APPENDIX L: ANNEXURE A- ALTERNATIVES

INVESTIGATION OF ALTERNATIVES TO REACH THE PROPOSED PREFERRED DEVELOPMENT

1. FEASIBLE AND REASONABLE ALTERNATIVES

"alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—

(a) the property on which or location where it is proposed to undertake the activity;

(b) the type of activity to be undertaken;

(c) the design or layout of the activity;

(d) the technology to be used in the activity;

(e) the operational aspects of the activity; and

(f) the option of not implementing the activity.

Legislative background

The very consideration of a development in terms of EIA is about the consideration of alternatives related to the development. The NEMA prescribes that all environmental impact assessments, which are to be utilised in informing an application for environmental authorisation, must identify and investigate the alternatives to the activity on the environment and include a description and comparative assessment of the advantages and disadvantages that the proposed activity and feasible and reasonable alternatives will have on the environment and on the community that may be affected by the activity. If, however, after having identified and investigated alternatives, no feasible and reasonable alternatives exist, no comparative assessment of alternatives, beyond the comparative assessment of the preferred alternative and the option of not implementing the proposed project, is required during the assessment phase. In this instance, the EAP managing the application must provide the competent authority / DEA with detailed, written proof of the investigation(s) undertaken and motivation indicating that no reasonable or feasible alternatives, other than the preferred alternative and the no-go option, exist.

Definition of Alternatives

"Alternatives", in relation to a proposed activity, means different ways of meeting the general purposes and requirements of the activity, which may include the following types of alternatives:

- The property on which, or location where, it is proposed to undertake the activity;
  - Refers to both alternative properties (locations) as well as alternative sites on the same property.
- The type of activity to be undertaken;
  - Provision of public transport rather than increasing the capacity of roads.
- The design or layout of the activity;

    - Different architectural and or engineering designs.
    - Consideration of different spatial configurations of an activity on a particular site (Site Layout).
- The technology to be used in the activity;
    - Option of achieving the same goal by using a different method or process.
- The operational aspects of the activity;
- Demand;
    - When a demand for a certain product or service can be met by some alternative means, i.e. the demand for electricity/storm water controls could be met by supplying more energy or using energy more efficiently by managing demand.
- Input;
    - Input alternatives for projects that may use different raw materials or energy sources in their processes.
- Routing;
    - Alternative routes generally apply to linear developments (pipeline routes).
- Scheduling and Timing;
    - Where several measures might play a part in an overall programme, but the order in which they are scheduled will contribute to the overall effectiveness of the end result.
- Scale and Magnitude;
    - Activities that can be broken down into smaller units and can be undertaken on different scales, i.e. for a housing development there could be the option 10, 15 or 20 housing units.
- The option of not implementing the activity (no-go option).
    - The no-go option is taken to be the existing rights on the property, and this includes all the duty of care and other legal responsibilities that apply to the owner of the property. All the applicable permits must be in place for a land use to be an existing right.

The key criteria when identifying and investigating alternatives are that they should be "feasible" and "reasonable". The "feasibility" and "reasonability" of and the need for alternatives must be determined by considering, *inter alia*, (a) the general purpose and requirements of the activity, (b) need and desirability, (c) opportunity costs, (d) the need to avoid negative impact altogether, (e) the need to minimise unavoidable negative impacts, (f) the need to maximise benefits, and (g) the need for equitable distributional consequences. The (development) alternatives must be socially, environmentally and economically sustainable. They must also aim to address the key significant impacts of the proposed development by maximising benefits and avoiding or minimising the negative impacts.

Given the definition and description of alternatives, alternatives for investigation in this assessment were first identified by considering whether the different types of alternatives could meet the general purposes and requirements of an irrigation dam, and subsequently constitute a comparable activity. Thereafter, the need for an alternative was assessed to determine whether it warranted further investigation. Given that core business of the project proponent (Macadamia Farming) was on the existing property of Farm Waterfall, other property alternatives could not be considered as legitimate alternatives for comparable assessment. Consequently, only alternatives that address site-specific impacts were considered throughout the assessment process, and mitigation(s) proposed.

Purpose and requirement of the Bospoort Pipeline and Reservoir

Rustenburg Local Municipality (RLM) is one of the fastest growing municipalities in South Africa with Rustenburg town growing rapidly and getting more and more urbanized. The increasing pressure on natural and human resources is manifesting in acute problems such as growth of informal settlements, uncoordinated mining activities, uncoordinated and fragmented housing development, sub-optimal infrastructure development, loss of biodiversity and heritage resources, decreased air quality and pressure on service provision. These and other issues threaten the sustainability of the environment within the municipal area. (Chanzo, 2011). The construction of the pipeline between the Bospoort WWTW and the Bospoort reservoirs falls within the district's wide objectives relating to sustainable water services to provide basic water and sanitation infrastructure to all communities in order to optimize infrastructural functionality, i.e. replacing a dysfunctional pipe with a larger new pipe.

Rustenburg Local Municipality (RLM) is growing rapidly due to major mining operations in the area. The Rustenburg Water Services Trust (RWST) compiled a Master Plan for Rustenburg's water services. The document highlighted that the water consumption in Rustenburg was over-stated relative to its true theoretical requirements. Immediate actions which can be implemented to alleviate water shortages and the installation of a new pipeline to replace the existing dysfunctional pipeline between Bospoort Water Treatment Works (WTW) and Rustenburg is crucial to ensure uninterrupted and reliable supply of potable water to the town and its surrounds.

The largest backlog when it comes to water services, including sanitation remains in the Rustenburg municipality (approximately 10 000 households), amongst other municipalities. (Bojanala Platinum District Municipality (IDP) - 2012-2017 Final Version). The construction of the pipeline between the Bospoort WTW and the Bospoort reservoir (Phase 1) and the onto Rustenburg town (Phase 2) falls within the district's wide objectives relating to sustainable water services to provide basic water and sanitation infrastructure to all communities in order to eradicate the backlog. The current pipeline has reached the end of its useful lifespan and is fraught with leak and other structural problems and needs to be decommissioned.

New housing developments & demand by the mining industry predominantly, place a heavy demand on potable water within the Rustenburg LM. The existing supply pipeline from Bospoort WTW is largely dysfunctional due to its age and lack of maintenance over the years. Installing a new pipeline directly adjacent to the existing line makes use of the current servitude with limited impact to other areas and land uses and allows supply to Rustenburg town in the existing line to continue without interruption until the new line is completed.

Water Treatment is an ongoing and essential aspect of municipal management and this activity aims to provide uninterrupted and improved supply to the town considering the numerous malfunctions and state of disrepair of the existing line. It does, however, encourage forward planning of municipal infrastructure to ensure that they can effectively service growing communities. The augmentation of the pipeline will ensure the capacity of the works keeps track of population growth and development needs of the community into the near- & medium-term future through the adequate provision of treated water.

Identification and investigation of alternatives including motivations

Alternative Type No. 1: Site and Location

- Purpose and Requirements

Motivation

The pipeline route selection and location of the associated WTW are inter-dependent. A change in one will impact on the other. The process of choosing a pipeline route could therefore not be separated from the existing Bospoort WTW location. During 2018 there was a re-alignment of the preferred pipeline route and the inclusion of the ne new reservoir. The preferred pipeline alignment (Alternative 1), which varies fundamentally in its position on the opposite side of the R510 provincial tar road from the original alignment (Alternative 3). Please refer to the layout map of the preferred pipeline alignment within **Appendix A: Annexure A1** and **Appendix A: Annexure A2.**

Alternative 1 (Preferred): The proposed pipeline route will run on the north western side of the R510 *outside* of the existing road reserve.

Alternative 2: The proposed pipeline route will run on the north western side of the R510 *inside* the existing road reserve.

Alternative 3: The proposed pipeline route will run on the south eastern side of the R510 within the existing historical/old pipeline servitude. (Light Blue Line on **Figure** below)

No-go Option: The option of not implementing the activity

- Methodology

In each case, environmental considerations have been considered as to whether the pipeline should be aligned on the left- or right-hand side of the various existing roads including the R510 that the pipeline follows. The preferred pipeline development footprint was based on the findings of the geotechnical survey, the site investigation and hydrology of the area. In addition to the preliminary site investigations, there have been additional specialist site assessments completed, including;

- An Aquatic Study and Wetland Delineation assessment was undertaken to, *inter alia*, investigate alternative dam sites;
- A terrestrial ecological and biodiversity value assessment;
- Land Capability Assessment; and
- Archaeological and Heritage Impact Assessment; and
- Palaeontological Assessment.

These were undertaken to determine the potential impacts on sensitive habitats within the study area and the impact of the proposed pipeline on the geographical, physical, biological, social, economic, heritage
and cultural aspects of the local area.

Criteria used to investigate and assess alternatives;
Requirements (criteria) used to identify comparable locations included:

- Within the Hex River catchment on Farm Tweedepoort 283 JQ, Reinkoyalskaal 278, Boschpoort 284 and Paardekraal 279.

It was not feasible or reasonable to consider alternative properties as the proposed pipeline was for the existing Bospoort WTW. The proposed pipeline is to service the Rustenburg basic water and sanitation infrastructure to all communities in order to optimize infrastructural functionality, i.e. replacing a dysfunctional pipe with a larger new pipe. However, alternative sites on the same property have been considered. The alternative sites for the upgrade of the pipeline were then based on the following technical, topography, environmental and socio-economic criteria:

Impact is assessed in several ways, the benefits to human society arising from the pipeline (agriculture, water, damage prevention and power), harm or benefit to biodiversity and landscape, impact on the geology of an area (whether the change to water flow and levels will increase or decrease stability), and the disruption to human lives (relocation, loss of archaeological or cultural matters underwater).

The criteria used are listed below:
-Significant geotechnical and geology considerations pipeline infrastructure:
Geology of the surrounding rock or soil types;
Slope stability and gradients; and
Water table and flood lines.

-Environmental impacts (River catchments, indigenous vegetation and wildlife)
Loss of biodiversity;
Disturbance of riparian habitat; and
Changes in local catchment hydrology;

-Social Impacts on human habitations
Job creation; and
Compensation for land being lost as well as population resettlement.

-Technical and Economic Considerations
Capital cost;
Accessibility;

Reasoned explanation why an alternative was not found to be feasible:
-Geotechnical Considerations
The first important consideration for pipeline routes and the existing WTW site needs the selected route to meet the requirement for gravity flow throughout the system. This generally involved following ground contours no higher than the hydraulic grade line of the pipelines whilst minimising deviations from the general direction of the pipeline.

-Environmental Considerations
Aquatic and Terrestrial Biodiversity Value:

The specialist studies identified the most sensitive areas along the pipeline alignment were four watercourses crossing and adjacent rocky kopjes which have higher biodiversity potential. The proposed pipeline would cross tributaries to the Hex River catchment. There are two tributaries with surface lows, the Dorps River at Crossing 1, and the Boschfontein Spruit at Crossing 2, and two tributaries that are drainage lines with ephemeral surface flows only during high rainfall events: Crossing 3, Kanana Drainage line and Crossing 4, Tierkop Spruit. According to the LUDS Report (BGIS, 2016) areas directly around the river crossings are in a built-up area along a national highway where very little natural habitat remains intact Further away from the highway the vegetation type is classified as "Ecosystem Status - Vulnerable" but will not be affected by the project. The wetland value of the river crossings is not featuring as NFEPA entities, indicating that the aquatic habitat in this area is not considered as very important. The only protected area in the project vicinity is in the form of a conservancy around the Bospoort Dam (Deacon, 2108). The vegetation at the stream crossings is visibly modified or ecologically degraded. Important mitigation measures are for alien invasive plant species not to establish in high quantities and for a rehabilitation plan to restore some cover of indigenous vegetation at these Stream Crossings.

A rocky hill is present at the northern end of the site and is part of a Critical Biodiversity Area 2 (CBA 2). Critical Biodiversity Area, together with protected areas, ensures that a viable representative sample of all ecosystem types and species can persist. From an environmental management perspective these Critical Biodiversity Areas must stay in largely natural condition (SANBI, 2017). The proposed footprint has been positioned to run through vegetation at the northern and north-eastern side of rocky hill at site that has been modified owing to excavations of the past. The proposed pipeline footprint avoids diverse indigenous vegetation at the southern side of the rocky hill.

Most of the site is on flat and ecologically disturbed terrain. The ecological sensitivity is considered low, as the margority of the pipeline footprint includes cleared areas adjacent to residential developments and tar roads. The stream crossings with their riparian zones and buffer zones and the rocky hill at the site have a medium-high sensitivity. The southern slopes of the rocky hill at the site is of high ecological sensitivity, however the pipeline alignment will avoid these sensitive areas.

There were no threatened or near threatened plant or animal species present at the site during the assessment. There was one Protected tree species, Sclerocarya birrea (Marula) found at the site, of which any impacts are avoided by the proposed footprint.

Hydrology and Stormwater:

The proposed activities were found to pose minimal pollution to receiving water bodies due to the limited infrastructure associated with the proposed development. Mitigation measures were recommended in order to mitigate the potential impacts during the construction phase and operational phases.

-Economic Considerations

The preferred pipeline route footprint would be deemed the most practicable, when cost and logistics are combined, meaning the most financially feasible.

-Social Considerations

The pipeline is largely planned outside the road reserve due to perceived difficulties in obtaining permissions from SANRAL. However, on a recent site visit following the change in pipeline alignment in 2018 there had been significant human settlement and development along the route. This would cause difficulties with access to install the pipeline including a 20m construction servitude with a 10m permanent servitude, without affecting numerous households (informal & formal) as well as local businesses.

If there are people living in the servitudes, they would need to be resettled and compensated, depending on how long they have lived there, and whether they are legally or not. A social impact assessment would be required to assist with determining whether a resettlement action plan should be done, or with whom the negotiations about access to the land should be. These socio-economic considerations have determined the preferred pipeline alignment alternative to work within the road reserve after interacting with SANRAL and/or the Provincial Roads Authority, then trying to address the plethora of social issues that will result from affecting private or illegal land owners.

The positive impacts of job creation and continued improvement of the basic water and sanitation infrastructure of the region outweigh any potential negative social impacts such as an increased burden on local transport.

-Heritage Resource Considerations

An Archaeological and Heritage Impact Desktop study was completed to address the cultural landscapes of the project area and the findings have been incorporated into the draft BAR.

Conclusion for Pipeline Development Footprint Alternative

Preferred Technical Pipeline Alternative 1

The appointed engineers consider alternative 1 the preferred pipeline route outside of the road reserve, due the potential complications of working within the SANRAL servitude and access constraints.

Preferred Environmental Pipeline Alternative 2

The environmental impacts for the watercourse crossings and avoidance of sensitive areas (i.e. rocky kopjes) remained relatively unchanged if the pipeline alignment was on either the western or eastern servitude of the R510. However, if the preferred pipeline alternative 1 is outside of the road reserve then it risks generating more potential impacts within neighbouring properties and areas of virgin ground that have not been already designated as a service servitude such as the SANRAL road reserve.

Assumptions and Limitations

The socio-economic factors maybe key in determining the preferred alternative pipeline that would follow the R510 on the north western alignment. These will have to be focused on limiting the disturbance to local community properties and other service providers within the preferred pipeline alternative servitude and including any SANRAL constraints.

Alternative Type No. 2: Type of Activity

- Purpose and Requirements

An activity alternative would be to consider different uses for the same financial investment that could provide potable and irrigation water to the supply area, improve the quality of life and generate an equivalent number of jobs and income to the area.

Motivation

The raw water will be abstracted from the Bospoort dam and treated at the upgraded 24 Mℓ/d Bospoort WTW. From the WTW, it will be pumped to the proposed 35 Mℓ Bospoort North reservoirs through a section of the existing 400mm diameter Bospoort pipeline and new 500mm diameter rising main. It will then gravitate from the reservoir, through the proposed 800mm diameter pipeline to the Kanana connection, before being distributed in the existing network.

Due to the deteriorated condition of the existing 450mm diameter steel pipeline, it is proposed that a new 500mm diameter replaces the existing. Various possibilities were investigated to determine the best long-term solution while remaining cost effective.

Three possible solutions were recommended and a final decision on which option is to be implemented needed to be taken by RLM. The recommended options were:

- Retaining the existing 450mm diameter steel pipeline and installing a new 450mm diameter pipeline; or
- Decommissioning the existing 450mm diameter steel pipeline after a new 600mm diameter is installed; or
- Retaining the existing 450mm diameter steel pipeline as a back-up system and installing a new 600mm diameter pipeline.

- Methodology

- Project Engineers Design Report; and
- Appointed Specialist Reports.

- Criteria used to investigate and assess alternatives

The development of pipeline infrastructure is considered the preferred alternative activity to transport raw water from the Bospoort WTW to the reservoirs and then to the Rustenburg District. However, other alternatives were considered including;

- Develop groundwater resources

Improving water infiltration will improve underground water reserves and could allow for the development of boreholes in villages to provide higher quality water. This alternative was considered but does not fully address the objectives of the project, notably in terms of socio-economic development of the area.

- Several smaller water sources rather than a large Potable Water Scheme

For rural water supply a single large water source or several smaller sources can be used. The option of several smaller schemes has been considered but the conclusion was reached that, for the large population involved, the cost and risks of a large scheme should be accepted because of the difficulties and cost of sustaining many smaller schemes (Muller, 2014). The smaller schemes alternative was therefore not considered in this report.

Provision of water by rain-fed tanks
Rain water harvesting does not fully address the objectives of the project, notably in terms of socio-economic development of the area. A rain water harvesting programme can however be implemented to complement the Rustenburg Water Project.

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible
It was decided that the most reasonable and feasible alternative was to decommission the existing 450mm steel pipe once the new 500mm diameter pipe is installed.

As the applicant for this project is the Department of Water and Sanitation who has a mandate to develop water resources infrastructure and not to implement development projects of a different nature, it is not feasible to investigate such alternatives. The purpose and requirement of the transportation of raw water from the upgraded Bospoort WTW and associated reservoirs cannot be achieved by using a different type of activity other than a raw water pipeline.

Alternative Type No. 3: Design and Layout
- Purpose and Requirements
The purpose and requirement of the proposed pipeline may be achieved using different pipeline designs and layouts.
Design Assumptions

The basic design assumptions used in the hydraulic modelling are listed below:

- The pipeline material will be steel as there is no equivalent material for the pipeline diameters and pressures under consideration in this report.
- The pipeline lining for both the raw and potable water sections is assumed to be a cement mortar lining.

- Methodology
The requirements of the specifications of the pipeline were calculated by the Engineer, including specific lengths, diameters and location to augment the availability of potable water to the town. A detailed demand projection exercise was undertaken to determine the water demand that the pipeline would need to cater for. Full details of this exercise are contained in the Bospoort Bulk Water Pipeline Preliminary Design report (Revision 00), April 2019 attached in **Appendix L: Annexure L4.**

In determining the design capacity of the raw water infrastructure, it is useful to understand the proposed phasing of the Water Infrastructure between the Bospoort WTW, reservoirs and Rustenburg town water network.

Phase 1 of the Bospoort Pipeline comprises the infrastructure listed below.

- The proposed 1.25km ne 500mm rising main pipeline connected to the existing 450mm pipeline from the Bospoort WTW to the new reservoir;

Phase 2

- The 8.3 km 800mm gravity fed pipeline from the reservoir to the Rustenburg water network.

- Criteria used to investigate and assess alternatives

The main criteria that define the preferred pipeline design are dependent on local topography, baseline raw water hydraulic pressure characteristics and economic feasibility. In order to objectively compare the different pipeline routes and configurations, design criteria were required.

The criteria used in the hydraulic modelling exercise were:

- Maintain gravity flow in the system.
- Maintain a positive residual head along the pipeline route at the peak design flow rate. In combination with the requirement to maintain gravity flow, this was the most critical design criterion.

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

The design alternatives that were investigated, it was considered a primary advantage to using a larger diameter pipe will reduce the flow velocities and associated friction losses. With lower friction losses, the required pump head will decrease which will reduce the power requirements for the motors at the pump station. But if used simultaneously with the existing smaller diameter pipe, very minimal energy will be saved.

Alternative Type No. 4: Technology

- Purpose and Requirements

The investigation into alternative options of achieving the same goal by using a different method or process.

Motivation

The requirements of the specifications of the pipeline were calculated by the Engineer, including specific lengths, diameters and location to augment the availability of potable water to the town, and the best option adopted.

- Methodology

- Project Engineers Design Report; and
- Appointed Specialist Reports.

- Criteria used to investigate and assess alternatives

There has been an emergence of green infrastructure technologies (e.g. natural or engineered systems which use soils and vegetation to capture, cleanse and reduce storm water and other excess flows) and methods (e.g. integrated water resource management) can avoid additional infrastructures and treatments and save major costs. Technological change also presents an opportunity to challenge some but not all the ways in which water services are provided.

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

The use of an alternative technology to supply water would require technologies that are reliable, cost effective, appropriate for those who must use them and capable of widespread adoption. The proposed upgrading of the Rustenburg Water Services infrastructure has been considered the most cost effective and appropriate solution in order to provide clean and adequate water supply to the community.

Alternative Type No. 5: Operational Aspects

- Purpose and Requirements

The purpose and requirement of the proposed pipeline and reservoir cannot be achieved using alternative operational aspects.

- Methodology

Not applicable

- Criteria used to investigate and assess alternatives

Not applicable

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

Not applicable

Alternative No. 6: Demand

- Purpose and Requirements

When a demand for a certain product or service can be met by some alternative means, i.e. the demand for electricity/storm water controls could be met by supplying more energy or using energy more efficiently by managing demand.

Motivation

The existing pipeline is not enough to deal with the new load that will come from the upgraded Bospoort WTW, hence the 12Ml/d will be upgraded to a pipeline that can convey the full 24Ml/d to the town.

The largest backlog when it comes to water services, including sanitation remains in the Rustenburg municipality (approximately 10 000 households), amongst other municipalities. (Bojanala Platinum District Municipality (IDP) - 2012-2017 Final Version). The construction of the pipeline between the Bospoort WTW and the Bospoort reservoir (Phase 1) and the onto Rustenburg town (Phase 2) falls within the district's wide objectives relating to sustainable water services to provide basic water and sanitation infrastructure to all communities in order to eradicate the backlog. The current pipeline has reached the end of its useful lifespan and is fraught with leak and other structural problems and needs to be decommissioned.

The main advantages of a properly segregated bulk and reticulation systems, including the ability to isolate zones within the areas, are the following:

- It is easier to control pressures in the zones by having a dedicated system feeding into a specific zone with a reservoir either at the correct level or with the necessary pressure reducing valves;

- RLM suffers from unacceptably high unaccounted for water losses (UAW) of up to 40%. This is partly due to aging reticulation infrastructure with leaks which is exacerbated by the high pressures and various other institutional problems. Water Demand Management and Water Loss Control (WDMLC) and the reduction of UAW is one of the primary performance objectives of the Municipality. A properly segregated bulk system and reticulation properly subdivided into pressure zones, will make it possible to implement effective WDMLC. Currently the Municipality cannot pinpoint problematic areas.

- Methodology

Not applicable

- Criteria used to investigate and assess alternatives

Not applicable

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

It is considered that there is not a reasonable or feasible alternative to achieve the increased demand for water supply to the Rustenburg area by any alternative means.

Alternative No. 7: Input

- Purpose and Requirements

The potential input alternatives for the project that may use different raw materials or energy sources in their processes.

Motivation

The appointed engineer went through multiple discussions and analyses on what pipe materials would be acceptable for this project. The key analysis is regarding the pressure class estimates in order to compare different pipe material options. Final pipe classes will be dependent on the results of a detail surge analysis as well as external pressure calculations. Once the pressure classes are finalised, the pipe diameters will be aligned.

Supply pipeline to the new Bospoort North reservoir

The following details are used in the hydraulic assessment of the pipeline:

Pipeline Design:	Design Value
Design flow:	278 ℓ/s (or 24 Mℓ/d) – Peak flow
Pump head:	164m
Pipe details:	500mm diameter steel grade X42, t = 4.5mm
Velocities:	1.93 m/s (450mm diameter) and 1.54 m/s (500mm diameter) under peak flow conditions
Internal lining:	Cement mortar lining (CML)
External coating:	To be confirmed
Pipeline length:	2.5km (1.25km x 450mm diameter and 1.25km x 500mm diameter)
Roughness (k) value:	0,4 mm (Colebrook-White formula);

Secondary losses in accordance with AWWA manual M11.	

Both steel and cement mortar lining pipeline materials have been used extensively in DWS water transmission system and plants and met the engineering and performance needs of this project.

Assessment

N/A.

- Methodology

Engineering Design Report

- Criteria used to investigate and assess alternatives

Hydraulic assessment of the pipeline material properties
Cost of raw materials and transport.

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

Alternative inputs were not considered to be a reasonable or feasible alternative because they cannot meet the same purpose or requirements of augmenting the existing pipeline proposed by the Engineer. Upgrading the existing pipeline largely within the same servitude has been selected and other options are not being considered.

Alternative No. 8: Routing

- Purpose and Requirements

The investigations for alternative routes generally apply to linear developments (pipeline routes).

Motivation

The proposed pipeline route alignment alternatives have been investigated and the full detail of the findings can be seen within section 1: Site and Location alternatives (Page 6).

- Methodology

NA

- Criteria used to investigate and assess alternatives

NA

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

NA

Alternative No. 9: Scheduling and Timing

- Purpose and Requirements

Where several measures might play a part in an overall programme, but the order in which they are scheduled will contribute to the overall effectiveness of the result.

Motivation

This upgrade needs to take place as soon as authorisation is granted. The largest backlog when it comes to water services, including sanitation remains in the Rustenburg municipality (approximately 10 000 households), amongst other municipalities. (Bojanala Platinum District Municipality (IDP) - 2012-2017 Final Version).

Installing the pipeline should be scheduled for the drier winter months to avoid runoff related impacts affecting these sensitive environments.

- Methodology

- Project Engineers Design Report; and
- Appointed Specialist Reports.

- Criteria used to investigate and assess alternatives

- Local rainfall and evaporation data; and
- Geotechnical properties of the soil.

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

The reasonable and feasible alternative for timing would include the requirement that construction works of the pipeline and reservoir should be completed within the drier winter months. This will prevent the potential negative impacts from storm events during the summer wetter months. These can be soil erosion, recruitment of alien invasive plants on disturbed ground and sedimentation of the water resources downstream of the pipeline watercourse crossings construction works.

-Alternative No. 10: Scale and Magnitude

- Purpose and Requirements

The activities that can be broken down into smaller units and can be undertaken on different scales, i.e. for a housing development there could be the option 10, 15 or 20 housing units.

Motivation

The pipeline diameter alternatives that were investigated, it was considered a primary advantage to using a larger diameter pipe will reduce the flow velocities and associated friction losses. With lower friction losses, the required pump head will decrease which will reduce the power requirements for the motors at the pump station. But if used simultaneously with the existing smaller diameter pipe, very minimal energy will be saved.

Use of the existing distribution pipelines will be made, downstream of the Kanana connection point. Preliminary investigations revealed that the existing 700mm, 600mm, 550mm and 500mm diameter pipes from Kanana to Boitekong may still have some useful life. Rather than blindly replacing these pipelines, a decision was taken to rather assess the condition of these pipes to try and quantify the remaining life of these lines.

Methodology

- Project Engineers Design Report; and

- Appointed Specialist Reports.

- Reasoned explanation why an alternative was or was not found to be reasonable or feasible

The preferred scale and magnitude of the pipeline and reservoir are considered appropriate and cost effective for the increased demand for water and the upgrade of the Bospoort WTW.

-Alternative No. 11: No-go Option

The option of not implementing the activity (no-go option) was used as the benchmark against which all impacts associated with the proposed development were assessed. Based on the findings and motivations there were no reasonable & feasible alternative(s) other than the preferred option (replacing the 450mm diameter pipeline with a 500mm diameter pipeline and installing a gravity fed 800mm pipeline and associated new reservoir). The No-Go option is not to be considered as the Bospoort plant is going to be upgraded and the capacity is going to be doubled from 12Ml/d to 24Ml/d.

A MOTIVATION FOR THE PREFERRED SITE, ACTIVITY AND TECHNOLOGY ALTERNATIVE;

(f) a motivation for the preferred site, activity and technology alternative;

Preferred Pipeline Development Footprint

The original preferred alternative pipeline alignment was alternative 3 which would follow the south eastern side of the R510 within the existing old pipeline servitude (450mm pipeline). However, since the original ground truthing there has been significant encroachment within the road reserve by informal settlements in which housing is now adjacent to the old pipeline. It was then considered an option to move the pipeline further to the east away from the original pipeline servitude. Unfortunately, this area has several active service provider servitudes including Eskom, Telkom, Neotel, Sasol, Vodacom, MTN, Rand Water and RLM which would cause problematic access to this eastern area of the R510.

These factors provided the motivation to move the proposed pipeline alignment to the north western side of the R510 outside of the SANRAL road reserve (Alternative 1) as there is more room and better access. The new alignment on the north western side of the R510 provided two alternatives. The preferred alternative 1 would have the pipeline outside the SANRAL road reserve and alternative 2 would be within the SANRAL road servitude.

Preferred Technical Pipeline Alternative 1

The appointed engineers consider alternative 1 the preferred pipeline route outside of the road reserve, due the potential complications of working within the SANRAL servitude and access constraints.

Preferred Environmental Pipeline Alternative 2

The environmental impacts for the watercourse crossings and avoidance of sensitive areas (i.e. rocky kopjes) remained relatively unchanged if the pipeline alignment was on either the western or eastern servitude of the R510. However, if the preferred pipeline alternative 1 is outside of the road reserve then it risks generating more potential impacts within neighbouring properties and areas of virgin

ground that have not been already designated as a service servitude such as the SANRAL road reserve.

Assumptions and Limitations

The socio-economic factors maybe key in determining the preferred alternative pipeline between alternative 1 and 2 on the north western side of the R510. These will have to be focused on limiting the disturbance to local community properties and other service providers within the preferred pipeline alternative servitude and including any SANRAL constraints. The land expropriation process and gaining access for temporary and permanent land use approvals and agreements will be key factors in the final pipeline alignment. In the event there are impacts that can not be mitigated then the pipeline route will have to be realigned to move out of sensitive areas and into the SANRAL road reserve following the land consultation process.

Preferred Reservoir Development Footprint

The preferred reservoir development footprint is alternative 1 which is located on an existing mining area and is heavily disturbed. There are also existing access roads to this proposed reservoir development footprint. This contrasts with reservoir alternative 2 that is in a CBA2 (NWBSP 2015: Terrestrial Assessment) and the access roads to this alternative would run through an area classified as vulnerable under the NBA 2011: Threatened Ecosystems. Please see attached sensitivity map for the project alternatives.

Preferred Construction Camp Footprint

The preferred construction camp footprint is alternative 1 as it is located on a less sensitive site compared to alternative 2. Alternative 2 is located with a Conservation Management Zone and classed as a CBA2 under the NWBSP 2015: Terrestrial Assessment.

Preferred Activity Alternative

As the applicant for this project is the Department of Water and Sanitation who has a mandate to develop water resources infrastructure and not to implement development projects of a different nature, it is not feasible to investigate such alternatives. The purpose and requirement of the transportation of raw water from the upgraded Bospoort WTW and associated reservoirs cannot be achieved by using a different type of activity other than a raw water pipeline.

Preferred Technology Alternative

The use of an alternative technology to supply water would require technologies that are reliable, cost effective, appropriate for those who must use them and capable of widespread adoption. The proposed upgrading of the Rustenburg Water Services infrastructure using the current technology alternative has been considered the most cost effective and appropriate solution in order to provide clean and adequate water supply to the community. The requirements of the specifications of the pipeline were calculated by the Engineer, including specific lengths, diameters and location to augment the availability of potable water to the town, and the best option adopted.