B.5.1 for bars of diameter:					
1.5.2		a) 8mm	t	35	1000.00	35000	00
1.5.3		b) 10mm	t	5	900.00	4500	00
1.5.4		c) 12mm	t	30	800.00	24000	00
	8.3.1	High tensile steel bars:					
1.5.5	8.1.2.2	Diameter 25mm: Basic price	t	395	12000.00	4740000	00
	8.1.2.3	Extra-over for item B.5.4 for bars of diameter:					
1.5.6		a) 10mm	t	95	900.00	85500	00
1.5.7		b) 12mm	t	200	800.00	160000	00
1.5.8		c) 16mm	t	60	700.00	42000	00
1.5.9		d) 20mm	t	40	600.00	24000	00
TOTAL CARRIED FORWARD						19451375	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						19451375	00
1.6	8.1.1	**FORMWORK**					
	8.2.6	Box out holes/Form voids:					
		Rectangular, in curved wall, with areas up to 3.91 m² and with depth of:					
		Over and Up to					
1.6.1		0,0 m 0,8 m	No	1	3500.00	3500	00
		Rectangular, in curved wall, with areas up to 4.59 m² and with depth of:					
		Over and Up to					
1.6.2		0,0 m 0,8 m	No	2	4500.00	9000	00
		Square, in straight wall, with areas up to 0.49 m² and with depth of:					
		Over and Up to					
1.6.3		0,0 m 0,5 m	No	4	1000.00	4000	00
		Square, in straight wall, with areas up to 16 m² and with depth of:					
		Over and Up to					
1.6.4		0,0 m 0,8 m	No	3	10000.00	30000	00
		Smooth vertical surfaces on:					
1.6.5		Sides of crump weir	m²	1245	250.00	311250	00
1.6.6		Sides of abstraction structure walls	m²	5900	250.00	1475000	00
		Smooth horizontal surfaces on:					
1.6.7		Soffit of hopper roof slab	m²	220	250.00	55000	00
1.7		**UNFORMED SURFACE FINISHES**					
		Wood-floated finish:					
1.7.1		On top of crump weir	m²	710	25.00	17750	00
1.7.2		On top of hopper roof slab	m²	285	25.00	7125	00
1.7.3		On floors of abstraction structure	m²	1325	25.00	33125	00
TOTAL CARRIED FORWARD						21397125	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						21397125	00
		Steel-floated finish					
1.7.4		On top of abstraction structure walls	m²	210	40.00	8400	00
1.8		**JOINTS**					
		Construction Joints:					
1.8.1		Supply and install 200mm PVC waterstop without centre bulbs at construction joints in walls	m	475	150.00	71250	00
		Expansion joints:					
1.8.2		In crump weir, between sections	m²	400	35.00	14000	00
1.8.3		In crump weir for sealing of joints between sections	m	360	150.00	54000	00
1.8.4		In abstraction structure walls	m	160	500.00	80000	00
1.8.5		In concrete floor slabs	m	30	300.00	9000	00
1.9		**GROUT PIPES AND SPECIAL FITTINGS INSTALLED BY MECHANICAL CONTRACTOR**					
1.9.1		Steel pipe in 900 x 900mm opening	No	4	2500.00	10000	00
1.10		**MISCELLANEOUS**					
1.10.1		Supply and install trashrack at 15° angle between gravel trap and hopper	Sum		350000.00	350000	00
1.10.2		Supply and install 40 x 40mm fine screens with dimensions of 10.8 x 2.6m before inlets	No	4	60000.00	240000	00
1.10.3		Supply and install 4 x 4m radial gates	No	3	1500000.00	4500000	00
1.11		**COFFER DAM**					
1.11.1		Supply gunny bags and sand, fill gunny bags with sand and construct a coffer dam to channel water into the bypass canal	Sum		1300000.00	1300000	00
TOTAL CARRIED FORWARD						28033775	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						28033775	00
1.12		**EMBANKMENT**					
1.12.1		Supply sand and compact in layers of 300mm	m^3	8610	200.00	1722000	00
1.12.2		Supply gravel and place on top of embankment, 300mm thick	m^2	485	60.00	29100	00
		Reno Mattresses					
		Construct mattresses using PVC-coated galvanised wire mesh					
		Mattresses with Type 80 mesh with 2.7/3.7mm mesh wire and coated with an extruded 0.5mm grey PVC layer					
1.12.3		3.5 x 4.0 x 0.3m	m^3	1025	3500.00	3587500	00
		Geotextile (Grade 1) non-woven min mass (320g/m2)					
1.12.4		Underneath mattresses	m^2	3400	20.00	68000	00
TOTAL CARRIED FORWARD TO SUMMARY						33440375	00

AUGMENTATION OF THE WESTERN CAPE
BERG RIVER-VOËLVLEI AUGMENTATION SCHEME
BILLS OF QUANTITIES

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: BERG RIVER WEIR	33440375.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		33440375.00

APPENDIX 7.2 – MECHANICAL / ELECTRICAL WORKS

Berg River-Voëlvlei Augmentation Scheme - Berg River Pump Station

Background

In winter, surplus water (over and above downstream ecological and other user requirements) will be diverted from the Berg River weir into the sump of the Berg River pump station from where it will be pumped to the existing Voëlvlei Dam.

Input Specifications:	**4m^3/s**	**6m^3/s**
Water	Raw water from river	Raw water from river
Flow	Max 4m^3/s	Max 6m^3/s
Static pressure in rising main	28 meter	28 meter
Friction	7.8 meter	9.5 meter
Inlet static pressure	1.8 meter	1.8 meter

Operation

When the Berg River has surplus winter flow, water will flow into the sump of the pump station. A level transmitter on the weir will give the input value to the flow calculation to determine the amount of water to be pumped to Voëlvlei dam and the pump station will be started to deliver the correct amount of water.
The pipeline could be partially empty.
The first pump will start by means of variable speed drive and slowly fill the line to build up to pressure until the water will flow into the Voëlvlei Dam.
Flow will be measured at the pump station to be able to deliver the required volume.
If more water is available for diversion a second pump will start, also be means of a variable speed drive and will increase the flow to the new required volume. The rest of the pumps will follow until the maximum of 6m^3/s is delivered. The pump(s) speed can then be adjusted to provide a specific delivery. This adjustment can be made locally at the pump station, or remotely via a SCADA system
A fifth pump will be installed as a back up.
A SCADA system will be provided for remote monitoring of the pumping system status (site unknown at this stage), such as the pumps operational status, flow, system pressure, dam level, etc. If so required, the system can also be utilized to provide a remote control facility.

Pump Station Specifications		**4m^3/s**	**6m^3/s**
Mech	Pumps	3+1 off - total of 4m^3/s @ 35.8m	4+1 off - total of 6m^3/s @ 37.5m
	Jet pumps	4 off	5 off
	Flow meter	2 x Magflow - 800mm	2 x Magflow - 800mm
	NRV	4 off - non slam - 1000mm	5 off - non slam - 1000mm
	Inlet isolating valves	4 off - Butterfly valves - 1200mm	5 off - Butterfly valves - 1200mm
	Outlet isolating valves	4 off - Butterfly valves - 1000mm	5 off - Butterfly valves - 1000mm
	Outlet manifold isolating valve	1 off - Butterfly valve 1700mm	1 off - Butterfly valve 1900mm
	Air valves	6 off	7 off
	Piping	Steel - coupon coated	Steel - coupon coated
Electrical	Eskom connection	MV bulk connection (cost excluded from estimated cost)	MV bulk connection (cost excluded from estimated cost)
	Transformer and protection	4MVA , MV/400V	5MVA , MV/400V
	Motors	750 kW 400 volt 3 phase	750 kW 400 volt 3 phase
	Motor control centre	4 variable speed drives PLC for control Pumpset protection to include, overload, over temperature, bearing temperature	5 variable speed drives PLC for control Pumpset protection to include, overload, over temperature, bearing temperature
	Instrumentation	Delivery flow, suction and delivery pressure	Delivery flow, suction and delivery pressure
	General electrical installation	LV busbar connection, cabling	LV busbar connection, cabling
Civil	Building	20m x 22 x 8m high	20m x 22 x 8m high
	Crawl	10 ton	10 ton
	Ventilation	Louvers	Louvers
	Lighting	Wall mounted fluorescent and central high bay luminaires	Wall mounted fluorescent and central high bay luminaires

Estimated cost (including P&Gs, 10% contingency; excluding VAT)	**4m^3/s**	**6m^3/s**
Mechanical	R 30.0 mil	R 38.0 mil
Electrical	R 12.2 mil	R 15.0 mil

APPENDIX 7.3 – CIVIL WORKS

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Pipelines	m	6300	5.00	31500	00
1.1.2		Remove and grub all trees and tree stumps regardless of the girth	m²	9500	10.00	95000	00
1.1.3		Remove and re-erect existing fences	m	500	30.00	15000	00
1.1.4		Remove and replace topsoil	m²	18150	50.00	907500	00
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**					
1.2	8.3.2	**EXCAVATION**					
		Excavate in all materials for trenches, select, backfill, compact and dispose of all surplus material for main pipes with:					
		dia up to 1700 mm for depths:					
		Over and Up to					
1.2.1		0,5 m 1,0 m	m	10	85.00	850	00
1.2.2		1,0 m 1,5 m	m	15	87.00	1305	00
1.2.3		1,5 m 2,0 m	m	10	90.00	900	00
1.2.4		2,0 m 2,5 m	m	30	95.00	2850	00
1.2.5		2,5 m 3,0 m	m	640	120.00	76800	00
1.2.6		3,0 m 3,5 m	m	2400	150.00	360000	00
1.2.7		3,5 m 4,0 m	m	2150	250.00	537500	00
1.2.8		4,0 m 4,5 m	m	825	350.00	288750	00
1.2.9		4,5 m 5,0 m	m	160	450.00	72000	00
1.2.10		5,0 m 5,5 m	m	45	650.00	29250	00
1.2.11		5,5 m 6,0 m	m	10	750.00	7500	00
1.2.12		6,0 m 6,5 m	m	5	900.00	4500	00
TOTAL CARRIED FORWARD						2431205	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						2431205	00
	8.3.2(b)	Extra-over items 1.2.1 to 1.2.12 for:					
1.2.13		Intermediate excavation	m³	9115	17.00	154955	00
1.2.14		Hard rock excavation	m³	6100	300.00	1830000	00
1.2.15		Excavate unsuitable material from trench bottom	m³	610	65.00	39650	00
1.2.16		Hand excavation to expose existing services	m³	300	200.00	60000	00
1.2.17		Extra over for hand excavation and backfill around existing services	m³	150	100.00	15000	00
1.3	8.3.3	**EXCAVATION ANCILLARIES**					
1.3.1		Compaction in road reserves	m³	50	40.00	2000	00
	8.3.3.4	Overhaul					
1.3.2		Limited overhaul	m³	37500	10.00	375000	00
1.3.3		Long overhaul	m³.km	750000	5.00	3750000	00
1.4	8.3.4	**PARTICULAR ITEMS**					
		Shore trench for depths: (Both sides)					
		Over and Up to					
1.4.1		2,0 m 3,0 m	m	670	100.00	67000	00
1.4.2		3,0 m 4,0 m	m	4550	150.00	682500	00
1.4.3		4,0 m 5,0 m	m	985	300.00	295500	00
1.4.4		5,0 m 6,0 m	m	55	450.00	24750	00
1.4.5		6,0 m 7,0 m	m	5	550.00	2750	00
1.5	8.3.5	**EXISTING SERVICES**					
		Services that intersect a trench					
1.5.1		Water main pipes	No	1	350.00	350	00
1.5.2		Low voltage electrical cables (Overhead)	No	10	500.00	5000	00
1.5.3		High voltage electrical cables (Overhead)	No	2	500.00	1000	00
TOTAL CARRIED FORWARD						9736660	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						9736660	00
1.5.4		Electric pole	No	2	400.00	800	00
1.5.5		Telkom cables (Overhead)	No	2	300.00	600	00
1.5.6		Wire fence	No	15	500.00	7500	00
1.5.7		Security fence	No	5	800.00	4000	00
1.5.8		Concrete Road	m²	50	800.00	40000	00
1.5.9		Bitumen Road	m²	40	60.00	2400	00
1.5.10		Gravel road	m²	500	30.00	15000	00
		Services that adjoin a trench					
1.5.11		Low voltage electrical cables (Overhead)	m	25	15.00	375	00
1.5.12		Telkom cables (Overhead)	m	10	40.00	400	00
1.5.13		Electrical pole	No	3	150.00	450	00
1.5.14		Wire fence	m	100	40.00	4000	00
1.5.15		Electric fence	m	250	100.00	25000	00
1.5.16		Trees	No	150	60.00	9000	00
1.5.17		Remove and reinstate existing grass areas	m²	900	30.00	27000	00
1.5.18		Reinstate gardens	m²	100	30.00	3000	00
1.5.19		River crossing complete	No	1	1800000.00	1800000	00
1.5.20		Railway crossing complete	No	1	850000.00	850000	00
1.5.21		R45 Road crossing complete	No	1	850000.00	850000	00
TOTAL CARRIED FORWARD						13376185	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						13376185	00
1.6	8.3.6	**FINISHINGS**					
	8.3.6.1	Reinstate road surfaces complete with all layers					
1.6.1		150 mm G9 lower selected layer	m²	40	15.00	600	00
1.6.2		150 mm G7 upper selected layer	m²	40	15.00	600	00
1.6.3		150 mm G5 subbase course	m²	40	15.00	600	00
1.6.4		150 mm G2 base course	m²	40	15.00	600	00
1.6.5		30 mm Asphalt	m²	40	141.00	5640	00
		Extra-over for imported material for:					
1.6.6		150 mm G9 lower selected layer	m³	10	180.00	1800	00
1.6.7		150 mm G7 upper selected layer	m³	10	200.00	2000	00
1.6.8		150 mm G5 subbase course	m³	10	220.00	2200	00
1.6.9		150 mm G2 base course	m³	10	350.00	3500	00
1.6.10		Cut bitumen layer	m	25	10.00	250	00
1.7	SABS 1200 LB	**BEDDING (PIPES)**					
	8.2.2.3	Provision of bedding material compacted to 93% of MAASHTO density (100% for sand) with material from commercial sources					
1.7.1		Selected granular material	m³	20000	200.00	4000000	00
1.7.2		Selected fill material	m³	3410	200.00	682000	00
1.7.3		Bedding for wet conditions	m³	1400	330.00	462000	00
1.7.4		Extra-over item 1.7.1 and 1.7.2 for 3% cement stabilisation	m³	1300	138.00	179400	00
TOTAL CARRIED FORWARD						18717375	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						18717375	00
1.8	SABS 1200 L	**MEDIUM-PRESSURE PIPELINES**					
	8.2.1	Supply, lay and bed Spigot and socket Vectus GRP pipes on bedding according to SABS 1200 drawing LB-2, test and disinfect the following pipes:					
1.8.1		1700 mm dia class 10 SN 5000	m	6300	9750.00	61425000	00
1.9		**SPECIALS AND FITTINGS**					
	8.2.2	Supply, lay, and bed on class C bedding, joint, including cut pipes to lengths where required, test and disinfect with necessary couplings					
		GRP bends for GRP pipes					
1.9.1		1700 mm dia 2°-30°	No	21	54000.00	1134000	00
1.9.2		1700 mm dia 30°-60°	No	5	81000.00	405000	00
1.9.3		1700 mm dia 60°-90°	No	1	105000.00	105000	00
1.10		**ANCILLARIES**					
1.10.1		Anchor/Thrust blocks	m³	820	2000.00	1640000	00
1.10.2		Transverse anchor blocks	No	4	3400.00	13600	00
1.10.3		Vertical anchor blocks	m³	65	2000.00	130000	00
1.10.4		Concrete casing river crossings	m³	205	2169.00	444645	00
1.10.5		Concrete casing road crossings	m³	35	2169.00	75915	00
1.11		**VALVE CHAMBERS AND MANHOLES**					
1.11.1		Check valve chamber complete	No	1	2200000.00	2200000	00
1.11.2		Air valve chambers for 4 x 200mm airvalves complete	No	10	365000.00	3650000	00
1.11.3		Scour valve chambers complete	No	5	320000.00	1600000	00
1.11.4		Scour valve chambers at river crossings complete	No	1	320000.00	320000	00
TOTAL CARRIED FORWARD						91860535	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						91860535	00
1.12		**SUNDRIES**					
1.12.1		Pipeline marker posts	No	25	110.00	2750	00
1.12.2		Connection structure from canal at WTW into pipeline	Sum		2300000.00	2300000	00
1.12.3		Discharge structure into river with connection from pipeline	Sum		2350000.00	2350000	00
1.13	SABS 1200DK	**GABIONS AND PITCHING**					
	8.2.1	Surface preparation for gabion bedding					
1.13.1		Cavities filled with approved excavated material or rock	m³	90	150.00	13500	00
	8.2.2	Construct gabions using PVC-coated galvanized wire mesh Mattresses with wire thickness of 2.5 mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.13.2		4,0 x 2,0 x 0,3 m	m³	75	2000.00	150000	00
		Gabions with wire thickness 2.5mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.13.3		2,0 x 0,5 x 0,5 m	m³	15	1115.00	16725	00
	8.2.4	Geotextile (Grade 3)					
1.13.4		Underneath mattresses and gabions	m²	336	8.00	2688	00
1.14	8.2.5	**PITCHING**					
1.14.1		Stone pitching	m³	50	1010.00	50500	00
TOTAL CARRIED FORWARD TO SUMMARY						96746698	00

AUGMENTATION OF THE WESTERN CAPE
BERG RIVER-VOËLVLEI AUGMENTATION SCHEME - 4m3/s
BILL OF QUANTITIES

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: WATER PIPELINE	96746698.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		96746698.00

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Pipelines	m	6300	5.00	31500	00
1.1.2		Remove and grub all trees and tree stumps regardless of the girth	m²	9500	10.00	95000	00
1.1.3		Remove and re-erect existing fences	m	500	30.00	15000	00
1.1.4		Remove and replace topsoil	m²	18150	50.00	907500	00
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**					
1.2	8.3.2	**EXCAVATION**					
		Excavate in all materials for trenches, select, backfill, compact and dispose of all surplus material for main pipes with:					
		dia up to 1900 mm for depths:					
		Over and Up to					
1.2.1		0,5 m 1,0 m	m	10	85.00	850	00
1.2.2		1,0 m 1,5 m	m	15	87.00	1305	00
1.2.3		1,5 m 2,0 m	m	25	90.00	2250	00
1.2.4		2,0 m 2,5 m	m	25	95.00	2375	00
1.2.5		2,5 m 3,0 m	m	500	120.00	60000	00
1.2.6		3,0 m 3,5 m	m	2525	150.00	378750	00
1.2.7		3,5 m 4,0 m	m	2125	250.00	531250	00
1.2.8		4,0 m 4,5 m	m	850	350.00	297500	00
1.2.9		4,5 m 5,0 m	m	160	450.00	72000	00
1.2.10		5,0 m 5,5 m	m	50	650.00	32500	00
1.2.11		5,5 m 6,0 m	m	10	750.00	7500	00
1.2.12		6,0 m 6,5 m	m	5	900.00	4500	00
TOTAL CARRIED FORWARD						2439780	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						2439780	00
	8.3.2(b)	Extra-over items 1.2.1 to 1.2.12 for:					
1.2.13		Intermediate excavation	m³	9900	17.00	168300	00
1.2.14		Hard rock excavation	m³	6600	300.00	1980000	00
1.2.15		Excavate unsuitable material from trench bottom	m³	700	65.00	45500	00
1.2.16		Hand excavation to expose existing services	m³	300	200.00	60000	00
1.2.17		Extra over for hand excavation and backfill around existing services	m³	150	100.00	15000	00
1.3	8.3.3	**EXCAVATION ANCILLARIES**					
1.3.1		Compaction in road reserves	m³	50	40.00	2000	00
	8.3.3.4	Overhaul					
1.3.2		Limited overhaul	m³	44000	10.00	440000	00
1.3.3		Long overhaul	m³.km	880000	5.00	4400000	00
1.4	8.3.4	**PARTICULAR ITEMS**					
		Shore trench for depths: (Both sides)					
		Over and Up to					
1.4.1		2,0 m 3,0 m	m	525	100.00	52500	00
1.4.2		3,0 m 4,0 m	m	4650	150.00	697500	00
1.4.3		4,0 m 5,0 m	m	1010	300.00	303000	00
1.4.4		5,0 m 6,0 m	m	60	450.00	27000	00
1.4.5		6,0 m 7,0 m	m	5	550.00	2750	00
1.5	8.3.5	**EXISTING SERVICES**					
		Services that intersect a trench					
1.5.1		Water main pipes	No	1	350.00	350	00
1.5.2		Low voltage electrical cables (Overhead)	No	10	500.00	5000	00
1.5.3		High voltage electrical cables (Overhead)	No	2	500.00	1000	00
TOTAL CARRIED FORWARD						10639680	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						10639680	00
1.5.4		Electric pole	No	2	400.00	800	00
1.5.5		Telkom cables (Overhead)	No	2	300.00	600	00
1.5.6		Wire fence	No	15	500.00	7500	00
1.5.7		Security fence	No	5	800.00	4000	00
1.5.8		Concrete Road	m²	50	800.00	40000	00
1.5.9		Bitumen Road	m²	40	60.00	2400	00
1.5.10		Gravel road	m²	500	30.00	15000	00
		Services that adjoin a trench					
1.5.11		Low voltage electrical cables (Overhead)	m	25	15.00	375	00
1.5.12		Telkom cables (Overhead)	m	10	40.00	400	00
1.5.13		Electrical pole	No	3	150.00	450	00
1.5.14		Wire fence	m	100	40.00	4000	00
1.5.15		Electric fence	m	250	100.00	25000	00
1.5.16		Trees	No	150	60.00	9000	00
1.5.17		Remove and reinstate existing grass areas	m²	900	30.00	27000	00
1.5.18		Reinstate gardens	m²	100	30.00	3000	00
1.5.19		River crossing complete	No	1	1800000.00	1800000	00
1.5.20		Railway crossing complete	No	1	850000.00	850000	00
1.5.21		R45 Road crossing complete	No	1	850000.00	850000	00
TOTAL CARRIED FORWARD						14279205	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						14279205	00
1.6	8.3.6	**FINISHINGS**					
	8.3.6.1	Reinstate road surfaces complete with all layers					
1.6.1		150 mm G9 lower selected layer	m²	40	15.00	600	00
1.6.2		150 mm G7 upper selected layer	m²	40	15.00	600	00
1.6.3		150 mm G5 subbase course	m²	40	15.00	600	00
1.6.4		150 mm G2 base course	m²	40	15.00	600	00
1.6.5		30 mm Asphalt	m²	40	141.00	5640	00
		Extra-over for imported material for:					
1.6.6		150 mm G9 lower selected layer	m³	10	180.00	1800	00
1.6.7		150 mm G7 upper selected layer	m³	10	200.00	2000	00
1.6.8		150 mm G5 subbase course	m³	10	220.00	2200	00
1.6.9		150 mm G2 base course	m³	10	350.00	3500	00
1.6.10		Cut bitumen layer	m	25	10.00	250	00
1.7	SABS 1200 LB	**BEDDING (PIPES)**					
	8.2.2.3	Provision of bedding material compacted to 93% of MAASHTO density (100% for sand) with material from commercial sources					
1.7.1		Selected granular material	m³	22500	200.00	4500000	00
1.7.2		Selected fill material	m³	3700	200.00	740000	00
1.7.3		Bedding for wet conditions	m³	1500	330.00	495000	00
1.7.4		Extra-over item 1.7.1 and 1.7.2 for 3% cement stabilisation	m³	1300	138.00	179400	00
TOTAL CARRIED FORWARD						20211395	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						20211395	00
1.8	SABS 1200 L	**MEDIUM-PRESSURE PIPELINES**					
	8.2.1	Supply, lay and bed Spigot and socket Vectus GRP pipes on bedding according to SABS 1200 drawing LB-2, test and disinfect the following pipes:					
1.8.1		1900 mm dia class 10 SN 5000	m	6300	11500.00	72450000	00
1.9		**SPECIALS AND FITTINGS**					
	8.2.2	Supply, lay, and bed on class C bedding, joint, including cut pipes to lengths where required, test and disinfect with necessary couplings					
		GRP bends for GRP pipes					
1.9.1		1900 mm dia 2°-30°	No	21	65000.00	1365000	00
1.9.2		1900 mm dia 30°-60°	No	5	98500.00	492500	00
1.9.3		1900 mm dia 60°-90°	No	1	138500.00	138500	00
1.10		**ANCILLARIES**					
1.10.1		Anchor/Thrust blocks	m³	820	2000.00	1640000	00
1.10.2		Transverse anchor blocks	No	4	3400.00	13600	00
1.10.3		Vertical anchor blocks	m³	65	2000.00	130000	00
1.10.4		Concrete casing river crossings	m³	205	2169.00	444645	00
1.10.5		Concrete casing road crossings	m³	35	2169.00	75915	00
1.11		**VALVE CHAMBERS AND MANHOLES**					
1.11.1		Check valve chamber complete	No	1	2200000.00	2200000	00
1.11.2		Air valve chambers for 4 x 200mm airvalves complete	No	10	390000.00	3900000	00
1.11.3		Scour valve chambers complete	No	5	340000.00	1700000	00
1.11.4		Scour valve chambers at river crossings complete	No	1	340000.00	340000	00
TOTAL CARRIED FORWARD						105101555	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						105101555	00
1.12		**SUNDRIES**					
1.12.1		Pipeline marker posts	No	25	110.00	2750	00
1.12.2		Connection structure from canal at WTW into pipeline	Sum		2300000.00	2300000	00
1.12.3		Discharge structure into river with connection from pipeline	Sum		2350000.00	2350000	00
1.13	SABS 1200DK	**GABIONS AND PITCHING**					
	8.2.1	Surface preparation for gabion bedding					
1.13.1		Cavities filled with approved excavated material or rock	m³	90	150.00	13500	00
	8.2.2	Construct gabions using PVC-coated galvanized wire mesh Mattresses with wire thickness of 2.5 mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.13.2		4,0 x 2,0 x 0,3 m	m³	75	2000.00	150000	00
		Gabions with wire thickness 2.5mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.13.3		2,0 x 0,5 x 0,5 m	m³	15	1115.00	16725	00
	8.2.4	Geotextile (Grade 3)					
1.13.4		Underneath mattresses and gabions	m²	336	8.00	2688	00
1.14	8.2.5	**PITCHING**					
1.14.1		Stone pitching	m³	50	1010.00	50500	00
TOTAL CARRIED FORWARD TO SUMMARY						109987718	00

AUGMENTATION OF THE WESTERN CAPE
BERG RIVER-VOËLVLEI AUGMENTATION SCHEME - 6m3/s
BILL OF QUANTITIES

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: WATER PIPELINE	109987718.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		109987718.00

APPENDIX 8 – COST ESTIMATES: MICHELL'S PASS SCHEME

APPENDIX 8.1 – MICHELL'S PASS SCHEME ALTERNATIVE A (NO PROVISION OF EWR PUMPING SCHEME)

APPENDIX 8.1.1 – MICHELL'S PASS WEIR WORKS FOR ALTERNATIVE A

SCHEDULE: MICHELL'S PASS WEIR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Coffer dam	m^2	605	10.00	6050	00
1.1.2		Diversion channel	m^2	938	10.00	9380	00
1.1.3		Abstraction works (including crump weir)	m^2	8506	10.00	85060	00
	SABS 1200 D	**EARTHWORKS**					
1.2	8.3.2	**EXCAVATION**					
		Excavation in all materials, backfill, fill and dispose of surplus and unsuitable materials for:					
1.2.1		Coffer dam	m^3	225	55.00	12375	00
1.2.2		Diversion channel	m^3	3350	55.00	184250	00
1.2.3		Crump weir	m^3	5702	55.00	313610	00
1.2.4		Abstraction works	m^3	4489	55.00	246895	00
	8.3.2 (b)	Extra over for:					
1.2.5		Intermediate material	m^3	1377	30.00	41310	00
1.2.6		Hard rock material	m^3	688	320.00	220160	00
1.2.7		Extra-over D.8.3.2 for temporary stockpiling of material	m^3	6883	15.00	103245	00
1.3	8.3.2	**EXCAVATION ANCILLARIES**					
	8.3.3.4	Overhaul					
1.3.1		Limited overhaul	m^3	6883	12.00	82596	00
1.3.2		Long overhaul	m^3km	137660	8.00	1101280	00
	SABS 1200 G	**CONCRETE (STRUCTURAL)**					
1.4	8.1.3	**CONCRETE**					
TOTAL CARRIED FORWARD						2406211	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						2406211	00
	8.4.2	Blinding layer in 20 MPa/19mm concrete					
TOTAL CARRIED FORWARD						2406211	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						2406211	00
1.4.1		50mm minimum thickness under crump weir	m²	2474	55.00	136070	00
1.4.2		50mm minimum thickness under abstraction works	m²	6032.0	55.00	331760	00
	8.4.3	Strength concrete: Grade - 20MPa/19mm					
1.4.3		Gravel trap and sand trap benching	m³	383	1100.00	421300	00
	8.4.3	Strength concrete: Grade - 30 MPa/19mm					
1.4.4		Crump weir	m³	8574	1300.00	11146200	00
1.4.5		Abstraction works	m³	3654	1300.00	4750200	00
1.5	8.1.2	**REINFORCEMENT**					
	8.3.1	Mild steel bars:					
1.5.1	8.1.2.2	Diameter 25mm: Basic price	t	181	12000.00	2172000	00
	8.1.2.3	Extra-over for item B.5.1 for bars of diameter:					
1.5.2		a) 8mm	t	91	1000.00	91000	00
1.5.3		b) 10mm	t	9	900.00	8100	00
1.5.4		c) 12mm	t	82	800.00	65600	00
	8.3.1	High tensile steel bars:					
1.5.5	8.1.2.2	Diameter 25mm: Basic price	t	1027	12000.00	12324000	00
	8.1.2.3	Extra-over for item B.5.4 for bars of diameter:					
1.5.6		a) 10mm	t	257	900.00	231300	00
1.5.7		b) 12mm	t	514	800.00	411200	00
1.5.8		c) 16mm	t	154	700.00	107800	00
1.5.9		d) 20mm	t	103	600.00	61800	00
TOTAL CARRIED FORWARD						34664541	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						34664541	00
1.6	8.1.1	**FORMWORK**					
	8.2.6	Box out holes/Form voids:					
		Rectangular, in curved wall, with areas up to 3.5 m² and with depth of:					
		Over and Up to					
1.6.1		0,0 m 0,8 m	No	3	3500.00	10500	00
		Rectangular, in straight wall, with areas up to 10 m² and with depth of:					
		Over and Up to					
1.6.2		0,0 m 0,8 m	No	3	10000.00	30000	00
		Smooth vertical surfaces on:					
1.6.3		Sides of crump weir	m²	2161	250.00	540250	00
1.6.4		Sides of abstraction works	m²	6675	250.00	1668750	00
1.7		**UNFORMED SURFACE FINISHES**					
		Wood-floated finish:					
1.7.1		On top of crump weir	m²	1949	25.00	48725	00
1.7.2		On top of abstraction works floors	m²	2004	25.00	50100	00
		Steel-floated finish					
1.7.3		On top of walls of abstraction works	m²	396	40.00	15840	00
1.8		**JOINTS**					
		Construction Joints:					
1.8.1		Supply and install 200mm PVC waterstop with centre bulbs at construction joints in walls	m	495	150.00	74250	00
		Expansion joints:					
1.8.2		Between sections of crump weir	m²	812	35.00	28420	00
1.8.3		In crump weir, sealing of section joints	m	322	150.00	48300	00
TOTAL CARRIED FORWARD						37179676	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						37179676	00
1.8.4		In abstraction works walls	m	203	220.00	44660	00
1.8.5		In concrete floor slabs	m	89	220.00	19580	00
1.9		**GROUT PIPES AND SPECIAL FITTINGS INSTALLED BY MECHANICAL CONTRACTOR**					
1.9.1		Steel pipe in 1300 x 1300mm opening	No	5	2500.00	12500	00
1.10		**MISCELLANEOUS**					
1.10.1		Supply and install trashrack at 15° angle between gravel trap and sand trap	Sum		180000.00	180000	00
1.10.2		Supply and install walkway gratings and handrails	Sum		200000.00	200000	00
1.10.3		Supply and install radial gates	No	3	1500000.00	4500000	00
1.10.4		Supply and install vertical sluice gates	No	5	1000000.00	5000000	00
1.10.5		Supply, fill with earth and install gunny bags for coffer dam	m^3	1000	530.00	530000	00
TOTAL CARRIED FORWARD TO SUMMARY						47666416	00

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: MICHELL'S PASS WEIR	47666416.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		47666416.00

APPENDIX 8.1.2 – CIVIL WORKS FOR ALTERNATIVE A

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (DIVERSION WEIR TO BALANCING TANK)
BILL OF QUANTITIES

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Pipelines	m	7600	5.00	38000	00
1.1.2		Remove and grub all trees and tree stumps regardless of the girth	m²	41500	10.00	415000	00
1.1.3		Remove and re-erect existing fences	m	985	30.00	29550	00
1.1.4		Remove and replace topsoil	m²	42300	50.00	2115000	00
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**					
1.2	8.3.2	**EXCAVATION**					
		Excavate in all materials for trenches, select, backfill, compact and dispose of all surplus material for main pipes with:					
		dia up to 2000 mm for depths:					
		Over and Up to					
1.2.1		2,5 m 3,0 m	m	45	120.00	5400	00
1.2.2		3,0 m 3,5 m	m	610	150.00	91500	00
1.2.3		3,5 m 4,0 m	m	1940	250.00	485000	00
1.2.4		4,0 m 4,5 m	m	2185	350.00	764750	00
1.2.5		4,5 m 5,0 m	m	1580	450.00	711000	00
1.2.6		5,0 m 5,5 m	m	555	650.00	360750	00
1.2.7		5,5 m 6,0 m	m	590	750.00	442500	00
1.2.8		6,0 m 6,5 m	m	85	900.00	76500	00
1.2.9		6,5 m 7,0 m	m	10	1000.00	10000	00
	8.3.2(b)	Extra-over items 1.2.1 to 1.2.9 for:					
1.2.10		Intermediate excavation	m³	15000	17.00	255000	00
TOTAL CARRIED FORWARD						5799950	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						5799950	00
1.2.11		Hard rock excavation	m³	5000	300.00	1500000	00
1.2.12		Excavate unsuitable material from trench bottom	m³	1500	65.00	97500	00
1.2.13		Hand excavation to expose existing services	m³	300	200.00	60000	00
1.2.14		Extra over for hand excavation and backfill around existing services	m³	150	100.00	15000	00
1.3	8.3.3	**EXCAVATION ANCILLARIES**					
1.3.1		Compaction in road reserves	m³	50	40.00	2000	00
	8.3.3.4	Overhaul					
1.3.2		Limited overhaul	m³	57000	10.00	570000	00
1.3.3		Long overhaul	m³.km	1140000	5.00	5700000	00
1.4	8.3.4	**PARTICULAR ITEMS**					
		Shore trench for depths: (Both sides)					
		Over and Up to					
1.4.1		2,0 m 3,0 m	m	45	100.00	4500	00
1.4.2		3,0 m 4,0 m	m	2550	150.00	382500	00
1.4.3		4,0 m 5,0 m	m	3765	300.00	1129500	00
1.4.4		5,0 m 6,0 m	m	1145	450.00	515250	00
1.4.5		6,0 m 7,0 m	m	95	550.00	52250	00
1.5	8.3.5	**EXISTING SERVICES**					
		Services that intersect a trench					
1.5.1		Water main pipes	No	1	350.00	350	00
1.5.2		Low voltage electrical cables (Overhead)	No	7	500.00	3500	00
1.5.3		High voltage electrical cables (Overhead)	No	1	500.00	500	00
TOTAL CARRIED FORWARD						15832800	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						15832800	00
1.5.4		Electric pole	No	4	400.00	1600	00
1.5.5		Telkom cables (Overhead)	No	2	300.00	600	00
1.5.6		Telkom pole	No	1	400.00	400	00
1.5.7		Wire fence	No	15	500.00	7500	00
1.5.8		Security fence	No	5	800.00	4000	00
1.5.9		Old Railway line	No	1	150000.00	150000	00
1.5.10		Gravel road	m²	260	30.00	7800	00
		Services that adjoin a trench					
1.5.11		Telkom cables (Overhead)	m	525	40.00	21000	00
1.5.12		Electrical pole	No	6	150.00	900	00
1.5.13		Wire fence	m	800	40.00	32000	00
1.5.14		Gravel road	m	1400	30.00	42000	00
1.5.15		Trees	No	150	60.00	9000	00
1.5.16		River crossing complete	No	1	1800000.00	1800000	00
1.5.17		Bridge crossing complete (underneath 2 bridges near weir)	No	1	170000.00	170000	00
1.5.18		Eufees Street crossing complete	Sum		30000.00	30000	00
1.6	SABS 1200 LB	**BEDDING (PIPES)**					
	8.2.2.3	Provision of bedding material compacted to 93% of MAASHTO density (100% for sand) with material from commercial sources					
1.6.1		Selected granular material	m³	30000	200.00	6000000	00
1.6.2		Selected fill material	m³	5000	200.00	1000000	00
1.6.3		Bedding for wet conditions	m³	1750	330.00	577500	00
1.6.4		Extra-over item 1.6.1 and 1.6.2 for 3% cement stabilisation	m³	1500	138.00	207000	00
TOTAL CARRIED FORWARD						25894100	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						25894100	00
1.7	SABS 1200 L	**MEDIUM-PRESSURE PIPELINES**					
	8.2.1	Supply, lay and bed Spigot and socket Vectus GRP pipes on bedding according to SABS 1200 drawing LB-2, test and disinfect the following pipes:					
1.7.1		2000 mm dia class 10 SN 5000	m	7600	12500.00	95000000	00
TOTAL CARRIED FORWARD						120894100	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						120894100	00
1.8		**SPECIALS AND FITTINGS**					
	8.2.2	Supply, lay, and bed on class C bedding, joint, including cut pipes to lengths where required, test and disinfect with necessary couplings GRP bends for GRP pipes					
1.8.1		2000 mm dia 2°-30°	No	18	72200.00	1299600	00
1.8.2		2000 mm dia 30°-60°	No	9	111000.00	999000	00
1.8.3		2000 mm dia 60°-90°	No	2	157000.00	314000	00
1.9		**ANCILLARIES**					
1.9.1		Anchor/Thrust blocks	m^3	1500	2000.00	3000000	00
1.9.2		Vertical anchor blocks	m^3	15	2000.00	30000	00
1.9.3		Concrete casing river crossings	m^3	225	2169.00	488025	00
1.9.4		Concrete casing road crossings	m^3	40	2169.00	86760	00
1.10		**VALVE CHAMBERS AND MANHOLES**					
1.10.1		Butterfly valve chamber complete	No	1	2500000.00	2500000	00
1.10.2		Air valve chambers for 4 x 200mm airvalves complete	No	12	400000.00	4800000	00
1.10.3		Scour valve chambers complete	No	3	365000.00	1095000	00
1.10.4		Scour valve chambers at river crossings complete	No	1	365000.00	365000	00
1.11		**SUNDRIES**					
1.11.1		Pipeline marker posts	No	30	110.00	3300	00
1.11.2		Connection to Weir	Sum		2300000.00	2300000	00
TOTAL CARRIED FORWARD						138174785	00

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						138174785	00
1.12	SABS 1200DK	**GABIONS AND PITCHING**					
	8.2.1	Surface preparation for gabion bedding					
1.12.1		Cavities filled with approved excavated material or rock	m³	90	150.00	13500	00
	8.2.2	Construct gabions using PVC-coated galvanized wire mesh Mattresses with wire thickness of 2.5 mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.12.2		4,0 x 2,0 x 0,3 m	m³	75	2000.00	150000	00
		Gabions with wire thickness 2.5mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.12.3		2,0 x 0,5 x 0,5 m	m³	15	1115.00	16725	00
	8.2.4	Geotextile (Grade 3)					
1.12.4		Underneath mattresses and gabions	m²	336	8.00	2688	00
1.13	8.2.5	**PITCHING**					
1.13.1		Stone pitching	m³	50	1010.00	50500	00
TOTAL CARRIED FORWARD TO SUMMARY						138408198	00

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (DIVERSION WEIR TO BALANCING TANK)
BILL OF QUANTITIES

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: WATER PIPELINE	138408198.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		138408198.00

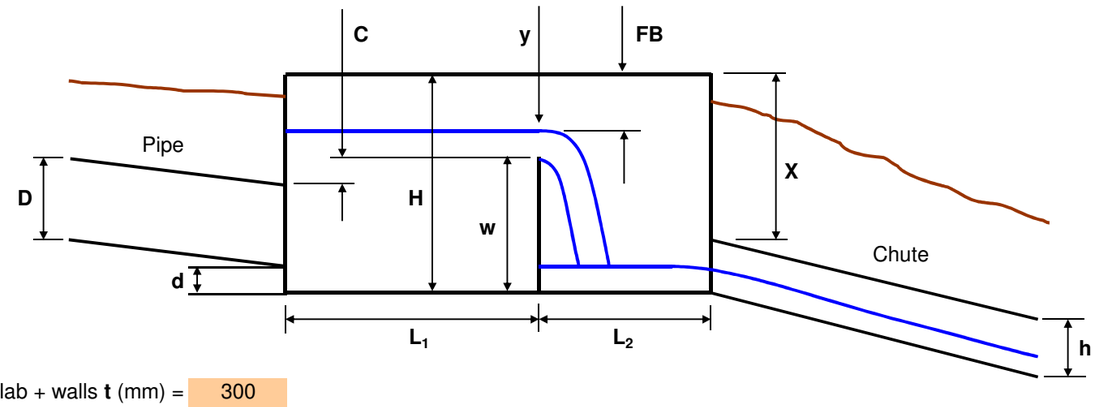
APPENDIX 8.1.3 – CHUTES AND RIVER PROTECTION FOR ALTERNATIVE A

BALANCING TANK

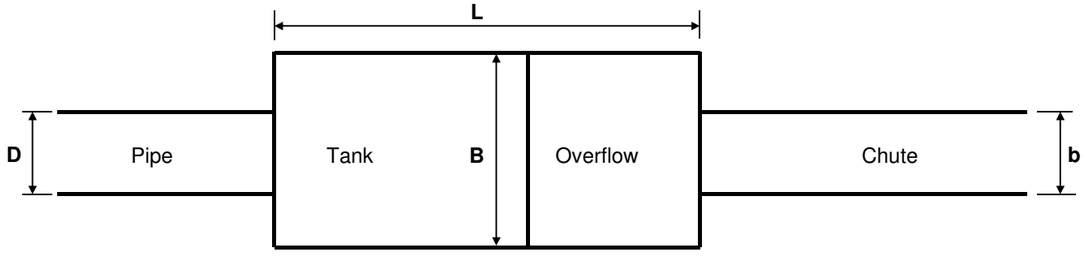
(between gravity pipeline and discharge chute)

Yield (m^3/s) =	5
Retention time in tank (min) =	5
Internal height of chute **h** (m) =	0.90
Incoming pipe diameter **D** (m) =	2.00
Step between pipe invert + floor **d** (m) =	0.50
Minimum water above pipe crown **C** (m) =	1.0
Freeboard above water level **FB** (m) =	1.0
Height of flow over weir **y** (m) =	0.22
Height of overflow weir **w** (m) =	3.50
Total internal height of tank **H** (m) =	4.80
Total external height of tank H_T (m) =	5.40
Cover above top of chute inlet **X** (m) =	3.90
Maximum water height (m) =	3.72

Balancing Tank



Thickness of slab + walls **t** (mm) =	300
Internal width of chute **b** (m) =	1.20
Total internal width of tank **B** (m) =	20.7
Internal length of tank at pipe L_1 (m) =	20.7
Internal length of tank at chute L_2 (m) =	6.9
Total external width of tank B_T (m) =	21.3
Total external length of tank **L** (m) =	28.5



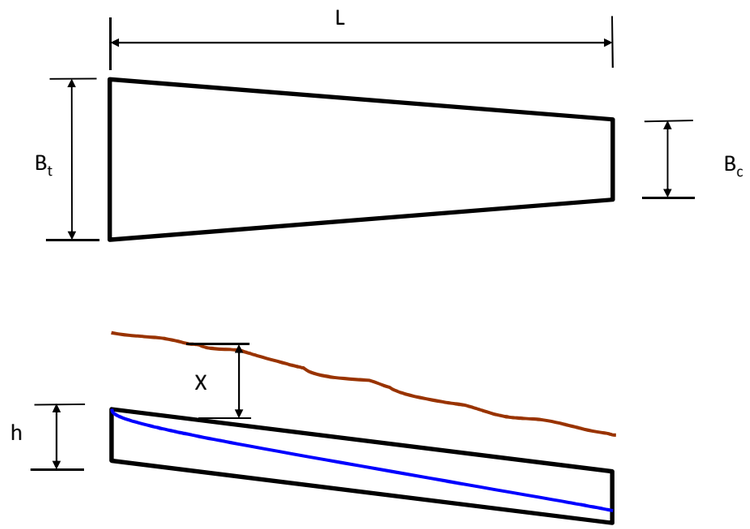
Earthworks		Quantity	Rate	Amount
Excavation				
Outer volume of structure (m^3) :		3280		
Total excavation volume (m^3) :		5570		
Soft material (base) (m^3) :	40%	2230	R100.00	R223,000.00
Intermediate material (m^3) :	20%	1120	R150.00	R168,000.00
Hard rock material (m^3) :	40%	2230	R300.00	R669,000.00
Haulage				
Material unsuitable for backfill (m^3) :		3350		
Long overhaul (m^3.km) at 20km :		67000	R10.00	R670,000.00
Importation of deficiency in backfill (m^3) :		600	R200.00	R120,000.00
			Subtotal :	R1,850,000.00

Reinforced Concrete	Quantity	Rate	Amount
Concrete			
Concrete for main structure (30 MPa) (m^3) :	350	R1,400.00	R490,000.00
Rebar			
Reinforcement (at 130kg/m^3) (ton) :	46	R10,500.00	R477,750.00
Formwork			
Vertical Formwork (rough outside) (m^2) :	540	R250.00	R135,000.00
Vertical Formwork (smooth inside) (m^2) :	610	R300.00	R183,000.00
		Subtotal :	R1,285,750.00

Steelwork	Quantity	Rate	Amount
Steel support structure for flooring (m^2) :	610		
Steel (at 20kg/m^2) (ton) :	12.2	R3,500.00	R42,700.00
Grid flooring over tank opening (m^2) :	610	R250.00	R152,500.00
		Subtotal :	R195,200.00

CONVERGENCE FROM BALANCING TANK TO DISCHARGE CHUTE

Culvert width at balancing tank B_t =	3.5	m
Culvert width at chute B_c =	1.2	m
Length of convergence L =	20	m
Culvert height h =	0.9	m
Concrete thickness =	300	mm



Calculations

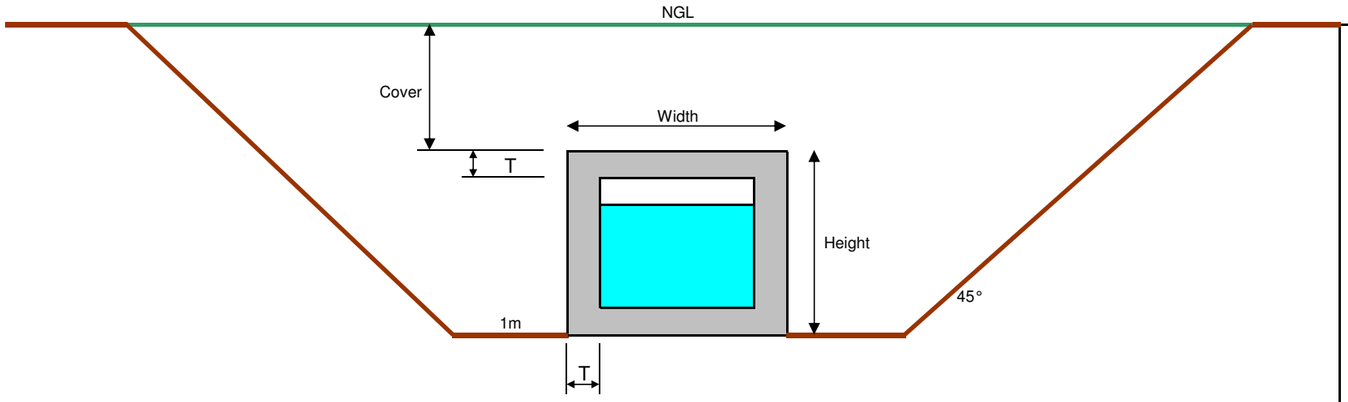
Outer height (m) =	1.50
Outer width at balancing tank (m) =	4.10
Outer width at chute (mm) =	1.80
Average outer width (m) =	2.95
Cover X (m) =	1.50

Earthworks		**Quantity**	**Rate**	**Amount**
Excavation				
Volume (m^3/m) :		4.4		
Total excavation volume (m^3/m) :		23.9		
Chute length (m) :		20		
Soft material (base) (m^3) :	40%	200	R100.00	R20,000.00
Intermediate material (m^3) :	20%	100	R150.00	R15,000.00
Hard rock material (m^3) :	40%	200	R300.00	R60,000.00
Haulage				
Material unsuitable for backfill (m^3) :		300		
Long overhaul (m^3.km) at 20km :		6000	R10.00	R60,000.00
Importation of deficiency in backfill (m^3) :		300	R200.00	R60,000.00
			Subtotal :	R215,000.00

Reinforced Concrete	**Quantity**	**Rate**	**Amount**
Concrete			
Concrete volume (30 MPa) (m^3) :	50	R1,400.00	R70,000.00
Rebar			
Reinforcement (at 130kg/m^3) (ton) :	7	R10,500.00	R68,250.00
Formwork			
Vertical Formwork (rough outside) (m^2) :	60	R250.00	R15,000.00
Vertical Formwork (smooth inside) (m^2) :	40	R300.00	R12,000.00
Horizontal Formwork (smooth inside) (m^2) :	50	R400.00	R20,000.00
		Subtotal :	R185,250.00

Total :	R400,250.00

DISCHARGE CHUTE



Parameters

Height (m) =	1.50
Width (m) =	1.80
Thickness (mm) =	300
Cover (m) =	1.50
Inner height (m) =	0.90
Inner width (m) =	1.20

Earthworks		**Quantity**	**Rate**	**Amount**
Excavation				
Volume of box culvert (m^3/m) :		2.7		
Total excavation volume (m^3/m) :		20.4		
Chute length (m) :		780		
Soft material (base) (m^3) :	40%	6370	R100.00	R637,000.00
Intermediate material (m^3) :	20%	3190	R150.00	R478,500.00
Hard rock material (m^3) :	40%	6370	R300.00	R1,911,000.00
Haulage				
Material unsuitable for backfill (m^3) :		9560		
Long overhaul (m^3.km) at 20km :		191200	R10.00	R1,912,000.00
Importation of deficiency in backfill (m^3) :		8800	R200.00	R1,760,000.00
			Subtotal :	R6,698,500.00

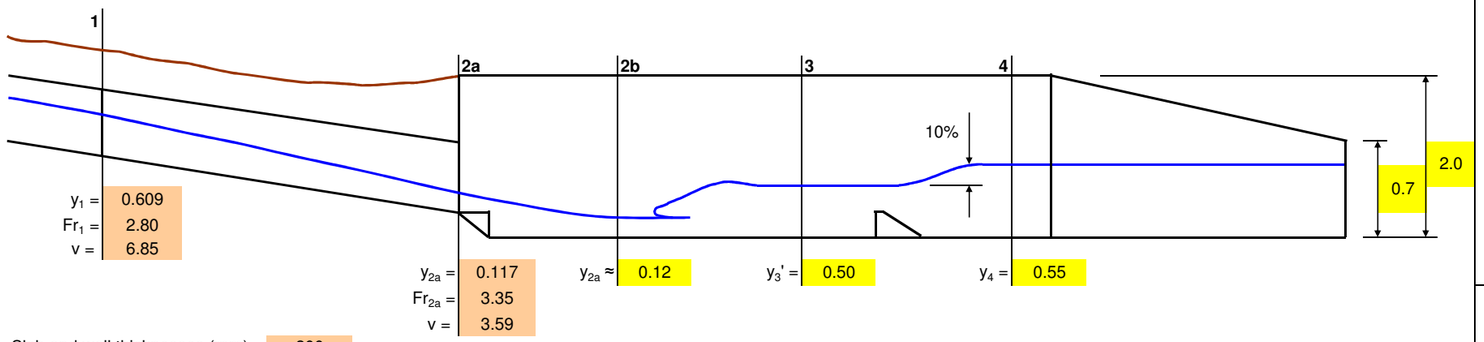
Reinforced Concrete	**Quantity**	**Rate**	**Amount**
Concrete			
Concrete volume (30 MPa) (m^3) :	1270	R1,400.00	R1,778,000.00
Rebar			
Reinforcement (at 130kg/m^3) (ton) :	165	R10,500.00	R1,733,550.00
Formwork			
Vertical Formwork (rough outside) (m^2) :	2340	R250.00	R585,000.00
Vertical Formwork (smooth inside) (m^2) :	1410	R300.00	R423,000.00
Horizontal Formwork (smooth inside) (m^2) :	940	R400.00	R376,000.00
		Subtotal :	R4,895,550.00

Total : R11,594,050.00

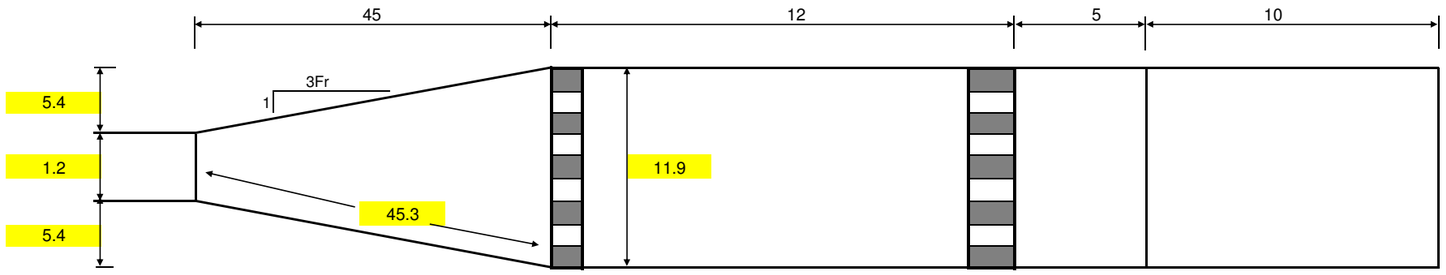
STILLING BASIN

(at discharge chute outlet into Blousloot River)

Internal width of chute (m) =	1.20
Internal height of chute (m) =	0.90
Cover over chute at exit (m) =	0.5



Slab and wall thicknesses (mm) =	300
Average excavation depth (m) =	2.3



Earthworks		Quantity	Rate	Amount
Excavation				
Outer volume of structure (m^3) :		1440		
Total excavation volume (m^3) :		2670		
Soft material (base) (m^3) :	40%	1070	R100.00	R107,000.00
Intermediate material (m^3) :	20%	540	R150.00	R81,000.00
Hard rock material (m^3) :	40%	1070	R300.00	R321,000.00
Haulage				
Material unsuitable for backfill (m^3) :		1070		
Long overhaul (m^3.km) at 20km :		21400	R10.00	R214,000.00
Importation of deficiency in backfill (m^3) :		200	R200.00	R40,000.00
			Subtotal :	R763,000.00

Reinforced Concrete	Quantity	Rate	Amount
Concrete			
Concrete for main structure (30 MPa) (m^3) :	350	R1,400.00	R490,000.00
Rebar			
Reinforcement (at 130kg/m^3) (ton) :	46	R10,500.00	R477,750.00
Formwork			
Vertical Formwork (rough outside) (m^2) :	250	R250.00	R62,500.00
Vertical Formwork (smooth inside) (m^2) :	180	R300.00	R54,000.00
Horizontal Formwork (smooth inside) (m^2) :	300	R400.00	R120,000.00
Baffle blocks in stilling basin :	200	R500.00	R100,000.00
		Subtotal :	R1,304,250.00

Total : R2,067,250.00

SUMMARY OF COSTS

Balancing Tank	R	3,330,950.00
Convergence	R	400,250.00
Discharge Chute	R	11,594,050.00
Stilling Basin	R	2,067,250.00
TOTAL	R	17,392,500.00

SUMMARY OF COSTS (10% escalation)

Balancing Tank	R	3,664,045.00
Convergence	R	440,275.00
Discharge Chute	R	12,753,455.00
Stilling Basin	R	2,273,975.00
TOTAL	R	19,131,750.00

AMOUNTS IN ESTIMATES

Balancing Tank	R	3,750,000.00
Closed Chute	R	15,500,000.00
River Protection (Alt A)	R	50,000,000.00
River Protection (Alt B)	R	40,000,000.00

APPENDIX 8.2 – MICHELL'S PASS SCHEME ALTERNATIVE B (WITH PROVISION OF EWR PUMPING SCHEME)

APPENDIX 8.2.1– MICHELL'S PASS WEIR WORKS FOR ALTERNATIVE B

SCHEDULE: MICHELL'S PASS WEIR

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Coffer dam	m^2	605	10.00	6050	00
1.1.2		Diversion channel	m^2	938	10.00	9380	00
1.1.3		Abstraction works (including crump weir)	m^2	8506	10.00	85060	00
	SABS 1200 D	**EARTHWORKS**					
1.2	8.3.2	**EXCAVATION**					
		Excavation in all materials, backfill, fill and dispose of surplus and unsuitable materials for:					
1.2.1		Coffer dam	m^3	225	55.00	12375	00
1.2.2		Diversion channel	m^3	3350	55.00	184250	00
1.2.3		Crump weir	m^3	5702	55.00	313610	00
1.2.4		Abstraction works	m^3	4489	55.00	246895	00
	8.3.2 (b)	Extra over for:					
1.2.5		Intermediate material	m^3	1377	30.00	41310	00
1.2.6		Hard rock material	m^3	688	320.00	220160	00
1.2.7		Extra-over D.8.3.2 for temporary stockpiling of material	m^3	6883	15.00	103245	00
1.3	8.3.2	**EXCAVATION ANCILLARIES**					
	8.3.3.4	Overhaul					
1.3.1		Limited overhaul	m^3	6883	12.00	82596	00
1.3.2		Long overhaul	m^3km	137660	8.00	1101280	00
	SABS 1200 G	**CONCRETE (STRUCTURAL)**					
1.4	8.1.3	**CONCRETE**					
TOTAL CARRIED FORWARD						2406211	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						2406211	00
	8.4.2	Blinding layer in 20 MPa/19mm concrete					
TOTAL CARRIED FORWARD						2406211	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						2406211	00
1.4.1		50mm minimum thickness under crump weir	m²	2474	55.00	136070	00
1.4.2		50mm minimum thickness under abstraction works	m²	6032.0	55.00	331760	00
	8.4.3	Strength concrete: Grade - 20MPa/19mm					
1.4.3		Gravel trap and sand trap benching	m³	383	1100.00	421300	00
	8.4.3	Strength concrete: Grade - 30 MPa/19mm					
1.4.4		Crump weir	m³	8574	1300.00	11146200	00
1.4.5		Abstraction works	m³	3654	1300.00	4750200	00
1.5	8.1.2	**REINFORCEMENT**					
	8.3.1	Mild steel bars:					
1.5.1	8.1.2.2	Diameter 25mm: Basic price	t	181	12000.00	2172000	00
	8.1.2.3	Extra-over for item B.5.1 for bars of diameter:					
1.5.2		a) 8mm	t	91	1000.00	91000	00
1.5.3		b) 10mm	t	9	900.00	8100	00
1.5.4		c) 12mm	t	82	800.00	65600	00
	8.3.1	High tensile steel bars:					
1.5.5	8.1.2.2	Diameter 25mm: Basic price	t	1027	12000.00	12324000	00
	8.1.2.3	Extra-over for item B.5.4 for bars of diameter:					
1.5.6		a) 10mm	t	257	900.00	231300	00
1.5.7		b) 12mm	t	514	800.00	411200	00
1.5.8		c) 16mm	t	154	700.00	107800	00
1.5.9		d) 20mm	t	103	600.00	61800	00
TOTAL CARRIED FORWARD						34664541	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						34664541	00
1.6	8.1.1	**FORMWORK**					
	8.2.6	Box out holes/Form voids:					
		Rectangular, in curved wall, with areas up to 3.5 m² and with depth of:					
		Over and Up to					
1.6.1		0,0 m 0,8 m	No	3	3500.00	10500	00
		Rectangular, in straight wall, with areas up to 10 m² and with depth of:					
		Over and Up to					
1.6.2		0,0 m 0,8 m	No	3	10000.00	30000	00
		Smooth vertical surfaces on:					
1.6.3		Sides of crump weir	m²	2161	250.00	540250	00
1.6.4		Sides of abstraction works	m²	6675	250.00	1668750	00
1.7		**UNFORMED SURFACE FINISHES**					
		Wood-floated finish:					
1.7.1		On top of crump weir	m²	1949	25.00	48725	00
1.7.2		On top of abstraction works floors	m²	2004	25.00	50100	00
		Steel-floated finish					
1.7.3		On top of walls of abstraction works	m²	396	40.00	15840	00
1.8		**JOINTS**					
		Construction Joints:					
1.8.1		Supply and install 200mm PVC waterstop with centre bulbs at construction joints in walls	m	495	150.00	74250	00
		Expansion joints:					
1.8.2		Between sections of crump weir	m²	812	35.00	28420	00
1.8.3		In crump weir, sealing of section joints	m	322	150.00	48300	00
TOTAL CARRIED FORWARD						37179676	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						37179676	00
1.8.4		In abstraction works walls	m	203	220.00	44660	00
1.8.5		In concrete floor slabs	m	89	220.00	19580	00
1.9		**GROUT PIPES AND SPECIAL FITTINGS INSTALLED BY MECHANICAL CONTRACTOR**					
1.9.1		Steel pipe in 1300 x 1300mm opening	No	5	2500.00	12500	00
1.10		**MISCELLANEOUS**					
1.10.1		Supply and install trashrack at 15° angle between gravel trap and sand trap	Sum		180000.00	180000	00
1.10.2		Supply and install walkway gratings and handrails	Sum		200000.00	200000	00
1.10.3		Supply and install radial gates	No	3	1500000.00	4500000	00
1.10.4		Supply and install vertical sluice gates	No	5	1000000.00	5000000	00
1.10.5		Supply, fill with earth and install gunny bags for coffer dam	m^3	1000	530.00	530000	00
TOTAL CARRIED FORWARD TO SUMMARY						47666416	00

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: MICHELL'S PASS WEIR	47666416.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		47666416.00

APPENDIX 8.2.2– MECHANICAL / ELECTRICAL WORKS FOR ALTERNATIVE B

Breede-Berg (Michell's Pass) Water Transfer Scheme - Boontjies EWR dam pump station

Background

In winter, surplus water will be diverted from the proposed Michell's Pass Diversion weir via a pipeline to the proposed Boontjies EWR dam. Spills from the proposed Boontjies EWR dam will be stored in the Voëlvlei Dam via the existing Klein Berg Diversion canal.
During summer, water must be put back into the Breede River to provide for the summer EWRs. To be able to do this, water must be stored in the proposed Boontjies EWR dam. Below the dam wall, the proposed Boontjies Dam Pump Station will deliver the water via the pipeline.

Input Specifications:

Water	Clean water from dam	
Flow	0.55 m^3/s up to 1m^3/s	
Static pressure in rising main	50m	
Friction	5m	max
Inlet static pressure	2m up to 6m	to be confirmed

Operation

In the summer months the pump station will be started to deliver the correct amount of water to provide for the summer EWRs and for irrigation entitlements.
The pipeline will be partially empty.
Valves to the outlet chute to the dam will then be closed to make sure the water will be pumped back to the Breede River.
The first pump will start by means of variable speed drive and slowly fill the line to build up pressure until the water will flow into the Breede river.
Flow will be measured at the pump station to be able to deliver the required volume.
If more water is required - a second pump will start, also be means of a variable speed drive and will increase the flow to the new required volume. The pump(s) speed can then be adjusted to provide a specific delivery. This adjustment can be made locally at the pump station, or remotely via a SCADA system
A third pump will be installed as a back up.
A SCADA system will be provided for remote monitoring of the pumping system status (site unknown at this stage), such as the pumps operational status, flow, system pressure, dam level, etc. If so required, the system can also be utilized to provide a remote control facility.

Pump Station Specifications

Mech	Pumps	3 off - 0.55 m3/s @ 60m
	Flow meter	Magflow - 600 mm
	NRV	3 off - non slam - 600mm
	Inlet isolating valves	3 off - Gate valves - 750mm
	Outlet isolating valves	3 off - Gate valves - 600mm
	Manifold intake valve	1 off - Butterfly valve 900mm
	Outlet manifold isolating valve	2 off - Butterfly valve 900mm
	Air valves	5 off - 200 mm
	Piping	Steel - coupon coated
Electrical	Eskom connection	MV bulk connection (cost excluded from estimated cost)
	Transformer and protection	1,6 MVA , MV/400V
	Motors	432 kW 400 volt 3 phase
	Motor control centre	3 variable speed drives PLC for control Pumpset protection to include, overload, over temperature, bearing temperature
	Instrumentation	Delivery flow, suction and delivery pressure
	General electrical installation	LV busbar connection, cabling
Civil	Building	13m x 20m x 8m high
	Crawl	7 ton
	Ventilation	Louvers
	Lighting	Wall mounted fluorescent and central high bay luminaires

Estimated cost (including P&Gs, 10% contingency; excluding VAT)

Mechanical	R 8 mil
Electrical	R 7 mil

APPENDIX 8.2.3 – CIVIL WORKS FOR ALTERNATIVE B

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (DIVERSION WEIR TO BALANCING TANK)
BILL OF QUANTITIES

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Pipelines	m	7600	5.00	38000	00
1.1.2		Remove and grub all trees and tree stumps regardless of the girth	m²	41500	10.00	415000	00
1.1.3		Remove and re-erect existing fences	m	985	30.00	29550	00
1.1.4		Remove and replace topsoil	m²	42300	50.00	2115000	00
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**					
1.2	8.3.2	**EXCAVATION**					
		Excavate in all materials for trenches, select, backfill, compact and dispose of all surplus material for main pipes with:					
		dia up to 2000 mm for depths:					
		Over and Up to					
1.2.1		2,5 m 3,0 m	m	45	120.00	5400	00
1.2.2		3,0 m 3,5 m	m	610	150.00	91500	00
1.2.3		3,5 m 4,0 m	m	1940	250.00	485000	00
1.2.4		4,0 m 4,5 m	m	2185	350.00	764750	00
1.2.5		4,5 m 5,0 m	m	1580	450.00	711000	00
1.2.6		5,0 m 5,5 m	m	555	650.00	360750	00
1.2.7		5,5 m 6,0 m	m	590	750.00	442500	00
1.2.8		6,0 m 6,5 m	m	85	900.00	76500	00
1.2.9		6,5 m 7,0 m	m	10	1000.00	10000	00
	8.3.2(b)	Extra-over items 1.2.1 to 1.2.9 for:					
1.2.10		Intermediate excavation	m³	15000	17.00	255000	00
TOTAL CARRIED FORWARD						5799950	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						5799950	00
1.2.11		Hard rock excavation	m³	5000	300.00	1500000	00
1.2.12		Excavate unsuitable material from trench bottom	m³	1500	65.00	97500	00
1.2.13		Hand excavation to expose existing services	m³	300	200.00	60000	00
1.2.14		Extra over for hand excavation and backfill around existing services	m³	150	100.00	15000	00
1.3	8.3.3	**EXCAVATION ANCILLARIES**					
1.3.1		Compaction in road reserves	m³	50	40.00	2000	00
	8.3.3.4	Overhaul					
1.3.2		Limited overhaul	m³	57000	10.00	570000	00
1.3.3		Long overhaul	m³.km	1140000	5.00	5700000	00
1.4	8.3.4	**PARTICULAR ITEMS**					
		Shore trench for depths: (Both sides)					
		Over and Up to					
1.4.1		2,0 m 3,0 m	m	45	100.00	4500	00
1.4.2		3,0 m 4,0 m	m	2550	150.00	382500	00
1.4.3		4,0 m 5,0 m	m	3765	300.00	1129500	00
1.4.4		5,0 m 6,0 m	m	1145	450.00	515250	00
1.4.5		6,0 m 7,0 m	m	95	550.00	52250	00
1.5	8.3.5	**EXISTING SERVICES**					
		Services that intersect a trench					
1.5.1		Water main pipes	No	1	350.00	350	00
1.5.2		Low voltage electrical cables (Overhead)	No	7	500.00	3500	00
1.5.3		High voltage electrical cables (Overhead)	No	1	500.00	500	00
TOTAL CARRIED FORWARD						15832800	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						15832800	00
1.5.4		Electric pole	No	4	400.00	1600	00
1.5.5		Telkom cables (Overhead)	No	2	300.00	600	00
1.5.6		Telkom pole	No	1	400.00	400	00
1.5.7		Wire fence	No	15	500.00	7500	00
1.5.8		Security fence	No	5	800.00	4000	00
1.5.9		Old Railway line	No	1	150000.00	150000	00
1.5.10		Gravel road	m²	260	30.00	7800	00
		Services that adjoin a trench					
1.5.11		Telkom cables (Overhead)	m	525	40.00	21000	00
1.5.12		Electrical pole	No	6	150.00	900	00
1.5.13		Wire fence	m	800	40.00	32000	00
1.5.14		Gravel road	m	1400	30.00	42000	00
1.5.15		Trees	No	150	60.00	9000	00
1.5.16		River crossing complete	No	1	1800000.00	1800000	00
1.5.17		Bridge crossing complete (underneath 2 bridges near weir)	No	1	170000.00	170000	00
1.5.18		Eufees Street crossing complete	Sum		30000.00	30000	00
1.6	SABS 1200 LB	**BEDDING (PIPES)**					
	8.2.2.3	Provision of bedding material compacted to 93% of MAASHTO density (100% for sand) with material from commercial sources					
1.6.1		Selected granular material	m³	30000	200.00	6000000	00
1.6.2		Selected fill material	m³	5000	200.00	1000000	00
1.6.3		Bedding for wet conditions	m³	1750	330.00	577500	00
1.6.4		Extra-over item 1.6.1 and 1.6.2 for 3% cement stabilisation	m³	1500	138.00	207000	00
TOTAL CARRIED FORWARD						25894100	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						25894100	00
1.7	SABS 1200 L	**MEDIUM-PRESSURE PIPELINES**					
	8.2.1	Supply, lay and bed Spigot and socket Vectus GRP pipes on bedding according to SABS 1200 drawing LB-2, test and disinfect the following pipes:					
1.7.1		2000 mm dia class 10 SN 5000	m	7600	12500.00	95000000	00
TOTAL CARRIED FORWARD						120894100	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						120894100	00
1.8		**SPECIALS AND FITTINGS**					
	8.2.2	Supply, lay, and bed on class C bedding, joint, including cut pipes to lengths where required, test and disinfect with necessary couplings GRP bends for GRP pipes					
1.8.1		2000 mm dia 2°-30°	No	18	72200.00	1299600	00
1.8.2		2000 mm dia 30°-60°	No	9	111000.00	999000	00
1.8.3		2000 mm dia 60°-90°	No	2	157000.00	314000	00
1.9		**ANCILLARIES**					
1.9.1		Anchor/Thrust blocks	m^3	1500	2000.00	3000000	00
1.9.2		Vertical anchor blocks	m^3	15	2000.00	30000	00
1.9.3		Concrete casing river crossings	m^3	225	2169.00	488025	00
1.9.4		Concrete casing road crossings	m^3	40	2169.00	86760	00
1.10		**VALVE CHAMBERS AND MANHOLES**					
1.10.1		Butterfly valve chamber complete	No	1	2500000.00	2500000	00
1.10.2		Air valve chambers for 4 x 200mm airvalves complete	No	12	400000.00	4800000	00
1.10.3		Scour valve chambers complete	No	3	365000.00	1095000	00
1.10.4		Scour valve chambers at river crossings complete	No	1	365000.00	365000	00
1.11		**SUNDRIES**					
1.11.1		Pipeline marker posts	No	30	110.00	3300	00
1.11.2		Connection to Weir	Sum		2300000.00	2300000	00
TOTAL CARRIED FORWARD						138174785	00

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						138174785	00
1.12	SABS 1200DK	**GABIONS AND PITCHING**					
	8.2.1	Surface preparation for gabion bedding					
1.12.1		Cavities filled with approved excavated material or rock	m³	90	150.00	13500	00
	8.2.2	Construct gabions using PVC-coated galvanized wire mesh Mattresses with wire thickness of 2.5 mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.12.2		4,0 x 2,0 x 0,3 m	m³	75	2000.00	150000	00
		Gabions with wire thickness 2.5mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.12.3		2,0 x 0,5 x 0,5 m	m³	15	1115.00	16725	00
	8.2.4	Geotextile (Grade 3)					
1.12.4		Underneath mattresses and gabions	m²	336	8.00	2688	00
1.13	8.2.5	**PITCHING**					
1.13.1		Stone pitching	m³	50	1010.00	50500	00
TOTAL CARRIED FORWARD TO SUMMARY						138408198	00

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (DIVERSION WEIR TO BALANCING TANK)
BILL OF QUANTITIES

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: WATER PIPELINE	138408198.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		138408198.00

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (BALANCING TANK TO DAM BALANCING TANK)
BILL OF QUANTITIES

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Pipelines	m	2045	5.00	10225	00
1.1.2		Remove and grub all trees and tree stumps regardless of the girth	m²	750	10.00	7500	00
1.1.3		Remove and re-erect existing fences	m	600	30.00	18000	00
1.1.4		Remove and replace topsoil	m²	19225	50.00	961250	00
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**					
1.2	8.3.2	**EXCAVATION**					
		Excavate in all materials for trenches, select, backfill, compact and dispose of all surplus material for main pipes with:					
		dia up to 2000 mm for depths:					
		Over and Up to					
1.2.1		3,0 m 3,5 m	m	910	150.00	136500	00
1.2.2		3,5 m 4,0 m	m	795	250.00	198750	00
1.2.3		4,0 m 4,5 m	m	270	350.00	94500	00
1.2.4		4,5 m 5,0 m	m	45	450.00	20250	00
1.2.5		5,0 m 5,5 m	m	5	650.00	3250	00
1.2.6		5,5 m 6,0 m	m	5	750.00	3750	00
1.2.7		6,0 m 6,5 m	m	15	900.00	13500	00
	8.3.2(b)	Extra-over items 1.2.1 to 1.2.7 for:					
1.2.8		Intermediate excavation	m³	3350	17.00	56950	00
1.2.9		Hard rock excavation	m³	1120	300.00	336000	00
1.2.10		Excavate unsuitable material from trench bottom	m³	225	65.00	14625	00
1.2.11		Hand excavation to expose existing services	m³	200	200.00	40000	00
TOTAL CARRIED FORWARD						1915050	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						1915050	00
1.2.12		Extra over for hand excavation and backfill around existing services	m^3	100	100.00	10000	00
1.3	8.3.3	**EXCAVATION ANCILLARIES**					
1.3.1		Compaction in road reserves	m^3	50	40.00	2000	00
	8.3.3.4	Overhaul					
1.3.2		Limited overhaul	m^3	15340	10.00	153400	00
1.3.3		Long overhaul	m^3.km	306800	5.00	1534000	00
1.4	8.3.4	**PARTICULAR ITEMS**					
		Shore trench for depths: (Both sides)					
		Over and Up to					
1.4.1		3,0 m 4,0 m	m	1705	150.00	255750	00
1.4.2		4,0 m 5,0 m	m	315	300.00	94500	00
1.4.3		5,0 m 6,0 m	m	10	450.00	4500	00
1.4.4		6,0 m 7,0 m	m	15	550.00	8250	00
1.5	8.3.5	**EXISTING SERVICES**					
		Services that intersect a trench					
1.5.1		Low voltage electrical cables (Overhead)	No	1	500.00	500	00
1.5.2		High voltage electrical cables (Overhead)	No	1	500.00	500	00
1.5.3		Electric pole	No	1	400.00	400	00
1.5.4		Telkom cables (Overhead)	No	1	300.00	300	00
1.5.5		Wire fence	No	8	500.00	4000	00
1.5.6		Gravel road	m^2	250	30.00	7500	00
		Services that adjoin a trench					
1.5.7		Low voltage electrical cables (Overhead)	m	25	15.00	375	00
1.5.8		Telkom cables (Overhead)	m	10	40.00	400	00
1.5.9		Electrical pole	No	3	150.00	450	00
TOTAL CARRIED FORWARD						3991875	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						3991875	00
1.5.10		Wire fence	m	500	40.00	20000	00
1.5.11		Trees	No	150	60.00	9000	00
1.5.12		Blousloot River crossing, complete (See drawing nr)	Sum		600000.00	600000	00
1.5.13		R46 Bitumen Road crossing, complete (See drawing nr)	Sum		850000.00	850000	00
1.6	SABS 1200 LB	**BEDDING (PIPES)**					
	8.2.2.3	Provision of bedding material compacted to 93% of MAASHTO density (100% for sand) with material from commercial sources					
1.6.1		Selected granular material	m³	7700	200.00	1540000	00
1.6.2		Selected fill material	m³	1230	200.00	246000	00
1.6.3		Bedding for wet conditions	m³	150	330.00	49500	00
1.6.4		Extra-over item 1.6.1 and 1.6.2 for 3% cement stabilisation	m³	500	138.00	69000	00
1.7	SABS 1200 L	**MEDIUM-PRESSURE PIPELINES**					
	8.2.1	Supply, lay and bed Spigot and socket Vectus GRP pipes on bedding according to SABS 1200 drawing LB-2, test and disinfect the following pipes:					
1.7.1		2000 mm dia class 10 SN 5000	m	2045	12500.00	25562500	00
1.8		**SPECIALS AND FITTINGS**					
	8.2.2	Supply, lay, and bed on class C bedding, joint, including cut pipes to lengths where required, test and disinfect with necessary couplings					
		GRP bends for GRP pipes					
1.8.1		2000 mm dia 2°-30°	No	17	75000.00	1275000	00
1.8.2		2000 mm dia 30°-60°	No	3	115000.00	345000	00
1.8.3		2000 mm dia 60°-90°	No	1	160000.00	160000	00
TOTAL CARRIED FORWARD						34717875	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						34717875	00
1.9		**ANCILLARIES**					
1.9.1		Anchor/Thrust blocks	m³	420	2000.00	840000	00
1.9.2		Transverse anchor blocks	No	10	3400.00	34000	00
1.9.3		Vertical anchor blocks	m³	585	2000.00	1170000	00
1.9.4		Concrete casing river crossings	m³	75	2169.00	162675	00
1.9.5		Concrete casing road crossings	m³	40	2169.00	86760	00
1.10		**VALVE CHAMBERS AND MANHOLES**					
1.10.1		Butterfly valve chamber complete	No	1	2300000.00	2300000	00
1.10.2		Air valve chambers for 4 x 200mm airvalves complete	No	10	400000.00	4000000	00
1.10.3		Scour valve chambers complete	No	5	365000.00	1825000	00
1.10.4		Scour valve chambers at river crossings complete	No	1	365000.00	365000	00
1.11		**SUNDRIES**					
1.11.1		Pipeline marker posts, complete as shown on dwg no STE/W-30	No	25	110.00	2750	00
1.12	SABS 1200DK	**GABIONS AND PITCHING**					
	8.2.1	Surface preparation for gabion bedding					
1.12.1		Cavities filled with approved excavated material or rock	m³	30	150.00	4500	00
	8.2.2	Construct gabions using PVC-coated galvanized wire mesh					
		Mattresses with wire thickness of 2.5 mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.12.2		4,0 x 2,0 x 0,3 m	m³	25	2000.00	50000	00
TOTAL CARRIED FORWARD						45558560	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						45558560	00
		Gabions with wire thickness 2.5mm and mesh openings of 100 x 80 mm for the following dimensions:					
1.12.3		2,0 x 0,5 x 0,5 m	m^3	5	1115.00	5575	00
	8.2.4	Geotextile (Grade 3)					
1.12.4		Underneath mattresses and gabions	m^2	115	8.00	920	00
1.13	8.2.5	**PITCHING**					
1.13.1		Stone pitching	m^3	50	1010.00	50500	00
TOTAL CARRIED FORWARD TO SUMMARY						45615555	00

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (BALANCING TANK TO DAM BALANCING TANK)
BILL OF QUANTITIES

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: WATER PIPELINE	45615555.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		45615555.00

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (PST TO DAM BALANCING TANK)
BILL OF QUANTITIES

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
1.1	SABS 1200 C	**SITE CLEARANCE**					
	8.2.1	Clear and grub					
1.1.1		Pipelines	m	1115	5.00	5575	00
1.1.2		Remove and grub all trees and tree stumps regardless of the girth	m²	750	10.00	7500	00
1.1.3		Remove and re-erect existing fences	m	500	30.00	15000	00
1.1.4		Remove and replace topsoil	m²	8400	50.00	420000	00
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**					
1.2	8.3.2	**EXCAVATION**					
		Excavate in all materials for trenches, select, backfill, compact and dispose of all surplus material for main pipes with:					
		dia up to 1100 mm for depths:					
		Over and Up to					
1.2.1		2,0 m 2,5 m	m	660	95.00	62700	00
1.2.2		2,5 m 3,0 m	m	375	120.00	45000	00
1.2.3		3,0 m 3,5 m	m	80	150.00	12000	00
	8.3.2(b)	Extra-over items 1.2.1 to 1.2.3 for:					
1.2.4		Intermediate excavation	m³	885	17.00	15045	00
1.2.5		Hard rock excavation	m³	295	300.00	88500	00
1.2.6		Excavate unsuitable material from trench bottom	m³	60	65.00	3900	00
1.2.7		Hand excavation to expose existing services	m³	60	200.00	12000	00
1.2.8		Extra over for hand excavation and backfill around existing services	m³	30	100.00	3000	00
TOTAL CARRIED FORWARD						690220	00

SCHEDULE: WATER PIPELINE

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						690220	00
1.3	8.3.3	**EXCAVATION ANCILLARIES**					
1.3.1		Compaction in road reserves	m^3	50	40.00	2000	00
	8.3.3.4	Overhaul					
1.3.2		Limited overhaul	m^3	3750	10.00	37500	00
1.3.3		Long overhaul	$m^3.km$	75000	5.00	375000	00
1.4	8.3.4	**PARTICULAR ITEMS**					
		Shore trench for depths: (Both sides)					
		Over and Up to					
1.4.1		2,0 m 3,0 m	m	1035	100.00	103500	00
1.4.2		3,0 m 4,0 m	m	80	150.00	12000	00
1.5	8.3.5	**EXISTING SERVICES**					
		Services that intersect a trench					
1.5.1		Low voltage electrical cables (Overhead)	No	5	500.00	2500	00
1.5.2		High voltage electrical cables (Overhead)	No	1	500.00	500	00
1.5.3		Electric pole	No	1	400.00	400	00
1.5.4		Telkom cables (Overhead)	No	1	300.00	300	00
1.5.5		Wire fence	No	5	500.00	2500	00
1.5.6		Bitumen Road	m^2	30	60.00	1800	00
		Services that adjoin a trench					
1.5.7		Low voltage electrical cables (Overhead)	m	25	15.00	375	00
1.5.8		Telkom cables (Overhead)	m	10	40.00	400	00
1.5.9		Electrical pole	No	3	150.00	450	00
1.5.10		Wire fence	m	440	40.00	17600	00
TOTAL CARRIED FORWARD						1247045	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						1247045	00
1.5.11		Trees	No	5	60.00	300	00
TOTAL CARRIED FORWARD						1247345	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						1247345	00
1.6	8.3.6	**FINISHINGS**					
	8.3.6.1	Reinstate road surfaces complete with all layers					
1.6.1		150 mm G9 lower selected layer	m²	30	15.00	450	00
1.6.2		150 mm G7 upper selected layer	m²	30	15.00	450	00
1.6.3		150 mm G5 subbase course	m²	30	15.00	450	00
1.6.4		150 mm G2 base course	m²	30	15.00	450	00
1.6.5		30 mm Asphalt	m²	30	141.00	4230	00
		Extra-over for imported material for:					
1.6.6		150 mm G9 lower selected layer	m³	10	180.00	1800	00
1.6.7		150 mm G7 upper selected layer	m³	10	200.00	2000	00
1.6.8		150 mm G5 subbase course	m³	10	220.00	2200	00
1.6.9		150 mm G2 base course	m³	10	350.00	3500	00
1.6.10		Cut bitumen layer	m	30	10.00	300	00
1.7	SABS 1200 LB	**BEDDING (PIPES)**					
	8.2.2.3	Provision of bedding material compacted to 93% of MAASHTO density (100% for sand) with material from commercial sources					
1.7.1		Selected granular material	m³	2220	200.00	444000	00
1.7.2		Selected fill material	m³	470	200.00	94000	00
1.7.3		Bedding for wet conditions	m³	100	330.00	33000	00
1.7.4		Extra-over item 1.7.1 and 1.7.2 for 3% cement stabilisation	m³	50	138.00	6900	00
TOTAL CARRIED FORWARD						1841075	00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R	c
BROUGHT FORWARD						1841075	00
1.8	SABS 1200 L	**MEDIUM-PRESSURE PIPELINES**					
	8.2.1	Supply, lay and bed Spigot and socket Vectus GRP pipes on bedding according to SABS 1200 drawing LB-2, test and disinfect the following pipes:					
1.8.1		1100 mm dia class 10 SN 5000	m	1115	4350.00	4850250	00
1.9		**SPECIALS AND FITTINGS**					
	8.2.2	Supply, lay, and bed on class C bedding, joint, including cut pipes to lengths where required, test and disinfect with necessary couplings					
		GRP bends for GRP pipes					
1.9.1		1100 mm dia 2°-30°	No	18	20690.00	372420	00
1.9.2		1100 mm dia 30°-60°	No	1	27700.00	27700	00
1.9.3		1100 mm dia 60°-90°	No	0	36500.00	0	00
1.10		**ANCILLARIES**					
1.10.1		Anchor/Thrust blocks	m^3	45	2000.00	90000	00
1.10.2		Vertical anchor blocks complete according to drawing 22128CKS0/19	m^3	90	2000.00	180000	00
1.11		**VALVE CHAMBERS AND MANHOLES**					
1.11.1		Check valve chamber complete	No	1	1100000.00	1100000	00
1.11.2		Butterfly valve chamber complete	No	1	1100000.00	1100000	00
1.11.3		Air valve chambers for 4 x 200mm airvalves complete	No	6	220000.00	1320000	00
1.11.4		Scour valve chambers complete	No	3	185000.00	555000	00
1.12		**SUNDRIES**					
1.12.1		Pipeline marker posts, complete as shown on dwg no STE/W-30	No	10	110.00	1100	00
TOTAL CARRIED FORWARD TO SUMMARY						11437545	00

AUGMENTATION OF THE WESTERN CAPE
MICHELL'S PASS SCHEME (PST TO DAM BALANCING TANK)
BILL OF QUANTITIES

SUMMARY OF SECTIONS

SECTION	DESCRIPTION	AMOUNT (RAND)
1	SCHEDULE: WATER PIPELINE	11437545.00
TOTAL CARRIED FORWARD TO SUMMARY OF SCHEDULES		11437545.00