List of Abbreviations and Acronyms

/a	: Per annum
m^3	: Cubic meter
m^3/a	: Cubic meter per annum
BPG	: Best Practice Guideline
DWS	: Department of Water and Sanitation
EAP	: Environmental Assessment Practitioner
EIA	: Environmental Impact Assessment
EMP	: Environmental Management Plan / Programme
ha	: Hectares
IWULA	: Integrated Water Use License Application
IWWMP	: Integrated Water and Waste Management Plan
LoM	: Life of Mine
Mm	: Millimeter
MAP	: Mean Annual Precipitation
MAR	: Mean Annual Runoff
PCD	: Pollution Control Dam
SAWS	: South African Weather Services
WMA	: Water Management Area
WRC	: Water Research Commission

1. Introduction

Letsolo Water and Environmental Services cc was appointed to conduct the Hydrological Impact Assessment Study for West Coast Resources (Pty) Ltd, hereafter referred to as WCR. WCR is a merger between Trans Hex Operations (Pty) Ltd, various companies and the Government Sector.

WCR intends to re-visit and mine a number of mines on the Namaqualand coast, particularly those in the existing mining licences for Koingnaas 475 and Samson's Bak 330.

WCR is re-establishing diamond mining in Koingaas area (Koingnaas Mine) under the existing Environmental Authorisation of July 2012. Diamond mining itself does not require the use of hazardous substances, as it is mostly a physical process. However, management of waste on site may have an influence on storm water. The mine is focused on ensuring that all operations and facilities manage effluents, wastes, emissions and hazardous substances to prevent pollution.

The mining approach would involve the construction of cofferdams in the intertidal area to optimise the extraction of coastal diamond resources, an amendment of the current environmental authorisations over these mining rights areas is required. These Authorisations trigger the need for the Hydrological Impact Assessment Study. This report provides details relating to the methodology applied for the hydrological Impact Assessment as well as the findings made.

The identified potential Hydrological Impacts Associated with the proposed Diamond Mining Activity were categorised as follows:

- Sediment Transport;
- Alteration of Water Quality;
- Alteration of Catchment Characteristics

ll There potential impacts were rated low.

1.1 Details of specialist

(a) Details of the specialist who prepared the report;

Details of the specialist who prepared this report are summarised as follows:

Surname	: Phalane
First Names	: Ishmael Letsolo
Specialty	: Hydrology
Entity	: Letsolo Water and Environmental Services
Cell phone number	: 082 821 6621
Work telephone no.	: 012 321 0073
Identity no	: 800602 5393 082
Nationality	: South African
NQF Level 5	: Baccalaureus Technologiae: Civil Engineering
Professional Registration 201480763	: Engineering Council of South Africa Reg No.
	: Water Institute of South Africa
	: Institute of Directors of South Africa

(b) The expertise of that specialist to compile a specialist report including a curriculum vitae;

Mr Phalane has more than 13 years' experience in the field of Hydrological Engineering (Hydraulics, Water Quality and Quantity). Over the years Mr Phalane gained valuable experience in the implementation of the National Water Act, 1998 (Act 36 of 1998), National Water Resource Strategy, implementation of the General Authorizations as well as Water Use License Authorizations.

Mr Phalane has extensive experience in Hydrological Impact Assessment for Environmental Impact Assessments (EIA's), Environmental Management Program

Reports (EMPR's), Site Management Plans, Water Balance Calculations, Mine Closure Applications and Water Conservation/Demand Management Principles.

Mr Phalane was appointed as a Technical manager by the Department of Water and Sanitation (DWS) during the Revision of Government Notice 704 (GN704) for the period starting on the 10th of January 2013 and ending on the 31rst of December 2013.

Mr Phalane was also part of the technical team assessing the Water Use License Applications on Behalf of the Department of Water and Sanitation (Letsema Backlog Project). Specifically, to review Storm Water Management Plans (SWMP), Hydrological Impact Assessment Reports (HIAR), Water Quality Management Reports (WQMR), Integrated Water And Waste Management Plans (IWWMP) and Section 27 Water Use Motivations. Mr Phalane also compiled the Record of Recommendation to be considered and approved by the Director General (DWS), on behalf of the Regional Director (DWS) (01 April 2013 – 31 March 2014).

Mr Phalane was part of the negotiation team during the transfer of Sand-Vet Government Water Scheme to Sand Vet Water User Association in 2001.

In the field of Civil Engineering Mr Phalane gained valuable experience in calculation and analysis of hydrological data and liaison with different organizations in the private, governmental and international sectors, through negotiations with Irrigation Boards. He is practical and have the ability to, logically and strategically, resolve a problem and to work under pressure of a deadline.

As a director, Mr Phalane is involved in strategic decision making in line with the company's vision, mission and values to ensure long term sustainability of the company during the recession time and beyond by being competitive, by developing staff as well as personal development in top management.

In today's engineering industry, new technologies and practices are making a significant difference on how projects get delivered. But the application of new tools, technologies, and practices may seem confusing. With his extensive experience, Mr Phalane has the ability to assist.

2. A declaration that the specialist is independent in a form as may be specified by the competent authority;

I, Ishmael Phalane, act as the independent specialist. I declare that there are no circumstances that may compromise my objectivity in performing such work. I have expertise in conducting the Hydrological Impact Assessment specialist study and report relevant to the environmental authorisation applications.

I confirm that I have knowledge of the relevant environmental Acts, Regulations and Guidelines that have relevance to the proposed activity and my field of expertise and will comply with the requirements therein. 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;All particulars furnished by me in this report are true and correct.

I realise that a false declaration is an offence in terms of regulation 48 of the National Environmental Management Act, 107 of 1998 (NEMA) and is punishable in terms of section 24F of the Act.

Signature of the environmental assessment practitioner:

Letsolo Water and Environmental Services cc

Name of company:

28 July 2016

Date:

3. An indication of the scope of, and the purpose for which, the report was prepared;

3.1 Scope of work

The Scope of work for the Hydrological Impact Assessment allows for the following:

- Identify Water Management Areas and Quaternary Catchment Areas in the Project area;
- Determine the current status of any surface water resources which are in the potential affected area or may be affected by the activities in terms of existing resource objectives, inclusive of water quality and in-stream flow;
- Flood line delineation;
- Develop and align the storm water management plan and water balance calculations in line with the Department of Water and Sanitation requirements.
- Review and update the surface water monitoring plan and parameters

3.2 Purpose of the Hydrological Impact Assessment

The Hydrological Impact Assessment is required to predict and quantify the potential impacts on surface water resources as well as to recommend reasonable mitigation measures. This Assessment is fundamental to the discipline of environmental management and is a requirement of environmental impact assessments (EIA), water use license applications (WULA), Environmental Management Programmes (EMP), mine closure plans and other studies.

In each instance there is a need to understand the future impact of a proposed / current activity and to then determine whether the management measures applied to that activity are appropriate or whether they should be modified. For the above reasons caution was fully exercised in applying hydrological impact prediction approaches and protocols developed to suit the regulatory environment.

4. The date and season of the site investigation and the relevance of the season to the outcome of the assessment;

A site visit was conducted on 23 June 2016. The purpose of the site visit was to obtain the understanding of current and intended activities in order to produce a site specific scope of work and clear deliverables.

No water quality samples were collected as the site investigation was undertaken during the dry season. No significant flow was observed on site nearby streams (Swartlintjies and Spoeg). Due to the nature of these streams, even during the wet season, flow is for a very short time.

5. A description of the methodology adopted in preparing the report or carrying out the specialised process;

A holistic approach is followed whereby the project area is analysed and compared against greater Water Management Areas (WMAs) and Quaternary Catchment Areas.

Desktop Assessment was conducted. During this phase, existing hydrological information was reviewed and assessed for relevance to the study area. A site visit was conducted in order to obtain an understanding of the hydrology in and around the site. Due to the nature of the water resources, no flow was observed during the assessment phase. Therefore, no water quality samples could be collected.

The specific process followed in the assessment is summarized as follows:

- Visual assessment of the site and obtaining an understanding of the hydrological conditions;
- Plotting of spatial data to asses hydrological characteristics;
- Building different computer models (for different applications) that represent the site as accurately as possible; and
- Analysing the models in order to obtain the most desirable outputs and deliverables.

There are different hydrological calculation methods that can be used to calculate flows and drainage in South Africa, the most common being:

- Rational method
- Alternative Rational method
- Unit Hydrograph method
- Standard Design Flood (SDF) method
- Empirical method

The Standard Design Flood (SDF) calculation method was selected as the most reliable method for the natural delineated catchments with a surface area exceeding 15km^2.

6. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;

WCR has an existing converted mining rights and prospecting rights over the area. The Mining/Prospecting Rights and their portions comprise:

1. Koingnaas – reference number SNC 522 MRC
    a. Portion of remaining extent of the farm Somnaas No 474,
    b. Portion of the farm Koingnaas No 475,
    c. Portion of the farm Swartlintjies No 484,
    d. Adjacent Sea Strips now described as unalienated state land, Portion of the Farm Langklip No 489,
    e. Portion of the farm Mitchels Bay No 495 and adjacent Sea strips now described as state land.
2. Samson's Bak - reference number SNC 525 MRC
    a. Portion of the farm Elandsklip 333,
    b. Portion of the Farm Koignaas 475

c. Portion of the farm Noup 473,
d. Portion of the farm Samson's bak 330,
e. Portion of the farm Schulpfontein 472,
f. Portion of the Remaining Extent and Portion 1 of the farm Somnaas 474 and
g. Portion of the farm Zwart Dunnen 332

6.1 Study Area/Site location

West Coast Resources is situated within the jurisdiction of South Africa, west coast in Nama Khoi Local Municipality, Richtersveld Local Municipality and Kamiesberg Local Municipality, Namakwa District Municipality in the Northern Cape area.

WCR is re-establishing diamond mining in Koingaas area under the existing Environmental Authorisation of July 2012. The operation of the mining activities will take place on Samson Bak Complex MR (farm Elnadsklip 333, Koingnaas 475, Noup 473, Samson's Bak 330, Schulpfontein 472, Zwart Dunnen 332 and Somnaas 474) and the Koingnaas Complex MR (farm Langklip 489, Mennels Vley 321, Koingnaas 475, Somnaas 474, Mitchell's bay 495 and Zwartlintjes River 484) within Namakwa District Municipality in the Northern Cape, South Africa.

West Coast Resources cover an area of 97 000 ha. West Coast Resources will have two plants in its operation of mining Alluvial Diamond during its life span. The plants will be situated on farm Koingnaas 475 and Mitchell's Bay 495 at West Coast Resources.

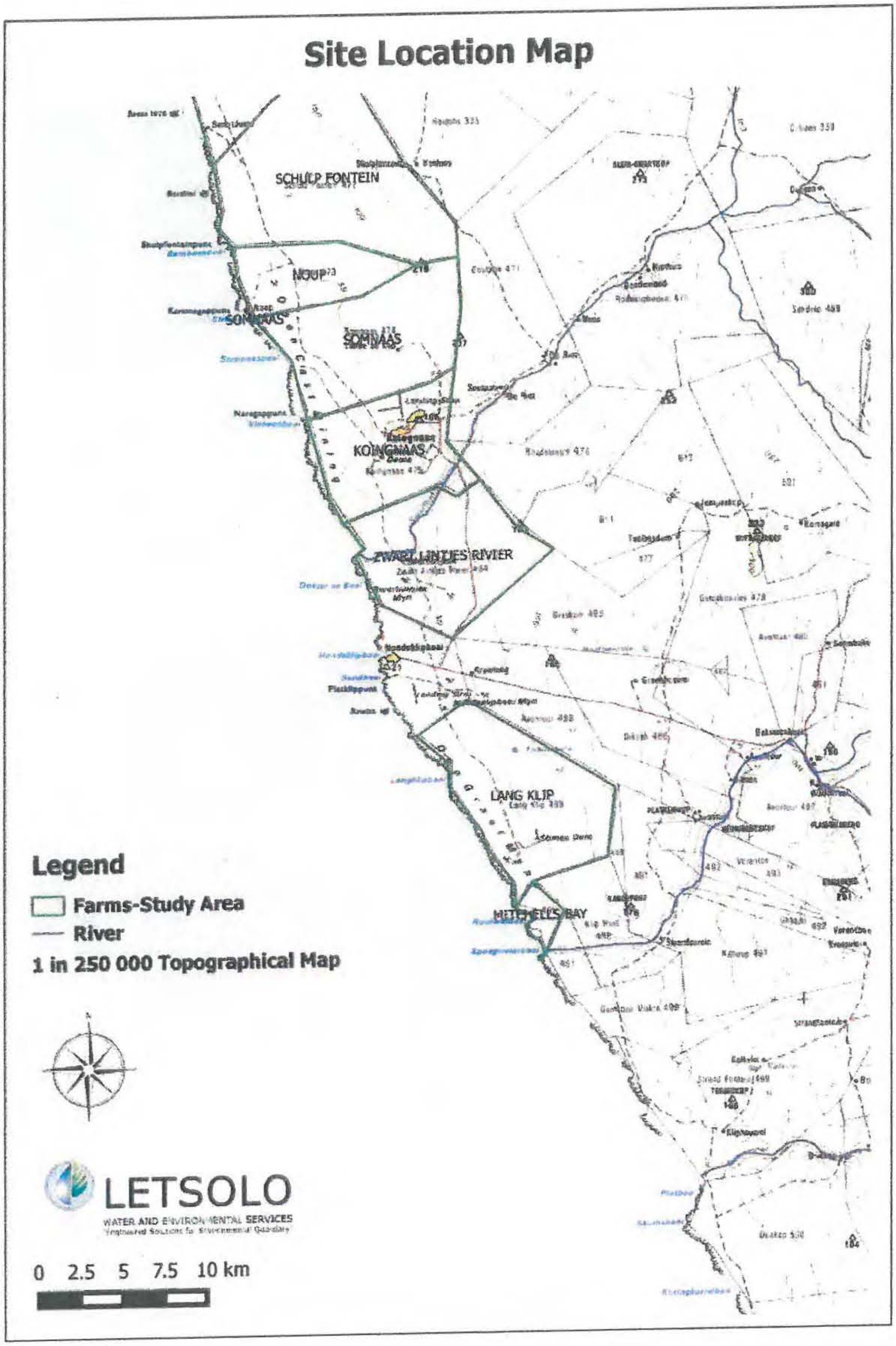


Figure 6.1-1: Site Location Map

6.2 Existing infrastructure

West Coast Resources is an existing mine which previously was under De Beer Consolidation Limited mine (Namaqualand mines), mining the alluvial diamond. When West Coast Resources (Pty) Ltd purchases the mine the existing structures was part of package.

The current activities are located as follows:

- Processing Plant located on the Remainder of the farm Koingnaas 475 and on the remainder of the farm Mitchell's Bay 495,
- WCR Buildings;
    - Administration buildings consisting of gate house, offices, first aid facility, parking bays, etc.;
    - Service buildings consisting of stores, weighbridge, substations, security kiosks, pump stations, access control building and emergency vehicle garage;
    - Workshop complex consisting of main workshops, workshop machinery/equipment, wash bay, tyre workshop, bulk fuel storage depot, light delivery vehicle workshop, etc.;
- Main entrance and access road;
- Haul roads;

6.3 Proposed Infrastructure

Over and above the existing infrastructure, the following mine related infrastructure will be required:

- Diversion berms and trenches, Slimes damsReturn Water / Pollution control dams (PCDs);

As indicated in **Figure 6.3-1**, all infrastructures which may have a potential impact on surface water resources were assessed. The hydrological characteristics of these activity areas are discussed further in the report.

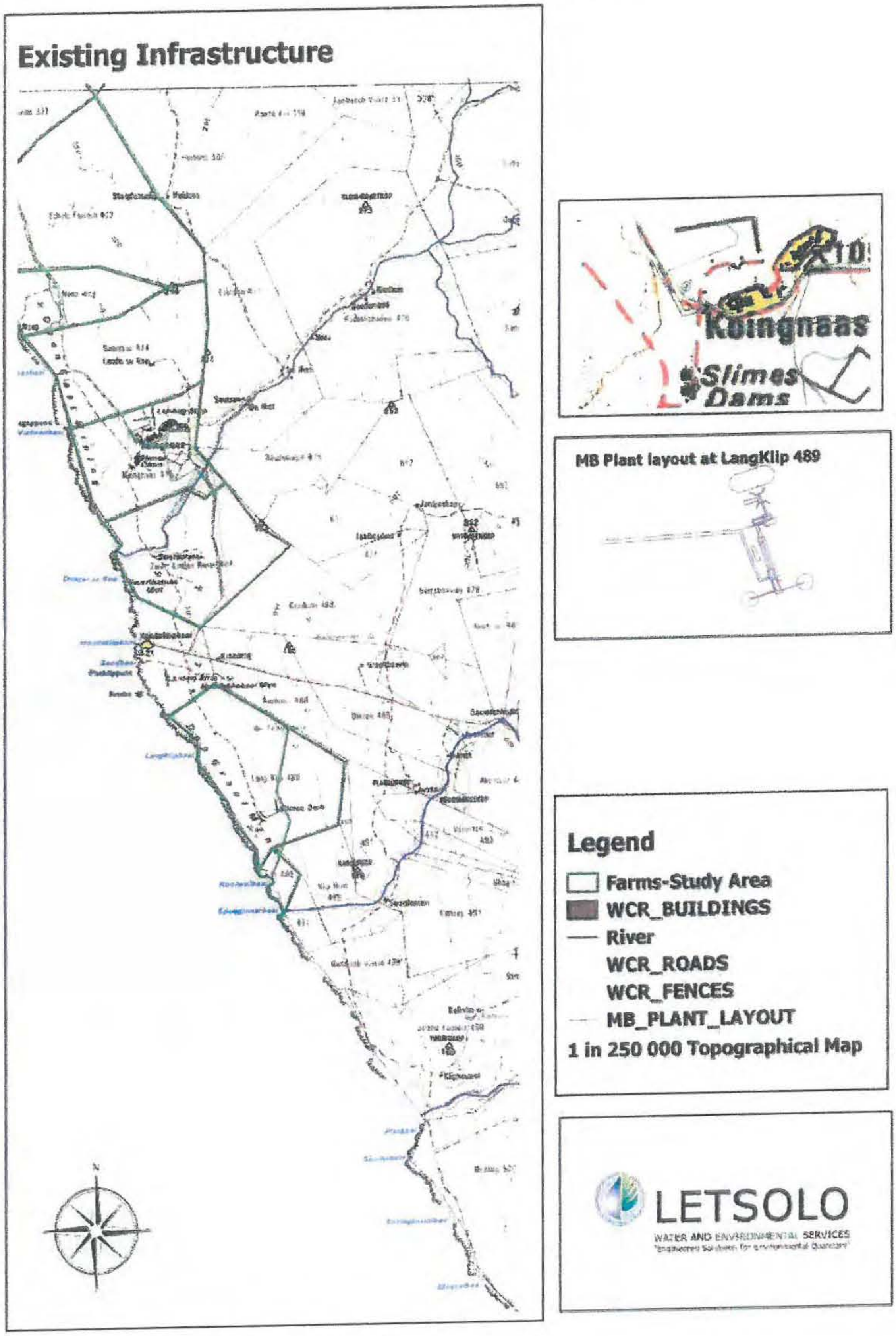


Figure 6.3-1 : Proposed Infrastructure

6.4 Catchment Analysis

The existing River systems in relation to the proposed project site are categorized in 3 Tiers as follows:

- Tier 1 : Water Management Area 14
- Tier 2 : Quaternary Catchment
- Tier 3: Site specific Catchment Areas

The WMA and catchment areas are discussed in detail below.

6.4.1 Source of Hydrological data

The following data, data sources, software, and methods were used in the assessment:

- Department of Water and Sanitation Hydrological Information Systems (B7E006):
  - Rainfall;
  - Evaporation;
- 1:50 000 topographical data (National Surveyor General) including the following:
  - Contours and
  - Rivers;
- The Utility Program for Drainage over South Africa (UPD) (SINOTECH, 2007):
- Google Earth Pro;
- Client data in the form of:
  - Total Project boundary;
  - Site specific boundaries;

6.4.2 Water Management Area (WMA14) – Lower Orange

The study area falls within WMA 14 – Lower Orange. WMA14 includes the following major rivers: Ongers, Hartbees and Orange.

The geographic extent of the Lower Orange WMA largely corresponds to that of the Northern Cape Province. It is situated in the western extremity of South Africa and borders on Botswana, Namibia and the Atlantic Ocean. According to the National Water Resource Strategy (2004), region's economy within the WMA14 depends extensively on mining and irrigation agricultural activities. Most of the mining activities are mainly extraction of alluvial diamonds and a variety of other minerals from locations both inland and along the coast.

Climate over the region is harsh semi-desert to desert. Rainfall is minimal, ranging from 20mm/a to a 400mm/a and is characterised by prolonged droughts. Because of the low rainfall, groundwater resources are also limited (*National Water Resource Strategy*, 2004).

The WMA14 has been dived into 3 sub-water management areas, which are Orange Coastal, Orange, and Orange Tributaries. For this specific study the sub area of interests is the Orange Coastal as all the quaternary catchments within the study area, namely F40A, F40D and F40F, fall in respectively.

6.4.3 Quaternary Catchments (F40A, F40D and F40F)

A catchment, in relation to a watercourse means the area from which any rainfall will drain into the watercourse or part of the water course through surface flow to a common point, or points (National Water Act, 1998, Act 36 of 1998).

The site falls within the F40A, F40D and F40F Quaternary Catchments.

6.4.4 Significant Surface Water Resources

The proposed mining activities are located in an arid area where there is little surface water resources.

According to the National Water Resource Strategy (2004) the Lower Orange WMA14 is impacted by upstream development, since it lies further downstream of five water management areas covering the Orange/Vaal basin. There are extensive inter-catchment transfers between most of these areas. For example the F40D quaternary catchment receives water from F40B quaternary catchment where the Swartlintjies River originates.

The study area lies in the F40A, F40D and F40F quaternary catchment regions that are draining to the sea with two significant non-perennial rivers, namely the Swartlintjies and the Spoeg River. However the study area lies mostly in F40A and F40F catchments.

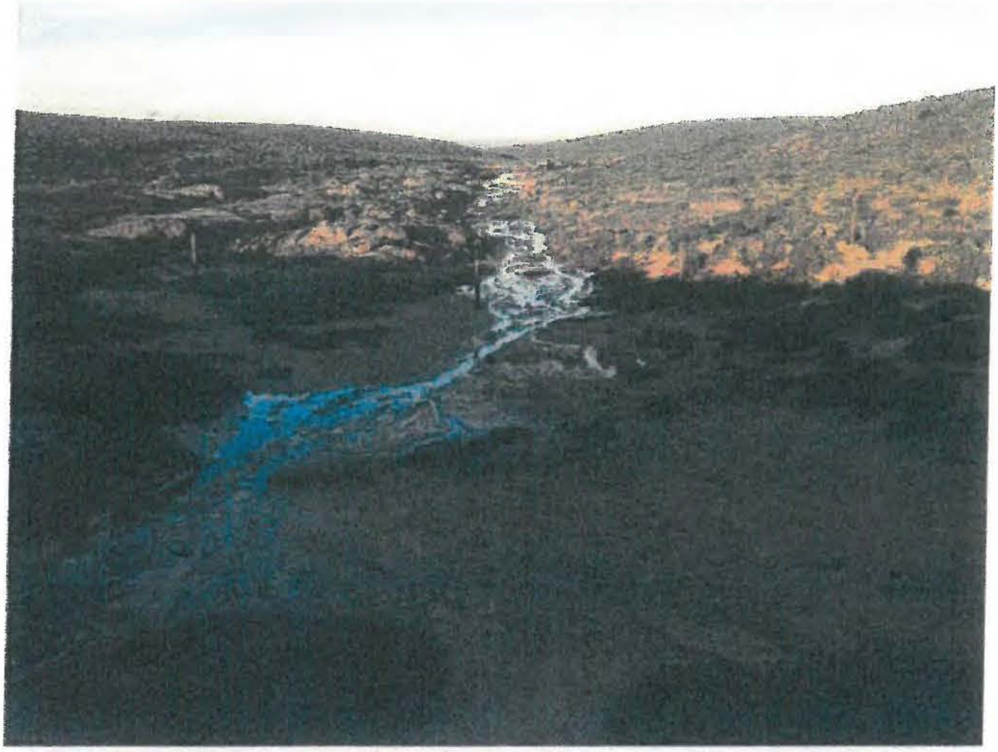
The flow characteristics of the Swartlintjies and the Spoeg Rivers are epheral (Short lived). This makes it difficult to have 12 months of water quality data in any given year. Water quality samples can only be collected during the wet season and shortly after a significant storm event.

6.4.4.1 Swartlintjies River

The Swartlinntjies River originates in the high ground of the escarpment, between Springbok and Kamieskroon. The River makes its way south westward, through Koignaas and into the Atlantic Ocean. An estuary is present at the mouth which is situated 6km north of Hondeklip Bay.

The Swartlintjies River traverse through the two quaternary catchments, F40B (draining in the South Westerly direction) and F40C (draining in the North Westerly direction), to the F40D catchment where Swartlintjies river transverse Koingnaas farm 475 to Zwartlintjies River 484 farm before it discharges to the sea in the south westerly direction. The river is 70 km long in extent from F40C while it extent to 64km from the F40B.

Due to the extent of the effective catchment area, strong flow can occur after prolonged rains. But the River is usually dry. Except for a few pools of standing water (as indicated in Picture below) , due to the high water table towards the mouth of the River.



Picture 6.4.4.1-1: Swartlintjies River Upstream of Hondeklip Bay

6.4.4.2 Spoeg River

Originating in the F40E catchment is the non-perennial Augabies River flowing north westerly then south for 44.2km before it discharges to non-perennial Spoeg River within this catchment. The Spoeg River arises in the high ground of the escarpment near Garies. This River drains in a north west and then west towards the Atlantic Ocean at Mitchell's Bay.

The Spoeg River then flows in the north westerly direction again for 28.9 km within F40E catchment to drain into the F40F catchment where it continues to flow for 22.5 km in south westerly then west direction traversing the southern part of Mitchell's Bay 495 farm to discharge at the Sea/ Atlantic Ocean.

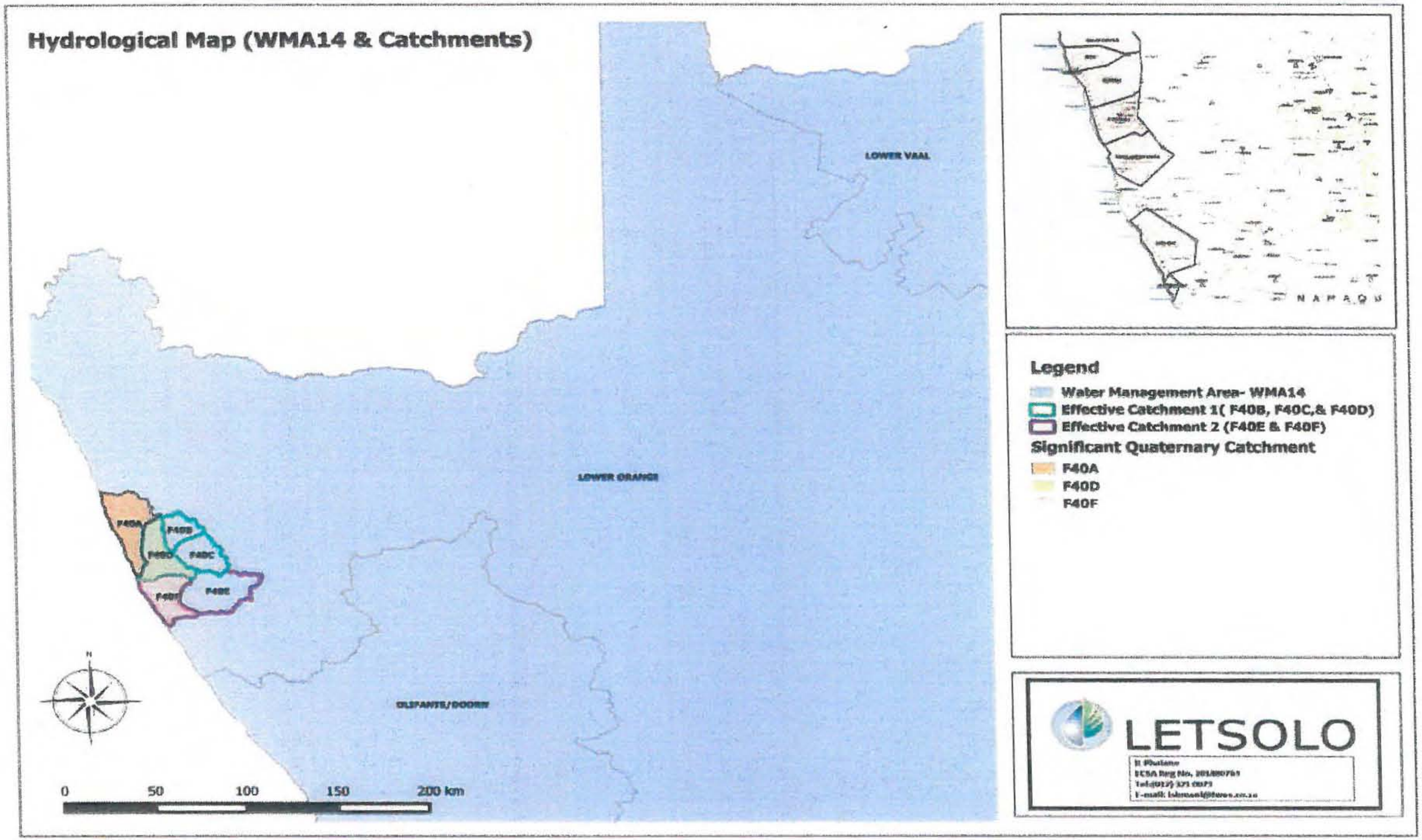


Figure 6.4.4.2-1: Hydrology Map (WMA14 and F40A, F40D, and F40 F Catchment)

6.5 Catchment Hydrology

The Department of Water and Sanitation (Hydrological Information System) was consulted in order to retrieve Hydrological data. Historic data for DWS Station F4E001, which is located in Hondeklip Bay area, was used for this assessment.

Table 6.5-0-1: Department of Water and Sanitation nearby Rainfall and Evaporation Station

Station Identity	Place	Latitude	Longitude
F4E001	Hondeklipbaai	30.31693	17.28269

6.5.1 Mean Annual Precipitation

Different rainfall data sources exist and data sets throughout the universe. All the sources have their own disadvantages and advantages. For the purpose of this study, hydrological information system from Department of Water and Sanitation (Hydrological Information System) was consulted in order to retrieve Hydrological data. Historic Hydrological data for Hondeklipbaai (F4E001) for a period starting on October 1964 and ending on September 1998 was used.

Mean Annual Precipitation (MAP) is representative of the average rainfall that occurs over an area during any given year. This rainfall is obtained by taking the total rainfall received over time at a specific point including any extreme periods and/or events and averaging it.

The rainfall data in table 5 shows that the study area experience low average rainfall between January and March, with the lowest average of 1.08 mm in January. The rainfall maximum average of 19.23 mm is experienced in June, with the high averages ranging between June and August.As indicated in Table 6.5.2.1, the site MAP is estimated at 108.46 mm

6.5.2 Mean Annual Evaporation

There is much less evaporation data that exists than data for rainfall and runoffs, however it is necessary to analyze the Mean Annual Evaporation (MAE). Evaporation is measured at dams and mostly stations that are operated by the department of Water and Sanitation (DWS), which provide such data used to interpret the monthly evaporation data for this specific study area. Same source as rainfall data was used, Hydrological data from Hondeklipbaai (F4E001), to obtain evaporation data.

Results shown in Table 6.5.2-1 below indicate that between May and July there is less average evaporation, with the minimum of 97.05 mm experienced in July. The higher averages are in November, December and in January, with the maximum of 213.96 mm in January.

As indicated in Table 6.5.2-1 and Figure 6.5.2-1, the site MAE is estimated at 1 775.89 mm.

Table 6.5.2-1: Rainfall and evaporation data

Description	Rainfall (mm)	Evaporation (mm)
Oct	8.34	165.95
Nov	6.61	197.04
Dec	5.47	211.39
Jan	1.08	213.96
Feb	2.80	168.25
Mar	3.52	158.43
Apr	10.08	121.37
May	11.84	109.91
June	19.23	97.08
Jul	16.42	97.05
Aug	14.44	107.81
Sep	8.63	127.65
Annual	***108.46***	***1775.89***

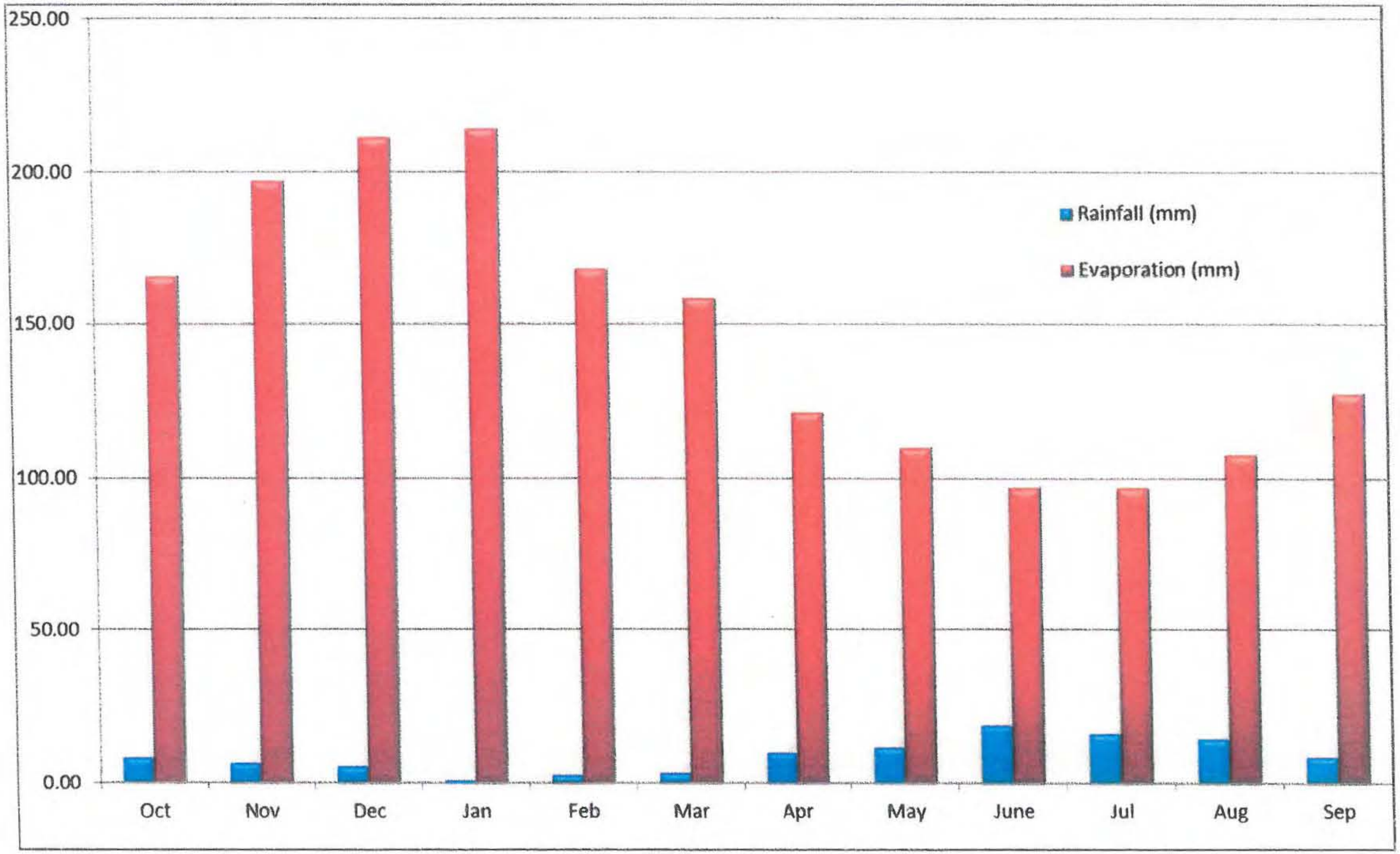


Figure 6.5.2-1: Rain and evaporation data (Hondeklipbaai (F4E001)).

6.5.3 Mean Annual Runoff

Runoff is the result of precipitation (rainfall) falling on a catchment and eventually running off from the catchment. The amount of rainfall that runs off is dependent on the catchment characteristics. Due to the complex nature of rainfall-runoff modeling it is not deemed necessary to set up specific models for small mining catchments (BPGs). Letsolo Water adopts a holistic approach and methodology whereby WR2005 quaternary catchment runoff data is downscaled to site specific runoff data by making use of area and volume relationships as well as a rainfall reduction factor.

The Mean Annual Runoff (MAR) calculations are highly dependent on the surface area. Runoff figures were analyzed statistically in a similar manner as rainfall. The MAR for the study area was sourced from the Water Research Commission database (WR2005). Table below provides activity based MAR and the quantified impact on the Effective and Quaternary Catchment Areas.

Table 6.5.3-0-1: MAR for DWS Catchment Areas

Description	Surface Area (km^2)	Catchment MAR (mm/annum)	Calculated MAR (m^3/annum)
Effective Catchment (F40B, F40C n F40D)	**1753**	**2.4**	**4 207 200**
Effective Catchment (F40E n F40F)	**1747**	**2.4**	**4 192 800**
F40A	1016	0.4	**406 400**
F40D	740	0.4	**296 000**
F40F	683	0.4	**273 200**

The table 6.5.3-1 above show the extent of the effective catchment within the study area to receive water from the upstream rivers.

Picture 6.5.3-1: Sandy Areas resulting in low MAR

Table 6.5.3-0-2: MAR for site infrastructure

	Farm Location	Latitude	Longitude	Surface Area (km^2)	Catchment MAR (mm/annum)	Calculated MAR (m^3/annum)
Slime Dams	1. Somnaas 474	30° 10' 2.64" S	17°13'57.72" E	0.89	0.4	**356**
	2. Somnaas 474 and Koingnaas 475	30° 9' 51.48" S	17°14'54.24" E	0.758	0.4	**303.2**
	3. Koingnaas 475	30° 11'54.24" S	17°14'39.84" E	2.07	0.4	**828**
	4. Koingnaas 475	30° 12'46.08" S	17°17'46.32" E	1.52	0.4	**608**
	5. Koingnaas 475 and Zwartlintjies 484	30° 14' 7.8" S	17°16'9.48" E	1.85	0.4	**740**
	1. Lang Klip 489	30° 22'34.68" S	17°19'18.84" E	1	0.4	**400**
	2. Lang Klip 489	30° 25'36.48" S	17°20'30.84" E	2.62	0.4	**1048**
	3. Lang Klip 489	30° 25' 5.16" S	17°21'12.96" E	1.71	0.4	**684**

6.6 Water Balance

The Water Balance (WB) of a development project is used to illustrate the cumulative flow of water through the system. The system comprises of many different individual components which each comprise of their own significant flows. The WB aims to ultimately provide cumulative flow for each component within the system.

The purpose of water balance calculations include:

- Providing the necessary information that will assist in defining and driving water management strategies.
- Auditing and assessment of the water reticulation system, with the main focus on water usage and pollution sources. This includes identifying and quantifying points of high water consumption or wastage, as well as pollution sources. Seepage and leakage points can also be identified and quantified when the balances are used as an auditing and assessment tool.
- Assisting with the design of storage requirements and minimizing the risk of spillage.
- Assisting with the water management decision-making process by simulating and evaluating various water management strategies before implementation.
- Paragraphs 6.6.1 – 6.6.4 seeks to provide the necessary guidance for the continuous management of water reticulation systems.

6.6.1 Clean water catchment area

Runoff from the clean water catchment will be allowed to freely flow back to the environment. Rainfall was regarded as the source of the clean water.

The results presented in Paragraphs 5.3.1 to 5.3.6 above, were used to interpolate the Peak Flows and Mean Annual Runoff for the underground working area. The hydrological characteristics of these areas are summarised as follows:

6.6.2 Dirty Water

Dirty Water Management will take into account GN704 guidelines relating to water management in mines. In general the on-site surface water management will maintain the activity footprint as small as possible, separate clean and dirty water runoff, prevent clean water runoff flowing onto the activity footprint and prevent dirty water runoff from the activity area from entering clean water runoff areas.

6.6.3 Water sources

Sea water will be abstracted and used at the plant.

6.6.4 Natural losses

Evaporation losses were calculated based on the estimated 1775.89 mm/annum.

6.6.5 Operational Assumptions

The following operational assumptions were made:

- Storage dam will be placed at the open-cast mining area, to collect seawater to be used at the plant. Seawater is abstracted for processing diamond mining and released back to the sea.
- PCD dam to be located at the lowest elevation of the operational area- screening plant facility, with 100m by 100m dimensions

6.6.6 Water balance calculations

Rainfall and evaporation data was used to quantify the annual rainfall and evaporation in cubic meters per annum (m^3/annum). Water use philosophies are summarised as follows:

Natural water sources are as follows:

- Rainfall (mm) was multiplied by the surface area and the runoff coefficient to determine the runoff for the following area:
  - Slimes dam area (Disposal area)
  - Water Return Dam (WRD)/ Pollution Control Dam (PCD) (Operational area)
- Direct rainfall in the recommended PCD was quantified using rainfall data and surface area of the dam.

Water requirements identified

- Dust suppression water as discussed in paragraph 7.2.2 above.

Natural Water loses

- Evaporation losses were quantified by multiplying evaporation with the surface area of exposed water storage areas.
- Plant losses

6.6.7 Component Water circuit

Water balance calculations were conducted for each component as summarised in the tables below:

Table 6.6.7-1: Processing plant water balance

Water-Balance	Source: Water-In (m^3/annum)		Loss: Water-Out (m^3/annum)		
Description	Seawater-Storage dam	Return Water from PCD/RWD	RWD/PCD	Slime Dams	Plant losses
Screening Plant	3120000	716065	1223040	2496000	117025
Total (m^3/a)	**3836065**		**3836065**		
Surplus/Deficit	**0**				

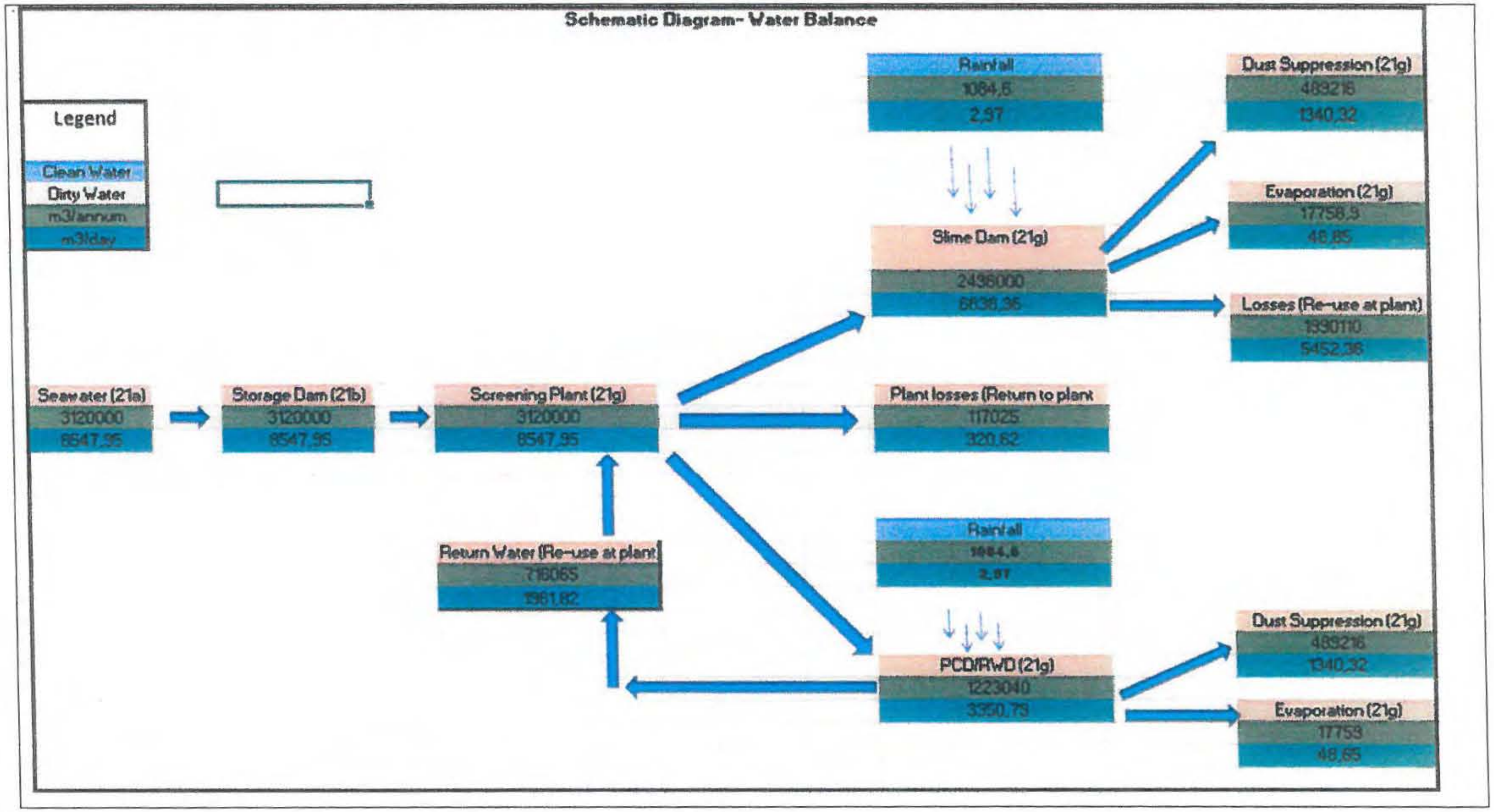
Table 6.6.7-2: Operational area water balance components

Water-Balance	Source: Water-In (m3/annum)	Source: Water-In (m³/annum)	Loss: Water-Out (m³/annum)		
Description	Plant	Rainfall	Evaporation	Dust suppression	Return to Plant (losses)
Slime Dams	2496000	1084.6	17758.9	489216	1990110
Total (m³/a)	2497084.6		2497084.6		
Surplus/Deficit		0			

Table 6.6.7-3: PCD or RWD

Water-Balance	Source: Water-In (m3/annum)		Loss: Water-Out (m³/annum)		
Description	Plant	Rainfall	Evaporation (at 10% Area$_{O/C}$)	Dust suppression	Return to Plant (losses)
PCD or RWD	1223040	1084.6	17759	489216	717150
Total (m³/a)	1224124.6		1224124.6		
Surplus/Deficit		0			

Figure 6.6.7-1: Water Balance Sketch



6.6.8 Dewatering sites and volume

Section 21 (j) of the National Water Act, 1998 (Act 36 of 1998) entails: removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.

The amount of water that will be removed from underground will be 600 000 m^3/a. This process of dewatering will take place on the following farm areas each with 150 000 m^3/a; Somnaas 474, Langklip 489, Zwartlinjies River 484 and Koingnaas 475

Table 6.6.8-0-1:

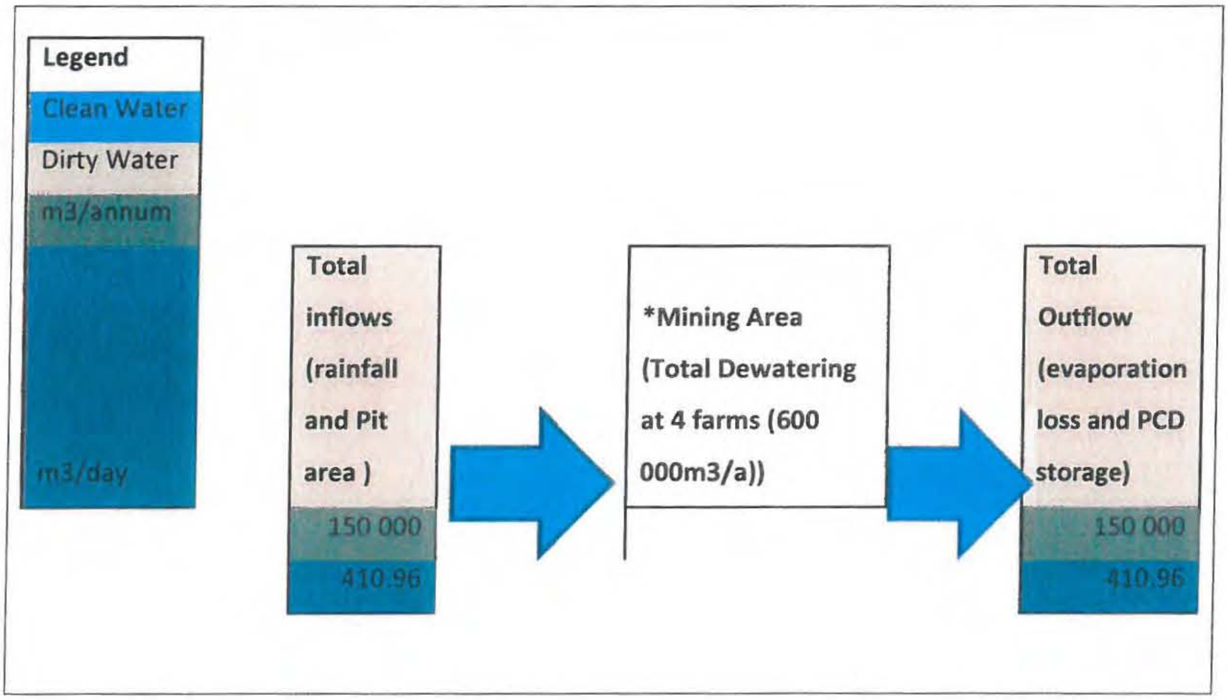
Type of water use	Description	Farm name	Co-ordinate	Volumes
Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Somnaas 474	E 17° 13' 25.86" S 30° 9' 47.76"	150 000 m3/a
Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Koingnaas 475	E 17° 17' 57.67" S 30° 17' 51.83"	150 000 m3/a

Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Langklip 489	E 17° 19' 31.75" S 30° 22' 37.70"	150 000 m3/a
Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Zwartlinjies River 484	E 17° 20' 54.06" S 30° 25' 51.08"	150 000 m3/a

Table 6.6.8-0-2: Component Water Balance at the opencast area

Water-Balance	Source: Water-In (m3/annum)	Loss: Water-Out (m^3/annum)
Description	Total inflows (rainfall and pit area)	Total outflow (evaporation and PCD storage)
Mining Area (Pit)	150000	150000
Total (m^3/a)	**150000**	**150000**

Figure 6.6.8-1: Water Balance for the dewatering component for S 21 (j)



*Dewatering activities at 4 different operational areas at a rate of 150 000m^3 per site. At a combined capacity of 600 000m^3.

7. An identification of any areas to be avoided, including buffers;

Flood calculations were conducted for each catchment area in order to quantify the final volumes discharging at the ocean.

7.1 Flood Calculations

A Standard Design Flood (SDF) Calculation Method was used to estimate the peak flows. A SDF is specific to a particular watershed, and specific to a particular length of time corresponding to the duration of the effective rainfall.

The approach can be simplified as follows:

- In-stream flow volumes
  - The SDF method was used to calculate in-stream flow volumes for the 1:5, 1:50 and 1:100 24 hours storm events.
  - This information is later used for the delineation of flood lines.
- The delineated catchment area for which flood calculations were conducted are summarised as follows:
  - Effective Catchment 1 (F40B, F0C, and F40D)
  - Effective Catchment 2 (F40E and F40F)
  - F40A Catchment
  - F40D Catchment
  - F40F Catchment
- For in-stream calculations, the following catchment characteristics have an influence on the hydrological yield:
  - Area
  - Length of watercourse
  - Height difference along the slope

- Slope
- Drainage Basin Characteristics – Region 15

(Please refer to Paragraphs 7.1.1 to 7.1.5 below for hydrological characteristics)

According to SRK Consulting (2005) Region 15 covers drainage regions E3 and F on the west coast (Namakwaland). The region is generally arid rainfall less than 150mm per year and the soil are generally sandy with a low runoff potential

7.2 Effective Catchment 1

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 1753 km²
Length of longest watercourse	= 70.164 km
1085 height difference	= 529 m
Average slope	= 0.0101 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3 Effective Catchment 2

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 1747 km²
Length of longest watercourse	= 66.1 km
1085 height difference	= 731 m
Average slope	= 0.0147 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3.1 F40A

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 1016 km²
Length of longest watercourse	= 35.3 km

1085 height difference	= 124 m
Average slope	= 0.0047 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3.2 F40D

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 740 km²
Length of longest watercourse	= 29.1 km
1085 height difference	= 142 m
Average slope	= 0.0065 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %

Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3.3 F40F

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 683 km²
Length of longest watercourse	= 22.5 km
1085 height difference	= 110 m
Average slope	= 0.0065 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15