Laingsburg Municipality

Water Safety and Security Plan for Laingsburg

June 2010

Prepared for:

Laingsburg Municipality
Private Bag X4
Laingsburg 6900

Tel: 023 5511 019
Fax: 023 5511 019

Prepared by:

Chris Swartz Water Utilization Engineers
67 Marsh Street PO Box 745
Mossel Bay 6500

Tel: 044 691 1242
Fax: 044 690 7960

Executive Summary

Need for a Water Safety and Security Plan

In its strive towards continuous improvement of drinking water management practices, the Department of Water Affairs (DWA) Drinking Water Quality Regulation Unit is applying increasingly comprehensive criteria for Water Services Authorities to meet during the biannual assessment of water supply systems (catchment to consumer). At the top of the list of these criteria is the drawing up of a Water Safety and Security Plan WSSP) to ensure the practising of comprehensive, preventative drinking water quality management for the municipality.

The Water Safety and Security Plan was drawn up for Laingsburg Municipality as a tool to fulfil the objective of ensuring the safety of drinking water supply through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in a water supply system from catchment to consumer. The DWA will be using the WSSP as one of the criteria for the Blue Drop Assessment of the water quality in all water supply areas in South Africa from 2010.

Water Supply Systems of the Laingsburg Municipality

Laingsburg Municipality supplies water to the consumers in their area of jurisdiction through the following water supply systems:

- Laingsburg Water Supply System
- Matjiesfontein Water Supply System

Methodology used in developing the Water Safety and Security Plan

The development of the WSSP for Laingsburg Municipality consisted of the following:

a. A first meeting was held with Laingsburg Municipality personnel to assemble the WSSP team for Laingsburg, and to brief the operations and management teams about the process that would be followed. The purpose of the meeting was also to discuss the different water supply systems of the municipality where assessments would be made.

b. Information was obtained on the different water supply systems, and assessments made of the current lay-out, operation and performance of these water supply systems (source to tap). A description of the water supply systems was made.

c. A hazard analysis was conducted which consisted of an identification of present and future risks to the infrastructure, service delivery and safety to consumers in and of the water supply systems (catchment to consumer).

d. Evaluation of the risks in accordance with the Hazard Risk Assessment Matrix method which is based on the WHO methodology for the setting up of water safety and security plans.

e. Drawing up of control measures for mitigating all the risks that were identified, with emphasis on the medium to high risk areas. The control measures include indication of the responsible institute(s)/person(s) to ensure that the control measures are in fact carried out, and time scales for performing these.

f. Defining of operational limits and monitoring programmes for managing the risks and their proposed control measures, and any support programmes which are required to assist with this risk management.

g. Establishment of corrective actions and incident response.

h. Documentation (this WSSP) and communication procedures were drafted.

i. Recommendations were made for proposed future inclusion into the operation and maintenance systems of the Laingsburg Municipality water supply system.

Laingsburg Water Safety and Security Plan Project Team

A team was assembled from all of the water supply operations and maintenance managers and supervisors of the Laingsburg Municipality. A first meeting of the Laingsburg WSSP team was held on 15 January 2010 at the Laingsburg Municipal Offices, during which the project team did a presentation to provide the aims, methodology and action plans for drawing up the WSSP for Laingsburg. The team members were as follows:

Name	Designation	Affiliation or treatment plant	Tel	Email
Noel Klink	Head Technical Department	Laingsburg / Matjiesfontein	023 - 5511 019	noelklink91@gmail.com
Alida Groenewald	CFO	Laingsburg Municipality	023 - 5511 019	laingsadmin@xinet.co.za
Andries Spannenberg	Handyman	Laingburg	023 - 5511 019	
Abraham Afford	Handyman	Matjiesfontein	023 - 5511 019	
Hendrik Pieterse	Operator	Laingsburg / Matjiesfontein	023 - 5511 019	
Martin Hermanus	Process Controller	Laingsburg / Matjiesfontein	023 - 5511 019	
Frederik Lukas	Storeman	Laingsburg Municipality	023 - 5511 019	
Jacobus Pieters	Operator	Laingsburg / Matjiesfontein	023 - 5511 019	
Chris Swartz	Project Leader	Chris Swartz Eng	082 820 4481	cswartz@mweb.co.za

Results

The main findings of the risk assessment for the Laingsburg Water Supply System are summarised in the risk matrix below, which provides an overview of the risks, its likelihood and consequences, and where the risks lie in terms of the severity of the risk (high risk, medium risk and low risk). The risk matrix is followed by tables indicating the proposed control measures to address and mitigate each of the risks, the responsible persons for performing the risk reduction measures, and the time frames within which this will be performed.

LAINGSBURG WATER SUPPLY SYSTEM RISK MATRIX

LIKELIHOOD (increasing likelihood/frequency)	CONSEQUENCE (increasing consequence/severity)				
	Insignificant consequence (no impact)	Minor consequence (small)	Moderate consequence (considerable)	Major consequence (severe)	Catastrophic consequence
Very high (almost certain)					
High (likely)				D1	
Moderate (possible)			C1; T2; D3	D2	
Low/occassional (unlikely)			C2	C3; T1; T3 T4; T5	
Very low/rare (has not occured)					

CATCHMENT AND RAW WATER SOURCE		TREATMENT, DESIGN AND OPERATION		DISTRIBUTION	
C1:	Possible contamination of the raw water in an open section of the channel leading to the first raw water reservoir	**T1:**	Potential of microbiological growth in the distribution network as a result of no disinfection being practised at present. A new gas chlorination system has just been installed, mitigating this risk.	**D1:**	Frequent interruption in water supply to Bergsig when pipe through the Wilgehoude River breaks during high flows in the river
C2:	Raw water pipelines at risk of pipe failures in future (but has not failed in recent years)	**T2:**	Screens before chlorination room sometimes blocks, resulting in reduced flow to the on-site reservoir. The screens are difficult to clean by hand	**D2:**	Interruptions in water suply and contamination of water in network due to valves and fire hoses used for flushing being old. Needs upgrading
C3:	Erosion of embankments causing clay to flow into the raw water canals	**T3:**	No way to ensure probable microbiological safety because chlorine not used as disinfectant	**D3:**	Interruption in water supply and ingress of dirt in the network as a result of pipe failure caused by tree roots

T4:	Turbidity of treated water exceeding the requirements of SANS 241 due to there being no filtration step in the treatment works
T5:	Rainfall in catchment results in high turbidities of the raw water

6. RISK MANAGEMENT

6.1 Control measures to mitigate the risks

For each of the risks identified above, control measures were also identified which should be implemented to mitigate the risks, in order to ensure that the risks are reduced or eliminated. According to the guidelines provided in the WRC Report TT415 (Thompson and Majam, 2009), risk items falling in the high risk zone require immediate attention, while items in the medium risk zone should also receive due attention (albeit not as urgently as those items in the high risk zone)(see chart below taken from the WRC report).

SCORE	RISK PROFILE
0 – 10	**Low** These are systems that operate with minor deficiencies. Usually the systems meet the water quality parameters specified by the appropriate guidelines (SANS 241: 2006)
11 – 56	**Medium** These are systems with deficiencies which individually or combined pose a high risk to the quality of water and human health. These systems would not generally require immediate action, but the deficiencies could be more easily corrected to avoid future problems.
57 - 100	**High** These are systems with major deficiencies which individually or combined pose a high risk to the quality of water and may lead to potential health and safety or environmental concerns. Once systems are classified under this category, immediate corrective action is required to minimize or eliminate deficiencies.

In the tables below, proposed control measures are provided (in order of priority from the highest risk to the lowest risk) for high and medium risks that were identified. The municipality should, however, in their operational programmes and planning sessions, also look at the low risks that were identified (minor deficiencies), with the aim of eliminating these where feasible.

LAINGSBURG RISK MITIGATION CONTROL MEASURES

Existing Risks	Risk Rating	Proposed Control Measures	Monitoring of Proposed Control Measures	Operational Parameters and/or Limits
CATCHMENT				
Possible contamination of the raw water in an open section of the channel leading to the first raw water reservoir	**10**	Ensure that fencing is in good condition	Do thorough inspection of all fencing on a monthly basis	Visual inspections
Raw water pipelines at risk of pipe failures in future (but has not failed in recent years)	**4**	Do regular pipeline inspections and replace sections that are at high risk of failing	Do inspections on a six-monthly basis	Pipeline inspections
Erosion of embankments causing clay and suspended material to flow into the raw water canals	**14**	Stabilize embankments. Provide gabions where necessary	Annual inspection of all embankments	Visual inspections
TREATMENT				
Potential of microbiological growth in the distribution network as a result of no disinfection being practised at present. A new gas chlorination system has just been installed, mitigating this risk.	**14**	Ensure that chlorination is performed continuously when water is pumped to the distribution network	Measure free chlorine residuals	Maintain free chlorine residuals at around 0,3 – 0,5 mg/L
Screens before chlorination room sometimes blocks, resulting in reduced flow to the on-site reservoir. The screens are difficult to clean by hand	**10**	Replace the screens in the medium term with self cleaning screeds	Ensure regular cleaning of screens until self-cleaning screens are installed	Cleaning register

No way to ensure probable microbiological safety because chlorine not used as disinfectant	**14**	Already converting to chlorination for disinfection	Measure free chlorine residuals	Maintain free chlorine residuals at around 0,3 – 0,5 mg/L
Turbidity of treated water exceeding the requirements of SANS 241 due to there being no filtration step in the treatment works	**14**	Monitor turbidity levels in the raw water on a regular basis. If the high turbidity incidences increases, provide chlorination and dosing facilities at the treatment plant	Monitor turbidity levels in raw water	If more than 3 NTU for prolonged periods, consider installing filtration system (membranes or sand filters)
Rainfall in catchment results in high turbidities of the raw water	**14**	Monitor turbidity levels in the raw water on a regular basis. If the high turbidity incidences increases, provide chlorination and dosing facilities at the treatment plant	Monitor turbidity levels in raw water	If more than 3 NTU for prolonged periods, consider installing filtration system (membranes or sand filters)
DISTRIBUTION				
Frequent interruption in water supply to Bergsig when pipe through the Wilgehoude River breaks during high flows in the river	**56**	Provide a permanent crossing for the pipeline accross the river that is not subject to damage by floods	Pipeline inspection	Visual inspection
Interruptions in water supply and contamination of water in network due to valves and fire hoses used for flushing being old. Needs upgrading	**35**	Replace old valves and fire hoses	Regular valve and fire hose inspection	Pipeline inspection
Interruption in water supply and ingress of dirt in the network as a result of pipe failure caused by tree roots	**10**	Remove encroaching roots on a regular basis	Regular inspection of possible problems with roots	Visual inspections

Conclusions

A number of significant risks that were identified as having been evident in the recent past have been addressed or is in the process of been addressed. This includes the provision of a new chlorination system at the Laingsburg main reservoir, to ensure a microbiologically safe water in the town on a consistent basis. It will be imperative that chlorination system be operated and maintained according to strict program to reduce the risk of ineffective disinfection due to blockages in the chlorination system pipelines, empty chlorine cylinders, faulty chlorinators or too high or too low chlorine dosages been applied. Further upgrading reducing the former risks are replacement of old infrastructure in Laingsburg (flushing systems and valves), and replacement of old pipelines in Matjiesfontein.

The pipeline crossing the river that is often broken during periods of strong water flow in the river constitutes a high risk, emanating from water supply interruptions to the Bergsig suburb. This should be addressed by providing a permanent solution by the civil consulting engineers of the municipality.

An operational monitoring program should be designed and implemented to ensure that the necessary settings at the water treatment works are checked daily and adjustments made as may be necessary.

The operational personnel should receive training on an on-going basis to ensure that operational and compliance monitoring programmes are carried out diligently, and that sufficient and safe water is provided to the consumers of Laingsburg on a continuous basis.

ACKNOWLEDGEMENTS

The authors wish to thank Mr N Klink and Ms A Groenewald for facilitation of the process of developing and drawing up the Water Safety and Security Plan for Laingsburg Municipality. The inputs of all the personnel during the assessments that were performed at the three water supply systems are gratefully acknowledged, in particular the arrangements and information supply by Mr N Klink, Ms Groenewald and the supervisors of the water supply systems.

Noel Klink	Head Technical Department	Laingsburg / Matjiesfontein
Alida Groenewald	CFO	Laingsburg Municipality
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Jacobus Pieters	Operator	Laingsburg / Matjiesfontein

CD Swartz, Chris Swartz Water Utilization Engineers (Project Leader)

June 2010

WATER SAFETY AND SECURITY PLAN FOR LAINGSBURG WATER SUPPLY SYSTEM

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WATER SAFETY AND SECURITY PLAN FOR LAINGSBURG

1. INTRODUCTION: AIMS AND SCOPE

The Department of Water Affairs (DWA), as the national custodian of South Africa's water resources and the overall leader of the water sector, is responsible for the regulation of water services. Drinking Water Quality is an area of water services regulation where significant progress has recently been made. However, current investigations have indicated that despite considerable improvements, there is still an unacceptably high incidence of poor drinking water quality in South Africa. The objective of this project was to prepare the first Water Safety and Security Plan for the Laingsburg Municipality. The DWA will be using the WSSP as one of the criterion for the Blue Drop Assessment of the water quality in all water supply areas in South Africa from 2010.

Water Safety and Security Plans (WSSP) have been adopted as a tool to fulfill the objective by ensuring the safety of drinking water supply through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in a water supply system from catchment to consumer. WSSP includes three key components as proposed by the World Health Organisation (2009):

System assessment – determines whether the drinking water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets.

Identifying control measures in a drinking water system that will collectively control identified risks and ensure that health based targets are met. For each control measure identified, an appropriate means of operational monitoring should be defined that will ensure that any deviation from the required performance is rapidly detected in a timely manner.

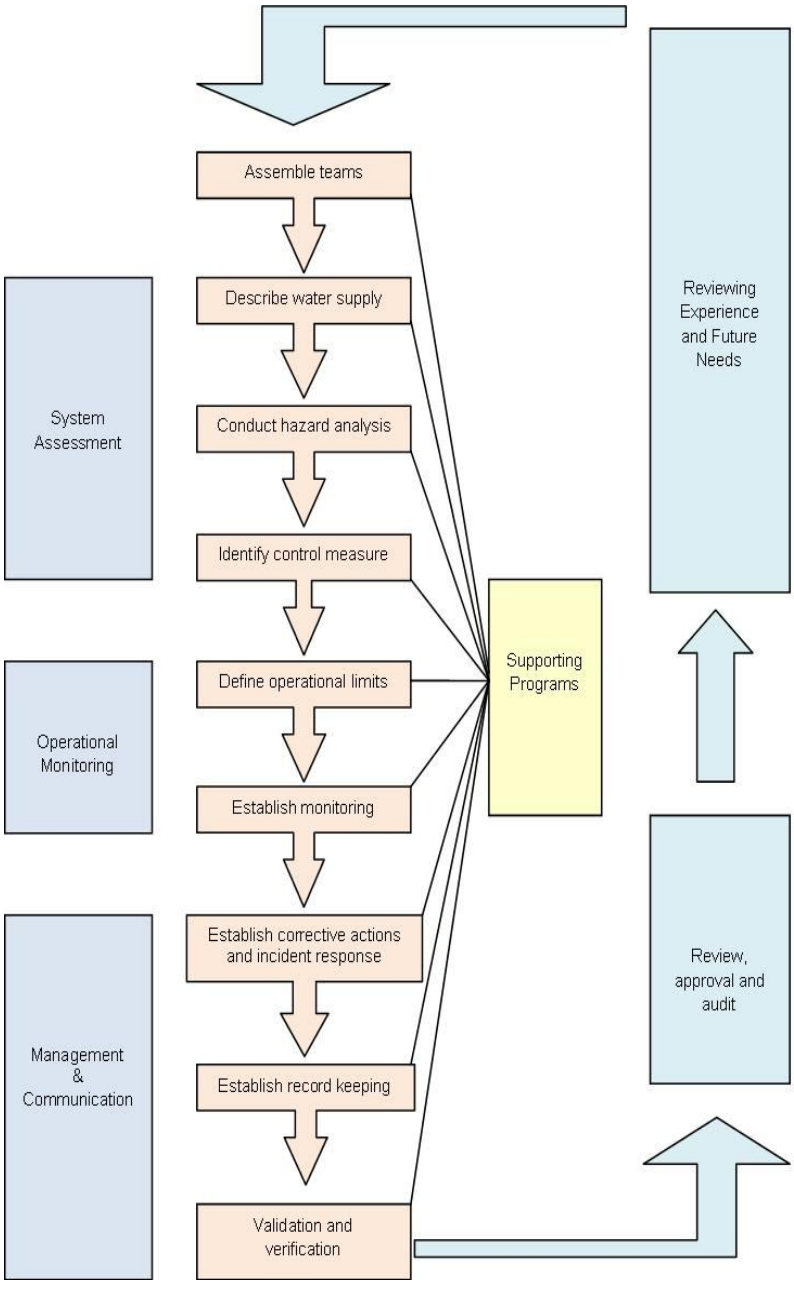
Management plans that describe actions to be taken during normal operation or incident conditions, and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes.

The WSSP for Laingsburg Municipality was developed for the following water supply systems within the jurisdictional area of the municipality:

- Laingsburg Water Supply System
- Matjiesfontein Water Supply System

2. METHODOLOGY

The sequential steps that were followed in developing the WSSP is in accordance with the procedure proposed by the World Health Organisation (WHO)(2005), which is presented below in the form of a flow diagram:



3. WATER SAFETY PLAN TEAM FOR THE LAINGSBURG MUNICIPALITY

A team was assembled from all of the water supply operations and maintenance managers and supervisors of the Laingsburg Municipality. A first meeting of the Laingsburg WSSP team was held at the Laingsburg Municipality Council Chambers in Laingsburg on 15 January 2010, during which the project team did a presentation to provide the aims, methodology and action plans for drawing up the WSSP for the Laingsburg Municipality. The team members were as follows:

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Chris Swartz	Project Leader	Chris Swartz Eng	082 820 4481	cswartz@mweb.co.za

4. DESCRIPTION OF THE LAINGSBURG WATER SUPPLY SYSTEM

Water supply to Laingsburg and Matjiesfontein is obtained from two independent water supply schemes and also delivered by two independent water distribution systems. The Laingsburg Water Supply System is described below (the Matjiesfontein Water supply System is described in the ***Water Safety and Security Plan for Matjiesfontein*** – a separate document).

Laingsburg is reliant on surface water sources as well as groundwater sources. The surface water is supplied from the Zoutkloof and Buffels River, while a number of groundwater sources consitute the rest of the water supply. Raw water from the Zoutkloof is stored in a 1 ML raw water reservoir, from where it flows to the Laingsburg Water Treatment Works via a 12 km pipeline, ranging from 75 mm diameter to 275 mm diameter. Water is pumped from the two The treatment works is located in town (on the north-western side) and consists of three in-line screens and an ozonation system for disinfection. The screens are manually cleaned (three times per week in summer, twice per week in winter). From the treatment works the water is distributed to the consumers.

Four bulk storage reservoirs with capacities of 1.0 ML, 1.0 ML, 0.296 ML and 0.394 ML are used for storage of the treated water, thus giving a total water storage of 2.690 ML. The reticulation system consists of a total of 25.225 km of pipework, ranging from less than 45 mm diameter to 275 mm diameter.

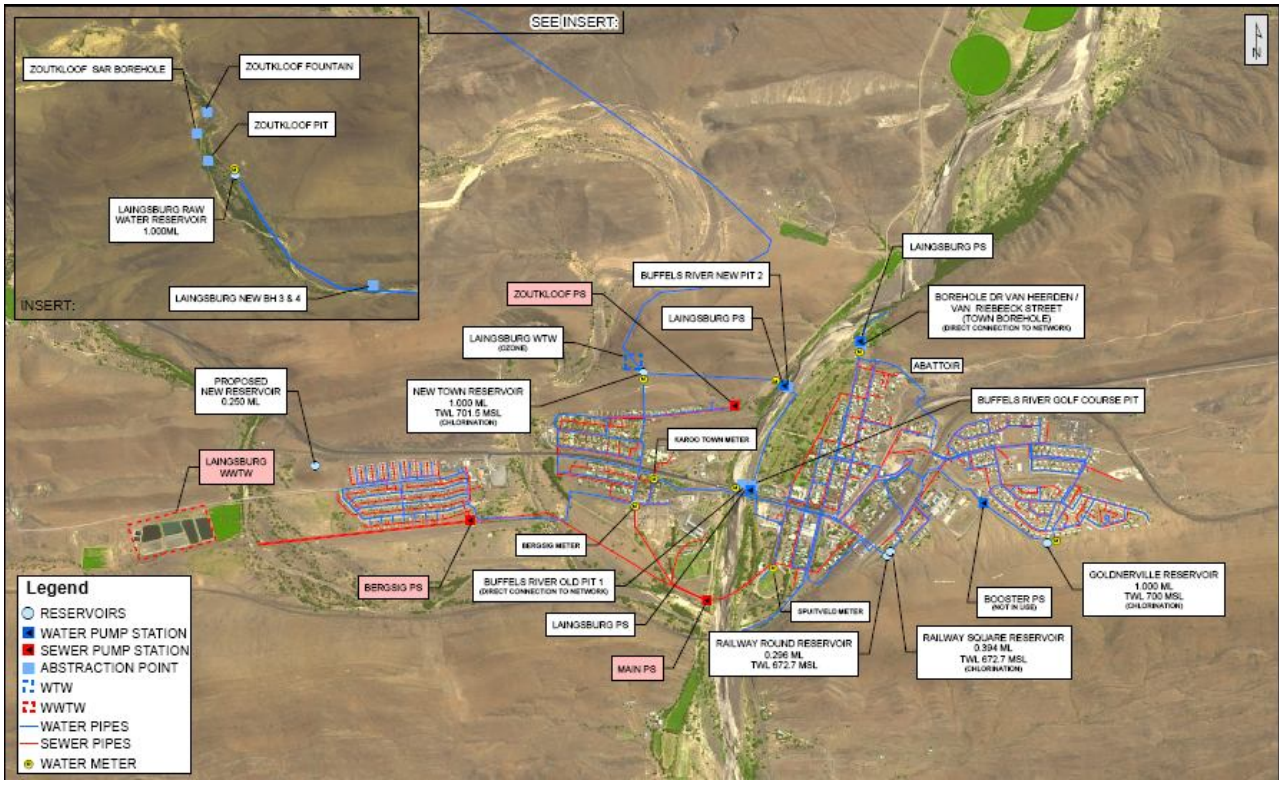
The total water supply system is shown on the map and flow diagram on the next page.

Provision has been made in 2006 for chlorination of the water at the Railway and Goldner reservoirs; However, these facilities are not currently in use.

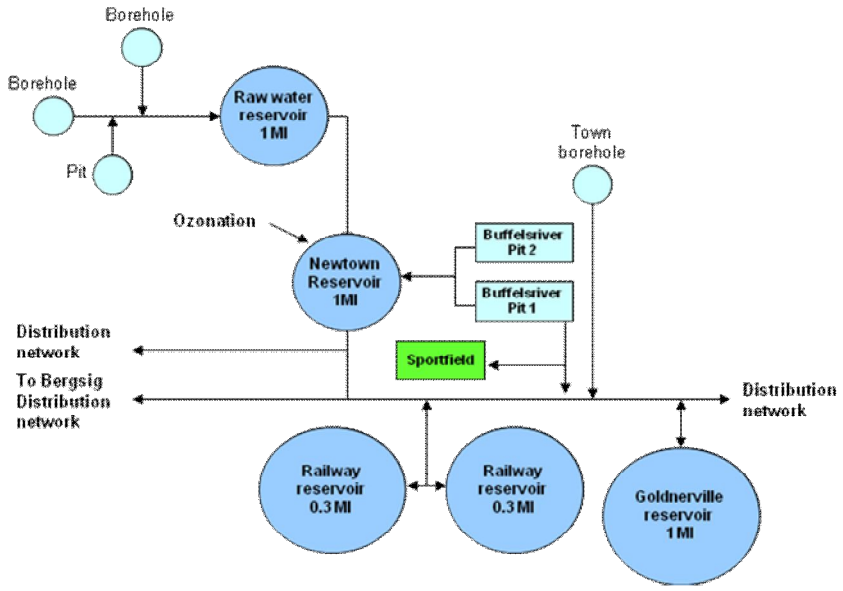
The water sources (springs, weirs, open canals) are protected with fencing, but not security fencing, to prevent vandalism or pollution of the sources; however, during periods of rainfall, soil erosion takes place which could cause a deterioration in the quality of the surface water. The surface water is also subject to possible pollution by game (steenbuck and duikers), as well as baboons.

The asbestos-cement pipes in first sections of the raw water supply pipeline has been provided in 1982, and no problems with pipe failures have been experienced to date. 20 new air release valves were installed in 2009.

The ozonation system will be replaced by a gas chlorination system. The facilities for this has already been provided at the water treatment plant (booster pump installed, safety equipment in place, only extractor fan still required). The ozonation system was not in operation during the plant visit.



Laingsburg Water Supply System Flow Diagram



Final water quality

The percentage compliance of the water quality samples taken during the months of July 08 to June 09, as loaded onto DWA's DWQM system, was as follows:

- E.Coli (Health), Sample Count 61, Compliance 91.8%

  (Western Cape Compliance 98.6%)

- Total Coliforms (Operational), Sample Count 65, Compliance 78.5%

  (Western Cape Compliance 95.0%)

- pH (Aesthetic/Operational), Sample Count 69, Compliance 98.6%

  (Western Cape Compliance 97.9%)

- Turbidity (Aesthetic/Operational/Indirect Health), Sample Count 33, Compliance 18.2% (Western Cape Compliance 80.4%)

- Electrical Conductivity (Aesthetic), Sample Count 61, Compliance 100%

  (Western Cape Compliance 99.5%)

From these results, it can be seen that the compliance with turbidity requirements for the drinking water in Laingsburg was not good during the aforementioned period, which is the result of there being no chemical dosing and sand filtration at the treatment plant. The screens on its own cannot remove the turbidity (fine colloidal matter/clay). While turbidity on its own does not present a direct health implication, the more important consequence of high turbidity levels in the water being disinfected (whether it be by ozonation or chlorination) is that it detrimentally affects the efficiency to kill the pathogens that may be present in the water, and thereby causing a potential health hazard.

The Blue Drop results for 2009 substantiates this problem, as may be seen by the DWQ compliance of only an E grading and overall score of 44.5% for Laingsburg Water Supply System. The results are summarized below (WSDP, November 2009).

Average Blue Drop Score	57.6%	Average DWQ Compliance	96.15%
Regulatory Impression: The Department notes the commendable improvement LM has made since the initial assessment in November 2008. It should be noted that Process Controlling, appropriate laboratory usage and incident preparedness still requires improvement.			

BLUE DROP REPORT CARD		
Criteria	**Laingsburg**	**Matjiesfontein**
Process Controlling	E	E
DWQ Monitoring Programme Efficiency	A	B
Credibility of Sample Analysis	D	D
Regular submission of DWQ data to DWA	A	A
DWQ compliance	E	A
Response to failures	G	G
Blue Drop Score	44.5%	70.7%
Actual DWQ compliance with Health Parameters of the National Standard	93.3%	99%

In 2010, the Blue Drop Results achieved by the Laingsburg Municipality were as follows:

Water Services Authority: **Laingsburg Local Municipality**

Water Services Provider: **Laingsburg LM**

Municipal Blue Drop Score: 63.9%

Water Supply Systems Blue Drop Performance

Performance Area	Systems	Laingsburg	Matjiesfontein
Water Safety Plan		F	F
Process Control & Maintenance Competency		B	B
Efficiency of Monitoring Programme		C	C
Credibility of Sample Analyses		B	B
Data Submission to DWA		B	B
Compliance with National Standard		G	G
Failure Response Management		A	A
Responsible Publication of Performance		B	B
Efficacy of Asset Management		A	A
Microbial DWQ Compliance with National Standard		86.84%* 12 months data	86.84%* 12 months data
Chemical DWQ Compliance with National Standard		99.99%* 02 months data	99.99%* 02 months data
Blue Drop Score (2010) + Trend		63.13% ↑	64.63% ↓
Blue Drop Score (2009)		*44.5%*	*70.7%*

* Compliance determined from Municipal Overview

As can be seen from the results, there are still shortcomings in the water quality compliance with the national standards. These results relate largely to turbidity and occasional microbiological non-compliance (E.Coli) (see Annexure K), due to disinfection shortcomings and quality of the water that is ozonated (because of turbidity levels exceeding the requirements). It is, however, encouraging to see that the Blue Drop Score has increased from 44.5% to 63.13%.

Annexures J and K contains results of chemical and microbiological analyses by BEMLAB and Swift Micro Laboratories, respectively, at the following sampling points:

- Soutkloof Spring
- Main Reservoir
- School Reservoir
- Goldnerville Reservoir
- School Tap
- Bergsig Tap
- Municipal tap
- Goldnerville House

Human Resources: Personnel in the Laingsburg Municipality Water Section

The following persons are employed in the water section of the Laingsburg Municipality.

Water Works	Class of Works	Personnel Qualification Level (and number of personnel on that level)	Full-time Process Controllers	Full-time Process Controllers required
Laingsburg		Process Controllers: NQF2 (2) (Martin Visagie; Martin Hermanus) Process Controllers: Unclassified (4) (Andries Spannenberg; Hendrik Pieterse; Frederik Lukas; Jacobus Pieters)	3	4
Matjiesfontein		Process Controllers: NQF2 (1) (Martin Hermanus) Process Controllers: Unclassified (3) (Abraham Afford; Hendrik Pieterse; Jacobus Pieters)	1	1

5. RISK ASSESSMENT

5.1 Identification of hazards and hazardous events

During the assessment of the water supply systems and discussions with the municipality's technical personnel, a number of hazard and/or hazardous events were identified. These hazards were then classified according to the type of hazard that it represents, the specific risks that are associated with the hazards, and the risk type, i.e. a health risk or aesthetical risk.

The hazards that were identified for Laingsburg, and its classification, are summarized in the table below.

LAINGSBURG WATER SUPPLY SYSTEM

COMPONENT	HAZARDOUS EVENT (Hazard)	TYPE OF HAZARD	RISK (Consequence)	RISK TYPE
CATCHMENT	Pollution of raw water sources (surface water sources) by wild animals	Biological	Poor quality inlet water may lead to health risk of final water	Health
	Pollution of raw water by animals in the open conveyance channels	Biological	Poor quality inlet water may lead to health risk of final water	Health
	Erosion of embankments causing clay and suspended material to flow into the raw water canals	Physical	Increased turbidity in the raw water flowing into the treatment plant	Aesthetic Health
	Raw water pipelines at risk of pipe failures in future (but has not failed in recent years)	Unavailability	Lack of adequate quantity of water	Health Economic
TREATMENT	Turbidity of treated water exceeding the requirements of SANS 241 due to there being no filtration step in the treatment works	Physical	Turbidity in final water and risk of illness from ingestion of harmful micro-organisms due to ineffective disinfection	Health Aesthetical
	Failure of ozonation system (faulty equipment) or inadequate ozone generation to properly disinfect the	Chemical	Microbiologically unsafe water due to ineffective disinfection, leading to infection by harmful	Health

	water		organisms. May lead to serious gastro problems and even death	
	No way to ensure probable microbiological safety because chlorine not used as disinfectant	Biological	Possible infection of consumers by pathogens in water because unknown disinfection residual status	Health
	Screens difficult to clean, leading to unsatisfactory cleaning from time to time	Unavailability	Blockages restricts the water flow and causes water shortages in the reservoirs, especially during the summer months	Health Economic
	Rainfall in catchment results in high turbidities of the raw water	Physical	Inadequate disinfection and possible infection of consumers using the water	Health
	Newtown borehole is not properly fenced, and the submersible pump is not secured	Mechanical Physical	The borehole may be polluted, sabotaged or vandalized, resulting in health hazards or unavailability of water	Economical Health
DISTRIBUTION	Pipeline from Soutkloof Reservoir to Main Resrvoir (Hoofreservoir) has failed on two occasions where it crosses the river – but it has now been cast in concrete	Unavailability	No water at reservoirs, and subsequently also not at the consumers	Health Economic
	Vandalism and theft of fencing at the Goldnerville Reservoir	Physical	The reservoir water may be polluted and/or the reservoir sabotaged or vandalized, resulting in health hazards or unavailability of water	Economical Health
	Buffels River Old Pit 1 covered by sand when high flow occurs in the river, and needs to be cleaned by hand	Unavailability	Back-up water supply from this pit not available, which may lead to water shortages during peak periods	Health
	Frequent interruption in water supply to Bergsig when pipe through the Wilgehoude River breaks during high flows in the river	Unavailability	Water shortages in Bergsig, leading to unhygienic conditions	Health
	Interruption in water supply and ingress of dirt in the network as a result of pipe failure caused by tree roots	Physical Unavailability	Interruption and concomitant shortages at certain residential areas	Health Aesthetical

	Interruptions in water suply and contamination of water in network due to valves and fire hoses used for flushing being old	Biological Unavailability	Water shortages in Bergsig, leading to unhygienic conditions	Health Economical

5.2 Assessment and evaluation of the risks

Following the identification of the hazards by the project team, the likelihood of each event occurring, and the actual (based on history) or potential consequences of such an event occurring, was quantified, using the following the risk rating scores:

LIKELIHOOD	RATING	CONSEQUENCE	RATING
Almost certain (once a day or permanent feature)	1.0	Catastrophic (Death expected from exposure)	100
Likely (once per week)	0.8	Major (Population exposed to significant illness)	70
Moderately likely (once per month)	0.5	Moderate (moderate impact to large population)	20
Unlikely (once per year)	0.2	Minor (minor impact to large population)	2
Rare (1 in 5 years)	0.1	Insignificant (No impact)	1

The risk rating was then obtained by multiplying the Likelihood score (L) with the Consequence score (C), to give a value of between 0.1 and 100.

The risk ratings that were estimated and calculated for Laingsburg is shown below.

LAINGSBURG RISK RATING

COMPONENT	HAZARDOUS EVENT (Hazard)	Control measure/s in place	Control measure effective (Y/N)?	Likelihood (L)	Conse-quence (C)	Risk Rating (L x C)
CATCHMENT	Pollution of raw water sources (surface water sources) by wild animals	Partial	Partial	0.1	20	2
	Pollution of raw water by animals in the open conveyance channels	Partial	Partial	0.5	20	10
	Erosion of embankments causing clay and suspended material to flow into the raw water canals	No		0.2	70	14
	Raw water pipelines at risk of pipe failures in future (but has not failed in recent years)	No		0.2	20	4
TREATMENT	Turbidity of treated water exceeding the requirements of SANS 241 due to there being no filtration step in the treatment works	No		0.2	70	14
	Failure of ozonation system (faulty equipment) or inadequate ozone generation to properly disinfect the	Yes, converting to chlorination	Yes	0.2	70	14

	water					
	No way to ensure probable microbiological safety because chlorine not used as disinfectant	Yes, converting to chlorination	Yes	0.2	70	14
	Screens difficult to clean, leading to unsatisfactory cleaning from time to time	No		0.2	20	4
	Rainfall in catchment results in high turbidities of the raw water	No		0.2	70	14
	Newtown borehole is not properly fenced, and the submersible pump is not secured	No		0.2	20	4
DISTRIBUTION	Pipeline from Soutkloof Reservoir to Main Resrvoir (Hoofreservoir) has failed on two occasions where it crosses the river – but it has now been cast in concrete	Yes	Yes	0.1	70	7
	Vandalism and theft of fencing at the Goldnerville Reservoir	No		0.2	2	0.4
	Buffels River Old Pit 1 covered by sand when high flow occurs in the river, and needs to be cleaned by hand	Partial	Yes	0.2	20	4
	Frequent	Partial	Only partial	0.8	70	56

	interruption in water supply to Bergsig when pipe through the Wilgehoude River breaks during high flows in the river					
	Interruption in water supply and ingress of dirt in the network as a result of pipe failure caused by tree roots	Partial	Yes	0.5	20	10
	Interruptions in water suply and contamination of water in network due to valves and fire hoses used for flushing being old	No		0.5	70	35

In this section, the results of the risk identification and risk evaluation of the Laingsburg Water Supply System are summarised in the form of risk matrices, in which the likelihood of the risks taken place is plotted on a matrix against the perceived consequence of that risk. The matrices provide in a user-friendly colour-coded format an indication of the main risks (existing or potential) of the different water supply systems and water treatment plants, and where these risks lie in relation to the importance of the risks (high, medium and low risks).

LAINGSBURG WATER SUPPLY SYSTEM RISK MATRIX

CONSEQUENCE

(increasing consequence/severity)

LIKELIHOOD (increasing likelihood/frequency)	Insignificant consequence (no impact)	Minor consequence (small)	Moderate consequence (considerable)	Major consequence (severe)	Catastrophic consequence
Very high (almost certain)					
High (likely)				D1	
Moderate (possible)			C1; T2; D3	D2	
Low/occassional (unlikely)			C2	C3; T1; T3 T4; T5	
Very low/rare (has not occured)					

CATCHMENT AND RAW WATER SOURCE		TREATMENT, DESIGN AND OPERATION		DISTRIBUTION	
C1:	Possible contamination of the raw water in an open section of the channel leading to the first raw water reservoir	**T1:**	Potential of microbiological growth in the distribution network as a result of no disinfection being practised at present. A new gas chlorination system has just been installed, mitigating this risk.	**D1:**	Frequent interruption in water supply to Bergsig when pipe through the Wilgehoude River breaks during high flows in the river
C2:	Raw water pipelines at risk of pipe failures in future (but has not failed in recent years)	**T2:**	Screens before chlorination room sometimes blocks, resulting in reduced flow to the on-site reservoir. The screens are difficult to clean by hand	**D2:**	Interruptions in water suply and contamination of water in network due to valves and fire hoses used for flushing being old. Needs upgrading
C3:	Erosion of embankments causing clay and suspended material to flow into the raw	**T3:**	No way to ensure probable microbiological safety because chlorine not used as disinfectant	**D3:**	Interruption in water supply and ingress of dirt in the network as a result of pipe

	water canals				failure caused by tree roots
		T4:	Turbidity of treated water exceeding the requirements of SANS 241 due to there being no filtration step in the treatment works		
		T5:	Rainfall in catchment results in high turbidities of the raw water		

6. RISK MANAGEMENT

6.1 Control measures to mitigate the risks

For each of the risks identified above, control measures were also identified which should be implemented to mitigate the risks, in order to ensure that the risks are reduced or eliminated. According to the guidelines provided in the WRC Report TT415 (Thompson and Majam, 2009), risk items falling in the high risk zone require immediate attention, while items in the medium risk zone should also receive due attention (albeit not as urgently as those items in the high risk zone)(see chart below taken from the WRC report).

SCORE	RISK PROFILE
0 – 10	**Low** These are systems that operate with minor deficiencies. Usually the systems meet the water quality parameters specified by the appropriate guidelines (SANS 241: 2006)
11 – 56	**Medium** These are systems with deficiencies which individually or combined pose a high risk to the quality of water and human health. These systems would not generally require immediate action, but the deficiencies could be more easily corrected to avoid future problems.
57 - 100	**High** These are systems with major deficiencies which individually or combined pose a high risk to the quality of water and may lead to potential health and safety or environmental concerns. Once systems are classified under this category, immediate corrective action is required to minimize or eliminate deficiencies.

In the tables below, proposed control measures are provided (in order of priority from the highest risk to the lowest risk) for high and medium risks that were identified. The municipality should, however, in their operational programmes and planning sessions, also look at the low risks that were identified (minor deficiencies), with the aim of eliminating these where feasible.

LAINGSBURG RISK MITIGATION CONTROL MEASURES

Existing Risks	Risk Rating	Proposed Control Measures	Monitoring of Proposed Control Measures	Operational Parameters and/or Limits
CATCHMENT				
Possible contamination of the raw water in an open section of the channel leading to the first raw water reservoir	**10**	Ensure that fencing is in good condition	Do thorough inspection of all fencing on a monthly basis	Visual inspections
Raw water pipelines at risk of pipe failures in future (but has not failed in recent years)	**4**	Do regular pipeline inspections and replace sections that are at high risk of failing	Do inspections on a six-monthly basis	Pipeline inspections
Erosion of embankments causing clay and suspended material to flow into the raw water canals	**14**	Stabilize embankments. Provide gabions where necessary	Annual inspection of all embankments	Visual inspections
TREATMENT				
Potential of microbiological growth in the distribution network as a result of no disinfection being practised at present. A new gas chlorination system has just been installed, mitigating this risk.	**14**	Ensure that chlorination is performed continuously when water is pumped to the distribution network	Measure free chlorine residuals	Maintain free chlorine residuals at around 0,3 – 0,5 mg/L
Screens before chlorination room sometimes blocks, resulting in reduced flow to the on-site reservoir. The screens are difficult to clean by hand	**10**	Replace the screens in the medium term with self cleaning screeds	Ensure regular cleaning of screens until self-cleaning screens are installed	Cleaning register

No way to ensure probable microbiological safety because chlorine not used as disinfectant	**14**	Already converting to chlorination for disinfection	Measure free chlorine residuals	Maintain free chlorine residuals at around 0,3 – 0,5 mg/L
Turbidity of treated water exceeding the requirements of SANS 241 due to there being no filtration step in the treatment works	**14**	Monitor turbidity levels in the raw water on a regular basis. If the high turbidity incidences increases, provide chlorination and dosing facilities at the treatment plant	Monitor turbidity levels in raw water	If more than 3 NTU for prolonged periods, consider installing filtration system (membranes or sand filters)
Rainfall in catchment results in high turbidities of the raw water	**14**	Monitor turbidity levels in the raw water on a regular basis. If the high turbidity incidences increases, provide chlorination and dosing facilities at the treatment plant	Monitor turbidity levels in raw water	If more than 3 NTU for prolonged periods, consider installing filtration system (membranes or sand filters)
DISTRIBUTION				
Frequent interruption in water supply to Bergsig when pipe through the Wilgehoude River breaks during high flows in the river	**56**	Provide a permanent crossing for the pipeline accross the river that is not subject to damage by floods	Pipeline inspection	Visual inspection
Interruptions in water supply and contamination of water in network due to valves and fire hoses used for flushing being old. Needs upgrading	**35**	Replace old valves and fire hoses	Regular valve and fire hose inspection	Pipeline inspection
Interruption in water supply and ingress of dirt in the network as a result of pipe failure caused by tree roots	**10**	Remove encroaching roots on a regular basis	Regular inspection of possible problems with roots	Visual inspections

6.2 Monitoring of control measures

Each control measure will be monitored to enable effective system management and to ensure that health-based targets are achieved. The parameters selected for operational monitoring will reflect the effectiveness of each control measure, provide a timely indication of performance, be readily measured and provide opportunity for an appropriate response.

The monitoring methods are also provided in the table above.

Monitoring is the act of conducting a planned series of observations or measurements of operational and/or critical limits to assess whether the components of the water supply are operating properly. The objectives of operational monitoring are for the drinking water supplier to monitor each control measure in a timely manner to enable effective system management and to ensure that health-based targets are achieved.

The parameters selected for operational monitoring of the Laingsburg WSP control measures have been drawn up to:

- reflect the effectiveness of each control measure
- provide a timely indication of performance
- be readily measured
- provide opportunity for an appropriate response

The control measures, as proposed in the table above, should be closely monitored, especially in the early stages of the WSP, in order to ensure that any problems that have been identified are rectified as quickly as possible.

The strategies and procedures for monitoring the various aspects of the water supply system should be documented.

The frequency of operational monitoring is generally dependent on population size.

6.3 Verification and validation of control measures

Verification, in addition to operational monitoring of the performance of the individual components of a drinking water system, is necessary to ensure that the system as a whole is operating safely. Verification may be undertaken by the Water Service Provider, the Water Service Authority, an independent authority or by a combination of these.

Verification provides a mechanism by which the water supplier and surveillance body are able to check whether the system is delivering water that meets safety requirements. Verifying performance requires assessment of a range of performance indicators. Verification will involve both operational audit and water quality analyses using a range of index organisms.

Operational audit should include the systematic review of operational procedures and documentation to ensure that the WSP is working. During the audit, operational records of all treatment processes and distribution system maintenance should be reviewed to assess whether they exhibit the requirements for each component of the system. In addition, spot checks in the field should be carried out. A key element of the audit process is to identify when monitoring results show deviation from critical limits and what operational shortcomings may have been the cause. The audit should identify shortcomings in the overall WSP and identify modifications and improvements required for the WSP.

7. ACTION POINTS FOR IMPROVEMENT AND UPGRADING

7.1 Mitigation of medium and high risks

The main findings of the risk assessment for Laingsburg are indicated in the table below. This includes a listing of the existing risks and rating of the risks into risk categories (high risk, medium risk and low risk), recommendations on how to address the risks (risk reduction measures), the responsible persons for performing the risk reduction measures, and the time frames within which this will be performed.

LAINGSBURG WATER SUPPLY SYSTEM:
MAIN EXISTING RISKS AND RECOMMENDED CONTROL MEASURES

Existing Risks	Risk Rating	Recommendations	Responsibility	Timeframe for implementation of mitigation measures
CATCHMENT				
Possible contamination of the Laingsburg raw water in an open section of the channel leading to the first raw water reservoir	**10**	This is a low risk, and may be managed by visual inspections and by frequent monitoring of the quality of the water feed to the raw water reservoirs	Foremen Process Controllers	On-going
Raw water pipelines (Laingsburg) at risk of pipe failures in future (but has not failed in recent years)	**4**	Low risk, no action required	Mr Klink	None required at present

Existing Risks	Risk Rating	Recommendations	Responsibility	Timeframe for implementation of mitigation measures
TREATMENT				
Potential of microbiological growth in the Laingsburg distribution network as a result of no disinfection being practised at present. A new gas chlorination system has just been installed, mitigating this risk.	**14**	This has already been addressed by the recent provision of a new chlorination system. The performance and safety measures should be inspected frequently	Mr Klink	Immediate and on-going
Screens before chlorination room in Laingsburg sometimes blocks, resulting in reduced flow to the on-site reservoir. The screens are difficult to clean by hand	**10**	Draw up a scheduled cleaning program for the screens, and ensure that the program is adhered to	Mr Klink	Immediate and on-going

Existing Risks	Risk Rating	Recommendations	Responsibility	Timeframe for implementation of mitigation measures
DISTRIBUTION				
Frequent interruption in water supply to Bergsig when pipe through the Wilgehoude River breaks during high flows in the river	**56**	Provide a permanent pipe crossing of the river which is not subject to the forces excerted by flooding water	Mr Klink Ms Groenewald Council to provide funding	12 months
Interruptions in water supply and contamination of water in Laingsburg	**35**	This is currently being upgraded. The upgrading programme should be	Mr Klink Ms Groenewald	Work already in progress

network due to valves and fire hoses used for flushing being old. Needs upgrading		comprehensive and include infrastructure in all sections of the town		
Interruption in water supply and ingress of dirt in the network as a result of pipe failure caused by tree roots in Laingsburg	**10**	This should be repaired when it occurs, or when it is evident that pipe failures will result in the near future	Foreman	On-going

8. VERIFICATION OF THE EFFECTIVENESS OF THE WSSP

To ensure that it working properly, it is essential to have a formal process for verification and auditing of the WSSP. Verification involves the following three activities which are taken together to provide evidence that the WSSP is working effectively (WHO, 2009):

- Operational monitoring (regular internal monitoring and periodic external auditing)
- Compliance monitoring
- Consumer satisfaction

Verification should provide the evidence that the overall system design and operation is capable of consistently delivering water complying with the specifications of SANS 241 to meet health-based targets. This is in accordance with the requirements of the Blue Drop Program of the Department of Water Affairs.

Water Quality:

The following implementation strategies have already been set by Laingsburg Municipality with regard to improving the operational and compliance water quality management (WSDP, 2009):

- Implement the required Water Quality Sampling Programmes at the two towns.
- Continue with the upgrading of the Laingsburg Water Treatment Works when necessary, in order to reduce the risk of source contamination (provision of filtration system in future). The water treatment works will need to be managed and operated to comply with the permitted standards.
- The municipality is committed to manage and operate sewage pump stations effectively to prevent any possible spillages.
- Provide the necessary training to the waterworks operators and ensure that fully qualified personnel are in control of the Laingsburg Water Treatment Works.
- Regular sampling of the water quality within the distribution networks of Laingsburg and Matjiesfontein and loading the results onto DWA's DWQM system, with support from the Central Karoo District Municipality.
- Develop a formal pollution contingency plan for all possible point and diffuse sources of pollution.

Operational monitoring (regular internal monitoring and periodic external auditing)

Rigorous monitoring and audits help to maintain the practical implementation of the WSSP, ensuring that water quality and risks are controlled. The operational monitoring should be done on a daily basis by the water section personnel of the municipality (water source, treatment and distribution network personnel), whilst the external auditing should be performed by an independent consultant or auditor.

The external process audits may have both an assessment and compliance-checking role. The frequency of audits for verification will depend on the level of confidence required by the municipality and DWA. These external audits should be done regularly. The DWA Blue Drop Program requires at least annual thorough external audits to be performed by qualified auditors.

Responsible	Test	Raw water	Final Water	Frequency
Plant operators	Turbidity		x	Every two hours
Plant senior foreman	Free chlorine		x	3 x per day
Plant senior foreman	pH	x	x	1 x per day
Plant senior foreman	Turbidity	x	x	1 x per day
Plant senior foreman	Jar Test	x		Weekly
Plant senior foreman	Electrical conductivity		x	Weekly
Plant senior foreman	Manganese, Iron, Aluminium		x	Weekly

Compliance monitoring

All the control measures should have a clearly defined monitoring regime validating effectiveness and monitoring performance against set limits. The municipality should expect to find results from compliance monitoring that are consistent with the water quality targets (SANS 241). Corrective action plans need to be developed to respond to, and understand the reasons for, any unexpected results. Verification monitoring frequencies will depend on the level of confidence required by the municipality and the Department of Water Affairs. The monitoring regime should include a review at intervals and at times of planned or unplanned changes in the supply system.

The compliance monitoring may be undertaken on behalf of the municipality by a private service provider, or by the municipality itself.

Consumer satisfaction

Verification includes checking that consumers are satisfied with the water supplied. Good communication with consumers about drinking water quality matters is therefore essential to ensure confidence and trust in the municipality.

Laingsburg Municipality regularly publishes results of their drinking water quality results to maintain consumer trust in the service delivery. Examples of these communications are shown in Appendix M.

9. MANAGEMENT PROCEDURES AND INCIDENTS RESPONSE PROTOCOLS

9.1 Documentation and communication procedures

All the relevant information regarding the water supply systems of the Laingsburg Municipality is contained in this Water Safety and Security Plan. The documentation and procedures entail description and assessment of drinking water system, plans for operational monitoring and verification of drinking water systems, water and safety management procedures for normal operation incidents and emergency situations.

If document updates are prepared as information becomes available, it reduces the amount of updating required at the end of the year and will allow Water Service Authorities to receive more up-to-date progress reports for their own planning services.

Documentation of a WSSP includes:

- Description and assessment of drinking water system including programmes to upgrade existing water delivery.
- A plan for operational monitoring and verification of drinking water system.
- Water and safety management procedures for normal operation and incident/ emergency situations (including communication plans).
- Description of supporting programmes.
- Communication strategies should include:
    - Procedures for promptly advising of any significant incidents within the drinking water supply, including notification of the public health authority.
    - Summary information to be available to consumers, e.g. through the media, annual reports and on the internet
    - Establishment of mechanisms to receive and actively address community complaints in a timely fashion.

9.2 Incident Response Management

Effective management involves actions to be taken in response to variations that occur during “normal” operating conditions and “incident” situations where the loss of a control system may occur, and of procedures to follow in unforeseen and emergency situations. Management plans should be documented alongside system assessment, monitoring plans, supporting programmes and communication required to ensure safe operating of the system.

Emergency response plans should clearly specify responsibilities for co-ordinating measures to be taken, a communication plan to inform/alert users of supply and plans for providing/distributing emergency supplies of water.

Key areas to be addressed in emergency response plans include:

- Response actions – including increased monitoring.
- Plans for emergency water supplies.
- Responsibilities and authorities internal and external to the organization.
- Communication strategies and protocols including notification procedures (internal, regulatory body, media, public).
- Mechanisms for increased public health surveillance.

The DWAF DWQ Framework (2007) has identified alert levels based on the public health risk and aesthetic quality to respond to acute drinking water failure. Three Alert Levels are proposed to respond to acute drinking water quality failures:

- Alert Level I (Drinking Water Incident – no significant risk to health): Routine problems including minor disruptions to the water system and single sample non-compliances.
- Alert Level II (Drinking Water Failure – potential minor risk to health): Minor emergencies, requiring additional sampling, process optimisation and reporting/ communication of the problem.
- Alert Level III (Drinking Water Emergency – potential major risk to health): Major emergencies requiring significant interventions to minimizepublic health risk (Engagement of a designated Emergency Management Team).

Actions will be taken in response to variations that occur during “normal” operating conditions and “incident” situations. Management procedures for incident situations in the Laingsburg Municipality water supply systems are provided below (Incident (Emergency) Response Management Protocol):

b. Incident Response Protocol

Incident Management for Health-related Drinking Water Quality Incidents

Classification of Incident: Alert Level I (Drinking Water Quality Incident)

Water Quality Constituent and Concentration:

- 1 *E.coli* per 100mL
- 1 Coli phage per 10mL
- Any health-related Physical or Chemical result that exceeds the upper limit of SANS 241: 2006 Drinking Water Class I Limit

Health implication/risk:

- Insignificant change of infection
- Very slight risk of viral infection with continuous exposure
- Insignificant risk to health – suitable for lifetime consumption

Incident Management:

Internal

Required Response Time:

Within 24hrs of result release

Action:

- Communicate out-of-range results to relevant Municipal staff;
- Assess associated information and implement corrective action to rectify the incident or resample to confirm result if required;
- If resample result confirms the initial result, implement corrective action to rectify the incident;
- If sample result exceed the concentrations specified in Alert Level I, proceed to Alert Level II.

Classification of Incident: Alert Level II (Drinking Water Quality Failure)

Water Quality Constituent and Concentration:

- 2-10 *E.coli* per 100mL
- 2-10 Coli phages per 10mL
- 1 Cryptosporium / Giardia per 10L
- Turbidity result > 5 NTU
- Fluoride result 0.9-1.7 mg/L

Health implication/risk:

- Clinical infections unlikely in healthy adults, but may occur in sensitive groups
- Low risk of viral infection with continuous exposure
- Low risk of protozoan parasite infection
- Indirect associated impacts on health through the shield of bacteria from disinfection
- Slight mottling of dental enamel

Incident Management:

Internal and External

Required Response Time:

Same day as result release

Action:

- Request additional monitoring as required (both spatially and increased frequency) to establish the source of the contamination and the risk to public health;
- Assess treatment process efficiency and implement corrective action to optimize the treatment process;
- Communicate the drinking water failure and health risk to the Municipal staff, DWAF and Doh;

- If any additional sample results exceeds concentrations specified in Alert II, proceed to Alert Level III.

Classification of Incident: Alert Level III (Drinking Water Quality Emergency)

Water Quality Constituent and Concentration:

- >10 E.coli per 100mL
- >10 Coli phages per 10mL
- >1 Cryptosporidium / Giardi a/10L
- Any health-related Physical or Chemical result that exceeds the upper limit of SANS 241: 2006 Drinking Water Class II limit (within exception of Turbidity)
- Fluoride result >1.7 mg/L

Health implication/risk:

- Clinical infections common, even with once-off consumption.
- Significant and increasing risk of Infectious disease transmission.
- Significant risk of protozoan parasite infection.
- Significant risk to human health –exceedance of maximum allowable limit.
- Severe tooth damage and skeletal fluorosis with long-term exposure

Incident Management:

Internal and External

Required Response Time:

Immediate

Action:

- Engage Emergency Management Team;
- Communicate drinking water emergency and heal the risk to relevant Municipal staff, DG of DWAF, head of Provincial DoH;
- Continue additional monitoring and extend to the distribution system and point-of-use to establish the source and extent of the incident and the risk to public health;
- Assess the communities at risk and the need for an al ternate water supply;
- Communicate drinking water emergency to community;
- Implement specialist process assessment and optimisation of the Drinking Water Supply System

from catchment to consumer;

- Phase out additional monitoring once the source of the incident has been identified and rectified and two consecutive results have been within specification;
- Prepare notifications advising of the end of the emergency;
- Assess required preventative action to reduce the likelihood of the incident recurring;
- Prepare a report to document and close the incident;
- Review and update Incident Management Protocol ;
- Retrain staff on revised Incident Management protocol.

Incident Management for Aesthetic Drinking Water Quality Incidents

Classification of Incident: Alert Level I (Drinking Water Quality Incident)

Water Quality Constituent and Concentration:

- Geosmin or 2-MIB 5-10ng/L
- Iron 0.2 - 1.0 mg/L
- Manganese 0.1-0.4 mg/L

Aesthetic implication/risk:

- Moderate unpleasant tastes/odours.
- Slight taste and colour, slight staining of white clothes
- Slight taste and colour, moderate staining of clothes and fixtures

Incident Management:

Internal

Required Response Time:

Within 24 hrs of result release

Action:

- Communicate out-of-range result to relevant Municipal staff;
- Assess associated information and implement corrective action to rectify the incident or resample to confirm result if required;

- If resample result confirms the initial result, implement corrective action to rectify the incident;
- If resample result exceeds the concentrations specified in Alert Level I, proceed to Alert Level II.

Classification of Incident: Alert Level II (Drinking Water Quality Failure)

Water Quality Constituent and Concentration:

- Geosmin or 2-MIB 11-20ng/L
- Iron 1.1-2.0 mg/L
- Manganese 0.5 -1.0 mg/L

Aesthetic implication/risk:

- Moderate unpleasant tastes/odours
- Moderate taste and colour, moderate staining of white clothes
- Moderate taste and colour, increasing staining of clothes and fixtures

Incident Management:

Internal and External

Required Response Time:

Same day as result release

Action:

- Request additional monitoring as required (both spatially and increased frequency) to establish the source of the contamination and the aesthetic impact;
- Assess treatment process efficiency and implement corrective action to optimise the treatment process;
- Communicate the drinking water failure and aesthetic impact to the relevant Municipal staff;
- If any additional sample results exceed concentrations specified in Alert Level II, proceed to Alert Level III.

Classification of Incident: Alert Level III (Drinking Water Quality Emergency)

Water Quality Constituent and Concentration:

- Geosmin or 2-MIB >20ng/L
- Iron >2 mg/L
- Manganese >1 mg/L

Aesthetic implication/risk:

- Objectionable and increasing unpleasant tastes/odours
- Objectionable taste and appearance, staining of clothes
- Off-putting taste and appearance, severe staining of clothes and fixtures

Incident Management:

Internal and External

Required Response Time:

Immediate

Action:

- Continue additional monitoring and extend to the distribution system and point-of-use to establish the source and extent of the incident and the aesthetic impact;
- Communicate aesthetic drinking water emergency to community;
- Implement specialist process assessment and optimisation of the Drinking Water Supply System from catchment to consumer;
- Phase out additional monitoring once the source of the incident has been identified and rectified and two consecutive results have been within specification;
- Prepare notifications advising of the end of the aesthetic drinking water emergency;
- Assess required preventative action to reduce the likelihood of the incident recurring;
- Prepare a report to document and close the incident;
- Review and update Incident Management Protocol ;
- Retrain staff on revised Incident Management Protocol.

Example of Water Quality Failure Response Protocols:

a. Bacteriological Failure Response Protocol

The following protocol is proposed:

- Monthly sample collection throughout the municipality.
- Laboratory results to Water Section.
- Immediately inform Supervisor/Manager/Engineer of bacteriological failures.
- Implement remedial measures (e.g. adjust chlorine dosing, flush network).
- Re-sample to assess if issue resolved.
- Provide a summary of bacteriological failures to management.
- Management review effectiveness and determine appropriate further interventions.

b. Disinfection Optimization Protocol

The following protocol is proposed:

- Check free chlorine residual values at reservoirs as per designated schedule, and adjust accordingly.
- When too low or too high chlorine residuals are measured, the municipality immediately implements remedial measures (e.g. adjust chlorine dosing).
- A summary of measured free chlorine residuals are provided to management.
- Management review effectiveness and determine appropriate further interventions.

c. Turbidity Protocol

The following protocol is proposed:

- Note is taken of any area/s where turbidities appeared excessive during sampling.
- It is confirmed by laboratory of water quality exceeding required max. limits (i.e. SANS 241)
- The municipality immediately implement remedial measures (e.g. network flushing)
- A summary of turbidity failures is provided to management

- Management review effectiveness and determine appropriate further interventions (e.g. pipe replacement program).

Incident Management Contact Details

LAINGSBURG MUNICIPALITY				
DRINKING WATER INCIDENT MANGEMENT PROTOCOL				
1.	**MANAGEMENT**			
	Post	**Name**	**Tel no:**	**Cell no:**
	Head: Technical Services	Mr N Klink		
	Chief Financial Officer	Ms A Groenewald		
2.	**LAINGSBURG**			
	Foreman	H Pieterse / M Visagie		
3.	MATJIESFONTEIN			
	Foreman	M Hermanus / J Pieters		
4.	CENTRAL KAROO DISTRICT MUNICIPALITY			
	Environmental Health Practitioner			

The Emergency Management Team should include the following:

- WSA Water Services Manager
- WSA Water Works Operations
- Local Government (DPLG)
- DWAF Regional Office
- Department of Health
- District Municipality Environmental Health Officers
- Provincial Disaster Management Unit

10. SUPPORT PROGRAMMES

Supporting programmes need to be developed in parallel with the Water Safety and Security Plan. These programmes are important actions that indirectly ensure drinking water safety.

The following supporting programmes are proposed for Laingsburg to ensure integrated drinking water supply management that will comply with the requirements for sufficient water quantity and quality to consumers:

a. Human Resources Development Program for the municipality's Water Section

This program should ensure that training is provided to every person in the water section of the municipality.

b. Catchment Management Program

A Catchment Management Program should ensure that any incidents related to the catchments and sources supplying Laingsburg with water that is treated for potable use, is managed according to a set protocol which will result in rapid action to be taken when incidents occur, e.g. fires in the catchment, accidental (or deliberate) discharge of pollutants into the water source, flooding, etc.

c. Master Plans for Drinking Water Supply (5 – 20 years)

Master Plan should be drawn up for future drinking water supply strategies.

11. CONCLUSIONS

A number of significant risks that were identified as having been evident in the recent past have been addressed or is in the process of been addressed. This includes the provision of a new chlorination system at the Laingsburg main reservoir, to ensure a microbiologically safe water in the town on a consistent basis. It will be imperative that chlorination system be operated and maintained according to strict program to reduce the risk of ineffective disinfection due to blockages in the chlorination system pipelines, empty chlorine cylinders, faulty chlorinators or too high or too low chlorine dosages been applied. Further upgrading reducing the former risks are replacement of old infrastructure in Laingsburg (flushing systems and valves), and replacement of old pipelines in Matjiesfontein.

The pipeline crossing the river that is often broken during periods of strong water flow in the river constitutes a high risk, emanating from water supply interruptions to the Bergsig suburb. This should be addressed by providing a permanent solution by the civil consulting engineers of the municipality.

An operational monitoring program should be designed and implemented to ensure that the necessary settings at the water treatment works are checked daily and adjustments made as may be necessary.

The operational personnel should receive training on an on-going basis to ensure that operational and compliance monitoring programmes are carried out diligently, and that sufficient and safe water is provided to the consumers of Laingsburg on a continuous basis.

12. REVIEW SCHEDULE FOR THE LAINGSBURG WSSP

The results of the verification exercise should be used to evaluate and review the water safety plan to see whether the field assessments identified need modifications. This requires analysis of the verification data to see if there are any deficiencies in the WSP. If verification shows that microbial contamination is detected despite the presence of control measures within their critical limits, this immediately indicates that control measures have been identified incorrectly, the critical limits are inappropriate or the control measures are insufficient. Internal or third party (independent) verification is recommended for the development of institutional relationships.

During the review, the following questions should be addressed:

- How well is the WSP working?
- Were the necessary management plans undertaken adequate?
- If not, which areas require improvement to provide long-term sustainability of the WSP?

The WSP should be reviewed:

- Annually.
- After an incident.
- After any significant change to the water supply.
- In response to finding a weakness in the plan.
- When additional information regarding the system is received that might warrant a revised risk level for that system.

The Water Safety and Security Plan is a dynamic document and must be reviewed on a regular basis by the Water Safety Plan Team. This is required to ensure that the information contained in the Plan is kept up to date, and that the risks be reviewed according to the mitigation measures as well as new developments taking place in the drinking water supply function of the municipality.

Specific items that need to be reviewed include the operational and compliance monitoring programmes, asset management programmes and capacity building of personnel in the water supply section of the municipality. The Plan also requires updates to be performed in the event of new water sources being

developed, new treatment plants constructed or existing plants upgraded or extended, and, importantly, when a major water quality incident occurs.

The review processes should be summarised in the table below:

Review Processes of the Laingsburg Water Safety and Security Plan			
Document Name	**Date**	**Review Period**	**Reason for Review**
WSSP Version 1	March 2010	Nov 2009 – March 2010	First version of the WSSP

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This Water Safety and Security Plan for the Laingsburg Municipality was drawn up and prepared by

Chris Swartz Eng
WATER UTILIZATION ENGINEERS

67 Marsh Street

P O Box 745

MOSSEL BAY

6500

Tel: +27 44 691 1242

Fax: +27 44 690 7960

e-mail: cswartz@mweb.co.za