SURFACE WATER IMPACT ASSESSMENTS FOR THE PROPOSED NEW TOMATO FARMING AND PROCESSING FACILITIES

Project Location: Limpopo Province, South Africa

Company Name: NYAMANE AGRO FOODS HOLDINGS (PTY) LTD AND NATIONAL EMPOWERMENT FUND (NEF) JV

Prepared for: Nsovo Environmental Consulting (Pty) Ltd

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Report Information

Report Name	SURFACE WATER IMPACT ASSESSMENTS FOR THE PROPOSED NEW TOMATO FARMING AND PROCESSING FACILITIES
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Executive Summary

Nyamane Agro Foods Holdings (Pty) Ltd proposes to develop a new tomato farm and associated processing facilities within the Lepelle-Nkumpi Local Municipality in the Limpopo Province. The proposed Nyamane Project is endorsed and supported by the National Empowerment Fund (NEF) via the Joint Venture. The project entails the preparation of approximately 1700 hectare (ha) for the planting of tomatoes and approximately 4ha for the establishment of the tomato processing facility.

Nsovo Environmental Consulting is the appointed environmental assessments practitioner8 and has appointed, CM Eclectic (Pty) Ltd to undertake Surface Water Impact Assessment for the Nyamane Project. The assessments support the Environmental Impact Assessments (EIA) in terms of the National Environmental Management Act of 1998 (NEMA) to obtain environmental authorisation of the proposed project.

This surface water study report presents a description and assessment of the baseline hydrology of the site and surroundings which may be impacted by the proposed Nyamane Project (tomato processing facility and farming activities). Although the legislation considered in the report was developed for mining projects, it has been referred to in compilation of this report as a best practice.

The project area falls within the Olifants WMA in the B52A quaternary catchment. The Olifants River is the only major perennial river passing on the southern boundary of the project area. Several non-perennial streams traverse the study area and drain in a southern direction towards the Olifants River. At the time of site visit, it was in the dry season and as expected the non-perennial streams had no baseflow. The mean annual precipitation and evaporation for the quaternary catchment B52A are 475 mm and 1900mm, respectively. The mean annual runoff (MAR) of the quaternary catchment is 4.59 million m^3, of which 3% will reduce due to the project footprint should all stormwater be managed on site.

An existing floodlines assessment demonstrates that the project infrastructure is located outside of the flood-lines.

Three water quality samples were collected in August 2019, and the results indicate similar water quality at all three points. The SANS 241 (2015), Drinking Water – Edition 2 and the series of Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines were used for interpretation of the water quality results.
The baseline water quality is relatively pristine with most parameters within standards except:

- turbidity marginally exceeding the SANS 241:2015 drinking water standards for operational and aesthetic use;
- total dissolved solids, electrical conductivity and calcium exceeding the Target Water Quality for Domestic Use;
- electrical conductivity exceeding Target Water Quality for Irrigation; and

- chloride and alkalinity exceeding Target Water Quality for Industrial Use

The site layout and project infrastructure have been reviewed in the context of the baseline hydrology and the potential unmitigated impacts were determined. The identified impacts are medium to low significance and include the following:

Deterioration of water quality as a result of the following:

- Siltation of watercourses - When a large area of vegetation is cleared coupled with heavy vehicle movement, the topsoil is exposed and disturbed, resulting in a large area of loose material, susceptible to erosion. During rainfall events, runoff from the exposed site will transport the eroded soil material into the nearby watercourses.
- Chemical and hydrocarbon contamination of watercourses - Uncontrolled spills of contaminants such as fuel and oils, solvents, paints, and waste materials, and subsequent washing away of these into the surface water resources result in water contamination.
- Chemical and nutrient contamination – aquatic eutrophication and ecotoxicity of watercourses may result for which the main culprits are nitrogen in the form of nitrate, phosphorus from phosphate fertilisers and pesticides mobilised towards the watercourses in stormwater runoff

Water quantity impacts as follows:

- A reduction of the runoff catchment area and change of flow regime - When the initial stormwater management measures and erosion control measures within the farming areas are constructed, the catchment area for runoff is reduced. This would also alter the runoff to the Olifants and tributaries. When coupled with the modifications in the river channel for the construction of an abstraction system, the flow regime of the Olifants River may also be altered.
- Reduction of downstream water availability – The abstraction of water at the pumping stations may reduce the water flow in the Olifants River, although this is typically informed by Ecological Reserves determined by Department of Water and Sanitation (DWS) any deviation from the allocated amount can have negative impacts for downstream users.

A series of mitigation measures were recommended for the project to minimise impacts on surface water resources.

Mitigation against water quality impacts

- The construction must be preferable during the dry season.
- The construction of surface stormwater drainage systems during the construction phase must be executed in a manner that would protect the quality and quantity of the downstream system.
- Erosion control of all riverbanks and farms plots must take place to reduce erosion and sedimentation processes.

- Stormwater channels should be protected against erosion through vegetation and flow energy dissipators constructed on steep slopes and areas of high runoff velocity.
- Vehicles and machinery should be serviced and maintained regularly to prevent hydrocarbon spillages that may wash off into nearby to watercourses during the rainy season.
- Storage of fertilisers should be in paved and covered storage area with protection from water.
- Controlled fertiliser application following monitoring of crop nitrogen needs and use precision application methods to prevent over-application of fertilisers.
- Controlled irrigation which potentially reduces water return flows and therefore can significantly reduce the migration of fertilisers and pesticides to water bodies.
- Choose lower nitrogen fertilisers, such as urea-based products, over calcium ammonium nitrate.
- Choose fewer toxic herbicides and pesticides and use Integrated Pest Management

Mitigation against water quantity impacts:

- Minimise the dirty area, ensure free drainage of the clean stormwater to the catchment watercourses.
- Design of weirs or any streamflow altering infrastructure should consider the stream geomorphology and velocities.
- No direct mitigation exists as stormwater management measures must remain for the protection of water quality. The loss of contained water to the catchment will, however, be minimal, but may affect downstream water users.

The imitations and recommendations were identified, which include the following:
Water quality sampling was done during a dry period (August 2019) and serves as a baseline description of the quality of surface water on site. These are once-off samples and do not necessarily indicate average quality at the site. Therefore, monitoring of water quality for the project should be conducted before the commencement of construction activities, including a wet season sample. A longer baseline record is always vital to improving the baseline data. It is important to have a good baseline for the protection of the resources as well as due diligence for the Nyamane Project.

Once both the Engineering designs and sizing of infrastructure have been finalised, the stormwater management plan should be amended to include the clean and dirty water separation system and also incorporate the expected overland stormwater run-off flows from the higher-lying properties through the development (if necessary) towards the low point.

Furthermore, when comments from the interested and affected party comments become available and fall within the scope, these will be addressed in the report.

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Table of Acronyms and Abbreviations

Acronym / Abbreviation	**Definition**
DDF	Depth Duration-Frequency
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographic Information system
GN 704	Government Notice 704
IDF	Intensity Depth Frequency
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MRA	Mining Right Area
NFEPA	National Freshwater Ecosystem Priority Areas
PrSciNat	Professional Natural Scientist
SABS	South Africa Bureau of Standards
SACNASP	South African Council for Natural Scientific Professions
SANRAL	South African National Road Agency
SANAS	South African National Accreditation System
SANS	South African National Standards
SAWS	South African Weather Service
SCS	Soil Conservation System
SAWS	South Africa Weather Services
Tc	Time of Concentration
UPD	Utility Programme for Drainage
WQG	Water Quality Guideline
WMA	Water Management Area
WR2005	Water Resources of South Africa 2005 Study
WULA	Water Use License Application
WR2012	Water Resources of South Africa 2012 Study

Table of Units

mg/l	Milligram per litre
m^3/s	Cubic meters per second
m^3	Cubic metres
Mcm	Million cubic metres
m	meters
Ha	Hectares
m^2	Square metres
L/day	Litres per day
Km	Kilometres
Km2	Square kilometres
mm	millimetres
m amsl	Metres above mean sea level

Table of Water Quality Parameter Symbols

EC	Electrical Conductivity
TDS	Total Dissolved Solids
N03 –N	Nitrogen in Nitrate
NH3	Ammonium
Cl	Chloride
$S0_4$	Sulphate
$P0_4$	Phosphate
Na	Sodium
K	Potassium
Ca	Calcium
Mg	Magnesium
F	Floride
Si	Silicon
T.Alk	T. Alk Alkalinity
V	Vanadium
Fe	Iron
Mn	Manganese
Cr	Chromium

1 Introduction

1.1 Background

Nyamane Agro Foods Holdings (Pty) Ltd (Nyamane) proposes to develop a new tomato farm and associated processing facilities within the Lepelle-Nkumpi Local Municipality in the Limpopo Province. The proposed Project is a joint venture between Nyamane Agro Foods and National Empowerment Fund (NEF) The proposed project entails the preparation of approximately 1700 hectares (ha) for the planting of tomatoes and approximately 4ha for a tomato processing facility.

Nsovo Environmental Consulting is the appointed environmental assessments practitioner and has appointed CM Eclectic (Pty) Ltd to undertake a Surface Water Impact Assessment for the proposed project. The assessments support the principles and needs of the Environmental Impact Assessments (EIA) that requires the developer/applicant to conduct an EIA and to obtain an Environmental Authorisation (EA) and a Water Use Licence (WUL) in terms of the National Environmental Management Act of 1998 (NEMA) EIA Regulations and the National Water Act (Act No. 36 of 1998) respectively.

An experienced Hydrologist registered with the South Africa Council for Natural Scientific Professions (SACNASP) as a Professional Natural Scientist (Pr.Sci.Nat.) in the field of Water Resources Science, conducted this surface water assessment with available information. The Specialist's Declaration of Independence and CV summary is attached as Appendix A.

1.2 Project Description

The central coordinate for the proposed site is at 24°26'29.5"S and 29°39'22.7"E. The proposed activities are located on Farm Platdoorns No.498 Portion 1 and Remainder of 498; Davidspoort No. 499 Portion 1 and Remainder of 499 and Graslaagte No. 522 Portions 1, 2, 3 and Remainder of 522 in the Limpopo Province as indicated in Figure 1-1 below. The site is located north of the Olifants River, south of Dithabaneng and Lekurung. The site falls within the Lepelle-Nkumpi Local Municipality located in the Capricorn District Municipality and shares its border with the Olifants River and the Sekhukhune District Municipality.

The proposed Nyamane Project activities entail the following activities, infrastructure and structures:

- Farming
    - Clearance of up to 1700ha vegetation for farming;
    - Construction of roads to and in between the tomato fields;
    - Construction of water abstraction works for irrigation,
    - Water pump station

- Water storage ponds (i.e. earth dams with lining); and
- Propagation Unit including nursery.

- Processing
  - Clearance of approximately 4ha vegetation for tomato processing facility;
  - Processing equipment to wash raw tomatoes, chop and juice tomatoes;
  - Construction of water recycling plant and warehouse;
  - Ancillary structures, parking and wash bay;
  - Surfaced road from the entrance to a processing facility (less than 1000m); and
  - Fuel storage area (3 x 2 200 diesel storage).

1.3 Legislation

Although the legislation in this section is for mining projects, it has been referred to in compilation of this report as a best practice for the assessments and management of surface water.

1.3.1 National Water Act

The National Water Act (Act No. 36 of 1998), Government Notice 704 (Government Gazette, Vol. 408, No. 20119 of 4 June 1999) (hereafter referred to as GN 704), was established to provide regulations for the use of water for mining and other related activities aimed at the protection of water resources. Regulations 4, 5, 6, and 7 of the GN704 are applicable in this study and are as follows:

- Regulation 4 which defines the restrictions for the locality of mine working and infrastructure Any residue deposit, dam, reservoir together with any associated structure or any other facility should be sited outside the 1: 100-year flood-line. Any underground or opencast mining, prospecting or any other operation or activity should be situated or undertaken outside of the 1: 50-year flood-line. Where the flood-line is less than 100 metres away from the watercourse, then a minimum watercourse buffer distance of 100 metres is required for infrastructure and activities;
- Regulation 5 which restricts the use of residue or substance which causes or is likely to cause pollution of a water resource. Such material may not be used in the construction of any dams, impoundments or embankments or any other infrastructure which may cause pollution of a water resource;
- Regulation 6 which describes the capacity requirements of clean and dirty water systems. Clean and dirty water systems must be kept separate and must be designed, constructed, maintained and operated to ensure conveyance of flows of a 1: 50-year recurrence event. Clean and dirty water systems should not spill into each other more frequently than once in

50 years. Any dirty water dams should have a minimum freeboard of 0.8m above full supply level.

- Regulation 7 which describes the measures which must be taken to protect water resource; All dirty water or substances which may cause pollution should be prevented from entering a water resource (by spillage, seepage or erosion) and ensure that water used in any process is recycled as far as practicable.

1.3.2 Best Practice Guidelines

In addition to the GN 704 regulations, the Department of Water and Sanitation (DWS) Best Practice Guidelines (BPG) for the mining industry is consulted in this study, namely:

- BPG G1: Storm Water Management;

The measures provided in the SWMP is developed to align with the principles of BPG G1: Stormwater management, to keep clean and dirty water separate., as defined by the following:

- Collect all stormwater that is of poor quality in a dirty water trench and contain it within the storage facilities (dam) for reuse within the reclamation operations;
- Ensure that all stormwater structures that are designed to keep dirty and clean water separate can accommodate a defined precipitation event. (The magnitude of the precipitation event used in this assessment is the 1:50 year, 24-hour event);
- Route all clean stormwater directly to natural watercourses without increasing the risk of a negative impact on safety and infrastructure, e.g. loss of life or damage to property due to an increase in the peak runoff flow;
- Ensure that the maximum volume of clean water runoff is diverted directly to watercourses;
- The SWMP must be sustainable over the life cycle of the mine and different hydrological cycles and must incorporate principles of risk management; and
- Consideration and incorporation of the statutory requirements of various regulatory agencies and the interests of stakeholders in the SWMP.

1.3.3 National Water **Resources** Strategy

The National Water Resource Strategy (NWRS) 2, is a tool designed to assist in the implementation of the National Water Act (NWA) to effectively manage water resources in South Africa (DWS, 2013). The NWRS sets out policies, strategies, objectives, plans, guidelines, procedures and institutional arrangements for the protection, use, development, conservation, management and control of South Africa's water resources. It is the primary mechanism for water management across all sectors in South Africa, which helps the Government to work towards achieving its development goals (DWS, 2013).

1.3.4 Catchment Management Agencies

The Catchment Management Agencies (CMAs) are tasked with coordinating the water demands, interests and responsibilities of all relevant government departments, institutions and water users within a specific CMA (DWS, 2012). This is to ensure that, on a regional scale, water is protected, used, developed, conserved, managed and controlled sustainably. The main instrument that guides and governs the activities of a CMA is the Catchment Management Strategy which, while conforming to relevant legislation and national strategies, provides detailed arrangements for the protection, use, development, conservation, management and control of the region's water resources. The proposed tomato processing facility project is situated in the Olifants Water Management Area (WMA 2) and Quaternary Catchment B52A.

1.4 Methodology and Scope Work

This study included the following

- Baseline Hydrology – Section 2 presents a summary of the baseline/ current environment hydrology of the site as obtained from literature and the site assessment. The summary includes topography, watercourse network and catchment delineation. The catchment attributes namely Mean Annual Runoff (MAR), Mean Annual Precipitation (MAP) and Mean Annual Evaporation (MAE) were obtained from the Water Research Commission (WRC) Reports K5/1491 (WRC, 2012). Furthermore, the extreme event rainfall depths/ design rainfall events were determined from the South African Weather Services (SAWS) rainfall information database using data from 6 nearest stations. A 24-hour design rainfall depths model was run on a Design Rainfall Estimation (DRE) in South Africa software (Smithers and Schulze, 2003) for the 1: 50 and 1: 100-year return periods;
- Water quality - Section 3 presents a review of the available water quality reports for the watercourses on site and the results from three surface water quality sample results from the laboratory. A site assessment was conducted to collect water quality samples within the nearby river selected up - and downstream samples along with the surface water resources for selected water quality parameters. The baseline quality is determined by benchmarking results of the sample analysis by a South African National Accreditation Systems' (SANAS) accredited laboratory against the South African National Standard (SANS) 241: 2015 Drinking Water and Department of Water and Sanitation water use specific guidelines;
- Stormwater management measures - Section 4 presents the recommended stormwater drainage measures to manage stormwater to the operation and minimise risks of polluting any water resources, including clean and dirty water catchment delineation and estimation of relevant peak flows,
- Impact Assessment – Section 5 presents an assessment of the impacts of the Nyamane project on the baseline surface water environment, a range of mitigation measures to minimise impacts, and recommendation on monitoring; and
- Conclusions and Recommendations – Section 6 presents the summary, findings and any further work recommended.

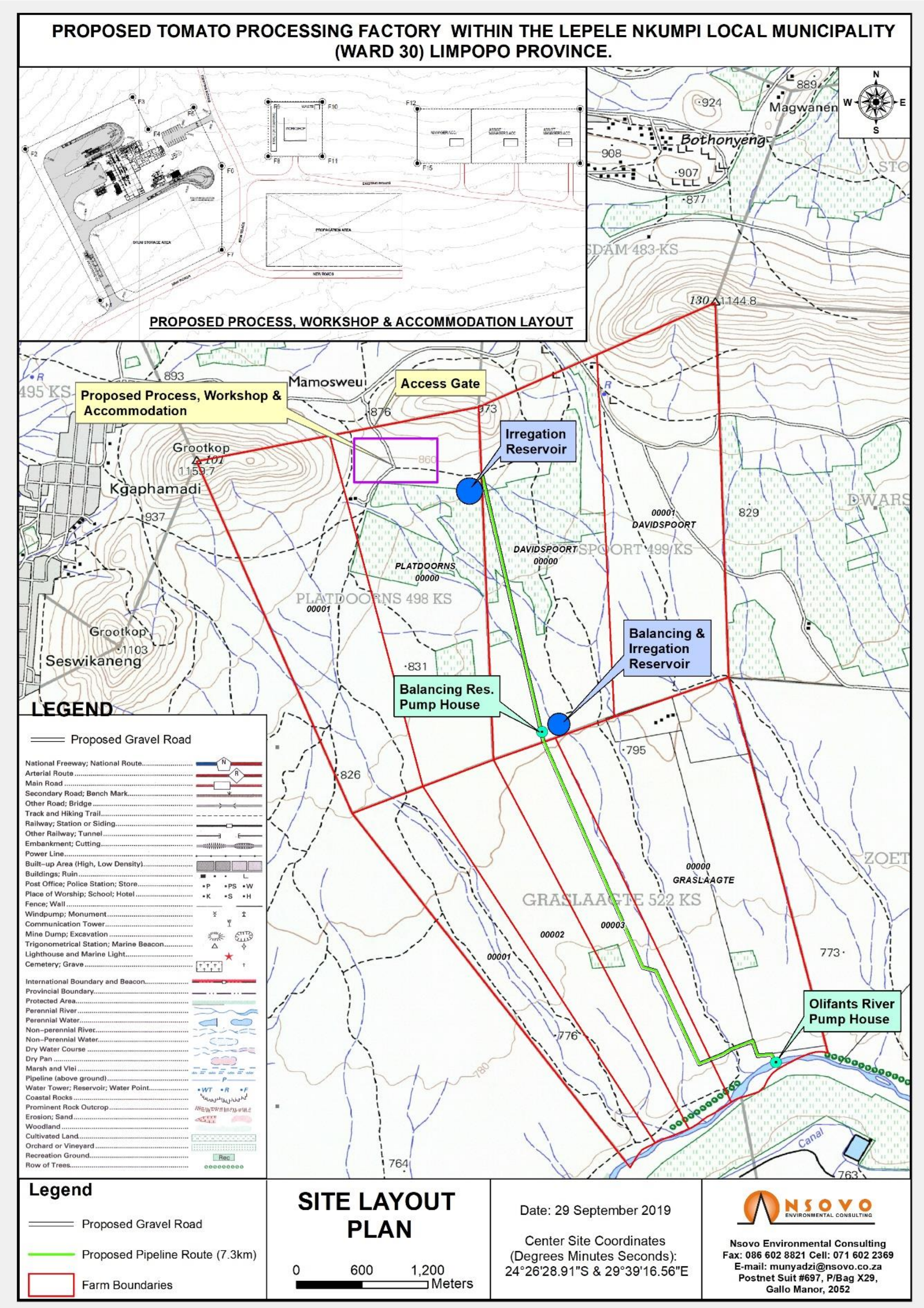


Figure 1-1: Proposed Nyamane Project Site Layout

2 Baseline Hydrology

This section presents the baseline climatic and hydrological conditions of the site and surroundings based on a review of various information sources.

Most of the sections in this report have been compiled following a review of various reports:

- Reports from other assessments for the tomato processing plant, namely:
  - Floodline Assessment (Sivest, June 2019)
  - Wetland and Riparian Assessment (Water Markers, September 2019)
- Classes and Resource Quality Objectives of Water Resources for Catchments of the Olifants in Terms of Section 13(1)(A) and (B) of the National Water Act (Act No.36 of 1998), (April 2016).

2.1 Catchment Characterisation

South Africa is divided into nine water management areas (WMA) in line with the National Water Resource Strategy 2 (NWRS 2)[1]. Each of the WMAs is made up of quaternary catchments which relate to the drainage regions of South Africa. This section presents a review of catchment information from various sources.

2.1.1 Regional Hydrology

The project area falls within the Olifants WMA in the B52A quaternary catchment. The quaternary catchment climatic and runoff parameters such as mean annual runoff (MAR), MAP and MAE from the WR2012 study are presented in Table 2-1 below (WRC, 2012)

Table 2-1: Quaternary Catchment Characteristics

Quaternary Catchment	Total Area (km^2)	MAR ($*10^6$ m^3)	MAP (mm)	MAE (mm)	Rainfall Zone	Evaporation Zone
B52A	566	4.59	475	1900	B5C	1A

2.1.2 Local Hydrology

The proposed Nyamane project falls within quaternary catchment B52A with all runoff from this catchment eventually draining into Olifants River. The Olifants River is the only major perennial river passing on the southern boundary of the proposed site. Several non-perennial streams are located within the study area and drain in a southern direction towards the Olifants River. The site visit was undertaken during the dry season and as expected the non-perennial streams had no baseflow.

[1] Department of Water and Sanitation, 2013. National Water Resource Strategy, Second Edition, June 2013.

The Olifants River upper reaches originate from the north of the towns of Hendrina, Bethal, Evander and Delmas in Mpumalanga draining northwards to the Nyamane Project Site. Downstream of the Nyamane site, the Olifants River drains in a northeasterly direction towards Phalaborwa in Limpopo and ultimately through Mozambique into the Indian Ocean. The hydrological setting of the proposed site is presented in Figure 2-1 below.

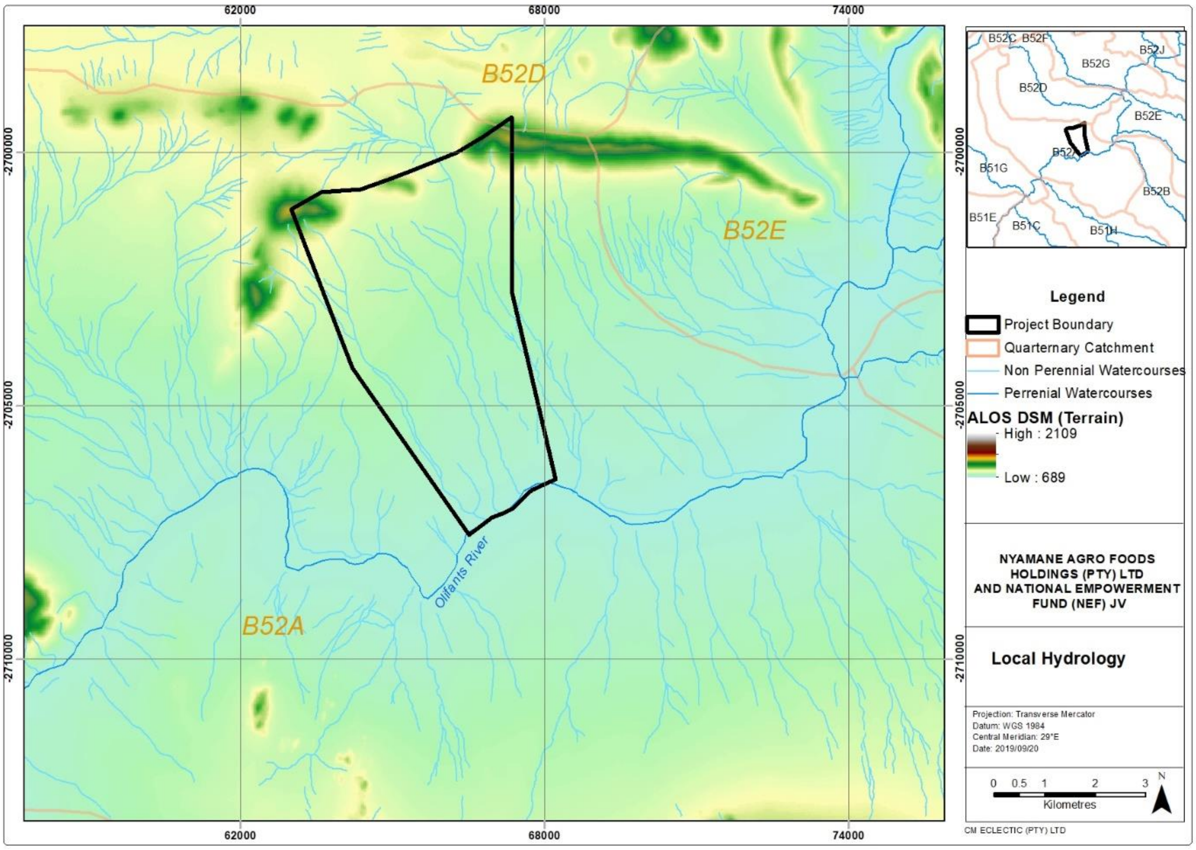


Figure 2-1: Local Hydrology

2.1.3 Streamflow

The DWS runs a streamflow monitoring programme throughout South Africa. The nearest flow gauging stations to the Nyamane project site are located on the Olifants River, and these are B5H002, B5H004 and B5R002. The flow data on the DWS Hydrological Services website[2] has missing information. As part of the WR2012 study, a great deal of work has been put in by Dr Bill Pitman and Mr Allan Bailey to patch the DWS observed streamflow data in rivers and dams. This data was updated in September 2010 and was obtained for stations B5H004 and B5R002. The summary and location of the gauging stations are presented in Table 2-2 below.

[2] https://www.dwaf.gov.za/hydrology/

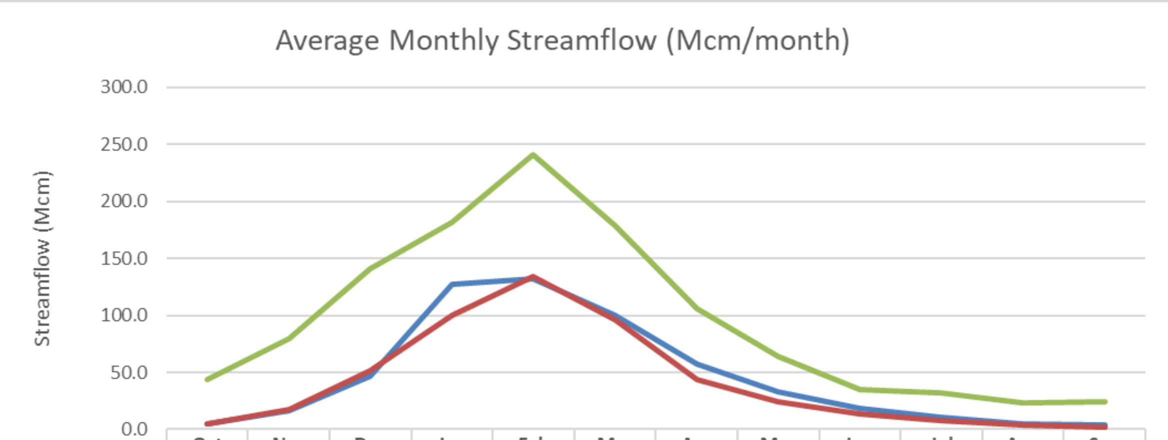
Table 2-2: Summary of DWS Streamflow Gauging Stations

Station Code	B5H002	B5R002	B5H004
Site Name	Olifants at Zeekoegat	Olifants River at Flag Boshielo Dam	Olifants River at Tambotieboom
Lat	-24.26817	-24.78069	-24.77508
Long	29.80113	29.42575	29.42196
Catchment Area km²	31416	23555	24791.6
Distance from Site	35km downstream	52km Upstream	52km Upstream
Record Length (years)	32	32	32
Start Record	1948/09/01	1987/06/30	1987/09/24
End Record	1980/01/31	2019/08/23	2019/08/23
Comment	On River	Monthly spill Volume	D/S river component of Flag Boshielo Dam

A summary of the flow data obtained from the DWS Hydrological Services website and the patched WR2012 data files presents the following:

- Monthly flow volumes upstream: patched records of total monthly flows between 1987 until 2009 for stations B5H004 and B5R002 show that the highest flow volume recorded within a single month was in February 1995 when 1 472.98 and 1 476.99 million m^3 passed the flow gauge.
- Monthly flow volumes downstream: the records of total monthly flows between 1948 to 1978 for the station B5H002 shows that the highest flow volume to pass through the flow gauge in a month was 2 244 million m^3 in March 1977.

Figure 2-2 below presents the average monthly streamflow/discharge distribution



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
B5H004	5.3	16.4	47.0	126.8	131.9	100.4	57.1	33.4	18.2	10.4	4.8	4.0
B5R002	4.8	17.8	51.6	99.6	134.3	95.8	43.3	24.1	13.8	7.6	3.4	1.8
B5H002	44.0	79.8	140.6	181.6	240.6	178.8	106.3	63.9	35.2	32.0	23.4	24.3

Figure 2-2: Average monthly volumes (Mcm/month))

Naturalised flow is obtained by removing man-made influences such as dams, irrigation schemes, abstractions for mines, industry and towns, return flows from treatment works, etc. Naturalised flows are used in other models such as the Water Resources Yield Model (WRYM), Water Quality Model (WQT), Hughes Desktop Reserve Model (for Ecological Water Requirements), and Water Resources Planning Model (WRPM). The naturalised flows are recorded monthly in million cubic metres and recorded in the WR2012 from 1920 to 2009 (hydrological years).

In the quaternary catchment B52A, the naturalised flow responds to the wet season peaking from November until January and slowly receding from February into the dry season onwards as indicated in Figure 2-3 below.

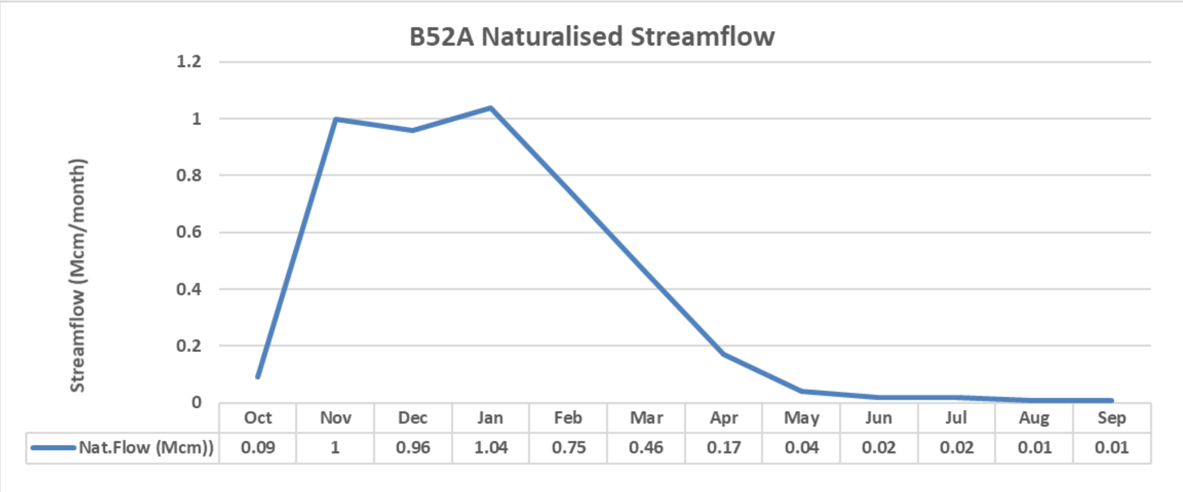


Figure 2-3: WR2012 Monthly Naturalised Streamflow for Catchment B52A (Mcm/month))

2.1.4 Topography

Various sources of topographical data for the proposed study area and surroundings were reviewed including:

- Advanced Land Observing Satellite (ALOS) Digital Surface Model obtained from the Japan Aerospace Exploration Agency Earth Observation Research Centre and has a horizontal resolution of 30m, and a 3-5 m vertical accuracy; and
- 2.5m contours for the project site, provided by JB Architecture (Figure 2-4).

The proposed site is characterised by mountain peaks to the northern boundary and generally slopes towards the south. The peaks range in height from 1107.5 to 892.5 mamsl and form the headwaters of the streams passing through the Project site. The proposed tomato processing facility infrastructure is located at the feet of two mountains with peaks 970 m and 1107.5 m and has a surface elevation between 870-850 mamsl. The mountain slopes are relatively steep with typical slopes of 0.32 (1:3.2) and 0.25 (1:4). The steep mountain slopes typically generate fast flowing stormwater runoff, and this may need to be diverted away from the site in the stormwater management plan.

The proposed farming area is on a gentle slope to the south, and typical gradients are very low 0.014 (1:70) up to the banks of the Olifants around 765 mamsl. Considering the topography, all the runoff from the site flows to the Olifants River.

2.2 Climatic Characterisation

2.2.1 Rainfall

Monthly average rainfall data is based on the WR2012 catchment derived rainfall from several nearest rainfall stations as presented in Water Resources of South Africa 2012 Study (WR2012). Table 2-3 below presents the average monthly distribution for the B52A quaternary catchment. The WR2012 rainfall information shows that 92% of the MAP of 475 mm occurs from October to April.

Table 2-3: Average Monthly Precipitation (WR2012)

Month	Distribution % of MAP	Monthly Rain (mm)
Jan	17.7	84.3
Feb	14.3	68.0
Mar	11.2	53.1
Apr	6.15	29.2
May	2.07	9.8
June	1.01	4.8
July	0.75	3.6
August	0.87	4.1
September	2.67	12.7
October	8.63	41.0
November	17.1	81.3
December	17.5	83.1
Total (MAP)	**100.0**	**475**

2.2.2 Evaporation

Symons pan (S-Pan) evaporation data is based on the WR2012 derived MAE for quaternary catchment B52A of 1900mm and the monthly distribution of the MAE for the evaporation zone 1A. S-Pan evaporation was converted to open water evaporation using evaporation coefficients from WR1990[3].Table 2-4 below indicates the evaporation distribution applicable to the project site.

[3] Surface Water Resources of South Africa 1990 - Volume 1 Appendices. WRC Report 298/1.1/94

Table 2-4: Average Monthly Evaporation

Month	S-Pan Evaporation (mm)	Conversion Factors	Lake Evaporation (mm)
January	195	0.84	164
February	167	0.9	147
March	164	0.9	145
April	132	0.9	116
May	114	0.87	100
June	92	0.85	78
July	102	0.83	85
August	139	0.81	113
September	180	0.81	145
October	211	0.81	171
November	199	0.82	163
December	203	0.83	169
Total	**1900**		**1596**

2.2.3 Design Storms

Design storm estimates for various return periods and storm durations are obtained from the Design Rainfall Estimation Software for South Africa, developed by the University of Kwazulu Natal in 2002 as part of a WRC project K5/1060 (JC Smithers and RE Schulze[4]). The software extracts the storm depth-duration-frequency (DDF) data for the six closest rainfall stations to the site (24°26'0.00"S; 29°38'60.00"E) and is used to interpolate DDF data for the project area. The Smithers and Schulze method of DDF rainfall estimation is considered more robust than previous single-site methods on South Africa. WRC Report No. K5/1060 provides further detail on the verification and validation of the method. Table 2-5 below presents six nearest stations used in the Design Rainfall Estimation Utility.

Table 2-5: Summary of Nearest Rainfall Stations

Station Name	SAWS Code	Distance from site (km)	Record length (Years)	MAP (mm)	Altitude (m)
Wonderboom	0635208_W	6.5	50.0	467.0	758.0
Chunniespoort (POL)	0635076_W	21	57	537	1030
Rustplaas	0635077_W	22	37	480	1066
Malipsdrif (POL)	0635554_W	28.1	47	412	780
Lobethal (SKL)	0592371_W	31.9	62	521	1215
Paschaskraal	0635862_W	34.6	40	516	890

[4] JC Smithers and RE Schulze, 2002. Design Rainfall and Flood Estimation in South Africa, WRC Report No. 1060/1/03

Table 2-6 below, presents the DDF rainfall estimates. The 1:50 year 24-hour storm event is 131.4mm.

Table 2-6: Storm Depth-Duration-Frequency (DDF) Rainfall for Project Site

Duration (hours and days)	Rainfall Depth (mm)						
	1:2yr	1:5yr	1:10yr	1:20yr	1:50yr	1:100yr	1:200yr
0.08	8.9	12.1	14.4	16.7	20	22.6	25.4
0.167	13.4	18.2	21.7	25.3	30.2	34.2	38.4
0.25	17	23.2	27.6	32.2	38.5	43.6	48.9
0.5	22.1	30.1	35.8	41.7	49.9	56.5	63.4
0.75	25.7	35	41.7	48.5	58.1	65.7	73.8
1	28.6	39	46.5	54.1	64.7	73.2	82.3
1.5	33.3	45.4	54.1	62.9	75.3	85.2	95.8
2	37.1	50.6	60.2	70.1	83.9	94.9	106.6
4	42.1	57.3	68.3	79.4	95.1	107.6	120.9
6	45.3	61.7	73.5	85.5	102.3	115.8	130.1
8	47.7	65	77.4	90	107.7	122	137
10	49.7	67.7	80.6	93.8	112.2	127	142.7
12	51.3	69.9	83.3	96.9	115.9	131.2	147.4
16	54.1	73.7	87.7	102.1	122.1	138.2	155.3
20	56.3	76.7	91.3	106.3	127.2	143.9	161.7
24	58.2	79.3	94.4	109.8	**131.4**	148.8	167.1
2d	59.3	80.8	96.2	112	134	151.6	170.4
3d	66.9	91.1	108.5	126.3	151.1	171.1	192.2
4d	72.4	98.6	117.4	136.6	163.5	185.1	207.9
5d	76.9	104.8	124.8	145.2	173.8	196.7	221
6d	80.8	110.1	131.2	152.6	182.6	206.7	232.2
7d	84.3	114.9	136.8	159.2	190.5	215.6	242.2

2.3 Impacts on Mean Annual Runoff

The mean annual runoff (MAR) of the quaternary catchment is presented in Section 2.1.1. The proposed project footprint of approximately 17.04km^2 produces stormwater which requires to be controlled or contained on both the proposed farming area and the processing plant. The impact of the diversion of the stormwater from this footprint on the MAR for the B52A quaternary catchments was estimated and presented in Table 2-7 below.

Table 2-7: Impacts on Mean Annual Runoff

Catchment Name	Area (km^2)	TOTAL MAR (mcm)	m^3/km	Contained Area (km^2)	MAR Reduction (mcm)	MAR Reduction (%)
B52A	566	4.59	8109.541	17.04	0.138187	3%

The data presented suggest that the proposed project footprint has a low impact on the MAR of the quaternary catchment

2.4 Floodlines

The GN704 regulations, state that infrastructure should not be placed within the 1:100-year floodline, or a horizontal distance of 100 m from a watercourse (whichever is greater). Therefore, Sivest SA (Pty) Ltd undertook a floodline assessment study for watercourses around the project site, and the findings are summarised below.

- Streams and drainage lines within the study area were assessed, namely Olifants River and drainage Lines cutting through the site.
- The Deterministic Methods Regional Maximum Flood Method, Midgley & Pitman Method, Standard Design Flood Method, Empirical – Rational Method and Unit Hydrograph Method, were used to calculate the 1:100-year peak flows for the Olifants River catchment.
- Rational Method 'Empirical' and the Rational Method 'Kerby' were used to calculate the 1:100-year peak flows for the drainage lines through the project area.
- As there was no infrastructure on the site at the time of the floodlines, the determined foodlines are a guide in the placement of infrastructure, and therefore no infrastructure falls within the flood lines.
- The study recommended that the Floodline Report be read in conjunction with all Stormwater Management Plans for this project. The Stormwater Management Plan outlines and focuses on the existing and proposed infrastructure above and below the natural ground and should simulate and incorporate the expected overland stormwater run-off flows from the higher-lying properties through the development (if necessary) towards the low point.

Figure 2-4 below shows the plotted 1:100 year floodline extents in red.

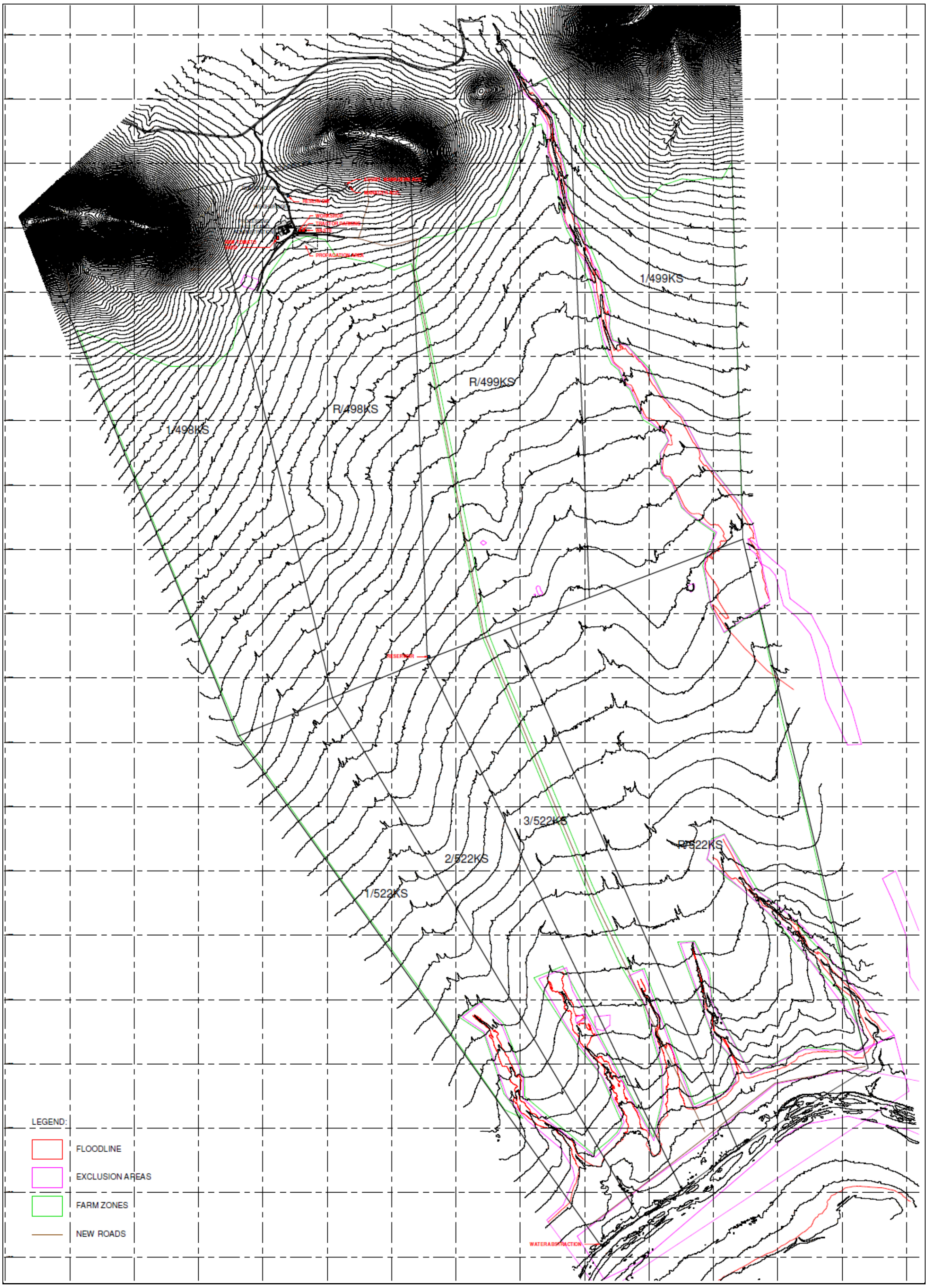


Figure 2-4: 1:100-year Flood Lines

2.5 Limitations and Further Work

The baseline information is considered adequate to make assessments for the impacts on the surface water environment, and the floodlines should guide the development of infrastructure and the SWMP on site.

3 Water Quality Assessments

A specialist conducted a site visit on the 24th of August 2019 and collected surface water quality samples from the surface water resources within the project area. Table 3-1 below indicates the location of surface water sampling points, also shown in Figure 3-1. The water samples analysis was conducted at Aquatico Laboratories (Pty) Ltd, a South African National Accreditation System (SANAS) accredited laboratory in Centurion for physical and chemical water quality parameters.

The following guidelines and standards were used for interpretation of the water quality results as and when applicable:

- SANS 241 (2015), Drinking Water – Edition 2.
- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines

The drinking water guidelines were used as they are the most comprehensive set of standards and provide for a worst-case scenario where the water is unintentionally used for consumption by humans. SANS 241 specifies the quality of acceptable drinking water, defined in terms of microbiological, physical, aesthetic and chemical determinants. Water that complies with SANS 241 is deemed to present an acceptable water quality for consumption (this implies an average consumption of 2 litres of water per day for 70 years by a person that weighs 60 kg).

Table 3-1: Surface Water Sampling Locations

Monitoring site	Description of Sampling Location	Longitude
SW1	Along the boundary of the proposed project site on the Olifants River	24°28’11.8’’S; 29°39’’23.8’’E
SW2	Upstream on the proposed project site on the Olifants River	24°28’39.1’’S; 29°38’39.2’’E
SW3	Along the boundary of the proposed project site on the Olifants River	24°28’08.8’’S; 29°39’27.8’’E

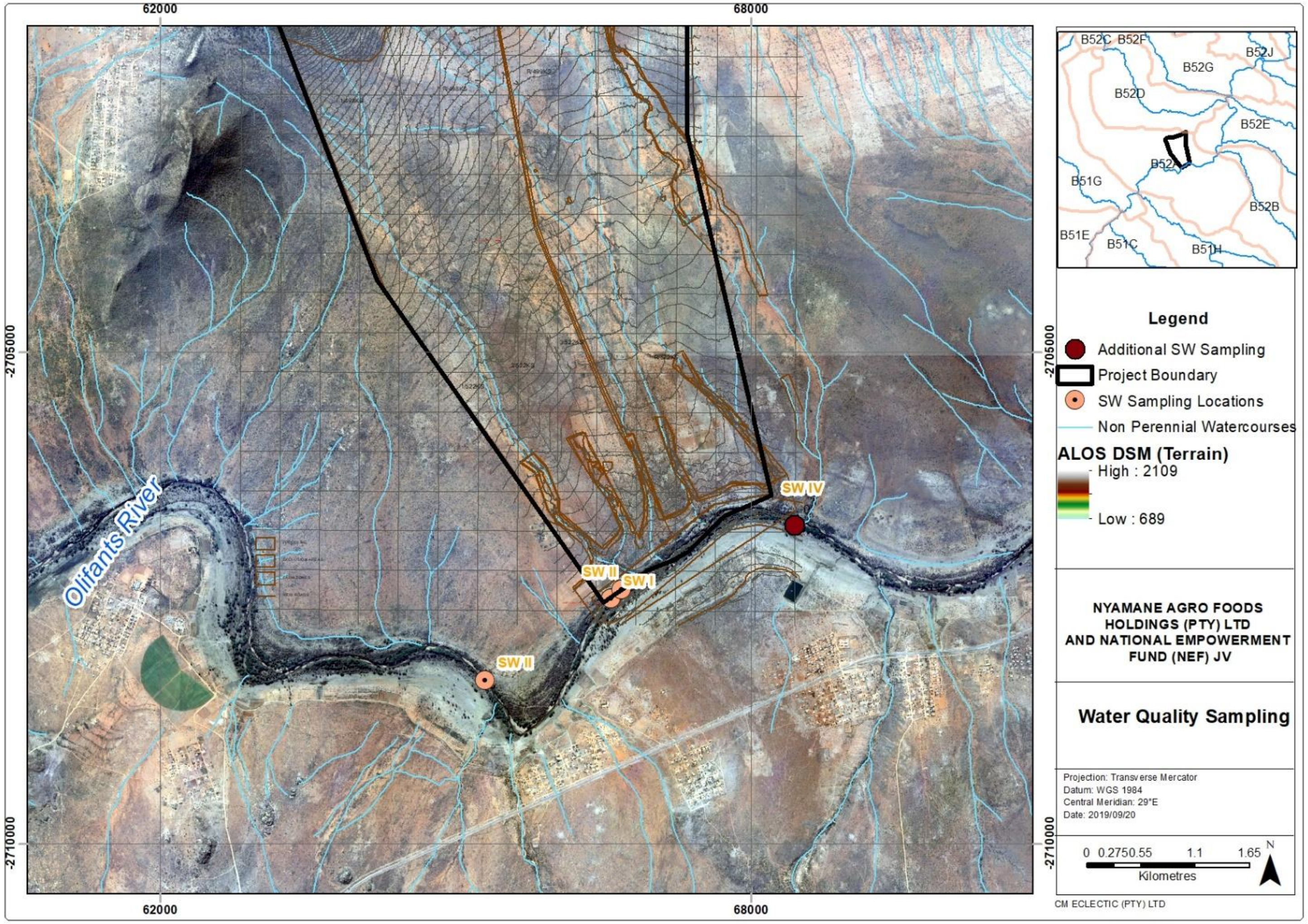


Figure 3-1: Surface Water Sampling Sites

3.1 Water Quality Results

The surface water quality of the Olifants River from the samples collected indicates the following:

- A relatively pristine, with the only parameter turbidity marginally exceeding the SANS 241:2015 drinking water standards for operational and aesthetic use.
- A few South African Water Quality Guidelines - (SAWQG), 1996 were exceeded, for the following:
    - Target Water Quality for Domestic Use - total dissolved solids, electrical conductivity and calcium.
    - Target Water Quality for Irrigation - electrical conductivity
    - Target Water Quality for Industrial Use - chloride and alkalinity, which may imply that the water is unusable at the tomato processing plant, however, subject to the water quality required by the tomato processing plant.
- All three samples indicate similar water quality with little variation in the concentrations of the various parameters.
- The baseline water quality is relatively pristine, and the operation of the tomato processing plant should be such that potential contamination of the surface water is minimised.

Water quality results are presented in Table 3-2 and accompanying test results in Appendix B.

Table 3-2 : Summary of Water Quality Results

Site Location			SANS 241:2015 Drinking Water Standards				South African Water Quality Guidelines -(SAWQG), 1996- Target Water Quality							Sample 1 - SW1	Sample 2- SW2	Sample 3 - SW3
Sampling Date			Aesthetic	Operational	Chronic Health	Acute Health	Domestic	Agriculture: Irrigation	Agriculture: Livestock Watering	Industrial	Recreational	Aquatic Systems		24-Aug-2019	24-Aug-2019	24-Aug-2019
Co-ordinates														24°28’11.8’’S; 29°39’’23.8’’E	24°28’39.1’’S; 29°38’39.2’’E	24°28’08.8’’S; 29°39’27.8’’E
Electical Conductivity	EC	mS/m	170	-	-	-	70	40	-	-	-	-		71.7	71.9	72.8
pH	pH	-	-	5-9.7	-	-	6.0-9.0	6.5-8.4	-	7.0-8.0	6.5-8.5	-		8.27	8.13	7.82
Chloride	Cl	mg/l	≤ 300	-	-	-	100	100	1500	20	-	-		48.1	48.2	49.3
Flouride	F	mg/L	-	-	≤ 1.5	-	1	2	2	-	-	0.75		0.758	0.754	0.755
Alkalinity	CacO3	mg/l	-	-	-	-	-	-	-	50	-	-		146	149	152
Nitrate	NO3	mg/l	-	-	-	≤ 11	6	-	100	-	-	-		0.358	0.31	0.332
Sulfate	SO4	mg/l	250	-	-	≤ 500	200	-	1 000	500	-	-		174	170	168
Total Dissolved Solids	TDS	mg/l	1200	-	-	-	450			1600				463	462	469
Aluminium	Al	mg/l	-	0.3	-	-	0.15	0.5	5			0.01		0.004	0.007	0.012
Calcium	Ca	mg/l	-	-	-	-	32		1000					46.8	46.6	49.1
Chromium	Cr	mg/l	-	-	0.05	-		0.1	1					-0.003	-0.003	-0.003
Copper	Cu	mg/l	-	-	2	-		0.2			0.8			-0.002	-0.002	-0.002
Iron	Fe	mg/l	0.3	-	2	-	0.1	5	10	10				-0.004	-0.004	-0.004
Potassium	K	mg/l	-	-	-	-	50							7.36	7.64	7.86
Magnesium	Mg	mg/l	-	-	-	-	30		500					28.9	29.1	29.8
Manganese	Mn	mg/l	0.1	-	0.4	-	0.05	0.02	10	10	0.18			-0.001	-0.001	-0.001
Sodium	Na	mg/l	200	-	-	-	200	70	2000					66.3	67.3	69.3
Nichel	Ni	mg/l	-	-	0.07	-		0.2	1					-0.002	-0.002	-0.002
Total hardness	Total hard (C	mg/l	-	-	-	-	-	1000	-	250	-	-		236	236	245
Turbidity	Turbidity	NTU	1	5			-	-	-	-	50	-		5.06	2.41	1.74
Nitrite	NO_2	mg/l	-	-	0.9	-	-	-	-	-	-	-		0.113	0.095	0.109
Ammonium (NH_4)	NH_4	mg/l	-	-	-	-	-	-	-	-	-	-		0.009	0.034	0.06
Orthophosphate (PO_4)	PO_4	mg/l	-	-	-	-	-	-	-	-	0.01	-		0.033	0.031	0.03

3.2 Limitations and Further Work

Sampling was done during a dry period (August 2019) and serves as a baseline description of the quality of surface water on site. These are once-off samples and do not necessarily indicate average quality at the site. Although dilution typically happens in the wet season and resulting in a reduction of the concentrations of some parameters, parameters like turbidity may the increased from runoff during the wet season. Therefore, monitoring of water quality for the project should be conducted before commencement of construction activities, including a wet season sample. Construction is best in the drier season and should avoid periods of heavy rains. A longer baseline record is always vital to improving the baseline data. It is essential to have a good baseline for the protection of the resources as well as due diligence for the Nyamane Project.

4 Storm Water Management Plan

As presented in Sections 1.3.1 and 1.3.2, the storm water management and drainage planning are critical for the management of water and waste at project sites. A Storm Water Management Plan (SWMP) needs to be developed under the guidance of the Department of Water and Sanitation (DWS) Best Practice Guidelines (BPG) (DWS, 2006) focusing on storm water management (BPG: G1).

The following definitions from GN 704 are appropriate to the classification of catchments and design of stormwater management measures for the proposed project

- **Clean water system,** includes any dam, other forms of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted (clean) water;
- **Dirty area,** means any area at a mine or ***activity*** which causes, has caused or is likely to cause pollution of a water resource; and
- **Dirty water system** includes any dam, other form of impoundment, canal, works, pipeline, residue deposit, and any other structure or facility constructed for the retention or conveyance of water containing waste.

4.1 Stormwater Management Measures

Based on a review of the proposed Nyamane Project site layout, presented in Figure 4-1 below (also read with Figure 1-1) the following stormwater management measures are recommended:

- The clean and dirty water catchment areas should be managed separately. The clean and dirty water are classified based on the expected quality of stormwater generated from the different catchments as, where:

  - Clean water catchment areas include the administration buildings, accommodation buildings, access gate, parking areas, area upstream of processing facility; and
  - Dirty water catchment areas include the tomato process facility, workshop areas and coal handling area (storage bund, loading and offloading).

- Clean stormwater from upstream of the processing facility infrastructure will be prevented from entering dirty water catchments by creating clean water diversion perimeter berms around the facility footprint (channels and berms).
- Where possible the diverted clean stormwater in the channels must pass through stormwater flow velocity attenuation and erosion control systems such as swales, berms, soil fences and detention ponds which should be constructed. Furthermore, the same measures can facilitate the settling of any eroded sediments.
- The stormwater control measures should be monitored and adjusted to ensure complete erosion and pollution control at all time.
- Tractor parking and repair workshops will be located on a paved surface, with the runoff collected into channels linked to an oil separator collection sump.
- Open channels are preferred for ease of maintenance.
- During the construction of the stormwater management measures at the site, where slopes are steep or flat, ground levels need to be adjusted. Re-designing the slopes ensures the achievement of controlled drainage gradients and removal of low spots. Slopes will need to be confirmed through more detailed design work.
- In the flatter areas (especially in the farming area) where soil conditions are favourable, infiltration measures will be the preferred form of on-site stormwater control and disposal.
- The consideration and incorporation of the statutory requirements of various regulatory agencies and the interests of stakeholders are required in the SWMP implementation.

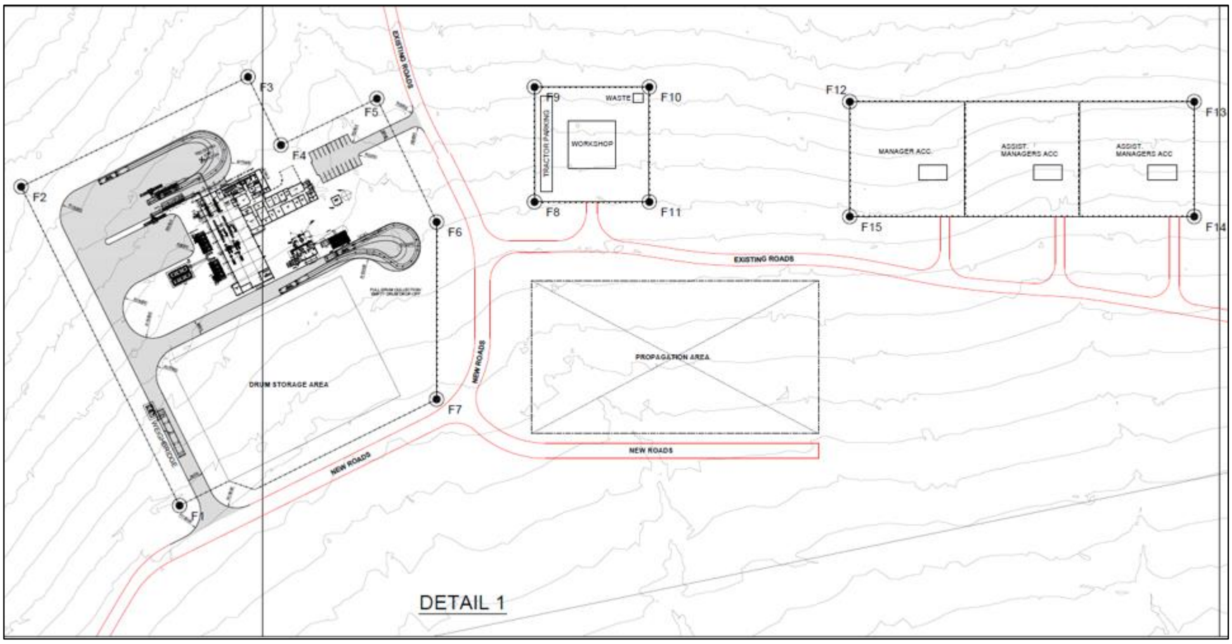


Figure 4-1: Proposed Process Workshop and Accommodation Area

5 Impact Assessments

The potential impacts and mitigation measures of the proposed activities on surface water receptors are discussed in the section below:

5.1 Receptor Sensitivity

This study determined nearby surface water receptors as the Olifants River and minor drainage lines / non-perennial tributaries within the project area, which are all considered as sensitive areas. The collected samples indicate that the surface water quality of the Olifants River is relatively pristine, with only turbidity exceeding the SANS 241:2015 drinking water standards for operational and aesthetic use. Furthermore, the water exceeds the South African Water Quality Guidelines -(SAWQG), 1996- Target Water Quality for Domestic Use for total dissolved solids, electrical conductivity and calcium. The watercourses are sensitive resources, and their almost pristine nature should be preserved for downstream water uses.

The 1:100-year flood-lines were delineated for the Olifants River and minor drainage lines within the study area. Any area located within the flood-lines extent is considered sensitive, and no infrastructure with potential impact should be established within these flood-lines.

5.2 Impact Identification

Table 5 1. below presents the identified impacts associated with the tomato farming and the tomato processing facility activities on the surface water resources.

Table 5-1: Summary of Identified Potential Impacts

Project Activities	Interaction	Impact description
Construction		
Site clearing for farming and tomato plant, preparations and construction of new surface infrastructures such as roads, pipelines, pump station, storage ponds, tomato processing facility warehouses, and ancillary structures	Water quality	Deterioration of water quality as a result of the following • Siltation of watercourses - When a large area of vegetation is cleared coupled with heavy vehicle movement, the topsoil is exposed and disturbed, resulting in a large area of loose material, susceptible to erosion. During rainfall events, runoff from the exposed site will transport the eroded soil material into the nearby watercourses. • Chemical and hydrocarbon contamination of watercourses - Uncontrolled spills of contaminants such as fuel and oils, solvents, paints, and waste materials, and subsequent washing away of these into the surface water resources result in water contamination.
Clearing of the vegetation for construction activities, Construction of instream weir across or extraction chamber next to the Olifants River, construction of pipelines, reservoir and Olifants River pump station	Water quantity	• A reduction of the runoff catchment area and change of flow regime - When the initial stormwater management measures and erosion control measures within the farming areas are constructed, the catchment area for runoff entail for quaternary catchment B52A by 3%. This would also alter the runoff to the Olifants River and tributaries. When coupled with the modifications in the river channel for the construction of an abstraction system, the flow regime of the Olifants River
Operation		
Operation of surface infrastructure (nursery, irrigated farming, diversion channels, irrigation pond/ reservoir, stockpiles, offices, cola handling areas storage of farming equipment and chemicals (including pesticides and fertilisers), waste dump), diesel storage tanks, and workshops	Water quality	Deterioration of water quality as a result of the following: • Sedimentation and hydrocarbons contamination of the surface water resources. All resulting from - Erosion of loosened soil material during the operation of the farms and roads and washing away of spillage fuels during refuelling at the workshops - spills, overflows, contaminated runoff as well as the improper material deposition onto the waste facility. • Chemical and nutrient contamination – aquatic eutrophication and ecotoxicity of watercourses may result. The main culprits are nitrogen in the form of nitrate, phosphorus from phosphate fertilisers and pesticides mobilised towards the watercourses in stormwater runoff.
Farming and abstraction of water for irrigation purposes	Water quantity	• Reduction of downstream water availability – The abstraction of water at the pumping stations may reduce the water flow in the Olifants River, although this is typically informed by Ecological Reserves determined by Department of Water and Sanitation (DWS) any deviation from the allocated amount can have negative impacts for downstream users.

5.3 Impact Rating

The design for the proposed Nyamane project includes various mitigation by design measures presented in the stormwater management plans and the flood lines determination as exclusion zones. If these design standards were not considered, the potential impacts on the environment would be much higher, and the project would almost certainly not be allowed to proceed without compliance with current best practice and relevant industry guidelines and consideration of any DWS recommendation.

The potential impacts (unrealistic worst-case scenario), and residual impacts of the project after considering the mitigation measures proposed within this report are assessed in this section. Some of the impacts identified in Table 5-1 are relevant during both construction and operational phases, and they were, rated once. The impacts rating methodology is presented in Appendix C and ranking is summarised in Table 5-2 below.

Table 5-2: Summary of Impacts Significance Ranking Scales

Numerical Value	Description	Numerical Value	Description
Extent		**Duration**	
5	International	5	Permanent
4	National	4	Long term (ceases after the operational life span of the project)
3	Regional/District	3	Medium term (5-15yrs)
2	Local (site boundary and immediate surrounds)	2	Short term (1-5yrs)
1	Site (site only)	1	Immediate (<1year)
Magnitude		**Probability**	
10	Very high / unsure (environmental functions permanently cease)	5	Definite
8	High (environmental functions temporarily cease)	4	High probability (most likely to occur)
6	Moderate (environmental functions altered but continue)	3	Medium probability (distinct probability that the impact will occur)
4	Low- negative	2	Low probability (unlikely to occur)
2	Minor- negative	1	Improbable (probability very low due to design or experience)
0	None	0	None (the impact will not occur)

5.3.1 Construction Phase

Construction activities include initial earthworks associated with site clearing, stripping and stockpiling of soil resources, preparations and construction of surface infrastructure as well as transport movement in and out of site with material.

5.3.1.1 Water Quality

The water resources are relatively pristine in terms of chemical contaminants except for Ca and TDS and EC. In terms of physical contamination, the turbidity for the baseline water quality exceeds operation and aesthetic quality standards. As a result, the impacts are anticipated to be of moderate magnitude. Table 5-3 and Table 5-4 below present the impact rating.

Table 5-3: Impact - Sedimentation of Watercourses

Issue	Corrective measures	Impact rating criteria					Significance
		Nature	Extent	Duration	Magnitude	Probability	
Erosion and sedimentation	No	Negative	4	2	6	3	36 Medium
	Yes	Negative	2	2	4	2	16 Low
Corrective Actions	• The construction of the tomato processing facility must be during the dry season • The construction of surface stormwater drainage systems must be done in a manner that would protect the quality and quantity of the downstream system. • Erosion control of all riverbanks and farms plots must be undertaken to reduce erosion and sedimentation processes. • Site roads should be well signposted, and speed limits should be adhered to at all times. This assist in preserving site roads and preventing soil from being washed into watercourses. • Stormwater channels should be protected against erosion through vegetation and flow energy dissipators constructed on steep slopes and areas of high runoff velocity.						

Table 5-4: Impact - Chemical and Hydrocarbon Contamination of Watercourses

Issue	Corrective measures	Impact rating criteria					Significance
		Nature	Extent	Duration	Magnitude	Probability	
Contamination	No	Negative	4	4	8	3	48 Medium
	Yes	Negative	1	4	4	2	18 Low
Corrective Actions	• Vehicles and machinery should be serviced and maintained regularly to prevent hydrocarbon spillages that may wash off into nearby watercourses during the rainy season.						

5.3.1.2 Water Quantity

The proposed project footprint of approximately 17.04km^2 is relatively small compared to the Olifants River catchment and the B52A quaternary catchment occupying approximately 3% of the catchment. When farming and processing sites are established, there is a requirement for containment of dirty stormwater from the footprint. The containment of stormwater needs to be contained, thereby reducing catchment contributing to catchment runoff. These impacts have limited direct corrective actions that one can implement to reduce the loss of runoff.

Table 5-5: Impact - Reduction of runoff catchment and change of flow regime

Issue	Corrective measures	Impact rating criteria					Significance
		Nature	Extent	Duration	Magnitude	Probability	
Surface water quantity	No	Negative	3	4	4	4	44 Medium
	Yes	Negative	2	4	4	3	30 Medium
Corrective Actions	• Minimise the dirty area, to ensure free drainage of the clean stormwater to the catchment watercourses • Design of weirs or any streamflow altering infrastructure should consider the stream geomorphology and velocities • No direct mitigation exists as stormwater management measures have to remain for the protection of water quality.						

5.3.2 Operational Phase

The operational phase activities include turning the soil for farming, water abstraction, tomato paste plant operation, discharge of wastewater from the processing facilities, use of unsurfaced haul roads, and generation and disposal of waste on-site.

5.3.2.1 Water Quality

The water resources are relatively pristine in terms of chemical nutrients all within the SANS241:2015 standards and DWS, 2016 Guidelines. As a result, the impacts are anticipated to be of high in magnitude. Some of the impacts are the same as for construction activities and are rated once. The additional impacts rated in Table 5-6 below.

Table 5-6: Impacts – Chemical and Nutrient Contamination

Issue	Corrective measures	Impact rating criteria					Significance
		Nature	Extent	Duration	Magnitude	Probability	
Fertiliser nutrient contamination	No	Negative	4	4	8	3	48 Medium
	Yes	Negative	2	4	4	2	20 Low
Corrective Actions	• Storage of fertilisers should be in an area that is lined with concrete or other impermeable material and covered from rainfall. • Regulate fertiliser application following monitoring of crop nitrogen needs and use precision application methods to prevent over-application of fertilisers • Regulate timing of fertiliser application and • Regulate irrigation which will reduce water return flows and therefore can significantly reduce the migration of fertilisers and pesticides to water bodies • Choose lower nitrogen fertilisers, such as urea-based products, over calcium ammonium nitrate. • Choose less toxic herbicides and pesticides and use Integrated Pest Management						

5.3.2.2 Water Quantity

The DWS controls the allowable abstraction of water by project proponents to ensure that the minimum ecological reserve is preserved for the Olifants River Catchment. Some of the impacts are the same as for construction activities and are not rated again. Table 5-7 below presents the impact rating of the identified impacts.

Table 5-7: Reduction of Downstream Freshwater Availability

Issue	Corrective measures	Impact rating criteria					Significance
		Nature	Extent	Duration	Magnitude	Probability	
Water Abstraction	No	Negative	3	4	6	3	39 Medium
	Yes	Negative	2	4	4	2	20 Low

Corrective Actions	• Water use efficiency measures should be implemented such as
	  ○ Efficient irrigation schemes by ensuring that the irrigation process is controlled.
	  ○ Use of water conservative irrigation techniques (e.g. drip over furrow irrigation or overhead).
	  ○ Reuse dirty water as much as possible onsite at the tomato processing facility instead of obtaining fresh water from the catchment. Alternatively, treat dirty water to acceptable standards and then discharge to the catchment.
	• Fixing any significant leaks that may result in more water being abstracted to compensate the losses as soon as they appear
	• The loss of runoff water to the catchment will continue as long as stormwater management measures are in place.						

5.4 Mitigation Measures

Below is a summary of mitigation by design measures and additional mitigation measures recommended to further reduce any residual impacts on both surface water drainage quality and quantity.

Mitigation by design measures:

Flood-Lines: mapping has verified that the surface infrastructure complex is outside of the flood-lines. The flood level determination can be used to inform the detailed design of the access road which crosses the drainage lines and allows for free flow of the peak flows thereby reducing the probability of impacts the project infrastructure on the baseline flow and quality of the local watercourses during flood events.

Storm Water Management: the project design infrastructure, including the design of site infrastructure, was reviewed, and clean and dirty water catchments identified. Measures are proposed to collect and treat stormwater from dirty areas, thereby reducing the probability of impacts from the project infrastructure on the baseline water quality of the local watercourses.

Water reuse: A water recycling plant is proposed so that the process plant will strive to be “water neutral” implying that Nyamane prioritises the reuse of dirty water, thereby ideally reducing the impacts from the project on the surface water resources.

In addition to the measures presented and discussed throughout this report, the following management measures should be implemented:

- Infrastructure design: the design of all roads, plant areas, stockpiles, waste facilities and farming patterns should consider stormwater management and erosion control during both the construction and operational phases;
- Good housekeeping practices should be maintained by clean-up of spillages and materials build-ups, as well as ensuring all material is kept within the confined storage footprints. Furthermore, clean-up material and materials safety data sheets for chemical and hazardous substances should be kept on-site for immediate clean-up of accidental spillages of pollutants;
- Water management facilities inspection and maintenance should be undertaken throughout the project, to include inspection of drainage structures for erosion;
- Farming vehicles and plant equipment servicing should be undertaken within suitably equipped facilities, either within workshops or within bunded areas, from which any stormwater is conveyed to a pollution control sump, preferably after passing through and oil and silt interceptor; and
- Chemical Storage – any substances which may potentially pollute surface water should be stored within a suitably sized bunded area and where practicable covered by a roof to prevent contact with rainfall and runoff.

All measures implemented for the mitigation of impacts should be regularly reviewed as best practice and as compliance with various licences issued on site by authorities including the Water Use Licences (WULs).

5.5 Monitoring Program

A monitoring programme is an essential tool to identify any risks of potential impacts as they arise and to assist in impact management plans by assessing if mitigation measures are operating effectively. Monitoring should continue throughout the project life on the monitoring sites presented in Section 3, Figure 3-1.

The Table 5-8 below presents the recommendations for a surface water monitoring programme

Table 5-8: Surface Water Monitoring Programme

Monitoring Element	Description	Frequency
Water quality	Ensure that monitoring is implemented to cover all sites in Figure 3-1. Additional point SW IV should be accessible when the project is operational.	Monthly initially followed by quarterly if water quality results do not indicate a substantial change
Flow Volumes	Flow monitoring should be carried out in channels and pipelines and at abstraction and discharge facilities on site	Monthly
Water Levels	Monitoring water levels in reservoirs and channels	Monthly through the dry season and weekly through the wet season or after storm events
Pollutants	Site walkovers to determine the condition of facilities and identify any leaks or overflows, blockages, overflows and system malfunctions for immediate remedial action	Weekly
Water management structures	Inspection of channels, silt traps, culverts, pipeline, dam walls and dams for signs of erosion, cracking, silting and blockages of inflows, to ensure the performance of the SWMP remains acceptable.	Monthly during the wet season and after storm events Monthly in the dry season
Meteorological data	Measure rainfall for water balance updates where possible	Daily

The recommended analytical suite for water quality analysis is presented in Table 5-9 below. Where applicable, the analysis results must be compared to relevant water quality standards.

Table 5-9: Recommended Water Quality Analytical suite

pH Value @ 20°C	Bicarbonate, HCO_3
Sodium, Na	Sodium Absorption Ratio (SAR)
Conductivity mS/m @ 25°C	Chloride, Cl
Potassium, K	Aluminium, Al
Total Dissolved Solids	Sulphate, SO_4
Free and Saline Ammonia as NH_4	Manganese, Mn
Calcium, Ca	Nitrate, NO_3
Magnesium Hardness as $CaCO_3$	Iron, Fe
Calcium Hardness as $CaCO_3$	Fluoride, F
Total Hardness as $CaCO_3$	Chromium, Cr
Langelier Saturation Index (pH-pHs)	Total Suspended Solids
Total Alkalinity as $CaCO_3$	Phosphorus, P

5.5.1 Reporting

Reporting on the above monitoring should be as follows:

- Internal Reporting – Monthly: reporting for flow volumes, water levels, drainage inspections and pollutant inspections
- External Reporting – Annual: reporting for abstraction volumes, discharge volumes, water quality, spillages / Emissions

6 Conclusions and Recommendations

This surface water study report presents a description of the baseline hydrology of the site and surroundings. Although the legislation in the report is for mining projects, it has been referred to in compilation of this report as a best practice.

The project area falls within the Olifants WMA in the B52A quaternary catchment. The Olifants River is the only major perennial river passing on the southern boundary of the project area. Several non-perennial streams traverse the study area and drain in a southern direction towards the Olifants River. The site visit was undertaken during the dry season and as expected the non-perennial streams had no base flow. The mean annual precipitation and evaporation for the quaternary catchment B52A are 475 mm and 1900mm, respectively. The mean annual runoff (MAR) of the quaternary catchment is 4.59 million m^3.

An existing floodlines assessment report was reviewed and demonstrate that the project infrastructure is located outside of the flood-lines.

Three water quality samples were collected in August 2019, and the results indicate similar water quality at all three points. The baseline water quality is relatively pristine with most parameters within standards except:

- turbidity marginally exceeding the SANS 241:2015 drinking water standards for operational and aesthetic use;
- total dissolved solids, electrical conductivity and calcium exceeding the Target Water Quality for Domestic Use;
- electrical conductivity exceeding Target Water Quality for Irrigation; and
- chloride and alkalinity exceeding Target Water Quality for Industrial Use

The site layout and project infrastructure have been reviewed in the context of the baseline hydrology, and the potential unmitigated impacts were determined. The identified impacts are medium to low significance. A series of mitigation measures were developed for the project to minimise impacts on surface water resources.

Sampling was done during a dry period (August 2019) and serves as a baseline description of the quality of surface water on site. These are once-off samples and do not necessarily indicate average quality at the site. Therefore, monitoring of water quality for the project should be conducted before commencement of construction activities, including a wet season sample. Construction is best in the drier season and should avoid periods of heavy rains. A longer baseline record is always vital to improving the baseline data. It is essential to have a good baseline for the protection of the resources as well as due diligence for the Nyamane Project.

Chenai E Makamure (*Pr Sci Nat*)

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Appendix A: Declaration of Independence

Declaration of Independence by Specialist

I, Chenai E Makamure, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered; and
- I am a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Chenai E Makamure Pr. Sci. Nat
Hydrology Specialist
SACNASP Registration Number 400150/16
Signature of the specialist:

CM Eclectic (Pty) Ltd
Name of company (if applicable):

2019-09-18
Date:

Appendix B: Water Quality Results

aquatico Laboratories (Pty). Ltd.

ilac-MRA sanas Testing Laboratory T0685

Test Report Page 1 of 1

Client: Nsovo Environmental Consulting
Address: 349 Spur Road, Baleiluch, Midrand, 1684
Report no: 74248
Project: Nsovo Evironmental Consulting

Date of certificate: 16 September 2019
Date accepted: 09 September 2019
Date completed: 16 September 2019
Date received: 02 September 2019

Lab no:				42018	42019	42020
Date sampled:				24-Aug-19	24-Aug-19	24-Aug-19
Aquatico sampled:				No	No	No
Sample type:				Water	Water	Water
Locality description:	**Analyses**			Sample 1	Sample 2	Sample 3
		Unit	**Method**			
A	pH @ 25°C	pH	ALM 20	8.27	8.13	7.82
A	Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	71.7	71.9	72.8
A	Total dissolved solids (TDS)	mg/l	ALM 26	463	462	469
A	Total alkalinity	mg CaCO3/l	ALM 01	146	149	152
A	Chloride (Cl)	mg/l	ALM 02	48.1	48.2	49.3
A	Sulphate (SO_4)	mg/l	ALM 03	174	170	168
A	Nitrate (NO_3) as N	mg/l	ALM 06	0.358	0.310	0.332
A	Nitrite (NO_2) as N	mg/l	ALM 07	0.113	0.095	0.109
A	Ammonium (NH_4) as N	mg/l	ALM 05	0.009	0.034	0.060
A	Orthophosphate (PO_4) as P	mg/l	ALM 04	0.033	0.031	0.030
A	Fluoride (F)	mg/l	ALM 08	0.758	0.754	0.755
A	Calcium (Ca)	mg/l	ALM 30	46.8	46.6	49.1
A	Magnesium (Mg)	mg/l	ALM 30	28.9	29.1	29.8
A	Sodium (Na)	mg/l	ALM 30	66.3	67.3	69.3
A	Potassium (K)	mg/l	ALM 30	7.36	7.64	7.86
A	Aluminium (Al)	mg/l	ALM 31	0.004	0.007	0.012
A	Iron (Fe)	mg/l	ALM 31	<0.004	<0.004	<0.004
A	Manganese (Mn)	mg/l	ALM 31	<0.001	<0.001	<0.001
A	Chromium (Cr)	mg/l	ALM 31	<0.003	<0.003	<0.003
A	Copper (Cu)	mg/l	ALM 31	<0.002	<0.002	<0.002
A	Nickel (Ni)	mg/l	ALM 31	<0.002	<0.002	<0.002
A	Turbidity	NTU	ALM 21	5.06	2.41	1.74
A	Total hardness	mg CaCO3/l	ALM 26	236	236	245

A = Accredited N = Non accredited Out = Outsourced Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternativ test report ; The results relates only to the test item tested; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory
The results apply to the sample received.

M. Swanepoel
Technical Signatory

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Appendix C: Impact Assessment Methodology

The impact assessment is undertaken using the following methodology

Status of Impact
The impacts are assessed as either having a:
The negative effect (i.e. at a `cost' to the environment),
Positive effect (i.e. a `benefit' to the environment), or
Neutral effect on the environment.

Extent of the Impact
(1) Site (site only),
(2) Local (site boundary and immediate surrounds),
(3) Regional,
(4) National, or
(5) International.

Duration of the Impact
The length that the impact will last for is described as either:
(1) Immediate (<1 year)
(2) Short term (1-5 years),
(3) Medium term (5-15 years),
(4) Long term (ceases after the operational life span of the project),
(5) Permanent.

Magnitude of the Impact
The intensity or severity of the impacts is indicated as either:
(0) none,
(2) Minor,
(4) Low,
(6) Moderate (environmental functions altered but continue),
(8) High (environmental functions temporarily cease), or
(10) Very high / unsure (environmental functions permanently cease).

Probability of Occurrence
The likelihood of the impact actually occurring is indicated as either:
(0) None (the impact will not occur),
(1) Improbable (probability very low due to design or experience)
(2) Low probability (unlikely to occur),
(3) Medium probability (distinct probability that the impact will occur),
(4) High probability (most likely to occur), or
(5) Definite.

Significance of the Impact

Based on the information contained in the points above, the potential impacts are assigned a significance rating (S). This rating is formulated by adding the sum of the numbers assigned to the extent (E), duration (D) and magnitude (M) and multiplying this sum by the probability (P) of the impact.

$S = (E+D+M) P$

The significance ratings are given below

- (<30) low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- (30-60) medium (i.e. where the impact could influence the decision to develop unless it is effectively mitigated),
- (>60) high (i.e. where the impact must influence the decision process to develop in the area).

Appendix D: Consultant Profile

Chenai E. Makamure (Pr. Sci. Nat)

Hydrologist

Qualifications and Accreditation

Pr Sci Nat	2016	Professional Natural Scientist registered with SACNASP
MSc	2010	Integrated Watershed Modelling and Management-
BSc (Hons)	2005	Applied Environmental Science

Expertise

- Baseline Hydrology Studies
- Hydrological Impact Assessment
- Water Balance Modelling
- Stormwater Management
- Water Resource Management
- Flood Modelling
- GN704 Auditing
- Integrated Water and Waste Mangement Plans

Chenai is a Hydrologist based in Johannesburg and has over 13 years' work or experience within the water and environmental sector; above 7 of which are in consultancy for mining, energy and infrastructure projects within Africa.

Chenai has broad experience from working in consulting, mining industry and the quasi-government sector, which gives advantage to the understanding of environmental issues in the various industrial sectors (mining, power, infrastructure development, agriculture and renewable energy). She specialises in hydrology, flood lines and flood risk assessments, stormwater management, mine water balances and water quality. Chenai makes inputs into the various stages of projects planning (gap analysis, scoping, and impact assessments) and implementation for environmental authorisations of different projects, including monitoring of water quality and quantity aspects.

Chenai works with clients, specialists and environment managers on sustainable water management issues. She has worked on projects that require compliance with the South African NEMA and NWA legislation, World Bank, IFC standards and other African countries legislation in the DRC, Sierra Leone, Liberia, Malawi, Mali, Ghana, South Africa, Zambia and Zimbabwe.

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