Appendix C: Alternatives Investigation

DE BEERS GROUP

VENETIA UNDERGROUND PROJECT

PROJECT NO: 1230C-00204

DOCUMENT NAME	:	**TRADE-OFF STUDY TRUCKING OR PUMPING DIESEL TO SERVICE SHAFT**
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REVISIONS

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20/11/2018	1.0	Issue for Review	F Botha

ABBREVIATIONS / ACRONYMS

ABBREVIATION / ACRONYM	DESCRIPTION
VUP	Venetia Underground Project

REFERENCE DOCUMENTS

DOCUMENT NAME	DOCUMENT NUMBER	REV NO

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1. ITRODUCTION

WorleyParsons have been requested to perform a trade-off study between the use of diesel bowser trucks versus using a diesel pipeline pumping system to transfer the underground diesel requirements from the Engen Bulk storage plant to the Service shaft. The purpose of the study is to confirm which will be the most cost effective and sustainable system for the underground construction and continued life of mine (LoM) diesel requirements

2. EXECUTIVE SUMMARY

Information sourced from the mine indicate that close to 50 million litres of diesel will be required from Jan 2019 to May 2044 for the LoM production. At the peak of production an average of 14500 litres per day are forecast. Currently a 7571 litre bowser truck is used to take diesel via the ramp to the underground workings. By installing an automated pumping system from the Engen Bulk Storage facility will result in a capital saving of R2 492 000.00 and the operational saving of R13 213 586.00 for the LOM. The minimum human interaction due to an automated pumping system results in a much higher risk free and security breach system

3. STUDY METHODOLOGY

The topography was analysed and possible overland pipe line routes from the Engen Bulk Surface Tanks to Service shaft 38000 litre storage tank were drawn.

A Specialist company designing diesel pumping system were consulted to assist in planning a possible pump and piping system.

The mine was consulted for the future production profile and diesel consumption required for the LoM.

Physical route walks were investigated to find the safest and most acceptable pipeline routes from the Engen Bulk Storage plant.

A diesel bowser truck delivery capacity was compared with a pumping system to compare the capital and operating cost.

4. OUTCOME

The diesel pumping system will be based on the currently installed system pumping to the Emergency Generator on site.

At peak production the Proposed pumping system must ensure that the 38000litre Diesel tank at the Service shaft bank can cope with the planned high demand litre diesel requirement per day as per FIGURE 1.

The proposed diesel pumping system design must be of high standard and environmental friendly

Although the Diesel Pumping /Trucking Trade-Off Study system was for the surface infrastructure, the underground diesel receives and supply had to be investigated to ensure a sustainable surface supply to the underground system

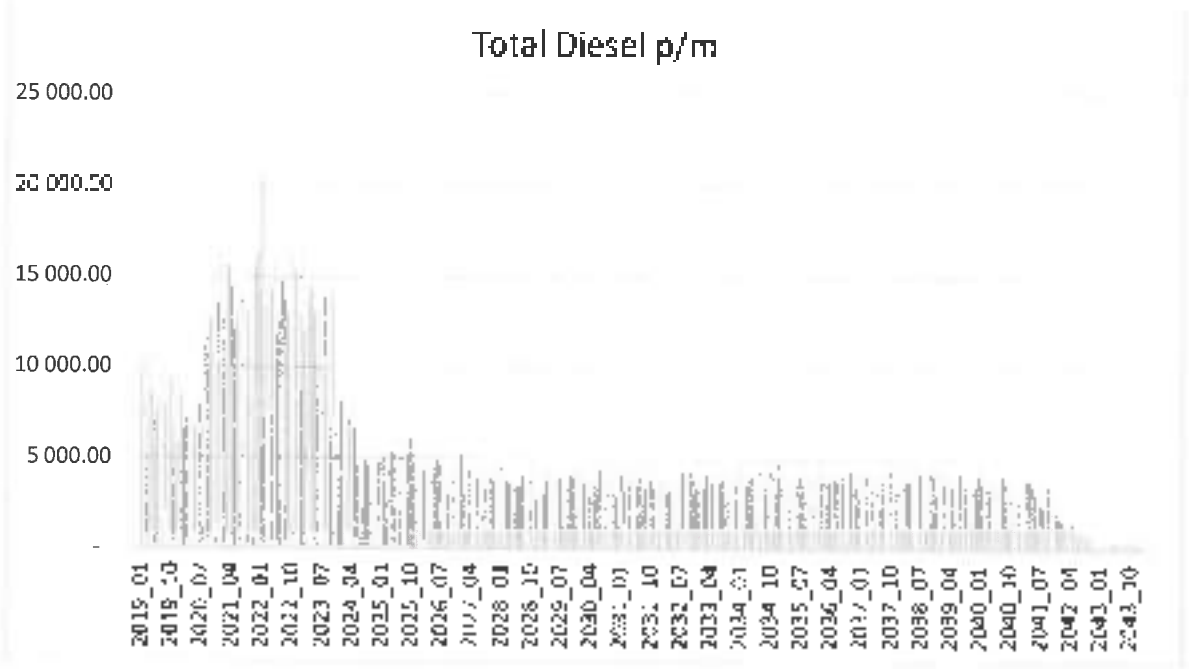

FIGURE 1: LOM DIESEL CONSUMPTION

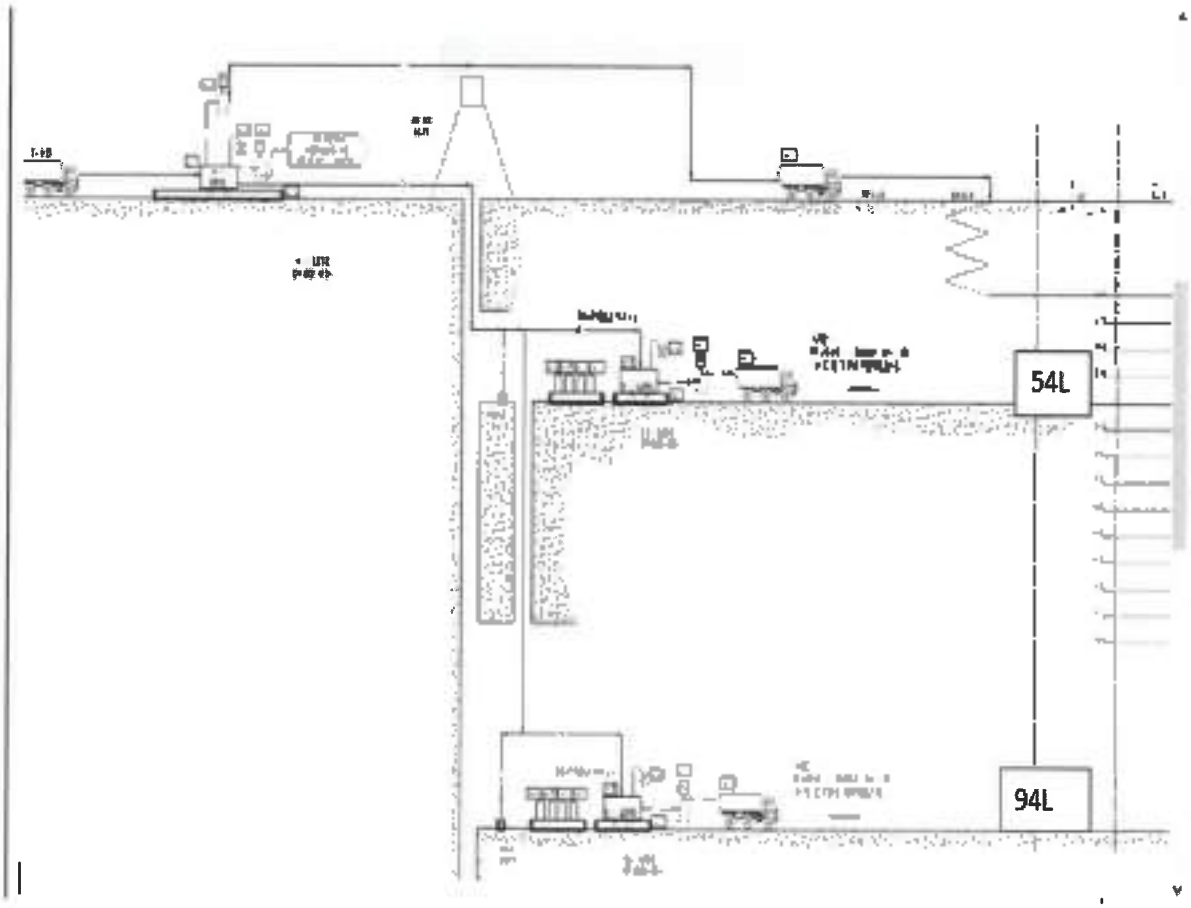

FIGURE 2: PROPOSED DIESEL SUPPLY SURFACE TO UNDERGROUND SYSTEM

4.1 Construction Analysis

Several diesel pipe lines from the Engen Bulk storage plant to the Service shaft were plotted and a team from the Mine, WorleyParsons and Atmel did the on-site inspection to ensure a safe and cost-effective system.

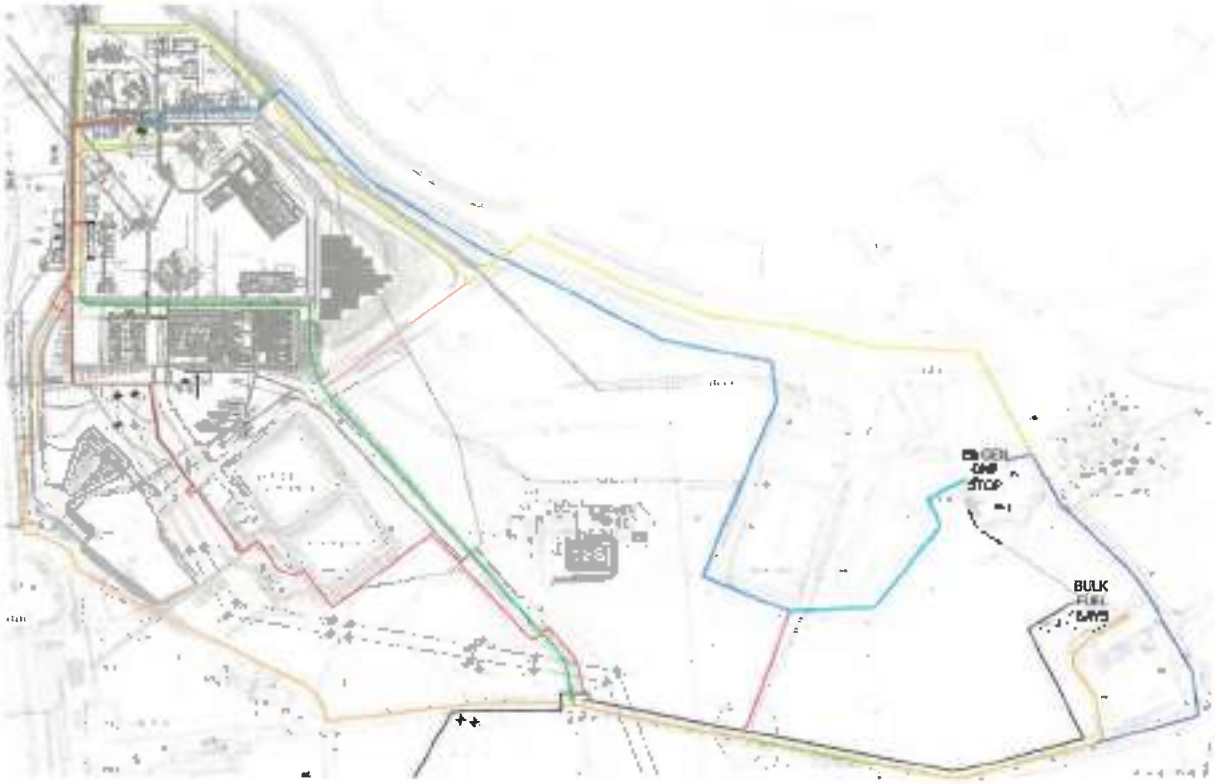

FIGURE 3: POSSIBLE DIESEL PIPE ROUTE INVESTIGATED

	EXISTING FUEL LINE		PIPE ROUTING C FROM ENGEN BAE STOP ±370m		ROAD ROUTING C FROM ENGEN BAE STOP ±1700m
	PIPE ROUTING A FROM ENGEN BAE STOP ±1855m		ROAD ROUTING A FROM BULK FUEL BAYS ±1963m		ROAD ROUTING D FROM ENGEN BAE STOP ±1595m
	PIPE ROUTING B FROM BULK FUEL BAYS ±1415m		ROAD ROUTING B FROM BULK FUEL BAYS ±2135m		ROAD ROUTING E FROM ENGEN BAE STOP ±1635m

TABLE 1: DIESEL PIPE ROUTE INVESTIGATED

4.2 Cost comparison

Pumping OPEX 305 months		Total		Truck OPEX 305 months		Total
Elec pumping cost per batch	R28.53			Cost per trip	R530.50	
Electrical cost to fill 55000l bank bowser LOM t	1200.0	R35 945.08		Diesel cost to full bank bowser LOM amps	2353	R1 587 577.87
Operating Labour wages 25 years	R1 288.57	R398 015.36		Operating Labour wages 25 years	R32 662.70	R9 908 223.50
Pumping MaintenanceMaintenace LOM	R30 085.05	R712 050.80		Truck Maintenace cost LOM		R2 808 800.00
Total		R1 151 015.24		Total		R14 344 601.37

TABLE 2: COST COMPARISON

4.2.1 Capital cost

	Capital Cost		
DIESEL BOWSER TRUCK		ATMEI PUMPING SYSTEM	
Truck supplied from Hino with modifications done by Flosolve. The total amount was R3.8mil for the truck, with additional spec changes amounting to R760 000.00	R3 800 000 00 R760 000.00	Mechanical Instalation	R1 065 424.26
		Electrical work	R347 001.35
		Preliminary & General	R655 734.07
Total	**R4 560 000.00**		**R2 068 159.68**

TABLE 3: CAPITAL COST

5. RISK ASSESSMENT SUMMARY

The recommended decision for pumping over trucking is based on the key risk drivers below as derived by the lead engineer:

- OPEX and CAPEX costs
- Safety

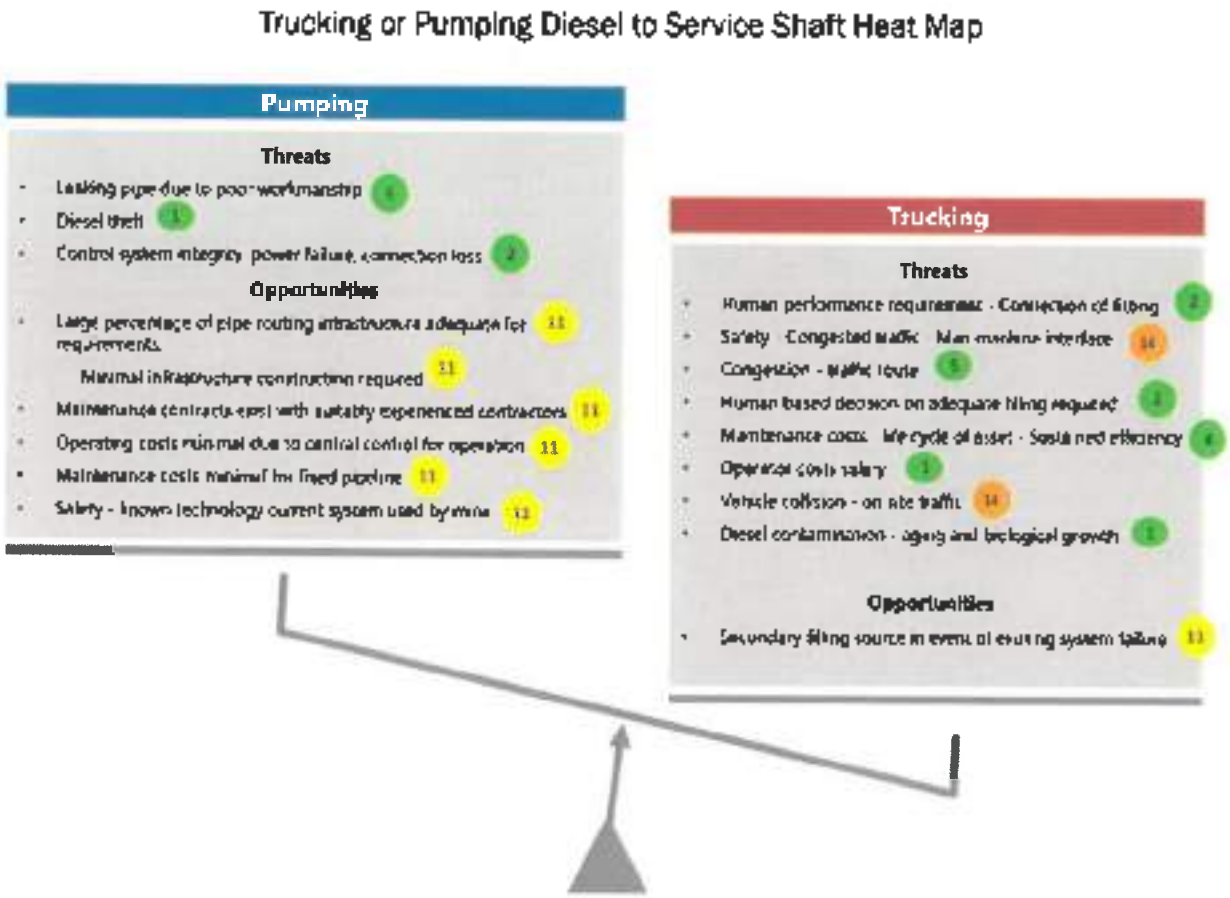

FIGURE 4: TRUCKING OR PUMPING DIESEL TO SERVICE SHAFT HEAT MAP

6. RECOMMENDATION

It is highly recommended that a well-designed diesel pumping system be implemented for the following reasons

1. An automated diesel system controlled from the control room will be much safer than manually filling trucks by operators, and the risk of spillage and miss-treatment of equipment will be minimized.
2. Where possible to eliminate any vehicles moving around the bank area; seeing it is a risk for people working around moving machinery.
3. The capital cost of R2 068 000.00 for a pumping system is more cost effective than for a diesel bowser truck at a cost of R 4 560 000.00.
4. The operating cost of R1 151 015.00 for a pumping system against R14 364 601.37 for a diesel bowser truck will result in a huge cost saving LoM.
5. The control of diesel supplied to the underground is easier by auto pump metering systems linked to the mines costing system

OPERATING COST	
Diesel Bowser Truck Operating cost LoM	R14 364 601.70
Pumping Operating cost LoM	R1 151 015.24
Operating Saving	**R13 213 586.13**
CAPITAL COST	
New Diesel bowser truck	R4 560 000.00
Pumping System	R2 068 159.68
Capital saving	**R2 491 840.32**

TABLE 4: OPERATING COST